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Network interface presentation**

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## Foreword

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

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

There are two 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".

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

## Introduction

The Council Directive on the application of Open Network Provision (ONP) to leased lines (92/44/EEC), concerns the harmonisation of conditions for open and efficient access to, and use of, the leased lines provided on public telecommunications networks and the availability throughout the Community (EEC) of a minimum set of leased lines with harmonised technical characteristics.

The consequence of the Directive is that Telecommunications Organisations within the EEC 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 interface presentation requirements.

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## 1 Scope

This ETS specifies the technical requirements and test principles for the network interface presentations of ONP 2 048 kbit/s digital unstructured leased lines using 120  $\Omega$  interfaces.

A connection is presented via interfaces at Network Termination Points (NTP). This ETS defines the network interface presented by the leased line provider and should be used in conjunction with the companion standard, ETS 300 247 specifying the connection characteristics between the NTPs of the leased line. Together, these documents describe the service offered.

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 in 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 (1988): "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<sub>b</sub> - safety".
- [5] ETS 300 046-5 (1992): "Integrated Services Digital Network (ISDN); Primary rate access - safety and protection, Part 5: Interface I<sub>b</sub> - protection".
- [6] ISO/IEC 10173 (1991): "Information technology - Integrated Services Digital Network (ISDN) primary access connector at reference points S and T".

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

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 network termination points 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.

**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, or between one accessible part and the equipment protective earthing terminal for a class I equipment, does not exceed a safe value (subclause 1.2.8.5 of EN 60950 [3]).

**Terminal Equipment (TE):** equipment intended to be connected to the public telecommunications network, i.e.:

- a) to be connected directly to the termination of a public telecommunication network; or
- b) 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.

## 4 Symbols and abbreviations

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

|                          |  |
|--------------------------|--|
| AIS                      | Alarm Indication Signal  |
| D2048U                   | 2 048 kbit/s digital unstructured ONP leased line                                    |
| DC                       | Direct Current   |
| EMC                      | Electro-Magnetic Compatibility   |
| HDB3                     | High Density Bipolar code of order 3 (see Annex B)                                   |
| ONP                      | Open Network Provision   |
| NTP                      | Network Termination Point  |
| ppm                      | parts per million  |
| PRBS(2 <sup>15</sup> -1) | Pseudo Random Bit Sequence (as defined in § 2.1 of CCITT Recommendation O.151 [2])   |
| rms                      | root mean square   |
| RX                       | Receive (a signal input at either the leased line interface or the test equipment)   |
| SELV                     | Safety Extra-Low Voltage   |
| TE                       | Terminal Equipment   |
| TX                       | Transmit (a signal output at either the leased line interface or the test equipment) |

## 5 Requirements

The 2 048 kbit/s unstructured leased line provides a bidirectional point-to-point digital leased line 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 by the network and any structuring is the responsibility of the user. The interface is not designed to provide power feeding capabilities to the attached terminal equipment.

NOTE: 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.

### 5.1 Physical characteristics

The physical connection arrangements shall be by a socket; however at the request of the user, and with agreement of the leased line provider, an alternative means of connection may be provided, which shall consist of a hardwired connection using insulation displacement connectors.

The use on the terminal equipment side of the interface of shielded cables may be necessary to meet radiation and immunity requirements defined in Electro-Magnetic Compatibility (EMC) standards. Therefore, 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 shield to a common reference. The common reference point does not necessarily have to be earthed.

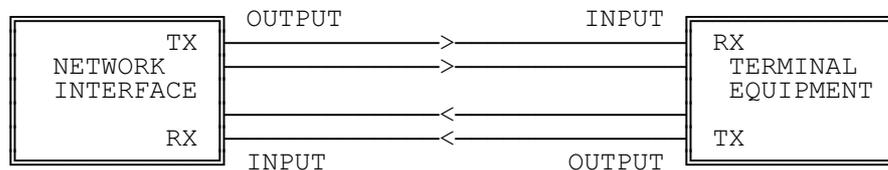
#### 5.1.1 Connector specification

**Requirement:** Where a connector is specified as the means of termination of the leased line, the network interface shall provide an 8-contact socket of the type specified in ISO/IEC 10173 [6] and with contact assignments as specified in table 1.

**Table 1: Contact assignment**

| Contact | Network interface      |
|---------|------------------------|
| 1 & 2   | Transmit pair          |
| 3       | Shield reference point |
| 4 & 5   | Receive pair           |
| 6       | Shield reference point |
| 7       | Unused                 |
| 8       | Unused                 |

NOTE: 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 standard, they refer to the network interface.



**Figure 1**

**Test:** There shall be a visual inspection that the socket is of the correct type. The contact assignments are tested indirectly through the tests in Annex A.

NOTE: All subsequent tests are carried out via the prescribed connector.

#### 5.1.2 Hardwired connection

**Requirement:** Where one or more leased lines are being terminated as hardwired connections, these connections shall be via an insulation displacement terminal block provided by the leased line provider. The

leased line provider shall provide information on the configuration of the insulation displacement terminals used for each leased line interface.

**Test:** There is no test.

NOTE: All subsequent tests are carried out via the appropriate connection method.

## 5.2 Electrical characteristics

### 5.2.1 Output port

#### 5.2.1.1 Signal coding

**Requirement:** The digital signal transmitted at the output port shall be coded in accordance with High Density Bipolar code of order 3 (HDB3) encoding rules (see Annex B).

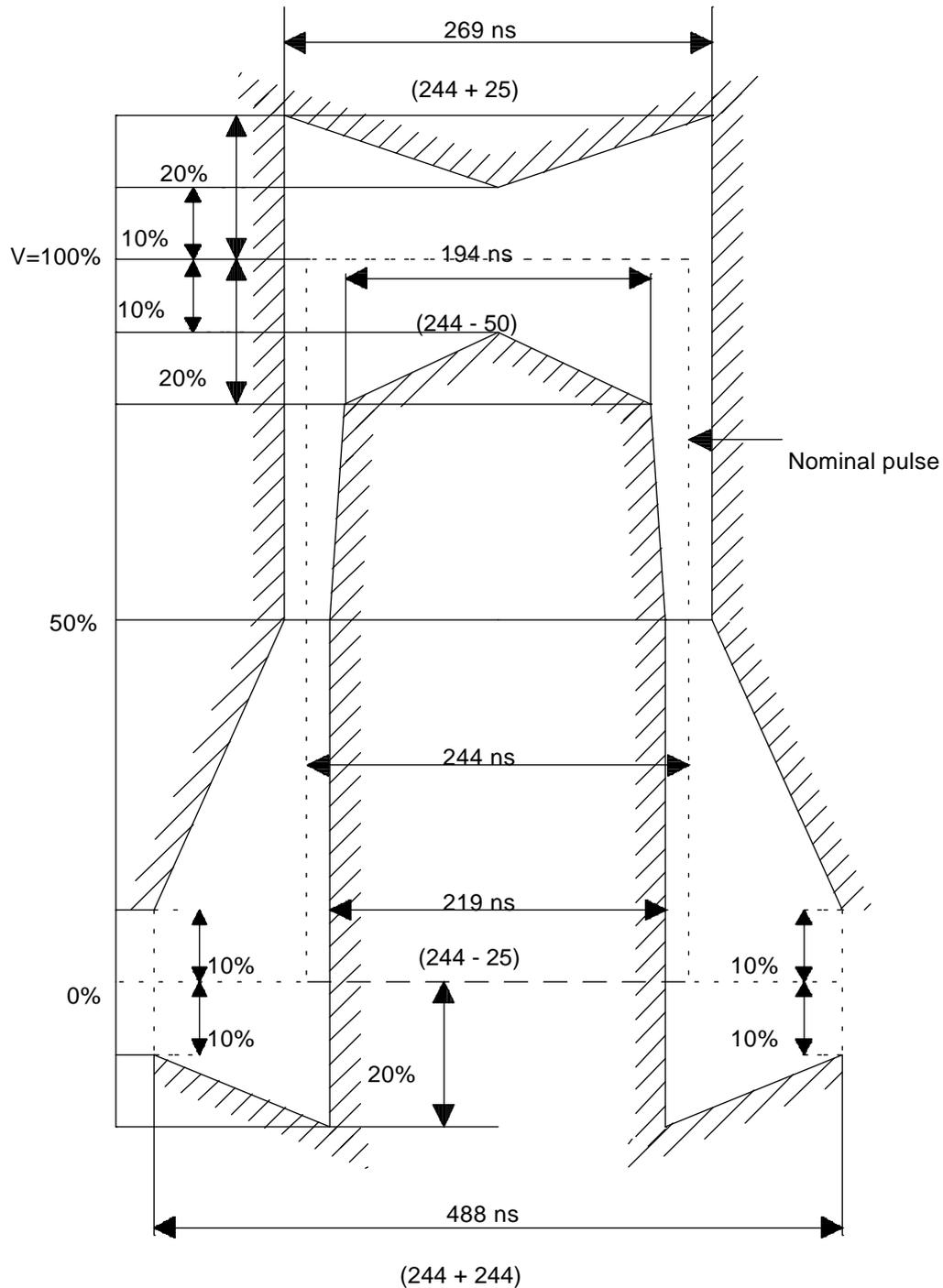
**Test:** The test shall be according to Annex A, subclause A.2.1.

#### 5.2.1.2 Waveform shape

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

**Table 2: Waveform shape at output port**

|   |   |
|---|---|
| Pulse shape<br>(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 $\Omega$ 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 Annex A, subclause A.2.2.

**5.2.1.3 Output timing under failure conditions**

**Requirement:** When there is a failure within the network and if a signal is presented at the interface output, the output timing shall be 2 048 kbit/s  $\pm$  50 ppm.

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

#### 5.2.1.4 Impedance towards ground

**Requirement:** The impedance towards ground of the output port shall be greater than 1 000  $\Omega$  for frequencies in the range 10 Hz to 1 MHz when measured with a sinusoidal test voltage of 2 V rms. For the purpose of this requirement, ground shall be pins 3 and 6 of the connecting socket or the equivalent reference point on a hardwired connection.

NOTE: This requirement is included to allow transformerless implementations.

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

#### 5.2.1.5 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.

#### 5.2.1.6 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).

### 5.2.2 Input port

#### 5.2.2.1 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 Annex A, subclause A.2.5.

#### 5.2.2.2 Input return loss

**Requirement:** The input return loss with respect to 120  $\Omega$  at the interface shall be greater than or equal to the values given in table 3, which is taken from § 6.3.3 of CCITT Recommendation G.703 [1].

**Table 3: 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 Annex A, subclause A.2.3.

#### 5.2.2.3 Input loss tolerance

**Requirement:** The input port shall correctly decode without errors a 2 048 kbit/s signal as defined in subclauses 5.2.1.1 and 5.2.1.2 above but modified by a cable or artificial cable with the following characteristics:

- a) attenuation that follows a  $f$  law with values throughout the range 0 to 6 dB at 1 024 kHz; and
- b) characteristic impedance of 120  $\Omega$  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 Annex A, subclause A.2.4.

#### 5.2.2.4 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 Pseudo Random Bit Sequence as defined in § 2.1 of CCITT Recommendation O.151 [2] (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  $\pm$  50 ppm and not synchronised to the normal signal.

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

#### 5.2.2.5 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 Annex A, subclause A.2.5.

#### 5.2.2.6 Impedance towards ground

**Requirement:** The impedance towards ground of the input port shall be greater than 1 000  $\Omega$  for frequencies in the range 10 Hz to 1 MHz when measured with a sinusoidal test voltage of 2 V rms.

NOTE: This requirement is included to allow transformerless implementations.

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

#### 5.2.2.7 Input timing and jitter tolerance

NOTE: Input timing and jitter tolerance of the leased line are specified in ETS 300 247.

### 5.3 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.

#### 5.3.1 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].

#### 5.3.2 Touch current

This requirement recognises 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 Annex A, 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].

#### 5.4 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 5.4.1 to 5.4.7 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 Annex A, subclause A.1.2.

##### 5.4.1 Surge simulation, common mode

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

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

##### 5.4.2 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  $\mu$ 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].

##### 5.4.3 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  $\mu$ s).

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

##### 5.4.4 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  $\mu$ s).

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

##### 5.4.5 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  $\mu$ 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].

#### **5.4.6 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  $\mu$ 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].

#### **5.4.7 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  $\mu$ 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].

### **5.5 Electro-magnetic compatibility**

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 will 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. The required test results do not make allowance for spurious events during testing (e.g. errors due to EMC effects).

The test configurations given do not imply a specific realisation 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 receive signal 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<sup>15</sup>-1);  
or
- c) where a) or b) cannot be provided, an alternative means of performing the test.

#### A.1.2 Equipment connection

The leased line interface may be supplied with either a socket or a insulation displacement connector. Testing shall be performed at the socket or connector as this is the point at which compliance with this ETS is required.

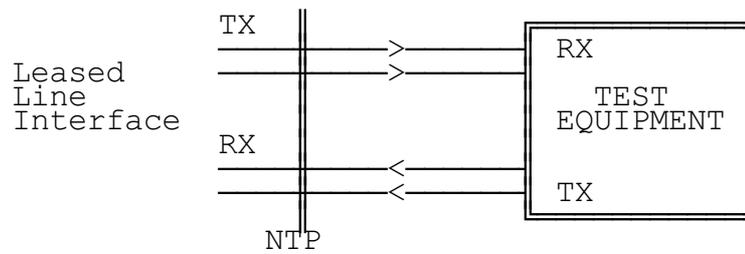
### A.2 Test methods

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 test the correct signal coding at the leased line interface output port.

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.

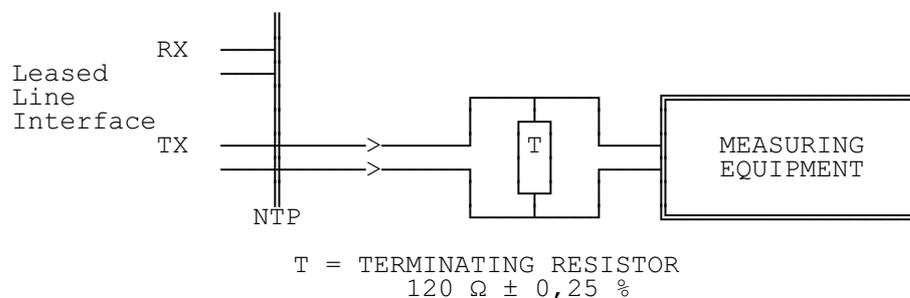
Results: There shall be no errors in the HDB3 encoding.

NOTE : A pseudo random bit stream, e.g. PRBS(2<sup>15</sup>-1), will be acceptable if the bit patterns of the above subclause are included in the bit stream.

### A.2.2 Waveform shape at output port

Purpose: To verify the output waveform.

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 contained 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 measure the return loss of the receive pair of the leased line interface.

Test configuration: Figure A.3.

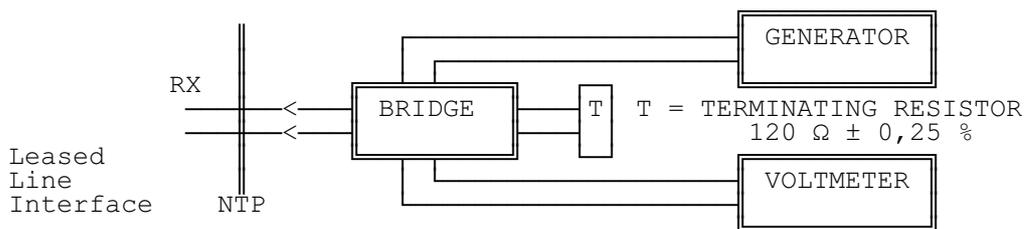


Figure A.3: Return loss at input port

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  $\Omega$ , 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 5.2.2.2 of this ETS.

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  $\Omega \pm 0,25$  % 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 check the input port immunity against an interfering signal combined with the input signal with a cable attenuation of maximum 6 dB.

Test configuration: Figure A.4.

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

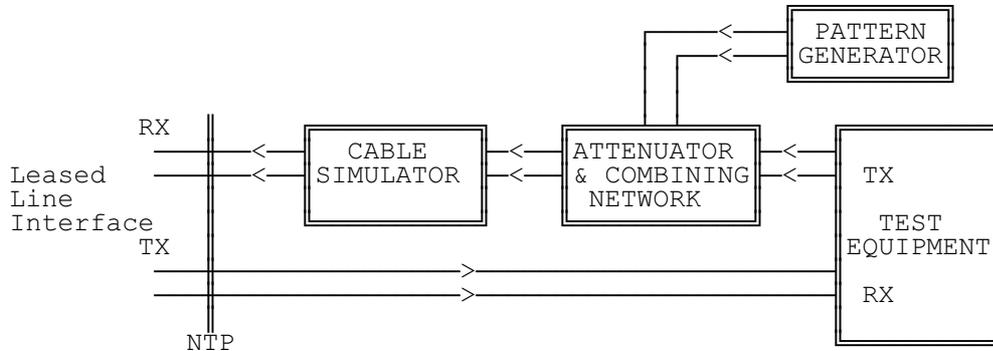
The cable simulator shall have an attenuation of 6 dB measured at 1 024 kHz and an attenuation characteristic that follows a 'f law.

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

- a) without cable simulator and without interfering signal; and

- b) with cable simulator and without interfering signal; and
- c) without cable simulator and with interfering signal; and
- d) with cable simulator and with interfering signal.

The test shall be repeated with the wires at the 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/G.703 of CCITT Recommendation G.703 [1], which is reproduced in figure 2 of this ETS. The binary content shall be a PRBS( $2^{15}-1$ ). The bit rate shall be within the limits  $2\,048\text{ kbit/s} \pm 50\text{ ppm}$ .

The interfering signal from the pattern generator shall be HDB3 encoded and conform to a pulse shape as defined in figure 15/G.703 of CCITT Recommendation G.703 [1], which is reproduced in figure 2 of this ETS. The binary content shall be a PRBS( $2^{15}-1$ ). The bit rate shall be within the limits  $2\,048\text{ kbit/s} \pm 50\text{ ppm}$  and shall not be synchronised to the output signal of the test equipment.

Monitor: Data at output port.

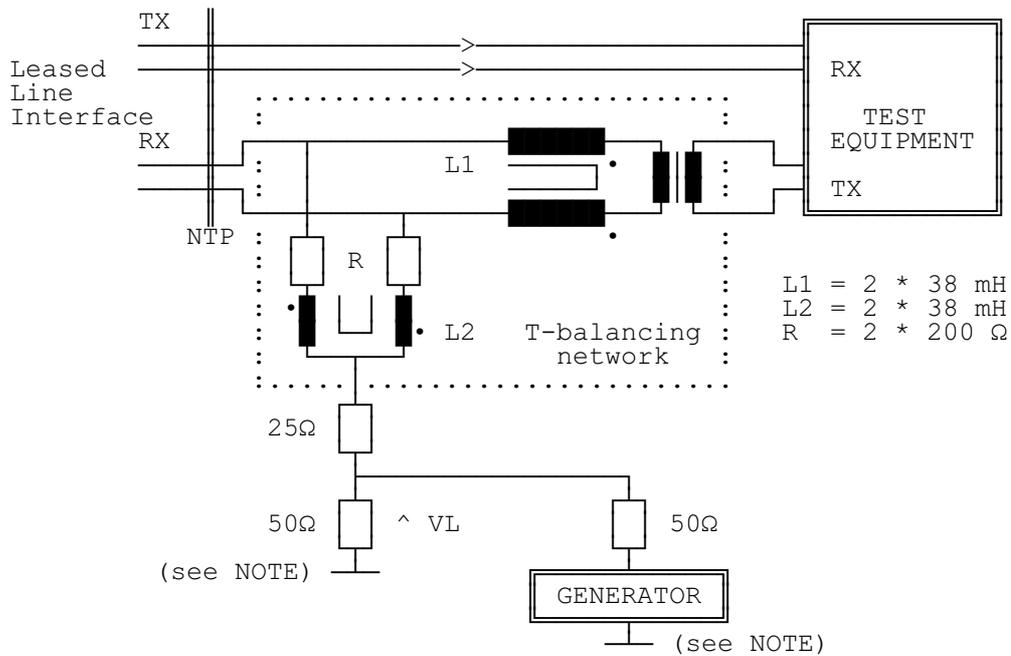
Results: There shall be no bit errors for at least one minute.

NOTE: The  $\sqrt{f}$  law of the cable simulator shall apply in the frequency range 100 kHz to 10 MHz.

### A.2.5 Tolerable longitudinal voltage and HDB3 input coding

Purpose: To check minimum tolerance to longitudinal voltages at the input of the leased line and correct recognition of HDB3 code.

Test configuration: Figure A.5.



NOTE: This point shall be pins 3 and 6 on the connecting socket or the equivalent reference point with a hardwired connection.

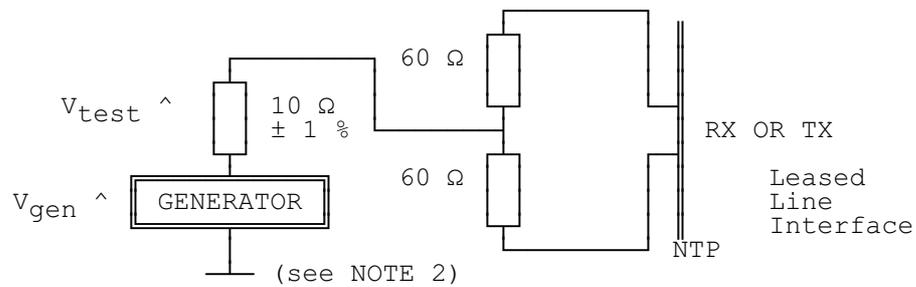
**Figure A.5: Tolerable longitudinal voltage and HDB3 input coding**

- 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/G.703 of CCITT Recommendation G.703 [1], which is reproduced in figure 2 of this ETS. The binary content shall be a PRBS( $2^{15}-1$ ).
- A longitudinal voltage VL of 2 V rms,  $\pm 20$  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:
- a) without longitudinal voltage; and
  - b) with longitudinal voltage.
- Results: There shall be no bit errors.

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 check leased line interface input and output ports impedance towards ground.
- Test configuration: Figure A.6.



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

NOTE 2: This point shall be pins 3 and 6 on the connecting socket or the equivalent reference point with a hardwired connection.

**Figure A.6: Impedance towards ground**

Interface state: Powered.

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

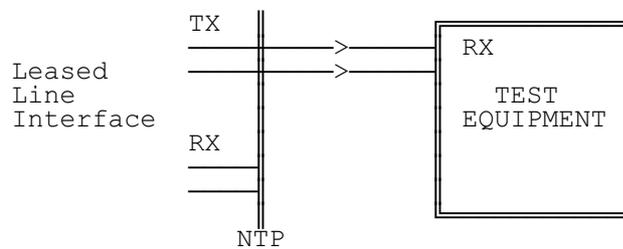
Monitor: Voltage of  $V_{test}$ .

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.

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. Alarm Indication Signal (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  $\pm 50$  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 [1].

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

- 1) 89/336/EEC: "Council Directive of 3 May 1989 on the approximation of the laws of Member States relating to electromagnetic compatibility".
- 2) 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".
- 3) 92/44/EEC: "Council Directive of 5 June 1992 on the application of Open Network Provision to leased lines".
- 4) EN 50082-1 (1992): "Electromagnetic compatibility generic immunity standard; Generic standard class: Domestic, commercial and light industry".
- 5) ETS 300 166 (1993): "Transmission and multiplexing; Physical/electrical characteristics of hierarchical digital interfaces for equipment using the 2 048 kbit/s-based plesiochronous or synchronous digital hierarchies (DE/TM-3002)".
- 6) ETS 300 247 (1993): "Open Network Provision (ONP) technical requirements; 2 048 kbit/s digital unstructured leased line (D2048U), Connection characteristics".

## History

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