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# Business TeleCommunications (BTC); 64 kbit/s digital unrestricted leased line with octet integrity (D64U) Network interface presentation

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# Contents

## 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 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 300 289: "Business TeleCommunications (BTC); 64 kbit/s digital unrestricted leased line with octet integrity (D64U), Connection characteristics";
>
> ETS 300 290: "Business TeleCommunications (BTC); 64 kbit/s digital unrestricted leased line with octet integrity (D64U), 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 over public telecommunications networks and the availability throughout the Community (EEC) of a minimum set of leased lines with harmonised technical characteristics.

Other countries outside the EEC may also choose to provide leased lines according to the standards produced to support the Directive (of which this ETS is one of the set).

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 Open Network Provision (ONP) 64 kbit/s digital unrestricted leased lines with octet integrity. These presentations are codirectional.

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 300 289 [6], which specifies 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, whose establishment or release does 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.152 (1988): "Error performance measuring equipment for 64 kbit/s paths".

[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 Ib - safety".

[5] ETS 300 046-5 (1992): "Integrated Services Digital Network (ISDN); Primary rate access - safety and protection, Part 5: Interface Ib - protection".

[6] ETS 300 289 (1994): "Business TeleCommunications (BTC); 64 kbit/s digital unrestricted leased line with octet integrity (D64U), Connection characteristics".

[7] 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 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 (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:

| | |
|---|---|
| D64U | 64 kbit/s digital unrestricted ONP leased line with octet integrity |
| dc | direct current |
| EMC | Electro-Magnetic Compatibility |
| NTP | Network Termination Point |
| ONP | Open Network Provision |
| ppm | parts per million |
| PRBS($2^{11}$-1) | Pseudo Random Bit Sequence (as defined in § 2.1 of CCITT Recommendation O.152 [2]) |
| rms | root mean square |
| RX | Receive (a signal input at either the leased line interface or the test equipment, see figure 1) |
| SELV | Safety Extra-Low Voltage |
| TE | Terminal Equipment |
| TX | Transmit (a signal output at either the leased line interface or the test equipment, see figure 1) |

# 5 Requirements

The 64 kbit/s unrestricted leased line provides a bidirectional, point-to-point digital leased line with a usable bit rate of 64 kbit/s and octet integrity, where the output timing is provided from the network. The interface timing arrangements are codirectional.

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 may provide a point, or points, to which the shield, or shields, of the cable on the terminal equipment side of the interface can be connected.

NOTE: The purpose of these points (if present) is to provide a path from the 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 [7] with contact assignments as specified in table 1.

**Table 1: Contact assignment**

| Contact | Network interface |
|---|---|
| 1 & 2 | Transmit pair |
| 3 | Shield reference point (if present) |
| 4 & 5 | Receive pair |
| 6 | Shield reference point (if present) |
| 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 ETS, they refer to the network interface. | |

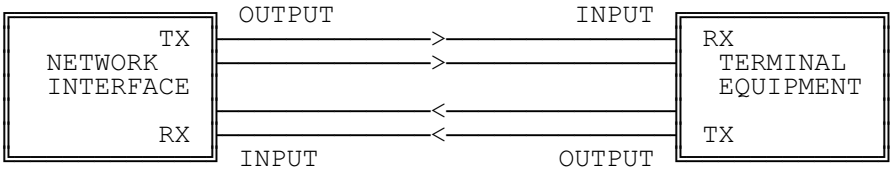



**Figure 1**

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

### 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 signal transmitted at the output port shall comply with the encoding rules given in Annex B.

NOTE: When there is no input signal or octet timing is not present at the leased line distant input or when there is a failure in the leased line connection, the octet timing at the leased line output will not be meaningful.

**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 figures 2 and 3, based on CCITT Recommendation G.703 [1].

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

| | |
|---|---|
| Pulse shape<br>(nominally rectangular) | All pulses of a valid signal shall conform with the masks (see figures 2 and 3) irrespective of the polarity. |
| Test load impedance | 120 Ω non-reactive |
| Nominal peak voltage V of a mark (pulse) | 1 V |
| Peak voltage of a space (no pulse) | 0 ± 0,1 V |
| Nominal pulse width | 3,9 µs for a single pulse<br>7,8 µs for a double pulse |
| 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 |

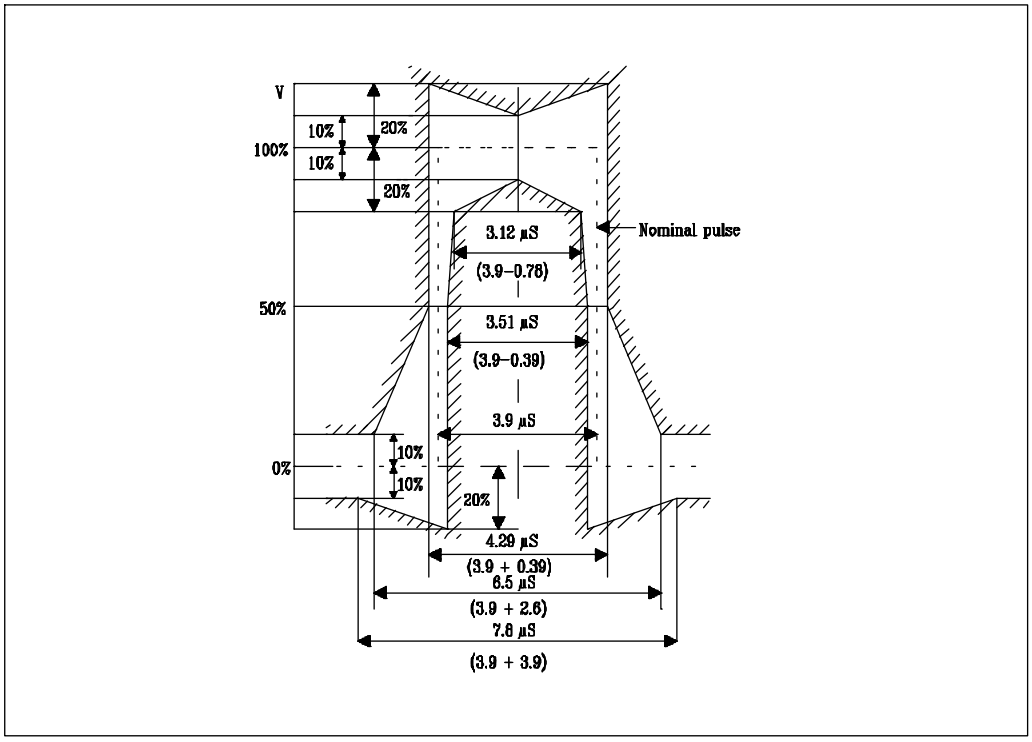



**Figure 2: Pulse mask for single pulse**

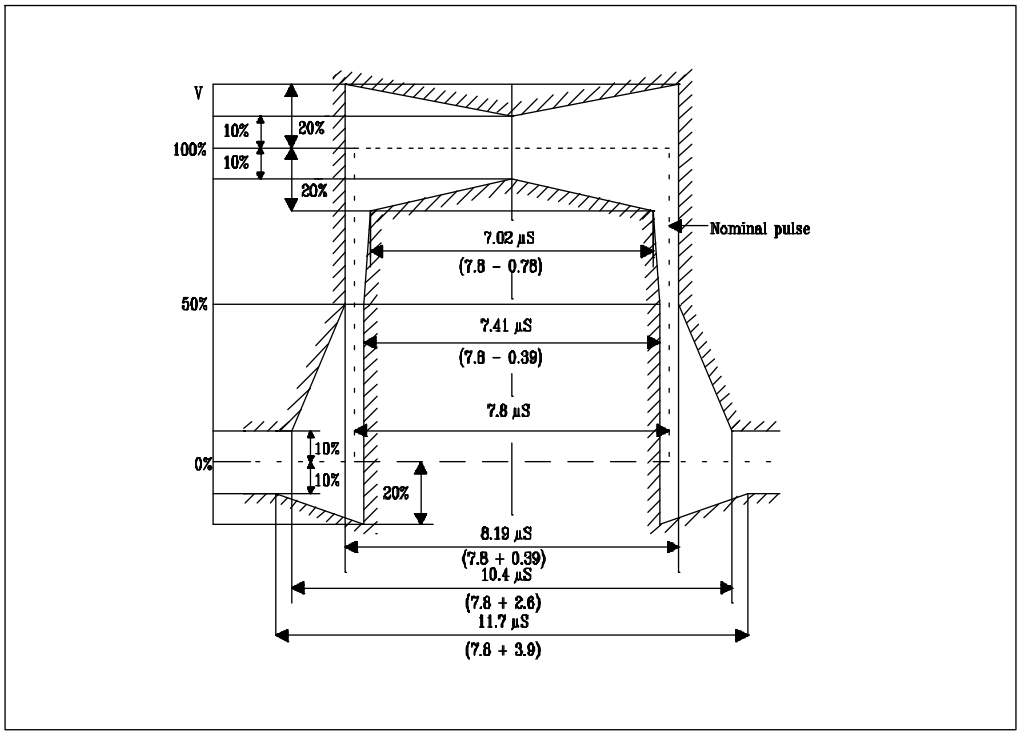



**Figure 3: Pulse mask for double pulse**

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

#### 5.2.1.3 Output timing

**Requirement:** Under normal operating conditions, the timing of the output signal shall be network timing.

NOTE: Network timing is timing that is derived from the source or sources of timing that are used for the whole network. Therefore, the timing provided by the leased line will be similar to that provided by other digital services.

**Test:** By declaration.

#### 5.2.1.4 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 timing of the output signal shall be 64 kbit/s ± 100 ppm.

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

#### 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 Impedance towards ground

**Requirement:** The impedance towards ground of the output port shall be greater than 1 000 Ω for frequencies in the range of 10 Hz to 1 MHz when measured with a sinusoidal test voltage of 2 V rms. Where a shield reference point is provided, ground shall be pins 3 and 6 on the connecting socket or the equivalent reference point on a hardwired connection. Where a shield reference point is not provided, the leased line provider shall declare the point to be used for testing.

NOTE: This requirement is included to allow transformerless implementations.

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

#### 5.2.1.7 Longitudinal conversion loss

**Requirement:** The longitudinal conversion loss of the output port shall be greater than or equal to the figures given in table 3. Where a shield reference point is provided, ground shall be pins 3 and 6 on the connecting socket or the equivalent reference point on a hardwired connection. Where a shield reference point is not provided, the leased line provider shall declare the point to be used for testing.

NOTE: This requirement is included to allow transformerless implementations.

**Table 3: Output port longitudinal conversion loss**

| Frequency | Longitudinal conversion loss |
|---|---|
| 3,4 kHz | 40 dB |
| 3,4 kHz to 34 kHz | decreasing 20 dB/decade from 40 dB to 20 dB |
| 34 kHz to 256 kHz | 20 dB |

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

#### 5.2.1.8 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 accept, without error, signals encoded in accordance with encoding rules of Annex B.

NOTE: The output signal is not defined when there is no input signal or octet timing present at the leased line distant input.

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

#### 5.2.2.2 Input timing and jitter tolerance

The requirement for input timing and jitter tolerance is given in the companion standard ETS 300 289 [6].

#### 5.2.2.3 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 4 taken from CCITT Recommendation G.703 [1].

**Table 4: Input port minimum return loss**

| Frequency range | | | Return loss |
|---|---|---|---|
| 4 kHz | to | 13 kHz | 12 dB |
| 13 kHz | to | 256 kHz | 18 dB |
| 256 kHz | to | 384 kHz | 14 dB |

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

#### 5.2.2.4 Input loss tolerance

**Requirement:** The input port shall correctly operate, without errors, with a 64 kbit/s input signal as defined in subclauses 5.2.1.1 and 5.2.1.2 above but modified by an intervening pair with the following characteristics:

a) attenuation that follows a ´f law with values throughout the range from 0 dB to 3 dB at 128 kHz; and

b) characteristic impedance of 120 Ω with a tolerance of ± 20 % in the frequency range from 200 kHz to 1 MHz, and ± 10 % at 1 MHz.

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

#### 5.2.2.5 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 from 0 dB to 3 dB at 128 kHz, no errors shall result due to the interfering signal.

The normal signal shall be a signal encoded according to Annex B, shaped according to the masks of figures 2 and 3, with a binary content in accordance with a Pseudo Random Bit Sequence as defined in § 2.1 of CCITT Recommendation O.152 [2] (PRBS(211-1)).

The interfering signal shall be the same as the normal signal except that the level shall be attenuated by 20 dB, the bit rate shall be within 64 kbit/s ± 100 ppm, and the timing shall not be synchronised to the normal signal.

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

#### 5.2.2.6 Impedance towards ground

**Requirement:** The impedance towards ground of the input port shall be greater than 1 000 Ω for frequencies in the range from 10 Hz to 1 MHz when measured with a sinusoidal test voltage of 2 V rms. Where a shield reference point is provided, ground shall be pins 3 and 6 on the connecting socket or the equivalent reference point on a hardwired connection. Where a shield reference point is not provided, the leased line provider shall declare the point to be used for testing.

NOTE: This requirement is included to allow transformerless implementations.

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

#### 5.2.2.7 Longitudinal conversion loss

**Requirement:** The longitudinal conversion loss of the input port shall be greater than or equal to the figures given in table 5. Where a shield reference point is provided, ground shall be pins 3 and 6 on the connecting socket or the equivalent reference point on a hardwired connection. Where a shield reference point is not provided, the leased line provider shall declare the point to be used for testing.

NOTE: This requirement is included to allow transformerless implementations.

**Table 5: Input port longitudinal conversion loss**

| Frequency | Longitudinal conversion loss |
|---|---|
| 3,4 kHz | 40 dB |
| 3,4 kHz to 34 kHz | decreasing 20 dB/decade from 40 dB to 20 dB |
| 34 kHz to 256 kHz | 20 dB |

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

### 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 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 is likely to 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 connection point for the interface cable shield as defined in ETS 300 046-4 [4] shall be pins 3 and 6 on the connecting socket or the equivalent reference point with a hardwired connection.

**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, based on definitions used in CCITT Recommendations in the K-series, shall be:

> The leased line interface shall operate properly within the limits of this specification and the companion specification, ETS 300 289 [6], 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 Ib in ETS 300 046-5 [5] shall be deemed to be the point of test referred to in Annex A, subclause A.1.2.

For the purpose of the following subclauses on protection, the connection point for the interface cable shield as defined in ETS 300 046-5 [5] shall be pins 3 and 6 on the connecting socket or the equivalent reference point with a hardwired connection.

#### 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 µs) on the 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 µs) 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 µs).

**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 µs).

**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 µs) 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 µs) 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 µs) (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 Electromagnetic 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 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.2.3, A.2.4, A.2.6 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 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 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($2^{11}$-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.

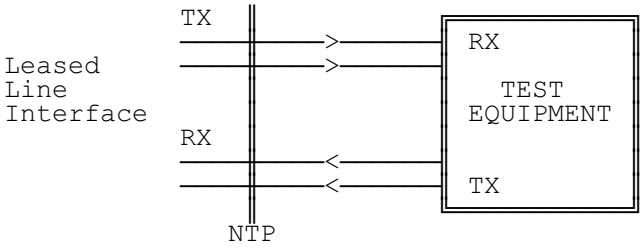



**Figure A.1: Signal coding at output port**

Interface state: Powered.

Stimulus: The leased line interface shall transmit a bit stream including both binary ONEs and binary ZEROs, for example a PRBS($2^{11}$-1).

Monitor: The output bit stream.

Results: Within a test duration of up to 5 minutes there shall be at least one period of one minute during which there are no errors in the encoding.

### A.2.2 Waveform shape at output port

Purpose: To verify the output waveform for both double and single pulses.

Test configuration: Figure A.2.

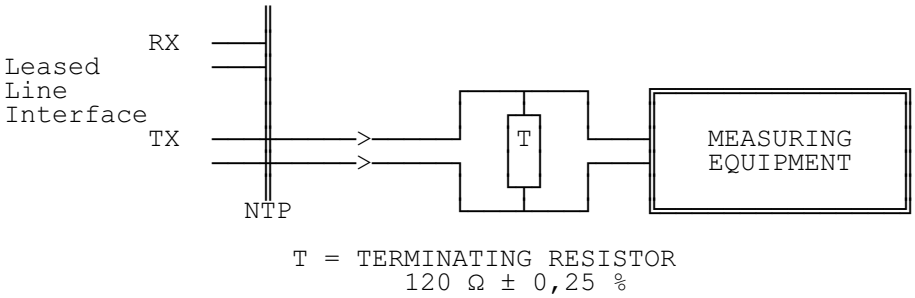



**Figure A.2: Waveform shape at output port**

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. 0,5 V).

The overall measurement accuracy shall be better than 30 mV. All the measurements shall be performed using measuring equipment capable of recording dc. A bandwidth of 200 MHz or greater shall be used to ensure the capture of overshoot or undershoot of the pulse.

Results: Both positive and negative pulses shall be within the masks of figures 2 and 3 as appropriate, where V = 100 % shall be 1 V.

The bit interval corresponding to a space shall not present voltages higher than ± 0,1 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 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.3.

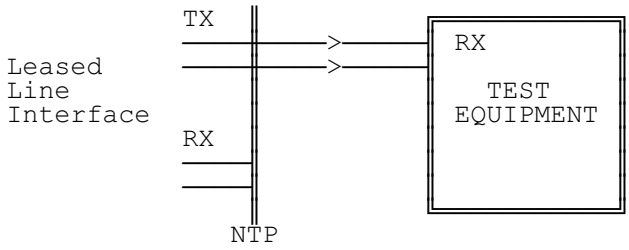



**Figure A.3: Output timing under failure conditions**

Interface state: Powered.

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

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

Results: The output bit rate shall be within the limits of 64 kbit/s ± 100 ppm.

### A.2.4 Input coding, loss tolerance and immunity against reflections

Purpose: To check the input port coding, input loss with a cable attenuation of maximum 3 dB and immunity against an interfering signal combined with the input signal.

Test configuration: Figure A.4.

The output signals of the test equipment and the pattern generator shall be encoded as in § 1.2.1.1.5 of CCITT Recommendation G.703 [1] and conform to a pulse shape as defined in table 1/G.703 and figure 5/G.703 of CCITT Recommendation G.703 [1], which are reproduced in figures 2 and 3 of this ETS. The binary content shall be a PRBS($2^{11}$-1). The output bit rate of the test equipment shall be the bit rate of the leased line (i.e. the timing is looped back). The output bit rate of the pattern generator shall be within the limits 64 kbit/s ± 100 ppm and shall not be synchronised to the output signal of the test equipment or leased line.

The interfering signal shall be combined with the main signal in a combining network of impedance 120 Ω, with 0 dB loss in the main path and an attenuation in the interference path of 20 dB.

The cable simulator shall have an attenuation of 3 dB measured at 128 kHz.

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

a) without cable simulator and without interfering tone, with the test equipment generating a PRBS($2^{11}$-1);

b) with cable simulator and without interfering tone;

c) without cable simulator and with interfering tone;

d) with cable simulator and with interfering tone.

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

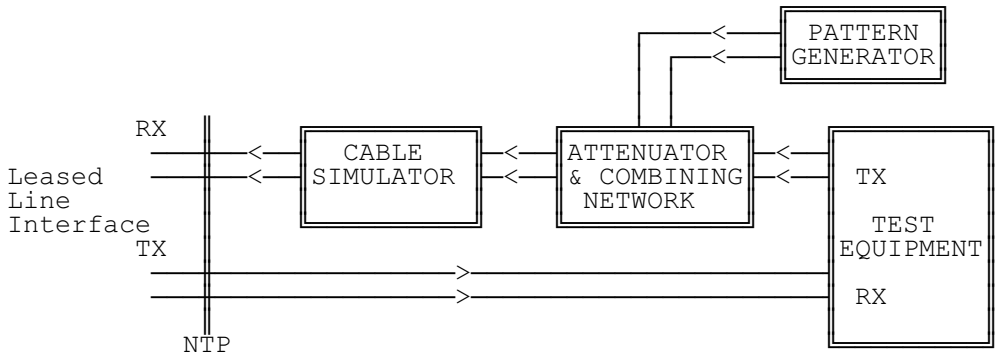



**Figure A.4: Immunity against reflections**

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

Stimulus: A PRBS($2^{11}$-1) bit stream, encoded as defined in Annex B.

Monitor: Data at output port.

Results: Within a test duration of up to 5 minutes there shall be at least one period of one minute during which there are no bit errors.

### A.2.5 Return loss at input port

Purpose: To measure the return loss with respect to 120 Ω of the receive pair of the leased line interface.

Test configuration: Figure A.5.

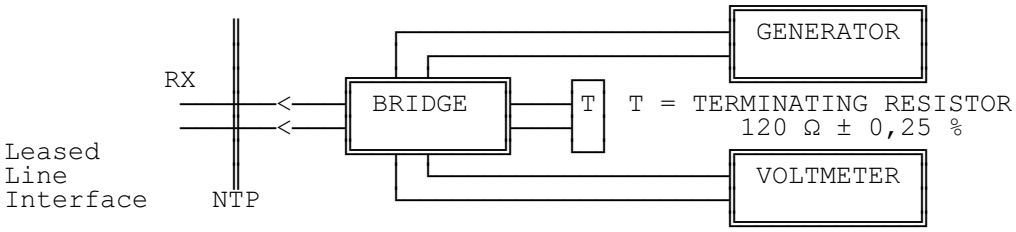



**Figure A.5: Return loss at input port**

Interface state: Powered.

Stimulus: Sinusoidal signal of 1 V peak at the input to the network interface with a frequency variable between 4 kHz and 384 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.

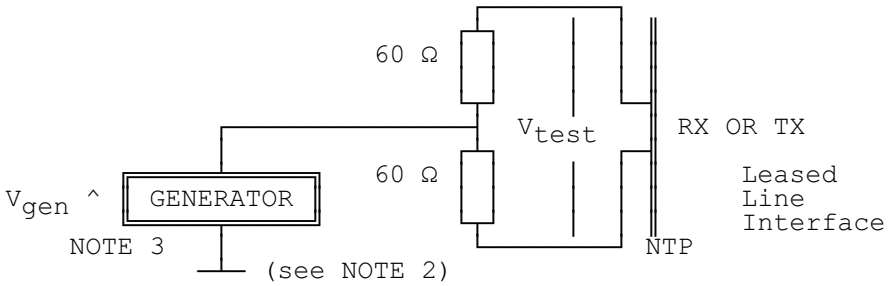
Results: The measured return loss shall be greater than or equal to the values in table 4 (subclause 5.2.2.3).

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 shall be 20 dB higher than the limits specified for the interface.

### A.2.6 Longitudinal conversion loss

Purpose: To measure the longitudinal conversion loss of the input and output ports.

Test configuration: Figure A.6.




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

NOTE 2: Where a shield reference point is provided, ground shall be pins 3 and 6 on the connecting socket or the equivalent reference point on a hardwired connection. Where a shield reference point is not provided, the leased line provider shall declare the point to be used for testing.

NOTE 3: The impedance of the generator shall be 120 Ω.

**Figure A.6: Longitudinal conversion loss**

Interface state: Powered.

Stimulus: Generator output ($V_{gen}$) 1 V rms ± 10 mV shall be applied at any frequency in the range from 3,4 kHz to 256 kHz.

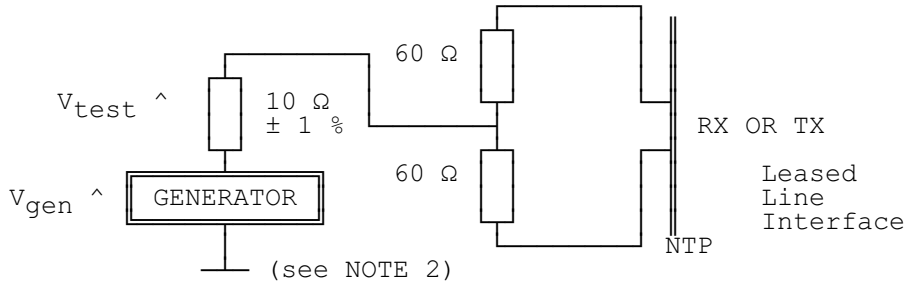
Monitor: Voltages $V_{gen}$ and $V_{test}$.

Results: The longitudinal conversion loss $20 \log_{10} (| V_{gen}/V_{test} |)$ shall be greater than or equal to the values given in table 3 (subclause 5.2.1.7) or table 5 (subclause 5.2.2.7) as applicable.

### A.2.7 Impedance towards ground

Purpose: To check leased line interface input and output ports impedance towards ground.

Test configuration: Figure A.7.




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

NOTE 2: Where a shield reference point is provided, ground shall be pins 3 and 6 on the connecting socket or the equivalent reference point on a hardwired connection. Where a shield reference point is not provided, the leased line provider shall declare the point to be used for testing.

**Figure A.7: Impedance towards ground**

Interface state: Powered.

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

Monitor: Voltage of $V_{test}$.

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

## Annex B (normative): Code conversion rules

This annex specifies the code conversion rules for the 64 kbit/s codirectional interface, defined in § 1.2.1.1.5 of CCITT Recommendation G.703 [1].

Step 1: A 64 kbit/s bit period is divided into four unit intervals.

Step 2: A binary 1 is encoded as a block of the following four bits:

1 1 0 0

Step 3: A binary 0 is encoded as a block of the following four bits:

1 0 1 0

Step 4: The binary signal is converted into a three-level signal by alternating the polarity of consecutive blocks.

Step 5: The alteration in polarity of the blocks is violated every 8th block. The violation marks the last bit in an octet.

These conversion rules are illustrated in figure B.1.

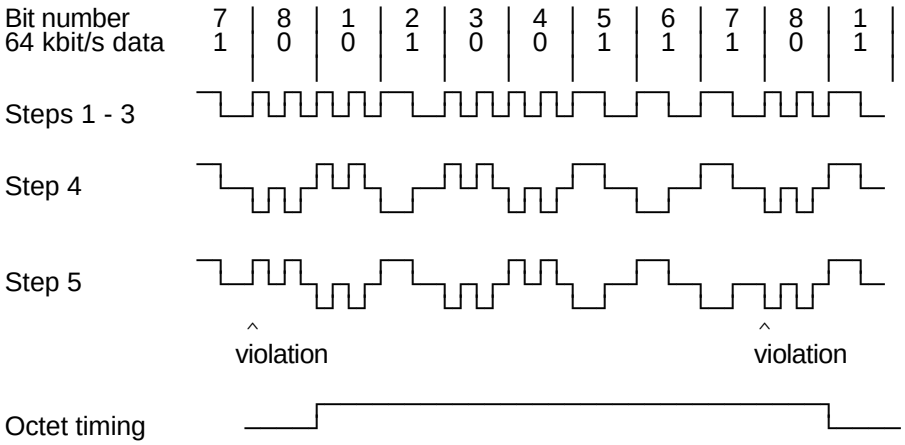



**Figure B.1: 64 kbit/s code conversion**

## 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) CCITT Recommendation K.22 (1988): "Overvoltage resistibility of equipment connected to an ISDN T/S bus".

5) EN 50082-1 (1992): "Electropomagnetic compatibility generic immunity standard; Generic standard class: Domestic, commercial and light industry".

6) ETS 300 166 (1993): "Transmission and Multiplexing (TM); Physical/electrical characteristics of hierarchical digital interfaces for equipment using the 2 048 kbit/s-based plesiochronous or synchronous digital hierarchies".

## History

| Document history | |
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