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Business Telecommunications (BT); Transmission characteristics at 2-wire analogue interfaces of a digital Private Automatic Branch Exchange (PABX)

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1 Foreword

This Interim-European Telecommunication Standard (I-ETS) was produced by the Business Telecommunications (BT) Technical Committee of the European Telecommunications Standards Institute (ETSI), and was adopted, having passed through the ETSI standards approval procedure.

This Standard was first prepared in the format of a CEPT Recommendation and was later converted into an ETSI standard. Consequently, it does not fully conform to the guidelines for the structure of ETSI standards although the ETSI "stylesheet" has been applied.

This Standard was submitted for Public Enquiry as an ETS, but, as it contains transmission parameters without specifying the exact measurement method it was decided to convert the standard into an I-ETS, thus allowing a two year period during which the BT Technical Committee can gain further experience with a view to modifying the parameter values and finalising the test method.

This Standard is intended to be used as a specification for the design of digital PABXs and for the harmonization of PABX transmission parameters throughout Europe. Parameters which are only of an informative instead of a normative character are highlighted as such.

During its preparation this I-ETS has been circulated to other European Standardization bodies (European Computer Manufacturers Association (ECMA) and European Committee for Electrotechnical Standardization (CENELEC)) who are also involved in the preparation of European Standards on ISPBXs.

There are three other standards directly connected with this Standard:

I-ETS 300 003: Business Telecommunications (BT); Transmission characteristics of digital Private Automatic Branch Exchange (PABX).

I-ETS 300 005: Business Telecommunications (BT); Transmission characteristics at 4-wire analogue interfaces of a digital Private Automatic Branch Exchange (PABX).

I-ETS 300 006: Business Telecommunications (BT); Transmission characteristics at digital interfaces of a digital Private Automatic Branch Exchange (PABX).

This Standard is based on information from CCITT Recommendations and the relevant Recommendation numbers are quoted where appropriate.

2 Scope

This Standard provides characteristics for:

- 2-wire analogue interfaces (Type K2, M2 and L2);
- input and output connections with 2-wire analogue interfaces; and
- half-connections with 2-wire analogue interfaces.

in accordance with definitions given in I-ETS 300 003 particularly in figure 2 of I-ETS 300 003.

The characteristics of the input and output connections of a given interface are not necessarily the same. The characteristics of half-connections are not necessarily identical for different types of interfaces.

This Standard is valid for digital PABXs that may terminate a public switched network 4-wire connection. It also includes, in a separate category, characteristics for 2-wire interfaces which are involved in 2-wire connections with the public switched telephone network (PSTN).

3 Related standards

I-ETS 300 003 (1991): "Business Telecommunications (BT); Transmission characteristics of digital Private Automatic Branch Exchange (PABX)".

I-ETS 300 005 (1991): "Business Telecommunications (BT); Transmission characteristics at 4-wire analogue interfaces of a digital Private Automatic Branch Exchange (PABX)".

I-ETS 300 005 (1991): "Business Telecommunications (BT); Transmission characteristics at 4-wire analogue interfaces of a digital Private Automatic Branch Exchange (PABX)".

I-ETS 300 006 (1991): "Business Telecommunications (BT); Transmission characteristics at digital interfaces of a digital Private Automatic Branch Exchange (PABX)".

ETS 300 132: "Equipment Engineering; Power supply interface at the input to telecommunications equipments".

CCITT Recommendation G.101: The transmission plan.

CCITT Recommendation G.103: Hypothetical reference connections.

CCITT Recommendation G.111: Loudness ratings (LRs) in an international connection.

CCITT Recommendation G.117: Transmission aspects of unbalance about earth (definitions and methods).

CCITT Recommendation G.121: Loudness ratings (LRs) of national systems.

CCITT Recommendation G.122: Influence of national systems on stability, talker echo, and listener echo in international connections.

CCITT Recommendation G.123: Circuit noise in national networks.

CCITT Recommendation G.223: Assumptions for the calculation of noise on hypothetical reference circuits for telephony.

CCITT Recommendation G.714: Separate performance characteristics for the encoding and decoding sides of PCM channels applicable to 4-wire voice-frequency interfaces.

CCITT Recommendation G.715: Separate performance characteristics for the encoding and decoding side of PCM channels applicable to 2-wire interfaces.

CCITT Recommendation K.4: Disturbance to signalling.

CCITT Recommendation K.10: Unbalance about earth of telecommunications installations.

CCITT Recommendation O.9: Measuring arrangements to assess the degree of unbalance about earth.

CCITT Recommendation O.81: Group-delay measuring equipment for telephone-type circuits.

CCITT Recommendation O.131: Quantizing distortion measuring equipment using a pseudo-random noise test signal.

CCITT Recommendation O.132: Quantizing distortion measuring equipment using a sinusoidal test signal.

CCITT Recommendation O.133: Equipment for measuring the performance of PCM encoders and decoders.

CCITT Recommendation Q.45bis: Transmission characteristics of an analogue international exchange.

CCITT Recommendation Q.543: Digital exchange performance design objectives.

CCITT Recommendation Q.552: Transmission characteristics at 2-wire analogue interfaces of a digital exchange.

CCITT Fascicle I.3: Terms and definitions.

CCITT Fascicle VI.5: Digital local, transit, combined and international exchanges in integrated digital networks and mixed analogue-digital networks.

CCITT Fascicle III.3 (Orange Book, 1980)
Supplement 13 to the G Series: Noise at the terminals of battery supply.

NOTE: All references to CCITT recommendations refer to the 1988 editions ("Blue Book") except if expressly otherwise noted.

4 Definitions

4.1 Definitions of interfaces

Interface K2: As defined in subclause 4.6.1.3 of I-ETS 300 003, the interface K2 provides for the direct connection of 2-wire analogue circuits to the public network.

Interface M2: As defined in subclause 4.6.1.2 of I-ETS 300 003, the interface M2 is subdivided into the interfaces "M21" and "M22". These interfaces may have different transmission characteristics.

- The interface M21 provides the termination of connections to/from the PSTN via 4-wire analogue (K4) or digital (KD) subscriber line access, with the PABX acting as a transit switch.

- The interface M22 provides the termination of connections other than those covered by M21. Typical is the interconnection of an L2 interface with an M22 interface in a PABX for routings through existing 2-wire analogue circuits to other PABXs (see figure 2 of I-ETS 300 003).

Interface L2: The interface L2 provides for the connection of 2-wire analogue extension lines and will carry signals such as speech, voice-band analogue data and multi-frequency push-button signals, etc. In addition, the interface L2 provides for ordinary functions such as DC feeding, DC signalling, ringing, etc. See also I-ETS 300 003, subclause 4.6.1.1.

4.2 Definition of parameters

4.2.1 Parameters relevant for echo and stability

Terminal Balance Return Loss (TBRL) is introduced in order to characterize the PABX performance required to comply with the network performance objective of CCITT Recommendation G.122 with respect to echo. The TBRL of an equipment port is measured in the talking state as in an established connection through a digital PABX.

The parameter "Stability Loss" as defined in CCITT Recommendation G.122, applies to the worst terminating conditions encountered at a 2-wire interface in normal operation.

4.2.1.1 Terminal Balance Return Loss (TBRL)

The term TBRL is used to characterize an impedance balancing property of the 2-wire analogue equipment port.

The expression for TBRL is:

$$TBRL = 20 \log \left| \frac{Z_a + Z_b}{2 \,.\, Z_a} \cdot \frac{Z_t + Z_a}{Z_t - Z_b} \right| \quad ....dB$$

where:

Z_a = PABX impedance of a 2-wire equipment port.

Z_b = impedance of the balance network presented at a 2-wire equipment port.

Z_t = impedance of the balance test network.

NOTE: Some Administrations have found that it is advantageous to choose Z_a=Z_b in order to optimize TBRL. In this case the expression reduces to:

$$TBRL = 20 \log \left| \frac{Z_t + Z_b}{Z_t - Z_b} \right| \quad ...dB$$

and the balance test network will be identical to the test network for the PABX impedance.

The TBRL is related to the loss a_{io} between the PABX test point T_i and T_o of a half connection as follows (see figure 1):

$$TBRL = a_{io} - \left(a_o + a_i\right)$$

where a_o and a_i are the losses between the PABX test point T_i and the 2-wire port and between the 2-wire port and the PABX test point T_o respectively.

TBRL can thus be determined by measurement of a_{io} provided the sum (a_o + a_i) is known. This can be derived in several ways:

a) a_o and a_i are assigned their nominal values NL_o and NL_i as defined in subclause 5.2.1.1.1. Then:

$$TBRL = a_{io} - \left(NL_o + NL_i\right)$$

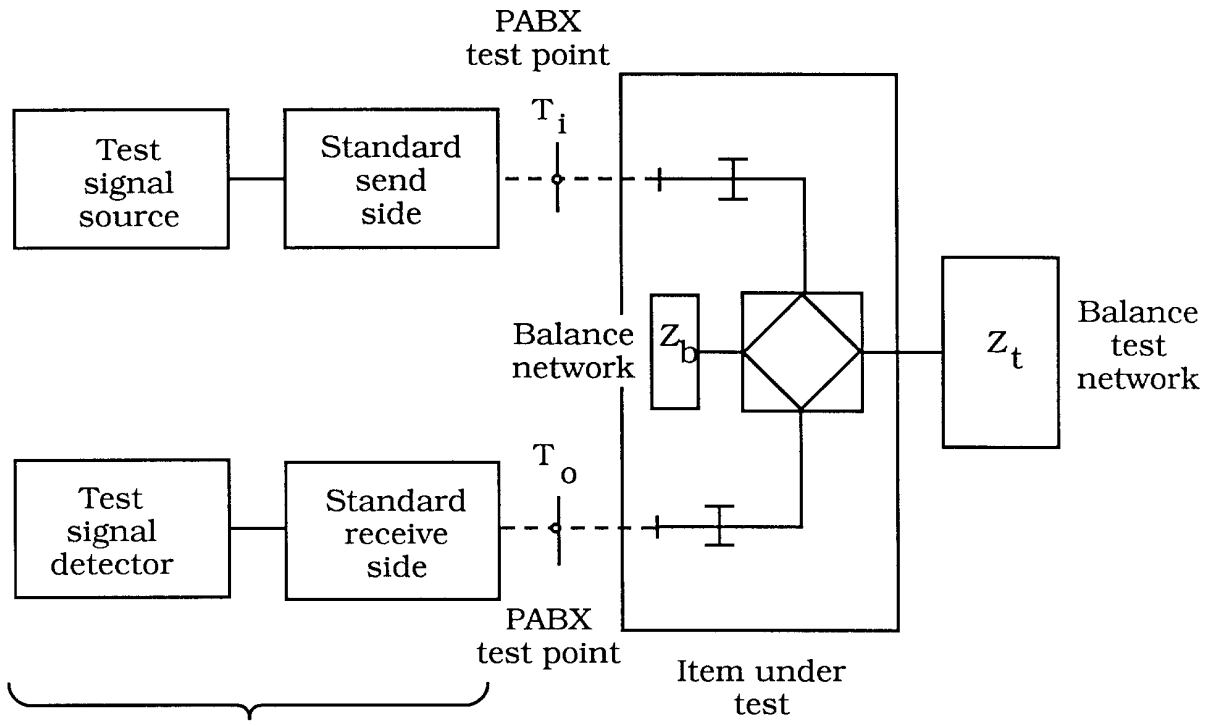
b) a_o and a_i are measured with the load matched to the PABX impedance as actual transmission loss AL_o and AL_i (see subclause 5.2.1.1.2). Then:

$$TBRL = a_{io} - \left(AL_o + AL_i\right)$$

c) losses a'_{io} and a''_{io} are measured with the 2-wire equipment port open- and short-circuited, respectively. Then:

$$TBRL = a_{io} - \frac{a'_{io} + a''_{io}}{2}$$

Method b) provides the most accurate results.



This equipment may be all digital, with equivalent functions (see CCITT Recommendation O.133). The test signal source and the test signal detector may be as shown in Figure A-1 of CCITT Recommendation G.122.

Figure 1: Arrangement for measuring the loss a_{io}

4.2.1.2 Stability loss

The stability loss is given by the parameter a_{io}, defined above.

4.2.2 Parameters for interference

NOTE: Under study.

5 2-wire interface specifications

5.1 Characteristics of interfaces

For measuring 2-wire analogue interface conditions a quiet code shall be applied, i.e. a PCM signal corresponding to decoder output value 1 (A-law) with the sign bit in a fixed state, to the PABX test point T_i, when no test signal is stipulated.

5.1.1 Characteristics of interfaces K2 and M2

5.1.1.1 PABX impedance

5.1.1.1.1 Nominal value

Nominal values of PABX impedance may be defined depending on national conditions. The definition shall include a test network for the PABX impedance. Administrations may want to adopt different test networks corresponding to the cable types used (e.g. unloaded and loaded).

NOTE: The principal criteria governing the choice of the nominal value of the PABX impedances are :

- with reference to the interface K2, to terminate the analogue subscriber line of a public digital exchange, to ensure that the public digital exchange will have adequate values of stability margin and echo;

- with reference to the interfaces M21 and M22, to terminate the analogue lines between PABXs, to ensure that every PABX will have adequate values of stability margin and echo.

At present no unique component values can be recommended. However, Annex A includes a model of the test network and a list of the nominal values specified by different European Administrations.

5.1.1.1.2 Return loss

The return loss of the impedance presented by K2 and M2 interfaces against the test network for the exchange impedance shall comply with the limits given in figure 2.

Annex K includes the requirements for Sweden.

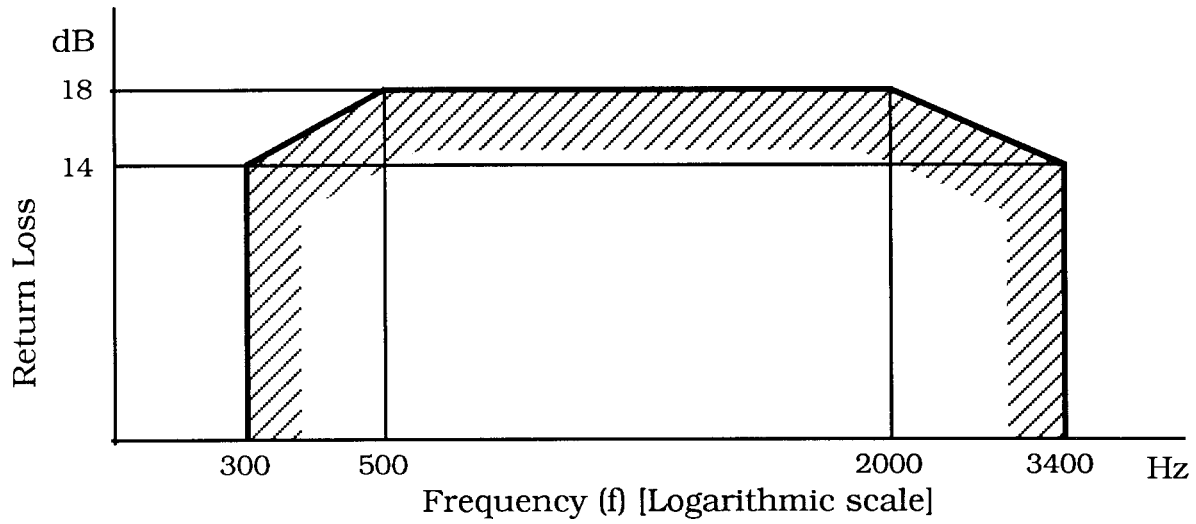


Figure 2: Minimum value of return loss against the test network for PABX impedance at a 2-wire interface

5.1.1.2 Impedance unbalance about earth

The Longitudinal Conversion Loss (LCL), defined in CCITT Recommendation G.117, § 4.1.3 shall exceed as a minimum requirement the following values :

300 - 600 Hz	40 dB
600 - 3400 Hz	46 dB

with the equipment under test in the normal talking and quiescent state, in accordance with CCITT Recommendation K.10. Some administrations specify other values and in some cases wider bandwidth (see Annex G).

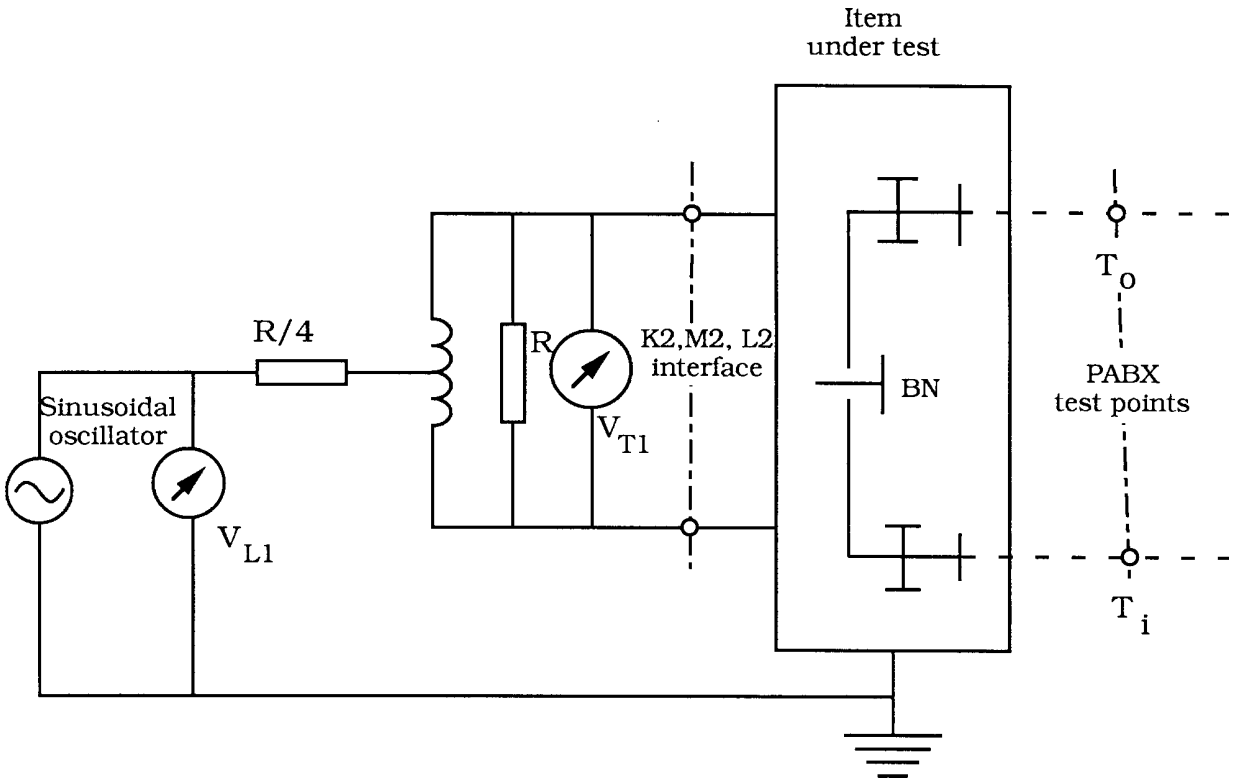
NOTE: A limit may also be required for the Transverse Conversion Loss (TCL), as defined in CCITT Recommendation G.117, § 4.1.2, if the PABX termination is not reciprocal with respect to the transverse and longitudinal paths. A suitable limit would be 40 dB to ensure an adequate near-end crosstalk attenuation between interfaces.

Test method

Longitudinal Conversion Loss shall be measured in accordance with the principles given in CCITT Recommendation O.9, § 2.1 and § 3. Figure 3 shows an example of the basic measuring arrangement for digital PABXs.

Transverse Conversion Loss shall be measured in accordance with the principles given in CCITT Recommendation O.9, § 2.2 and § 3.

Measurements of the longitudinal and transverse voltages should preferably be done with a frequency selective level meter.



Longitudinal Conversion Loss:

$$LCL = 20 \log_{10} \left| \frac{V_{L1}}{V_{T1}} \right| \ldots dB$$

NOTE: Special care must be taken in those applications using active hybrids.

Figure 3: Arrangement for measuring LCL

5.1.1.3 Relative levels

As presented in this standard, the values here are informative. However some Administrations also apply these values for normative purposes.

5.1.1.3.1 Nominal levels

5.1.1.3.1.1 Interface M21

M21 interfaces shall meet the recommended values for L2 interfaces in subclause 5.1.2.3.1 if no loss compensation comparable to annex F is provided.

5.1.1.3.1.2 Interfaces K2 and M22

To adjust the transmission loss of a digital PABX to the values of national transmission planning for local or national traffic, depending on the relative levels given in subclause 5.1.1.3.1.1 and subclause 5.1.2.3.1, the table in Annex B includes the requirements for K2 and M22 interfaces of different European Administrations.

5.1.1.3.2 Tolerances of relative levels

The difference between the actual relative level and the nominal relative level shall lie within the following values :

- input relative level : - 0.3 to + 0.7 dB;
- output relative level : - 0.7 to + 0.3 dB.

NOTE 1: These differences may arise, for example, from design tolerances, cabling (between cabinet and the Distribution Frame (DF)), and adjustment increments.

NOTE 2: Level adjustment procedures are given in CCITT Recommendation G.715, § 2.1.

5.1.2 Characteristics of interface L2

5.1.2.1 PABX impedance

5.1.2.1.1 Nominal value

The use of the preferred configuration shown in Annex C will minimize the diversity of types of PABX impedances. At present no unique component values can be recommended. However, the table in Annex C includes a list of the nominal values specified by different European Administrations.

NOTE 1: The principal criterion governing the choice of the nominal value of the PABX impedance is to ensure an adequate sidetone performance for telephone sets, particularly those operated on short lines. If this criterion is met, the impedance will also be suitable for extension lines fitted with voice band modems.

NOTE 2: As a general rule a complex PABX impedance with a capacitive reactance is necessary to achieve satisfactory values of stability, echo and sidetone. For additional information, see Supplement No. 1, Fascicle VI.5 of the CCITT Blue Book and CCITT Recommendations G.111 and G.121.

5.1.2.1.2 Return loss

The return loss of the impedance presented by a 2-wire port against the test network for the PABX impedance shall comply with limits which depend on the particular conditions of the extension network considered. These are given in the template of figure 2.

Annex K includes the requirements for Sweden.

5.1.2.2 Impedance unbalance about earth

The Longitudinal Conversion Loss (LCL) defined in CCITT Recommendation G.117, § 4.1.3 shall exceed, as a minimum requirement, the following values :

300 - 600 Hz	40 dB
600 - 3400 Hz	46 dB

measured in accordance with the test method given in figure 3. Some administrations specify other values and in some cases wider bandwidth (see Annex G).

5.1.2.3 Relative levels

As presented in this standard, the values here are informative. However some Administrations may also apply these values for normative purposes.

NOTE 1: Considering that the European Administrations have already determined the relative levels of the analogue subscriber line interface (Z) of digital local exchanges, the same values may be adopted for then analogue extension line interface (L2) of digital PABXs.

NOTE 2: See also I-ETS 300 003, subclause 4.2.

If within the ranges of L_i and L_o given in Annex B and Annex D, the values may be chosen such that $L_i - L_o \geq 6$ dB, and if adequate balance networks are used (see subclause 5.2.1.8 and figure 9), the requirements of CCITT Recommendation G.121, § 6 (Incorporation of PCM digital processes in national extensions) as well as for CCITT Recommendation G.122 (Stability and echo loss) will be satisfied.

5.1.2.3.1 Nominal levels

The values which shall be used by PABXs for the relative levels at the L2 interfaces for different administrations are given in Annex D. Such values are in accordance with Annex C to CCITT Recommendation G.121 (columns 1,2 and 3 of table C-1/G.121).

NOTE 1: CCITT Recommendation G.101, § 5.3.2.3 indicates that if the minimum nominal Send Loudness Rating (SLR) on an extension referred to a 0 dBr point is not less than - 1.5 dB, then the peak power of the speech will be suitably controlled. It follows that, for instance, the value $L_i = 0$ dBr (lower limit of the range for L_i) is suited to a send loudness rating $\geq$ -1.5 dB.

NOTE 2: The values given above are in conformity with current national practices and with the existing text of CCITT Recommendation G.101. However, the latter is itself partly based on a very old investigation (which CCITT Study Group XII has been asked to review) of the relationship between loudness ratings and speech levels. This may, in the near future, lead to amending the basis of objectives, so that it may be useful to allow wider design margins.

5.1.2.3.2 Tolerances of relative levels

The difference between the actual relative level and the nominal relative level shall lie within the following limits:

- input relative level: - 0.3 to + 0.7 dB,
- output relative level: - 0.7 to + 0.3 dB.

NOTE 1: These differences may arise, for example, from design tolerances, cabling (between analogue ports and the DF) and adjustment increments. Short-term variation of loss with time as discussed in subclause 5.2.1.1.3 is not included.

NOTE 2: Procedures for adjusting relative levels are given in CCITT Recommendation G.715, § 2.1.

5.2 Characteristics of half connections

In measuring an input connection a quiet code shall be applied (i.e. a PCM signal corresponding to decoder output value 1 (A-law) with the sign bit in a fixed state to the PABX test point T_i). (See I-ETS 300 003, subclause 5.1.1).

5.2.1 Characteristics common to all 2-wire analogue interfaces

5.2.1.1 Transmission loss

As presented in this standard, the values here are informative. However some Administrations may also apply these values for normative purposes.

5.2.1.1.1 Nominal value

The nominal transmission loss according to I-ETS 300 003, subclause 4.3.1 is defined in subclause 5.2.2.1 and subclause 5.2.3.1 for input and output connections of half connections with a 2-wire analogue interface.

5.2.1.1.2 Tolerances of transmission loss

The difference between the actual transmission loss and the nominal transmission loss of an input or output connection, according to subclause 5.1.1.3.2 and subclause 5.1.2.3.2 shall lie within the following range:

-0.3 to + 0.7 dB.

NOTE: These differences may arise, for example, from design tolerances, cabling (between analogue equipment ports and the DF) and adjustment increments. Short-term variation of loss with time as discussed in subclause 5.2.1.1.3 is not included.

5.2.1.1.3 Short-term variation of loss with time

When a sine-wave test signal at the reference frequency of 1020 Hz and at a level of -10 dBm0 (if preferred, the value 0 dBm0 may be used) is applied to the 2-wire analogue interface of any input connection, or a digitally simulated sine-wave signal of the same characteristic is applied to the PABX test point T_i of any output connection, the level at the corresponding PABX test point T_o and the 2-wire analogue interface respectively shall not vary by more than ± 0.2 dB during any 10-minute interval of typical operation under steady state condition with the permitted variations in the power supply voltage and temperature. (See ETS 300 132).

5.2.1.1.4 Variation of gain with input level

With a sine-wave test signal at the reference frequency 1020 Hz and at a level between -55 dBm0 and +3 dBm0 applied to the 2-wire analogue interface of any input connection, or with a digitally simulated sine-wave signal of the same characteristic applied to the PABX test point T_i of any output connection, the gain variation of that connection, relative to the gain at an input level of -10 dBm0, shall lie within the limits given in figure 4.

NOTE: The measurement should be made with a frequency-selective level meter to reduce the effect of the PABX noise. This requires a sinusoidal test signal.

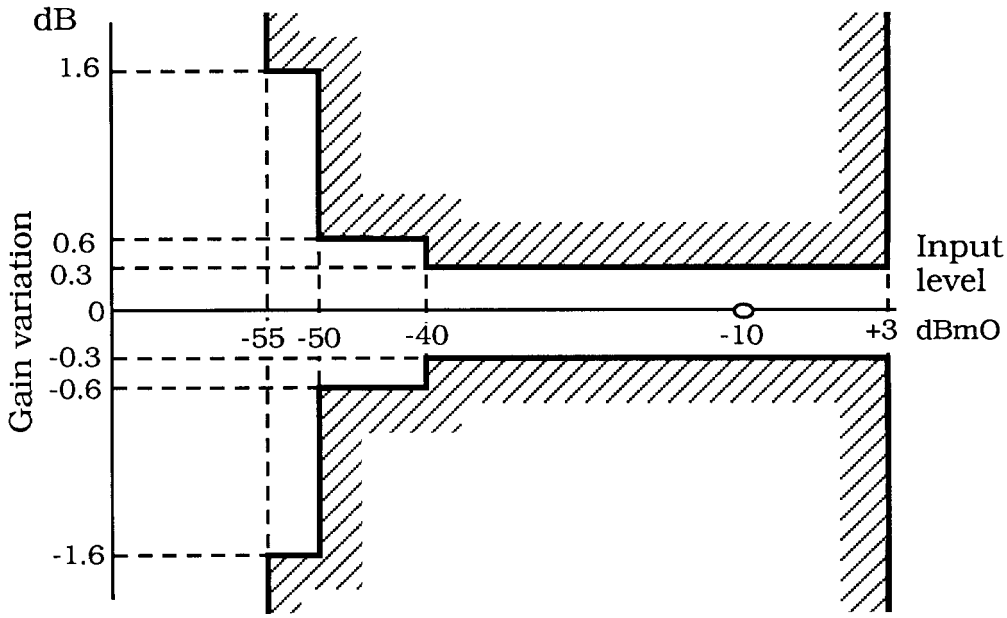
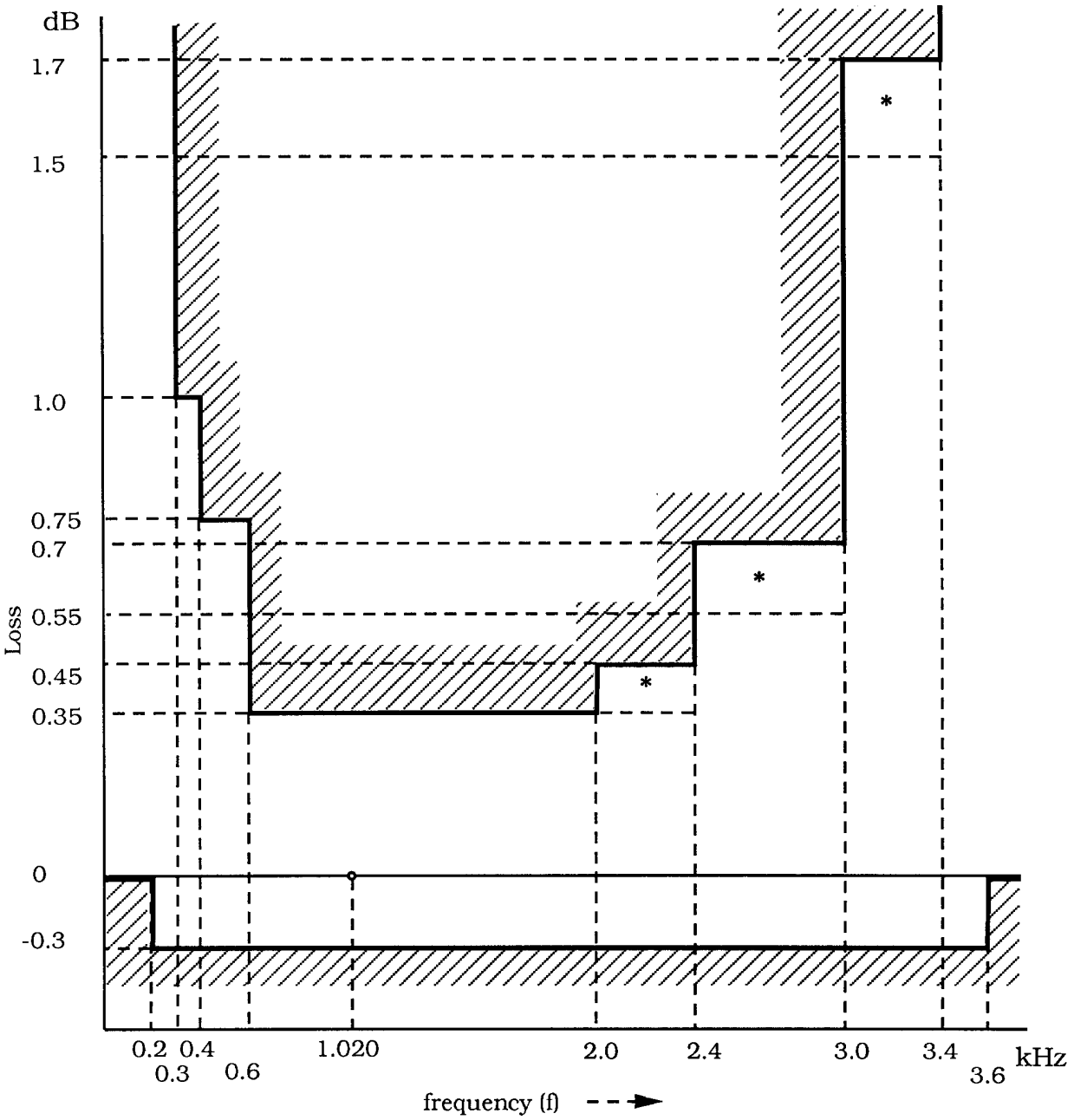


Figure 4: Variation of gain with input level

5.2.1.1.5 Loss distortion with frequency

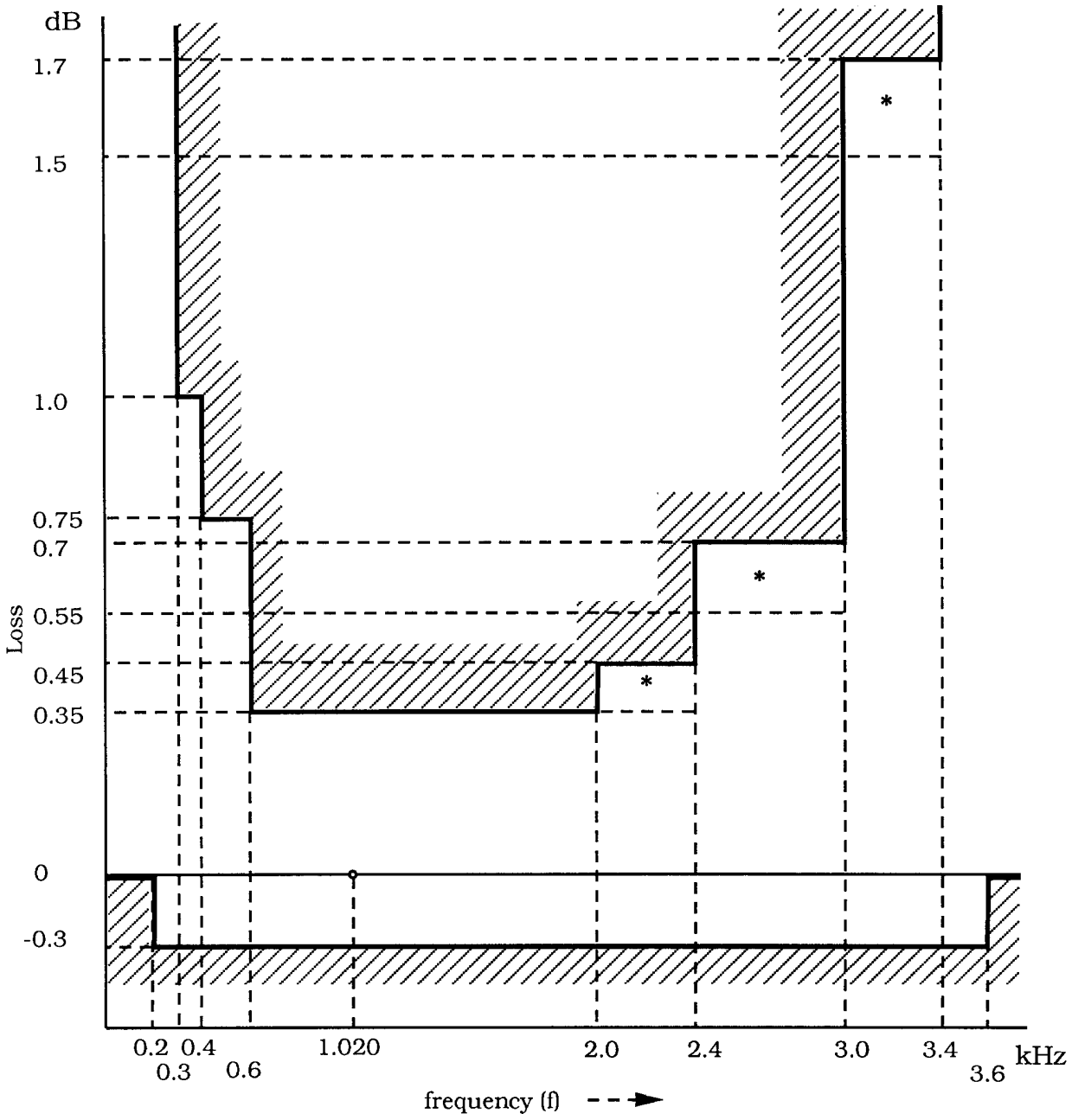
The loss distortion with frequency of any input or output connection according to I-ETS 300 003, subclause 4.4 shall lie within the limits shown in the mask of figure 5a or 5b respectively. The preferred input level is -10 dBm0.

The limits of this clause shall not apply to L2 half-connections which include equalization for the distortion in the extension line.



*: In the marked frequency ranges relaxed limits are shown which apply if the maximum length between cabinet and DF is used. The more stringent limits shown apply if no such cabling is present.

Figure 5a: Loss distortion with frequency - input connection



*: In the marked frequency ranges relaxed limits are shown which apply if the maximum length between cabinet and DF is used. The more stringent limits shown apply if no such cabling is present.

Figure 5b: Loss distortion with frequency - output connection

5.2.1.2 Group delay

5.2.1.2.1 Absolute group delay

NOTE: See I-ETS 300 003, subclause 4.7.3.1

5.2.1.2.2 Group delay distortion with frequency

Taking as the reference the minimum group delay, in the frequency range between 500 Hz and 2500 Hz, of the input or output connection, the group delay distortion of that connection shall lie within the limits shown in the template of figure 6. Group delay distortion is measured in accordance with CCITT Recommendation O.81.

These requirements shall be met at an input level of -10 dBm0.

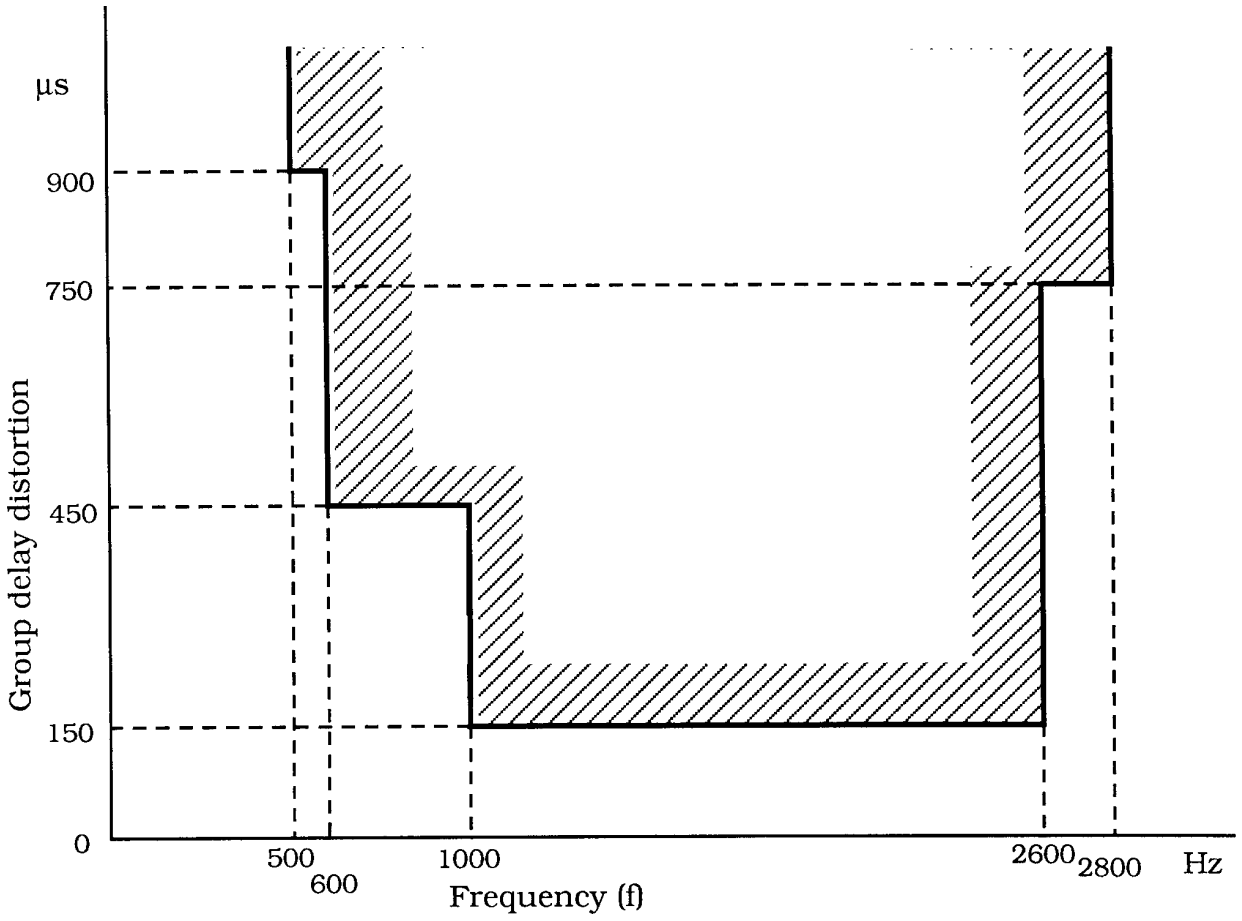


Figure 6: Group delay distortion limits with frequency

5.2.1.3 Single frequency noise

The level of any unwanted single frequency (in particular the sampling frequency and its multiples), measured selectively with a bandwidth of 80 Hz in the frequency range from 4 kHz to 72 kHz at the interface of an output connection shall not exceed -50 dBm0.

Some administrations specify the requirement in different ways (see Annex J).

NOTE 1: In this case "unwanted" refers to self generated noise such as feed-through of sampling frequencies and not to tones used for signalling or for normal traffic.

NOTE 2: The values above are preliminary and will be adapted to CCITT values, if CCITT comes to different results.

5.2.1.4 Crosstalk

For crosstalk measurements, auxiliary signals shall be injected as indicated in figures 7 and 8. These signals are :

- the quiet code, (see I-ETS 300 003, subclause 5.1.1);

- a low level activating signal. Suitable activating signals are, for example, a band limited noise signal (see CCITT Recommendation O.131), at a level in the range -50 to -60 dBm0 or a sine-wave signal at a level in the range from -33 to -40 dBm0.

NOTE: Care must be taken in the choice of frequency and the filtering characteristics of the measuring apparatus in order that the activating signal does not significantly affect the accuracy of the crosstalk measurement.

5.2.1.4.1 Input crosstalk

A sine-wave test signal at the reference frequency of 1020 Hz and at a level of 0 dBm0, applied to an analogue 2-wire interface, shall not produce a level measured selectively in any other half connection exceeding -73 dBm0 for Near-End CrossTalk (NEXT) and -70 dBm0 for Far-End Crosstalk (FEXT) (see figure 7).

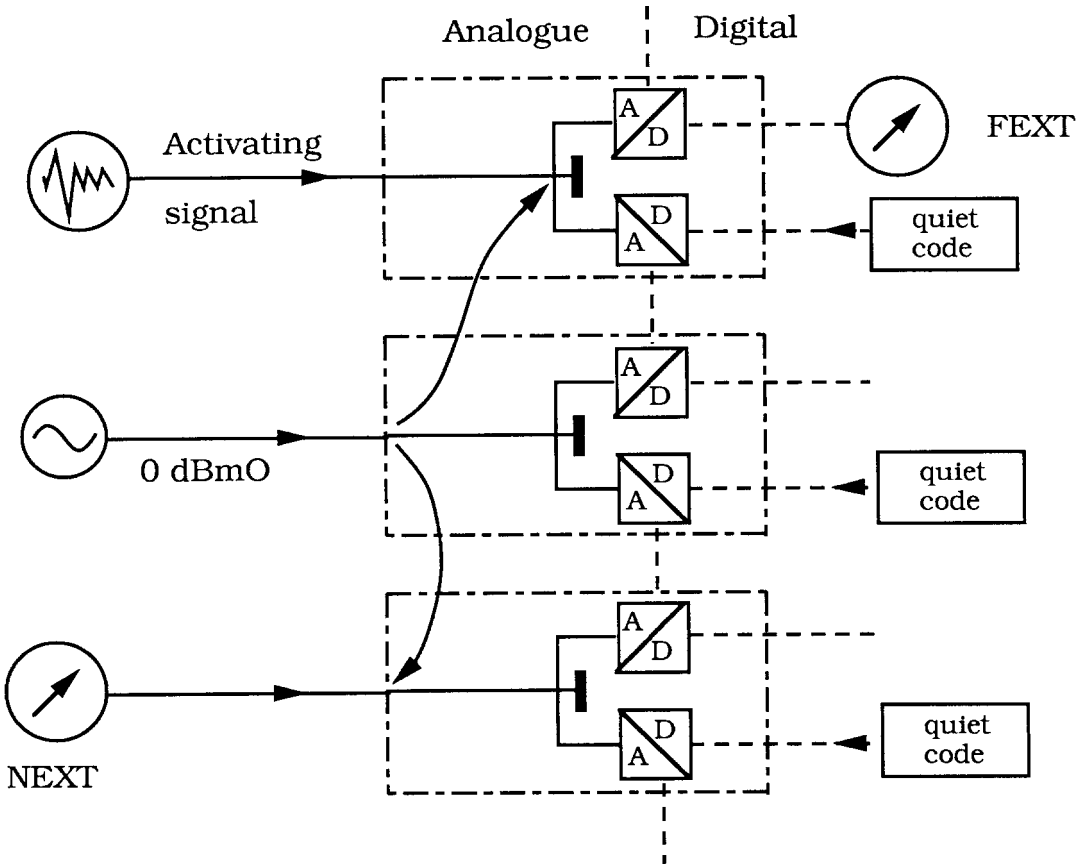


Figure 7: Measurement with an analogue test signal between different equipment

5.2.1.4.2 Output crosstalk

A digitally simulated sine-wave test signal at the reference frequency of 1020 Hz applied at a level of 0 dBm0 to PABX test point T_i of any output connection, shall not produce a level measured selectively in any other half connection exceeding -70 dBm0 for near-end crosstalk (NEXT) and -73 dBm0 for far-end crosstalk (FEXT) (see figure 8).

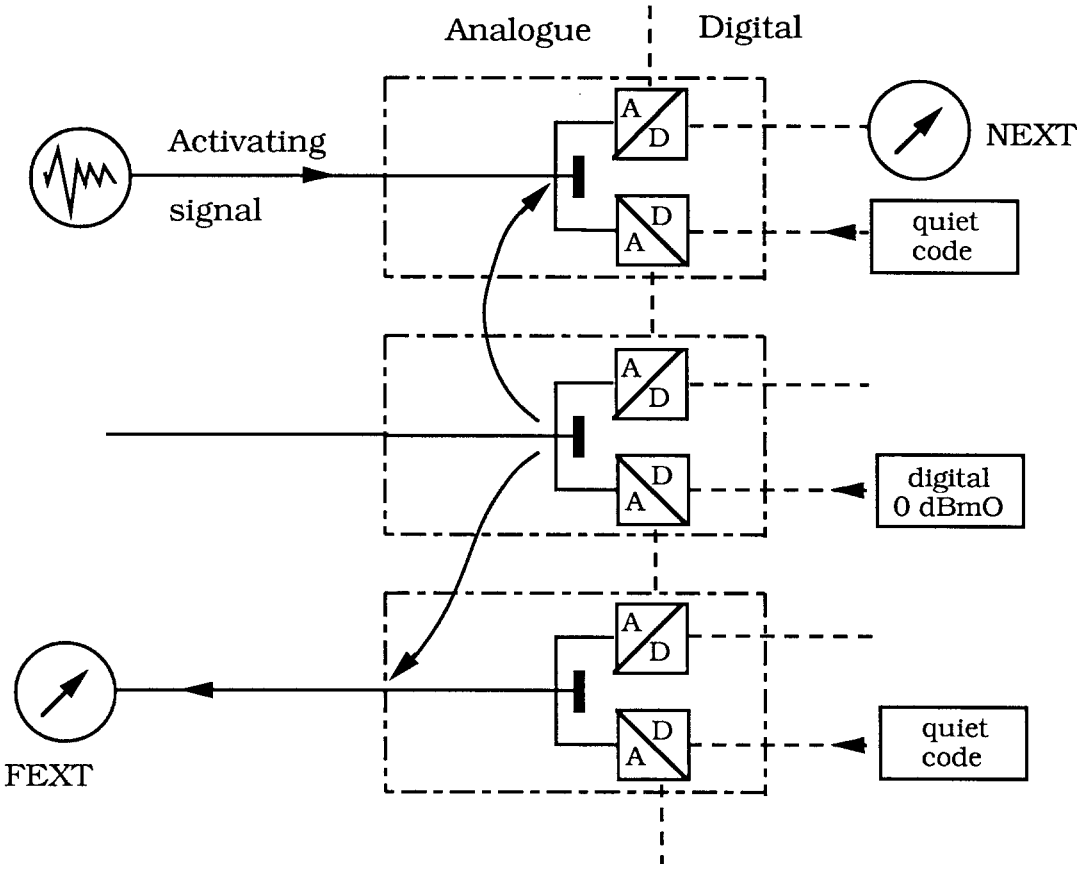


Figure 8: Measurement with a digital test signal between different equipment

5.2.1.5 Total distortion including quantizing distortion

With a sine-wave test signal at the reference frequency of 1020 Hz (see CCITT Recommendation O.132) applied to the 2-wire interface of an input connection, or with a digitally simulated sine-wave signal of the same characteristic applied to the PABX test point T_i of an output connection, the signal-to-total distortion ratio, measured at the corresponding outputs of the half connection with a proper noise weighting (see table 4 of CCITT Recommendation G.223) shall lie above the limits given in subclause 5.2.2.3, figures 10 and 11 for interfaces K2, M21 and M22 without feeding bridge and limits calculated according to subclause 5.2.3.3 for interfaces L2, M21 and M22 with feeding bridge. (figure 12 shows examples assuming the relative levels L_i = 0 dBr and L_o = -7 dBr.)

NOTE: The sinusoidal test signal is chosen to obtain results independent of the spectral content of the PABX noise.

5.2.1.6 Discrimination against out-of-band signals applied to the input interface

5.2.1.6.1 Input signals above 4.6 kHz

With a sine-wave signal in the range from 4.6 kHz to 72 kHz applied to the 2-wire interface of an input connection at a level of -25 dBm0, the level of any image frequency produced in the time slot corresponding to the input connection shall be at least 25 dB below the level of the test signal.

NOTE: If the respective values in CCITT will be changed, than the above given value will be corrected accordingly.

5.2.1.6.2 Signals below 300 Hz

At present no harmonized requirement can be specified. National values given by administrations shall be used and are given in annex H.

5.2.1.6.3 Overall requirement

Under the most adverse conditions encountered in a national network, the half connection should not contribute more than 100 pWOp of additional noise in the band 10 Hz - 4 kHz at the output of the input connection, as a result of the presence of out-of-band signals at the 2-wire interface of the input connection. This requirement is included as informative only.

5.2.1.7 Spurious out-of-band signals received at the output interface

5.2.1.7.1 Level of individual components

With a digitally simulated sine-wave signal in the frequency range 300 - 3400 Hz and at a level of 0 dBm0 applied to the PABX test point T_i of a half connection, the level of spurious out-of-band image signals measured selectively at the 2-wire interface of the output connection shall be lower than -25 dBm0.

NOTE: If the respective values in CCITT will be changed, than the above given value will be corrected accordingly.

5.2.1.7.2 Overall requirement

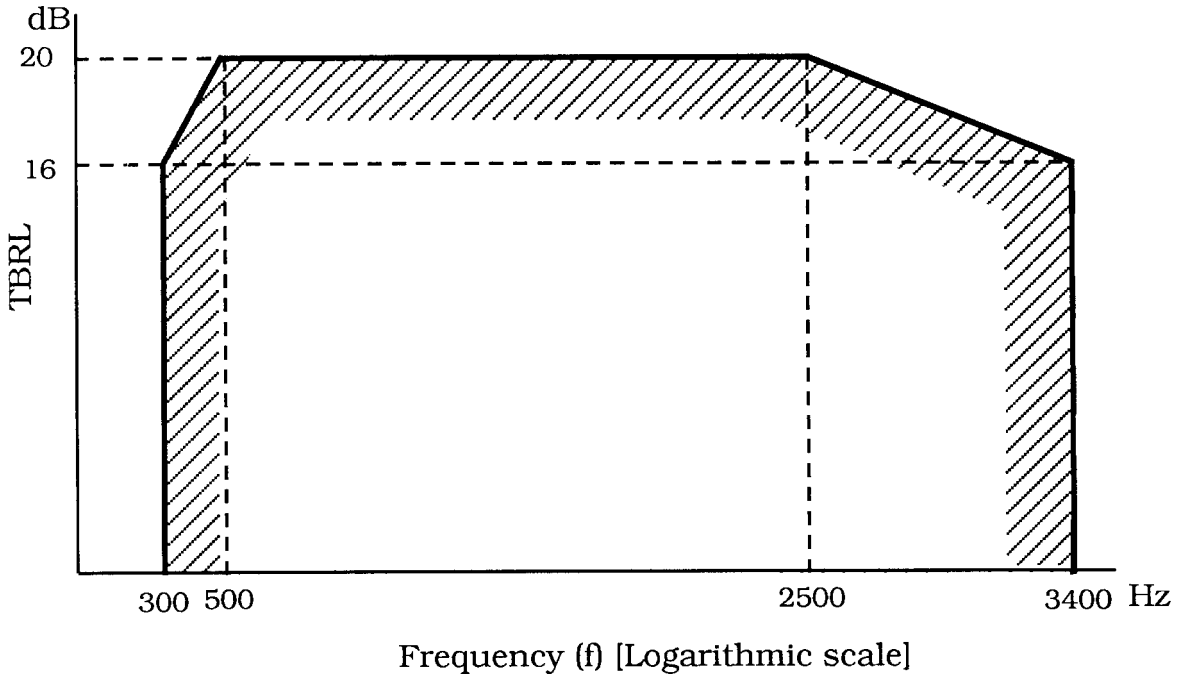
This requirement is included as informative only.

NOTE: Spurious out-of-band signals should not give rise to unacceptable interference in equipment connected to the digital PABX. In particular, the intelligible and unintelligible crosstalk in a connected FDM channel should not exceed a level of -65 dBm0 as a consequence of spurious out-of-band signals at the half connections.

5.2.1.8 Echo and stability

5.2.1.8.1 Terminal Balance Return Loss (TBRL)

Using the arrangement of figure 1 and sinusoidal test signals, the measured TBRL shall exceed the limits shown in figure 9.



NOTE: The balance test network, on which TBRL depends (see subclause 4.2.1.1) should be representative of the impedance conditions to be expected from a population of terminated lines connected to 2-wire interfaces, as determined by the national transmission planning. Annex E presents the balance test networks adopted by different European Administrations for unloaded lines.

Figure 9: Limits for TBRL

5.2.1.8.2 Stability loss

The stability loss measured with worst case terminating conditions on the 2-wire interfaces L2 or M21, between the PABX test points T_i and T_o of a half connection (figure 1) shall be:

$$\text{Stability Loss} = a_{io} \geq 6 \text{ dB};$$

for sinusoidal signals at all frequencies between 200 Hz and 3600 Hz. This frequency band is determined by the filters used in the interface designs.

NOTE 1: Certain implementations of the L2 interface, designed for use together with a minimum line length, will achieve a half connection stability loss of 6 dB if this half connection stability loss is determined with the "worst case" termination which includes this minimum extension line.

NOTE 2: Some Administrations may find that open- and short-circuit terminations are sufficiently representative of worst case conditions.

NOTE 3: In some PABXs the 4-wire call path is left open during the dialling or before the terminating equipment has answered the call, thus preventing the effects due to short-circuit and open-circuit termination conditions.

NOTE 4: Where the digital PABX is connected to the public digital exchange using a 4-wire line, the half connection of the digital PABX may provide the total stability loss of the entire path across the public network. The value of stability loss (a_{io}) that is required for a 2-wire interface is a matter of national control provided that the requirements of CCITT Recommendation G.122 are met. A a_{io} value of 6 dB at all frequencies between 200 Hz and 3600 Hz will ensure that the CCITT G.122 requirements are met. However, a_{io} values of between 6 dB and 0 dB will formally comply with the requirements of G.122 but further study is required to provide guidance in this area.

NOTE 5: In the case that the input impedance is not equal to the balance impedance, the Austrian PTT accept $a_{io} \geq 4$ dB under open- or short-circuit terminating conditions.

5.2.2 Characteristics of interfaces K2 and M2

5.2.2.1 Nominal value of transmission loss

NOTE: According to the relative levels defined in subclause 5.1.1.3, the nominal transmission losses of input or output connections NL_i and NL_o of a half connection with K2 and M2 interfaces can be calculated according to I-ETS 300 003, subclause 4.3.1.

5.2.2.2 Noise

5.2.2.2.1 Weighted noise

NOTE: For the calculation of noise, worst case conditions at the K2 and M2 interfaces are assumed. The band limiting effect of the encoder on the noise has not been taken into account. For a more exact calculation further study is necessary.

5.2.2.2.1.1 Output connection

The maximum value for the overall weighted noise, measured in the talking state at the K2 and M2 interfaces shall be :

-68.8 dBm0p for equipment with signalling on the speech wires and without feeding bridge (all K2 interfaces and some M21 and M22 interfaces);

-75.0 dBm0p for equipment with signalling on separate wires.

NOTE 1: For calculation of these values, two components of noise must be considered. One of these arises at the quiet decoder output, the other from analogue sources, such as signalling equipment. The first component is limited by CCITT Recommendation G.714 § 10 as receiving equipment noise to -75 dBm0p; the other component is limited to -70 dBm0p for K2, M21 interface and M22 interface without feeding bridge and to -67 dBmp for M21 interface and M22 interface with feeding bridge.

NOTE 2: The limit for interfaces with feeding bridge (some M21 interfaces and some M22 interfaces) depends on the output relative levels and can be calculated by the same formula reported in subclause 5.2.3.2.1.1 for interface L2, considering the same range of output relative levels for M21 interface and a wider range for M22 interface (see Annex B).

5.2.2.2.1.2 Input connection

The maximum value for the overall weighted noise measured at the test-point T_o in the talking state at the K2 and M2 interface shall be :

-64,5 dBm0p for equipment with signalling on the speech wires and without feeding bridge (all K2 interfaces and some M21 and M22 interfaces);

-66,0 dBm0p for equipment with signalling on separate wires.

NOTE 1: For calculation of these values two components of noise must be considered. One of these arises from the encoding process, the other from analogue sources, such as signalling equipment. The first component is limited by CCITT Recommendation G.714, § 9 as idle channel noise to -66 dBm0p; the other component is limited to -70 dBm0p for K2, M21 interface and M22 interface without feeding bridge and to -67 dBmp for M21 interface and M22 interface with feeding bridge.

NOTE 2: The limit for interfaces with feeding bridge (some M21 interfaces and some M22 interfaces) depends on the input relative levels and can be calculated by the same formula reported in subclause 5.2.3.2.1.2 for interface L2, considering the same range of input relative levels for M21 interface and a wider range for M22 interface (see Annex B).

5.2.2.2.2 Unweighted noise

NOTE: This noise will be more dependent on the noise on the power supply and on the rejection ratio. The need for and value of this parameter are both under study.

5.2.2.2.3 Impulsive noise

NOTE: It will be necessary to place limits on impulsive noise arising from sources within the PABX. The sources of impulsive noise are often associated with signalling functions (or in some cases the power supply) and may produce either transverse or longitudinal voltage at K2/M2 interfaces.

The disturbances to be considered are those to speech or modem data at audio frequencies, and also those causing bit errors on parallel digital lines carried in the same cable. This latter case, involving impulsive noise with high frequency content, is not presently covered by the measurement procedure of CCITT Recommendation Q.45bis.

5.2.2.3 Values of total distortion

The total distortion including quantizing distortion of a half connection with K2 and M2 interfaces shall be measured in accordance with subclause 5.2.1.5.

The signal-to-total distortion ratio for a half connection at interfaces K2 and M2 shall lie above the limits shown :

- in figure 10, for equipment with signalling on separate wires (some M21 interfaces and some M22 interfaces),

- in figure 11, for equipment with signalling on the speech wires and without feeding bridge (all K2 interfaces and some M22 interfaces); these values include the limits for the encoding process, given in figure 5 of CCITT Recommendation G.714, and the allowance for the noise contributed via signalling circuits from the exchange power supply and other analogue sources (e.g. analogue coupling), which is limited to -70 dBm0p.

All measurements shall be done with equipment in the talking state.

NOTE 1: The templates for input and output connections of an interface with feeding bridge (some M21 interfaces and some M22 interfaces) depend, respectively, on the input and output relative levels and can be calculated by the same formula reported in subclause 5.2.3.3 for interface L2.

NOTE 2: One resulting template for input and output connections is shown in figures 12a and 12b as an example, assuming the relative levels L_i = 0 dBr and L_o = -7 dBr.

NOTE 3: These templates include the limits for the coding process, given in figure 5 of CCITT Recommendation G.714, and the allowance for the noise contributed via signalling circuits from the PABX power supply and other analogue sources (e.g. analogue coupling), which is limited to -67 dBmp.

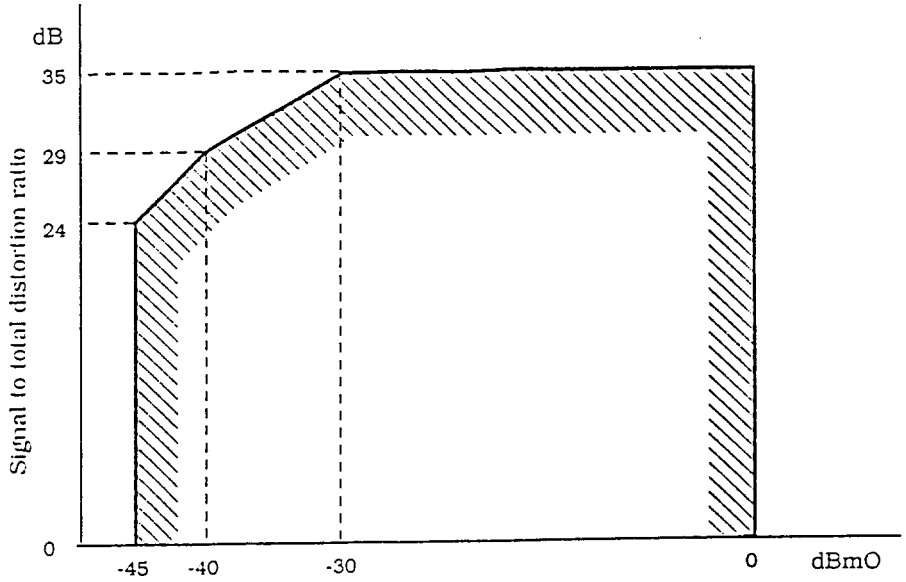


Figure 10: Limits for signal-to-total distortion ratio as a function of input level - input or output connection with signalling on separate wires

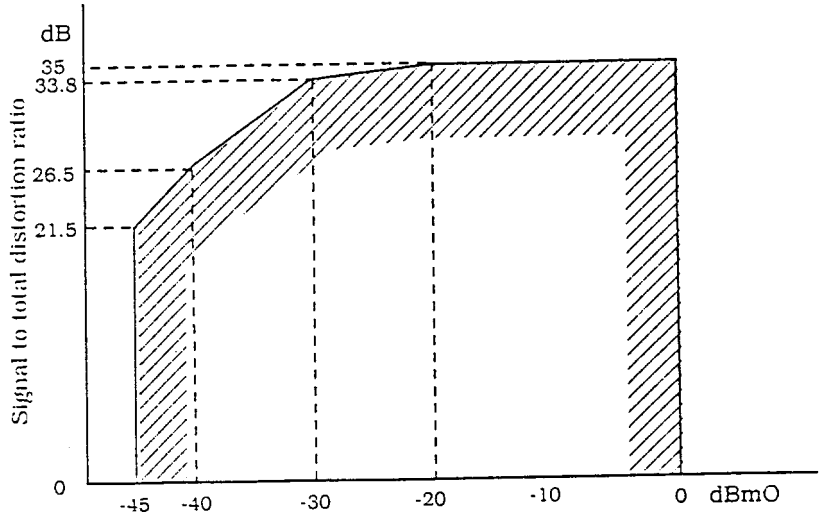


Figure 11: Limits for signal-to-total distortion ratio as a function of input level - input or output connection with signalling on the speech wires without feeding bridge

5.2.3 Characteristics of interface L2

5.2.3.1 Nominal value of transmission loss

NOTE: According to the relative levels defined in subclause 5.1.1.3, the nominal transmission losses of input or output connections NL_i and NL_o of a half connection with L2 interfaces can be computed according to I-ETS 300 003, subclause 4.3.1

5.2.3.2 Noise

5.2.3.2.1 Weighted noise

NOTE: For the calculation of noise, worst case conditions at the L2 interface are assumed. The band limiting effect of the encoder on the noise has not been taken into account.

5.2.3.2.1.1 Output connection

NOTE 1: Two components of noise must be considered. One of these, (noise arising from the decoding process) is dependent upon the output relative level. The other (power supply noise from the feeding bridge) is independent of the output relative level. The first component is limited by CCITT Recommendation G.714, § 10 as receiving equipment noise to -75 dBm0p; the other component is assumed by CCITT Recommendation G.103, to be 200 pWp (-67 dBmp). This can be caused by the main DC power supply and auxiliary DC-DC converters.

NOTE 2: Information about the subject of noise on the DC power supply is given in Supplement No. 13 to the G-Series Recommendations (Orange Book, Volume III.3).

The total psophometric power allowed at a L2 interface with a relative output level of L_o dB can be calculated by the formula :

$$P_{TNo} = P_{AN} + 10^{0.1\left(90 + L_{INo} + L_o\right)} \ldots pWp$$

The total noise level is given by:

$$L_{TNo} = [\,10 \log \left| \frac{P_{TNo}}{1\ pW} \right| - 90\,] \ldots . dBmp$$

where:

P_{TNo}: total weighted noise power for the output connection of the digital PABX;

P_{AN}: weighted noise power in pWp caused by analogue functions according to CCITT Recommendation G.103;

L_{INo}: receiving equipment noise (weighted) in dBm0p for PCM translating equipment according to CCITT Recommendation G.714, § 10, i.e. -75 dBm0p;

L_o: output relative level in dBr of a half channel of a digital PABX according to Annex D, e.g. -5.0 to -7.0 dBr;

L_{TNo}: total weighted noise level for the output connection of the digital PABX.

The resulting psophometric powers and the total noise levels for the output connection shall be not more than:

L_o = -5,0 -6,0 -7,0 ....dBr

P_{TNo} = 210,0 208,0 206,0 ....pWp

L_{TNo} = -66,8 -66,8 -66,9 ....dBmp

5.2.3.2.1.2 Input connection

NOTE: Two components of noise must be considered. One of these (noise arising from the encoding process) is dependent upon the input relative level. The other (power supply noise from the feeding bridge) must be corrected by the input relative level for calculation at the PABX test point T_o. The first component is limited by CCITT Recommendation G.714, § 9 as idle channel noise to -66 dBm0p; the other component is assumed by CCITT Recommendation G.103 to be 200 pWp (-67 dBmp) which results in -67 dBmp -L_i at the PABX test point T_o.

The total psophometric power allowed at the PABX test point T_o with a relative input level of L_i can be calculated by the formula:

$$P_{TNi} = P_{AN} + 10^{-0.1L_i} + 10^{-0.1(90 + L_{INi})} \ldots pWp$$

and the total noise level by

$$L_{TNi} = [\,10 \log \left[\frac{P_{TNi}}{1\,pW} \right] - 90\,] \ldots . dBm0p$$

where:

P_{TNi}: total weighted noise power for the input connection of the digital PABX;

P_{AN}: weighted noise power in pWp caused by analogue functions according to CCITT Recommendation G.103, i.e. 200 pWp;

L_{INi}: idle channel noise (weighted) in dBm0p for the input connection of a digital PABX according to CCITT Recommendation G.714, § 9, i.e. -66 dBm0p;

L_i: input relative level in dBr of a half channel of a digital PABX, e.g. 0 to +2.0 dBr;

L_{TNi}: total weighted noise level for the input connection of the digital PABX.

The resulting psophometric power and the total noise levels for the input connection shall be not more than:

L_i = 0,0 +1,0 +2,0 ....dBr

P_{TNi} = 451,0 410,0 377,0 ....pWOp

L_{TNi} = -63,5 -63,9 -64,2 ....dBm0p

5.2.3.2.2 Unweighted noise

NOTE: The noise will be more dependent on the noise on the power supply and on the rejection ratio. The need for and value of this parameter are both under study.

5.2.3.2.3 Impulsive noise

NOTE: It will be necessary to place limits on impulsive noise arising from sources within the PABX; these limits are under study.

The sources of impulsive noise are often associated with signalling functions (or in some cases the power supply and the ringing voltage) and may produce either transverse or longitudinal voltages at L2 interfaces.

The disturbances to be considered are those to speech or modem data at audio frequencies, and also those causing bit errors on parallel digital subscriber lines carried in the same cable. This latter case, involving impulsive noise with high frequency content, is not presently covered by the measurement procedure of CCITT Recommendation Q.45bis.

5.2.3.3 Values of total distortion

The total distortion including quantizing distortion on half connections with L2 interfaces shall be measured in accordance with subclause 5.2.1.5.

The signal-to-total distortion ratio required for a half connection can be calculated by the formula :

$$\frac{S}{N_t} = L_s + L_r - 10 \log \left[10^{0.1(L_s + L_r - S/N)} + 10^{0.1 L_N} \right] \ldots . dB$$

where

S/N_T: resulting signal-to-total distortion ratio for input or output connections in digital PABXs;

L_s: signal level of the measuring signal in dBm0;

L_r: for input connections input relative level L_i in dBr; for output connections, output relative level L_o in dBr;

S/N: signal-to-total distortion ratio in dB for PCM translating equipment, see CCITT Recommendation G.714;

L_N: weighted noise in dBmp caused by analogue functions according to CCITT Recommendation G.103 for PABXs, i.e. -67 dBmp at the L2 interface.

NOTE 1: One resulting template for the signal-to-total distortion ratio of input and output connections in a PABX is shown in figure 12a and 12b as an example. The relative levels are assumed to be L_i = 0 dBr and L_o = -7 dBr.

NOTE 2: The values of figures 12a and 12b include the limits for the coding process given in figure 5 of CCITT Recommendation G.714 and the allowance for the noise contributed from the digital PABX power supply and other analogue sources, which is limited to -67 dBmp for a L2 interface (with feeding) by CCITT Recommendation G.103.

NOTE 3: For input connection the calculation above is assumed to be the worst case. No band limiting effect of the encoder on the noise was taken into account.

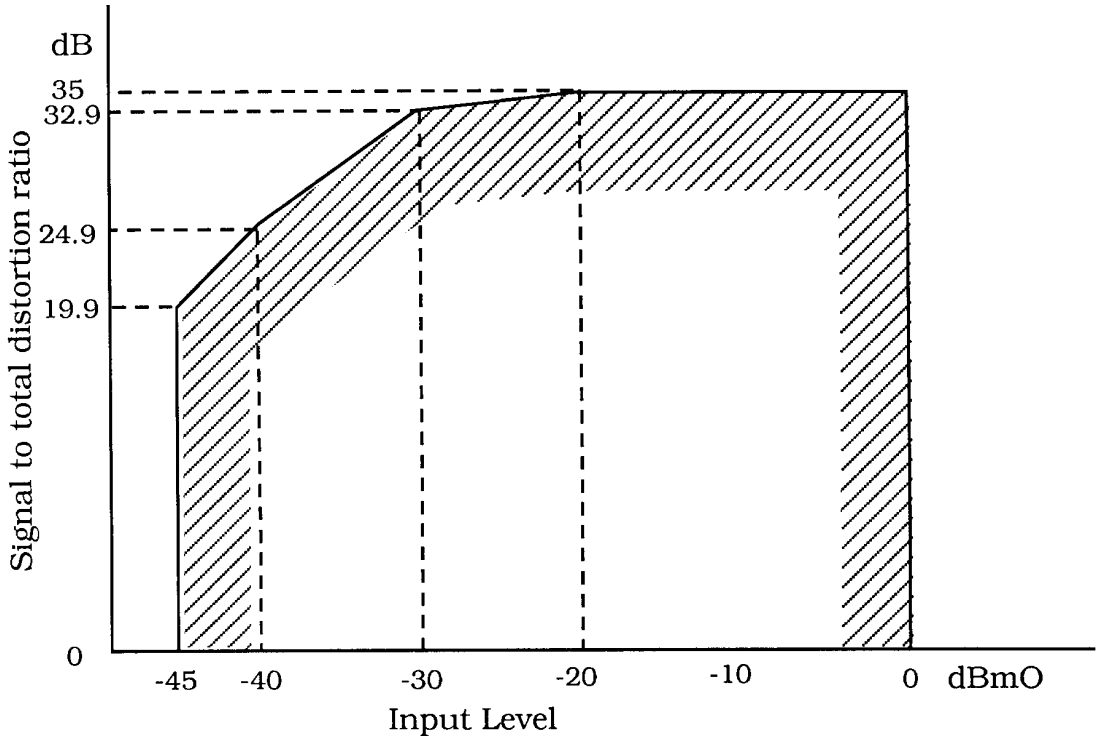


Figure 12a: Input connection - L_i = 0 dBr

Limits for signal-to-total distortion ration as a function of input level including analogue noise (interfaces L2 and M3 with feeding bridges)

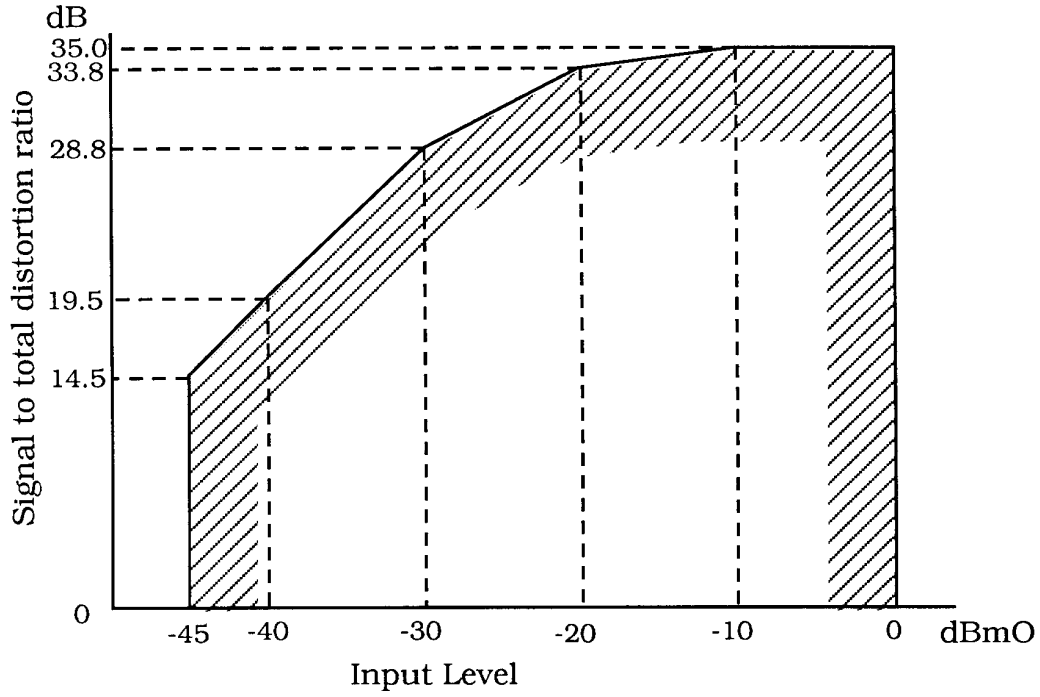


Figure 12b: Output connection - L_0 = -7 dBr

Limits for signal-to-total distortion ration as a function of input level including analogue noise (interfaces L2 and M3 with feeding bridges)

Annex A: Test networks for PABX input impedances at interfaces K2 and M2

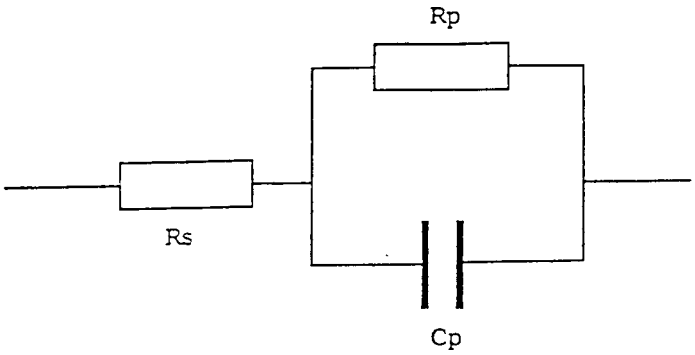


Figure A.1

Table A.1: Values specified by different European Administrations

		Rs (ohms)	Rp (ohms)	Cp(nF)
AUSTRIA	(K2/M21/M22)	220	820	115
	or (see also note 1)	600	0	0
BELGIUM		150	830	72
DENMARK	(K2/M21/M22)	400	500	330
FINLAND	(K2/M2) case a : NOTE 3	600	0	0
	(K2/M2) case b : NOTE 3	270	910	120
FRANCE	(K2/M21/M22)	215	1000	137
	Option a : See NOTE 2	180	910	150
	Option b	900	0	0
	Option c	600	0	0
FRG	(K2/M21/M22)	220	820	115
GREECE		220	820	115
ITALY	(K2/M21/M22)	600	0	0
NETHERLANDS	(K2/M21/M22)	600	0	0
NORWAY		120	820	110
PORTUGAL			under study	
SPAIN	(K2)	220	820	120
SPAIN	(M2)		not specified	
SWEDEN	(K2/M21/M22)	0	900	30
SWITZERLAND	(K2/M2)	220	820	115
U.K.	(K2 and M2)	370	620	310

NOTE 1: In order to get a high echo loss in the public network and in the case of subscriber loop with a resistance less than 450 Ohms, in Austria a 3 dB artificial line (T-pad: 180 Ohm / 100 nF / 180 Ohm) must be inserted into the subscriber line (K2-interface).

NOTE 2: Main values quoted are for new PABXs. The options a, b, and c are for intermediate values which may not be used in the future. These options are referred to in later annexes.

NOTE 3: It must be possible to easily change the nominal input impedance. Case a is used when the length of a trunk or a tie line is ≤ 1 km and case b when the length is > 1 km.

Annex B: Relative levels for K2 and M22 interfaces in dBr

Table B.1

		K2		M22	
		Lo	Li	Lo	Li
AUSTRIA	(NOTE 1)	-1	-6	-1/-7	-6/0
BELGIUM	< 3dB @ 1020 Hz	-3	-4	not specified	
	≥ 3dB @ 1020 Hz	-1	-6	not specified	
DENMARK		$-3 \leq L_0 \leq 0$	$-6 \leq L_i \leq -3$	under study	
FINLAND		-2,5	-4,5		
FRANCE	≤ 2 dB	-5.9	-4.9	-5.9	-4.9
	option a (See NOTE 3)	-5.4	-4.4	-5.4	-4.4
	option b	-5.7	-4.7	-5.7	-4.7
	option c	-4	-3	-4	-3
FRANCE	> 2 dB	-2.9	-7.9	-2.9	-7.9
	option a (See NOTE 3)	-2.4	-7.4	-2.4	-7.4
	option b	-2.7	-7.7	-2.7	-7.7
	option c	-1	-6	-1	-6
FRG	≤ 2dB	-2	-5	-2	-5
	≤ 2dB (optional)	+1	-8	+1	-8
	> 2 dB	+0	-7	0	-7
	> 2dB (optional)	+3	-10	+3	-10
GREECE		-1	-6	-1	-6
ITALY		-1	-6	-7/-1	0/-6
ITALY	(only for single PABX, not forming part of a private network)	-2	-5		
NETHERLANDS	< 3dB @ 800 Hz	-3	-4		
	> 3dB @ 800 Hz (NOTE 4)	-1	-6		
NORWAY	≤ 3dB @ 800 Hz	-1	-2	-4	+1
	> 3dB @ 800 Hz	+1	-4	-4	+1
PORTUGAL		under study			
SPAIN(K2)	≤ 3dB @ 800 Hz	-3	-4	not specified	
	> 3dB @ 800 Hz	-1	-6	not specified	
SWEDEN		-3	-2	-5	0
SWITZERLAND	≤ 2 dB	-4	-2,5	-6.5	0
	> 2 dB	-2	-4,5	-6.5	0
U.K.		≤+3	$-11 \leq L_i \leq -3$*	under study	

* For UK : dependant on the loss of the line.

NOTE 1: Echo depends essentially on the balance impedance and the terminating of the hybrid. In Austria in the case of a short subscriber line, a real impedance on the LE and a complex balance impedance in K2-interface, the adjustment of the transmission loss should be made by inserting an artificial line into the subscriber line, instead of changing the relative levels (see NOTE to Annex A).

NOTE 2: K2 Interface relative level values of some countries are given in two different sets, depending on the loss of the analogue subscriber line involved in the connection. This loss is normally expressed in dB's

NOTE 3: For French figures refer to Annex A.

NOTE 4: Figures only for design objectives. Type approval figures: L_o = -1 dBr, L_i = -6 dBr.

Annex C: Test networks for PABX input impedances at interface L2

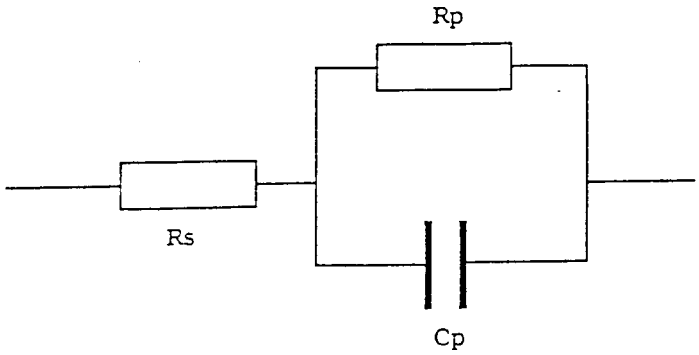


Figure C.1

Table C.1: Values specified by different European Administrations

	Rs ohm	Rp ohm	Cp nF
AUSTRIA (I)	600	0	0
AUSTRIA (II)	220	820	115
BELGIUM	150	830	72
DENMARK	300	1000	220
FINLAND	270	910	120
FRANCE	215	1000	137
option : see NOTE 4	180	910	150
FRG	220	820	115
GREECE	400	500	50
ITALY	180	630	60
NORWAY	120	820	110
NETHERLANDS		Not specified	
PORTUGAL		under study	
SPAIN	220	820	120
SWEDEN	200	1000	100
SWITZERLAND	220	820	115
U.K.	300	1000	220

NOTE 1: The test network and the component values represent a configuration that exhibits the required exchange impedance. It need not necessarily correspond to any actual network provided in the exchange interface.

NOTE 2: The range of component values reflects the fact that there are substantial differences in the sensitivity and sidetone performance of the various telephone instruments throughout the world. In general, the combination of short lines and sensitive telephone sets might be rather common in the future due to increased use of remote concentration. In order to control sidetone performance, Administrations need to take into account telephone set parameters.

Not only the parameters of existing telephone sets should be considered but also the parameters that may be desirable in the future allow improvement in sidetone performance to be achieved.

NOTE 3: It may be necessary to group the extension lines of a particular PABX into classes, each requiring a different PABX impedance of the L2 interface.

NOTE 4: French figures include an option which is allowed at present. The main values will be used in the future. This option is referred to in later annexes.

Annex D: Relative levels at interface L2 and M21 in dBr

Table D.1

Country		Lo	Li
AUSTRIA		-7	0
BELGIUM	(L2)	-7	0
	(M21)	not specified	
DENMARK		-6	0
FINLAND		-7	0
FRANCE	(L2)	-8.9	-1.9
	option: See NOTE 1	-8.4	-1.4
FRANCE	(M21)	-8.9	-1.9
	Option a: See NOTE 2	-8.4	-1.4
	Option b	-8.7	-1.7
	Option c	-7	0
FRG		-7	0
FRG	(optional)	-10	+3
GREECE		-7	0
ITALY		-7	0
NETHERLANDS		-7	+0
NORWAY	(L2) (See NOTE 4)	-5	+2
NORWAY	(M21)	-4	+1
PORTUGAL		under study	
SPAIN	(M21)	not specified	
SPAIN	(L2)	-7	0
SWEDEN	(See NOTE 3)	-5	0
SWITZERLAND			-6,5 0
U.K.	(L2)	not specified	·+3
U.K.	(M21)	-6	+1

NOTE 1: For French option figures refer to Annex C.

NOTE 2: For French options figures refer to Annex A.

NOTE 3: On international connections 2dB digitally implemented loss is added at international switching centre in the receiving transmission direction.

NOTE 4: In Norway, for connections to/from digital exchange lines, the relative levels may have to be changed to L_o = -11 dBr and L_i = +7 dBr to satisfy the requirements in ETR 004.

Annex E: Test networks for TBRL in different European Administrations

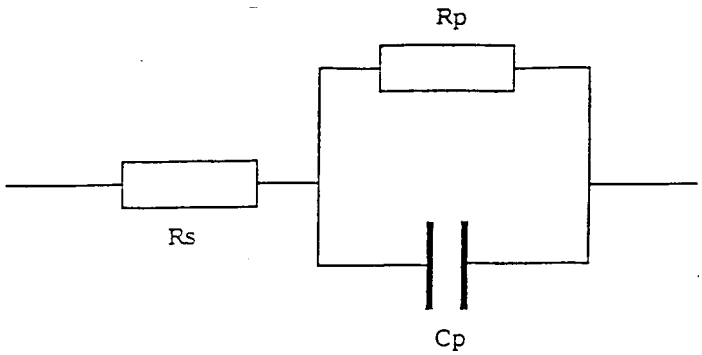


Figure E.1

Table E.1: Values specified by different European Administrations

		Rs ohm	Rp ohm	Cp (nF)
AUSTRIA	(L2)	600	0	0
AUSTRIA	(K2)	220	1200	150
AUSTRIA	(M2)	220	820	115
BELGIUM	(L2) Short lines	600	0	0
	Long lines	150	830	72
BELGIUM	(K2)	150	830	72
	option see NOTE 6			
DENMARK	(L2)	400	500	330
DENMARK	(K2) Case a: see NOTE 7	270	390	91
DENMARK	(K2) Case b: see NOTE 7	300	1000	220
DENMARK	(M2)		under study	
FINLAND	(L2/K2/M2) Case a: see NOTE 5	390	620	100
FINLAND	(L2/K2/M2) Case b: see NOTE 5	270	1200	120
FRANCE	(K2/M21/M22)	215	1000	137
	Option (see NOTE 3)	180	910	150
FRANCE	(L2)	600	0	0
FRG	(K2/L2/M2)	220	820	115
GREECE		220	820	115
ITALY	(L2)	0	750	18
ITALY	K2/M2)	400	700	200
NETHERLANDS	(L2/M2/K2)		not specified	
	For design objective (K2/M2)	430	887	215
NORWAY(K2/L2/M2)	120	820	110	
PORTUGAL			under study	
SPAIN	(M2)		not specified	
SPAIN	(K2/L2)	220	820	120
SWEDEN	(K2)	0	900	60
SWEDEN	(L2)	0	900	30
SWEDEN	(M2) (see NOTE 4)	0	900	30-60
SWITZERLAND	(L2/K2/M2)	220	820	115
U.K.	(L2)	370	620	310
U.K.	(K2, M2) case a : see NOTE 1	600	0	0
U.K.	(K2, M2) case b : see NOTE 1	370	620	310

NOTE 1: Use of case a or case b depends on the line length (however this length is not specified).

NOTE 2: For some countries more that one test network is given, depending on the length of the analogue subscriber line involved in the connection.

NOTE 3: French figures also refer to a presently allowed option.

NOTE 4: One single value in the range for Cp.

NOTE 5: It must be possible to easily change between cases a and b. Case a is used when the input impedance of an extension or a trunk or a tie line is 600 ohm (res.). Case b is used when the input impedance of an extension or a trunk or a tie line is complex or meets the requirements of figure 1.

NOTE 6: For long exchange lines connected to "Stone bridge" type central offices the following test network is allowed:

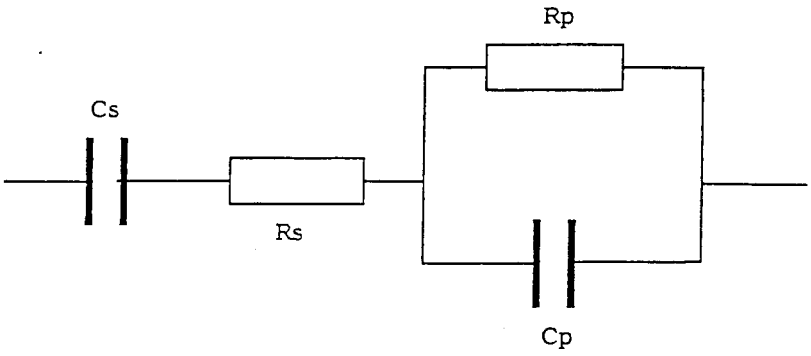


Figure E.2

where Cs = 1.39 µF, Rs = 176 ohms, Rp = 873 ohms and Cp = 166 nF.

NOTE 7: Use of case a or b depends on length of the subscriber line and input impedance of the public exchange.

Annex F: Compensation of losses on long or short 2-wire lines

F.1 Lines connected to interfaces K2 and M2

In order to compensate loss on short or long lines, an Administration may, to satisfy local conditions, choose values of relative levels derived from the basic values as follows:

$L_i' = L_i + x$ dB

$L_o' = L_o - x$ dB

The value of x is in national competence. Such compensation of loss requires careful selection and application of balance networks.

It is assumed that the interfaces in a PABX are interconnected in such a way that the resulting loss is in the range of 0 to 7 dB.

It has been recognized that it is not necessary for a particular design of equipment to be capable of operating over the entire level range.

F.2 Extension lines

In order to compensate for the loss of short or long extension lines, some Administrations may choose values of the relative levels derived from the basic values as follows:

$L_i' = L_i + x$ dB

$L_o' = L_o - x$ dB

The value of x is within national competence (e.g. x = 3 dB for short extension lines).

If values of L_i and L_o are chosen as indicated, the loss difference with respect to the conditions given in subclause 5.1.2.3.1 will be left unchanged.

The use of values of $x < 0$ requires careful selection of balance networks; values of $x < -3$ dB are not recommended.

Annex G: Impedance unbalance about earth in different European Administrations

Table G.1

Country	Frequency Range	LCL
Interfaces K2 and M2		
Denmark	40 - 600 Hz	40 dB
	600 - 3400 Hz	46 dB
	> 3400 Hz	6 dB decrease/octave
France	25 - 300 Hz	30 dB
	300 - 3400 Hz	52 dB
Norway (see NOTE)	16 - 300 Hz	40 dB
	300 - 600 Hz	46 dB
	600 - 3400 Hz	52 dB
Sweden	15 - 50 Hz	40 dB
	50 - 600 Hz	46 dB
	600 - 3400 Hz	52 dB
Switzerland	15 - 300 Hz	42 dB
	300 - 3400 Hz	52 dB
Interface L2		
Denmark	40 - 600 Hz	40 dB
	600 - 3400 Hz	46 dB
	> 3400 Hz	6 dB decrease/octave
France	25 - 300 Hz	30 dB
	300 - 3400 Hz	46 dB
Norway (see NOTE)	40 - 300 Hz	40 dB
	300 - 600 Hz	46 dB
	600 - 3400 Hz	52 dB
Sweden	15 - 50 Hz	30 dB
	50 - 600 Hz	40 dB
	600 - 3400 Hz	46 dB
Switzerland	15 - 300 Hz	42 dB
	300 - 3400 Hz	52 dB

NOTE: This requirement applies for all states of normal operation lasting more than 100 ms.

Annex H: Discrimination against out-of-band signals applied to the input interface:

Sweden: The rejection of signals in the band 15-50 Hz shall be at least 20 dB.

Italy: The rejection of signals at 50 Hz shall be at least 20 dB. (Under study).

Annex J: Single frequency noise (dBm0)

Table H.1: Requirements specified, in the frequency ranges

	15 - 75 Hz	75 - 300 Hz	0,3 - 3,4 kHz	3,4 - 150 kHz
by:				
Sweden	-17 dBm0	-27 dBm0	*	-50 dBm0

* The requirements in speech band 0,3 - 3,4 kHz are covered by those associated with psophometric noise. (see subclause 5.2.2.2.1 and subclause 5.2.3.2.1).

NOTE: This parameter is under study also in CCITT, mainly for the extent of the bandwidth where the measure has to be done.

Annex K: Return loss

Requirements specified by Sweden:

As in figure 2 but completed with a requirement of 10 dB at the frequencies 200 Hz and 3800 Hz with straight lines to the closed breaking points at 300 Hz and 3400 Hz respectively.

History

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