All drawings appearing in this Recommendation have been done in Autocad.

Recommendation Q.551

TRANSMISSION CHARACTERISTICS OF DIGITAL EXCHANGES

1 Introduction

1.1 *General*

The field of application of this Recommendation is found in Recommendation Q.500.

Note — A high percentage of international calls will have a digital PABX included in the connection. Therefore, Recommendations Q.551—Q.554 are applicable also for digital PABXs with regard to those specific transmission parameters affecting the transmission quality of an international call, for instance Loudness Ratings, noise, talker's and listener's sidetone, echo and stability. These Recommendations primarily concern digital PABXs connected digitally to the international network. However, Administrations may find some of the specification details useful for digital PABXs connected by analogue means to the international network.

The signals taken into consideration are passed through the following interfaces as described in Recommendations Q.511 and Q.512 and Figures 1/Q.551 and 2/Q.551.

— Interface A is for primary digital signals at 2048 kbit/s or 1544 kbit/s.

— Interface B is for secondary digital signals at 8448 kbit/s or 6312 kbit/s.

— Interface C comprises both 4—wire and 2—wire analogue trunk interfaces. Interfaces C_1 4—wire and C_2 2-wire represent possible applications of interface C in Figure 1/Q.511.

Interface C_1 represents a 4—wire and interface C_2 a 2—wire analogue trunk interface. For practical reasons, C_1 and C_2 are further sub—divided into C_{11}, C_{12}, C_{13}, C_{21} and C_{22}.

C_{11} interfaces channel translating equipment. C_{12} and C_{13} interface 4—wire analogue exchanges; C_{12} via the relay sets, C_{13} directly to the switching stages.

C_{21} is an interface applicable when a 2—wire circuit connects a digital transit exchange with a local exchange, analogue or digital. C_{22} is an interface applicable when a 2—wire circuit connects local exchanges, analogue and/or digital.

See Figures 1/Q.551 and 2/Q.551 for illustration of the principles.

— Interface type V is for digital subscriber line access.

— Interface type Z is for analogue subscriber line access.

Note 1 — Remote analogue exchange concentrators and analogue PABXs may use interface Z for access to a digital exchange.

Note 2 — In the future, differences in circuit configurations with respect to transmission parameters may cause a sub—division of the Z interface.

Figure 1/Q.551 - T1107790-87

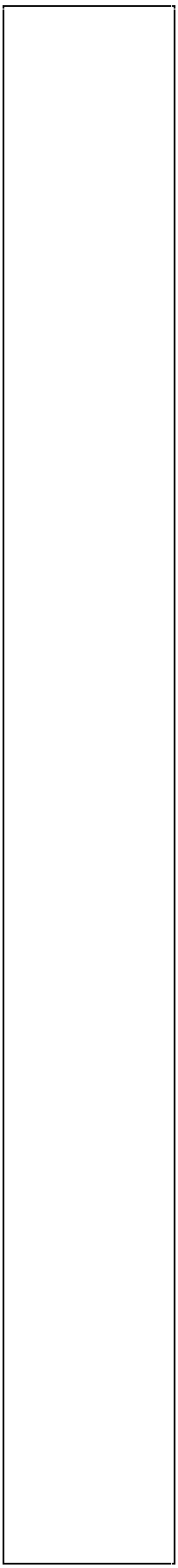
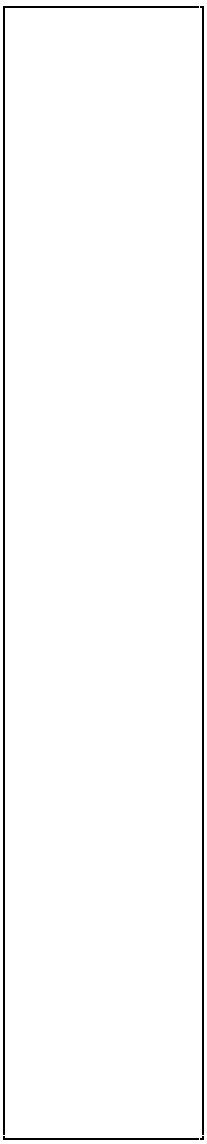


Figure 2/Q.551 - T1107800-87



Also for ports other than those designated Z, there can exist types whose transmission characteristics have not been defined, even though they may be recognized as being in practical operation. This may be due to CCITT not having considered their international standardization justified, e.g., because of their limited use, or because their function is to coordinate with pre—existing national standards. However, later additions to recommended interfaces are not ruled out (e.g., 4—wire subscriber interface).

Interface types V and Z may appear remote from the exchange through the use of digital transmission facilities. When this occurs, there should be no impact on transmission parameters other than delay. Transmission parameters associated with interface Z include the effects of the equipment provided for interfacing the analogue subscriber line to the digital switching network of the exchange.

Multislot channels are not considered in this Recommendation. This requires further study.

It is necessary to ensure that representative feeding currents are flowing during the measurements of all of these transmission parameters. These feeding currents can contribute to noise, distortion, crosstalk, variation of gain with input level, etc. Therefore, appropriate allowances for this must be made. In some cases, where indicated, the permissible limits quoted include these allowances.

Detailed transmission characteristics for these interfaces are provided in the following Recommendations:

— Recommendation Q.552 for 2—wire analogue interfaces

— Recommendation Q.553 for 4—wire analogue interfaces

— Recommendation Q.554 for digital interfaces.

In the present Recommendations, values given for transmission characteristics relate to the path from an exchange test point to an exchange interface and vice—versa; the overall characteristics for connections involving two interfaces can in most cases be obtained by suitably combining these values (see Recommendation Q.551, § 3).

In the future, other interfaces may be defined.

At this time these Recommendations consider analogue signals which are encoded in accordance with Recommendation G.711. Other coding laws may be defined in the future and these Recommendations will need to take them into account.

The transmission characteristics of voice—frequency (VF) connections through a digital transit exchange should in principle provide performance in accordance with Recommendations G.712, G.713 and, where applicable, Q.45 *bis* (see also Recommendation G.142).

The principles of Recommendation G.142 and the limits of Recommendations G.714 and G.715 have been used as a basis for establishing the transmission characteristics for analogue voice frequency connections specified in §§ 2 and 3 of Recommendations Q.552 and Q.553, respectively. The limit values are not necessarily identical with those specified in the G—Series, since in the case of a connection through the exchange, additional allowances generally have been made for cabling (see § 2). The principles of Recommendations G.714 and G.715 have been used for the analogue/digital test connections referred to in §§ 2 and 3 of Recommendations Q.552 and Q.553, respectively.

The values given are to be considered as either “design” or “performance objectives” according to the explanations of the terms given in Recommendation G.102 (Transmission performance and objectives and recommendations) and the particular context.

The specification clauses in this Recommendation exclude the effects of auxiliary functions such as echo suppression, echo cancellation or transmission to the subscriber of metering impulses, or of non—telephony functions such as telemetering over the subscriber pair.

1.2 *Definitions*

1.2.1 *Exchange test points, exchange input and output and half—connections*

1.2.1.1 **exchange test points**

The exchange test points shown in Figure 1/Q.551 are defined for specification purposes. They may not physically exist in an exchange but may be accessed via the digital switching network. In this case, some or all of the switching network will be included in the path from the exchange interface to the access points.

The transmission parameters affected by this means of access are the absolute group delay and possibly jitter and wander and bit error ratio. For most other parameters, either the exchange test points or the access points are located such that end—to—end performance can be determined by suitably combining performances between each interface and either the exchange test points or the access points.

1.2.1.2 **exchange input and output**

The exchange input and output for a connection through a digital exchange are located at the interfaces identified in § 1.1 and shown in Figures 1/Q.551 and 2/Q.551.

The exact position of each of these points depends on national practice, and it is not necessary for the CCITT to define it.

However, the applicability of recommended values to points arbitrarily located is subject to certain restrictions:

— for analogue interfaces, as referred to in § 2 of this Recommendation (maximum length of exchange cabling between exchange equipment ports and the interface);

— for digital interfaces, as also mentioned in § 2 (maximum loss between exchange interfaces and connected equipment, e.g., digital line or higher order multiplex equipment).

1.2.1.3 *Half—connections*

input connection — A unidirectional path from an interface of a digital exchange to an exchange test point.

output connection — A unidirectional path from an exchange test point to an interface of a digital exchange.

half connection — A bidirectional path comprised of an input connection and an output connection, both having the same exchange interface.

Note 1 — These terms may be qualified by the words analogue or digital, the qualification signifying the property of the exchange interface.

Note 2 — An analogue input (output) (half) connection may be further qualified by the words 2—wire or 4-wire.

Note 3 — Refer to Recommendation Q.9 for additional information.

1.2.2 *Relative levels*

1.2.2.1 *Exchange test points*

The nominal relative level at the input and output exchange test points is assigned the value 0 dBr.

1.2.2.2 *Analogue interfaces*

The nominal relative level at the exchange input point is designated L_I.

The nominal relative level at the exchange output point is designated L_O.

1.2.2.3 *Digital interfaces*

The relative level to be associated with a point in a digital path carrying a digital bit stream generated by a coder lined—up in accordance with the principles of Recommendation G.101 is determined by the value of the digital loss or gain between the output of the coder and the point considered.

If there is no such loss or gain the relative levels at the exchange input and output points (i.e., digital interfaces V, A and B) are by convention said to be 0 dBr. For further information, see Recommendation G.101, § 5.3.2.4.

Note — The digital level may be established using measuring equipment in accordance with Recommendation O.133.

Relative level has no meaning for digital bit streams that are not derived from real or simulated analogue sources.

1.2.3 *Measurement conditions*

1.2.3.1 *Common measurement conditions*

All digital signal processing devices which affect bit integrity of the 64 kbit/s path (e.g., digital loss pads, code converters, digital echo control devices, digital speech interpolation apparatus or all—zero suppressors) must be rendered inoperative when measuring the transmission parameters of this Recommendation. However, if the nominal transmission loss, NL, for speech connections is implemented by a digital loss pad, the loss pad must *not* be inoperative for the output connection when measuring parameters dependent on NL.

Where measuring transmission parameters between 2—wire ports is considered necessary, the opposite direction of transmission must be interrupted in order to avoid disturbing effects due to reflections at hybrids.

In addition, a quiet code, i.e., a PCM signal corresponding to decoder output value 0 (μ—law) or output value 1 (A—law), with the sign bit in a fixed state should be applied to the exchange test point.

Note — These patterns are slightly different from the idle code produced by an exchange (see e.g., Recommendation Q.522, § 2.12).

1.2.3.2 *Reference frequency*

For the reference frequency, Recommendation O.6 applies:

— A reference test frequency of 1020 Hz is recommended for test frequency generating circuits or instruments that provide reference test frequencies. The specified frequency tolerance should be +2 to -7 Hz.

1.2.3.3 *Impedance*

Unless otherwise specified, measurements at analogue interfaces shall be made under nominally matched conditions.

Note — The preferred interpretation of this statement should be that the nominal exchange impedance should be used as the internal impedance of the analogue test generator and the analogue level meter. However, under some circumstances it may be preferable to use a low impedance generator and a high impedance meter which corresponds to an exact matching to the actual exchange impedance. (Losses measured according to the two methods will only differ by a small amount, in the same order of magnitude as the loss of a very short subscriber cable.)

1.2.3.4 *Test levels at analogue interfaces*

At the reference frequency, test levels are defined in terms of the apparent power relative to 1 mW.

Where no value is given, the test level should be —10 dBm0.

At frequencies different from the reference frequency, test levels are defined as having the same voltage as the test level at the reference frequency. Measurements are based on the use of a test generator with a frequency—independent EMF.

The above considerations are primarily concerned with measurements at discrete frequencies. Their impact on the measurement at interfaces with complex impedances of broadband signals (e.g., random or quasi—random noise with defined spectral intensity) and *vice versa* needs further study.

1.2.4 *Transmission loss*

1.2.4.1 *Nominal transmission loss*

A connection through the exchange (see Figure 1/Q.551) is established by connecting in both directions an input located at one interface to an output located at another interface.

The **nominal transmission loss for a connection through an exchange** is equal to the difference of the relative levels at the input and the output.

$$NL = (L_i - L_o) \text{ dB}$$

The **nominal transmission loss between the input at an analogue interface and the exchange test point** is defined as:

$$NL_i = L_i$$

The **nominal transmission loss between the exchange test point and the output of an analogue interface** is defined as:

$$NL_o = -L_o$$

This is equal to the nominal “composite loss” (see definition in Blue Book, Fascicle I.3) at the reference frequency. See also Recommendation G.101, § 5.3 and Supplement No. 1 in Fascicle VI.5 of the CCITT Blue Book.

Note 1 — The nominal transmission loss, NL, may be implemented by an analogue loss pad. It may also be implemented by a digital loss pad. In the latter case, the digital loss pad may be on the incoming side of the digital switching network, or on the outgoing side of the digital switching network or both.

As a general principle, the use of digital loss pads should be avoided because bit integrity is lost for digital services and additional transmission impairments are introduced for analogue services.

However, it is recognized that during the transition stage to a completely digital network, existing national transmission plans may require digital pads to be inserted for speech.

In addition, connections in a future ISDN used for voice can be expected to contain other devices which destroy bit integrity of the 64 kbit/s path (e.g., code converters, digital echo control devices, digital speech interpolation apparatus, or all—zero—suppressors). Provision must be made to render all such devices inoperative when necessary. See Recommendation Q.521, § 4.3.7.

Note 2 — The nominal transmission loss of the exchange may be different in the two directions.

1.2.5 *Attenuation frequency distortion*

The attenuation frequency distortion (loss distortion) is the logarithmic ratio of output voltage at the reference frequency (nominally 1020 Hz), $U(1020\ \text{Hz})$, divided by its value at frequency f, $U(f)$:

$$LD = 20 \log \frac{U(1020\ \text{Hz})}{U(f)}$$

See Recommendation G.101, § 5.3 and Supplement No. 1 in Fascicle VI.5 of the CCITT Blue Book.

1.2.6 *Digital parameters*

1.2.6.1 **bit integrity**

The property of a digital half connection of a digital exchange in which the binary values and the sequence of the bits in an octet at the input of the half connection are reproduced exactly at the output.

Note — Digital processing devices such as A/μ law converters, echo suppressors and digital pads must be disabled to provide bit integrity.

2 Characteristics of interfaces

The interfaces taken into account are those of Figures 1/Q.511 and 1/Q.551. For voice—frequency interfaces (C and Z), the electrical parameters refer to the appropriate distribution frame (DF), on the assumption that the length of the cabling between the DF and the actual exchange does not exceed 100 m (exchange cables). In this respect, Recommendation Q.45 *bis* § 3 applies. For corresponding limitations on the location of digital interfaces, see Recommendation G.703.

2.1 *Two—wire analogue interfaces*

Detailed transmission characteristics of 2—wire analogue interfaces are provided in Recommendation Q.552.

2.1.1 *Interface Z*

The interface Z provides for the connection of analogue subscriber lines and will carry signals such as speech, voice—band analogue data and multi—frequency push button signals, etc. In addition, the interface Z must provide for DC feeding the subscriber set and ordinary functions such as DC signalling, ringing, metering, etc., where appropriate.

Other extraordinary (supplementary) functions, as mentioned in § 1.1 above, are not considered as forming part of the exchange but rather of the line, i.e. included on the exchange side. Since the interface Z ordinarily terminates the subscriber line, it is necessary to control the impedance and unbalance about earth. (While this will also be true of equipment providing supplementary functions, its specification is not dealt with here.)

When the Z interface is used as an extension line interface of a digitally connected digital PABX, additional functions may be required to provide special features of the PABX. If the extension line is entirely contained within a building some attributes of the PABX such as longitudinal conversion loss, may no longer need to be specified and others may take special values.

2.1.2 *Interface C_2*

The interface C_2 provides for the connection of 2—wire analogue circuits to other exchanges.

The interface C_{21} provides the termination of outgoing and incoming international long—distance connections and possibly national connections also with the exchange acting as a transit switch (see Figure 2/Q.551).

The interface C_{22} provides for the connection of a 2—wire trunk line. Typical is the interconnection of a Z interface with a C_{22} interface in a local exchange for routings through the existing 2—wire analogue trunk network. A C_{22} interface cannot be part of the international 4—wire chain.

2.2 *Four—wire analogue interfaces*

Detailed transmission characteristics of 4—wire analogue interfaces are provided in Recommendation Q.553.

2.2.1 *Interface C_1*

The interface C_1 provides for the connection of 4—wire analogue circuits to other exchanges.

According to Figure 1/Q.551, the interface C_{11} of a digital exchange is intended for connection to the channel translating equipment of an FDM system.

According to Figure 1/Q.551, the interface C_{12} of a digital exchange is intended for connection to the incoming and outgoing relay set of an analogue 4—wire exchange (see Figure 1/Q.45 *bis*).

According to Figure 1/Q.551, the interface C_{13} of a digital exchange is intended for connection to a 4—wire analogue switching stage (see Figure 1/G.142, case 5.)

2.3 *Digital interfaces*

Detailed transmission characteristics of digital interfaces are provided in Recommendation Q.554.

2.3.1 *Interface A*

The interface A operating at a rate of 1544 kbit/s or 2048 kbit/s provides for the digital connection of circuits to other exchanges.

2.3.2 *Interface B*

The interface B operating at a rate of 6312 kbit/s or 8448 kbit/s provides for the digital connection of circuits to other exchanges.

2.3.3 *V—type interfaces*

V—type interfaces provide for digital subscriber line access.

V—type interfaces allow the connection to the exchange of a digital subscriber line capable of providing digital subscriber side access for ISDN. The different variants, V_2, V_3 etc., are described in Recommendation Q.512 § 3. It will be seen that the differences lie essentially in multiplexing and in the associated signalling facilities, the transmission requirements being substantially identical, i.e., providing 64 kbit/s B channels, with bit integrity assumed unless the transmission plan specifically requires otherwise. See also Recommendation Q.554, § 2.5.

Note — The designation "V_1" is applied to a reference point which is connected to a basic access digital section.

3 Voice frequency parameters of a connection between two interfaces of the same exchange

3.1 *General*

This section of Recommendation Q.551 provides guidance on obtaining the overall characteristics for connections between two interfaces of the same exchange. For overall connections involving one or more digital interfaces, the results may be interpreted by assuming that ideal send and receive sides (see Recommendations G.714 and Q.715) are connected to the digital inputs and outputs, respectively.

In this section, transmission parameters relating to the path from an exchange interface to an exchange test point will be referred to as input parameters. Transmission parameters relating to the path from an exchange test point to an exchange interface will be referred to as output parameters.

3.2 *Transmission loss through the exchange*

The transmission loss through the exchange is equal to the algebraic sum of the input transmission loss and the output transmission loss.

The overall characteristic for the following parameters can be obtained the same way.

— short—term variation of loss with time;

— attenuation/frequency distortion;

— variation of gain with input level.

3.3 *Group delay*

3.3.1 *Absolute group delay*

"Absolute group delay" refers to the minimum group delay measured in the frequency band 500—2800 Hz.

The absolute group delay through an exchange will very much depend on the exchange architecture and the types of connections involved. Table 1/Q.551 gives estimated mean and 0.95 probability of not exceeding values of round trip delay between interfaces exemplified in Figure 3/Q.551. These values may not be applicable to digital PABXs.

The absolute group delay includes delay due to electronic devices such as frame aligners and time stages of the switching matrix but does not include delays due to ancillary functions, such as echo suppression or echo cancellation.

TABLE 1/Q.551

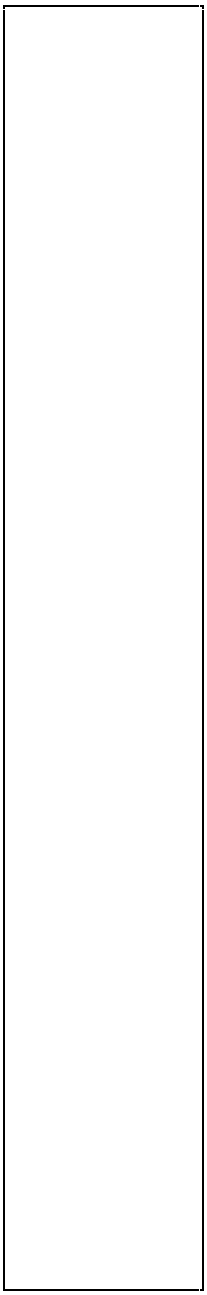
Round trip delay between interfaces as depicted in Figure 3/Q.551

Figure	Mean μs	0.95 probability of not exceeding μs
a)	900	1500
b)	1950	2700
c)	1650	2500
d)	3000	3900
e)	2700	3700
f)	2400	3500

Note 1 — These values for the absolute group delays are applicable under reference load A conditions as defined in Recommendation Q.543.

Note 2 — These values do not include the propagation delay associated with transmission across the link between the main part and any remotely located parts of a digital local exchange.

Figure 3/Q.551 - T1105720-87



3.3.2 *Group delay distortion*

The total group delay distortion is equal to the sum of the input and the output group delay distortions.

3.4 *Noise and total distortion*

When evaluating the exchange noise characteristics, it is necessary to consider two components of noise. One of these arises from the PCM translating process, the other from analogue sources e.g., signalling circuits, exchange power supply, line power feeding on both sides of a connection between two interfaces through the same exchange.

The noise arising from the PCM translating process is limited by Recommendation G.712, the noise from analogue sources by Recommendation G.123. This applies to both weighted noise and total distortion. The requirements for weighted noise and total distortion for connections between the same interfaces and through the same exchange are of value for test purposes.

In real connections through the network, usually several connections between different exchanges with different levels and different interfaces apply. This would result in very complex calculations for the overall noise contribution and cannot be handled in a simple way. Consideration of the contribution of noise and total distortion for

each individual half connection as specified in Recommendations Q.552 and Q.553 for the case in question should be preferred.

3.4.1 *Weighted noise*

The total psophometric noise power allowed at a Z interface contributed by a whole connection through the exchange Z—Z is approximated by the formula:

$$P_{TN} = P_{AN}\left(1+10^{\frac{Lo - Li}{10}}\right) + 10^{\frac{90 + LIN + Lo}{10}} \text{ pWp}$$

respective the total noise level

$$L_{TN} = 10 \log\left(\frac{P_{TN}}{1 \text{ pW}}\right) - 90 \text{ dBmp}$$

where

P_{TN} : Total weighted noise power of a whole connection through the local digital exchange Z—Z.

P_{AN} : Weighted noise power caused by analogue functions according to Recommendation G.123, Annex A, i.e., 200 pWp.

L_o : Output relative level at the Z interface.

L_i : Input relative level at the Z interface of the same exchange.

L_{IN} : Weighted noise (idle channel noise) for PCM translating equipment according to Recommendation G.712, i.e., —65 dBm0p

L_{TN} : Total weighted noise level of a whole connection through the local digital exchange Z—Z.

Alternatively the same P_{TN} and L_{TN} can be obtained by adding the relevant values for input and output connections at Z interfaces according to Recommendation Q.552, § 3.3.2.1, observing that the values for L_{INi} and L_{INo} are different from L_{IN}.

However, a small difference in the numerical results occurs due to approximation errors between L_{IN} on the one hand compared with L_{INi} and L_{INo} on the other.

For the C_2 interfaces, similar considerations can be made to obtain the allowed psophometric noise power.

Either calculating the idle channel noise according to Recommendation G.712 (to be maximum —65 dBm0p) together with the analogue noise according to Recommendation G.123 (to be maximum —67 dBm0p) which results in approximately —63 dBm0p. Alternatively, the allowed values for the input and output connections according to Recommendation Q.553, § 3.2.2.1 for equipment with signalling on the speech wires can be combined, giving again approximately —63 dBm0p.

3.4.2 *Total distortion including quantizing distortion*

The method shown below uses the sinusoidal test signal with the reference frequency of 1020 Hz as specified in Recommendation O.132. The ratio of signal—to—total—distortion power for a whole connection through the exchange is given by the formula:

$$\frac{S}{N_T} = L_S + L_o - 10 \log\left(10^{\frac{LS + Lo - S/N}{10}} + 10^{\frac{LN}{10}}\right)$$

where

S/N_T : resulting signal—to—total distortion ratio for a whole connection through a digital exchange.

L_S : signal level of the measuring signal in dBm0.

L_o : output relative level of the local exchange in dBr.

S/N : signal—to—total distortion ratio for PCM translating equipment in Recommendation G.712 (whole connection).

L_N : Weighted noise caused by analogue functions according to Recommendation G.123, Annex A, i.e., —67 dBmp.

Note — No band limiting effect on the noise by the encoding process was taken into account to compensate for overall effects. Thus the calculation above is assumed to give the worst case requirements.

This calculation of S/N_T applies to both Z and C_2 interfaces.

Total distortion including quantizing distortion using the noise method as specified in Recommendation O.131 will be the subject of further study.

3.5 *Crosstalk*

Where measurement of the signal to crosstalk ratio between any two complete connections (analogue to analogue) through the exchange is considered necessary, a sine wave test signal at the reference frequency of 1020 Hz and at a level of 0 dBm0 is applied to the analogue 2—wire or 4—wire interface of one connection. An auxiliary low level activation signal, for example a band limited noise signal (see Recommendation O.131) at a level in the range —50 to —60 dBm0 is injected into the input of the connection to be measured. The level produced in any other connection should not exceed —65 dBm0 (value to be further studied).

Care must be taken on the choice of frequency and the filtering characteristics of the selective measuring equipment, in order to avoid that the activating signal and noise affects the accuracy of the crosstalk measurement. This measurement arrangement is shown in Figure 4/Q.551.

Note 1 — The go to return crosstalk of 4—wire connections is covered by Recommendation Q.553 §§ 3.1.4.1.2 and 3.1.4.2.2.

Note 2 — Measurement of NEXT is not required, as it is the same as in a half—connection.

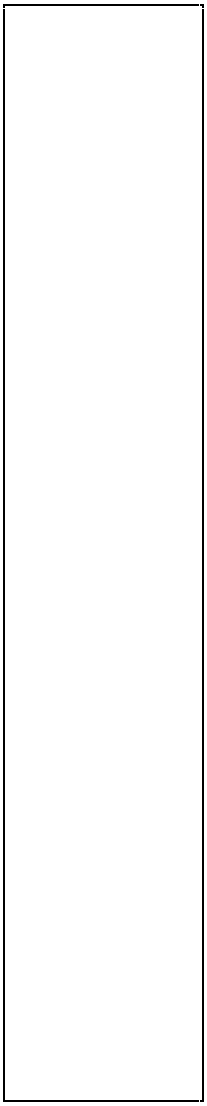
Note 3 — If it is not possible without considerable difficulty to break the return path of the 4—wire loop, reflection should be minimized by making the terminating impedance and the balance impedance equal.

Note 4 — Further study is required to determine whether MORE STRINGENT LIMITS or measurements at additional frequencies should be specified.

3.6 *Discrimination against out—of—band signals applied to the input interface*

The values for these parameters for a complete connection through an exchange are identical to the corresponding values for a half connection. See Recommendation Q.552, § 3.1.6 and Recommendation Q.553, § 3.1.6.

Figure 4/Q.551 - T1108990-87



3.7 *Spurious out—of—band signals received at the output interface*

The values for these parameters for a complete connection through an exchange are identical to the corresponding values for a half connection. See Recommendation Q.552, § 3.1.7 and Recommendation Q.553, § 3.1.7.

3.8 *Echo and stability*

When a complete connection, comprised of a 2—wire analogue half connection and a 4—wire half connection, terminates the international chain, the total stability loss of the national extension is provided by the 2—wire analogue half connection. See Recommendation Q.552, § 3.1.8.

If in a digital exchange (including PABXs), 2—wire half connections (Z or C_2 interfaces) cooperate in such a way that an additional 2—wire—4—wire—2—wire is included as part of an international connection, then Recommendation G.122 concerning echo, stability and especially effects of listener echo has to be fulfilled.

The effects of listener echo depend on the maximum total number of loops in a complete connection. Listener echo signals:

— can lead to objectionable “hollowness” in voice communications, and

— can impair the bit error ratio of received voice—band data signals.

4 Exchange transfer function — jitter and wander

The exchange transfer function relates wander at the output of the exchange to wander at the inputs used for synchronization purposes. It is recognized that the approach of using the exchange transfer function to specify the performance of an exchange is not applicable to all implementations (e.g., when mutual synchronization methods are used). The exchange transfer mask is similar to that of a low pass filter with a maximum gain of 0.2 dB, a break point at 0.1 Hz and slope of 6 dB/octave as shown in Figure 5/Q.551.

The higher frequency (jitter) portion of the mask is undefined, but must provide significant attenuation above 100 Hz.

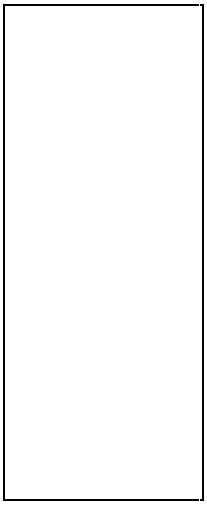



Figure 5/Q.551 - CCITT 35941