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SERIES I: INTEGRATED SERVICES DIGITAL NETWORK (ISDN)

OVERALL NETWORK ASPECTS AND FUNCTIONS, ISDN USER–NETWORK INTERFACES

ISDN user-network interfaces: layer 1 Recommendations

BASIC USER-NETWORK INTERFACE – LAYER 1 SPECIFICATION

Reedition of CCITT Recommendation I.430 published in the Blue Book, Fascicle III.8 (1988)

NOTES

1 CCITT Recommendation I.430 was published in Fascicle III.8 of the *Blue Book*. This file is an extract from the *Blue Book.* While the presentation and layout of the text might be slightly different from the *Blue Book* version, the contents of the file are identical to the *Blue Book* version and copyright conditions remain unchanged (see below).

2 In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Recommendation I.430

BASIC USER-NETWORK INTERFACE – LAYER 1 SPECIFICATION

(Malaga-Torremolinos, 1984; amended at Melbourne, 1988)

1 General

This Recommendation defines the layer 1 characteristics of the user-network interface to be applied at the S or T reference points for the basic interface structure defined in Recommendation I.412. The reference configurations for the interface is defined in Recommendation I.411 and is reproduced in Figure 1/I.430.

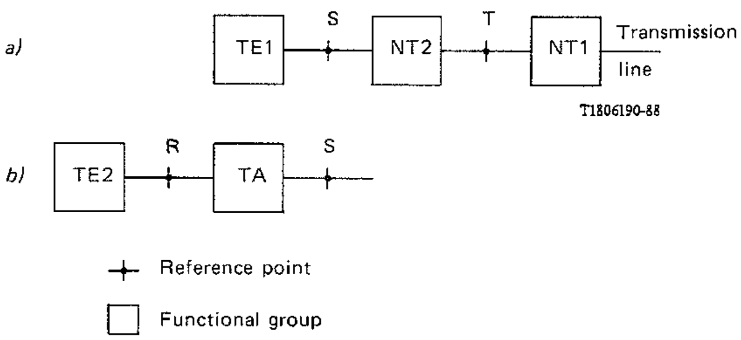


FIGURE 1/I.430

Reference configurations for the ISDN user-network interfaces

In this Recommendation, the term “NT” is used to indicate network terminating layer 1 aspects of NT1 and NT2 functional groups, and the term “TE” is used to' indicate terminal terminating layer 1 aspects of TE1, TA and NT2 functional groups, unless otherwise indicated. However, in § 6.2 only, the terms “NT” and “TE” have the following meaning: the term “NT” is used to indicate the layer 1 network side of the basic access interface; the term “TE” is used to indicate the layer 1 terminal side of the basic access interface.

The terminology used in this Recommendation is very specific and not contained in the relevant terminology Recommendations. Therefore Annex E to this Recommendation provides terms and definitions used in this Recommendation.

2 Service characteristics

2.1 *Services required from the physical medium*

Layer 1 of this interface requires a balanced metallic transmission medium, for each direction of transmission, capable of supporting 192 kbit/s.

2.2 *Service provided to layer 2*

Layer 1 provides the following services to layer 2 and the management entity:

2.2.1 *Transmission capability*

Layer 1 provides the transmission capability, by means of appropriately encoded bit streams, for the B- and D-channels and the related timing and synchronization functions.

2.2.2 *Activation/deactivation*

Layer 1 provides the signalling capability and the necessary procedures to enable customer TEs and/or NTs to be deactivated when required and reactivated when required. The activation and deactivation procedures are defined in § 6.2.

2.2.3 *D-channel access*

Layer 1 provides the signalling capability and the necessary procedures to allow TEs to gain access to the common resource of the D-channel in an orderly fashion while meeting the performance requirement of the D-channel signalling system. These D-channel access control procedures are defined in § 6.1.

2.2.4 *Maintenance*

Layer 1 provides the signalling capability, procedures and necessary functions at layer 1 to enable the maintenance functions to be performed.

2.2.5 *Status indication*

Layer 1 provides an indication to the higher layers of the status of layer 1.

2.3 *Primitives between layer 1 and the other entities*

Primitives represent, in an abstract way, the logical exchange of information and control between layer 1 and other entities. They neither specify nor constrain the implementation of entities or interfaces.

The primitives to be passed across the layer 1/2 boundary or to the management entity and parameter values associated with these primitives are defined and summarized in Table 1/I.430. For description of the syntax and use of the primitives, refer to Recommendation X.211 and relevant detailed descriptions in § 6.

3 Modes of operation

Both point-to-point and point-to-multipoint modes of operation, as described below, are intended to be accommodated by the layer 1 characteristics of the user-network interface. In this Recommendation, the modes of operation apply only to the layer 1 procedural characteristics of the interface and do not imply any constraints on modes of operation at higher layers.

3.1 *Point-to-point operation*

Point-to-point operation at layer 1 implies that only one source (transmitter) and one sink (receiver) are active at any one time in each direction of transmission at an S or T reference point. (Such operation is independent of the number of interfaces which may be provided on a particular wiring configuration – see § 4).

TABLE 1/I.430

Primitives associated with layer 1

Generic name	Specific name		Parameter		Message unit contents
	REQUEST	INDICATION	Priority indicator	Message unit	
L1 ↔ L2					
PH-DATA	X (Note 1)	X	X (Note 2)	X	Layer 2 peer-to-peer message
PH-ACTIVATE	X	X	–	–	
PH-DEACTIVATE	–	X	–	–	
M ↔ L1					
MPH-ERROR	–	X	–	X	Type of error or recovery from a previously reported error
MPH-ACTIVATE	–	X	–	–	
MPH-DEACTIVATE	X	X	–	–	
MPH-INFORMATION	–	X	–	X	Connected/disconnected

Note 1 – PH-DATA REQUEST implies underlying negotiation between layer 1 and layer 2 for the acceptance of the data.

Note 2 – Priority indication applies only to the request type.

3.2 *Point-to-multipoint operation*

Point-to-multipoint operation at layer 1 allows more than one TE (source and sink pair) to be simultaneously active at an S or T reference point. (The multipoint mode of operation may be accommodated, as discussed in § 4, with point-to-point or point-to-multipoint wiring configurations.)

4 Types of wiring configuration

The electrical characteristics of the user-network interface are determined on the basis of certain assumptions about the various wiring configurations which may exist in the user premises. These assumptions are identified in two major configuration descriptions, § 4.1 and § 4.2, together with additional material contained in Annex A. Figure 2/I.430 shows a general Reference Configuration for wiring in the user premises.

4.1 *Point-to-point configuration*

A point-to-point wiring configuration implies that only one source (transmitter) and one sink (receiver) are interconnected on an interchange circuit.

4.2 *Point-to-multipoint configuration*

A point-to-multipoint wiring configuration allows more than one source to be connected to the same sink or more than one sink to be connected to the same source on an interchange circuit. Such distribution systems are characterized by the fact that they contain no active logic elements performing functions (other than possibly amplification or regeneration of the signal).

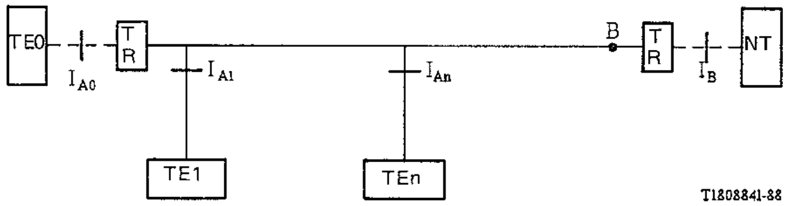
4.3 *Wiring polarity integrity*

For a point-to-point wiring configuration, the two wires of the interchange circuit pair may be reversed. However, for a point-to-multipoint wiring configuration, the wiring polarity integrity of the interchange circuit (TE-to-NT direction) must be maintained between TEs (see the reference configuration in Figure 20/I.430).

In addition, the wires of the optional pairs, which may be provided for powering, may not be reversed in either configuration.

4.4 *Location of the interfaces*

The wiring in the user premises is considered to be one continuous cable run with jacks for the TEs and NT attached directly to the cable or using stubs less than 1 metre in length. The jacks are located at interface points I_A and I_B (see Figure 2/I.430). One interface point, I_A, is adjacent to each TE. The other interface point I_B, is adjacent to the NT. However, in some applications, the NT may be connected to the wiring without the use of a jack or with a jack which accommodates multiple interfaces (e.g., when the NT is a port on a PBX). The required electrical characteristics (described in § 8) for I_A and I_B are different in some aspects.



TR Terminating resistor
I Electrical interface
B Location of I_B when the terminating resistor (TR) is included in the NT

FIGURE 2/I.430

Reference configuration for wiring in the user premises location

4.5 *NT and TE associated wiring*

The wiring from the TE or the NT to its appropriate jack affects the interface electrical characteristics. A TE, or an NT that is not permanently connected to the interface wiring, may be equipped with either of the following for connection to the interface point (I_A and I_B, respectively):

– a hard wired connecting cord (of not more than 10 metres in the case of a TE, and not more than 3 metres in the case of an NT) and a suitable plug, or;

– a jack with a connecting cord (of not more than 10 metres in the case of a TE, and not more than 3 metres in the case of an NT) which has a suitable plug at each end.

Normally, the requirements of I.430 apply to the interface point (I_A and I_B, respectively), and the cord forms part of the associated TE or NT. However, as a national option, where the terminating resistors are connected internally to the NT, the connecting cord may be considered as an integral part of the interface wiring. In this case, the requirements of this Recommendation may be applied to the NT at the connection of the connecting cord to the NT. Note that the NT may attach directly to the interface wiring without a detachable cord. Also note that the connector, plug and jack used for the connection of the detachable cord to the NT is not subject to standardization.

Although a TE may be provided with a cord of less than 5 metres in length, it shall meet the requirements of this Recommendation with a cord having a minimum length of 5 metres. As specified above, the TE cord may be detachable. Such a cord may be provided as a part of the TE, or the TE may be designed to conform to the electrical characteristics specified in § 8 with a "standard ISDN basic access TE cord" conforming to the requirements specified in § 8.9 of this Recommendation and having the maximum permitted capacitance.

The use of an extension cord, of up to 25 metres in length, with a TE is permitted but only on point-to-point wiring configurations. (The total attenuation of the wiring and of the cord in this case should not exceed 6 dB.)

5 Functional characteristics

The following paragraphs show the functions for the interface.

5.1 *Interface functions*

5.1.1 *B-channel*

This function provides, for each direction of transmission, two independent 64 kbit/s channels for use as B-channels (as defined in Recommendation 1.412).

5.1.2 *Bit timing*

This function provides bit (signal element) timing at 192 kbit/s to enable the TE and NT recover information from the aggregate bit stream.

5.1.3 *Octet timing*

This function provides 8 kHz octet timing for the NT and TE.

5.1.4 *Frame alignment*

This function provides information to enable NT and TE to recover the time division multiplexed channels.

5.1.5 *D-channel*

This function provides, for each direction of transmission, one D-channel at a bit rate of 16 kbit/s, as defined in Recommendation I.412.

5.1.6 *D-channel access procedure*

This function is specified to enable TEs to gain access to the common resource of the D-channel in an orderly controlled fashion. The functions necessary for these procedures include an echoed D-channel at a bit rate of 16 kbit/s in the direction NT to TE. For the definition of the procedures relating to D-channel access see § 6.1.

5.1.7 *Power feeding*

This function provides for the capability to transfer power across the interface. The direction of power transfer depends on the application. In a typical application, it may be desirable to provide for power transfer from the NT towards the TEs in order to, for example, maintain a basic telephony service in the event of failure of the locally provided power. (In some applications unidirectional power feeding or no power feeding at all, across the interface, may apply.) The detailed specification of power feeding capability is contained in § 9.

5.1.8 *Deactivation*

This function is specified in order to permit the TE and NT to be placed in a low power consumption mode when no calls are in progress. For TEs that are power fed across the interface from power source 1 and for remotely power fed NTs, deactivation places the functions that are so powered into a low power consumption mode (see § 9). The procedures and precise conditions under which deactivation takes place are specified in § 6.2. (For some applications it will be appropriate for NTs to remain in the active state all the time.)

5.1.9 *Activation*

This function restores all the functions of a TE or an NT, which may have been placed into a low power consumption mode during deactivation, to an operating power mode (see § 9), whether under normal or restricted power conditions. The procedures and precise conditions under which activation takes place are defined in § 6.2. (For some applications it will be appropriate for NTs to remain in the active state all the time.)

5.2 *Interchange circuits*

Two interchange circuits, one for each direction of transmission, shall be used to transfer digital signals across the interface. All of the functions described in § 5.1, except for power feeding, shall be carried by means of a digitally multiplexed signal structured as defined in § 5.4.

5.3 *Connected/disconnected indication*

The appearance/disapearance of power is the criterion used by a TE to determine whether it is connected/ disconnected at the interface. This is necessary for TEI (Terminal Endpoint Identifier) assignments according to the procedures described in Recommendation I.441.

A TE which considers itself connected, when unplugged, can cause duplication of TEI values after reconnection. When duplication occurs, procedures described in Recommendation I.441 will permit recovery.

5.3.1 *TEs powered across the interface*

A TE which is powered from power source 1 or 2 across the interface shall use the detection of power source 1 or 2, respectively, to establish the connection status. (See § 9 and Figure 20/I.430 for a description of the power sources.)

5.3.2 *TEs not powered across the interface*

A TE which is not powered across the interface may use either:

a) the detection of power source 1 or power source 2, whichever may be provided, to establish the connection status; or

b) the presence/absence of local power to establish the connection status.

TEs which are not powered across the interface and are unable to detect the presence of power source 1 or 2 shall consider themselves connected/disconnected when local power is applied/removed.

Note – It is desirable to use the detection of power source 1 or source 2 to establish the connection status when automatic TEI selection procedures are used within the management entity.

.3.3 *Indication of connection status*

TEs which use the detection of power source 1 or 2, whichever is used to determine connection/disconnection, to establish the connection status shall inform the management entity (for TEI purposes) using:

a) MPH-INFORMATION INDICATION (connected)

when operational power and the presence of power source 1 or 2, whichever is used to determine connection/disconnection, is detected; and

b) MPH-INFORMATION INDICATION (disconnected)

when the disappearance of power source 1 or 2, whichever is used to determine connection/ disconnection, is detected, or power in the TE is lost.

TEs which are unable to detect power source 1 or 2, whichever may be provided, and, therefore, use the presence/absence of local power to estabish the connection status [see § 5.3.2 b)], shall inform the management entity using:

a) MPH-INFORMATION INDICATION (disconnected)

when power (see Note) in the TE is lost;

b) MPH-INFORMATION INDICATION (connected)

when power (see Note) in the TE is applied.

Note – The term “power” could be the full operational power or backup power. Backup power is defined such that it is enough to hold TEI values in memory and maintain the capability of receiving and transmiting layer 2 frames associated with the TEI procedures.

5.4 *Frame structure*

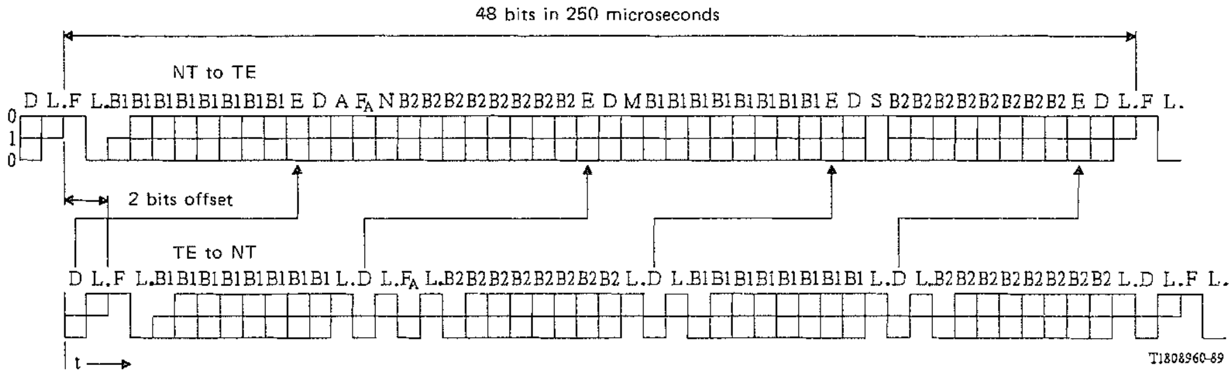
In both directions of transmission, the bits shall be grouped into frames of 48 bits each. The frame structure shall be identical for all configurations (point-to-point and point-to-multipoint).

5.4.1 *Bit rate*

The nominal transmitted bit rate at the interfaces shall be 192 kbit/s in both directions of transmission.

5.4.2 *Binary organization of the frame*

The frame structures are different for each direction of transmission. Both structures are illustrated diagrammatically in Figure 3/I.430.



F	Framing bit	N	Bit set to a binary value $N = \bar{F}_A$ (NT to TE)
L	D.C. balancing bit	B1	Bit within B-channel 1
D	D-channel bit	B2	Bit within B-channel 2
E	D-echo-channel bit	A	Bit used for activation
F_A	Auxiliary framing bit (see § 6.3)	S	Use of this bit is for further study
		M	Multiframing bit

Note 1 – Dots demarcate those parts of the frame that are independently d.c.-balanced.

Note 2 – The F_A bit in the direction TE to NT is used as a Q bit in every fifth frame if the Q-channel capability is applied (see § 6.3.3).

Note 3 – The nominal 2-bit offset is as seen from the TE (I_A in Figure 2/I.430). The corresponding offset at the NT may be greater due to delay in the interface cable and varies by configuration.

FIGURE 3/I.430

Frame structure at reference points S and T

5.4.2.1 *TE to NT*

Each frame consists of the groups of bits shown in Table 2/I.430; each individual group is d.c.-balanced by its last bit (L bit).

5.4.2.2 *NT to TE*

Frames transmitted by the NT contain an echo channel (E bits) used to retransmit the D bits received from the TEs. The D-echo channel is used for D-channel access control. The last bit of the frame (L bit) is used for balancing each complete frame.

The bits are grouped as shown in Table 3/I.430.

TABLE 2/I.430

Bit position	Group
1 and 2	Framing signal with balance bit
3 – 11	B1-channel (first octet) with balance bit
12 and 13	D-channel bit with balance bit
14 and 15	F_A auxiliary framing bit or Q bit with balance bit
16 – 24	B2-channel (first octet) with balance bit
25 and 26	D-channel bit with balance bit
27 – 35	B1-channel (second octet) with balance bit
36 and 37	D-channel bit with balance bit
38 – 46	B2-channel (second octet) with balance bit
47 and 48	D-channel bit with balance bit

TABLE 3/I.430

Bit position	Group
1 and 2	Framing signal with balance bit
3 – 10	B1-channel (first octet)
11	E, D-echo-channel bit
12	D-channel bit
13	Bit A used for activation
14	F_A auxiliary framing bit
15	N bit (coded as defined in § 6.3)
16 – 23	B2-channel (first octet)
24	E, D-echo-channel bit
25	D-channel bit
26	M, multiframing bit
27 – 34	B1-channel (second octet)
35	E, D-echo-channel bit
36	D-channel bit
37	S, The use of this bit is for further study
38 – 45	B2-channel (second octet)
46	E, D-echo-channel bit
47	D-channel bit
48	Frame balance bit

Note – *S* is set to binary ZERO.

5.4.2.3 *Relative bit positions*

At the TEs, timing in the direction TE to NT shall be derived from the frames received from the NT.

The first bit of each frame transmitted from a TE towards the NT shall be delayed, nominally, by two bit periods with respect to the first bit of the frame received from the NT. Figure 3/I.430 illustrates the relative bit positions for both transmitted and received frames.

5.5 *Line code*

For both directions of transmission, pseudo-ternary coding is used with 100% pulse width as shown in Figure 4/I.430. Coding is performed in such a way that a binary ONE is represented by no line signal; whereas, a binary ZERO is represented by a positive or negative pulse. The first binary ZERO following the framing bit-balance bit is of the same polarity as the framing bit-balance bit. Subsequent binary ZEROs must alternate in polarity. A balance bit is a binary ZERO if the number of binary ZEROs following the previous balance bit is odd. A balance bit is a binary ONE if the number of binary ZEROs following the previous balance bit is even.

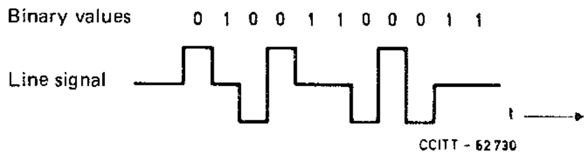


FIGURE 4/I.430

Pseudo-ternary code – example of application

5.6 *Timing considerations*

The NT shall derive its timing from the network clock. A TE shall derive its timing (bit, octet, frame) from the signal received from the NT and use this derived timing to synchronize its transmitted signal.

6 Interface procedures

6.1 *D-channel access procedure*

The following procedure allows for a number of TEs connected in a multipoint configuration to gain access to the D-channel in an orderly fashion. The procedure always ensures that, even in cases where two or more TEs attempt to access the D-channel simultaneously, one, but only one, of the TEs will be successful in completing transmission of its information. This procedure relies upon the use of layer 2 frames delimited by flags consisting of the binary pattern "01111110" and the use of zero bit insertion to prevent flag imitation (see Recommendation I.441).

The procedure also permits TEs to operate in a point-to-point manner.

6.1.1 *Interframe (layer 2) time fill*

When a TE has no layer 2 frames to transmit, it shall send binary ONEs on the D-channel, i.e., the interframe time fill in the TE-to-NT direction shall be binary ONEs.

When an NT has no layer 2 frames to transmit, it shall send binary ONEs or HDLC flags, i.e., the interframe time fill in the NT-to-TE direction shall be either all binary ONEs or repetitions of the octet "01111110". When the interframe time fill is HDLC flags, the flag which defines the end of a frame may define the start of the next frame.

6.1.2 *D-echo channel*

The NT, on receipt of a D-channel bit from TE or TEs, shall reflect the binary value in the next available D-echo channel bit position towards the TE. (It may be necessary to force the D-echo channel bits to all binary ZEROs during certain loopbacks – see Note 4 of Table I.1/I.430 and § 5 of Recommendation G.960).

6.1.3 *D-channel monitoring*

A TE, while in the active condition, shall monitor the D-echo channel, counting the number of consecutive binary ONEs. If a ZERO bit is detected, the TE shall restart counting the number of consecutive ONE bits. The current value of the count is called C.

Note – C need not be incremented after the value eleven has been reached.

6.1.4 *Priority mechanism*

Layer 2 frames are transmitted in such a way that signalling information is given priority (priority class 1) over all other types of information (priority class 2). Furthermore, to ensure that within each priority class all competing TEs are given a fair access to the D-channel, once a TE has successfully completed the transmission of a frame, it is given a lower level of priority within that class. The TE is given back its normal level within a priority class when all TEs have had an opportunity to transmit information at the normal level within that priority class.

The priority class of a particular layer 2 frame may be a characteristic of the TE which is preset at manufacture or at installation, or it may be passed down from layer 2 as a parameter of the PH-DATA REQUEST primitive.

The priority mechanism is based on the requirement that a TE may start layer 2 frame transmission only when C (see § 6.1.3) is equal to, or exceeds, the value X_1 for priority class 1 or is equal to, or exceeds, the value X_2 for priority class 2. The value of X1 shall be eight for the normal level and nine for the lower level of priority. The value of X_2 shall be ten for the normal level and eleven for the lower level of priority.

In a priority class the value of the normal level of priority is changed into the value of the lower level of priority (i.e. higher value) when a TE has successfully transmitted a layer 2 frame of that priority class.

The value of the lower level of priority is changed back to the value of the normal level of priority when C (see § 6.1.3) equals the value of the lower level of priority, (i.e. higher value).

6.1.5 *Collision detection*

While transmitting information in the D-channel, the TE shall monitor the received D-echo channel and compare the last transmitted bit with the next available D-echo bit. If the transmitted bit is the same as the received echo, the TE shall continue its transmission. If, however, the received echo is different from the transmitted bit, the TE shall cease transmission immediately and return to the D-channel monitoring state.

6.1.6 *Priority system*

Annex B describes an example of how the priority system may be implemented.

6.2 *Activation/deactivation*

6.2.1 *Definitions*

6.2.1.1 *TE states*

6.2.1.1.1 State Fl (inactive): In this inactive state the TE is not transmitting. In the case of locally powered TEs which cannot detect the appearance/disappearance of power source 1 or 2, this state is entered when local power is not present. For TEs which can detect power source 1 or power source 2, this state is entered whenever loss of power (required to support all TEI functions) is detected, or when the absence of power from source 1 or 2, whichever power source is used for determining the connection status, is detected.

6.2.1.1.2 State F2 (sensing): This state is entered after the TE has been powered on but has not determined the type of signal (if any) that the TE is receiving.

6.2.1.1.3 State F3 (deactivated): This is the deactivated state of the physical protocol. Neither the NT nor the TE is transmitting.

6.2.1.1.4 State F4 (awaiting signal): When the TE is requested to initiate activation by means of a PH-ACTIVATE REQUEST primitive, it transmits a signal (INFO 1) and waits for a response from the NT.

6.2.1.1.5 State F5 (identifying input): At the first receipt of any signal from the NT, the TE ceases to transmit INFO 1 and awaits identification of signal INFO 2 or INFO 4.

6.2.1.1.6 State F6 (synchronized): When the TE receives an activation signal (INFO 2) from the NT, it responds with a signal (INFO 3) and waits for normal frames (INFO 4) from the NT.

6.2.1.1.7 State F7 (activated): This is the normal active state with the protocol activated in both directions. Both the NT and the TE are transmitting normal frames.

6.2.1.1.8 State F8 (lost framing): This is the condition when the TE has lost frame synchronization and is awaiting re-synchronization by receipt of INFO 2 or INFO 4 or deactivation by receipt of INFO 0.

6.2.1.2 *NT states*

6.2.1.2.1 State G1 (deactive): In this deactivated state the NT is not transmitting.

6.2.1.2.2 State G2 (pending activation): In this partially active state the NT sends INFO 2 while waiting for INFO 3. This state will be entered on request by higher layers, by means of a PH-ACTIVATE REQUEST primitive, or on the receipt of INFO 0 or lost framing while in the active state (G3). Then the choice to eventually deactivate is up to higher layers within the NT.

6.2.1.2.3 State G3 (active): This is the normal active state where the NT and TE are active with INFO 4 and INFO 3, respectively. A deactivation may be initiated by the NT system management, by means of an MPH-DEACTIVE REQUEST primitive, or the NT may be in the active state all the time, under non-fault conditions.

6.2.1.2.4 State G4 (pending deactivation): When the NT wishes to deactivate, it may wait for a timer to expire before returning to the deactivated state.

6.2.1.3 *Activate primitives*

The following primitives should be used between layers 1 and 2 and between layer 1 and the management entity in the activation procedures. For use in state diagrams, etc., abbreviations of the primitive names are also given.

PH-ACTIVATE REQUEST (PH-AR)

PH-ACTIVATE INDICATION (PH-AI)

MPH-ACTIVATE INDICATION (MPH-AI)

6.2.1.4 *Deactivate primitives*

The following primitives should be used between layers 1 and 2 and between layer 1 and the management entity in the deactivation procedures. For use in state diagrams, etc., abbreviations of the primitive names are also given.

MPH-DEACTIVATE REQUEST (MPH-DR)

MPH-DEACTIVATE INDICATION (MPH-DI)

PH-DEACTIVATE INDICATION (PH-DI)

6.2.1.5 *Management primitives*

The following primitives should be used between layer 1 and the management entity. For use in state diagrams, etc., abbreviations of the primitive names are also given.

MPH-ERROR INDICATION (MPH-EI)

Message unit contains type of error or recovery from a previously reported error.

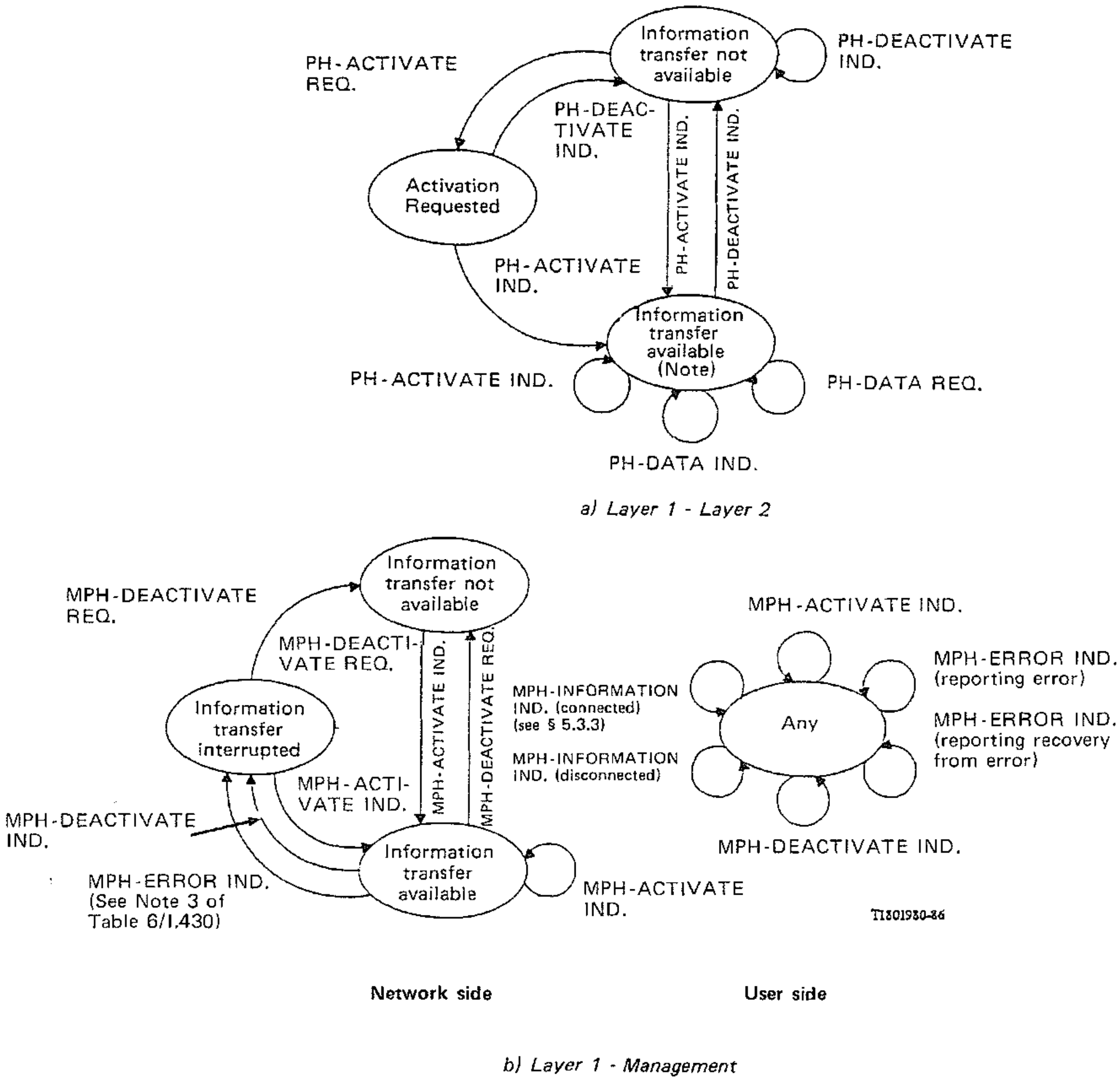
MPH-INFORMATION INDICATION (MPH-II)

Message unit contains information regarding the physical layer conditions. Two parameters are provisionally defined: connected and disconnected.

Note – Implementation of primitives in NTs and TEs is not for recommendation.

6.2.1.6 *Valid primitive sequences*

The primitives defined in § 6.2.1.3, § 6.2.1.4 and § 6.2.1.5 specify, conceptually, the service provided by layer 1 to layer 2 and the layer 1 management entity. The constraints on the sequence in which the primitives may occur are specified in Figure 5/I.430. These diagrams do not represent the states which must exist for the layer 1 entity. However, they do illustrate the condition that the layer 2 and management enities perceive layer 1 to be in at a result of the primitives transferred between entities. Furthermore, Figure 5/I.430 does not represent an interface and is used only for modelling purposes.



Note — Layer 2 is not aware if the information transfer capability is temporarily interrupted.

FIGURE 5/I.430

Valid primitive sequences as perceived by layer 2 and management entities

6.2.2 *Signals*

The identifications of specific signals across the S/T reference point are given in Table 4/1.430. Also included is the coding for these signals.

TABLE 4/I.430

Definition of INFO Signals (Note 1)

Signals from NT to TE		Signals from TE to NT	
INFO 0	No signal.	INFO 0	No signal.
		INFO 1 (Note 2)	A continuous signal with the following pattern: Positive ZERO, negative ZERO, six ONEs.  CCITT-62731 Nominal bit rate = 192 kbit/s
INFO 2 (Note 3)	Frame with all bits of B, D, and D-echo channels set to binary ZERO. Bit A set to binary ZERO. N and L bits set according to the normal coding rules.		
		INFO 3	Synchronized frames with operational data on B and D channels.
INFO 4 (Note 3)	Frames with operational data on B, D, and D-echo channels. Bit A set to binary ONE.		

Note 1 – For configurations where the wiring polarity may be reversed (see § 4.3) signals may be received with the polarity of the binary ZEROs inverted. All NT and TE receivers should be designed to tolerate wiring polarity reversals.

Note 2 – TEs which do not need the capability to initiate activation of a deactivated I.430 interface (e.g., TEs required to handle only incoming calls) need not have the capability to send INFO I. In all other respects, these TEs shall be in accordance with § 6.2. It should be noted that in the point-to-multipoint configuration more than one TE transmitting simultaneously will produce a bit pattern, as received by the NT, different form that described above, e.g., two or more overlapping (asynchronous) instances of INFO 1.

Note 3 – During the transmission of INFO 2 or INFO 4, the F_A bits and the M bits from the NT may provide the Q-bit pattern designation as described in § 6.3.3.

6.2.3 *Activation/deactivation procedure for TEs*

6.2.3.1 *General TE procedures*

All TEs conform to the following (these statements are an aid to understanding; the complete procedures are specified in § 6.2.3.2):

a) TEs, when first connected, when power is applied, or upon the loss of frame alignment (see § 6.3.1.1) shall transmit INFO 0. However, the TE that is disconnected but powered is a special situation and could be transmitting INFO 1 when connected.

b) TEs transmit INFO 3 when frame alignment is established (see § 6.3.1.2). However, the satisfactory transmission of operational data cannot be assured prior to the receipt of INFO 4.

c) TEs that are locally powered shall, when power is removed, initiate the transmission of INFO 0 before frame alignment is lost.

6.2.3.2 *Specification of the procedure*

The procedure for TEs which can detect power source 1 or 2 is shown in the form of a finite state matrix Table 5/I.430. An SDL representation of the procedure is outlined in Annex C. The finite state matrices for two other TE types are given in Annex C, Tables C-1/I.430 and C-2/I.430. The finite state matrix and SDL representations reflect the requirements necessary to assure proper interfacing of a TE with an NT conforming to the procedures described in Table 6/1.430. They also describe primitives at the layer 1/2 boundary and layer 1 /management entity boundary.

6.2.4 *Activation/deactivation for NTs*

6.2.4.1 *Activating/deactivating NTs*

The procedure is shown in the form of a finite state matrix in Table 6/I.430. An SDL representation of the procedure is outlined in Annex C. The finite state matrix and SDL representations reflect the requirements necessary to assure proper interfacing of an **activating/deactivating** NT with a TE conforming to the procedures described in Table 5/I.430. They also describe primitives at the layer 1/2 boundary and layer 1/management entity boundary.

6.2.4.2 *Non-activating/non-deactivating NTs*

The behaviour of such NTs is the same as that of an activating/deactivating NT never receiving MPH-DEACTIVATE REQUEST from the management entity. States GI (deactive), G4 (pending deactivation) and timers 1 and 2 may not exist from such NTs.

6.2.5 *Timer values*

The finite state matrix tables show timers on both the TE and the NT. The following values are defined for timers:

– TE: Timer 3, not to be specified (the value depends on the subscriber loop transmission technique. The worst case value is 30s).

– NT: Timer 1, not to be specified.
Timer 2, 25 to 100 ms.

6.2.6 *Activation times*

6.2.6.1 *TE activation times*

A TE in the deactivated state (F3) shall, upon the receipt of INFO 2, establish frame synchronization and initiate the transmission of INFO 3 within 100 ms. A TE shall recognize the receipt of INFO 4 within two frames (in the absence of errors).

A TE in the “waiting for signal” state (F4) shall, upon the receipt of INFO 2, cease the transmission of INFO 1 and initiate the transmission of INFO 0 within 5 ms and then respond to INFO 2, within 100 ms, as above. (Note that in Table 5/1.430, the transition from F4 to F5 is indicated as the result of the receipt of “any signal” which is in recognition of the fact that a TE may not know that the signal being received is INFO 2 until after it has recognized the presence of a signal.)

6.2.6.2 *NT activation times*

An NT in the deactivate state (GI) shall, upon the receipt of INFO 1, initiate the transmission of INFO 2 (synchronized to the network) within 1 s under normal conditions. Delays, “Da”, as long as 30 s are acceptable under abnormal (non-fault) conditions, e.g., as a result of a need for retrain for an associated loop transmission system.

An NT in the “pending activation” state (G2) shall, upon the receipt of INFO 3, initiate the transmission of INFO 4 within 500 ms under normal conditions. Delays, “Db”, as long as 15 s are acceptable under abnormal (non-fault) conditions provided that the sum of the delays “Da” and “Db” are not greater than 30 s.

TABLE 5/I.430

Activation/deactivation layer 1 finite state matrix for TEs
TEs powered from power source 1 ou 2

State name / State number / INFO sent / Event	Inactive	Sensing	Deactivated	Awaiting signal	Identifying input	Synchronized	Activated	Lost framing
State number	Fl	F2	F3	F4	F5	F6	F7	F8
INFO sent	INFO 0	INFO 0	INFO 0	INFO I	INFO 0	INFO 3	INFO 3	INFO 0
Power on and detection of Power S (Note 1 and Note 2)	F2	–	–	–	–	–	–	–
Loss of power (Note 1)	–	F1	MPH-II(d); F1	MPH-II(d), MPH-DI, PH-DI; F1	MPH-II(d), MPH-DI, PH-DI; Fl	MPH-II(d), MPH-DI, PH-DI; F1	MPH-II(d), MPH-DI, PH-DI; F1	MPH-II(d), MPH-DI, PH-DI; F1
Disappearance of power S (Note 2)	–	Fl	MPH-II(d); Fl	MPH-II(d), MPH-DI, PH-DI; Fl	MPH-II(d), MPH-DI, PH-DI; F1	MPH-II(d), MPH-DI, PH-DI; F1	MPH-II(d), MPH-DI, PH-DI; Fl	MPH-II(d), MPH-DI, PH-DI; F1
PH-ACTIVATE REQUEST	/	|	ST. T3; F4	|	|	–	|	–
Expiry T3	/	/	–	MPH-DI, PH-DI; F3	MPH-DI, PH-DI; F3	MPH-DI, PH-DI; F3	–	–
Receive INFO 0	/	MPH-II(c); F3	–	–	–	MPH-DI, PH-DI; F3	MPH-DI, PH-DI; F3	MPH-DI, PH-DI, MPH-EI2; F3
Receive any signal (Note 3)	/	–	–	F5	–	/	/	–

TABLE 5/I.430 (*cont.*)

Activation/deactivation layer 1 finite state matrix for TEs
TEs powered from power source 1 ou 2

State name	Inactive	Sensing	Deactivated	Awaiting signal	Identifying input	Synchronized	Activated	Lost framing
State number	Fl	F2	F3	F4	F5	F6	F7	F8
Event / INFO sent	INFO 0	INFO 0	INFO 0	INFO I	INFO 0	INFO 3	INFO 3	INFO 0
Receive INFO 2	/	MPH-II(c); F6	F6	/	F6 (Note 4)	–	MPH-EIl; F6	MPH-EI2; F6
Receive INFO 4	/	MPH-II(c), PH-AI, MPH-Al; F7	PH-AI, MPH-AI;	/	PH-AI, MPH-AI; FI (Note 4)	PH-AI, MPH-AI, MPH-EI2; F7	–	PH-AI, MPH-AI, MPH-EI2; F7
Lost framing	/	/	/	/	/	MPH-EI1; F8	MPH-EI1; F8	–

–	No change, no action	MPH-DI	Primitive MPH-DEACTIVATE INDICATION
|	Impossible by the definition of the layer 1 service	MPH-Ell	Primitive MPH-ERROR INDICATION reporting error
/	Impossible situation	MPH-EI2	Primitive MPH-ERROR INDICATION reporting recovery from error
a, b; Fn	Issue primitives “a” and “b” and then go to state “Fn”	MPH-II(c)	Primitive MPH-INFORMATION INDICATION (connected)
PH-AI	Primitive PH-ACTIVATE INDICATION	MPH-II(d)	Primitive MPH-INFORMATION INDICATION (disconnected)
PH-DI	Primitive PH-DEACTIVATE INDICATION	ST. T3	Start timer T3
MPH-AI	Primitive MPH-ACTIVATE INDICATION	Power S	Power source 1 or power source 2.

Primitives are signals in a conceptual queue and will be cleared on recognition, while the INFO signals are continuous signals which are available all the time.

Note 1 – The term “power” could be the full operational power or backup power. Backup power is defined such that it is enough to hold the TEI value in memory and maintain the capability of receiving and transmitting layer 2 frames associated with the TEI procedures.

Note 2 – The procedures described in Table 5/I.430 require the provision of power source 1 or power source 2 to enable their complete operation. A TE which determines that it is connected to an NT not providing power source I or 2 should default to the procedures described in Table C-1/I.430.

Note 3 – This event reflects the case where a signal is received and the TE has not (yet) determined whether it is INFO 2 or INFO 4.

Note 4 – If INFO 2 or INFO 4 is not recognized within 5 ms after the appearance of a signal, TEs must go to F5.

TABLE 6/I.430

Activation/deactivation layer 1 finite state matrix for NTs

Event / State name / State number / INFO sent	Deactive	Pending activation	Active	Pending deactivation
State number	G1	G2	G3	G4
INFO sent	INFO 0	INFO 2	INFO 4	INFO 0
PH-ACTIVATE REQUEST	Stan timer T1 G2	|	|	Start timer T1 G2
MPH-DEACTIVATE REQUEST	|	Start timer T2 PH-DI; G4	Start timer T2 PH-DI; G4	|
Expiry Tl (Note 1)	–	Start timer T2 PH-DI; G4	/	–
Expiry T2 (Note 2)	–	–	–	Gl
Receiving INFO 0	–	–	MPH-DI, MPH-EI; G2 (Note 3)	G1
Receiving INFO 1	Start timer T1 G2	–	/	–
Receiving INFO 3	/	Stop timer Ti PH-AI, MPH-AI; G3 (Note 4)	–	–
Lost framing	/	/	MPH-DI, MPH-El; G2 (Note 3)	–

–	No state change
/	Impossible by the definition of peer-to-peer physical layer procedures or system internal reasons
|	Impossible by the definition of the physical layer service
a, b; Gn	Issue primitives “a” and “b” then go to state “Gn”
PH-Al	Primitive PH-ACTIVATE INDICATION
PH-DI	Primitive PH-DEACTIVATE INDICATION
MPH-Al	Primitive MPH-ACTIVATE INDICATION
MPH-DI	Primitive MPH-DEACTIVATE INDICATION
MPH-EI	Primitive MPH-ERROR INDICATION

Primitives are signals in a conceptual queue and will be cleared on recognition, while the INFO signals are continuous signals which are available all the time.

Notes relating to Table 6/I.430:

Note 1 – Timer 1 (Ti) is a supervisory timer which has to take into account the overall time to activate. This time includes the time it takes to activate both the ET-NT and the NT-TE portion of the customer access. ET is the exchange termination.

Note 2 – Timer 2 (T2) prevents unintentional reactivation. Its value is 25 ms [a]G value 100 ms. This implies that a TE has to recognize INFO 0 and to react on it within 25 ms. If the NT is able to unambiguously recognize INFO 1, then the value of timer 2 may be 0.

Note 3 – These notifications (MPH-DI, MPH-EI) need not be transferred to a management entity at the NT.

Note 4 – As an implementation option, to avoid premature transmission of information (i.e., INFO 4), layer I may not initiate the transmission of INFO 4 or send the primitives PH-ACTIVATE INDICATION and MPH-ACTIVATE INDICTION (to layer 2 and management, respectively) until a period of 100 ms has elapsed since the receipt of INFO 3. Such a delay time should be implemented in the ET, if required.

6.2.7 *Deactivation times*

A TE shall respond to the receipt of INFO 0 by initiating the transmission of INFO 0 within 25 ms.

An NT shall respond to the receipt of INFO 0 or the loss of frame synchronization by initiating the transmission of INFO 2 within 25 ms; however, the layer 1 entity does not deactivate in response to INFO 0 from a TE.

6.3 *Frame alignment procedures*

The first bit of each frame is the framing bit, F; it is a binary ZERO.

The frame alignement procedure makes use of the fact that the framing bit is represented by a pulse having the same polarity as the preceding pulse (line code violation). This allows rapid reframing.

According to the coding rule, both the framing bit and the first binary ZERO bit following the framing bit-balance bit (in position 2 in the same frame) produce a line code violation. To guarantee secure framing, the auxiliary framing bit pair F_A and N in the direction NT to TE or the auxiliary framing bit F_A with the associated balancing bit L in the direction TE to NT are introduced. This ensures that there is a line code violation at 14 bits or less from the framing bit F, due to F_A or N being a binary ZERO bit (NT to TE) or to F_A being a binary ZERO bit (TE to NT) if the F_A bit position is not used as a Q bit. The framing procedures do not depend on the polarity of the framing bit F, and thus are not sensitive to wiring polarity.

The coding rule for the auxiliary framing bit pair F_A and N, in the direction NT to TE, is such that N is the binary opposite of F_A ($N = F_A$). The F_A and L bits in the direction TE to NT are always coded such that the binary values of F_A and L are equal.

6.3.1 *Frame alignment procedure in the direction NT to TE*

Frame alignment, on initial activation of the TE, shall comply with the procedures defined in § 6.2.

6.3.1.1 *Loss of frame alignment*

Loss of frame alignment may be assumed when a time period equivalent to two 48-bit frames has elapsed without having detected valid pairs of line code violations obeying the ≤ 14 bit criterion as described above. The TE shall cease transmission immediately.

6.3.1.2 *Frame alignments*

Frame alignment may be assumed to occur when three consecutive pairs of line code violations obeying the ≤ 14 bit criterion have been detected.

6.3.2 *Frame alignment in the direction TE to NT*

The criterion of a line code violation at 13 bits or less from the framing bit (F) shall apply except if the Q-channel (see § 6.3.3) is provided, in which case the 13 bit criterion applies in four out of five frames.

6.3.2.1 *Loss of frame alignment*

The NT may assume loss of frame alignment if a time period equivalent to at least two 48-bit frames has elapsed since detecting consecutive violations according to the 13 bit criterion, if all F_A bits have been set to binary ZERO. Otherwise, a time period equivalent to at least three 48-bit frames shall be allowed before assuming loss of frame alignment. On detection of loss of frame alignment the NT shall continue transmitting towards the TE.

6.3.2.2 *Frame alignment*

The NT may assume that frame alignment has been regained when three consecutive pairs of line code violations obeying the 13 bit criterion have been detected.

6.3.3 *Multi framing*

A multi-frame described in the following paragraphs is intended to provide extra layer 1 capacity in the TE-to-NT direction through the use of an extra channel between the TE and NT (Q-channel). This extra layer 1 capacity exists only between the TE and NT, i.e., there is no requirement for the transmission of signals between NT and ET to carry the information conveyed by this extra layer 1 capacity. The use of the Q-channel is for further study. However, TEs shall provide for identification of the bit positions which provide this extra capacity, designated Q bits. TEs not using this capability shall provide for setting each Q bit to a binary ONE. The provision of this capability in NTS is optional.

The use of the Q bits shall be the same in point-to-point as in point-to-multipoint configurations. Future standardization for the use of Q bits is for further study. (There is no inherent collision detection mechanism provided, and any collision detection mechanism that is required for any application of the Q bits will be outside the scope of this Recommendation.)

6.3.3.1 *General mechanism*

a) Q bit identification: The Q bits (TE-to-NT) are defined to be the bits in the F_A bit position of every fifth frame. The Q-bit positions in the TE-to-NT direction are identified by binary inversions of the F_A/N bit pair (F_A = binary ONE, N = binary ZERO) in the NT-to-TE direction. The provision of the capability in NTs is optional. The provision for identification of the Q-bit positions in the NT-to-TE direction permits all TEs to synchronize transmission in Q-bit positions – thereby avoiding interference of F_A-bits from one TE with the Q-bits of a second TE in passive bus configurations.
b) Multi-frame identification: A multi-frame, which provides for structuring the Q bits in groups of four (Q1–Q4), is established by setting the M bit, in position 26 of the NT-to-TE frame, to binary ONE in every twentieth frame. This structure provides for 4-bit characters in a single channel, TE-to-NT. The provision of the capability in NTs is optional.

6.3.3.2 *Q-bit position identification algorithm*

The Q-bit position identification algorithm is illustrated in Table 7/I.430. Two examples of how such an identification algorithm can be realized are as follows. The TE Q-bit identification algorithm may be simply the transmission of a Q bit in each frame in which a binary ONE is received in the F_A-bit position of the NT-to-TE frame (i.e., echoing of the received F_A bits). Alternatively, to minimize the Q-bit transmission errors that could result from errors in the F_A bits of NT-to-TE frames, a TE may synchronize a frame counter to the Q-bit rate and transmit Q bits in every fifth frame, i.e., in frames in which F_A bits should be equal to binary ONE. The F_A bit is present in every frame. Q bits would be transmitted only after counter synchronization to the frame binary ONEs in the F_A bit positions of the NT-to-TE frames is achieved (and only if such bits are received). When the counter is not synchronized (not achieved or lost), a TE which uses such algorithm shall transmit binary ZEROs in Q-bit positions. The algorithm used by a TE to determine when synchronization is defined to be achieved or the algorithm used to determine when it is defined to be lost is not described in this Recommendation, but it should be noted that the transmission of multi-framing from an NT is not mandatory.

No special Q-bit identification is required in the NT because the maximum round trip delay of NT-to-TE-to-NT is a small fraction of a frame and, therefore, Q-bit identification is inherent in the NT.

TABLE 7/I.430

Q-bit position identification and multi-frame structure

Frame Number	NT-to-TE F_A bit position	TE-to NT F_A bit position (Notes 1 and 2)	NT-to-TE M Bit
1	ONE	Ql	ONE
2	ZERO	ZERO	ZERO
3	ZERO	ZERO	ZERO
4	ZERO	ZERO	ZERO
5	ZERO	ZERO	ZERO
6	ONE	Q2	ZERO
7	ZERO	ZERO	ZERO
8	ZERO	ZERO	ZERO
9	ZERO	ZERO	ZERO
10	ZERO	ZERO	ZERO
11	ONE	Q3	ZERO
12	ZERO	ZERO	ZERO
13	ZERO	ZERO	ZERO
14	ZERO	ZERO	ZERO
15	ZERO	ZERO	ZERO
16	ONE	Q4	ZERO
17	ZERO	ZERO	ZERO
18	ZERO	ZERO	ZERO
19	ZERO	ZERO	ZERO
20	ZERO	ZERO	ZERO
1	ONE	QI	ONE
2	ZERO	ZERO	ZERO
etc.			

Note 1 – If the Q-bits are not used by a TE, the Q-bits shall be set to binary ONE.

Note 2 – Where multi-frame identification is not provided with a binary ONE in an appropriate M bit, but where Q-bit positions are identified, Q-bits 1 through 4 are not distinguished.

6.3.3.3 *TE Multi frame identification*

The first frame of the multi-frame is identified by the M bit equal to a binary ONE. TEs that are not intended to use, nor to provide for the use of, the Q-channel are not required to identify the multi-frame. TEs that are intended to use, or to provide for the use of, the Q-channel shall use the M bit equal to a binary ONE to identify the start of the multi-frame.

The algorithm used by a TE to determine when synchronization or loss of synchronization of the multi-frame is achieved is not described in this Recommendation, however, it should be noted that the transmission of multi-framing from an NT is not mandatory.

6.3.4 *S-bit channel structuring algorithm*

The algorithm for structuring the S-bits (NT-to-TE frame bit position 37) into an S-channel will use a combination of the F_A-bit inversions and the M bit used to structure the Q-bit channel as described in § 6.3.3. The use of the S-channel and its structure are for further study.

6.4 *Idle channel code on the B-channels*

A TE shall send binary ONEs in any B-channel which is not assigned to it.

7 Layer 1 maintenance

The test loopbacks defined for the basic user-network interface are specified in Appendix I.

8 Electrical characteristics

8.1 *Bit rate*

8.1.1 *Nominal rate*

The nominal bit rate is 192 kbit/s.

8.1.2 *Tolerance*

The tolerance (free running mode) is ± 100 ppm.

8.2 *Jitter and bit phase relationship between TE input and output*

8.2.1 *Test configurations*

The jitter and phase deviation measurements are carried with four different waveforms at the TE input, in accordance with the following configurations:

i) point-to-point configuration with 6 dB attenuation measured between the two terminating resistors at 96 kHz (high capacitance cable);

ii) short passive bus with 8 TEs (including the TE under test) clustered at the far end from the signal source (high capacitance cable);

iii) short passive bus with the TE under test adjacent to the signal source and the other seven TEs clustered at the far end from the signal source. Configuration a): high capacitance cable; configuration b): low capacitance cable;

iv) ideal test signal condition, with one source connected directly to the receiver of the TE under test (i.e., without artificial line).

Examples of waveforms that correspond to the configurations i), ii), iiia) and iiib) are given in Figure 6/I.430 to Figure 9/I.430. Test configurations which can generate these signals are given in Annex D.

8.2.2 *Timing extraction jitter*

Timing extraction jitter, as observed at the TE output, shall be within –7% to +7% of a bit period, when the jitter is measured using a high pass filter with a cut-off frequency (3 dB point) of 30 Hz under the test conditions described in § 8.2.1. The limitation applies with an output data sequence having binary ZEROs in both B-channels and with input data sequences described in a) to c) below. The limitation applies to the phase of all zero-volt crossings of all adjacent binary ZEROs in the output data sequence.

a) A sequence consisting of continuous frames with all binary ONEs in D-, D-echo and both B-channels;

b) a sequence, repeated continuously for at least 10 seconds, consisting of:

   – 40 frames with continous octets of "10101010" (the first bit to be transmitted is binary ONE) in both B-channels and continuous binary ONEs in D- and D-echo channels, followed by

   – 40 frames with continuous binary ZEROs in D-, D-echo and both B-channels;

c) a sequence consisting of a pseudo random pattern with a length of $2^{19} - 1$ in D-, D-echo and both B-channels. (This pattern may be generated with a shift register with 19 stages with the outputs of the first, the second, the fifth and the nineteenth stages added together (modulo 2) and fed back to the input.)

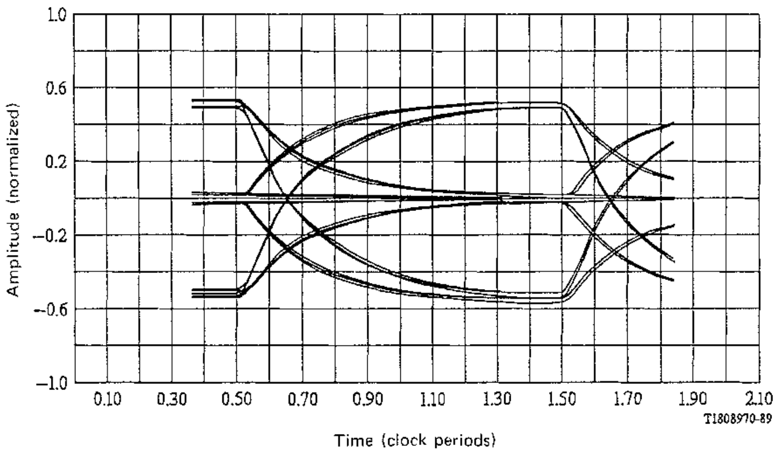


FIGURE 6/I.430

Waveform for test configuration i) – point-to-point (6 dB) (C = 120 nF/km)

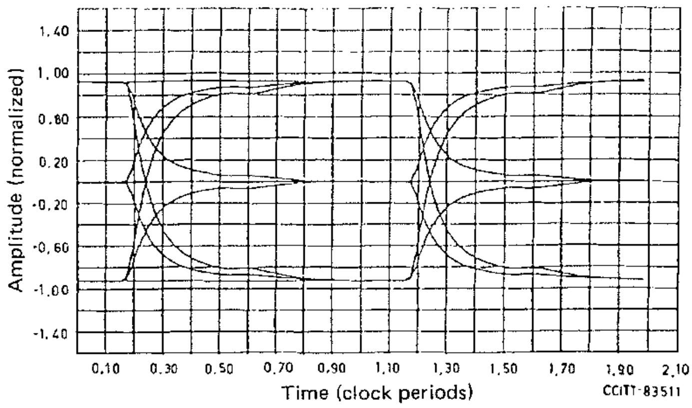


FIGURE 7/I.430

Waveform for test configuration ii) – short passive bus with eight clustered TEs at the far end (C = 120 nF/km)

8.2.3 *Total phase deviation input to output*

The total phase deviation (including effects of timing extraction jitter in the TE), between the transitions of signal elements at the output of the TE and the transitions of signal elements associated with the signal applied to the TE input, should not exceed the range of –7% to + 15% of a bit period. This limitation applies to the output signal transitions of each frame with the phase reference defined as the average phase of the crossing of zero volts which occurs between the framing pulse and its associated balance pulse at the start of the frame and the corresponding crossings at the start of the three preceding frames of the input signal.

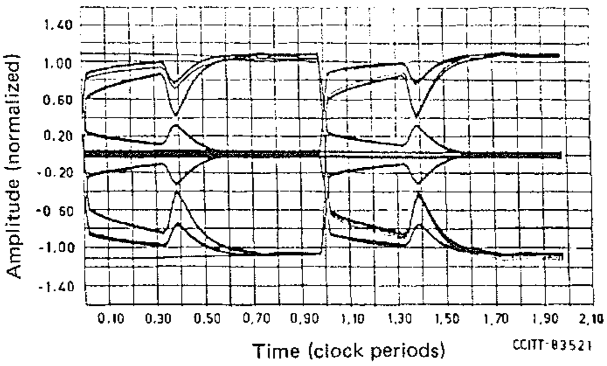


FIGURE 8/I.430

Waveform for test configuration iii a) – short passive bus with one TE near to NT, and seven TEs at the far end (C = 120 nF/km)

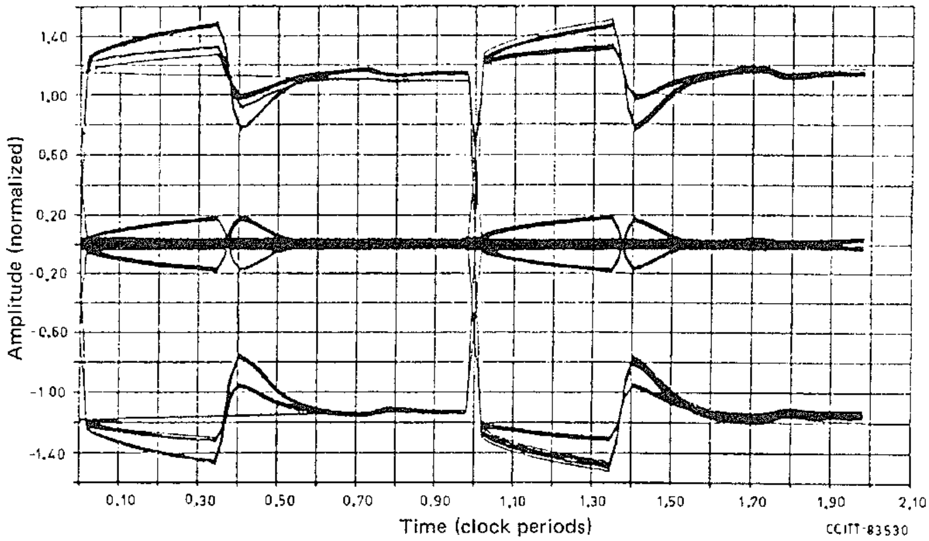


FIGURE 9/I.430

Waveform for test configuration iii) b) – short passive bus with one TE near to NT, and seven TEs at the far end (C = 30 nF/km)

For the purpose of demonstrating compliance of an equipment, it is sufficient to use (as the input signal phase reference) only the crossing of zero volts between the framing pulse and its associated balance pulse of the individual frame. This latter method, requiring a simpler test set, may create additional jitter at frequencies higher than about 1 kHz and is therefore more restrictive. The limitation applies to the phase of the zero-volt crossings of all adjacent binary ZEROs in the output data sequence, which shall be as defined in § 8.2.2. The limitation applies under all test conditions described in § 8.2.1, with the additional input signal conditions specified in a) to d) below, and with the superimposed jitter as specified in Figure 10/I.430 over the range of frequencies from 5 Hz to 2 kHz. The limitation applies for input bit rates of 192 kbit/s ± 100 ppm.

a) A sequence consisting of continuous frames with all binary ONEs in the D-, D-echo and both B-channels;

b) a sequence consisting of continuous frames with the octet "10101010" (the first bit to be transmitted is binary ONE) in both B-channels and binary ONEs in D- and D-echo channels;

c) a sequence of continuous frames with binary ZEROs in D, D-echo and both B-channels;

d) a sequence of continuous frames with a pseudo random pattern, as described in § 8.2.2 c), in D-, D-echo and both B-channels.

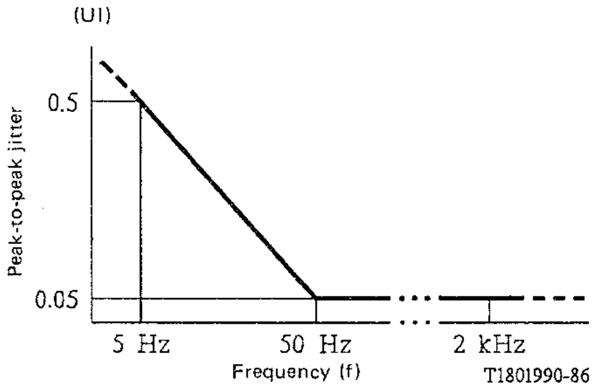


FIGURE 10/I.430

Lower limit of maximum tolerable jitter at TE input (log-log scale)

8.3 *NT jitter characteristics*

The maximum jitter (peak-to-peak) in the output sequence of an NT shall be 5% of a bit period when measured using a high pass filter having a cut-off frequency (3 dB point) of 50 Hz and an asymptotic roll off of 20 dB per decade. The limitation applies for all data sequences, but for the purpose of demonstrating the compliance of an equipment, it is sufficient to measure jitter with an output data sequence consisting of binary ONEs in D- and B-channels and with an additional sequence as described in § 8.2.2 c) in D- and B-channels. The limitation applies to the phase of all zero-volt crossings of all adjacent binary ZEROs in the output data sequence.

8.4 *Termination of the line*

The interchange circuit pair termination (resistive) should be 100 ohms ± 5% (see Figure 2/I.430).

8.5 *Transmitter output characteristics*

8.5.1 *Transmitter output impedance*

The following requirements apply at interface point I_A (see Figure 2/I.430) for TEs and at interface point I_B for NTs (see § 4.5 and § 8.9 regarding capacitance of the cord).

8.5.1.1 *NT transmitter output impedance*

a) When inactive or transmitting a binary ONE, the output impedance, in the frequency range of 2 kHz to 1 MHz, shall exceed the impedance indicated by the template in Figure 11/I.430. The requirement is applicable with an applied sinusoidal voltage of at least 100 mV (r.m.s. value).

   Note – In some applications, the terminating resistor can be combined with the NT (see point B of Figure 2/I.430). The resulting impedance is the impedance needed to exceed the combination of the template and the 100-ohm termination.

b) When transmitting a binary ZERO, the output impedance shall be ≥ 20 ohms.

Note – The output impedance limit shall apply for two nominal load impedance (resistive) conditions: 50 ohms and 400 ohms. The output impedance for each nominal load shall be defined by determining the peak pulse amplitude for loads equal to the nominal value ± 10%. The peak amplitude shall be defined as the amplitude at the midpoint of a pulse. The limitation applies for pulses of both polarities.

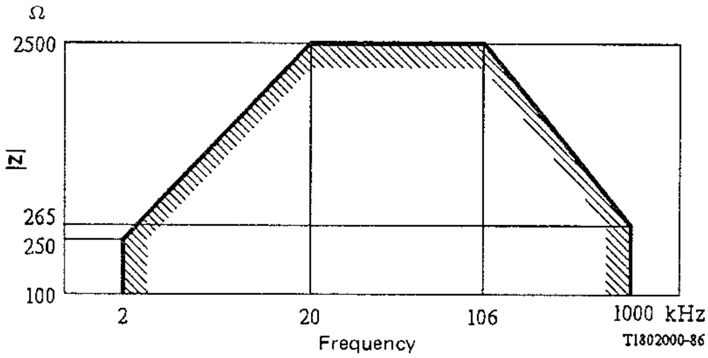


FIGURE 11/I.430

NT impedance template (log-log scale)

8.5.1.2 *TE transmitter output impedance*

a) In the inactive and powered-down states or when transmitting a binary ONE, the following requirements apply:

   i) The output impedance, in the frequency range of 2 kHz to 1 MHz, should exceed the impedance indicated by the template in Figure 12/I.430. This requirement is applicable with an applied sinusoidal voltage of at least 100 mV (r.m.s. value).

   ii) At a frequency of 96 kHz, the peak current which results from an applied voltage of up to 1.2 V (peak value) should not exceed 0.6 mA (peak value).

b) When transmitting a binary ZERO, the output impedance shall be ≥ 20 ohms.

Note – The output impedance limit shall apply for two nominal load impedance (resistive) conditions: 50 ohms and 400 ohms. The output impedance for each nominal load shall be defined by determining the peak pulse amplitude for loads equal to the nominal value ± 10%. The peak amplitude shall be defined as the amplitude at the midpoint of a pulse. The limitation applies for pulses of both polarities.

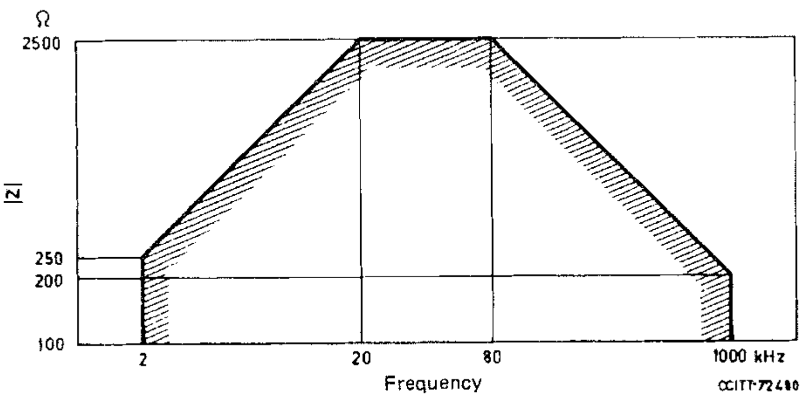


FIGURE 12/I.430

TE impedance template (log-log scale)

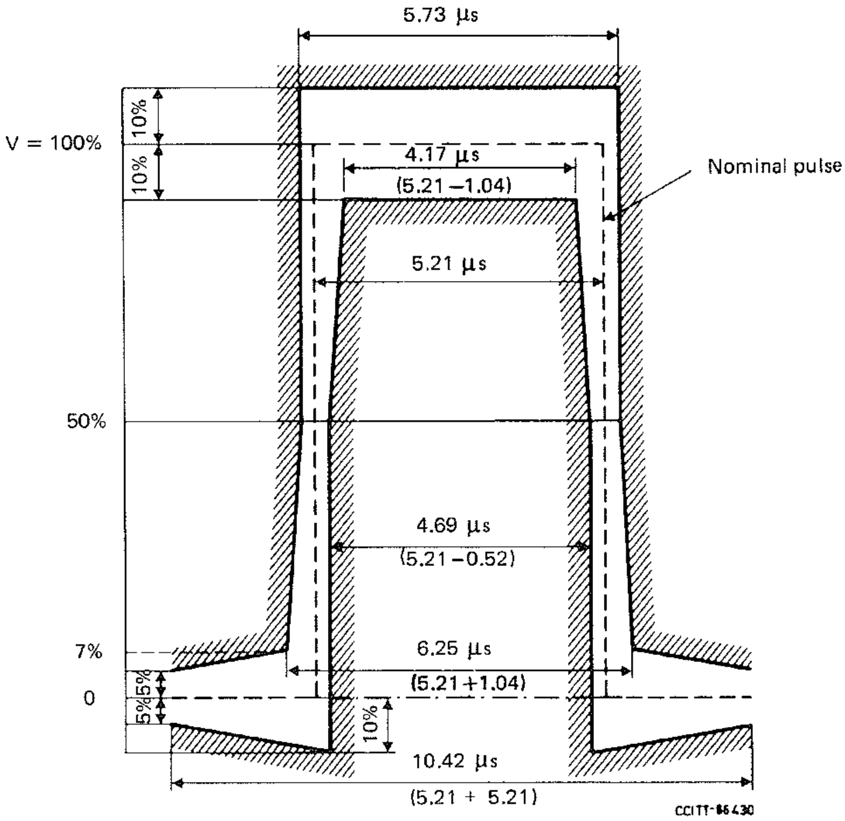
8.5.2 *Test load impedance*

The test load impedance shall be 50 ohms (unless otherwise indicated).

8.5.3 *Pulse shape and amplitude (binary ZERO)*

8.5.3.1 *Pulse shape*

Except for overshoot, limited as follows, pulses shall be within the mask of Figure 13/I.430. Overshoot, at the leading edge of pulses, of up to 5% of the pulse amplitude at the middle of a signal element, is permitted, provided that such overshoot has, at 1/2 of its amplitude, a duration of less than 0.25 μs.



Note – For clarity of presentation, the above values are based on a pulse width of 5.21 µs. See § 8.1 for a precise specification of the bit rate.

FIGURE 13/I.430

Transmitter output pulse mask

8.5.3.2 *Nominal pulse amplitude*

The nominal pulse amplitude shall be 750 mV, zero to peak.

A positive pulse (in particular, a framing pulse) at the output port of the NT and TE is defined as a positive polarity of the voltage measured between access leads e to f and d to c respectively (see Figure 20/I.430). (See Table 9/I.430 for the relationship to connector pins.)

8.5.4 *Pulse unbalance*

The "pulse unbalance", i.e., the relative difference in $\int U(t)\mathrm{d}t$ for positive pulses and $\int U(t)\mathrm{d}t$ for negative pulses shall be ≤ 5%.

8.5.5 *Voltage on other test loads (TE only)*

The following requirements are intended to assure compatibility with the condition where multiple TEs are simultaneously transmitting pulses on to a passive bus.

8.5.5.1 *400-ohm load*

A pulse (binary ZERO) shall conform to the limits of the mask shown in Figure 14/I.430 when the transmitter is terminated in a 400-ohm load.

8.5.5.2 *5.6-ohm load*

To limit the current flow with two drivers having opposite polarities, the pulse amplitude (peak) with a 5.6-ohm load shall be ≤ 20% of the nominal pulse amplitude.

8.5.6 *Unbalance about earth*

The following requirements apply under all possible power feeding conditions, under all possible connections of the equipment to ground, and with two 100-ohm terminations across the transmit and receive ports.

8.5.6.1 *Longitudinal conversion loss*

Longitudinal conversion loss (LCL) which is measured in accordance with Recommendation G.117, § 4.1.3 (see Figure 15/I.430), shall meet the following requirements:

a) 10 kHz < f ≤ 300 kHz: ≥ 54 dB

b) 300 kHz < f ≤ 1 MHz: minimum value decreasing from 54 dB at 20 dB/decade.

8.5.6.2 *Output signal balance*

Output signal balance which is measured in accordance with Recommendation G.117, § 4.3.1 (see Figure 16/I.430), shall meet the following requirements:

a) f = 96 kHz: ≥ 54 dB

b) 96 kHz < f ≤ 1 MHz: minimum value decreasing from 54 dB at 20 dB/decade.

8.6 *Receiver input characteristics*

8.6.1 *Receiver input impedance*

8.6.1.1 *TE receiver input impedance*

TEs shall meet the same input impedance requirements as specified in § 8.5.1.2 a) for the input impedance.

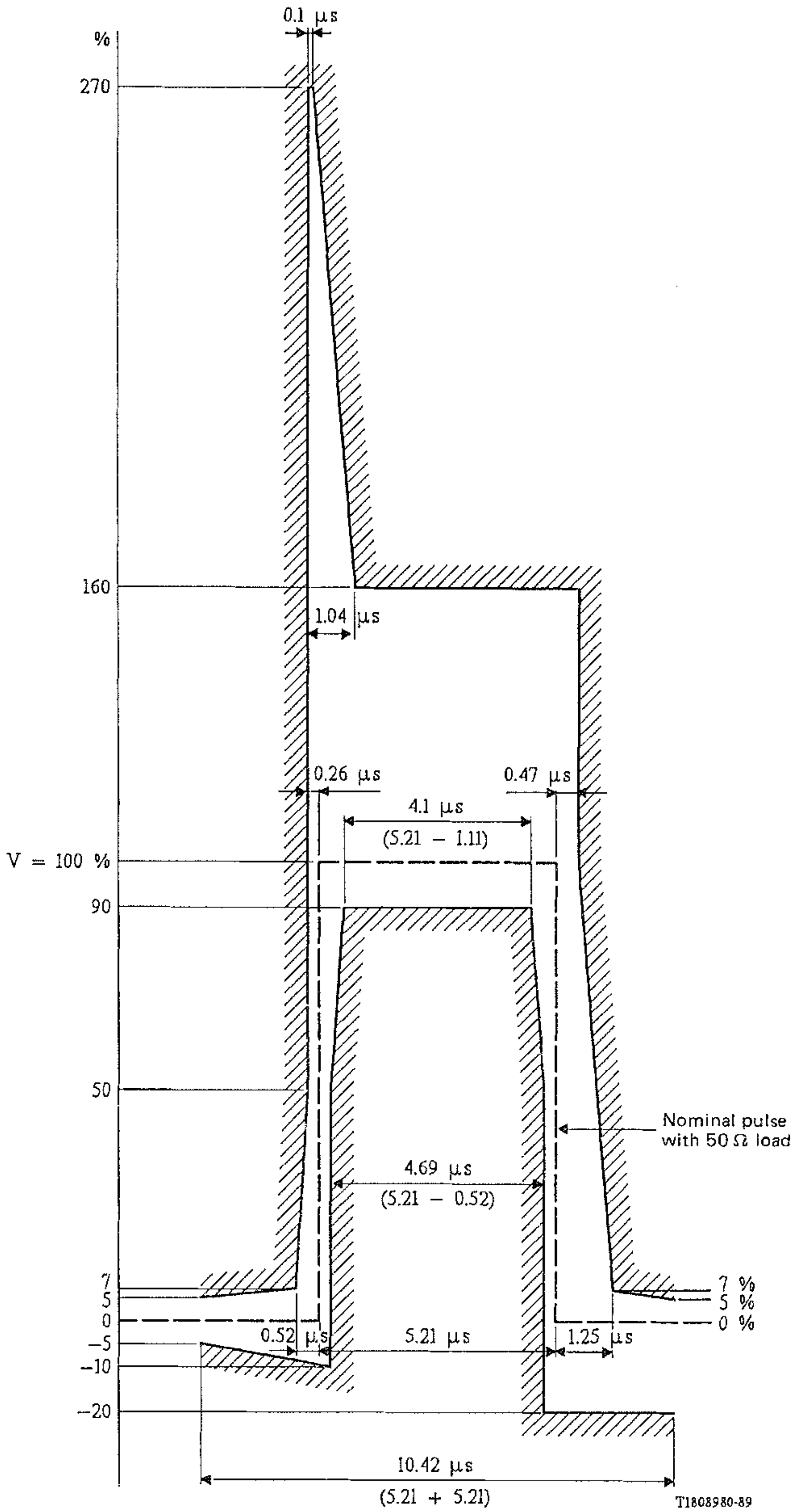
8.6.1.2 *NT receiver input impedance*

In the inactive and powered-down states, the following requirements apply:

i) the input impedance in the frequency range of 2 kHz to 1 MHz, should exceed the impedance indicated by the template in Figure 11/I.430. This requirement is applicable with an applied sinusoidal voltage of at least 100 mV (r.m.s. value);

ii) at a frequency of 96 kHz, the peak current which results from an applied voltage of up to 1.2 V (peak value) should not exceed 0.5 mA (peak value).

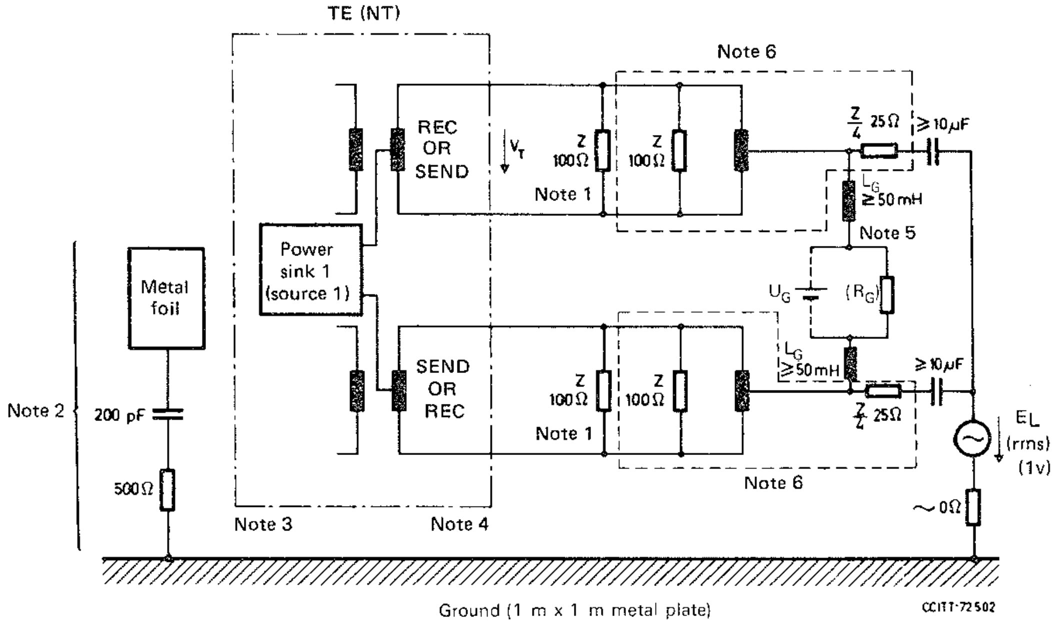
Note – In some applications, the 100-ohm terminating resistor can be combined with the NT (see point B of Figure 2/I.430). The resulting impedance is the impedance needed to exceed the combination of the template and the 100-ohm termination.



Note – For clarity of presentation, the above values are based on a pulse width of 5.21 μs. See § 8.1 for a precise specification of the bit rate.

FIGURE 14/I.430

Voltage for an isolated pulse with a test load of 400 ohms



The longitudinal conversion loss: $LCL = 20 \log_{10} \left| \frac{E_L}{V_T} \right|$ dB

The voltages V_T and E_L should be measured within the frequency range from 10 kHz up to 1 MHz using selective test measuring equipment.

The measurement should be carried out in the states:

- deactivated (receive, send),
- power off (receive, send),
- activated (receive).

The interconnecting cord shall lie on the metal plate.

Note 1 — This resistor must be omitted if the termination is already built into the TE (NT).

Note 2 — Hand imitation is a thin metal foil with approximately the size of a hand.

Note 3 — TE (NT) with a metallic housing shall have a galvanic connection to the metal plate. Other TE (NT) with non-metallic housing shall be placed on the metal plate.

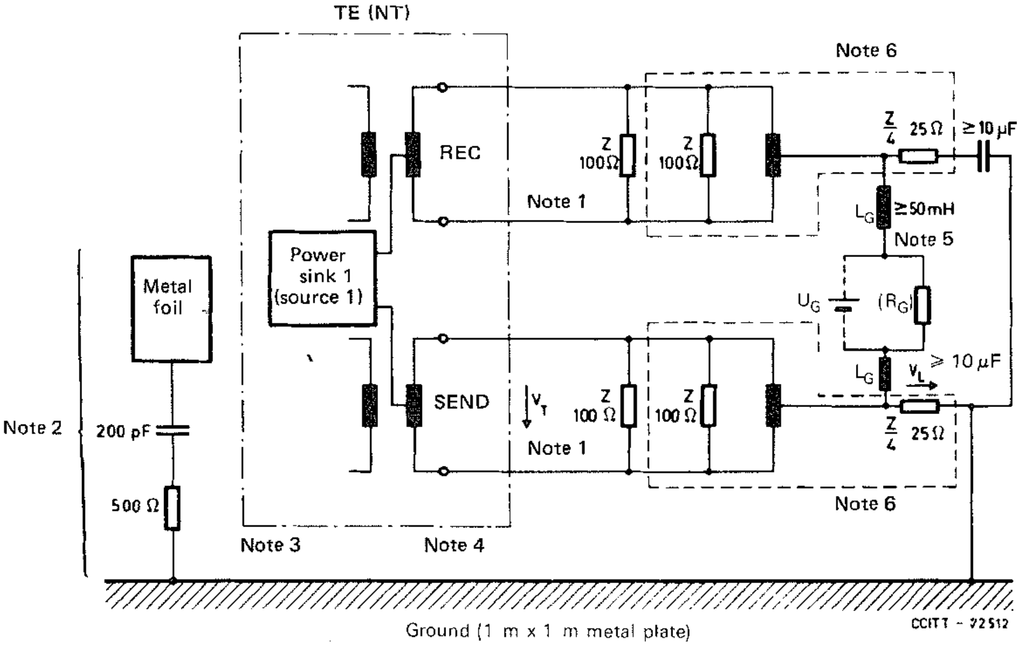
Note 4 — The power cord for mains-powered TE (NT) shall lie on the metal plate and the earth protective wire of the mains shall be connected to the metal plate.

Note 5 — If there is no power source 1 in the NT, R_G and L_G are not required.

Note 6 — This circuit provides a transverse termination of 100 ohms and a balanced longitudinal termination of 25 ohms. Any equivalent circuit is acceptable. However, for equivalent circuits given in Recommendations G.117 and O.121, powering cannot be provided.

FIGURE 15/I.430

Receiver input or transmitter output unbalance about earth



Output signal balance $= 20 \log_{10} \left| \frac{V_T}{V_L} \right|$ dB

The voltage V_T and V_L should be measured within the frequency range from 10 kHz up to 1 MHz using selective test measuring equipment. The measurement should be carried out in the active state. The pulse patterns should contain all binary ZEROs. However, for the purpose of demonstrating the compliance of an equipment, it is sufficient to measure the output signal unbalance about earth with a pulse pattern of continuous frames with at least the B1 and B2 Channels containing all binary ZEROs.

The interconnecting cord shall lie on the metal plate.

Note – See notes to this figure in Figure 15/I.430.

FIGURE 16/I.430

Transmitter output unbalance about earth

8.6.2 *Receiver sensitivity – Noise and distortion immunity*

Requirements applicable to TEs and NTs for three different interface wiring configurations are given in the following sections. TEs and/or NTs shall receive, without errors (for a period of at least one minute), an input with a pseudo-random sequence (word length ≥ 511 bits) in all information channels (combination of B-channel, D-channel and, if applicable, the D-echo channel).

The receiver shall operate, with any input sequence, over the full range indicated by the waveform mask.

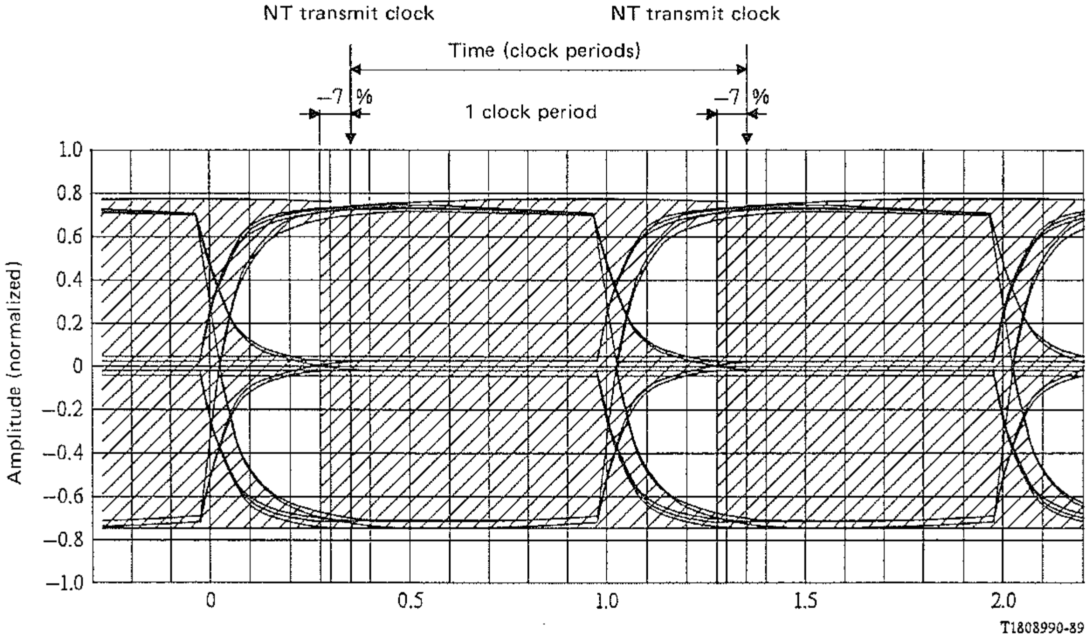
8.6.2.1 *TEs*

TEs shall operate with the input signals conforming to the waveforms specified in § 8.2.1. For the waveforms in Figures 7/I.430 to 9/I.430, TEs shall operate with the input signals having any amplitude in the range of +1.5 dB to –3.5 dB relative to the nominal amplitude of the transmitted signal as specified in § 8.5.3.2. For signals conforming to the waveform in Figure 6/I.430, operation shall be accomplished for signals having any amplitude in the range of +1.5 to –7.5 dB relative to the nominal amplitude of the transmitted signal as specified in § 8.5.3.2. In addition, TEs shall operate with signals conforming to each waveform with jitter up to the maximum permiteed (see § 8.3) in the output signal of NTs superimposed on the input signals.

Additionally, for input signals having the waveform shown in Figure 6/I.430, the TEs shall operate with sinusoidal signals having an amplitude of 100 mV (peak-to-peak value) at frequencies of 200 kHz and 2 MHz superimposed individually on the input signals along with jitter.

8.6.2.2 *NTs for short passive bus (fixed timing)*

NTs designed to operate with only short passive bus wiring configurations shall operate when receiving input signals indicated by the waveform mask shown in Figure 17/I.430. NTs shall operate, with the input signals having any amplitude in the range of +1.5 dB to –3.5 dB relative to the nominal amplitude of the transmitted signal as specified in § 8.5.3.2.



Note 1 – Shaded area is the region in which pulse transitions may occur.

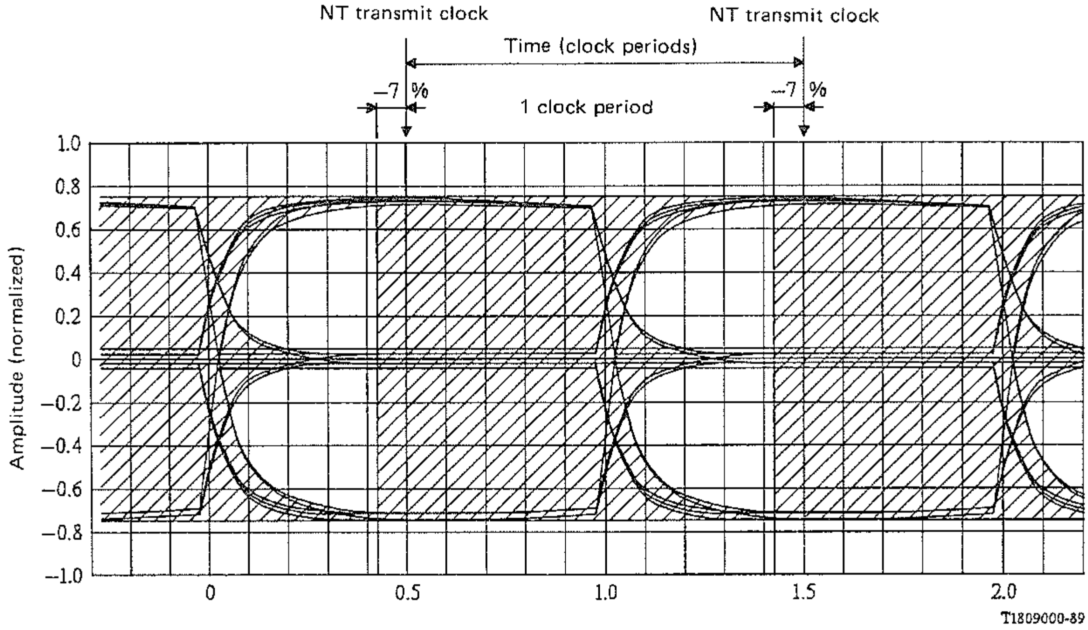
Note 2 – The waveform mask is based on the "worst case" configuration shown in Annex D, Figure D-1/I.430 and waveforms ii) and iii) in § 8.2.1. The shaded area of –7% of one clock period accounts for the situation of a single TE connected directly to the NT with a zero length passive bus. However, the waveform mask does not show the higher possible amplitude of framing and D-channel bit pulses and their associated balancing bits. It should be noted that the above waveform mask does not account for transient effects.

FIGURE 17/I.430

Short passive bus receive pulse waveform mask

8.6.2.3 *NTs for both point-to-point and short passive bus configurations (adaptive timing)*

NTs designed to operate with either point-to-point or short passive bus wiring configurations shall operate when receiving input signals indicated by the waveform mask shown in Figure 18/I.430. These NTs shall operate with the input signals having any amplitude in the range of +1.5 dB to –3.5 dB relative to the nominal amplitude of the transmitted signal as specified in § 8.5.3.2. These NTs shall also operate when receiving signals conforming to the waveform in Figure 6/I.430. For signals conforming to this waveform, operation shall be accomplished for signals having any amplitude in the range of +1.5 to –7.5 dB relative to the nominal amplitude of the transmitted signal as specified in § 8.5.3.2. Additionally, these NTs shall operate with the sinusoidal signals, as specified in § 8.6.2.1, and with jitter up to the maximum permitted in the output signal of TEs (see § 8.2.2), superimposed on the input signals having the waveform in Figure 6/I.430.



Note 1 – Shaded area is the region in which pulse transitions may occur.

Note 2 – The waveform mask is based on the same "worst case" passive bus configuration as the waveform mask in Figure 17/I.430 except that the permitted round trip delay of the cable is reduced. The shaded area of – 7% of one clock period accounts for the situation of a single TE connected directly to the NT with a zero length passive bus. However, the waveform mask does not show the higher possible amplitude of framing and D-channel bit pulses and their associated balancing bits. It should be noted that the above waveform mask does not account for transient effects.

FIGURE 18/I.430

Passive bus receive pulse waveform mask

(NTs designed to operate with either point-to-point or short passive bus wiring configurations)

8.6.2.4 *NTs for extended passive bus wiring configurations*

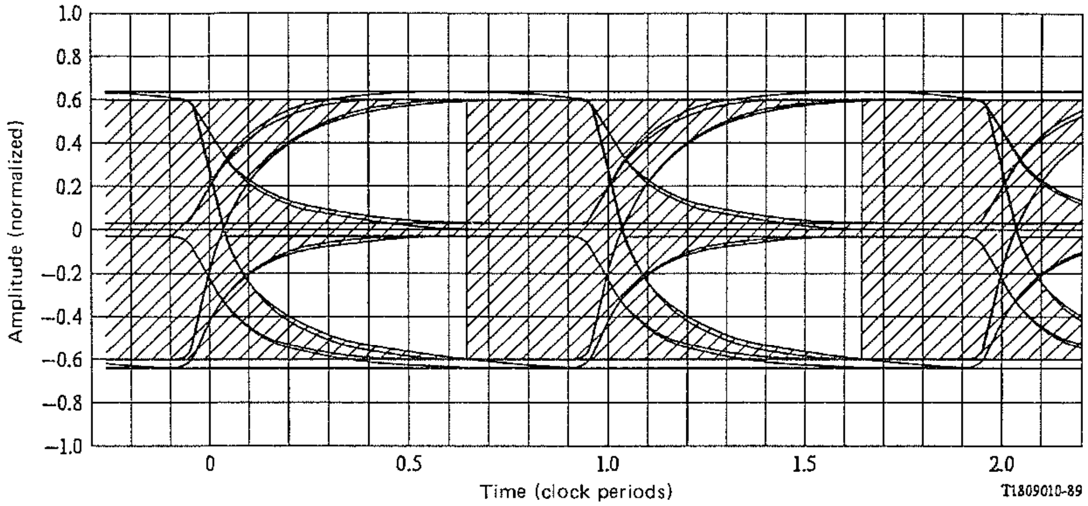
NTs designed to operate with extended passive bus wiring configurations shall operate when receiving input signals indicated by the waveform mask shown in Figure 19/I.430. These NTs shall operate with the input signals having any amplitude in the range of +1.5 dB to –5.5 dB relative to the nominal amplitude of the transmitted signal as specified in § 8.5.3.2. Additionally, these NTs shall operate with the sinusoidal signals, as specified in § 8.6.2.1, superimposed on the input signals having the waveform shown in Figure 19/I.430. (The above values assume a maximum cable loss of 3.8 dB. NTs may be implemented to accommodate higher cable loss).

8.6.2.5 *NTs for point-to-point configurations only*

NTs designed to operate with only point-to-point wiring configurations shall operate when receiving input signals having the waveform shown in Figure 6/I.430. These NTs shall operate with the input signals having any amplitude in the range of +1.5 to –7.5 dB relative to the nominal amplitude of the transmitted signal as specified in § 8.5.3.2. Additionally, these NTs shall operate with the sinusoidal signals, as specified in § 8.6.2.1, and with jitter up to the maximum permitted in the output signal of TEs (see § 8.2.2) superimposed on the input signals having the waveform shown in Figure 6/I.430.

8.6.3 *NT receiver input delay characteristics*

Note – Round trip delay is always measured between the zero-volt crossings of the framing pulse and its associated and balance bit pulse at the transmit and receive side of the NT (see also Annex A).



Note 1 – Shaded area is the region in which pulse transitions may occur.

Note 2 – The waveform mask is based on the worst case extended passive bus wiring configuration. It consists of a cable having a characteristic impedance of 75 ohms, a capacitance of 120 nF/km, a loss of 3.8 dB at 96 kHz, four TEs connected such that the differential delay is at the maximum permitted by § 8.6.3.3. The waveform mask does not show the higher possible amplitude of framing and D-channel bit pulses and their associated balancing bits. It should be noted that the above waveform mask does not account for transient effects.

FIGURE 19/I.430

Extended passive bus receive pulse waveform mask

8.6.3.1 *NT or short passive bus*

NTs shall accommodate round trip delays of the complete installation, including TEs, in the range 10 to 14 μs.

8.6.3.2 *NT for both point-to-point and passive bus*

NTs shall accommodate round trip delays (for passive bus configurations) in the range 10 to 13 μs.

NTs shall accommodate round trip delays (for point-to-point configurations) in the range 10 to 42 μs.

8.6.3.3 *NT for extended passive bus*

NTs shall accommodate round trip delays in the range 10 to 42 μs, provided that the differential delay of signals from different TEs is in the range 0 to 2 μs.

8.6.3.4 *NT for point-to-point only*

NTs shall accommodate round trip delays specified in § 8.6.3.2 for point-to-point configurations.

8.6.4 *Unbalance about earth*

Longitudinal conversion loss (LCL) of receiver inputs, measured in accordance with Recommendation G.117, § 4.1.3, by considering the power feeding and two 100-ohm terminations at each port, shall meet the following requirements (see Figure 15/I.430):

a) 10 kHz ≤ *f* ≤ 300 kHz: ≥ 54 dB

b) 300 kHz ≤ f 1 MHz: minimum value decreasing from 54 dB with 20 dB/decade.

8.7 *Isolation from external voltages*

IEC Publication 479-1, Second Issue 1984, specifies current limitation dealing with human safety. According to that publication, the value of a touchable leakage alternating current measured through a resistor of 2 kohms is limited. The application of this requirement to the user-network interface is not a subject of this Recommendation, but should be recognized that an apportionment of this limited current to each mains powered equipment connected to the passive bus is necessary.

8.8 *Interconnecting media characteristics*

Longitudinal conversion loss of pairs at 96 kHz shall be ≥ 43 dB.

8.9 *Standard ISDN basic access TE cord*

A connecting cord for use with a TE designed for connection with a "standard ISDN basic access TE cord" shall have a maximum length of 10 metres and shall conform to the following:

a) Cords having a maximum length of 7 metres:
   - the maximum capacitance of pairs for transmit and receive functions shall be less than 300 pF;
   - the characteristic impedance of pairs used for transmit and receive functions shall be greater than 75 ohms at 96 kHz;
   - the crosstalk loss, at 96 kHz, between any pair and a pair to be used for transmit or receive functions shall be greater than 60 dB with terminations of 100 ohms;
   - the resistance of an individual conductor shall not exceed 3 ohms;
   - cords shall be terminated at both ends in plugs (individual conductors shall be connected to the same contact in the plug at each end);

b) Cords having a length greater than 7 metres:
   - cords shall conform to the above requirements except that a capacitance of 350 pF is permitted;
   - TEs may be designed that include a connecting cord which is part of the TE. In this case the requirements for a standard ISDN basic access TE cord do not apply.

9 Power feeding

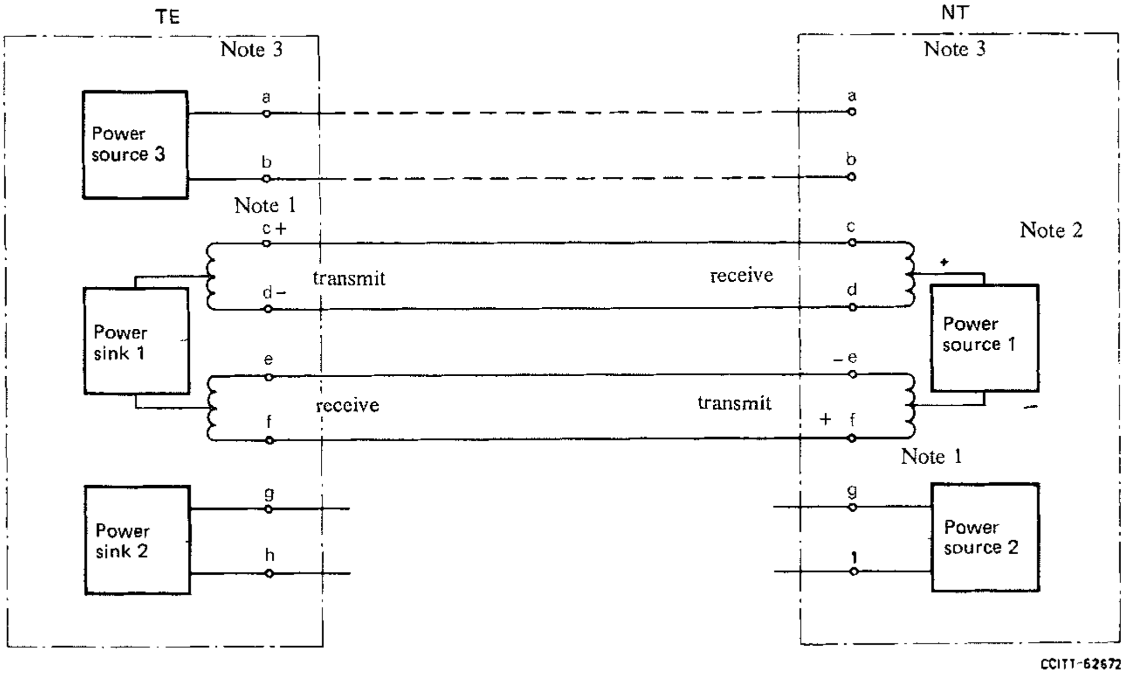
9.1 *Reference configuration*

The reference configuration for power feeding, which is based on an eight-pin interface connector, is described in Figure 20/I.430. The access lead designations, "a" through "h", are not intended to reflect particular pin assignments, which, as indicated in § 10, are to be specified in an ISO standard. The use of leads c, d, e and f is mandatory. The use of leads a, b, g and h is optional.

The reference configuration allows unique physical and electrical characteristics, for the interface at reference points S and T, which are independent of the choice of internal or external power source arrangements.

Power source 1 may derive its power from the network and/or locally (mains and/or batteries). While the source for restricted power is an integral part of the NT, the source for normal conditions may be physically separate and may be connected at any point in the interface wiring. Note that such a separate source should be considered functionally part of the NT. However, the provision of such a source is subject to the approval of the Administration/network provider. To avoid interworking problems, it is not permitted to connect such a separate source of phantom mode power in wiring associated with NTs having an internal source for normal conditions. Where a separate source of phantom mode power is provided, its compatibility with a source for restricted power that is part of the associated NT must be assured by the provider of the separate source. In particular, the resolution of power contention, which may result from the provision of the separate source, between the separate source and a restricted power condition source internal to an NT, is not specified in this Recommendation and must be taken into account. In addition, any effects on the transmission characteristics of interface cabling must also be accounted for, e.g., the impedance of a power source that bridges the interchange circuit pairs may require a reduction in the number of TEs that can be accommodated on a passive bus.

Power source 2 derives its power locally (mains and/or batteries). Power source 2 may be located in (or associated with) the NT as indicated, or it may be located separately.



Note 1 – This symbol refers to the polarity of framing pulses.

Note 2 – This symbol refers to the polarity of power during normal power conditions (reversed for restricted conditions).

Note 3 – The access lead assignments indicated in this figure are intended to provide for direct interface cable wiring, i.e. each interface pair is connected to a pair of access leads having the same two letters at TEs and NTs.

FIGURE 20/I.430

Reference configuration for signal transmission and power-feeding in normal operating mode

9.1.1 *Functions specified at the access leads*

The eight access leads for TE and NT shall be applied as follows:

i) Access lead pairs c-d and a-f are for the bidirectional transmission of the digital signal and may provide a phantom circuit for power transfer from NT to TE (power source 1).

ii) Access lead pair g-h may be used for additional power transfer from the NT to TE (power source 2).

iii) Access lead pair a-b may also be used for power transfer (power source 3) in TE-TE interconnection; this is not the subject of a CCITT Recommendation.

9.1.2 *Provision of power sources and sinks*

Power source 1 may not always be provided. Provision of power source 2 is subject to the decision of individual Administrations. Power source 3 is not subject to CCITT Recommendation. Power sink 1 is optional. Administrations may limit the use of power from power source 1 to those TEs capable of providing a minimum service. Power sink 2 is optional.

Note – It should be noted that a TE that is to be portable (for example from network to network, country to country) cannot rely exclusively on phantom power for its operation.

9.2 *Power available from NT*

It is desirable for power sources to include current limiting provisions to provide short-circuit protection.

9.2.1 *Power source 1 normal and restricted power conditions*

Power source 1 may provide either normal or restricted power conditions or both.

When power source 1 is provided, the power conditions are considered as follows:

i) Where power is provided under normal conditions, the power available from power source 1 is the responsibility of the individual Administration/network provider. However, power source 1 together with any separate source, as described in § 9.1, shall provide at least the power for the consumption of 1 watt (the maximum specified in § 9.3.1 that a TE may draw; see also note to § 9.3.1.1) at TE interfaces. The power required to be available from the NT may depend upon the possible provision of a separate source and the cable configuration.

ii) Under restricted power conditions, the minimum power available from power source 1 shall be 420 mW. When power source 1 enters a condition where it is able to supply only restricted power, it should indicate this condition by reversing its polarity. In this condition, only the unrestricted power functions of TEs are allowed to consume power from source 1.

iii) If power source 1 (and any separate source combination) can supply power in both normal and restricted power conditions, the change of condition of power source 1 from the normal to restricted power condition may occur when power source 1 (and any separate source combination) is unable to supply the "nominal" level of power. [The "nominal" level of power is defined as the minimum power that the power source 1 (or separate power source) is designed to supply.] In any case, the transition from normal to restricted condition shall occur when the power described in i) above is not available from power source 1 (as a result of a loss of its source of power).

9.2.2 *Minimum voltage at NT from power source 1*

9.2.2.1 *Normal power conditions*

Under normal power conditions, the nominal value of voltage of power source 1, if provided, at the output of the NT shall be 40 V and the tolerances shall be +5% and –15% when supplying up to the maximum available power.

9.2.2.2 *Restricted power conditions*

Under restricted power conditions, the nominal value of the voltage of power source 1, if provided, at the output of the NT shall be 40 V and the tolerances shall be +5% and –15% when supplying up to 420 mW.

9.2.3 *Minimum voltage of power source 2*

The nominal voltage of power source 2 (optional third pair) shall be 40 V. The maximum voltage shall be 40 V +5% and the minimum voltage shall assure compliance with the requirements specified in § 9.3.2 concerning power available at a TE.

9.3 *Power available at a TE*

9.3.1 *Power source 1 – phantom mode*

9.3.1.1 *Normal power conditions*

Under normal power conditions, the maximum voltage at the interface of a TE shall be 40 V + 5% and the minimum voltage shall be 40 V – 40% (24 V) when drawing up to a maximum permitted power consumption of 1 watt.

Note – For a period until the end of 1988, TEs which cannot meet this requirement may consume up to 1.5 watts, subject to this power being available.

9.3.1.2 *Restricted power conditions*

In restricted power conditions, the nominal value of the voltages at the inputs of TEs (from power source 1) shall be 40 V and the tolerance shall be +5% abd –20% when drawing a power of up to 400 mW (380 mW for a designated TE and 20 mW for other TEs).

9.3.2 *Power source 2 – optional third pair*

9.3.2.1 *Normal power conditions*

Under normal power conditions, the voltage at the interface of a TE shall be a maximum of 40 V + 5% and a minimum voltage of 40 V – 20% when the TE is drawing a power of up to the minimum available power of 7 watts.

9.3.2.2 *Restricted power conditions*

When power source 2 is unable to provide 7 watts, it may go to a restricted power condition where it will provide a minimum power of 2 watts. The provision of this restricted power condition is subject to the power source 2 provider's assumed responsibility. The nominal value of the voltages at the inputs of the TEs shall be 40 V and the tolerance shall be +5% and –20%. The mechanism to indicate this condition to the TEs is for further study.

9.4 *Current transient*

The rate of change of current drawn by a TE (for example, when connected or as a result of a change in polarity when a change from the normal condition to the restricted power condition occurs) shall not exceed 5 mA/µs.

9.5 *Power source 1 consumption*

The different values concerning the power source 1 consumption are summarized in Table 8/I.430.

9.5.1 *Normal power conditions*

Under normal power conditions and in the activated state, a TE which draws power from power source 1 shall draw no more than 1 watt (see Note of § 9.3.1.1). When a TE is not involved in a call, it is desirable that it minimize its power consumption (see Note below).

When in the deactivated state, a TE which draws power from power source 1 shall draw no more than 100 mW. However, if a local action has to be initiated in the TE when the interface is not activated, this TE shall not enter a "local action" state.

In this "local action" state the TE may consume up to 1 watt if the following conditions are assured:

– the corresponding power is provided by the NT (e.g., this service is supported by the NT);
– the "local action" state is not a permanent one. (A typical example of the use of this state is the modification of prestored dialing numbers in the TE.).

Note – The definition of "not involved in a call" mode may be based on the knowledge of the status of layer 2 (link established or not). When this limitation is applied in the design of a TE, a maximum value of 380 mW is recommended.

9.5.2 *Restricted power conditions*

9.5.2.1 *Power available to the TE "designated" for restricted power operation*

A TE which is permitted to draw power from power source 1 under restricted power conditions shall consume no more than 380 mW.

In restricted power conditions, a designated TE which is powered down may consume power from power source 1 only to maintain a line activity detector and to retain its Terminal Endpoint Identifier (TEI) value. The value of the power down mode consumption shall be 25 mW (see Note below).

Note – For a period until the end of 1988, TEs may consume up to 100 mW subject to this power being available.

TABLE 8/I.430

Summary of the different possible power source 1 consumptions

TE type and state	Maximum consumption
Normal conditions	
TE drawing power from PSI Active state	1 W (Note 1)
TE drawing power from PSI Deactivated state	100 mW

TE type and state	Maximum consumption
Normal conditions	
TE drawing power from PSI Local action state	1 W (Note 2)
Restricted conditions	
TE drawing power from PSI Designated TE; Active state	380 mW
TE drawing power from PSI Designated; Deactivated state	25 mW (Note 3)
TE drawing power from PSI Not designated	0 mW
TE drawing power from PSI Designated; Local action state	380 mW (Note 2)
Locally powered TE using connected detector Any state	3 mW
Locally powered TE not using connected detector Any state	0 mW

PSI Power source 1

Note 1 – See note to § 9.3.1.1.

Note 2 – Subject to the provision of the corresponding amount of power by power source 1.

Note 3 – See note to § 9.5.2.1.

9.5.2.2 *Power available to "non-designated" TEs*

Non-designated locally powered TEs which make use of a connected/disconnected detector may consume no more than 3 mW from power source 1 in restricted power conditions.

Non-designated locally powered TEs which do not make use of a connected/disconnected detector and non-designated TEs which are normally powered from power source I (normal conditions) shall not consume any power from power source I in restricted power conditions.

9.6 *Galvanic isolation*

TEs that provide power sinks 1 or 2 shall provide galvanic isolation between power sources 1 or 2 and the earths of additional sources of power and/or of other equipment. (This provision is intended to preclude earth loops or paths which could result in currents that would interfere with the satisfactory operation of the TE. It is independent of any requirement, for such isolation, related to safety which may result from the study under way in the IEC. It shall not be interpreted to require isolation which conflicts with necessary provisions for safety.) The way in which the galvanic isolation is to be implemented is left for further study.

10 Interface connector contact assignments

The interface connector and the contact assignments are the subject of an ISO standard. Table 9/I.430 is reproduced from the Draft International Standard, DIS 8877, dated November 1985. For the transmit and receive leads, pole numbers 3 through 6, the polarity indicated is for the polarity of the framing pulses. For the power leads, pole numbers 1, 2, 7 and 8, the polarity indicated is for the polarity of the d.c. voltages. See Figure 20/I.430 for the polarity of the power provided in the phantom mode. In that figure, the leads that are lettered a, b, c, d, e, f, g and h, correspond with pole numbers 1, 2, 3, 6, 5, 4, 7 and 8, respectively.

TABLE 9/I.430

Pole (contact) assignments for 8-pole connections (plugs and jacks)

Pole number	Function		Polarity
	TE	NT	
1	Power source 3	Power sink 3	+
2	Power source 3	Power sink 3	–
3	Transmit	Receive	+
4	Receive	Transmit	+
5	Receive	Transmit	–
6	Transmit	Receive	–
7	Power sink 2	Power source 2	–
8	Power sink 2	Power source 2	+

Note – This reference is only provisional.

ANNEX A

(to Recommendation I.430)

Wiring configurations and round trip delay considerations used as a basis for electrical characteristics

A.1 Introduction

A.1.1 In § 4, two major wiring arrangements are identified. These are point-to-point configuration and a point-to-multipoint configuration using a passive bus.

While these configurations may be considered to be the limiting cases for the definition of the interfaces and the design of the associated TE and NT equipments, other significant arrangements should be considered.

A.1.2 The values of overall length, in terms of cable loss and delay assumed for each of the possible arrangements, are indicated below.

A.1.3 Figure 2/I.430 is a composite of the individual configurations. These individual configurations are shown in this annex.

A.2 *Wiring configurations*

A.2.1 *Point-to-multipoint*

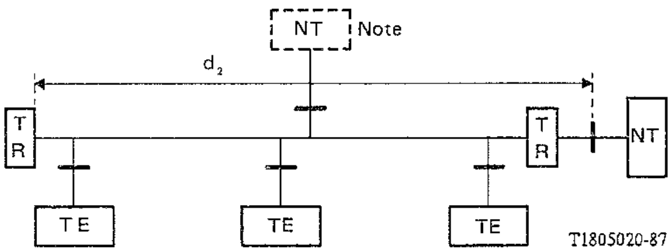
A.2.1.1 The point-to-multipoint wiring configuration identified in § 4.2 may be provided by the “short passive bus” or other configurations such as an “extended passive bus”.

A.2.1.2 *Short passive bus* (Figure A-1/I.430)

An essential configuration to be considered is a passive bus in which the TE devices may be connected at random points along the full length of the cable. This means that the NT receiver must cater for pulses arriving with different delays from various terminals. For this reason, the length limit for this configuration is a function of the maximum round trip delay and not of the attenuation.

An NT receiver with fixed timing can be used if the round trip delay is between 10 to 14 µs. This relates to a maximum operational distance from the NT in the order of 100-200 metres (d_2 in Figure A-1/I.430) [200 m in the case of a high impedance cable (4 = 150 ohms) and 100 m in the case of a low impedance cable (Z_c = 75 ohms)]. It should be noted that the TE connections act as stubs on the cable thus reducing the NT receiver margin over that of a point-to-point configuration. A maximum number of 8 TEs with connections of 10 m in length are to be accommodated.

The range of 10 to 14 µs for the round trip delay is composed as follows. The lower value of 10 µs is composed of two bits offset delay (see Figure 3/I.430) and the negative phase deviation of –7% (see § 8.2.3). In this case the TE is located directly at the NT. The higher value of 14 µs is calculated assuming the TE is located at the far end of a passive bus. This value is composed of the offset delay between frames of two bits (10.4 µs), the round trip delay of the unloaded bus installation (2 µs), the additional delay due to the load of TEs (i.e. 0.7 µs) and the maximum delay of the TE transmitter according to § 8.2.3 (15% = 0.8 µs).



TR Terminating resistor

Note – In principle, the NT may be located at any point along the passive bus. The electrical characteristics in this Recommendation, however, are based on the NT located at one end. The conditions related to other locations require confirmation.

FIGURE A-1/I.430

Short passive bus

A.2.1.3 *Extended passive bus (Figure A-2/I.430)*

A configuration which may be used at an intermediate distance in the order of 100 to 1 000 metres is known as an extended passive bus. This configuration takes advantage of the fact that terminal connection points are restricted to a grouping at the far end of the cable from the NT. This places a restriction on the differential distance between TEs. The differential round trip delay is defined as that between zero-volt crossings of signals from different TEs and is restricted to 2 µs.

This differential round trip delay is composed of a TE differential delay of 22% or 1.15 µs according to § 8.2.3, the round trip delay of the unloaded bus installation of 0.5 µs (line length 25 to 50 metres) and an additional delay due to the load of 4 TEs (0.35 µs).

The objective from this extended passive bus configuration is a total length of at least 500 metres (d_4 in Figure A-2/I.430) and a differential distance between TE connection points of 25 to 50 metres (d_3 in Figure A-2/I.430). (d_3 depends on the characteristics of the cable to be used.) However, an appropriate combination of the total length, the differential distance between TE connection points and the number of TEs connected to the cable may be determined by individual Administrations.

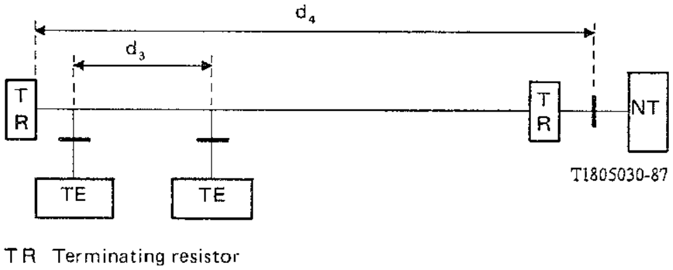


FIGURE A-2/I.430

Extended passive bus

A.2.2 *Point-to-point (Figure A-3/I.430)*

This configuration provides for one transmitter/receiver only at each end of the cable (see Figure A-3/I.430). It is, therefore, necessary to determine the maximum permissible attenuation between the ends of the cable to establish the transmitter output level and the range of receiver input levels. In addition, it is necessary to establish the maximum round trip delay for any signal which must be returned from one end to the other within a specified time period (limited by D-echo bits).

A general objective for the operational distance between TE and NT or NT1 and NT2 is 1 000 meters (d_i in Figure A-3/I.430). It is agreed to satisfy this general objective with a maximum cable attenuation of 6 dB at 96 kHz. The round trip delay is between 10 to 42 μs.

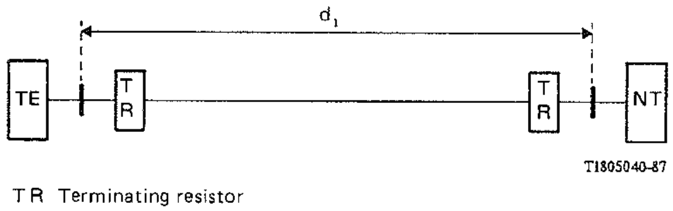


FIGURE A-3/I.430

Point-to-point

The lower value of 10 μs is derived in the same way as for the passive bus configuration. The upper value is composed of the following elements:

– 2 bits due to frame offset (2 × 5.2 μs = 10.4 μs, see § 5.4.2.3.);
– maximum 6 bits delay permitted due to the distance between NT and TE and the required processing time (6 × 5.2 ms = 31.2 ms);
– the fraction (+15%) of a bit period due to phase deviation between TE input and output (see § 8.2.3, 0.15 × 5.2 ms = 0.8 μs).

It should be noted that an adaptive timing device at the receiver is required at the NT to meet these limits.

For the NT used for both point-to-point and passive bus configurations (see § 8.6.3.2), the tolerable round trip delay in passive bus wiring configurations is reduced to 13 ps due to the extra tolerance required for the adaptive timing. Using this type of wiring configuration, it is also possible to provide point-to-multipoint mode of operation at layer 1.

Note – Point-to-multipoint operation can be accommodated using only point-to-point wiring. One suitable arrangement is an NT1 STAR illustrated in Figure A-4/I.430. In such an implementation, bit streams from TEs must be buffered to provide for operation of the D-echo channel(s) to provide for contention resolution, but only layer 1 functionality is required. It is also possible to support passive bus wiring configurations on the ports of NT1 STARs. Support of this configuration does not affect the provisions of Recommendations I.430, I.441 or I.451.

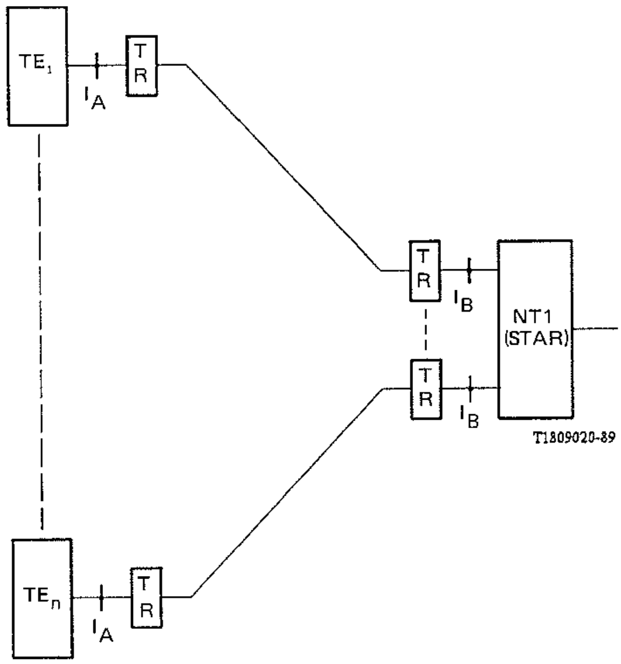


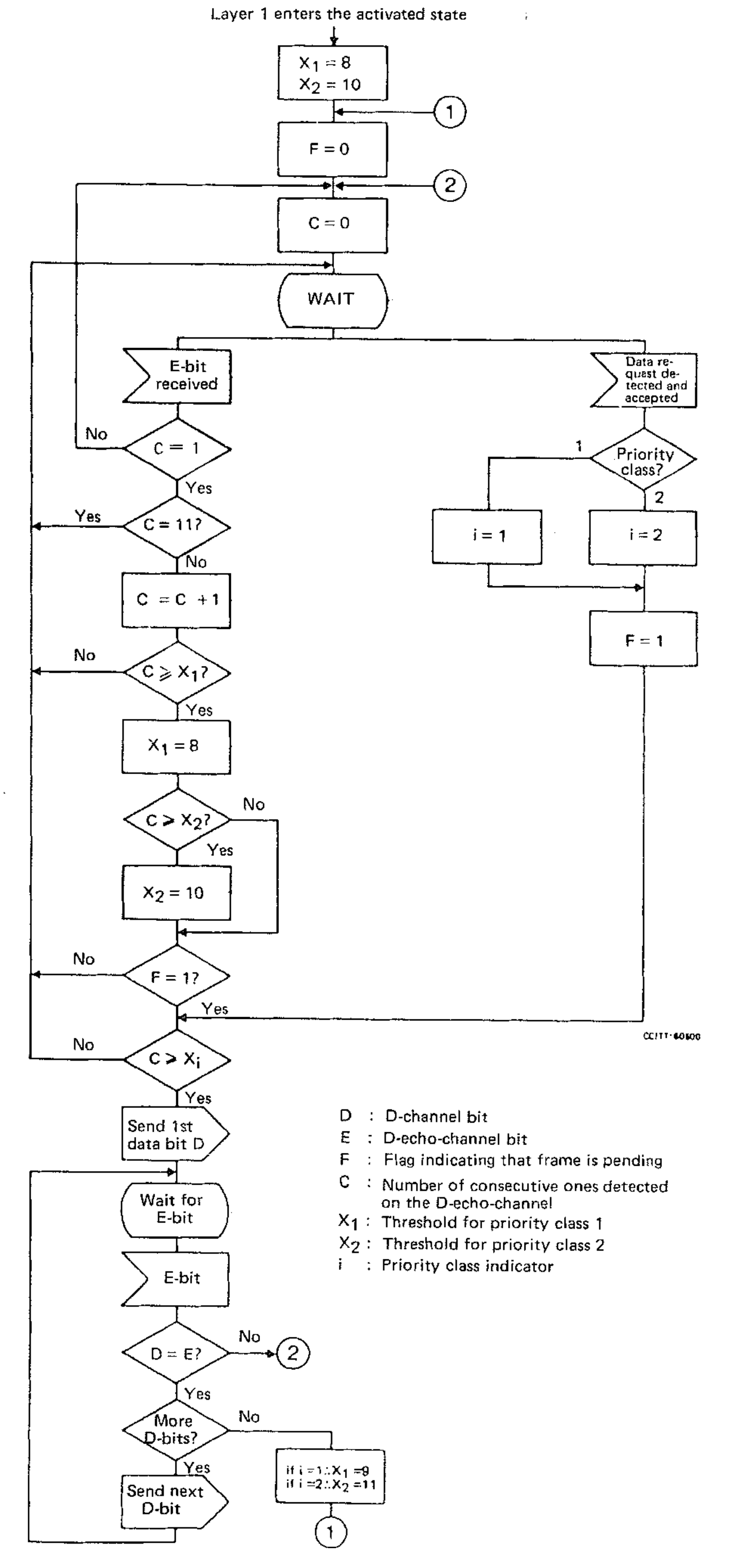
FIGURE A-4/I.430

NT1 STAR

ANNEX B

(to Recommendation I.430)

SDL representation of a possible implementation of the D-Channel access



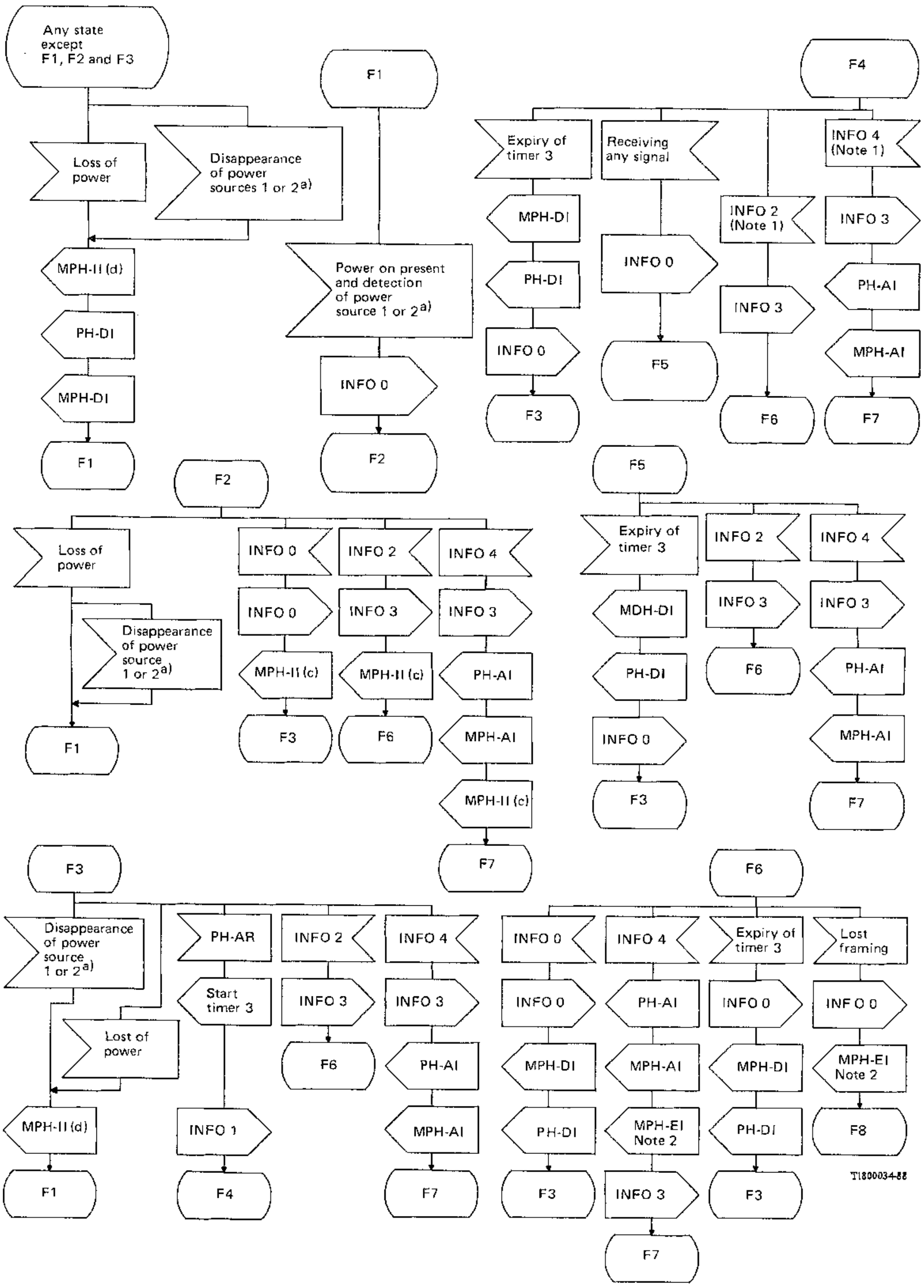
ANNEX C

(to Recommendation I.430)
(see Table 5/I.430)

C.1 *SDL representation of activation/deactivation procedures for TEs which can detect power source 1 or power source 2*

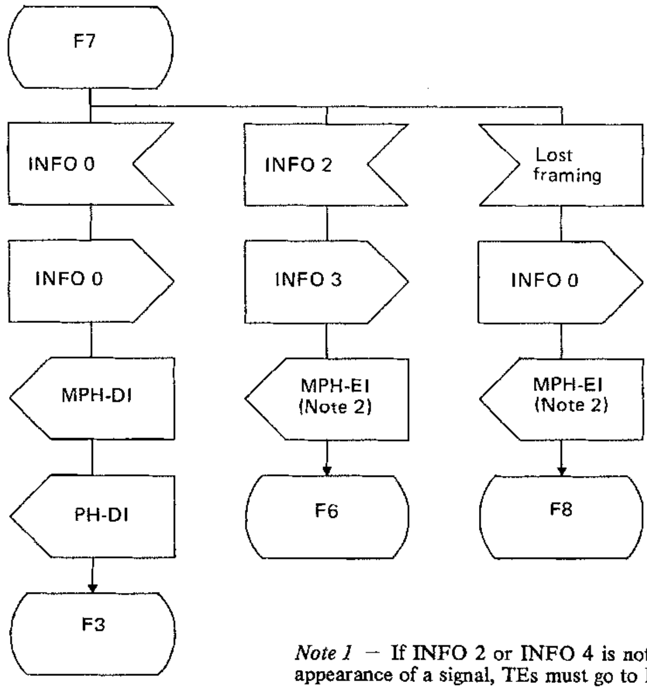
C.2 In § 6.2.3 the procedure at the terminal is specified in form of a finite state matrix given in Table 5/I.430. This Annex provides finite state matrices for two TE types in Tables C-1/I.430 and C-2/I.430.

C.3 *SDI representation of activation/deactivation procedures for NTs* (see Table 6/I.430)



a) Whichever power source is used for determining the connection status.

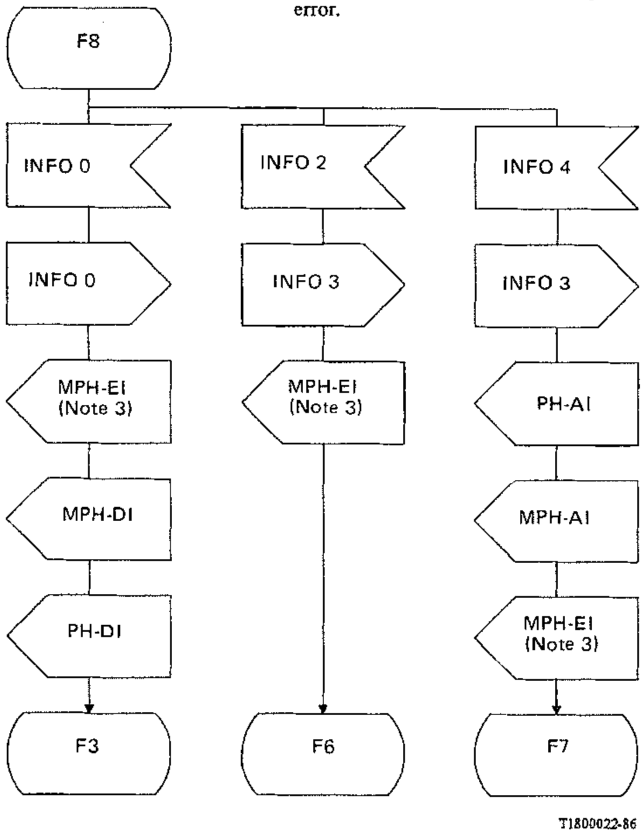
FIGURE C-1/I.430 (sheet 1 of 2)



Note 1 – If INFO 2 or INFO 4 is not recognized within 5 ms after the appearance of a signal, TEs must go to F5.

Note 2 – This error indication reports the detection of an error.

Note 3 – This error indication reports recovery from a previously reported error.



PH-AI	Primitive PH-ACTIVATE INDICATION
MPH-AI	Primitive MPH-ACTIVATE INDICATION
MPH-DI	Primitive MPH-DEACTIVATE INDICATION
PH-DI	Primitive PH-DEACTIVATE INDICATION
MPH-EI	Primitive MPH-ERROR INDICATION including a parameter indicating the cause
MPH-II (c)	Primitive MPH-INFORMATION INDICATION (connected)
MPH-II (d)	Primitive MPH-INFORMATION INDICATION (disconnected)
PH	layer 1 ⟷ layer 2
MPH	layer 1 ⟷ management entity

FIGURE C-1/I.430 (sheet 2 of 2)

TABLE C-1/I.430

Activation/deactivation for TEs

TEs locally powered and unable to detect power source 1 or 2

State name	Inactive	Sensing	Deactivated	Awaiting signal	Identifying input	Synchro-nized	Activated	Lost framing
State number	Fl	F2	F3	F4	F5	F6	F7	F8
Event / INFO sent	INFO 0	INFO 0	INFO 0	INFO I	INFO 0	INFO 3	INFO 3	INFO 0
Loss of power (Note 2)	/	Fl	MPH-II(d); Fl	MPH-II(d), MPH-DI, PH-DI; Fl	MPH-II(d), MPH-DI, PH-DI; F1	MPH-II(d), MPH-DI, PH-DI; Fl	MPH-II(d), MPH-DI, PH-DI; F1	MPH-II(d), MPH-DI, PH-DI; Fl
Application of power (Note 2)	F2	/	/	/	/	/	/	/
Detect power S	Event not applicable to this type of terminal							
Disappearance of power S	Event not applicable to this type of terminal							
PH-Activate Request	/	|	ST.T3 F4	|	|	–	|	–
Expiry T3	/	/	–	MPH-DI, PH-DI; F3	MPH-DI, PH-DI; F3	MPH-DI, PH-DI; F3	–	–
Receiving INFO 0	/	MPH-II(c); F3	–	–	–	MPH-DI, PH-DI; F3	MPH-DI, PH-DI; F3	MPH-DI, PH-DI, MPH-EI2; F3

TABLE C-1/I.430 *(cont.)*

Event / INFO sent / State number / State name	Inactive	Sensing	Deactivated	Awaiting signal	Identifying input	Synchro-nized	Activated	Lost framing
State number	Fl	F2	F3	F4	F5	F6	F7	F8
INFO sent	INFO 0	INFO 0	INFO 0	INFO I	INFO 0	INFO 3	INFO 3	INFO 0
Receiving any signal (Note 2)	/	–	–	F5	–	/	/	–
Receiving INFO 2	/	MPH-II(c); F6	F6	F6 (Note 3)	F6	–	MPH-EII; F6	MPH-EI2; F6
Receiving INFO 4	/	MPH-II(c), PH-AI, MPH-AI; F7	pH-AI, MPH-AI; F7	PH-AI, MPH-AI; F7 (Note 3)	PH-AI, MPH-AI; F7	PH-AI, MPH-AI, MPH-EI2; F7	–	PH-AI, MPH-AI, MPH-EI2; F7
Lost framing	/	/	/	/	/	MPH-Ell; F8	MPH-Ell ; F8	–

–	No change, no acton
|	Impossible by the definition of the layer 1 service
/	Impossible situation
a, b; Fn	Issue primitives “a” and “b” and then go to state “Fn”
PH-AI	Primitive PH-ACTIVATE INDICATION
PH-DI	Primitive PH-DEACTIVATE INDICATION
MPH-AI	Primitive MPH-ACTIVATE INDICATION
MPH-DI	Primitive MPH-DEACTIVATE INDICATION
MPH-Ell	Primitive MPH-ERROR INDICATION reporting error
MPH-EI2	Primitive MPH-ERROR INDICATION reporting recovery from error
MPH-II(c)	Primitive MPH-INFORMATION INDICATION (connected)
MPH-II(d)	Primitive MPH-INFORMATION INDICATION (disconnected)
ST.T3	Start timer T3
Power S	Power source 1 or power source 2

Pimitives are signals in a conceptual queue and will be cleared on recognition, while the INFO signals are continuous signals which are available all the time.

Note 1 – This event reflects the case where a signal is received and the TE has not (yet) determined whether it is INFO 2 or INFO 4.

Note 2 – The term “power” could be the full operational power or backup power. Backup power is defined such that it is enough to hold the TEI values in memory and maintain the capability of receiving and transmitting layer 2 frames associated with the TEI procedures.

Note 3 – If INFO 2 or INFO 4 is not recognized within 5 ms after the appearance of a signal, TEs must go to F5.

TABLE C-2/I.430

Activation/deactivation for TEs

TEs locally powered and able to detect power source 1 or 2. Use confined to NTs which provide power source 1 or 2

State name	Inactive		Sensing	Deactivated	Awaiting signal	Identifying input	Synchro-nized	Activated	Lost framing
	Power off	Power on							
State number	F1.0	F1.1	F2	F3	F4	F5	F6	F7	F8
Event / INFO sent	INFO 0	INFO 0	INFO 0	INFO 0	INFO I	INFO 0	INFO 3	INFO 3	INFO 0
Loss of power (Note 2)	/	F1.0	F1.0	MPH-II(d); F1.0	MPH-II(d), MPH-DI, PH-DI; F1.0	MPH-II(d), MPH-DI, PH-DI; F1.0	MPH-II(d), MPH-DI, PH-DI; F1.0	MPH-II(d), MPH-DI, PH-DI; F1.0	MPH-II(d), MPH-DI, PH-DI; F1.0
Application of power (Note 2)	Fl.1	/	/	/	/	/	/	/	/
Detect power S	/	F2	/	/	/	/	/	/	/
Disappearence of power S	/	/	Fl 1	MPH-II(d); F1.1	MPH-II(d), MPH-DI, PH-DI; F1.1	MPH-II(d), MPH-DI, PH-DI; F1.1	MPH-II(d), MPH-DI, PH-DI; F1.1	MPH-II(d), MPH-DI, PH-DI; F1.1	MPH-II(d), MPH-DI, PH-DI; F1.1
PH-ACR REQ	/	|	I	ST F4 4	|	|	–	|	–
Expiry T3	/	–	–	–	MPH-DI, PH-DI; F3	MPH-DI, PH-DI; F3	MPH-DI, PH-DI; F3	–	–

TABLE C-2/I.430 *(cont.)*

State name / State number / INFO sent / Event	Inactive: Power off	Inactive: Power on	Sensing	Deactivated	Awaiting signal	Identifying input	Synchro-nized	Activated	Lost framing
State number	F1.0	F1.1	F2	F3	F4	F5	F6	F7	F8
INFO sent	INFO 0	INFO 0	INFO 0	INFO 0	INFO I	INFO 0	INFO 3	INFO 3	INFO 0
Receiving INFO 0	/	/	MPH-II(c); F3	–	–	–	MPH-DI, PH-DI; F3	MPH-DI, PH-DI; F3	MPH-DI, MPH EI2; F3
Receiving signal (Note 1)	/	/	–	–	F5	–	/	/	–
Receiving INFO 2	/	/	MPH-II(c); F6	F6	F6 (Note 3)	F6	–	MPH-EI1; F6	MPH-EI2; F6
Receiving INFO 4	/	/	MPH-II(c), PH-AI MPH-AI; F7	PH AI, MPH-AI; F7	PH-AI, MPH-AI; F7 (Note 3)	PH-AI, MPH-AI; F7	PH-AI, MPH-AI, MPH-EI2; F7	–	PH-AI, MPH-AI, MPH-EI2; F7
Lost framing	/	/	/	/	/	/	MPH-EI1; F8	MPH-EI1; F8	–

For notation and notes, see Table C-1/I.430.

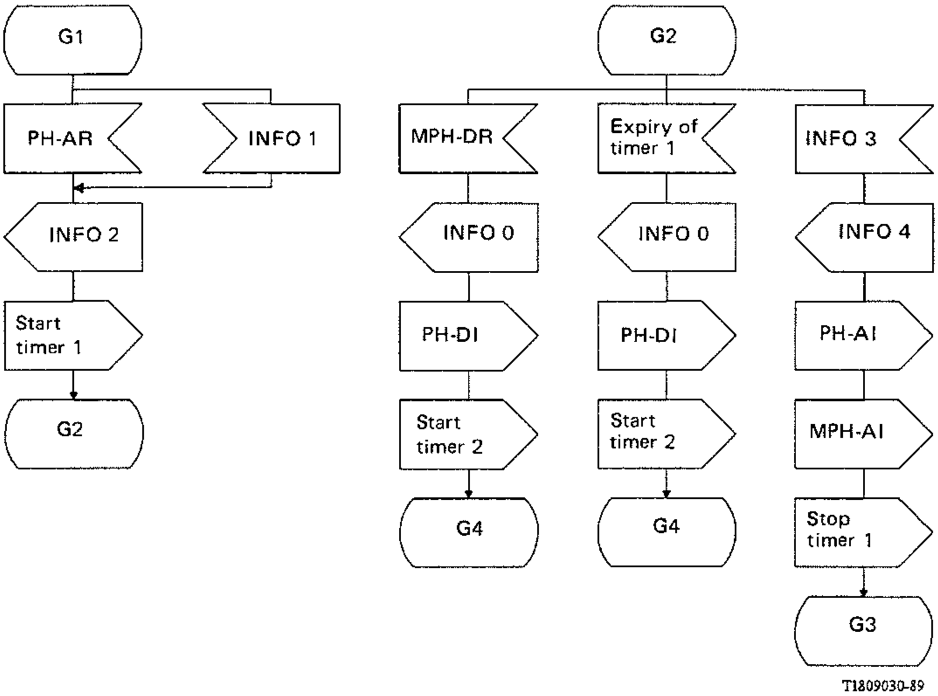
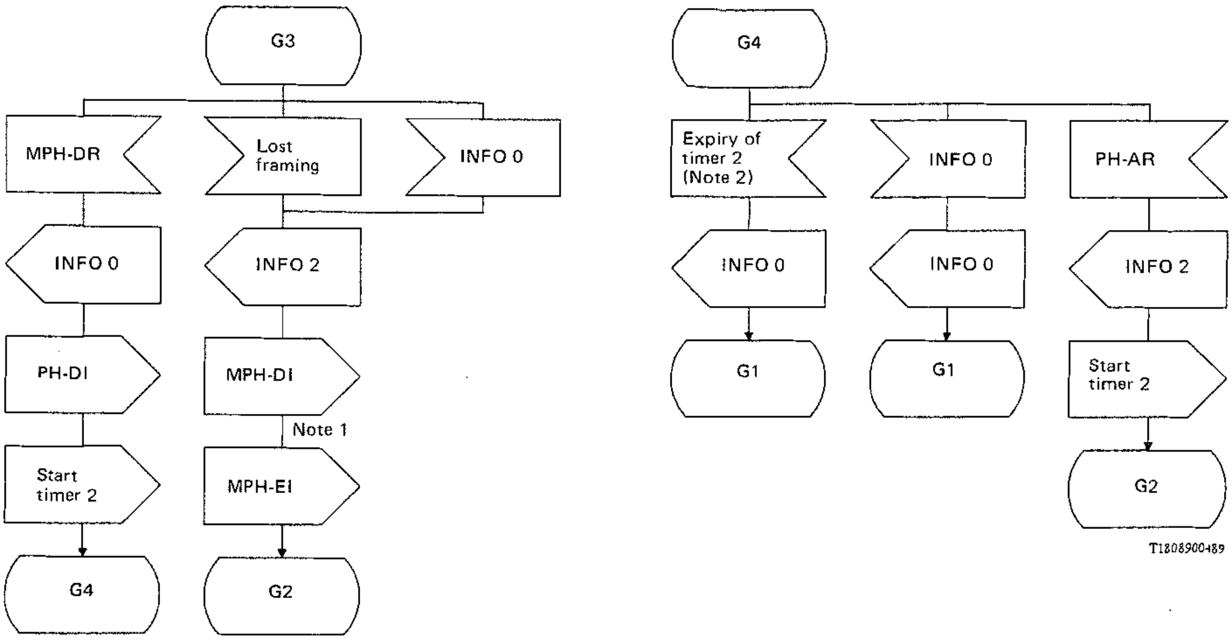


FIGURE C-2/I.430 (sheet 1 of 2)



Note 1 – The notification MPH-DI and MPH-EI need not be transferred to the management entity at the NT.

Note 2 – The duration of timer 2 is network dependent (25 to 100 ms). This implies that a TE has to recognize INFO 0 and to react on it within 25 ms. If the NT is able to unambiguously recognize INFO 1, then the value of timer 2 may be 0.

FIGURE C-2/I.430 (sheet 2 of 2)

ANNEX D

(to Recommendation I.430)

Test configuration

In § 8, waveforms are shown for testing NT and TE equipment. This Annex describes configurations, for testing TE equipment, which can be used to generate these waveforms (see Figure D-1/I.430). Similar configurations can be used to test NT equipment.

Table D-1/1.430 gives the parameters for the artificial lines reproduced in Figure D-1/1.430. The artificial lines are used to derive the waveforms. For test configurations ii) and iii), the cable length used corresponds to a signal delay of 1 µs.

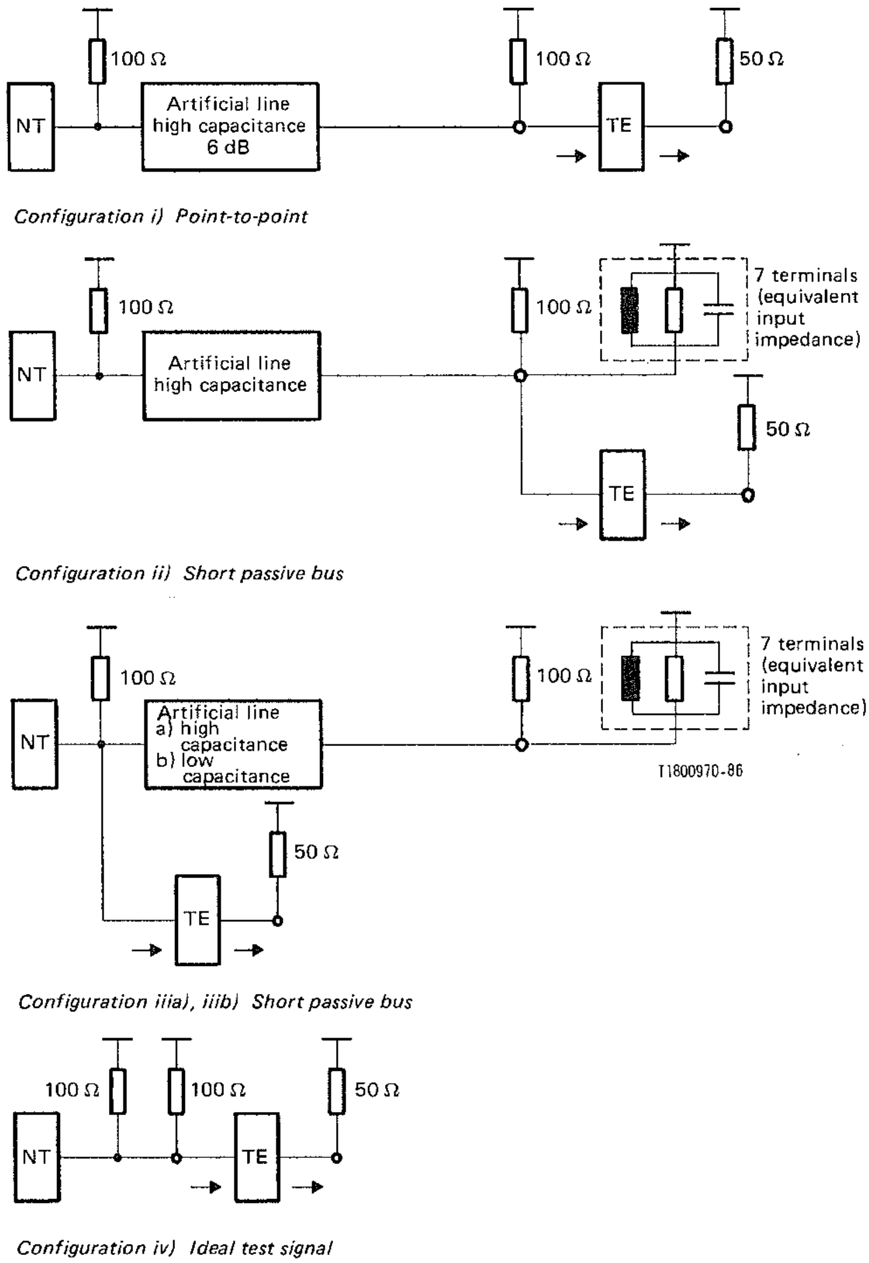


FIGURE D-1/I.430

Test configurations

TABLE D-l/I.430

Parameters for the artificial lines

Parameters	High capacitance cable	Low capacitance cable
R (96 kHz)	160 ohms/km	160 ohms/km
C (1 kHz)	120 nF/km	30 nF/km
Zo (96 kHz)	75 ohms	150 ohms
Wire diameter	0.6 mm	0.6 mm

ANNEX E

(to Recommendation I.430)

Vocabulary of terms used in connection with Recommendations I.430, I.431, G.960 and G.961

Introduction

This Annex provides a vocabulary of terms and definitions that are appropriate to layer 1 aspects of the ISDN customer access for basic access and primary rate access.

It should be considered in relation to Recommendations I.430, I.431, G.960 and G.961 since its scope is limited to these Recommendations. It is provided for a clear understanding of these Recommendations and will be reviewed during the next Study Period for alignment with Recommendations produced by other bodies.

A small number of terms in this Annex are duplicated in other Recommendations (e.g. Recommendation I.112 and/or Recommendation G.701). References to these are given in parenthesis as an aid to ensuring consistency between the Recommendations in the event of future amendments (e.g. "complete loopback {M.125}"). Where the term is defined differently, but the spirit is maintained, the reference is shown as in the following example: "functional group [11.112 419}]".

According to the conventions applied in this Annex any term in common usage, but whose use is deprecated in the sense defined, is shown after the recommended term as in the following example: "line [loop]".

Where a truncated term is widely used in an understood context the complete term is quoted following the colloquial form, for example: "multiplex, digital multiplex equipment".

§ E.7 contains an alphabetical list of all of the terms contained in this Recommendation.

§ E.8 illustrates the general aspects of the terminology.

§ E.9 explains the V reference point, V interface, and interface point concept.

E.1 *General*

101 **basic access, basic rate access**

A user-network access arrangement that corresponds to the interface structure composed of two B-channels and one D-channel. The bit rate of the D-channel for this type of access is 16 kbit/s.

102 **primary rate access**

A user-network access arrangement that corresponds to the primary rates of 1 544 kbit/s and 2 048 kbit/s. The bit rate of the D-channel for this type of access is 64 kbit/s. The typical primary rate interface structures are as given in Recommendations I.412 and I.431.

103 **local exchange, ISDN local exchange**

The exchange which, in addition to the switching function, contains the exchange termination for the ISDN customer accesses.

104 **line termination (LT)**

The functional group containing at least the transmit and receive functions terminating one end of a digital transmission system.

105 **exchange termination (ET)**

The functional group containing at least the layer 2 and layer 3 network side functions of the I.420 interface at the T reference point.

Note 1 – This may not be true if concentrators or other intelligent equipment are located in the local line distribution network.

Note 2 – The ET is not the switching function. The extent to which the ET supports call control processing and management is not defined.

106 **network termination (NT)**

The functional group on the network side of a user-network interface.

Note – In Recommendations I.430 and I.431, "NT" is used to indicate network terminating layer 1 aspects of NT1 and NT2 functional groups.

107 **terminal equipment (TE)**

The functional group on the user side of a user network interface.

Note – In Recommendations I.430 and I.431, "TE" is used to indicate terminal terminating layer 1 aspects of TE1, TA and NT2 functional groups.

108 **functional group** [{I.112 419}]

A set of functions that may be performed by a single equipment.

Note 1 – The transmission medium is not part of any functional group.

Note 2 – Regenerators, multiplexers and concentrators are functional groups which are outside the scope of Recommendation I.411.

109 **access connection element [subscriber access]** [{I.324}]

The equipment providing the concatenation of functional groups between and including the exchange termination and the NT1. The term should be qualified by the type of access supported. That is:

– basic access connection element
– primary rate access connection element.

110 **customer equipment [subscriber installation]** [{I.324}]

The concatenation of equipment on the user side of the T reference point (i.e. TAs, TE2s, TE1s NT2 and associated transmission media). In the case of multiple access, the customer equipment includes all the equipment on the user side of all those accesses comprising the multiple access.

Note 1 – This term should not imply or restrict ownership or responsibility for providing equipment.

Note 2 – The terms “user equipment” and “subscriber equipment” are deprecated.

111 **ISDN customer access [ISDN subscriber access]**

The equipment providing the concatenation of all functional groups relevant to an individual or group of related access connection elements (i.e. customer equipment and access connection element).

Note – This term should not imply or restrict ownership or responsibility for providing equipment.

112 **direct access, direct access connection element**

A specific access connection element in which the basic access digital section or primary rate access digital section is directly connected to the exchange termination at a V_1 or V_3 reference point respectively.

113 **remote access, remote access connection element**

A specific access connection element in which the digital section is not directly connected to the exchange termination but is connected through a multiplexer or concentrator.

114 **reference point** {11.412 420}

A conceptual point at the conjunction of two non-overlapping functional groups.

Note – Each reference point is assigned a prefix letter, for example: T reference point.

115 **interface, physical interface** {I.112 408; G.701 1008}

The common boundary between physical equipment.

116 **user network interface [customer network interface]** {I.112 409}

An interface, at which the access protocols apply, and which is located at the S or T reference point.

117 **V interface**

A digital interface which usually coincides with the V reference point.

Note – A specific V interface is denoted by a suffix number.

Note – The V interfaces are internal network interfaces.

118 V_1 reference point

A V reference point at the network side of a basic access digital section for the provision of a single basic access.

Note – The V_1 interface is a functional boundary between the exchange termination and the line termination and may or may not exist as a physical interface. The V_1 interface structure is comprised of two B-channels, one D-channel, and a C_{v1}-channel.

119 **V_2 reference point**

A V reference point at the network side of a concentrator for the provision of a number of basic and/or primary rate accesses.

120 **V_3 reference point**

A V reference point at the network side of a primary rate access digital section for the provision of a single primary rate access.

121 **V_4 reference point**

A V reference point at the network side of a multiplexer supporting several basic access digital sections.

E.2 *Digital transmission*

201 **Digital link, digital transmission link** [{I.112 302; G.701 3005}]

The whole of the means of digital transmission of a digital signal of specified rate between specified reference points.

Note – A digital link comprises one or more digital sections and may include either a multiplexer or concentrator, but not switching.

202 **digital access link**

A digital link between the T reference point and the V reference point in the case of remote access only.

203 **digital section [section]** [{G.701 3007}]

The whole of the means of digital transmission of a digital signal of specified rate between two consecutive reference points. The term should be qualified by the type of access supported, or by a prefix denoting the V interface at the digital section boundaries. For example:

– basic access digital section;
– primary rate access digital section;
– V_x digital section.

204 **digital section boundaries**

The reference points at the near and far ends of the digital section.

205 **digital system, digital transmission system [system]** [{G.701 3014}]

A specific means of providing a digital section.

Note – For a specific type of system this term may be qualified by the insertion of the name of the transmission medium employed by that specific system. Some examples are:

– digital line transmission system;
– digital radio system;
– digital optical transmission system.

206 **transmission method**

The technique by which the transmission system transmits and receives signals via the transmission medium.

207 **echo cancellation**

A transmission method used in digital transmission systems in which bi-directional transmission occurs simultaneously on the same line and in the same frequency band. An echo canceller is required to attenuate the echo of the near-end transmission.

208 **time compression multiplex [burst mode]**

A transmission method used in digital transmission systems in which bi-directional transmission occurs in non-overlapping uni-directional bursts.

209 **multiplex, digital multiplex equipment** [{G.701 4017}]

The combination of a digital multiplexer and a digital demultiplexer at the same location, operating in opposite directions of transmission.

210 **static multiplex [fixed multiplex]**

A multiplex where each tributary channel is assigned to one or more main-stream time-slots and the assignment is fixed.

211 **dynamic multiplex [statistical multiplex]**

A multiplex where signalling information of some or all tributary D-channels is assigned to a lesser number of main-stream time-slots on a statistical basis, but the assignment of other channels is fixed.

212 **concentrator, digital concentrator**

Equipment containing the means to combine, in one direction, a number of basic accesses, and/or primary rate accesses into a lesser number of time-slots by omitting the idle channels and/or redundancy, and to perform the corresponding separation in the contra-direction.

E.3 *Signalling*

301 **INFO**

A defined layer 1 signal with specified meaning and coding at a basic access user-network interface.

302 **SIG**

A signal representing an exchange of layer 1 information between line terminations of a digital transmission system for basic access.

303 **function elements (FEs)**

A signal representing a functional exchange of layer 1 information at the V_1 interface.

304 **control channel; C-channel [service channel]**

Additional dedicated transmission capability provided at a reference point or interface, or transported by a digital transmission system, to support the execution of management functions.

Note – The control channel at a specific reference point, interface or type of transmission system is denoted by an appropriate suffix. For example:

– C_{v1} channel: the control channel at the V_1 interface
– C_L-channel: the control channel at the line.

E.4 *Activation/deactivation*

401 **deactivation**

A function which places a system, or part of a system, into a non-operating or partially operating mode where the power consumption of the system may be decreased (low power consumption mode).

402 **activation**

A function which places a system, or part of a system, which may have been in a low power consumption mode during deactivation, into its fully operating mode.

403 **permanent activation**

Activation of a system, or part of a system, that will not be deactivated even when it is not required to be fully operating.

404 **line activation**

The function which requires the digital line transmission system to be activated but which may also activate the user-network interface.

405 **line-only activation**

The function which requires the activation of only the digital line transmission system and does not activate the user-network interface.

406 **one-step activation**

A type of activation which invokes a sequence of actions to activate the digital line transmission system and user-network interface from a single command.

407 **two-step activation**

A type of activation which is initiated by one command to invoke a sequence of actions to activate the digital line transmission system and continued by a second command to invoke a sequence of actions to activate the user-network interface.

408 **one-step deactivation**

Deactivation of the digital line transmission system and user-network interface invoked by a single command.

409 **user-network interface only deactivation**

Deactivation of the user-network interface which does not deactivate the digital line transmission system.

E.5 *Loopbacks*

501 **loopback, digital loopback** {M.125} **[test loop]** [{I.112 G}]

A mechanism incorporated into a piece of equipment whereby a bi-directional communication path may be connected back on itself so that some or all of the information contained in the bit sream sent on the transmit path is returned on the receive path.

502 **loopback type**

The characteristic of a loopback which specifies the relationship between information entering the loopback and the information leaving the loopback in the contra-direction.

503 **complete loopback** {M.125}

A physical layer 1 mechanism which operates on the full bit stream. At the loopback point, the receive bit stream shall be transmitted back towards the transmitting station without modification.

Note – The use of the term "complete loopback" is not related to implementation since such a loopback may be provided by means of active logic elements or controlled unbalance of a hybrid transformer, etc. At the control point only the information channels may be available.

504 **partial loopback** {M.125} **[echoing Ioopback]**

A physical layer 1 mechanism which operates on one or more specified channels multiplexed within the full bit stream. At the loopback point, the received bit stream associated with the specified channel(s) shall be transmitted back towards the transmitting station without modification.

505 **logical loopback** {M.125}

A loopback which acts selectively on certain information within a specified channel or channels and may result in some specified modification of the looped information. Logical loopbacks may be defined to apply at any layer, depending on the detailed maintenance procedures specified.

506 **loopback point** [{M.125}]

The precise location of the loopback.

507 **loopback control mechanism [control mechanism]** {M.125}

The means by which the loopback is operated and released from the loopback control point.

508 **loopback control point [control point]** {M.125}

The point which has the ability to directly control loopbacks. The loopback control point may receive requests for loopback operation from several loopback requesting points.

509 **loopback requesting point** [{M.125}]

The point which requests the loopback control point to operate loopbacks.

510 **loopback application** {M.125}

The maintenance phase for which the loopback operation is used.

511 **forward signal**

The signal transmitted beyond the loopback point.

Note – The forward signal may be a defined signal or unspecified.

512 **loopback test pattern** [{M.125}]

The information transmitted during the operation of the loopback in the channel or channels which are to be redirected by the loopback.

513 **transparent loopback** {M.125}

A transparent loopback is one in which the signal transmitted beyond the loopback point (the forward signal) when the loopback is activated, is the same as the received signal at the loopback point. See Figure E-1/I.430.

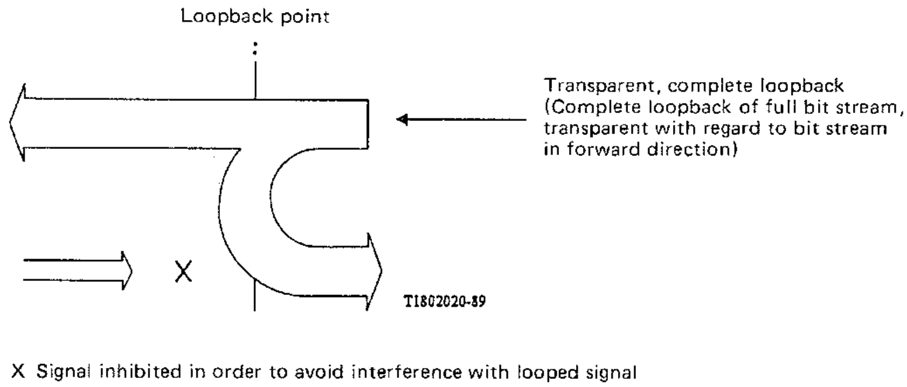


FIGURE E-1/I.430

514 **non-transparent loopback** {M.125}

A non-transparent loopback is one in which the signal transmitted beyond the loopback point (the forward signal) when the loopback is activated is not the same as the received signal at the loopback point. The forward signal may be a defined signal or unspecified. See Figure E-2/I.430.

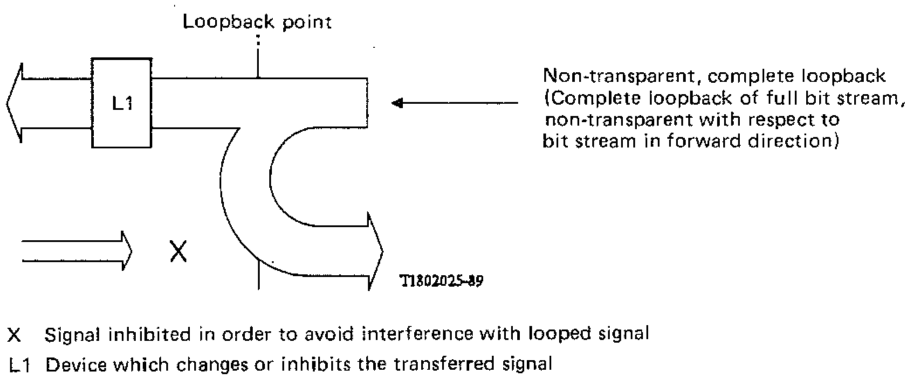


FIGURE E-2/I.430

E.6 *local line distribution network*

601 **local line distribution network**

A network of cables and wires which are currently installed between a local exchange and customer premises.

602 **twisted pair**

A line or part of a line which has each (insulated) conductor twisted around the other to reduce the effect of induction from stray electromagnetic and/or electrostatic fields.

Note – This definition also applies to twisted quad except that two pairs are twisted together.

603 **exchange cable**

A cable forming part of the local Iine distribution network, used in the local exchange between the line termination and main distribution frame.

604 **main cable**

A cable used in the local line distribution network between the main distribution frame and a cross connection point.

605 **distribution cable**

A cable used in the local line distribution network between the cross connection point and a distribution point.

606 **installation cable [subscriber cable]**

A cable or single pair of metallic wires used in the local line distribution point and the customer premises.

607 **bridged tap**

A length of unused open circuit line that is "T"ed to the customer line to provide flexibility in the local line distribution network.

Note – Bridged taps are not used in all local line distribution networks.

608 **open wire**

A pair of suspended and often uninsulated metallic wires which run parallel to each other.

Note – Overhead installation cables in common use between distribution poles and customer premises are not open wires.

609 **loading coil**

A device used to modify the electric characteristics of a line to give relatively constant attenuation over the voice-frequency range, but which gives relatively high attenuation beyond that range.

610 **crosstalk**

A phenomenon by which an unwanted signal is introduced into a line through coupling to one or more other lines.

611 **intrasystem crosstalk**

Crosstalk between lines sharing the same cable on which the same type of transmission system is used on each line.

612 **intersystem crosstalk**

Crosstalk between lines sharing the same cable and on which different types of transmission systems are used on each line.

613 **near-end crosstalk (NEXT)**

Crosstalk where the coupling is occurring at or near to the transmitter.

614 **far-end crosstalk (FEXT)**

Crosstalk where the coupling is occurring at or near to the end of the line furthest from the transmitter.

615 **line [loop]**

The transmission medium between line terminations. The term may be qualified by the type of medium used, for example:

– metallic line: a pair of metallic (usually copper) wires,

– optical line: one optical fibre (bi-directional transmission), or one pair of fibres (uni-directional transmission).

616 **local line [subscriber line]**

An individual line which is continuous between the line termination (LT) and the customer premises, passing through the exchange, main, distribution and installation cables.

617 **digital local line**

A local line which is used by a digital transmission system.

Note – Regenerators are not part of the line but may be inserted between two line lengths.

E.7 *Alphabetical list of terms contained in this Annex*

E.8 *Ilustration of the general aspects of the terminology*

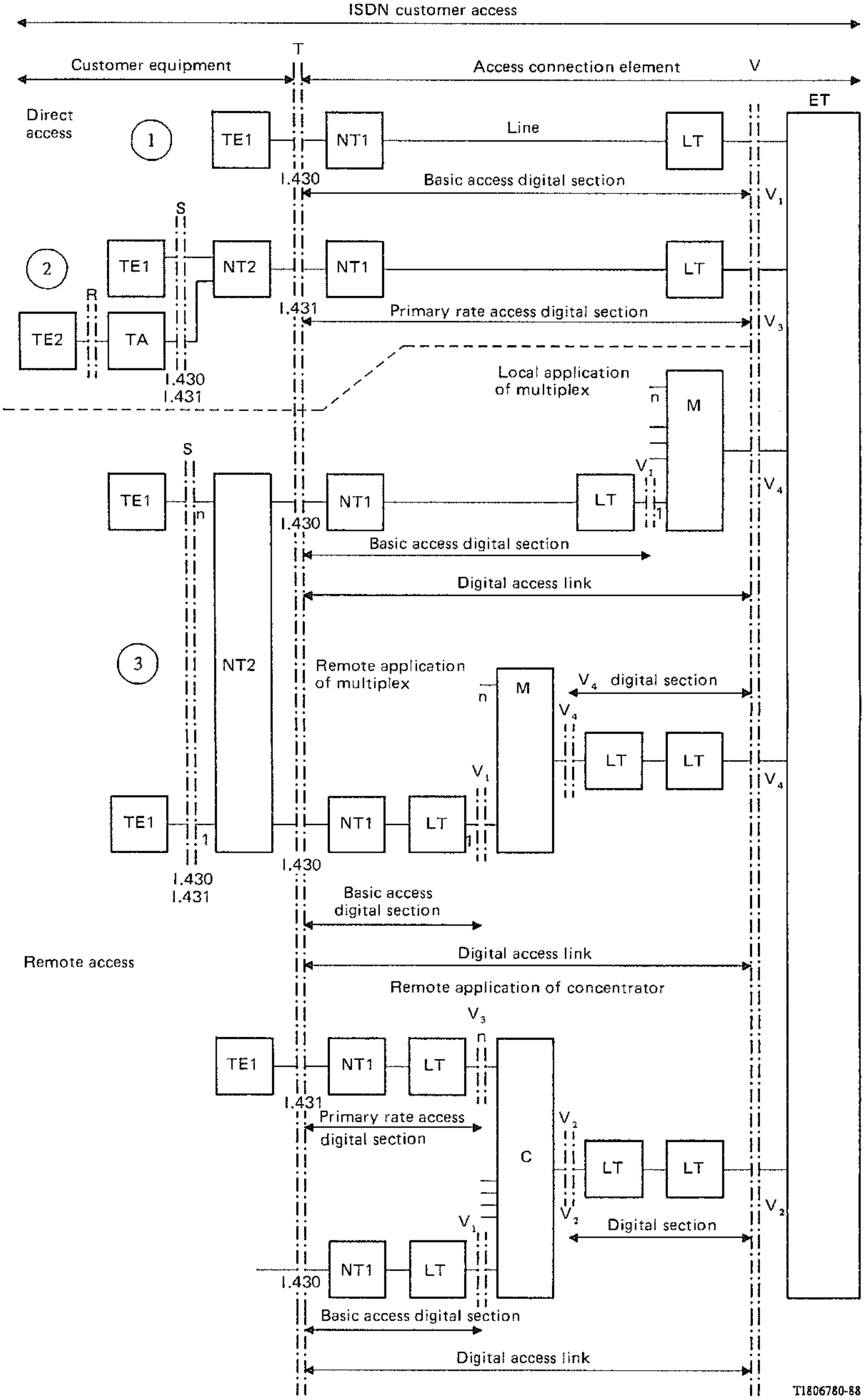


FIGURE E-3/I.430

E.9 *Clarification of the V reference point, V interface, and reference point concept*

E.9.1 The V_1 reference point and the V_3 reference point are always on the network side of the line termination and are applicable to individual (low order) accesses.

A reference point, when physically realized by an interface, requires the specification of at least two interface points. See Figure E-4/I.430.

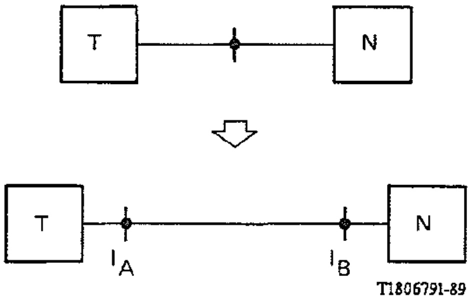
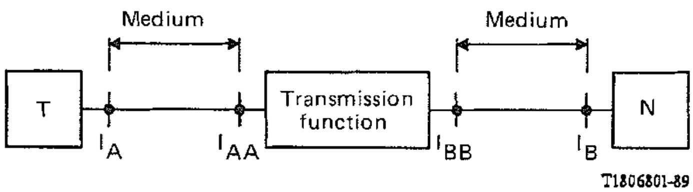


FIGURE E-4/I.430

E.9.2 Interface point

One of at least two physical locations associated with an interface. The interface points mark the end of the transmission medium which supports the interface and may be the location of connectors (if used).

The reach of any interface may be extended by the use of a transmission system, providing that the transmission system is transparent with regard to the functions transported by the interface. In such a case, two further interface points would be required. See Figure E-5/I.430.



Note – The insertion of a transmission system to a specific interface may be limited by performance related requirements.

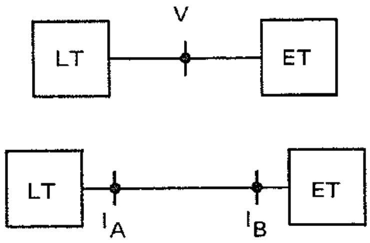
FIGURE E-5/I.430

E.9.3 A group of individual accesses may be multiplexed or concentrated together to comprise a higher order access (i.e. V_2 or V_6 for basic access higher order interfaces).

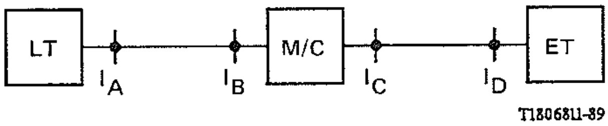
There is only one V reference point at which the V interfaces may be implemented (between LT and ET). See Figure E-6/I.430.

This approach aligns with the use of I_B and I_A interface points in Recommendations I.430 and I.431.

– with the modelling technique used so far;
– with the terminology used so far;
– with the fact that an S or T reference point may support a range of interfaces (I.430/I.431);
– does not contradict Recommendation Q.512.



a) Low order interface application



b) High order interface application

M/C Multiplexer or concentrator

Note – I_B and I_A are the interface points supporting V_1 or V_3 interfaces. I_C and I_D are the interface points supporting V_2 or V_4 interfaces.

FIGURE E-6/I.430

APPENDIX I

(to Recommendation I.430)

Test loopbacks defined for the basic user-network interface

I.1 *Introduction*

Recommendations in the I.600-Series specify an overall approach to be employed in maintaining the ISDN basic access. An integral part of that approach is the use of looping mechanisms in the failure confirmation and failure localization phases of network maintenance.

Detailed specifications of how such loopbacks are to be used may be found in the I.600-Series Recommendations. However, since the required loopbacks may impact the design of terminating pieces of equipment, a brief description of the loopbacks and their characteristics is presented in this Appendix.

I.2 *Loopback mechanism definitions*

This section defines the terminology used in specifying the characteristics of loopbacks.

The loopback point is the location of the loopback.

The control point is the location from which activation/deactivation of the loopback is controlled.

Note – The generation of the test pattern used over the loopback may not be located at the control point.

The following three types of loopback mechanisms are defined:

a) *Complete loopback* – a complete loopback is a layer 1 mechanism which operates on the full bit stream. At the loopback point, the received bit stream shall be transmitted back towards the transmitting station without modification.

Note – The use of the term “complete loopback” is not related to implementation since such a loopback may be provided by means of active logic elements or controlled unbalance of a hybrid transformer, etc. At the control access point only the information channels may be available.

b) *Partial loopback* – a partial loopback is a layer 1 mechanism which operates on one or more specified channels multiplexed within the full bit stream. At the loopback point, the received bit stream associated with the specified channel(s) shall be transmitted back towards the transmitting station without modification.

c) *Logical loopback* – a logical loopback acts selectively on certain information within a channel or channels and may result in some specified modification of the looped information. Logical loopbacks may be defined at any layer of the OSI model and depend on the detailed maintenance procedures specified.

For each of the above three types of loopback mechanisms, the loopback may be further categorized as either transparent or non-transparent.

i) A transparent loopback is one in which the signal transmitted beyond the loopback point (the forward signal) when the loopback is activated, is the same as the received signal at the loopback point. See Figure I-1/I.430.

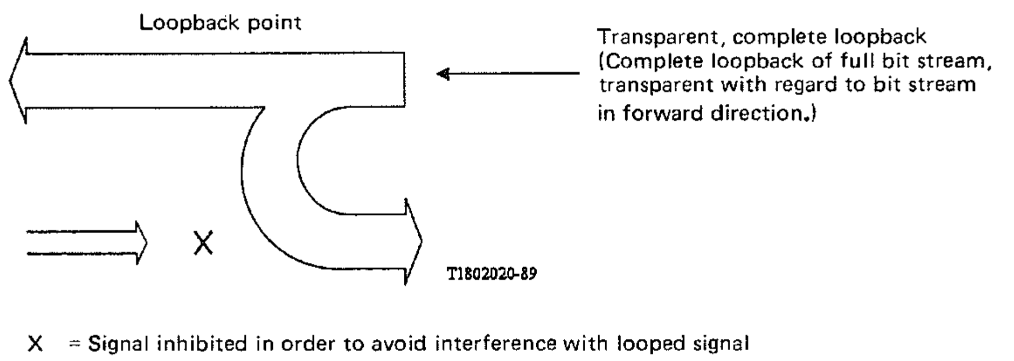


FIGURE I-1/I.430

Transparent loopback

ii) A non-transparent loopback is one in which the signal transmitted beyond the loopback point (the forward signal) when the loopback is activated is not the same as the received signal at the loopback point. The forward signal may be a defined signal or unspecified. See Figure I-2/I.430.

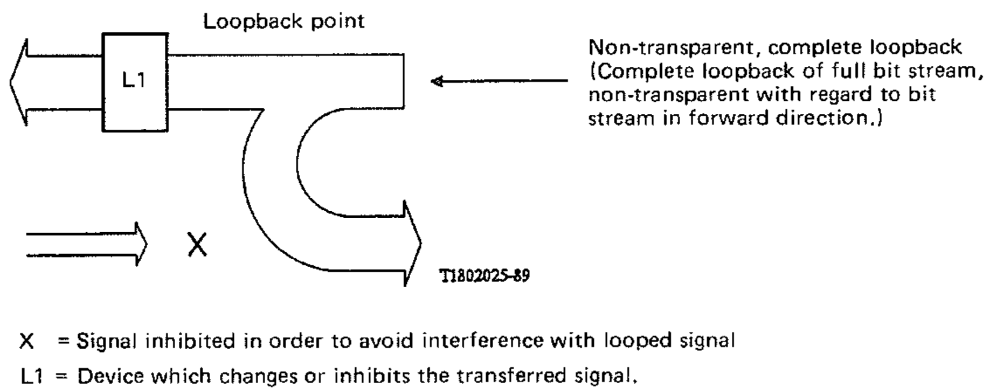


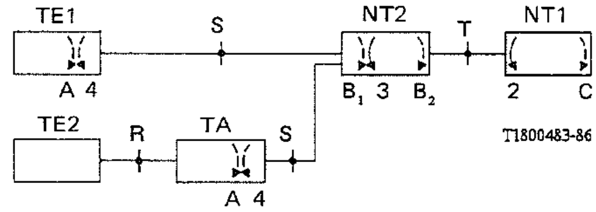
FIGURE I-2/I.430

Non-transparent loopback

Note – Whether or not a transparent loopback is used, the loopback should not be affected by facilities connected beyond the point at which the loop is provided, e.g. by the presence of short circuits, open circuits or foreign voltages.

I.3 *Test loopback reference configuration*

Figure I-3/I.430 shows the possible locations of test loopbacks pertaining to the maintenance of the ISDN basic user-network interface. Recommended and desirable loopbacks are drawn in solid lines. Optional loopbacks are drawn with dashed lines. These optional loopbacks may not be provided by all equipments. The characteristics of each of these loopbacks are given in Tables I-1/I.430 and I-2/I.430, respectively.



Note – Loopbacks B_1 and 3 are applicable to each individual interface at reference point S.

FIGURE I-3/I.430

Location of loopbacks

I.4 *Test loopback characteristics*

Tables I-1/I.430 and I-2/I.430 present the characteristics applicable to each recommended, desirable and optional loopback. In particular, the control point, control mechanism, loopback type, and loopback location are identified.

The loopback type indicates whether a complete, partial or logical loopback is required and whether the loopback should be transparent or non-transparent.

The loopback location is specified in a somewhat approximate manner, since the precise location may be implementation dependent.

The choice of loopback mechanism is dictated by the protocol layers available at the looping point and the addressing requirements. Thus, for instance, loopback 3 is controlled via layer 3 since selection of a particular S interface may be required.

Table I-3/I.430 lists characteristics of those loopbacks whose use and parameters are for further study.

TABLE I-1/I.430

Characteristics of recommended loopbacks

Loopback (see Figure I-3/I.430)	Location	Channel(s) looped	Loopback type	Control point	Control mechanism	Implementation
2	In NT1, as near as possible to T reference point, towards the ET (Note 1)	2B + D channels	Complete, transparent or non-transparent (see Note to § I.2) (Note 4)	Under control of local exchange	Layer 1 signals in transmission system	Recommended
3	In NT2, as near as possible to S reference point, towards the ET	2B + D channels	Complete, transparent or non-transparent (see Note to § 1.2)	NT2	Local maintenance	Desirable (Note 3)
				NT2	Layer 3 messages in D-channel or in band signalling in B-channel (Note 2)	

Note 1 – In the case of a combined NT1 and NT2 (i.e., an NT12), loopback 2 is located at the position within the NT12 which equates to the T reference point.

Note 2 – Activation/deactivation of loopback 3 may be initiated by request from a remote maintenance server by layer 3 messages in the D channel or other signalling in the B channel. However, the generation of the test pattern over the loopback would be by the NT2.

Note 3 – From a technical viewpoint, it is desirable (although not mandatory) that loopback 3 can always be implemented, therefore the design of protocols for loopback control should include the operation of loopback 3.

Note 4 – In case a transparent loopback 2 is applied, the NT1 should send INFO 4 frames toward the user with the D-echo channel bits set to binary ZERO.

TABLE 1-2/1.430

Characteristics of optional loopbacks

Loopbacks (see Figure I-3/I.430)	Location	Channel(s) looped	Loopback type	Control point	Control mechanism	Implementation
C	Inside NT1	B_1, B_2 (Note 4)	Partial, transparent or non-transparent	TE, NT2	Layer 1 (Note 1)	Optional
				Under control of local exchange	(Note 2)	
B_1	Inside the NT2, at subscriber side (Note 3)	B_1, B_2 (Note 4)	Partial, transparent or non-transparent	TE, NT2	Layer 1 or Layer 3	Optional
B_2	Inside the NT2, at the network side	These loopbacks are optional in the TE/NT2. When used, e.g. as part of an internal test, no information should be sent towards the network interface, (i.e. INFO 0 is transmitted to the interface).				
A	Inside the TE					
4	Inside the TA or TE	B_1, B_2 (Note 4)	Partial, transparent or non-transparent	NT2 local exchange, remote maintenance server or remote user	Layer 3	Optional

Note 1 – An exchange of layer 3 service messages may take place between TE (or NT2) and the exchange prior to the use of the layer 1 control mechanism. However, there are situations where the TE (or NT2) may not receive a reply:

a) the message may not be transmitted when the interface is in a failure situation;

b) a network that does not support the layer 3 signalling option, need not respond.

The definition of layer 1 control signal from TE (or NT2) towards NT1 (based on the use of the optional multi-frame) is for further study.

Note 2 – The control mechanism in this case could be the same as in Note 1 except that the network controls the loopback by spare capacity in the transmission system.

Note 3 – Loopback B_1 is applicable to each individual interface at reference point S.

Note 4 – The B_1- and B_2-channel loopbacks are controlled by separate control signals. However, both loopbacks may be applied at the same time.

TABLE I-3/I.430

Characteristics of loopbacks whose need and parameters are for further study

Loopbacks (see Figure I-3/I.430)	Location	Channel(s) looped	Loopback type	Control point	Control mechanism	Implementation
2_1	Within the NT1, not impacting the network interface	B_1, B_2 (Note)	Partial, transparent or non-transparent	Under control of the local exchange	Layer 1 signals in the transmission system	Optional

Note – The B_1- and B_2-channel loopbacks are controlled by separate control signals; however, both loopbacks may be applied at the same time.

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