Recommendation X.21 *bis*

USE ON PUBLIC DATA NETWORKS OF DATA TERMINAL EQUIPMENT (DTE) WHICH IS DESIGNED FOR INTERFACING TO SYNCHRONOUS V–SERIES MODEMS

(Geneva, 1976; amended at Geneva, 1980, Malaga–Torremolinos, 1984 and Melbourne, 1988)

The CCITT,

considering that

(a) the interface between Data Terminal Equipment (DTE) and Data Circuit–terminating Equipment (DCE) for synchronous operation on public data networks is specified in Recommendation X.21;

(b) several Administrations are also planning to provide as an interim measure the connection to public data networks of synchronous DTEs which are designed for interfacing to synchronous V–Series modems,

unanimously recommends

(1) the connection of DTEs with V–Series–type interface to public data networks allow for:

i) the leased circuit service (point–to–point and centralized multipoint),

ii) the direct call facility,

iii) the address call facility;

(2) this Recommendation specifies the operational modes and the optional features which apply when the data circuit interconnects V–Series DTEs. Interworking between V–Series DTEs and X.21 DTEs is described in Annex A.

1 The use of V–Series DTEs for leased circuit service and packet–switched service (X.25, Layer 1)

1.1 *General*

The use of V–Series DTEs utilizing the leased circuit service in public data networks is discussed in the following.

The data signalling rates are those defined in Recommendation X.1 for user classes of service employing synchronous transmission.

1.2 *Use of interchange circuits*

The electrical characteristics of the interchange circuits at both the DCE side and the DTE side of the interface may comply either with Recommendation V.28 using the 25–pole DTE/DCE interface connector and contact number assignments standardized by ISO 2110 or with Recommendation X.26 using the 37–pole DTE/DCE interface connector and contact number assignments standardized by ISO 4902. Administrations may choose to offer only one of the interface options. Where the Administration permits interworking between V.28 equipment on one side of the interface and X.26 equipment on the other side of the interface, refer to Recommendation X.26 and ISO 4902. (The onus is on the provider of X.26 equipment to supply the adaptor needed to interwork with the V.28 equipment.)

For applications of the data signalling rate of 48 kbit/s, the connector and electrical characteristics at both the DCE side and the DTE side of the interface are given in the ISO standard for the assignment of the 34–pin interface connector ISO 2593 and in Recommendation V.35 respectively. Alternatively for the data signalling rate of 48 kbit/s, the connector and electrical characteristics at both the DCE side and the DTE side of the interface may use ISO 4902 and Recommendations X.26/X.27 respectively as applied for Recommendation V.36. Interworking with ISO 2593 and Recommendation V.35 configuration is for further study. Administrations may choose to offer only one of the interface options at 48 kbit/s.

Table 1/X.21 *bis* shows the use of interchange circuits for the leased circuit service.

TABLE 1/X.21 *bis*

V.24 Interchange circuit No.	Designation
102	Signal ground or common return
103	Transmitted data
104	Received data
105	Request to send
106	Ready for sending
107	Data set ready (see Note 1)
108/1	Connect data set to line (see Notes 2 and 3)
109	Data channel received line signal detector
114	Transmitter signal element timing (DCE) (see Note 4)
115	Receiver signal element timing (DCE) (see Note 4)
140	Loopback/maintenance test (see Note 5)
141	Local loopback (see Note 5)
142	Test indicator (DCE)

Note 1 – Circuit 107 shall go OFF only in cases of DCE power–off (normally the indeterminate state is interpreted as OFF), loss of service (see § 3.2 below) or when circuit 108/1, when implemented, is turned OFF.

Note 2 – Not required for V.29, V.35 and V.36 compatible interfaces.

Note 3 – The DCE interprets the ON condition on circuit 108/1, when implemented, as an indication that the DTE is operational. If circuit 108/1 is not provided the DCE will consider the lack of circuit 108/1 as the ON condition. The DCE turns circuit 107 ON while circuit 108/1, if present, is ON and the circuit connection is available.

Note 4 – The DCE shall provide the DTE with transmitter and receiver signal element timings; this is donne by feeding circuits 114 and 115 with the same timing signal from the DCE.

Note 5 – Not required in those networks which do not provide automatic activation of the loops.

All these circuit functions are in accordance with Recommendation V.24 and the appropriate modem Recommendations (see also § 1.2.1 below).

1.2.1 *Operational requirements*

1.2.1.1 *Half–duplex operation*

In principle the data circuit provided has duplex transmission capability. However, when a remote response from circuit 105 to circuit 109 is required it may be provided on an optional basis (see also Annex A).

Note – Attention is drawn to the fact that, although circuit 105 can control circuit 109 at the other end, in case of the half–duplex facility, the detection of a line signal should be replaced by some other control mechanism.

1.2.1.2 *Response times*

The response time of the OFF to ON transition of circuit 106 as a response to circuit 105 OFF to ON should provisionally be between 30 and 50 ms for the 600 bit/s user rate, and 10 to 20 ms for the higher user rate.

1.2.1.3 *Clamping*

The following conditions apply:

– In the event of line failure (e.g. channel out of service, loss of alignment) the DCE shall clamp circuit 104 to steady binary 1 condition and circuit 109 to OFF condition.

– In all applications the DCE shall hold circuit 104 in binary 1 condition, when circuit 109 is in the OFF condition.

– In addition, when the half–duplex facility is provided, the DCE shall hold circuit 104 in the binary 1 condition and circuit 109 in the OFF condition when circuit 105 is in the ON condition.

– When circuit 105 or circuit 106 or both are OFF, the DTE shall maintain a binary 1 condition on circuit 103.

1.2.1.4 *Timing arrangements*

Timing signals on circuits 114 and 115 should always be maintained when the DCE is capable of generating them, disregarding the conditions of the other circuits. Circuits 114 and 115 should be held by the DCE in the OFF condition when the DCE is unable to generate the timing information.

2 The use of V–Series DTEs for direct call and address call facilities

2.1 *General*

The use of V–Series DTEs utilizing the *direct call* or the *address* facility in public data networks is discussed below.

The data signalling rates are those defined in Recommendation X.1 for user classes of service employing synchronous transmission.

2.2 *Use of interchange circuits*

The electrical characteristics of the interchange circuits at both the DCE side and the DTE side of the interface may comply either with Recommendation V.28 using the 25–pole DTE/DCE interface connector and contact number assignments standardized by ISO 2110 or with Recommendation X.26 using the 37–pole DTE/DCE interface connector and contact number assignments standardized by ISO 4902. Administrations may choose to offer only one of the interface options. Where the Administrations permit interworking between V.28 equipment on one side of the interface and X.26 equipment on the other side of the interface, refer to Recommendation X.26 and ISO 4902. (The onus is on the provider of the X.26 equipment to supply the adaptor needed to interwork with the V.28 equipment.)

For applications of the data signalling rate of 48 kbit/s, the connector and electrical characteristics at both the DCE side and the DTE side of the interface are given in the ISO standard for the assignment of the 34–pin interface connector ISO 2593 and in Recommendation V.35 respectively. Alternatively for the data signalling rate of 48 kbit/s, the connector and electrical characteristics at both the DCE side and the DTE side of the interface may use ISO 4902 and Recommendations X.26/X.27 respectively as applied for Recommendation V.36. Interworking with ISO 2593 and Recommendation V.35 configuration is for further study. Administrations may choose to offer only one of the interface options at 48 kbit/s.

Table 2/X.21 *bis* shows the list of interchange circuits.

TABLE 2/X.21 *bis*

V.24 Interchange circuit No.	Designation
102	Signal ground or common return
103	Transmitted data
104	Received data
105	Request to send
106	Ready for sending
107	Data set ready
108/1 or	Connect data set to line
108/2	Data terminal ready
109	Data channel received line signal detector
114	Transmitter signal element timing (DCE)
115	Receiver signal element timing (DCE)
125	Calling indicator
141	Local loopback
142	Test indicator (DCE)

For further definitions of the interchange circuits outlined below, refer to Recommendation V.24 and the appropriate V–Series modem Recommendations.

2.2.1 *Call establishment and disconnection phases*

The following interchange circuits should be used for control signalling in the call establishment and disconnection phases:

Circuit 102 – Signal ground or common return

Circuit 107 – Data set ready

This circuit is used to indicate the following operational functions.

Condition of circuit 107	Function in the network (see § 2.2.1.1)
ON	Ready for data
OFF	DCE clear indication
OFF	DCE clear confirmation

Note – In duplex transmission when no circuit 105 operation is used by the DTE, circuit 106 will be set to ON with a delay from 0 to 20 ms with respect to the transition of circuit 107 to ON.

Circuit 108/1 – Connect data set to line

This circuit is used alternatively to circuit 108/2. The following operational functions should be indicated.

Condition of circuit 108/1	Function in the network (see § 2.2.1.1)
ON	Call request
ON	Call accepted
OFF	DTE clear request
OFF	DTE clear confirmation

Note – This circuit should not be operated when the DTE is connected to a modem which does not terminate this circuit.

Circuit 108/2 – Data terminal ready

This circuit is used alternatively to circuit 108/1. The following operational functions should be indicated.

Condition of circuit 108/2	Function in the network (see § 2.2.1.1)
ON	Call accepted
OFF	DTE clear request
OFF	DTE clear confirmation

Note – This circuit should not be operated when the DTE is connected to a modem which does not terminate this circuit.

Circuit 114 – Transmitter signal element timing (DCE)

Circuit 115 – Receiver signal element timing (DCE)

The DCE shall provide the DTE with transmitter and receiver element timings. This is done by feeding circuits 114 and 115 with the same timing signal from the DCE.

Circuit 125 – Calling indicator

The ON condition indicates *incoming call*. The circuit will be turned OFF as follows:

– in conjunction with circuit 107 turned ON, or

– *DCE ready* is received from the network, or

– *DCE clear indication* is received from the network.

Circuit 141 – Local loopback

Signals on this circuit are used to control the loop 3 test condition in the local DCE. Not required in those networks which do not provide automatic activation of the loops.

Circuit 142 – Test indicator

This circuit is used to indicate to the DTE the test–mode status of the DCE.

2.2.1.1 *Operational requirements*

2.2.1.1.1 *Call request*

For a *direct call facility* the DTE indicates a *call request* by turning circuit 108/1 ON. Circuit 108/2 cannot be used for this purpose.

2.2.1.1.2 *Call accepted*

A DTE receiving an *incoming call* should turn circuit 108/1 or 108/2 from OFF to ON within 500 ms to indicate *call accepted*, otherwise the call will be cleared. A DCE presenting an *incoming call* to a DTE which already has circuit 108/2 ON will regard the ON condition on circuit 108/2 as an indication of *call accepted*. Optionally when a DTE does not provide circuit 108/1 or 108/2, the *call accepted* signal to the network would be generated within the DCE as an answer to the *incoming call* signal received from the network. However, it may be also possible to signal to the network a *DTE controlled not ready* by a manual action on the DCE.

2.2.1.1.3 *DCE clear indication/DTE clear confirmation*

DCE clear indication is signalled to the DTE by turning circuit 107 OFF. The *DTE clear confirmation*, when implemented, should be given by the DTE turning OFF circuit 108/1 or 108/2 within 500 ms after the *DCE clear indication* is signalled on circuit 107. Otherwise, the DCE may consider the DTE as being *uncontrolled not ready* until circuit 108/1 or 108/2 is turned OFF or a *ready* signal is generated by a manual action on the DCE.

Circuit 108/1 should always be able to give *DTE clear confirmation*.

Optionally, when a DTE does not turn circuit 108/2 OFF for *DTE clear confirmation* this would be automatically generated within the DCE as an answer to the *clear indication* received from the network and the DTE will be considered in the ready condition.

In the case when the DTE expects to have circuit 107 OFF only as a response to circuit 108/1 or 108/2 OFF, the DCE will not turn circuit 107 OFF as a *DCE clear indication* and in this case the *DCE clear indication* will not be signalled to the DTE across the interface. The *DTE clear confirmation* signal will then be automatically generated within the DCE as an answer to the *clear indication* signal received from the network. The DTE may be regarded as *uncontrolled not ready* until circuit 108/1 or 108/2 is turned OFF.

2.2.1.1.4 *Line identification*

Calling and *called line identification* signals cannot be handled by V–Series DTEs.

2.2.1.1.5 *Call progress signals*

Call progress signals cannot be handled by V–Series DTEs. If automatic address calling is provided in accordance with Recommendation V.25, the reception of negative *call progress* signals will be indicated to the DTE on circuit 205.

2.2.2 *Data transfer phase*

The interchange circuits shown in Table 3/X.21 *bis* should be used in the *data transfer* phase.

TABLE 3/X.21 *bis*

V.24 Interchange circuit No.	Designation
102	Signal ground or common return
103	Transmitted data
104	Received data
105	Request to send
106	Ready for sending
109	Data channel received line signal detector
114	Transmitter signal element timing (DCE) (see Note)
115	Receiver signal element timing (DCE) (see Note)

Note – The DCE shall provide the DTE with transmitter and receiver element timings. This is donne by feeding circuits 114 and 115 with the same timing signal from the DCE.

All the circuit functions are in accordance with Recommendation V.24 and the appropriate modem Recommendations.

2.2.2.1 *Operational requirements*

2.2.2.1.1 *Half–duplex operation*

In principle the data circuit provided has duplex transmission capability. However, when a remote response from circuit 105 to circuit 109 is required it may be provided on an optional basis (see also Annex A).

2.2.2.1.2 *Response times*

The response time of the OFF to ON transition of circuit 106 as a response to circuit 105 OFF to ON should provisionally be between 30 and 50 ms for the 600 bit/s user rate, and 10 to 20 ms for the higher user rate.

2.2.2.1.3 *Clamping*

The following conditions shall apply:

– In the event of line failure (e.g. channel out of service, loss of alignment) the DCE shall clamp circuit 104 to steady binary 1 condition and circuit 109 to OFF condition.

– In all applications the DCE shall hold circuit 104 in binary 1 condition, when circuit 109 is in the OFF condition.

– In addition, when the half–duplex facility is provided, the DCE shall hold circuit 104 in the binary 1 condition and circuit 109 in the OFF condition when circuit 105 is in the ON condition.

– When circuit 105 or circuit 106 or both are OFF, the DTE shall maintain a binary 1 condition on circuit 103.

2.2.2.1.4 *Timing arrangements*

Timing signals on circuits 114 and 115 should always be maintained when the DCE is capable of generating them, disregarding the conditions of the other circuits. Circuits 114 and 115 should be held by the DCE in the OFF condition when the DCE is unable to generate the timing information.

Continuous isochronous operation should be used.

2.3 *Operational modes*

2.3.1 *Direct call facility*

The following operational modes may be provided for:

i) Automatic direct call and automatic disconnection from the DTE. Circuit 108/1 should be used. In this case manual disconnection from the DCE should not be used.

ii) Manual direct call from the DCE and automatic disconnection from the DTE. Circuit 108/2 should be used.

iii) Manual direct call and manual disconnection from the DCE; for DTEs not providing circuit 108 or unable to use circuit 108/2 for disconnection.

Only automatic call answering controlled by circuit 108/1 or 108/2 when provided, or automatically within the DCE itself, should be implemented. However in the last case it is possible to signal to the network *DTE controlled not ready* by a manual action on the DCE.

Note – Consideration of manual answering and the implications of manual *DTE clear confirmation* are for further study.

2.3.2 *Address call facility*

The following operational modes may be provided for:

i) Manual address calling from the DCE and automatic disconnection from DTE. Circuit 108/2 should be used.

ii) Manual address calling and manual disconnection from the DCE; for DTEs not providing circuit 108/1 or 108/2 or unable to use circuit 108/2 for disconnection.

Only automatic answering controlled by circuit 108/2 when provided, or automatically within the DCE itself, should be implemented. However in the last case it is possible to signal to the network *DTE controlled not ready* by a manual action on the DCE.

iii) Automatic address calling and automatic disconnection from DTE if provided, should use the 200 series interchange circuits and the Recommendation V.25 relevant procedures. The spare and code positions on the digit signal circuits 206–209 may be used for special purposes during the selection sequence in public data networks. The relationship between control characters on circuits 206–209 and those of Recommendation X.21 is as shown in Table 4/X.21 *bis*.

TABLE 4/X.21 *bis*

Binary states				Corresponding X.21
209	208	207	206	control characters
1	1	0	0	+
1	1	0	1	,
1	1	1	1	/
1	1	1	0	.
1	0	1	0	–

For an interim period some Administrations may provide a relationship according to Table 5/X.21 *bis*.

TABLE 5/X.21 *bis*

Binary states				Corresponding X.21
209	208	207	206	control characters
1	0	1	1	+
1	1	0	0	,
1	1	1	1	/
1	1	1	0	.
1	1	0	1	–

3 Failure detection and isolation

3.1 *Indeterminate conditions on interchange circuits*

If the DTE or DCE is unable to determine the condition of circuits 105, 107, 108/1 or 108/2 and possibly circuits 103 and 104 as specified in the relevant electrical interfaces specifications, it shall interpret this as the OFF condition or binary 1 (circuits 103 and 104).

3.2 *DCE fault conditions*

If the DCE is unable to provide service (e.g. loss of alignment or of incoming line signal) for a period longer than a fixed duration it will turn circuit 107 to the OFF condition. The value of this duration is network dependent.

Moreover, as soon as the DCE detects this condition it turns circuit 109 in the OFF condition and circuit 104 in the binary 1 condition.

3.3 *Test loops*

The definitions of the loops and the principles of maintenance testing using the test loops are provided in Recommendation X.150.

3.3.1 *DTE test loop – type 1 loop*

This loop is used as a basic test of the operation of the DTE, by looping back the transmitted signals inside the DTE for checking. The loop should be set up inside the DTE as close as possible to the DTE/DCE interface.

Except as noted below, while the DTE is in the loop 1 test condition:

– circuit 103 is connected to circuit 104 of the DTE;

– circuit 103 as presented to the DCE must be in the binary 1 condition;

– circuit 105 must be in the OFF condition;

– circuit 108/1 or 108/2 may be in the same condition as it was before the test;

– circuits 140 and 141, if implemented, must be in the OFF condition;

– the DCE continues to present signal element timing information on circuits 114 and 115. The DTE need not make use of the timing information.

The conditions of the other interchange circuits are not specified but they should if possible permit normal working.

Loop 1 may be established from either the *data transfer* phase or the *idle* phase.

If the loop is established from the *data transfer* phase, the DCE may continue to deliver data to the DTE during the test as though the DTE were in normal operation. It will be the responsibility of the DTE to recover from any errors that might occur while the test loop is activated.

If the loop is established from the *idle* phase, the DTE should continue to monitor circuit 125 so that an incoming call may be given priority over a routine test.

3.3.2 *Local test loop – type 3 loop*

Local test loops (type 3 loop) are used to test the operation of the DTE, the interconnecting cable and either all or parts of the local DCE, as discussed below.

Where allowed by national testing principles, loop 3 may be established from any state.

For testing on leased circuits and for short duration testing, on circuit–switched connections the DCE should either continue to present toward the line the conditions that existed before the test (e.g. either *data transfer* or *ready* state) or send the *controlled not–ready* state to the remote DTE. Where this is not practical (e.g. in some cases for loop 3a) or desirable (e.g. for long duration testing in circuit–switched applications), the DCE should terminate an existing call and, if possible, signal toward the subscriber line one of the *not–ready* states.

Manual control should be provided on the DCE for activation of the test loop.

The automatic activation of this loop, if provided, should be controlled by circuit 141.

The precise implementation of the test loop within the DCE is a national option. At least one of the following local test loops should be implemented.

3.3.2.1 *Loop 3d*

This loop is used to test the operation of the DTE, including the interconnecting cable, by returning transmitted signals to the DTE for checking. The loop is set up inside the local DCE and does not include interchange circuit generators and loads.

While the DCE is in the loop 3d test condition:

– circuit 103 is conneced to the circuit 104;

– circuit 105 is connected to both circuits 106 and 109;

Note – DTE designers should note that this connection results in one generator driving two loads in parallel.

– circuits 107 and 142 are placed in the ON condition;

– the DCE continues to present signal element timing information on circuits 114 and 115. The DTE must make use of the timing information.

Note – While test loop 3d is operated, the effective length of the interface cable is doubled. Therefore, to insure proper operation of loop 3d, the maximum DTE/DCE interface cable length should be one–half the length normally appropriate for the data signalling rate in use.

3.3.2.2 *Loop 3c*

This loop is used to test the operation of the DTE, including the interconnecting cable and DCE interchange circuit generators and loads.

The configuration is identical to that given for loop 3d in § 3.3.2.1 with the exception that the looping of circuit 103 to circuit 104 and the looping of circuit 105 to circuit 109 includes the interchange circuit generators and loads. Circuit 106 should follow circuit 105 with the usual delay or with no delay. The notes concerning restriction of interface cable length and load input impedance are not applicable.

3.3.2.3 *Loop 3b*

This loop is used as a test of the operation of the DTE and the line coding and control logic and circuitry of the DCE. It includes all the circuitry of the DCE with the exclusion of the line signal conditioning circuitry (e.g., impedance matching transformers, amplifiers, equalizers, etc.). The delay between transmitted and received test data is a few octets (see Note).

The configuration is identical to that given for loop 3c in § 3.3.2.2 except for the location of the point of loopback.

Note – In some DCEs, the setting of loop 3b will result in momentary loss of envelope alignment causing random signals to appear on the receiving interchange circuit for a period of time. This may impact upon the DTE test procedure. In some networks, the setting of loop 3b will cause clearing of existing connections.

3.3.2.4 *Loop 3a*

This loop is used to test the operation of the DTE and the DCE. The loop should include the maximum amount of circuitry used in DCE working including, in particular, the line signal conditioning circuitry. It is recognized that, in some cases, the inclusion of devices (e.g. attenuators, equalizers or test loop translators) may be necessary in the loopback path. The subscriber line is suitably terminated during a loop 3a test condition. The delay between transmitted and received test data is a few octets (see Note).

The configuration is identical to that given for test loop 3b in § 3.3.2.3 except for the location of the point of loopback.

Note – In some DCEs, the setting of loop 3a will result in momentary loss of envelope alignment causing random signals to appear on the receiving interchange circuit for a period of time. This may impact upon the DTE test procedure. In some networks, the setting of loop 3a will cause clearing of existing connections.

3.3.3 *Network test loop – type 2 loop*

Network test loops (test 2 loops) are used by the Administration's test centre to test the operation of the leased line or subscriber line and either all or part of the DCE, as discussed below.

Where allowed by national testing principles, loop 2 may be used by a DTE, as follows:

a) In the case of switched circuit networks in the *data transfer* phase to test the operation of the network connection including the remote DCE. It should be possible to re–enter the *data transfer* phase after completion of the network loop test.

b) In the case of leased lines in the *idle* phase to test the operation of the line including the remote DCE. When the test is in progress, the DCE will return circuits 107 and 109 in the OFF condition, circuit 104 in the binary 1 condition and circuit 142 in the ON condition.

The loop may be controlled manually by a switch on the DCE or automatically by the network. The control of the loop and the method used for automatic control, when implemented, is a national option. In the leased circuit service, customer control of the loop, if provided, should be by circuit 140.

In case of a collision between a *call request* and the activation of the loop, the loop activation command will have priority and the *call request* is ignored.

The precise implementation of the test loop within the DCE is a national option. One of the following network test loops should be implemented:

3.3.3.1 *Loop 2b*

This loop is used by either the Administration's test centre(s) and/or the remote DTE to test the operation of the subscriber line and all the circuitry of the DCE with the exception of interchange circuit generators and loads.

While the DCE is in the loop 2b test condition:

– circuit 104 is connected to circuit 103 inside of the DCE;

– circuit 109 is connected to circuit 105 inside of the DCE;

– at the interface, the DCE places circuit 104 in the binary 1 condition and circuit 109 in the OFF condition, or alternatively, may present an open circuit or power off condition on circuits 104 and 109;

– circuits 106, 107 and 125 to the DTE are placed in the OFF condition;

– circuit 142 to the DTE is placed in the ON condition;

– the DCE provides timing information on circuits 114 and 115.

3.3.3.2 *Loop 2a*

This loop is used by either the Administration's test centre(s) or the remote DTE to test the operation of the subscriber line and the entire DCE.

The configuration is identical to that given for loop 2b in § 3.3.3.1 except for the location of the point of loopback.

3.3.4 *Subscriber–line test loop – type 4 loop*

Subscriber–line test loops (type 4 loops) are provided for the maintenance of lines by the Administrations.

3.3.4.1 *Loop 4a*

This loop is only provided in the case of 4–wire subscriber lines. Loop 4a is for the maintenance of lines by Administrations. When receiving and transmitting pairs are connected together, the resulting circuit cannot be considered normal. Loop 4a may be established inside the DCE or in a separate device.

While the DCE is in the loop 4a test condition:

– circuit 104 to the DTE is placed in the binary 1 condition;

– circuits 106, 107, 109 and 125 to the DTE are placed in the OFF condition;

– circuit 142 to the DTE is placed in the ON condition;

– the DCE provides timing information on circuits 114 and 115.

3.3.4.2 *Loop 4b*

This loop is used by Administrations to test the operation of the subscriber line including the line signal conditioning circuitry in the DCE. When the receiving and transmitting circuits are connected at this point, loop 4b provides a connection that can be considered as normal; however, some impairment of the performance is expected since the DCE does not perform a complete signal regeneration.

The configuration is identical to that given for loop 4a in § 3.3.4.1 except for the location of the point of loopback.

3.4 *Signal element timing*

The signal element timing signal is delivered to the DTE on circuits 114 and 115 whenever possible. In particular it is delivered to the DTE when one of the loops described in § 3.3 above is activated or when the DCE loses alignment or the incoming line signal. The tolerance of the signal element timing during these conditions will be ± 1%.

ANNEX A

(to Recommendation X.21 *bis*)

Interworking between DTEs conforming to Recommendations X.21 and X.21 *bis*

It is recognized that interworking between V–Series DTEs connected to a public data network according to Recommendation X.21 *bis* at one end and Recommendation X.21 DTEs at the other end should always be possible for DTEs not using half duplex operation.

Certain Administrations may provide facilities allowing interworking between DTEs operating in accordance with Recommendation X.21 and Recommendation X.21 *bis* using half–duplex operation by switching circuits C, I and circuits 109, 105 during data transfer phase in accordance with Figure A–1/X.21 *bis*.

Those Administrations not providing this facility shall cause the X.21 DCE to signal r = 1, i = ON when the X.21 *bis* DTE signals circuit 105 OFF. This will permit half–duplex operation for those DTEs that do not require circuit 109 to be OFF before signalling circuit 105 ON.

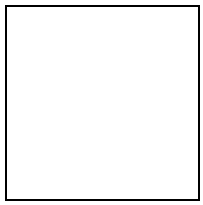

FIGURE A-1/X.21 *bis* CCITT-25000