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Data communication — Arrangements for DTE to DTE physical connection using V.24 and X.24 interchange circuits

Transmission des données — Arrangements pour la connexion physique ETTD à ETTD utilisant des circuits de jonction V.24 et X.24

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ISO/TR 7477 was prepared by Technical Committee ISO/TC 97, *Information processing systems*.

The reasons which led to the decision to publish this document in the form of a technical report type 2 are explained in the Introduction.

0 Introduction

Consideration has been given to the existing DTE/DCE interface specifications which provide the mechanical, electrical, functional and procedural characteristics for the physical interconnection of DTEs to modems in telephone networks (CCITT V-series Recommendations) or to termination units of data networks (CCITT X-series Recommendations); a unique ISO requirement exists to further define the direct interconnection of such DTEs without intervening telecommunication facilities.

Also, in the DTE to DTE physical connection, the distance of interconnection may be considerably greater when compared with the usual short telephone/data network interconnections; an additional option to permit the alternate use of balanced type electrical characteristics is therefore required.

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In the case of synchronous transmission, a variety of arrangements to provide signal element timing in lieu of the network clocks must also be supported.

In view of further developments of interfaces for future telecommunication facilities by the CCITT, an appropriate time for reconsidering the publication of an International Standard may be at the end of the CCITT 1985 to 1988 study period.

This Technical Report deals with the interconnection of Data Terminal Equipment (DTE) without any signal conversion, whereby a DTE is not attached to Data Circuit-terminating Equipment (DCE) which is part of a telecommunication facility.

The desired DTE to DTE direct connection may be totally located at the user's territory. The aim being to relate these interconnections to the elements of the CCITT recommended/ISO standardized DTE/DCE interfaces, in order to avoid equipment proliferation.

1 Scope and field of application

This Technical Report describes various arrangements for the interconnection of Data Terminal Equipment (DTE), without intermediate Data Circuit-terminating Equipment (DCE), in terms of electrical, mechanical, and functional characteristics.

This Technical Report applies to DTEs with interface circuits standardized in CCITT Recommendation V.24 for data transmission over telephone networks or with interface circuits standardized in CCITT Recommendation X.24 for transmission over public data networks.

The interconnections are restricted to point-to-point connections. Extension to multipoint configurations requires further study.

This Technical Report applies primarily to DTEs which employ the balanced electrical characteristics of CCITT Recommendation V.11 (X.27) for data signalling rates up to 10 Mbit/s. Additionally, it may be applied to DTEs employing the unbalanced electrical characteristics of CCITT Recommendation V.10 (X.26) for data signalling rates up to 100 kbit/s and of CCITT Recommendation V.28 for data rates below 20 kbit/s. Interworking between a DTE employing V.10 (X.26) and a DTE employing V.11 (X.27) or with a DTE employing V.28 is permitted.

The interconnection may be used for start-stop and synchronous transmission. For synchronous transmission, the signal element timing may be provided by either one DTE, both DTEs, or by an external signal element timing source which is inserted as intermediate equipment.

2 References

ISO 2110, *Data Communication — 25-pin DTE/DCE interface connector and pin assignments.*

ISO 4902, *Data communication — 37-pin and 9-pin DTE/DCE interface connectors and pin assignments.*

ISO 4903, *Data communication — 15-pin DTE/DCE interface connector and pin assignments.*

CCITT Recommendation V.10 (or X.26), *Electrical characteristics for unbalanced double-current interchange circuits for general use with integrated circuit equipment in the field of data communications.*

CCITT Recommendation V.11 (or X.27), *Electrical characteristics for balanced double-current interchange circuits for general use with integrated circuit equipment in the field of data communications.*

CCITT Recommendation V.24, *List of definitions for interchange circuits between data terminal equipment (DTE) and data circuit-terminating equipment (DCE).*

CCITT Recommendation X.24, *List of definitions for interchange circuits between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) on public data networks (PDN).*

CCITT Recommendation V.28, *Electrical characteristics for unbalanced double-current interchange circuits.*

3 Interconnection configurations

Three types of DTE to DTE interconnection configurations are considered for point-to-point connections with interfaces according to CCITT Recommendations V.24 and X.24. They are shown in figure 1.

There are two lines of demarcation between the two interconnecting DTEs, one located at each DTE connector. The adaptor and any cable linking these two DTE connectors are not part of either DTE.

Intermediate balanced pair cable may be provided with a length mainly dependent on the parameters of the electrical characteristics of the interchange circuits.

4 Interchange circuit requirements

The interchange circuit requirements are specified in terms of electrical, functional, mechanical, and interchange point cross-over characteristics.

4.1 Electrical characteristics

The electrical characteristics of CCITT Recommendation V.11 are preferred in all configurations.

Recommendation V.11 (X.27) gives guidance to operational constraints imposed by the length, balance, and terminating resistance of the interconnecting cable in relation to the data signalling rate. With additional considerations, longer distances may be possible.

DTEs employing the unbalanced electrical characteristics, with the category 1 receiver configuration of CCITT Recommendation V.10 (X.26), are also permitted for applications up to 100 kbit/s. Reduced performance in terms of cable length may be experienced, however. Reference should be made to CCITT Recommendation V.10 (X.26) for constraints imposed by length of interconnecting cable in relation to data signalling rate.

Interoperation between DTEs employing V.10 (X.26) generators on one side of the DTE/DTE interface and V.11 (X.27) generators on the other side of the DTE/DTE interface is permitted as described in CCITT Recommendation V.10 (X.26).

In addition, DTEs using the electrical characteristics for unbalanced double-current interchange circuits of CCITT Recommendation V.28 are permitted for applications below 20 kbit/s. The distance capability however is limited.

Interoperation between a DTE employing V.10 (X.26) electrical characteristics and a DTE employing V.28 characteristics is also permitted, provided the precautions outlined in annex D of ISO 4903 are observed.

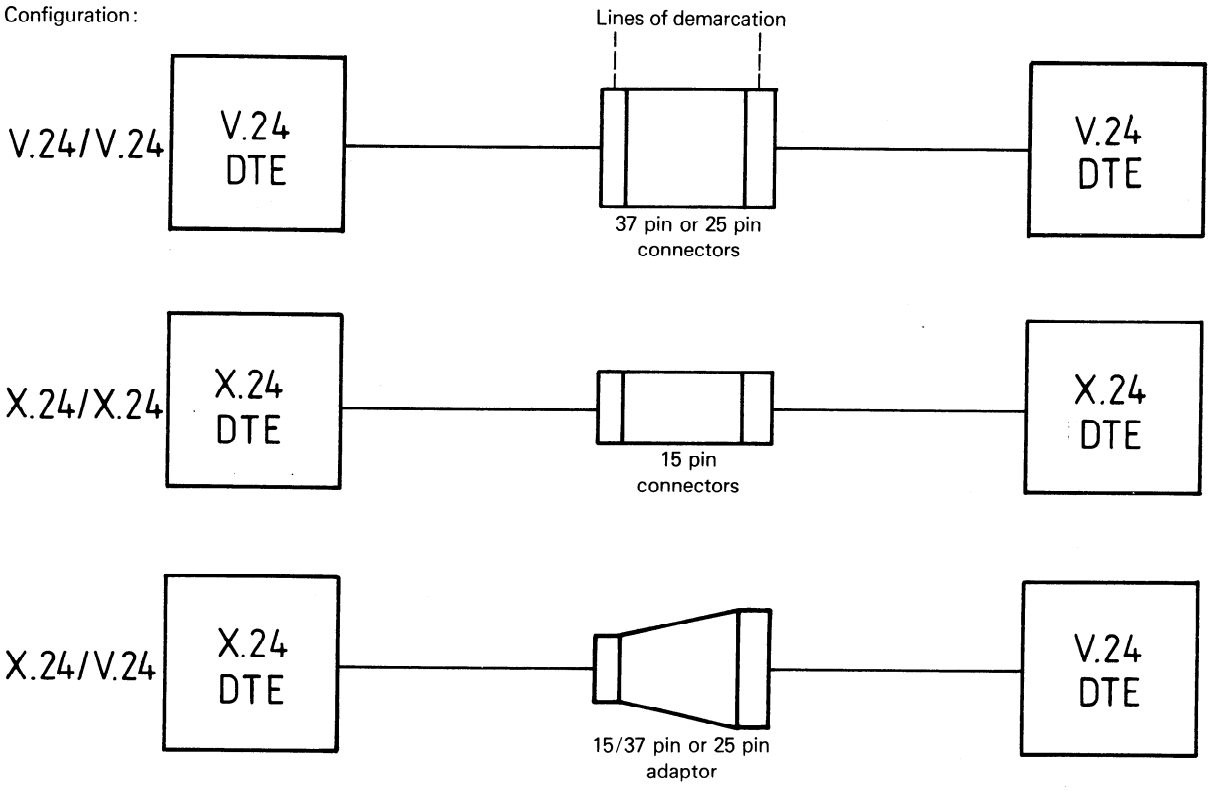

Figure 1 — DTE interconnection configurations

Table 1 — List of V.24 circuits for DTE interconnection

V.24 circuit number	Interchange points		ISO 4902 pin number	ISO 2110 pin number	Circuit description/remarks
	V.11	V.10			
—	—	—	1	1	Cable shield [1]
102	C — C′	C — C′	19	7	Signal ground (see 4.6)
103	A — A′ B — B′	A — A′ C — B′	4 22	2	Transmitted data
104	A — A′ B — B′	A — A′ C — B′	6 24	3	Received data
105	A — A′ B — B′	A — A′ C — B′	7 25	4	Request to send [2]
106	A — A′ B — B′	A — A′ C — B′	9 27	5	Ready for sending
107	A — A′ B — B′	A — A′ C — B′	11 29	6	Data set ready
108	A — A′ B — B′	A — A′ C — B′	12 30	20	Connect data set to line/Data terminal ready
109	A — A′ B — B′	A — A′ C — B′	13 31	8	Data channel received line signal detector
113	A — A′ B — B′	A — A′ C — B′	17 35	24	Transmitter signal element timing, DTE source [3]
114	A — A′ B — B′	A — A′ C — B′	5 23	15	Transmitter signal element timing, DCE source [3]
115	A — A′ B — B′	A — A′ C — B′	8 26	17	Receiver signal element timing

1) Pin 1 is for connecting the shields between tandem sections of shielded interface cable.

2) This circuit is optionally provided by the DTE.

3) Uses of circuits 113 and 114 are described in clause 5.

Table 2 — List of X.24 circuits for DTE interconnection

X.24 circuit designation	Interchange points		ISO 4903 pin number	ISO 2110 pin number	Circuit description/remarks
	V.11	V.10			
—	—	—	1	1	Cable shield [1]
G	C — C′	C — C′	8	7	Signal ground (see 4.6)
T	A — A′ B — B′	A — A′ C — B′	2 9	2	Transmit
R	A — A′ B — B′	A — A′ C — B′	4 11	3	Receive
C	A — A′ B — B′	A — A′ C — B′	3 10	—	Control
I	A — A′ B — B′	A — A′ C — B′	5 12	—	Indication
S	A — A′ B — B′	A — A′ C — B′	6 13	—	Signal element timing (DCE source)
B	A — A′ B — B′	A — A′ C — B′	7 14	—	Byte timing [2]
X	A — A′ B — B′	B — B′ C — B′	7 14	—	Signal element timing (DTE source) (see clause 5)

1) Pin 1 is for connecting the shields between tandem sections of shielded interface cable.

2) For DTEs using X.24 interchange circuits and requiring byte timing on circuit B, arrangement 6 of figure 4 applies with the addition on an external source of byte timing.

4.2 Functional characteristics

The functional characteristics of interchange circuits conform to either CCITT Recommendation V.24 or CCITT Recommendation X.24 for each interface of an interconnecting DTE, depending on the configuration (see figure 1). The interchange circuits required in each case are listed in table 1 and in table 2, respectively.

An additional interchange circuit, designated X, may be used with X.24 as detailed in clause 5.

4.3 Mechanical characteristics

The mechanical characteristics of the interface conform to ISO 2110 and ISO 4902 for V.24 interchange circuits, and ISO 2110 and ISO 4903 for X.24 interchange circuits. Both DTEs provide the appropriate DTE connector, while the circuit cross-over arrangement specified in 4.4, including any associated cable, with the mating connectors conforming to the appropriate DCE connectors as described in ISO 2110, ISO 4902 and ISO 4903, is furnished by the installation authority.

The circuit cross-over arrangement will therefore also be an adaptor between 15-pin, 25-pin, and 37-pin connectors as required by the DTEs to be interconnected.

4.4 Interchange point cross-over characteristics

Figure 2 shows the basic cross-over arrangement in accordance with the interconnecting configuration shown in figure 1. For synchronous transmission, the various alternatives for providing signal element timing are not included in figure 2 and figure 3, but are described in clause 5.

4.5 Connection options

The circuit cross-over arrangement shall allow access to the circuits for the purpose of effecting through-, cross-, or loopback-connections as required in the particular application.

For the leads conveying status information to the DTE, optional arrangements are necessary.

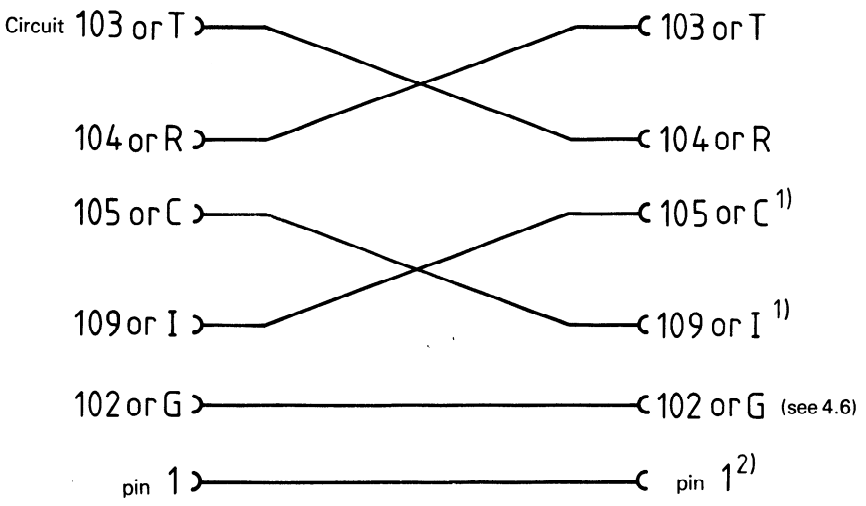

Figure 2 — Basic circuit cross-over arrangement for V.24 and X.24 interfaces

1) For start-stop transmission DTEs and other special cases, circuits C and I are omitted. CTs 105 and 109 may also be omitted by mutual agreement.

2) Pin 1 is for connecting the shields between tandem sections of shielded interface cable.

Basically, information that was required by the DTE from the remote DCE should now be provided by connection to the complementary circuit from the remote DTE, whereas information that was required from the local DCE should now be provided by connection to the complementary circuit of the same DTE.

Circuit 109 may be needed to monitor the state of the other DTE and should therefore be cross-connected to circuit 105. In duplex transmission, circuit 109 can be cross-connected to circuit 108 to be constantly ON.

If the DTE expects a "ready for sending" indication in response to its "request to send" then circuit 106 should be looped back onto its own circuit 105. In all other cases, circuit 106 can be looped back onto circuit 108.

Following these principles and the fact that users may or may not wish to operate additional control circuits to the remote end, the arrangements are indicated in figure 3 as Alternative 1 (with remote operation of control circuits) and Alternative 2 (without remote operation of control circuits).

In the case of V.28 DTEs, connection of one generator to more than one load may result in an operation outside the CCITT specification and consequently may not function satisfactorily.

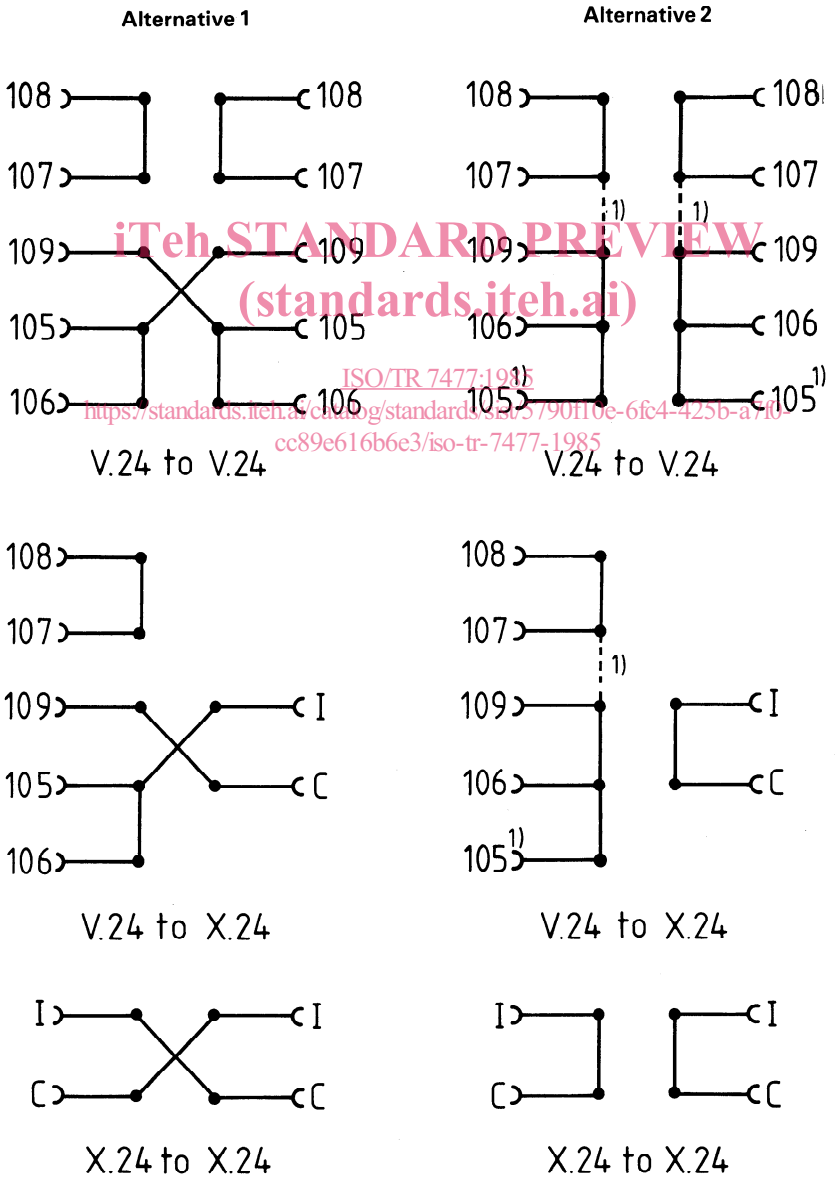

Figure 3 — Connection options for control circuits

1) If circuit 105 is not provided by the DTE then circuits 106, 107 and 109 shall be connected to circuit 108.

4.6 Earthing

Depending on local safety requirements and for electromagnetic compatibility (EMC) considerations it may be required to connect circuit 102 (signal ground) to the protective earth in each DTE.

If the DTEs are connected to different primary power supplies with different earthing systems, significant potential differences may arise between the signal ground terminals of the interconnected DTEs. If these voltages are higher than the common mode acceptance specified in the electrical characteristics of the interchange circuit, transmission errors and even damage to the circuitry may result.

If CT 102 or G is completed between the DTEs it may reduce this potential difference but excessive circulating currents may result.

NOTE — In practice, different signal ground arrangements may need to be considered for a particular situation.

5 Timing alternatives

For synchronous transmission, signal element timing may be provided by both DTEs, by one DTE, or by an external signal element timing source which is inserted as intermediate equipment.

All three alternatives are available for DTEs using V.24 interchange circuits. However, DTEs using X.24 interchange circuits normally obtain signal element timing information from the DCE. Therefore, these DTEs will require an external timing source for direct DTE/DTE connection.

Alternatively, these X-series DTEs may provide an additional circuit for DTE-source signal element timing. This additional DTE-source signal element timing circuit is designated circuit X and has the same function as circuit 113 defined in CCITT Recommendation V.24. Circuit X is assigned to share the same connector pins as circuits B and F in ISO 4903. Since the direction of transmission of circuit X is opposite to that of circuits B and F, a logical switch or physical option in the DTE may be necessary if the DTE intends to use more than one of these circuits for alternative applications.

Alternative timing arrangements for connecting two V-series DTEs, two X-series DTEs, or a V-series DTE and an X-series DTE are illustrated in figure 4 and described below.

5.1 Symmetrical timing

Symmetrical timing is the provision of signal element timing by each DTE for the transmit direction. This requires a cross-over of the timing circuits in the cross-over arrangements (figure 4, arrangements 1, 4 and 7).

This arrangement, unlike the other arrangements, does not cause skewing between data and timing circuits.

5.2 Timing provided by one DTE

With proper connections in the cross-over arrangement, it is possible for one DTE to provide timing for both DTEs (figure 4, arrangements 2, 5, 8 and 9).

5.3 External timing

External timing provided by intermediate equipment may be used and added to the passive cross-over arrangements (figure 4, arrangements 3, 6 and 10). This is necessary for the interconnection of DTEs that normally depend on DCE signal element timing and have no provision within the DTE to provide signal element timing.

A single timing source may be used to supply signal element timing to more than one pair of interconnected DTEs.

NOTE — As the cable length increases or the data signalling rate increases, the phase relationship between the data and timing signals may shift in non-symmetrical timing configurations. This skewing effect normally will create no problem for data signalling rates of 9,6 kbit/s and below within cable distances recommended. At higher data signalling rates and longer cable lengths, additional phase correction techniques may be necessary to correctly align the data and timing signals.

6 Use of control procedures

This Technical Report places no restrictions on the use of any data link control procedure or any higher level data transfer protocol.

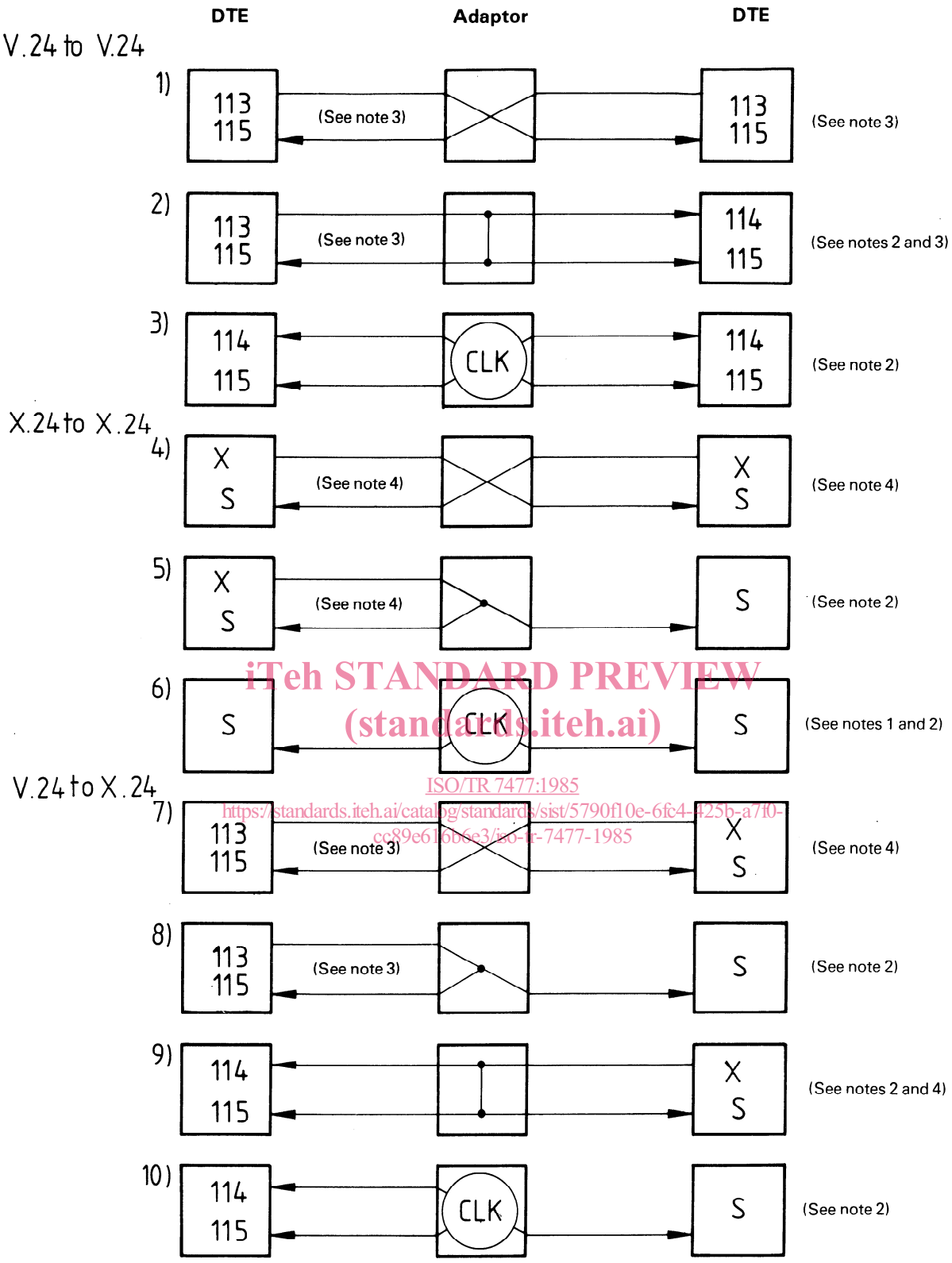

Figure 4 — Optional signal element timing configurations

NOTES

1 For DTEs using X.24 interchange circuits and requiring byte timing on circuit B, arrangement 6 of figure 4 applies with the addition of an external source of byte timing.

2 As the cable length increases or the data signalling rate increases, the phase relationship between the data and timing signals may shift in these arrangements. This skewing effect normally will create no problem for data signalling rates of 9,6 kbit/s and below within cable distances recommended. At higher data signalling rates and longer cable lengths, additional phase correction techniques may be necessary to correctly align the data and timing signals.

3 Some DTEs using V.24 interchange circuits require signal element timing on circuit 114 when supplying transmit signal element timing on circuit 113. In this case, a connection between circuit 113 and 114 should be made as close to the DTE as practical.

4 When circuit X is employed circuit S is used only for sampling the received data.