

**Recommendation T/CD 01-09 E (Ostende 1979, revised at Cannes 1983)
concerning the engineering requirements for a telegraph modem**

Recommendation proposed by Working Group T/WG 10 "Data Communications" (CD)

Text of the revised Recommendation adopted by the "Telecommunications" Commission:

"The Conference of European Post and Telecommunications Administrations,

Considering

- that Recommendation T/CD 01-01 contains the text of the Specifications of the general engineering requirements for data circuit terminating equipment for analogue and digital networks;
- that working groupe CD has studied the harmonization of such a modem under the auspices of Question CD 1.

Recommends

- that the attached Specification of engineering requirements for a telegraph modem as contained in the Annex to this Recommendation should be taken into account by all CEPT Administrations when implementation of such types of equipment is being planned by Administrations."

Administrations are free to stipulate additional requirements, and also which of the optional requirements, if any, are to be provided.

Note 1: The specification is subject of continuous study and possible amendment.

Note 2: The Annex is an integral part of the Recommendation.

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Section A. *Common requirements*

1. **GENERAL**

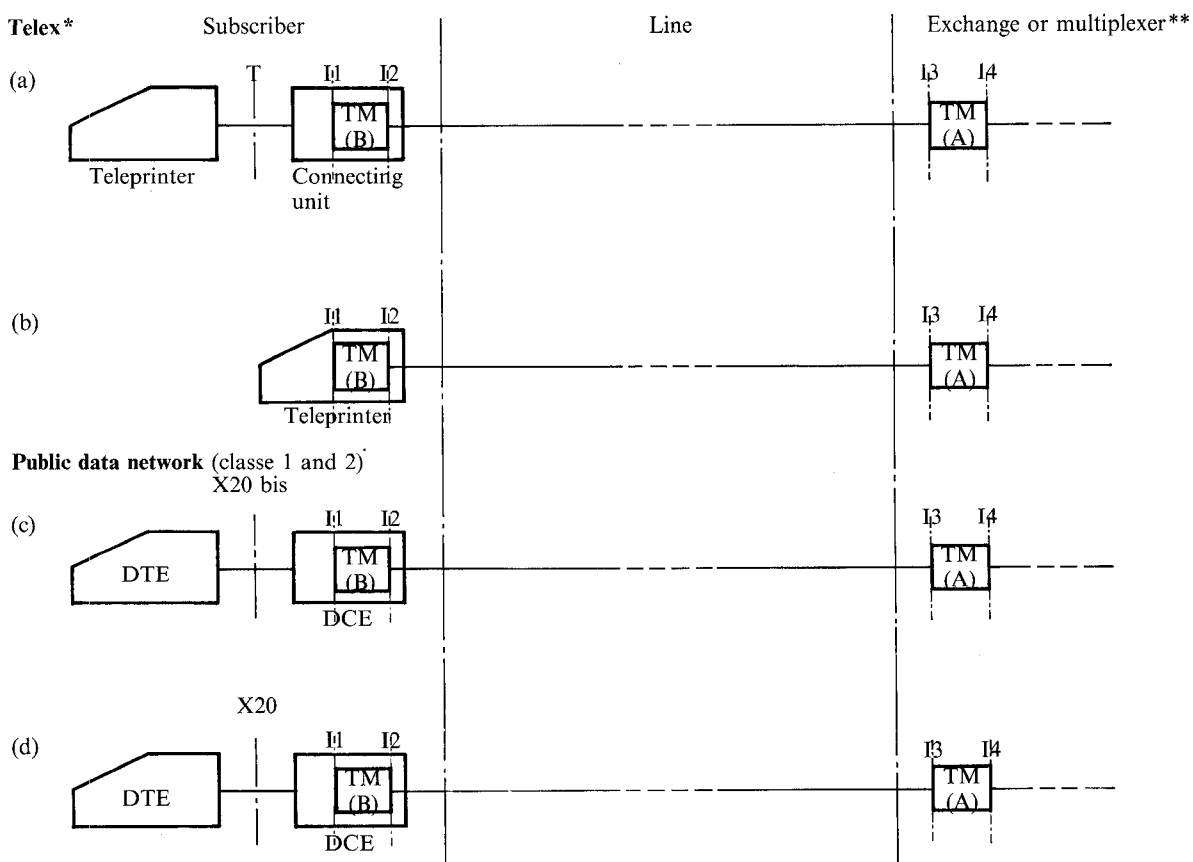
This specification defines the facilities and performance requirements of a frequency shift modulation means for providing telex and telegraph transmission over voice band circuits. The specification is generally in accordance with CCITT Recommendation R.20.

The modulation means shall be provided by a modulator and demodulator, together with line terminating facilities for simultaneous transmission and reception of signals at modulation rates up to 300 bit/s over two-wire presented circuits.

The modulator, demodulator, and line terminating facilities shall hereinafter be referred to as the Telegraph Modem (TM). Two types of TM will be used, the choice depending normally on the physical location of the modem:

TM (A) = equipment in the exchange or in a multiplexer;

TM (B) = that part (transmission unit) of the subscriber equipment which can be used as a plug-in unit in e.g. the following equipment:



* T = telegraph interface (e.g. 2-wire single current, 4-wire single current, 4-wire double current).

** If the TM (A) is used in a R101-multiplexer, I3 = external tributary interface, and I4 = internal tributary interface.

When the modem is used in conjunction with equipment other than a customer's station or exchange, i.e. transmission or test equipment, the modem working to a customer's station will normally be a TM (A), and the modem working to an exchange will normally be a TM (B).

In the situation whereby two similar equipments are working to each other, e.g. station to station or exchange to exchange, one end will be declared the "A" end and will incorporate a TM (A). Conversely the other end will be described as the "B" end and will incorporate a TM (B). The decision as to which is the "A" end is arbitrary in this situation.

2. **MODULATION RATE**

The modulation rate shall be up to 300 baud.

3. **INTERFACES (I1 or I4)**

3.1. **Interchange circuits**

3.1.1. *Functional characteristics*

The following table gives a list of interchange circuits used in TM (B) as I1 and in TM (A) as I4.

Interchange circuit designation	Interchange circuit name	Direction	
		from TM	from TM
TT	Data input		×
TR	Data output	×	

3.1.2. **Electrical characteristics**

Depending on the implementation the electrical characteristics should be V.28 compatible or of logic level.

4. **MODULATION AND CODING**

The modulation is a binary modulation obtained by frequency shift.

No coding restrictions shall be imposed by the telegraph modem.

4.1. **Line interface (I2 or I3)**

The following table gives a list of interchange circuits used in TM (B) as I2 and in TM (A) as I3. if TM (A) or TM (B) is not an integrated part of telex or other equipments, then the same connector should be used to accommodate both I1 and I2, or I3 and I4, respectively.

4.2. **TM (B)**

(a) Transmitted data: (TM (B) to TM (A))

The TM (B) shall convert the serial binary telegraph signals into the nominal characteristic frequencies. The frequencies are defined below:

Nominal mean frequency (Hz)	1,750
Frequency deviation (Hz)	± 100
Characteristic frequencies (Hz)	
F_A : binary 0 (space)	1,850
F_Z : binary 1 (mark)	1,650

The characteristic frequencies as measured at the modulator output must not differ by more than ± 3 Hz from the nominal frequencies.

(b) Received data: (TM (B) from TM (A))

The TM (B) shall convert the received line signal to serial binary telegraph signals. The conversion shall be as defined below:

$1,180 \pm 9$ Hz = binary 0 (space)
980 ± 9 Hz = binary 1 (mark)

4.3. **TM (A)**

(a) Transmitted data: (TM (A) to TM (B))

The TM (A) shall convert the serial binary telegraph signals into the nominal characteristic frequencies. The frequencies are defined below:

Nominal mean frequency (Hz)	1,080
Frequency deviation (Hz)	± 100
Characteristic frequencies (Hz)	
F_A : binary 0 (space)	1,180
F_Z : binary 1 (mark)	980

The characteristic frequencies as measured at the modulator output must not differ by more than ± 3 Hz from the nominal frequencies.

- (b) Received data: (TM (A) from TM (B))

The TM (A) shall convert the received line signal to serial binary telegraph signals. The conversion shall be as defined below:

1,850 ± 9 Hz = binary 0 (space)

1,650 ± 9 Hz = binary 1 (mark)

5. LINE SIGNAL LEVELS AND TERMINATING IMPEDANCE

The line interface of the modem shall be balanced and shall present an impedance of 600 ohm with a return loss (reference 600 ohm resistive) of not less than 14 dB (reflection coefficient not greater than 20%) over the range 800-2,800 Hz.

5.1. Output signal level

- (a) When terminated by 600 ohm the output level shall be capable of being pre-set to one or more of the following values: -3, -6, -9, -13 or -15 dBm ± 1 dB.
- (b) The difference in output levels between the binary 1 (mark) and binary 0 (space) signals shall not be greater than 1 dB for either of the channels.

5.2. Receive signal level

- (a) If the receive signal level falls below -48 dBm (with the local transmit signal still keying) the binary data output shall be clamped to binary 0 or 1 (condition A or Z), (Clamp ON), even if the audio line is broken.
- (b) If the receive signal level is greater than -43 dBm the clamp shall remain inoperative. (Clamp OFF.)
- (c) The detector used to control the condition of this clamp shall respond to the total power contained within the nominal spectrum occupied by the received line signal and shall exhibit a hysteresis action such that the level at which the OFF-ON transition occurs is 2 to 3 dB lower than the level at which the ON-OFF transition occurred.
- (d) The detector used to control the clamp shall be such that the clamp satisfies the following times:
OFF-ON: When the level of the received signal is less than the level at which the OFF-ON transition occurs for a period greater than or equal to 20 ms, the clamp shall be in the ON condition. When the level of the received signal is less than the level at which the OFF-ON transition occurs for a period less than or equal to 10 ms, the clamp shall be in the OFF condition.
ON-OFF: When the level of the received signal is greater than the level at which the ON-OFF transition occurs for a period greater than or equal to 20 ms, the clamp shall be in the OFF condition. When the level of the received signal is greater than the level at which the ON-OFF transition occurs for a period less than or equal to 10 ms, the clamp shall be in the ON condition.

5.3. Protection against higher voltages

The requirements of Recommendation T/CD 01-01 shall apply.

5.4. Line wetting

Line wetting where required by the type of line plant used will normally be sourced by the in-station equipment and looped by the subscriber's equipment.

The current has a maximum value of 15 mA with the line short circuited. The wetting current shall be a minimum of 5 mA on 4,000 ohm lines. The open circuit voltage shall be under 80 V.

Note: In some countries other values may apply.

The noise applied to the line from the wetting power supply shall be under -80 dBm (600 ohms) over a range 300 to 3,400 Hz (flat).

6. OUT-OF-BAND INTERFERENCE

The requirements of Recommendation T/CD 01-01 shall apply.

7. PERFORMANCE REQUIREMENTS

The modem under test shall be connected to another modem (to this Recommendation or to Recommendation V.21) via an attenuator having a return loss of 4 dB and an insertion loss of 25 dB.

Uniform spectrum Gaussian noise (band limited to 10 kHz) shall be added to give a normalized signal-to-noise ratio of 32 dB.

Test signals to CCITT Recommendation R.51 bis (QKS) shall be sent at -13 dBm transmit level in both directions simultaneously. (To ensure incoherence, the rate of the test signals for the direction not under test shall be slightly lower.) The test period shall be 15 seconds error free.

The performance shall be in accordance with the following table.

Transmit rate bit/s	Maximum isochronous distortion %	
	(600 ohm line)	(140 or 2,600 ohm line)
50	2	2
110	3	5
200	8	10
300	10	15

In certain configurations it is not possible to check the modem distortion, e.g. telegraph terminals, multiplex and switching equipment with integral telegraph modems on which the d.c. signal output of the telegraph modem is inaccessible for any reason. The performance will normally be in the form of a test for distortion margin before errors are output from the equipment.

Note: The modem need only be tested at the maximum modulation rate of the equipment into which it is to be incorporated.

The design of the telegraph modem shall be such that the transmission performance is guaranteed without adjustment on installation or subsequently.

8. TESTING AND MEASURING REQUIREMENTS

8.1. Digital interface I1 or I4

A disconnecter should optionally be provided enabling tests at the digital interface, if this interface is really accessible.

8.2. Line interface I2 or I3

A disconnecter should be provided enabling tests at the line interface.

9. FAILURE CONDITIONS ON THE DIGITAL INTERFACE

9.1. Interruption at the data input of interface I4

In this case 1,180 Hz or optionally 980 Hz should be transmitted to the TM (B).

9.2. Interruption at the data input of interface I1

In this case 1,850 Hz or optionally 1,650 Hz should be transmitted to the TM (A).

10. CONSTRUCTION AND SPECIFIC DESIGN REQUIREMENTS

There are 3 possibilities:

- The TM (A) or TM (B) will be designed in conjunction with the telegraph equipment into which it is to be integrated. Thus the physical design will depend on the nature of this equipment and will be described in the relevant equipment specification.
- The TM (A) or TM (B) is a plug-in unit, which can be put in into several equipments: only for this case the possible mechanical requirements are given in the Appendix as an example only.
- The TM (A) or TM (B) can be
 - either a plug-in unit in the exchange or in a multiplexer;
 - or a plug-in unit only in the subscriber equipment (e.g. in a DCE).

Note: The card size should be such that the Recommendation T/TR 02-01 will be met.

11. POWER SUPPLY

The power required by the TM (A) or TM (B) shall be supplied by the equipment in which it is integrated or put in.

The total power requirements of the telegraph modem shall be as low as possible and shall not, under normal operational conditions, exceed 500 mW (excluding the line wetting requirements and high level d.c. interface where applicable).

12. **ENVIRONMENTAL REQUIREMENTS**

The requirements of Recommendation T/TR 02-03 shall apply.

Section B. *Network dependent requirements*

1. **ELECTRICAL CHARACTERISTICS**

The electrical characteristics of the digital interface may be of high level d.c. (e.g. 80 V). The actual level will depend on national requirements.

Section C. *Optional requirements*

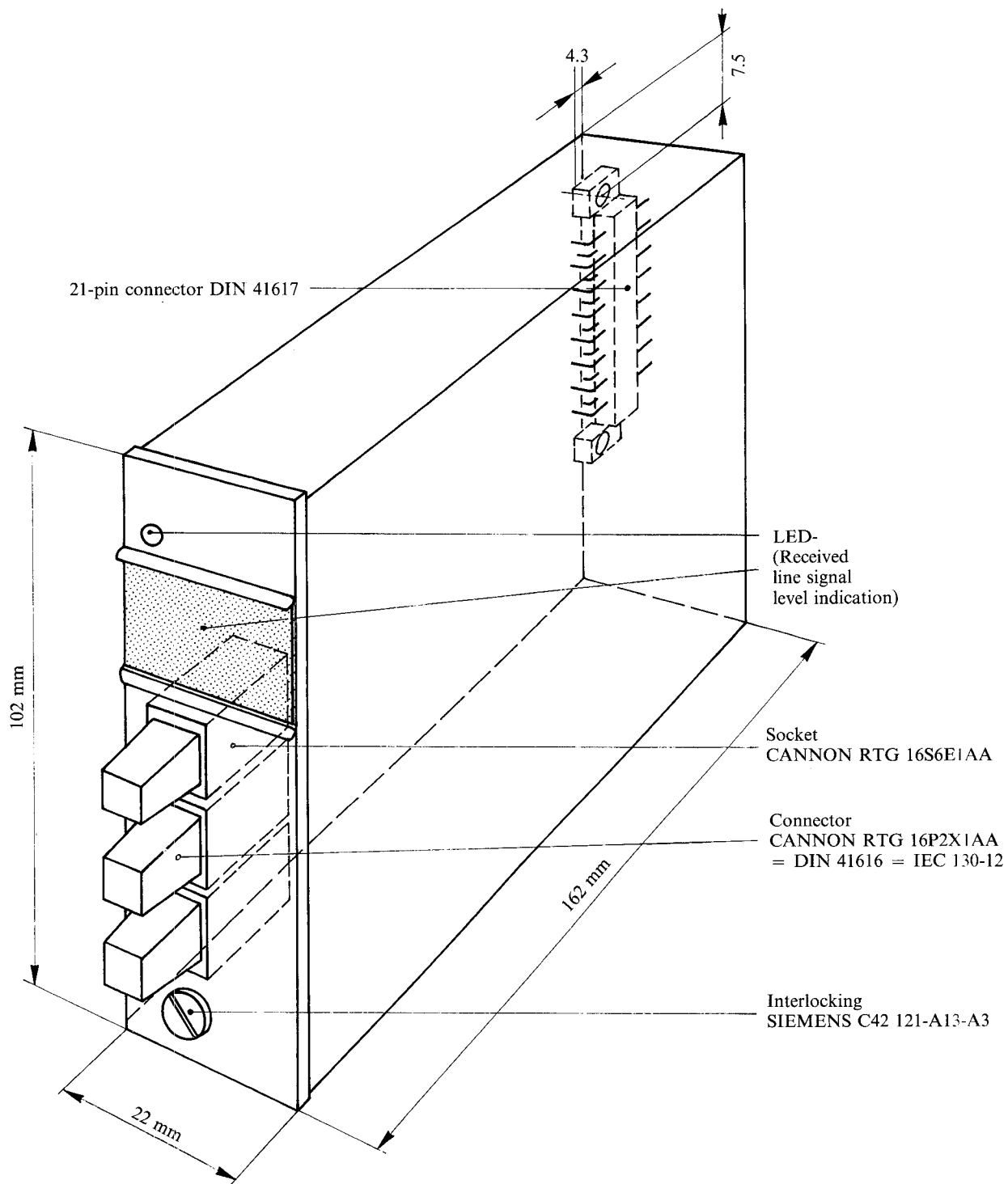
1. **INTERCHANGE CIRCUITS**

Interchange circuit designation	Interchange circuit name	Direction	
		from TM	to TM
TLC	Loop control		×
TA	Received line signal detector	×	

2. **INDICATION OF RECEIVED LINE SIGNAL LEVEL**

The interchange circuit TA for the received line signal level detector is optional and therefore also the visible indication.

Appendix



Example of an assembly suited for plug-in cards 100 × 160 mm (European standard).