INTERNATIONAL TELECOMMUNICATION UNION

ITU-T V.23

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OVER THE TELEPHONE NETWORK

600/1200-BAUD MODEM STANDARDIZED FOR USE IN THE GENERAL SWITCHED TELEPHONE NETWORK

ITU-T Recommendation V.23

(Extract from the *Blue Book*)

NOTES

1 ITU-T Recommendation V.23 was published in Fascicle VIII.1 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.

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Recommendation V.23

600/1200-BAUD MODEM STANDARDIZED FOR USE IN THE GENERAL SWITCHED TELEPHONE NETWORK

(Geneva, 1964; amended at Mar del Plata, 1968, Geneva, 1972, 1976 and 1980, Malaga-Torremolinos, 1984 and at Melbourne, 1988)

Note - The modem, designed for use on connections set up by switching in the general telephone network, can obviously be used on leased lines.

1 The principal characteristics recommended for a modem to transmit data at medium speed in the general switched telephone network are as follows:

- use of modulation rates up to 600/1200 bauds on the communication channel (see Recommendation V.5);
- frequency modulation with synchronous or asynchronous mode of operation;
- inclusion of a backward channel at modulation rates up to 75 bauds for error control, use of this channel being optional.

2 Modulation rates and characteristic frequencies for the forward data-transmission channel

	F_0	F_Z (symbol 1, mark)	F_A (symbol 0, space)
Mode 1: up to 600 bauds	1500 Hz	1300 Hz	1700 Hz
Mode 2: up to 1200 bauds	1700 Hz	1300 Hz	2100 Hz

It is understood that the modem would be used in mode 1 when the presence of long loaded cables and/or the presence on some connections of signalling receivers operating close to 2000 Hz would prevent satisfactory transmission in mode 2. The modem could be used in mode 2 on suitable connections.

3 Tolerances on the characteristic frequencies for the forward channel

It should be possible with all rates of modulation to permit a tolerance, at the transmitter, of ± 10 Hz on both the F_A *and* F_Z frequencies. This tolerance should be considered as a limit.

Acceptance of these tolerances would give a tolerance of ± 10 Hz for the mean-frequency $F_0 = (F_A + F_Z)/2$.

The tolerance on the frequency difference $F_A - F_Z$ with regard to the nominal value would be ± 20 Hz.

A maximum frequency drift of ± 6 Hz has been assumed in the connection between the modems which might consist of several carrier circuits connected in tandem. This would make the tolerances on the mark and space frequencies at the receiving modem ± 16 Hz.

4 Modulation rate and characteristic frequencies for the backward channel

The modulation rate and characteristic frequencies for the backward channel are as follows:

	F_Z (symbol 1, mark)	F_A (symbol 0, space)
Modulation rate up to 75 bauds	390 Hz	450 Hz

In the absence of any signal on the backward channel interface, the condition Z signal is to be transmitted.

5 Tolerances on the characteristic frequencies of the backward channel

As the backward channel is a VF telegraph-type channel, the frequency tolerances should be as recommended in Recommendation R.35 [1] for frequency-shift voice-frequency telegraphy.

The ± 6-Hz frequency drift in the connection between the modems postulated in § 3 above would produce additional distortion in the backward channel. This should be taken into account in the design.

6 Division of power between the forward and backward channels

Considering the following table which shows the levels of power for total power remaining equal to 1 mW:

Forward channel level (dBm)	*Backward channel level* (dBm)
0	- ∞
- 1	- 7
- 2	- 4
- 3	- 3

equal division of power between the forward and backward channels could be recommended provisionally.

7 The following information is provided to assist equipment manufacturers:

a) The nominal range of attenuations in subscriber-to-subscriber connections is from 5 to 30 dB at the reference frequency (800 or 1000 Hz), assuming up to 35-dB attenuation at the recommended mean frequency (F_0) of the forward channel.

b) A convenient range of sensitivity at the mean frequency F_0 for data receivers has been found to be -40 to 0 dBm for the forward channel at the subscribers' terminals.

c) The data modem should have no adjustment for send level or receive sensitivity under the control of the operator.

8 Interchange circuits

The configurations of interchange circuits are those essential for the particular switched network or leased circuit requirement as indicated in Tables 1/V.23 and 2/V.23. Where one or more of such requirements are provided in a modem, then all the appropriate interchange circuits should be provided.

8.1 *List of interchange circuits essential for the modems when used on the general switched telephone network, including terminals equipped for manual calling or answering or automatic calling or answering* (see Table 1 /V.23).

8.2 *List of interchange circuits essential for the modems when used on non-switched leased telephone circuits* (see Table 2/V.23)

8.3 *Response times of circuits 106 and 109, 121 and 122*

8.3.1 *Definitions*

8.3.1.1 Circuits 109 and 122 response times are the times that elapse between the connection or removal of a tone to or from the modem receive line terminals and the appearance of the corresponding ON or OFF condition on circuits 109 and 122.

The test tone should have a frequency corresponding to the characteristic frequency of binary 1 and be derived from a source with an impedance equal to the nominal input impedance of the modem.

The level of the test tone should fall within the level range between 3 dB above the actual threshold of the received line signal detector and the maximum admissible level of the received signal. At all levels within this range the measured response times shall be within the specified limits.

TABLE 1/V.23

Interchange circuit		Forward (data) channel one-way system (Note 1)				Forward (data) channel either way system (Note 1)	
		Without backward channel		With backward channel			
No.	Designation	Transmit end	Receive end	Transmit end	Receive end	Without backward channel	With backward channel
102	Signal ground or common return	X	X	X	X	X	X
103	Transmitted data	X	-	X	-	X	X
104	Received data	-	X	-	X	X	X
105	Request to send	-	-	-	-	X	X
106	Ready for sending	X	-	X	-	X	X
107	Data set ready	X	X	X	X	X	X
108/1 or 108/2 (Note 2)	Connect data set to line Data terminal ready	X	X	X	X	X	X
109	Data channel received line signal detector	-	X	-	X	X	X
111	Data signalling rate selector (DTE)	X	X	X	X	X	X
114 (Note 3)	Transmitter signal element timing (DCE)	X	-	X	-	X	X
115 (Note 3)	Receiver signal element timing (DCE)	-	X	-	X	X	X
118	Transmitted backward channel data	-	-	-	X	-	X
119	Receiver backward channel data	-	-	X	-	-	X
120	Transmit backward channel line signal	-	-	-	-	-	X
121 (Note 4)	Backward channel ready	-	-	-	X	-	X
122 (Note 4)	Backward channel received line signal detector	-	-	X	-	-	X
125	Calling indicator	X	X	X	X	X	X

Note 1 - All essential interchange circuits and any others which are provided shall comply with the functional and operational requirements of Recommendation V.24. All interchange circuits indicated by X shall be properly terminated in the data terminal equipment and in the data circuit-terminating equipment in accordance with the appropriate Recommendation for electrical characteristics (see § 9).

Note 2 - This circuit shall be capable of operation as circuit 108/1 - *Connect data set to line* or circuit 108/2 - *Data terminal ready* depending on its use.

Note 3 - These circuits are required when the optional clock is implemented in the modem.

Note 4 - These circuits are not required if the modem is operating in an asymmetrical duplex mode.

TABLE 2/V.23

Interchange circuit		Forward (data) channel one-way system (Note 1)				Forward data channel either way or both ways simultaneously system (Note 1)	
		Without backward channel		With backward channel		Without	With
No.	Designation	Transmit end	Receive end	Transmit end	Receive end	backward channel	backward channel
102	Signal ground or common return	X	X	X	X	X	X
103	Transmitted data	X	-	X	-	X	X
104	Received data	-	X	-	X	X	X
105	Request to send	X	-	X	-	X	X
106	Ready for sending	X	-	X	-	X	X
107	Data set ready	X	X	X	X	X	X
108/1	Connect data set to line	X	X	X	X	X	X
109	Data channel received line signal detector	-	X	-	X	X	X
111	Data signalling rate selector (DTE)	X	X	X	X	X	X
114 (Note 2)	Transmitter signal element timing (DCE)	X	-	X	-	X	X
115 (Note 2)	Receiver signal element timing (DCE)	-	X	-	X	X	X
118	Transmitted backward channel data	-	-	-	X	-	X
119	Received backward channel data	-	-	X	-	-	X
120	Transmit backward channel line signal	-	-	-	X	-	X
121	Backward channel ready	-	-	-	X	-	X
122	Backward channel received line signal detector	-	-	X	-	-	X

Note 1 - All essential interchange circuits and any others which are provided shall comply with the functional and operational requirements of Recommendation V.24. All interchange circuits indicated by X shall be properly terminated in the data terminal equipment and in the data circuit terminating equipment in accordance with the appropriate Recommendation for electrical characteristics (see § 9).

Note 2 - These circuits are required when the optional clock is implemented in the modem.

8.3.1.2 Circuit 106 response times are from the connection of an ON or OFF condition on:

- circuit 105 (where it is provided) to the appearance of the corresponding ON or OFF condition on circuit 106;

- circuit 122 (where circuit 105 is not provided) to the appearance of the corresponding ON or OFF condition on circuit 106 in a configuration having a single data channel together with a single backward channel only;

- circuit 107 (where circuits 105 and 122 are not provided) to the appearance of the corresponding ON or OFF condition on circuit 106;

8.3.1.3 Circuit 121 response times are from the connection of an ON or OFF condition on:

- circuit 120 (where it is provided) to the appearance of the corresponding ON or OFF condition on circuit 121;

- circuit 109 (where circuit 120 is not provided) to the appearance of the corresponding ON or OFF condition on circuit 121.

8.3.2 *Response times*

TABLE 3/V.23

Circuit 106		
OFF to ON	750 ms to 1400 ms (see Note 1)	a) 20 ms to 40 ms (see Note 2) b) 200 ms to 275 ms (see Note 2)
ON to OFF	≤ 2 ms	
Circuit 109		
OFF to ON	300 ms to 700 ms (see Note 1)	10 ms to 20 ms (see Note 1)
ON to OFF	5 ms to 15 ms	
Circuit 121		
OFF to ON	80 ms to 160 ms	
ON to OFF	≤ 2 ms	
Circuit 122		
OFF to ON	< 80 ms	
ON to OFF	15 ms to 80 ms	

Note 1 - For automatic calling and answering, the longer response times of circuits 106 and 109 are to be used during call establishment only.

Note 2 - The choice of response times depends upon the system application:

a) no protection given against line echoes;
b) protection given against line echoes.

Note 3 - The above parameters are provisional and are the subject of further study.

8.4 *Threshold of data channel and backward channel received line signal detectors*

Level of received line signal at receive line terminals of modern for all types of connections, i.e. general switched telephone network or non-switched leased telephone circuits:

greater than - 43 dBm circuits 109/122 ON

less than - 48 dBm circuits 109/122 OFF

The condition of circuits 109 and 122 for levels between -43 dBm and -48 dBm is not specified except that the signal detectors shall exhibit a hysteresis action such that the level at which the OFF to ON transition occurs is at least 2 dB greater than that for the ON to OFF transition.

Where transmission conditions are known on switched or leased circuits, Administrations should be permitted at the time of modem installation to change these response levels of the received line signal detectors to less sensitive values (e.g. -33 dBm and -38 dBm respectively).

8.5 *Clamping in half-duplex mode*

The DCE, when operating in half-duplex mode on a 2-wire line, shall hold, where implemented:

i) circuit 104 in the binary 1 condition and circuit 109 in the OFF condition when circuit 105 is in the ON condition and, where required to protect circuit 104 from false signals, for a period of 150 ± 25 milliseconds following the ON to OFF transition on circuit 105. The use of this additional delay is optional, based on system considerations;

ii) circuit 119 in the binary 1 condition and circuit 122 in the OFF condition when circuit 120 is in the ON condition and, where required to protect circuit 119 from false signals, for a time interval following the ON to OFF transition on circuit 120. The specific duration of this time interval is left for further study. The additional delay is optional, based on system considerations.

8.6 *Fault condition of interchange circuits*

(See Recommendation V.28, § 7 for association of the receiver failure detection types).

8.6.1 The DTE should interpret a fault condition on circuit 107 as an OFF condition using failure detection type 1.

8.6.2 The DCE should interpret a fault condition on circuits 105 and 108 as an OFF condition using failure detection type 1.

8.6.3 All other circuits not referred to above may use failure detection types 0 or 1.

9 Electrical characteristics of interchange circuits

Use of electrical characteristics conforming to Recommendation V.28 is recommended together with the connector pin assignment plan specified by ISO 2110.

Note - Manufacturers may wish to note that the long-term objective is to replace electrical characteristics specified in Recommendation V.28, and that Study Group XVII has agreed that the work shall proceed to develop a more efficient, all balanced, interface for the V-Series application which minimizes the number of interchange circuits.

10 Equipment for the disablement of echo suppressors

When echo control device disabling is required, it is recommended that the procedures specified in Recommendation V.25 be followed.

11 Inclusion of a clock in the modem

A clock is not an essential item in the standardized modem. However, the modem may conveniently include a clock when used primarily for synchronous transmission.

If such a clock is included in the modem, a synchronizing pattern consisting of alternate binary 0 and binary 1 at clock rate should be transmitted for the whole interval between the OFF to ON transitions of interchange circuits 105 and 106. Users should note that part of this synchronizing pattern may appear at the distant receiver on circuit 104 after the OFF to ON transition of circuit 109. The data terminal equipment should make provision to differentiate between these false signals and true data.

Reference

[1] CCITT Recommendation *Standardization of FMVFT systems for a modulation rate of 50 bauds,* Vol. VII, Rec. R.35.