



INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

V.22 *bis*

DATA COMMUNICATION OVER THE TELEPHONE NETWORK

**2400 BITS PER SECOND DUPLEX MODEM
USING THE FREQUENCY DIVISION
TECHNIQUE STANDARDIZED FOR USE ON
THE GENERAL SWITCHED TELEPHONE
NETWORK AND ON POINT-TO-POINT
2-WIRE LEASED TELEPHONE-TYPE
CIRCUITS**

ITU-T Recommendation V.22 *bis*

(Extract from the *Blue Book*)

NOTES

1 ITU-T Recommendation V.22 *bis* 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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**2400 BITS PER SECOND DUPLEX MODEM
USING THE FREQUENCY DIVISION TECHNIQUE STANDARDIZED FOR USE
ON THE GENERAL SWITCHED TELEPHONE NETWORK AND ON
POINT-TO-POINT 2-WIRE
LEASED TELEPHONE-TYPE CIRCUITS**

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

The CCITT,

considering

(a) that there is a demand for data transmission at 2400 bit/s in the duplex mode over the General Switched Telephone Network (GSTN) and on point-to-point 2-wire leased telephone-type circuits;

(b) that there is a demand to have the fall-back mode compatibility with modems in accordance with Recommendation V.22;

(c) that in this case the frequency division technique shall be used,

(unanimously) declares

that the characteristics of the modems for this service shall provisionally be as follows:

1 Introduction

These modems are intended for use on connections on the GSTN and on point-to-point 2-wire leased telephone-type circuits (see Note). The principal characteristics of these modems are as follows:

- a) duplex mode of operation on the GSTN and point-to-point leased circuits,
- b) channel separation by frequency division,
- c) quadrature amplitude modulation for each channel with synchronous line transmission at 600 baud (nominal),
- d) inclusion of a scrambler,
- e) inclusion of an adaptive equalizer and a compromise equalizer,
- f) inclusion of test facilities,
- g) data signalling rates of:
 - 2400 bit/s synchronous,
 - 2400 bit/s start-stop,
 - 1200 bit/s synchronous,
 - 1200 bit/s start-stop,
- h) it is compatible with a V.22 modem operating in Modes i) or ii) at the 1200 bit/s signalling rate and includes automatic bit rate recognition.

Note - In certain countries the use of such modems over the GSTN may not be allowed.

2 Line signals

2.1 Carrier and guard tone frequencies

The carrier frequencies shall be 1200 ± 0.5 Hz for the low channel and 2400 ± 1 Hz for the high channel. A guard tone of 1800 ± 20 Hz, to be transmitted only when the modem is transmitting in the high channel, may be disabled as a national option. An alternative guard tone of 550 ± 20 Hz, to be transmitted only when the modem is transmitting in the high channel, may be incorporated as a national option.

2.2 Data and guard tone line signal levels

The 1800 Hz or 550 Hz guard tones shall be levels 6 ± 1 dB or 3 ± 1 dB, respectively, below the level of the data signal power in the high channel. Because of the 1800 Hz guard tone, the power level of data signals in the high channel will be approximately 1 dB lower than that of data signals in the low channel.

2.3 Fixed compromise equalizer

Fixed compromise equalization shall be incorporated in the modem transmitter.

2.4 Spectrum and group delay characteristics

The transmitted line signals, excluding the characteristics of the fixed compromise equalizer, shall have a frequency amplitude spectrum equivalent to the square root of a raised cosine shaping with 75% roll-off and within the limits shown in Figure 1/V.22 bis. Similarly, the group delay of the transmitter output shall be within the range of ± 150 microseconds over the frequency ranges 900-1500 Hz (low channel) and 2100-2700 Hz (high channel). These figures are provisional.

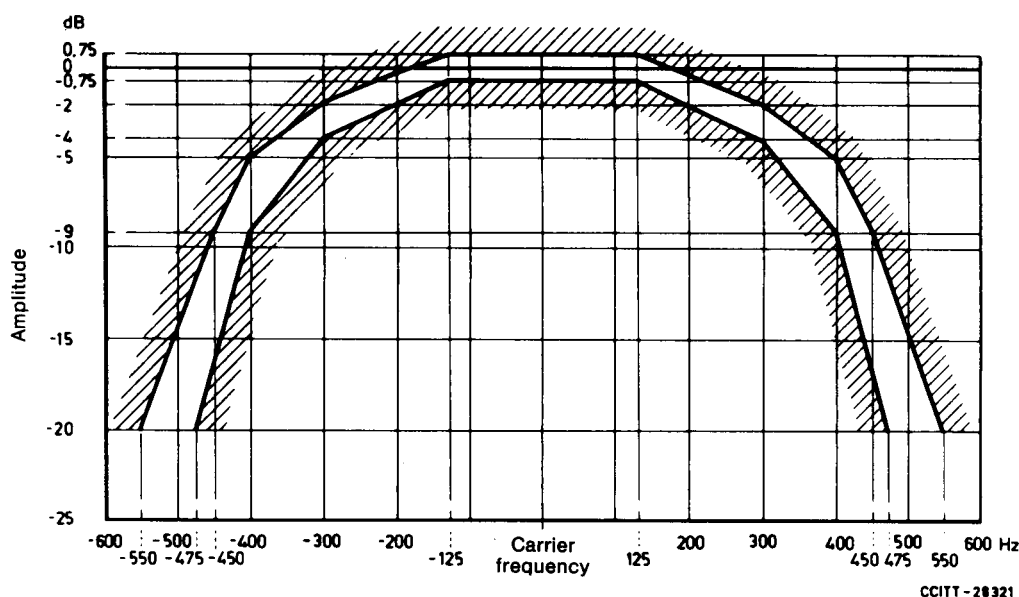


FIGURE 1/V.22 bis

Amplitude limits for transmitted line signal (unequalized)

2.5 Modulation

2.5.1 Data signalling rates

The data rate transmitted to line shall be 2400 bit/s or 1200 bit/s $\pm 0.01\%$ with a modulation rate of 600 baud $\pm 0.01\%$.

2.5.2 Encoding of data bits

2.5.2.1 2400 bits per second

The data stream to be transmitted shall be divided into groups of 4 consecutive bits (quadbits). The first two bits of a quadbit shall be encoded as a phase quadrant change relative to the quadrant occupied by the preceding signal element. (See Figure 2/V.22 bis and Table 1/V.22 bis.)

The last two bits of each quadbit define one of 4 signalling elements associated with the new quadrant (see Figure 2/V.22 bis). The left hand bits in Table 1/V.22 bis and Figure 2/V.22 bis are the first of each pair in the data stream as it enters the modulator portion of the modem after the scrambler.

TABLE 1/V.22 bis

Line encoding

First two bits in quabit (2400 bit/s) or dibit values (1200 bit/s)	Phase quadrant change	
00	1→ 2 2→ 3 3→ 4 4→ 1	90°
01	1→ 1 2→ 2 3→ 3 4→ 4	0°
11	1→ 4 2→ 1 3→ 2 4→ 3	270°
10	1→ 3 2→ 4 3→ 1 4→ 2	180°

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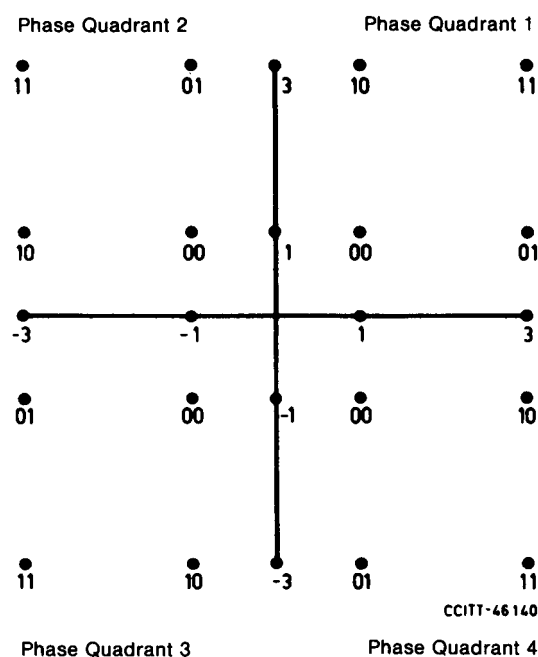


FIGURE 2/V.22 bis
Signal constellation

2.5.2.2 1200 bits per second

The data stream to be transmitted shall be divided into groups of 2 consecutive bits (dibits). The dibits shall be encoded as a phase quadrant change relative to the quadrant occupied by the preceding signal element (see Table 1/V.22 bis). The signalling elements corresponding to 01 in the signal constellation (Figure 2/V.22 bis) shall be transmitted irrespective of the quadrant concerned. This ensure compatibility with Recommendation V.22.

2.6 Received signal frequency tolerance

The receiver shall be able to operate with received frequency offsets of up to ± 7 Hz.

3 Interchange circuits

3.1 Essential and optional interchange circuits

These are listed in Table 2/V.22 bis.

3.2 Circuits 106 and 109 response times

After the handshaking sequences, circuit 106 will follow OFF to ON or ON to OFF transitions of circuit 105 within 3.5 ms. The OFF to ON transition of circuit 109 is part of the handshake sequence specified in § 6. Circuit 109 shall turn OFF 40 to 65 ms after the level of the received signal appearing at the line terminal of the modem falls below the relevant threshold defined in § 3.3. In the fall-back mode, the response time may be reduced to a value in the 10 to 24 ms range specified in Recommendation V.22. Following a dropout, after the initial handshake, circuit 109 shall turn ON 40 to 205 ms after the level of the received signal appearing at the line terminal of the modem exceeds the relevant threshold defined in § 3.3.