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STANDARDIZATION SECTOR
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V.37

DATA COMMUNICATION OVER THE TELEPHONE NETWORK

SYNCHRONOUS DATA TRANSMISSION AT A DATA SIGNALLING RATE HIGHER THAN 72 kbit/s USING 60-108 kHz GROUP BAND CIRCUITS

ITU-T Recommendation V.37

(Extract from the *Blue Book*)

NOTES

1 ITU-T Recommendation V.37 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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HIGHER THAN 72 kbit/s USING 60-108 kHz GROUP BAND CIRCUITS**

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

1 Introduction

On leased circuits, considering that there exist and will come into being other modems with features designed to meet the requirements of Administrations and users, this Recommendation in no way restricts the use of any other modems.

The only group reference pilot frequency which can be used in conjunction with this modem is 104.08 kHz.

The modem is intended to be used on group band circuits not necessarily conforming to [1].

Principal characteristics:

- a) transmission of any type of high-speed synchronous data in duplex constant carrier mode on 4-wire (60-108 kHz) group band circuits;
- b) primary data signalling rates up to 144 kbit/s;
- c) inclusion of an automatic adaptive equalizer;
- d) class IV partial response pulse amplitude single sideband signalling and modulation;
- e) optional inclusion of an overhead-free multiplexer combining existing data signalling rates;
- f) optional voice channel.

2 Data signalling rates

2.1 The recommended synchronous data signalling rates are 96 kbit/s, 112 kbit/s, 128 kbit/s and 144 kbit/s. For some applications with agreement from the Administration, data signalling rates up to 168 kbit/s are applicable. (See the Note to § 7.)

2.2 The permitted tolerance for all data signalling rates is $\pm 5 \times 10^{-5}$.

3 Scrambler/descrambler

In order to be bit sequence independent, to avoid high amplitude spectral components on the line, and to allow the automatic equalizer to remain converged, the data should be scrambled and descrambled by means of the logical arrangements described in Appendix I.

4 Encoding method

The binary bit stream A, delivered by the scrambler, to be transmitted is divided into consecutive groups of 2 bits A_1 and A_2 (dibits), A_1 being the first in time delivered by the scrambler.

An amplitude level B is assigned to each dibit (A) as shown in Table 1/V.37.

TABLE 1/V.37

A_1	A_2	Equivalent B amplitude level
0	0	0
0	1	+1
1	1	+2
1	0	+3

A pre-encoder circuit converts the stream B into another quaternary stream C which conforms to the relation:

$$C_i = B_i \oplus C_{i-2}$$

where

$\oplus$ represents the modulo 4 sum

and the subscript i represents the i^{th} element of B or C.

The resulting quaternary stream C can be processed to form a baseband signal.

5 Baseband signal shaping

The equivalent baseband signal shaping process is based upon the binary coded partial response pulse, often referred to as class IV, whose time and spectral function are defined by:

$$g(t) = \frac{2}{\pi} \cdot \frac{\sin \frac{\pi}{T} t}{\left(\frac{t}{T}\right)^2 - 1}$$

and

$$G(f) = \begin{cases} 2 T j \sin 2 \pi T f, & |f| \leq \frac{1}{2 T} \\ 0, & |f| > \frac{1}{2 T} \end{cases}$$

respectively, where $1/T$ denotes the modulation rate.

The reference to equivalent baseband signals recognizes that the modem implementation may be such that the binary signal at the input and output of the modem is converted to and from the line signal without appearing as an actual baseband signal.

The baseband signal formed by the processes described above will present 7 levels (see Table 2/V.37).

The baseband signal shaping is performed in the transmitter,