INTERNATIONAL TELECOMMUNICATION UNION

# ITU-T G.742

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

## GENERAL ASPECTS OF DIGITAL TRANSMISSION SYSTEMS

## TERMINAL EQUIPMENTS

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# SECOND ORDER DIGITAL MULTIPLEX EQUIPMENT OPERATING AT 8448 kbit/s AND USING POSITIVE JUSTIFICATION

## ITU-T Recommendation G.742

(Extract from the *Blue Book*)

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**NOTES**

1 ITU-T Recommendation G.742 was published in Fascicle III.4 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.

**Recommendation G.742**

## SECOND ORDER DIGITAL MULTIPLEX EQUIPMENT OPERATING AT 8448 kbit/s AND USING POSITIVE JUSTIFICATION

*(Geneva, 1972; further amended)*

### 1 General

The second order digital multiplex equipment using positive justification, described below, is intended for use on digital paths between countries using 2048 kbit/s primary multiplex equipments.

### 2 Bit rate

The nominal bit rate should be 8448 kbit/s.

The tolerance on that rate should be ± 30 parts per million (ppm).

### 3 Frame structure

Table 1/G.742 gives:

- the tributary bit rate and the number of tributaries;
- the number of bits per frame;
- the bit numbering scheme;
- the bit assignment;
- the bunched frame alignment signal.

TABLE 1/G.742

**8448-kbit/s multiplexing frame structure**

| | |
|---|---|
| Tributary bit rate (kbit/s) | 2048 |
| Number of tributaries | 4 |
| Frame structure | Bit number |
| | *Set I* |
| Frame alignment signal (1111010000) | 1 to 10 |
| Alarm indication to the remote digital multiplex equipment | 11 |
| Bit reserved for national use | 12 |
| Bits from tributaries | 13 to 212 |
| | *Set II* |
| Justification control bits $C_{j1}$ (see Note) | 1 to 4 |
| Bits from tributaries | 5 to 212 |
| | *Set III* |
| Justification control bits $C_{j2}$ (see Note) | 1 to 4 |
| Bits from tributaries | 5 to 212 |
| | *Set IV* |
| Justification control bits $C_{j2}$ (see Note) | 1 to 4 |
| Bits from tributaries available for justification | 5 to 8 |
| Bits from tributaries | 9 to 212 |
| Frame length | 848 bits |
| Bits per tributary | 206 bits |
| Maximum justification rate per tributary | 10 kbit/s |
| Nominal justification ratio | 0.424 |

*Note* - $C_{ji}$ indicates the *i*th justification control bit of the *j*th tributary.

## 4 Loss and recovery of frame alignment and consequent action

Loss of frame alignment should be assumed to have taken place when four consecutive frame alignment signals have been incorrectly received in their predicted positions.

When frame alignment is assumed to be lost, the frame alignment device should decide that such alignment has effectively been recovered when it detects the presence of three consecutive frame alignment signals.

The frame alignment device having detected the appearance of a single correct frame alignment signal, should begin a new search for the frame alignment signal when it detects the absence of the frame alignment signal in one of the two following frames.

*Note* - As it is not strictly necessary to specify the detailed frame alignment strategy, any suitable frame alignment strategy may be used provided the performance achieved is at least as efficient in all respects as that obtained by the above frame alignment strategy.

## 5 Multiplexing method

Cyclic bit interleaving in the tributary numbering order and positive justification is recommended.

The justification control signal should be distributed and use the $C_{jn}$-bits ($n$ = 1, 2, 3, see Table 1/G.742).

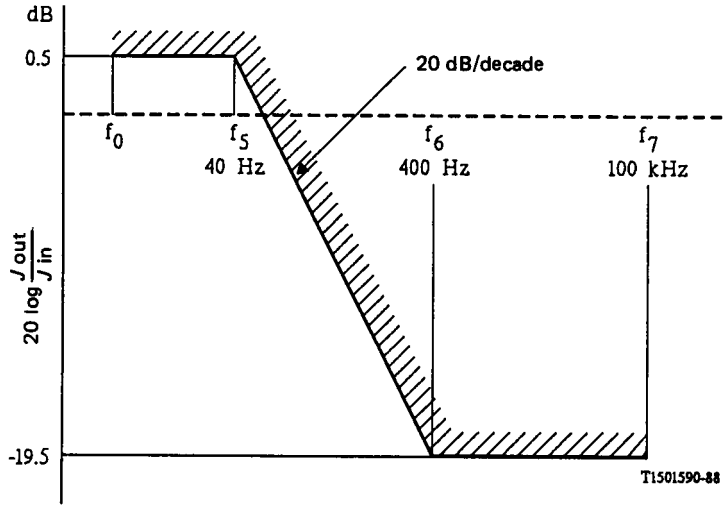
Positive justification should be indicated by the signal 111, no justification by the signal 000. Majority decision is recommended.

Table 1/G.742 gives the maximum justification rate per tributary and the nominal justification ratio.

## 6 Jitter

### 6.1 *Jitter transfer characteristic*

A 2048 kbit/s signal, modulated by sinusoidal jitter, should be subject to a muldex jitter transfer characteristic within the gain/frequency limits given in Figure 1/G.742. The equivalent binary content of the test signal should be 1000.




*Note 1* - The frequency $f_0$ should be less than 20 Hz and as low as possible (e.g. 10 Hz), taking into account the limitations of measuring equipment.

*Note 2* - To achieve accurate measurements, the use of a selective method is recommended with a bandwidth sufficiently small referred to the relevant measurement frequency, but not wider than 40 Hz.

*Note* 3 - The need to tolerate spurious responses greater than -19.5 dB in the frequency range $f_6$ to $f_7$ is for further study.

FIGURE 1/G.742

### 6.2 *Tributary output jitter*

The peak-to-peak jitter at a tributary output in the absence of input jitter should not exceed 0.25 UI when measured in the frequency range up to 100 kHz.

When measured with an instrument incorporating a bandpass filter having a lower cutoff frequency of 18 kHz, a roll-off of 20 dB/decade and an upper limit of 100 kHz, the peak-to-peak output jitter should not exceed 0.05 UI with a probability of 99.9% during a measurement period of 10 s.

*Note* - For interfaces meeting the national high Q option, detailed in Recommendation G.703, the lower cutoff frequency for the above measurement should be 700 Hz.

### 6.3 *Multiplex signal output jitter*

In the case where the transmitting timing signal is derived from an internal oscillator, the peak-to-peak jitter at

the 8448 kbit/s output should not exceed 0.05 UI when it is measured within the frequency range from $f_1$ = 20 Hz to $f_4$ = 400 kHz.

## 7 Digital interfaces

The digital interfaces at 2048 kbit/s and 8448 kbit/s should be in accordance with Recommendation G.703.

## 8 Timing signal

If it is economically feasible, it may be desirable to be able to derive the multiplexer timing signal from an external source as well as from an internal source.

## 9 Service digits

Two bits per frame are available for service functions. Bit 11 of Set I is used to transmit an alarm indication to the remote multiplex equipment when specific fault conditions are detected in the multiplex equipment (see § 10 below). Bit 12 of Set I is reserved for national use. On the digital path crossing the border, this bit is fixed at 1.

## 10 Fault conditions and consequent conditions

10.1 *Fault conditions*

The digital multiplex equipment should detect the following fault conditions:

10.1.1 Failure of power supply.

10.1.2 Loss of an incoming signal at 2048 kbit/s at the input of the multiplexer.

*Note* - Where separate circuits are used for the digital signal and the timing signal then loss of either or both should constitute loss of the incoming signal.

10.1.3 Loss of the incoming signal at 8448 kbit/s at the input of the demultiplexer.

*Note 1* - The detection of this fault condition is required only when it does not result in an indication of loss of frame alignment.

*Note 2* - Where separate circuits are used for the digital signal and the timing signal, then loss of either or both should constitute loss of the incoming signal.

10.1.4 Loss of frame alignment.

10.1.5 Alarm indication received from the remote multiplex equipment at the 8448 kbit/s input of the demultiplexer (see § 10.2.2 below).

10.2 *Consequent actions*

Further to the detection of a fault condition, appropriate actions should be taken as specified by Table 2/G.742. The consequent actions are as follows:

10.2.1 Prompt maintenance alarm indication generated to signify that performance is below acceptable standards and maintenance attention is required locally. When the Alarm Indication Signal (AIS) (see Note 2 under § 10.2.5 below) at 8448 kbit/s is detected at the input of the demultiplexer, the prompt maintenance alarm indication associated with loss of frame alignment should be inhibited, while the rest of the consequent actions are in accordance with those associated in Table 2/G.742 with the fault condition.

*Note* - The location and provision of any visual and/or audible alarm activated by this maintenance alarm indication is left to the discretion of each Administration.

10.2.2 Alarm indication to the remote multiplex equipment generated by changing from the state 0 to the state 1 bit 11 of Set I at the 8448 kbit/s output of the multiplexer.

10.2.3 AIS (see Notes 1 and 2 below) applied to all four 2048 kbit/s tributary outputs from the demultiplexer.

10.2.4 AIS (see Notes 1 and 2 below) applied to the 8448 kbit/s output of the multiplexer.

10.2.5 AIS (see Note 2 below) applied to the time slots of the 8448 kbit/s signal at the output of the multiplexer, corresponding to the relevant 2048 kbit/s tributary.

The method of transmitting the AIS at the output port of the multiplexer in time slots corresponding to a faulty input tributary, should be such that the status of the justification control digits is controlled so as to ensure that the AIS is within the tolerance specified for that tributary.

TABLE 2/G.742

**Fault conditions and consequent actions**

| Equipment part | Fault condition (see § 10.1) | Consequent actions (see § 10.2) | | | | |
|---|---|---|---|---|---|---|
| | | Prompt maintenance alarm indication generated | Alarm indication to the remote multiplex equipment generated | AIS applied | | |
| | | | | To all the tributaries | To the composite signal | To the relevant time slots of the composite signal |
| Multiplexer and demultiplexer | Failure of power supply | Yes | | Yes, if practicable | Yes, if practicable | |
| Multiplexer only | Loss of incoming signal on a tributary | Yes | | | | Yes |
| Demultiplexer only | Loss of incoming signal at 8448 kbit/s | Yes | Yes | Yes | | |
| | Loss of frame alignment | Yes | Yes | Yes | | |
| | Alarm indication received from the remote multiplex equipment | | | | | |

*Note* - A *Yes* in the table signifies that a certain action should be taken as a consequence of the relevant fault condition. An *open space* in the table signifies that the relevant action should *not* be taken as a consequence of the relevant fault condition, if this condition is the only one present. If more than one fault condition is simultaneously present the relevant action should be taken if, for at least one of the conditions, a *Yes* is defined in relation to this action.

*Note 1* - The bit rate of the AIS at the output of the multiplexer equipment or at the output of the demultiplexer equipment should be in accordance with the interface specifications.

*Note 2* - The equivalent binary content of the AIS at 2048 kbit/s and 8448 kbit/s is nominally a continuous stream of 1s. The strategy for detecting the presence of the AIS should be such that the AIS is detectable even in the presence of an error ratio $1 \cdot 10^{-3}$. However, a signal, with all bits except the frame alignment signal in the 1s state, should not be mistaken for an AIS.

10.3 *Time requirements*

The fault detection and the application of the consequent actions listed in §§ 10.2.2 to 10.2.5, including the detection of AIS, should be completed within a time limit of 1 ms.