



INTERNATIONAL TELECOMMUNICATION UNION

**ITU-T**

TELECOMMUNICATION  
STANDARDIZATION SECTOR  
OF ITU

**G.754**

**GENERAL ASPECTS OF DIGITAL TRANSMISSION  
SYSTEMS**

**TERMINAL EQUIPMENTS**

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**FOURTH ORDER DIGITAL MULTIPLEX  
EQUIPMENT OPERATING AT 139 264 kbit/s  
AND USING POSITIVE/ZERO/NEGATIVE  
JUSTIFICATION**

**ITU-T Recommendation G.754**

(Extract from the *Blue Book*)

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## NOTES

1 ITU-T Recommendation G.754 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.754**

**FOURTH ORDER DIGITAL MULTIPLEX EQUIPMENT OPERATING  
AT 139 264 kbit/s AND USING POSITIVE/ZERO/NEGATIVE JUSTIFICATION**

*(Geneva, 1980; further amended)*

**1 General**

The fourth order digital multiplex system with positive/zero/negative pulse justification as given below is intended for use on digital connection between countries having the same type of justification using any third order digital systems at 34 368 kbit/s.

**2 Bit rate**

The nominal bit rate should be 139 264 kbit/s. The tolerance on that rate should not be more than  $\pm 15$  parts per million (ppm).

**3 Frame structure**

Table 1/G.754 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.754

**139 264-kbit/s multiplexing frame structure using positive/zero/negative justification**

Tributary bit rate (kbit/s)	34 368
Number of tributaries	4
Frame structure	
Frame alignment signal	<i>Set I</i>
Bits for service functions	1 to 10
Bits from tributaries	11 to 12 13 to 544
Justification control bit ( $C_{j1}$ )	<i>Set II</i>
Bits from tributaries	1 to 4 5 to 544
Justification control bit ( $C_{j2}$ )	<i>Set III</i>
Bits from tributaries	1 to 4 5 to 544
Justification control bit ( $C_{j3}$ )	<i>Set IV</i>
Bits from tributaries available for negative justification	1 to 4
Bits from tributaries available for positive justification	5 to 8
Bits from tributaries	9 to 12 13 to 544
Frame length	2176 bits
Frame duration	15.625 $\mu$ s
Bits per tributaries	537
Maximum justification rate per tributary	64 kbit/s

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

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

The frame alignment system should be adaptive to the error rate in the line link. Until frame alignment is restored the frame alignment system should retain its position. A new search for the frame alignment signal should be undertaken when three and more consecutive frame alignment signals have been incorrectly received in their position.

Frame alignment is considered to have been recovered when more than two consecutive frame alignment signals have been correctly received in their predicted positions.

#### **5 Multiplexing method**

Cyclic bit interleaving in the tributary numbering order and positive-negative justification with two command control are recommended. The justification control signal should be distributed and use  $C_{jn}$ -bits ( $n = 1, 2, 3$  see Table 1/G.754). Correction of one symbol error in a command is possible.

Positive justification should be indicated by the signal 111, transmitted in each of two consecutive frames; negative justification should be indicated by the signal 000, transmitted in each of two consecutive frames, and no justification by the signal 111 in one frame followed by 000 in the next frame.

Digit time slots 5, 6, 7, 8 (Set IV) are used for information carrying bits (for negative justification), and digit time slots 9, 10, 11, 12 in Set IV, when it is necessary, are used for no information carrying bits (for positive justification) for the tributaries 1, 2, 3, 4.

Besides, when information from tributaries 1, 2, 3 and 4 is not transmitted, bits 5, 6, 7 and 8 in Set IV are available for transmitting information concerning the type of justification (positive or negative) in frames containing commands of positive justification control and intermediate amount of jitter in frames containing commands of negative justification.

Table 1/G.754 gives maximum justification rate per each third order tributary.

#### **6 Jitter**

The amount of jitter that should be accepted at the inputs of the demultiplexer and multiplexer and should be at the output of the demultiplexer is under study.

#### **7 Digital interface**

The interface at the nominal bit rates 34 368 kbit/s and 139 264 kbit/s is under study.

#### **8 Timing signal**

The clock should be able to be controlled by an external source.

#### **9 Service functions**

Some spare bits per frame are available for service functions (bits 11 and 12 in Set I) for national and international use. Bit 11 in Set I is available for a digital service channel (using 32 kbit/s Adaptive Delta Modulation) and bit 12 is available for ringing up a digital service channel.

#### **10 Fault conditions and consequent actions**

10.1 The digital multiplex equipment should detect the following fault conditions:

10.1.1 Failure of power supply.

10.1.2 Loss of the incoming signal at 34 368 kbit/s at the input of the multiplexer.

10.1.3 Loss of the incoming signal at 139 264 kbit/s at the input of the demultiplexer.

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

10.1.4 Loss of frame alignment.

10.1.5 Alarm indication received from the remote multiplex equipment at the 139 264 kbit/s input of the demultiplexer (see § 10.2.2 below).

## 10.2 *Consequent actions*

After detection of a fault condition appropriate actions should be taken as specified in the Table 2/G.754. The consequent actions are as follows:

10.2.1 Prompt maintenance alarm indication generated to signify that the performance is below acceptable standards and maintenance attention is required locally. When detecting the Alarm Indication Signal (AIS) at the 139 264 kbit/s input of the demultiplexer the prompt maintenance alarm indication associated with loss of frame alignment should be inhibited (see Note 1 below).

*Note* - The location and provision of any visual and/or audible alarm activated by this prompt 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 12 of Set I at the 139 264 kbit/s output of the multiplexer.

10.2.3 AIS (see Note 2 below) applied to all the four outputs of the 34 368 kbit/s tributary outputs from the demultiplexer.

10.2.4 AIS (see Note 2 below) applied to the 139 264 kbit/s output of the multiplexer.

10.2.5 AIS (see Note 2 below) applied to the time slots of the 139 264 kbit/s signal at the multiplexer output corresponding to the relevant 34 368 kbit/s tributary.

*Note 1* - The bit rate of the AIS at the output of the corresponding demultiplexer should be as specified for the tributaries. The method of achieving this is under study.

*Note 2* - The equivalent binary content of the AIS at 34 368 kbit/s and 139 264 kbit/s is a continuous stream of binary 1s.

TABLE 2/G.754

**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 multiplexer generated	AIS applied		
				To all 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	Yes, if practicable	
Multiplexer only	Loss of incoming signal on a tributary	Yes				Yes
Demultiplexer only	Loss of incoming signal at 139 264 kbit/s	Yes	Yes	Yes		
	Loss of frame alignment	Yes	Yes	Yes		
	AIS received from the remote multiplexer					

*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.