INTERNATIONAL TELECOMMUNICATION UNION

CCITT

THE INTERNATIONAL
TELEGRAPH AND TELEPHONE
CONSULTATIVE COMMITTEE

G.736

(11/1988)

SERIES G: TRANSMISSION SYSTEMS AND MEDIA, DIGITAL SYSTEMS AND NETWORKS

International telephone connections and circuits – General definitions

---

CHARACTERISTICS OF A SYNCHRONOUS DIGITAL MULTIPLEX EQUIPMENT OPERATING AT 2048 kbit/s

Reedition of CCITT Recommendation G.736 published in the Blue Book, Fascicle III.4 (1988)

NOTES

1 CCITT Recommendation G.736 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.736

CHARACTERISTICS OF A SYNCHRONOUS DIGITAL MULTIPLEX EQUIPMENT OPERATING AT 2048 kbit/s

(former Recommendation G.738 of Volume III of the Yellow Book)

This Recommendation gives the characteristics of a synchronous digital multiplex equipment, to combine up to 31 tributary channels at 64 kbit/s in a 2048 kbit/s digital stream. It is foreseen that in the future the need may arise to devote *n* 64 kbit/s time slots to services requiring more than a single 64 kbit/s channel. The additions to this Recommendation to allow this facility (e.g. definition of proper interfaces at *n* × 64 kbit/s) are under study.

1 General characteristics

1.1 *Bit rate*

The nominal bit rate is 2048 kbit/s. The tolerance on this rate is ± 50 parts per million (ppm).

1.2 *Timing signal*

It should be possible to derive the transmit timing signal from any of the following:

a) from the received 2048 kbit/s signal,

b) from an external source at 2048 kHz (see § 5),

c) from an internal oscillator.

Note 1 – The possibility of also deriving the transmitting timing signal from a 64 kbit/s tributary is under study.

Note 2 – The provision of a timing signal output, available for the purpose of synchronizing other equipments, is an option that might be required depending upon national synchronization arrangements.

2 Frame structure

Refer to §2.3 of Recommendation G.704 for frame structure and for use of derived channel time slots. Bit 1 of the frame should be used in accordance with § 2.3.3 of Recommendation G.704, i.e. for a CRC check bit procedure.

Note – In case of interconnection with multiplex equipment using time slot 16 for internal purposes, the use of this time slot for a 64 kbit/s tributary could be excluded.

3 Frame alignment and CRC procedures

An illustration of the procedure is given in Figure 2/G.706.

3.1 *Loss of frame alignment*

Refer to § 4.1.1 of Recommendation G.706.

3.2 *Recovery of frame alignment*

Refer to § 4.1.2 of Recommendation G.706.

3.3 *CRC multiframe alignment in TS0*

Refer to § 4.2 of Recommendation G.706.

3.4 *CRC bit monitoring*

Refer to § 4.3 of Recommendation G.706.

4 Fault conditions and consequent actions

4.1 *Fault conditions*

The digital muldex should detect the following fault conditions:

4.1.1 Failure of power supply.

4.1.2 Loss of the incoming signal at the 64 kbit/s tributary input port.

Note – This detection is not mandatory when contradirectional interfaces are used.

4.1.3 Loss of the incoming signal at 2048 kbit/s.

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, the loss of either or both should constitute loss of the incoming signal.

4.1.4 Loss of frame alignment at 2048 kbit/s.

4.1.5 Excessive bit error ratio detected by monitoring the frame alignment signal.

4.1.5.1 With a random bit error ratio of $\leq 10^{-4}$, the probability of activating the indication of fault condition within a few seconds should be less than 10^{-6}.

With a random bit error ratio of $\geq 10^{-3}$, the probability of activating the indication of fault condition within a few seconds should be higher than 0.95.

4.1.5.2 With a random bit error ratio of $\geq 10^{-3}$, the probability of desactivating the indication of fault condition within a few seconds should be almost 0.

With a random bit error ratio of $\leq 10^{-4}$, the probability of of desactivating the indication of fault condition within a few seconds should be higher than 0.95.

Note – The activating and the deactivating period specified as "a few seconds" is intended to be in the order of 4 to 5 seconds.

4.1.6 Alarm indication received from the remote digital muldex (see § 4.2).

4.2 *Consequent actions*

Further to the detection of a fault condition, appropriate actions should be taken as specified in Table 1/G.736. The consequent actions are as follows:

4.2.1 Prompt maintenance alarm indication generated to signify that performance is below acceptable standards and maintenance attention is required locally. When the AIS (see General Notes below to § 4.2) at 2048 kbit/s input is detected, the prompt maintenance alarm indication associated with loss of frame alignment (see § 4.1.4) and excessive error ratio (see § 4.1.5) should be inhibited, while the rest of the consequent actions are in accordance with those associated in Table 1/G.736 with the two fault conditions.

Note – The location and provision of any visual and/or audible alarm activated by the alarm indications given in § 4.2.1 is left to the discretion of each Administration.

4.2.2 Alarm indication to the remote end transmitted by changing bit 3 of channel time slot 0 from the state 0 to the state 1 in those frames not containing the frame alignment signal. This should be effected as soon as possible.

4.2.3 AIS applied to all 64 kbit/s outputs (see General Notes below to § 4.2). This action should be taken as soon as possible and not later than 2 ms after the detection of the fault condition.

4.2.4 AIS applied to relevant time slots in the composite 2048 kbit/s output signal (if supervision of incoming 64 kbit/s signal is provided).

General Notes to § 4.2

Note 1 – The equivalent binary content of the alarm indication signal (AIS) is a continuous stream of binary 1s. The strategy for detecting the presence of the AIS should be such that with a high probability the AIS is detectable even in the presence of random errors having a mean error ratio $1 \cdot 10^{-3}$. Nevertheless, a signal in which all the binary elements, with the exception of the frame alignment signal, are in the state 1, should not be taken as an AIS.

Note 2 – All timing requirements quoted apply equally to restoration, subsequent to the fault condition clearing.

TABLE 1/G.736

Fault conditions and consequent actions for the 2048 kbit/s synchronous digital multiplex equipment

Equipment part	Fault conditions (see § 4.1)	Dispositions correspondantes (voir le § 4.2)			
		Prompt maintenance alarm indication generated	Alarm indication to the remote end transmitted	AIS applied to all 64 kbit/s outputs	AIS applied to the relevant time slot of the 2048 kbit/s 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 at a 64 kbit/s input (see Note under § 4.1.2)	Yes			Yes
Demultiplexer only	Loss of incoming signal at 2048 kbit/s	Yes	Yes	Yes	
	Loss of frame alignment (see Note 2 of Rec.G.706, § 4.2)	Yes (see § 4.2.1)	Yes	Yes	
	Error ratio $1 \cdot 10^{-3}$ on the frame alignment signal	Yes (see § 4.2.1)	Yes	Yes	
	Alarm indication received from the remote end				

Note – A *Yes* in the table signifies that an 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 the 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.

5 Interfaces

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

The digital interfaces at 64 kbit/s should be of either the codirectional or the contradirectional type specified in Recommendation G.703. The interface for external synchronization of the transmitting timing signal should be in accordance with G.703.

Note 2 – In the case of the 64 kbit/s codirectional interface, the design of the input ports should take account of the need to provide octet alignment, to allow controlled slips when the tributary timing and that of the multiplexer timing source are plesiochronous, and to absorb jitter and wander up to the limits given in Recommendation G.823.

6 Jitter

6.1 *Jitter at 2048 kbit/s output*

6.1.1 In the case where the transmitting timing signal is derived from an internal oscillator, the peak-to-peak jitter at the 2048 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 = 100 kHz. See Figure 2/G.823.

6.1.2 In the case where the transmitting timing signal is derived from an external source having no jitter, the peak-to-peak jitter at the 2048 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 = 100 kHz.

6.1.3 In the case where the transmitting timing signal is derived from the incoming 2048 kbit/s signal having no jitter, the peak-to-peak jitter at the 2048 kbit/s output should not exceed 0.10 UI when it is measured within the frequency range from f_1 = 20 Hz to f_4 = 100 kHz. The equivalent binary content of the test signal applied at the 2048 kbit/s input shall be a pseudo-random bit sequence of length 2^{15}–1 as specified in Recommendatoin O.151.

Note – It may be necessary to include a frame alignment signal in the test signal to enable the measurement to be carried out.

6.2 *Jitter at 64 kbit/s output*

In the case where the incoming 2048 kbit/s signal has no jitter, the peak-to-peak jitter at the 64 kbit/s output should not exceed 0.025 UI when it is measured within the frequency range from f_1 = 20 Hz to f_4 = 10 kHz. The equivalent binary content of the test signal applied to the 2048 kbit/s input shall be a pseudo-random bit sequence of length 2^{15} – 1 as specified in Recommendation O.151.

Note – In order to carry out this measurement without invoking AIS at the 64 kbit/s output, it will normally be necessary to include a frame alignment signal in the test signal.

6.3 *Jitter transfer functions*

6.3.1 The jitter transfer function between the 2048 kHz external synchronisation signal and the 2048 kbit/s output signal should not exceed the gain/frequency limits given in Figure 1/G.736. The 2048 kHz signal shall be modulated with sinusoidal jitter.

Some Administrations require that equipment be fitted with jitter reducers. In this case, the jitter transfer function should not exceed the gain/frequency limits given in Figure 2/G.736.

6.3.2 In the case where the transmitting timing is derived from the incoming signal, the jitter transfer junction between the 2048 kbit/s input and 2048 kbit/s output shall be as specified in § 6.3.1.

Note 1 – The 2048 kbit/s test signal shall be modulated by sinusoidal jitter. The equivalent binary content of the test signal shall be 1000.

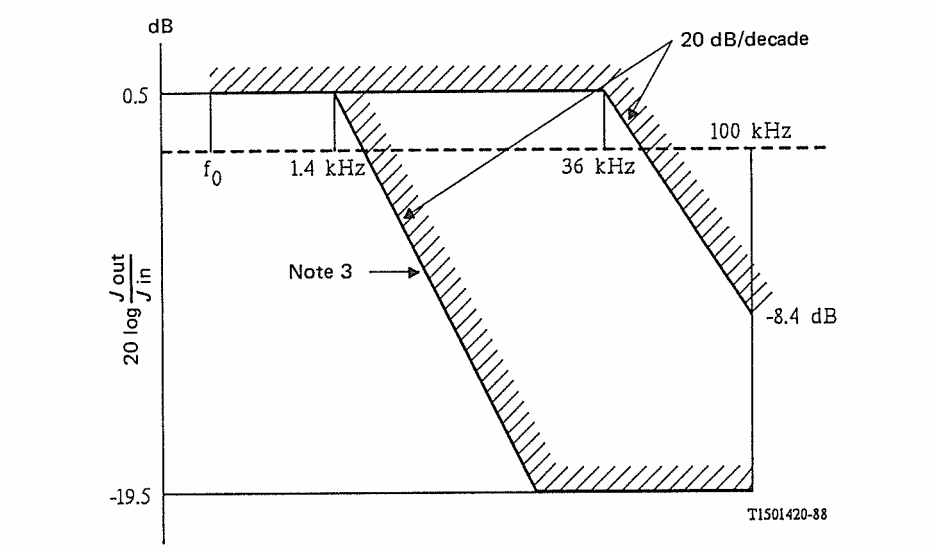
Note 2 – It may be necessary to include a frame alignment signal in the test signal to enable the measurement to be carried out.

6.3.3 The jitter transfer function between the 2048 kbit/s and the 64 kbit/s output should not exceed –29.6 dB when measured over the frequency range f_0 to 10 kHz. 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 1 – The 2048 kbit/s test signal shall be modulated by sinusoidal jitter. The equivalent binary content of the test signal shall be 1000.

Note 2 – In order to carry out this measurement without invoking AIS at the 64 kbit/s output, it will normally be necessary to include a frame alignment signal in the test signal.

Note 3 – The jitter reduction of 1/32 due to demultiplexing is equivalent to –30.1 dB.

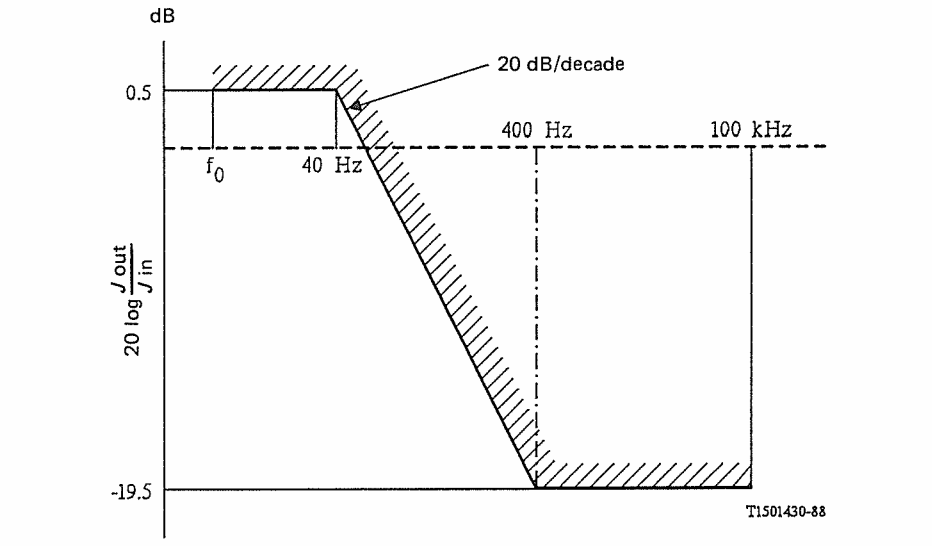


Note 1 – The frequency f_0 should be less than 20 Hz and as low as possible (e.g. 10 Hz), taking into account the limitations of measuring equipment.

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 – For interfaces within national boundaries, this characteristic may be used.

FIGURE 1/G.736



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.

FIGURE 2/G.736

ITU-T RECOMMENDATIONS SERIES

Series A	Organization of the work of the ITU-T
Series B	Means of expression: definitions, symbols, classification
Series C	General telecommunication statistics
Series D	General tariff principles
Series E	Overall network operation, telephone service, service operation and human factors
Series F	Non-telephone telecommunication services
Series G	**Transmission systems and media, digital systems and networks**
Series H	Audiovisual and multimedia systems
Series I	Integrated services digital network
Series J	Transmission of television, sound programme and other multimedia signals
Series K	Protection against interference
Series L	Construction, installation and protection of cables and other elements of outside plant
Series M	TMN and network maintenance: international transmission systems, telephone circuits, telegraphy, facsimile and leased circuits
Series N	Maintenance: international sound programme and television transmission circuits
Series O	Specifications of measuring equipment
Series P	Telephone transmission quality, telephone installations, local line networks
Series Q	Switching and signalling
Series R	Telegraph transmission
Series S	Telegraph services terminal equipment
Series T	Terminals for telematic services
Series U	Telegraph switching
Series V	Data communication over the telephone network
Series X	Data networks and open system communications
Series Y	Global information infrastructure and Internet protocol aspects
Series Z	Languages and general software aspects for telecommunication systems

Printed in Switzerland

Geneva, 2007