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SPECIFICATIONS FOR MEASURING EQUIPMENT

EQUIPMENT TO PERFORM IN-SERVICE MONITORING ON 1544 kbit/s SIGNALS

ITU-T Recommendation O.163

(Extract from the *Blue Book*)

NOTES

1   ITU-T Recommendation O.163 was published in Fascicle IV.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.

EQUIPMENT TO PERFORM IN-SERVICE MONITORING ON 1544 kbit/s SIGNALS

(Melbourne, 1988)

1 General

1.1 This specification describes frame alignment signal monitoring equipment for 1544 kbit/s frame structures that are in accordance with Recommendation G.704 [1]. This equipment is intended to monitor 12-frame multiframe (superframe format – SF) or 24-frame multiframe (extended superframe format – ESF) structures having either AMI or B8ZS line codes as defined in § 2 of Recommendation G.703 [2].

1.2 This equipment shall provide the following capabilities:

   a) monitor and display the error performance of the frame alignment signal;

   b) detect and accumulate the counts of occurrences of loss of frame alignment;

   c) measure and display the error performance of 24-frame multiframe signals by monitoring the cyclic redundancy check (CRC-6) bits and performing a CRC-6 procedure in accordance with Recommendation G.704 [1] and as described below;

   d) detect and display the various alarm or fault conditions including loss of signal, loss of frame alignment, and other alarm conditions indicated by specific bit patterns.

1.3 The equipment may optionally provide the following additional capabilities:

   a) detect and display the code violations in the 1544 kbits signal in accordance with Recommendation O.161;

   b) provide an external interface for extracting the information bits conveyed in any selected channel time slot;

   c) provide an external interface for extracting the 4 kbit/s data link bits defined in the 24-frame multiframe structure;

   d) provide an external interface for extracting the signalling bits in the 12-frame and 24-frame structures.

2 Input requirements

2.1 *Interface*

The monitoring equipment shall be capable of operating with a test load impedance at a 1544 kbit/s interface as defined in § 2 of Recommendation G.703 [2]. It shall also be capable of operating when connected to protected monitoring points[1] (see also Recommendation G.772 [3]).

2.2 *Input impedance*

2.2.1 *Input impedance* (resistive) .... 100 ohms

2.2.2 *Return loss (20 kHz to 1600 kHz)* .... > 20 dB

2.3 *Input sensitivity*

As a minimum, the monitoring equipment shall operate properly in the line terminating mode over the range of bit rates, pulse shapes and signal levels defined in § 2 of Recommendation G.703 [2]. It shall also be equipped with an additional gain to compensate for the isolation loss incurred at protected monitoring points[1] (see also Recommendation G.772 [3]). A signal level indicator, or other means, shall be provided for the proper adjustment of input sensitivity.

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[1] The specification of protected monitoring points is under study in SG XV and SG IV

2.4   *Input jitter tolerance*

The monitoring equipment shall be able to tolerate input jitter specified in Table 2/G.824 [4] without degradation of measuring accuracy.

2.5   *Input line codes*

The monitoring equipment is intended for use with both AMI and B8ZS line codes. The instrument shall have the capability to select either AMI or B8ZS, through a switch or other appropriate means. The instrument should indicate when it is receiving B8ZS when switched to the AMI mode, and vice versa.

3   Detection, measurement, and indication requirements

3.1   *Detection and indication of fault conditions*

3.1.1   *Loss of line signal*

Under study.

3.1.2   *Loss of frame alignment*

The equipment shall recognize the loss of frame alignment as defined in Recommendation G.706 [5], and an appropriate indication shall be given.

3.1.3   *Recovery of frame alignment*

The procedure for determining recovery of frame alignment shall be in accordance with Recommendation G.706 [5]. When frame recovery is complete, the indication of loss of frame alignment shall cease.

3.1.4   *Alarm indication signal (AIS) from an upstream failure*

The equipment shall recognize the presence of an alarm indication signal (AIS) indicating an upstream failure, and an appropriate indication shall be given. The binary equivalent of the AIS corresponds to an all ones signal. The strategy for the detection of the presence of an AIS shall be such that with a high probability, it is detected even in the presence of a code violation ratio of 1 in 1000.

3.1.5   *Distant alarm indication signal (DAIS)*

The equipment shall recognize the presence of distant alarm indication signal as defined in Recommendation G.733 [6], § 4.2.4 for both 12-frame and 24-frame multiframe signals, and an appropriate indication shall be given. The strategy for the detection of the presence of this distant alarm indication signal shall be such that with a high probability, it is detected even in the presence of a code violation ratio of 1 in 1000.

3.2   *Frame alignment signal (FAS) error performance measurements*

3.2.1   *Count of errored seconds*

The equipment shall be capable of counting the number of one second intervals in which one or more errors occur in the FAS bits associated with the 12-frame or 24-frame structures as defined in Recommendation G.704 [1]. The number of errored seconds in a selectable time period (see § 4.1) shall be counted and displayed. The equipment shall establish one-second intervals independent of the occurrence of errors.

3.2.2   *Count of errors*

The equipment shall be capable of counting the number of FAS bit errors occurring in a selectable time period (see § 4.1).

3.3   *CRC-6 error performance monitoring*

3.3.1   *Count of errored seconds*

The equipment shall be capable of counting the number of one-second intervals in which one or more CRC-6 violations are detected in 24-frame multiframe signals using the CRC-6 procedure defined in Recommendation G.704 [1] and G.706 [5]. The number of errored seconds in a selectable time period shall be counted and displayed. The equipment shall establish one-second intervals independent of the occurrence of errors.

3.3.2   *Performance indications*

As an option the instrument shall be capable of providing performance information in accordance with Recommendation G.821 [7].

3.3.3   *Estimate of bit-error-ratio*

This equipment shall optionally be capable of providing an estimate of the bit-error-ratio performance of 24-frame multiframe signals in the range 10^{-4} to 10^{-7} by detecting CRC-6 violations. In performing this measurement, it shall be assumed that only one bit-error has occurred each time a CRC–6 violation is detected. It is noted that this may not be an accurate estimate since more than one bit-error may occur within a 24-frame multiframe, due to the bursty nature of error occurrences.

The time interval for each bit-error-ratio measurement that is within the required range of the equipment shall be sufficiently long to include at least ten CRC violations.

3.3.4   *Count of errors*

The equipment shall also be capable of counting the number of CRC-6 violations occurring in a selectable time period (see § 4.1).

3.4   *Loss of frame-alignment count*

The equipment shall be capable of counting the occurrences of loss of frame alignment over a selectable time period (see § 4.1). Error counters shall be disabled during intervals of loss of frame alignment.

3.5   *Measurement of code violations*

If the measurement of 1544 kbit/s code violations is included, the equipment shall meet the requirements of Recommendation O.161.

3.6   *Channel time slot access*

As an option, receiving access may be provided to a selected 64 kbit/s channel at an external interface. An interface meeting the requirements of a co-directional interface output port defined in Recommendation G.703 [2], is preferred. In addition a centralized clock interface as defined in Recommendation G.703 [2] may be provided.

3.7   *4 kbit/s data link access*

Under study.

3.8   *Signaling bit access*

Under study.

4   Control and display requirements

4.1   *Measurement timer*

A measurement interval timer shall be provided for the convenience of the user when counting errors. The timer shall be adjustable from 5 minutes to 24 hours in steps of one minute or continuous. Manual "start" and "stop" controls shall also be provided.

4.2   *Count registers*

The count registers shall have a capacity of at least 99999. A separate means for indicating overflow shall be provided. Each of the registers shall be capable of being independently reset. A separate register shall be provided for each parameter or condition listed in §§ 3.1 through 3.4.

4.3   *Selection of multiframe structure*

A control shall be provided to permit a user to select whether the 12-frame or 24-frame multiframe structure is being monitored. As an option the equipment may automatically sense and display whether the signal being monitored is a 12-frame, 24-frame or neither multiframe structure.

4.4   *Lock/reset of displays*

For each of the fault condition indications given in § 3.1 means shall be provided whereby the display will remain visible until a manual reset is operated.

5   Monitoring equipment self diagnostics

5.1   As an option, an internal self diagnostic system to check for correct functioning of the instrument, shall be provided.

6   Interface for remote control and measurement results

6.1   As an option, an interface shall be provided for remote control of the frame signal monitoring equipment, and transmission of measurement results. If provided, the interface bus shall comply with one of the following:

a)   ANSI/IEEE Std 488-1978 [8]

b)   IEC Publication 625 [9]

c)   ANSI/EIA-232-D-1986 [10].

7   Operating environment

The electrical performance requirements shall be met when operating under climatic conditions as specified in Recommendation O.3, § 2.1.

References

[1]   CCITT Recommendation *Synchronous frame structures used at primary and secondary hierarchical levels*, Vol. III, Rec. G.704.

[2]   CCITT Recommendation *Physical/electrical characteristics of hierarchical digital interfaces*, Vol. III, Rec. G.703.

[3]   CCITT Recommendation *Digital protected monitor points*, Vol. III, Rec. G.772.

[4]   CCITT Recommendation *The control of jitter and wander within digital networks which are based on the 1544 kbit/s hierarchy*, Vol. III, Rec. G.824.

[5]   CCITT Recommendation *Frame alignment and cyclic redundancy check (RCR) procedures relating to basic frame structures defined in Recommendation G.704*, Vol. III, Rec. G.706.

[6]   CCITT Recommendation *Characteristics of primary PCM multiplex equipment operating at 1544 kbit/s*, Vol. III, Rec. G.733.

[7]   CCITT Recommendation *Error performance of an international digital connection forming part of an integrated service digital network*, Vol. III, Rec. G.821.

[8]   ANSI/IEEE Std 488-1978, *IEEE standard digital interface for programmable instrumentation*.

[9]   IEC Publication 625 *An interface system for programmable measuring instruments (byte serial, bit parallel)*.

[10]   ANSI/EIA-232-D-1986 *Interface between data terminal equipment and data circuit terminating equipment employing serial binary data interexchange*.