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**ITU-T**

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**SPECIFICATIONS FOR MEASURING EQUIPMENT**

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**IN-SERVICE CODE VIOLATION  
MONITORS FOR DIGITAL SYSTEMS**

**ITU-T Recommendation O.161**

(Extract from the *Blue Book*)

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## NOTES

1 ITU-T Recommendation O.161 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.

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## Recommendation O.161

### IN-SERVICE CODE VIOLATION MONITORS FOR DIGITAL SYSTEMS

(Geneva, 1980; amended Malaga-Torremolinos, 1984)

#### 1 General

This specification describes an in-service code violation monitor for the first and second level in the digital transmission hierarchy.

The pseudoternary codes to be monitored are alternate mark inversion (AMI), high density bipolar with a maximum of 3 consecutive zeros (HDB3), B6ZS and B8ZS.

#### 2 Definition of code violation<sup>1)</sup>

##### 2.1 AMI

Two consecutive marks of the same polarity. This may not be the absolute number of errors.

##### 2.2 HDB3

Two consecutive bipolar violations of the same polarity. This may not be the absolute number of errors.

##### 2.3 B6ZS

Two consecutive marks of the same polarity excluding violations caused by the zero substitution code. This may not be the absolute number of errors.

##### 2.4 B8ZS

Two consecutive marks of the same polarity excluding violations caused by the zero substitution code. This may not be the absolute number or errors.

#### 3 Input signal

##### 3.1 Interface

The code violation monitor shall be capable of operating at the following bit rates and corresponding interface characteristics as described in the appropriate paragraphs of Recommendation G.703 [1]:

- a) 1544 kbit/s;
- b) 6312 kbit/s;
- c) 2048 kbit/s;
- d) 8448 kbit/s.

##### 3.2 Instrument operation

3.2.1 The instrument may be equipped to monitor only one or two of the listed codes and operate at the appropriate bit rates for those codes.

##### 3.3 Input sensitivity

3.3.1 The instrument is required to operate satisfactorily under the following input conditions.

3.3.1.1 Input impedances and levels in accordance with Recommendation G.703 [1].

3.3.1.2 The instrument shall also be capable of monitoring at protected test points on digital equipment. Therefore, a high impedance input and/or additional gain of 30 dB (40 dB – see Note) shall be provided to compensate for the loss at the monitoring points already provided on some equipment.

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<sup>1)</sup> According to the definitions of code violations in this Recommendation it should be taken into account that the code violation monitor will not detect zero sequences which violate the relevant coding rules.

*Note* – As an option for instruments operating at an interface of 1544 kbit/s corresponding to the Recommendation cited in [1], the additional gain, where provided, shall be 40 dB.

3.3.1.3 Additionally, the instrument is required to operate satisfactorily, in both the terminated and monitor mode, when connected to an interface output in accordance with Recommendation G.703 [1] via a length of cable which can have an insertion loss of 0 dB to 6 dB at the half bit rate of the signal. The insertion loss of the cable at other frequencies will be proportional to  $\sqrt{f}$ .

3.4 *Input impedance*

3.4.1 The instrument shall have a return loss better than 20 dB under the conditions listed in Table 1/O.161.

TABLE 1/O.161

Instrument operating at (kbit/s)	Test conditions	
1544	100 ohms, nonreactive	20 kHz to 1.6 MHz
2048	75/120/130 ohms, nonreactive	40 kHz to 2.5 MHz
6312	75/110 ohms, nonreactive	100 kHz to 6.5 MHz
8448	75 ohms, nonreactive	100 kHz to 10.0 MHz

3.5 *Signal input gating*

3.5.1 The instrument shall incorporate a sampling circuit, operated from the incoming digital signal, such that the instrument senses only the voltages which are present during a short gating period at the midpoint of each digit time slot.

3.6 *Input jitter tolerance*

3.6.1 The instrument shall be able to tolerate the lower limit of maximum tolerable input jitter specified in the appropriate paragraph of Recommendation G.703 [1].

**4 Display**

4.1 The instrument shall incorporate an indicator to show the presence of a digital signal of correct amplitude and bit rate.

4.2 The code violation rate shall be indicated in the range 1 in  $10^3$  to at least 1 in  $10^6$ . Indication of code violations, occurring in the input signal and detected as defined in § 2 above, shall be determined by counting the number of code violations that occur during the period of at least  $10^6$  digit time slots.

4.3 It shall be possible to indicate the sum of the code violations. This facility will not be required at the same time as the code violation rate is being counted and displayed.

4.4 The count capacity shall be 99 999 and a separate indicator shall be given if the count exceeds this figure.

4.5 The counting sequence shall be started by operating a “start” control and shall be stopped by a “stop” control.

4.6 The counter, and its display, shall be capable of being reset.

**5 Instrument check**

5.1 A check facility shall be provided. This facility is to enable a check to be made of the display, counter and recorder output and optionally of the instrument input circuits.

5.2 Where the optional check of the input circuits is provided, the method of introducing code violations into the input digital signal shall be agreed. The violations shall be as defined in § 2 above.

## 6 Recorder output

6.1 An output signal may optionally be provided by the instrument to enable the status of the digital signal to be recorded externally in analogue and/or digital form.

6.2 For the analogue output, the signal shall vary corresponding to the measured result.

6.3 If the instrument has an analogue output, appropriate means for calibrating the external recorder shall be provided.

6.4 A possible arrangement relating the status of the digital input signal to the d.c. output signal is given in Table 2/O.161. The actual arrangement will depend upon the count period specified for the instrument (see § 4.2 above).

6.5 For the digital output of the measurement result, where provided, a parallel signal in binary coded decimal (BCD) form with transistor-transistor logic (TTL) levels shall be used.

## 7 Operating environment

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

TABLE 2/O.161

Status	Deflection (mA or volts)	Tolerance (mA or volts)
No signal	0	–
Valid signal	5	± 0.2
Violation rate $\geq 1 \cdot 10^{-3}$	2	± 0.2
Violation rate $\geq 1 \cdot 10^{-4}$	2.5	± 0.2
Violation rate $\geq 1 \cdot 10^{-5}$	3	± 0.2
Violation rate $\geq 1 \cdot 10^{-6}$	3.5	± 0.2
Single code violation	4	± 0.2

### Reference

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