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**SPECIFICATIONS FOR MEASURING EQUIPMENT**

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**PHASE AND AMPLITUDE HIT COUNTERS  
FOR TELEPHONE-TYPE CIRCUITS**

**ITU-T Recommendation O.95**

(Extract from the *Blue Book*)

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## NOTES

1 ITU-T Recommendation O.95 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.95**

**PHASE AND AMPLITUDE HIT COUNTERS FOR TELEPHONE-TYPE CIRCUITS**

(Geneva, 1980)

**1 General**

This specification provides the outline requirements for an instrument to be used for counting phase and amplitude hits on telephone-type circuits. The instrument will independently count the number of phase hits and the number of amplitude hits that occur in a given period of time.

Phase or amplitude hits are defined as sudden positive or negative changes in phase or amplitude of an observed test signal which exceed a specified threshold and persist for a period of time greater than a specified duration.

The specifications given below for the transmitter and receiver input section shall correspond with §§ 2.2 b) to 2.2 d) and §§ 2.3 b) to 2.3 d) of Recommendation O.91 in order to facilitate the combination of this instrument with a phase jitter meter conforming to Recommendation O.91 in one set.

**2 Transmitter**

- 2.1 Test signal frequency ..... 1020 ± 10 Hz
- 2.2 Send level..... -30 dBm to 0 dBm
- 2.3 *Output impedance* (frequency range 300 Hz to 4 kHz)
  - Balanced, earth free (other impedances optional) ..... 600 ohms
  - Return loss..... ≥ 30 dB
  - Output signal balance ..... ≥ 40 dB
- 2.4 Phase jitter at source ..... ≤ 0.1 degree peak-to-peak (see Recommendation O.91)

**3 Receiver input section**

3.1 *Sensitivity and frequency range*

The receiver should be capable of measuring with input levels between - 40 and +10 dBm and frequencies between 990 and 1030 Hz.

3.2 *Selectivity*

Power line hum protection – high-pass filter with a nominal cutoff frequency of 400 Hz with at least 12 dB per octave slope.

If the filter is not located directly at the instrument input, hum voltages equal to or smaller than the test signal shall not result in measurement errors greater than those with the filter in front of the set.

Protection for limiter against channel noise – low-pass filter with a nominal cutoff frequency of 1800 Hz with at least 24 dB per octave slope.

3.3 *Input impedance* (frequency range 300 Hz to 4 kHz)

- Balanced, earth free
- Input longitudinal interference loss ..... ≥ 46 dB
- 3.3.1 *Terminating impedance* (other impedances optional) ..... 600 ohms
  - Return loss..... ≥ 30 dB
- 3.3.2 *High impedance* ..... approx. 20 kohms
  - Bridging loss across 300 ohms ..... ≤ 0.15 dB

## **4 Phase hit detection characteristics**

### *4.1 Threshold settings*

Settings from 5° to 45° in steps of 5° shall be provided with an accuracy of  $\pm 0.5$ ,  $\pm 10\%$  referred to the selected threshold<sup>1)</sup>. Additional settings may be optionally provided.

### *4.2 Guard interval*

A guard interval shall be provided by electronic gating or other equivalent means to prevent the counter from registering phase hits shorter than 4 ms. The guard interval shall be tested as follows:

With a threshold setting of 20°, phase hits shall be counted correctly if the test signal is changed in phase by 25° for a duration of 5 ms or more. When the duration of the 25° phase changes is gradually reduced until the phase hit counter stops counting, the corresponding duration of the phase changes of the test signal shall be 4 ms  $\pm 10\%$ .

### *4.3 Hit rate of change*

Slow phase changes shall not be counted. This characteristic shall be tested as follows:

With a threshold setting of 20°, a phase hit shall be counted when the phase of a test signal is linearly varied by 100° in a time interval of 20 ms or less. A phase hit shall not be counted when the phase of the test signal is linearly varied by 100° in a time interval of 50 ms or more. The same requirements shall be met with 100° changes of opposite polarity.

### *4.4 Amplitude of phase conversion*

An 8 dB amplitude hit of either polarity shall not cause a phase hit to be counted at thresholds of 10° or more.

## **5 Amplitude hit detection characteristics**

### *5.1 Threshold settings*

Settings of 2, 3 and 6 dB shall be provided with an accuracy of  $\pm 0.5$  dB. Additional settings not exceeding 9 dB may be optionally provided.

### *5.2 Guard interval*

A guard interval shall be provided by electronic gating or other equivalent means to prevent the counter from registering amplitude hits shorter than 4 ms. The guard interval shall be tested as follows:

With a threshold of 2 dB, amplitude hits shall be counted correctly if the test signal is changed in amplitude by 3 dB for a duration of 5 ms or more. When the duration of the 3-dB amplitude changes is gradually reduced until the amplitude hit counter stops counting, the corresponding duration of the amplitude changes of the test signal shall be 4 ms  $\pm 10\%$ .

### *5.3 Hit rate of change*

Slow amplitude changes shall not be counted. This characteristic shall be tested as follows:

With a threshold setting of 2 dB, an amplitude hit shall be counted when the level of a test signal is linearly varied by 4 dB in a time interval of 200 ms or less. An amplitude hit shall not be counted when the amplitude of the test signal is linearly varied by 4 dB in a time interval of 600 ms or more. The same requirements shall be met with 4-dB changes of opposite polarity.

### *5.4 Phase to amplitude conversion*

A 180 degree phase hit shall not cause an amplitude hit to be counted at any threshold.

## **6 Count capacity**

The counting apparatus shall be equipped with independent phase and amplitude hit counters each having a register capacity of at least 9999 counts.

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<sup>1)</sup> This specification should not preclude the use of existing instruments which have tolerances of  $\pm 2 \pm 5\%$  on the accuracy of the threshold setting.

## **7 Counting rate and dead time**

The maximum counting rate for either phase or amplitude hits shall be approximately 8 counts per second, which can be accomplished with a dead time of  $125 \pm 25$  ms after each recognized phase or amplitude hit. For the purpose of this specification, the dead time is defined as the time interval that starts when a phase or amplitude hit exceeds the threshold, and ends when the phase or amplitude counter is ready to register another phase or amplitude hit. This characteristic shall be tested as follows:

With a threshold setting of  $20^\circ$ , phase hits having a duration of approximately 5 ms shall be counted correctly when the repetition rate is 5 hits per second or less. When the repetition rate is gradually increased until the phase hit counter fails to register all counts, the repetition rate shall be 8 hits per second  $\pm 20\%$ . The same requirement shall apply to the amplitude hit counter with a threshold of 2 dB when 3-dB amplitude hits having a duration of approximately 5 ms are applied.

## **8 Interruption of the test signal**

If transmission of the signal is interrupted and the received test signal drops in level by 10 dB or more, the phase and amplitude hit detectors shall be blocked from counting until  $1 \pm 0.2$  s after the test signal is restored. There shall be a maximum of 1 phase hit and 1 amplitude hit recorded with each interruption of the test signal.

## **9 Timer**

A timer accurate to  $\pm 5\%$  shall be provided for the convenience of the operator. Periods of 5, 15 and 60 minutes and continuous operation should be provided under switch control if the timer is not continuously adjustable.

## **10 Auxiliary logic output**

Auxiliary two-state logic outputs shall be provided from the phase and amplitude detectors for recording or computer processing of phase and amplitude hit activity. A logic "1" signal shall be output when the hit is present and a logic "0" signal at other times. The output levels shall be compatible with TTL (Transistor-Transistor Logic) integrated circuits. The output impedance shall be less than 2000 ohms or as specified by individual Administrations.

## **11 Operating environment**

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

## **12 Simultaneous measurements**

The measurement of amplitude and phase hits may be provided in one instrument which also makes measurements of other transient impairments e.g. impulse noise, interruptions. Therefore, in order to facilitate the integration of several measurements of transient phenomena into one instrument, the measurement of interruptions in accordance with the principles of Recommendation O.61, but made with a test signal frequency of  $1020 \text{ Hz} \pm 10 \text{ Hz}$  could be included in such a combined instrument.