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SPECIFICATIONS FOR MEASURING EQUIPMENT EQUIPMENT FOR THE MEASUREMENT OF ANALOGUE PARAMETERS

PSOPHOMETER FOR USE ON TELEPHONE-TYPE CIRCUITS

ITU-T Recommendation O.41

(Previously "CCITT Recommendation")

FOREWORD

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The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 1 (Helsinki, March 1-12, 1993).

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NOTE

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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ABSTRACT

Defines the basic requirements for an instrument to measure noise and other interfering signals on telephone circuits.

KEYWORDS

Complex impedances, measurement, noise measurement, psophometer, tester, weighting filter.

Recommendation O.41

PSOPHOMETER FOR USE ON TELEPHONE-TYPE CIRCUITS*(Published 1972; revised 1984, 1988, 1992, 1995)***1 Introduction**

This Recommendation provides basic requirements for psophometers to be used for the measurement of noise and other interfering signals on international telephone circuits and circuit sections.

2 General

To accomplish the measurements as stated above, a psophometer should have the following significant characteristics:

- a) The relative sensitivity of the instrument, at various frequencies, should be as specified by the psophometric weighting characteristics. (See Note.)
- b) The reference point for the sensitivity of the instrument should be 0 dBm (one milliwatt) at 800 Hz.
- c) The r.m.s. (root mean square) value of the weighted noise signal should be detected and displayed. (See Note.)
- d) The dynamics of the detector and display device should meet requirements given in clause 3.
- e) The overall accuracy of the instrument when being used in its normal range and environmental conditions should be ± 1.0 dB or better. Specific tests for accuracy of various aspects of the instrument are given in clause 3.

NOTE – The characteristics of the weighting filter combined with an r.m.s. detector can be described by the formula (P_p means psophometric power):

$$P_p = \frac{1}{F_2 - F_1} \cdot \int_{F_1}^{F_2} \frac{V^2(f)}{10^{-3} \cdot |Z_n(F_0)|} \cdot 10^{W(f)/10} \cdot df \quad \text{mVA}$$

In this formula, $W(f)$ is the weighting filter of the psophometer with the limiting frequencies $F_1 = 16.66$ Hz and $F_2 = 6$ kHz as given in Table 1. $Z_n(F_0)$ is the input impedance of the instrument at the reference frequency F_0 . V is the unknown voltage to be measured. See also Annex A/G.100 [3].

Annex A provides a comparison of the ITU-T psophometric and North American (C-message) noise weighting currently in use.

3 Specific requirements

The following provides a minimum set of requirements that should be met by an instrument used as a psophometer.

3.1 Input impedance

All given impedances are for a balanced (earth free) input. The impedance to ground at 800 Hz shall be > 200 k Ω .

3.1.1 Terminating mode

When used in a terminating mode, the input impedance shall be 600 ohms with a return loss of ≥ 30 dB from 300 to 4000 Hz.

3.1.2 Bridging mode

When used in a bridging mode, the tapping loss across 300 ohms shall be ≤ 0.15 dB from 300 to 4000 Hz.

3.1.3 Complex input impedances

For measurements at interfaces with complex impedances, the instrument shall be equipped with corresponding input impedances. Examples for such impedances are given in Table 1/Q.552 [6].

For this application, the instrument shall be calibrated in accordance with A.3/G.100 [3], namely:

At the reference frequency of 1020 Hz, 0 dBm0 represents an absolute power level of 1 milliwatt measured at the transmission reference point (0 dBr point).

The voltage V of a 0 dBm0 tone at any voice band frequency is given by the expression:

$$V = \sqrt{1 \text{ W} \cdot 10^{-3} \cdot |Z_{1020}|}$$

where $|Z_{1020}|$ is the modulus of the nominal impedance, Z , at the reference frequency 1020 Hz. Z may be resistive or complex.

If the psophometer is not equipped with complex input impedances, measurements can be carried out using an appropriate impedance converter. (See e.g. Annex B/P.64. [7].) An impedance converter is a circuit that an input impedance equal to the applicable nominal complex impedance and an output impedance equal to 600 Ω . The output is decoupled from the input. The gain of the circuit is such that 0 dBm at the input equals 0 dBm at the output. This means that the level meter reads the level correctly in dBm.

When calibrating for weighted noise measurements at interfaces with complex impedances, the loss characteristic of the weighting filter at the two frequencies 800 Hz and 1020 Hz has to be taken into account. See Annex B.

3.2 Longitudinal losses

Input longitudinal interference loss and longitudinal conversion loss shall be ≥ 110 dB at 50 Hz. This requirement decreases 20 dB per decade to 5000 Hz. (The impressed longitudinal r.m.s. voltage shall not exceed 42 V.)

3.3 Measuring range

The usable measuring range of the instrument shall be -90 to 0 dBm.

3.4 Calibration accuracy at 800 Hz

The output indication shall be 0 dBm ± 0.2 dB with an input signal of 0 dBm at 800 Hz. For other levels over the usable measuring range of the instrument, the measurement error limits shall be as follows:

Range	Error limit
0 à -60 dBm	± 0.5 dB
-60 à -90 dBm	± 1.0 dB

3.5 Relative gain versus frequency (frequency weighting)

The required frequency weighting coefficients and accuracy limits at various frequencies are given in Table 1. In addition, the equivalent noise bandwidth of the weighting network shall be 1823 ± 87 Hz.