THE EBU STANDARD PEAK-PROGRAMME METER FOR THE CONTROL OF INTERNATIONAL TRANSMISSIONS

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Note: This Technical Document is now superseded by EBU R128, “Loudness normalisation and permitted maximum level of audio signals”. The current document is therefore kept only as a historical record.

CONTENTS

INTRODUCTION

From the earliest days of broadcasting there has been a need for an instrument capable of measuring the amplitude of the electrical signals corresponding to a sound programme. This need arises because of the conflict between the artistic requirement that the relative loudness of the various parts of a sound programme should correspond at the listener's ear to the dramatic effects intended, and the technical requirements imposed by the limited dynamic range available, in any transmission chain, between the noise level on the one hand and the onset of unacceptable distortion on the other. Because the human ear is subject to adaptation and fatigue and the opinions of a listener are affected by subjective judgements of the interest of the programme material, many organisations have produced instruments which give an instantaneous indication of the approximate amplitude of the signals in a form which can be observed visually, and is thus practically immune from these disadvantages.

With the expansion of broadcasting leading to exchanges of programmes between organisations in different countries, the need for standardisation of the characteristics of the programme-volume indicating instruments was soon recognised, and attempts to obtain international agreement on this point were made by organisations such as the former C.C.I.F., the C.C.I.R., the former U.I.R., the O.I.R.T. and the E.B.U. Agreement was not achieved, due partly to the desire of many organisations to avoid changing instruments with which their staff were already familiar, and also because the requirements for the instrument intended for use in the studio control room are not necessarily the same as those for an instrument used to supervise the international exchange of programmes.

As a result of the difficulties with the transmission of the sound components which have been encountered in programme exchanges within the framework of Eurovision, particularly when mixing signals from sources in different countries, the E.B.U. decided to determine the desirable features of a programme-volume indicator that might be standardised for use in the supervision of international programme transmissions. To avoid the complication mentioned above, the intention was expressed that this standard instrument should be installed in addition to the existing national instrument, essentially at points where international programme exchanges were frequently supervised.

The characteristics were originally defined by the sound Sub-group of Working Party M of the E.B.U. Technical Committee and were published in the first edition of this document. Several manufacturers produced instruments to this specification and the E.B.U. standard peak-programme meter is now widely used by broadcasters for the control of international sound-programme transmissions.

The data contained in the first edition was submitted to Sub-committee 29B (Audio Engineering) of the International Electrotechnical Commission for inclusion in Publication 268-10 which deals with programme level meters. The I.E.C. recognizes three types of peak-programme meters, namely types I, IIa and IIb. Types IIa and IIb differ only in respect of the scale divisions and marking and in fact the latter corresponds to the standard E.B.U. meter. Sub-committee 29B made several minor amendments and additions to the characteristics as set out in the first edition of this document and Sub-group T4 of E.B.U. Working Party T decided that a second revised edition should be published to take account of these changes. This document covers only the E.B.U. standard peak-programme meter (type IIb); I.E.C. Publication 268-10 and its supplement Publication 268-10A should be consulted for information on other types.

GENERAL

The principal special features of this instrument are as follows:

a) It may be used in either of two conditions.

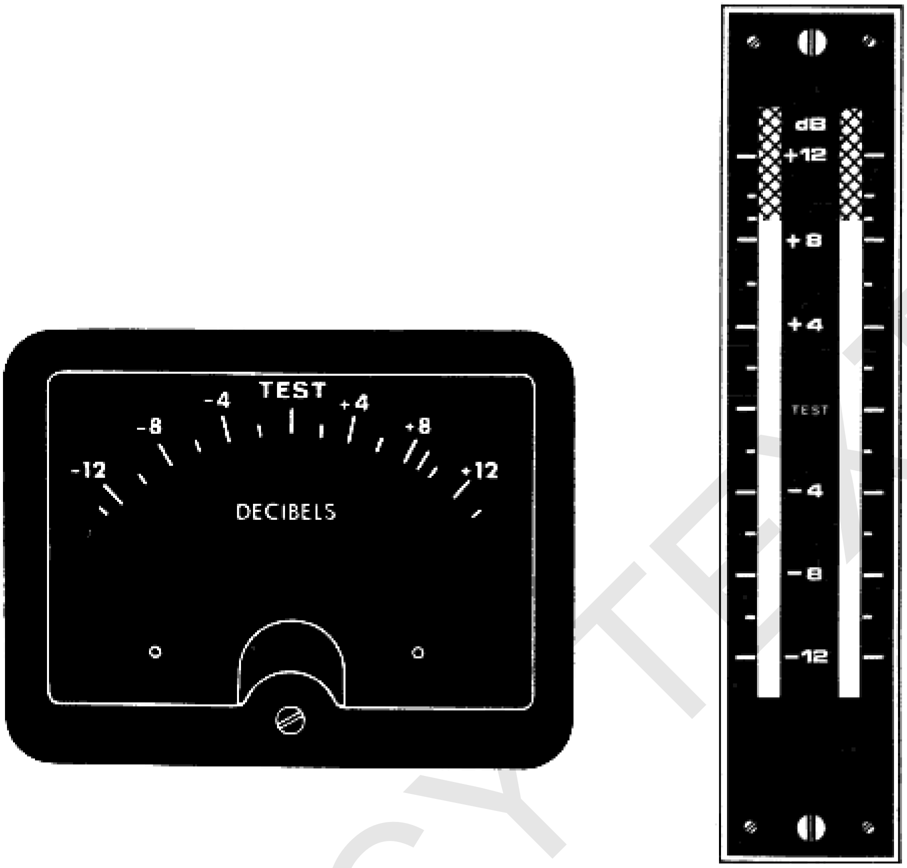
In the first condition (normal mode) it is a quasi-peak-reading instrument having a nominal integration time* of 10 ms and it is used for measuring the test signals and for monitoring the programme volume at the ends of an international circuit.

In the second condition (slow-indication mode), obtained by the operation of a non-locking switch, the integration time is greatly increased so that the programme signals are averaged over a period of about one second. It is then suitable for the comparison of programme volume at different points along a circuit.

b) It is fitted with a scale specially adapted to the primary purpose of the instrument (Fig. 1). The sensitivity of the meter must be set so that the calibration point marked "Test" corresponds to the level of line-up tone that is normally used by broadcasting organisations to verify the alignment of international sound-prograrnme circuits; that is, 0 dB, referred to 0.775 V MS, at a zero relative level point. This level is 9 dB below the maximum amplitude of programme signals transmitted on international sound-programme circuits permitted according to C.C.I.T.T. Recommendations. The term "Test" has been chosen to avoid confusion between absolute and relative levels; it should be noted, however, that the transmission of continuous tones at "Test" level on international sound-programme circuits is no longer permitted under C.C.I.T.T. Recommendations (See J.14, Vol. 111-2).

It is desirable that it should be possible to increase the sensitivity of the meter by 10 or 12 dB when required for monitoring the level of continuous test tones, which are normally transmitted at 12 dB below "Test" level.

* The integration time is defined by the I.E.C. as "the duration of a burst of sinusoidal voltage of 5000 Hz at reference level which results in an indication 2 dB below reference indication".



(a)

(b)

Fig. 1. The E.B.U. standard peak-programme meter: scale design and calibration

a) mechanical (galvanometer) Instruments

b) Electro-luminescent displays (two-channel version &bows)

CHARACTERISTICS OF THE STANDARD INSTRUMENT

1. Presentation

1. 1. Scale

The scale shall be divided into twelve approximately equal 2 dB divisions marked in white on a matt black surface. The general form of the scale and the system of marking are given in Fig. 1. The principal scale markings are the points at 4 dB intervals above and below the "Test" level mark, which is at the mid-scale position. There is an additional mark at the point 9 dB above test level. The total scale length shall be not less than approximately 8 cm.

1.2. Indication

Where a rigid mechanical pointer is used, this shall be of the parallel type, i.e. not tapered, usually white in colour and having at least 50% of its length clearly visible at any deflection.

Where a luminous display is used, the reading shall be given in the form of a continuous column, as opposed to a single moving spot.

Overload (readings exceeding +9) shall, in instruments using electro-luminescent displays, be indicated by a colour change or an increase in the brightness of the display. Mechanical instruments may be provided with a warning light. either incorporated in the meter case or fitted externally.

2. Static Performance

2.1. Calibration

Facilities for the gradual adjustment of the no-signal and sensitivity indications shall be provided so that::

a) Mechanical (galvanometer) displays only: after mechanically setting the pointer to the end of the scale with the power supply "off", the pointer can be set by adjusting the zero control to give the same reading with the input terminals short-circuited;

b) All instruments: when a steady, pure sinusoidal tone at a frequency near 1 kHz and of 0.775 V RMS amplitude (or a known number of decibels above or below this value, corresponding to the setting of an internal attenuator) is applied to the input, the instrument can be set to indicate the "Test" position exactly*[*].

2.2. Calibration tolerances

When a sinusoidal voltage at 1 kHz having a distortion less than 1% is applied to the input terminals the indication shall be within the limits given in *Table 1*.

Table I.- Calibration tolerances

Indicating instrument reading (neglecting drift due to temperature or supply voltage variation)	Relative input voltage . (rms) (dB)
Minimum	-∞
-12	-12 ± 0.5
-8	-8 ± 0. 3**
-4	-4 ± 0.3
Test	0
+4	+4 ± 0.3
+8	+8 ± 0. 3**[**]
+12	+12 ±0.5

[*] This does not correspond to the normal alignment procedure, in which the sensitivity at the -8 dB point is adjusted first.

[**] It is preferable that the amplifier controls are arranged that the errors on the values "minimum", -8, 0 and +8 may be eliminated simultaneously

2.3. Amplitude-frequency response

Within the range 31.5 Hz to 16 000 Hz, the deviations from the ideal "flat" response shall be less than ±0.3 dB at each scale division between -8 and +8 inclusive.

Above 16 kHz, the response shall fall smoothly to at least 100 kHz and lie between the limits of 0 dB and -6 dB at 40 kHz. Below 31.5 Hz, the response shall lie within ±2 dB down to 12 Hz and fall smoothly below this frequency.

2.4. Reversibility error

This is the difference in level indication when the polarity of a specified asymmetrical signal is reversed.

A sinusoidal voltage is applied to the input terminals and its amplitude adjusted to give an indication of +9. The signal is then clipped so that the peaks of the half-waves of one polarity are reduced to 25% of their original value. The DC component is removed. The reading is noted. The polarity of the asymmetrical signal is inverted. The reading is noted. The difference between the first and second readings shall not be greater than 0.5 dB.

3. Dynamic response

3 1 Normal mode

When an isolated rectangular burst of sinusoidal voltage at 5 kHz, and of amplitude such that when continuously applied gives an indication of +8 dB, the relation between burst duration and indication shall be in accordance with Table 2.

Table 2- Dynamic performance In normal mode

Burst duration (ms)	Indication	Tolerance (dB)
100	+8	± 0.5
10	+6	± 0.5
5	+4	± 0.75
1.5	-1	± 1.0
0.5*	-9	± 2.0

* Since it is necessary for the tone-burst to include a minimum of five cycles, a frequency of at least 10 kHz is required for this measurement.

3.2. Slow mode

When an isolated rectangular burst of sinusoidal voltage at 5 kHz, and of amplitude such that when continuously applied gives an indication of +8 dB, the relation between burst duration and indication shall be in accordance with table 3.

Table 3.- Dynamic performance In slow mode

Burst duration (ms)	Indication	Tolerance (dB)
5000	+8	± 0.5
10	-3	± 1
10 (repeated every 100 m)	+7	± 0.5

Note: The above values apply to instruments in which the integration circuit precedes the logarithmic stage. Early instruments, while giving equivalent readings on programme signals, had a different arrangement and the above values do not therefore apply.

3.3. Integration time

The integration time is defined as the duration of a burst of sinusoidal voltage of 5000 Hz, of amplitude such that if continuously applied gives an indication of +9, which results in an indication of +7. The integration time in normal mode shall be 10 ±2 ms.

3.4. Pulse response (normal mode)

Isolated unidirectional rectangular pulses with a duration of about 1 ms are applied to the input terminals and the pulse amplitude adjusted to give a reading of "Test". When the pulse duration is progressively shortened to less than 50 us the indicated reading shall progressively decrease. The indicated reading for a pulse duration of 100 us shall not be higher than -10.

3.5. Dynamic linearity within scale range (normal mode)

When the amplitudes of successive tone bursts having a constant duration of 10 ms (the amplitude of the initial burst having been adjusted to give an indication of +9) are reduced progressively, the indications shall decrease by directly proportional amounts (within 1 dB) over the scale range of the instrument.

3.6. Dynamic response below minimum calibration point (normal mode)

Isolated 10 ms bursts of 5 kHz at a level of -21 dB with respect to "Test" shall cause just-perceptible movements of the display.

3.7. Overload characteristic (normal mode)

When the amplitude of isolated 5 kHz bursts of 1.5 ms duration at an amplitude that when continuously applied gives an indication of +9 dB, is increased by 10 dB the resulting increase in reading shall be not less than +5 dB and not greater than +10 dB.

3.8. Delay time

When a sinusoidal voltage of 1000 Hz, at an amplitude that gives a steady-state reading of +9, is applied to the input terminals the indication shall pass through the +8 mark after a time interval not greater than 150 ms.

3.9. Overswing

When a sinusoidal voltage of 1000 Hz, at an amplitude that gives a continuous reading of +9, is suddenly applied to the input terminals, the transitory excess of indication shall not exceed 0.5 dB.

3.10. Return time

When a 1 kHz sinusoidal voltage at an amplitude that gives a continuous reading of +12 is suddenly removed from the input, the indication shall fall to the -12 mark in 2.8 ±0.3 s in the normal mode, and in 3.8 ±0.5 s in the slow mode. The return speed should be approximately constant.

4. Miscellaneous characteristics

4.1. Input impedance

The input impedance shall be at least 50 times the highest value of source impedance to which the instrument is likely to be connected and this impedance shall be maintained at all frequencies between 31.5 and 16 kHz. This implies an input impedance of at least 30 kΩ for use on a 600-Ω circuit.

4.2. Distortion introduced by the instrument

The total non-linear distortion introduced by the instrument into a source of 600- Ω impedance shall be less than 0.1% even if the power supply to the instrument is switched off.

4.3. Temperature range

The drift in indicated readings with a change in ambient temperature from +I0°C to +50°C shall not exceed the values given in Table 4.

Table 4.- Temperature-dependent drift

Indication	Minimum	- 8	TEST	+ 8
Drift	3.75% of scale length	± 1.3 dB	± 0.5 dB	± 0.2 dB

4.4. Overload input level

It shall be possible to apply a sinusoidal signal to the instrument at a level at least 29 dB above "Test" level (62 V peak-to-peak) for an unlimited period of time without resultant damage to the instrument or effect on the calibration.

4.5. Supply voltage range

When the power supply voltage varies between +10% and -10% of the rated value, the drift in indicated readings shall not exceed the values given in Table 5.

Table 5- Voltage-dependent drift

Indication	Minimum	+8
Drift (total)	2.5% of scale length	0.5 dB

Correction of "zero" drift by electrical adjustment shall result in a reduction of calibration errors.

Appendix 1

Additional information for mechanical (galvanometer) instrument:s

1. Characteristics of standard meter movement

Full-scale current

1 mA ±2%.

Calibration of indicating instrument

The relationship between the deflection and current shall be as shown in Table 6, to an accuracy of ±1% of the full-scale value.

Table 6- calibration

Scale mark	% full-scale current
Minimum scale value	0
-12	10
-8	22
-4	35
Test	51
+4	67
+8	80
+12	93
Full scale	100

Damping

When a direct current giving a pointer deflection to mark +12 is suddenly applied from a source resistance of 100 kΩ ±5%, the pointer overshoot shall not exceed 5% of the steady-rate reading.

Speed

When a rectangular, unidirectional pulse of the stated duration and with a peak e.m.f. equal to the steady (d.c.) e.m.f. which causes a pointer deflection to the mark of +12 is applied to the indicating instrument from a source resistance of 6.2 Ω ±5%, the response shall be as shown in Table 7.

Table 7.- Dynamic response

Pulse duration	Peak reading
80 ms	+8.5 ± dB
20 ms	-7 ± dB

2. Slow mode of operation

The slow mode may be obtained by inserting a network with the following characteristics between the output of the processing amplifier and the display device.

The total resistance of the meter circuit should be ascertained (including the output resistance R_S of the processing amplifier, the resistance of display device R_M and any series resistance R_L provided to allow for the possibility of adding extra display devices in series with the main one) and this value divided in the proportions 5 : 3 (the former corresponding to the source resistance). A capacitor of value such that when its value is multiplied by the total load resistance calculated above gives a product equal to 1.15 s should be connected between the points in the circuit. which divide it in the ratio previously mentioned.

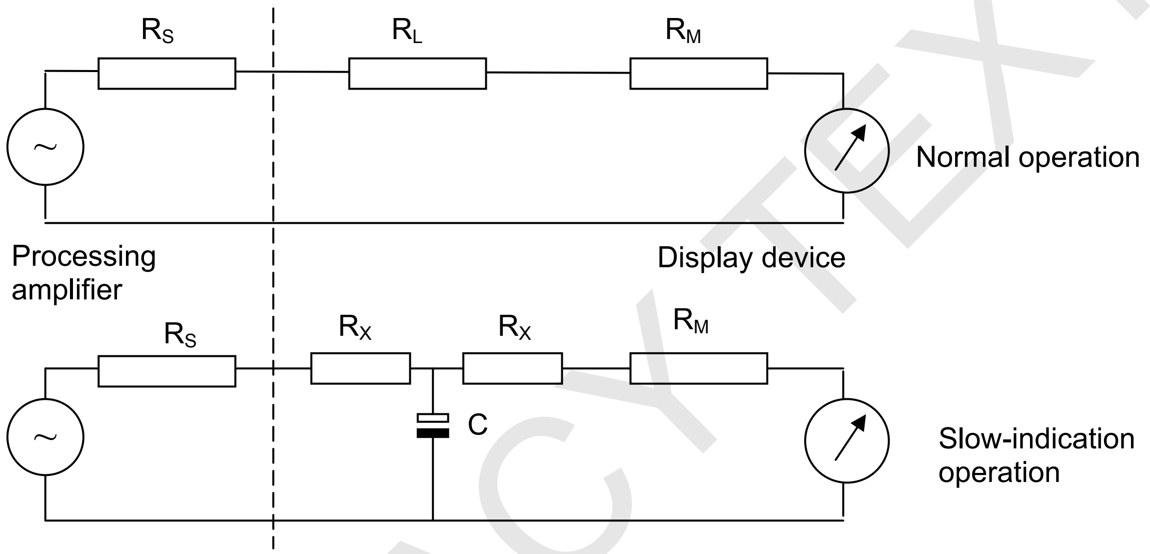


Fig. 2 Circuit used to obtain the slow-indication mode

The values of C, Rx and Ry are determined by the following equations:

$R_X + R_Y = R_L$ $\qquad \dfrac{R_S + R_X}{R_M + R_Y} = 1.3$ $\qquad C(R_M + R_Y) = 1.15$ s

Note: The above values apply to instruments having the logarithmic stage preceded by the integration circuit. Early instruments arranged differently use other values in order to give the same readings on programme signals.

APPENDIX 2

Comparison with indications produced by other instruments

Although it is very desirable that instruments complying with the foregoing specifications should be available for use at all points at which international sound-programme transmissions are monitored, it is inevitable that on some occasions this will not be the case. In order to avoid the need to allow an excessive margin of safety, which of course would restrict the dynamic range of the signals that could be handled, however, it is essential that the relationship between the peak allowable signal level and the pre-transmission line-up tone level originated at the programme source should be maintained at all intermediate points and at the destination, even if instruments of different types are in use. Table 8 illustrates the levels indicated at a zero relative-level point by instruments of various types in common use for:

a) continuous line-up tone set at the originally recommended value of 9 dB below the peak-allowable level *;

b) the proposed new value of 21 dB below the peak-allowable level.

It should be noted that the values quoted do not take into account any tolerances, or any loading of circuits by measuring instruments.

Table 8.- Comparison of Indications given by various Instruments

	Root mean square	600-Ω circuit nominal level	Level indicated at a zero point relative level point						
			EBU (IEC type IIb)	IEC-Type 1	BBC (IEC type 11a)	DIN	VU(1)	OIRT(2)	Local
a)	0.775 V	0 dBm	TEST	-9	4	-9	-4	-9	
b)	0.194 V	-12 dBm	-12	-21	1	-21	-16	-21	

Notes: (1) Although 0 VU is defined as equivalent to 0 dBm, most available VU meters are powered only from the circuit being monitored, and incorporate a 4-dB attenuator to reduce the loading, even when used at a zero relative level point.

(2) Information based on O.I.R.T. draft Recommendation No. 41-11.

(3) Insert the figures applicable to the type of instrument used by your organisation, if not included already.

* C.C.I.T.T. Recommendations J.13 and J.14, Volume III of the C.C.I.T.T. "Orange Book", (Documents of the 6th Plenary Assembly, Geneva 1976).