

RECOMMENDATION ITU-R BS.645-2<sup>\*,\*\*</sup>**Test signals and metering to be used on international sound programme connections**

(1986-1990-1992)

The ITU Radiocommunication Assembly,

*considering*

- a) that many impairments in international programme exchange on sound-programme connections are attributed to different national test signal definitions and methods of metering;
- b) that some existing definitions are found in different Recommendations of ITU-T and ITU-R;
- c) that for clarification, a list of those definitions should be available,

*recommends*

that for an international sound-programme connection only the test signals defined below should be used, in conjunction with methods of metering described in Annexes 1 and 2.

**1 Alignment signal (AS)**

Sine-wave signal at frequency of 1 kHz which is used to align the international sound-programme connection. The signal level corresponds to 0 dBu0s (see Note 1) (i.e. 0.775 V r.m.s. at a zero relative level point). In accordance with ITU-T Recommendation N.13, the period of sending the alignment signal should be kept as short as possible – preferably to less than 30 s.

NOTE 1 – The notation “dBu0s” is defined in Recommendation ITU-R V.574. Other related texts of Telecommunication Standardization Study Group 9 use the notation “dBm0s” also defined in Recommendation ITU-R V.574.

**2 Measurement signal (MS)**

Sine-wave signal at a level 12 dB below the alignment signal level which should be used for long-term measurements and measurements at all frequencies (see ITU-T Recommendations N.12, N.13, N.21 and N.23).

**3 Permitted maximum signal (PMS)**

Sine-wave signal at 1 kHz, 9 dB above the alignment signal level, equivalent to the permitted maximum programme-signal level. The sound-programme signal should be controlled by the sending broadcaster so that the amplitudes of the peaks only rarely exceed the peak amplitude of the PMS.

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\* Telecommunication Standardization Study Group 9 and Radiocommunication Study Group 6 will coordinate the future development of this Recommendation. This Recommendation should be brought to the attention of Telecommunication Standardization Study Group 4.

\*\* Radiocommunication Study Group 6 made editorial amendments to this Recommendation in 2002 in accordance with Resolution ITU-R 44.

NOTE 1 – Under these conditions a peak programme meter will indicate levels not exceeding the level of the permitted maximum signal.

A numerical example may serve to clarify this definition. The alignment signal has an r.m.s. voltage of 0.775 V and a peak amplitude of 1.1 V at a zero relative level point. The instantaneous peak amplitude of the sound-programme signal at this point should only rarely exceed 3.1 V.

Although it is intended that the peaks of the sound-programme signal should not exceed the permitted maximum signal level, an overload margin must be provided so that rare excursions of the sound-programme signal above the permitted maximum signal level may be tolerated.

NOTE 2 – Annex 1 describes the response of peak programme and vu meters to these test signals.

Annex 2 describes the principal characteristics of the various instruments used for monitoring the volume of peaks during programme transmissions.

Annex 3 gives an explanation of dBu0s and dBrs terminology.

## ANNEX 1

### **Alignment using the recommended test signals with peak programme meters and vu meters**

**1** Broadcasters have evolved, over a period of forty years, procedures for using both types of meter to control programme levels. These procedures are satisfactory to the organizations using them, so that they produce neither over-modulation, leading to distortion, nor under-modulation, leading to impairment from noise.

Although different kinds of programme material deflect the two meters differently, the organizations using them have evolved techniques that produce satisfactory level control and artistic balance within the programme.

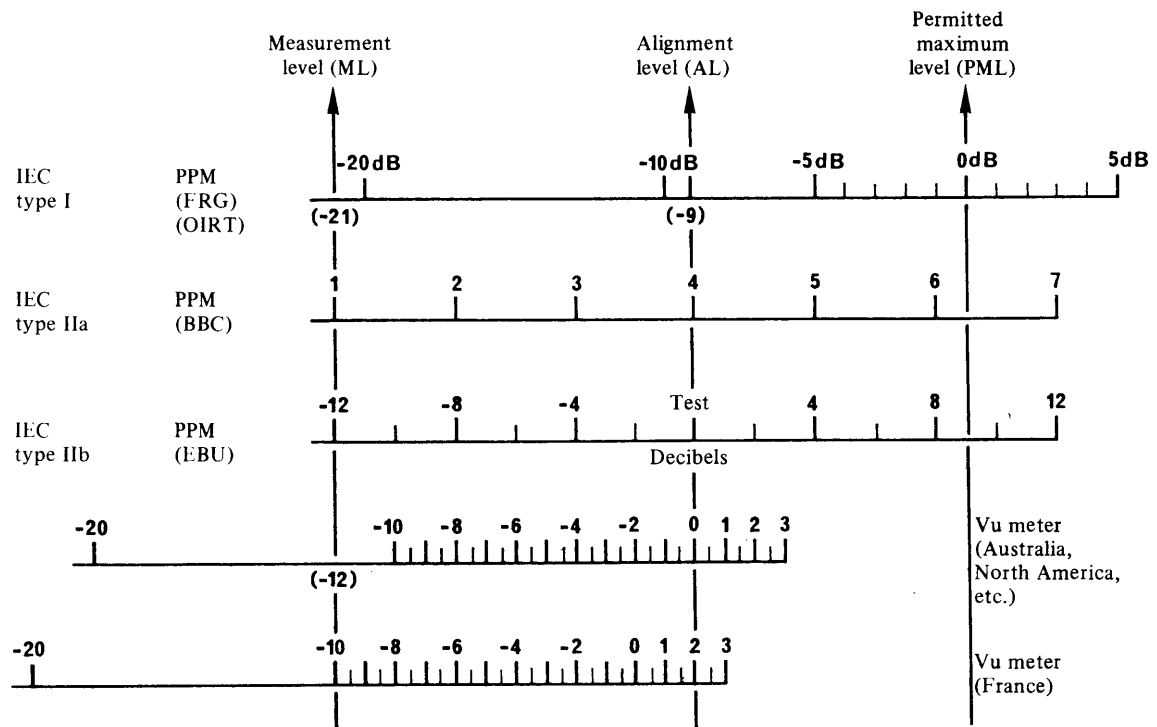
**2** The sensitivity of peak programme meters (PPM) is such that a sine-wave signal at the alignment level, 0 dBu0s, indicates “test” on an EBU PPM (this corresponds to “4” on the BBC PPM and “-9” on the PPMs of the Federal Republic of Germany and the OIRT (see Fig. 1)).

**3** The sensitivity of the vu meter is such that a sine-wave signal at the alignment level, 0 dBu0s, produces nearly full indication, 0 vu in Australia and North America and +2 vu in France (see Fig. 1).

**4** The PPM reads “quasi-peak”, that is, its peak indication on programme signals reads a little lower than true peaks. Operators are instructed to make the programme peaks give the same indication as a sinusoidal tone at +9 dBu0s (+8 dBu0s in some organizations). The true peaks of the programme are higher than indicated by up to 3 dB. When, additionally, operator errors are taken into account, the true peaks of the programme signal may reach the amplitude of a sinusoidal tone at +15 dBu0s.

FIGURE 1

Indications produced by various types of programme meter with the recommended test signals



Note 1 – Meter indications are schematic – not to scale.

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5 The vu meter indicates the mean level of the programme, which is generally much lower than the true peak. Operators are instructed to make programmes peak generally to the 0 vu reading. Experience has shown that the true programme peaks are higher than indicated by between +6 dB and +13 dB, depending on the programme material. When, additionally, operator errors are taken into account, the true peaks of the signal may be up to 16 dB higher than indicated, corresponding to the peak amplitude of a sinusoidal tone at +16 dBu0s, or alternatively +14 dBu0s when application of the alignment level signal results in +2 vu indication.

6 Thus, although the dynamic characteristics of the two meters are different, the highest peak levels encountered after control using either meter are very similar.

7 Thus, an international connection between broadcasters will be correctly aligned regardless of the type of meter employed when a sinusoidal signal at alignment level, 0 dBu0s, produces the indication appropriate to that level at both the sending and receiving ends of the circuit.

To avoid any confusion between alignment level and other levels that might be used, it is recommended that the three-level tone test signal described in ex-CCIR Recommendation 661 be used for the alignment of an international sound-programme connection.

Figure 1 illustrates the indications given by a number of programme level meters when the recommended test signals are applied to them.

## ANNEX 2

TABLE 1

**Principal characteristics of the various instruments used for monitoring the volume or peaks during programme transmissions**

Type of instrument	Rectifier characteristics (Note 3)	Time to reach 99% of final reading (ms)	Integration time (ms) (Note 4)	Time to fall (value and definition)
1 ITU-T – V.U. meter (United States of America) C 16.5 – 1954 ANSI (Note 1) and IEC Publ. 268-17	1.0-1.4	300	165 (approx.)	Equal to the integration time
2 ITU-T – Peak indicator for programme transmission used by the BBC (BBC Peak Programme Meter) (Note 2). Type IIa of IEC Publ. 268-10A	1		10	3 s for the indication to fall 26 dB
3 ITU-T – Maximum amplitude indicator used by the Federal Republic of Germany, Type 1 of IEC Publ. 268-10 and OIRT, Recommendation 59	1		5	1.7 s for the indication to fall 20 dB
4 EBU Standard peak programme meter (Note 5) EBU Tech. 3205 and Type IIb of IEC Publ. 268-10A	1	–	10	2.8 s for the indication to fall 24 dB

NOTE 1 – In France, a meter has been standardized which is similar to that defined in item 1 of this Table.

NOTE 2 – In the Netherlands, a meter has been standardized (Type NOS-SN-411) which is similar to that defined in item 2 of this Table.

NOTE 3 – The number given in this column of the Table is the exponential  $n$  in the formula  $V_{out} = (V_{in})^n$  applicable for each half-cycle.

NOTE 4 – The “integration time” was defined by ITU-R as the “minimum period during which a sinusoidal voltage should be applied to the instrument for the pointer to reach to within 0.2 N, or nearly 2 dB of the deflection which would be obtained if the voltage applied indefinitely”. A logarithmic ratio of 2 dB corresponds to 79.5% and a ratio of 0.2 N to 82%.

NOTE 5 – This meter is intended specifically for use in monitoring sound signals transmitted internationally, and therefore incorporates a scale conforming with ITU-T Recommendation N.15, calibrated in dB from –12 to +12 relative to a level marked “TEST” corresponding to 0 dBu at a zero relative level point. In addition to the normal mode of operation having the characteristics shown above, the meter may be operated temporarily in a “slow” mode facilitating the comparison of observations made at widely separate points. The peak values indicated in this mode have no absolute significance, and may only be used for such comparisons.

## ANNEX 3

**dBu0s and dBrs terminology**

**1** Transmission over long-distance circuits should be in accordance with ITU-T Recommendation J.14, considering the definitions given in this Recommendation.

**2** ITU-T Recommendation J.14 uses terminology that is not always familiar in broadcasting practice. As a result transmission has not always been satisfactory.

One important source of misunderstanding is the use of different electrical levels at various points of the chain to represent the same sound (or measurement) signal.

These points are said to have different “relative levels”.

Absolute electrical levels must therefore be accompanied by an indication of the relative level at the point of measurement.

As an alternative, the use of dBu0 (see § 3.3) may lead to expressions independent of the relative level.

**3** This Annex describes the terms in broadcasters’ language and is based on the definitions given in Recommendation ITU-R V.574. These terms are:

**3.1 dBu**

The term dBu is used to describe the r.m.s. voltage of a signal relative to 0.775 V (r.m.s.). Thus 0 dBu = 0.775 V r.m.s.

**3.2 dBr**

The term dBr is used to describe the r.m.s. voltage of a signal at a point in a system relative to the r.m.s. voltage of the same signal at a point where the alignment signal (AS) is at a level of 0 dBu.

For example, at a point of zero relative level (0 dBr) the alignment signal is at a level of 0 dBu (0.775 V r.m.s.).

**3.3 dBu0**

The term dBu0 is used to describe the r.m.s. voltage of a signal, occurring at a point which is not necessarily a point of zero relative level, as though it were occurring at a point of zero relative level (or adjusted to the voltage which would be obtained at a point of zero relative level).

For example, a 0 dBu signal occurring at a 0 dBr point is a 0 dBu0 signal; a +6 dBu signal occurring at a +6 dBr point is also a 0 dBu0 signal; a –6 dBu signal occurring at a +6 dBr point is a –12 dBu0 signal, and so on.

Levels expressed in dBu0 correspond to measurements referred to in the alignment signal.

### 3.4 dBrs and dBu0s

Telecommunication Standardization Study Group 15 has proposed that the suffix “s” be added to the terms dBu0 and dBr when these refer to sound programme transmission and not to telephone circuits. The “s” may be used where necessary in broadcasting practice to avoid confusion.

It is therefore evident that:

- $\text{dBu (voltage level)} = \text{dBu0s (normalized test signal level)} + \text{dBrs (normalizing factor)}$ .

NOTE 1 – The dBrs value is determined by circuit gain or loss.

- The addition sign must be taken to indicate algebraic addition.
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