# Broadcast Audio

RANDY HOFFNER

## SETTING AUDIO LEVELS FOR INTERNATIONAL PROGRAM EXCHANGE

● In this age of electronic sophistication, it may seem that the setting of audio levels would be a trivial pursuit. Indeed, we have been at this business of sound broadcasting long enough that such a basic operation as level setting should be the least of our worries.

When we enter the word of international audio program exchange, however, we encounter a confusing potpourri of reference levels, terminologies, and metering devices. This confusion often leads to misunderstandings between sending and receiving parties, and thereby, to audio level discrepancies.

### THE UBIQUITOUS VU METER

The vu meter has been the standard audio level indicator in this country since 1939, while the peak-program meter (ppm) has occupied that niche in most of Europe. The vu meter's ballistics and scale are well-standardized, but peak-program meters are characterized by several different sets of ballistic specifications, and numerous different scales. The European Broadcasting Union, in EBU-3205, has specified a standard peak-program meter for international program exchange. *Figure 1* contains a schematic representation of various types of ppm scales used in Europe. The IEC Type 1 scale is philosophically similar to the vu meter, being laid out in a logarithmic topology with its operating point labelled "0 dB."

**The three test levels are called alignment level (AL), measurement level (ML), and permitted maximum level (PML).**

Type IIa, the BBC scale, illustrates another scale philosophy. Like many other ppm scales, it displays 24 dB in 4 dB divisions, and is laid out in decibel-linear topology rather than logarithmic. The scale is marked not in decibels, but with the arbitrary numbers 1 through 7. Type IIb is the EBU scale, which also displays 24 dB in 4 dB divisions. On this scale, however, the mid-scale point is marked "0" and "test," and the operating point is a mark at the point 9 dB above "test." To further muddy the water, some users operate this meter at the "+8" mark.

If this state of affairs does not create sufficient confusion, standard line-up level is variously referred to as "reference level," "normal level," or "nominal level," to name a few, and is expressed in such units as vu, dBm, volts, Nepers and others.

### ATTEMPTS AT STANDARDIZATION

In an attempt to clear up the confusion associated with audio level setting and monitoring for international program exchange, the CCIR, in its Recommendation 645 (1986), recommends standard test signals for international sound program connections, and in Recommendation 661 (1986) describes a composite test signal program to be used for identification and alignment of such circuits.

Recommendation 645 describes three test signal levels. The name for each sine wave test level was carefully chosen to describe its purpose while remaining

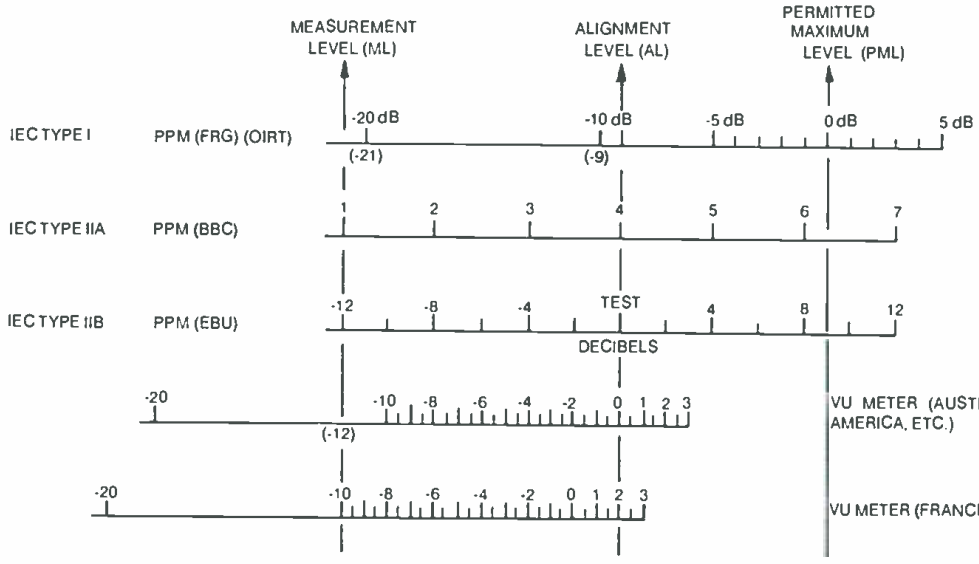


*Figure 1. A schematic representation of various types of ppm scales.*

free of ambiguity. The names were selected to avoid previous association with other names, and to be unambiguously translatable into various languages.

The three test levels are called alignment level (AL), measurement level (ML), and permitted maximum level (PML). The levels are expressed in terms of "dBmOs," which is the normalized test signal level. The normalizing factor is the "dBrs" value at the measurement point. This factor permits the absolute power level of a signal at any point in the transmission path to be determined by the equation: dBm (power level)- dBmOs + dBrs. For example, 0 dBm or one milliwatt is the actual power level at the measuring point in some European sound circuits. In that case, 0 dBmOs corresponds to an actual power level of 0 dBm and the dBrs value is 0. In North America, the actual power at sound circuit measuring points is +8 dBm. The dBrs factor at these measurement points is +8, and the circuit is described as a +8 dBr system. To give an example of what may be encountered internationally, the United Kingdom uses 0 dBr systems, the Federal Republic of Germany, -3 dBr, and France +6 dBr. The letter "s" identifies a sound program circuit, rather than a telephony circuit. The expression of relative levels in dBmOs provides a means of avoiding complications and the mental arithmetic involved in translating between the various reference and power levels often encountered at opposite ends of an international audio program circuit.

Recommendation 645, "Test Signals to be Used on International Sound-Programme Connections," recommends that only the following test signals be used.

The alignment signal is a 1 kHz sine wave signal used to align the circuit. Its level is 0 dBmOs. The measurement signal is a sine wave signal 12 dB lower in level than the alignment signal or -12 dBmOs. It is to be used for frequency response measurements and for long-term testing, as it is recommended that the alignment signal's duration be kept as short as possible. The permitted maximum signal is a 1 kHz sine wave signal at a level of +9 dBmOs. This signal is to correspond to the permitted maximum program signal level. The program signal's peaks as read on a ppm should only rarely exceed the indication of the permitted maximum signal.

**The spoken identification is followed by two seconds of silence, two seconds at measurement level, then eight seconds at alignment level.**

Figure 1 illustrates the indication that each of the three test signals will produce on various audio level meters. The 0 dBmOs alignment signal will produce a "test" or mid-scale reading on the EBU peak-program meter, or any other peak-program meter with a scale of a 24 dB in decibel-linear format. It will also produce a reading of "0" on the vu meter used in North America and Australia, while in the +6 dBr French systems, a +2 vu reading will be indicated. Note that on the Type I ppm scale, alignment level does not produce an indication on a scale mark. Measurement level falls on a definite scale mark for the BBC and EBU ppm scales and the French vu meter scale, but does not on the North American vu meter or on the Type I ppm scale. Permitted maximum level corresponds to a scale mark for the Type I and the EBU ppm scales, but falls at an unmarked point on the BBC ppm, and on a vu meter, is so far off-scale that it will result in a pinned meter. It is seen that while an EBU ppm scale, for example, can take advantage of all three test signal levels, the vu meter as used in the United States may be precisely calibrated with only one of the recommended test levels, alignment level.

## DEFINITIONS

The three test signals are defined as sine wave signals, the purpose of which is to provide calibration points in a given circuit. Permitted maximum level is a test signal, and not to be confused with the upper limit of program peaks. It is understood that the true peaks of the audio program signal will exceed the permitted maximum signal level, and that an overload margin must be provided above this level. The vu meter's average-reading ballistics produce an indication several dB below the program peaks. The peak-program meter, which would more correctly be called a quasi-peak program meter, also fails to indicate the true peak level of the audio program material, although it comes much closer to doing so than the vu meter. It is interesting and instructive to note that over the past fifty years peak-program meters and vu meters have been used to equal advantage to control audio levels. From a practical point of view, general agreement exists that the upper limit for actual program peaks is about 15 dBmOs in systems using both ppms and vu meters.

**So the three-level test program is in fact currently a two-level test program.**

## THE CCIR RECOMMENDATION

CCIR recommendation 661 describes a composite test program incorporating the three test levels. The first section is a spoken announcement which identifies the source of the signal. The spoken identification is followed by two seconds of silence, two seconds at measurement level, then eight seconds at alignment level. After the alignment level signal, channel identification is provided by two seconds at permitted maximum level in the left channel and silence in the right channel, three seconds of silence, then two seconds at permitted maximum level in the right channel and silence in the left channel. The program repeats cyclically.

It should be noted that because all transmission systems are not at present capable of carrying sinusoidal signals at +9 dBmOs without producing excessive channel loading or crosstalk into other channels, the permitted maximum level portion of the test program is presently replaced in the recommendation with a signal at alignment level. So the three-level test program is in fact currently a two-level test program. Because vu meters are pinned by the PML signal and have no mark at which to set measurement level, only alignment level may be precisely used, reducing the test program to a single-level test program in this case.

Although the three-level test signal cannot be fully used everywhere and at all times, it provides a basis for clarification of some of the confusion involving level measurement for international audio program exchange. db