

Standards project report - Considerations for accurate peak metering of digital audio signals

Published by

Audio Engineering Society, Inc.

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Abstract

Peak meters in digital audio systems often register 'peak sample' values rather than 'true peak' levels. Such meters are simple to implement, but they do not always register the true peak value of the audio signal.

Problems occur because the actual peak values of a sampled signal usually fall between sampling instants rather than precisely at a single sampling instant. This results in several peak-sample meter anomalies, including inconsistent peak readings, unexpected overloads, and under-reading and beating of metered tones

In order to meter the maximum amplitude, or true-peak value, of a sampled signal it is necessary to 'over sample' (or 'up sample') the signal, essentially using interpolation to increase the sampling frequency of the signal and thus recreating the original signal between the existing samples.

This report discusses criteria for the design of a true-peak meter and proposes appropriate over-sampling ratios to achieve true-peak metering accuracy.

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Foreword

This foreword is not part of AES-R7, *Standards project report - Considerations for accurate peak metering of digital audio signals*.

This report was produced as part of AES standards project AES-X141, *Accurate measurement and indication of peak signal levels to avoid overload of digital media*, which had been set up to contribute to a liaison with ITU-R Working Party 6P, Special Rapporteur Group 3 (6P/SG3), investigating audio level metering for interchange.

In 2005-10, SC-02-01 Vice Chair Ian Dennis wrote a note on the subject of digital peak metering, and the various problems which may be encountered in implementing a true-peak meter. The note was communicated to ITU-R 6P/SG3 through our liaison and appeared as an appendix in their final report. Since that time, although AES standards working group SC-02-01 has had the opportunity for discussion and comment, the material of Dennis' report remains essentially unchanged, except for minor changes for editorial style. Figures by Soeren H. Nielsen.

Steve Harris
Chair, SC-02-01
2006-06-13

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What's the problem?

Peak meters in digital audio systems often register 'peak-sample' rather than 'true-peak'.

A peak-sample meter usually works by comparing the absolute (rectified) value of each incoming sample with the meter's current reading; if the new sample is larger it replaces the current reading; if not, the current reading is multiplied by a constant slightly less than unity to produce a logarithmic decay. Such meters are ubiquitous because they are simple to implement, but they do not always register the true peak value of the audio signal.

So using a peak-sample meter where accurate metering of program peaks is important can lead to problems. Unfortunately, most digital peak meters are peak-sample meters, although this is not usually obvious to the operator.

The problem occurs because the actual peak values of a sampled signal usually occur 'between samples' rather than precisely at a sampling instant, and as such are not correctly registered by the peak-sample meter.

This results in several familiar peak-sample meter anomalies (see figures 1 & 2):

Inconsistent peak readings

It is often noticed that repeatedly playing an analogue recording into a digital system with a peak-sample meter produces quite different readings of program peaks on each play. Similarly, if a digital recording is repeatedly played through a sampling-frequency converter before metering, registered peaks are likewise different on each play. This is because the sample instants can fall upon different parts of the true signal on each play.

Unexpected overloads

Since sampled signals may contain overloads even when they have no samples at (or even close to) digital full scale, overload indication by a peak-sample meter is unreliable. Concealed "inter-sample" overloads, although undetected by peak-sample metering, may cause clipping in subsequent processes - for example within D/A converters or during sampling-frequency conversion or other processing. Since D/A converters have different tolerances to inter-sample overloads, it is not even possible to rely on listening to detect the presence of such overloads in a signal.

Under-reading and beating of metered tones

Pure tones (such as line-up tones) close to integer factors of the sampling frequency may under-read or may produce a constantly varying reading even if the amplitude of the tone is constant.