



## Application Note 1

# System 5 Metering: Peak vs. Average

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<b>Product:</b>	System 5 Software	<b>Software Version:</b>	All
<b>Audience:</b>	Broadcast, Post-Film, Music	<b>Document Revision:</b>	1.1
<b>Subassembly:</b>	eMix software	<b>Date:</b>	January, 2002

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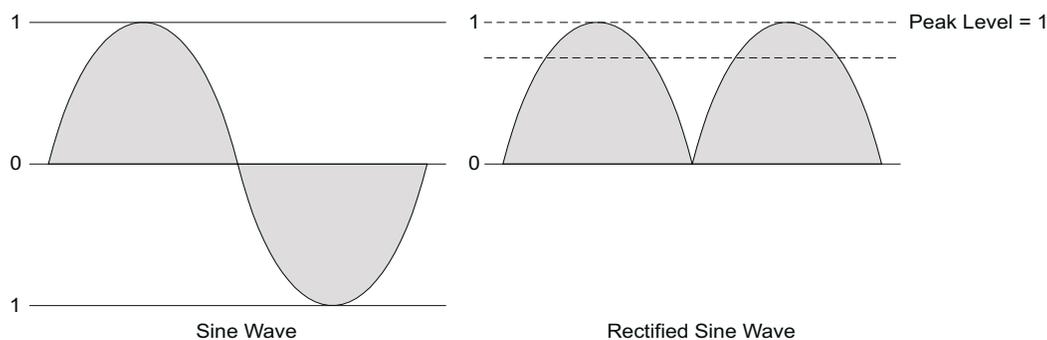
Customers have been asking us why a sine wave registers a different level in the Peak and Average metering modes on the Euphonix System 5 console. Some customers are also confused why a Dorrough Loudness Meter registers the same value for peak and average measurement of a sine wave.

### Terminology

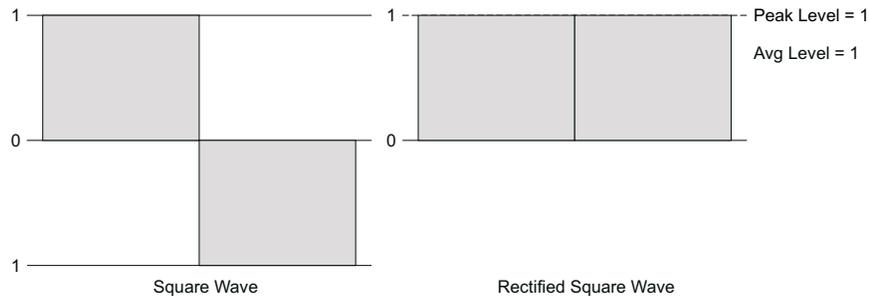
Figure 1 shows a sine wave through a complete 360° cycle. The graph depicts voltage (y-axis) changing over time (x-axis). To determine the peak and average levels of this sine wave, we must rectify it, which converts the AC voltage to DC (i.e., flips the negative voltage to positive). The peak level is determined by the maximum amplitude above the zero line, which requires no calculation, just remembering the maximum voltage.

The *root mean square* (RMS) average, which describes the energy within the sine wave, is calculated using instantaneous voltages measured over a complete cycle. A sine wave has an RMS value of 0.707 times its peak value. On a logarithmic dB scale, the difference between a sine wave's peak and RMS average level is 3 dB.

Euphonix bases its metering on the Audio Precision measurement system, which adheres to the RMS average technique. What you see on a Euphonix meter is the mathematical truth!



**Figure 1** Sine Wave



**Figure 2** Square wave

## Dorrough and Euphonix Metering Techniques

The Dorrough technical manual states, “The peak excursion and persistence amplitude are equal under steady-state, sine wave conditions.” *Persistence amplitude* refers to the method by which Dorrough establishes their average value; it is *not* an RMS average. Why does a Dorrough Loudness Meter show a zero average and zero peak for a sine wave? It has been a convention in the audio industry to *display* a sine wave’s peak and average values as 0 on a VU meter. Remember, this is not the *actual* RMS average; it is just how the meter responds. Dorrough has chosen to implement their averaging technique to yield this familiar result.

An anomaly arises, though, when a Dorrough meter measures a square wave (Figure 2). It is clear from Figure 2 that the square wave’s RMS average and peak values are equal. A Dorrough meter presents a perplexing result: the peak level is 3 dB *lower* than the average level.

Fortunately, there is a reasonable explanation for this! Dorrough depends on the audio industry’s penchant for using sine waves to make calibration measurements and designed their meters accordingly; the square wave anomaly is considered an acceptable trade-off. Furthermore, sine and square waves are generated signals that do not occur in nature; audio signals are complex waveforms. Measuring pink noise, as well as audio signals, on a System 5 meter and a Dorrough Loudness Meter produce the same levels.

Euphonix and Dorrough meters do have different displays. Euphonix uses the DBFS convention with 0 at the top and negative values below. Dorrough uses 0 at the bottom and positive values above. Both meters measure decibels. With a reference level of -20 dBFS in System 5, pink noise measures around -12 dBFS peak and -20 dBFS average. The Dorrough meter shows a peak value of +8 and an average level of 0. The difference between peak and average values for both System 5 and Dorrough meters is the same.

For more information on metering, see <http://www.dk-audio.com/> and click [Promotions](#) and then [Literature](#). Then click [Audio - Levels & Readings](#) to download the PDF.