

## A FUNDAMENTALS OF LOGARITHMIC AMPLIFIERS AND RECENT ADVANCES

B. Gilbert

Analog Devices, Inc., Beaverton, OR, U.S.A.

### *Abstract*

This is a tutorial address. Numerous real-world signals exhibit a large dynamic range (DR)--the ratio of the strongest amplitude to the weakest, usually expressed in decibels. These signals are often handled by high-resolution A/D converters (24 b = 144.5 dB). But these are expensive, especially when fast response is required.

Today, a large family of monolithic integrated circuits can address these needs. They compress the dynamic range of an input on a precise logarithmic scale, and provide an output representing the input expressed in dB with DR capabilities up to 200 dB, bandwidths to over 20G Hz, response times down to 1.5 ns, current-measurement capabilities from 1 pA to 10 mA in one range, and operation from supply voltages as low as 1.5 V. Many are also tiny (sometimes barely visible) and inexpensive.

This talk will present various ways by which a logarithmic response is achieved, starting with strong mathematical foundations that also provides fundamental insights as to how practical logarithmic amplifiers must be designed. The principles are then elaborated by showing several basic circuit forms to address diverse measurement requirements.