

Engineering News



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BOOKS

Technical Letter No. 166

DECIBELS

Weber-Fechner law.

This law of psychology states that the least change in the stimulus necessary to produce a perceptible change in response is proportional to the stimulus already existing.

Senses compared.

The sensitivities of the various senses are not the same. Typical differences are:

Sensitivity to light intensity changes 1%, .1dB

Sensitivity to change in length of a line 2%, .2dB

Sensitivity to change in weight 10%, 1dB

Sensitivity to change in sound loudness 30%, 3dB

This type of response is called logarithmic hence the use of a logarithmic scale allows meaningful figures of reasonable size to cover the range of sensitivity involved. It is quite ordinary to run into SPL's that vary by a ratio of 10,000,000 to 1 and a range of 0 to 140 dB is easier to cope with.

Logarithms.

Logarithms are a very handy mathematical tool that reduces multiplication to addition; division to subtraction; raising a power to multiplication; and extracting a root to division.

For example: $10^2 = 100$ can be written $\text{Log}_{10} 100 = 2$

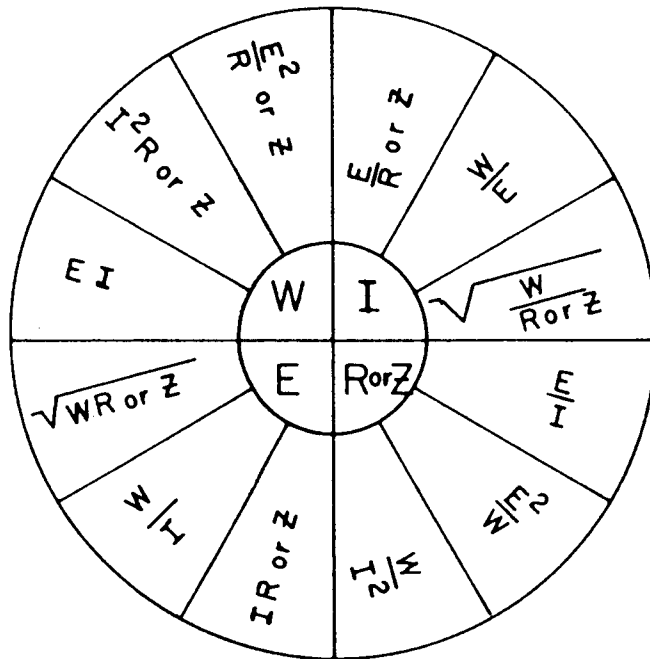
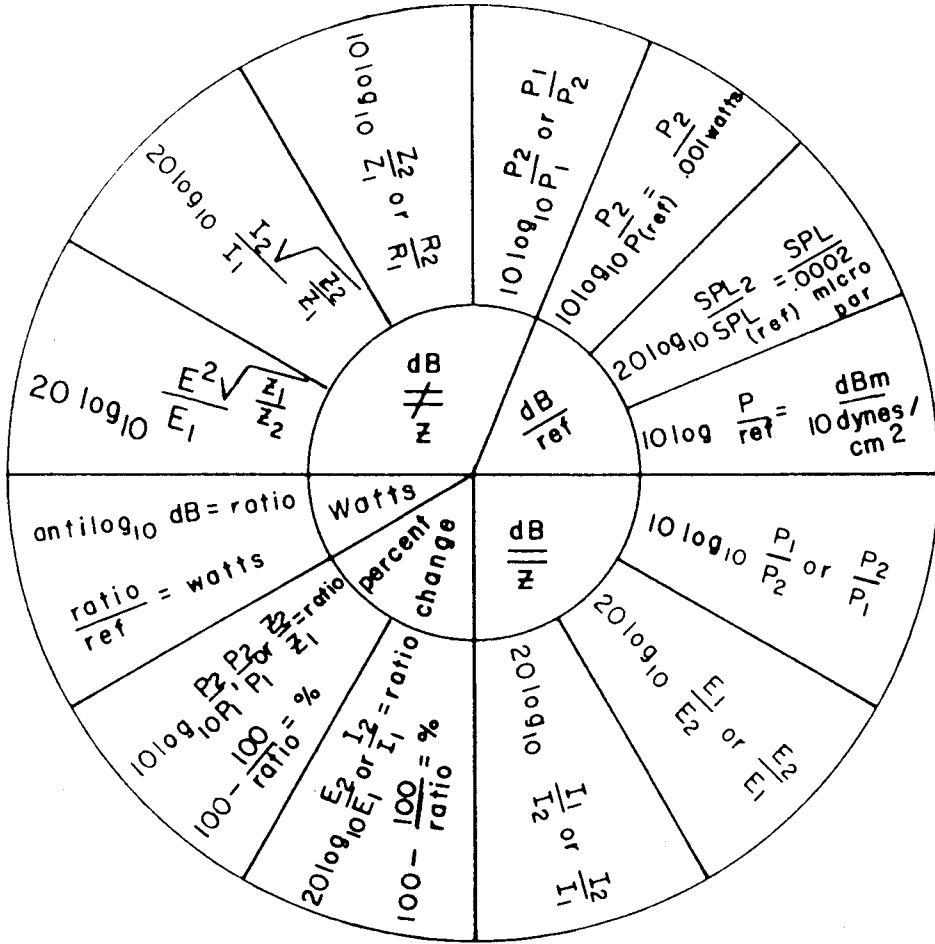
Bel and Decibel.

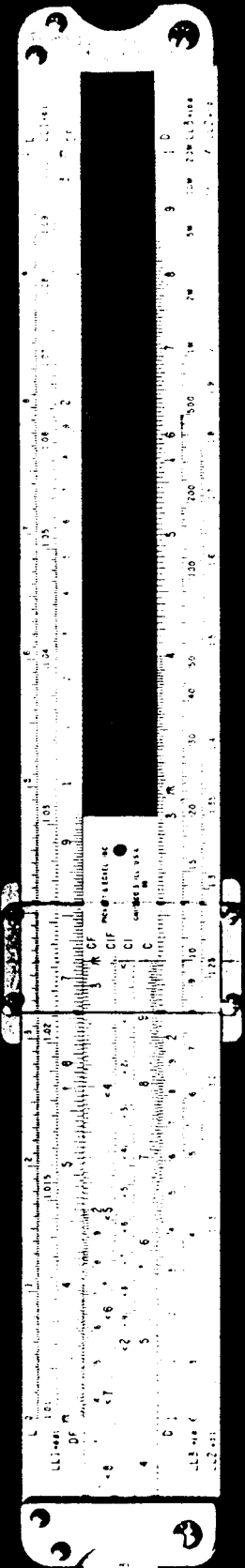
The Bel is named in honor of Alexander Graham Bell. In the metric system "deci" is the prefix meaning one tenth, and it was soon discovered that meaningful increments should be expressed in decibels. This is why the abbreviation is written dB. Decibel written logarithmically is the $\log_{10} N = B$.

For example: $\log_{10} 2 = .3010$ Bel.

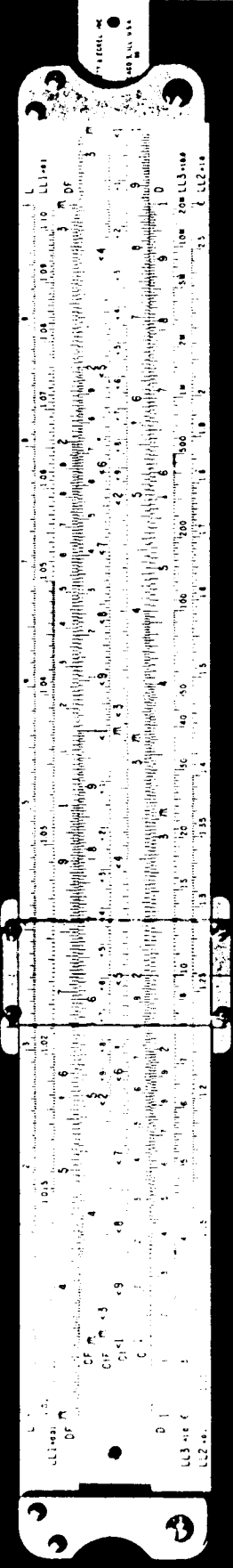
Now if the Bel is divided into ten parts to become a decibel then $10 \log_{10} 2 = 3.010$ decibels. $10 \log_{10} 2^2 = 6.021$ or $20 \log_{10} 2 = 6.021$. In other words to remove the power from the number, multiply 10 by the power and find the logarithm of the number. The formulas shown on the attached dB "wheel" are derived from basic logarithms, ohms law, and the basic power, voltage, and acoustical references.

dB WHEEL

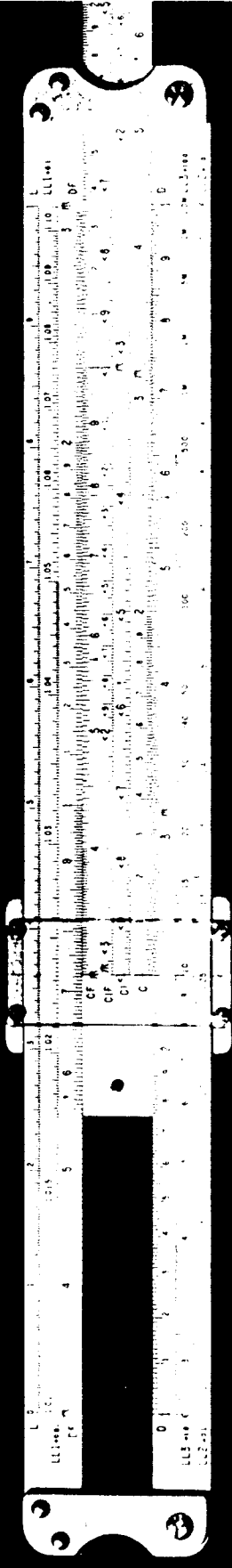




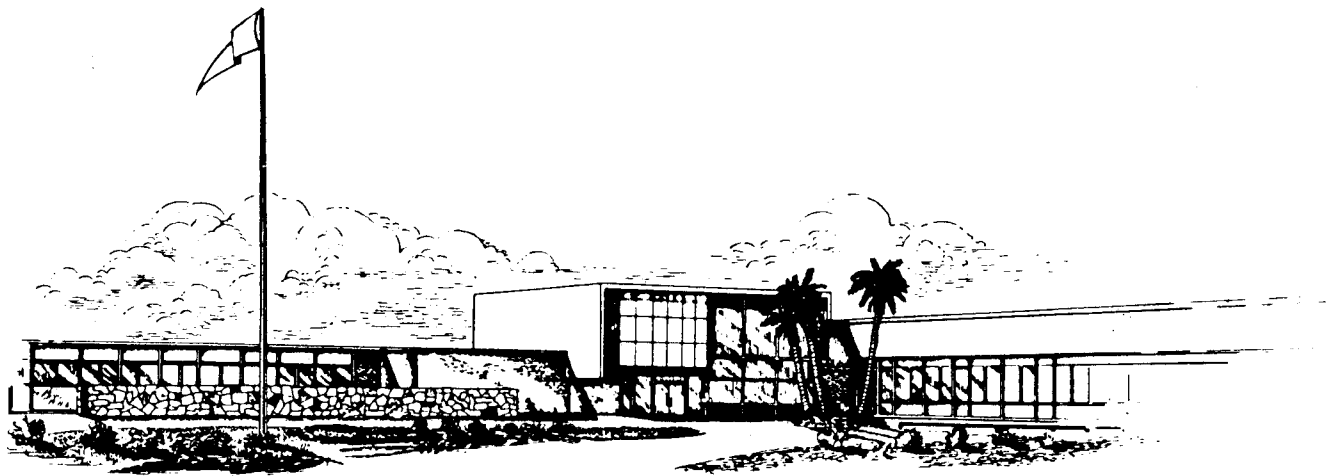
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