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THE DECIBEL IN BROADCASTING

The decibel was originally defined as a logarithmic comparison between two powers.

$$dB = 10 \lg \frac{P_1}{P_2}$$

where P_1 and P_2 are the two powers under consideration.

However, IEC 27-3 (1974) has redefined the decibel so that it applies to any field quantity (ie ones whose square is proportional to power). Hence for voltages and currents the definition becomes:

$$dB = 20 \lg \frac{I_1}{I_2}$$

$$dB = 20 \lg \frac{V_1}{V_2}$$

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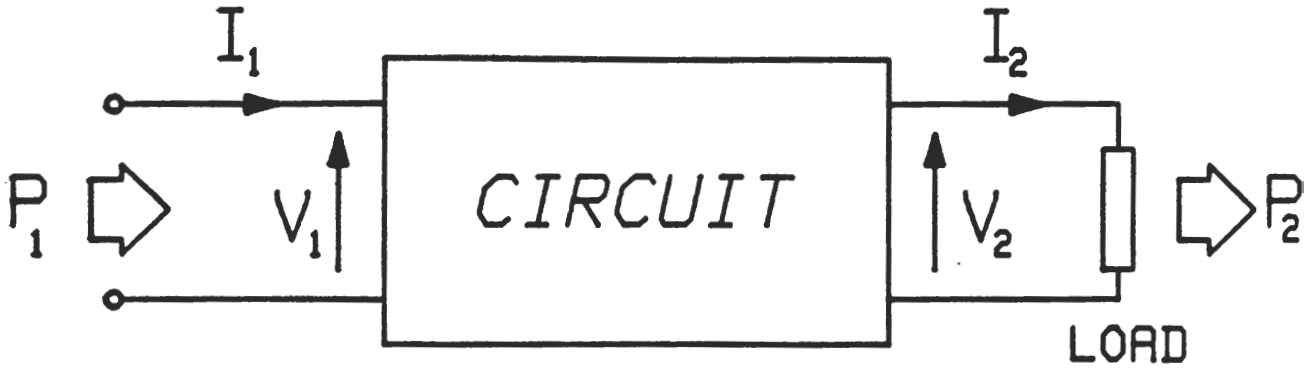

Figure 1: Example of dB Calculation

In the circuit shown in Figure 1 the gain or loss can be expressed as:-

$$dB = 10 \lg \frac{\text{power into circuit}}{\text{power into load}} = 10 \lg \frac{P_1}{P_2}$$

$$dB = 20 \lg \frac{\text{voltage at input}}{\text{voltage across load}} = 20 \lg \frac{V_1}{V_2}$$

$$dB = 20 \lg \frac{\text{current into circuit}}{\text{current in load}} = 20 \lg \frac{I_1}{I_2}$$

However, each of these calculations will give a different answer unless the input resistance of the circuit is the same as the load. Which ratio is used depends on the context under which the circuit is being used. Most situations involving the broadcast chain involve voltage comparisons, often because voltage is the easiest signal parameter to monitor. On the other hand specifications for transmitters are often based on power considerations.

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REFERENCE LEVELS

The decibel is essentially a logarithmic ratio of the two quantities concerned. However it can be used for absolute measurement provided some reference level is defined. Typical reference levels are 1mW, 1V, 0.775V, 1µV, 20µPa.

Power measurements are often referred to 1mW. Decibel measurements with respect to 1mW should be written as dB(mW). Thus some power P_1 watts would become

$$dB\ (mW) = 10\ lg\ \frac{P_1}{1 \times 10^{-3}}$$

Values above the reference are specified as +dB and values below as -dB.
(e.g. 4mW = +6dB(mW) and 0.5mW = -3dB mW).

In a chain of broadcast equipment it is usual to make measurements of the signal in terms of voltage.

Consequently most dB measurements in audio and video work are made using the relationship.

$$dB = 20\ lg\ \frac{V_1}{V_2}$$

Audio and video circuits use different reference voltages when making absolute measurements.

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Audio measurements are usually based on a reference of 0.775V. (In the early days of audio engineering audio circuits were designed to have input and output resistances of 600Ω. At that time the sole reference for the decibel was 1mW which when dissipated in 600Ω gives a r.m.s. voltage of 0.775V. Nowadays audio equipment uses a wide range of different input and output resistances but audio engineers continue to use 0.775V r.m.s. as the reference).

Video measurements are usually based on a reference level of 1V.pk. to pk. (The nature of the video waveform is such that r.m.s. values are of little significance and a video signal is invariably specified in terms of its peak to peak value).

dB NOMENCLETURE

Because of the different interpretations which can be placed on the decibel the following conventions can be applied to the definition.

1. dB with no suffix ie dB.
   A simple logarithmic ratio of two parameters
   e.g. $20 \lg \frac{10V}{5V} = 6dB$

2. dB with suffix in brackets i.e. dB (abc).
Indicates the value has been specified with respect to some reference which is defined by the contents of the brackets i.e. abc

e.g. 1V w.r.t. 2μV

$$= 20 \lg \frac{1}{2 \times 10^{-6}} = +114\text{dB } (2\mu\text{V})$$

If the reference quantity is unitity then the numerical value can be omitted from the brackets. e.g. 1V w.r.t. 1μV = + 120dB (μV)

Note that within the BBC dB(0.775V) is normally abbreviated to dBu.

3. dB with suffix and no brackets i.e. dB abc.

abc specifies the way in which the measurement is made. This may also include some reference level in the definition.

e.g. dBA is an acoustical measurement made using a specified filter and relative to a standard pressure.

It is important that the suffix definitions above are used where applicable. Some writers are given to using definitions carelessly or omitting them altogether. In such circumstances the reader must endeavour to establish which definition has been adopted.

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