ATTENUATOR (ELECTRONICS)

An **attenuator** is an electronic device that reduces the power of a signal without appreciably distorting its waveform.

An attenuator is effectively the opposite of an amplifier, though the two work by different methods. While an amplifier provides gain, an attenuator provides loss, or gain less than 1.

Construction and usage

Attenuators are usually passive devices made from simple voltage divider networks. Switching between different resistances forms adjustable stepped attenuators and continuously adjustable ones using potentiometers. For higher frequencies precisely matched low VSWR resistance networks are used.

Fixed attenuators in circuits are used to lower voltage, dissipate power, and to improve impedance matching. In measuring signals, attenuator pads or adapters are used to lower the amplitude of the signal a known amount to enable measurements, or to protect the measuring device from signal levels that might damage it. Attenuators are also used to 'match' impedance by lowering apparent SWR.

Attenuator circuits

Basic circuits used in attenuators are pi pads (π-type) and T pads. These may be required to be balanced or unbalanced networks depending on whether the line geometry with which they are to be used is balanced or unbalanced. For instance, attenuators used with coaxial lines would be the unbalanced form while attenuators for use with twisted pair are required to be the balanced form.

Four fundamental attenuator circuit diagrams are given in the figures on the left. Since an attenuator circuit consists solely of passive resistor elements, it is both linear and reciprocal. If the circuit is also made symmetrical (this is usually the case since it is usually required that the input and output impedance Z_1 and Z_2 are equal), then the input and output ports are not distinguished, but by convention the left and right sides of the circuits are referred to as input and output, respectively.

Attenuator characteristics

Key specifications for attenuators are:

- **Attenuation** expressed in decibels of relative power. A 3 dB pad reduces power to one half, 6 dB to one fourth, 10 dB to one tenth, 20 dB to one hundredth, 30 dB to one thousandth and so on. For voltage, you double the dBs so for example 6 dB is half in voltage.
- **Nominal impedance**, for example 50 ohm
- **Frequency bandwidth**, for example DC-18 GHz
- **Power dissipation** depends on mass and surface area of resistance material as well as possible additional cooling fins.
- **SWR** is the standing wave ratio for input and output ports
- **Accuracy**
- **Repeatability**

RF attenuators

Radio frequency attenuators are typically coaxial in structure with precision connectors as ports and coaxial, micro strip or thin-film internal structure. Above SHF special waveguide structure is required.

Important characteristics are:

- accuracy,
- low SWR,
- flat frequency-response and
- repeatability.

The size and shape of the attenuator depends on its ability to dissipate power. RF attenuators are used as loads for and as known attenuation and protective dissipation of power in measuring RF signals.[2]

Audio attenuators

A line-level attenuator in the preamp or a power attenuator after the power amplifier uses electrical resistance to reduce the amplitude of the signal that reaches the speaker, reducing the volume of the output. A line-level attenuator has lower power handling, such as a 1/2-watt potentiometer or voltage divider and controls preamp level signals, whereas a power attenuator has higher power handling capability, such as 10 watts or more, and is used between the power amplifier and the speaker.

- Power attenuator (guitar)
- Guitar amplifier