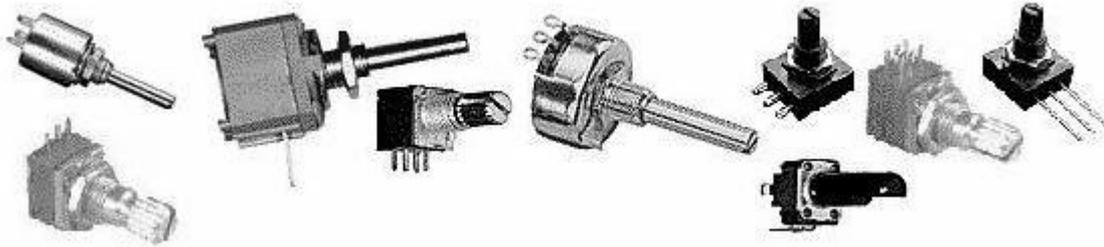


## Tech Notes – Variable Resistors

As well as fixed resistors it is often necessary to include variable resistors in a circuit to provide some means of adjustment. This may be due to a calibration requirement where a circuit needs to be adjusted to compensate for component tolerances or simply a user adjustment such as the volume control on an amplifier.

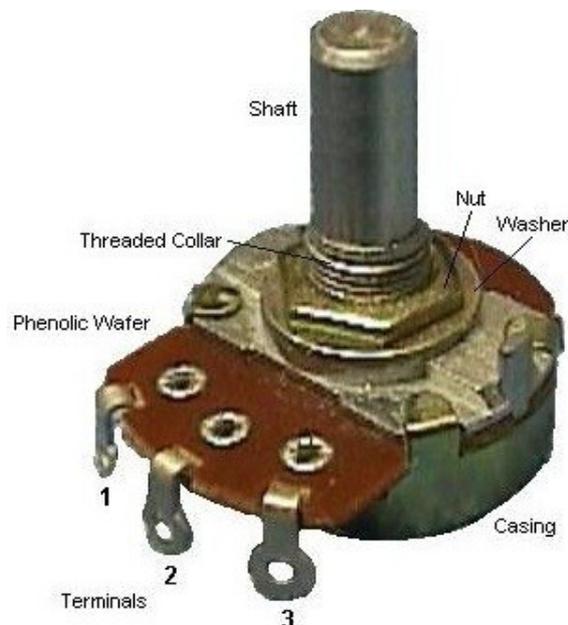
ESP



A variable resistor has 3 terminals and is usually constructed as a resistive track with a terminal at each end and a movable terminal known as the wiper which makes contact with the track. The exact mechanical construction and materials used depends upon the application and environment in which it is going to be used. Variable resistors may often be referred to as potentiometers or rheostats.

### Potentiometer

This uses all 3 connections of the variable resistor and is used to give voltage adjustment. The voltage on the wiper terminal may be varied between the voltages at either end of the track of the resistor. Examples of the use of a potentiometer is the volume and tone controls on a radio receiver. A typical modern single gang potentiometer is shown below.



### Dual Gang

It is often necessary to adjust two values of resistance in step at the same time and so Dual Gang potentiometers have two resistance elements on the same shaft adjusted together. The volume and tone controls on a stereo system are usually dual gang potentiometers.

# Tech Notes – Variable Resistors

## Concentric

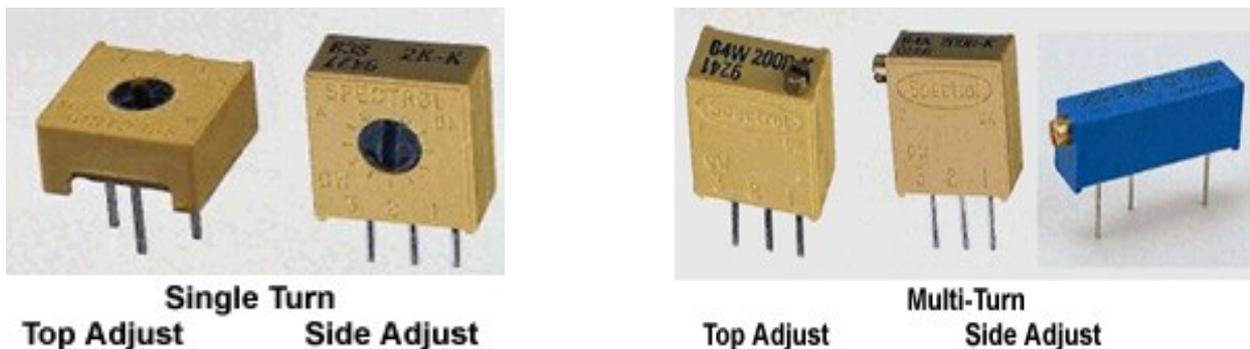
These have two resistance sections mounted one behind the other but with two control shafts brought out one inside the other. These were very commonly used in early Television Receivers to reduce the number of knobs on the front of the set.

## Rheostat

This term is usually applied to a variable resistor which only uses one end terminal and the wiper terminal of the variable resistor. The unused end terminal is usually connected to the wiper.

## Preset or Trimmer

Variable resistors used to set internal parameters on circuits are generally referred to as presets or trimmers. They are usually small in construction and require a screwdriver for adjustment. There are many different package styles with the screwdriver adjustment slot in different places for either top access or front access.



## Multi-turn

As well as the basic rotary type, there is also the multi-turn type. This type propels the wiper terminal along the track using a screw thread. This can give a much finer range of adjustment and may be used where a precision setting is required. These can be either potentiometers or preset resistors.

## Switched Potentiometers

Often in older radio equipment the Volume or the Tone control also provided the On/Off switch. This was achieved by fitting a switch mechanism to the rear of these controls. The switch action could be either rotary, push-pull or push-push. The same switch in a television receiver also often “killed” the bright spot that would have been left on the screen as the receiver powered down.

## Rotary or Slider control potentiometers

In the early days of radio and electronics all potentiometers were built as rotary types, a circular knob was used to adjust the control. Some only rotated 180 degree, others rotated 270 degree. In the 1960's designers of domestic electronic equipment started to used slider controls, perhaps because it

## Tech Notes – Variable Resistors

looked more technical to the user. They are also available in single and dual gang types and is also available in different travel lengths.



### Logarithmic or Linear

The resistance element in a potentiometer may not produce a linear change in resistance across its range of travel. For example, potentiometers used as volume controls in audio equipment produce a logarithmic change in resistance throughout their range of resistance. This is because the human ear has a logarithmic response to changes in sound level. In the early days of Television, potentiometers that followed an anti-log or some special characteristic required to produce the brightness or contrast characteristic the design desired were often used.

### Tapped Potentiometers

Many potentiometers in older equipment may have a tapping on the track. The most common reason for this is to provide for a “loudness circuit” but taps were also used on brightness and contrast controls in early television receivers.

### Motor Drive Potentiometers

Before the large scale use of integrated circuits in domestic entertainment equipment, remote control of various controls was often achieved by using potentiometers with a motor drive attached. The drive mechanism could free-wheel so the control could be operated manually. Electronic circuitry is now used to achieve the same effect.

### Potentiometer Markings

The resistance value is usually easy to identify, it used K or M after a number. There should have been a simple code to indicate the resistance law of a pot but this has changed over the years. To make matters worse, there is an overlap, the letter A is used in both schemes for different characteristics.

Taper	Old Code	New Code	Alternate
Linear	A	B	LIN
Logarithmic (Audio)	C	A	LOG
Antilog	F	N/A	N/A

## Tech Notes – Variable Resistors

### Determining the “law” of a potentiometer

If in doubt, it is easy to determine the law a potentiometer follows. Set the shaft to half way (the centre of its travel) and measure the resistance of each half of the device. If each half has equal resistance it is a Linear Potentiometer and if the resistance is a split of about 10% and 90% then it is a Logarithmic Potentiometer.

**Note:** A linear potentiometer used as a volume control would give the impression that all the adjustment was cramped at one end of the track. The logarithmic potentiometer gives the impression of a more even volume adjustment across the full length of the track.

### Control Knobs

The control shafts of potentiometers up to the 1960's usually had a ¼ inch (6.4mm) or if made in Europe a 6mm shaft, and the knob was attached by the use of a grub screw. As a cost cutting exercise the shaft was then fitted with a flat and simpler knob with a locking ring was used. To further reduce the cost the shaft was then made with a split and flutes and the knob was made with matching flutes. When building electronic equipment, be sure to get the knobs that match the potentiometers you have.

### Panel or PCB mounting

When purchasing potentiometers you have a choice between printed circuit mounting types, often with no threaded mounting boss, or panel mount types where there is a threaded mounting boss. Make sure you obtain the nuts and washers when purchasing this type potentiometer.