Potentiometer Cheat Sheet

A concise guide to potentiometers, covering types, applications, specifications, and practical usage. This cheat sheet provides essential information for electronics enthusiasts and engineers working with these variable resistors.

Potentiometer Basics

Definition

A potentiometer (or pot) is a three-terminal resistor with a sliding or rotating contact that forms an adjustable voltage divider.

It acts as a variable resistor, allowing you to adjust the resistance value by turning a knob or slider.

Key Components

Resistive Element:	A track of resistive material (carbon composition, cermet, wirewound) determining the total resistance.
Wiper (Sliding Contact):	A movable contact that slides along the resistive element, tapping off a fraction of the total resistance.
Terminals:	Three terminals: two connected to the ends of the resistive element, and one connected to the wiper.

Operation

By adjusting the position of the wiper, the resistance between the wiper and one end terminal changes. This allows a fraction of the applied voltage to be tapped off.

When used as a potentiometer, all three terminals are connected. When used as a variable resistor (rheostat), only two terminals are used (one end and the wiper).

Symbol

https://upload.wikimedia.org/wikipedia/commons/thumb/f/fc/Potentiometer_symbols.svg/1280px-Potentiometer_symbols.svg.png

Schematic symbol for potentiometer

Types of Potentiometers

Based on Resistive Material

Carbon Film:	Low cost, general purpose, higher noise. Typically used in audio controls and low-precision applications.
Cermet:	Good stability, higher precision, lower noise than carbon film. Used in precision circuits and trimmers.
Wirewound:	High power rating, high precision, but limited resolution. Used in high-power applications and precision control.
Conductive Plastic:	Low noise, long life, moderate precision. Used in high-end audio equipment and precision controls.

Based on Mechanical Configuration

Rotary Potentiometers:	Adjusted by rotating a shaft. Common in volume controls, user interfaces.
Slider Potentiometers:	Adjusted by sliding a knob linearly. Used in audio mixers and graphic equalizers.
Trimmer Potentiometers (Trimpots):	Small potentiometers designed for infrequent adjustments, often used for calibration purposes on PCBs.
Multi-turn Potentiometers:	Require multiple rotations of the shaft to cover the full resistance range, allowing for finer adjustments. Used in precision instrumentation.

Key Specifications

Electrical Characteristics

Total Resistance:	The overall resistance between the two end terminals, typically ranging from a few ohms to several megaohms.
Tolerance:	The allowable variation in the total resistance, expressed as a percentage (e.g., ±10%).
Power Rating:	The maximum power the potentiometer can dissipate without damage, typically expressed in watts.
Taper (Linear/Logarithmic):	Describes the relationship between the wiper position and the resistance. Linear taper means resistance changes linearly with position; logarithmic taper (audio taper) means resistance changes logarithmically.
Resolution:	The smallest possible change in resistance that can be achieved. Wirewound pots have lower resolution than film pots.

Environmental Considerations

Temperature Coefficient:	Describes how much the resistance changes with temperature. Important for high-precision applications.
Operating Temperature Range:	The range of temperatures within which the potentiometer will function correctly.
Humidity Sensitivity:	How much the resistance changes with humidity.

Applications

Common Uses

Volume controls in audio equipment.

Brightness/contrast adjustments in displays.

Calibration trimmers in circuits.

Position feedback sensors in robotics.

Adjustable voltage dividers.

Circuit Examples

Voltage Divider:	A potentiometer connected to a voltage source provides an adjustable output voltage. `Vout = Vin * (R2 / (R1 + R2))` where R2 is the resistance between the wiper and ground.
Rheostat:	A potentiometer used as a two-terminal variable resistor can control current in a circuit (e.g., dimming an LED).

Practical Considerations

Always select a potentiometer with a suitable power rating for the application to prevent overheating.

Consider the required precision and stability when choosing between different potentiometer types (e.g., carbon film vs. cermet).

Use a linear taper for general-purpose adjustments and a logarithmic taper (audio taper) for volume controls.