

The following explanation of terms, based on the booklet of industrial standards published by the Variable Electronic Components Institute (VECI), will help you understand the purpose, construction and applications for trimmer potentiometers.

General Terms

Trimmer Potentiometer. An electrical mechanical variable resistor with three terminals. Two of the terminals are connected to the resistive element (one at each end), and one terminal is connected to a movable conductive contact which slides over the element, thus allowing the input voltage to be divided as a result of the mechanical input. It is designed to function as a voltage divider or rheostat. These trimmers are commonly included in a circuit for easy adjustment and are used to correct variations in other circuit components or for changes due to aging. They are used for infrequent adjustment and, therefore, usually not accessible to the operator.

Wirewound Trimmer Potentiometer. A trimming potentiometer characterized by a resistance element made up of turns of wire on which the wiper contacts only a small portion of each turn.

Non-Wirewound Trimmer Potentiometer. A trimming potentiometer characterized by the continuous nature of the surface area of the resistance element to be contacted. Contact is maintained over a continuous, unbroken path. The resistance is achieved by using material compositions other than wire such as cermet, carbon, conductive plastic or metal film.

Resistance Element. A continuous, unbroken length of resistive material without joints, bonds or welds except at the junction of the element and the electrical terminals connected to each end of the element.

Terminal. An external part that provides electrical access to the resistance element and wiper.

Leadwire Type Terminal. Flexible insulated conductor.

Printed Circuit Terminal. Rigid uninsulated electrical conductor suitable for printed circuit board plug-in.

Solder Lug Terminal. Rigid uninsulated electrical conductor suitable for external lead attachment.

Wiper. The part of a trimmer which makes contact with the resistive element that allows the output to be varied when the adjustment shaft is rotated.

Stop, Clutch Action. An internal device which allows the wiper to idle at the ends of the resistive element without damage as the adjustment shaft continues to be actuated in the same direction.

Stop, Solid. A positive limit to mechanical and/or electrical adjustment.

Stacking. The mounting of one trimmer potentiometer adjacent to or on top of another utilizing the same mounting hardware.

Theoretical Resolution. (wirewound only) The theoretical measurement of sensitivity to which the output ratio may be adjusted and is the reciprocal of the number of turns of wire in resistance winding expressed as a percentage.

N = Total number of resistance wire turns.

$$\frac{1}{N} \times 100 = \text{Theoretical resolution percent.}$$

Input and Output Terms

Total Applied Voltage. The total voltage applied between the designated input terminals.

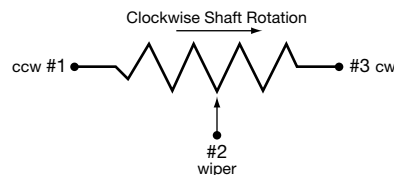
Output Voltage. The voltage between the wiper terminal and the designated reference point. Unless otherwise specified, the designated reference point is the counterclockwise (CCW) terminal.

Output Ratio. The ratio of the output voltage to the designated input reference voltage. Unless otherwise specified, the reference voltage is the total applied voltage.

Load Resistance. An external resistance as seen by the output voltage (connected between the wiper terminal and the designated reference point).

Adjustment Terms

Direction of Travel. Clockwise (CW) or counterclockwise (CCW) rotation when viewing the adjustment shaft end of the potentiometer. The designation of terminals in the figure below corresponds to the direction of wiper travel.



Actuation. Turning the shaft or other mechanical movement of a trimmer in order to move the wiper over the surface of the resistive element.

Adjustability. The precision with which the output of a trimmer can be adjusted to the desired value.

Adjustment Locking. Refers to the sealing or marking of the position of the adjustment screw after initial setting with viscous paint or other similar substance.

Adjustment Shaft. The mechanical input part of a trimmer potentiometer which when actuated causes the wiper to traverse the resistance element resulting in a change in output voltage or resistance.

Adjustment Travel, Electrical. The total travel of the adjustment shaft between minimum and maximum output voltages.

Backlash. The play or unimpeded motion of the adjustment mechanism which causes poor adjustability.

Continuity Travel. The total travel of the shaft over which electrical continuity is maintained between the wiper and the resistive element.

Mechanical Cycle. Movement of the wiper from one end of travel to the other and back again.

Mechanical Travel, Solid Stops. The total travel of the adjustment shaft between integral stops. Continuity must be maintained throughout the travel.

Mechanical Travel, Clutch Action. The total travel of the adjustment shaft between the points where clutch actuation begins. Continuity must be maintained throughout the travel and during clutch actuation.

Mechanical Travel, Continuous Rotation. The total travel of the adjustment shaft when the wiper movement is unrestricted at either end of the resistive element as the adjustment shaft continues to be actuated.

Multi-Turn Adjustment. Requires more than 360° mechanical input to cause the wiper to traverse the total resistance element.

Single-Turn Adjustment. Requires 360° or less mechanical input to cause the wiper to traverse the total resistance element.

Electrical and Operational Terms

Absolute Minimum Resistance. The resistance measured between the wiper terminal and each end terminal with the wiper positioned to give a minimum value.

Adjustability, Output Resistance. The precision with which the output resistance of a device can be set to the desired value.

Adjustability, Output Voltage Ratio. The precision with which the output voltage ratio of a device can be set to the desired value.

Adjustment Noise. Random unpredictable and undesirable electrical signals that are superimposed on the output of a trimmer during the adjustment rotation.

Contact Resistance Variation (CRV). The apparent resistance seen between the wiper and the resistance element when the wiper is energized with a specified current and moved over the adjustment travel in either direction at a constant speed. The output variations are measured over a specified frequency bandwidth, exclusive of the effects due to roll-on or roll-off of the terminations and is expressed in ohms or percentage of total resistance.

Continuity. Continuity is the maintenance of continuous electrical contact between the wiper and both end terminals of the resistive element.

Dielectric Strength. The ability to withstand the application of a specified potential of a given characteristic between the terminals and all other external conducting parts such as shaft, housing and mounting hardware without exceeding a specified leakage current value.

End Resistance. The resistance measured between the wiper terminal and an end terminal when the wiper is positioned at the corresponding end of mechanical travel. Absolute minimum resistance and end resistance are synonymous for continuous rotation trimmers.

Equivalent Noise Resistance (ENR). (wirewound only) Any spurious variation in the electrical output not present in the input, defined quantitatively in terms of an equivalent parasitic, transient resistance in ohms, appearing between the contact and the resistive element when the shaft is rotated or translated. The ENR is defined independently of the resolution, functional characteristics and the total travel. The magnitude of the ENR is the maximum departure from a specific reference line. The wiper of the potentiometer is required to be excited by a specific current and moved at a specific speed.

Inductance. Wirewound trimmers generally exhibit inductance function or phase shift, associated with the construction of the element, when operated in a high frequency application.

Insulation Resistance. The resistance to a specified DC voltage impressed between the terminals and all other external conducting parts such as shaft, housing and mounting hardware.

Linear Taper. The plot of the trimmer output that is directly proportionate to constant rate of shaft movement.

Load Life. The number of hours at which a device may dissipate rated power under specified operating conditions while remaining within specified allowable degradations.

Log Taper. The plot of the trimmer output that is logarithmically proportionate to constant rate of shaft movement.

Ohm. The basic unit of electrical resistance.

Power Rating. The maximum power that a trimmer potentiometer can dissipate across the total resistive element under specified conditions while meeting specified performance requirements.

Resistance-Temperature Characteristic (RTC). The difference between the total resistance values measured at a reference temperature of +25°C and the specified test temperature expressed as a percent of the total resistance.

$$RTC = \frac{R_2 - R_1}{R_1} \times 100$$

Where: R_1 = Resistance at reference temperature (+25°C) in ohms.

R_2 = Resistance at test temperature in ohms.

Resistance Tolerance. The total resistance range that can be tolerated by the circuit after giving consideration to changes due to aging and wear. It is NOT a measure of variable resistor quality. This tolerance applies to total resistance only, not to the set point of the wiper circuit.

Roll-On Step. The abrupt change in output that occurs as the wiper moves from the termination area onto the resistive material of a non-wirewound element.

Resolution. The ability of a trimmer to make very fine adjustments. In a wirewound trimmer, the percent of total output produced by a single turn of wire. Non-wirewound trimmers have essentially infinite resolution. Wirewound trimmers have a step function increase in resistance across the element, so ohmic values between these steps cannot be obtained.

Rotational Life. The number of cycles obtainable under specific operating conditions while remaining within specified allowable degradation. A cycle is defined as one complete traversal of the wiper over the resistive element in both directions.

Setting Stability. The amount of change in the output voltage, without readjustment, expressed as a percentage of the total applied voltage.

Temperature Coefficient of Resistance (TC). The unit change in resistance per degree celsius change from a reference temperature, expressed in parts per million per degree celsius as follows:

$$TC = \frac{R_2 - R_1}{R_1 (T_2 - T_1)} \times 10^6$$

Where: R_1 = Resistance at reference temperature in ohms.
 R_2 = Resistance at test temperature in ohms.
 T_1 = Reference temperature in degrees celsius.
 T_2 = Test temperature in degrees celsius.

Total Resistance. The DC resistance between the input terminals with the wiper positioned to either end stop, or in dead band for continuous rotation potentiometers.

Wiper Current. The maximum allowable sustained current through the wiper contact. This value is essentially independent of total resistance. It is especially important in rheostat mode applications.

Mechanical Terms

Carbon Composition. A type of resistive element made from a mixture of carbon powders in a binder molded into a solid mass, under heat and pressure, as an integral part of its substrate.

Cermet. (from CERamic and METals) A type of resistive element consisting of a mixture of metal particles, precious metal oxides and glass powders, which are mixed with a liquid vehicle, screened onto a ceramic substrate and fired at vitrifying temperatures.

Collector Rail. The part of a trimmer on which the wiper travels that is electrically connected to the wiper terminal.

Contact Force. The force that holds the wiper in contact with the surface of the element.

Immersion Sealed. The ability of the unit to withstand submersion in acceptable cleaning solutions used in normal soldering processes without performance degradation under specific environmental conditions.

Potting. Process in which the space between a component and its case is filled with a compound which hardens to provide an airtight, moisture-proof, insulating seal.

Rotor. An insulated part of a trimmer, attached to the shaft, to which the wiper is connected.

Solderability. The ability of the terminals to accept a uniform coating of solder under specified conditions.

Starting Torque. The maximum moment in the clockwise and counterclockwise directions required to initiate shaft adjustment anywhere in the mechanical travel.

Stick-Slip. A condition in which starting torque is greater than running torque. This creates a very abrupt transition between the two, making fine adjustments difficult.

Stop Torque. The maximum static moment that can be applied to adjustment shaft at each mechanical stop for a specified period of time without loss of continuity or mechanical damage affecting operational characteristics.

Terminal Strength. The ability of the terminals to withstand specified mechanical stresses without sustaining damage that would affect utility of the terminals or operation of the trimming potentiometer.

Termination. The connection between the resistive element and the terminals.

Weldability. The ability of materials to be welded together under specified conditions.