Technical Parameters - Definitions

1.1 PRECISION POTENTIOMETER

A mechanical-electrical transducer dependent upon the relative position of a moving contact (wiper) and a resistance element for its operation. It delivers to a high degree of accuracy, a voltage output that is some specified function of applied voltage and shaft position.

1.2 WIREWOUND PRECISION POTENTIOMETER

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

2.1 TOTAL APPLIED VOLTAGE "E"

The total voltage applied between the designated input terminals.

E = Total applied voltage (peak to peak applied voltage).

2.2 OUTPUT VOLTAGE "e"

The voltage between the wiper and the designated reference point. Unless otherwise specified, the designated reference point is the CCW terminal.

2.3 OUTPUT RATIO "e/E"

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

2.4 CONFORMITY

The fidelity of the relationship between the actual function characteristic and the theoretical function characteristic.

Mathematically:

$$\frac{e}{E} = f(\theta) \pm C$$

2.5 LINEARITY

A specific type of conformity where theoretical function characteristic is a straight line.

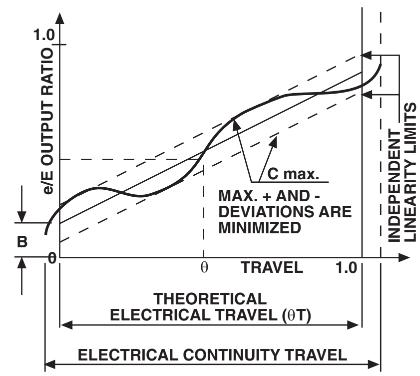
Mathematically:

$$\frac{e}{E} = f(\theta) \pm C = A(\theta) + B \pm C$$

Where A is a given slope; B is a given intercept at q = 0.

2.6 INDEPENDENT LINEARITY

The maximum deviation of the actual function characteristic from a straight reference line with its slope and position chosen to minimize the maximum deviations. It is expressed as a percentage of the total applied voltage and is measured over the specified theoretical electrical travel.



2.7 ABSOLUTE LINEARITY

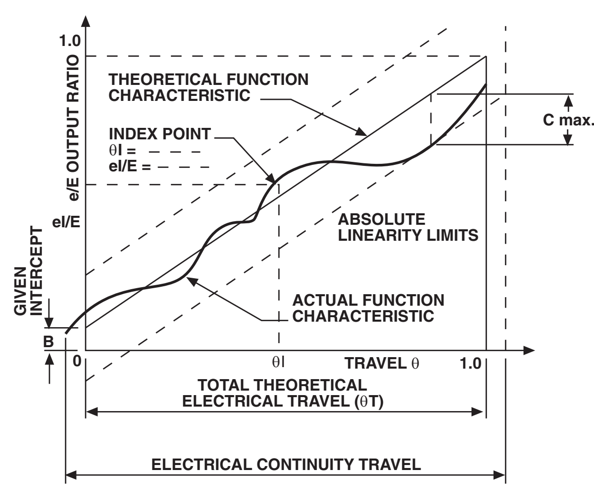
This linearity is harder to achieve than the one above because it is the maximum deviation of the actual function characteristic from a fully defined straight reference line. It is expressed as a percentage of the total applied voltage and measured over the theoretical electrical travel. An index point on the actual output is required.

The straight reference line may be fully defined by specifying the low and high theoretical end output ratios separated by the theoretical electrical travel. Unless otherwise specified, these end output ratios are 0.0 and 1.0, respectively.

Mathematically:

$$\frac{e}{E} = A(\theta/\theta T) + B \pm C$$

Where A is a given slope; B is a given intercept at q = 0.
Unless otherwise specified A = 1; B = 0.



2.8 GRADIENT

The rate of change of output ratio relative to shaft travel.

$$G = \frac{de/E}{d\theta}\ (mV/V/°)$$

(rotational)

$$G = \frac{de/E}{d}\ (mV/V/mm)$$

(linear)

2.9 INDEX POINT

A point of reference fixing the relationship between a specified shaft position and the output ratio. It is used to establish a shaft position reference.

3.1 LIFE

The number of shaft revolutions or translations obtainable under specific operating conditions and within specified allowable degradations of specific characteristics.

3.2 RESOLUTION

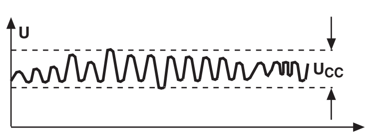
A measure of the sensitivity to which the output ratio of the potentiometer may be set.
Theoretically infinite for plastic film precision potentiometers.
For wirewound: The reciprocal of the number of turns of wire in resistance winding in the actual electrical travel expressed as a percentage
N = total number of resistance wire turns
1/N x 100 = Theoretical resolution percent

3.3 REPEATABILITY

It is the maximum difference found on the output ratio for a same mechanical position all along the theoretical electrical stroke after several travels. It is expressed as a percentage of the total applied voltage.

3.4 OUTPUT SMOOTHNESS
(non wirewound only)

Output smoothness is a measurement of any spurious variation in the electrical output not present in the input. It is expressed as a percentage of the total applied voltage and measured for specified travel increments over the theoretical electrical travel. Output smoothness includes effects of contact resistance variations, resolution, and other micrononlinearities in the output.



Ucc: maximum variations peak to peak.

$$RTS = \frac{U_{CC}}{E} \times 100 = ...\ \%$$

3.5 NOISE (wirewound potentiometers only)

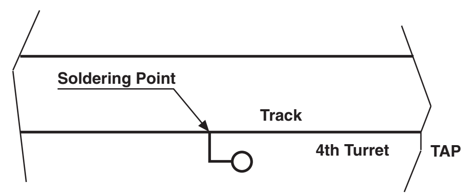
Any spurious variation in the electrical output not present in the input defined quantitatively in terms of an equivalent parasitic transient resistance in ohms, appearing between the contact and the resistance element when the shaft is rotated or translated (the wiper is excited by a specified current and moved at a specified speed).

3.6 END VOLTAGE

The voltage between the wiper terminal and an end terminal when the shaft is positioned at the corresponding end of electrical continuity travel. End voltage is expressed as a percentage of the total applied voltage.

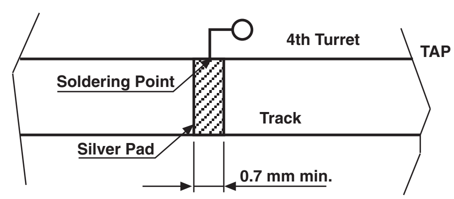
3.7 VOLTAGE TAP

An electrical connection fixed to the resistance element which introduces no significant distortion in the output characteristic.
A voltage tap usually has significant tap resistance and may not be capable of carrying rated element current. A voltage tap involves a fourth turret which delivers a fixed voltage. This voltage only depends on the position of the tap on the track and of the total applied voltage. It is usually located at the middle of the TET.



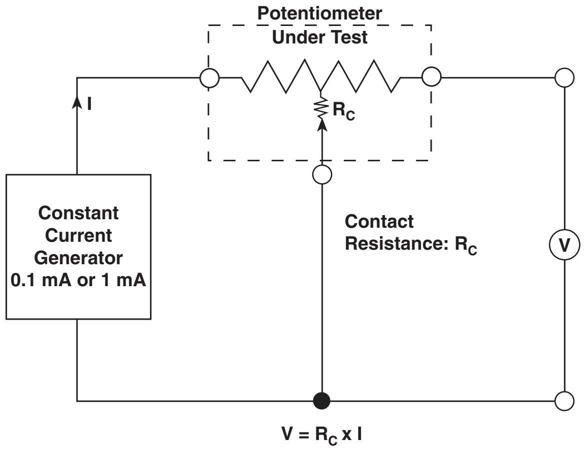
3.8 CURRENT TAP

An electrical connection fixed to the resistance element which is capable of carrying rated element current and may distort the output characteristic.



3.9 CONTACT RESISTANCE

The resistance appearing between the wiper and the resistive element when the shaft is rotated or translated. The wiper of the potentiometer is excited by a specific current and moved at a specified speed over a specified portion of the actual electrical travel.



4.1 THEORETICAL ELECTRICAL TRAVEL: TET

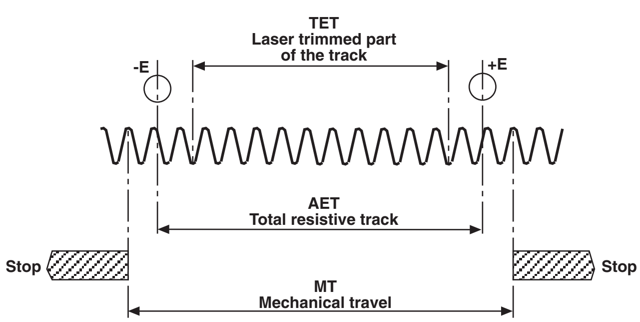
The specified shaft travel over which the theoretical function characteristic and its associated conformity limits are respected.

4.2 ACTUAL ELECTRICAL TRAVEL: AET

The total travel of the shaft between the two points at which the first and the last measurable change in output ratio occur.

4.3 MECHANICAL TRAVEL: MT

The total travel of the shaft between integral stops. In potentiometers without stops, the mechanical travel is continuous (rotationals only!).



4.4 STARTING TORQUE

The moment in the clockwise and counterclockwise directions required to initiate shaft rotation anywhere in the total mechanical travel.

4.5 DIELECTRIC WITHSTANDING VOLTAGE

Ability to withstand under prescribed conditions a specified potential of a given characteristic between the terminals of each cup and the exposed conducting surfaces of the potentiometer, or between the terminals of each cup and the terminals of every other cup in the gang without exceeding a specified leakage current value.

4.6 INSULATION RESISTANCE

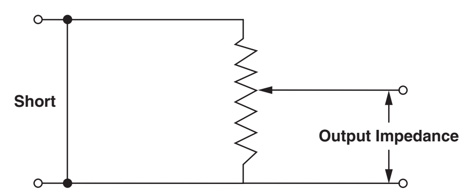
The resistance to a specified impressed DC voltage between the terminals of each cup and the exposed conducting surfaces of the potentiometer, or between the terminals of each cup and the terminals of every other cup in the gang under described conditions.

4.7 POWER RATING

The maximum power that a potentiometer can dissipate under specified conditions while meeting specified performance requirements.

4.8 OUTPUT IMPEDANCE

Maximum impedance between wiper and either end terminal with the input shorted, and measured at a specified voltage and frequency.



5.1 SHAFT RUNOUT

The eccentricity of the shaft diameter with respect to the rotational axis of the shaft, measured at a specified distance from the end of the shaft. The body of the potentiometer is held fixed and the shaft is rotated with a specified load applied radially to the shaft. The eccentricity is expressed in inches, TIR.

5.2 LATERAL RUNOUT

The perpendicularity of the mounting surface with respect to the rotational axis of the shaft, measured on the mounting surface at a specified distance from the outside edge of the mounting surface. The shaft is held fixed and the body of the potentiometer is rotated with specified loads applied radially and axially to the body of the pot. The Lateral Runout is expressed in inches, TIR.

5.3 PILOT DIAMETER RUNOUT

The eccentricity of the pilot diameter with respect to the rotational axis of the shaft, measured on the pilot diameter. The shaft is held fixed and the body of the potentiometer is rotated with a specified load applied radially to the body of the pot. The eccentricity is expressed in inches, TIR.

5.4 SHAFT RADIAL PLAY

The total radial excursion of the shaft, measured at a specified distance from the front surface of the unit. A specified radial load is applied alternately in opposite directions at a specified point. Shaft Radial Play is expressed in inches.

5.5 SHAFT END PLAY

The total axial excursion of the shaft, measured at the end of the shaft with a specified axial load supplied alternately in opposite directions. Shaft End Play is expressed in inches.

5.6 SEALING LEVELS

See below “Protection Levels”

PROTECTIONS LEVELS			
FIRST DIGIT PROTECTION AGAINST SOLID SUBSTANCES		**SECOND DIGIT PROTECTION AGAINST LIQUIDS**	
IP	Tests	IP	Tests
0	Without protection	**0**	Without protection
1	Protected against solid substances (size > 50 mm)	**1**	Protected against water drops (condensation)
2	Protected against solid substances (size > 12 mm)	**2**	Protected against water drops from up to 15 feet
3	Protected against solid substances (size > 2.5 mm)	**3**	Protected against water drops up to 60 feet
4	Protected against solid substances (size > 1 mm)	**4**	Protected against water drops above 60 feet
5	Protected against dust (> 0.1 mm < 1 mm)	**5**	Protected against splashes of water in all directions
6	Fully protected against dust	**6**	Protected against projections of water in all directions
		7	Protected against action of immersion < 15 cm and water jet pressure all directions
		8	Protected against long time action of immersion < 1 meter and water jet pressure in all directions

Note

- To symbolize the protection levels, we use ip letters followed by 2 digits

Examples:

IP50	Sealing level: Protected against dust but not water.
IP65	Sealing level: Protected against dust and splashes of water in all directions.

These 2 levels are the most frequently met ones.

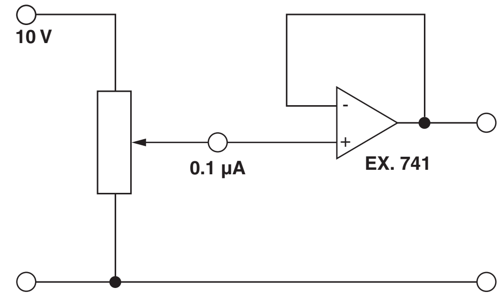
VOLTAGE DIVIDER

In order to reach the same performances than the ones we achieve during final quality control, for parameters like: linearity, lifespan, micro linearity, all along the temperature range, our precision potentiometers must work accordingly to the principle of a voltage divider.

The drawing is showing one of the most common and recommended way to connect a precision potentiometer, the wiper output is connected to an operational amplifier, the high input impedance of the amplifier maintains the current at a low level (I.e. < 1 µA).

Nearly all the current remains in the potentiometer track, the current in the wiper is too low to generate a significant disturbance and the potentiometer works as a voltage divider.

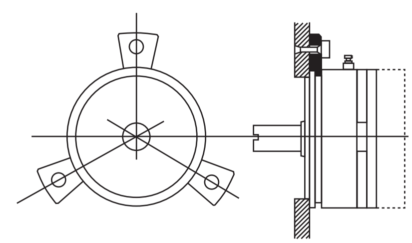
A recommended value for the load impedance is generally specified as 1000 times the total ohmic value of the potentiometer.



MOUNTING TYPES

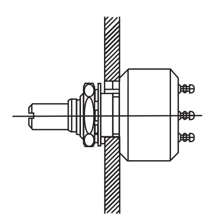
1. Servo Mounting

3 clamps are screwed into the mounting plate after being inserted in the groove of the front plate. The potentiometer is centered on its flange diameter inside the mounting plate.



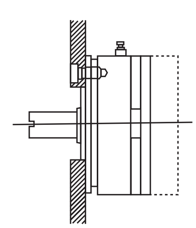
2. Bushing Mount

The potentiometer is fixed on the mounting plate when the nut (+ washer) is screwed onto the bushing. The antirotation pin prevents the potentiometer from turning.



3. Screw Mounting

The front plate of the potentiometer has 3 drilled holes, 3 screws are used to assemble the mounting plate together with the potentiometer.



GENERAL PERFORMANCES	
Rotational Speed	600 RPM (Shaft guiding: Ball bearings): 150 RPM (Shaft guiding: Sleeve bearing)
Temperature Range	- 55 °C to + 125 °C
Temperature Coefficient	- 300 ppm/°C ± 500 ppm/°C
Resolution	Essentially infinite for conductive plastic technology
Lifespan	Depending on the model; up to 50 million revolutions
Drift of Performances Along Life	Some parameters like: linearity, contact resistance, ohmic value are changing along the life of the products, first two ones can typically increase by 50 % at mid life (20M cycles); third one can decrease by a few percents (negative TC).