Conductive Plastic Technology

The polymer film track has a conductive plastic paste laid upon it. This paste includes an inert filler of carbon black which constitutes the basis of Vishay SFERNICE's technology for manufacturing precision potentiometers.

The resistive track obtained can be used:

- inside a cylindrical housing for making a rotational potentiometer
- on a flat support when manufacturing a linear motion transducer.

This method of producing the plastic film creates a resistive track which is exceptionally uniform in its resistivity and which allows excellent results regarding linearity.

1 - FUNCTION AND PRINCIPLE

The function of a motion transducer is to convert a mechanical displacement, either rotational or linear, into an electrical signal.

In order to achieve this, the resistive track is placed on the fixed part of the potentiometer and the mechanical displacement to be measured is connected to the wiper assembly which moves on the resistive track.

The track of the potentiometer is connected to a stabilised DC voltage which allows a small current flow (µ Amperes). The voltage, when measured between the wiper and the input turret, is directly proportional to the position of the wiper on the track.

The use of the potentiometer as a voltage divider, minimises the necessity for accuracy of the total resistance of the track because the changes in resistance, due to the variations of temperature, do not affect the measured result.

2 - COMMON APPLICATIONS

Conductive plastic potentiometers are used in all kinds of fields e.g.: military, aerospace, automotive, medical, measurement, robotics, nuclear and of course general industrial.

In particular they are suitable for guided missiles, flight control equipment, wheel balancing and wheel alignment machinery for vehicles, XY chart recorder, physiotherapy apparatus, professional joystick and servo control of actuators on moulding machinery.

3 - HOW TO CHOOSE A MOTION TRANSDUCER

Important parameters include :

- precision of the linearity required
- expected lifespan of the product
- repeatability and resolution
- price.

For particular applications, other features may also be critical when choosing the technology :

- low torque requirement
- device exposed to vibration or shock
- high speed application.

Conductive Plastic Film Motion Transducers are excellent value for money in relation to the performance offered and the electrical and mechanical characteristics of each product are detailed in this catalog.

4 - TECHNICAL PARAMETERS - DEFINITIONS

4.1 - TOTAL APPLIED VOLTAGE "E"

The total voltage applied between the designated input terminals.

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

4.2 - OUTPUT VOLTAGE "e"

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

4.3 - OUTPUT RATIO $\frac{\text{"e"}}{E}$

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

4.4 - CONFORMITY

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

Mathematically: $\frac{e}{E} = f(q) +/-C$

4.5 - LINEARITY

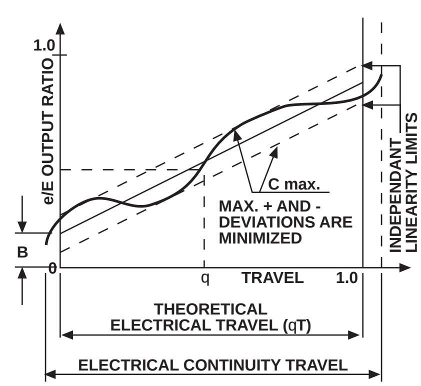
A specific type of conformity where theoretical function characteristic is a straight line.

Mathematically: $\frac{e}{E} = f(q) +/-C = A(q) + B +/-C$

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

4.6 - 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.



4.7 - ABSOLUTE LINEARITY

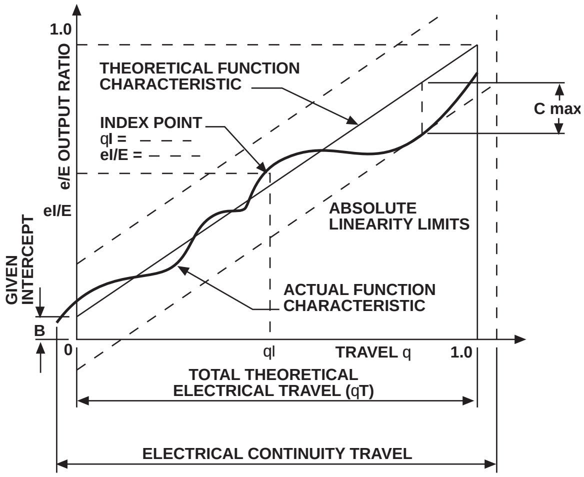
This linearity is harder to achieve than the one above because it is the maximum deviation of the actual function characteristic from a fully defined straight reference line. It is expressed as a percentage of the total applied voltage and measured over the theoretical electrical travel. An index point 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: $\frac{e}{E} = A(q / q_T) + B \pm C$

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

Unless otherwise specified A = 1; B = 0.



4.8 - LIFE

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

4.9 - RESOLUTION

A measure of the sensitivity to which the output ratio of the potentiometer may be set.

4.10 - 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.

4.11 - TRAVELS

4.11.1 - Theoretical electrical travel: TET

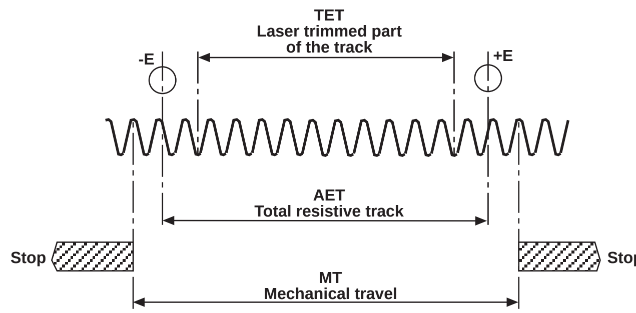
The specified shaft travel over which the theoretical function characteristic and its associated conformity limits are respected.

4.11.2 - 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.

4.11.3 - Mechanical travel : MT

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



4.12 - GRADIENT

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

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

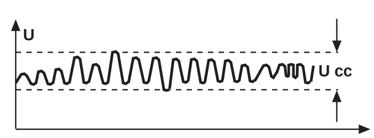
(rotational) (linear)

4.13 - 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.

4.14 - OUTPUT SMOOTHNESS

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 micro-nonlinearities in the output.



Ucc: maximum variations peak to peak.

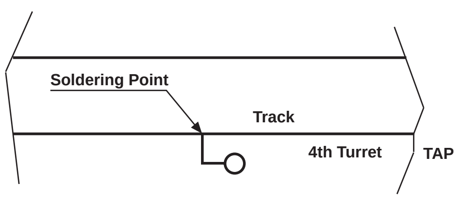
$$RTS = \frac{Ucc}{E} \times 100 = ... \%$$

4.15 - 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.

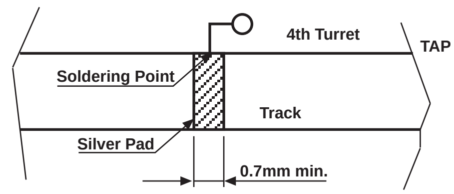
4.16 - VOLTAGE TAP

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 in the middle of the TET.



4.17 - CURRENT TAP

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



4.18 - STARTING TORQUE

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

4.19 - MOMENT OF INERTIA

The mass moment of inertia of the rotating elements of the potentiometer about their rotational axis