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- 2.0 Terms and definitions
- 3.0 Tests
- 4.0 Spindle ends, mounting means and terminations
- 5.0 Preferred values of rated resistance
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- 7.0 Product and detail specifications

- 1.0 Used standards and specifications  
Valid standards (Stand 09/2004) are listed.

1.1 Standards on potentiometers

DIN EN 60062	Marking codes for resistors and capacitors
DIN IEC 60063	Preferred number series for resistors and capacitors
DIN IEC 60393-1	Potentiometer for use in electronics equipment Generic specification
DIN 41450-1	Preset potentiometers, lead screw actuated or rotary Terms and definitions, characteristics, methods of test
DIN 41450-2	Single turn rotary potentiometers Terms and definitions, characteristics, methods of test
DIN 41591	Spindle ends for electromechanical component parts
DIN 45922-1	Generic specification: Potentiometer (CECC 41000)
DIN 45922-11	Sectional specification: Preset potentiometers (CECC 41100)
DIN 45922-12	Sectional specification: Power potentiometers (CECC 41200)
DIN 45922-13	Sectional specification: Low power single turn rotary potentiometers (CECC 41300)
DIN 45922-14	Sectional specification: Rotary precision potentiometers (CECC 41400)
DIN 45922-112	Blank detail specification: Preset potentiometers (CECC 41102) (Assessment level M)
DIN 45922-121	Blank detail specification: Power potentiometers (CECC 41201) (Assessment level S)
DIN 45922-122	Blank detail specification: Power potentiometers (CECC 41202) (Assessment level M)
DIN 45922-131	Blank detail specification: Low power single turn rotary potentiometers (CECC 41301)
DIN 45922-141	Blank detail specification: Rotary precision potentiometers (CECC 41401)
DIN EN 141101	Blank detail specification: Preset potentiometers

1.2 Standards for test methods and inspection procedures

DIN EN 60068-1	Environmental testing, general and guidance
DIN EN 60068-2-1	Test A: Cold
DIN EN 60068-2-2	Test B: Dry heat

DIN EN 60068-2-6	Test Fc: Vibration (sinusoidal)
DIN EN 60068-2-13	Test M: Low air pressure
DIN EN 60068-2-14	Test N: Change of temperature
DIN EN 60068-2-17	Test Q: Sealing
DIN IEC 60068-2-20	Test T: Soldering
DIN EN 60068-2-21	Test U: Robustness of terminations and integral mounting devices
DIN EN 60068-2-27	Test Ea and guidance: Shock
DIN EN 60068-2-30	Test Db and guidance: Damp heat cyclic
DIN EN 60068-2-45	Test XA and guidance: Immersion in cleaning solvents
DIN EN 60068-2-78	Test Cab: Damp heat, steady state
DIN ISO 2859-1	Sampling procedures for inspection by attributes, sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection

### 1.3. Dimensions

Dimension that are given in the catalogue subject to change. Samples and drawings with tolerance specifications can be hand out on request. Technical changes and improvements for our products are reserved.

## 2.0 Terms and definitions according to DIN IEC 60 393-1 and DIN 45922-1

### 2.1 Potentiometer

A potentiometer is a component with at least three terminations intended primarily for use as an adjustable voltage divider. Two of the terminations are connected to the ends of a resistive element and the third to a moving contact which can be moved mechanically along the resistive element.

#### 2.1.1 Pre-set or trimmer potentiometer

A preset or trimmer potentiometer is a potentiometer of simple construction designed for infrequent adjustment of a voltage ratio or a resistance value generally by using a separate actuator with an amount and duration of movement of the moving contact considerably less than that of a potentiometer for common use.

#### 2.1.2 Rotational potentiometer (single-turn or multi-turn)

A rotational potentiometer is a potentiometer which is actuated by a spindle and may be operated frequently to adjust voltage or resistance operational values.

#### 2.1.3 Power potentiometer

A power potentiometer is one that has a resistive element which normally can dissipate more than 4 W, and which is designed and constructed with specific consideration to internal temperature rise and heat transfer.

#### 2.1.4 Precision potentiometer

A precision potentiometer is a potentiometer in which the voltage or resistance between one of the end terminations to the element and the wiper termination as a function of the positioning of the wiper follows an exactly defined law making it suitable for measuring purposes or for use in automatic and other control equipment. Element, wiper and actuating device are designed for a corresponding precision and stability during a prolonged useful life and may be suitable for servo actuation.

#### 2.1.5 Ganged potentiometer

A ganged potentiometer consists of two or more sections operated simultaneously by a common spindle. Phasing requirements may be taken into consideration.

#### 2.1.6 Multiple (dual) potentiometer

A multiple potentiometer consists of two or more sections operated independently by e.g. concentric spindles.

#### 2.1.7 Attenuation control trimmer (T-pad attenuator)

An attenuation control trimmer is a ganged (often lead-screw actuated) preset triple potentiometer suitable for high frequency use (up to approximately 1 000 MHz) and of such design that the input and the output impedances remain constant and equal to a specified value independent of the attenuation setting.

### 2.2 Operation

#### 2.2.1 Actuating device

The actuating device serves to move the wiper of the potentiometer along the element. It may be a spindle, a linear motion shaft, or a lead screw, designed for manual or tool operation or for connection to a servo drive.

#### 2.2.2 End stops

End stops serve to mechanically limit the motion of the wiper. The force or torque applied to the actuating device with the wiper in contact with a stop should not be higher than a given value.

#### 2.2.3 Slipping clutches

A slipping clutch is a device permitting continuous rotation of the actuating device after the moving contact has reached either end of the resistive element. When a given force is exceeded it mechanically unlinks the wiper and the actuating device in order to prevent mechanical damage to the wiper, end stops and actuating device. To keep dynamic forces low, it may be necessary to limit the speed of rotation.

#### 2.2.4 Designation of terminations

The terminations of the potentiometer are designated as follows:

a is the end termination electrically nearest to the moving contact with the spindle set fully anticlockwise as defined in 2.2.5

b is the termination of the moving contact.

c is the other end termination.

The numerals 1, 2 and 3 or A, S, and E may be used as alternatives to a, b and c respectively. The terminations may not be marked on the potentiometer, especially with linear law devices. The designation of any additional terminations is defined in the description of the potentiometer.

## 2.2.5 Direction of rotation

The direction of rotation is defined as clockwise or anticlockwise when viewing the face of the potentiometer which includes the means of actuation. If this position cannot be recognized without doubt, it is to be identified as stated in the detail specification.

## 2.3 Climatic category DIN EN 60068-1

The climatic category is a coded indication of the limits of the principal environmental tests which the potentiometer will withstand within its claimed stability range. It may be used to estimate the climate range of application, provided the component ambient is correctly taken into consideration. The climatic category is given in the following format:

ab/cde/fg

wherein      ab = severity of test A, cold, indicated by the lower category temperature in °C  
              cde = severity of test B, dry heat, indicated by the upper category temperature in °C  
              fg = severity of test C, damp heat, steady state, indicated by its duration in days

Example: Climate category 25/125/21 means a lower category temperature of -25°C, an upper category temperature of 125°C and a damp heat steady state test duration of 21 days.

For the duration of the damp heat, cyclic, test, a relation to the climatic category is fixed in the generic specification. For other environmental tests, the applicable severity is stated in the description of the potentiometer (or in the detail specification, if available).

### 2.3.1 Lower category temperature

The lower category temperature is the minimum ambient temperature for which a potentiometer has been designed to operate continuously.

### 2.3.2 Upper category temperature

The upper category temperature is the maximum ambient temperature for which a potentiometer has been designed to operate continuously at that portion of the rated dissipation which is specified as being the category dissipation.

### 2.3.3 Category temperature range

The category temperature range is the range of temperatures for which the potentiometer has been designed to operate continuously; this is defined by the lower and the upper category temperature of its appropriate category.

### 2.3.4 Surface temperature

The surface temperature is the temperature on a defined portion of the surface of the potentiometer measured under specified conditions. This may be hot spot temperature (in very simple designs only) or the hottest point on the (open) resistive element or the temperature of some portion of the bearing or of the actuating means. Normally, the surface temperature is stated for power potentiometers only.

### 2.3.5 Stability

The stability figure indicates the maximum permitted change of element resistance in the long term tests. The maximum permitted change of element resistance in other tests and the limits of change of other characteristics are related to this.

2.4 Ratings and characteristics

All ratings and characteristics except the rated dissipation are given for reference conditions as selected from DIN EN 60068-1:

Temperature: 20 °C; air pressure: 1 01,3 kPa (1 013 mbar)

They remain practically unchanged within the range of standard atmospheric conditions for testing of DIN EN 60068-1:

- temperature: 15 °C to 35 °C
- relative humidity: 25 % to 75 %
- air pressure: 86 kPa to 1 06 kPa  
(860 mbar to 1 060 mbar)

Any details given in the description of the potentiometer (or in the detail specification, where applicable) shall be taken into consideration, especially when using the component outside the above standard range of ambient conditions.

2.4.1 Rated resistance  $R_N$

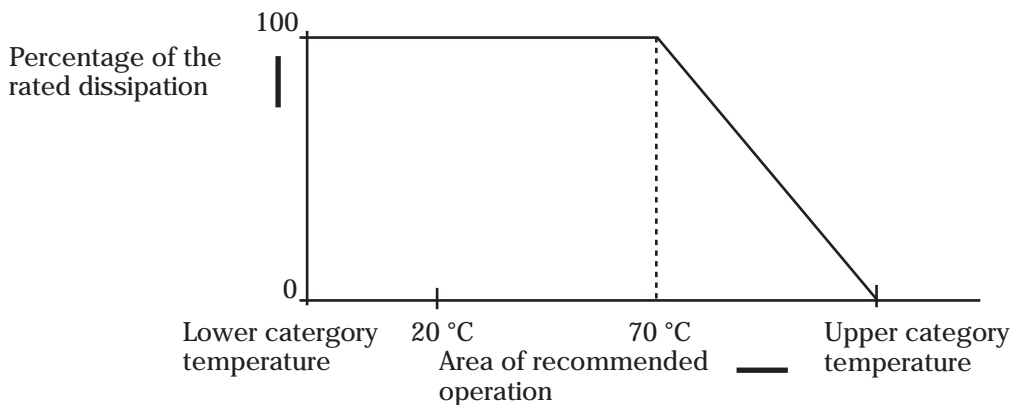
The rated resistance is the resistance value by which the potentiometer is characterized and which is marked on it. Normally, it corresponds to the total resistance of the potentiometer, which can be measured between terminations a and c.

2.4.2 Rated dissipation  $P_N$

The rated dissipation is the maximum allowable dissipation in W of the resistive element between terminations a and c at an ambient temperature of 70 °C under the conditions of the electrical endurance test at 70 °C which will result in a change in total resistance not greater than that specified for the given stability figure.

2.4.3 Dissipation at temperatures other than 70 °C (derating)

At ambient temperatures below 70 °C, at least the rated dissipation may be applied. At ambient temperatures higher than 70 °C, the potentiometers shall be derated according to a curve as shown below. Any details and deviations are given in the description of the potentiometer.



Note: In practice the dissipation is modified by the following conditions:

- For high values of resistance the limiting element voltage may prevent the rated dissipation being attained.
- Where only terminations a or c and b are being used and the control spindle is set at less than 100 % of the effective electrical travel, in this case the moving contact limiting current may define the limiting dissipation.
- If a maximum surface temperature is specified for some part of the potentiometer, this shall not be exceeded.

## 2.4.4 Category dissipation $P_C$

The category dissipation is the maximum allowable dissipation under continuous load at an ambient temperature equal to the upper category temperature and is normally expressed as a percentage of the rated dissipation. The category dissipation may be zero.

## 2.4.5 Rated voltage $U_N$

The rated voltage is the d.c. or a.c. rms voltage calculated from the square root of the product of the rated resistance and the rated dissipation:

$$U_N = \sqrt{R_N \cdot P_N}$$

Note: At high values of resistance, the calculated rated voltage may be higher than the limiting element voltage. In that case it must not be applied to the potentiometer.

## 2.4.6 Limiting element voltage $U_G$

The limiting element voltage is the maximum d.c. or a.c. rms voltage which may be applied across the element of a potentiometer. If the peak value of the applied a.c. voltage is higher than 1.42 times its rms value, the limit shall be reduced accordingly.

Note: This voltage shall only be applied to a potentiometer when the resistance value is equal to or higher than the critical value.

## 2.4.7 Critical resistance $R_K$

The critical resistance is the resistance value at which the rated voltage is equal to the limiting element voltage:

$$R_K = U_G^2 / P_N$$

Below the critical resistance the maximum voltage which may be applied across the terminations a and c of a potentiometer is the rated voltage. Above that value the maximum voltage is the limiting element voltage.

## 2.4.8 Limiting wiper current $I_S$

The limiting wiper current is the maximum current that may be passed between the resistive element and the moving contact. It is resulting from  $I_S = \sqrt{\frac{P_N}{R_N}}$  considering the highest allowable element voltage and is independent on wiper position.

## 2.4.9 Isolation voltage $U_I$

The isolation voltage is the maximum peak voltage under continuous operating conditions which may be applied between the potentiometer terminations and other external conducting parts (like casing, actuating device and mounting means) connected together. The value of the isolation voltage shall not be less than 1.42 times of the limiting element voltage, at normal air pressure. Under conditions of low air pressure the value of the isolation voltage will be less and is given in the description of the potentiometer.

## 2.4.10 Insulation resistance $R_I$

The insulation resistance is the resistance measured with d.c. between the terminations of the potentiometer and other external conducting parts (like casing, actuating device and mounting means) connected together.

#### 2.4.11 Variation of resistance with temperature

The variation of resistance with temperature refers to the element resistance as measured between terminations a and c. It may be expressed either as temperature characteristic or as temperature coefficient. The temperature characteristic indicates the maximum reversible variation of resistance produced by a given variation of temperature within the category temperature range and related to the element resistance value at the reference temperature.

The temperature coefficient indicates the maximum average slope of the curve of variation of resistance with temperature over the category temperature range related to the element resistance value at the reference temperature.

International standards state that either presentation should be understood as not to imply any degree of linearity of the function in question. Nevertheless we prefer to give figures for the temperature coefficient and understand that this implies a smooth variation of resistance with temperature exhibiting only such degree of nonlinearity as is inherent to the resistive material.

Note: A high value of the temperature coefficient of resistance does not necessarily mean that the temperature coefficient of the output ratio is also high.

#### 2.4.12 Variation of output ratio with temperature

The temperature coefficient of the output ratio  $U_{ab}/U_{ac}$  may depend on the potentiometer setting, especially in non-linear potentiometers. It does, not however, depend on the temperature coefficient of the element resistance, but only on its variation along the track.

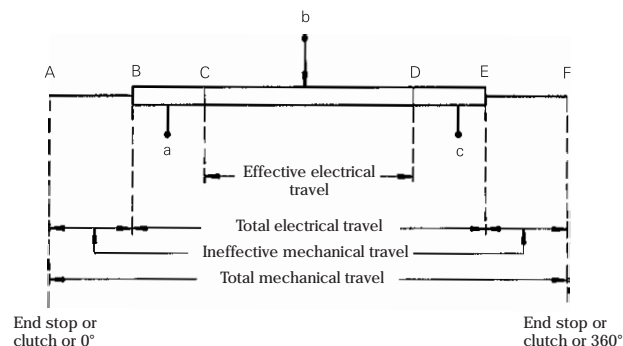
#### 2.4.13 Seals in potentiometers

In a potentiometer, seals of different kind may be provided. In international standards, spindle seals, panel seals, container seals against ingress of dust or fluids, and combinations of these are mentioned. The sealing features of our potentiometers are indicated in the respective descriptions as a supplement to the climatic category. The effectiveness of sealing is verified by the relevant test of DIN EN 60068-2-17, Test Group Q: Sealing.

### 2.5 Resistance/travel relationships

#### 2.5.1 Total mechanical travel

The total mechanical travel is the range of movement of the actuating device, in which a movement of the actuating device results in a movement of the wiper. The total mechanical travel may be expressed in degrees or in mm. It may be unlimited (continuous rotation potentiometer, usual statement: „360° rotation”) or it may be limited by end stops or by both end stops and slipping clutches. In single turn rotary potentiometers the total mechanical travel normally is less than 360°; in lead-screw actuated potentiometers and other multiturn components multiples of 360° regularly occur.



## 2.5.2 Switch actuating travel

The switch actuating travel is that part of the total mechanical travel outside the effective electrical travel which is necessary to actuate an integrated (rotary) switch. It begins at the point where the potentiometer control moving to outside the effective electrical travel first engages the switch actuating means in a way to influence the control torque.

## 2.5.3 Total electrical travel (continuity travel)

The total electrical travel is the amount of travel of the actuating device between two end positions during which there should not normally be any interruption in contact between the moving contact and the resistive element. In our potentiometers with end stops or slipping clutches, it coincides with the total mechanical travel. In continuous rotation potentiometers it is always less than 360°.

## 2.5.4 Effective electrical travel

The effective electrical travel is the amount of travel of the actuating device necessary to move the moving contact in such a manner that the resistance or voltage output ratio between termination b and the relevant other termination changes as prescribed by the specified resistance or voltage output ratio law. The effective electrical travel may coincide with the total electrical travel.

## 2.5.5 Effective resistance

The effective resistance is that portion of the total resistance over which the resistance changes in the manner prescribed by the specified resistance or voltage ratio law.

## 2.5.6 Wiper contact resistance (static)

The wiper contact resistance is the mean value of resistance measured within the effective electrical travel between the wiper termination and the resistive track. It may comprise the value of an integral current limiting protective resistor for the wiper. In certain cases its value may depend on specific ambient conditions.

## 2.5.7 Residual resistance

The residual resistance is the resistance obtained between the end termination a or c and the termination b of the moving contact when the moving contact is set against the relevant end stop or to the point just prior to the clutch commencing to slip.

## 2.5.8 Minimum effective resistance (hop on and hop off values)

The minimum effective resistance is the resistance value, at either end of the effective electrical travel, between termination b and the electrically nearer end termination a or c.

Note: Where there is a steady transition of resistance between the end of travel and the point where the minimum effective resistance is observed, the residual resistance, the terminal resistance and the minimum effective resistance may become the same. If there is an integral current overload protective resistor in the wiper path, its value is included in the resistance values of 2.5.6 to 2.5.8.

## 2.6. Voltage conditions

### 2.6.1 Total applied voltage $U_{ac}$

The total applied voltage is the voltage applied between the input terminations a and c. It should not be higher than the rated voltage or the limiting element voltage, whichever is the lower.

### 2.6.2 Output voltage

The output voltage is the voltage between termination b and termination a or c respectively, which depends on the positions of the actuating means.

### 2.6.3. Output ratio and attenuation

The output ratio is the ratio of the output voltage ( $U_{ab}$  or  $U_{bc}$  respectively) to the total applied voltage ( $U_{ac}$ ). It is normally expressed as a percentage of the total applied voltage. The attenuation is the reciprocal of the output ratio and is normally expressed in dB.

### 2.6.4 Minimum output ratio

The minimum output ratio is the ratio of the minimum voltage which can be obtained between the moving contact termination and one or other of the end terminations to the fixed voltage applied between the end terminations.

### 2.6.5 Load resistance $R_L$

The load resistance is the external resistance as seen by the output voltage (connected between the moving contact termination b and either termination a or c).

### 2.6.7 Loading error

The loading error is the difference between the output ratio with an infinite load resistance and the output ratio with a specified finite load resistance at any position of the actuating device as long as it is the same position for both output ratio measurements.

Note: In precision potentiometers designed for a precisely defined law the loading error may be minimized by compensating the resistance element to give the desired output with a specified load resistance. This is referred to as „load compensation”.

## 2.7. Function law (resistance/travel relationship)

The function law is the relationship of the voltage ratio or the resistance between termination b and the appropriate end termination a or c to the mechanical position of the moving contact (the actuating means). Common potentiometer laws are:

linear

nonlinear rising (positive logarithmic)

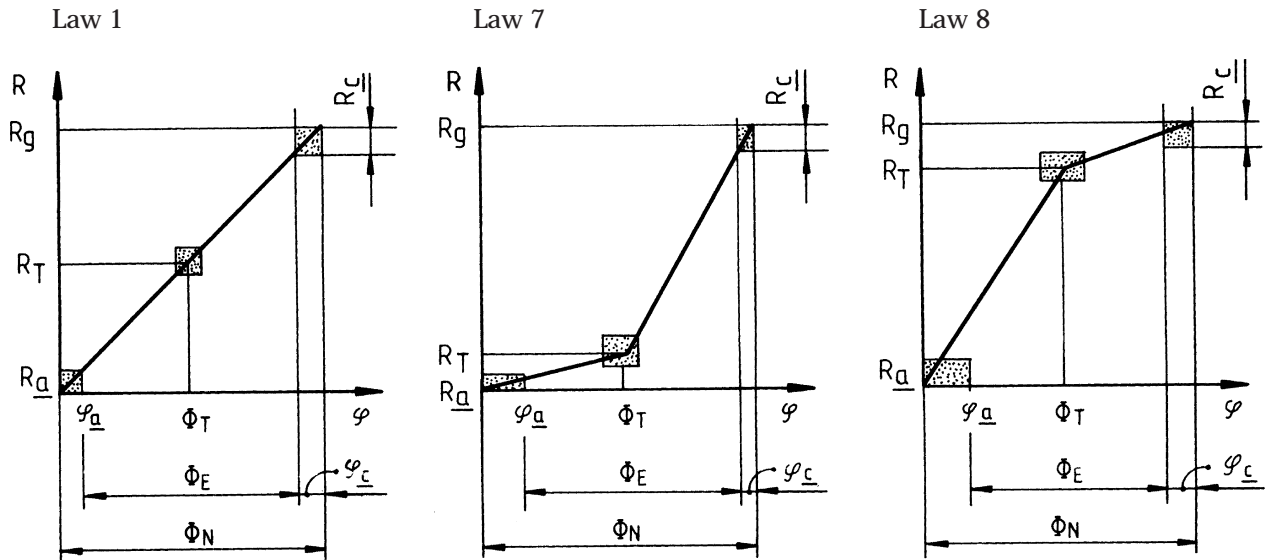
nonlinear falling (inverse or negative logarithmic)

With nonlinear falling law the reference point (see 2.2.4) for the setting movement is termination a and the reference point for the voltage or resistance measurement is termination c.

Note: Simple nonlinear potentiometers often are referred to as „logarithmic” and are marked so, even if the law differs considerably from a true logarithmic one.

### 2.7.1 Preset potentiometer laws

The law of preset potentiometers is described by three „windows”, one for the lower hop on value, one for the upper hop off value and one for the mechanical center value of effective electrical travel. Unless otherwise indicated in the description of the potentiometer, size and position of the windows are as shown in the drawing and table below. A nonlinear law curve is normally composed of two linear parts.

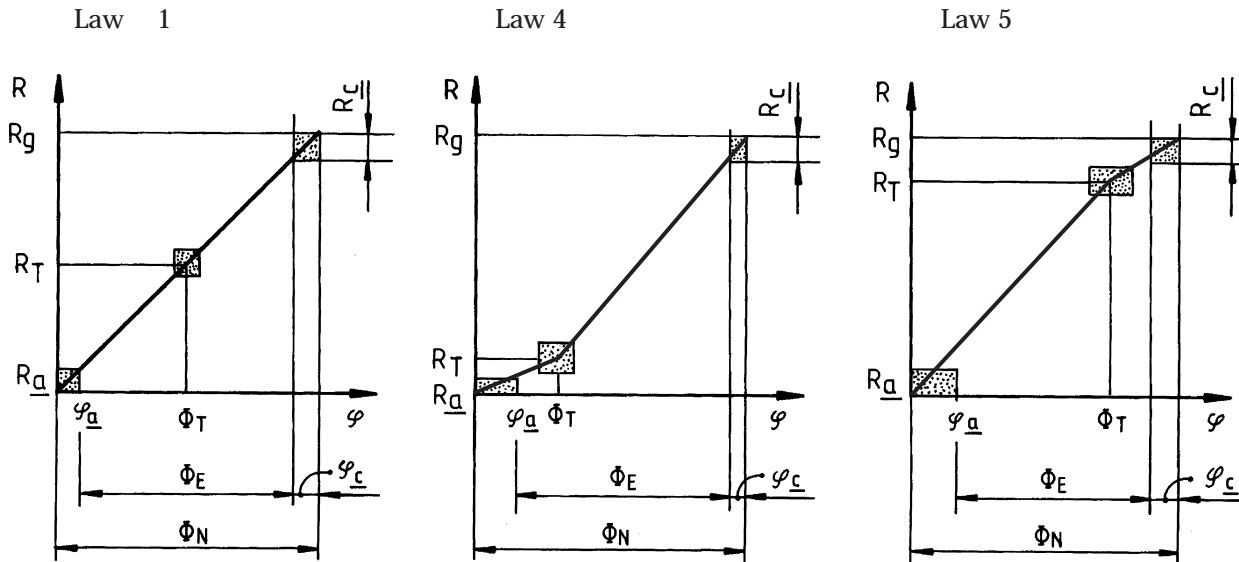


Law		1 (lin)	7 (pos. log)	8 (neg. log)
Residual resistance (= terminal resistance) see also DIN 45922 part 1 and 11	$R_a$	$\cong 5 \times 10^{-3} R_N^{1)}$	$\cong 2 \times 10^{-3} R_N^{1)}$	$\cong 2 \times 10^{-2} R_N^{1)}$
	$R_c$	$\cong 5 \times 10^{-3} R_N^{1)}$	$\cong 2 \times 10^{-2} R_N^{1)}$	$\cong 2 \times 10^{-3} R_N^{1)}$
Conformity valid for	$\Phi_E$	For values see description of potentiometer		
	$\mathcal{I}_a \sim \mathcal{I}_c$	$\cong 20^\circ$		
Part angle	$\mathcal{I}_T$	$0,5 \cdot \Phi_N \pm 5^\circ$	$0,5 \cdot \Phi_N \pm 15^\circ$	
Part resistance	$R_T$	$(0,4 \text{ to } 0,6) \cdot R_g$	$(0,05 \text{ to } 0,15) \cdot R_g$	$(0,85 \text{ to } 0,95) \cdot R_g$

1) but not less than 2 Ohms

2.7.2 Resistance law of single-turn rotary

The law of single turn rotary (and linear motion) potentiometers is described in a similar way as for preset potentiometers by three windows, or where necessary by four windows the intermediate two of which are situated at approximately 1/3 and 2/3 of the effective electrical travel. Unless otherwise indicated in the description of the potentiometer, size and position of the windows are as shown in the drawing and table below. A nonlinear law curve is often composed of two or three approximately linear parts.



Law		1 (lin)	4 (pos. log)	5 (neg. log)
Residual resistance (= terminal resistance) see also DIN 45922 part 1 and 11	$R_a$	$\leq 1 \times 10^{-3} R_N^{1)}$	$\leq 1 \times 10^{-3} R_N^{1)}$	$\leq 2 \times 10^{-2} R_N^{1)}$
	$R_c$	$\leq 1 \times 10^{-3} R_N$	$\leq 2 \times 10^{-2} R_N$	$\leq 1 \times 10^{-3} R_N$
Minimum effective resistance	$R_A$	$\leq 2 \times 10^{-2} R_N$	$\leq 1 \times 10^{-2} R_N$	$\leq 2 \times 10^{-2} R_N$
	$R_E$	$\leq 2 \times 10^{-2} R_N$	$\leq 2 \times 10^{-2} R_N$	$\leq 1 \times 10^{-2} R_N$
Conformity valid for	$\Phi_E$	For values see description of potentiometer		
	$\mathcal{I}_a \sim \mathcal{I}_c$	$\leq 20^\circ$		
Part angle	$\mathcal{I}_T$	$0,5 \cdot \Phi_N \pm 5^\circ$	$0,2 \cdot \Phi_N \pm 15^\circ$	$0,8 \cdot \Phi_N \pm 15^\circ$
Part resistance	$R_T$	$(0,4 \text{ to } 0,6) \cdot R_g$	$(0,05 \text{ to } 0,15) \cdot R_g$	$(0,85 \text{ to } 0,95) \cdot R_g$

<sup>1)</sup> but not less than 2 Ohms.

### 2.7.3 Resistance law of power potentiometers

The resistance law of power potentiometers is described as for preset potentiometers. In cases where a required nonlinear ("logarithmic") law can only be met by more than two linear parts the transition between the parts shall be specified by additional windows. Size and position of these windows are subject to agreement with the user.

## 2.7.4 Precision potentiometer laws

For linear precision potentiometers the linearity is defined according to DIN IEC 60393-1. Unless otherwise agreed upon our potentiometers are trimmed to independent linearity. For nonlinear precision potentiometers, description, tolerances and verification of the law are principally subject to arrangement with the user.

## 2.7.5 Taps

Taps to the resistive element can be provided except for preset potentiometers. A tap is located by specifying a window of wiper position and resistance value or voltage ratio, similar to the intermediate window for the law. Within the window the resistance value or the voltage ratio may remain constant, but the direction of slope shall not reverse.

## 2.7.6 Conformity

The conformity indicates the maximum permissible difference between the specified law and the actual law. It is given as a percentage of total applied voltage or element resistance. According to existing standards, different ways of presentation mainly referring to precision potentiometers are in use. For the potentiometers under 2.7.1 to 2.7.3 no conformity requirements in addition to the windows should be specified, except in very special cases.

## 2.7.7 Phasing point marking

On potentiometers intended for ganging (on a common spindle) the position of the wiper corresponding to a specified point of the law curve may be marked. Such phasing marks serve to pre-align the potentiometer sections of the ganged array.

## 2.8 Other characteristics

### 2.8.1 Rotational noise

Rotational noise is, in a wirewound potentiometer, any spurious variation in the electrical output, when moving the wiper and caused by contact resistance variation and/or track resistance variation. It is expressed in terms of equivalent noise resistance.

### 2.8.2 Resolution (adjustability)

The resolution indicates the precision with which the resistance or output voltage ratio of a potentiometer can be set to a desired value. It is normally expressed as a percentage of total applied voltage or of total resistance. In wirewound potentiometers, the theoretical resolution is equal to the reciprocal of the number of turns of the resistance winding in the effective electrical travel when expressed as a percentage.

### 2.8.3 Starting torque and running torque

The starting torque is the torque necessary on the spindle to start movement of the wiper in either direction from any point of setting (except notch positions) within the range of total mechanical travel. It is always higher than the running torque necessary to keep the wiper moving along the mechanical travel after the movement has been started.

### 2.8.4 Switch torque

The switch torque is the torque necessary to operate a built-on switch. It is always higher than the starting torque and is expressed as a maximum value.

### 2.8.5 End stop torque

The end stop torque is the maximum permissible torque which may be applied to the actuating device with the wiper set to either end stop without changing the electrical or mechanical parameters to outside the specified limits or to cause mechanical damage.

### 2.8.6 Backlash

Backlash is the maximum difference in the actuating device position that occurs when it is moved to the same actual output ratio point from opposite directions.

### 2.8.7 Radial play of the spindle

The radial play of the spindle is the maximum deviation between the distance moved by a point of the spindle's cylindrical surface and the ideal movement of such a point with the spindle's rotational axis perpendicular to the mounting face. The radial play may be caused by the tolerances of the bearing and/or by elastic deformation of the spindle (especially of a plastic moulded spindle) the amount of deviation shall be equated to the length of the spindle. It shall be measured according to DIN IEC 60393-1 with the spindle's length clamped and the bearing preloaded as specified in the description of the potentiometer.

## 3.0 Test and inspection procedures

All potentiometers undergo continuous in-production inspection and tests, these are based on the relevant schedules of tests in the CECC specifications which together with the IECQ systems usually only lists post-production tests. Due to technical and organisational reasons specific tests during the production schedule may be carried out in an alternative manner, however, they are all designed to establish a guaranteed level of quantity and performance for every product tested.

Generally we adhere to the methods of test and measurement according to CECC 41000, DIN IEC 60393-1 and DIN EN 60068-1 and -2 unless the point has explicitly been covered by a special agreement.

## 4.0 Spindle ends, mounting means and terminations

### 4.1 Spindles and bushings

Potentiometers fitted with spindle as actuating means are preferably equipped as follows (see CECC 41000/suppl. G):

Spindle diameter 6 mm, basic length 50 mm, threaded bushing M 10 x 0,75 for single hole mounting, preferred length from seating plane 8 mm, 10 mm or 12 mm.

Spindle diameter 4 mm, basic length 50 mm, threaded bushing M 7 x 0,75 for single hole mounting, preferred length from seating plane 8 mm.

### 4.2 Terminations and mounting means for printed circuits

Terminations and mounting means for printed circuits may be arranged depending on the position of the axis of the operating means either parallel or perpendicular to the printed board plane. In preset (trimmer) potentiometers the terminations serve also for mounting. The position of the holes for terminating and mounting pins on the printed board, the reference planes and the details of dimensions are to be taken from the descriptions of the potentiometer styles.

Printed circuit connection pins normally are of punch cut flat configuration 1,1 mm wide. With some styles, snap-in terminations are available on request. For more details, see the descriptions of potentiometer styles.

## 5.0 Preferred values of the rated resistance

Within the resistance ranges given for each style, the values of the R3 series can be delivered. Further values can be delivered on request.

The values of the R3 series: 10 - 22 - 47 - 100 and the decimal multiples and parts of it can be delivered.

## 6.0 Marking of potentiometers

Every potentiometer is usually marked with its rated resistance value on the product and/or on the packaging, if necessary in code form, and when of non-linear law with an indication of that law. The tolerance of the rated resistance may be marked in addition. The termination designations of 2.2.4 are marked only in cases where the inner connection relationship does not correspond to the positions of the terminations on the potentiometer body.

Where partly or the complete marking is in code, we preferably use the alphanumeric marking codes for resistance value and tolerance as given in DIN EN 60062. A nonlinear law is marked by „lg“ or „-lg“. For precision potentiometers additional and more detailed marking methods apply.