MODULAR CARBON AND CERMET POTENTIOMETERS

The PP17 series includes resistance elements (linear and logarithmic), battery switches, drive units, mounting brackets, detents, shielding, cover, and heatsink, which can be efficiently assembled to customer's order to form an almost infinite variety of carbon and cermet control potentiometers. All types of these rectangular potentiometers are custom built from standard stock parts and are therefore available within comparitively short delivery times. The surveys on the following pages show the most probable combinations of items. The various modular elements are then described, and the electrical and mechanical details of complete units are given. The resistance elements can also be supplied separately.

QUICK REFERENCE DATA

Resistance range (E3 series)	
carbon, linear law	220 Ω to 2,2 MΩ
carbon, logarithmic law	2200 Ω to 2,2 MΩ
cermet, linear law	220 Ω to 4,7 MΩ
Maximum dissipation at T_{amb} = 40 °C	
carbon, linear law	0,2 W
carbon, logarithmic law	0,1 W
cermet, linear law	1 to 3 W
Climatic category (IEC 68)	
carbon	25/070/10
cermet, versions with metal spindle	40/100/56
cermet, versions with plastic spindle or without spindle	25/070/56

DESCRIPTION

The potentiometer family can be divided into two groups:
- versions without spindle, to be activated by customized snap-in devices (survey 1);
- versions with one of many available spindle types (survey 2).

All versions can be supplied with either carbon or cermet resistance elements, fixed in a self extinguishing glass-fibre filled polycarbonate housing (black).

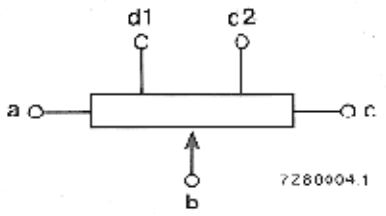
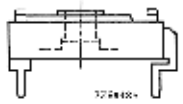
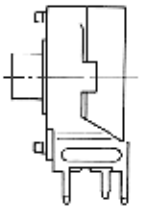
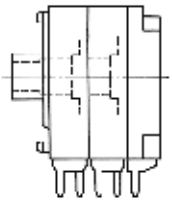
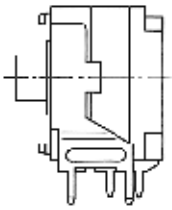
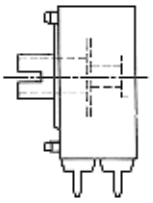
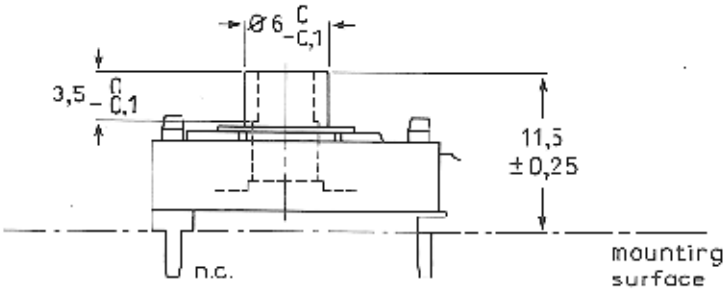


Fig. 1 Designation of terminals.

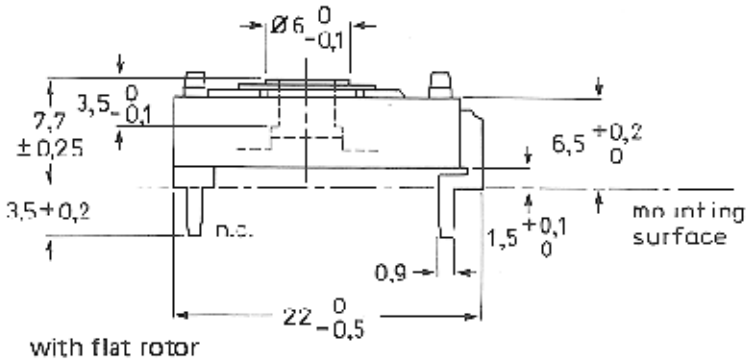
The carbon resistance element is a carbon track on a phenolic paper substrate; the cermet resistance element is Al_2O_3 substrate. The metallic multi-finger wiper is mounted in a plastic rotor. Terminals are designated as shown in Fig. 1 in accordance with IEC 393-1, sub-clause 4.5.

single horizontal	tandem vertical				dual vertical
Type D 		 with bracket	 with battery switch	 with bracket and battery switch	Type E 
2322 5.0 0.5..	2322 5.0 05...	2322 5.0 07...	2322 5.0 150..	2322 5.0 170..	2322 5.0 9...
●					
●	●	●	●	●	X
X (1)					
●	●	●	●	●	X
	●	●	● tap versions	X tap versions	X
	●	●	●	●	X
	X				X
	X				X
●					
	X	X			X
	X	X			X

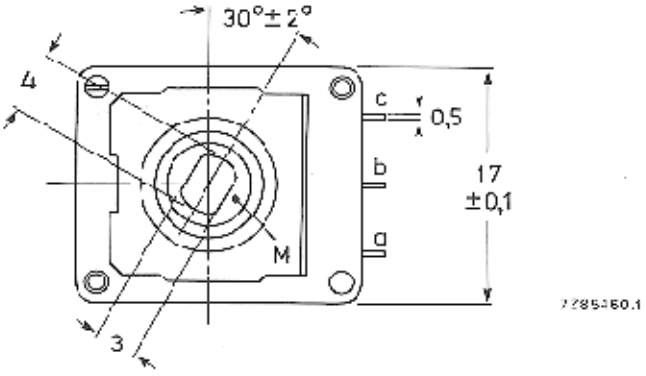
VERSION WITHOUT SPINDLE, SINGLE HORIZONTAL (TYPE D)



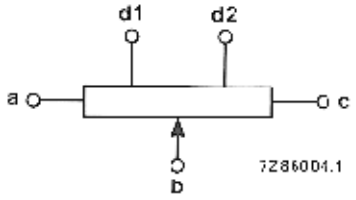
with protruding rotor



with flat rotor



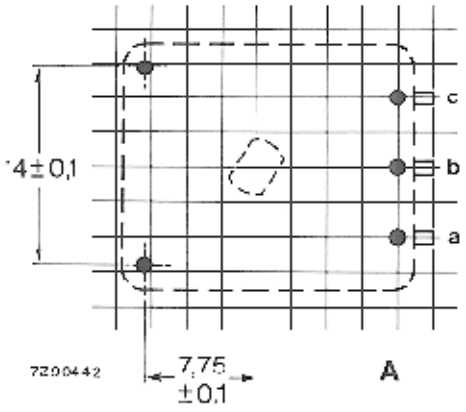
Rotor drawn at fully counter-clockwise position.
M = mark for position of slider.



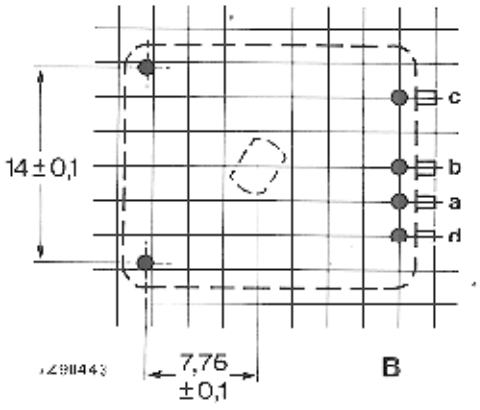
designation of terminals

Hole patterns

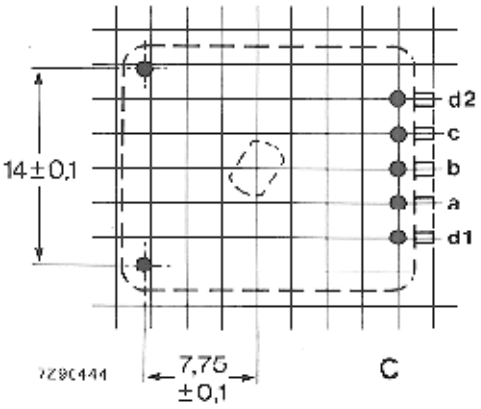
For connection to printed-wiring boards with a grid pitch of 2,54 mm, viewed from component side. Hole dia. 1,3 + 0,05 mm.



no tap



one tap



two taps

Fig.8 Version without spindle, single horizontal.

Main properties

Climatic category (IEC 68)	carbon 25/070/10, cermet 25/070/56
Resistance range, E3 series	
carbon, linear (linearity 4%)	220 Ω to 2,2 MΩ, tolerance 20%
carbon, non-linear	2200 Ω to 2,2 MΩ, tolerance 20%
cermet, linear (linearity 4%)	220 Ω to 4,7 MΩ, tolerance 10%
Resistance law (see Fig.35)	carbon, A, B, C, H cermet A
Maximum dissipation at T_{amb} = 40 °C	
carbon, linear	0,2 W
carbon, non-linear	0,1 W
cermet, linear	1,25 W
Test voltage for 1 minute	500 V, 50 Hz

For further information see Electrical Data and Mechanical Data.

Composition of the catalogue number, PP17 without spindle, single, horizontal

2322 5.0 0.5. .

- code for element
  - 0 = carbon
  - 1 = cermet
- code for rotor
  - 0 = protruding rotor
  - 1 = flat rotor
- resistance code
  - Table for R_{nom}

R \ law	linear	logarithmic*	rev. logarithmic*	log. with tap
220 Ω	02	–	–	–
470 Ω	03	–	–	–
1 kΩ	04	–	–	–
2,2 kΩ	05	25	45	–
4,7 kΩ	06	26	46	–
10 kΩ	07	27	47	–
22 kΩ	08	28	48	–
47 kΩ	09	29	49	–
100 kΩ	11	31	51	–
220 kΩ	12	32	52	–
470 kΩ	13	33	53	–
1 MΩ	14	34	–	–
2,2 MΩ	15	35	–	–
4,7 MΩ	16	–	–	–

* carbon only.

Catalogue numbers for other versions on request.

ELECTRICAL DATA

Unless otherwise specified, all values are valid at an ambient temperature of 18 to 22 °C, an atmospheric pressure of 86 to 106 kPa and a relative humidity of 45 to 75%.

For measuring and test methods, see IEC publications 393-1 and 68. The terms used are explained in general section Terms and Definitions.

	carbon		cermet
Resistance range, E3 series*			
potentiometers without spindle			
linear law	220 Ω to 2,2 MΩ		220 Ω to 2,2 MΩ
logarithmic law	2200 Ω to 2,2 MΩ		–
potentiometers with spindle			
linear law	220 Ω to 2,2 MΩ		220 Ω to 2,2 MΩ
logarithmic law	2200 Ω to 2,2 MΩ		–
Tolerance on resistance	± 20%*		± 10%
Resistance law and tolerances (see Fig.35)	type A, B, C, H		type A
Ganging tolerance (tandem potentiometers)	standard	special	
linear law			
at values between 10 and 90% of R_{ac}	< 2 dB		
(reversed) logarithmic law			
at attenuations between 0 and 20 dB	< 2 dB		
at attenuations between 20 and 40 dB	< 3 dB		
at attenuations between 40 and 60 dB	< 4 dB		
with a tap at 10% of R_{total}, tap load 1% of R_{ac}			
at attenuations between 0 and 20 dB	< 2 dB	< 2 dB	
at attenuations between 20 and 40 dB	< 3 dB	< 3 dB	
at attenuations between 40 and 60 dB	< 4 dB	< 3 dB	
at attenuations between 60 and 70 dB	< 6 dB	< 3 dB	
at attenuations between 70 and 80 dB	< 8 dB	< 8 dB	
Terminal resistance, (residual)	⩽ 2% of R_{nom} or 10 Ω		⩽ 1% of R_{nom} or 10
Resistance at the tap	⩽ 1,5% or R_{nom} or 10 Ω		
Contact resistance moving, initially,			
linear law	⩽ 4% of R_{ac}		⩽ 2,5% of R_{ac}
logarithmic law	⩽ 8% of R_{ac}		–
Contact resistance variation (CRV),			
(acc. to IEC 393-1, sub. clause 4.17) initially,			
linear law	⩽ 1%		⩽ 1% of R_{ac}
logarithmic law	⩽ 2%		–
Temperature coefficient of resistance	± 500 x 10^{-6}/K		± 100 x 10^{-6}
Insulation resistance			
after damp heat test	after 21 days		after 56 days
(IEC 68, test C)	> 100 MΩ		> 100 MΩ

* 10% on request.

ELECTRICAL DATA (continued)

	carbon	cermet
Maximum attenuation		
$R_{ac} \geqslant 22\ k\Omega$, logarithmic law	⩾ 90 dB	
$R_{ac} < 22\ k\Omega$, logarithmic law	⩾ 75 dB	
$R_{ac} < 22\ k\Omega$, linear law	⩾ 55 dB	⩾ 60 dB
Maximum dissipation at $T_{amb} = 40\ ^oC$ (P_{max}) *		
linear law	0,2 W	1,25 W **
logarithmic law	0,1 W	
linear law, using a heatsink		3 W **
Test voltage for 1 minute	500 V, 50 Hz	500 V, 50 Hz
with cover	1000 V, 50 Hz	1000 V, 50 Hz
Working temperature range		
versions without spindle	−25 to + 70 °C	−25 to + 70 °C
versions with spindle	−25 to + 70 °C	−40 to + 125 °C
Storage temperature range		
without switch, versions without spindle	−40 to + 90 °C	−40 to + 90 °C
without switch, versions with spindle		−40 to + 100 °C
with switch	−40 to + 85 °C	
Climatic category (IEC 68)		
versions without spindle	25/070/10	25/070/56
versions with metal spindle	25/070/10	25/100/56
versions with plastic spindle	25/070/10	25/070/56

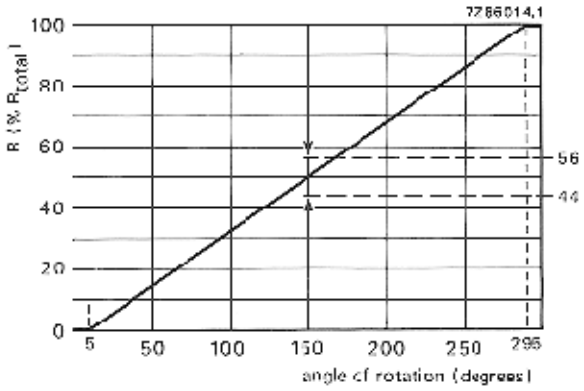
ENVIRONMENTAL TESTS

tests	requirements		
		carbon	cermet
Climatic sequence	$\Delta R_{ac}/R_{ac}$	⩽ 10%	⩽ 2%
Damp heat, steady state			
$R \leqslant 100\ k\Omega$	$\Delta R_{ac}/R_{ac}$	⩽ 15%	⩽ 2%
$R > 100\ k\Omega$		⩽ 20%	⩽ 2%
Mechanical endurance			
25 000 cycles	$\Delta R_{ac}/R_{ac}$	⩽ 10%	⩽ 2%
Electrical endurance			
1000 h at 70 °C, cyclic	$\Delta R_{ac}/R_{ac}$	⩽ 10%	⩽ 2%
Resistance to soldering heat			
(IEC 68-2, test T)	$\Delta R_{ac}/R_{ac}$	⩽ 2%	⩽ 1%
Change of temperature	$\Delta R_{ac}/R_{ac}$	⩽ 3%	⩽ 1%
	$\Delta V_{ab}/V_{ac}$	⩽ 1%	⩽ 0,5%
Bump and vibration	$\Delta R_{ac}/R_{ac}$	⩽ 2%	⩽ 0,5%
	$\Delta V_{ab}/V_{ac}$	⩽ 1%	⩽ 0,5%

* For derating see Fig.36.

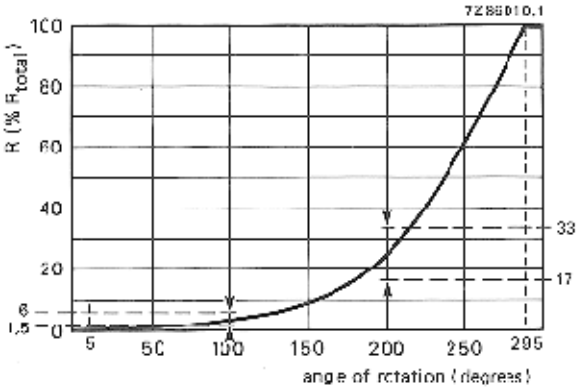
** For versions with metal spindle. The max. dissipation of cermet types with plastic spindle is 1 W (lin. law) and 2 W (lin. law with heatsink).

Characteristics of potentiometers without switch



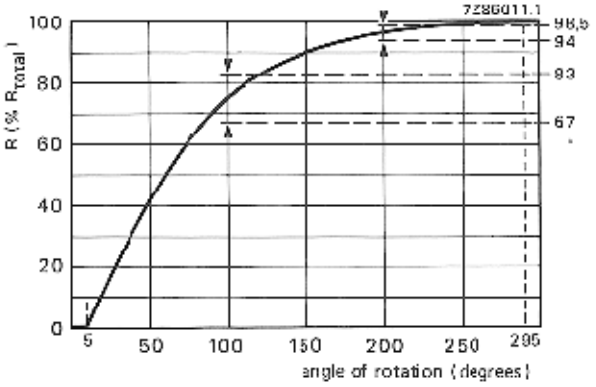
Type A

Fig.35a Linear law.



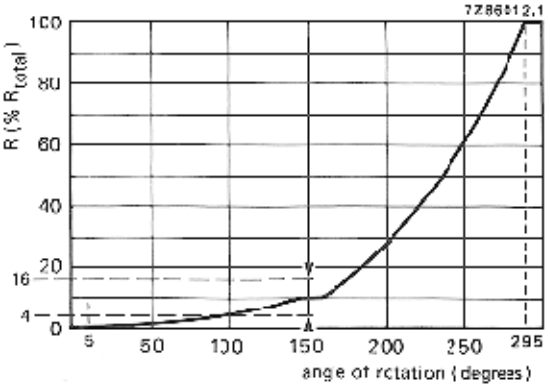
Type B

Fig.35b Logarithmic law.



Type C

Fig.35c Reversed logarithmic law.

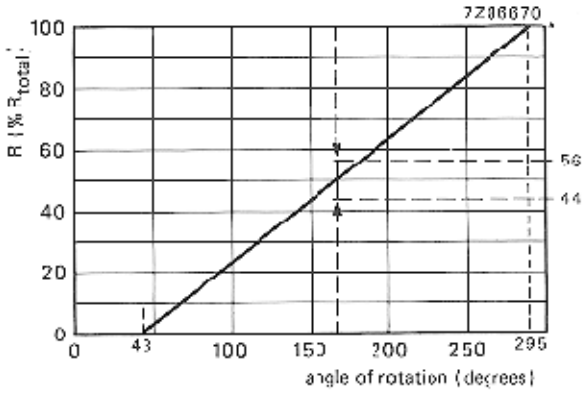


Type H

Fig.35d Logarithmic law, tap at 10%.

Characteristics of potentiometers with switch

The curves of Fig.35a to d have to be adapted since the effective angle of rotation is from 43° to 295°. An example for linear law is given in Fig.35e.



Type A

Fig.35e Linear law.

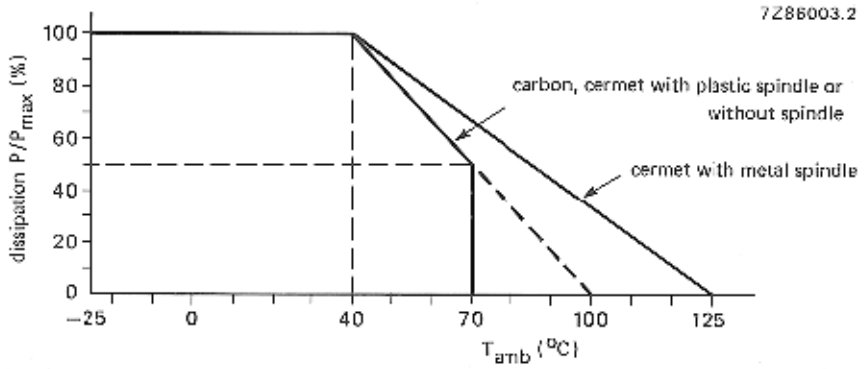


Fig.36 Max mum permissible dissipation as a function of ambient temperature.

MARKING

The potentiometers are marked according to IEC 62 as follows:

- nominal resistance (in RKM code)
- resistance law
- code for year and month of manufacture.

MECHANICAL DATA

	versions without spindle		versions with spindle		
	single duo	tandem	single duo	tandem	unit
Max. axial force	80*	80*	100	100	N
Operating torque initial	4 to 16	4 to 20	5 to 20	5 to 30	mNm
Operating torque of switch	25 to 75	25 to 75	25 to 75	25 to 75	mNm
Max. permissible end-stop torque	600	600	4ϕ: 600 6ϕ: 800	4ϕ: 600 6ϕ: 800	mNm mNm
Angle of rotation	300 ± 2	300 ± 2	300 ± 2	300 ± 2	deg
Effective angle of rotation with switch	290 ± 2,5 252 ± 2,5	290 ± 2,5 252 ± 2,5	290 ± 2,5 252 ± 2,5	290 ± 2,5 252 ± 2,5	deg deg
Axial rotor/spindle play	≤ 0,2	≤ 0,2	≤ 0,3	≤ 0,3	mm
Radial rotor/spindle play	≤ 0,2	≤ 0,2	≤ 0,1 per 10 mm	≤ 0,1 per 10 mm	mm

Angle of rotation

1. Types without switch
   total mechanical angle — 0° to 300°
   effective R-angle — 5° to 295°
   For performance see — Fig.37a

2. Types with switch
   total mechanical angle — 0° to 300°
   O to A; radial spindle play in "off" position (c.c.w.) — 10° max.
   O to B; switch angle — 43° max.
   B to C; effective R-angle — 43° to 295°
   For performance see — Fig.37b

a

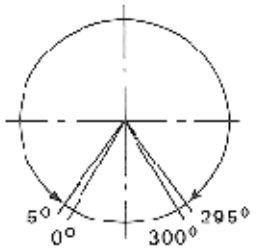


Fig.37a.

b

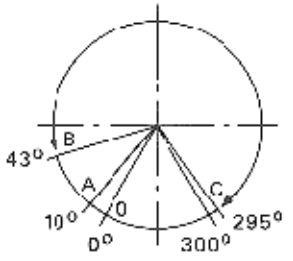


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Fig.37b.

MOUNTING

The potentiometers with printed-wiring terminals are intended for p.c. board mounting with a grid pitch of 1e (2,54 mm). The holes in the board should be 1,3 ± 0,5 mm; the board thickness not over 2 mm. Potentiometers with bushing should be mounted as described in Figs 29 and 30.

* If not supported: 20 N.