

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 comparatively 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 $T_{amb} = 40\text{ °C}$	
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).

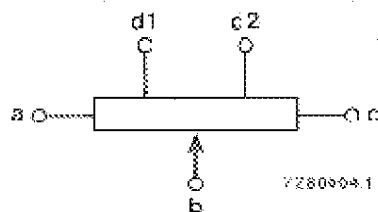

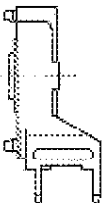
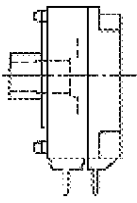
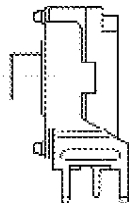


Fig. 1 Designation of terminals.

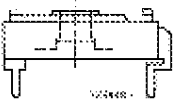
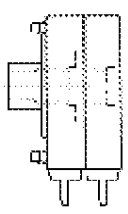
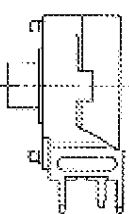

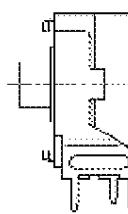
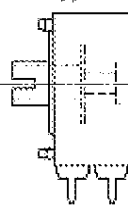
The carbon resistance element is a carbon track on a phenolic paper substrate; the cermet resistance element is Al_2O_3 substrate. The metallic multi-finger wiper is mounted in a plastic rotor. Terminals are designated as shown in Fig. 1 in accordance with IEC 393-1, sub-clause 4.5.

SURVEY 1, VERSIONS WITHOUT SPINDLE

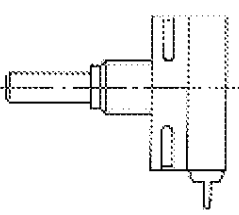
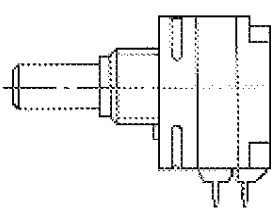
version		single vertical				
		Type A 	Type B 	Type C 		
			with bracket	with battery switch	with bracket and battery switch	
Catalogue numbers		2322 5.0 0...	2322 5.0 0...	2322 5.0 100..	2322 5.0 120..	
rotor	flat, snap-in	◆	◆			
	protruding, snap-in	◆	◆	◆	◆	
	flat, slotted	X (1)				
terminal configuration	in-line	◆	◆	◆	◆	
	staggered	◆	◆	◆ tap version	X tap version	
type of terminal	vertical versions	spindle height	12,5 mm	◆	◆	◆
		18,0 mm	X			
	solder tag	X				
horizontal version						
optional	metal shield	X				
	plastic cover	X				

X = available
◆ = preferred.

(1) Used in versions with spindle.

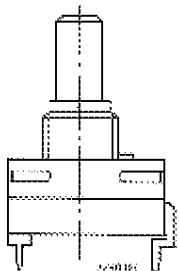
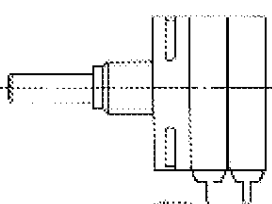
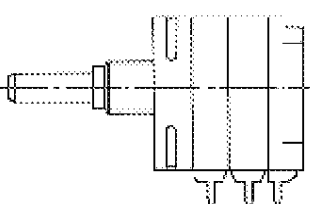
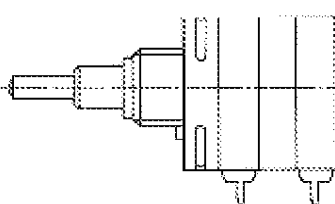
single horizontal	tandem vertical				dual vertical
Type D					Type E
					
		with bracket	with battery switch	with bracket and battery switch	
2322 5.0 0.5..	2322 5.0 05..	2322 5.0 07..	2322 5.0 150..	2322 5.0 170..	2322 5.0 9..
•					
•	•	•	•	•	X
X (1)					
•	•	•	•	•	X
	•	•	• tap versions	X tap versions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

SURVEY 2, VERSIONS WITH SPINDLE

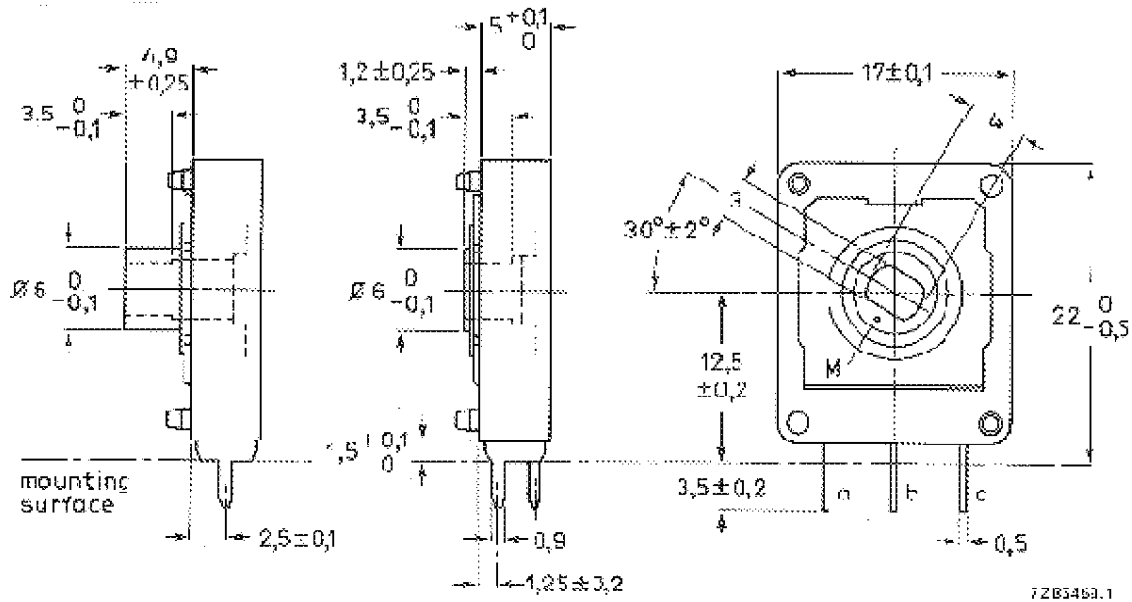
				single vertical	
				Type F	Type G
version					 with battery switch
Catalogue numbers				2322 5.1 0....	2322 5.1 1....
bushing L = 8 mm (1)	M7	spindle dia. 4 mm	plastic	⊙ (10)	⊙ (10)
			metal	⊙ (9)	⊙ (9)
	M10	spindle dia. 6 mm	plastic	⊙ (10)	⊙ (10)
			metal	⊙ (9)	⊙ (9)
type of terminal (2)	vertical versions	spindle height	12,5 mm	⊙	⊙
			18,0 mm	X	
	solder tag			X	X
	horizontal version				
	slow-motion drive 4, 6: 1			X	
	centre detent (3), carbon only			X	
	optional:				
metal shield			X		
plastic cover			X		
heatsink, cermet only			X		

X = available,
⊙ = preferred.

- (1) The figures between brackets give the number of spindle types.
 (2) See sheet of relevant version for terminal configuration.
 (3) More detents on request.

single horizontal	tandem vertical		dual vertical
Type H	Type I		Type J
		 with battery switch	
2322 5.1 9...	2322 5.2 0...	2322 5.2 1...	2322 5.3
• (10)	• (10)	• (10)	
• (9)	• (9)	• (9)	X (1)
• (10)	• (10)	• (10)	
• (9)	• (9)	• (9)	X (1)
	•	•	X
	X	X	X
	X	X	X
•			
X	X		
X	X		X
	X		X
	X		X
	X		X

VERSION WITHOUT SPINDLE, SINGLE VERTICAL (TYPE A)



Enter drawn at fully counter-clockwise position. M = mark for position of slider.
For other terminals see Fig.34.

Fig.2 Version without spindle, single vertical.

Hole patterns

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

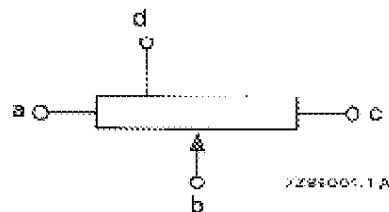
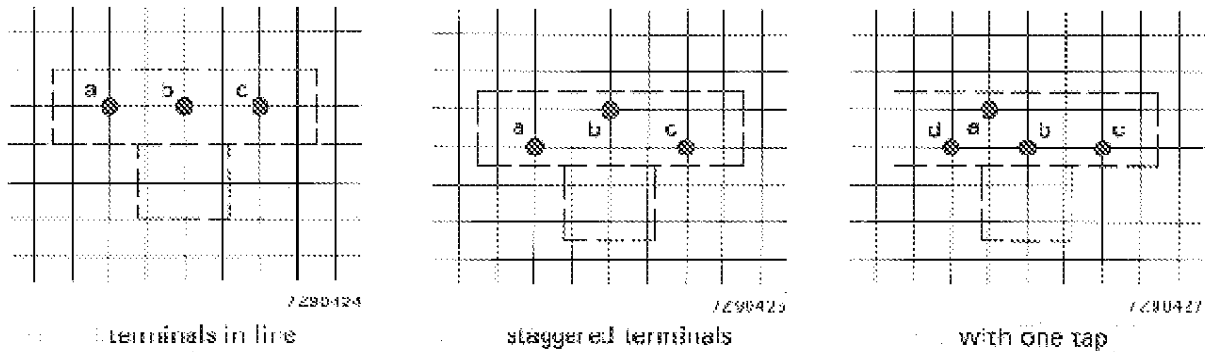


Fig.3 Version without spindle, single vertical: hole pattern and terminal designation.

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
with plastic cover	1000 V, 50 Hz

For further information see Electrical Data and Mechanical Data.

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

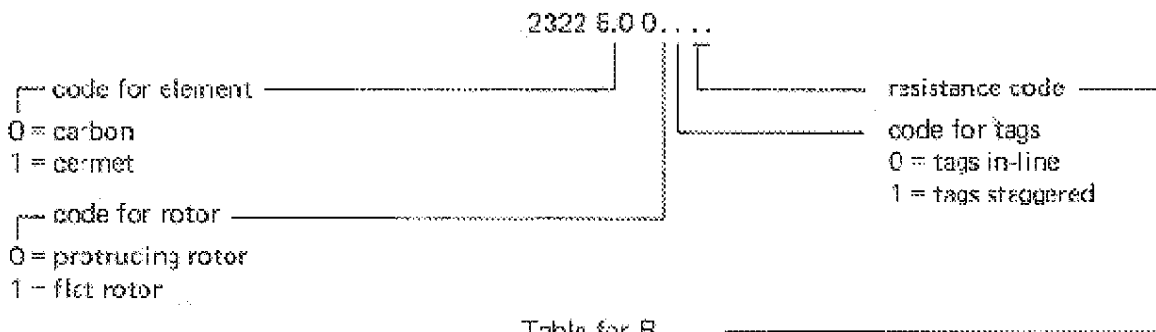


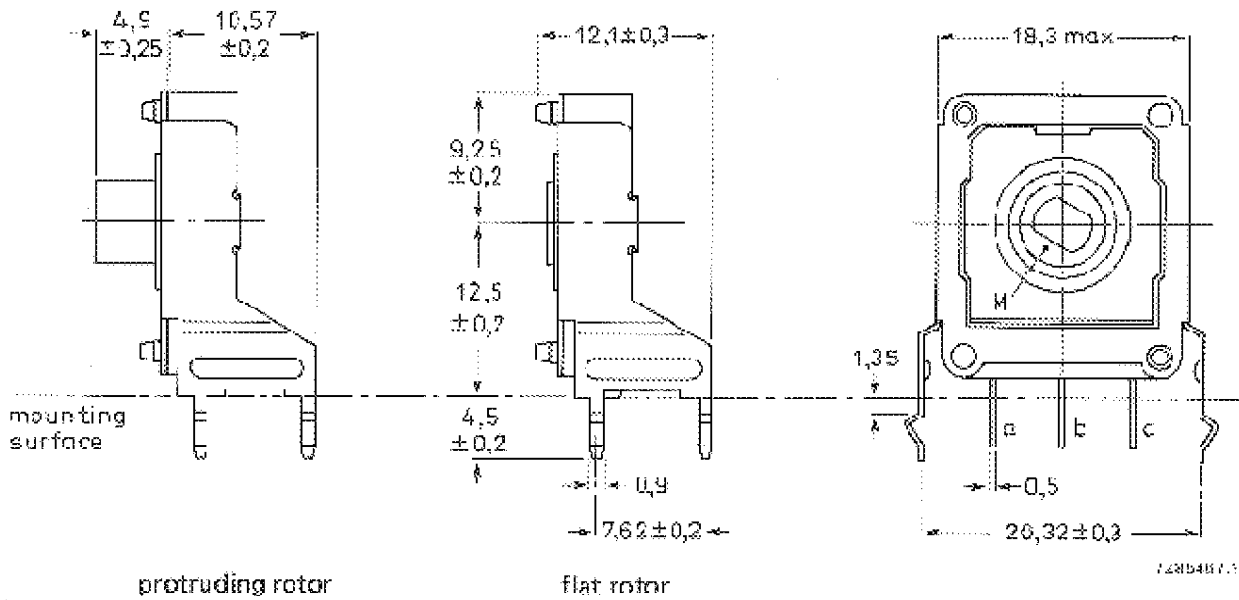
Table for R_{nom}

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.

VERSION WITHOUT SPINDLE, SINGLE VERTICAL WITH BRACKET (TYPE B)



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

Fig.4 Version without spindle, single vertical with bracket.

Hole patterns

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

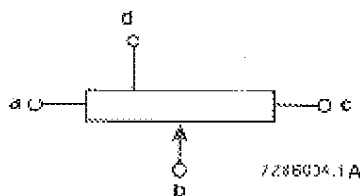
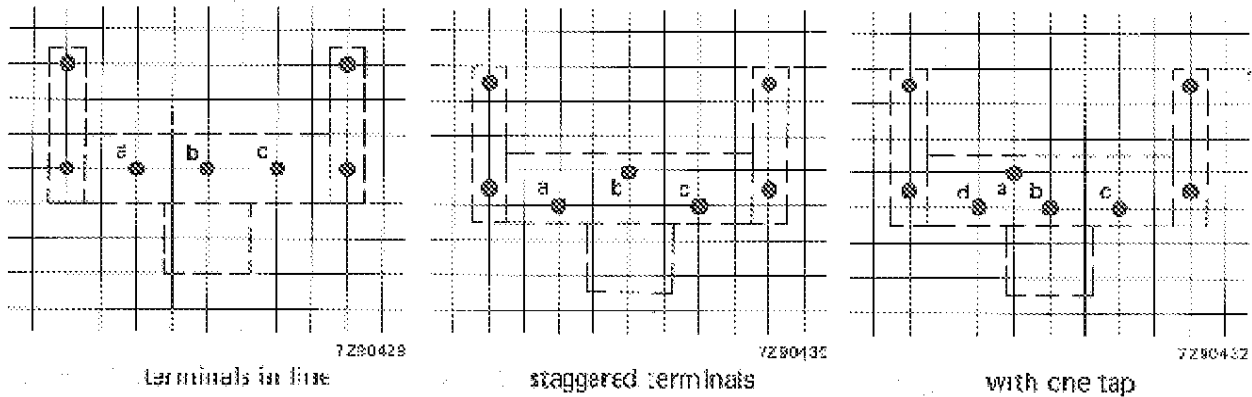


Fig.5 Version without spindle, single vertical with bracket: hole pattern and terminal designation.

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	600 V, 60 Hz
with plastic cover	1000 V, 50 Hz

For further information see Electrical Data and Mechanical Data.

Composition of the catalogue number, PP17 without spindle; single, vertical, with bracket

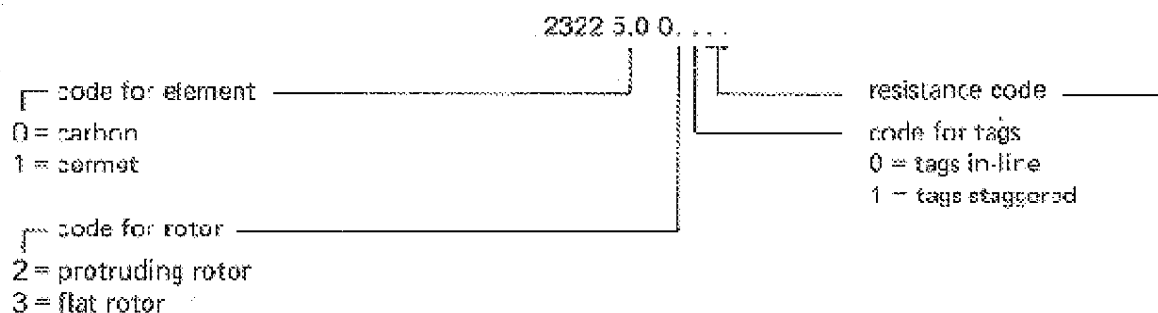


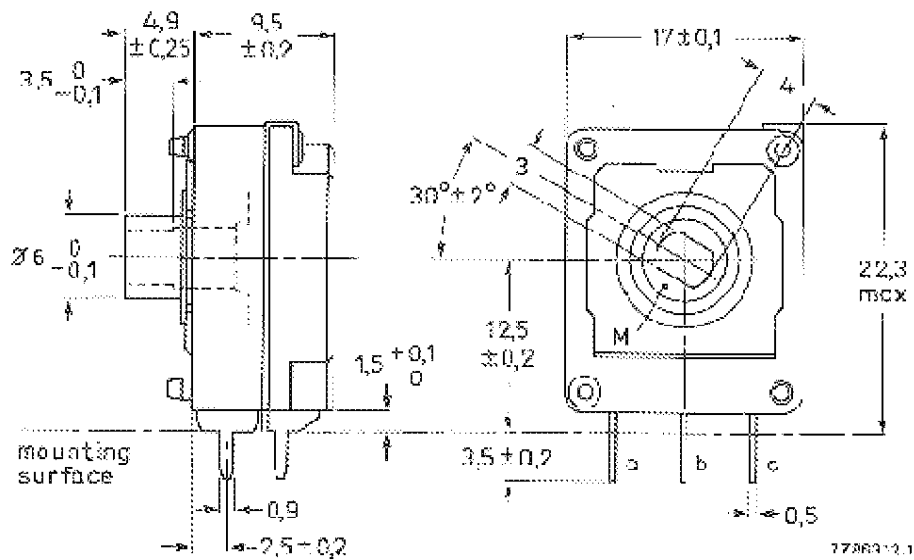
Table for R_{nom}

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	43	—
10 kΩ	07	27	47	—
22 kΩ	08	28	43	—
47 kΩ	09	29	43	—
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.

VERSION WITHOUT SPINDLE, SINGLE VERTICAL WITH BATTERY SWITCH (TYPE C)

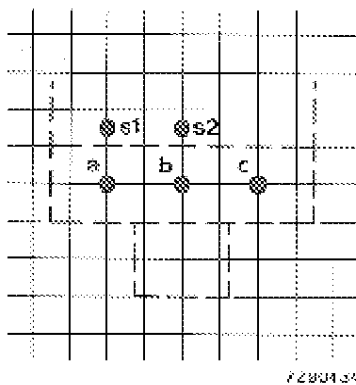


Rotor drawn at fully counter-clockwise position. M = mark for position of slider.

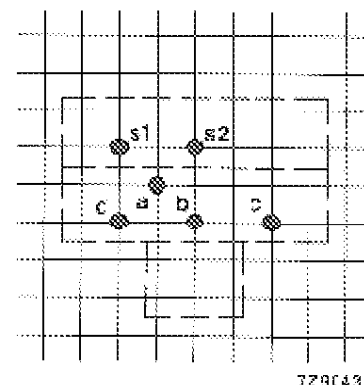
Fig.6 Version without spindle, single vertical with battery switch.

Hole patterns

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



terminals in line



terminals with one tap

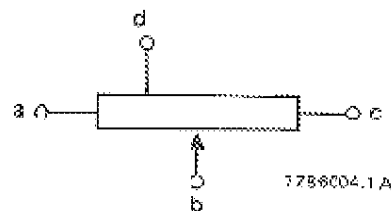


Fig.7 Version without spindle, single vertical with battery switch: hole pattern and terminal designation.

Main properties

Climatic category (IEC 60)	carbon 25/070/10, cermet 25/070/58
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 $T_{amb} = 40^{\circ}C$	
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, Mechanical Data and Battery Switch.

Composition of the catalogue number, PP17 without spindle, single, vertical with switch

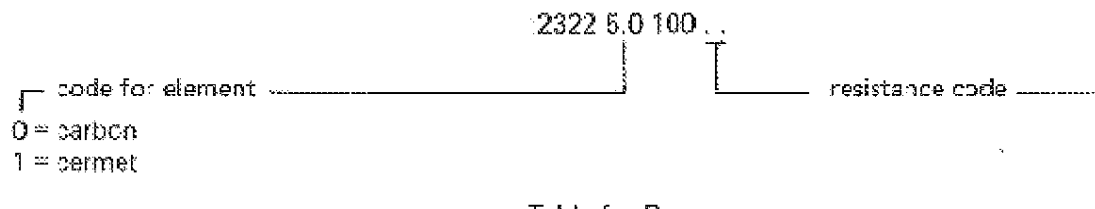


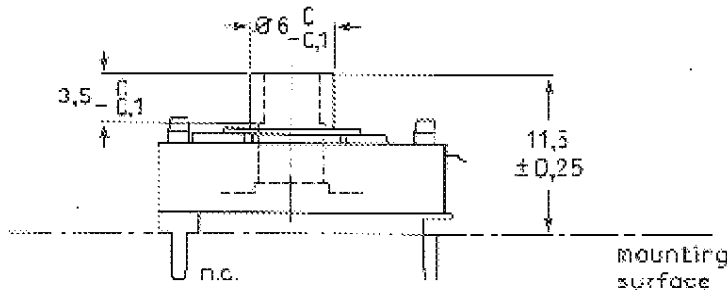
Table for R_{nom}

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	—	—	—

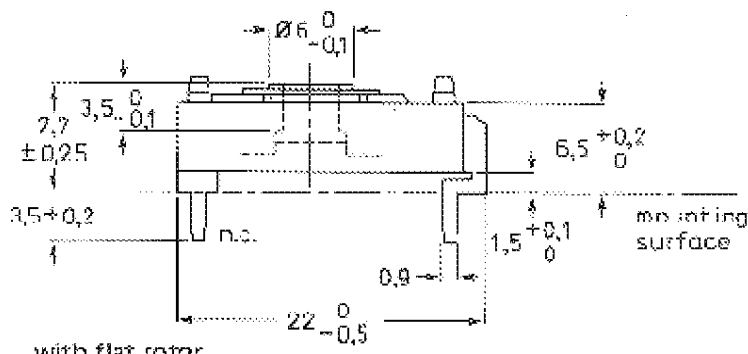
* carbon only.

Catalogue numbers for other versions on request.

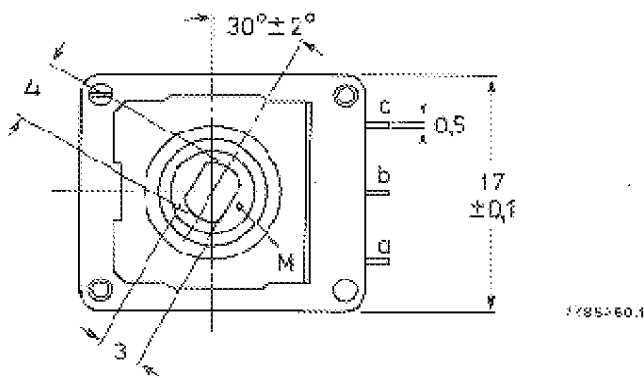
VERSION WITHOUT SPINDLE, SINGLE HORIZONTAL (TYPE D)



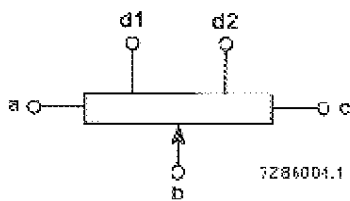
with protruding rotor



with flat rotor



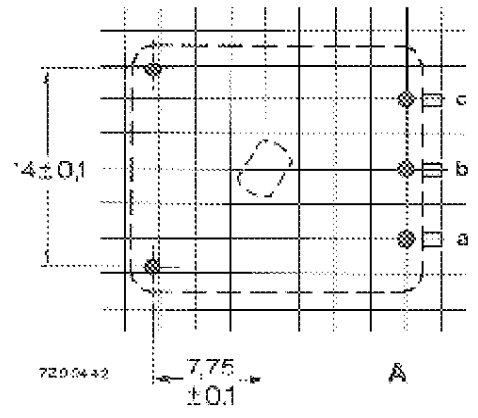
Rotor drawn at fully counter-clockwise position.
M = mark for position of slider.



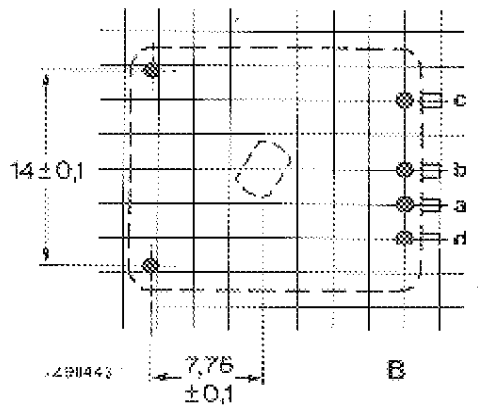
designation of terminals

Hole patterns

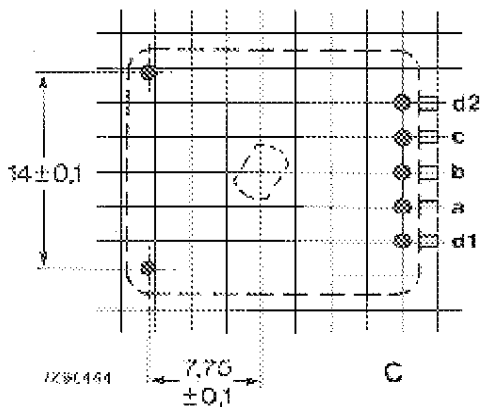
For connection to printed-wiring boards with a grid pitch of 2,54 mm, viewed from component side. Hole dia. $1,3 + 0,05$ mm.



no tap



one tap



two taps

Fig.B 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

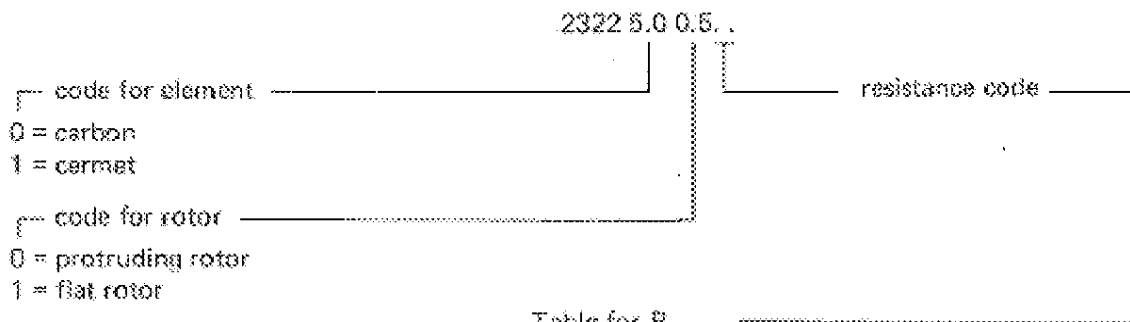


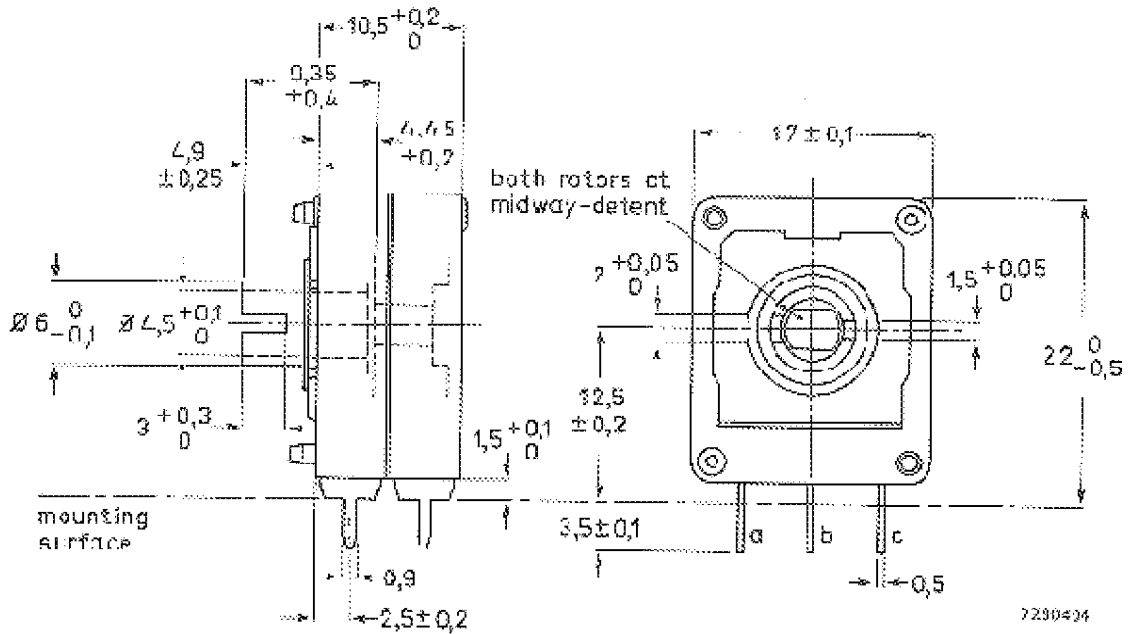
Table for R_{nom}

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.

VERSION WITHOUT SPINDLE, DUAL VERTICAL (TYPE E)

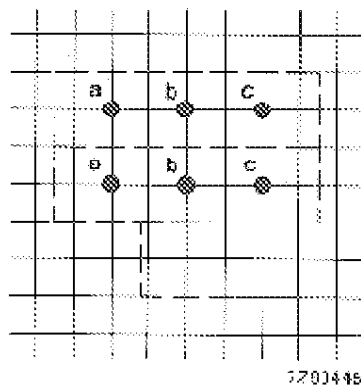


Both rotors at mid-position.

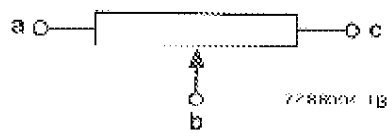
Fig.9 Version without spindle, dual vertical.

Hole pattern

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



Dual potentiometers with tap on request.



terminals in line

Fig.10 Version without spindle, dual vertical: hole pattern and terminal designation.

Main properties

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

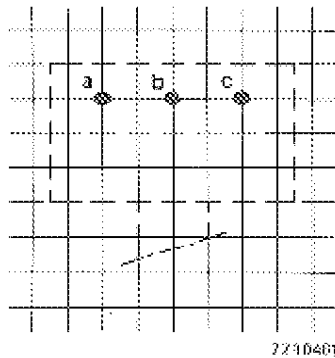
For further information see Electrical Data and Mechanical Data.

Catalogue number

On request.

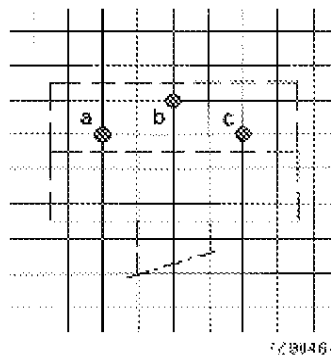
Hole patterns

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



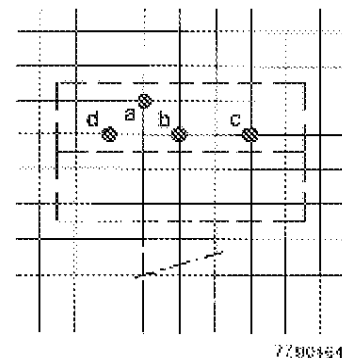
7210401

terminals in line



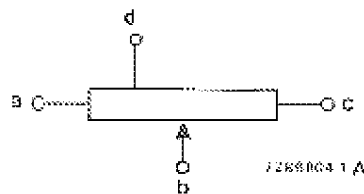
7280461

staggered terminals



7280464

with one tap



7268064 1 A

Fig. 12 Version with spindle, single vertical: hole pattern and terminal designation.

Main properties

Climatic category (EC 68)

metal spindle
metal spindle
plastic spindle

cermet and heatsink 40/125/56
carbon 25/070/10, cermet 40/100/56
carbon 25/070/10, cermet 25/370/56

Resistance range, E3 series

carbon, linear (linearity 4%)
carbon, non-linear
cermet, linear (linearity 4%)

220 Ω to 2,2 MΩ, tolerance 20%
2200 Ω to 2,2 MΩ, tolerance 20%
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
carbon, non-linear
cermet, linear
cermet, with heatsink

0,2 W
0,1 W
2 W } metal spindle, 1 W } plastic spindle
3 W } 2 W }

Test voltage for 1 minute
with plastic cover

500 V, 50 Hz
1000 V, 50 Hz

For further information see Electrical Data and Mechanical Data.

Composition of the catalogue number, PP17 with spindle, single, vertical

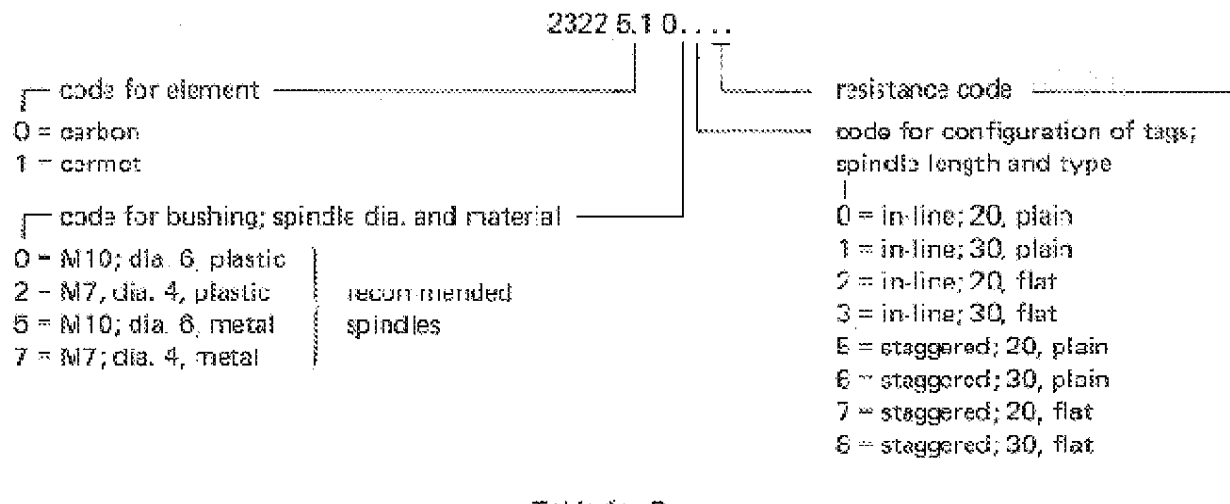


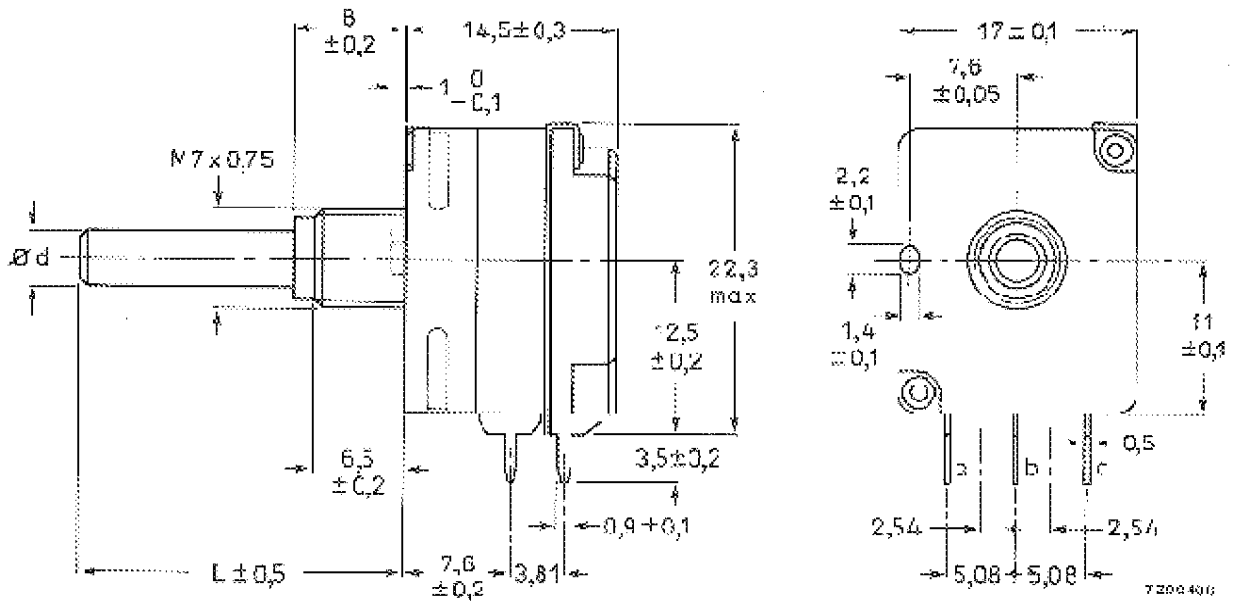
Table for R_{nom}

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

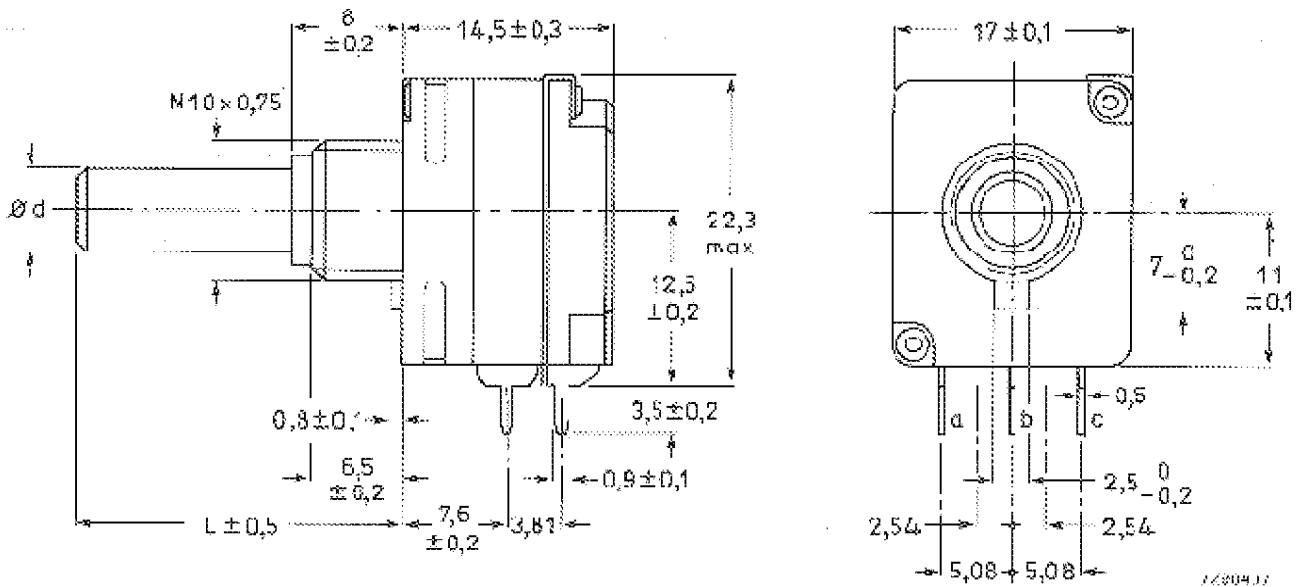
* carbon only.

Catalogue numbers for other versions on request.

VERSION WITH SPINDLE, SINGLE VERTICAL WITH BATTERY SWITCH (TYPE G)



with mounting bush M7 x 0,75 mm.



with mounting bush M10 x 0,75 mm.

For dimensions d and l, see under Spindles. For other terminals see Fig.34.

Fig.13 Version with spindle, single vertical with battery switch.

Hole patterns

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

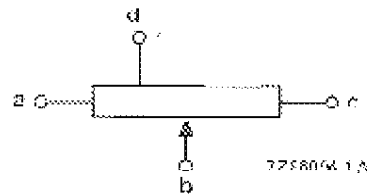
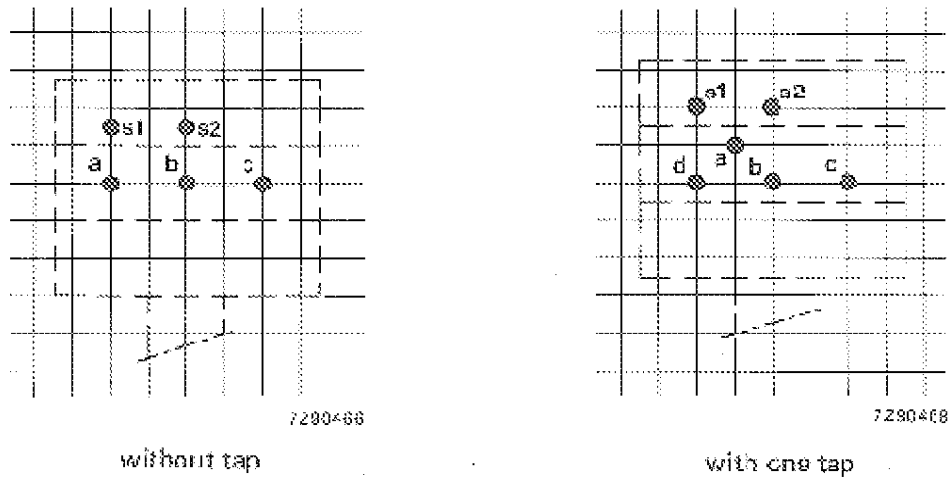


Fig.14 Version with spindle, single vertical with battery switch:
hole pattern and terminal designation.

Main properties

Climatic category (IEC 68)	metal spindle plastic spindle	carbon 25/070/10, cermet 40/125/56 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 $T_{amb} = 40^\circ C$		
carbon, linear		0,2 W
carbon, non-linear		0,1 W
cermet, linear		1,25 W (metal spindle), 1 W (plastic spindle)
Test voltage for 1 minute		500 V, 50 Hz
For extended data see under Electrical Data, Mechanical Data and Battery Switch.		

Composition of the catalogue number, PP17 with spindle, single, vertical with switch

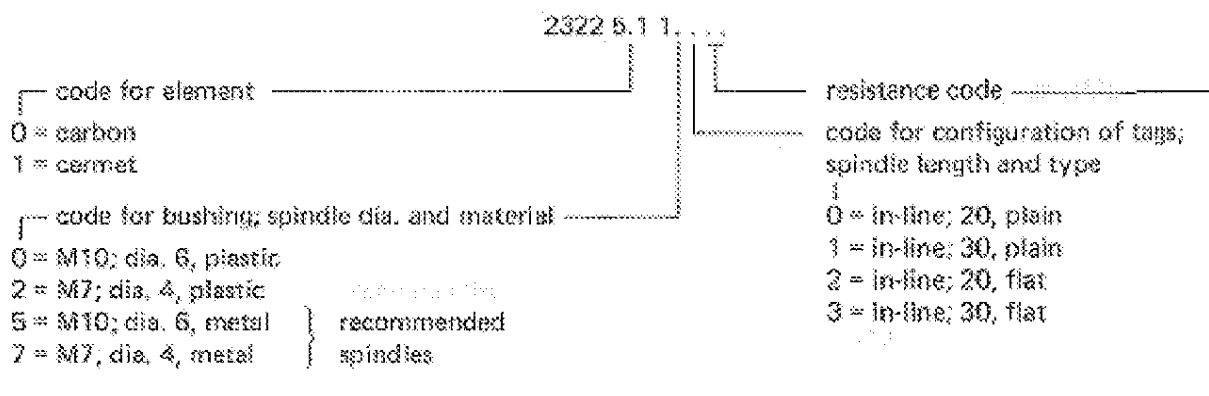


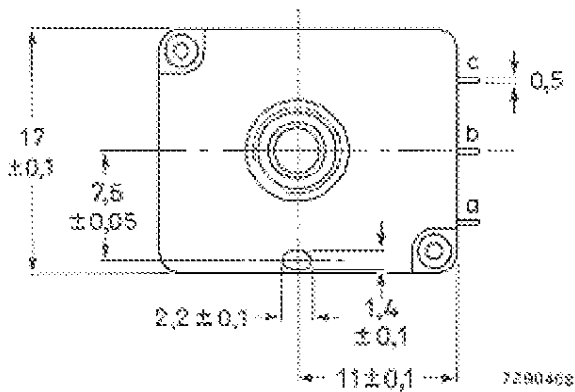
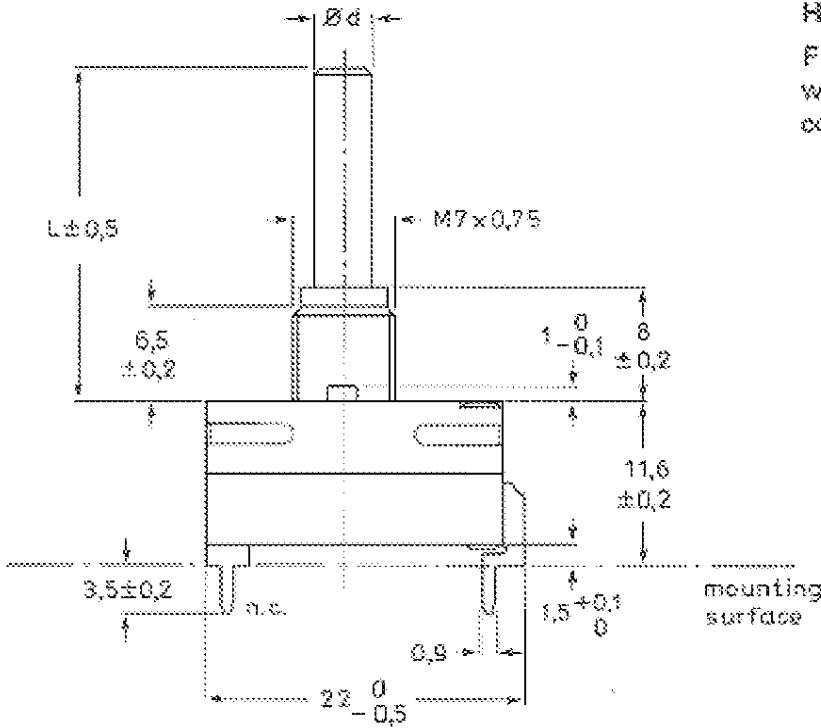
Table for R_{nom}

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

* carbon only.

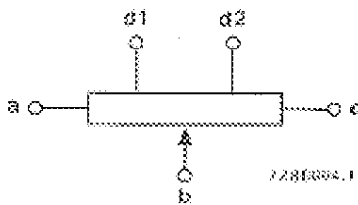
Catalogue numbers for other versions on request.

VERSION WITH SPINDLE, SINGLE HORIZONTAL (TYPE H)



with mounting bush $M7 \times 0,75$ mm.

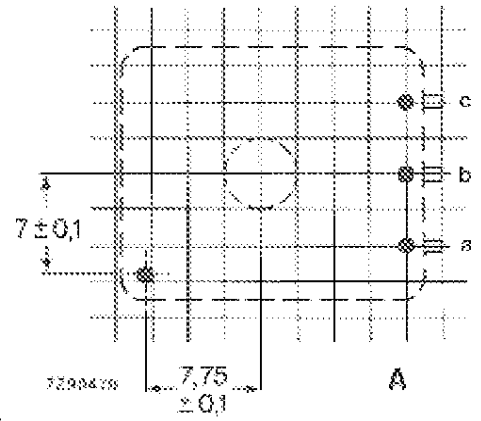
For dimensions d and l , see under Spindles.



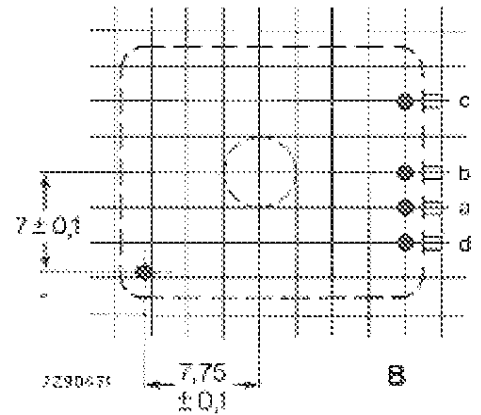
designation of terminals

Hole patterns

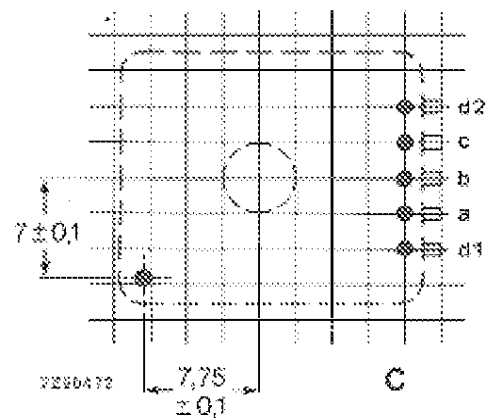
For connection to printed-wiring boards with a grid pitch of 2,54 mm, viewed from component side. Hole dia. $1,3 \pm 0,05$ mm.



no tap



one tap



two taps

Fig.15 Version with spindle, single horizontal.

Hole patterns

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

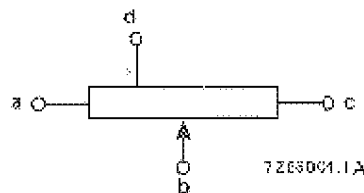
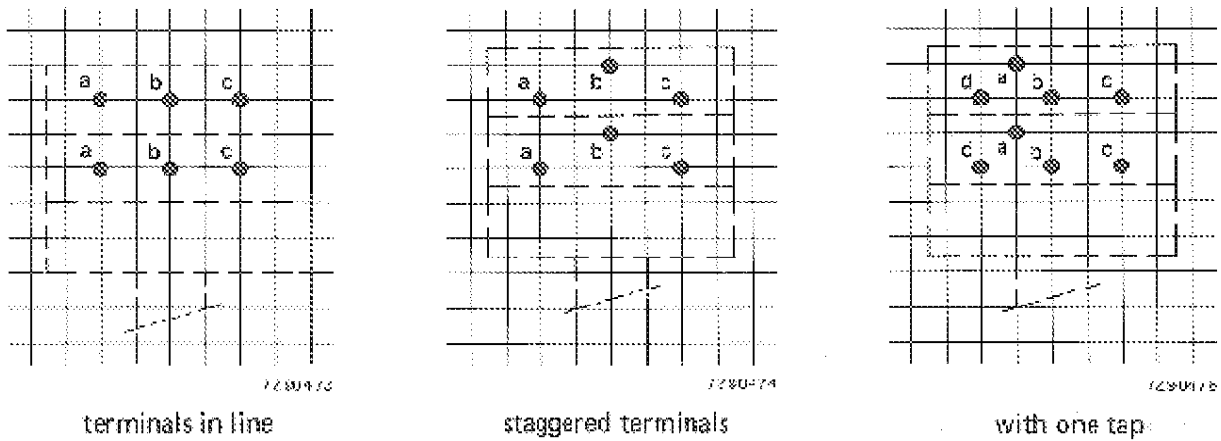


Fig. 17 Version with spindle, tandem vertical: hole pattern and terminal designation.

Main properties

Climatic category (IEC 68)	metal spindle plastic spindle	carbon 25/070/10, cermet 40/100/58 carbon 25/0/0/10, 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 $T_{amb} = 40^{\circ}C$		
carbon, linear		0,2 + 0,2 W
carbon, non-linear		0,1 + 0,1 W
cermet, linear		1,25 + 1,25 W metal 1 + 1 W plastic
cermet, with heatsink		2 + 2 W spindle, 1,5 + 1,5 W spindle
Test voltage for 1 minute		500 V, 50 Hz

For further information see Electrical Data and Mechanical Data.

Composition of the catalogue number, PP17 with spindle, tandem, vertical

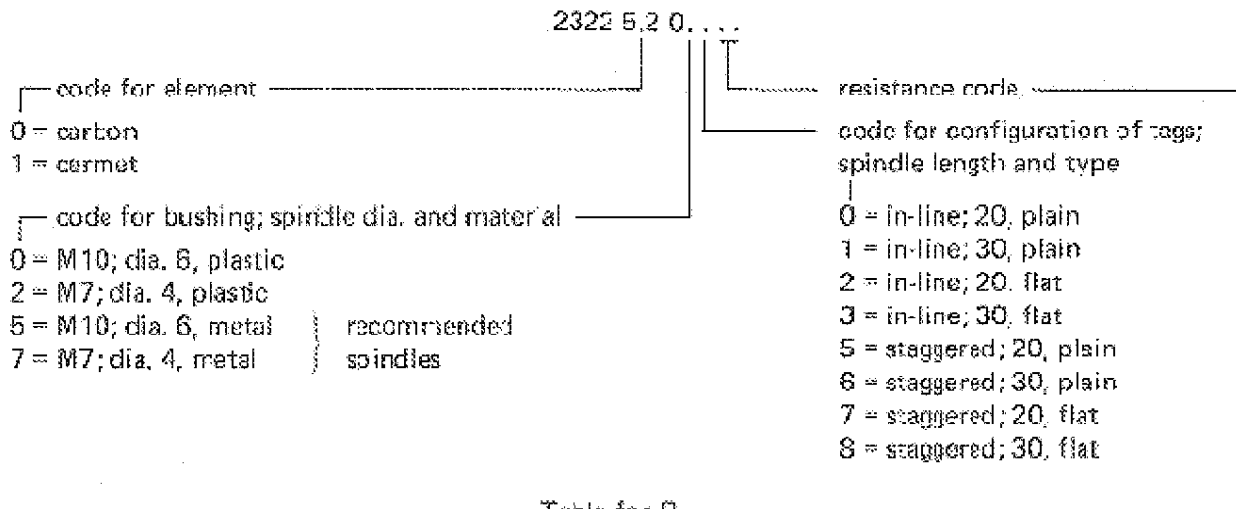


Table for R_{nom}

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

* carbon only.

Catalogue numbers for other versions on request.

VERSION WITH SPINDLE, DUAL VERTICAL (TYPE J)

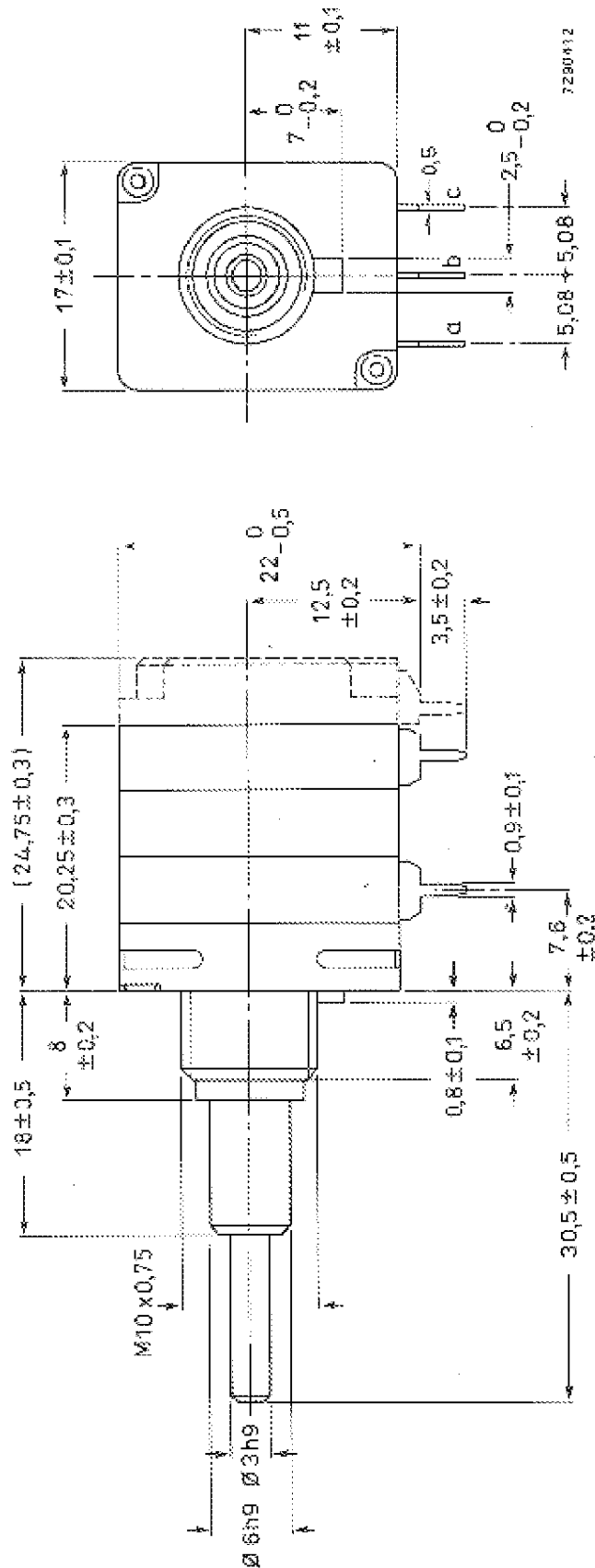


Fig. 18 Version with spindle, dual vertical.

Hole patterns

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

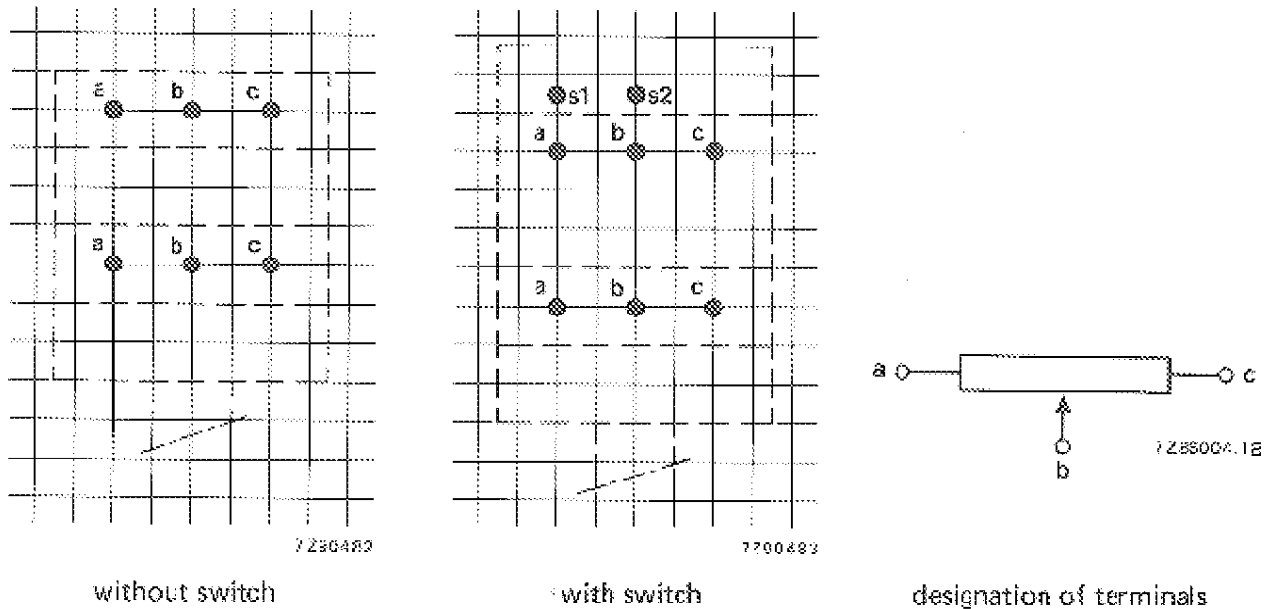


Fig. 19 Version with spindle, dual vertical: hole pattern and terminal designation.

Main properties

Climatic category (IEC68)	carbon 25/070/10, cermet 25/070/56
Resistance range, E3 series	
carbon, linear (linearity 4%)	220 Ω to 2,2 M Ω , tolerance 20%
carbon, non-linear	2200 Ω to 2,2 M Ω , tolerance 20%
cermet, linear (linearity 4%)	220 Ω to 4,7 M Ω , 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 + 0,2 W
carbon, non-linear	0,1 + 0,1 W
cermet, linear	1,25 + 1,25 W (metal spindle), 1 - 1 W (plastic spindle)
Test voltage for 1 minute	500 V, 50 Hz
For further information see Electrical Data, Mechanical Data and Battery Switch.	

Catalogue number

On request.

BUILDING ELEMENTS FOR POTENTIOMETERS WITHOUT SPINDLE (Survey 1)

Potentiometer with flat rotor, snap-in type

To be used with snap-in actuating devices, see Fig.22. Cannot be combined with other PP17 potentiometers and switches.

Maximum axial force	20 N
if mechanically supported, e.g. by mounting bracket	80 N

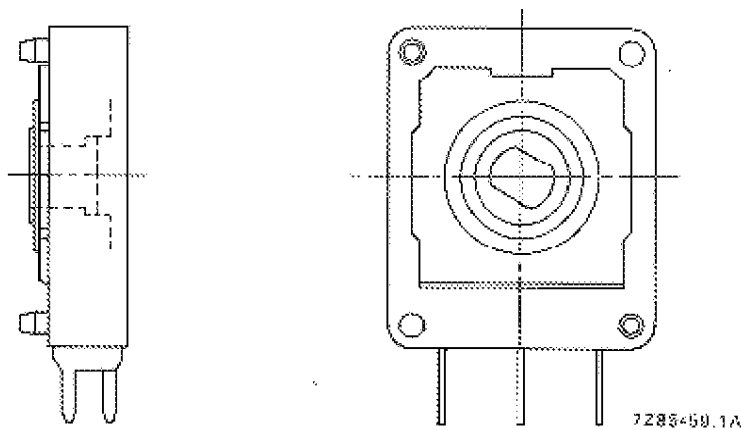


Fig.20 Flat rotor, snap-in type.

Potentiometer with protruding rotor, snap-in type

To be used with snap-in actuating devices, see Fig.22. Can be combined with another PP17 potentiometer and/or switch.

Maximum axial force	20 N
if mechanically supported, e.g. by mounting bracket	80 N

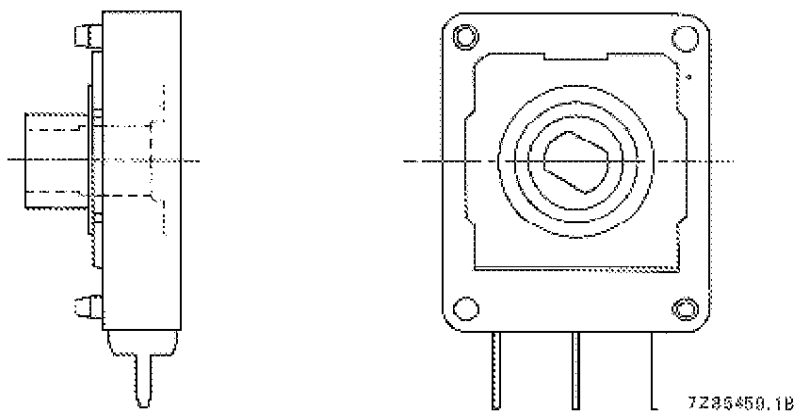


Fig.21 Protruding rotor, snap-in type.

Actuating device

Figure 22 shows the snap-in part of a plastic actuating device. A limited range of actuating devices is available — see PP12 series.

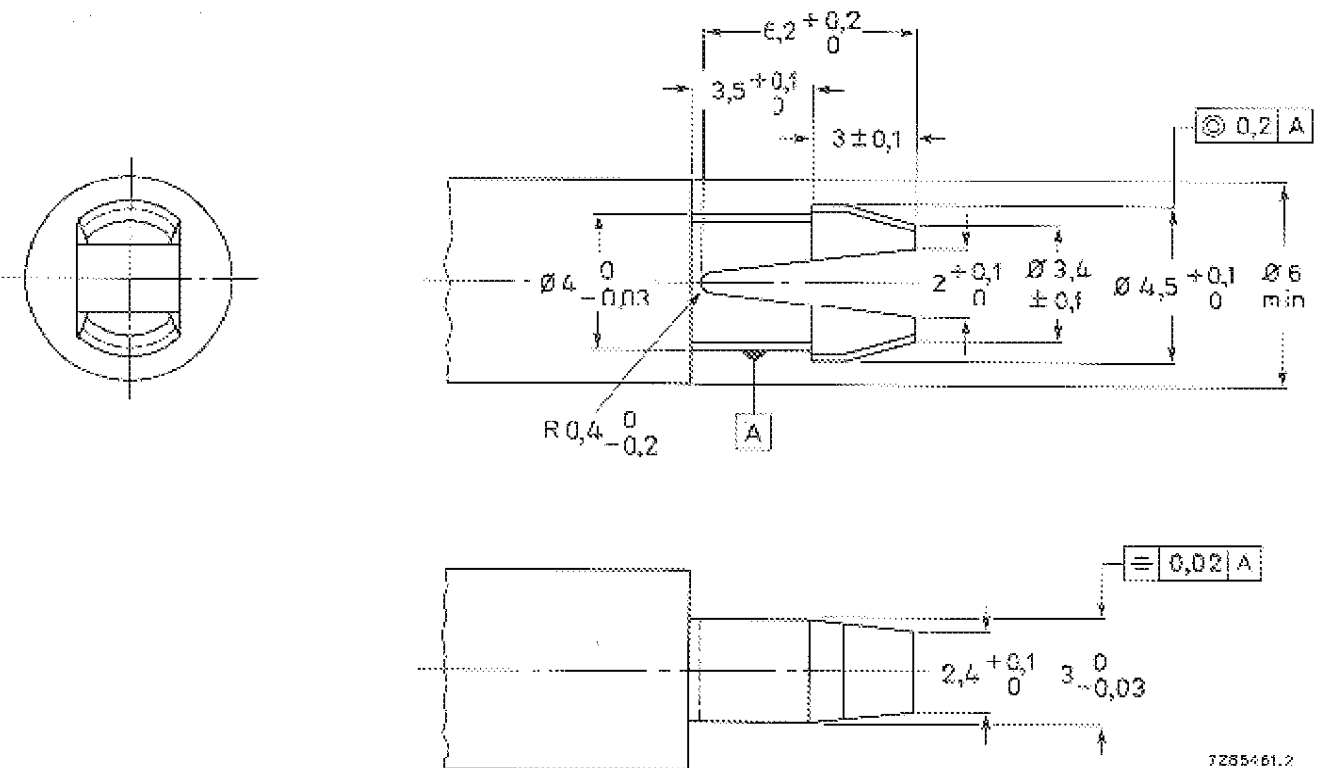


Fig.22 Actuating device.

Mounting bracket

For extra stability of single vertical or tandem vertical potentiometers. Use of this bracket permits an axial force of maximum 80 N to the potentiometers opposite.

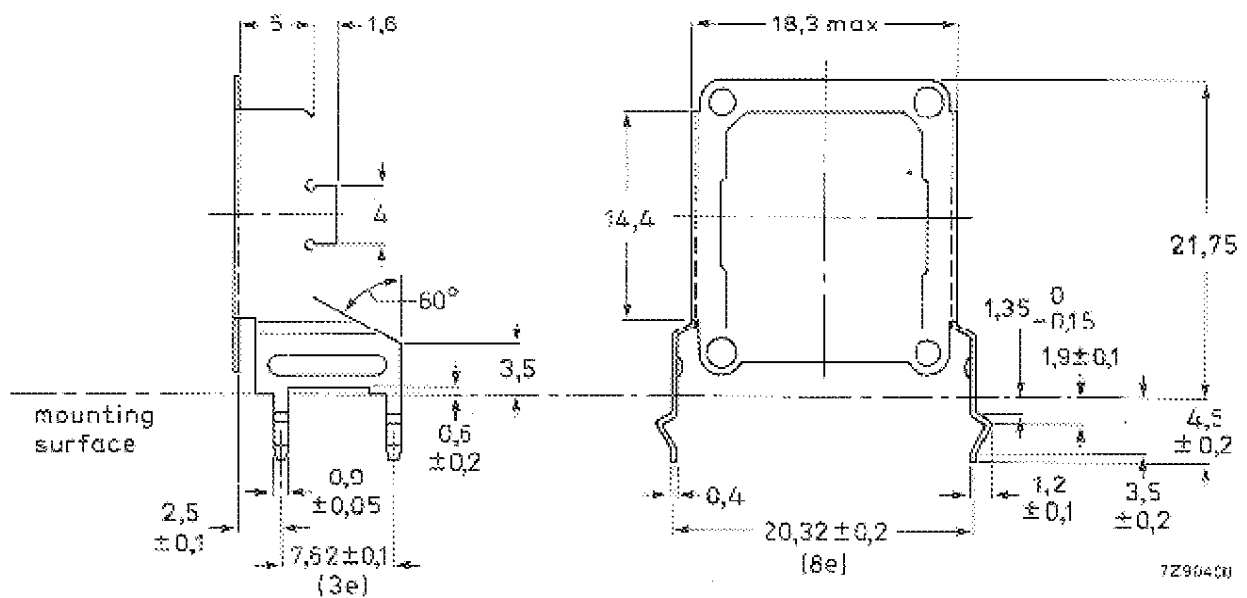


Fig.23 Mounting bracket.

BUILDING ELEMENTS FOR POTENTIOMETERS WITH SPINDLE (Survey 2)

Potentiometer with flat rotor, slotted type

To be used with spindle as single or tandem potentiometer. Cannot be combined with a switch.

Maximum axial force 20 N

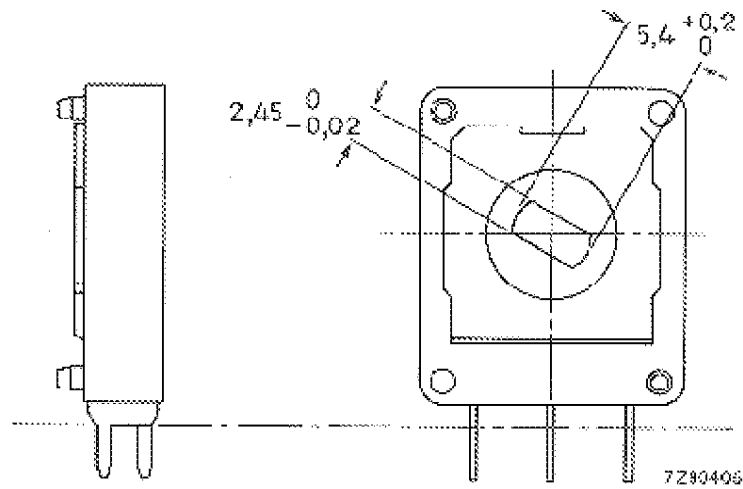


Fig.24 Flat rotor, slotted type.

Heatsink

Zinc heatsinks are available to increase the maximum permissible dissipation of cermet potentiometers. They can be added to single potentiometers and to both potentiometers of a tandem version.

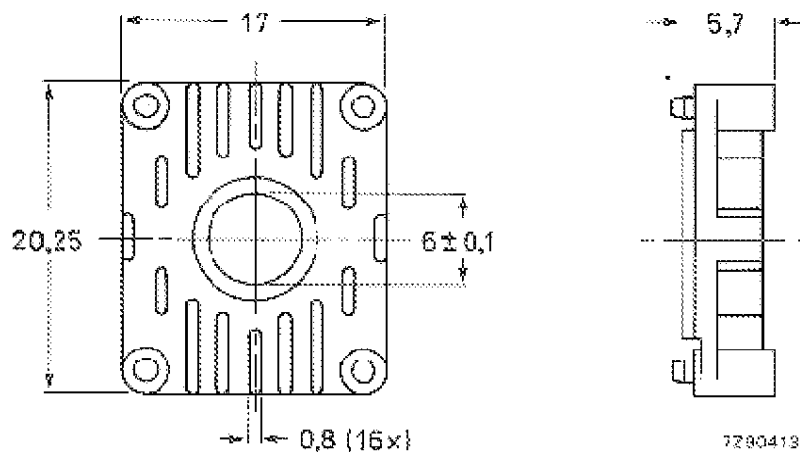
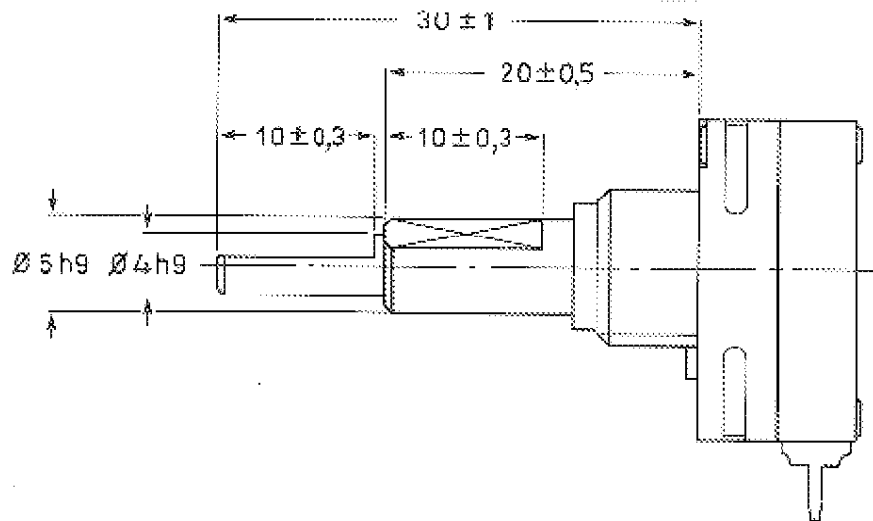


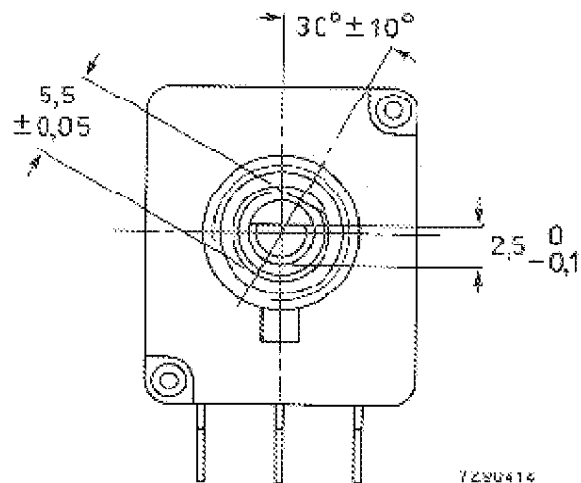
Fig.25 Heatsink.

Slow-motion drive

For fine adjustment. Gear ratio 4,6 : 1 and 7 : 1. (Other spindles on request.)



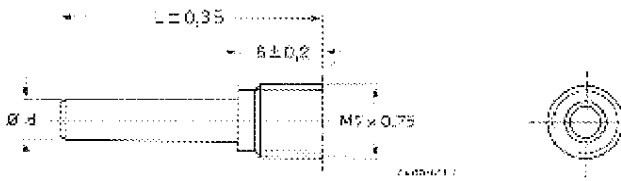
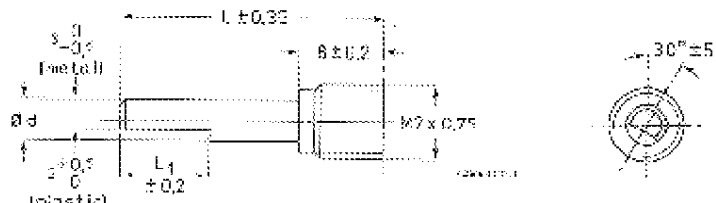
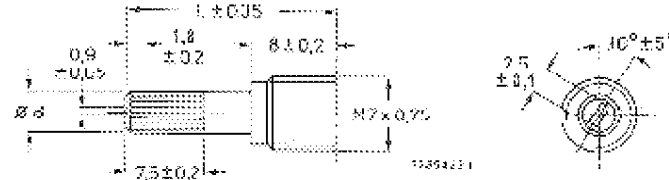
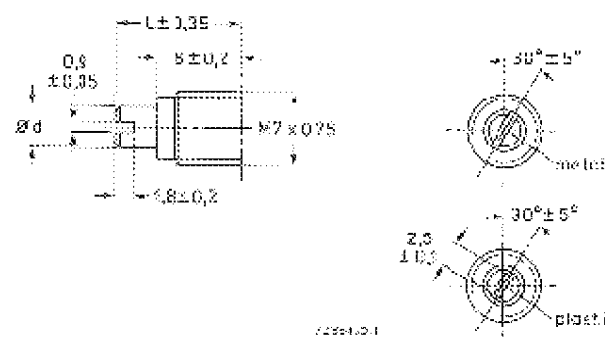
side view



front view

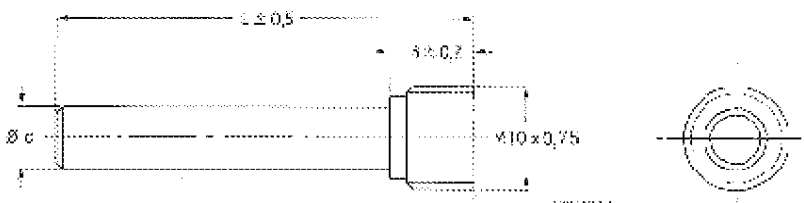
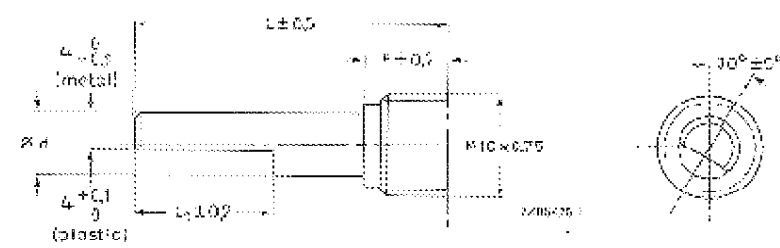
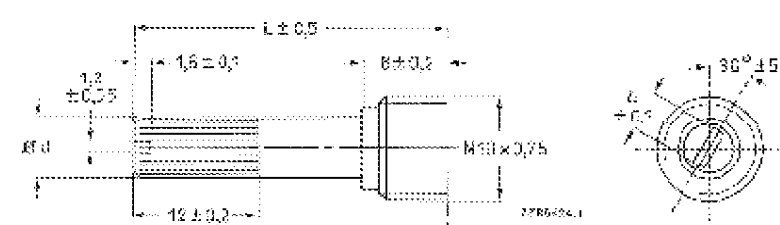
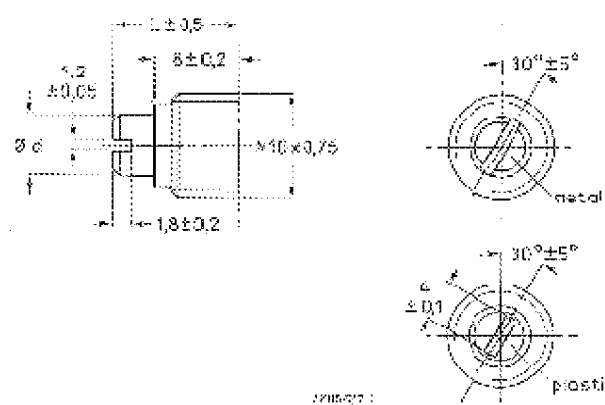
Fig.26 Slow-motion drive.

Spindles, metal or plastic, M7 bushing

	CCW position	L mm	L ₁ mm	d metal	d plastic
 <p>Fig.27a.</p>		15		4h9	$4 \begin{smallmatrix} 0 \\ -0,1 \end{smallmatrix}$
		20		*4h9	$*4 \begin{smallmatrix} 0 \\ -0,1 \end{smallmatrix}$
		25		4h9	$4 \begin{smallmatrix} 0 \\ -0,1 \end{smallmatrix}$
		30		*4h9	$*4 \begin{smallmatrix} 0 \\ -0,1 \end{smallmatrix}$
 <p>Fig.27h.</p>		15	3,0	4h9	$4 \begin{smallmatrix} 0 \\ -0,1 \end{smallmatrix}$
		20	7,5	*4h9	$*4 \begin{smallmatrix} 0 \\ -0,1 \end{smallmatrix}$
		25	8,5	4h9	$4 \begin{smallmatrix} 0 \\ -0,1 \end{smallmatrix}$
		30	8,5	*4h9	$*4 \begin{smallmatrix} 0 \\ -0,1 \end{smallmatrix}$
 <p>Fig.27c.</p>		20			$4 \begin{smallmatrix} 0 \\ -0,1 \end{smallmatrix}$
 <p>Fig.27d.</p>		12		4h9	$4 \begin{smallmatrix} 0 \\ -0,1 \end{smallmatrix}$

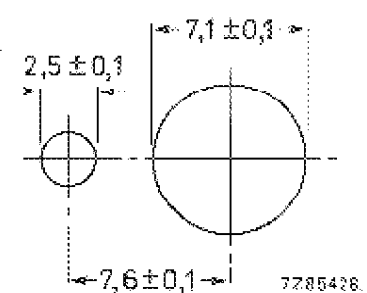
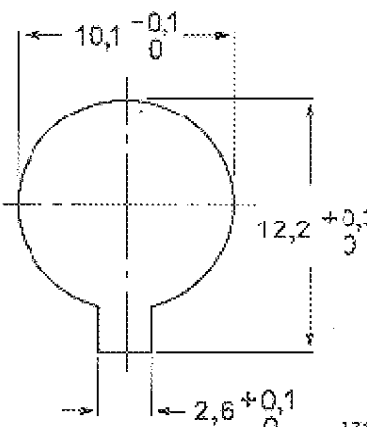
* Recommended spindle types in metal for all versions and in plastic only for single versions without switch.

Spindles, metal or plastic, M10 bushing

	CCW position	L mm	L ₁ mm	d	
				metal	plastic
 <p>Fig. 28a.</p>		20		6h9	$6^{+0}_{-0,1}$
		30		6h9	$6^{+0}_{-0,1}$
		40		6h9	$6^{+0}_{-0,1}$
		60		6h9	$6^{+0}_{-0,1}$
 <p>Fig. 28b.</p>		20	7,5	6h9	$6^{+0}_{-0,1}$
		30	13,5	6h9	$6^{+0}_{-0,1}$
		60	13,5	6h9	$6^{+0}_{-0,1}$
 <p>Fig. 28c.</p>		30			$6^{+0}_{-0,1}$
 <p>Fig. 28d.</p>		12		6h9	$6^{+0}_{-0,1}$

* Recommended spindle types in metal for all versions and in plastic only for single versions without switch.

Mounting holes for potentiometers with spindle

for single and tandem potentiometers	required mounting holes in chassis	fixing of potentiometer
<p>with mounting bush M7 x 0,75 mm</p>	 <p>Fig.29.</p>	<p>with supplied mounting nut; max. torque for tightening = 1 Nm; minimum thickness of mounting plate = 1 mm</p>
<p>with mounting bush M10 x 0,75 mm</p>	 <p>Fig.30.</p>	<p>with supplied mounting nut; max. torque for tightening = 3,5 Nm; minimum thickness of mounting plate = 1 mm</p>

**BUILDING ELEMENTS FOR POTENTIOMETERS WITHOUT SPINDLE (Survey 1)
AND WITH SPINDLE (Survey 2)**

Battery switch (s.p.s.t.)

Operating torque, initial	25 to 75 mNm
Mechanical endurance	≥ 16 000 cycles
DC voltage/current rating	14,4 V/3,5 A
Test voltage	
initial	500 V DC for 1 minute
after 21 days humidity test IEC 68-C	100 V DC for 1 minute
Contact resistance	
initial	≤ 20 mΩ
after 16 000 cycles (under load)	≤ 50 mΩ
Insulation resistance, between switch contacts, and between interconnected contacts and housing	
initial	> 100 MΩ
after 21 days humidity test IEC 68-C	≥ 2 MΩ

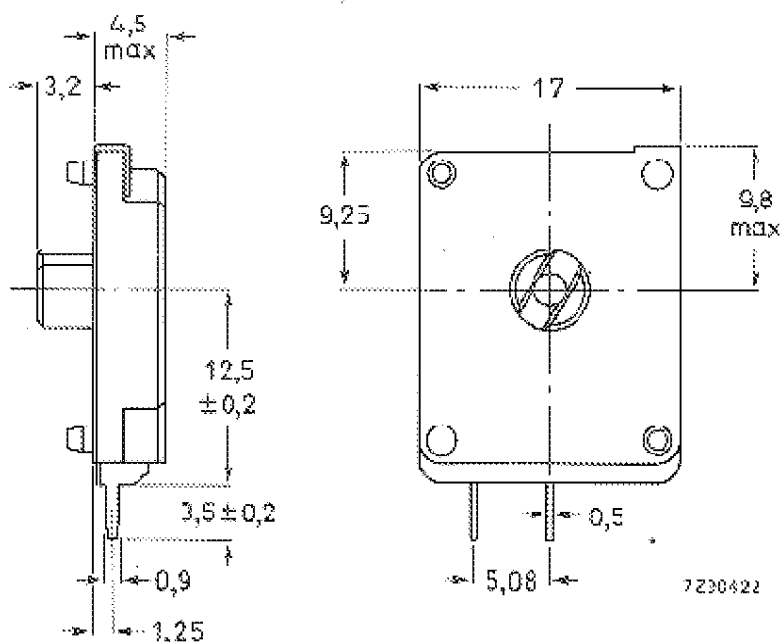


Fig.31 Battery switch (s.p.s.t.).

Metal shield

For the suppression of hum, crosstalk and noise. Provided with earth tag. Can be mounted at the rear of the potentiometers. Material: finished steel. Potentiometers with a switch do not need this shield (the switch already has one).

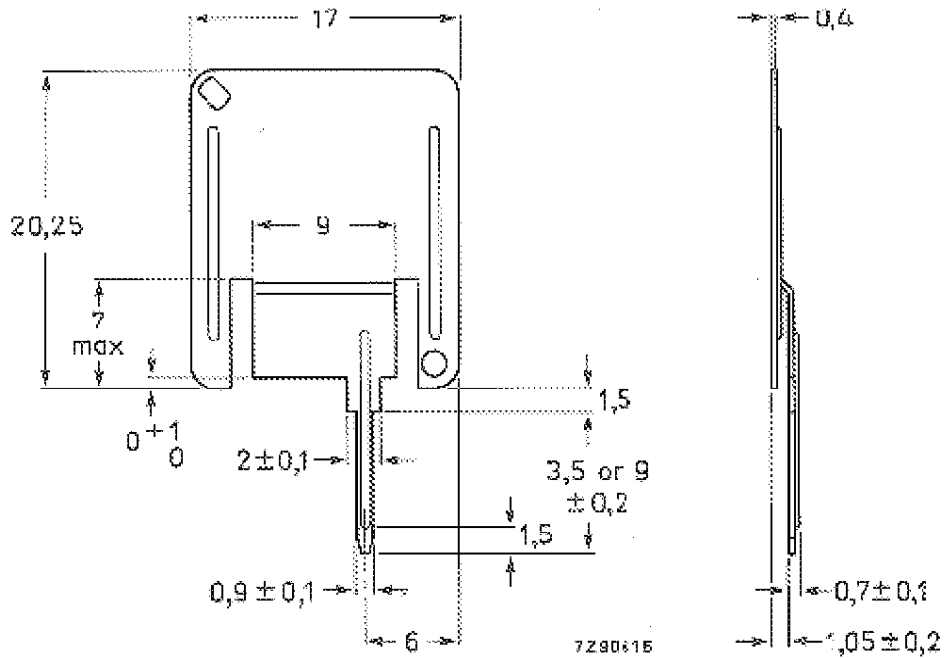


Fig.32 Metal shield.

Plastic cover

Can be mounted at the rear of the potentiometer. Use is necessary if a test voltage of 1000 V AC must be withstood for 1 minute. (Vertical types only).

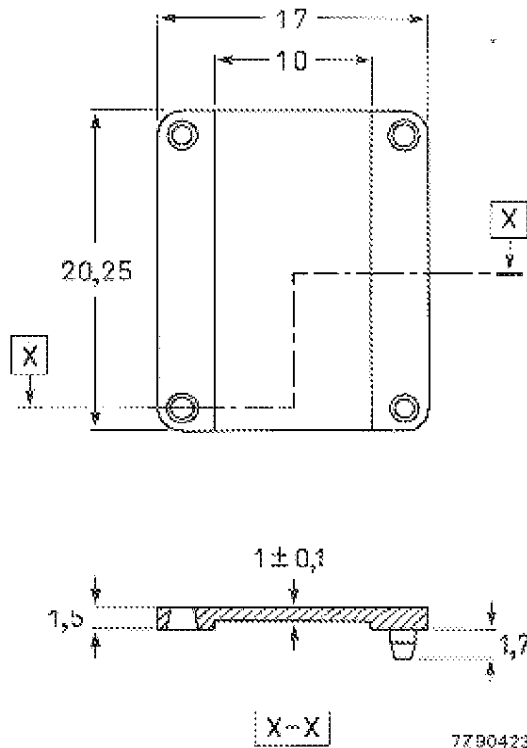


Fig.33 Plastic cover.

Terminals

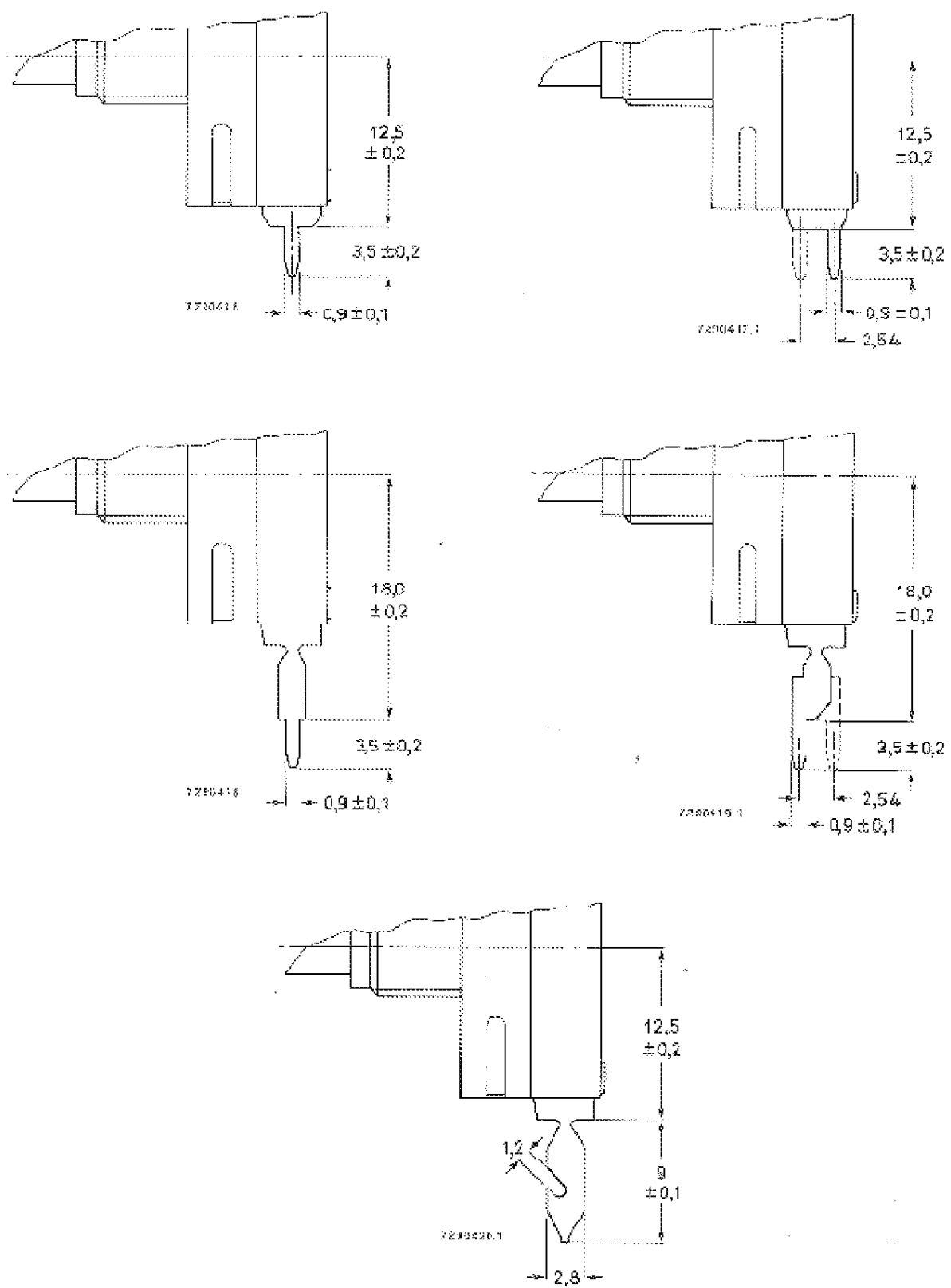


Fig.34 Terminals.

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
	standard	special	
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)			
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 Ω
Resistance at the tap	≤ 1,5% of 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 × 10 ⁻⁶ /K		± 100 × 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		
$R_{ac} \geq 22 \text{ k}\Omega$, logarithmic law	$\geq 90 \text{ dB}$	
$R_{ac} < 22 \text{ k}\Omega$, logarithmic law	$\geq 75 \text{ dB}$	
$R_{ac} < 22 \text{ k}\Omega$, linear law	$\geq 55 \text{ dB}$	$\geq 60 \text{ dB}$
Maximum dissipation at $T_{amb} = 40 \text{ }^\circ\text{C}$ (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 with cover	500 V, 50 Hz 1000 V, 50 Hz	500 V, 50 Hz 1000 V, 50 Hz
Working temperature range		
versions without spindle	-25 to + 70 $^\circ\text{C}$	-25 to + 70 $^\circ\text{C}$
versions with spindle	-25 to + 70 $^\circ\text{C}$	-40 to + 125 $^\circ\text{C}$
Storage temperature range		
without switch, versions without spindle	-40 to + 90 $^\circ\text{C}$	-40 to + 90 $^\circ\text{C}$
without switch, versions with spindle		-40 to + 100 $^\circ\text{C}$
with switch	-40 to + 85 $^\circ\text{C}$	
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

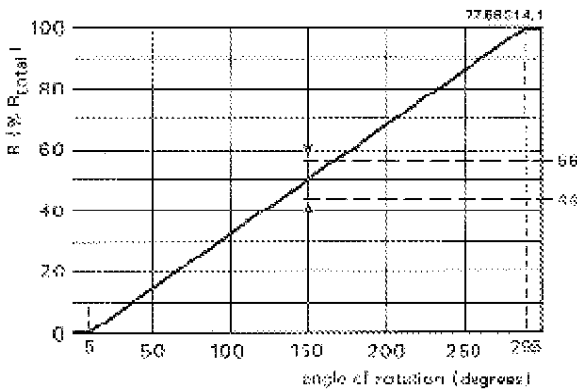
ENVIRONMENTAL TESTS

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

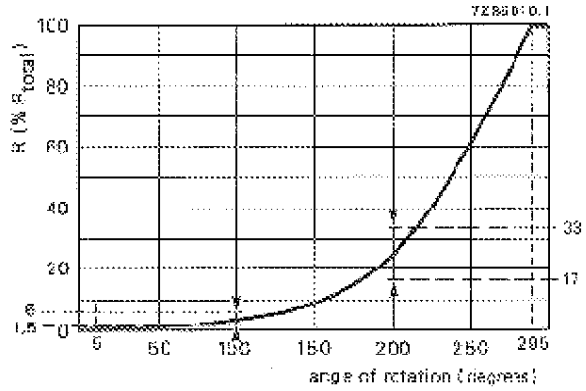
* For derating see Fig.36.

** 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).

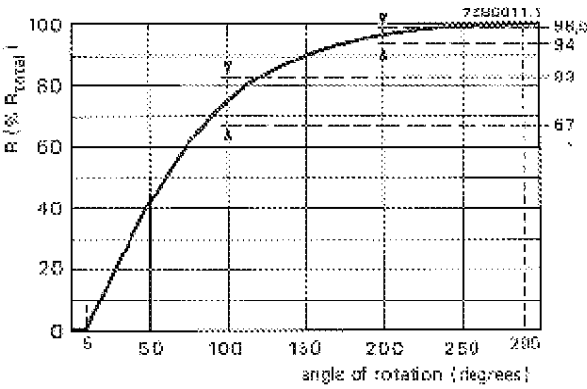
Characteristics of potentiometers without switch



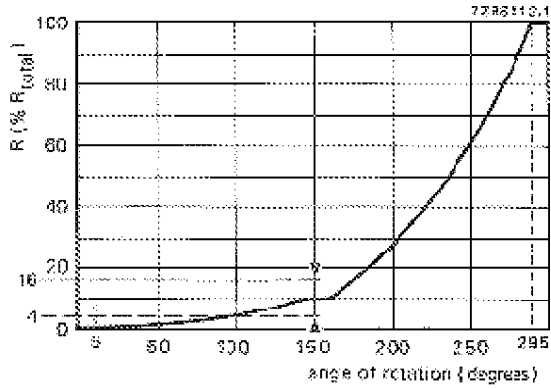
Type A
Fig.35a Linear law.



Type B
Fig.35b Logarithmic law.



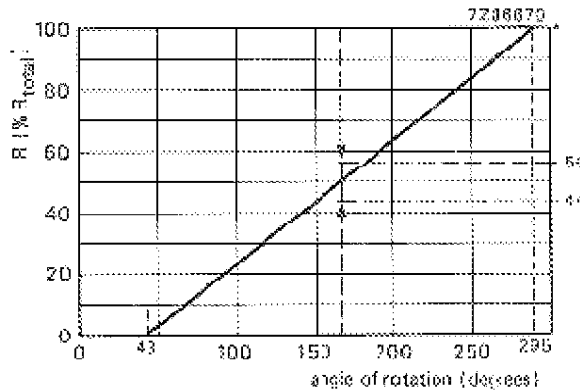
Type C
Fig.35c Reversed logarithmic law.



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.

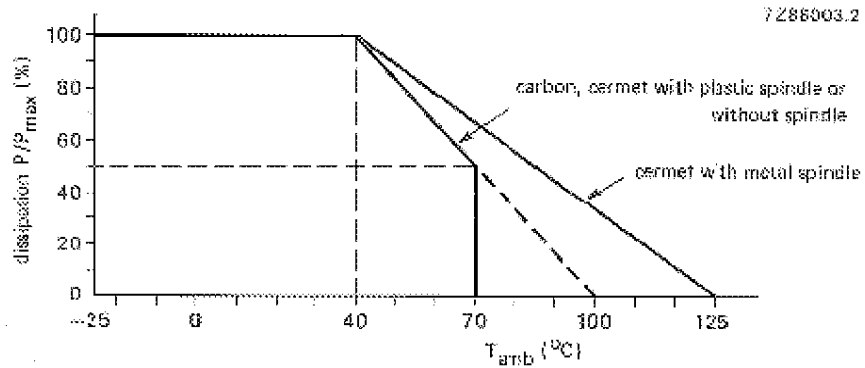


Fig.36 Max mum permissible dissipation as a function of ambient temperature.

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		unit
	single duo	tandem	single duo	tandem	
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
Angle of rotation	300 ± 2	300 ± 2	300 ± 2	300 ± 2	deg
Effective angle of rotation with switch	290 ± 2,5	290 ± 2,5	290 ± 2,5	290 ± 2,5	deg
	252 ± 2,5	252 ± 2,5	252 ± 2,5	252 ± 2,5	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

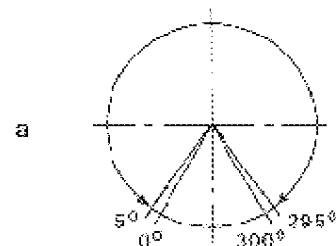


Fig.37a.

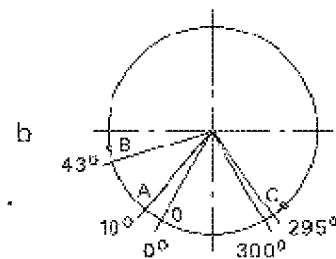


Fig.37b.

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.