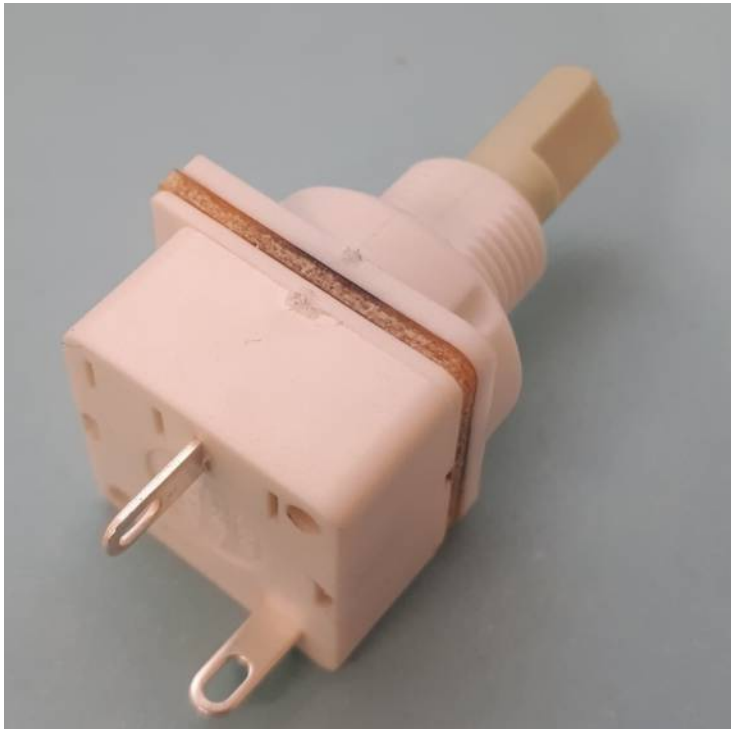


B4/OW1S ROTARY SWITCH

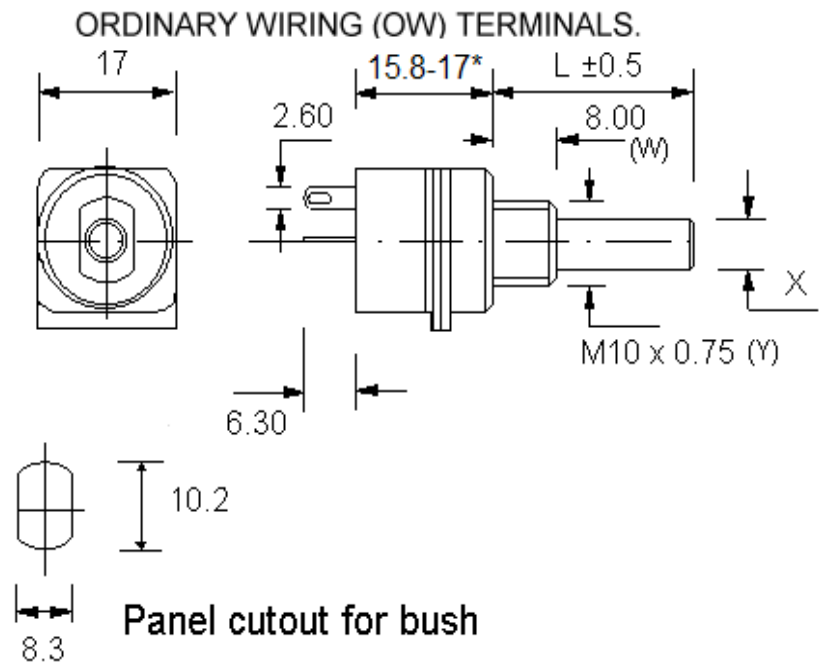
4 Amp Single Pole (single Throw) Switch (SPST)

OW - Ordinary Wiring Terminals (for soldering)

ON/OFF Switch Function with Limited Rotation

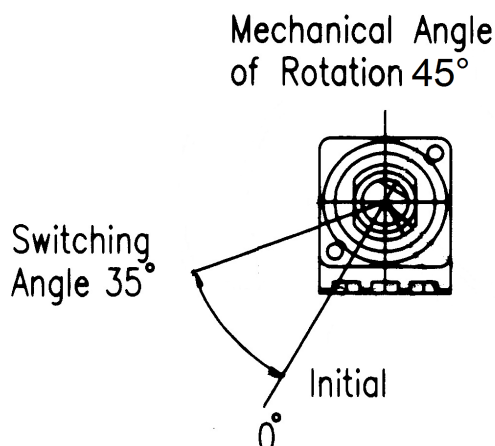


SPINDLE END VIEW



- X Spindle Diameter
- L Spindle Length

* Dependant on quantity and Spindle Selection



Rotary Switch Specification

The rotary switch modules are manufactured to EN61058-1 standard using high quality materials with a flame retardant housing. Although no longer certified due to the excessive cost of maintaining approvals, the 1 Amp and 4 Amp switch series have both been previously certified by UL International Demko (copies of previous certificates are available on our website or on request). The same materials, components and production techniques are used as in the certified versions and Omeg Ltd continues to test to the EN61058-1 standard

The 1 Amp contact rating is only available when mounted on the ECO potentiometer

1 A Contact Rating:

Note: The 1A contact rating is NOT available for mounting on the P16 or P20 potentiometer.

1A/250Vac 2.5A/12Vdc

Surge rating (0.01 seconds): 20A

Contact gap: 3mm (Full mains separation of contacts)

Manufactured to EN61058-1 standard

4 A Contact Rating:

4A/250Vac 10A/12Vdc

Surge rating (0.01 seconds): 80A

Switch contacts: Silver tin oxide

Contact gap: 2mm (Micro disconnection of switch - micro separation of contacts)

Manufactured to EN61058-1 standard

Common features

Housing material: Flame Retardant Glass filled polyester (UL 94 VO)

Initial contact resistance: 20 milliohms

Insulation resistance: 50,000 Megohms

Life (operations at full load): 10,000 minimum

Operating temperature: -25°C to +70°C

Operating torque for SPST/SPDT: 1.5 - 3 cNm

Operating torque for DPST/DPDT: 3.0 - 6 cNm

Mechanical rotation: 300°

Proof voltage: 3kV minimum

Rotary Switch Terminals

Layout

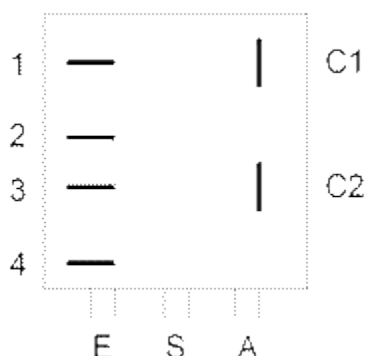


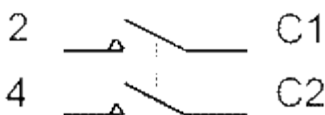
Diagram as viewed on the rear of the switch module:

(Potentiometer terminals at the bottom)

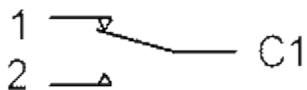
Configuration



SPST - Single pole (1S), Single throw (On-Off)

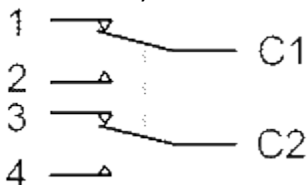


DPST - Double pole (2S), Single throw (On-Off)



SPDT - Single pole (1S), Double throw (CH)

(**NOT** certified)



DPDT - Double pole (2S), Double throw (CH)

(**NOT** certified)

Notes

1. Moving contact(s) shown when the potentiometer shaft is in a counterclockwise (CCW) position.
2. 'Ordinary Wiring'(OW) or 'Printed Circuit'(PC) terminals can be requested on the switch.
3. Terminals 1 and 3 are only fitted for the Double Throw ('CH' or Changeover) versions which are **NOT** approved nor certified.

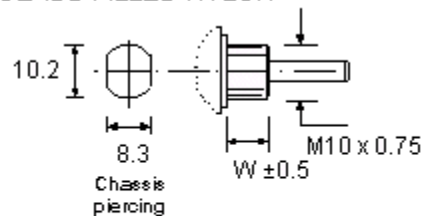
Components

ECO Bush Housing (Mounting)

The ECO bush housing is made of glass filled nylon, the thread is M10 x0.75mm pitch and 8mm long, alternatively **a 12mm long thread is also available** from October 2008.

Do not attempt to prevent any unwanted body rotation by overtightening the retaining nut, since this can cause thread damage, distortion, change of electrical resistance and restrict shaft rotation. BS9130:1972 provides further details on this topic. The **recommended torque** for tightening the retaining nut is 45cN.m and this can be achieved cost effectively by using a Torque Limiting device as shown on our **Accessories** page.

GLASS FILLED NYLON



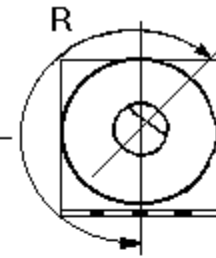
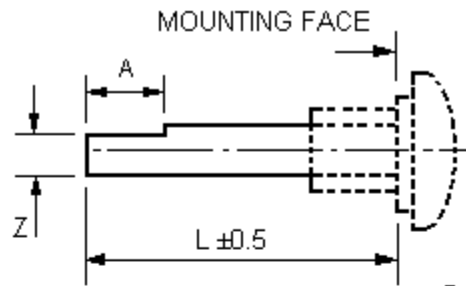
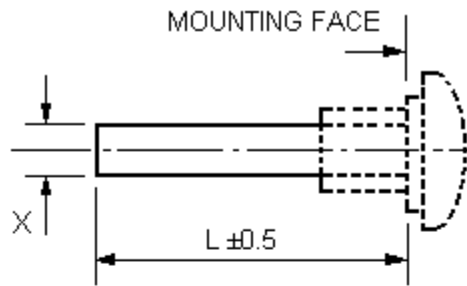
TYPE PLASTIC BODY	
W(mm)	8 (optional 12)

ECO Spindles

The ECO plastic spindles are fixed and not removable.
They are available in the following three diameters:

- 6.0mm Diameter - Length (L) available from 14mm to 65mm
 - Cylindrical (Type F1)
 - 4.0 x 12mm Flat (Type F2)
 - 5.0 x 15mm Flat (Type F3)
 - 5.0 x 10mm Flat (Type F4)
 - 4.6mm x 15mm Flat (Type F11)
 - 4.0 x 8mm Flat (Type F13)
 - 5.0 x 8mm Flat (Type F14)
- 4.0mm Diameter - Length (L) available from 14mm to 35mm
 - Cylindrical (Type F21)
 - 3.0 x 8.5mm Flat (Type F22)
- 6.35mm Diameter - Length (L) available from 14mm to 65mm
 - Cylindrical (Type F41)
 - 5.5 x 10mm Flat (Type F42)

Cylindrical and Flatted Spindles



Spindle in full CCW position

TYPE	DESC. (X)	L (mm)
F21	4 mm Dia Plastic	14 - 35
F1	6 mm Dia Plastic	14 - 65
F41	6.35mm Dia Plastic	14 - 65

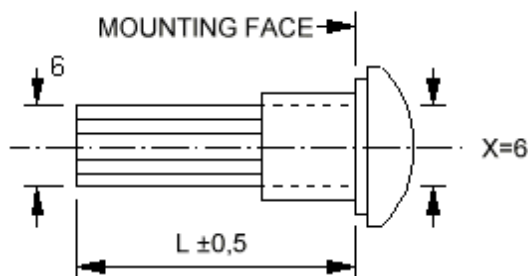
All spindles fixed.

TYPE	DESC. (X)	L (mm)	Flat (ZxA)
F22	4 mm Dia Plastic	14 - 35	3 x 8.5
F13	6 mm Dia Plastic	14 - 65	4 x 8
F2	6 mm Dia Plastic	14 - 65	4 x 12
F14	6 mm Dia Plastic	14 - 65	5 x 8
F4	6 mm Dia Plastic	14 - 65	5 x 10
F3	6 mm Dia Plastic	14 - 65	5 x 15
F11	6 mm Dia Plastic	14 - 65	4.6 x 15
F42	6.35mm Dia Plastic	14 - 65	5.5 x 10

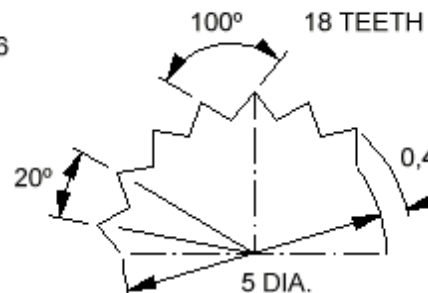
Standard flat angle
R = 210°

Splined Spindle (6.0mm diameter)

A splined form is also available on the 6.0mm diameter ECO plastic spindle.



TYPE	DESC.	L (mm)
F5	Plastic Fixed	14 - 30

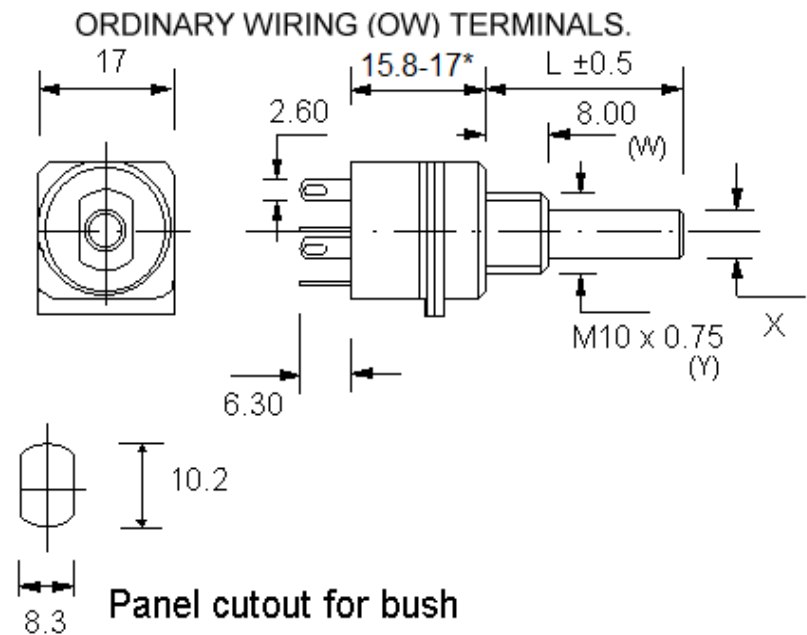
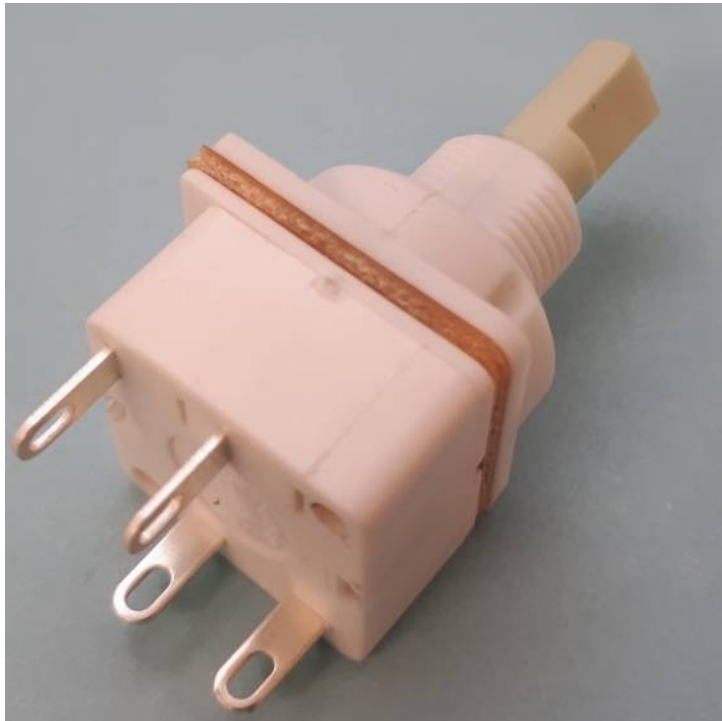


B4/OW2S ROTARY SWITCH

4 Amp Double Pole (single Throw) Switch (DPST)

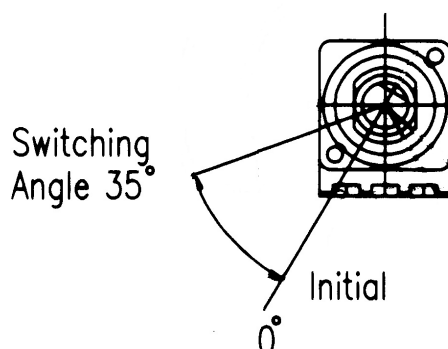
OW - Ordinary Wiring Terminals (for Soldering)

ON/OFF Switch Function with Limited Rotation



SPINDLE END VIEW

Mechanical Angle
of Rotation 45°



- X Spindle Diameter
- L Spindle Length

* Dependant on quantity and
Spindle Selection

Rotary Switch Specification

The rotary switch modules are manufactured to EN61058-1 standard using high quality materials with a flame retardant housing. Although no longer certified due to the excessive cost of maintaining approvals, the 1 Amp and 4 Amp switch series have both been previously certified by UL International Demko (copies of previous certificates are available on our website or on request). The same materials, components and production techniques are used as in the certified versions and Omeg Ltd continues to test to the EN61058-1 standard

The 1 Amp contact rating is only available when mounted on the ECO potentiometer

1 A Contact Rating:

Note: The 1A contact rating is NOT available for mounting on the P16 or P20 potentiometer.

1A/250Vac 2.5A/12Vdc

Surge rating (0.01 seconds): 20A

Contact gap: 3mm (Full mains separation of contacts)

Manufactured to EN61058-1 standard

4 A Contact Rating:

4A/250Vac 10A/12Vdc

Surge rating (0.01 seconds): 80A

Switch contacts: Silver tin oxide

Contact gap: 2mm (Micro disconnection of switch - micro separation of contacts)

Manufactured to EN61058-1 standard

Common features

Housing material: Flame Retardant Glass filled polyester (UL 94 VO)

Initial contact resistance: 20 milliohms

Insulation resistance: 50,000 Megohms

Life (operations at full load): 10,000 minimum

Operating temperature: -25°C to +70°C

Operating torque for SPST/SPDT: 1.5 - 3 cNm

Operating torque for DPST/DPDT: 3.0 - 6 cNm

Mechanical rotation: 300°

Proof voltage: 3kV minimum

Rotary Switch Terminals

Layout

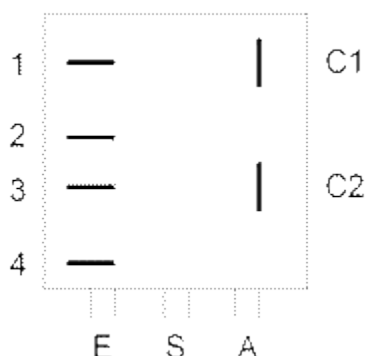


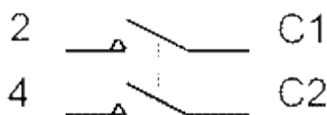
Diagram as viewed on the rear of the switch module:

(Potentiometer terminals at the bottom)

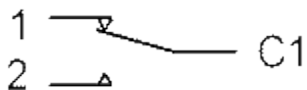
Configuration



SPST - Single pole (1S), Single throw (On-Off)

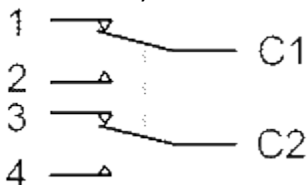


DPST - Double pole (2S), Single throw (On-Off)



SPDT - Single pole (1S), Double throw (CH)

(**NOT** certified)



DPDT - Double pole (2S), Double throw (CH)

(**NOT** certified)

Notes

1. Moving contact(s) shown when the potentiometer shaft is in a counterclockwise (CCW) position.
2. 'Ordinary Wiring'(OW) or 'Printed Circuit'(PC) terminals can be requested on the switch.
3. Terminals 1 and 3 are only fitted for the Double Throw ('CH' or Changeover) versions which are **NOT** approved nor certified.

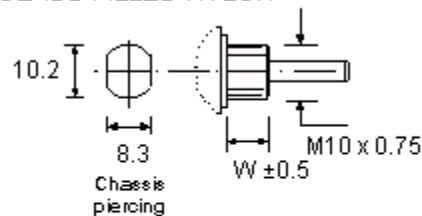
Components

ECO Bush Housing (Mounting)

The ECO bush housing is made of glass filled nylon, the thread is M10 x0.75mm pitch and 8mm long, alternatively **a 12mm long thread is also available** from October 2008.

Do not attempt to prevent any unwanted body rotation by overtightening the retaining nut, since this can cause thread damage, distortion, change of electrical resistance and restrict shaft rotation. BS9130:1972 provides further details on this topic. The **recommended torque** for tightening the retaining nut is 45cN.m and this can be achieved cost effectively by using a Torque Limiting device as shown on our **Accessories** page.

GLASS FILLED NYLON



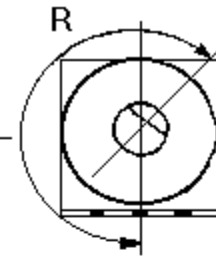
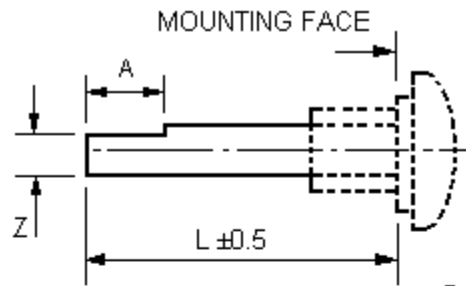
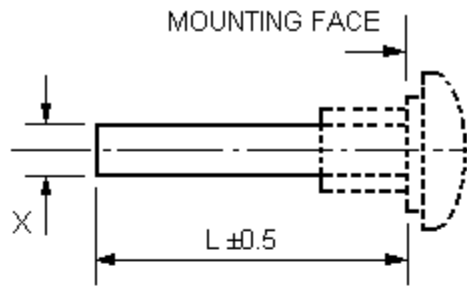
TYPE PLASTIC BODY	
W(mm)	8 (optional 12)

ECO Spindles

The ECO plastic spindles are fixed and not removable.
They are available in the following three diameters:

- 6.0mm Diameter - Length (L) available from 14mm to 65mm
 - Cylindrical (Type F1)
 - 4.0 x 12mm Flat (Type F2)
 - 5.0 x 15mm Flat (Type F3)
 - 5.0 x 10mm Flat (Type F4)
 - 4.6mm x 15mm Flat (Type F11)
 - 4.0 x 8mm Flat (Type F13)
 - 5.0 x 8mm Flat (Type F14)
- 4.0mm Diameter - Length (L) available from 14mm to 35mm
 - Cylindrical (Type F21)
 - 3.0 x 8.5mm Flat (Type F22)
- 6.35mm Diameter - Length (L) available from 14mm to 65mm
 - Cylindrical (Type F41)
 - 5.5 x 10mm Flat (Type F42)

Cylindrical and Flatted Spindles



Spindle in full CCW position

TYPE	DESC. (Ø)	L (mm)
F21	4 mm Dia Plastic	14 - 35
F1	6 mm Dia Plastic	14 - 65
F41	6.35mm Dia Plastic	14 - 65

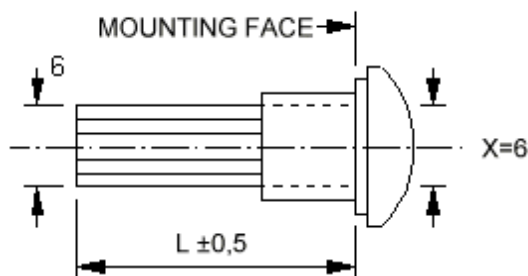
All spindles fixed.

TYPE	DESC. (Ø)	L (mm)	Flat (ZxA)
F22	4 mm Dia Plastic	14 - 35	3 x 8.5
F13	6 mm Dia Plastic	14 - 65	4 x 8
F2	6 mm Dia Plastic	14 - 65	4 x 12
F14	6 mm Dia Plastic	14 - 65	5 x 8
F4	6 mm Dia Plastic	14 - 65	5 x 10
F3	6 mm Dia Plastic	14 - 65	5 x 15
F11	6 mm Dia Plastic	14 - 65	4.6 x 15
F42	6.35mm Dia Plastic	14 - 65	5.5 x 10

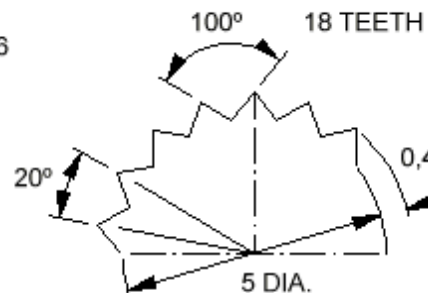
Standard flat angle
R = 210°

Splined Spindle (6.0mm diameter)

A splined form is also available on the 6.0mm diameter ECO plastic spindle.



TYPE	DESC.	L (mm)
F5	Plastic Fixed	14 - 30

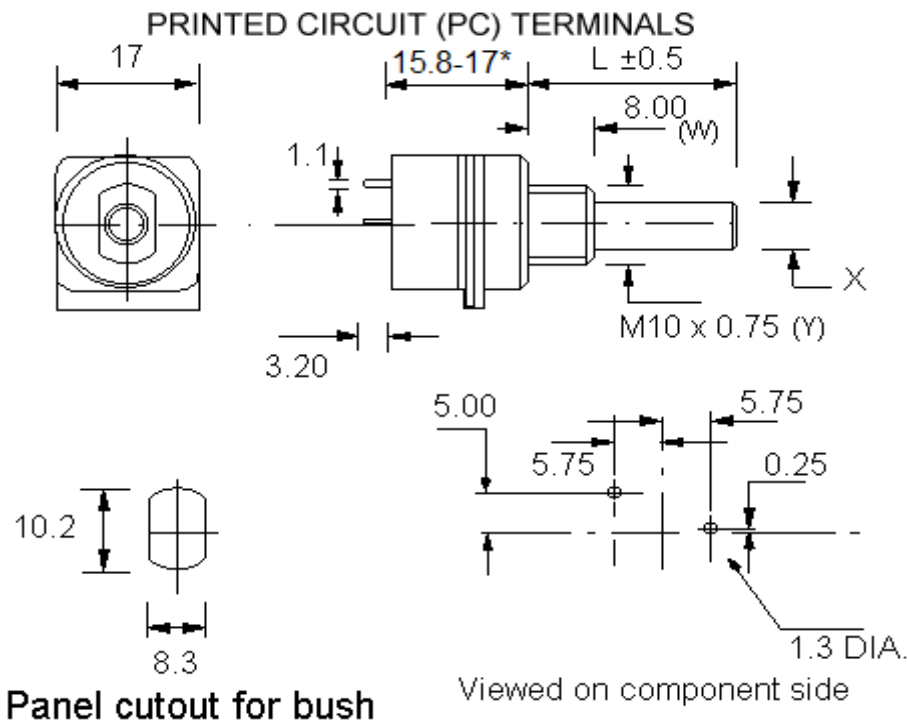
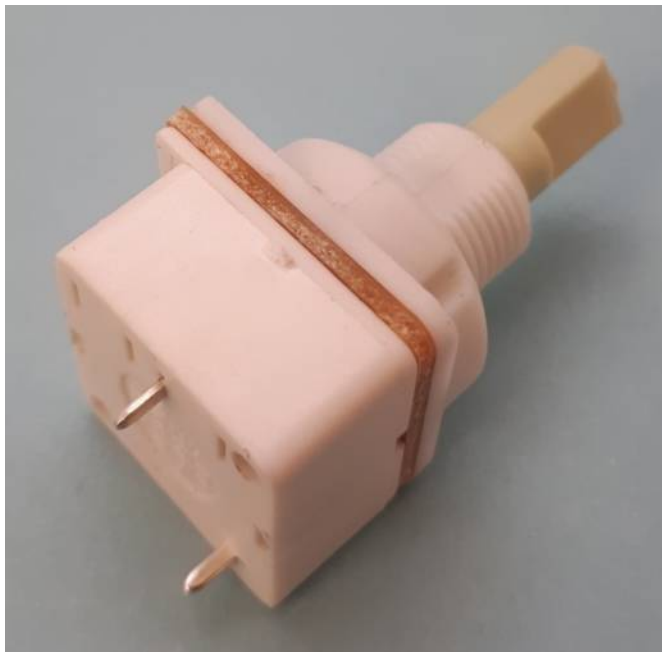


B4/PC1S ROTARY SWITCH

4 Amp Single Pole (single Throw) Switch (SPST)

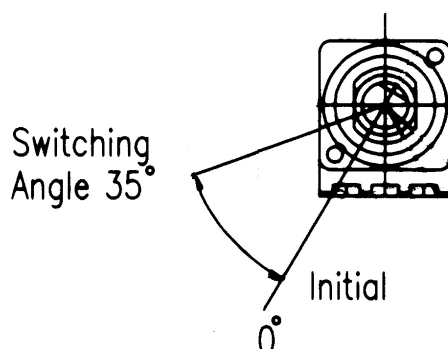
PC - Printed Circuit Terminals

ON/OFF Switch Function with Limited Rotation



SPINDLE END VIEW

Mechanical Angle
of Rotation 45°



- X Spindle Diameter
- L Spindle Length

* Dependant on quantity and
Spindle Selection

Rotary Switch Specification

The rotary switch modules are manufactured to EN61058-1 standard using high quality materials with a flame retardant housing. Although no longer certified due to the excessive cost of maintaining approvals, the 1 Amp and 4 Amp switch series have both been previously certified by UL International Demko (copies of previous certificates are available on our website or on request). The same materials, components and production techniques are used as in the certified versions and Omeg Ltd continues to test to the EN61058-1 standard

The 1 Amp contact rating is only available when mounted on the ECO potentiometer

1 A Contact Rating:

Note: The 1A contact rating is NOT available for mounting on the P16 or P20 potentiometer.

1A/250Vac 2.5A/12Vdc

Surge rating (0.01 seconds): 20A

Contact gap: 3mm (Full mains separation of contacts)

Manufactured to EN61058-1 standard

4 A Contact Rating:

4A/250Vac 10A/12Vdc

Surge rating (0.01 seconds): 80A

Switch contacts: Silver tin oxide

Contact gap: 2mm (Micro disconnection of switch - micro separation of contacts)

Manufactured to EN61058-1 standard

Common features

Housing material: Flame Retardant Glass filled polyester (UL 94 VO)

Initial contact resistance: 20 milliohms

Insulation resistance: 50,000 Megohms

Life (operations at full load): 10,000 minimum

Operating temperature: -25°C to +70°C

Operating torque for SPST/SPDT: 1.5 - 3 cNm

Operating torque for DPST/DPDT: 3.0 - 6 cNm

Mechanical rotation: 300°

Proof voltage: 3kV minimum

Rotary Switch Terminals

Layout

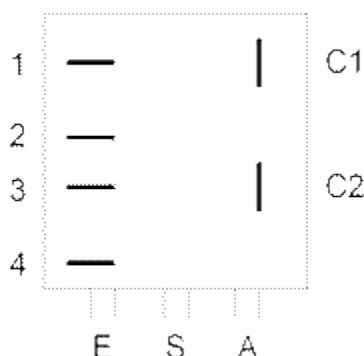


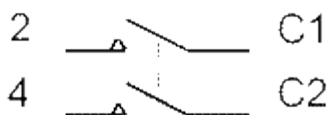
Diagram as viewed on the rear of the switch module:

(Potentiometer terminals at the bottom)

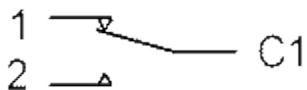
Configuration



SPST - Single pole (1S), Single throw (On-Off)

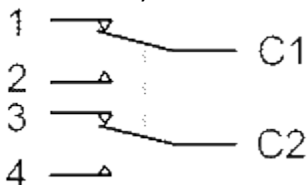


DPST - Double pole (2S), Single throw (On-Off)



SPDT - Single pole (1S), Double throw (CH)

(**NOT** certified)



DPDT - Double pole (2S), Double throw (CH)

(**NOT** certified)

Notes

1. Moving contact(s) shown when the potentiometer shaft is in a counterclockwise (CCW) position.
2. 'Ordinary Wiring'(OW) or 'Printed Circuit'(PC) terminals can be requested on the switch.
3. Terminals 1 and 3 are only fitted for the Double Throw ('CH' or Changeover) versions which are **NOT** approved nor certified.

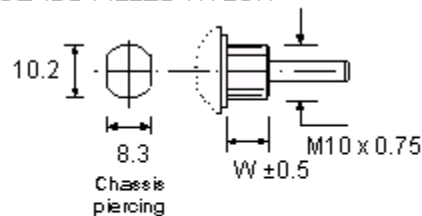
Components

ECO Bush Housing (Mounting)

The ECO bush housing is made of glass filled nylon, the thread is M10 x0.75mm pitch and 8mm long, alternatively **a 12mm long thread is also available** from October 2008.

Do not attempt to prevent any unwanted body rotation by overtightening the retaining nut, since this can cause thread damage, distortion, change of electrical resistance and restrict shaft rotation. BS9130:1972 provides further details on this topic. The **recommended torque** for tightening the retaining nut is 45cN.m and this can be achieved cost effectively by using a Torque Limiting device as shown on our **Accessories** page.

GLASS FILLED NYLON



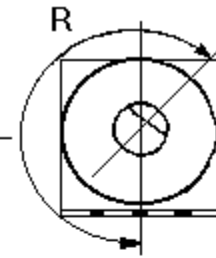
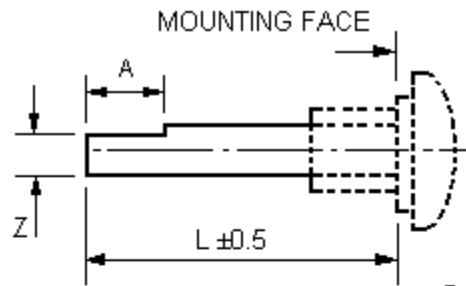
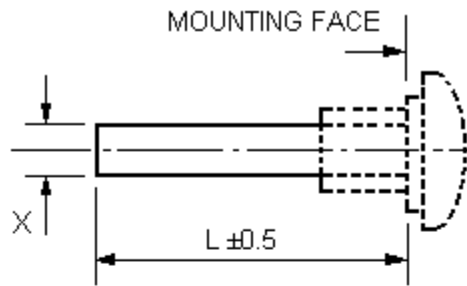
TYPE PLASTIC BODY	
W(mm)	8 (optional 12)

ECO Spindles

The ECO plastic spindles are fixed and not removable.
They are available in the following three diameters:

- 6.0mm Diameter - Length (L) available from 14mm to 65mm
 - Cylindrical (Type F1)
 - 4.0 x 12mm Flat (Type F2)
 - 5.0 x 15mm Flat (Type F3)
 - 5.0 x 10mm Flat (Type F4)
 - 4.6mm x 15mm Flat (Type F11)
 - 4.0 x 8mm Flat (Type F13)
 - 5.0 x 8mm Flat (Type F14)
- 4.0mm Diameter - Length (L) available from 14mm to 35mm
 - Cylindrical (Type F21)
 - 3.0 x 8.5mm Flat (Type F22)
- 6.35mm Diameter - Length (L) available from 14mm to 65mm
 - Cylindrical (Type F41)
 - 5.5 x 10mm Flat (Type F42)

Cylindrical and Flatted Spindles



Spindle in full CCW position

TYPE	DESC. (X)	L (mm)
F21	4 mm Dia Plastic	14 - 35
F1	6 mm Dia Plastic	14 - 65
F41	6.35mm Dia Plastic	14 - 65

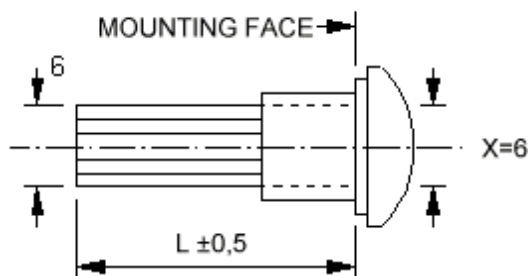
All spindles fixed.

TYPE	DESC. (X)	L (mm)	Flat (ZxA)
F22	4 mm Dia Plastic	14 - 35	3 x 8.5
F13	6 mm Dia Plastic	14 - 65	4 x 8
F2	6 mm Dia Plastic	14 - 65	4 x 12
F14	6 mm Dia Plastic	14 - 65	5 x 8
F4	6 mm Dia Plastic	14 - 65	5 x 10
F3	6 mm Dia Plastic	14 - 65	5 x 15
F11	6 mm Dia Plastic	14 - 65	4.6 x 15
F42	6.35mm Dia Plastic	14 - 65	5.5 x 10

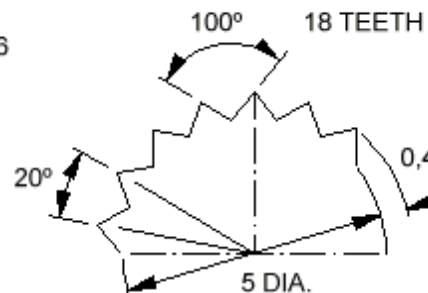
Standard flat angle
R = 210°

Splined Spindle (6.0mm diameter)

A splined form is also available on the 6.0mm diameter ECO plastic spindle.



TYPE	DESC.	L (mm)
F5	Plastic Fixed	14 - 30

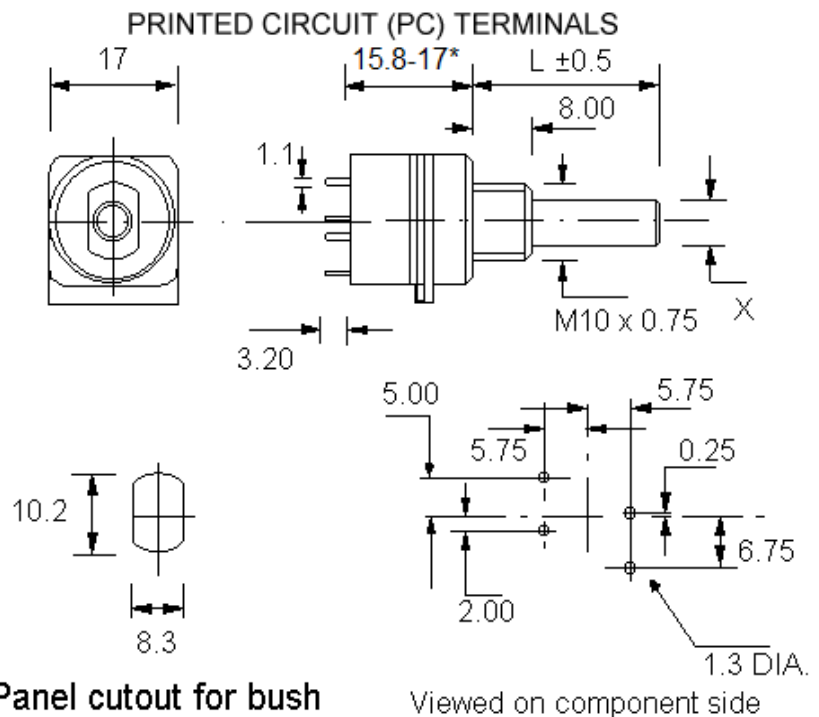
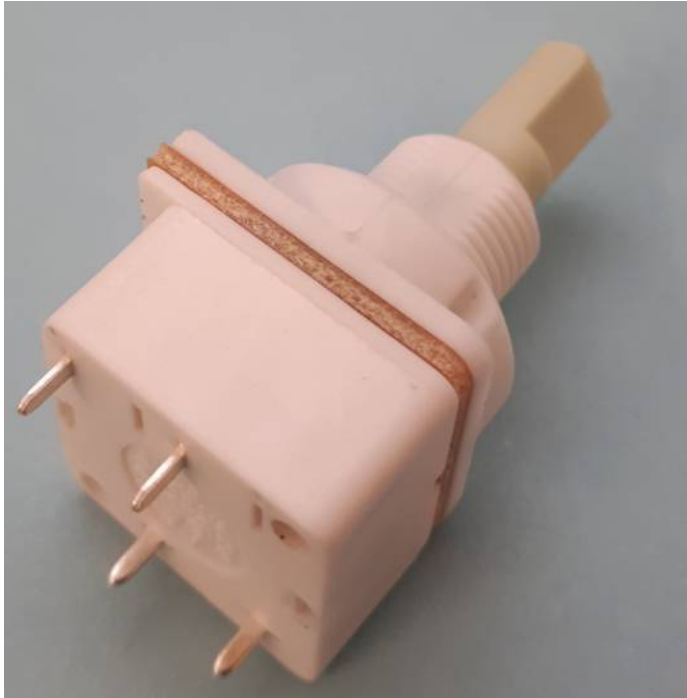


B4/PC2S ROTARY SWITCH

4 Amp Double Pole (single Throw) Switch (DPST)

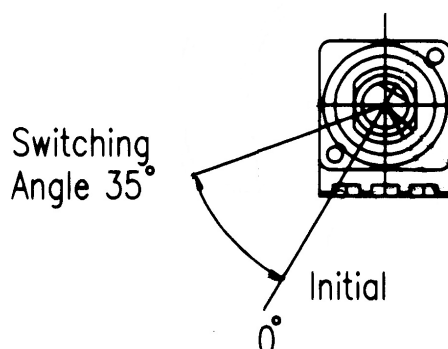
PC - Printed Circuit Terminals

ON/OFF Switch Function with Limited Rotation



SPINDLE END VIEW

Mechanical Angle
of Rotation 45°



- X Spindle Diameter
- L Spindle Length

* Dependant on quantity and
Spindle Selection

Rotary Switch Specification

The rotary switch modules are manufactured to EN61058-1 standard using high quality materials with a flame retardant housing. Although no longer certified due to the excessive cost of maintaining approvals, the 1 Amp and 4 Amp switch series have both been previously certified by UL International Demko (copies of previous certificates are available on our website or on request). The same materials, components and production techniques are used as in the certified versions and Omeg Ltd continues to test to the EN61058-1 standard

The 1 Amp contact rating is only available when mounted on the ECO potentiometer

1 A Contact Rating:

Note: The 1A contact rating is NOT available for mounting on the P16 or P20 potentiometer.

1A/250Vac 2.5A/12Vdc

Surge rating (0.01 seconds): 20A

Contact gap: 3mm (Full mains separation of contacts)

Manufactured to EN61058-1 standard

4 A Contact Rating:

4A/250Vac 10A/12Vdc

Surge rating (0.01 seconds): 80A

Switch contacts: Silver tin oxide

Contact gap: 2mm (Micro disconnection of switch - micro separation of contacts)

Manufactured to EN61058-1 standard

Common features

Housing material: Flame Retardant Glass filled polyester (UL 94 VO)

Initial contact resistance: 20 milliohms

Insulation resistance: 50,000 Megohms

Life (operations at full load): 10,000 minimum

Operating temperature: -25°C to +70°C

Operating torque for SPST/SPDT: 1.5 - 3 cNm

Operating torque for DPST/DPDT: 3.0 - 6 cNm

Mechanical rotation: 300°

Proof voltage: 3kV minimum

Rotary Switch Terminals

Layout

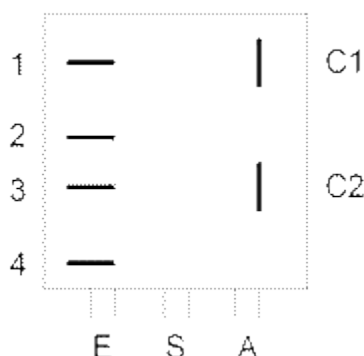


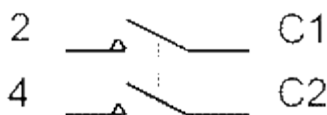
Diagram as viewed on the rear of the switch module:

(Potentiometer terminals at the bottom)

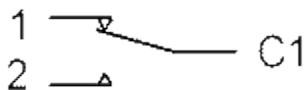
Configuration



SPST - Single pole (1S), Single throw (On-Off)

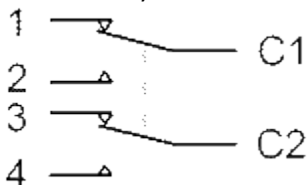


DPST - Double pole (2S), Single throw (On-Off)



SPDT - Single pole (1S), Double throw (CH)

(**NOT** certified)



DPDT - Double pole (2S), Double throw (CH)

(**NOT** certified)

Notes

1. Moving contact(s) shown when the potentiometer shaft is in a counterclockwise (CCW) position.
2. 'Ordinary Wiring'(OW) or 'Printed Circuit'(PC) terminals can be requested on the switch.
3. Terminals 1 and 3 are only fitted for the Double Throw ('CH' or Changeover) versions which are **NOT** approved nor certified.

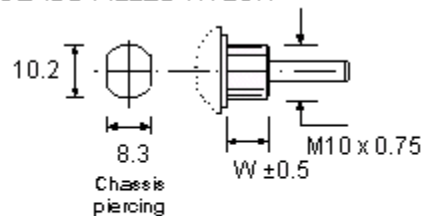
Components

ECO Bush Housing (Mounting)

The ECO bush housing is made of glass filled nylon, the thread is M10 x0.75mm pitch and 8mm long, alternatively **a 12mm long thread is also available** from October 2008.

Do not attempt to prevent any unwanted body rotation by overtightening the retaining nut, since this can cause thread damage, distortion, change of electrical resistance and restrict shaft rotation. BS9130:1972 provides further details on this topic. The **recommended torque** for tightening the retaining nut is 45cN.m and this can be achieved cost effectively by using a Torque Limiting device as shown on our **Accessories** page.

GLASS FILLED NYLON



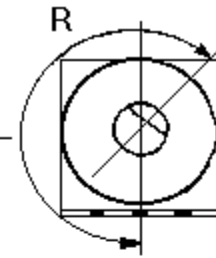
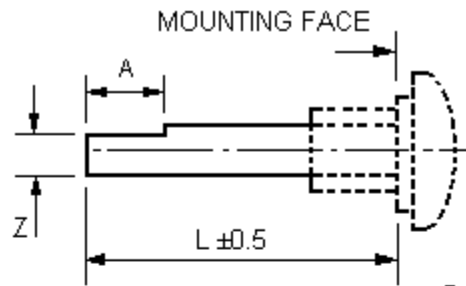
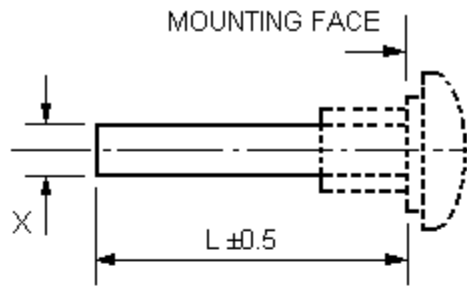
TYPE PLASTIC BODY	
W(mm)	8 (optional 12)

ECO Spindles

The ECO plastic spindles are fixed and not removable.
They are available in the following three diameters:

- 6.0mm Diameter - Length (L) available from 14mm to 65mm
 - Cylindrical (Type F1)
 - 4.0 x 12mm Flat (Type F2)
 - 5.0 x 15mm Flat (Type F3)
 - 5.0 x 10mm Flat (Type F4)
 - 4.6mm x 15mm Flat (Type F11)
 - 4.0 x 8mm Flat (Type F13)
 - 5.0 x 8mm Flat (Type F14)
- 4.0mm Diameter - Length (L) available from 14mm to 35mm
 - Cylindrical (Type F21)
 - 3.0 x 8.5mm Flat (Type F22)
- 6.35mm Diameter - Length (L) available from 14mm to 65mm
 - Cylindrical (Type F41)
 - 5.5 x 10mm Flat (Type F42)

Cylindrical and Flatted Spindles



Spindle in full CCW position

TYPE	DESC. (X)	L (mm)
F21	4 mm Dia Plastic	14 - 35
F1	6 mm Dia Plastic	14 - 65
F41	6.35mm Dia Plastic	14 - 65

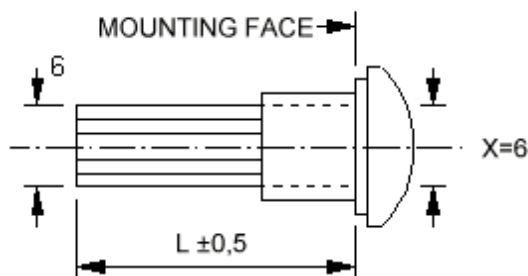
All spindles fixed.

TYPE	DESC. (X)	L (mm)	Flat (ZxA)
F22	4 mm Dia Plastic	14 - 35	3 x 8.5
F13	6 mm Dia Plastic	14 - 65	4 x 8
F2	6 mm Dia Plastic	14 - 65	4 x 12
F14	6 mm Dia Plastic	14 - 65	5 x 8
F4	6 mm Dia Plastic	14 - 65	5 x 10
F3	6 mm Dia Plastic	14 - 65	5 x 15
F11	6 mm Dia Plastic	14 - 65	4.6 x 15
F42	6.35mm Dia Plastic	14 - 65	5.5 x 10

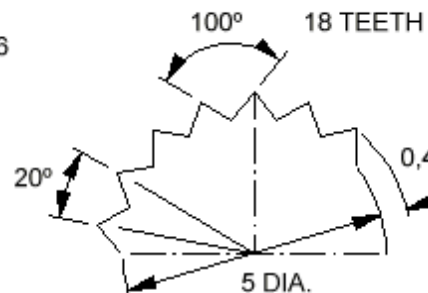
Standard flat angle
R = 210°

Splined Spindle (6.0mm diameter)

A splined form is also available on the 6.0mm diameter ECO plastic spindle.

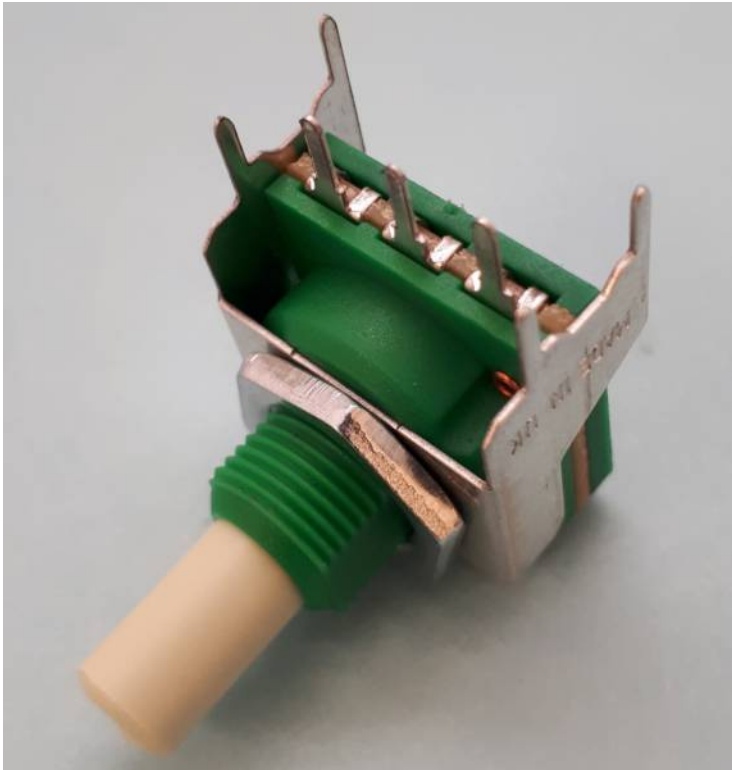


TYPE	DESC.	L (mm)
F5	Plastic Fixed	14 - 30

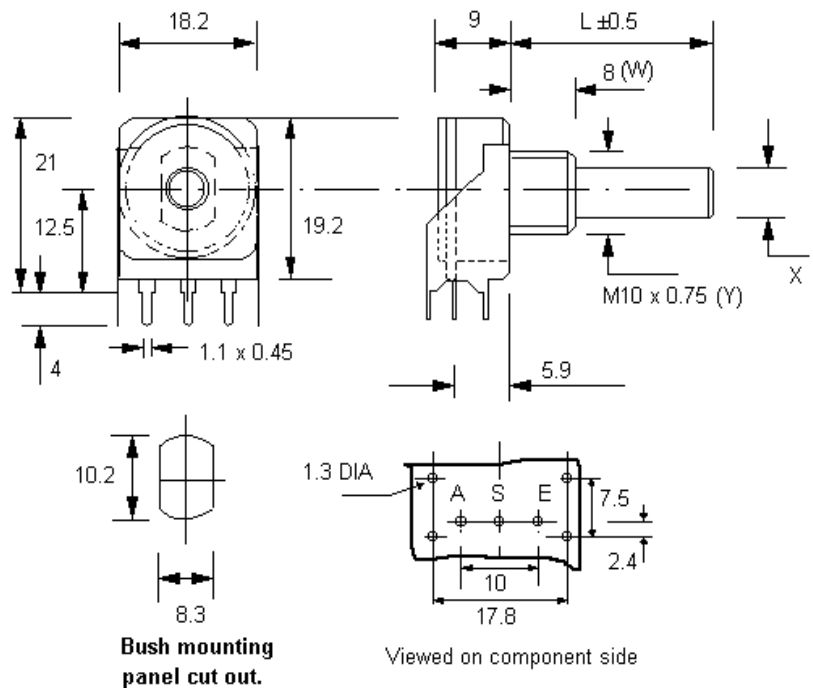


BR16ECO

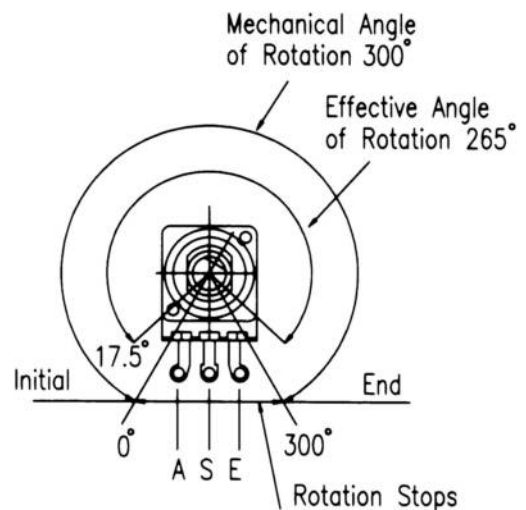
BR – Bracket with Printed Circuit Terminals



BRACKET SUPPLIED LOOSE FOR FITTING BY CUSTOMER



SPINDLE END VIEW



Total mechanical and effective electrical angles of rotation of potentiometers without rotary switch

- W Mounting Height
- Y Mounting Diameter
- X Spindle Diameter
- L Spindle Length
- A Initial Termination
- S Wiper (or moving contact) termination
- E End Termination

Technical Data

Rated Power Dissipation @40°C for ECO potentiometers:

0.25W linear law

0.12W nonlinear law

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Effective rotation: 265° nominal

Operating Torque: 0.4 – 1.5 cN.m

Permissible Axial Spindle Load: 50 N (5 Sec. maximum)

Permissible Torque at End Stop: 35 cN.m

Rotation angle: 300° ±5°

Optional click stop (indents) for rotational tactile feedback

Rotational torque of spindle can be made high or low

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Insulation Resistance: >= 4 Gohms

Rated Resistance: E3 Series

Optional: E6 Series

Linear Law: 1K – 1M

Nonlinear Law: 4K7 – 470K

ELECTRICAL SPECIFICATION COMMON TO ALL POTENTIOMETERS

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Insulation Resistance: >= 4 Gohms

Rated Resistance: E3 Series

- Optional: E6 Series
- Linear Law: 1K - 1M
- Nonlinear Law: 4K7 - 470K

Tolerance on Rated Resistance: ± 20%

- Optional Tolerance on 1K - 1M: ± 10%

Resistance Laws (Taper):

- Linear: A
- Nonlinear: B - Log (Audio) or C - Antilog (Reverse Audio)
- Other laws: Please refer to Sales office

ELECTRICAL SPECIFICATION UNIQUE TO ECO POTENTIOMETERS

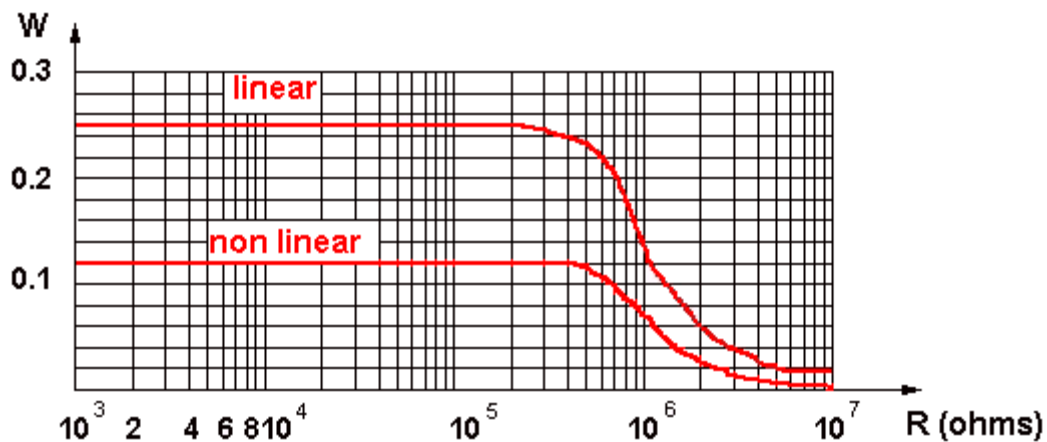
Effective rotation:

- Without a switch: 265° nominal
- With push push switch (/10APP, /MS): 265° nominal
- With rotary switch: 242° nominal

Rated Power Dissipation @40°C for ECO potentiometers:

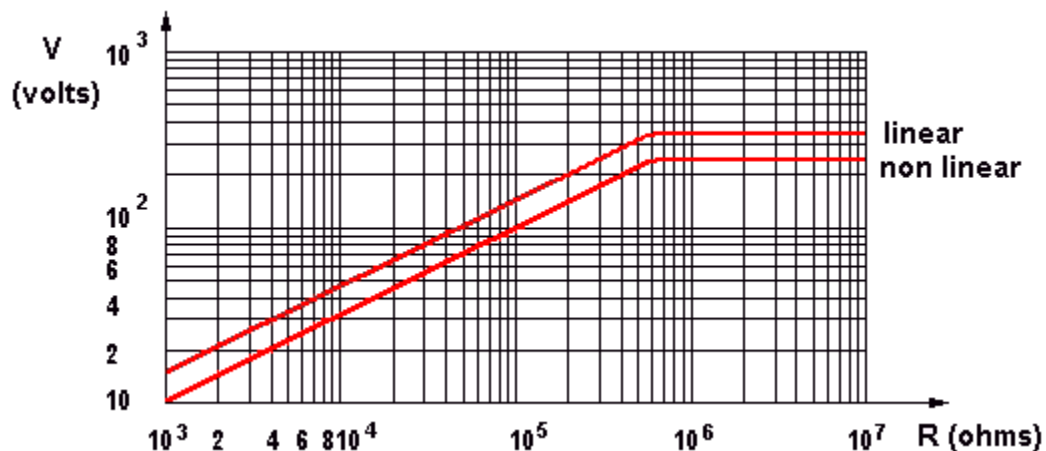
- 0.25W linear law
- 0.12W nonlinear law

ECO, P16 power dissipating curve



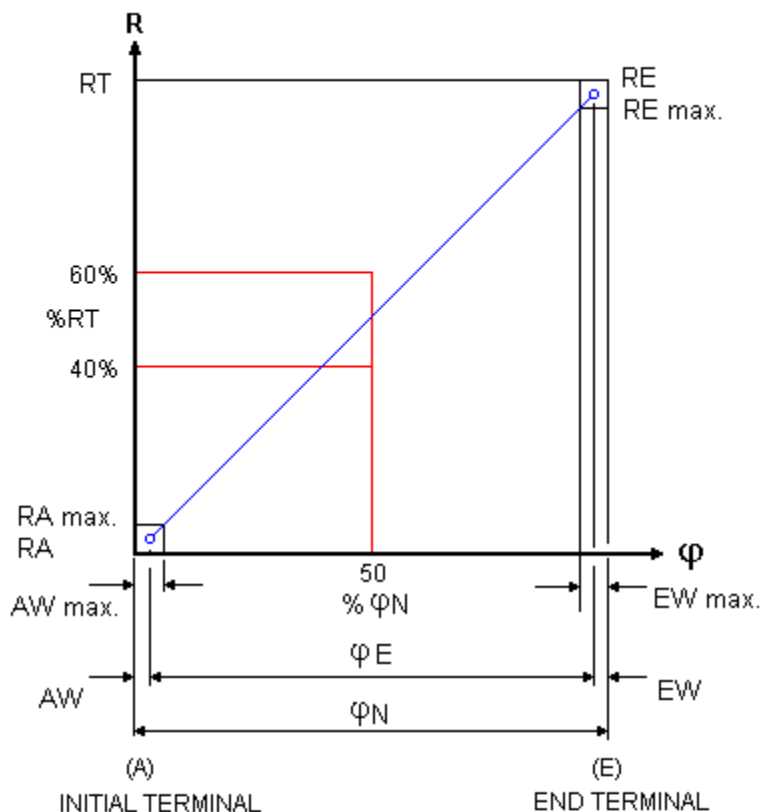
Limiting Element Voltage: 350 V DC for 16mm potentiometers

ECO, P16 maximum working voltage curve



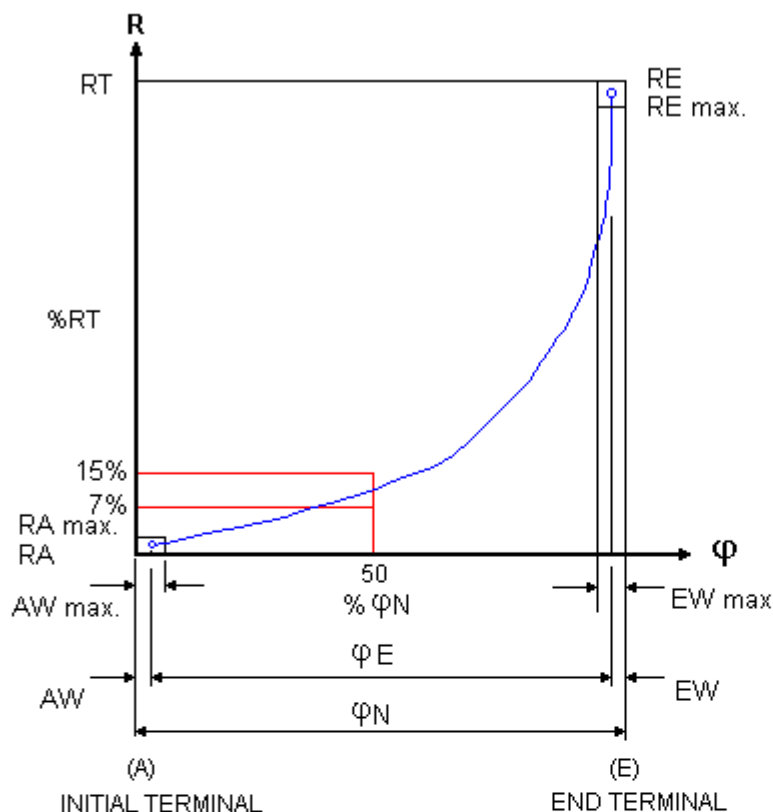
Insulating Voltage: 500 V AC for ECO potentiometers

Resistance law A - Linear



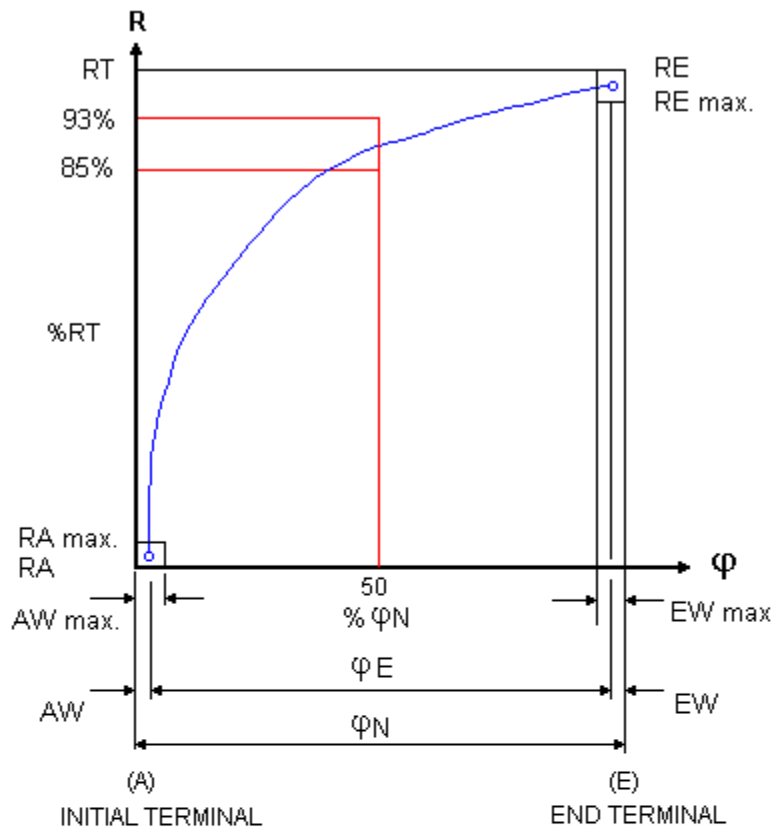
AW	Initial Path	AW max. 12% ϕ_N
EW	Final Path	EW max. 12% ϕ_N
Ra	Initial Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RA	Hop-on Resistance	$\leq 1\% RN$
Re	End Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RE	Hop-off Resistance	$\leq 1\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕ_E	Effective Electrical Angle of Rotation	
ϕ_N	Effective Mechanical Angle of Rotation	

Resistance law B – Log (Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RA	Hop-on Resistance	$RN \leq 10K$ 5% RN $RN > 10K$ 0.15% RN
Re	End Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RE	Hop-off Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K$ 0.5% RN
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φ E	Effective Electrical Angle of Rotation	
φ N	Effective Mechanical Angle of Rotation	

Resistance law C – Antilog (Reverse Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RA	Hop-on Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K 0.5\% RN$
Re	End Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RE	Hop-off Resistance	$RN \leq 10K 5\% RN$ $RN > 10K 0.15\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

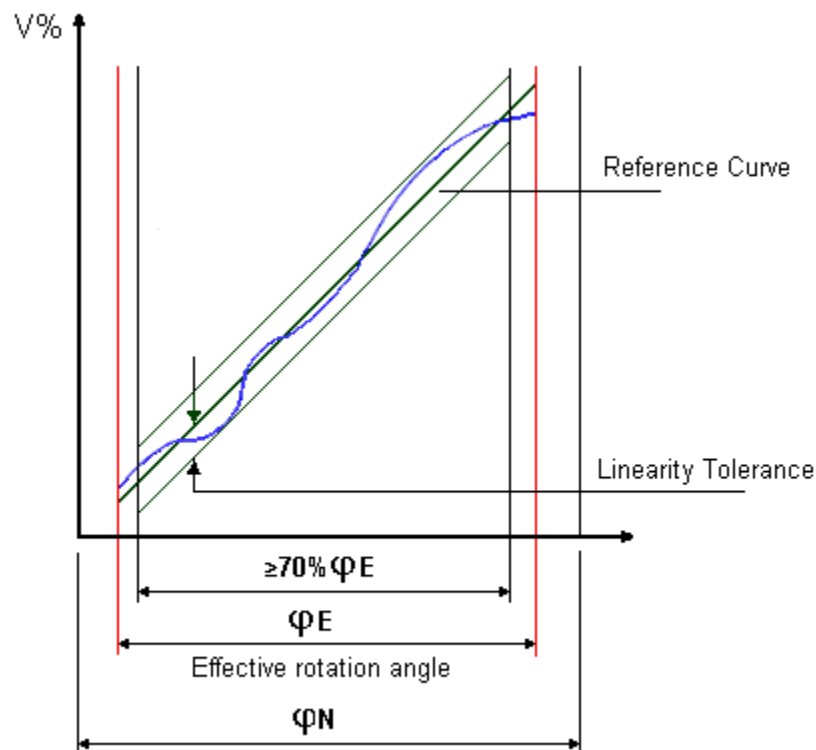
Linearity

As a basis of assessing Linearity Tolerance the independent method is the most practical, permitting as it does, the reference curve to be aligned as near as possible to the actual output curve. This avoids the use of the theoretical starting and finishing points, it is normal for the customer to realign the achieved curve with series trimmers at each end of the device if required.

Linearity Tolerance is 4% over the Nominal Resistance range of 1K0 to 1M0. The Linearity Tolerance is measured on at least 70% of the effective rotation range.

Note. In the case of Terminal and Zero-based linearity, both present constraints which increase the manufacturing difficulty and in consequence have an adverse effect on the product's price and availability.

Potentiometer linearity

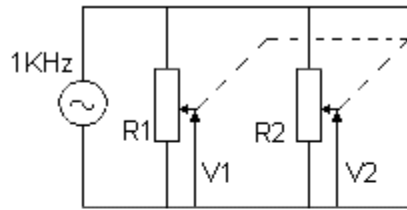


Matching Tolerance (For Tandem Stereo Potentiometers)

Tandem Potentiometers have two identical resistor units with the same variation law. The mismatching of the two resistor units, expressed in dB, is measured by the difference between the attenuations introduced by each resistor unit at various points of travel.

- Law A: 4 dB at Attenuation range 0 - 20 dB
- Law B and C: 3 dB at Attenuation range 0 - 20 dB

Matched Tolerance for Stereo

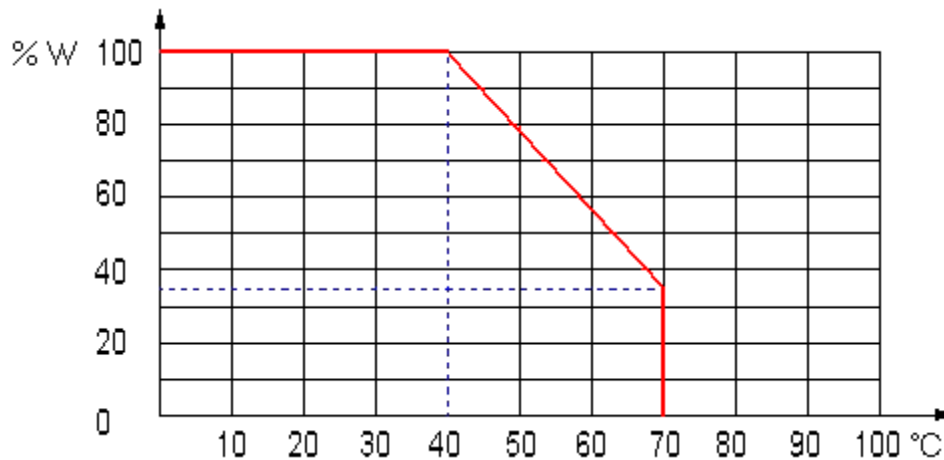


LAW	ATTENUATION RANGE	MATCHING TOLERANCE *
A	0 - 20dB	4dB
B & C	0 - 20dB	3dB

$$* \text{Matching Tolerance} = 20 \log \frac{V1}{V2}$$

Operating Temperature: -25°C to +70°C

Temperature Derating Curve



Temperature Coefficient of Resistance: +300 -500 ppm

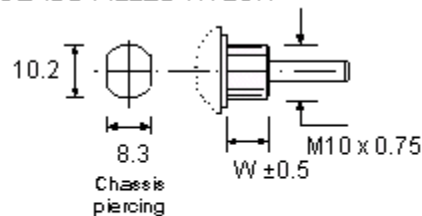
Components

ECO Bush Housing (Mounting)

The ECO bush housing is made of glass filled nylon, the thread is M10 x0.75mm pitch and 8mm long, alternatively **a 12mm long thread is also available** from October 2008.

Do not attempt to prevent any unwanted body rotation by overtightening the retaining nut, since this can cause thread damage, distortion, change of electrical resistance and restrict shaft rotation. BS9130:1972 provides further details on this topic. The **recommended torque** for tightening the retaining nut is 45cN.m and this can be achieved cost effectively by using a Torque Limiting device as shown on our **Accessories** page.

GLASS FILLED NYLON



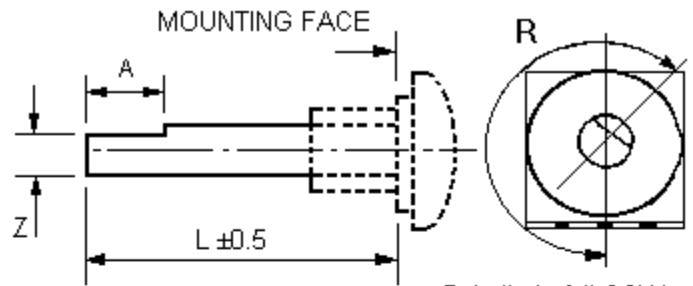
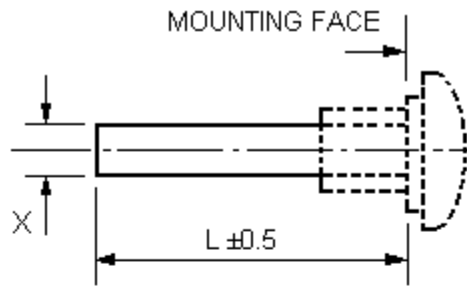
TYPE PLASTIC BODY	
W(mm)	8 (optional 12)

ECO Spindles

The ECO plastic spindles are fixed and not removable.
They are available in the following three diameters:

- 6.0mm Diameter - Length (L) available from 14mm to 65mm
 - Cylindrical (Type F1)
 - 4.0 x 12mm Flat (Type F2)
 - 5.0 x 15mm Flat (Type F3)
 - 5.0 x 10mm Flat (Type F4)
 - 4.6mm x 15mm Flat (Type F11)
 - 4.0 x 8mm Flat (Type F13)
 - 5.0 x 8mm Flat (Type F14)
- 4.0mm Diameter - Length (L) available from 14mm to 35mm
 - Cylindrical (Type F21)
 - 3.0 x 8.5mm Flat (Type F22)
- 6.35mm Diameter - Length (L) available from 14mm to 65mm
 - Cylindrical (Type F41)
 - 5.5 x 10mm Flat (Type F42)

Cylindrical and Flatted Spindles



Spindle in full CCW position

TYPE	DESC. (Ø)	L (mm)
F21	4 mm Dia Plastic	14 - 35
F1	6 mm Dia Plastic	14 - 65
F41	6.35mm Dia Plastic	14 - 65

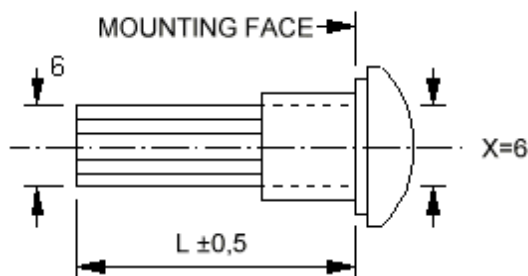
All spindles fixed.

TYPE	DESC. (Ø)	L (mm)	Flat (ZxA)
F22	4 mm Dia Plastic	14 - 35	3 x 8.5
F13	6 mm Dia Plastic	14 - 65	4 x 8
F2	6 mm Dia Plastic	14 - 65	4 x 12
F14	6 mm Dia Plastic	14 - 65	5 x 8
F4	6 mm Dia Plastic	14 - 65	5 x 10
F3	6 mm Dia Plastic	14 - 65	5 x 15
F11	6 mm Dia Plastic	14 - 65	4.6 x 15
F42	6.35mm Dia Plastic	14 - 65	5.5 x 10

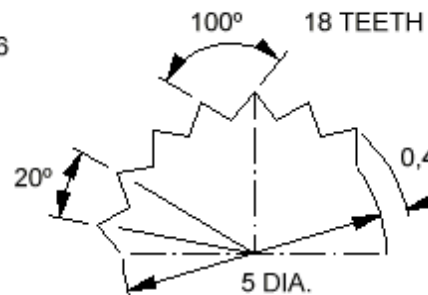
Standard flat angle
R = 210°

Splined Spindle (6.0mm diameter)

A splined form is also available on the 6.0mm diameter ECO plastic spindle.

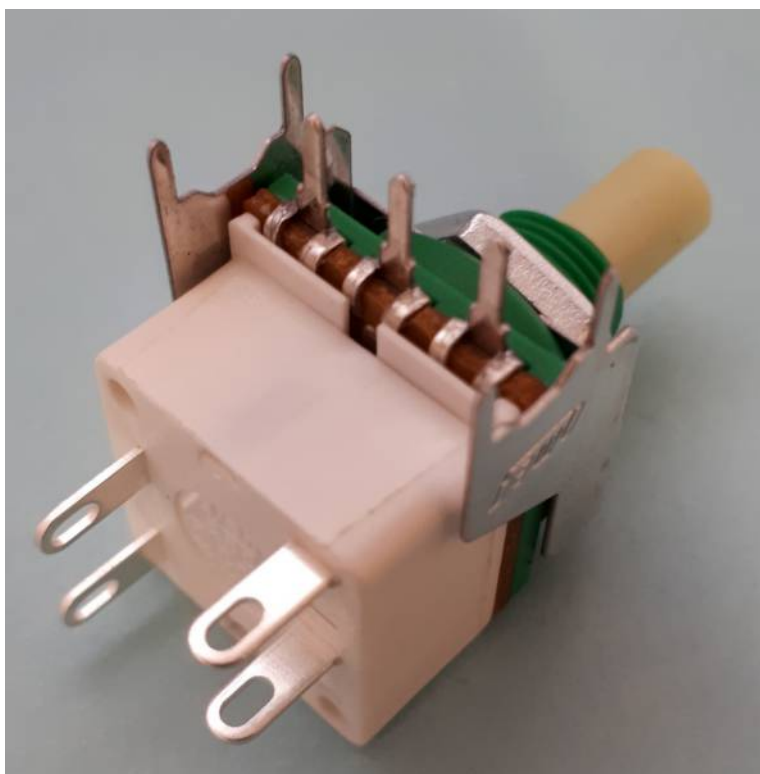


TYPE	DESC.	L (mm)
F5	Plastic Fixed	14 - 30

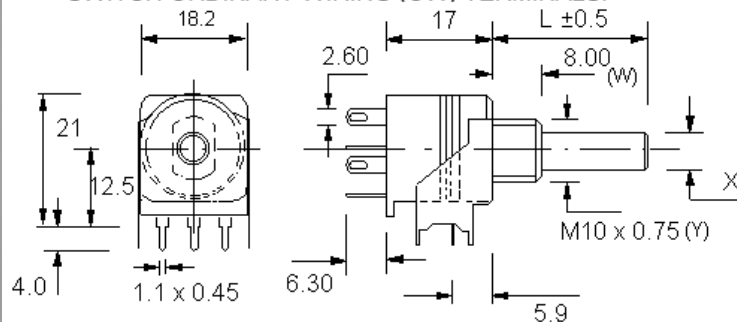


BR16ECO/B4OW2S

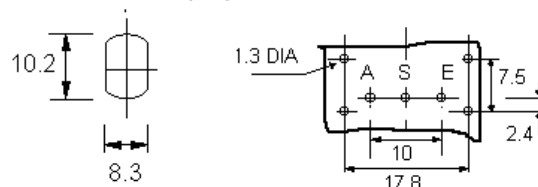
B4OW2S - 4 Amp Double Pole (Single Throw) Switch
OW – Ordinary Wiring Terminals (for soldering)
BR – Bracket mounting with PC Terminals
PC – Printed Circuit Terminals



SWITCH ORDINARY WIRING (OW) TERMINALS.



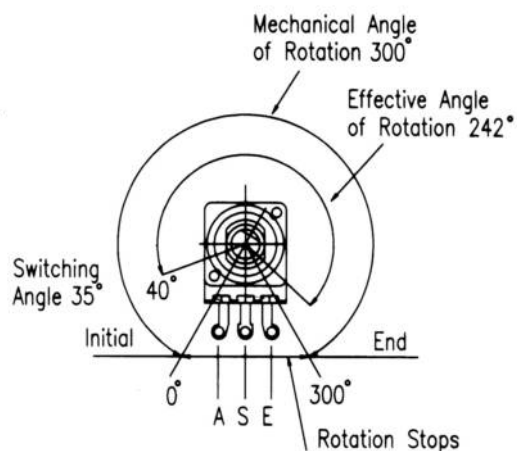
POTENTIOMETER
PRINTED CIRCUIT (PC) TERMINALS.



Panel cutout for bush

Viewed on component side

SPINDLE END VIEW



Total mechanical and effective electrical
angles of rotation of potentiometers
with rotary switch

- W Mounting Height
- Y Mounting Diameter
- X Spindle Diameter
- L Spindle Length
- A Initial Termination
- S Wiper (or moving contact) termination
- E End Termination



ECO Range Technical Data

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Rotation angle: $300^{\circ} \pm 5^{\circ}$ (Switched and Unswitched)

Operating Torque: 0.4 – 2.0 N.cm (Initial Torque may be higher)

Rotational torque of spindle can be made high or low

Detents (stop positions) Available: Centre, 11, 21, 31

Permissible Axial Spindle Load: 50 N (5 Sec. maximum)

Permissible Torque at End Stop: 35 N.cm

ELECTRICAL SPECIFICATION

Rated Power Dissipation @40°C for ECO potentiometers:

0.25W linear law

0.12W nonlinear law

Rotation angle: $300^{\circ} \pm 5^{\circ}$

Effective rotation - Unswitched: 265° nominal

Effective rotation - Switched: 242° nominal

Insulation Resistance: ≥ 4 Gohms

Rated Resistance: E3 Series

- Optional: E6 Series
- Linear Law: 1K - 1M
- Nonlinear Law: 4K7 - 470K

Tolerance on Rated Resistance: $\pm 20\%$

- Optional Tolerance on 1K - 1M: $\pm 10\%$

Resistance Laws (Taper):

- Linear: A
- Nonlinear: B - Log (Audio) or C - Antilog (Reverse Audio)
- Other laws: Please refer to Sales office

Rotary Switch Specification

The rotary switch modules are manufactured to EN61058-1 standard using high quality materials with a flame retardant housing. Although no longer certified due to the excessive cost of maintaining approvals, the 1 Amp and 4 Amp switch series have both been previously certified by UL International Demko (copies of previous certificates are available on our website or on request). The same materials, components and production techniques are used as in the certified versions and Omeg Ltd continues to test to the EN61058-1 standard

The 1 Amp contact rating is only available when mounted on the ECO potentiometer

1 A Contact Rating:

Note: The 1A contact rating is NOT available for mounting on the P16 or P20 potentiometer.

1A/250Vac 2.5A/12Vdc

Surge rating (0.01 seconds): 20A

Contact gap: 3mm (Full mains separation of contacts)

Manufactured to EN61058-1 standard

4 A Contact Rating:

4A/250Vac 10A/12Vdc

Surge rating (0.01 seconds): 80A

Switch contacts: Silver tin oxide

Contact gap: 2mm (Micro disconnection of switch - micro separation of contacts)

Manufactured to EN61058-1 standard

Common features

Housing material: Flame Retardant Glass filled polyester (UL 94 VO)

Initial contact resistance: 20 milliohms

Insulation resistance: 50,000 Megohms

Life (operations at full load): 10,000 minimum

Operating temperature: -25°C to +70°C

Operating torque for SPST/SPDT: 1.5 - 3 cNm

Operating torque for DPST/DPDT: 3.0 - 6 cNm

Mechanical rotation: 300°

Proof voltage: 3kV minimum

Rotary Switch Terminals

Layout

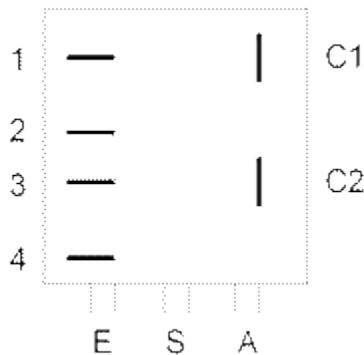


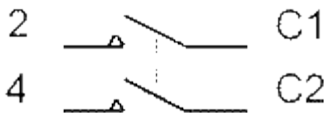
Diagram as viewed on the rear of the switch module:

(Potentiometer terminals at the bottom)

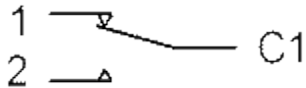
Configuration



SPST - Single pole (1S), Single throw (On-Off)

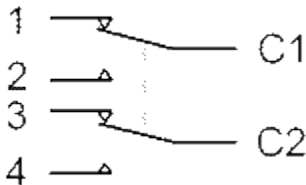


DPST - Double pole (2S), Single throw (On-Off)



SPDT - Single pole (1S), Double throw (CH)

(**NOT** certified)



DPDT - Double pole (2S), Double throw (CH)

(**NOT** certified)

Notes

1. Moving contact(s) shown when the potentiometer shaft is in a counterclockwise (CCW) position.
2. 'Ordinary Wiring'(OW) or 'Printed Circuit'(PC) terminals can be requested on the switch.
3. Terminals 1 and 3 are only fitted for the Double Throw ('CH' or Changeover) versions which are **NOT** approved nor certified.

Rotary Switch Terminals



Standard (1A or 4A contact ratings)

N/O normally OPEN Switch

Contacts normally OPEN;

CLOCKwise rotation to CLOSE contacts

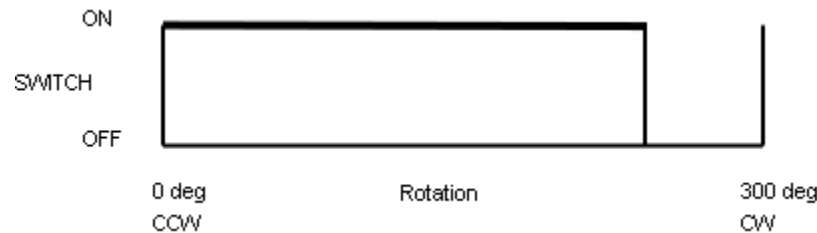


Option 1 (4A contact rating only)

N/C normally CLOSED Switch

Contacts normally CLOSED;

CLOCKwise rotation to OPEN contacts

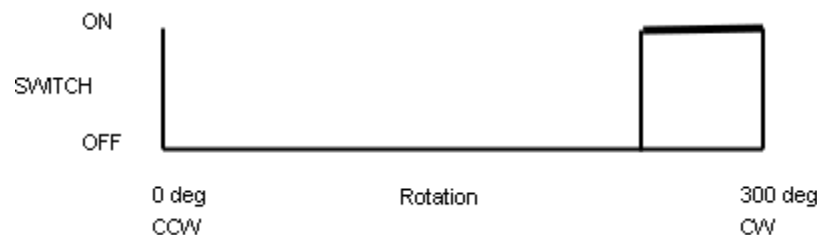


Option 2 (4A contact rating only)

REVERSED N/O normally OPEN Switch

Contacts normally OPEN at fully clockwise position;

ANTI-clockwise rotation to CLOSE contacts



Option 3 (4A contact rating only)

REVERSED N/C normally CLOSED Switch

Contacts normally CLOSED at fully clockwise position;

ANTI-clockwise rotation to OPEN contacts

ELECTRICAL SPECIFICATION UNIQUE TO ECO POTENTIOMETERS

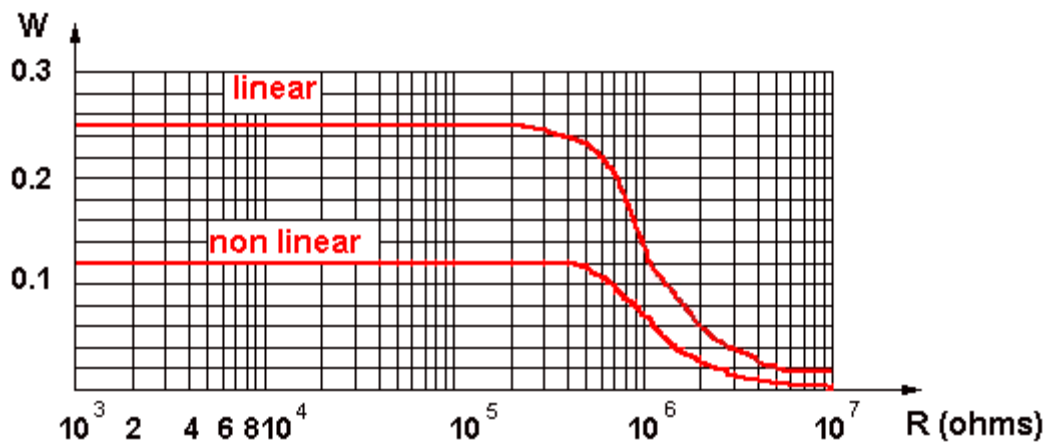
Effective rotation:

- Without a switch: 265° nominal
- With push push switch (/10APP, /MS): 265° nominal
- With rotary switch: 242° nominal

Rated Power Dissipation @40°C for ECO potentiometers:

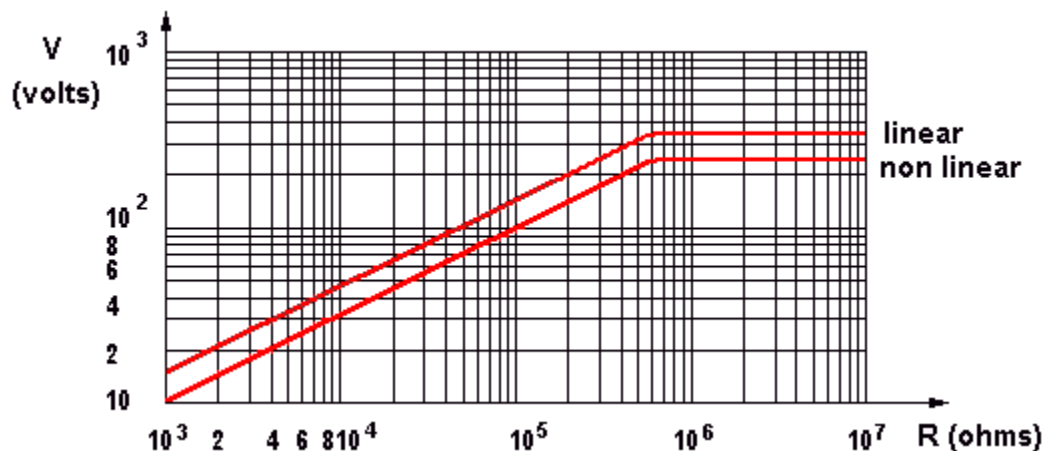
- 0.25W linear law
- 0.12W nonlinear law

ECO, P16 power dissipating curve



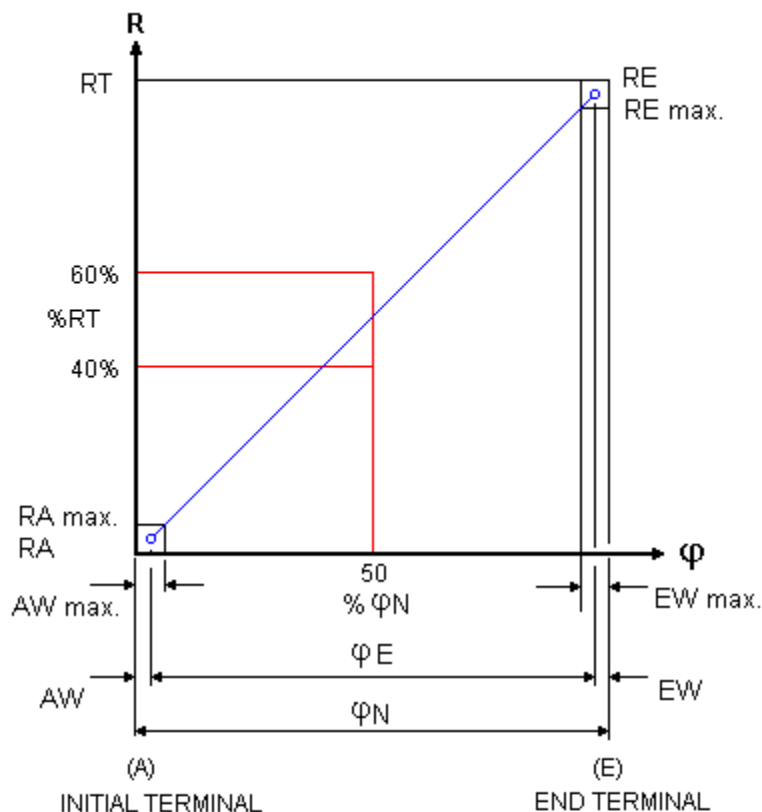
Limiting Element Voltage: 350 V DC for 16mm potentiometers

ECO, P16 maximum working voltage curve



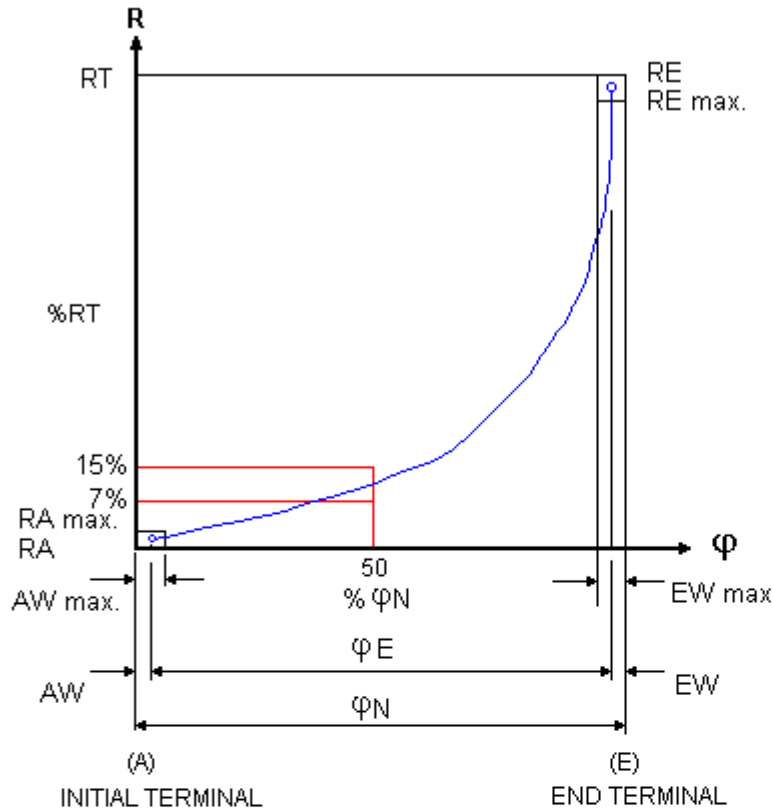
Insulating Voltage: 500 V AC for ECO potentiometers

Resistance law A - Linear



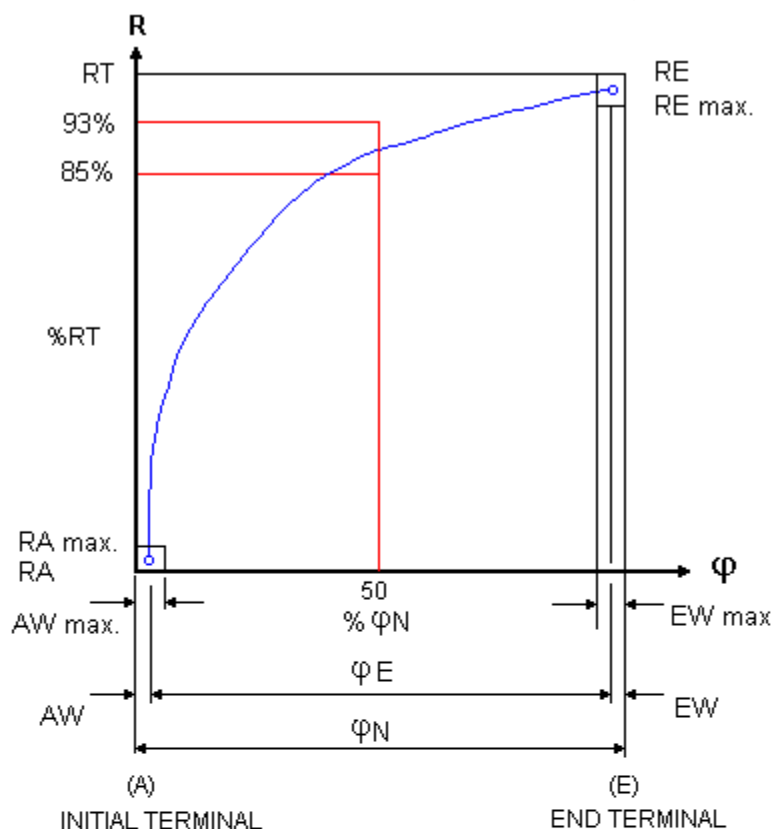
AW	Initial Path	AW max. 12% ϕN
EW	Final Path	EW max. 12% ϕN
Ra	Initial Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RA	Hop-on Resistance	$\leq 1\% RN$
Re	End Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RE	Hop-off Resistance	$\leq 1\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

Resistance law B – Log (Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RA	Hop-on Resistance	$RN \leq 10K$ 5% RN $RN > 10K$ 0.15% RN
Re	End Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RE	Hop-off Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K$ 0.5% RN
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

Resistance law C – Antilog (Reverse Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RA	Hop-on Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K 0.5\% RN$
Re	End Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RE	Hop-off Resistance	$RN \leq 10K 5\% RN$ $RN > 10K 0.15\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

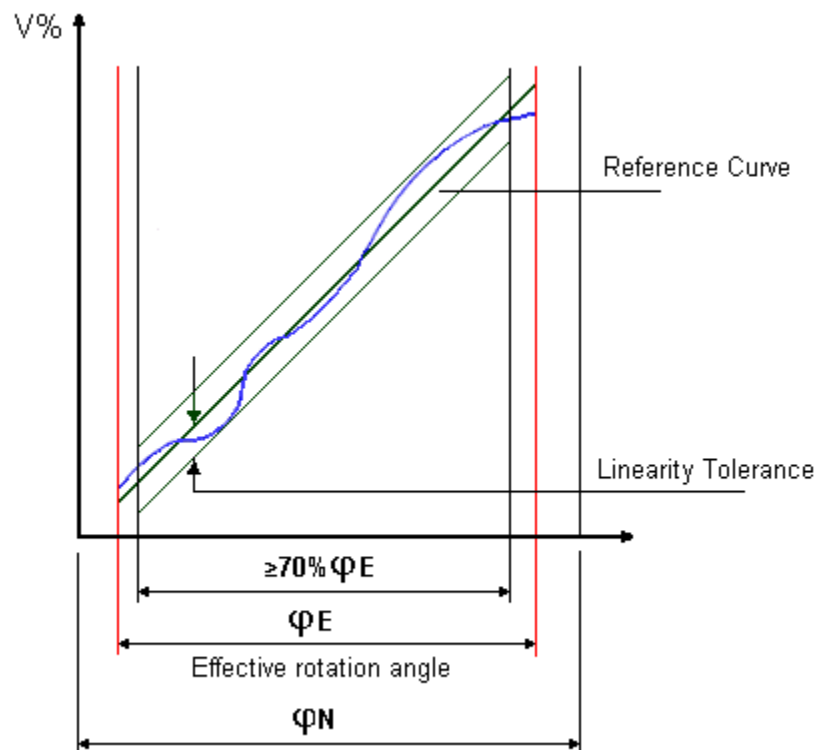
Linearity

As a basis of assessing Linearity Tolerance the independent method is the most practical, permitting as it does, the reference curve to be aligned as near as possible to the actual output curve. This avoids the use of the theoretical starting and finishing points, it is normal for the customer to realign the achieved curve with series trimmers at each end of the device if required.

Linearity Tolerance is 4% over the Nominal Resistance range of 1K0 to 1M0. The Linearity Tolerance is measured on at least 70% of the effective rotation range.

Note. In the case of Terminal and Zero-based linearity, both present constraints which increase the manufacturing difficulty and in consequence have an adverse effect on the product's price and availability.

Potentiometer linearity

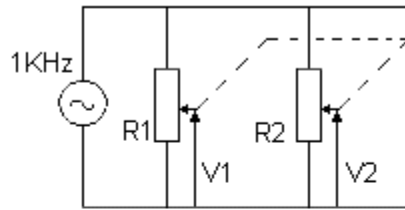


Matching Tolerance (For Tandem Stereo Potentiometers)

Tandem Potentiometers have two identical resistor units with the same variation law. The mismatching of the two resistor units, expressed in dB, is measured by the difference between the attenuations introduced by each resistor unit at various points of travel.

- Law A: 4 dB at Attenuation range 0 - 20 dB
- Law B and C: 3 dB at Attenuation range 0 - 20 dB

Matched Tolerance for Stereo

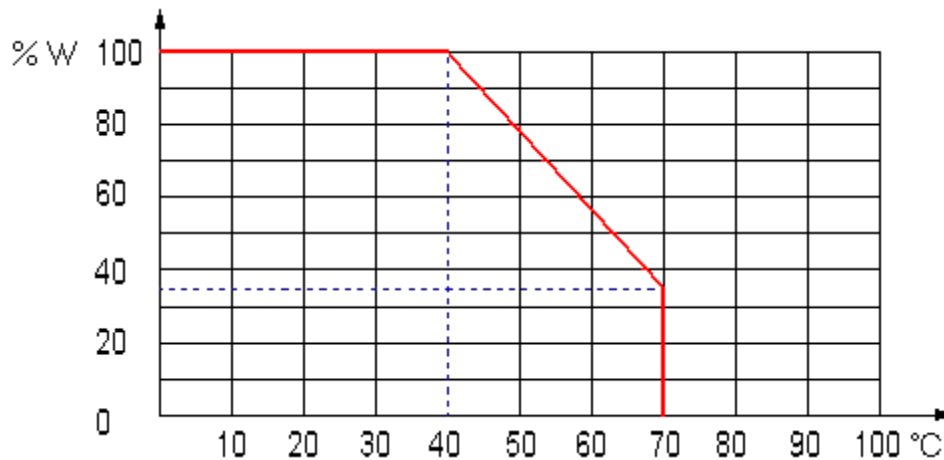


LAW	ATTENUATION RANGE	MATCHING TOLERANCE *
A	0 - 20dB	4dB
B & C	0 - 20dB	3dB

$$* \text{Matching Tolerance} = 20 \log \frac{V1}{V2}$$

Operating Temperature: -25°C to +70°C

Temperature Derating Curve



Temperature Coefficient of Resistance: +300 -500 ppm

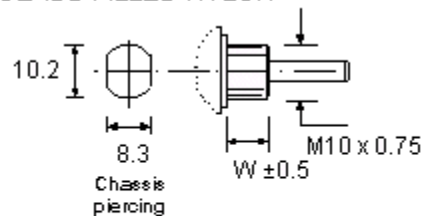
Components

ECO Bush Housing (Mounting)

The ECO bush housing is made of glass filled nylon, the thread is M10 x0.75mm pitch and 8mm long, alternatively **a 12mm long thread is also available** from October 2008.

Do not attempt to prevent any unwanted body rotation by overtightening the retaining nut, since this can cause thread damage, distortion, change of electrical resistance and restrict shaft rotation. BS9130:1972 provides further details on this topic. The **recommended torque** for tightening the retaining nut is 45cN.m and this can be achieved cost effectively by using a Torque Limiting device as shown on our **Accessories** page.

GLASS FILLED NYLON



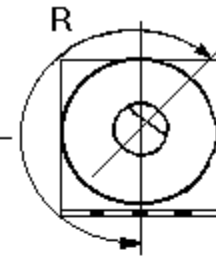
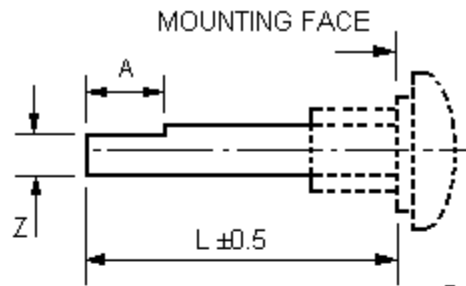
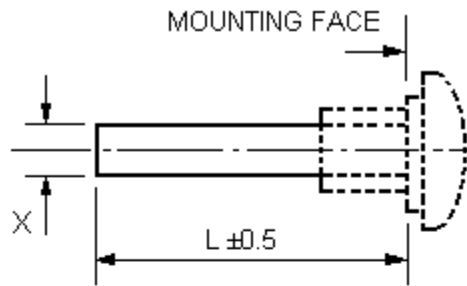
TYPE PLASTIC BODY	
W(mm)	8 (optional 12)

ECO Spindles

The ECO plastic spindles are fixed and not removable.
They are available in the following three diameters:

- 6.0mm Diameter - Length (L) available from 14mm to 65mm
 - Cylindrical (Type F1)
 - 4.0 x 12mm Flat (Type F2)
 - 5.0 x 15mm Flat (Type F3)
 - 5.0 x 10mm Flat (Type F4)
 - 4.6mm x 15mm Flat (Type F11)
 - 4.0 x 8mm Flat (Type F13)
 - 5.0 x 8mm Flat (Type F14)
- 4.0mm Diameter - Length (L) available from 14mm to 35mm
 - Cylindrical (Type F21)
 - 3.0 x 8.5mm Flat (Type F22)
- 6.35mm Diameter - Length (L) available from 14mm to 65mm
 - Cylindrical (Type F41)
 - 5.5 x 10mm Flat (Type F42)

Cylindrical and Flatted Spindles



Spindle in full CCW position

TYPE	DESC. (X)	L (mm)
F21	4 mm Dia Plastic	14 - 35
F1	6 mm Dia Plastic	14 - 65
F41	6.35mm Dia Plastic	14 - 65

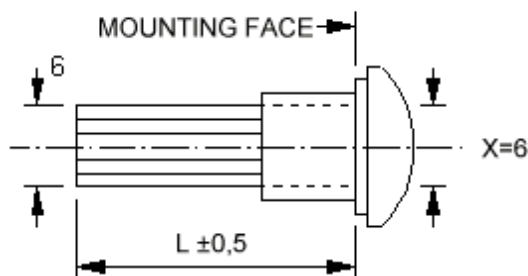
All spindles fixed.

TYPE	DESC. (X)	L (mm)	Flat (ZxA)
F22	4 mm Dia Plastic	14 - 35	3 x 8.5
F13	6 mm Dia Plastic	14 - 65	4 x 8
F2	6 mm Dia Plastic	14 - 65	4 x 12
F14	6 mm Dia Plastic	14 - 65	5 x 8
F4	6 mm Dia Plastic	14 - 65	5 x 10
F3	6 mm Dia Plastic	14 - 65	5 x 15
F11	6 mm Dia Plastic	14 - 65	4.6 x 15
F42	6.35mm Dia Plastic	14 - 65	5.5 x 10

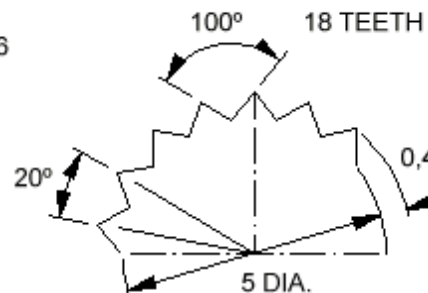
Standard flat angle
R = 210°

Splined Spindle (6.0mm diameter)

A splined form is also available on the 6.0mm diameter ECO plastic spindle.

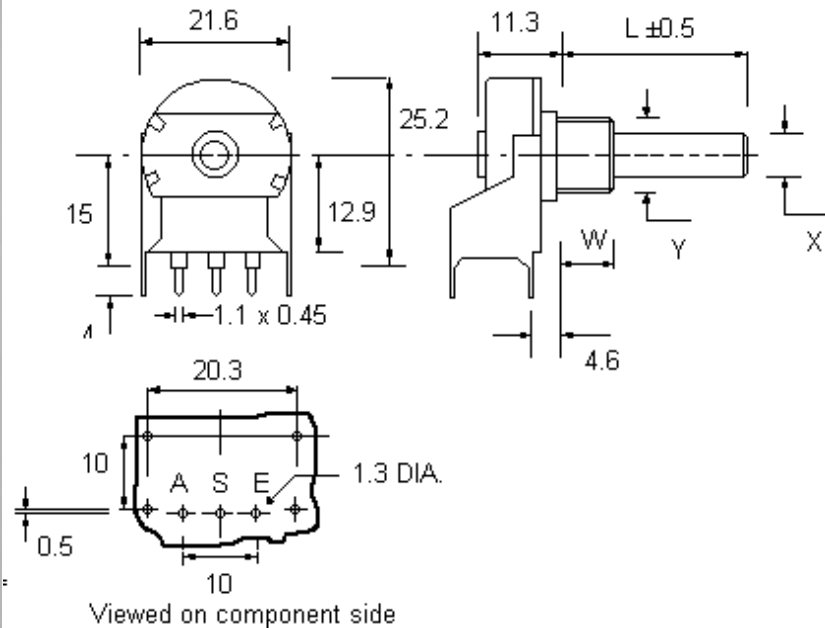


TYPE	DESC.	L (mm)
F5	Plastic Fixed	14 - 30



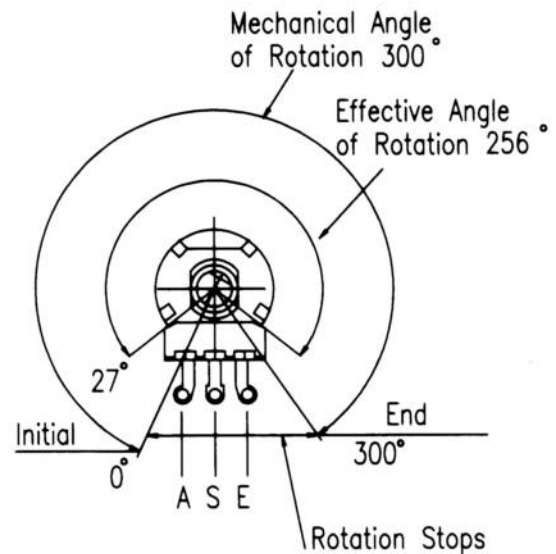
BR20BU

BR – Bracket (With Printed Circuit Terminals)



SPINDLE END VIEW

- W Mounting Height
- Y Mounting Diameter
- X Spindle Diameter
- L Spindle Length
- A Initial Termination
- S Wiper (or moving contact) termination
- E End Termination



Total mechanical and effective electrical angles of rotation of potentiometers without rotary switch

Technical Data

Rated Power Dissipation @40°C for P20 potentiometers:

0.4W linear law

0.2W nonlinear law

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Effective rotation: 256° nominal

Operating Torque: 0.4 – 1.5 cN.m

Permissible Axial Spindle Load: 100 N (5 Sec. maximum)

Permissible Torque at End Stop: 80 cN.m

Rotation angle: 300° ±5°

Optional Click stop (indents) for rotational tactile feedback

Rotational torque of spindle can be made high or low

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Insulation Resistance: >= 4 Gohms

Rated Resistance: E3 Series

Optional: E6 Series

Linear Law: 1K – 1M (±10%)

Nonlinear Law: 4K7 – 470K

ELECTRICAL SPECIFICATION COMMON TO ALL POTENTIOMETERS

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Insulation Resistance: >= 4 Gohms

Rated Resistance: E3 Series

- Optional: E6 Series
- Linear Law: 1K - 1M
- Nonlinear Law: 4K7 - 470K

Tolerance on Rated Resistance: ± 20%

- Optional Tolerance on 1K - 1M: ± 10%

Resistance Laws (Taper):

- Linear: A
- Nonlinear: B - Log (Audio) or C - Antilog (Reverse Audio)
- Other laws: Please refer to Sales office

ELECTRICAL SPECIFICATION UNIQUE TO P20 POTENTIOMETERS

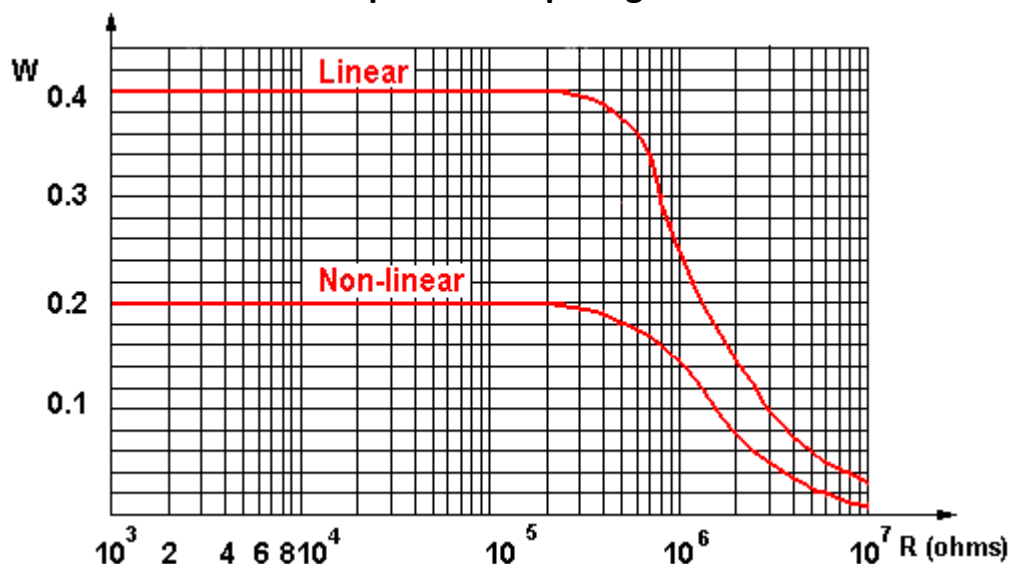
Effective rotation:

- Without a switch: 256° nominal
- With switch: 243° nominal
- With rotary switch: 243° nominal

Rated Power Dissipation @40°C for P20 potentiometers:

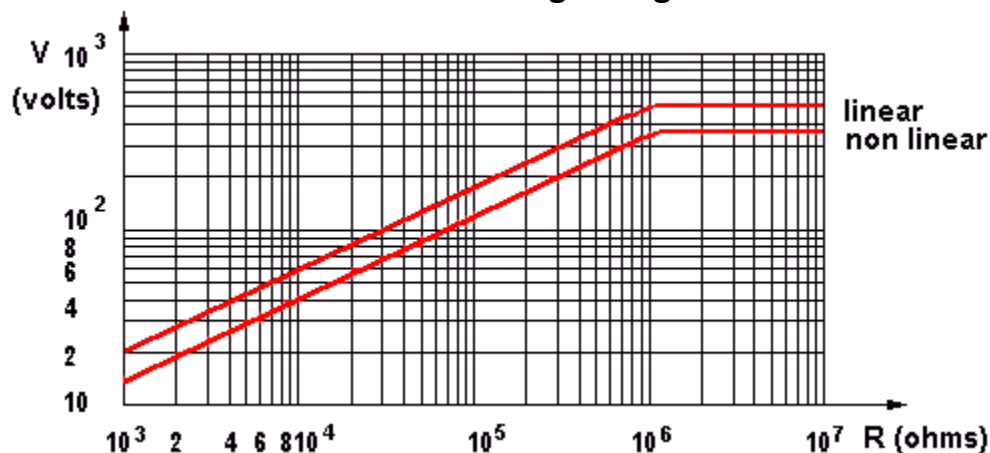
- 0.4W linear law
- 0.2W nonlinear law

P20 power dissipating curve



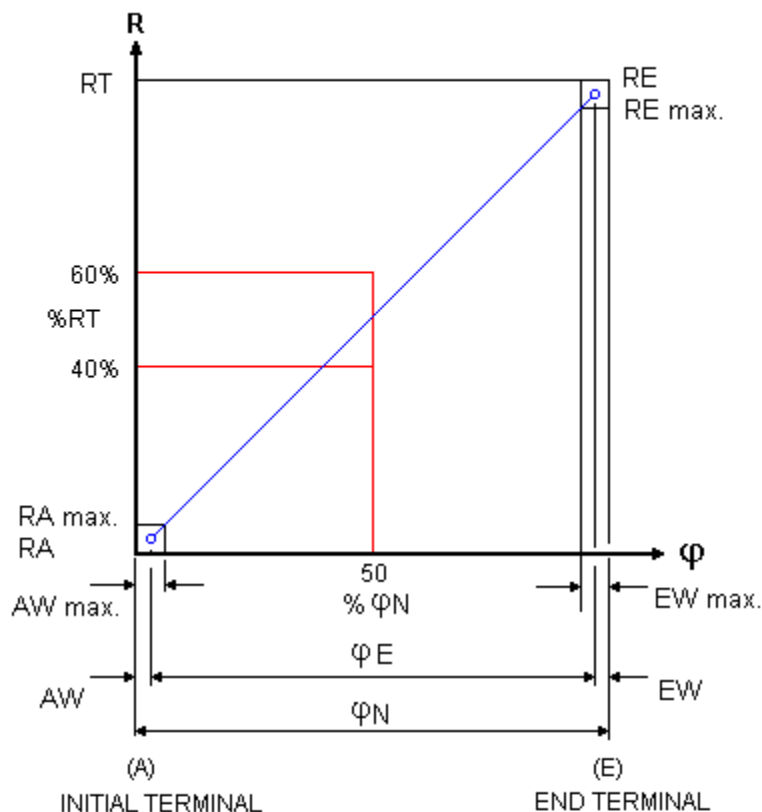
Limiting Element Voltage: 500 V DC for 20mm potentiometers

P20 maximum working voltage curve



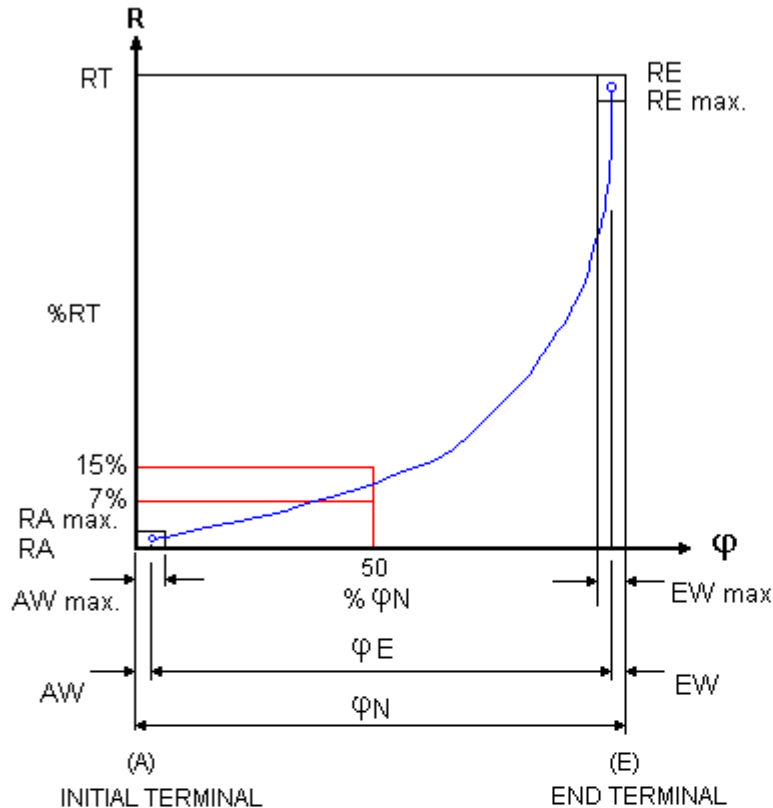
Insulating Voltage: 1000 V AC for 20mm potentiometers

Resistance law A - Linear



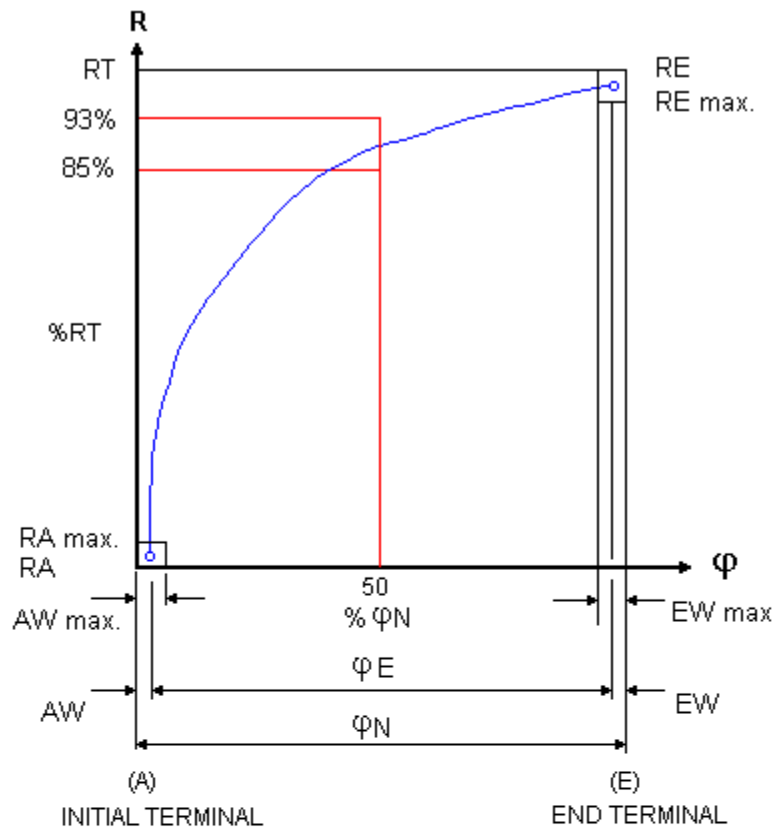
AW	Initial Path	AW max. 12% ϕN
EW	Final Path	EW max. 12% ϕN
Ra	Initial Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RA	Hop-on Resistance	$\leq 1\% RN$
Re	End Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RE	Hop-off Resistance	$\leq 1\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

Resistance law B – Log (Audio)



AW	Initial Path	AW max. 10% ϕN
EW	Final Path	EW max. 10% ϕN
Ra	Initial Stop Value	$R_N \leq 10K \leq 1.10^{-3} R_N$ (Minimum 2 ohms) $R_N > 10K \leq 2.10^{-4} R_N$ (Minimum 10 ohms)
RA	Hop-on Resistance	$R_N \leq 10K$ 5% R_N $R_N > 10K$ 0.15% R_N
Re	End Stop Value	$R_N \leq 100K \leq 2.10^{-2} R_N$ $R_N > 100K \leq 1.10^{-2} R_N$
RE	Hop-off Resistance	$R_N \leq 10K < 1\% R_N$ $R_N > 10K$ 0.5% R_N
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

Resistance law C – Antilog (Reverse Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RA	Hop-on Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K 0.5\% RN$
Re	End Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RE	Hop-off Resistance	$RN \leq 10K 5\% RN$ $RN > 10K 0.15\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

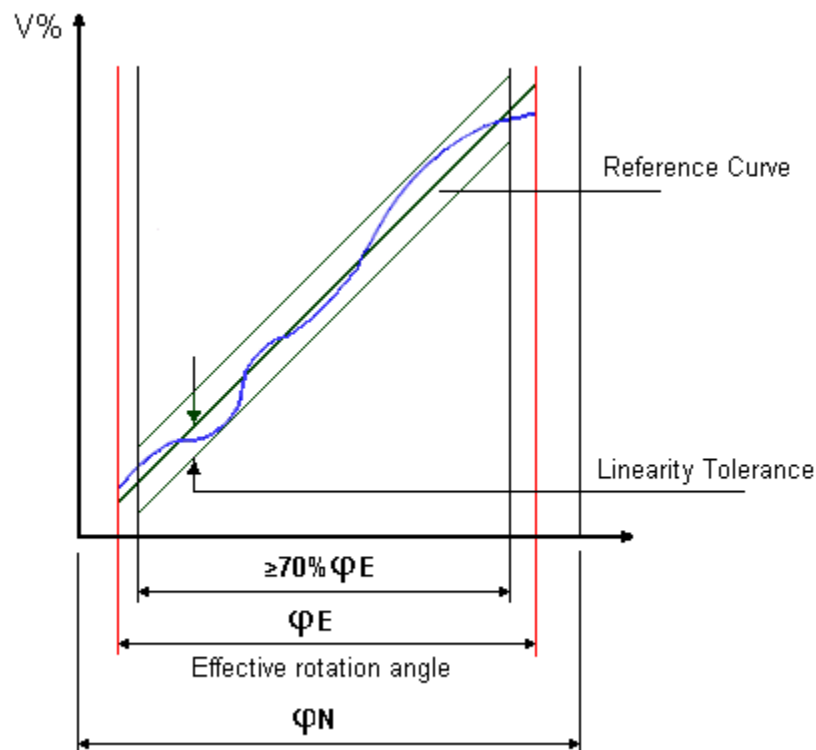
Linearity

As a basis of assessing Linearity Tolerance the independent method is the most practical, permitting as it does, the reference curve to be aligned as near as possible to the actual output curve. This avoids the use of the theoretical starting and finishing points, it is normal for the customer to realign the achieved curve with series trimmers at each end of the device if required.

Linearity Tolerance is 4% over the Nominal Resistance range of 1K Ω to 1M Ω . The Linearity Tolerance is measured on at least 70% of the effective rotation range.

Note. In the case of Terminal and Zero-based linearity, both present constraints which increase the manufacturing difficulty and in consequence have an adverse effect on the product's price and availability.

Potentiometer linearity

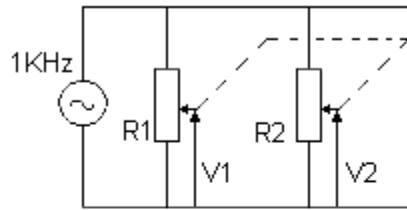


Matching Tolerance (For Tandem Stereo Potentiometers)

Tandem Potentiometers have two identical resistor units with the same variation law. The mismatching of the two resistor units, expressed in dB, is measured by the difference between the attenuations introduced by each resistor unit at various points of travel.

- Law A: 4 dB at Attenuation range 0 - 20 dB
- Law B and C: 3 dB at Attenuation range 0 - 20 dB

Matched Tolerance for Stereo

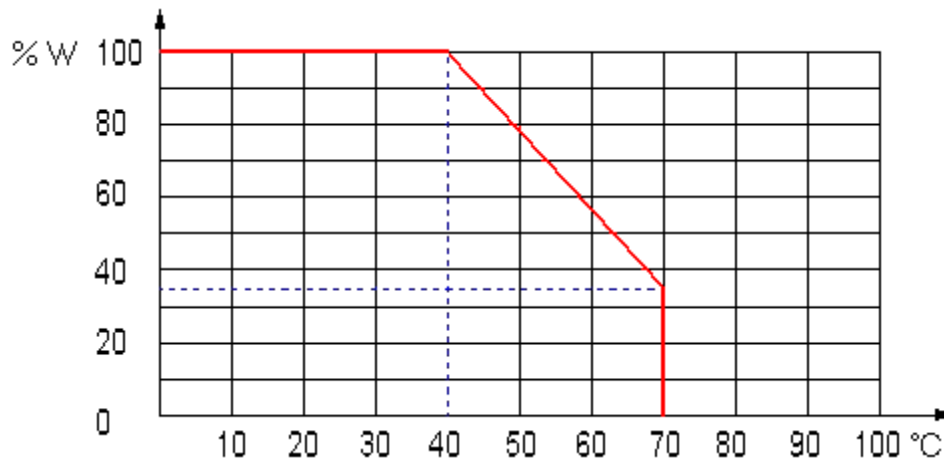


LAW	ATTENUATION RANGE	MATCHING TOLERANCE *
A	0 - 20dB	4dB
B & C	0 - 20dB	3dB

$$* \text{Matching Tolerance} = 20 \log \frac{V1}{V2}$$

Operating Temperature: -25°C to +70°C

Temperature Derating Curve



Temperature Coefficient of Resistance: +300 -500 ppm

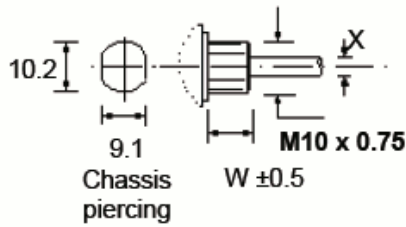
Components

P20 Bush Housing (Mounting)

The P20 bushes are available in metal or nylon; with three thread options; and with or without a locating feature:

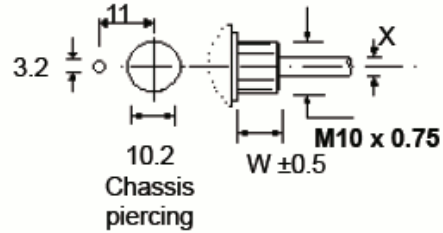
- Diecast Zinc Alloy
 - M10 x0.75mm pitch (Type C)
 - M10 x0.75mm pitch, **with locator** (Type CEBS)
 - 9.52mm x32tpi (Type CBS)
 - 9.52mm x32tpi, **with locator** (Type CBSL)
 - M7 x0.75mm pitch (Type CG)
- Glass Filled Nylon
 - M10 x0.75mm (Type CP)

DIECAST ZINC ALLOY



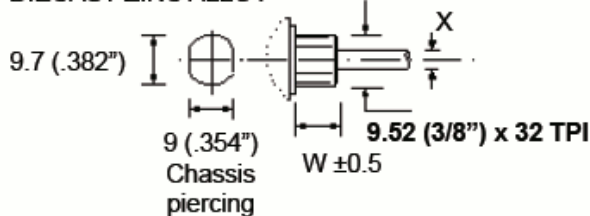
Type C (without locator)	
X (mm)	6
W (mm)	9

DIECAST ZINC ALLOY



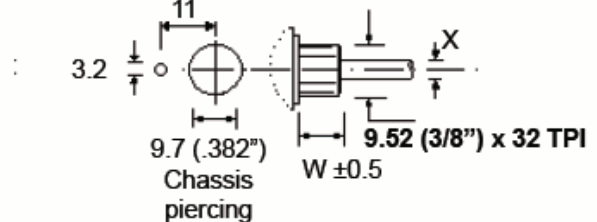
Type CEBS (with locator)	
X (mm)	6
W (mm)	9

DIECAST ZINC ALLOY



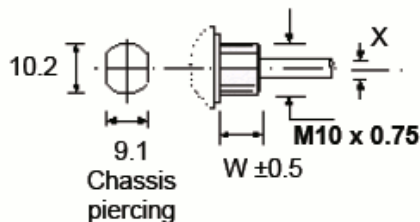
Type CBS (without locator)		
X (mm)	6	6.35
W (mm)	8 or 12	8 or 12

DIECAST ZINC ALLOY



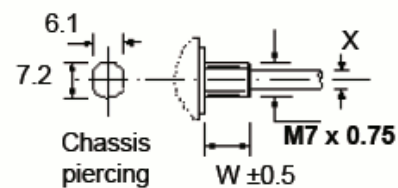
Type CBSL (with locator)		
X (mm)	6.35	6.35
W (mm)	8	12

GLASS FILLED NYLON



Type CP (GFN)		
X (mm)	6	6.35
W (mm)	7 or 10	7 or 10

DIECAST ZINC ALLOY



Type CG (without locator)	
X (mm)	4
W (mm)	6

P20 Spindles

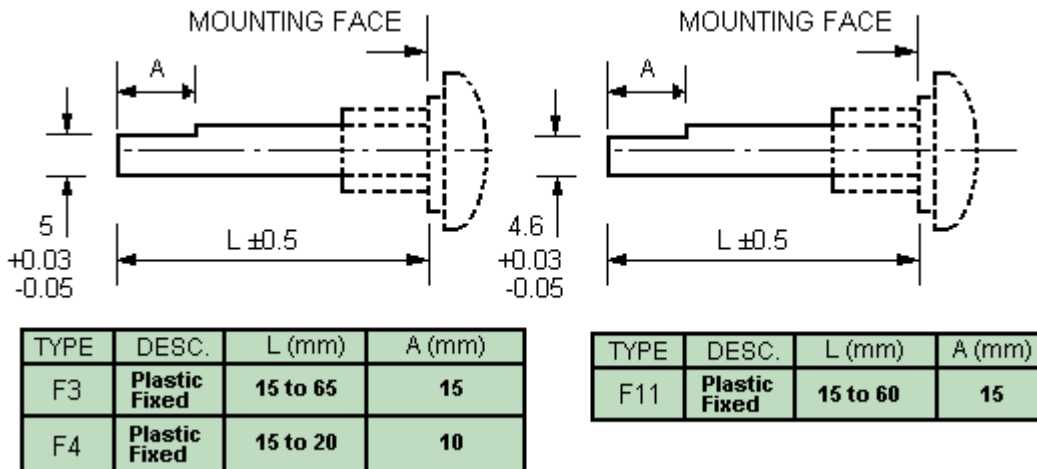
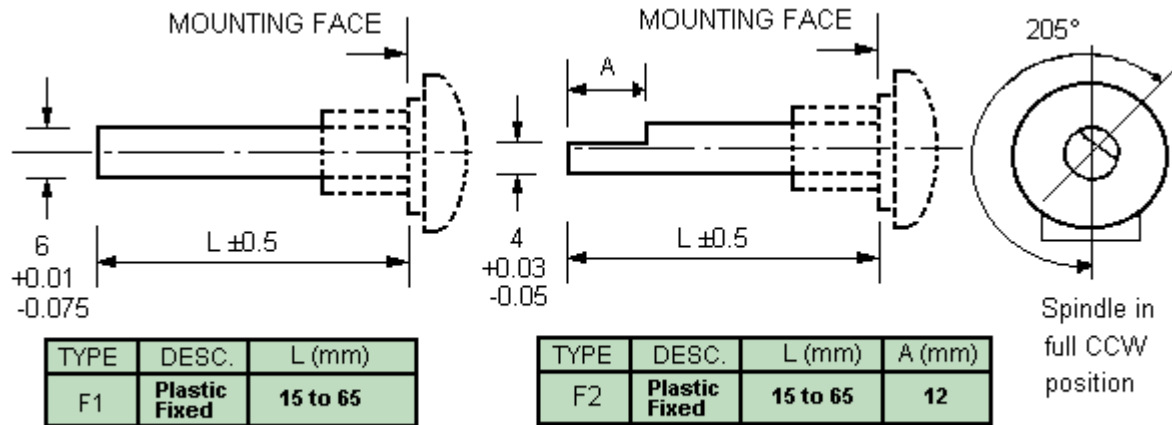
The P20 spindles are plastic and fixed i.e. not removable, unless otherwise stated and they are available in three diameters:

- 6.0mm Diameter
 - Cylindrical (Type F1)
 - 4.0 x 12mm Flat (Type F2)
 - 5.0 x 15mm Flat (Type F3)
 - 5.0 x 10mm Flat (Type F4)
 - 4.6mm x 15mm Flat (Type F11)
- 4.0mm Diameter
 - Cylindrical (Type F21)
 - 3.0 x 8.5mm Flat (Type F22)
 - 3.0 x 13.5mm Flat (Type F23)
 - Cylindrical (Type M21 - Metal)
 - 3.0 x 8.5mm Flat (Type M22 - Metal)
 - 3.0 x 13.5mm Flat (Type M23 - Metal)
- 6.35mm Diameter
 - Cylindrical (Type F41)
 - 5.5 x 10mm Flat (Type F42)
 - 5.5 x 15mm Flat (Type F43)
- Splined Spindle - 6.0mm dia. 18 teeth
- Dual Concentric
 - Flatted/Slotted (Type M15 - Metal)
 - Cylindrical (Type M16 - Metal)

6.0mm Diameter Spindles

Note: *Specials to customer's specification up to 65mm.

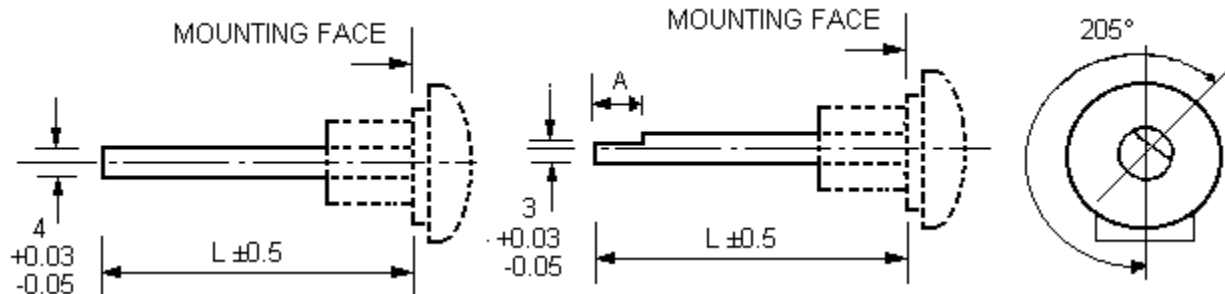
REMOVABLE SPINDLES, similar in specification to 'fixed' spindles are supplied separate from the potentiometer. These can be indefinitely taken in and out and their holding strength is >1kg.



4.0mm Diameter Spindles

Note: The orientation of the flat as illustrated is for plastic spindles only.

For metal spindles, unless specified on the order, the orientation may be different on each potentiometer type.



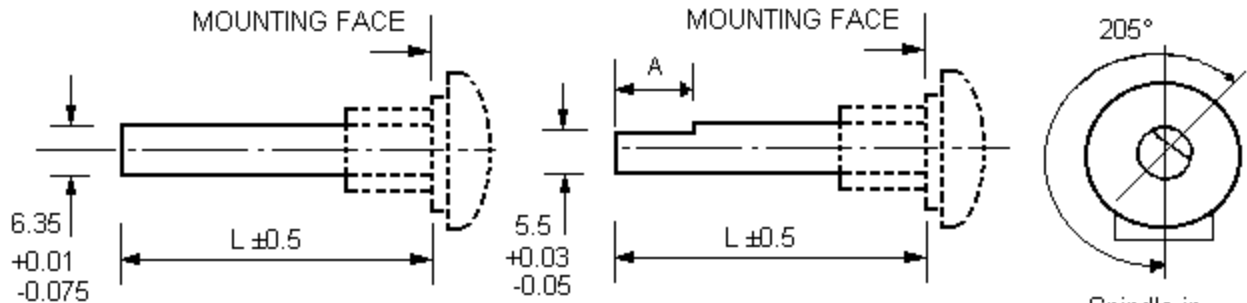
TYPE	DESC.	L (mm)
F21	Plastic Fixed	8 to 65
M21	Metal Fixed	8 to 65

TYPE	DESC.	L (mm)	A (mm)
F22	Plastic Fixed	11 to 60	8.5
M22	Metal Fixed	11 to 60	8.5
F23	Plastic Fixed	16 to 60	13.5
M23	Metal Fixed	16 to 60	13.5

Spindle in
full CCW
position

6.35mm Diameter Spindles

Note: *Specials to customer's specification up to 65mm.



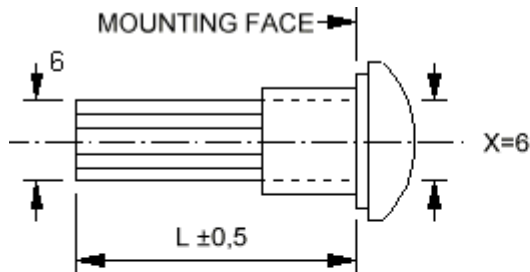
TYPE	DESC.	L (mm)
F41	Plastic Fixed	15 to 65

TYPE	DESC.	L (mm)	A (mm)
F42	Plastic Fixed	15 to 20	10
F43	Plastic Fixed	20 to 60	15

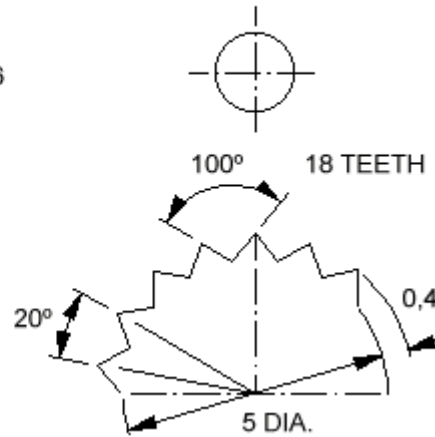
Spindle in
full CCW
position

Splined Spindle - 6.0mm dia. 18 teeth

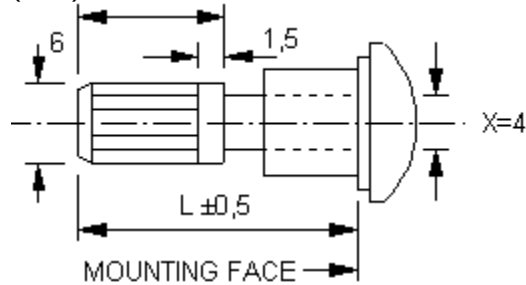
A splined form is available on the 6.0mm diameter P20 plastic spindle (F5) or alternatively a 6mm 'Splined Adaptor' (8,7mm long) can be fitted on a 4mm dia. Spindle



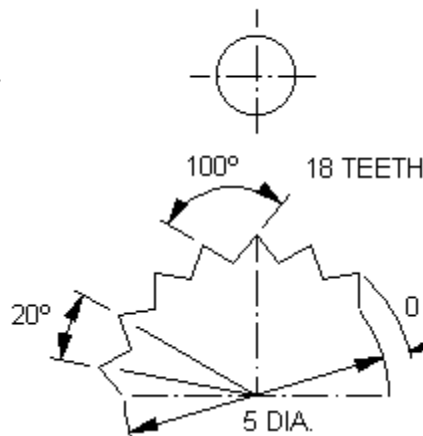
TYPE	DESC.	L (mm)
F5	Plastic Fixed	19



(F5A):

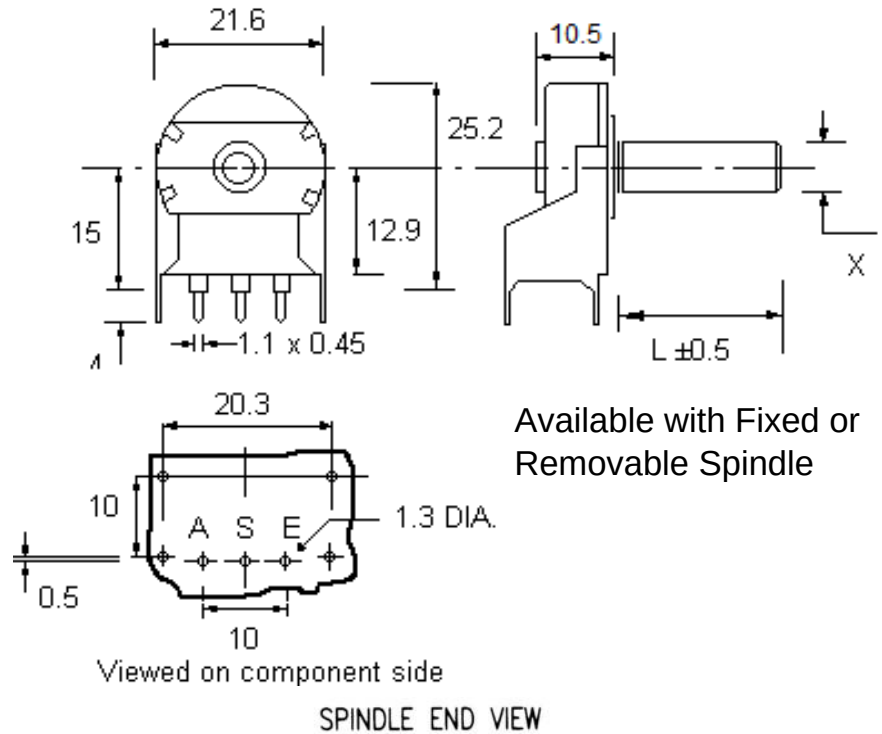


TYPE	DESC.	L (mm)
F5A	Plastic Fixed	16-36

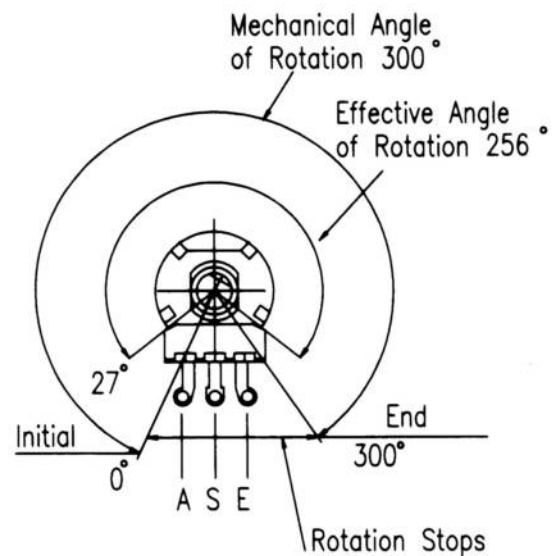


BR20SP

BR – Bracket (With Printed Circuit Terminals)



- X Spindle Diameter
- L Spindle Length
- A Initial Termination
- S Wiper (or moving contact) termination
- E End Termination



Total mechanical and effective electrical angles of rotation of potentiometers without rotary switch

Technical Data

Rated Power Dissipation @40°C for P20 potentiometers:

0.4W linear law

0.2W nonlinear law

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Effective rotation: 256° nominal

Operating Torque: 0.4 – 1.5 cN.m

Permissible Axial Spindle Load: 100 N (5 Sec. maximum)

Permissible Torque at End Stop: 80 cN.m

Rotation angle: 300° ±5°

Optional Click stop (indents) for rotational tactile feedback

Rotational torque of spindle can be made high or low

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Insulation Resistance: >= 4 Gohms

Rated Resistance: E3 Series

Optional: E6 Series

Linear Law: 1K – 1M (±10%)

Nonlinear Law: 4K7 – 470K

ELECTRICAL SPECIFICATION COMMON TO ALL POTENTIOMETERS

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Insulation Resistance: >= 4 Gohms

Rated Resistance: E3 Series

- Optional: E6 Series
- Linear Law: 1K - 1M
- Nonlinear Law: 4K7 - 470K

Tolerance on Rated Resistance: ± 20%

- Optional Tolerance on 1K - 1M: ± 10%

Resistance Laws (Taper):

- Linear: A
- Nonlinear: B - Log (Audio) or C - Antilog (Reverse Audio)
- Other laws: Please refer to Sales office

ELECTRICAL SPECIFICATION UNIQUE TO P20 POTENTIOMETERS

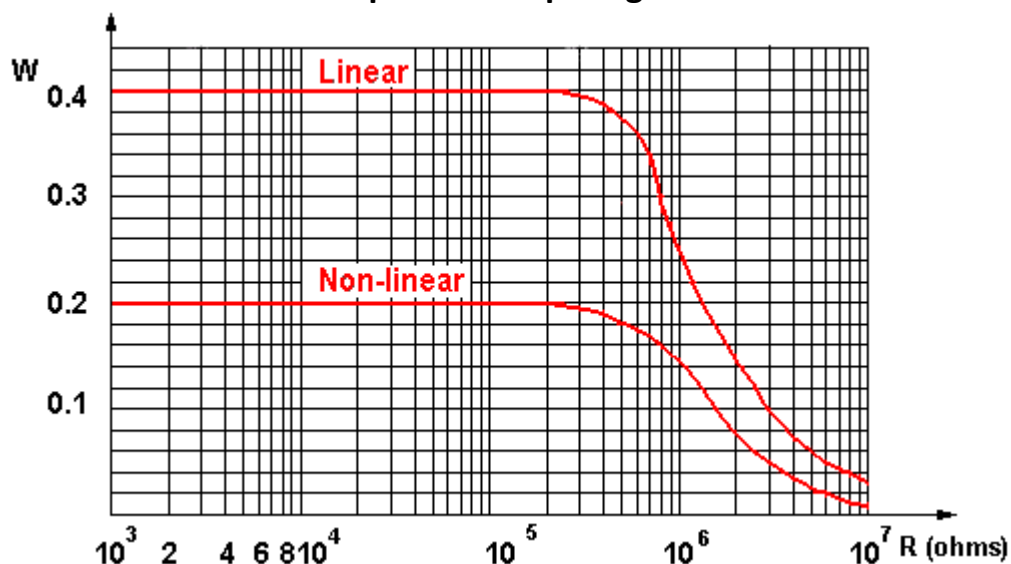
Effective rotation:

- Without a switch: 256° nominal
- With switch: 243° nominal
- With rotary switch: 243° nominal

Rated Power Dissipation @40°C for P20 potentiometers:

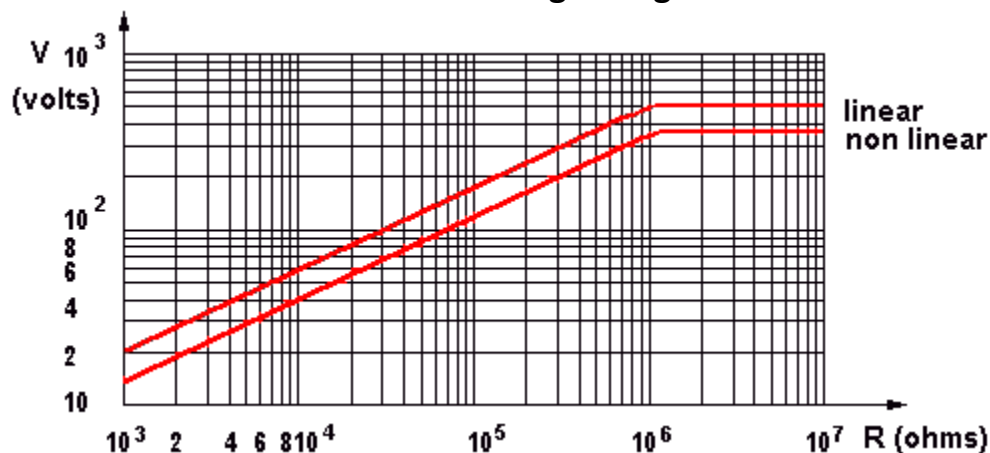
- 0.4W linear law
- 0.2W nonlinear law

P20 power dissipating curve



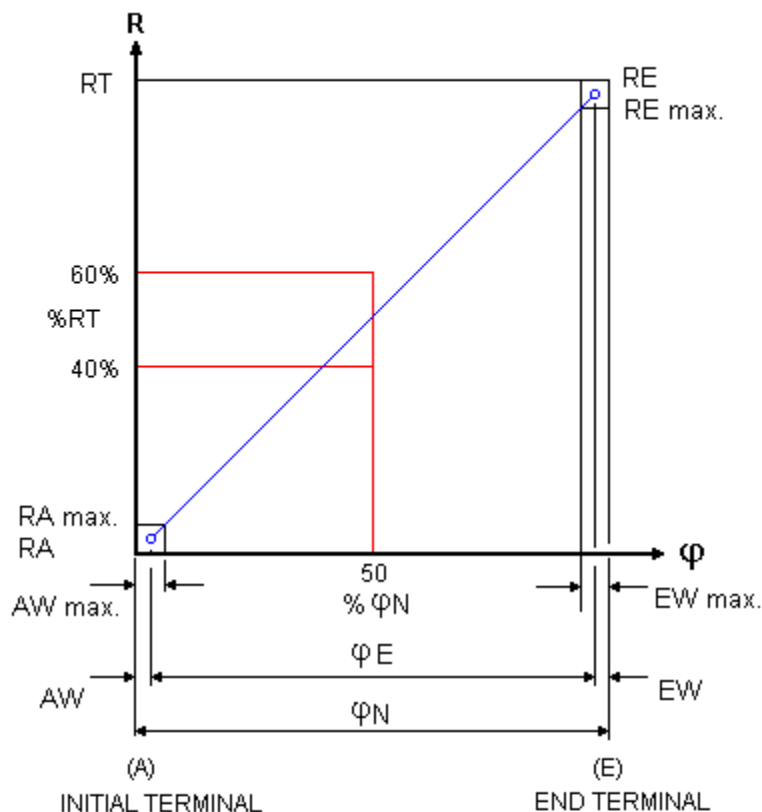
Limiting Element Voltage: 500 V DC for 20mm potentiometers

P20 maximum working voltage curve



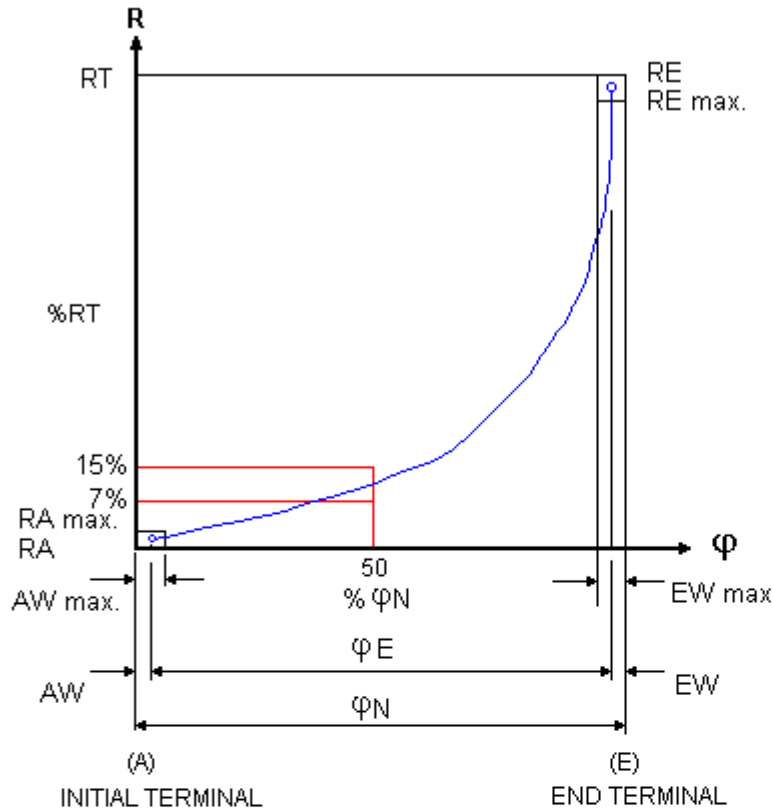
Insulating Voltage: 1000 V AC for 20mm potentiometers

Resistance law A - Linear



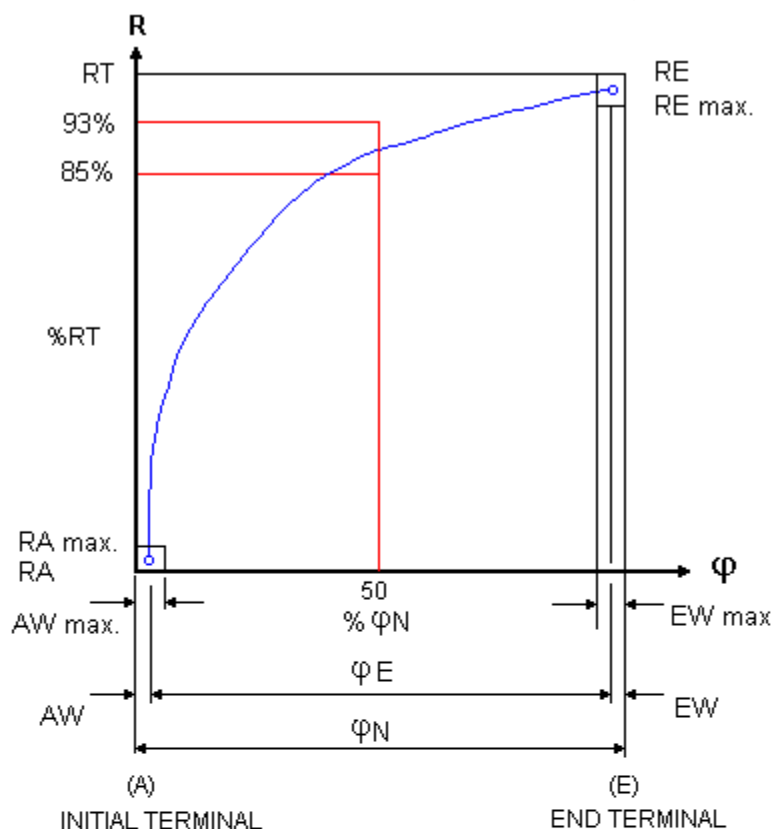
AW	Initial Path	AW max. 12% ϕN
EW	Final Path	EW max. 12% ϕN
Ra	Initial Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RA	Hop-on Resistance	$\leq 1\% RN$
Re	End Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RE	Hop-off Resistance	$\leq 1\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

Resistance law B – Log (Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RA	Hop-on Resistance	$RN \leq 10K$ 5% RN $RN > 10K$ 0.15% RN
Re	End Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RE	Hop-off Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K$ 0.5% RN
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

Resistance law C – Antilog (Reverse Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RA	Hop-on Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K 0.5\% RN$
Re	End Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RE	Hop-off Resistance	$RN \leq 10K 5\% RN$ $RN > 10K 0.15\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

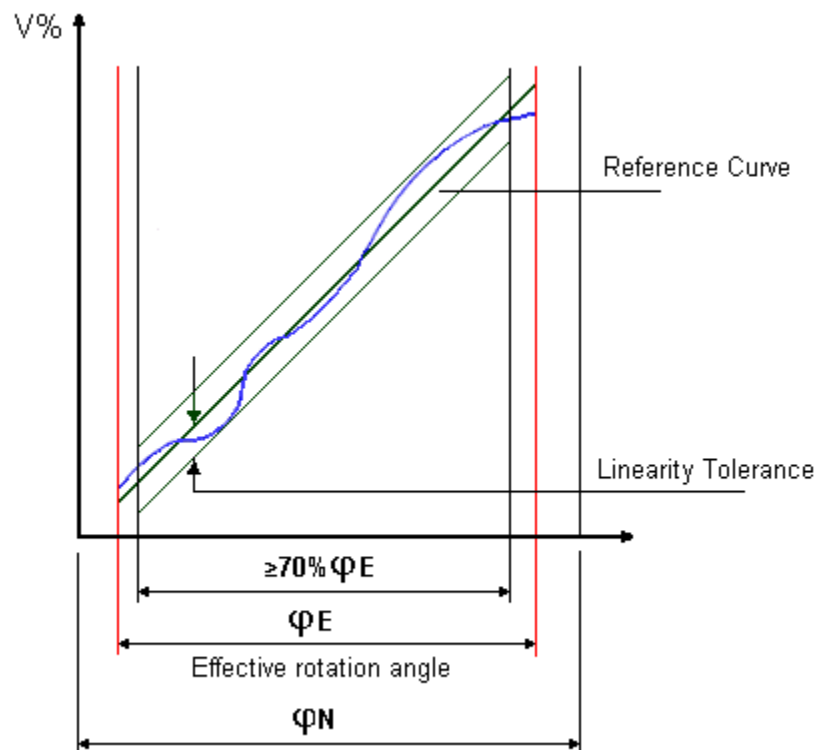
Linearity

As a basis of assessing Linearity Tolerance the independent method is the most practical, permitting as it does, the reference curve to be aligned as near as possible to the actual output curve. This avoids the use of the theoretical starting and finishing points, it is normal for the customer to realign the achieved curve with series trimmers at each end of the device if required.

Linearity Tolerance is 4% over the Nominal Resistance range of 1K Ω to 1M Ω . The Linearity Tolerance is measured on at least 70% of the effective rotation range.

Note. In the case of Terminal and Zero-based linearity, both present constraints which increase the manufacturing difficulty and in consequence have an adverse effect on the product's price and availability.

Potentiometer linearity

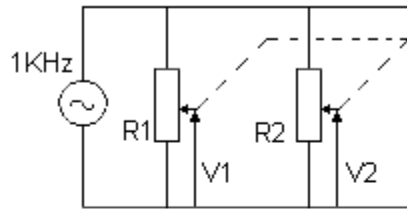


Matching Tolerance (For Tandem Stereo Potentiometers)

Tandem Potentiometers have two identical resistor units with the same variation law. The mismatching of the two resistor units, expressed in dB, is measured by the difference between the attenuations introduced by each resistor unit at various points of travel.

- Law A: 4 dB at Attenuation range 0 - 20 dB
- Law B and C: 3 dB at Attenuation range 0 - 20 dB

Matched Tolerance for Stereo

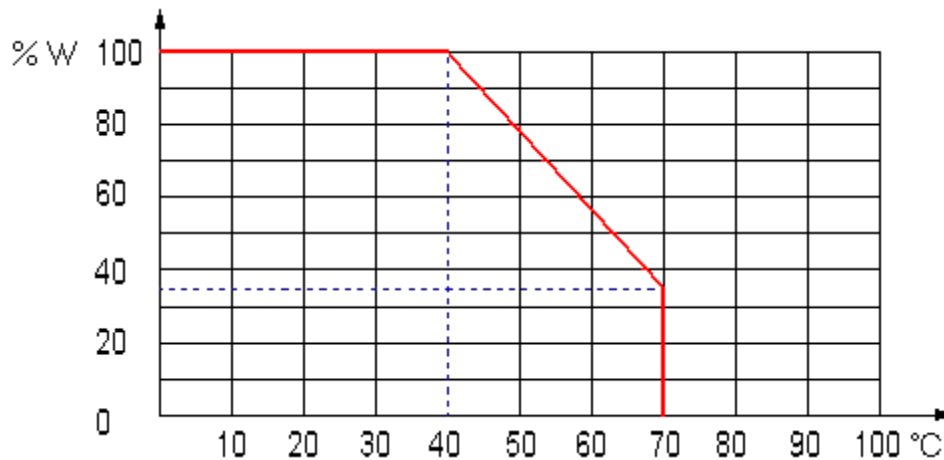


LAW	ATTENUATION RANGE	MATCHING TOLERANCE *
A	0 - 20dB	4dB
B & C	0 - 20dB	3dB

$$* \text{Matching Tolerance} = 20 \log \frac{V1}{V2}$$

Operating Temperature: -25°C to +70°C

Temperature Derating Curve



Temperature Coefficient of Resistance: +300 -500 ppm

P20 Spindles

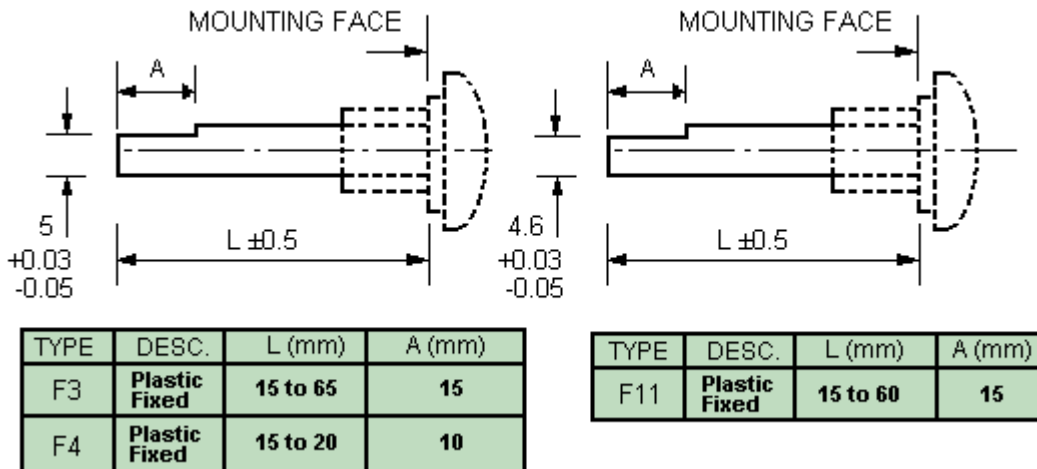
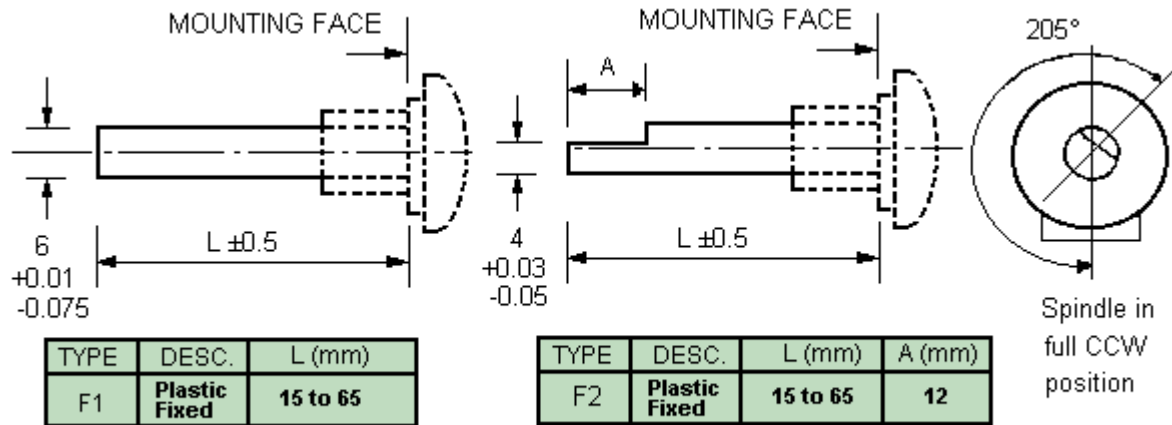
The P20 spindles are plastic and fixed (unless otherwise stated) and they are available in three diameters. A limited range of removable spindles are also available.

- 6.0mm Diameter
 - Cylindrical (Type F1)
 - 4.0 x 12mm Flat (Type F2)
 - 5.0 x 15mm Flat (Type F3)
 - 5.0 x 10mm Flat (Type F4)
 - 4.6mm x 15mm Flat (Type F11)
- 4.0mm Diameter
 - Cylindrical (Type F21)
 - 3.0 x 8.5mm Flat (Type F22)
 - 3.0 x 13.5mm Flat (Type F23)
 - Cylindrical (Type M21 - Metal)
 - 3.0 x 8.5mm Flat (Type M22 - Metal)
 - 3.0 x 13.5mm Flat (Type M23 - Metal)
- 6.35mm Diameter
 - Cylindrical (Type F41)
 - 5.5 x 10mm Flat (Type F42)
 - 5.5 x 15mm Flat (Type F43)
- Splined Spindle - 6.0mm dia. 18 teeth
- Dual Concentric
 - Flatted/Slotted (Type M15 - Metal)
 - Cylindrical (Type M16 - Metal)

6.0mm Diameter Spindles

Note: *Specials to customer's specification up to 65mm.

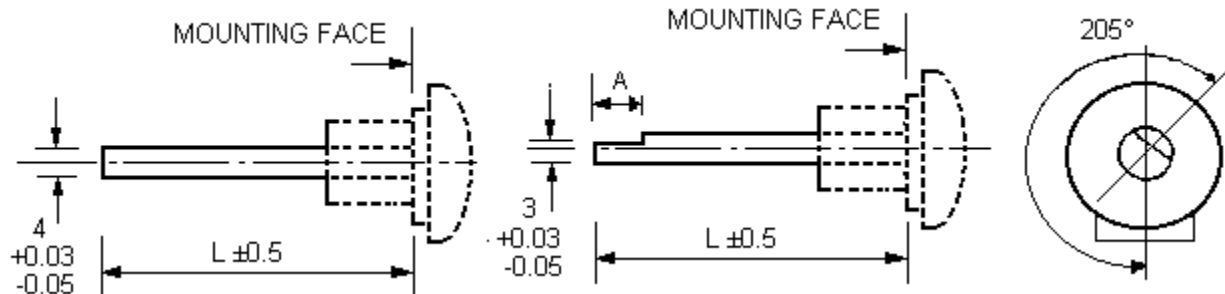
REMOVABLE SPINDLES, similar in specification to 'fixed' spindles are supplied separate from the potentiometer. These can be indefinitely taken in and out and their holding strength is >1kg.



4.0mm Diameter Spindles

Note: The orientation of the flat as illustrated is for plastic spindles only.

For metal spindles, unless specified on the order, the orientation may be different on each potentiometer type.



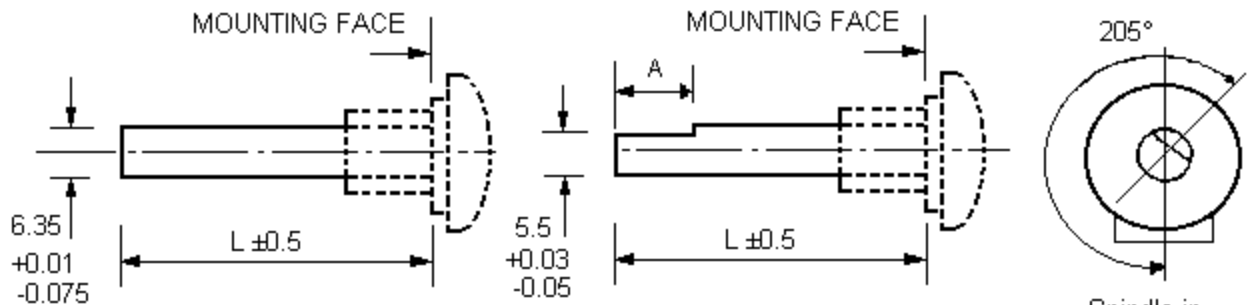
TYPE	DESC.	L (mm)
F21	Plastic Fixed	8 to 65
M21	Metal Fixed	8 to 65

TYPE	DESC.	L (mm)	A (mm)
F22	Plastic Fixed	11 to 60	8.5
M22	Metal Fixed	11 to 60	8.5
F23	Plastic Fixed	16 to 60	13.5
M23	Metal Fixed	16 to 60	13.5

Spindle in full CCW position

6.35mm Diameter Spindles

Note: *Specials to customer's specification up to 65mm.



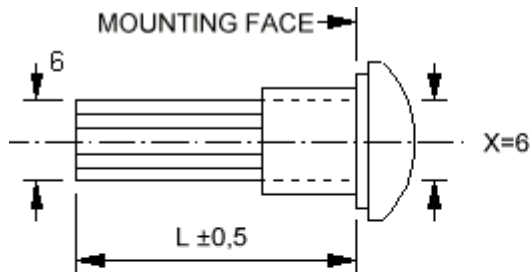
TYPE	DESC.	L (mm)
F41	Plastic Fixed	15 to 65

TYPE	DESC.	L (mm)	A (mm)
F42	Plastic Fixed	15 to 20	10
F43	Plastic Fixed	20 to 60	15

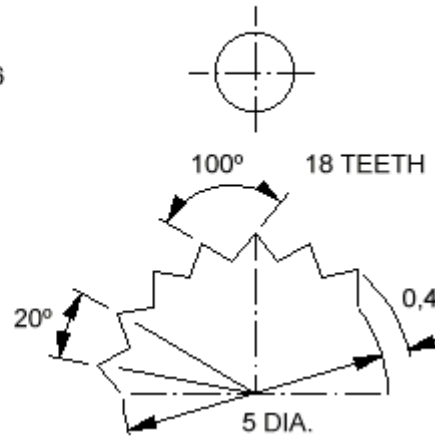
Spindle in full CCW position

Splined Spindle - 6.0mm dia. 18 teeth

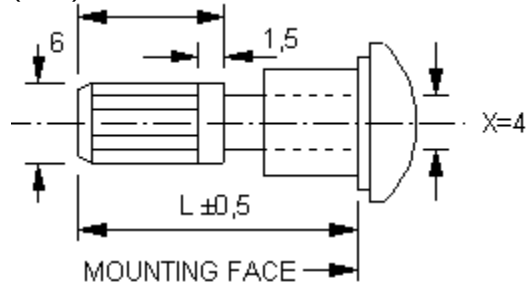
A splined form is available on the 6.0mm diameter P20 plastic spindle (F5) or alternatively a 6mm 'Splined Adaptor' (8,7mm long) can be fitted on a 4mm dia. Spindle



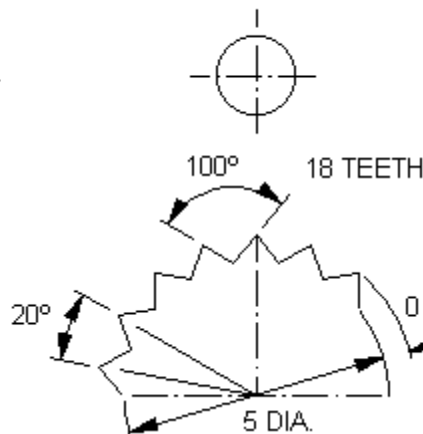
TYPE	DESC.	L (mm)
F5	Plastic Fixed	19



(F5A):

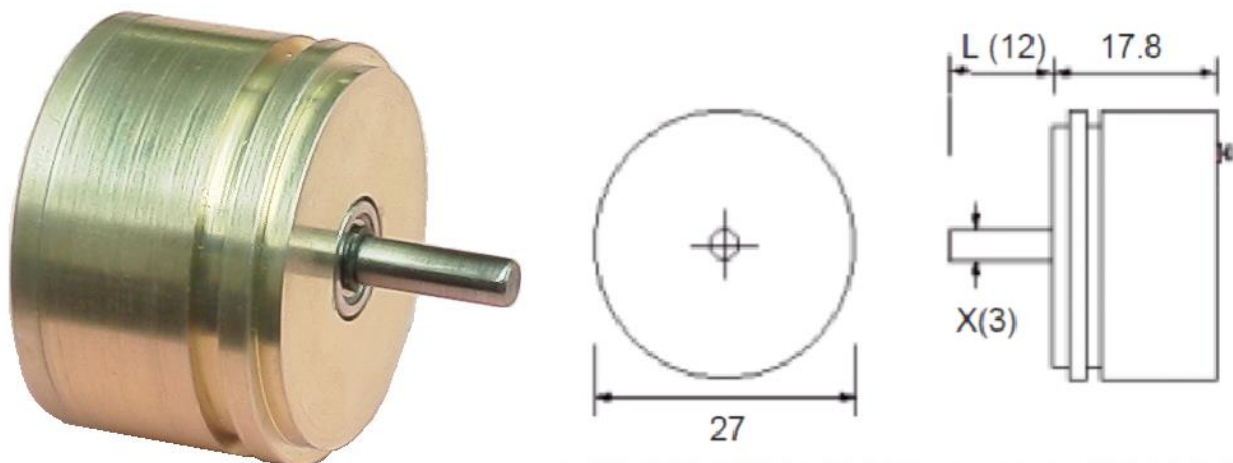


TYPE	DESC.	L (mm)
F5A	Plastic Fixed	16-36



CP11 SERVO

Precision Potentiometer



The servo potentiometers are constructed with a precision ball bearing system and long life flush bonded conductive track. The wipers have multiple fingers to achieve low contact resistance. The Resistive Element is Conductive Plastic (CP)

Mountings are by bush and locknut, servo clamp or 2 hole fixing on the front face.
A centre tap is available to special order.
Connection by Terminals or Flying leads.

To Order we require:

Model(CP11)/Resistance/Angle/Diameter(X)/Length(L)

See diagram above for (X) and (L)

See Technical data below for other information

Technical Data

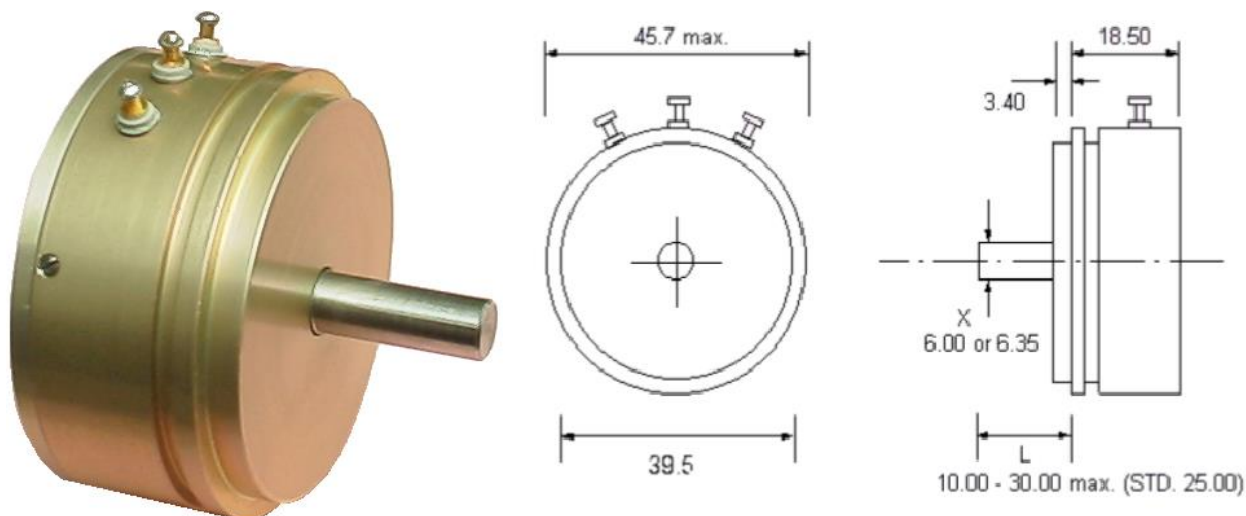
Electrical Data

Resistance Range	1K to 50K
Resistance Tolerance	±10%
Independent Linearity	2% Standard
Power Dissipation at 20°C	0.5W
Insulation Resistance	50 M ohms At 500V dc
Dielectric Strength	1000 V rms
Temperature Coefficient	±300 ppm/°C

Mechanical Data

Mechanical Rotation	360° continuous
Electrical Angle	300, 355° (±3°)
Starting Torque	10 gm-cm Max.
Wiper Velocity	1200°/sec Max. (200 rpm)
Life	>10 million cycles
Temperature Range	- 20° C to + 120° C

CP18 SERVO Precision Potentiometer



The servo potentiometers are constructed with a precision ball bearing system and long life flush bonded conductive track. The wipers have multiple fingers to achieve low contact resistance. The Resistive Element is Conductive Plastic (CP)

Mountings are by bush and locknut, servo clamp or 3 hole fixing on the front face.
A centre tap is available to special order.

To Order we require:

Model(CP18)/Resistance/Angle/Diameter(X)/Length(L)

See diagram above for (X) and (L)

See Technical data below for other information

Technical Data

Electrical Data

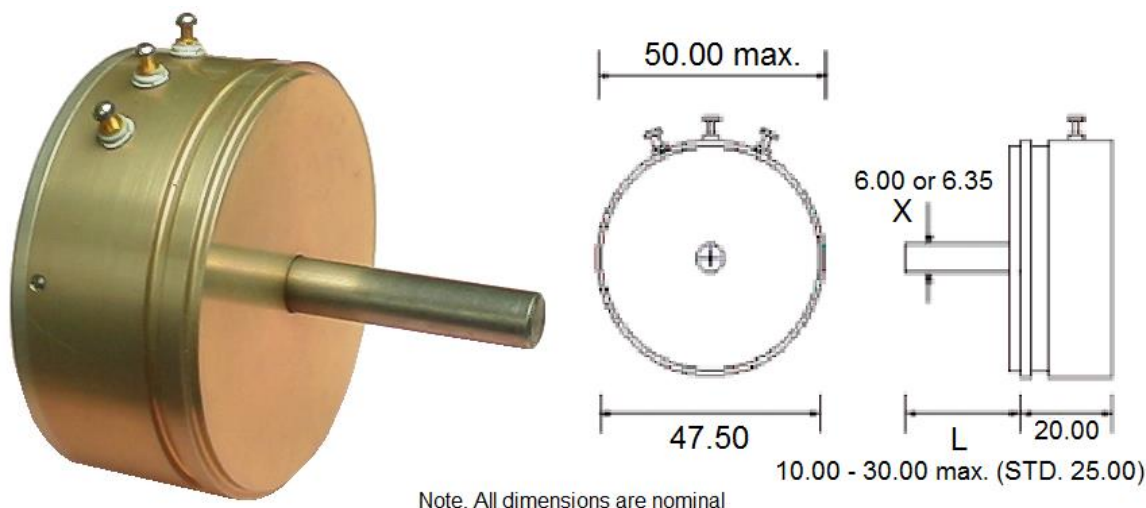
Resistance Range	1K to 50K
Resistance Tolerance	±10%
Independent Linearity	1% standard
Power Dissipation at 20°C	3.0 W
Insulation Resistance	50 M ohms At 500V dc
Dielectric Strength	1000 V rms
Temperature Coefficient	±300 ppm/°C

Mechanical Data

Mechanical Rotation	360° continuous
Electrical Angle	355, 90°
Starting Torque	10 gm-cm Max.
Wiper Velocity	1200°/sec Max. (200 rpm)
Life	>10 million cycles
Temperature Range	- 20° C to + 120° C

CP20 SERVO

Precision Potentiometer



The servo potentiometers are constructed with a precision ball bearing system and long life flush bonded conductive track. The wipers have multiple fingers to achieve low contact resistance. The Resistive Element is Conductive Plastic (CP)

Mountings are by bush and locknut, servo clamp or 3 hole fixing on the front face.
A centre tap is available to special order.

To Order we require:

Model(CP20)/Resistance/Angle/Diameter(X)/Length(L)

See diagram above for (X) and (L)

See Technical data below for other information

Technical Data

Electrical Data

Resistance Range	1K to 50K
Resistance Tolerance	±10%
Independent Linearity	1% standard
Power Dissipation at 20°C	5.0 W
Insulation Resistance	50 M ohms At 500V dc
Dielectric Strength	1000 V rms
Temperature Coefficient	±300 ppm/°C

Mechanical Data

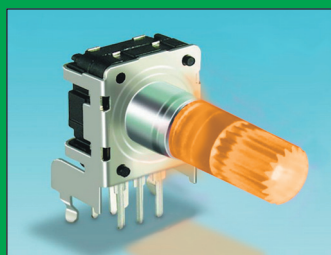
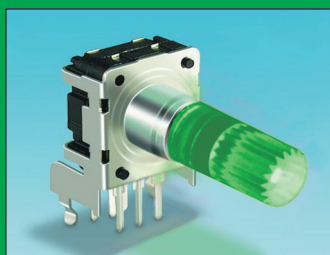
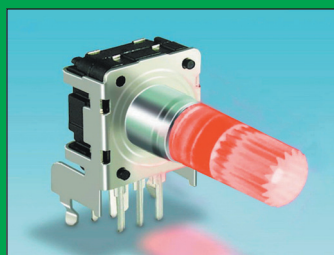
Mechanical Rotation	360° continuous
Electrical Angle	300, 90°
Starting Torque	10 gm-cm Max.
Wiper Velocity	1200°/sec Max. (200 rpm)
Life	>10 million cycles
Temperature Range	- 20° C to +120° C

ISSUE 2

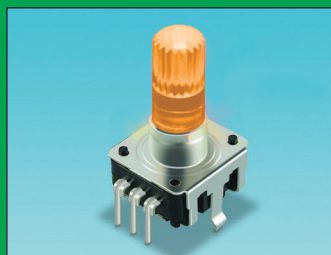
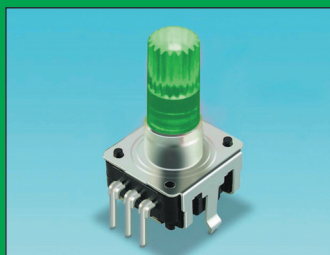
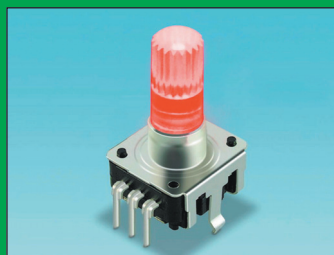


E12 Series

12mm Rotary Encoders with LED Illuminated Spindles
and optional momentary action switches



Horizontal spindles



Vertical spindles

Introduction

E12 rotary encoders have transparent spindles for illumination with integral LEDs. This provides users with a visual indication of the system state (e.g. whether the equipment has power and if it's in standby or on mode).

The encoders are available with optional momentary action switches and a choice of PCB mounting with the spindle horizontal or vertical. For rotational 'feel' purposes, spindles can be supplied with or without detents.

Both the encoders and switches are RoHS compliant.

Typical Applications

Volume and tone controls for car radios, hi-fi systems and audio mixing desks. Washing machine controls, oven timer and temperature controls, speed controllers for fans, food mixers and disabled electric vehicles. Miscellaneous equipment where a rotary control and indicator light are required.

Encoder Type

Incremental, digital, 24 pulse, rotary encoders with conductive tracks and LED illuminated spindles. Single colour LED without switch, two LEDs when switch is fitted.

Switch Type

Momentary, single pole, push to make.

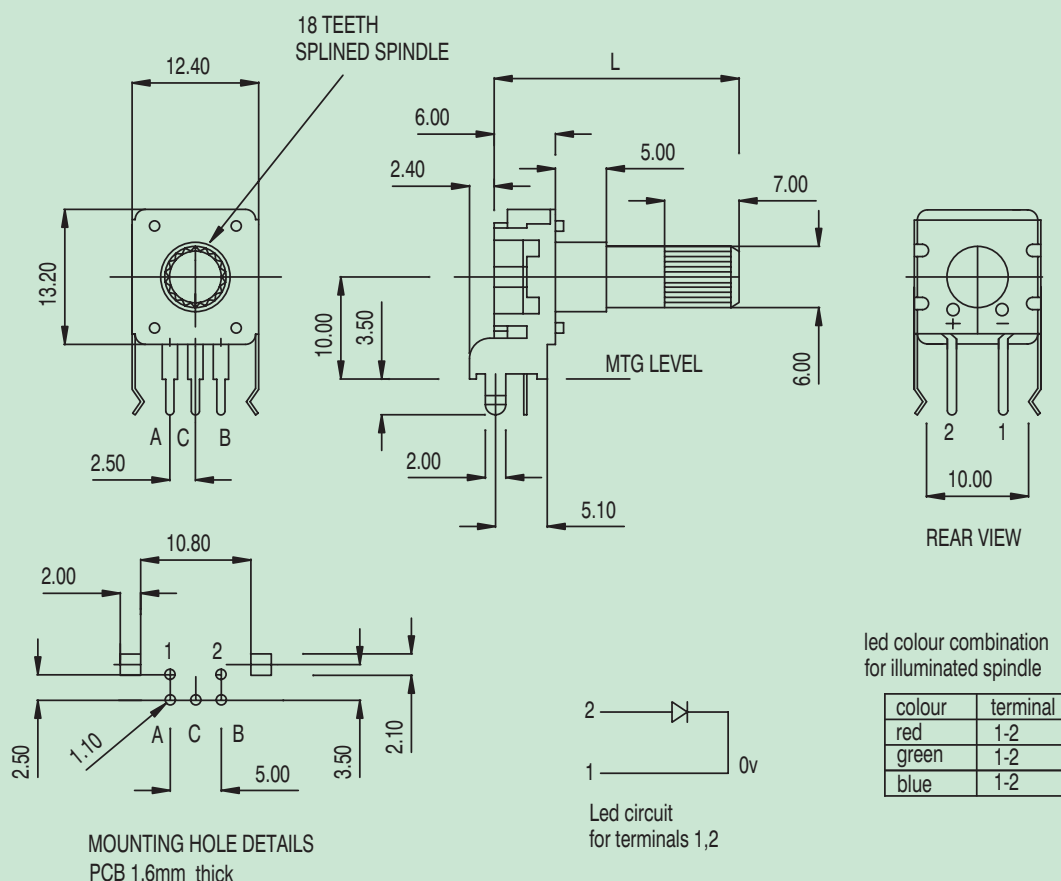
Encoder Specification

Resolution	24 pulses/360° for each phase
Encoder Rating	DC 5V 0.5mA
Phase A and B	Common Terminal C
Rotation	360° endless
Insulation Resistance	100 Megohms
Life	30,000 ops min at rated load
Operating Temperature	- 25°C to +70°C

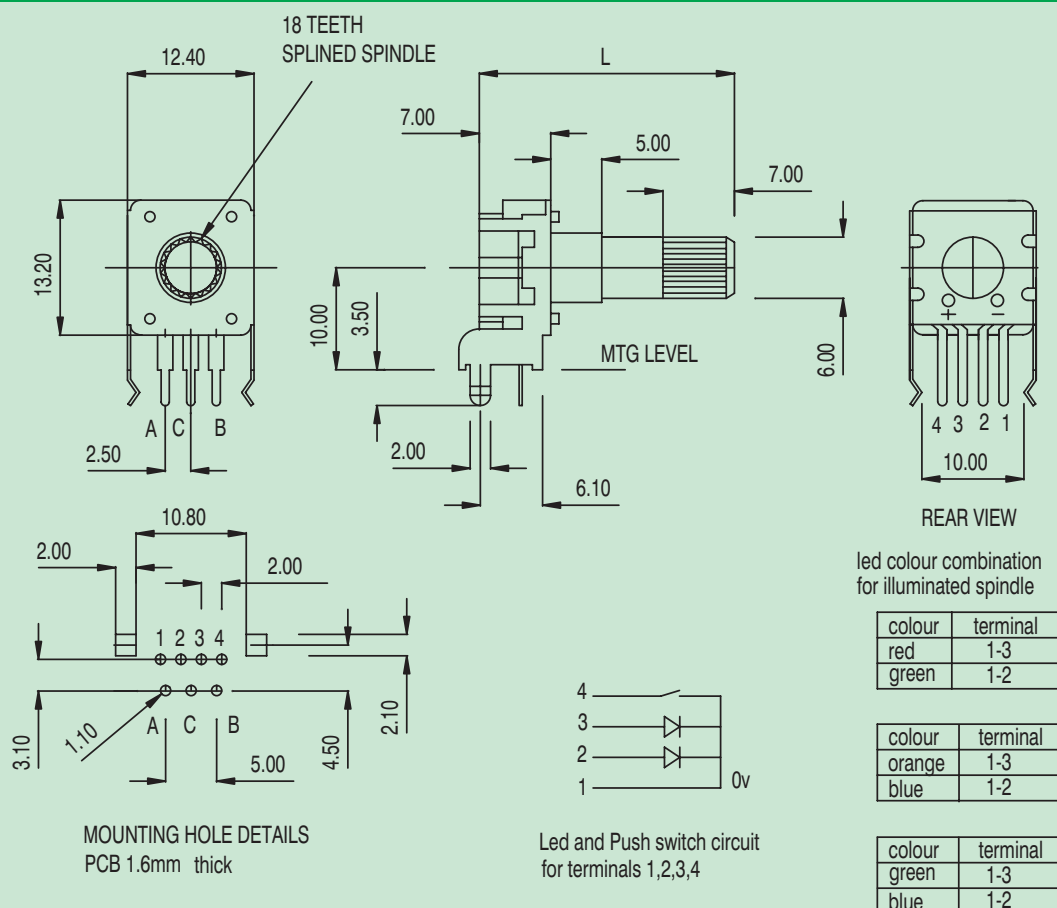
Switch Specification

Contact Rating	DC 5V 10mA
Actuation	Momentary, push to make
Type	SP (Single pole)
Switch Travel	0.50 mm
Life	20,000 ops min at rated load
Insulation Resistance	100 Megohms
Contact Resistance	200 milliohms
Plunger	Insulated from switch
Operating Temperature	- 25°C to +70°C

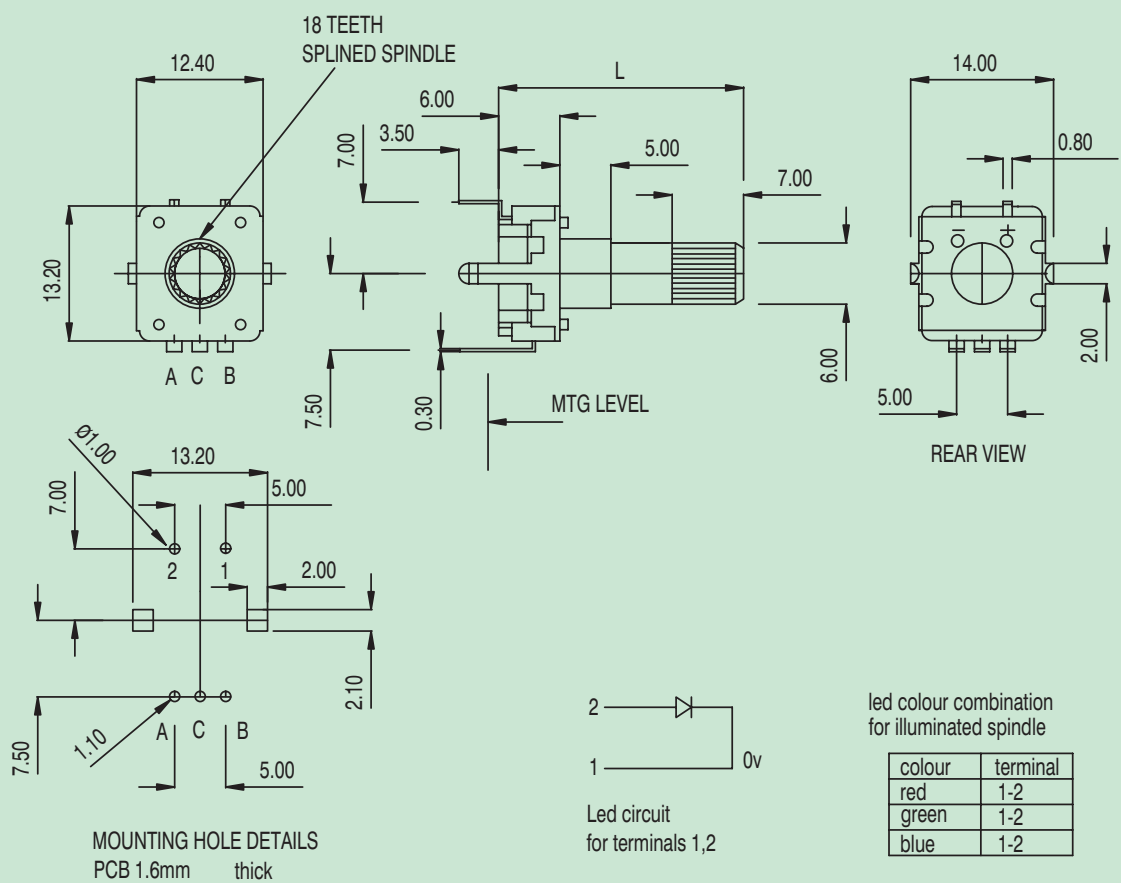
E12 horizontal spindle, without switch



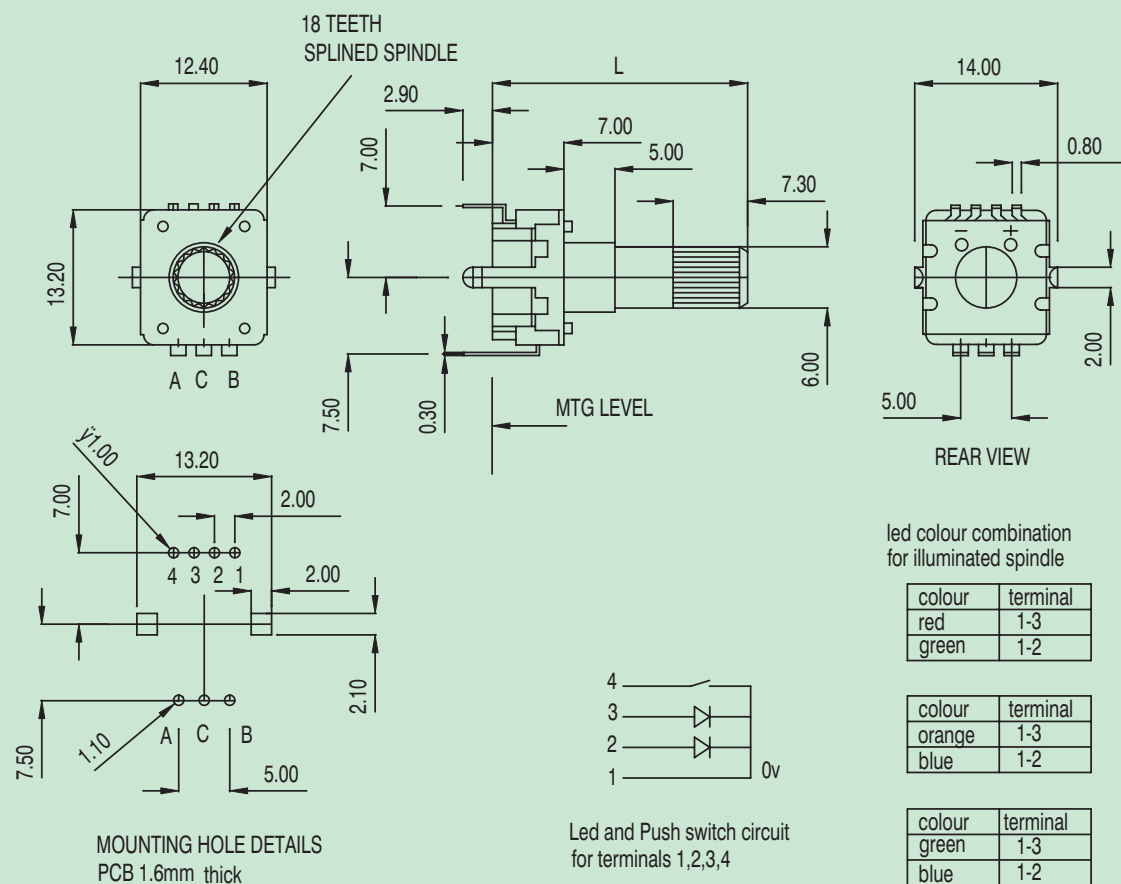
E12 horizontal spindle, with switch



E12 vertical spindle, without switch



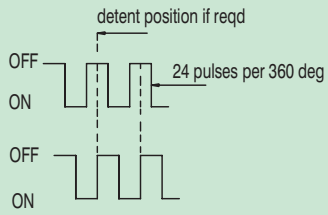
E12 vertical spindle, with switch



Encoder output clockwise rotation

Encoder output
Shaft rotation CW
terminals A-C
phase A

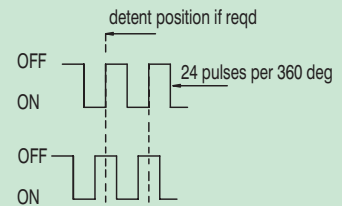
terminals B-C
phase B



Encoder output counter clockwise rotation

Encoder output
Shaft rotation CCW
terminals A-C
phase A

terminals B-C
phase B



LED Characteristics

Reverse current: $[I_R] = 10\mu A$ $[V_R] = 5V$

Reverse voltage: 5V

Operating temperature: $-40^\circ C$ to $+85^\circ C$

Emitted colour	Power dissipation	DC forward current	VF at IF=20mA	
			Max	Typical
Blue	100mW	20mA	3.5V	2.5V
Red	63mW	25mA	2.5V	2.0V
Green	63mW	20mA	2.5V	2.0V
Orange	75mW	30mA	2.5V	2.1V

Control Knobs



Diameter	Height	Part No.
10.2	14.2	P1014A

Transparent body, white cap with indicator



Diameter	Height	Part No.
10.2	14.2	P1014

Transparent body, white cap without indicator



Diameter	Height	Part No.
15	12.5	P1513

Transparent body



Diameter	Height	Part No.
18.5	18.7	P1919

Transparent body



Diameter	Height	Part No.
15.6	17.1	P1617

Black body, transparent top

Order codes

E12 * * * * ** **

Rotary encoder
12 mm (incremental)

Mounting orientation

V = vertical spindle

H = horizontal spindle

Detents

N = none

24 = 24 detents

Spindle type

S = splined

Spindle, length 'L' without switch

24 = 24 mm SPLINED spindle

Spindle, length 'L' with switch

25 = 25 mm SPLINED spindle

LED colour without switch

R = red

G = green

B = blue

LED colours with switch

BG = blue and green

BO = blue and orange

GR = green and red

Optional switch

/S = with switch

blank = without switch



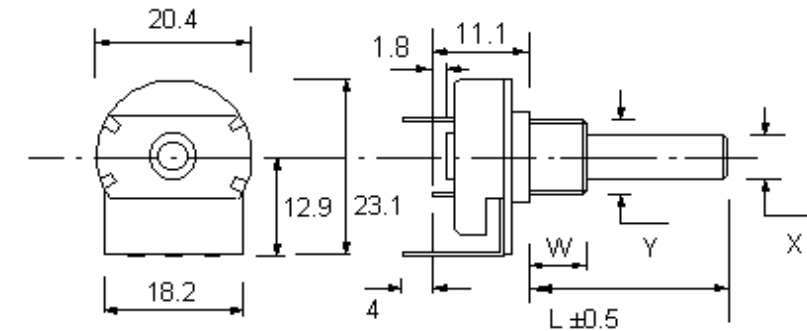
OMEG LIMITED, Imberhorne Industrial Estate, East Grinstead, West Sussex RH19 1RJ

Tel: 01342 410420 Fax: 01342 316253 Email: sales@omeg.com Web: www.omeg.com

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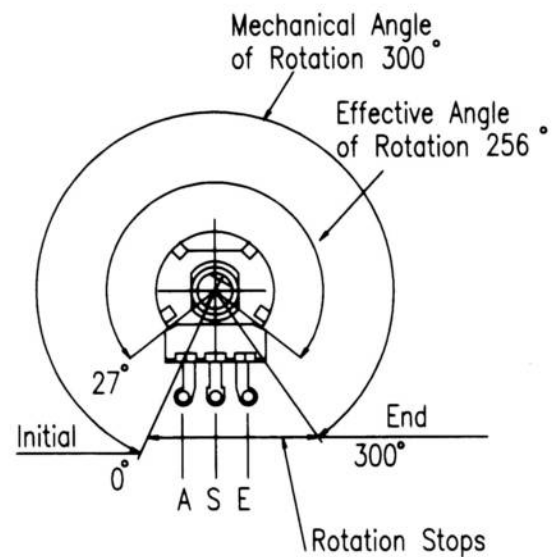
LA20BU

LA – Terminals are bent Long Away from Spindle



Viewed from component side

SPINDLE END VIEW



Total mechanical and effective electrical angles of rotation of potentiometers without rotary switch

- W Mounting Height
- Y Mounting Diameter
- X Spindle Diameter
- L Spindle Length
- A Initial Termination
- S Wiper (or moving contact) termination
- E End Termination

Technical Data

Rated Power Dissipation @40°C for P20 potentiometers:

0.4W linear law

0.2W nonlinear law

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Effective rotation: 256° nominal

Operating Torque: 0.4 – 1.5 cN.m

Permissible Axial Spindle Load: 100 N (5 Sec. maximum)

Permissible Torque at End Stop: 80 cN.m

Rotation angle: 300° ±5°

Optional Click stop (indents) for rotational tactile feedback

Rotational torque of spindle can be made high or low

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Insulation Resistance: >= 4 Gohms

Rated Resistance: E3 Series

Optional: E6 Series

Linear Law: 1K – 1M (±10%)

Nonlinear Law: 4K7 – 470K

ELECTRICAL SPECIFICATION COMMON TO ALL POTENTIOMETERS

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Insulation Resistance: >= 4 Gohms

Rated Resistance: E3 Series

- Optional: E6 Series
- Linear Law: 1K - 1M
- Nonlinear Law: 4K7 - 470K

Tolerance on Rated Resistance: ± 20%

- Optional Tolerance on 1K - 1M: ± 10%

Resistance Laws (Taper):

- Linear: A
- Nonlinear: B - Log (Audio) or C - Antilog (Reverse Audio)
- Other laws: Please refer to Sales office

ELECTRICAL SPECIFICATION UNIQUE TO P20 POTENTIOMETERS

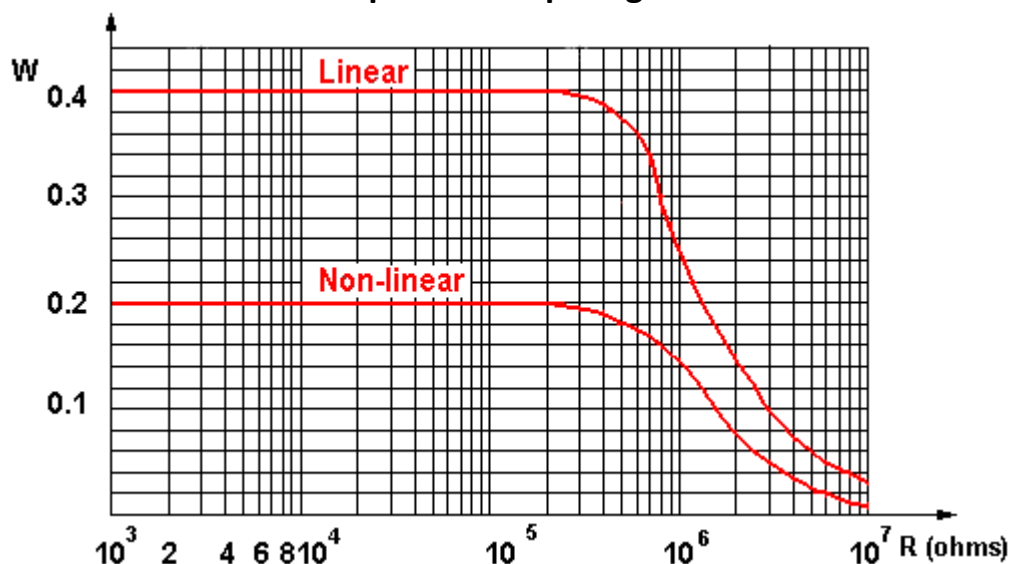
Effective rotation:

- Without a switch: 256° nominal
- With switch: 243° nominal
- With rotary switch: 243° nominal

Rated Power Dissipation @40°C for P20 potentiometers:

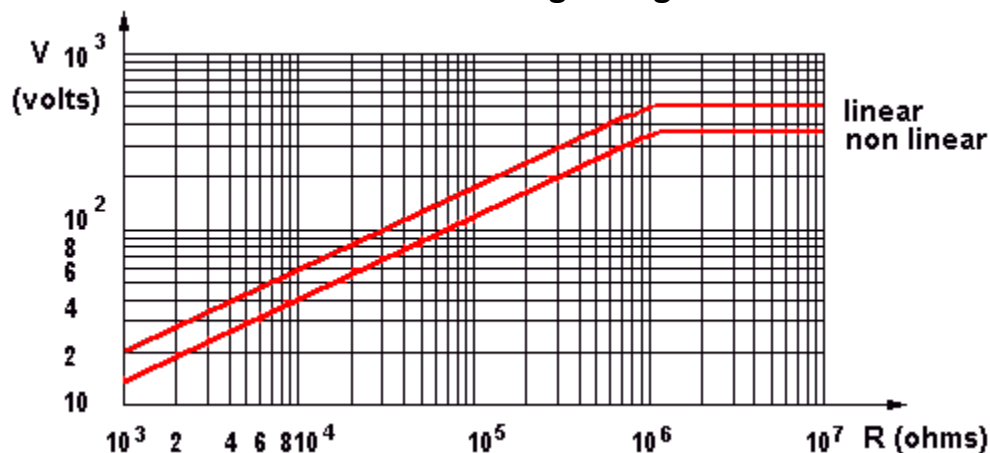
- 0.4W linear law
- 0.2W nonlinear law

P20 power dissipating curve



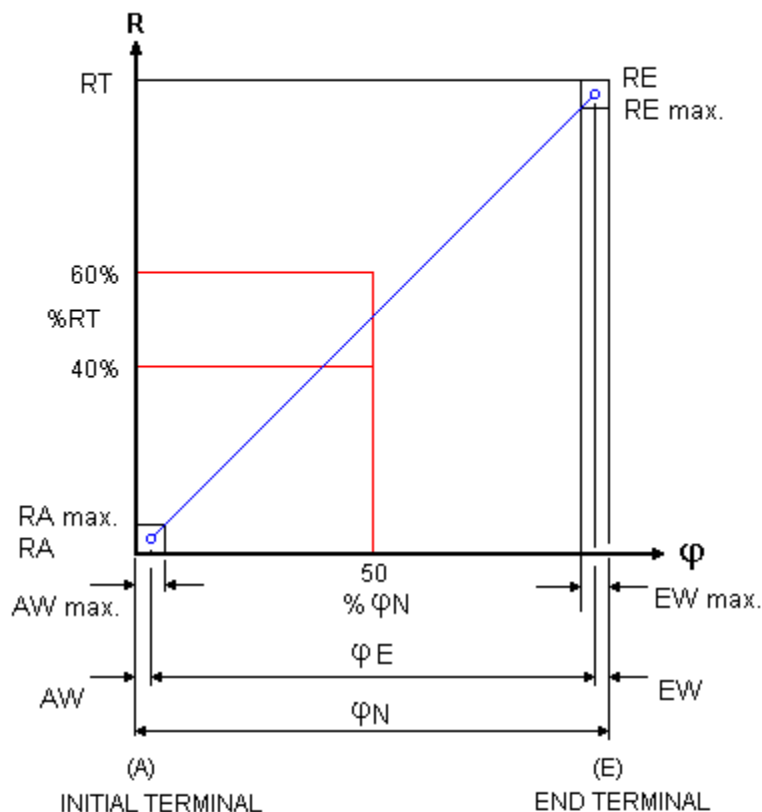
Limiting Element Voltage: 500 V DC for 20mm potentiometers

P20 maximum working voltage curve



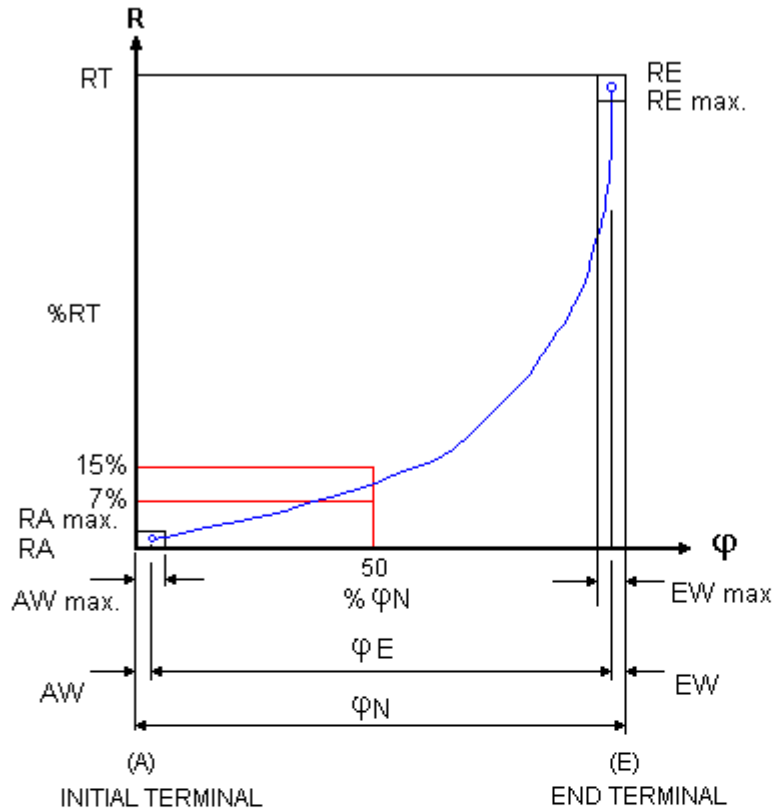
Insulating Voltage: 1000 V AC for 20mm potentiometers

Resistance law A - Linear



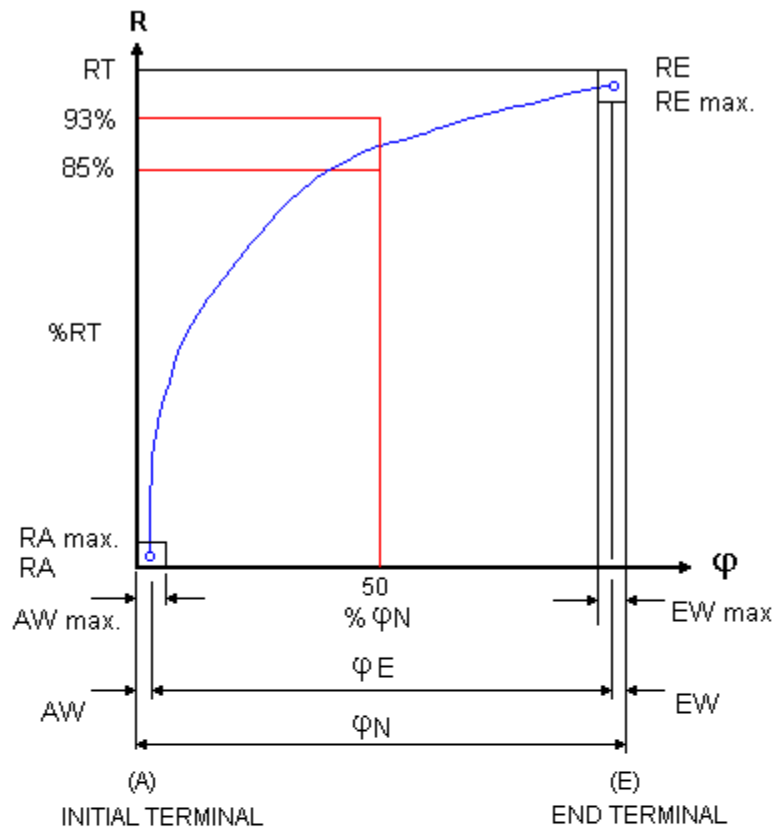
AW	Initial Path	AW max. 12% ϕ_N
EW	Final Path	EW max. 12% ϕ_N
Ra	Initial Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RA	Hop-on Resistance	$\leq 1\% RN$
Re	End Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RE	Hop-off Resistance	$\leq 1\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

Resistance law B – Log (Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RA	Hop-on Resistance	$RN \leq 10K$ 5% RN $RN > 10K$ 0.15% RN
Re	End Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RE	Hop-off Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K$ 0.5% RN
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

Resistance law C – Antilog (Reverse Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RA	Hop-on Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K 0.5\% RN$
Re	End Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RE	Hop-off Resistance	$RN \leq 10K 5\% RN$ $RN > 10K 0.15\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

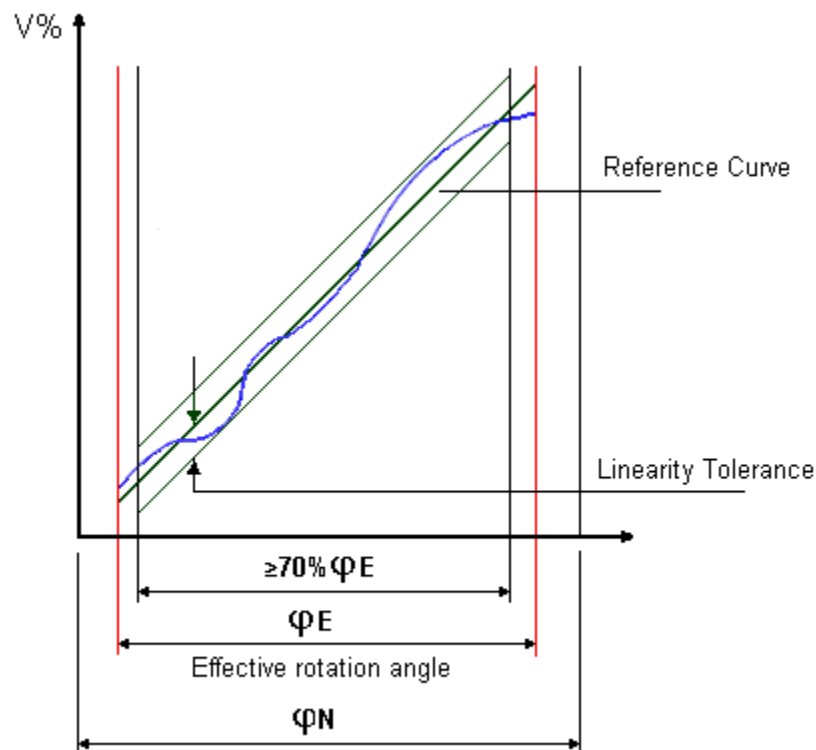
Linearity

As a basis of assessing Linearity Tolerance the independent method is the most practical, permitting as it does, the reference curve to be aligned as near as possible to the actual output curve. This avoids the use of the theoretical starting and finishing points, it is normal for the customer to realign the achieved curve with series trimmers at each end of the device if required.

Linearity Tolerance is 4% over the Nominal Resistance range of 1K Ω to 1M Ω . The Linearity Tolerance is measured on at least 70% of the effective rotation range.

Note. In the case of Terminal and Zero-based linearity, both present constraints which increase the manufacturing difficulty and in consequence have an adverse effect on the product's price and availability.

Potentiometer linearity

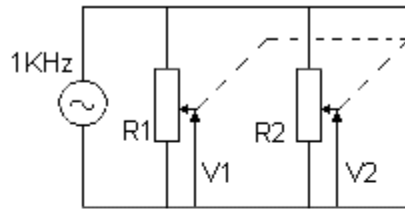


Matching Tolerance (For Tandem Stereo Potentiometers)

Tandem Potentiometers have two identical resistor units with the same variation law. The mismatching of the two resistor units, expressed in dB, is measured by the difference between the attenuations introduced by each resistor unit at various points of travel.

- Law A: 4 dB at Attenuation range 0 - 20 dB
- Law B and C: 3 dB at Attenuation range 0 - 20 dB

Matched Tolerance for Stereo

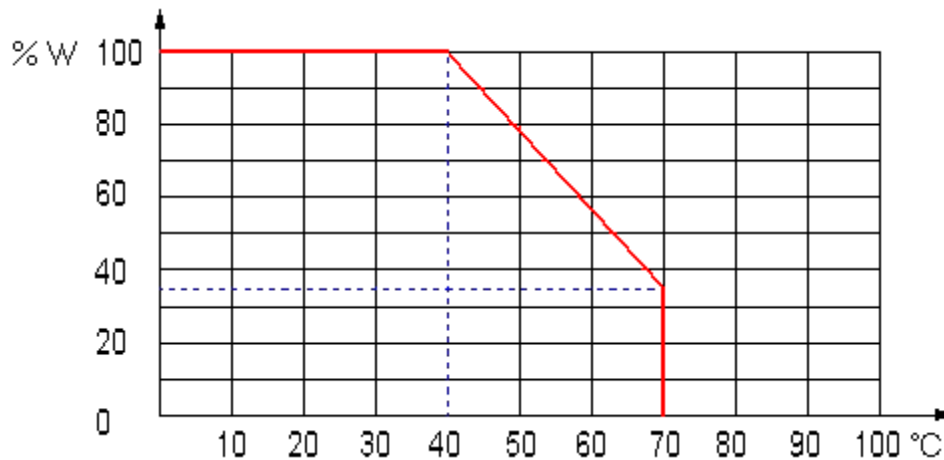


LAW	ATTENUATION RANGE	MATCHING TOLERANCE *
A	0 - 20dB	4dB
B & C	0 - 20dB	3dB

$$* \text{Matching Tolerance} = 20 \log \frac{V1}{V2}$$

Operating Temperature: -25°C to +70°C

Temperature Derating Curve



Temperature Coefficient of Resistance: +300 -500 ppm

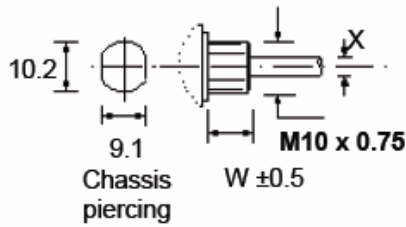
Components

P20 Bush Housing (Mounting)

The P20 bushes are available in metal or nylon; with three thread options; and with or without a locating feature:

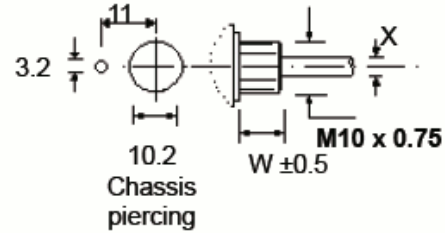
- Diecast Zinc Alloy
 - M10 x0.75mm pitch (Type C)
 - M10 x0.75mm pitch, **with locator** (Type CEBS)
 - 9.52mm x32tpi (Type CBS)
 - 9.52mm x32tpi, **with locator** (Type CBSL)
 - M7 x0.75mm pitch (Type CG)
- Glass Filled Nylon
 - M10 x0.75mm (Type CP)

DIECAST ZINC ALLOY



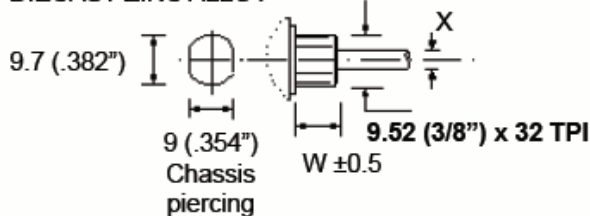
Type C (without locator)	
X (mm)	6
W (mm)	9

DIECAST ZINC ALLOY



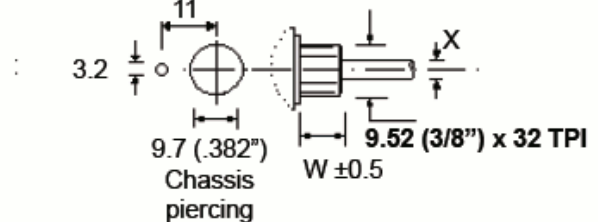
Type CEBS (with locator)	
X (mm)	6
W (mm)	9

DIECAST ZINC ALLOY



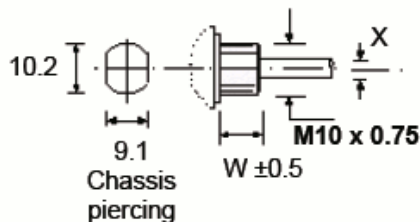
Type CBS (without locator)		
X (mm)	6	6.35
W (mm)	8 or 12	8 or 12

DIECAST ZINC ALLOY



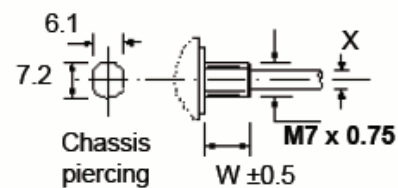
Type CBSL (with locator)		
X (mm)	6.35	6.35
W (mm)	8	12

GLASS FILLED NYLON



Type CP (GFN)		
X (mm)	6	6.35
W (mm)	7 or 10	7 or 10

DIECAST ZINC ALLOY



Type CG (without locator)	
X (mm)	4
W (mm)	6

P20 Spindles

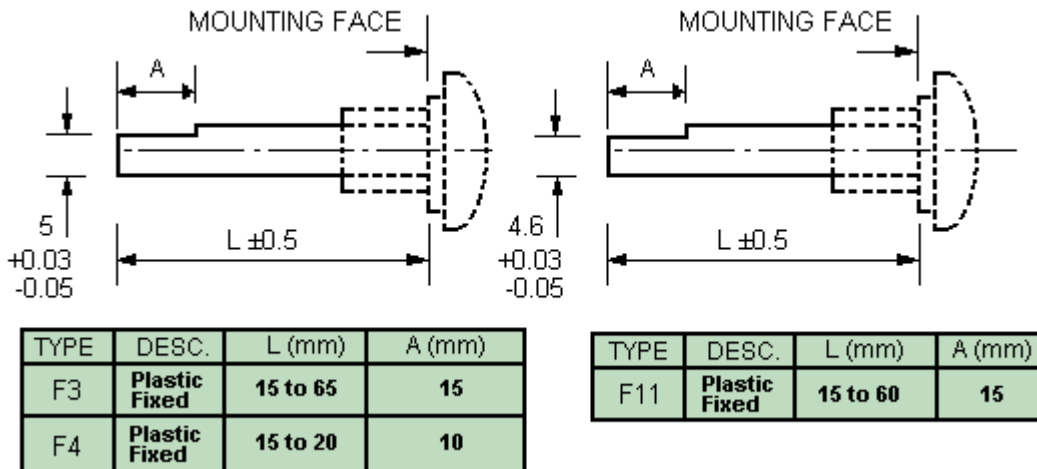
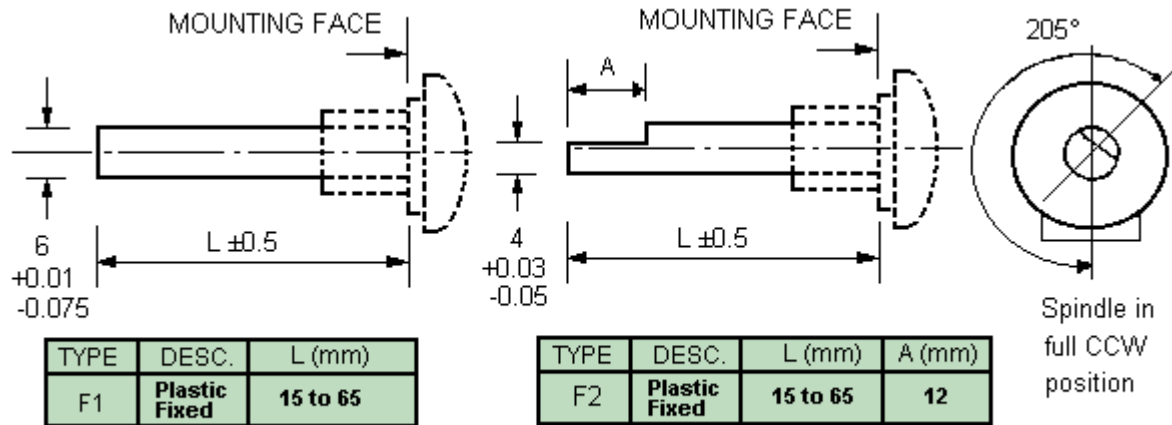
The P20 spindles are plastic and fixed i.e. not removable, unless otherwise stated and they are available in three diameters:

- 6.0mm Diameter
 - Cylindrical (Type F1)
 - 4.0 x 12mm Flat (Type F2)
 - 5.0 x 15mm Flat (Type F3)
 - 5.0 x 10mm Flat (Type F4)
 - 4.6mm x 15mm Flat (Type F11)
- 4.0mm Diameter
 - Cylindrical (Type F21)
 - 3.0 x 8.5mm Flat (Type F22)
 - 3.0 x 13.5mm Flat (Type F23)
 - Cylindrical (Type M21 - Metal)
 - 3.0 x 8.5mm Flat (Type M22 - Metal)
 - 3.0 x 13.5mm Flat (Type M23 - Metal)
- 6.35mm Diameter
 - Cylindrical (Type F41)
 - 5.5 x 10mm Flat (Type F42)
 - 5.5 x 15mm Flat (Type F43)
- Splined Spindle - 6.0mm dia. 18 teeth
- Dual Concentric
 - Flatted/Slotted (Type M15 - Metal)
 - Cylindrical (Type M16 - Metal)

6.0mm Diameter Spindles

Note: *Specials to customer's specification up to 65mm.

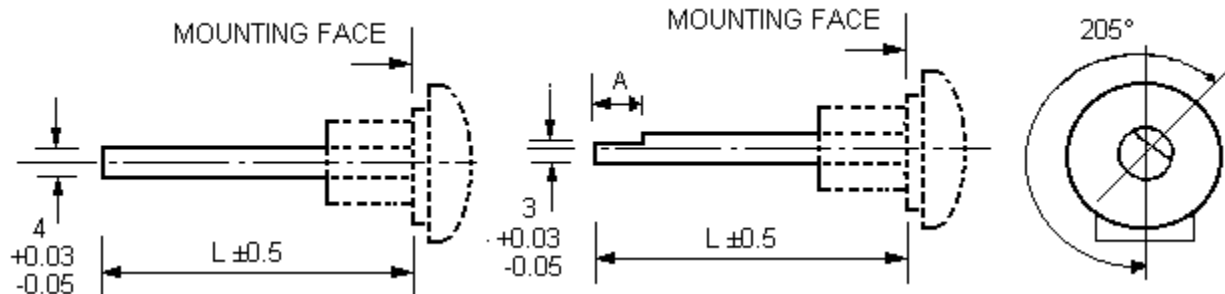
REMOVABLE SPINDLES, similar in specification to 'fixed' spindles are supplied separate from the potentiometer. These can be indefinitely taken in and out and their holding strength is >1kg.



4.0mm Diameter Spindles

Note: The orientation of the flat as illustrated is for plastic spindles only.

For metal spindles, unless specified on the order, the orientation may be different on each potentiometer type.



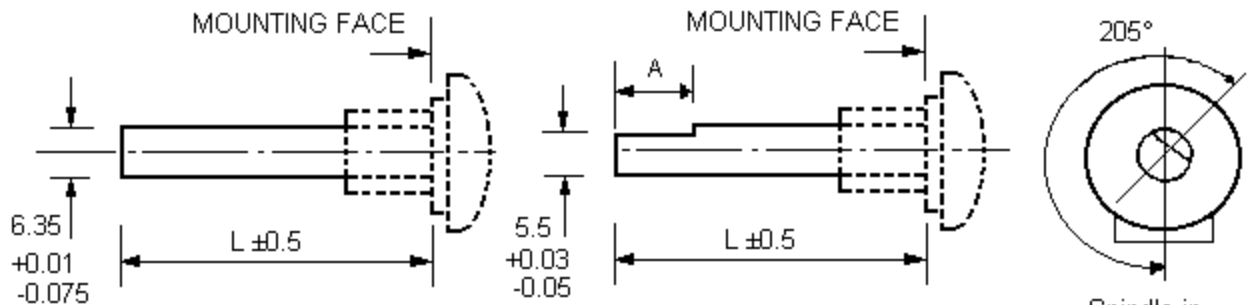
TYPE	DESC.	L (mm)
F21	Plastic Fixed	8 to 65
M21	Metal Fixed	8 to 65

TYPE	DESC.	L (mm)	A (mm)
F22	Plastic Fixed	11 to 60	8.5
M22	Metal Fixed	11 to 60	8.5
F23	Plastic Fixed	16 to 60	13.5
M23	Metal Fixed	16 to 60	13.5

Spindle in full CCW position

6.35mm Diameter Spindles

Note: *Specials to customer's specification up to 65mm.



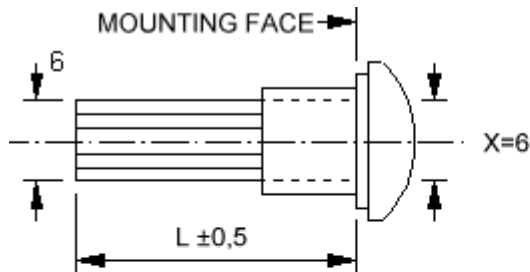
TYPE	DESC.	L (mm)
F41	Plastic Fixed	15 to 65

TYPE	DESC.	L (mm)	A (mm)
F42	Plastic Fixed	15 to 20	10
F43	Plastic Fixed	20 to 60	15

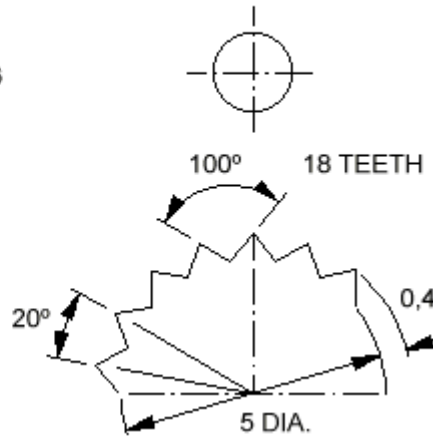
Spindle in full CCW position

Splined Spindle - 6.0mm dia. 18 teeth

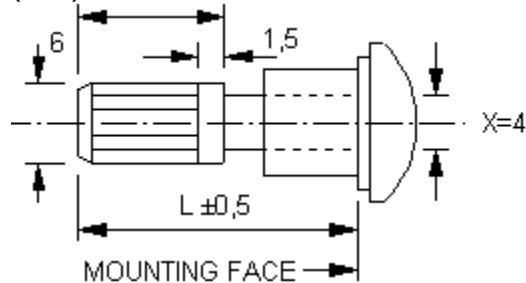
A splined form is available on the 6.0mm diameter P20 plastic spindle (F5) or alternatively a 6mm 'Splined Adaptor' (8,7mm long) can be fitted on a 4mm dia. Spindle



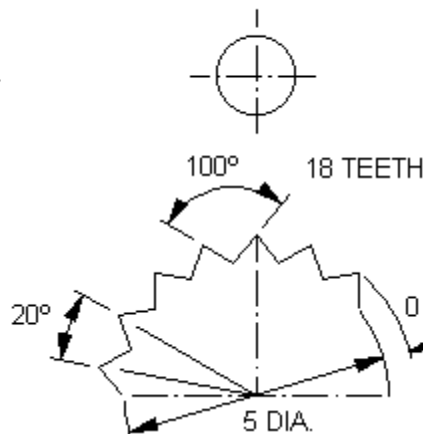
TYPE	DESC.	L (mm)
F5	Plastic Fixed	19



(F5A):

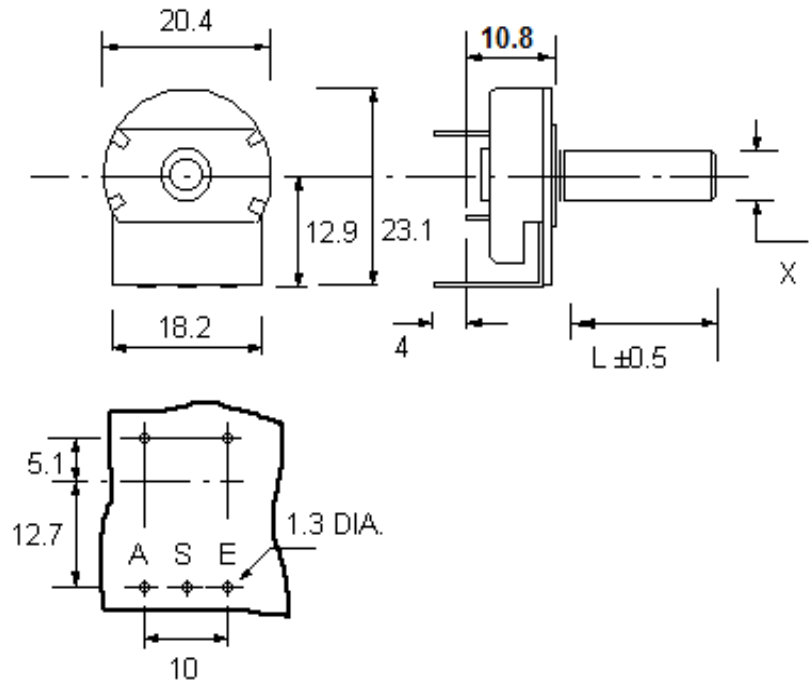


TYPE	DESC.	L (mm)
F5A	Plastic Fixed	16-36



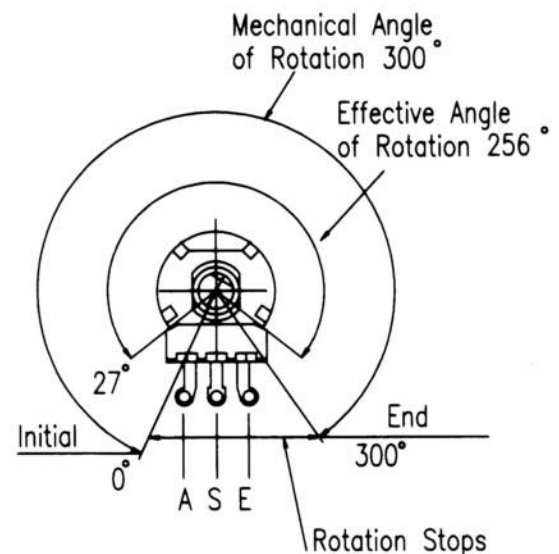
LA20SP

LA – Terminals are bent Long Away from Spindle



Viewed from component side
 SPINDLE END VIEW

- X Spindle Diameter
- L Spindle Length
- A Initial Termination
- S Wiper (or moving contact) termination
- E End Termination



Total mechanical and effective electrical angles of rotation of potentiometers without rotary switch

Technical Data

Rated Power Dissipation @40°C for P20 potentiometers:

0.4W linear law

0.2W nonlinear law

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Effective rotation: 256° nominal

Operating Torque: 0.4 – 1.5 cN.m

Permissible Axial Spindle Load: 100 N (5 Sec. maximum)

Permissible Torque at End Stop: 80 cN.m

Rotation angle: 300° ±5°

Optional Click stop (indents) for rotational tactile feedback

Rotational torque of spindle can be made high or low

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Insulation Resistance: >= 4 Gohms

Rated Resistance: E3 Series

Optional: E6 Series

Linear Law: 1K – 1M (±10%)

Nonlinear Law: 4K7 – 470K

ELECTRICAL SPECIFICATION COMMON TO ALL POTENTIOMETERS

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Insulation Resistance: >= 4 Gohms

Rated Resistance: E3 Series

- Optional: E6 Series
- Linear Law: 1K - 1M
- Nonlinear Law: 4K7 - 470K

Tolerance on Rated Resistance: ± 20%

- Optional Tolerance on 1K - 1M: ± 10%

Resistance Laws (Taper):

- Linear: A
- Nonlinear: B - Log (Audio) or C - Antilog (Reverse Audio)
- Other laws: Please refer to Sales office

ELECTRICAL SPECIFICATION UNIQUE TO P20 POTENTIOMETERS

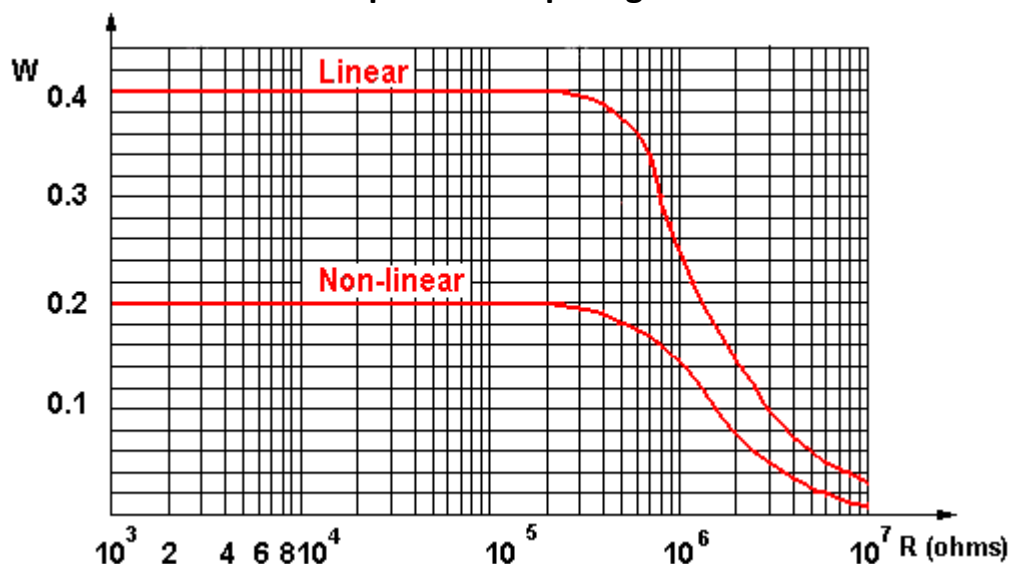
Effective rotation:

- Without a switch: 256° nominal
- With switch: 243° nominal
- With rotary switch: 243° nominal

Rated Power Dissipation @40°C for P20 potentiometers:

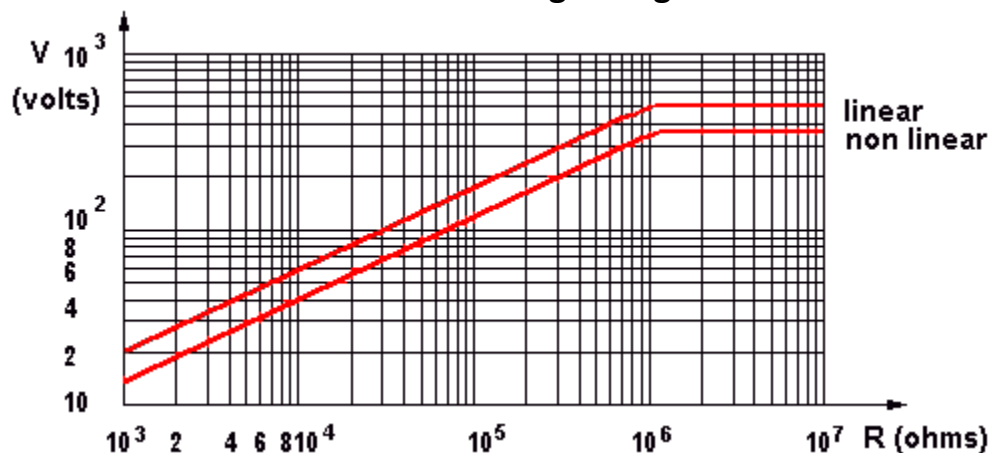
- 0.4W linear law
- 0.2W nonlinear law

P20 power dissipating curve



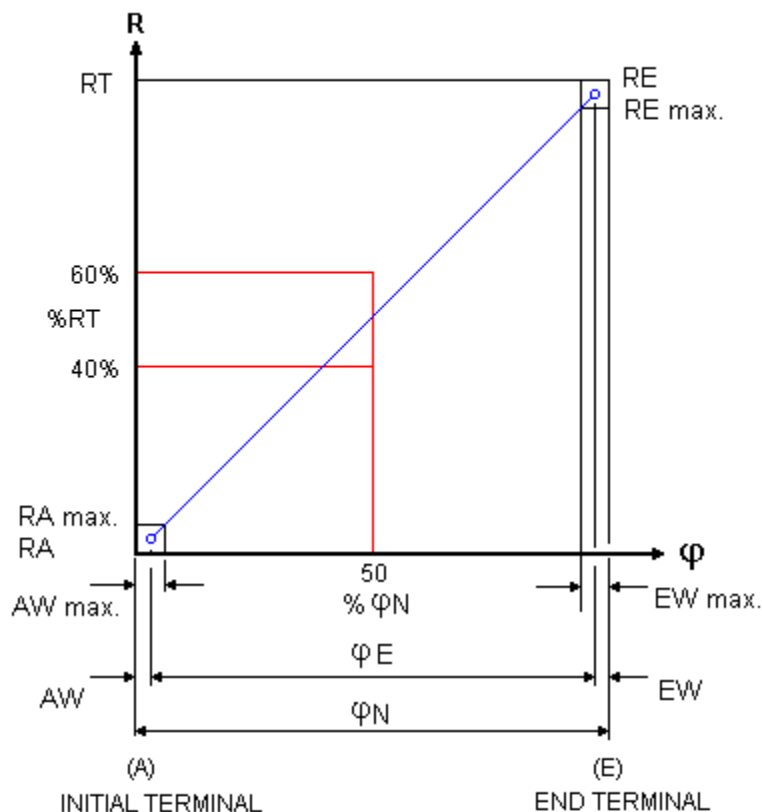
Limiting Element Voltage: 500 V DC for 20mm potentiometers

P20 maximum working voltage curve



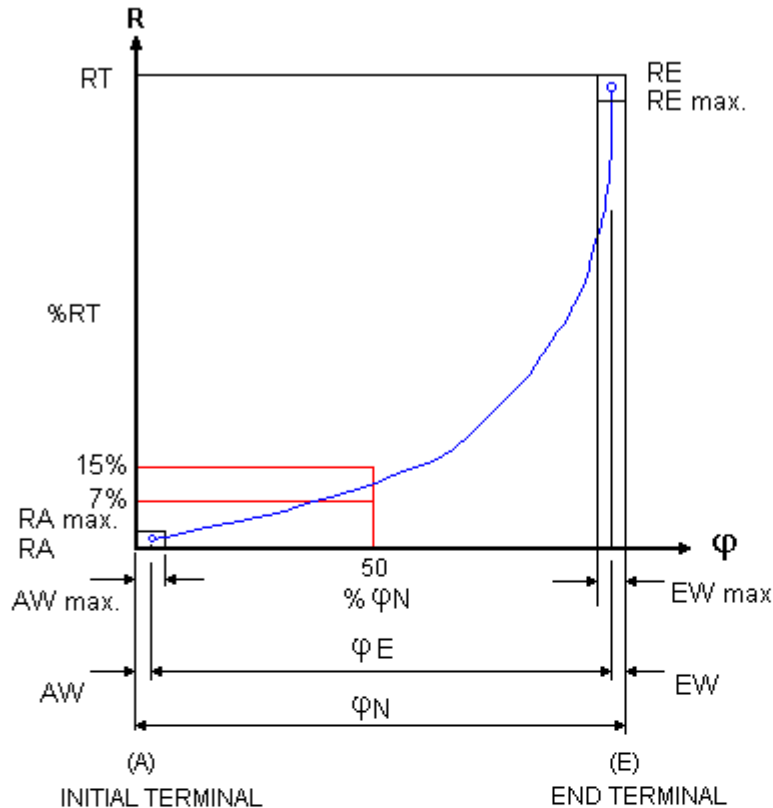
Insulating Voltage: 1000 V AC for 20mm potentiometers

Resistance law A - Linear



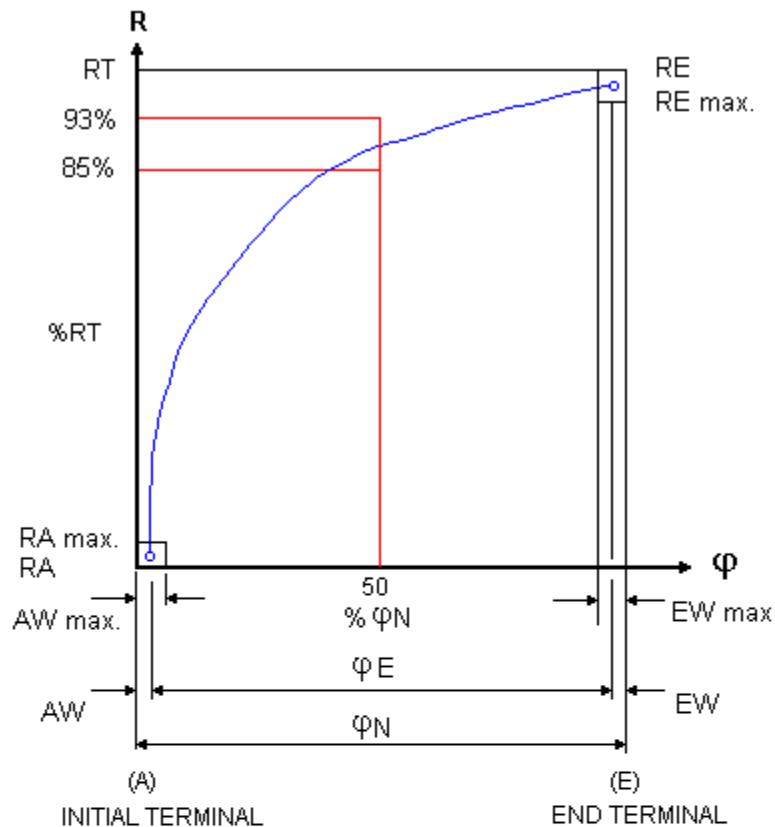
AW	Initial Path	AW max. 12% ϕN
EW	Final Path	EW max. 12% ϕN
Ra	Initial Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RA	Hop-on Resistance	$\leq 1\% RN$
Re	End Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RE	Hop-off Resistance	$\leq 1\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

Resistance law B – Log (Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RA	Hop-on Resistance	$RN \leq 10K$ 5% RN $RN > 10K$ 0.15% RN
Re	End Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RE	Hop-off Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K$ 0.5% RN
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

Resistance law C – Antilog (Reverse Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RA	Hop-on Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K 0.5\% RN$
Re	End Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RE	Hop-off Resistance	$RN \leq 10K 5\% RN$ $RN > 10K 0.15\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

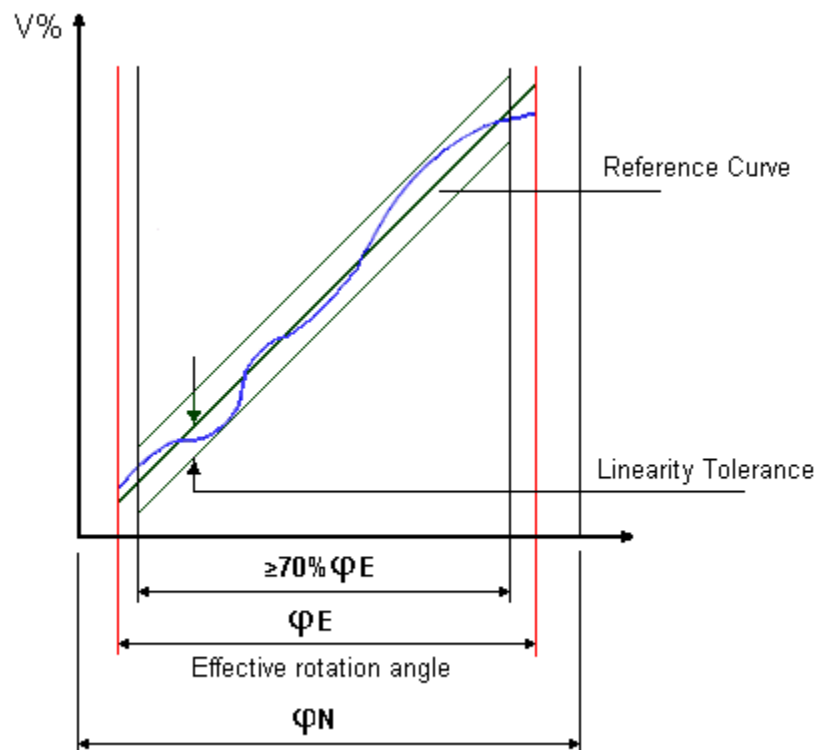
Linearity

As a basis of assessing Linearity Tolerance the independent method is the most practical, permitting as it does, the reference curve to be aligned as near as possible to the actual output curve. This avoids the use of the theoretical starting and finishing points, it is normal for the customer to realign the achieved curve with series trimmers at each end of the device if required.

Linearity Tolerance is 4% over the Nominal Resistance range of 1K0 to 1M0. The Linearity Tolerance is measured on at least 70% of the effective rotation range.

Note. In the case of Terminal and Zero-based linearity, both present constraints which increase the manufacturing difficulty and in consequence have an adverse effect on the product's price and availability.

Potentiometer linearity

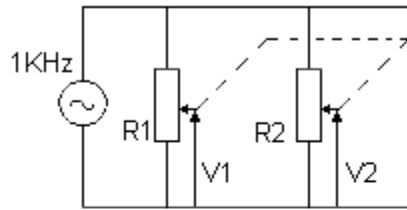


Matching Tolerance (For Tandem Stereo Potentiometers)

Tandem Potentiometers have two identical resistor units with the same variation law. The mismatching of the two resistor units, expressed in dB, is measured by the difference between the attenuations introduced by each resistor unit at various points of travel.

- Law A: 4 dB at Attenuation range 0 - 20 dB
- Law B and C: 3 dB at Attenuation range 0 - 20 dB

Matched Tolerance for Stereo

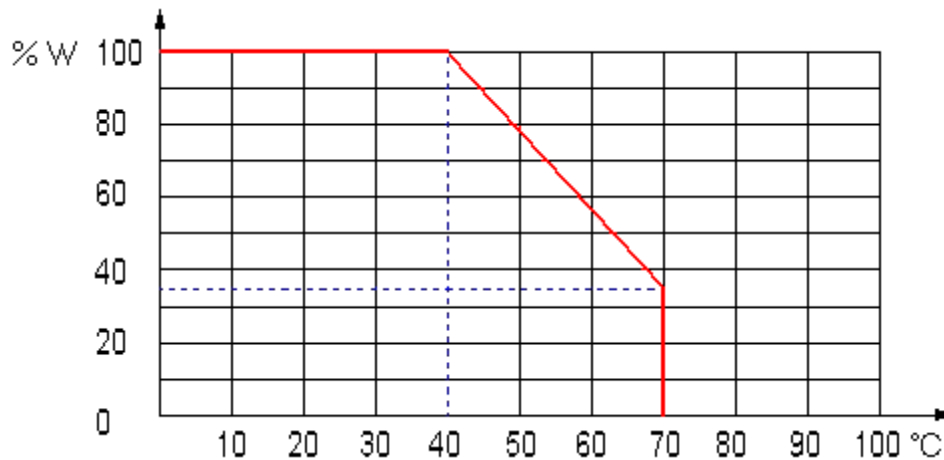


LAW	ATTENUATION RANGE	MATCHING TOLERANCE *
A	0 - 20dB	4dB
B & C	0 - 20dB	3dB

$$* \text{Matching Tolerance} = 20 \log \frac{V1}{V2}$$

Operating Temperature: -25°C to +70°C

Temperature Derating Curve



Temperature Coefficient of Resistance: +300 -500 ppm

P20 Spindles

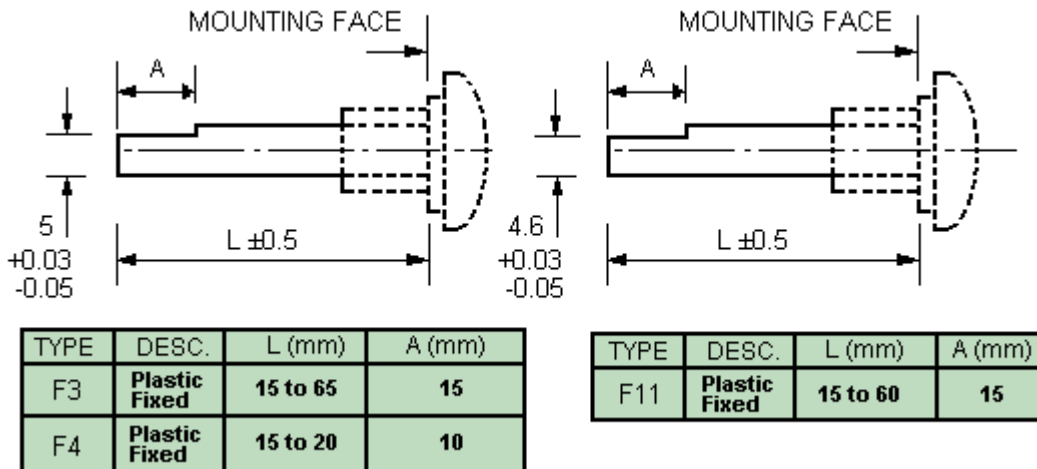
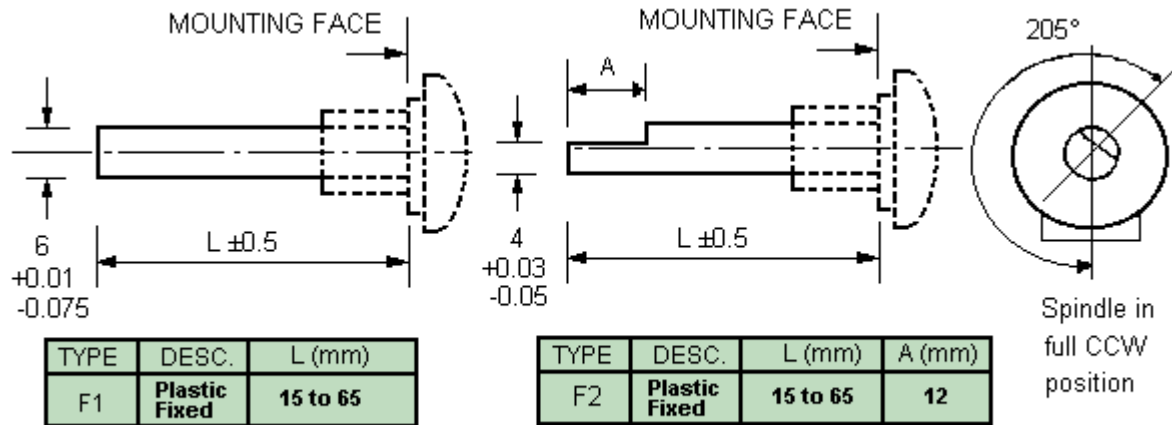
The P20 spindles are plastic and fixed i.e. not removable, unless otherwise stated and they are available in three diameters:

- 6.0mm Diameter
 - Cylindrical (Type F1)
 - 4.0 x 12mm Flat (Type F2)
 - 5.0 x 15mm Flat (Type F3)
 - 5.0 x 10mm Flat (Type F4)
 - 4.6mm x 15mm Flat (Type F11)
- 4.0mm Diameter
 - Cylindrical (Type F21)
 - 3.0 x 8.5mm Flat (Type F22)
 - 3.0 x 13.5mm Flat (Type F23)
 - Cylindrical (Type M21 - Metal)
 - 3.0 x 8.5mm Flat (Type M22 - Metal)
 - 3.0 x 13.5mm Flat (Type M23 - Metal)
- 6.35mm Diameter
 - Cylindrical (Type F41)
 - 5.5 x 10mm Flat (Type F42)
 - 5.5 x 15mm Flat (Type F43)
- Splined Spindle - 6.0mm dia. 18 teeth
- Dual Concentric
 - Flatted/Slotted (Type M15 - Metal)
 - Cylindrical (Type M16 - Metal)

6.0mm Diameter Spindles

Note: *Specials to customer's specification up to 65mm.

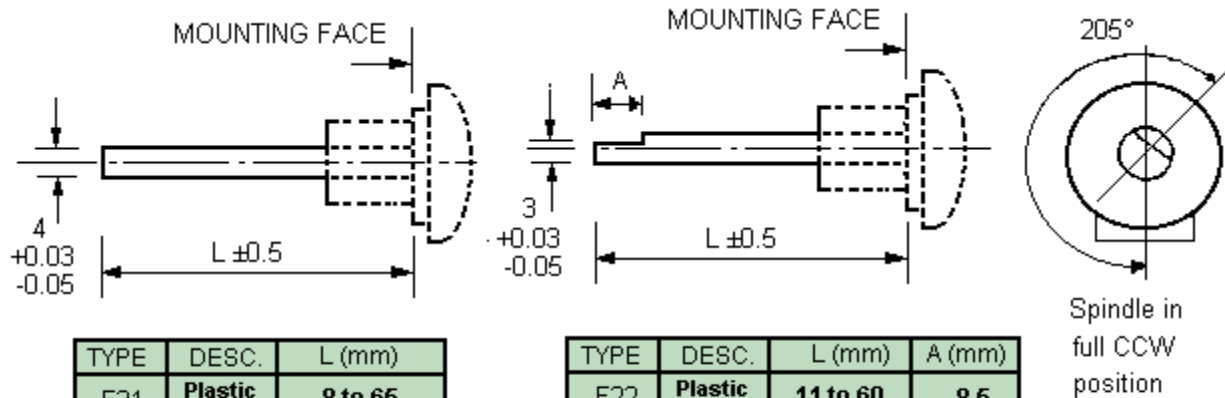
REMOVABLE SPINDLES, similar in specification to 'fixed' spindles are supplied separate from the potentiometer. These can be indefinitely taken in and out and their holding strength is >1kg.



4.0mm Diameter Spindles

Note: The orientation of the flat as illustrated is for plastic spindles only.

For metal spindles, unless specified on the order, the orientation may be different on each potentiometer type.

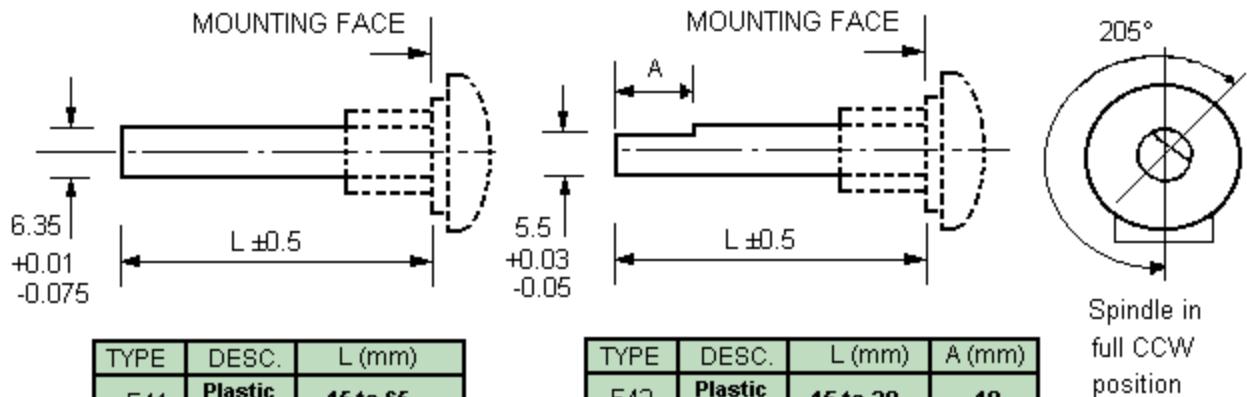


TYPE	DESC.	L (mm)
F21	Plastic Fixed	8 to 65
M21	Metal Fixed	8 to 65

TYPE	DESC.	L (mm)	A (mm)
F22	Plastic Fixed	11 to 60	8.5
M22	Metal Fixed	11 to 60	8.5
F23	Plastic Fixed	16 to 60	13.5
M23	Metal Fixed	16 to 60	13.5

6.35mm Diameter Spindles

Note: *Specials to customer's specification up to 65mm.

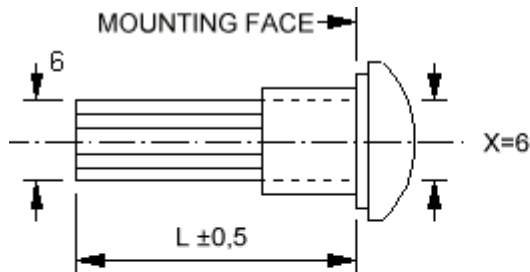


TYPE	DESC.	L (mm)
F41	Plastic Fixed	15 to 65

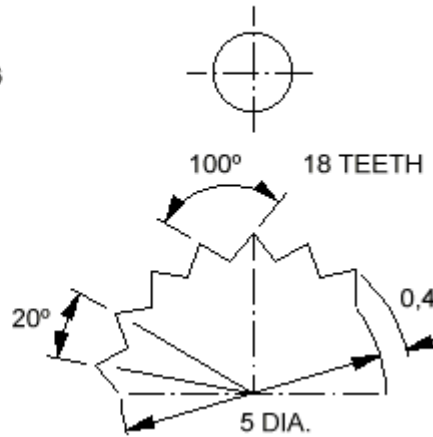
TYPE	DESC.	L (mm)	A (mm)
F42	Plastic Fixed	15 to 20	10
F43	Plastic Fixed	20 to 60	15

Splined Spindle - 6.0mm dia. 18 teeth

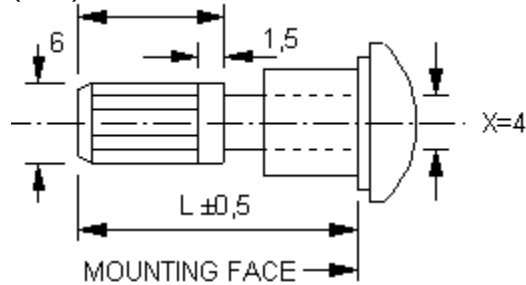
A splined form is available on the 6.0mm diameter P20 plastic spindle (F5) or alternatively a 6mm 'Splined Adaptor' (8,7mm long) can be fitted on a 4mm dia. Spindle



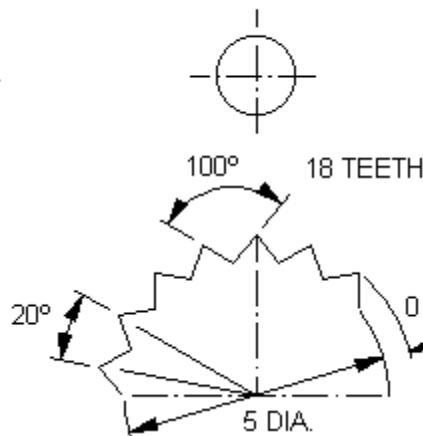
TYPE	DESC.	L (mm)
F5	Plastic Fixed	19



(F5A):



TYPE	DESC.	L (mm)
F5A	Plastic Fixed	16-36

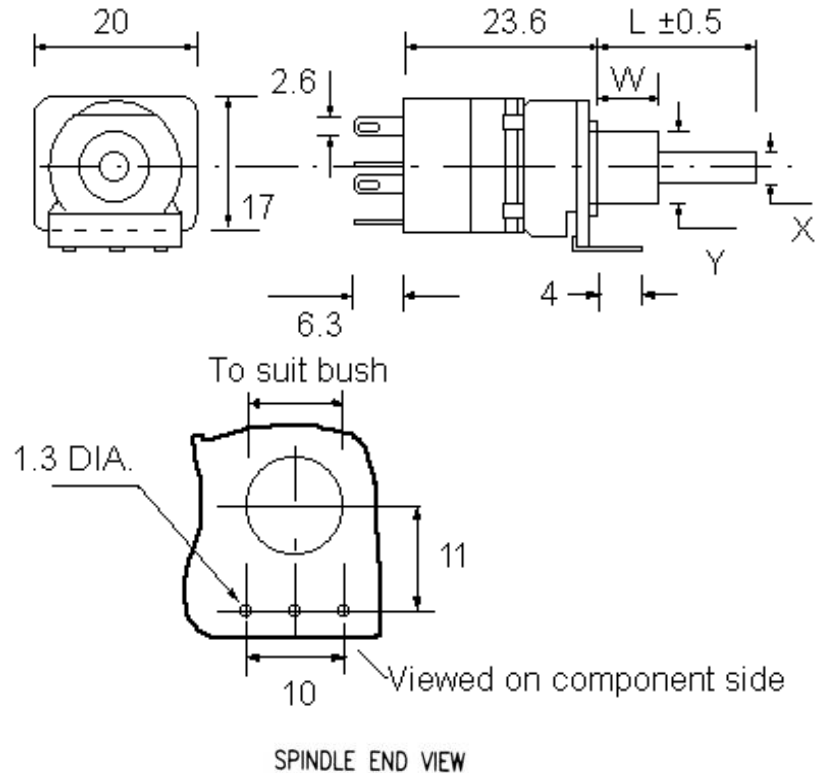
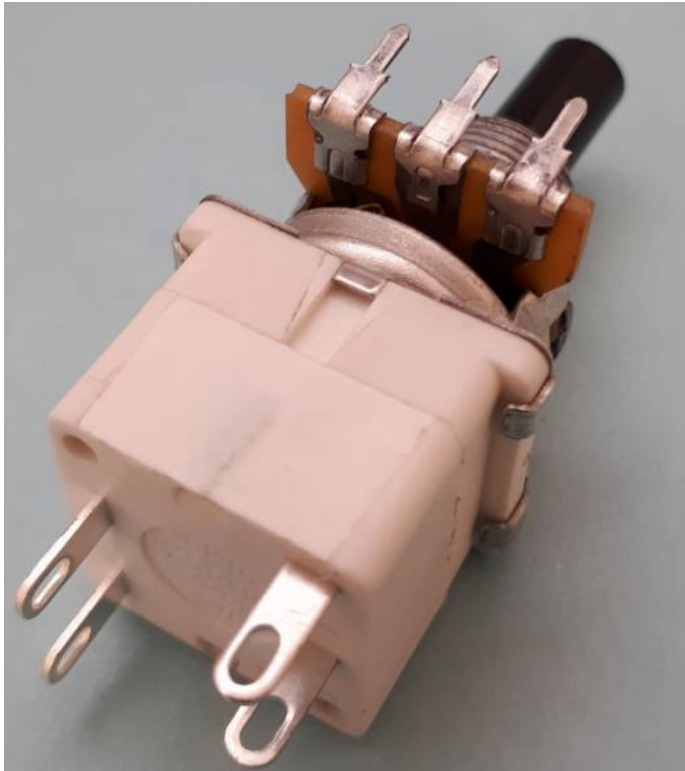


LT16BU/B4OW2S

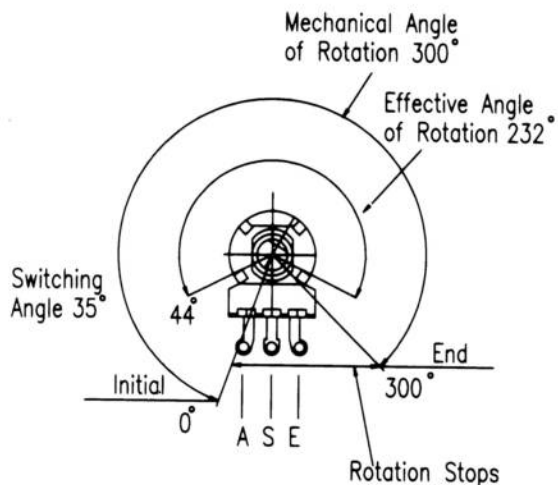
B4OW2S – 4 Amp Double Pole (Single Throw) Switch

OW – Ordinary Wiring Terminals (for soldering)

LT – Terminals bent Long Towards Spindle on potentiometer



- W Mounting Height
- Y Mounting Diameter
- X Spindle Diameter
- L Spindle Length
- A Initial Termination
- S Wiper (or moving contact) termination
- E End Termination



Total mechanical and effective electrical angles of rotation of potentiometers with rotary switch



P16 Range Technical Data

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Rotation angle: $270^{\circ} \pm 5^{\circ}$ (Unswitched), $300^{\circ} \pm 5^{\circ}$ (Switched)

Operating Torque: 0.4 – 2.0 N.cm (Initial Torque may be higher)

Rotational torque of spindle can be made high or low

Detents (stop positions) Available: Centre, 11, 21, 31, 41

Permissible Axial Spindle Load: 50 N (5 Sec. maximum)

Permissible Torque at End Stop: 35 N.cm

ELECTRICAL SPECIFICATION

Rated Power Dissipation @40°C for ECO potentiometers:

0.25W linear law

0.12W nonlinear law

Rotation angle: $270^{\circ} \pm 5^{\circ}$ (Unswitched), $300^{\circ} \pm 5^{\circ}$ (Switched)

Effective rotation: 232° nominal

Insulation Resistance: ≥ 4 Gohms

Rated Resistance: E3 Series

- Optional: E6 Series
- Linear Law: 1K - 1M
- Nonlinear Law: 4K7 - 470K

Tolerance on Rated Resistance: $\pm 20\%$

- Optional Tolerance on 1K - 1M: $\pm 10\%$

Resistance Laws (Taper):

- Linear: A
- Nonlinear: B - Log (Audio) or C - Antilog (Reverse Audio)
- Other laws: Please refer to Sales office

Rotary Switch Specification

The rotary switch modules are manufactured to EN61058-1 standard using high quality materials with a flame retardant housing. Although no longer certified due to the excessive cost of maintaining approvals, the 1 Amp and 4 Amp switch series have both been previously certified by UL International Demko (copies of previous certificates are available on our website or on request). The same materials, components and production techniques are used as in the certified versions and Omeg Ltd continues to test to the EN61058-1 standard

The 1 Amp contact rating is only available when mounted on the ECO potentiometer

1 A Contact Rating:

Note: The 1A contact rating is NOT available for mounting on the P16 or P20 potentiometer.

1A/250Vac 2.5A/12Vdc

Surge rating (0.01 seconds): 20A

Contact gap: 3mm (Full mains separation of contacts)

Manufactured to EN61058-1 standard

4 A Contact Rating:

4A/250Vac 10A/12Vdc

Surge rating (0.01 seconds): 80A

Switch contacts: Silver tin oxide

Contact gap: 2mm (Micro disconnection of switch - micro separation of contacts)

Manufactured to EN61058-1 standard

Common features

Housing material: Flame Retardant Glass filled polyester (UL 94 VO)

Initial contact resistance: 20 milliohms

Insulation resistance: 50,000 Megohms

Life (operations at full load): 10,000 minimum

Operating temperature: -25°C to +70°C

Operating torque for SPST/SPDT: 1.5 - 3 cNm

Operating torque for DPST/DPDT: 3.0 - 6 cNm

Mechanical rotation: 300°

Proof voltage: 3kV minimum

Rotary Switch Terminals

Layout

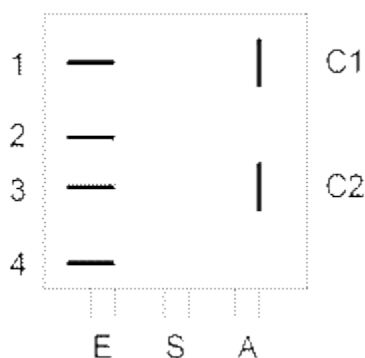


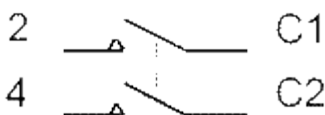
Diagram as viewed on the rear of the switch module:

(Potentiometer terminals at the bottom)

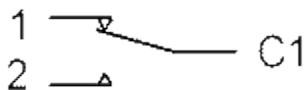
Configuration



SPST - Single pole (1S), Single throw (On-Off)

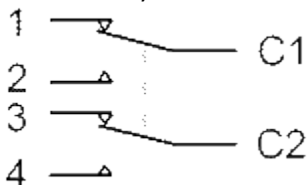


DPST - Double pole (2S), Single throw (On-Off)



SPDT - Single pole (1S), Double throw (CH)

(**NOT** certified)



DPDT - Double pole (2S), Double throw (CH)

(**NOT** certified)

Notes

1. Moving contact(s) shown when the potentiometer shaft is in a counterclockwise (CCW) position.
2. 'Ordinary Wiring'(OW) or 'Printed Circuit'(PC) terminals can be requested on the switch.
3. Terminals 1 and 3 are only fitted for the Double Throw ('CH' or Changeover) versions which are **NOT** approved nor certified.

Rotary Switch Terminals



Standard (1A or 4A contact ratings)

N/O normally OPEN Switch

Contacts normally OPEN;

CLOCKwise rotation to CLOSE contacts

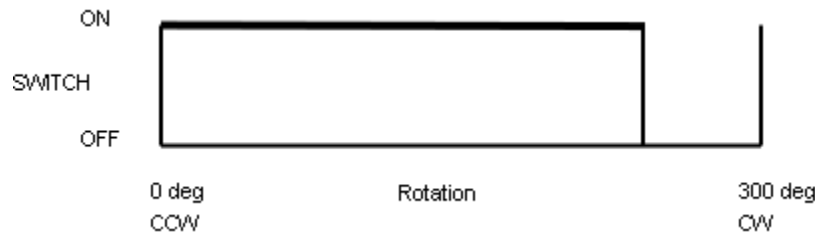


Option 1 (4A contact rating only)

N/C normally CLOSED Switch

Contacts normally CLOSED;

CLOCKwise rotation to OPEN contacts

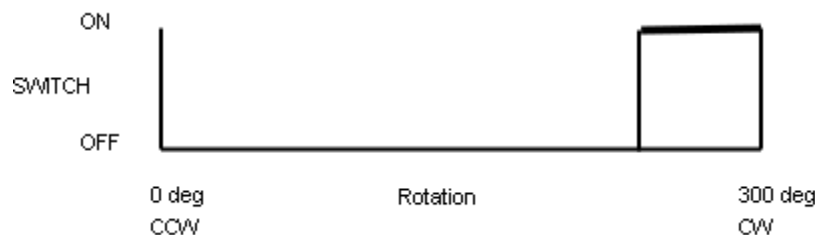


Option 2 (4A contact rating only)

REVERSED N/O normally OPEN Switch

Contacts normally OPEN at fully clockwise position;

ANTI-clockwise rotation to CLOSE contacts



Option 3 (4A contact rating only)

REVERSED N/C normally CLOSED Switch

Contacts normally CLOSED at fully clockwise position;

ANTI-clockwise rotation to OPEN contacts

ELECTRICAL SPECIFICATION UNIQUE TO P16 POTENTIOMETERS

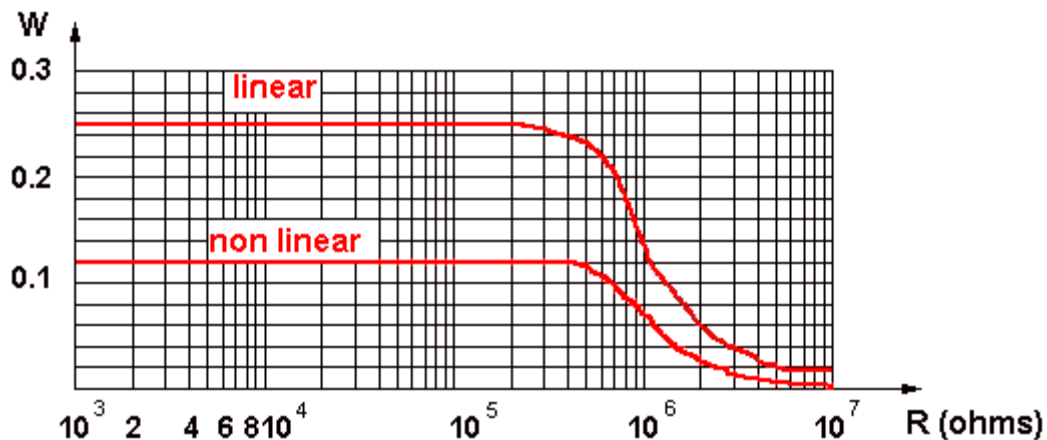
Effective rotation:

- Without a switch: 232° nominal
- With rotary switch: 232° nominal

Rated Power Dissipation @40°C for ECO potentiometers:

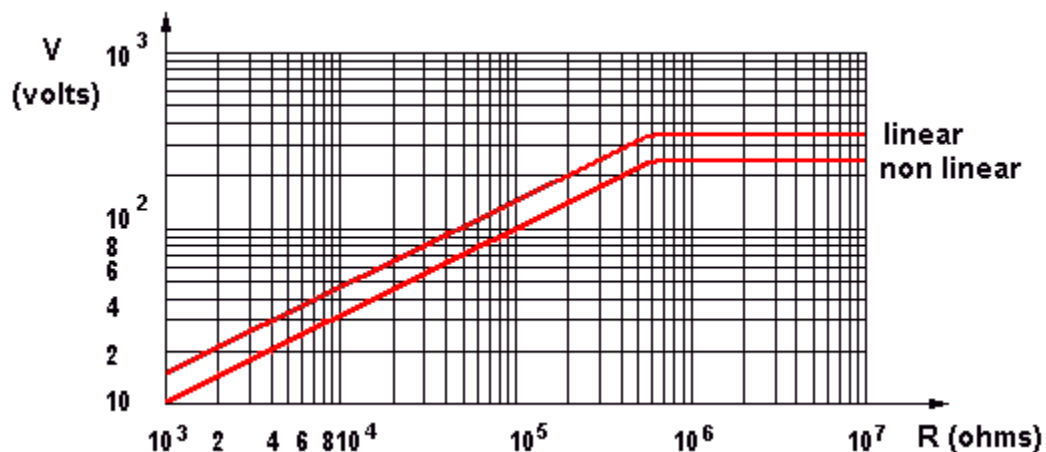
- 0.25W linear law
- 0.12W nonlinear law

ECO, P16 power dissipating curve



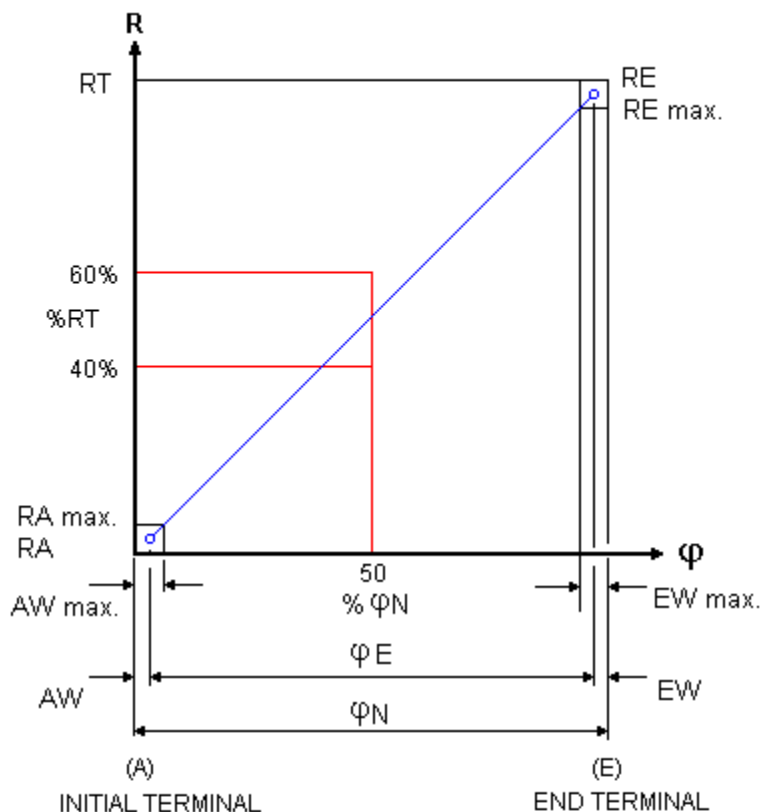
Limiting Element Voltage: 350 V DC for 16mm potentiometers

ECO, P16 maximum working voltage curve



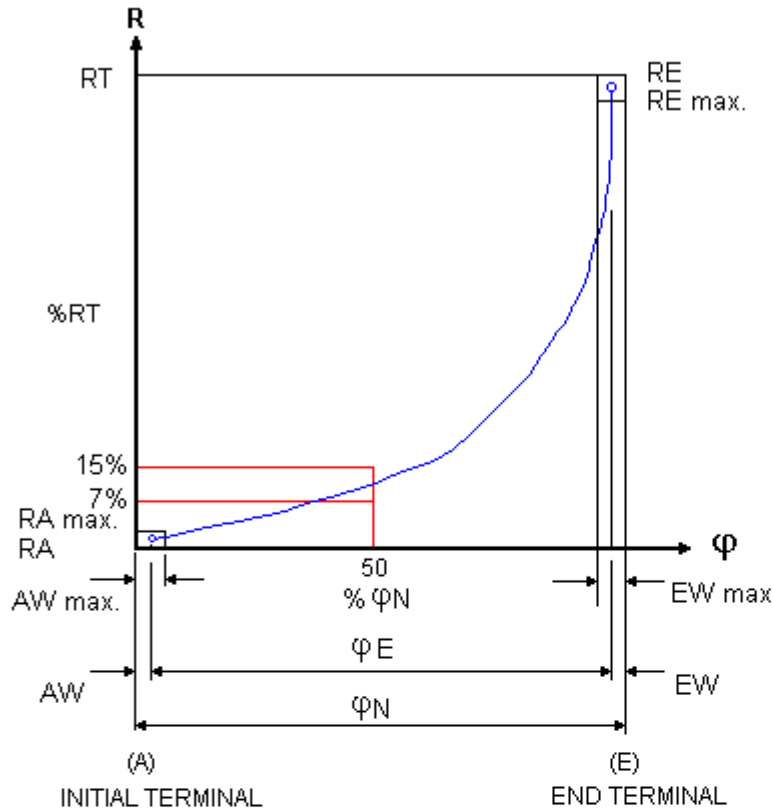
Insulating Voltage: 500 V AC for ECO potentiometers

Resistance law A - Linear



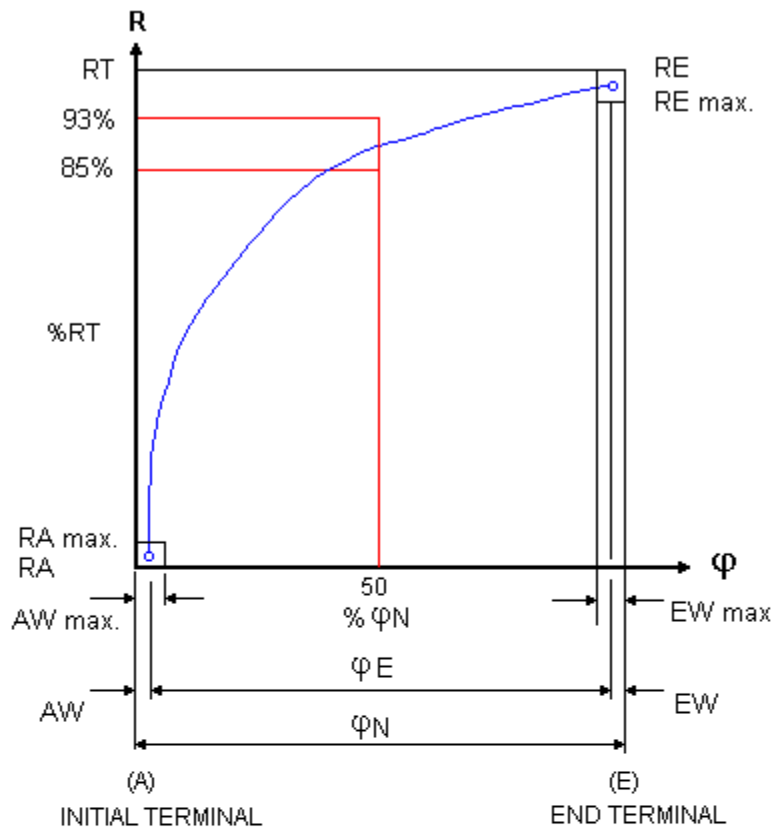
AW	Initial Path	AW max. 12% ϕN
EW	Final Path	EW max. 12% ϕN
Ra	Initial Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RA	Hop-on Resistance	$\leq 1\% RN$
Re	End Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RE	Hop-off Resistance	$\leq 1\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

Resistance law B – Log (Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RA	Hop-on Resistance	$RN \leq 10K$ 5% RN $RN > 10K$ 0.15% RN
Re	End Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RE	Hop-off Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K$ 0.5% RN
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

Resistance law C – Antilog (Reverse Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RA	Hop-on Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K 0.5\% RN$
Re	End Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RE	Hop-off Resistance	$RN \leq 10K 5\% RN$ $RN > 10K 0.15\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

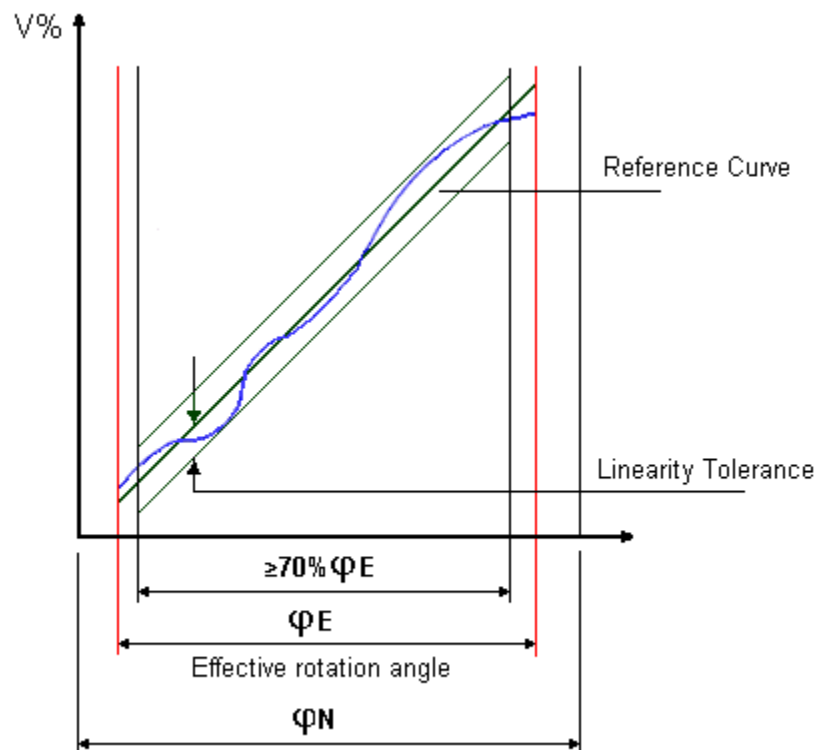
Linearity

As a basis of assessing Linearity Tolerance the independent method is the most practical, permitting as it does, the reference curve to be aligned as near as possible to the actual output curve. This avoids the use of the theoretical starting and finishing points, it is normal for the customer to realign the achieved curve with series trimmers at each end of the device if required.

Linearity Tolerance is 4% over the Nominal Resistance range of 1K0 to 1M0. The Linearity Tolerance is measured on at least 70% of the effective rotation range.

Note. In the case of Terminal and Zero-based linearity, both present constraints which increase the manufacturing difficulty and in consequence have an adverse effect on the product's price and availability.

Potentiometer linearity

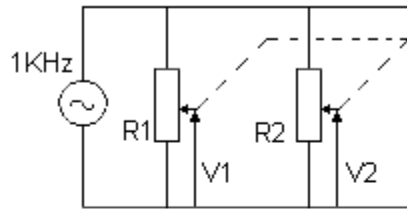


Matching Tolerance (For Tandem Stereo Potentiometers)

Tandem Potentiometers have two identical resistor units with the same variation law. The mismatching of the two resistor units, expressed in dB, is measured by the difference between the attenuations introduced by each resistor unit at various points of travel.

- Law A: 4 dB at Attenuation range 0 - 20 dB
- Law B and C: 3 dB at Attenuation range 0 - 20 dB

Matched Tolerance for Stereo

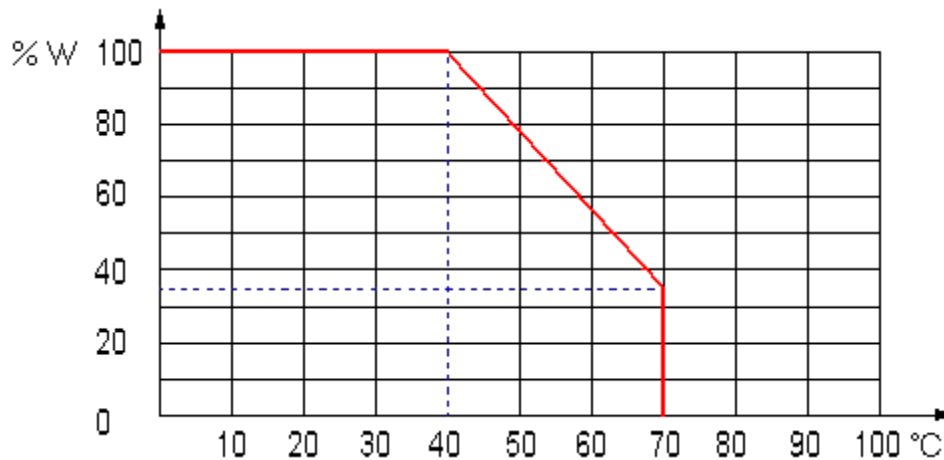


LAW	ATTENUATION RANGE	MATCHING TOLERANCE *
A	0 - 20dB	4dB
B & C	0 - 20dB	3dB

$$* \text{Matching Tolerance} = 20 \log \frac{V1}{V2}$$

Operating Temperature: -25°C to +70°C

Temperature Derating Curve



Temperature Coefficient of Resistance: +300 -500 ppm

Components

P16 Bush Housing (Mounting)

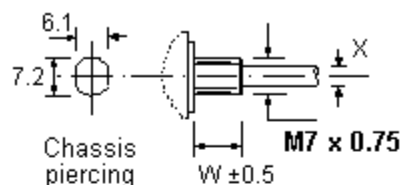
The P16 bushes are available in metal or nylon with an M7 or M10 thread both with and without a locating feature:

Diecast Zinc Alloy M10 x 0.75mm pitch (Type C) or M7 0.75mm pitch (Type CG)

Glass Filled Nylon M10 x 0.75mm pitch (Type CP)

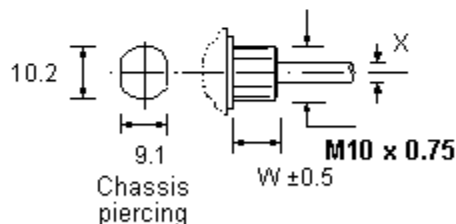
Do not attempt to prevent any unwanted body rotation by overtightening the retaining nut, since this can cause thread damage, distortion, change of electrical resistance and restrict shaft rotation. BS9130:1972 provides further details on this topic. The **recommended torque** for tightening the retaining nut is 45cN.m and this can be achieved cost effectively by using a Torque Limiting device as shown on our **Accessories** page.

DIECAST ZINC ALLOY



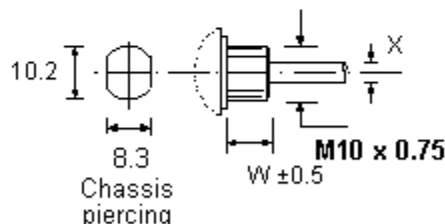
TYPE CG (without locator)	
X (mm)	4
W (mm)	6

DIECAST ZINC ALLOY



TYPE C (without locator)	
X (mm)	6 or 6.35
W (mm)	8

GLASS FILLED NYLON



TYPE CP (GFN)	
X (mm)	4 or 6
W (mm)	8

P16 Spindles

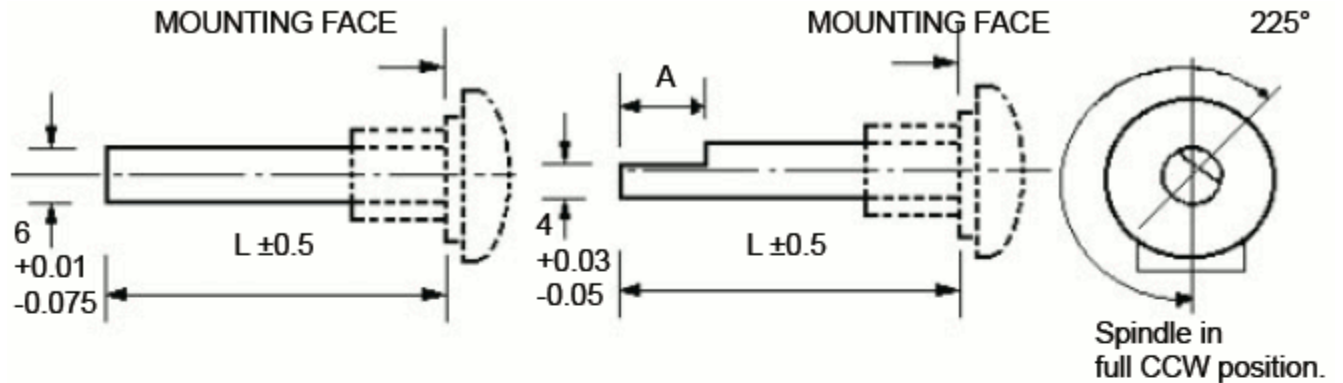
The P16 spindles are plastic, unless otherwise stated, fixed i.e. not removable and they are available in three diameters:

- 6.0mm Diameter
 - Cylindrical (Type F1)
 - 4.0 x 12mm Flat (Type F2)
 - 5.0 x 15mm Flat (Type F3)
 - 5.0 x 10mm Flat (Type F4)
 - 4.6mm x 15mm Flat (Type F11)
- 4.0mm Diameter
 - Cylindrical (Type F21)
 - 3.0 x 8.5mm Flat (Type F22)
 - 3.0 x 8.5mm Flat (Type M22 - Metal)
- 6.35mm Diameter
 - Cylindrical (Type F41)
 - 5.5 x 10mm Flat (Type F42)
 - 5.5 x 15mm Flat (Type F43)
- Splined Spindle - 6.0mm dia. 18 teeth
- Dual Concentric
 - Flatted/Slotted (Type M15 - Metal)
 - Cylindrical (Type M16 - Metal)

Cylindrical and Flatted Spindles

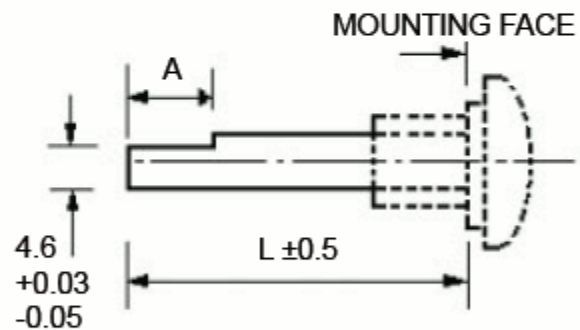
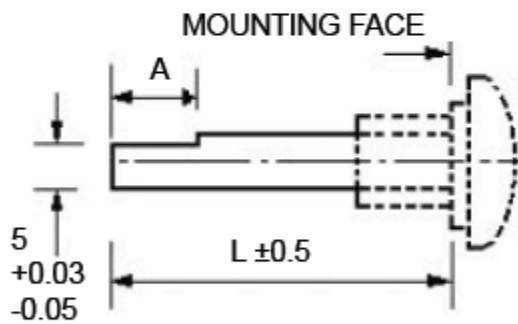
6.0mm Diameter Spindles

Note: *Specials to customer's specification up to 65mm.



TYPE	DESC.	L (mm)
F1	Plastic Fixed	15 to 50*

TYPE	DESC.	L (mm)	A (mm)
F2	Plastic Fixed	20 to 35*	12

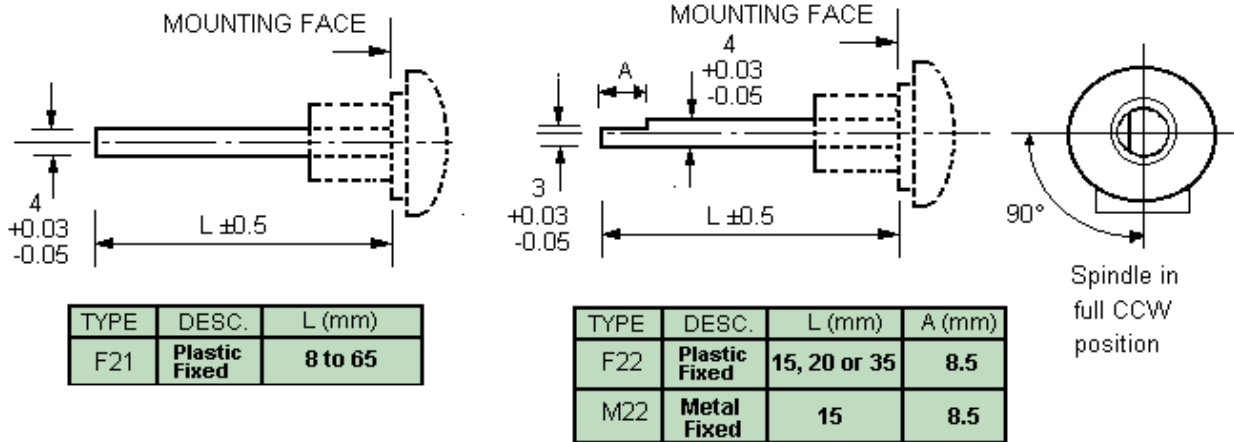


TYPE	DESC.	L (mm)	A (mm)
F3	Plastic Fixed	15 to 35*	15
F4	Plastic Fixed	15 to 35*	10

TYPE	DESC.	L (mm)	A (mm)
F11	Plastic Fixed	15 to 35*	15

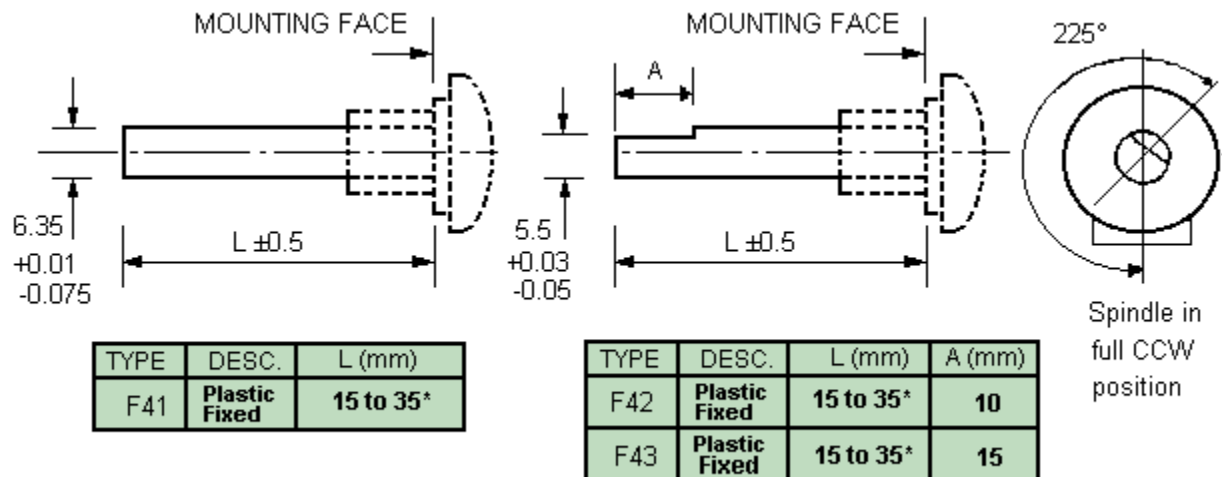
4.0mm Diameter Spindles

Note: The orientation of the flat as illustrated is for plastic spindles only.
 For metal spindles, unless specified on the order, the orientation may be different on each potentiometer type



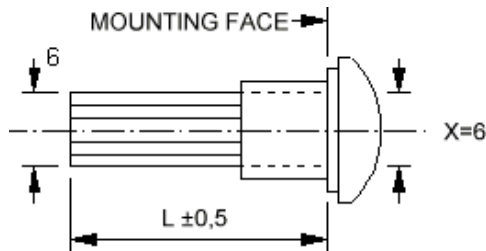
6.35mm Diameter Spindles

Note: *Specials to customer's specification up to 65mm.

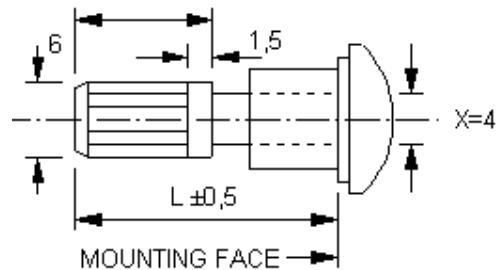
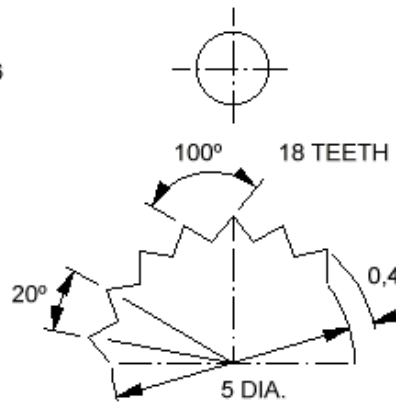


Splined Spindle - 6.0mm dia. 18 teeth

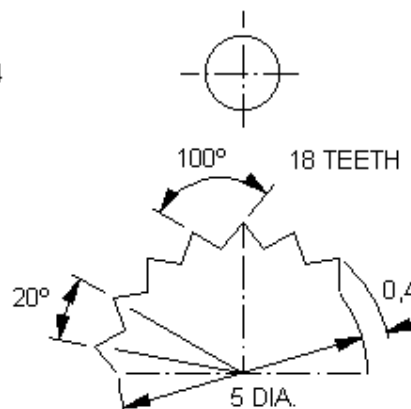
A splined form is available on the 6.0mm diameter P16 plastic spindle (F5)
 or alternatively,
 a 6mm 'Splined Adaptor' (8.7mm long) can be fitted on a 4mm dia. Spindle (F5A):



TYPE	DESC.	L (mm)
F5	Plastic Fixed	19



TYPE	DESC.	L (mm)
F5A	Plastic Fixed	16-36

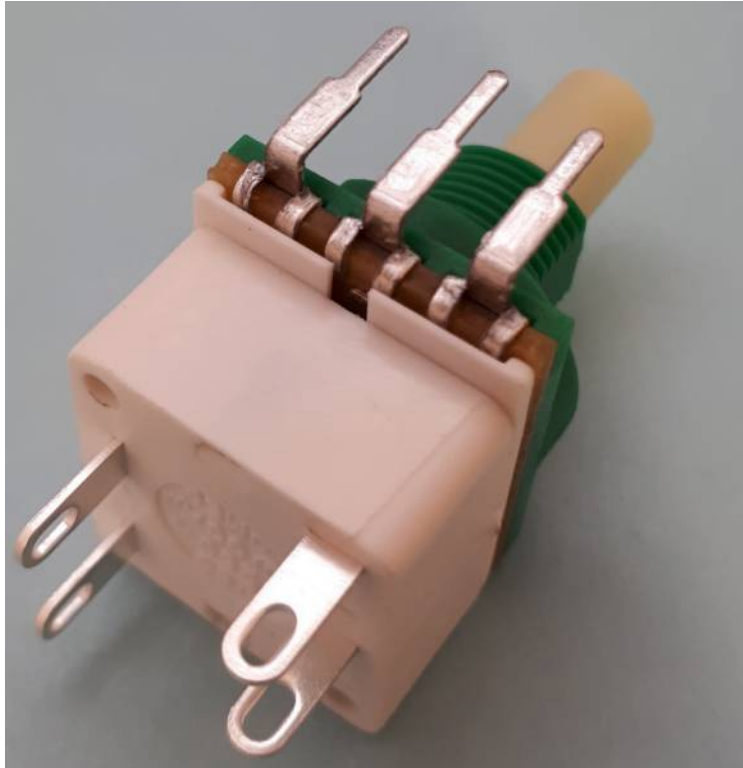


LT16ECO/B4OW2S

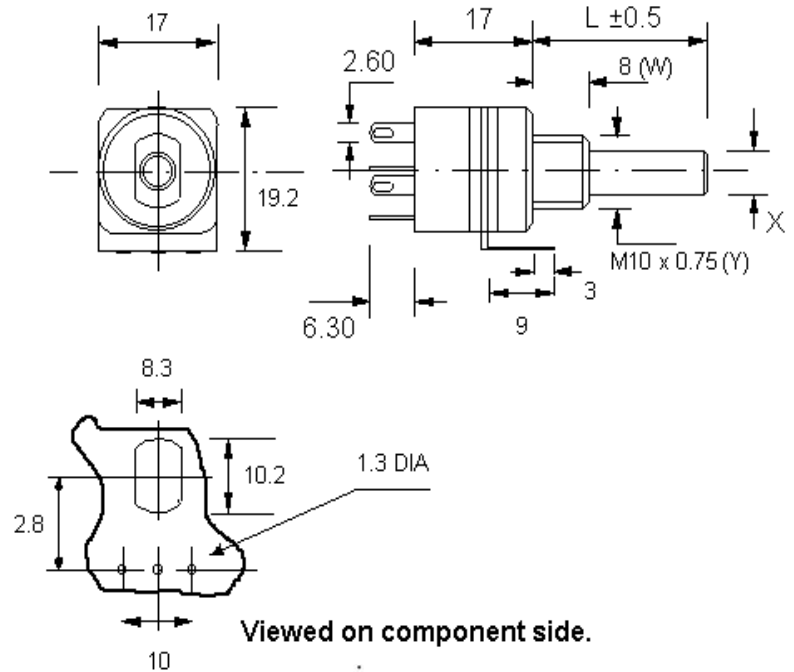
B4OW2S - 4 Amp Double Pole (Single Throw) Switch

OW – Ordinary Wiring Terminals (for soldering)

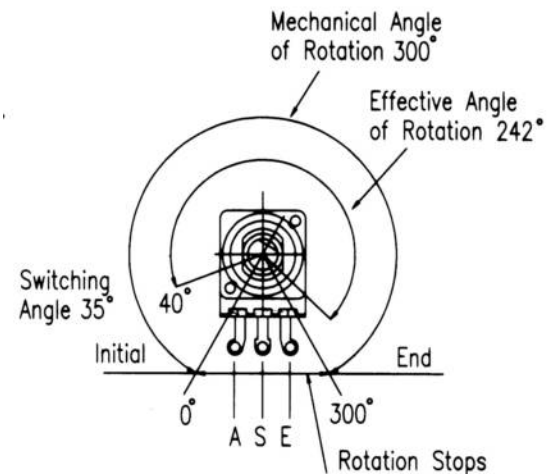
LT – Long Terminals bent Towards the Spindle



SWITCH ORDINARY WIRING (OW) TERMINALS.



SPINDLE END VIEW



Total mechanical and effective electrical angles of rotation of potentiometers with rotary switch

- W Mounting Height
- Y Mounting Diameter
- X Spindle Diameter
- L Spindle Length
- A Initial Termination
- S Wiper (or moving contact) termination
- E End Termination



ECO Range Technical Data

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Rotation angle: $300^{\circ} \pm 5^{\circ}$ (Switched and Unswitched)

Operating Torque: 0.4 – 2.0 N.cm (Initial Torque may be higher)

Rotational torque of spindle can be made high or low

Detents (stop positions) Available: Centre, 11, 21, 31

Permissible Axial Spindle Load: 50 N (5 Sec. maximum)

Permissible Torque at End Stop: 35 N.cm

ELECTRICAL SPECIFICATION

Rated Power Dissipation @40°C for ECO potentiometers:

0.25W linear law

0.12W nonlinear law

Rotation angle: $300^{\circ} \pm 5^{\circ}$

Effective rotation - Unswitched: 265° nominal

Effective rotation - Switched: 242° nominal

Insulation Resistance: ≥ 4 Gohms

Rated Resistance: E3 Series

- Optional: E6 Series
- Linear Law: 1K - 1M
- Nonlinear Law: 4K7 - 470K

Tolerance on Rated Resistance: $\pm 20\%$

- Optional Tolerance on 1K - 1M: $\pm 10\%$

Resistance Laws (Taper):

- Linear: A
- Nonlinear: B - Log (Audio) or C - Antilog (Reverse Audio)
- Other laws: Please refer to Sales office

Rotary Switch Specification

The rotary switch modules are manufactured to EN61058-1 standard using high quality materials with a flame retardant housing. Although no longer certified due to the excessive cost of maintaining approvals, the 1 Amp and 4 Amp switch series have both been previously certified by UL International Demko (copies of previous certificates are available on our website or on request). The same materials, components and production techniques are used as in the certified versions and Omeg Ltd continues to test to the EN61058-1 standard

The 1 Amp contact rating is only available when mounted on the ECO potentiometer

1 A Contact Rating:

Note: The 1A contact rating is NOT available for mounting on the P16 or P20 potentiometer.

1A/250Vac 2.5A/12Vdc

Surge rating (0.01 seconds): 20A

Contact gap: 3mm (Full mains separation of contacts)

Manufactured to EN61058-1 standard

4 A Contact Rating:

4A/250Vac 10A/12Vdc

Surge rating (0.01 seconds): 80A

Switch contacts: Silver tin oxide

Contact gap: 2mm (Micro disconnection of switch - micro separation of contacts)

Manufactured to EN61058-1 standard

Common features

Housing material: Flame Retardant Glass filled polyester (UL 94 VO)

Initial contact resistance: 20 milliohms

Insulation resistance: 50,000 Megohms

Life (operations at full load): 10,000 minimum

Operating temperature: -25°C to +70°C

Operating torque for SPST/SPDT: 1.5 - 3 cNm

Operating torque for DPST/DPDT: 3.0 - 6 cNm

Mechanical rotation: 300°

Proof voltage: 3kV minimum

Rotary Switch Terminals

Layout

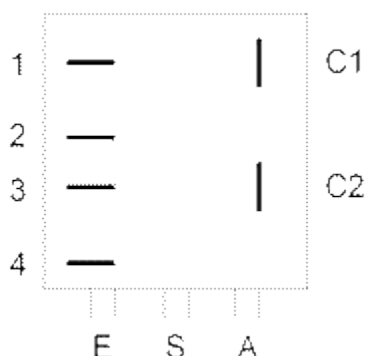


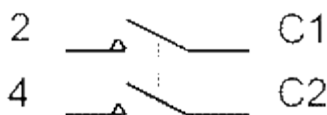
Diagram as viewed on the rear of the switch module:

(Potentiometer terminals at the bottom)

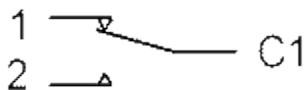
Configuration



SPST - Single pole (1S), Single throw (On-Off)

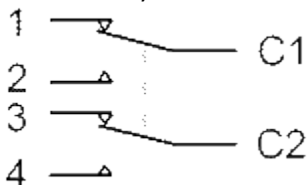


DPST - Double pole (2S), Single throw (On-Off)



SPDT - Single pole (1S), Double throw (CH)

(**NOT** certified)



DPDT - Double pole (2S), Double throw (CH)

(**NOT** certified)

Notes

1. Moving contact(s) shown when the potentiometer shaft is in a counterclockwise (CCW) position.
2. 'Ordinary Wiring'(OW) or 'Printed Circuit'(PC) terminals can be requested on the switch.
3. Terminals 1 and 3 are only fitted for the Double Throw ('CH' or Changeover) versions which are **NOT** approved nor certified.

Rotary Switch Terminals



Standard (1A or 4A contact ratings)

N/O normally OPEN Switch

Contacts normally OPEN;

CLOCKwise rotation to CLOSE contacts

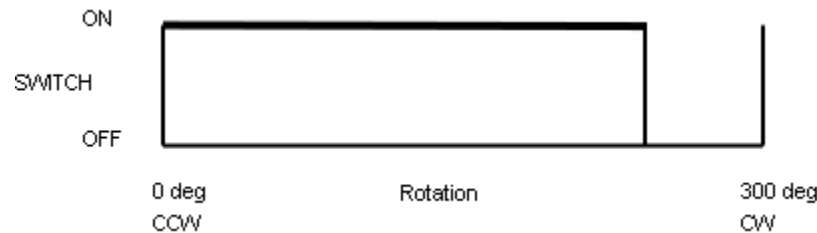


Option 1 (4A contact rating only)

N/C normally CLOSED Switch

Contacts normally CLOSED;

CLOCKwise rotation to OPEN contacts

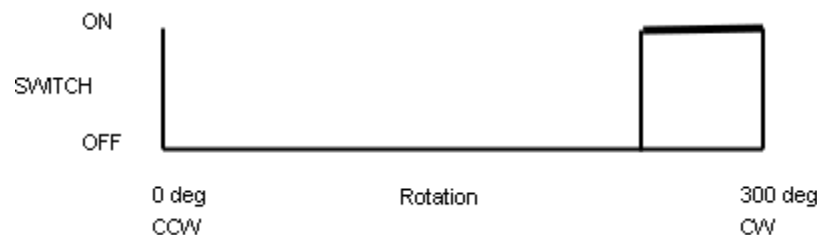


Option 2 (4A contact rating only)

REVERSED N/O normally OPEN Switch

Contacts normally OPEN at fully clockwise position;

ANTI-clockwise rotation to CLOSE contacts



Option 3 (4A contact rating only)

REVERSED N/C normally CLOSED Switch

Contacts normally CLOSED at fully clockwise position;

ANTI-clockwise rotation to OPEN contacts

ELECTRICAL SPECIFICATION UNIQUE TO ECO POTENTIOMETERS

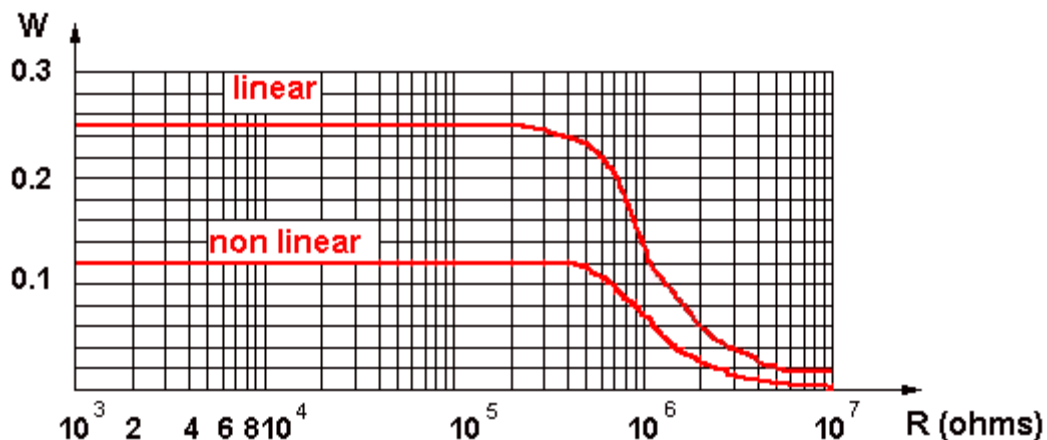
Effective rotation:

- Without a switch: 265° nominal
- With push push switch (/10APP, /MS): 265° nominal
- With rotary switch: 242° nominal

Rated Power Dissipation @40°C for ECO potentiometers:

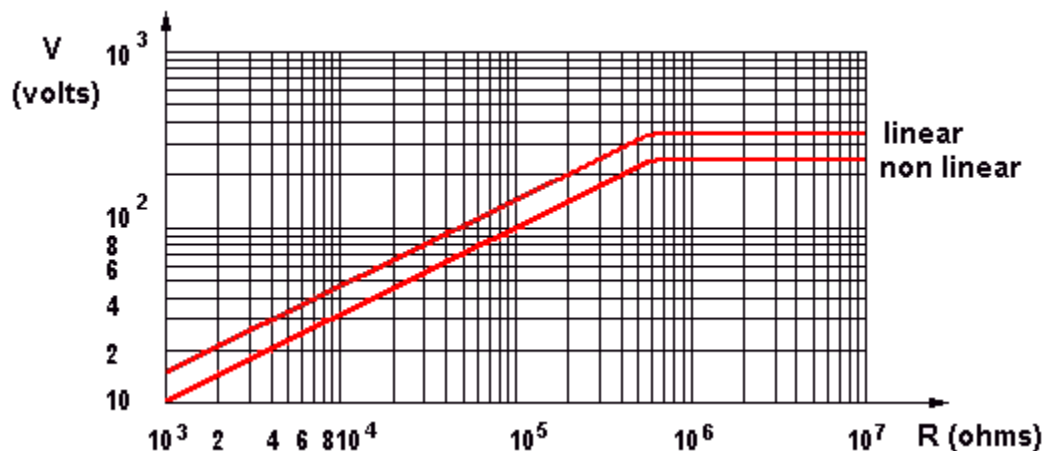
- 0.25W linear law
- 0.12W nonlinear law

ECO, P16 power dissipating curve



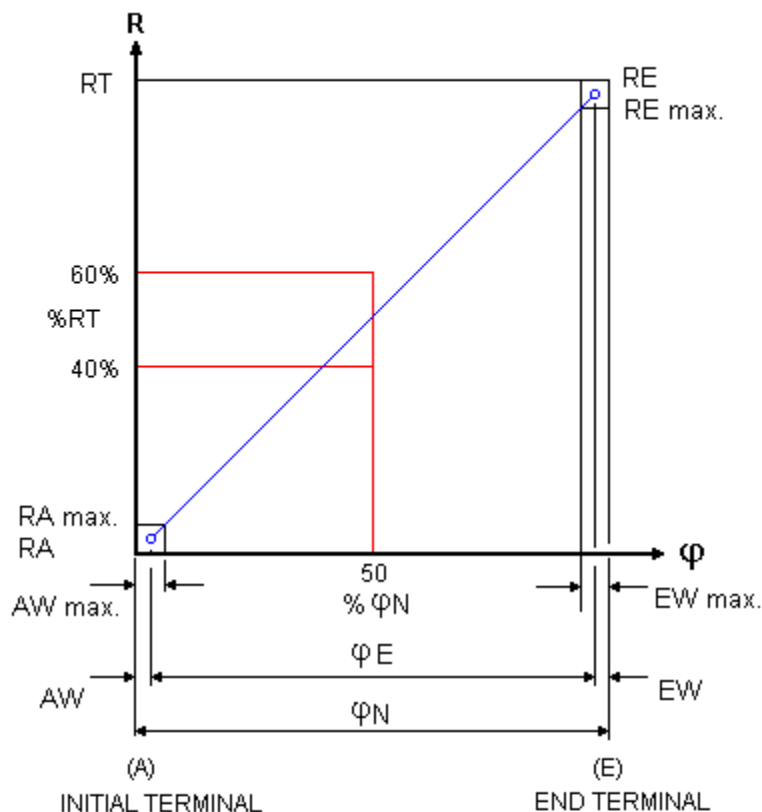
Limiting Element Voltage: 350 V DC for 16mm potentiometers

ECO, P16 maximum working voltage curve



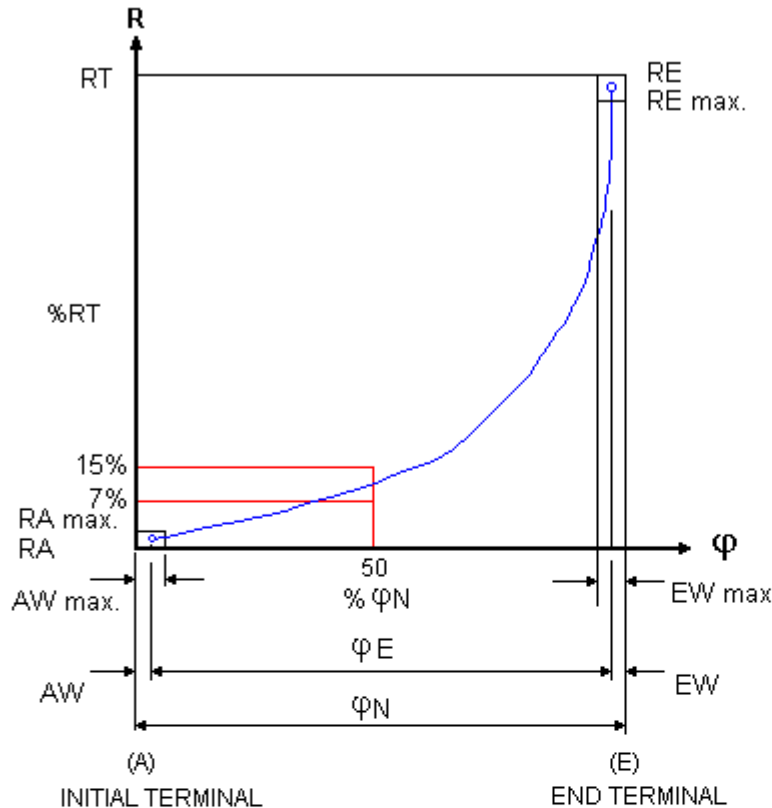
Insulating (Breakdown) Voltage: 2,500 V AC for ECO Potentiometers

Resistance law A - Linear



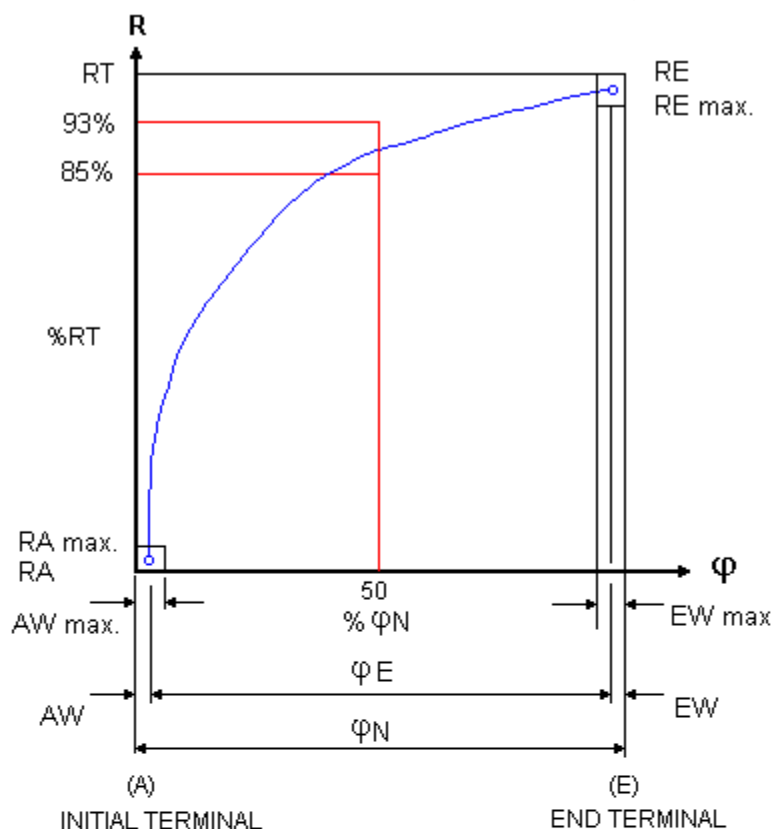
AW	Initial Path	AW max. 12% ϕN
EW	Final Path	EW max. 12% ϕN
Ra	Initial Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RA	Hop-on Resistance	$\leq 1\% RN$
Re	End Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RE	Hop-off Resistance	$\leq 1\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

Resistance law B – Log (Audio)



AW	Initial Path	AW max. 10% ϕ_N
EW	Final Path	EW max. 10% ϕ_N
Ra	Initial Stop Value	$R_N \leq 10K \leq 1.10^{-3} R_N$ (Minimum 2 ohms) $R_N > 10K \leq 2.10^{-4} R_N$ (Minimum 10 ohms)
RA	Hop-on Resistance	$R_N \leq 10K$ 5% R_N $R_N > 10K$ 0.15% R_N
Re	End Stop Value	$R_N \leq 100K \leq 2.10^{-2} R_N$ $R_N > 100K \leq 1.10^{-2} R_N$
RE	Hop-off Resistance	$R_N \leq 10K < 1\% R_N$ $R_N > 10K$ 0.5% R_N
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

Resistance law C – Antilog (Reverse Audio)



AW	Initial Path	AW max. 10% ϕN
EW	Final Path	EW max. 10% ϕN
Ra	Initial Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RA	Hop-on Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K 0.5\% RN$
Re	End Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RE	Hop-off Resistance	$RN \leq 10K 5\% RN$ $RN > 10K 0.15\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

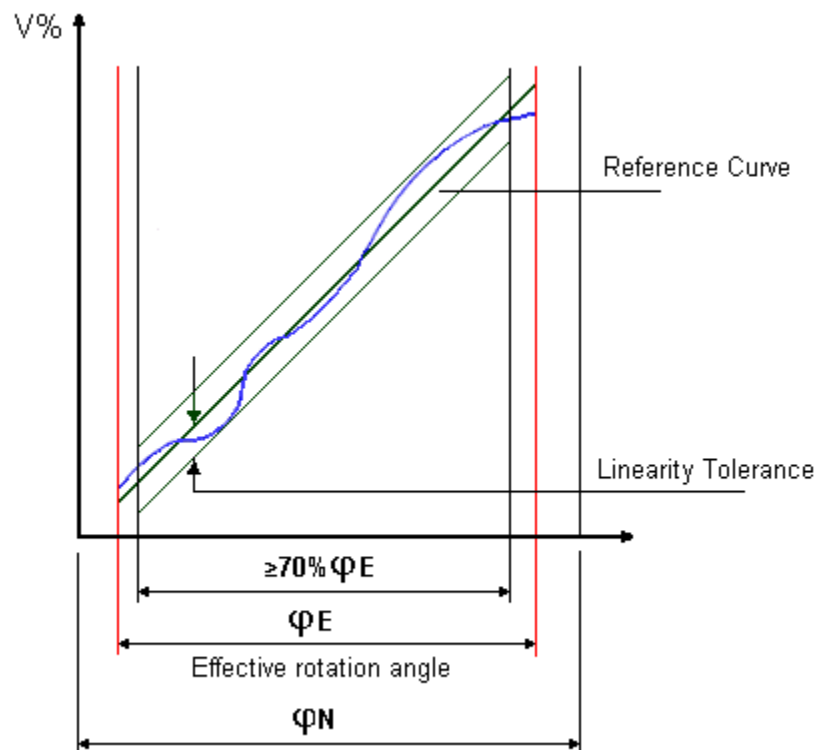
Linearity

As a basis of assessing Linearity Tolerance the independent method is the most practical, permitting as it does, the reference curve to be aligned as near as possible to the actual output curve. This avoids the use of the theoretical starting and finishing points, it is normal for the customer to realign the achieved curve with series trimmers at each end of the device if required.

Linearity Tolerance is 4% over the Nominal Resistance range of 1K0 to 1M0. The Linearity Tolerance is measured on at least 70% of the effective rotation range.

Note. In the case of Terminal and Zero-based linearity, both present constraints which increase the manufacturing difficulty and in consequence have an adverse effect on the product's price and availability.

Potentiometer linearity

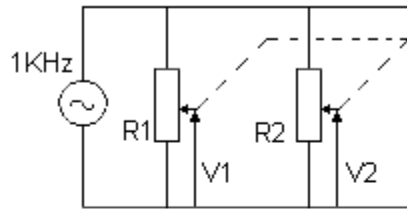


Matching Tolerance (For Tandem Stereo Potentiometers)

Tandem Potentiometers have two identical resistor units with the same variation law. The mismatching of the two resistor units, expressed in dB, is measured by the difference between the attenuations introduced by each resistor unit at various points of travel.

- Law A: 4 dB at Attenuation range 0 - 20 dB
- Law B and C: 3 dB at Attenuation range 0 - 20 dB

Matched Tolerance for Stereo

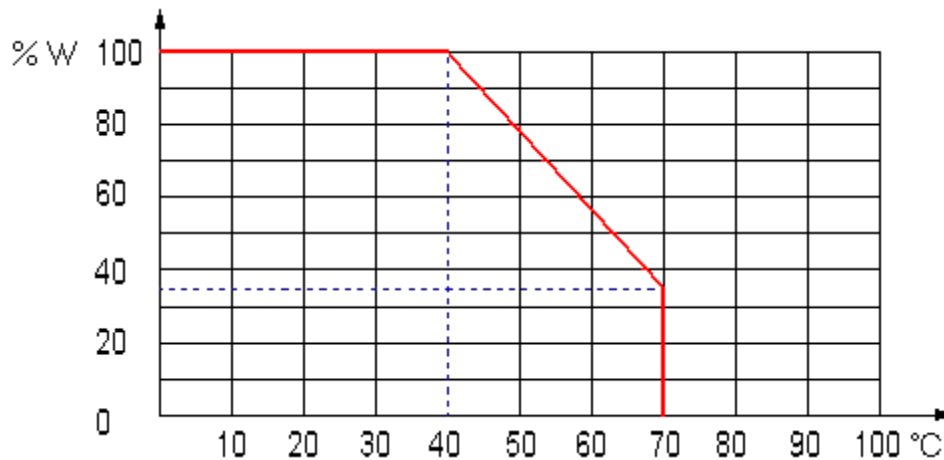


LAW	ATTENUATION RANGE	MATCHING TOLERANCE *
A	0 - 20dB	4dB
B & C	0 - 20dB	3dB

$$* \text{Matching Tolerance} = 20 \log \frac{V1}{V2}$$

Operating Temperature: -25°C to +70°C

Temperature Derating Curve



Temperature Coefficient of Resistance: +300 -500 ppm

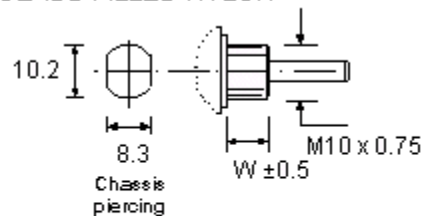
Components

ECO Bush Housing (Mounting)

The ECO bush housing is made of glass filled nylon, the thread is M10 x0.75mm pitch and 8mm long, alternatively **a 12mm long thread is also available** from October 2008.

Do not attempt to prevent any unwanted body rotation by overtightening the retaining nut, since this can cause thread damage, distortion, change of electrical resistance and restrict shaft rotation. BS9130:1972 provides further details on this topic. The **recommended torque** for tightening the retaining nut is 45cN.m and this can be achieved cost effectively by using a Torque Limiting device as shown on our **Accessories** page.

GLASS FILLED NYLON



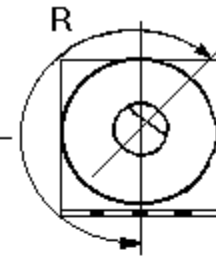
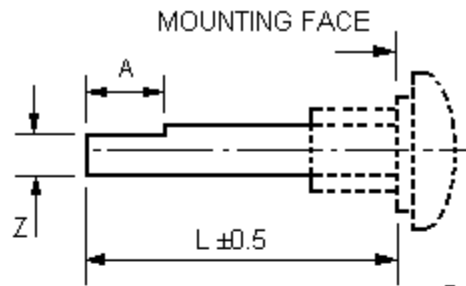
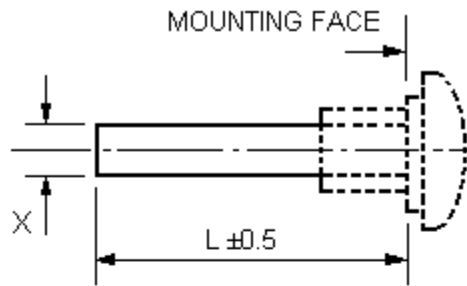
TYPE PLASTIC BODY	
W(mm)	8 (optional 12)

ECO Spindles

The ECO plastic spindles are fixed and not removable.
They are available in the following three diameters:

- 6.0mm Diameter - Length (L) available from 14mm to 65mm
 - Cylindrical (Type F1)
 - 4.0 x 12mm Flat (Type F2)
 - 5.0 x 15mm Flat (Type F3)
 - 5.0 x 10mm Flat (Type F4)
 - 4.6mm x 15mm Flat (Type F11)
 - 4.0 x 8mm Flat (Type F13)
 - 5.0 x 8mm Flat (Type F14)
- 4.0mm Diameter - Length (L) available from 14mm to 35mm
 - Cylindrical (Type F21)
 - 3.0 x 8.5mm Flat (Type F22)
- 6.35mm Diameter - Length (L) available from 14mm to 65mm
 - Cylindrical (Type F41)
 - 5.5 x 10mm Flat (Type F42)

Cylindrical and Flatted Spindles



Spindle in full CCW position

TYPE	DESC. (Ø)	L (mm)
F21	4 mm Dia Plastic	14 - 35
F1	6 mm Dia Plastic	14 - 65
F41	6.35mm Dia Plastic	14 - 65

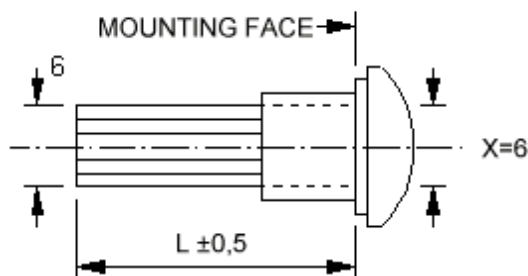
All spindles fixed.

TYPE	DESC. (Ø)	L (mm)	Flat (ZxA)
F22	4 mm Dia Plastic	14 - 35	3 x 8.5
F13	6 mm Dia Plastic	14 - 65	4 x 8
F2	6 mm Dia Plastic	14 - 65	4 x 12
F14	6 mm Dia Plastic	14 - 65	5 x 8
F4	6 mm Dia Plastic	14 - 65	5 x 10
F3	6 mm Dia Plastic	14 - 65	5 x 15
F11	6 mm Dia Plastic	14 - 65	4.6 x 15
F42	6.35mm Dia Plastic	14 - 65	5.5 x 10

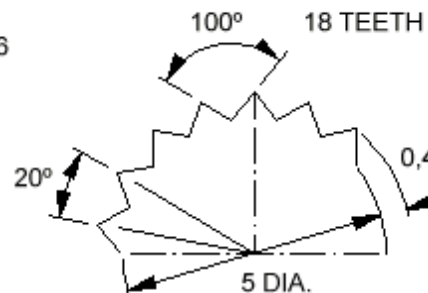
Standard flat angle
R = 210°

Splined Spindle (6.0mm diameter)

A splined form is also available on the 6.0mm diameter ECO plastic spindle.

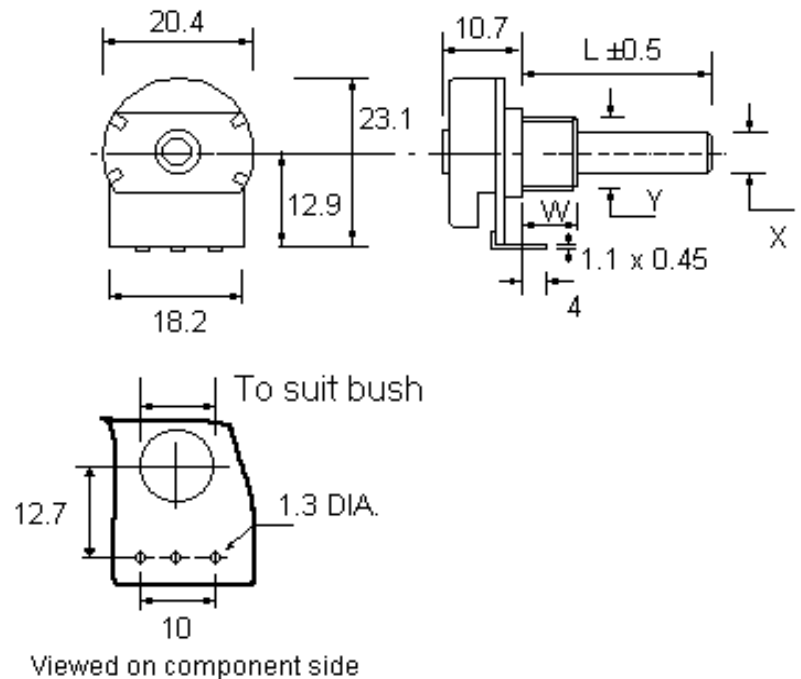


TYPE	DESC.	L (mm)
F5	Plastic Fixed	14 - 30



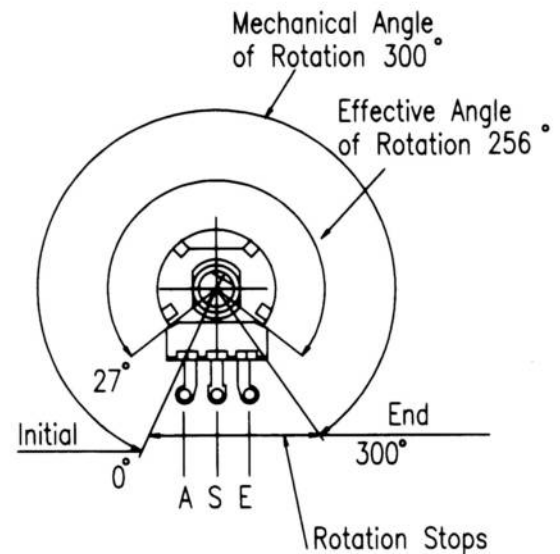
LT20BU

LT – Terminals are bent Long Towards Spindle



SPINDLE END VIEW

- W Mounting Height
- Y Mounting Diameter
- X Spindle Diameter
- L Spindle Length
- A Initial Termination
- S Wiper (or moving contact) termination
- E End Termination



Total mechanical and effective electrical angles of rotation of potentiometers without rotary switch

Technical Data

Rated Power Dissipation @40°C for P20 potentiometers:

0.4W linear law

0.2W nonlinear law

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Effective rotation: 256° nominal

Operating Torque: 0.4 – 1.5 cN.m

Permissible Axial Spindle Load: 100 N (5 Sec. maximum)

Permissible Torque at End Stop: 80 cN.m

Rotation angle: 300° ±5°

Optional Click stop (indents) for rotational tactile feedback

Rotational torque of spindle can be made high or low

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Insulation Resistance: >= 4 Gohms

Rated Resistance: E3 Series

Optional: E6 Series

Linear Law: 1K – 1M (±10%)

Nonlinear Law: 4K7 – 470K

ELECTRICAL SPECIFICATION COMMON TO ALL POTENTIOMETERS

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Insulation Resistance: >= 4 Gohms

Rated Resistance: E3 Series

- Optional: E6 Series
- Linear Law: 1K - 1M
- Nonlinear Law: 4K7 - 470K

Tolerance on Rated Resistance: ± 20%

- Optional Tolerance on 1K - 1M: ± 10%

Resistance Laws (Taper):

- Linear: A
- Nonlinear: B - Log (Audio) or C - Antilog (Reverse Audio)
- Other laws: Please refer to Sales office

ELECTRICAL SPECIFICATION UNIQUE TO P20 POTENTIOMETERS

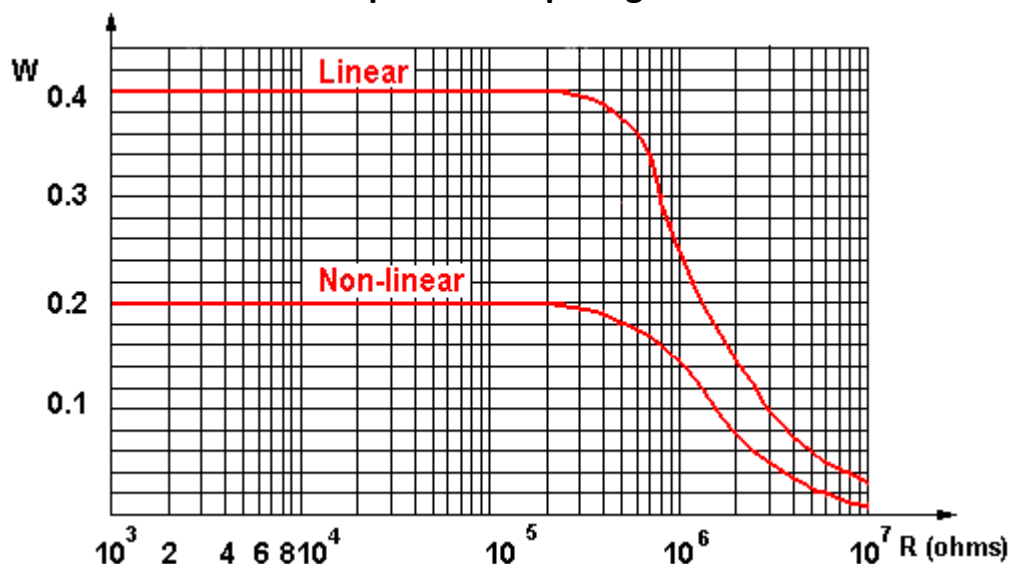
Effective rotation:

- Without a switch: 256° nominal
- With switch: 243° nominal
- With rotary switch: 243° nominal

Rated Power Dissipation @40°C for P20 potentiometers:

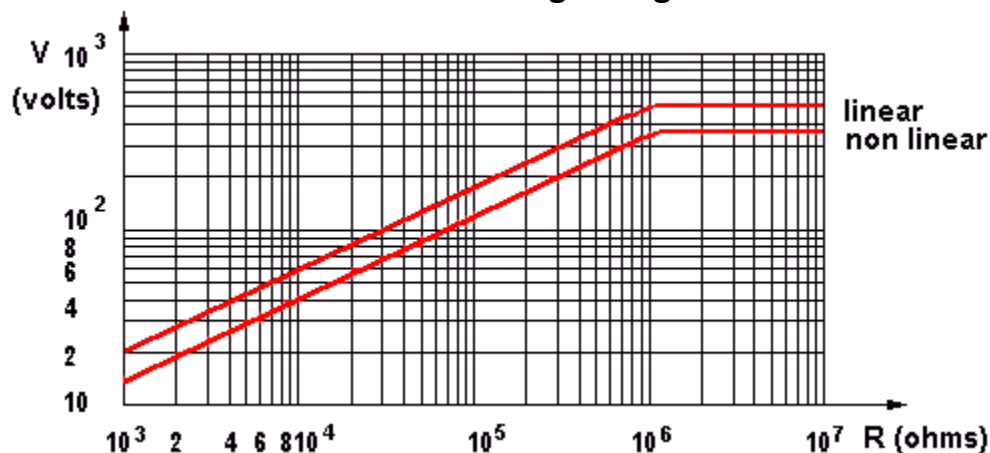
- 0.4W linear law
- 0.2W nonlinear law

P20 power dissipating curve



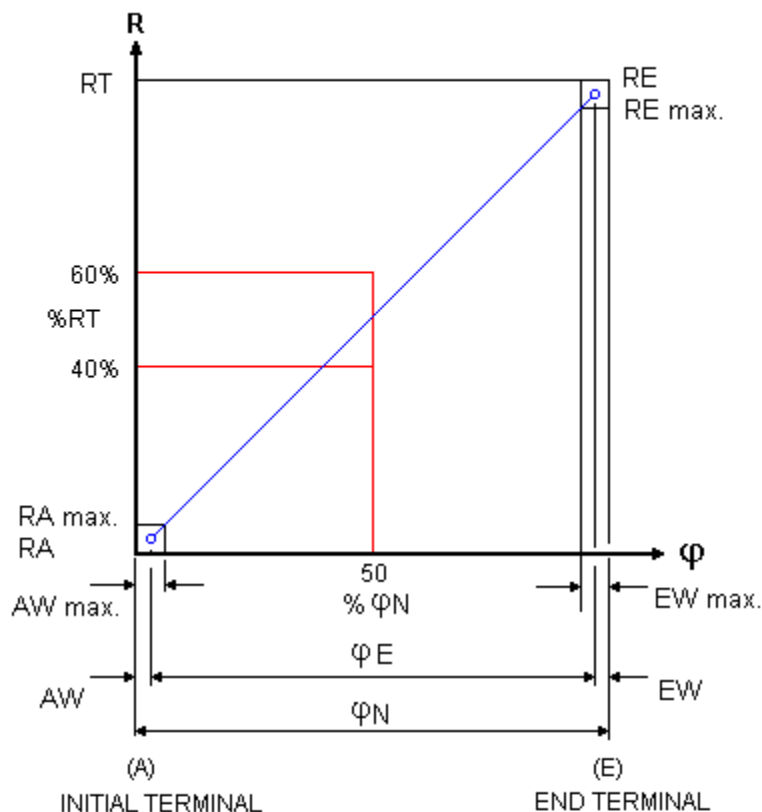
Limiting Element Voltage: 500 V DC for 20mm potentiometers

P20 maximum working voltage curve



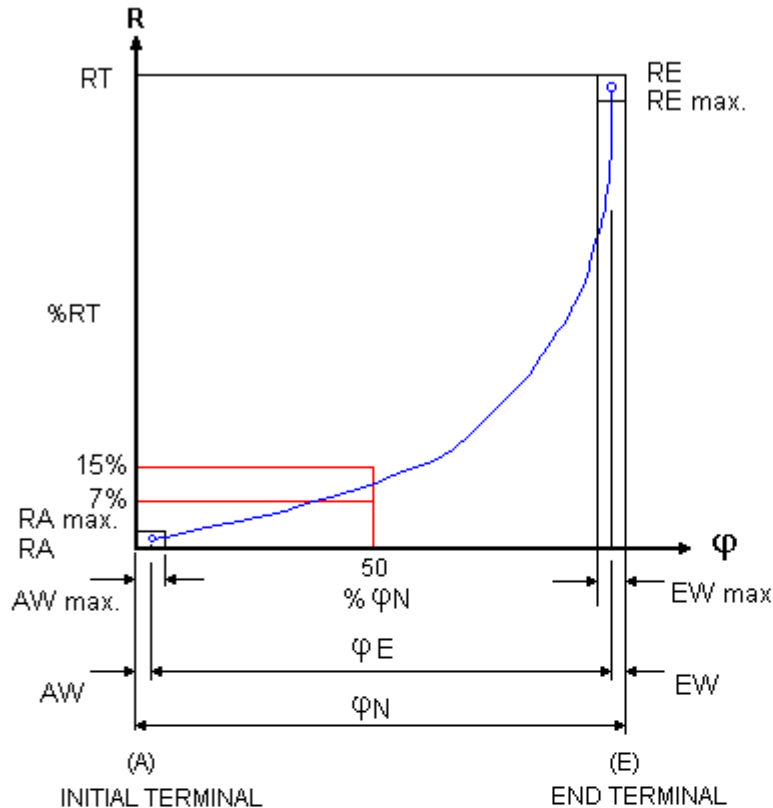
Insulating Voltage: 1000 V AC for 20mm potentiometers

Resistance law A - Linear



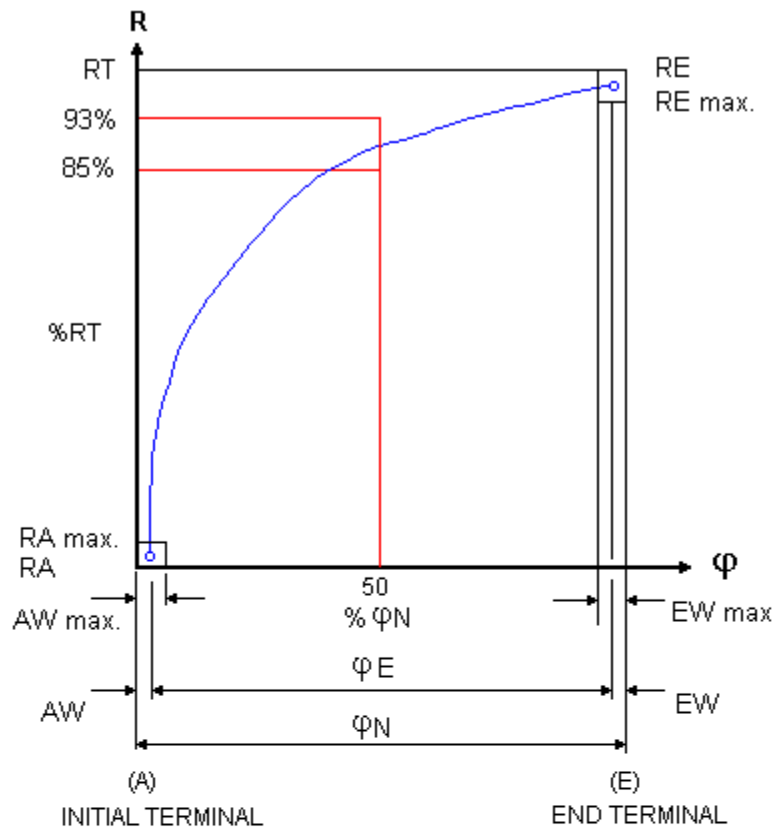
AW	Initial Path	AW max. 12% ϕN
EW	Final Path	EW max. 12% ϕN
Ra	Initial Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RA	Hop-on Resistance	$\leq 1\% RN$
Re	End Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RE	Hop-off Resistance	$\leq 1\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

Resistance law B – Log (Audio)



A_W	Initial Path	$A_W \text{ max.}$ 10% ϕ_N
E_W	Final Path	$E_W \text{ max.}$ 10% ϕ_N
R_a	Initial Stop Value	$R_N \leq 10K \leq 1.10^{-3} R_N$ (Minimum 2 ohms) $R_N > 10K \leq 2.10^{-4} R_N$ (Minimum 10 ohms)
R_A	Hop-on Resistance	$R_N \leq 10K$ 5% R_N $R_N > 10K$ 0.15% R_N
R_e	End Stop Value	$R_N \leq 100K \leq 2.10^{-2} R_N$ $R_N > 100K \leq 1.10^{-2} R_N$
R_E	Hop-off Resistance	$R_N \leq 10K < 1\% R_N$ $R_N > 10K$ 0.5% R_N
R_N	Rated Resistance	
R_T	Effective Resistance	
ϕ	Rotation Angle	
ϕ_E	Effective Electrical Angle of Rotation	
ϕ_N	Effective Mechanical Angle of Rotation	

Resistance law C – Antilog (Reverse Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RA	Hop-on Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K 0.5\% RN$
Re	End Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RE	Hop-off Resistance	$RN \leq 10K 5\% RN$ $RN > 10K 0.15\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

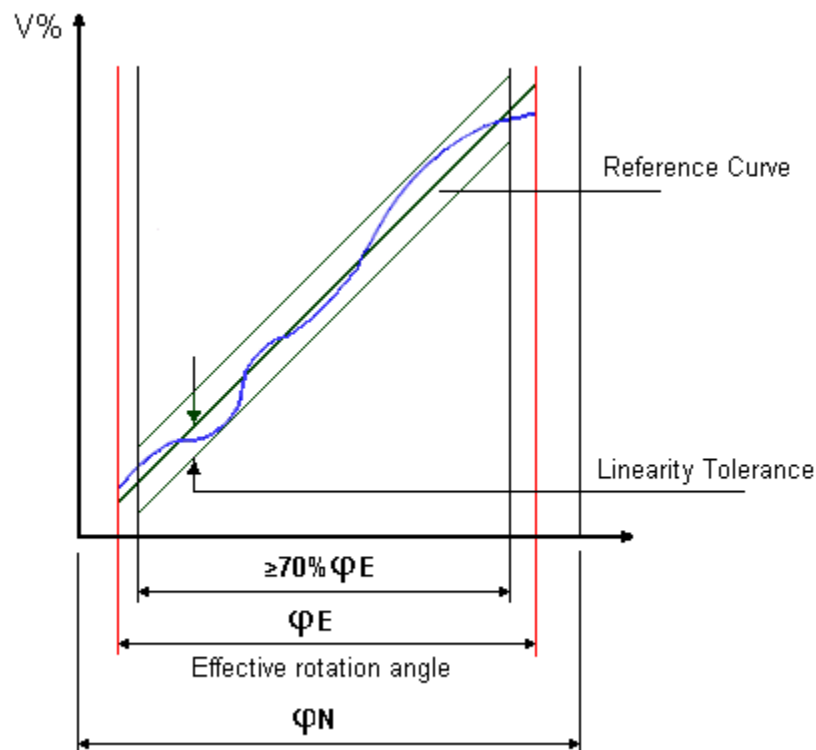
Linearity

As a basis of assessing Linearity Tolerance the independent method is the most practical, permitting as it does, the reference curve to be aligned as near as possible to the actual output curve. This avoids the use of the theoretical starting and finishing points, it is normal for the customer to realign the achieved curve with series trimmers at each end of the device if required.

Linearity Tolerance is 4% over the Nominal Resistance range of 1K Ω to 1M Ω . The Linearity Tolerance is measured on at least 70% of the effective rotation range.

Note. In the case of Terminal and Zero-based linearity, both present constraints which increase the manufacturing difficulty and in consequence have an adverse effect on the product's price and availability.

Potentiometer linearity

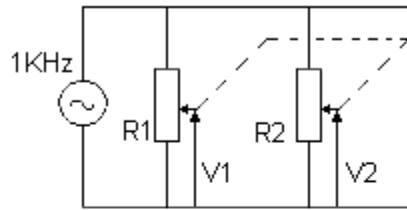


Matching Tolerance (For Tandem Stereo Potentiometers)

Tandem Potentiometers have two identical resistor units with the same variation law. The mismatching of the two resistor units, expressed in dB, is measured by the difference between the attenuations introduced by each resistor unit at various points of travel.

- Law A: 4 dB at Attenuation range 0 - 20 dB
- Law B and C: 3 dB at Attenuation range 0 - 20 dB

Matched Tolerance for Stereo

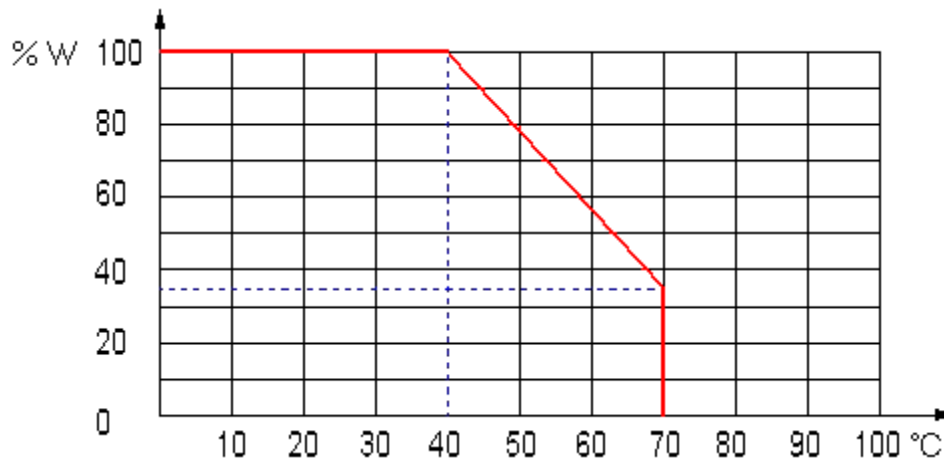


LAW	ATTENUATION RANGE	MATCHING TOLERANCE *
A	0 - 20dB	4dB
B & C	0 - 20dB	3dB

$$\text{*Matching Tolerance} = 20 \log \frac{V1}{V2}$$

Operating Temperature: -25°C to +70°C

Temperature Derating Curve



Temperature Coefficient of Resistance: +300 -500 ppm

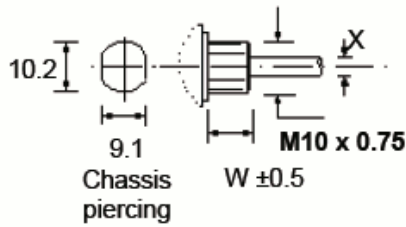
Components

P20 Bush Housing (Mounting)

The P20 bushes are available in metal or nylon; with three thread options; and with or without a locating feature:

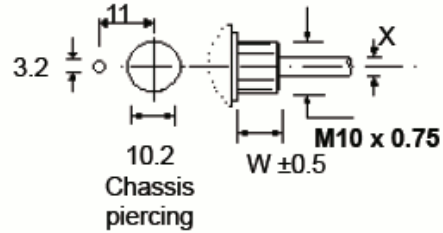
- Diecast Zinc Alloy
 - M10 x0.75mm pitch (Type C)
 - M10 x0.75mm pitch, **with locator** (Type CEBS)
 - 9.52mm x32tpi (Type CBS)
 - 9.52mm x32tpi, **with locator** (Type CBSL)
 - M7 x0.75mm pitch (Type CG)
- Glass Filled Nylon
 - M10 x0.75mm (Type CP)

DIECAST ZINC ALLOY



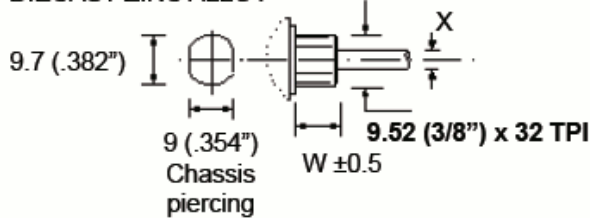
Type C (without locator)	
X (mm)	6
W (mm)	9

DIECAST ZINC ALLOY



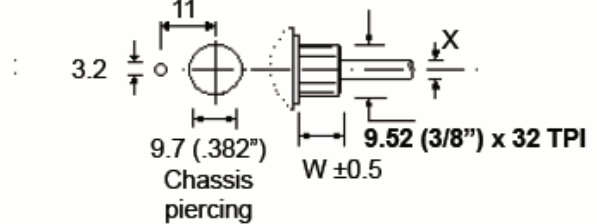
Type CEBS (with locator)	
X (mm)	6
W (mm)	9

DIECAST ZINC ALLOY



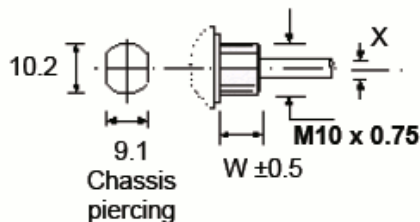
Type CBS (without locator)		
X (mm)	6	6.35
W (mm)	8 or 12	8 or 12

DIECAST ZINC ALLOY



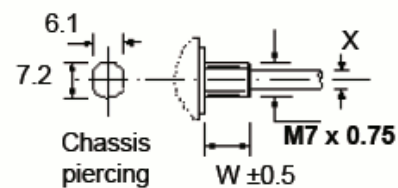
Type CBSL (with locator)		
X (mm)	6.35	6.35
W (mm)	8	12

GLASS FILLED NYLON



Type CP (GFN)		
X (mm)	6	6.35
W (mm)	7 or 10	7 or 10

DIECAST ZINC ALLOY



Type CG (without locator)	
X (mm)	4
W (mm)	6

P20 Spindles

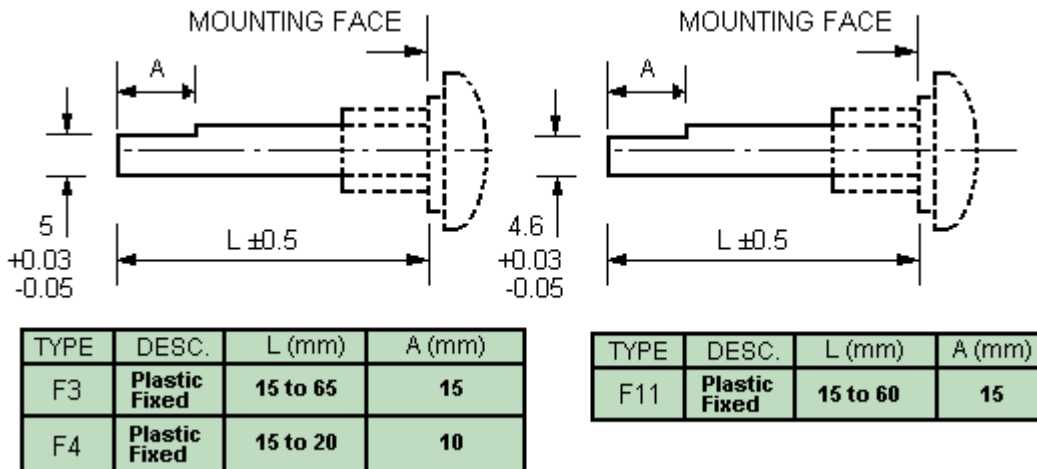
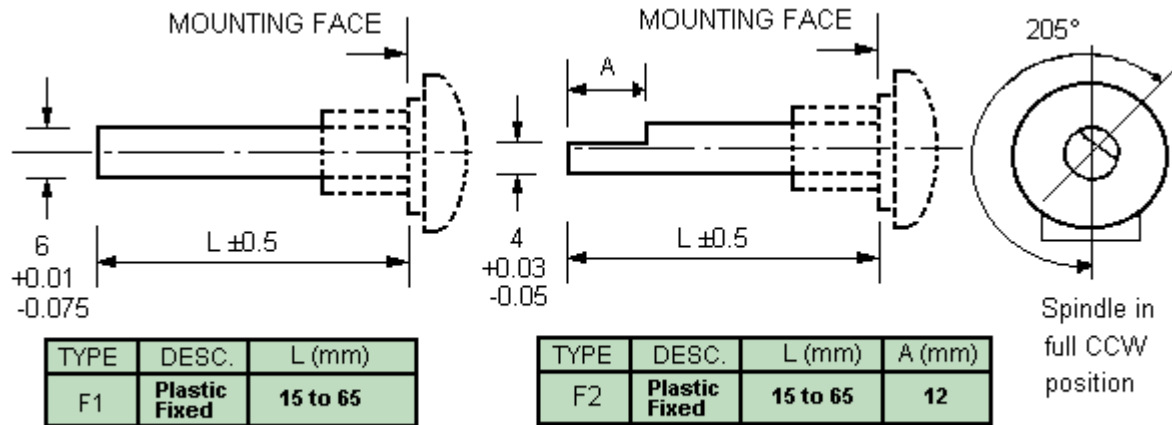
The P20 spindles are plastic and fixed i.e. not removable, unless otherwise stated and they are available in three diameters:

- 6.0mm Diameter
 - Cylindrical (Type F1)
 - 4.0 x 12mm Flat (Type F2)
 - 5.0 x 15mm Flat (Type F3)
 - 5.0 x 10mm Flat (Type F4)
 - 4.6mm x 15mm Flat (Type F11)
- 4.0mm Diameter
 - Cylindrical (Type F21)
 - 3.0 x 8.5mm Flat (Type F22)
 - 3.0 x 13.5mm Flat (Type F23)
 - Cylindrical (Type M21 - Metal)
 - 3.0 x 8.5mm Flat (Type M22 - Metal)
 - 3.0 x 13.5mm Flat (Type M23 - Metal)
- 6.35mm Diameter
 - Cylindrical (Type F41)
 - 5.5 x 10mm Flat (Type F42)
 - 5.5 x 15mm Flat (Type F43)
- Splined Spindle - 6.0mm dia. 18 teeth
- Dual Concentric
 - Flatted/Slotted (Type M15 - Metal)
 - Cylindrical (Type M16 - Metal)

6.0mm Diameter Spindles

Note: *Specials to customer's specification up to 65mm.

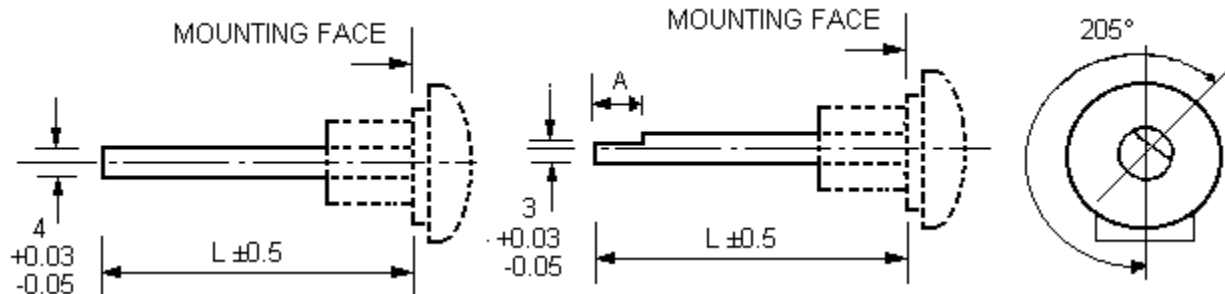
REMOVABLE SPINDLES, similar in specification to 'fixed' spindles are supplied separate from the potentiometer. These can be indefinitely taken in and out and their holding strength is >1kg.



4.0mm Diameter Spindles

Note: The orientation of the flat as illustrated is for plastic spindles only.

For metal spindles, unless specified on the order, the orientation may be different on each potentiometer type.



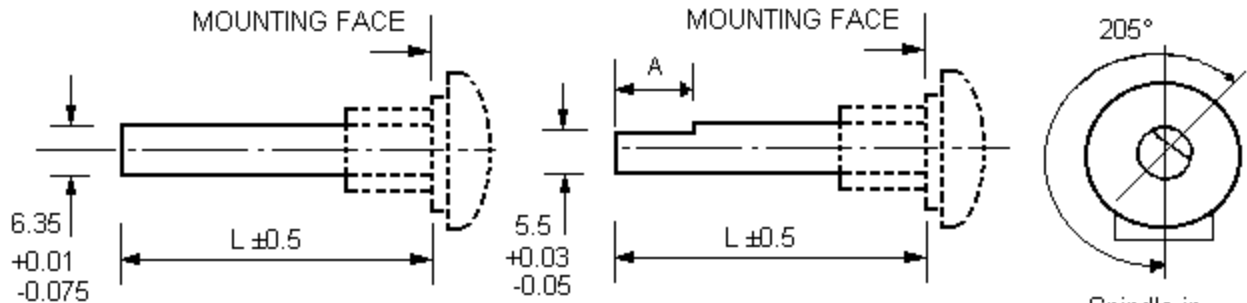
TYPE	DESC.	L (mm)
F21	Plastic Fixed	8 to 65
M21	Metal Fixed	8 to 65

TYPE	DESC.	L (mm)	A (mm)
F22	Plastic Fixed	11 to 60	8.5
M22	Metal Fixed	11 to 60	8.5
F23	Plastic Fixed	16 to 60	13.5
M23	Metal Fixed	16 to 60	13.5

Spindle in
full CCW
position

6.35mm Diameter Spindles

Note: *Specials to customer's specification up to 65mm.



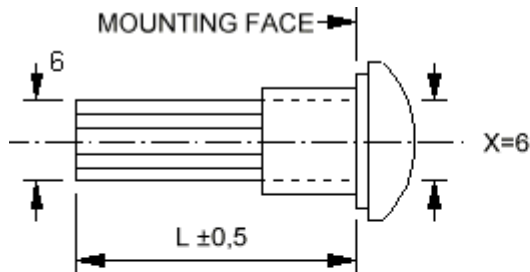
TYPE	DESC.	L (mm)
F41	Plastic Fixed	15 to 65

TYPE	DESC.	L (mm)	A (mm)
F42	Plastic Fixed	15 to 20	10
F43	Plastic Fixed	20 to 60	15

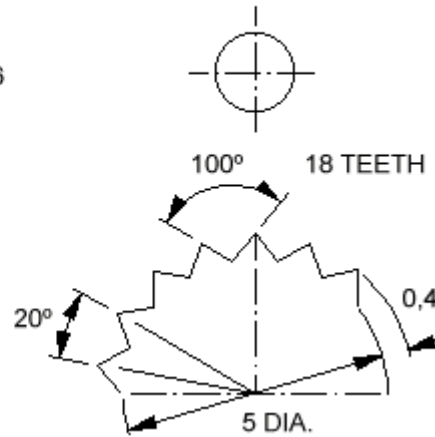
Spindle in
full CCW
position

Splined Spindle - 6.0mm dia. 18 teeth

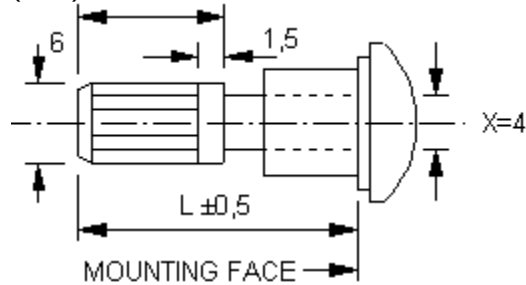
A splined form is available on the 6.0mm diameter P20 plastic spindle (F5) or alternatively a 6mm 'Splined Adaptor' (8,7mm long) can be fitted on a 4mm dia. Spindle



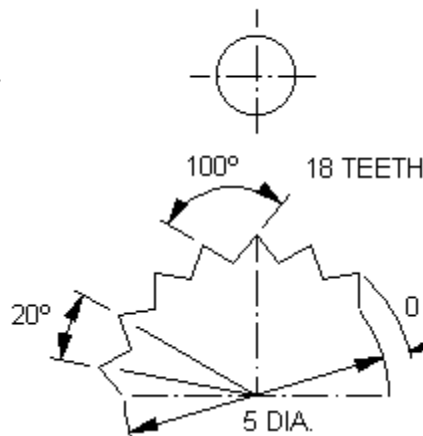
TYPE	DESC.	L (mm)
F5	Plastic Fixed	19



(F5A):



TYPE	DESC.	L (mm)
F5A	Plastic Fixed	16-36

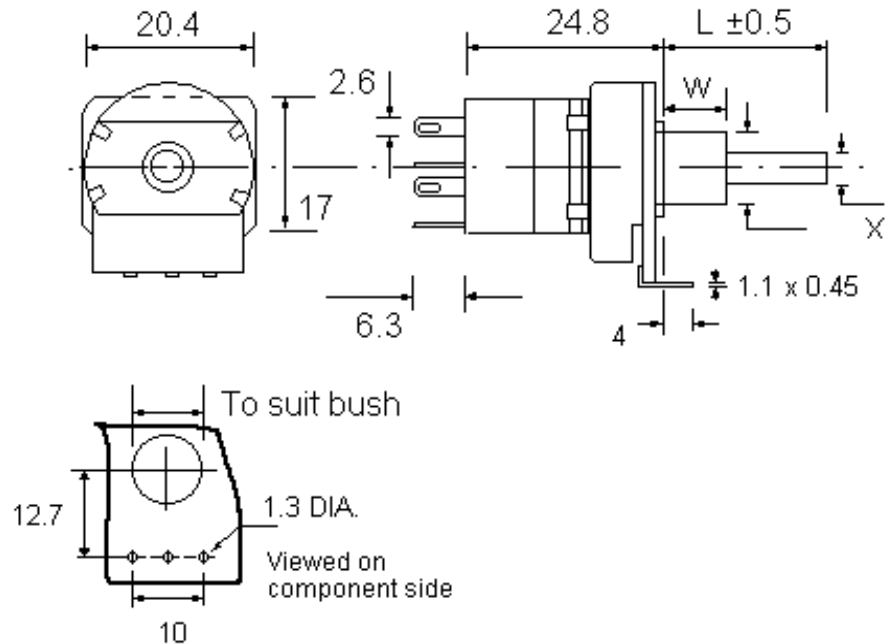
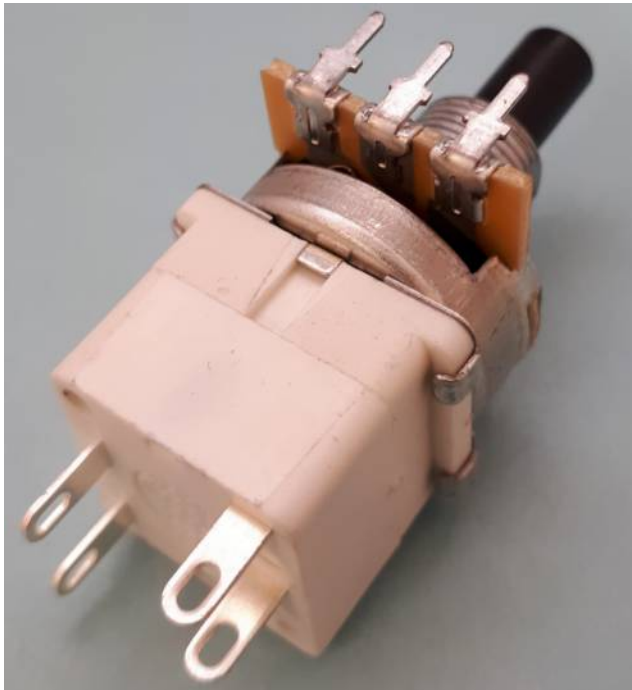


LT20BU/B4OW2S

B4OW2S – 4 Amp Double Pole (Single Throw) Switch

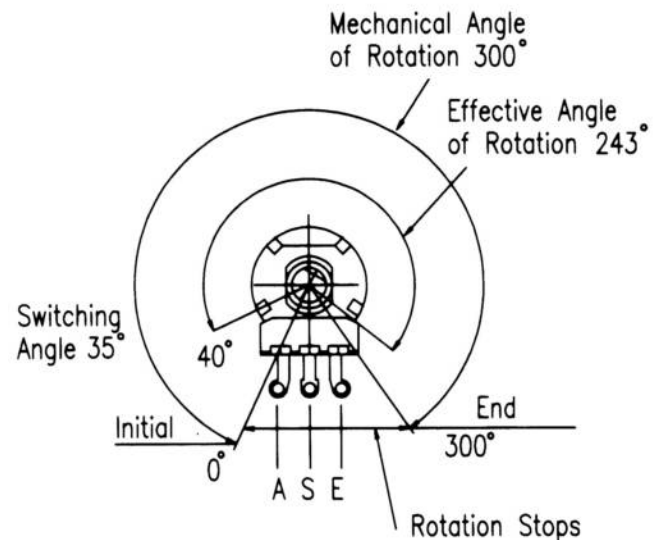
LT – Terminals bent Long Towards Spindle

OW – Ordinary Wiring (recommended for soldering)



SPINDLE END VIEW

- W Mounting Height
- Y Mounting Diameter
- X Spindle Diameter
- L Spindle Length
- A Initial Termination
- S Wiper (or moving contact) termination
- E End Termination



Total mechanical and effective electrical angles of rotation of potentiometers with rotary switch



P20 Range Technical Data

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Rotation angle: $300^{\circ} \pm 5^{\circ}$ (Switched and Unswitched)

Operating Torque: 0.4 – 2.0 N.cm (Initial Torque may be higher)

Rotational torque of spindle can be made high or low

Detents (stop positions) Available: Centre, 11, 21, 31, 41

Permissible Axial Spindle Load: 100 N (5 Sec. maximum)

Permissible Torque at End Stop: 80 N.cm

ELECTRICAL SPECIFICATION

Rated Power Dissipation @40°C for ECO potentiometers:

0.4W linear law

0.2W nonlinear law

Rotation angle: $300^{\circ} \pm 5^{\circ}$

Effective rotation - Unswitched: 243° nominal

Effective rotation - Switched: 256° nominal

Insulation Resistance: ≥ 4 Gohms

Rated Resistance: E3 Series

- Optional: E6 Series
- Linear Law: 1K - 1M
- Nonlinear Law: 4K7 - 470K

Tolerance on Rated Resistance: $\pm 20\%$

- Optional Tolerance on 1K - 1M: $\pm 10\%$

Resistance Laws (Taper):

- Linear: A
- Nonlinear: B - Log (Audio) or C - Antilog (Reverse Audio)
- Other laws: Please refer to Sales office

Rotary Switch Specification

The rotary switch modules are manufactured to EN61058-1 standard using high quality materials with a flame retardant housing. Although no longer certified due to the excessive cost of maintaining approvals, the 1 Amp and 4 Amp switch series have both been previously certified by UL International Demko (copies of previous certificates are available on our website or on request). The same materials, components and production techniques are used as in the certified versions and Omeg Ltd continues to test to the EN61058-1 standard

The 1 Amp contact rating is only available when mounted on the ECO potentiometer

1 A Contact Rating:

Note: The 1A contact rating is NOT available for mounting on the P16 or P20 potentiometer.

1A/250Vac 2.5A/12Vdc

Surge rating (0.01 seconds): 20A

Contact gap: 3mm (Full mains separation of contacts)

Manufactured to EN61058-1 standard

4 A Contact Rating:

4A/250Vac 10A/12Vdc

Surge rating (0.01 seconds): 80A

Switch contacts: Silver tin oxide

Contact gap: 2mm (Micro disconnection of switch - micro separation of contacts)

Manufactured to EN61058-1 standard

Common features

Housing material: Flame Retardant Glass filled polyester (UL 94 VO)

Initial contact resistance: 20 milliohms

Insulation resistance: 50,000 Megohms

Life (operations at full load): 10,000 minimum

Operating temperature: -25°C to +70°C

Operating torque for SPST/SPDT: 1.5 - 3 cNm

Operating torque for DPST/DPDT: 3.0 - 6 cNm

Mechanical rotation: 300°

Proof voltage: 3kV minimum

ROTARY SWITCH TERMINALS

Layout

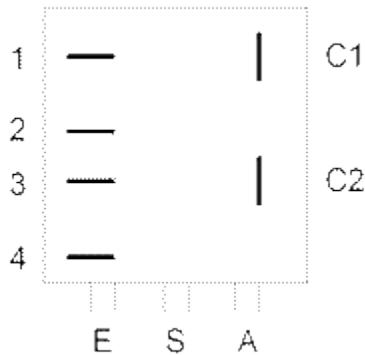
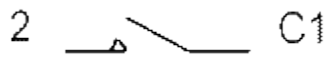
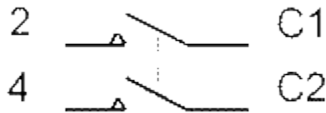


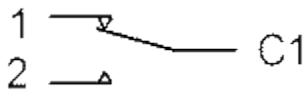
Diagram as viewed on the rear of the switch module:
 (Potentiometer terminals at the bottom)



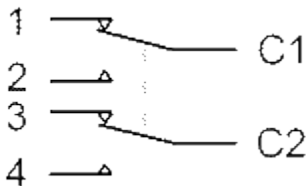
SPST - Single pole (1S), Single throw (On-Off)



DPST - Double pole (2S), Single throw (On-Off)



SPDT - Single pole (1S), Double throw (CH)
 (**NOT** certified)

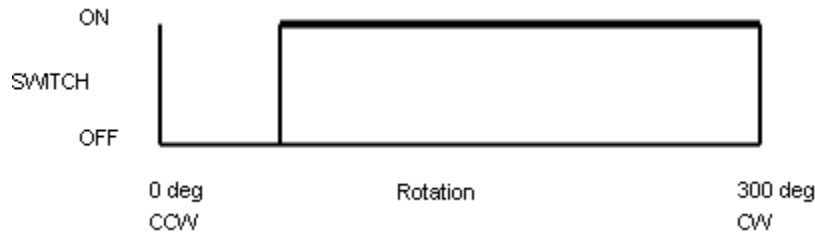


DPDT - Double pole (2S), Double throw (CH)
 (**NOT** certified)

Notes

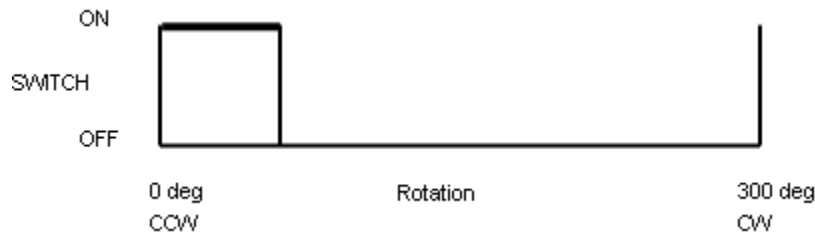
1. Moving contact(s) shown when the potentiometer shaft is in a counterclockwise (CCW) position.
2. 'Ordinary Wiring'(OW) or 'Printed Circuit'(PC) terminals can be requested on the switch.
3. Terminals 1 and 3 are only fitted for the Double Throw ('CH' or Changeover) versions which are **NOT** approved nor certified.

ROTARY SWITCH FUNCTIONS



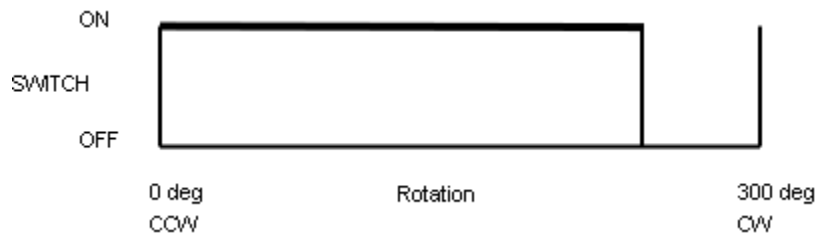
Standard (1A or 4A contact ratings)

N/O normally OPEN Switch
 Contacts normally OPEN;
 CLOCKwise rotation to CLOSE contacts



Option 1 (4A contact rating only)

N/C normally CLOSED Switch
 Contacts normally CLOSED;
 CLOCKwise rotation to OPEN contacts



Option 2 (4A contact rating only)

REVERSED N/O normally OPEN Switch
 Contacts normally OPEN at fully clockwise position;
 ANTI-clockwise rotation to CLOSE contacts



Option 3 (4A contact rating only)

REVERSED N/C normally CLOSED Switch
 Contacts normally CLOSED at fully clockwise position;
 ANTI-clockw

ELECTRICAL SPECIFICATION UNIQUE TO P20 POTENTIOMETERS

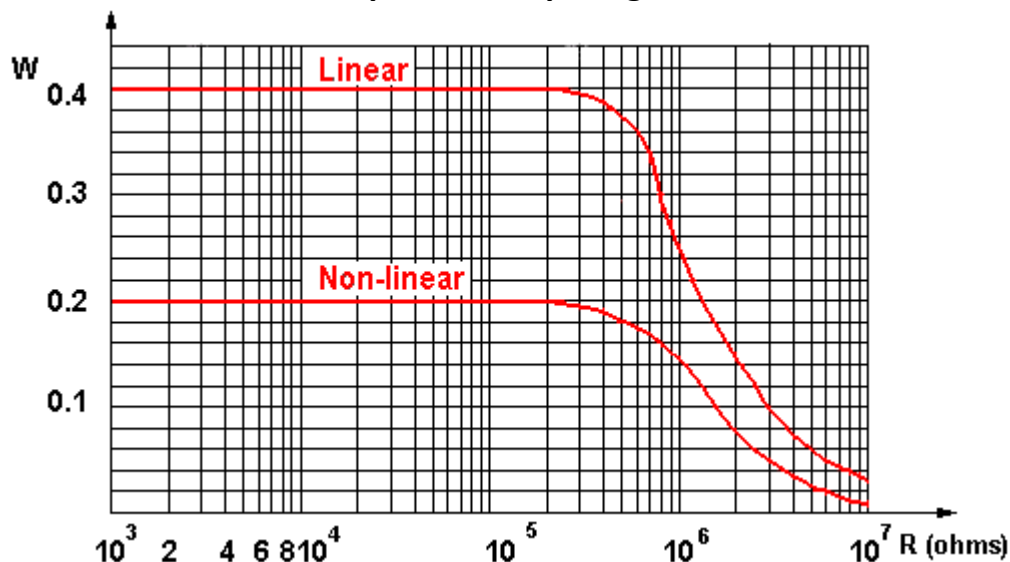
Effective rotation:

- Without a switch: 256° nominal
- With switch: 243° nominal
- With rotary switch: 243° nominal

Rated Power Dissipation @40°C for P20 potentiometers:

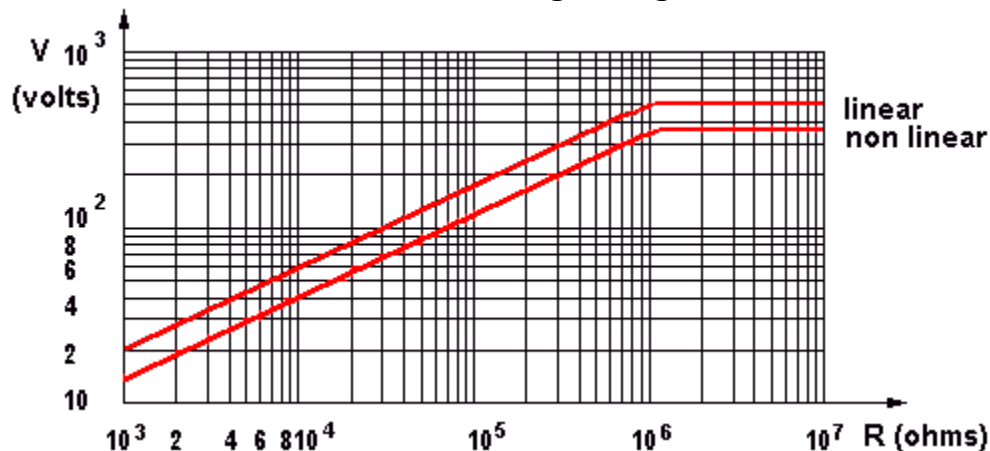
- 0.4W linear law
- 0.2W nonlinear law

P20 power dissipating curve



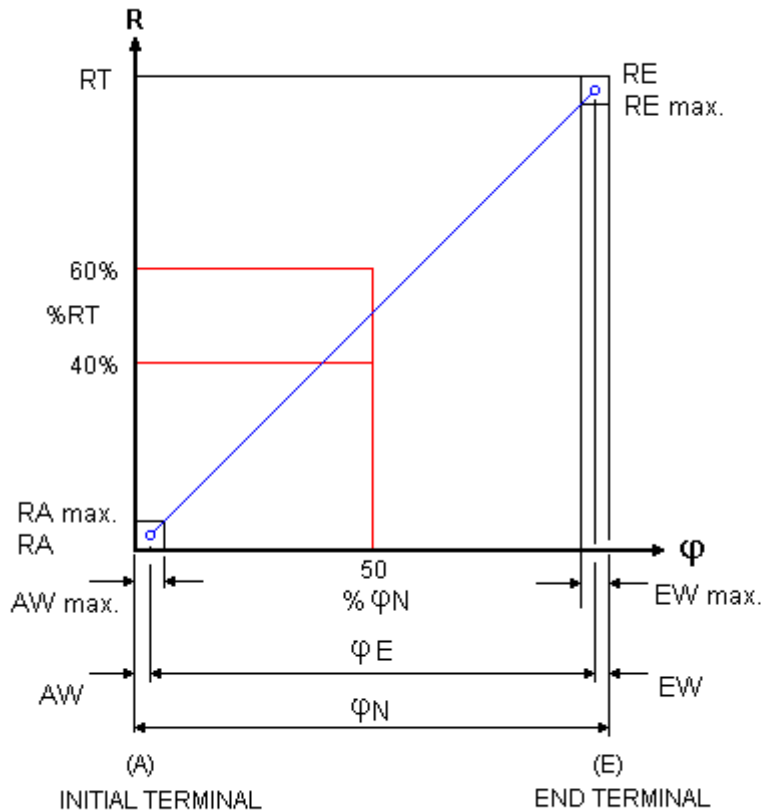
Limiting Element Voltage: 500 V DC for 20mm potentiometers

P20 maximum working voltage curve



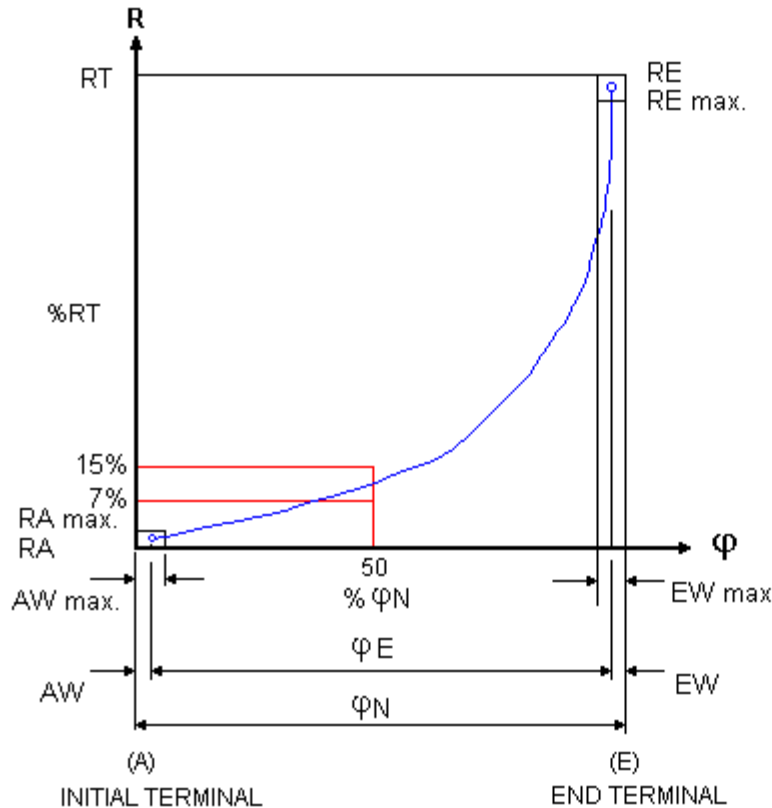
Insulating Voltage: 1000 V AC for 20mm potentiometers

Resistance law A - Linear



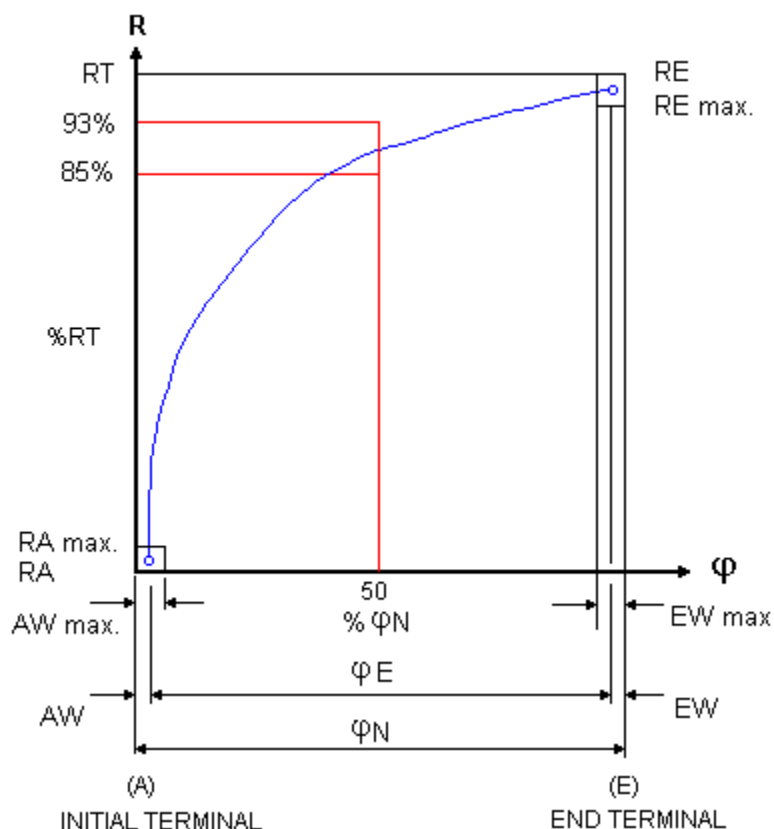
AW	Initial Path	AW max. 12% φN
EW	Final Path	EW max. 12% φN
Ra	Initial Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RA	Hop-on Resistance	$\leq 1\% RN$
Re	End Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RE	Hop-off Resistance	$\leq 1\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

Resistance law B – Log (Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RA	Hop-on Resistance	$RN \leq 10K$ 5% RN $RN > 10K$ 0.15% RN
Re	End Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RE	Hop-off Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K$ 0.5% RN
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

Resistance law C – Antilog (Reverse Audio)



AW	Initial Path	AW max. 10% ϕ_N
EW	Final Path	EW max. 10% ϕ_N
Ra	Initial Stop Value	$R_N \leq 100K \leq 2.10^{-2} R_N$ $R_N > 100K \leq 1.10^{-2} R_N$
RA	Hop-on Resistance	$R_N \leq 10K < 1\% R_N$ $R_N > 10K 0.5\% R_N$
Re	End Stop Value	$R_N \leq 10K \leq 1.10^{-3} R_N$ (Minimum 2 ohms) $R_N > 10K \leq 2.10^{-4} R_N$ (Minimum 10 ohms)
RE	Hop-off Resistance	$R_N \leq 10K 5\% R_N$ $R_N > 10K 0.15\% R_N$
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

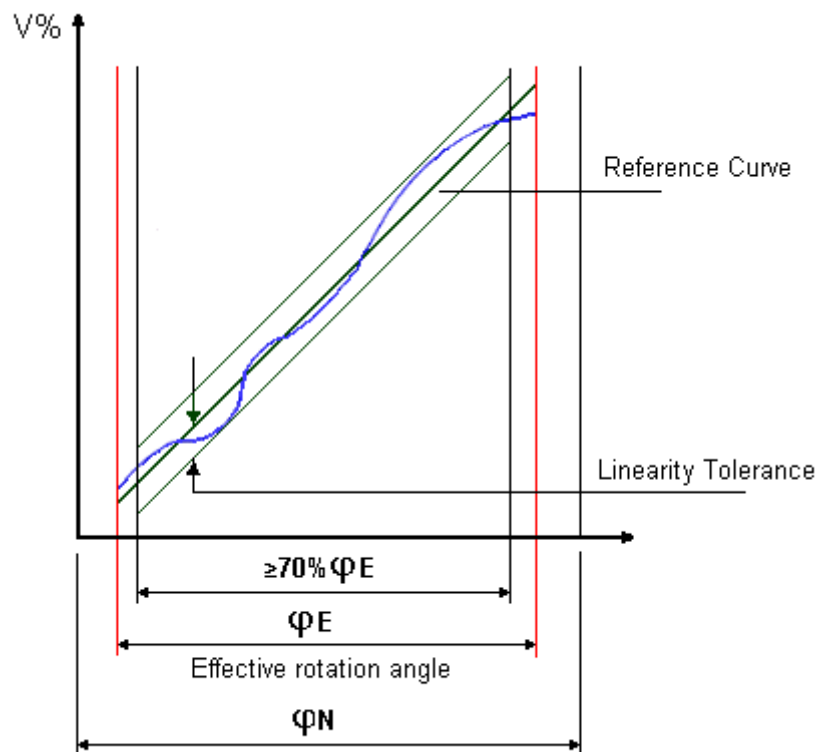
Linearity

As a basis of assessing Linearity Tolerance the independent method is the most practical, permitting as it does, the reference curve to be aligned as near as possible to the actual output curve. This avoids the use of the theoretical starting and finishing points, it is normal for the customer to realign the achieved curve with series trimmers at each end of the device if required.

Linearity Tolerance is 4% over the Nominal Resistance range of 1K0 to 1M0. The Linearity Tolerance is measured on at least 70% of the effective rotation range.

Note. In the case of Terminal and Zero-based linearity, both present constraints which increase the manufacturing difficulty and in consequence have an adverse effect on the product's price and availability.

Potentiometer linearity

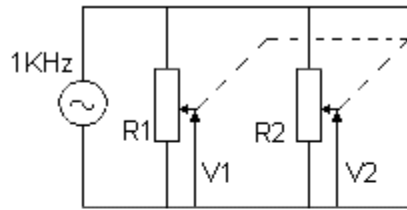


Matching Tolerance (For Tandem Stereo Potentiometers)

Tandem Potentiometers have two identical resistor units with the same variation law. The mismatching of the two resistor units, expressed in dB, is measured by the difference between the attenuations introduced by each resistor unit at various points of travel.

- Law A: 4 dB at Attenuation range 0 - 20 dB
- Law B and C: 3 dB at Attenuation range 0 - 20 dB

Matched Tolerance for Stereo

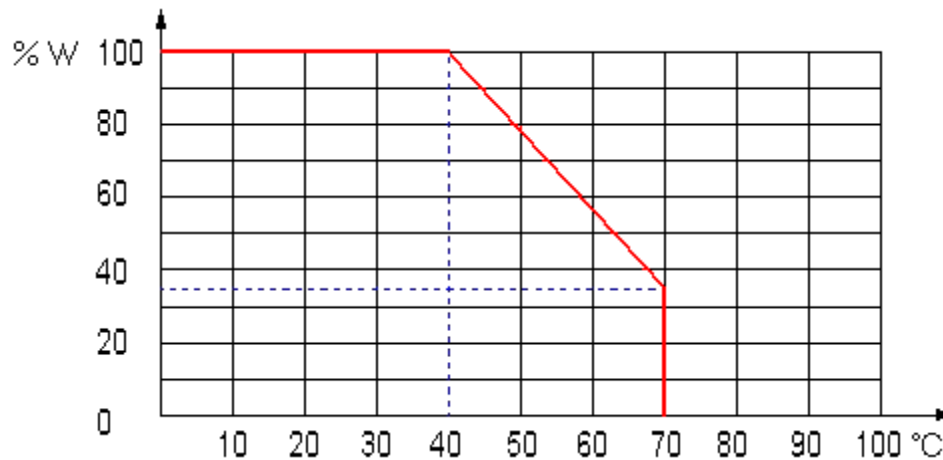


LAW	ATTENUATION RANGE	MATCHING TOLERANCE *
A	0 - 20dB	4dB
B & C	0 - 20dB	3dB

$$* \text{Matching Tolerance} = 20 \log \frac{V1}{V2}$$

Operating Temperature: -25°C to +70°C

Temperature Derating Curve



Temperature Coefficient of Resistance: +300 -500 ppm

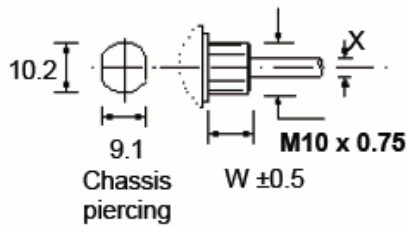
Components

P20 Bush Housing (Mounting)

The P20 bushes are available in metal or nylon; with three thread options; and with or without a locating feature:

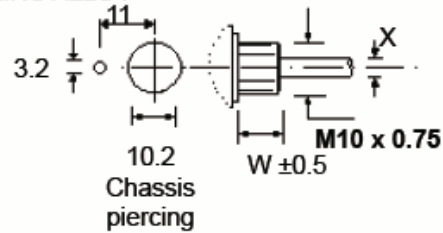
- Diecast Zinc Alloy
 - M10 x0.75mm pitch (Type C)
 - M10 x0.75mm pitch, **with locator** (Type CEBS)
 - 9.52mm x32tpi (Type CBS)
 - 9.52mm x32tpi, **with locator** (Type CBSL)
 - M7 x0.75mm pitch (Type CG)
- Glass Filled Nylon
 - M10 x0.75mm (Type CP)

DIECAST ZINC ALLOY



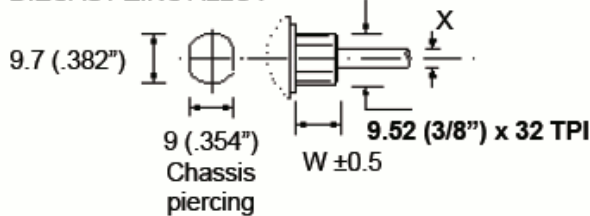
Type C (without locator)	
X (mm)	6
W (mm)	9

DIECAST ZINC ALLOY



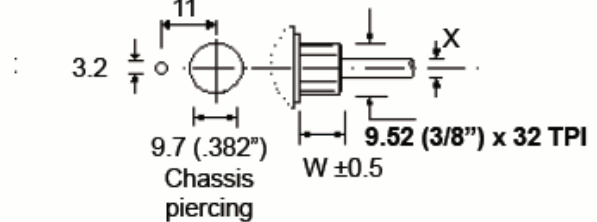
Type CEBS (with locator)	
X (mm)	6
W (mm)	9

DIECAST ZINC ALLOY



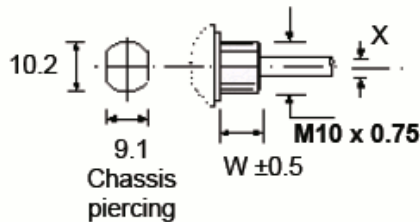
Type CBS (without locator)		
X (mm)	6	6.35
W (mm)	8 or 12	8 or 12

DIECAST ZINC ALLOY



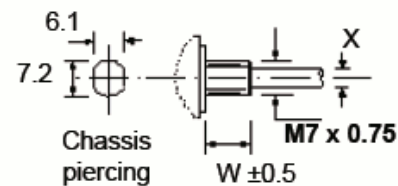
Type CBSL (with locator)		
X (mm)	6.35	6.35
W (mm)	8	12

GLASS FILLED NYLON



Type CP (GFN)		
X (mm)	6	6.35
W (mm)	7 or 10	7 or 10

DIECAST ZINC ALLOY



Type CG (without locator)	
X (mm)	4
W (mm)	6

P20 Spindles

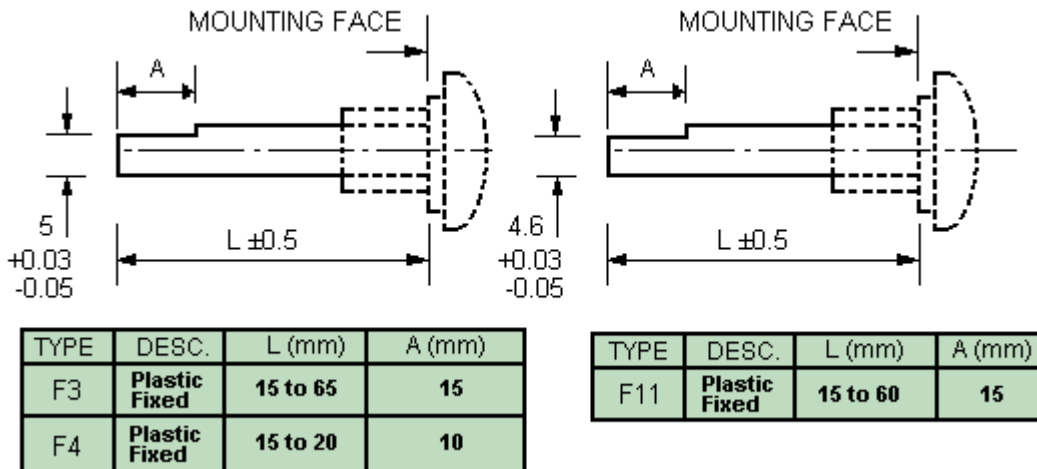
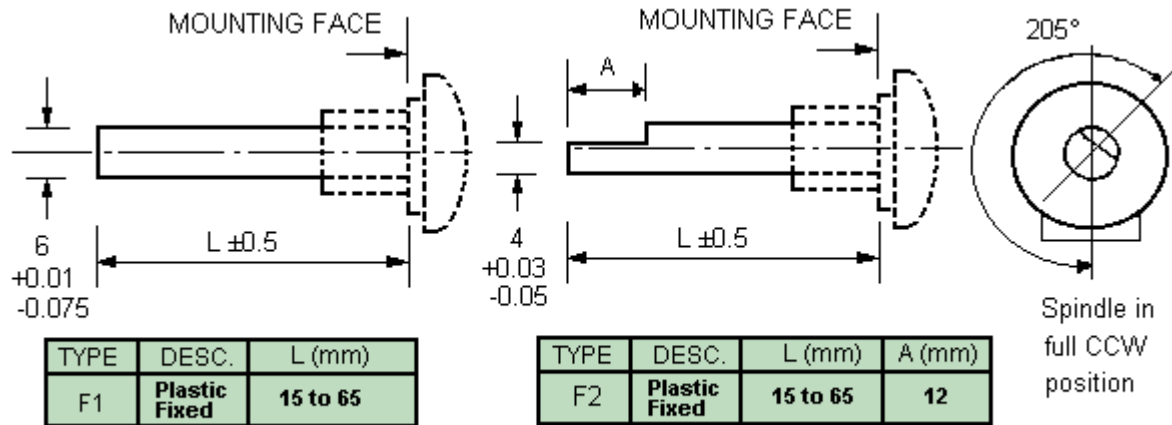
The P20 spindles are plastic and fixed i.e. not removable, unless otherwise stated and they are available in three diameters:

- 6.0mm Diameter
 - Cylindrical (Type F1)
 - 4.0 x 12mm Flat (Type F2)
 - 5.0 x 15mm Flat (Type F3)
 - 5.0 x 10mm Flat (Type F4)
 - 4.6mm x 15mm Flat (Type F11)
- 4.0mm Diameter
 - Cylindrical (Type F21)
 - 3.0 x 8.5mm Flat (Type F22)
 - 3.0 x 13.5mm Flat (Type F23)
 - Cylindrical (Type M21 - Metal)
 - 3.0 x 8.5mm Flat (Type M22 - Metal)
 - 3.0 x 13.5mm Flat (Type M23 - Metal)
- 6.35mm Diameter
 - Cylindrical (Type F41)
 - 5.5 x 10mm Flat (Type F42)
 - 5.5 x 15mm Flat (Type F43)
- Splined Spindle - 6.0mm dia. 18 teeth
- Dual Concentric
 - Flatted/Slotted (Type M15 - Metal)
 - Cylindrical (Type M16 - Metal)

6.0mm Diameter Spindles

Note: *Specials to customer's specification up to 65mm.

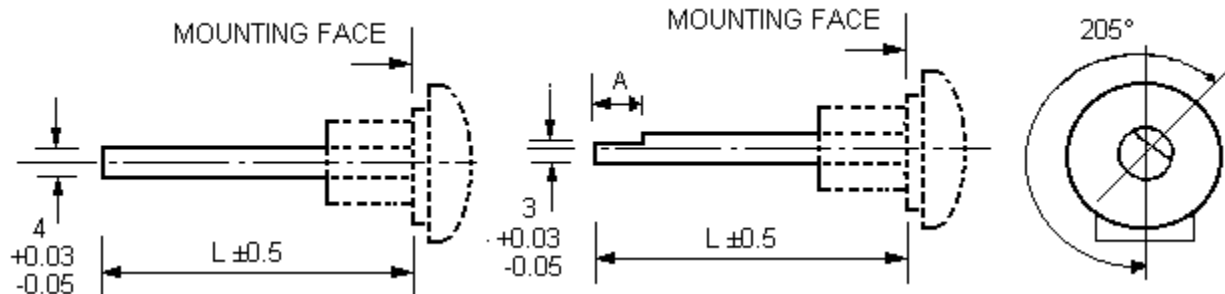
REMOVABLE SPINDLES, similar in specification to 'fixed' spindles are supplied separate from the potentiometer. These can be indefinitely taken in and out and their holding strength is >1kg.



4.0mm Diameter Spindles

Note: The orientation of the flat as illustrated is for plastic spindles only.

For metal spindles, unless specified on the order, the orientation may be different on each potentiometer type.



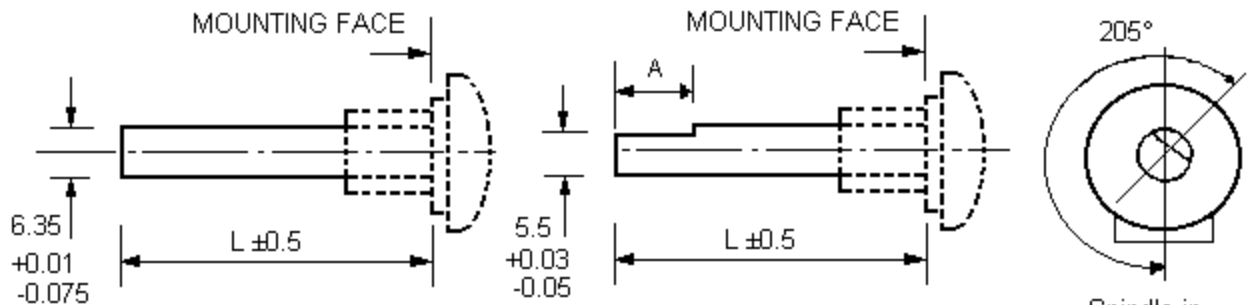
TYPE	DESC.	L (mm)
F21	Plastic Fixed	8 to 65
M21	Metal Fixed	8 to 65

TYPE	DESC.	L (mm)	A (mm)
F22	Plastic Fixed	11 to 60	8.5
M22	Metal Fixed	11 to 60	8.5
F23	Plastic Fixed	16 to 60	13.5
M23	Metal Fixed	16 to 60	13.5

Spindle in full CCW position

6.35mm Diameter Spindles

Note: *Specials to customer's specification up to 65mm.



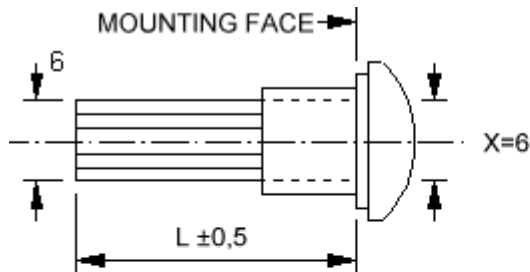
TYPE	DESC.	L (mm)
F41	Plastic Fixed	15 to 65

TYPE	DESC.	L (mm)	A (mm)
F42	Plastic Fixed	15 to 20	10
F43	Plastic Fixed	20 to 60	15

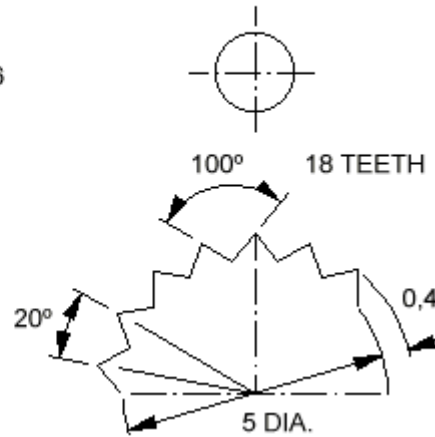
Spindle in full CCW position

Splined Spindle - 6.0mm dia. 18 teeth

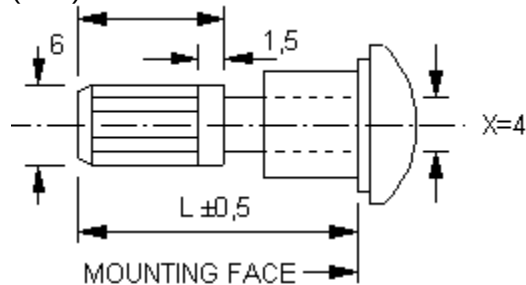
A splined form is available on the 6.0mm diameter P20 plastic spindle (F5) or alternatively a 6mm 'Splined Adaptor' (8,7mm long) can be fitted on a 4mm dia. Spindle



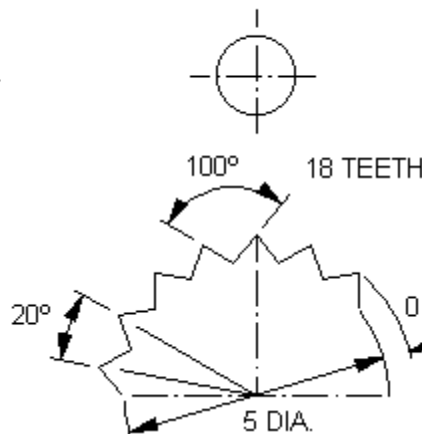
TYPE	DESC.	L (mm)
F5	Plastic Fixed	19



(F5A):

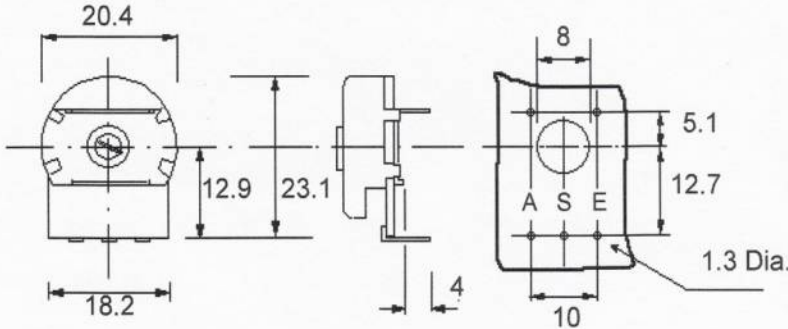


TYPE	DESC.	L (mm)
F5A	Plastic Fixed	16-36

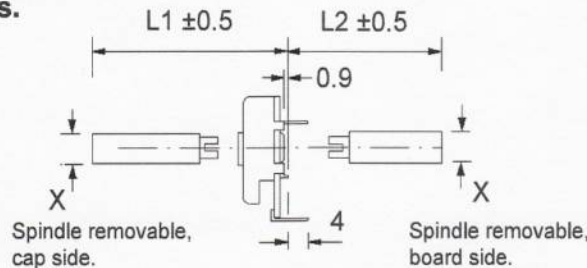
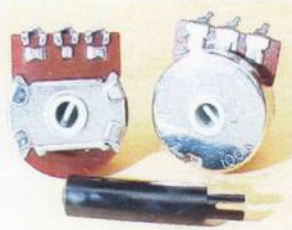


LT20ST

LT – Terminals are bent Long Towards Spindle



TYPE 1 Removable spindles.



SPINDLE VARIATIONS *	
Plastic	X (mm)
Removable*	6
Removable*	4
Removable*	6.35

* Removable Spindles, if supplied, are separate from the potentiometer and can be plugged indefinitely in and out. The holding strength is >1Kg.

Please refer to the diagram above:- L1 Spindle is CAP side

L2 Spindle is BOARD side

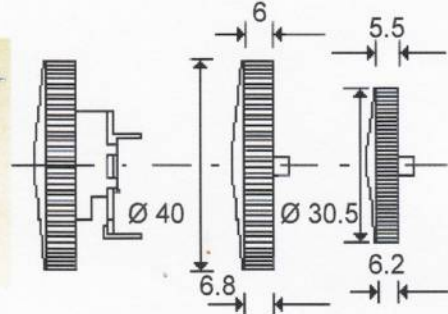
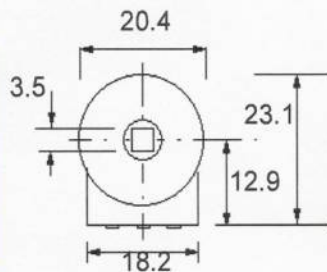
If a removable spindle is NOT required then please indicate as follows for use with a SCREWDRIVER:-

S2 Screwdriver Slot CAP side

S1 Screwdriver Slot BOARD side

TYPE 2 Wiper with square hole intended for use by customers who supply their own drive units.

TYPE 3 Wiper for use with edge control knob.



Note.
 Drive can be inserted both sides of the metal case.

Note.
 Potentiometers are supplied without knob.
 Knobs D30 or D40 are available in black or grey.

Note. If the track law is either B or C then the following will apply.
 The start of the law is obtained by rotating the spindle or edge control knob to the fully anticlockwise position, when the knob or spindle is viewed from the face or end.

Technical Data

Rated Power Dissipation @40°C for P20 potentiometers:

0.4W linear law

0.2W nonlinear law

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Effective rotation: 256° nominal

Operating Torque: 0.4 – 1.5 cN.m

Permissible Axial Spindle Load: 100 N (5 Sec. maximum)

Permissible Torque at End Stop: 80 cN.m

Rotation angle: 300° ±5°

Optional Click stop (indents) for rotational tactile feedback

Rotational torque of spindle can be made high or low

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

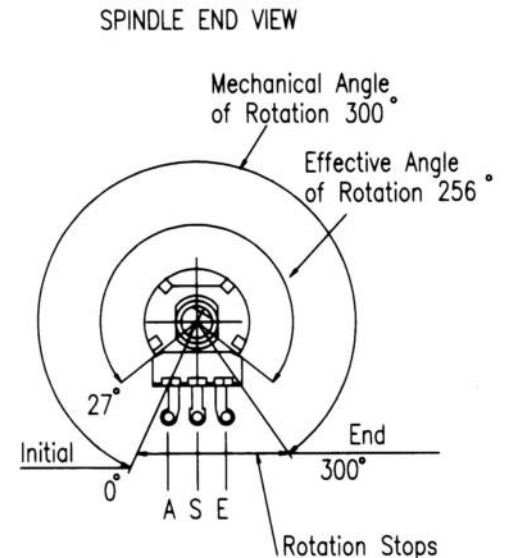
Insulation Resistance: ≥ 4 Gohms

Rated Resistance: E3 Series

Optional: E6 Series

Linear Law: 1K – 1M (±10%)

Nonlinear Law: 4K7 – 470K



Total mechanical and effective electrical angles of rotation of potentiometers without rotary switch

ELECTRICAL SPECIFICATION COMMON TO ALL POTENTIOMETERS

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Insulation Resistance: ≥ 4 Gohms

Rated Resistance: E3 Series

- Optional: E6 Series
- Linear Law: 1K - 1M
- Nonlinear Law: 4K7 - 470K

Tolerance on Rated Resistance: ± 20%

- Optional Tolerance on 1K - 1M: ± 10%

Resistance Laws (Taper):

- Linear: A
- Nonlinear: B - Log (Audio) or C - Antilog (Reverse Audio)
- Other laws: Please refer to Sales office

ELECTRICAL SPECIFICATION UNIQUE TO P20 POTENTIOMETERS

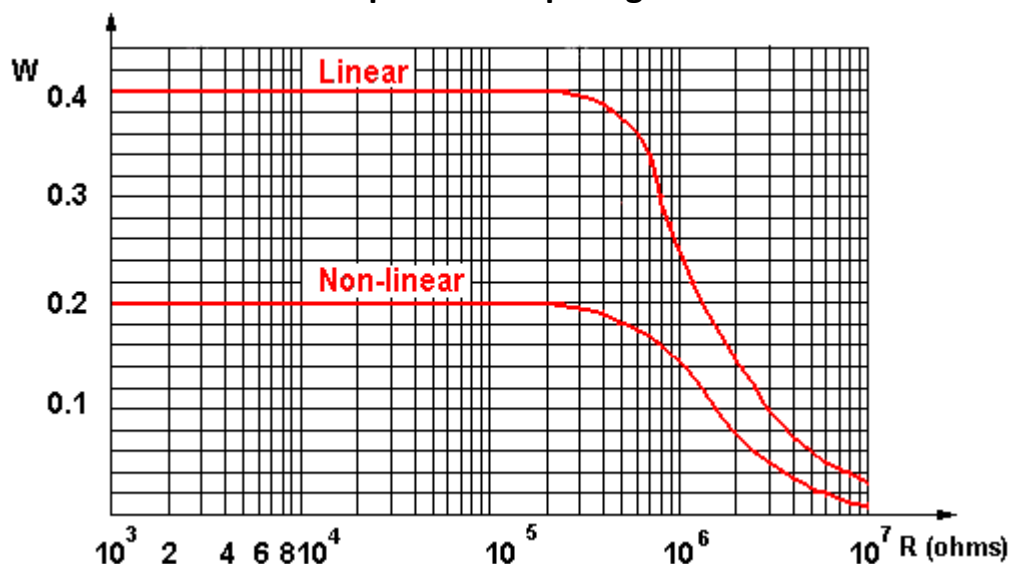
Effective rotation:

- Without a switch: 256° nominal
- With switch: 243° nominal
- With rotary switch: 243° nominal

Rated Power Dissipation @40°C for P20 potentiometers:

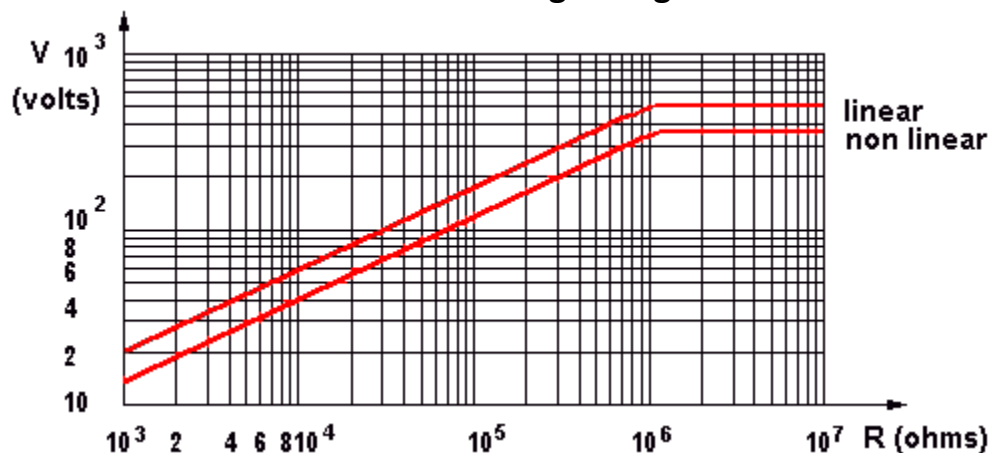
- 0.4W linear law
- 0.2W nonlinear law

P20 power dissipating curve



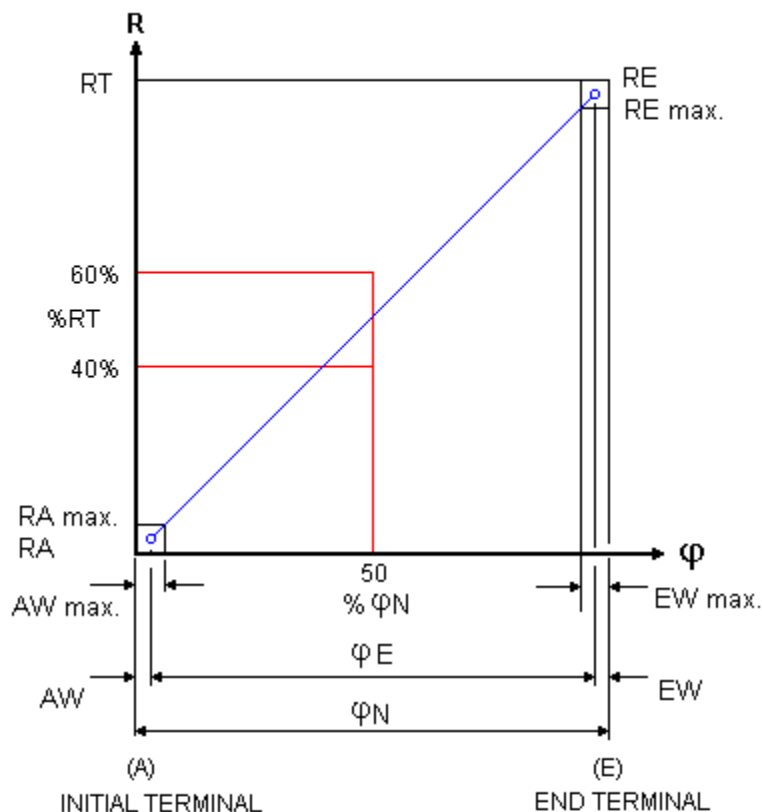
Limiting Element Voltage: 500 V DC for 20mm potentiometers

P20 maximum working voltage curve



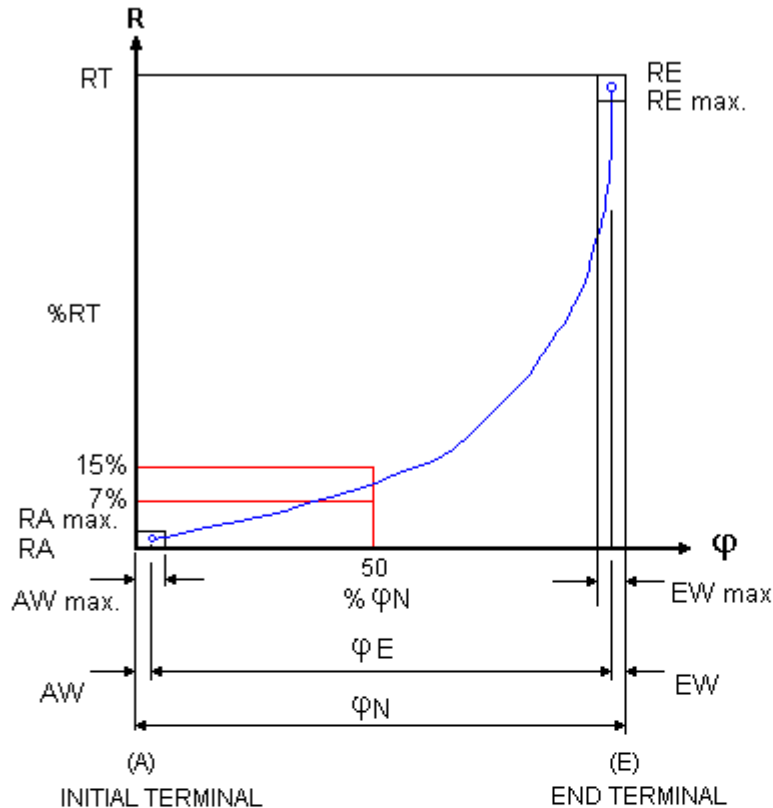
Insulating Voltage: 1000 V AC for 20mm potentiometers

Resistance law A - Linear



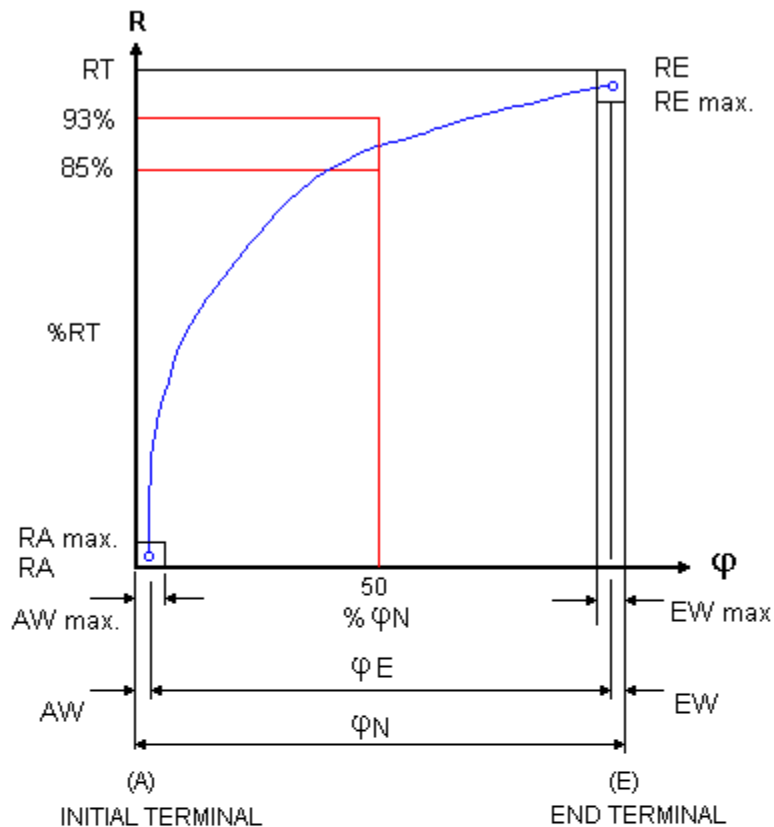
AW	Initial Path	AW max. 12% ϕ_N
EW	Final Path	EW max. 12% ϕ_N
Ra	Initial Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RA	Hop-on Resistance	$\leq 1\% RN$
Re	End Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RE	Hop-off Resistance	$\leq 1\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

Resistance law B – Log (Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RA	Hop-on Resistance	$RN \leq 10K$ 5% RN $RN > 10K$ 0.15% RN
Re	End Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RE	Hop-off Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K$ 0.5% RN
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

Resistance law C – Antilog (Reverse Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RA	Hop-on Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K 0.5\% RN$
Re	End Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RE	Hop-off Resistance	$RN \leq 10K 5\% RN$ $RN > 10K 0.15\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

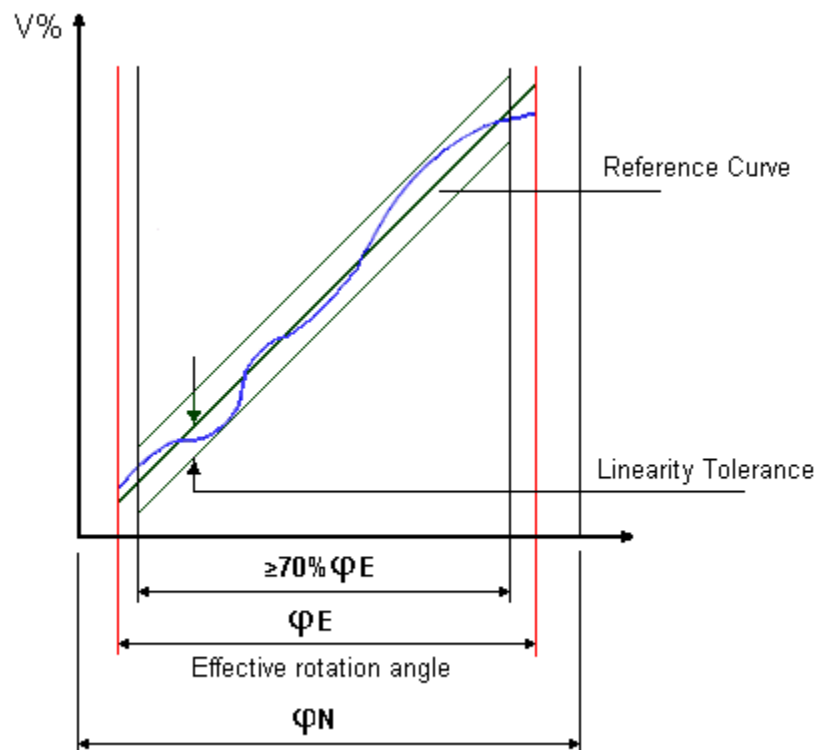
Linearity

As a basis of assessing Linearity Tolerance the independent method is the most practical, permitting as it does, the reference curve to be aligned as near as possible to the actual output curve. This avoids the use of the theoretical starting and finishing points, it is normal for the customer to realign the achieved curve with series trimmers at each end of the device if required.

Linearity Tolerance is 4% over the Nominal Resistance range of 1K0 to 1M0. The Linearity Tolerance is measured on at least 70% of the effective rotation range.

Note. In the case of Terminal and Zero-based linearity, both present constraints which increase the manufacturing difficulty and in consequence have an adverse effect on the product's price and availability.

Potentiometer linearity

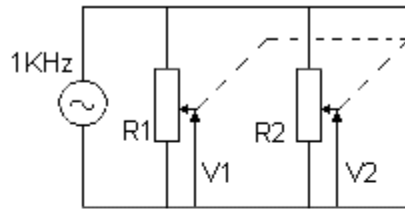


Matching Tolerance (For Tandem Stereo Potentiometers)

Tandem Potentiometers have two identical resistor units with the same variation law. The mismatching of the two resistor units, expressed in dB, is measured by the difference between the attenuations introduced by each resistor unit at various points of travel.

- Law A: 4 dB at Attenuation range 0 - 20 dB
- Law B and C: 3 dB at Attenuation range 0 - 20 dB

Matched Tolerance for Stereo

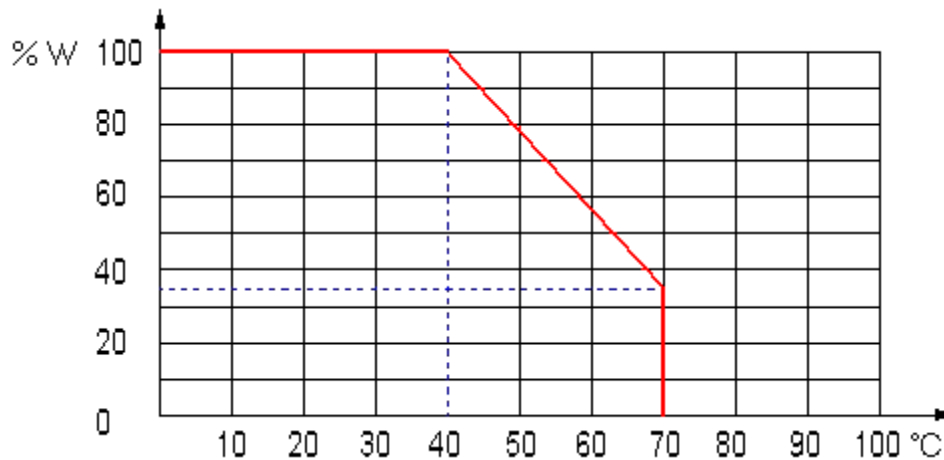


LAW	ATTENUATION RANGE	MATCHING TOLERANCE *
A	0 - 20dB	4dB
B & C	0 - 20dB	3dB

$$\text{*Matching Tolerance} = 20 \log \frac{V1}{V2}$$

Operating Temperature: -25°C to +70°C

Temperature Derating Curve



Temperature Coefficient of Resistance: +300 -500 ppm

P20 Spindles

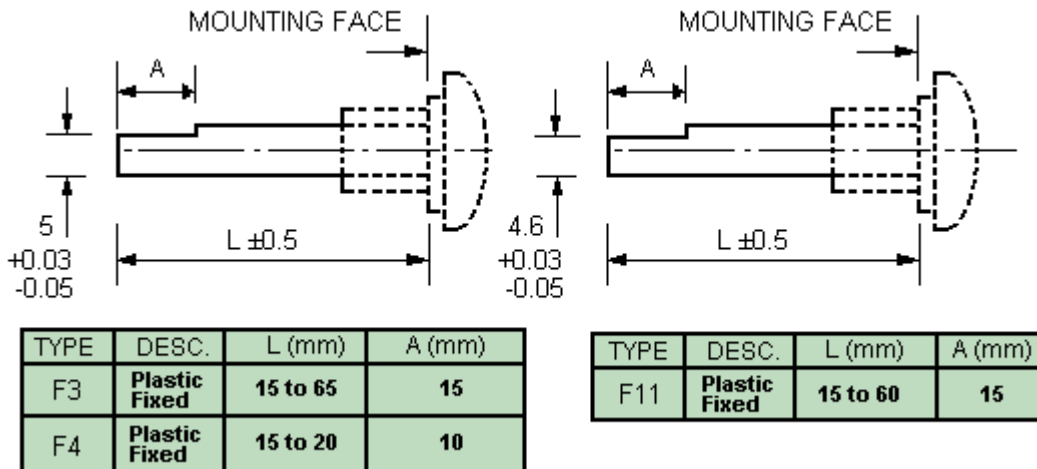
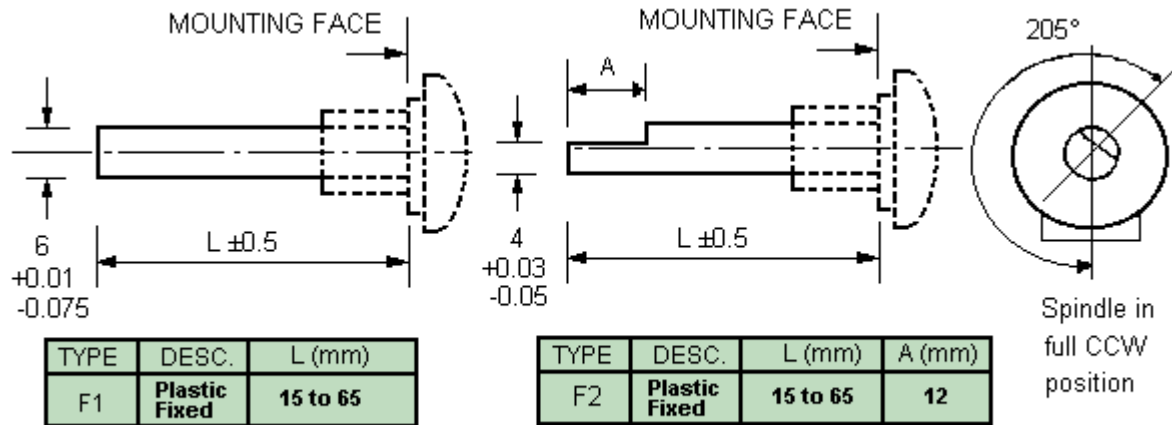
The P20 spindles are plastic and fixed (unless otherwise stated) and they are available in three diameters. A limited range of removable spindles are also available.

- 6.0mm Diameter
 - Cylindrical (Type F1)
 - 4.0 x 12mm Flat (Type F2)
 - 5.0 x 15mm Flat (Type F3)
 - 5.0 x 10mm Flat (Type F4)
 - 4.6mm x 15mm Flat (Type F11)
- 4.0mm Diameter
 - Cylindrical (Type F21)
 - 3.0 x 8.5mm Flat (Type F22)
 - 3.0 x 13.5mm Flat (Type F23)
 - Cylindrical (Type M21 - Metal)
 - 3.0 x 8.5mm Flat (Type M22 - Metal)
 - 3.0 x 13.5mm Flat (Type M23 - Metal)
- 6.35mm Diameter
 - Cylindrical (Type F41)
 - 5.5 x 10mm Flat (Type F42)
 - 5.5 x 15mm Flat (Type F43)
- Splined Spindle - 6.0mm dia. 18 teeth
- Dual Concentric
 - Flatted/Slotted (Type M15 - Metal)
 - Cylindrical (Type M16 - Metal)

6.0mm Diameter Spindles

Note: *Specials to customer's specification up to 65mm.

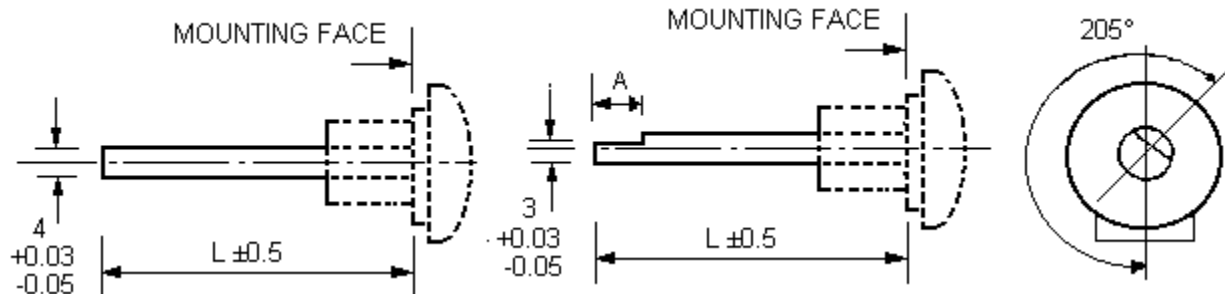
REMOVABLE SPINDLES, similar in specification to 'fixed' spindles are supplied separate from the potentiometer. These can be indefinitely taken in and out and their holding strength is >1kg.



4.0mm Diameter Spindles

Note: The orientation of the flat as illustrated is for plastic spindles only.

For metal spindles, unless specified on the order, the orientation may be different on each potentiometer type.



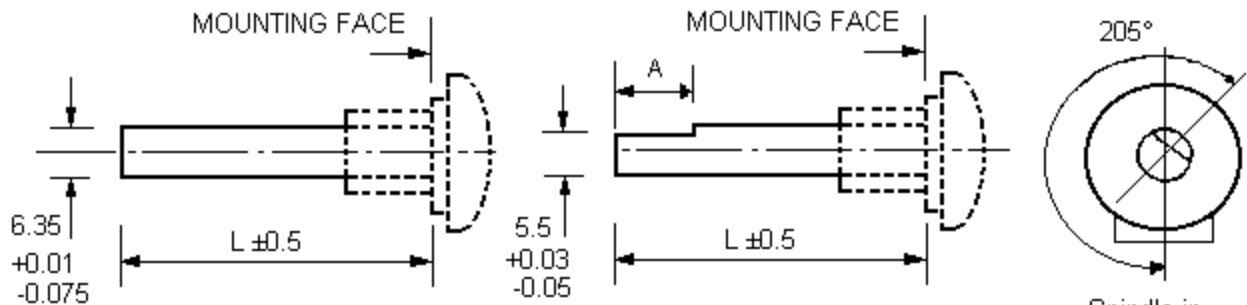
TYPE	DESC.	L (mm)
F21	Plastic Fixed	8 to 65
M21	Metal Fixed	8 to 65

TYPE	DESC.	L (mm)	A (mm)
F22	Plastic Fixed	11 to 60	8.5
M22	Metal Fixed	11 to 60	8.5
F23	Plastic Fixed	16 to 60	13.5
M23	Metal Fixed	16 to 60	13.5

Spindle in
full CCW
position

6.35mm Diameter Spindles

Note: *Specials to customer's specification up to 65mm.



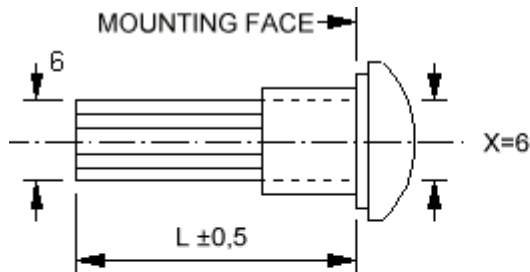
TYPE	DESC.	L (mm)
F41	Plastic Fixed	15 to 65

TYPE	DESC.	L (mm)	A (mm)
F42	Plastic Fixed	15 to 20	10
F43	Plastic Fixed	20 to 60	15

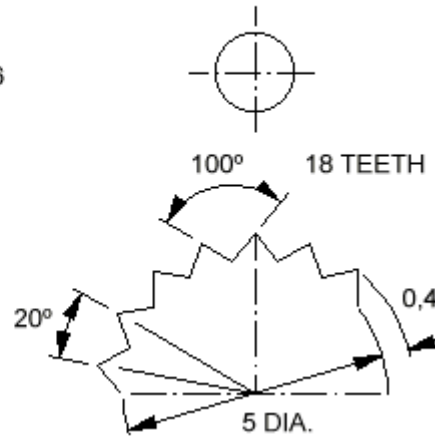
Spindle in
full CCW
position

Splined Spindle - 6.0mm dia. 18 teeth

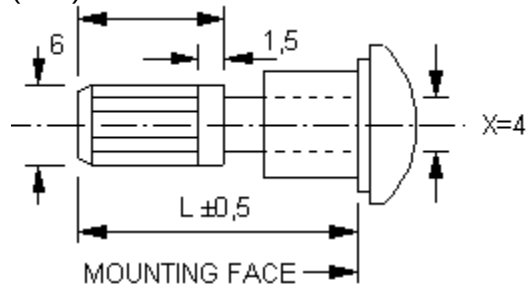
A splined form is available on the 6.0mm diameter P20 plastic spindle (F5) or alternatively a 6mm 'Splined Adaptor' (8,7mm long) can be fitted on a 4mm dia. Spindle



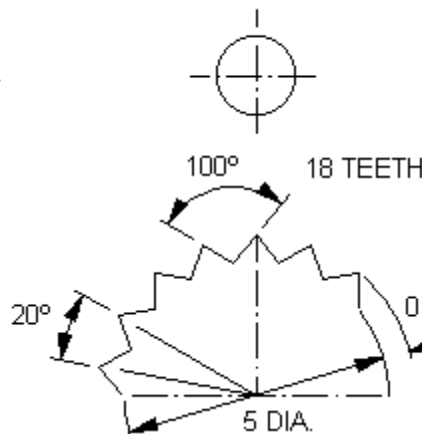
TYPE	DESC.	L (mm)
F5	Plastic Fixed	19



(F5A):



TYPE	DESC.	L (mm)
F5A	Plastic Fixed	16-36



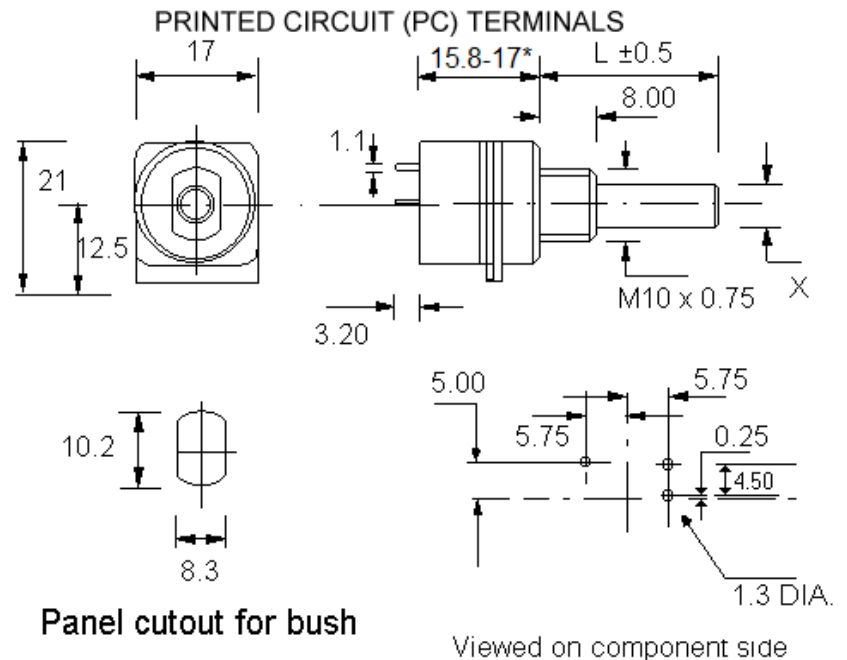
N4/PC1S-CH ROTARY SWITCH

4 Amp Single Pole (Double Throw) Switch (SPDT)

PC - Printed Circuit Terminals

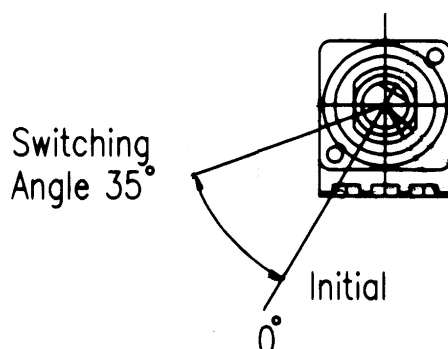
CH - Change Over (Double Throw)

Change over Switch Function with Limited Rotation



SPINDLE END VIEW

Mechanical Angle
of Rotation 45°



- X Spindle Diameter
- L Spindle Length

* Dependant on quantity and
Spindle Selection

**The Double Throw Change Over
Switch has never been Certified**

Rotary Switch Specification

The rotary switch modules are manufactured to EN61058-1 standard using high quality materials with a flame retardant housing. Although no longer certified due to the excessive cost of maintaining approvals, the 1 Amp and 4 Amp switch series have both been previously certified by UL International Demko (copies of previous certificates are available on our website or on request). The same materials, components and production techniques are used as in the certified versions and Omeg Ltd continues to test to the EN61058-1 standard

The 1 Amp contact rating is only available when mounted on the ECO potentiometer

1 A Contact Rating:

Note: The 1A contact rating is NOT available for mounting on the P16 or P20 potentiometer.

1A/250Vac 2.5A/12Vdc

Surge rating (0.01 seconds): 20A

Contact gap: 3mm (Full mains separation of contacts)

Manufactured to EN61058-1 standard

4 A Contact Rating:

4A/250Vac 10A/12Vdc

Surge rating (0.01 seconds): 80A

Switch contacts: Silver tin oxide

Contact gap: 2mm (Micro disconnection of switch - micro separation of contacts)

Manufactured to EN61058-1 standard

Common features

Housing material: Flame Retardant Glass filled polyester (UL 94 VO)

Initial contact resistance: 20 milliohms

Insulation resistance: 50,000 Megohms

Life (operations at full load): 10,000 minimum

Operating temperature: -25°C to +70°C

Operating torque for SPST/SPDT: 1.5 - 3 cNm

Operating torque for DPST/DPDT: 3.0 - 6 cNm

Mechanical rotation: 300°

Proof voltage: 3kV minimum

Rotary Switch Terminals

Layout

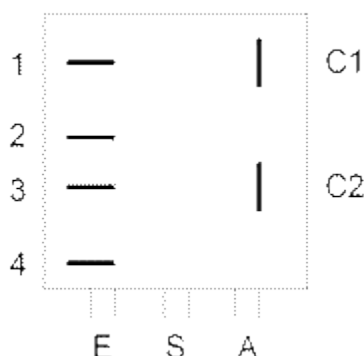


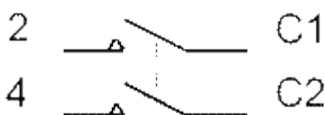
Diagram as viewed on the rear of the switch module:

(Potentiometer terminals at the bottom)

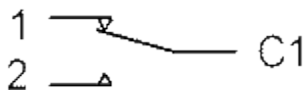
Configuration



SPST - Single pole (1S), Single throw (On-Off)

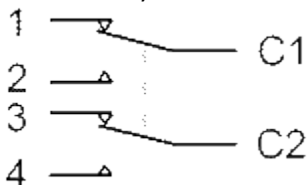


DPST - Double pole (2S), Single throw (On-Off)



SPDT - Single pole (1S), Double throw (CH)

(**NOT** certified)



DPDT - Double pole (2S), Double throw (CH)

(**NOT** certified)

Notes

1. Moving contact(s) shown when the potentiometer shaft is in a counterclockwise (CCW) position.
2. 'Ordinary Wiring'(OW) or 'Printed Circuit'(PC) terminals can be requested on the switch.
3. Terminals 1 and 3 are only fitted for the Double Throw ('CH' or Changeover) versions which are **NOT** approved nor certified.

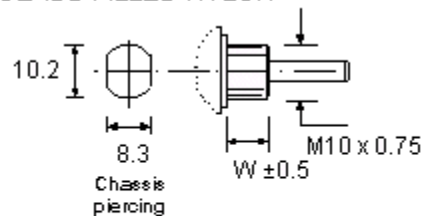
Components

ECO Bush Housing (Mounting)

The ECO bush housing is made of glass filled nylon, the thread is M10 x0.75mm pitch and 8mm long, alternatively **a 12mm long thread is also available** from October 2008.

Do not attempt to prevent any unwanted body rotation by overtightening the retaining nut, since this can cause thread damage, distortion, change of electrical resistance and restrict shaft rotation. BS9130:1972 provides further details on this topic. The **recommended torque** for tightening the retaining nut is 45cN.m and this can be achieved cost effectively by using a Torque Limiting device as shown on our **Accessories** page.

GLASS FILLED NYLON



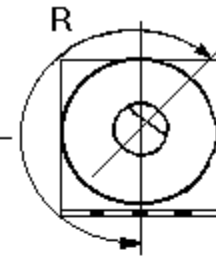
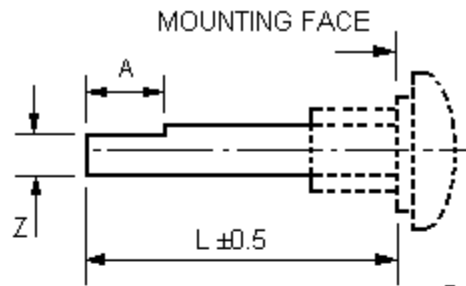
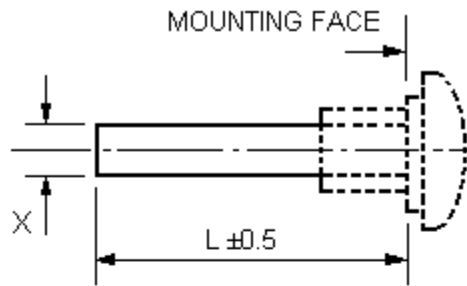
TYPE PLASTIC BODY	
W(mm)	8 (optional 12)

ECO Spindles

The ECO plastic spindles are fixed and not removable.
They are available in the following three diameters:

- 6.0mm Diameter - Length (L) available from 14mm to 65mm
 - Cylindrical (Type F1)
 - 4.0 x 12mm Flat (Type F2)
 - 5.0 x 15mm Flat (Type F3)
 - 5.0 x 10mm Flat (Type F4)
 - 4.6mm x 15mm Flat (Type F11)
 - 4.0 x 8mm Flat (Type F13)
 - 5.0 x 8mm Flat (Type F14)
- 4.0mm Diameter - Length (L) available from 14mm to 35mm
 - Cylindrical (Type F21)
 - 3.0 x 8.5mm Flat (Type F22)
- 6.35mm Diameter - Length (L) available from 14mm to 65mm
 - Cylindrical (Type F41)
 - 5.5 x 10mm Flat (Type F42)

Cylindrical and Flatted Spindles



Spindle in full CCW position

TYPE	DESC. (Ø)	L (mm)
F21	4 mm Dia Plastic	14 - 35
F1	6 mm Dia Plastic	14 - 65
F41	6.35mm Dia Plastic	14 - 65

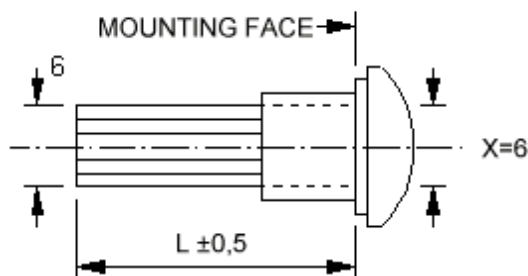
All spindles fixed.

TYPE	DESC. (Ø)	L (mm)	Flat (ZxA)
F22	4 mm Dia Plastic	14 - 35	3 x 8.5
F13	6 mm Dia Plastic	14 - 65	4 x 8
F2	6 mm Dia Plastic	14 - 65	4 x 12
F14	6 mm Dia Plastic	14 - 65	5 x 8
F4	6 mm Dia Plastic	14 - 65	5 x 10
F3	6 mm Dia Plastic	14 - 65	5 x 15
F11	6 mm Dia Plastic	14 - 65	4.6 x 15
F42	6.35mm Dia Plastic	14 - 65	5.5 x 10

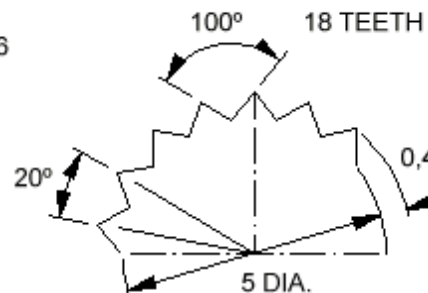
Standard flat angle
R = 210°

Splined Spindle (6.0mm diameter)

A splined form is also available on the 6.0mm diameter ECO plastic spindle.



TYPE	DESC.	L (mm)
F5	Plastic Fixed	14 - 30



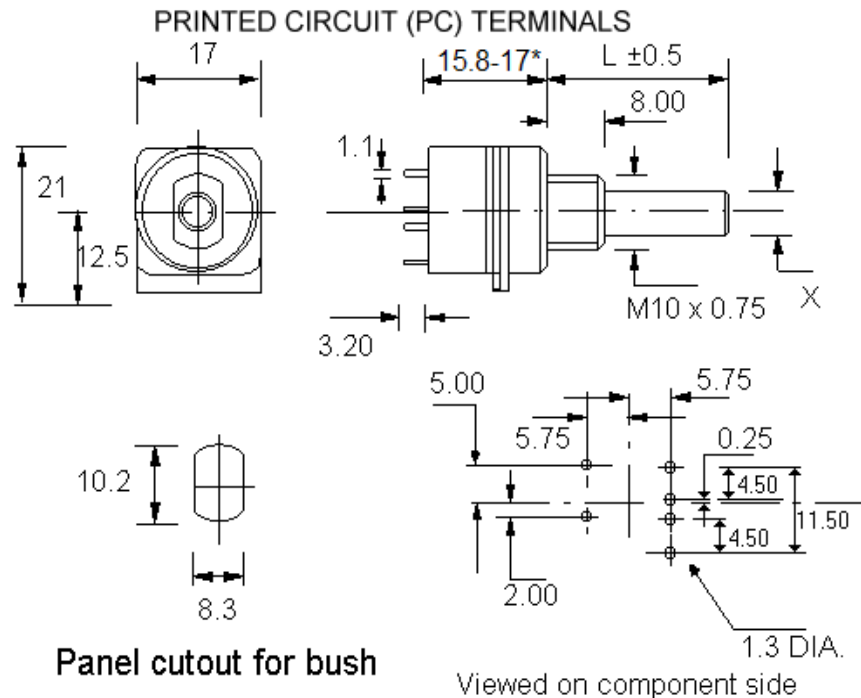
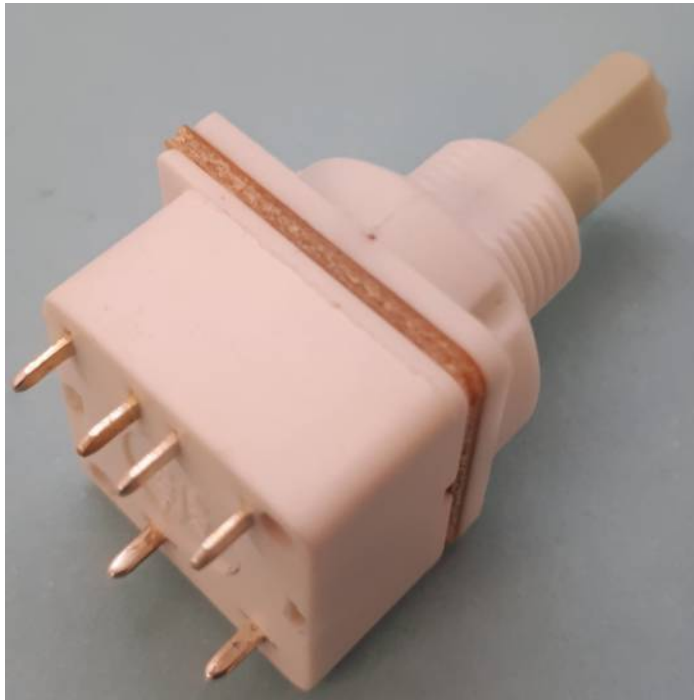
N4/PC2S-CH ROTARY SWITCH

4 Amp Double Pole (Double Throw) Switch (DPDT)

PC - Printed Circuit Terminals

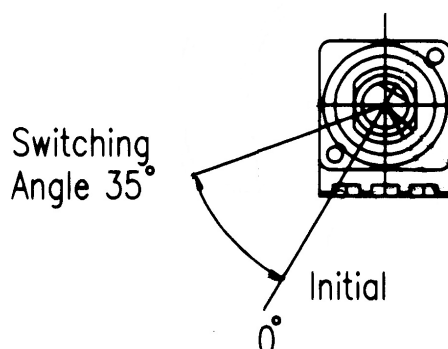
CH - Change Over (Double Throw)

Change over Switch Function with Limited Rotation



SPINDLE END VIEW

Mechanical Angle
of Rotation 45°



- X Spindle Diameter
- L Spindle Length

* Dependant on quantity and
Spindle Selection

**The Double Throw Change Over
Switch has never been Certified**

Rotary Switch Specification

The rotary switch modules are manufactured to EN61058-1 standard using high quality materials with a flame retardant housing. Although no longer certified due to the excessive cost of maintaining approvals, the 1 Amp and 4 Amp switch series have both been previously certified by UL International Demko (copies of previous certificates are available on our website or on request). The same materials, components and production techniques are used as in the certified versions and Omeg Ltd continues to test to the EN61058-1 standard

The 1 Amp contact rating is only available when mounted on the ECO potentiometer

1 A Contact Rating:

Note: The 1A contact rating is NOT available for mounting on the P16 or P20 potentiometer.

1A/250Vac 2.5A/12Vdc

Surge rating (0.01 seconds): 20A

Contact gap: 3mm (Full mains separation of contacts)

Manufactured to EN61058-1 standard

4 A Contact Rating:

4A/250Vac 10A/12Vdc

Surge rating (0.01 seconds): 80A

Switch contacts: Silver tin oxide

Contact gap: 2mm (Micro disconnection of switch - micro separation of contacts)

Manufactured to EN61058-1 standard

Common features

Housing material: Flame Retardant Glass filled polyester (UL 94 VO)

Initial contact resistance: 20 milliohms

Insulation resistance: 50,000 Megohms

Life (operations at full load): 10,000 minimum

Operating temperature: -25°C to +70°C

Operating torque for SPST/SPDT: 1.5 - 3 cNm

Operating torque for DPST/DPDT: 3.0 - 6 cNm

Mechanical rotation: 300°

Proof voltage: 3kV minimum

Rotary Switch Terminals

Layout

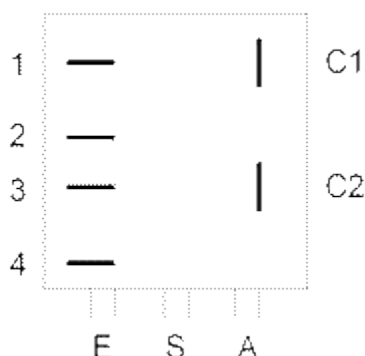


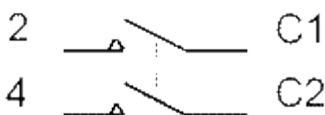
Diagram as viewed on the rear of the switch module:

(Potentiometer terminals at the bottom)

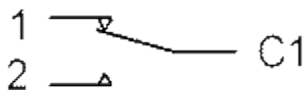
Configuration



SPST - Single pole (1S), Single throw (On-Off)

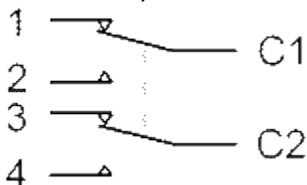


DPST - Double pole (2S), Single throw (On-Off)



SPDT - Single pole (1S), Double throw (CH)

(**NOT** certified)



DPDT - Double pole (2S), Double throw (CH)

(**NOT** certified)

Notes

1. Moving contact(s) shown when the potentiometer shaft is in a counterclockwise (CCW) position.
2. 'Ordinary Wiring'(OW) or 'Printed Circuit'(PC) terminals can be requested on the switch.
3. Terminals 1 and 3 are only fitted for the Double Throw ('CH' or Changeover) versions which are **NOT** approved nor certified.

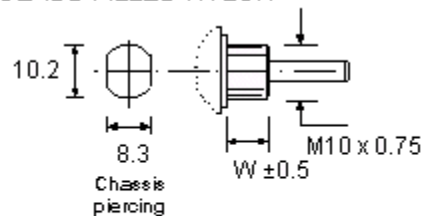
Components

ECO Bush Housing (Mounting)

The ECO bush housing is made of glass filled nylon, the thread is M10 x0.75mm pitch and 8mm long, alternatively **a 12mm long thread is also available** from October 2008.

Do not attempt to prevent any unwanted body rotation by overtightening the retaining nut, since this can cause thread damage, distortion, change of electrical resistance and restrict shaft rotation. BS9130:1972 provides further details on this topic. The **recommended torque** for tightening the retaining nut is 45cN.m and this can be achieved cost effectively by using a Torque Limiting device as shown on our **Accessories** page.

GLASS FILLED NYLON



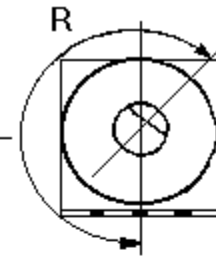
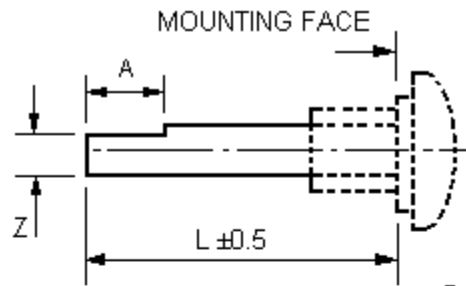
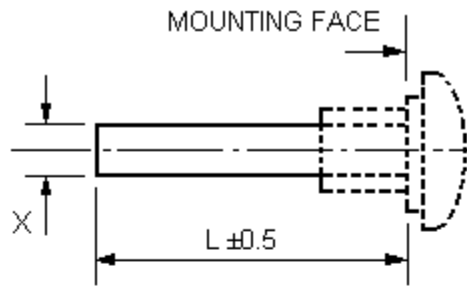
TYPE PLASTIC BODY	
W(mm)	8 (optional 12)

ECO Spindles

The ECO plastic spindles are fixed and not removable.
They are available in the following three diameters:

- 6.0mm Diameter - Length (L) available from 14mm to 65mm
 - Cylindrical (Type F1)
 - 4.0 x 12mm Flat (Type F2)
 - 5.0 x 15mm Flat (Type F3)
 - 5.0 x 10mm Flat (Type F4)
 - 4.6mm x 15mm Flat (Type F11)
 - 4.0 x 8mm Flat (Type F13)
 - 5.0 x 8mm Flat (Type F14)
- 4.0mm Diameter - Length (L) available from 14mm to 35mm
 - Cylindrical (Type F21)
 - 3.0 x 8.5mm Flat (Type F22)
- 6.35mm Diameter - Length (L) available from 14mm to 65mm
 - Cylindrical (Type F41)
 - 5.5 x 10mm Flat (Type F42)

Cylindrical and Flatted Spindles



Spindle in full CCW position

TYPE	DESC. (Ø)	L (mm)
F21	4 mm Dia Plastic	14 - 35
F1	6 mm Dia Plastic	14 - 65
F41	6.35mm Dia Plastic	14 - 65

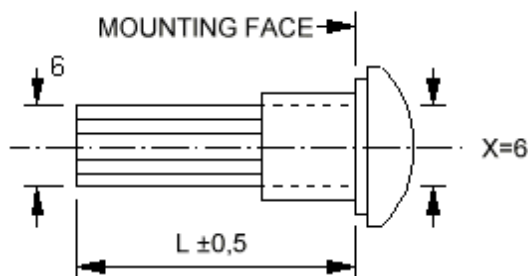
All spindles fixed.

TYPE	DESC. (Ø)	L (mm)	Flat (ZxA)
F22	4 mm Dia Plastic	14 - 35	3 x 8.5
F13	6 mm Dia Plastic	14 - 65	4 x 8
F2	6 mm Dia Plastic	14 - 65	4 x 12
F14	6 mm Dia Plastic	14 - 65	5 x 8
F4	6 mm Dia Plastic	14 - 65	5 x 10
F3	6 mm Dia Plastic	14 - 65	5 x 15
F11	6 mm Dia Plastic	14 - 65	4.6 x 15
F42	6.35mm Dia Plastic	14 - 65	5.5 x 10

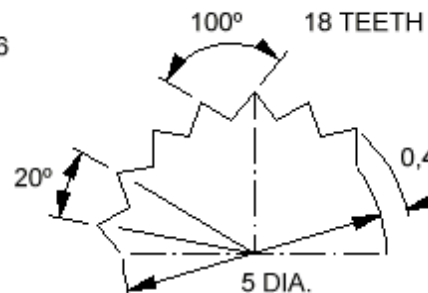
Standard flat angle
R = 210°

Splined Spindle (6.0mm diameter)

A splined form is also available on the 6.0mm diameter ECO plastic spindle.

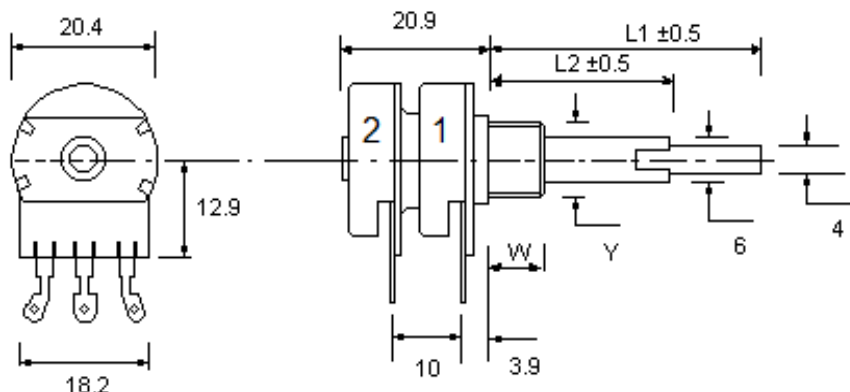


TYPE	DESC.	L (mm)
F5	Plastic Fixed	14 - 30



OW2C20BU

OW – Ordinary Wiring Terminals (Recommended for soldering)



L1 = Spindle controlling gang 2

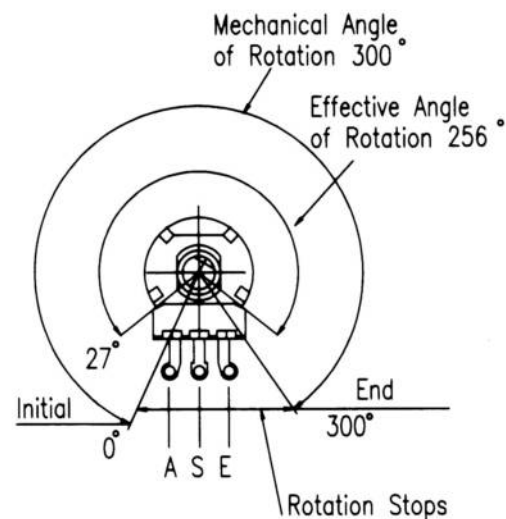
L2 = Tube controlling gang 1

- W Mounting Height
- Y Mounting Diameter
- X Spindle Diameter
- L Spindle Length

- A Initial Termination
- S Wiper (or moving contact) termination
- E End Termination

Prefix (Potentiometer terminals)

- BR - Bracket (included with printed circuit terminals)
- FN - Faston (or spade)
- LA - Long bent and away from the spindle
- LT - Long bent and towards the spindle
- OW - Ordinary wiring (eyelets) - **recommended for hand soldering of wires**
- PC - Printed circuit
- XA - Extra long, bent away from the spindle (mainly used with switches)



Total mechanical and effective electrical angles of rotation of potentiometers without rotary switch

Technical Data

Rated Power Dissipation @40°C for P20 potentiometers:

0.4W linear law

0.2W nonlinear law

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Effective rotation: 256° nominal

Operating Torque: 0.4 – 1.5 cN.m

Permissible Axial Spindle Load: 100 N (5 Sec. maximum)

Permissible Torque at End Stop: 80 cN.m

Rotation angle: 300° ±5°

Rotational torque of spindle can be made high or low

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Insulation Resistance: >= 4 Gohms

Rated Resistance: E3 Series

Optional: E6 Series

Linear Law: 1K – 1M (±10%)

Nonlinear Law: 4K7 – 470K

ELECTRICAL SPECIFICATION COMMON TO ALL POTENTIOMETERS

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Insulation Resistance: >= 4 Gohms

Rated Resistance: E3 Series

- Optional: E6 Series
- Linear Law: 1K - 1M
- Nonlinear Law: 4K7 - 470K

Tolerance on Rated Resistance: ± 20%

- Optional Tolerance on 1K - 1M: ± 10%

Resistance Laws (Taper):

- Linear: A
- Nonlinear: B - Log (Audio) or C - Antilog (Reverse Audio)
- Other laws: Please refer to Sales office

ELECTRICAL SPECIFICATION UNIQUE TO P20 POTENTIOMETERS

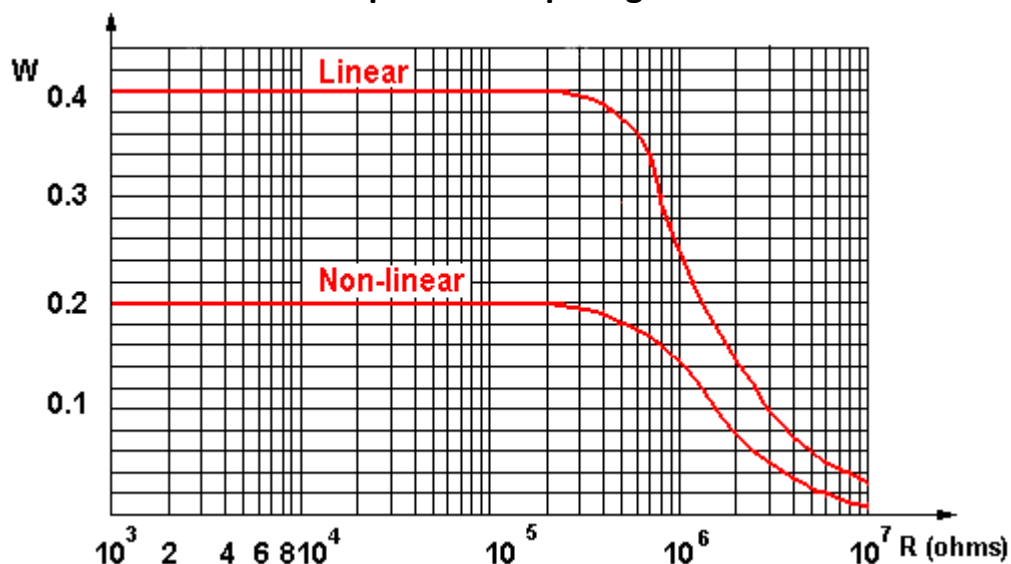
Effective rotation:

- Without a switch: 256° nominal
- With switch: 243° nominal
- With rotary switch: 243° nominal

Rated Power Dissipation @40°C for P20 potentiometers:

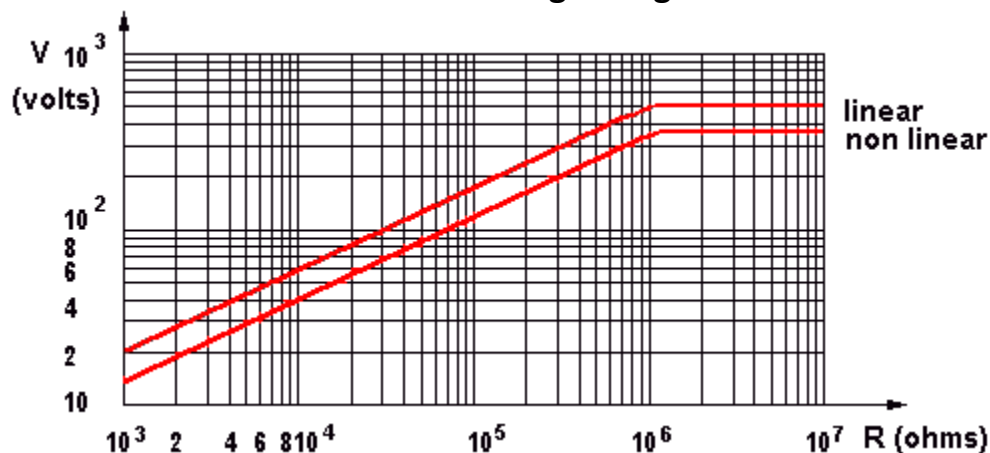
- 0.4W linear law
- 0.2W nonlinear law

P20 power dissipating curve



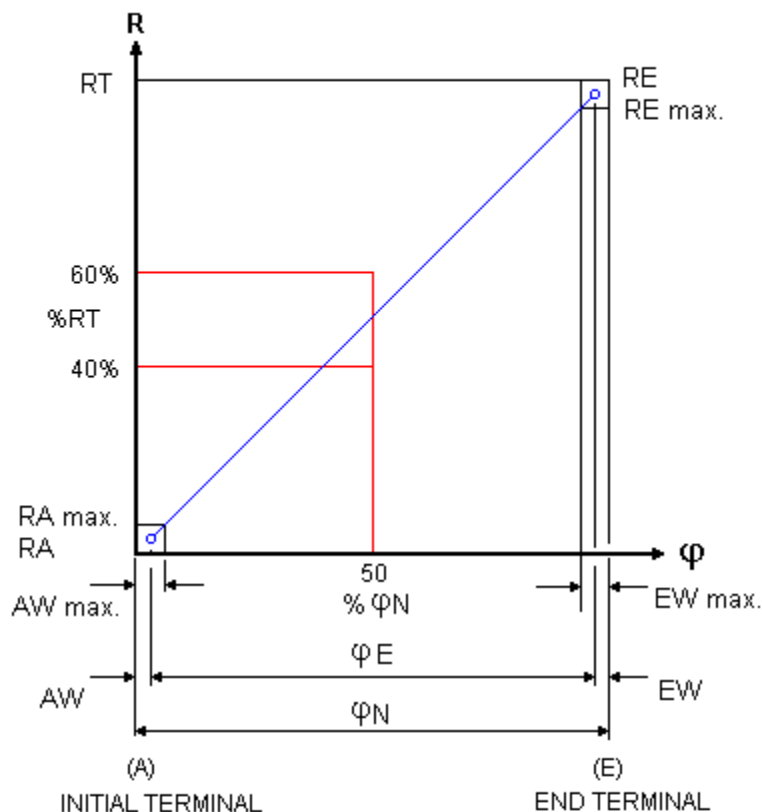
Limiting Element Voltage: 500 V DC for 20mm potentiometers

P20 maximum working voltage curve



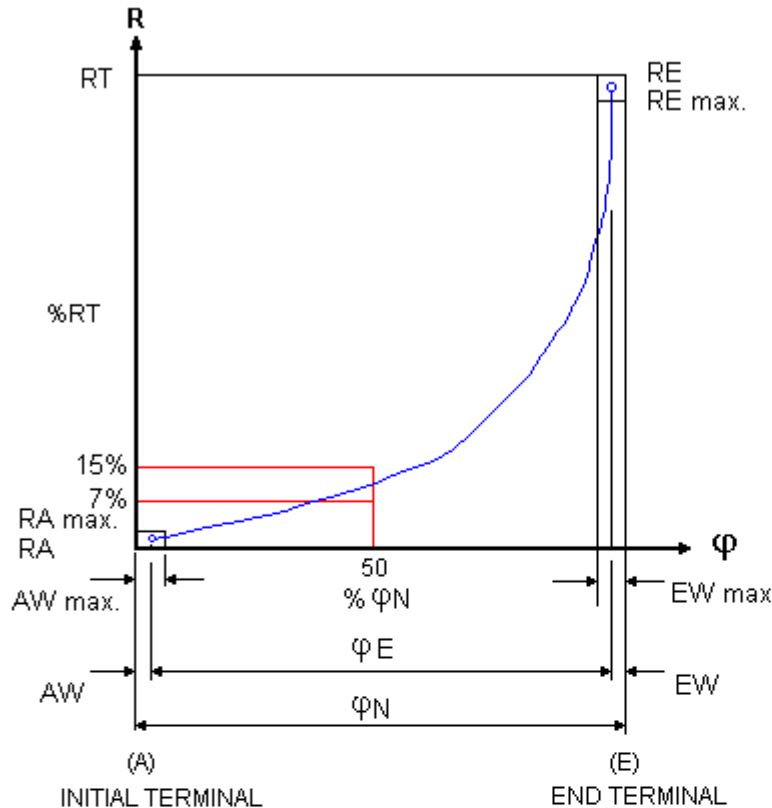
Insulating Voltage: 1000 V AC for 20mm potentiometers

Resistance law A - Linear



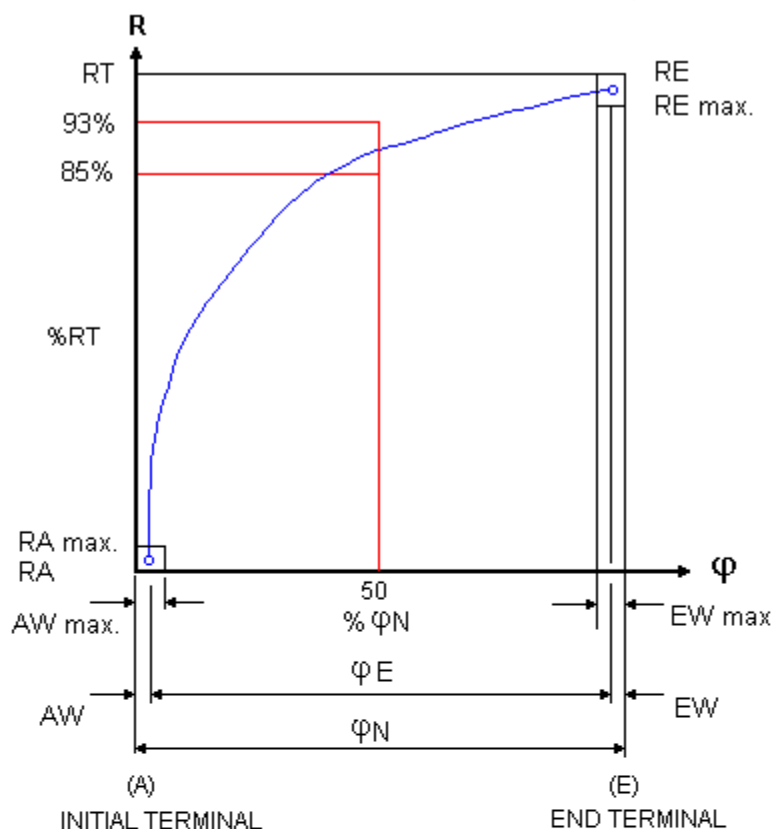
AW	Initial Path	AW max. 12% ϕN
EW	Final Path	EW max. 12% ϕN
Ra	Initial Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RA	Hop-on Resistance	$\leq 1\% RN$
Re	End Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RE	Hop-off Resistance	$\leq 1\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

Resistance law B – Log (Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RA	Hop-on Resistance	$RN \leq 10K$ 5% RN $RN > 10K$ 0.15% RN
Re	End Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RE	Hop-off Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K$ 0.5% RN
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

Resistance law C – Antilog (Reverse Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RA	Hop-on Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K 0.5\% RN$
Re	End Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RE	Hop-off Resistance	$RN \leq 10K 5\% RN$ $RN > 10K 0.15\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

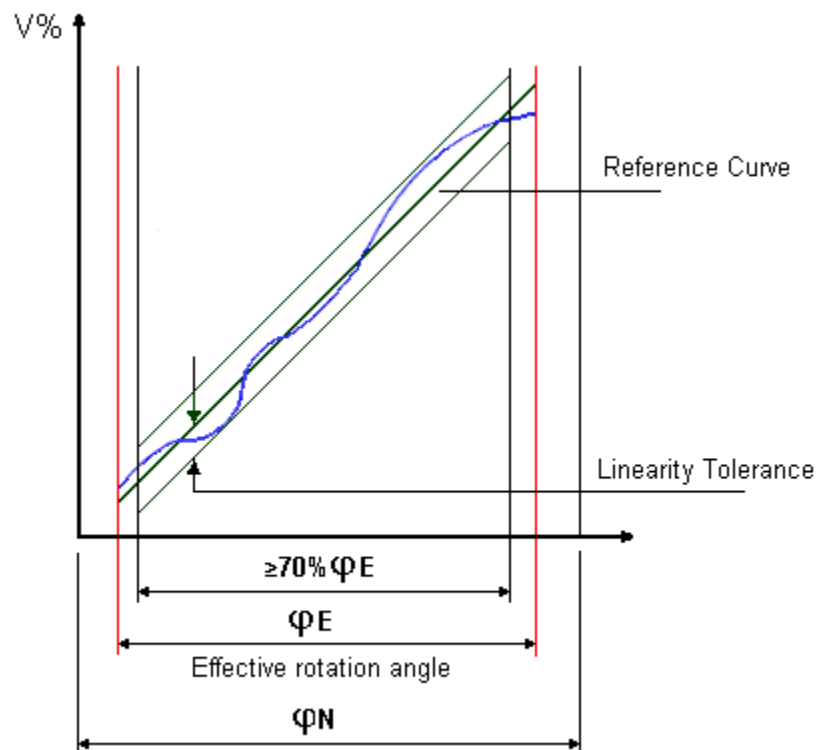
Linearity

As a basis of assessing Linearity Tolerance the independent method is the most practical, permitting as it does, the reference curve to be aligned as near as possible to the actual output curve. This avoids the use of the theoretical starting and finishing points, it is normal for the customer to realign the achieved curve with series trimmers at each end of the device if required.

Linearity Tolerance is 4% over the Nominal Resistance range of 1K Ω to 1M Ω . The Linearity Tolerance is measured on at least 70% of the effective rotation range.

Note. In the case of Terminal and Zero-based linearity, both present constraints which increase the manufacturing difficulty and in consequence have an adverse effect on the product's price and availability.

Potentiometer linearity

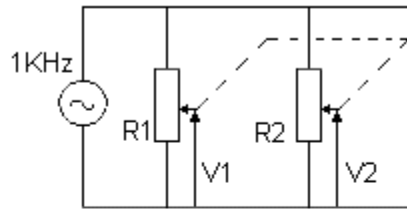


Matching Tolerance (For Tandem Stereo Potentiometers)

Tandem Potentiometers have two identical resistor units with the same variation law. The mismatching of the two resistor units, expressed in dB, is measured by the difference between the attenuations introduced by each resistor unit at various points of travel.

- Law A: 4 dB at Attenuation range 0 - 20 dB
- Law B and C: 3 dB at Attenuation range 0 - 20 dB

Matched Tolerance for Stereo

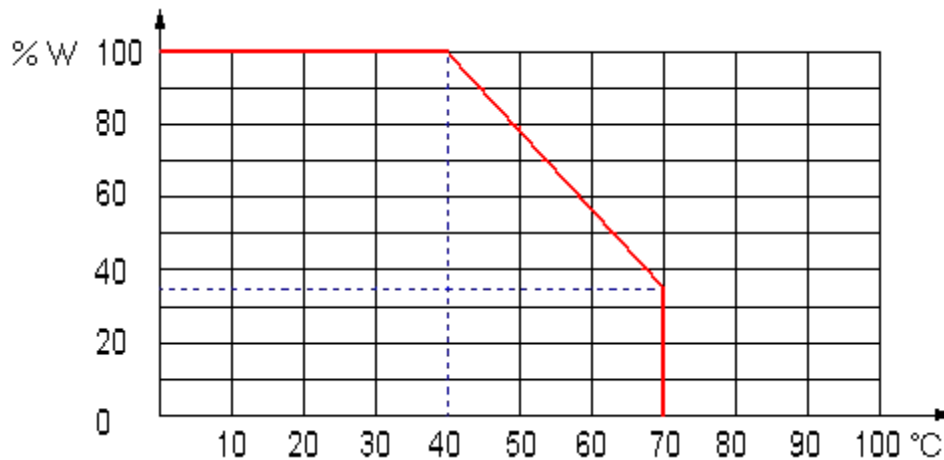


LAW	ATTENUATION RANGE	MATCHING TOLERANCE *
A	0 - 20dB	4dB
B & C	0 - 20dB	3dB

$$* \text{Matching Tolerance} = 20 \log \frac{V1}{V2}$$

Operating Temperature: -25°C to +70°C

Temperature Derating Curve



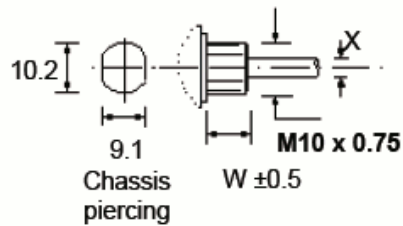
Temperature Coefficient of Resistance: +300 -500 ppm

Components

P20 Bush Housing (Mounting)

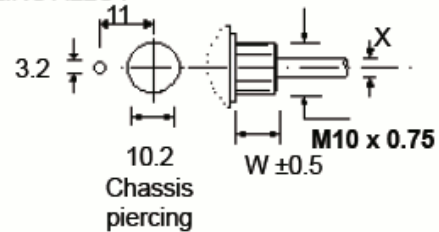
The P20 bushes are available in metal or nylon; with three thread options; and with or without a locating feature:

DIECAST ZINC ALLOY



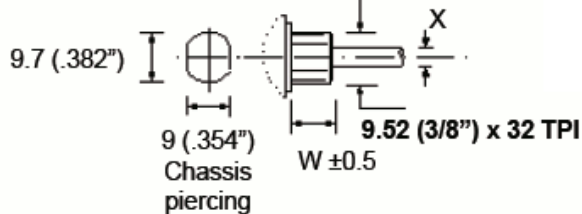
Type C (without locator)	
X (mm)	6
W (mm)	9

DIECAST ZINC ALLOY



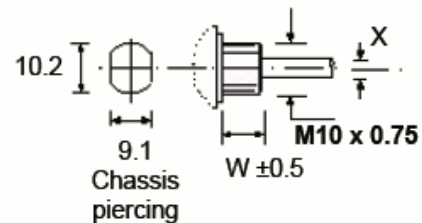
Type CEBS (with locator)	
X (mm)	6
W (mm)	9

DIECAST ZINC ALLOY

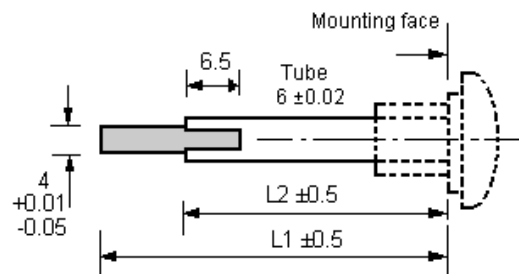


Type CBS (without locator)	
X (mm)	6
W (mm)	8 or 12

GLASS FILLED NYLON



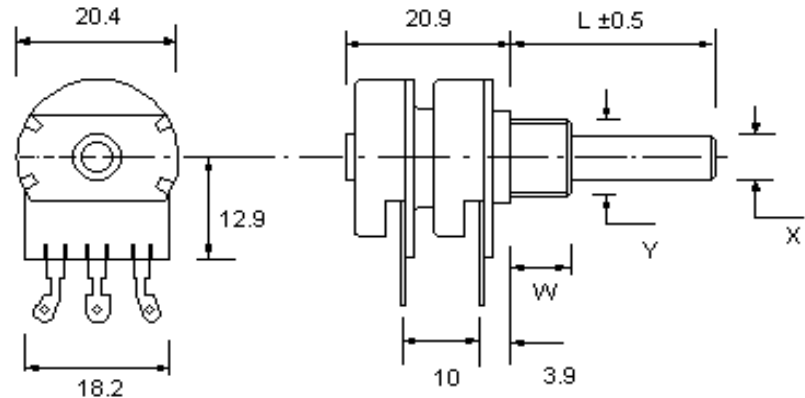
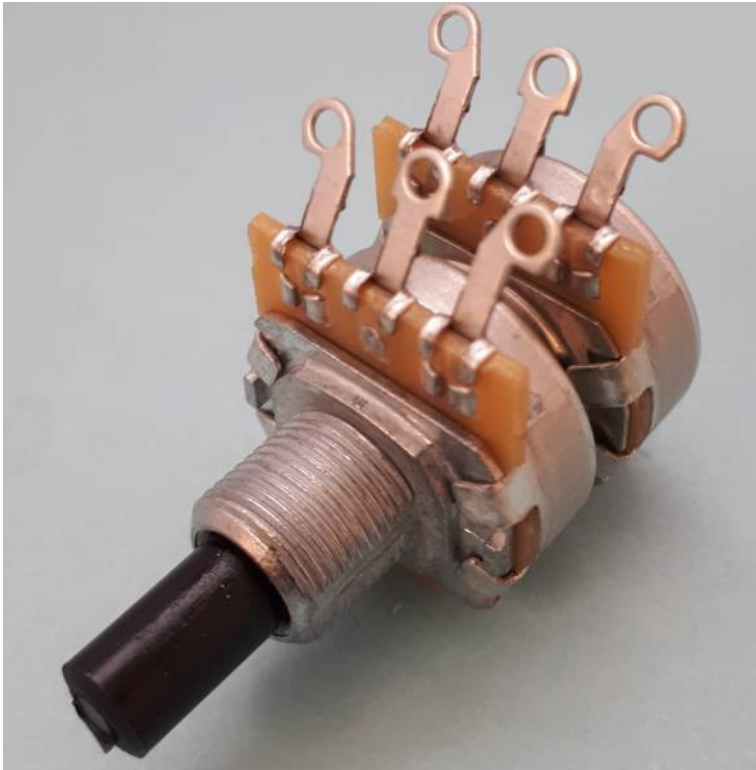
Type CP (GFN)		
X (mm)	6	6.35
W (mm)	7 or 10	7 or 10



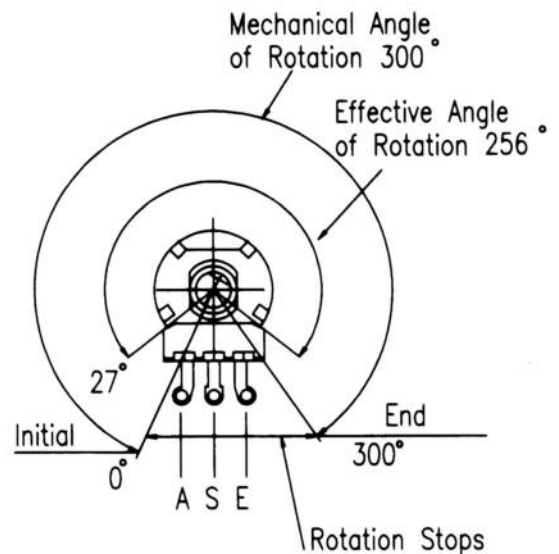
TYPE	DESC.	L1 (mm)	L2 (mm)
M15	Metal Fixed	60 (max.)	50 (max.)

OW2G20BU

OW – Ordinary Wiring Terminals (Recommended for soldering)



SPINDLE END VIEW



Total mechanical and effective electrical angles of rotation of potentiometers without rotary switch

- W Mounting Height
- Y Mounting Diameter
- X Spindle Diameter
- L Spindle Length
- A Initial Termination
- S Wiper (or moving contact) termination
- E End Termination

Technical Data

Rated Power Dissipation @40°C for P20 potentiometers:

0.4W linear law

0.2W nonlinear law

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Effective rotation: 256° nominal

Operating Torque: 0.4 – 1.5 cN.m

Permissible Axial Spindle Load: 100 N (5 Sec. maximum)

Permissible Torque at End Stop: 80 cN.m

Rotation angle: 300° ±5°

Rotational torque of spindle can be made high or low

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Insulation Resistance: >= 4 Gohms

Rated Resistance: E3 Series

Optional: E6 Series

Linear Law: 1K – 1M (±10%)

Nonlinear Law: 4K7 – 470K

ELECTRICAL SPECIFICATION COMMON TO ALL POTENTIOMETERS

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Insulation Resistance: >= 4 Gohms

Rated Resistance: E3 Series

- Optional: E6 Series
- Linear Law: 1K - 1M
- Nonlinear Law: 4K7 - 470K

Tolerance on Rated Resistance: ± 20%

- Optional Tolerance on 1K - 1M: ± 10%

Resistance Laws (Taper):

- Linear: A
- Nonlinear: B - Log (Audio) or C - Antilog (Reverse Audio)
- Other laws: Please refer to Sales office

ELECTRICAL SPECIFICATION UNIQUE TO P20 POTENTIOMETERS

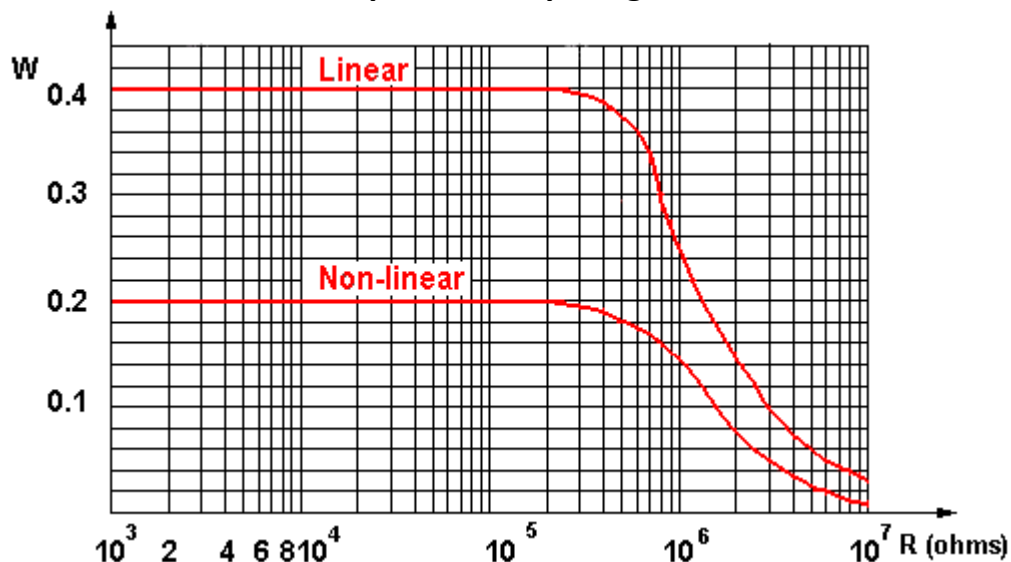
Effective rotation:

- Without a switch: 256° nominal
- With switch: 243° nominal
- With rotary switch: 243° nominal

Rated Power Dissipation @40°C for P20 potentiometers:

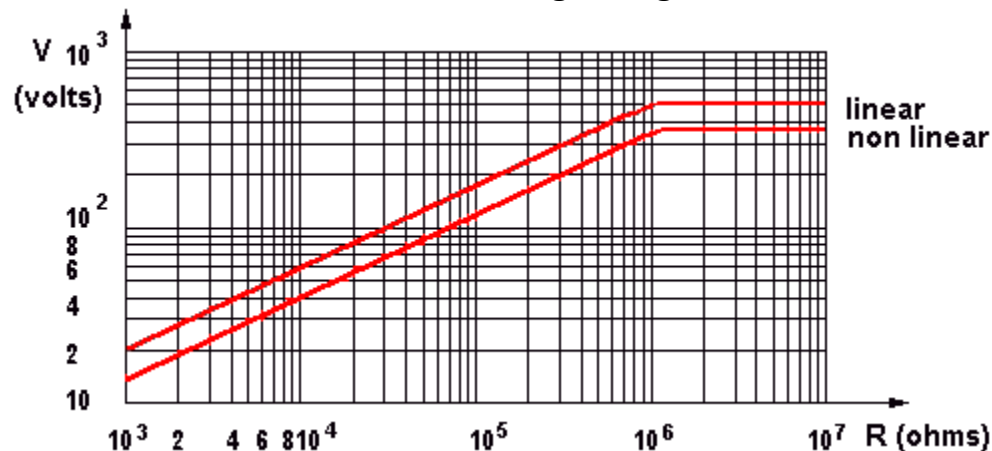
- 0.4W linear law
- 0.2W nonlinear law

P20 power dissipating curve



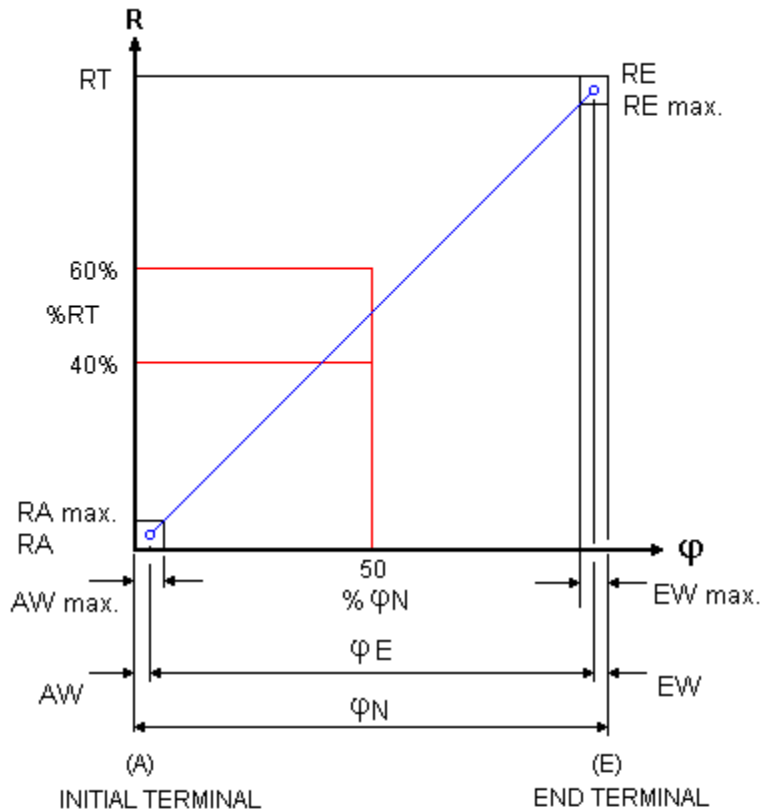
Limiting Element Voltage: 500 V DC for 20mm potentiometers

P20 maximum working voltage curve



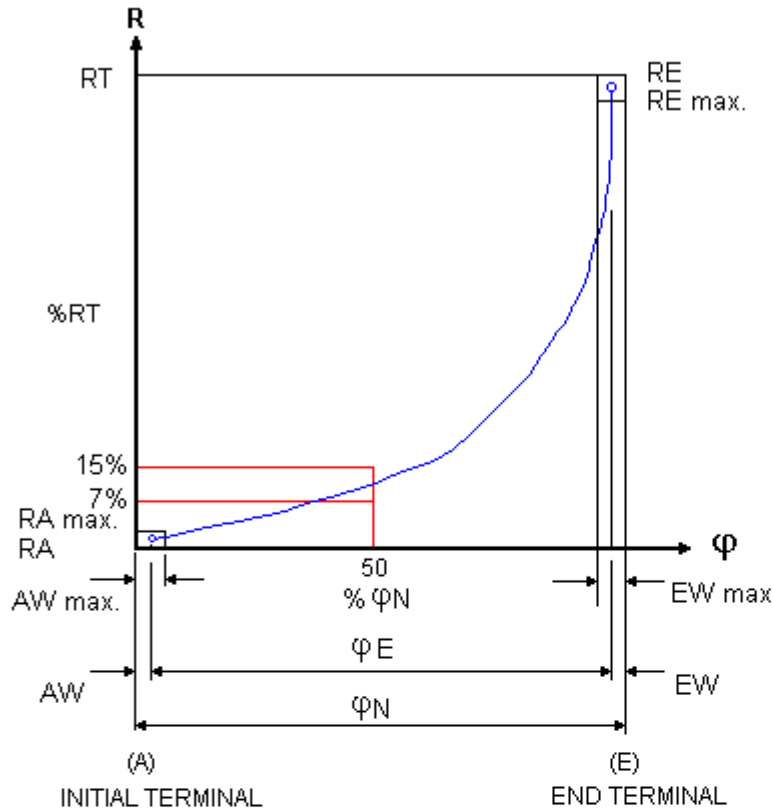
Insulating Voltage: 1000 V AC for 20mm potentiometers

Resistance law A - Linear



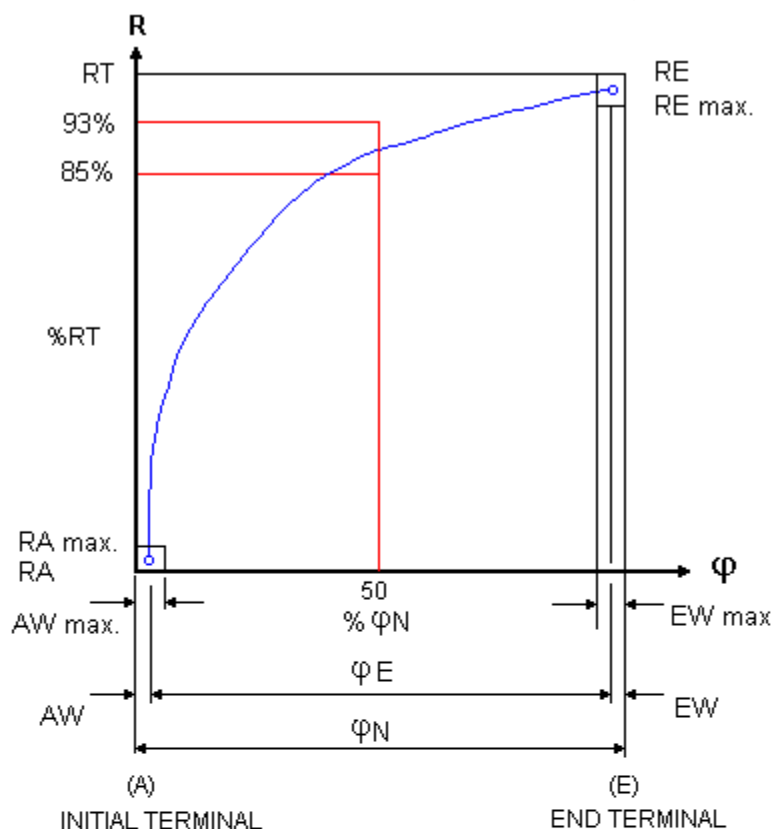
AW	Initial Path	AW max. 12% ϕN
EW	Final Path	EW max. 12% ϕN
Ra	Initial Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RA	Hop-on Resistance	$\leq 1\% RN$
Re	End Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RE	Hop-off Resistance	$\leq 1\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

Resistance law B – Log (Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RA	Hop-on Resistance	$RN \leq 10K$ 5% RN $RN > 10K$ 0.15% RN
Re	End Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RE	Hop-off Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K$ 0.5% RN
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

Resistance law C – Antilog (Reverse Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RA	Hop-on Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K 0.5\% RN$
Re	End Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RE	Hop-off Resistance	$RN \leq 10K 5\% RN$ $RN > 10K 0.15\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

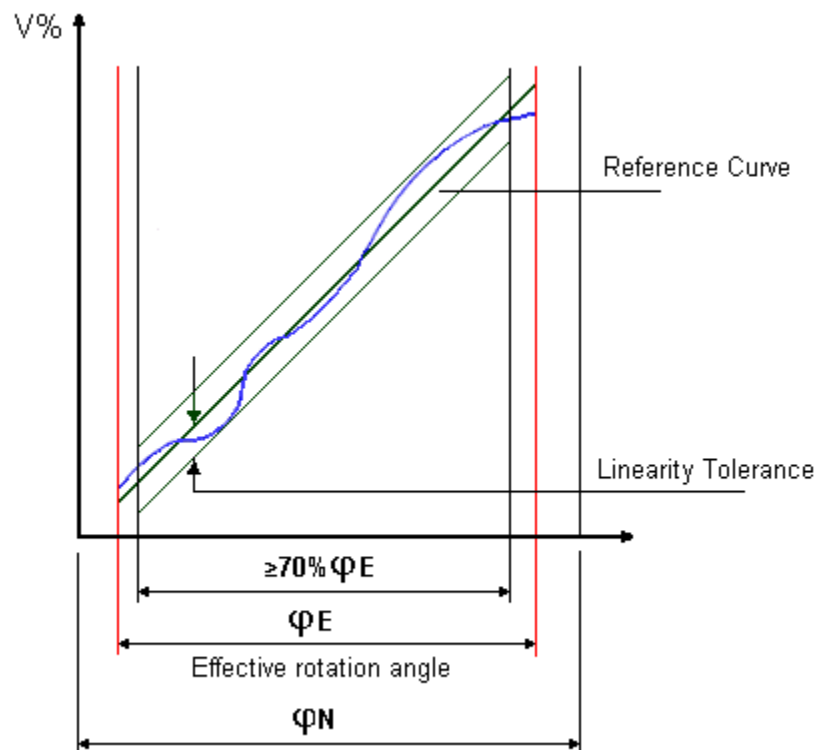
Linearity

As a basis of assessing Linearity Tolerance the independent method is the most practical, permitting as it does, the reference curve to be aligned as near as possible to the actual output curve. This avoids the use of the theoretical starting and finishing points, it is normal for the customer to realign the achieved curve with series trimmers at each end of the device if required.

Linearity Tolerance is 4% over the Nominal Resistance range of 1K Ω to 1M Ω . The Linearity Tolerance is measured on at least 70% of the effective rotation range.

Note. In the case of Terminal and Zero-based linearity, both present constraints which increase the manufacturing difficulty and in consequence have an adverse effect on the product's price and availability.

Potentiometer linearity

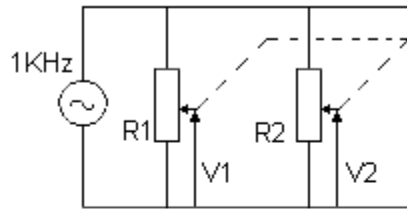


Matching Tolerance (For Tandem Stereo Potentiometers)

Tandem Potentiometers have two identical resistor units with the same variation law. The mismatching of the two resistor units, expressed in dB, is measured by the difference between the attenuations introduced by each resistor unit at various points of travel.

- Law A: 4 dB at Attenuation range 0 - 20 dB
- Law B and C: 3 dB at Attenuation range 0 - 20 dB

Matched Tolerance for Stereo

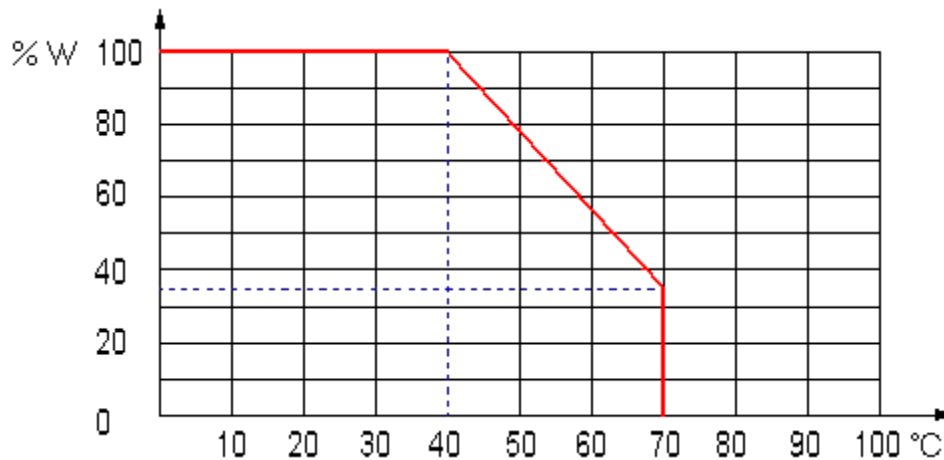


LAW	ATTENUATION RANGE	MATCHING TOLERANCE *
A	0 - 20dB	4dB
B & C	0 - 20dB	3dB

$$* \text{Matching Tolerance} = 20 \log \frac{V1}{V2}$$

Operating Temperature: -25°C to +70°C

Temperature Derating Curve



Temperature Coefficient of Resistance: +300 -500 ppm

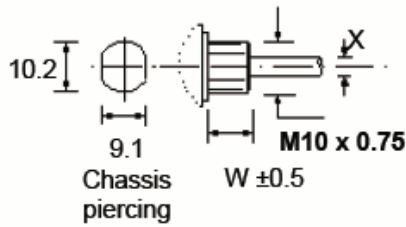
Components

P20 Bush Housing (Mounting)

The P20 bushes are available in metal or nylon; with three thread options; and with or without a locating feature:

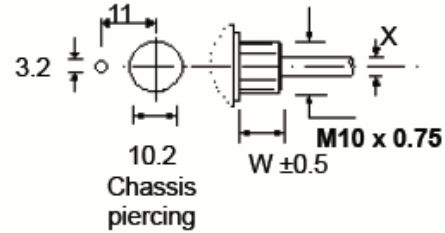
- Diecast Zinc Alloy
 - M10 x0.75mm pitch (Type C)
 - M10 x0.75mm pitch, **with locator** (Type CEBS)
 - 9.52mm x32tpi (Type CBS)
 - 9.52mm x32tpi, **with locator** (Type CBSL)
 - M7 x0.75mm pitch (Type CG)
- Glass Filled Nylon
 - M10 x0.75mm (Type CP)

DIECAST ZINC ALLOY



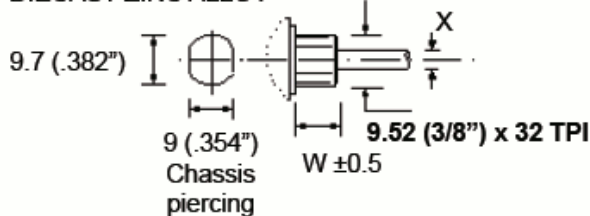
Type C (without locator)	
X (mm)	6
W (mm)	9

DIECAST ZINC ALLOY



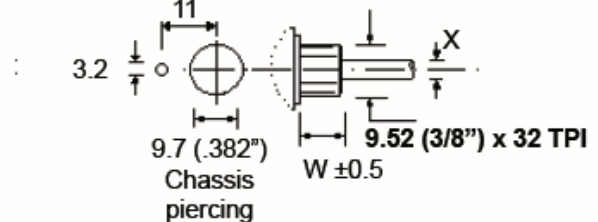
Type CEBS (with locator)	
X (mm)	6
W (mm)	9

DIECAST ZINC ALLOY



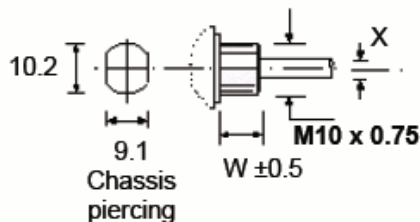
Type CBS (without locator)		
X (mm)	6	6.35
W (mm)	8 or 12	8 or 12

DIECAST ZINC ALLOY



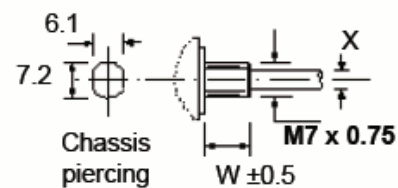
Type CBSL (with locator)		
X (mm)	6.35	6.35
W (mm)	8	12

GLASS FILLED NYLON



Type CP (GFN)		
X (mm)	6	6.35
W (mm)	7 or 10	7 or 10

DIECAST ZINC ALLOY



Type CG (without locator)	
X (mm)	4
W (mm)	6

P20 Spindles

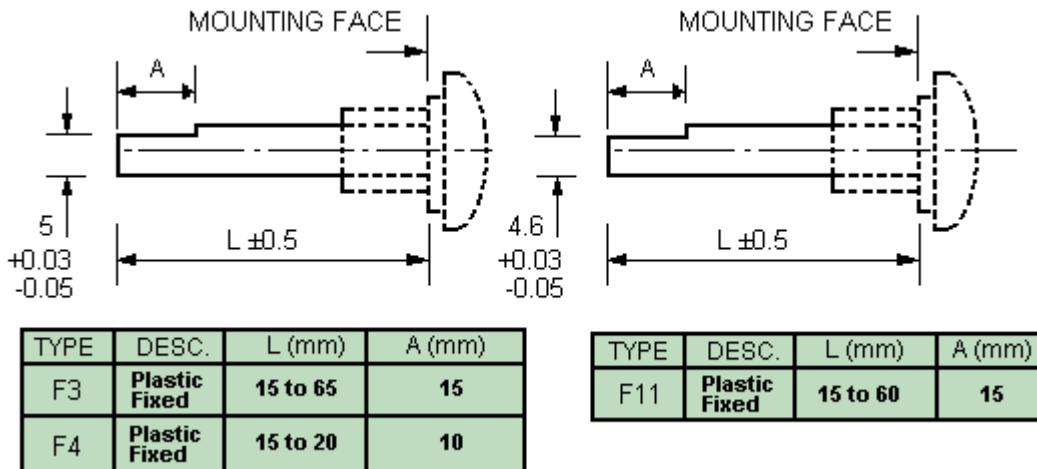
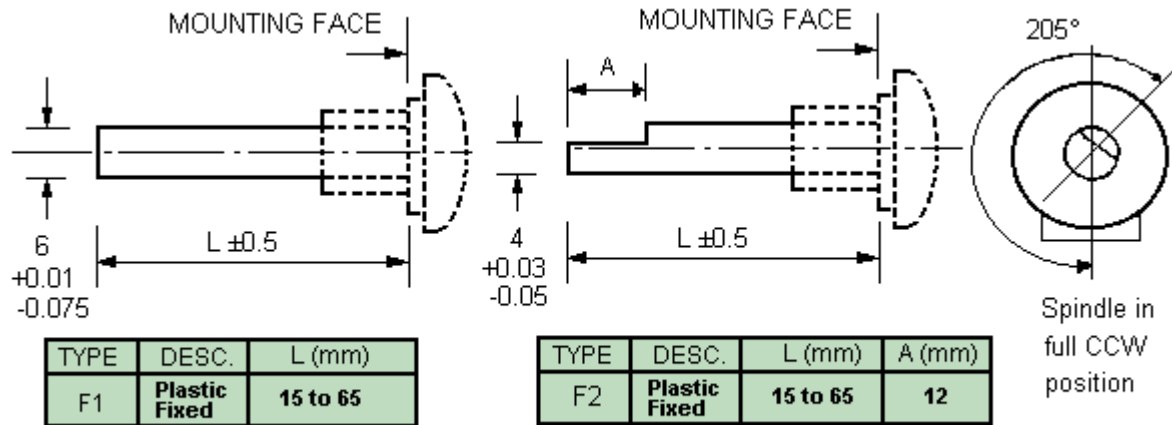
The P20 spindles are plastic and fixed i.e. not removable, unless otherwise stated and they are available in three diameters:

- 6.0mm Diameter
 - Cylindrical (Type F1)
 - 4.0 x 12mm Flat (Type F2)
 - 5.0 x 15mm Flat (Type F3)
 - 5.0 x 10mm Flat (Type F4)
 - 4.6mm x 15mm Flat (Type F11)
- 4.0mm Diameter
 - Cylindrical (Type F21)
 - 3.0 x 8.5mm Flat (Type F22)
 - 3.0 x 13.5mm Flat (Type F23)
 - Cylindrical (Type M21 - Metal)
 - 3.0 x 8.5mm Flat (Type M22 - Metal)
 - 3.0 x 13.5mm Flat (Type M23 - Metal)
- 6.35mm Diameter
 - Cylindrical (Type F41)
 - 5.5 x 10mm Flat (Type F42)
 - 5.5 x 15mm Flat (Type F43)
- Splined Spindle - 6.0mm dia. 18 teeth
- Dual Concentric
 - Flatted/Slotted (Type M15 - Metal)
 - Cylindrical (Type M16 - Metal)

6.0mm Diameter Spindles

Note: *Specials to customer's specification up to 65mm.

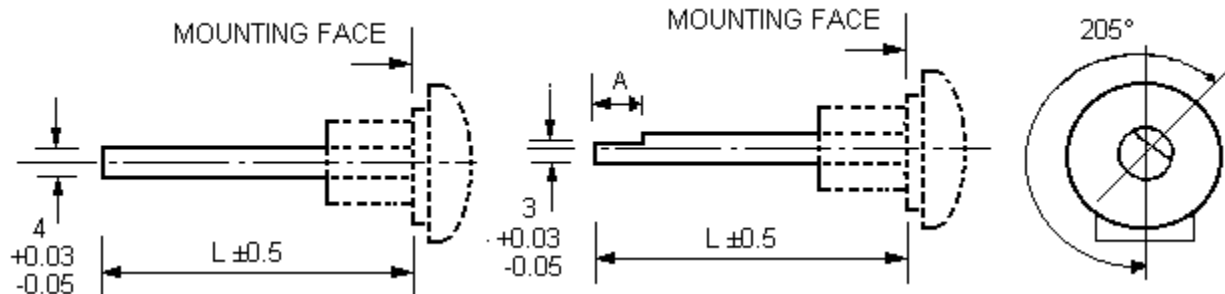
REMOVABLE SPINDLES, similar in specification to 'fixed' spindles are supplied separate from the potentiometer. These can be indefinitely taken in and out and their holding strength is >1kg.



4.0mm Diameter Spindles

Note: The orientation of the flat as illustrated is for plastic spindles only.

For metal spindles, unless specified on the order, the orientation may be different on each potentiometer type.



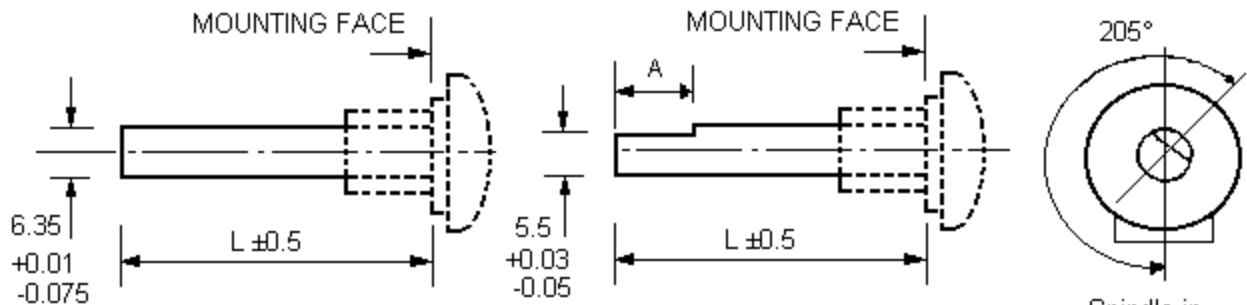
TYPE	DESC.	L (mm)
F21	Plastic Fixed	8 to 65
M21	Metal Fixed	8 to 65

TYPE	DESC.	L (mm)	A (mm)
F22	Plastic Fixed	11 to 60	8.5
M22	Metal Fixed	11 to 60	8.5
F23	Plastic Fixed	16 to 60	13.5
M23	Metal Fixed	16 to 60	13.5

Spindle in
full CCW
position

6.35mm Diameter Spindles

Note: *Specials to customer's specification up to 65mm.



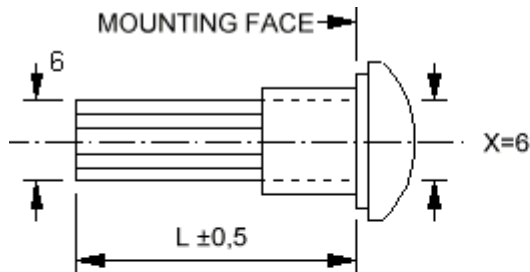
TYPE	DESC.	L (mm)
F41	Plastic Fixed	15 to 65

TYPE	DESC.	L (mm)	A (mm)
F42	Plastic Fixed	15 to 20	10
F43	Plastic Fixed	20 to 60	15

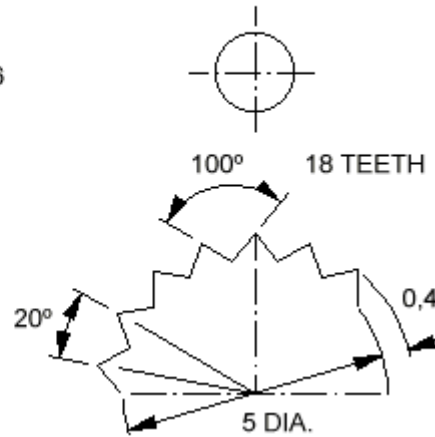
Spindle in
full CCW
position

Splined Spindle - 6.0mm dia. 18 teeth

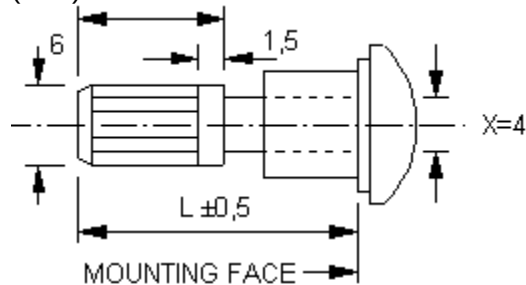
A splined form is available on the 6.0mm diameter P20 plastic spindle (F5) or alternatively a 6mm 'Splined Adaptor' (8,7mm long) can be fitted on a 4mm dia. Spindle



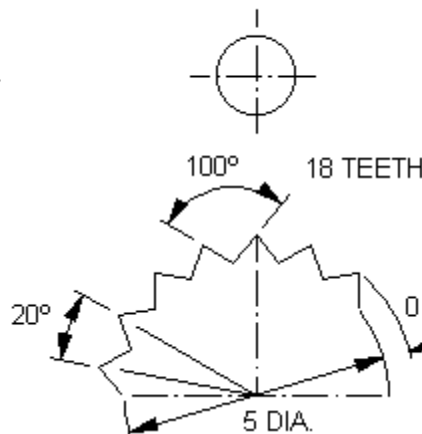
TYPE	DESC.	L (mm)
F5	Plastic Fixed	19



(F5A):

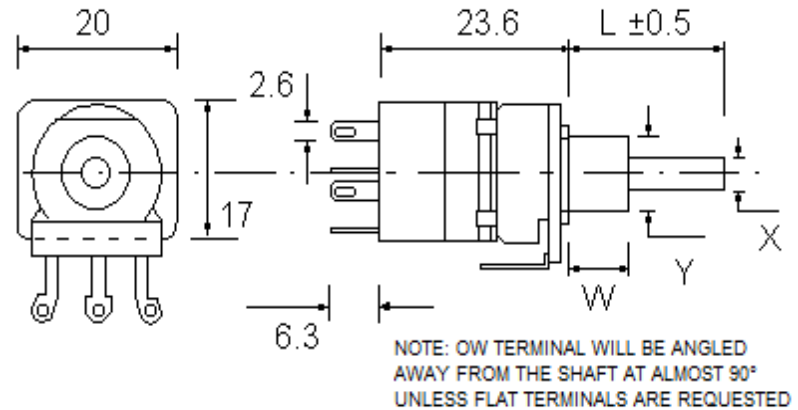
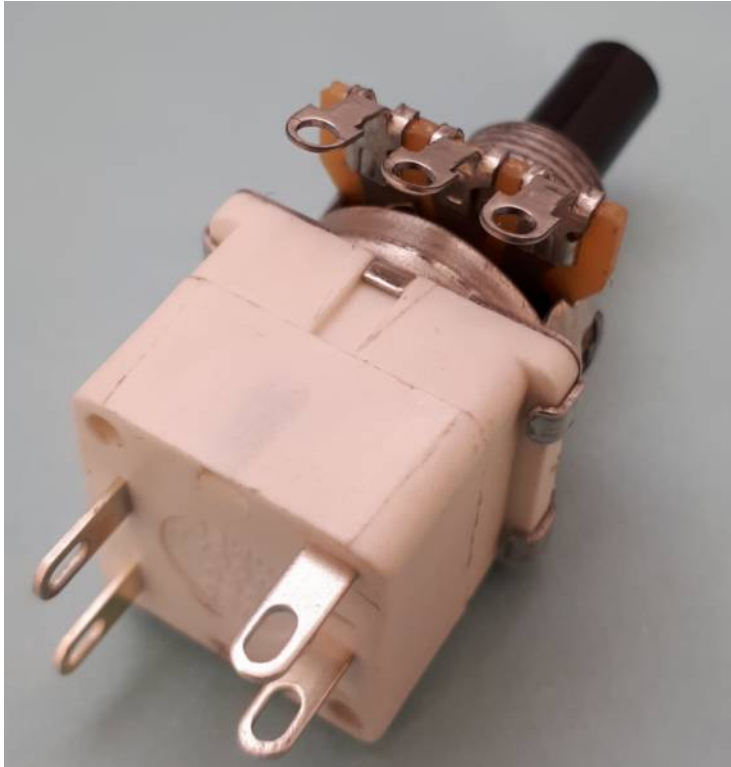


TYPE	DESC.	L (mm)
F5A	Plastic Fixed	16-36

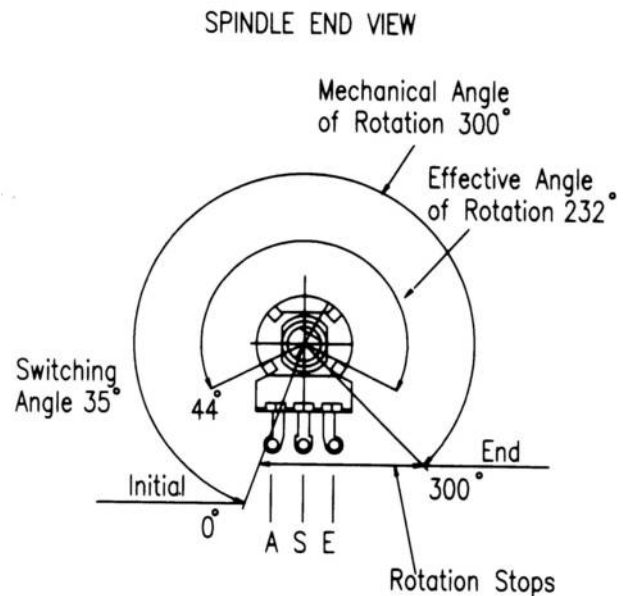


OW16BU/B4OW2S

B4OW2S – 4 Amp Double Pole (Single Throw) Switch OW – Ordinary Wiring Terminals (for soldering)



- W Mounting Height
- Y Mounting Diameter
- X Spindle Diameter
- L Spindle Length
- A Initial Termination
- S Wiper (or moving contact) termination
- E End Termination



Total mechanical and effective electrical angles of rotation of potentiometers with rotary switch



P16 Range Technical Data

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Rotation angle: 270° ±5° (Unswitched), 300° ±5° (Switched)

Operating Torque: 0.4 – 2.0 N.cm (Initial Torque may be higher)

Rotational torque of spindle can be made high or low

Detents (stop positions) Available: Centre, 11, 21, 31, 41

Permissible Axial Spindle Load: 50 N (5 Sec. maximum)

Permissible Torque at End Stop: 35 N.cm

ELECTRICAL SPECIFICATION

Rated Power Dissipation @40°C for ECO potentiometers:

0.25W linear law

0.12W nonlinear law

Rotation angle: 270° ±5° (Unswitched), 300° ±5° (Switched)

Effective rotation: 232° nominal

Insulation Resistance: >= 4 Gohms

Rated Resistance: E3 Series

- Optional: E6 Series
- Linear Law: 1K - 1M
- Nonlinear Law: 4K7 - 470K

Tolerance on Rated Resistance: ± 20%

- Optional Tolerance on 1K - 1M: ± 10%

Resistance Laws (Taper):

- Linear: A
- Nonlinear: B - Log (Audio) or C - Antilog (Reverse Audio)
- Other laws: Please refer to Sales office

Rotary Switch Specification

The rotary switch modules are manufactured to EN61058-1 standard using high quality materials with a flame retardant housing. Although no longer certified due to the excessive cost of maintaining approvals, the 1 Amp and 4 Amp switch series have both been previously certified by UL International Demko (copies of previous certificates are available on our website or on request). The same materials, components and production techniques are used as in the certified versions and Omeg Ltd continues to test to the EN61058-1 standard

The 1 Amp contact rating is only available when mounted on the ECO potentiometer

1 A Contact Rating:

Note: The 1A contact rating is NOT available for mounting on the P16 or P20 potentiometer.

1A/250Vac 2.5A/12Vdc

Surge rating (0.01 seconds): 20A

Contact gap: 3mm (Full mains separation of contacts)

Manufactured to EN61058-1 standard

4 A Contact Rating:

4A/250Vac 10A/12Vdc

Surge rating (0.01 seconds): 80A

Switch contacts: Silver tin oxide

Contact gap: 2mm (Micro disconnection of switch - micro separation of contacts)

Manufactured to EN61058-1 standard

Common features

Housing material: Flame Retardant Glass filled polyester (UL 94 VO)

Initial contact resistance: 20 milliohms

Insulation resistance: 50,000 Megohms

Life (operations at full load): 10,000 minimum

Operating temperature: -25°C to +70°C

Operating torque for SPST/SPDT: 1.5 - 3 cNm

Operating torque for DPST/DPDT: 3.0 - 6 cNm

Mechanical rotation: 300°

Proof voltage: 3kV minimum

Rotary Switch Terminals

Layout

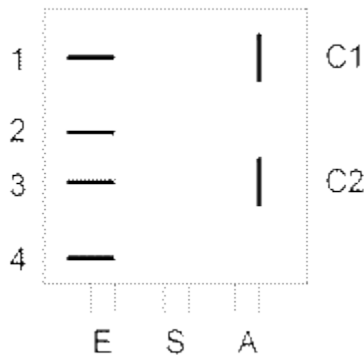


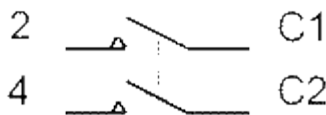
Diagram as viewed on the rear of the switch module:

(Potentiometer terminals at the bottom)

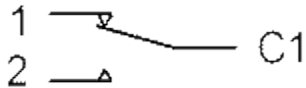
Configuration



SPST - Single pole (1S), Single throw (On-Off)

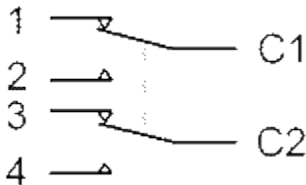


DPST - Double pole (2S), Single throw (On-Off)



SPDT - Single pole (1S), Double throw (CH)

(**NOT** certified)



DPDT - Double pole (2S), Double throw (CH)

(**NOT** certified)

Notes

1. Moving contact(s) shown when the potentiometer shaft is in a counterclockwise (CCW) position.
2. 'Ordinary Wiring'(OW) or 'Printed Circuit'(PC) terminals can be requested on the switch.
3. Terminals 1 and 3 are only fitted for the Double Throw ('CH' or Changeover) versions which are **NOT** approved nor certified.

Rotary Switch Terminals



Standard (1A or 4A contact ratings)

N/O normally OPEN Switch

Contacts normally OPEN;

CLOCKwise rotation to CLOSE contacts

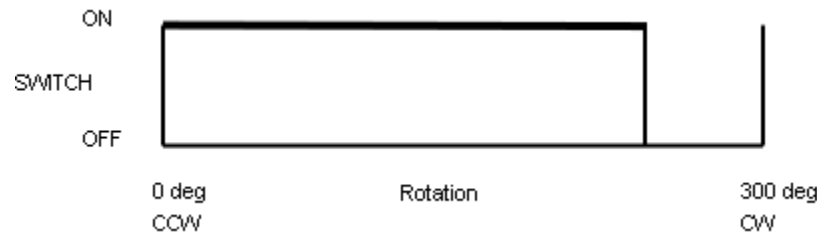


Option 1 (4A contact rating only)

N/C normally CLOSED Switch

Contacts normally CLOSED;

CLOCKwise rotation to OPEN contacts

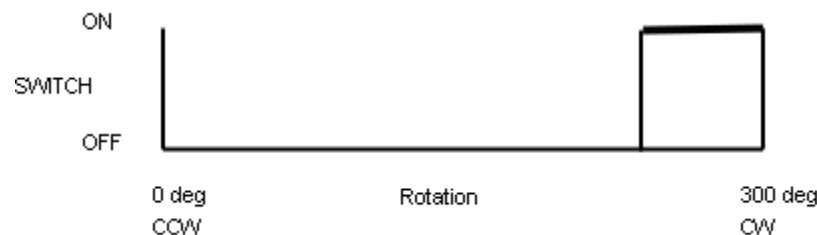


Option 2 (4A contact rating only)

REVERSED N/O normally OPEN Switch

Contacts normally OPEN at fully clockwise position;

ANTI-clockwise rotation to CLOSE contacts



Option 3 (4A contact rating only)

REVERSED N/C normally CLOSED Switch

Contacts normally CLOSED at fully clockwise position;

ANTI-clockwise rotation to OPEN contacts

ELECTRICAL SPECIFICATION UNIQUE TO P16 POTENTIOMETERS

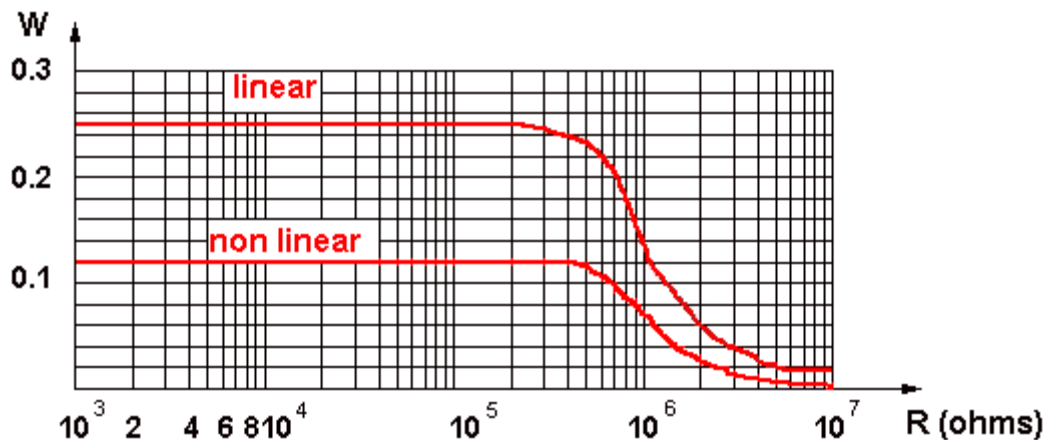
Effective rotation:

- Without a switch: 232° nominal
- With rotary switch: 232° nominal

Rated Power Dissipation @40°C for ECO potentiometers:

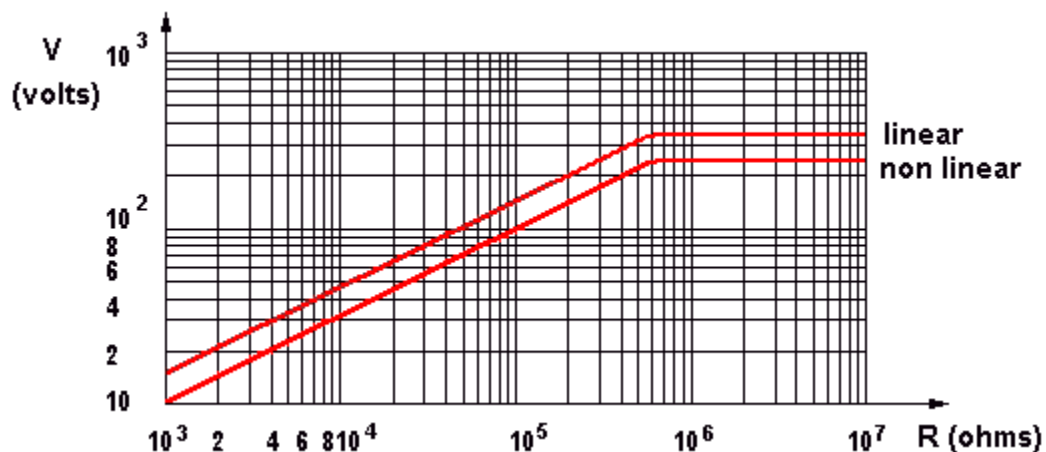
- 0.25W linear law
- 0.12W nonlinear law

ECO, P16 power dissipating curve



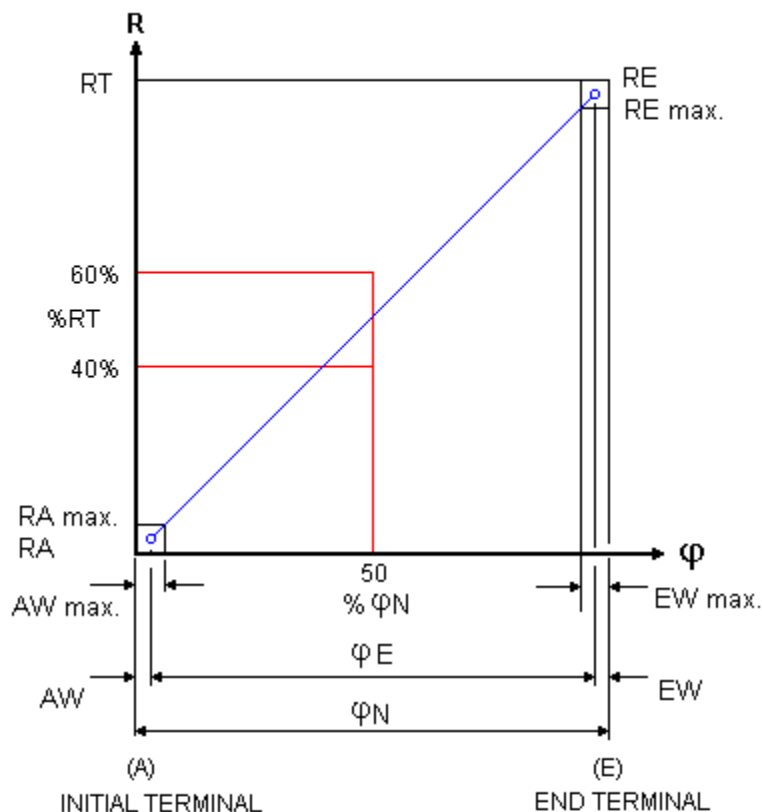
Limiting Element Voltage: 350 V DC for 16mm potentiometers

ECO, P16 maximum working voltage curve



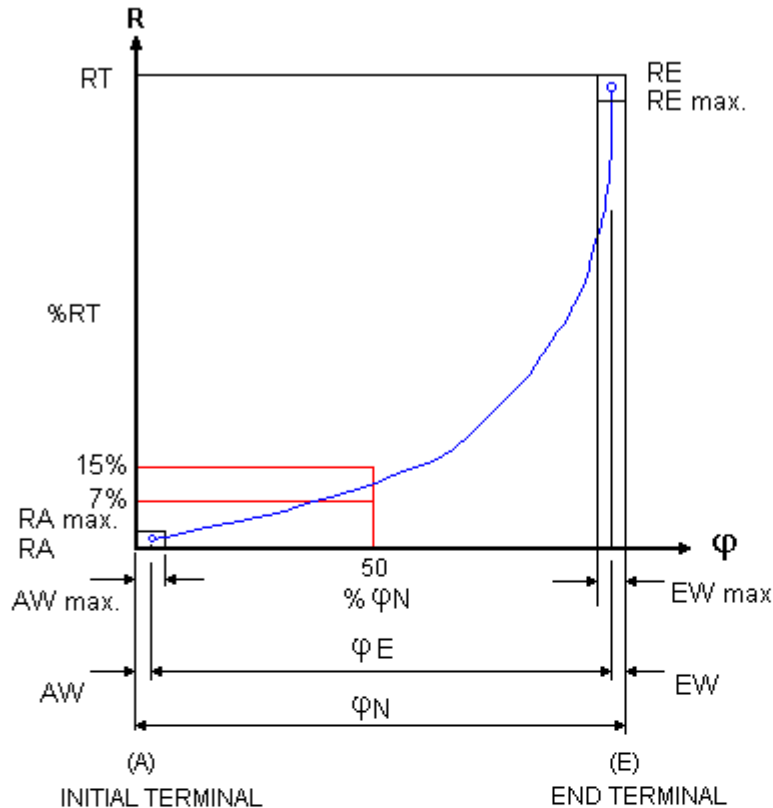
Insulating Voltage: 500 V AC for ECO potentiometers

Resistance law A - Linear



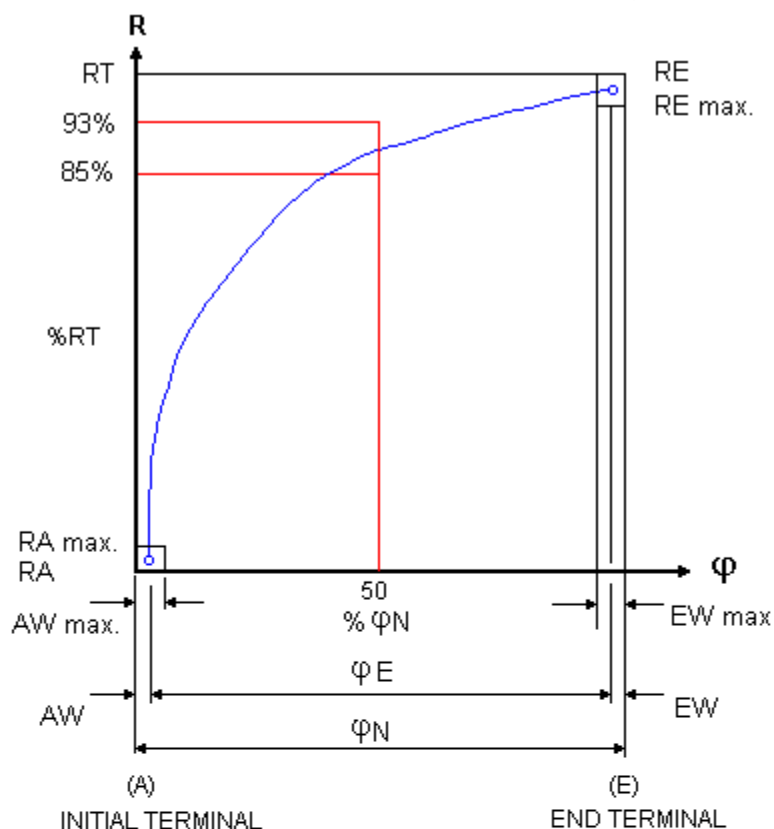
AW	Initial Path	AW max. 12% ϕN
EW	Final Path	EW max. 12% ϕN
Ra	Initial Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RA	Hop-on Resistance	$\leq 1\% RN$
Re	End Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RE	Hop-off Resistance	$\leq 1\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

Resistance law B – Log (Audio)



AW	Initial Path	AW max. 10% ϕN
EW	Final Path	EW max. 10% ϕN
Ra	Initial Stop Value	$R_N \leq 10K \leq 1.10^{-3} R_N$ (Minimum 2 ohms) $R_N > 10K \leq 2.10^{-4} R_N$ (Minimum 10 ohms)
RA	Hop-on Resistance	$R_N \leq 10K$ 5% R_N $R_N > 10K$ 0.15% R_N
Re	End Stop Value	$R_N \leq 100K \leq 2.10^{-2} R_N$ $R_N > 100K \leq 1.10^{-2} R_N$
RE	Hop-off Resistance	$R_N \leq 10K < 1\% R_N$ $R_N > 10K$ 0.5% R_N
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

Resistance law C – Antilog (Reverse Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RA	Hop-on Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K 0.5\% RN$
Re	End Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RE	Hop-off Resistance	$RN \leq 10K 5\% RN$ $RN > 10K 0.15\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

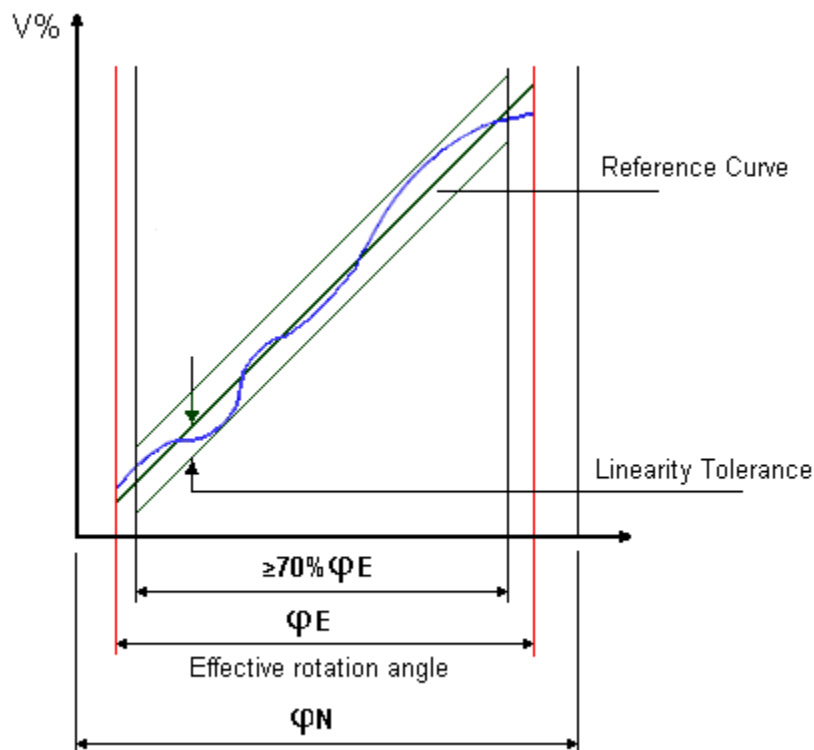
Linearity

As a basis of assessing Linearity Tolerance the independent method is the most practical, permitting as it does, the reference curve to be aligned as near as possible to the actual output curve. This avoids the use of the theoretical starting and finishing points, it is normal for the customer to realign the achieved curve with series trimmers at each end of the device if required.

Linearity Tolerance is 4% over the Nominal Resistance range of 1K Ω to 1M Ω . The Linearity Tolerance is measured on at least 70% of the effective rotation range.

Note. In the case of Terminal and Zero-based linearity, both present constraints which increase the manufacturing difficulty and in consequence have an adverse effect on the product's price and availability.

Potentiometer linearity

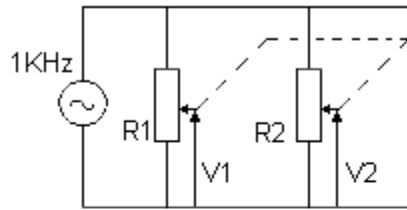


Matching Tolerance (For Tandem Stereo Potentiometers)

Tandem Potentiometers have two identical resistor units with the same variation law. The mismatching of the two resistor units, expressed in dB, is measured by the difference between the attenuations introduced by each resistor unit at various points of travel.

- Law A: 4 dB at Attenuation range 0 - 20 dB
- Law B and C: 3 dB at Attenuation range 0 - 20 dB

Matched Tolerance for Stereo

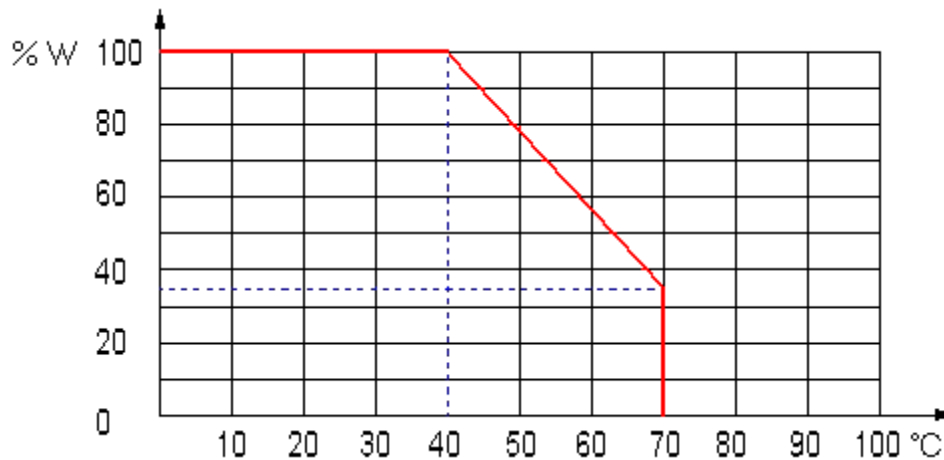


LAW	ATTENUATION RANGE	MATCHING TOLERANCE *
A	0 - 20dB	4dB
B & C	0 - 20dB	3dB

$$* \text{Matching Tolerance} = 20 \log \frac{V1}{V2}$$

Operating Temperature: -25°C to +70°C

Temperature Derating Curve



Temperature Coefficient of Resistance: +300 -500 ppm

Components

P16 Bush Housing (Mounting)

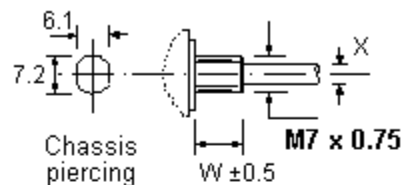
The P16 bushes are available in metal or nylon with an M7 or M10 thread both with and without a locating feature:

Diecast Zinc Alloy M10 x 0.75mm pitch (Type C) or M7 0.75mm pitch (Type CG)

Glass Filled Nylon M10 x 0.75mm pitch (Type CP)

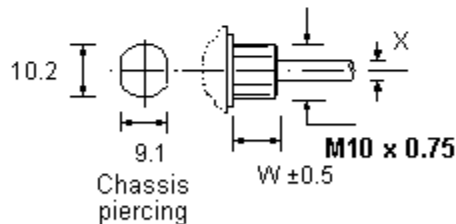
Do not attempt to prevent any unwanted body rotation by overtightening the retaining nut, since this can cause thread damage, distortion, change of electrical resistance and restrict shaft rotation. BS9130:1972 provides further details on this topic. The **recommended torque** for tightening the retaining nut is 45cN.m and this can be achieved cost effectively by using a Torque Limiting device as shown on our **Accessories** page.

DIECAST ZINC ALLOY



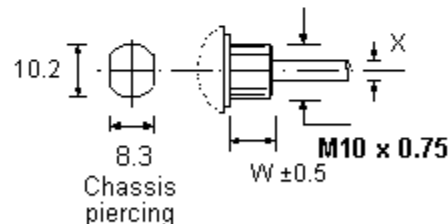
TYPE CG (without locator)	
X (mm)	4
W (mm)	6

DIECAST ZINC ALLOY



TYPE C (without locator)	
X (mm)	6 or 6.35
W (mm)	8

GLASS FILLED NYLON



TYPE CP (GFN)	
X (mm)	4 or 6
W (mm)	8

P16 Spindles

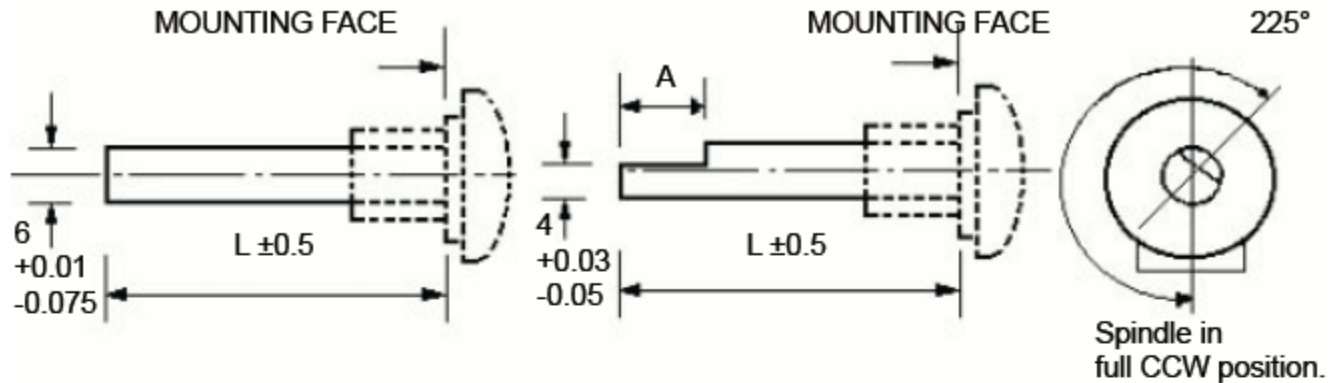
The P16 spindles are plastic, unless otherwise stated, fixed i.e. not removable and they are available in three diameters:

- 6.0mm Diameter
 - Cylindrical (Type F1)
 - 4.0 x 12mm Flat (Type F2)
 - 5.0 x 15mm Flat (Type F3)
 - 5.0 x 10mm Flat (Type F4)
 - 4.6mm x 15mm Flat (Type F11)
- 4.0mm Diameter
 - Cylindrical (Type F21)
 - 3.0 x 8.5mm Flat (Type F22)
 - 3.0 x 8.5mm Flat (Type M22 - Metal)
- 6.35mm Diameter
 - Cylindrical (Type F41)
 - 5.5 x 10mm Flat (Type F42)
 - 5.5 x 15mm Flat (Type F43)
- Splined Spindle - 6.0mm dia. 18 teeth
- Dual Concentric
 - Flatted/Slotted (Type M15 - Metal)
 - Cylindrical (Type M16 - Metal)

Cylindrical and Flatted Spindles

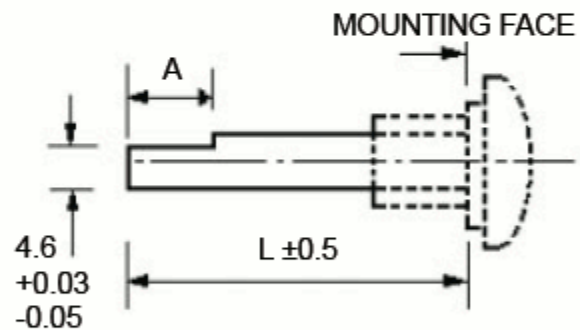
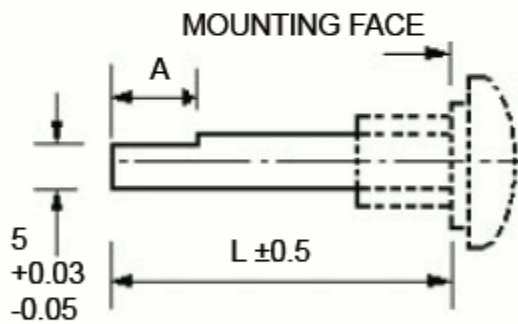
6.0mm Diameter Spindles

Note: *Specials to customer's specification up to 65mm.



TYPE	DESC.	L (mm)
F1	Plastic Fixed	15 to 50*

TYPE	DESC.	L (mm)	A (mm)
F2	Plastic Fixed	20 to 35*	12

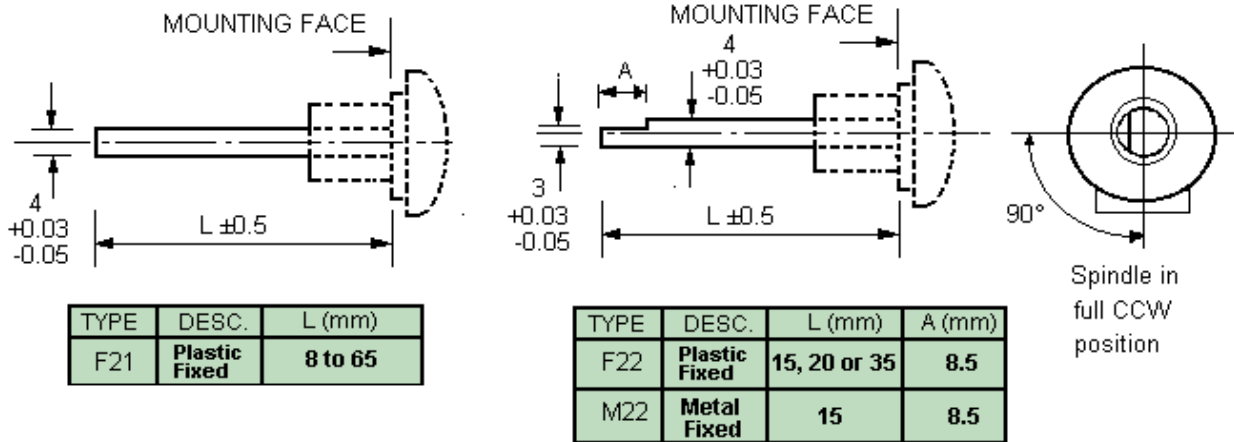


TYPE	DESC.	L (mm)	A (mm)
F3	Plastic Fixed	15 to 35*	15
F4	Plastic Fixed	15 to 35*	10

TYPE	DESC.	L (mm)	A (mm)
F11	Plastic Fixed	15 to 35*	15

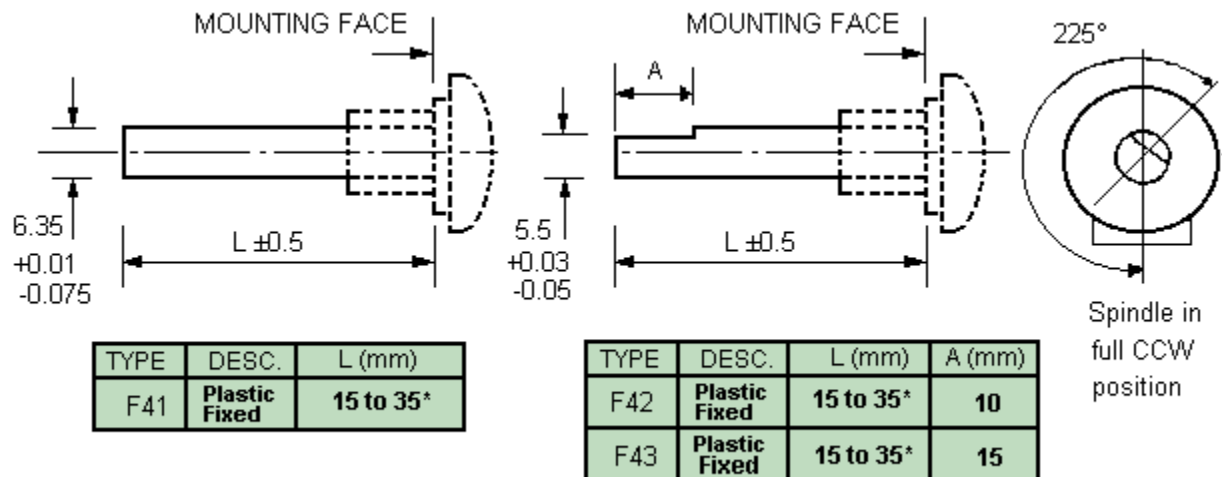
4.0mm Diameter Spindles

Note: The orientation of the flat as illustrated is for plastic spindles only.
For metal spindles, unless specified on the order, the orientation may be different on each potentiometer type



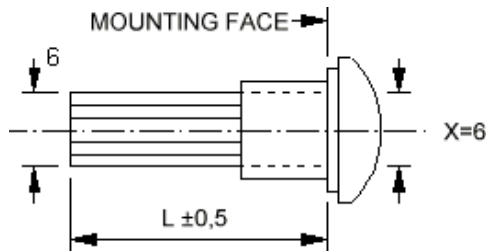
6.35mm Diameter Spindles

Note: *Specials to customer's specification up to 65mm.

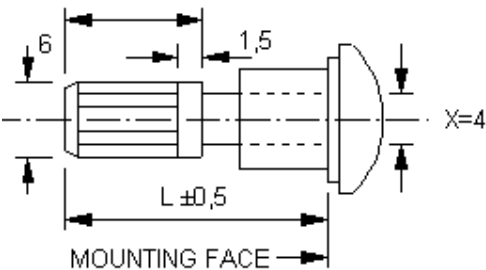
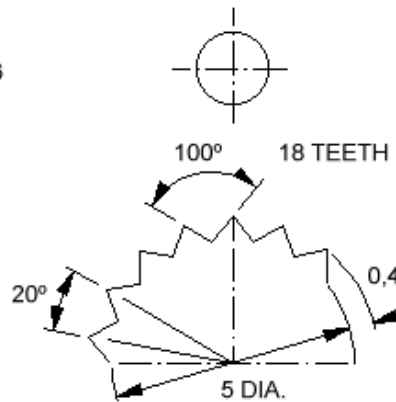


Splined Spindle - 6.0mm dia. 18 teeth

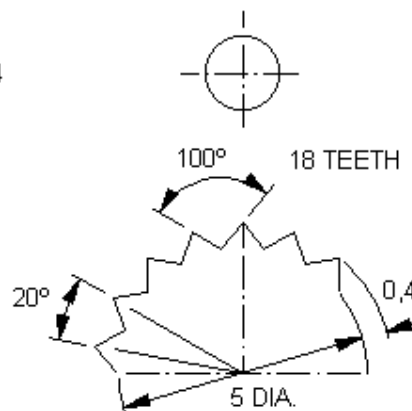
A splined form is available on the 6.0mm diameter P16 plastic spindle (F5)
 or alternatively,
 a 6mm 'Splined Adaptor' (8.7mm long) can be fitted on a 4mm dia. Spindle (F5A):



TYPE	DESC.	L (mm)
F5	Plastic Fixed	19

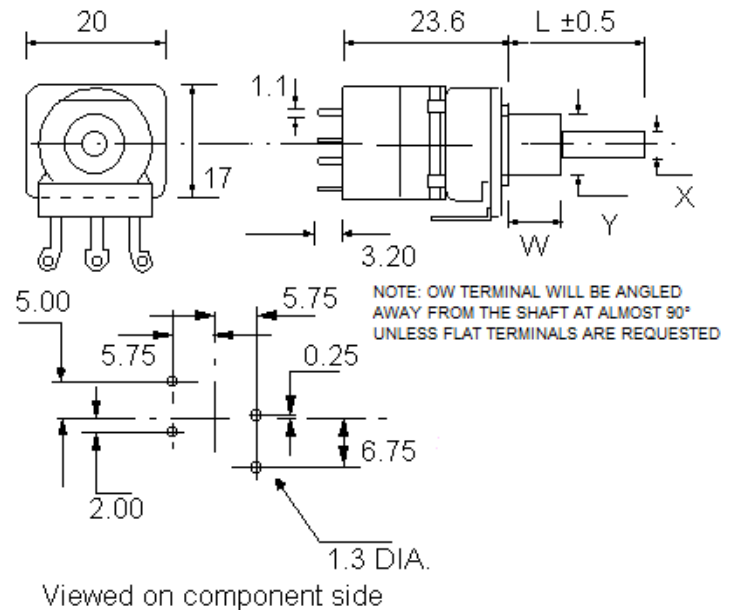


TYPE	DESC.	L (mm)
F5A	Plastic Fixed	16-36

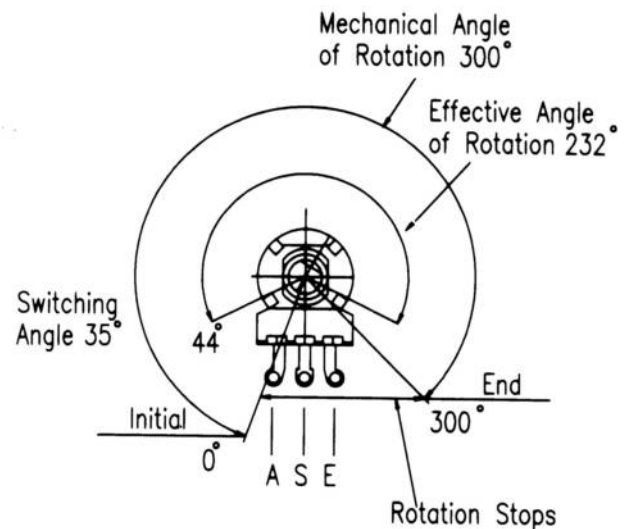


OW16BU/B4PC2S

B4PC2S – 4 Amp Double Pole (single throw) Switch
OW – Ordinary Wiring Terminals (for soldering)
PC - Printed Circuit Terminals



SPINDLE END VIEW



Total mechanical and effective electrical angles of rotation of potentiometers with rotary switch

- W Mounting Height
- Y Mounting Diameter
- X Spindle Diameter
- L Spindle Length
- A Initial Termination
- S Wiper (or moving contact) termination
- E End Termination



P16 Range Technical Data

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Rotation angle: $270^{\circ} \pm 5^{\circ}$ (Unswitched), $300^{\circ} \pm 5^{\circ}$ (Switched)

Operating Torque: 0.4 – 2.0 N.cm (Initial Torque may be higher)

Rotational torque of spindle can be made high or low

Detents (stop positions) Available: Centre, 11, 21, 31, 41

Permissible Axial Spindle Load: 50 N (5 Sec. maximum)

Permissible Torque at End Stop: 35 N.cm

ELECTRICAL SPECIFICATION

Rated Power Dissipation @40°C for ECO potentiometers:

0.25W linear law

0.12W nonlinear law

Rotation angle: $270^{\circ} \pm 5^{\circ}$ (Unswitched), $300^{\circ} \pm 5^{\circ}$ (Switched)

Effective rotation: 232° nominal

Insulation Resistance: ≥ 4 Gohms

Rated Resistance: E3 Series

- Optional: E6 Series
- Linear Law: 1K - 1M
- Nonlinear Law: 4K7 - 470K

Tolerance on Rated Resistance: $\pm 20\%$

- Optional Tolerance on 1K - 1M: $\pm 10\%$

Resistance Laws (Taper):

- Linear: A
- Nonlinear: B - Log (Audio) or C - Antilog (Reverse Audio)
- Other laws: Please refer to Sales office

Rotary Switch Specification

The rotary switch modules are manufactured to EN61058-1 standard using high quality materials with a flame retardant housing. Although no longer certified due to the excessive cost of maintaining approvals, the 1 Amp and 4 Amp switch series have both been previously certified by UL International Demko (copies of previous certificates are available on our website or on request). The same materials, components and production techniques are used as in the certified versions and Omeg Ltd continues to test to the EN61058-1 standard

The 1 Amp contact rating is only available when mounted on the ECO potentiometer

1 A Contact Rating:

Note: The 1A contact rating is NOT available for mounting on the P16 or P20 potentiometer.

1A/250Vac 2.5A/12Vdc

Surge rating (0.01 seconds): 20A

Contact gap: 3mm (Full mains separation of contacts)

Manufactured to EN61058-1 standard

4 A Contact Rating:

4A/250Vac 10A/12Vdc

Surge rating (0.01 seconds): 80A

Switch contacts: Silver tin oxide

Contact gap: 2mm (Micro disconnection of switch - micro separation of contacts)

Manufactured to EN61058-1 standard

Common features

Housing material: Flame Retardant Glass filled polyester (UL 94 VO)

Initial contact resistance: 20 milliohms

Insulation resistance: 50,000 Megohms

Life (operations at full load): 10,000 minimum

Operating temperature: -25°C to +70°C

Operating torque for SPST/SPDT: 1.5 - 3 cNm

Operating torque for DPST/DPDT: 3.0 - 6 cNm

Mechanical rotation: 300°

Proof voltage: 3kV minimum

Rotary Switch Terminals

Layout

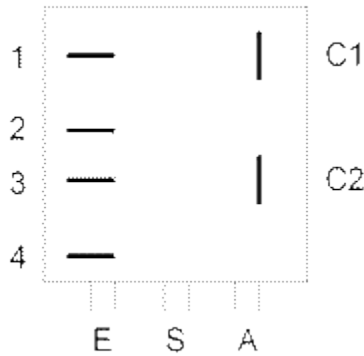
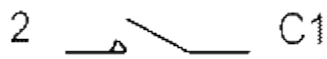


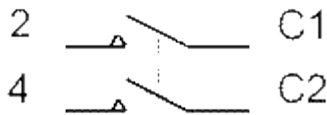
Diagram as viewed on the rear of the switch module:

(Potentiometer terminals at the bottom)

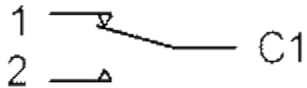
Configuration



SPST - Single pole (1S), Single throw (On-Off)

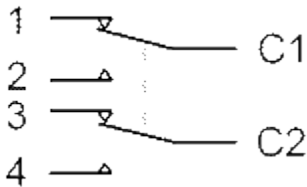


DPST - Double pole (2S), Single throw (On-Off)



SPDT - Single pole (1S), Double throw (CH)

(**NOT** certified)



DPDT - Double pole (2S), Double throw (CH)

(**NOT** certified)

Notes

1. Moving contact(s) shown when the potentiometer shaft is in a counterclockwise (CCW) position.
2. 'Ordinary Wiring'(OW) or 'Printed Circuit'(PC) terminals can be requested on the switch.
3. Terminals 1 and 3 are only fitted for the Double Throw ('CH' or Changeover) versions which are **NOT** approved nor certified.

Rotary Switch Terminals



Standard (1A or 4A contact ratings)

N/O normally OPEN Switch

Contacts normally OPEN;

CLOCKwise rotation to CLOSE contacts

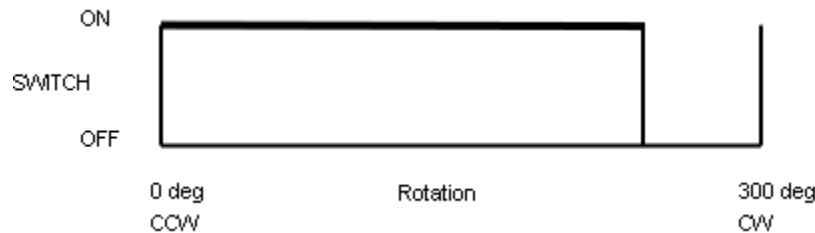


Option 1 (4A contact rating only)

N/C normally CLOSED Switch

Contacts normally CLOSED;

CLOCKwise rotation to OPEN contacts

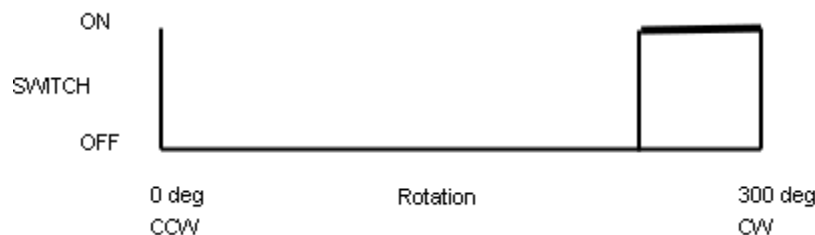


Option 2 (4A contact rating only)

REVERSED N/O normally OPEN Switch

Contacts normally OPEN at fully clockwise position;

ANTI-clockwise rotation to CLOSE contacts



Option 3 (4A contact rating only)

REVERSED N/C normally CLOSED Switch

Contacts normally CLOSED at fully clockwise position;

ANTI-clockwise rotation to OPEN contacts

ELECTRICAL SPECIFICATION UNIQUE TO P16 POTENTIOMETERS

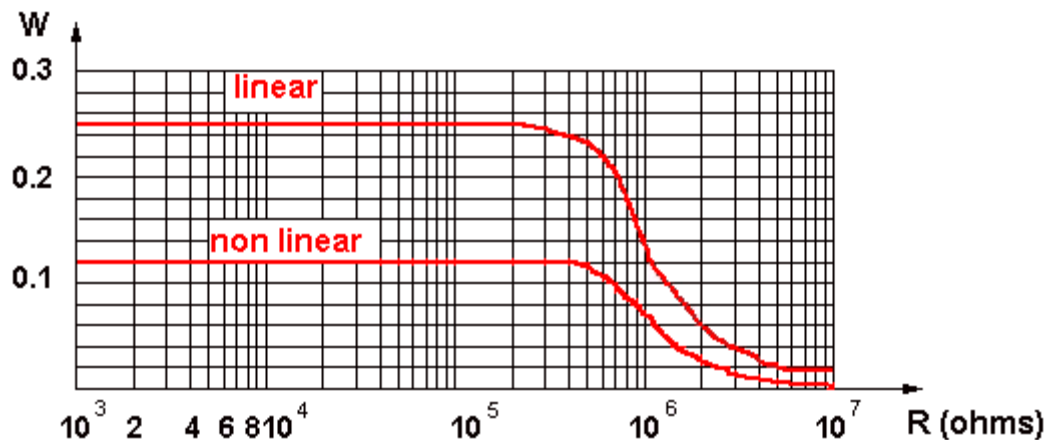
Effective rotation:

- Without a switch: 232° nominal
- With rotary switch: 232° nominal

Rated Power Dissipation @40°C for ECO potentiometers:

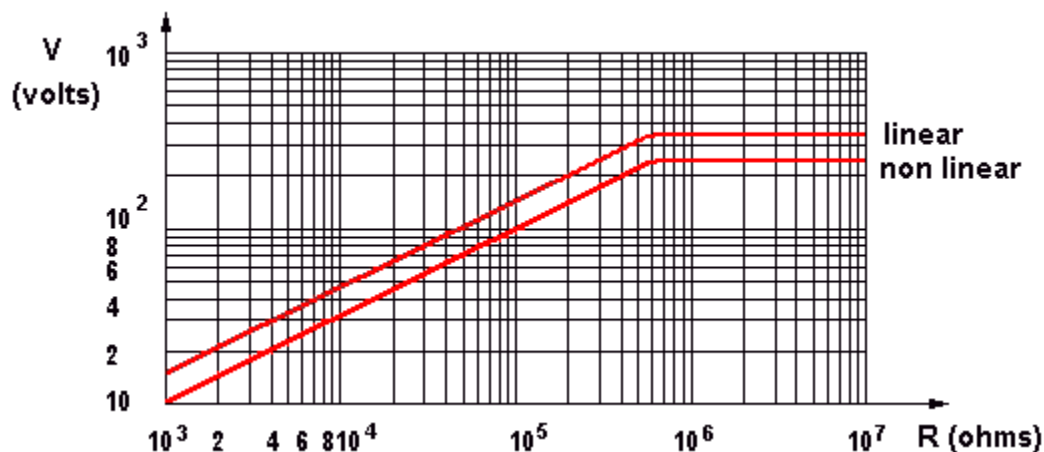
- 0.25W linear law
- 0.12W nonlinear law

ECO, P16 power dissipating curve



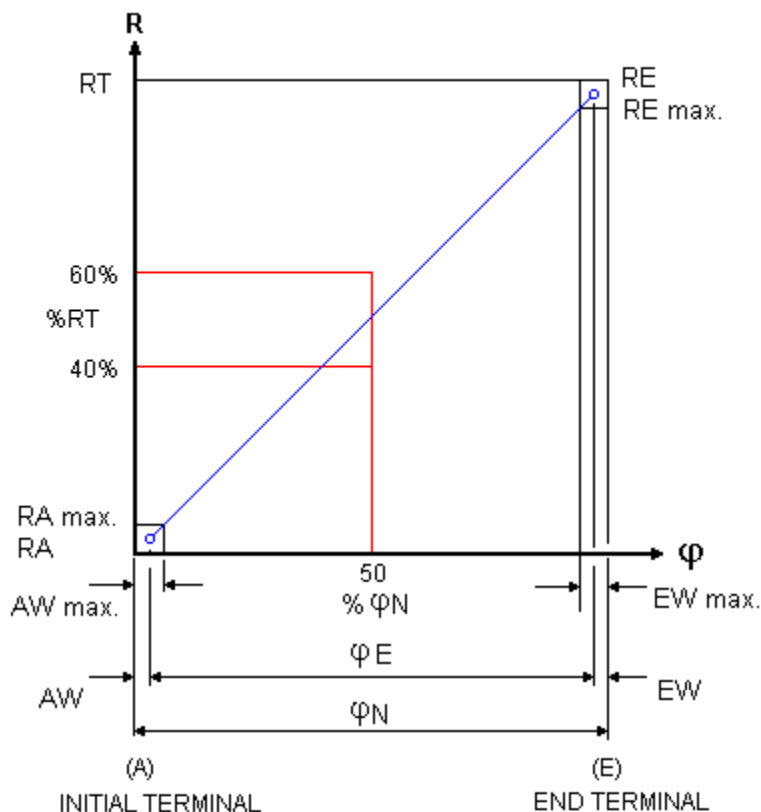
Limiting Element Voltage: 350 V DC for 16mm potentiometers

ECO, P16 maximum working voltage curve



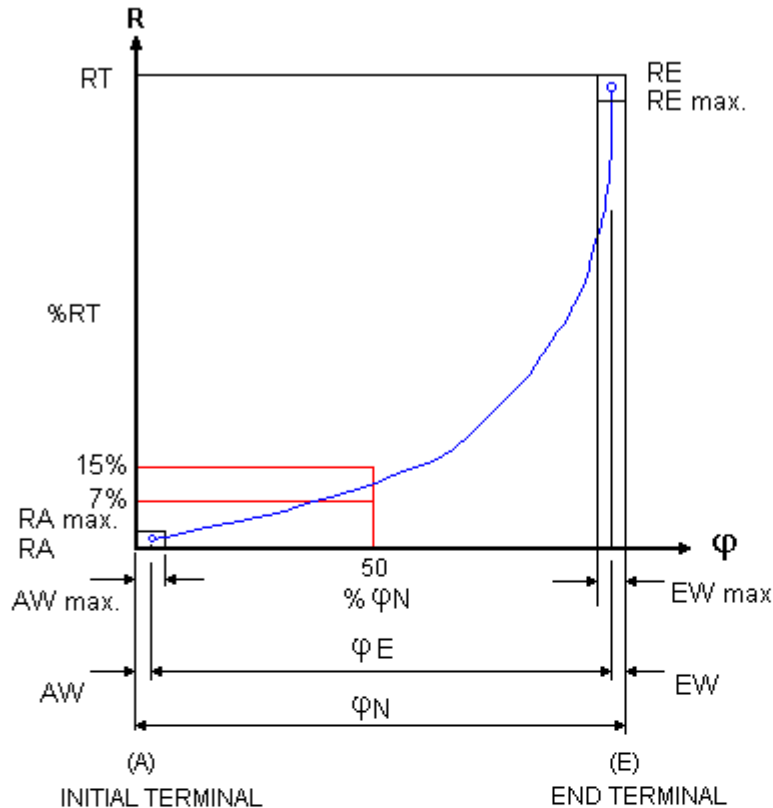
Insulating Voltage: 500 V AC for ECO potentiometers

Resistance law A - Linear



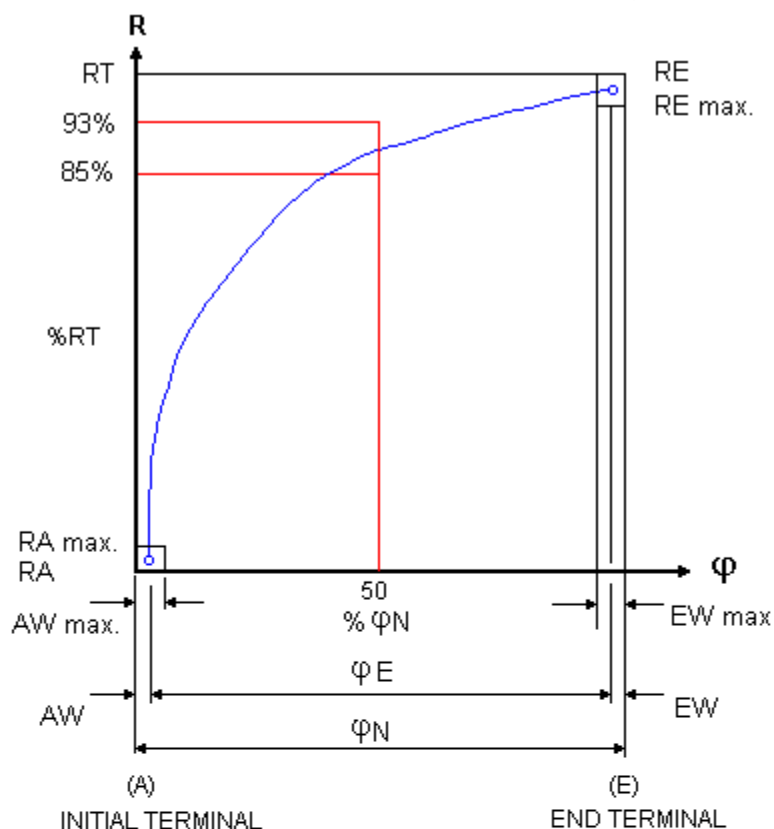
AW	Initial Path	AW max. 12% φN
EW	Final Path	EW max. 12% φN
Ra	Initial Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RA	Hop-on Resistance	$\leq 1\% RN$
Re	End Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RE	Hop-off Resistance	$\leq 1\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φ E	Effective Electrical Angle of Rotation	
φ N	Effective Mechanical Angle of Rotation	

Resistance law B – Log (Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RA	Hop-on Resistance	$RN \leq 10K$ 5% RN $RN > 10K$ 0.15% RN
Re	End Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RE	Hop-off Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K$ 0.5% RN
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

Resistance law C – Antilog (Reverse Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RA	Hop-on Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K 0.5\% RN$
Re	End Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RE	Hop-off Resistance	$RN \leq 10K 5\% RN$ $RN > 10K 0.15\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

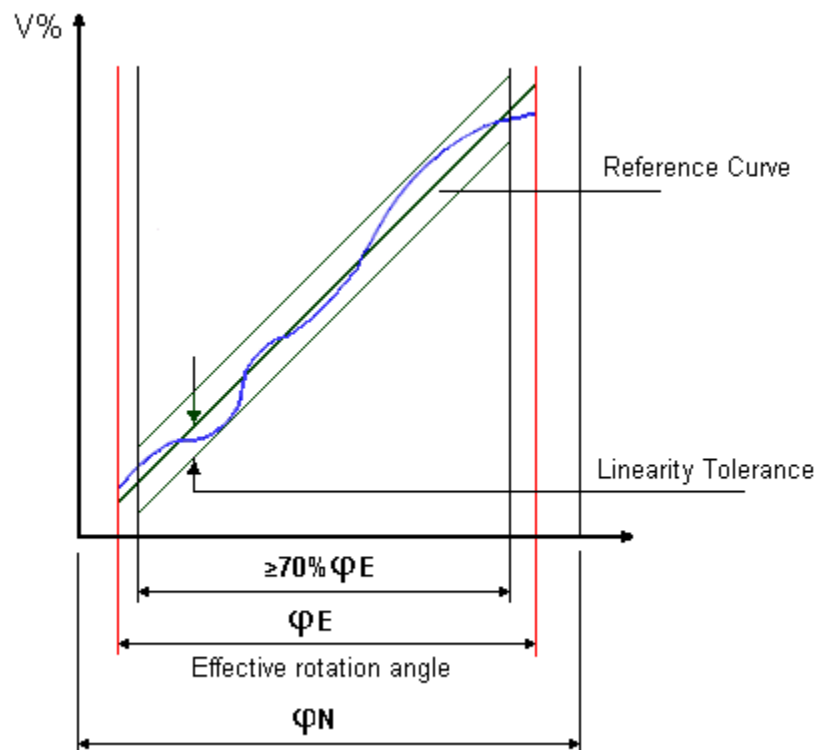
Linearity

As a basis of assessing Linearity Tolerance the independent method is the most practical, permitting as it does, the reference curve to be aligned as near as possible to the actual output curve. This avoids the use of the theoretical starting and finishing points, it is normal for the customer to realign the achieved curve with series trimmers at each end of the device if required.

Linearity Tolerance is 4% over the Nominal Resistance range of 1K Ω to 1M Ω . The Linearity Tolerance is measured on at least 70% of the effective rotation range.

Note. In the case of Terminal and Zero-based linearity, both present constraints which increase the manufacturing difficulty and in consequence have an adverse effect on the product's price and availability.

Potentiometer linearity

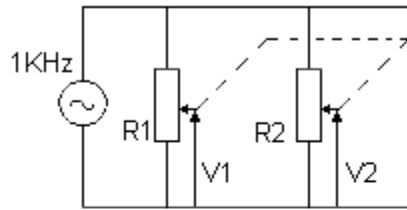


Matching Tolerance (For Tandem Stereo Potentiometers)

Tandem Potentiometers have two identical resistor units with the same variation law. The mismatching of the two resistor units, expressed in dB, is measured by the difference between the attenuations introduced by each resistor unit at various points of travel.

- Law A: 4 dB at Attenuation range 0 - 20 dB
- Law B and C: 3 dB at Attenuation range 0 - 20 dB

Matched Tolerance for Stereo

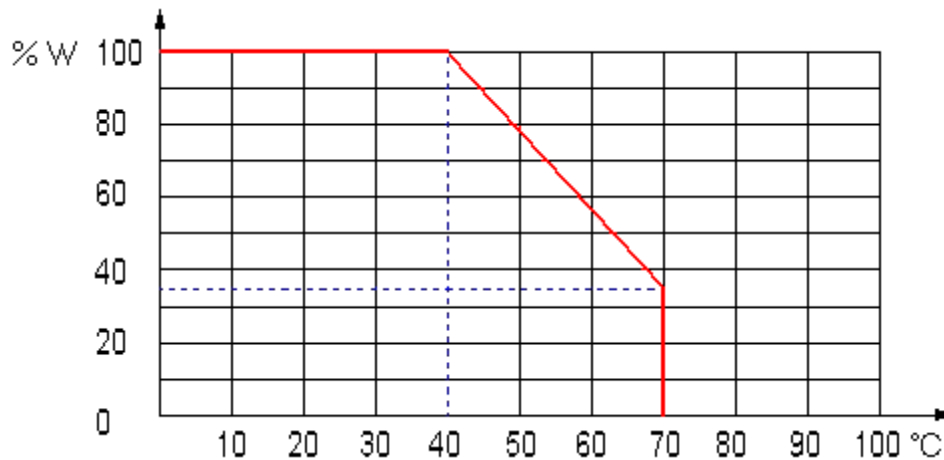


LAW	ATTENUATION RANGE	MATCHING TOLERANCE *
A	0 - 20dB	4dB
B & C	0 - 20dB	3dB

$$\text{*Matching Tolerance} = 20 \log \frac{V1}{V2}$$

Operating Temperature: -25°C to +70°C

Temperature Derating Curve



Temperature Coefficient of Resistance: +300 -500 ppm

Components

P16 Bush Housing (Mounting)

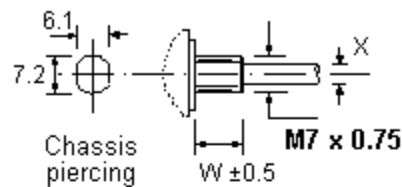
The P16 bushes are available in metal or nylon with an M7 or M10 thread both with and without a locating feature:

Diecast Zinc Alloy M10 x 0.75mm pitch (Type C) or M7 0.75mm pitch (Type CG)

Glass Filled Nylon M10 x 0.75mm pitch (Type CP)

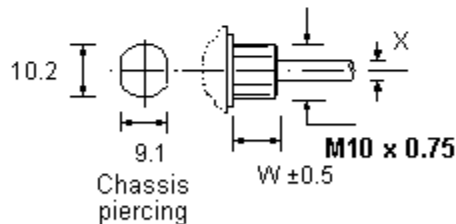
Do not attempt to prevent any unwanted body rotation by overtightening the retaining nut, since this can cause thread damage, distortion, change of electrical resistance and restrict shaft rotation. BS9130:1972 provides further details on this topic. The **recommended torque** for tightening the retaining nut is 45cN.m and this can be achieved cost effectively by using a Torque Limiting device as shown on our **Accessories** page.

DIECAST ZINC ALLOY



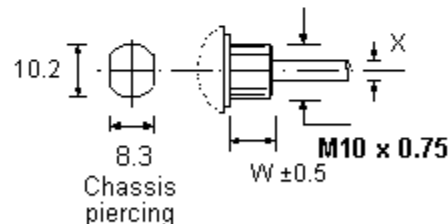
TYPE CG (without locator)	
X (mm)	4
W (mm)	6

DIECAST ZINC ALLOY



TYPE C (without locator)	
X (mm)	6 or 6.35
W (mm)	8

GLASS FILLED NYLON



TYPE CP (GFN)	
X (mm)	4 or 6
W (mm)	8



P16 Spindles

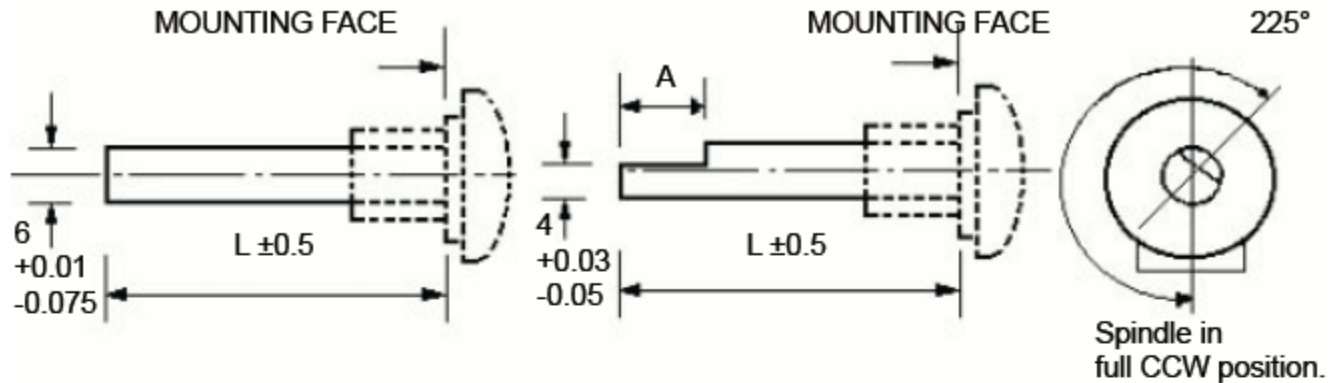
The P16 spindles are plastic, unless otherwise stated, fixed i.e. not removable and they are available in three diameters:

- **6.0mm Diameter**
 - Cylindrical (Type F1)
 - 4.0 x 12mm Flat (Type F2)
 - 5.0 x 15mm Flat (Type F3)
 - 5.0 x 10mm Flat (Type F4)
 - 4.6mm x 15mm Flat (Type F11)
- **4.0mm Diameter**
 - Cylindrical (Type F21)
 - 3.0 x 8.5mm Flat (Type F22)
 - 3.0 x 8.5mm Flat (Type M22 - Metal)
- **6.35mm Diameter**
 - Cylindrical (Type F41)
 - 5.5 x 10mm Flat (Type F42)
 - 5.5 x 15mm Flat (Type F43)
- **Splined Spindle - 6.0mm dia. 18 teeth**
- **Dual Concentric**
 - Flatted/Slotted (Type M15 - Metal)
 - Cylindrical (Type M16 - Metal)

Cylindrical and Flatted Spindles

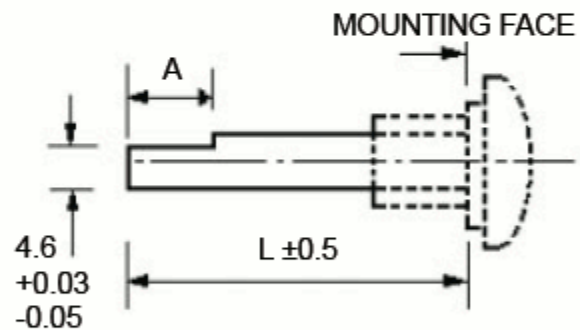
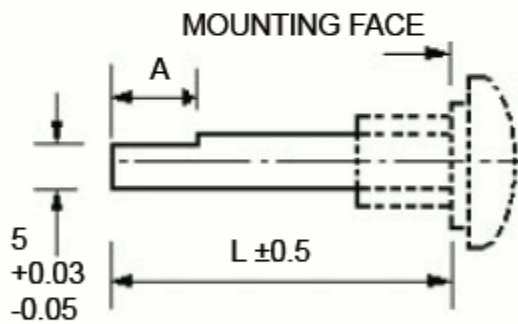
6.0mm Diameter Spindles

Note: *Specials to customer's specification up to 65mm.



TYPE	DESC.	L (mm)
F1	Plastic Fixed	15 to 50*

TYPE	DESC.	L (mm)	A (mm)
F2	Plastic Fixed	20 to 35*	12

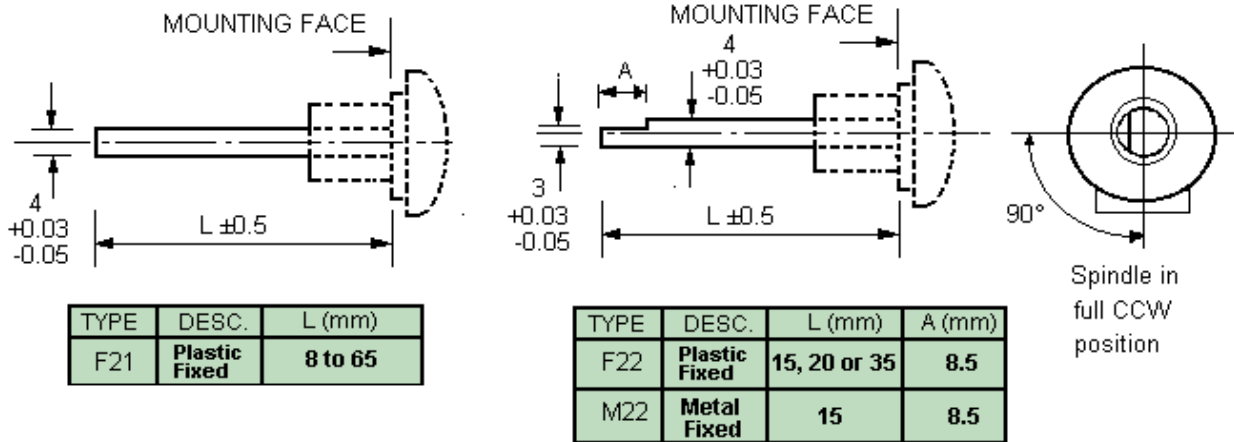


TYPE	DESC.	L (mm)	A (mm)
F3	Plastic Fixed	15 to 35*	15
F4	Plastic Fixed	15 to 35*	10

TYPE	DESC.	L (mm)	A (mm)
F11	Plastic Fixed	15 to 35*	15

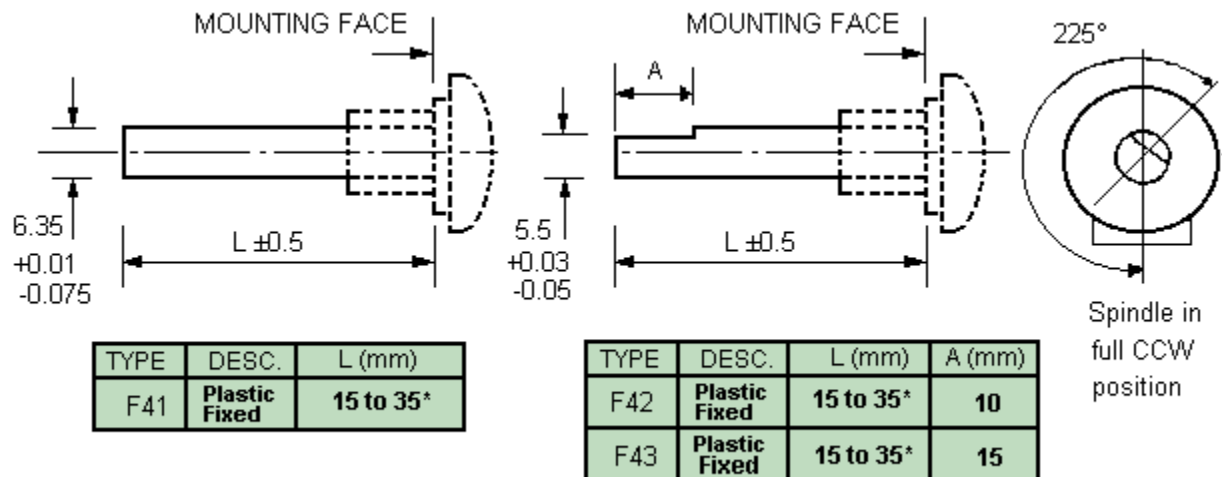
4.0mm Diameter Spindles

Note: The orientation of the flat as illustrated is for plastic spindles only.
For metal spindles, unless specified on the order, the orientation may be different on each potentiometer type



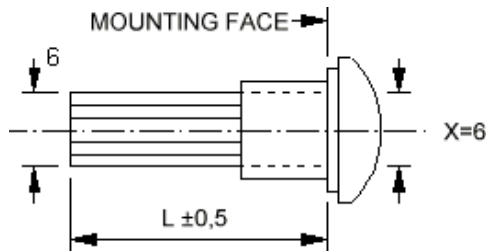
6.35mm Diameter Spindles

Note: *Specials to customer's specification up to 65mm.

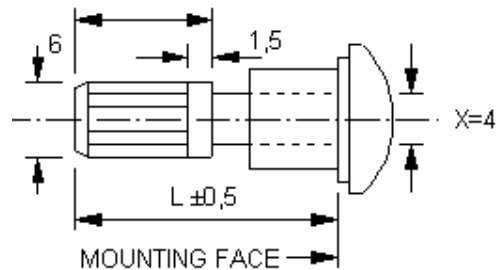
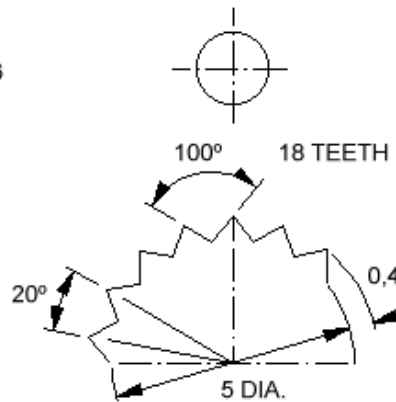


Splined Spindle - 6.0mm dia. 18 teeth

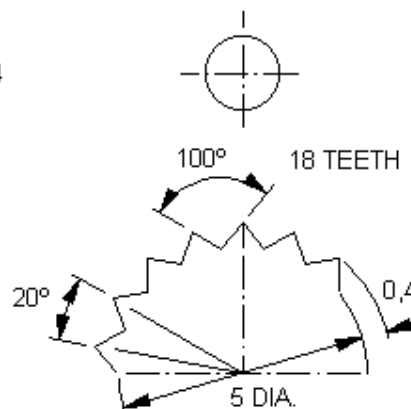
A splined form is available on the 6.0mm diameter P16 plastic spindle (F5)
 or alternatively,
 a 6mm 'Splined Adaptor' (8.7mm long) can be fitted on a 4mm dia. Spindle (F5A):



TYPE	DESC.	L (mm)
F5	Plastic Fixed	19

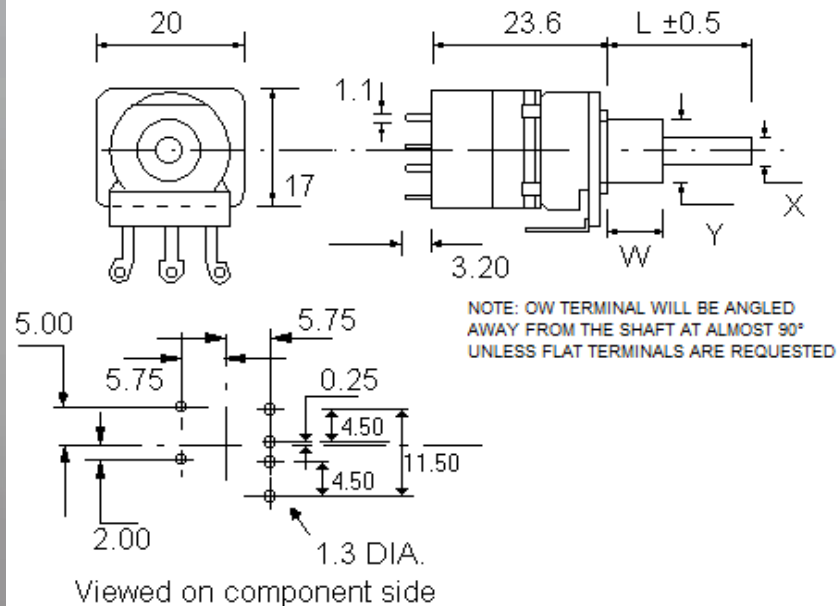
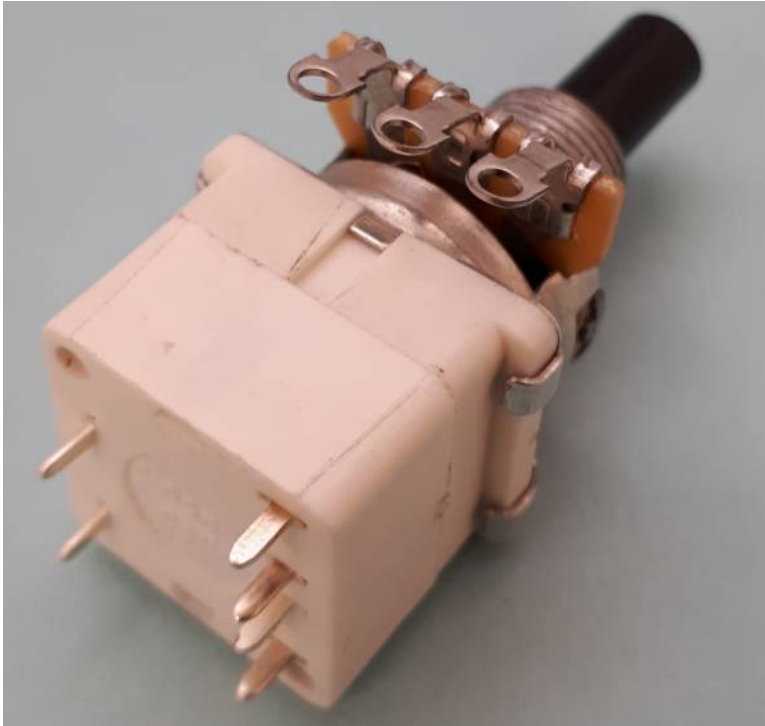


TYPE	DESC.	L (mm)
F5A	Plastic Fixed	16-36

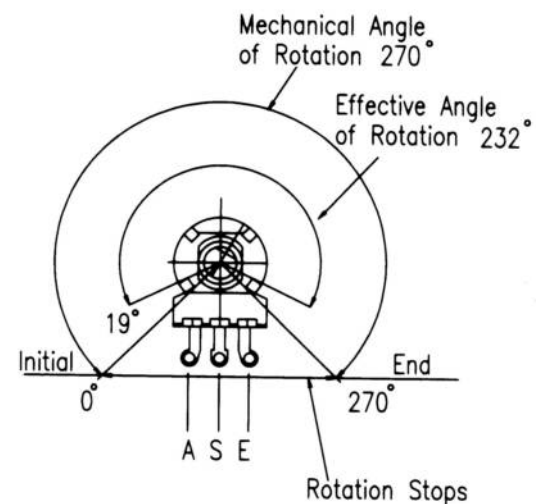


OW16BU/N4PC2S-CH

N4PC2S – 4 Amp Double Pole Switch
CH – Change Over (Double Throw)
OW – Ordinary Wiring Terminals (for soldering)
PC – Printed Circuit Terminals



SPINDLE END VIEW



- W Mounting Height
- Y Mounting Diameter
- X Spindle Diameter
- L Spindle Length
- A Initial Termination
- S Wiper (or moving contact) termination
- E End Termination

Prefix (Potentiometer terminals)

- OW - Ordinary wiring (eyelets) - **recommended for hand soldering of wires**
- PC - Printed circuit
- LT - Long bent and towards the spindle

Please Note: The Double Throw 'Change Over' Switch is not UL Demko Certified

Total mechanical and effective electrical angles of rotation of potentiometers



P16 Range Technical Data

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Rotation angle: $270^{\circ} \pm 5^{\circ}$ (Unswitched), $300^{\circ} \pm 5^{\circ}$ (Switched)

Operating Torque: 0.4 – 2.0 N.cm (Initial Torque may be higher)

Rotational torque of spindle can be made high or low

Detents (stop positions) Available: Centre, 11, 21, 31, 41

Permissible Axial Spindle Load: 50 N (5 Sec. maximum)

Permissible Torque at End Stop: 35 N.cm

ELECTRICAL SPECIFICATION

Rated Power Dissipation @40°C for ECO potentiometers:

0.25W linear law

0.12W nonlinear law

Rotation angle: $270^{\circ} \pm 5^{\circ}$ (Unswitched), $300^{\circ} \pm 5^{\circ}$ (Switched)

Effective rotation: 232° nominal

Insulation Resistance: ≥ 4 Gohms

Rated Resistance: E3 Series

- Optional: E6 Series
- Linear Law: 1K - 1M
- Nonlinear Law: 4K7 - 470K

Tolerance on Rated Resistance: $\pm 20\%$

- Optional Tolerance on 1K - 1M: $\pm 10\%$

Resistance Laws (Taper):

- Linear: A
- Nonlinear: B - Log (Audio) or C - Antilog (Reverse Audio)
- Other laws: Please refer to Sales office

Rotary Switch Specification

The rotary switch modules are manufactured to EN61058-1 standard using high quality materials with a flame retardant housing. Although no longer certified due to the excessive cost of maintaining approvals, the 1 Amp and 4 Amp switch series have both been previously certified by UL International Demko (copies of previous certificates are available on our website or on request). The same materials, components and production techniques are used as in the certified versions and Omeg Ltd continues to test to the EN61058-1 standard

The 1 Amp contact rating is only available when mounted on the ECO potentiometer

1 A Contact Rating:

Note: The 1A contact rating is NOT available for mounting on the P16 or P20 potentiometer.

1A/250Vac 2.5A/12Vdc

Surge rating (0.01 seconds): 20A

Contact gap: 3mm (Full mains separation of contacts)

Manufactured to EN61058-1 standard

4 A Contact Rating:

4A/250Vac 10A/12Vdc

Surge rating (0.01 seconds): 80A

Switch contacts: Silver tin oxide

Contact gap: 2mm (Micro disconnection of switch - micro separation of contacts)

Manufactured to EN61058-1 standard

Common features

Housing material: Flame Retardant Glass filled polyester (UL 94 VO)

Initial contact resistance: 20 milliohms

Insulation resistance: 50,000 Megohms

Life (operations at full load): 10,000 minimum

Operating temperature: -25°C to +70°C

Operating torque for SPST/SPDT: 1.5 - 3 cNm

Operating torque for DPST/DPDT: 3.0 - 6 cNm

Mechanical rotation: 300°

Proof voltage: 3kV minimum

Rotary Switch Terminals

Layout

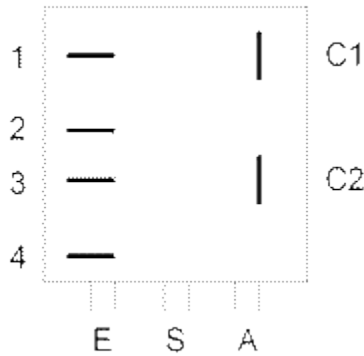
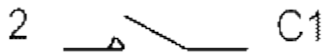


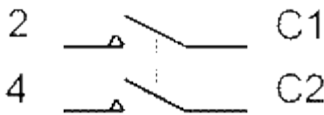
Diagram as viewed on the rear of the switch module:

(Potentiometer terminals at the bottom)

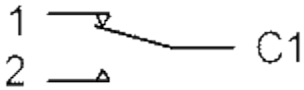
Configuration



SPST - Single pole (1S), Single throw (On-Off)

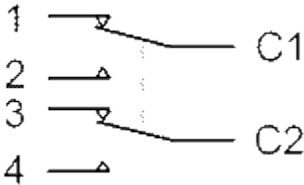


DPST - Double pole (2S), Single throw (On-Off)



SPDT - Single pole (1S), Double throw (CH)

(**NOT** certified)



DPDT - Double pole (2S), Double throw (CH)

(**NOT** certified)

Notes

1. Moving contact(s) shown when the potentiometer shaft is in a counterclockwise (CCW) position.
2. 'Ordinary Wiring'(OW) or 'Printed Circuit'(PC) terminals can be requested on the switch.
3. Terminals 1 and 3 are only fitted for the Double Throw ('CH' or Changeover) versions which are **NOT** approved nor certified.

Rotary Switch Terminals



Standard (1A or 4A contact ratings)

N/O normally OPEN Switch

Contacts normally OPEN;

CLOCKwise rotation to CLOSE contacts

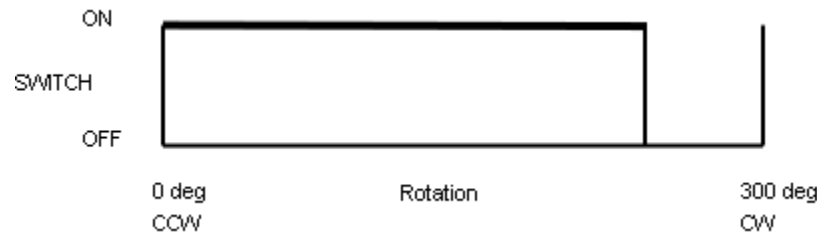


Option 1 (4A contact rating only)

N/C normally CLOSED Switch

Contacts normally CLOSED;

CLOCKwise rotation to OPEN contacts

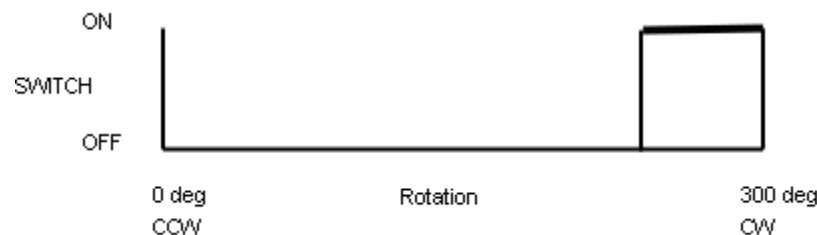


Option 2 (4A contact rating only)

REVERSED N/O normally OPEN Switch

Contacts normally OPEN at fully clockwise position;

ANTI-clockwise rotation to CLOSE contacts



Option 3 (4A contact rating only)

REVERSED N/C normally CLOSED Switch

Contacts normally CLOSED at fully clockwise position;

ANTI-clockwise rotation to OPEN contacts

ELECTRICAL SPECIFICATION UNIQUE TO P16 POTENTIOMETERS

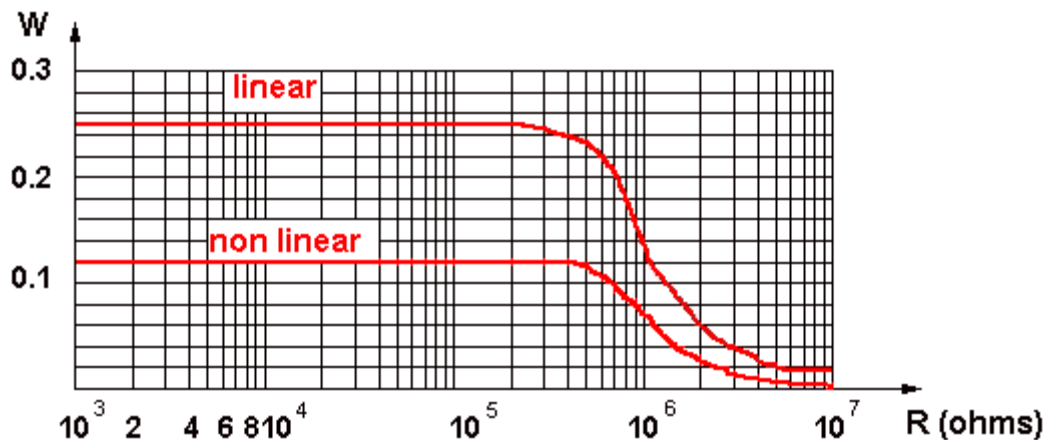
Effective rotation:

- Without a switch: 232° nominal
- With rotary switch: 232° nominal

Rated Power Dissipation @40°C for ECO potentiometers:

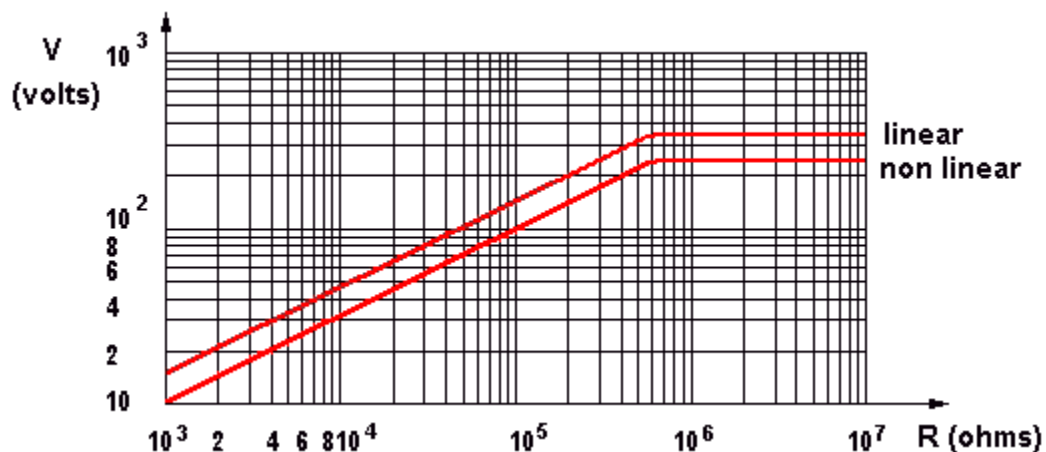
- 0.25W linear law
- 0.12W nonlinear law

ECO, P16 power dissipating curve



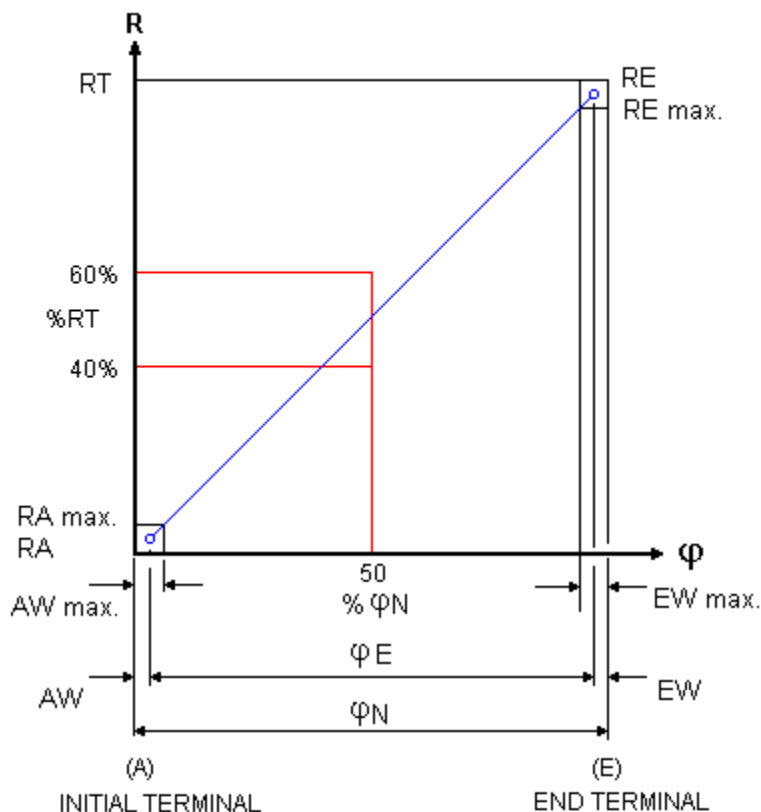
Limiting Element Voltage: 350 V DC for 16mm potentiometers

ECO, P16 maximum working voltage curve



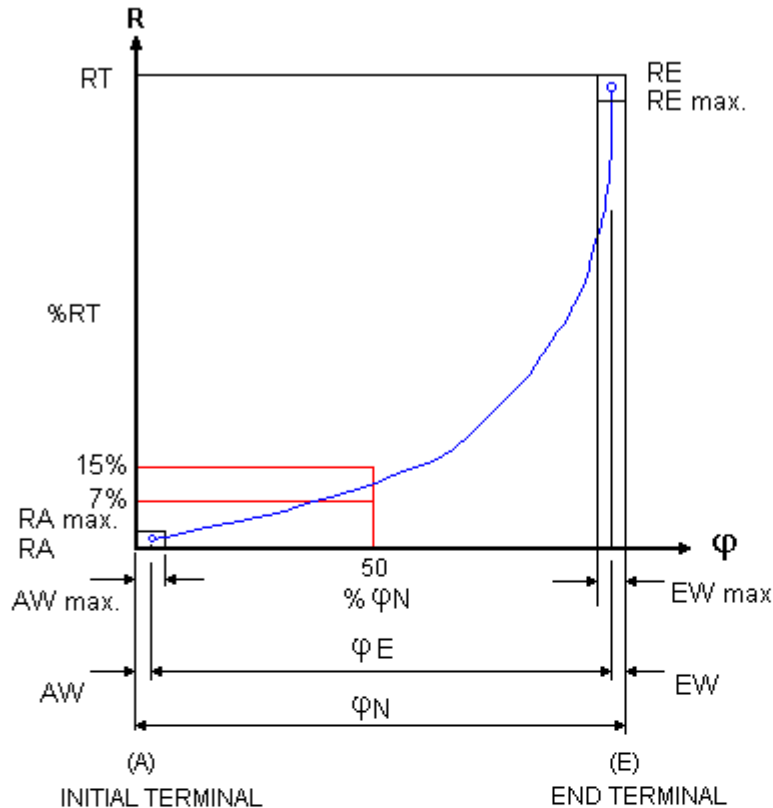
Insulating Voltage: 500 V AC for ECO potentiometers

Resistance law A - Linear



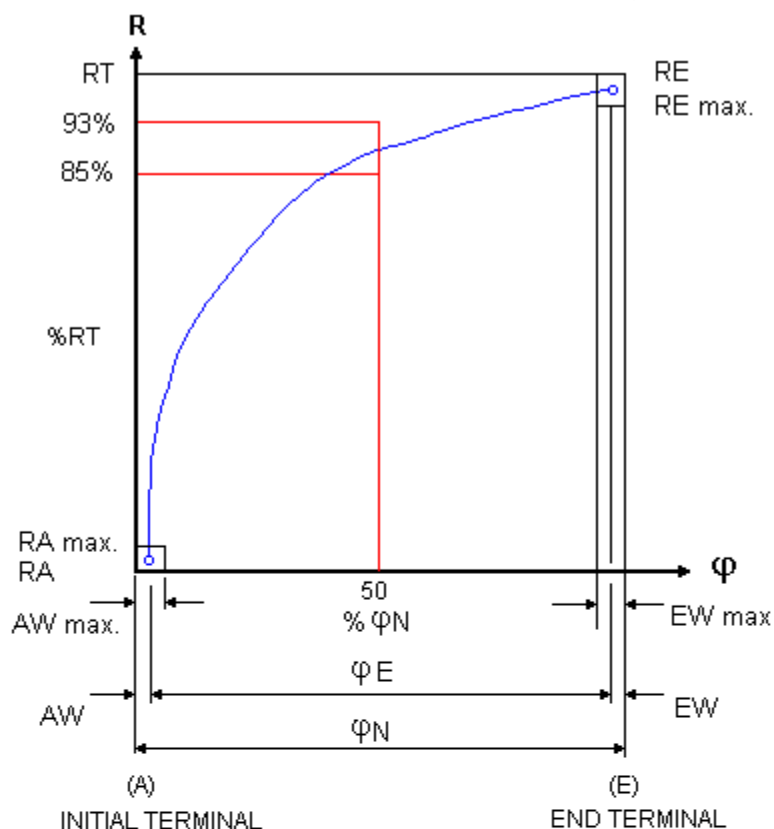
AW	Initial Path	AW max. 12% ϕN
EW	Final Path	EW max. 12% ϕN
Ra	Initial Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RA	Hop-on Resistance	$\leq 1\% RN$
Re	End Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RE	Hop-off Resistance	$\leq 1\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

Resistance law B – Log (Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RA	Hop-on Resistance	$RN \leq 10K$ 5% RN $RN > 10K$ 0.15% RN
Re	End Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RE	Hop-off Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K$ 0.5% RN
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

Resistance law C – Antilog (Reverse Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RA	Hop-on Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K 0.5\% RN$
Re	End Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RE	Hop-off Resistance	$RN \leq 10K 5\% RN$ $RN > 10K 0.15\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

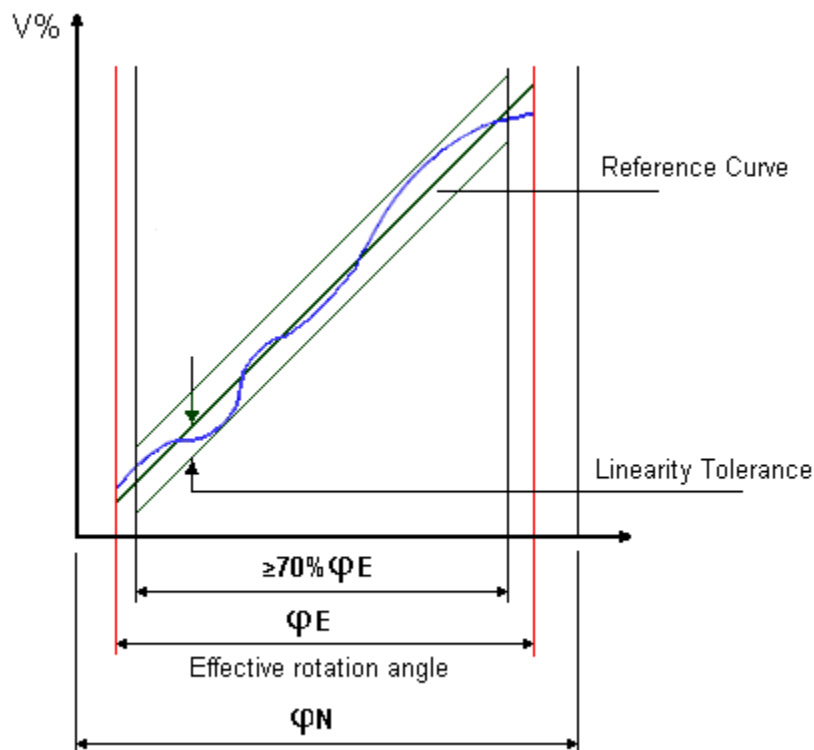
Linearity

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Linearity Tolerance is 4% over the Nominal Resistance range of 1K0 to 1M0. The Linearity Tolerance is measured on at least 70% of the effective rotation range.

Note. In the case of Terminal and Zero-based linearity, both present constraints which increase the manufacturing difficulty and in consequence have an adverse effect on the product's price and availability.

Potentiometer linearity

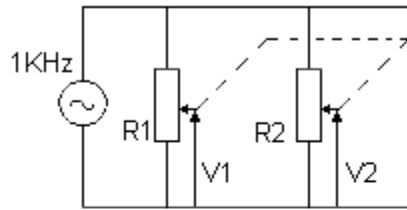


Matching Tolerance (For Tandem Stereo Potentiometers)

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- Law A: 4 dB at Attenuation range 0 - 20 dB
- Law B and C: 3 dB at Attenuation range 0 - 20 dB

Matched Tolerance for Stereo

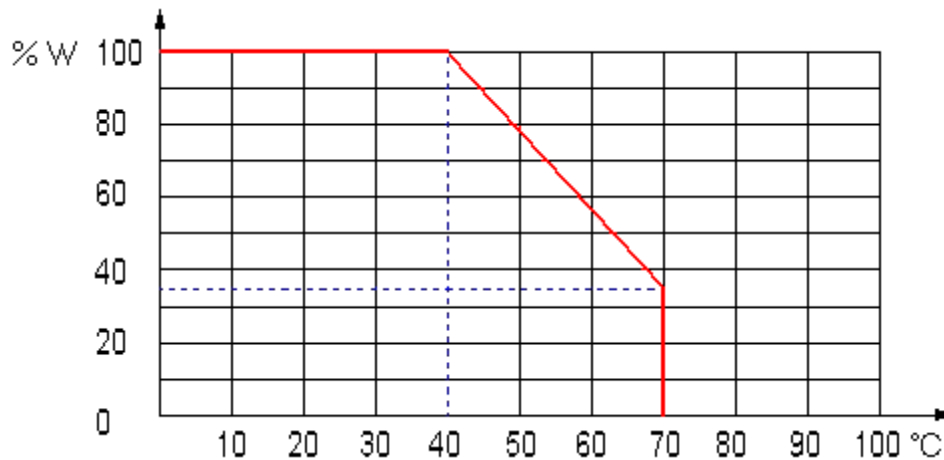


LAW	ATTENUATION RANGE	MATCHING TOLERANCE *
A	0 - 20dB	4dB
B & C	0 - 20dB	3dB

$$* \text{Matching Tolerance} = 20 \log \frac{V1}{V2}$$

Operating Temperature: -25°C to +70°C

Temperature Derating Curve



Temperature Coefficient of Resistance: +300 -500 ppm

Components

P16 Bush Housing (Mounting)

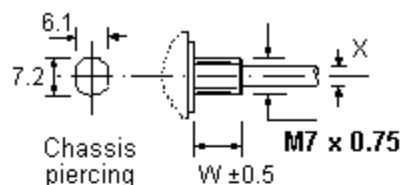
The P16 bushes are available in metal or nylon with an M7 or M10 thread both with and without a locating feature:

Diecast Zinc Alloy M10 x 0.75mm pitch (Type C) or M7 0.75mm pitch (Type CG)

Glass Filled Nylon M10 x 0.75mm pitch (Type CP)

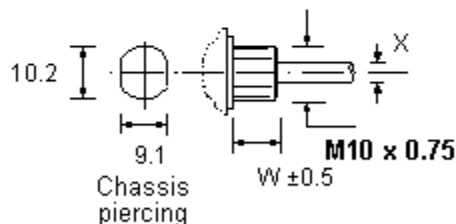
Do not attempt to prevent any unwanted body rotation by overtightening the retaining nut, since this can cause thread damage, distortion, change of electrical resistance and restrict shaft rotation. BS9130:1972 provides further details on this topic. The **recommended torque** for tightening the retaining nut is 45cN.m and this can be achieved cost effectively by using a Torque Limiting device as shown on our **Accessories** page.

DIECAST ZINC ALLOY



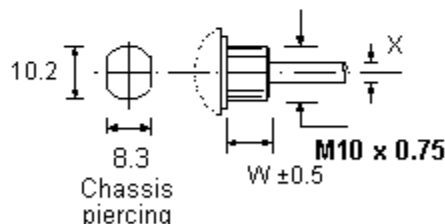
TYPE CG (without locator)	
X (mm)	4
W (mm)	6

DIECAST ZINC ALLOY



TYPE C (without locator)	
X (mm)	6 or 6.35
W (mm)	8

GLASS FILLED NYLON



TYPE CP (GFN)	
X (mm)	4 or 6
W (mm)	8



P16 Spindles

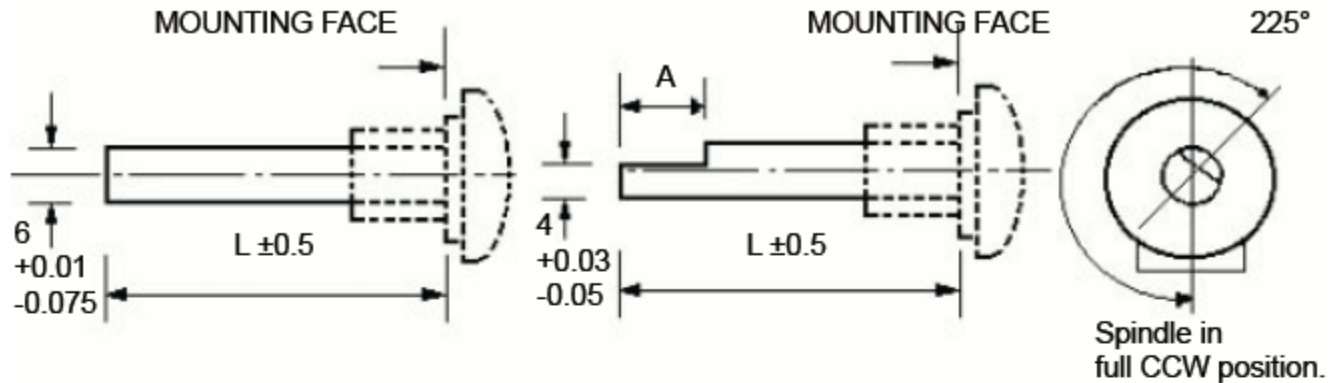
The P16 spindles are plastic, unless otherwise stated, fixed i.e. not removable and they are available in three diameters:

- **6.0mm Diameter**
 - Cylindrical (Type F1)
 - 4.0 x 12mm Flat (Type F2)
 - 5.0 x 15mm Flat (Type F3)
 - 5.0 x 10mm Flat (Type F4)
 - 4.6mm x 15mm Flat (Type F11)
- **4.0mm Diameter**
 - Cylindrical (Type F21)
 - 3.0 x 8.5mm Flat (Type F22)
 - 3.0 x 8.5mm Flat (Type M22 - Metal)
- **6.35mm Diameter**
 - Cylindrical (Type F41)
 - 5.5 x 10mm Flat (Type F42)
 - 5.5 x 15mm Flat (Type F43)
- **Splined Spindle - 6.0mm dia. 18 teeth**
- **Dual Concentric**
 - Flatted/Slotted (Type M15 - Metal)
 - Cylindrical (Type M16 - Metal)

Cylindrical and Flatted Spindles

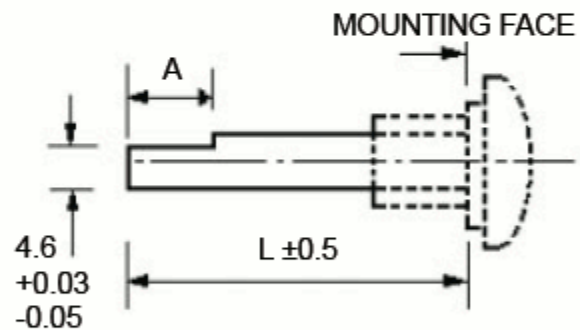
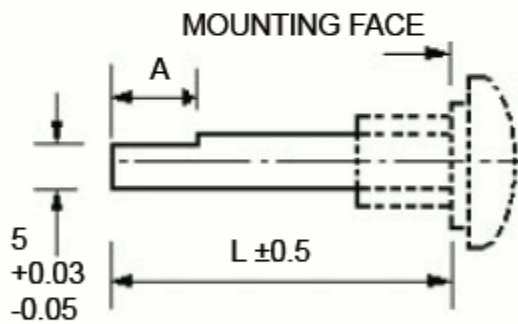
6.0mm Diameter Spindles

Note: *Specials to customer's specification up to 65mm.



TYPE	DESC.	L (mm)
F1	Plastic Fixed	15 to 50*

TYPE	DESC.	L (mm)	A (mm)
F2	Plastic Fixed	20 to 35*	12

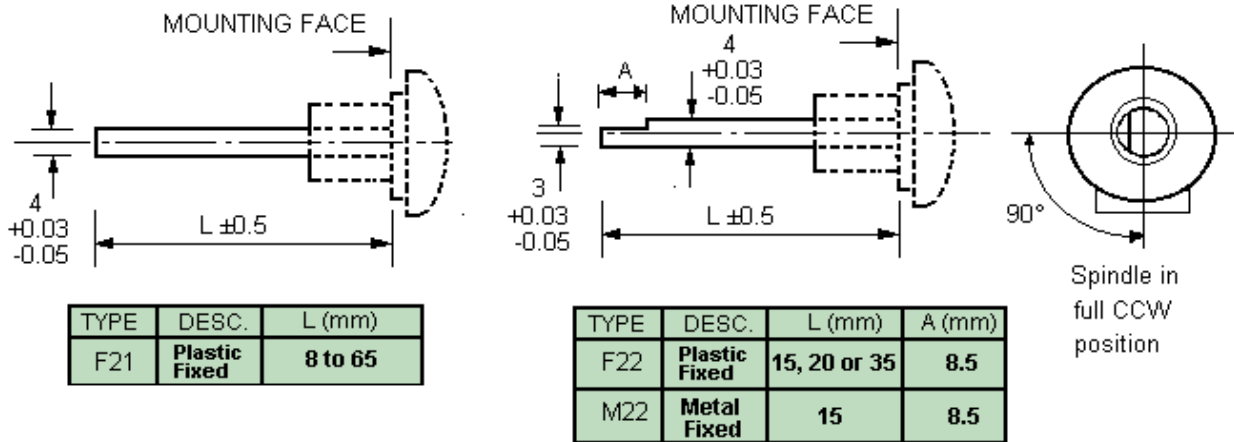


TYPE	DESC.	L (mm)	A (mm)
F3	Plastic Fixed	15 to 35*	15
F4	Plastic Fixed	15 to 35*	10

TYPE	DESC.	L (mm)	A (mm)
F11	Plastic Fixed	15 to 35*	15

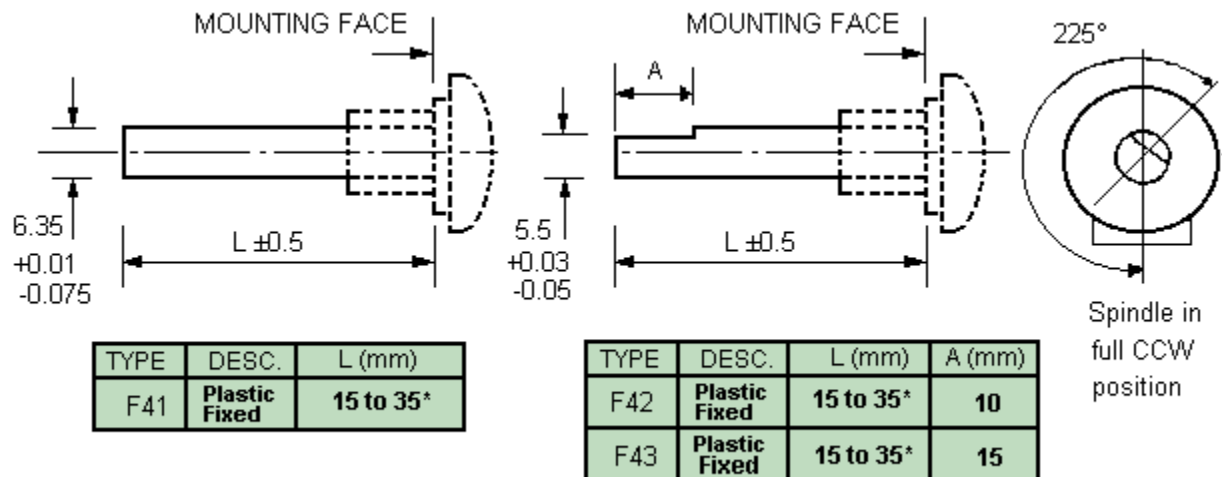
4.0mm Diameter Spindles

Note: The orientation of the flat as illustrated is for plastic spindles only.
For metal spindles, unless specified on the order, the orientation may be different on each potentiometer type



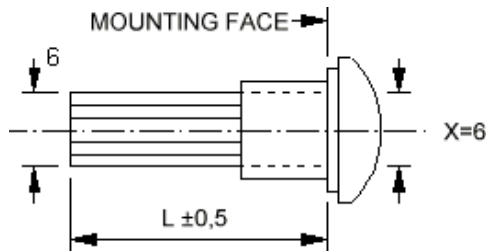
6.35mm Diameter Spindles

Note: *Specials to customer's specification up to 65mm.

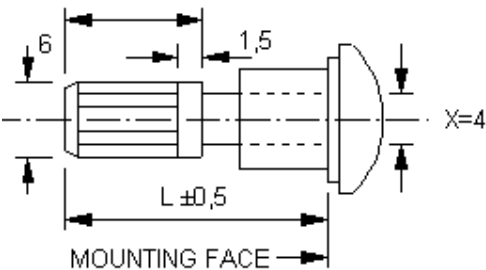
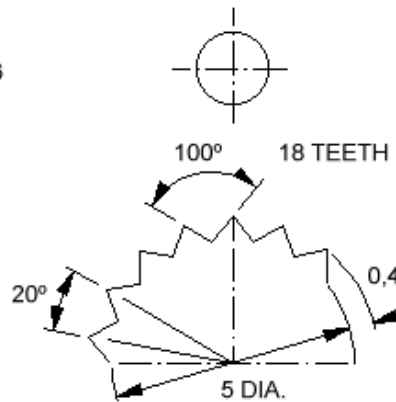


Splined Spindle - 6.0mm dia. 18 teeth

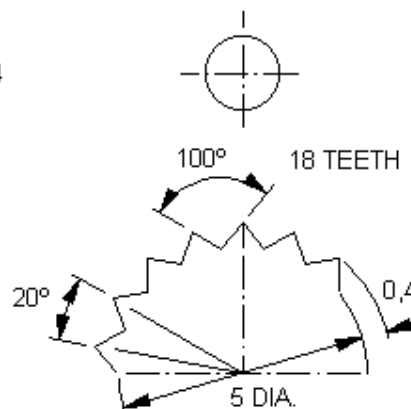
A splined form is available on the 6.0mm diameter P16 plastic spindle (F5)
 or alternatively,
 a 6mm 'Splined Adaptor' (8.7mm long) can be fitted on a 4mm dia. Spindle (F5A):



TYPE	DESC.	L (mm)
F5	Plastic Fixed	19

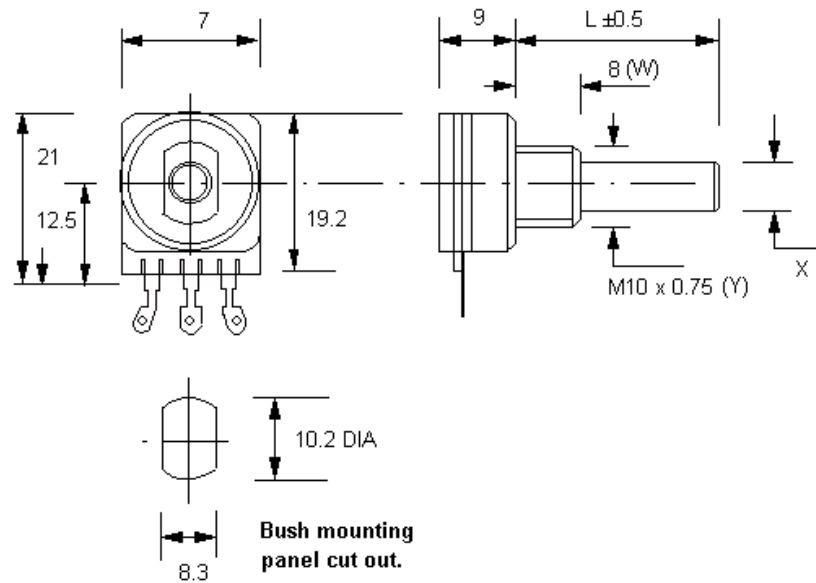


TYPE	DESC.	L (mm)
F5A	Plastic Fixed	16-36



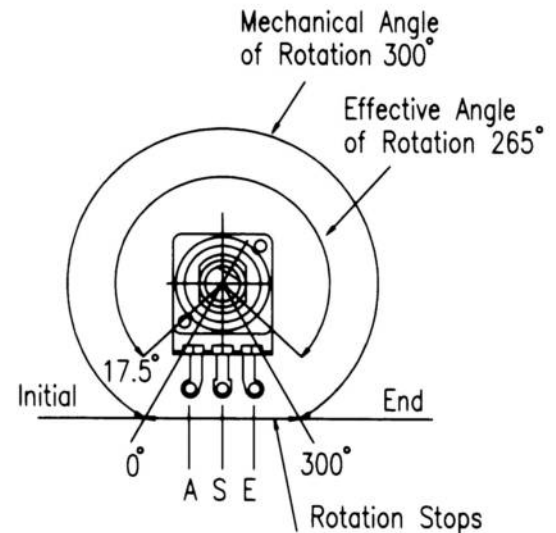
OW16ECO

OW – For Ordinary Wiring (Hand Soldering Wires)



SPINDLE END VIEW

- W Mounting Height
- Y Mounting Diameter
- X Spindle Diameter
- L Spindle Length
- A Initial Termination
- S Wiper (or moving contact) termination
- E End Termination



Total mechanical and effective electrical angles of rotation of potentiometers without rotary switch



ECO Range Technical Data

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Rotation angle: $300^{\circ} \pm 5^{\circ}$ (Switched and Unswitched)

Operating Torque: 0.4 – 2.0 N.cm (Initial Torque may be higher)

Rotational torque of spindle can be made high or low

Detents (stop positions) Available: Centre, 11, 21, 31

Permissible Axial Spindle Load: 50 N (5 Sec. maximum)

Permissible Torque at End Stop: 35 N.cm

ELECTRICAL SPECIFICATION

Rated Power Dissipation @40°C for ECO potentiometers:

0.25W linear law

0.12W nonlinear law

Rotation angle: $300^{\circ} \pm 5^{\circ}$

Effective rotation - Unswitched: 265° nominal

Effective rotation - Switched: 242° nominal

Insulation Resistance: ≥ 4 Gohms

Rated Resistance: E3 Series

- Optional: E6 Series
- Linear Law: 1K - 1M
- Nonlinear Law: 4K7 - 470K

Tolerance on Rated Resistance: $\pm 20\%$

- Optional Tolerance on 1K - 1M: $\pm 10\%$

Resistance Laws (Taper):

- Linear: A
- Nonlinear: B - Log (Audio) or C - Antilog (Reverse Audio)
- Other laws: Please refer to Sales office

ELECTRICAL SPECIFICATION UNIQUE TO ECO POTENTIOMETERS

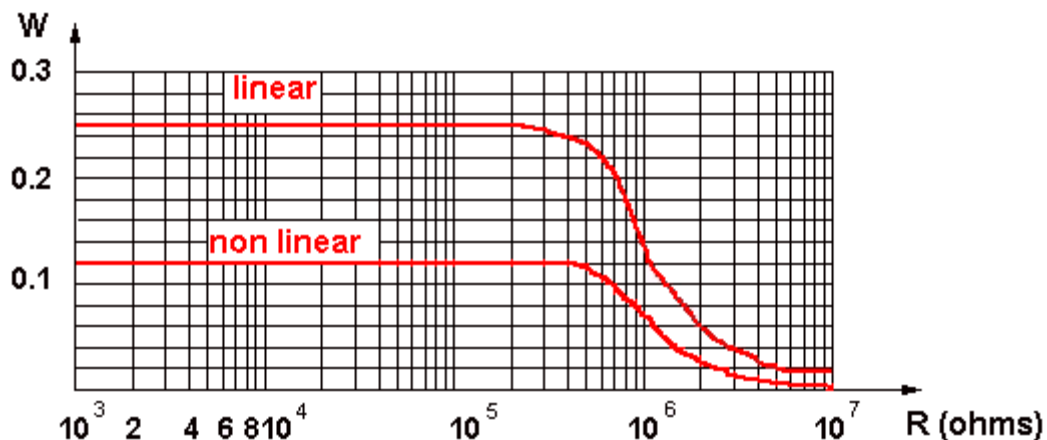
Effective rotation:

- Without a switch: 265° nominal
- With push push switch (/10APP, /MS): 265° nominal
- With rotary switch: 242° nominal

Rated Power Dissipation @40°C for ECO potentiometers:

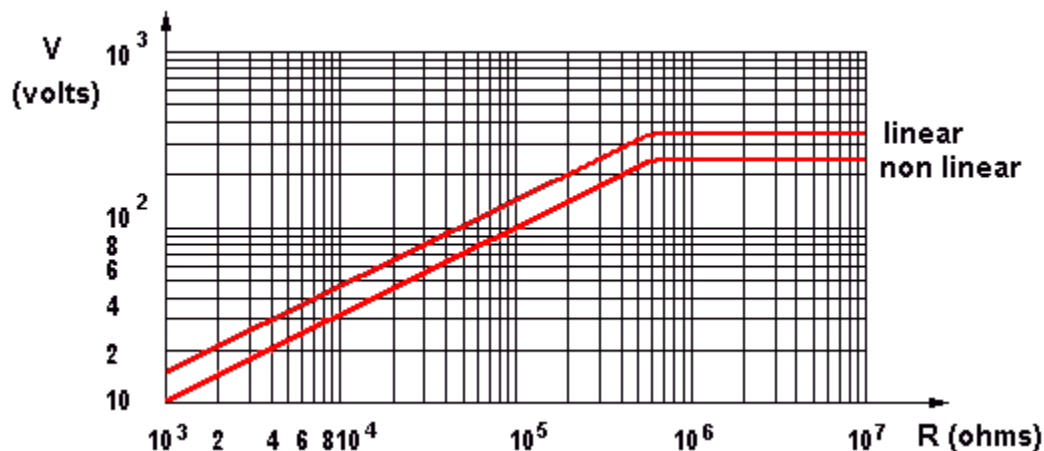
- 0.25W linear law
- 0.12W nonlinear law

ECO, P16 power dissipating curve



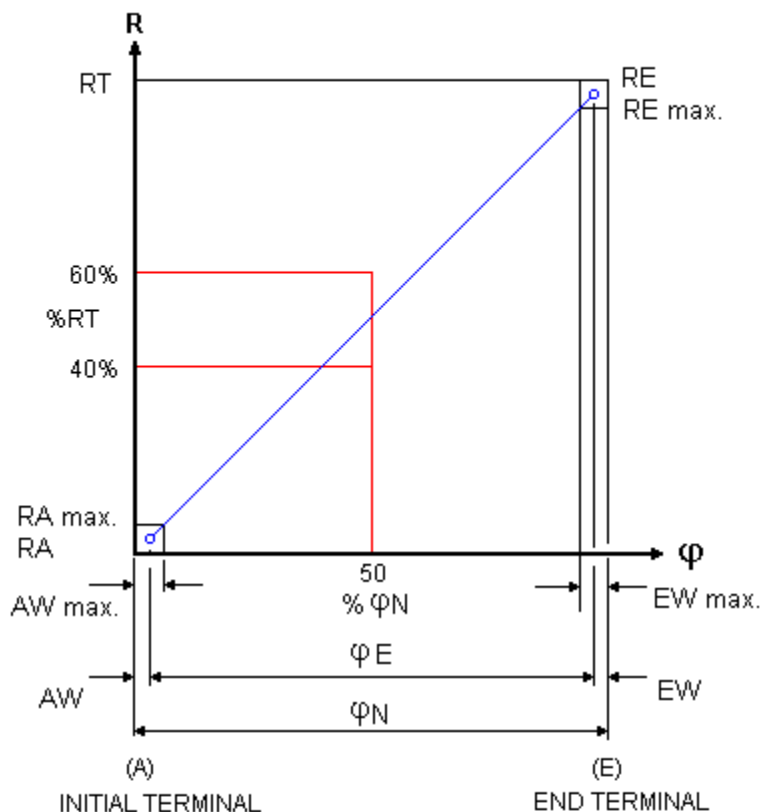
Limiting Element Voltage: 350 V DC for 16mm potentiometers

ECO, P16 maximum working voltage curve



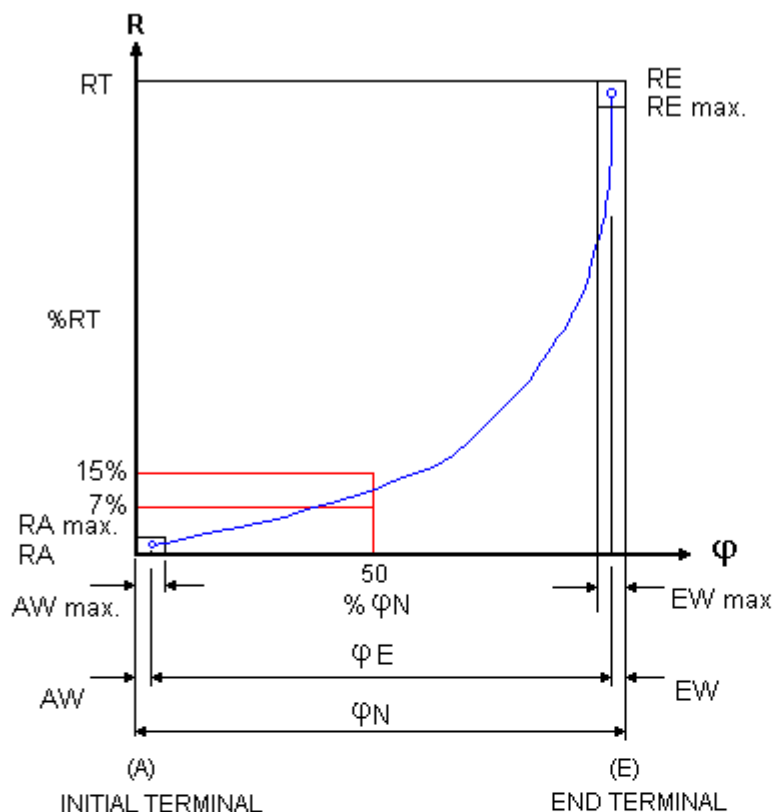
Insulating (Breakdown) Voltage: 2,500 V AC for ECO Potentiometers

Resistance law A - Linear



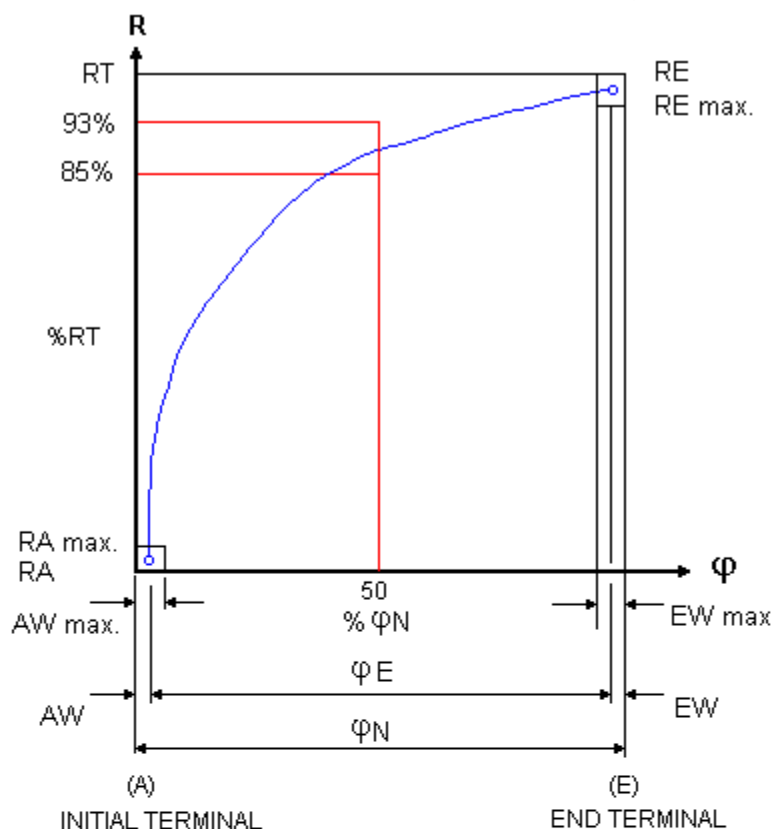
AW	Initial Path	AW max. 12% ϕN
EW	Final Path	EW max. 12% ϕN
Ra	Initial Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RA	Hop-on Resistance	$\leq 1\% RN$
Re	End Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RE	Hop-off Resistance	$\leq 1\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

Resistance law B – Log (Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RA	Hop-on Resistance	$RN \leq 10K$ 5% RN $RN > 10K$ 0.15% RN
Re	End Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RE	Hop-off Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K$ 0.5% RN
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

Resistance law C – Antilog (Reverse Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RA	Hop-on Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K 0.5\% RN$
Re	End Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RE	Hop-off Resistance	$RN \leq 10K 5\% RN$ $RN > 10K 0.15\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

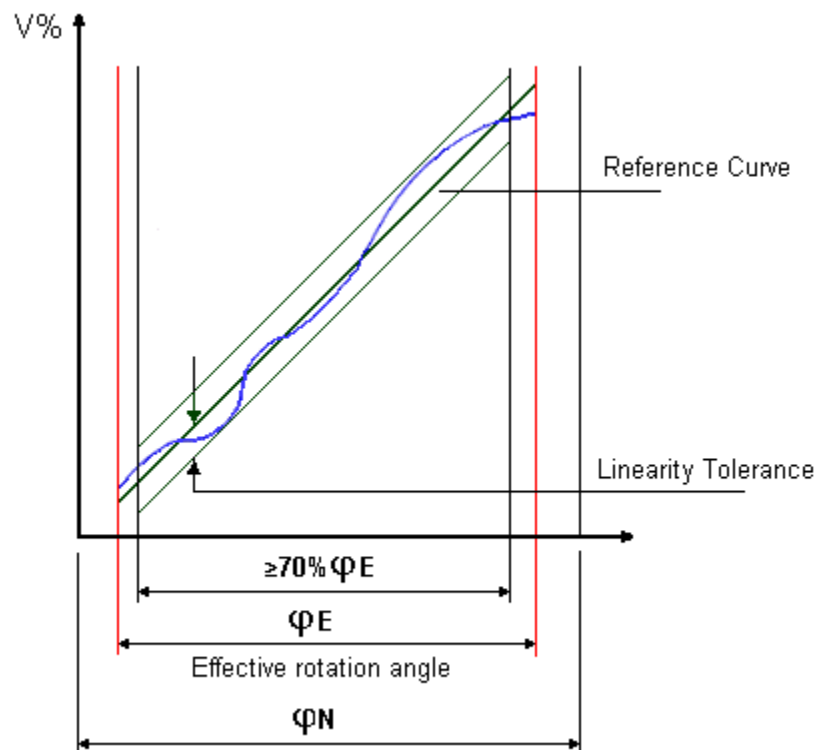
Linearity

As a basis of assessing Linearity Tolerance the independent method is the most practical, permitting as it does, the reference curve to be aligned as near as possible to the actual output curve. This avoids the use of the theoretical starting and finishing points, it is normal for the customer to realign the achieved curve with series trimmers at each end of the device if required.

Linearity Tolerance is 4% over the Nominal Resistance range of 1K0 to 1M0. The Linearity Tolerance is measured on at least 70% of the effective rotation range.

Note. In the case of Terminal and Zero-based linearity, both present constraints which increase the manufacturing difficulty and in consequence have an adverse effect on the product's price and availability.

Potentiometer linearity

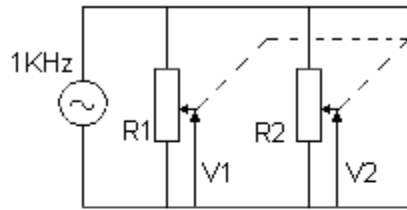


Matching Tolerance (For Tandem Stereo Potentiometers)

Tandem Potentiometers have two identical resistor units with the same variation law. The mismatching of the two resistor units, expressed in dB, is measured by the difference between the attenuations introduced by each resistor unit at various points of travel.

- Law A: 4 dB at Attenuation range 0 - 20 dB
- Law B and C: 3 dB at Attenuation range 0 - 20 dB

Matched Tolerance for Stereo

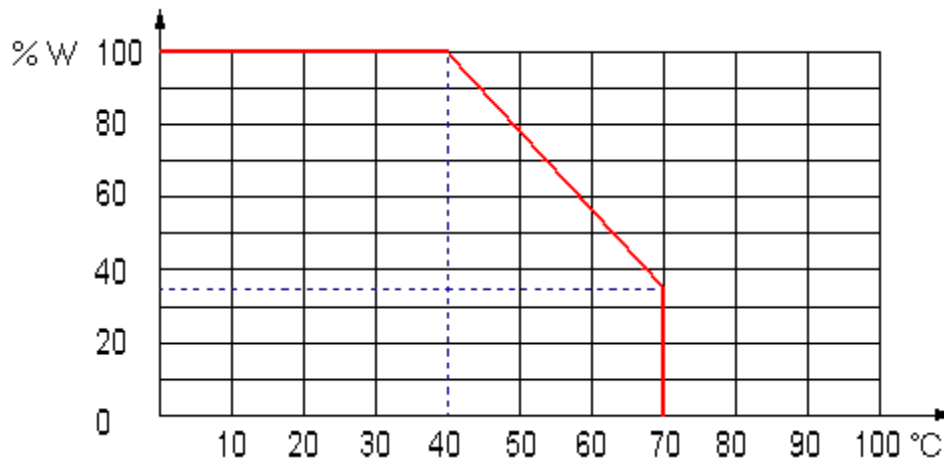


LAW	ATTENUATION RANGE	MATCHING TOLERANCE *
A	0 - 20dB	4dB
B & C	0 - 20dB	3dB

$$* \text{Matching Tolerance} = 20 \log \frac{V1}{V2}$$

Operating Temperature: -25°C to +70°C

Temperature Derating Curve



Temperature Coefficient of Resistance: +300 -500 ppm

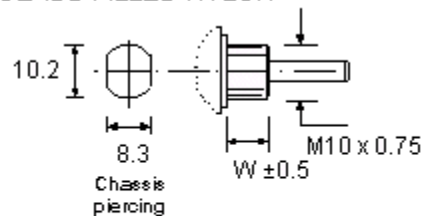
Components

ECO Bush Housing (Mounting)

The ECO bush housing is made of glass filled nylon, the thread is M10 x0.75mm pitch and 8mm long, alternatively **a 12mm long thread is also available** from October 2008.

Do not attempt to prevent any unwanted body rotation by overtightening the retaining nut, since this can cause thread damage, distortion, change of electrical resistance and restrict shaft rotation. BS9130:1972 provides further details on this topic. The **recommended torque** for tightening the retaining nut is 45cN.m and this can be achieved cost effectively by using a Torque Limiting device as shown on our **Accessories** page.

GLASS FILLED NYLON



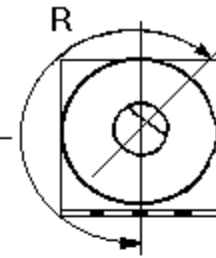
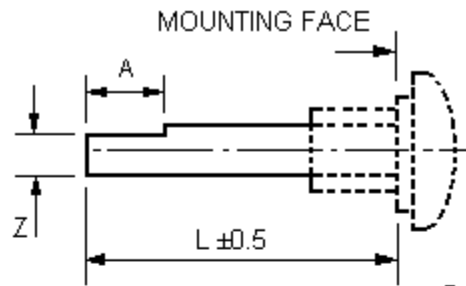
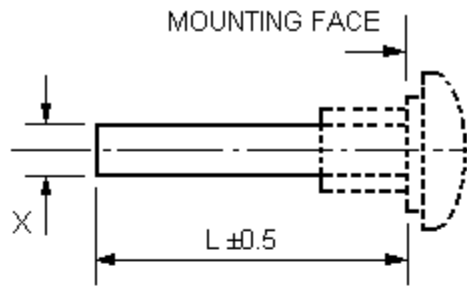
TYPE PLASTIC BODY	
W(mm)	8 (optional 12)

ECO Spindles

The ECO plastic spindles are fixed and not removable.
They are available in the following three diameters:

- 6.0mm Diameter - Length (L) available from 14mm to 65mm
 - Cylindrical (Type F1)
 - 4.0 x 12mm Flat (Type F2)
 - 5.0 x 15mm Flat (Type F3)
 - 5.0 x 10mm Flat (Type F4)
 - 4.6mm x 15mm Flat (Type F11)
 - 4.0 x 8mm Flat (Type F13)
 - 5.0 x 8mm Flat (Type F14)
- 4.0mm Diameter - Length (L) available from 14mm to 35mm
 - Cylindrical (Type F21)
 - 3.0 x 8.5mm Flat (Type F22)
- 6.35mm Diameter - Length (L) available from 14mm to 65mm
 - Cylindrical (Type F41)
 - 5.5 x 10mm Flat (Type F42)

Cylindrical and Flatted Spindles



Spindle in full CCW position

TYPE	DESC. (X)	L (mm)
F21	4 mm Dia Plastic	14 - 35
F1	6 mm Dia Plastic	14 - 65
F41	6.35mm Dia Plastic	14 - 65

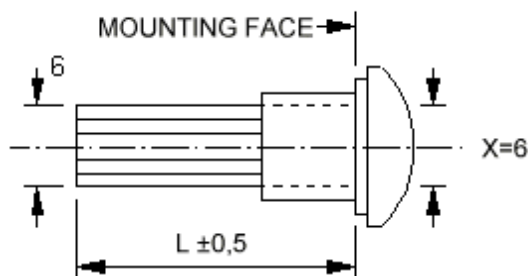
All spindles fixed.

TYPE	DESC. (X)	L (mm)	Flat (ZxA)
F22	4 mm Dia Plastic	14 - 35	3 x 8.5
F13	6 mm Dia Plastic	14 - 65	4 x 8
F2	6 mm Dia Plastic	14 - 65	4 x 12
F14	6 mm Dia Plastic	14 - 65	5 x 8
F4	6 mm Dia Plastic	14 - 65	5 x 10
F3	6 mm Dia Plastic	14 - 65	5 x 15
F11	6 mm Dia Plastic	14 - 65	4.6 x 15
F42	6.35mm Dia Plastic	14 - 65	5.5 x 10

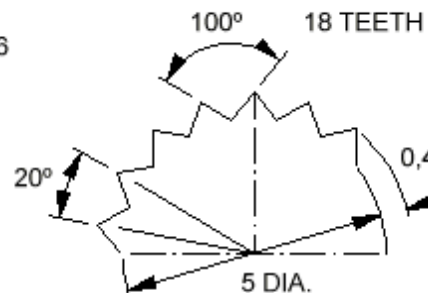
Standard flat angle
R = 210°

Splined Spindle (6.0mm diameter)

A splined form is also available on the 6.0mm diameter ECO plastic spindle.

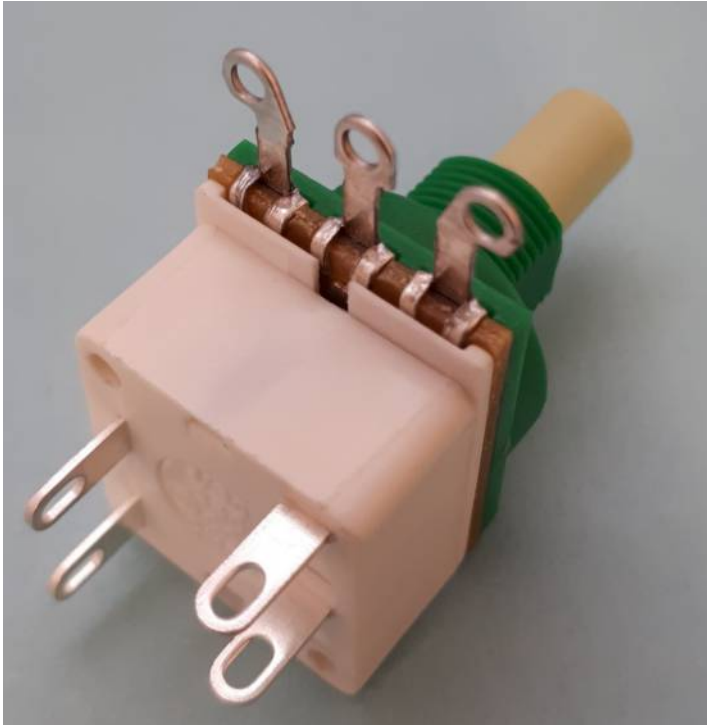


TYPE	DESC.	L (mm)
F5	Plastic Fixed	14 - 30

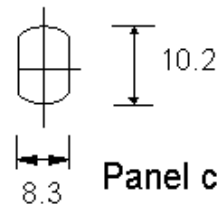
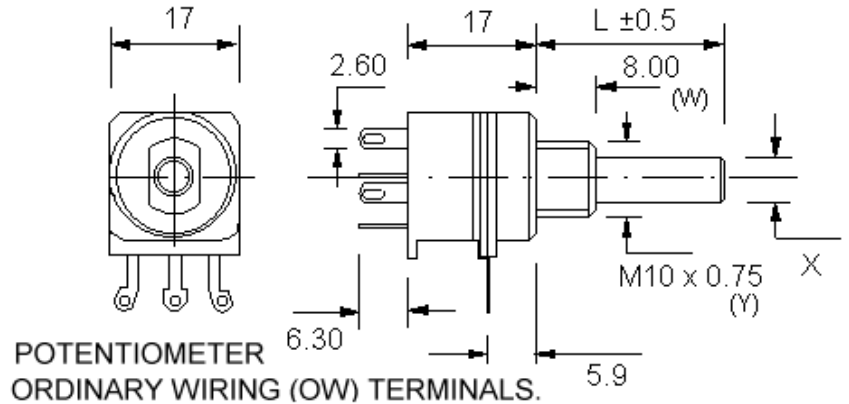


OW16ECO/B4OW2S

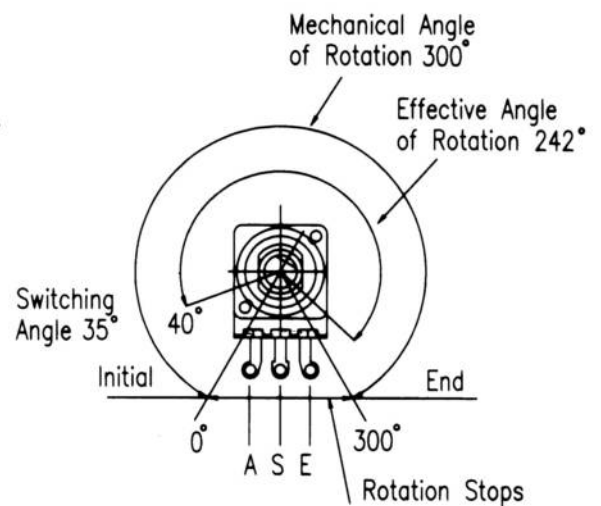
B4OW2S - 4 Amp Double Pole (Single Throw) Switch OW – Ordinary Wiring Terminals (for soldering)



SWITCH ORDINARY WIRING (OW) TERMINALS.



SPINDLE END VIEW



Total mechanical and effective electrical angles of rotation of potentiometers with rotary switch

- W Mounting Height
- Y Mounting Diameter
- X Spindle Diameter
- L Spindle Length
- A Initial Termination
- S Wiper (or moving contact) termination
- E End Termination



ECO Range Technical Data

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Rotation angle: $300^{\circ} \pm 5^{\circ}$ (Switched and Unswitched)

Operating Torque: 0.4 – 2.0 N.cm (Initial Torque may be higher)

Rotational torque of spindle can be made high or low

Detents (stop positions) Available: Centre, 11, 21, 31

Permissible Axial Spindle Load: 50 N (5 Sec. maximum)

Permissible Torque at End Stop: 35 N.cm

ELECTRICAL SPECIFICATION

Rated Power Dissipation @40°C for ECO potentiometers:

0.25W linear law

0.12W nonlinear law

Rotation angle: $300^{\circ} \pm 5^{\circ}$

Effective rotation - Unswitched: 265° nominal

Effective rotation - Switched: 242° nominal

Insulation Resistance: ≥ 4 Gohms

Rated Resistance: E3 Series

- Optional: E6 Series
- Linear Law: 1K - 1M
- Nonlinear Law: 4K7 - 470K

Tolerance on Rated Resistance: $\pm 20\%$

- Optional Tolerance on 1K - 1M: $\pm 10\%$

Resistance Laws (Taper):

- Linear: A
- Nonlinear: B - Log (Audio) or C - Antilog (Reverse Audio)
- Other laws: Please refer to Sales office

Rotary Switch Specification

The rotary switch modules are manufactured to EN61058-1 standard using high quality materials with a flame retardant housing. Although no longer certified due to the excessive cost of maintaining approvals, the 1 Amp and 4 Amp switch series have both been previously certified by UL International Demko (copies of previous certificates are available on our website or on request). The same materials, components and production techniques are used as in the certified versions and Omeg Ltd continues to test to the EN61058-1 standard

The 1 Amp contact rating is only available when mounted on the ECO potentiometer

1 A Contact Rating:

Note: The 1A contact rating is NOT available for mounting on the P16 or P20 potentiometer.

1A/250Vac 2.5A/12Vdc

Surge rating (0.01 seconds): 20A

Contact gap: 3mm (Full mains separation of contacts)

Manufactured to EN61058-1 standard

4 A Contact Rating:

4A/250Vac 10A/12Vdc

Surge rating (0.01 seconds): 80A

Switch contacts: Silver tin oxide

Contact gap: 2mm (Micro disconnection of switch - micro separation of contacts)

Manufactured to EN61058-1 standard

Common features

Housing material: Flame Retardant Glass filled polyester (UL 94 VO)

Initial contact resistance: 20 milliohms

Insulation resistance: 50,000 Megohms

Life (operations at full load): 10,000 minimum

Operating temperature: -25°C to +70°C

Operating torque for SPST/SPDT: 1.5 - 3 cNm

Operating torque for DPST/DPDT: 3.0 - 6 cNm

Mechanical rotation: 300°

Proof voltage: 3kV minimum

Rotary Switch Terminals

Layout

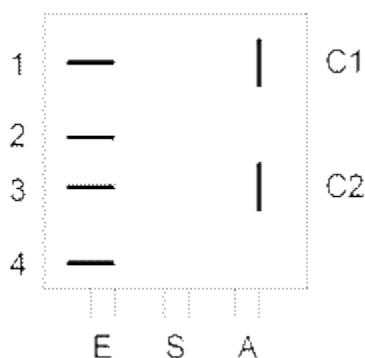


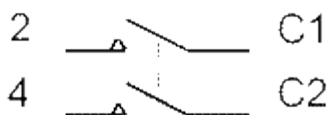
Diagram as viewed on the rear of the switch module:

(Potentiometer terminals at the bottom)

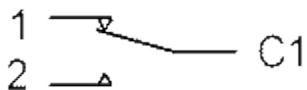
Configuration



SPST - Single pole (1S), Single throw (On-Off)

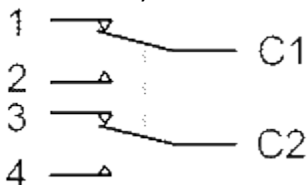


DPST - Double pole (2S), Single throw (On-Off)



SPDT - Single pole (1S), Double throw (CH)

(**NOT** certified)



DPDT - Double pole (2S), Double throw (CH)

(**NOT** certified)

Notes

1. Moving contact(s) shown when the potentiometer shaft is in a counterclockwise (CCW) position.
2. 'Ordinary Wiring'(OW) or 'Printed Circuit'(PC) terminals can be requested on the switch.
3. Terminals 1 and 3 are only fitted for the Double Throw ('CH' or Changeover) versions which are **NOT** approved nor certified.

Rotary Switch Terminals



Standard (1A or 4A contact ratings)

N/O normally OPEN Switch

Contacts normally OPEN;

CLOCKwise rotation to CLOSE contacts

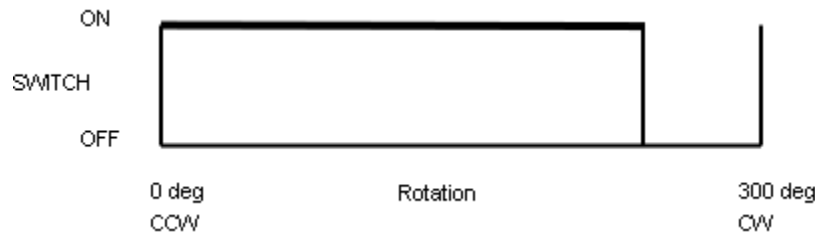


Option 1 (4A contact rating only)

N/C normally CLOSED Switch

Contacts normally CLOSED;

CLOCKwise rotation to OPEN contacts

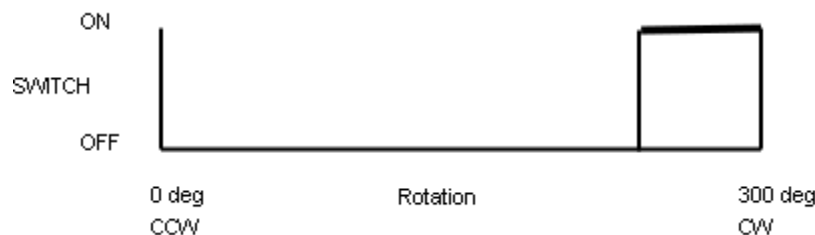


Option 2 (4A contact rating only)

REVERSED N/O normally OPEN Switch

Contacts normally OPEN at fully clockwise position;

ANTI-clockwise rotation to CLOSE contacts



Option 3 (4A contact rating only)

REVERSED N/C normally CLOSED Switch

Contacts normally CLOSED at fully clockwise position;

ANTI-clockwise rotation to OPEN contacts

ELECTRICAL SPECIFICATION UNIQUE TO ECO POTENTIOMETERS

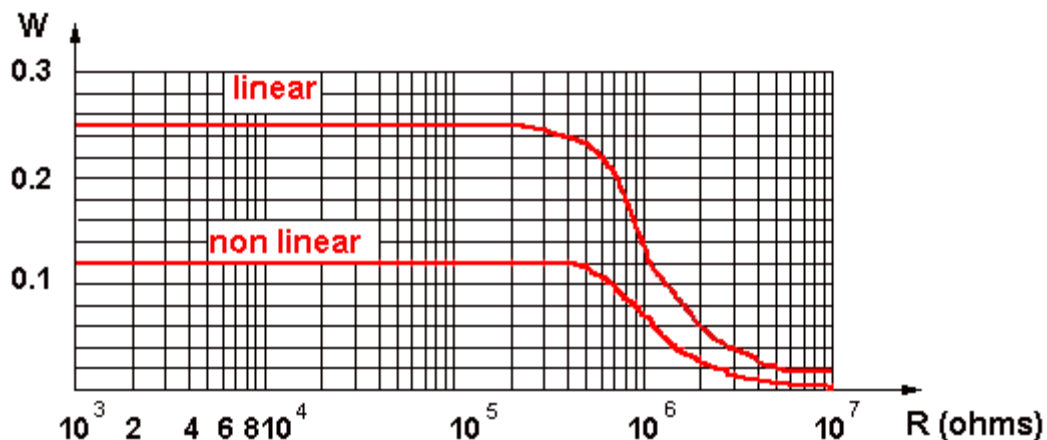
Effective rotation:

- Without a switch: 265° nominal
- With push push switch (/10APP, /MS): 265° nominal
- With rotary switch: 242° nominal

Rated Power Dissipation @40°C for ECO potentiometers:

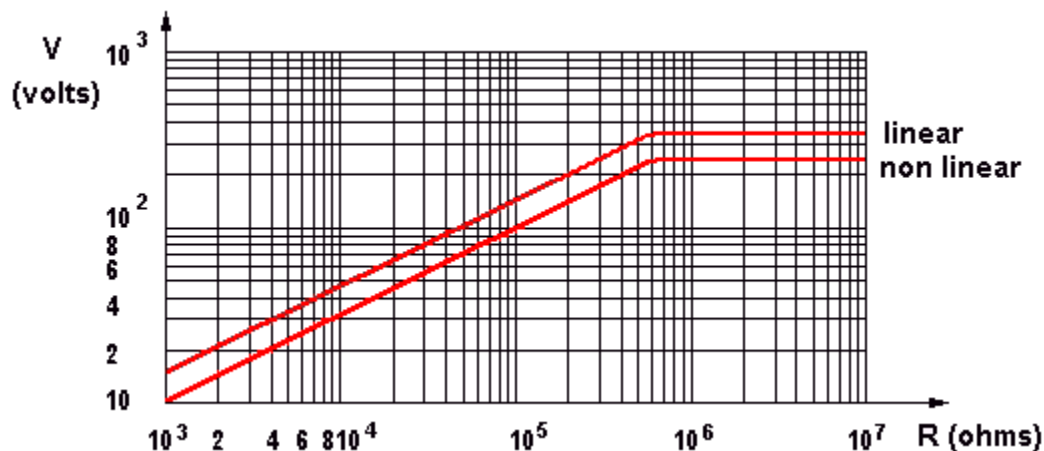
- 0.25W linear law
- 0.12W nonlinear law

ECO, P16 power dissipating curve



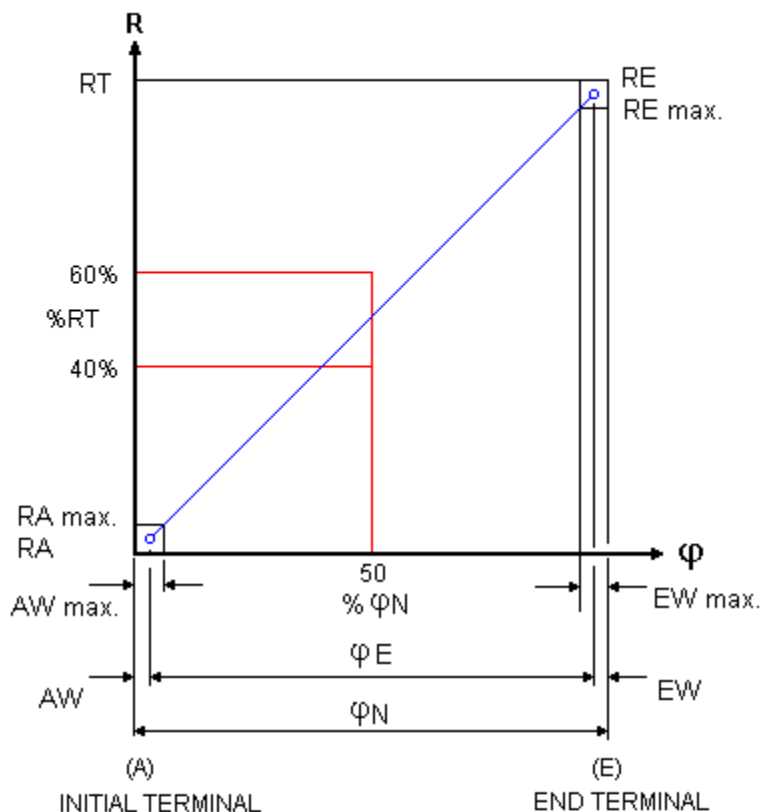
Limiting Element Voltage: 350 V DC for 16mm potentiometers

ECO, P16 maximum working voltage curve



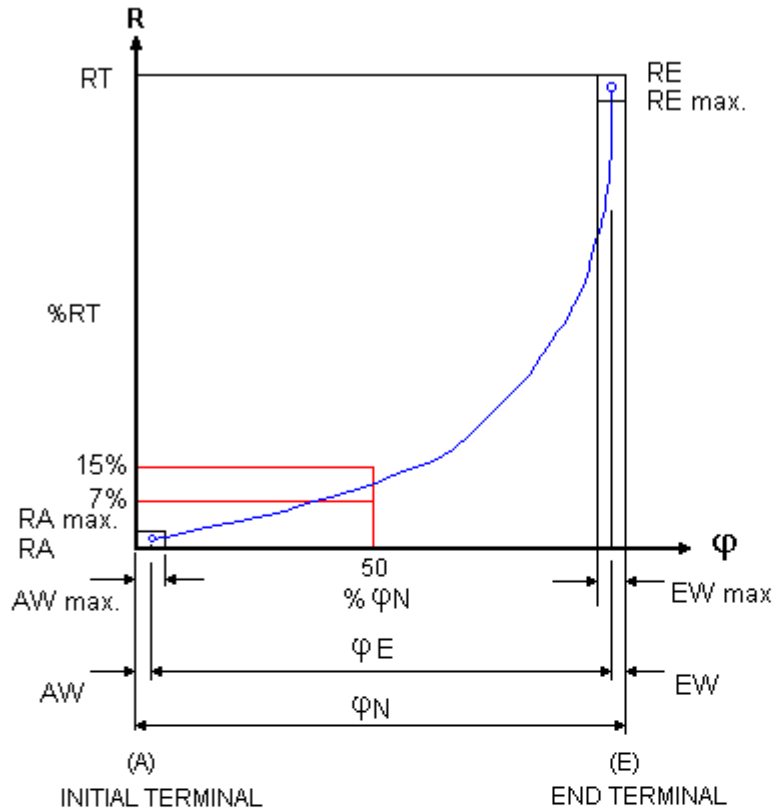
Insulating (Breakdown) Voltage: 2,500 V AC for ECO Potentiometers

Resistance law A - Linear



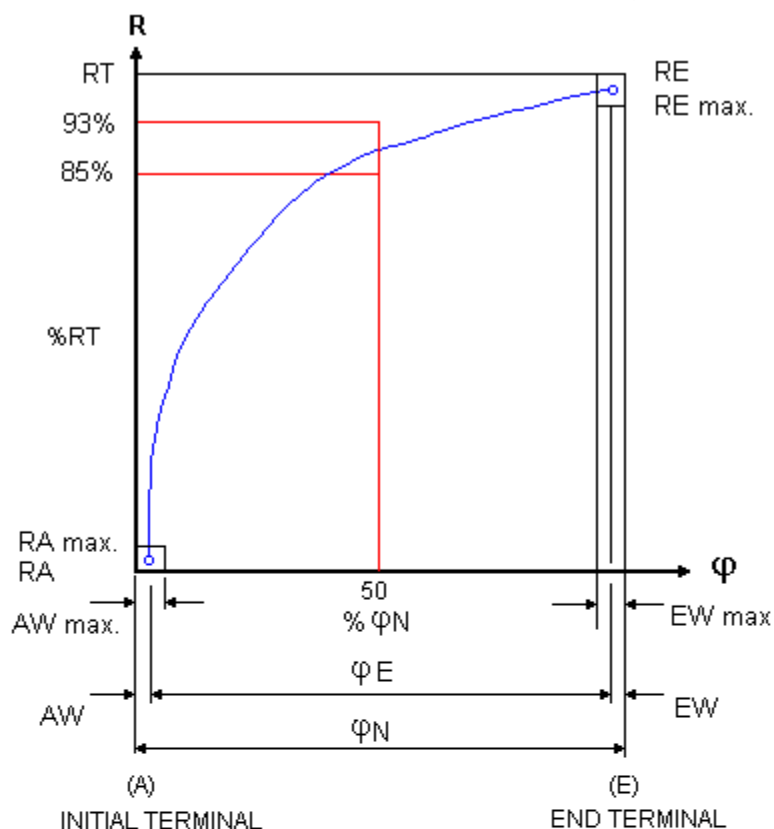
AW	Initial Path	AW max. 12% ϕN
EW	Final Path	EW max. 12% ϕN
Ra	Initial Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RA	Hop-on Resistance	$\leq 1\% RN$
Re	End Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RE	Hop-off Resistance	$\leq 1\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

Resistance law B – Log (Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RA	Hop-on Resistance	$RN \leq 10K$ 5% RN $RN > 10K$ 0.15% RN
Re	End Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RE	Hop-off Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K$ 0.5% RN
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

Resistance law C – Antilog (Reverse Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RA	Hop-on Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K 0.5\% RN$
Re	End Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RE	Hop-off Resistance	$RN \leq 10K 5\% RN$ $RN > 10K 0.15\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

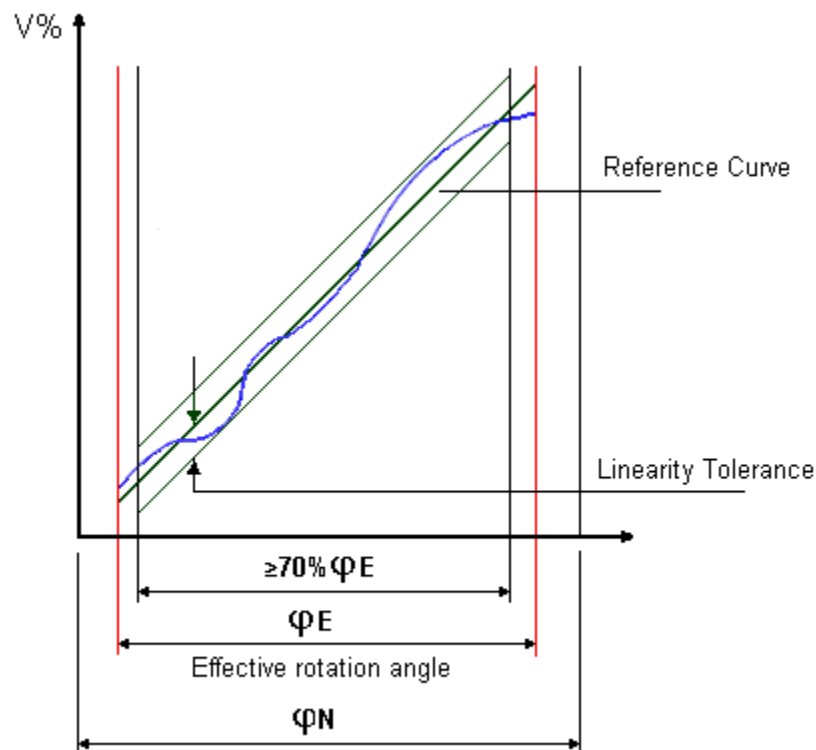
Linearity

As a basis of assessing Linearity Tolerance the independent method is the most practical, permitting as it does, the reference curve to be aligned as near as possible to the actual output curve. This avoids the use of the theoretical starting and finishing points, it is normal for the customer to realign the achieved curve with series trimmers at each end of the device if required.

Linearity Tolerance is 4% over the Nominal Resistance range of 1K Ω to 1M Ω . The Linearity Tolerance is measured on at least 70% of the effective rotation range.

Note. In the case of Terminal and Zero-based linearity, both present constraints which increase the manufacturing difficulty and in consequence have an adverse effect on the product's price and availability.

Potentiometer linearity

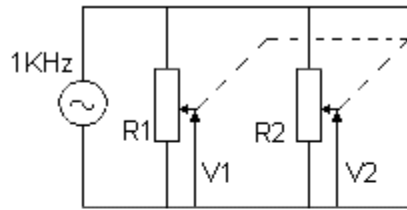


Matching Tolerance (For Tandem Stereo Potentiometers)

Tandem Potentiometers have two identical resistor units with the same variation law. The mismatching of the two resistor units, expressed in dB, is measured by the difference between the attenuations introduced by each resistor unit at various points of travel.

- Law A: 4 dB at Attenuation range 0 - 20 dB
- Law B and C: 3 dB at Attenuation range 0 - 20 dB

Matched Tolerance for Stereo

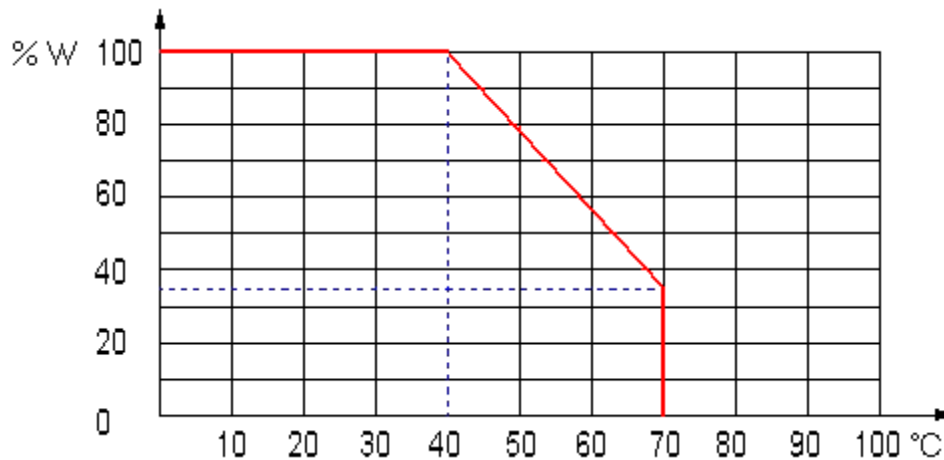


LAW	ATTENUATION RANGE	MATCHING TOLERANCE *
A	0 - 20dB	4dB
B & C	0 - 20dB	3dB

$$* \text{Matching Tolerance} = 20 \log \frac{V1}{V2}$$

Operating Temperature: -25°C to +70°C

Temperature Derating Curve



Temperature Coefficient of Resistance: +300 -500 ppm

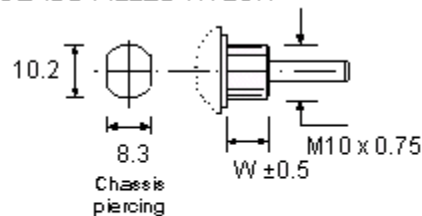
Components

ECO Bush Housing (Mounting)

The ECO bush housing is made of glass filled nylon, the thread is M10 x0.75mm pitch and 8mm long, alternatively **a 12mm long thread is also available** from October 2008.

Do not attempt to prevent any unwanted body rotation by overtightening the retaining nut, since this can cause thread damage, distortion, change of electrical resistance and restrict shaft rotation. BS9130:1972 provides further details on this topic. The **recommended torque** for tightening the retaining nut is 45cN.m and this can be achieved cost effectively by using a Torque Limiting device as shown on our **Accessories** page.

GLASS FILLED NYLON



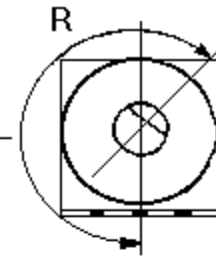
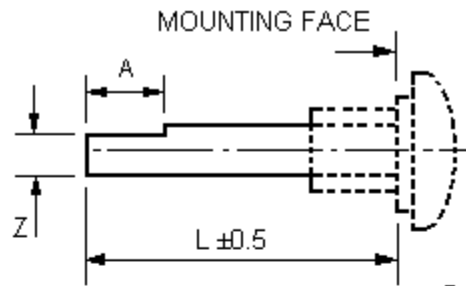
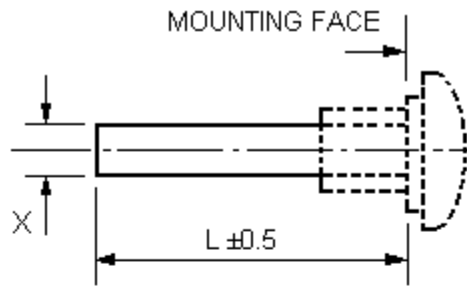
TYPE PLASTIC BODY	
W(mm)	8 (optional 12)

ECO Spindles

The ECO plastic spindles are fixed and not removable.
They are available in the following three diameters:

- 6.0mm Diameter - Length (L) available from 14mm to 65mm
 - Cylindrical (Type F1)
 - 4.0 x 12mm Flat (Type F2)
 - 5.0 x 15mm Flat (Type F3)
 - 5.0 x 10mm Flat (Type F4)
 - 4.6mm x 15mm Flat (Type F11)
 - 4.0 x 8mm Flat (Type F13)
 - 5.0 x 8mm Flat (Type F14)
- 4.0mm Diameter - Length (L) available from 14mm to 35mm
 - Cylindrical (Type F21)
 - 3.0 x 8.5mm Flat (Type F22)
- 6.35mm Diameter - Length (L) available from 14mm to 65mm
 - Cylindrical (Type F41)
 - 5.5 x 10mm Flat (Type F42)

Cylindrical and Flatted Spindles



Spindle in full CCW position

TYPE	DESC. (Ø)	L (mm)
F21	4 mm Dia Plastic	14 - 35
F1	6 mm Dia Plastic	14 - 65
F41	6.35mm Dia Plastic	14 - 65

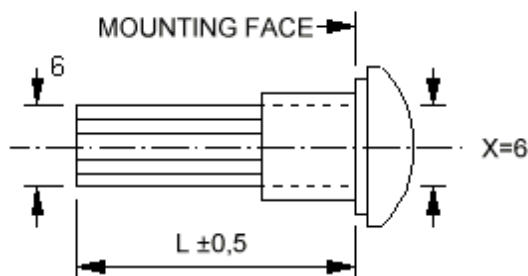
All spindles fixed.

TYPE	DESC. (Ø)	L (mm)	Flat (ZxA)
F22	4 mm Dia Plastic	14 - 35	3 x 8.5
F13	6 mm Dia Plastic	14 - 65	4 x 8
F2	6 mm Dia Plastic	14 - 65	4 x 12
F14	6 mm Dia Plastic	14 - 65	5 x 8
F4	6 mm Dia Plastic	14 - 65	5 x 10
F3	6 mm Dia Plastic	14 - 65	5 x 15
F11	6 mm Dia Plastic	14 - 65	4.6 x 15
F42	6.35mm Dia Plastic	14 - 65	5.5 x 10

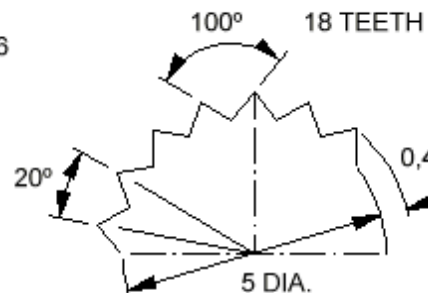
Standard flat angle
R = 210°

Splined Spindle (6.0mm diameter)

A splined form is also available on the 6.0mm diameter ECO plastic spindle.

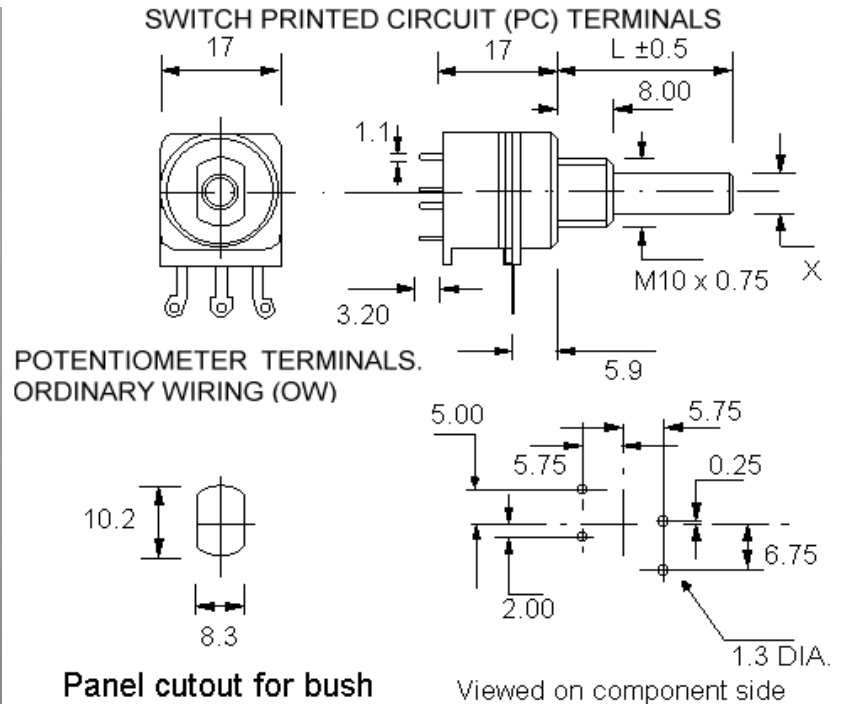
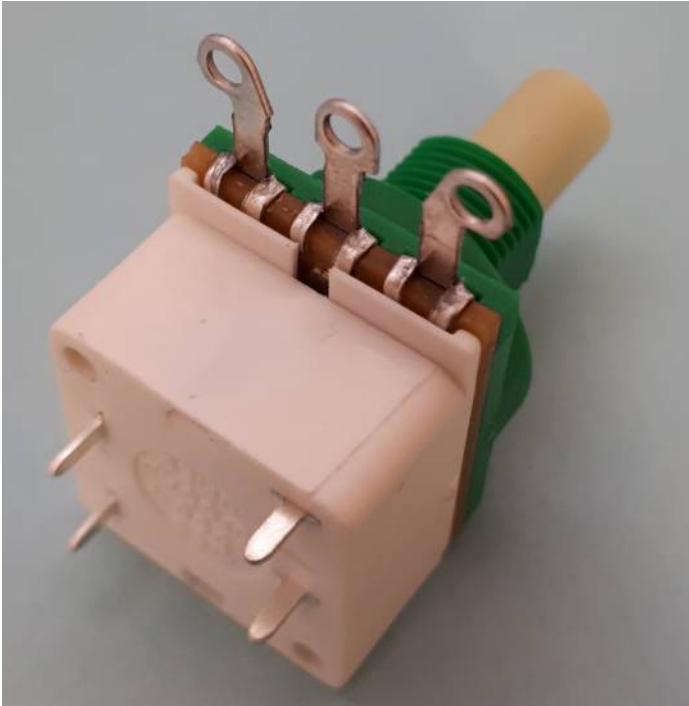


TYPE	DESC.	L (mm)
F5	Plastic Fixed	14 - 30

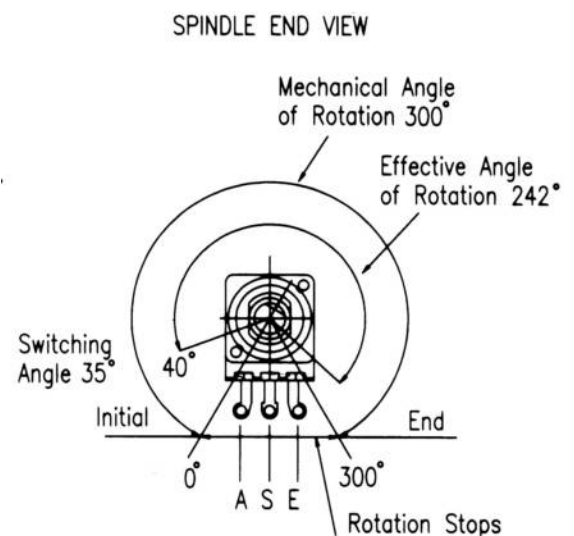


OW16ECO/B4PC2S

B4PC2S - 4 Amp Double Pole (Single Throw) Switch
OW – Ordinary Wiring Terminals (for soldering)
PC – Printed Circuit Terminals



- W Mounting Height
- Y Mounting Diameter
- X Spindle Diameter
- L Spindle Length
- A Initial Termination
- S Wiper (or moving contact) termination
- E End Termination



Total mechanical and effective electrical angles of rotation of potentiometers with rotary switch



ECO Range Technical Data

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Rotation angle: $300^{\circ} \pm 5^{\circ}$ (Switched and Unswitched)

Operating Torque: 0.4 – 2.0 N.cm (Initial Torque may be higher)

Rotational torque of spindle can be made high or low

Detents (stop positions) Available: Centre, 11, 21, 31

Permissible Axial Spindle Load: 50 N (5 Sec. maximum)

Permissible Torque at End Stop: 35 N.cm

ELECTRICAL SPECIFICATION

Rated Power Dissipation @40°C for ECO potentiometers:

0.25W linear law

0.12W nonlinear law

Rotation angle: $300^{\circ} \pm 5^{\circ}$

Effective rotation - Unswitched: 265° nominal

Effective rotation - Switched: 242° nominal

Insulation Resistance: ≥ 4 Gohms

Rated Resistance: E3 Series

- Optional: E6 Series
- Linear Law: 1K - 1M
- Nonlinear Law: 4K7 - 470K

Tolerance on Rated Resistance: $\pm 20\%$

- Optional Tolerance on 1K - 1M: $\pm 10\%$

Resistance Laws (Taper):

- Linear: A
- Nonlinear: B - Log (Audio) or C - Antilog (Reverse Audio)
- Other laws: Please refer to Sales office

Rotary Switch Specification

The rotary switch modules are manufactured to EN61058-1 standard using high quality materials with a flame retardant housing. Although no longer certified due to the excessive cost of maintaining approvals, the 1 Amp and 4 Amp switch series have both been previously certified by UL International Demko (copies of previous certificates are available on our website or on request). The same materials, components and production techniques are used as in the certified versions and Omeg Ltd continues to test to the EN61058-1 standard

The 1 Amp contact rating is only available when mounted on the ECO potentiometer

1 A Contact Rating:

Note: The 1A contact rating is NOT available for mounting on the P16 or P20 potentiometer.

1A/250Vac 2.5A/12Vdc

Surge rating (0.01 seconds): 20A

Contact gap: 3mm (Full mains separation of contacts)

Manufactured to EN61058-1 standard

4 A Contact Rating:

4A/250Vac 10A/12Vdc

Surge rating (0.01 seconds): 80A

Switch contacts: Silver tin oxide

Contact gap: 2mm (Micro disconnection of switch - micro separation of contacts)

Manufactured to EN61058-1 standard

Common features

Housing material: Flame Retardant Glass filled polyester (UL 94 VO)

Initial contact resistance: 20 milliohms

Insulation resistance: 50,000 Megohms

Life (operations at full load): 10,000 minimum

Operating temperature: -25°C to +70°C

Operating torque for SPST/SPDT: 1.5 - 3 cNm

Operating torque for DPST/DPDT: 3.0 - 6 cNm

Mechanical rotation: 300°

Proof voltage: 3kV minimum

Rotary Switch Terminals

Layout

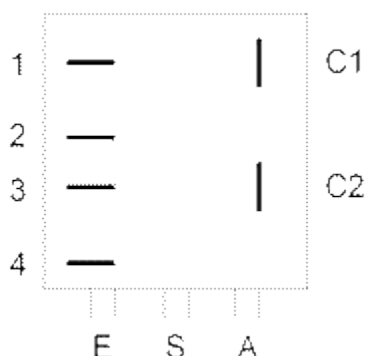


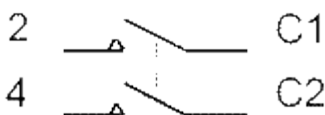
Diagram as viewed on the rear of the switch module:

(Potentiometer terminals at the bottom)

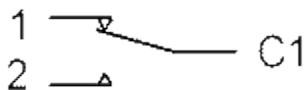
Configuration



SPST - Single pole (1S), Single throw (On-Off)

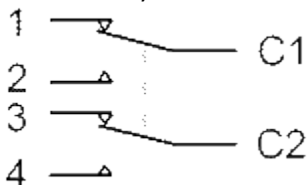


DPST - Double pole (2S), Single throw (On-Off)



SPDT - Single pole (1S), Double throw (CH)

(**NOT** certified)



DPDT - Double pole (2S), Double throw (CH)

(**NOT** certified)

Notes

1. Moving contact(s) shown when the potentiometer shaft is in a counterclockwise (CCW) position.
2. 'Ordinary Wiring'(OW) or 'Printed Circuit'(PC) terminals can be requested on the switch.
3. Terminals 1 and 3 are only fitted for the Double Throw ('CH' or Changeover) versions which are **NOT** approved nor certified.

Rotary Switch Terminals



Standard (1A or 4A contact ratings)

N/O normally OPEN Switch

Contacts normally OPEN;

CLOCKwise rotation to CLOSE contacts

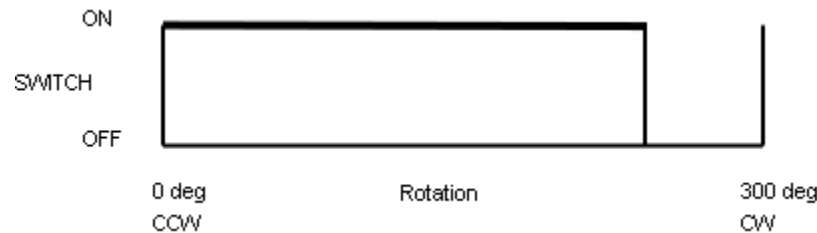


Option 1 (4A contact rating only)

N/C normally CLOSED Switch

Contacts normally CLOSED;

CLOCKwise rotation to OPEN contacts

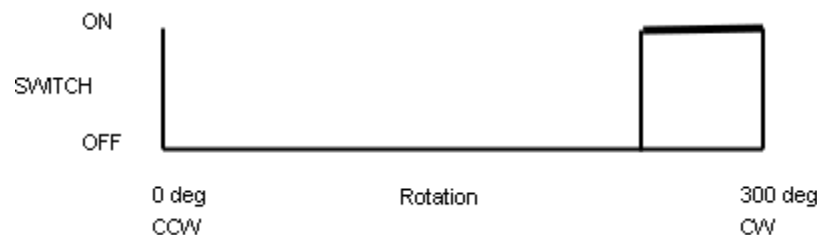


Option 2 (4A contact rating only)

REVERSED N/O normally OPEN Switch

Contacts normally OPEN at fully clockwise position;

ANTI-clockwise rotation to CLOSE contacts



Option 3 (4A contact rating only)

REVERSED N/C normally CLOSED Switch

Contacts normally CLOSED at fully clockwise position;

ANTI-clockwise rotation to OPEN contacts

ELECTRICAL SPECIFICATION UNIQUE TO ECO POTENTIOMETERS

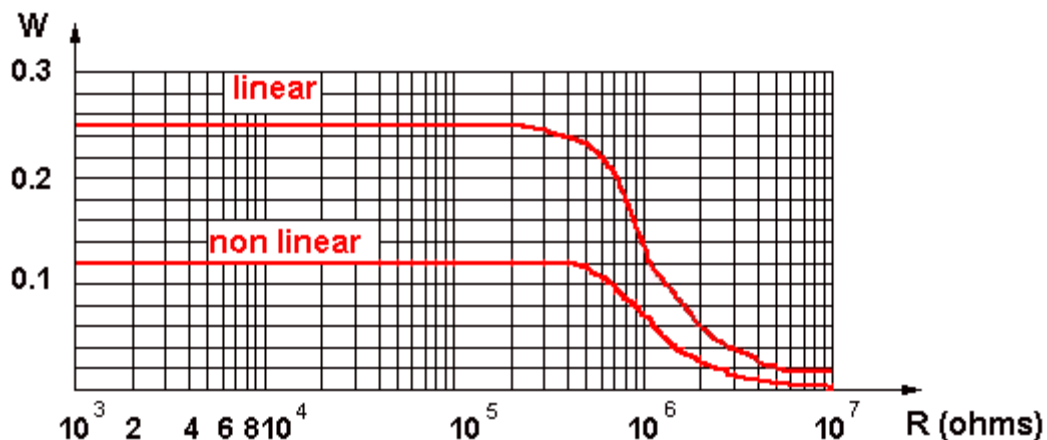
Effective rotation:

- Without a switch: 265° nominal
- With push push switch (/10APP, /MS): 265° nominal
- With rotary switch: 242° nominal

Rated Power Dissipation @40°C for ECO potentiometers:

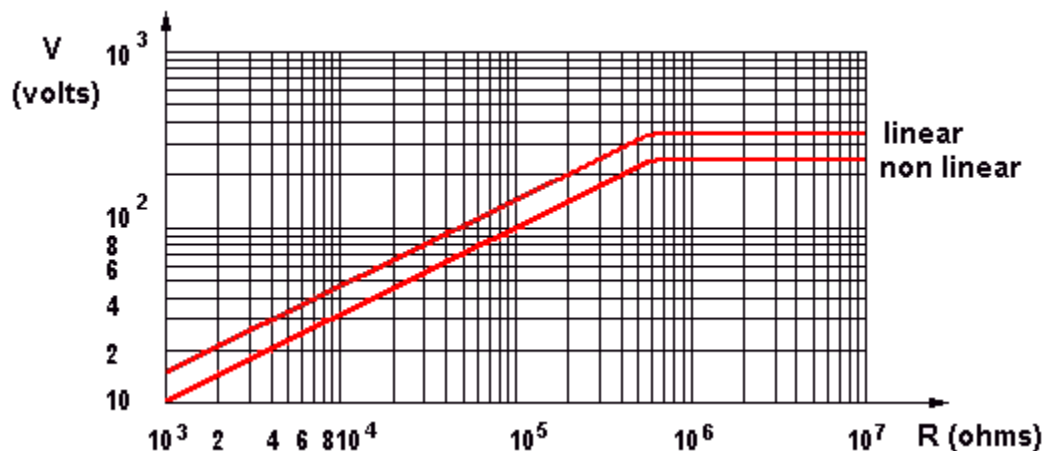
- 0.25W linear law
- 0.12W nonlinear law

ECO, P16 power dissipating curve



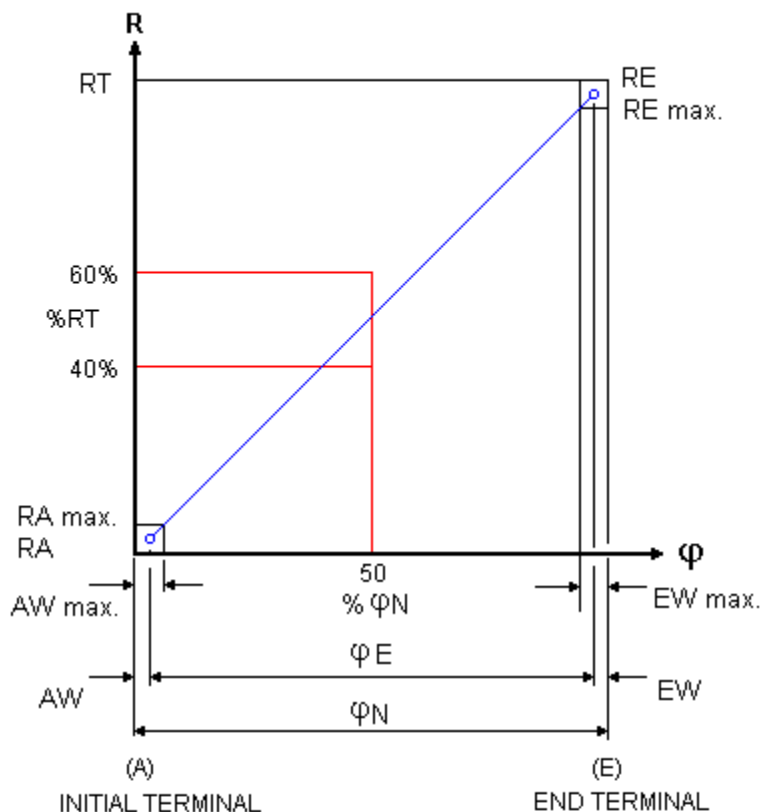
Limiting Element Voltage: 350 V DC for 16mm potentiometers

ECO, P16 maximum working voltage curve



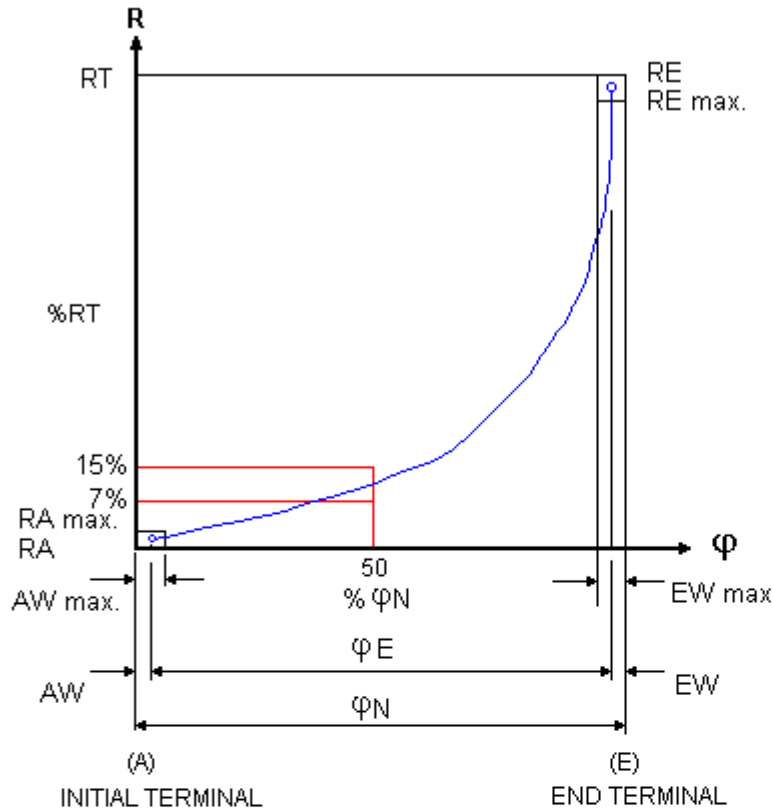
Insulating (Breakdown) Voltage: 2,500 V AC for ECO Potentiometers

Resistance law A - Linear



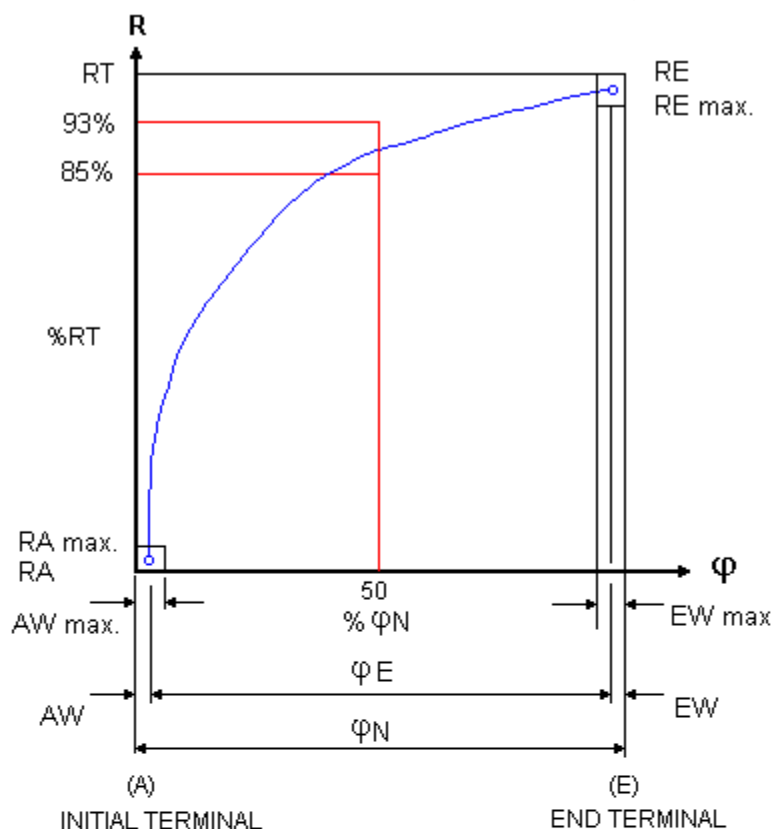
AW	Initial Path	AW max. 12% ϕN
EW	Final Path	EW max. 12% ϕN
Ra	Initial Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RA	Hop-on Resistance	$\leq 1\% RN$
Re	End Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RE	Hop-off Resistance	$\leq 1\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

Resistance law B – Log (Audio)



AW	Initial Path	AW max. 10% ϕ_N
EW	Final Path	EW max. 10% ϕ_N
Ra	Initial Stop Value	$R_N \leq 10K \leq 1.10^{-3} R_N$ (Minimum 2 ohms) $R_N > 10K \leq 2.10^{-4} R_N$ (Minimum 10 ohms)
RA	Hop-on Resistance	$R_N \leq 10K$ 5% R_N $R_N > 10K$ 0.15% R_N
Re	End Stop Value	$R_N \leq 100K \leq 2.10^{-2} R_N$ $R_N > 100K \leq 1.10^{-2} R_N$
RE	Hop-off Resistance	$R_N \leq 10K < 1\% R_N$ $R_N > 10K$ 0.5% R_N
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

Resistance law C – Antilog (Reverse Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RA	Hop-on Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K 0.5\% RN$
Re	End Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RE	Hop-off Resistance	$RN \leq 10K 5\% RN$ $RN > 10K 0.15\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

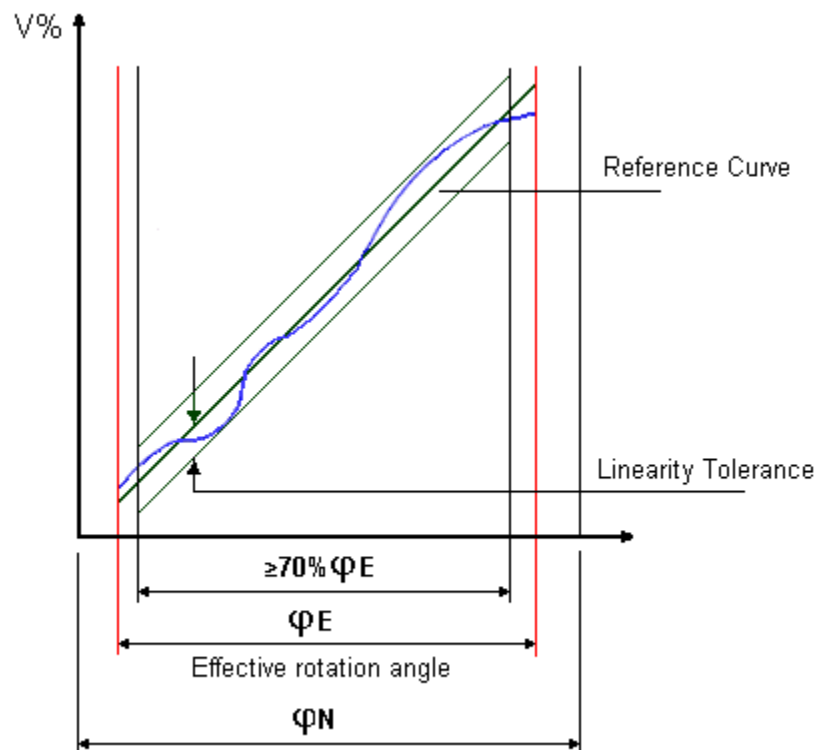
Linearity

As a basis of assessing Linearity Tolerance the independent method is the most practical, permitting as it does, the reference curve to be aligned as near as possible to the actual output curve. This avoids the use of the theoretical starting and finishing points, it is normal for the customer to realign the achieved curve with series trimmers at each end of the device if required.

Linearity Tolerance is 4% over the Nominal Resistance range of 1K0 to 1M0. The Linearity Tolerance is measured on at least 70% of the effective rotation range.

Note. In the case of Terminal and Zero-based linearity, both present constraints which increase the manufacturing difficulty and in consequence have an adverse effect on the product's price and availability.

Potentiometer linearity

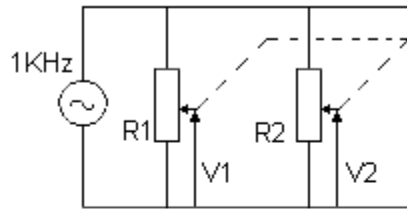


Matching Tolerance (For Tandem Stereo Potentiometers)

Tandem Potentiometers have two identical resistor units with the same variation law. The mismatching of the two resistor units, expressed in dB, is measured by the difference between the attenuations introduced by each resistor unit at various points of travel.

- Law A: 4 dB at Attenuation range 0 - 20 dB
- Law B and C: 3 dB at Attenuation range 0 - 20 dB

Matched Tolerance for Stereo

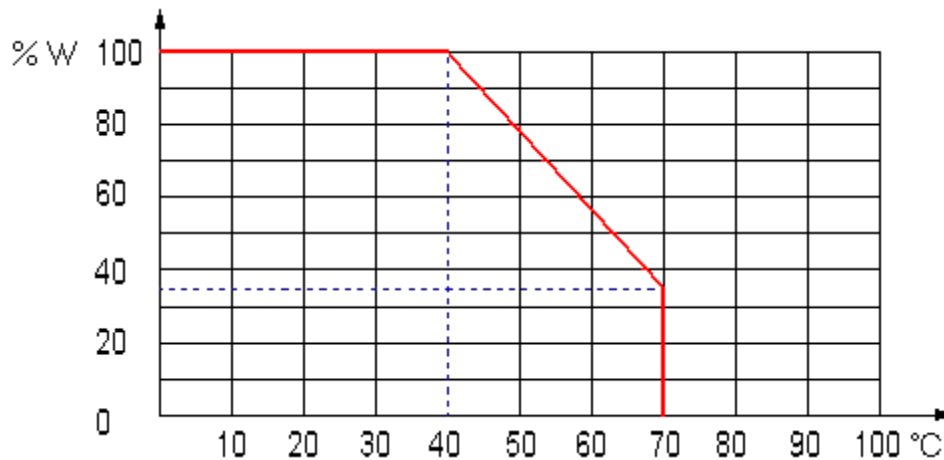


LAW	ATTENUATION RANGE	MATCHING TOLERANCE *
A	0 - 20dB	4dB
B & C	0 - 20dB	3dB

$$* \text{Matching Tolerance} = 20 \log \frac{V1}{V2}$$

Operating Temperature: -25°C to +70°C

Temperature Derating Curve



Temperature Coefficient of Resistance: +300 -500 ppm

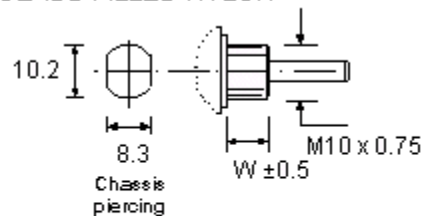
Components

ECO Bush Housing (Mounting)

The ECO bush housing is made of glass filled nylon, the thread is M10 x0.75mm pitch and 8mm long, alternatively **a 12mm long thread is also available** from October 2008.

Do not attempt to prevent any unwanted body rotation by overtightening the retaining nut, since this can cause thread damage, distortion, change of electrical resistance and restrict shaft rotation. BS9130:1972 provides further details on this topic. The **recommended torque** for tightening the retaining nut is 45cN.m and this can be achieved cost effectively by using a Torque Limiting device as shown on our **Accessories** page.

GLASS FILLED NYLON



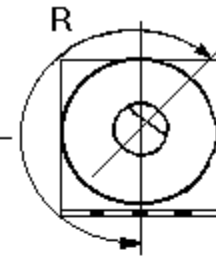
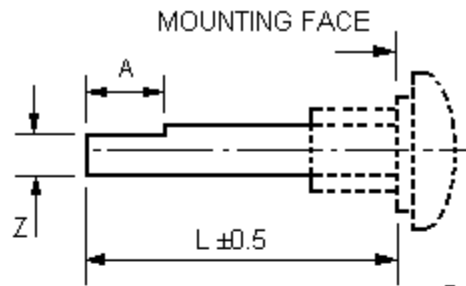
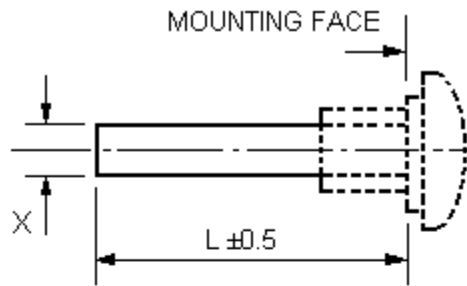
TYPE PLASTIC BODY	
W(mm)	8 (optional 12)

ECO Spindles

The ECO plastic spindles are fixed and not removable.
They are available in the following three diameters:

- 6.0mm Diameter - Length (L) available from 14mm to 65mm
 - Cylindrical (Type F1)
 - 4.0 x 12mm Flat (Type F2)
 - 5.0 x 15mm Flat (Type F3)
 - 5.0 x 10mm Flat (Type F4)
 - 4.6mm x 15mm Flat (Type F11)
 - 4.0 x 8mm Flat (Type F13)
 - 5.0 x 8mm Flat (Type F14)
- 4.0mm Diameter - Length (L) available from 14mm to 35mm
 - Cylindrical (Type F21)
 - 3.0 x 8.5mm Flat (Type F22)
- 6.35mm Diameter - Length (L) available from 14mm to 65mm
 - Cylindrical (Type F41)
 - 5.5 x 10mm Flat (Type F42)

Cylindrical and Flatted Spindles



Spindle in full CCW position

TYPE	DESC. (X)	L (mm)
F21	4 mm Dia Plastic	14 - 35
F1	6 mm Dia Plastic	14 - 65
F41	6.35mm Dia Plastic	14 - 65

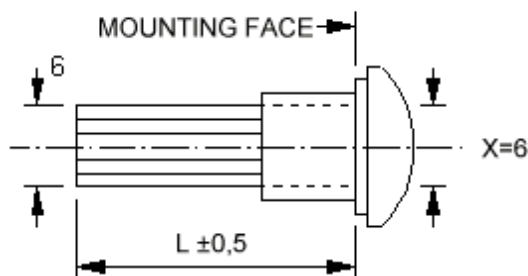
All spindles fixed.

TYPE	DESC. (X)	L (mm)	Flat (ZxA)
F22	4 mm Dia Plastic	14 - 35	3 x 8.5
F13	6 mm Dia Plastic	14 - 65	4 x 8
F2	6 mm Dia Plastic	14 - 65	4 x 12
F14	6 mm Dia Plastic	14 - 65	5 x 8
F4	6 mm Dia Plastic	14 - 65	5 x 10
F3	6 mm Dia Plastic	14 - 65	5 x 15
F11	6 mm Dia Plastic	14 - 65	4.6 x 15
F42	6.35mm Dia Plastic	14 - 65	5.5 x 10

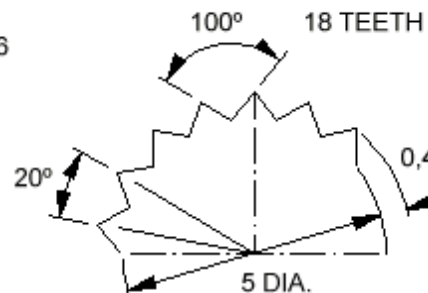
Standard flat angle
R = 210°

Splined Spindle (6.0mm diameter)

A splined form is also available on the 6.0mm diameter ECO plastic spindle.

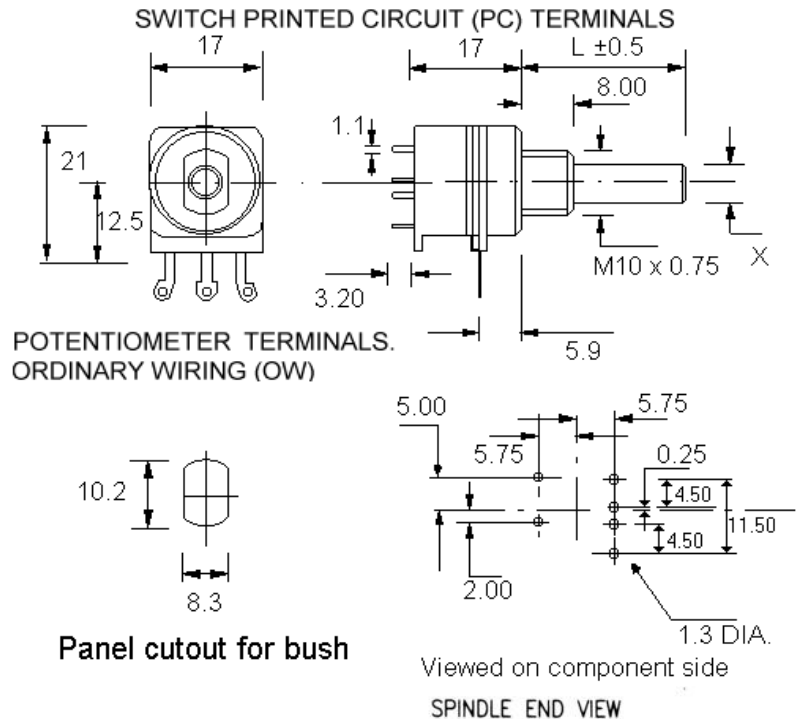
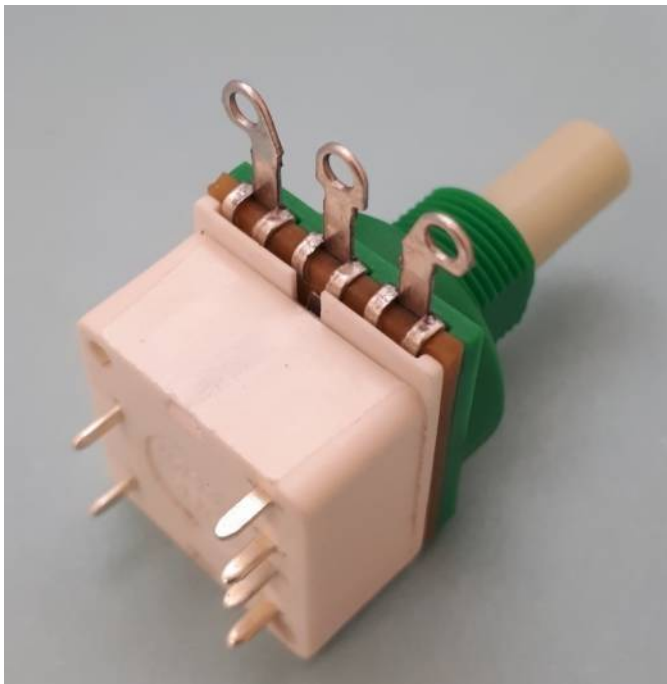


TYPE	DESC.	L (mm)
F5	Plastic Fixed	14 - 30

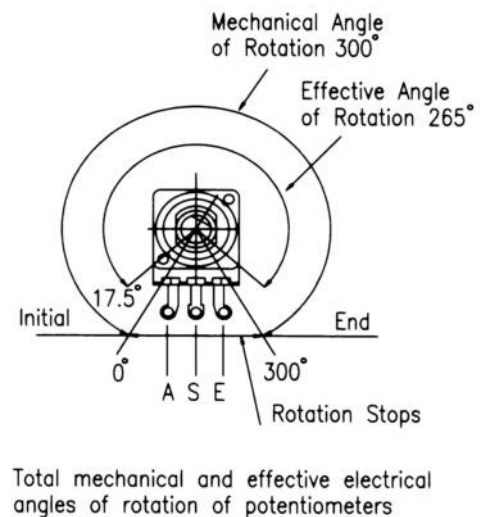


OW16ECO/N4PC2S-CH

N4PC2S – 4 Amp Double Pole Switch
CH – Change Over (Double Throw)
OW – Ordinary Wiring Terminals (for soldering)
PC – Printed Circuit Terminals



- W Mounting Height
- Y Mounting Diameter
- X Spindle Diameter
- L Spindle Length
- A Initial Termination
- S Wiper (or moving contact) termination
- E End Termination



Please note the Double Throw 'Change Over' Switch has never been Certified



ECO Range Technical Data

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Rotation angle: $300^{\circ} \pm 5^{\circ}$ (Switched and Unswitched)

Operating Torque: 0.4 – 2.0 N.cm (Initial Torque may be higher)

Rotational torque of spindle can be made high or low

Detents (stop positions) Available: Centre, 11, 21, 31

Permissible Axial Spindle Load: 50 N (5 Sec. maximum)

Permissible Torque at End Stop: 35 N.cm

ELECTRICAL SPECIFICATION

Rated Power Dissipation @40°C for ECO potentiometers:

0.25W linear law

0.12W nonlinear law

Rotation angle: $300^{\circ} \pm 5^{\circ}$

Effective rotation - Unswitched: 265° nominal

Effective rotation - Switched: 242° nominal

Insulation Resistance: ≥ 4 Gohms

Rated Resistance: E3 Series

- Optional: E6 Series
- Linear Law: 1K - 1M
- Nonlinear Law: 4K7 - 470K

Tolerance on Rated Resistance: $\pm 20\%$

- Optional Tolerance on 1K - 1M: $\pm 10\%$

Resistance Laws (Taper):

- Linear: A
- Nonlinear: B - Log (Audio) or C - Antilog (Reverse Audio)
- Other laws: Please refer to Sales office

Rotary Switch Specification

The rotary switch modules are manufactured to EN61058-1 standard using high quality materials with a flame retardant housing. Although no longer certified due to the excessive cost of maintaining approvals, the 1 Amp and 4 Amp switch series have both been previously certified by UL International Demko (copies of previous certificates are available on our website or on request). The same materials, components and production techniques are used as in the certified versions and Omeg Ltd continues to test to the EN61058-1 standard

The 1 Amp contact rating is only available when mounted on the ECO potentiometer

1 A Contact Rating:

Note: The 1A contact rating is NOT available for mounting on the P16 or P20 potentiometer.

1A/250Vac 2.5A/12Vdc

Surge rating (0.01 seconds): 20A

Contact gap: 3mm (Full mains separation of contacts)

Manufactured to EN61058-1 standard

4 A Contact Rating:

4A/250Vac 10A/12Vdc

Surge rating (0.01 seconds): 80A

Switch contacts: Silver tin oxide

Contact gap: 2mm (Micro disconnection of switch - micro separation of contacts)

Manufactured to EN61058-1 standard

Common features

Housing material: Flame Retardant Glass filled polyester (UL 94 VO)

Initial contact resistance: 20 milliohms

Insulation resistance: 50,000 Megohms

Life (operations at full load): 10,000 minimum

Operating temperature: -25°C to +70°C

Operating torque for SPST/SPDT: 1.5 - 3 cNm

Operating torque for DPST/DPDT: 3.0 - 6 cNm

Mechanical rotation: 300°

Proof voltage: 3kV minimum

Rotary Switch Terminals

Layout

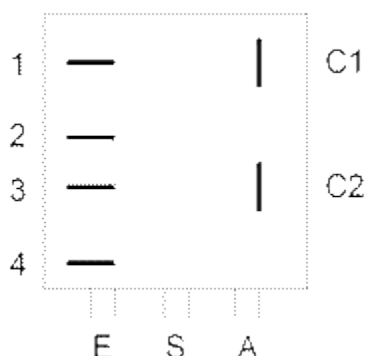


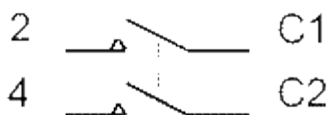
Diagram as viewed on the rear of the switch module:

(Potentiometer terminals at the bottom)

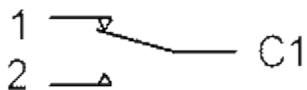
Configuration



SPST - Single pole (1S), Single throw (On-Off)

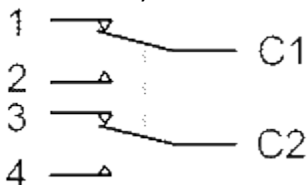


DPST - Double pole (2S), Single throw (On-Off)



SPDT - Single pole (1S), Double throw (CH)

(**NOT** certified)



DPDT - Double pole (2S), Double throw (CH)

(**NOT** certified)

Notes

1. Moving contact(s) shown when the potentiometer shaft is in a counterclockwise (CCW) position.
2. 'Ordinary Wiring'(OW) or 'Printed Circuit'(PC) terminals can be requested on the switch.
3. Terminals 1 and 3 are only fitted for the Double Throw ('CH' or Changeover) versions which are **NOT** approved nor certified.

Rotary Switch Terminals



Standard (1A or 4A contact ratings)

N/O normally OPEN Switch

Contacts normally OPEN;

CLOCKwise rotation to CLOSE contacts

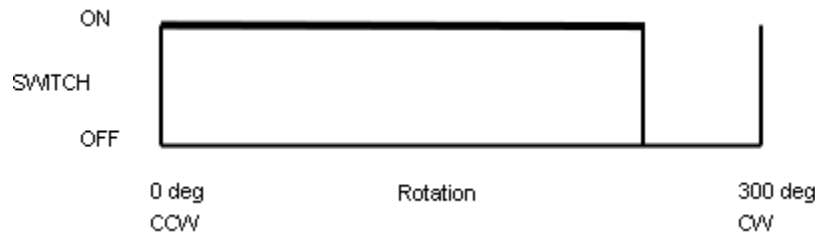


Option 1 (4A contact rating only)

N/C normally CLOSED Switch

Contacts normally CLOSED;

CLOCKwise rotation to OPEN contacts

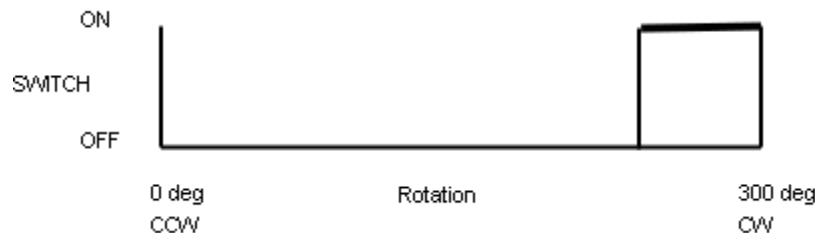


Option 2 (4A contact rating only)

REVERSED N/O normally OPEN Switch

Contacts normally OPEN at fully clockwise position;

ANTI-clockwise rotation to CLOSE contacts



Option 3 (4A contact rating only)

REVERSED N/C normally CLOSED Switch

Contacts normally CLOSED at fully clockwise position;

ANTI-clockwise rotation to OPEN contacts

ELECTRICAL SPECIFICATION UNIQUE TO ECO POTENTIOMETERS

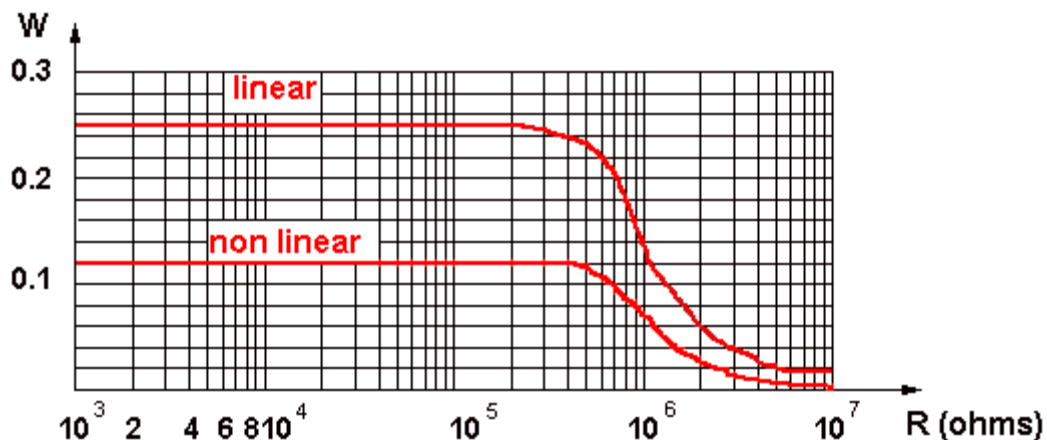
Effective rotation:

- Without a switch: 265° nominal
- With push push switch (/10APP, /MS): 265° nominal
- With rotary switch: 242° nominal

Rated Power Dissipation @40°C for ECO potentiometers:

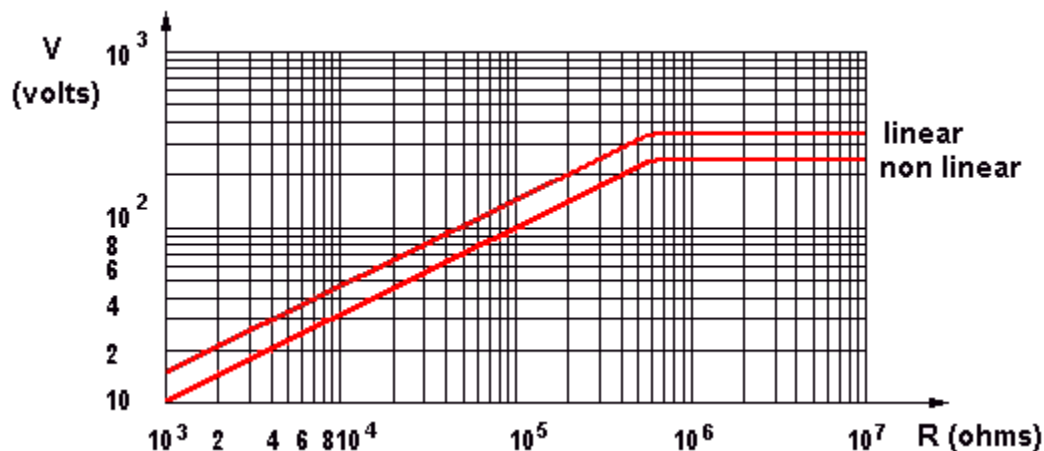
- 0.25W linear law
- 0.12W nonlinear law

ECO, P16 power dissipating curve



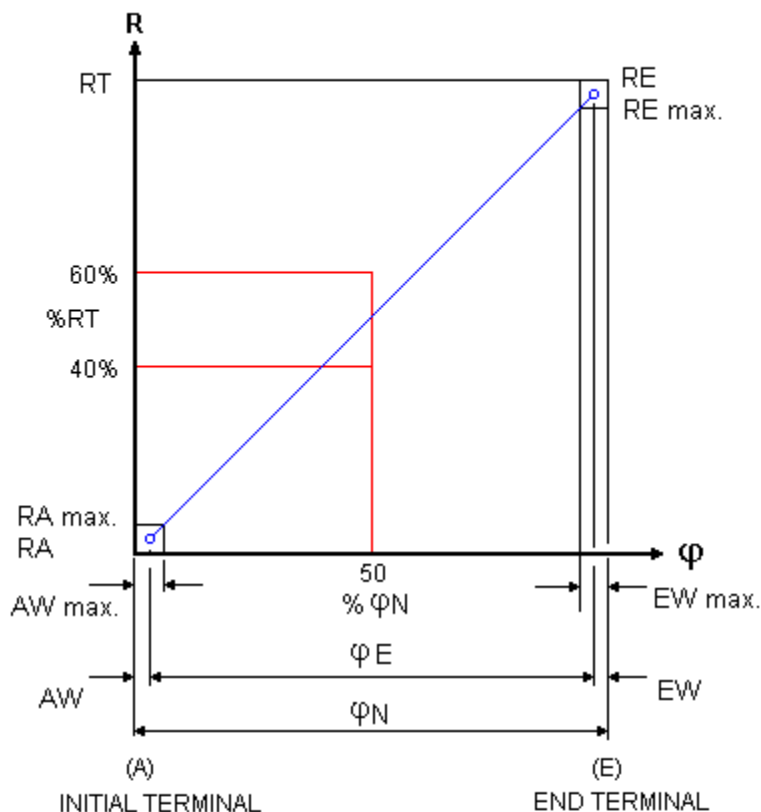
Limiting Element Voltage: 350 V DC for 16mm potentiometers

ECO, P16 maximum working voltage curve



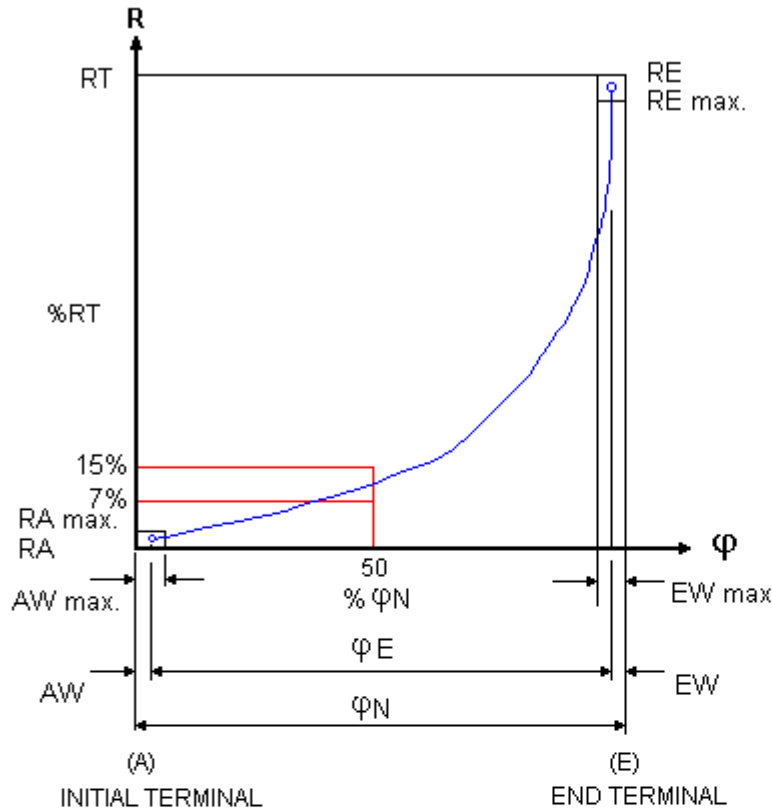
Insulating (Breakdown) Voltage: 2,500 V AC for ECO Potentiometers

Resistance law A - Linear



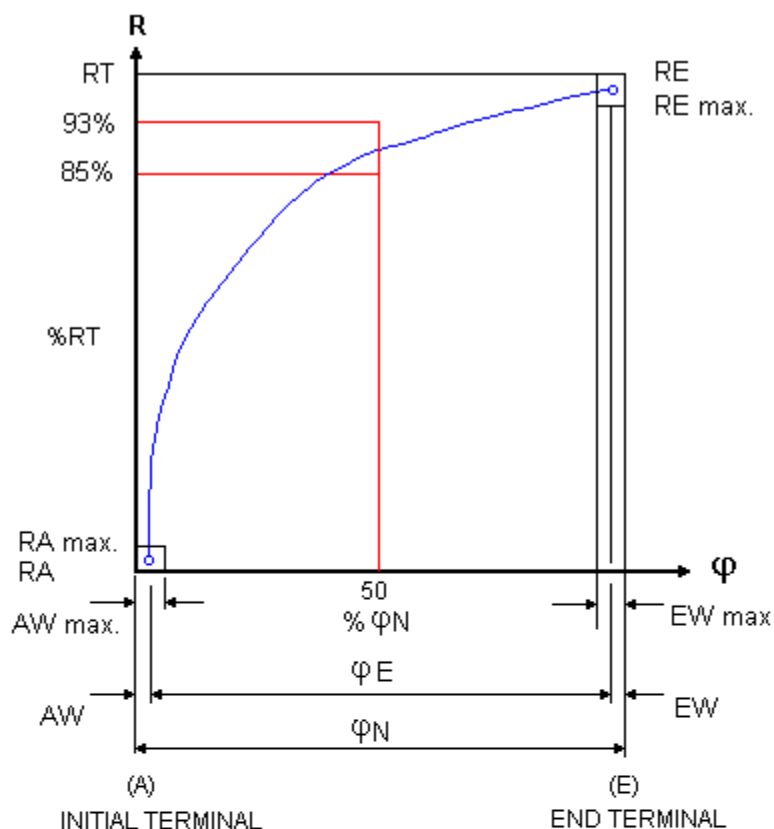
AW	Initial Path	AW max. 12% ϕN
EW	Final Path	EW max. 12% ϕN
Ra	Initial Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RA	Hop-on Resistance	$\leq 1\% RN$
Re	End Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RE	Hop-off Resistance	$\leq 1\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

Resistance law B – Log (Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RA	Hop-on Resistance	$RN \leq 10K$ 5% RN $RN > 10K$ 0.15% RN
Re	End Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RE	Hop-off Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K$ 0.5% RN
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

Resistance law C – Antilog (Reverse Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RA	Hop-on Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K 0.5\% RN$
Re	End Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RE	Hop-off Resistance	$RN \leq 10K 5\% RN$ $RN > 10K 0.15\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

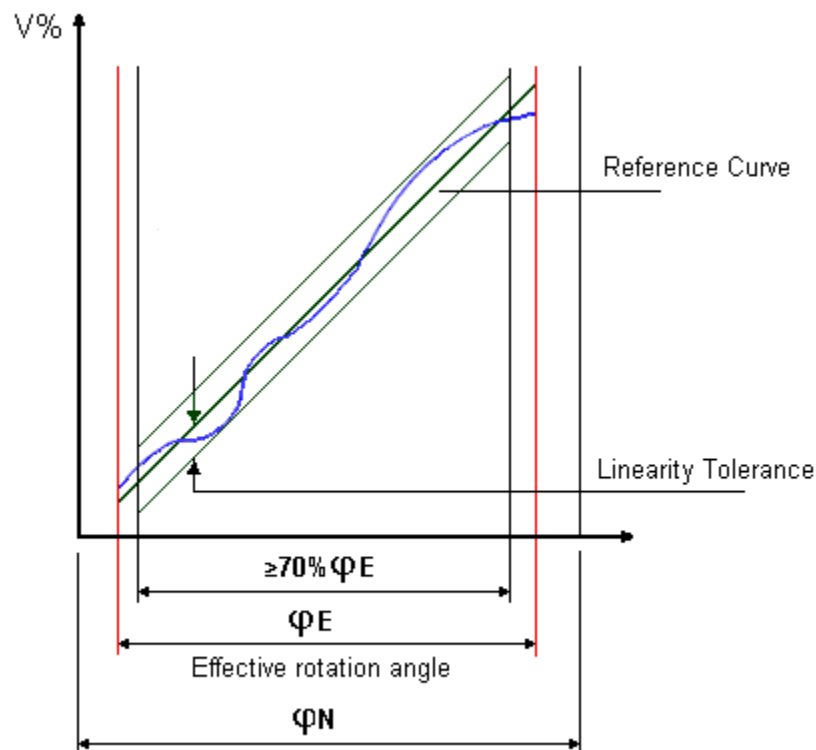
Linearity

As a basis of assessing Linearity Tolerance the independent method is the most practical, permitting as it does, the reference curve to be aligned as near as possible to the actual output curve. This avoids the use of the theoretical starting and finishing points, it is normal for the customer to realign the achieved curve with series trimmers at each end of the device if required.

Linearity Tolerance is 4% over the Nominal Resistance range of 1K Ω to 1M Ω . The Linearity Tolerance is measured on at least 70% of the effective rotation range.

Note. In the case of Terminal and Zero-based linearity, both present constraints which increase the manufacturing difficulty and in consequence have an adverse effect on the product's price and availability.

Potentiometer linearity

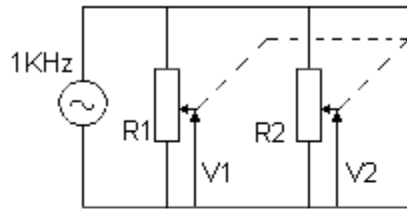


Matching Tolerance (For Tandem Stereo Potentiometers)

Tandem Potentiometers have two identical resistor units with the same variation law. The mismatching of the two resistor units, expressed in dB, is measured by the difference between the attenuations introduced by each resistor unit at various points of travel.

- Law A: 4 dB at Attenuation range 0 - 20 dB
- Law B and C: 3 dB at Attenuation range 0 - 20 dB

Matched Tolerance for Stereo

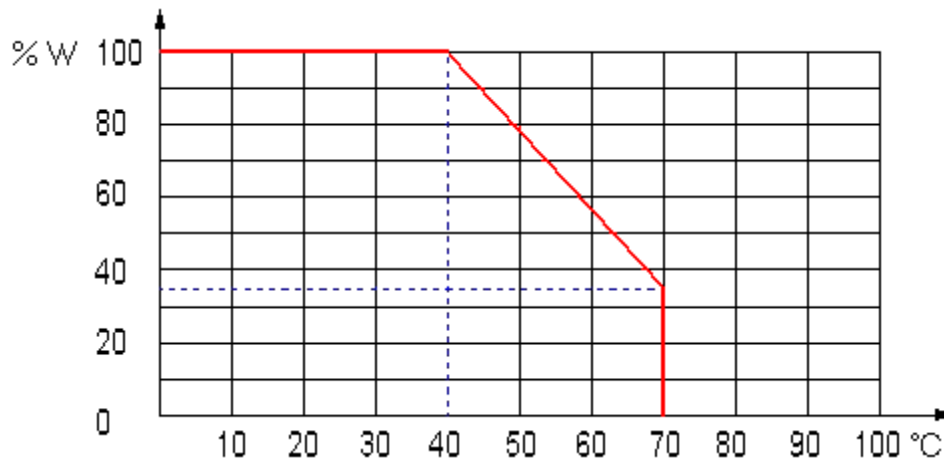


LAW	ATTENUATION RANGE	MATCHING TOLERANCE *
A	0 - 20dB	4dB
B & C	0 - 20dB	3dB

$$* \text{Matching Tolerance} = 20 \log \frac{V1}{V2}$$

Operating Temperature: -25°C to +70°C

Temperature Derating Curve



Temperature Coefficient of Resistance: +300 -500 ppm

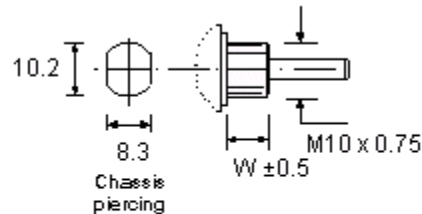
Components

ECO Bush Housing (Mounting)

The ECO bush housing is made of glass filled nylon, the thread is M10 x0.75mm pitch and 8mm long, alternatively **a 12mm long thread is also available** from October 2008.

Do not attempt to prevent any unwanted body rotation by overtightening the retaining nut, since this can cause thread damage, distortion, change of electrical resistance and restrict shaft rotation. BS9130:1972 provides further details on this topic. The **recommended torque** for tightening the retaining nut is 45cN.m and this can be achieved cost effectively by using a Torque Limiting device as shown on our **Accessories** page.

GLASS FILLED NYLON



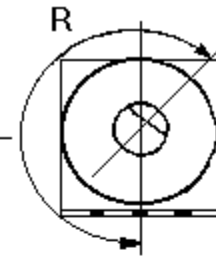
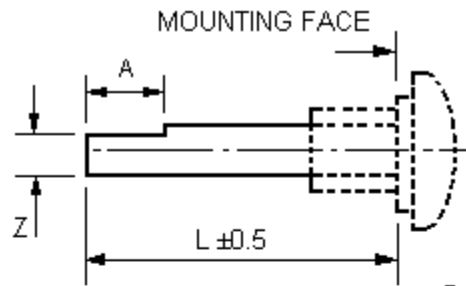
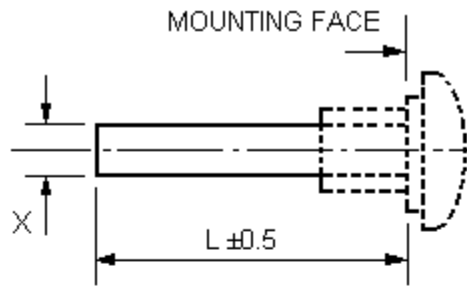
TYPE PLASTIC BODY	
W(mm)	8 (optional 12)

ECO Spindles

The ECO plastic spindles are fixed and not removable.
They are available in the following three diameters:

- 6.0mm Diameter - Length (L) available from 14mm to 65mm
 - Cylindrical (Type F1)
 - 4.0 x 12mm Flat (Type F2)
 - 5.0 x 15mm Flat (Type F3)
 - 5.0 x 10mm Flat (Type F4)
 - 4.6mm x 15mm Flat (Type F11)
 - 4.0 x 8mm Flat (Type F13)
 - 5.0 x 8mm Flat (Type F14)
- 4.0mm Diameter - Length (L) available from 14mm to 35mm
 - Cylindrical (Type F21)
 - 3.0 x 8.5mm Flat (Type F22)
- 6.35mm Diameter - Length (L) available from 14mm to 65mm
 - Cylindrical (Type F41)
 - 5.5 x 10mm Flat (Type F42)

Cylindrical and Flatted Spindles



Spindle in full CCW position

TYPE	DESC. (X)	L (mm)
F21	4 mm Dia Plastic	14 - 35
F1	6 mm Dia Plastic	14 - 65
F41	6.35mm Dia Plastic	14 - 65

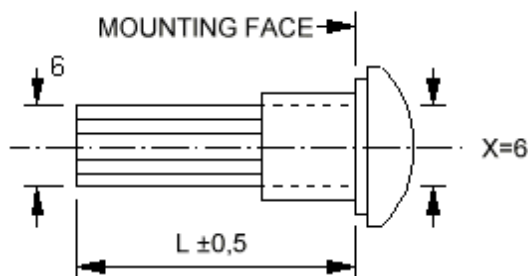
All spindles fixed.

TYPE	DESC. (X)	L (mm)	Flat (ZxA)
F22	4 mm Dia Plastic	14 - 35	3 x 8.5
F13	6 mm Dia Plastic	14 - 65	4 x 8
F2	6 mm Dia Plastic	14 - 65	4 x 12
F14	6 mm Dia Plastic	14 - 65	5 x 8
F4	6 mm Dia Plastic	14 - 65	5 x 10
F3	6 mm Dia Plastic	14 - 65	5 x 15
F11	6 mm Dia Plastic	14 - 65	4.6 x 15
F42	6.35mm Dia Plastic	14 - 65	5.5 x 10

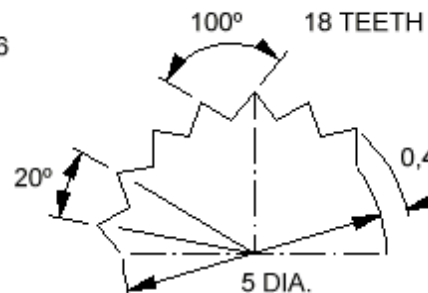
Standard flat angle
R = 210°

Splined Spindle (6.0mm diameter)

A splined form is also available on the 6.0mm diameter ECO plastic spindle.

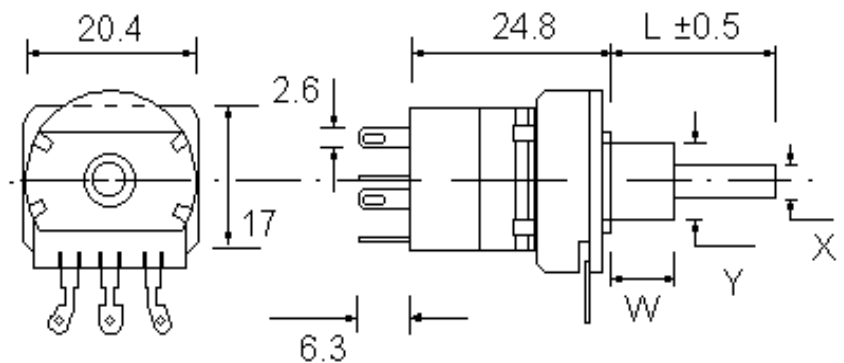
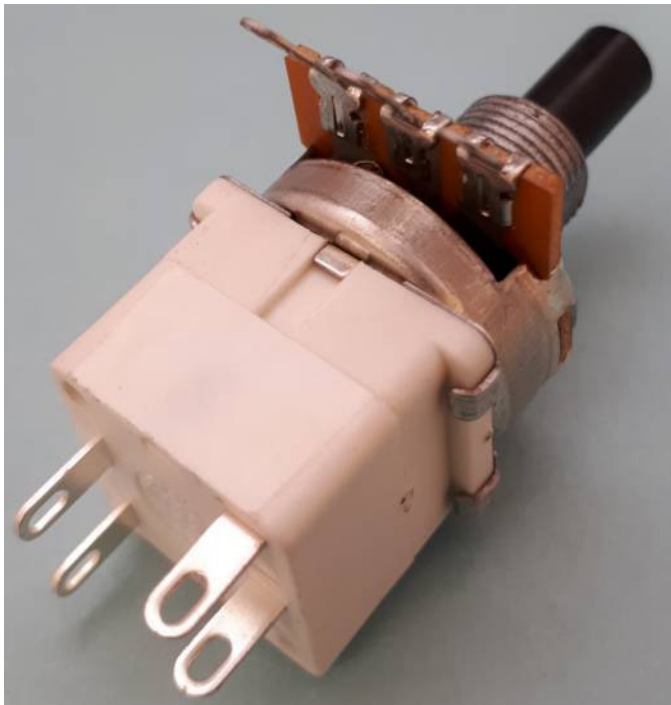


TYPE	DESC.	L (mm)
F5	Plastic Fixed	14 - 30



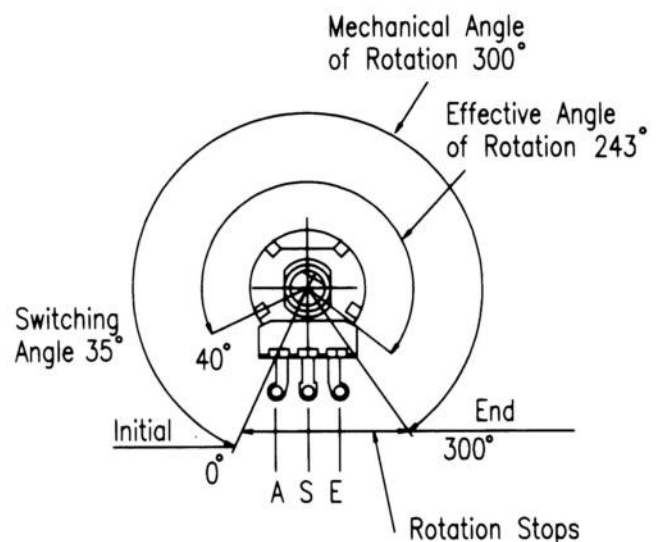
OW20BU/B4OW2S

B4OW2S– 4 Amp Double Pole (Single Throw) Switch
OW – Ordinary Wiring (recommended for soldering)



SPINDLE END VIEW

- W Mounting Height
- Y Mounting Diameter
- X Spindle Diameter
- L Spindle Length
- A Initial Termination
- S Wiper (or moving contact) termination
- E End Termination



Total mechanical and effective electrical angles of rotation of potentiometers with rotary switch



P20 Range Technical Data

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Rotation angle: $300^{\circ} \pm 5^{\circ}$ (Switched and Unswitched)

Operating Torque: 0.4 – 2.0 N.cm (Initial Torque may be higher)

Rotational torque of spindle can be made high or low

Detents (stop positions) Available: Centre, 11, 21, 31, 41

Permissible Axial Spindle Load: 100 N (5 Sec. maximum)

Permissible Torque at End Stop: 80 N.cm

ELECTRICAL SPECIFICATION

Rated Power Dissipation @40°C for ECO potentiometers:

0.4W linear law

0.2W nonlinear law

Rotation angle: $300^{\circ} \pm 5^{\circ}$

Effective rotation - Unswitched: 243° nominal

Effective rotation - Switched: 256° nominal

Insulation Resistance: ≥ 4 Gohms

Rated Resistance: E3 Series

- Optional: E6 Series
- Linear Law: 1K - 1M
- Nonlinear Law: 4K7 - 470K

Tolerance on Rated Resistance: $\pm 20\%$

- Optional Tolerance on 1K - 1M: $\pm 10\%$

Resistance Laws (Taper):

- Linear: A
- Nonlinear: B - Log (Audio) or C - Antilog (Reverse Audio)
- Other laws: Please refer to Sales office

Rotary Switch Specification

The rotary switch modules are manufactured to EN61058-1 standard using high quality materials with a flame retardant housing. Although no longer certified due to the excessive cost of maintaining approvals, the 1 Amp and 4 Amp switch series have both been previously certified by UL International Demko (copies of previous certificates are available on our website or on request). The same materials, components and production techniques are used as in the certified versions and Omeg Ltd continues to test to the EN61058-1 standard

The 1 Amp contact rating is only available when mounted on the ECO potentiometer

1 A Contact Rating:

Note: The 1A contact rating is NOT available for mounting on the P16 or P20 potentiometer.

1A/250Vac 2.5A/12Vdc

Surge rating (0.01 seconds): 20A

Contact gap: 3mm (Full mains separation of contacts)

Manufactured to EN61058-1 standard

4 A Contact Rating:

4A/250Vac 10A/12Vdc

Surge rating (0.01 seconds): 80A

Switch contacts: Silver tin oxide

Contact gap: 2mm (Micro disconnection of switch - micro separation of contacts)

Manufactured to EN61058-1 standard

Common features

Housing material: Flame Retardant Glass filled polyester (UL 94 VO)

Initial contact resistance: 20 milliohms

Insulation resistance: 50,000 Megohms

Life (operations at full load): 10,000 minimum

Operating temperature: -25°C to +70°C

Operating torque for SPST/SPDT: 1.5 - 3 cNm

Operating torque for DPST/DPDT: 3.0 - 6 cNm

Mechanical rotation: 300°

Proof voltage: 3kV minimum

ROTARY SWITCH TERMINALS

Layout

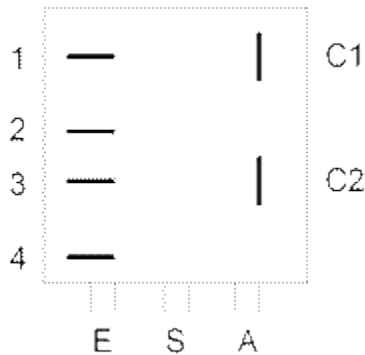
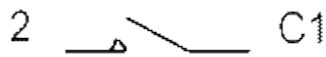
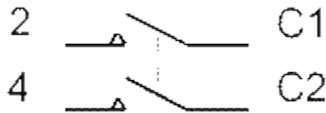


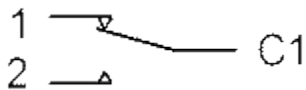
Diagram as viewed on the rear of the switch module:
(Potentiometer terminals at the bottom)



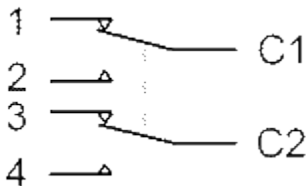
SPST - Single pole (1S), Single throw (On-Off)



DPST - Double pole (2S), Single throw (On-Off)



SPDT - Single pole (1S), Double throw (CH)
(**NOT** certified)

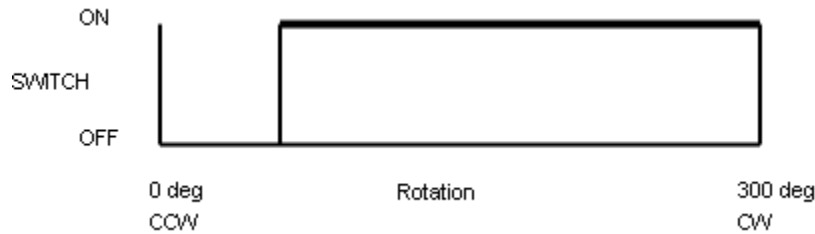


DPDT - Double pole (2S), Double throw (CH)
(**NOT** certified)

Notes

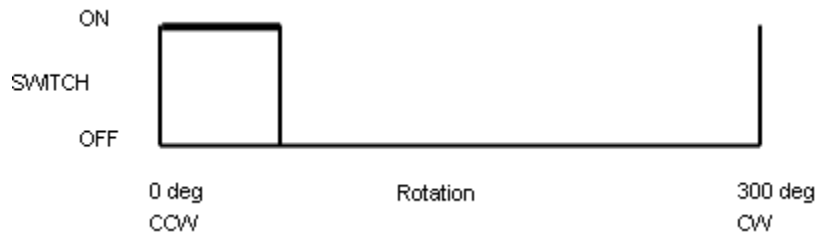
1. Moving contact(s) shown when the potentiometer shaft is in a counterclockwise (CCW) position.
2. 'Ordinary Wiring'(OW) or 'Printed Circuit'(PC) terminals can be requested on the switch.
3. Terminals 1 and 3 are only fitted for the Double Throw ('CH' or Changeover) versions which are **NOT** approved nor certified.

ROTARY SWITCH FUNCTIONS



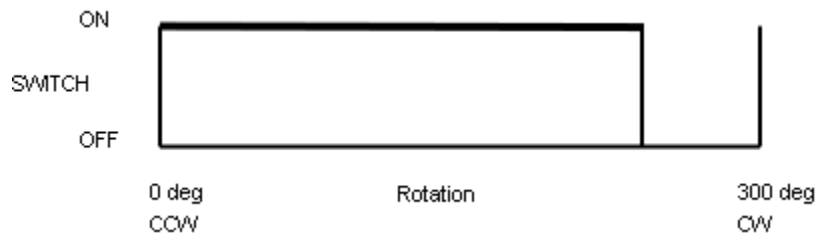
Standard (1A or 4A contact ratings)

N/O normally OPEN Switch
 Contacts normally OPEN;
 CLOCKwise rotation to CLOSE contacts



Option 1 (4A contact rating only)

N/C normally CLOSED Switch
 Contacts normally CLOSED;
 CLOCKwise rotation to OPEN contacts



Option 2 (4A contact rating only)

REVERSED N/O normally OPEN Switch
 Contacts normally OPEN at fully clockwise position;
 ANTI-clockwise rotation to CLOSE contacts



Option 3 (4A contact rating only)

REVERSED N/C normally CLOSED Switch
 Contacts normally CLOSED at fully clockwise position;
 ANTI-clockw

ELECTRICAL SPECIFICATION UNIQUE TO P20 POTENTIOMETERS

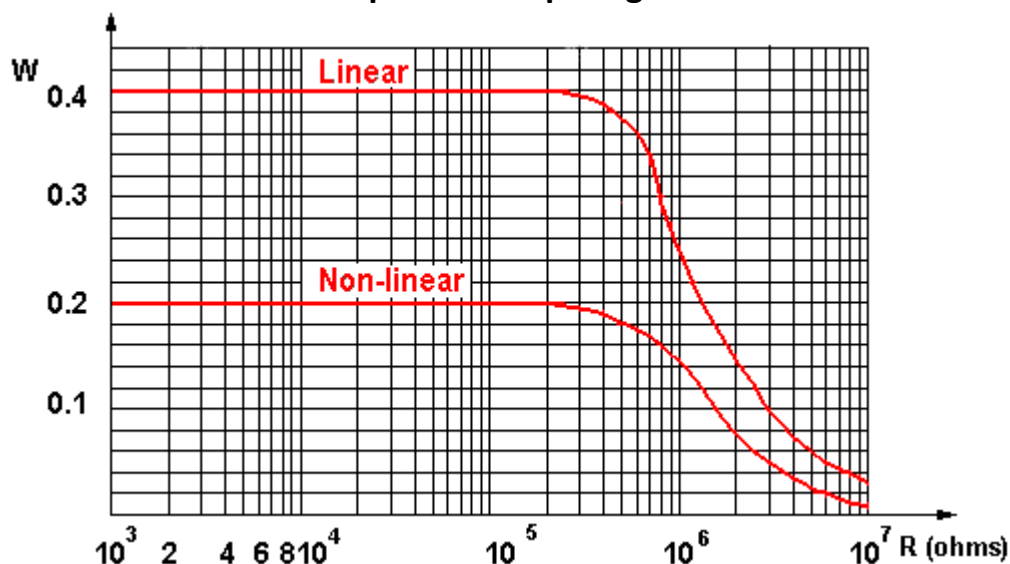
Effective rotation:

- Without a switch: 256° nominal
- With switch: 243° nominal
- With rotary switch: 243° nominal

Rated Power Dissipation @40°C for P20 potentiometers:

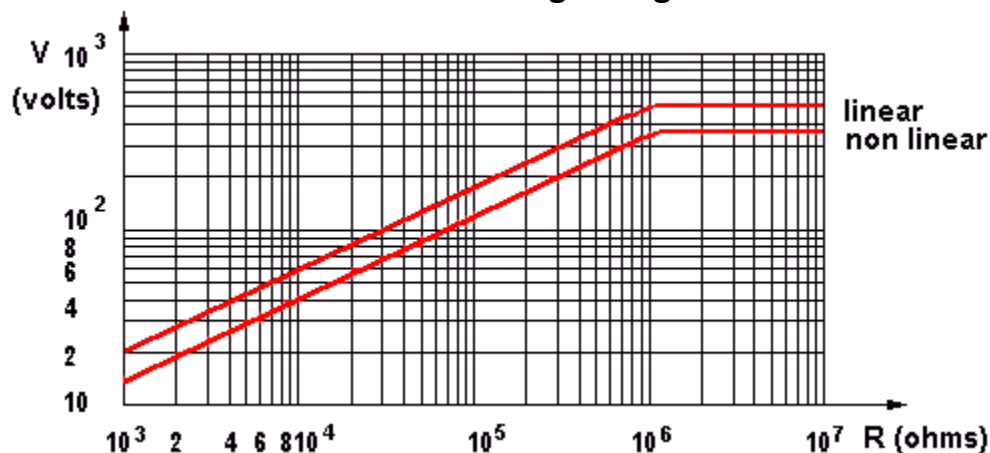
- 0.4W linear law
- 0.2W nonlinear law

P20 power dissipating curve



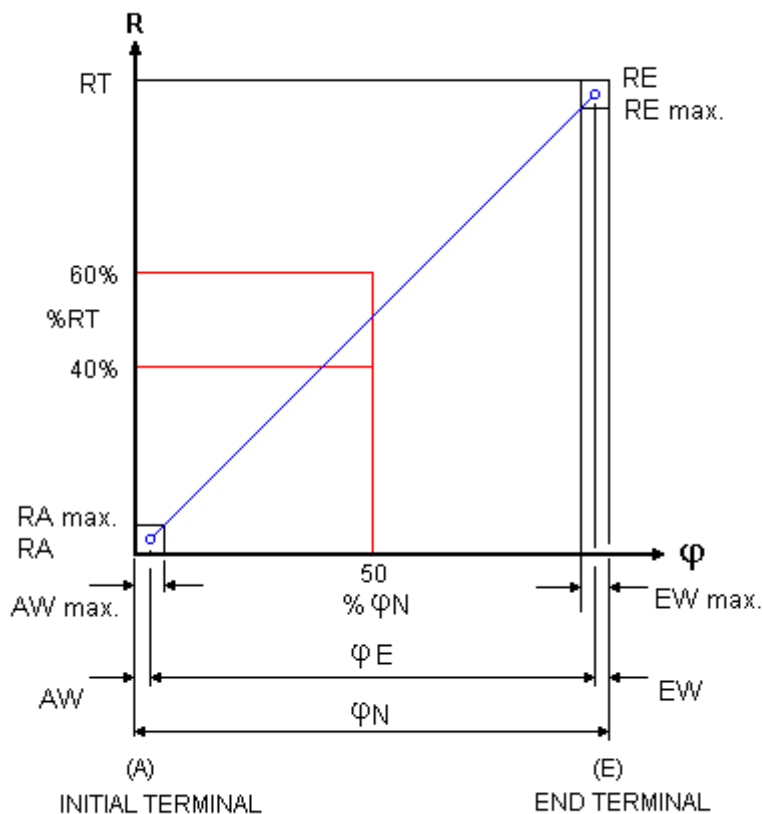
Limiting Element Voltage: 500 V DC for 20mm potentiometers

P20 maximum working voltage curve



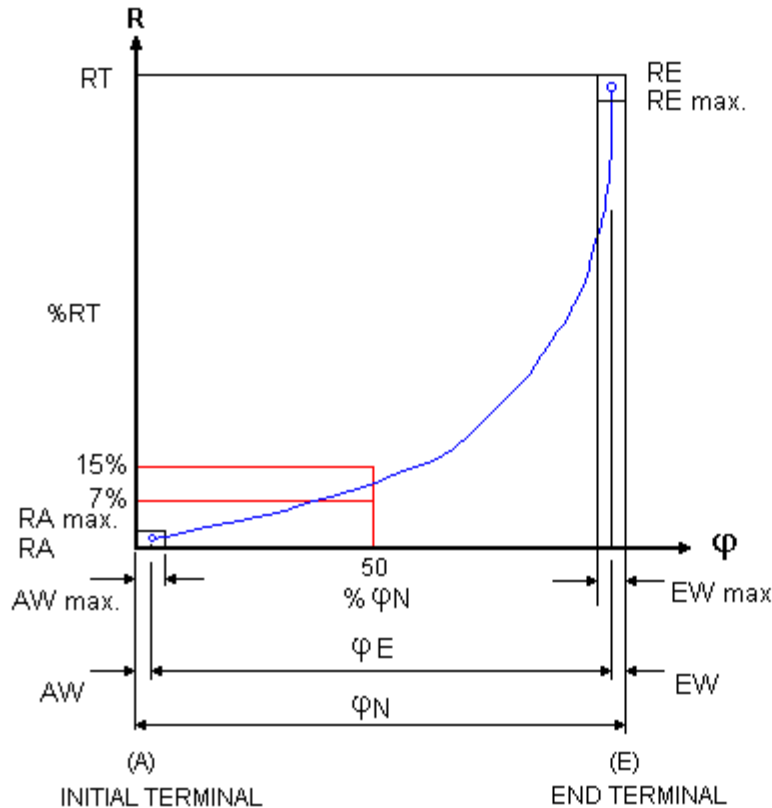
Insulating Voltage: 1000 V AC for 20mm potentiometers

Resistance law A - Linear



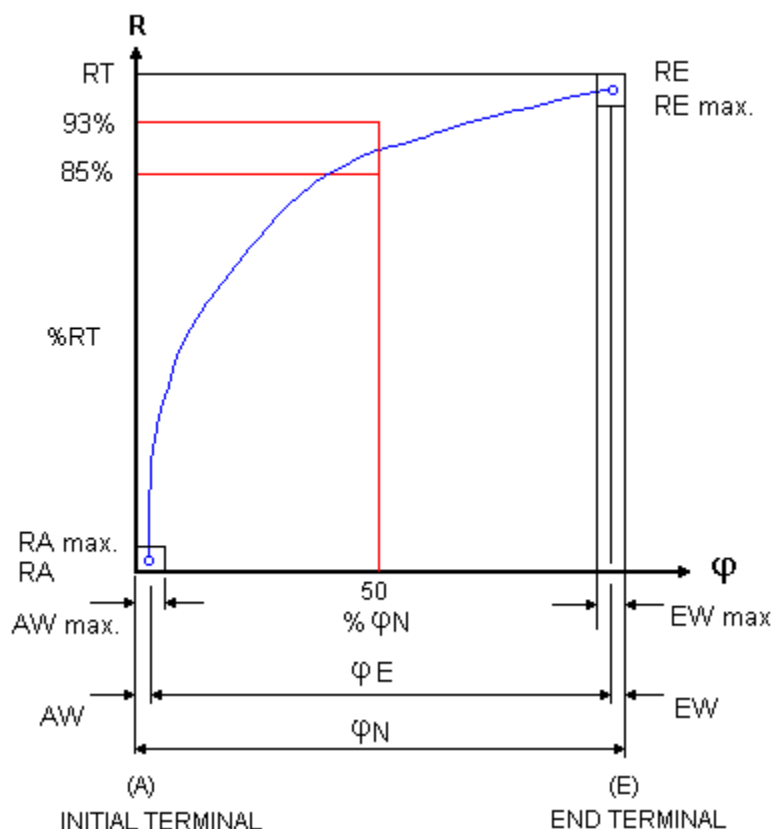
AW	Initial Path	AW max. 12% ϕN
EW	Final Path	EW max. 12% ϕN
Ra	Initial Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RA	Hop-on Resistance	$\leq 1\% RN$
Re	End Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RE	Hop-off Resistance	$\leq 1\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

Resistance law B – Log (Audio)



AW	Initial Path	AW max. 10% ϕ_N
EW	Final Path	EW max. 10% ϕ_N
Ra	Initial Stop Value	$R_N \leq 10K \leq 1.10^{-3} R_N$ (Minimum 2 ohms) $R_N > 10K \leq 2.10^{-4} R_N$ (Minimum 10 ohms)
RA	Hop-on Resistance	$R_N \leq 10K$ 5% R_N $R_N > 10K$ 0.15% R_N
Re	End Stop Value	$R_N \leq 100K \leq 2.10^{-2} R_N$ $R_N > 100K \leq 1.10^{-2} R_N$
RE	Hop-off Resistance	$R_N \leq 10K < 1\% R_N$ $R_N > 10K$ 0.5% R_N
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

Resistance law C – Antilog (Reverse Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RA	Hop-on Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K 0.5\% RN$
Re	End Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RE	Hop-off Resistance	$RN \leq 10K 5\% RN$ $RN > 10K 0.15\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

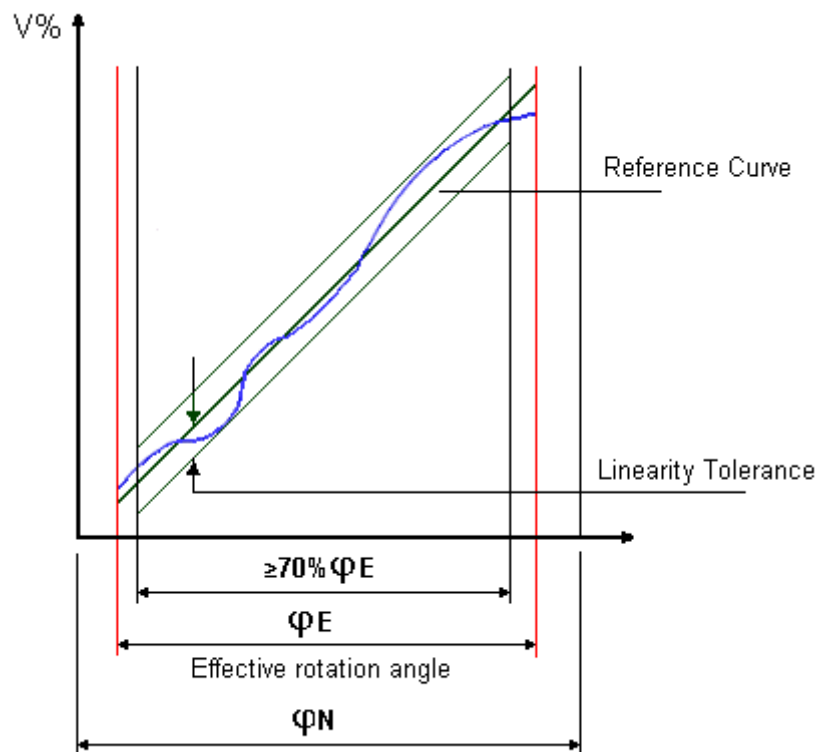
Linearity

As a basis of assessing Linearity Tolerance the independent method is the most practical, permitting as it does, the reference curve to be aligned as near as possible to the actual output curve. This avoids the use of the theoretical starting and finishing points, it is normal for the customer to realign the achieved curve with series trimmers at each end of the device if required.

Linearity Tolerance is 4% over the Nominal Resistance range of 1K0 to 1M0. The Linearity Tolerance is measured on at least 70% of the effective rotation range.

Note. In the case of Terminal and Zero-based linearity, both present constraints which increase the manufacturing difficulty and in consequence have an adverse effect on the product's price and availability.

Potentiometer linearity

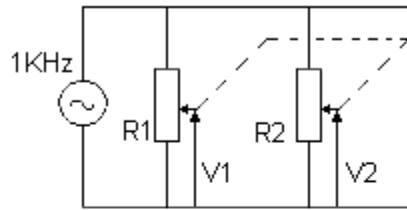


Matching Tolerance (For Tandem Stereo Potentiometers)

Tandem Potentiometers have two identical resistor units with the same variation law. The mismatching of the two resistor units, expressed in dB, is measured by the difference between the attenuations introduced by each resistor unit at various points of travel.

- Law A: 4 dB at Attenuation range 0 - 20 dB
- Law B and C: 3 dB at Attenuation range 0 - 20 dB

Matched Tolerance for Stereo

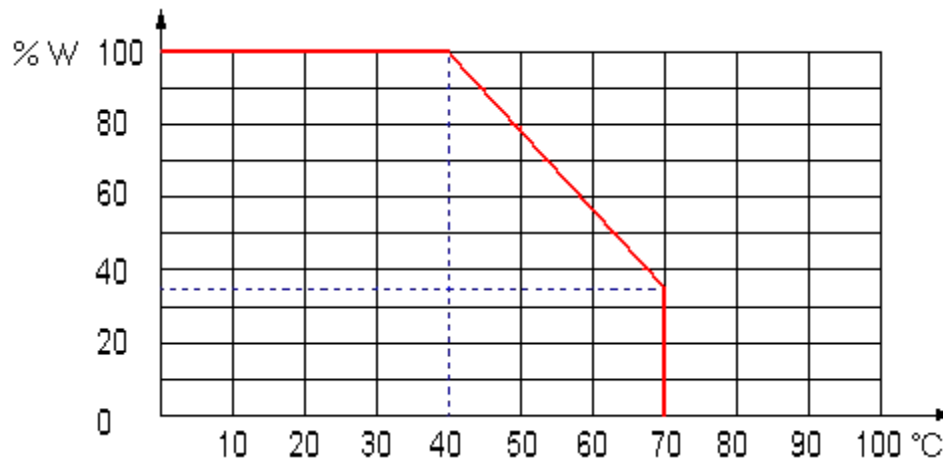


LAW	ATTENUATION RANGE	MATCHING TOLERANCE *
A	0 - 20dB	4dB
B & C	0 - 20dB	3dB

$$* \text{Matching Tolerance} = 20 \log \frac{V1}{V2}$$

Operating Temperature: -25°C to +70°C

Temperature Derating Curve



Temperature Coefficient of Resistance: +300 -500 ppm

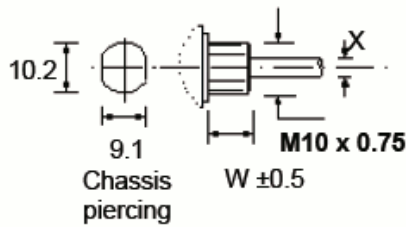
Components

P20 Bush Housing (Mounting)

The P20 bushes are available in metal or nylon; with three thread options; and with or without a locating feature:

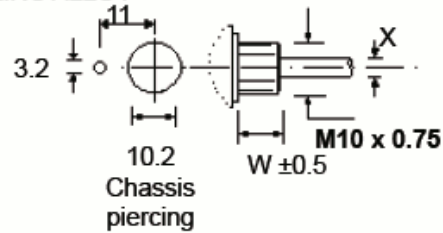
- Diecast Zinc Alloy
 - M10 x0.75mm pitch (Type C)
 - M10 x0.75mm pitch, **with locator** (Type CEBS)
 - 9.52mm x32tpi (Type CBS)
 - 9.52mm x32tpi, **with locator** (Type CBSL)
 - M7 x0.75mm pitch (Type CG)
- Glass Filled Nylon
 - M10 x0.75mm (Type CP)

DIECAST ZINC ALLOY



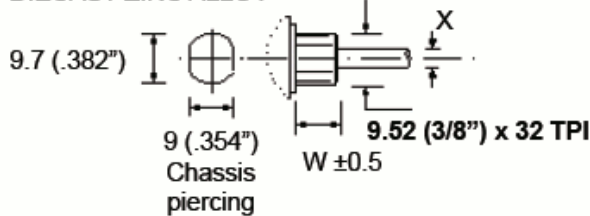
Type C (without locator)	
X (mm)	6
W (mm)	9

DIECAST ZINC ALLOY



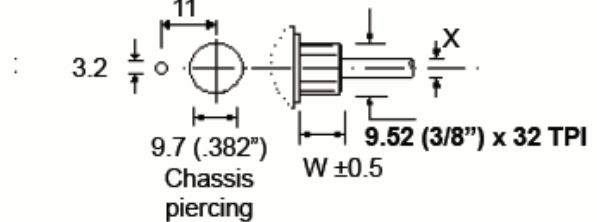
Type CEBS (with locator)	
X (mm)	6
W (mm)	9

DIECAST ZINC ALLOY



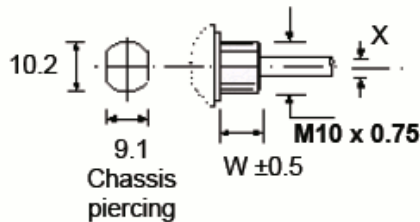
Type CBS (without locator)		
X (mm)	6	6.35
W (mm)	8 or 12	8 or 12

DIECAST ZINC ALLOY



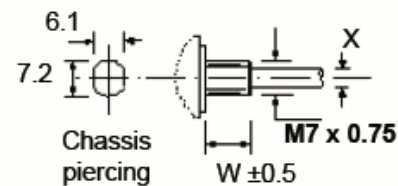
Type CBSL (with locator)		
X (mm)	6.35	6.35
W (mm)	8	12

GLASS FILLED NYLON



Type CP (GFN)		
X (mm)	6	6.35
W (mm)	7 or 10	7 or 10

DIECAST ZINC ALLOY



Type CG (without locator)	
X (mm)	4
W (mm)	6

P20 Spindles

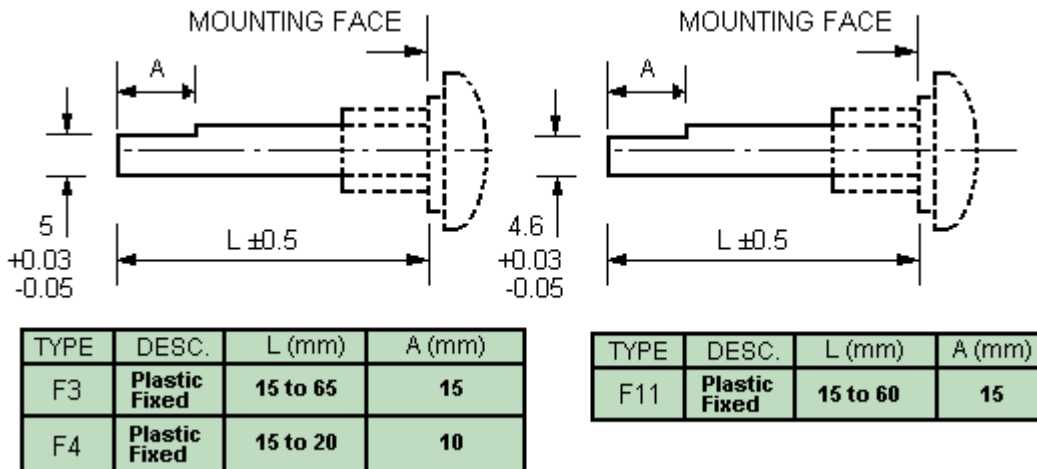
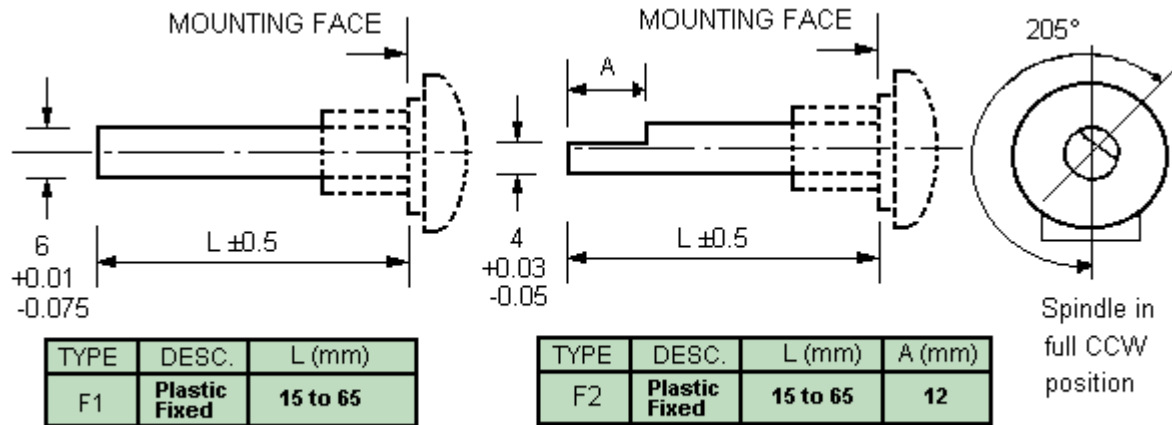
The P20 spindles are plastic and fixed i.e. not removable, unless otherwise stated and they are available in three diameters:

- 6.0mm Diameter
 - Cylindrical (Type F1)
 - 4.0 x 12mm Flat (Type F2)
 - 5.0 x 15mm Flat (Type F3)
 - 5.0 x 10mm Flat (Type F4)
 - 4.6mm x 15mm Flat (Type F11)
- 4.0mm Diameter
 - Cylindrical (Type F21)
 - 3.0 x 8.5mm Flat (Type F22)
 - 3.0 x 13.5mm Flat (Type F23)
 - Cylindrical (Type M21 - Metal)
 - 3.0 x 8.5mm Flat (Type M22 - Metal)
 - 3.0 x 13.5mm Flat (Type M23 - Metal)
- 6.35mm Diameter
 - Cylindrical (Type F41)
 - 5.5 x 10mm Flat (Type F42)
 - 5.5 x 15mm Flat (Type F43)
- Splined Spindle - 6.0mm dia. 18 teeth
- Dual Concentric
 - Flatted/Slotted (Type M15 - Metal)
 - Cylindrical (Type M16 - Metal)

6.0mm Diameter Spindles

Note: *Specials to customer's specification up to 65mm.

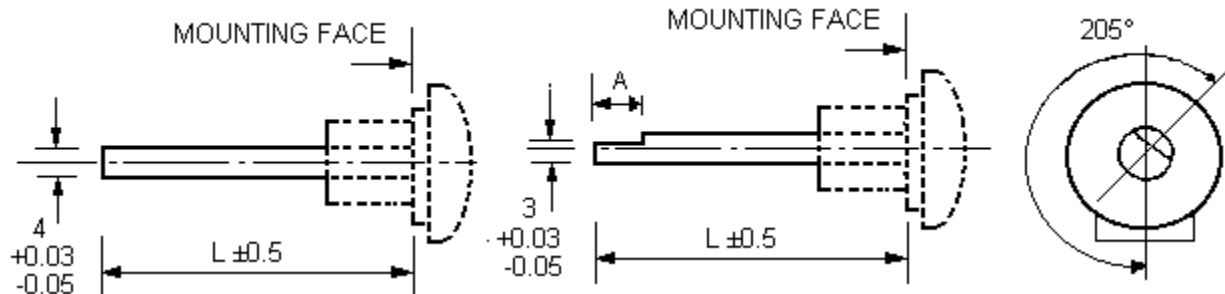
REMOVABLE SPINDLES, similar in specification to 'fixed' spindles are supplied separate from the potentiometer. These can be indefinitely taken in and out and their holding strength is >1kg.



4.0mm Diameter Spindles

Note: The orientation of the flat as illustrated is for plastic spindles only.

For metal spindles, unless specified on the order, the orientation may be different on each potentiometer type.



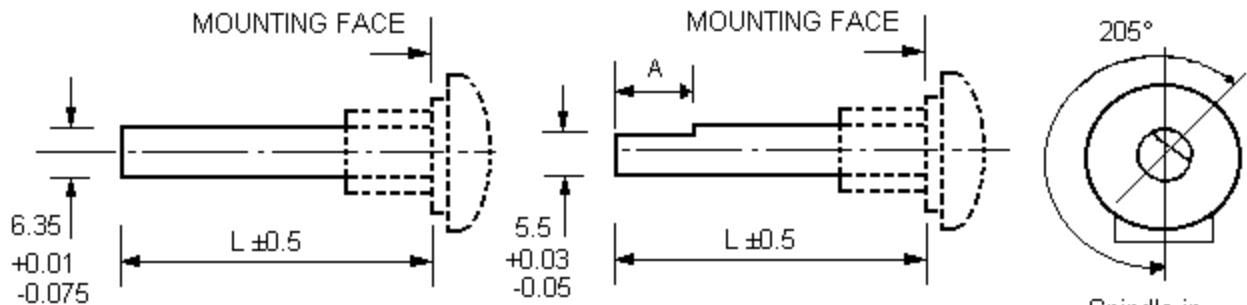
TYPE	DESC.	L (mm)
F21	Plastic Fixed	8 to 65
M21	Metal Fixed	8 to 65

TYPE	DESC.	L (mm)	A (mm)
F22	Plastic Fixed	11 to 60	8.5
M22	Metal Fixed	11 to 60	8.5
F23	Plastic Fixed	16 to 60	13.5
M23	Metal Fixed	16 to 60	13.5

Spindle in full CCW position

6.35mm Diameter Spindles

Note: *Specials to customer's specification up to 65mm.



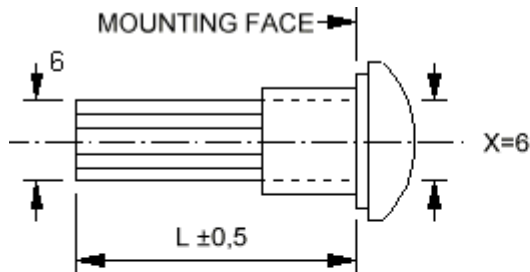
TYPE	DESC.	L (mm)
F41	Plastic Fixed	15 to 65

TYPE	DESC.	L (mm)	A (mm)
F42	Plastic Fixed	15 to 20	10
F43	Plastic Fixed	20 to 60	15

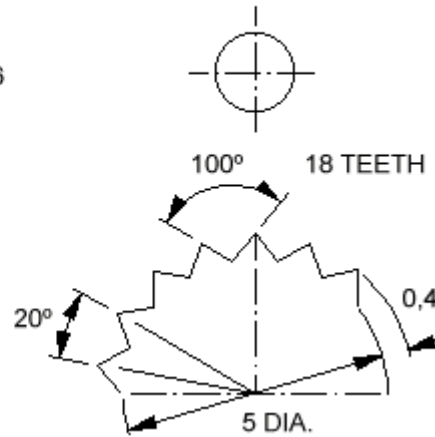
Spindle in full CCW position

Splined Spindle - 6.0mm dia. 18 teeth

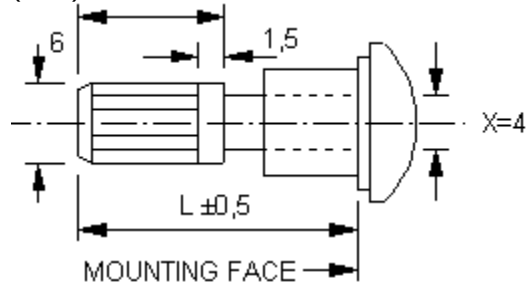
A splined form is available on the 6.0mm diameter P20 plastic spindle (F5) or alternatively a 6mm 'Splined Adaptor' (8,7mm long) can be fitted on a 4mm dia. Spindle



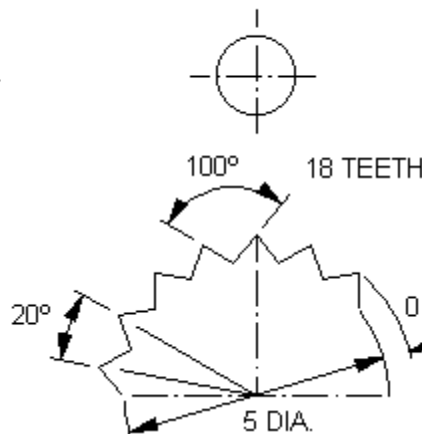
TYPE	DESC.	L (mm)
F5	Plastic Fixed	19



(F5A):



TYPE	DESC.	L (mm)
F5A	Plastic Fixed	16-36

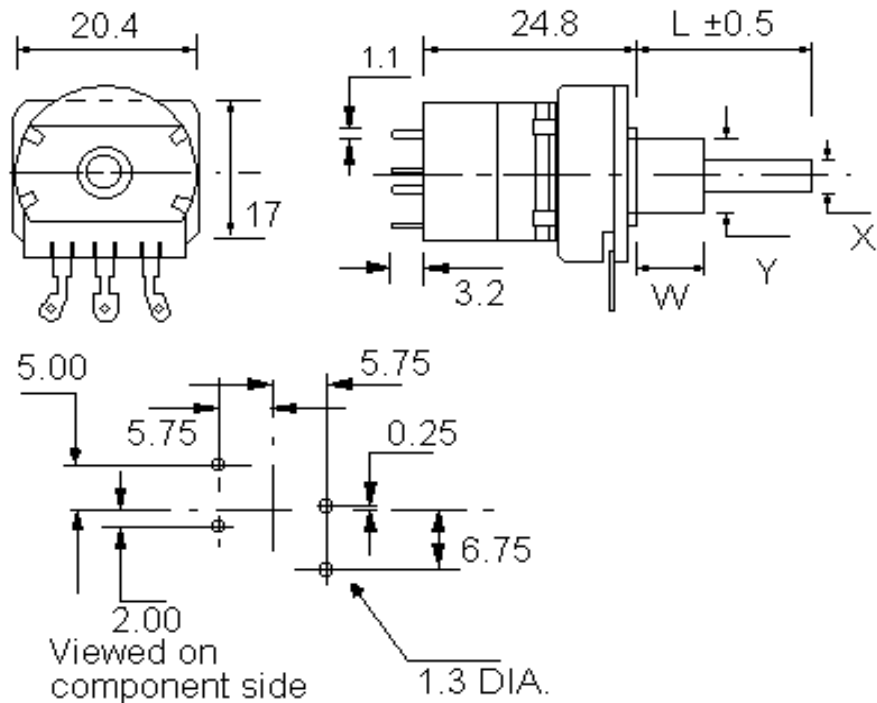


OW20BU/B4PC2S

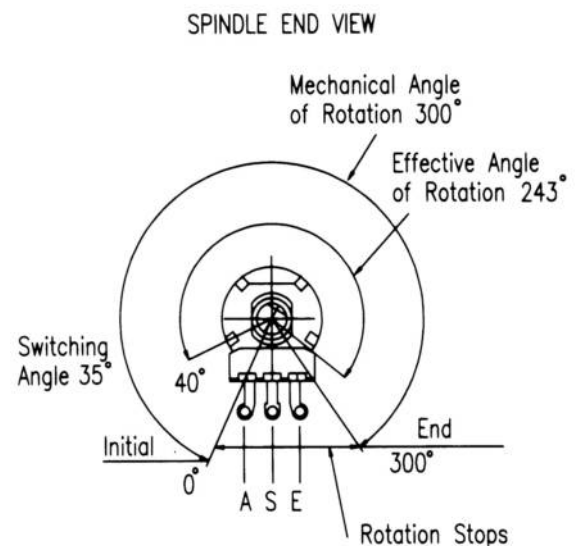
B4PC2S – 4 Amp Double Pole (Single Throw) Switch

PC – For Printed Circuit

OW – Ordinary Wiring (recommended for soldering)



- W Mounting Height
- Y Mounting Diameter
- X Spindle Diameter
- L Spindle Length
- A Initial Termination
- S Wiper (or moving contact) termination
- E End Termination



Total mechanical and effective electrical angles of rotation of potentiometers with rotary switch



P20 Range Technical Data

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Rotation angle: $300^{\circ} \pm 5^{\circ}$ (Switched and Unswitched)

Operating Torque: 0.4 – 2.0 N.cm (Initial Torque may be higher)

Rotational torque of spindle can be made high or low

Detents (stop positions) Available: Centre, 11, 21, 31, 41

Permissible Axial Spindle Load: 100 N (5 Sec. maximum)

Permissible Torque at End Stop: 80 N.cm

ELECTRICAL SPECIFICATION

Rated Power Dissipation @40°C for ECO potentiometers:

0.4W linear law

0.2W nonlinear law

Rotation angle: $300^{\circ} \pm 5^{\circ}$

Effective rotation - Unswitched: 243° nominal

Effective rotation - Switched: 256° nominal

Insulation Resistance: ≥ 4 Gohms

Rated Resistance: E3 Series

- Optional: E6 Series
- Linear Law: 1K - 1M
- Nonlinear Law: 4K7 - 470K

Tolerance on Rated Resistance: $\pm 20\%$

- Optional Tolerance on 1K - 1M: $\pm 10\%$

Resistance Laws (Taper):

- Linear: A
- Nonlinear: B - Log (Audio) or C - Antilog (Reverse Audio)
- Other laws: Please refer to Sales office

Rotary Switch Specification

The rotary switch modules are manufactured to EN61058-1 standard using high quality materials with a flame retardant housing. Although no longer certified due to the excessive cost of maintaining approvals, the 1 Amp and 4 Amp switch series have both been previously certified by UL International Demko (copies of previous certificates are available on our website or on request). The same materials, components and production techniques are used as in the certified versions and Omeg Ltd continues to test to the EN61058-1 standard

The 1 Amp contact rating is only available when mounted on the ECO potentiometer

1 A Contact Rating:

Note: The 1A contact rating is NOT available for mounting on the P16 or P20 potentiometer.

1A/250Vac 2.5A/12Vdc

Surge rating (0.01 seconds): 20A

Contact gap: 3mm (Full mains separation of contacts)

Manufactured to EN61058-1 standard

4 A Contact Rating:

4A/250Vac 10A/12Vdc

Surge rating (0.01 seconds): 80A

Switch contacts: Silver tin oxide

Contact gap: 2mm (Micro disconnection of switch - micro separation of contacts)

Manufactured to EN61058-1 standard

Common features

Housing material: Flame Retardant Glass filled polyester (UL 94 VO)

Initial contact resistance: 20 milliohms

Insulation resistance: 50,000 Megohms

Life (operations at full load): 10,000 minimum

Operating temperature: -25°C to +70°C

Operating torque for SPST/SPDT: 1.5 - 3 cNm

Operating torque for DPST/DPDT: 3.0 - 6 cNm

Mechanical rotation: 300°

Proof voltage: 3kV minimum

ROTARY SWITCH TERMINALS

Layout

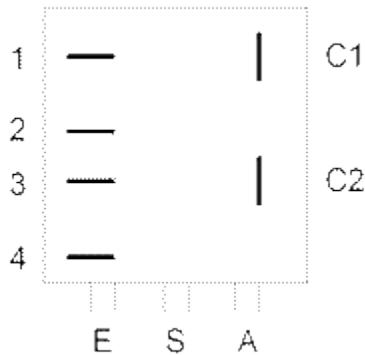
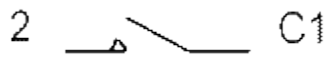
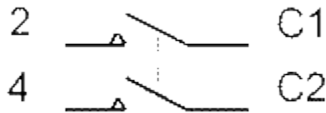


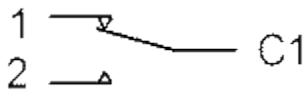
Diagram as viewed on the rear of the switch module:
(Potentiometer terminals at the bottom)



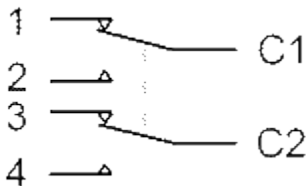
SPST - Single pole (1S), Single throw (On-Off)



DPST - Double pole (2S), Single throw (On-Off)



SPDT - Single pole (1S), Double throw (CH)
(**NOT** certified)

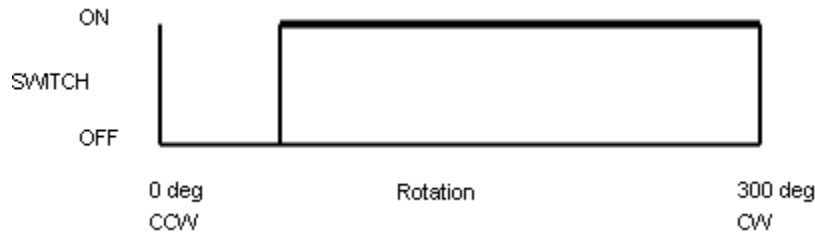


DPDT - Double pole (2S), Double throw (CH)
(**NOT** certified)

Notes

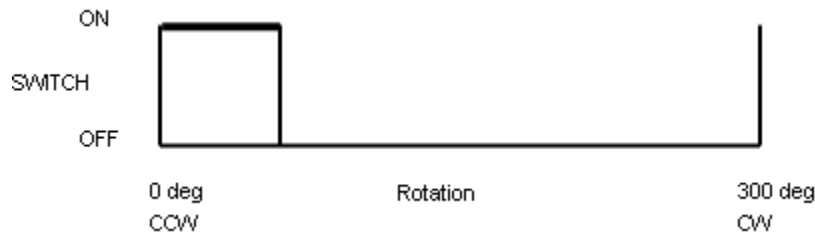
1. Moving contact(s) shown when the potentiometer shaft is in a counterclockwise (CCW) position.
2. 'Ordinary Wiring'(OW) or 'Printed Circuit'(PC) terminals can be requested on the switch.
3. Terminals 1 and 3 are only fitted for the Double Throw ('CH' or Changeover) versions which are **NOT** approved nor certified.

ROTARY SWITCH FUNCTIONS



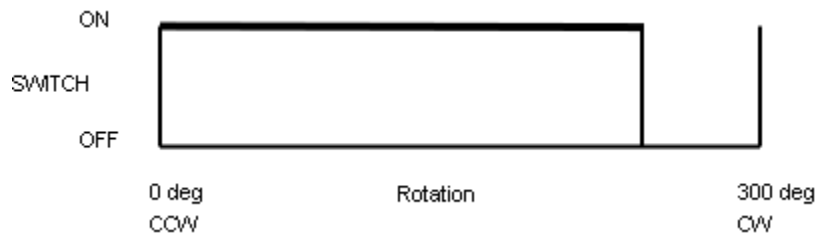
Standard (1A or 4A contact ratings)

N/O normally OPEN Switch
 Contacts normally OPEN;
 CLOCKwise rotation to CLOSE contacts



Option 1 (4A contact rating only)

N/C normally CLOSED Switch
 Contacts normally CLOSED;
 CLOCKwise rotation to OPEN contacts



Option 2 (4A contact rating only)

REVERSED N/O normally OPEN Switch
 Contacts normally OPEN at fully clockwise position;
 ANTI-clockwise rotation to CLOSE contacts



Option 3 (4A contact rating only)

REVERSED N/C normally CLOSED Switch
 Contacts normally CLOSED at fully clockwise position;
 ANTI-clockw

ELECTRICAL SPECIFICATION UNIQUE TO P20 POTENTIOMETERS

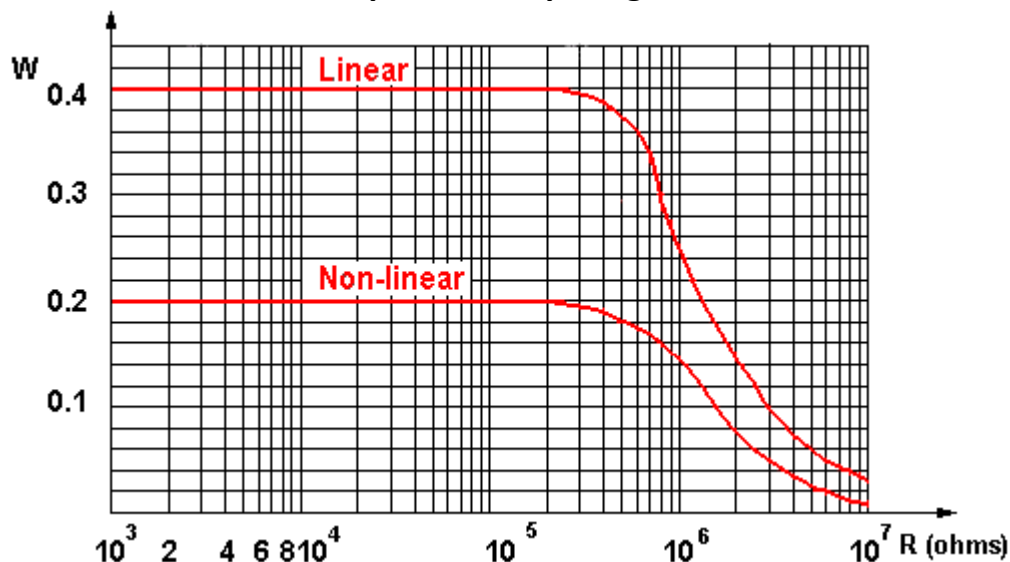
Effective rotation:

- Without a switch: 256° nominal
- With switch: 243° nominal
- With rotary switch: 243° nominal

Rated Power Dissipation @40°C for P20 potentiometers:

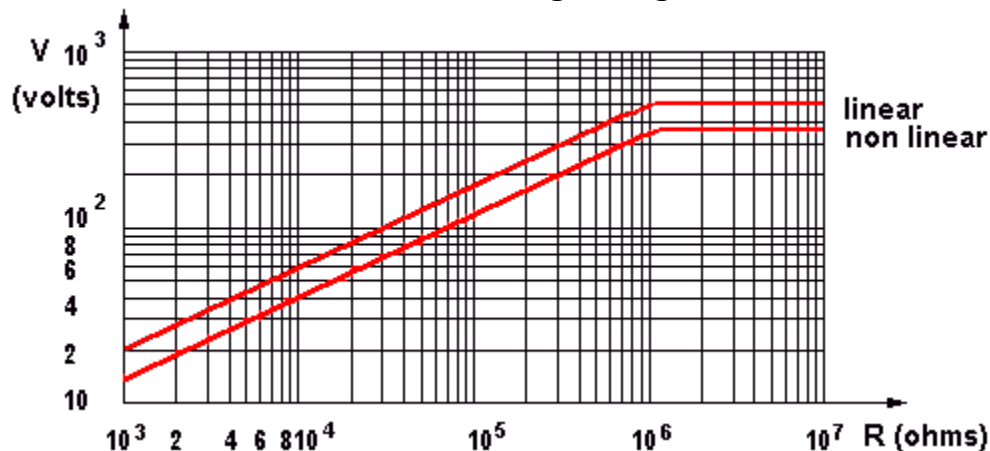
- 0.4W linear law
- 0.2W nonlinear law

P20 power dissipating curve



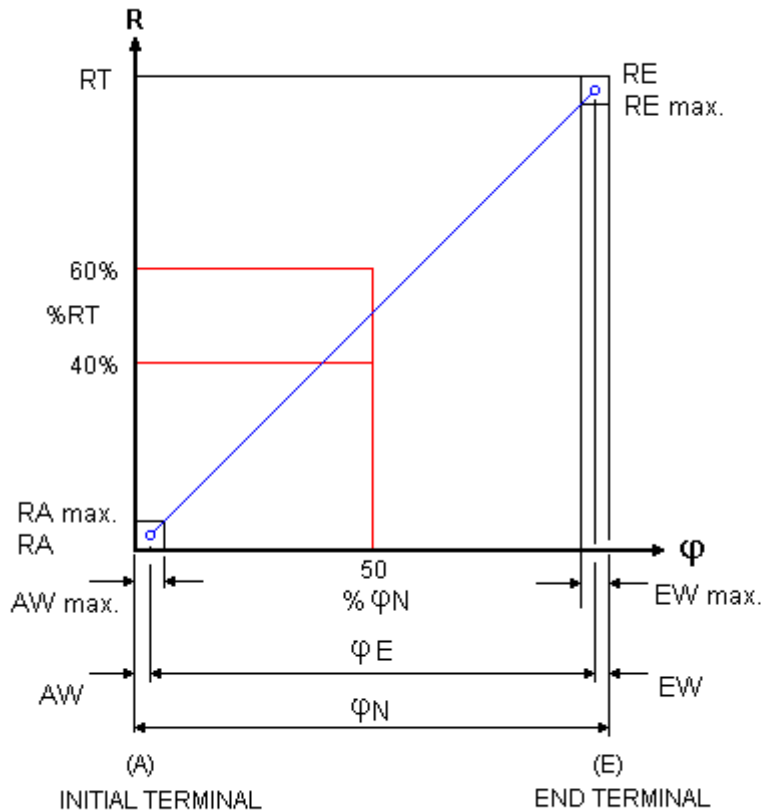
Limiting Element Voltage: 500 V DC for 20mm potentiometers

P20 maximum working voltage curve



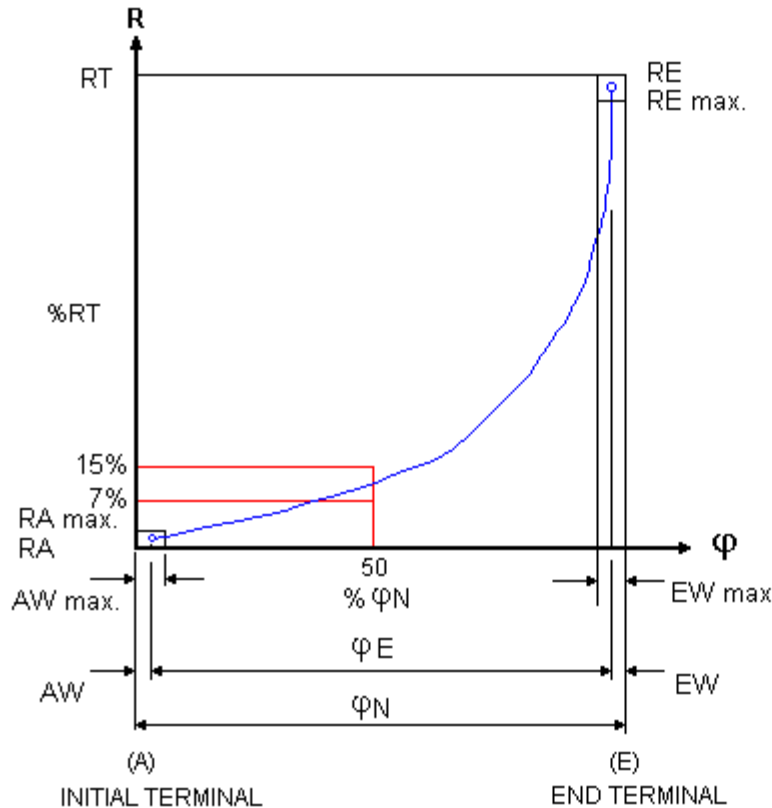
Insulating Voltage: 1000 V AC for 20mm potentiometers

Resistance law A - Linear



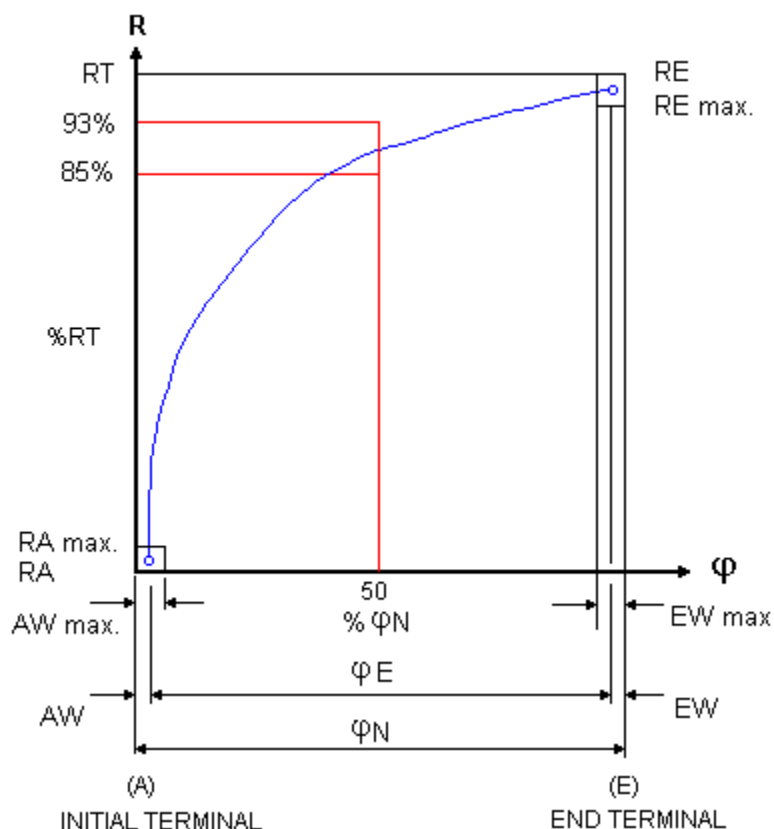
AW	Initial Path	AW max. 12% ϕ_N
EW	Final Path	EW max. 12% ϕ_N
Ra	Initial Stop Value	$\leq 1 \cdot 10^{-3} R_N$ (Minimum 2 ohms)
RA	Hop-on Resistance	$\leq 1\% R_N$
Re	End Stop Value	$\leq 1 \cdot 10^{-3} R_N$ (Minimum 2 ohms)
RE	Hop-off Resistance	$\leq 1\% R_N$
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

Resistance law B – Log (Audio)



AW	Initial Path	AW max. 10% ϕ_N
EW	Final Path	EW max. 10% ϕ_N
Ra	Initial Stop Value	$R_N \leq 10K \leq 1.10^{-3} R_N$ (Minimum 2 ohms) $R_N > 10K \leq 2.10^{-4} R_N$ (Minimum 10 ohms)
RA	Hop-on Resistance	$R_N \leq 10K$ 5% R_N $R_N > 10K$ 0.15% R_N
Re	End Stop Value	$R_N \leq 100K \leq 2.10^{-2} R_N$ $R_N > 100K \leq 1.10^{-2} R_N$
RE	Hop-off Resistance	$R_N \leq 10K < 1\% R_N$ $R_N > 10K$ 0.5% R_N
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

Resistance law C – Antilog (Reverse Audio)



AW	Initial Path	AW max. 10% ϕ_N
EW	Final Path	EW max. 10% ϕ_N
Ra	Initial Stop Value	$R_N \leq 100K \leq 2 \cdot 10^{-2} R_N$ $R_N > 100K \leq 1 \cdot 10^{-2} R_N$
RA	Hop-on Resistance	$R_N \leq 10K < 1\% R_N$ $R_N > 10K 0.5\% R_N$
Re	End Stop Value	$R_N \leq 10K \leq 1 \cdot 10^{-3} R_N$ (Minimum 2 ohms) $R_N > 10K \leq 2 \cdot 10^{-4} R_N$ (Minimum 10 ohms)
RE	Hop-off Resistance	$R_N \leq 10K 5\% R_N$ $R_N > 10K 0.15\% R_N$
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

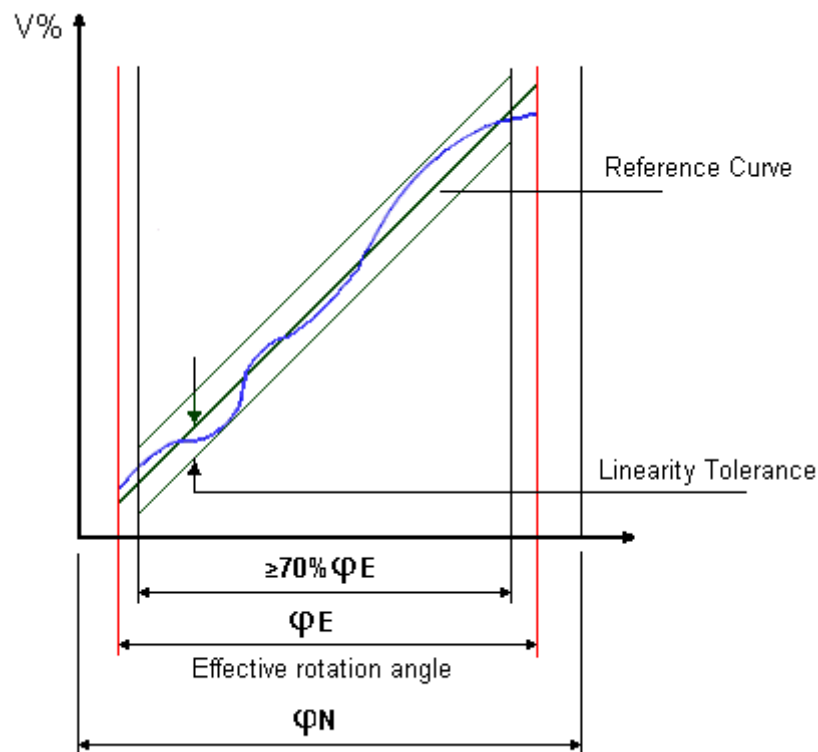
Linearity

As a basis of assessing Linearity Tolerance the independent method is the most practical, permitting as it does, the reference curve to be aligned as near as possible to the actual output curve. This avoids the use of the theoretical starting and finishing points, it is normal for the customer to realign the achieved curve with series trimmers at each end of the device if required.

Linearity Tolerance is 4% over the Nominal Resistance range of 1K0 to 1M0. The Linearity Tolerance is measured on at least 70% of the effective rotation range.

Note. In the case of Terminal and Zero-based linearity, both present constraints which increase the manufacturing difficulty and in consequence have an adverse effect on the product's price and availability.

Potentiometer linearity

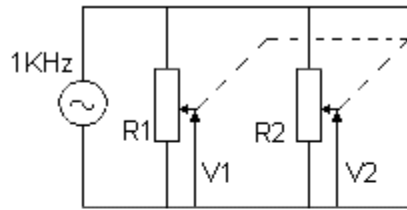


Matching Tolerance (For Tandem Stereo Potentiometers)

Tandem Potentiometers have two identical resistor units with the same variation law. The mismatching of the two resistor units, expressed in dB, is measured by the difference between the attenuations introduced by each resistor unit at various points of travel.

- Law A: 4 dB at Attenuation range 0 - 20 dB
- Law B and C: 3 dB at Attenuation range 0 - 20 dB

Matched Tolerance for Stereo

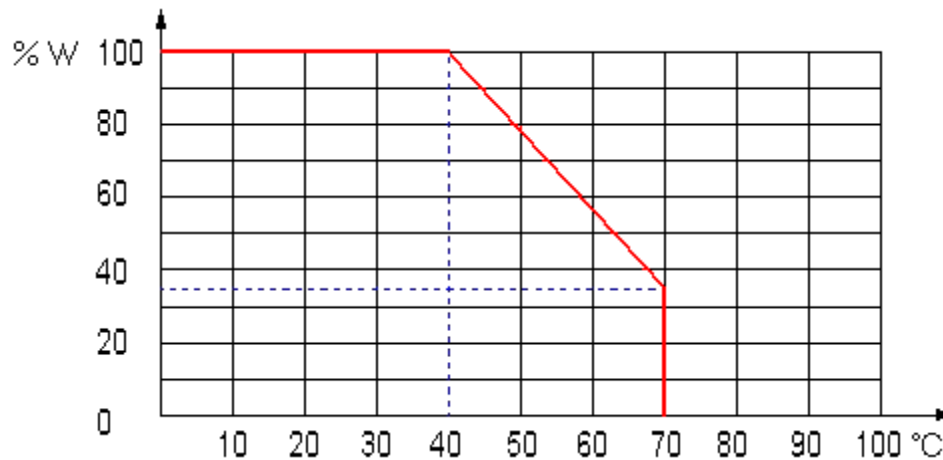


LAW	ATTENUATION RANGE	MATCHING TOLERANCE *
A	0 - 20dB	4dB
B & C	0 - 20dB	3dB

$$* \text{Matching Tolerance} = 20 \log \frac{V1}{V2}$$

Operating Temperature: -25°C to +70°C

Temperature Derating Curve



Temperature Coefficient of Resistance: +300 -500 ppm

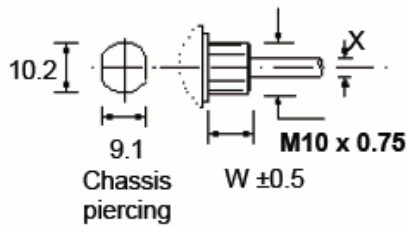
Components

P20 Bush Housing (Mounting)

The P20 bushes are available in metal or nylon; with three thread options; and with or without a locating feature:

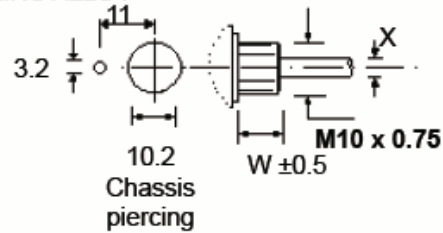
- Diecast Zinc Alloy
 - M10 x0.75mm pitch (Type C)
 - M10 x0.75mm pitch, **with locator** (Type CEBS)
 - 9.52mm x32tpi (Type CBS)
 - 9.52mm x32tpi, **with locator** (Type CBSL)
 - M7 x0.75mm pitch (Type CG)
- Glass Filled Nylon
 - M10 x0.75mm (Type CP)

DIECAST ZINC ALLOY



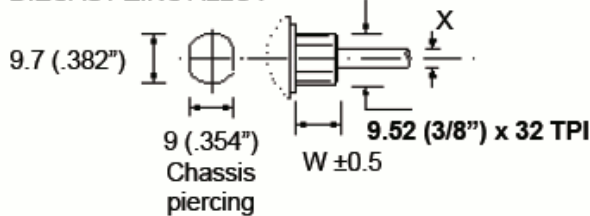
Type C (without locator)	
X (mm)	6
W (mm)	9

DIECAST ZINC ALLOY



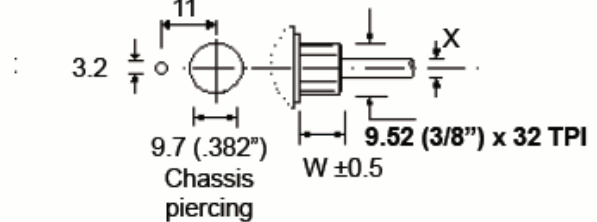
Type CEBS (with locator)	
X (mm)	6
W (mm)	9

DIECAST ZINC ALLOY



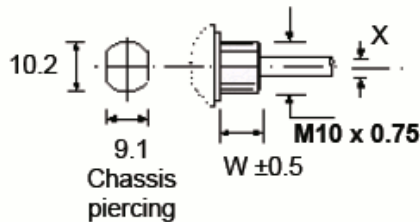
Type CBS (without locator)		
X (mm)	6	6.35
W (mm)	8 or 12	8 or 12

DIECAST ZINC ALLOY



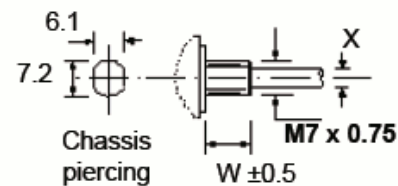
Type CBSL (with locator)		
X (mm)	6.35	6.35
W (mm)	8	12

GLASS FILLED NYLON



Type CP (GFN)		
X (mm)	6	6.35
W (mm)	7 or 10	7 or 10

DIECAST ZINC ALLOY



Type CG (without locator)	
X (mm)	4
W (mm)	6

P20 Spindles

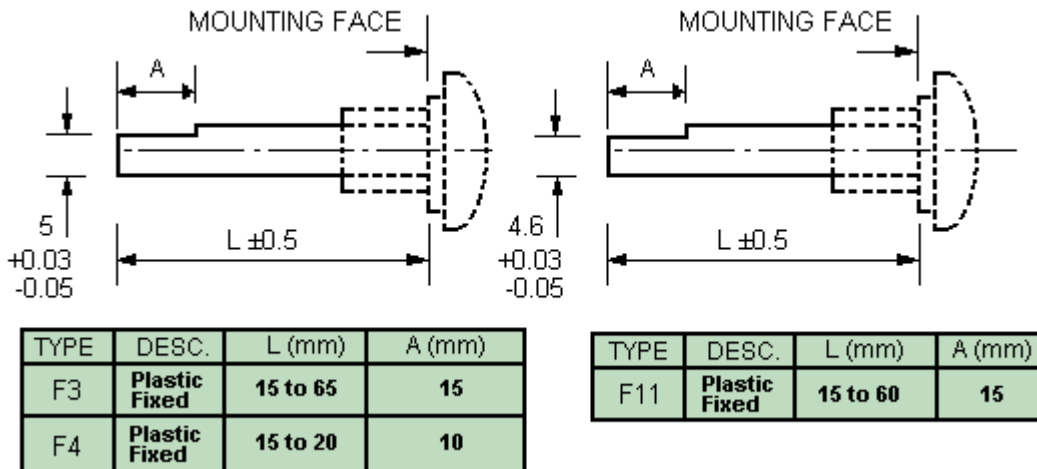
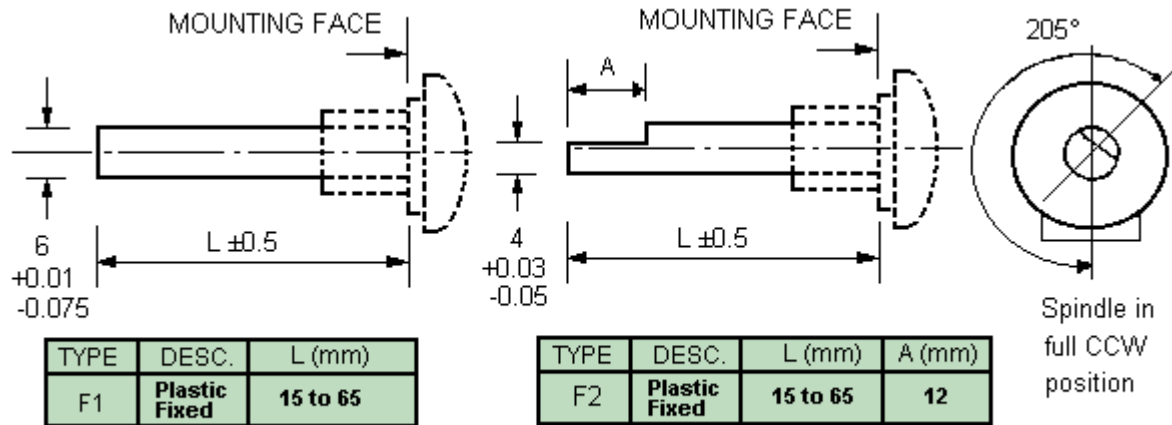
The P20 spindles are plastic and fixed i.e. not removable, unless otherwise stated and they are available in three diameters:

- 6.0mm Diameter
 - Cylindrical (Type F1)
 - 4.0 x 12mm Flat (Type F2)
 - 5.0 x 15mm Flat (Type F3)
 - 5.0 x 10mm Flat (Type F4)
 - 4.6mm x 15mm Flat (Type F11)
- 4.0mm Diameter
 - Cylindrical (Type F21)
 - 3.0 x 8.5mm Flat (Type F22)
 - 3.0 x 13.5mm Flat (Type F23)
 - Cylindrical (Type M21 - Metal)
 - 3.0 x 8.5mm Flat (Type M22 - Metal)
 - 3.0 x 13.5mm Flat (Type M23 - Metal)
- 6.35mm Diameter
 - Cylindrical (Type F41)
 - 5.5 x 10mm Flat (Type F42)
 - 5.5 x 15mm Flat (Type F43)
- Splined Spindle - 6.0mm dia. 18 teeth
- Dual Concentric
 - Flatted/Slotted (Type M15 - Metal)
 - Cylindrical (Type M16 - Metal)

6.0mm Diameter Spindles

Note: *Specials to customer's specification up to 65mm.

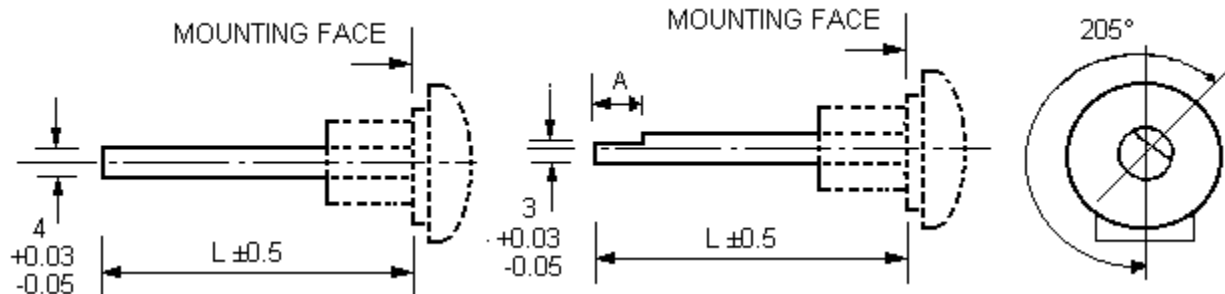
REMOVABLE SPINDLES, similar in specification to 'fixed' spindles are supplied separate from the potentiometer. These can be indefinitely taken in and out and their holding strength is >1kg.



4.0mm Diameter Spindles

Note: The orientation of the flat as illustrated is for plastic spindles only.

For metal spindles, unless specified on the order, the orientation may be different on each potentiometer type.



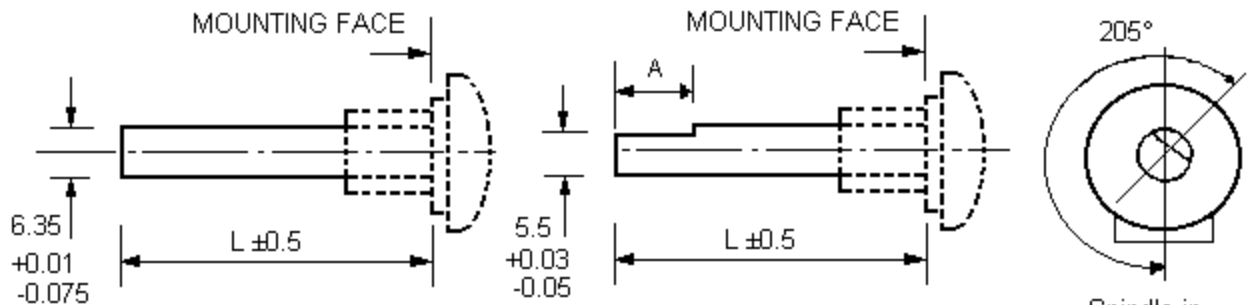
TYPE	DESC.	L (mm)
F21	Plastic Fixed	8 to 65
M21	Metal Fixed	8 to 65

TYPE	DESC.	L (mm)	A (mm)
F22	Plastic Fixed	11 to 60	8.5
M22	Metal Fixed	11 to 60	8.5
F23	Plastic Fixed	16 to 60	13.5
M23	Metal Fixed	16 to 60	13.5

Spindle in full CCW position

6.35mm Diameter Spindles

Note: *Specials to customer's specification up to 65mm.



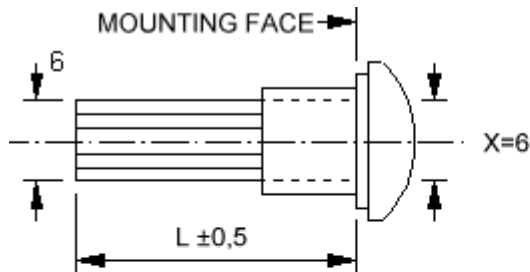
TYPE	DESC.	L (mm)
F41	Plastic Fixed	15 to 65

TYPE	DESC.	L (mm)	A (mm)
F42	Plastic Fixed	15 to 20	10
F43	Plastic Fixed	20 to 60	15

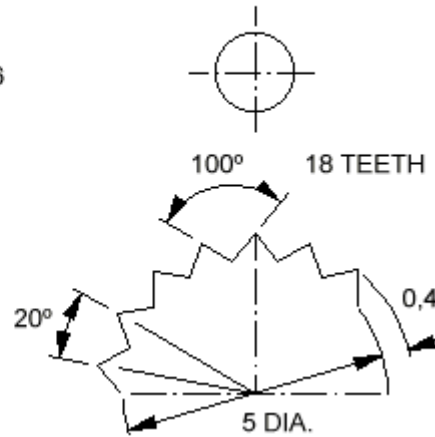
Spindle in full CCW position

Splined Spindle - 6.0mm dia. 18 teeth

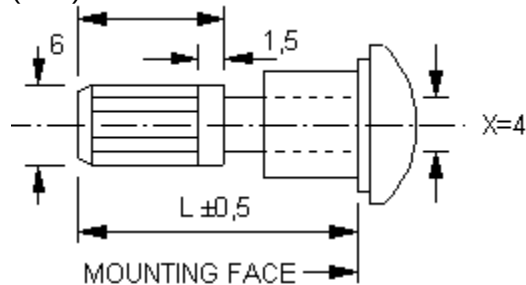
A splined form is available on the 6.0mm diameter P20 plastic spindle (F5) or alternatively a 6mm 'Splined Adaptor' (8,7mm long) can be fitted on a 4mm dia. Spindle



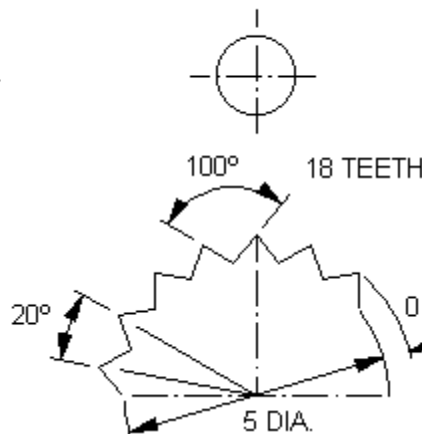
TYPE	DESC.	L (mm)
F5	Plastic Fixed	19



(F5A):



TYPE	DESC.	L (mm)
F5A	Plastic Fixed	16-36



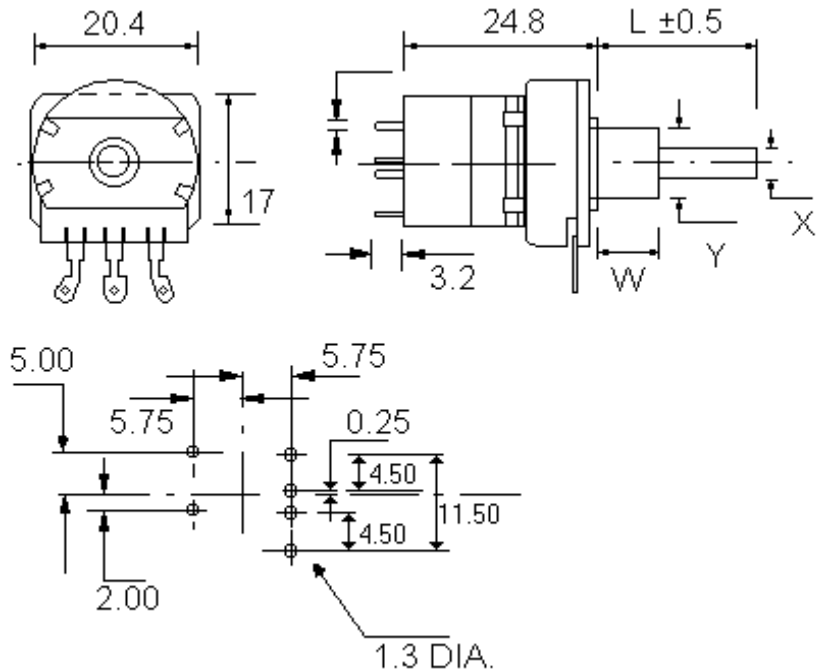
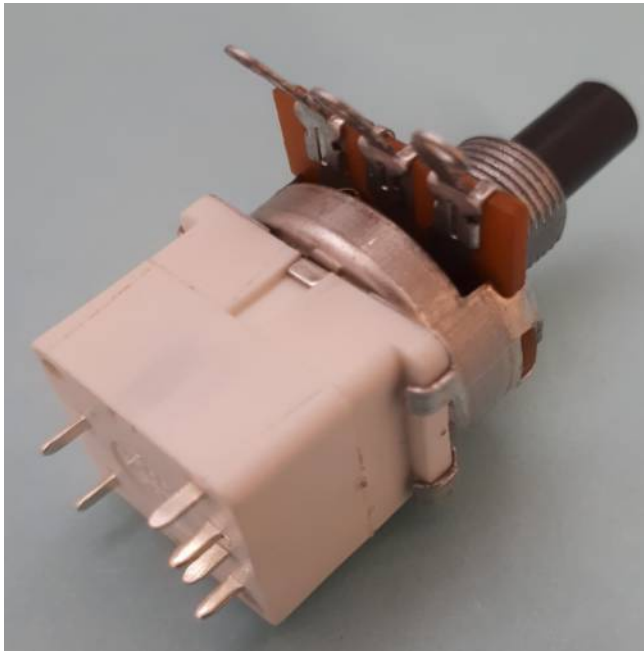
OW20BU/N4PC2S-CH *

N4PC2S - 4 Amp Double Pole Switch

CH – Change Over (Double Throw)

OW – Ordinary Wiring (recommended for soldering)

PC – For Printed Circuit



Viewed on component side

* Representative of range:
Switch can have PC or OW Terminals
Potentiometer Terminal options are show below

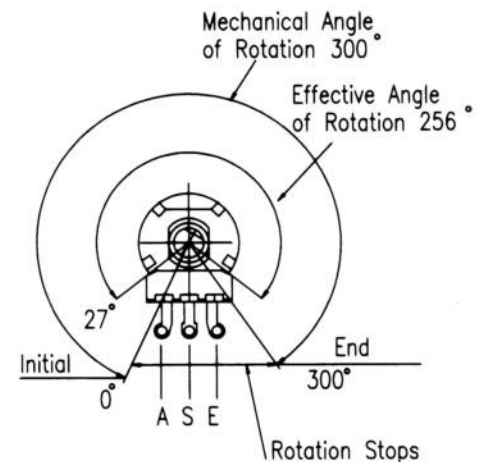
- W Mounting Height
- Y Mounting Diameter
- X Spindle Diameter
- L Spindle Length

- A Initial Termination
- S Wiper (or moving contact) termination
- E End Termination

Prefix (Potentiometer terminals)

- LT - Long bent and towards the spindle
- OW - Ordinary wiring (eyelets) - **recommended for hand soldering of wires**
- PC - Printed circuit
- BR - Bracket (with printed circuit terminals included)

SPINDLE END VIEW



Total mechanical and effective electrical angles of rotation of potentiometers

Please note the Double Throw 'Change over' has never been Certified

This information is supplied in good faith but the customer is politely reminded that it is their responsibility to check the suitability of our products for their particular application, production techniques and processes. Please note that all dimensions are for reference purposes only and, as it is the Company's policy to continuously improve our products, we reserve the right to incorporate changes without notice. Please read our terms and conditions before purchasing our products. Published 01-04- 2018



P20 Range Technical Data

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Rotation angle: $300^{\circ} \pm 5^{\circ}$ (Switched and Unswitched)

Operating Torque: 0.4 – 2.0 N.cm (Initial Torque may be higher)

Rotational torque of spindle can be made high or low

Detents (stop positions) Available: Centre, 11, 21, 31, 41

Permissible Axial Spindle Load: 100 N (5 Sec. maximum)

Permissible Torque at End Stop: 80 N.cm

ELECTRICAL SPECIFICATION

Rated Power Dissipation @40°C for ECO potentiometers:

0.4W linear law

0.2W nonlinear law

Rotation angle: $300^{\circ} \pm 5^{\circ}$

Effective rotation - Unswitched: 243° nominal

Effective rotation - Switched: 256° nominal

Insulation Resistance: ≥ 4 Gohms

Rated Resistance: E3 Series

- Optional: E6 Series
- Linear Law: 1K - 1M
- Nonlinear Law: 4K7 - 470K

Tolerance on Rated Resistance: $\pm 20\%$

- Optional Tolerance on 1K - 1M: $\pm 10\%$

Resistance Laws (Taper):

- Linear: A
- Nonlinear: B - Log (Audio) or C - Antilog (Reverse Audio)
- Other laws: Please refer to Sales office

Rotary Switch Specification

The rotary switch modules are manufactured to EN61058-1 standard using high quality materials with a flame retardant housing. Although no longer certified due to the excessive cost of maintaining approvals, the 1 Amp and 4 Amp switch series have both been previously certified by UL International Demko (copies of previous certificates are available on our website or on request). The same materials, components and production techniques are used as in the certified versions and Omeg Ltd continues to test to the EN61058-1 standard

The 1 Amp contact rating is only available when mounted on the ECO potentiometer

1 A Contact Rating:

Note: The 1A contact rating is NOT available for mounting on the P16 or P20 potentiometer.

1A/250Vac 2.5A/12Vdc

Surge rating (0.01 seconds): 20A

Contact gap: 3mm (Full mains separation of contacts)

Manufactured to EN61058-1 standard

4 A Contact Rating:

4A/250Vac 10A/12Vdc

Surge rating (0.01 seconds): 80A

Switch contacts: Silver tin oxide

Contact gap: 2mm (Micro disconnection of switch - micro separation of contacts)

Manufactured to EN61058-1 standard

Common features

Housing material: Flame Retardant Glass filled polyester (UL 94 VO)

Initial contact resistance: 20 milliohms

Insulation resistance: 50,000 Megohms

Life (operations at full load): 10,000 minimum

Operating temperature: -25°C to +70°C

Operating torque for SPST/SPDT: 1.5 - 3 cNm

Operating torque for DPST/DPDT: 3.0 - 6 cNm

Mechanical rotation: 300°

Proof voltage: 3kV minimum

ROTARY SWITCH TERMINALS

Layout

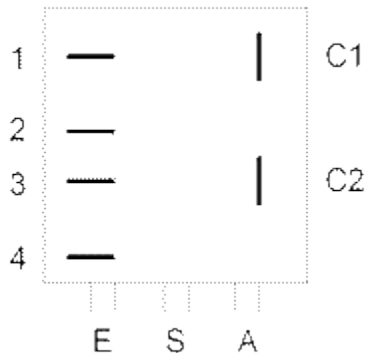
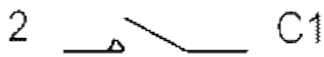
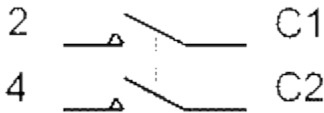


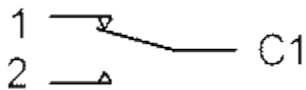
Diagram as viewed on the rear of the switch module:
(Potentiometer terminals at the bottom)



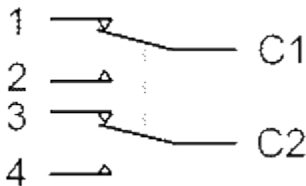
SPST - Single pole (1S), Single throw (On-Off)



DPST - Double pole (2S), Single throw (On-Off)



SPDT - Single pole (1S), Double throw (CH)
(**NOT** certified)

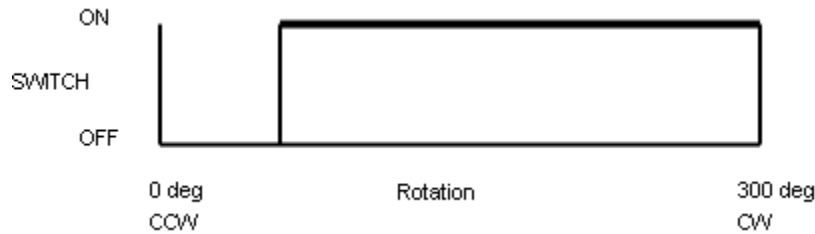


DPDT - Double pole (2S), Double throw (CH)
(**NOT** certified)

Notes

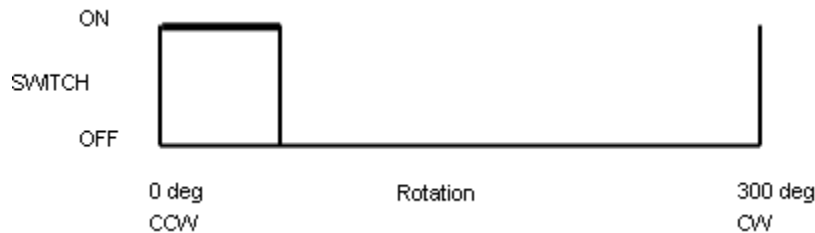
1. Moving contact(s) shown when the potentiometer shaft is in a counterclockwise (CCW) position.
2. 'Ordinary Wiring'(OW) or 'Printed Circuit'(PC) terminals can be requested on the switch.
3. Terminals 1 and 3 are only fitted for the Double Throw ('CH' or Changeover) versions which are **NOT** approved nor certified.

ROTARY SWITCH FUNCTIONS



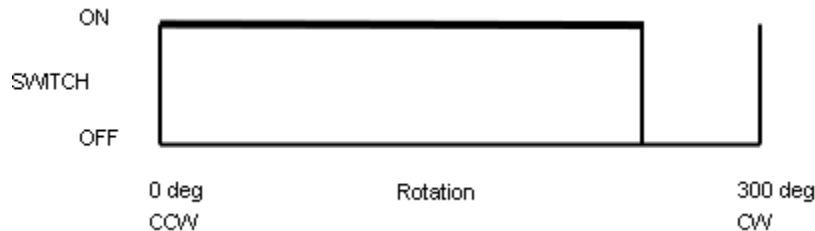
Standard (1A or 4A contact

ratings)
 N/O normally OPEN Switch
 Contacts normally OPEN;
 CLOCKwise rotation to CLOSE contacts



Option 1 (4A contact rating only)

N/C normally CLOSED Switch
 Contacts normally CLOSED;
 CLOCKwise rotation to OPEN contacts



Option 2 (4A contact rating only)

REVERSED N/O normally OPEN Switch
 Contacts normally OPEN at fully clockwise position;
 ANTI-clockwise rotation to CLOSE contacts



Option 3 (4A contact rating only)

REVERSED N/C normally CLOSED Switch
 Contacts normally CLOSED at fully clockwise position;
 ANTI-clockw

ELECTRICAL SPECIFICATION UNIQUE TO P20 POTENTIOMETERS

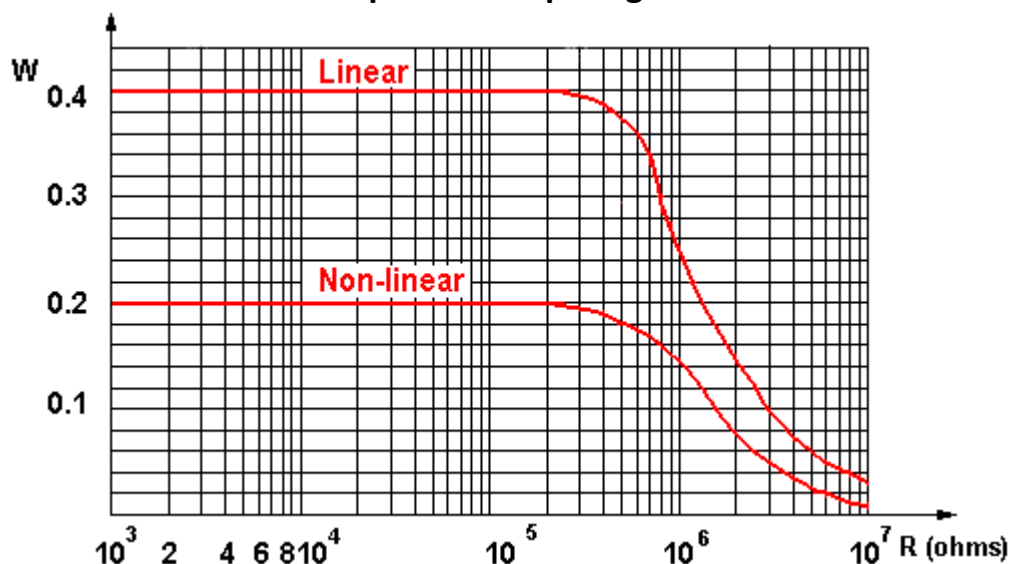
Effective rotation:

- Without a switch: 256° nominal
- With switch: 243° nominal
- With rotary switch: 243° nominal

Rated Power Dissipation @40°C for P20 potentiometers:

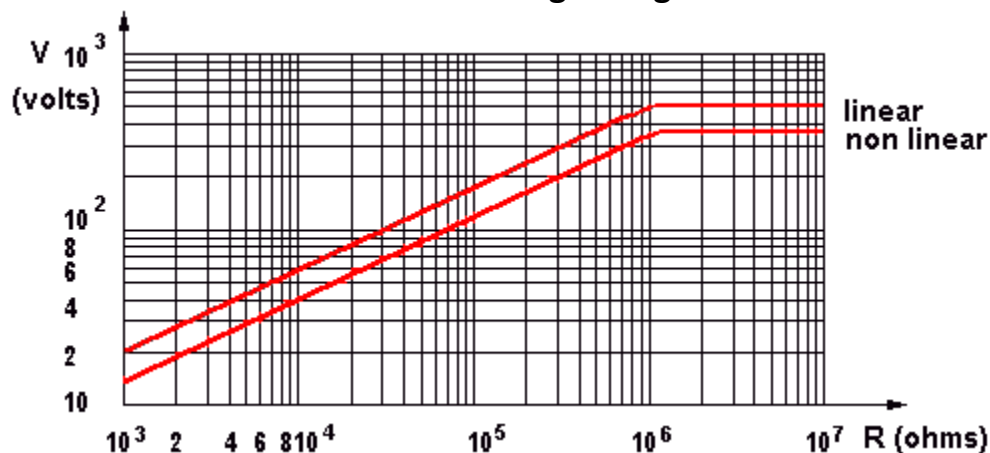
- 0.4W linear law
- 0.2W nonlinear law

P20 power dissipating curve



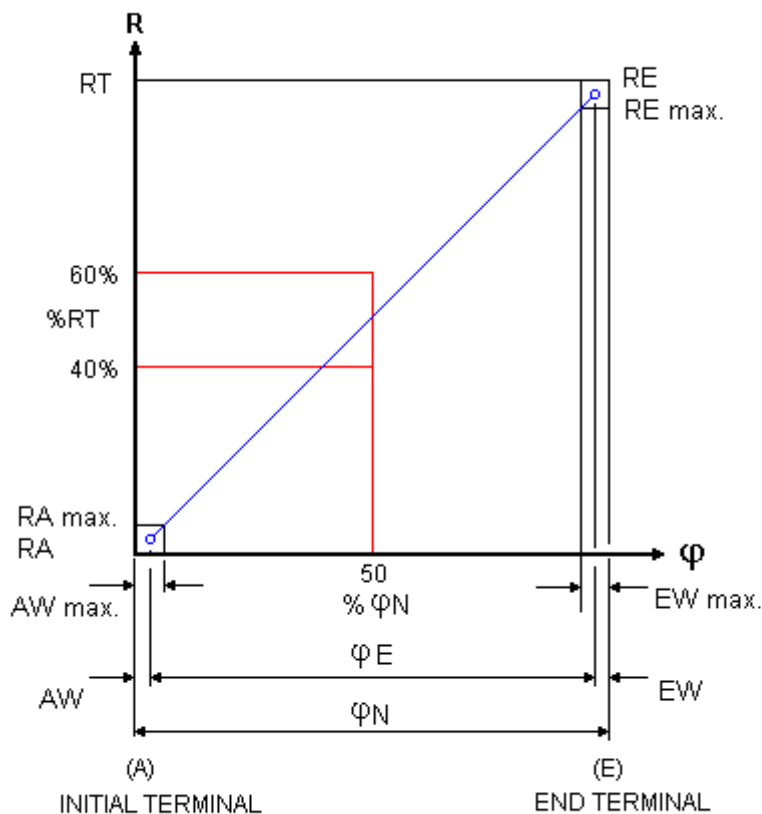
Limiting Element Voltage: 500 V DC for 20mm potentiometers

P20 maximum working voltage curve



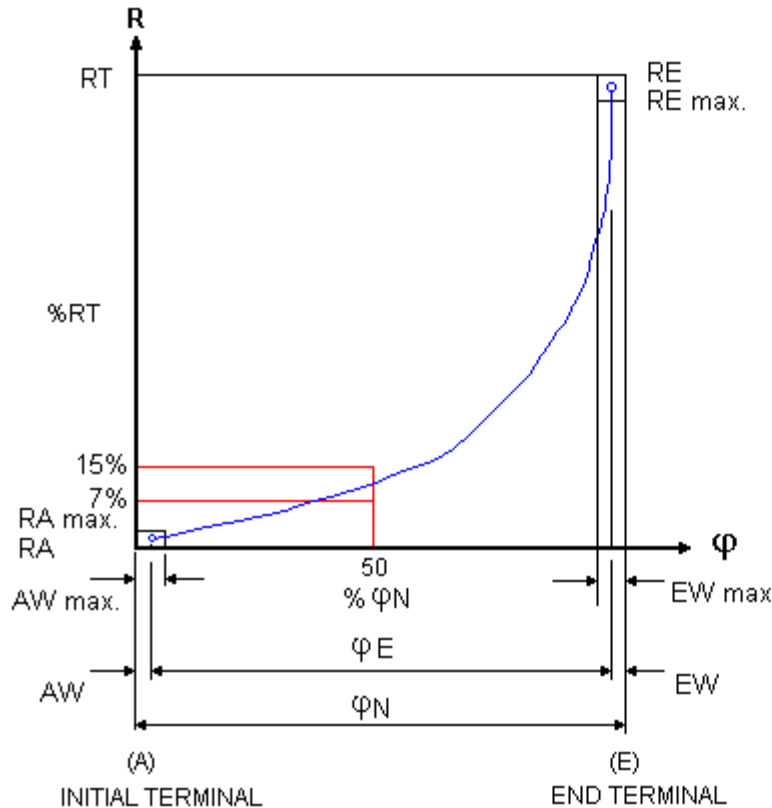
Insulating Voltage: 1000 V AC for 20mm potentiometers

Resistance law A - Linear



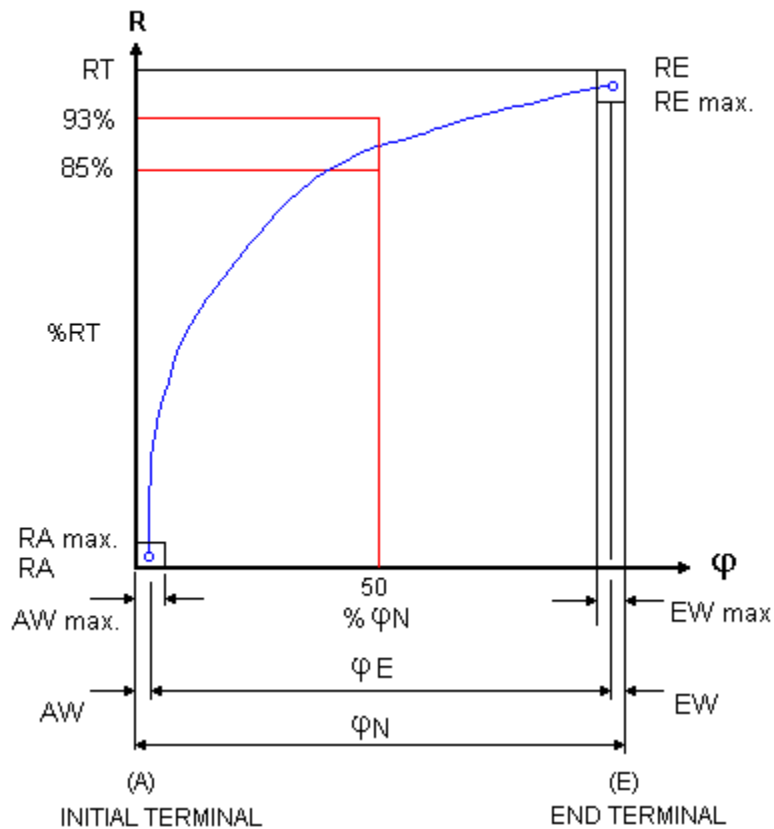
AW	Initial Path	AW max. 12% ϕN
EW	Final Path	EW max. 12% ϕN
Ra	Initial Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RA	Hop-on Resistance	$\leq 1\% RN$
Re	End Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RE	Hop-off Resistance	$\leq 1\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

Resistance law B – Log (Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RA	Hop-on Resistance	$RN \leq 10K$ 5% RN $RN > 10K$ 0.15% RN
Re	End Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RE	Hop-off Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K$ 0.5% RN
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

Resistance law C – Antilog (Reverse Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RA	Hop-on Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K 0.5\% RN$
Re	End Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RE	Hop-off Resistance	$RN \leq 10K 5\% RN$ $RN > 10K 0.15\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

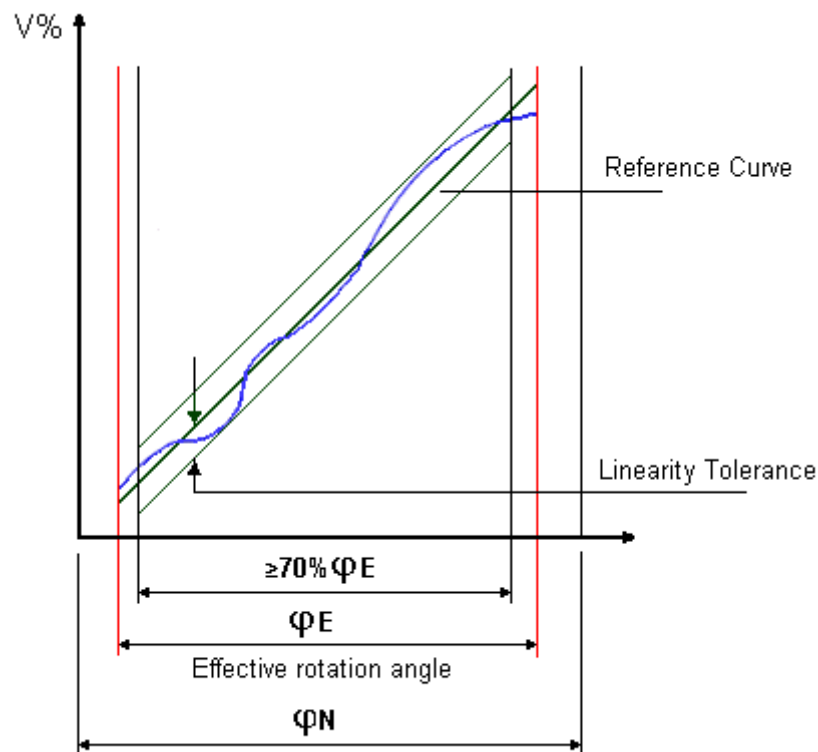
Linearity

As a basis of assessing Linearity Tolerance the independent method is the most practical, permitting as it does, the reference curve to be aligned as near as possible to the actual output curve. This avoids the use of the theoretical starting and finishing points, it is normal for the customer to realign the achieved curve with series trimmers at each end of the device if required.

Linearity Tolerance is 4% over the Nominal Resistance range of 1K Ω to 1M Ω . The Linearity Tolerance is measured on at least 70% of the effective rotation range.

Note. In the case of Terminal and Zero-based linearity, both present constraints which increase the manufacturing difficulty and in consequence have an adverse effect on the product's price and availability.

Potentiometer linearity

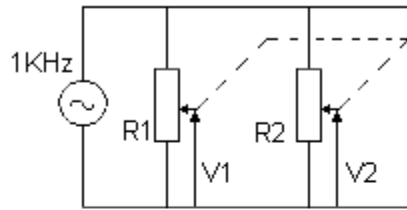


Matching Tolerance (For Tandem Stereo Potentiometers)

Tandem Potentiometers have two identical resistor units with the same variation law. The mismatching of the two resistor units, expressed in dB, is measured by the difference between the attenuations introduced by each resistor unit at various points of travel.

- Law A: 4 dB at Attenuation range 0 - 20 dB
- Law B and C: 3 dB at Attenuation range 0 - 20 dB

Matched Tolerance for Stereo

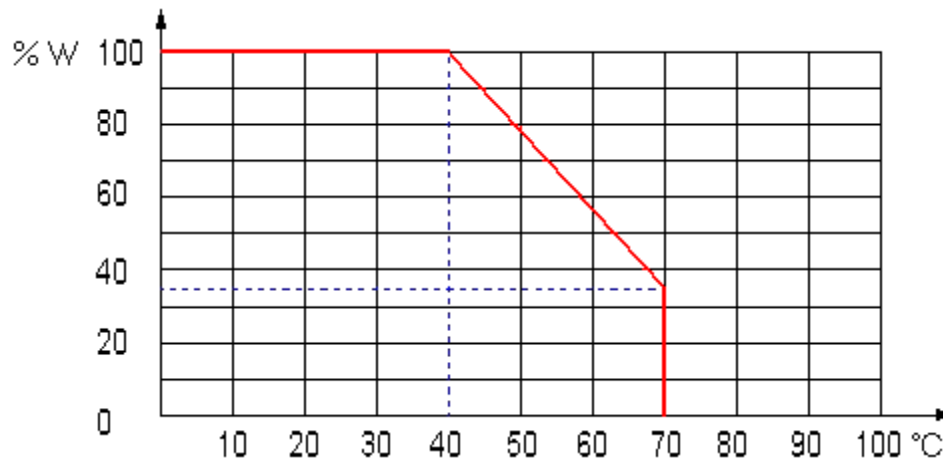


LAW	ATTENUATION RANGE	MATCHING TOLERANCE *
A	0 - 20dB	4dB
B & C	0 - 20dB	3dB

$$* \text{Matching Tolerance} = 20 \log \frac{V1}{V2}$$

Operating Temperature: -25°C to +70°C

Temperature Derating Curve



Temperature Coefficient of Resistance: +300 -500 ppm

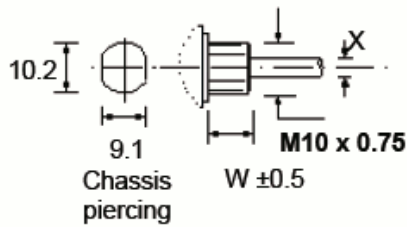
Components

P20 Bush Housing (Mounting)

The P20 bushes are available in metal or nylon; with three thread options; and with or without a locating feature:

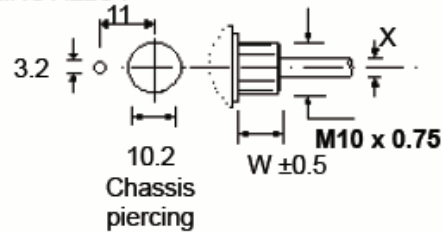
- Diecast Zinc Alloy
 - M10 x0.75mm pitch (Type C)
 - M10 x0.75mm pitch, **with locator** (Type CEBS)
 - 9.52mm x32tpi (Type CBS)
 - 9.52mm x32tpi, **with locator** (Type CBSL)
 - M7 x0.75mm pitch (Type CG)
- Glass Filled Nylon
 - M10 x0.75mm (Type CP)

DIECAST ZINC ALLOY



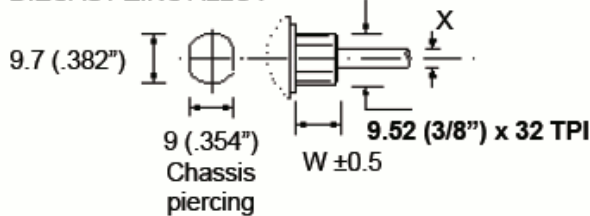
Type C (without locator)	
X (mm)	6
W (mm)	9

DIECAST ZINC ALLOY



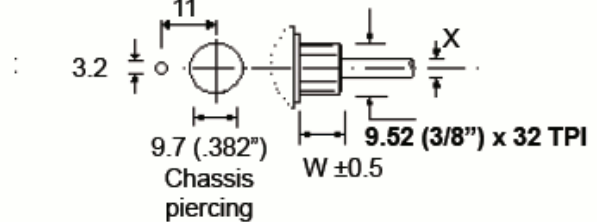
Type CEBS (with locator)	
X (mm)	6
W (mm)	9

DIECAST ZINC ALLOY



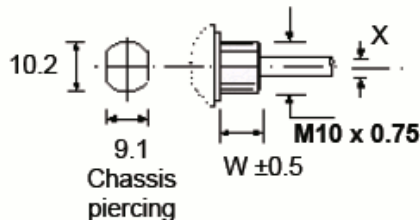
Type CBS (without locator)		
X (mm)	6	6.35
W (mm)	8 or 12	8 or 12

DIECAST ZINC ALLOY



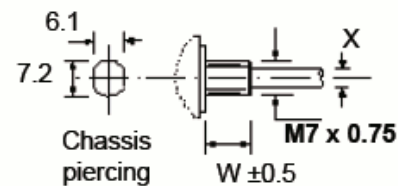
Type CBSL (with locator)		
X (mm)	6.35	6.35
W (mm)	8	12

GLASS FILLED NYLON



Type CP (GFN)		
X (mm)	6	6.35
W (mm)	7 or 10	7 or 10

DIECAST ZINC ALLOY



Type CG (without locator)	
X (mm)	4
W (mm)	6

P20 Spindles

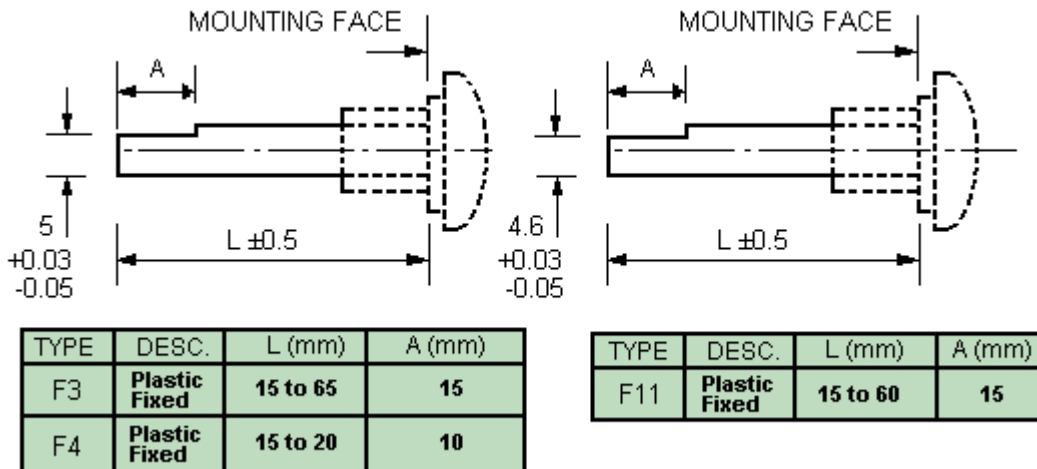
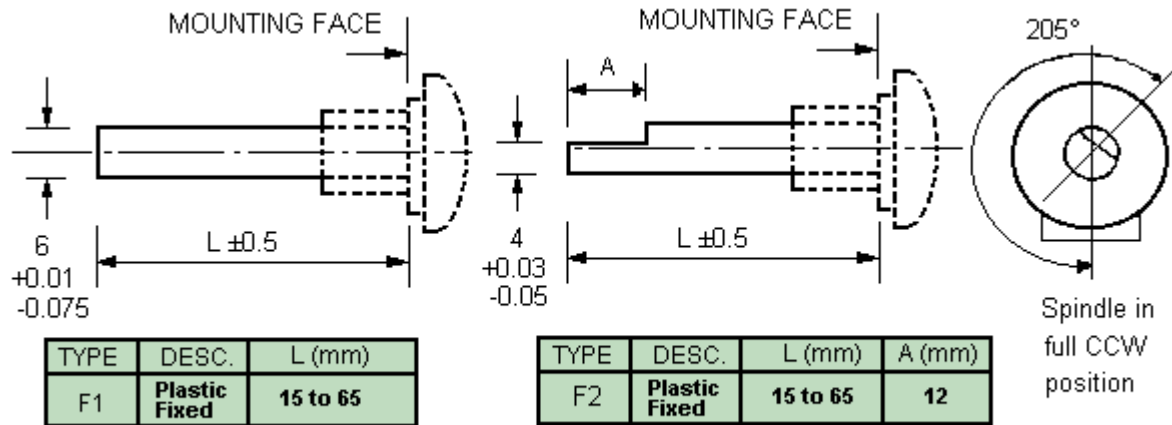
The P20 spindles are plastic and fixed i.e. not removable, unless otherwise stated and they are available in three diameters:

- 6.0mm Diameter
 - Cylindrical (Type F1)
 - 4.0 x 12mm Flat (Type F2)
 - 5.0 x 15mm Flat (Type F3)
 - 5.0 x 10mm Flat (Type F4)
 - 4.6mm x 15mm Flat (Type F11)
- 4.0mm Diameter
 - Cylindrical (Type F21)
 - 3.0 x 8.5mm Flat (Type F22)
 - 3.0 x 13.5mm Flat (Type F23)
 - Cylindrical (Type M21 - Metal)
 - 3.0 x 8.5mm Flat (Type M22 - Metal)
 - 3.0 x 13.5mm Flat (Type M23 - Metal)
- 6.35mm Diameter
 - Cylindrical (Type F41)
 - 5.5 x 10mm Flat (Type F42)
 - 5.5 x 15mm Flat (Type F43)
- Splined Spindle - 6.0mm dia. 18 teeth
- Dual Concentric
 - Flatted/Slotted (Type M15 - Metal)
 - Cylindrical (Type M16 - Metal)

6.0mm Diameter Spindles

Note: *Specials to customer's specification up to 65mm.

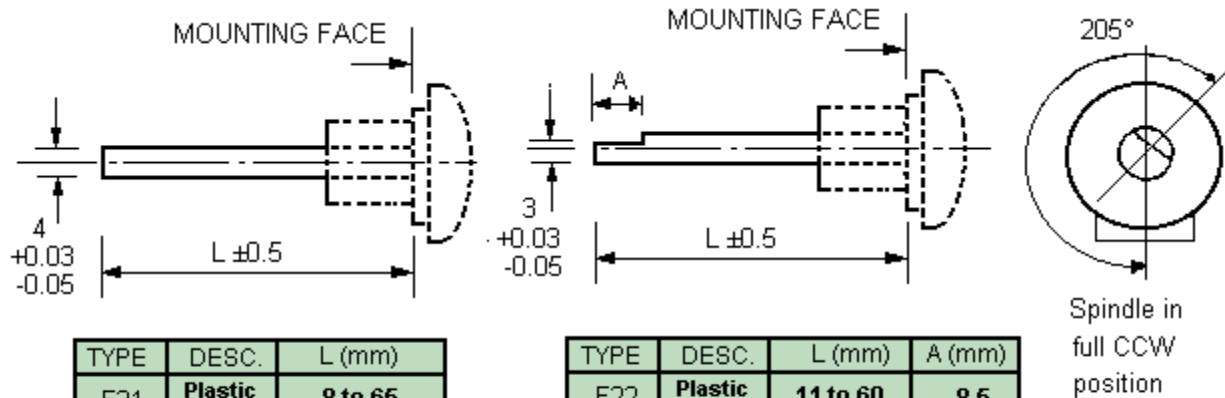
REMOVABLE SPINDLES, similar in specification to 'fixed' spindles are supplied separate from the potentiometer. These can be indefinitely taken in and out and their holding strength is >1kg.



4.0mm Diameter Spindles

Note: The orientation of the flat as illustrated is for plastic spindles only.

For metal spindles, unless specified on the order, the orientation may be different on each potentiometer type.

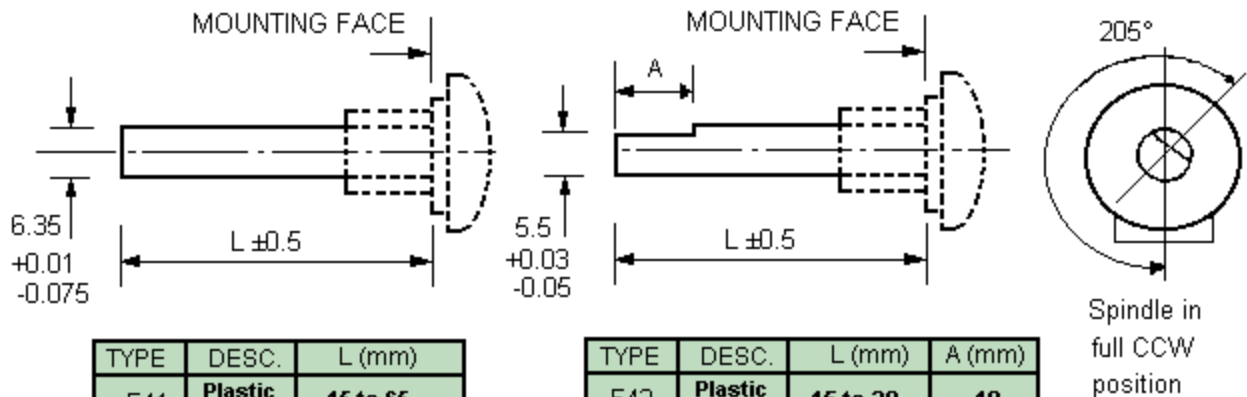


TYPE	DESC.	L (mm)
F21	Plastic Fixed	8 to 65
M21	Metal Fixed	8 to 65

TYPE	DESC.	L (mm)	A (mm)
F22	Plastic Fixed	11 to 60	8.5
M22	Metal Fixed	11 to 60	8.5
F23	Plastic Fixed	16 to 60	13.5
M23	Metal Fixed	16 to 60	13.5

6.35mm Diameter Spindles

Note: *Specials to customer's specification up to 65mm.

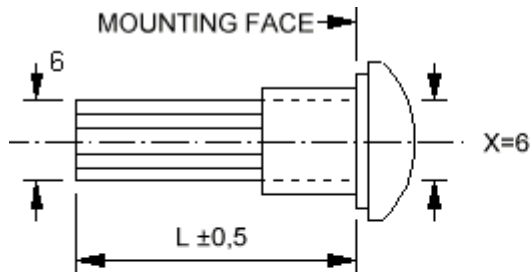


TYPE	DESC.	L (mm)
F41	Plastic Fixed	15 to 65

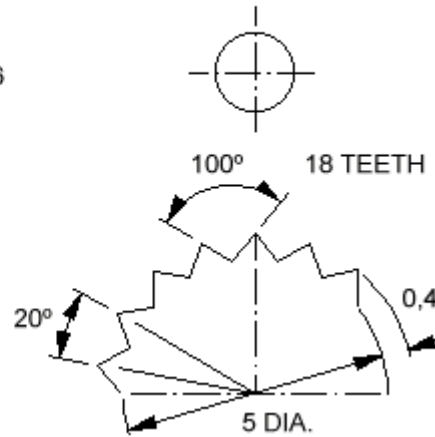
TYPE	DESC.	L (mm)	A (mm)
F42	Plastic Fixed	15 to 20	10
F43	Plastic Fixed	20 to 60	15

Splined Spindle - 6.0mm dia. 18 teeth

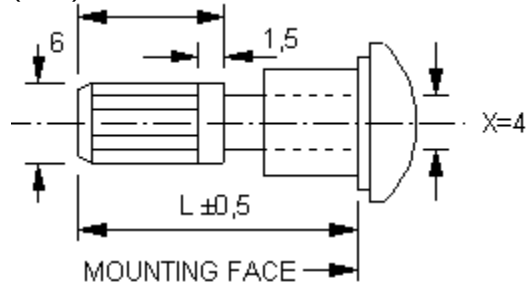
A splined form is available on the 6.0mm diameter P20 plastic spindle (F5) or alternatively a 6mm 'Splined Adaptor' (8,7mm long) can be fitted on a 4mm dia. Spindle



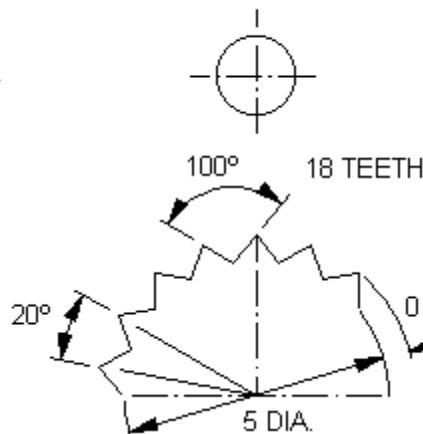
TYPE	DESC.	L (mm)
F5	Plastic Fixed	19



(F5A):

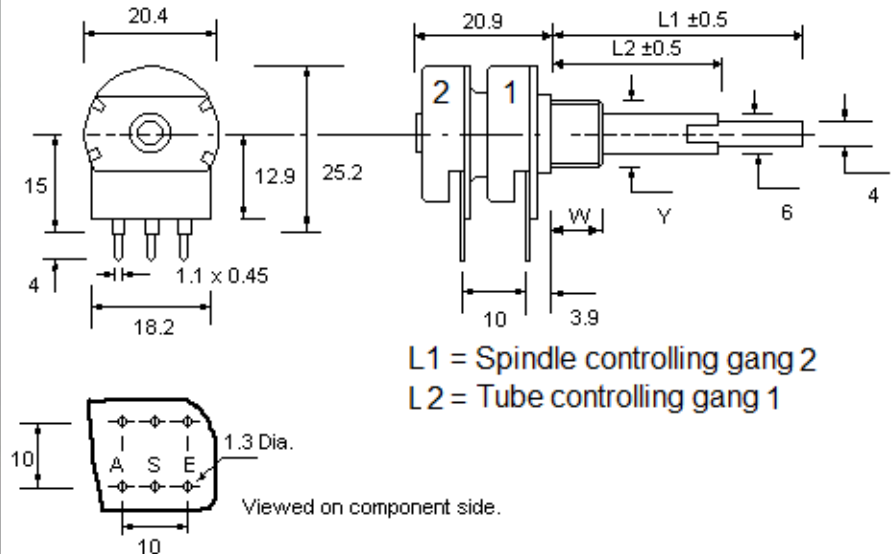


TYPE	DESC.	L (mm)
F5A	Plastic Fixed	16-36

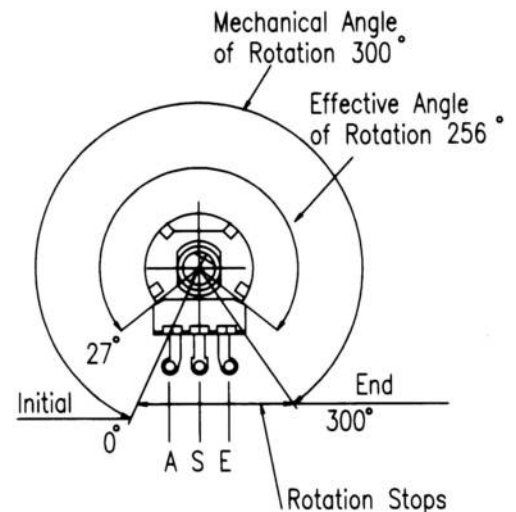


PC2C20BU

PC – Printed Circuit Terminals



SPINDLE END VIEW



- W Mounting Height
- Y Mounting Diameter
- X Spindle Diameter
- L Spindle Length
- A Initial Termination
- S Wiper (or moving contact) termination
- E End Termination

Prefix (Potentiometer terminals)

- BR - Bracket (included with printed circuit terminals)
- FN - Faston (or spade)
- LA - Long bent and away from the spindle
- LT - Long bent and towards the spindle
- OW - Ordinary wiring (eyelets) - **recommended for hand soldering of wires**
- PC - Printed circuit
- XA - Extra long, bent away from the spindle (mainly used with switches)

Total mechanical and effective electrical angles of rotation of potentiometers without rotary switch

Technical Data

Rated Power Dissipation @40°C for P20 potentiometers:

0.4W linear law

0.2W nonlinear law

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Effective rotation: 256° nominal

Operating Torque: 0.4 – 1.5 cN.m

Permissible Axial Spindle Load: 100 N (5 Sec. maximum)

Permissible Torque at End Stop: 80 cN.m

Rotation angle: 300° ±5°

Rotational torque of spindle can be made high or low

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Insulation Resistance: >= 4 Gohms

Rated Resistance: E3 Series

Optional: E6 Series

Linear Law: 1K – 1M (±10%)

Nonlinear Law: 4K7 – 470K

ELECTRICAL SPECIFICATION COMMON TO ALL POTENTIOMETERS

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Insulation Resistance: >= 4 Gohms

Rated Resistance: E3 Series

- Optional: E6 Series
- Linear Law: 1K - 1M
- Nonlinear Law: 4K7 - 470K

Tolerance on Rated Resistance: ± 20%

- Optional Tolerance on 1K - 1M: ± 10%

Resistance Laws (Taper):

- Linear: A
- Nonlinear: B - Log (Audio) or C - Antilog (Reverse Audio)
- Other laws: Please refer to Sales office

ELECTRICAL SPECIFICATION UNIQUE TO P20 POTENTIOMETERS

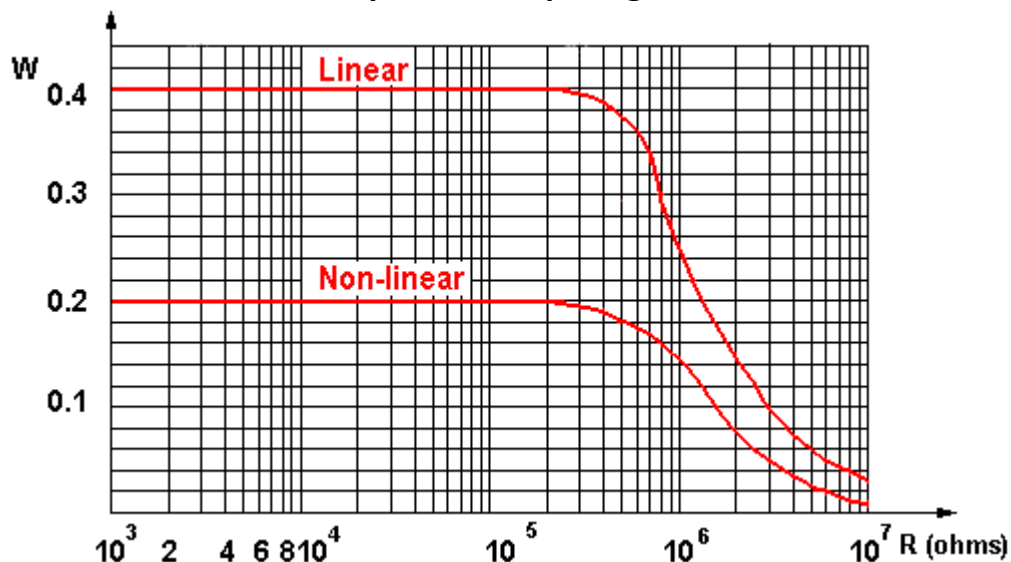
Effective rotation:

- Without a switch: 256° nominal
- With switch: 243° nominal
- With rotary switch: 243° nominal

Rated Power Dissipation @40°C for P20 potentiometers:

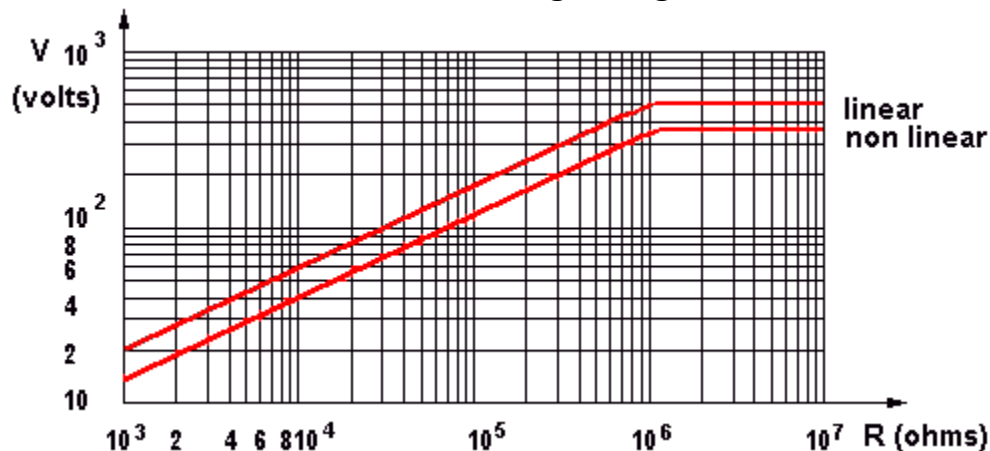
- 0.4W linear law
- 0.2W nonlinear law

P20 power dissipating curve



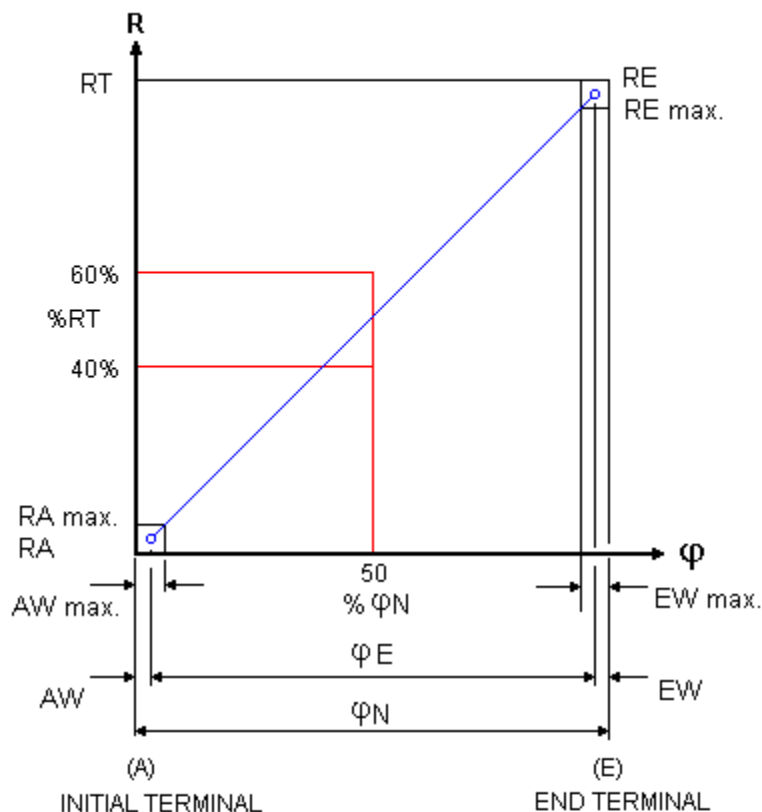
Limiting Element Voltage: 500 V DC for 20mm potentiometers

P20 maximum working voltage curve



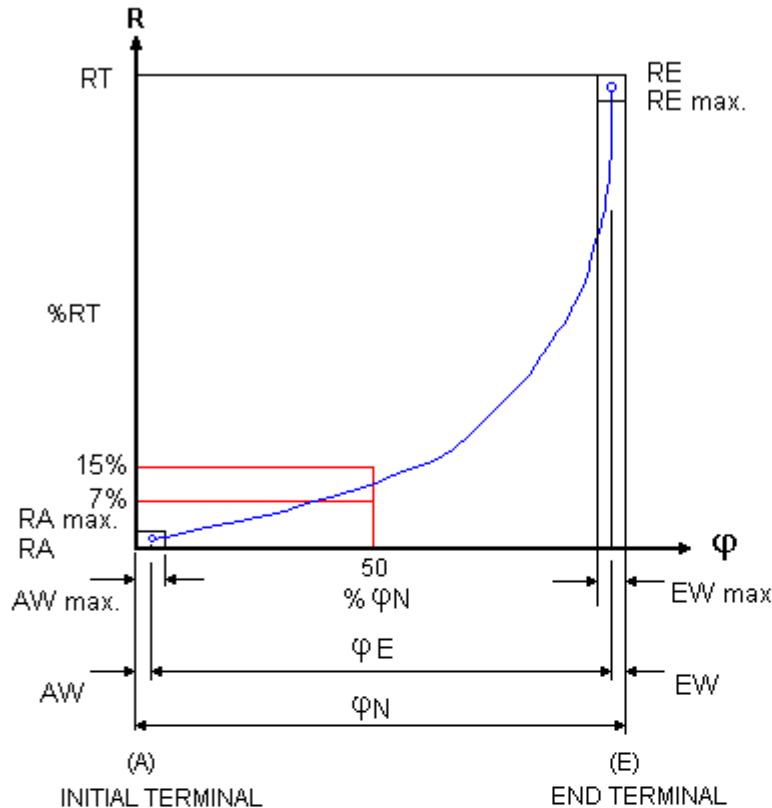
Insulating Voltage: 1000 V AC for 20mm potentiometers

Resistance law A - Linear



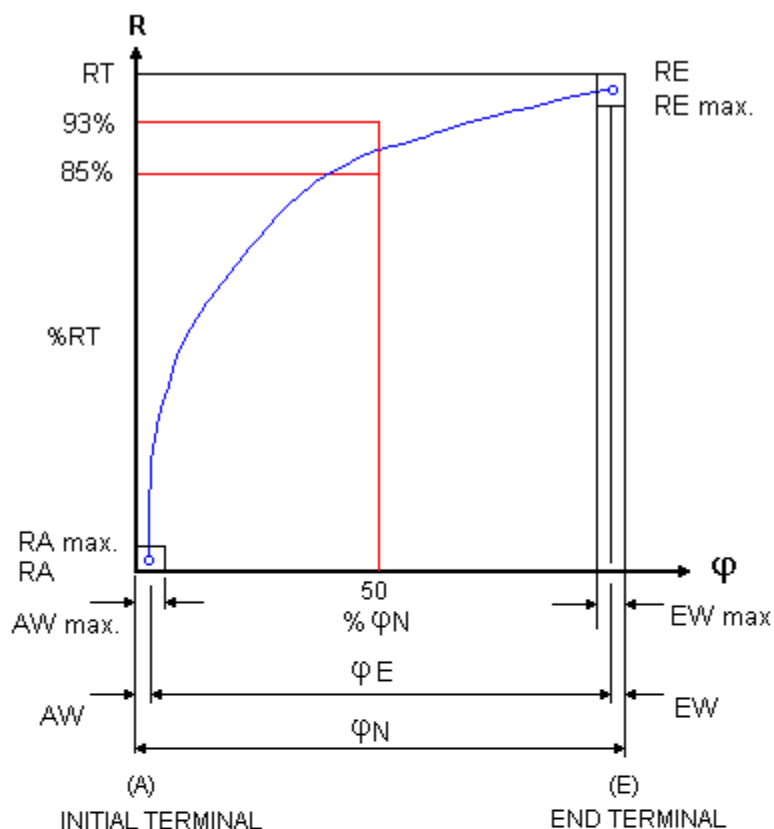
AW	Initial Path	AW max. 12% ϕ_N
EW	Final Path	EW max. 12% ϕ_N
Ra	Initial Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RA	Hop-on Resistance	$\leq 1\% RN$
Re	End Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RE	Hop-off Resistance	$\leq 1\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕ_E	Effective Electrical Angle of Rotation	
ϕ_N	Effective Mechanical Angle of Rotation	

Resistance law B – Log (Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RA	Hop-on Resistance	$RN \leq 10K$ 5% RN $RN > 10K$ 0.15% RN
Re	End Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RE	Hop-off Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K$ 0.5% RN
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

Resistance law C – Antilog (Reverse Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RA	Hop-on Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K 0.5\% RN$
Re	End Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RE	Hop-off Resistance	$RN \leq 10K 5\% RN$ $RN > 10K 0.15\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

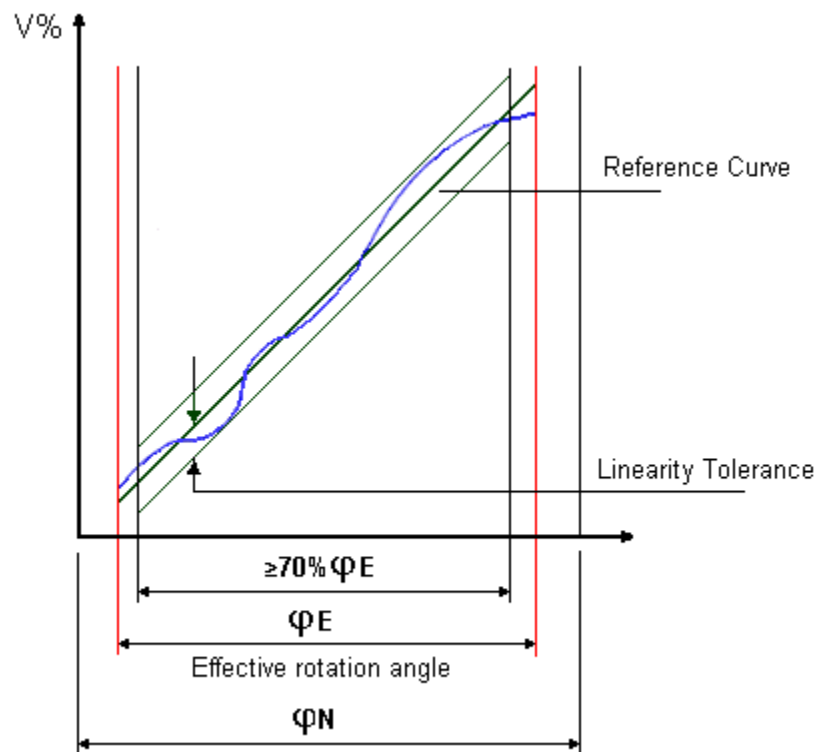
Linearity

As a basis of assessing Linearity Tolerance the independent method is the most practical, permitting as it does, the reference curve to be aligned as near as possible to the actual output curve. This avoids the use of the theoretical starting and finishing points, it is normal for the customer to realign the achieved curve with series trimmers at each end of the device if required.

Linearity Tolerance is 4% over the Nominal Resistance range of 1K Ω to 1M Ω . The Linearity Tolerance is measured on at least 70% of the effective rotation range.

Note. In the case of Terminal and Zero-based linearity, both present constraints which increase the manufacturing difficulty and in consequence have an adverse effect on the product's price and availability.

Potentiometer linearity

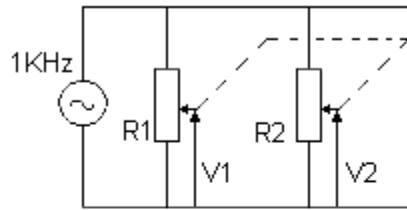


Matching Tolerance (For Tandem Stereo Potentiometers)

Tandem Potentiometers have two identical resistor units with the same variation law. The mismatching of the two resistor units, expressed in dB, is measured by the difference between the attenuations introduced by each resistor unit at various points of travel.

- Law A: 4 dB at Attenuation range 0 - 20 dB
- Law B and C: 3 dB at Attenuation range 0 - 20 dB

Matched Tolerance for Stereo

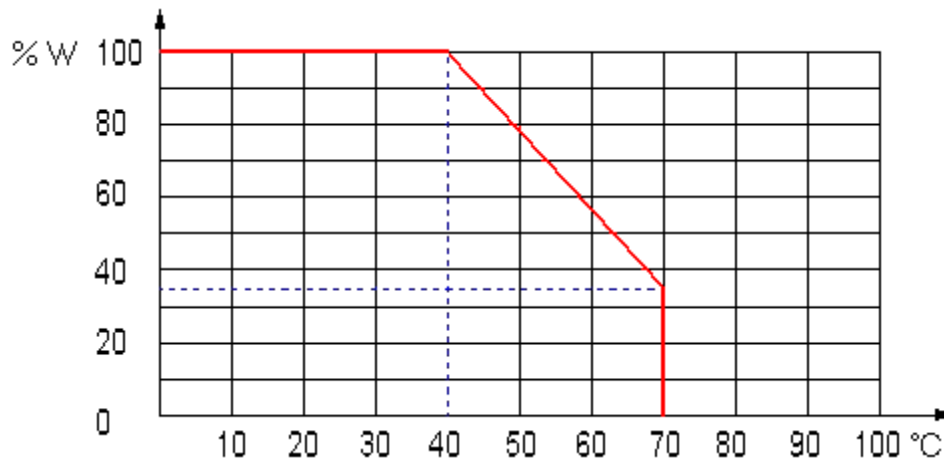


LAW	ATTENUATION RANGE	MATCHING TOLERANCE *
A	0 - 20dB	4dB
B & C	0 - 20dB	3dB

$$* \text{Matching Tolerance} = 20 \log \frac{V1}{V2}$$

Operating Temperature: -25°C to +70°C

Temperature Derating Curve



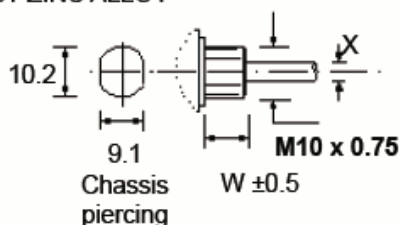
Temperature Coefficient of Resistance: +300 -500 ppm

Components

P20 Bush Housing (Mounting)

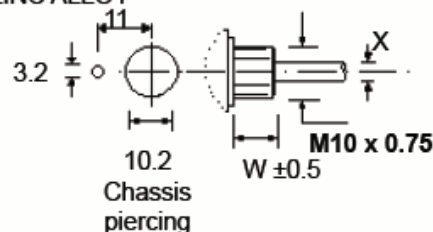
The P20 bushes are available in metal or nylon; with three thread options; and with or without a locating feature:

DIECAST ZINC ALLOY



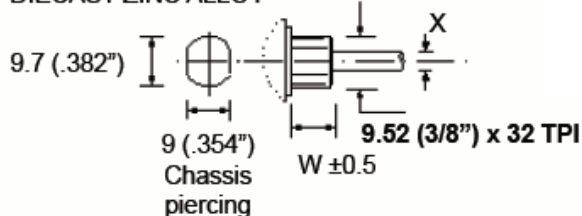
Type C (without locator)	
X (mm)	6
W (mm)	9

DIECAST ZINC ALLOY



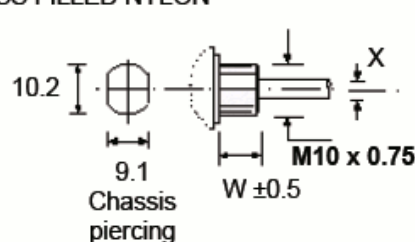
Type CEBS (with locator)	
X (mm)	6
W (mm)	9

DIECAST ZINC ALLOY

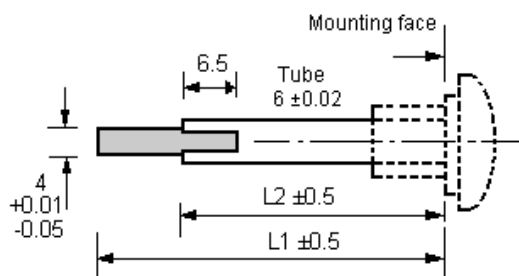


Type CBS (without locator)	
X (mm)	6
W (mm)	8 or 12

GLASS FILLED NYLON



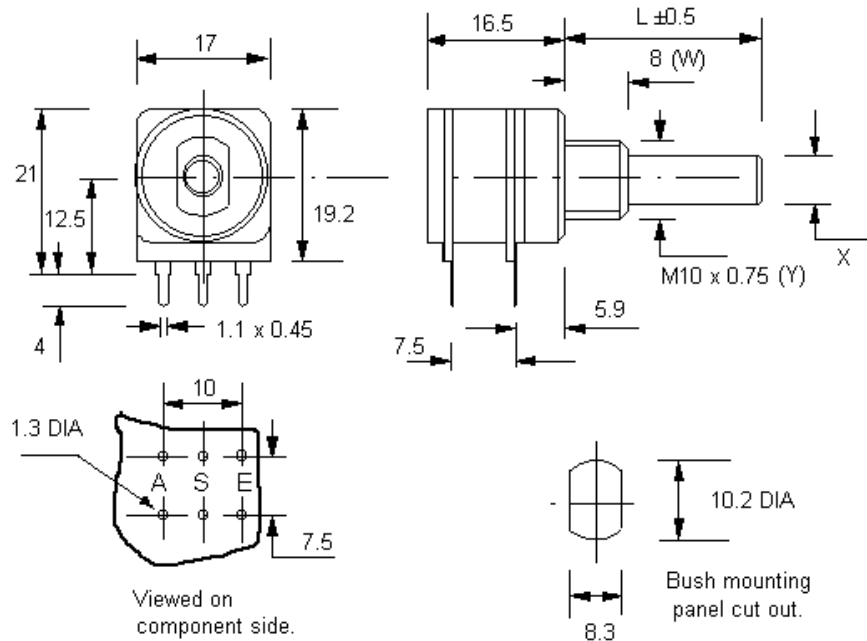
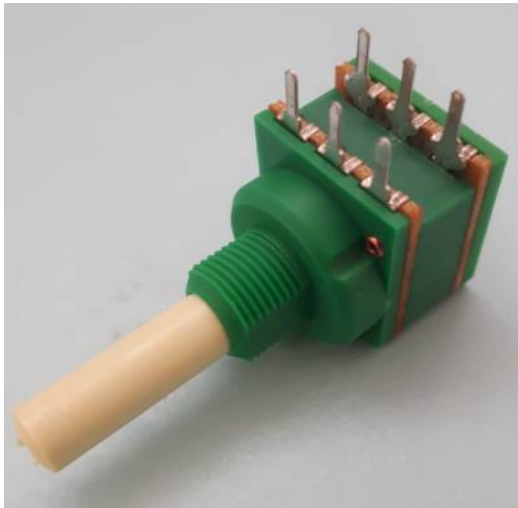
Type CP (GFN)		
X (mm)	6	6.35
W (mm)	7 or 10	7 or 10



TYPE	DESC.	L1 (mm)	L2 (mm)
M15	Metal Fixed	60 (max.)	50 (max.)

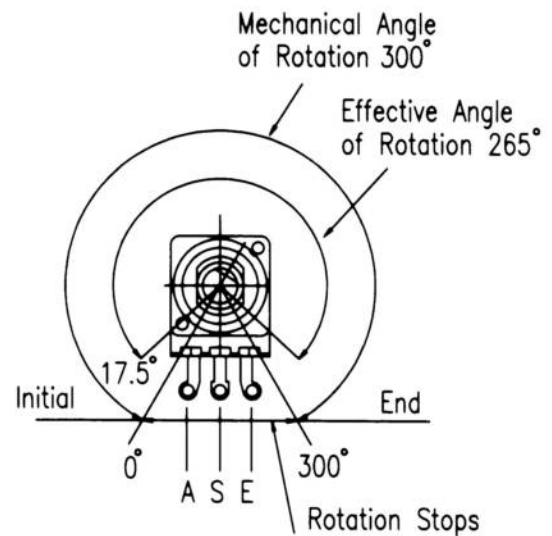
PC2G16ECO

PC – For Printed Circuit
2G – 2 Gang (two tracks)



SPINDLE END VIEW

- W Mounting Height
- Y Mounting Diameter
- X Spindle Diameter
- L Spindle Length
- A Initial Termination
- S Wiper (or moving contact) termination
- E End Termination



Total mechanical and effective electrical angles of rotation of potentiometers without rotary switch

Technical Data

Rated Power Dissipation @40°C for ECO potentiometers:

0.25W linear law

0.12W nonlinear law

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Effective rotation: 265° nominal

Operating Torque: 0.4 – 1.5 cN.m

Permissible Axial Spindle Load: 50 N (5 Sec. maximum)

Permissible Torque at End Stop: 35 cN.m

Rotation angle: 300° ±5°

Optional Click stop (indents) for rotational tactile feedback

Rotational torque of spindle can be made high or low

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Insulation Resistance: >= 4 Gohms

Rated Resistance: E3 Series

Optional: E6 Series

Linear Law: 1K – 1M

Nonlinear Law: 4K7 – 470K

ELECTRICAL SPECIFICATION COMMON TO ALL POTENTIOMETERS

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Insulation Resistance: >= 4 Gohms

Rated Resistance: E3 Series

- Optional: E6 Series
- Linear Law: 1K - 1M
- Nonlinear Law: 4K7 - 470K

Tolerance on Rated Resistance: ± 20%

- Optional Tolerance on 1K - 1M: ± 10%

Resistance Laws (Taper):

- Linear: A
- Nonlinear: B - Log (Audio) or C - Antilog (Reverse Audio)
- Other laws: Please refer to Sales office

ELECTRICAL SPECIFICATION UNIQUE TO ECO POTENTIOMETERS

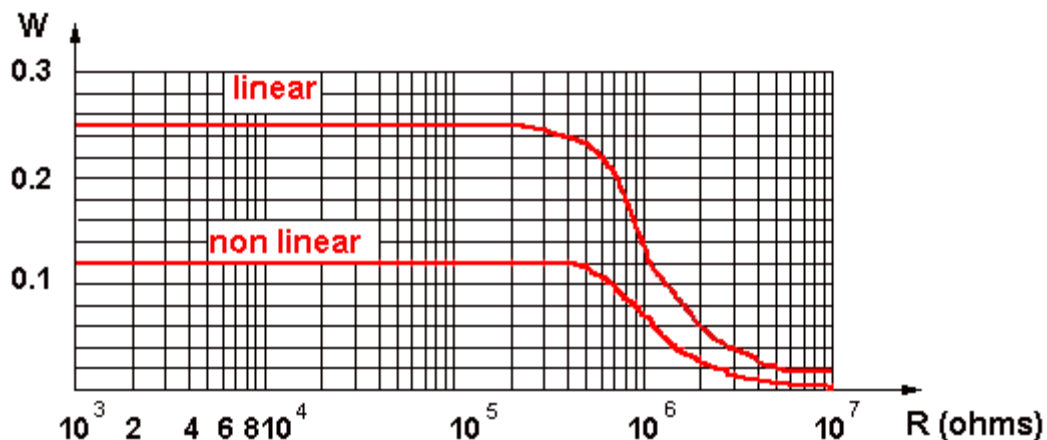
Effective rotation:

- Without a switch: 265° nominal
- With push push switch (/10APP, /MS): 265° nominal
- With rotary switch: 242° nominal

Rated Power Dissipation @40°C for ECO potentiometers:

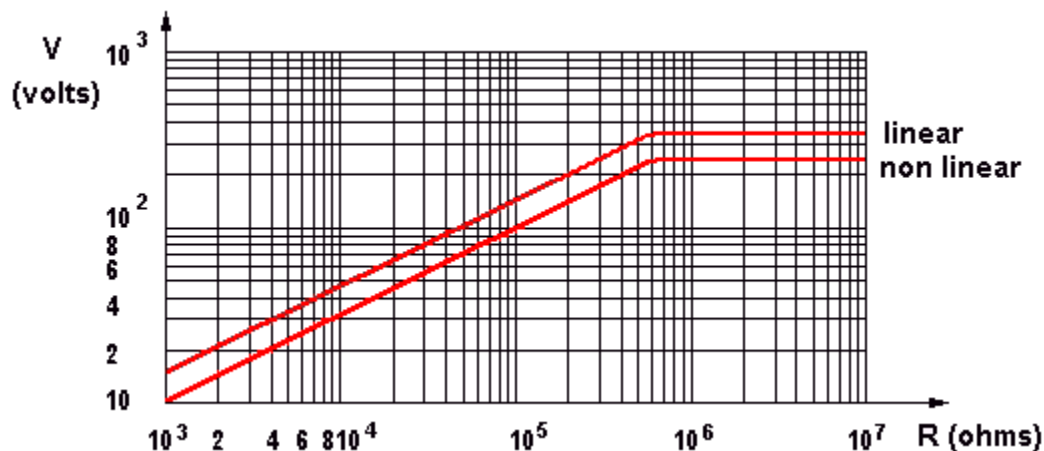
- 0.25W linear law
- 0.12W nonlinear law

ECO, P16 power dissipating curve



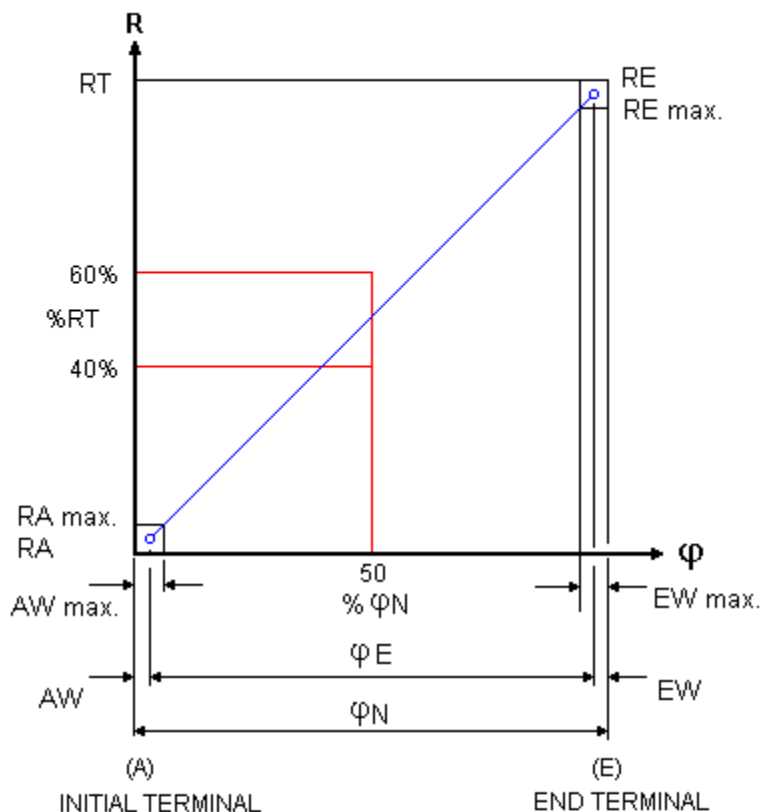
Limiting Element Voltage: 350 V DC for 16mm potentiometers

ECO, P16 maximum working voltage curve



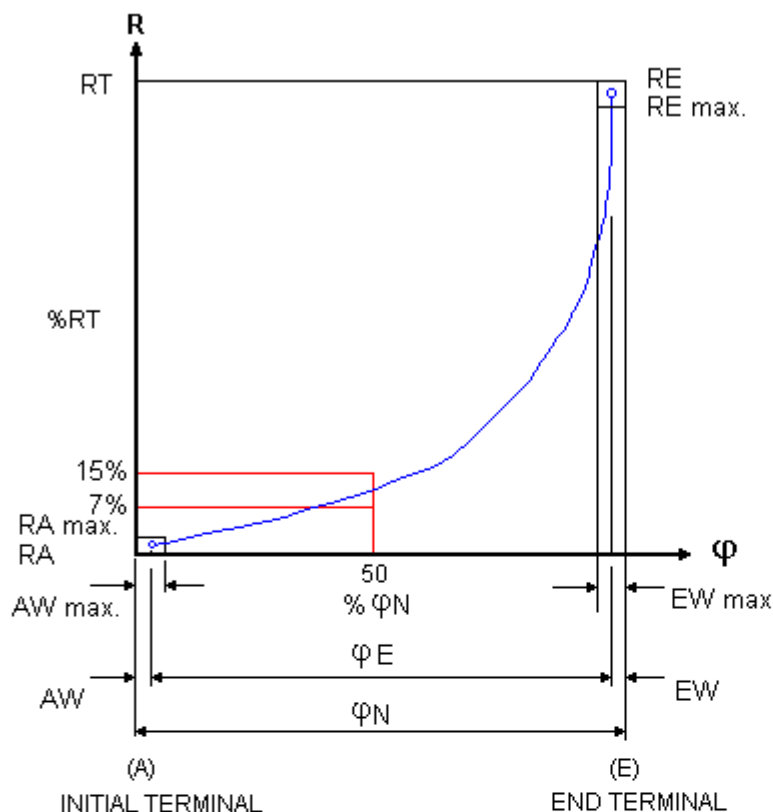
Insulating (Breakdown) Voltage: 2,500 V AC for ECO Potentiometers

Resistance law A - Linear



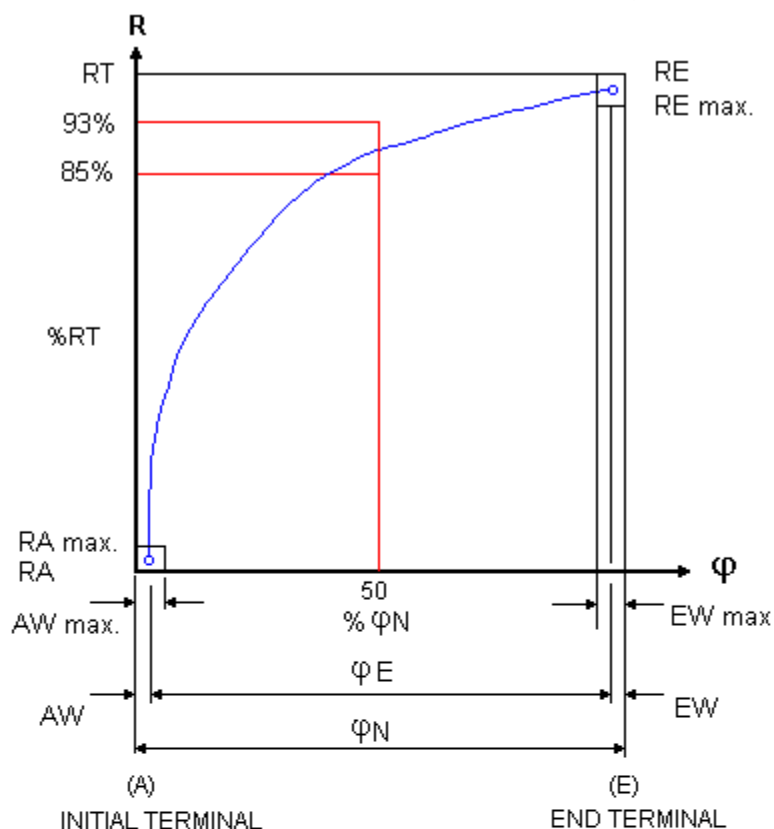
AW	Initial Path	AW max. 12% ϕN
EW	Final Path	EW max. 12% ϕN
Ra	Initial Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RA	Hop-on Resistance	$\leq 1\% RN$
Re	End Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RE	Hop-off Resistance	$\leq 1\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

Resistance law B – Log (Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RA	Hop-on Resistance	$RN \leq 10K$ 5% RN $RN > 10K$ 0.15% RN
Re	End Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RE	Hop-off Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K$ 0.5% RN
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

Resistance law C – Antilog (Reverse Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RA	Hop-on Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K 0.5\% RN$
Re	End Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RE	Hop-off Resistance	$RN \leq 10K 5\% RN$ $RN > 10K 0.15\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

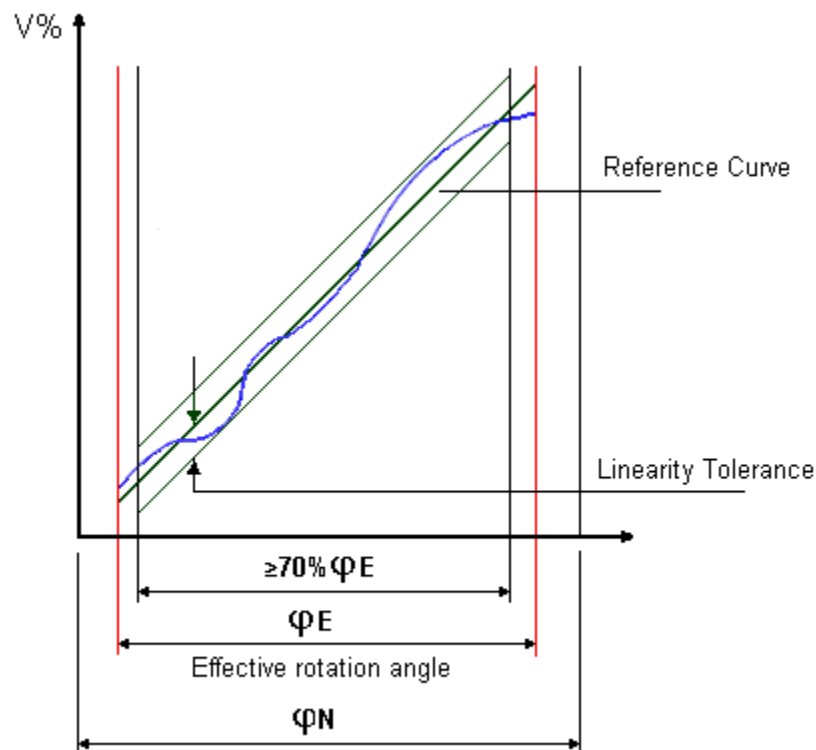
Linearity

As a basis of assessing Linearity Tolerance the independent method is the most practical, permitting as it does, the reference curve to be aligned as near as possible to the actual output curve. This avoids the use of the theoretical starting and finishing points, it is normal for the customer to realign the achieved curve with series trimmers at each end of the device if required.

Linearity Tolerance is 4% over the Nominal Resistance range of 1K Ω to 1M Ω . The Linearity Tolerance is measured on at least 70% of the effective rotation range.

Note. In the case of Terminal and Zero-based linearity, both present constraints which increase the manufacturing difficulty and in consequence have an adverse effect on the product's price and availability.

Potentiometer linearity

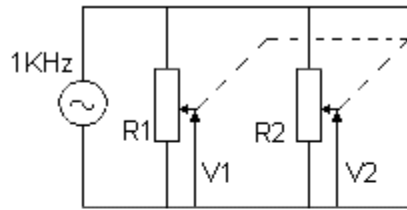


Matching Tolerance (For Tandem Stereo Potentiometers)

Tandem Potentiometers have two identical resistor units with the same variation law. The mismatching of the two resistor units, expressed in dB, is measured by the difference between the attenuations introduced by each resistor unit at various points of travel.

- Law A: 4 dB at Attenuation range 0 - 20 dB
- Law B and C: 3 dB at Attenuation range 0 - 20 dB

Matched Tolerance for Stereo

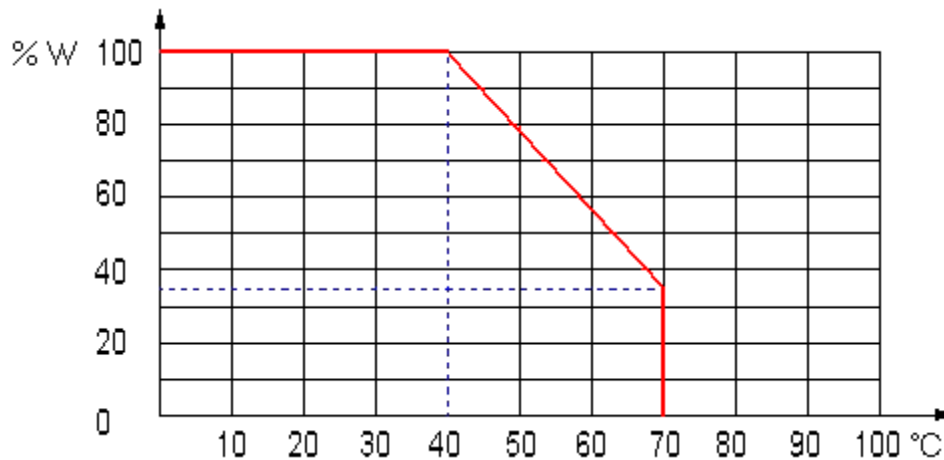


LAW	ATTENUATION RANGE	MATCHING TOLERANCE *
A	0 - 20dB	4dB
B & C	0 - 20dB	3dB

$$\text{*Matching Tolerance} = 20 \log \frac{V1}{V2}$$

Operating Temperature: -25°C to +70°C

Temperature Derating Curve



Temperature Coefficient of Resistance: +300 -500 ppm

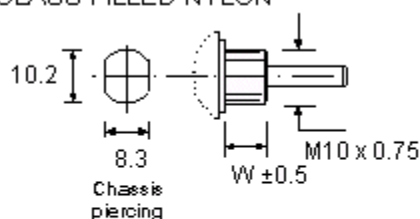
Components

ECO Bush Housing (Mounting)

The ECO bush housing is made of glass filled nylon, the thread is M10 x0.75mm pitch and 8mm long, alternatively **a 12mm long thread is also available** from October 2008.

Do not attempt to prevent any unwanted body rotation by overtightening the retaining nut, since this can cause thread damage, distortion, change of electrical resistance and restrict shaft rotation. BS9130:1972 provides further details on this topic. The **recommended torque** for tightening the retaining nut is 45cN.m and this can be achieved cost effectively by using a Torque Limiting device as shown on our **Accessories** page.

GLASS FILLED NYLON



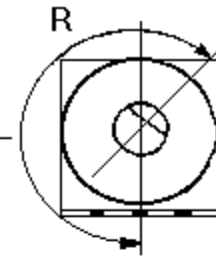
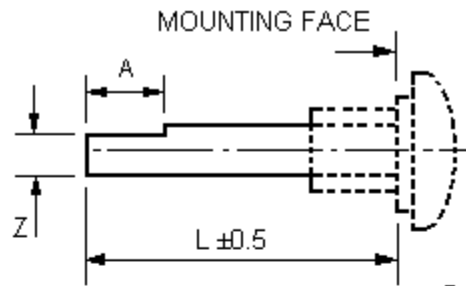
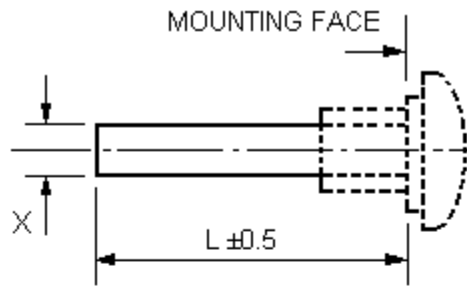
TYPE PLASTIC BODY	
W(mm)	8 (optional 12)

ECO Spindles

The ECO plastic spindles are fixed and not removable.
They are available in the following three diameters:

- 6.0mm Diameter - Length (L) available from 14mm to 65mm
 - Cylindrical (Type F1)
 - 4.0 x 12mm Flat (Type F2)
 - 5.0 x 15mm Flat (Type F3)
 - 5.0 x 10mm Flat (Type F4)
 - 4.6mm x 15mm Flat (Type F11)
 - 4.0 x 8mm Flat (Type F13)
 - 5.0 x 8mm Flat (Type F14)
- 4.0mm Diameter - Length (L) available from 14mm to 35mm
 - Cylindrical (Type F21)
 - 3.0 x 8.5mm Flat (Type F22)
- 6.35mm Diameter - Length (L) available from 14mm to 65mm
 - Cylindrical (Type F41)
 - 5.5 x 10mm Flat (Type F42)

Cylindrical and Flatted Spindles



Spindle in full CCW position

TYPE	DESC. (Ø)	L (mm)
F21	4 mm Dia Plastic	14 - 35
F1	6 mm Dia Plastic	14 - 65
F41	6.35mm Dia Plastic	14 - 65

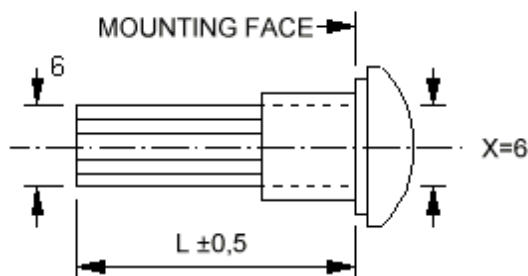
All spindles fixed.

TYPE	DESC. (Ø)	L (mm)	Flat (ZxA)
F22	4 mm Dia Plastic	14 - 35	3 x 8.5
F13	6 mm Dia Plastic	14 - 65	4 x 8
F2	6 mm Dia Plastic	14 - 65	4 x 12
F14	6 mm Dia Plastic	14 - 65	5 x 8
F4	6 mm Dia Plastic	14 - 65	5 x 10
F3	6 mm Dia Plastic	14 - 65	5 x 15
F11	6 mm Dia Plastic	14 - 65	4.6 x 15
F42	6.35mm Dia Plastic	14 - 65	5.5 x 10

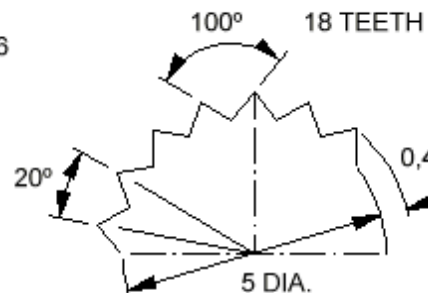
Standard flat angle
R = 210°

Splined Spindle (6.0mm diameter)

A splined form is also available on the 6.0mm diameter ECO plastic spindle.

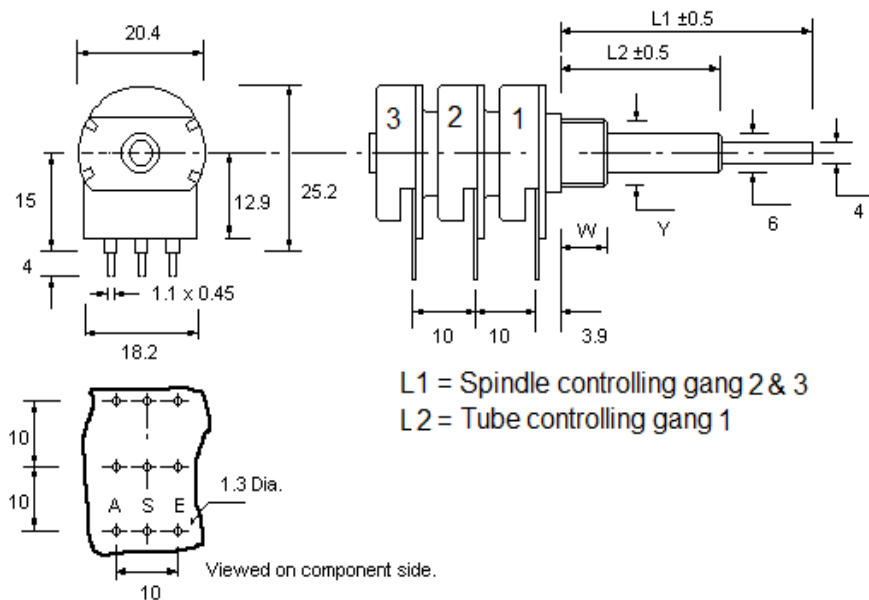


TYPE	DESC.	L (mm)
F5	Plastic Fixed	14 - 30



PC3C20BU

PC – Printed Circuit Terminals

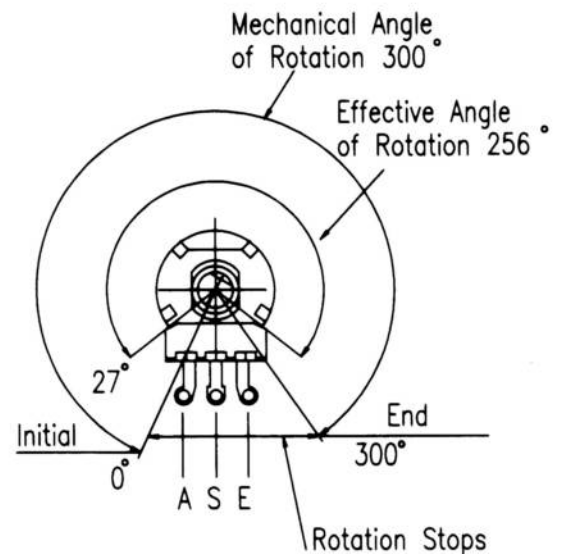


- W Mounting Height
- Y Mounting Diameter
- X Spindle Diameter
- L Spindle Length
- A Initial Termination
- S Wiper (or moving contact) termination
- E End Termination

Prefix (Potentiometer terminals)

- BR - Bracket (included with printed circuit terminals)
- FN - Faston (or spade)
- LA - Long bent and away from the spindle
- LT - Long bent and towards the spindle
- OW - Ordinary wiring (eyelets) - **recommended for hand soldering of wires**
- PC - Printed circuit
- XA - Extra long, bent away from the spindle (mainly used with switches)

SPINDLE END VIEW



Total mechanical and effective electrical angles of rotation of potentiometers without rotary switch

Technical Data

Rated Power Dissipation @40°C for P20 potentiometers:

0.4W linear law

0.2W nonlinear law

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Effective rotation: 256° nominal

Operating Torque: 0.4 – 1.5 cN.m

Permissible Axial Spindle Load: 100 N (5 Sec. maximum)

Permissible Torque at End Stop: 80 cN.m

Rotation angle: 300° ±5°

Rotational torque of spindle can be made high or low

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Insulation Resistance: >= 4 Gohms

Rated Resistance: E3 Series

Optional: E6 Series

Linear Law: 1K – 1M (±10%)

Nonlinear Law: 4K7 – 470K

ELECTRICAL SPECIFICATION COMMON TO ALL POTENTIOMETERS

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Insulation Resistance: >= 4 Gohms

Rated Resistance: E3 Series

- Optional: E6 Series
- Linear Law: 1K - 1M
- Nonlinear Law: 4K7 - 470K

Tolerance on Rated Resistance: ± 20%

- Optional Tolerance on 1K - 1M: ± 10%

Resistance Laws (Taper):

- Linear: A
- Nonlinear: B - Log (Audio) or C - Antilog (Reverse Audio)
- Other laws: Please refer to Sales office

ELECTRICAL SPECIFICATION UNIQUE TO P20 POTENTIOMETERS

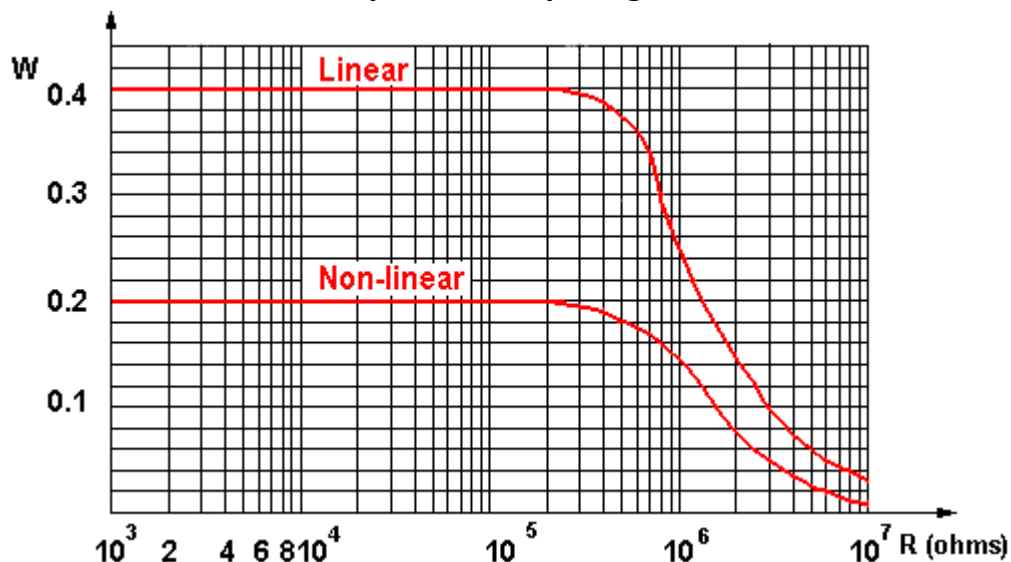
Effective rotation:

- Without a switch: 256° nominal
- With switch: 243° nominal
- With rotary switch: 243° nominal

Rated Power Dissipation @40°C for P20 potentiometers:

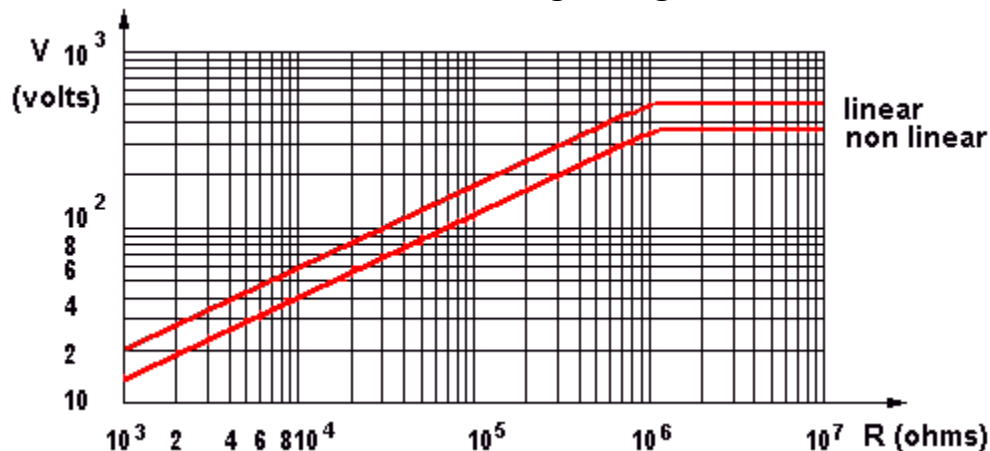
- 0.4W linear law
- 0.2W nonlinear law

P20 power dissipating curve



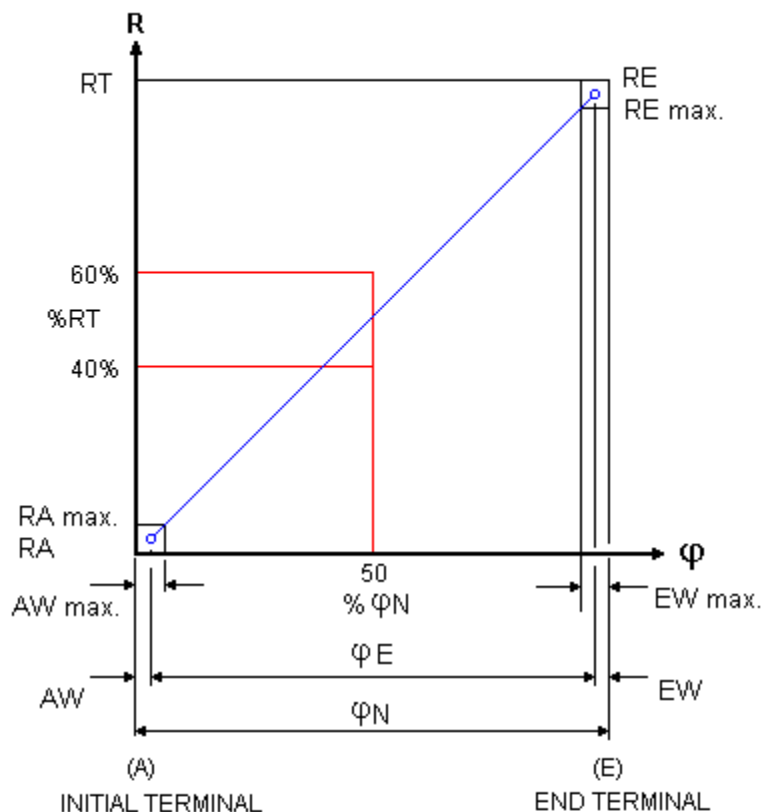
Limiting Element Voltage: 500 V DC for 20mm potentiometers

P20 maximum working voltage curve



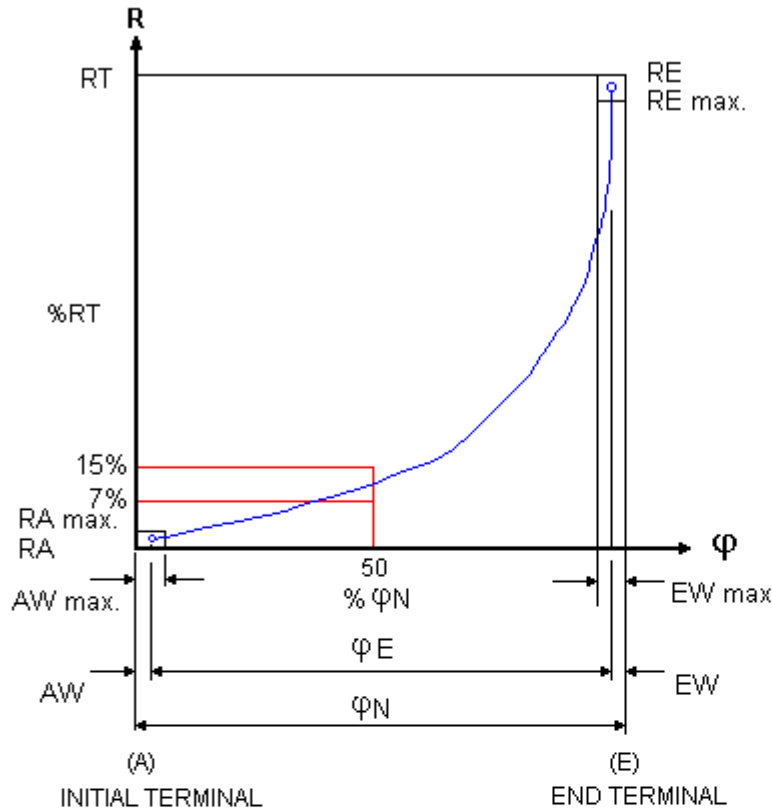
Insulating Voltage: 1000 V AC for 20mm potentiometers

Resistance law A - Linear



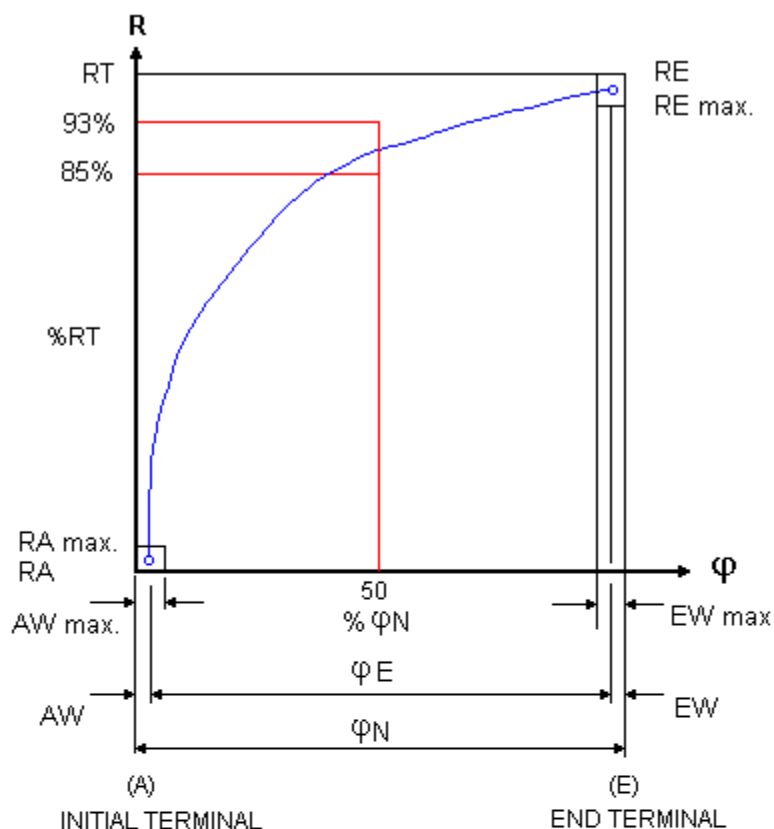
AW	Initial Path	AW max. 12% ϕN
EW	Final Path	EW max. 12% ϕN
Ra	Initial Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RA	Hop-on Resistance	$\leq 1\% RN$
Re	End Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RE	Hop-off Resistance	$\leq 1\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

Resistance law B – Log (Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RA	Hop-on Resistance	$RN \leq 10K$ 5% RN $RN > 10K$ 0.15% RN
Re	End Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RE	Hop-off Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K$ 0.5% RN
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

Resistance law C – Antilog (Reverse Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 100K \leq 2 \cdot 10^{-2} RN$ $RN > 100K \leq 1 \cdot 10^{-2} RN$
RA	Hop-on Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K 0.5\% RN$
Re	End Stop Value	$RN \leq 10K \leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2 \cdot 10^{-4} RN$ (Minimum 10 ohms)
RE	Hop-off Resistance	$RN \leq 10K 5\% RN$ $RN > 10K 0.15\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

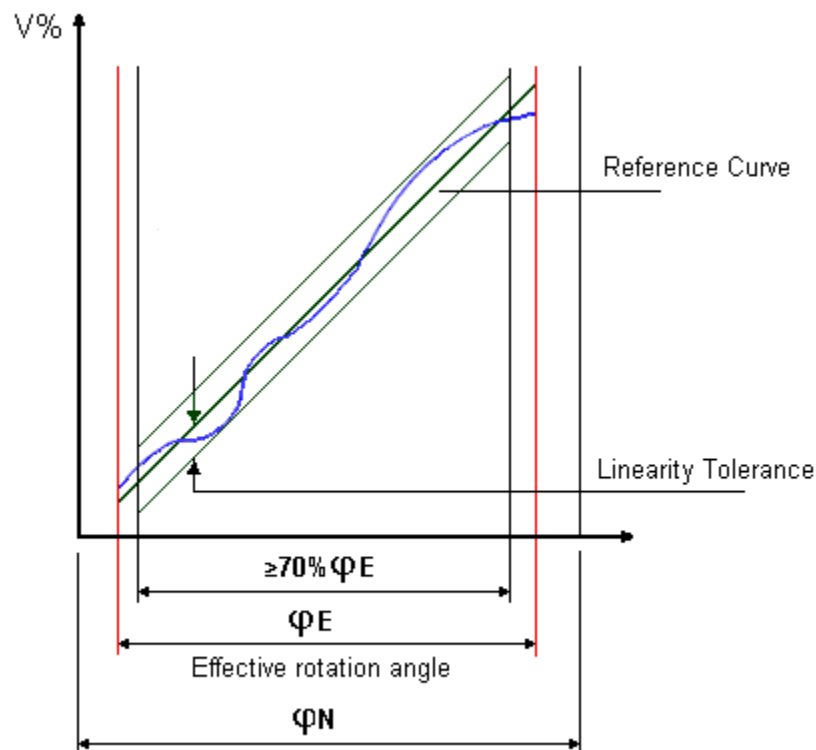
Linearity

As a basis of assessing Linearity Tolerance the independent method is the most practical, permitting as it does, the reference curve to be aligned as near as possible to the actual output curve. This avoids the use of the theoretical starting and finishing points, it is normal for the customer to realign the achieved curve with series trimmers at each end of the device if required.

Linearity Tolerance is 4% over the Nominal Resistance range of 1K Ω to 1M Ω . The Linearity Tolerance is measured on at least 70% of the effective rotation range.

Note. In the case of Terminal and Zero-based linearity, both present constraints which increase the manufacturing difficulty and in consequence have an adverse effect on the product's price and availability.

Potentiometer linearity

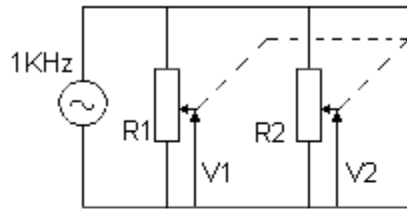


Matching Tolerance (For Tandem Stereo Potentiometers)

Tandem Potentiometers have two identical resistor units with the same variation law. The mismatching of the two resistor units, expressed in dB, is measured by the difference between the attenuations introduced by each resistor unit at various points of travel.

- Law A: 4 dB at Attenuation range 0 - 20 dB
- Law B and C: 3 dB at Attenuation range 0 - 20 dB

Matched Tolerance for Stereo

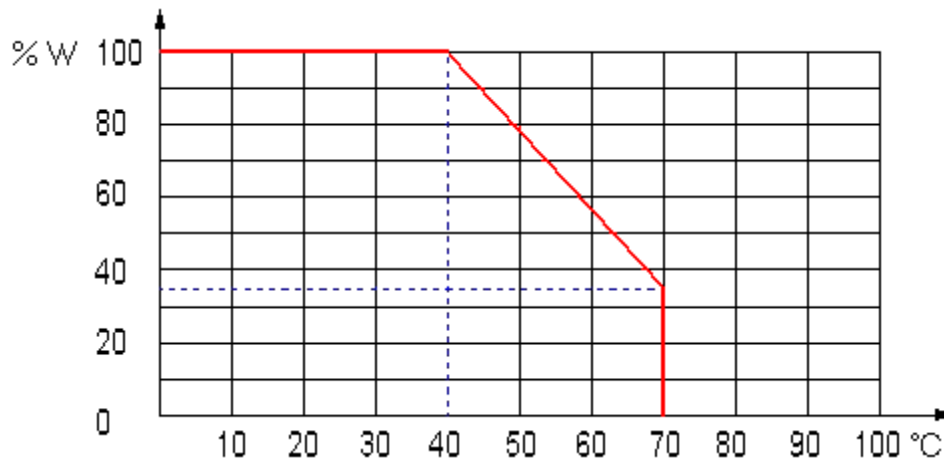


LAW	ATTENUATION RANGE	MATCHING TOLERANCE *
A	0 - 20dB	4dB
B & C	0 - 20dB	3dB

$$* \text{Matching Tolerance} = 20 \log \frac{V1}{V2}$$

Operating Temperature: -25°C to +70°C

Temperature Derating Curve



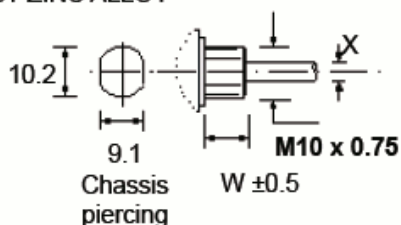
Temperature Coefficient of Resistance: +300 -500 ppm

Components

P20 Bush Housing (Mounting)

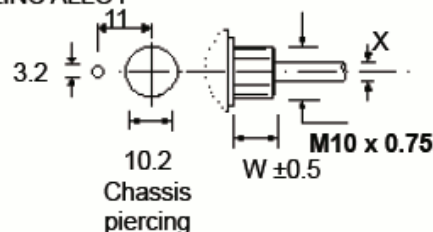
The P20 bushes are available in metal or nylon; with three thread options; and with or without a locating feature:

DIECAST ZINC ALLOY



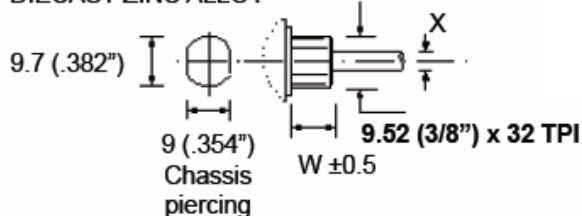
Type C (without locator)	
X (mm)	6
W (mm)	9

DIECAST ZINC ALLOY



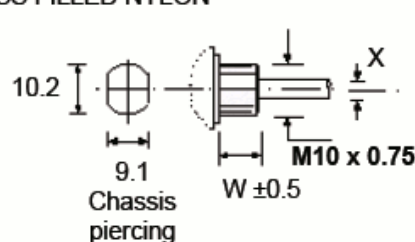
Type CEBS (with locator)	
X (mm)	6
W (mm)	9

DIECAST ZINC ALLOY

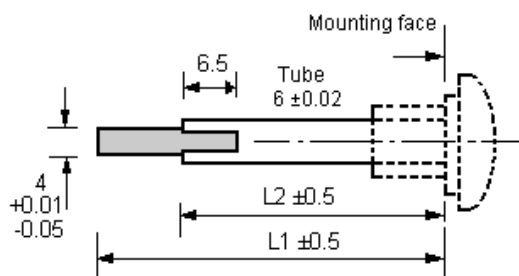


Type CBS (without locator)	
X (mm)	6
W (mm)	8 or 12

GLASS FILLED NYLON



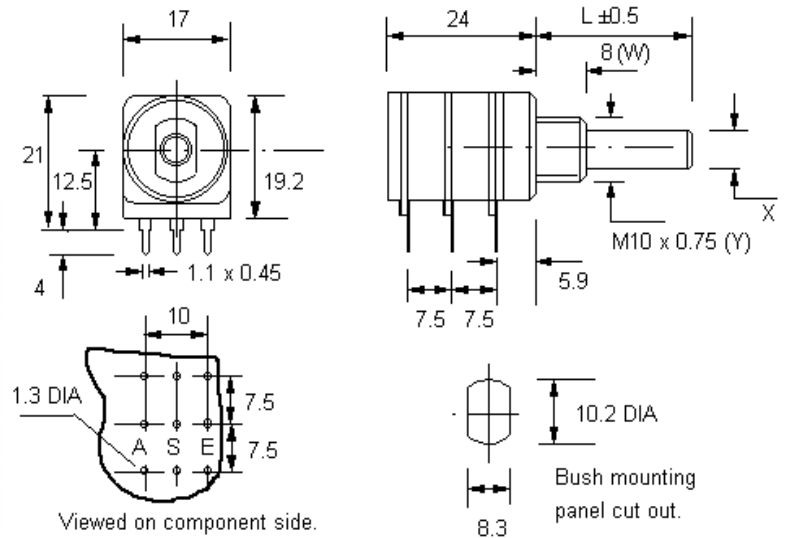
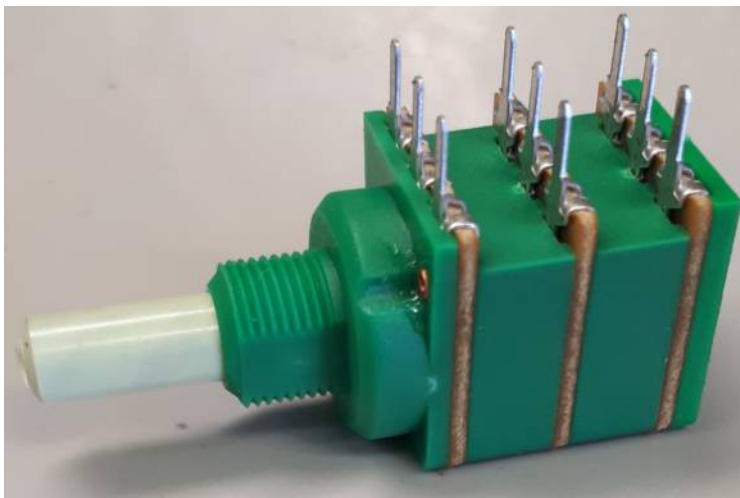
Type CP (GFN)		
X (mm)	6	6.35
W (mm)	7 or 10	7 or 10



TYPE	DESC.	L1 (mm)	L2 (mm)
M15	Metal Fixed	60 (max.)	50 (max.)

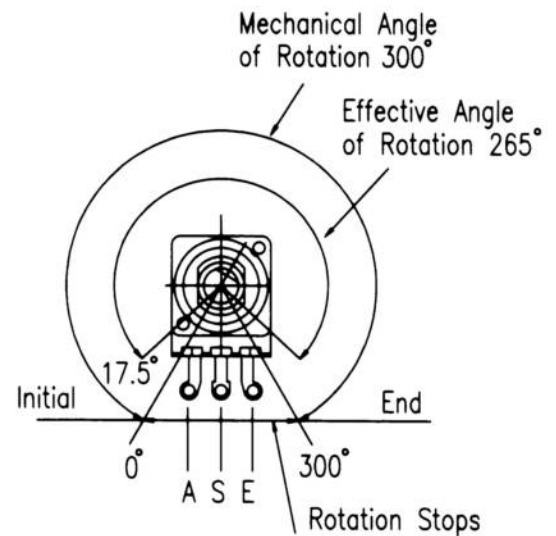
PC3G16ECO

PC – For Printed Circuit
3G – 3 Gang (three tracks)



SPINDLE END VIEW

- W Mounting Height
- Y Mounting Diameter
- X Spindle Diameter
- L Spindle Length
- A Initial Termination
- S Wiper (or moving contact) termination
- E End Termination



Total mechanical and effective electrical angles of rotation of potentiometers without rotary switch

Technical Data

Rated Power Dissipation @40°C for ECO potentiometers:

0.25W linear law

0.12W nonlinear law

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Effective rotation: 265° nominal

Operating Torque: 0.4 – 1.5 cN.m

Permissible Axial Spindle Load: 50 N (5 Sec. maximum)

Permissible Torque at End Stop: 35 cN.m

Rotation angle: 300° ±5°

Optional Click stop (indents) for rotational tactile feedback

Rotational torque of spindle can be made high or low

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Insulation Resistance: >= 4 Gohms

Rated Resistance: E3 Series

Optional: E6 Series

Linear Law: 1K – 1M

Nonlinear Law: 4K7 – 470K

ELECTRICAL SPECIFICATION COMMON TO ALL POTENTIOMETERS

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Insulation Resistance: >= 4 Gohms

Rated Resistance: E3 Series

- Optional: E6 Series
- Linear Law: 1K - 1M
- Nonlinear Law: 4K7 - 470K

Tolerance on Rated Resistance: ± 20%

- Optional Tolerance on 1K - 1M: ± 10%

Resistance Laws (Taper):

- Linear: A
- Nonlinear: B - Log (Audio) or C - Antilog (Reverse Audio)
- Other laws: Please refer to Sales office

ELECTRICAL SPECIFICATION UNIQUE TO ECO POTENTIOMETERS

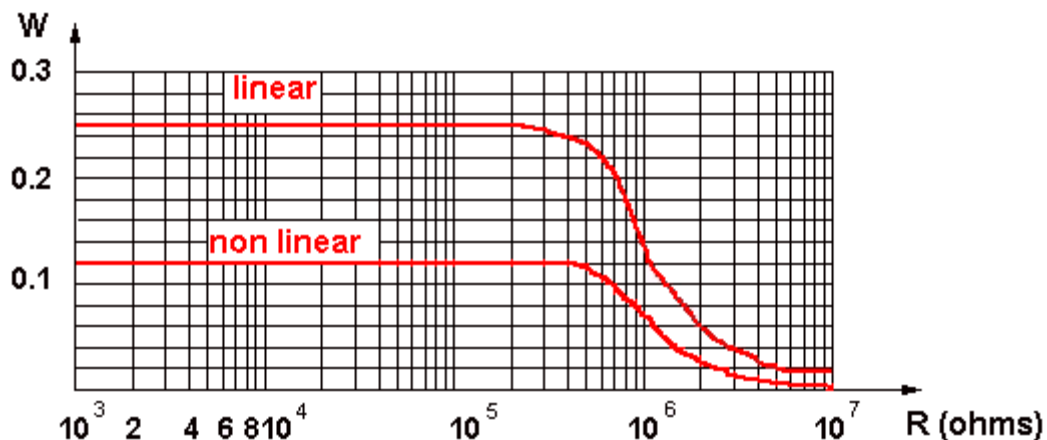
Effective rotation:

- Without a switch: 265° nominal
- With push push switch (/10APP, /MS): 265° nominal
- With rotary switch: 242° nominal

Rated Power Dissipation @40°C for ECO potentiometers:

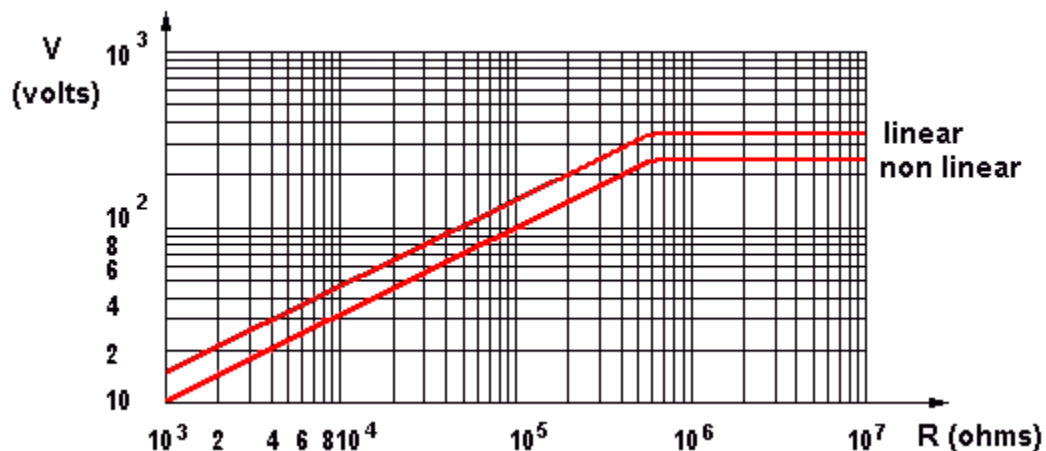
- 0.25W linear law
- 0.12W nonlinear law

ECO, P16 power dissipating curve



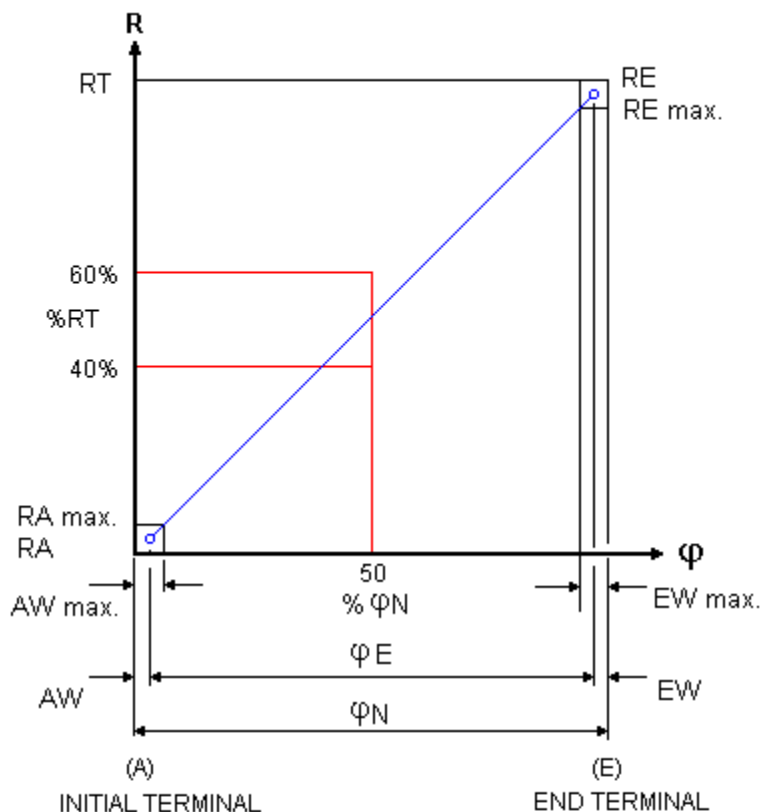
Limiting Element Voltage: 350 V DC for 16mm potentiometers

ECO, P16 maximum working voltage curve



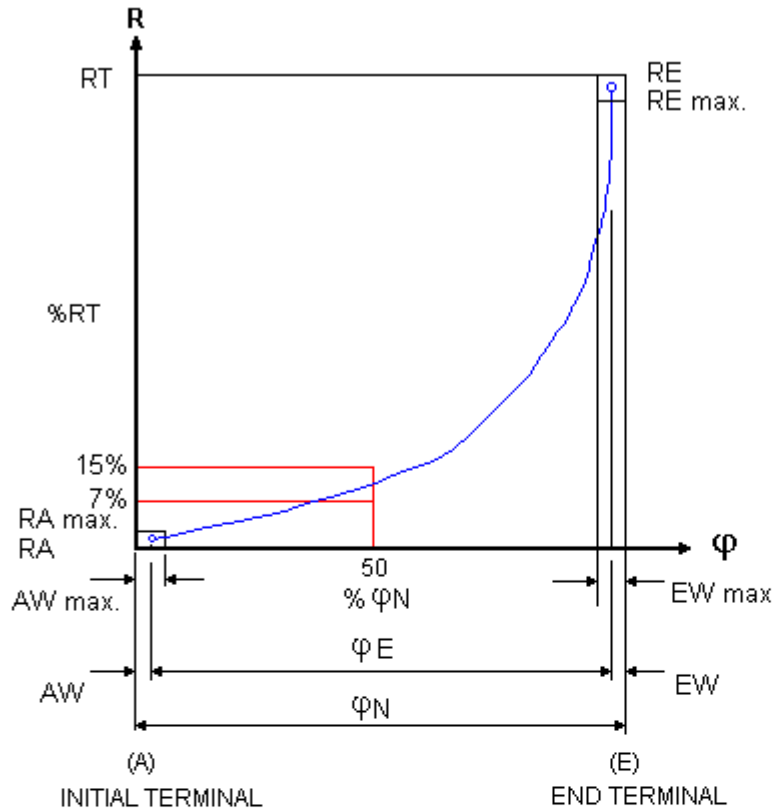
Insulating (Breakdown) Voltage: 2,500 V AC for ECO Potentiometers

Resistance law A - Linear



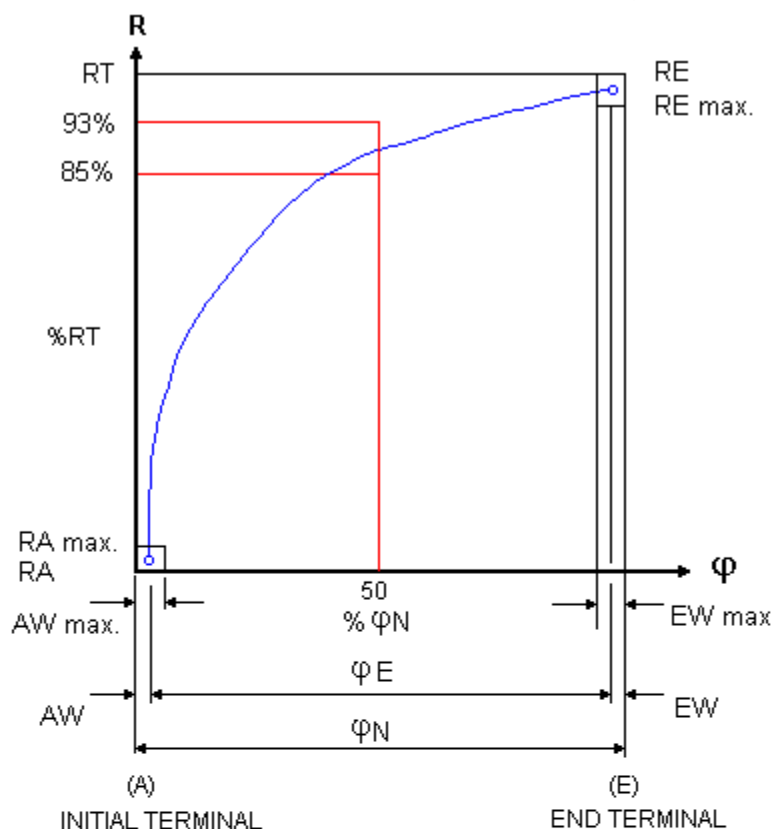
AW	Initial Path	AW max. 12% ϕN
EW	Final Path	EW max. 12% ϕN
Ra	Initial Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RA	Hop-on Resistance	$\leq 1\% RN$
Re	End Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RE	Hop-off Resistance	$\leq 1\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

Resistance law B – Log (Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RA	Hop-on Resistance	$RN \leq 10K$ 5% RN $RN > 10K$ 0.15% RN
Re	End Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RE	Hop-off Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K$ 0.5% RN
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

Resistance law C – Antilog (Reverse Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RA	Hop-on Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K 0.5\% RN$
Re	End Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RE	Hop-off Resistance	$RN \leq 10K 5\% RN$ $RN > 10K 0.15\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

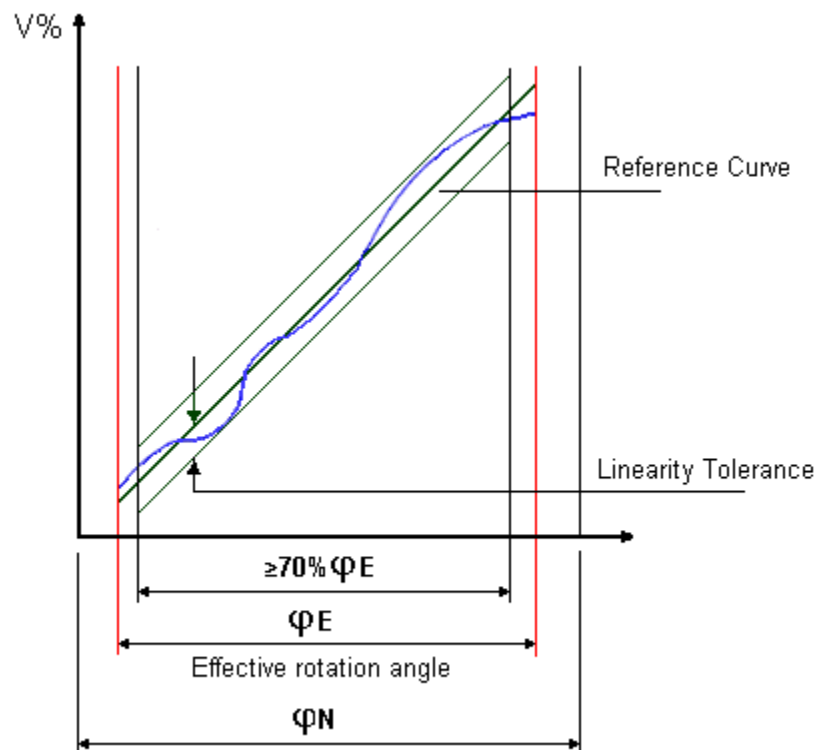
Linearity

As a basis of assessing Linearity Tolerance the independent method is the most practical, permitting as it does, the reference curve to be aligned as near as possible to the actual output curve. This avoids the use of the theoretical starting and finishing points, it is normal for the customer to realign the achieved curve with series trimmers at each end of the device if required.

Linearity Tolerance is 4% over the Nominal Resistance range of 1K Ω to 1M Ω . The Linearity Tolerance is measured on at least 70% of the effective rotation range.

Note. In the case of Terminal and Zero-based linearity, both present constraints which increase the manufacturing difficulty and in consequence have an adverse effect on the product's price and availability.

Potentiometer linearity

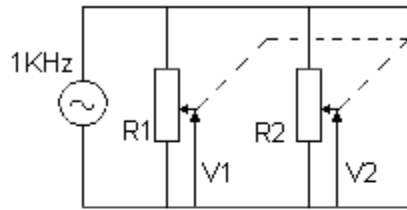


Matching Tolerance (For Tandem Stereo Potentiometers)

Tandem Potentiometers have two identical resistor units with the same variation law. The mismatching of the two resistor units, expressed in dB, is measured by the difference between the attenuations introduced by each resistor unit at various points of travel.

- Law A: 4 dB at Attenuation range 0 - 20 dB
- Law B and C: 3 dB at Attenuation range 0 - 20 dB

Matched Tolerance for Stereo

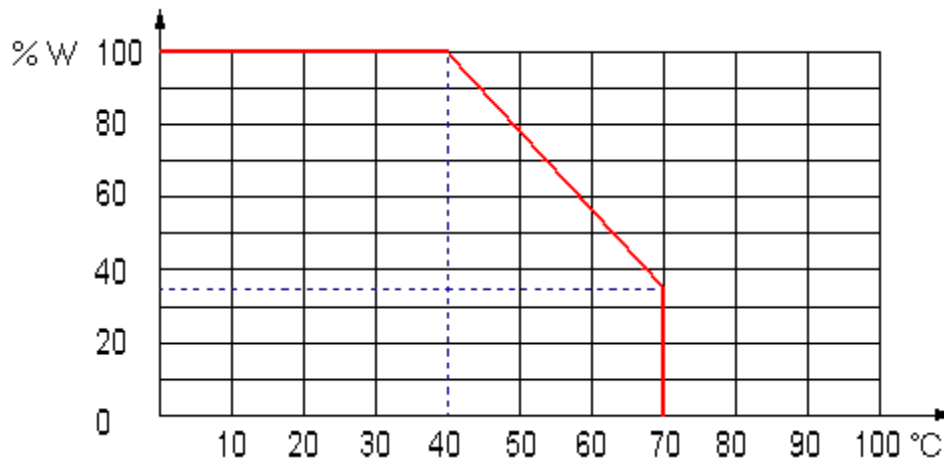


LAW	ATTENUATION RANGE	MATCHING TOLERANCE *
A	0 - 20dB	4dB
B & C	0 - 20dB	3dB

$$* \text{Matching Tolerance} = 20 \log \frac{V1}{V2}$$

Operating Temperature: -25°C to +70°C

Temperature Derating Curve



Temperature Coefficient of Resistance: +300 -500 ppm

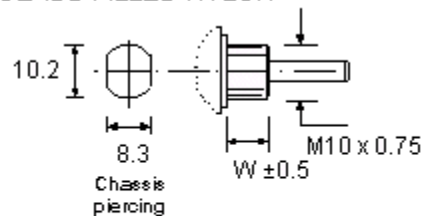
Components

ECO Bush Housing (Mounting)

The ECO bush housing is made of glass filled nylon, the thread is M10 x0.75mm pitch and 8mm long, alternatively **a 12mm long thread is also available** from October 2008.

Do not attempt to prevent any unwanted body rotation by overtightening the retaining nut, since this can cause thread damage, distortion, change of electrical resistance and restrict shaft rotation. BS9130:1972 provides further details on this topic. The **recommended torque** for tightening the retaining nut is 45cN.m and this can be achieved cost effectively by using a Torque Limiting device as shown on our **Accessories** page.

GLASS FILLED NYLON



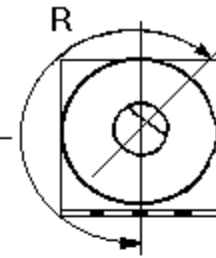
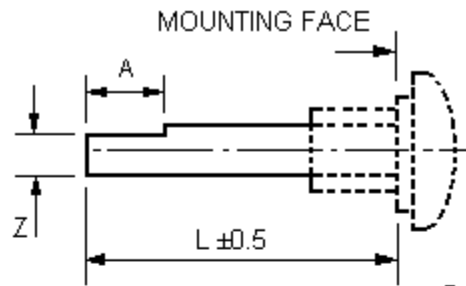
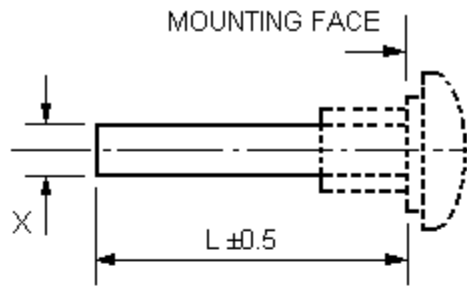
TYPE PLASTIC BODY	
W(mm)	8 (optional 12)

ECO Spindles

The ECO plastic spindles are fixed and not removable.
They are available in the following three diameters:

- 6.0mm Diameter - Length (L) available from 14mm to 65mm
 - Cylindrical (Type F1)
 - 4.0 x 12mm Flat (Type F2)
 - 5.0 x 15mm Flat (Type F3)
 - 5.0 x 10mm Flat (Type F4)
 - 4.6mm x 15mm Flat (Type F11)
 - 4.0 x 8mm Flat (Type F13)
 - 5.0 x 8mm Flat (Type F14)
- 4.0mm Diameter - Length (L) available from 14mm to 35mm
 - Cylindrical (Type F21)
 - 3.0 x 8.5mm Flat (Type F22)
- 6.35mm Diameter - Length (L) available from 14mm to 65mm
 - Cylindrical (Type F41)
 - 5.5 x 10mm Flat (Type F42)

Cylindrical and Flatted Spindles



Spindle in full CCW position

TYPE	DESC. (Ø)	L (mm)
F21	4 mm Dia Plastic	14 - 35
F1	6 mm Dia Plastic	14 - 65
F41	6.35mm Dia Plastic	14 - 65

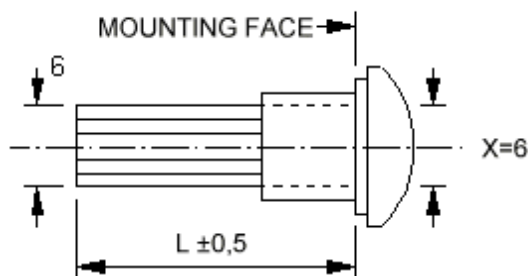
All spindles fixed.

TYPE	DESC. (Ø)	L (mm)	Flat (ZxA)
F22	4 mm Dia Plastic	14 - 35	3 x 8.5
F13	6 mm Dia Plastic	14 - 65	4 x 8
F2	6 mm Dia Plastic	14 - 65	4 x 12
F14	6 mm Dia Plastic	14 - 65	5 x 8
F4	6 mm Dia Plastic	14 - 65	5 x 10
F3	6 mm Dia Plastic	14 - 65	5 x 15
F11	6 mm Dia Plastic	14 - 65	4.6 x 15
F42	6.35mm Dia Plastic	14 - 65	5.5 x 10

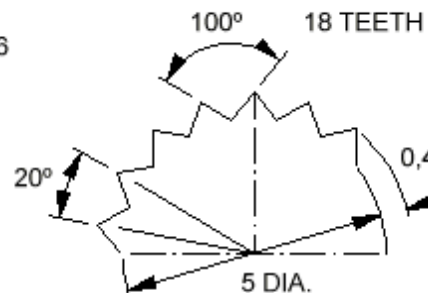
Standard flat angle
R = 210°

Splined Spindle (6.0mm diameter)

A splined form is also available on the 6.0mm diameter ECO plastic spindle.

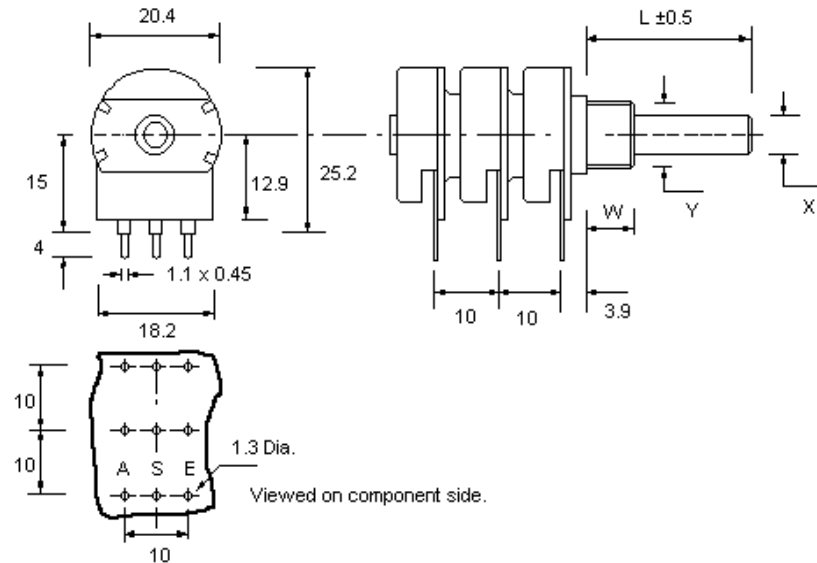
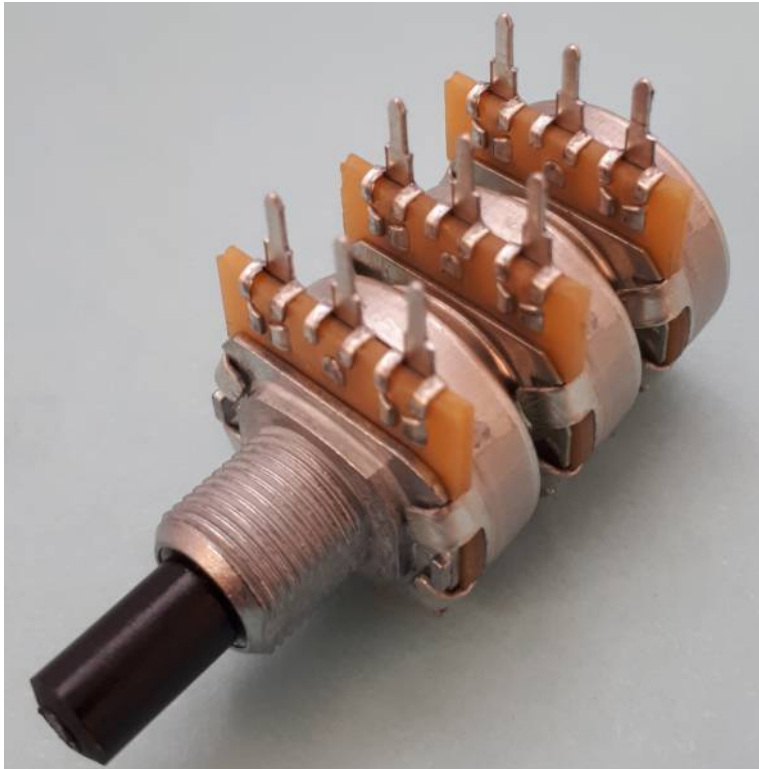


TYPE	DESC.	L (mm)
F5	Plastic Fixed	14 - 30



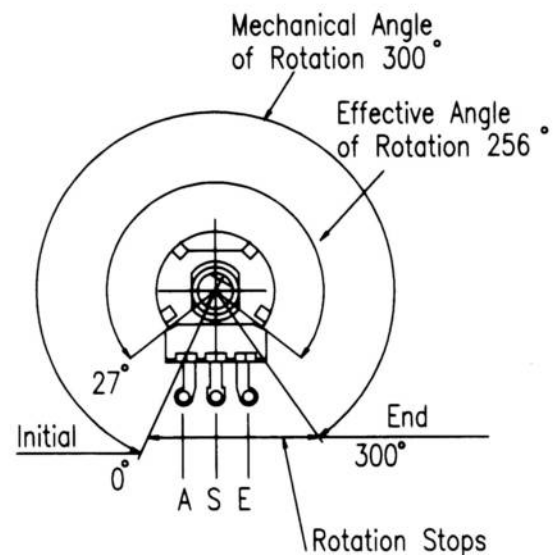
PC3G20BU

PC– Printed Circuit Terminals



SPINDLE END VIEW

- W Mounting Height
- Y Mounting Diameter
- X Spindle Diameter
- L Spindle Length
- A Initial Termination
- S Wiper (or moving contact) termination
- E End Termination



Total mechanical and effective electrical angles of rotation of potentiometers without rotary switch

Technical Data

Rated Power Dissipation @40°C for P20 potentiometers:

0.4W linear law

0.2W nonlinear law

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Effective rotation: 256° nominal

Operating Torque: 0.4 – 1.5 cN.m

Permissible Axial Spindle Load: 100 N (5 Sec. maximum)

Permissible Torque at End Stop: 80 cN.m

Rotation angle: 300° ±5°

Rotational torque of spindle can be made high or low

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Insulation Resistance: >= 4 Gohms

Rated Resistance: E3 Series

Optional: E6 Series

Linear Law: 1K – 1M (±10%)

Nonlinear Law: 4K7 – 470K

ELECTRICAL SPECIFICATION COMMON TO ALL POTENTIOMETERS

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Insulation Resistance: >= 4 Gohms

Rated Resistance: E3 Series

- Optional: E6 Series
- Linear Law: 1K - 1M
- Nonlinear Law: 4K7 - 470K

Tolerance on Rated Resistance: ± 20%

- Optional Tolerance on 1K - 1M: ± 10%

Resistance Laws (Taper):

- Linear: A
- Nonlinear: B - Log (Audio) or C - Antilog (Reverse Audio)
- Other laws: Please refer to Sales office

ELECTRICAL SPECIFICATION UNIQUE TO P20 POTENTIOMETERS

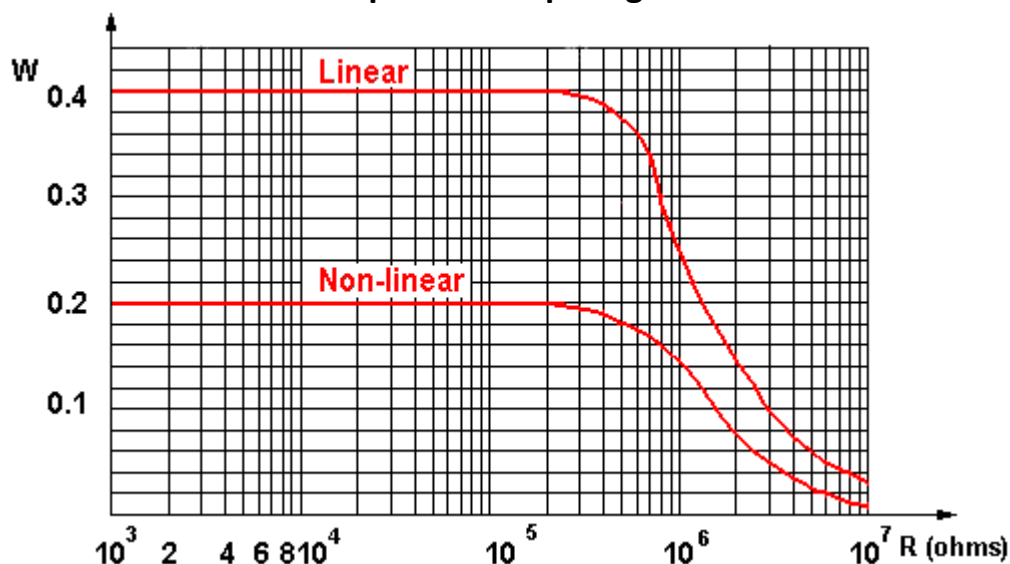
Effective rotation:

- Without a switch: 256° nominal
- With switch: 243° nominal
- With rotary switch: 243° nominal

Rated Power Dissipation @40°C for P20 potentiometers:

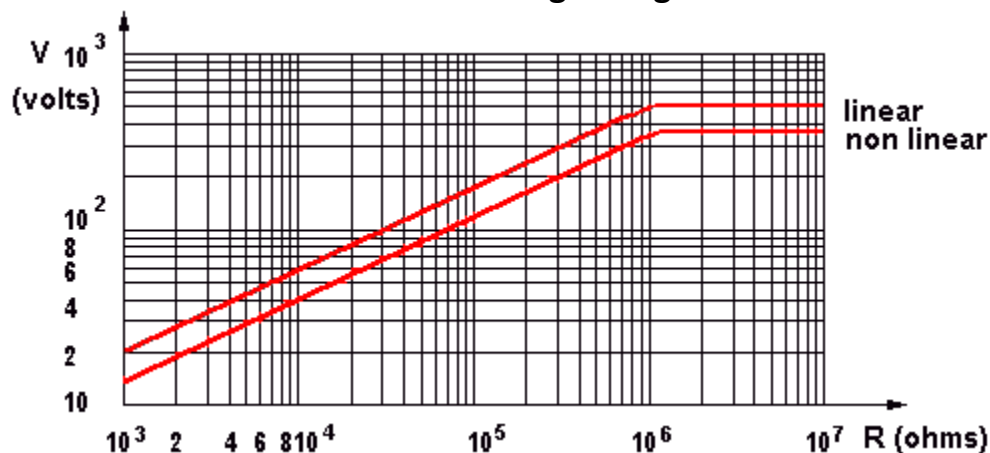
- 0.4W linear law
- 0.2W nonlinear law

P20 power dissipating curve



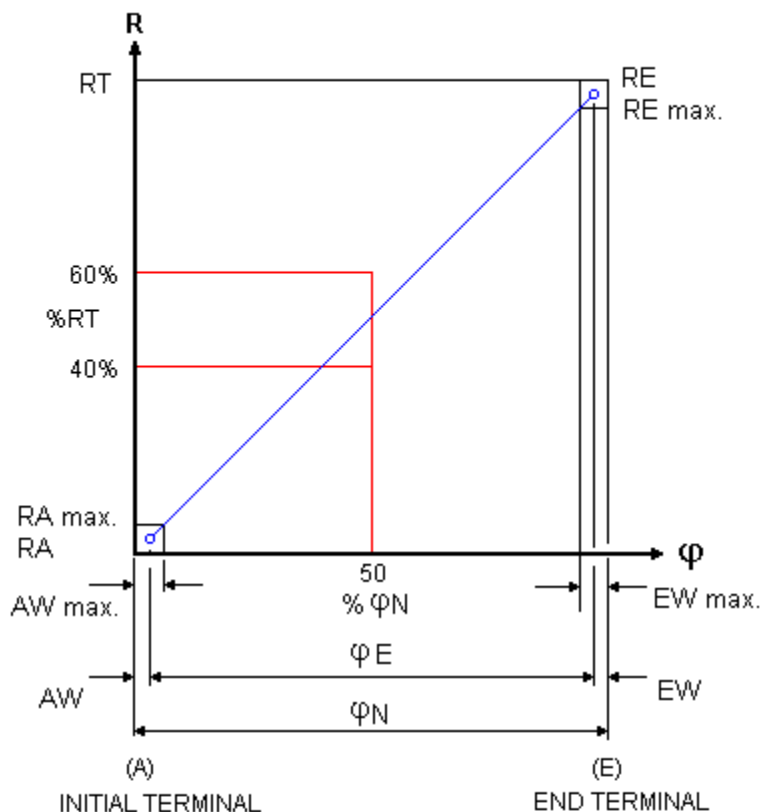
Limiting Element Voltage: 500 V DC for 20mm potentiometers

P20 maximum working voltage curve



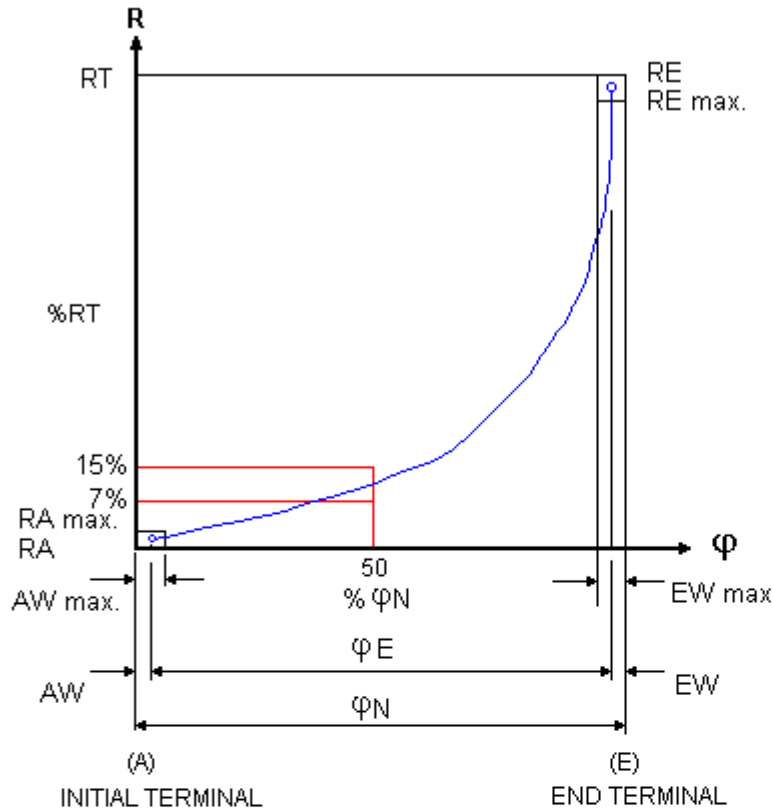
Insulating Voltage: 1000 V AC for 20mm potentiometers

Resistance law A - Linear



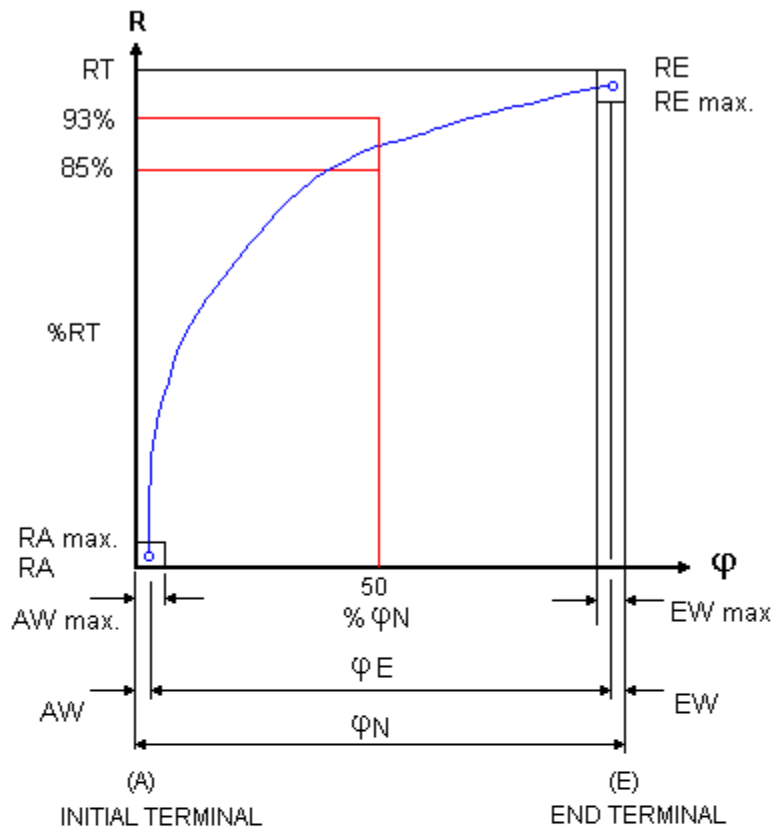
AW	Initial Path	AW max. 12% φN
EW	Final Path	EW max. 12% φN
Ra	Initial Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RA	Hop-on Resistance	$\leq 1\% RN$
Re	End Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RE	Hop-off Resistance	$\leq 1\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φ E	Effective Electrical Angle of Rotation	
φ N	Effective Mechanical Angle of Rotation	

Resistance law B – Log (Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RA	Hop-on Resistance	$RN \leq 10K$ 5% RN $RN > 10K$ 0.15% RN
Re	End Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RE	Hop-off Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K$ 0.5% RN
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

Resistance law C – Antilog (Reverse Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RA	Hop-on Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K 0.5\% RN$
Re	End Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RE	Hop-off Resistance	$RN \leq 10K 5\% RN$ $RN > 10K 0.15\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

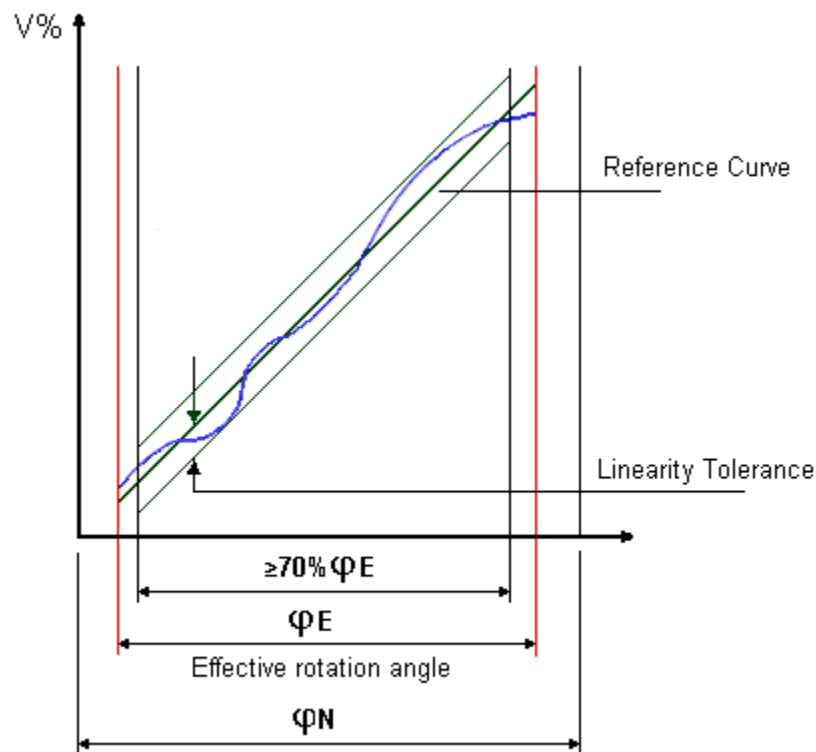
Linearity

As a basis of assessing Linearity Tolerance the independent method is the most practical, permitting as it does, the reference curve to be aligned as near as possible to the actual output curve. This avoids the use of the theoretical starting and finishing points, it is normal for the customer to realign the achieved curve with series trimmers at each end of the device if required.

Linearity Tolerance is 4% over the Nominal Resistance range of 1K0 to 1M0. The Linearity Tolerance is measured on at least 70% of the effective rotation range.

Note. In the case of Terminal and Zero-based linearity, both present constraints which increase the manufacturing difficulty and in consequence have an adverse effect on the product's price and availability.

Potentiometer linearity

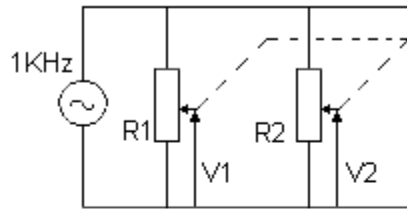


Matching Tolerance (For Tandem Stereo Potentiometers)

Tandem Potentiometers have two identical resistor units with the same variation law. The mismatching of the two resistor units, expressed in dB, is measured by the difference between the attenuations introduced by each resistor unit at various points of travel.

- Law A: 4 dB at Attenuation range 0 - 20 dB
- Law B and C: 3 dB at Attenuation range 0 - 20 dB

Matched Tolerance for Stereo

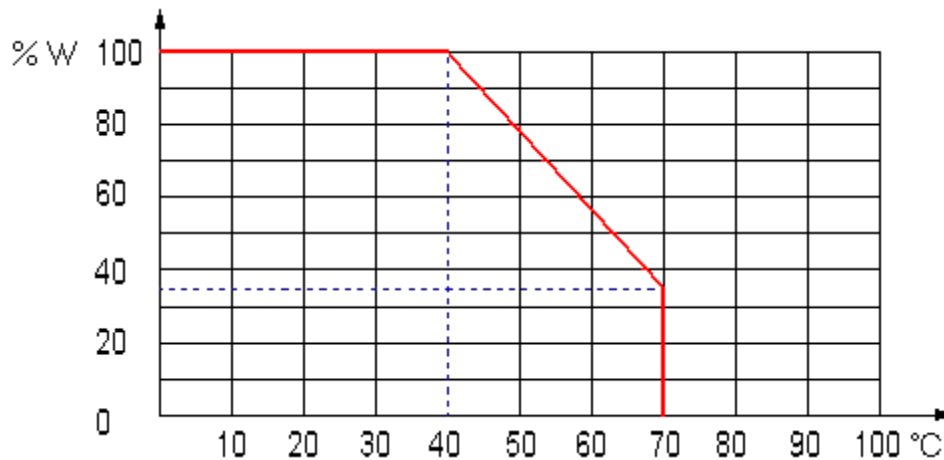


LAW	ATTENUATION RANGE	MATCHING TOLERANCE *
A	0 - 20dB	4dB
B & C	0 - 20dB	3dB

$$* \text{Matching Tolerance} = 20 \log \frac{V1}{V2}$$

Operating Temperature: -25°C to +70°C

Temperature Derating Curve



Temperature Coefficient of Resistance: +300 -500 ppm

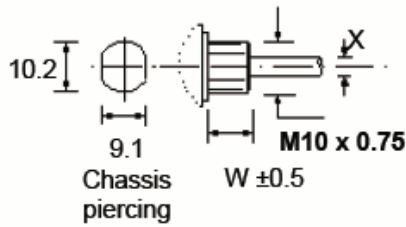
Components

P20 Bush Housing (Mounting)

The P20 bushes are available in metal or nylon; with three thread options; and with or without a locating feature:

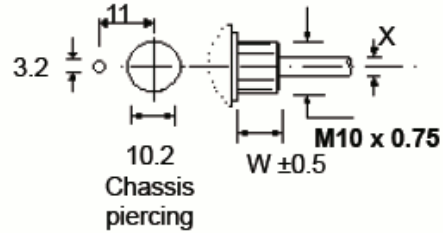
- Diecast Zinc Alloy
 - M10 x0.75mm pitch (Type C)
 - M10 x0.75mm pitch, **with locator** (Type CEBS)
 - 9.52mm x32tpi (Type CBS)
 - 9.52mm x32tpi, **with locator** (Type CBSL)
 - M7 x0.75mm pitch (Type CG)
- Glass Filled Nylon
 - M10 x0.75mm (Type CP)

DIECAST ZINC ALLOY



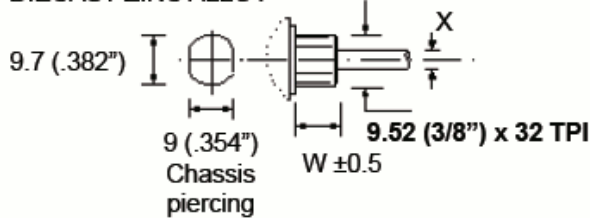
Type C (without locator)	
X (mm)	6
W (mm)	9

DIECAST ZINC ALLOY



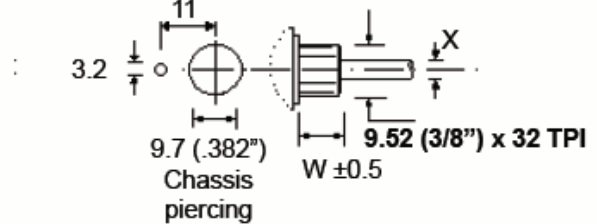
Type CEBS (with locator)	
X (mm)	6
W (mm)	9

DIECAST ZINC ALLOY



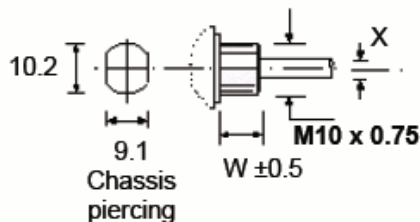
Type CBS (without locator)		
X (mm)	6	6.35
W (mm)	8 or 12	8 or 12

DIECAST ZINC ALLOY



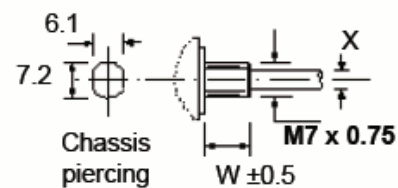
Type CBSL (with locator)		
X (mm)	6.35	6.35
W (mm)	8	12

GLASS FILLED NYLON



Type CP (GFN)		
X (mm)	6	6.35
W (mm)	7 or 10	7 or 10

DIECAST ZINC ALLOY



Type CG (without locator)	
X (mm)	4
W (mm)	6

P20 Spindles

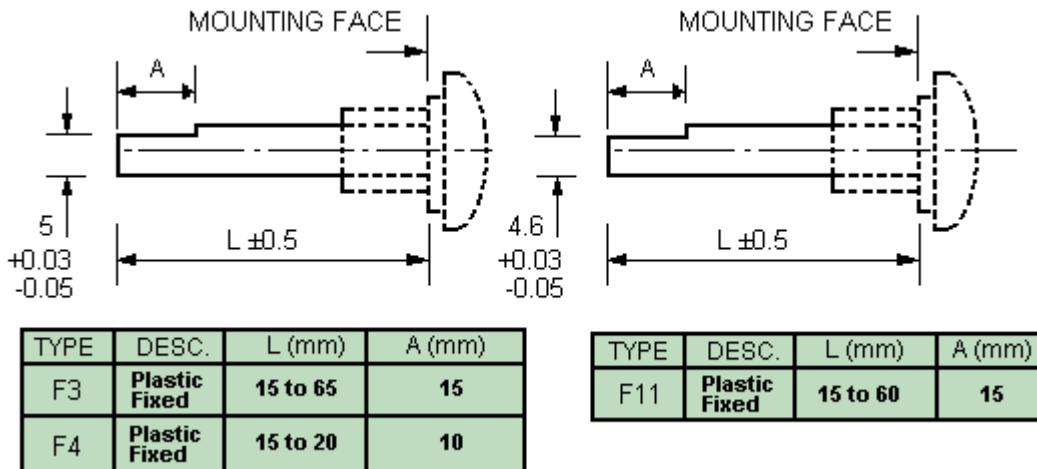
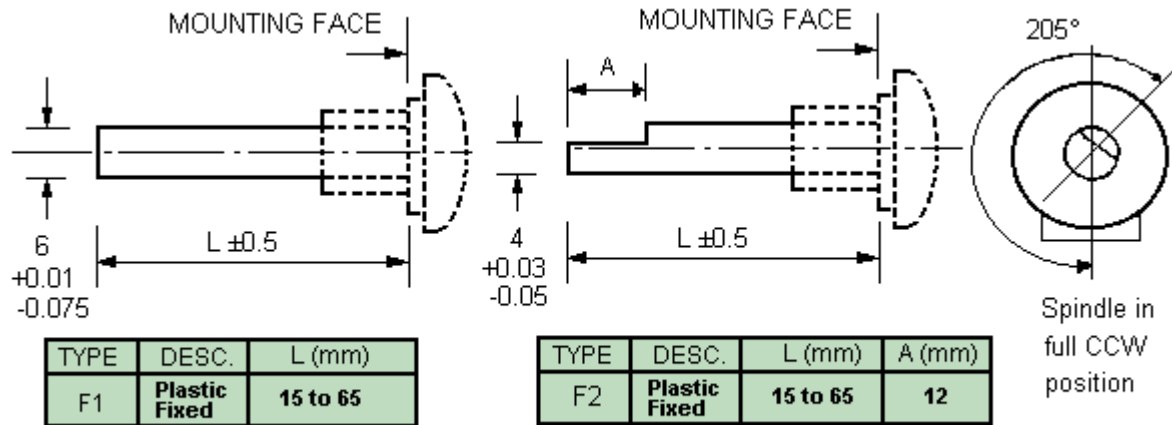
The P20 spindles are plastic and fixed i.e. not removable, unless otherwise stated and they are available in three diameters:

- 6.0mm Diameter
 - Cylindrical (Type F1)
 - 4.0 x 12mm Flat (Type F2)
 - 5.0 x 15mm Flat (Type F3)
 - 5.0 x 10mm Flat (Type F4)
 - 4.6mm x 15mm Flat (Type F11)
- 4.0mm Diameter
 - Cylindrical (Type F21)
 - 3.0 x 8.5mm Flat (Type F22)
 - 3.0 x 13.5mm Flat (Type F23)
 - Cylindrical (Type M21 - Metal)
 - 3.0 x 8.5mm Flat (Type M22 - Metal)
 - 3.0 x 13.5mm Flat (Type M23 - Metal)
- 6.35mm Diameter
 - Cylindrical (Type F41)
 - 5.5 x 10mm Flat (Type F42)
 - 5.5 x 15mm Flat (Type F43)
- Splined Spindle - 6.0mm dia. 18 teeth
- Dual Concentric
 - Flatted/Slotted (Type M15 - Metal)
 - Cylindrical (Type M16 - Metal)

6.0mm Diameter Spindles

Note: *Specials to customer's specification up to 65mm.

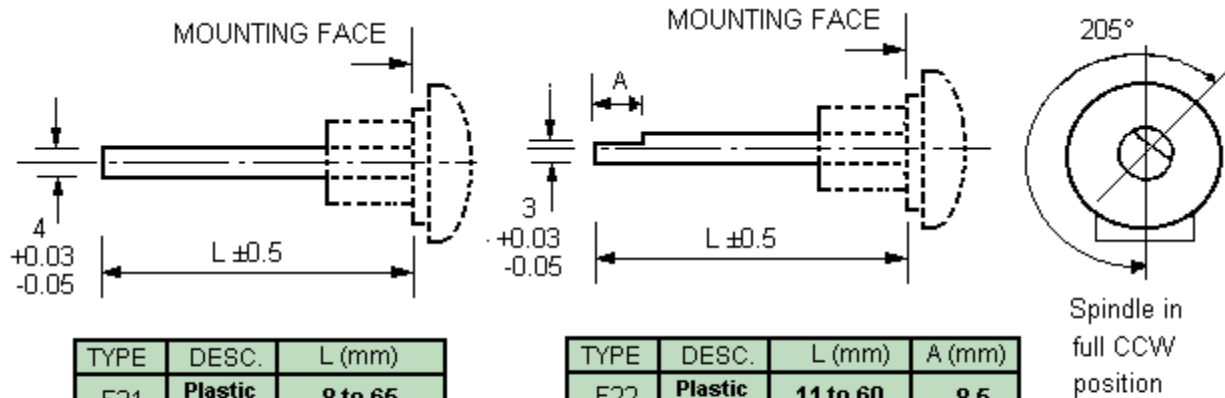
REMOVABLE SPINDLES, similar in specification to 'fixed' spindles are supplied separate from the potentiometer. These can be indefinitely taken in and out and their holding strength is >1kg.



4.0mm Diameter Spindles

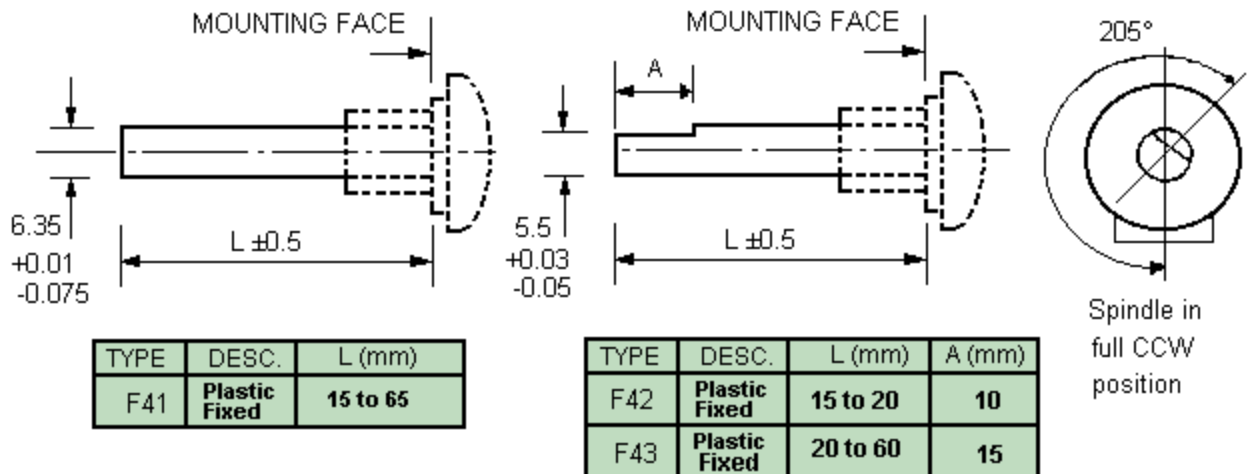
Note: The orientation of the flat as illustrated is for plastic spindles only.

For metal spindles, unless specified on the order, the orientation may be different on each potentiometer type.



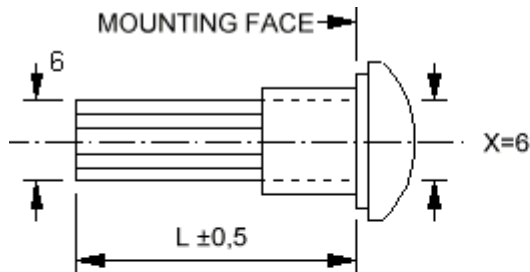
6.35mm Diameter Spindles

Note: *Specials to customer's specification up to 65mm.

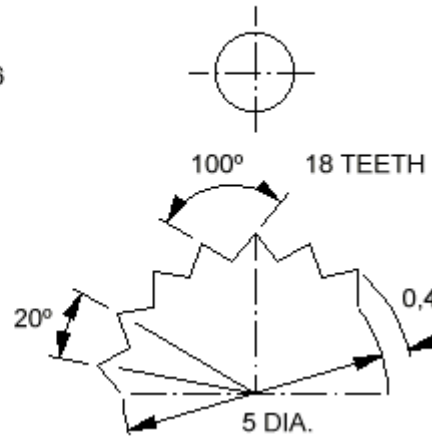


Splined Spindle - 6.0mm dia. 18 teeth

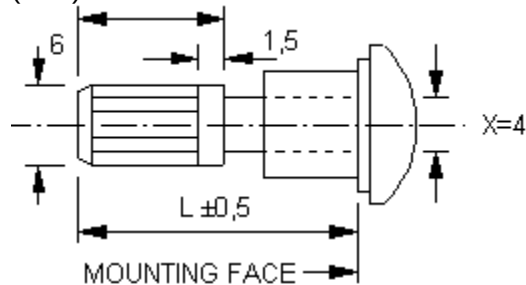
A splined form is available on the 6.0mm diameter P20 plastic spindle (F5) or alternatively a 6mm 'Splined Adaptor' (8,7mm long) can be fitted on a 4mm dia. Spindle



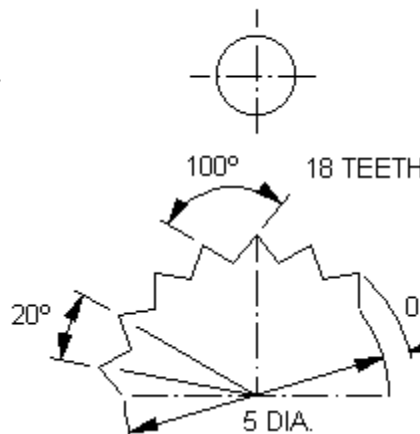
TYPE	DESC.	L (mm)
F5	Plastic Fixed	19



(F5A):

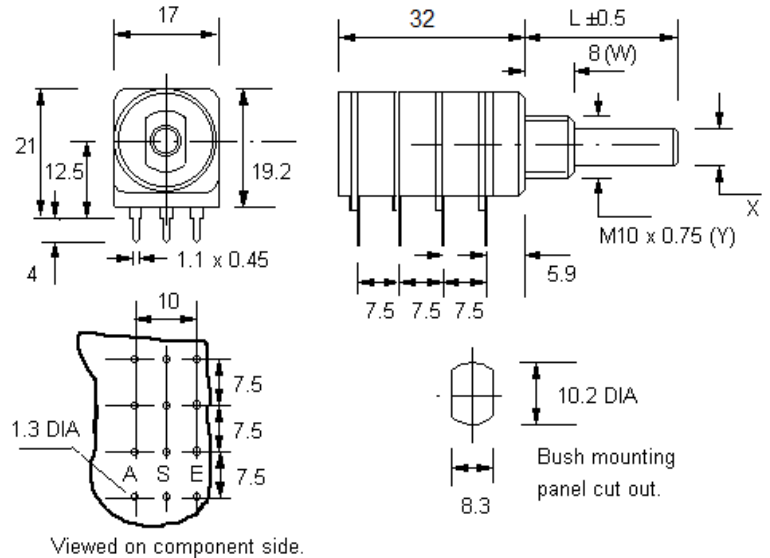
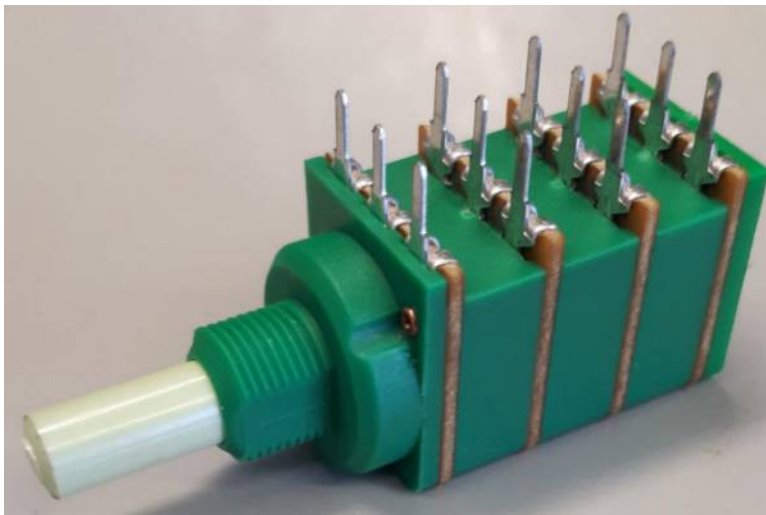


TYPE	DESC.	L (mm)
F5A	Plastic Fixed	16-36

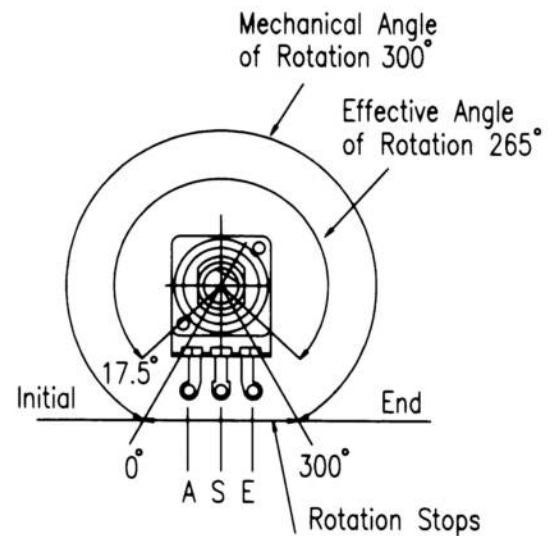


PC4G16ECO

PC – For Printed Circuit
4G - 4 GANG



SPINDLE END VIEW



Total mechanical and effective electrical angles of rotation of potentiometers without rotary switch

- W Mounting Height
- Y Mounting Diameter
- X Spindle Diameter
- L Spindle Length
- A Initial Termination
- S Wiper (or moving contact) termination
- E End Termination

Technical Data

Rated Power Dissipation @40°C for ECO potentiometers:

0.25W linear law

0.12W nonlinear law

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Effective rotation: 265° nominal

Operating Torque: 0.4 – 1.5 cN.m

Permissible Axial Spindle Load: 50 N (5 Sec. maximum)

Permissible Torque at End Stop: 35 cN.m

Rotation angle: 300° ±5°

Optional Click stop (indents) for rotational tactile feedback

Rotational torque of spindle can be made high or low

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Insulation Resistance: >= 4 Gohms

Rated Resistance: E3 Series

Optional: E6 Series

Linear Law: 1K – 1M

Nonlinear Law: 4K7 – 470K

ELECTRICAL SPECIFICATION COMMON TO ALL POTENTIOMETERS

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Insulation Resistance: >= 4 Gohms

Rated Resistance: E3 Series

- Optional: E6 Series
- Linear Law: 1K - 1M
- Nonlinear Law: 4K7 - 470K

Tolerance on Rated Resistance: ± 20%

- Optional Tolerance on 1K - 1M: ± 10%

Resistance Laws (Taper):

- Linear: A
- Nonlinear: B - Log (Audio) or C - Antilog (Reverse Audio)
- Other laws: Please refer to Sales office

ELECTRICAL SPECIFICATION UNIQUE TO ECO POTENTIOMETERS

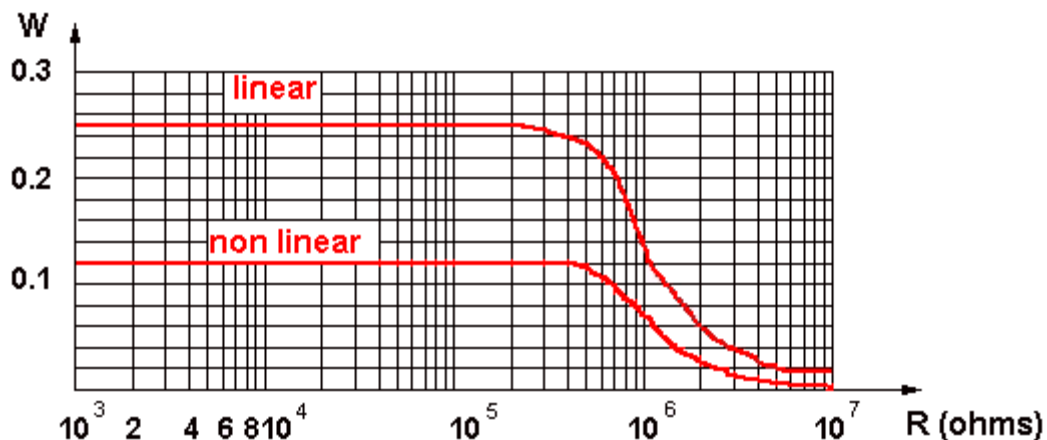
Effective rotation:

- Without a switch: 265° nominal
- With push push switch (/10APP, /MS): 265° nominal
- With rotary switch: 242° nominal

Rated Power Dissipation @40°C for ECO potentiometers:

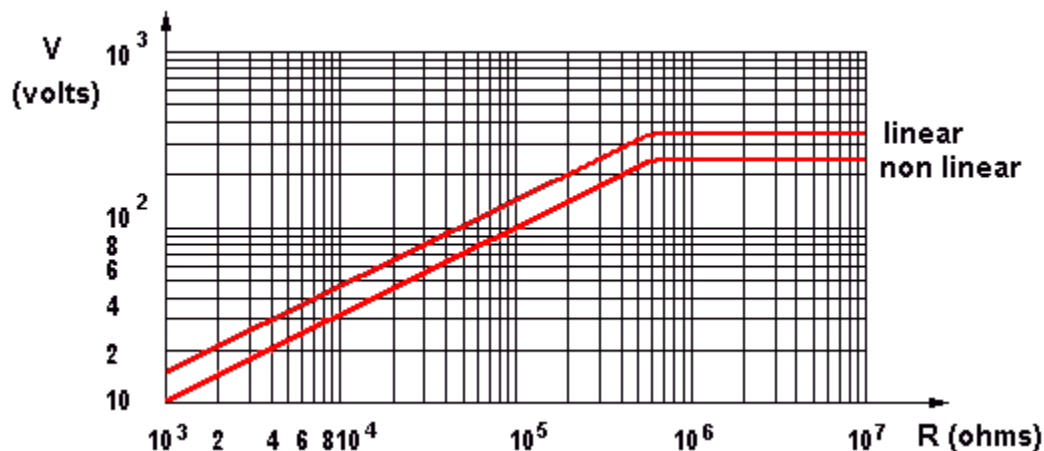
- 0.25W linear law
- 0.12W nonlinear law

ECO, P16 power dissipating curve



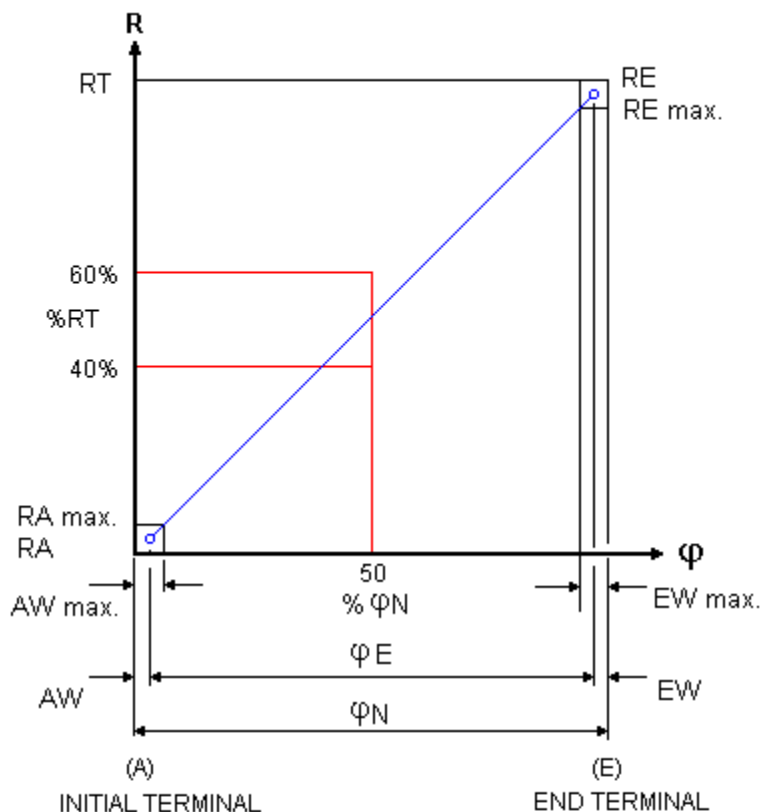
Limiting Element Voltage: 350 V DC for 16mm potentiometers

ECO, P16 maximum working voltage curve



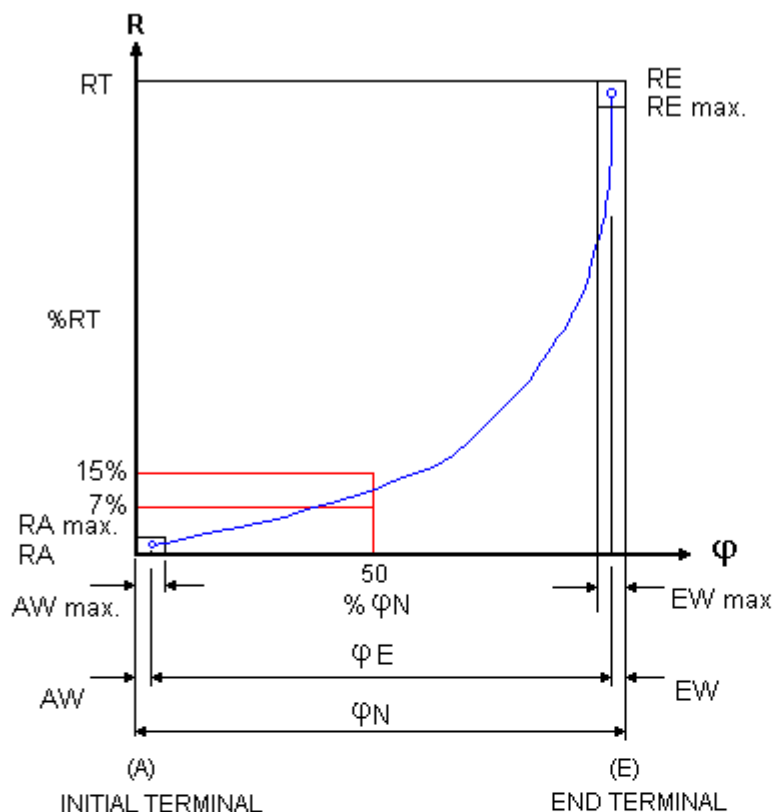
Insulating (Breakdown) Voltage: 2,500 V AC for ECO Potentiometers

Resistance law A - Linear



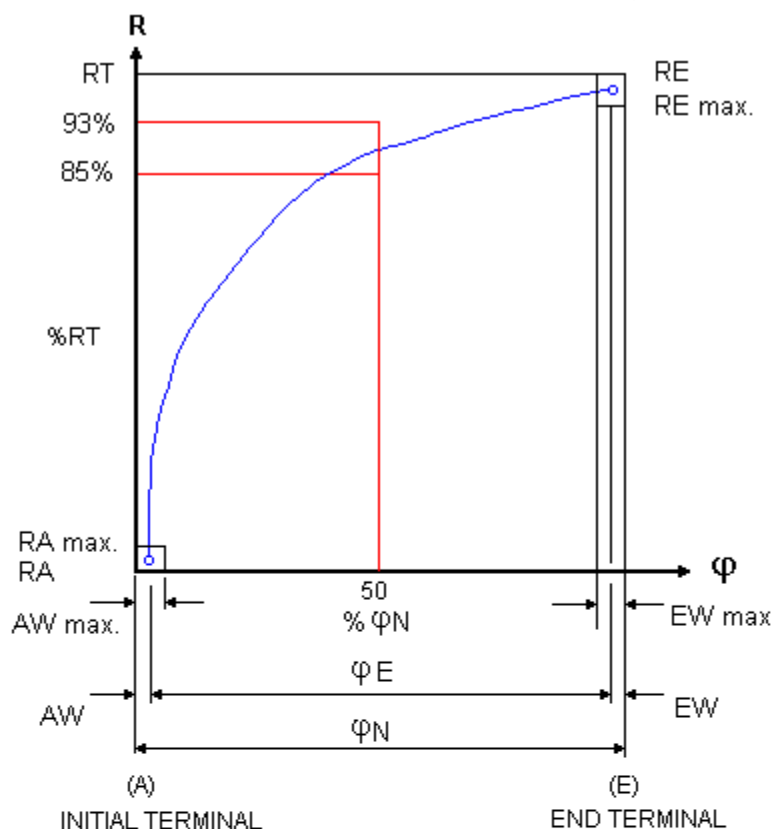
AW	Initial Path	AW max. 12% ϕN
EW	Final Path	EW max. 12% ϕN
Ra	Initial Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RA	Hop-on Resistance	$\leq 1\% RN$
Re	End Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RE	Hop-off Resistance	$\leq 1\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

Resistance law B – Log (Audio)



A_W	Initial Path	$A_W \text{ max.}$ 10% ϕ_N
E_W	Final Path	$E_W \text{ max.}$ 10% ϕ_N
R_a	Initial Stop Value	$R_N \leq 10K \leq 1.10^{-3} R_N$ (Minimum 2 ohms) $R_N > 10K \leq 2.10^{-4} R_N$ (Minimum 10 ohms)
R_A	Hop-on Resistance	$R_N \leq 10K$ 5% R_N $R_N > 10K$ 0.15% R_N
R_e	End Stop Value	$R_N \leq 100K \leq 2.10^{-2} R_N$ $R_N > 100K \leq 1.10^{-2} R_N$
R_E	Hop-off Resistance	$R_N \leq 10K < 1\% R_N$ $R_N > 10K$ 0.5% R_N
R_N	Rated Resistance	
R_T	Effective Resistance	
ϕ	Rotation Angle	
ϕ_E	Effective Electrical Angle of Rotation	
ϕ_N	Effective Mechanical Angle of Rotation	

Resistance law C – Antilog (Reverse Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	RN ≤ 100K $\leq 2.10^{-2}$ RN RN > 100K $\leq 1.10^{-2}$ RN
RA	Hop-on Resistance	RN ≤ 10K < 1% RN RN > 10K 0.5% RN
Re	End Stop Value	RN ≤ 10K $\leq 1.10^{-3}$ RN (Minimum 2 ohms) RN > 10K $\leq 2.10^{-4}$ RN (Minimum 10 ohms)
RE	Hop-off Resistance	RN ≤ 10K 5% RN RN > 10K 0.15% RN
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

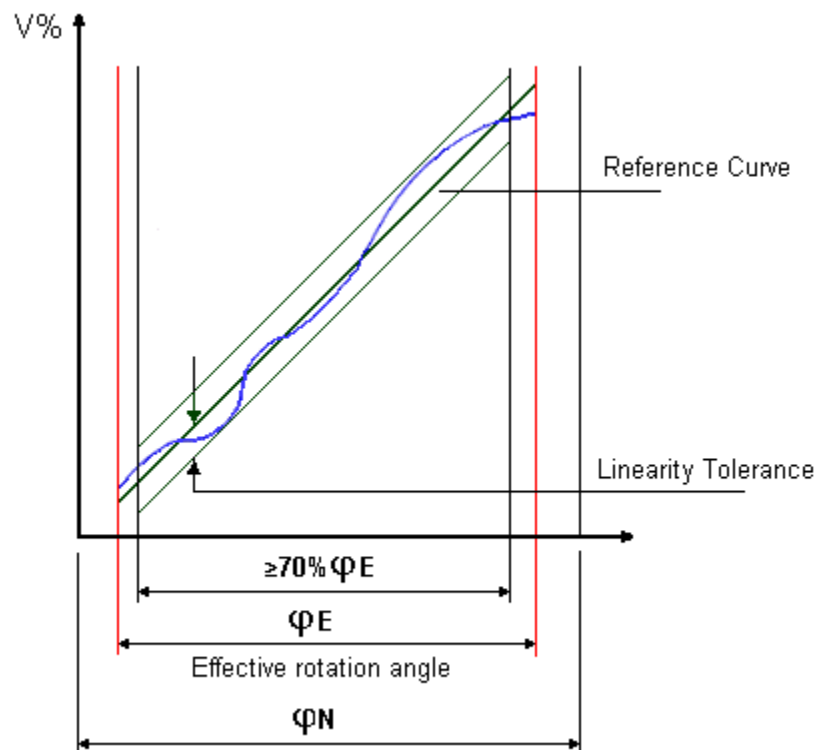
Linearity

As a basis of assessing Linearity Tolerance the independent method is the most practical, permitting as it does, the reference curve to be aligned as near as possible to the actual output curve. This avoids the use of the theoretical starting and finishing points, it is normal for the customer to realign the achieved curve with series trimmers at each end of the device if required.

Linearity Tolerance is 4% over the Nominal Resistance range of 1K0 to 1M0. The Linearity Tolerance is measured on at least 70% of the effective rotation range.

Note. In the case of Terminal and Zero-based linearity, both present constraints which increase the manufacturing difficulty and in consequence have an adverse effect on the product's price and availability.

Potentiometer linearity

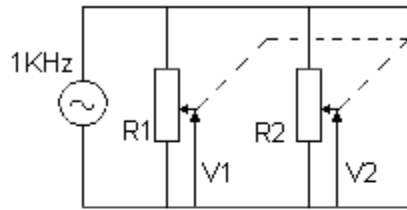


Matching Tolerance (For Tandem Stereo Potentiometers)

Tandem Potentiometers have two identical resistor units with the same variation law. The mismatching of the two resistor units, expressed in dB, is measured by the difference between the attenuations introduced by each resistor unit at various points of travel.

- Law A: 4 dB at Attenuation range 0 - 20 dB
- Law B and C: 3 dB at Attenuation range 0 - 20 dB

Matched Tolerance for Stereo

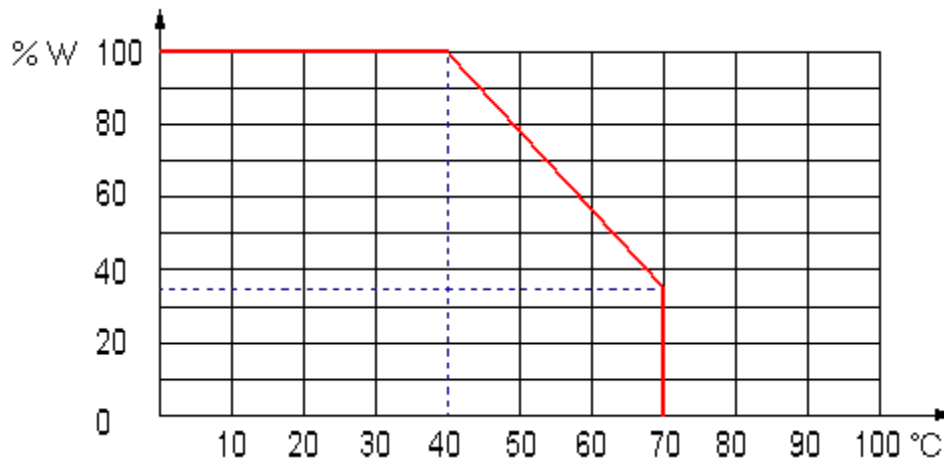


LAW	ATTENUATION RANGE	MATCHING TOLERANCE *
A	0 - 20dB	4dB
B & C	0 - 20dB	3dB

$$* \text{Matching Tolerance} = 20 \log \frac{V1}{V2}$$

Operating Temperature: -25°C to +70°C

Temperature Derating Curve



Temperature Coefficient of Resistance: +300 -500 ppm

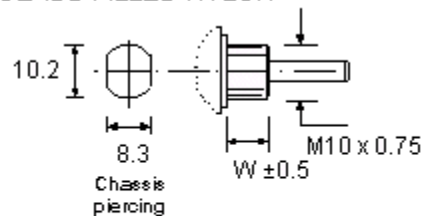
Components

ECO Bush Housing (Mounting)

The ECO bush housing is made of glass filled nylon, the thread is M10 x0.75mm pitch and 8mm long, alternatively **a 12mm long thread is also available** from October 2008.

Do not attempt to prevent any unwanted body rotation by overtightening the retaining nut, since this can cause thread damage, distortion, change of electrical resistance and restrict shaft rotation. BS9130:1972 provides further details on this topic. The **recommended torque** for tightening the retaining nut is 45cN.m and this can be achieved cost effectively by using a Torque Limiting device as shown on our **Accessories** page.

GLASS FILLED NYLON



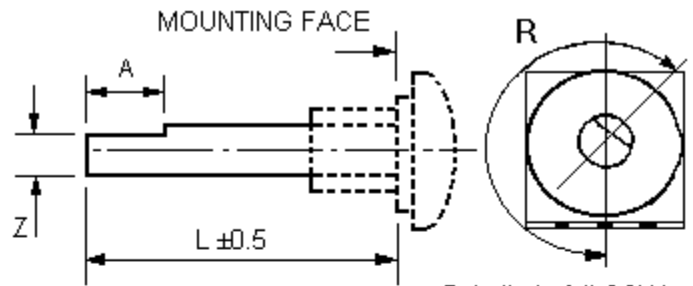
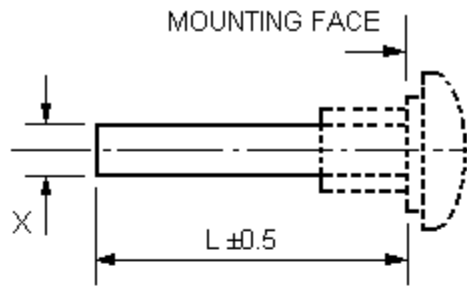
TYPE PLASTIC BODY	
W(mm)	8 (optional 12)

ECO Spindles

The ECO plastic spindles are fixed and not removable.
They are available in the following three diameters:

- 6.0mm Diameter - Length (L) available from 14mm to 65mm
 - Cylindrical (Type F1)
 - 4.0 x 12mm Flat (Type F2)
 - 5.0 x 15mm Flat (Type F3)
 - 5.0 x 10mm Flat (Type F4)
 - 4.6mm x 15mm Flat (Type F11)
 - 4.0 x 8mm Flat (Type F13)
 - 5.0 x 8mm Flat (Type F14)
- 4.0mm Diameter - Length (L) available from 14mm to 35mm
 - Cylindrical (Type F21)
 - 3.0 x 8.5mm Flat (Type F22)
- 6.35mm Diameter - Length (L) available from 14mm to 65mm
 - Cylindrical (Type F41)
 - 5.5 x 10mm Flat (Type F42)

Cylindrical and Flatted Spindles



Spindle in full CCW position

TYPE	DESC. (Ø)	L (mm)
F21	4 mm Dia Plastic	14 - 35
F1	6 mm Dia Plastic	14 - 65
F41	6.35mm Dia Plastic	14 - 65

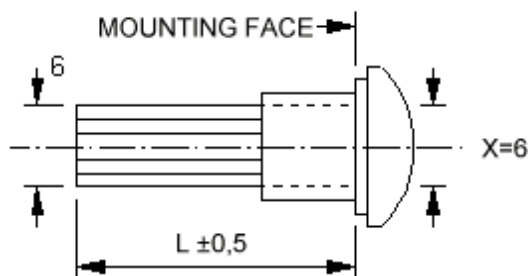
All spindles fixed.

TYPE	DESC. (Ø)	L (mm)	Flat (ZxA)
F22	4 mm Dia Plastic	14 - 35	3 x 8.5
F13	6 mm Dia Plastic	14 - 65	4 x 8
F2	6 mm Dia Plastic	14 - 65	4 x 12
F14	6 mm Dia Plastic	14 - 65	5 x 8
F4	6 mm Dia Plastic	14 - 65	5 x 10
F3	6 mm Dia Plastic	14 - 65	5 x 15
F11	6 mm Dia Plastic	14 - 65	4.6 x 15
F42	6.35mm Dia Plastic	14 - 65	5.5 x 10

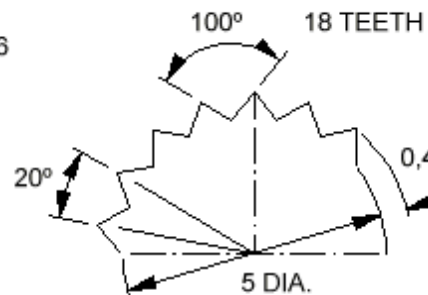
Standard flat angle
R = 210°

Splined Spindle (6.0mm diameter)

A splined form is also available on the 6.0mm diameter ECO plastic spindle.

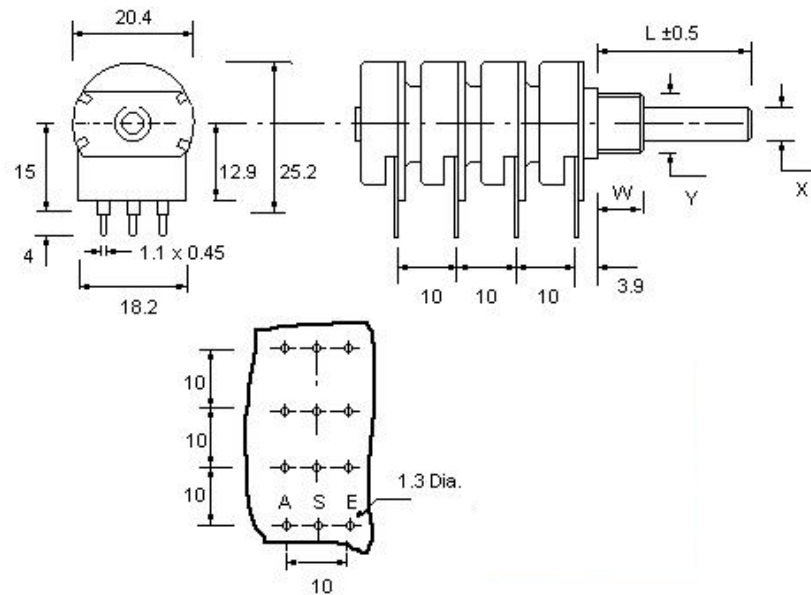
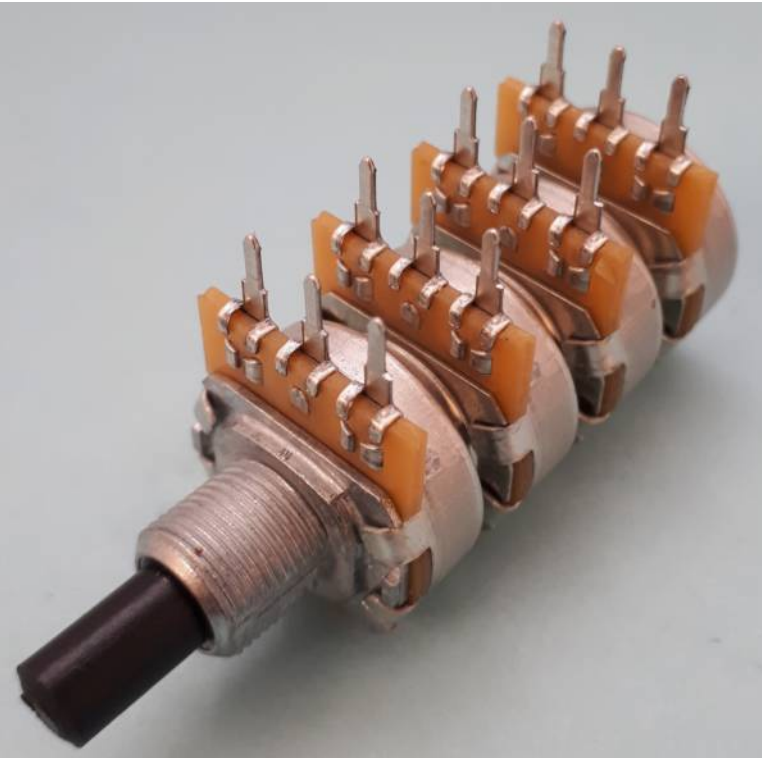


TYPE	DESC.	L (mm)
F5	Plastic Fixed	14 - 30



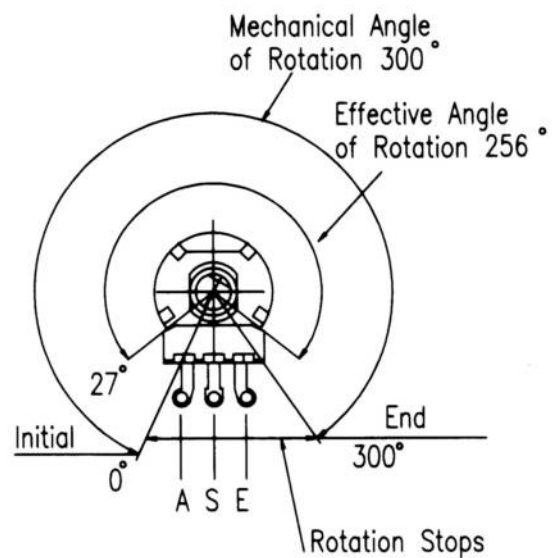
PC4G20BU

PC – Printed Circuit Terminals



SPINDLE END VIEW

- W Mounting Height
- Y Mounting Diameter
- X Spindle Diameter
- L Spindle Length
- A Initial Termination
- S Wiper (or moving contact) termination
- E End Termination



Total mechanical and effective electrical angles of rotation of potentiometers without rotary switch

Technical Data

Rated Power Dissipation @40°C for P20 potentiometers:

0.4W linear law

0.2W nonlinear law

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Effective rotation: 256° nominal

Operating Torque: 0.4 – 1.5 cN.m

Permissible Axial Spindle Load: 100 N (5 Sec. maximum)

Permissible Torque at End Stop: 80 cN.m

Rotation angle: 300° ±5°

Rotational torque of spindle can be made high or low

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Insulation Resistance: >= 4 Gohms

Rated Resistance: E3 Series

Optional: E6 Series

Linear Law: 1K – 1M (±10%)

Nonlinear Law: 4K7 – 470K

ELECTRICAL SPECIFICATION COMMON TO ALL POTENTIOMETERS

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Insulation Resistance: >= 4 Gohms

Rated Resistance: E3 Series

- Optional: E6 Series
- Linear Law: 1K - 1M
- Nonlinear Law: 4K7 - 470K

Tolerance on Rated Resistance: ± 20%

- Optional Tolerance on 1K - 1M: ± 10%

Resistance Laws (Taper):

- Linear: A
- Nonlinear: B - Log (Audio) or C - Antilog (Reverse Audio)
- Other laws: Please refer to Sales office

ELECTRICAL SPECIFICATION UNIQUE TO P20 POTENTIOMETERS

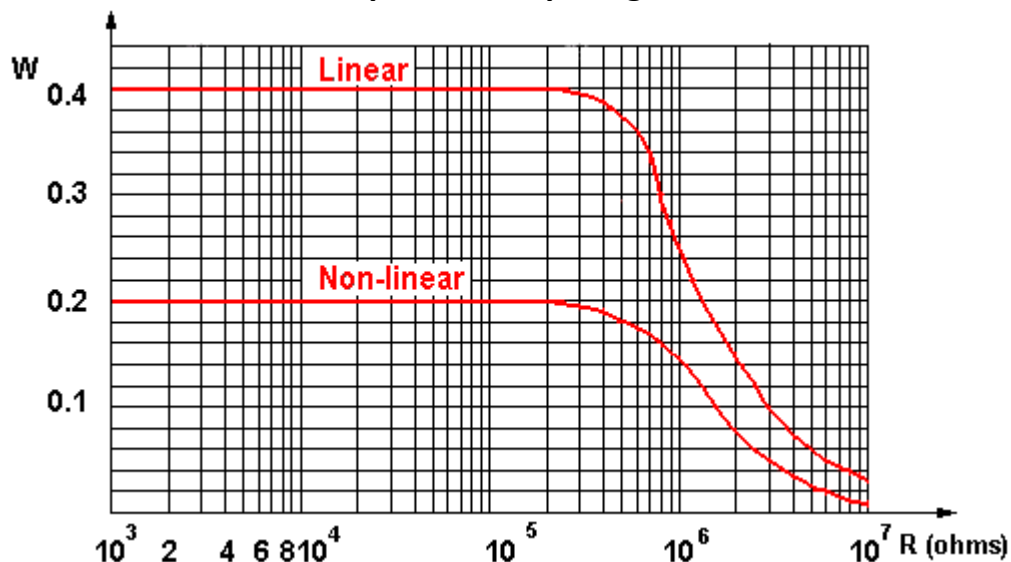
Effective rotation:

- Without a switch: 256° nominal
- With switch: 243° nominal
- With rotary switch: 243° nominal

Rated Power Dissipation @40°C for P20 potentiometers:

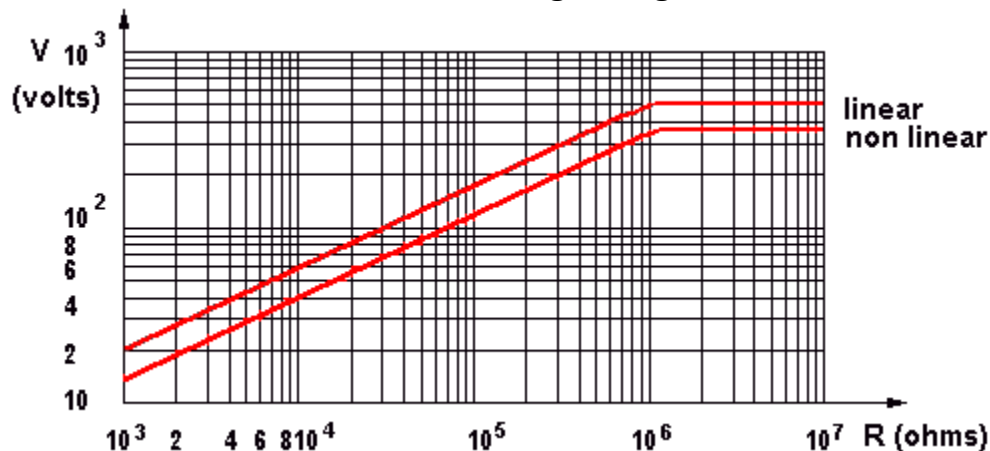
- 0.4W linear law
- 0.2W nonlinear law

P20 power dissipating curve



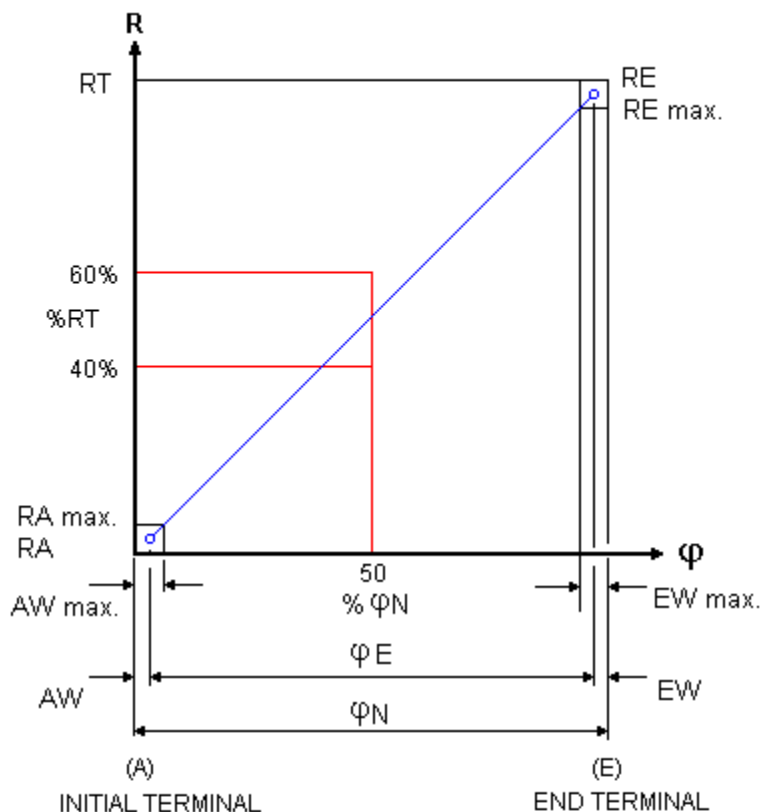
Limiting Element Voltage: 500 V DC for 20mm potentiometers

P20 maximum working voltage curve



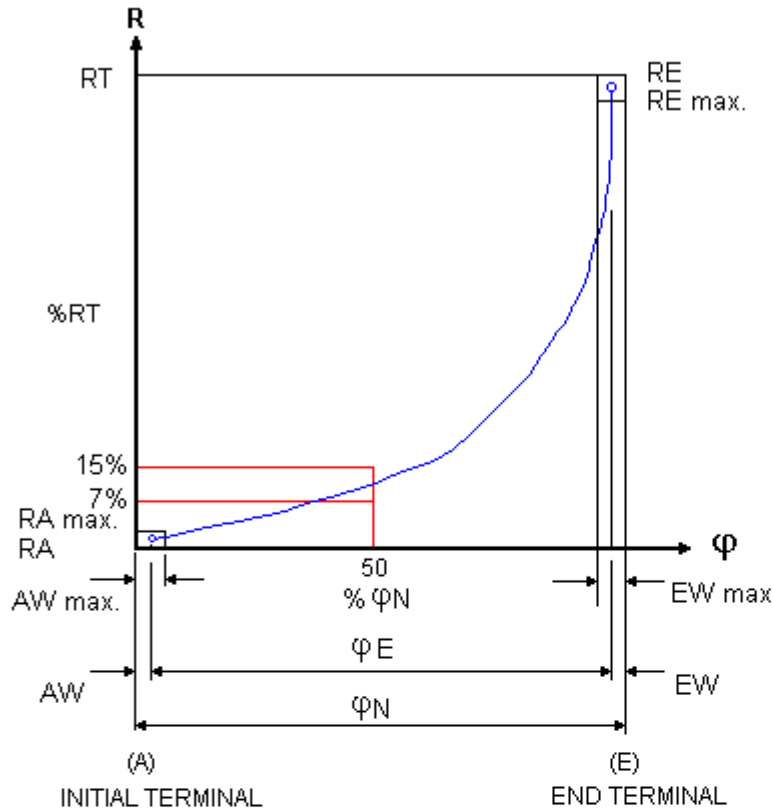
Insulating Voltage: 1000 V AC for 20mm potentiometers

Resistance law A - Linear



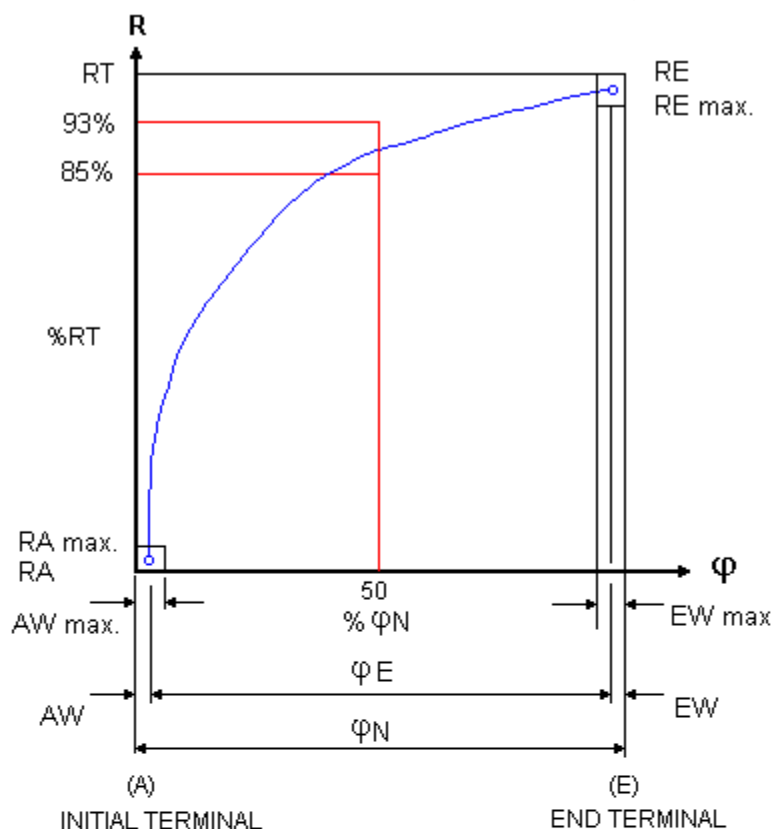
AW	Initial Path	AW max. 12% φN
EW	Final Path	EW max. 12% φN
Ra	Initial Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RA	Hop-on Resistance	$\leq 1\% RN$
Re	End Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RE	Hop-off Resistance	$\leq 1\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

Resistance law B – Log (Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RA	Hop-on Resistance	$RN \leq 10K$ 5% RN $RN > 10K$ 0.15% RN
Re	End Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RE	Hop-off Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K$ 0.5% RN
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

Resistance law C – Antilog (Reverse Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RA	Hop-on Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K 0.5\% RN$
Re	End Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RE	Hop-off Resistance	$RN \leq 10K 5\% RN$ $RN > 10K 0.15\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

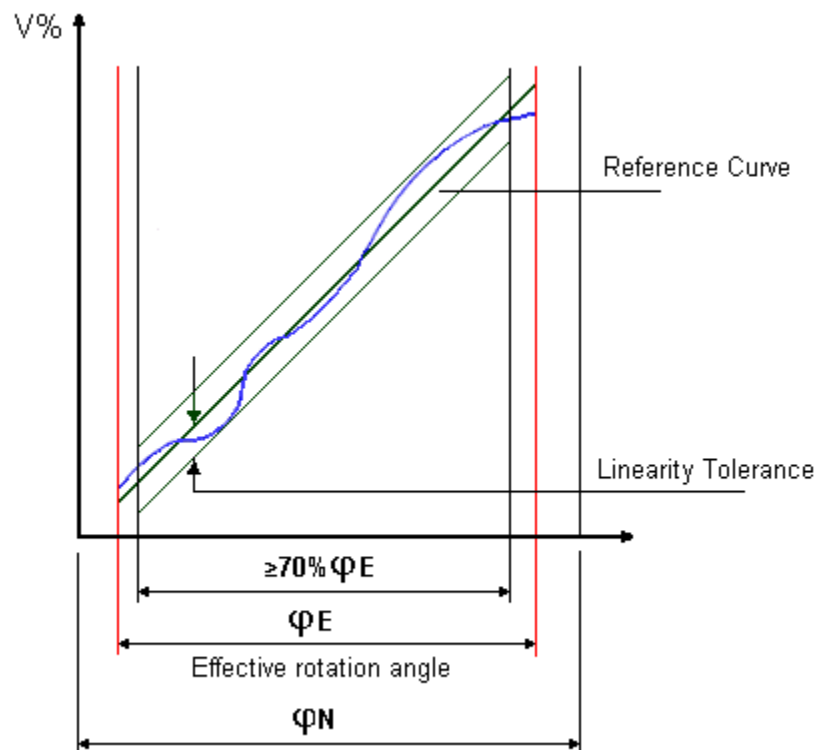
Linearity

As a basis of assessing Linearity Tolerance the independent method is the most practical, permitting as it does, the reference curve to be aligned as near as possible to the actual output curve. This avoids the use of the theoretical starting and finishing points, it is normal for the customer to realign the achieved curve with series trimmers at each end of the device if required.

Linearity Tolerance is 4% over the Nominal Resistance range of 1K0 to 1M0. The Linearity Tolerance is measured on at least 70% of the effective rotation range.

Note. In the case of Terminal and Zero-based linearity, both present constraints which increase the manufacturing difficulty and in consequence have an adverse effect on the product's price and availability.

Potentiometer linearity

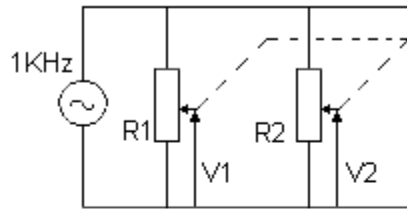


Matching Tolerance (For Tandem Stereo Potentiometers)

Tandem Potentiometers have two identical resistor units with the same variation law. The mismatching of the two resistor units, expressed in dB, is measured by the difference between the attenuations introduced by each resistor unit at various points of travel.

- Law A: 4 dB at Attenuation range 0 - 20 dB
- Law B and C: 3 dB at Attenuation range 0 - 20 dB

Matched Tolerance for Stereo

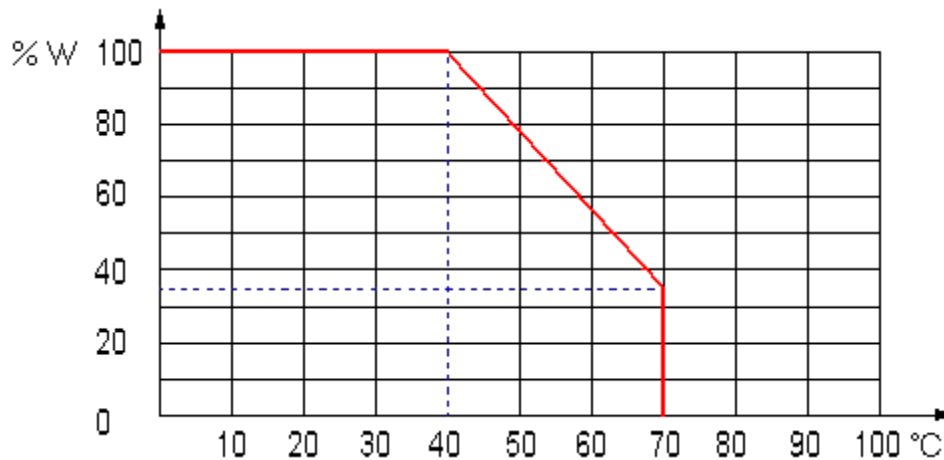


LAW	ATTENUATION RANGE	MATCHING TOLERANCE *
A	0 - 20dB	4dB
B & C	0 - 20dB	3dB

$$* \text{Matching Tolerance} = 20 \log \frac{V1}{V2}$$

Operating Temperature: -25°C to +70°C

Temperature Derating Curve



Temperature Coefficient of Resistance: +300 -500 ppm

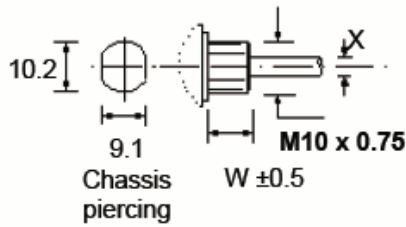
Components

P20 Bush Housing (Mounting)

The P20 bushes are available in metal or nylon; with three thread options; and with or without a locating feature:

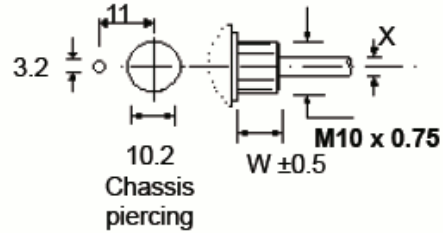
- Diecast Zinc Alloy
 - M10 x0.75mm pitch (Type C)
 - M10 x0.75mm pitch, **with locator** (Type CEBS)
 - 9.52mm x32tpi (Type CBS)
 - 9.52mm x32tpi, **with locator** (Type CBSL)
 - M7 x0.75mm pitch (Type CG)
- Glass Filled Nylon
 - M10 x0.75mm (Type CP)

DIECAST ZINC ALLOY



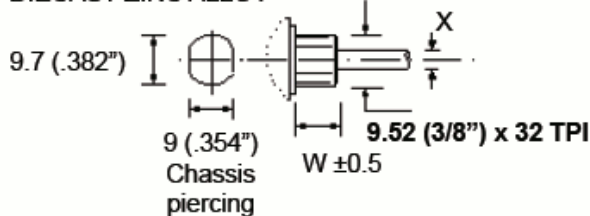
Type C (without locator)	
X (mm)	6
W (mm)	9

DIECAST ZINC ALLOY



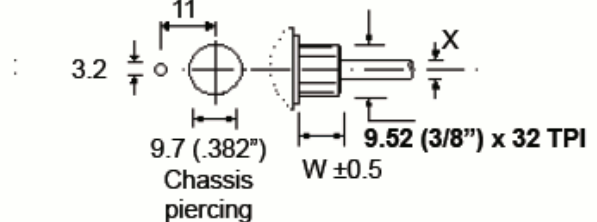
Type CEBS (with locator)	
X (mm)	6
W (mm)	9

DIECAST ZINC ALLOY



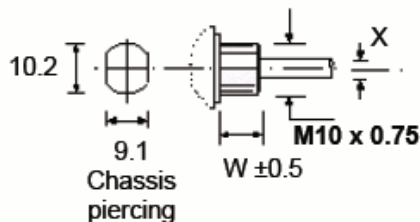
Type CBS (without locator)		
X (mm)	6	6.35
W (mm)	8 or 12	8 or 12

DIECAST ZINC ALLOY



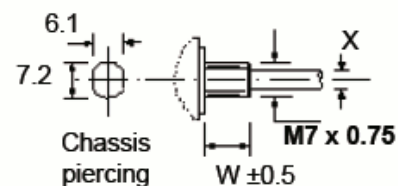
Type CBSL (with locator)		
X (mm)	6.35	6.35
W (mm)	8	12

GLASS FILLED NYLON



Type CP (GFN)		
X (mm)	6	6.35
W (mm)	7 or 10	7 or 10

DIECAST ZINC ALLOY



Type CG (without locator)	
X (mm)	4
W (mm)	6

P20 Spindles

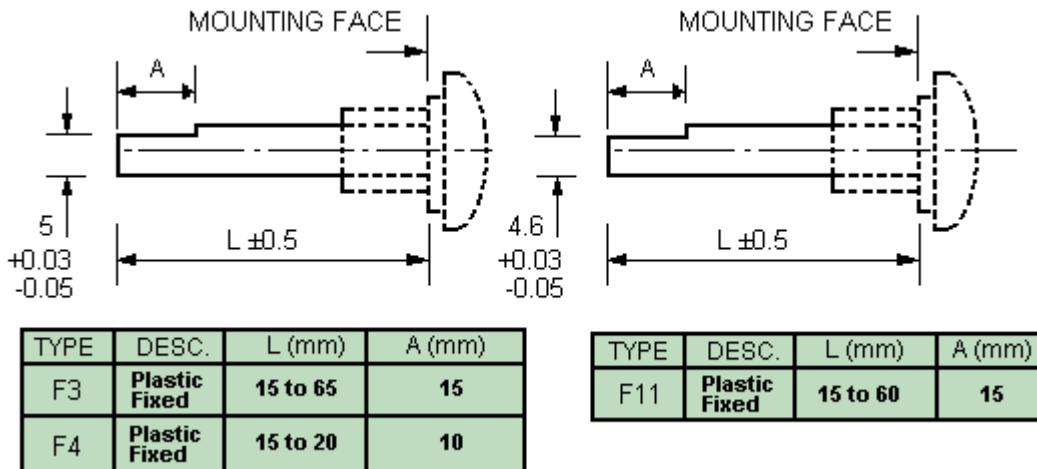
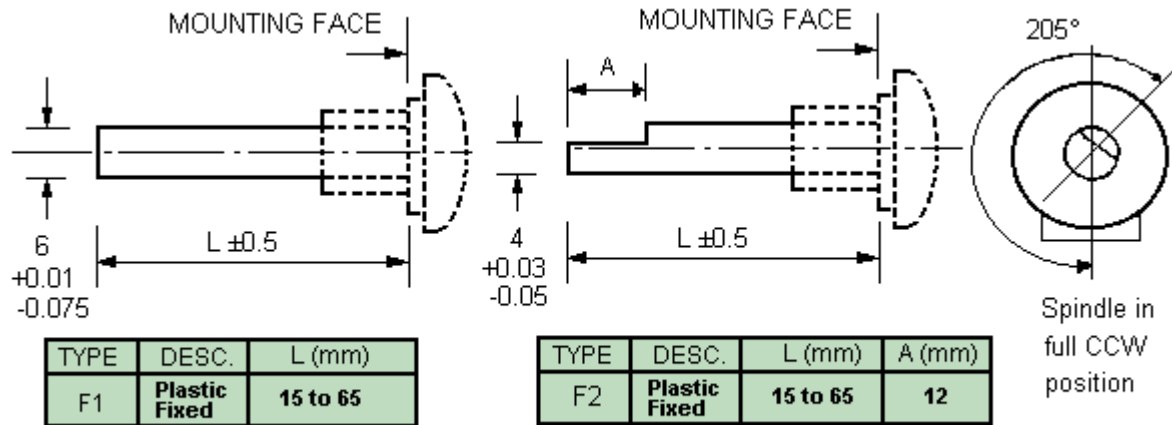
The P20 spindles are plastic and fixed i.e. not removable, unless otherwise stated and they are available in three diameters:

- 6.0mm Diameter
 - Cylindrical (Type F1)
 - 4.0 x 12mm Flat (Type F2)
 - 5.0 x 15mm Flat (Type F3)
 - 5.0 x 10mm Flat (Type F4)
 - 4.6mm x 15mm Flat (Type F11)
- 4.0mm Diameter
 - Cylindrical (Type F21)
 - 3.0 x 8.5mm Flat (Type F22)
 - 3.0 x 13.5mm Flat (Type F23)
 - Cylindrical (Type M21 - Metal)
 - 3.0 x 8.5mm Flat (Type M22 - Metal)
 - 3.0 x 13.5mm Flat (Type M23 - Metal)
- 6.35mm Diameter
 - Cylindrical (Type F41)
 - 5.5 x 10mm Flat (Type F42)
 - 5.5 x 15mm Flat (Type F43)
- Splined Spindle - 6.0mm dia. 18 teeth
- Dual Concentric
 - Flatted/Slotted (Type M15 - Metal)
 - Cylindrical (Type M16 - Metal)

6.0mm Diameter Spindles

Note: *Specials to customer's specification up to 65mm.

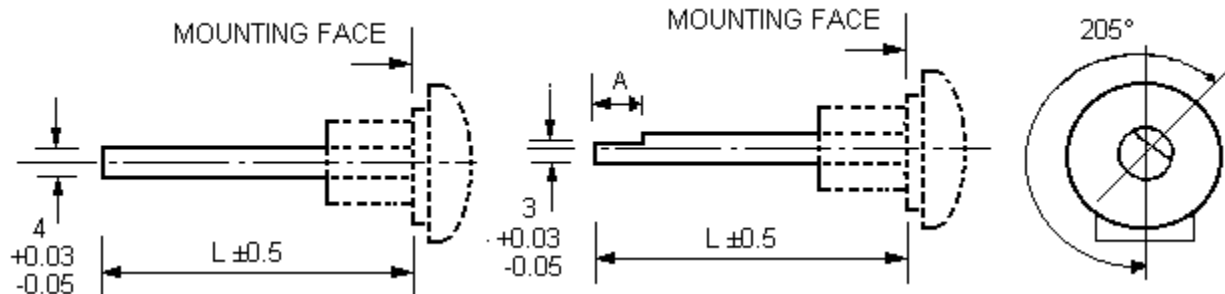
REMOVABLE SPINDLES, similar in specification to 'fixed' spindles are supplied separate from the potentiometer. These can be indefinitely taken in and out and their holding strength is >1kg.



4.0mm Diameter Spindles

Note: The orientation of the flat as illustrated is for plastic spindles only.

For metal spindles, unless specified on the order, the orientation may be different on each potentiometer type.



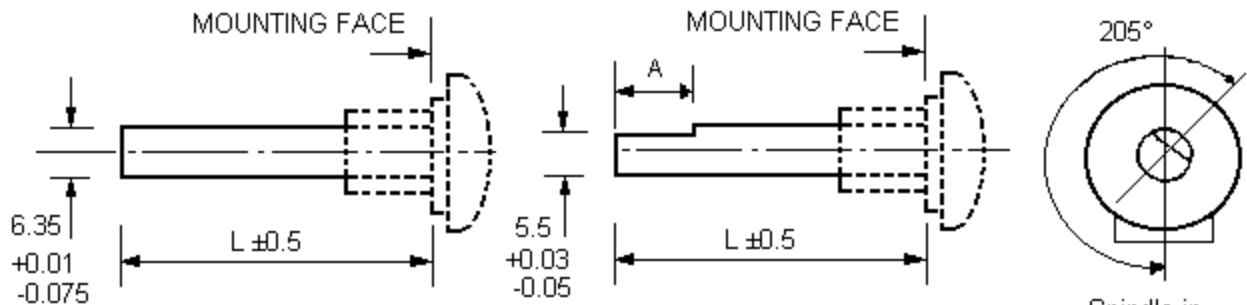
TYPE	DESC.	L (mm)
F21	Plastic Fixed	8 to 65
M21	Metal Fixed	8 to 65

TYPE	DESC.	L (mm)	A (mm)
F22	Plastic Fixed	11 to 60	8.5
M22	Metal Fixed	11 to 60	8.5
F23	Plastic Fixed	16 to 60	13.5
M23	Metal Fixed	16 to 60	13.5

Spindle in full CCW position

6.35mm Diameter Spindles

Note: *Specials to customer's specification up to 65mm.



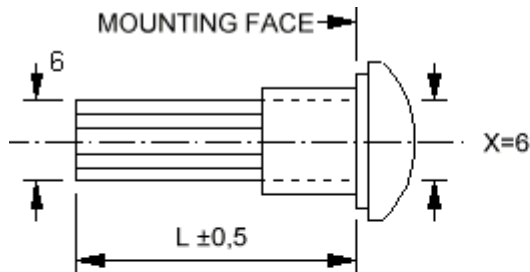
TYPE	DESC.	L (mm)
F41	Plastic Fixed	15 to 65

TYPE	DESC.	L (mm)	A (mm)
F42	Plastic Fixed	15 to 20	10
F43	Plastic Fixed	20 to 60	15

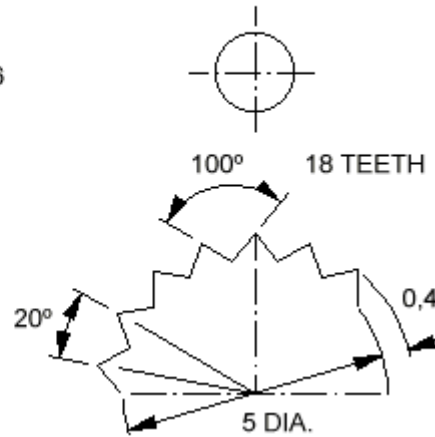
Spindle in full CCW position

Splined Spindle - 6.0mm dia. 18 teeth

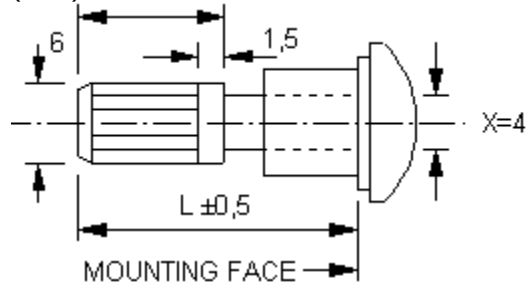
A splined form is available on the 6.0mm diameter P20 plastic spindle (F5) or alternatively a 6mm 'Splined Adaptor' (8,7mm long) can be fitted on a 4mm dia. Spindle



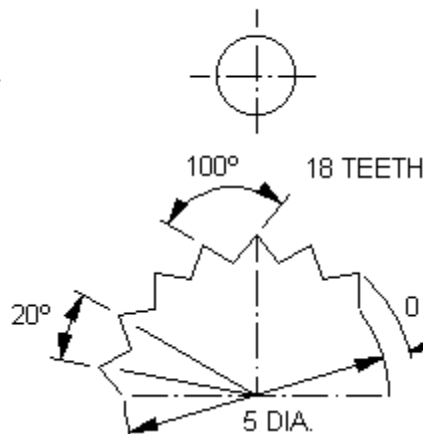
TYPE	DESC.	L (mm)
F5	Plastic Fixed	19



(F5A):



TYPE	DESC.	L (mm)
F5A	Plastic Fixed	16-36

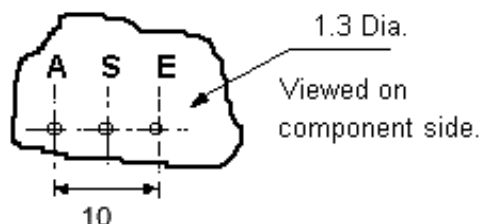
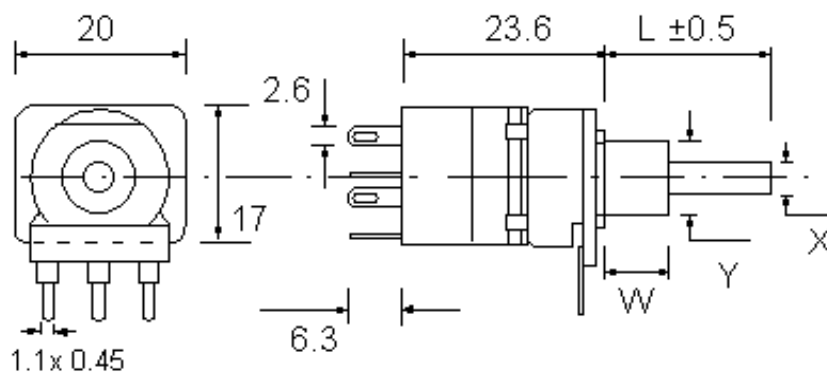
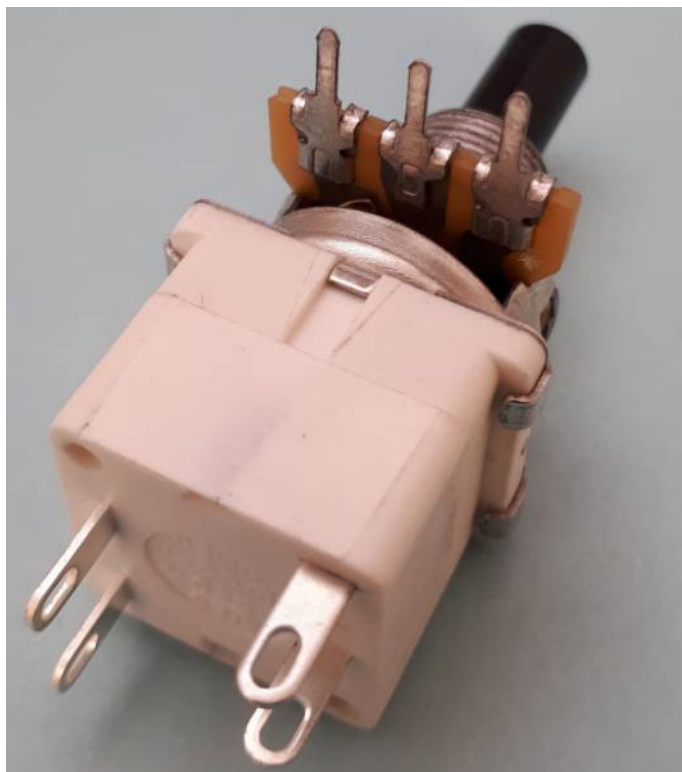


PC16BU/B4OW2S

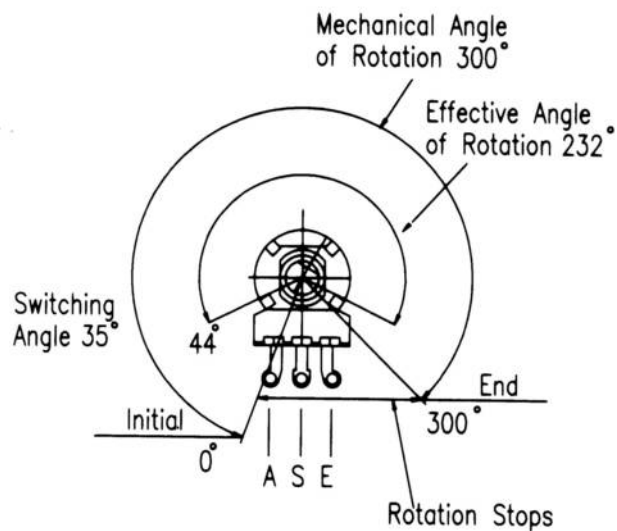
B4OW2S – 4 Amp Double Pole (Single Throw) Switch

OW – Ordinary Wiring Terminals (for soldering)

PC – Printed Circuit Terminals



SPINDLE END VIEW



Total mechanical and effective electrical angles of rotation of potentiometers with rotary switch

- W Mounting Height
- Y Mounting Diameter
- X Spindle Diameter
- L Spindle Length
- A Initial Termination
- S Wiper (or moving contact) termination
- E End Termination



P16 Range Technical Data

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Rotation angle: 270° ±5° (Unswitched), 300° ±5° (Switched)

Operating Torque: 0.4 – 2.0 N.cm (Initial Torque may be higher)

Rotational torque of spindle can be made high or low

Detents (stop positions) Available: Centre, 11, 21, 31, 41

Permissible Axial Spindle Load: 50 N (5 Sec. maximum)

Permissible Torque at End Stop: 35 N.cm

ELECTRICAL SPECIFICATION

Rated Power Dissipation @40°C for ECO potentiometers:

0.25W linear law

0.12W nonlinear law

Rotation angle: 270° ±5° (Unswitched), 300° ±5° (Switched)

Effective rotation: 232° nominal

Insulation Resistance: >= 4 Gohms

Rated Resistance: E3 Series

- Optional: E6 Series
- Linear Law: 1K - 1M
- Nonlinear Law: 4K7 - 470K

Tolerance on Rated Resistance: ± 20%

- Optional Tolerance on 1K - 1M: ± 10%

Resistance Laws (Taper):

- Linear: A
- Nonlinear: B - Log (Audio) or C - Antilog (Reverse Audio)
- Other laws: Please refer to Sales office

Rotary Switch Specification

The rotary switch modules are manufactured to EN61058-1 standard using high quality materials with a flame retardant housing. Although no longer certified due to the excessive cost of maintaining approvals, the 1 Amp and 4 Amp switch series have both been previously certified by UL International Demko (copies of previous certificates are available on our website or on request). The same materials, components and production techniques are used as in the certified versions and Omeg Ltd continues to test to the EN61058-1 standard

The 1 Amp contact rating is only available when mounted on the ECO potentiometer

1 A Contact Rating:

Note: The 1A contact rating is NOT available for mounting on the P16 or P20 potentiometer.

1A/250Vac 2.5A/12Vdc

Surge rating (0.01 seconds): 20A

Contact gap: 3mm (Full mains separation of contacts)

Manufactured to EN61058-1 standard

4 A Contact Rating:

4A/250Vac 10A/12Vdc

Surge rating (0.01 seconds): 80A

Switch contacts: Silver tin oxide

Contact gap: 2mm (Micro disconnection of switch - micro separation of contacts)

Manufactured to EN61058-1 standard

Common features

Housing material: Flame Retardant Glass filled polyester (UL 94 VO)

Initial contact resistance: 20 milliohms

Insulation resistance: 50,000 Megohms

Life (operations at full load): 10,000 minimum

Operating temperature: -25°C to +70°C

Operating torque for SPST/SPDT: 1.5 - 3 cNm

Operating torque for DPST/DPDT: 3.0 - 6 cNm

Mechanical rotation: 300°

Proof voltage: 3kV minimum

Rotary Switch Terminals

Layout

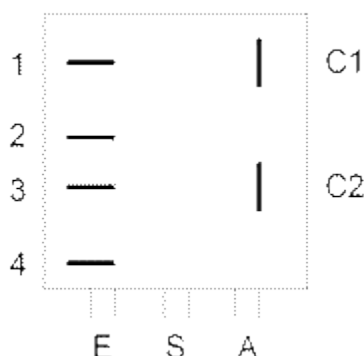


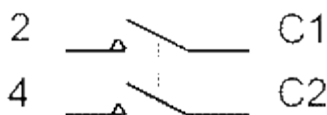
Diagram as viewed on the rear of the switch module:

(Potentiometer terminals at the bottom)

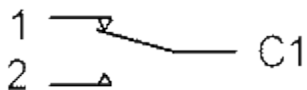
Configuration



SPST - Single pole (1S), Single throw (On-Off)

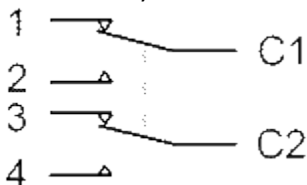


DPST - Double pole (2S), Single throw (On-Off)



SPDT - Single pole (1S), Double throw (CH)

(**NOT** certified)



DPDT - Double pole (2S), Double throw (CH)

(**NOT** certified)

Notes

1. Moving contact(s) shown when the potentiometer shaft is in a counterclockwise (CCW) position.
2. 'Ordinary Wiring'(OW) or 'Printed Circuit'(PC) terminals can be requested on the switch.
3. Terminals 1 and 3 are only fitted for the Double Throw ('CH' or Changeover) versions which are **NOT** approved nor certified.

Rotary Switch Terminals



Standard (1A or 4A contact ratings)

N/O normally OPEN Switch

Contacts normally OPEN;

CLOCKwise rotation to CLOSE contacts

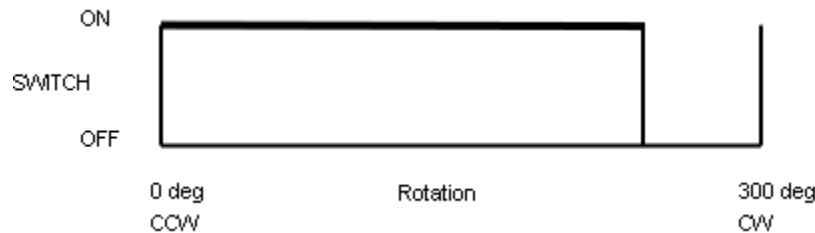


Option 1 (4A contact rating only)

N/C normally CLOSED Switch

Contacts normally CLOSED;

CLOCKwise rotation to OPEN contacts

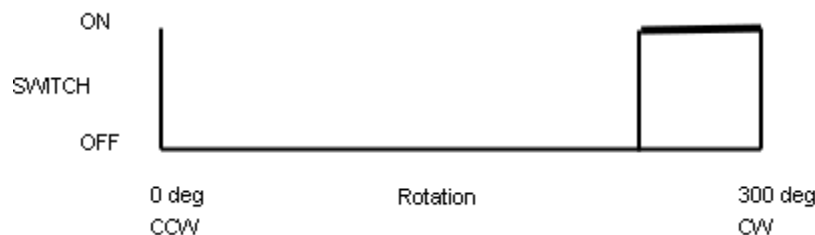


Option 2 (4A contact rating only)

REVERSED N/O normally OPEN Switch

Contacts normally OPEN at fully clockwise position;

ANTI-clockwise rotation to CLOSE contacts



Option 3 (4A contact rating only)

REVERSED N/C normally CLOSED Switch

Contacts normally CLOSED at fully clockwise position;

ANTI-clockwise rotation to OPEN contacts

ELECTRICAL SPECIFICATION UNIQUE TO P16 POTENTIOMETERS

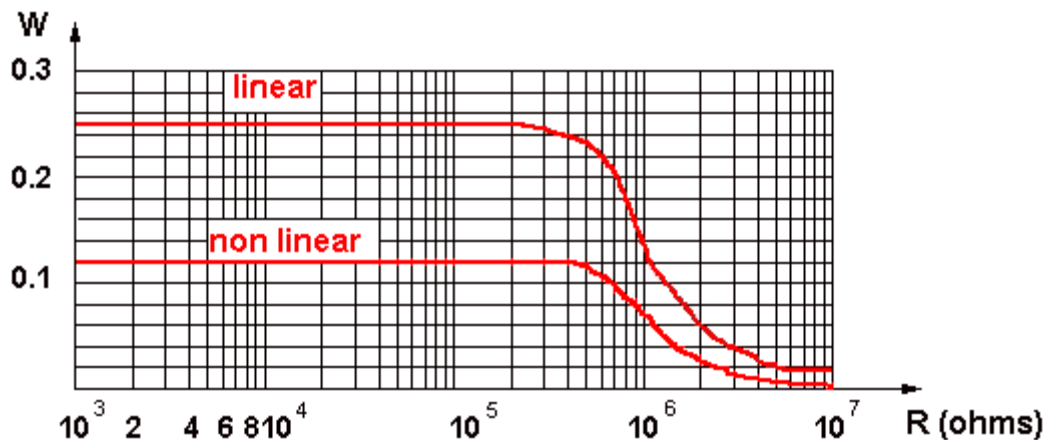
Effective rotation:

- Without a switch: 232° nominal
- With rotary switch: 232° nominal

Rated Power Dissipation @40°C for ECO potentiometers:

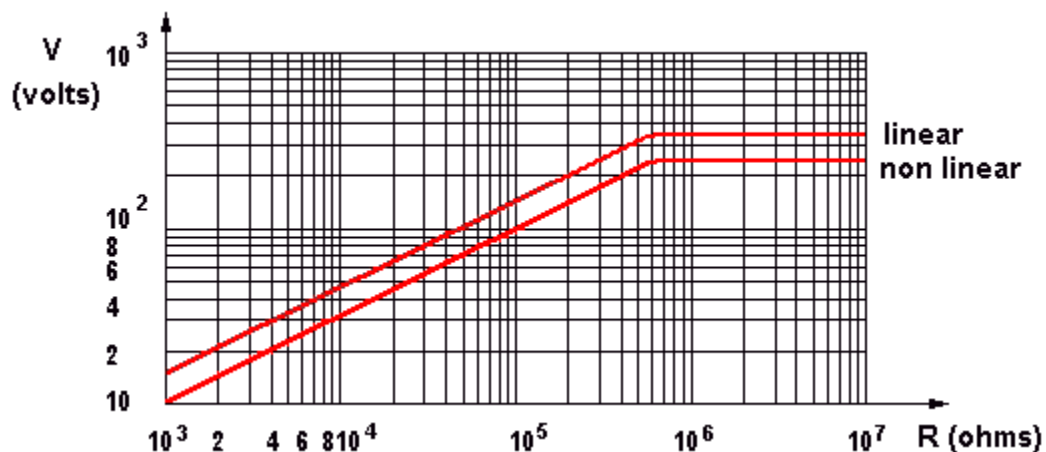
- 0.25W linear law
- 0.12W nonlinear law

ECO, P16 power dissipating curve



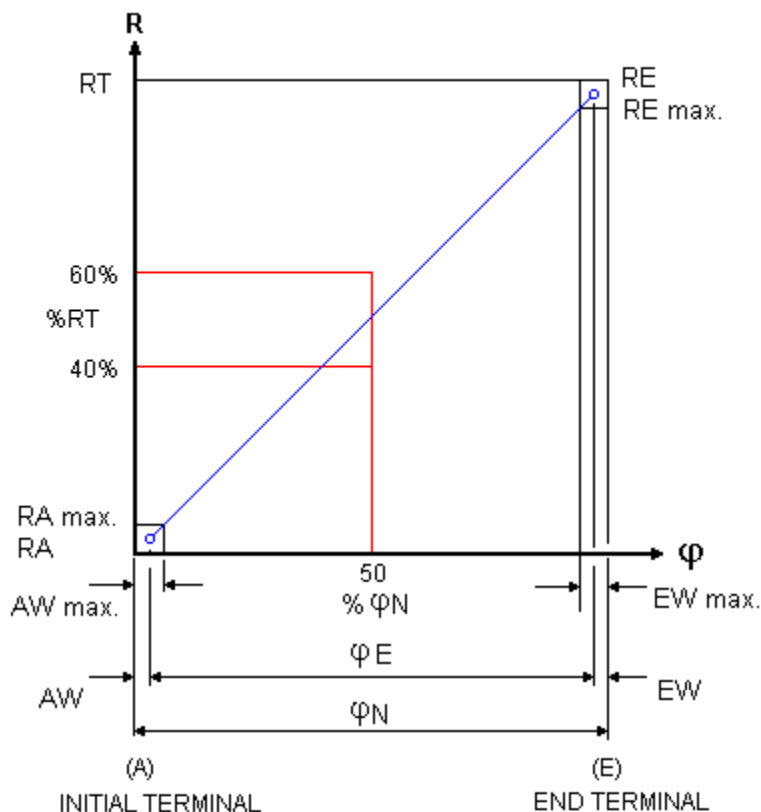
Limiting Element Voltage: 350 V DC for 16mm potentiometers

ECO, P16 maximum working voltage curve



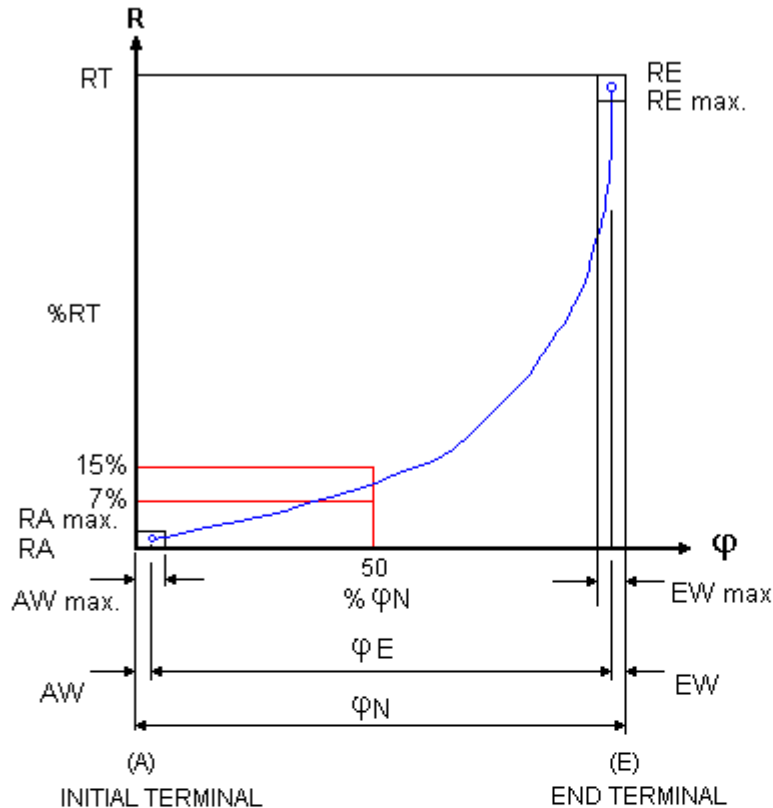
Insulating Voltage: 500 V AC for ECO potentiometers

Resistance law A - Linear



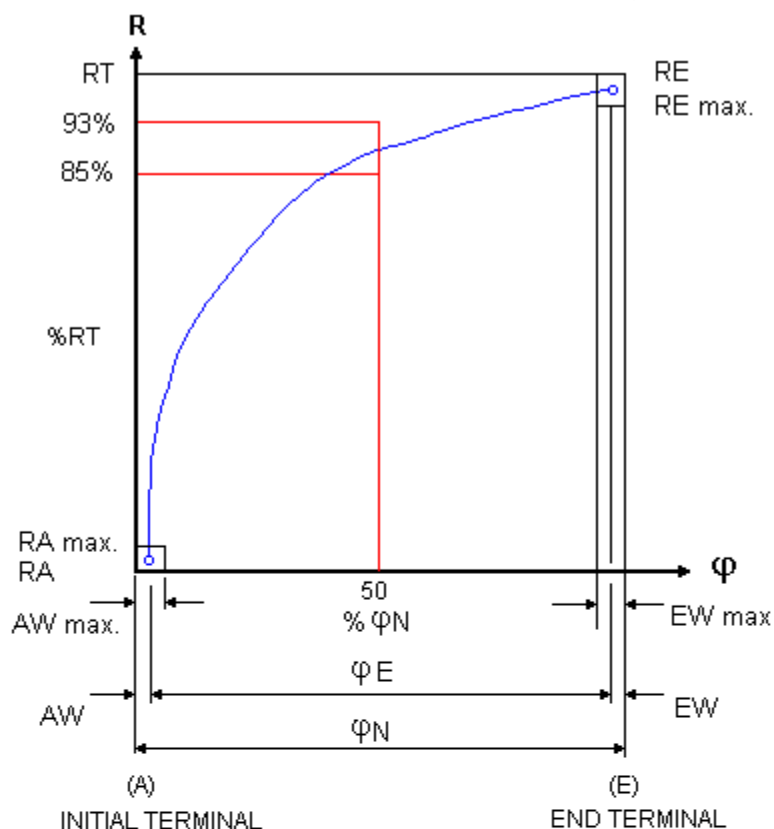
AW	Initial Path	AW max. 12% ϕN
EW	Final Path	EW max. 12% ϕN
Ra	Initial Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RA	Hop-on Resistance	$\leq 1\% RN$
Re	End Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RE	Hop-off Resistance	$\leq 1\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

Resistance law B – Log (Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RA	Hop-on Resistance	$RN \leq 10K$ 5% RN $RN > 10K$ 0.15% RN
Re	End Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RE	Hop-off Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K$ 0.5% RN
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

Resistance law C – Antilog (Reverse Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RA	Hop-on Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K 0.5\% RN$
Re	End Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RE	Hop-off Resistance	$RN \leq 10K 5\% RN$ $RN > 10K 0.15\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

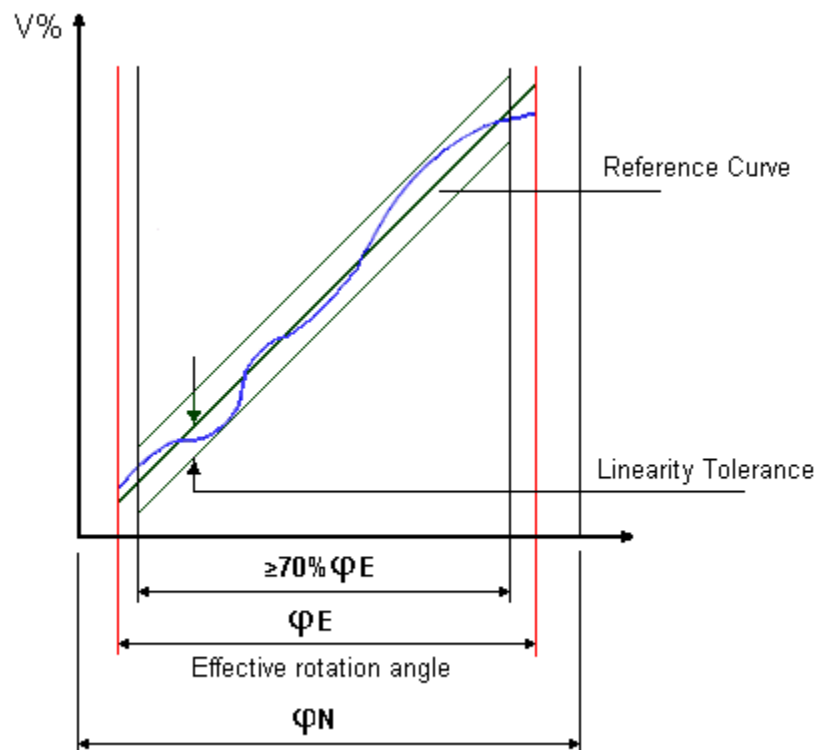
Linearity

As a basis of assessing Linearity Tolerance the independent method is the most practical, permitting as it does, the reference curve to be aligned as near as possible to the actual output curve. This avoids the use of the theoretical starting and finishing points, it is normal for the customer to realign the achieved curve with series trimmers at each end of the device if required.

Linearity Tolerance is 4% over the Nominal Resistance range of 1K0 to 1M0. The Linearity Tolerance is measured on at least 70% of the effective rotation range.

Note. In the case of Terminal and Zero-based linearity, both present constraints which increase the manufacturing difficulty and in consequence have an adverse effect on the product's price and availability.

Potentiometer linearity

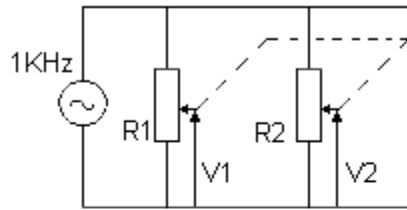


Matching Tolerance (For Tandem Stereo Potentiometers)

Tandem Potentiometers have two identical resistor units with the same variation law. The mismatching of the two resistor units, expressed in dB, is measured by the difference between the attenuations introduced by each resistor unit at various points of travel.

- Law A: 4 dB at Attenuation range 0 - 20 dB
- Law B and C: 3 dB at Attenuation range 0 - 20 dB

Matched Tolerance for Stereo

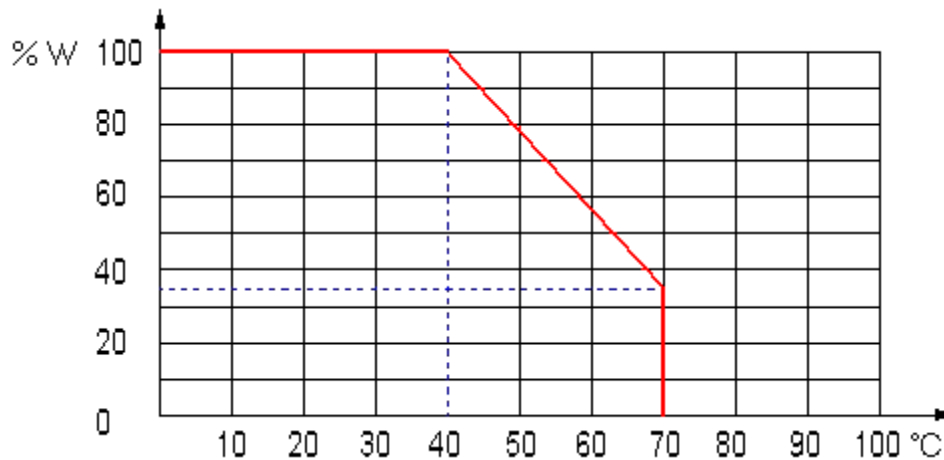


LAW	ATTENUATION RANGE	MATCHING TOLERANCE *
A	0 - 20dB	4dB
B & C	0 - 20dB	3dB

$$* \text{Matching Tolerance} = 20 \log \frac{V1}{V2}$$

Operating Temperature: -25°C to +70°C

Temperature Derating Curve



Temperature Coefficient of Resistance: +300 -500 ppm

Components

P16 Bush Housing (Mounting)

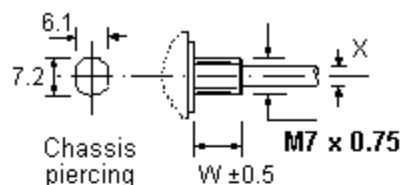
The P16 bushes are available in metal or nylon with an M7 or M10 thread both with and without a locating feature:

Diecast Zinc Alloy M10 x 0.75mm pitch (Type C) or M7 0.75mm pitch (Type CG)

Glass Filled Nylon M10 x 0.75mm pitch (Type CP)

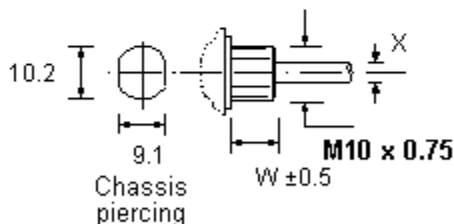
Do not attempt to prevent any unwanted body rotation by overtightening the retaining nut, since this can cause thread damage, distortion, change of electrical resistance and restrict shaft rotation. BS9130:1972 provides further details on this topic. The **recommended torque** for tightening the retaining nut is 45cN.m and this can be achieved cost effectively by using a Torque Limiting device as shown on our **Accessories** page.

DIECAST ZINC ALLOY



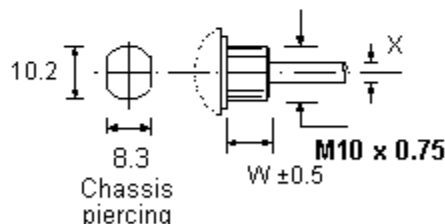
TYPE CG (without locator)	
X (mm)	4
W (mm)	6

DIECAST ZINC ALLOY



TYPE C (without locator)	
X (mm)	6 or 6.35
W (mm)	8

GLASS FILLED NYLON



TYPE CP (GFN)	
X (mm)	4 or 6
W (mm)	8

P16 Spindles

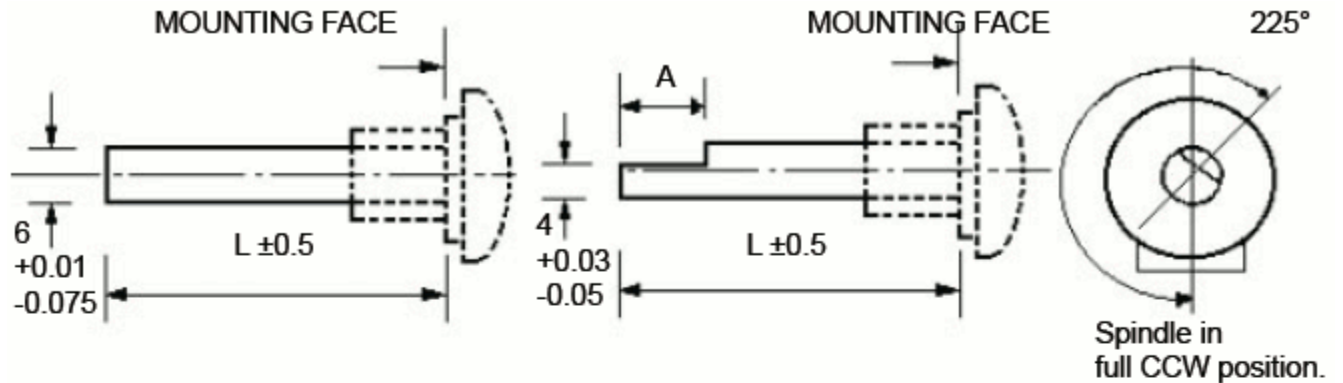
The P16 spindles are plastic, unless otherwise stated, fixed i.e. not removable and they are available in three diameters:

- 6.0mm Diameter
 - Cylindrical (Type F1)
 - 4.0 x 12mm Flat (Type F2)
 - 5.0 x 15mm Flat (Type F3)
 - 5.0 x 10mm Flat (Type F4)
 - 4.6mm x 15mm Flat (Type F11)
- 4.0mm Diameter
 - Cylindrical (Type F21)
 - 3.0 x 8.5mm Flat (Type F22)
 - 3.0 x 8.5mm Flat (Type M22 - Metal)
- 6.35mm Diameter
 - Cylindrical (Type F41)
 - 5.5 x 10mm Flat (Type F42)
 - 5.5 x 15mm Flat (Type F43)
- Splined Spindle - 6.0mm dia. 18 teeth
- Dual Concentric
 - Flatted/Slotted (Type M15 - Metal)
 - Cylindrical (Type M16 - Metal)

Cylindrical and Flatted Spindles

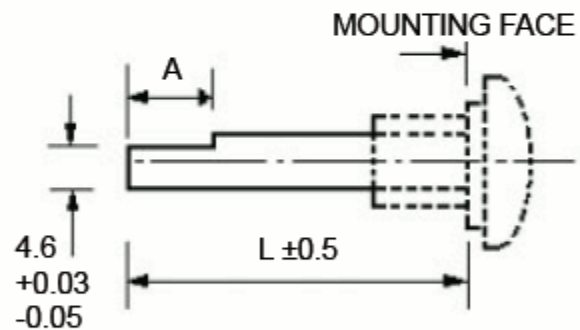
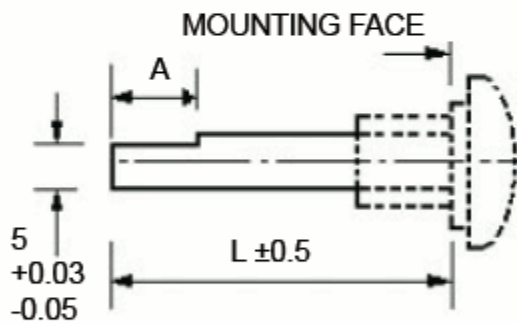
6.0mm Diameter Spindles

Note: *Specials to customer's specification up to 65mm.



TYPE	DESC.	L (mm)
F1	Plastic Fixed	15 to 50*

TYPE	DESC.	L (mm)	A (mm)
F2	Plastic Fixed	20 to 35*	12

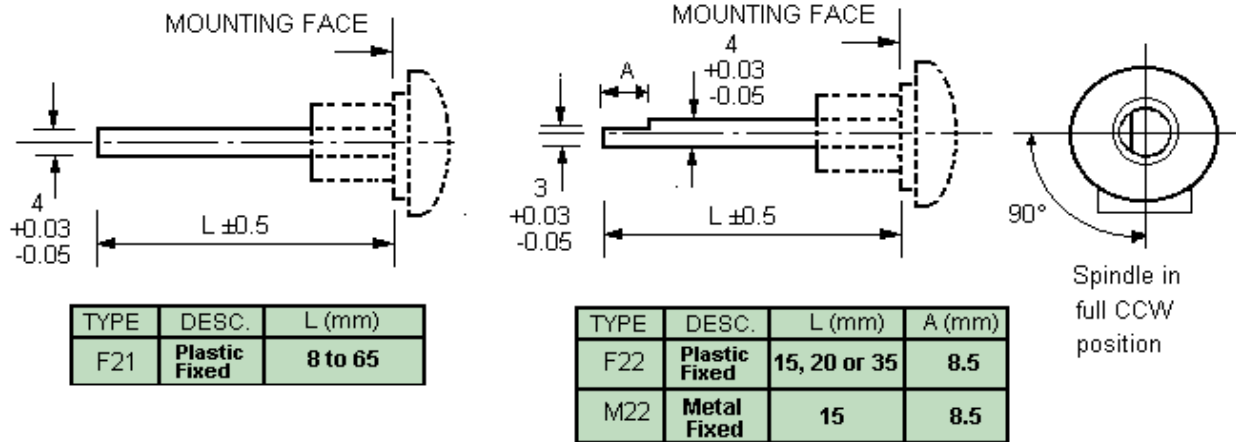


TYPE	DESC.	L (mm)	A (mm)
F3	Plastic Fixed	15 to 35*	15
F4	Plastic Fixed	15 to 35*	10

TYPE	DESC.	L (mm)	A (mm)
F11	Plastic Fixed	15 to 35*	15

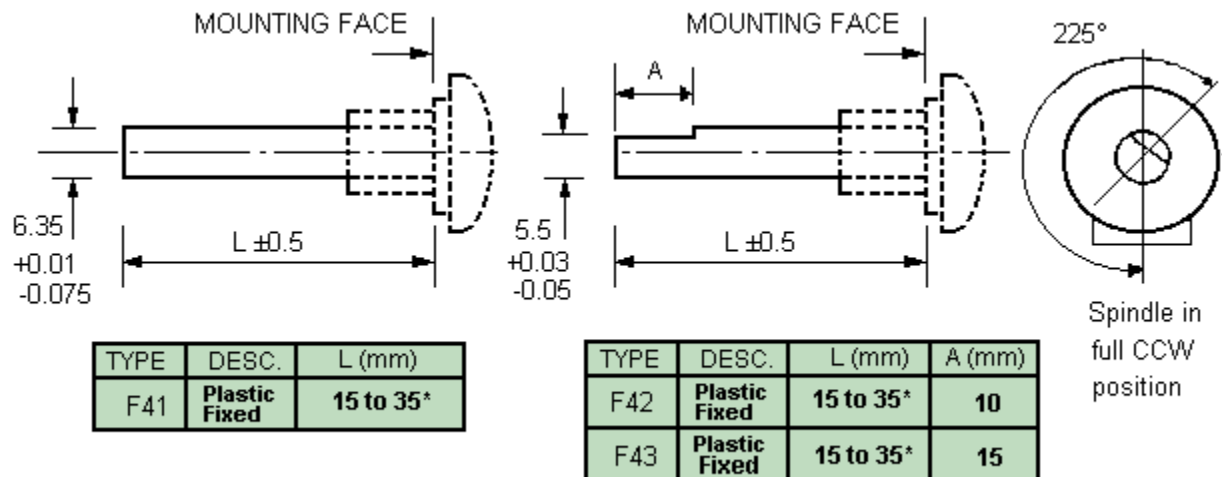
4.0mm Diameter Spindles

Note: The orientation of the flat as illustrated is for plastic spindles only.
 For metal spindles, unless specified on the order, the orientation may be different on each potentiometer type



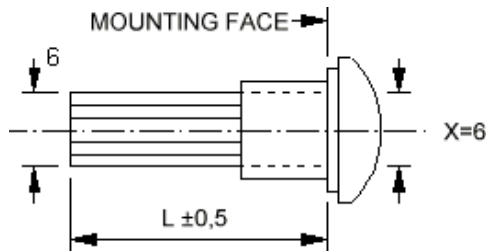
6.35mm Diameter Spindles

Note: *Specials to customer's specification up to 65mm.

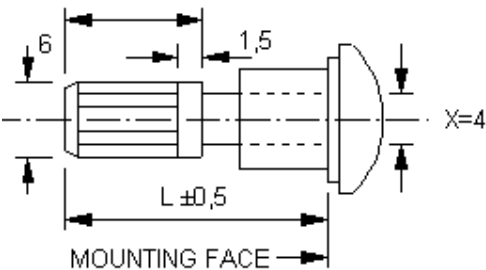
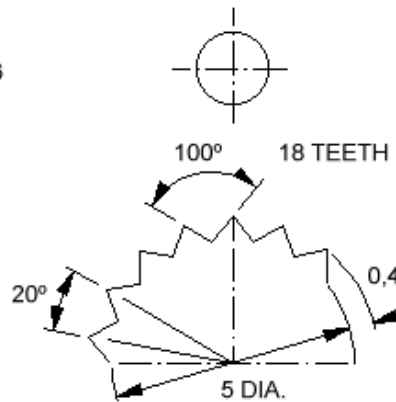


Splined Spindle - 6.0mm dia. 18 teeth

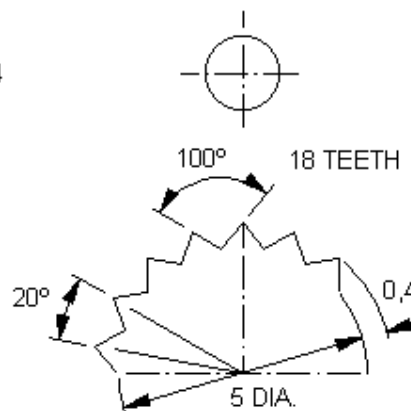
A splined form is available on the 6.0mm diameter P16 plastic spindle (F5)
 or alternatively,
 a 6mm 'Splined Adaptor' (8.7mm long) can be fitted on a 4mm dia. Spindle (F5A):



TYPE	DESC.	L (mm)
F5	Plastic Fixed	19

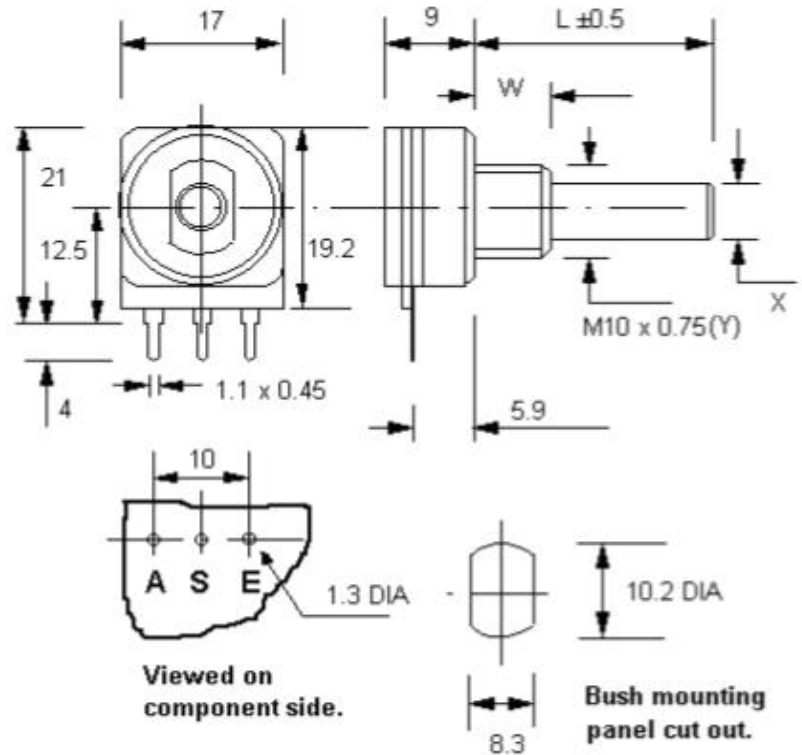


TYPE	DESC.	L (mm)
F5A	Plastic Fixed	16-36



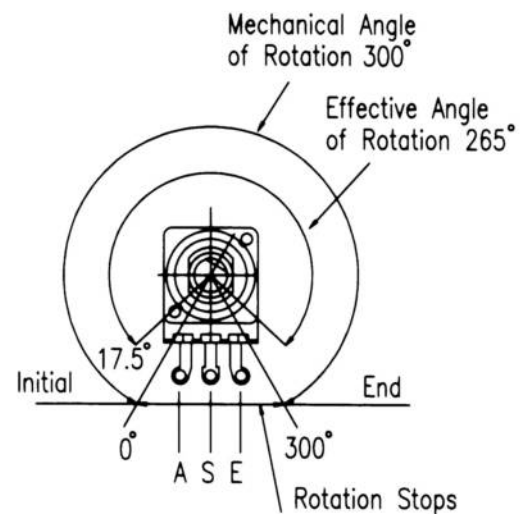
PC16ECO

PC – For Printed Circuit



SPINDLE END VIEW

- W Mounting Height
- Y Mounting Diameter
- X Spindle Diameter
- L Spindle Length
- A Initial Termination
- S Wiper (or moving contact) termination
- E End Termination



Total mechanical and effective electrical angles of rotation of potentiometers without rotary switch



ECO Range Technical Data

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Rotation angle: $300^{\circ} \pm 5^{\circ}$ (Switched and Unswitched)

Operating Torque: 0.4 – 2.0 N.cm (Initial Torque may be higher)

Rotational torque of spindle can be made high or low

Detents (stop positions) Available: Centre, 11, 21, 31

Permissible Axial Spindle Load: 50 N (5 Sec. maximum)

Permissible Torque at End Stop: 35 N.cm

ELECTRICAL SPECIFICATION

Rated Power Dissipation @40°C for ECO potentiometers:

0.25W linear law

0.12W nonlinear law

Rotation angle: $300^{\circ} \pm 5^{\circ}$

Effective rotation - Unswitched: 265° nominal

Effective rotation - Switched: 242° nominal

Insulation Resistance: ≥ 4 Gohms

Rated Resistance: E3 Series

- Optional: E6 Series
- Linear Law: 1K - 1M
- Nonlinear Law: 4K7 - 470K

Tolerance on Rated Resistance: $\pm 20\%$

- Optional Tolerance on 1K - 1M: $\pm 10\%$

Resistance Laws (Taper):

- Linear: A
- Nonlinear: B - Log (Audio) or C - Antilog (Reverse Audio)
- Other laws: Please refer to Sales office

ELECTRICAL SPECIFICATION UNIQUE TO ECO POTENTIOMETERS

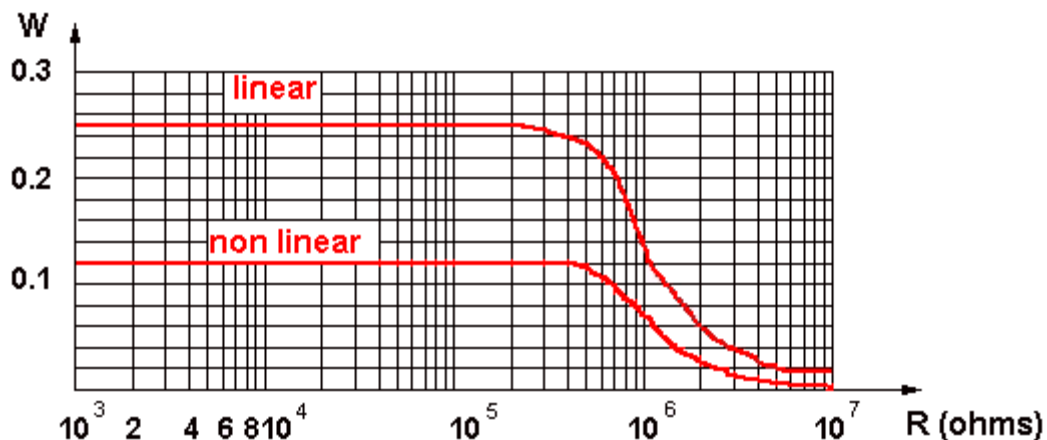
Effective rotation:

- Without a switch: 265° nominal
- With push push switch (/10APP, /MS): 265° nominal
- With rotary switch: 242° nominal

Rated Power Dissipation @40°C for ECO potentiometers:

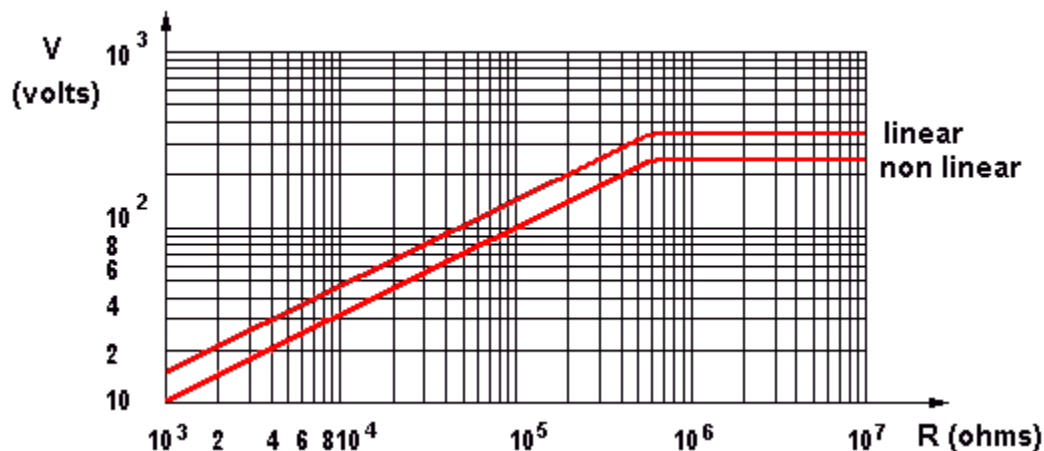
- 0.25W linear law
- 0.12W nonlinear law

ECO, P16 power dissipating curve



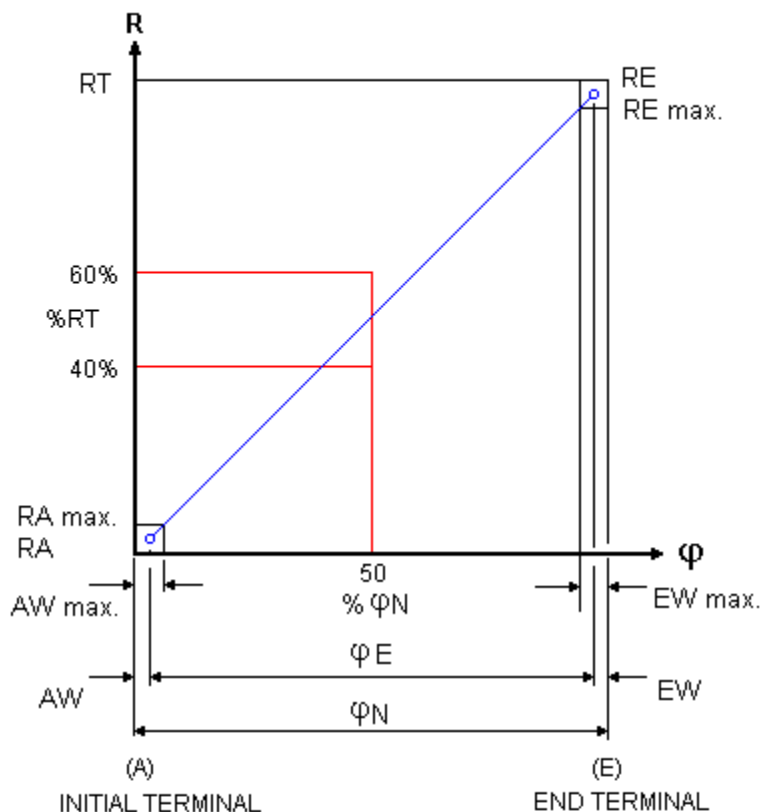
Limiting Element Voltage: 350 V DC for 16mm potentiometers

ECO, P16 maximum working voltage curve



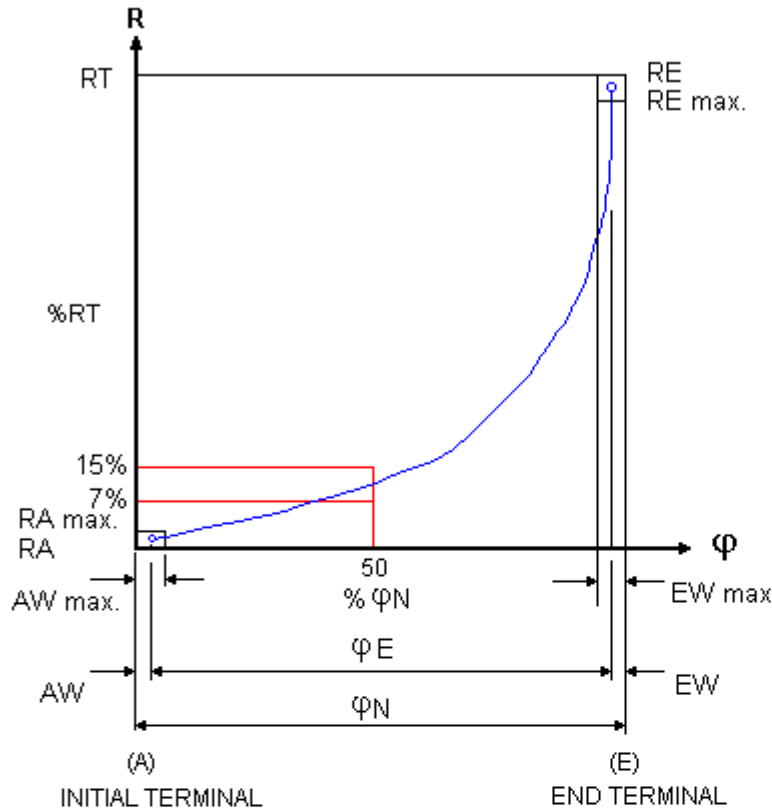
Insulating (Breakdown) Voltage: 2,500 V AC for ECO Potentiometers

Resistance law A - Linear



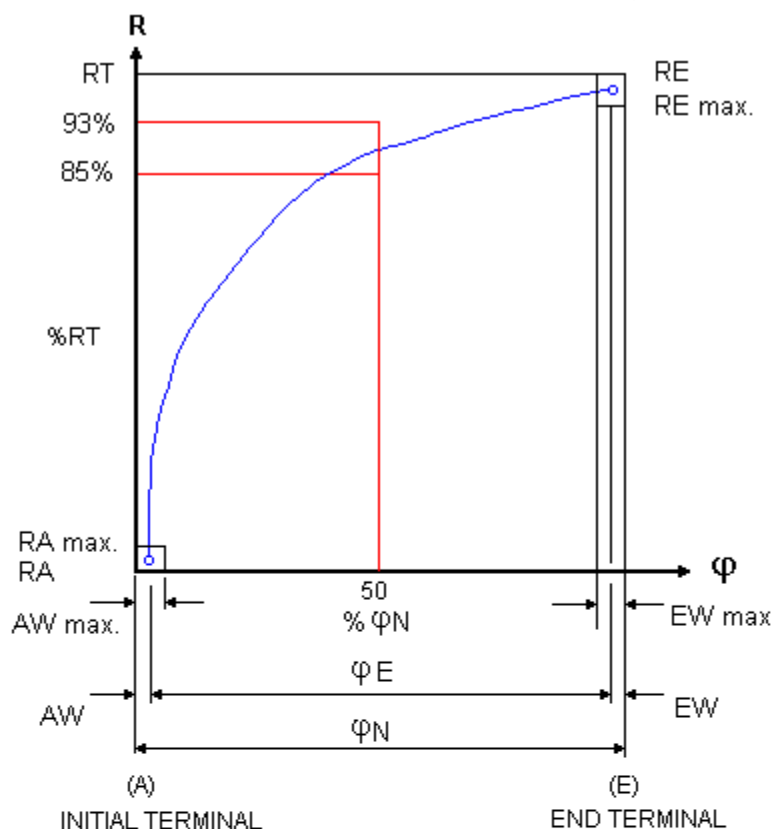
AW	Initial Path	AW max. 12% ϕN
EW	Final Path	EW max. 12% ϕN
Ra	Initial Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RA	Hop-on Resistance	$\leq 1\% RN$
Re	End Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RE	Hop-off Resistance	$\leq 1\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

Resistance law B – Log (Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RA	Hop-on Resistance	$RN \leq 10K$ 5% RN $RN > 10K$ 0.15% RN
Re	End Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RE	Hop-off Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K$ 0.5% RN
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

Resistance law C – Antilog (Reverse Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RA	Hop-on Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K 0.5\% RN$
Re	End Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RE	Hop-off Resistance	$RN \leq 10K 5\% RN$ $RN > 10K 0.15\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

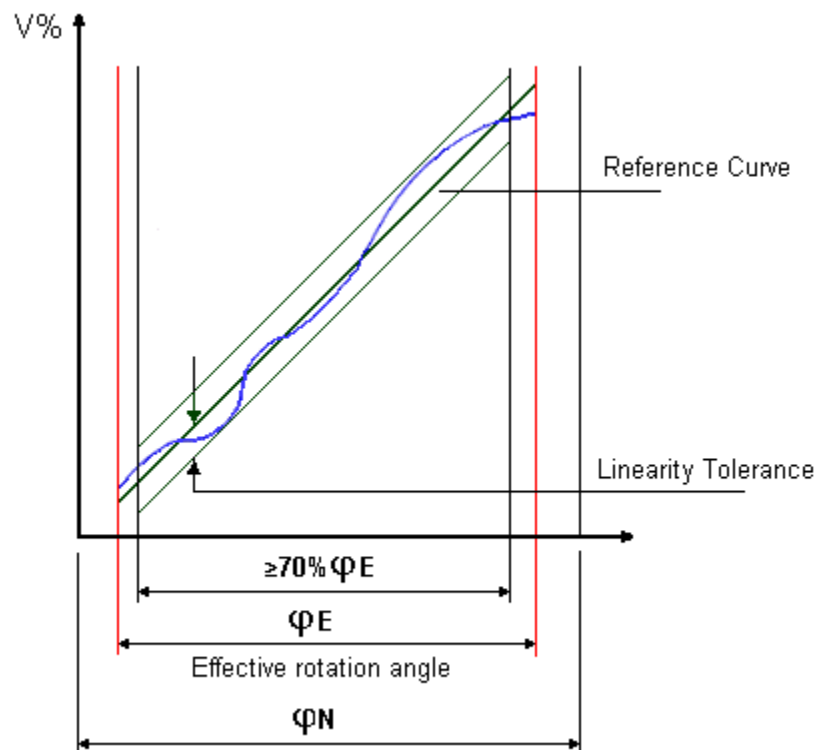
Linearity

As a basis of assessing Linearity Tolerance the independent method is the most practical, permitting as it does, the reference curve to be aligned as near as possible to the actual output curve. This avoids the use of the theoretical starting and finishing points, it is normal for the customer to realign the achieved curve with series trimmers at each end of the device if required.

Linearity Tolerance is 4% over the Nominal Resistance range of 1K0 to 1M0. The Linearity Tolerance is measured on at least 70% of the effective rotation range.

Note. In the case of Terminal and Zero-based linearity, both present constraints which increase the manufacturing difficulty and in consequence have an adverse effect on the product's price and availability.

Potentiometer linearity

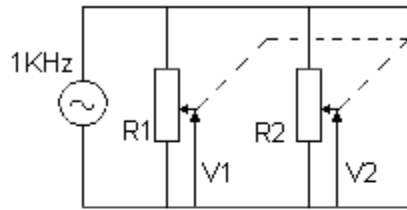


Matching Tolerance (For Tandem Stereo Potentiometers)

Tandem Potentiometers have two identical resistor units with the same variation law. The mismatching of the two resistor units, expressed in dB, is measured by the difference between the attenuations introduced by each resistor unit at various points of travel.

- Law A: 4 dB at Attenuation range 0 - 20 dB
- Law B and C: 3 dB at Attenuation range 0 - 20 dB

Matched Tolerance for Stereo

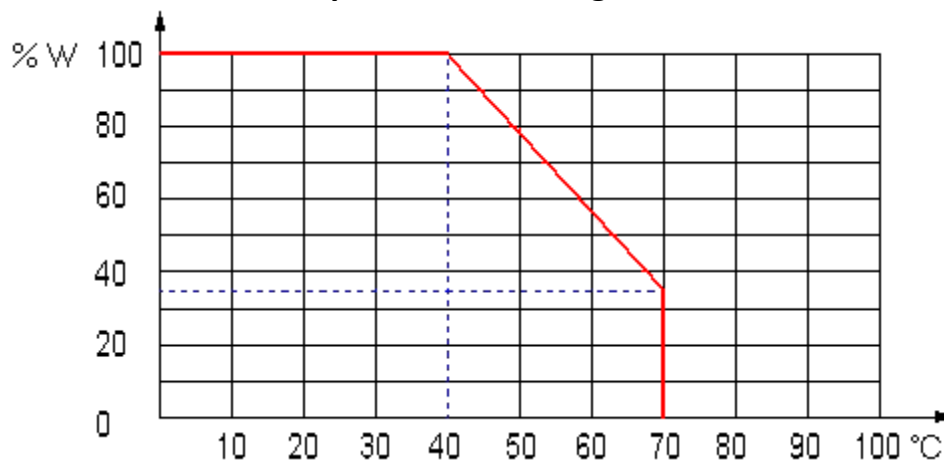


LAW	ATTENUATION RANGE	MATCHING TOLERANCE *
A	0 - 20dB	4dB
B & C	0 - 20dB	3dB

$$* \text{Matching Tolerance} = 20 \log \frac{V1}{V2}$$

Operating Temperature: -25°C to +70°C

Temperature Derating Curve



Temperature Coefficient of Resistance: +300 -500 ppm

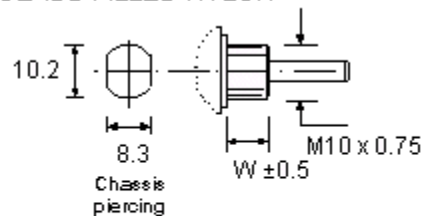
Components

ECO Bush Housing (Mounting)

The ECO bush housing is made of glass filled nylon, the thread is M10 x0.75mm pitch and 8mm long, alternatively **a 12mm long thread is also available** from October 2008.

Do not attempt to prevent any unwanted body rotation by overtightening the retaining nut, since this can cause thread damage, distortion, change of electrical resistance and restrict shaft rotation. BS9130:1972 provides further details on this topic. The **recommended torque** for tightening the retaining nut is 45cN.m and this can be achieved cost effectively by using a Torque Limiting device as shown on our **Accessories** page.

GLASS FILLED NYLON



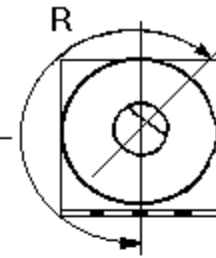
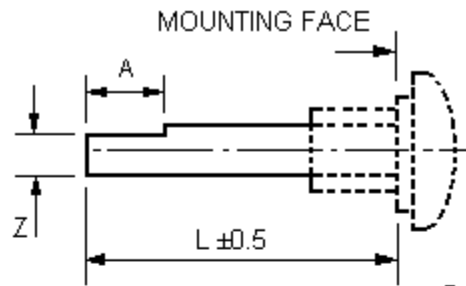
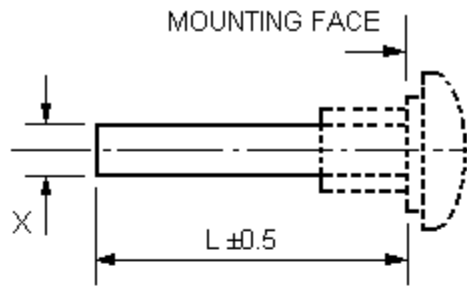
TYPE PLASTIC BODY	
W(mm)	8 (optional 12)

ECO Spindles

The ECO plastic spindles are fixed and not removable.
They are available in the following three diameters:

- 6.0mm Diameter - Length (L) available from 14mm to 65mm
 - Cylindrical (Type F1)
 - 4.0 x 12mm Flat (Type F2)
 - 5.0 x 15mm Flat (Type F3)
 - 5.0 x 10mm Flat (Type F4)
 - 4.6mm x 15mm Flat (Type F11)
 - 4.0 x 8mm Flat (Type F13)
 - 5.0 x 8mm Flat (Type F14)
- 4.0mm Diameter - Length (L) available from 14mm to 35mm
 - Cylindrical (Type F21)
 - 3.0 x 8.5mm Flat (Type F22)
- 6.35mm Diameter - Length (L) available from 14mm to 65mm
 - Cylindrical (Type F41)
 - 5.5 x 10mm Flat (Type F42)

Cylindrical and Flatted Spindles



Spindle in full CCW position

TYPE	DESC. (X)	L (mm)
F21	4 mm Dia Plastic	14 - 35
F1	6 mm Dia Plastic	14 - 65
F41	6.35mm Dia Plastic	14 - 65

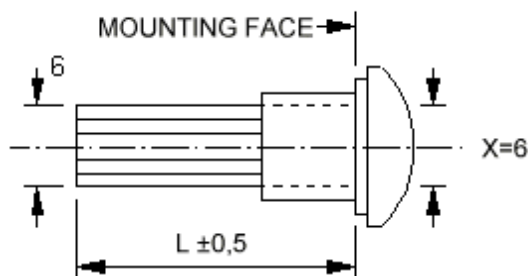
All spindles fixed.

TYPE	DESC. (X)	L (mm)	Flat (ZxA)
F22	4 mm Dia Plastic	14 - 35	3 x 8.5
F13	6 mm Dia Plastic	14 - 65	4 x 8
F2	6 mm Dia Plastic	14 - 65	4 x 12
F14	6 mm Dia Plastic	14 - 65	5 x 8
F4	6 mm Dia Plastic	14 - 65	5 x 10
F3	6 mm Dia Plastic	14 - 65	5 x 15
F11	6 mm Dia Plastic	14 - 65	4.6 x 15
F42	6.35mm Dia Plastic	14 - 65	5.5 x 10

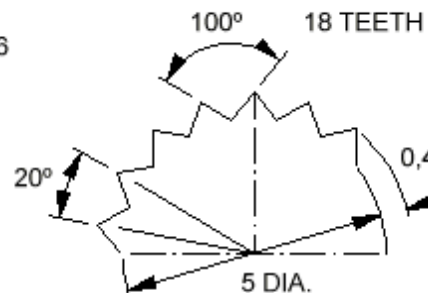
Standard flat angle
R = 210°

Splined Spindle (6.0mm diameter)

A splined form is also available on the 6.0mm diameter ECO plastic spindle.

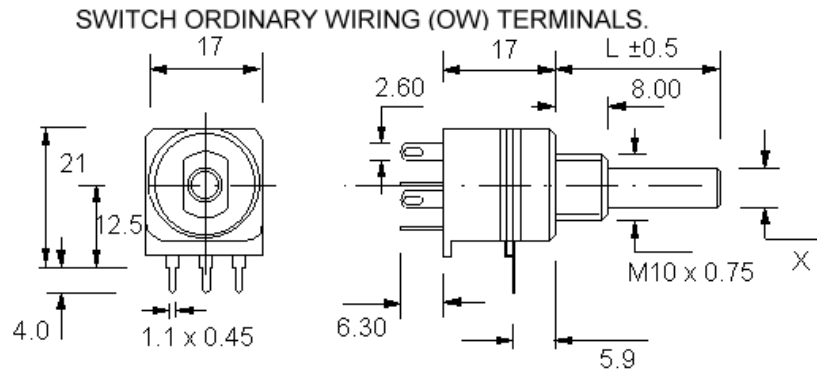
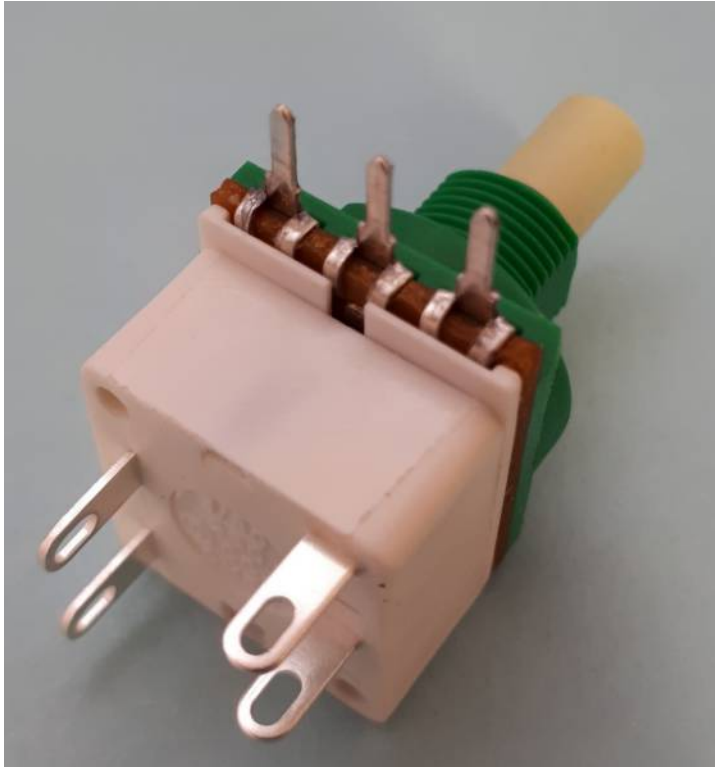


TYPE	DESC.	L (mm)
F5	Plastic Fixed	14 - 30

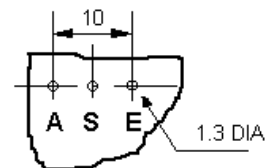


PC16ECO/B4OW2S

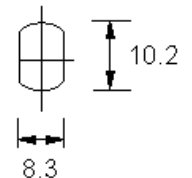
B4OW2S - 4 Amp Double Pole (Single Throw) Switch
OW – Ordinary Wiring Terminals (for soldering)
PC – Printed Circuit Terminals



**POTENTIOMETER with
PRINTED CIRCUIT (PC) TERMINALS.**

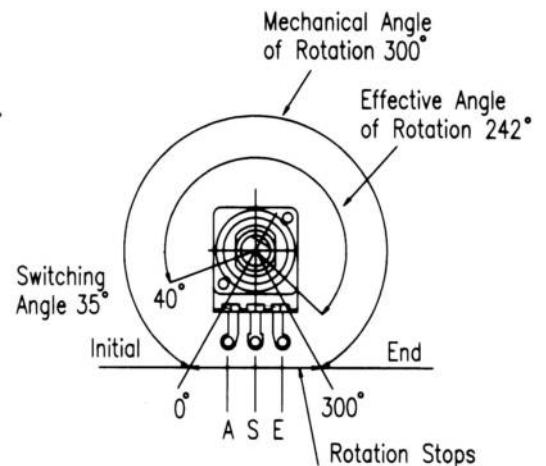


**Viewed on
component side.**



Panel cutout for bush

SPINDLE END VIEW



**Total mechanical and effective electrical
angles of rotation of potentiometers
with rotary switch**

- W Mounting Height
- Y Mounting Diameter
- X Spindle Diameter
- L Spindle Length
- A Initial Termination
- S Wiper (or moving contact) termination
- E End Termination



ECO Range Technical Data

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Rotation angle: $300^{\circ} \pm 5^{\circ}$ (Switched and Unswitched)

Operating Torque: 0.4 – 2.0 N.cm (Initial Torque may be higher)

Rotational torque of spindle can be made high or low

Detents (stop positions) Available: Centre, 11, 21, 31

Permissible Axial Spindle Load: 50 N (5 Sec. maximum)

Permissible Torque at End Stop: 35 N.cm

ELECTRICAL SPECIFICATION

Rated Power Dissipation @40°C for ECO potentiometers:

0.25W linear law

0.12W nonlinear law

Rotation angle: $300^{\circ} \pm 5^{\circ}$

Effective rotation - Unswitched: 265° nominal

Effective rotation - Switched: 242° nominal

Insulation Resistance: ≥ 4 Gohms

Rated Resistance: E3 Series

- Optional: E6 Series
- Linear Law: 1K - 1M
- Nonlinear Law: 4K7 - 470K

Tolerance on Rated Resistance: $\pm 20\%$

- Optional Tolerance on 1K - 1M: $\pm 10\%$

Resistance Laws (Taper):

- Linear: A
- Nonlinear: B - Log (Audio) or C - Antilog (Reverse Audio)
- Other laws: Please refer to Sales office

Rotary Switch Specification

The rotary switch modules are manufactured to EN61058-1 standard using high quality materials with a flame retardant housing. Although no longer certified due to the excessive cost of maintaining approvals, the 1 Amp and 4 Amp switch series have both been previously certified by UL International Demko (copies of previous certificates are available on our website or on request). The same materials, components and production techniques are used as in the certified versions and Omeg Ltd continues to test to the EN61058-1 standard

The 1 Amp contact rating is only available when mounted on the ECO potentiometer

1 A Contact Rating:

Note: The 1A contact rating is NOT available for mounting on the P16 or P20 potentiometer.

1A/250Vac 2.5A/12Vdc

Surge rating (0.01 seconds): 20A

Contact gap: 3mm (Full mains separation of contacts)

Manufactured to EN61058-1 standard

4 A Contact Rating:

4A/250Vac 10A/12Vdc

Surge rating (0.01 seconds): 80A

Switch contacts: Silver tin oxide

Contact gap: 2mm (Micro disconnection of switch - micro separation of contacts)

Manufactured to EN61058-1 standard

Common features

Housing material: Flame Retardant Glass filled polyester (UL 94 VO)

Initial contact resistance: 20 milliohms

Insulation resistance: 50,000 Megohms

Life (operations at full load): 10,000 minimum

Operating temperature: -25°C to +70°C

Operating torque for SPST/SPDT: 1.5 - 3 cNm

Operating torque for DPST/DPDT: 3.0 - 6 cNm

Mechanical rotation: 300°

Proof voltage: 3kV minimum

Rotary Switch Terminals

Layout

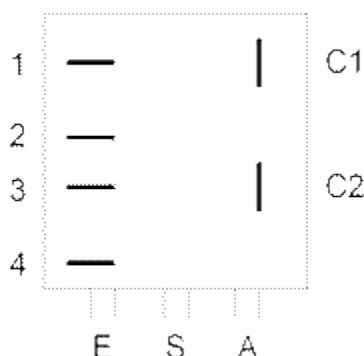


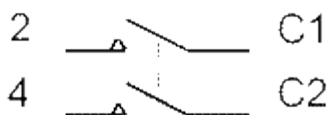
Diagram as viewed on the rear of the switch module:

(Potentiometer terminals at the bottom)

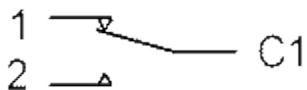
Configuration



SPST - Single pole (1S), Single throw (On-Off)

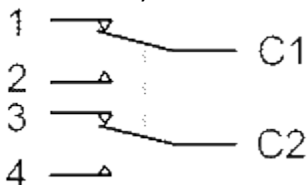


DPST - Double pole (2S), Single throw (On-Off)



SPDT - Single pole (1S), Double throw (CH)

(**NOT** certified)



DPDT - Double pole (2S), Double throw (CH)

(**NOT** certified)

Notes

1. Moving contact(s) shown when the potentiometer shaft is in a counterclockwise (CCW) position.
2. 'Ordinary Wiring'(OW) or 'Printed Circuit'(PC) terminals can be requested on the switch.
3. Terminals 1 and 3 are only fitted for the Double Throw ('CH' or Changeover) versions which are **NOT** approved nor certified.

Rotary Switch Terminals



Standard (1A or 4A contact ratings)

N/O normally OPEN Switch

Contacts normally OPEN;

CLOCKwise rotation to CLOSE contacts

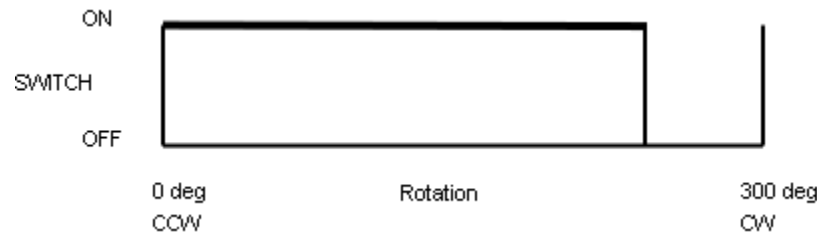


Option 1 (4A contact rating only)

N/C normally CLOSED Switch

Contacts normally CLOSED;

CLOCKwise rotation to OPEN contacts

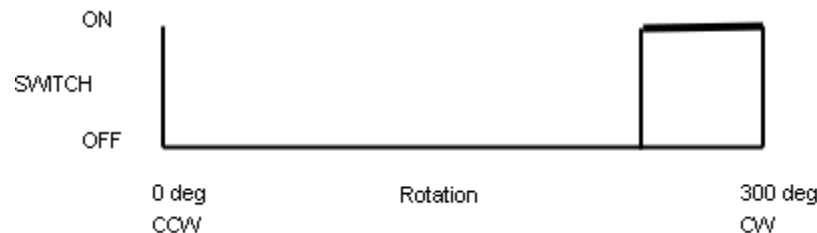


Option 2 (4A contact rating only)

REVERSED N/O normally OPEN Switch

Contacts normally OPEN at fully clockwise position;

ANTI-clockwise rotation to CLOSE contacts



Option 3 (4A contact rating only)

REVERSED N/C normally CLOSED Switch

Contacts normally CLOSED at fully clockwise position;

ANTI-clockwise rotation to OPEN contacts

ELECTRICAL SPECIFICATION UNIQUE TO ECO POTENTIOMETERS

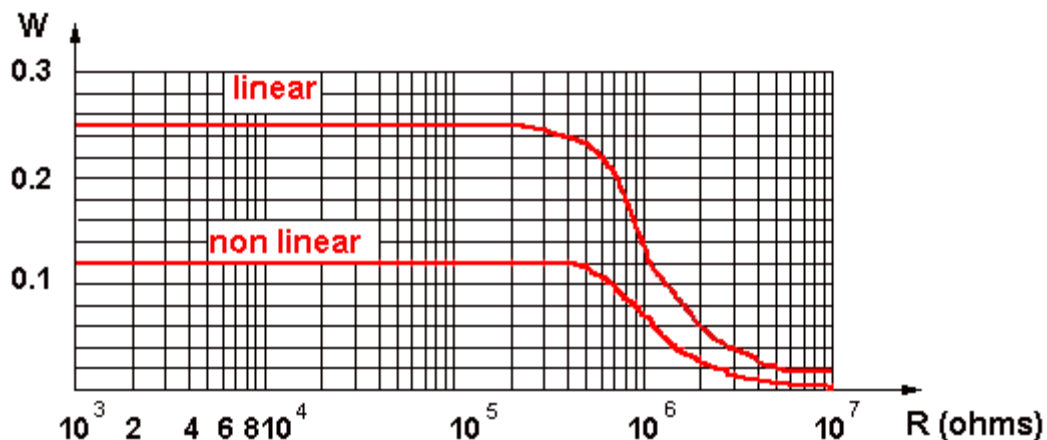
Effective rotation:

- Without a switch: 265° nominal
- With push push switch (/10APP, /MS): 265° nominal
- With rotary switch: 242° nominal

Rated Power Dissipation @40°C for ECO potentiometers:

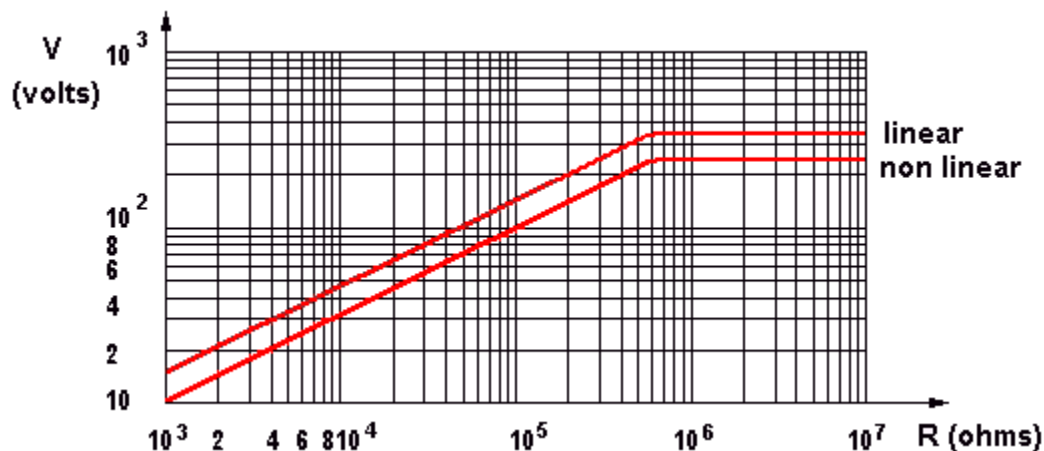
- 0.25W linear law
- 0.12W nonlinear law

ECO, P16 power dissipating curve



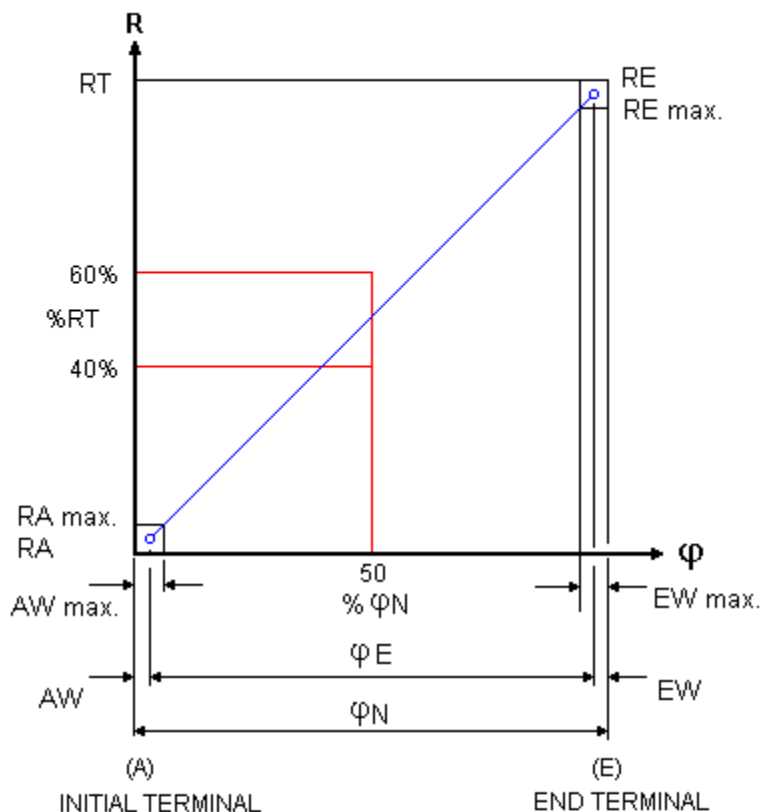
Limiting Element Voltage: 350 V DC for 16mm potentiometers

ECO, P16 maximum working voltage curve



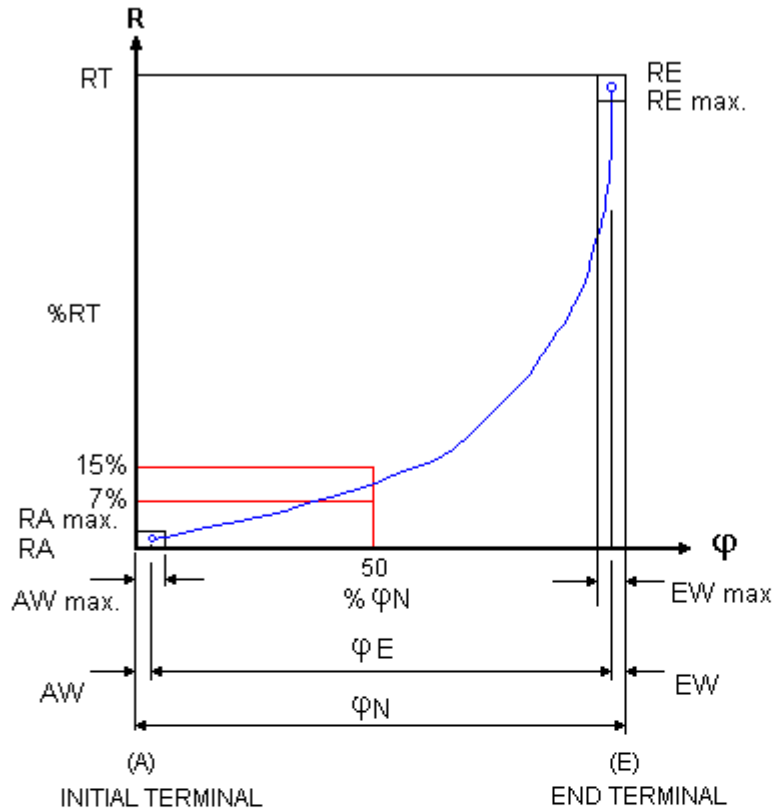
Insulating (Breakdown) Voltage: 2,500 V AC for ECO Potentiometers

Resistance law A - Linear



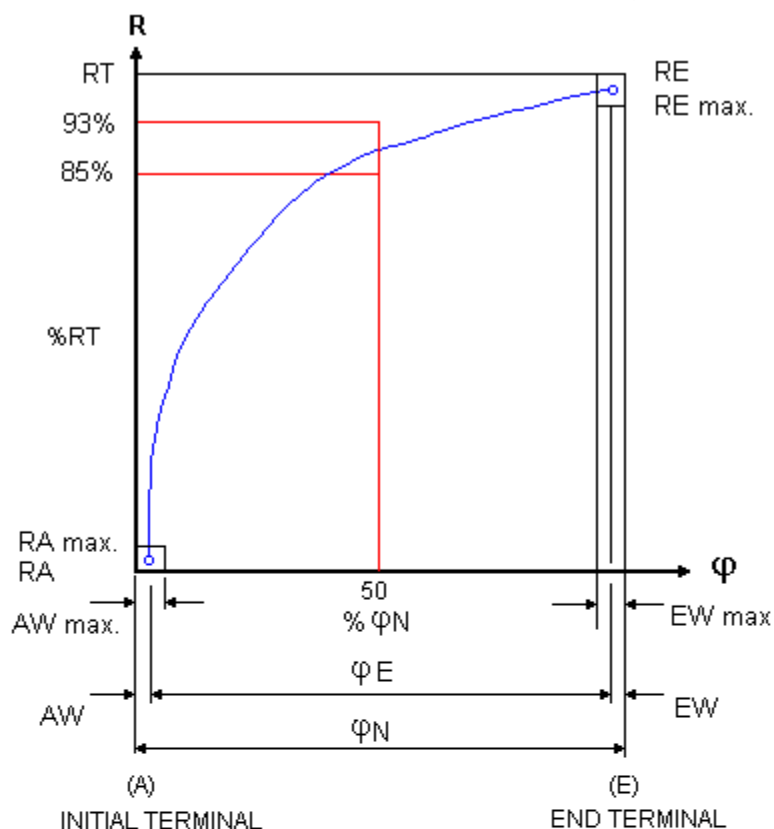
AW	Initial Path	AW max. 12% φN
EW	Final Path	EW max. 12% φN
Ra	Initial Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RA	Hop-on Resistance	$\leq 1\% RN$
Re	End Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RE	Hop-off Resistance	$\leq 1\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

Resistance law B – Log (Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RA	Hop-on Resistance	$RN \leq 10K$ 5% RN $RN > 10K$ 0.15% RN
Re	End Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RE	Hop-off Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K$ 0.5% RN
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

Resistance law C – Antilog (Reverse Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RA	Hop-on Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K 0.5\% RN$
Re	End Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RE	Hop-off Resistance	$RN \leq 10K 5\% RN$ $RN > 10K 0.15\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

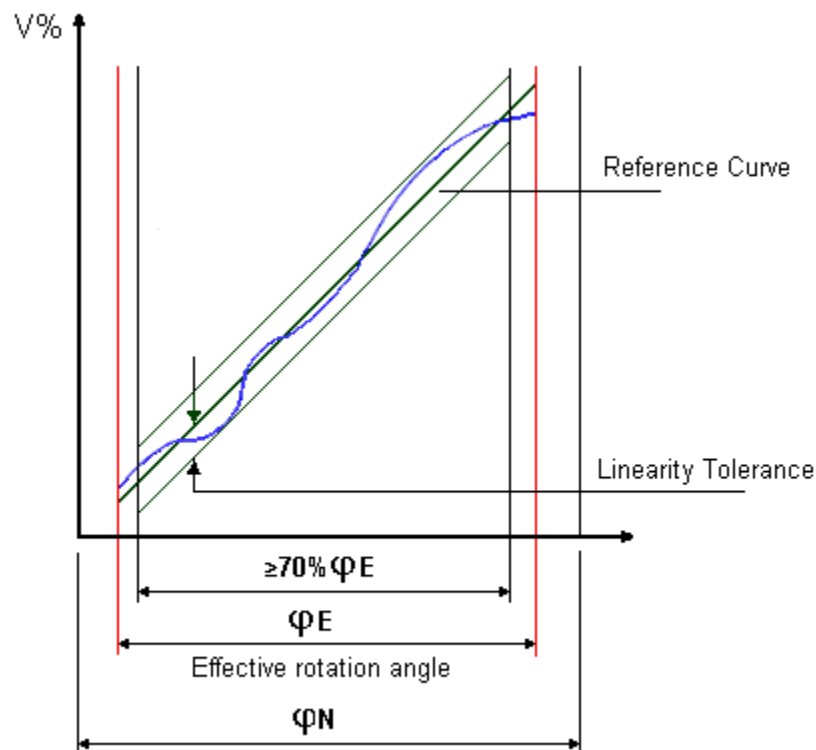
Linearity

As a basis of assessing Linearity Tolerance the independent method is the most practical, permitting as it does, the reference curve to be aligned as near as possible to the actual output curve. This avoids the use of the theoretical starting and finishing points, it is normal for the customer to realign the achieved curve with series trimmers at each end of the device if required.

Linearity Tolerance is 4% over the Nominal Resistance range of 1K Ω to 1M Ω . The Linearity Tolerance is measured on at least 70% of the effective rotation range.

Note. In the case of Terminal and Zero-based linearity, both present constraints which increase the manufacturing difficulty and in consequence have an adverse effect on the product's price and availability.

Potentiometer linearity

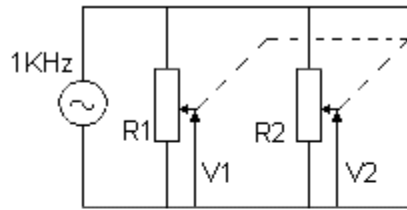


Matching Tolerance (For Tandem Stereo Potentiometers)

Tandem Potentiometers have two identical resistor units with the same variation law. The mismatching of the two resistor units, expressed in dB, is measured by the difference between the attenuations introduced by each resistor unit at various points of travel.

- Law A: 4 dB at Attenuation range 0 - 20 dB
- Law B and C: 3 dB at Attenuation range 0 - 20 dB

Matched Tolerance for Stereo

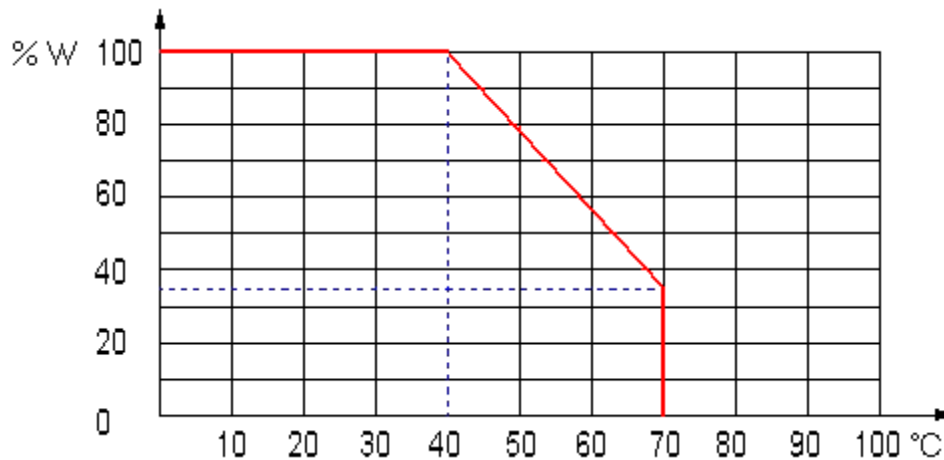


LAW	ATTENUATION RANGE	MATCHING TOLERANCE *
A	0 - 20dB	4dB
B & C	0 - 20dB	3dB

$$* \text{Matching Tolerance} = 20 \log \frac{V1}{V2}$$

Operating Temperature: -25°C to +70°C

Temperature Derating Curve



Temperature Coefficient of Resistance: +300 -500 ppm

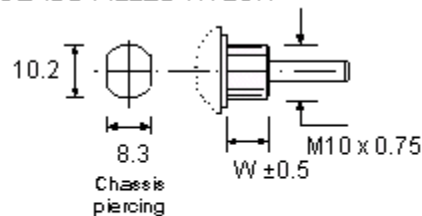
Components

ECO Bush Housing (Mounting)

The ECO bush housing is made of glass filled nylon, the thread is M10 x0.75mm pitch and 8mm long, alternatively **a 12mm long thread is also available** from October 2008.

Do not attempt to prevent any unwanted body rotation by overtightening the retaining nut, since this can cause thread damage, distortion, change of electrical resistance and restrict shaft rotation. BS9130:1972 provides further details on this topic. The **recommended torque** for tightening the retaining nut is 45cN.m and this can be achieved cost effectively by using a Torque Limiting device as shown on our **Accessories** page.

GLASS FILLED NYLON



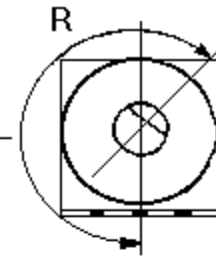
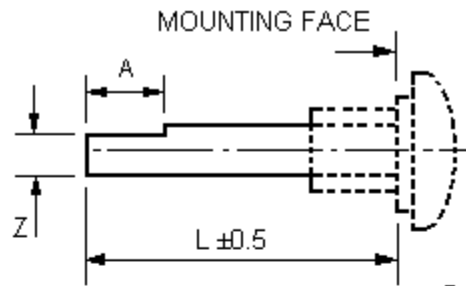
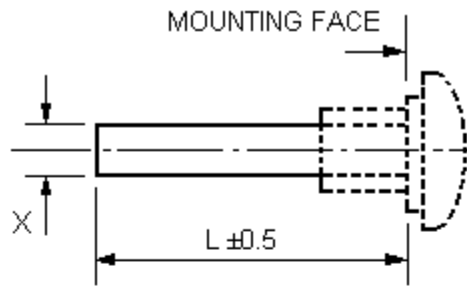
TYPE PLASTIC BODY	
W(mm)	8 (optional 12)

ECO Spindles

The ECO plastic spindles are fixed and not removable.
They are available in the following three diameters:

- 6.0mm Diameter - Length (L) available from 14mm to 65mm
 - Cylindrical (Type F1)
 - 4.0 x 12mm Flat (Type F2)
 - 5.0 x 15mm Flat (Type F3)
 - 5.0 x 10mm Flat (Type F4)
 - 4.6mm x 15mm Flat (Type F11)
 - 4.0 x 8mm Flat (Type F13)
 - 5.0 x 8mm Flat (Type F14)
- 4.0mm Diameter - Length (L) available from 14mm to 35mm
 - Cylindrical (Type F21)
 - 3.0 x 8.5mm Flat (Type F22)
- 6.35mm Diameter - Length (L) available from 14mm to 65mm
 - Cylindrical (Type F41)
 - 5.5 x 10mm Flat (Type F42)

Cylindrical and Flatted Spindles



Spindle in full CCW position

TYPE	DESC. (Ø)	L (mm)
F21	4 mm Dia Plastic	14 - 35
F1	6 mm Dia Plastic	14 - 65
F41	6.35mm Dia Plastic	14 - 65

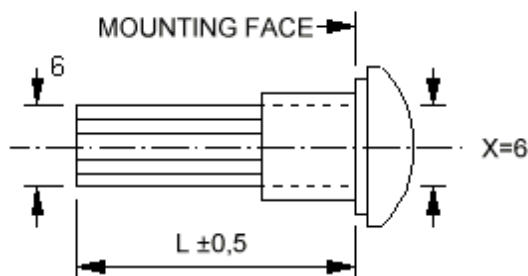
All spindles fixed.

TYPE	DESC. (Ø)	L (mm)	Flat (ZxA)
F22	4 mm Dia Plastic	14 - 35	3 x 8.5
F13	6 mm Dia Plastic	14 - 65	4 x 8
F2	6 mm Dia Plastic	14 - 65	4 x 12
F14	6 mm Dia Plastic	14 - 65	5 x 8
F4	6 mm Dia Plastic	14 - 65	5 x 10
F3	6 mm Dia Plastic	14 - 65	5 x 15
F11	6 mm Dia Plastic	14 - 65	4.6 x 15
F42	6.35mm Dia Plastic	14 - 65	5.5 x 10

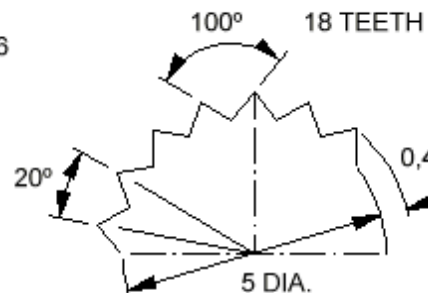
Standard flat angle
R = 210°

Splined Spindle (6.0mm diameter)

A splined form is also available on the 6.0mm diameter ECO plastic spindle.

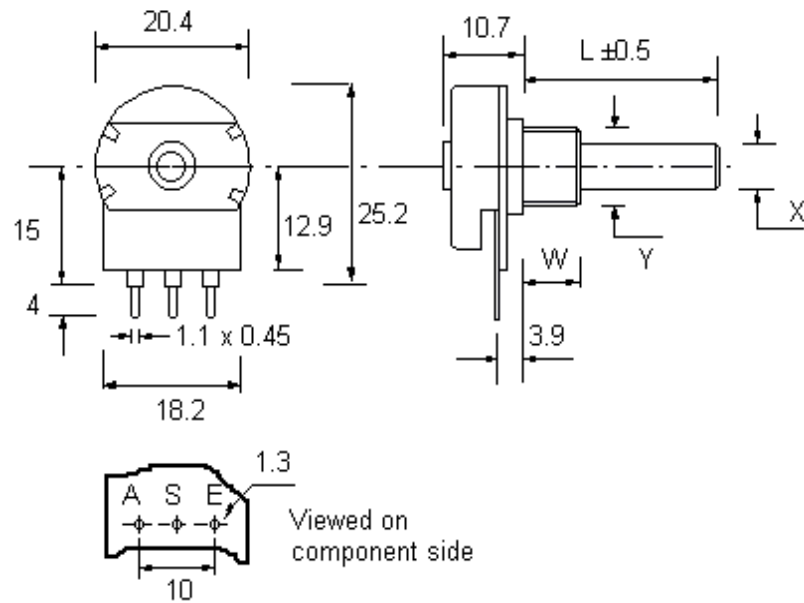


TYPE	DESC.	L (mm)
F5	Plastic Fixed	14 - 30

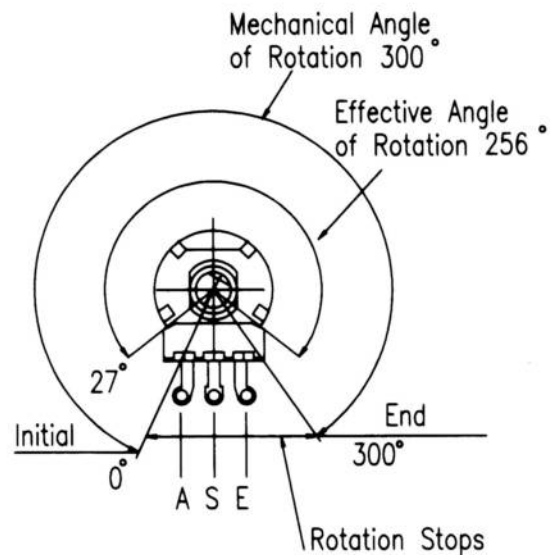


PC20BU

PC – Printed Circuit Terminals



SPINDLE END VIEW



Total mechanical and effective electrical angles of rotation of potentiometers without rotary switch

- W Mounting Height
- Y Mounting Diameter
- X Spindle Diameter
- L Spindle Length
- A Initial Termination
- S Wiper (or moving contact) termination
- E End Termination



P20 Range Technical Data

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Rotation angle: $300^{\circ} \pm 5^{\circ}$ (Switched and Unswitched)

Operating Torque: 0.4 – 2.0 N.cm (Initial Torque may be higher)

Rotational torque of spindle can be made high or low

Detents (stop positions) Available: Centre, 11, 21, 31, 41

Permissible Axial Spindle Load: 100 N (5 Sec. maximum)

Permissible Torque at End Stop: 80 N.cm

ELECTRICAL SPECIFICATION

Rated Power Dissipation @40°C for ECO potentiometers:

0.4W linear law

0.2W nonlinear law

Rotation angle: $300^{\circ} \pm 5^{\circ}$

Effective rotation - Unswitched: 243° nominal

Effective rotation - Switched: 256° nominal

Insulation Resistance: ≥ 4 Gohms

Rated Resistance: E3 Series

- Optional: E6 Series
- Linear Law: 1K - 1M
- Nonlinear Law: 4K7 - 470K

Tolerance on Rated Resistance: $\pm 20\%$

- Optional Tolerance on 1K - 1M: $\pm 10\%$

Resistance Laws (Taper):

- Linear: A
- Nonlinear: B - Log (Audio) or C - Antilog (Reverse Audio)
- Other laws: Please refer to Sales office

ELECTRICAL SPECIFICATION UNIQUE TO P20 POTENTIOMETERS

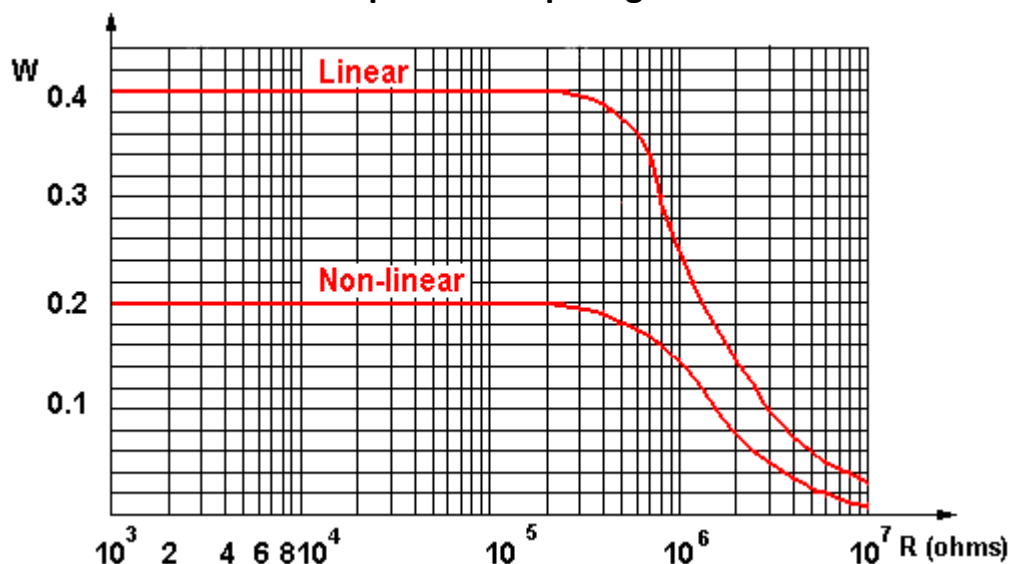
Effective rotation:

- Without a switch: 256° nominal
- With switch: 243° nominal
- With rotary switch: 243° nominal

Rated Power Dissipation @40°C for P20 potentiometers:

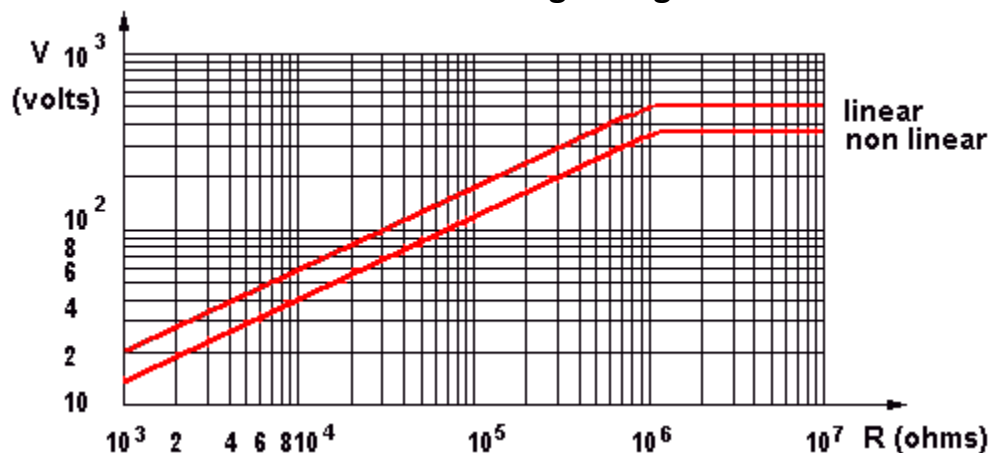
- 0.4W linear law
- 0.2W nonlinear law

P20 power dissipating curve



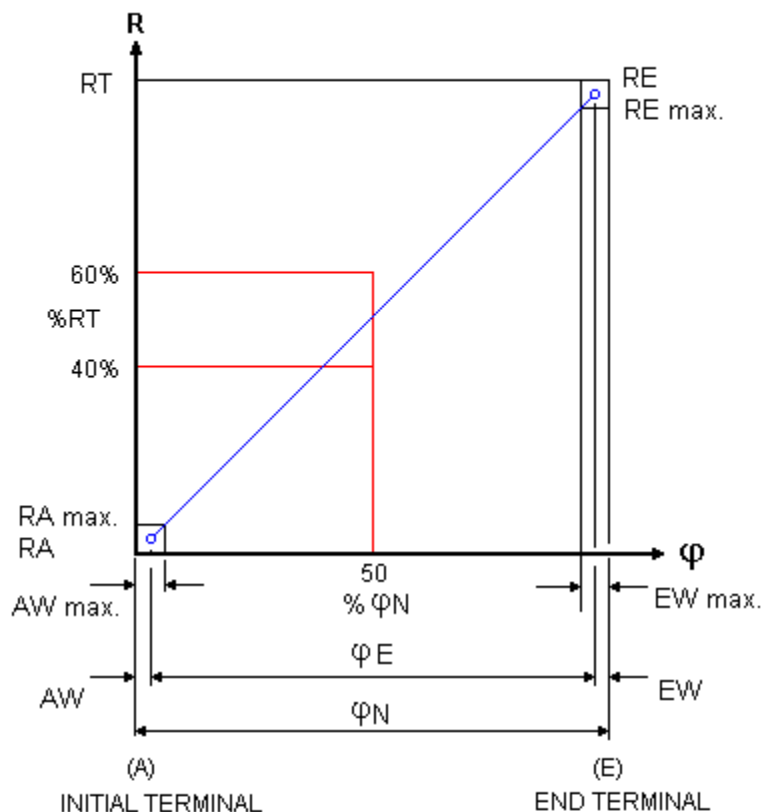
Limiting Element Voltage: 500 V DC for 20mm potentiometers

P20 maximum working voltage curve



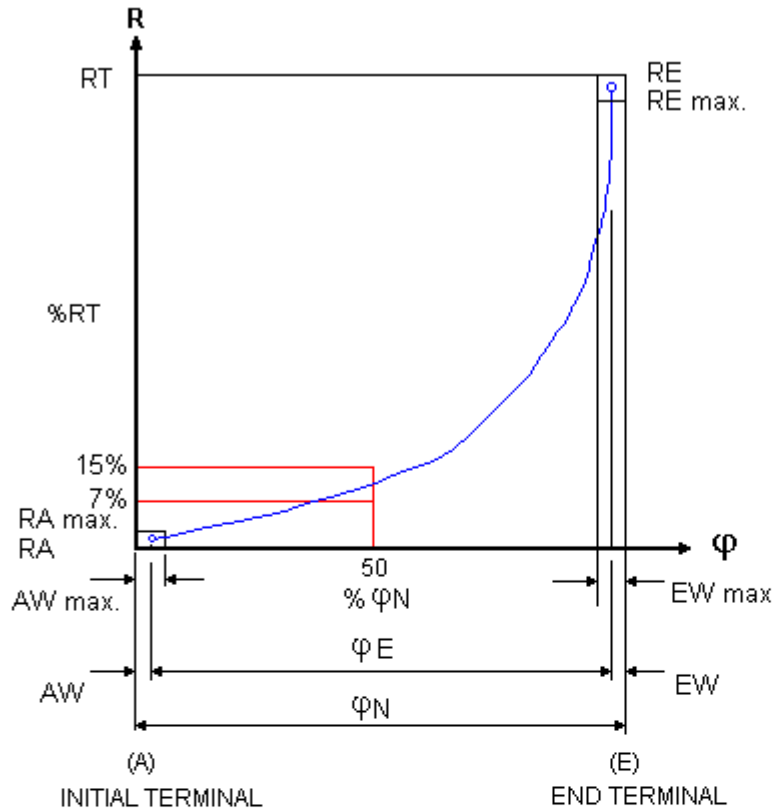
Insulating Voltage: 1000 V AC for 20mm potentiometers

Resistance law A - Linear



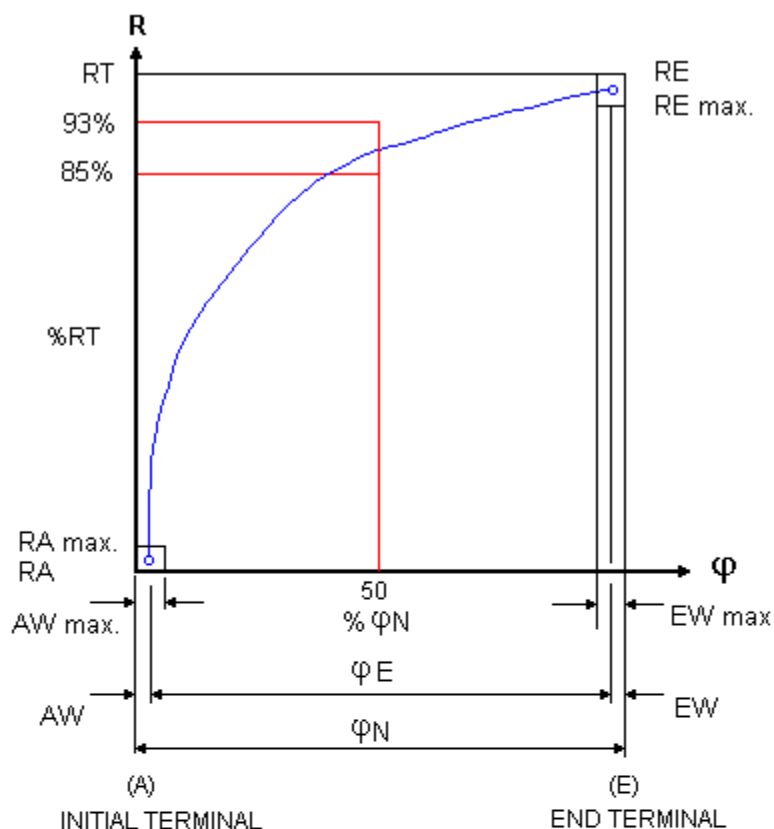
AW	Initial Path	AW max. 12% φN
EW	Final Path	EW max. 12% φN
Ra	Initial Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RA	Hop-on Resistance	$\leq 1\% RN$
Re	End Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RE	Hop-off Resistance	$\leq 1\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

Resistance law B – Log (Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RA	Hop-on Resistance	$RN \leq 10K$ 5% RN $RN > 10K$ 0.15% RN
Re	End Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RE	Hop-off Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K$ 0.5% RN
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

Resistance law C – Antilog (Reverse Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RA	Hop-on Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K 0.5\% RN$
Re	End Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RE	Hop-off Resistance	$RN \leq 10K 5\% RN$ $RN > 10K 0.15\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

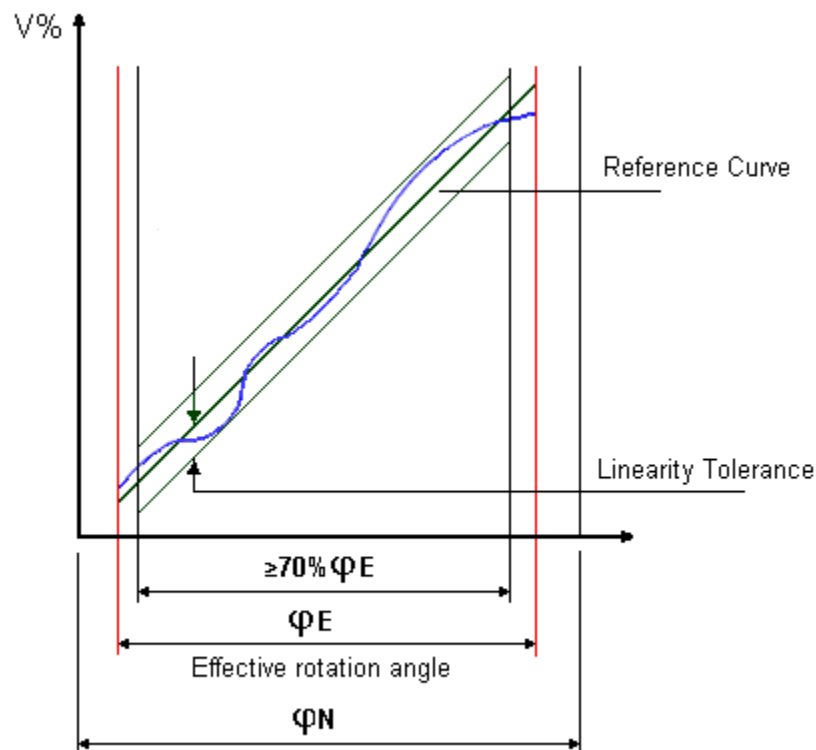
Linearity

As a basis of assessing Linearity Tolerance the independent method is the most practical, permitting as it does, the reference curve to be aligned as near as possible to the actual output curve. This avoids the use of the theoretical starting and finishing points, it is normal for the customer to realign the achieved curve with series trimmers at each end of the device if required.

Linearity Tolerance is 4% over the Nominal Resistance range of 1K Ω to 1M Ω . The Linearity Tolerance is measured on at least 70% of the effective rotation range.

Note. In the case of Terminal and Zero-based linearity, both present constraints which increase the manufacturing difficulty and in consequence have an adverse effect on the product's price and availability.

Potentiometer linearity

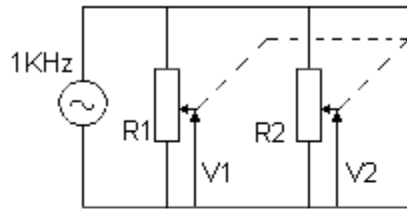


Matching Tolerance (For Tandem Stereo Potentiometers)

Tandem Potentiometers have two identical resistor units with the same variation law. The mismatching of the two resistor units, expressed in dB, is measured by the difference between the attenuations introduced by each resistor unit at various points of travel.

- Law A: 4 dB at Attenuation range 0 - 20 dB
- Law B and C: 3 dB at Attenuation range 0 - 20 dB

Matched Tolerance for Stereo

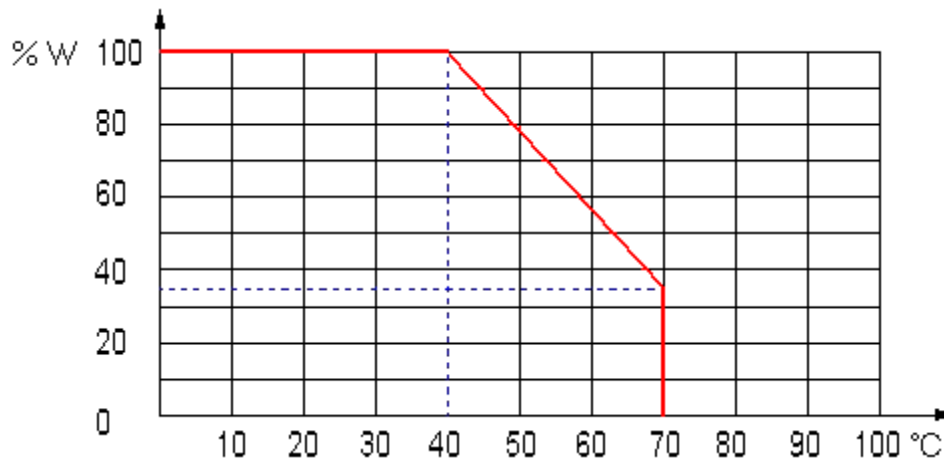


LAW	ATTENUATION RANGE	MATCHING TOLERANCE *
A	0 - 20dB	4dB
B & C	0 - 20dB	3dB

$$* \text{Matching Tolerance} = 20 \log \frac{V1}{V2}$$

Operating Temperature: -25°C to +70°C

Temperature Derating Curve



Temperature Coefficient of Resistance: +300 -500 ppm

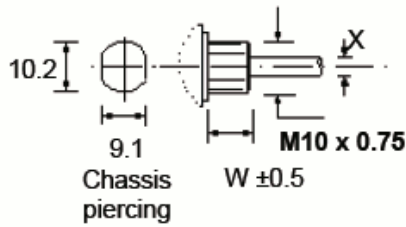
Components

P20 Bush Housing (Mounting)

The P20 bushes are available in metal or nylon; with three thread options; and with or without a locating feature:

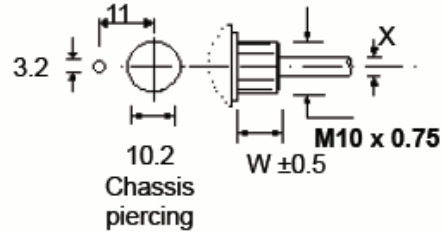
- Diecast Zinc Alloy
 - M10 x0.75mm pitch (Type C)
 - M10 x0.75mm pitch, **with locator** (Type CEBS)
 - 9.52mm x32tpi (Type CBS)
 - 9.52mm x32tpi, **with locator** (Type CBSL)
 - M7 x0.75mm pitch (Type CG)
- Glass Filled Nylon
 - M10 x0.75mm (Type CP)

DIECAST ZINC ALLOY



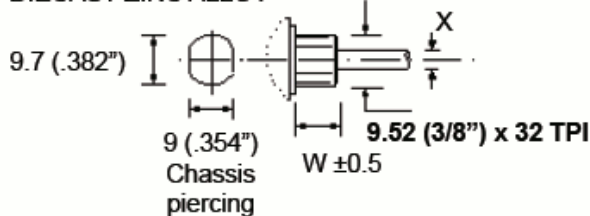
Type C (without locator)	
X (mm)	6
W (mm)	9

DIECAST ZINC ALLOY



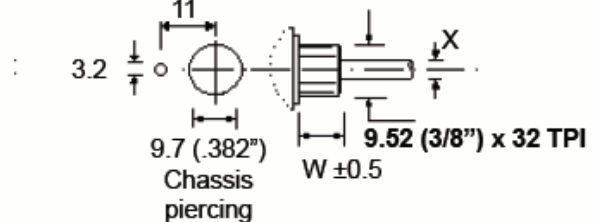
Type CEBS (with locator)	
X (mm)	6
W (mm)	9

DIECAST ZINC ALLOY



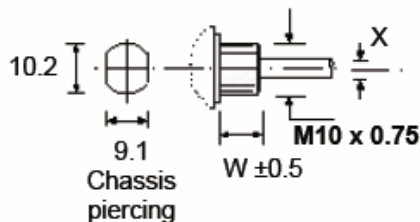
Type CBS (without locator)		
X (mm)	6	6.35
W (mm)	8 or 12	8 or 12

DIECAST ZINC ALLOY



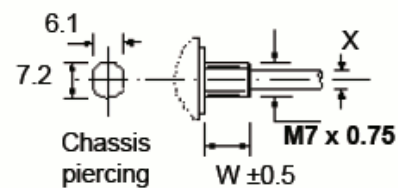
Type CBSL (with locator)		
X (mm)	6.35	6.35
W (mm)	8	12

GLASS FILLED NYLON



Type CP (GFN)		
X (mm)	6	6.35
W (mm)	7 or 10	7 or 10

DIECAST ZINC ALLOY



Type CG (without locator)	
X (mm)	4
W (mm)	6

P20 Spindles

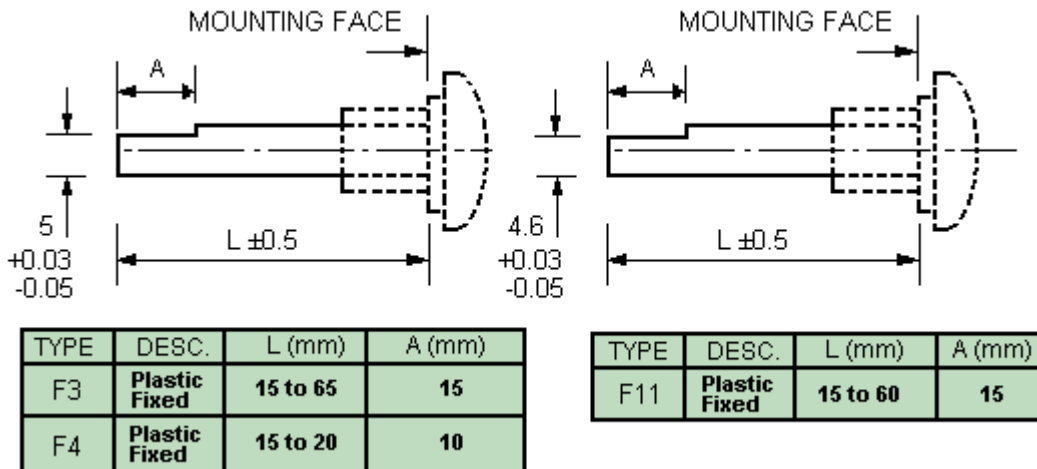
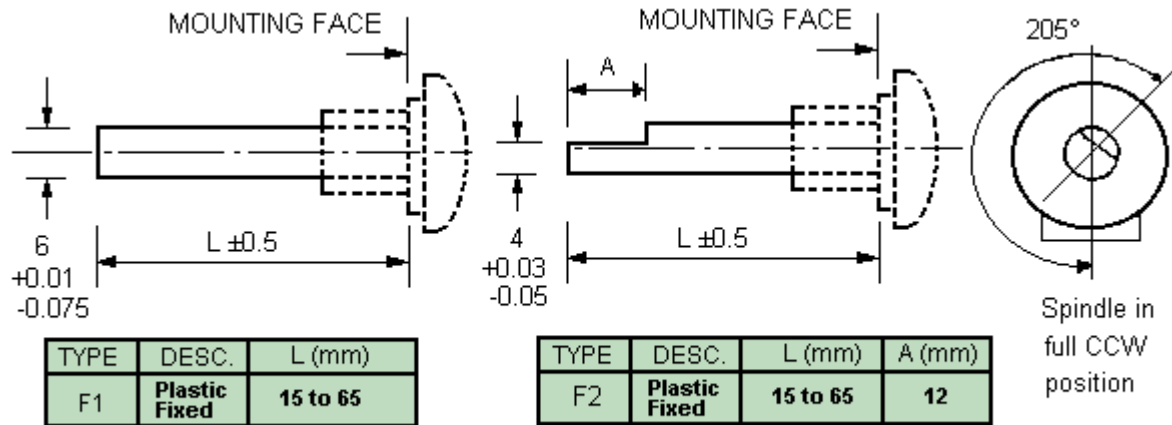
The P20 spindles are plastic and fixed i.e. not removable, unless otherwise stated and they are available in three diameters:

- 6.0mm Diameter
 - Cylindrical (Type F1)
 - 4.0 x 12mm Flat (Type F2)
 - 5.0 x 15mm Flat (Type F3)
 - 5.0 x 10mm Flat (Type F4)
 - 4.6mm x 15mm Flat (Type F11)
- 4.0mm Diameter
 - Cylindrical (Type F21)
 - 3.0 x 8.5mm Flat (Type F22)
 - 3.0 x 13.5mm Flat (Type F23)
 - Cylindrical (Type M21 - Metal)
 - 3.0 x 8.5mm Flat (Type M22 - Metal)
 - 3.0 x 13.5mm Flat (Type M23 - Metal)
- 6.35mm Diameter
 - Cylindrical (Type F41)
 - 5.5 x 10mm Flat (Type F42)
 - 5.5 x 15mm Flat (Type F43)
- Splined Spindle - 6.0mm dia. 18 teeth
- Dual Concentric
 - Flatted/Slotted (Type M15 - Metal)
 - Cylindrical (Type M16 - Metal)

6.0mm Diameter Spindles

Note: *Specials to customer's specification up to 65mm.

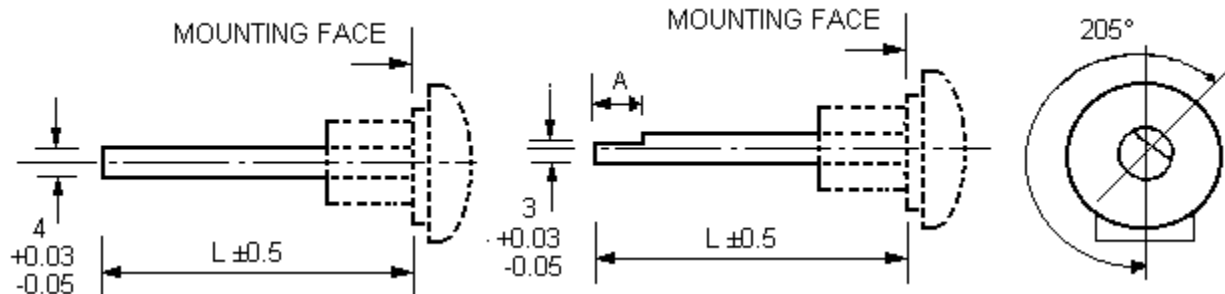
REMOVABLE SPINDLES, similar in specification to 'fixed' spindles are supplied separate from the potentiometer. These can be indefinitely taken in and out and their holding strength is >1kg.



4.0mm Diameter Spindles

Note: The orientation of the flat as illustrated is for plastic spindles only.

For metal spindles, unless specified on the order, the orientation may be different on each potentiometer type.



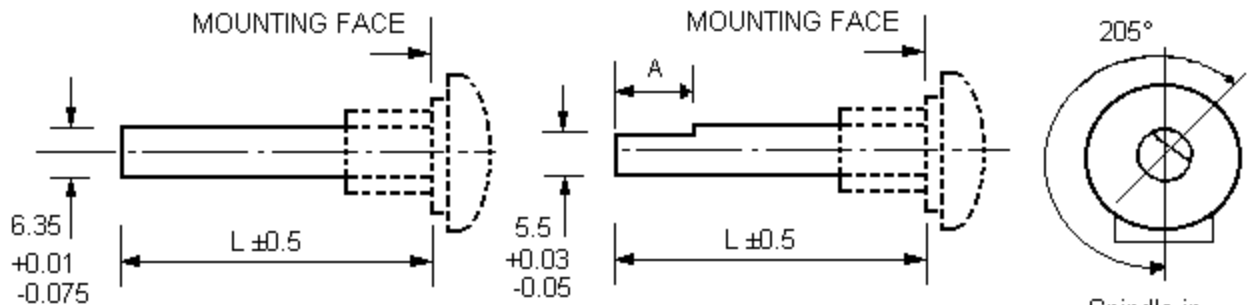
TYPE	DESC.	L (mm)
F21	Plastic Fixed	8 to 65
M21	Metal Fixed	8 to 65

TYPE	DESC.	L (mm)	A (mm)
F22	Plastic Fixed	11 to 60	8.5
M22	Metal Fixed	11 to 60	8.5
F23	Plastic Fixed	16 to 60	13.5
M23	Metal Fixed	16 to 60	13.5

Spindle in
full CCW
position

6.35mm Diameter Spindles

Note: *Specials to customer's specification up to 65mm.



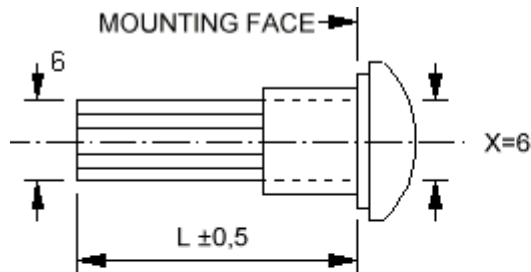
TYPE	DESC.	L (mm)
F41	Plastic Fixed	15 to 65

TYPE	DESC.	L (mm)	A (mm)
F42	Plastic Fixed	15 to 20	10
F43	Plastic Fixed	20 to 60	15

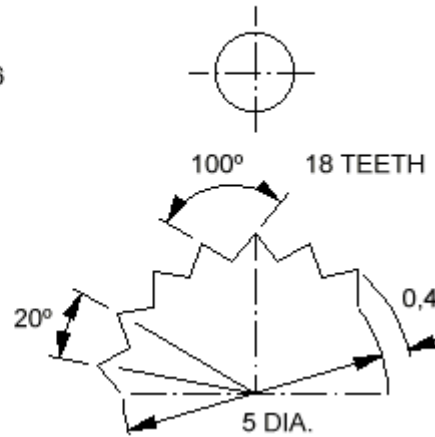
Spindle in
full CCW
position

Splined Spindle - 6.0mm dia. 18 teeth

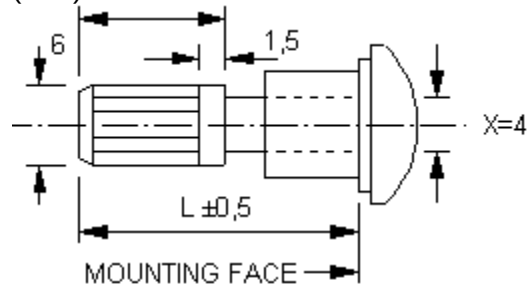
A splined form is available on the 6.0mm diameter P20 plastic spindle (F5) or alternatively a 6mm 'Splined Adaptor' (8,7mm long) can be fitted on a 4mm dia. Spindle



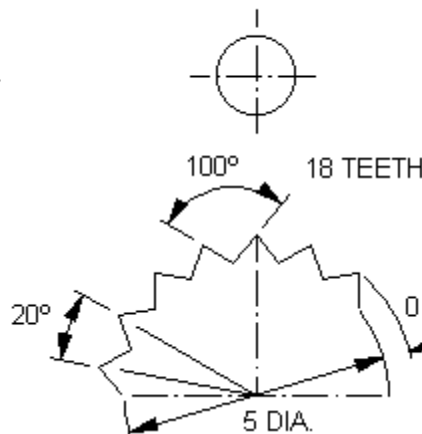
TYPE	DESC.	L (mm)
F5	Plastic Fixed	19



(F5A):

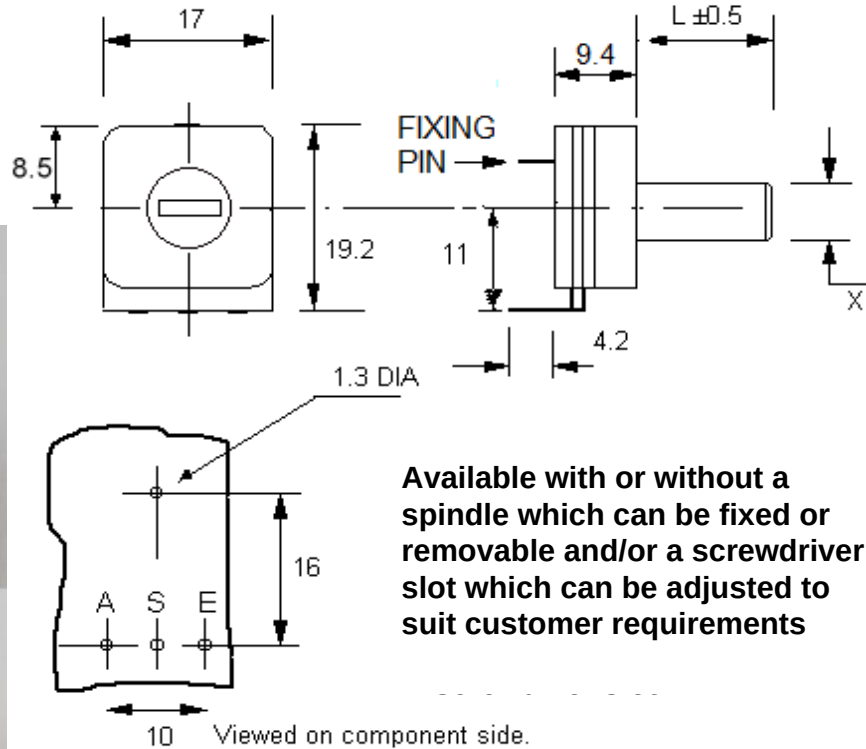


TYPE	DESC.	L (mm)
F5A	Plastic Fixed	16-36

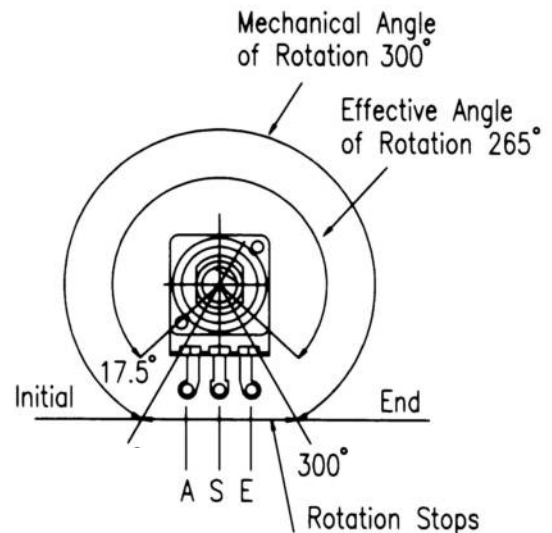


THIN PROFILE ECO

0 - 25mm



SPINDLE END VIEW



Total mechanical and effective electrical angles of rotation of potentiometers without rotary switch

Single gang shown, Multi gang versions available

- X Spindle Diameter
- L Spindle Length
- A Initial Termination
- S Wiper (or moving contact) termination
- E End Termination

Technical Data

Rated Power Dissipation @40°C for ECO potentiometers:

0.25W linear law

0.12W nonlinear law

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Effective rotation: 265° nominal

Operating Torque: 0.4 – 1.5 cN.m

Permissible Axial Spindle Load: 50 N (5 Sec. maximum)

Permissible Torque at End Stop: 35 cN.m

Rotation angle: 300° ±5°

Optional Click stop (indents) for rotational tactile feedback

Rotational torque of spindle can be made high or low

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Insulation Resistance: >= 4 Gohms

Rated Resistance: E3 Series

Optional: E6 Series

Linear Law: 1K – 1M

Nonlinear Law: 4K7 – 470K

ELECTRICAL SPECIFICATION COMMON TO ALL POTENTIOMETERS

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Insulation Resistance: >= 4 Gohms

Rated Resistance: E3 Series

- Optional: E6 Series
- Linear Law: 1K - 1M
- Nonlinear Law: 4K7 - 470K

Tolerance on Rated Resistance: ± 20%

- Optional Tolerance on 1K - 1M: ± 10%

Resistance Laws (Taper):

- Linear: A
- Nonlinear: B - Log (Audio) or C - Antilog (Reverse Audio)
- Other laws: Please refer to Sales office

ELECTRICAL SPECIFICATION UNIQUE TO ECO POTENTIOMETERS

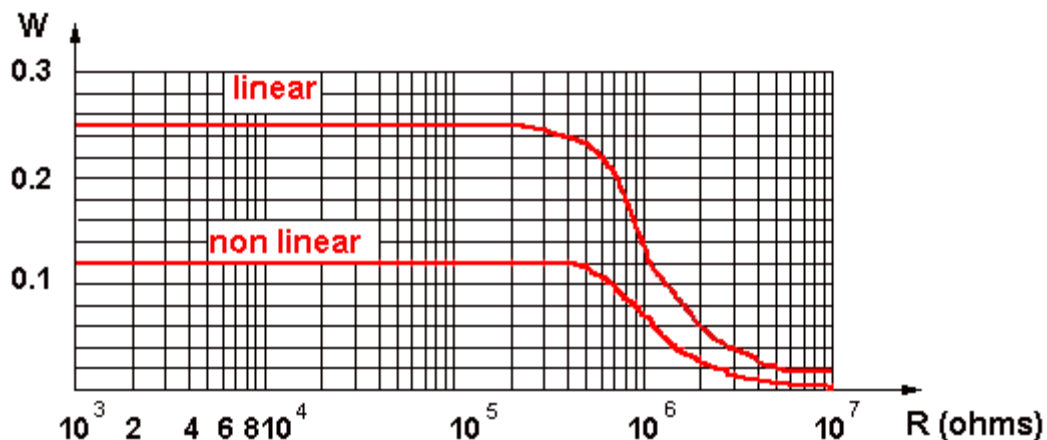
Effective rotation:

- Without a switch: 265° nominal
- With push push switch (/10APP, /MS): 265° nominal
- With rotary switch: 242° nominal

Rated Power Dissipation @40°C for ECO potentiometers:

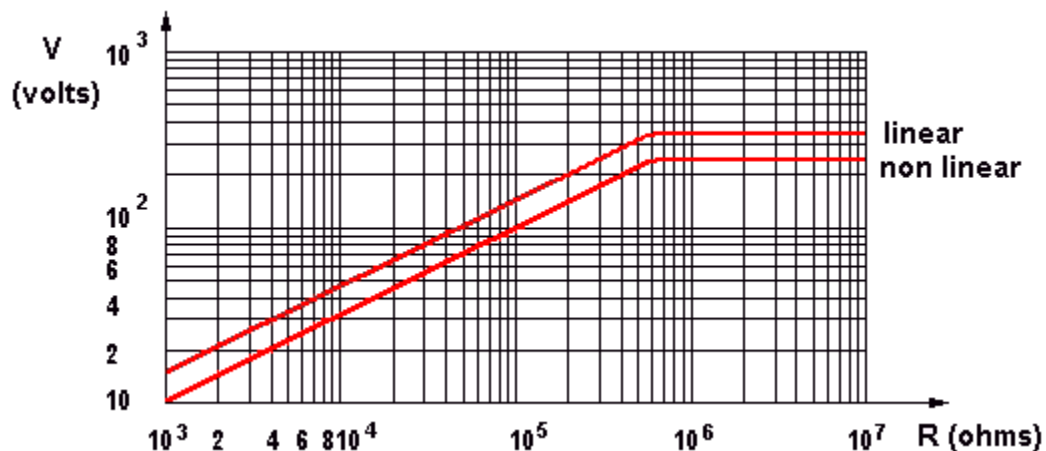
- 0.25W linear law
- 0.12W nonlinear law

ECO, P16 power dissipating curve



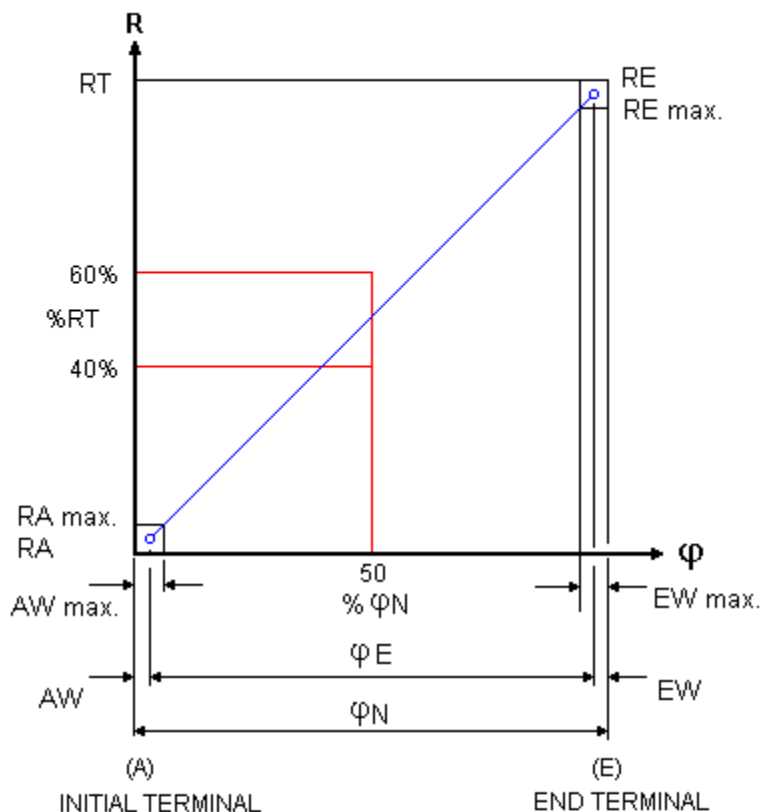
Limiting Element Voltage: 350 V DC for 16mm potentiometers

ECO, P16 maximum working voltage curve



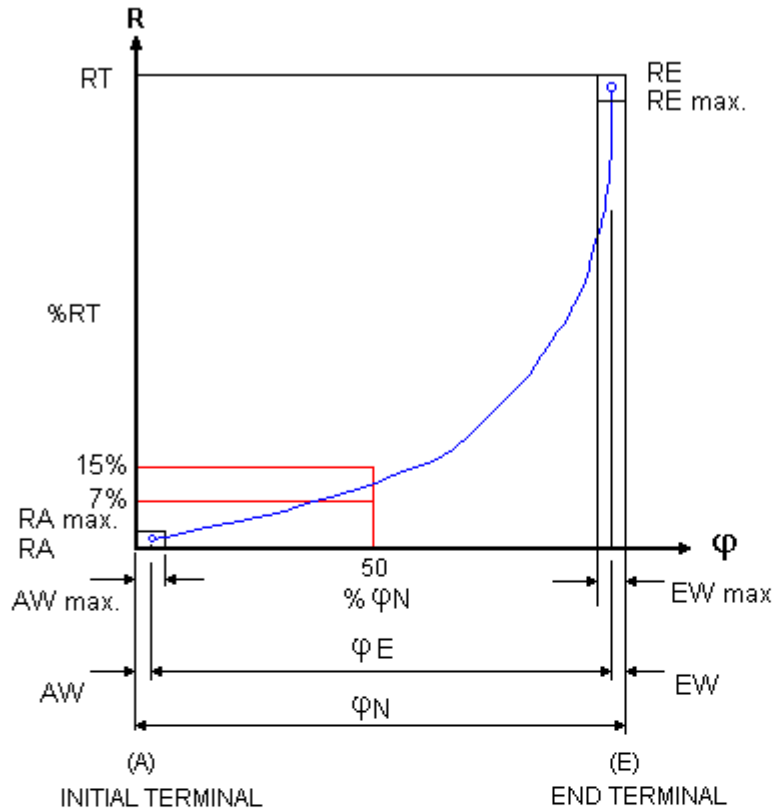
Insulating (Breakdown) Voltage: 2,500 V AC for ECO Potentiometers

Resistance law A - Linear



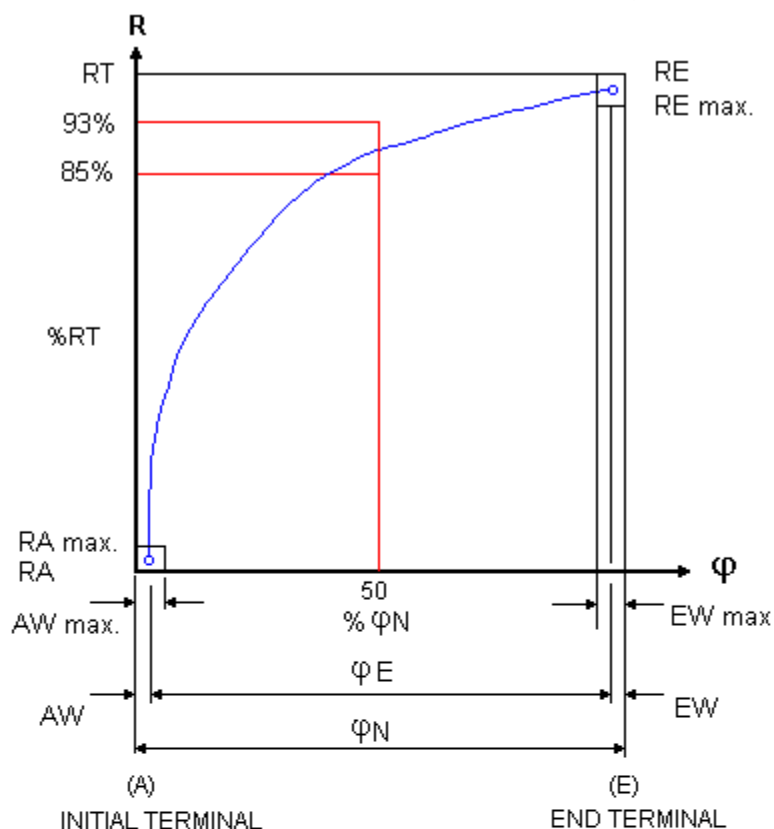
AW	Initial Path	AW max. 12% ϕN
EW	Final Path	EW max. 12% ϕN
Ra	Initial Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RA	Hop-on Resistance	$\leq 1\% RN$
Re	End Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RE	Hop-off Resistance	$\leq 1\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

Resistance law B – Log (Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RA	Hop-on Resistance	$RN \leq 10K$ 5% RN $RN > 10K$ 0.15% RN
Re	End Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RE	Hop-off Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K$ 0.5% RN
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

Resistance law C – Antilog (Reverse Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RA	Hop-on Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K 0.5\% RN$
Re	End Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RE	Hop-off Resistance	$RN \leq 10K 5\% RN$ $RN > 10K 0.15\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

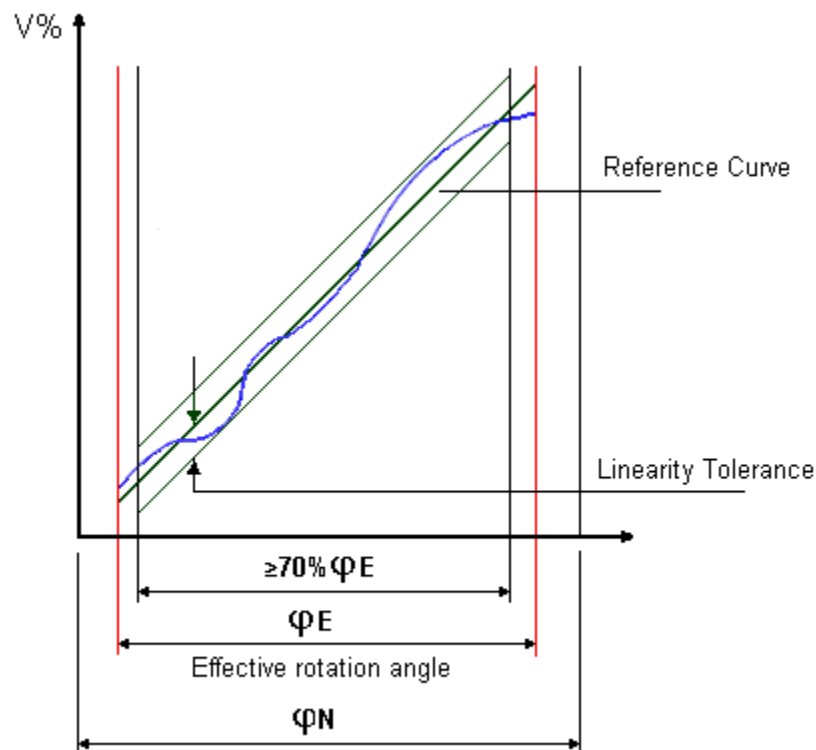
Linearity

As a basis of assessing Linearity Tolerance the independent method is the most practical, permitting as it does, the reference curve to be aligned as near as possible to the actual output curve. This avoids the use of the theoretical starting and finishing points, it is normal for the customer to realign the achieved curve with series trimmers at each end of the device if required.

Linearity Tolerance is 4% over the Nominal Resistance range of 1K0 to 1M0. The Linearity Tolerance is measured on at least 70% of the effective rotation range.

Note. In the case of Terminal and Zero-based linearity, both present constraints which increase the manufacturing difficulty and in consequence have an adverse effect on the product's price and availability.

Potentiometer linearity

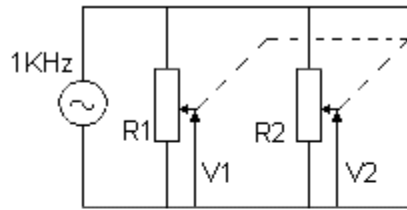


Matching Tolerance (For Tandem Stereo Potentiometers)

Tandem Potentiometers have two identical resistor units with the same variation law. The mismatching of the two resistor units, expressed in dB, is measured by the difference between the attenuations introduced by each resistor unit at various points of travel.

- Law A: 4 dB at Attenuation range 0 - 20 dB
- Law B and C: 3 dB at Attenuation range 0 - 20 dB

Matched Tolerance for Stereo

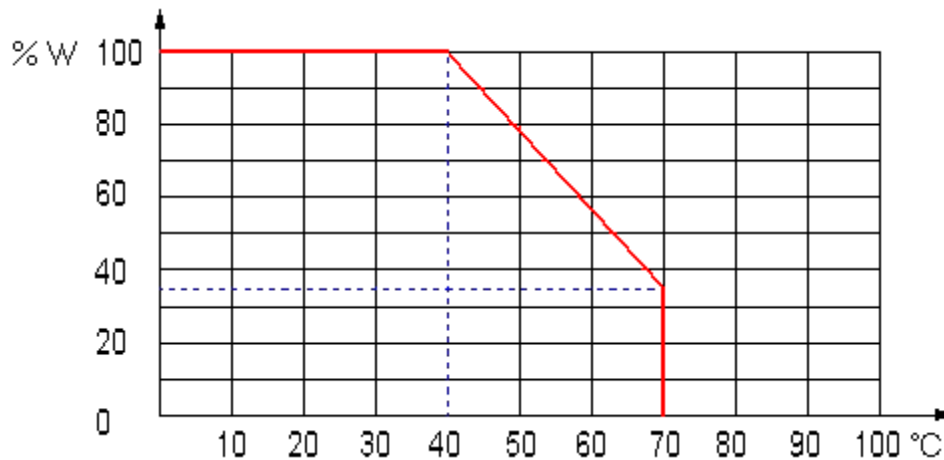


LAW	ATTENUATION RANGE	MATCHING TOLERANCE *
A	0 - 20dB	4dB
B & C	0 - 20dB	3dB

$$* \text{Matching Tolerance} = 20 \log \frac{V1}{V2}$$

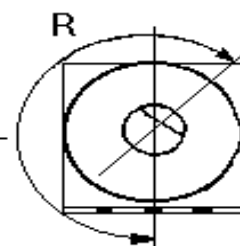
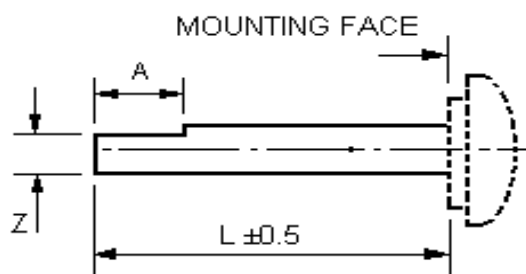
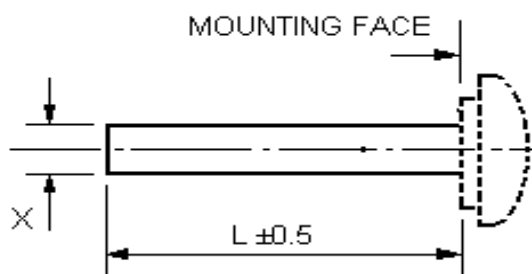
Operating Temperature: -25°C to +70°C

Temperature Derating Curve



Temperature Coefficient of Resistance: +300 -500 ppm

Cylindrical and Flatted Spindles



Spindle in full CCW position

TYPE	DESC. (X)	L (mm)
F1	6 mm Dia Plastic	0 - 25
F41	6.35mm Dia Plastic	0 - 25

All spindles fixed.

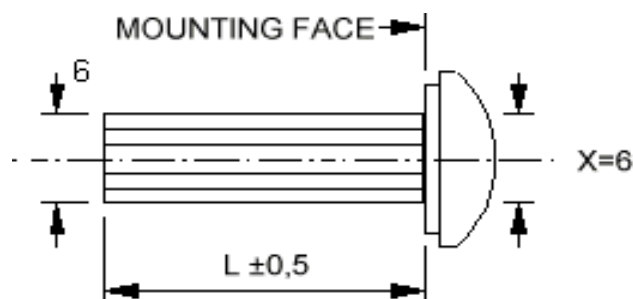


Screwdriver slot
Angle can be adjusted to customer requirement

TYPE	DESC. (X)	L (mm)	Flat (ZxA)
F13	6 mm Dia Plastic	0 - 25	4 x 8
F2	6 mm Dia Plastic	0 - 25	4 x 12
F14	6 mm Dia Plastic	0 - 25	5 x 8
F4	6 mm Dia Plastic	0 - 25	5 x 10
F3	6 mm Dia Plastic	0 - 25	5 x 15
F11	6 mm Dia Plastic	0 - 25	4.6 x 15
F42	6.35mm Dia Plastic	0 - 25	5.5 x 10

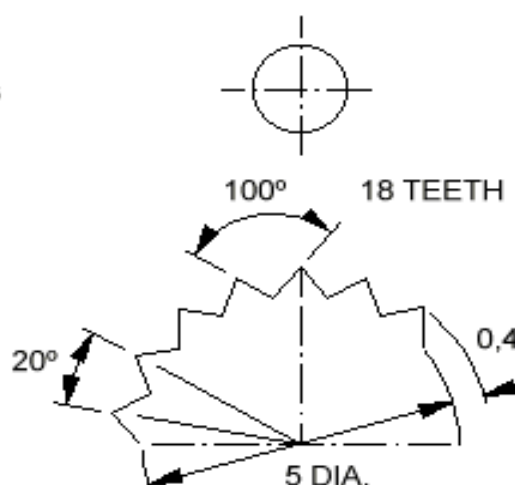
Standard flat angle
R = 210°

Splined Spindle (6.0mm diameter)
Available for Special Order



TYPE	DESC.	L (mm)
F5	Plastic Fixed	0 - 25

SPINDLE CAN BE FIXED OR REMOVABLE

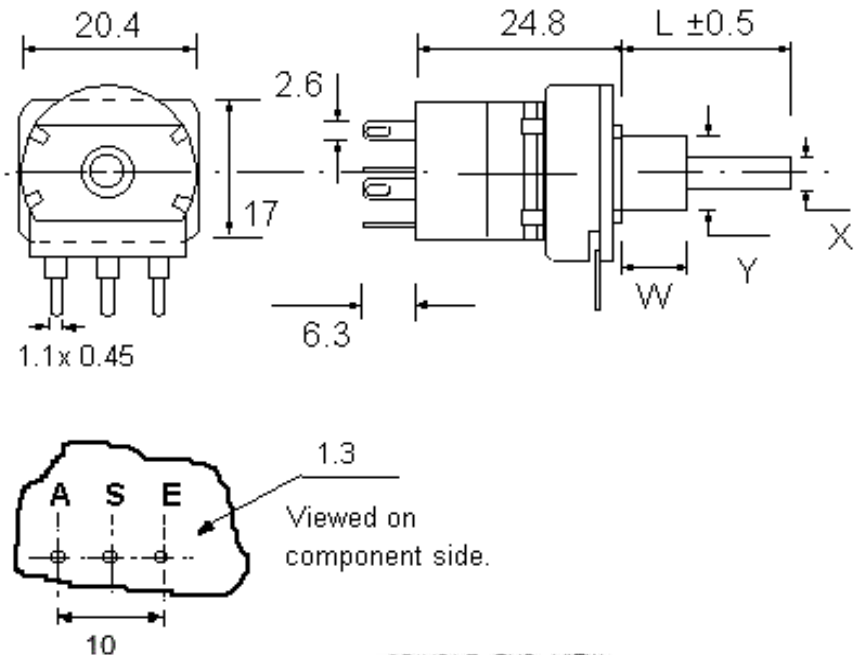
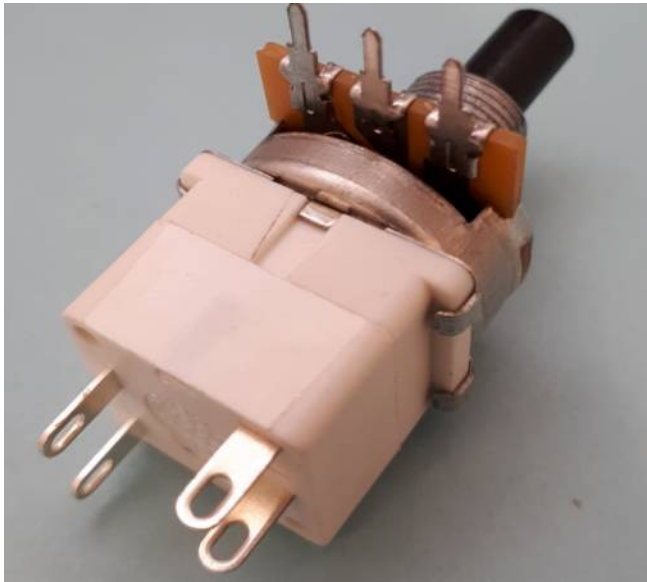


PC20BU/B4OW2S

B4OW2S – 4 Amp Double Pole (Single Throw) Switch

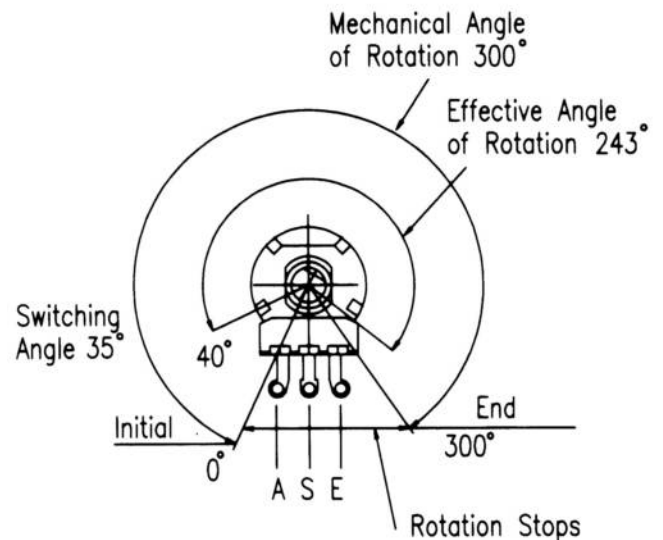
PC – For Printed Circuit

OW – Ordinary Wiring (recommended for soldering)



SPINDLE END VIEW

- W Mounting Height
- Y Mounting Diameter
- X Spindle Diameter
- L Spindle Length
- A Initial Termination
- S Wiper (or moving contact) termination
- E End Termination



Total mechanical and effective electrical angles of rotation of potentiometers with rotary switch



P20 Range Technical Data

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Rotation angle: $300^{\circ} \pm 5^{\circ}$ (Switched and Unswitched)

Operating Torque: 0.4 – 2.0 N.cm (Initial Torque may be higher)

Rotational torque of spindle can be made high or low

Detents (stop positions) Available: Centre, 11, 21, 31, 41

Permissible Axial Spindle Load: 100 N (5 Sec. maximum)

Permissible Torque at End Stop: 80 N.cm

ELECTRICAL SPECIFICATION

Rated Power Dissipation @40°C for ECO potentiometers:

0.4W linear law

0.2W nonlinear law

Rotation angle: $300^{\circ} \pm 5^{\circ}$

Effective rotation - Unswitched: 243° nominal

Effective rotation - Switched: 256° nominal

Insulation Resistance: ≥ 4 Gohms

Rated Resistance: E3 Series

- Optional: E6 Series
- Linear Law: 1K - 1M
- Nonlinear Law: 4K7 - 470K

Tolerance on Rated Resistance: $\pm 20\%$

- Optional Tolerance on 1K - 1M: $\pm 10\%$

Resistance Laws (Taper):

- Linear: A
- Nonlinear: B - Log (Audio) or C - Antilog (Reverse Audio)
- Other laws: Please refer to Sales office

Rotary Switch Specification

The rotary switch modules are manufactured to EN61058-1 standard using high quality materials with a flame retardant housing. Although no longer certified due to the excessive cost of maintaining approvals, the 1 Amp and 4 Amp switch series have both been previously certified by UL International Demko (copies of previous certificates are available on our website or on request). The same materials, components and production techniques are used as in the certified versions and Omeg Ltd continues to test to the EN61058-1 standard

The 1 Amp contact rating is only available when mounted on the ECO potentiometer

1 A Contact Rating:

Note: The 1A contact rating is NOT available for mounting on the P16 or P20 potentiometer.

1A/250Vac 2.5A/12Vdc

Surge rating (0.01 seconds): 20A

Contact gap: 3mm (Full mains separation of contacts)

Manufactured to EN61058-1 standard

4 A Contact Rating:

4A/250Vac 10A/12Vdc

Surge rating (0.01 seconds): 80A

Switch contacts: Silver tin oxide

Contact gap: 2mm (Micro disconnection of switch - micro separation of contacts)

Manufactured to EN61058-1 standard

Common features

Housing material: Flame Retardant Glass filled polyester (UL 94 VO)

Initial contact resistance: 20 milliohms

Insulation resistance: 50,000 Megohms

Life (operations at full load): 10,000 minimum

Operating temperature: -25°C to +70°C

Operating torque for SPST/SPDT: 1.5 - 3 cNm

Operating torque for DPST/DPDT: 3.0 - 6 cNm

Mechanical rotation: 300°

Proof voltage: 3kV minimum

ROTARY SWITCH TERMINALS

Layout

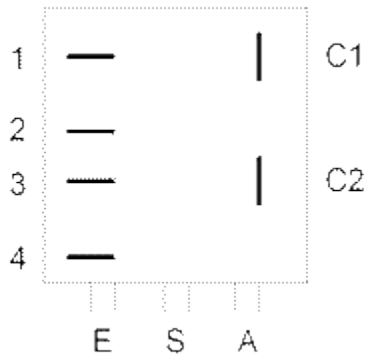
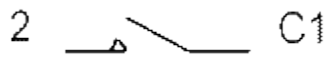
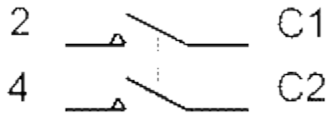


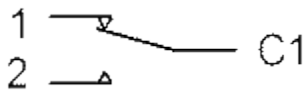
Diagram as viewed on the rear of the switch module:
(Potentiometer terminals at the bottom)



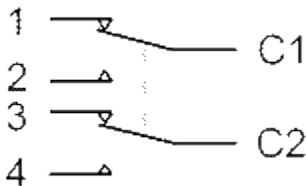
SPST - Single pole (1S), Single throw (On-Off)



DPST - Double pole (2S), Single throw (On-Off)



SPDT - Single pole (1S), Double throw (CH)
(**NOT** certified)

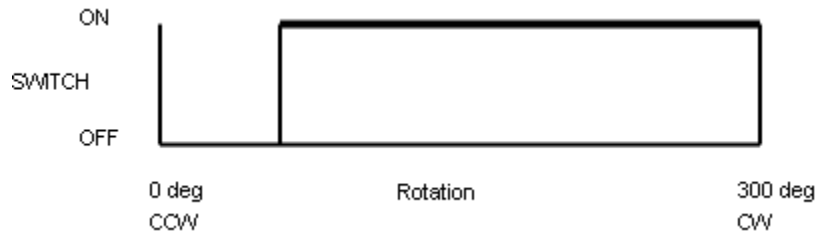


DPDT - Double pole (2S), Double throw (CH)
(**NOT** certified)

Notes

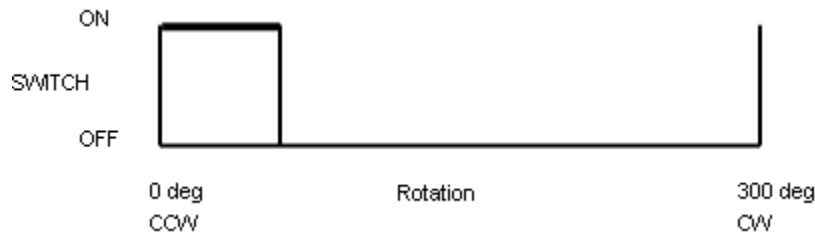
1. Moving contact(s) shown when the potentiometer shaft is in a counterclockwise (CCW) position.
2. 'Ordinary Wiring'(OW) or 'Printed Circuit'(PC) terminals can be requested on the switch.
3. Terminals 1 and 3 are only fitted for the Double Throw ('CH' or Changeover) versions which are **NOT** approved nor certified.

ROTARY SWITCH FUNCTIONS



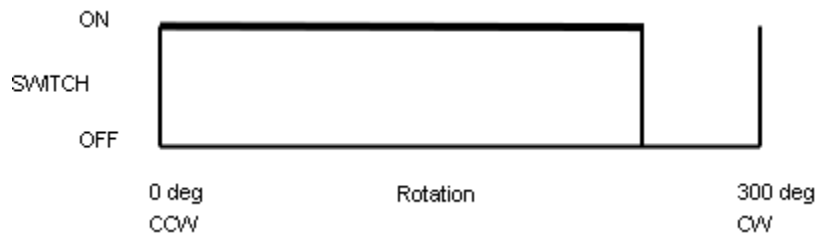
Standard (1A or 4A contact ratings)

N/O normally OPEN Switch
 Contacts normally OPEN;
 CLOCKwise rotation to CLOSE contacts



Option 1 (4A contact rating only)

N/C normally CLOSED Switch
 Contacts normally CLOSED;
 CLOCKwise rotation to OPEN contacts



Option 2 (4A contact rating only)

REVERSED N/O normally OPEN Switch
 Contacts normally OPEN at fully clockwise position;
 ANTI-clockwise rotation to CLOSE contacts



Option 3 (4A contact rating only)

REVERSED N/C normally CLOSED Switch
 Contacts normally CLOSED at fully clockwise position;
 ANTI-clockw

ELECTRICAL SPECIFICATION UNIQUE TO P20 POTENTIOMETERS

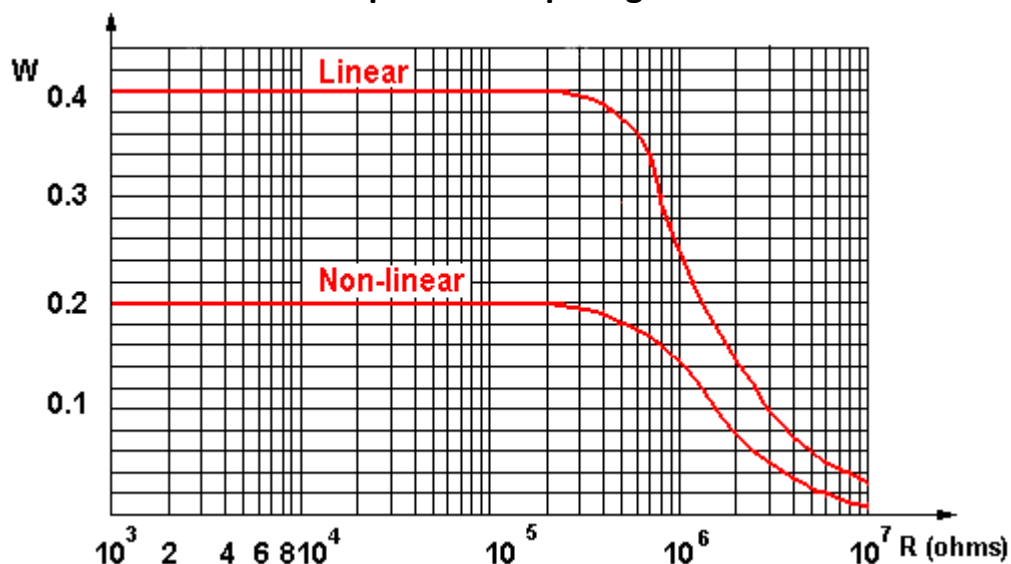
Effective rotation:

- Without a switch: 256° nominal
- With switch: 243° nominal
- With rotary switch: 243° nominal

Rated Power Dissipation @40°C for P20 potentiometers:

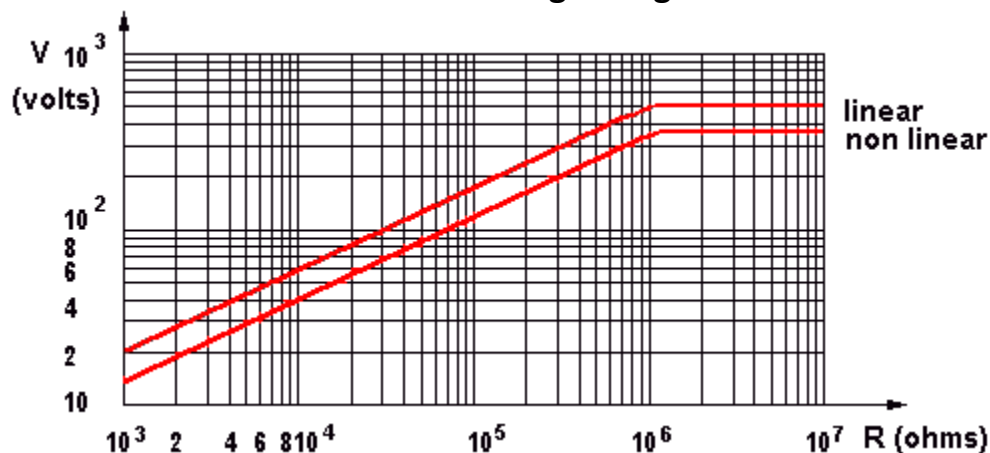
- 0.4W linear law
- 0.2W nonlinear law

P20 power dissipating curve



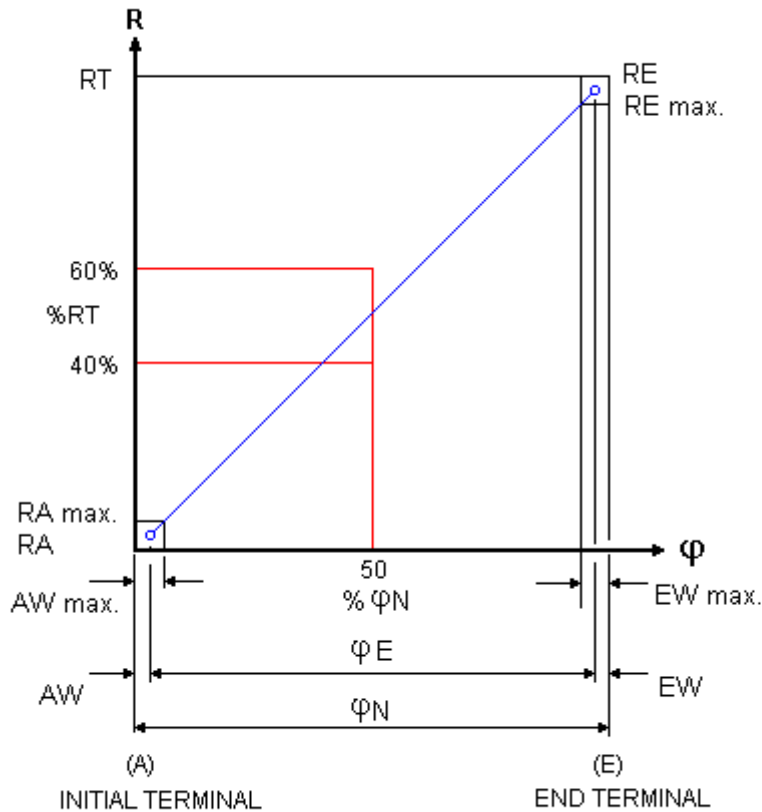
Limiting Element Voltage: 500 V DC for 20mm potentiometers

P20 maximum working voltage curve



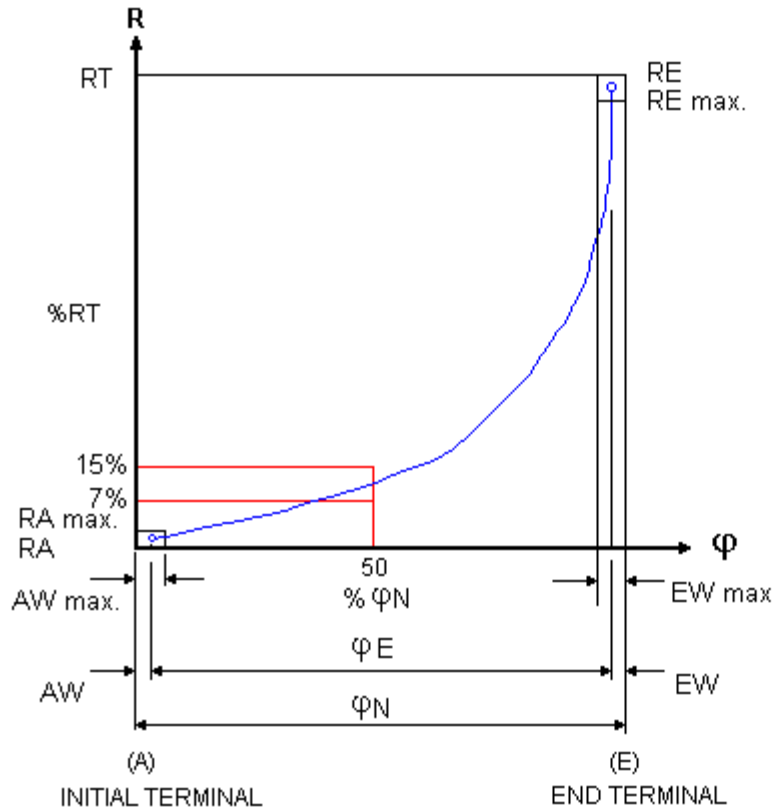
Insulating Voltage: 1000 V AC for 20mm potentiometers

Resistance law A - Linear



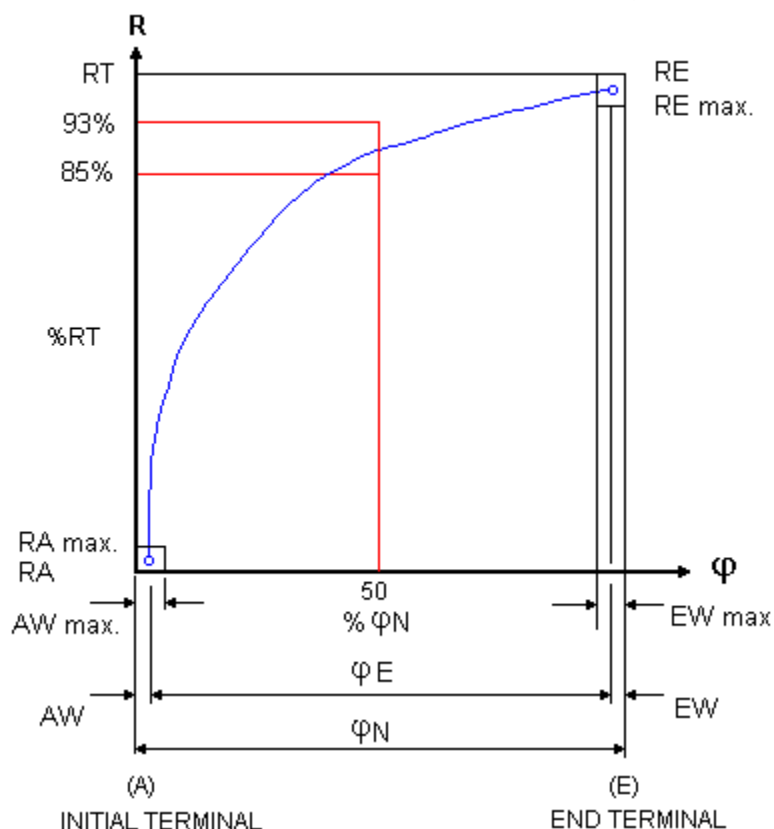
AW	Initial Path	AW max. 12% ϕN
EW	Final Path	EW max. 12% ϕN
Ra	Initial Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RA	Hop-on Resistance	$\leq 1\% RN$
Re	End Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RE	Hop-off Resistance	$\leq 1\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

Resistance law B – Log (Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RA	Hop-on Resistance	$RN \leq 10K$ 5% RN $RN > 10K$ 0.15% RN
Re	End Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RE	Hop-off Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K$ 0.5% RN
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

Resistance law C – Antilog (Reverse Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RA	Hop-on Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K 0.5\% RN$
Re	End Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RE	Hop-off Resistance	$RN \leq 10K 5\% RN$ $RN > 10K 0.15\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

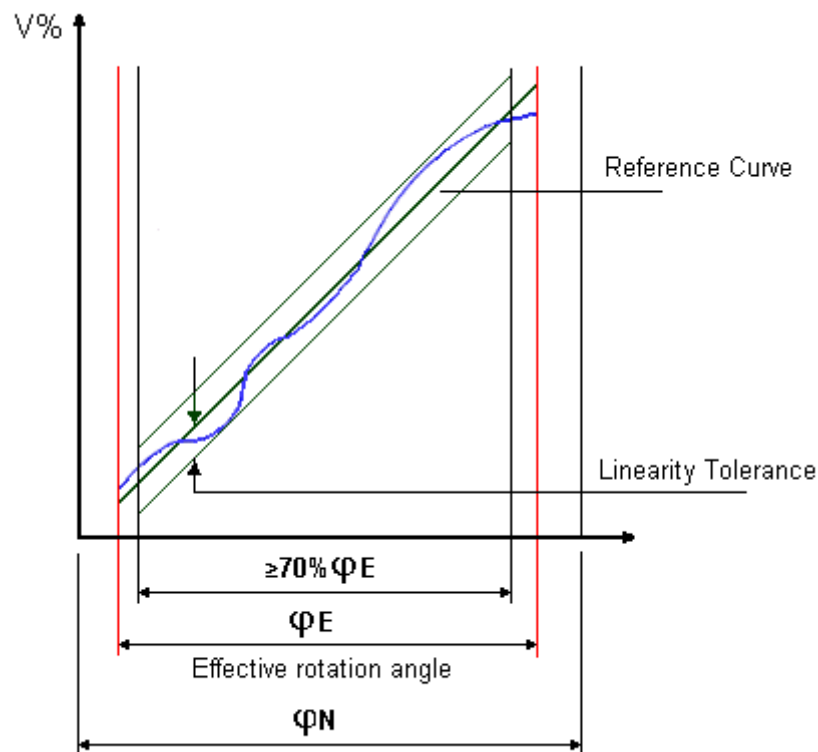
Linearity

As a basis of assessing Linearity Tolerance the independent method is the most practical, permitting as it does, the reference curve to be aligned as near as possible to the actual output curve. This avoids the use of the theoretical starting and finishing points, it is normal for the customer to realign the achieved curve with series trimmers at each end of the device if required.

Linearity Tolerance is 4% over the Nominal Resistance range of 1K0 to 1M0. The Linearity Tolerance is measured on at least 70% of the effective rotation range.

Note. In the case of Terminal and Zero-based linearity, both present constraints which increase the manufacturing difficulty and in consequence have an adverse effect on the product's price and availability.

Potentiometer linearity

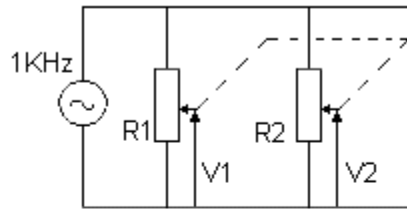


Matching Tolerance (For Tandem Stereo Potentiometers)

Tandem Potentiometers have two identical resistor units with the same variation law. The mismatching of the two resistor units, expressed in dB, is measured by the difference between the attenuations introduced by each resistor unit at various points of travel.

- Law A: 4 dB at Attenuation range 0 - 20 dB
- Law B and C: 3 dB at Attenuation range 0 - 20 dB

Matched Tolerance for Stereo

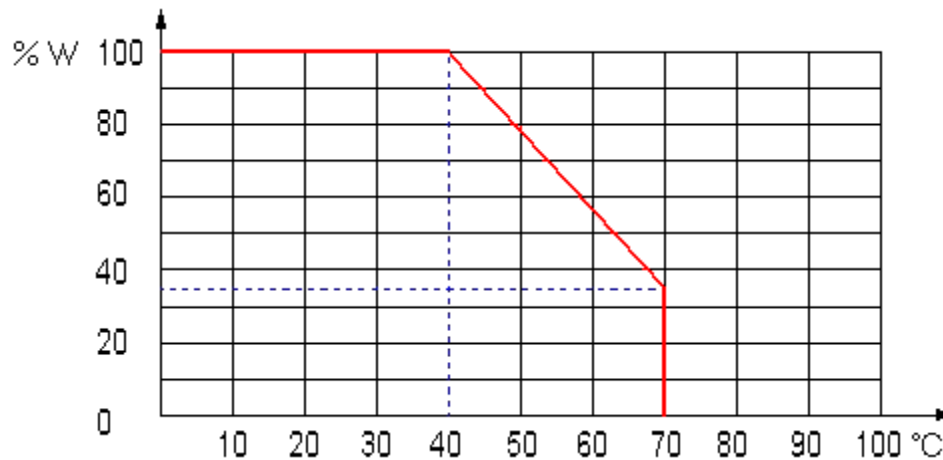


LAW	ATTENUATION RANGE	MATCHING TOLERANCE *
A	0 - 20dB	4dB
B & C	0 - 20dB	3dB

$$* \text{Matching Tolerance} = 20 \log \frac{V1}{V2}$$

Operating Temperature: -25°C to +70°C

Temperature Derating Curve



Temperature Coefficient of Resistance: +300 -500 ppm

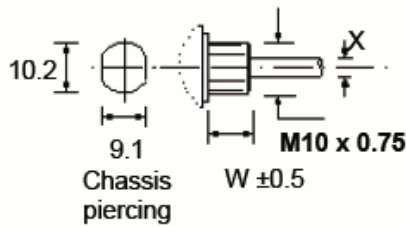
Components

P20 Bush Housing (Mounting)

The P20 bushes are available in metal or nylon; with three thread options; and with or without a locating feature:

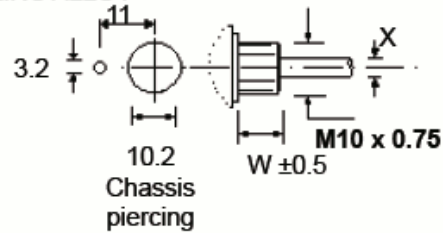
- Diecast Zinc Alloy
 - M10 x0.75mm pitch (Type C)
 - M10 x0.75mm pitch, **with locator** (Type CEBS)
 - 9.52mm x32tpi (Type CBS)
 - 9.52mm x32tpi, **with locator** (Type CBSL)
 - M7 x0.75mm pitch (Type CG)
- Glass Filled Nylon
 - M10 x0.75mm (Type CP)

DIECAST ZINC ALLOY



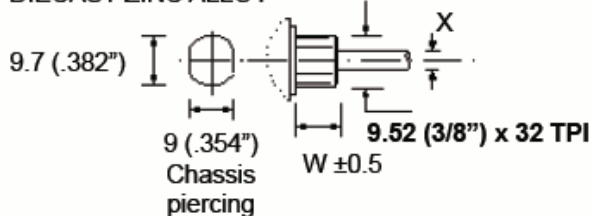
Type C (without locator)	
X (mm)	6
W (mm)	9

DIECAST ZINC ALLOY



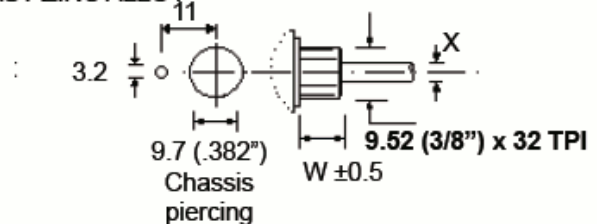
Type CEBS (with locator)	
X (mm)	6
W (mm)	9

DIECAST ZINC ALLOY



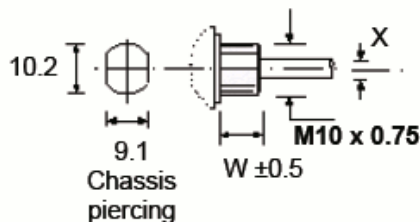
Type CBS (without locator)		
X (mm)	6	6.35
W (mm)	8 or 12	8 or 12

DIECAST ZINC ALLOY



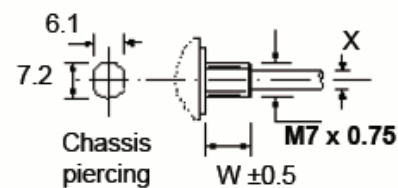
Type CBSL (with locator)		
X (mm)	6.35	6.35
W (mm)	8	12

GLASS FILLED NYLON



Type CP (GFN)		
X (mm)	6	6.35
W (mm)	7 or 10	7 or 10

DIECAST ZINC ALLOY



Type CG (without locator)	
X (mm)	4
W (mm)	6

P20 Spindles

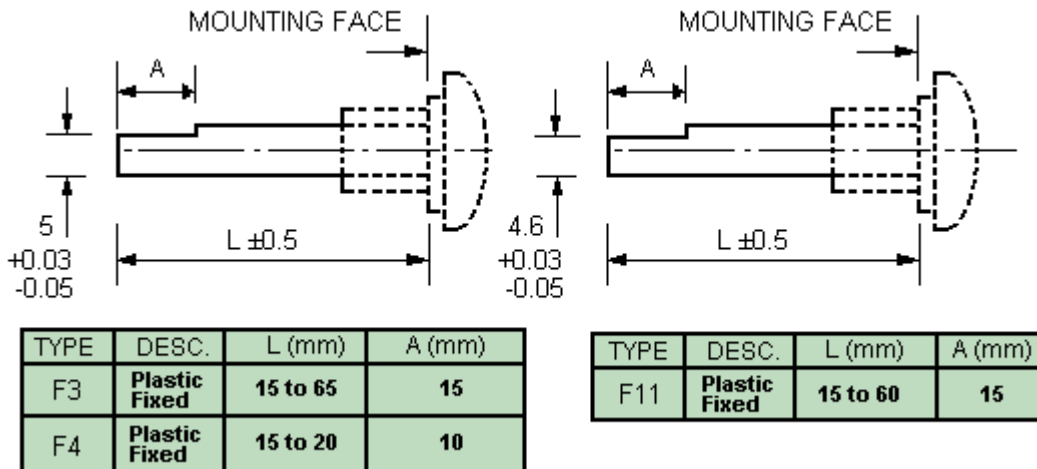
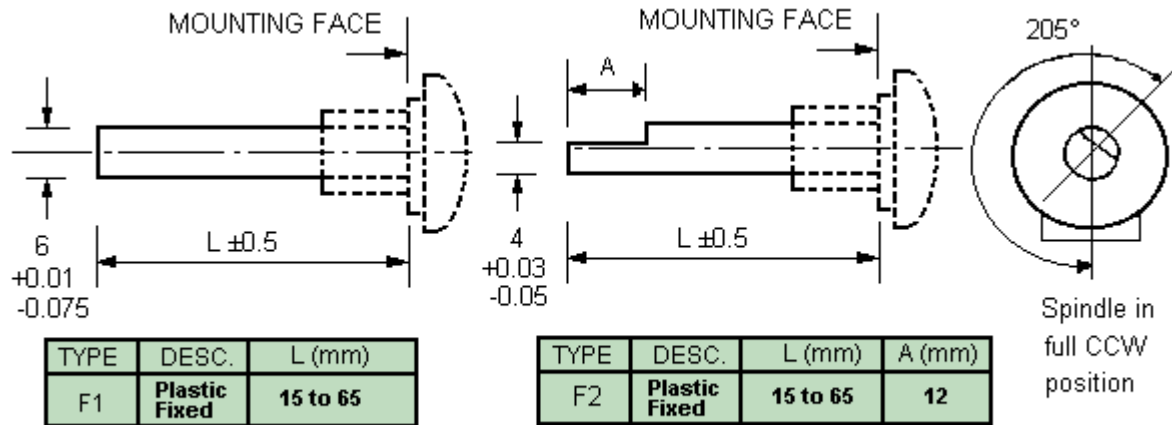
The P20 spindles are plastic and fixed i.e. not removable, unless otherwise stated and they are available in three diameters:

- 6.0mm Diameter
 - Cylindrical (Type F1)
 - 4.0 x 12mm Flat (Type F2)
 - 5.0 x 15mm Flat (Type F3)
 - 5.0 x 10mm Flat (Type F4)
 - 4.6mm x 15mm Flat (Type F11)
- 4.0mm Diameter
 - Cylindrical (Type F21)
 - 3.0 x 8.5mm Flat (Type F22)
 - 3.0 x 13.5mm Flat (Type F23)
 - Cylindrical (Type M21 - Metal)
 - 3.0 x 8.5mm Flat (Type M22 - Metal)
 - 3.0 x 13.5mm Flat (Type M23 - Metal)
- 6.35mm Diameter
 - Cylindrical (Type F41)
 - 5.5 x 10mm Flat (Type F42)
 - 5.5 x 15mm Flat (Type F43)
- Splined Spindle - 6.0mm dia. 18 teeth
- Dual Concentric
 - Flatted/Slotted (Type M15 - Metal)
 - Cylindrical (Type M16 - Metal)

6.0mm Diameter Spindles

Note: *Specials to customer's specification up to 65mm.

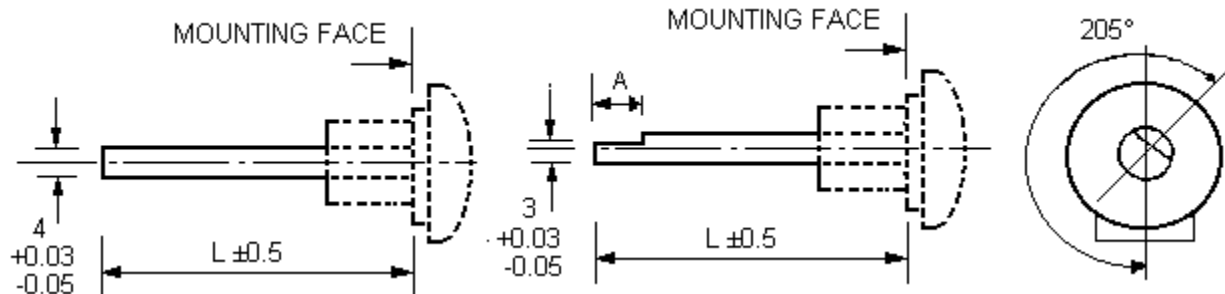
REMOVABLE SPINDLES, similar in specification to 'fixed' spindles are supplied separate from the potentiometer. These can be indefinitely taken in and out and their holding strength is >1kg.



4.0mm Diameter Spindles

Note: The orientation of the flat as illustrated is for plastic spindles only.

For metal spindles, unless specified on the order, the orientation may be different on each potentiometer type.



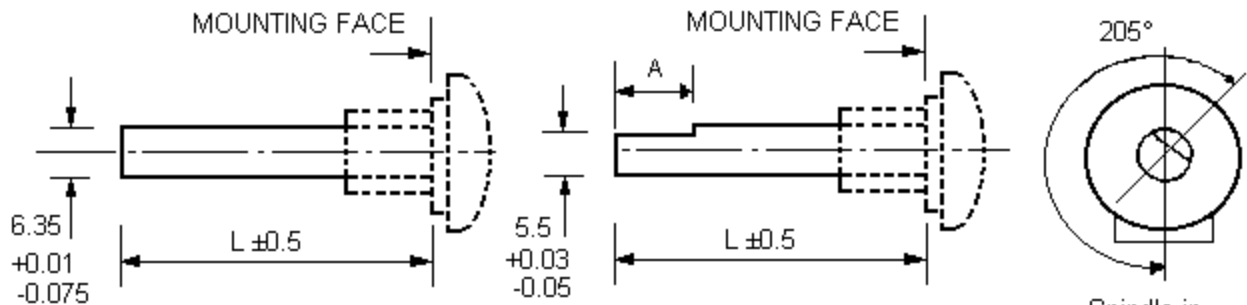
TYPE	DESC.	L (mm)
F21	Plastic Fixed	8 to 65
M21	Metal Fixed	8 to 65

TYPE	DESC.	L (mm)	A (mm)
F22	Plastic Fixed	11 to 60	8.5
M22	Metal Fixed	11 to 60	8.5
F23	Plastic Fixed	16 to 60	13.5
M23	Metal Fixed	16 to 60	13.5

Spindle in
full CCW
position

6.35mm Diameter Spindles

Note: *Specials to customer's specification up to 65mm.



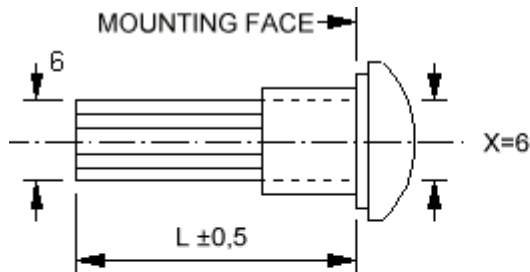
TYPE	DESC.	L (mm)
F41	Plastic Fixed	15 to 65

TYPE	DESC.	L (mm)	A (mm)
F42	Plastic Fixed	15 to 20	10
F43	Plastic Fixed	20 to 60	15

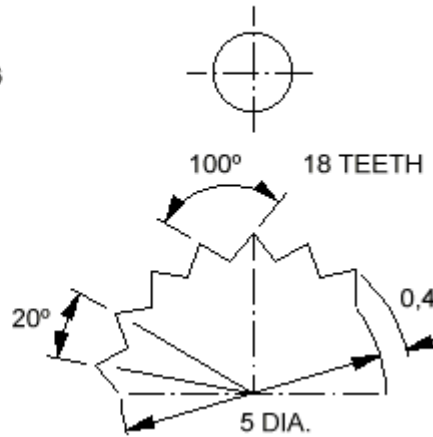
Spindle in
full CCW
position

Splined Spindle - 6.0mm dia. 18 teeth

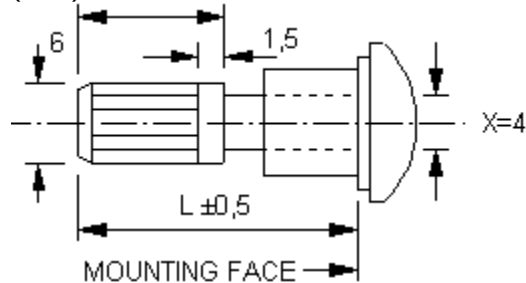
A splined form is available on the 6.0mm diameter P20 plastic spindle (F5) or alternatively a 6mm 'Splined Adaptor' (8,7mm long) can be fitted on a 4mm dia. Spindle



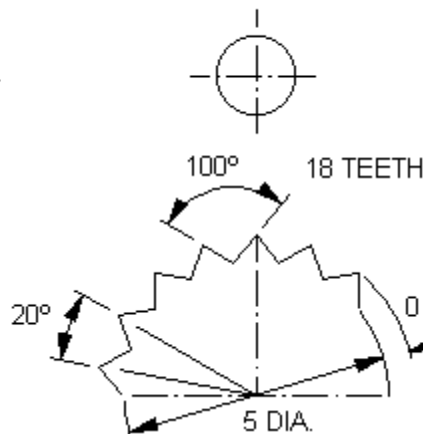
TYPE	DESC.	L (mm)
F5	Plastic Fixed	19



(F5A):



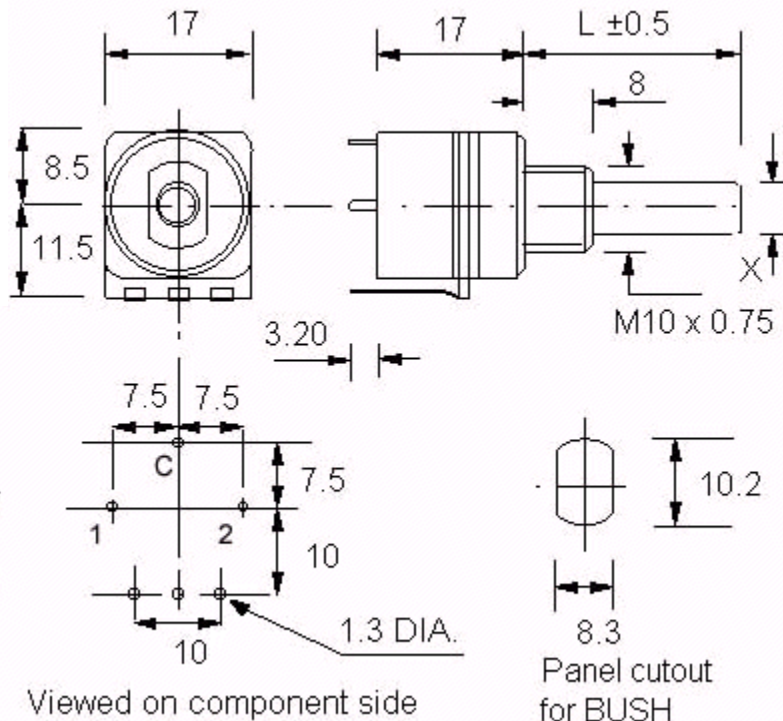
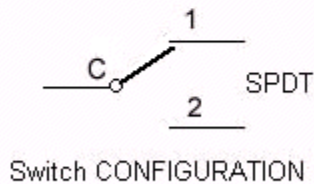
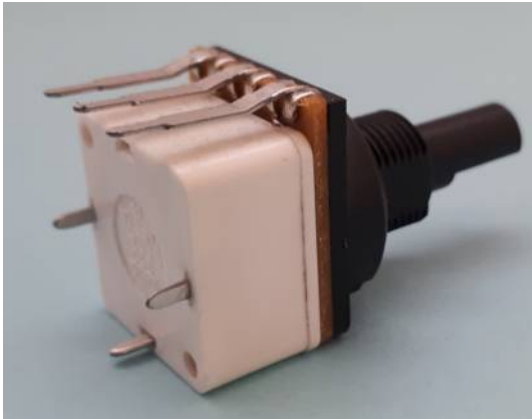
TYPE	DESC.	L (mm)
F5A	Plastic Fixed	16-36



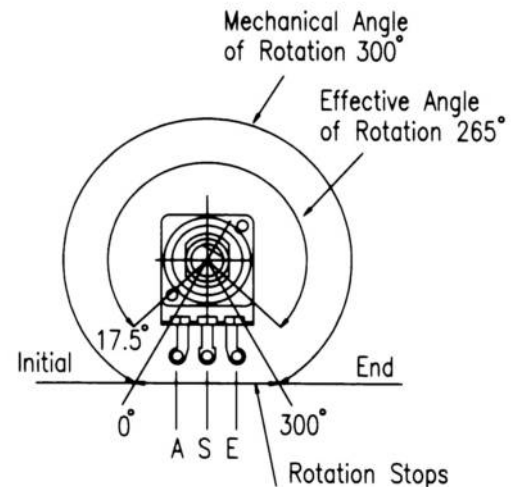
XA16ECO/10APP

10APP – 10 Amp Push Push Switch

XA – Extra Long Terminals bent away from spindle



- W Mounting Height
- Y Mounting Diameter
- X Spindle Diameter
- L Spindle Length
- A Initial Termination
- S Wiper (or moving contact) termination
- E End Termination



Total mechanical and effective electrical angles of rotation of potentiometer

Technical Data

Rated Power Dissipation @40°C for ECO potentiometers:

0.25W linear law

0.12W nonlinear law

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Effective rotation: 265° nominal

Operating Torque: 0.4 – 1.5 cN.m

Permissible Axial Spindle Load: 50 N (5 Sec. maximum)

Permissible Torque at End Stop: 35 cN.m

Rotation angle: 300° ±5°

Optional Click stop (indents) for rotational tactile feedback

Rotational torque of spindle can be made high or low

Life Expectancy of >25,000 cycles (minimum)

Insulation Resistance: >= 4 Gohms

Rated Resistance: E3 Series

Optional: E6 Series

Linear Law: 1K – 1M

Nonlinear Law: 4K7 – 470K

Switch Specification

- Manufactured to EN61058-1 (previously certified by UL International Demko)
- Contact rating: 10A/250V AC resistive load
- Proof voltage: 3KV min.
- Operating temperature: -25°C to +70°C
- Housing material: Glass filled polyester
- Life: 25,000 (minimum) operations at rated load
- Switch operating force: 4 - 6N
- Spindle travel: 3mm minimum

PLEASE NOTE: When tightening the nut please ensure the spindle is free to move.

The recommended torque setting for the bush nut on our potentiometers is 45cN.m Torque.

ELECTRICAL SPECIFICATION COMMON TO ALL POTENTIOMETERS

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Life Expectancy of >25,000 cycles (tested at 30 times per minute)

Insulation Resistance: ≥ 4 Gohms

Rated Resistance: E3 Series

- Optional: E6 Series
- Linear Law: 1K - 1M
- Nonlinear Law: 4K7 - 470K

Tolerance on Rated Resistance: $\pm 20\%$

- Optional Tolerance on 1K - 1M: $\pm 10\%$

Resistance Laws (Taper):

- Linear: A
- Nonlinear: B - Log (Audio) or C - Antilog (Reverse Audio)
- Other laws: Please refer to Sales office

ELECTRICAL SPECIFICATION UNIQUE TO ECO POTENTIOMETERS

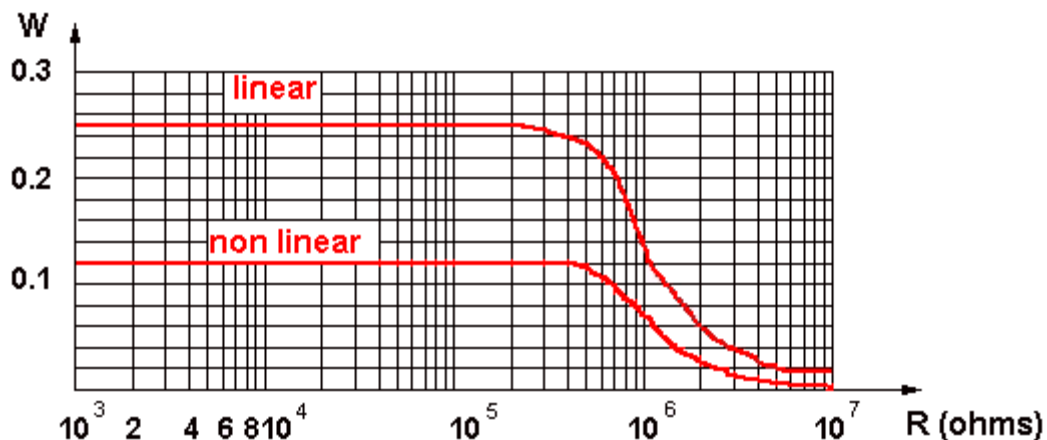
Effective rotation:

- Without a switch: 265° nominal
- With push push switch (/10APP, /MS): 265° nominal
- With rotary switch: 242° nominal

Rated Power Dissipation @40°C for ECO potentiometers:

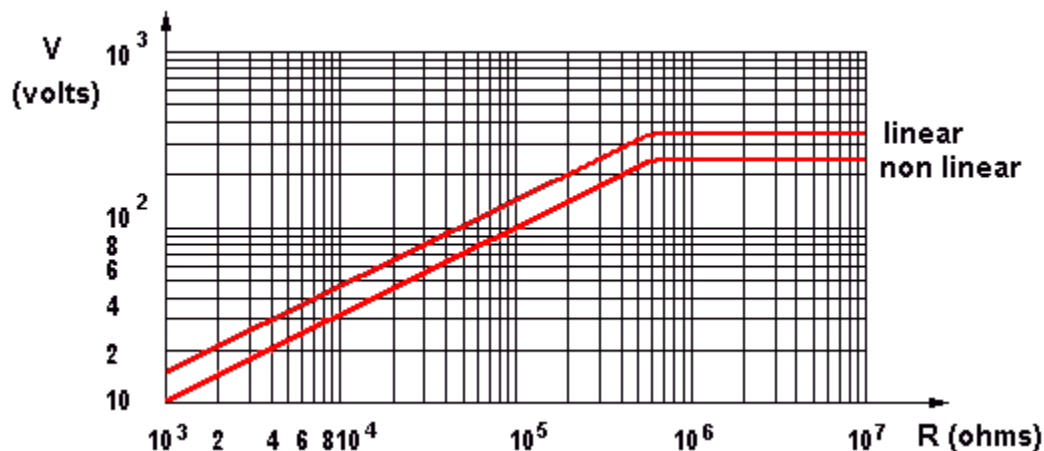
- 0.25W linear law
- 0.12W nonlinear law

ECO, P16 power dissipating curve



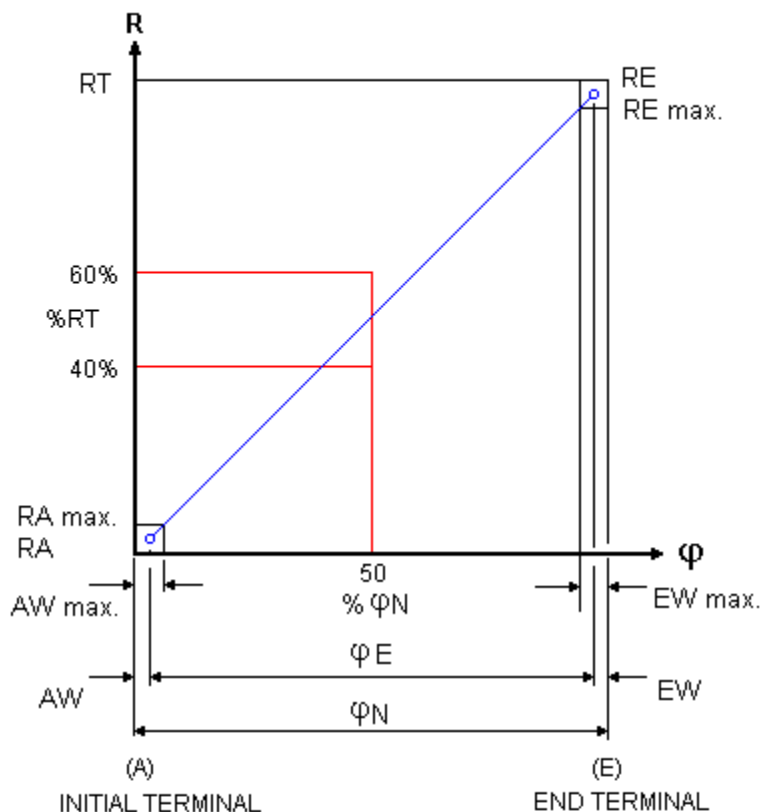
Limiting Element Voltage: 350 V DC for 16mm potentiometers

ECO, P16 maximum working voltage curve



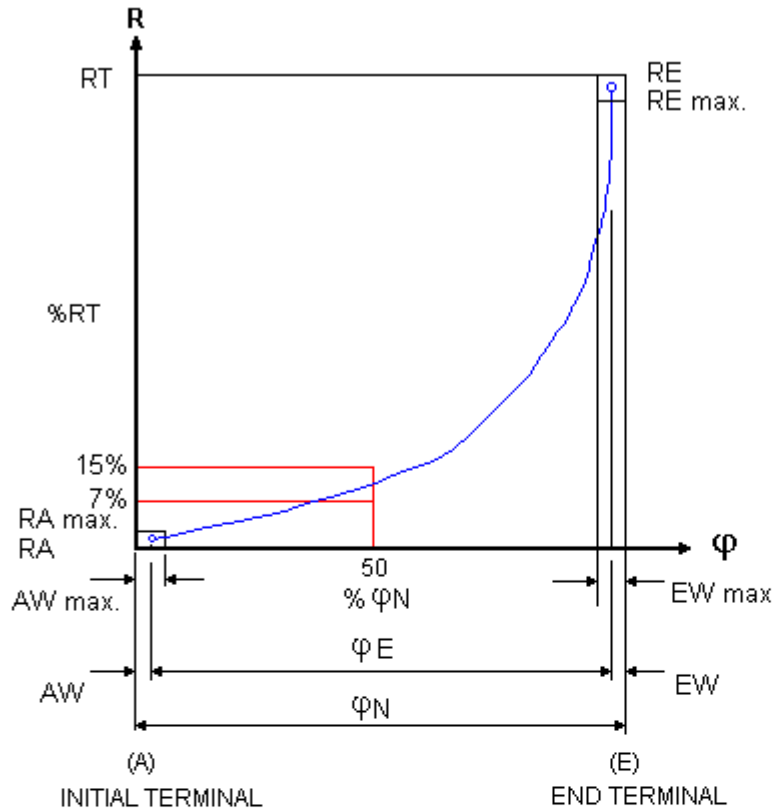
Insulating (Breakdown) Voltage: 2,500 V AC for ECO Potentiometers

Resistance law A - Linear



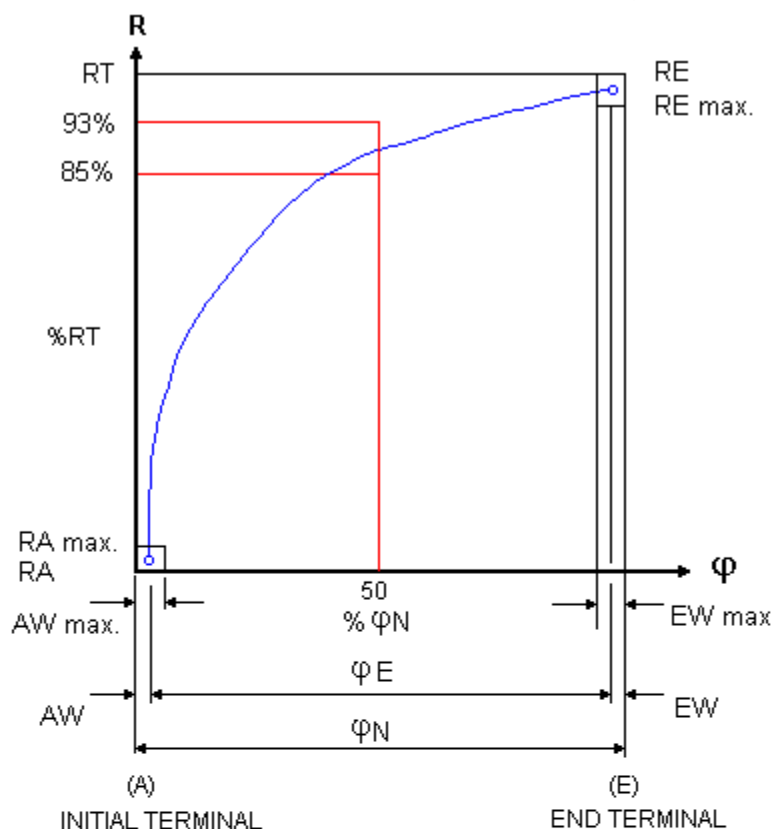
AW	Initial Path	AW max. 12% ϕN
EW	Final Path	EW max. 12% ϕN
Ra	Initial Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RA	Hop-on Resistance	$\leq 1\% RN$
Re	End Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RE	Hop-off Resistance	$\leq 1\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

Resistance law B – Log (Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RA	Hop-on Resistance	$RN \leq 10K$ 5% RN $RN > 10K$ 0.15% RN
Re	End Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RE	Hop-off Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K$ 0.5% RN
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

Resistance law C – Antilog (Reverse Audio)



AW	Initial Path	AW max. 10% ϕN
EW	Final Path	EW max. 10% ϕN
Ra	Initial Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RA	Hop-on Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K 0.5\% RN$
Re	End Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RE	Hop-off Resistance	$RN \leq 10K 5\% RN$ $RN > 10K 0.15\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

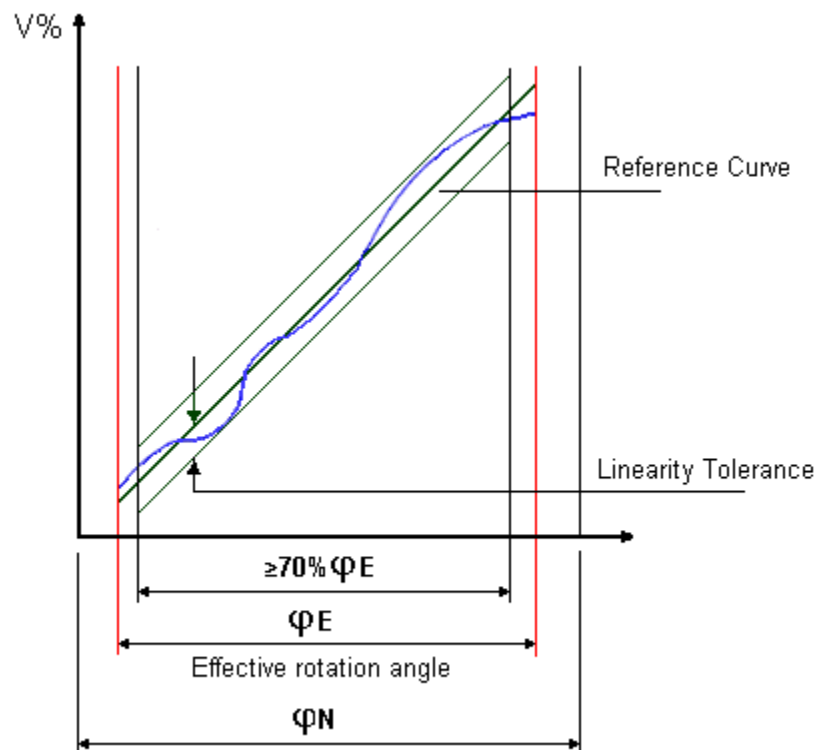
Linearity

As a basis of assessing Linearity Tolerance the independent method is the most practical, permitting as it does, the reference curve to be aligned as near as possible to the actual output curve. This avoids the use of the theoretical starting and finishing points, it is normal for the customer to realign the achieved curve with series trimmers at each end of the device if required.

Linearity Tolerance is 4% over the Nominal Resistance range of 1K0 to 1M0. The Linearity Tolerance is measured on at least 70% of the effective rotation range.

Note. In the case of Terminal and Zero-based linearity, both present constraints which increase the manufacturing difficulty and in consequence have an adverse effect on the product's price and availability.

Potentiometer linearity

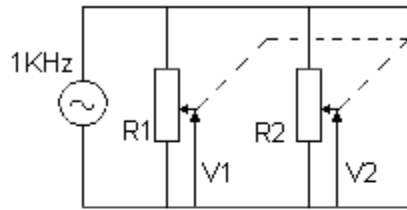


Matching Tolerance (For Tandem Stereo Potentiometers)

Tandem Potentiometers have two identical resistor units with the same variation law. The mismatching of the two resistor units, expressed in dB, is measured by the difference between the attenuations introduced by each resistor unit at various points of travel.

- Law A: 4 dB at Attenuation range 0 - 20 dB
- Law B and C: 3 dB at Attenuation range 0 - 20 dB

Matched Tolerance for Stereo

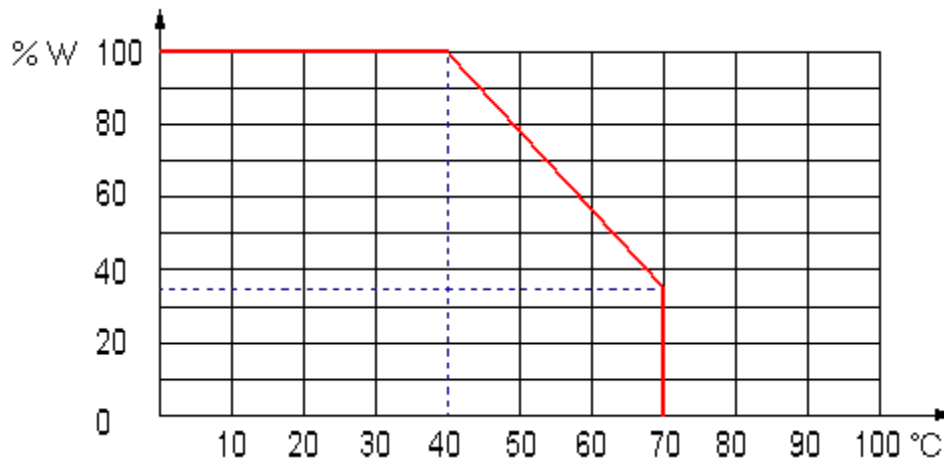


LAW	ATTENUATION RANGE	MATCHING TOLERANCE *
A	0 - 20dB	4dB
B & C	0 - 20dB	3dB

$$* \text{Matching Tolerance} = 20 \log \frac{V1}{V2}$$

Operating Temperature: -25°C to +70°C

Temperature Derating Curve



Temperature Coefficient of Resistance: +300 -500 ppm

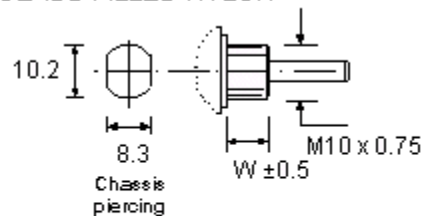
Components

ECO Bush Housing (Mounting)

The ECO bush housing is made of glass filled nylon, the thread is M10 x0.75mm pitch and 8mm long, alternatively **a 12mm long thread is also available** from October 2008.

Do not attempt to prevent any unwanted body rotation by overtightening the retaining nut, since this can cause thread damage, distortion, change of electrical resistance and restrict shaft rotation. BS9130:1972 provides further details on this topic. The **recommended torque** for tightening the retaining nut is 45cN.m and this can be achieved cost effectively by using a Torque Limiting device as shown on our **Accessories** page.

GLASS FILLED NYLON



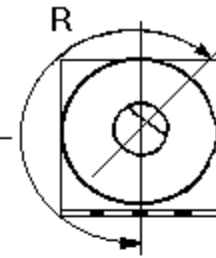
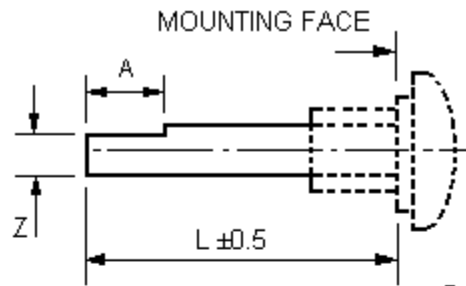
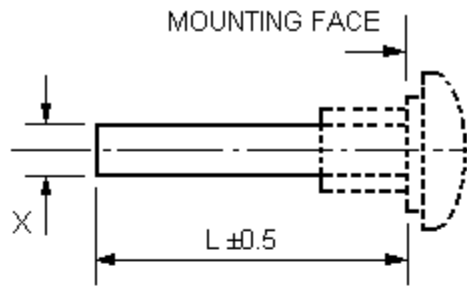
TYPE PLASTIC BODY	
W(mm)	8 (optional 12)

ECO Spindles

The ECO plastic spindles are fixed and not removable.
They are available in the following three diameters:

- 6.0mm Diameter - Length (L) available from 14mm to 65mm
 - Cylindrical (Type F1)
 - 4.0 x 12mm Flat (Type F2)
 - 5.0 x 15mm Flat (Type F3)
 - 5.0 x 10mm Flat (Type F4)
 - 4.6mm x 15mm Flat (Type F11)
 - 4.0 x 8mm Flat (Type F13)
 - 5.0 x 8mm Flat (Type F14)
- 4.0mm Diameter - Length (L) available from 14mm to 35mm
 - Cylindrical (Type F21)
 - 3.0 x 8.5mm Flat (Type F22)
- 6.35mm Diameter - Length (L) available from 14mm to 65mm
 - Cylindrical (Type F41)
 - 5.5 x 10mm Flat (Type F42)

Cylindrical and Flatted Spindles



Spindle in full CCW position

TYPE	DESC. (X)	L (mm)
F21	4 mm Dia Plastic	14 - 35
F1	6 mm Dia Plastic	14 - 65
F41	6.35mm Dia Plastic	14 - 65

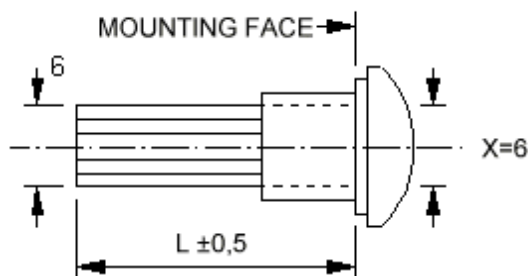
All spindles fixed.

TYPE	DESC. (X)	L (mm)	Flat (ZxA)
F22	4 mm Dia Plastic	14 - 35	3 x 8.5
F13	6 mm Dia Plastic	14 - 65	4 x 8
F2	6 mm Dia Plastic	14 - 65	4 x 12
F14	6 mm Dia Plastic	14 - 65	5 x 8
F4	6 mm Dia Plastic	14 - 65	5 x 10
F3	6 mm Dia Plastic	14 - 65	5 x 15
F11	6 mm Dia Plastic	14 - 65	4.6 x 15
F42	6.35mm Dia Plastic	14 - 65	5.5 x 10

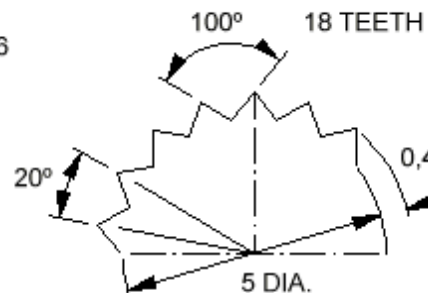
Standard flat angle
R = 210°

Splined Spindle (6.0mm diameter)

A splined form is also available on the 6.0mm diameter ECO plastic spindle.

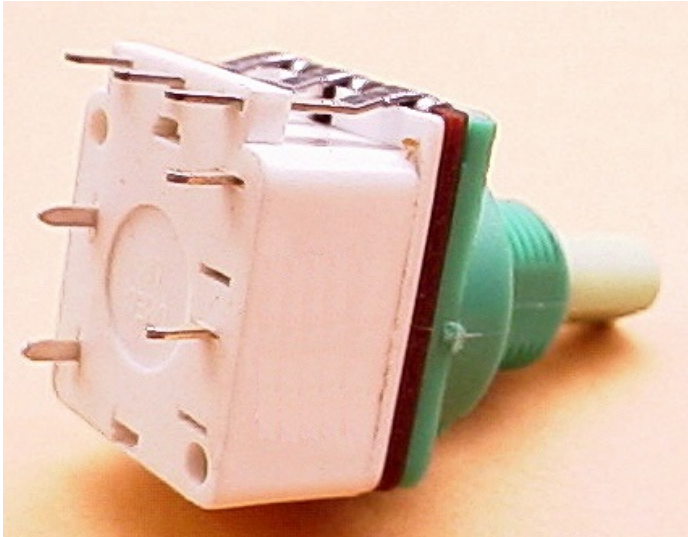


TYPE	DESC.	L (mm)
F5	Plastic Fixed	14 - 30

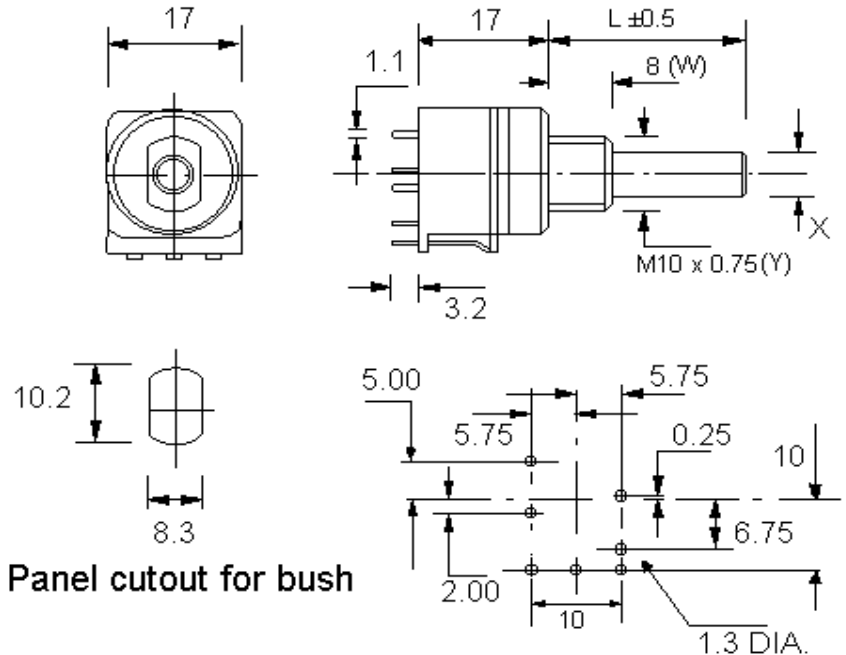


XA16ECO/B4PC2S

B4PC2S - 4 Amp Double Pole (Single Throw) Switch PC – Printed Circuit Terminals



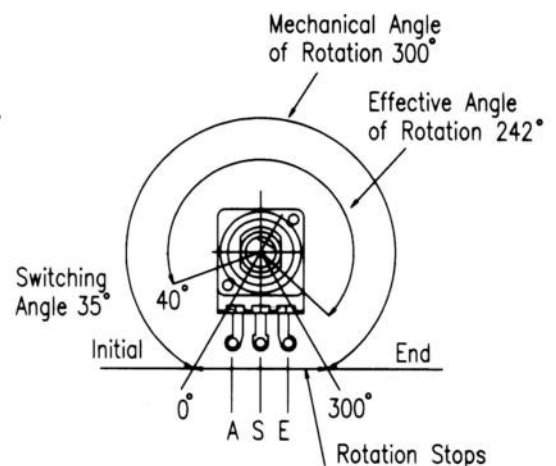
PRINTED CIRCUIT (PC) TERMINALS on SWITCH



Panel cutout for bush

Viewed on component side

SPINDLE END VIEW



Total mechanical and effective electrical angles of rotation of potentiometers with rotary switch

- W Mounting Height
- Y Mounting Diameter
- X Spindle Diameter
- L Spindle Length
- A Initial Termination
- S Wiper (or moving contact) termination
- E End Termination



ECO Range Technical Data

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Rotation angle: $300^{\circ} \pm 5^{\circ}$ (Switched and Unswitched)

Operating Torque: 0.4 – 2.0 N.cm (Initial Torque may be higher)

Rotational torque of spindle can be made high or low

Detents (stop positions) Available: Centre, 11, 21, 31

Permissible Axial Spindle Load: 50 N (5 Sec. maximum)

Permissible Torque at End Stop: 35 N.cm

ELECTRICAL SPECIFICATION

Rated Power Dissipation @40°C for ECO potentiometers:

0.25W linear law

0.12W nonlinear law

Rotation angle: $300^{\circ} \pm 5^{\circ}$

Effective rotation - Unswitched: 265° nominal

Effective rotation - Switched: 242° nominal

Insulation Resistance: ≥ 4 Gohms

Rated Resistance: E3 Series

- Optional: E6 Series
- Linear Law: 1K - 1M
- Nonlinear Law: 4K7 - 470K

Tolerance on Rated Resistance: $\pm 20\%$

- Optional Tolerance on 1K - 1M: $\pm 10\%$

Resistance Laws (Taper):

- Linear: A
- Nonlinear: B - Log (Audio) or C - Antilog (Reverse Audio)
- Other laws: Please refer to Sales office

Rotary Switch Specification

The rotary switch modules are manufactured to EN61058-1 standard using high quality materials with a flame retardant housing. Although no longer certified due to the excessive cost of maintaining approvals, the 1 Amp and 4 Amp switch series have both been previously certified by UL International Demko (copies of previous certificates are available on our website or on request). The same materials, components and production techniques are used as in the certified versions and Omeg Ltd continues to test to the EN61058-1 standard

The 1 Amp contact rating is only available when mounted on the ECO potentiometer

1 A Contact Rating:

Note: The 1A contact rating is NOT available for mounting on the P16 or P20 potentiometer.

1A/250Vac 2.5A/12Vdc

Surge rating (0.01 seconds): 20A

Contact gap: 3mm (Full mains separation of contacts)

Manufactured to EN61058-1 standard

4 A Contact Rating:

4A/250Vac 10A/12Vdc

Surge rating (0.01 seconds): 80A

Switch contacts: Silver tin oxide

Contact gap: 2mm (Micro disconnection of switch - micro separation of contacts)

Manufactured to EN61058-1 standard

Common features

Housing material: Flame Retardant Glass filled polyester (UL 94 VO)

Initial contact resistance: 20 milliohms

Insulation resistance: 50,000 Megohms

Life (operations at full load): 10,000 minimum

Operating temperature: -25°C to +70°C

Operating torque for SPST/SPDT: 1.5 - 3 cNm

Operating torque for DPST/DPDT: 3.0 - 6 cNm

Mechanical rotation: 300°

Proof voltage: 3kV minimum

Rotary Switch Terminals

Layout

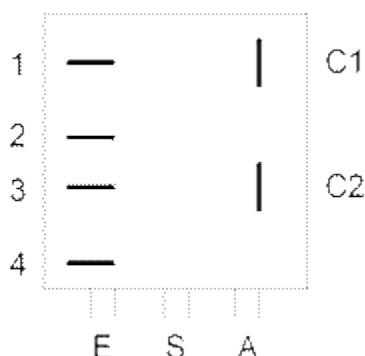


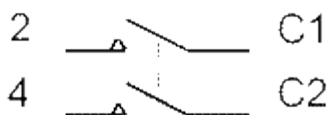
Diagram as viewed on the rear of the switch module:

(Potentiometer terminals at the bottom)

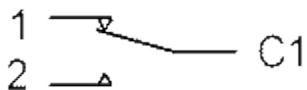
Configuration



SPST - Single pole (1S), Single throw (On-Off)

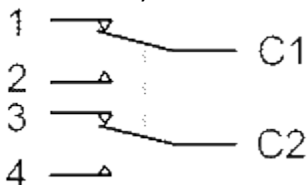


DPST - Double pole (2S), Single throw (On-Off)



SPDT - Single pole (1S), Double throw (CH)

(**NOT** certified)



DPDT - Double pole (2S), Double throw (CH)

(**NOT** certified)

Notes

1. Moving contact(s) shown when the potentiometer shaft is in a counterclockwise (CCW) position.
2. 'Ordinary Wiring'(OW) or 'Printed Circuit'(PC) terminals can be requested on the switch.
3. Terminals 1 and 3 are only fitted for the Double Throw ('CH' or Changeover) versions which are **NOT** approved nor certified.

Rotary Switch Terminals



Standard (1A or 4A contact ratings)

N/O normally OPEN Switch

Contacts normally OPEN;

CLOCKwise rotation to CLOSE contacts

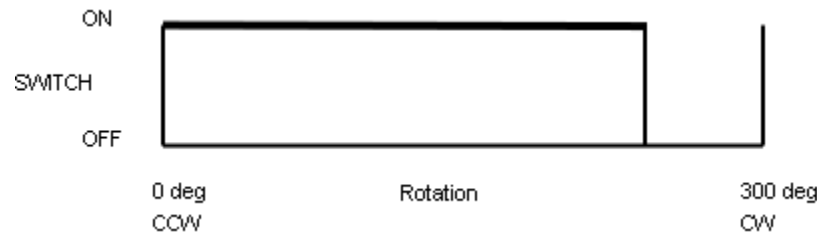


Option 1 (4A contact rating only)

N/C normally CLOSED Switch

Contacts normally CLOSED;

CLOCKwise rotation to OPEN contacts

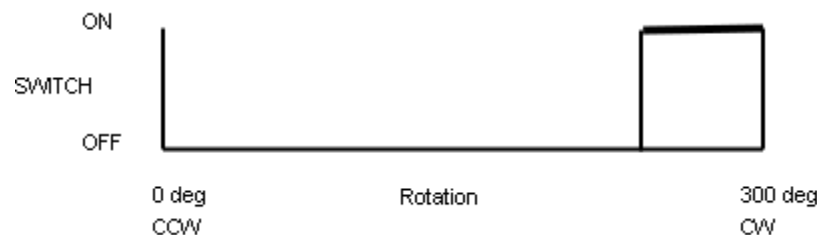


Option 2 (4A contact rating only)

REVERSED N/O normally OPEN Switch

Contacts normally OPEN at fully clockwise position;

ANTI-clockwise rotation to CLOSE contacts



Option 3 (4A contact rating only)

REVERSED N/C normally CLOSED Switch

Contacts normally CLOSED at fully clockwise position;

ANTI-clockwise rotation to OPEN contacts

ELECTRICAL SPECIFICATION UNIQUE TO ECO POTENTIOMETERS

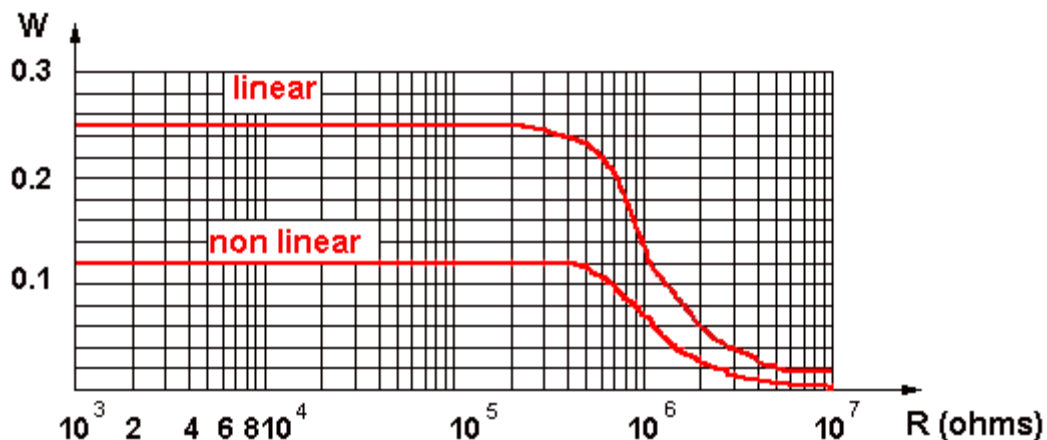
Effective rotation:

- Without a switch: 265° nominal
- With push push switch (/10APP, /MS): 265° nominal
- With rotary switch: 242° nominal

Rated Power Dissipation @40°C for ECO potentiometers:

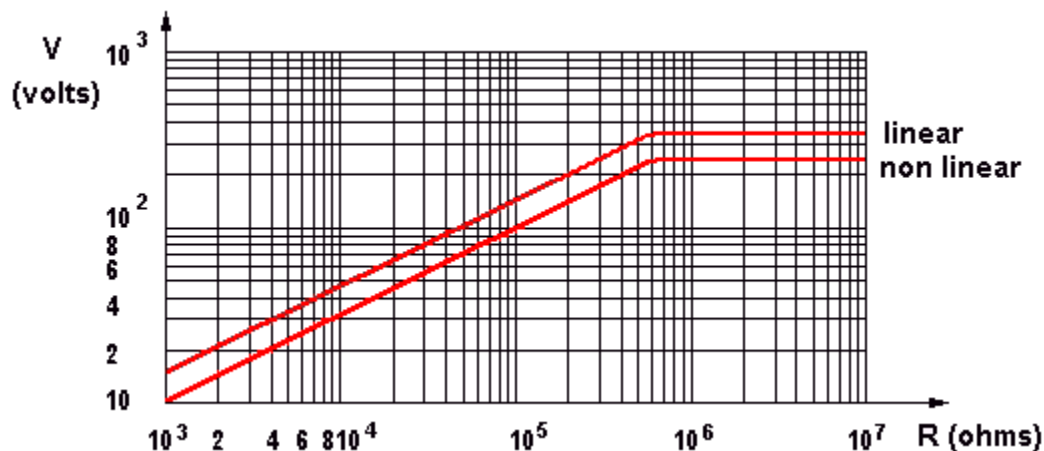
- 0.25W linear law
- 0.12W nonlinear law

ECO, P16 power dissipating curve



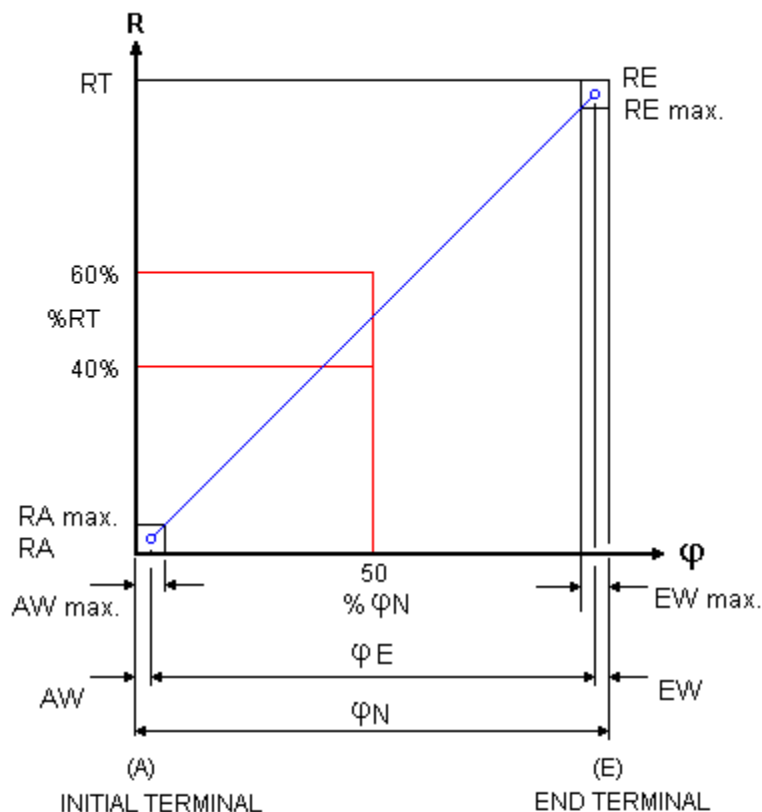
Limiting Element Voltage: 350 V DC for 16mm potentiometers

ECO, P16 maximum working voltage curve



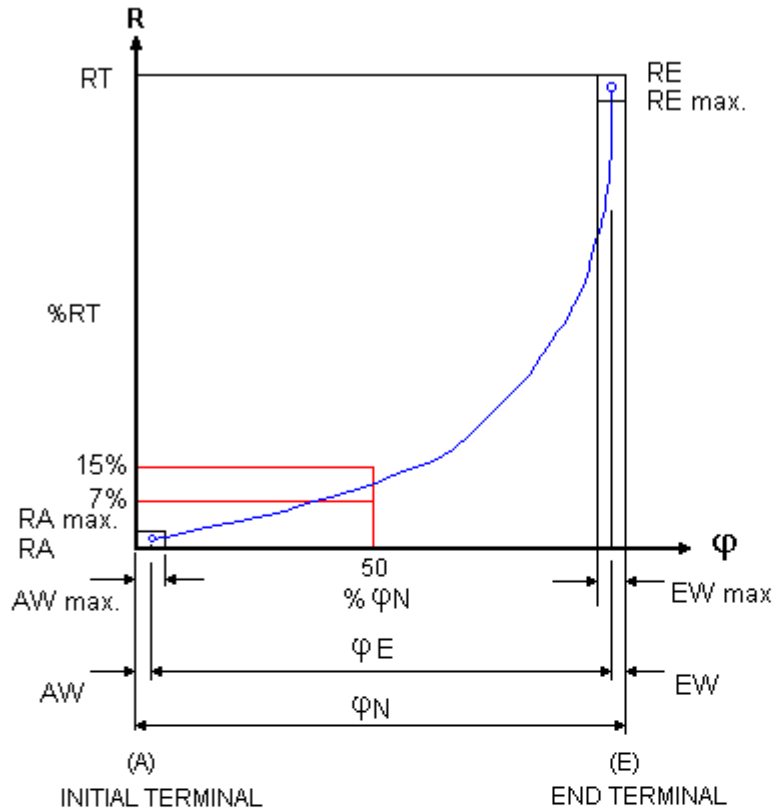
Insulating (Breakdown) Voltage: 2,500 V AC for ECO Potentiometers

Resistance law A - Linear



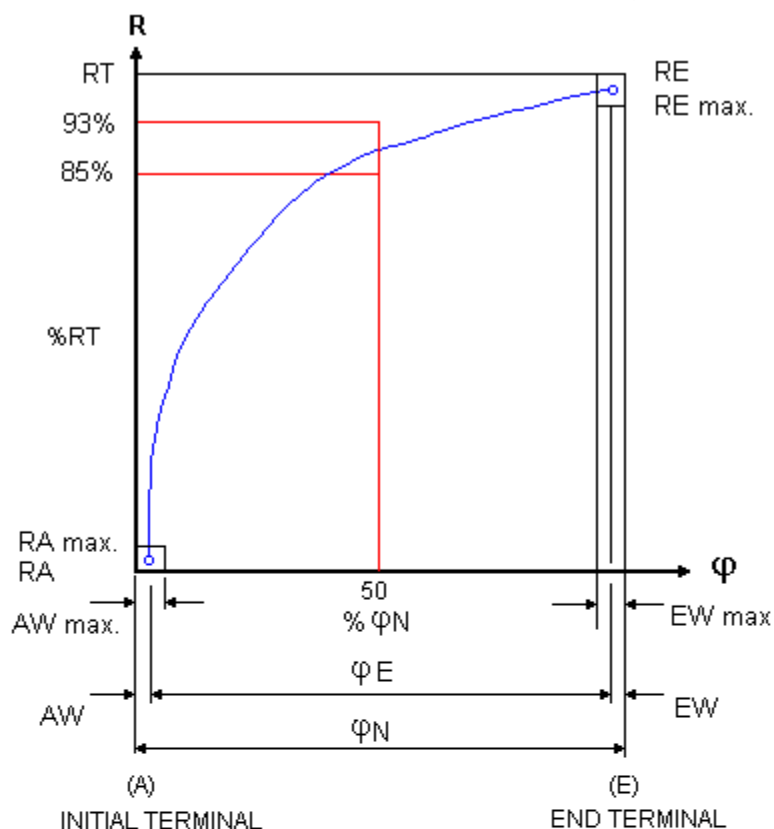
AW	Initial Path	AW max. 12% ϕN
EW	Final Path	EW max. 12% ϕN
Ra	Initial Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RA	Hop-on Resistance	$\leq 1\% RN$
Re	End Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RE	Hop-off Resistance	$\leq 1\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

Resistance law B – Log (Audio)



A_W	Initial Path	$A_W \text{ max.}$ 10% ϕN
E_W	Final Path	$E_W \text{ max.}$ 10% ϕN
R_a	Initial Stop Value	$R_N \leq 10K \leq 1.10^{-3} R_N$ (Minimum 2 ohms) $R_N > 10K \leq 2.10^{-4} R_N$ (Minimum 10 ohms)
R_A	Hop-on Resistance	$R_N \leq 10K$ 5% R_N $R_N > 10K$ 0.15% R_N
R_e	End Stop Value	$R_N \leq 100K \leq 2.10^{-2} R_N$ $R_N > 100K \leq 1.10^{-2} R_N$
R_E	Hop-off Resistance	$R_N \leq 10K < 1\% R_N$ $R_N > 10K$ 0.5% R_N
R_N	Rated Resistance	
R_T	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

Resistance law C – Antilog (Reverse Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RA	Hop-on Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K 0.5\% RN$
Re	End Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RE	Hop-off Resistance	$RN \leq 10K 5\% RN$ $RN > 10K 0.15\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

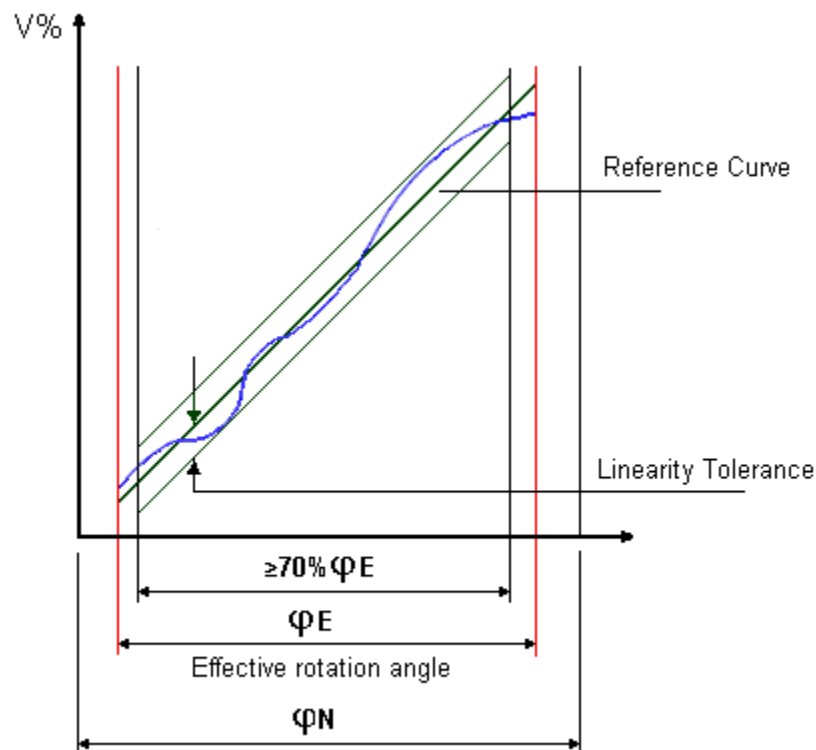
Linearity

As a basis of assessing Linearity Tolerance the independent method is the most practical, permitting as it does, the reference curve to be aligned as near as possible to the actual output curve. This avoids the use of the theoretical starting and finishing points, it is normal for the customer to realign the achieved curve with series trimmers at each end of the device if required.

Linearity Tolerance is 4% over the Nominal Resistance range of 1K0 to 1M0. The Linearity Tolerance is measured on at least 70% of the effective rotation range.

Note. In the case of Terminal and Zero-based linearity, both present constraints which increase the manufacturing difficulty and in consequence have an adverse effect on the product's price and availability.

Potentiometer linearity

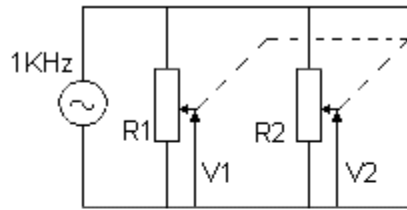


Matching Tolerance (For Tandem Stereo Potentiometers)

Tandem Potentiometers have two identical resistor units with the same variation law. The mismatching of the two resistor units, expressed in dB, is measured by the difference between the attenuations introduced by each resistor unit at various points of travel.

- Law A: 4 dB at Attenuation range 0 - 20 dB
- Law B and C: 3 dB at Attenuation range 0 - 20 dB

Matched Tolerance for Stereo

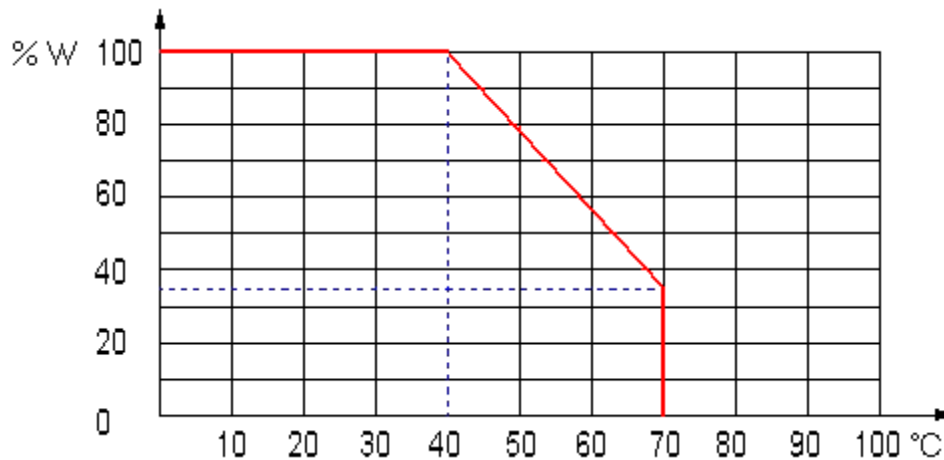


LAW	ATTENUATION RANGE	MATCHING TOLERANCE *
A	0 - 20dB	4dB
B & C	0 - 20dB	3dB

$$* \text{Matching Tolerance} = 20 \log \frac{V1}{V2}$$

Operating Temperature: -25°C to +70°C

Temperature Derating Curve



Temperature Coefficient of Resistance: +300 -500 ppm

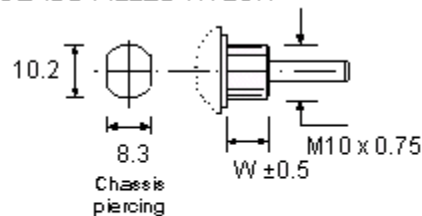
Components

ECO Bush Housing (Mounting)

The ECO bush housing is made of glass filled nylon, the thread is M10 x0.75mm pitch and 8mm long, alternatively **a 12mm long thread is also available** from October 2008.

Do not attempt to prevent any unwanted body rotation by overtightening the retaining nut, since this can cause thread damage, distortion, change of electrical resistance and restrict shaft rotation. BS9130:1972 provides further details on this topic. The **recommended torque** for tightening the retaining nut is 45cN.m and this can be achieved cost effectively by using a Torque Limiting device as shown on our **Accessories** page.

GLASS FILLED NYLON



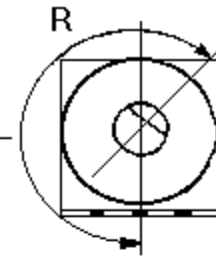
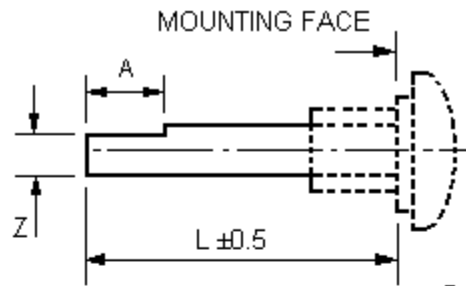
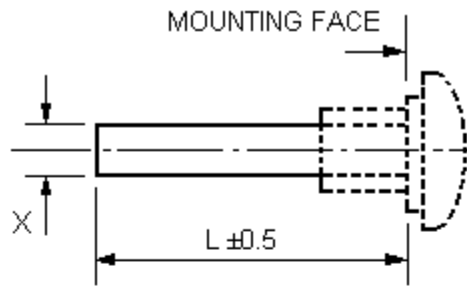
TYPE PLASTIC BODY	
W(mm)	8 (optional 12)

ECO Spindles

The ECO plastic spindles are fixed and not removable.
They are available in the following three diameters:

- 6.0mm Diameter - Length (L) available from 14mm to 65mm
 - Cylindrical (Type F1)
 - 4.0 x 12mm Flat (Type F2)
 - 5.0 x 15mm Flat (Type F3)
 - 5.0 x 10mm Flat (Type F4)
 - 4.6mm x 15mm Flat (Type F11)
 - 4.0 x 8mm Flat (Type F13)
 - 5.0 x 8mm Flat (Type F14)
- 4.0mm Diameter - Length (L) available from 14mm to 35mm
 - Cylindrical (Type F21)
 - 3.0 x 8.5mm Flat (Type F22)
- 6.35mm Diameter - Length (L) available from 14mm to 65mm
 - Cylindrical (Type F41)
 - 5.5 x 10mm Flat (Type F42)

Cylindrical and Flatted Spindles



Spindle in full CCW position

TYPE	DESC. (X)	L (mm)
F21	4 mm Dia Plastic	14 - 35
F1	6 mm Dia Plastic	14 - 65
F41	6.35mm Dia Plastic	14 - 65

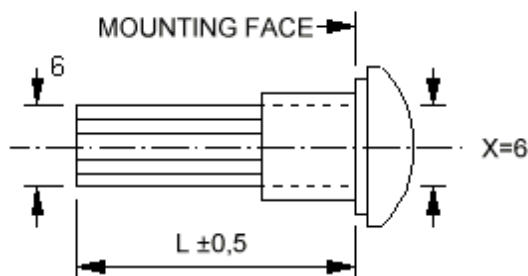
All spindles fixed.

TYPE	DESC. (X)	L (mm)	Flat (ZxA)
F22	4 mm Dia Plastic	14 - 35	3 x 8.5
F13	6 mm Dia Plastic	14 - 65	4 x 8
F2	6 mm Dia Plastic	14 - 65	4 x 12
F14	6 mm Dia Plastic	14 - 65	5 x 8
F4	6 mm Dia Plastic	14 - 65	5 x 10
F3	6 mm Dia Plastic	14 - 65	5 x 15
F11	6 mm Dia Plastic	14 - 65	4.6 x 15
F42	6.35mm Dia Plastic	14 - 65	5.5 x 10

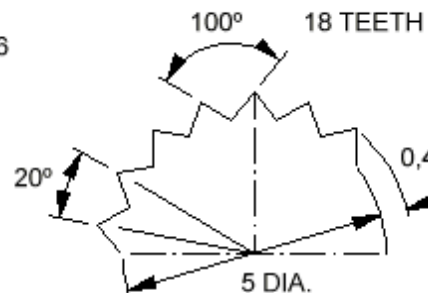
Standard flat angle
R = 210°

Splined Spindle (6.0mm diameter)

A splined form is also available on the 6.0mm diameter ECO plastic spindle.



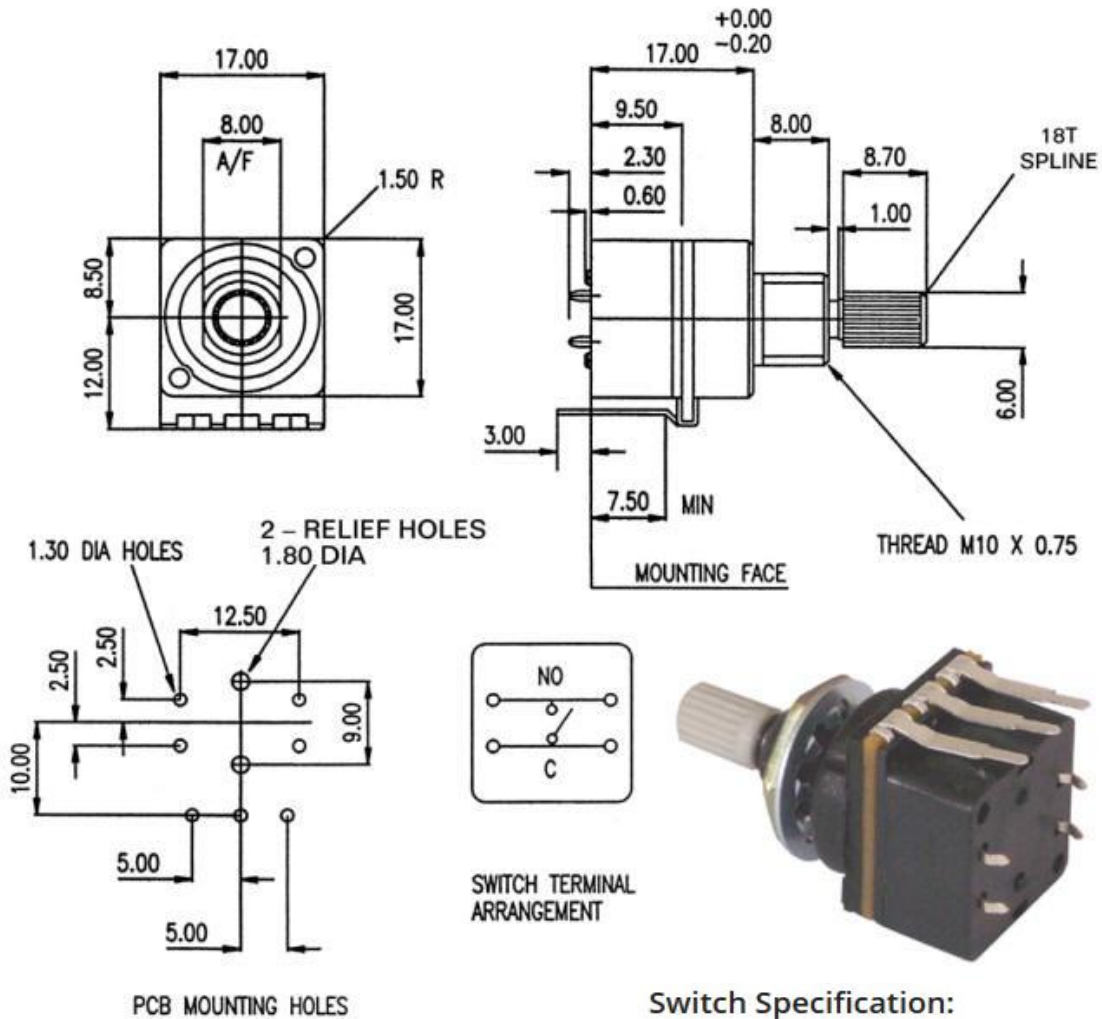
TYPE	DESC.	L (mm)
F5	Plastic Fixed	14 - 30



XA16ECO/MS

MS – Momentary Switch

XA – Extra Long Terminals bent away from spindle



- W Mounting Height
- Y Mounting Diameter
- X Spindle Diameter
- L Spindle Length
- A Initial Termination
- S Wiper (or moving contact) termination
- E End Termination

Switch Specification:

- Contact rating: 5 to 24VDC, 1 to 50mA resistive load
- Insulation voltage: 30VDC
- Contact Resistance: 100m ohm max. (rated 5VDC, 1mA)
- Insulation Resistance: 100M ohm min. (at 250VDC)
- Dielectric strength: 500VAC 50/60 Hz for 1 min.
- Bounce time: 5 ms max.
- Life expectancy: 1,000,000 operations
- Operating temperature: -25°C to +70°C
- Spindle Travel: 0.8mm (switch actuation 0.25mm)

Technical Data

Rated Power Dissipation @40°C for ECO potentiometers:

0.25W linear law

0.12W nonlinear law

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Effective rotation: 265° nominal

Operating Torque: 0.4 – 1.5 cN.m

Permissible Axial Spindle Load: 50 N (5 Sec. maximum)

Permissible Torque at End Stop: 35 cN.m

Rotation angle: 300° ±5°

Optional Click stop (indents) for rotational tactile feedback

Rotational torque of spindle can be made high or low

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Insulation Resistance: >= 4 Gohms

Rated Resistance: E3 Series

Optional: E6 Series

Linear Law: 1K – 1M

Nonlinear Law: 4K7 – 470K

ELECTRICAL SPECIFICATION COMMON TO ALL POTENTIOMETERS

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Insulation Resistance: >= 4 Gohms

Rated Resistance: E3 Series

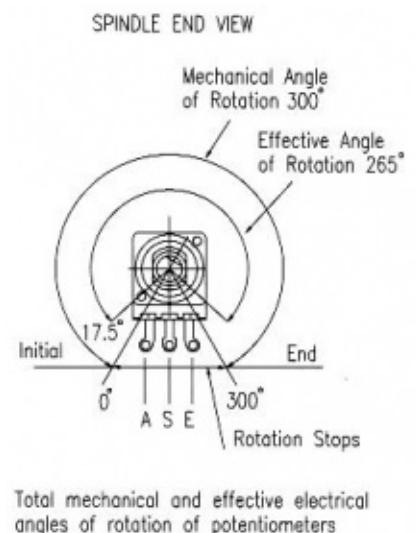
- Optional: E6 Series
- Linear Law: 1K - 1M
- Nonlinear Law: 4K7 - 470K

Tolerance on Rated Resistance: ± 20%

- Optional Tolerance on 1K - 1M: ± 10%

Resistance Laws (Taper):

- Linear: A
- Nonlinear: B - Log (Audio) or C - Antilog (Reverse Audio)
- Other laws: Please refer to Sales office



ELECTRICAL SPECIFICATION UNIQUE TO ECO POTENTIOMETERS

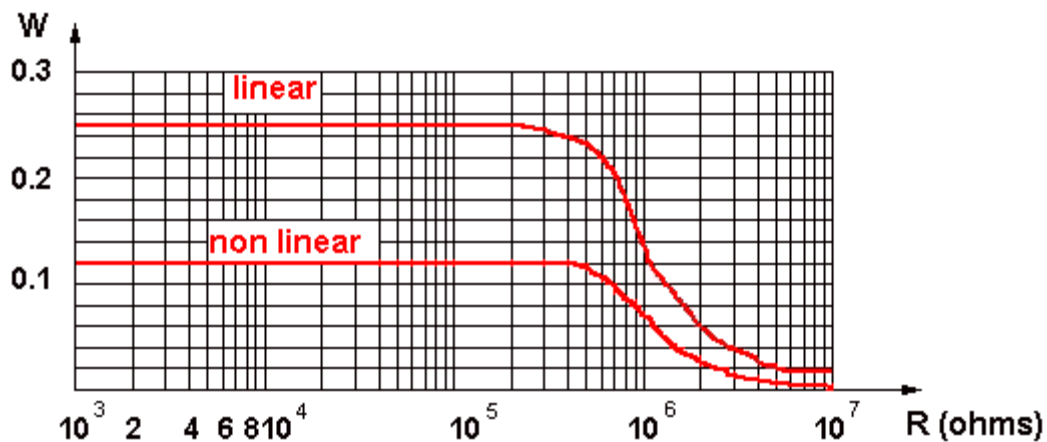
Effective rotation:

- Without a switch: 265° nominal
- With push push switch (/10APP, /MS): 265° nominal
- With rotary switch: 242° nominal

Rated Power Dissipation @40°C for ECO potentiometers:

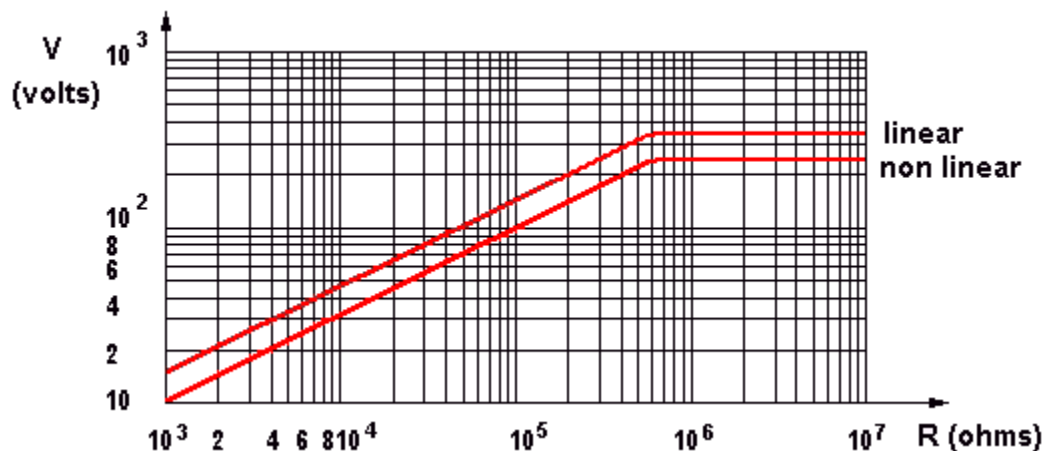
- 0.25W linear law
- 0.12W nonlinear law

ECO, P16 power dissipating curve



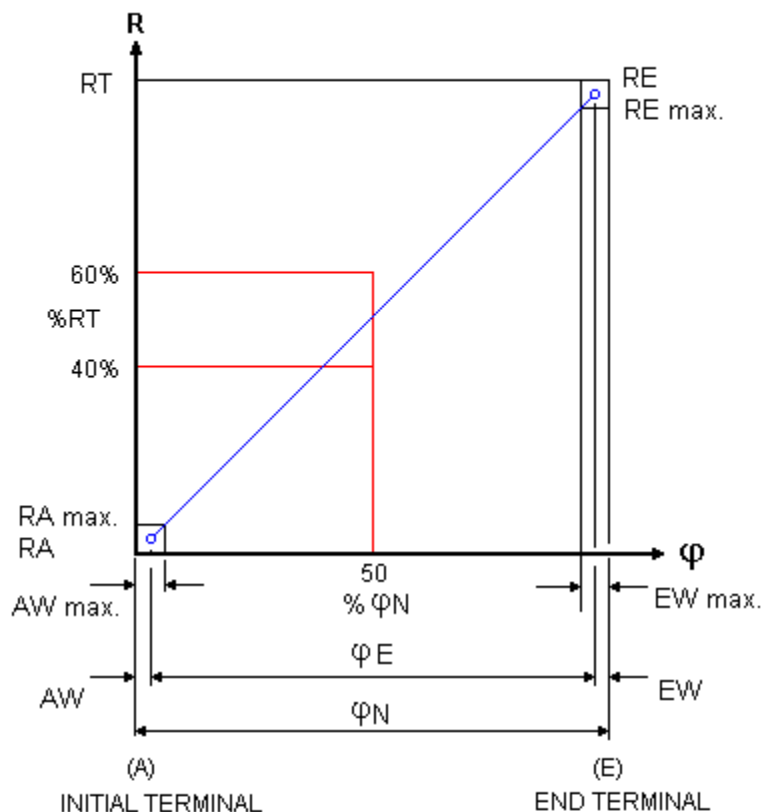
Limiting Element Voltage: 350 V DC for 16mm potentiometers

ECO, P16 maximum working voltage curve



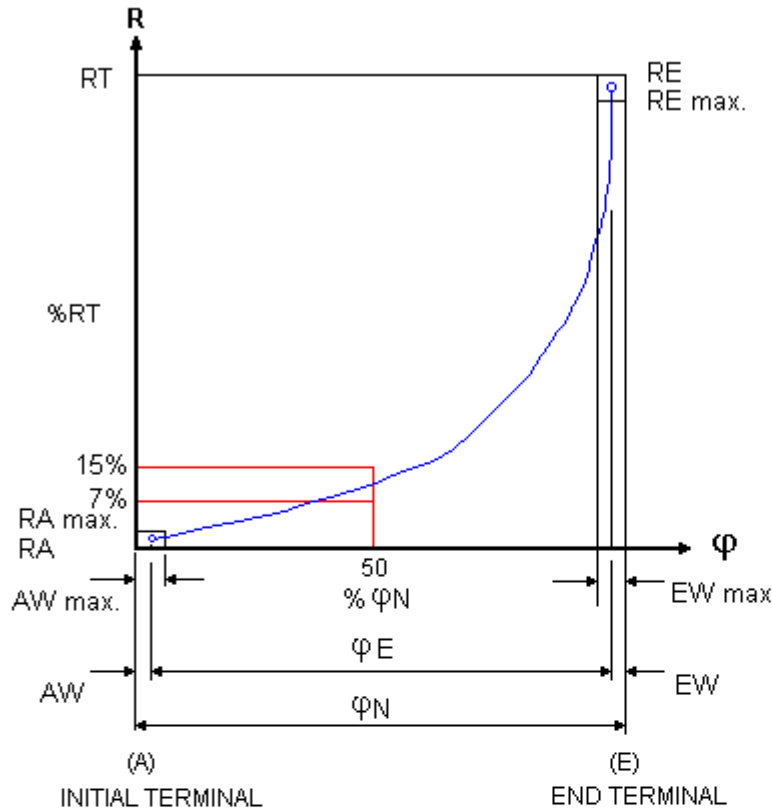
Insulating Voltage: 500 V AC for ECO potentiometers

Resistance law A - Linear



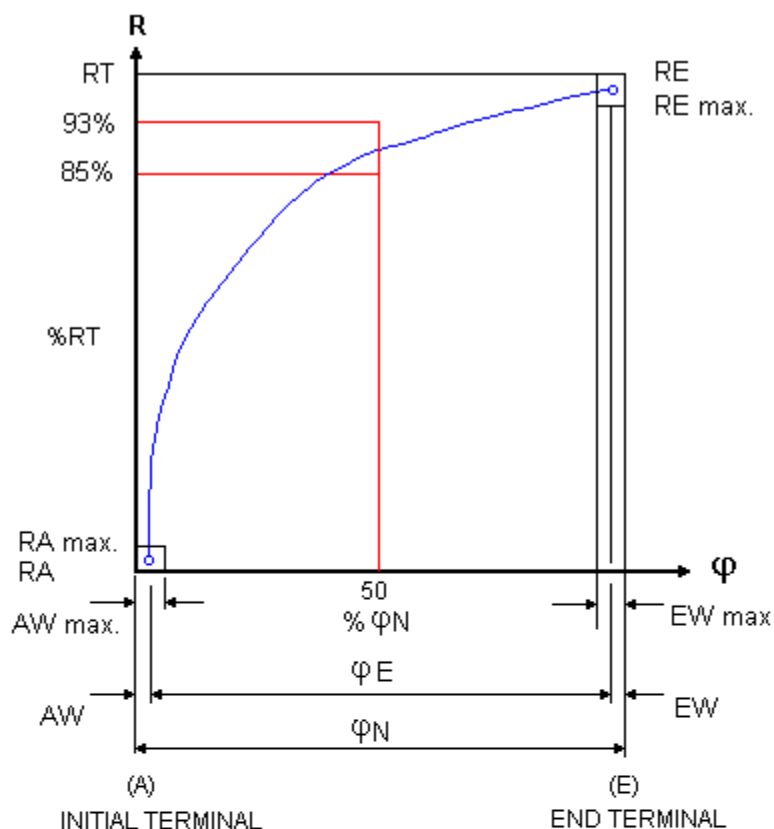
AW	Initial Path	AW max. 12% ϕN
EW	Final Path	EW max. 12% ϕN
Ra	Initial Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RA	Hop-on Resistance	$\leq 1\% RN$
Re	End Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RE	Hop-off Resistance	$\leq 1\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

Resistance law B – Log (Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RA	Hop-on Resistance	$RN \leq 10K$ 5% RN $RN > 10K$ 0.15% RN
Re	End Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RE	Hop-off Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K$ 0.5% RN
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

Resistance law C – Antilog (Reverse Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RA	Hop-on Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K 0.5\% RN$
Re	End Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RE	Hop-off Resistance	$RN \leq 10K 5\% RN$ $RN > 10K 0.15\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

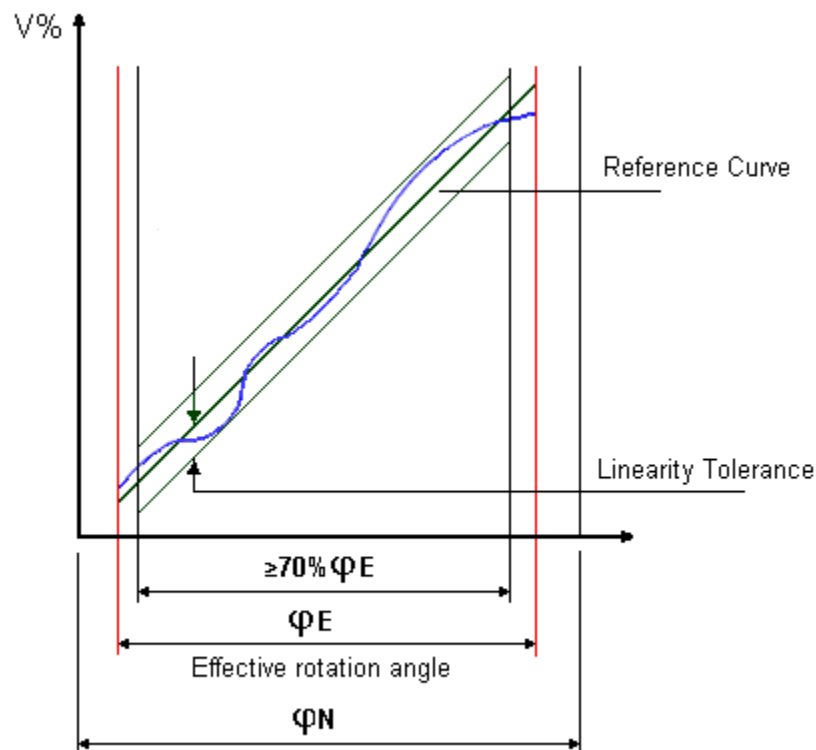
Linearity

As a basis of assessing Linearity Tolerance the independent method is the most practical, permitting as it does, the reference curve to be aligned as near as possible to the actual output curve. This avoids the use of the theoretical starting and finishing points, it is normal for the customer to realign the achieved curve with series trimmers at each end of the device if required.

Linearity Tolerance is 4% over the Nominal Resistance range of 1K Ω to 1M Ω . The Linearity Tolerance is measured on at least 70% of the effective rotation range.

Note. In the case of Terminal and Zero-based linearity, both present constraints which increase the manufacturing difficulty and in consequence have an adverse effect on the product's price and availability.

Potentiometer linearity

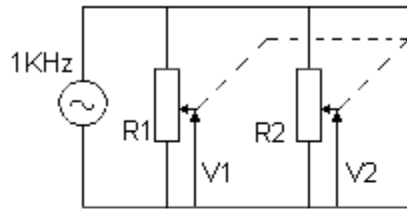


Matching Tolerance (For Tandem Stereo Potentiometers)

Tandem Potentiometers have two identical resistor units with the same variation law. The mismatching of the two resistor units, expressed in dB, is measured by the difference between the attenuations introduced by each resistor unit at various points of travel.

- Law A: 4 dB at Attenuation range 0 - 20 dB
- Law B and C: 3 dB at Attenuation range 0 - 20 dB

Matched Tolerance for Stereo

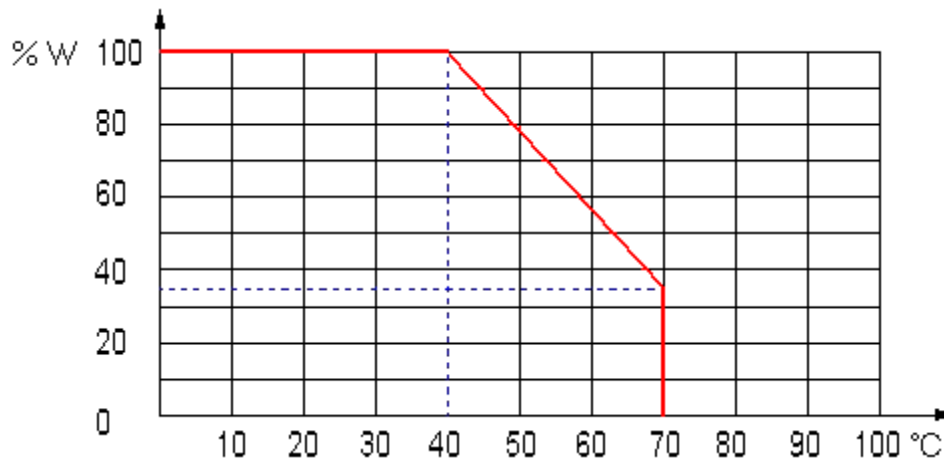


LAW	ATTENUATION RANGE	MATCHING TOLERANCE *
A	0 - 20dB	4dB
B & C	0 - 20dB	3dB

$$* \text{Matching Tolerance} = 20 \log \frac{V1}{V2}$$

Operating Temperature: -25°C to +70°C

Temperature Derating Curve

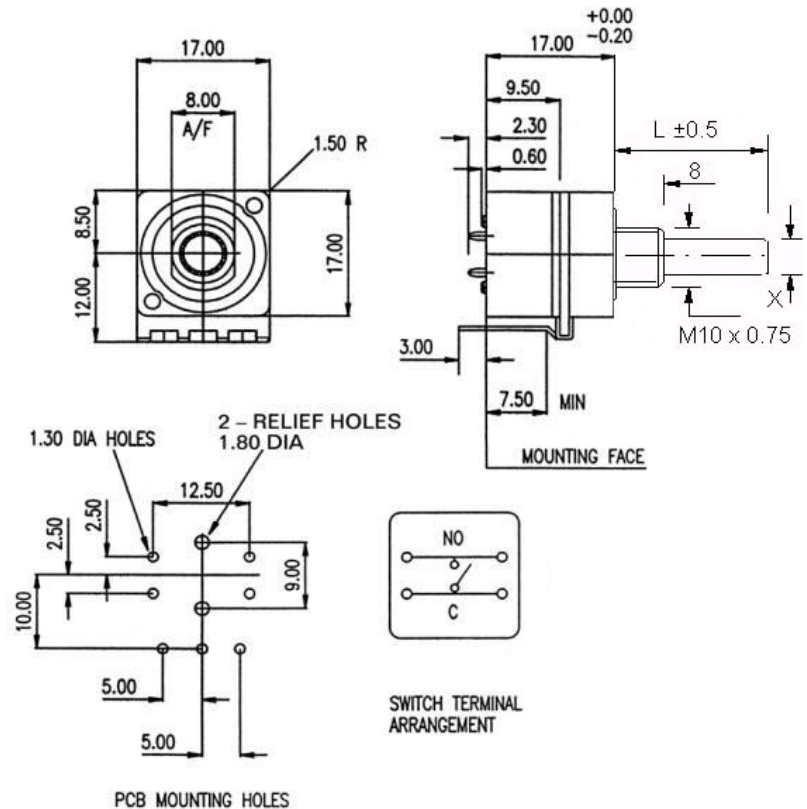
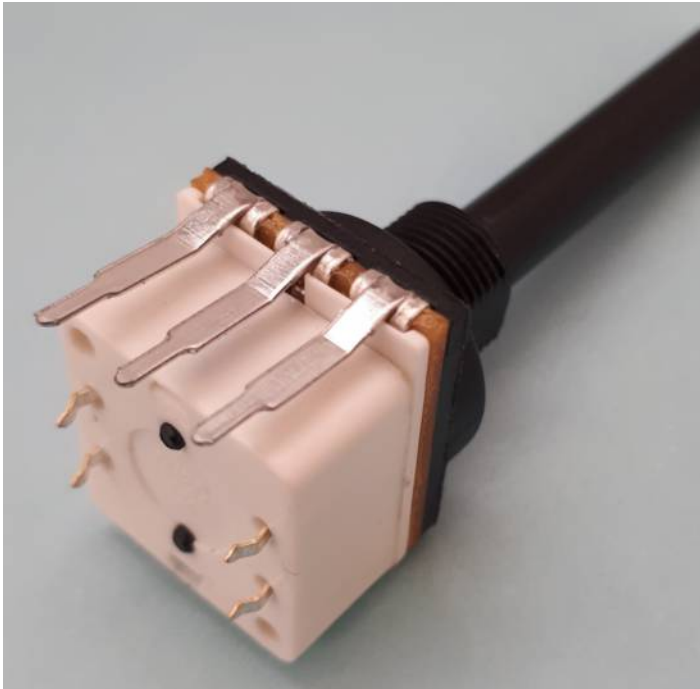


Temperature Coefficient of Resistance: +300 -500 ppm

XA16ECO/MS PLASTIC SPINDLE VERSION

MS – Momentary Switch

XA – Extra Long Terminals bent away from spindle



- W Mounting Height
- Y Mounting Diameter
- X Spindle Diameter
- L Spindle Length
- A Initial Termination
- S Wiper (or moving contact) termination
- E End Termination

Technical Data

Rated Power Dissipation @40°C for ECO potentiometers:

0.25W linear law

0.12W nonlinear law

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Effective rotation: 265° nominal

Operating Torque: 0.4 – 1.5 cN.m

Permissible Axial Spindle Load: 50 N (5 Sec. maximum)

Permissible Torque at End Stop: 35 cN.m

Rotation angle: 300° ±5°

Optional Click stop (indents) for rotational tactile feedback

Rotational torque of spindle can be made high or low

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Insulation Resistance: >= 4 Gohms

Rated Resistance: E3 Series

Optional: E6 Series

Linear Law: 1K – 1M

Nonlinear Law: 4K7 – 470K

ELECTRICAL SPECIFICATION COMMON TO ALL POTENTIOMETERS

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Insulation Resistance: >= 4 Gohms

Rated Resistance: E3 Series

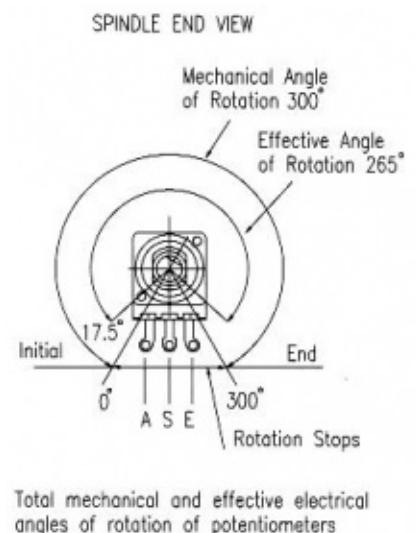
- Optional: E6 Series
- Linear Law: 1K - 1M
- Nonlinear Law: 4K7 - 470K

Tolerance on Rated Resistance: ± 20%

- Optional Tolerance on 1K - 1M: ± 10%

Resistance Laws (Taper):

- Linear: A
- Nonlinear: B - Log (Audio) or C - Antilog (Reverse Audio)
- Other laws: Please refer to Sales office



ELECTRICAL SPECIFICATION UNIQUE TO ECO POTENTIOMETERS

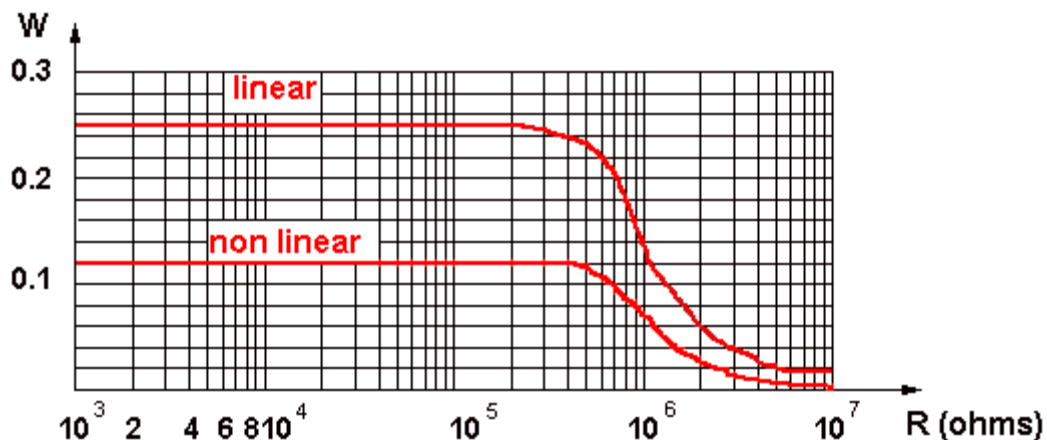
Effective rotation:

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- With push push switch (/10APP, /MS): 265° nominal
- With rotary switch: 242° nominal

Rated Power Dissipation @40°C for ECO potentiometers:

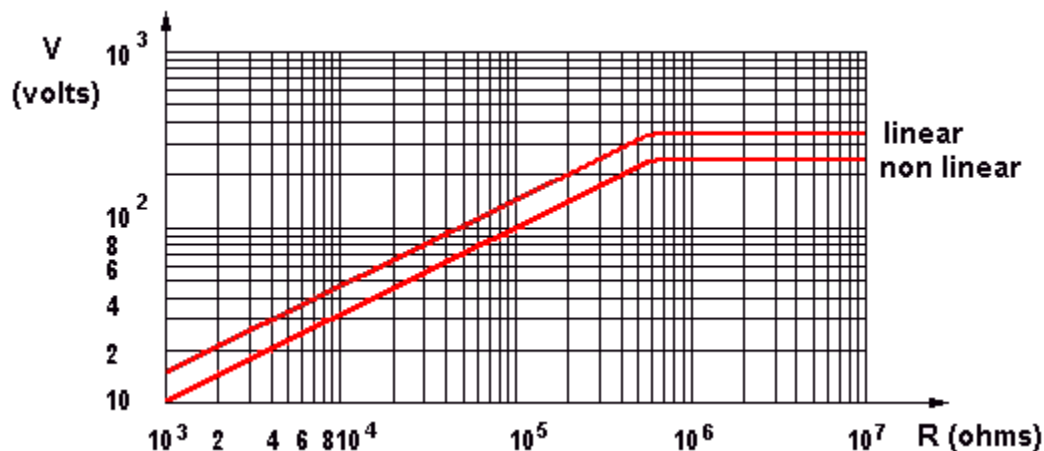
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ECO, P16 power dissipating curve



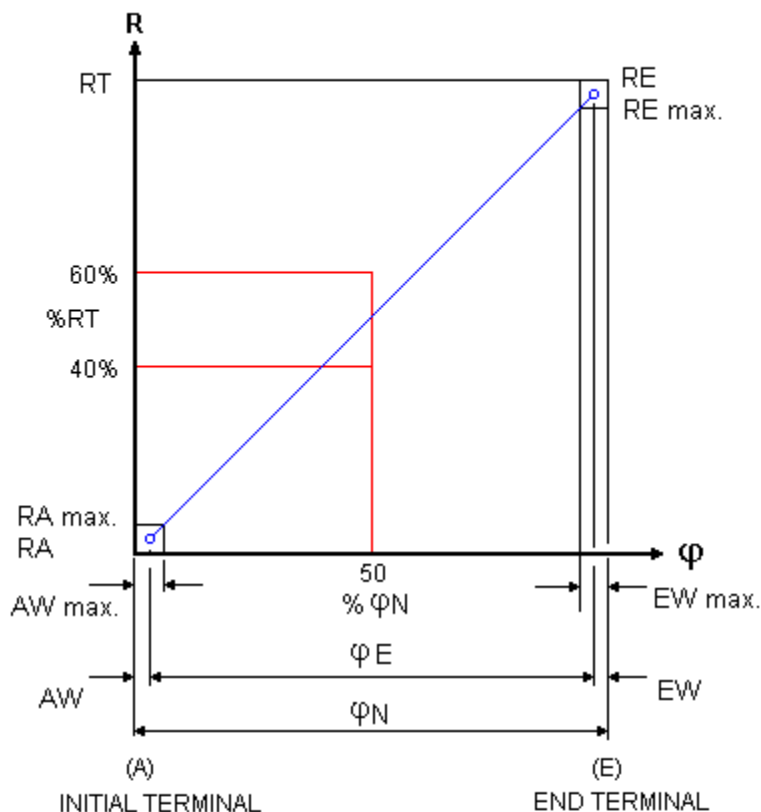
Limiting Element Voltage: 350 V DC for 16mm potentiometers

ECO, P16 maximum working voltage curve



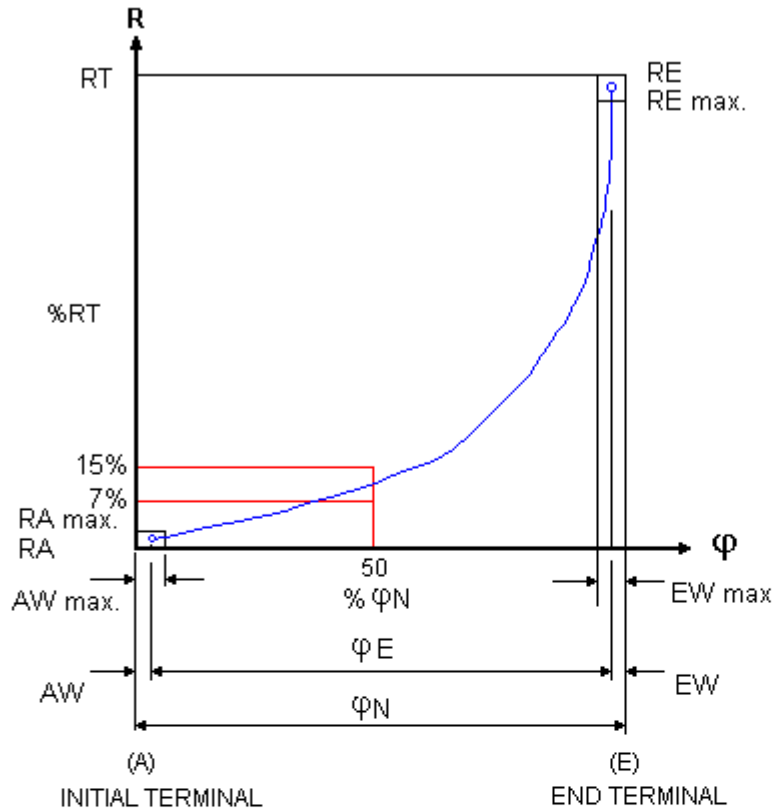
Insulating Voltage: 500 V AC for ECO potentiometers

Resistance law A - Linear



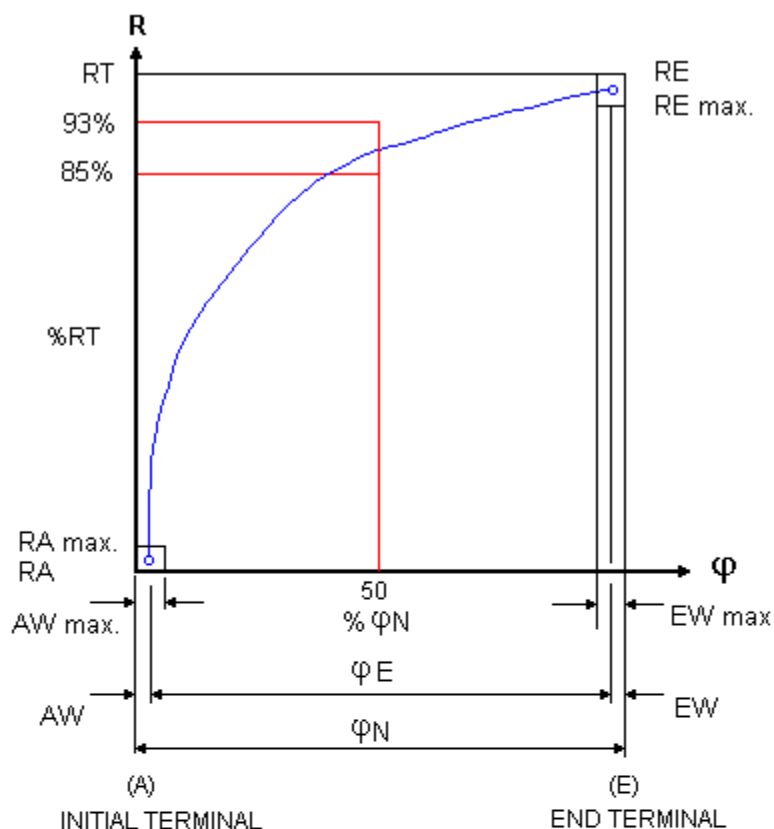
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EW	Final Path	EW max. 12% ϕN
Ra	Initial Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RA	Hop-on Resistance	$\leq 1\% RN$
Re	End Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RE	Hop-off Resistance	$\leq 1\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

Resistance law B – Log (Audio)



AW	Initial Path	AW max. 10% ϕ_N
EW	Final Path	EW max. 10% ϕ_N
Ra	Initial Stop Value	$R_N \leq 10K \leq 1.10^{-3} R_N$ (Minimum 2 ohms) $R_N > 10K \leq 2.10^{-4} R_N$ (Minimum 10 ohms)
RA	Hop-on Resistance	$R_N \leq 10K$ 5% R_N $R_N > 10K$ 0.15% R_N
Re	End Stop Value	$R_N \leq 100K \leq 2.10^{-2} R_N$ $R_N > 100K \leq 1.10^{-2} R_N$
RE	Hop-off Resistance	$R_N \leq 10K < 1\% R_N$ $R_N > 10K$ 0.5% R_N
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
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ϕN	Effective Mechanical Angle of Rotation	

Resistance law C – Antilog (Reverse Audio)



AW	Initial Path	AW max. 10% ϕN
EW	Final Path	EW max. 10% ϕN
Ra	Initial Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RA	Hop-on Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K 0.5\% RN$
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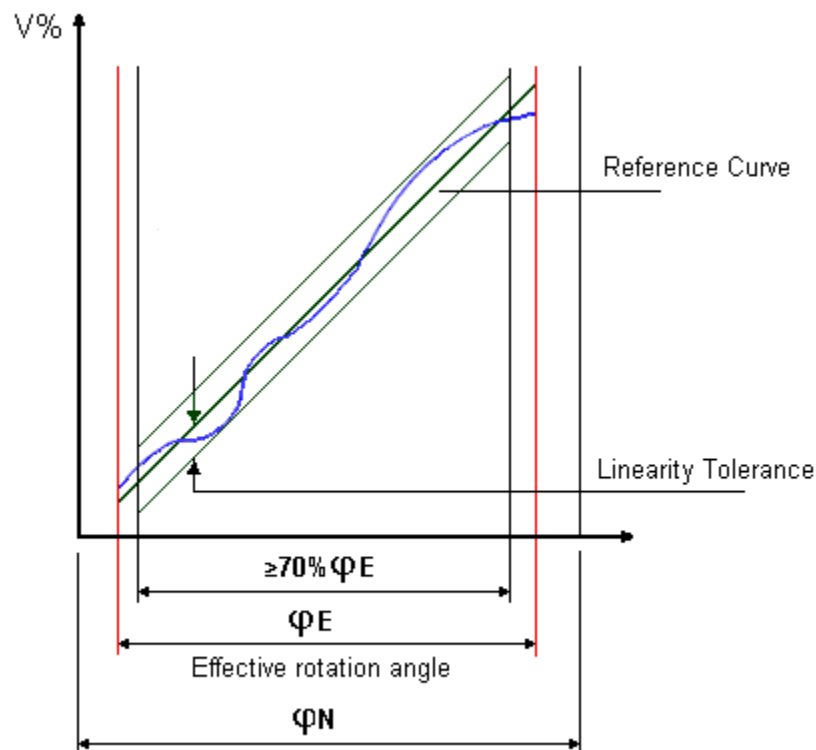
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Potentiometer linearity

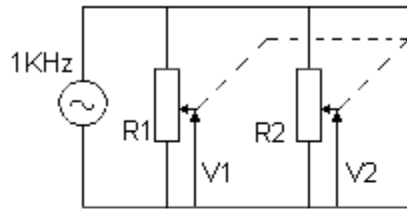


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Matched Tolerance for Stereo

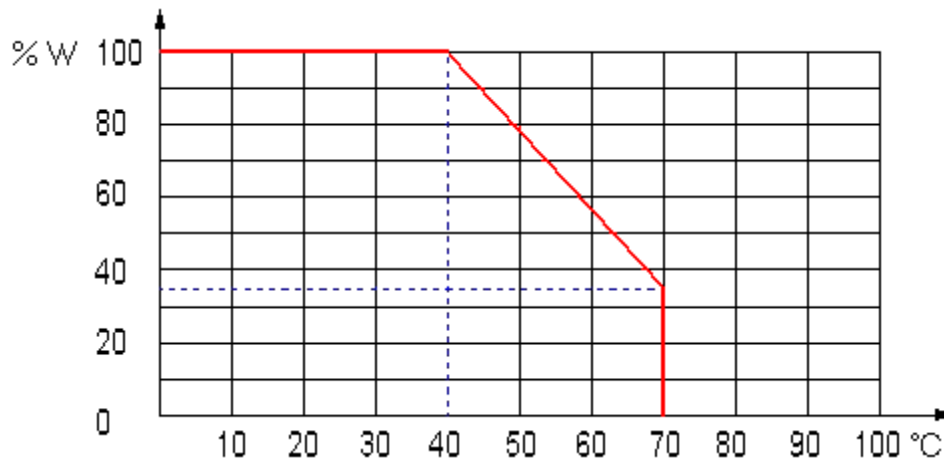


LAW	ATTENUATION RANGE	MATCHING TOLERANCE *
A	0 - 20dB	4dB
B & C	0 - 20dB	3dB

$$* \text{Matching Tolerance} = 20 \log \frac{V1}{V2}$$

Operating Temperature: -25°C to +70°C

Temperature Derating Curve



Temperature Coefficient of Resistance: +300 -500 ppm

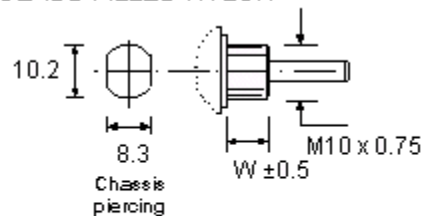
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ECO Bush Housing (Mounting)

The ECO bush housing is made of glass filled nylon, the thread is M10 x0.75mm pitch and 8mm long, alternatively **a 12mm long thread is also available** from October 2008.

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GLASS FILLED NYLON



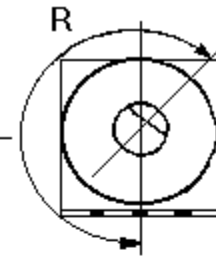
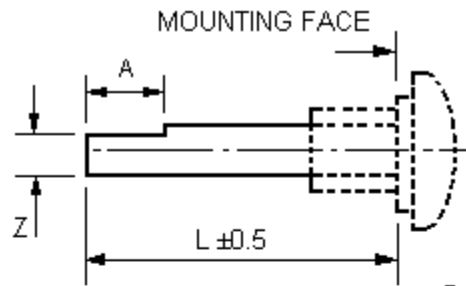
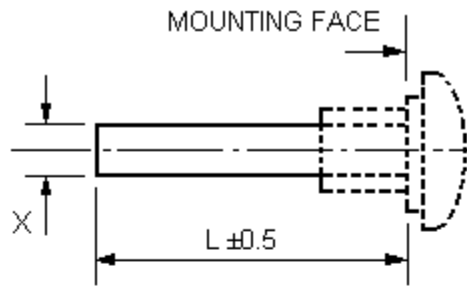
TYPE PLASTIC BODY	
W(mm)	8 (optional 12)

ECO Spindles

The ECO plastic spindles are fixed and not removable.
They are available in the following three diameters:

- 6.0mm Diameter - Length (L) available from 14mm to 65mm
 - Cylindrical (Type F1)
 - 4.0 x 12mm Flat (Type F2)
 - 5.0 x 15mm Flat (Type F3)
 - 5.0 x 10mm Flat (Type F4)
 - 4.6mm x 15mm Flat (Type F11)
 - 4.0 x 8mm Flat (Type F13)
 - 5.0 x 8mm Flat (Type F14)
- 4.0mm Diameter - Length (L) available from 14mm to 35mm
 - Cylindrical (Type F21)
 - 3.0 x 8.5mm Flat (Type F22)
- 6.35mm Diameter - Length (L) available from 14mm to 65mm
 - Cylindrical (Type F41)
 - 5.5 x 10mm Flat (Type F42)

Cylindrical and Flatted Spindles



Spindle in full CCW position

TYPE	DESC. (Ø)	L (mm)
F21	4 mm Dia Plastic	14 - 35
F1	6 mm Dia Plastic	14 - 65
F41	6.35mm Dia Plastic	14 - 65

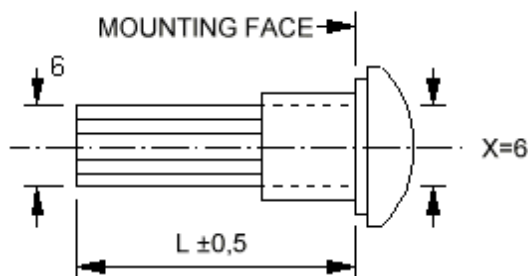
All spindles fixed.

TYPE	DESC. (Ø)	L (mm)	Flat (ZxA)
F22	4 mm Dia Plastic	14 - 35	3 x 8.5
F13	6 mm Dia Plastic	14 - 65	4 x 8
F2	6 mm Dia Plastic	14 - 65	4 x 12
F14	6 mm Dia Plastic	14 - 65	5 x 8
F4	6 mm Dia Plastic	14 - 65	5 x 10
F3	6 mm Dia Plastic	14 - 65	5 x 15
F11	6 mm Dia Plastic	14 - 65	4.6 x 15
F42	6.35mm Dia Plastic	14 - 65	5.5 x 10

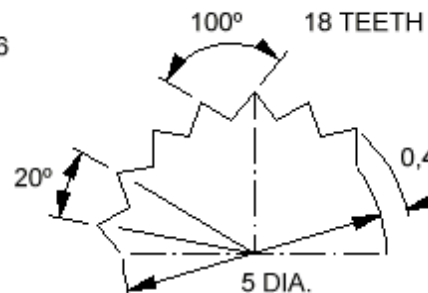
Standard flat angle
R = 210°

Splined Spindle (6.0mm diameter)

A splined form is also available on the 6.0mm diameter ECO plastic spindle.

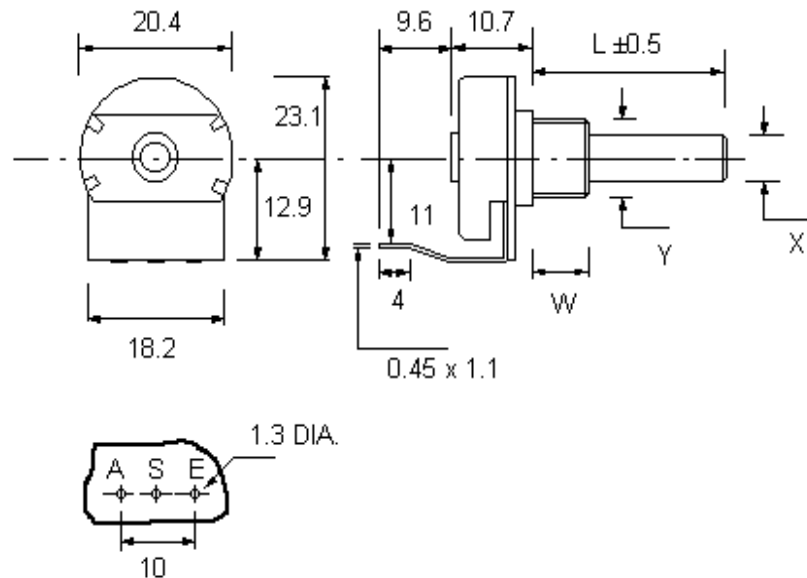
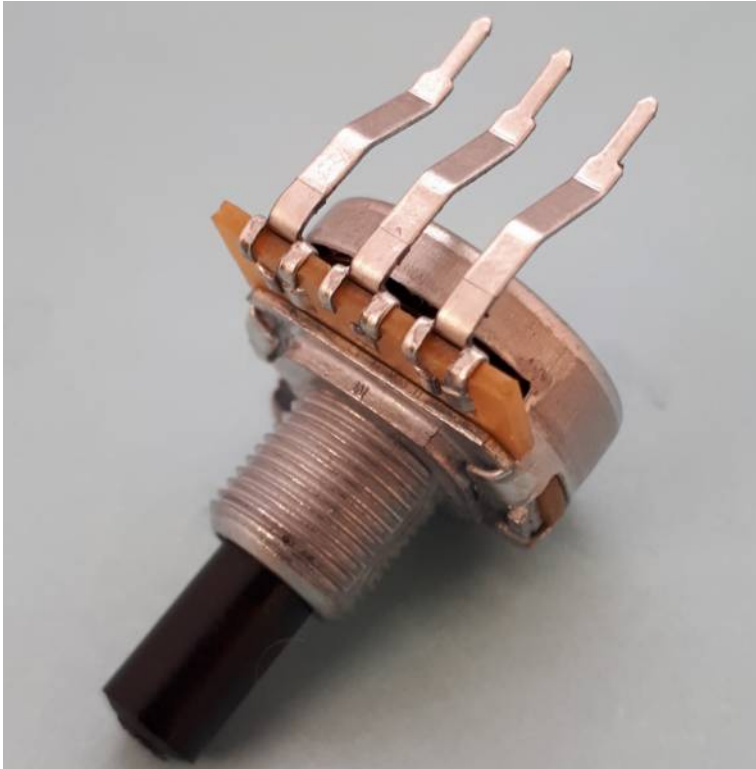


TYPE	DESC.	L (mm)
F5	Plastic Fixed	14 - 30



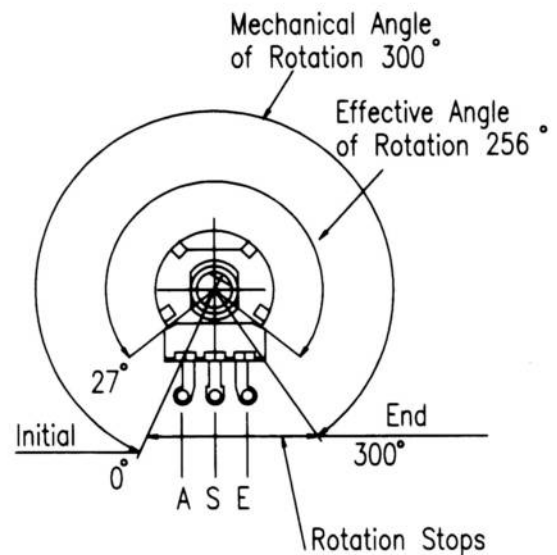
XA20BU

XA – Terminals are bent Extra Long Away from Spindle



Viewed on component side

SPINDLE END VIEW



Total mechanical and effective electrical angles of rotation of potentiometers without rotary switch

- W Mounting Height
- Y Mounting Diameter
- X Spindle Diameter
- L Spindle Length
- A Initial Termination
- S Wiper (or moving contact) termination
- E End Termination

Technical Data

Rated Power Dissipation @40°C for P20 potentiometers:

0.4W linear law

0.2W nonlinear law

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Effective rotation: 256° nominal

Operating Torque: 0.4 – 1.5 cN.m

Permissible Axial Spindle Load: 100 N (5 Sec. maximum)

Permissible Torque at End Stop: 80 cN.m

Rotation angle: 300° ±5°

Optional Click stop (indents) for rotational tactile feedback

Rotational torque of spindle can be made high or low

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Insulation Resistance: >= 4 Gohms

Rated Resistance: E3 Series

Optional: E6 Series

Linear Law: 1K – 1M (±10%)

Nonlinear Law: 4K7 – 470K

ELECTRICAL SPECIFICATION COMMON TO ALL POTENTIOMETERS

Conductive polymer (plastic) track (over twice the life of carbon tracks)

Life Expectancy of >20,000 cycles (tested at 30 times per minute)

Insulation Resistance: >= 4 Gohms

Rated Resistance: E3 Series

- Optional: E6 Series
- Linear Law: 1K - 1M
- Nonlinear Law: 4K7 - 470K

Tolerance on Rated Resistance: ± 20%

- Optional Tolerance on 1K - 1M: ± 10%

Resistance Laws (Taper):

- Linear: A
- Nonlinear: B - Log (Audio) or C - Antilog (Reverse Audio)
- Other laws: Please refer to Sales office

ELECTRICAL SPECIFICATION UNIQUE TO P20 POTENTIOMETERS

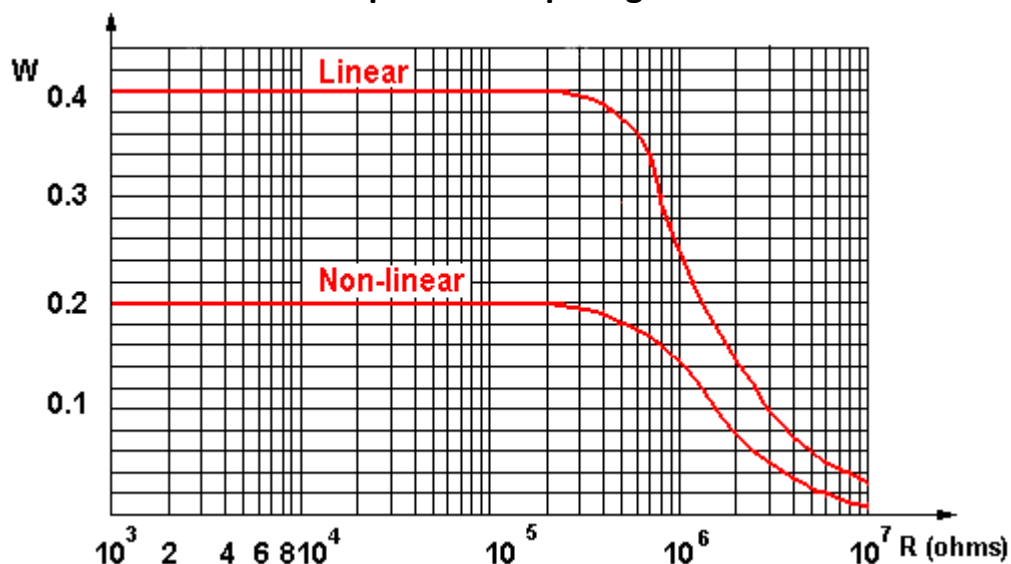
Effective rotation:

- Without a switch: 256° nominal
- With switch: 243° nominal
- With rotary switch: 243° nominal

Rated Power Dissipation @40°C for P20 potentiometers:

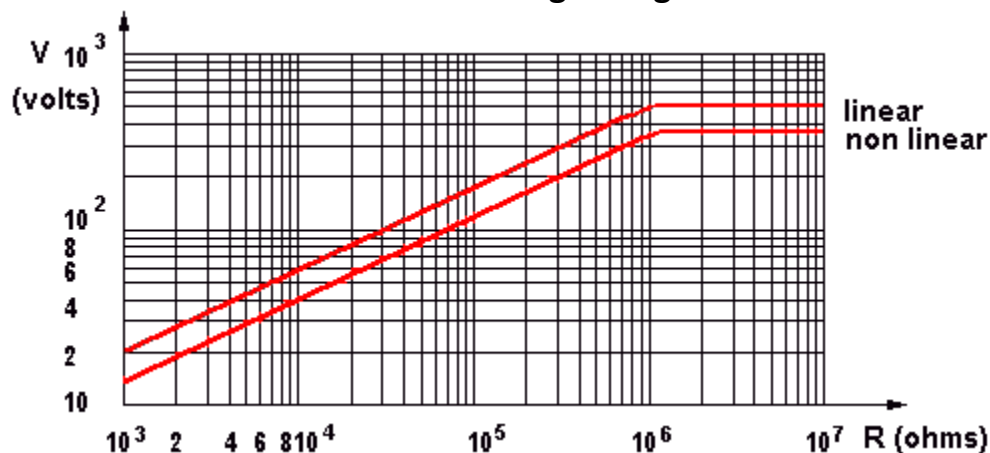
- 0.4W linear law
- 0.2W nonlinear law

P20 power dissipating curve



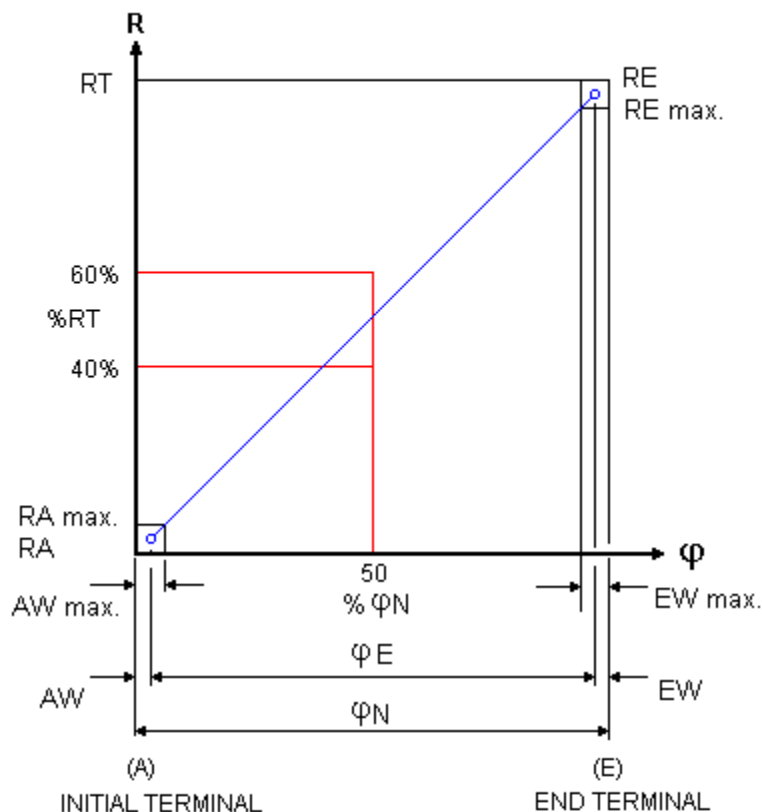
Limiting Element Voltage: 500 V DC for 20mm potentiometers

P20 maximum working voltage curve



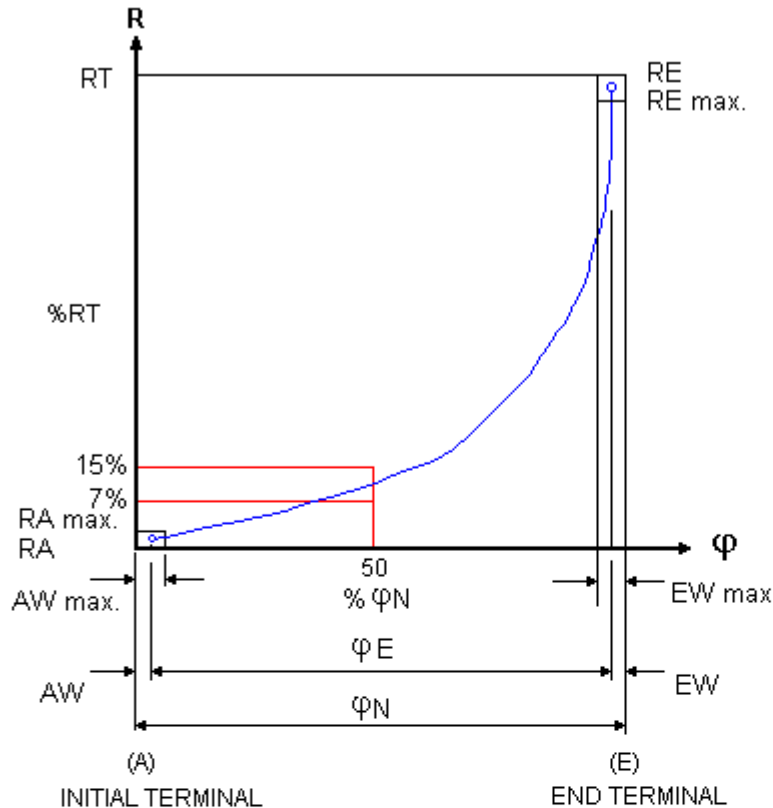
Insulating Voltage: 1000 V AC for 20mm potentiometers

Resistance law A - Linear



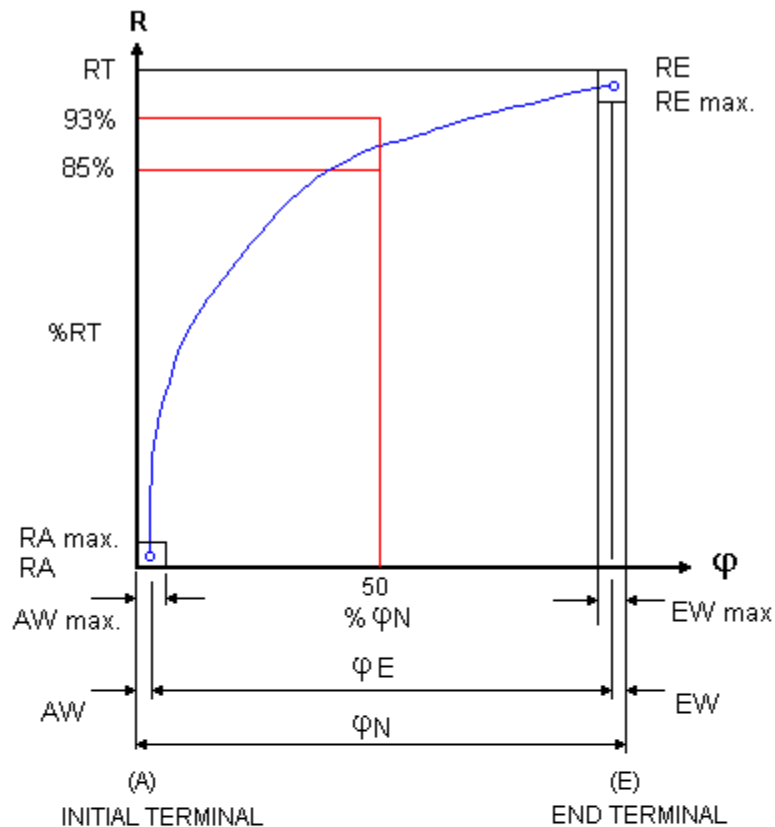
AW	Initial Path	AW max. 12% φN
EW	Final Path	EW max. 12% φN
Ra	Initial Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RA	Hop-on Resistance	$\leq 1\% RN$
Re	End Stop Value	$\leq 1 \cdot 10^{-3} RN$ (Minimum 2 ohms)
RE	Hop-off Resistance	$\leq 1\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

Resistance law B – Log (Audio)



AW	Initial Path	AW max. 10% ϕ_N
EW	Final Path	EW max. 10% ϕ_N
Ra	Initial Stop Value	$R_N \leq 10K \leq 1.10^{-3} R_N$ (Minimum 2 ohms) $R_N > 10K \leq 2.10^{-4} R_N$ (Minimum 10 ohms)
RA	Hop-on Resistance	$R_N \leq 10K$ 5% R_N $R_N > 10K$ 0.15% R_N
Re	End Stop Value	$R_N \leq 100K \leq 2.10^{-2} R_N$ $R_N > 100K \leq 1.10^{-2} R_N$
RE	Hop-off Resistance	$R_N \leq 10K < 1\% R_N$ $R_N > 10K$ 0.5% R_N
RN	Rated Resistance	
RT	Effective Resistance	
ϕ	Rotation Angle	
ϕE	Effective Electrical Angle of Rotation	
ϕN	Effective Mechanical Angle of Rotation	

Resistance law C – Antilog (Reverse Audio)



AW	Initial Path	AW max. 10% φN
EW	Final Path	EW max. 10% φN
Ra	Initial Stop Value	$RN \leq 100K \leq 2.10^{-2} RN$ $RN > 100K \leq 1.10^{-2} RN$
RA	Hop-on Resistance	$RN \leq 10K < 1\% RN$ $RN > 10K 0.5\% RN$
Re	End Stop Value	$RN \leq 10K \leq 1.10^{-3} RN$ (Minimum 2 ohms) $RN > 10K \leq 2.10^{-4} RN$ (Minimum 10 ohms)
RE	Hop-off Resistance	$RN \leq 10K 5\% RN$ $RN > 10K 0.15\% RN$
RN	Rated Resistance	
RT	Effective Resistance	
φ	Rotation Angle	
φE	Effective Electrical Angle of Rotation	
φN	Effective Mechanical Angle of Rotation	

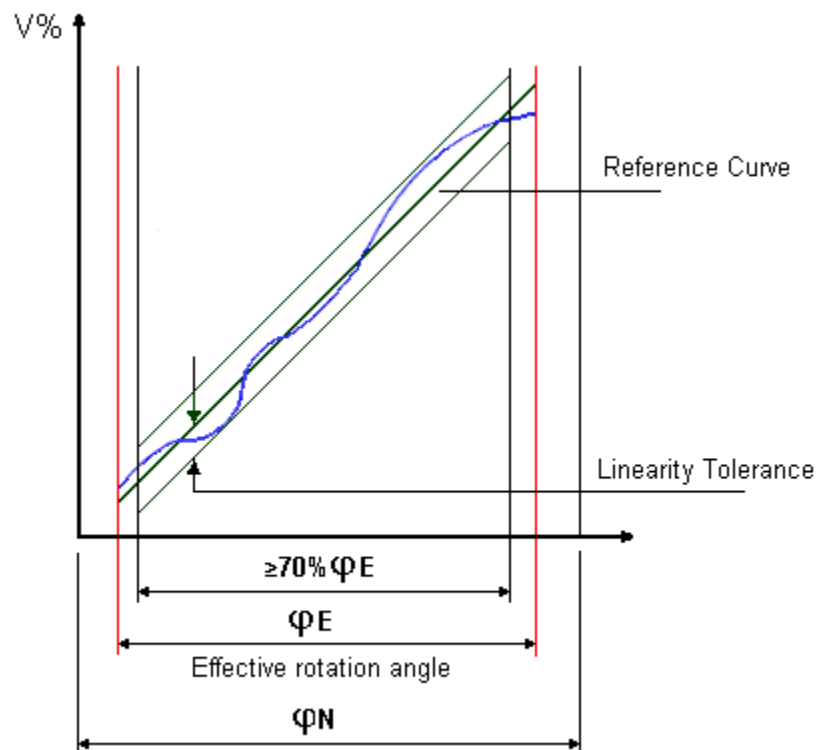
Linearity

As a basis of assessing Linearity Tolerance the independent method is the most practical, permitting as it does, the reference curve to be aligned as near as possible to the actual output curve. This avoids the use of the theoretical starting and finishing points, it is normal for the customer to realign the achieved curve with series trimmers at each end of the device if required.

Linearity Tolerance is 4% over the Nominal Resistance range of 1K Ω to 1M Ω . The Linearity Tolerance is measured on at least 70% of the effective rotation range.

Note. In the case of Terminal and Zero-based linearity, both present constraints which increase the manufacturing difficulty and in consequence have an adverse effect on the product's price and availability.

Potentiometer linearity

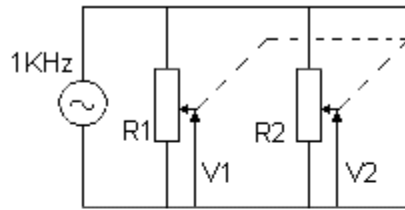


Matching Tolerance (For Tandem Stereo Potentiometers)

Tandem Potentiometers have two identical resistor units with the same variation law. The mismatching of the two resistor units, expressed in dB, is measured by the difference between the attenuations introduced by each resistor unit at various points of travel.

- Law A: 4 dB at Attenuation range 0 - 20 dB
- Law B and C: 3 dB at Attenuation range 0 - 20 dB

Matched Tolerance for Stereo

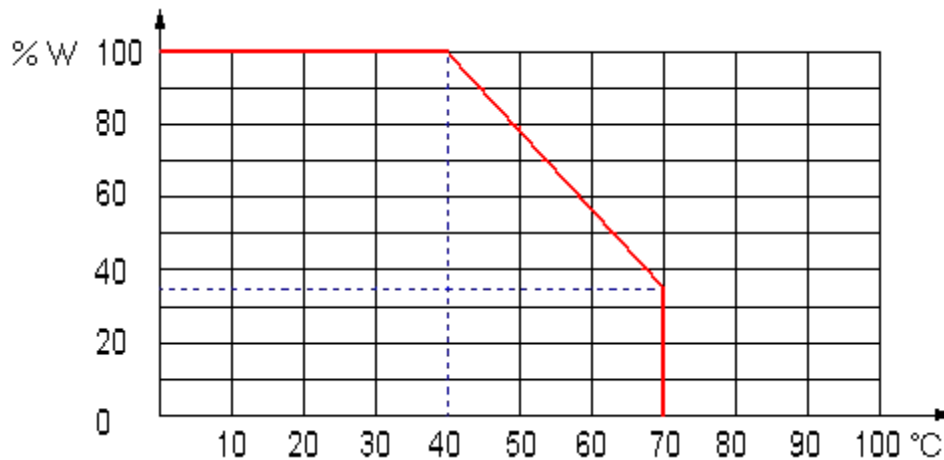


LAW	ATTENUATION RANGE	MATCHING TOLERANCE *
A	0 - 20dB	4dB
B & C	0 - 20dB	3dB

$$* \text{Matching Tolerance} = 20 \log \frac{V1}{V2}$$

Operating Temperature: -25°C to +70°C

Temperature Derating Curve



Temperature Coefficient of Resistance: +300 -500 ppm

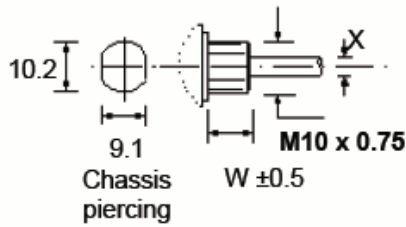
Components

P20 Bush Housing (Mounting)

The P20 bushes are available in metal or nylon; with three thread options; and with or without a locating feature:

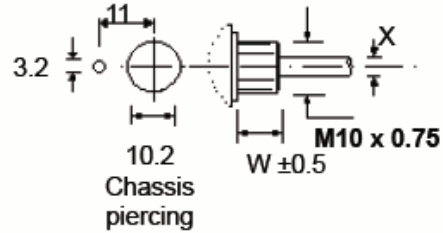
- Diecast Zinc Alloy
 - M10 x0.75mm pitch (Type C)
 - M10 x0.75mm pitch, **with locator** (Type CEBS)
 - 9.52mm x32tpi (Type CBS)
 - 9.52mm x32tpi, **with locator** (Type CBSL)
 - M7 x0.75mm pitch (Type CG)
- Glass Filled Nylon
 - M10 x0.75mm (Type CP)

DIECAST ZINC ALLOY



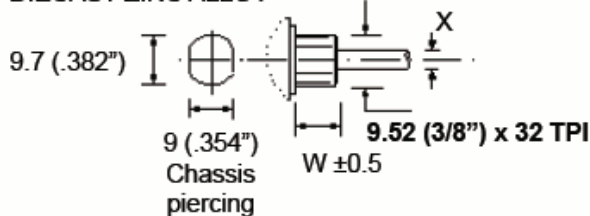
Type C (without locator)	
X (mm)	6
W (mm)	9

DIECAST ZINC ALLOY



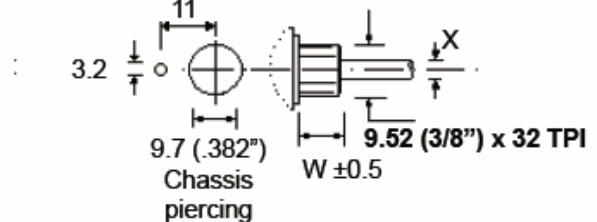
Type CEBS (with locator)	
X (mm)	6
W (mm)	9

DIECAST ZINC ALLOY



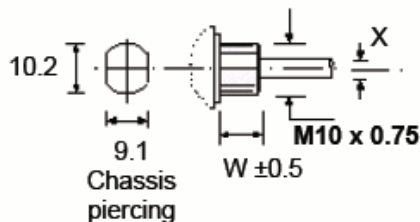
Type CBS (without locator)		
X (mm)	6	6.35
W (mm)	8 or 12	8 or 12

DIECAST ZINC ALLOY



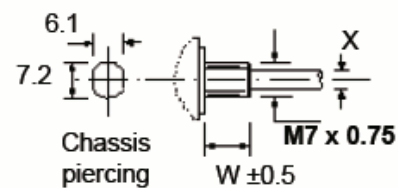
Type CBSL (with locator)		
X (mm)	6.35	6.35
W (mm)	8	12

GLASS FILLED NYLON



Type CP (GFN)		
X (mm)	6	6.35
W (mm)	7 or 10	7 or 10

DIECAST ZINC ALLOY



Type CG (without locator)	
X (mm)	4
W (mm)	6

P20 Spindles

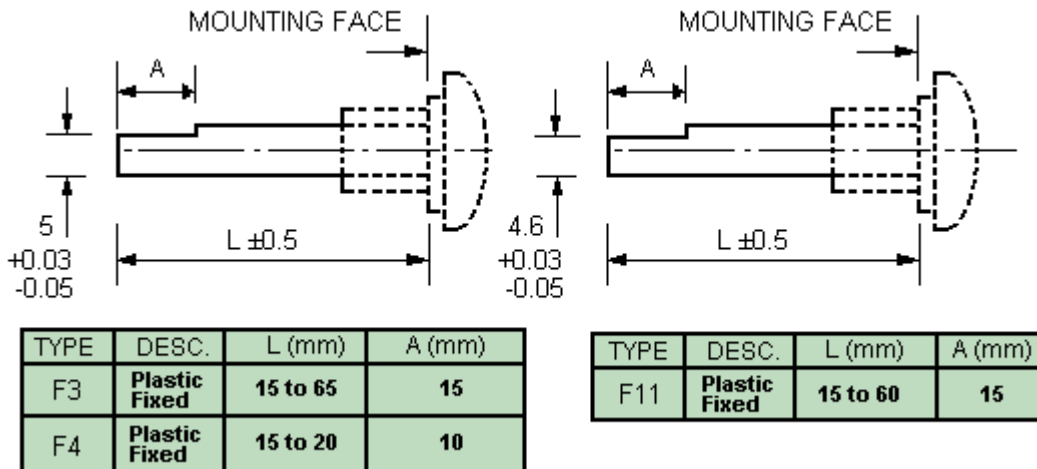
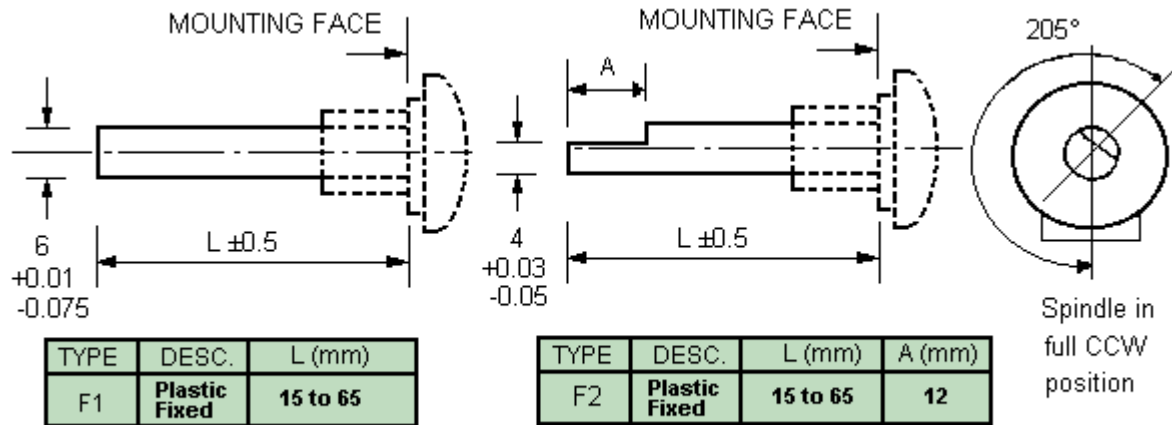
The P20 spindles are plastic and fixed i.e. not removable, unless otherwise stated and they are available in three diameters:

- 6.0mm Diameter
 - Cylindrical (Type F1)
 - 4.0 x 12mm Flat (Type F2)
 - 5.0 x 15mm Flat (Type F3)
 - 5.0 x 10mm Flat (Type F4)
 - 4.6mm x 15mm Flat (Type F11)
- 4.0mm Diameter
 - Cylindrical (Type F21)
 - 3.0 x 8.5mm Flat (Type F22)
 - 3.0 x 13.5mm Flat (Type F23)
 - Cylindrical (Type M21 - Metal)
 - 3.0 x 8.5mm Flat (Type M22 - Metal)
 - 3.0 x 13.5mm Flat (Type M23 - Metal)
- 6.35mm Diameter
 - Cylindrical (Type F41)
 - 5.5 x 10mm Flat (Type F42)
 - 5.5 x 15mm Flat (Type F43)
- Splined Spindle - 6.0mm dia. 18 teeth
- Dual Concentric
 - Flatted/Slotted (Type M15 - Metal)
 - Cylindrical (Type M16 - Metal)

6.0mm Diameter Spindles

Note: *Specials to customer's specification up to 65mm.

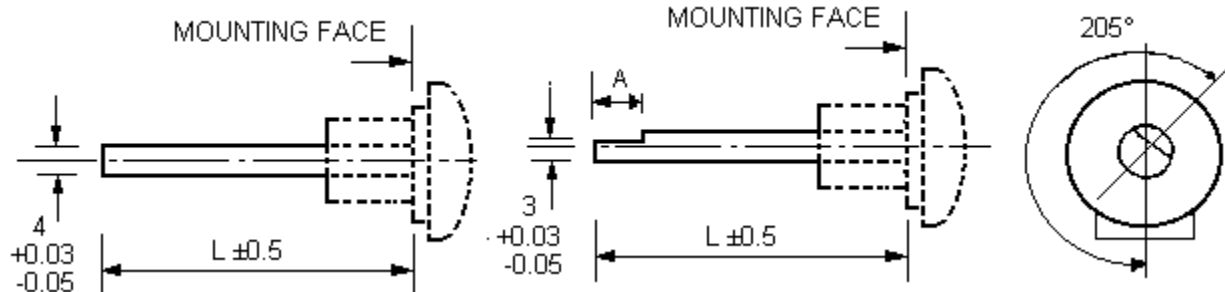
REMOVABLE SPINDLES, similar in specification to 'fixed' spindles are supplied separate from the potentiometer. These can be indefinitely taken in and out and their holding strength is >1kg.



4.0mm Diameter Spindles

Note: The orientation of the flat as illustrated is for plastic spindles only.

For metal spindles, unless specified on the order, the orientation may be different on each potentiometer type.



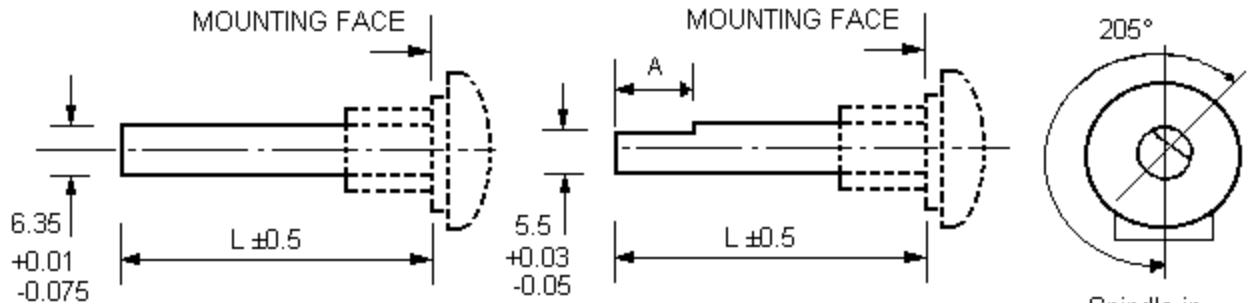
TYPE	DESC.	L (mm)
F21	Plastic Fixed	8 to 65
M21	Metal Fixed	8 to 65

TYPE	DESC.	L (mm)	A (mm)
F22	Plastic Fixed	11 to 60	8.5
M22	Metal Fixed	11 to 60	8.5
F23	Plastic Fixed	16 to 60	13.5
M23	Metal Fixed	16 to 60	13.5

Spindle in full CCW position

6.35mm Diameter Spindles

Note: *Specials to customer's specification up to 65mm.



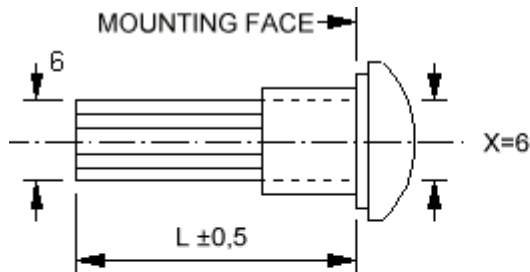
TYPE	DESC.	L (mm)
F41	Plastic Fixed	15 to 65

TYPE	DESC.	L (mm)	A (mm)
F42	Plastic Fixed	15 to 20	10
F43	Plastic Fixed	20 to 60	15

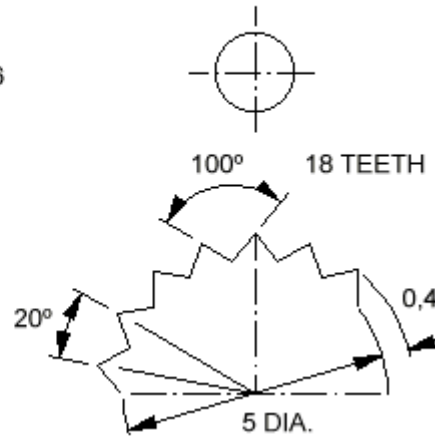
Spindle in full CCW position

Splined Spindle - 6.0mm dia. 18 teeth

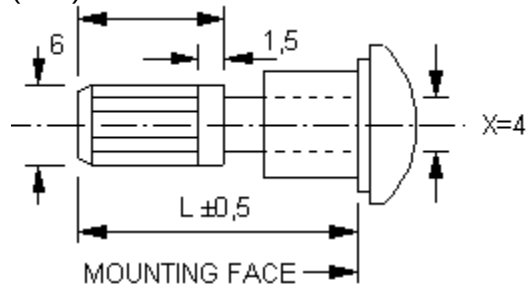
A splined form is available on the 6.0mm diameter P20 plastic spindle (F5) or alternatively a 6mm 'Splined Adaptor' (8,7mm long) can be fitted on a 4mm dia. Spindle



TYPE	DESC.	L (mm)
F5	Plastic Fixed	19



(F5A):



TYPE	DESC.	L (mm)
F5A	Plastic Fixed	16-36

