CA9

Carbon Potentiometers CA

CE9

Cermet Potentiometers CE

CARBON – CA9

9mm carbon potentiometers with plastic housing and Ingress Protection rating type IP 54 (high level of protection against dust and also against water splashing), according to IEC 60529. Plastic materials can be self-extinguishable according to UL 94 V-0 under request.

Through-hole and SMD configurations are available. Terminals and collector are normally manufactured in tinned brass, although versions with steel terminals are also available under request. Terminals for through-hole models can be provided straight or crimped, which helps hold the component to the PCB during soldering.

Tapers can be linear, log and antilog; special tapers can also be studied.

ACP's potentiometers can be adjusted from either the front or the back, both in the horizontal and the vertical adjustment types. Thumbwheels and shafts can be ordered either separately or already inserted in the potentiometer.

Potentiometers can be manufactured in a wide range of possibilities regarding:

- Resistance value.
- Tolerance.
- Tapers / variation laws.
- Pitch.
- Positioning of the wiper (standard is at 50% rotation).
- Housing and rotor color.
- Mechanical life.
- Click effect (up to 20 detents available).
- Self-extinguishable plastic parts according to UL 94 V-0.

Applications

9mm potentiometers are mainly used in control applications, in different markets:

- Industrial: Timers and relays, dimmers, adjustment of output.
- Electronic appliances: volume regulation, temperature controls and function selection.
- Automotive: Lighting regulation (position adjustment and sensing for headlights), dimmers, seat heating controls.

CERMET – CE9

9mm cermet potentiometers with plastic housing and Ingress Protection rating type IP 54 (high level of protection against dust and also against water splashing), according to IEC 60529. Plastic materials (housing and rotor) are self-extinguishable according to UL 94 V-0 for ACP's cermet potentiometers.

Cermet potentiometers have better thermal stability, allow for higher thermal dissipation and withstand higher temperatures than carbon potentiometers.

Through-hole and SMD configurations are available. Terminals and collector are manufactured in tinned brass, although versions with steel terminals are also available under request. Terminals for through-hole models can be provided straight or crimped, which helps hold the component to the PCB during soldering.

Tapers can be linear, log and antilog; special tapers can also be studied.

ACP's potentiometers can be adjusted from either the front or the back, both in the horizontal and the vertical adjustment types. Thumbwheels and shafts can be ordered either separately or already inserted in the potentiometer.

Potentiometers can be manufactured in a wide range of possibilities regarding:

- Resistance value.
- Tolerance.
- Tapers / variation laws.
- Pitch.
- Positioning of the wiper (the standard is at 50%).
- Housing and rotor color.
- Mechanical life.
- Click effect (up to 20 detents available).

Applications

9mm cermet potentiometers are used in applications where either the operating temperature is high, or where the application requires product with excellent ohmic value stability:

- Electronic appliances: temperature controls.
- Automotive: climate controls, position sensors, seat heating controls.
- Industrial electronics: multimeters, oscilloscopes, time relays, measurement and test equipment.

CA9 CE9 HOW TO ORDER

EXAMPLE: **CA9MH2,5-10KA2020 SNP PI WT-9005-BA**

EXAMPLE: **CE9MH2,5-10KA2020 SNP PI WT-9005-BA-V0**

Standard features								Extra features							Assembled accessory			
Series	Rotor	Model	Packg.	Ohm value	Taper	Tol.	Life	Track	Detents	Snap in	Housing	Rotor	Wiper	Lin.	Assembly	Ref #	Color	Flam.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		16		
CA9/CE9	M	H2,5		- 10K	A	2020				SNP			PI		WT	-9005	-BA	-V0

Standard configuration:	CA9 Through-hole	CA9 SMD	CE9 Through-hole and SMD
Dimensions:		9mm	
Protection:		IP 54 (dust-proof) On request: Self-extinguishable, to meet UL 94 V-0	
Substrate:	Carbon technology	Carbon technology, special for high temperature	Cermet
Color:	Blue housing + white rotor	Brown housing + grey rotor	Brown housing + white rotor
Packaging:		Bulk	
Wiper position:		at 50% ±15°	
Terminals:		Straight, without crimping.	
Marking:		Resistive value marked on housing. Others on request.	

Customized products: A drawing is requested when ordering a customized product. Series, rotor, model and total resistive value are indicated before the code that includes all special specifications. Example: CA9PH2,5-10K **CODE C00111**.

1 - Series

■ CA9 ■ CE9

2 - Rotors

C	D	E	J	K	KA	M	MA	MT	P	R	Y

3 - Model and pitch

H2,5	H3,8	HS3,8	H5	HSMD	V7,5	V10	VK10	VR10
MAV10	MTV10	VSMD	VSMD WT-9002	VSMD...CY	VSMD...CY WT-9002			

4 - Packaging

	Trough-hole	SMD models
Bulk	(blank)...(1)	(blank)...(1)
T&R (Tape and 13" reel)	T&R	T&R
T&R (Tape and 15" reel)	T&R15	T&R15

(1) If blank, bulk packaging is implied.

5 - Resistance value

100Ω	200Ω	220Ω	250Ω	470Ω	500Ω	1KΩ	2KΩ ...	500KΩ	1MΩ	2MΩ	2M2Ω	4M7Ω	5MΩ
100	200	220	250	470	500	1K	2K	500K	1M	2M	2M2	4M7	5M

6 - Resistance law / taper

Lin - Linear	A
Log - Logarithmic	B
Antilog - Antilogarithmic	C
- Special tapers have codes assigned:	CODE YXXXXX

7 - Tolerance

±20%	±30%	+50%,-30%	±10%	±5%
2020	3030	5030	1010	0505

8 - Operating Life (Cycles)

Standard (1.000 cycles)	(leave blank)
Long life: LV + the number of cycles. ex: LV10 for 10.000 cycles. (others on request)	LVXX: ex: LV10

9 - Cut Track – Open circuit.

Open circuit at beginning of track, fully CCW	PCI
Open circuit at end of track, fully CW	PCF

10 - Detents (DT)

One detent at the beginning	DTI
One detent at the end	DTF
X number of detents	XDT: 10DT

Special detents are available on request: If you need to assign a voltage value to each detent, please inquire.

11 - Terminals

SNAP IN P	SNP
SNAP IN J	SNJ
Shorter tip of terminal, TPXX, where XX is tip length (under request)	TPXX, ex: TP25
Steel Terminals	SH

12 - Housing

Color: For colors other than standard: -See color chart below-	CJ-color, ex., red: CJ-RO

13 - Rotor

Color: For colors other than standard: -See color chart below-	RT-color; ex., blue: RT-AZ

*** Self-extinguishable property, V0, for housing and rotor:**

By default, carbon is non self-extinguishable, cermet is self-extinguishable:	(blank)
For carbon: self-extinguishable property can be added. V0 means housing and rotor are V0 if only the housing needs to be V0, then CJ-V0.	V0 CJ-V0, RT-V0
If only rotor: RT-V0	

14 - Wiper

Wiper position (Standard: 50% ± 15°)	(leave blank)
Initial or CCW	PI
Final or CW	PF
Others: following clock positions; at 3 hours: P3H	PXH, ex: P3H
Wiper torque (Standard: <2.5Ncm, for detents: <3.5)	(leave blank)
Low torque, < 1.5Ncm	PGB

15 - Linearity

Not controlled	(leave blank)
Independent linearity controlled & below x%, for example, 3%: LN3%	LNx%; ex: LN3%
Absolute linearity controlled & below x%	LAx%

16 - Potentiometers with assembled accessories

Assembled from terminal side	WT
Assembled from collector side	WTI
Accessory Reference See list of shafts and thumbwheels available	-XXXXX Example: 9010
Color of shaft or thumbwheel	-YY Example, white: BA
Non self-extinguishable. Self-extinguishable according to standard UL 94 (-V0 in box 17 modifies only the accessory, please, note.)	(leave blank) -V0

For ordering spare accessories:

Accessory reference - color- flammability. Ex. 9010-AZ-V0 is a blue self-extinguishable 9010 thumbwheel	XXXX-YY-V0

Color chart for rotor, housing and accessories

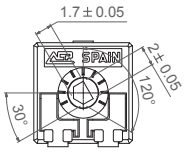
Black(1)	White	Neutral	Transp.	Red	Green	Yellow	Blue	Grey	Brown
NE	BA	IN	TA	RO	VE	AM	AZ	GS	MR

(1) black is not an option for housings.

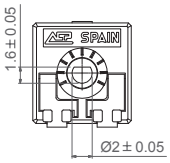
Rotors

Rotors are drawn in their standard positioning, 50% of rotation. Alternative delivery positioning can be requested. Accessories in this catalogue are designed for the M rotor, unless otherwise stated.

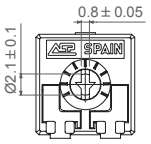
C



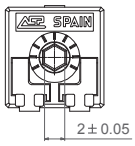
D



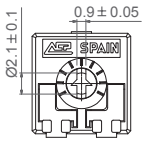
E



J

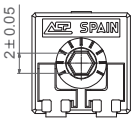


K

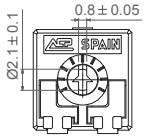


Standard color for K rotor is red

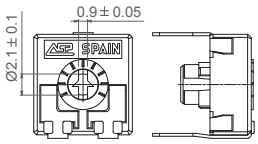
M



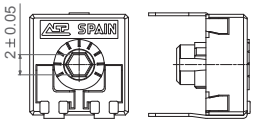
P



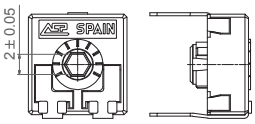
KA



MA



MT



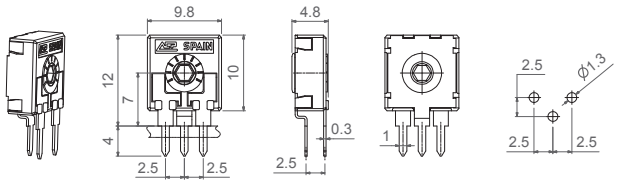
R

Y

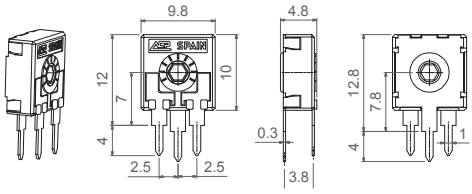
Models

All models shown here have the most common rotor for 9mm potentiometers: the M rotor. Different rotors are available from the menu above.

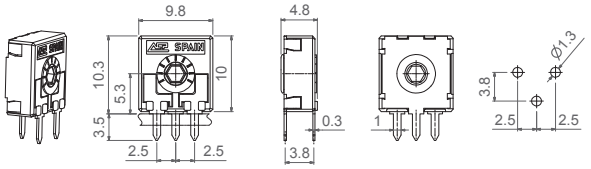
H2,5



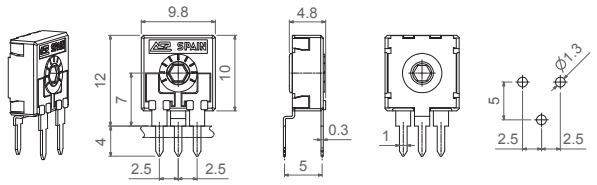
H3,8



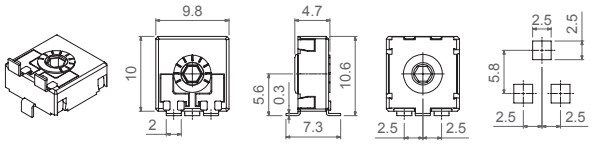
HS3,8



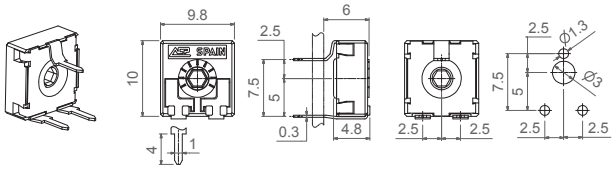
H5



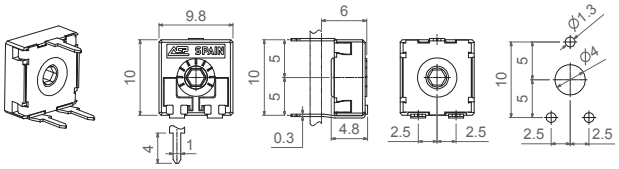
HSMD



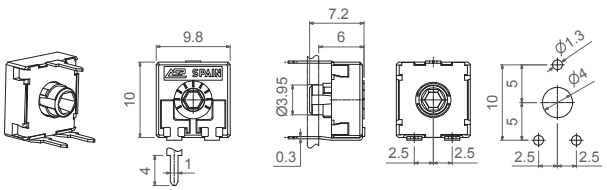
V7,5



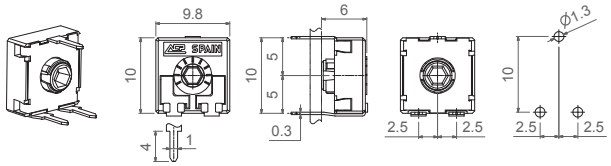
V10



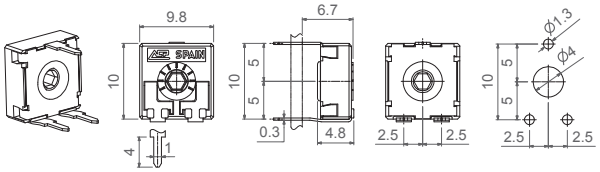
V10 (With rotors MA or KA)



V10 (With rotor MT)

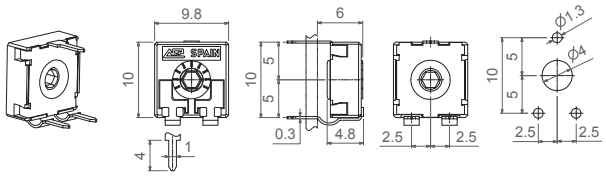


VK10

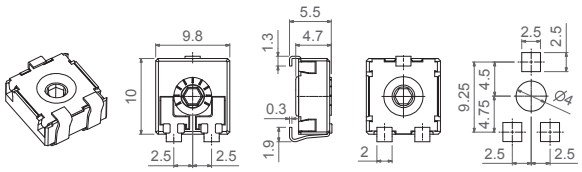


Models

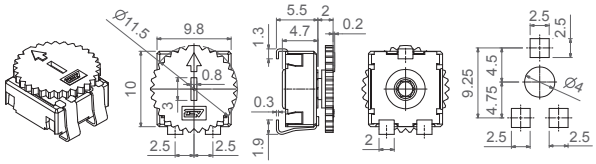
VR10



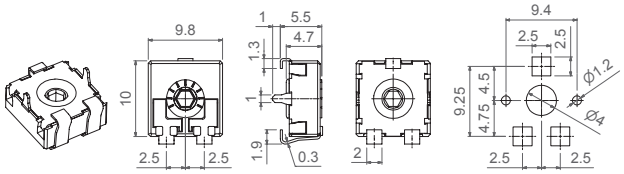
VSMD



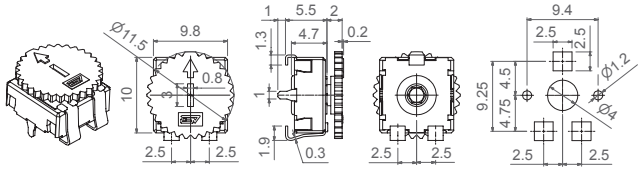
VSMD WT-9002



VSMD...CY



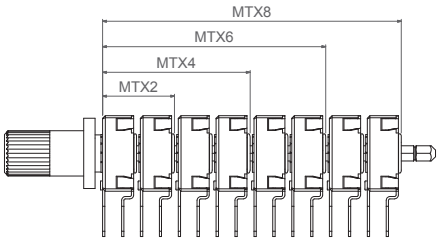
VSMD...CY WT-9002



GANGED

GANGED: Set of potentiometers in a row that allows for simultaneous adjustment of all of them through one shaft. Recommended potentiometer model is H2,5. MTX2 (2 potentiometers), MTX4 (4), MTX6 (6), MTX8 (8).

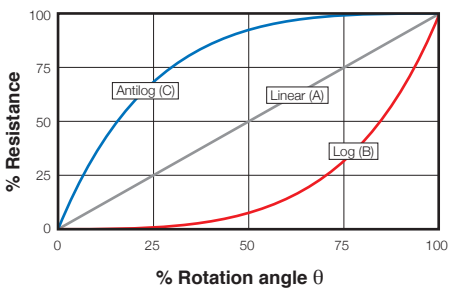
Model	MTX2	MTX4	MTX6	MTX8
Shaft	9048, 9074, 9076	9039, 9051	9018	9056



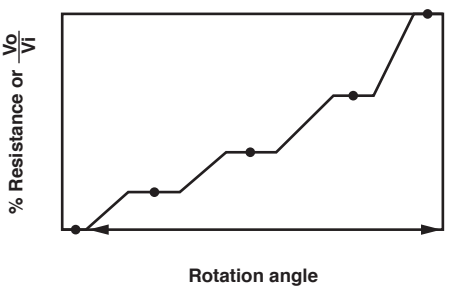
Tapers

The standard taper is linear (A). Log (B) and Antilog (C) tapers are also available, as well as special tapers according to customer's specifications. For example, a special taper can be matched with a potentiometer with detents (click effect) to guarantee a value in a specific position – see "detents" section.-

REGULAR TAPERS



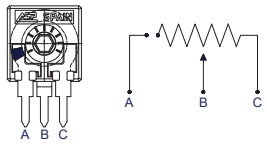
SPECIAL TAPERS



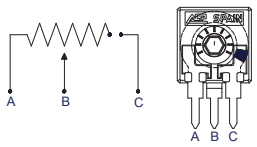
Potentiometers with cut track

The cut track is an area with very high resistive value, resulting in an open circuit. It is widely used in lighting applications. Mechanical life with cut track needs to be confirmed.
PCI = Cut at initial position, when the potentiometer is turned fully counter clockwise.
PCF = Cut at final position, when the potentiometer is turned fully clockwise.
Other positions are available on request.

PCI



PCF

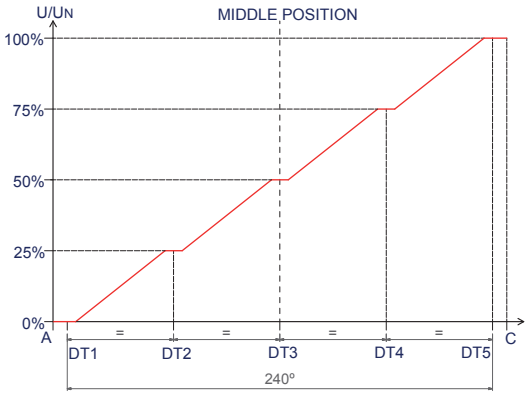


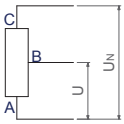
Potentiometers with detents

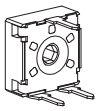
ACP's patented detent (DT) feature is especially suitable for control applications where the end used will turn a knob inserted in the potentiometer. Detents can be used to add a click feeling to the turning of the potentiometer or to control the position in which the wiper is placed, assuring a particular output value with a narrow tolerance.

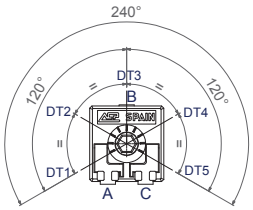
Detents can be light or strong, or even a combination of different feelings. They can be evenly distributed along the angle (standard) or tailored to match customers' request. They can also be combined with special tapers: constant value areas, open circuit zone, different slopes, etc. One common example is a potentiometer with detents and matching non-overlapping voltage values in specific angular positions, used to feed in a voltage value to a microprocessor:

Example of 5DT with control of value in each DT.



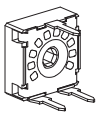


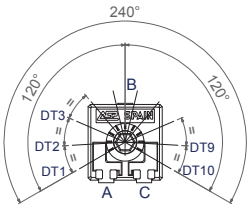




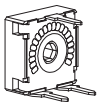
Other examples of potentiometers with detents:

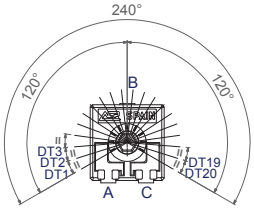
10DT





20DT





Number of standard detents (evenly distributed) already available.	1 (initial or final), 2 DT (initial and final), 3, 4, 5, 6, 7, 8,10, 20.
Maximum number of detents for feeling only	20
Maximum number of detents when the voltage value in each detent is controlled and non-overlapping.	10

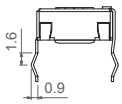
Our patented design with two wipers has improved the performance of these potentiometers, giving them more stable electrical parameters, improved reliability and Contact Resistance Variation (CRV) as well as narrower tolerances for detent positioning.

For potentiometers with detents, mechanical life is also 1.000 cycles if no additional cycles are mentioned. Please, indicate the number of cycles needed with LV (number of cycles), for example: LV07, for 7.000 cycles.

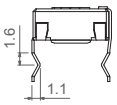
Terminals

By default, terminals are always straight, as shown on the “models” section. ACP can provide crimped terminals (with snap in, “SNP” or “SNJ”) to better hold the component to the PCB during the soldering operation.

SNP

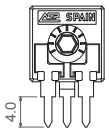


SNJ

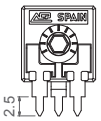


Also, there is an option of having shorter terminal tips:

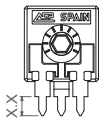
Standard Terminal



Shorter terminal, for H5 TP25



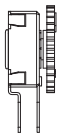
Shorter terminal, TPXX (under request)



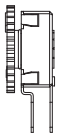
Possibilities for insertion of accessories

Accessories can be mounted on potentiometers through either the front side (WT) or the collector side (WTI). For the specific angular position of shafts with planes, a drawing with the exact position is requested.

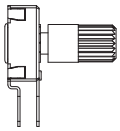
WT Front side



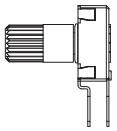
WTI Collector side



WT Front side



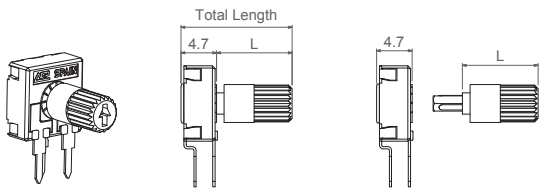
WTI Collector side



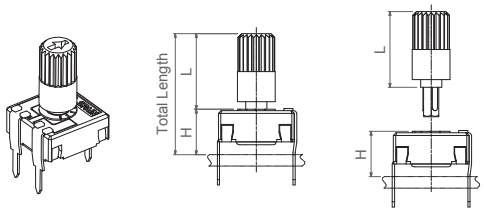
Shafts

Shafts are available in different colors (color chart in “how to order” section) and with self-extinguishable property, according to UL 94 V-0, under request. ACP can study special shaft designs.
Shafts can be sold separately or delivered already mounted on the potentiometer at ACP.
Unless otherwise stated, the arrow in the shafts is in line with the wiper and it points to 50% when assembled with M rotors.
When a shaft is mounted on a potentiometer, the distance from the top of the potentiometer to the top of the shaft is marked with “L” in the table below, as shown in the drawings:

H potentiometer + shaft

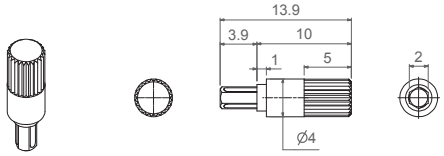


V potentiometer + shaft

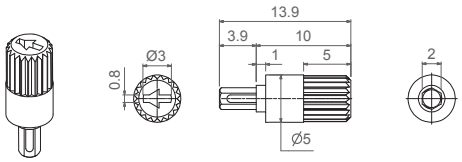


Shaft	9071	9067	9072	9074	9054	9004	9005	9064	9055	9070	9076	9053	9018	9039	9048	9056	9009	9059	9063	9010	9051	9006	9019	9073	9020	9047
L Dimension	3.5	5.5	6.5	9.3	9.5	10	10	10	10.8	11.9	12	12.1	12.8	12.8	12.8	12.8	14.5	14.5	14.5	15	15	19.7	19.9	25.5	25.9	29.8

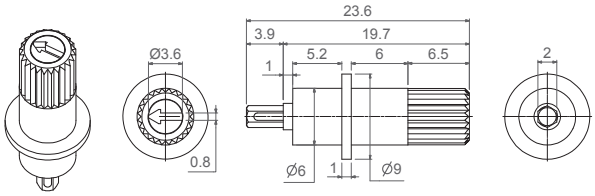
9004



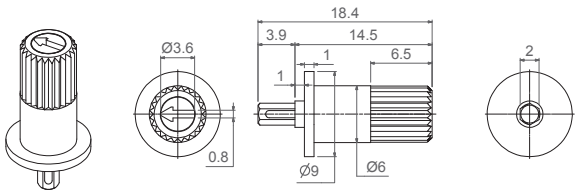
9005



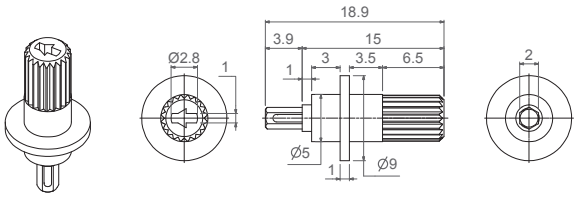
9006



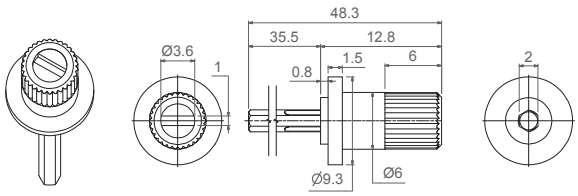
9009



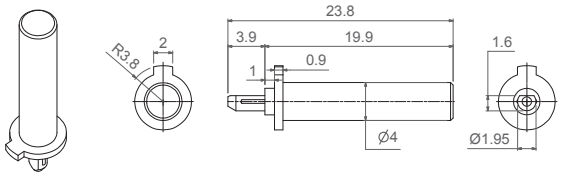
9010



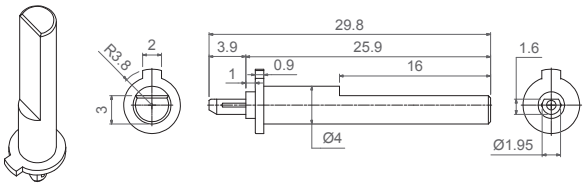
9018 (for 6 ganged potentiometers)



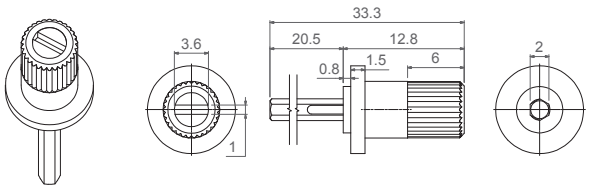
9019 (Designed for D rotor)



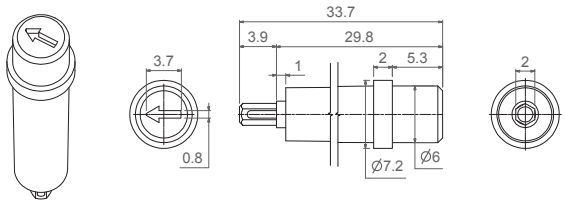
9020 (Designed for D rotor)



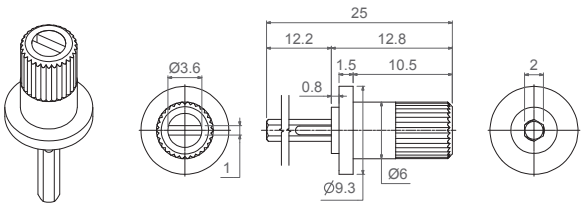
9039 (for 4 ganged potentiometers)



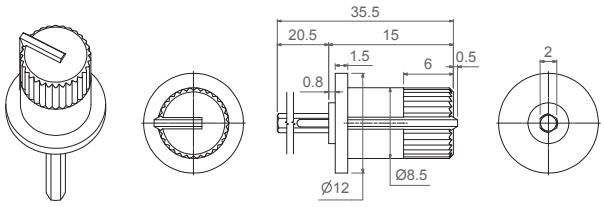
9047



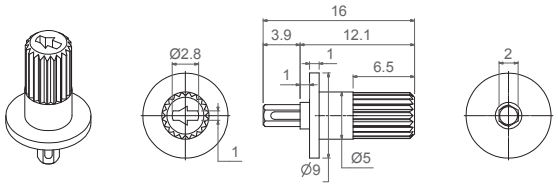
9048 (for 2 ganged potentiometers)



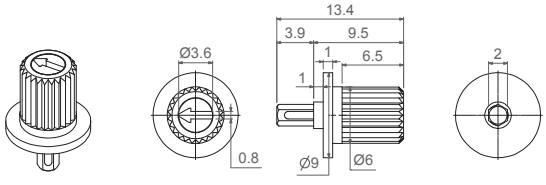
9051 (for 4 ganged potentiometers)



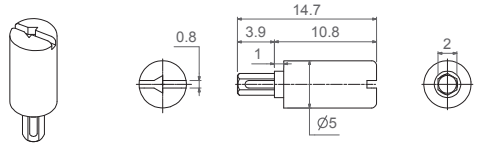
9053



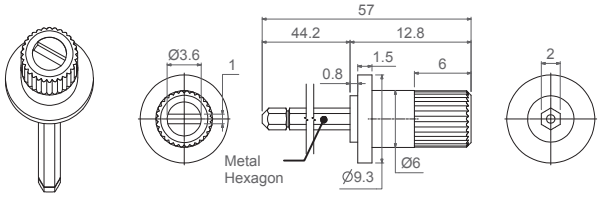
9054



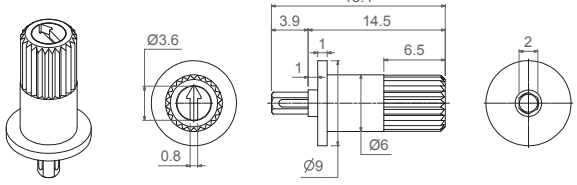
9055



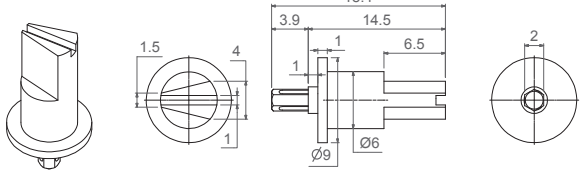
9056 (for 8 ganged potentiometers)



9059



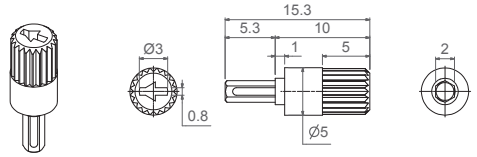
9063



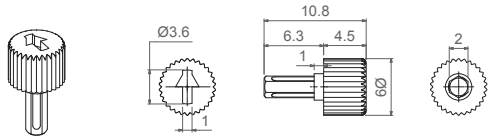
The arrow is in line with the wiper when potentiometer has rotor J (with M rotor, there is a 30º difference).

Shafts

9064

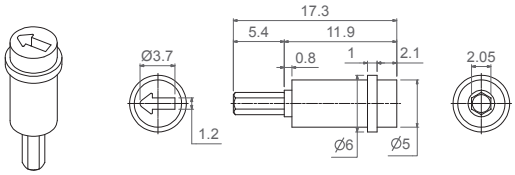


9067

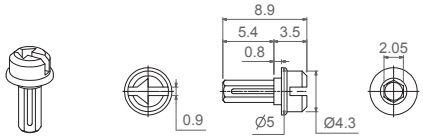


The arrow is in line with the wiper when potentiometer has rotor J (with M rotor, there is a 30° difference).

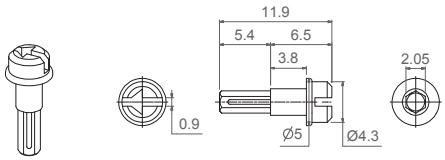
9070



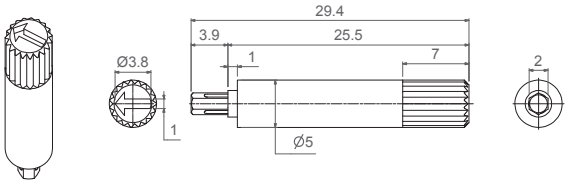
9071



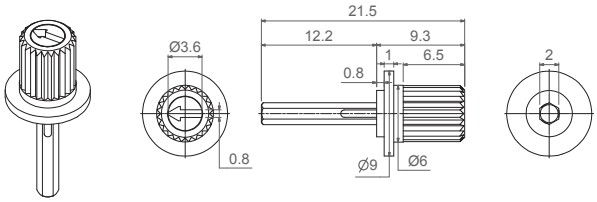
9072



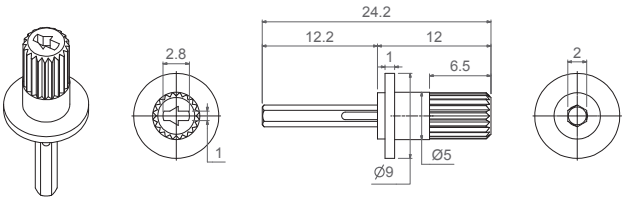
9073



9074 (for 2 ganged potentiometers)



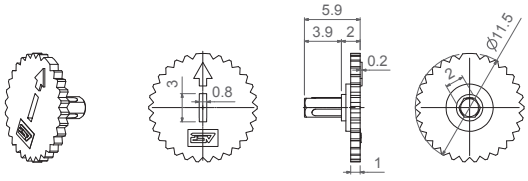
9076 (for 2 ganged potentiometers)



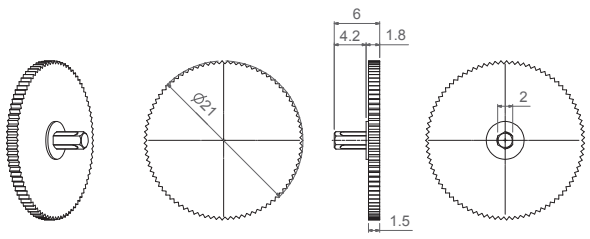
Thumbwheel

Thumbwheels are available in different colors (color chart in “how to order” section) and with self-extinguishable property according to UL 94 V-0, under request.
Thumbwheels can be mounted on the potentiometers at ACP or sold separately. ACP can study special thumbwheel designs.

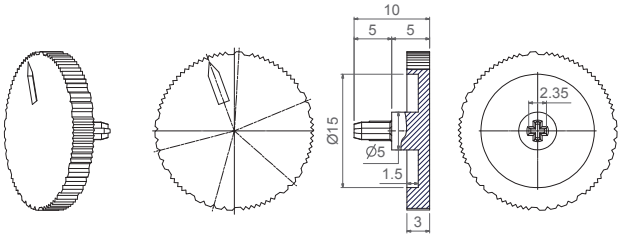
9002



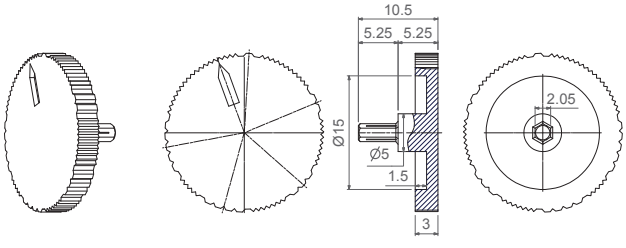
9041



9060 (Designed for R rotor)



9061



Packaging

Bulk packaging:

Potentiometer model	With shaft or thumbwheel inserted?	Pieces per small box (150 x 100 x 70)	Pieces per bigger box (250 x 150 x 70, CG on description)
H2,5 - H3,8 - HS3,8 - H5 HSMD - V7,5 - V10 VK10 - VR10 - VSMD	None, only potentiometers.	500	1.500
	9002	250	1.000
	9004, 9005, 9006, 9009, 9010, 9018, 9039, 9041, 9047, 9048, 9051, 9053, 9054, 9055, 9056, 9059, 9060, 9061, 9063, 9064, 9067, 9070.	200	1.000 in general
	9071, 9072	400	1.250
KAV - MAV – MTV	None, only potentiometers.	400	1.250
MTX2	9048, 9074, 9076	150	To be determined.
MTX4	9039, 9051	75	To be determined.
MTX6	9018	50	To be determined.
MTX8	9056	40	To be determined.

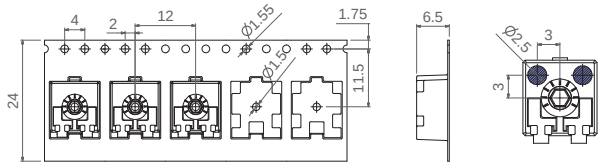
Tape & Reel packaging:

	With thumbwheel inserted?	13” Reel (Standard), with 24mm width tape	15” Reel, with 24mm width tape
VSMD	None, only potentiometers.	900 pcs per reel, 12mm step between cavities.	1.250 pcs per reel, 12mm step between cavities.
	9002	700 pcs per reel, 12mm step between cavities.	To be determined.
VSMD…CY	None, only potentiometers.	750 pcs per reel, 12 mm step between cavities	1000 pcs per reel, 12 mm step between cavities
	9002	To be determined	To be determined
HSMD	None, only potentiometers or 9002	350 pcs per reel, 16 mm step between cavities	475 pcs per reel, 16 mm step between cavities
H2,5…TP25 - H5… TP25 - HS3,8		250	350
V7,5 - V10 - V10… TP25 - VR10		250	400

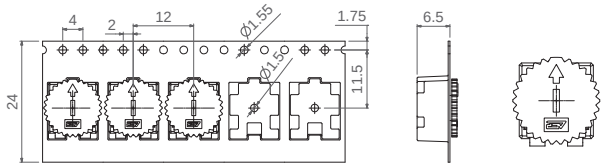
The 13” reel is the standard. For the 15” reel, T&R15 is added to the description.

Packaging

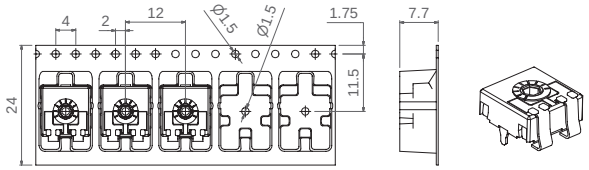
VSMD-T&R



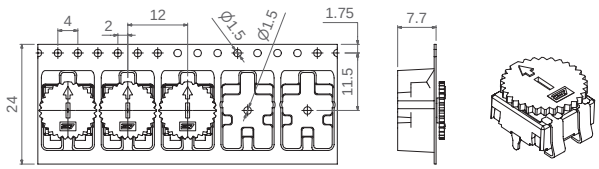
VSMD-T&R...WT-9002



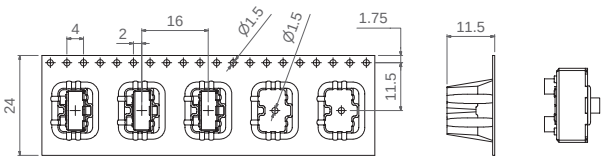
VSMD-T&R ...CY



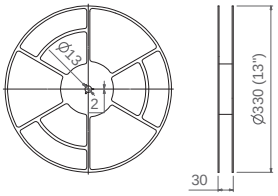
VSMD-T&R...CY WT-9002



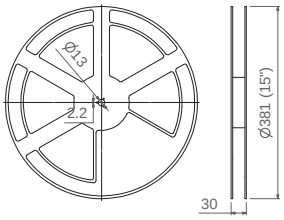
HSMD-T&R



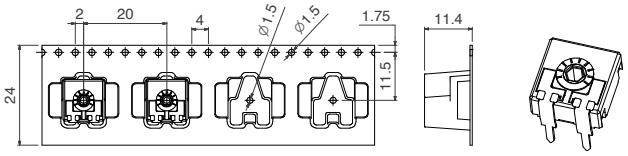
13"Reel



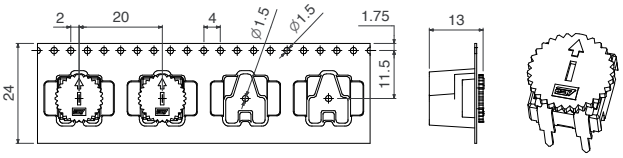
15"Reel



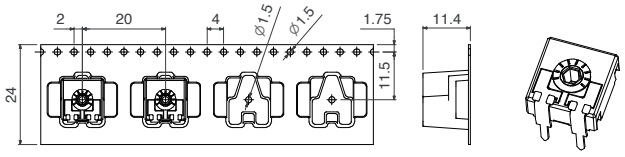
V7,5-T&R



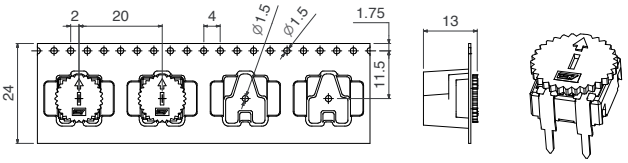
V7,5-T&R... WT-9002



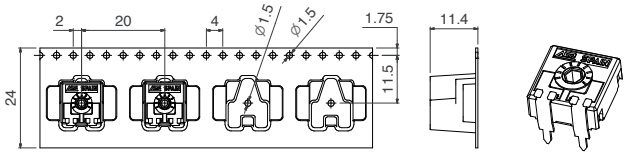
V10-T&R



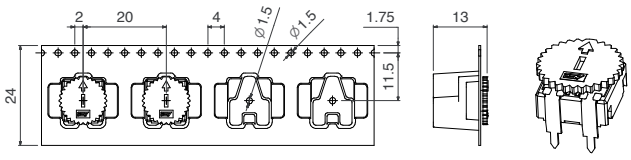
V10-T&R... WT-9002



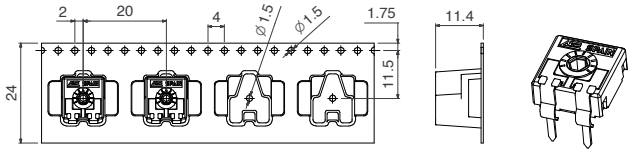
V10-T&R... TP25



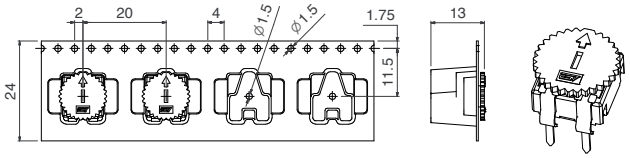
V10-T&R... TP25 WT-9002



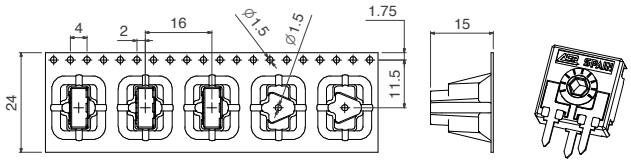
VR10-T&R



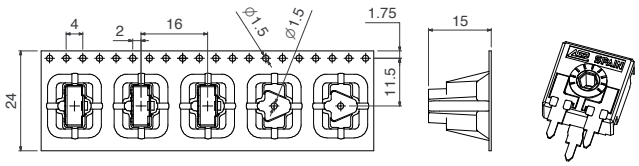
VR10-T&R... WT-9002



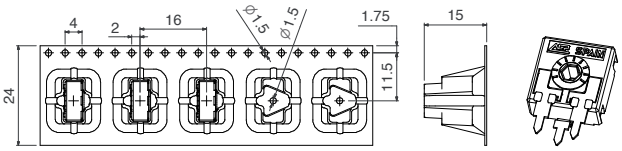
HS3,8-T&R



H5-T&R... TP25



H2,5-T&R... TP25



Electric Specifications

These are standard features; other specifications and out of range values can be studied on request.

	CA9 Through-hole	CA9 SMD	CE9 Through-hole and SMD
Range of resistance values* Lin (A) Log (B) Antilog (C)	 100Ω ≤ Rn ≤ 5MΩ 1 KΩ ≤ Rn ≤ 2M2Ω	 100Ω ≤ Rn ≤ 1MΩ 1 KΩ ≤ Rn ≤ 1 MΩ	 100Ω ≤ Rn ≤ 5MΩ 1 KΩ ≤ Rn ≤ 2M2Ω
Tolerance* Rn < 100Ω: 100Ω ≤ Rn ≤ 100KΩ 100K< Rn ≤ 1MΩ: 1MΩ < Rn ≤5MΩ: Rn > 5MΩ:	 +50%, -30% (out of range) ±20% ±20% ±30% +50%, -30% (out of range)	 - ±30% ±40% ±50% -	 - ±20% ±20% ±30% -
Variation laws	Lin (A), Log (B), Antilog (C). Other tapers available on request		
Residual resistance	Lin (A), Log (B), Antilog (C) ≤ 5*10-3*Rn. Minimum value 2Ω		≤2Ω
CRV - Contact Resistance Variation (dynamic)	Lin (A) Electrical Angle 220º±20º ≤ 3%Rn. Other tapers, please inquire		
CRV - Contact Resistance Variation (static)	Lin (A) Electrical Angle 220º±20º ≤ 5%Rn. Other tapers, please inquire		
Maximum power dissipation** Lin (A) Log (B), Antilog (C)	at 50ºC 0.15W 0.10W		at 70º C. 0.5W 0.20W
Maximum voltage Lin (A) Log (B), Antilog (C)	 200VDC 150VDC		 200VDC
Operating temperature	-25ºC … +70ºC (+85ºC on request)		-40ºC … +90ºC (+125ºC on request)
Temperature coefficient 100Ω ≤ Rn ≤ 10KΩ 10KΩ < Rn ≤ 5MΩ	 +200/ -300 ppm +200/ -500 ppm	 +200/ -500 ppm +200/ -1000 ppm	 ±100 ppm ±100 ppm

* Out of range ohm values and tolerances are available on request, please, inquire.
** Dissipation of special tapers will vary, please, inquire.

Mechanical Specifications

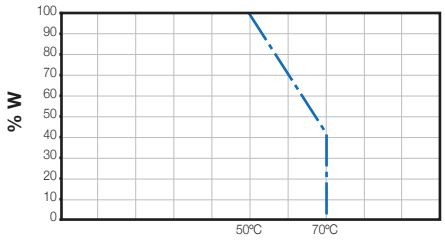
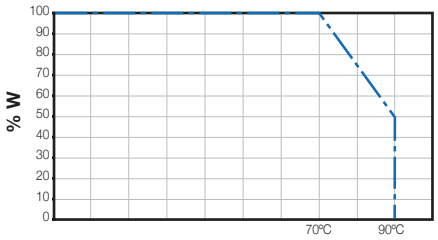
	CA9 Through-hole	CA9 SMD	CE9 Through-hole and SMD
Resistive element	Carbon technology	Carbon technology	Cermet
Angle of rotation (mechanical)	240º ± 5º		
Angle of rotation (electrical)	220º ± 20º		
Wiper standard delivery position	50% ± 15º		
Max. stop torque	5 Ncm		
Max. push/pull on rotor	40 N		
Wiper torque*	<2 Ncm Potentiometers with detents: <2.5 Ncm		
Mechanical life	1.000 cycles (many more available on request, please, inquire)		

* Stronger or softer torque feeling is available on request.

Test results

The following typical test results are given at 23ºC ±2ºC and 50% ±25% RH.

	CA9 Through-hole and SMD		CE9 Through-hole and SMD	
	Test conditions	Typical variation of nominal resistance	Test conditions	Typical variation of nominal resistance
Damp heat	500 h. at 40°C and 95% RH	+5%, -2%	500 h. at 40°C and 95% RH	±2%
Thermal cycles	16 h at 85ºC, plus 2 h at –25ºC	±2.5%	16 h at 90ºC, plus 2 h at –40ºC	±2%
Load life	1.000 h. at 50°C	+0%; -6%	1.000 h. at 70°C	±2%
Mechanical life	1.000 cycles at 10 c.p.m. and at 23°C ± 2°C	±3%	1.000 cycles at 10 c.p.m. and at 23°C ± 2°C	±3%
Storage (3 years)	3 years at 23°C ± 2°C	±3%	3 years at 23°C ± 2°C	±1%

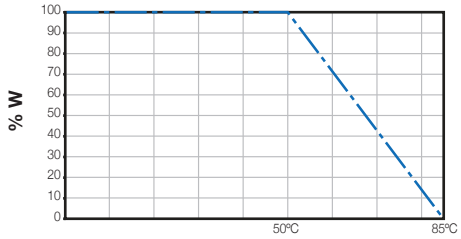
	CA9 Through-hole and SMD	CE9 Through-hole and SMD
Power derating curve:		

For temperatures out of range

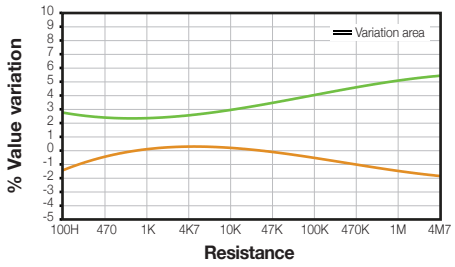
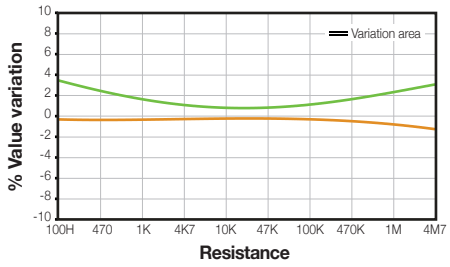
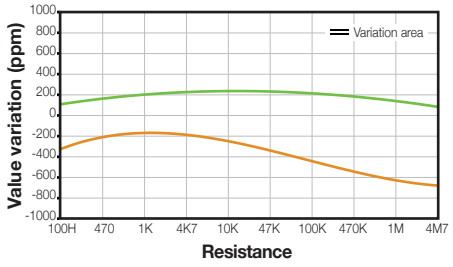
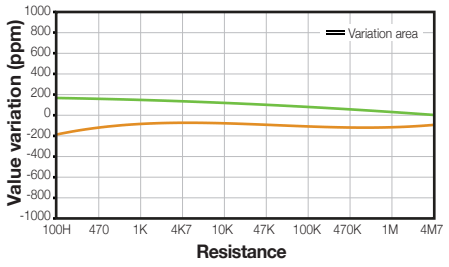
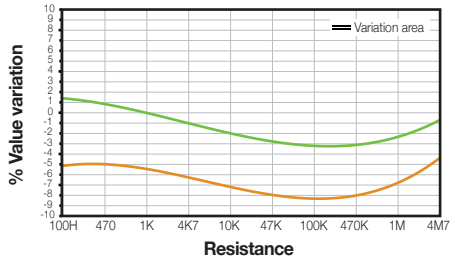
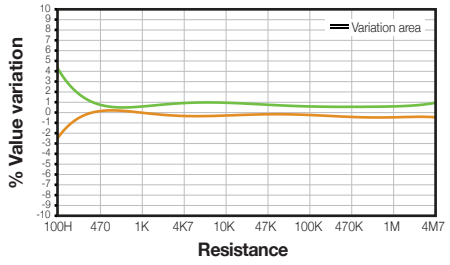
The normal operation temperature for a carbon ACP potentiometer is -25ºC to +70ºC. When the temperature goes up to 85ºC, the following variations should be observed:

Load life	1.000 h. at 50ºC	+0%; -6%	1.000 h. at 85ºC	+0%; -15%

The power derating curve to consider is:



Representation of the typical variation of nominal resistance (with 95% confidence) throughout the ohm value range:

	CA9 Through-hole and SMD	CE9 Through-hole and SMD
Damp heat		
Temperature Coefficient		
Load life		
Mechanical life