General catalogue





Aragonesa de Componentes Pasivos

The world we have is the result of our way of thinking.

Albert Einstein





Aragonesa de Componentes Pasivos, S. A. (ACP), based in Tarazona (Zaragoza) Spain, is a World recognized specialist in thick-film technology and its application in the field of variable resistance since 1988. Our products include angular position sensors, potentiometers and trimmers which can be found in the following markets: appliances, automotive and industrial.

ACP's expertise lays in the development, characterization and manufacturing of polymeric pastes (resistive, conductive and dielectric) and its deposition in a wide range of substrates. We are vertically integrated, we also design and manufacture the plastic and the metal components that make part of our final products, being experts in materials and manufacturing processes. Finally, we put together all these components in our automated assembly lines that feature the control of the electrical parameters of each and every finished product.

This expertise allows us to adapt our products for customers with special and demanding requirements, providing electromechanical tailor made solutions.

Our products are RoHS and Reach compliant, and we are certified by IQNet under ISO 9001 and ISO/TS 16949.

ACP has a strong R&D department that includes mechanical, chemical, materials, electronics and electrical engineers and also holds collaborations with universities and research institutes. We count with a professional team that makes our flexibility and high service level a key part of our value proposition. Our Prototype Building Team is able to prepare samples in very short lead time.

Equipment:

- In-house designed fully automated assembly lines, with integrated automated control systems.
- Type C clean room (class 10.000), with screen-printing equipment.
- On line drying, curing and sintering furnaces.
- Convection curing furnaces.
- Laser trimmer.
- Reel to reel electroplating.
- Dies and presses for metal strip stamping.
- Plastic injection machines.
- Quality testing laboratory: climate chambers, profile projectors, mechanical life equipment, shakers...



Company certificates:

ISO 9001 (ER-0205/1994)

ISO/TS 16949 (IATF: 0117469, RA02-0006/2005)



Sometimes we have ideas that seem to clash with the world, as we know it. But if we are willing to take a different approach and look at things from a different point of view; they might become a reality. This way of thinking confirms what we understood at ACP some time ago: to be innovative we need to look at things from a different perspective, we need to challenge the established standards. Facing this situation, we have reversed the first rule of industrial production: instead of designing to manufacturing, we manufacture for design. It is the only way to make ideas and the reality compatible and to come up with advanced concepts... We do know that there is no more powerful tool than imagination.

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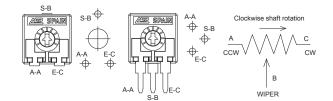


GENERAL CONCEPTS

Potentiometer configuration

The pin that corresponds to the reading of the wiper is pin B.

A and C are connected to the ends of the resistor, being pin A the initial position and C the final position.



Electric use

Variable resistor

When pins A and B or C and B are connected, the current goes through the wiper (blue line).

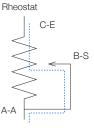
Depending on where in the resistor the wiper is placed, it indicates a lower resistive value than the whole resistor would (we say it is used as variable resistor or rheostat). Voltage divider

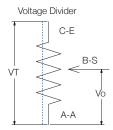
When a voltage is applied between the ends of the resistor (A and C), the current goes through the resistor, not the wiper.

The wiper sees a proportional share of the voltage applied between the ends (we say this is a Voltage Divider).

The output is a voltage, measured in V.







Resistance

Total resistance (RT):

It is the resistance found between the input terminal and the wiper when the latter is positioned to give the maximum value.

Electric noise or contact resistance (Rc):

Noise is any variation in the output signal that does not correspond to a similar variation in the input signal. It appears in the contact point between the resistive element and the wiper. It is measured in Ohms.

This noise can also be measured as "contact resistance variation" (CRV), which is expressed in the percentage of change between the initial resistance and the value of the resistance after a test. It is measured statically and dynamically. ACP's potentiometers have less than 5% CRV.

ACP's standard resistive values

The standard values are as follows, although values out of range can also be studied.

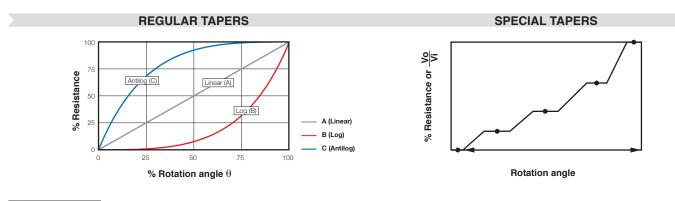
100Ω 100	200Ω 200	220Ω 220	250Ω 250	470Ω 470	500Ω 500	1KΩ 1K	2KΩ 2K	2.2KΩ 2K2	2.5KΩ 2K5	4.7KΩ 4K7	5KΩ 5K	10KΩ 10K	20ΚΩ 20Κ	22KΩ 22K
25KΩ	47KΩ	50KΩ	100KΩ	200KΩ	220Kg	2 2	50KΩ	470KΩ	500KΩ	1MΩ	2MΩ	2.5MΩ	4.7MΩ	5MΩ
25K	47K	50K	100K	200K	220K	. 2	250K	470K	500K	1M	2M	2M5	4M7	5M

Variation laws - 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 bellow.-

ACP can also provide with tapers with different slopes, with areas with constant value or jumps, according to customer's specifications.

Special tapers can be combined with physical detents to match the areas where the customer wants to guarantee a constant value with a particular angular position. This is particularly suitable in applications which can benefit from a feeling of maintained control over the position, for example, regulation of temperature or speed.



Linearity

with a straight line.

The term "linearity" implies that the real law obtained from plotting angular position vs voltage output is compared

Independent linearity (LN)

It is the maximum vertical deviation of the real law from the straight reference line chosen to best minimize the distance from the real line in any position.

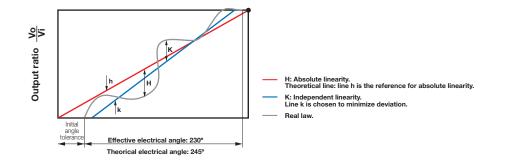
It is expressed as a percentage of the total voltage applied.

In the graph below, "K" would be the maximum independent linearity and "k" the line with which the real law is compared.

Absolute Linearity (LA)

It is the maximum vertical deviation of the real law from the straight reference line that runs through specified minimum and maximum points. These points would be zero and 100% of the maximum applied voltage.

In the graph below, "H" would be the maximum absolute linearity of the real law and "h" the theoretical line with which the real line is compared. When some customers are looking for correspondence of angle and value, this is the concept to consider.



Recommended soldering conditions

Soldering conditions (Lead free, RoHS compliant)*

	Manual soldering	Reflow soldering SMD	Flow (wave) soldering
	Soldering tools of 20W max.	Preheating temperature: Max 150°C; 60-90 s	Recommended Alloy: SnAgCu
	Maximum temperature of soldering tools: 280°C	Temperature Ramp-up: 2-3°C / s.	Preheating stage: Max 100°C; 30-60 s.
	Time: 3 s. max.	Over 220°C:<40 s.	Temperature Ramp-up:1.2-2.5°C/s.
0		Solder temperature: 240°C for 5 ± 1 s.	Max. wave temp.: 260°C for 4s., (245°C recommended)
5		Besides recommended conditions, ACP SMD potentiometers have successfully passed tests at 260°C (air temp) for 10s.	Time within +0°-10°C of peak: 10s.
			Cooling rate: 5°C/s.

 $({}^{\star})$ For other information on soldering conditions, please, contact us.







CARBON – CA6 🕅

6mm 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.
- Self-extinguishable plastic parts according to UL 94 V-0 under request.

Applications

6mm potentiometers are mainly used in trimming applications, in different markets:

- Industrial: Timers and relays, dimmers, adjustment of output.
- Electronic appliances: volume regulation, temperature controls and function selection.
- Automotive: Lighting regulation, dimmers.
- Measurement and test equipment.
- Telecommunication equipment (antenna amplifiers and receivers, videocomm, intercomm).
- Alarm systems.

CA6 🖷 HOW TO ORDER

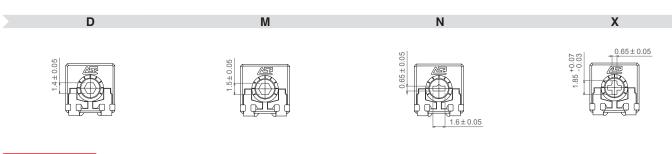
EXAMPLE: CA6XV2,5-10KA2020 SNP PI WT-6030-BA

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MD	VESN			10100														
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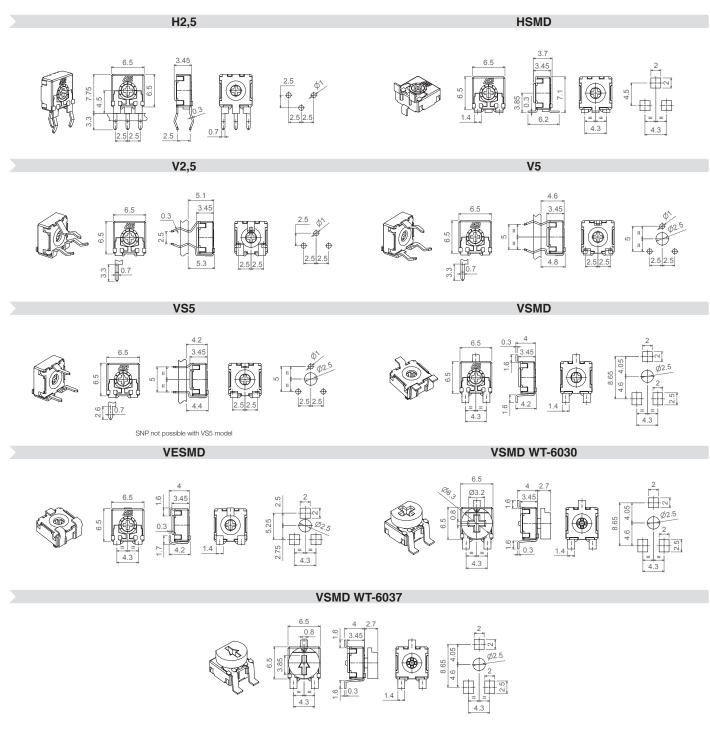
Rotors

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

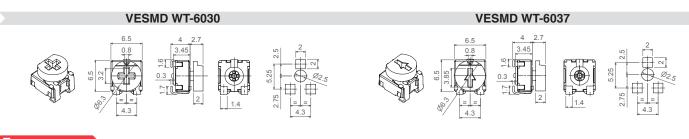


Models

All models shown here have the most common rotor for 6mm potentiometers: the X rotor. Different rotors are available from the menu above.

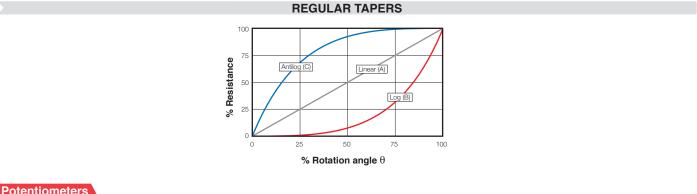


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Tapers

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.



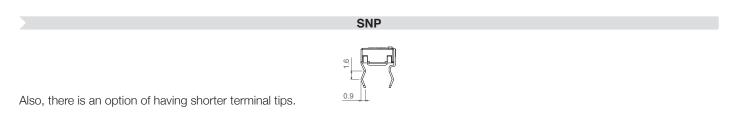
Potentiometers with cut track

The cut track is an area with very high resistive value, resulting in an open circuit. It is widely used in lighting applications. 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.



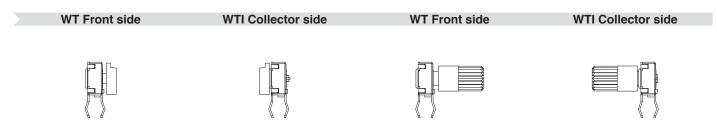
Terminals

By default, terminals are always crimped (with snap in, "SNP") to better hold the component to the PCB during the soldering operation, except for VS5, with short terminals that do not allow for SNP. ACP can provide straight terminals if needed.



Possibilities for insertion of accessories

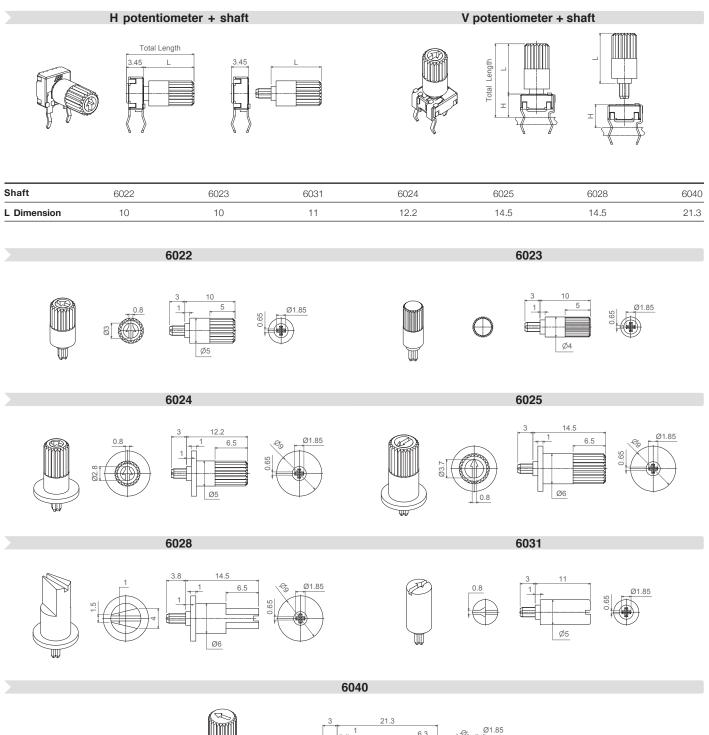
Accessories can be mounted on potentiometers through either the front side (WT) or the collector side (WTI). For the specific angular position of shafts with planes, a drawing with the exact position is requested.

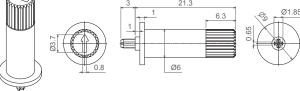


Shafts are available in different colors (color chart in "how to order" section) and with self-extinguishable property, according to UL 94 V-0, under request. ACP can study special shaft designs.

Shafts can be sold separately or delivered already mounted on the potentiometer at ACP.

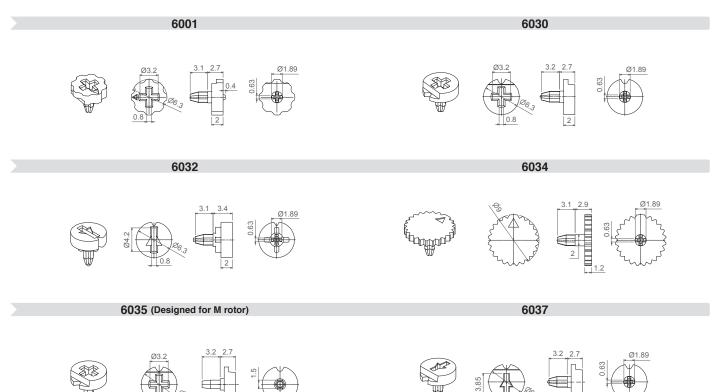
When a shaft is mounted on a potentiometer, the distance from the top of the potentiometer to the top of the shaft is marked with "L" in the table below, as shown in the drawings:





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 (see models with WT-6030 or WT-6037) or sold separately. ACP can study special thumbwheel designs.



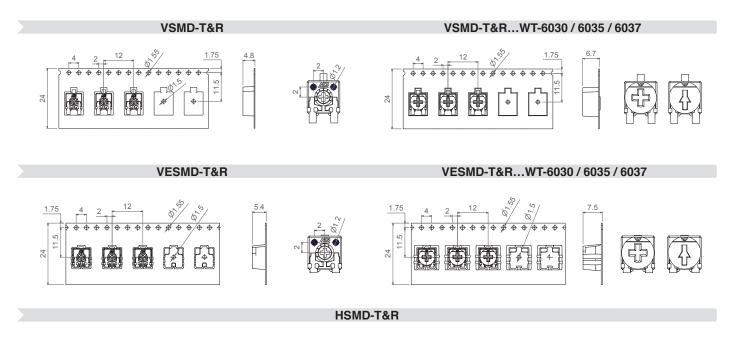
Packaging

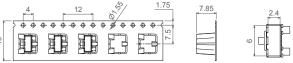
Bulk packaging:

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)
	None, only potentiometers.	1.000	4.000
H2,5 - V2,5 - V5	6001, 6030, 6032, 6035, 6037	1.000	3.000
VS5 - HSMD - VSMD - VESMD	6024, 6025, 6028	300	To be determined.
	6022, 6023, 6031	500	To be determined.

Tape & Reel packaging:	With thumbwheel inserted?	13" Reel (Standard), with 24mm width tape	15" Reel, with 24mm width tape
VSMD - VESMD	None, only potentiometers.	1.200 pcs per reel, 12mm step between cavities.	1.700 pcs per reel, 12mm step between cavities.
VSIVID - VESIVID	6030, 6035, 6037	750 pcs per reel, 12mm step between cavities.	1.100 pcs per reel, 12mm step between cavities.
HSMD	None, only potentiometers.	750 pcs per reel, 12mm step between cavities.	1.000 pcs per reel, 12mm step between cavities.
	With specific thumbwheel.	Under request.	Under request.

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







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

	CA6 Through-hole	CA6 SMD
Range of resistance values* Lin (A) Log (B) Antilog (C)	100Ω ≤ Rn ≤ 5MΩ 1 KΩ ≤ Rn ≤ 2M2Ω	$100\Omega \le Rn \le 1M\Omega$ 1 K $\Omega \le Rn \le 1 M\Omega$
Tolerance* Rn < 100 Ω : 100 $\Omega \le Rn \le 100K\Omega$ 100K< Rn $\le 1M\Omega$: 1M Ω < Rn $\le 5M\Omega$: Rn > 5M Ω :	+50%, -30% (out of range)	- ±25% ±25% ±50% -
Variation laws	Lin (A), Log (B), Antilog (C). Ot	her tapers available on request
Residual resistance	Lin (A), Log (B), Antilog (C) \leq 5	5*10-3*Rn. Minimum value 2Ω
CRV - Contact Resistance Variation (dynamic)	Lin (A) Electrical Angl Other tapers,	
CRV - Contact Resistance Variation (static)		le 215°±20° ≤ 5%Rn. please inquire
Maximum power dissipation** Lin (A) Log (B), Antilog (C)	0.1	50°C 0W 6W
Maximum voltage Lin (A) Log (B), Antilog (C)		VDC /DC
Operating temperature	-25°C +70°C (-	+85°C on request)
Temperature coefficient $100\Omega \le \text{Rn} \le 10\text{K}\Omega$ $10\text{K}\Omega < \text{Rn} \le 5\text{M}\Omega$	+200/ -300 ppm +200/ -500 ppm	+200/ -500 ppm +200/ -1000 ppm

* Out of range ohm values and tolerances are available on request, please, inquire.

** Dissipation of special tapers will vary, please, inquire.

Mechanical Specifications		
	CA6 Through-hole	CA6 SMD
Resistive element	Carbon technology	Carbon technology
Angle of rotation (mechanical)	235° ± 1	0°
Angle of rotation (electrical)	215° ± 2	0°
Wiper standard delivery position	50% ± 1	5°
Max. stop torque	4 Ncm	
Max. push/pull on rotor	9.8 N	
Wiper torque*	<2 Ncn	n
Mechanical life	1.000 cycles (others ava	ailable on request)

* Stronger or softer torque feeling is available on request.

Test results

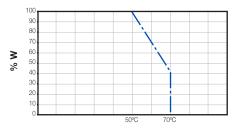
The following typical test results are given at 23°C $\pm 2^{\circ}$ C and 50% $\pm 25\%$ RH.

CA6 Through-hole and SMD

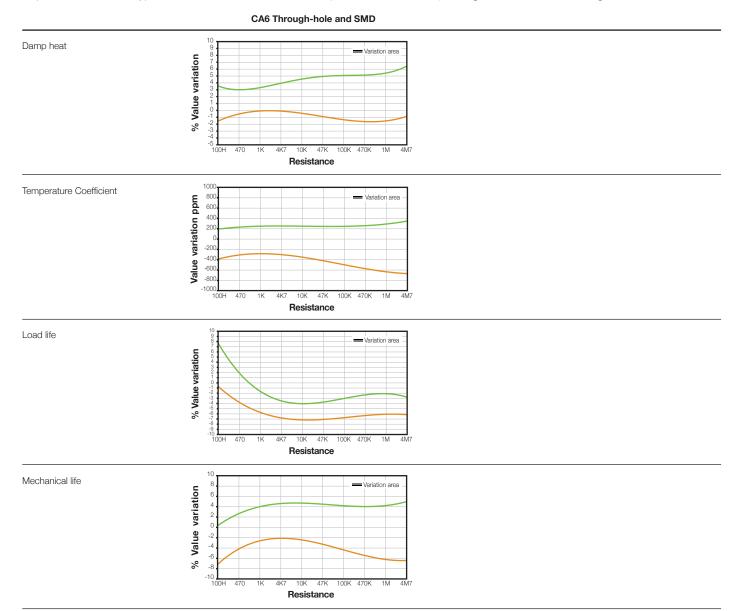
	Test conditions	Typical variation of nominal resistance
Damp heat	500 h. at 40°C and 95% RH	+5%, -2%
Thermal cycles	16 h at 85℃, plus 2 h at –25℃	±2.5%
Load life	1.000 h. at 50°C	+0%; -6%
Mechanical life	1.000 cycles at 10 c.p.m. and at 23°C \pm 2°C	±4%
Soldering effect	2 seconds at 350°C	±1%
Storage (3 years)	3 years at 23°C ± 2°C	±3%

CA6 Through-hole and SMD

Power derating curve:



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









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 A CE9 A HOW TO ORDER

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

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

Standard	featur	es						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	М	H2,5		- 10K	А	2020				SNP			PI		WT	-9005	-BA	-V0

Standard configuration:	CA9 Through-hole	CE9 Through-hole and SME			
Dimensions:					
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.			

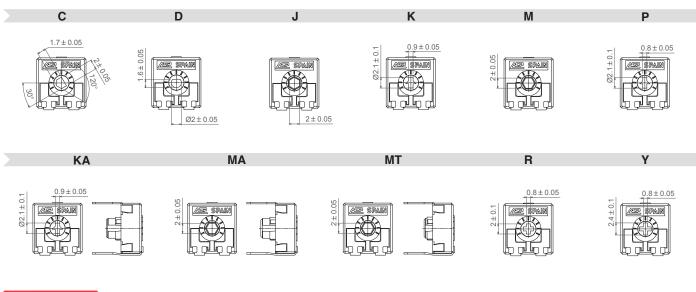
Customized products: A drawing is requested when ordering a customized product. Series, rotor, model and total resistive value are indicated before the code that includes all special specifications. Example: CA9PH2,5-10K CODE C00111.

CA9)	CE9												SNAP IN	ΝP		
2 - R	otoro													SNAP II	۱J		
C	D		J	K	K	A	М	MA	MT		P	R	Y	Shorter	tip of tei	minal, TPX	Х,
														12 - Ho	usina		
<u>3 - M</u> H2,5	odel		<mark>bitch</mark> ⊣3,8		HS	33,8		H5		HS	MD		V7,5	-		other than	sta
V10		VK10		VR		,	V10	MTV1	0	-		MD WT		13 - Ro	tor		
		VICI		••••		100	10							Color: F	or colors	other than	sta
<u>4 - Pa</u>	acka	ging			٦		h-hol	e			D mo			* Self-e	xtingui	shable pr	ор
Bulk						(blar	1k) ⁽¹⁾			(b	lank)	(1)		,		n is non self extinguishab	
T&R (Tape	and 1	3" ree	el)		(N.	A.) ⁽²⁾				T&R			and rotor	r are V0 i	f only the ho	
T&R (Tape	and 1	5" ree	el)		(N.	A.) ⁽²⁾			-	T&R15	5		If only rot	or: RT-V	0	
(1) If blar	nk, bulk	packagi	ng is imp	olied. (2)	N.A., No	t Applica	able: Tape	and Reel p	ackaging	is only a	vailable f	or SMD te	rminals.	14 - Wi			
5 - Re	esist	ance	value	•										Wiper p	ositior	(Standard	1:
100Ω	200Ω	220Ω	250Ω	470Ω	500Ω	1KΩ	2KΩ .	500KΩ	1MΩ	2MΩ	2M2Ω	4M7Ω	5MΩ	Initial or	CCW		
100	200	220	250	470	500	1K	2K	500K	1M	2M	2M2	4M7	5M	Final or	CW		
с . р.			law /											Others:	followin	g clock po	siti
Lin - L			iaw /	tape						A				Wiper t	orque	Standard:	<2
										B				Low tor	que, < 1	.5Ncm	
Log -	-			io						С				15 - Lir	nearity		
Antilog									CODE	-	~~~			Not con	trolled		-
- Spec	Jiai la	apersi	lave (codes	assigr	ieu:			CODE	. 1777	~~			Independ	dent linea	arity controll	ed
7 - To	olera	nce												Absolute	e lineari	y controlle	d a
±20%			±30	0%		+50%	6,-30%)	±10	%		±5°	%			-	
2020			30	30		50	030		101	0		050)5			neters wit n terminal s	
8 - Oj	perat	ting L	ife (C	ycles)									Assemb	led fron	n collector	sic
Stand	ard (*	1.000	cycle	s)	-						(leave b	lank)	Accesso			
Long li	fe: LV	+ the I	numbe	er of cy	cles. ex	:: LV10) for 10.	000 cycle	es. (other	rs on requ	iest) L'	VXX: ex:	LV10			s and thun	
			_											Color of Non self-		r thumbwh	ee
_				n circu		fully (PCI						le according	y tc
<u> </u>			-	ing of	-											odifies only t	
Open 10 - E				track,	fully C	;vv			1	PCF				Accesso	ory refer	pare acce ence - colo) is a blue :	or-
		-	-	inning						DTI				Color c	hart fo	r rotor, ho	bus
One d	letent	t at the	e end							DTF				Black ⁽¹⁾	White	Neutral	
X num	nber d	of dete	ents						XD1	: 10D	Т			NE	BA	IN	-
			ilablo or		· If you n	eed to :	assign a v	oltage valu	e to each	1 detent	nlease i	nauire		(1) black is	not an opt	ion for housing	s.

11 - Ie	rminals								
SNAP II	ΝP							SNF)
SNAP II	NЈ							SNJ	
Shorter	tip of ter	minal, TP	XX, where	e XX is tij	p length (under reques	t) 7	FPXX, ex:	TP25
12 - Ho	ousing								
Color: F	or colors	other tha	n standarc	I: -See co	olor chart	below-	CJ-co	lor, ex., re	d: CJ-RO
13 - Ro	otor								
Color: F	or colors	other tha	n standarc	I: -See co	olor chart	below-	RT-col	or; ex., blu	ue: RT-AZ
By defau For carb and roto	ilt, carbor on: self-e	n is non se xtinguisha only the l	elf-extingui	shable, c ty can be	ermet is s e added. \	and roto elf-extingui /0 means h CJ-V0.	ishable:	,	olank) V0), RT-V0
14 - W	iper								
Wiper	position	(Standa	rd: 50%	± 15°)				(leave bl	ank)
Initial or	CCW							PI	
Final or	CW							PF	
Others:	following	g clock p	ositions;	at 3 hou	urs: P3H			PXH, ex:	РЗН
Wiper	torque (Standard	l: <2.5Nc	m, for de	etents: <	3.5)		(leave bl	ank)
Low tor	que, < 1	.5Ncm						PGE	3
15 - Lii	nearity								
Not cor	ntrolled							(leave bl	ank)
Indepen	dent linea	rity contro	olled & belo	ow x%, fo	or example	e, 3%: LN3	% LI	Nx%; ex:	LN3%
Absolut	e linearit	y control	led & belo	w x%				LAx9	6
16 - Po	tentiom	eters w	ith asser	nbled a	ccessor	ies			
Assemb	oled from	i termina	side					WT	
Assemb	oled from	collecto	r side					WTI	
	ory Refer of shafts		mbwheel	s availab	ble		E>	-XXXXX (ample: 9	
		thumbw	/heel				-YY Ex	ample, w	/hite: BA
Self-extin		e accordir	ng to stand the acces)		(leave bla -V0	ank)
Access Ex. 901	ory refere 0-AZ-V0	ence - co is a blue		nability. nguishat		thumbwh		XXXX-YY	-V0
Black ⁽¹⁾	White		Transp.	Red	Green	Yellow	Blue	Grey	Brown
NE	BA	IN	TA	RO	VE	AM	AZ	GS	MR

Rotors

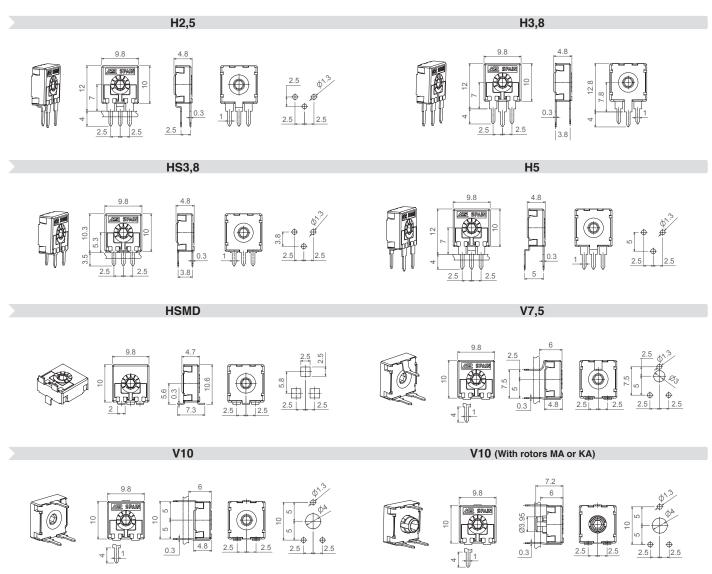
Rotors are drawn in their standard positioning, 50% of rotation. Alternative delivery positioning can be requested. Accessories in this catalogue are designed for the M rotor, unless otherwise stated.



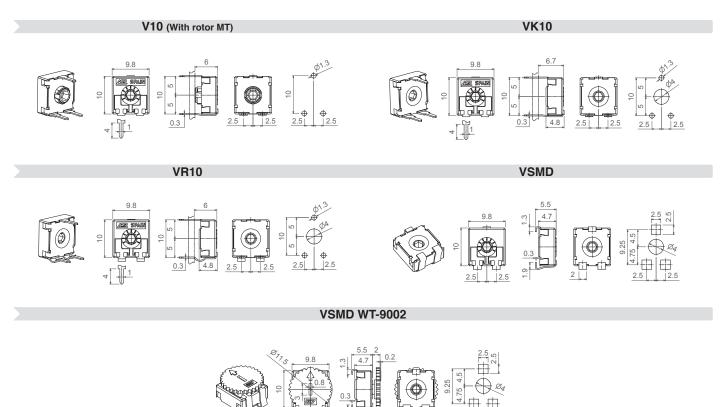
Models

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

from the menu above.



CA9 🖷 CE9

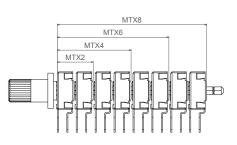


GANGED

2.5

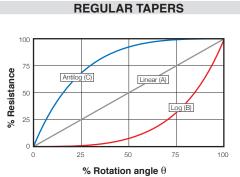
GANGED: Set of potentiometers in a row that allows for simultaneous adjustment of all of them through one shaft. Recommended potentiometer model is H2,5. MTX2 (2 potentiometers), MTX4 (4), MTX6 (6), MTX8 (8).

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.-



SPECIAL TAPERS



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.

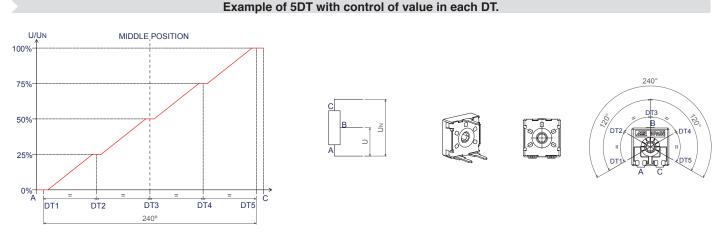
Other positions are available on request.



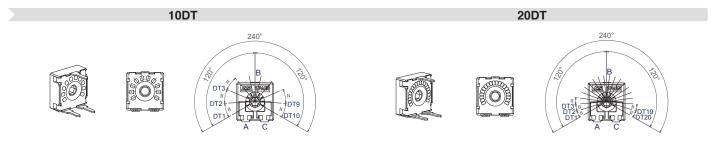
Potentiometers with detents

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:



Other examples of potentiometers with detents:



Number of standard detents (evenly distributed) already available.	1 (Initial, final or central), 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.

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

 Image: spectrum of the spect

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

 Image: Collector side
 Image: Collector side
 Image: Collector side
 Image: Collector side

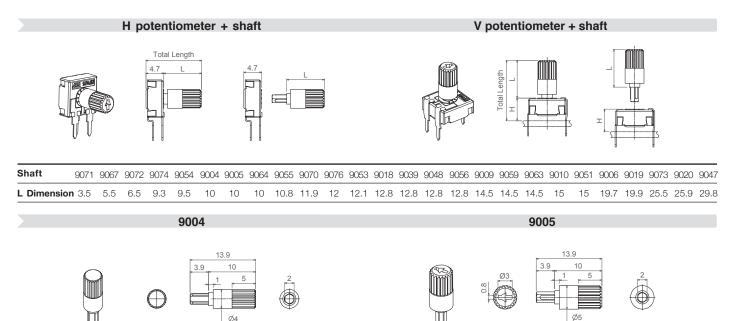
Shafts

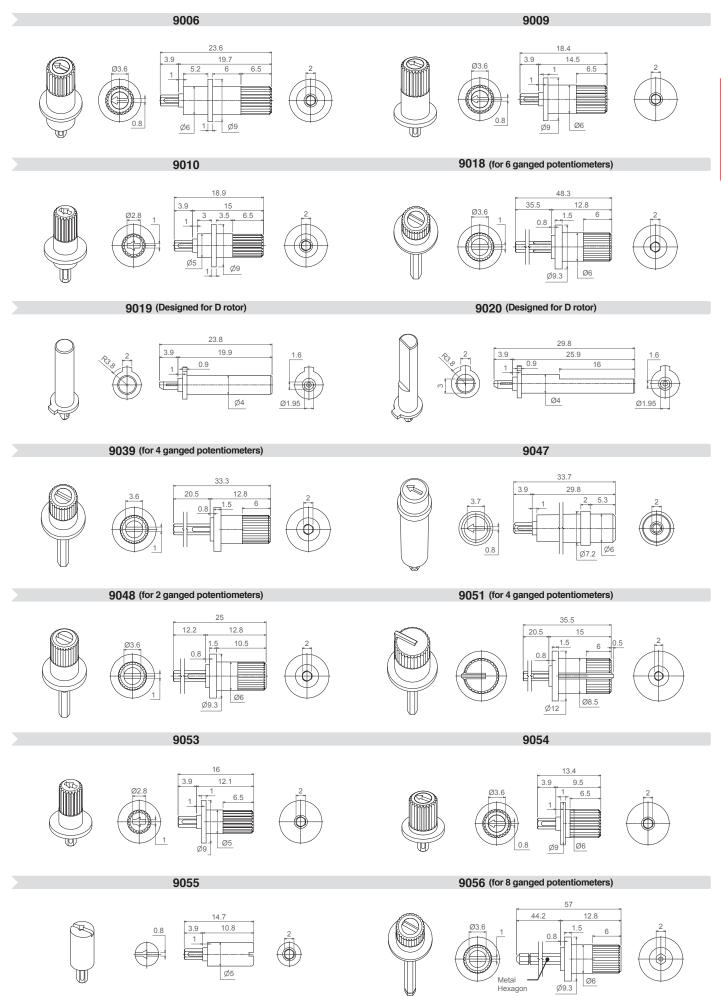
Shafts are available in different colors (color chart in "how to order" section) and with self-extinguishable property, according to UL 94 V-0, under request. ACP can study special shaft designs.

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:

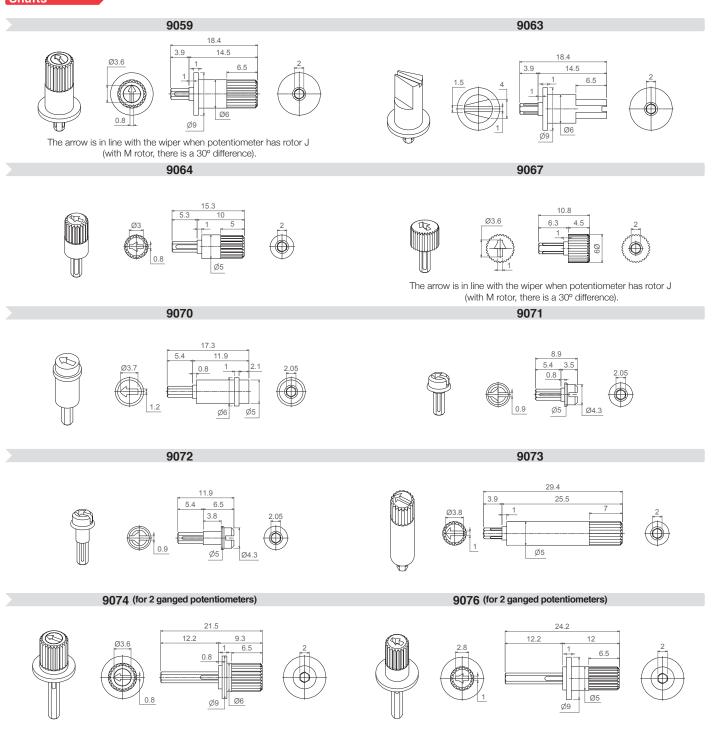




31

CA9 🐖 CE9

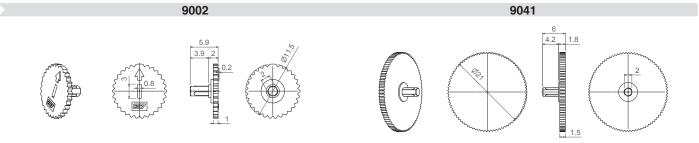


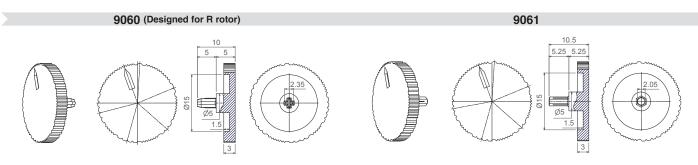


Thumbwheel

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.





Packaging

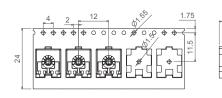
Bulk packaging:

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)	
	None, only potentiometers.	500	1.500	
	9002	250	1.000	
H2,5 - H3,8 - HS3,8 - H5 HSMD - V7,5 - V10 VK10 - VR10 - VSMD	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	
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.	

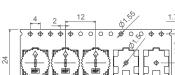
Tape & Reel packaging:	With thumbwheel inserted?	13" Reel (Standard), with 24mm width tape	15" Reel, with 24mm width tape
VSMD	None, only potentiometers.	900 pcs per reel, 12mm step between cavities.	1.250 pcs per reel, 12mm step between cavities.
UND	9002	700 pcs per reel, 12mm step between cavities.	To be determined.
HSMD		350 pcs per reel, 16 mm step between cavities	500 pcs per reel, 16 mm step between cavities

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



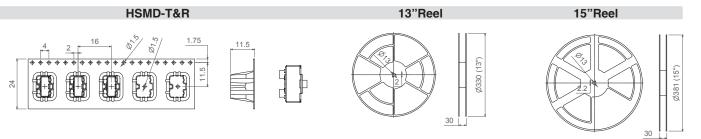






VSMD-T&R...WT-9002





Electric Specifications

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

		8	•	
	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),	_og (B), Antilog (C). Other tapers available on request		
Residual resistance	Lin (A), Log (B), Antilog (C) ≤ 5	≤2Ω		
CRV - Contact Resistance Variation (dynamic)				
CRV - Contact Resistance Variation (static)	Lin (A) Electrical Angle 220°±20° ≤ 5%Rn. Other tapers, please inquire			
Maximum power dissipation** Lin (A) Log (B), Antilog (C)	Lin (A) 0.15W		at 70° C. 0.5W 0.20W	
Maximum voltage Lin (A) Log (B), Antilog (C)	200VDC 150VDC		200VDC	
Operating temperature	erating temperature -25°C +70°C (+85°C on request)		-40°C +90°C (+125°C 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)	240° ± 5°			
Angle of rotation (electrical) 220° ± 20°				
Wiper standard delivery position	50% ± 15°			
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

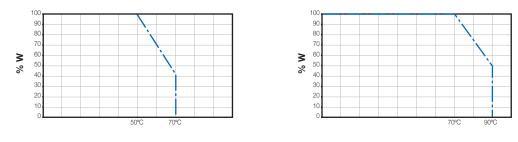
The following typical test results are given at 23°C \pm 2°C and 50% \pm 25% RH.

	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 85°C, plus 2 h at –25°C	±2.5%	16 h at 90°C, plus 2 h at -40°C	±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%	
Soldering effect	2 seconds at 350°C	±1%	2 seconds at 350°C	±1%	
Storage (3 years)	3 years at 23°C ± 2°C	±3%	3 years at 23°C ± 2°C	±1%	

CA9 Through-hole and SMD

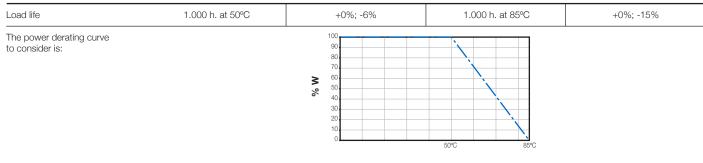
CE9 Through-hole and SMD

Power derating curve:

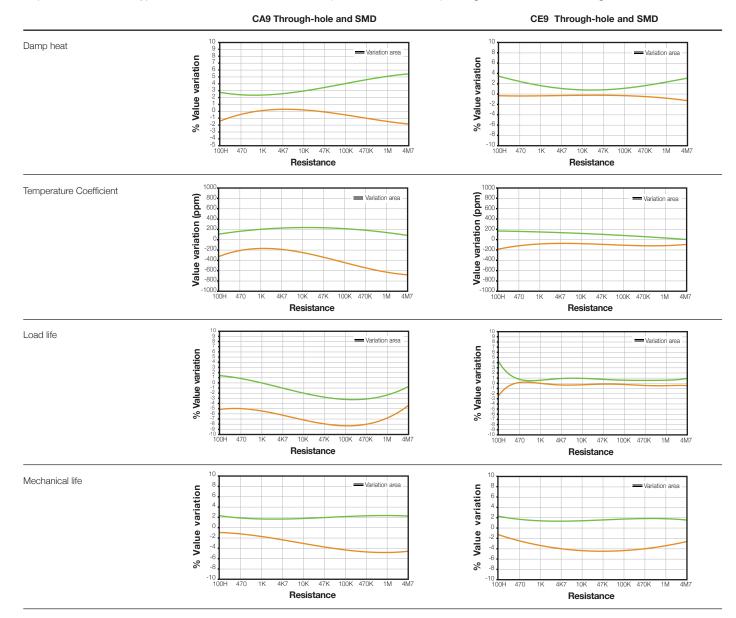


For temperatures out of range

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



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



CA9 🖷 CE9







CARBON – CA14

CERMET – CE14 🕅

14mm 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 38 detents available).
- Self-extinguishable plastic parts according to UL 94 V-0.

Applications

14mm potentiometers are mainly used in control applications in different markets:

- Electronic household appliances, heating, ventilation and air conditioning (HVAC) equipment, thermostats.
- Automotive: HVAC controls, lighting regulation (position adjustment and sensing), dimmers, seat heating controls.
- Industrial electronics: multimeters, oscilloscopes, time relays, measurement and test equipment.

14mm 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. ACP's 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 38 detents available).

Applications

14mm cermet potentiometers are used in applications where either the operating temperature is high, or where the applications requires product with excellent ohmic value stability:

- Electronic appliances: boilers, water heaters.
- Automotive: climate controls, position sensors.
- Industrial electronics: multimeters, oscilloscopes, time relays, measurement and test equipment.

EXAMPLE: CA14NV12,5-10KA2020 10DT SNP PI WT-14117-BA

EXAMPLE: CE14NV12,5-10KA2020 10DT SNP PI WT-14117-BA-V0

Standard features					Extra fe	eatures						Assemb	led acc	essory				
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		
CA14/CE14	Ν	H2,5		- 10K	А	2020			10DT	SNP			PI		WT	14117	-BA	-V0

CA14 Through-hole	CA14 SMD	CE14 Through-hole and SMD
	14mm	
	IP 54 (dust-proof) On request: Self-extinguishable, to meet UL 94 V-0	
Carbon technology	Carbon technology, special for high temperature	Cermet
Blue housing + white rotor	Brown housing + grey rotor	Brown housing + white rotor
	Bulk	
	at 50% ±15°	
	Straight, without crimping.	
	Resistive value marked on housing. Others on request.	
	Carbon technology	14mm IP 54 (dust-proof) IP 54 (dust-proof) On request: Self-extinguishable, to meet UL 94 V-0 Carbon technology Carbon technology, special for high temperature Blue housing + white rotor Brown housing + grey rotor Bulk at 50% ±15° Straight, without crimping.

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: CA14PH2,5-10K CODE C00111.

	Series		cificatio	113. LAC	inpic.	UA1-	+1 1 12	_,0-10	ι.Ο	ODL	0001			
	14 🔳		4											
2 - F	Rotors	5												
В	D		E	F	G	Κ		М	Ν		Ρ	Т	Х	Z
3 - N	/lodel	and	d pitch											
HO	HC	0	H2,5	H4	H5	F	IA5	HL	5	V12,	5	VA12,5	5 VI	_12,5
VR12	2,5 \	/15	VJ15	(V15)) CFF	V	17,5	VD7	,5	VD11	VS	SMD	VSMD	CY
			HS	SMD (L	Inder re	eque	st, no	ot read	lily a	vailab	le)			
4 - F	Packa	ging	9		Tr	roug	h-ho	ole			SM	D mod	dels	
Bulk						(blan	k) ⁽¹)			(k	olank)	(1)	
T&R	(Tape	and	13" ree	el)		(N.4	A.) ⁽²⁾					T&R		
T&R	(Tape	and	15" ree	el)		(N.4	A.) ⁽²⁾					T&R15		
(1) If bl	ank, bulk	< pack	aging is in	plied. (2)	N.A., Not	Applica	able: Ta	ape and R	leel p	ackaging	is only	available f	or SMD te	erminals
5 - F	Resist	anc	e value	e										
100Ω	200Ω	220	Ω 250Ω	470Ω	500Ω	1KΩ	2KΩ	500)KΩ	1MΩ	2MΩ	2M2Ω	4M7Ω	5MΩ
100	200	22	0 250	470	500	1K	2K	50	0K	1M	2M	2M2	4M7	5M
Other r	esistive	values	s available	on reque	st.									
6 - F	lesist	anc	e law /	' taper										
Lin -	Linea	r									А			
Log ·	- Loga	arithr	nic								В			
Antik	og - Ai	ntilo	garithm	ic							С			
- Spe	ecial ta	aper	s have	codes	assigne	ed:			(CODE	YXX	XXX		
7 - 1	olera	nce												
±209	6		±30	0%	+	-50%	5,-30	%		±10	%		±5°	%
2020)		30	30		50)30			101	0		050)5
8 - C	pera	ting	Life (C	Cycles)									
			0 cycle									(eave b	lank)
Lona	life: LV	' + th	e numbe	er of cyc	les. ex:	LV10	for 1	0.000 c	cycle	S. (other	s on req	uest) L\	/XX: 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) DTI One detent at the beginning 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.

SNAP IN P	SNP
SNAP IN R	SNR
Shorter tip of terminal, TPXX, where XX is tip length (under request)	TPXX, ex: TP30
12 - Housing	
Color: For colors other than standard: -See color chart below-	CJ-color, ex., red: CJ-RC
13 - Rotor	
Color: For colors other than standard: -See color chart below-	RT-color; ex., blue: RT-A
* Self-extinguishable property, V0, for housing and rotor: By default, carbon is non self-extinguishable, cermet is Self-extinguis For carbon: self-extinguishable property can be added. V0 means ho and rotor are V0. If only the housing needs to be V0, then CJ-V0. If only rotor: RT-V0	hable: (blank)
14 - Wiper	
Wiper position (Standard: $50\% \pm 15^{\circ}$)	(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%
Other features could be available on request, please, ask.	
16 - Potentiometers with assembled accessories	
Assembled from terminal side	WT

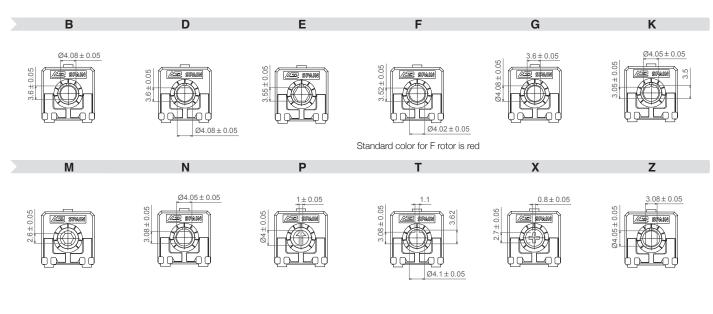
Assembled from terminal side							WT			
Assembled from collector side								WTI		
Accessory Reference See list of shafts and thumbwheels available							Exa	-XXXXX Example: 14117		
Color of shaft or thumbwheel						-YY Exa	ample, w	hite: BA		
Non self-extinguishable. Self-extinguishable according to standard UL 94 (-V0 in box 17 modifies only the accessory, please, note.)						(le	eave blar -V0	nk)		
Accesso	ory refer	ence - cc	cessories Nor- flamn Ne self-ext	nability.	able 1411	7 thumb	wheel	XXX>	<-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.

Specifications on this catalog are for reference only, as they are subject to change without notice.

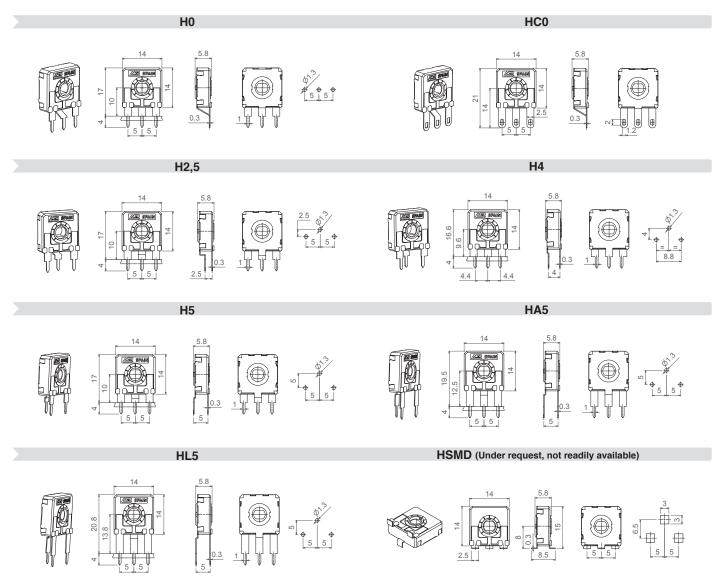
Rotors

Rotors are drawn in their standard positioning, 50% of rotation. Alternative delivery positioning can be requested. Accessories in this catalogue are designed for N, Z and T rotors, unless otherwise stated.



Models

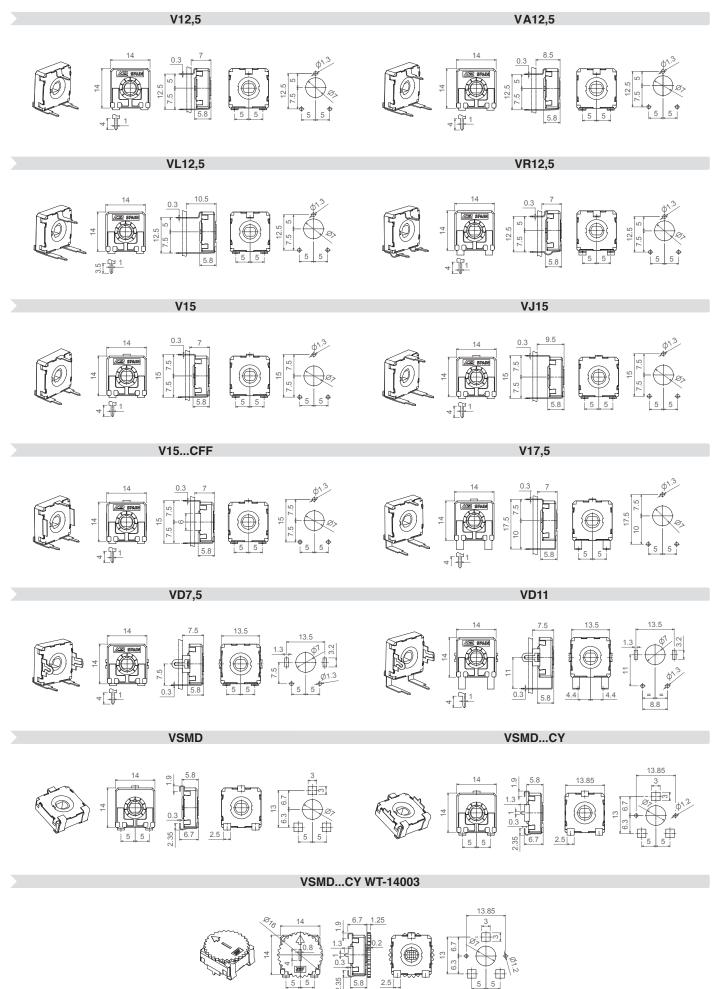
All models shown here have the most common rotor for 14mm potentiometers: the N rotor. Different rotors are available from the menu above.



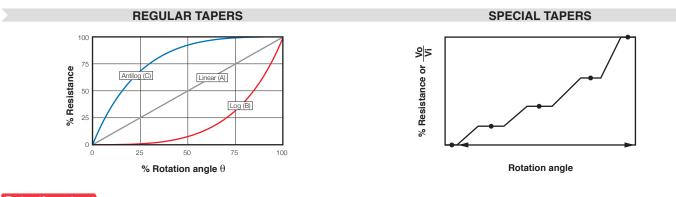
Specifications on this catalog are for reference only, as they are subject to change without notice.

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CA14 🙀 CE14 🖗



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.-



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.

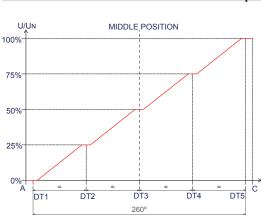
Other positions are available on request.



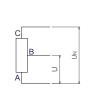
Potentiometers with detents

ACP's patented detent (DT) feature is especially suitable for control applications where the end user 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.

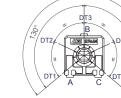
Detents can be light or strong, or even a combination of different feelings. They can be evenly distributed along the angle (standard) or tailored to match customers' request. They can also be combined with special tapers: constant value areas, open circuit zone, different slopes, etc. One common example 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.

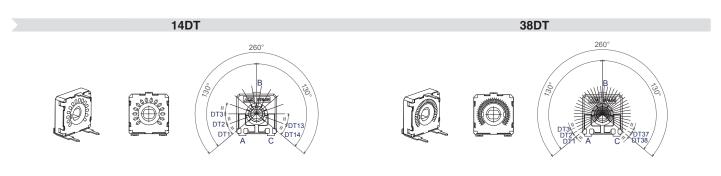






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Examples of some potentiometers with detents:



Number of standard detents (evenly distributed) already available. Other configurations are available under request.	1 (Initial, final or central), 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 17, 22, 27, 38.
Maximum number of detents for feeling only	38
Maximum number of detents when the voltage value in each detent is controlled and non-overlapping.	14

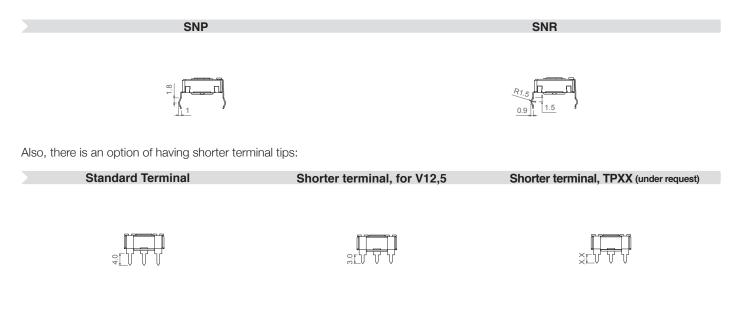
Our patented design with two wipers has improved the performance of these potentiometers, giving them more stable electrical parameters, improved reliability and Contact Resistance Variation (CRV) and narrower tolerances for detent positioning.

For potentiometers with detents, mechanical life is also 1.000 cycles, if no additional cycles are mentioned. Up to 10.000 cycles are available. Please, indicate the number of cycles needed with LV (number of cycles), for example: LV10, for 10.000 cycles.

Terminals

Potentiometers with detents

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



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.

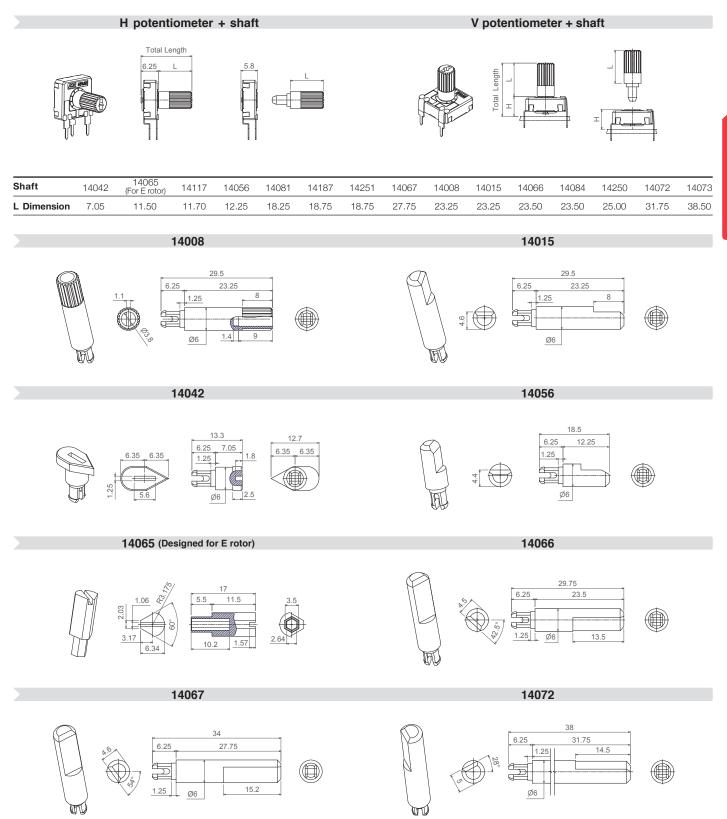
WT Front side	WTI Collector side	WT Front side	WTI Collector side
-	-	_	_
		1	
11		1 1	

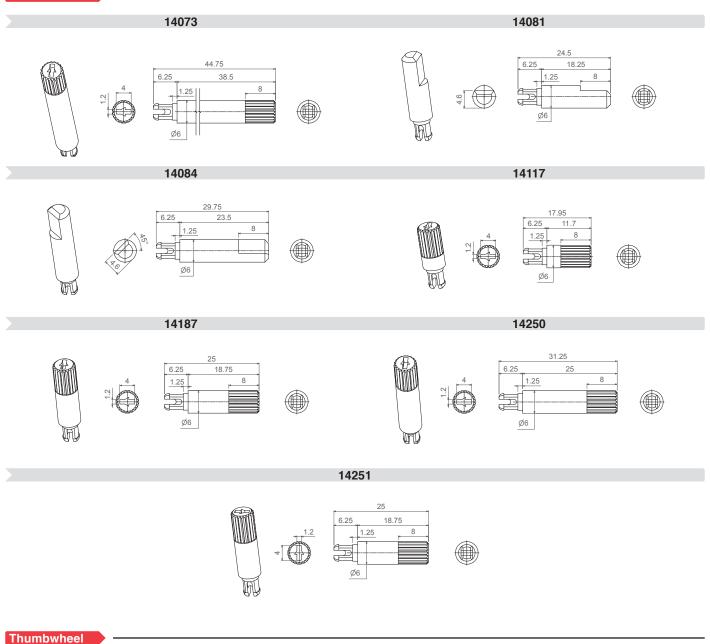
Shafts

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.

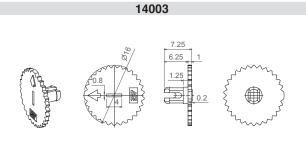
When a shaft is mounted, the distance from the top of the potentiometer to the top of the shaft is marked with "L" in the table below, as shown in the drawings:





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.



Packaging

Bulk packaging:

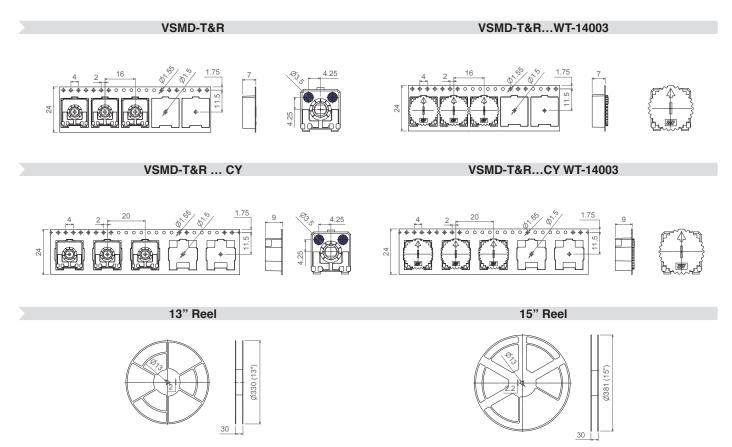
Potentiometer model	With shaft or thumbwheel inserted? Pieces per small box (150 x 1		Pieces per bigger box (250 x 150 x 70, CG on description)	
H2.5 - H4 - H5- HA5- HL5- H0	None, only potentiometers.	200 150 for models with*	700 600 for VJ15 - V17,5 - VD7,5 500 for VD11	
HC0 - V12,5 - V15 - VA12,5 VL12,5 - VJ15 - V17,5*	14003, 14117, 14042, 14056, 14065	100	400 350 for models with*	
VD11* - VD7,5* - VR12,5	14008, 14015, 14066, 14067, 14072, 14073, 14081, 14084, 14187, 14250.	75	To be determined.	

For models with * and an inserted accessory, please, inquire about the quantity per box in that case. Optional box 140x140x70 is available on request.

Tape & Reel packaging:

	With thumbwheel inserted?	13" Reel (Standard), with 24mm width tape	15" Reel, with 24mm width tape	
VSMD	None, only potentiometers.	500 pcs per reel, 16mm step between cavities.	800 pcs per reel, 16mm step between cavities.	
VOIVID	14003	450 pcs per reel, 16mm step between cavities.	To be determined.	
VSMD CY	None, only potentiometers.	350 pcs per reel, 20mm step between cavities.	500 pcs per reel, 20mm step between cavities.	
VSIMD UT	14003	350 pcs per reel, 20mm step between cavities.	To be determined.	
HSMD		To be determined	To be determined.	

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



Electric Specifications

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

			1		
	CA14 Through-hole	CA14 SMD	CE14 Through-hole and SMD		
Range of resistance values* Lin (A) Log (B) Antilog (C)	100Ω ≤ Rn ≤ 5MΩ 1 KΩ ≤ Rn ≤ 2M2Ω	$100\Omega \le Rn \le 1M\Omega$ 1 K $\Omega \le Rn \le 1 M\Omega$	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 c	n request		
Residual resistance	Lin (A), Log (B), Antilog (C) ≤ 5	5*10-3*Rn. Minimum value 2Ω	≤2Ω		
CRV - Contact Resistance Variation (dynamic)		Lin (A) Electrical Angle 245°±20° ≤ 3%Rn. Other tapers, please inquire			
CRV - Contact Resistance Variation (static)		Lin (A) Electrical Angle 245°±20° ≤ 5%Rn. Other tapers, please inquire			
Maximum power dissipation** Lin (A) Log (B), Antilog (C)	0.2	at 50°C 0.25W 0.13W			
Maximum voltage Lin (A) Log (B), Antilog (C)					
Operating temperature	-25°C +70°C (-25°C +70°C (+85°C 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

	CA14 Through-hole	CA14 SMD	CE14 Through-hole and SMD				
Resistive element	Carbon technology	Carbon technology	Cermet				
Angle of rotation (mechanical)		$265^{\circ} \pm 5^{\circ}$					
Angle of rotation (electrical)	245° ± 20°						
Wiper standard delivery position	50% ± 15°						
Max. stop torque		10 Ncm					
Max. push/pull on rotor		50 N					
Wiper torque*		<2.5 Ncm Potentiometers with detents: <3.5 Ncm					
Mechanical life	1.000 cycles (many more available on request, please, inquire)						

* Stronger or softer torque feeling is available on request.

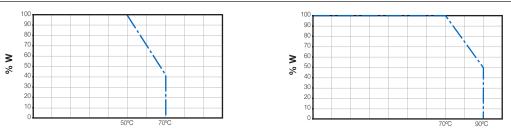
Test results

The following typical test results (with 95% confidence) are given at 23°C \pm 2°C and 50% \pm 25% RH.

	CA14 Through-	hole and SMD	CE14 Through-hole and SMD			
	Test conditions	Typical variation of Rn	Test conditions	Typical variation of Rn		
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 85°C, plus 2 h at –25°C	±2.5%	16 h at 90°C, plus 2 h at –40°C	±2%		
Load life	1.000 h. at 50°C	+0%; -5%	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	±2%		
Soldering effect	2 seconds at 350°C	±1%	2 seconds at 350°C	±1%		
Storage (3 years)	3 years at 23°C ± 2°C	±3%	3 years at 23°C ± 2°C	±1%		

Power derating curve:

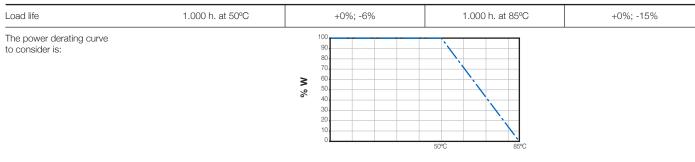
CA14 Through-hole and SMD



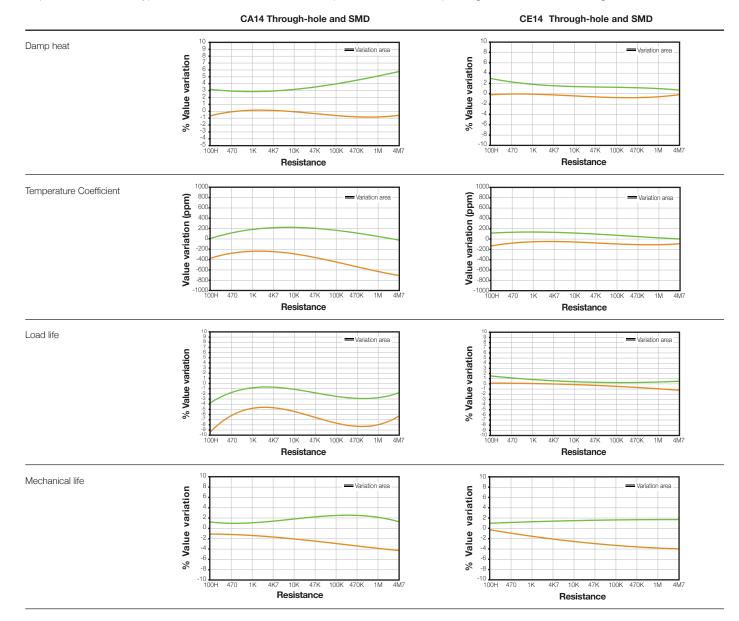
CE14 Through-hole and SMD

For temperatures out of range

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

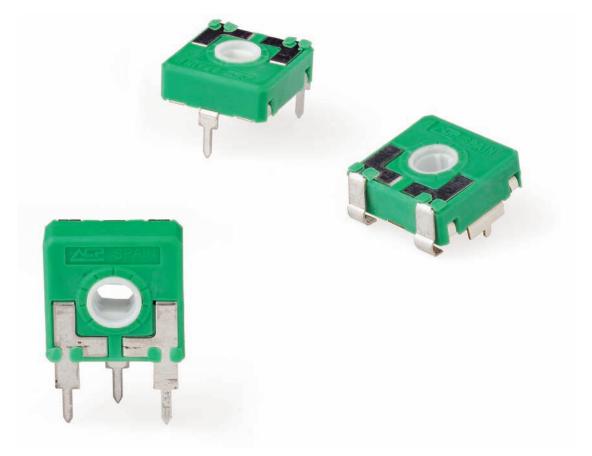


Representation of the typical variation of nominal resistance (with 95% confidence) throughout the ohm value range:



CA14 👷 CE14 👷





RS14 🖪

14mm Rotary Sensor with up to 1.000.000 cycles of mechanical life on its standard configuration, making it particularly appropriate for control applications.

RS14 has 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 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.

Standard taper is linear, with linearity of $\pm 3\%$. ACP can study other special tapers (even cut tracks, step curves with areas of constant value, etc), as well as more strict linearity.

Thumbwheels and shafts can be provided either separately or already inserted in the sensor. Our RS14 can be manufactured in a wide range of possibilities regarding: resistance value, tolerance, tapers, pitch, positioning of the wiper, housing and rotor color.

Applications

- Household appliances: temperature control, position sensor.
- Automotive: position adjustment and sensing.
- Industrial controls.

RS14 R HOW TO ORDER

EXAMPLE: RS14TV15-10KA3030 WT-14008-NE-V0

Standard	l featu	res						Extra fe	atures						Assemb	oled acc	essory	
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		
RS14	Т	V15		- 10K	А	3030									WT	-14008	B -NE	-V0
andard configuration: RS14 Through-h			ole						R	S14 SMD								
mensions: 14mm																		
otection:				IP 54 (dust-proof) On request: Self-extinguistrable, to meet UI, 94 V-0														

	Offequest. Self-extinguishable, to meet of 94 v-0				
Substrate:	Carbon technology	Carbon technology, special for high temperature			
Color:	Green housing + white rotor	Green housing + grey 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: RS14TV15-10K CODE C00111.

1 - 5	Serie	es									
RS	614										
2 - F	Roto	ors									
F				Ν				Т			Z
<u>3 - N</u>	Nod	el and	d pitch								
HO	Н	C0	H2,5	H4	H5	HA5	HL5	V12,5	VA12	,5	VL12,5
VR12	2,5	V15	VJ15	(V15).	CFF	V17,5	VD7,5	VD11	VSMD	VSN	1D CY
			ЦС		dor ro	nuoet no	t roadily	availabla	1		

HSMD (Under request, not readily available)

4 - Packaging	Trough-hole	SMD models
Bulk	(blank) ⁽¹⁾	(blank) ⁽¹⁾
T&R (Tape and 13" reel)	(N.A.) ⁽²⁾	T&R
T&R (Tape and 15" reel)	(N.A.) ⁽²⁾	T&R15

(1) If blank, bulk packaging is implied. (2) N.A., Not Applicable: Tape and Reel packaging is only available for SMD terminals.

5 - Resistance value

10K

The RS14 has 10K, linear taper and \pm 30% by default. Other resistive values, tolerances and tapers (log, antilog, cut tracks, constant value areas, etc.) can be studied on request. Please, enclose a drawing when ordering special tapers.

6 - Resistance law / taper

Lin - Linear	A		
- Special tapers have codes assigned:	CODE YXXX	XX	
7 - Tolerance			
±30%			
3030			
8 - Operating Life (Cycles)			
Standard (1.000 cycles)		(leave blank)	
Long life: LV + number of cycles. i.e: LV100 for 100.000	0 cycles, LV150, LV1M	LVXXX: ex: LV100	
9 - Cut Track – Open circuit.			
Open circuit at beginning of track, fully CCW	PCI		

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

10 - Detents (DT)

Not applicable for RS14

11 - Terminals	
SNAP IN P	SNP
SNAP IN J	SNJ
Shorter tip of terminal, TPXX, where XX is tip length (under reques	st) TPXX, ex: TP3
12 - Housing	
Color: For colors other than standard: -See color chart below-	CJ-color, ex., red: CJ-R
13 - Rotor	
Color: For colors other than standard: -See color chart below-	RT-color; ex., blue: RT-A
* Self-extinguishable property, V0, for housing and roto By default, carbon is non self-extinguishable. Self-extinguishable pr can be added. V0 means housing and rotor are V0. If only the housing needs to be V0, then CJ-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: <1.5Ncm	(leave blank)
Stronger or softer torque feeling is available on request.	
15 - Linearity	
Standard linearity 3%	(leave blank)
Independent linearity controlled & below x%, for example, 2%: LN2	2% LNx%; ex: LN2%
Absolute linearity controlled & below x%	LAx%
Other features could be available on request, please, ask.	
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: 1411

15 - Linearity	
Standard linearity 3%	(leave blank)
Independent linearity controlled & below x%, for example, 2%: LN2%	LNx%; ex: LN2%
Absolute linearity controlled & below x%	LAx%

Assembled from terminal side	WT
Assembled from collector side	WTI
Accessory Reference See list of shafts and thumbwheels available	-XXXXX Example: 14117
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. 14117-AZ-V0 is a blue self-extinguishable 14117 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 optio	on for housin	gs.						

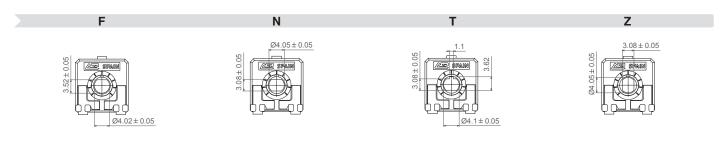
www.acptechnologies.com 50

Specifications on this catalog are for reference only, as they are subject to change without notice.

Rotors

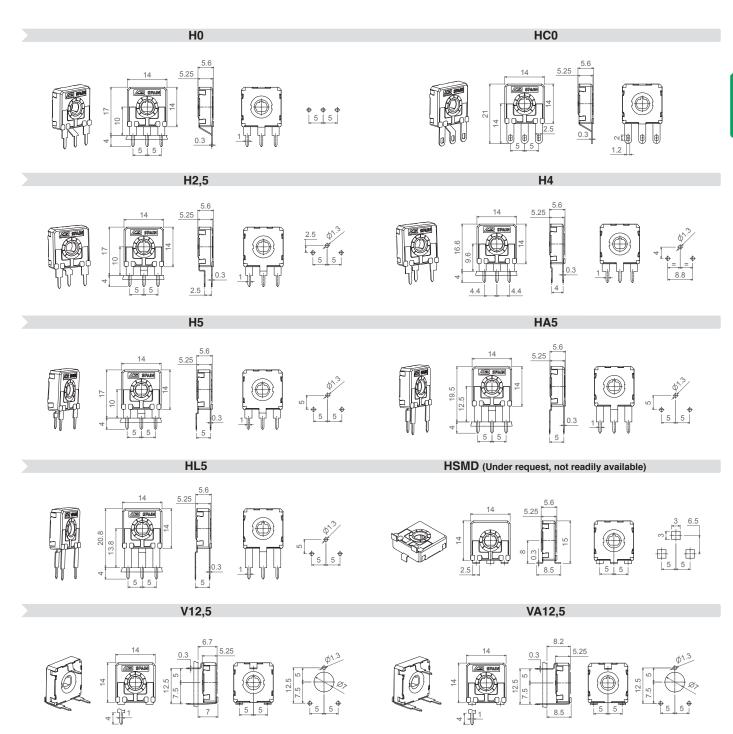
T is the standard rotor for RS14. Rotors are drawn in their standard positioning, 50% of rotation. Alternative delivery

positioning can be requested. Accessories in this catalogue are designed for N, Z and T rotors, unless otherwise stated. Other rotor styles, on request.



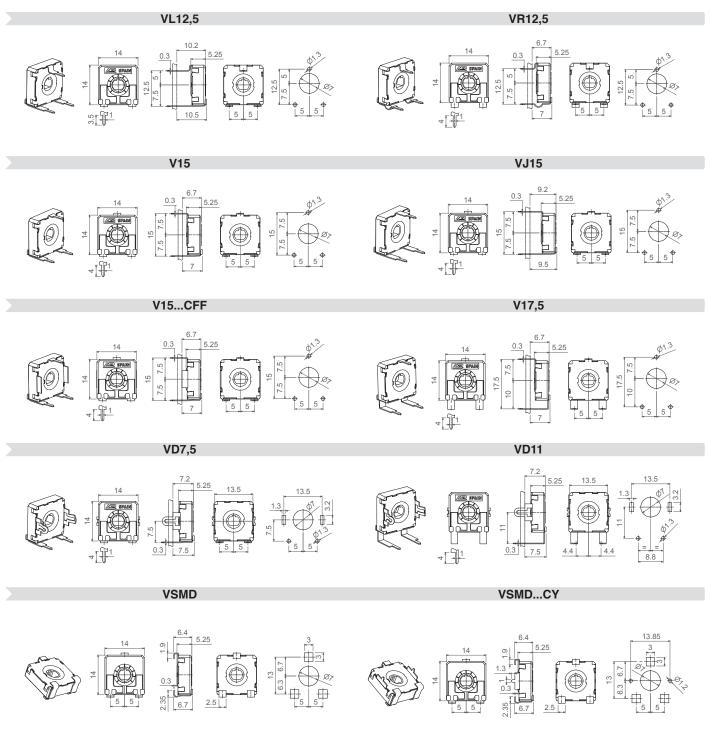
Models

All models shown here have the most common rotor for RS14, the T rotor.



Specifications on this catalog are for reference only, as they are subject to change without notice.

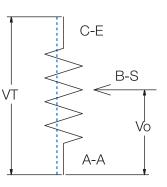
RS14 👰



Tapers

The standard taper is linear (A) and the standard ohm value is 10K, since a RS14 will normally be used as a voltage divider. For other tapers, please, inquire.

Voltage Divider



Specifications on this catalog are for reference only, as they are subject to change without notice.

Potentiometers with cut track

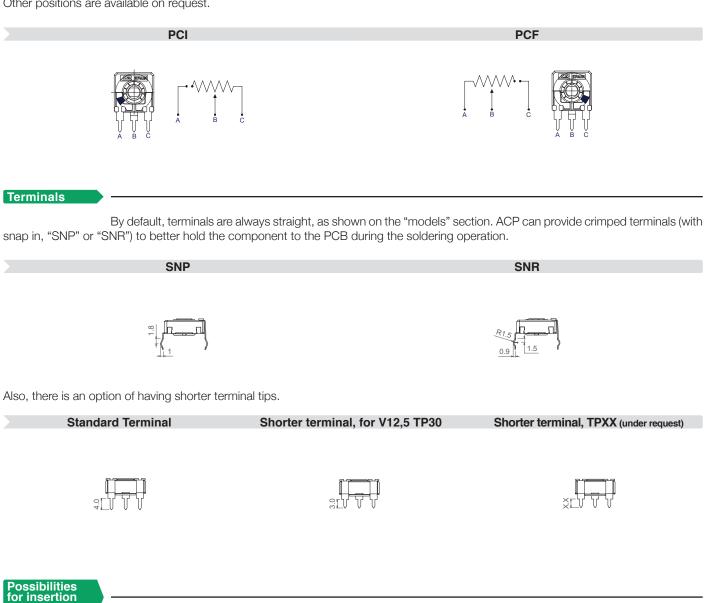
accessories

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 available with cut track needs to be confirmed case by case.

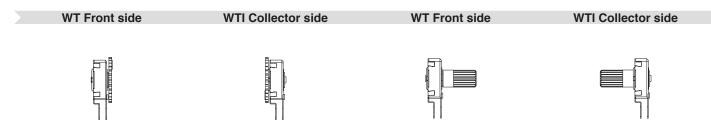
PCI = Cut at initial position, when the potentiometer is turned fully counter clockwise.

PCF = Cut at final position, when the potentiometer is turned fully clockwise.

Other positions are available on request.



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.

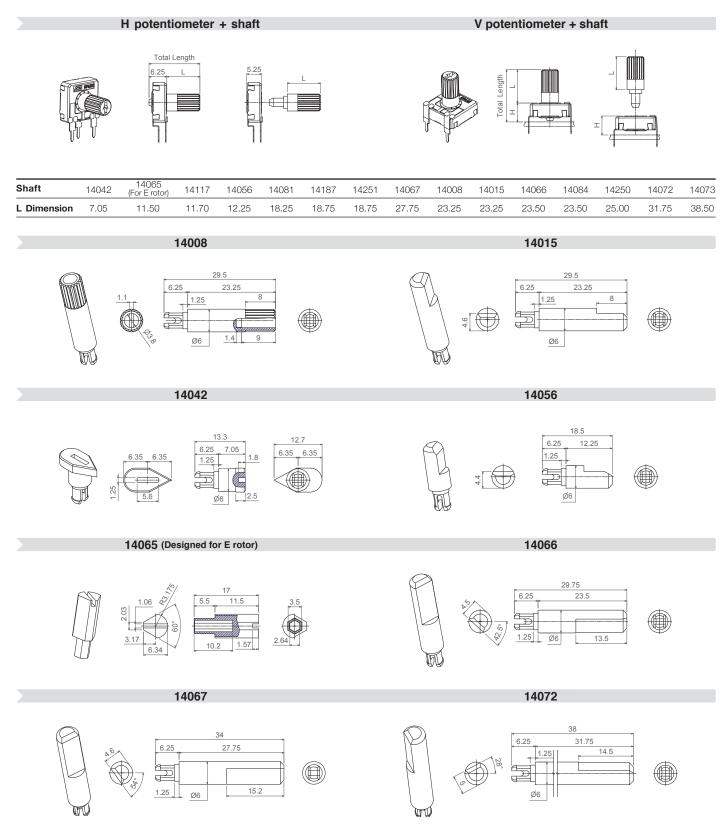


Shafts

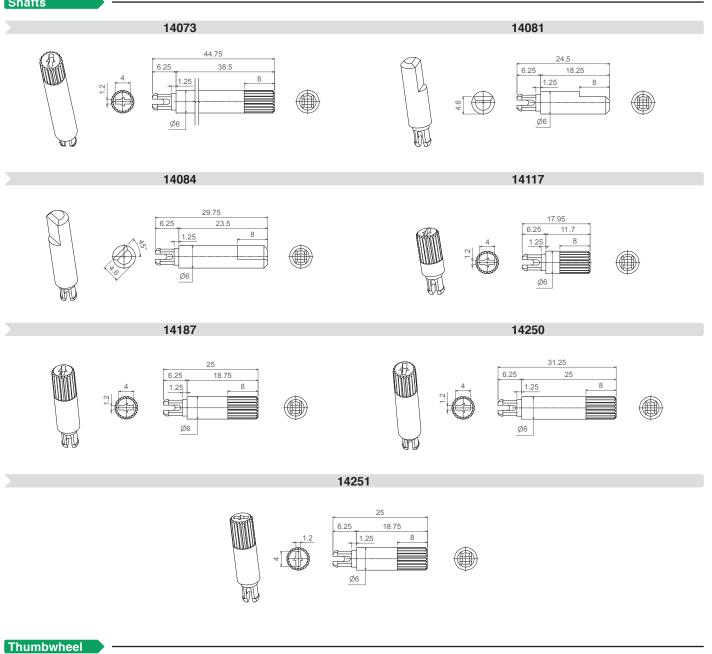
Shafts are available in different colors (color chart in "how to order" section) and with self-extinguishable property, according to UL 94 V-0, under request. ACP can study special shaft designs.

Shafts can be sold separately or delivered already mounted on the potentiometer at ACP.

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:

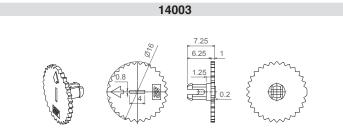






Thumbwheels are available in different colors (color chart in "how to order" section) and with self-extinguishable property according to UL 94 V-0, under request.

Thumbwheels can be mounted on the potentiometers at ACP or sold separately. ACP can study special thumbwheel designs.



RS14 🙀

Packaging

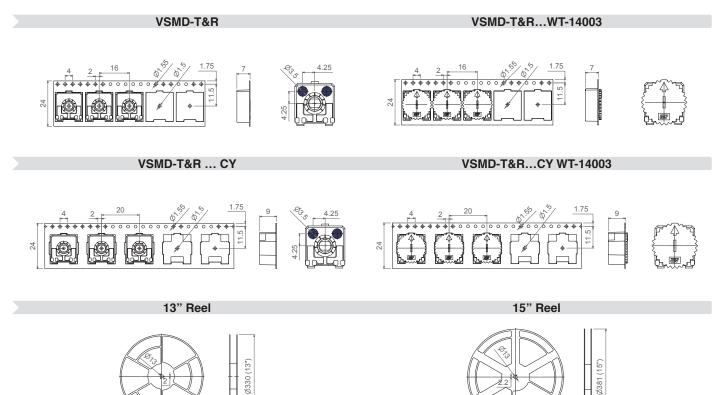
Bulk packaging:

RS14 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 - H4 - H5- HA5- HL5- H0	None, only potentiometers.	200 150 for models with*	700 600 for VJ15 - V17,5 - VD7,5 500 for VD11	
HC0 - V12,5 - V15 - VA12,5 VL12,5 - VJ15 - V17,5*	14003, 14117, 14042, 14056, 14065	100	400 350 for models with*	
VD11* - VD7,5* - VR12,5	14008, 14015, 14066, 14067, 14072, 14073, 14081, 14084, 14187, 14250.	75	To be determined.	

For models with * and an inserted accessory, please, inquire about the quantity per box in that case.

Tape & Reel packaging:	With thumbwheel inserted?	13" Reel (Standard), with 24mm width tape	15" Reel, with 24mm width tape
VSMD	None, only potentiometers.	500 pcs per reel, 16mm step between cavities.	800 pcs per reel, 16mm step between cavities.
VSMD	14003	450 pcs per reel, 16mm step between cavities.	To be determined.
VSMD CY	None, only potentiometers.	350 pcs per reel, 20mm step between cavities.	500 pcs per reel, 20mm step between cavities.
	14003	To be determined.	To be determined.

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



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

	RS14 Through-hole	RS14 SMD						
Range of resistance values* Lin (A)	Standard value is 10K, as v	oltage divider use is supposed						
Tolerance*	3	30%						
Variation laws	Lin (A). Other taper	s available on request						
Residual resistance	Minimum value 2Ω							
CRV - Contact Resistance Variation (dynamic)	Lin (A) Electrical Angle 245°±20° ≤ 3%Rn. Other tapers, please inquire							
CRV - Contact Resistance Variation (static)	Lin (A) Electrical Angle 245°±20° ≤ 5%Rn. Other tapers, please inquire							
Maximum power dissipation** Lin (A)	at 50%	C, 0.15W						
Maximum voltage Lin (A)	25	OVDC						
Operating temperature	-25°C	+85°C						
Linearity		3%						
Temperature coefficient $100\Omega \le Rn \le 10K\Omega$ $10K\Omega < Rn \le 5M\Omega$	+200/ -300 ppm +200/ -500 ppm	+200/ -500 ppm +200/ -1000 ppm						

* Out of range ohm values and tolerances are available on request, please, inquire.

** Dissipation of special tapers will vary, please, inquire.

Mechanical Specifications

	RS14 Through-hole and SMD	
Resistive element	Carbon technology	
Angle of rotation (mechanical)	265° ± 5°	
Angle of rotation (electrical)	245° ± 20°	
Wiper standard delivery position	50% ± 15°	
Max. stop torque	10 Ncm	
Max. push/pull on rotor	50 N	
Wiper torque*	<1.5 Ncm	
Mechanical life	Up to 1.000.000 cycles (please, specify the cycles needed).	

* Stronger or softer torque feeling is available on request.

Test results

	Test conditions	Typical variation of Rn
Damp heat	500 h. at 40°C and 95% RH	±20%
Temperature Coefficient	16 h at 85℃, plus 2 h at –25℃	±20%
Load life	1.000 h. at 50°C	±20%
Mechanical life	150.000 cycles at 10 c.p.m. and at $23^{\circ}C \pm 2^{\circ}C$	±20%
Storage (3 years)	3 years at 23°C ± 2°C	±3%

Power derating curve:









14mm rotary position sensor with 360° mechanical rotation angle (electrical angle up to 330°).

Two configurations available:

- Standard, 15.000 turns, combinable with detents.
- Long life, up to 1 million turns.

Our 360° rotary sensor, CS14, can be manufactured in a wide range of possibilities regarding: resistance, tolerance, tapers, click effect (up to 50), positioning of the wiper, housing and rotor color.

Standard taper is linear. ACP can study other special tapers, (even cut tracks, step curves with areas of constant values, etc) as well as more strict linearity.

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

CS14 has plastic housing and Ingress Protection rating type IP 54 (high level 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.

Thumbwheels and shafts can be provided either separately or already inserted in the sensor.

Applications

Control, function selector, position sensor for household appliances, automotive and industrial.

CS14 🌪 HOW TO ORDER

EXAMPLE: CS14NV15-10KA2020 LV15 RSN LN3% WT-14015-NE-V0

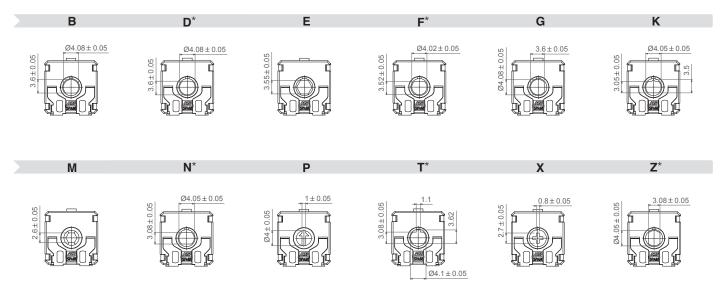
Carlos		res						Extra f	eatures						Assen	nbled a	ccess	ory	
Series	Rotor	Model	Packg.	Ohm value	Taper	Tol.	Life	Track	Detents	Snap in	Housing	Rotor	Wiper	Lin.	Assemb	ly Ref	# C	olor	Flam.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		16			
CS14	Ν	V15		- 10K	А	2020	LV15					RSN		LN3%	WT	-140	15 -	NE	-V0
andard co	onfigura	tion			63	14 Thr	ough-ho	le							CS14 SMI	ר			
nensions:	Jiligura					14 1110	Jugn-no			1.	4mm				0314 3101				
otection:										IP 54 (d	dust-proo								
bstrate:					C	arbon to	chnolog		equest: Se	elf-extingu	uishable, t				, special fe	or bigh t	ompo	ratura	
lor:							q + white	, 				U.		0.	$\frac{1}{10000000000000000000000000000000000$	0		ature	
ckaging:					Ciccii		ulk	10101							T&R	JIEY IOL	/		
per positio	on:									at 50)% ±15°								
minals:					Straig	ht, with	out crim	oing.							J-Lead				
irking:								°.	/e value m	narked or	housing	Others	on reque	st.					
special sp Series				s requester S14NV15-				nized pro	1	12 - Hou	sing				e indicated				
S14											COURS OT	iei (Haft) S	ianuaru: -	See COIC	or chart belo	JVV-	-00-CO	or, ex.,	ieu: C
Rotors	E	F*	G	K M	N*	P	T*	Х	7* •	13 - Roto									
tors available t		·	-		IN	1	1	~	- !	Rotors N								RSI	N
Model a			io tarrior								s rotors:						(leave b	lank)
H2,5	i H	5 V [.]	12,5	V15	V15CF	F	VSMD	VSM	DCY .	Color: For	r colors oth	ner than s	tandard: -	See colo	or chart belo)W-	RT-col	or; ex., l	olue: F
Packagi Ik R (Tape ar	-	el)	(b	ugh-hole lank) ⁽¹⁾ N.A.) ⁽²⁾	•	5	SMD mo (blank) T&R	(1)	1 H 0	Not V0 (b Housing a Only hous	y default) and rotor sing V0	•	perty V0) for ho	using and	l rotor		(le	ave b VC CJ-V
R (Tape ar	nd 15" re	el)	(N.A.) ⁽²⁾			T&R1	5		Only roto									RT-\
Box: See			(,				-		14 - Wip		Yop dovd	E00/ .	1 5 0)				(100) (0	blast
		mplied (2) N								wiper po	osition (S	standard	50% ±	15*)				(leave	Diarik
г ралк, рик ра		npieu. (2) 1	I.A., Not Ap	plicable: Tape	and Reel pa	ckaging is o	only available	for SMD ter	minals.	laitial ar (ור
Resistan	ce valu				and Reel pa	ckaging is o	only available	for SMD ter		Initial or () 드
Resistan		e (see al	so page				only available		5MΩ	Final or C	W				DOLL			F	٣F
Resistan	20Ω 250Ω	e (see al Ω 470Ω 5	so page 500Ω 1K	e 10) Ω 2KΩ		1MΩ 21	VIΩ 2M29	2 4M7Ω	5MΩ 5M	Final or C Others: fo	SW Sollowing c	lock pos	itions. Ex	c at 3 hc	ours: P3H				۶F
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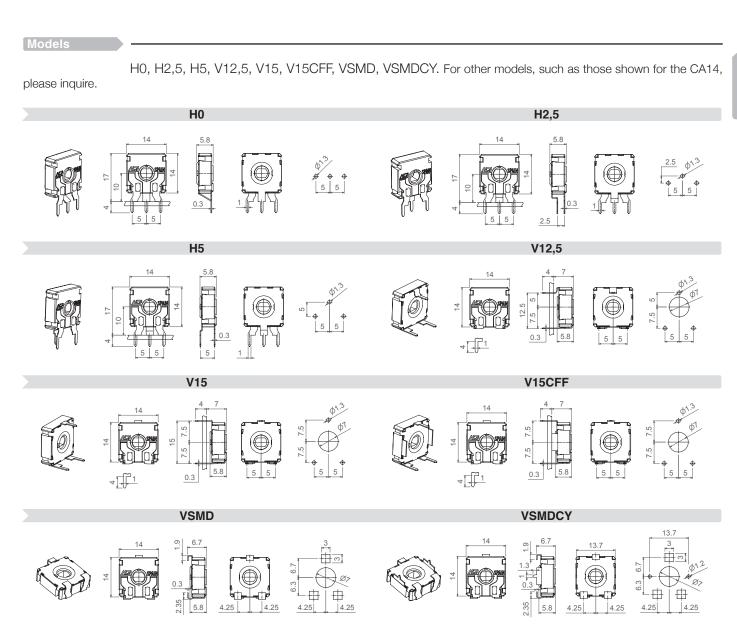
Specifications on this catalog are for reference only, as they are subject to change without notice.

N is the standard rotor for CS14, but the following options are also available. Rotors are drawn in their standard positioning, 50% of rotation. Alternative delivery positioning can be requested.

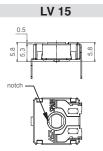
Accessories in this catalogue are designed for N, Z and T rotors, unless otherwise stated. Other rotor styles, on request.



*Please, note that for more than 15.000 turns (up to 1.000.000 turns) the following rotors are available: D, F, N, T, Z.



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Position indicating notch included on all LV15 rotors, except types M and P.

Tapers

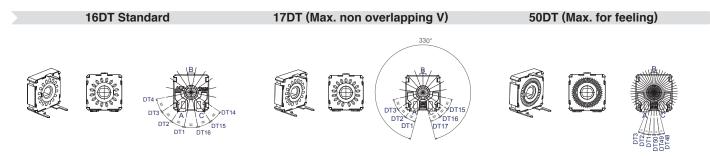
The Standard taper is linear (A). Log (B) and Antilog (C) tapers are also available, as well as special tapers according to customer specifications. See an example on the application described on page 11.

Potentiometers with detents

ACP's patented detent (DT) feature is especially suitable for control applications where the end user 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.

Examples of some potentiometers with detents:



Our patented design with two wipers gives 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 15.000 turns if no additional turns are mentioned. Please, indicate the number of turns needed. When needing a special number of detents or matching taper, a drawing is kindly requested.

Terminals

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

SNP





SNR

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

Standard Terminal



Shorter terminal, TPXX (under request)





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

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.

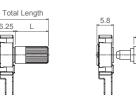
Shafts can be sold separately or already mounted on the potentiometer.

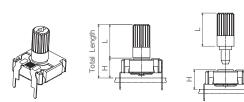
When a shaft is mounted on a potentiometer, the distance from the top of the potentiometer to the top of the shaft is marked with "L" in the table below, as shown in the drawing:

H potentiometer + shaft

6.25



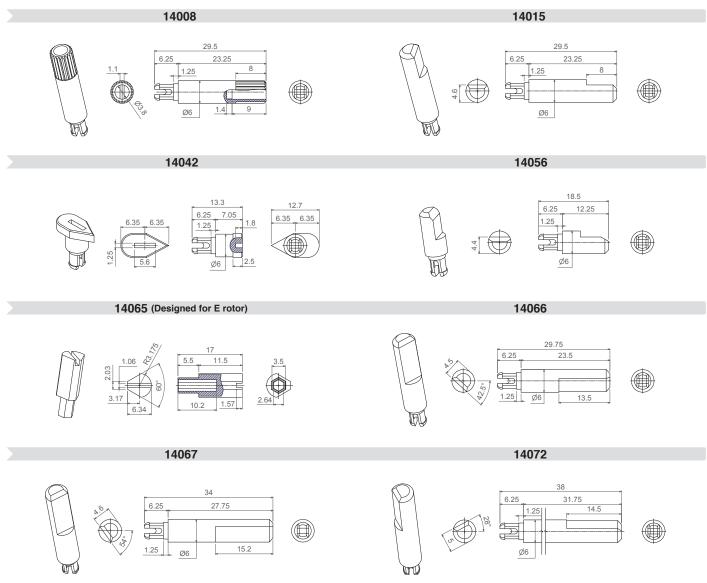




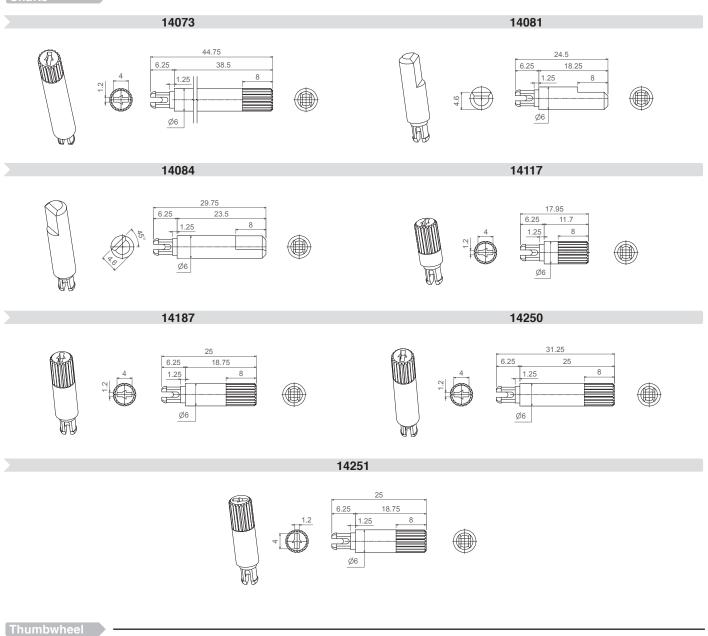
V potentiometer + shaft

(H is set by the potentiometer model. See page 5)

Shaft	14042	14065 (For E rotor)	14117	14056	14081	14187	14251	14067	14008	14015	14066	14084	14250	14072	14073
L Dimension	7.05	11.50	11.70	12.25	18.25	18.75	18.75	27.75	23.25	23.25	23.50	23.50	25.00	31.75	38.50

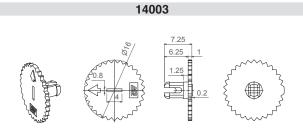


S14 🔶



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.



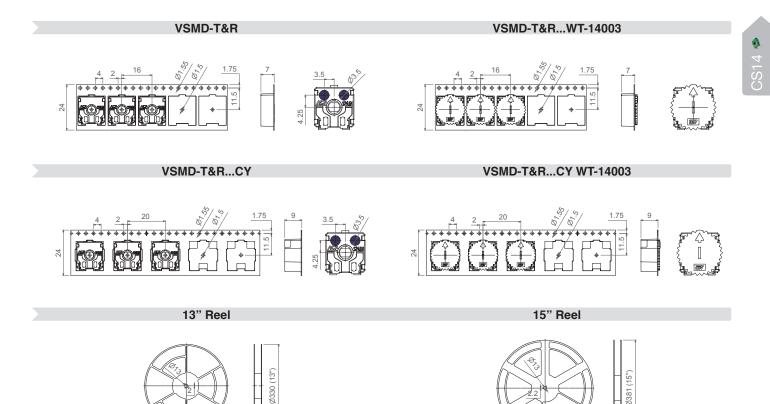
Packaging

Bulk packaging:

	CS14 model	With shaft or thumbwheel inserted?	Pieces per small box (150 x 100 x 70)	Pieces per bigger box (250 x 150 x 70) add CG at the end of the product description
ĺ		None, only potentiometers.	200	700
	H0 - H2,5 - H5 - V12,5 V15 - V15CFF	14003, 14117, 14042, 14056, 14065	100	400
		14008, 14015, 14066, 14067, 14072, 14073, 14081, 14084, 14187, 14250.	75	To be determined.

Tape & Reel packaging:	With thumbwheel inserted?	13" Reel, with 24mm width tape	15" Reel, with 24mm width tape		
VSMD	None, only potentiometers.	500 pcs per reel, 16mm step between cavities.	800 pcs per reel, 16mm step between cavities.		
(on request*)	14003	450 pcs per reel, 16mm step between cavities.	To be determined.		
VSMD CY	None, only potentiometers.	350 pcs per reel, 20mm step between cavities.	500 pcs per reel, 20mm step between cavities.		
(on request*)	14003	To be determined.	To be determined.		

Sticker on component available on request.



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

	CS14 Through-hole	CS14 SMD (upon availability)				
Range of resistance values* Lin (A) Log (B) Antilog (C)	100Ω ≤ Rn ≤ 5MΩ 1 KΩ ≤ Rn ≤ 2M2Ω	$100\Omega \le Rn \le 1M\Omega$ 1 K $\Omega \le Rn \le 1 M\Omega$				
Tolerance* (Please, inquire for >100K turns) $100\Omega \le \text{Rn} \le 100K\Omega$ $100K< \text{Rn} \le 1M\Omega$: $1M\Omega < \text{Rn} \le 5M\Omega$: $\text{Rn} > 5M\Omega$:	±20% ±20% ±30% +50%, -30% (out of range)	±30% ±40% ±50%				
Variation laws	Lin (A). Other tape	rs available on request				
CRV - Contact Resistance Variation (dynamic)	Lin (A) Electrical Angle 330°±20° ≤ 3%Rn. Other tapers, please inquire					
CRV - Contact Resistance Variation (static)		igle 330°±20° ≤ 5%Rn. s, please inquire				
Maximum power dissipation** Lin (A)	at 50°	PC, 0.15W				
Maximum voltage Lin (A)	25	50VDC				
Operating temperature		C (+85°C on request) Version 120° C				
Angle of rotation (electrical)	330)° ± 20°				
Temperature coefficient $100\Omega \le \text{Rn} \le 10\text{K}\Omega$ $10\text{K}\Omega < \text{Rn} \le 5\text{M}\Omega$	+200/ -300 ppm +200/ -500 ppm	+200/ -500 ppm +200/ -1000 ppm				

* Out of range ohm values and tolerances are available on request, please, inquire.

** Dissipation of special tapers will vary, please, inquire.

Mechanical Specifications		
Specifications	CS14 Through-hole and SMD	
Resistive element	Carbon technology	
Angle of rotation (mechanical)	360°	
Wiper standard delivery position	50% ± 15°	
Max. push/pull on rotor	35 N / 50 N	
Wiper torque*	For 15.000 turns <2.5 Ncm, detents <3.5 Ncm For >15.000 turns <1.5Ncm	
Mechanical life	Standard is 15.000 turns. Up to 1.000.000 turns available depending on configuration	

* Stronger or softer torque feeling is available on request.

results

The following typical test results (with 95% confidence) are given at 23°C \pm 2°C and 50% \pm 25% RH.

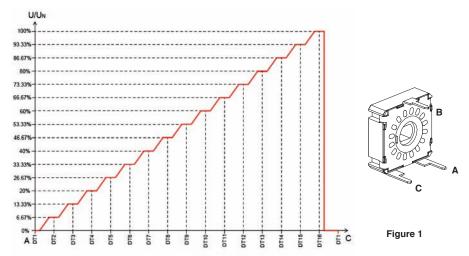
CS14 Through-hole and SMD

	Test conditions	Typical variation of Rn
Damp heat	500 h. at 40°C and 95% RH	±20%
Temperature Coefficient	16 h at 85°C, plus 2 h at –25°C	±20%
Load life	1.000 h. at 50°C	±20%
Mechanical life	15.000 turns at 10 c.p.m. and at 23°C ± 2°C	±20%
Storage (3 years)	3 years at 23°C ± 2°C	±3%

CS14 as alternative to a 4 bit absolute encoder.

The CS14 wide electrical angle of 330° gives the possibility to include up to 17 silver zones guarantying that there will be no voltage overlapping of contiguous positions. Let's take a look at the particular case of 16 silver zones combined with 16 detents:

The step function that results from this configuration (see the graph on figure 1) makes it possible to differentiate 16 non overlapping different voltage levels from the collector output pin. (B in figure 2)

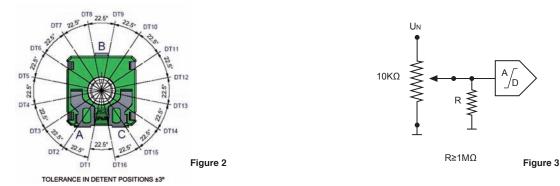


The detents are set to position and fix the wiper contact on the surface of each silver zone thus absorbing any mechanical play and printing tolerances. The electrical contact between the metal surface of the wiper and the silver area minimizes the contact resistance. The mechanical detents are evenly spread 22.5°±3° from each other along the circumference as it can be seen in the figure 2 drawing.

The endless rotation feature of the CS14 allows to move the wiper from the detent number 16 (U/Un = 100%) to the detent number 1 (U/Un=0%). During the transition between these two detents it will slide on a dead zone for a few degrees, meaning that at that moment there will be no electrical contact with the resistive track.

In order to cope with this, a pull-up or a pulldown resistor is to be introduced into the circuit design. ACP recommendation is the latter, a pull-down resistor whose value has to be at least 100 times the potentiometer nominal value. In that case, the collector pin output will be 0% (U/Un) when the slider transits on the dead zone.

ACP standard configuration is a potentiometer of 10K Ohm recommending a pull-down resistor to be equal or greater than 1MΩ. (Figure 3)

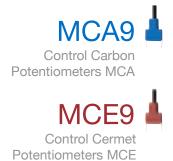


Connecting the collector terminal to the AD port of a microcontroller to feed the output voltage of said configuration will allow for the selection of 16 different functions.

The table below (figure 4) shows the equivalence between the output function of this potentiometer, indicating the tolerance at each detent, and a 4 bit digital encoder signal. In summary, a CS14 fitted with these features can be used as an alternative to a 4 bit rotary encoder.

Detent	U/UN	Decimal	Hexadecimal	Binary	Octal	
1	(0,00±3,32)%	0	0	0000	0	
2	(6,67±3,32)%	1	1	0001	1	
3	(13,33±3,32)%	2	2	0010	2	
4	(20,00±3,32)%	3	3	0011	3	
5	(26,67±3,32)%	4	4	0100	4	
6	(33,33±3,32)%	5	5	0101	5	
7	(40,00±3,32)%	6	6	0110	6	
8	(46,67±3,32)%	7	7	0111	7	
9	(53,33±3,32)%	8	8	1000	10	
10	(60,00±3,32)%	9	9	1001	11	
11	(66,67±3,32)%	10	A	1010	12	
12	(73,33±3,32)%	11	В	1011	13	
13	(80,00±3,32)%	12	С	1100	14	
14	(86,67±3,32)%	13	D	1101	15	
15	(93,33±3,32)%	14	E	1110	16	
16	(100,00±3,32)%	15	F	1111	17	

Figure 4





CARBON – MCA9

9mm carbon potentiometers with plastic enclosure and shaft.

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.

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.

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

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 – MCE9

9mm cermet potentiometers with plastic enclosure and shaft. 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.

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.

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

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.

MCA9 A MCE9 A HOW TO ORDER

EXAMPLE: MCA9DH5-10KA2020 SNP PI WT-9020-NE

EXAMPLE: MCE9DH5-10KA2020 SNP PI WT-9020-NE-V0

SNP

SNJ

				<u></u>	-			-		0					Assemb			-
Series f			Packg.	Ohm value		Tol.	Life		Detents	<u> </u>		Rotor	Wiper	Lin.	Assembly		Color	Flam.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		16		
MCA9/MCE9	D	H5		- 10K	Α	2020				SNP			PI		WT	-9020	-NE	-V0
andard cor	nfigura	ation:			M	CA9 Thr	ough-h	ole						MCE9	Through-h	ole		
mensions:										ç	mm							
rotection:								On	request: S		dust-proo		. 94 V-0					
ubstrate:					(Carbon te	chnolo	gy						(Cermet			
olor:					Blue	housing	+ white	e rotor					Bro	own hou	sing + white	e rotor		
ackaging:										l	Bulk							
/iper position	:									at 50)% ±15°							
erminals:									Str	aight, wi	hout crim	nping.						
larking:								Resistiv	e value m	arked or	housing.	. Others	on reques	st.				
ustomized p I special spec								omized pro	oduct. Sei	ries, roto	r, model a	and total	resistive	value are	e indicated b	pefore th	e code t	hat inclu
- Series										11 - Teri	ninals							

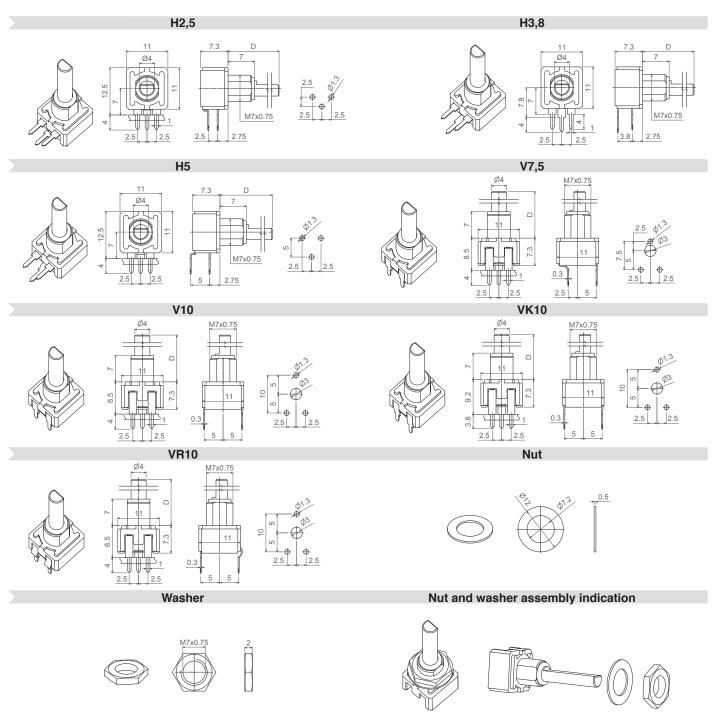
1 - S	eries													11 - Term
MC	A9	MC	E9											SNAP IN F
														SNAP IN J
2 - R	otors	6												Shorter tip
D														
3 - M	lodel	and j	oitch											<u>12 - Hous</u>
H2,5		H3,8		H5		V7,5		V10		VK10		١	/R10	Color: For
														13 - Roto
4 - P	acka	ging					Tro	ough-ho	le					Color: For
Bulk								(blank)						* Self-ext
														By default, For carbon:
		220Ω			5000	1KΩ	21/0	500KΩ	1140	2MΩ	01400	4M7Ω	5140	and rotor a
													5MΩ	If only rotor
100	200	220	250	470	500	1K	2K	500K	1M	2M	211/12	4M7	5M	14 - Wipe
6 - R	esist	ance	law /	taper										Wiper po
Lin - I										А				Initial or C
Log - Logarithmic B										Final or C\				
Antilog - Antilogarithmic								С						Others: fol
- Special tapers have codes assigned:							CODE YXXXXX						Wiper tor	
														Low torqu
7 - T	olera	nce												
±20%	ò	±30%			+50%,-30%		±10%			±5%		%	15 - Line	
2020 3030			5030 101			0 0505)5	Not contro				
														Independer
	-	ting L		-	;)						(1		lonld	Absolute li
		1.000		,	-1		- fau AF	000				eave b		10 B I
Long life: LV + the number of cycles. ex: LV45 for 45.000 cycles. (others on request) LVXX: ex: LV45									16 - Pote Assemble					
9 - C	ut Tra	ack –	Oper	ı circı	uit.									Accessory
9 - Cut Track – Open circuit. Open circuit at beginning of track, fully CCW							CCW	PCI					Color of st	
Open circuit at end of track, fully CW							PCF					Non self-ex		
														Self-extingu (-V0 in box
		nts (D	-	nnina										
		t at the	-	rining				DTI						
		t at the			-8-4-9			DTF					Black ⁽¹⁾	
					distrib					T: 10D				NE
Special	aetents	s are ava	liable or	request	: If you a	uso nee	a to assig	n a voltage	value to	each de	etent, plea	ase inquir	e.	black is not

Shorter tip of termina	st) TPXX, ex: TP25			
12 - Housing				
Color: For colors othe	r than standard: -See color chart below-	CJ-color, ex., red: CJ-R		
13 - Rotor				
Color: For colors othe	r than standard: -See color chart below-	RT-color; ex., blue: RT-A		
By default, carbon is n For carbon: self-exting	ble property, V0, for housing and rot on self-extinguishable, cermet is Self-exting uishable property can be added. V0 means y the housing needs to be V0, then CJ-V0.	uishable: (blank)		
14 - Wiper				
Wiper position (Sta	(leave blank)			
Initial or CCW	PI			
Final or CW	PF			
Others: following clo	PXH, ex: P3H			
Wiper torque (Stan	(leave blank)			
Low torque, < 1.5No	PGB			
15 - Linearity				
Not controlled	(leave blank)			
Independent linearity c	ontrolled & below x%, for example, 3%: LN	3% LNx%; ex: LN3%		
Absolute linearity co	LAx%			
16 - Potentiometer	rs with assembled accessories			
Assembled from terr	WT-			
	-XXXXX, Example: 901			
Accessory Reference	5 (5015 01 5020)			

	5 Noutia	transp.	Red	Green	Yellow	Blue	Grey	Brown
NE BA	IN	TA	RO	VE	AM	AZ	GS	MR

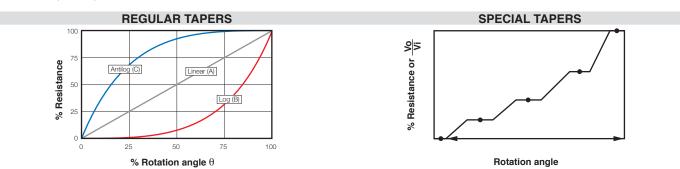
Specifications on this catalog are for reference only, as they are subject to change without notice.

All models shown here have shaft 9020, but other shafts can be chosen from the list below (Page 71). The D dimension indicated on the drawings refers to the possible length of the shaft, to be chosen at "shafts" section. Potentiometers are sold separately from the nuts and washers.



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.-



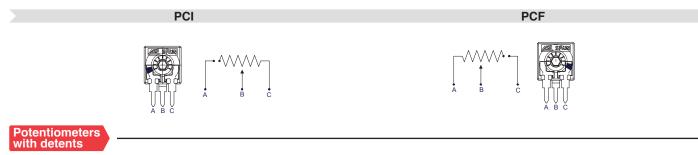
Potentiometers with cut track

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.

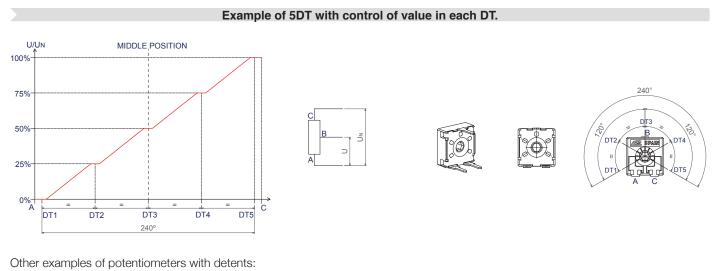
PCF = Cut at final position, when the potentiometer is turned fully clockwise.

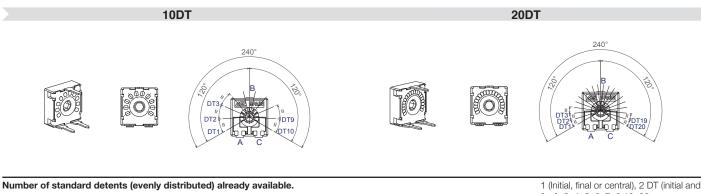
Other positions are available on request.



ACP's patented detent (DT) feature is especially suitable for control applications where the end user 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:





	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.

When needing a special number of detents or matching taper, a drawing is kindly requested.

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

 Image: provide the standard Terminal
 Image: provide the standard Terminal

 Standard Terminal
 Shorter terminal, for H5 TP25
 Shorter terminal, TPXX (under request)

 Image: provide the standard Terminal
 Image: provide the standard Terminal
 Image: provide the standard Terminal

 Image: provide the standard Terminal
 Shorter terminal, for H5 TP25
 Shorter terminal, TPXX (under request)

 Image: provide the standard Terminal
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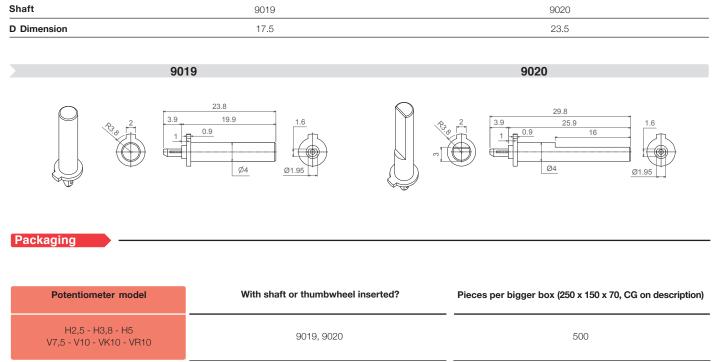
Should the shaft need to be positioned differently than shown on the "models" section on this catalogue, a drawing with the exact position is kindly requested.

Shafts

accessories

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.

D dimension is the distance from the housing to the top of the shaft, as shown in the different models.



-67



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

	MCA9 Through-hole	MCE9 Through-hole		
Range of resistance values* Lin (A) Log (B) Antilog (C)	100Ω ≤ Rn ≤ 5MΩ 1 KΩ ≤ Rn ≤ 2M2Ω	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)	- +20% +20% +30% -		
Variation laws	Lin (A), Log (B), Antilog (C). Ot	ther tapers available on request		
Residual resistance	Lin (A), Log (B), Antilog (C) $\leq 5^{*}10-3^{*}$ Rn. Minimum value 2 Ω	≤2Ω		
CRV - Contact Resistance Variation (dynamic)	Lin (A) Electrical Angle 220°±20° ≤ 3%Rn. Other tapers, please inquire			
CRV - Contact Resistance Variation (static)	Lin (A) Electrical Angl Other tapers,	le 220°±20° ≤ 5%Rn. please inquire		
Maximum power dissipation** Lin (A) Log (B), Antilog (C)	at 50°C 0.15W 0.10W	at 70° C. 0.5W 0.20W		
Maximum voltage Lin (A) Log (B), Antilog (C)	150VDC 200VDC	200VDC		
Operating temperature	-25°C +70°C (+85°C on request)	-40°C +90°C (+125°C on request)		
Temperature coefficient 100Ω ≤ Rn ≤ 10KΩ 10KΩ < Rn ≤ 5MΩ	+200/ -300 ppm +200/ -500 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

	MCA9 Through-hole	MCE9 Through-hole			
Resistive element	Carbon technology	Cermet			
Angle of rotation (mechanical)	240° ± 5°				
Angle of rotation (electrical)	220° ± 20°				
Wiper standard delivery position	50% ± 15°				
Max. stop torque	5 Ncm				
Max. push/pull on rotor	40 N				
Wiper torque*		2 Ncm ith 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

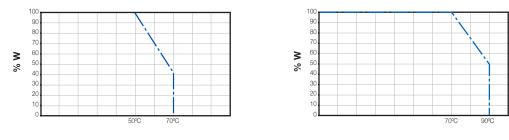
The following typical test results are given at 23°C $\pm 2^{\circ}$ C and 50% $\pm 25\%$ RH.

	MCA9 Thro	ough-hole	MCE9 Thr	ough-hole
	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 85°C, plus 2 h at –25°C	±2.5%	16 h at 90°C, plus 2 h at -40°C	±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%
Soldering effect	2 seconds at 350°C	±1%	2 seconds at 350°C	±1%
Storage (3 years)	3 years at 23°C ± 2°C	±3%	3 years at 23°C ± 2°C	±1%

MCA9 Through-hole

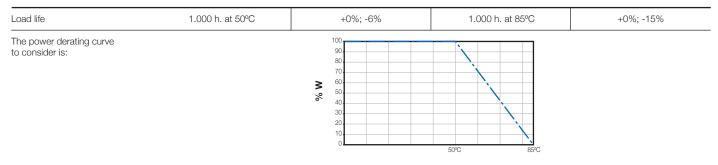


Power derating curve:

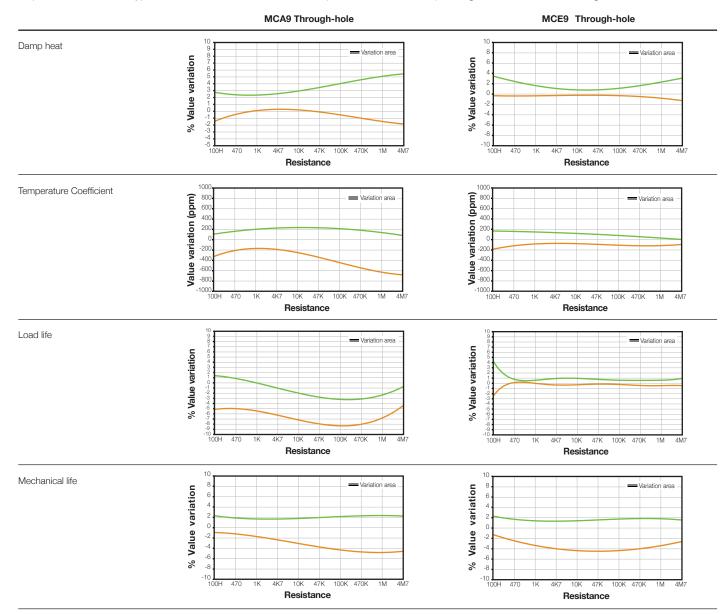


For temperatures out of range

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



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



MCA9 🛓 MCE9 🛓



Control Cermet Potentiometers MCE



CARBON – MCA14

14mm carbon potentiometers with plastic enclosure and shaft.

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.

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.

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

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 38 detents available).
- Self-extinguishable plastic parts according to UL 94 V-0.

Applications

14mm potentiometers are mainly used in control applications, in different markets:

- Electronic household appliances, heating, ventilation and air conditioning (HVAC) equipment, thermostats.

CERMET – MCE14

14mm cermet potentiometers with plastic enclosure and shaft. 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.

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.

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

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 38 detents available).

Applications

14mm cermet potentiometers are used in applications where either the operating temperature is high, or where the applications requires product with excellent ohmic value stability:

- Electronic appliances: boilers, water heaters.
- Industrial electronics: multimeters, oscilloscopes, time relays, measurement and test equipment.

-0

MCA14 L MCE14 L HOW TO ORDER

EXAMPLE: MCA14NH2,5-10KA2020 SNP PI WT-14187-BA

EXAMPLE: MCE14NH2,5-10KA2020 SNP PI WT-14187-BA-VO

o :				0	-	T 1	1.16			· ·		D .	100	1.1	A 11	D (//	0.1	-
Series	Rotor	Model	Packg.	Ohm value	laper	Iol.	Life	Irack	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		
MCA14 MCE14	N	H2,5		- 10K	А	2020				SNP			PI		WT	-14187	-BA	

Standard configuration:	MCA14 Through-hole	MCE14 Through-hole
Dimensions:	1	4mm
Protection:	IP 54 ((dust-proof)
	On request: Self-exting	uishable, to meet UL 94 V-0
Substrate:	Carbon technology	Cermet
Color:	Blue housing + white rotor	Brown housing + white rotor
Packaging:		Bulk
Wiper position:	at 50	0% ±15°
Terminals:	Straight, wi	ithout crimping.
Marking:	Resistive value marked or	n 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: MCA14PH2,5-10K CODE C00111. Other features could be available on request, please, ask.

1 - S	eries												
MC	A14	MCI	E14										
2 - R	otors												
N		Z											
		and p											
HO		HC0		H2,5		H4		H5	HA5		HL5		/12,5
VA12	,5	VL12	,5	VR12	,5	V15		VJ15	V17	,5	VD7,5	5 \	VD11
4 - P	acka	ging					Tre	ough-ho	ole				
Bulk							(blank) ⁽¹)				
5 - R	aciet	ance	value	-									
				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													
			0					B					
	-	arithmi ntiloga		lo						C			
	-	-		codes	opoio	nodi			CODE YXXXXX				
- ope			ave	00000	assig	neu.				_ 1/00	~~~		
7 - To	olera	nce											
±20%	, D		±3(0%		+50%	%,-30%	6	±10)%		±59	%
2020)		30	30		5	030	1010				0505	
8 - 0	nora	tina I	ifo (C	Cycles	•								
		1.000			''						()	eave b	lank)
			-	-	cles. e	x: LV45	5 for 45	.000 cycle	S. (othe	rs on requ		/XX: ex:	
				n circ									
						, fully (CCW			PCI			
Open	i circu	iit at ei	nd of	track,	fully (CW				PCF			
10 - I	Deter	nts (D	T)										
		t at the	-	inning						DTI			
One c	deten	t at the	e end							DTF			
X nun	nber (of dete	ents						XE	DT: 10	DT		
Special	detents	are avai	ilable or	n request	: If you	also nee	d to assid	gn a voltage	value to	each de	etent, plea	ise inquin	e.

11 - Terminals

SNAP IN P	SNP
SNAP IN R	SNR
Shorter tip of terminal, TPXX, where XX is tip length (under request)	TPXX, ex: TP30

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 s	tandard: -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) V0 For carbon: self-extinguishable property can be added. V0 means housing CJ-V0, RT-V0 and rotor are V0. If only the housing needs to be V0, then CJ-V0. If only rotor: RT-V0

14 - Wiper

Wiper position (Standard: $50\% \pm 15^{\circ}$)	(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
Accessory Reference	-XXXXX
See list of shafts and thumbwheels available	Example: 14187
Color of shaft or thumbwheel	-YY Example, white: BA
Non self-extinguishable. Self-extinguishable according to standard	(leave blank)
UL 94 (-V0 in box 17 modifies only the accessory, please, note.)	-V0

Color chart for rotor, housing and accessories

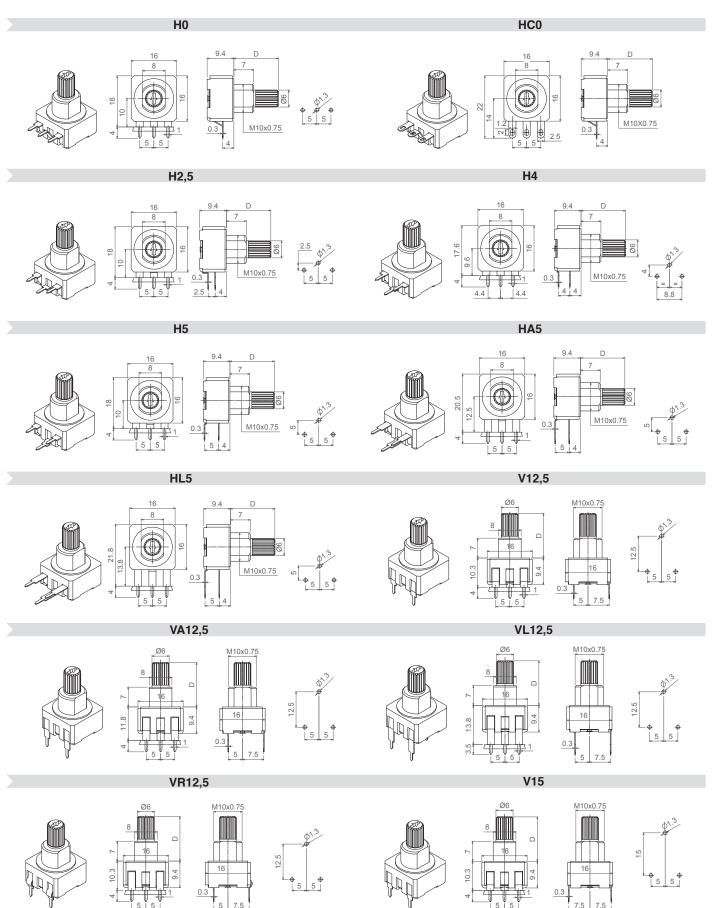
Black ⁽¹⁾	White	Neutral	Transp.	Red	Green	Yellow	Blue	Grey	Brown
NE	BA	IN	TA	RO	VE	AM	AZ	GS	MR
(1) black is	not an opt	ion for housir	ıgs.						

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Specifications on this catalog are for reference only, as they are subject to change without notice.

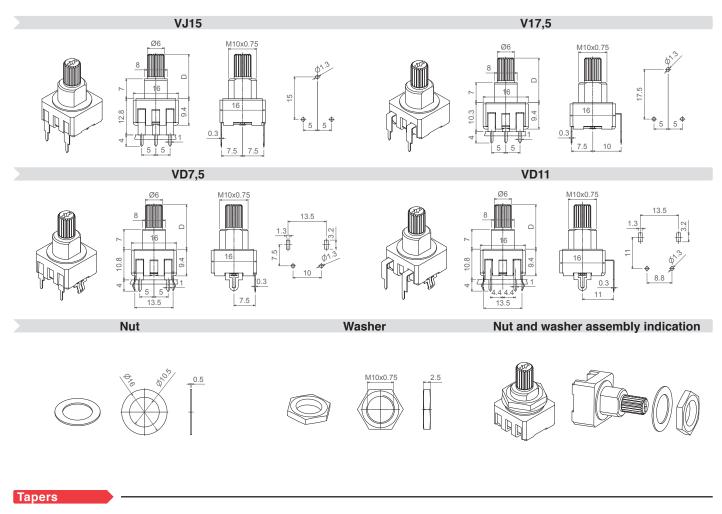
Models

All models shown here have shaft 14187, but other shafts can be chosen from the list below. The D dimension indicated on the drawings refers to the possible length of the shaft, to be chosen at "shafts" section. Potentiometers are sold separately from the nuts and washers.

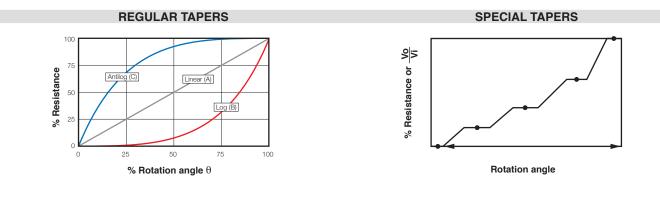


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79



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.-



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.

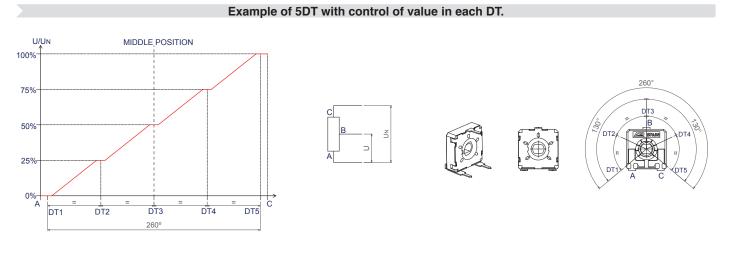
Other positions are available on request.



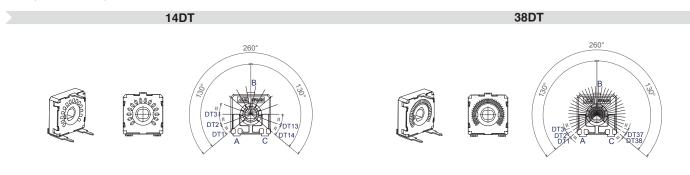
Potentiometers with detents

ACP's patented detent (DT) feature is especially suitable for control applications where the end user 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:



Examples of some potentiometers with detents:



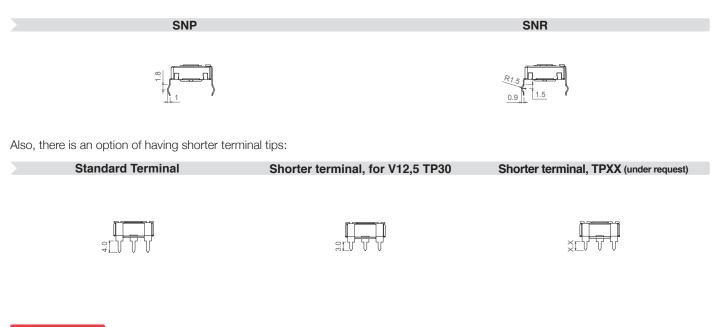
Number of standard detents (evenly distributed) already available.	1 (Initial, final or central), 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 17, 22, 27, 38.
Maximum number of detents for feeling only	38
Maximum number of detents when the voltage value in each detent is controlled and non-overlapping.	14

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) and narrower tolerances for detent positioning.

For potentiometers with detents, mechanical life is also 1.000 cycles if no additional cycles are mentioned. Up to 10.000 cycles are available. Please, indicate the number of cycles needed with LV (number of cycles), for example: LV10, for 10.000 cycles.

When needing a special number of detents or matching taper, a drawing is kindly requested.

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



Adjustment and orientation

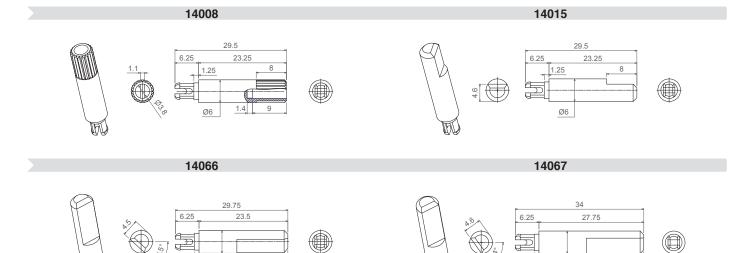
Should the shaft need to be positioned differently than shown on the "models" section on this catalogue, a drawing with the exact position is kindly requested.

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.

D dimension is the distance from the housing to the top of the shaft, as shown in the different models.

Shaft	14081	14187	14067	14008	14015	14066	14084	14250	14072	14073
D Dimension	15.2	15.7	24.7	20.2	20.2	20.45	20.45	21.95	28.7	35.45

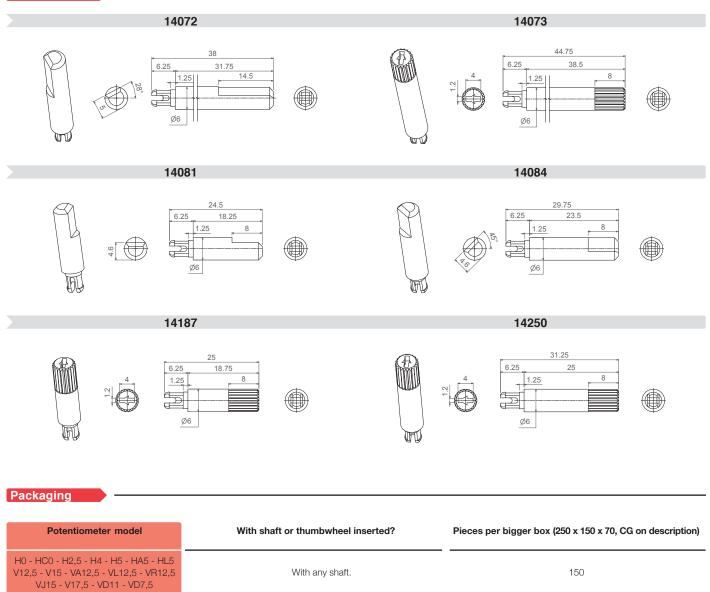


1.25

1.25

Ø6

15.2





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

	MCA14 Through-hole	MCE14 Through-hole		
Range of resistance values* Lin (A) Log (B) Antilog (C)	100Ω ≤ Rn ≤ 5MΩ 1 KΩ ≤ Rn ≤ 2M2Ω	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)	- ±20% ±20% ±30% -		
Variation laws	Lin (A), Log (B), Antilog (C). Of	ther tapers available on request		
Residual resistance	Lin (A), Log (B), Antilog (C) \leq 5*10-3*Rn. Minimum value 2 Ω	≤2Ω		
CRV - Contact Resistance Variation (dynamic)	Lin (A) Electrical Angl Other tapers,	le 245°±20° ≤ 3%Rn. please inquire		
CRV - Contact Resistance Variation (static)	Lin (A) Electrical Angl Other tapers,	le 245°±20° ≤ 5%Rn. please inquire		
Maximum power dissipation** Lin (A) Log (B), Antilog (C)	at 50°C 0.25W 0.13W	at 70°C. 0.7W 0.30W		
Maximum voltage Lin (A) Log (B), Antilog (C)		VDC VDC		
Operating temperature	-25°C +70°C (+85°C on request)	-40°C +90°C (+125°C on request)		
Temperature coefficient 100Ω ≤ Rn ≤ 10KΩ 10KΩ < Rn ≤ 5MΩ	+200/ -300 ppm +200/ -500 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.

	MCA14 Through-hole	MCE14 Through-hol
Resistive element	Carbon technology	Cermet
Angle of rotation (mechanical)	265	± 5°
Angle of rotation (electrical)	245°	± 20°
Wiper standard delivery position	50%	± 15°
Max. stop torque	101	Ncm
Max. push/pull on rotor	50	Ν
Wiper torque*		Ncm n detents: <3.5 Ncm
Mechanical life	1.000 cycles (many more availa	able on request, please, inquire)

* Stronger or softer torque feeling is available on request.

Test results

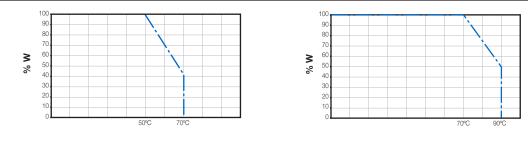
The following typical test results (with 95% confidence) are given at 23°C \pm 2°C and 50% \pm 25% RH.

	MCA14 Th	rough-hole	MCE14 Through-hole				
	Test conditions	Typical variation of Rn	Test conditions	Typical variation of Rn			
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 85°C, plus 2 h at –25°C	±2.5%	16 h at 90°C, plus 2 h at –40°C	±2%			
Load life	1.000 h. at 50°C	+0%; -5%	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	±2%			
Soldering effect	2 seconds at 350°C	±1%	2 seconds at 350°C	±1%			
Storage (3 years)	3 years at 23°C ± 2°C	±3%	3 years at 23°C ± 2°C	±1%			

Power derating curve:

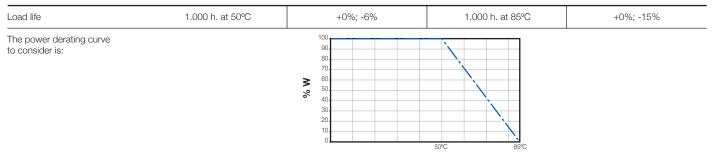
MCA14 Through-hole

MCE14 Through-hole

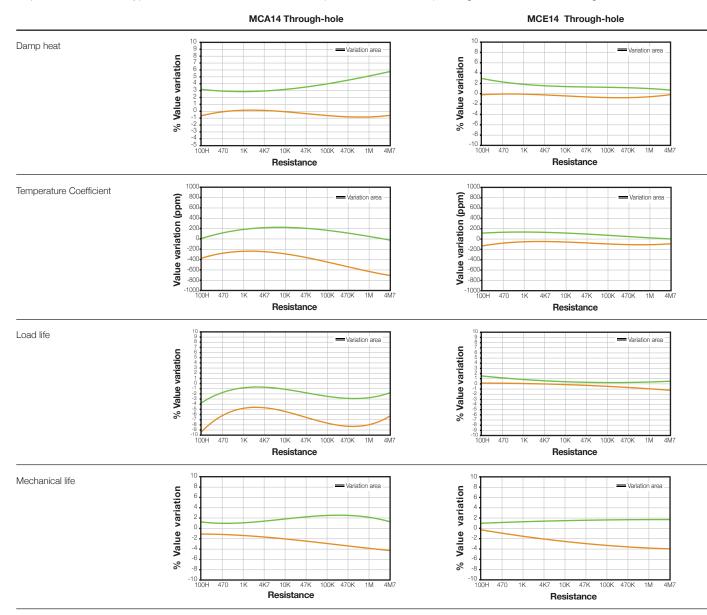


For temperatures out of range

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



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



Specifications on this catalog are for reference only, as they are subject to change without notice.

MCA14 🛔 MCE14 🎽







ROTARY SWITCH – COM

Rotary switches are available in all different models already existing for the potentiometers: 6, 9 and 14mm in carbon and cermet technology. Please, refer to those sections to choose the external configuration of your switch.

ACP's Rotary switches are based on the design of the potentiometers: they have one input and two possible outputs. The commuting angle between outputs can be customized.

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. The switch has 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.

Thumbwheels and shafts can be provided either separately or already inserted in the switch.

Our switches can be manufactured in a wide range of possibilities regarding:

- Switching angle.
- Positioning of the wiper (the standard is at 50%).
- Housing and rotor color.
- Mechanical life.
- Pause effect (recommended for each possible circuit position).
- Self-extinguishable plastic parts, according to UL 94 V-0.

Applications

- Dimmers.
- Telecommunications (antenna control).

COM 🖬 HOW TO ORDER

ACP's switches (COM) follow the same configuration as the potentiometers, as shown in previous sections of this catalogue. The word COM needs to be added to the description. The cells 5, 6 and 7 (value, taper and tol) are left blank. If the switching angle is different from our standard, then it should be indicated.

Examples:

From CA9: COMCA9MH2,5 2DT SNP PI WT-9005-BA (switch in configuration CA9MH2,5 with 2 detents, terminals with snap in, wiper at CCW position, and white shaft reference 9005 already inserted).

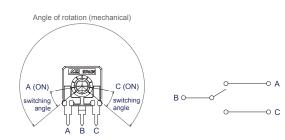
Standard features				Extra f	eatures						Assemb	led acc	essory						
Se	eries	Rotor	Model	Packg.	Ohm value	Taper	Tol.	Life	Track	Collector	Terminals	Housing	Rotor	Wiper position	Lin	Assembly	Ref #	Color	Flam.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		16		17
COM C	CA9	М	H2,5		-	-	-			2DT	SNP			PI		WT	-9005	-BA	

From CA14: COMCA14PV15 AC45°±15° (switch in configuration CA14V15, switching angle at 45°).

Stan	dard fe	atures							Extra f	eatures						Assembled a	cessory	
	Series	Rotor	Model	Packg.	Ohm value	Taper	Tol.	Life	Track	Collector	Terminals	Housing	Rotor	Wiper position	Lin	Assembly Ref	t Color	Flam.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16		17
COM	1 CA14	Ρ	V15		-	-	-		AC45°±	15°								

Electric Function

The three terminals of the potentiometer are equivalent to one input (B) and two outputs (A and C), as shown in the figure. The middle terminal (B) corresponds to the internal wiper, which switches between positions. The switching angle can be customized. Unless otherwise requested, the housing will be neutral color, with the marking in black.



Electric

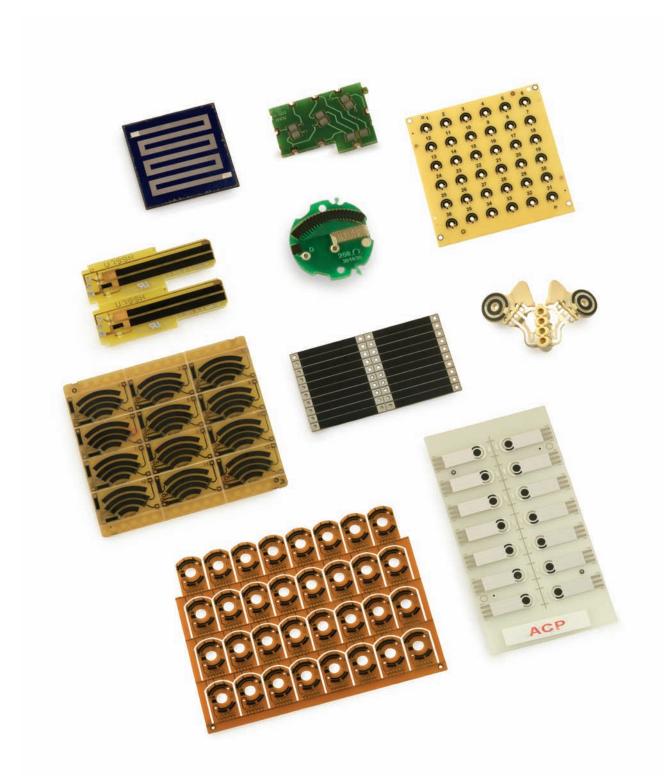
Specifications	COM CA6	COM CA9 / MCA9 COM CA14 / MCA14	COM CE9 / MCE9 COM CE14 / MCE14
Resistive element	Carbon	Carbon	Cermet
Power ratio	15V / 12mA	24V / 12mA	24V / 12mA
Resistance at ON position	≤5Ω	≤5Ω	≤5Ω
Dielectric Strength	600V	1500V	1500V
Insulation resistance	100ΜΩ	100GΩ	100GΩ
Switching angle at ON position	20° ± 15°	30° ± 15°	30° ± 15°
Operating temperature	-25°C +7	0°C (+85°C)	-40°C +90°C (+125°C)

Please, note that these are standard features; other specifications are available on request.

Mechanical			
Specifications	6mm	9mm	14mm
Angle of rotation	235° ± 10°	240° ± 5°	265° ± 5°
Mechanical life	1.000	1.000	1.000
Wiper torque	< 2 Ncm	< 2 Ncm	< 2.5 Ncm
Max. stop torque	4 Ncm	5 Ncm (CA9, CE9) 25 Ncm (MCA9, MCE9)	10 Ncm (CA14, CE14) 15 Ncm (MCA14, MCE14)
Max. push/pull on rotor	9.8 N	40 N / 50 N	40 N / 50 N







THICK FILM SOLUTIONS PRINTED CIRCUIT RESISTORS

Thick Film Printed Circuit Resistors are screen printed layers of resistive, conductive and/or dielectric pastes deposited on different types of substrates, like FR, CEM, Alumina, Polyester, Polyimide, PA, Dielectric on Metal etc.

There are two basic technologies depending on the type of pastes applied: Carbon and Cermet, the latter needed on applications where high power dissipation is required or when resistor value stability at high temperatures is important.

Potentiometer Tracks is the type of Printed Circuit Resistors that ACP specializes in. This is one of our core competences and it is the heart of all our potentiometer families. Our know-how includes the expertise in the different technologies involved in the production process:

- Pastes and inks formulation and blending
- Screen printing in type C (class 10.000) clean room
- Curing or Sintering
- Laser trimming
- Automated testing

Design patterns and shapes are varied; every specific project has different geometrical requirements. We are able to process from single to multiple circuit panel configurations, with maximum panel dimensions of: 280mm - 180mm (Pattern 250mm x 150mm).

Let us know about your project and our engineers will propose the most suitable designs for each specific application. In many instances, mixed solutions where Potentiometer Tracks, Trimmed Fixed Resistors and Contact Switches are combined, make the most cost effective circuit design.

Features

- Resistive element: Resistive blends from 10 to 1M Ohm/square allow for a wide range of resistive tracks and values.
- Tapers: Linear tapers with up to 1.8% independent linearity, step functions, logarithmic and antilog curves. Combination of potentiometer and on/off switches or symmetrical double track potentiometers.
- Tolerance: Laser trimming up to 1% of Rn.
- Minimum resistive track separation: Up to 0.3mm between adjacent tracks.
- Type of substrates: FR2, FR4, CEM1, CEM2, Polyester, Polyimide, Polyamide, Alumina.
- Mechanical life: The Mechanical Life performance depends on the interaction between the wiper and the resistive track contact surfaces. A balanced wear of both surfaces is key to guarantee the expected results. Several factors have an influence:
 - Wiper: Geometry, material, finishing, pressure, number of fingers, finger tip shape.
 - Inks: Type of ink, ink blend, materials contained and the process parameters when deposited and cured, geometry of the printed pad.
 - Speed of wiping slide cycle.
 - Climatic conditions: Working Temperature and Humidity.
 - Thermal cycles: Temperature and humidity cycles.
 - Working environment.
 - Lubricants: They can help providing a good performance, however, they are not always needed.

A detailed and comprehensive understanding of the above parameters is fundamental in order to provide the adequate PCR track and substrate: We have solutions that range from 10.000 to 5.000.000 cycles under aggressive thermal and climate conditions.

Aplications

Applications where Potentiometer Tracks can be applied can be classified in two major types: 1) Position Sensors and 2) Switches & Controls. Examples in different markets are listed below:

Automotive and Vehiche Markets

Position Sensors: Feedback Potentiometers on HVAC Actuators, Side Mirror Memory Actuators, Throttle Sensors, Head Lamp Levelling Actuators, Fuel Tank Senders, Start-Stop, Steering Wheel Angle Sensor, Drive by Wire, Break by Wire, Seat Positioning Actuators, Adaptive Front Lighting, etc.

Switches and Controls: Climate Control Switches (Fan Speed, Temperature Setting, Air Flow Distribution), Head Lamp Levelling Switch, Dash Board Light Dimmer, Seat Heating Controls, Haptic Control, Light Switch, Airbag Enable/ Disable Switch, etc.

Industrial and Consumer Markets

Position Sensors: Feedback Potentiometers on different types of Actuators (HVAC, Window Blinds, Valve Controls,)

Switches and Controls: Joystick Controls, Speed Control of Professional Power Tools, DIY tools, Garden and Lawn Electric Tools.

How to Order

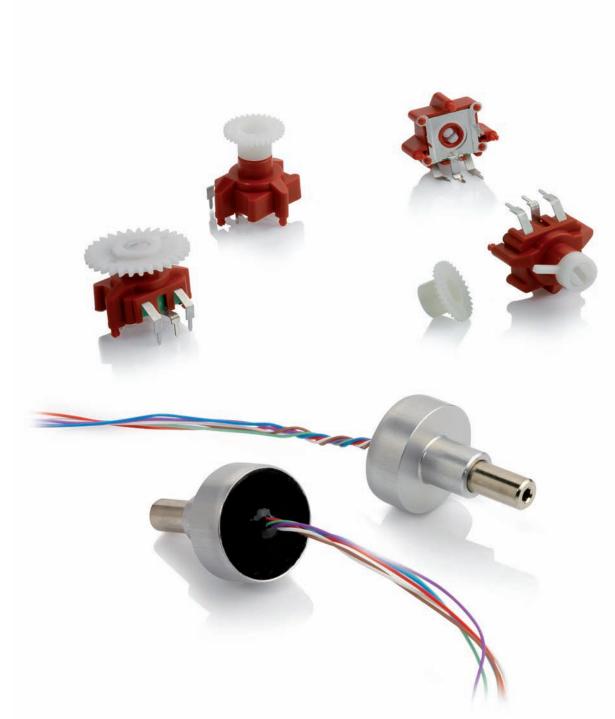
Thick-Film solutions are customized. We kindly request a drawing with dimensions, electrical use, application, mechanical life and other significant data.

Please, send us your project specifications and we will send you our proposal.

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Synchronized switch and potentiometer functions in a metal enclosure sealed with resin to secure IP 65 environmental protection.

Metal shaft with endless rotation.

Interface by means of wires.

More than 1 million turns mechanical life.

GEARED POSITION # SENSORS

Modified RS14 with special housing and pin layout.

Mechanical interface by means of different gears.

Up to 1.000.000 mechanical cycles.

Revision July 2015



Aragonesa de Componentes Pasivos

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