# 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 IATF 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)

IATF 16949 (IATF: 0290599, 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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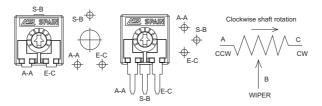
1 General concepts

# **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.



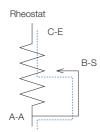
#### Electric use

#### 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).

The output is measured in ohms.

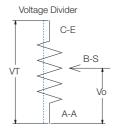


#### Voltage divider

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 (R⊤):

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.

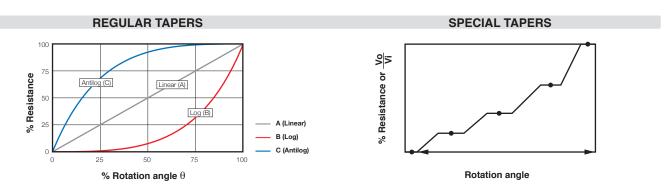
25K	47K	50K	100K	200K	220K	25	oK .	470K	500K	1M	2M	2M5	4M7	5M
0514	4716	501/	40016	0001/	0001/	0.5	.01/	4701/	E001/	414	014	ONAE	4847	
25ΚΩ	47ΚΩ	50ΚΩ	100ΚΩ	200ΚΩ	220KΩ	2 250	ΟΚΩ	470ΚΩ	500ΚΩ	1ΜΩ	2ΜΩ	2.5MΩ	4.7ΜΩ	5ΜΩ
100	200	220	250	470	500	1K	2K	2K2	2K5	4K7	5K	10K	20K	22K
$100\Omega$	$200\Omega$	$220\Omega$	$250\Omega$	$470\Omega$	$500\Omega$	1ΚΩ	$2K\Omega$	$2.2 \text{K}\Omega$	$2.5$ K $\Omega$	$4.7$ K $\Omega$	5ΚΩ	10ΚΩ	$20$ K $\Omega$	22ΚΩ

#### 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 below.-

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

The term "linearity" implies that the real law obtained from plotting angular position vs voltage output is compared with a straight line.

#### 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.

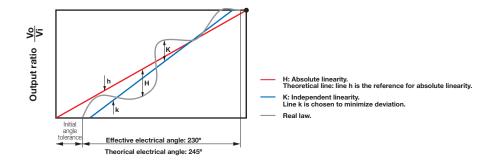
It is expressed as a percentage of the total voltage applied.

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.
	Solder temperature: 240°C for 5 ± 1 s.	Max. wave temp.: 260°C for 4s., (245°C recommended)
	Besides recommended conditions, ACP SMD potentiometers have successfully passed IEC 60068-2-58 tests.	Time within +0°-10°C of peak: 10s.
		Cooling rate: 5°C/s.

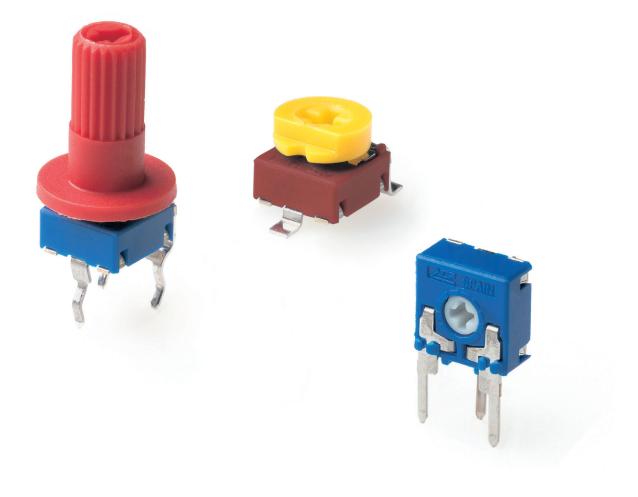
<sup>(\*)</sup> For other information on soldering conditions, please, contact us.

(For reflow soldering SMD) The conditions above are valid for one reflow pass only. For multiple passes, please, enquire.



**2** Potentiometers and sensors





# 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

Standard features						Extra fe	Extra features					Assembled accessory				
Series	Rotor	Model	Packg.	Ohm value	Taper	Tol.	Life	Track	Snap in	Housing	Rotor	Wiper	Assembly	Ref #	Color	Flam
1	2	3	4	5	6	7	8	9	10	11	12	13		14		
CA6	Χ	V2,5		- 10K	Α	2020			SNP			PI	WT	-6030	-BA	

Standard configuration:	CA6 Through-hole	CA6 SMD
Dimensions:		6mm
Protection:		54 (dust-proof) tinguishable, to meet UL 94 V-0
Substrate:	Carbon technology	Carbon technology, special for high temperature
Color:	Blue housing + white rotor	Brown housing + grey rotor
Packaging:	Bul	k or Tape & Reel
Wiper position:		at 50% ±15°
Terminals:	Snap in P (except model CA6VS5)	
Marking:	Resistive value marke	ed 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: CA6XH2,5-10K CODE C00120.

#### 1 - Series

CAG	
CAO	

#### 2 - Rotors D Μ Χ

#### 3 - Model and pitch

H2,5	HSMD	V2,5	V5	VS5
VSMD	VESMD	VSMD W	Т	VESMD WT

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

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

#### 5 - Resistance value

100Ω	200Ω	220Ω	250Ω	470Ω	500Ω	1ΚΩ	2ΚΩ	. 500KΩ	1ΜΩ	$2M\Omega$	$2\text{M}2\Omega$	4M7Ω	5ΜΩ
100	200	220	250	470	500	1K	2K	500K	1M	2M	2M2	4M7	5M

#### 6 - Resistance law / taper

Lin - Linear	Α
Log - Logarithmic	В
Antilog - Antilogarithmic	С
- Special tapers have codes assigned:	CODE YXXXXX

#### 7 - Tolerance

±20%	±25%	±30%	+50%,-30%	±10%	±5%
2020	2525	3030	5030	1010	0505

#### 8 - Operating Life (Cycles)

Standard (1.000 cycles)	(leave blank)
Long life: LV + the number of cycles. ex: LV06 for 6.000 cycles. (others on request)	LVXX: ex: LV06

#### 9 - Cut Track - Open circuit.

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

#### 10 - Terminals

SNAP IN P	SNP
Shorter tip of terminal, TPXX, where XX is tip length (under request)	TPXX, ex: TP20
Steel Terminals	SH

#### 11 - Housing

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

#### 12 - Rotor

Color: For colors other than standard: -See color chart below- RT-color; ex., blue: RT-A
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#### \* Self-extinguishable property, V0, for housing and rotor:

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

#### 13 - 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: <2Ncm)	(leave blank)
Low torque, < 1.5Ncm	PGB

#### 14 - Potentiometers with assembled accessories

Assembled from terminal side	WT
Assembled from collector side	WTI
Accessory Reference	-XXXX
See list of shafts and thumbwheels available	Example: 6030
Color of shaft or thumbwheel	-YY Example, white: BA
Non self-extinguishable.	(leave blank)
Self-extinguishable according to standard UL 94	-V0
(-V0 in box 17 modifies only the accessory, please, note.)	

#### For ordering spare accessories: Accessory reference - color- flammability.

Ex. 6030-AZ-V0 is a blue self-extinguishable 6030 thumbwheel

XXXX-YY-V0

#### Color chart for rotor, housing and accessories

Black <sup>(1)</sup>	White	Neutral	Transp.	Red	Green	Yellow	Blue	Grey	Brown
NE	ВА	IN	TA	RO	VE	AM	AZ	GS	MR

(1) black is not an option for housings.

#### Rotors

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

D M N X





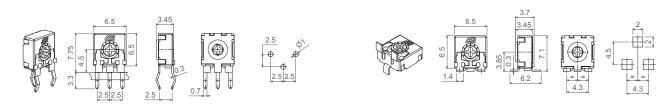




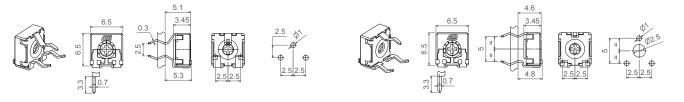
#### Models

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

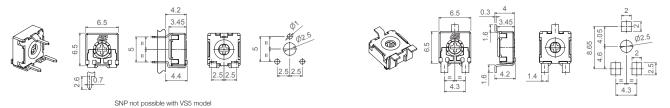
H2,5 HSMD



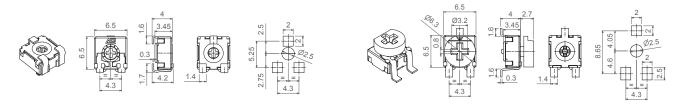
V2,5



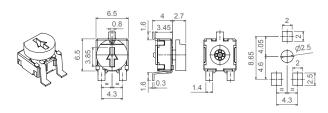
VS5 VSMD



#### VESMD VSMD WT-6030



#### **VSMD WT-6037**



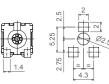
#### **VESMD WT-6030**

#### VESMD WT-6037











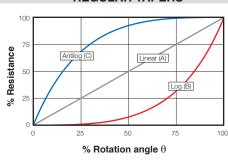




#### **Tapers**

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.

#### **REGULAR TAPERS**



# Potentiometers with cut track

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

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

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

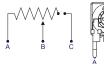
Other positions are available on request.

PCI









#### **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.

#### SNP



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

Possibilities for insertion of accessories

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

WT Front side WTI Collector side WT Front side WTI Collector side









Shafts 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.

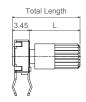
Shafts can be sold separately or delivered already mounted on the potentiometer at ACP.

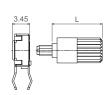
When a shaft is mounted on a potentiometer, the distance from the top of the potentiometer to the top of the shaft is marked with "L" in the table below, as shown in the drawings:

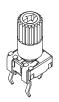
#### H potentiometer + shaft

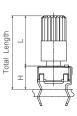
#### V potentiometer + shaft

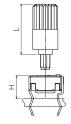












Shaft	6022	6023	6031	6024	6025	6028	6040
L Dimension	10	10	11	12.2	14.5	14.5	21.3

6022 6023

















6024

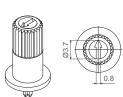


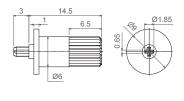










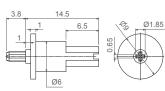


6028

6031

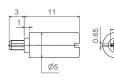




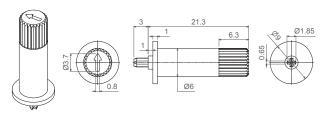








6040



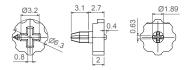
#### Thumbwheel

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.

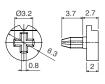
Thumbwheels can be mounted on the potentiometers at ACP (see models with WT-6030 or WT-6037) or sold separately. ACP can study special thumbwheel designs.

> 6001 6030







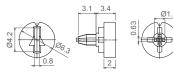




6032

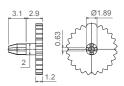








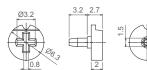




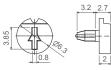
6035 (Designed for M rotor)

6037





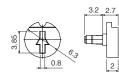






6043





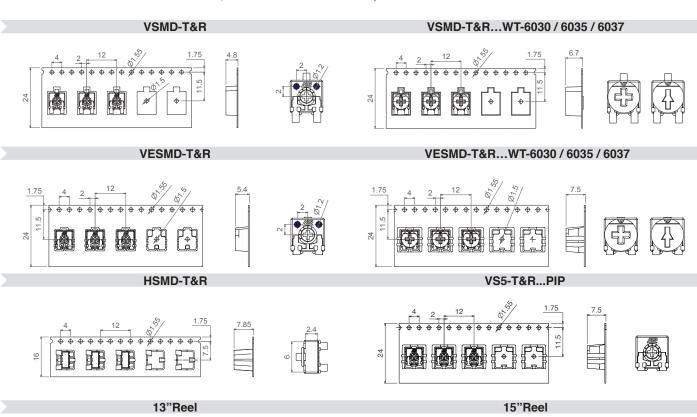


#### Bulk packaging:

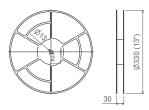
Potentiometer model	With shaft or thumbwheel inserted?	Pieces per small box (150 x 100 x 70)	Pieces per bigger box (250 x 150 x 70, CG on description)
	None, only potentiometers.	1.000	4.000
H2,5 - V2,5 - V5	6001, 6030, 6032, 6035, 6037	1.000	3.000
VS5 - HSMD - VSMD - VESMD	6024, 6025, 6028	300	To be determined.
	6022, 6023, 6031	500	To be determined.

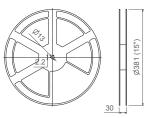
Tape & Reel packaging:	With thumbwheel inserted?	13" Reel (Standard), with 24mm width tape	15" Reel, with 24mm width tape
VSMD	None, only potentiometers.	1.200 pcs per reel, 12mm step between cavities.	1.700 pcs per reel, 12mm step between cavities.
VOIVID	6030, 6035, 6037	750 pcs per reel, 12mm step between cavities.	1.100 pcs per reel, 12mm step between cavities.
VESMD	None, only potentiometers.	1.000 pcs per reel, 12mm step between cavities.	1.500 pcs per reel, 12mm step between cavities.
VESIVID	6030, 6035, 6037	700 pcs per reel, 12mm step between cavities.	1.000 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.
ПЭІУІЛ	With specific thumbwheel.	Under request.	Under request.
VS5PIP	None, only potentiometers.	900 pcs per reel, 12mm step between cavities.	1.200 pcs per reel, 12mm step between cavities.

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	100Ω ≤ Rn ≤ 1MΩ 1 KΩ ≤ Rn ≤ 1 MΩ		
Tolerance* $ \begin{array}{l} Rn < 100\Omega : \\ 100\Omega \le Rn \le 100K\Omega \\ 100K < Rn \le 1M\Omega : \\ 1M\Omega < Rn \le 5M\Omega : \\ Rn > 5M\Omega : \\ \end{array} $	+50%, -30% (out of range)	±25% ±25% ±50%		
Variation laws	Lin (A), Log (B), Antilog (C). Oth	er tapers available on request		
Residual resistance	Lin (A), Log (B), Antilog (C) $\leq 5*10-3*Rn$ . Minimum value $2\Omega$			
CRV - Contact Resistance Variation (dynamic)	Lin (A) Electrical Angle 215°±20° ≤ 3%Rn. Other tapers, please inquire			
CRV - Contact Resistance Variation (static)	Lin (A) Electrical Angle 215°±20° ≤ 5%Rn. Other tapers, please inquire			
Maximum power dissipation** Lin (A) Log (B), Antilog (C)	at 50°C 0.10W 0.06W			
Maximum voltage Lin (A) Log (B), Antilog (C)	100VDC 60VDC			
Operating temperature	-25°C +70°C (+85°C on request)			
Temperature coefficient $100\Omega \leq \text{Rn} \leq 10\text{K}\Omega$ $10\text{K}\Omega < \text{Rn} \leq 5\text{M}\Omega$	+200/ -300 ppm +200/ -500 ppm	+200/ -500 ppm +200/ -1000 ppm		

<sup>\*</sup> Out of range ohm values and tolerances are available on request, please, inquire.

# Mechanical Specifications

	CA6 Through-hole	CA6 SMD	
Resistive element	Carbon technology Carbon technology		
Angle of rotation (mechanical)	235° ± 10°		
Angle of rotation (electrical)	215° ± 20°		
Wiper standard delivery position	50% ± 15°		
Max. stop torque	4 Ncm		
Max. push/pull on rotor	9.8 N		
Wiper torque*	<2 Ncm		
Mechanical life	1.000 cycles (others available on request)		

<sup>\*</sup> 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.

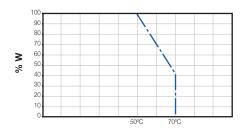
#### CA6 Through-hole and SMD

	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°C, plus 2 h at −25°C	±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 ± 2°C	±4%
Storage (3 years)	3 years at 23°C ± 2°C	±3%

<sup>\*\*</sup> Dissipation of special tapers will vary, please, inquire.

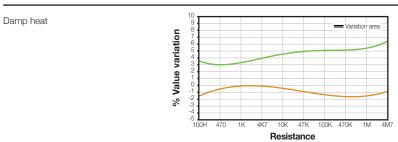
#### CA6 Through-hole and SMD

Power derating curve:

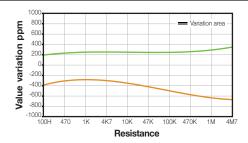


Representation of the typical variation of nominal resistance (with 95% confidence) throughout the ohm value range:

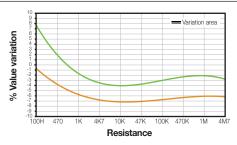




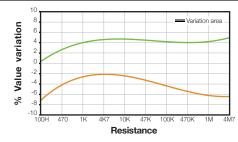
Temperature Coefficient



Load life



Mechanical life









# 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.

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

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

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	Α	2020				SNP			PI		WT	-9005	-BA	-V0

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

Customized products: A drawing is requested when ordering a customized product. Series, rotor, model and total resistive value are indicated before the code that includes

1 - Serie	·	cations	s. Exa	imple:	: CA9	PH2,5-1	IUK CC	DE C00	111.		
CA9	■ CE9										
2 - Roto	ors										
C D	Е	J	ŀ	<	KA	М	MA	MT	Р	R	Υ
3 - Mod	el and p	oitch									
H2,5	H3,8	HS3	3,8	H5	Н	HSMD	V7,5	V10	VK1	0 \	/R10
MAV10	MTV1	0 V	SMD	VS	SMD V	VT-9002	VSM	IDCY	VSMD	CY WT-	9002
4 - Pack	aging			1	Troug	h-hole		s	MD mo	dels	
1 1 401	wayiii y								1110		
Bulk	tuging					nk) <sup>(1)</sup>			(blank)	(1)	
		3" reel)			(bla					(1)	
Bulk	e and 1				(bla	nk) <sup>(1)</sup>			(blank)		
Bulk T&R (Tap	e and 1	5" reel)			(bla	nk) <sup>(1)</sup> F&R			(blank) T&R		
Bulk T&R (Tap T&R (Tap	pe and 1; ne and 1; nulk packagir	5" reel)			(bla	nk) <sup>(1)</sup> F&R			(blank) T&R		
Bulk T&R (Tap T&R (Tap (1) If blank, br	pe and 15 pe and 15 pe and 15 pulk packagin	5" reel)  ng is implie	ed.		(bla	r&R \$R15	500ΚΩ		(blank) T&R	i	5ΜΩ

I&R	паре	and i	91)	I&RI5					IARIS						
(1) If bla	ank, bulk	packagi	ing is imp	olied.											
5 - F	Resist	ance	value	)											
100Ω	200Ω	220Ω	250Ω	470Ω	500Ω	1ΚΩ	2ΚΩ		500ΚΩ	1ΜΩ	2ΜΩ	2Μ2Ω	4M7Ω	5MS	
100	200	220	250	470	500	1K	2K		500K	1M	2M	2M2	4M7	5M	
6 - F	Resist	ance	law /	tape	r										
Lin - Linear A															
Log - Logarithmic B															
Antilo	og - A	ntiloga	arithm	ic							С				
- Spe	ecial ta	apers	have o	codes	assig	ned:			1	CODE	YXX	XX			
7 - 1	olera	nce													
±20%	6		±30	)%		+50%	%,-30°	%	±10%				±5%		
2020	)		30	30		5	030			10	10		050	)5	
8 - C	)pera	ting L	.ife (C	ycles	s)										
Stan	dard (	1.000	cycle	s)								(I	eave b	lank)	
Long	life: LV	+ the	numbe	er of cy	cles. e	k: LV10	) for 10	0.00	00 cycle	es. (othe	rs on requ	uest) L\	/XX: ex:	LV10	
0 0	· T		0	a oiro	.:.										

Standard (1.000 cycles)		(leave blank)
Long life: LV + the number of cycles. ex: LV10 for 10.000	Cycles. (others on request)	LVXX: ex: LV10
9 - Cut Track - Open circuit.		
Open circuit at beginning of track, fully CCW	PCI	
Open circuit at end of track, fully CW	PCF	
Pin in Paste option (Reflow Soldering)	PIP	
10 - Detents (DT)		
One detent at the beginning	DTI	
One detent at the end	DTF	
X number of detents	XDT: 10DT	
Special detents are available on request: If you need to assign a voltage	e value to each detent, plea	se inquire.

11	_	Terminals	

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

#### Color: For colors other than standard: -See color chart below-

CJ-color, ex., red: CJ-RO

## 13 - Rotor

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

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

By default, carbon is non self-extinguishable, cermet is self-extinguishable: (blank) For carbon: self-extinguishable property can be added. V0 means housing V0 and rotor are V0 if only the housing needs to be V0, then CJ-V0. CJ-V0, RT-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 & bolousy0/	L A > 0/

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

#### For ordering spare accessories:

Accessory reference - color- flammability. XXXX-YY-V0

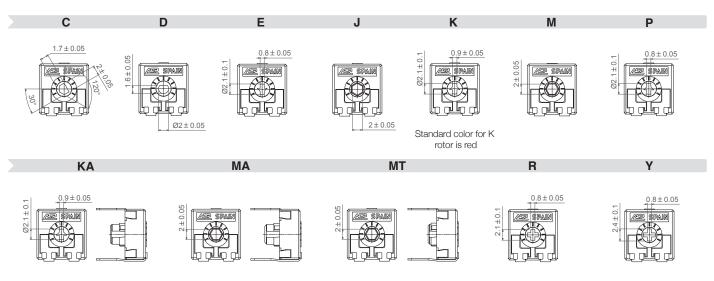
Ex. 9010-AZ-V0 is a blue self-extinguishable 9010 thumbwheel

#### Color chart for rotor, housing and accessories

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

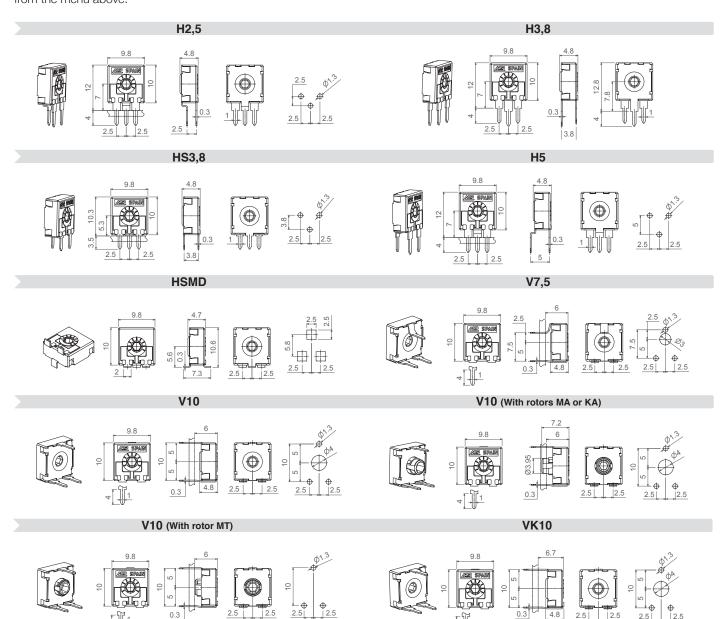
(1) black is not an option for housings.

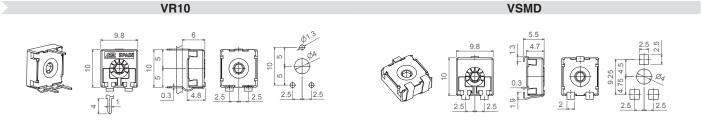
Rotors are drawn in their standard positioning, 50% of rotation. Alternative delivery positioning can be requested. Accessories in this catalogue are designed for the M rotor, unless otherwise stated.



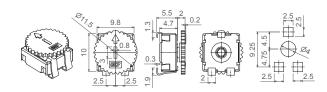
#### Models

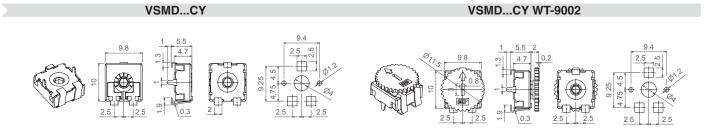
All models shown here have the most common rotor for 9mm potentiometers: the M rotor. Different rotors are available from the menu above.





#### **VSMD WT-9002**

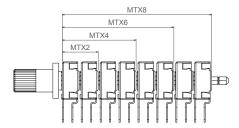




#### **GANGED**

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

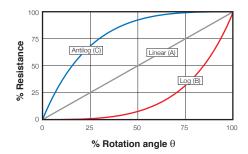
Model	MTX2	MTX4	MTX6	MTX8
Shaft	9048, 9074, 9076	9039, 9051	9018	9056

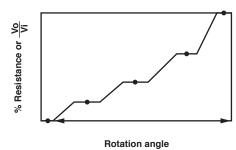


#### **Tapers**

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

# REGULAR TAPERS SPECIAL TAPERS







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

Mechanical life with cut track needs to be confirmed.

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

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

Other positions are available on request.

PCI PCF







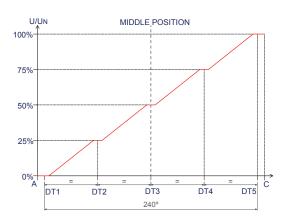


# Potentiometers with detents

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

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

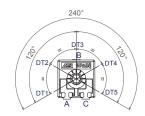
#### Example of 5DT with control of value in each DT.











Other examples of potentiometers with detents:

10DT 20DT













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

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

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

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

> SNP **SNJ**





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

**Standard Terminal** 

Shorter terminal, for H5 TP25

Shorter terminal, TPXX (under request)







**Possibilities** for insertion accessories

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

**WT Front side** WTI Collector side **WT Front side** WTI Collector side









Shafts

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

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

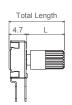
Unless otherwise stated, the arrow in the shafts is in line with the wiper and it points to 50% when assembled with M rotors.

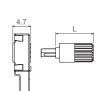
When a shaft is mounted on a potentiometer, the distance from the top of the potentiometer to the top of the shaft is marked with "L" in the table below, as shown in the drawings:

#### H potentiometer + shaft

#### V potentiometer + shaft

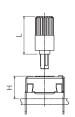












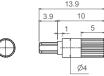
Shaft

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

> 9004 9005















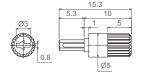


# Shafts 9006 9009 9010 9018 (for 6 ganged potentiometers) Ø6 9019 (Designed for D rotor) 9020 (Designed for D rotor) 0.9 9039 (for 4 ganged potentiometers) 9047 9048 (for 2 ganged potentiometers) 9051 (for 4 ganged potentiometers) 20.5 Ø12 9053 9054 Ø5 9055 9056 (for 8 ganged potentiometers) Metal -Hexagon 9059 9063 18.4 18.4

Ø9

9064 9067









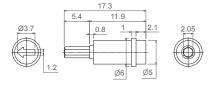




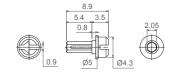
The arrow is in line with the wiper when potentiometer has rotor  $\boldsymbol{J}$ (with M rotor, there is a 30° difference).

9070 9071



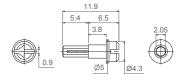




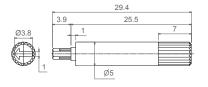


9073 9072





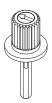


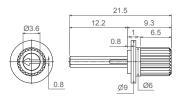




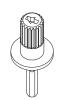
9074 (for 2 ganged potentiometers)

9076 (for 2 ganged potentiometers)

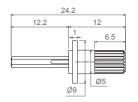














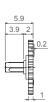
### Thumbwheel

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

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

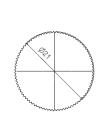
# 9002





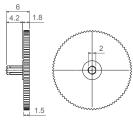




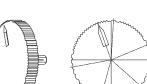


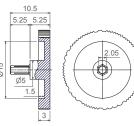
9041

9061

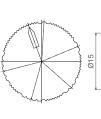


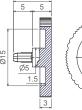
#### 9060 (Designed for R rotor)

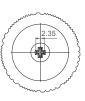












#### **Bulk packaging:**

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
KAV - MAV – MTV	None, only potentiometers.	400	1.250
MTX2	9048, 9074, 9076	150	To be determined.
MTX4	9039, 9051	75	To be determined.
MTX6	9018	50	To be determined.
MTX8	9056	40	To be determined.

Tape & Reel packaging:	With thumbwheel inserted?	13" Reel (Standard), with 24mm width tape	15" Reel, with 24mm width tape
	None, only potentiometers.	900 pcs per reel, 12mm step between cavities.	1.250 pcs per reel, 12mm step between cavities.
VSMD	9002	700 pcs per reel, 12mm step between cavities.	To be determined.
VSMDCY	None, only potentiometers.	750 pcs per reel, 12 mm step between cavities	1000 pcs per reel, 12 mm step between cavities
V3IVIDC1	9002	To be determined	To be determined
HSMD		350 pcs per reel, 16 mm step between cavities	475 pcs per reel, 16 mm step between cavities

250

250

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

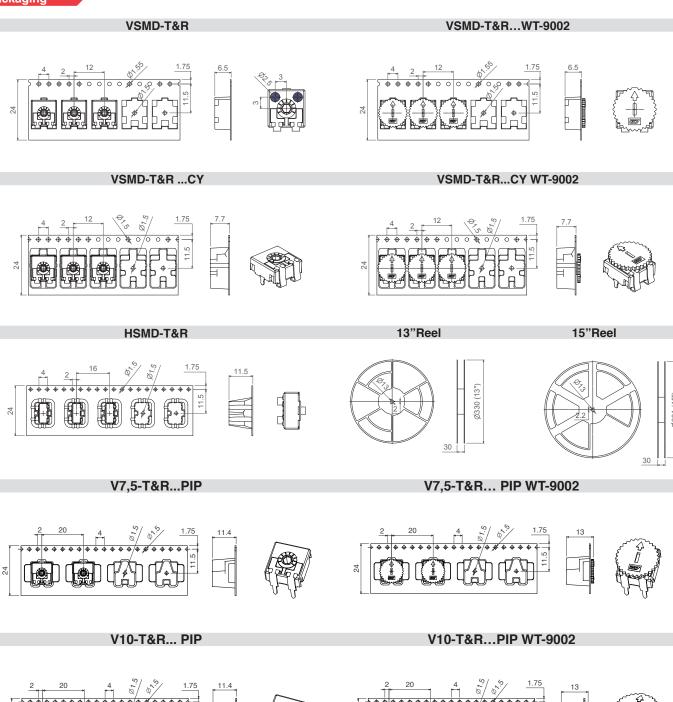
None, only potentiometers or 9002

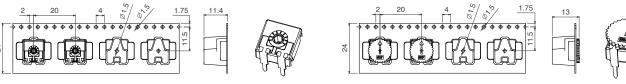
H2,5...PIP TP25 -H5...PIP TP25 -HS3,8...PIP

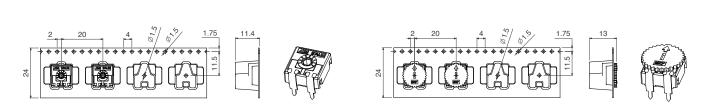
V7,5...PIP -V10...PIP -V10...PIP TP25 -VR10...PIP

350

400





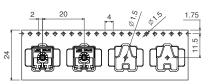


V10-T&R...PIP TP25

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

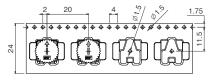
#### VR10-T&R...PIP

#### VR10-T&R... PIP WT-9002







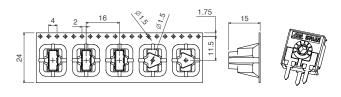


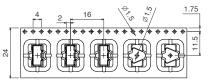




HS3,8-T&R... PIP

H5-T&R...PIP TP25

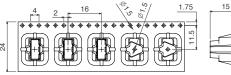








H2,5-T&R...PIP TP25









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

	CA9 Through-hole	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* $ \begin{array}{l} Rn < 100\Omega \colon \\ 100\Omega \leq Rn \leq 100K\Omega \\ 100K < Rn \leq 1M\Omega \colon \\ 1M\Omega < Rn \leq 5M\Omega \colon \\ Rn > 5M\Omega \colon \\ \end{array} $	+50%, -30% (out of range) ±20% ±20% ±30% +50%, -30% (out of range)	±20% ±30% ±20% ±40% ±30% ±50%			
Variation laws	Lin (A),	Log (B), Antilog (C). Other tapers available o	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 220°±20° ≤ 3%Rn. Other tapers, please inquire			
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)	0.1	at 50°C 0.15W 0.10W			
Maximum voltage Lin (A) Log (B), Antilog (C)	200° 150°	200VDC			
Operating temperature	-25°C +70°C (-	-25°C +70°C (+85°C on request)			
Temperature coefficient $100\Omega \leq Rn \leq 10K\Omega$ $10K\Omega < Rn \leq 5M\Omega$	+200/ -300 ppm +200/ -500 ppm	+200/ -500 ppm +200/ -1000 ppm	±100 ppm ±100 ppm		

<sup>\*</sup> Out of range ohm values and tolerances are available on request, please, inquire.

<sup>\*\*</sup> 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 cyc	es (many more available on request, pl	ease, inquire)				

<sup>\*</sup> Stronger or softer torque feeling is available on request.

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

#### CA9 Through-hole and SMD

#### CE9 Through-hole and SMD

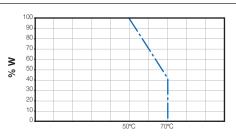
	Test conditions	Typical variation of nominal resistance	Test conditions	Typical variation of nominal resistance
Damp heat	500 h. at 40°C and 95% RH	+5%, -2%	500 h. at 40°C and 95% RH	±2%
Thermal cycles	16 h at 85°C, plus 2 h at -25°C	±2.5%	16 h at 90°C, plus 2 h at -40°C	±2%
Load life	1.000 h. at 50°C	+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%
Storage (3 years)	3 years at 23°C ± 2°C	±3%	3 years at 23°C ± 2°C	±1%

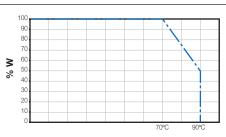
Test results



CE9 Through-hole and SMD

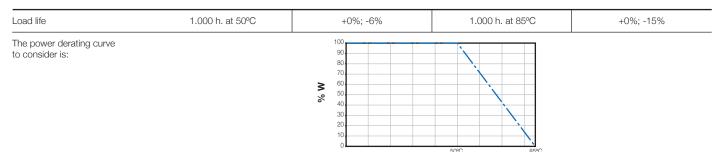
Power derating curve:



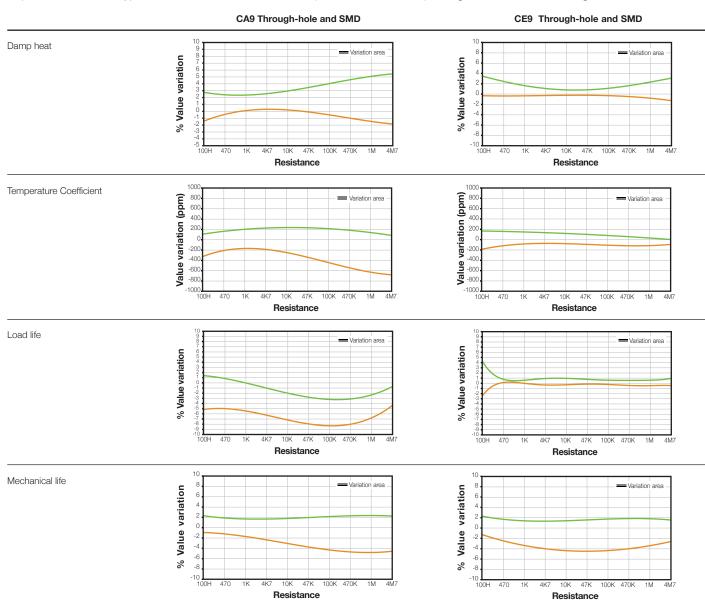


#### For temperatures out of range

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:









### CARBON - CA14

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.

### CERMET - CE14

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.

# CA14 R CE14 R HOW TO ORDER

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

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

						Extra fe	atures						Assemb	led acc	essory	
Series Rotor Mo	odel Packg. (	Ohm value	Taper	Tol.	Life	Track	Detents	s 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 N H2	2,5	- 10K	А	2020			10DT	SNP			PI		WT	14117	-BA	-V0
andard configuration	n:	CA14	Throug	h-hole				CA1	4 SMD			c	E14 Thro	ugh-hol	e and S	MD
mensions:								14	4mm							
rotection:									dust-proo							
ubstrate:		Carbo	n techr	ology				Self-extingunology, sp						Cermet		
olor:		Blue hous			ır	Oarb		own hous		-	Jerature		Brown hou		vhite rota	nr .
ackaging:		Dide Hous	51119 1 W	THIC TOLO	"				Bulk	10101			Brownino	331119 T V	VI III C T O I C	
/iper position:									)% ±15°							
erminals:							St	raight, wit		ping.						
larking:						Resistive		narked or			on reques	t.				
special specifications.  - Series  CA14  CE14	Example: CA	.14PH2,5-	-10K C(	ODE COO	)111.			<u>11 - Term</u> SNAP IN								SNP
								SNAP IN								SNR
- Rotors  D E F	G k	< M	N	P	т	X	_			al TDVV	' whore Y	V ic tip l	ength (under r	oguant)	TDV	(X, ex:
	G r	\ IVI	IN		- 1	^				iai, IFA	, WHELE A	15 tip it	singti i (under i	equesti	117	SH
- Model and pitch  DHC0 H2,5		HA5	HL5	V12,5	VA12,	,5 VL1	0.5	Steel Terr								ЭП
						-		12 - Hou Color: For		er than s	tandard: -9	See color	chart below	- C.I	-color, ex	red: C
•	/15) CFF		-		VOIVID	VSMD				ici tilaii 3	taridara. C		CHAIT DOIOW		00101, 02	., 100. 0
	) (Under requ	iest, not r	eadily a					13 - Roto Color: For		er than s	tandard: -9	See color	chart below	- RT-	color; ex.	blue: F
- Packaging		igh-hole		S	MD mo								using and		00.01, 07.	, 5,000, 1
AR (Tape and 13" reel) AR (Tape and 15" reel)	(N	ank) <sup>(1)</sup> I.A.) <sup>(2)</sup> I.A.) <sup>(2)</sup>			(blank) T&R T&R1:	1	_	By default, For carbor and rotor a	carbon is a: self-extin	non self- guishable	extinguisha property of	ble, cern an be a	net is Self-ex dded. V0 me /0, then CJ-\	tinguishal ans housi	ng	(blank V0 J-V0, R
Mileterate to the all and a second and the formation of	(O) NI A NI-+ A	Saabla, Taaaa	and Deel an		-1			If only roto								
	. (2) N.A., Not Appl	licable: Tape a	and Reel pa	ackaging is o	nly available		inals.	14 - Wip	er	tandard:	50% + 1	59)			(leav	e blank
- Resistance value						e for SMD termi	inals.	14 - Wip Wiper po	er osition (S	tandard:	50% ± 1	5°)			(leav	
- Resistance value 0Ω 200Ω 220Ω 250Ω 47	0Ω 500Ω 1ΚΩ	Ω 2ΚΩ	500ΚΩ	1MΩ 2N	MΩ 2M2Ω	e for SMD termi $\Omega$ 4M7 $\Omega$ 5	inals.	14 - Wip Wiper po	er osition (S	tandard:	50% ± 1	5°)			(leav	PI
- Resistance value 00 2000 2200 2500 47 00 200 220 250 4	0Ω 500Ω 1KΩ 70 500 1K	Ω 2ΚΩ		1MΩ 2N	MΩ 2M2Ω	e for SMD termi	inals. iMΩ 5MΩ	14 - Wip Wiper po Initial or C	er osition (S CCW				DOLL			PI PF
- Resistance value           100         2000         2200         2500         47           00         200         220         250         4           her resistive values available on resistive values availabl	0Ω 500Ω 1KG 70 500 1K	Ω 2ΚΩ	500ΚΩ	1MΩ 2N	MΩ 2M2Ω	e for SMD termi $\Omega$ 4M7 $\Omega$ 5	inals. iMΩ 5M	14 - Wip Wiper po Initial or C Final or C Others: fo	er  position (S  CCW  W  bllowing c	ock pos	itions; at	3 hours			PXH,	PI PF ex: P3I
- Resistance value  0Ω 200Ω 220Ω 250Ω 47  00 200 220 250 4  ner resistive values available on r  - Resistance law / ta	0Ω 500Ω 1KG 70 500 1K	Ω 2ΚΩ	500ΚΩ	1MΩ 2N 1M 2	MΩ 2M2Ω	e for SMD termi $\Omega$ 4M7 $\Omega$ 5	inals. SMΩ SM	14 - Wip Wiper po Initial or C Final or C Others: fo Wiper to	er position (SCW) W pllowing c rque (Sta	ock pos ndard: <	itions; at	3 hours	: P3H nts: <3.5)		PXH,	PI PF ex: P3I e blank
- Resistance value  0Ω 200Ω 220Ω 250Ω 47  00 200 220 250 4  ner resistive values available on n  - Resistance law / ta  n - Linear	0Ω 500Ω 1KG 70 500 1K	Ω 2ΚΩ	500ΚΩ	1MΩ 2M 1M 2	MΩ 2M2Ω	e for SMD termi $\Omega$ 4M7 $\Omega$ 5	inals. SMΩ SM	14 - Wip Wiper po Initial or C Final or C Others: fo	er position (SCW) W pllowing c rque (Sta	ock pos ndard: <	itions; at	3 hours			PXH,	PI PF ex: P3
- Resistance value  10Ω 20Ω 220Ω 250Ω 47  10Ω 20Ω 220 250 4  10Ω 20Ω 220 250 4  10Ω 2ΩΩ 220 250 4  10Ω 20Ω 220 250 4  10Ω 20Ω 20Ω 20Ω 250 4  10Ω 20Ω 20Ω 250 4  10Ω 20Ω 20Ω 250 4  10Ω 20Ω 250 4  10Ω 20Ω 250 4  10Ω 250 4  10Ω 20Ω 250 4  10Ω	0Ω 500Ω 1KG 70 500 1K	Ω 2ΚΩ	500ΚΩ	1MΩ 2N 1M 2	MΩ 2M2Ω	e for SMD termi $\Omega$ 4M7 $\Omega$ 5	inals.	14 - Wip Wiper po Initial or C Final or C Others: fc Wiper to Low torqu	er  osition (S  CCW  W  obllowing c  rque (Statue, < 1.5N  earity	ock pos ndard: <	itions; at	3 hours			PXH, (leav	PI PF ex: P3I e blank
- Resistance value  0\Omega 200\Omega 220\Omega 250\Omega 47  0\Omega 200 220 250 4  ner resistive values available on re - Resistance law / ta n - Linear  og - Logarithmic  ntilog - Antilogarithmic	0Ω 500Ω 1KΩ 70 500 1K equest.	Ω 2ΚΩ	500KΩ 500K	1MΩ 2N 1M 2 A B C	//Ω 2M2S	e for SMD termi $\Omega$ 4M7 $\Omega$ 5	inals.	14 - Wiper pount of the control of t	er  position (SCCW)  W  Ullowing c  rque (Statue, < 1.5N  parity  olled	ock pos ndard: <	itions; at 2.5Ncm,	3 hours	nts: <3.5)		PXH, (leav	PI PF ex: P3I e blank PGB
- Resistance value  100 2000 2200 2500 47  100 200 220 250 4  100 200 220 250 4  100 - Resistance law / ta  101 - Linear  102 - Logarithmic  103 - Antilogarithmic  104 Special tapers have coordinated.	0Ω 500Ω 1KΩ 70 500 1K equest.	Ω 2ΚΩ	500KΩ 500K	1MΩ 2N 1M 2	//Ω 2M2S	e for SMD termi $\Omega$ 4M7 $\Omega$ 5	inals.	14 - Wiper pount of Control of Co	er position (S CCW W pollowing c rque (Sta pue, < 1.5N parity olled ont linearity	ock pos ndard: < Icm	2.5Ncm,	3 hours for dete		LN3%	PXH, (leav f) (leav LNx%;	PI PF ex: P3I e blank PGB e blank ex: LN;
- Resistance value  100 2000 2200 2500 47  100 200 220 250 4  The resistive values available on resistance law / ta  101 - Linear  102 - Logarithmic  103 - Antilogarithmic  104 - Special tapers have cood-  105 - Tolerance	0Ω 500Ω 1KΩ 70 500 1K equest.  per	2 2KΩ ( 2K	500KΩ 500K	1MΩ 2M 1M 2 A B C	//Ω 2M2S	e for SMD term $\Omega = \frac{4M7\Omega}{2} + \frac{5}{4}$	inals.	14 - Wiper po Wiper po Initial or C Final or C Others: fo Wiper to Low torqui 15 - Line Not contr Independed	er  position (S  CCW  W  billowing c  rque (Sta  ue, < 1.5N  earity  olled  Int linearity c	ock pos ndard: < lcm controlled	d & below & below	3 hours for dete	nts: <3.5)	LN3%	PXH, (leav f) (leav LNx%;	PI PF ex: P3H e blank PGB
- Resistance value  00 2000 2200 2500 47  00 200 220 250 4  The resistive values available on resistive values available on resistive values available on resistive values available on resistance law / tan - Linear  og - Logarithmic  ntilog - Antilogarithmic  Special tapers have coor  - Tolerance  20% ±30%	0Ω 500Ω 1KG 70 500 1K peruest. per	2 2KΩ 2 2K	500KΩ 500K	1MΩ 2h 1M 2  A B C C CODE YX	//Ω 2M2S	±5%	inals.	14 - Wiper pount of the control of t	er  position (SCW)  W  Ullowing c  rque (Statue, < 1.5N  parity  olled  int linearity c  s could be av	ock pos ndard: < lcm controllec	d & below & below equest, pleaset, plea	3 hours for dete	nts: <3.5)	LN3%	PXH, (leav f) (leav LNx%;	PI PF ex: P3t e blank PGB e blank ex: LNC
- Resistance value  00 2000 2200 2500 47  00 200 220 250 4  The resistive values available on resistance law / tamer resistive values available on resistance law / tamer - Linear  10 - Linear  10 - Logarithmic - Linear  10 - Linear	0Ω 500Ω 1KΩ 70 500 1K squest.  per  les assigned:  +50	2 2KΩ ( 2K	500KΩ 500K	1MΩ 2M 1M 2 A B C	//Ω 2M2S	e for SMD term $\Omega = \frac{4M7\Omega}{2} + \frac{5}{4}$	inals.	14 - Wiper po Wiper po Initial or C Final or C Others: fo Wiper to Low torqui 15 - Line Not contr Independed	er  position (SCW)  W  Ullowing c  rque (Statue, < 1.5N  parity  olled  int linearity c  s could be aventiometer	ock pos ndard: < lcm controlled ontrolled ailable on re	d & below & below equest, please	3 hours for dete	nts: <3.5)	LN3%	PXH, (leav f) (leav LNx%;	PI PF ex: P3t e blank PGB e blank ex: LN: Ax%
- Resistance value  10Ω 200Ω 220Ω 250Ω 47  100 200 220 250Ω 47  100 200 220 250Ω 47  100 200 220 250Ω 47  100 200 200 250Ω 47  100 250Ω 4	0Ω 500Ω 1KΩ 70 500 1K squest.  per  les assigned:  +50	2 2KΩ 2 2K	500KΩ 500K	1MΩ 2h 1M 2  A B C C CODE YX	M 2M29	±5% 0 for SMD term  4M7Ω 5  4M7Ω 5	inals.	14 - Wiper pount of the control of t	er  position (S  CCW  W  pollowing c  rque (Sta  ue, < 1.5N  parity  colled  linearity c  s could be av  entiomete  entio	ock pos ndard: < lcm controlled ailable on re ers with	d & below a & below a seemb de	3 hours for dete	nts: <3.5)	LN3%	PXH, (leav LNx%; L	PI PF ex: P3H e blank PGB ex: LN Ax%
- Resistance value  100 2000 2200 2500 47  100 200 220 250 4  101 200 220 250 4  102 200 220 250 4  103 200 220 250 4  104 250 4  105 250 4  106 250 4  107 250 4  108 250 4  109 250 4  10	0Ω 500Ω 1KG 70 500 1K equest. per  les assigned: +50	2 2KΩ 2 2K 2 2K 2 2K 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	500KΩ 500K	1MΩ 2M 1M 2 A B C CCODE YY ±10%	MΩ 2M29 M 2M29	±5% (leave blar	inals.	14 - Wiper pount of the control of t	er  position (S  CCW  W  pollowing c  rque (Sta  ue, < 1.5N  parity  colled  c	ock pos ndard: < localized to the controlled aliable on re ers with rminal si ollector s	d & below a & below a seemb de	3 hours for dete	nts: <3.5)	LN3%	PXH, (leav f) (leav LNx%; L	ex: P3h eblank) PGB e blank) ex: LN3 Ax%
	0Ω 500Ω 1KG 70 500 1K equest. per  les assigned: +50	2 2KΩ 2 2K 2 2K 2 2K 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	500KΩ 500K	1MΩ 2M 1M 2 A B C CCODE YY ±10%	MΩ 2M29 M 2M29	±5% 0 for SMD term  4M7Ω 5  4M7Ω 5	5MΩ 5MΩ 5MM	14 - Wiper pount of the control of t	er  position (S  CCW  W  pollowing c  rque (Sta  Lue, < 1.5N  parity  colled  linearity c  s could be av  entiomet  ent from te  dd from cc  y Referen  f shafts ar	ock pos ndard: < lcm controllec ontrollec ailable on re ers with rminal si ollector s ce nd thumb	d & below a & below assemb	3 hours for dete	nts: <3.5)		PXH, (leav  (leav  LNx%;  L  W  -XX  Example	PI PF ex: P3H e blank) PGB e blank) ex: LN3 Ax%
- Resistance value  00 2000 2200 2500 47  00 200 220 250 4  ner resistive values available on re - Resistance law / ta n - Linear  og - Logarithmic  ntilog - Antilogarithmic  Special tapers have coc - Tolerance 20% ±30%  020 3030  - Operating Life (Cyc andard (1.000 cycles)  ong life: LV + the number of - Cut Track - Open c	0Ω 500Ω 1KΩ 70 500 1KΩ rouest.  per  les assigned:  +50  les)	2 2KΩ 2 2K 20%,-30% 5030	500KΩ 500K	1MΩ 2M 1M 2  A B C CODE Y> ±10% 1010	MΩ 2M2C  M 2M2  WXXX  request) L	±5% (leave blar	5MΩ 5MΩ 5M	14 - Wiper pount of the second	er  position (S  CCW  W  pollowing c  rque (Sta  Lue, < 1.5N  parity  colled  colled  colled  colled  colled  colled  colled  from te  colled from te  colled from te  colled from colled  y Referen  i shafts ar  shaft or th	ock pos ndard: < ld> lcm  controlled ontrolled ailable on re ers with rminal si bllector s ce nd thumb	d & below : & below : & below : assemb de ide	3 hours for dete	xample, 3%:	-YY	PXH, (leav  [leav  LNx%;  L  W  -XXX  Example  Example	PI PF ex: P3H e blank; PGB e blank; ex: LN: Ax%
- Resistance value  00 2000 2200 2500 47  00 200 220 250 4  ner resistive values available on re - Resistance law / ta n - Linear  og - Logarithmic  ntilog - Antilogarithmic  Special tapers have coc - Tolerance 20% ±30%  020 3030  - Operating Life (Cyc andard (1.000 cycles)  ong life: LV + the number of - Cut Track - Open c	0Ω 500Ω 1KΩ 70 500 1KΩ rouest.  per  les assigned:  +50  les)	2 2KΩ 2 2K 20%,-30% 5030	500KΩ 500K	1MΩ 2M 1M 2  A B C CODE Y> ±10% 1010	MΩ 2M29 M 2M29	±5% (leave blar	inals.  iMΩ  iMΩ  ink)  v10	14 - Wiper pount of the state o	er  position (S  CCW  W  W  ollowing c  rque (Sta  ue, < 1.5N  parity  olled  ant linearity c  s could be av  pentiomete  d from te  d from te  d from co  y Referen  f shafts ar  shaft or th  ktinguishalt	ock pos ndard: < lcm controlled ailable on re ers with rminal si bllector s ce nd thumb	d & below a & below a assemb de ide	3 hours for dete	nts: <3.5)	-YY	PXH, (leave	PI PF ex: P3H e blank; PGB e blank; ex: LN: Ax%
- Resistance value  0Ω 200Ω 220Ω 250Ω 47  00 200 220 250 4  The resistive values available on the resistiv	0Ω 500Ω 1KG 70 500 1KG rougest.  per  les assigned:  +50  grouit.  rouit.	2 2KΩ 2 2K 20%,-30% 5030	500KΩ 500K	1MΩ 2M 1M 2  A B C CODE Y> ±10% 1010  S. (others on	MΩ 2M2C  M 2M2  WXXX  request) L	±5% (leave blar	inals.  iMΩ  iMΩ  iMΩ  ink)  v10	14 - Wiper pount of the control of t	position (SCCW)  W  W  Ollowing c  rque (Statue, < 1.5N  parity  Olled  Int linearity c  social be av  pentiomete  and from te  and fro	ock pos ndard: < lcm  controlled ailable on re ers with rminal si bllector s ce nd thumb umbwhe ble. Self-e modifies re acces	d & below a & below a sesories:	3 hours for dete  x%, for e  x% , ask.  ded acc  vailable  le accorcessory,	essories	-YY	PXH, (leave	PI PF ex: P3I e blank PGB ex: LN: Ax%  /T TI XXX e: 1411; e, white blank)
- Resistance value  0Ω 200Ω 220Ω 250Ω 47  00 200 220 250Ω 4  ner resistive values available on ner  - Resistance law / taner - Linear  og - Logarithmic  ntilog - Antilogarithmic  Special tapers have cocce  - Tolerance  20% ±30%  020 3030  - Operating Life (Cycce)  andard (1.000 cycles)  ong life: LV + the number of compen circuit at beginning  pen circuit at end of transpect of the compensation of the	0Ω 500Ω 1KG 70 500 1KG rougest.  per  les assigned:  +50  grouit.  rouit.	2 2KΩ 2 2K 20%,-30% 5030	500KΩ 500K	1MΩ 2M 1M 2  A B C CODE Y> ±10% 1010  S. (others on	MΩ 2M2S  M 2M2S  M 2M2S  CI	±5% (leave blar	inals. iMΩ inals. iMΩ inals. iMΩ inals. iMΩ inals. imals.	14 - Wiper pount of the control of t	position (SCW)  W  W  Ollowing c  rque (Sta  Jue, < 1.5N  parity  olled  Int linearity c  so sould be ave  entiometr  and from te  and from te  and from co  y Referen  f shafts ar  shaft or the  xtinguishat  y reference  y reference  y reference  y reference	ock pos ndard: < lcm controlled ailable on re ers with rminal si bllector s ce nd thumb umbwhe ble. Self-e modifies e acces e - color	d & below: & below: & below: assemb de	3 hours for dete	essories	-YY dard )	PXH, (leav  F (leave LNx%;  L  W  W  -XXX  Example Example (leave	PI PF ex: P3I e blank PGB ex: LN: Ax%
- Resistance value  100 2000 2200 2500 47  100 200 220 250 4  101 200 220 250 4  102 200 220 250 4  103 200 220 250 4  104 250 4  105 250 4  106 250 4  107 250 4  108 250 4  109 250 4  10	0Ω 500Ω 1KΩ 70 500 1K equest.  per  les assigned:  +50  cycles. ex: LV1 ircuit. of track, fully CW	2 2KΩ 2 2K 20%,-30% 5030	500KΩ 500K	1MΩ 2M 1M 2  A B C CODE Y> ±10% 1010  S. (others on	MΩ 2M2C  M 2M2C  M 2M2C  CI  CI  CF	±5% (leave blar	inals.  iMΩ  iMΩ  inh()  v10	14 - Wiper pount of the control of t	position (SCCW)  W  W  Ollowing c  rque (Statue, < 1.5N  parity  olled  Int linearity c  sould be av  pentiomete  and from te  and from	ock pos ndard: < lcm controlled ontrolled ailable on re ers with rminal si ollector s ce nd thumb umbwhee ole. Self-e modifies e acces e - color s a blue :	d & below a & below a delevatinguishal only the actions assertion of the actions are also results.	3 hours for dete	essories  ding to stand please, note	-YY dard )	PXH, (leav  F (leave LNx%;  L  W  W  -XXX  Example Example (leave	PI PF ex: P3 e blank PGB e blank ex: LN Ax%

X number of detents

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

XDT: 10DT

NE

ВА

(1) black is not an option for housings.

IN

RO

VΕ

AM

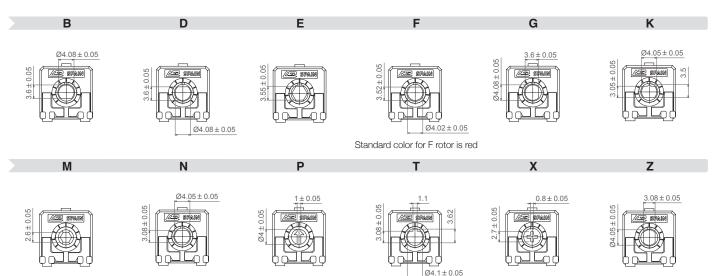
ΑZ

GS

MR

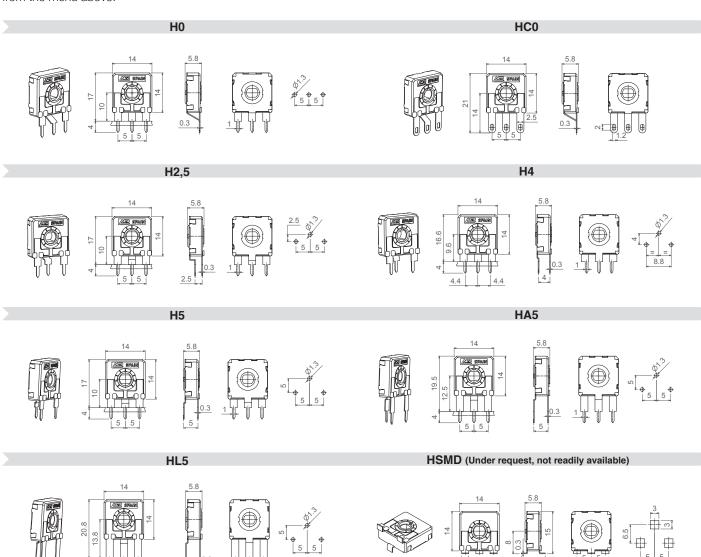
TA

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.

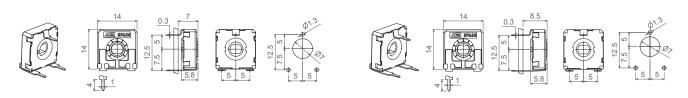


#### Models

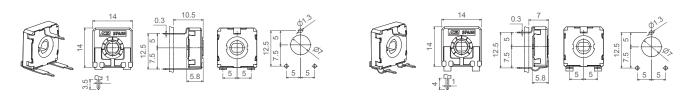
All models shown here have the most common rotor for 14mm potentiometers: the N rotor. Different rotors are available from the menu above.



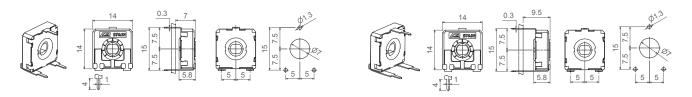
V12,5 VA12,5



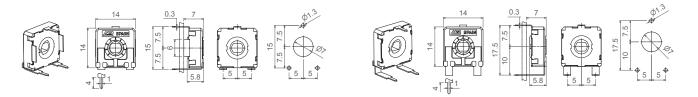
VR12,5 VL12,5



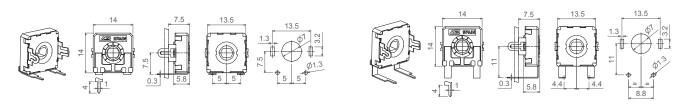
VJ15 V15



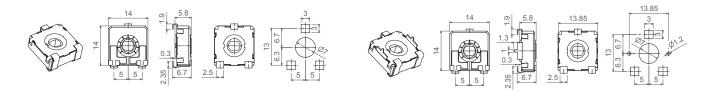
V17,5 V15...CFF



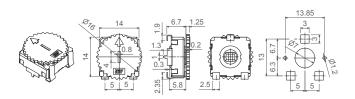
**VD7,5** VD11



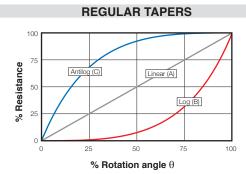
**VSMD** VSMD...CY

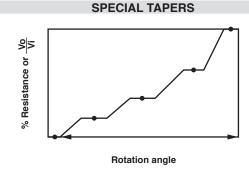


### VSMD...CY WT-14003



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.

PCI PCF







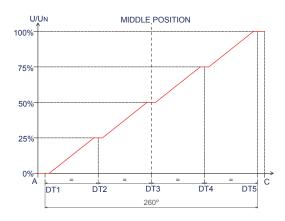


### Potentiometers with detents

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:

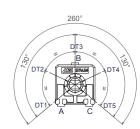
#### Example of 5DT with control of value in each DT.





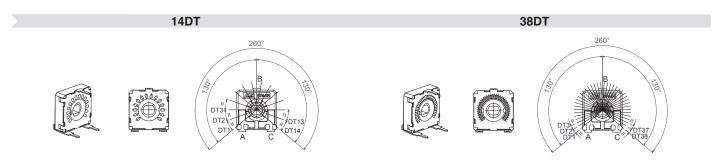








Examples of some potentiometers with detents:



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**

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



R1.5

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

Standard Terminal	Shorter terminal, for V12,5	Shorter terminal, TPXX (under request)
	,	
\$ <u></u>	SIN A	žĽV V V

Possibilities for insertion

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
		$\Pi$	T

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.

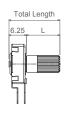
Shafts can be sold separately or delivered already mounted on the potentiometer at ACP.

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:

#### H potentiometer + shaft

#### V potentiometer + shaft

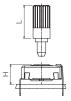










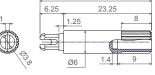


Shaft	14042	14065 (For E rotor)	14117	14056	14081	14187	14251	14067	14008	14015	14066	14084	14250	14072	14073
L Dimension	7.05	11.50	11.70	12.25	18.25	18.75	18.75	27.75	23.25	23.25	23.50	23.50	25.00	31.75	38.50

14008 14015



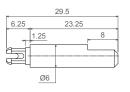














14042

14056

















#### 14065 (Designed for E rotor)

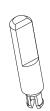
#### 14066



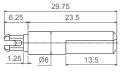












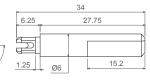


14067

### 14072



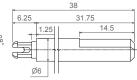














14073

14081

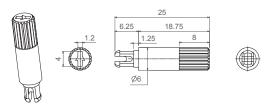
14084

14117

14187

14250

### 14251



#### Thumbwheel

6.25

1.25

18.75

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.

#### 14003

6.25

1.25

Ø6

#### Bulk packaging:

Potentiometer model	With shaft or thumbwheel inserted?	Pieces per small box (150 x 100 x 70)	Pieces per bigger box (250 x 150 x 70, CG on description)
H2.5 - 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.

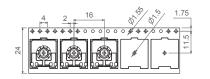
For models with  $^*$  and an inserted accessory, please, inquire about the quantity per box in that case. Optional box 140x140x70 is available on request.

#### Tape & Reel packaging:

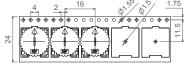
	With thumbwheel inserted?	13" Reel (Standard), with 24mm width tape	15" Reel, with 24mm width tape
VSMD	None, only potentiometers.	500 pcs per reel, 16mm step between cavities.	800 pcs per reel, 16mm step between cavities.
VSIVID	14003	450 pcs per reel, 16mm step between cavities.	To be determined.
VSMD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

VSMD-T&R VSMD-T&R...WT-14003





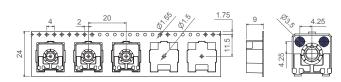


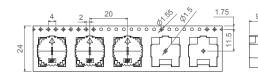




VSMD-T&R ... CY

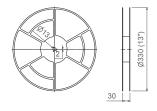
#### VSMD-T&R...CY WT-14003

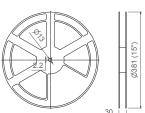






13" Reel 15" Reel







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

	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	100Ω ≤ Rn ≤ 1MΩ 1 KΩ ≤ Rn ≤ 1 MΩ	100Ω ≤ Rn ≤ 5MΩ 1 KΩ ≤ Rn ≤ 2M2Ω		
Tolerance* $ \begin{array}{l} Rn < 100\Omega \colon \\ 100\Omega \leq Rn \leq 100K\Omega \\ 100K < Rn \leq 1M\Omega \colon \\ 1M\Omega < Rn \leq 5M\Omega \colon \\ Rn > 5M\Omega \colon \\ \end{array} $	+50%, -30% (out of range) ±20% ±20% ±30% +50%, -30% (out of range)	±20% ±30% ±20% ±40% ±30% ±50%			
Variation laws	Lin (A),	Log (B), Antilog (C). Other tapers available of	n request		
Residual resistance	Lin (A), Log (B), Antilog (C) ≤ 8	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)	at 5 0.2 0.1	at 70° C. 0.7W 0.30W			
Maximum voltage Lin (A) Log (B), Antilog (C)					
Operating temperature	-25°C +70°C (	-40°C +90°C (+125°C on request)			
mperature coefficient $100\Omega \leq \text{Rn} \leq 10\text{K}\Omega \\ 10\text{K}\Omega < \text{Rn} \leq 5\text{M}\Omega \\ +200/\ -300 \text{ ppm}$		+200/ -500 ppm +200/ -1000 ppm	±100 ppm ±100 ppm		

<sup>\*</sup> Out of range ohm values and tolerances are available on request, 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° ± 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*		<2.5 Ncm Potentiometers with detents: <3.5 Nc	m						
Mechanical life	1.000 cy	cles (many more available on request, pl	ease, inquire)						

<sup>\*</sup> Stronger or softer torque feeling is available on request.



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

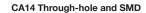
#### CA14 Through-hole and SMD

#### 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%
Storage (3 years)	3 years at 23°C ± 2°C	±3%	3 years at 23°C ± 2°C	±1%

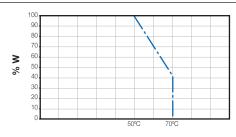
<sup>\*\*</sup> Dissipation of special tapers will vary, please, inquire.

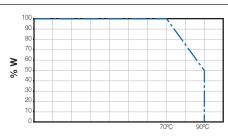




#### CE14 Through-hole and SMD

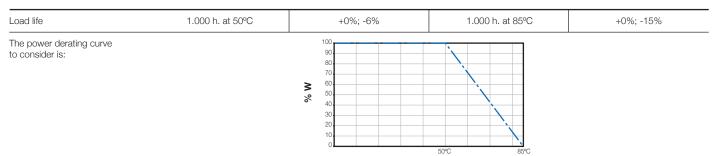
Power derating curve:



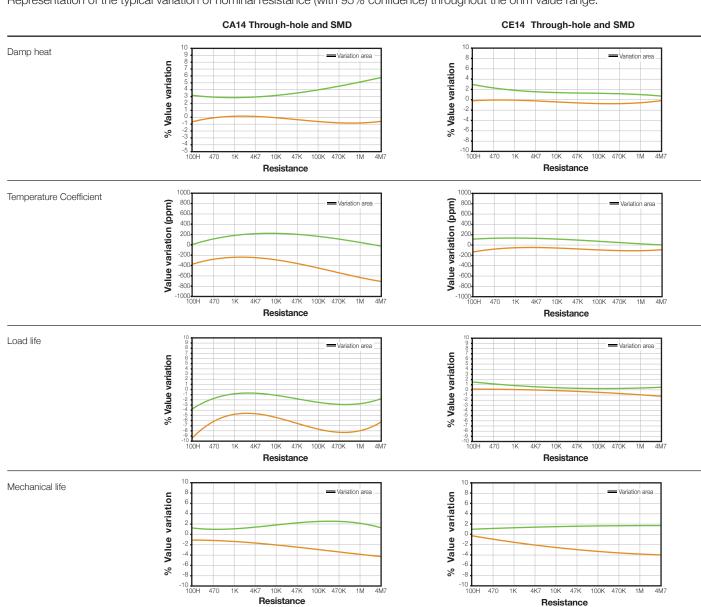


#### For temperatures out of range

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:





Carbon Potentiometers CAR



Cermet Potentiometers CER







### CARBON - CAR 14

This product family born as an alternative to the CA14 series when curved designs appear. Housing shape has been modified in order to set the product properly.

CAR14, 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 configuration is available; for SMD version, please, inquire. 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.

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.

#### **Applications**

CAR14 is 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.

## CERMET - CER14



This product family born as an alternative to the CA14 series when curved designs appear. Housing shape has been modified in order to set the product properly.

CER14, 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 configuration is available; for SMD version, please, inquire. 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.

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.

#### **Applications**

CER14 is 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.

# CAR14 CER14 HOW TO ORDER

Tol.

Life

8

Extra features

Track Detents Snap in Housing Rotor

EXAMPLE: CAR14NV12,5-10KA2020 10DT SNP PI WT-14117-BA

Series Rotor Model Packg. Ohm value Taper

Standard features

EXAMPLE: CER14NV12,5-10KA2020 10DT SNP PI WT-14117-BA-V0

Lin.

15

Wiper

14

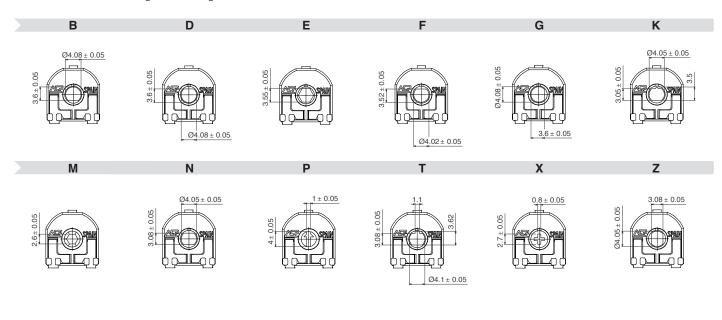
13

**Assembled accessory** 

Assembly Ref # Color Flam.

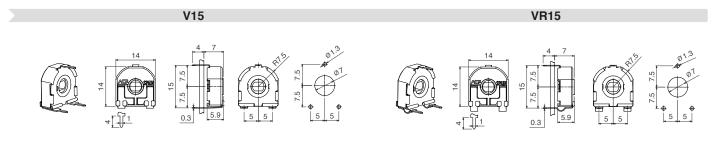
Standard configuration: CAR14 Th	hrough-hole							С	ER14	Throug	h-hole	
Dimensions:				14mm								
Protection:		On request:		(dust-p		t UL 94 V-0	)					
Substrate: Carbon	n technology			<u> </u>	<u> </u>				(	Cermet		
Color: Blue housi	ing + white rotor							Brov	wn hou	sing + v	hite rotor	
Packaging:				Bulk								
Viper position:			at (	50% ±1	5°							
Terminals:			Straight, v	vithout o	crimping.							
Marking:		Resistive value	marked o	on hous	ing. Othe	ers on req	uest.					
<b>Customized products:</b> A drawing is requested all special specifications. Example: CAR14PH2,5	· ·	•	Series, rot	or, mod	el and to	tal resistiv	e value	are indic	ated be	efore the	e code tha	t include
- Series			11 - Tei	minals								
CAR14 ■ CER14			SNAP II	NΡ								SNP
? - Rotors			Shorter	tip of te	rminal, Ti	PXX, wher	e XX is t	ip length	(under re	quest)	TPXX	, ex: TP:
B D E F G K M	N P	T X Z	Steel Te	erminals								SH
			12 - Ho	ousing								
3 - Model and pitch			Color: F	or colors	other tha	an standard	d: -See c	olor chart	below-	CJ	-color, ex.,	red: CJ-F
/15 VR15			13 - Ro	tor								
Dockooing Trough hole					other tha	an standard	d: -See c	olor chart	below-	RT-	color; ex., l	olue: RT-
P - Packaging Trough-hole  Bulk (blank)(1)			* Self-e	xtingui	shable ı	property,	V0, for	housing	g and ı	rotor:		
If blank, bulk packaging is implied.			For carb	on: self-e r are V0.	extinguish If only the	elf-extingu able prope e housing r	rty can b	e added.	V0 mea	ans housi	ng	(blank) V0 V0, RT-
5 - Resistance value 100Ω 200Ω 220Ω 250Ω 470Ω 500Ω 1ΚΩ 2ΚΩ ξ	500ΚΩ 1ΜΩ 2ΜΩ 2	2M2Ω 4M7Ω 5MΩ	14 - Wi									
		2M2 4M7 5M			ı (Standa	ard: 50%	± 15°)				(leave	blank)
	SUUK IIVI ZIVI	21012 41017 5101	Initial or		`						`F	
ther resistive values available on request.			Final or								P	
6 - Resistance law / taper					a clock r	oositions;	at 3 ho	urs: P3H			PXH, e	x. B3H
in - Linear	А					d: <2.5Nc					(leave	
Log - Logarithmic	В		Low tor		,	J. \Z.UINC	111, 101 C	icterita. <	.0.0)		PC	
Antilog - Antilogarithmic	С		LOW LOF	que, <	I.SINCIII						PC	3D
Special tapers have codes assigned:	CODE YXXXX	×	15 - Liı									
			Not cor								,	blank)
' - Tolerance :20% ±30% +50%,-30%	±10%	±5%	Independ	dent linea	arity contr	olled & bel	ow x%, f	or exampl	e, 3%: I	LN3%	LNx%; e	x: LN3%
<u> </u>						lled & belo					LA	x%
2020 3030 5030	1010	0505				on request, p						
- Operating Life (Cycles)						rith asser	mbled a	accesso	ries		WT	
Standard (1.000 cycles)		(leave blank)			n termina							
ong life: LV + the number of cycles. ex: LV10 for 10.00	00 cycles. (others on reques	st) LVXX: ex: LV10	Accesso		n collecto	or side					WTI	
- Cut Track – Open circuit.			See list	of shaft		umbwhee wheel	ls availa	ble			Example: Example,	14117
Open circuit at beginning of track, fully CCW	PCI					elf-extinguis					(leave b	,
Open circuit at end of track, fully CW	PCF		For ord	lering s	pare ac	<b>cessorie</b> : olor- flamr	s:	ory, pieas	e, note.	.)		, XX-YY-\
0 - Detents (DT)			Ex. 141	17-AZ-\	/0 is a bl	ue self-ex	tinguish	able 141	17 thui	mbwhee	el	
One detent at the beginning	DTI					housing						
One detent at the end	DTF		Black <sup>(1)</sup>	White	Neutral	Transp.	Red	Green	Yello	w Blu	ie Gre	y Brov

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.



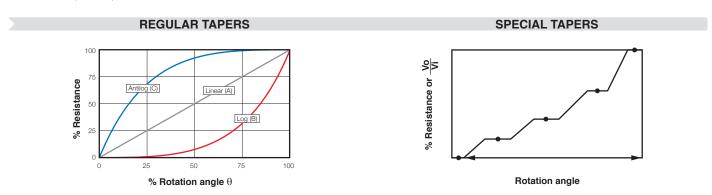
#### Models

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



#### 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.

PCI PCF







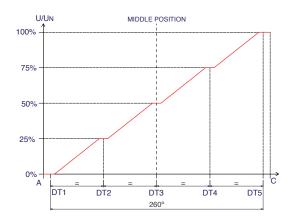


### Potentiometers with detents

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.

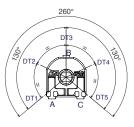
Detents can be light or strong, or even a combination of different feelings. They can be evenly distributed along the angle (standard) or tailored to match customers' request. They can also be combined with special tapers: constant value areas, open circuit zone, different slopes, etc. One common example 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 5T with control of value in each DT.









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 this product, detents are only available under request.

#### **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.

#### SNF



Shorter terminal tips are only available under request.

## Possibilities for insertion

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 WTI





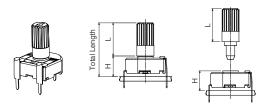
#### **Shafts**

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.

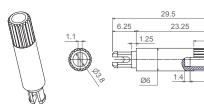
When a shaft is mounted, the distance from the top of the potentiometer to the top of the shaft is marked with "L" in the table below, as shown in the drawings:

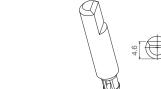
### V potentiometer + shaft

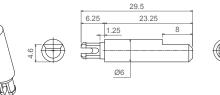


Shaft	14042	14065 (For E rotor)	14117	14056	14081	14187	14251	14067	14008	14015	14066	14084	14250	14072	14073
L Dimension	7.05	11.50	11.70	12.25	18.25	18.75	18.75	27.75	23.25	23.25	23.50	23.50	25.00	31.75	38.50

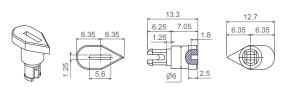
14008 14015

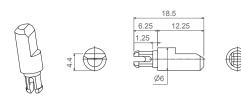






14042 14056





#### 14065 (Designed for E rotor) 14066



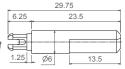




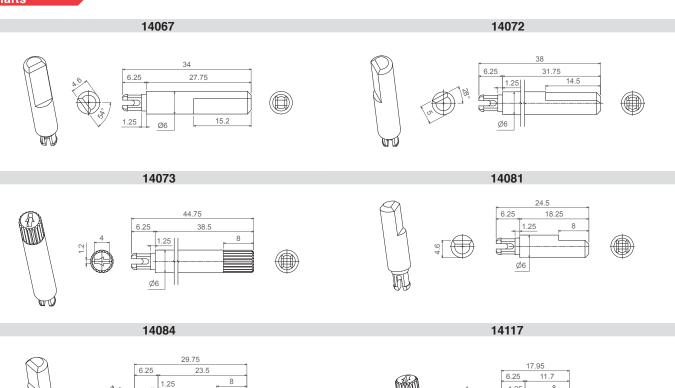








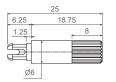




14187 14250



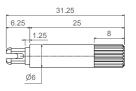










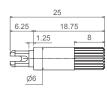


Ø6



#### 14251







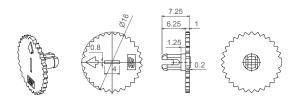
56

#### 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.

#### 14003



#### **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.	200 150 for models with*	700
V15 - VR15	14003, 14117, 14042, 14056, 14065	100	400 350 for models with*
	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.



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

#### CAR14 Through-hole

#### CER14 Through-hole

Range of resistance values* Lin (A)	100Ω ≤ Rn ≤ 5MΩ	100Ω ≤ Rn ≤ 5MΩ						
Log (B) Antilog (C)	1 KΩ ≤ Rn ≤ 2M2Ω	$1 \text{ K}\Omega \leq \text{Rn} \leq 2\text{M}2\Omega$						
Tolerance* $Rn < 100\Omega: \\ 100\Omega \le Rn \le 100K\Omega \\ 100K < Rn \le 1M\Omega: \\ 1M\Omega < Rn \le 5M\Omega: \\ Rn > 5M\Omega:$	+50%, -30% (out of range)	- ±20% ±20% ±30% -						
Variation laws	Lin (A), Log (B), Antilog (C). Oth	her tapers available on request						
Residual resistance	Lin (A), Log (B), Antilog (C) ≤ 5*10-3*Rn. Minimum value 2Ω	≤2Ω						
CRV - Contact Resistance Variation (dynamic)		Lin (A) Electrical Angle 245°±20° ≤ 3%Rn. Other tapers, please inquire						
CRV - Contact Resistance Variation (static)	Lin (A) Electrical Angle Other tapers, p							
Maximum power dissipation** Lin (A) Log (B), Antilog (C)	at 50℃ 0.25W 0.13W	at 70° C. 0.7W 0.30W						
Maximum voltage Lin (A) Log (B), Antilog (C)	250V 200V							
Operating temperature	-25°C +70°C (+85°C on request)	-40°C +90°C (+125°C on request)						
Temperature coefficient $100\Omega \leq Rn \leq 10K\Omega$ $10K\Omega < Rn \leq 5M\Omega$	+200/ -300 ppm +200/ -500 ppm	±100 ppm ±100 ppm						

<sup>\*</sup> Out of range ohm values and tolerances are available on request, please, inquire.

### Mechanical Specifications

	CAR14 Through-hole	CER14 Through-hole						
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	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 avail	able on request, please, inquire)						

<sup>\*</sup> Stronger or softer torque feeling is available on request.

### Test results

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

#### **CAR14 Through-hole**

#### **CER14 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%
Storage (3 years)	3 years at 23°C ± 2°C	±3%	3 years at 23°C ± 2°C	±1%

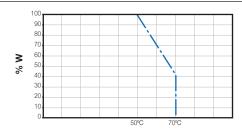
<sup>\*\*</sup> Dissipation of special tapers will vary, please, inquire.

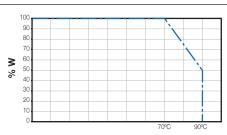


#### CAR14 Through-hole

#### CER14 Through-hole

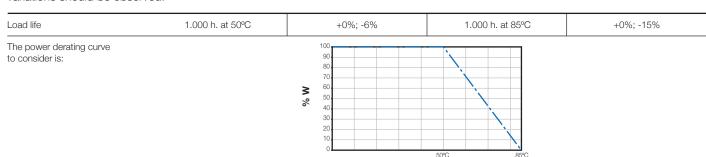
Power derating curve:



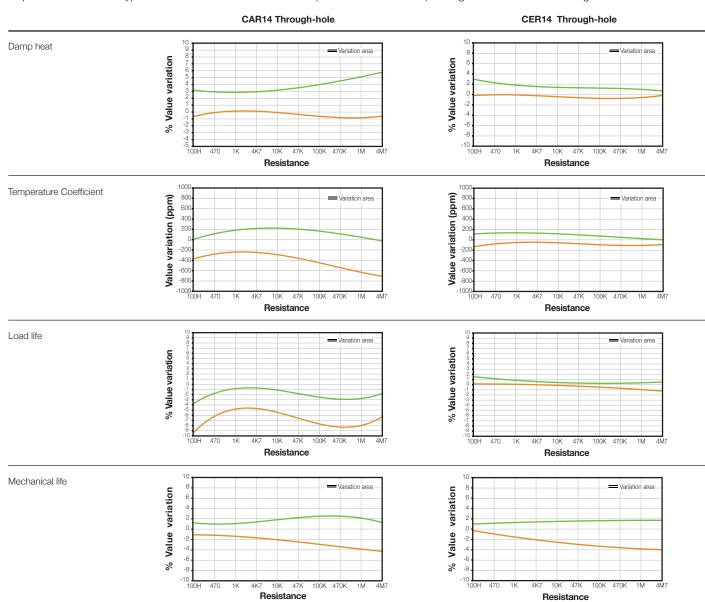


#### For temperatures out of range

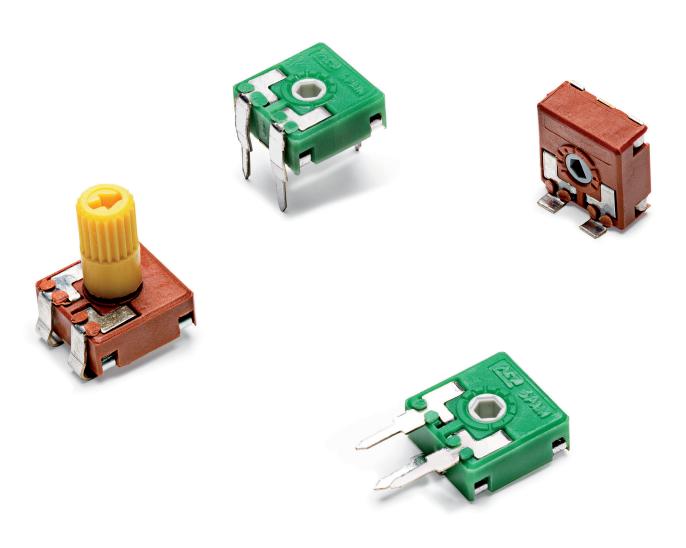
The normal operation temperature for a carbon ACP potentiometer is  $-25^{\circ}$ C to  $+70^{\circ}$ C. When the temperature goes up to  $85^{\circ}$ C, the following variations should be observed:



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









9mm Rotary Sensor appropriated for position sensing and control applications capable of withstanding high configurations of mechanical life.

- Standard: from 15.000 to 50.000 cycles
- Long life: up to 200.000 cycles. More cylcles available under request.

RS9 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 independent linearity of ±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 RS9 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.

### RS9 F HOW TO ORDER

#### EXAMPLE: RS9MH2,5-10KA2020 SNP PI WT-9005-BA

Standard features							Extra features							Assembled accessory				
Series	Rotor	Model	Packg.	Ohm value	Taper	Tol.	Life	Track	Detents	Snap in	Housing	Rotor	Wiper	Lin.	Assembly	Ref#	Color	Flam
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		16		
RS9	М	H2,5		- 10K	А	2020				SNP			PI		WT	-9005	-BA	-VC

Standard configuration:	RS9 Through-hole	RS9 SMD					
Dimensions:		9mm					
Protection:		54 (dust-proof) tinguishable, to meet UL 94 V-0					
Substrate:	Carbon technology	Carbon technology, special for high temperature					
Color:	Green housing + white rotor	Brown housing + grey rotor					
Packaging:		Bulk					
Wiper position:		at 50% ±15°					
Terminals:	Straigh	t, without crimping.					
Marking:	Resistive value marke	ed on housing. Others on request.					

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

#### 1 - Series

_		
_	000	

2 - Rotors										
С	D	Е	J	K	М	Р	R	Y		

#### 3 - Model and pitch

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

4 - Packaging	Trough-hole	SMD models
Bulk	(blank) <sup>(1)</sup>	(blank) <sup>(1)</sup>
T&R (Tape and 13" reel)	(N.A.) <sup>(2)</sup>	T&R
T&R (Tape and 15" reel)	(N.A.) <sup>(2)</sup>	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 RS9 has 10K, linear taper and ±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	Α
- Special tapers have codes assigned:	CODE YXXXXX

#### 7 - Tolerance

±30% 3030

#### 8 - Operating Life (Cycles)

Standard: between 15.000-50.000 cycles	ex:LV15; LV50
Long life: LV+the number of cycles. ex: LV200 for 200.000 cycles. (others on request)	LVXXX:ex: LV200

#### 9 - Cut Track - Open circuit.

Open circuit at beginning of track, fully CCW	PCI
Open circuit at end of track, fully CW	PCF
Pin in Paste option (Reflow Soldering)	PIP

#### 10 - Detents (DT)

Not applicable for RS9

1	1	-	ıeı	m	ına	IS

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

#### 12 - Housing

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

#### 13 - Rotor

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

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

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

#### 14 - Wiper

Wiper position (Standard: 50% ± 15°)	(leave blank)		
Initial or CCW	PI		
Final or CW	PF		
Others: following clock positions; at 3 hours: P3H	PXH, ex: P3H		
Wiper torque (Standard: <2Ncm) (lea			
Stronger or softer torque feeling is available on request.			

#### 15 - Linearity

Standard Independent Linearity	LN3%
Other Independent linearity below x%, for example, 4%: LN4% LNx%; ex:	LN4%
Absolute linearity controlled & below x% L Ax%	Ι Δν%

#### 16 - Potentiometers with assembled accessories

Assembled from terminal side	VVI
Assembled from collector side	WTI
Accessory Reference	-XXXX
See list of shafts and thumbwheels available	Example: 9010
Color of shaft or thumbwheel	-YY Example, white: BA

Non self-extinguishable. Self-extinguishable according to standard UL 94 (leave blank) (-V0 in box 17 modifies only the accessory, please, note.) -V0

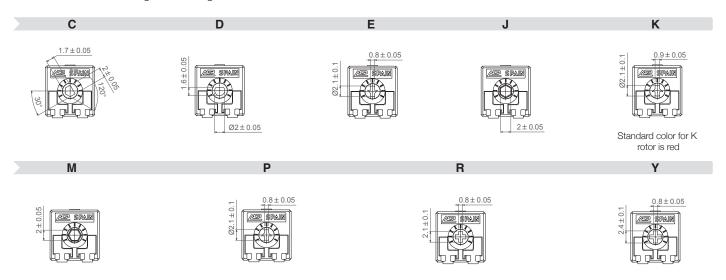
For ordering spare accessories: Accessory reference - color- flammability. Ex. 9010-AZ-V0 is a blue self-extinguishable 9010 thumbwheel XXXX-YY-V0

#### Color chart for rotor, housing and accessories

Black <sup>(1)</sup>	White	Neutral	Transp.	Red	Green	Yellow	Blue	Grey	Brown
NE	ВА	IN	TA	RO	VE	AM	AZ	GS	MR

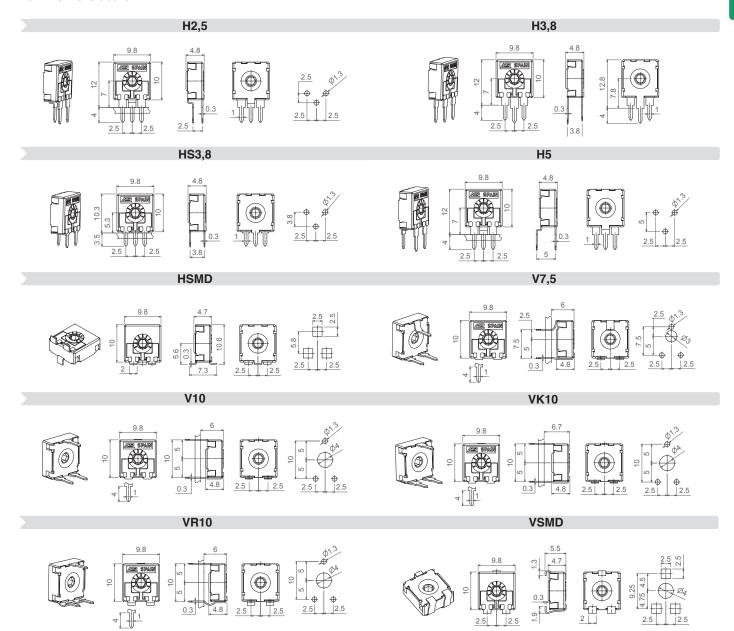
(1) black is not an option for housings.

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.

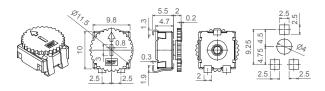


#### Models

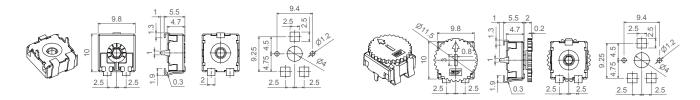
All models shown here have the most common rotor for 9mm potentiometers: the M rotor. Different rotors are available from the menu above.



#### **VSMD WT-9002**



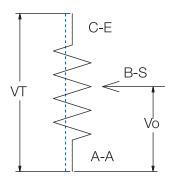
VSMD...CY **VSMD...CY WT-9002** 



#### Tapers

The standard taper is linear (A) and the standard ohm value is 10K, since a RS9 will normally be used as a voltage divider. For other tapers, please, inquire.

#### Voltage Divider



## Potentiometers with cut track

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

Mechanical life with cut track needs to be confirmed.

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

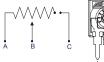
PCF = Cut at final position, when the potentiometer is turned fully clockwise.

Other positions are available on request.

PCI **PCF** 









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

> SNP **SNJ**





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

#### **Standard Terminal**

#### Shorter terminal, for H5 TP25

#### Shorter terminal, TPXX (under request)







Possibilities for insertion of accessori

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

**WT Front side WTI Collector side WT Front side** WTI Collector side









#### **Shafts**

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

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

Unless otherwise stated, the arrow in the shafts is in line with the wiper and it points to 50% when assembled with M rotors.

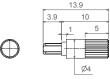
When a shaft is mounted on a potentiometer, the distance from the top of the potentiometer to the top of the shaft is marked with "L" in the table below, as shown in the drawings:

#### V potentiometer + shaft H potentiometer + shaft Total Length Shaft 9071 9067 9072 9054 9004 9005 9064 9055 9070 9053 9009 9059 9063 9010 9006 9019 9073 9020 9047 3.5 6.5 9.5 10 10 10 10.8 12.1 14.5 14.5 15 19.7 19.9 25.5 L Dimension 14.5 25.9 29.8

9004 9005













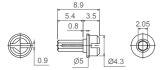




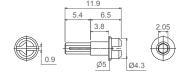
# 9006 9009 18.4 3.9 Ø9 Ø6 9010 9019 (Designed for D rotor) 0.9 Ø4 9020 (Designed for D rotor) 9047 9054 9053 9055 9059 18.4 3.9 14.5 Ø6 Ø9 The arrow is in line with the wiper when potentiometer has rotor J (with M rotor, there is a 30° difference). 9064 9063 18.4 9067 9070 17.3

9071 9072



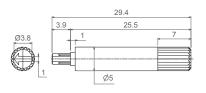






9073



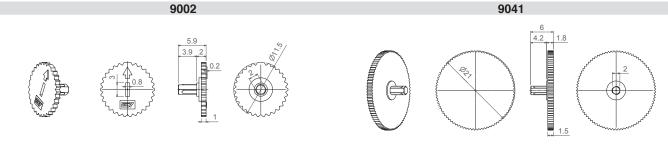


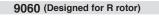


#### Thumbwheel

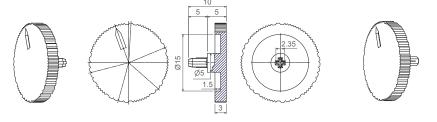
Thumbwheels are available in different colors (color chart in "how to order" section) and with self-extinguishable property according to UL 94 V-0, under request.

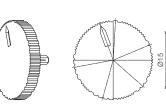
Thumbwheels can be mounted on the potentiometers at ACP or sold separately. ACP can study special thumbwheel designs.

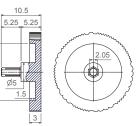




#### 9061







#### **Gear Wheels**

In addition to the range of shafts and thumbwheels we can provide gear wheels under study according to customer's requirements. The below model is already available for prototyping purposes. It can be supplied loose or already mounted on the RS9 series









#### Packaging

#### **Bulk packaging:**

HSMD

H2,5...PIP TP25 -H5...PIP TP25 -

HS3,8... PIP

V7,5...PIP -V10...PIP -V10...PIP TP25 -VR10...PIP

Potentiometer model With share		With shaft or thumbwheel inserted?	Pieces per small box (150 x 100 x 70)	Pieces per bigger box (250 x 150 x 70, CG on description)
H2,5 - H3,8 - HS3,8 - H5 HSMD - V7,5 - V10 VK10 - VR10 - VSMD		None, only potentiometers.	500	1.500
		9002	250	1.000
		9004, 9005, 9006, 9009, 9010, 9041, 9047, 9053, 9054, 9055, 9059, 9060, 9061, 9063, 9064, 9067, 9070.		1.000 in general
		9071, 9072	400	1.250
	Гаре & Reel packaging:	With thumbwheel inserted?	13" Reel (Standard), with 24mm width tape	15" Reel, with 24mm width tape
		None, only potentiometers.	900 pcs per reel, 12mm step between cavities.	1.250 pcs per reel, 12mm step between cavities.
VSMD		9002	700 pcs per reel, 12mm step between cavities.	To be determined.
		None, only potentiometers.	750 pcs per reel, 12 mm step between cavities	1000 pcs per reel, 12 mm step between cavities
	VSMDCY	9002	To be determined	To be determined

350 pcs per reel, 16 mm step between cavities

250

250

475 pcs per reel, 16 mm step between cavities

350

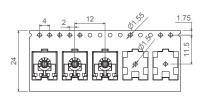
400

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

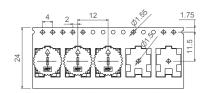
None, only potentiometers or 9002

RS9 🖷

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





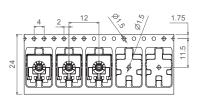




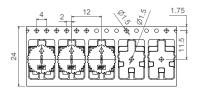


VSMD-T&R ...CY

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







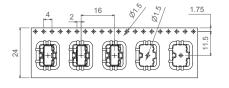




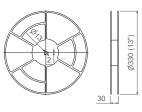
**HSMD-T&R** 

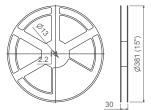
13"Reel

15"Reel



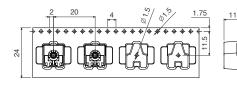




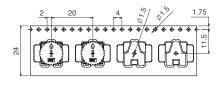


V7,5-T&R...PIP

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





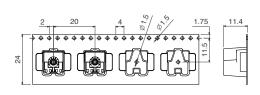




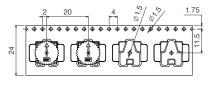


V10-T&R... PIP

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





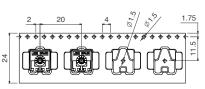






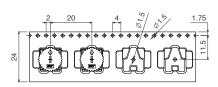
V10-T&R...PIP TP25

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







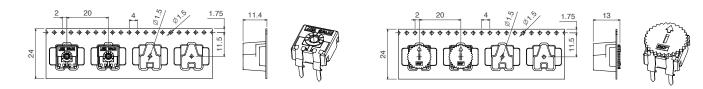






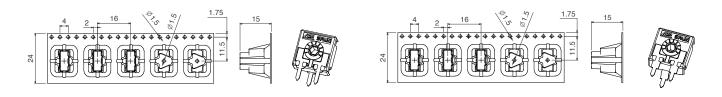
#### VR10-T&R...PIP

#### VR10-T&R... PIP WT-9002

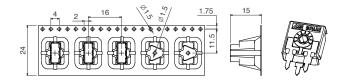


HS3,8-T&R... PIP

#### H5-T&R...PIP TP25



#### H2,5-T&R...PIP TP25





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

#### RS9 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	
Tolerance* $Rn < 100\Omega: \\ 100\Omega \le Rn \le 100K\Omega \\ 100K < Rn \le 1M\Omega: \\ 1M\Omega < Rn \le 5M\Omega: \\ Rn > 5M\Omega:$	+50%, -30% (out of range) ±20% ±20% ±30% +50%, -30% (out of range)	±30% ±40% ±50%	
Variation laws	Lin (A). Other tapers	s available on request	
Residual resistance	Lin (A) ≤ 5*10-3*Rr	n. Minimum value 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 Angle 220°±20° ≤ 5%Rn. Other tapers, please inquire		
Maximum power dissipation** Lin (A) Log (B), Antilog (C)	at 50°C 0.15W 0.10W		
Maximum voltage Lin (A) Log (B), Antilog (C)	200VDC 150VDC		
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	

<sup>\*</sup> Out of range ohm values and tolerances are available on request, please, inquire.

#### Mechanical Specifications

#### RS9 Through-hole and SMD

Resistive element	Carbon technology	
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	
Mechanical life	Standard: between 15.000 and 50.000cycles. Long life: up to 200.000cycles (more available on request, please, inquire)	

<sup>\*</sup> Stronger or softer torque feeling is available on request.

## Test results

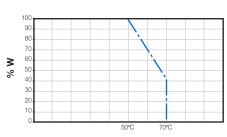
The following typical test results are given at 23°C  $\pm 2$ °C and 50%  $\pm 25$ % RH.

#### **RS9 Through-hole and SMD**

	Test conditions	Typical variation of nominal resistance
Damp heat	500 h. at 40°C and 95% RH	±20%
Thermal cycles	16 h at 85°C, plus 2 h at -25°C	±20%
Load life	1.000 h. at 50°C	±20%
Mechanical life	1.000 cycles at 10 c.p.m. and at 23°C ± 2°C	±20%
Storage (3 years)	3 years at 23°C ± 2°C	±20%

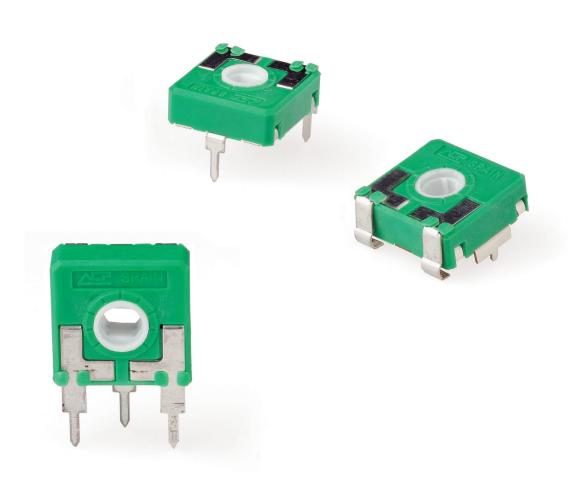
#### Power derating curve:

#### RS9 Through-hole and SMD



<sup>\*\*</sup> Dissipation of special tapers will vary, please, inquire.





## RS14 M

14mm Rotary Sensor appropriated for position sensing and control applications capable of withstanding high configurations of mechanical life.

- Standard: 100.000, 150.000 or 250.000 cycles.
- Long life, up to 1 million turns (please inquiry)

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 ±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 HOW TO ORDER

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

Standard features				Extra features					Assembled accessory									
Series	Rotor	Model	Packg.	Ohm value	Taper	Tol.	Life	Track	Detents	Snap in	Housing	Rotor	Wiper	Lin.	Assembly	Ref #	Color	Flam
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		16		
RS14	Т	V15		- 10K	Α	3030									WT	-14008	-NE	-V0

Standard configuration: RS14 Through-hole		RS14 SMD
Dimensions:		14mm
Protection:		<sup>2</sup> 54 (dust-proof) extinguishable, to meet UL 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:	Straig	ht, without crimping.
Marking:	Resistive value mark	ked 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 - Series ■ RS14 2 - Rotors Ν Τ Ζ

### 3 - Model and pitch VSMD VSMD ... CY VR12,5 V15 (V15) ... CFF V17,5 VD7,5 VD11 HSMD (Under request, not readily available)

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

Lin - Linear

The RS14 has 10K, linear taper and ±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

- Special tapers have codes assigned:	CODE YXXXXX	
7 - Tolerance		
±30%		
3030		

Standard:		00 cycles: LV150 00 cycles: LV250
		,
Long life: LV + number of cycles. i.e: LV100 for 300.000 cycles, LV300,	LV1M	LVXXX: ex: LV300

### 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)

Not applicable for RS14

I	1	-	ıer	mı	na	IS	

SNAP IN P	SNP
SNAP IN J	SNJ
Shorter tip of terminal, TPXX, where XX is tip length (under request)	TPXX, ex: TP30
Steel Terminals	SH

### 12 - Housing

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

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

V0

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

(blank) By default, carbon is non self-extinguishable. Self-extinguishable property can be added. V0 means housing and rotor are V0. CJ-V0, RT-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

100.000 cycles: LV100

Standard linearity 3%	(leave blank)
Independent linearity controlled & below x%, for example, 2%: LN2%	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: 14117
Color of shaft or thumbwheel	-YY Example, white: BA
Non self-extinguishable. Self-extinguishable according to standard	(leave blank) -V0

UL 94 (-V0 in box 17 modifies only the accessory, please, note.) For ordering spare accessories: Accessory reference - color- flammability. Ex. 14117-AZ-V0 is a blue self-extinguishable 14117 thumbwheel XXXX-YY-V0

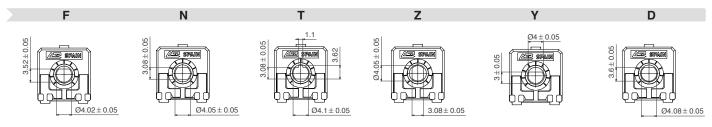
### Color chart for rotor, housing and accessories

Black <sup>(1)</sup>	White	Neutral	Transp.	Red	Green	Yellow	Blue	Grey	Brown
NE	ВА	IN	TA	RO	VE	AM	AZ	GS	MR

(1) black is not an option for housings.

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

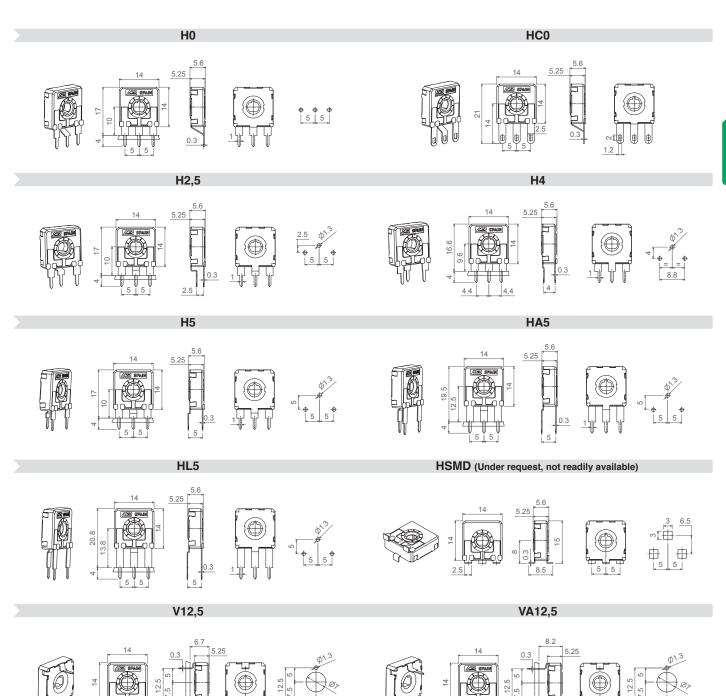
Accessories in this catalogue are designed for N, Z and T rotors, unless otherwise stated. Other rotor styles, on request.



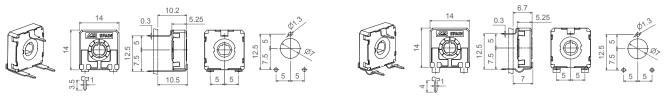
Standard color for F rotor is red

### Models

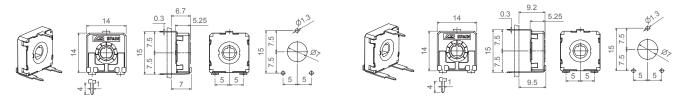
All models shown here have the most common rotor for RS14, the T rotor.



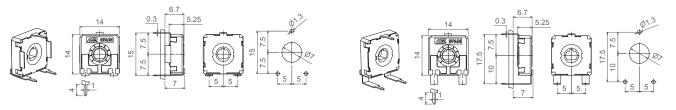




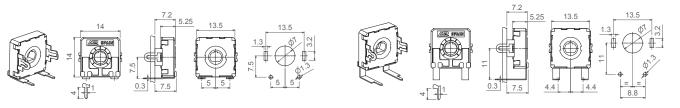
V15 VJ15



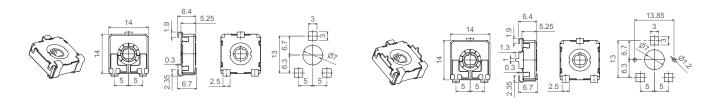
V15...CFF V17,5



VD7,5 VD11



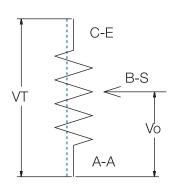
VSMD...CY



### 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**





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.

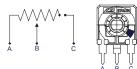
PCF = Cut at final position, when the potentiometer is turned fully clockwise.

Other positions are available on request.

**PCI PCF** 







### **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, for V12,5 TP30

Shorter terminal, TPXX (under request)







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

**WT Front side WTI Collector side WT Front side WTI Collector side** 









Shafts 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.

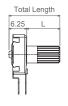
Shafts can be sold separately or delivered already mounted on the potentiometer at ACP.

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:

### H potentiometer + shaft

### V potentiometer + shaft

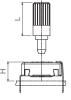










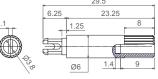


Shaft	14042	14065 (For E rotor)	14117	14056	14081	14187	14251	14067	14008	14015	14066	14084	14250	14072	14073
L Dimension	7.05	11.50	11.70	12.25	18.25	18.75	18.75	27.75	23.25	23.25	23.50	23.50	25.00	31.75	38.50

14008 14015

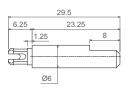














14042

14056















14065 (Designed for E rotor)

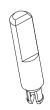
### 14066

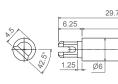












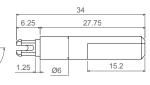


14067

### 14072

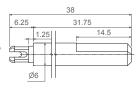








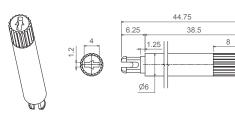


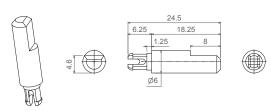




78

14073 14081

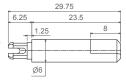




14084 14117













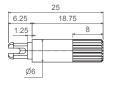




14187 14250



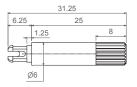










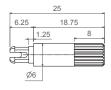




14251









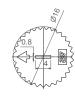
### Thumbwheel

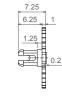
Thumbwheels are available in different colors (color chart in "how to order" section) and with self-extinguishable property according to UL 94 V-0, under request.

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

### 14003









### Bulk packaging:

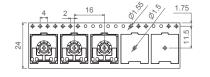
RS14 model	With shaft or thumbwheel inserted?	Pieces per small box (150 x 100 x 70)	Pieces per bigger box (250 x 150 x 70, CG on description)	
H2.5 - H4 - H5- HA5- HL5- H0	None, only potentiometers.	200 150 for models with*	700 600 for VJ15 - V17,5 - VD7,5 500 for VD11	
HC0 - V12,5 - V15 - VA12,5 VL12,5 - 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.

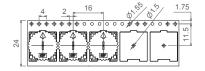
Tape & Reel packaging:	With thumbwheel inserted?	13" Reel (Standard), with 24mm width tape	15" Reel, with 24mm width tape	
VSMD	None, only potentiometers.	500 pcs per reel, 16mm step between cavities.	800 pcs per reel, 16mm step between cavities.	
VOIVID	14003	450 pcs per reel, 16mm step between cavities.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

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

### VSMD-T&R VSMD-T&R...WT-14003





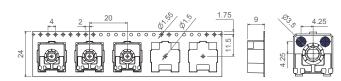


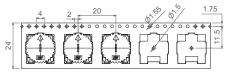




VSMD-T&R ... CY

### VSMD-T&R...CY WT-14003

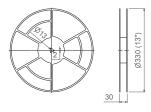


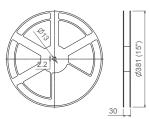






15" Reel 13" Reel







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 voltage divider use is supposed					
Tolerance*	30%					
Variation laws	Lin (A). Other tapers 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)	250VDC					
Operating temperature	-25℃ +85℃					
Linearity	3%					
Temperature coefficient $100\Omega \leq \text{Rn} \leq 10\text{K}\Omega$ $10\text{K}\Omega < \text{Rn} \leq 5\text{M}\Omega$	+200/ -300 ppm +200/ -500 ppm	+200/ -500 ppm +200/ -1000 ppm				

<sup>\*</sup> Out of range ohm values and tolerances are available on request, 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	Standard: 100.000. 150.000 and 250.000 cycles. Up to 1.000.000 cycles (please, inquiry).				

<sup>\*</sup> Stronger or softer torque feeling is available on request.

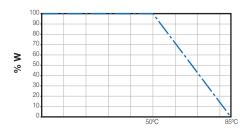
## Test results

The following typical test results (with 95% confidence) are given at 23°C  $\pm$ 2°C and 50%  $\pm$ 25% RH. Maximum linearity after mechanical tests: 4%.

### **RS14 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	150.000 cycles at 10 c.p.m. and at 23°C ± 2°C	±20%	
Storage (3 years)	3 years at 23°C ± 2°C	±3%	

Power derating curve:



<sup>\*\*</sup> Dissipation of special tapers will vary, please, inquire.









## RSR14

This product family born as an alternative to the RS14 series when curved designs appear. Housing shape has been modified in order to set the product properly.

14mm Rotary Sensor appropriated for position sensing and control applications capable of withstanding high configurations of mechanical life.

- Standard: 100.000, 150.000 or 250.000 cycles
- Long life, up to 1 million turns (please, inquiry)

RSR14 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 configurations is available; for SMD version, please inquire. 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 independent linearity of ±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 RSR14 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.



## RSR14 HOW TO ORDER

### EXAMPLE: RSR14TV15-10KA3030 WT-14008-NE-V0

Standard features							Extra features						Assembled accessory					
Series F	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		
RSR14	Т	V15		- 10K	А	3030									WT	-14008	-NE	-V0

Standard configuration:	RSR14 Through-hole	
Dimensions:	14mm	
Protection:	IP 54 (dust-proof) On request: Self-extinguishable, to meet UL 94 V-0	
Substrate:	Carbon technology	
Color:	Green 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: RS14TV15-10K CODE C00111.

### 1 - Series RSR14

2 - Rotors					
F	N	Т	D	Υ	Z

### 3 - Model and pitch

V15

4 - Packaging	Trough-hole	SMD models
Bulk	(blank) <sup>(1)</sup>	(blank) <sup>(1)</sup>

(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 RSR14 has 10K, linear taper and ±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 YXXXXX

### 7 - Tolerance

±30% 3030

### 8 - Operating Life (Cycles)

	100.000 cycles: LV100
Standard:	150.000 cycles: LV150
	250.000 cycles: LV250
Long life: I.V. Loumber of evelop in: I.V.100 for 200,000 eve	oloc 11/200 11/1M 11/000 ov: 11/200

### 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)

Not applicable for RSR14

П	١-	ıer	mı	na	IS

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

### 12 - Housing

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

### 13 - Rotor

Color: For colors other than standard: -See color chart below-

(blank)

V0

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

By default, carbon is non self-extinguishable. Self-extinguishable property can be added. V0 means housing and rotor are V0. If only the housing needs to be VO, then CJ-VO. CJ-V0, RT-V0 If only rotor: RT-VO

### 14 - Wiper

Wiper position (Standard: 50% ± 15°) (leave bla			
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 Independent linearity 3%	LN3%
Other Independent linearity below x%, for example, 4%: LN4%	LNx%; ex: LN4%
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: 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

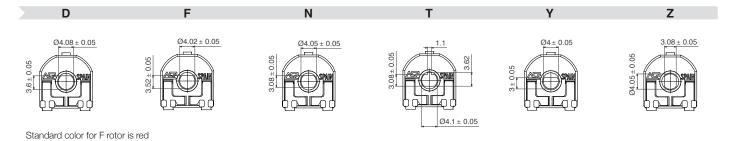
Black <sup>(1)</sup>	White	Neutral	Transp.	Red	Green	Yellow	Blue	Grey	Brown
NE	ВА	IN	TA	RO	VE	AM	AZ	GS	MR

(1) black is not an option for housings.

### Rotors

T is the standard rotor for RSR14. Rotors are drawn in their standard positioning, 50% of rotation. Alternative delivery positioning can be requested.

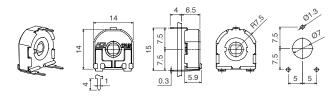
Accessories in this catalogue are designed for N, Z and T rotors, unless otherwise stated. Other rotor styles, on request.



Models

All models shown here have the most common rotor for RSR14, the T rotor.

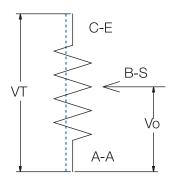
### V15



Tapers

The standard taper is linear (A) and the standard ohm value is 10K, since a RSR14 will normally be used as a voltage divider. For other tapers, please, inquire.

### **Voltage Divider**



## 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 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.

PCI PCF









### **Terminals**

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

### **SNP**



Shorter terminal tips are only available under request.

## Possibilities for insertion of accessories

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

WT Front side WTI Collector side





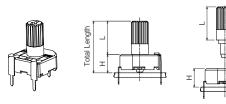
### Shafts

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:

### V potentiometer + shaft

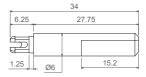


Shaft	14117	14081	14187	14251	14067	14084	14250	14072	14073
L Dimension	11.70	18.25	18.75	18.75	27.75	23.50	25.00	31.75	38.50

14067 14072



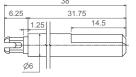








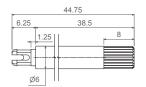








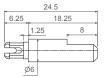




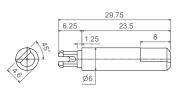
















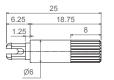








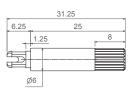








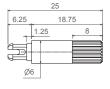














### Thumbwheel

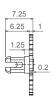
Thumbwheels are available in different colors (color chart in "how to order" section) and with self-extinguishable property according to UL 94 V-0, under request.

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

### 14003









### **Packaging**

### Bulk packaging:

RSR14 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.	200 150 for models with*	700
V15	14003, 14117	100	400 350 for models with*
	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.



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

### RSR14 Through-hole

Range of resistance values* Lin (A)	Standard value is 10K, as voltage divider use is supposed	
Tolerance*	30%	
Variation laws	Lin (A). Other tapers 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)	250VDC	
Operating temperature	-25°C +85°C	
Independent Linearity	3%	
Temperature coefficient $100\Omega \leq \text{Rn} \leq 10\text{K}\Omega$ $10\text{K}\Omega < \text{Rn} \leq 5\text{M}\Omega$	+200/ -300 ppm +200/ -500 ppm	

<sup>\*</sup> Out of range ohm values and tolerances are available on request, please, inquire.

### Mechanical Specifications

### RSR14 Through-hole

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	Standard: 100.000. 150.000 and 250.000 cycles.  Up to 1.000.000 cycles (please, inquiry).	

<sup>\*</sup> Stronger or softer torque feeling is available on request.

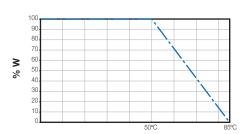
## Test results

The following typical test results (with 95% confidence) are given at 23°C  $\pm$ 2°C and 50%  $\pm$ 25% RH. Maximum linearity after mechanical tests: 4%.

### RSR14 Through-hole

	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	150.000 cycles at 10 c.p.m. and at 23°C ± 2°C	±20%
Storage (3 years)	3 years at 23°C ± 2°C	±3%

Power derating curve:



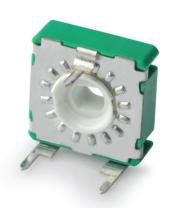
<sup>\*\*</sup> Dissipation of special tapers will vary, please, inquire.

# Carbon Endless Sensor













## CS14 🎓

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 PHOW TO ORDER

EXAMPLE: CS14NV15-10KA3030 LV15 RSN LN3% WT-14015-NE-V0

Standard features						Extra features						Assembled accessory								
Series R	Rotor	Model	Connect.	Packg.	Ohm value	Taper	Tol.	Life	Track	Detents	s Snap in	Housing	Rotor	Wiper	Lin.	Oper.Ta	Assembly	Ref#	Color	Flam.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17		18		
CS14	Ν	V15			- 10K	А	2020										WT	-14015	-NE	-V0

Standard configuration:	CS14 Through-hole	CS14 SMD			
Dimensions:		14mm			
Protection:		i4 (dust-proof) inguishable, to meet UL 94 V-0			
Substrate:	Carbon technology	Carbon technology, special for high temperature			
Color:	Green housing + white rotor	Brown housing + grey rotor			
Packaging:	Bulk	T&R			
Wiper position:	8	t 50% ±15°			
Terminals:	Straight, without crimping.	J-Lead			
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: CS14NV15-10K CODE C00111.

### 1 - Series

■ CS14

### 2 - Rotors Z\* D\* Ε G Р Y\*

### 3 - Model and pitch

H0	H2,5	H5	HP	V12,5	V12,5x5	V15	V15CFF	VSMD	VSMDCY
----	------	----	----	-------	---------	-----	--------	------	--------

### 4 - Connector - Only available with HP model

SHORT latching shape and groove at INITIAL terminal side.	SI
SHORT latching shape and groove at FINAL terminal side.	SF
LONG latching shape and groove at INITIAL terminal side.	Ц
LONG latching shape and groove at FINAL terminal side.	LF

5 - Packaging	Trough-hole	SMD models
Bulk	(blank) <sup>(1)</sup>	(blank) <sup>(1)</sup>
T&R (Tape and 13" reel)	(N.A.) <sup>(2)</sup>	T&R
T&R (Tape and 15" reel)	(N.A.) <sup>(2)</sup>	T&R15
Big Box: See page 9		

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

### 6 - Resistance value

1ΚΩ	2ΚΩ	2K2 Ω	4K7 Ω	5ΚΩ	10K $\Omega$ (standard)	4M7 Ω	5M $\Omega$
1K	2K	2K2	4K7	5K	10K (standard)	4M7	5M

### 7 - Resistance law / taper (see also page 10)

Lin - Linear	А
Log - Logarithmic	В
Antilog - Antilogarithmic	С
- Special tapers have codes assigned:	CODE YXXXXX

## 8 - Tolerance (see also page 10)

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

### 9 - Operating Life (Turns)

Standard (15.000 turns) (others on request).	LV15
Long life: LV + number of turns ex: LV100 for 100 000 turns LV150 LV1M	IVXXX: ex: IV100

### 10 - Cut Track - Open circuit

CS14 already has an open circuit area at the base of the potentiometer (between 330° and 0°). Additional cut tracks can be studied on request.

### 11 - Detents (DT) (Available for up to 15.000 turns) Standard 16 detents

X number of detents: ex.16 detents	XDT, ex:16DT
------------------------------------	--------------

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

### 12 - Terminals (THT)

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

### 13 - Housing

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

### 14 - Rotor

Rotors N, T, Z	RSN
All others rotors:	(leave blank)
Color: For colors other than standard: -See color chart below-	RT-color; ex., blue: RT-AZ

### \* Self extinguishable property V0 for housing and rotor

Not V0 (by default)	(leave blank)
Housing and rotor V0	VO
Only housing V0	CJ-V0
Only rotor V0	RT-V0

### 15 - Wiper

Wiper position (Standard: 50% ± 15°)	(leave blank)
Initial or CCW	PI
Final or CW	PF
Others: following clock positions. Ex at 3 hours: P3H	PXH, ex: P3H
Wiper torque	
Standard for 15.000 turns: <2.5 Ncm, detents <3.5 Ncm	(leave blank)
Special low torque for 15.000 turns <1.5 Ncm	PGB
Standard for >15.000 turns <1.5 Ncm	(leave blank)

### Stronger or softer feeling than above, available on request.

### 16 - Linearity

Standard, according to IEC 190	(leave blank)
Independent linearity controlled and below x%. Ex: 3%	LNx%, ex: LN3%
Absolute linearity controlled and below x%. Ex: 2,5%	LAx%, ex: LA2,5%

<sup>\*</sup> Rotors available for versions with > 15,000 turns.

### 17 - Operating temperature

-25°C +70°C	(blank)
-25°C +85°C	T <sup>a</sup> D
-25°C +105°C	T <sup>a</sup> B

### 18 - Potentiometers with assembled accessories

Assembled from terminal side	WT
Assembled from collector side	WTI
Accessory Reference See list of shafts and thumbwheels available	-XXXXX ex: 14117
Color of shaft or thumbwheel	-YY ex: 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

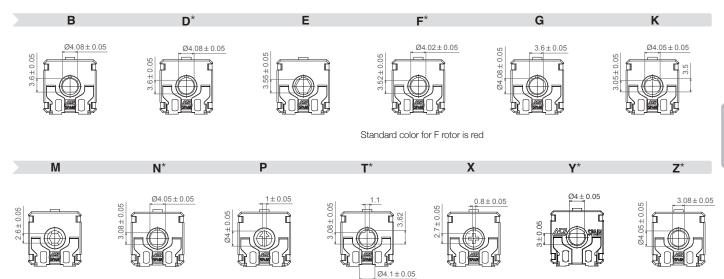
Black <sup>(1)</sup>	White	Neutral	Transp.	Red	Green	Yellow	Blue	Grey	Brown
NE	BA	IN	TA	RO	VE	AM	AZ	GS	MR

<sup>(1)</sup> black is not an option for housings.

### Rotors

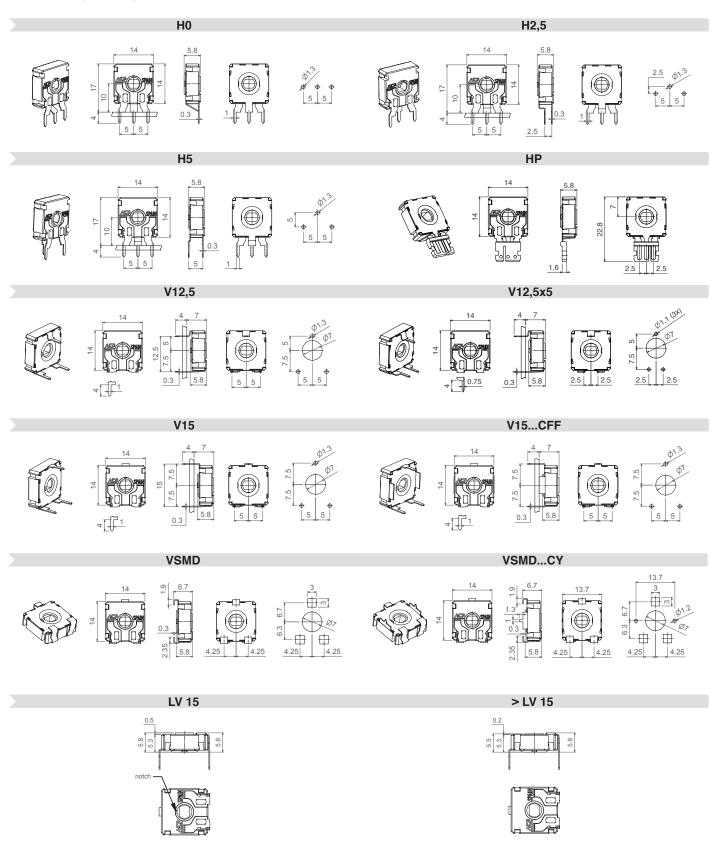
N is the standard rotor for CS14, but the following options are also available. Rotors are drawn in their standard positioning, 50% of rotation. Alternative delivery positioning can be requested.

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, Y, Z.

H0, H2,5, H5, V12,5, V15, V15...CFF, V12,5x5, VSMD, VSMD...CY. For other models, such as those shown for the CA14, please inquire.

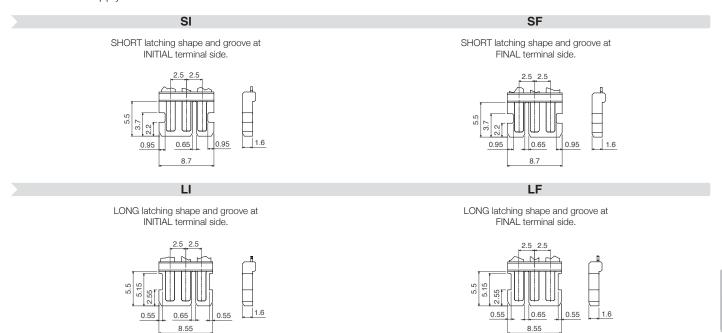


The Standard taper is linear (A). Log (B) and Antilog (C) tapers are also available, as well as special tapers according to customer specifications. See an example on the application described on page 11.

### Connector

ACP offers the possibility to turn one CS14 standard into a pluggable version. Thanks to an external RAST 2,5 card edge connector in which terminals are embedded, customer can transmit the output signal from the potentiometer to the electronic module. The three pins of the potentiometer (the collector and the two terminals) are fitted into a 1,55 mm thick plastic part with a pitch of 2,5mm. Extended temperature versions covering a range from -40°C to +120°C are available for applications where the working temperature interval exceeds the standard limits of -25°C to+70°C. The self-extinguishable version of the plastic parts, V0, can be supplied under request.

A typical application would be as feedback position sensor of the cooking style selector for kitchen ovens. ACP is able to supply different kind of connectors:

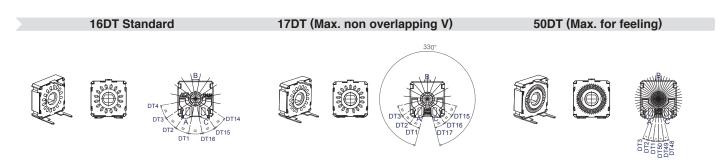


## Potentiometers with detents

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.

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 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:

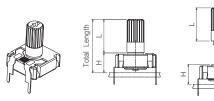
### H potentiometer + shaft

### V potentiometer + shaft





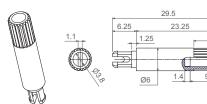


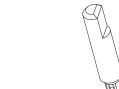


(H is set by the potentiometer model. See page 5)

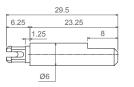
14015

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











14042

14008

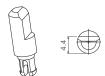
### 14056















### 14065 (Designed for E rotor)

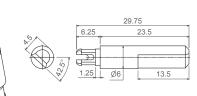
14066



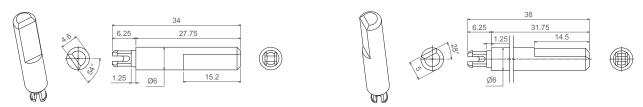




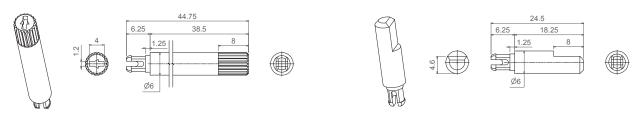




14067 14072



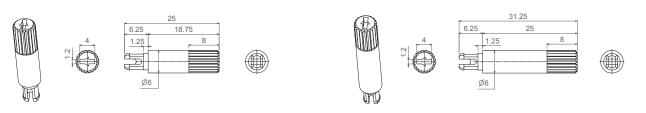
14073 14081



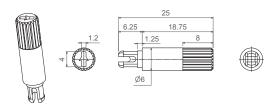
14084 14117



14187 14250



14251

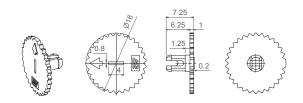


### Thumbwheel

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.

### 14003



### **Bulk packaging:**

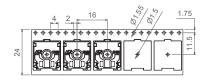
CS14 model	With shaft or thumbwheel inserted?	Pieces per small box (150 x 100 x 70)	Pieces per bigger box (250 x 150 x 70) add CG at the end of the product description		
	None, only potentiometers.	200	700		
H0 - HP - H2,5 - H5 - V12,5 V12,5x5 - V15 V15CFF	14003, 14117, 14042, 14056, 14065	100	400		
VISOIT	14008, 14015, 14066, 14067, 14072, 14073, 14081, 14084, 14187, 14250.	75	To be determined.		

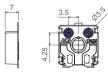
Tape & Reel packaging:	With thumbwheel inserted?	13" Reel, with 24mm width tape	15" Reel, with 24mm width tape
VSMD	None, only potentiometers.	None, only potentiometers.  500 pcs per reel, 16mm step between cavities.	
(on request*)	14003	450 pcs per reel, 16mm step between cavities.	To be determined.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

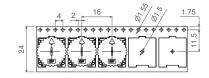
Sticker on component available on request.

### **VSMD-T&R**

### VSMD-T&R...WT-14003





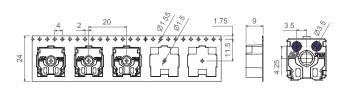


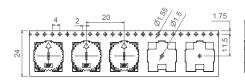




### VSMD-T&R...CY

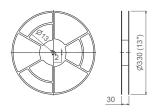
### VSMD-T&R...CY WT-14003

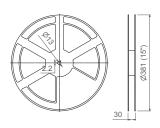






13" Reel 15" Reel







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\* $1K\Omega \le Rn \le 5M\Omega$ $1K\Omega \leq Rn \leq 1M\Omega$ Lin (A) $10K\Omega \le Rn \le 2M2\Omega$ $10K\Omega \le Rn \le 1 M\Omega$ Log (B) Antilog (C) Tolerance\* (Please, inquire for >100K turns) ±30% $100\Omega \le \text{Rn} \le 100\text{K}\Omega$ ±30% 100KΩ< Rn ≤ 1MΩ: ±40% ±30% 1MΩ < Rn ≤5MΩ: ±50% ±30% $Rn > 5M\Omega$ : +50%, -30% (out of range) Variation laws Lin (A). Other tapers available on request CRV - Contact Resistance Lin (A) Electrical Angle 330°±20° ≤ 3%Rn. Variation (dynamic) Other tapers, please inquire CRV - Contact Resistance Lin (A) Electrical Angle 330°±20° ≤ 5%Rn. Variation (static) Other tapers, please inquire Maximum power dissipation\*\* Lin (A) at 50°C, 0.15W Maximum voltage Lin (A) 250VDC -25°C ... +70°C (standard) -25°C ... +85°C Operating temperature -25°C ... +105°C $330^{\circ} \pm 20^{\circ}$ Angle of rotation (electrical) Temperature coefficient +200/ -500 ppm $100\Omega \leq \mathsf{Rn} \leq 10\mathsf{K}\Omega$ +200/ -300 ppm 10KΩ < Rn ≤ 5MΩ +200/ -500 ppm +200/ -1000 ppm

### Mechanical 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				

<sup>\*</sup> Stronger or softer torque feeling is available on request.

### Test results

The following typical test results (with 95% confidence) are given at 23°C ±2°C and 50% ±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	ture 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%		
orage (3 years) 3 years at 23°C ± 2°C		±3%		

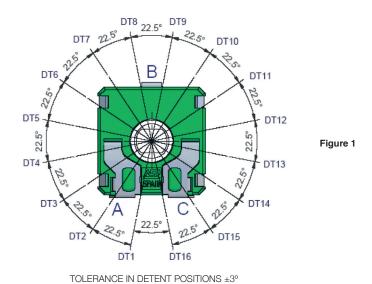
<sup>\*</sup> Out of range ohm values and tolerances are available on request, please, inquire.

<sup>\*\*</sup> Dissipation of special tapers will vary, please, inquire.

### CS14 as alternative to a 4 bit absolute encoder. Linear curve.

A combination of a controlled linear curve and mechanical detents distributed along the 360° of the endless turn CS14 is an alternative to a 4-bit absolute encoder

Using the CS14 as a voltage divider, we can obtain 16 non-overlapping voltage values at each one of the 16 detents located evenly spread along the full circumference with a separation of 22.5° between each contiguous detent. See figure 1.



The graph of the linear curve that provides this performance is in the figure 2. We call it the curve FP and it makes possible to differentiate 16 non-overlapping different voltage levels from the collector output pin. (B in figure 1)

The function of the detents is to position and fix the wiper contact on the surface of the linear taper. An electrical control of each one of the 16 detents of each individual potentiometer during the assembly process ensures that the voltage levels are correct in each one of them.

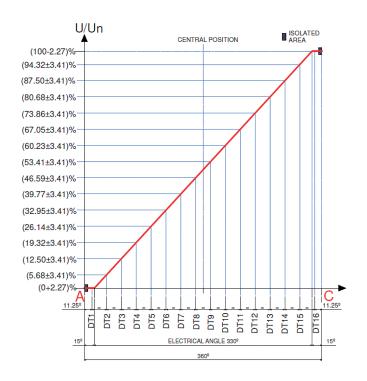
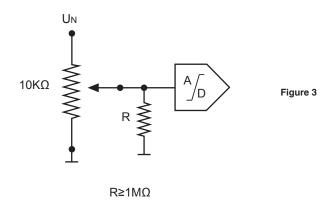


Figure 2 Curve FP

The endless rotation feature of the CS14 allows to move from the detent number 16 (U/Un = 100%) to the detent number 1 (U/Un = 0%). During the transition between these two detents, the wiper 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 we recommend either to introduce a pull-up or pull-down resistor into the circuit design. ACP proposes 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 and a recommended pull-down resistor equal or greater than  $1M\Omega$ . (Figure 3). The mechanical life is 15.000 turns.

Connecting the collector terminal to the AD port of a microcontroller to feed into it the output voltage of such a 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.

An example of How to Order would be CS14NV15-10KFP3030 LV15 16DT RSN. Note that it is not necessary to indicate the linearity, as it is already implicit in the curve FP.

Detent	U/UN	Decimal	Hexadecimal	Binary	Octal
1	(0+2,27)%	0	0	0000	0
2	(5,68±3,41)%	1	1	0001	1
3	(12,50±3,41)%	2	2	0010	2
4	(19,32±3,41)%	3	3	0011	3
5	(26,14±3,41)%	4	4	0100	4
6	(32,95±3,41)%	5	5	0101	5
7	(39,77±3,41)%	6	6	0110	6
8	(46,59±3,41)%	7	7	0111	7
9	(53,41±3,41)%	8	8	1000	10
10	(60,23±3,41)%	9	9	1001	11
11	(67,05±3,41)%	10	А	1010	12
12	(73,86±3,41)%	11	В	1011	13
13	(80,68±3,41)%	12	С	1100	14
14	(87,50±3,41)%	13	D	1101	15
15	(94,32±3,41)%	14	Е	1110	16
16	(100-2,27)%	15	F	1111	17

Figure 4











## Q16 **9**

Q16 is a particular application of the CS14 product family when robust and precise detents are required. This ACP patented design consists of a 16x15mm. rectangular shape external housing with a built-in detent mechanism, fitted on a CS14 V potentiometer.

The standard configuration has 16 detents evenly distributed along its 360° endless rotation, and allows to choose between 4 different detent torque values, from 3 Ncm to 6 Ncm to provide different degrees of softer or harder feeling.

The linear characteristics and materials of the CS14 core potentiometer, combined with the detent mechanism, guarantee at least 10.000 turns and no voltage overlapping between contiguous positions.

The rotor design allows a thru shaft to be inserted into the rotor from either top or below side. A Poka-Yoke feature incorporated in the rotor avoids shaft misplacement.

This Rotary Potentiometer Switch is the ideal alternative to Absolute Encoders and Rotary Switches for control applications like Program Selector Switches in White Goods: Washing Machines, Dishwashers, Dryers, Electrical Ovens etc., Controls in other Appliances like Ranges, Microwave Ovens, Kitchen Robots, etc., and HVAC in Automotive: Air Flow Distribution Switch, Temperature Setting and Fan Speed Selection.

Ingress Protection rating type is IP54 and plastic materials can be self-extinguishable according to UL 94V0 whenever required.

## Q16 HOW TO ORDER

EXAMPLE: Q16RV15 10KA3030 LV10 16DT 3N PDT1

Standard fo	eatures											
Series	Rotor	Model	Packaging	Ohm value	Taper	Tolerance	Life	Nº Detents	Det.torque.	Terminals	Flammability	Position
1	2	3	4	5	6	7	8	9	10	11	12	13
Q16	R	V15		10K	А	3030	LV10	16DT	3N			PDT1

Standard configuration:	Q16			
Dimensions:	16x15mm			
Protection:	IP 54. On request: Self extinguishable, to meet UL 94 V0			
Core potentiometer:	CS14			
Packaging:	Bulk			
Wiper position:	Detent 1 (PDT1)			
Terminals:	Straight			
Marking:	Resistive value marked on housing. Others on request.			

1 - Se	ries							
■ Q16								
2 - Ro	tors							
R Stan	dard. (O	thers und	der study	).				
3 - Mo	del and	pitch						
V15 S	tandard.	VSMD u	nder stu	dy.				
4 - Pa	ckaging	l						
Bulk				(blank	<) <sup>(1)</sup>			
(1) Produ	cts supplied	bulk packed	in bags, unle	ss otherwis	e specified.			
5 - Re	sistive v	alue						
100Ω	200Ω	220Ω	250Ω	470Ω	500Ω	1ΚΩ	10KΩ standard	5ΜΩ

Lin - Linear		A					
Others under study. Code will be assigned case by case.							
7 - Tolerance							
100 Ω ≤ Rn ≤ 100 KΩ:	100 KΩ < Rn ≤ 1MΩ:	1 MΩ < Rn ≤ 5MΩ:					
±30%	±30%	+50%,-30%					
3030	3030	5030					
Special tolerances under request. Pleas	e check availability						

8 - Operating Life (Turns)	
Standard (10.000 turns) (others on request).	LV10
Long life: LV + number of turns. (please inquire availability).	LVXXX: ex: LV20
9 - Numbers of detents	
Standard: 16 detents.	16DT
Other configurations under study	
10 - Detent torque	
Standard: 3 Ncm	3N
Others available 4Ncm, 5Ncm, 6Ncm	4N, 5N, 6N
11 - Terminals	
By default, terminals are always straight	(leave blank)
SNAP IN P	SNP
Steel Terminals	SH
12 - Flammability	
Standard: Non self extinguishable. All housings and rotors self extinguishable according to UL 94 V0.	(leave blank) V0
Only Q16 housing and rotor self extinguishable V0	Q-V0
13 - Delivery position	
Standard, position at detent 1	PDT1
Position at detent. XX= (position number)	PDTXX

### Rotor

100

6 - Taper

200

220

250

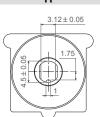
470

1K

10K

5M

R is the standard rotor for Q16. Other options can be made under study.



Special marking

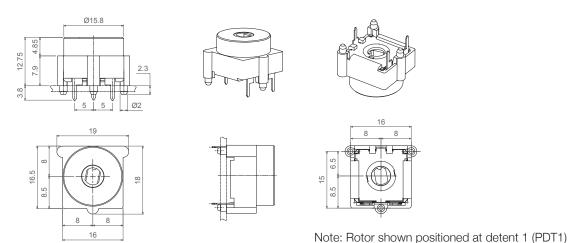
Special marking

This drawing shows the rotor at 50% position in order to better depict the dimensions and tolerances, it is not a valid delivery option of the 16 position version.

GRE

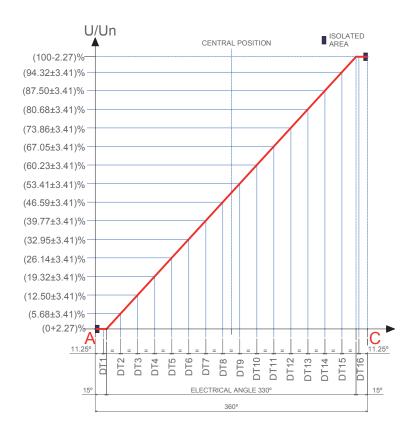
V15 is the standard model.

### V15



### **Tapers**

The CS14 core potentiometer has a linear taper that provides the voltage ratios indicated at each detent shown in the graph. Non overlapping voltage between contiguous positions is guaranteed.



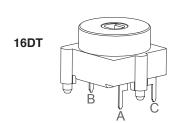
DETENT	VALUE
1	(0+2.27)% Un
2	(5.68±3.41)% Un
3	(12.50±3.41)% Un
4	(19.32±3.41)% Un
5	(26.14±3.41)% Un
6	(32.95±3.41)% Un
7	(39.77±3.41)% Un
8	(46.59±3.41)% Un
9	(53.41±3.41)% Un
10	(60.23±3.41)% Un
11	(67.05±3.41)% Un
12	(73.86±3.41)% Un
13	(80.68±3.41)% Un
14	(87.50±3.41)% Un
15	(94.32±3.41)% Un
16	(100-2.27)% Un

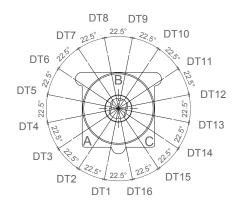
### Detents/Torque

Conceived specifically for control applications where robust click feeling is required along the full circumference. The Q16 incorporates an ACP patented design that provides 4 possible different torque levels: 3Ncm, 4Ncm, 5Ncm or 6Ncm, upon customer's choice, with a mechanical life of at least 10.000 turns.

The standard number of detents is 16, all of them evenly spread along the 360° mechanical travel, an ideal configuration for 16 function selection in White Goods.

Tailor made configurations with different number of detents, preferrably even numbers equally spread along the 360°, can be studied on request. Other mechanical life requirements are also possible upon study.





### Delivery Position

Unless otherwise specified, the Q16 is delivered with the wiper on position 1 (PDT1).

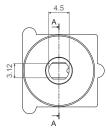
### **Shafts**

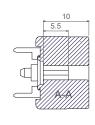
Shafts are sold separately. They can be inserted from either top or below side.

Please consult ACP for studying special designs.

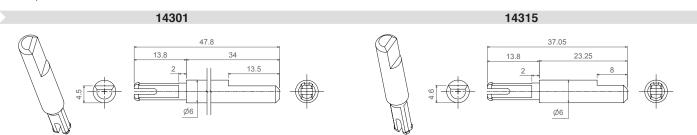
Rotor inner dimensions shown for customer's own shaft design.

### **Rotor inner dimensions**





This drawing shows the rotor at 50% position in order to better depict the dimensions and tolerances, it is not a valid delivery option of the 16 position version.



### **Packaging**

### **Bulk packaging:**

Pieces per box (250 x 150 x 70)

Q16 model

200

## Electrical Specifications

(See CS14 Through Hole table on page 66).

### Mechanical Specifications

Resistive element	Carbon
Angle of rotation (mechanical)	360°
Wiper standard delivery position	Detent 1 (PDT1)
Max. push/pull on rotor	50N
Wiper torque*	From 3N to 6N depending on customer choice.
Mechanical life	At least 10.000 turns.

## Test results

_
(See CS14 table on page 66)
_







## QJ16 9

ACP Q16 series expands its range with the launching of the new spring loaded potentiometer version called QJ16.

Keeping the same dimensions and layout of the Q16, the functionality is completely different. When the operator turns the knob CW or CCW from the central rest position, a spring mechanism fitted into the component provides an opposite torque. When releasing the knob, the spring returns the potentiometer to the central rest position.

Electrically, the potentiometer is a standard 245° linear taper with a 5% absolute linearity. The mechanical rest position corresponds to the physical middle position, hence to the central value of the output signal. Starting from there, the output value varies along the linear curve until reaching the corresponding end stop.

An alternative output signal to the above is an SPDT (Single Pole, Doble Throw) configuration, with "on" positions at both mechanical end stops and "off" position in the central rest position. Mechanical angle option available is ±45°.

This Spring Loaded potentiometer is the ideal alternative to a tact switch or incremental encoder to increase or decrease the value of a certain parameter.

## QJ16 HOW TO ORDER

EXAMPLE: QJ16RV15 10KA3030 LV10

atures										
Rotor	Model	Packaging	Ohm value	Taper	Tolerance	Life	Mechanical Angle	Terminals	Flammability	Position
2	3	4	5	6	7	8	9	10	11	12
R	V15		10K	А	3030	LV10	±45°			
	Rotor 2	Rotor Model 2 3	Rotor Model Packaging 2 3 4	Rotor Model Packaging Ohm value 2 3 4 5	Rotor Model Packaging Ohm value Taper 2 3 4 5 6	Rotor Model Packaging Ohm value Taper Tolerance 2 3 4 5 6 7	Rotor Model Packaging Ohm value Taper Tolerance Life 2 3 4 5 6 7 8	RotorModelPackagingOhm valueTaperToleranceLifeMechanical Angle23456789	RotorModelPackagingOhm valueTaperToleranceLifeMechanical AngleTerminals2345678910	RotorModelPackagingOhm valueTaperToleranceLifeMechanical AngleTerminalsFlammability234567891011

QJ16			
16x15mm			
on: IP 54. On request: Self extinguishable, to meet UL 94 V0			
CA14 // RS14			
Bulk A			
Middle position			
Straight			
Resistive value marked on housing. Others on request.			
	16x15mm IP 54. On request: Self extinguishable, to meet UL 94 V0 CA14 // RS14 Bulk A Middle position Straight		

1 - Series		
QJ16		

(1) Products supplied bulk packed in bags, unless  $\,$  otherwise specified.

Others under study. Code will be assigned case by case.

2 - Rotors	
B Standard (Others under study)	

3 - Model and pitch	
V15 Standard. VSMD under study.	

4 - Packaging	
Bulk	(blank) <sup>(1)</sup>

5 - Re	sistive v	alue						
100Ω	200Ω	220Ω	250Ω	470Ω	500Ω	1ΚΩ	10KΩ standard	5ΜΩ
100	200	220	250	470	500	1K	10K	5M

100	200	220	250	470	500	1K	10K	5N
6 - Tap	ner							
Lin - Li							А	

7 - Tolerance		
100Ω ≤Rn≤ 100KΩ:	100KΩ ≤Rn≤ 1MΩ:	1MΩ ≤Rn≤ 5MΩ:
±30%	±30%	+50%,-30%
3030	3030	5030

Special tolerances unde	r request.	Please	check	availability.
				,

Standard (10.000 cycles)	LV10
Long life: LV + number of cycles. (please inquire availability).	LVXXX: ex: LV20

### 9 - Mechanical Angle

Standard ±45°	(leave blank)
Other configurations under study	

### 10 - Terminals

By default, terminals are always straight	(leave blank)
SNAP IN P	SNP
Steel Terminals	SH

### 11 - Flammability

Standard: Non self extinguishable.	(leave blank)
All housings and rotors self extinguishable according to UL 94 VO.	VO
Only QJ16 housing and rotor self extinguishable V0	Q-V0

### 12 - Delivery position

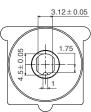
Standard, middle position (l	eave blank)
------------------------------	-------------

Special	marking

Special marking	GRE
-----------------	-----

### Rotor

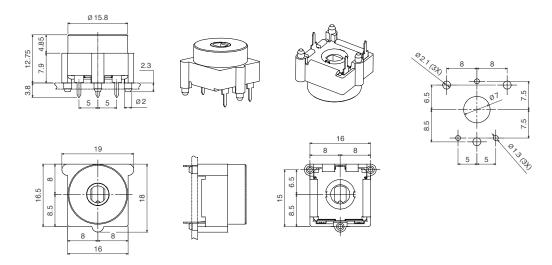
R is the standard rotor for QJ16. Other options can be made under study.



This drawing shows the rotor at 50% position, which is the standard delivery position.

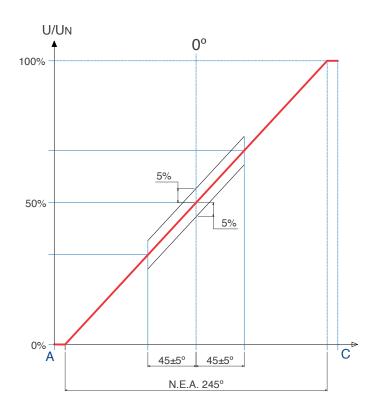
V15 is the standard model.

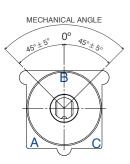
### V15



### **Tapers**

The core potentiometer is a standard 245° linear taper with a 5% absolute linearity. The mechanical rest position corresponds to the physical middle position, hence to the central value of the output signal. Starting from there, the output value varies along the linear curve until reaching the corresponding end stop.





An alternative output signal to the above is an SPDT\* configuration, with "on" positions at both mechanical end stops and "off" position in the central rest position. Mechanical angle option available: ±45°

\*Single pole, double throw. A simple break-before-make changeover switch: C (COM, Common) is connected either to L1 or to L2

Delivery Position

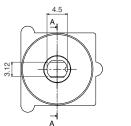
The QJ16 is delivered with the wiper on middle position.

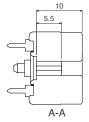
Shafts are sold separately. They can be inserted from either top or below side.

Please consult ACP for studying special designs.

Rotor inner dimensions shown for customer's own shaft design.

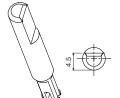
### **Rotor inner dimensions**

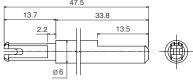


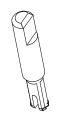


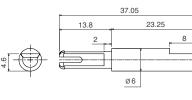
This drawing shows the rotor at 50% position, which is the standard delivery position

14301 14315











### **Packaging**

**Bulk packaging:** 

Pieces per box (250 x 150 x 70)

QJ16 model

200

### Electrical Specifications

Range of resistance values*	Standard value is 10k
Tolerance	±30%
Variation laws	Lin (A). Other tapers available on request
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**	at 50°C, 0.15W
Maximum voltage	250VDC
Operating temperature	-25°C +70°C (Other under request)
Electrical angle	245° ± 20°
Linearity	5%
Temperature coefficient	+200/ -300 ppm

### Mechanical Specifications

Resistive element	Carbon technology
Angle of rotation (mechanical)	±45° ±5°
Wiper standard delivery position	Neutral position ±5°
Max. stop torque	50Ncm
Max. push/pull on rotor	50N
Wiper torque*	0,5-3,5Ncm
Mechanical life	10.000 cycles.

- $^{\star}$  Out of range ohm values and tolerances are available on request, please, inquire.
- \*\* Dissipation of special tapers will vary, please, inquire.

# Test results

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

	Test conditions	Typical variation of Rn	Linearity after test
Damp heat	500 h. at 40°C and 95% RH	±20%	7%
Thermal cycles	16 h at 85°C, plus 2 h at −25°C	±20%	7%
Load life	1.000 h. at 50°C	±20%	7%
Mechanical life	10.000 cycles at 10 c.p.m. and at 23°C ± 2°C	±20%	7%
Storage (3 years)	3 years at 23°C ± 2°C	±3%	7%









# 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.
- 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 ▲ MCE9 ▲ HOW TO ORDER

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

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

0 . 0 .	ures						Extra 1	features						Asseml	bled acc	cessory	
Series Rotor	r Model	Packg.	Ohm value	Taper	Tol.	Life	Track	Detents	s 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		
MCA9/MCE9 D	H5		- 10K	А	2020				SNP			PI		WT	-9020	-NE	-V0
andard configu	ration:			М	CA9 Thr	ough-h	ole						MCE9	Through-l	nole		
mensions:									9	mm							
otection:							0			lust-proo		041//0					
ıbstrate:					Carbon to	echnolog		request: 8	Self-extingu	iisnabie, to	meet UL	. 94 V-U		Cermet			
olor:						+ white	-					Bro		ısing + whit	te rotor		
ickaging:									F	Bulk							
iper position:									at 50	1% ±15°							
rminals:								St	raight, wit	hout crin	nping.						
arking:							Resisti		narked on			on reque:	st.				
special specifica  Series	tions. Exa				_		mized pr	roduct. Se	11 - Term	ninals	and total	resistive	/alue are	e indicated	before th	ne code	
MCA9 ■ MCE9									SNAP IN								SNP
Rotors									SNAP IN		1.75\0	, , ,	A/: .: :				SNJ
1101013											nal, IPXX	(, where )	(X is tip I	ength (under	request)	IP.	XX, ex: TI
									Steel Terr	minals							SH
Model and pite	ch								12 - Hou	sina							
2,5 H3,8	Н	5	V7,5	V	′10	VK10	V	/R10			her than s	tandard: -	See colo	r chart belov	v- C	J-color, e	x., red: CJ-
					NA				13 - Rote	or .							
Packaging				<b>ugh-ho</b> (blank)	ole			_		colors ot				r chart belov		Γ-color; ex	
	lue				oie				Color: For * Self-ex By default,	colors ot tinguish carbon is	able pro	perty, V(	), for ho	ousing and	I rotor: xtinguisha	able:	(blank) V0
lk		500Ω 1k	(			MΩ 2M2:	Ω 4Μ7Ω		* Self-ex By default, For carbor	colors ot tinguish carbon is self-extin	able pro	perty, V( extinguish e property	), for ho able, cerr can be a	ousing and	I rotor: xtinguisha eans hous	able:	(blank) V0
Resistance va	0Ω 470Ω		(Ω 2ΚΩ	(blank)	1ΜΩ 2		Ω 4M7Ω 2 4M7	5ΜΩ	* Self-ex By default, For carbor	tinguish carbon is a: self-extinate V0. If co	able pro	perty, V( extinguish e property	), for ho able, cerr can be a	<b>pusing and</b> met is Self-e dded. V0 m	I rotor: xtinguisha eans hous	able:	(blank) V0
Resistance va Ω 200Ω 220Ω 25	0Ω 470Ω		(Ω 2ΚΩ	(blank)	1ΜΩ 2			5ΜΩ	* Self-ex By default, For carbor and rotor a If only roto	tinguish carbon is a: self-extinare VO. If corr: RT-VO	able pro	perty, V( extinguish e property	), for ho able, cerr can be a	<b>pusing and</b> met is Self-e dded. V0 m	I rotor: xtinguisha eans hous	able:	(blank) V0
Resistance va Ω 200Ω 220Ω 25	0Ω 470Ω 50 470		(Ω 2ΚΩ	(blank)	1ΜΩ 2			5MΩ 5M	* Self-ex By default, For carbonand rotor a	tinguish carbon is are VO. If c r: RT-VO	able pro non self- nguishable nly the ho	perty, Vo extinguish e property busing nee	), for ho able, cerr can be a ds to be	<b>pusing and</b> met is Self-e dded. V0 m	I rotor: xtinguisha eans hous	able: sing (	(blank) V0
Resistance va  Ω 200Ω 220Ω 25   0 200 220 25	0Ω 470Ω 50 470		(Ω 2ΚΩ	(blank)	1ΜΩ 2	2M 2M		5MΩ 5M	* Self-ex By default, For carbon and rotor a If only roto	tinguish carbon is a: self-extinare VO. If care VO. If care VO.	able pro non self- nguishable nly the ho	perty, Vo extinguish e property busing nee	), for ho able, cerr can be a ds to be	<b>pusing and</b> met is Self-e dded. V0 m	I rotor: xtinguisha eans hous	able: sing (	(blank) V0 CJ-V0, RT-
Resistance va Ω 200Ω 220Ω 25 Ο 200 220 25 Resistance lav	0Ω 470Ω 50 470		(Ω 2ΚΩ	(blank)	1MΩ 2	2M 2M		5MΩ 5M	* Self-ex By default, For carbor and rotor a If only roto  14 - Wip Wiper po	tinguish carbon is n: self-extin are V0. If c r: RT-V0 er position (S	able pro non self- nguishable nly the ho	perty, Vo extinguish e property busing nee	), for ho able, cerr can be a ds to be	<b>pusing and</b> met is Self-e dded. V0 m	I rotor: xtinguisha eans hous	able: sing (	(blank) V0 CJ-V0, RT- e blank)
Resistance va  Ω 200Ω 220Ω 25   0 200 220 25   Resistance law   - Linear	0Ω 470Ω 50 470 v / taper		(Ω 2ΚΩ	(blank)	1MΩ 2 1M 2	2M 2M		5MΩ 5M	* Self-ex By default, For carbor and rotor a If only roto 14 - Wip Wiper po Initial or C	tinguish carbon is n: self-extinate VO. If c r: RT-VO er esition (S	able pro non self- nguishablo nly the ho	perty, Vextinguish e property using nee	D, for ho able, cerr can be a ds to be	ousing and met is Self-e dded. V0 m V0, then CJ	I rotor: xtinguisha eans hous	able: sing ( (leave	(blank) V0 CJ-V0, RT- e blank) PI
Resistance va  \( \Omega 200\Omega 220\Omega 25 \)  Resistance lav  - Linear  g - Logarithmic	0Ω 470Ω 50 470 <b>v / taper</b>	500 1	(Ω 2KΩ K 2K	(blank) . 500KΩ 500K	1MΩ 2 1M 2	2M 2M:		5MΩ 5M	Color: For  * Self-ex By default, For carbor and rotor a If only roto  14 - Wip Wiper po Initial or C  Final or C  Others: fc	tinguish carbon is in self-extinguish carbon is in self-extinare VO. If care RT-VO er sition (SCCW)	able pro non self- nguishable nly the ho	perty, Vextinguish exproperty property property pusing nee	o, for ho able, cerr can be a ds to be	ousing and met is Self-e dded. V0 m V0, then CJ-	I rotor: xtinguisha eans hous	able: sing ( (leave	(blank) V0 CJ-V0, RT- e blank) PI PF ex: P3H
Resistance va Ω 200Ω 220Ω 25 Ω 200 220 25 Resistance lav - Linear g - Logarithmic tilog - Antilogarith	0Ω 470Ω 50 470 <b>v / taper</b>	500 1	(Ω 2KΩ K 2K	(blank) . 500KΩ 500K	1MΩ 2 1M 2 A B	2M 2M:		5MΩ 5M	Color: For  * Self-ex By default, For carbor and rotor a If only roto  14 - Wip Wiper po Initial or C Others: fc Wiper to	r colors ot  tinguish carbon is carbon is r: self-extin are V0. If c r: RT-V0  er  position (S  CCW  W  Ullowing c  rque (Sta	able pro- non self- nguishable nly the ho Standard:	perty, Vextinguish exproperty property property pusing nee	o, for ho able, cerr can be a ds to be	ousing and met is Self-e dded. V0 m V0, then CJ	I rotor: xtinguisha eans hous	elable:  (leave)  PXH, (leave)	(blank) V0 CJ-V0, RT- e blank) PI PF ex: P3H
Resistance va  \( \Omega 200\Omega 220\Omega 25 \)  Resistance lav  - Linear  g - Logarithmic tilog - Antilogaritt pecial tapers hav  Tolerance	0Ω 470Ω 50 470 v / taper nmic ve codes a	500 1	(Ω 2KΩ K 2K	(blank) . 500KΩ 500K	1MΩ 2 1M 2 A B	2M 2M:	2 4M7	5MΩ 5M	Color: For  * Self-ex By default, For carbor and rotor a If only roto  14 - Wip Wiper po Initial or C  Final or C  Others: fc	r colors ot  tinguish carbon is carbon is r: self-extin are V0. If c r: RT-V0  er  position (S  CCW  W  Ullowing c  rque (Sta	able pro- non self- nguishable nly the ho Standard:	perty, Vextinguish exproperty property property pusing nee	o, for ho able, cerr can be a ds to be	ousing and met is Self-e dded. V0 m V0, then CJ-	I rotor: xtinguisha eans hous	elable:  (leave)  PXH, (leave)	V0 CJ-V0, RT- e blank) PI PF ex: P3H
Resistance va  \( \Omega 200\Omega 220\Omega 25 \)  Resistance lav  - Linear  g - Logarithmic tilog - Antilogaritt pecial tapers hav  Tolerance	0Ω 470Ω 50 470 <b>v / taper</b>	500 1	(Ω 2KΩ K 2K	(blank) . 500KΩ 500K	1MΩ 2 1M 2 A B	2M 2M:		5MΩ 5M	Color: For  * Self-ex By default, For carbor and rotor a If only roto  14 - Wip Wiper po Initial or C Others: fc Wiper to	tinguish carbon is carbon	able pro- non self- nguishable nly the ho Standard:	perty, Vextinguish exproperty property property pusing nee	o, for ho able, cerr can be a ds to be	ousing and met is Self-e dded. V0 m V0, then CJ-	I rotor: xtinguisha eans hous	elable:  (leave)  PXH, (leave)	(blank) V0 CJ-V0, RT- e blank) PI PF ex: P3H
Resistance va  \( \Omega 200\Omega 220\Omega 25  \) Resistance lav - Linear g - Logarithmic tilog - Antilogarith pecial tapers hav  Tolerance	0Ω 470Ω 50 470 v / taper nmic ve codes a	500 1	(Ω 2KΩ K 2K	(blank) . 500KΩ 500K	1MΩ 2 1M 2 A B C CODE Y	2M 2M:	2 4M7	5MΩ 5M	* Self-ex By default, For carbor and rotor a If only roto  14 - Wip Wiper pc Initial or C  Tinal or C  Wiper to Low torqu	tinguish carbon is in self-extinate vo. If carbon is reself-extinate vo. If carbon is carbon is self-extinate vo. If carbon	able pro- non self- nguishable nly the ho Standard:	perty, Vextinguish exproperty property property pusing nee	o, for ho able, cerr can be a ds to be	ousing and met is Self-e dded. V0 m V0, then CJ-	I rotor: xtinguisha eans hous	eable: (leave  PXH, (leave	(blank) V0 CJ-V0, RT- e blank) PI PF ex: P3H
Resistance va  \( \Omega 2000  2200  25 \)  Resistance lav  - Linear  g - Logarithmic tilog - Antilogarith pecial tapers hav  Tolerance  \( \Omega    25 \)	0Ω 470Ω 50 470 v / taper mmic ve codes a ±30%	assigned +5	(Ω 2KΩ K 2K  I:	(blank) . 500KΩ 500K	1MΩ 2 1M 2 A B C CODE Y	2M 2M:	2 4M7 ±5%	5MΩ 5M	Color: For  * Self-ex By default, For carbor and rotor a If only roto  14 - Wip Wiper pc Initial or C  Tinal or C  Others: fc  Wiper to Low torqu  Not contr	r colors of tinguish carbon is in self-exti are V0. If c r: RT-V0  er esition (S CCW  W  ollowing C rque (Sta ue, < 1.50	able pro non self- nguishablo nly the ho Standard: slock pos andard: <	perty, V(extinguish extinguish extinguish extinguish extinguish extinguish extinguished extingui	), for ho able, cern can be a ds to be	ousing and met is Self-e dded. V0 m V0, then CJ-	I rotor: xtinguisha eans hous VO.	eable: Sing (leave) PXH, (leave) P(leave)	(blank) V0 CJ-V0, RT- e blank) PF ex: P3H e blank) PGB
Resistance va  2000 2200 25  Resistance lav - Linear g - Logarithmic tilog - Antilogarith pecial tapers hav  Tolerance 0% = 20  Operating Life	0Ω 470Ω 50 470 v / taper nmic ve codes a ±30% 3030	assigned +5	(Ω 2KΩ K 2K  I:	(blank) . 500KΩ 500K	1MΩ 2 1M 2 A B C CODE Y	2M 2M:	±5% 050	5MΩ 5M	Color: For  * Self-ex By default, For carbor and rotor a If only roto  14 - Wip Wiper pc Initial or C  Tinal or C  Others: fc  Wiper to Low torqu  Not contr	tinguish carbon is carbon is no self-extinguish carbon is no self-exting are V0. If correction (Section (Sectio	able pronon self-non	perty, V(extinguish extinguish ex	), for he able, cern can be a ds to be 15°)  3 hours for dete	busing and met is Self-edded. V0 met v0, then CJ-self-edded. V	I rotor: xtinguisha eans hous VO.	leave  PXH,  (leave  (leave  LNx%;	(blank) V0 CJ-V0, RT- e blank) PF ex: P3H e blank) PGB
Resistance va  \( \Omega 2000  2200  25 \)  Resistance lav  - Linear  g - Logarithmic tilog - Antilogarith pecial tapers hav  Tolerance  \( \Omega    25 \)	0Ω 470Ω 50 470 v / taper nmic ve codes a ±30% 3030	assigned +5	(Ω 2KΩ K 2K  I:	(blank) . 500KΩ 500K	1MΩ 2 1M 2 A B C CODE Y	2M 2M:	2 4M7 ±5%	5MΩ 5M	* Self-ex By default, For carbor and rotor a If only roto  14 - Wip Wiper pc Initial or C Others: fc Wiper to Low torqu  15 - Line Not contr Independe	tinguish carbon is carbon is no self-extinguish carbon is no self-exting are V0. If correction (Section (Sectio	able pronon self-non	perty, V(extinguish extinguish ex	), for he able, cern can be a ds to be 15°)  3 hours for dete	busing and met is Self-edded. V0 met v0, then CJ-self-edded. V	I rotor: xtinguisha eans hous VO.	leave  PXH,  (leave  (leave  LNx%;	(blank) V0 CJ-V0, RT- e blank) PI ex: P3H e blank) PGB
Resistance va  2000 2200 25  Resistance lav - Linear g - Logarithmic tilog - Antilogarith pecial tapers hav  Tolerance 0% = 20  Operating Life	0Ω 470Ω  10Ω 47	assigned +5	(Ω 2KΩ K 2K  I:  0%,-30%	(blank) . 500KΩ 500K	1MΩ 2 1M 2 A B C CODE Y ±10%	2M 2M:	±5% 050	5MΩ 5M	Color: For  * Self-ex By default, For carbor and rotor a If only roto  14 - Wip Wiper po Initial or C  Thinal or C  Wiper to Low torqu  15 - Line Not contr Independe Absolute	tinguish carbon is in self-extinate V0. If carbon is	able pronon self-nguishable non self-nguishable nily the horizontal self-nguishable nily the horizonta	perty, Viewing and the property of the propert	3 hours for dete	busing and met is Self-edded. V0 met v0, then CJ-self-edded. V	I rotor: xtinguisha eans hous VO.	leave  PXH,  (leave  (leave  LNx%;	(blank) V0 CJ-V0, RT- e blank) PI ex: P3H e blank) PGB
Resistance va  10 2000 2200 25  Resistance lav - Linear g - Logarithmic tilog - Antilogarith pecial tapers hav  Tolerance  120  Operating Life andard (1.000 cycle) g life: LV + the nun	0Ω 470Ω 50 470 v / taper mmic ve codes a 3030 (Cycles) cles)	assigned +5	(Ω 2KΩ K 2K  I:  0%,-30%	(blank) . 500KΩ 500K	1MΩ 2 1M 2 A B C CODE Y ±10%	2M 2M:	±59 050	5MΩ 5M	Color: For  * Self-ex By default, For carbor and rotor a If only roto  14 - Wip Wiper po Initial or C  Thinal or C  Wiper to Low torqu  15 - Line Not contr Independe Absolute	tinguish carbon is in self-extinate VO. If care VO. If	able pronon self-nguishable nily the horizontal self-nguishable ni	perty, View perty, View property, View property	3 hours for dete	busing and met is Self-edded. V0 met v0, then CJ-self-edded. V	I rotor: xtinguisha eans hous VO.	eable:  (leave  PXH,  (leave  LNx%;	(blank) V0 CJ-V0, RT- e blank) PI ex: P3H e blank) PGB
Resistance va  2000 2200 25  Resistance lav - Linear g - Logarithmic tilog - Antilogarith pecial tapers hav  Tolerance 0%  Operating Life andard (1.000 cycleg life: LV + the nun  Cut Track - Op	00 4700 50 470 v / taper minic ve codes a 3030 (Cycles) cles) hber of cyc	assigned +5	(Ω 2KΩ K 2K  I:  1:  1:  1:  1:  1:  1:  1:  1:  1:	(blank) . 500KΩ 500K	1MΩ 2 1M 2  1M 2  A B C CODE Y  ±10% 1010	2M 2M:	±59 050	5MΩ 5M	* Self-ex By default, For carbor and rotor a If only roto  14 - Wip Wiper po Initial or C  The control  Wiper to Low torqu  15 - Line Not contr Independe Absolute	tinguish carbon is: self-extinguish carbon is: self-extinare v0. If c r: RT-V0  er esition (SCW)  W  ollowing c  rque (Staue, < 1.50  erarity  olled  int linearity c  entiomet  ed from te	able pronon self-nguishable pronon self-nguishable pronon self-nguishable pronon self-nguishable pronon self-nguishable prononn self-nguishable prononnn self-nguishable prononn self-nguishable prononn self-nguishable prononn self-nguishable prononn self-nguishable prononnn self-nguishable pron	perty, V(extinguish extinguish ex	3 hours for dete	busing and met is Self-edded. V0 met v0, then CJ-self-edded. V	I rotor: xtinguisha eans hous -VO.	(leave	(blank) V0 CJ-V0, RT- e blank) PF ex: P3H e blank) PGB e blank) ex: LN3% Axx%
Resistance va  2000 2200 25  Resistance lav - Linear g - Logarithmic tilog - Antilogarith pecial tapers hav  Tolerance 0%  Operating Life andard (1.000 cyc ng life: LV + the nun  Cut Track - Operating Life life life life life.	0Ω 470Ω  10Ω 47	assigned +5	(Ω 2KΩ K 2K  I:  1:  1:  1:  1:  1:  1:  1:  1:  1:	(blank) . 500KΩ 500K	1MΩ 2 1M 2 A B C CODE Y ±10% 1010	2M 2M:	±59 050	5MΩ 5M 66 5 ank) LV45	Color: For  * Self-ex By default, For carbor and rotor a If only roto  14 - Wip Wiper po Initial or C  Final or C  Others: fc  Wiper to Low torqu  15 - Line Not contr Independe Absolute  16 - Pote Assemble Accessor Color of s	tinguish carbon is: self-extitute of the carbon is: self-extit	able pronon self-nguishable pronon self-nguishable pronon self-nguishable prononned pr	perty, V(extinguish extinguish ex	3 hours for dete	busing and met is Self-edded. V0 met v0, then CJ-self-edded. V	I rotor: xtinguisha eans hous VO.	lable: sing (leave PXH, (leave LNx%; V XXXX, Ex	(blank) V0 CJ-V0, RT  e blank) PI ex: P3H e blank) 'GB  e blank) VT- kample: 90 ble, black:
Resistance va  2000 2200 25  Resistance lav - Linear g - Logarithmic tilog - Antilogarith pecial tapers hav  Tolerance 0%  Operating Life andard (1.000 cycleg life: LV + the nun  Cut Track - Op	0Ω 470Ω  10Ω 47	assigned +5	(Ω 2KΩ K 2K  I:  1:  1:  1:  1:  1:  1:  1:  1:  1:	(blank) . 500KΩ 500K	1MΩ 2 1M 2  1M 2  A B C CODE Y  ±10% 1010	2M 2M:	±59 050	5MΩ 5M 66 5 ank) LV45	Color: For  * Self-ex By default, For carbor and rotor a If only roto  14 - Wip Wiper po Initial or C  Thinal or C  Others: fc Wiper to Low torqu  15 - Line Not contr Independe Absolute  16 - Pote Assemble Accessor	tinguish carbon is in self-extinguish carbon is in self-extinare v0. If c r: RT-V0  er esition (S CCW  W  ollowing c rque (Staue, < 1.50  erity olled ant linearity c entiomet ed from te y Referer chaft extinguisha	able pronon self-nguishable non self-nguishabl	perty, V(extinguish to property, V(extinguish to property using need to the property using the	3 hours for dete	busing and met is Self-edded. V0 met v0, then CJ-self-edded. V	I rotor: xtinguisha eans hous VO.	(leave	(blank) V0 CJ-V0, RT  e blank) PI ex: P3H e blank) PGB  eblank) VGB  VT-  cample: 96
Resistance va  10 2000 2200 25  Resistance lav - Linear g - Logarithmic tilog - Antilogarith pecial tapers hav  Tolerance  120  Operating Life andard (1.000 cycle) g life: LV + the nun  Cut Track - Operatine circuit at beginen circuit at end	0Ω 470Ω  10Ω 47	assigned +5	(Ω 2KΩ K 2K  I:  1:  1:  1:  1:  1:  1:  1:  1:  1:	(blank) . 500KΩ 500K	1MΩ 2 1M 2 A B C CODE Y ±10% 1010	2M 2M:	±59 050	5MΩ 5M 66 5 ank) LV45	Color: For  * Self-ex By default, For carbor and rotor a If only roto  14 - Wip Wiper pc Initial or C  Cothers: fc Wiper to Low torqu  15 - Line Not contr Independe Absolute  16 - Pote Accessor  Color of s Non self-e.	tinguish carbon is is self-extin are V0. If c r: RT-V0  er esition (S CCW  W  Ollowing C  rque (Sta ue, < 1.51  earity olled int linearity c entiomet d from te y Referer shaft txtinguishable a	able pronon self-nguishable non self-nguishabl	perty, View perty, View perty, View perty, View property perty per	3 hours for dete	busing and met is Self-edded. V0 met v0, then CJ-example, 3%	I rotor: xtinguisha eans hous VO.	(leave	(blank) V0 CJ-V0, RT  e blank) PF ex: P3H e blank) PGB ex: LN3% Ax%  VT- cample: 90 ole, black: e blank)
Resistance va  2000 2200 25  Resistance lav - Linear g - Logarithmic tilog - Antilogarith pecial tapers hav  Tolerance 0%  Operating Life andard (1.000 cyc ng life: LV + the nun  Cut Track - Operating Life life life life life.	0Ω 470Ω  470Ω  470Ω  v / taper  minic  ve codes a  3030  (Cycles)  cles)  mber of cycles  codes a  codes a  codes a	assigned +5	(Ω 2KΩ K 2K  I:  1:  1:  1:  1:  1:  1:  1:  1:  1:	(blank) . 500KΩ 500K	1MΩ 2 1M 2 A B C CODE Y ±10% 1010	2M 2M:	±59 050	5MΩ 5M 66 5 ank) LV45	* Self-ex By default, For carbor and rotor a If only roto  14 - Wip Wiper po Initial or C  The control  The c	tinguish carbon is is self-extin are V0. If c r: RT-V0  er esition (S CCW  W  ollowing c rque (Sta ue, < 1.50  erity olled ant linearity c entiomet ed from te y Referer chaft ktinguisha uishable a 1.17 modif	able pronon self- nguishable standard: standard: standard: controlle controllect ers with erminal si nce (901s)	perty, V(extinguish to property, V(extinguish to property using need to standar to stand	3 hours for dete	cusing and met is Self-edded. V0 met is Self-edded. V0 met v0, then CJ-self-edded. V0 met v0,	I rotor: xtinguisha eans hous VO.	(leave	(blank) V0 CJ-V0, RT  e blank) PF ex: P3H e blank) PGB ex: LN3% Axx%  VT- cample: 90 ole, black: e blank)

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

X number of detents, evenly distributed.

XDT: 10DT

RO

VΕ

ΑM

ΑZ

GS

MR

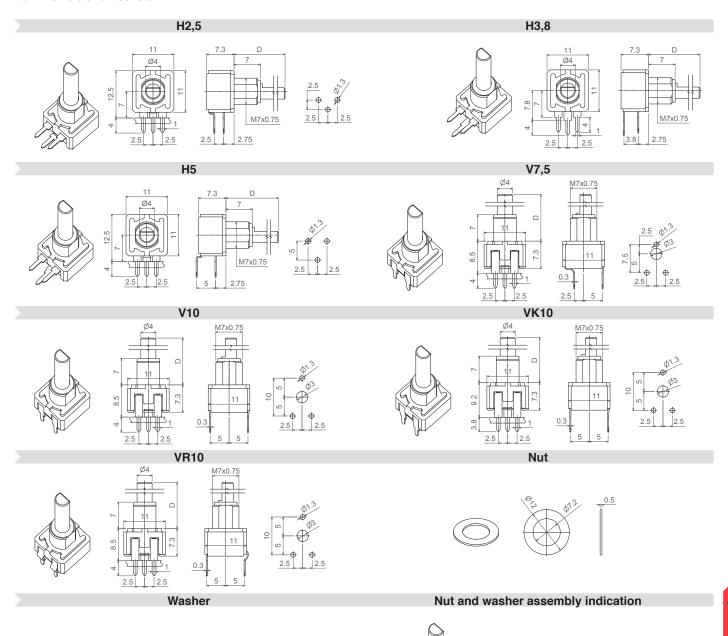
TA

ΝE

BA

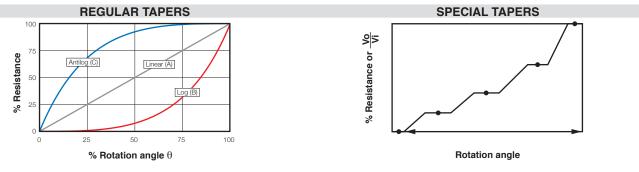
(1) black is not an option for housings.

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.-





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.

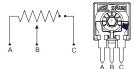
PCF = Cut at final position, when the potentiometer is turned fully clockwise.

Other positions are available on request.

**PCF PCI** 





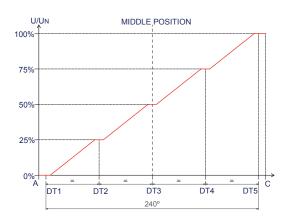




ACP's patented detent (DT) feature is especially suitable for control applications where the end user will turn a knob inserted in the potentiometer. Detents can be used to add a click feeling to the turning of the potentiometer or to control the position in which the wiper is placed, assuring a particular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









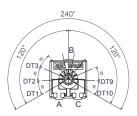


Other examples of potentiometers with detents:

10DT **20DT** 

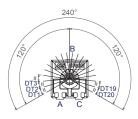












Number of standard detents (evenly distributed) already available.	1 (initial or final), 2 DT (initial and final), 3, 4, 5, 6, 7, 8,10, 20.
Maximum number of detents for feeling only	20
Maximum number of detents when the voltage value in each detent is controlled and non-overlapping.	10

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

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

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 "SNJ"), to better hold the component to the PCB during the soldering operation.

SNP SNJ





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

**Standard Terminal** 

Shorter terminal, for H5 TP25

Shorter terminal, TPXX (under request)







Possibilities for insertion of accessories

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.

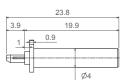
 $\ensuremath{\mathsf{D}}$  dimension is the distance from the housing to the top of the shaft, as shown in the different models.

Shaft	9019	9020
D Dimension	17.5	23.5

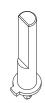
9019 9020



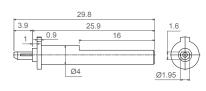












### Packaging

Potentiometer model	With shaft or thumbwheel inserted?	Pieces per bigger box (250 x 150 x 70, CG on description)
H2,5 - H3,8 - H5 V7,5 - V10 - VK10 - VR10	9019, 9020	500



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* $Rn < 100\Omega: \\ 100\Omega \le Rn \le 100K\Omega \\ 100K < Rn \le 1M\Omega: \\ 1M\Omega < Rn \le 5M\Omega: \\ Rn > 5M\Omega:$	+50%, -30% (out of range) ±20% ±20% ±30% +50%, -30% (out of range)	- ±20% ±20% ±30%				
Variation laws	ther tapers available on request					
Residual resistance	Lin (A), Log (B), Antilog (C) $\leq$ 5*10-3*Rn. Minimum value $2\Omega$	≤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 Angle 220°±20° ≤ 5%Rn. Other tapers, 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 $100\Omega \leq \text{Rn} \leq 10\text{K}\Omega$ $10\text{K}\Omega < \text{Rn} \leq 5\text{M}\Omega$	+200/ -300 ppm +200/ -500 ppm	±100 ppm ±100 ppm				

<sup>\*</sup> Out of range ohm values and tolerances are available on request, please, inquire.

# Mechanical Specifications

<u> Сросиновного</u>	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 Potentiometers with detents: <2.5 Ncm						
Mechanical life	1.000 cycles (many more available on request, please, inquire)						

<sup>\*</sup> Stronger or softer torque feeling is available on request.



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

### MCA9 Through-hole

### MCE9 Through-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%
Storage (3 years)	3 years at 23°C ± 2°C	±3%	3 years at 23°C ± 2°C	±1%

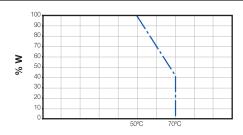
<sup>\*\*</sup> Dissipation of special tapers will vary, please, inquire.

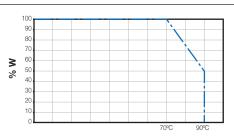




### MCE9 Through-hole

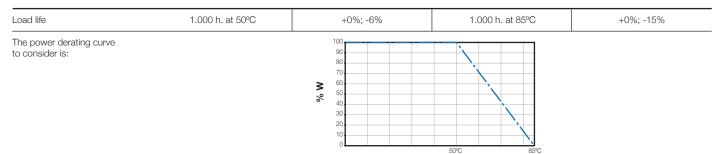
Power derating curve:



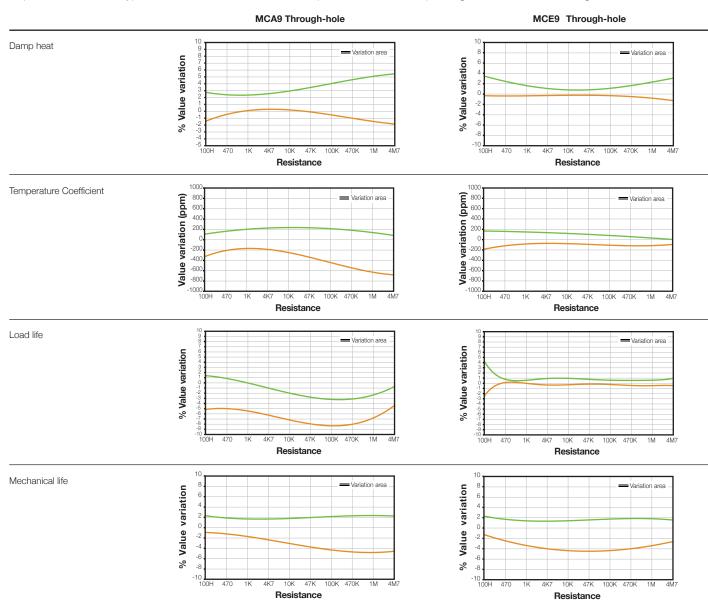


### For temperatures out of range

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



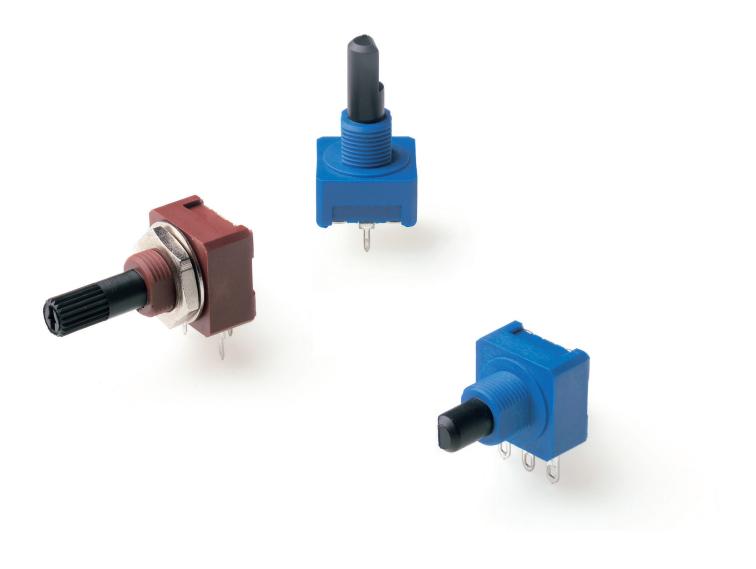
Representation of the typical variation of nominal resistance (with 95% confidence) throughout the ohm value range:



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# CARBON - MCA14 1

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.

# CFRMFT - MCF14 L

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.

# MCA14 MCE14 HOW TO ORDER

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

EXAMPLE: MCE14NH2,5-10KA2020 SNP PI WT-14187-BA-V0

Standard features					Extra features							Assembled accessory						
Series	Rotor	Model	Packg.	Ohm value	Taper	Tol.	Life	Track	Detents	Snap in	Housing	Rotor	Wiper	Lin.	Assembly	Ref #	Color	Flam
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		16		
MCA14 MCE14	N	H2,5		- 10K	Α	2020				SNP			PI		WT	-14187	-BA	

MCA14 Through-hole	MCE14 Through-hole				
14mm					
	(dust-proof) juishable, to meet UL 94 V-0				
Carbon technology	Cermet				
Blue housing + white rotor	Brown housing + white rotor				
	Bulk				
at 5	0% ±15°				
Straight, w	rithout crimping.				
Resistive value marked o	n housing. Others on request.				
	IP 54 On request: Self-exting Carbon technology Blue housing + white rotor  at 5 Straight, w				

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 - Seri	4 ■ MCE14	1					
IVICAT	4 - IVICE 12	+					
2 - Roto	ors						
N	Z						
3 - Mod	el and pito	<b>:</b> h					
H0	HC0	H2,5	H4	H5	HA5	HL5	V12,5
VA12,5	VL12,5	VR12,5	V15	VJ15	V17,5	VD7,5	VD11

4 - Packaging	Trough-hole
Bulk	(blank) <sup>(1)</sup>

100Ω       200Ω       220Ω       250Ω       470Ω       500Ω       1KΩ       2KΩ        500KΩ       1MΩ       2MΩ       2MΩ       4M7Ω       5MΩ         100       200       220       250       470       500       1K       2K       500K       1M       2M       2M2       4M7       5M														
100 200 220 250 470 500 1K 2K 500K 1M 2M 2M2 4M7 5M	100Ω	200Ω	220Ω	250Ω	470Ω	500Ω	1ΚΩ	2KΩ	. 500KΩ	1ΜΩ	2ΜΩ	2Μ2Ω	4M7Ω	5ΜΩ
	100	200	220	250	470	500	1K	2K	500K	1M	2M	2M2	4M7	5M

6 - Resistance law / taper				
Lin - Linear	А			
Log - Logarithmic	В			
Antilog - Antilogarithmic	С			
- Special tapers have codes assigned:	CODE YXXXXX			

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

8 - Operating Life (Cycles)	
Standard (1.000 cycles)	(leave blank)
Long life: LV + the number of cycles. ex: LV45 for 45.000 cycles.	Cles. (others on request) LVXX: ex: LV45
9 - Cut Track - Open circuit.	
Open circuit at beginning of track, fully CCW	PCI

PCF

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

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

11 -	Ter	mina	als

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

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

13 - Rotor	
Onlaw Foundation attended to a standard	0

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

\* Self-extinguishable property, V0, for housing and rotor: By default, carbon is non self-extinguishable, cermet is Self-extinguishable:

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

### 14 - Wiper

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

### 15 - Linearity

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

### 16 - Potentiometers with assembled accessories

Assembled from terminal side	WT
Accessory Reference See list of shafts and thumbwheels available	-XXXXX Example: 14187
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

### Color chart for rotor, housing and accessories

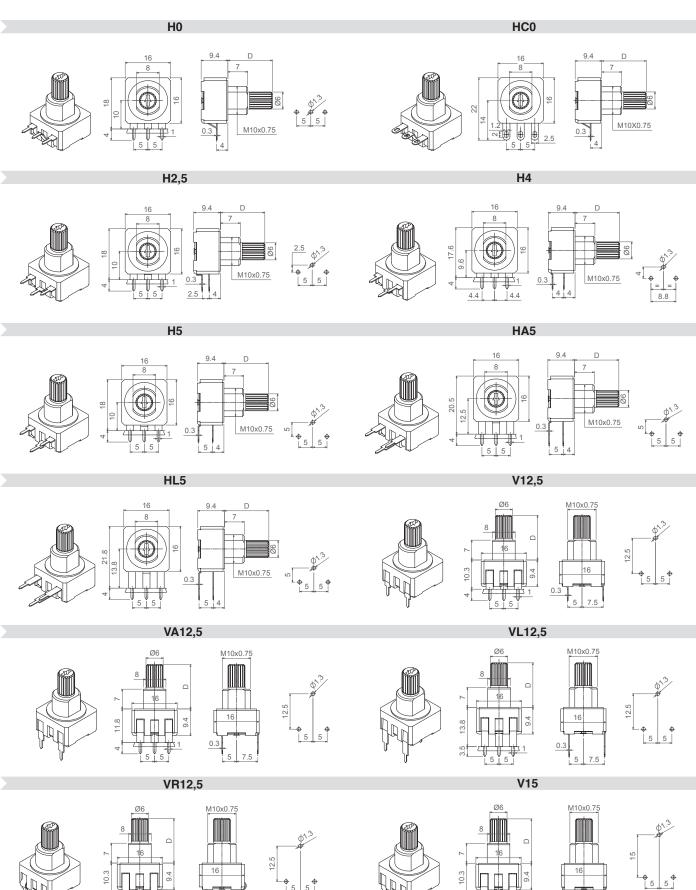
Black <sup>(1)</sup>	White	Neutral	Transp.	Red	Green	Yellow	Blue	Grey	Brown
NE	ВА	IN	TA	RO	VE	AM	AZ	GS	MR

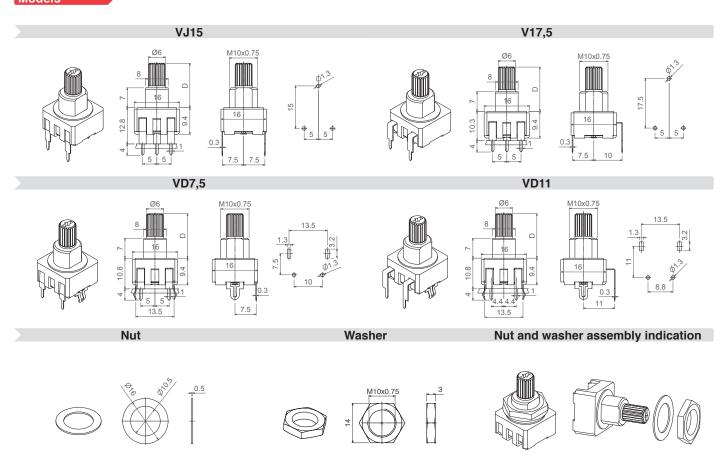
(1) black is not an option for housings.

5 - Resistance value

Open circuit at end of track, fully CW

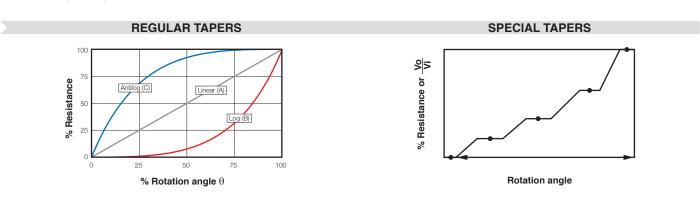
All models shown here have shaft 14187, but other shafts can be chosen from the list below. The D dimension indicated on the drawings refers to the possible length of the shaft, to be chosen at "shafts" section. Potentiometers are sold separately from the nuts and washers.





### 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.

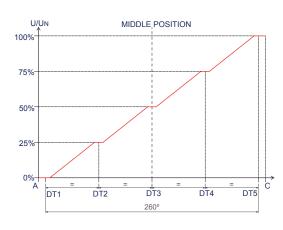




ACP's patented detent (DT) feature is especially suitable for control applications where the end user will turn a knob inserted in the potentiometer. Detents can be used to add a click feeling to the turning of the potentiometer or to control the position in which the wiper is placed, assuring a particular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

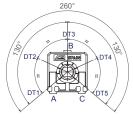
### Example of 5DT with control of value in each DT.











Examples of some potentiometers with detents:

14DT 38DT













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.

### **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, for V12,5 TP30

Shorter terminal, TPXX (under request)







# 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.

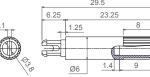
D dimension is the distance from the housing to the top of the shaft, as shown in the different models.

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

14008 14015

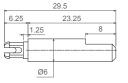








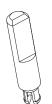




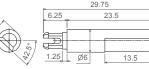


14066

14067

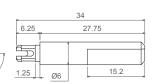










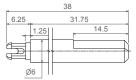




14072 14073



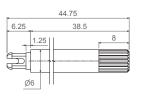










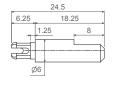




14081 14084



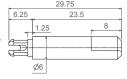










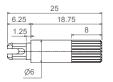




14250 14187



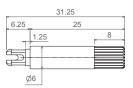














Packaging

Potentiometer model

With shaft or thumbwheel inserted?

Pieces per bigger box (250 x 150 x 70, CG on description)

H0 - HC0 - H2,5 - H4 - H5 - HA5 - HL5 V12,5 - V15 - VA12,5 - VL12,5 - VR12,5 VJ15 - V17,5 - VD11 - VD7,5

With any shaft.

150



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* $ \begin{array}{l} \text{Rn} < 100\Omega \text{:} \\ 100\Omega \leq \text{Rn} \leq 100 \text{K}\Omega \\ 100 \text{K} < \text{Rn} \leq 1 \text{M}\Omega \text{:} \\ 100 \text{K} < \text{Rn} \leq 5 \text{M}\Omega \text{:} \\ \text{Rn} > 5 \text{M}\Omega \text{:} \\ \end{array} $	+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 $2\Omega$	≤2Ω			
CRV - Contact Resistance Variation (dynamic)	Lin (A) Electrical Angl Other tapers,				
CRV - Contact Resistance Variation (static)	Lin (A) Electrical Angl Other tapers,				
Maximum power dissipation** Lin (A) Log (B), Antilog (C)	at 50°C 0.25W 0.13W	at 70℃. 0.7W 0.30W			
Maximum voltage Lin (A) Log (B), Antilog (C)		NDC NDC			
Operating temperature	-25°C +70°C (+85°C on request)	-40°C +90°C (+125°C on request)			
Temperature coefficient $100\Omega \leq Rn \leq 10K\Omega$ $10K\Omega < Rn \leq 5M\Omega$	+200/ -300 ppm +200/ -500 ppm	±100 ppm ±100 ppm			

<sup>\*</sup> Out of range ohm values and tolerances are available on request, please, inquire.

<sup>\*\*</sup> Dissipation of special tapers will vary, please, inquire.

Mechanical Specifications

	MCA14 Through-hole	MCE14 Through-hole				
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	10 Ncm					
Max. push/pull on rotor	50	N				
Wiper torque*		Ncm detents: <3.5 Ncm				
Mechanical life	1.000 cycles (many more avail	able on request, please, inquire)				

<sup>\*</sup> Stronger or softer torque feeling is available on request.



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

### MCA14 Through-hole

### MCE14 Through-hole

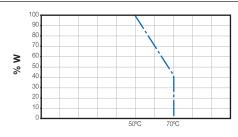
	Test conditions	Typical variation of Rn	Test conditions	Typical variation of Rn
Damp heat	500 h. at 40°C and 95% RH	+5%, -2%	500 h. at 40°C and 95% RH	±2%
Thermal cycles	16 h at 85°C, plus 2 h at -25°C	±2.5%	16 h at 90°C, plus 2 h at -40°C	±2%
Load life	1.000 h. at 50°C	+0%; -5%	1.000 h. at 70°C	±2%
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%
Storage (3 years)	3 years at 23°C ± 2°C	±3%	3 years at 23°C ± 2°C	±1%

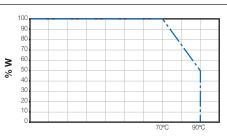
Test results



### MCE14 Through-hole

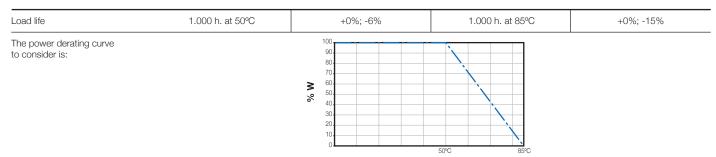
Power derating curve:



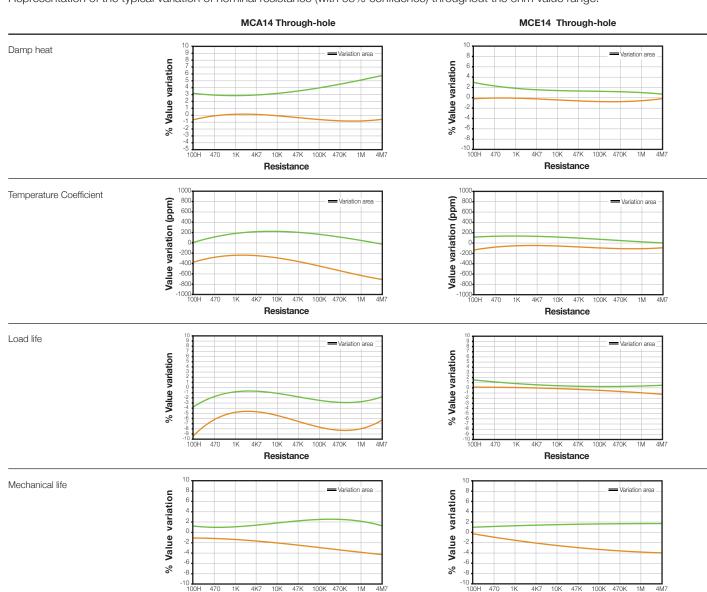


### For temperatures out of range

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:



Resistance

Resistance





# CARBON - MCS14

MCS14mm carbon potentiometer with plastic enclosure and shaft. Thanks to the CS14 placed inside its plastic enclousure, we can achive 360° of mechanical rotation (electrical angle up to 330°).

The plastic enclosure is fitted with a bushing for fixation to a panel through a nut and a washer.

Through-hole and pluggable 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 50 detents available).

### **Applications**

MCS14 potentiometers are used in control applications:

- Electronic appliances, heating, HVAC systems, thermostats, washing machines, dishwashers, tumble-dryers, etc...

# MCS14 ♣ HOW TO ORDER

### EXAMPLE: MCS14NH2,5-10KA2020 SNP PI WT-14187-BA

Standard features					Extra features							Assembled accessory								
Series	Rotor	Model	Connector.	Packg.	Ohm value	Taper	Tol.	Life	Track	Detents	Snap in	Housing	Rotor	Wiper	Lin.	Oper.Ta	Assembly	Ref #	Color	Flam.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17		18		
MCS14	N	H2,5			- 10K	Α	2020				SNP			PI			WT	-14187	-BA	

Standard configuration:	MCS14 Through-hole	
Dimensions:	14mm	
Protection:	IP 54 (dust-proof) On request: Self-extinguishable, to meet UL 94 V-0	
Substrate:	Carbon technology	
Color:	Blue 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:MCS14NH2,5-10K CODE C00111. Other features could be available on request, please, ask.

1 - Ser	ies								
MCS	14								
2 - Rot	tors								
N	Z								
3 - Mo	del and pi	tch							
H0	HC0*	H2,	5	H5	HP	V12,5	V1		
* Under red	quest.								
4 - Coı	nnector								
SHORT	latching sh	nape and g	oove at IN	IITIAL termi	nal side		SI		
SHORT	latching sh	nape and g	oove at Fl	NAL termin	al side		SF		
LONG I	atching sha	ape and gro	ove at INI	ΓIAL termin	al side		LI		
LONG I	atching sha	ape and gro	ove at FIN	AL termina	l side		LF		
5 - Pac	ckaging			Trough	-hole				
Bulk									
				(blank	<u>,                                      </u>				
6 - Res 1KΩ	2KΩ	alue 2K2Ω	4K7Ω	5ΚΩ	10ΚΩ	4M7Ω	5MS		
1K	2K	2K2	4K7	5K	10K	4M7	5M		
7 - Res	sistance la	w / taper							
Lin - Lir	near			А					
Log - Lo	ogarithmic				В				
Antilog	- Antilogari	thmic			С				
	al tapers ha	ive codes a	ssigned:	CODE YXXXXX					
- Specia									
- Specia	erance								
		+50%,-30%	ó	±20%	±1	0%	±5%		

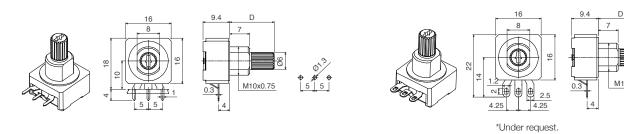
9 - Operating Life (Cycles)	
Standard (15.000 cycles) (Others on request)	LV15
Long life: LV + the number of cycles. ex: LV50 for 50.000 cycles. (others on request)	LVXX: ex: LV50

MCS14 already has an open circuit area at the base of the potentiometer (between
330° and 0°). Additional cut tracks can be studied on request.

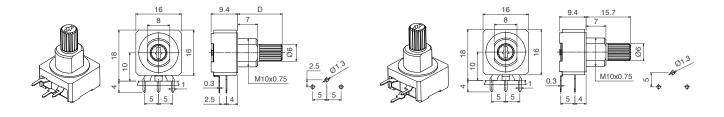
11 - Detents (DT)	
X number of detents: ex. 16 detents	XDT, ex:16DT
Special detents are available on request: If you also need to assign a	voltage value to each detent, please inquire

12 - Terminals			
SNAP IN P		S	NP
SNAP IN J		S	NJ
Shorter tip of terminal, TPXX, where XX is tip length (under request)	st)	TPXX, e	ex: TP25
Steel Terminals		9	SH
13 - Housing			
Color: For colors other than standard: -See color chart below-	CJ-co	lor, ex., re	d: CJ-RC
14 - Rotor			
Color: For colors other than standard: -See color chart below-	RT-col	or; ex., blu	ue: RT-AZ
* Self-extinguishable property, V0, for housing and rote Not V0 (by default)	or:	(b	lank)
Housing and rotor V0			V0
Only housing V0 Only rotor V0			J-V0 T-V0
15 - Wiper			
Wiper position (Standard: 50% ± 15°)		(leave bl	lank)
Initial or CCW		PI	
Final or CW		PF	
Others: following clock positions; at 3 hours: P3H		PXH, ex:	РЗН
Wiper torque (Standard: <2.5Ncm, for detents: <3.5)		(leave bl	lank)
Low torque, < 1.5Ncm		PGE	3
16 - Linearity			
Standard, according to IEC 190		(leave bl	ank)
Independent linearity controlled & below x%, for example, 3%: LN3	3% L	Nx%; ex:	LN3%
Absolute linearity controlled & below x%		LAx9	6
17 - Operating Temperature			
-25°C +70°C		(leave bl	ank)
-25°C +85°C		TªD	
-25°C +105°C		TªB	
18 - Potentiometers with assembled accessories			
Assembled from terminal side		WT	
Accessory Reference See list of shafts and thumbwheels available		-XXXXX Example	e: 14187
Color of shaft or thumbwheel	-YY Ex	kample, w	vhite: BA
Non self-extinguishable. Self-extinguishable according to standard UL 94 (-V0 in box 17 modifies only the accessory, please, note.)		(leave b	lank)
of 34 (-vo in box 17 modilles only the accessory, please, note.)			
Color chart for rotor, housing and accessories			
	Blue	Grey	Brown

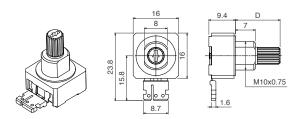
H0 HC0\*



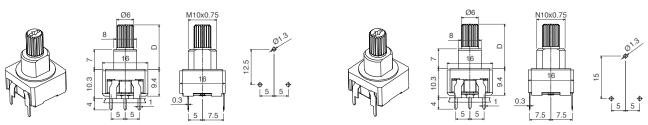
H2,5 **H5** 



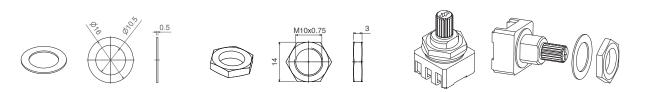
HP



V12,5 V15



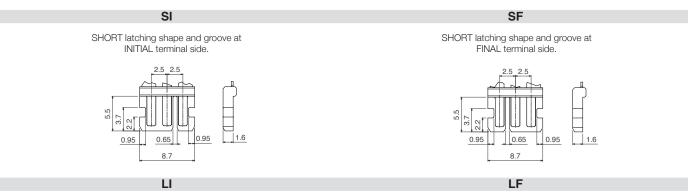
Nut Washer Nut and washer assembly indication



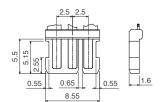
### Connector

ACP offers the possibility to turn one CS14 standard into a pluggable version. Thanks to an external RAST 2,5 card edge connector in which terminals are embedded, customer can transmit the output signal from the potentiometer to the electronic module. The three pins of the potentiometer (the collector and the two terminals) are fitted into a 1,55 mm thick plastic part with a pitch of 2,5mm. Extended temperature versions covering a range from -40°C to +120°C are available for applications where the working temperature interval exceeds the standard limits of -25°C to+70°C. The self-extinguishable version of the plastic parts, V0, can be supplied under request.

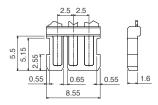
A typical application would be as feedback position sensor of the cooking style selector for kitchen ovens. ACP is able to supply different kind of connectors:



LONG latching shape and groove at INITIAL terminal side.

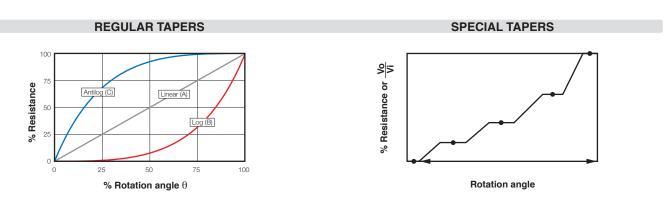


LONG latching shape and groove at FINAL terminal side.



### **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.-





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:

# 16DT Standard 17DT (Max. non overlapping V) 50DT (Max. for feeling)

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.



## Adjustment and orientation

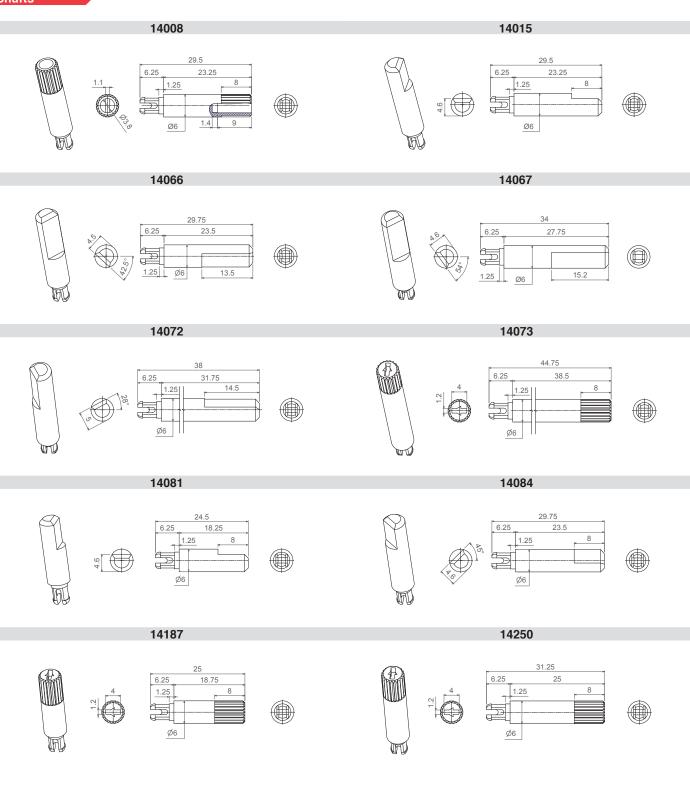
Should the shaft need to be positioned differently than shown on the "models" section on this catalogue, a drawing with the exact position is kindly requested.

### 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



### Packaging

Potentiometer model	With shaft or thumbwheel inserted?	Pieces per bigger box (250 x 150 x 70, CG on description)
H0 - HC0 - H2,5 - H5 - HP - V12,5 - V15	With any shaft.	150



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

### MCS14 Through-hole

Range of resistance values* Lin (A) Log (B) Antilog (C)	$1 K \Omega \leq R n \leq 5 M \Omega$ $10 K \Omega \leq R n \leq 2 M 2 \Omega$
Tolerance* (Please, inquire for >100K turns) $100\Omega \leq Rn \leq 100K\Omega$ $100K < Rn \leq 1M\Omega:$ $1M\Omega < Rn \leq 5M\Omega:$ $Rn > 5M\Omega:$	±30% ±30% ±30% +50%, -30% (out of range)
Variation laws	Lin (A), Log (B), Antilog (C). Other tapers available on request
CRV - Contact Resistance Variation (dynamic)	Lin (A) Electrical Angle $330^{\circ}\pm20^{\circ}\leq3\%$ Rn. Other tapers, please inquire
CRV - Contact Resistance Variation (static)	Lin (A) Electrical Angle 330°±20° ≤ 5%Rn. Other tapers, please inquire
Maximum power dissipation** Lin (A) Log (B), Antilog (C)	at 50℃, 0.15W
Maximum voltage Lin (A) Log (B), Antilog (C)	250VDC
Operating temperature	-25°C +70°C (standard) -25°C +85°C -25°C +105°C
Temperature coefficient $100\Omega \leq \text{Rn} \leq 10 \text{K}\Omega$ $10 \text{K}\Omega < \text{Rn} \leq 5 \text{M}\Omega$	+200/ -300 ppm +200/ -500 ppm

<sup>\*</sup> Out of range ohm values and tolerances are available on request, please, inquire.

# Mechanical Specifications

### MCS14 Through-hole

Resistive element	Carbon technology					
Angle of rotation (mechanical)	360°					
Angle of rotation (electrical)	330° ± 20°					
Wiper standard delivery position	50% ± 15°					
Max. push/pull on rotor	35N / 50 N					
Wiper torque*	For 15.000 turns <2.5 Ncm, detents: <3.5 Ncm For > 15.000 turns <1.5 Ncm					
Mechanical life	Standard is 15.000 turns. Up to 1.000.000 turns available depending on configuration					

<sup>\*</sup> Stronger or softer torque feeling is available on request.

# Test results

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

### MCS14 Through-hole

	Test conditions	Typical variation of Rn						
Damp heat	500 h. at 40°C and 95% RH	±20%						
Thermal cycles	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 cycles at 10 c.p.m. and at 23°C ± 2°C	±20%						
Storage (3 years)	3 years at 23°C ± 2°C	±3%						

<sup>\*\*</sup> Dissipation of special tapers will vary, please, inquire.

3 Rotary switches







# 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 M 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.

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).

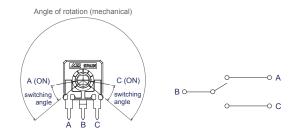
Standard features							Extra f	eatures						Assembl	ed acc	essory			
	Series	Rotor	Model	Packg.	Ohm value	Taper	Tol.	Life	Track	Collector	Terminals	Housing	Rotor	Wiper position	Lin	Assembly	Ref#	Color	Flam.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		16		17
COM	1 CA9	М	H2,5		-	-	-			2DT	SNP			PI		WT	-9005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

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

Series Rotor Model Packg. Ohm value Taper Tol. Life Track	Collector Te	Terminals	Hausina	D					
		TOTT III ICIO	Housing	Rotor Wip	er position	Lin	Assembly Ref #	Color	Flam.
1 2 3 4 5 6 7 8 9	10	11	12	13	14	15	16		17
COM CA14 P V15 AC45°±1	±15°								



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.



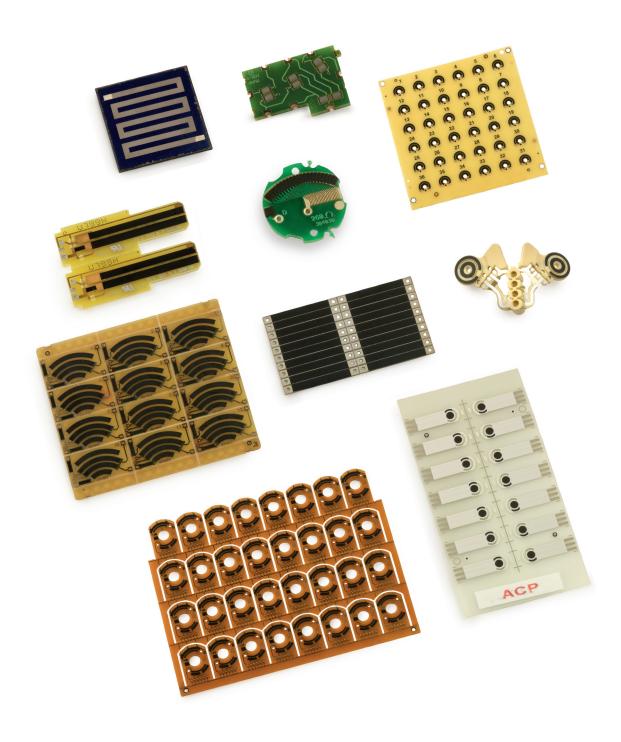
Electric						
Specifications	COM CA6	COM CA9 / MCA9 COM CA14 / MCA14	COM CE9 / MCE9 COM CE14 / MCE14			
Resistive element	Carbon	Carbon	Cermet			
Power ratio	15V / 12mA	24V / 12mA	24V / 12mA			
Resistance at ON position	≤5Ω	≤5Ω	≤5Ω			
Dielectric Strength	600V	1500V	1500V			
Insulation resistance	100ΜΩ	100GΩ	100GΩ			
Switching angle at ON position	20° ± 15°	30° ± 15°	30° ± 15°			
Operating temperature	erating temperature -25°C +70°C (+85°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	







### **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
- 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.

# 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.

### **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.

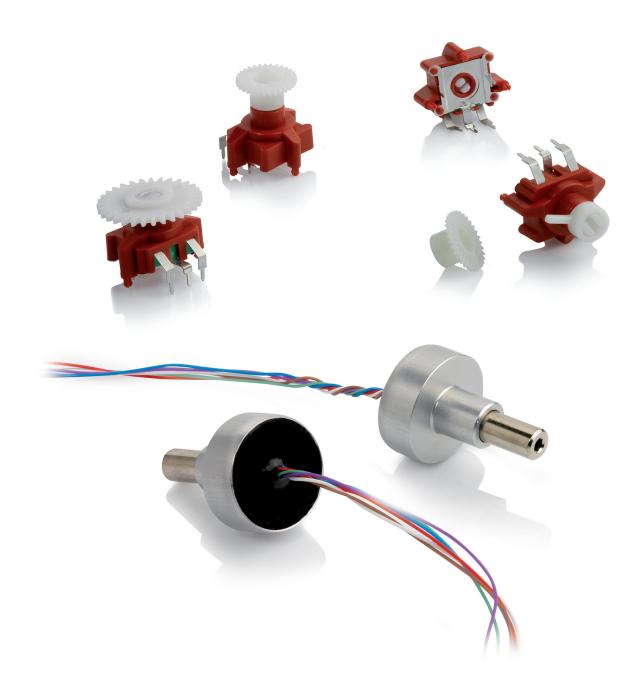
### **How to Order**

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.

# 5 Special potentiometers





# METAL CASE **POTENTIOMETER**

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.





### Aragonesa de Componentes Pasivos