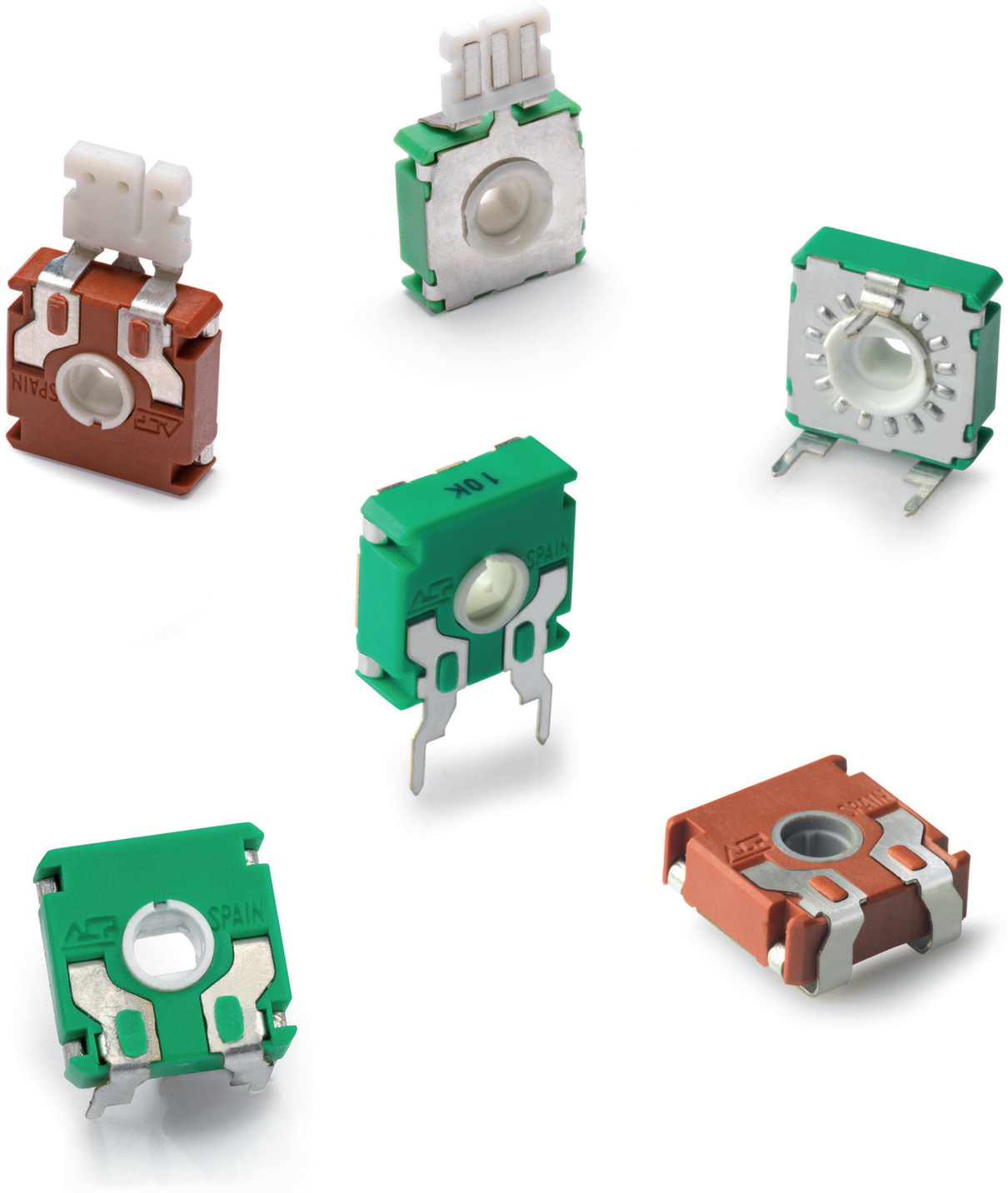
CS14

Carbon Endless Sensor



CS14 

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

Two configurations available:

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

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

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

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

CS14 has plastic housing and Ingress Protection rating type IP 54 (high level protection against dust and also against water splashing), according to IEC 60529. Plastic materials can be self-extinguishable according to UL 94 V-0 under request.

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

Applications

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

CS14 HOW TO ORDER

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

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

Standard configuration:	**CS14 Through-hole**	**CS14 SMD**
Dimensions:	14mm	
Protection:	IP 54 (dust-proof) On request: Self-extinguishable, 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:	at 50% ±15º	
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

B	D*	E	F*	G	K	M	N*	P	T*	X	Y*	Z*

* Rotors available for versions with > 15.000 turns.

3 - Model and pitch

H0	H2,5	H5	HP	V12,5	V12,5x5	V15	V15...CFF	VSMD	VSMD...CY

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.	LI
LONG latching shape and groove at FINAL terminal side.	LF

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

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

6 - Resistance value

1K Ω	2K Ω	2K2 Ω	4K7 Ω	5K Ω	10K Ω (standard)…	4M7 Ω	5M Ω
1K	2K	2K2	4K7	5K	10K (standard)…	4M7	5M

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

Lin - Linear	A
Log - Logarithmic	B
Antilog - Antilogarithmic	C
- 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	LVXXX: ex: LV100

10 - Cut Track - Open circuit

CS14 already has an open circuit area at the base of the potentiometer (between 330º and 0º). 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	V0
Only housing V0	CJ-V0
Only rotor V0	RT-V0

15 - Wiper

Wiper position (Standard: 50% ± 15º)	(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%

17 - Operating temperature

-25ºC... +70ºC	(blank)
-25ºC... +85ºC	T°D
-25ºC... +105ºC	T°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

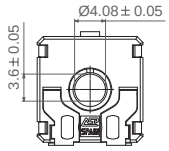
Black(1)	White	Neutral	Transp.	Red	Green	Yellow	Blue	Grey	Brown
NE	BA	IN	TA	RO	VE	AM	AZ	GS	MR

(1) black is not an option for housings.

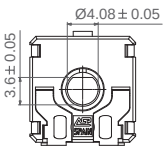
Rotors

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.

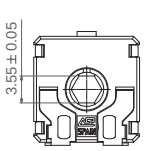
B



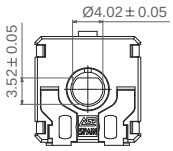
D*



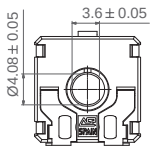
E



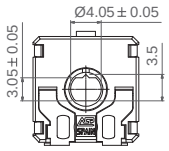
F*



G

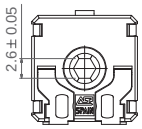


K

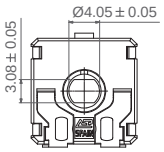


Standard color for F rotor is red

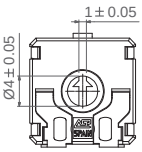
M



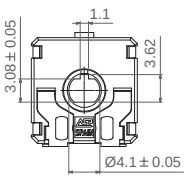
N*



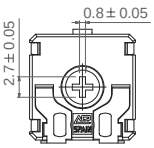
P



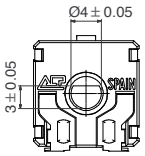
T*



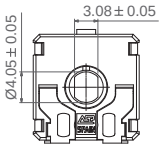
X



Y*



Z*

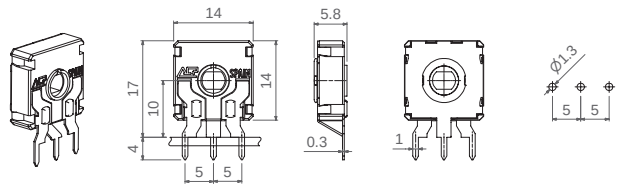


*Please, note that for more than 15.000 turns (up to 1.000.000 turns) the following rotors are available: D, F, N, T, Y, Z.

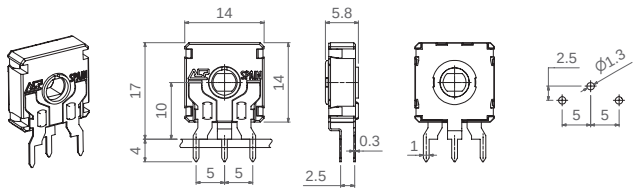
Models

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.

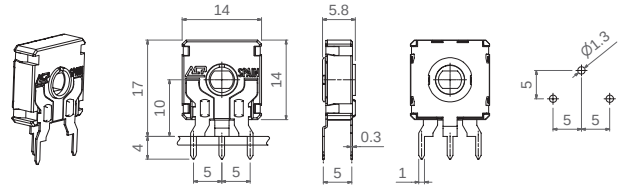
H0



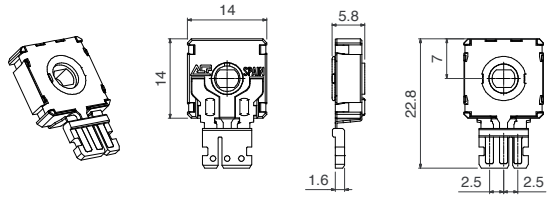
H2,5



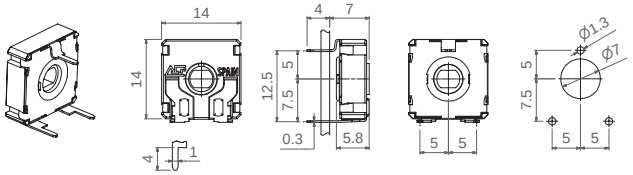
H5



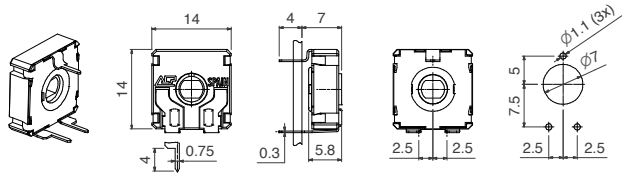
HP



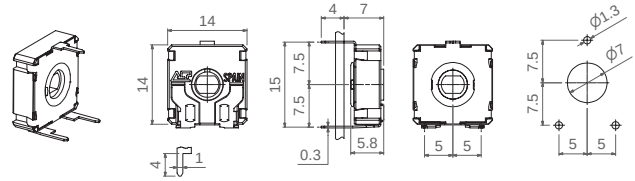
V12,5



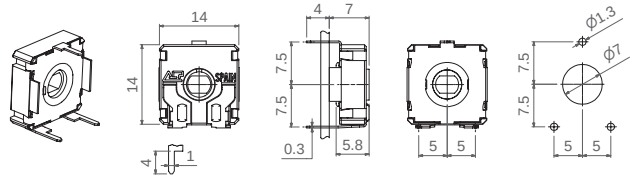
V12,5x5



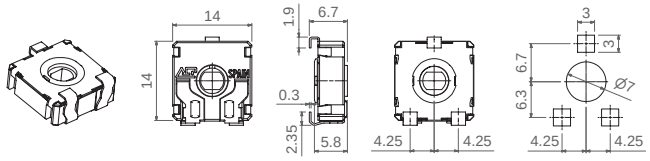
V15



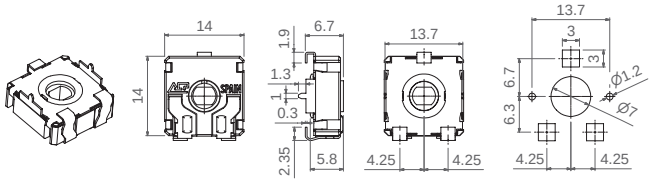
V15...CFF



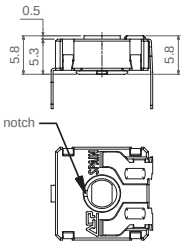
VSMD



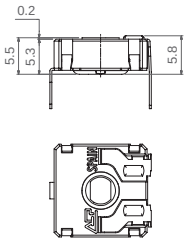
VSMD...CY



LV 15



> LV 15



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

Tapers

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

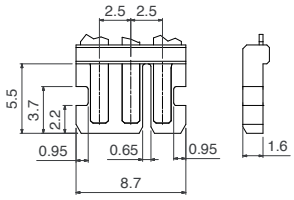
Connector

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:

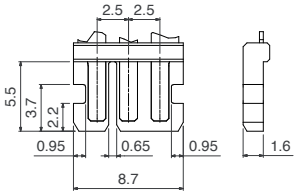
SI

SHORT latching shape and groove at INITIAL terminal side.



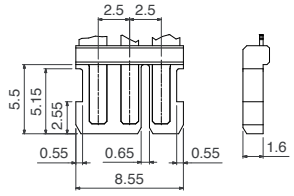
SF

SHORT latching shape and groove at FINAL terminal side.



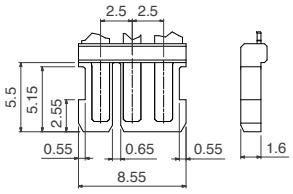
LI

LONG latching shape and groove at INITIAL terminal side.



LF

LONG latching shape and groove at FINAL terminal side.



CS14

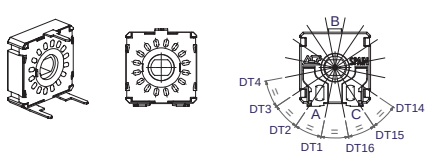
Potentiometers with detents

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.

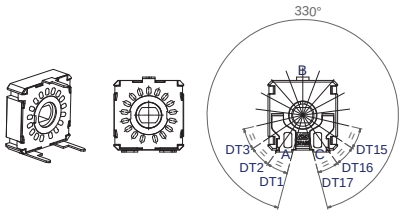
Detents can be light or strong, or even a combination of different feelings. They can be evenly distributed along the angle (standard) or tailored to match customers' request. They can also be combined with special tapers: constant value areas, open circuit zone, different slopes, etc. One common example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

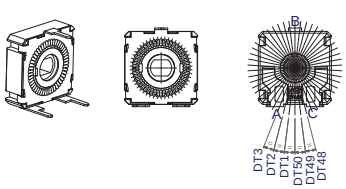
16DT Standard



17DT (Max. non overlapping V)



50DT (Max. for feeling)

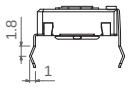


Our patented design with two wipers gives more stable electrical parameters, improved reliability and Contact Resistance Variation (CRV), as well as narrower tolerances for detent positioning.
For potentiometers with detents, mechanical life is also 15.000 turns if no additional turns are mentioned. Please, indicate the number of turns needed. When needing a special number of detents or matching taper, a drawing is kindly requested.

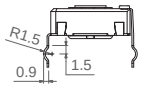
Terminals

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

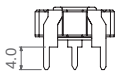


SNR

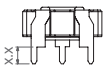


Also, there is an option of having shorter terminal tips.

Standard Terminal



Shorter terminal, TPXX (under request)



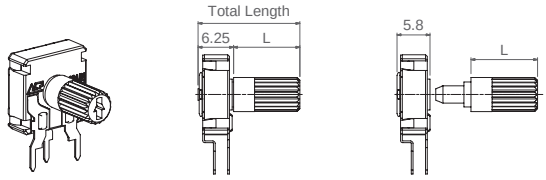
Possibilities for insertion of accessories

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

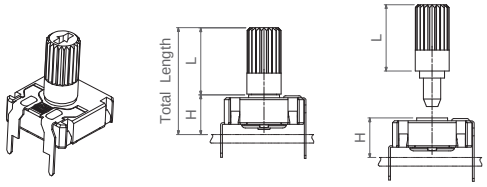
Shafts

Shafts are available in different colors (color chart in “how to order” section) and with self-extinguishable property, according to UL 94 V-0, under request. ACP can study special shaft designs.
Shafts can be sold separately or already mounted on the potentiometer.
When a shaft is mounted on a potentiometer, the distance from the top of the potentiometer to the top of the shaft is marked with “L” in the table below, as shown in the drawing:

H potentiometer + shaft



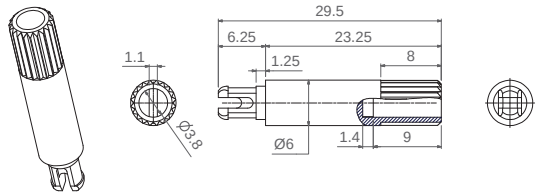
V potentiometer + shaft



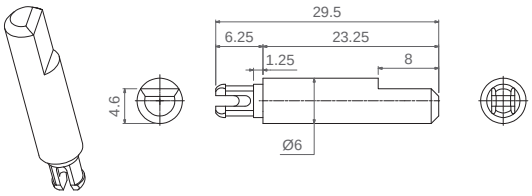
(H is set by the potentiometer model. See page 5)

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

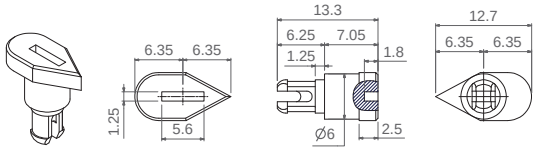
14008



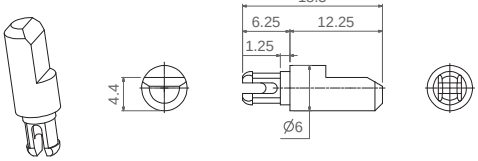
14015



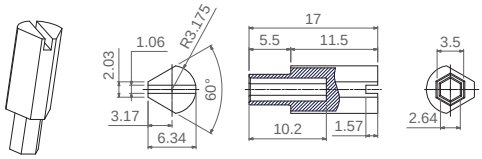
14042



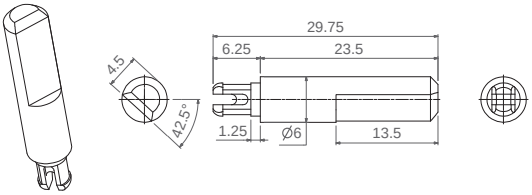
14056



14065 (Designed for E rotor)

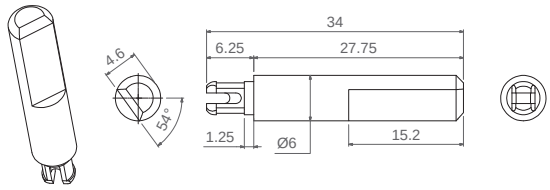


14066

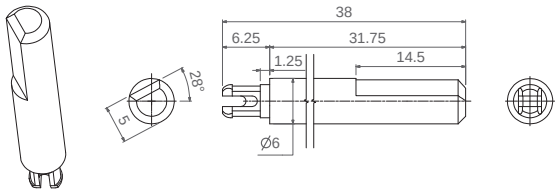


Shafts

14067



14072



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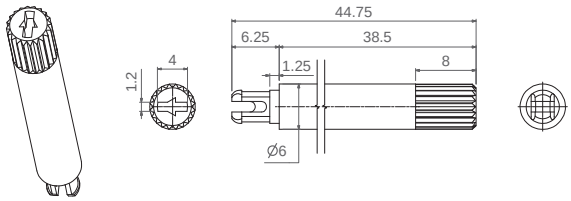

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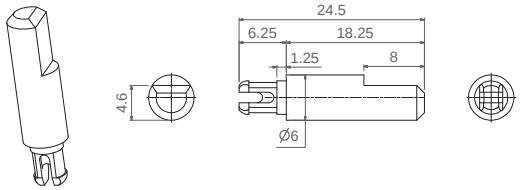
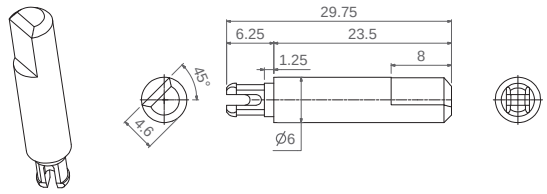
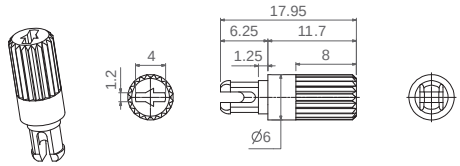


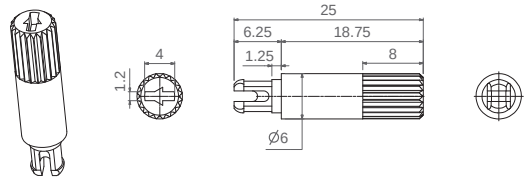
14084



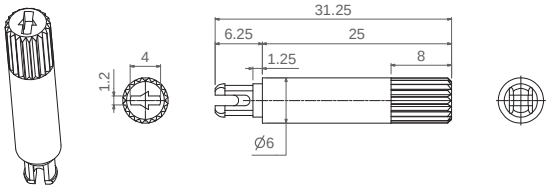
14117



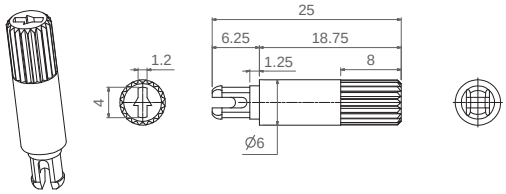
14187



14250



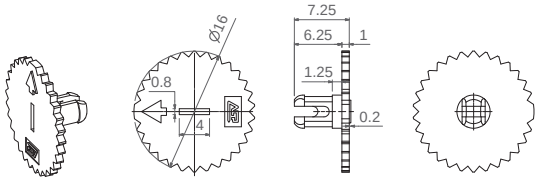
14251



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



Packaging

Bulk packaging:

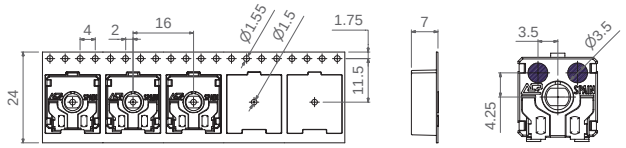
CS14 model	With shaft or thumbwheel inserted?	Pieces per small box (150 x 100 x 70)	Pieces per bigger box (250 x 150 x 70) add CG at the end of the product description
H0 - HP - H2,5 - H5 - V12,5 V12,5x5 - V15 V15CFF	None, only potentiometers.	200	700
	14003, 14117, 14042, 14056, 14065	100	400
	14008,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

Tape & Reel packaging:

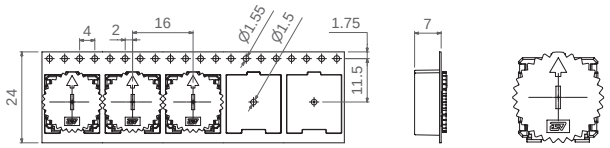
	With thumbwheel inserted?	13" Reel, with 24mm width tape	15" Reel, with 24mm width tape
VSMD (on request*)	None, only potentiometers.	500 pcs per reel, 16mm step between cavities.	800 pcs per reel, 16mm step between cavities.
	14003	450 pcs per reel, 16mm step between cavities.	To be determined.
VSMD...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

Sticker on component available on request.

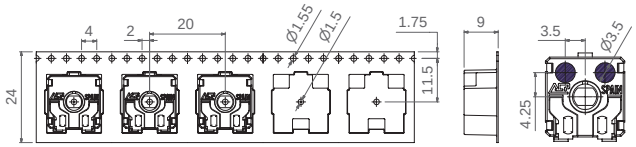
VSMD-T&R



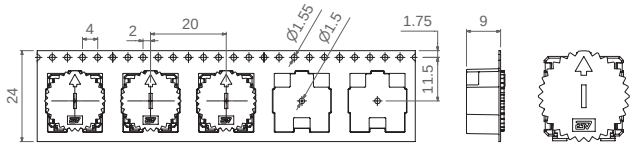
VSMD-T&R...WT-14003



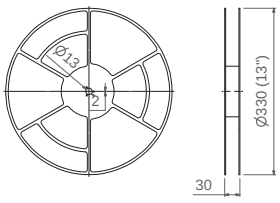
VSMD-T&R...CY



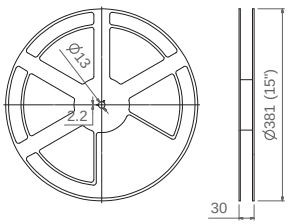
VSMD-T&R...CY WT-14003



13" Reel



15" Reel



Electric Specifications

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

	CS14 Through-hole	CS14 SMD (upon availability)
Range of resistance values* Lin (A) Log (B) Antilog (C)	 1KΩ ≤ Rn ≤ 5MΩ 10KΩ ≤ Rn ≤ 2M2Ω	 1KΩ ≤ Rn ≤ 1MΩ 10KΩ ≤ Rn ≤ 1 MΩ
Tolerance* (Please, inquire for >100K turns) 100Ω ≤ Rn ≤ 100KΩ 100KΩ< Rn ≤ 1MΩ: 1MΩ < Rn ≤5MΩ: Rn > 5MΩ:	 ±30% ±30% ±30% +50%, -30% (out of range)	 - ±30% ±40% ±50% -
Variation laws	Lin (A). Other tapers available on request	
CRV - Contact Resistance Variation (dynamic)	Lin (A) Electrical Angle 330º±20º ≤ 3%Rn. Other tapers, please inquire	
CRV - Contact Resistance Variation (static)	Lin (A) Electrical Angle 330º±20º ≤ 5%Rn. Other tapers, please inquire	
Maximum power dissipation** Lin (A)	at 50ºC, 0.15W	
Maximum voltage Lin (A)	250VDC	
Operating temperature	-25ºC … +70ºC (standard) -25ºC … +85ºC -25ºC … +105ºC	
Angle of rotation (electrical)	330º ± 20º	
Temperature coefficient 100Ω ≤ Rn ≤ 10KΩ 10KΩ < Rn ≤ 5MΩ	 +200/ -300 ppm +200/ -500 ppm	 +200/ -500 ppm +200/ -1000 ppm

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

Mechanical Specifications

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

* Stronger or softer torque feeling is available on request.

Test results

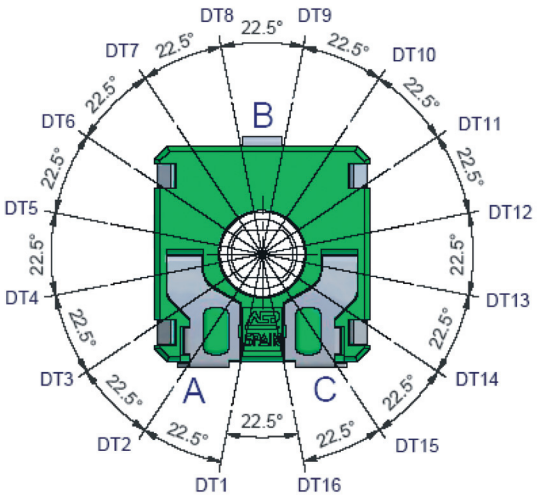
The following typical test results (with 95% confidence) are given at 23ºC ±2ºC and 50% ±25% RH.

	CS14 Through-hole and SMD	
	Test conditions	**Typical variation of Rn**
Damp heat	500 h. at 40°C and 95% RH	±20%
Temperature Coefficient	16 h at 85ºC, plus 2 h at –25ºC	±20%
Load life	1.000 h. at 50°C	±20%
Mechanical life	15.000 turns at 10 c.p.m. and at 23°C ± 2°C	±20%
Storage (3 years)	3 years at 23°C ± 2°C	±3%

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

A combination of a controlled linear curve and mechanical detents distributed along the 360º 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 22.5º between each contiguous detent. See figure 1.



TOLERANCE IN DETENT POSITIONS ±3º

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.

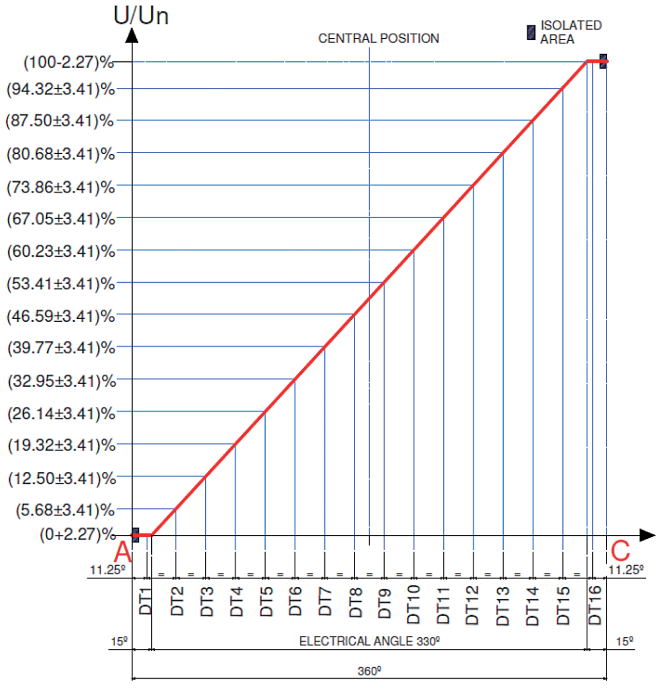
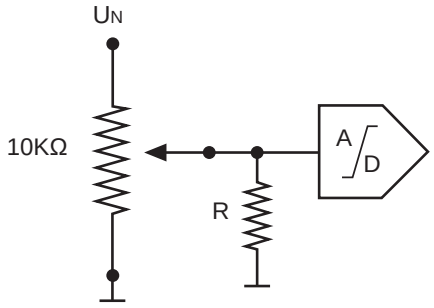


Figure 2

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.



R≥1MΩ

Figure 3

ACP standard configuration is a potentiometer of 10K Ohm and a recommended pull-down resistor equal or greater than 1MΩ. (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	A	1010	12
12	(73,86±3,41)%	11	B	1011	13
13	(80,68±3,41)%	12	C	1100	14
14	(87,50±3,41)%	13	D	1101	15
15	(94,32±3,41)%	14	E	1110	16
16	(100-2,27)%	15	F	1111	17

Figure 4