

COMPONENTS

Multi-functional **Main AC Switch**  
for rolling stock  
Type MACS



With the **MACS**, Sécheron offers a new generation of AC vacuum circuit-breaker to the manufacturers and operators of vehicles running on AC networks. This product completes the BVAC's range that has been marketed by Sécheron since 1991. All the field experience gathered since then on thousands of BVAC in operation worldwide, has been integrated to provide the **MACS** with the maximum added value for car builders and operators.

The **MACS** is a multi-functional switch that is proposed in three main variants: the AC circuit-breaker (AC VCB) remains the core of the product, to which an Earthing Switch (ES) or/and a Surge Arrester (SA) can be integrated,

making it a unique and compact unit.

Its small dimensions associated to a light weight make the **MACS** the perfect solution for your rolling stock material running on 15 kV or/and 25 kVAC networks.

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The **MACS** can also be delivered in an aluminium housing type AC MODBOX integrating also other high voltage functions such as current and voltage measurement, disconnectors, filters, transient inductors and all the low voltage corresponding control equipments

## Applications

Switching and protection of main and auxiliary electric circuits for locomotives, trains and EMUs running on 15 kVAC or/and 25 kVAC networks.

## Main features

- Compact multi-functional switch including: AC Circuit-Breaker, Earthing Switch (option) and Surge Arrester (option) on a single support of 940 mm x 430 mm.

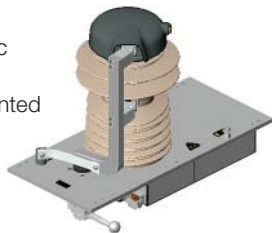
### AC Circuit-Breaker

- Suitable for 15 kVAC and/or 25 kVAC networks
- Conventional free air thermal current: 1000 A
- Rated impulse withstand voltage (1.2 / 50  $\mu$ s):  $U_{imp} = 125$  kV or 170 kV
- Indoor or outdoor installation
- External creepage distances > 1000 mm
- Vacuum interrupter
- Electric operation (closing and holding)
- High safety thanks to the automatic opening through spring release in case of interruption of supply voltage (no need of stored auxiliary electrical energy)
- High mechanical and electrical endurance (at  $I_b = 1000$  A): > 200'000 operations
- Vertical or horizontal mounting
- Low height: 563 mm (for  $U_{imp} = 125$  kV) above the roof and 140 mm below the roof
- Low weight: < 100 kg for the AC Circuit-Breaker
- Usable in various ranges of ambient temperature from -40°C to +70°C (-50°C to +70°C in option)
- Reference standards: IEC60077-1 /-2 /-4, IEC61373, EN50121-3-2, NF F16-101 /-102



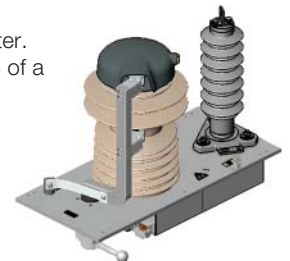
### Earthing Switch

- Optional integrated Earthing Switch with manual or electric operation
- Safe manual operation guaranteed by optional interlocking keys
- Ice breaking capability (20 mm ice)

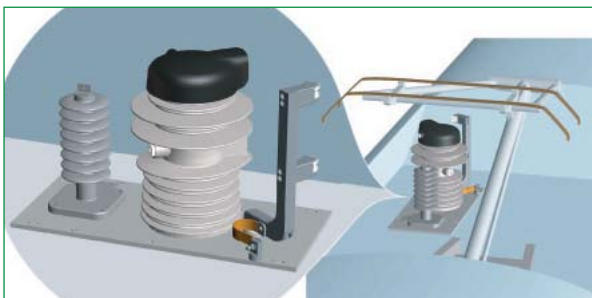


### Surge Arrester

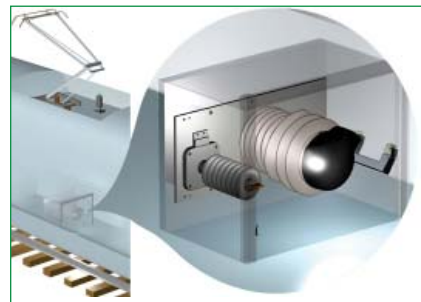
- Optional integrated Surge Arrester. Refer to page 6 for the selection of a Surge Arrester



### Vertical mounting on the roof



### Horizontal mounting



Underframe mounting or roof mounting in special high voltage box (Sécheron AC MODBOX)

## Technical data

### MAIN HIGH VOLTAGE CIRCUIT

#### AC Circuit-Breaker

	Symbol	Unit	15 kV	25 kV
Rated operational voltage	$U_e$	[V <sub>AC</sub> ]	17'250 <sup>(1)</sup>	27'500 <sup>(1)</sup>
Rated insulation voltage	$U_i$	[V <sub>AC</sub> ]	27'500 <sup>(1)</sup>	27' 500 <sup>(1)</sup>
Rated operational current	$I_e$	[A]	1000	1000
Conventional free air thermal current <sup>(2)</sup>	$I_{th}$	[A]	1000	1000
Rated operational frequency	$f$	[Hz]	16.7	50, 60
Operational category			C3	C3
Peak short-circuit making current	$I_{MC}$	[kA]	63	50
Rated short-circuit breaking current / % value of the dc component		[kA]/%	25/50	20/50
Peak and rated short-time withstand current	$\hat{I}_{cw}/I_{cw}/t$	[kA]/[kA]/[s]	63/25/1	63/25/1
Rated power-frequency withstand voltage (50 Hz, 1 mn)	$U_{50}$	[kV <sub>rms</sub> ]	75	75
Rated impulse withstand voltage (1.2 / 50 $\mu$ s)	$U_{imp}$	[kV]	125	125 / 170

(1) For higher values, please contact Sécheron

(2) At  $T_{amb} = +40^\circ\text{C}$  and tested with high voltage connections according to standard IEC/EN 60943

#### Earthing Switch

Peak and rated short-time withstand current	$\hat{I}_{cw}/I_{cw}/t$	[kA]/[kA]/[s]	63/25/1	63/25/1
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**Surge Arrester:** refer to page 6

### LOW VOLTAGE AUXILIARY CIRCUIT

#### Control circuit

AC Circuit-Breaker

Nominal voltage	$U_n$	[V <sub>DC</sub> ]	24 to 110
Range of voltage			[0.7 - 1.25] $U_n$
Maximum power (loading and holding) <sup>(3)(4)</sup>	$P_{max}$	[W]	$\leq 80$
Nominal holding power <sup>(4)</sup>	$P_h$	[W]	$\leq 40$
Opening power		[W]	0
Mechanical opening time <sup>(4)</sup>	$T_o$	[ms]	$\leq 50$
Mechanical closing time <sup>(4)</sup>	$T_c$	[ms]	$\leq 65$

Earthing Switch (optional electric operation)

Nominal voltage	$U_n$	[V <sub>DC</sub> ]	24, 32, 36, 48/50, 72, 110
Operating power <sup>(4)</sup>		[W]	125
Commutation time <sup>(4)</sup>		[s]	$\leq 3$

(3) Loading time < 12 seconds

(4) At  $U_n$  and  $T_{amb} = +20^\circ\text{C}$

#### Auxiliary contacts

Type of contacts (refer to definition page 7)			Potential free
Rated voltage		[V <sub>DC</sub> ]	24 to 110
Conventional thermal current	$I_{th}$	[A]	10
Maximum breaking capacity at 110 V <sub>DC</sub> and $\tau=5$ ms		[A]	6
Minimum let-through current at 24 V <sub>DC</sub> <sup>(5)</sup>		[mA]	10 (silver contacts)
		[mA]	4 (gold contacts)

(5) For a dry and clean environment

#### Low voltage interface

Type of connection <sup>(6)</sup>			
- AC VCB with or without manual Earthing Switch			1 connector: Harting 51 P
- AC VCB with electric Earthing Switch			2 connectors: Harting 51 P + Harting 24 DD

(6) Refer to page 7 for mobile connector informations

#### Insulation

Rated power-frequency withstand voltage (50 Hz, 1 mn)	$U_{50}$	[kV <sub>rms</sub> ]	1.5
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### OPERATING CONDITIONS

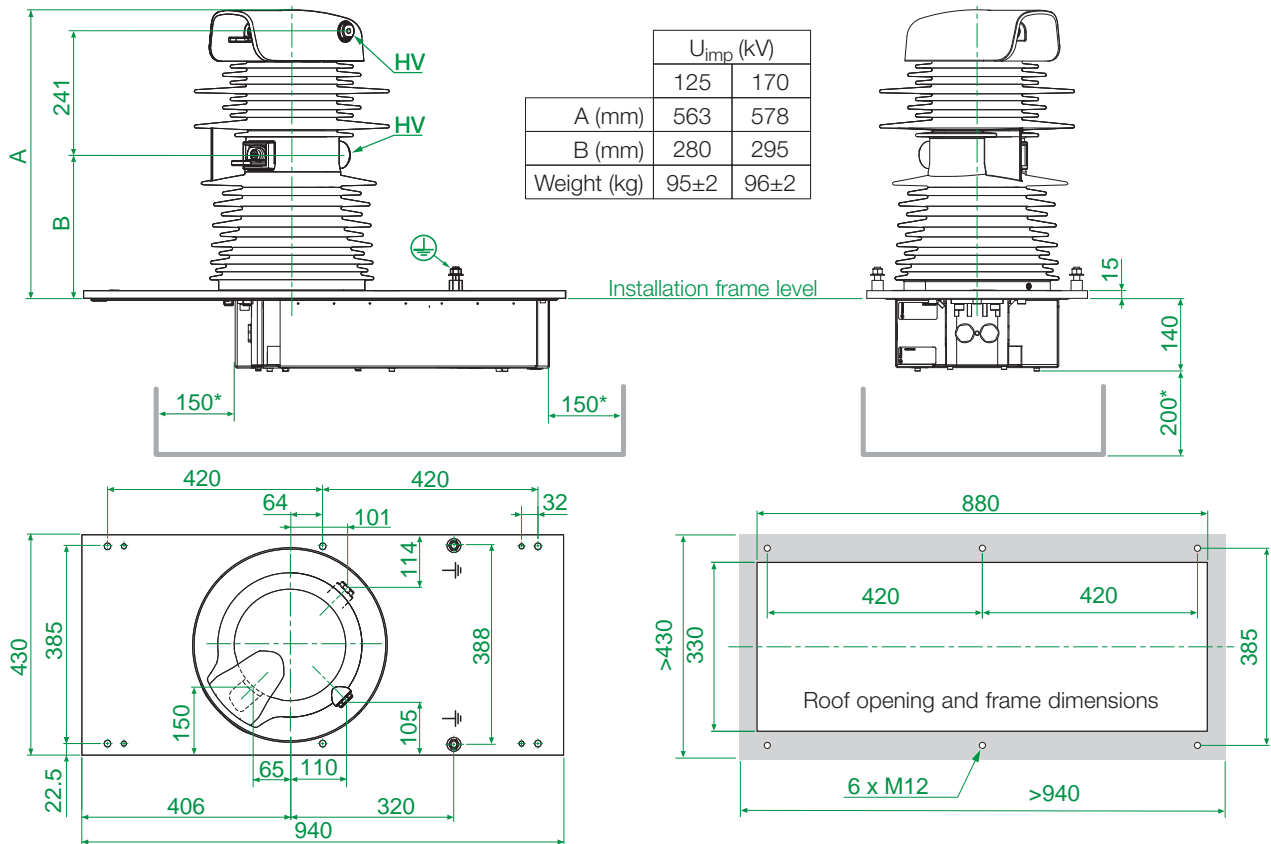
Installation			Indoors or outdoors
Altitude		[m]	<1400
Working ambient temperature	$T_{amb}$	[ $^\circ\text{C}$ ]	-40 to +70 / -50 to +70
Humidity			Class 5K2
Pollution degree			PD4
Minimum mechanical durability	N	Cycles	200'000

## Main dimensions

The DIN-ISO 2768-1 coarse tolerances are applied to these dimensions. All dimensions are in mm.  
The maximum allowed flatness deviation of the support frame is 1 mm.  
HV and earth connections: M12 screws.

**Weight:**

Refer to the table



\*: Space needed to remove the cover and to operate the optional Earthing Switch.

## Options

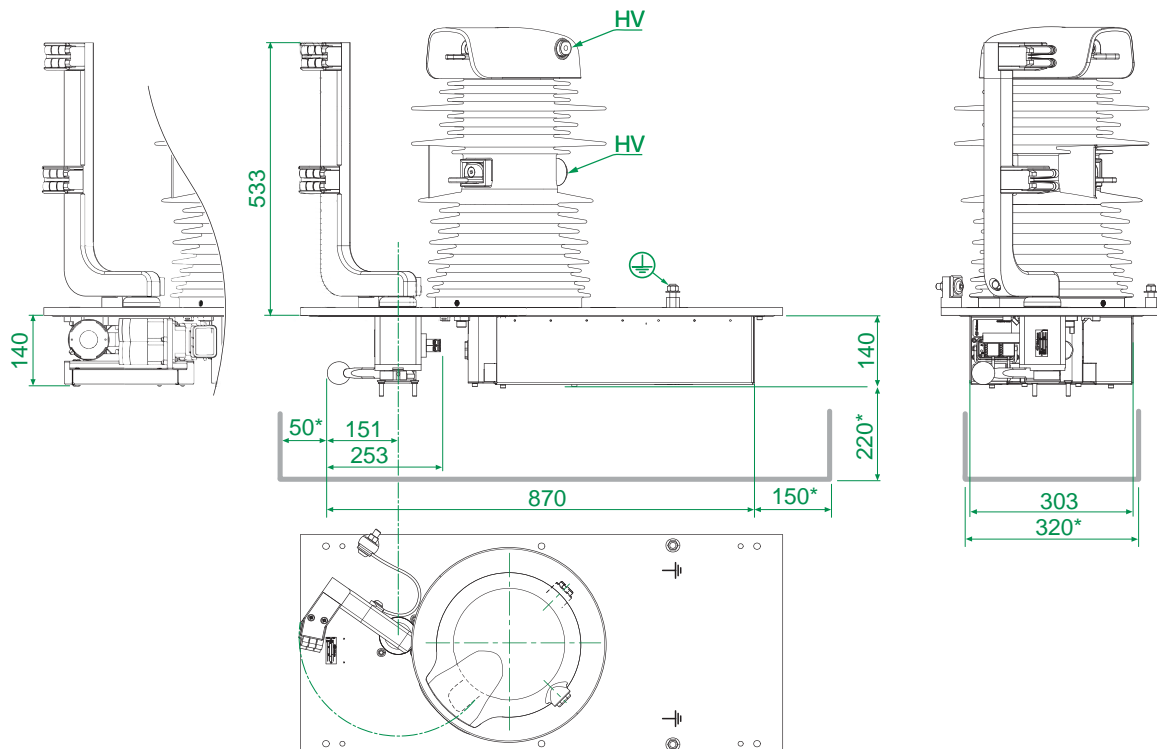
### AC Circuit-Breaker ( $U_{imp} = 125$ kV) and Earthing Switch

**Weight:**

**Electric version** (option)

**Manual version** (standard)

AC Circuit-Breaker + 13 kg (manual version)  
AC Circuit-Breaker + 21 kg (electric version)



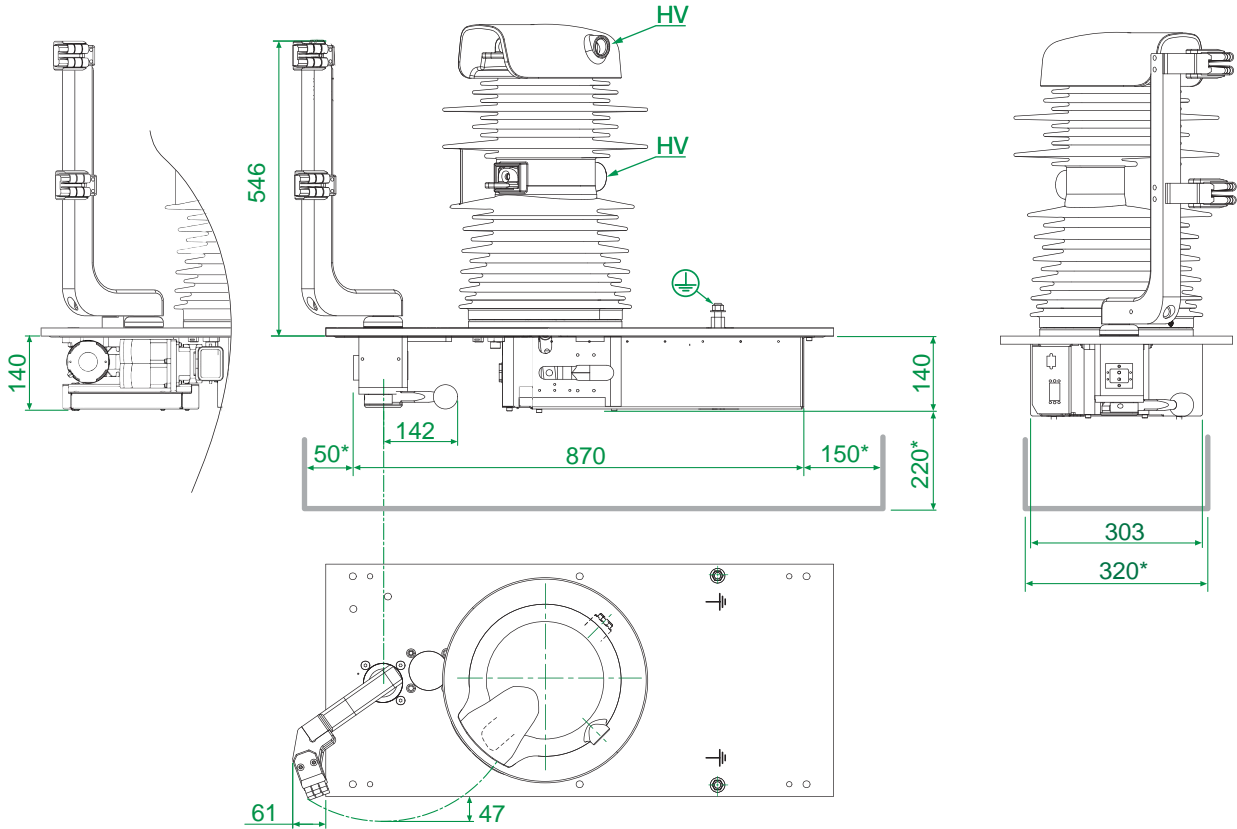
### AC Circuit-Breaker and Earthing Switch ( $U_{imp} = 170 \text{ kV}$ )

**Weight:**

AC Circuit-Breaker + 14 kg (manual version)  
 AC Circuit-Breaker + 22 kg (electric version)

**Electric version (option)**

**Manual version (standard)**



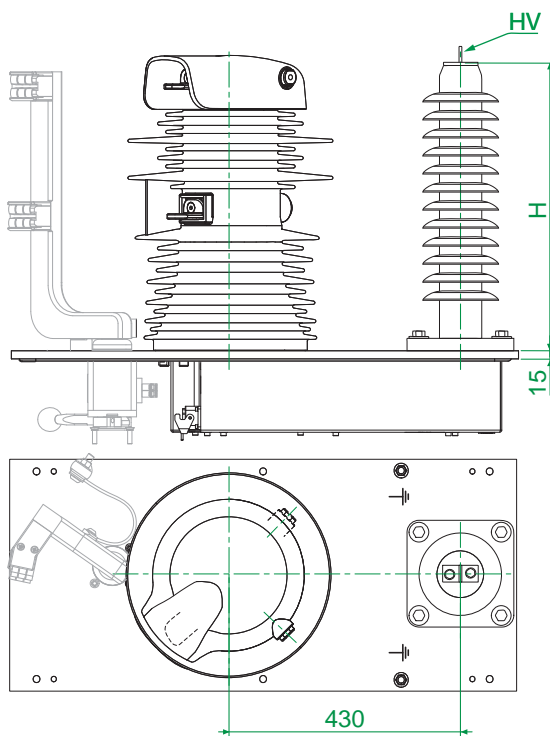
### AC Circuit-Breaker and Surge Arrester

Surge Arrester connections: M12 screws.

**Weight:**

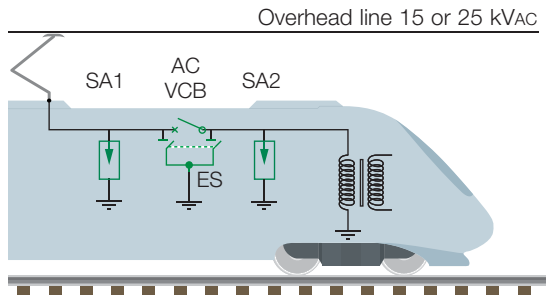
Refer to the table page 6 for the additional weight of Surge Arrester.

H: refer to page 6 for the Surge Arrester height.



The connection between the AC Circuit-Breaker and the Surge Arrester is not represented on the drawing but is available in the scope of supply from Sécheron.

## AC Circuit-Breaker and Surge Arrester



SA1, SA2 : Surge Arresters  
 AC VCB : AC Vacuum Circuit-Breaker  
 ES : Earthing Switch

Sécheron recommends for a safe and efficient protection against lightning and switching overvoltages to use two Surge Arresters, SA1 and SA2, in the high voltage circuit of the vehicle.

Should the customer want to integrate one Surge Arrester to the MACS, the appropriate type corresponding to application and service conditions can be found in the following table.

## Technical data for selection of Surge Arresters

- Metal oxide Surge Arrester without spark gaps, designed for rolling stock applications and outdoor mounting
- High current impulse  $I_n = 4/10 \mu s : 100 \text{ kA}_{\text{peak}}$
- Maximum ambient temperature:  $+40^\circ\text{C}$
- Maximum service altitude: 1400 m
- Frequency: 16.7 Hz, 50/60 Hz
- Comply to IEC60099-4

For any other needs differing from the above specified values, please do not hesitate to inform Sécheron about your particular conditions to receive an appropriate recommendation.

### Application:

SA2a: Surge Arrester to be selected for mounting on the MACS when the customer installs a Surge Arrester SA1 between the pantograph and the AC Circuit-Breaker.

SA2b: Surge Arrester to be selected for mounting on the MACS when the customer, at its own responsibility, does not install a Surge Arrester SA1 between the pantograph and the AC Circuit-Breaker. For 25 kV applications, this configuration can only be combined with a MACS version  $U_{\text{imp}} = 170 \text{ kV}$ .

Maximum continuous operating voltage	Maximum speed <sup>(1)</sup> [km/h]	Application	Type	Code for designation <sup>(2)</sup>	Line discharge class	Nominal discharge current $I_n$ 8/20 $\mu s$ [kA]	Maximum residual voltage in kV at specified impulse current				Height <sup>(3)</sup> H [mm]	Weight <sup>(4)</sup> [kg]	
							wave 1/... $\mu s$ 10 kA <sub>peak</sub>	wave 8/20 $\mu s$ at					wave 30/60 $\mu s$ at 1 kA <sub>peak</sub>
								5 kA <sub>peak</sub>	10 kA <sub>peak</sub>	20 kA <sub>peak</sub>			
18	$V \leq 160$	SA2a	SIEMENS 3EB4 230-5AL42-0D	<b>A</b>	1	10	64	56	60	67	48	$\leq 385$	$\leq 13$
			ABB POLIM-I 18N	<b>B</b>	2	10	57.7	46.8	52.2	55.3	46.1		
		SA2b	SIEMENS 3EB4 230-6AL42-0D	<b>C</b>	3	10	58	52	55	61	45		
			ABB POLIM-H 18N	<b>D</b>	4	20	58.5	50.2	52.2	57.5	44.4		
	$160 < V \leq 360$	SA2a	SIEMENS 3EB1 230-5AL22-0A	<b>E</b>	1	10	64	56	60	68.5	48		
		SA2b	SIEMENS 3EB1 230-6AL22-0A	<b>F</b>	3	10	58	52	55	68.5	45		
29	$V \leq 160$	SA2a	SIEMENS 3EB4 370-5AX42-0D	<b>G</b>	1	10	102	89	96	108	77	$\leq 485$	$\leq 16$
			ABB POLIM-I 29N	<b>H</b>	2	10	97.2	84.2	89.1	101.6	71.3		
		SA2b	SIEMENS 3EB4 370-6AX42-0D	<b>I</b>	3	10	94	84	89	99	73		
			ABB POLIM-H 29N	<b>J</b>	4	20	94.2	80.8	84.1	92.6	71.5		
	$160 < V \leq 360$	SA2a	SIEMENS 3EB1 370-5AX22-0A	<b>K</b>	1	10	102	89	96	110	77		
		SA2b	SIEMENS 3EB1 370-6AX22-0A	<b>L</b>	3	10	94	84	89	98.8	73		

(1) For outdoor mounting

(2) Select your designation code for product code page 8

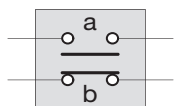
(3) Includes supporting frame but not HV connection

(4) Not included HV connection nor earthing connection

**Note:** Surge Arrester data extracted from relevant data sheets of Surge Arrester suppliers at date of brochure release. Sécheron declines any responsibility in case of changes without prior information.

## Definition of the auxiliary switches














Potential free contact  
Type: PF



The contact "a" corresponds to a NO (Normally Open) contact.  
The contact "b" corresponds to a NC (Normally Close) contact.

## Designation code for separately ordered items

### LV mobile connector for AC Circuit-Breaker

MACS configurations				Mobile connectors						
Auxiliary switches			Fixed connector type	Type	Number of pin		Cable gland	Cable entry	Secheron's number	
Device <sup>(1)</sup>	Number	Type <sup>(2)</sup>			Size 2.5 mm <sup>2</sup>	Size 1.5 mm <sup>2</sup>				
AC Circuit-Breaker without Earthing Switch										
Case 1	AC VCB	4a + 4b	PF	Harting HAN 51 P	Harting HAN 51 P	3	21	M25		SG325249R00101
										SG325249R00201
Case 2	AC VCB	8a + 8b	PF	Harting HAN 51 P	Harting HAN 51 P	3	37	M32		SG325249R00302
										SG325249R00402
AC Circuit-Breaker with manual Earthing Switch										
Case 3	AC VCB + ES	4a + 4b	PF	Harting HAN 51 P	Harting HAN 51 P	3	21	M25		SG325249R00101
		0a + 0b								SG325249R00201
Case 4	AC VCB + ES	4a + 4b	PF	Harting HAN 51 P	Harting HAN 51 P	3	29	M32		SG325249R00303
		2a + 2b								SG325249R00403
Case 5	AC VCB + ES	8a + 8b	PF	Harting HAN 51 P	Harting HAN 51 P	3	37	M32		SG325249R00302
		0a + 0b								SG325249R00402
Case 6	AC VCB + ES	8a + 8b	PF	Harting HAN 51 P	Harting HAN 51 P	3	45	M32		SG325249R00304
		2a + 2b								SG325249R00404
AC Circuit-Breaker with electric Earthing Switch										
In this case the customer shall buy a specific and separate LV mobile connector for the electric Earthing Switch, in addition to the LV mobile connector of the AC Circuit-Breaker (case 1 or 2).										
Case 7	ES	2a + 2b	PF	Harting HAN 24 DD	Harting HAN 24 DD	2	12	M25		SG325249R00520

(1) AC VCB : AC Vacuum Circuit-Breaker      (2) PF : Potential free  
ES : Earthing Switch

The above references are given for mobile connectors considering that all the auxiliary contacts are wired, and with an external wire diameter of 2.8 mm for a copper section of 2.5mm<sup>2</sup> and 2.3 mm for a copper section of 1.5 mm<sup>2</sup>. If the conditions are different from these, the above references may change. In such case please inform Sécheron accordingly.

## Designation code information

- Be sure to establish the designation code from the latest version of our brochure by downloading it from the website: [www.secheron.com](http://www.secheron.com).
- Be careful to write down the 11 digits for the type designation code when placing your order.
- It could be, for technical reasons, that some configurations of variants and options indicated in the designation code cannot be combined.
- For other configurations not described in the brochure, please contact Sécheron.

**Designation code (options are subject to additional costs) - Order form**

Line	Description	Designation	Standard	Options	Customer's choice
10	Product type	MACS	M		M
11	Nominal voltage	15 kV or 25 kV (U <sub>imp</sub> = 125 kV) 25 kV (U <sub>imp</sub> = 170 kV)	2	3	
12	Mechanical interface Standard base plate / aluminium / natural galvanic oxidation / vertical mounting		A		A
13	Earthing Switch (ES)	No Yes with manual operation Yes with electric operation	0	1 2	
14	Surge Arrester (SA) <sup>(1)</sup>	No SA2a - U <sub>C</sub> = 18 kV <sub>rms</sub> SA2a - U <sub>C</sub> = 29 kV <sub>rms</sub> For other selection , please refer to codification table page 6 .....	0	A G .....	.....
15	Control voltage	24 V <sub>DC</sub> 32 V <sub>DC</sub> 36 V <sub>DC</sub> 48 V <sub>DC</sub> / 50 V <sub>DC</sub> 72 V <sub>DC</sub> 110 V <sub>DC</sub>	A B C D E	F	
16	Auxiliary contacts of the AC Circuit-Breaker	4a+4b - (switch PF) - silver type 4a+4b - (switch PF) - gold type 8a+8b - (switch PF) - silver type 8a+8b - (switch PF) - gold type	A	C B D	
17	Auxiliary contacts of the Earthing Switch	(No Earthing Switch) Not applicable None <sup>(2)</sup> 2a+2b - (switch PF) - silver type <sup>(3)</sup> 2a+2b - (switch PF) - gold type <sup>(3)</sup>	Z 0	B C	
18	Interlocking keys for Earthing Switch (Electric operation or no Earthing Switch) Not applicable	1 blue + 1 yellow 1 blue + 2 yellow 2 blue + 1 yellow 1 yellow + 1 green 1 yellow + 2 green 2 yellow + 1 green Key / locks delivered by customer	Z	B C F H I L S	
19	Key and lock codification for each unit (Electric operation or no Earthing Switch) Not applicable	No Yes	Z 0	1	
20	Ambient temperature range	-40°C to +70°C -50°C to +70°C	1	2	

- (1) Refer to page 6 for other Surge Arresters selection
- (2) For manual Earthing Switch only
- (3) Compulsory for electric Earthing Switch, optional for manual Earthing Switch

**The low voltage connector** must be ordered separately (refer to page 7).

- LV mobile connector for the AC Circuit-Breaker with or without manual Earthing Switch:

- |   |   |   |   |
|---|---|---|---|
| <input type="checkbox"/> SG325249R00101 | <input type="checkbox"/> SG325249R00201 | <input type="checkbox"/> SG325249R00302 | <input type="checkbox"/> SG325249R00303 |
| <input type="checkbox"/> SG325249R00304 | <input type="checkbox"/> SG325249R00402 | <input type="checkbox"/> SG325249R00403 | <input type="checkbox"/> SG325249R00404 |

- Additional LV mobile connector for the electric Earthing Switch:  SG325249R00520

**Example of customer's choice:** M 2 A 1 A E A B Z Z 1  
 Line | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20

Place and date:	Signature:
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