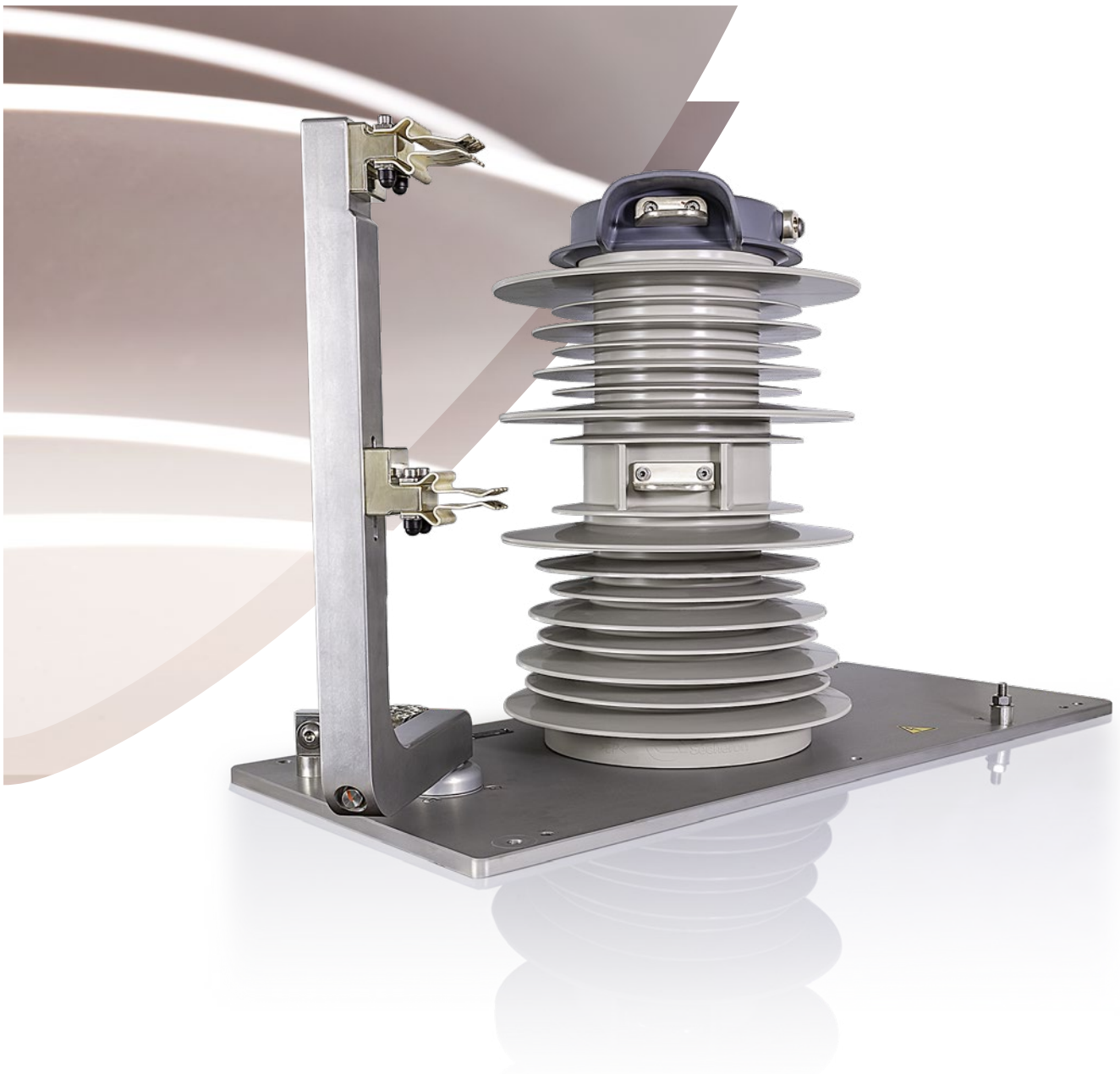


AC VACUUM CIRCUIT BREAKER

Type **MACS**

RAIL VEHICLES



GENERAL INFORMATION

MACS is Sécheron's main circuit breaker platform for installation on AC rail vehicles. It offers car builders a highly modular platform which is ideally suited to their various applications and requirements.

MACS can be mounted vertically on the roof of EMUs and Trains, as well as inside the high voltage compartment of locomotives. To limit roof cut-outs, as well as noise transmission, MACS can also be supplied with optional roof box. Another option is horizontal installation inside Sécheron's high-voltage compact modular enclosure, **AC MODBOX®**, either on the roof or under the chassis. MACS is a fully electrically operated circuit breaker, designed to automatically open through spring release if the low voltage supply is interrupted.

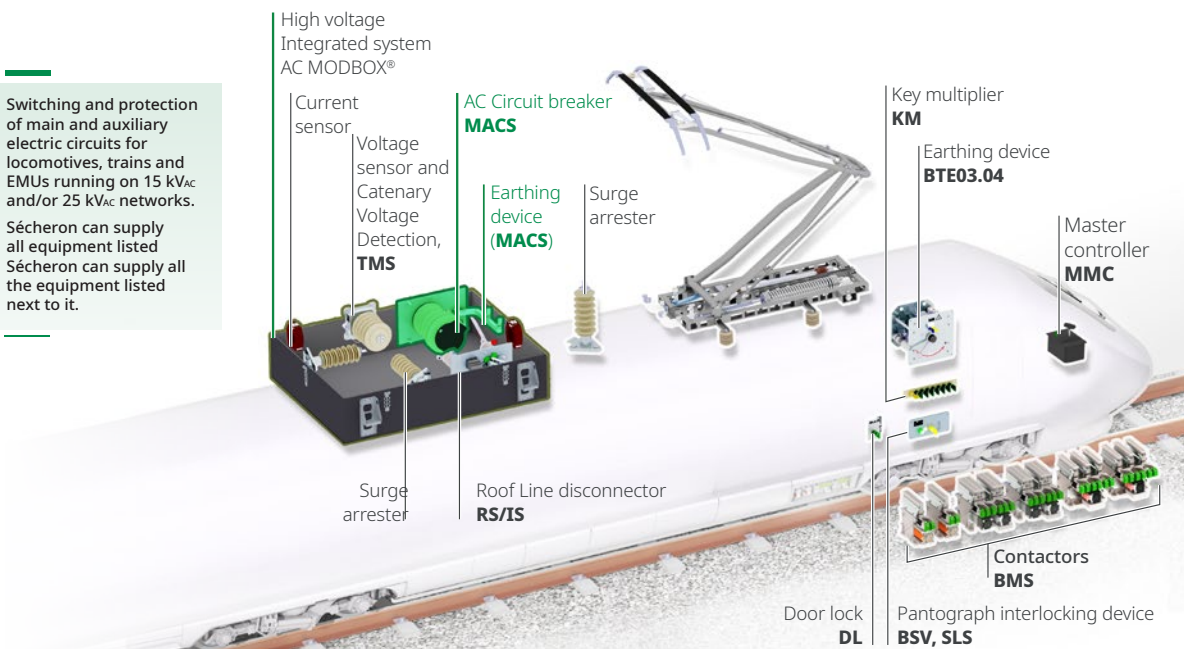
This fail-safe concept is a key safety benefit for electrically operated rolling stock circuit breakers.

With its optional **Point-on-Wave (PoW)/ Synchronous switching**, the MACS breaker can be closed or/and open synchronously with any phase angle of the line voltage, enabling a smart mitigation of Electromagnetic Interferences (EMI) or/and transformer's inrush currents.

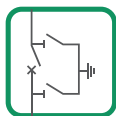
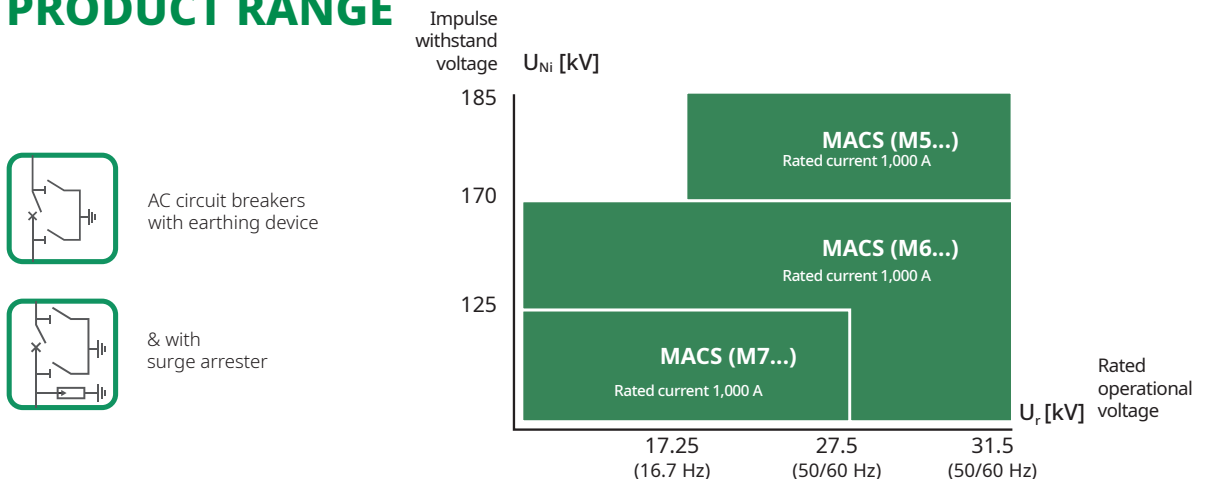
The MACS lightweight platform with its modularity and compact dimensions, as well as the **AC MODBOX®** allowing MACS to be integrated with other high voltage functions such as current and voltage measurements, disconnect switch, filters, and transient inductors in a compact aluminium housing, are perfect solutions for your rolling stock running on 15 kV_{AC} and/or 25 kV_{AC} networks.

APPLICATIONS

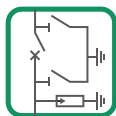
Switching and protection of main and auxiliary electric circuits for locomotives, trains and EMUs running on 15 kV_{AC} and/or 25 kV_{AC} networks. Sécheron can supply all equipment listed Sécheron can supply all the equipment listed next to it.



PRODUCT RANGE



AC circuit breakers with earthing device



& with surge arrester

MAIN FEATURES

- Compact multi-functional switch incorporating: AC circuit breaker, earthing device and optional surge arrester on a single 940 mm x 430 mm footprint.

For integration of roof disconnect switch, contact Sécheron.

// AC CIRCUIT BREAKER

- Suitable for 15 kV_{AC} and/or 25 kV_{AC} networks.
- Conventional free air thermal current 1,000 A.
- Rated impulse withstand voltage (1.2 / 50 μ s):
U_{Ni} = 125 kV, 170 kV and 185 kV.
- External creepage distances
> 1,000 mm (U_{Ni} = 125 kV and 170 kV)
> 1,250 mm (U_{Ni} = 185 kV).
- Electric operation (closing and holding).
- Operation in ambient temperature from -40 °C to +70 °C (-50 °C to +70 °C in option).
- Reference standards: IEC/EN 60077-4, IEC/EN 61373, EN 50121-3-2, EN 45545.

// EARTHING DEVICE

- Integrated earthing device with manual or electric operation.
- Safe manual operation guaranteed through interlocking keys.
- Ice breaking capability (20 mm ice).

// SURGE ARRESTER

- Optional integrated surge arrester (to be defined by Sécheron upon customer's specifications).

MAIN BENEFITS

- ✓ Indoor or outdoor installation.
- ✓ Vertical or horizontal mounting.
- ✓ Specific version (U_{Ni} = 185 kV) with increased insulation level for outdoor operation in harsh environmental conditions (pollution, humidity, etc.).
- ✓ High level of safety thanks to automatic opening via spring release (no need for stored auxiliary electrical energy).
- ✓ Wide range of configurations and options to suit all operating conditions and requirements.
- ✓ Optional Point-on-Wave/Synchronous switching at closing or/and opening, to mitigate against electromagnetic interferences or/and inrush currents.
- ✓ Optional roof box to limit roof cut-outs and structural noise transmission.
- ✓ Can be supplied with other high- and low- voltage components inside MODBOX® to mitigate operational risks from harsh environmental conditions (ice, sand, etc.).
- ✓ Compliant with LOC & PAS TSI, 1302/2014/EU.
- ✓ Specific configurations can also be developed for particular environments.
- ✓ Experts with a comprehensive understanding of working environments and coordination of protective devices.

DATA FOR PRODUCT SELECTION

		Symbol	Unit					
MAIN HIGH VOLTAGE CIRCUIT								
AC circuit breaker								
Application		Single & dual voltage				Harsh environment		
MACS designation code		M7		M6		M5		
Nominal voltage	U_n	[kV]	15	25	15	25	25	
Rated operational voltage	U_r	[kV]	17.25 ⁽¹⁾	27.25 ⁽¹⁾	17.25 ⁽¹⁾	31.5 ⁽¹⁾	31.5 ⁽¹⁾	
Rated insulation voltage	U_{Nm}	[kV]	30		31.5		33	
Rated operational frequency	f_r	[Hz]	16.7	50 & 60	16.7	50 & 60	50 & 60	
Rated impulse withstand voltage (1.2/50 μ s)	U_{Ni}	[kV]	125		170		185	
Rated power-frequency withstand voltage (50 Hz, 1 mn)								
- Pole-pole	U_a	[kV]	75		80		85	
- Pole-earth	U_a	[kV]	75		80		100	
Conventional free air thermal current ⁽²⁾	I_{th}	[A]	1,000		1,000		1,000	
Rated operational current	I_r	[A]	1,000		1,000		1,000	
Operational category		C3		C3		C3		
Peak short-circuit making current	I_{MC}	[kA]	62.5	50	62.5	50	50	
Rated short-circuit breaking current	I_{BC}	[kA]	25	20	25	20	20	
DC component for asymmetrical breaking current		%		≤ 50		≤ 50		≤ 50
Peak and rated short-time withstand current (1 s)	\hat{I}_{cw}/I_{cw}	[kA]/[kA]	62.5/25		62.5/25		62.5/25	
Short-time withstand current (0.1 s)	I_{cw}	[kA]	40	-	40	-	-	
Minimum creepage distances		[mm]	$> 1,000$		$> 1,000$		$> 1,250$	
⁽¹⁾ For other values, please contact Sécheron. • ⁽²⁾ At $T_{amb} = +40$ °C and tested with high voltage connections according to standard IEC/EN 60943.								
Earthing device								
Peak and rated short-time withstand current (1 s)	\hat{I}_{cw}/I_{cw}	[kA]/[kA]	62.5/25		62.5/25		62.5/25	
LOW VOLTAGE AUXILIARY CIRCUIT								
Control circuit								
AC circuit breaker								
Nominal voltage (power supply and control order)	U_n	[V _{dc}]	24 to 110					
Range of voltage (power supply and control order)		[0.7 - 1.25] U_n						
Maximum power (loading and holding) ⁽³⁾⁽⁴⁾	P_{max}	[W]	≤ 180 (depends on battery voltage)					
Nominal holding power ⁽⁴⁾	P_h	[W]	≤ 35					
Opening power		[W] 0						
Mechanical opening time ⁽⁴⁾	T_o	[ms]	≤ 50					
Mechanical closing time ⁽⁴⁾	T_c	[ms]	≤ 65					
Earthing device (electrically operated version)								
Nominal voltage	U_n	[V _{dc}]	24, 32, 36, 48/50, 72, 110					
Operating power ⁽⁴⁾		[W]	125					
Commutation time ⁽⁴⁾	P_{max}	[W]	≤ 3					
⁽³⁾ Loading time < 12 seconds. • ⁽⁴⁾ At U_n and $T_{amb} = +23$ °C.								
Auxiliary contacts								
Type of contacts		Potential free						
Rated voltage		[V _{dc}]	24 to 110					
Conventional thermal current	I_{th}	[A]	10					
Switching categories according to EN60947 (silver contacts)		AC - 15 230 V _{ac} 1.0 A DC - 13 110 V _{dc} 0.5 A						
Minimum let-through current at 24 V _{dc} ⁽⁵⁾		[mA]	≥ 10 (silver contacts) or $4 \leq I < 10$ (gold contacts)					
AC circuit breaker								
Quantity	4a+4b (standard) / 4a+4b (additional in option) ⁽⁶⁾							
Earthing switch								
Quantity	0 (standard) / 2a+2b (option) - For manual earthing switch 2a+2b (option) - For electric earthing switch							
⁽⁵⁾ For a dry and clean environment. ⁽⁶⁾ For MACS version with Point-on-Wave/Synchronous switching, only 2a+2b additional in option. •								
Low voltage interface								
Type of connection ⁽⁷⁾								
- AC VCB with manual earthing device		1 Connector: Harting 51 P						
- AC VCB with electric earthing device		2 Connectors: Harting 51 P + Harting 24 DD						
⁽⁷⁾ Refer to page 12 for mobile connector information.								
Insulation								
Rated power-frequency withstand voltage (50 Hz, 1 mn)	U_a	[kV]	1.5					
OPERATING CONDITIONS								
Installation		Indoor or outdoor						
Altitude		[m]	$\leq 2,000$					
Working ambient temperature	T_{amb}	[°C]	-40 to +70 / -50 to +70 (option)					
Humidity		Class 5K2						
Pollution degree		[IP] PD4						
Minimum mechanical durability	N	[Cycles]	250,000					

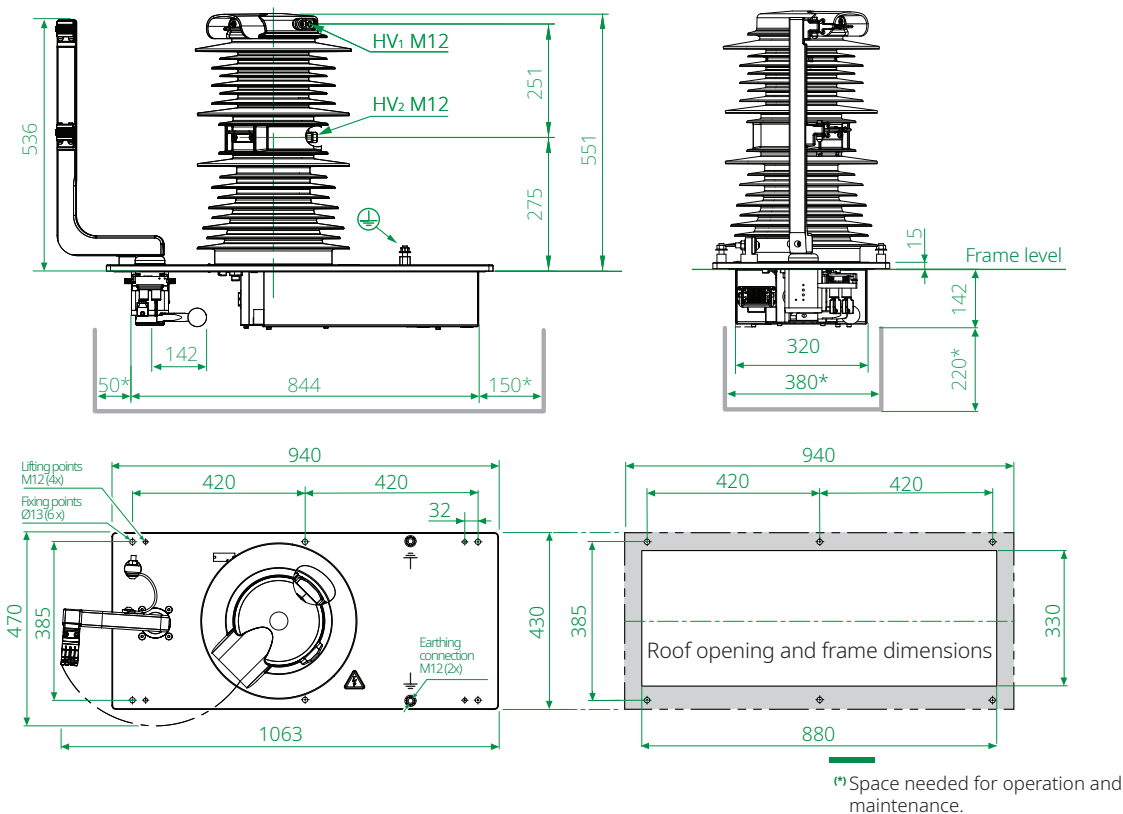
PRODUCT INTEGRATION

MAIN DIMENSIONS

Dimensions without tolerances are approximate only. All dimensions given in mm. The maximum permissible flatness deviation of the support frame is 0.5 mm. HV and earth connections: M12 screws.

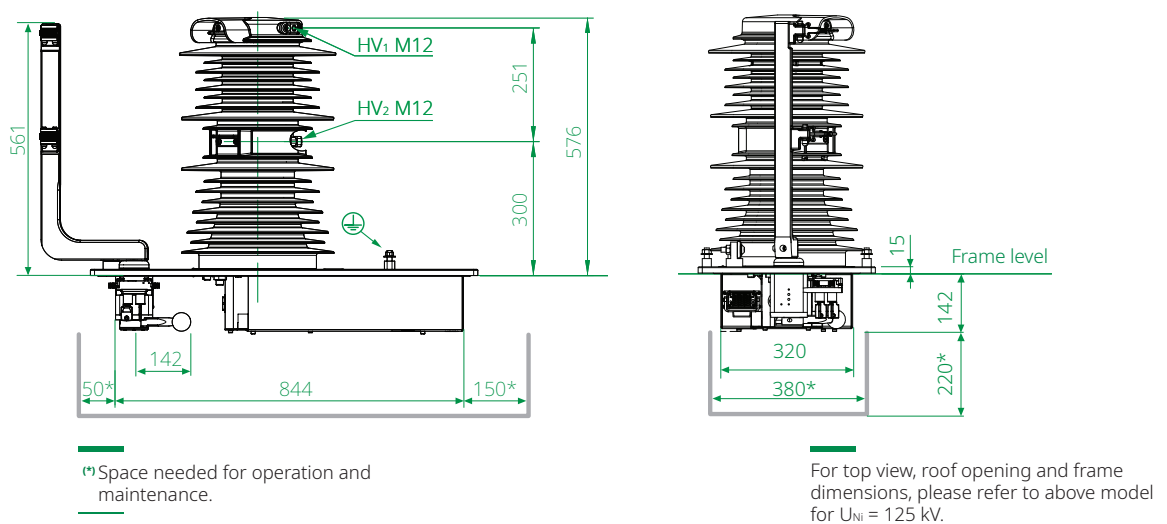
AC CIRCUIT BREAKER 15/25 kV_{AC} - U_{Ni} = 125 kV (MACS M7.. DESIGNATION CODE)

Weight : 103 kg



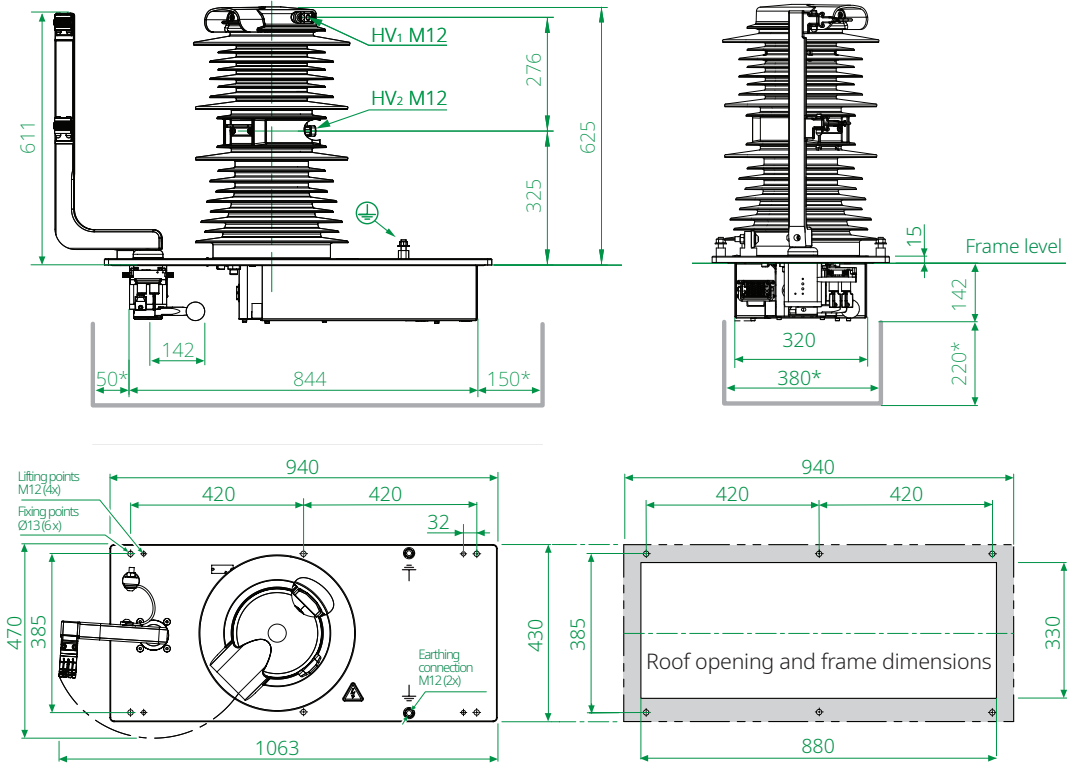
AC CIRCUIT BREAKER 15/25 kV_{AC} - U_{Ni} = 170 kV (MACS M6.. DESIGNATION CODE)

Weight : 104 kg



AC CIRCUIT BREAKER 25 kV_{AC} - U_{Ni} = 185 kV (MACS M5.. DESIGNATION CODE)

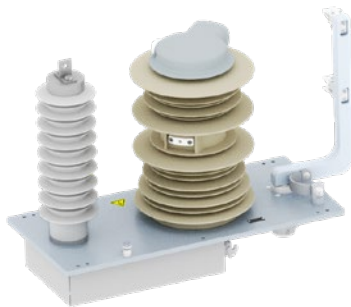
Weight : 105 kg



* Space needed for operation and maintenance.

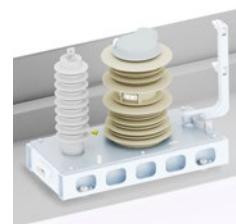
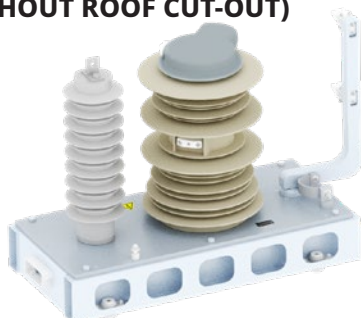
INSTALLATION POSSIBILITIES

VERTICAL INSTALLATION ON THE ROOF (WITH ROOF CUT-OUT)



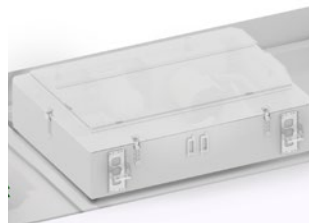
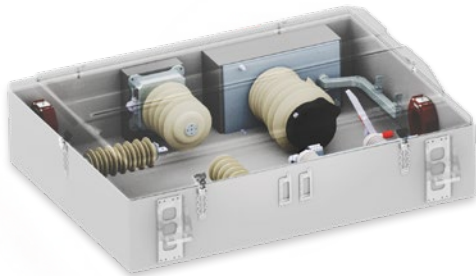
With this solution a roof cut-out is required for the MACS low voltage compartment as well as for the manual operating mechanism of the earthing device.

VERTICAL INSTALLATION ON THE ROOF (WITHOUT ROOF CUT-OUT)



To avoid roof cut-out while reducing structural noise transmission, MACS can also be delivered together with Sécheron's optional roof box.

HORIZONTAL INSTALLATION ON THE ROOF OR UNDERFRAME



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

LOW VOLTAGE WIRING DIAGRAM (HARTING HAN® MODULAR 51-PINS CONNECTOR)

Legend of the schemes:

	Circuit breaker main contacts		Low voltage connector interface (male pin)
	Earthing device main contacts		1a + 1b - switch PF
	Closing coils		Earthing device manual operation
	Harting connector		Optional auxiliary contact
B	Battery power supply	O	Control order
R	Ready switch (MACS ready to close)	ES	Earthing device

The representation below depicts **MACS** in standard configuration (4a+4b – switch PF), with optional additional auxiliary switches (4a+4b – switch PF) and manual earthing device (2a+2b – switch PF).

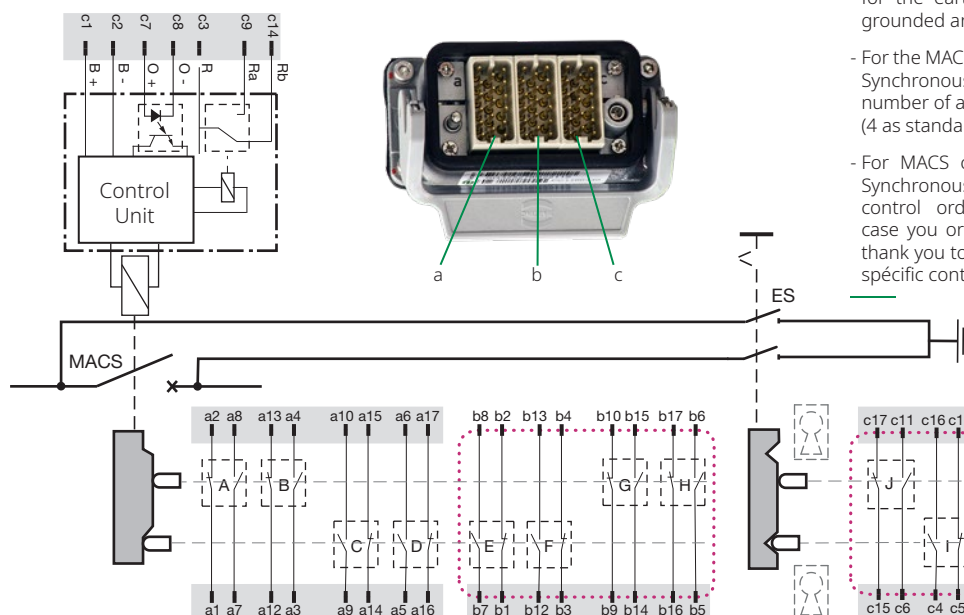
For electric earthing device, please contact Sécheron.

- The auxiliary switches' state is represented for the MACS in open position.

- The auxiliary switches' state is represented for the earthing device in position not grounded and locked in this position.

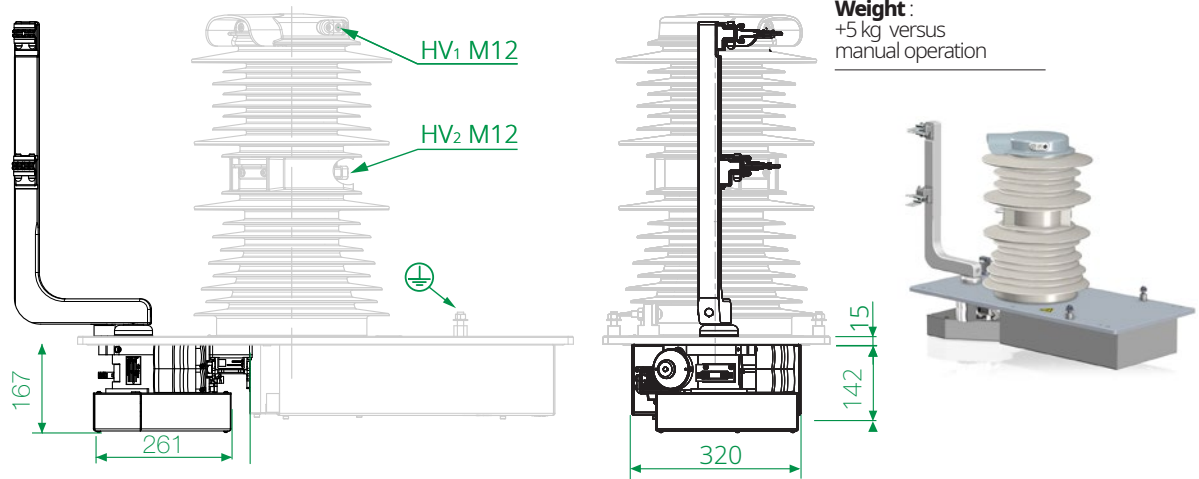
- For the MACS version with Point-on-Wave/ Synchronous switching option, maximum number of available auxiliary switches is 6 (4 as standard + 2 as option).

- For MACS ordered with Point-on-wave/ Synchronous switching option, two control orders would be needed. In case you order this MACS configuration, thank you to ask Sécheron for the related specific control scheme.

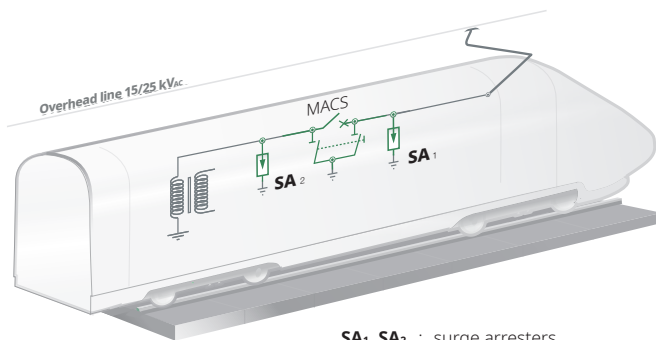


OPTIONS (SUBJECT TO ADDITIONAL COSTS)

EARTHING DEVICE - ELECTRIC OPERATION



INTEGRATION OF SURGE ARRESTER



SA₁, SA₂ : surge arresters
 MACS : AC vacuum circuit breaker + earthing device

For safe and efficient protection against lightning and switching overvoltages, Sécheron strongly recommends the use of two surge arresters SA₁ and SA₂ in the vehicle's high voltage circuit.

In order to effectively protect the AC circuit breaker, the distance between each surge arrester and the AC circuit breaker must not be too long.

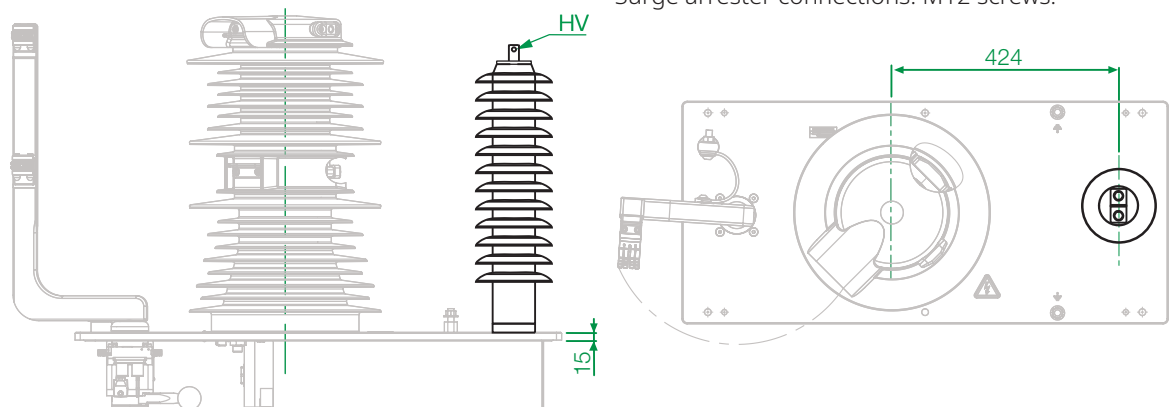
Customers wishing to add a surge arrester to the MACS can rely on Sécheron's specialists to specify the most appropriate type.



The connection between the AC circuit breaker and the surge arrester is not shown on the drawing but can also be delivered by Sécheron.

Weight and height of surge arresters depend on selected type.

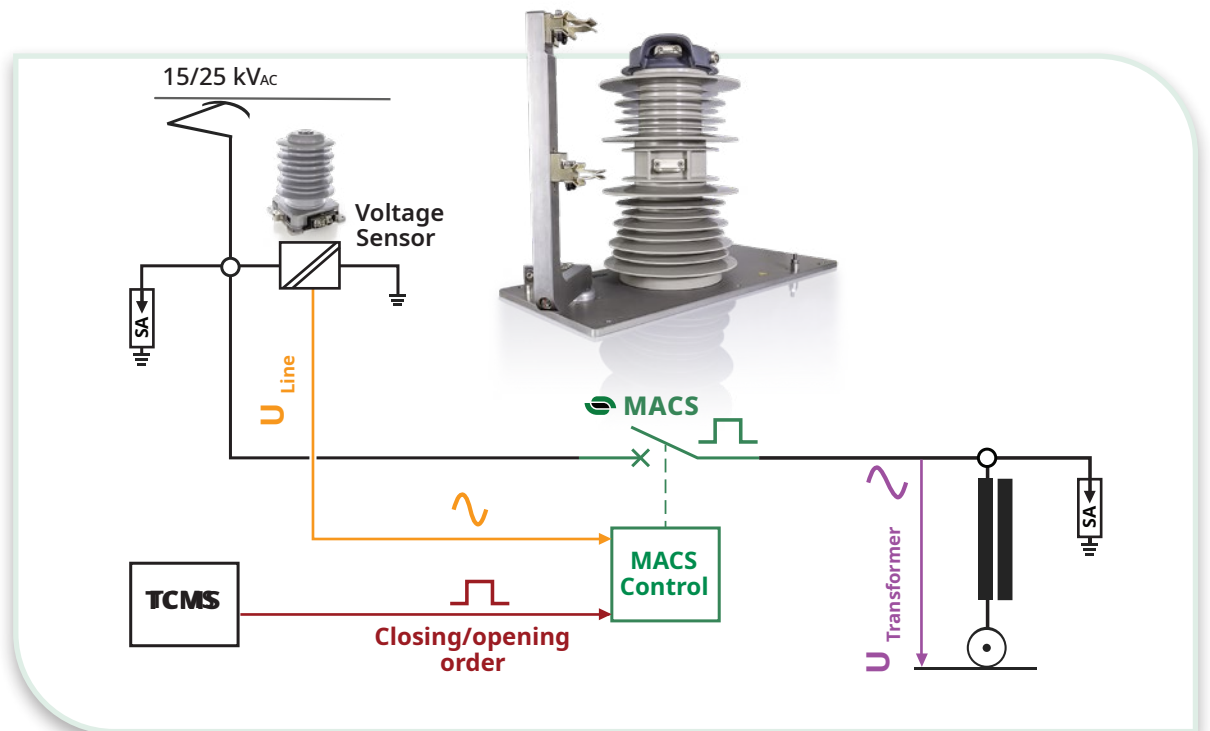
Surge arrester connections: M12 screws.



POINT-ON-WAVE/SYNCHRONOUS SWITCHING FUNCTION

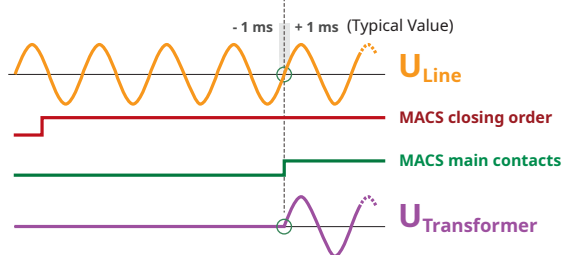
Sécheron has designed a unique **Point-on-Wave/Synchronous switching** function that can be installed on our AC circuit breakers type **MACS**. This function enables to close or/and open repetitively the **MACS** on a predefined phase angle of the line voltage and with a typical accuracy within ± 1 ms (± 18 degree at 50 Hz). With this function, MACS can for instance be closed on the phase 0 degree (or

180 degrees) so that the main contacts closes at the exact time when the line voltage is 0 volts, avoiding thus high dv/dt and limiting induced potential electromagnetic interferences. If closing on the phase 90 degrees (or 270 degrees) is selected, the AC circuit breaker will close when the value of the line voltage wave is at its maximum, minimizing the vehicle inrush current .



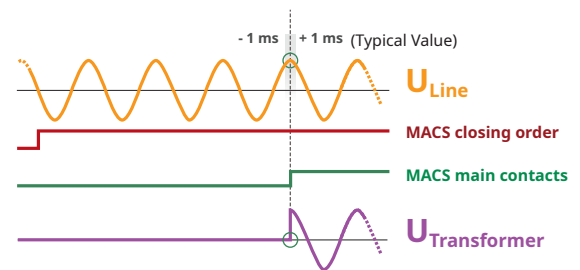
Closing synchronous switching at 0°

⇒ Reduction of Electromagnetic interference (EMI)



Closing synchronous switching at 90°

⇒ Reduction of transformer's inrush current



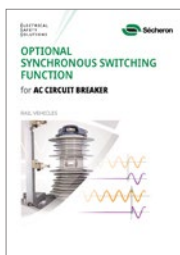
MAIN BENEFITS

- ✓ Synchronous switching of the MACS with the line voltage phase
- ✓ Adjustable setting of the predefined phase angle of line voltage for synchronous closing or/and opening
- ✓ Setting of the predefined phase angle can be different for closing and opening
- ✓ High accuracy for Point-on-Wave/Synchronous switching, typically within ± 1 ms
- ✓ Switching accuracy independent from the ambient temperature
- ✓ Suitable for 12 kV (25 Hz), 15 kV (16.7 Hz), 25 kV (50 & 60 Hz)
- ✓ Reliable closing at 0 Volts crossing to avoid dV/dt and subsequent electromagnetic interferences
- ✓ Reliable closing at maximum voltage of the sine wave to limit vehicle inrush current
- ✓ Auto-calibration, to keep the synchronization accuracy function of ambient temperature and control voltage.
- ✓ Point-on-Wave/Synchronous switching function can be directly integrated in the MACS control unit with no impact on the product's dimensions.

REQUIREMENTS TO ORDER POINT-ON-WAVE/SYNCHRONOUS SWITCHING FUNCTION

- Have one AC voltage sensor's analog output available for connection to the MACS control unit. The output can come from Sécheron's **TMS** voltage & current sensor (current loop output) or from a Voltage Transformer (voltage output).
Voltage sensor analog output range:
 - from 37.5 to 120 V_{AC} ⁽¹⁾
 - 8 to 25 mA
- Define precisely the goal to be achieved using the Point-on-Wave/Synchronous switching function, so that Sécheron can recommend the best settings adapted to your application and requirements: reduce Inrush Current, reduce Electromagnetic Interferences (EMI), others,
- To order the Point-on-Wave/Synchronous switching option, select the code J or L (function of the voltage sensor type) for the line 21 of the ordering code page 15.
- Upon the needs of the application, the synchronous switching behaviour of the orders can be set in different modes
 - Point-on-Wave/Synchronous switching at closing only (at any predefined phase)
 - Point-on-Wave/Synchronous switching at opening and closing (at any predefined phase angle, possibly different than closing phase angle).

For the Point-on-Wave/Synchronous switching function you can also refer to our below brochure.



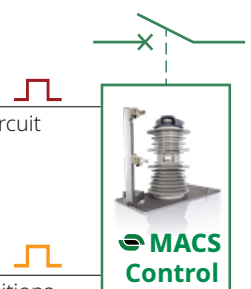
Brochure
Synchronous switching
AC circuit breakers
SA013236BEN

Order 1 trip orders

- ✓ Overcurrent or short-circuit
- ✓ Instant opening
- ✓ priority order

Order 2 switching orders

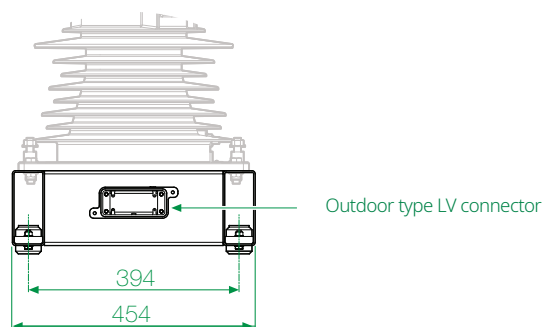
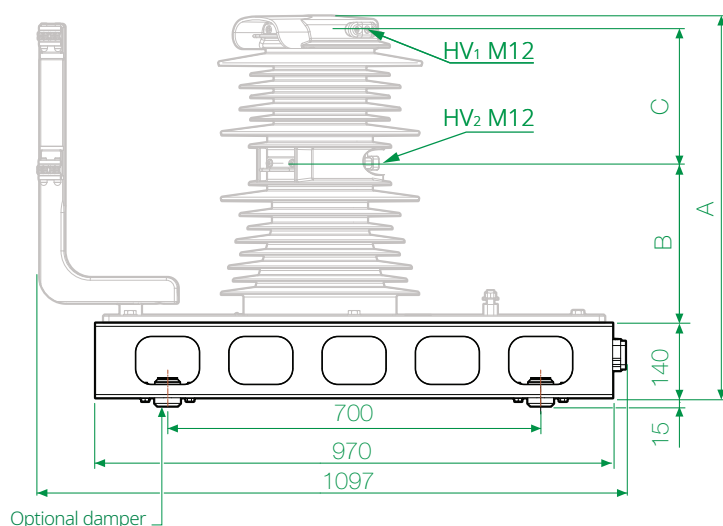
- ✓ Normal operating conditions
- ✓ Synchronous switching
- ✓ Delayed closing or/and opening



⁽¹⁾ for other voltage ranges, please contact Sécheron.

Please note that in case the Point-on-Wave/Synchronous switching option is selected, the maximum number of auxiliary switches for the MACS is limited to 6 instead of 8 (4 as standard + 2 as option).

ROOF BOX



Main dimensions:

Refer to the table below

	MACS designation code		
	M7	M6	M5
U_{ni} [kV]	125	170	185
A (mm)	691	716	766
B (mm)	275	300	325
C (mm)	251	251	276

Roof box dimensions are only indicative.

Selecting the optional electrically operated earthing device together with the roof box, will limit the roof crossing to the low voltage connections.

In case the manual earthing device is selected with the optional roof box, a roof crossing for the earthing device manual operation as well as for the low voltage connections is to be foreseen.

MAIN BENEFITS









- ✓ No roof cut-out required to install the AC circuit breaker.
- ✓ No roof cut-out if the optional electric version for earthing device is selected.
- ✓ Reduced size hole in roof for the operating mechanism of the manual earthing device.
- ✓ Substantial reduction in noise transmission through the car body structure.
- ✓ Structural validation according to EN 12663.
- ✓ Validated for vibrations & shocks according to IEC/EN 61373.

LOW VOLTAGE MOBILE CONNECTOR (HARTING HAN® MODULAR 51-PINS CONNECTOR)

MACS configurations				Mobile connectors					
Auxilliary Switches			Fixed connector type	Type	Number of pin		Cable gland	Cable entry	Secheron's reference
Device ⁽¹⁾	Number	Type ⁽²⁾			Size 2.5 mm ²	Size 1.5 mm ²			

⁽¹⁾ AC VCB : AC vacuum circuit breaker
 ES : Earthing device.
⁽²⁾ PF : potential free.

AC circuit breaker with manual or electric ⁽³⁾ earthing device

Case	AC VCB + ES	Number	Type	Fixed connector type	Type	Size 2.5 mm ²	Size 1.5 mm ²	Cable gland	Cable entry	Secheron's reference
Case 1	AC VCB + ES	4a + 4b	PF	Harting HAN® Modular 51 pins	Harting HAN® Modular 51 pins	2	21	M25		SG325249R00101
		0a + 0b								SG325249R00201
Case 2	AC VCB + ES	4a + 4b	PF	Harting HAN® Modular 51 pins	Harting HAN® Modular 51 pins	2	29	M32		SG325249R00303
		2a + 2b								SG325249R00403
Case 3	AC VCB + ES	8a + 8b	PF	Harting HAN® Modular 51 pins	Harting HAN® Modular 51 pins	2	37	M32		SG325249R00302
		0a + 0b								SG325249R00402
Case 4	AC VCB + ES	8a + 8b	PF	Harting HAN® Modular 51 pins	Harting HAN® Modular 51 pins	2	45	M32		SG325249R00304
		2a + 2b								SG325249R00404

⁽³⁾ For the electric earthing device the additional low voltage mobile connector indicated below must be considered.

Additional low voltage mobile connector for electric earthing device

Device	Number	Type	Fixed connector type	Type	Size 2.5 mm ²	Size 1.5 mm ²	Cable gland	Cable entry	Secheron's reference
ES	2a + 2b	PF	Harting HAN® 24 DD	Harting HAN® 24 DD	2	12	M25		SG325249R00521
									SG325249R00520

Notes:

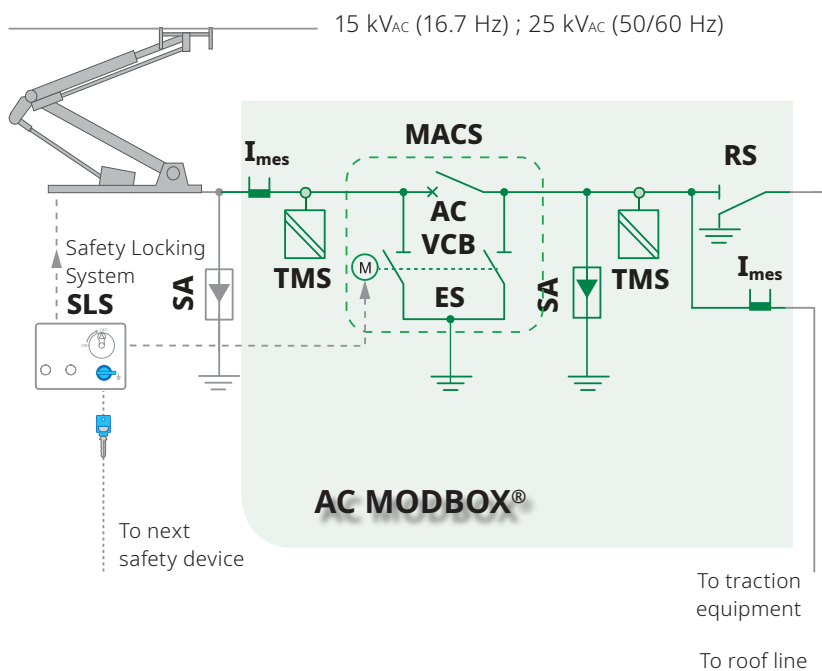
- Harting Han® Modular 51-pin connector composed of 3 Harting HAN® DDD17 modules (each module supplied with 17 pins).
- The above references are given for mobile connectors assuming that all the auxiliary contacts are wired, with an external wire diameter of 2.8 mm for a 2.5 mm² conductor size and 2.3 mm for a 1.5 mm² conductor size. If the conditions differ from these, the above references may change. In this case, please inform Sécheron accordingly.
- In case the Point-on-Wave/Synchronous switching option is selected, please contact Sécheron to get the relevant references of the mobile connector to be ordered with the MACS.

AC MODBOX®

The Sécheron **AC MODBOX®** enclosure includes our AC circuit breaker type **MACS** and various high- and low-voltage components. The compact, smart enclosure ensures safe and efficient integration of high-voltage components for installation on the roof, under the car body or inside the vehicle. Each **AC MODBOX®** is engineered and configured to meet the needs of your project, taking into account integrated functions and interfaces with the vehicle. We primarily use Sécheron components and can include other

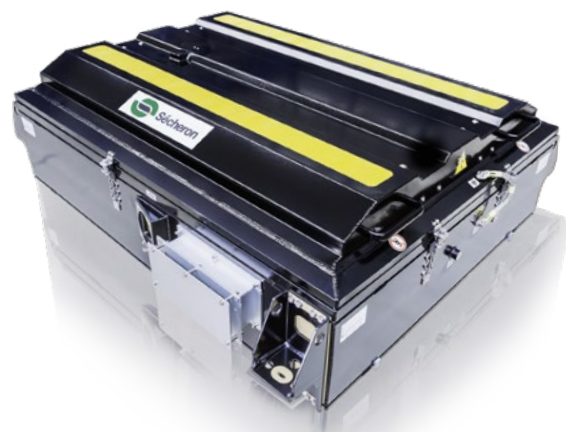
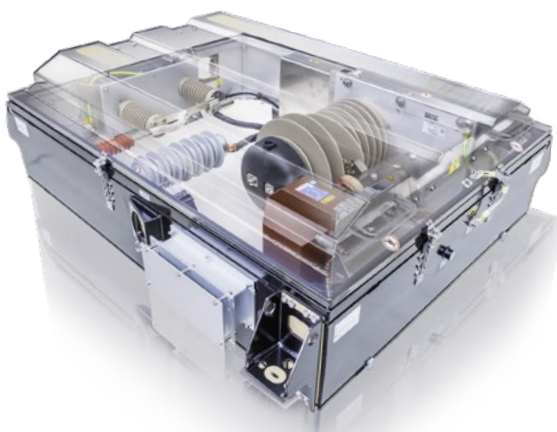
devices from best-in-class suppliers to provide you with a turnkey solution. With its limited height (535 mm) and a shape designed to meet aerodynamic requirements, **AC MODBOX®** offers efficient solutions to roof space, insulation and speed constraints. It also provides the high-voltage AC components with protection from the most severe environmental conditions in their operation. **AC MODBOX®** simplifies project management, logistics, and installation tasks for the car builder.

For more information about the **MODBOX®** program, please refer to brochure SG580044B.



Functional scope:

- SLS** : Safety Locking System
- SA** : Surge arrester
- I_{mes}** : Current measurement
- TMS** : AC voltage measurement
- MACS** : Main AC switch
- AC VCB** : AC vacuum circuit breaker (MACS)
- ES** : Earthing device (MACS)
- RS** : Roof switch



SÉCHERON COMPONENTS & SYSTEMS OVERVIEW FOR AC RAIL VEHICLES

Sécheron offers one of the most comprehensive range of components and systems for the AC rail vehicles. All our solutions are designed to ensure vehicles' passengers and operators the highest and most coherent safety during operation and maintenance.

All Sécheron's solutions are valued by car builders and operators throughout the world for their high reliability and low maintenance requirements. They all represent the highest level of technology for such components on the world market for rail vehicles.

ROOF INSTALLED COMPONENTS AND SYSTEMS

REFERENCE BROCHURES



RS
Off-load switches
SP1870125BEN



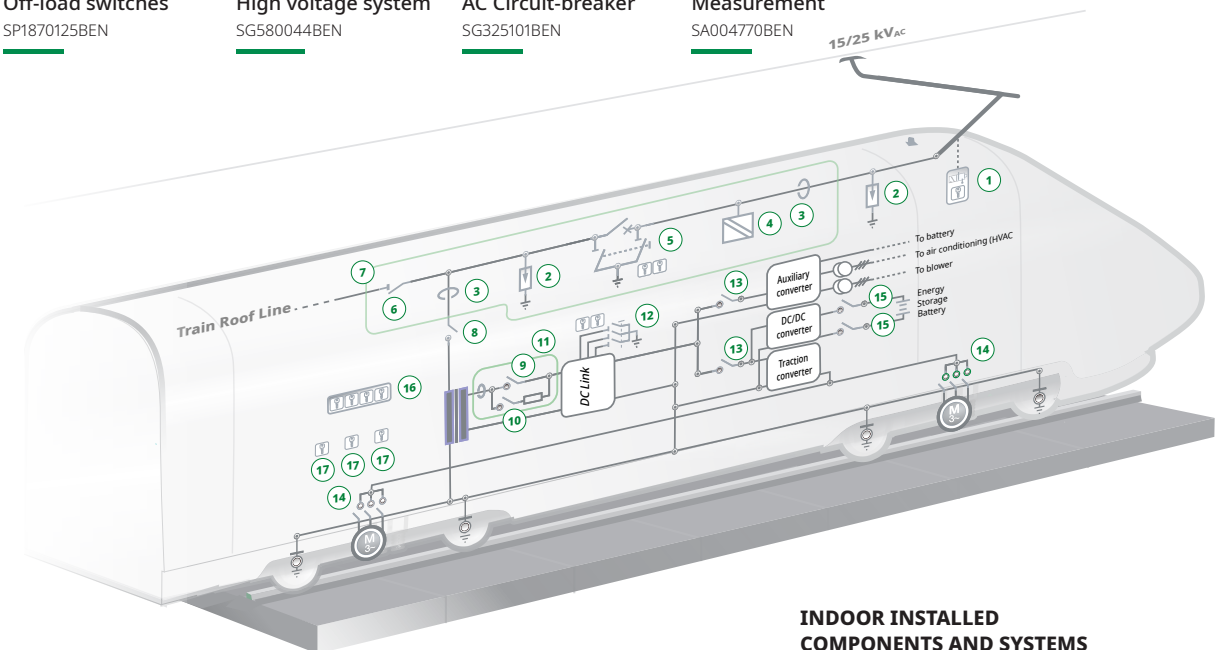
MODBOX®
High voltage system
SG580044BEN



MACS
AC Circuit-breaker
SG325101BEN



TMS
Measurement
SA004770BEN



INDOOR INSTALLED COMPONENTS AND SYSTEMS

REFERENCE BROCHURES



**BMS...08,
BMS...10**
Contactors
SG201096BEN



**BMS...15,
BMS...18**
Contactors
SG202454BEN



KM, DL
Off-load switches
SA011495BEN



BTE03.04
Off-load switches
SP1880136BEN



BSV, SLS
Off-load switches
SP1880129BEN

DESIGNATION CODE FOR ORDERING

- Be sure to establish the designation code from the latest version of our brochure by downloading it from the website: www.secheron.com
- Be careful to write down the complete alphanumerical designation code with 12 characters when placing your order
- For technical reasons some variants and options indicated in the designation code might not be combined
- For other configurations not described in the brochure, please contact Sécheron.

DESIGNATION CODE

^(*) Options are subject to additional costs

Example of customer's choice:	M	7	A	1	Ø	E	A	H	Z	Z	1	J
Line:	10	11	12	13	14	15	16	17	18	19	20	21

Line	Description	Designation	standard	Options*	Customer's choice
10	Product type	MACS	M	M	M
11	Nominal Voltage & Insulation	15 kV or/and 25 kV (U _{Ni} = 125 kV) 15 kV or/and 25 kV (U _{Ni} = 170 kV) 25 kV - Harsh environment (U _{Ni} = 185 kV)	7 6 5		
12	Mechanical interface	Standard base plate / vertical mounting Version for optional roof box ⁽¹⁾	A	F	
13	Earthing device (ES)	Yes (with manual operation) Yes (with electric operation)	1	2	
14	Integrated surge arrester (SA _z)	No Yes - For surge arrester type and code, please contact Sécheron	Ø	...	
15	Control voltage	24 V _{DC} 32 V _{DC} 36 V _{DC} 48 V _{DC} / 50 V _{DC} 72 V _{DC} 110 V _{DC}	A B C D E	F	
16	Auxiliary contacts on the AC circuit breaker	4a + 4b - (switch PF) - silver type 4a + 4b - (switch PF) - gold type 8a + 8b - (switch PF) - silver type ⁽²⁾ 8a + 8b - (switch PF) - gold type ⁽²⁾	A	C B D	
17	Auxiliary contacts on the earthing device	None ⁽³⁾ 2a + 2b - (switch PF) - silver type 2a + 2b - (switch PF) - gold type	Z	H C	
18	Interlocking keys/locks for earthing device	(Electric operation) Not applicable blue (master) + 1 yellow (slave) 1 blue (master) + 2 yellow (slave) 2 blue (master) + 1 yellow (slave) 1 yellow (master) + 1 green (slave) 1 yellow (master) + 2 green (slave) 2 yellow (master) + 1 green (slave) Key / locks delivered by customer	Z	B C F H I L S	
19	Key and lock codification for each unit	(Electric operation) Not applicable No Yes	Z Ø	1	
20	Ambient temperature range	-40 °C to +70 °C -50 °C to +70 °C ⁽⁴⁾	1	2	
21	Point-on-Wave/Synchronous switching (voltage sensor type on vehicle)	No Yes ⁽⁵⁾ (Sécheron TMS voltage sensor input) Yes ⁽⁵⁾ (Voltage sensor transformer type)	A	J L	

⁽¹⁾ The roof box kit must be ordered separately.

⁽²⁾ If the Point-on-Wave/Synchronous switching function is selected line 21, then the AC circuit breaker will be delivered with a maximum of 6a+6b auxiliary contacts (Switch PF type).

⁽³⁾ For manual switch only

⁽⁴⁾ This option cannot be combined with options line 21

⁽⁵⁾ The Point-on-Wave/Synchronous switching parameters (closing phase angle and/or opening phase angle) have to be defined when ordering, and the below box to be checked function of your project configuration..

TMS output type: Bipolar type (The output connected to the MACS for the synchronous switching function must be a bipolar one. The remaining 2 other outputs to be configured according to their use.)

Voltage transformer output: ≤ 100 V > 100 V & ≤ 150 V

Catenary supply voltage: 25 kV (50 Hz) 25 kV (60 Hz) 25 kV (50 Hz) & 15 kV (16.7 Hz)
 15 kV (16.7 Hz) 12.5 kV (25 Hz)

Signature:

Name:

Place and date:

MATERIAL TO BE ORDERED SEPARATELY AND ADDITIONALLY TO THE MACS

/// Low voltage connector(s)

The low voltage connector must be ordered separately (refer to page 12).

- LV mobile connector for the AC circuit breaker with manual earthing device:

in case Point-on-Wave/Synchronous switching option is selected,
please contact Sécheron to get the reference of the mobile connector.

SG325249R00...__ __ __ (select the last 3 digits in the table page 12 function of your selection)

- Additional LV mobile connector for the electric earthing device:

SG325249R00521

SG325249R00520

/// Optional roof box kit

for MACS with electrically operated earthing device

for MACS with manual Earthing device

Signature:

Name:

Place and date:



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