SIEMENS

Totally Integrated Power: SION

SION Vacuum Circuit Breaker 3AE5

Medium-Voltage Equipment

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Edition 2020

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SION Vacuum Circuit Breaker 3AE5 from 7.2 kV to 24 kV – The Modular Devices

SION vacuum circuit breakers control all switching operations in medium-voltage distribution systems and are suitable for installation in all established and new air-insulated medium-voltage switchgear as well as for retrofitting existing switchgear.

They are applicable for operation of, for example, overhead lines, cables, transformers, capacitors and motors. The optional installation accessories enable easy integration into switchgear panels, and, maximally equipped as a module with an earthing switch, form almost the complete circuit breaker compartment inside the switchgear.

Our comprehensive range of circuit breakers offers a wide selection of pole-centre distances and vertical distances between terminals as well as various equipment options for voltage levels from 7.2 kV to 24 kV. The withdrawable element, contact arms, contacts and bushings enable easy integration in all customary medium-voltage switchgear types. Identical dimensions and connection dimensions across several voltage levels reduce planning costs and the variety of panel versions. High reliability and availability are a matter of course, as are 10,000 maintenance-free operating cycles.

SION vacuum circuit breaker for fixed mounting

Thanks to a range of options, SION vacuum circuit breakers can be precisely tailored to your requirements. This switching device can be mounted on a withdrawable element. Furthermore, mountable contact arms, contacts and bushings allow easy integration into your switchgear.

SION vacuum circuit breaker on withdrawable element – with contacts

The SION vacuum circuit breakers can be supplied with contact arms and contacts.

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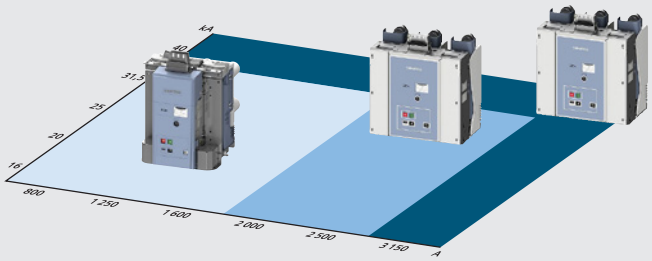
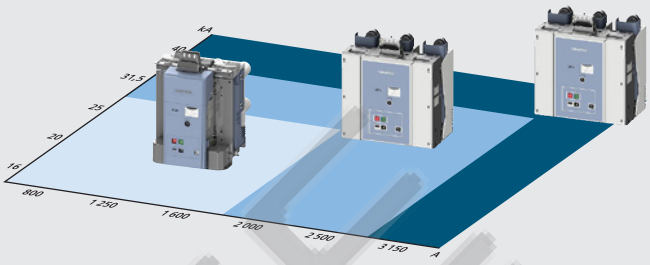
SION 3AE5 Portfolio

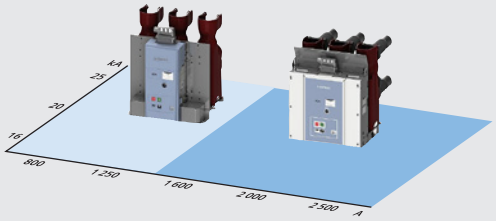
SION vacuum circuit breaker 3AE5, 7.2 kV – 12 kV

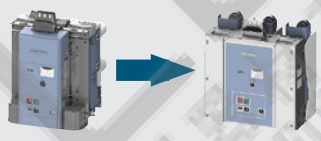


SION vacuum circuit breaker 3AE5, 17.5 kV



SION vacuum circuit breaker 3AE5, 24 kV





All 3AE5 with a small cover can be ordered optionally with a wide cover.

SION Installation options

	SION for fixed mounting	SION with components				
	Fixed-mounted	with contact arms and contacts	with contact arms and contacts, fixed contacts and bushings	on withdrawable element	on withdrawable element with contact arms and contacts	on withdrawable element with contact arms and contacts, fixed contacts and bushings
Circuit breaker	■	■	■	■	■	■
withdrawable element	–			■	■	■
Contact arm and contacts	–	■	■	–	■	■
Bushings and fixed contacts	–	–	■	–	–	■
Order No.	13th position = 0	13th position = 2 order code M22	13th position = 3 order code M23	13th position = 1	13th position = 2	13th position = 3

SION on withdrawable element

	"Heavy Duty"		"Standard"
	≤17.5 kV	24 kV	≤17.5 kV
Order No.	Order No. without order code	Order No. without order code	Order No. with order code W89
Kinematic chain	■	■	–
Racking path	220 mm (180/200 mm optional)	260 mm	200 mm
Interlocking with earthing switch	Suitable for SION modules	Suitable for SION modules	Suitable for most panels
Motor-operated racking	–	–	optional DC 110/220 V

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Switching medium

Proven and fully developed for more than 40 years, vacuum switching technology is the principal arc-quenching element used in vacuum interrupters.

Pole assemblies

The pole assemblies consist of vacuum interrupters and pole shells. The vacuum interrupters are air-insulated and freely accessible. The pole assemblies are fixed on the mechanism mounting plate and supported by means of the pole shell (6). The vacuum interrupter (5) is mounted rigidly to the upper interrupter support. The lower part of the interrupter is guided into the lower interrupter support, allowing axial movement. The pole shell (6) absorbs external forces resulting from switching operations and the contact pressure.

Operating mechanism

The whole operating mechanism with motor (13), releases (11), indicators and actuating devices is mounted on the mechanism mounting plate (9). This compact design enables very fast operating times.

The circuit breaker operating mechanism is a stored-energy spring mechanism. The force is transmitted from the operating mechanism to the pole assemblies via operating levers. The closing spring (15) can be charged either electrically or manually, and latches in automatically when charging is complete. The closing spring (15) acts as a stored-energy mechanism.

To close the breaker, the closing spring (15) can be unlatched either mechanically at the device (ON pushbutton), or electrically by remote control. The closing spring (15) charges the opening and/or contact-pressure springs (17) as the breaker closes. The now discharged closing spring (15) will be charged again automatically by the motor (13).

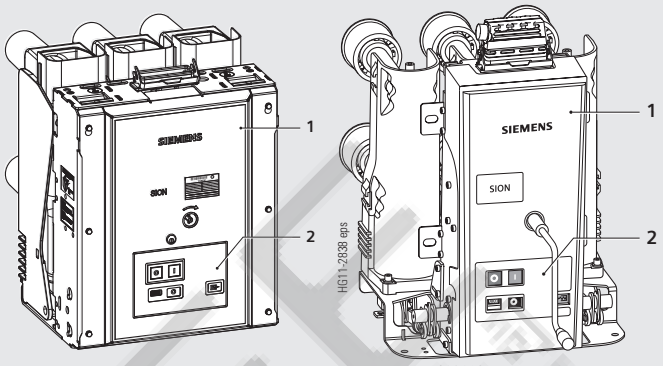
In this way, the stored-energy mechanism stores the OPEN – CLOSE – OPEN operating sequence that is required for an auto-reclosing operation on the system side. All stored-energy mechanisms perform the switching duties of synchronizing, rapid load transfer, and auto-reclosing.

Trip-free mechanism

The circuit breakers have a trip-free mechanism. In the event of an opening command being given after a closing operation has been initiated, the moving contacts return to the open position and remain there even if the closing command is sustained. However, the vacuum circuit breaker contacts are momentarily in the closed position.

For charging the closing spring (15), the motor (13) operates in short-time duty. For this reason, the voltage and power consumption might differ from the data of the motor rating plate.

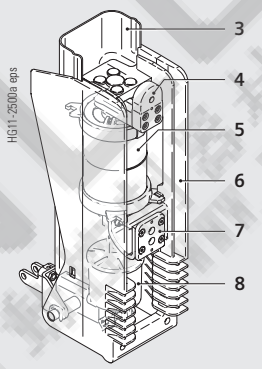
3AE5



Front view

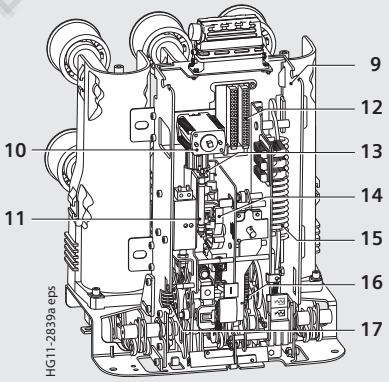
1 Cover of low-voltage interface

2 Central control board



Pole structure

3 Insulating shell to the operating mechanism
4 Upper connection
5 Vacuum interrupter
6 Pole shell
7 Lower connection
8 Insulator



Operating mechanism 3AE5 without cover

9 Mechanism mounting plate
10 Auxiliary switch
11 1st release
12 Terminal strip
13 Motor
14 Closing solenoid
15 Closing spring
16 Gear
17 Opening spring

Releases

A release is a device that transfers electrical commands from an external source, such as a control room, to the latching mechanism of the vacuum circuit breaker so that it can be opened or closed. The releases are designed for short-time duty up to 1 minute and are reset internally. The various types of releases available are described in detail below:

Closing solenoid

The closing solenoid unlatches the charged closing spring of the vacuum circuit breaker, closing it by electrical means.

Shunt releases

Shunt releases are used for automatic tripping of the circuit breaker by suitable protection relays and for deliberate tripping by electrical means. They are intended for connection to an external power supply (DC or AC voltage).

Current-transformer-operated release

Current-transformer-operated releases consist of a stored energy mechanism, an unlatching mechanism and an electromagnet system. They are used when there is no external source of auxiliary power (e.g., a battery). Tripping is effected by means of a protection relay (e.g., overcurrent time protection) acting on the current-transformer-operated release.

Undervoltage releases

Undervoltage releases consist of a stored-energy mechanism, an unlatching mechanism and an electromagnet system that is permanently connected to the secondary or auxiliary voltage while the circuit breaker is closed. If the voltage falls below a predetermined value, unlatching of the release is enabled and the circuit breaker is opened via the stored-energy mechanism.

A maximum of three releases can be equipped in accordance with page 24–26. The consumption data of the releases is listed on page 60.

Closing and anti-pumping

In the standard version, the circuit breakers can be closed electrically via remote. In addition, they can be mechanically closed locally by direct unlatching of the closing spring. If constant electrical signals for CLOSE and OPEN commands are present at the circuit breaker at the same time, the circuit breaker will carry out an OPEN-CLOSE-OPEN or a CLOSE-OPEN operating sequence. A new CLOSE command is given only following a brief interruption of the closing signal. This prevents continuous closing and opening (= "pumping") operations.

Closing spring charged indication

SION circuit breakers have a mechanically operated spring charged indicator. The status of the closing spring is also indicated electrically by means of an integrated position limit switch.

Circuit breaker tripping signal

During electrical opening, the NO contact S6 makes brief contact. This is often used to operate a hazard warning system which should respond to automatic tripping of the circuit breaker. In case of local control, the NO contact S6 does not close.

The corresponding circuit diagrams can be found in the associated circuit manuals. See also page 64.

Interlocking

Mechanical interlocking

At the interface of the mechanical interlocking of the circuit breaker, sensors on the switchgear side can check the switch position and prevent the associated disconnector from being operated while the circuit breaker is closed. The system also prevents the circuit breaker from being closed while the associated disconnector is in the fault position.

Circuit breakers mounted on withdrawable elements are mechanically interlocked so that the handle for racking the withdrawable element can only be inserted while the breaker is in the OPEN position. The lock of the withdrawable element can be released by operating the pushing handles and only while the withdrawable element is in the disconnected position.

If the circuit breaker on the withdrawable element is in an intermediate position (neither in the service nor in the disconnected position), operation is prevented by the mechanical interlocking.

An optional key-operated interlock enables mechanical and electrical closing only in combination with the operated lock.

Electrical interlocking

The auxiliary and signaling contacts which query the switch position of the circuit breaker or the position of the withdrawable element can be integrated in the switchgear interlocking concept. Furthermore, mechanical and electrical closing can also be prevented by means of an optional, electrical closing lock-out. This makes it possible to exclude impermissible switching sequences.

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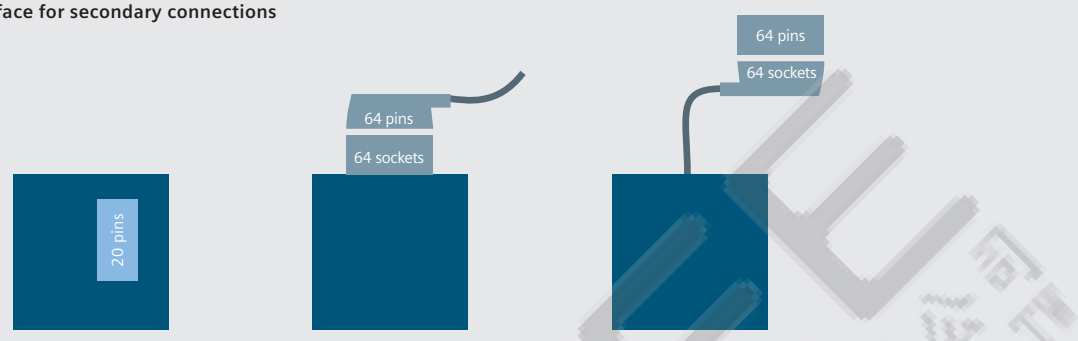
Low-voltage interface

The removable cover of the SION 3AE5 vacuum circuit breakers allows easy access to the low-voltage interface. All customer-side options for controls and signals are available here.

SION customer interface for secondary connections



Order No.	15th Position = A or J	15th Position = N or V	15th Position = X (length via order codes B01–B08)
	internal 20-pole terminal strip	64-pole plug	extended cable harness with 64-pole plug

Standards

The circuit breakers conform to the following standards:

- IEC 62271-1
- IEC 62271-100

All circuit breakers fulfil the endurance classes C2, E2, M2 and S1 according to IEC 62271-100, as well as the shortest rated operating sequence O - 0.3s - CO - 15s - CO.

3AE5 circuit breakers up to 12 kV / 31.5 kA / 1250 A comply with the DNVGL-CG-0339 classification for marine applications.

The modules have been tested according to

- IEC 62271-200, 62271-1 and 62271-102 regarding
  - Dielectric strength
  - Temperature rise
  - Switching capacity.

For class C2, all circuit breakers fulfil the following values acc. to IEC 62271-100.

	Line	Cable	Capacitors	Back-to-back capacitor bank	
Rated voltage	Rated line-charging breaking current	Rated cable-charging breaking current	Rated single-capacitor-bank breaking current	Rated back-to-back-capacitor-bank breaking current	Frequency of the inrush current
U_r	I_l	I_c	I_{sb}	I_{bb}	f_{bi}
kV, r.m.s.	A, r.m.s.	A, r.m.s.	A, r.m.s.	A, r.m.s.	Hz
7.2	10	10	400	400	4250
12	10	25	400	400	4250
17.5	10	31.5	400	400	4250
24	10	31.5	400	400	4250

Rated back-to-back-capacitor-bank inrush making current – see chapter 3: Technical data

Maintenance-free design

The circuit breakers are maintenance-free:

- Under normal ambient conditions according to IEC 62271-1
- Up to 10,000 operating cycles maintenance-free
  - no regreasing
  - no readjusting
- Up to 30,000 operating cycles with maintenance work

The ratings are independent within their tolerances of the switching frequency or standing times without switching.

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Equipment

Features	Minimum equipment	Alternative equipment	Remarks
Operating mechanism	Electrical operating mechanism	None	Also for manual operation
Closing	Closing solenoid and mechanical manual closing	None	–
1st release	shunt release	None	–
2nd release	None	Shunt release, undervoltage release, c.-t.-operated release	–
3rd release	None	Shunt release, Current-transformer-operated release	–
Varistor circuit	Standard for ≥ 60 V DC	None	For limiting switching overvoltages
Auxiliary switch	6 NO + 6 NC	12 NO + 12 NC	The actual number of available auxiliary switch contacts varies depending on the equipment level.
Plug connection	20-pole terminal strip	64-pole plug	–
Anti-pumping	Available	None	–
Circuit breaker tripping signal	Available	None	–
Operation cycles counter	Available	None	–
Position switches for withdrawable element	4 momentary-contact position switches per position	None	–
Interlocking	Mechanical interlocking for withdrawable element available	Electrical closing interlock Key-operated interlocking	–
Installation type	Fixed-mounted	Withdrawable element with/without contact arms and contact, fixed contacts and bushings	–

Product range overview: Circuit breaker without installation accessories

Type	Rated voltage	Rated short-circuit breaking current	Rated normal current	Pole-centre distance (in mm)									
				150			160			210			275
				Vertical distance between terminals (in mm)									
	kV	kA	A	205	275	310	205	275	310	205	275	310	310
3AE50	7.2	16/20/25/31.5	800/1250	■	■	■	■	■	■	■	■	■	
3AE50	7.2	16/20/25/31.5	1600									■	
3AE50	7.2	25/31.5	2000/2500									■	
3AE50	7.2	40	1250/2000, 2500/3150									■	
3AE51	12	16/20/25/31.5	800/1250	■	■	■	■	■	■	■	■	■	
3AE51	12	16/20/25/31.5	1600									■	
3AE51	12	20/25/31.5	2000/2500									■	■
3AE51	12	40	1250/2000, 2500/3150									■	■
3AE52	17.5	16/25/31.5	800/1250	■	■	■	■	■	■	■	■	■	
3EA52	17.5	16/25/31.5	1600			■			■			■	■
3AE52	17.5	25/31.5	2000/2500									■	■
3AE52	17.5	40	1250/2000, 2500/3150									■	■
3AE53	24	16/20/25	800/1250									■	■
3AE53	24	16	800/1250/2000									■	■
3AE53	24	20/25	2000/2500									■	■

Note: The circuit breaker is available with various installation accessories.
These versions can be configured from page 16 onwards.

Ordering information for accessories and spare parts

The article numbers in the spare part overviews are valid for currently manufactured vacuum circuit breakers. When mounting parts or spare parts are being ordered for an existing vacuum circuit breaker, always quote the type designation, serial number and the year of manufacture of the circuit breaker to be sure to get the correct parts.

Retrofitting

When releases /solenoids are retrofitted, the article numbers of the mounting parts must also be specified. For other additional equipment, the required mounting parts are included in the scope of supply.

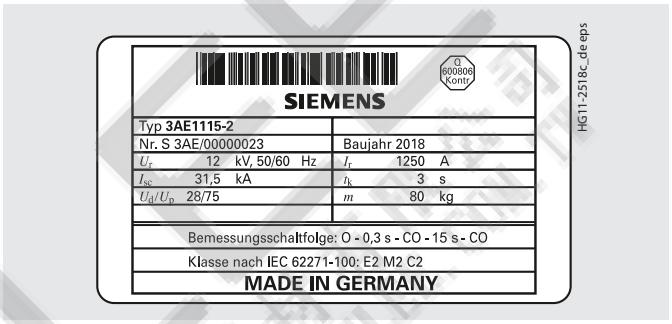
Spare parts may only be replaced by qualified personnel.

Accessories for the plug connector

Included in the scope of supply of the basic equipment for 3AE vacuum circuit breakers:

For 64-pole plug connector
– Lower part of plug
– Upper part of plug
– Crimp sockets according to number of contacts

Rating plate



Note: The following 3 details are necessary for any query regarding spare parts, subsequent deliveries, etc.:
– Type designation
– Serial No.
– Year of manufacture

					Position: 1 – 9
Designation	Description		Spare parts	Mounting parts	Order No.
Handles	Hand crank for circuit breaker 3AX15 30-4B				3AX1530-4B
	Long hand crank for circuit breaker				3AX1430-2B
	Hand crank for withdrawable element				3AX1430-2C
Lubricants	180 g of Klüber-Isoflex Topas L32N				3AX1133-3H
	1 kg of Klüber-Isoflex Topas L32N				3AX1133-3E
	1 kg Molykote grease				3AX1133-2L
	1 kg Vaseline, Atlantic				3AX1133-4A
Closing solenoid	24 – 32 V DC		■	■	3AY1410-0B
for On and 1st Shunt	48 V DC		■	■	3AY1410-0C
release	60 V DC		■	■	3AY1410-0D
	110 – 127 V DC		■	■	3AY1410-0E
	220 – 240 V DC		■	■	3AY1410-0F
	100/125 V AC, 50/60 Hz		■	■	3AY1410-0J
	230/240 V AC, 50/60 Hz		■	■	3AY1410-0K
2nd and 3rd Working	24 – 32 V DC		■	■	3AX1101-2B
current release	48 – 60 V DC		■	■	3AX1101-2C
	110 – 127 V DC		■	■	3AX1101-2E
	220 – 240 V DC		■	■	3AX1101-2F
	100 – 125 V AC, 50 Hz		■	■	3AX1101-2G
	230 – 240 V AC, 50 Hz		■	■	3AX1101-2J
	100 – 125 V AC, 60 Hz		■	■	3AX1101-3G
	230 – 240 V AC, 60 Hz		■	■	3AX1101-3J
Current-transformer-	For rated operating current 0.5 A		■	■	3AX1102-2A
operated release	For rated operating current 1 A		■	■	3AX1102-2B
	For tripping impulse ≥ 0.1 Ws, 20 Ω for 7SJ45 protection system		■	■	3AX1104-2B
	For rated operating current 5 A incl. rectifier		■	■	3AX1402-2E
Mounting parts	For 2nd working current/c.t.-operated release			■	3AX1411-5A
	For 2nd and 3rd Release			■	3AX1411-5B

Technical data

Electrical data, dimensions and masses

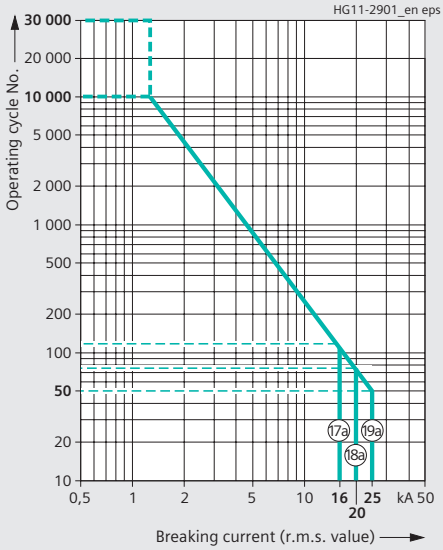
24 kV 50/60 Hz Order No.	Rated operating current I_r A	Pole-centre distance mm	Vertical distance between terminals mm	Rated short-circuit breaking current I_{sc} kA	DC component in % of the rated short-circuit breaking current %	Asymmetric breaking current kA	Rated short-circuit making current (at 50/60 Hz) I_{ma} kA	Rated back-to-back-capacitor-bank inrush making current I_{bi} kA, peak	Rated lightning impulse voltage U_p kV	Rated short-time AC withstand voltage U_d kV	Voltage drop ΔU between connections (acc. to IEC 62271-1 at 100 A DC) mV	Minimum creepage distance vacuum interrupters mm	Minimum creepage distance phase-to-earth mm	Minimum clearance phase-to-phase mm	Minimum clearance phase-to-earth mm	Mass [1] (fixed-mounted circuit breaker / module) kg	Detailed dimension drawing (must be explicitly requested)	Operating cycle diagram No. (see page 60)
3AE5322-1	800	210	310	16	50	19.6	40/42	20	125	50	2.4	240	250	180	185	65/105	A7E10950000	17a
3AE5322-2	1250	210	310	16	50	19.6	40/42	20	125	50	2.4	240	250	180	185	65/105	A7E10950000	17a
3AE5322-4	2000	210	310	16	50	19.6	40/42	20	125	50	1.3	240	248	194	152	126/176	A7E10908000	17
3AE5323-1	800	210	310	20	50	24.5	50/52	20	125	50	2.4	240	250	180	185	65/105	A7E10950000	18a
3AE5323-2	1250	210	310	20	50	24.5	50/52	20	125	50	2.4	240	250	180	185	65/105	A7E10950000	18a
3AE5323-4	2000	210	310	20	50	24.5	50/52	20	125	50	1.3	240	248	194	152	126/176	A7E10908000	18
3AE5323-6	2500	210	310	20	50	24.5	50/52	20	125	50	1.3	240	248	194	152	126/176	A7E10908000	18
3AE5324-1	800	210	310	25	50	30.6	63/65	20	125	50	2.4	240	250	180	185	65/105	A7E10950000	19a
3AE5324-2	1250	210	310	25	50	30.6	63/65	20	125	50	2.4	240	250	180	185	65/105	A7E10950000	19a
3AE5324-4	2000	210	310	25	50	30.6	63/65	20	125	50	1.3	240	248	194	152	126/176	A7E10908000	19
3AE5324-6	2500	210	310	25	50	30.6	63/65	20	125	50	1.3	240	248	194	152	126/176	A7E10908000	19
3AE5352-1	800	275	310	16	50	19.6	40/42	20	125	50	2.4	240	250	245	185	68/108	A7E10950000	17a
3AE5352-2	1250	275	310	16	50	19.6	40/42	20	125	50	2.4	240	250	245	185	68/108	A7E10950000	17a
3AE5352-4	2000	275	310	16	50	19.6	40/42	20	125	50	1.3	240	248	259	152	136/186	A7E10908000	17
3AE5353-1	800	275	310	20	50	24.5	50/52	20	125	50	2.4	240	250	245	185	68/108	A7E10950000	18a
3AE5353-2	1250	275	310	20	50	24.5	50/52	20	125	50	2.4	240	250	245	185	68/108	A7E10950000	18a
3AE5353-4	2000	275	310	20	50	24.5	50/52	20	125	50	1.3	240	248	259	152	136/186	A7E10908000	18
3AE5353-6	2500	275	310	20	50	24.5	50/52	20	125	50	1.3	240	248	259	152	136/186	A7E10908000	18
3AE5354-1	800	275	310	25	50	30.6	63/65	20	125	50	2.4	240	250	245	185	68/108	A7E10950000	19a
3AE5354-2	1250	275	310	25	50	30.6	63/65	20	125	50	2.4	240	250	245	185	68/108	A7E10950000	19a
3AE5354-4	2000	275	310	25	50	30.6	63/65	20	125	50	1.3	240	248	259	152	136/186	A7E10908000	19
3AE5354-6	2500	275	310	25	50	30.6	63/65	20	125	50	1.3	240	248	259	152	136/186	A7E10908000	19
3AE5714-0	1000	210	310	25	50	30.6	63/65	20	125	50	2.4	240	250	180	185	65/105	A7E10950000	19a
3AE5714-1	800	210	310	25	50	30.6	63/65	20	125	50	2.4	240	250	180	185	65/105	A7E10950000	19a
3AE5714-2	1250	210	310	25	50	30.6	63/65	20	125	50	2.4	240	250	180	185	65/105	A7E10950000	19a
3AE5744-4	2000	275	310	25	50	30.6	63/65	20	125	50	1.3	240	248	259	152	136/186	A7E10908005	19
3AE5744-6	2500	275	310	25	50	30.6	63/65	20	125	50	1.3	240	248	259	152	136/186	A7E10908005	19

▲ On request

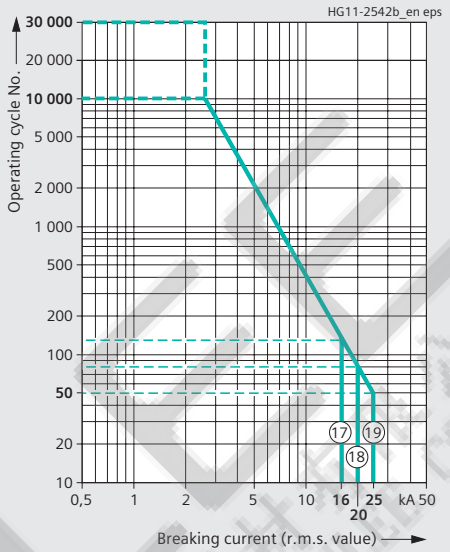
1) The mass of the fixed-mounted circuit breaker, mounted on the withdrawable element, increases by the values specified in the dimension drawing of the withdrawable element (page 58)

3

Operating cycle diagrams for 24 kV



The permissible number of electrical operating cycles is shown as a function of the breaking current (r.m.s. value). All SION vacuum circuit breakers fulfil the endurance classes E2, M2 and C2 according to IEC 62271-100.



The curve shape beyond the parameters defined in IEC 62271-100 is based on average usage data. The number of operating cycles that can actually be reached can be different depending on the respective application.

Technical data

Operating times and internal times, short-circuit protection of motors, consumption data of the releases




Operating times and internal times for 3AE5

Operating times at rated voltage of the secondary circuit	Equipment of circuit breaker	Circuit breaker operating time
Closing time	–	≤ 60 ms
Opening time	1st shunt release	≤ 30 ms
	2nd and 3rd release	≤ 45 ms
Arcing time	–	< 15 ms
Break time	1st shunt release	≤ 45 ms
	2nd and 3rd release	≤ 60 ms
CLOSE/OPEN contact time	1st shunt release	≤ 45 ms
	2nd and 3rd release	≤ 60 ms
Minimum command duration	Closing solenoid	45 ms
	1st shunt release	40 ms
	2nd and 3rd release	20 ms
Pulse time for circuit breaker tripping signal	1st shunt release	> 10 ms
	2nd and 3rd Release	> 6 ms
Charging time for electrical operation		< 15 s
Synchronism error between the poles		≤ 2 ms

Motor short-circuit protection (fuse protection of drive motors) for 3AE5

Rated voltage of the motor	Operating voltage		Power consumption of the motor	Smallest possible rated current [1] of the miniature circuit breaker with C-characteristic
V	max. V	min. V	W / VA	A
24 DC	26	20	140	6
48 DC	53	41	110	3
60 DC	66	51	130	3
110 DC	121	93	100	3
220 DC	242	187	110	1.2
110 AC	121	93	170	3
230 AC	244	187	200	1.2

1) The inrush current in the drive motor can be neglected due to its very short presence.

Consumption data of releases for 3AE5

Release	Power consumption		Tripping ranges	
	Operation at		Tripping voltage	Tripping voltage or triggering current
	DC approx. W	AC 50/60 Hz approx. VA	at DC	At 50/60 Hz AC
Closing solenoid 3AY14 10	300 – 370	300 – 370	85 to 110% U	85 to 110% U
1st shunt release (without stored-energy mechanism) 3AY14 10	300	300	70 to 110% U	85 to 110% U
2nd and 3rd Shunt release (with stored-energy mechanism) 3AX11 01	70	50	70 to 110% U	85 to 110% U
Undervoltage release 3AX11 03	20	20	35 to 100% U	35 to 100% U
C.t.-operated release 3AX (rated operating current 0.5 A, 1 A or 5 A)	–	10 [2]	–	90 to 110% I_a
C.t.-operated release 3AX11 04 (tripping pulse ≥ 0.1 Ws)	–	–	–	–

2) Consumption at pickup current (90% of the rated operating current) and open armature.

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