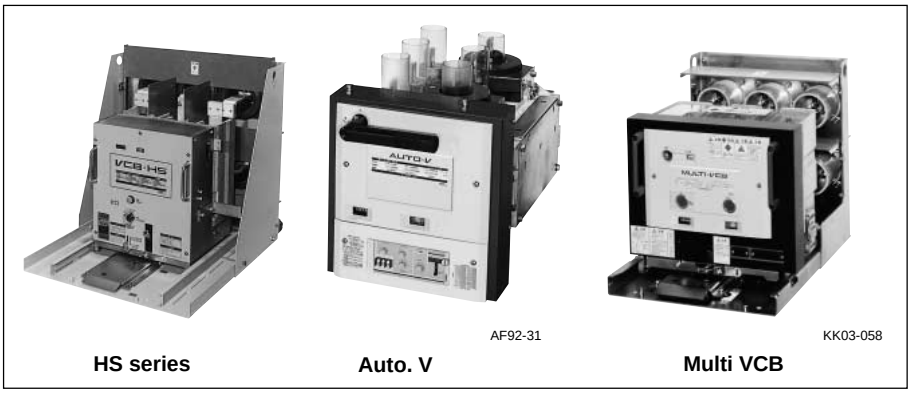
■ FUJI vacuum circuit breakers

Vacuum circuit breakers are compact circuit breakers designed for safe operation, high reliability and easy maintenance, and are widely used for various types of high voltage circuits. FUJI V-circuit breakers (VCB) have been developed through the use of our many years of successful experience and advanced technology. They are compact and light-weight, and are available in a number of current ratings.



HS series **Auto. V** **Multi VCB**

● HS series

These types are available in all ratings from 3.6 to 36kV, and can be applied to a variety of H.V. switchgear. The motor-spring stored-energy types feature auto-reclosing. The HS types are comparatively high in breaking current with ratings of over 7.2kV, 20kA.

- Breaking currents: 12.5kA to 50kA
- Rated voltage: 3.6kV to 36kV
- Standards: JEC, IEC

See page 12/4.

● Auto. V

Auto. Vs are provided with a built-in electronic overcurrent relay and toroidal-type CT.
They require little space for installation and also facilitate the system wide protective coordination.
The inverse-time operating and instantaneous trip currents can be set by means of the dial.

- Breaking currents: 8kA, 12.5kA
- Rated voltage: 3.6/7.2kV
- Standards: JIS C4603

See page 12/26.

● Multi VCB

The Multi VCBs are general purpose VCBs which are small in size and simple in construction thus allowing them to be applied to many types of switchgear.

- Breaking currents: 8kA, 12.5kA
- Rated voltage: 3.6/7.2kV
- Standards: JIS C4603

See page 12/45.

■ Quick selection table

Breaking current (kA)	Rated current JIS, JEC (A)	Rated voltage (kV)	Closing system	Type □ : Installation
20	600 1200 2000	3.6/7.2	Motor-spring	**HS2006□-06Mf-E** **HS2006□-12Mf-E** **HS2006□-20Mf-E**
25	600 1200 2000	3.6/7.2		**HS2506□-06Mf-E** **HS2506□-12Mf-E** **HS2506□-20Mf-E**
31.5	1200 2000 3000	3.6/7.2		**HS3106□-12Mf-E** **HS3106□-20Mf-E** Discontinued Mar.2007 **HS3106□-30Mf-N**
40	1200 2000 3000 4000	3.6/7.2		**HS4006□-12Mf-E** **HS4006□-20Mf-E** Discontinued Mar.2007 **HS4006□-30Mf-N** **HS4006□-40Mf-N**
50	1200 2000 3000	3.6/7.2		**HS5006□-12Mf-NA** **HS5006□-20Mf-NA** **HS5006□-30Mf-N**
12.5	600 1200 2000	12		**HS1210□-06Mf-E** **HS1210□-12Mf-E** **HS1210□-20Mf-E**
16	600 1200 2000	12		**HS1610□-06Mf-E** **HS1610□-12Mf-E** **HS1610□-20Mf-E**
20	600 1200 2000	12		**HS2010□-06Mf-E** **HS2010□-12Mf-E** **HS2010□-20Mf-E**
25	600 1200 2000	12		**HS2510□-06Mf-E** **HS2510□-12Mf-E** **HS2510□-20Mf-E**
31.5	1200 2000 3000	12		**HS3110□-12Mf-E** **HS3110□-20Mf-E** **HS3110□-30Mf-N**

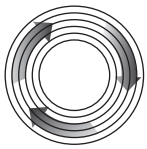
Breaking current (kA)	Rated current JIS, JEC (A)	Rated voltage (kV)	Closing system	Type □ : Installation
40	1200 2000 3000 4000	12	Motor-spring	**HS4010□-12Mf-NA** **HS4010□-20Mf-NA** **HS4010□-30Mf-N** **HS4010□-40Mf-N**
50	1200 2000 3000	12		**HS5010□-12Mf-NA** **HS5010□-20Mf-NA** **HS5010□-30Mf-N**
12.5	600 1200	24		**HS1220□-06Mf-K** **HS1220□-12Mf-K**
16	600 1200	24		**HS1620□-06Mf-E** **HS1620□-12Mf-E**
25	600 1200 2000	24		**HS2520□-06Mf-E** **HS2520□-12Mf-E** **HS2520□-20Mf-E**
40	1200 2000 3000	24		**HS4020□-12Mf-N** **HS4020□-20Mf-N** **HS4020□-30Mf-N**
25	600 1200 2000	36		**HS2530□-06Mf-N** **HS2530□-12Mf-N** **HS2530□-20Mf-N**
8.0 12.5	400 600	3.6/7.2	Manual-spring	**HA08□-H□** **HA12□-H□**
8.0 12.5	400 600	3.6/7.2	Motor-spring Fixed	**HA08□-A□** **HA12□-A□**
8.0 12.5	400 600	3.6/7.2	Motor-spring Draw-out	**HA08A□-A8** **HA12A□-A8**
8.0 12.5	400 600	3.6/7.2	Motor-spring Fixed	**HA08□-A□** **HA12□-A□**
8.0 12.5	400 600	3.6/7.2	Motor-spring Draw-out	**HA08A□-A□** **HA12A□-A□**

Note: □ Installation : *See pages 12/4 for HS series, 12/26 for Auto. V and 12/45 for Multi VCB.*

■ **Description**
3.6kV to 36kV, 600 to 4000A, 12.5 to 50kA

The revolutionary arc extinguishing system

● **Rotary**

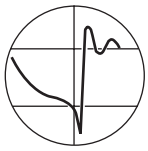


FUJI VCBs have employed a unique design principle in which the contacts are provided with a succession of slits having toroidal-type CrCu contacts mounted on them.
The arc is driven round the circular contact surface as it is being extinguished. Since the arc is not localized at one point there is no fear of overheating.
This results in much improved inter-electrode dielectric strength so ensuring excellent breaking capability. Moreover, uneven contact wear is minimized.

● **Getter**

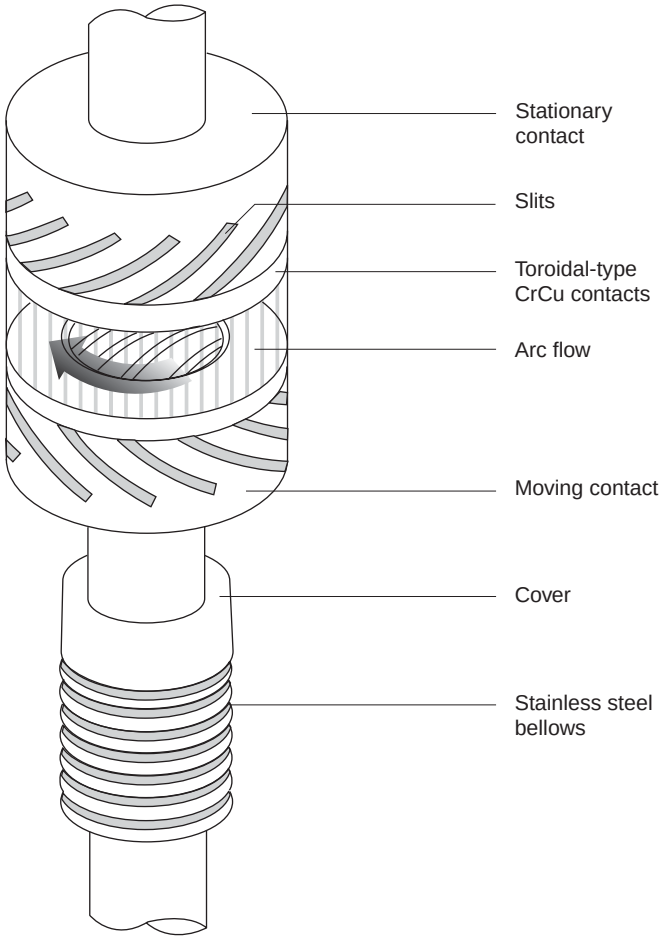
FUJI vacuum interrupters make use of the gettering effect. The toroidal-type contacts are made of a special chromium-copper (CrCu) alloy specially developed by FUJI so as to ensure a large “getter” quality.
The metallic gases thus produced at interruption and left in the vacuum are quickly absorbed by the getter. The gases are neutralized so maintaining the high degree of vacuum.
The interrupters require a minimum of attention over their long service life.

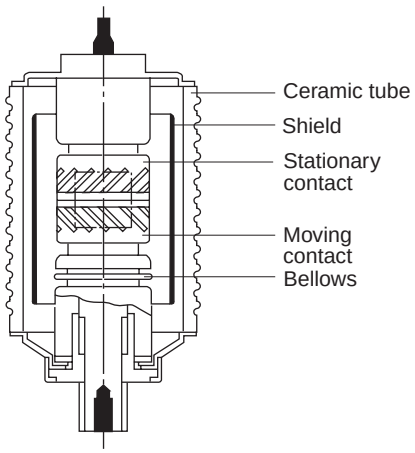
● **Surge**



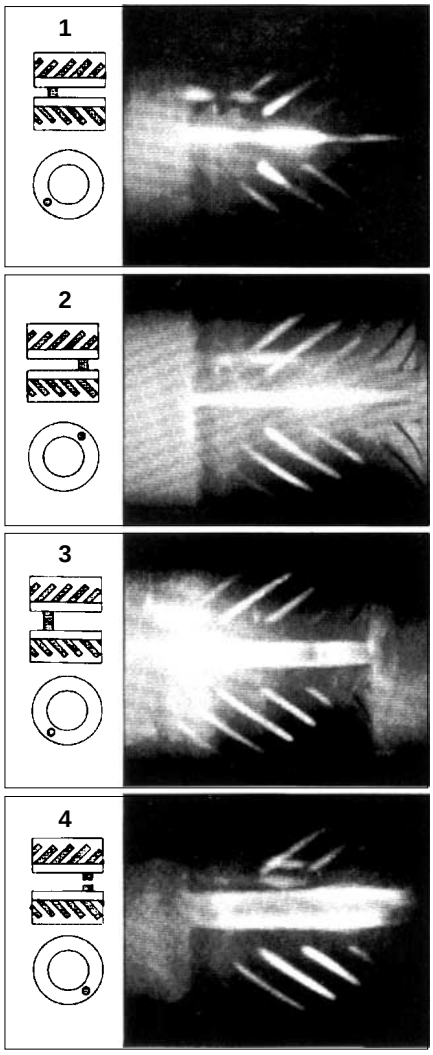
Switching surges can be generated at small current breaking due to the VCB inherent chopping current.
FUJI has paid much attention to this problem, and after much effort on design and materials research it has been possible to reduce the chopping current to 3.5 Amps. This very small chopping current means that the corresponding surge voltage will be reduced and cost efficient surge protection can be carried out for motors, transformers and other load equipment.

The revolutionary arc extinguishing system





● Progress of arc extinction
Arcs generated by VCBs have inherent characteristics that change when approximately 10kA is reached. Less than 10kA a dispersed arc occurs, over this value the arc is concentrated. The photos were taken consecutively and illustrate an interruption in the 25kA range (concentrated arc). About 4 1/2 rotations occurred (10ms at 50Hz). This time is typical, but varies according to breaking current and arcing times.



Explanation
1. The contacts begin to open and the arc moves from the center to the left hand side.
2. 3. The arc is driven round the toroidal-type contact surface.
4. The contacts are in the full open position just before interruption is completed.

■ Definitions

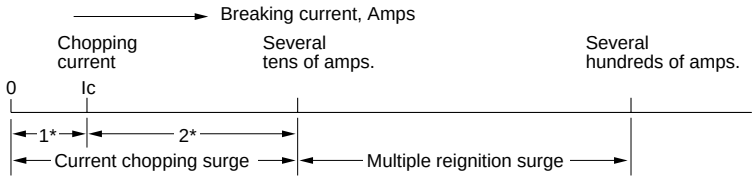
● What is the action of the "getter"?
Sometimes called a "degasser" the "getter" uses a special material such as zirconium alloy that has the property of absorbing metallic gases in a vacuum. This allows the high degree of vacuum to be maintained.

● Switching surges and VCBs?
Switching surges can be generated when breaking currents within several hundreds range.
VCB inherent switching surges are generated under certain specific conditions which mainly comprise current chopping surges and multiple current reignition surges. No problem is posed by switching surges when breaking current exceeds several hundred amperes.

Surge voltages
The value of the surge voltage due to switching surges varies according to the load circuit conditions.
This can be expressed in the following simple formula:
Surge voltage = Surge impedance × Chopping current
Therefore, it is necessary to keep the chopping current low in order to reduce the surge voltage to the minimum. The peak transient voltage is obtained by adding to the above calculation the voltage on the load side at the time of current chopping.

Chopping surge
The chopping surge occurs when a low current is interrupted, the arc is unstable before current becomes zero and the current is forcedly chopped. At this time a surge is generated by the energy remaining in the load inductance.
Example:
When the no-load interruption of a transformer is carried out the exciting current only is interrupted.

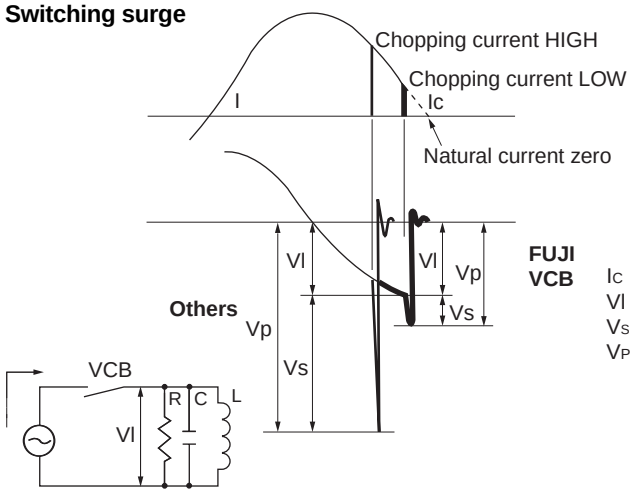
Chopping surge



1* Chopping surge suppresed by reignition
2* Chopping surge not accompanied with reignition

Multiple reignition surge
The multiple reignition surges can occur when breaking currents range from tens to hundreds of amperes. Although no problem is normally posed even when breaking these currents, a high surge voltage can be generated when breaking an inrush current on starting the motors.

Switching surge



FUJI VCB
- Ic : Chopping current
- Vl : Voltage at load side
- Vs : Surge transient voltage
- Vp : Peak transient voltage
  Vp= Vl + Vs
  Vs= Surge impedance × Ic
  Surge impedance:

$$Z=\sqrt{\frac{L}{C}}$$

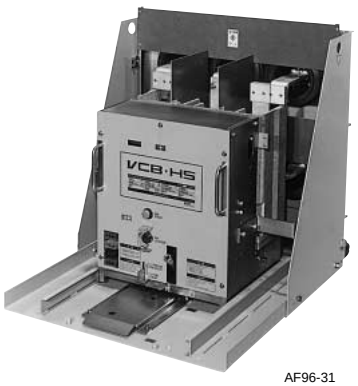
12

■ Description

HS type 3.6kV to 36kV up to 63kA. FUJI HS series vacuum circuit breakers are designed to meet the many special needs of industry. The vacuum interrupter system employed reflects the latest technology. The circuit breaker has a very stable and constant breaking performance over a wide range of currents up to the rated short circuit current value.
The motor spring type (M) closing system can perform high speed reclosing.
The contacts are made of a special alloy and require no maintenance over their long life time.
The interrupter is provided with a contact-wear indicator which gives notice when replacement is required.
The open and close positioning indicator, operating counter, pushbutton for manual interruption and manual closing device are conveniently installed on the control section of the dead-front operating panel, and are isolated from the high-voltage breaking section for safety reasons and to facilitate operation and inspection. FUJI VCBs comprise the fixed mounted (P) type and cradle (X and Y) types. Since the cradle version is provided with a draw-out system switchgear assembly is easily carried out.

■ Ordering information

Specify the following:
1. Type number
2. Rated voltage, current and frequency
3. Rated breaking capacity
4. Installation system
5. Operating voltage and frequency (M) of closing system
6. Voltage and current of tripping system
7. Optional accessories, if required



AF96-31

Series of FUJI VCB

Breaking current \ Rated voltage	3.6kV	7.2kV	12kV	15kV	24kV	36kV
12.5kA	–		HS1210: 600A 1200A, 2000A	–	HS1220: 600A 1200A	–
16kA	–		HS1610: 600A 1200A, 2000A	HS1615: 600A, 1200A, 2000A	HS1620: 600A 1200A	–
20kA	HS2006: 600A 1200A, 2000A		HS2010: 600A 1200A, 2000A	HS2015: 600A, 1200A, 2000A	–	–
25kA	HS2506: 600A 1200A, 2000A		HS2510: 600A 1200A, 2000A	HS2515: 600A, 1200A, 2000A	HS2520: 600A 1200A, 2000A	HS2530: 600A 1200A, 2000A
31.5kA	HS3106: 1200A 2000A, 3000A		HS3110: 1200A 2000A, 3000A	HS3115: 600A, 1200A, 2000A	–	–
40kA	HS4006: 1200A 2000A, 3000A, 4000A4000A		HS4010: 1200A 2000A, 3000A	HS4015: 600A, 1200A, 2000A	HS4020: 1200A 2000A, 3000A	–
50kA	HS5006: 1200A, 2000A, 3000A		HS5010: 1200A 2000A, 3000A	–	–	–
63kA	HS6306: 1200A, 2000A		–	–	–	–

■ Type number nomenclature

HS 20 06 M- 06 M f

Basic type
HS: 7.2kV 12.5kA and over

Rated breaking current
12: 12.5kA 31: 31.5kA
16: 16kA 40: 40kA
20: 20kA 50: 50kA
25: 25kA 63: 63kA

Rated voltage
06: 3.6/7.2kV 20: 24kV
10: 12kV 30: 36kV

Installation
P : Fixed type
X : Draw-out type with cradle for JEM1425 Class CW
U : Draw-out type with cradle for JEM1425 Class CW
Y : Draw-out type with cradle and shutter for JEM1425 MW, PW
M: Draw-out type for HS2530

Tripping system
f : Shunt trip
Specify the frequency and voltage (AC or DC)

Closing system
M: Motor-spring stored energy (High speed reclosing)
Specify the frequency and voltage (AC or DC)

Rated current
06: 600, 630A 20: 2000A
12: 1200, 1250A 30: 3000A
40: 4000A

■ Specifications

Type			HS2006□ -■Mf-E		HS2506□ -■Mf-E		HS3106□ -■Mf-E	
Rated voltage [kV]			3.6	7.2	3.6	7.2	3.6	7.2
Rated current [A] ■ :06, 12, 20, 30		JEC	600, 1200 2000		600, 1200 2000		1200, 2000, 3000	
		IEC	630, 1250 2000		630, 1250 2000		1250, 2000, 3000	
Rated breaking capacity		[kA]	20		25		31.5	
		[MVA] Ref. value	125	250	160	310	200	390
Rated short-circuit making current [kA]			50		63		80	
Rated short-time withstand current [kA]		JEC: 2 sec. IEC: 1 sec. *1	20 20		25 25		31.5 31.5	
Rated breaking time [cycle]			3		3		3	
Rated withstand voltage	Power frequency (1 min.)	JEC [kV] IEC [kV]	22 20		22 20		22 20	
	Impulse (1.2×50μs) [kV]		60		60		60	
Closing time at no load [sec]			0.04		0.04		0.04 (3000A: 0.05)	
Rated operating sequence		JEC IEC	O-1min-CO-3min-CO, O-3min-CO-3min-CO,		CO-15s-CO or O-0.35s-CO-1min-CO CO-15s-CO or O-0.3s-CO-3min-CO			
Opening time [sec.]		JEC	0.03		0.03		0.03	
		IEC	0.03		0.03		0.03	
Closing system			Motor-spring stored energy (High speed reclosing) (M)					
Operating voltage and current for closing			100V AC/DC, 1.7A*3 200V AC/DC, 1A		100V AC/DC, 2A 200V AC/DC, 1A		100V AC/DC, 2.5A 200V AC/DC, 1.7A	
Control voltage and current for closing			100V AC/DC, 4A 200V AC/DC, 2A		100V AC/DC, 4A 200V AC/DC, 2A		100V AC/DC, 5A 200V AC/DC, 2.5A	
Tripping system*2			Shunt trip (f)					
Operating voltage and current for tripping			100V DC, 4A 200V DC, 2A				100V DC, 4A 200V DC, 2A	
Auxiliary contact			4NO+4NC, Rating 100/200V AC: 20/10A, 100/200V DC: 5/3A					
Durability	Mechanical [operations] Electrical [operations]		10000 10000					
Installation □			P, Y X, U (600, 1200A only)		P, Y X, U (600, 1200A only)		P, Y X (1200, 2000A only)	
Mass (draw-out type without cradle)[kg]			62 (X, U, Y: 600A) 66 (Y: 1200A) 117 (Y: 2000A)		66 (X, U, Y: 600A) 70 (Y: 1200A) 117 (Y: 2000A)		122 (X, Y: 1200A) 130 (X, Y: 2000A) 220 (Y: 3000A)	

Notes: *1 Contact FUJI for the information concerning the 3 sec. rating of IEC.
*2 If capacitor tripping system is required, connect a capacitor trip device VCB-T1A or VCB-T2A (optional accessory) to AC power supply.
*3 2A for 2000A rating.

■ Specifications

Type			HS4006□ -■Mf-E		HS4006□ -40Mf-N		HS5006□ -■Mf-NA		HS5006□ -30Mf-N		HS6306□ -■Mf-NB	
Rated voltage [kV]			3.6	7.2	3.6	7.2	3.6	7.2	3.6	7.2	3.6	7.2
Rated current [A] ■: 12, 20, 30		JEC	1200, 2000, 3000		4000		1200, 2000		3000		1200, 2000	
		IEC	1250, 2000, 3000		4000		1250, 2000		3000		1250, 2000	
Rated breaking capacity		[kA]	40		40		50		50		63	
		[MVA] Ref. value	250	500	250	500	310	620	310	620	390	780
Rated short-circuit making current [kA]			100		100		125		125		160	
Rated short-time withstand current [kA]	JEC: 2 sec. IEC: 1 sec. *1		40 40		40 40		50 50		50 50		63 63	
Rated breaking time [cycle]			5		5		5		5		5	
Rated withstand voltage	Power frequency (1 min.)	JEC [kV] IEC [kV]	22 20		22 20		22 20		22 20		22 20	
	Impulse (1.2×50μs) [kV]		60		60		60		60		60	
Closing time at no load [sec]			0.04(3000A: 0.05)		0.1		0.1		0.1		0.1	
Rated operating sequence		JEC IEC	O-1min-CO-3min-CO, CO-15s-CO or O-0.35s-CO-1min-CO O-3min-CO-3min-CO, CO-15s-CO or O-0.3s-CO-3min-CO									
Opening time [sec.]		JEC	0.03		0.07		0.07		0.07		0.07	
		IEC	0.04		0.07		0.07		0.07		0.07	
Closing system			Motor-spring stored energy (High speed reclosing) (M)									
Operating voltage and current for closing			100V AC/DC, 2.5A 200V AC/DC, 1.7A		100V AC/DC, 6A 200V AC/DC, 3A		100V AC/DC, 6A 200V AC/DC, 3A		100V AC/DC, 6A 200V AC/DC, 3A		100V AC/DC, 6A 200V AC/DC, 3A	
Control voltage and current for closing			100V AC/DC, 5A 200V AC/DC, 2.5A		100V AC/DC, 4A 200V AC/DC, 2A		100V AC/DC, 4A 200V AC/DC, 2A		100V AC/DC, 4A 200V AC/DC, 2A		100V AC/DC, 4A 200V AC/DC, 2A	
Tripping system *2			Shunt trip (f)									
Operating voltage and current for tripping			100V DC, 4A: JEC 3A: IEC 200V DC, 2A: JEC 1.5A: IEC		100V DC, 4A 200V DC, 2A							
Auxiliary contact			4NO+4NC, Rating 100/200V AC: 20/10A, 100/200V DC: 5/3A									
Durability	Mechanical [operations] Electrical [operations]		10000 10000									
Installation □			P, Y X (1200, 2000A only)		P, X, Y		P, Y		P, Y		Y	
Mass (draw-out type without cradle) [kg]			122 (X, Y: 1200A) 130 (X, Y: 2000A) 220 (Y: 3000A)		400		240		320		350	

Notes: *1 Contact FUJI for the information concerning the 3 sec. rating of IEC.
*2 If capacitor tripping system is required, connect a capacitor trip device VCB-T1A or VCB-T2A (optional accessory) to AC power supply.

■ Specifications

Type			HS1210□ -■Mf-E	HS1610□ -■Mf-E	HS2010□ -■Mf-E	HS2510□ -■Mf-E	HS3110□ -■Mf-E
Rated voltage [kV]			12	12	12	12	12
Rated current [A] ■: 06, 12, 20		JEC	600, 1200 2000	600, 1200 2000	600, 1200 2000	600, 1200 2000	1200, 2000
		IEC	630, 1250 2000	630, 1250 2000	630, 1250 2000	630, 1250 2000	1250, 2000
Rated breaking capacity		[kA]	12.5	16	20	25	31.5
		[MVA] Ref. value	260	330	415	520	650
Rated short-circuit making current [kA]			31.5	40	50	63	80
Rated short-time withstand current [kA]	JEC: 2 sec. IEC: 1 sec. *1		12.5 12.5	16 16	20 20	25 25	31.5 31.5
Rated breaking time [cycle]			3	3	3	3	3
Rated withstand voltage	Power frequency (1 min.)	JEC [kV] IEC [kV]	28 28	28 28	28 28	28 28	28 28
	Impulse (1.2×50μs) [kV]		75	75	75	75	75
Closing time at no load [sec.]			0.04	0.04	0.04	0.04	0.04
Rated operating sequence		JEC	O-1min-CO-3min-CO, CO-15s-CO or O-0.35s-CO-1min-CO				
		IEC	O-3min-CO-3min-CO, CO-15s-CO or O-0.3s-CO-3min-CO				
Opening time [sec.]		JEC	0.03	0.03	0.03	0.03	0.03
		IEC	0.03	0.03	0.03	0.03	0.03
Closing system			Motor-spring stored energy (High speed reclosing) (M)				
Operating voltage and current for closing			100V AC/DC, 1.7A (600, 1200A), 2.5A (2000A) 200V AC/DC, 1A (600, 1200A), 1.7A (2000A)				100V AC/DC, 2.5A 200V AC/DC, 1.7A
Control voltage and current for closing			100V AC/DC, 4A (600, 1200A), 5A (2000A) 200V AC/DC, 2A (600, 1200A), 2.5A (2000A)				100V AC/DC, 5A 200V AC/DC, 2.5A
Tripping system*2			Shunt trip (f)				
Operating voltage and current for tripping			100V DC, 4A 200V DC, 2A				100V DC, 4A 200V DC, 2A
Auxiliary contact			4NO+4NC, Rating 100/200V AC: 20/10A, 100/200V DC: 5/3A				
Durability	Mechanical [operations] Electrical [operations]		10000 10000				
Installation □			P, Y X (600, 1200A only)	P, Y X (600, 1200A only)	P, Y X (600, 1200A only)	P, Y X (600, 1200A only)	P, X, Y
Mass (draw-out type, without cradle) [kg]			71 (Y: 600A) 71 (Y: 1200A) 130 (X, Y: 2000A)	71 (Y: 600A) 71 (Y: 1200A) 130 (X, Y: 2000A)	71 (Y: 600A) 71 (Y: 1200A) 130 (X, Y: 2000A)	75 (Y: 600A) 75 (Y: 1200A) 130 (X, Y: 2000A)	122 (X, Y: 1200A) 130 (X, Y: 2000A)

Notes: *1 Contact FUJI for the information concening the 3 sec. rating of IEC.
*2 If capacitor tripping system is required, connect a capacitor trip device VCB-T1A or VCB-T2A (optional accessory) to an AC power supply.

■ Specifications

Type			HS3110 -30Mf-N	HS4010 -■Mf-NA	HS4010 -■Mf-N	HS5010 -■Mf-NA	HS5010 -30Mf-N
Rated voltage [kV]			12	12	12	12	12
Rated current [A] ■: 12, 20, 30, 40		JEC	3000	1200, 2000	3000, 4000	1200, 2000	3000
		IEC	3000	1250, 2000	3000, 4000	1250, 2000	3000
Rated breaking capacity		[kA]	31.5	40	40	50	50
		[MVA] Ref. value	650	830	830	1040	1040
Rated short-circuit making current [kA]			80	100	100	125	125
Rated short-time withstand current [kA]	JEC: 2 sec. IEC: 1 sec. *1		31.5 31.5	40 40	40 40	50 50	50 50
Rated breaking time [cycle]			3	5	5	5	5
Rated withstand voltage	Power frequency (1 min.)	JEC [kV] IEC [kV]	28 28	28 28	28 28	28 28	28 28
	Impulse (1.2×50μs) [kV]		75	75	75	75	75
Closing time at no load [sec.]			0.1	0.1	0.1	0.1	0.1
Rated operating sequence		JEC IEC	O-1min-CO-3min-CO, CO-15s-CO or O-0.35s-CO-1min-CO O-3min-CO-3min-CO, CO-15s-CO or O-0.3s-CO-3min-CO				
Opening time [sec.]		JEC	0.04	0.04	0.04*3	0.07	0.07
		IEC	0.04	0.04	0.04*3	0.07	0.07
Closing system			Motor-spring stored energy (High speed reclosing) (M)				
Operating voltage and current for closing			100V AC/DC, 6A 200V AC/DC, 3A				
Control voltage and current for closing			100V AC/DC, 4A 200V AC/DC, 2A				
Tripping system*2			Shunt trip (f)				
Operating voltage and current for tripping			100V DC, 4A 200V DC, 2A				
Auxiliary contact			4NO+4NC, Rating 100/200V AC: 20/10A, 100/200V DC: 5/3A				
Durability	Mechanical [operations] Electrical [operations]		10000 10000				
Installation			P, Y	P, Y	P, Y(3000A) X(4000A)	P, Y	P, Y
Mass (draw-out type without cradle) [kg]			320	240	320 (3000A) 400 (4000A)	240	320

Notes: *1 Contact FUJI for the information concerning the 3 sec. rating of IEC.
*2 If capacitor tripping system is required, connect a capacitor trip device VCB-T1A or VCB-T2A (optional accessory) to AC power supply.
*3 0.07s for 4000A rating.