

# H.V. Distribution Equipment

## Vacuum circuit breakers

### Auto. V

#### Auto.V

##### ■ Description

7.2/3.6kV, 400A, 600A, 8kA, 12.5kA  
FUJI Auto. Vs are vacuum circuit breakers which incorporate a built-in solid-state OCR and CT.

As they do not require to have a CT installed inside the switchgear cubicle or an OCR fixed to the front panel, space is saved in the cubicle and wiring and installation are simplified.

A system protection is easily arranged using Auto. Vs with primary circuit breaker and also a protective coordination with low voltage MCCBs. The CT is a compactly built toroidal type and it is fitted to the upper part of the VCB. Its overcurrent withstanding value is as large as 12.5kA, 1 sec.

##### ■ Features

- Built-in solid-state OCR and CT are provided
- System protective coordination is easily arranged using the VCBs.
- Compactly assembled, so saving space
- With a CT having a large overcurrent withstand value of 12.5kA
- The setting range of the rated current is 24A to 320A.
- Applicable to the receiving and distribution facilities of 6kV, 170 to 2000kVA.



AF92-35

##### ■ Specifications

Type	HA08□-H6 HA08□-H7	HA12□-H6 HA12□-H7	HA08□-A6 HA08□-A7	HA12□-A6 HA12□-A7
Closing system	Manual-spring		Motor-spring	
Installation □	Fixed: B, C, P		Fixed: B, C, P	
Rated voltage (kV)	3.6/7.2		3.6/7.2	
Rated current (A)	400	600	400	600
Rated frequency (Hz)	50/60		50/60	
Rated breaking capacity (kA)	8 50MVA at 3.6kV 100MVA at 7.2kV	12.5 80MVA at 3.6kV 160MVA at 7.2kV	8 50MVA at 3.6kV 100MVA at 7.2kV	12.5 80MVA at 3.6kV 160MVA at 7.2kV
Rated making current, peak value (kA)	20	31.5	20	31.5
Rated closing time (s)	—		0.03	
Rated short-time current, 1 second (kA)	8	12.5	8	12.5
Insulation level	Dielectric: 22kV, 1 minute    Impulse (1.2 × 50μs): 60kV			
Rated breaking time	3-cycle		3-cycle	
Opening time (s)	0.03		0.03	
Operating duty	0 — 1 min. — CO — 3 min. — CO or CO — 15 sec. — CO			
OCR	Rated operating current setting value *1 (A)	24—30—36—42—48—60—75—90—105—120—160—200—240—280—320		
	Instantaneous trip current	5, 7.5, 10, 12.5, 15 times the rated operating current		
	Operating current	Inverse time element	Within ± 10% of each setting current	
		Instantaneous element	Within ± 15% of each setting current	
Operating time	Inverse time element	Time setting 10:	Input 300% 10 sec.	Input 700% 1.6 sec.
		Time setting 6 :	Input 300% 6 sec.±17%	Input 700% 1 sec.±12%
Inertia characteristic	Instantaneous element	Less than 0.05 sec. at 200% of setting current		
		90% of the operating time obtained when 1,000% of the setting value input at minimum current setting value and time setting 10.		
Durability	Mechanical (operations)	10,000		
	Electrical (operations)	10,000		
No. of operations (operations/hour)	60			
Applicable capacitor capacity *2 (kVA)	3,000	5,000	3,000	5,000
Auxiliary contact	2NO + 2NC (5NO + 5NC available on request)			
Alarm contact	1NO 100/110V AC 2.0A, 200/220V AC 1.0A, 100/110V DC 0.3A			
Mass (kg)	Fixed	25	28	27
Standard	H.V. circuit breaker: JIS C 4603 (1990)    AC circuit breaker: JEC2300 (1998) Overcurrent relays for H. V. power receiving: JIS C 4602 (1986)			

Note: \*1 Operating current setting value 8 to 80A is also available.

\*2 Maximum values when the VCB is used with a 6% reactor connected in a 6.6kV AC circuit.  
Halve these values for a 3.3kV AC circuit.

#### ■ Design features

The four dials facilitate the setting of the overcurrent protection as follows:

#### ● Rated operating current

Rated current range: 24 to 320A  
(8 to 80A)

No. of steps: 15

Steps from 24A to 320A can be set by the two dials—CT's primary current dial and multiplying factor dial of primary current. These breakers are most suitable for receiving and distributing facilities with capacities from 6kV, 170 to 2000kVA. Since the rating for the primary current can be freely changed expenses for changing the CT ratio can be saved when expanding electrical facilities.

#### ● Operating time

No. of steps: 16 (T=50 to T=0.5)

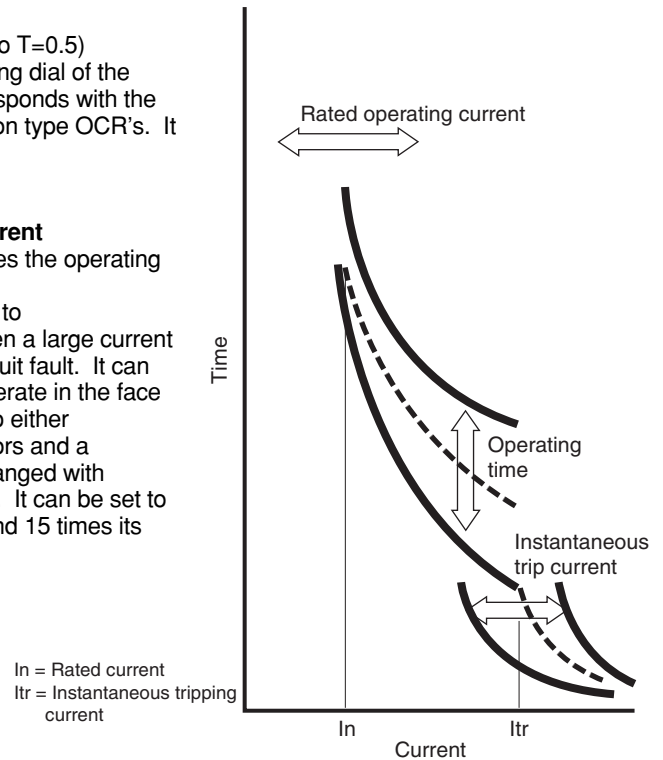
The operating time setting dial of the solid-state OCR's corresponds with the time lever of the induction type OCR's. It has 16 steps, from T = 50 to T = 0.5.

#### ● Instantaneous trip current

Trip current: 5 to 15 times the operating current.

This device is designed to instantaneously trip when a large current flows due to a short-circuit fault. It can be set so it does not operate in the face of inrush currents due to either transformers or capacitors and a coordination can be arranged with primary circuit breakers. It can be set to operate at between 5 and 15 times its operating current.

#### Operating current and time setting range for Auto. V



#### Rated operating current setting dials

The combination of these two dials permits the setting of 15 possible combinations.

#### ① Rated operating current value (A)

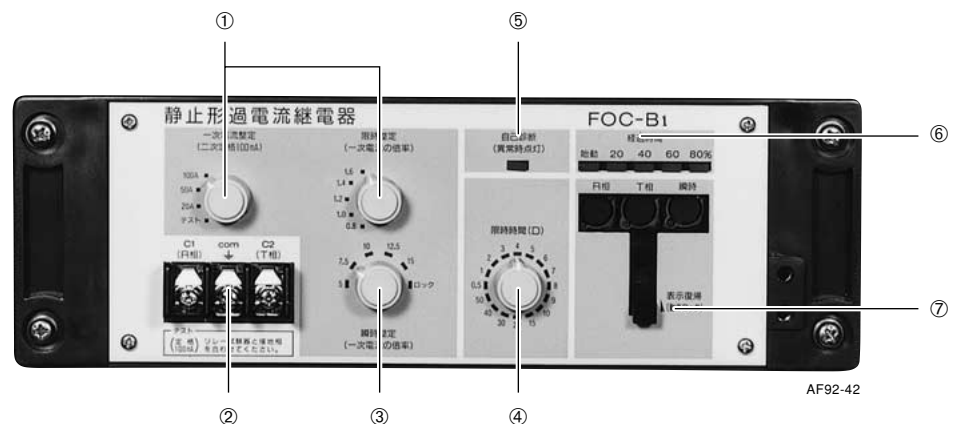
Primary current setting dial		Multiplying factor dial				
		0.8	1.0	1.2	1.4	1.6
Standard	30A	24	30	36	42	48
	75A	60	75	90	105	120
	200A	160	200	240	280	320
TEST	Set at this point when carrying out the operating test of OCR's					

#### ② Terminals for operating tests

When carrying out the operating test, set the rated operating current setting dial at the TEST position and apply the test current between the C1-com and C2-com terminals.

#### ③ Instantaneous tripping current setting dial

This can be set to 5 to 15 times the rated operating current value. When set at the LOCK position the instantaneous function stops.



#### ④ Operating time setting dial

This corresponds to the time lever for the induction type relay and can be set at 16 steps, from T = 50 to T = 0.5.

#### ⑤ Self diagnostic function

Continuously monitors operation of the internal microcomputer and lights alarm LEDs on detection of abnormal conditions.

#### ⑥ Elapsed operating time indicators (LEDs)

- Start: This LED lights whenever main circuit current exceeds the operating current setting for overcurrent interruption.
- Elapsed operating time: These four LEDs indicate the breaker's overcurrent activation status in 20, 40, 60, or 80% of the maximum overcurrent duration before interruption occurs.

#### ⑦ Reset lever

Resets the OCR and its operation indicators.

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#### ■ Design features

##### ● Auto. V improves system dependability

FUJI solid-state type OCR's are provided with the ideal inverse time characteristics instead of the conventional electronic type linear characteristics.

In the case of the conventional induction type OCR's their long inverse time zone in characteristic curves do not extend smoothly, and so they do not meet the requirements of the operating characteristics of L. V. breakers thus making it difficult to arrange a coordination. The operating time of Auto. V's at 300% current has been greatly improved to 10 sec. as against 2 to 3 sec. for conventional OCR's. The function to extend the operating time by five times, an option of the previous Auto. V is included in the new Auto. V as a standard feature.

##### ● Inertia characteristics exceed 90%

The inertia characteristics correspond with the "non-operating characteristics (permissible)".

When carrying out the coordination with the low voltage MCCB's, it is necessary to consider the "non-operating characteristics" and "coordination" in which the inertia characteristics are taken into consideration.

In the case of the induction type OCR's the inertia characteristics normally exceed 60%, thus make it difficult to establish coordination with low voltage MCCB's. On the other hand in the electronic type OCR's their inertia characteristics exceed 90%, giving them ideal operating characteristics.

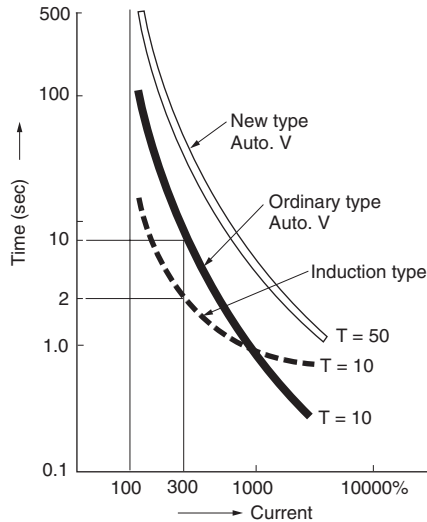
##### ● The overcurrent withstanding value of the CT is 12.5kA

The CT built in the Auto. V is extremely small in size but its toroidal design permits it to withstand overcurrents having values as large as 12.5kA for 1 sec.

##### CT with large overcurrent constant

The internal CT's overcurrent constant of 20 or more was achieved by combining a CT with a very low activation power OCR. When using a CT in combination with a protective relay, the CT's overcurrent constant must be large enough for the overcurrent. To determine compatibility, overall OCR operation must be checked from the combined CT and OCR characteristics as shown in the figure at right.

The operating characteristics of Auto. V and induction type OCR (FUJI CH1-53 type)

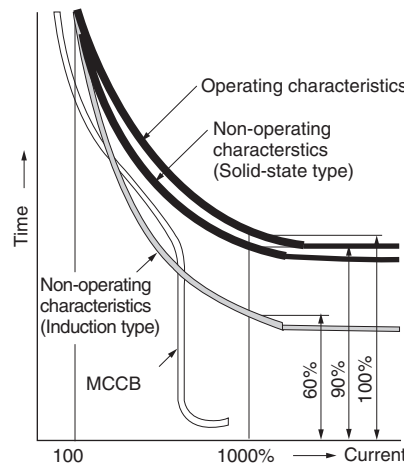


#### ■ Operating characteristics of overcurrent relays

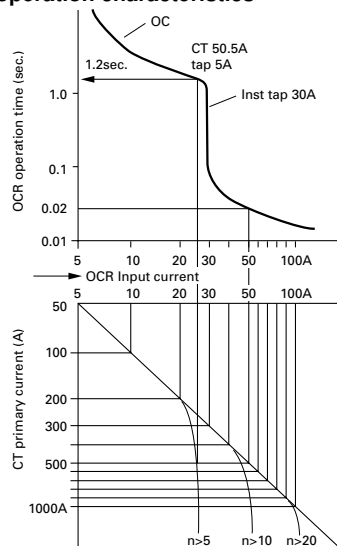
The curves indicate the time-current characteristics of OCR's. These characteristics meet the requirements of JIS C4602 "Overcurrent Relays for H. V. Power Receiving"

Note: For practical dial setting method or the test method of solid state OCR's please contact FUJI.

The inertia characteristics of Auto. V and induction type OCR



CT overcurrent constant and OCR operation characteristics



Note:

\* Overcurrent constant

In CT the secondary current increases proportionally to the increase of the primary current.

When the value exceeds a certain value a saturation takes place due to magnetic saturation. The overcurrent constant(n) indicates the value obtained by dividing, the current value at the point where the error reaches 10%, by the rated current.

$$n = \frac{\text{Current at the point where the error reach 10\%}}{\text{Rated current}}$$

JEC190 (1977) instrument transformer for protective relay is stipulated as "n>5, n>10 and n>20". It is necessary that they have an adequately large overcurrent constant when incorporated with protective relays.

■ **Types and ratings**

Ratings	Installation	Closing system System type	Operating voltage	Shunt trip 100/110V AC		100/110V DC	
				Type	Ordering code	Type	Ordering code
Voltage 3.6/7.2kV  Breaking current 8.0kA  Rated current 400A	Fixed: B Switchboard use	Manual-spring		<b>HA08B-H6F</b>	HA31BH6-400F	<b>HA08B-H7F</b>	HA31BH7-400F
		Motor-spring Instantaneous	100/110V AC/DC	<b>HA08B-A6F</b>	HA31BA6-400F	<b>HA08B-A7F</b>	HA31BA7-400F
			200/220V AC/DC	<b>HA08B-B6F</b>	HA31BB6-400F	<b>HA08B-B7F</b>	HA31BB7-400F
			48V DC	<b>HA08B-C6F</b>	HA31BC6-400F	<b>HA08B-C7F</b>	HA31BC7-400F
			21/24V DC	<b>HA08B-D6F</b>	HA31BD6-400F	<b>HA08B-D7F</b>	HA31BD7-400F
		Fixed: C Cubicle use	Manual-spring		<b>HA08C-H6F</b>	HA31CH6-400F	<b>HA08C-H7F</b>
	Motor-spring Instantaneous		100/110V AC/DC	<b>HA08C-A6F</b>	HA31CA6-400F	<b>HA08C-A7F</b>	HA31CA7-400F
			200/220V AC/DC	<b>HA08C-B6F</b>	HA31CB6-400F	<b>HA08C-B7F</b>	HA31CB7-400F
			48V DC	<b>HA08C-C6F</b>	HA31CC6-400F	<b>HA08C-C7F</b>	HA31CC7-400F
			21/24V DC	<b>HA08C-D6F</b>	HA31CD6-400F	<b>HA08C-D7F</b>	HA31CD7-400F
	Fixed: P Portable type		Manual-spring		<b>HA08P-H6F</b>	HA31PH6-400F	<b>HA08P-H7F</b>
		Motor-spring Instantaneous	100/110V AC/DC	<b>HA08P-A6F</b>	HA31PA6-400F	<b>HA08P-A7F</b>	HA31PA7-400F
200/220V AC/DC			<b>HA08P-B6F</b>	HA31PB6-400F	<b>HA08P-B7F</b>	HA31PB7-400F	
48V DC			<b>HA08P-C6F</b>	HA31PC6-400F	<b>HA08P-C7F</b>	HA31PC7-400F	
21/24V DC			<b>HA08P-D6F</b>	HA31PD6-400F	<b>HA08P-D7F</b>	HA31PD7-400F	
Voltage 3.6/7.2kV  Breaking current 12.5kA  Rated current 600A		Fixed: B Switchboard use	Manual-spring		<b>HA12B-H6F</b>	HA32BH6-600F	<b>HA12B-H7F</b>
	Motor-spring Instantaneous		100/110V AC/DC	<b>HA12B-A6F</b>	HA32BA6-600F	<b>HA12B-A7F</b>	HA32BA7-600F
			200/220V AC/DC	<b>HA12B-B6F</b>	HA32BB6-600F	<b>HA12B-B7F</b>	HA32BB7-600F
			48V DC	<b>HA12B-C6F</b>	HA32BC6-600F	<b>HA12B-C7F</b>	HA32BC7-600F
			21/24V DC	<b>HA12B-D6F</b>	HA32BD6-600F	<b>HA12B-D7F</b>	HA32BD7-600F
	Fixed: C Cubicle use		Manual-spring		<b>HA12C-H6F</b>	HA32CH6-600F	<b>HA12C-H7F</b>
		Motor-spring Instantaneous	100/110V AC/DC	<b>HA12C-A6F</b>	HA32CA6-600F	<b>HA12C-A7F</b>	HA32CA7-600F
			200/220V AC/DC	<b>HA12C-B6F</b>	HA32CB6-600F	<b>HA12C-B7F</b>	HA32CB7-600F
			48V DC	<b>HA12C-C6F</b>	HA32CC6-600F	<b>HA12C-C7F</b>	HA32CC7-600F
			21/24V DC	<b>HA12C-D6F</b>	HA32CD6-600F	<b>HA12C-D7F</b>	HA32CD7-600F
		Fixed: P Portable type	Manual-spring		<b>HA12P-H6F</b>	HA32PH6-600F	<b>HA12P-H7F</b>
	Motor-spring Instantaneous		100/110V AC/DC	<b>HA12P-A6F</b>	HA32PA6-600F	<b>HA12P-A7F</b>	HA32PA7-600F
200/220V AC/DC			<b>HA12P-B6F</b>	HA32PB6-600F	<b>HA12P-B7F</b>	HA32PB7-600F	
48V DC			<b>HA12P-C6F</b>	HA32PC6-600F	<b>HA12P-C7F</b>	HA32PC7-600F	
21/24V DC			<b>HA12P-D6F</b>	HA32PD6-600F	<b>HA12P-D7F</b>	HA32PD7-600F	