

Fuji Electric's Offer to Renew Your Power Distribution Equipment

Before a serious accident occurs...
consider renewing equipment



Renewing equipment at the appropriate serious accidents and their spread

For your safe use of distribution facilities, the key is to operate them based on the operating environments recommended by the electrical manufacturer, periodic maintenance and inspection, and equipment renewal at the appropriate time.



Preventive maintenance is the key

Preventive maintenance is the key for industrial electrical equipment.

Breakdown maintenance

Breakdown maintenance is the practice of replacing products, such as household light bulbs, after their lifetimes have ended. Breakdown maintenance with industrial electrical equipment can result in power outages, and in some cases, secondary disasters or aftereffects.

Preventive maintenance

Preventive maintenance is based on the idea that equipment is renewed or repaired before its life expectancy is reached when allowable failure rate values are exceeded. Preventive maintenance reduces failure rates (including power outages and accidents) significantly.

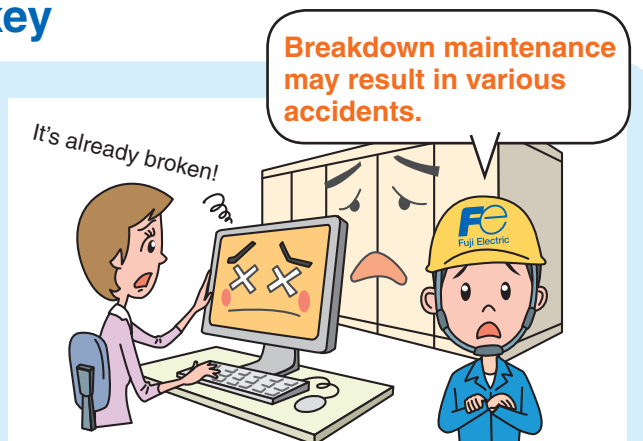
1. Time based maintenance

Equipment is renewed or repaired in a planned way before its failure rate reaches the allowable value.

2. Condition based maintenance

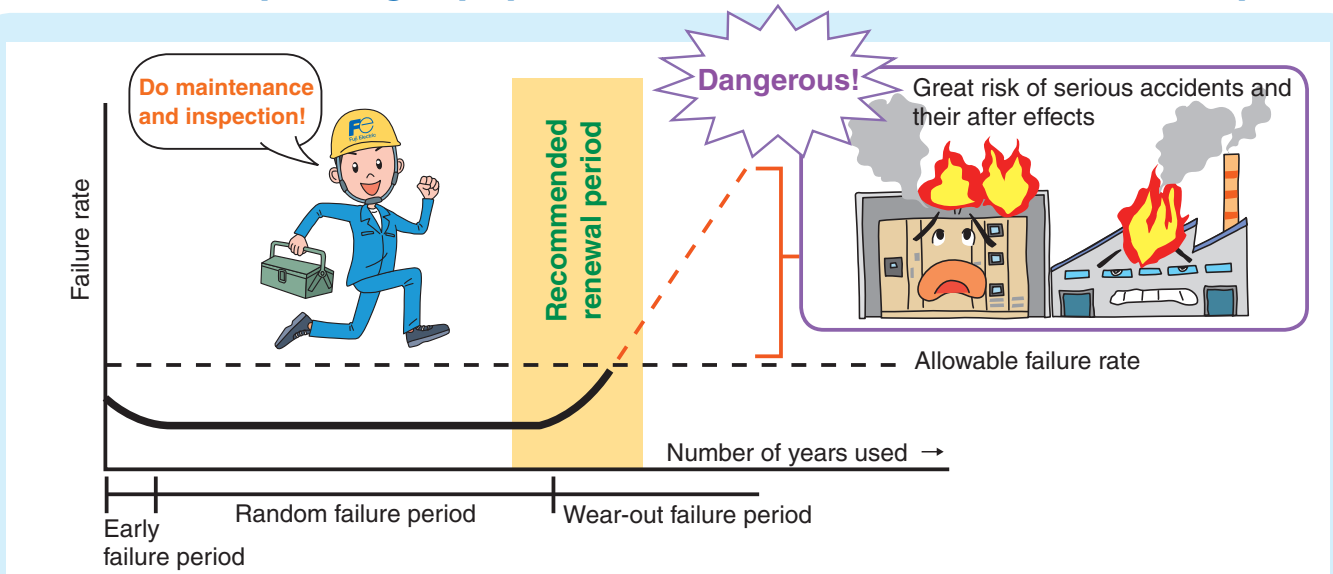
Equipment is renewed or repaired when periodic diagnosis detects that its failure rate exceeded the allowable value.

★ High-voltage equipment needs appropriate preventive maintenance with consideration to power outages, aftereffects, and other influences.



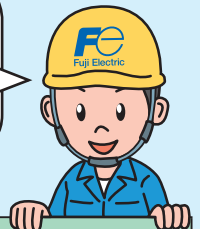
time prevents

Consider replacing equipment in the recommended renewal period



- (a) **Early failure period:** Equipment may have a weakness in that it takes time to adjust to an external environment after starts to be used or have a failure attributed to its manufacture.
- (b) **Random failure period:** The failure rate continues to be almost constant without relation to time elapsed.
- (c) **Wear-out failure period:** The period in which the failure rate increases with time due to deterioration or wear of components. This is the period where overhaul or renewal of equipment should be considered in order to maintain the functionality as a facility.

The Japan Electrical Manufacturers' Association (JEMA) suggests the following recommended renewal periods by type of equipment used for high-voltage facilities based on reports from the Institute of Electrical Engineers of Japan and questionnaires to business operators by the Ministry of Land, Infrastructure, Transport and Tourism.



Recommended renewal periods of equipment

Product	Recommended renewal period (after start of use)
High-voltage AC load break switch*	Indoor use: 15 years or 200 load current switch operations Outdoor use: 10 years or 200 load current switch operations GR switch control equipment: 10 years after start of use
Disconnecting switch*	Manual operation: 20 years or 1,000 operations Power operation: 20 years or 10,000 operations
Lightning arrester	15 years
AC circuit breaker*	20 years or specified switching times
Instrument transformer	15 years
Protective relay	15 years
High-voltage current-limiting fuse	Indoor use: 15 years , Outdoor use: 10 years
High-voltage AC magnetic contactor*	15 years or specified switching times
High-voltage phase advancing capacitor, series reactor, uncontrolled/unused coil	15 years 15 years
High-voltage distribution transformer	20 years
Molded case circuit breaker, earth leakage circuit breaker	15 years or specified switching times Low-voltage magnetic contactor/switch
Low-voltage magnetic contactor/starter	10 years or specified switching times

*1 This recommended renewal period is not a value for functionality or performance guaranteed by manufacturers, but indicates the period in which it is considered generally more advantageous to replace the equipment with new equipment, in view of cost efficiency, given that the equipment is used under normal conditions and with the normal maintenance and inspection.

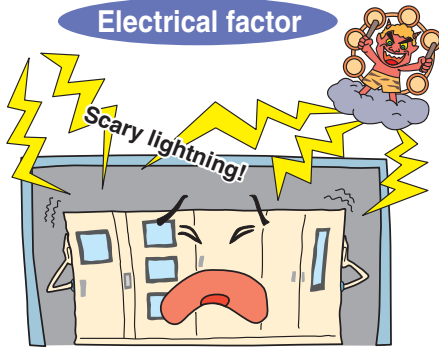
2 The period indicated for equipment with an asterisk () does not mean the maximum life before which the equipment should be replaced. The indicated period is provided on the assumption that consumables, wear parts, electronic parts, etc. should be replaced appropriately according to the maintenance and inspection results or the parts replacement criteria recommended by the manufacturer. In addition, before using spare parts which have been stored for a long time, perform sufficient inspection and maintenance on them.

Equipment deteriorates due to various

Factors behind deterioration of equipment

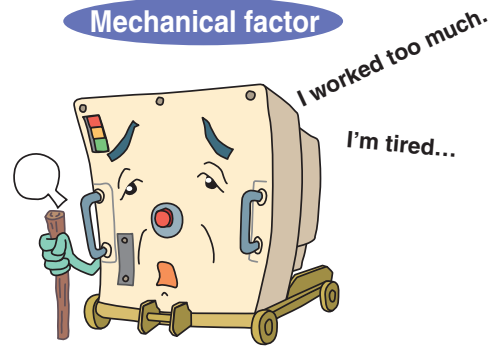
Factors behind deterioration of equipment range widely. Measures need to be examined from every possible angle. The following examples show typical cases of deterioration.

Electrical factor



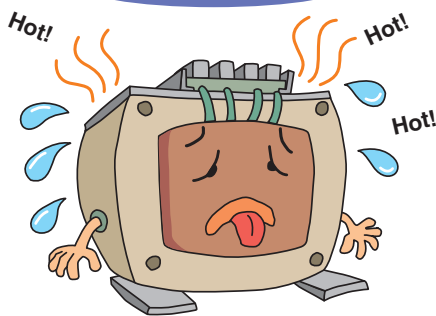
- Surge voltages (lightning surges affecting external or internal power systems), over-voltages
- Overload switching, short-circuit breaking, inclusion of harmonics

Mechanical factor



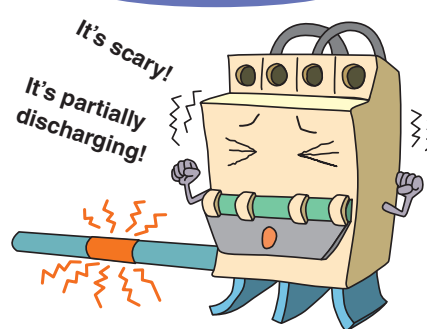
- Repeated operation, external stress
- Vibrations, shocks, over-current

Thermal factor



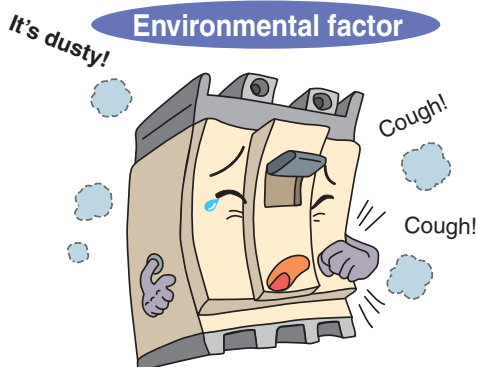
- Over-current, overload
- Inclusion of harmonics, heat cycle

Chemical factor



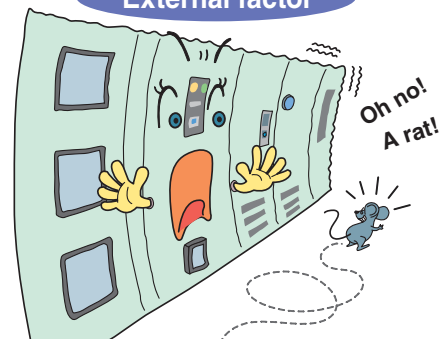
- Chemical products, reduced insulation

Environmental factor



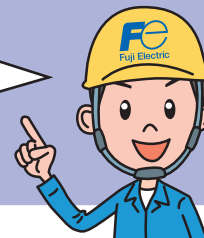
- Dust particles, contamination, moisture
- High temperature, corrosive gas

External factor



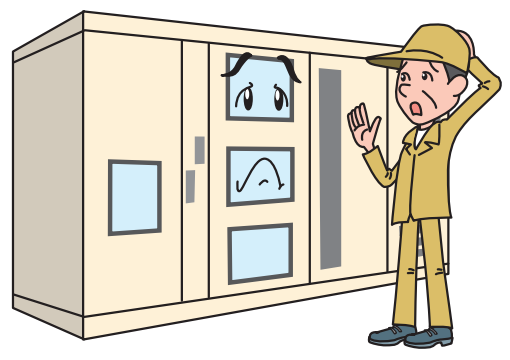
- External flaws, small animal intrusion, defective construction

Any one of the factors above or a combination of them develops and causes deterioration of equipment. Other factors such as defective construction work or maintenance also may accelerate deterioration.



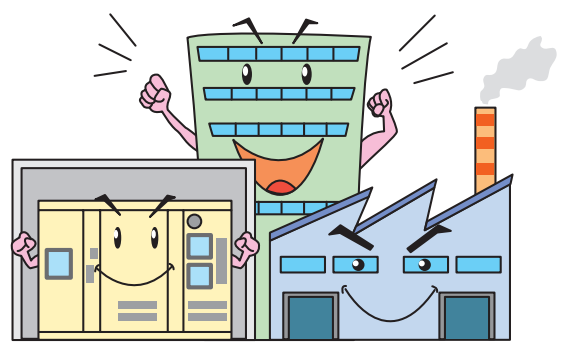
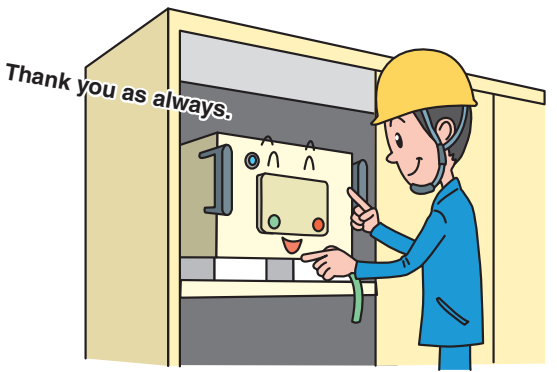
factors

If deterioration factors fail to be detected...



The insulation capability of electrical equipment will gradually deteriorate, causing a grounding fault or shorting, and resulting in a power outage, aftereffect, fire, etc.

If everyday maintenance is properly carried out...



Periodic inspection and appropriate equipment renewal lead to secure and safe operation of the plants and operation sites.

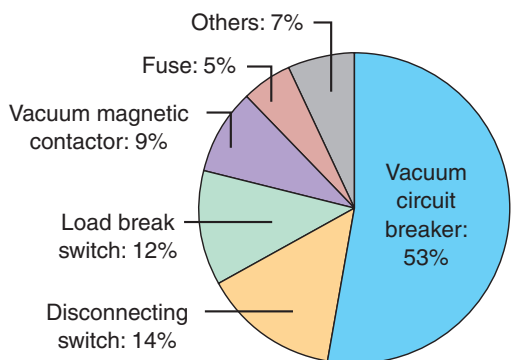
Statistics on inquiries about Fuji Electric's products

The following data shows failure-related or other investigations requested by customers regarding our products.

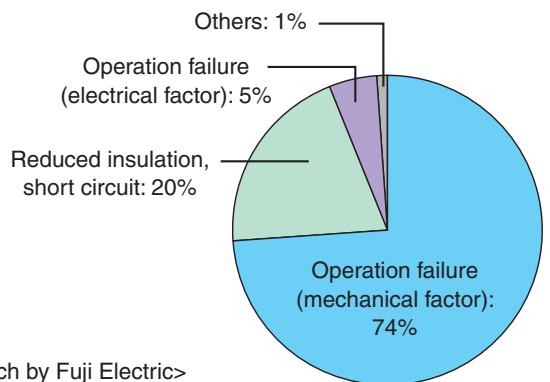


1. The vacuum circuit breaker represents 53% of all high-voltage (7.2 kV or below) equipment.
2. As causes, many customers have been reporting mechanical operation failures and insulation deterioration, which are caused by a combination of high temperature, humidity, dust particles, etc.

<By product>



<By type of damage>



<Research by Fuji Electric>

Renewal of equipment is recommended if signs of deterioration are noticed

Deterioration examples

Examples of deterioration signs and accidents of equipment are shown below with a skeleton diagram example.

● Disconnecting switch (DS)

[Sign] Discoloration and rust on conductive areas, cracking and contamination on insulators, loose screws



The sliding area's open/close operation was hindered, resulting in heat and burning



Rust on contact areas due to long-term use → Hardened grease



Normal use condition

● Vacuum circuit breaker (VCB)

[Sign] Discoloration and rust on conductive areas, abnormal sound, abnormal switch operation, dirt and tracking on insulators



Interphase short-circuit occurs, resulting in burning and power outage



Tracking (carbonized conductive path) occurs on the insulator due to the atmosphere (dust particles, moisture, etc.)



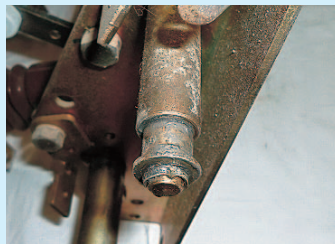
Normal use condition

● Load break switch (LBS)

[Sign] Discoloration and rust on moving areas, cracking and damage on insulators, and abrasion of contact areas



The mechanical section does not work due to hardened grease, resulting in burning



Discoloration and rust on the latch due to long-term use, hardened grease



Normal use condition

● Molded transformer

[Sign] Discoloration and rust on conductive areas, and cracking on insulators



Cracking develops and causes dielectric breakdown, resulting in an accident

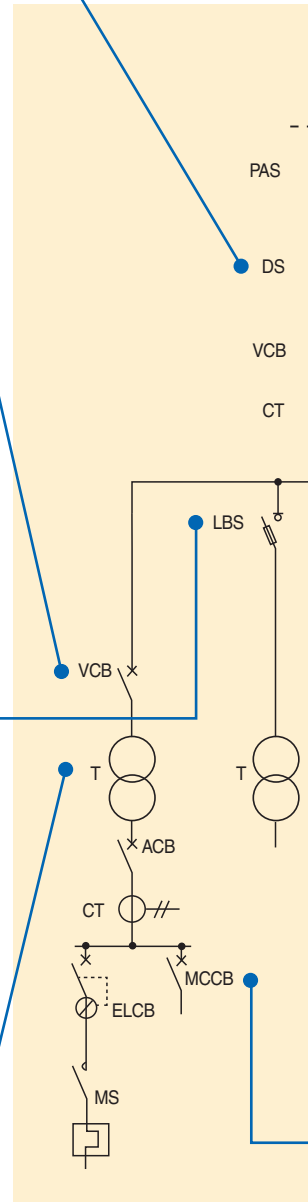


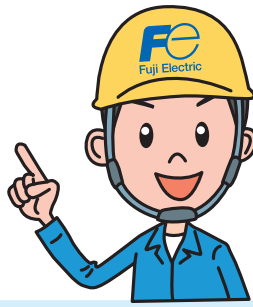
The resin component vaporizes and cracking occurs due to long-term use



Normal use condition

Instrument





Preventive maintenance before suffering these!

● Instrument transformer

[Sign] Discoloration and rust on conductive areas, and dirt and tracking on insulators
Deterioration inside transformers is difficult to judge → Periodic renewal is recommended



Normal use condition



Deterioration of epoxy resin due to long-term use, resulting in cracking



Cracking develops and causes partial discharge, resulting in a grounding fault

● Protective relay

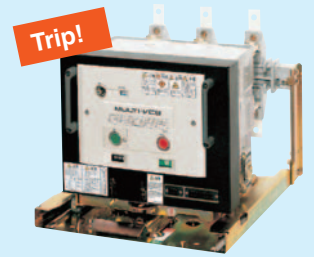
[Sign] Abnormal operating characteristics and external appearance Abnormalities inside relays are difficult to detect in an inspection → Periodic renewal is recommended



Normal use condition



Deterioration of internal electronic parts due to long-term use



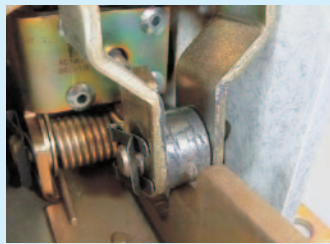
An incorrect trip instruction to the circuit breaker causes a power outage

● Vacuum magnetic contactor

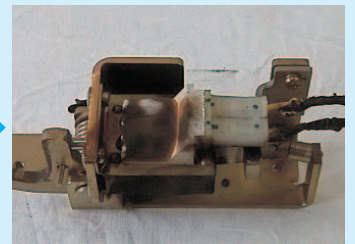
[Sign] Discoloration and rust on conductive areas, abnormal sound, abnormal switch operation, dirt and tracking on insulators



Normal use condition



No greasing for a long time makes the mechanical section not work



The internal coil is burned, making the contactor not work

● Molded case circuit breaker

[Sign] Abnormal switch operation → Periodic renewal is recommended



Normal use condition

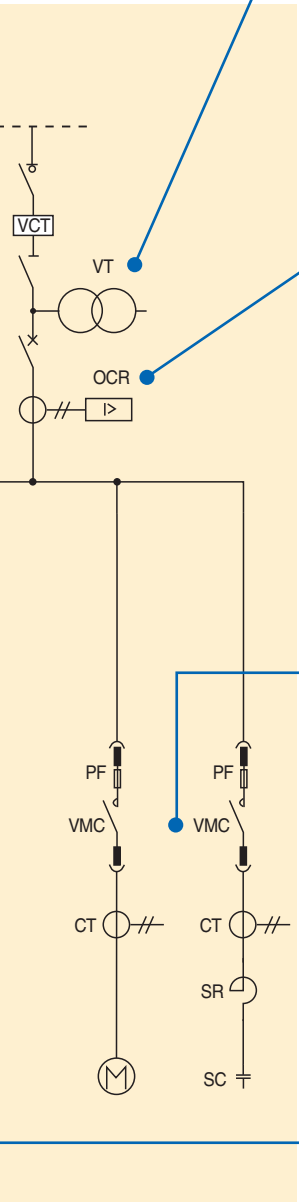


Dried grease in the mechanical section due to long-term use

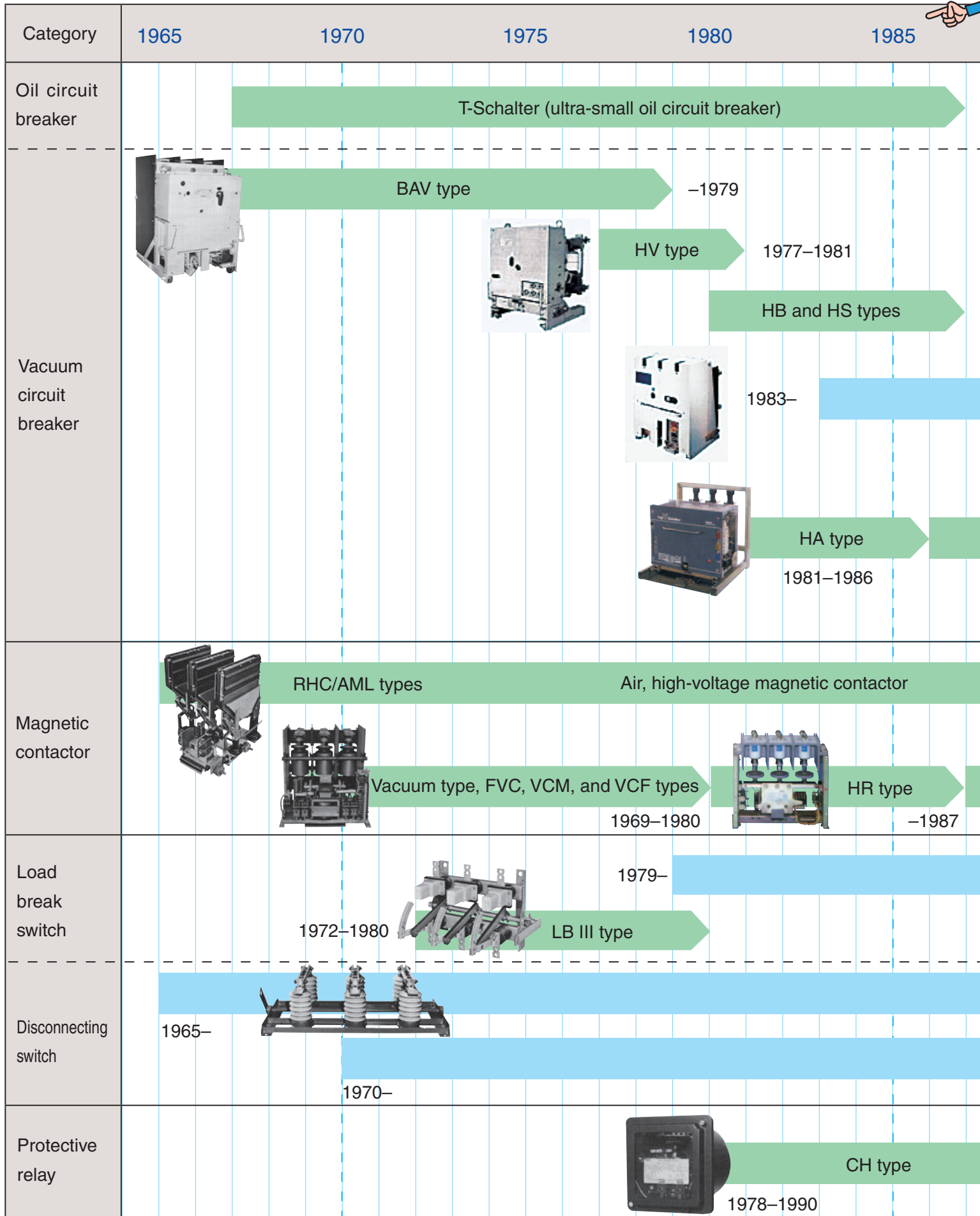


Unable to turn on again after a trip, making the breaker not work

transformer



Transitions of Fuji Electric's High-voltage Power Distribution Equipment





The products produced around this year are entering into their renewal periods.

Current model

Discontinued model

1990

1995

2000

2005

2010

NOW

-1987



HS-N type

1980-1987



1996-



HS-E type

HA-N/NA types

Multi VCB (draw-out and fixed types)

Multi VCB (new fixed type)

-1992

1992-

2003-

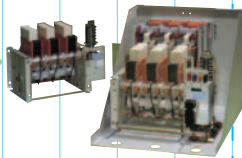


2013-

Multi VCB (new draw-out type)

HC type

1965-1996



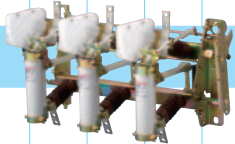
HN type



HN46A type

-2000

2000-



LBS and LB types

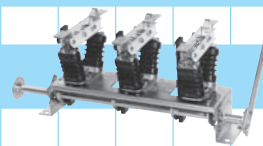


LBS type (NEW)

2013-

RF240 type

V-type disconnecting switch



QH type



-2013

QHA type



2012-

We offer products that pay attention to in

Advantages of using interchangeable equipment models

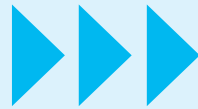
Fuji Electric has been manufacturing power receiving/distribution equipment for approximately 50 years. Products have gone through various model changes and modifications over time in order to reduce the sizes of equipment or improve their power interruption or switching performance. Many of them often do not provide interchangeability between current and past models. We offer products that are made by paying attention to interchangeability with old-type products on the basis of currently manufactured products.

[Renewal examples] Fuji Electric has been providing many interchangeable models

- **Renewal of vacuum circuit breaker: Service interruption time is greatly reduced by directly reusing the distribution panel's disconnecting unit and the fixing frame**

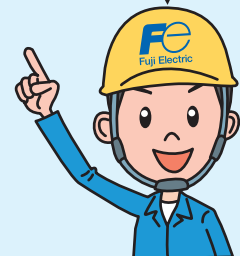


Existing VCB manufactured in 1982



Renewed VCB manufactured in 2011

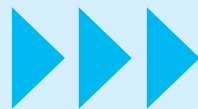
Made easy with an interchangeable model!



- **Renewal of vacuum circuit breaker: Minimized modification in a panel by installing a rack and attachments to a standard vacuum circuit breaker**

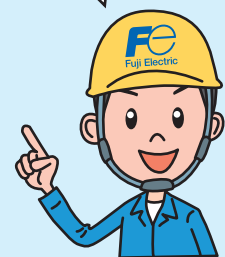


Existing VCB manufactured in 1982



Renewed VCB manufactured in 2012

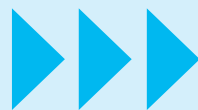
Use of attachments has made modification work easy.



- **Renewal of magnetic contactor: Service interruption time is greatly reduced by directly reusing the distribution panel's disconnecting unit and the fixing frame**



Existing HC23 air magnetic contactor



Renewed contactor manufactured in 2012
HN46AX-2S-HC vacuum magnetic contactor

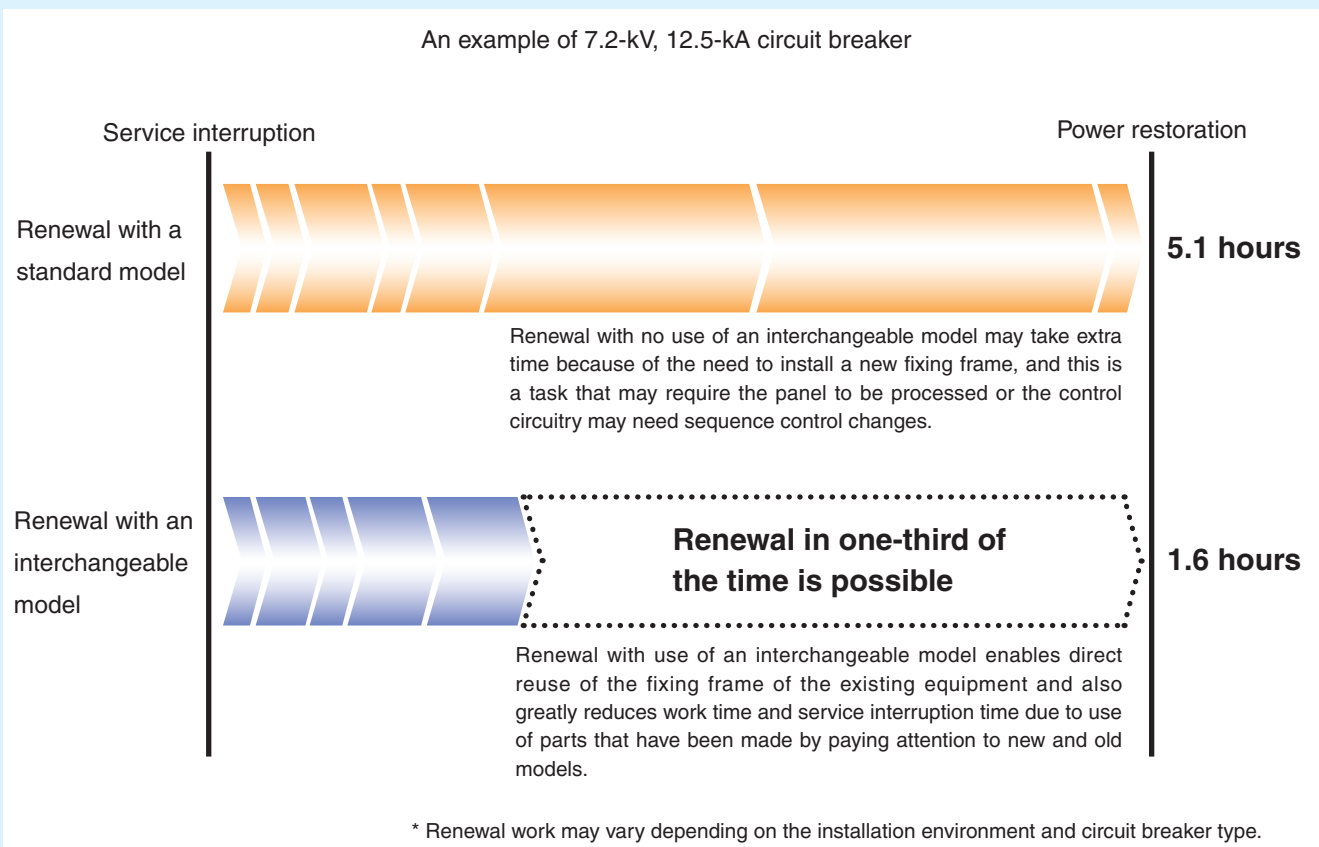
Service interruption time can be greatly reduced with a model in which the disconnecting unit and the fixing frame can be directly reused.



Interchangeability with old product models

When an interchangeable model for a high-voltage vacuum circuit breaker (VCB) is used

Using an interchangeable model at renewal greatly reduces the work duration (service interruption time).

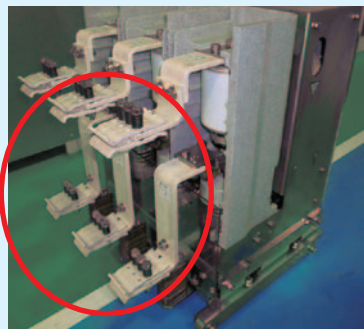


[Main renewal work with an interchangeable model]

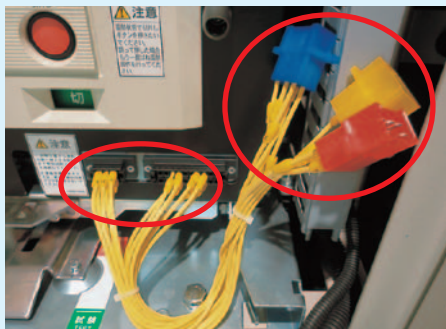
- [1] Draw out the existing circuit breaker: Remove the control circuitry and draw the circuit breaker out of the panel using a lifter, etc.
- [2] Clean and check the panel's inside: Perform inspection and maintenance of the disconnecting unit on the panel side and the fixing frame (greasing, etc.).
- [3] Check the existing circuit breaker's specifications: Check the electrical specifications and check the structure against the existing circuit breaker's drawings.
- [4] Check the interchangeable circuit breaker: Check with the existing circuit breaker's specifications and make a final check of the circuit breaker.
- [5] Insert the interchangeable circuit breaker: Insert the circuit breaker into the panel using a lifter, etc., and check its operation and the contacts between the circuit breaker and the panel.
Check and insert the control circuitry cables.

Reduced time by direct utilization of an existing cradle!

Point!



The interchangeable model is designed so that the main circuitry's conductors are in the same positions as those of the existing model.



Connectors compatible with new and old models with consideration given to each connection are available (VCB side: new connectors / distribution panel side: old connectors)

Easy cabling changes with replacement-purpose control circuitry connectors!

Point!



Renewal of high-voltage equipment - 1

High-voltage vacuum circuit breaker (VCB) Examples of 20kV

Old product

Current product



T-Schalter



HB type



VCB HS series

[History of models]

Series	Type	Manufacture year
(1) T-Schalter (TCB)	HF515-10M	1967–1987
(2) BAV type (TCB)	BAV06FPM	1965–1979
(3) HV type (TCB)	HV126-06	1977–1981
(4) HB type (TCB)	HB1206X-06Hf-F	1980–1987
(5) HS-N type (TCB)	HS2530X-06Mf-N	1983–Current model
(6) HS-E type (TCB)	HS2520X-06Mf-E	1996–Current model

Advantages of renewal

From T-Schalter to HS type

Higher functionality and performance

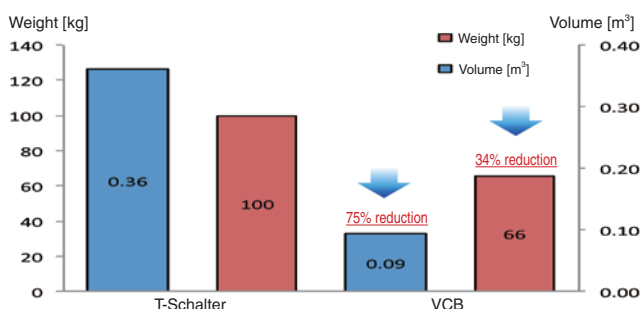
- Replacement with a vacuum circuit breaker reduces the breaking time, and replacement of a protective relay with a static type or digital relay further facilitates protection coordination.

Breaking time T-Schalter: 5 cycles → VCB: 3 cycles

* 5 cycles for some existing models

Reduced size and weight

- A general-purpose vacuum circuit breaker has been reduced in volume from T-Schalter to approximately one-fourth (in-house comparison). The weight has also been reduced to one-third, achieving higher workability for maintenance.



From HB type to HS type

Reduced power consumption

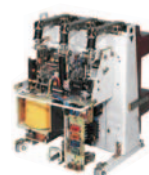
- Operation of the HB type involves running a large making current into a making electromagnet for direct making with a plunger. However, with the HS type, a small making current is used to drive a motor for stretching the making springs, thereby storing making energy for making. Reducing the making current allows the making power supply to be smaller, which contributes to cost reduction.

Making current HB type: 27 A → HS type: 1.7 A

[Structure of making actuator]

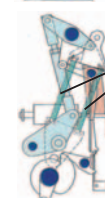
[Electromagnetic making actuator]

HB



Making electromagnet

HS



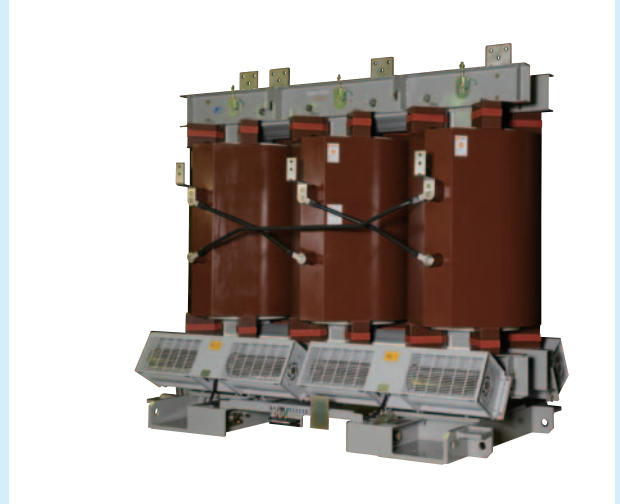
Making spring

Molded transformer Examples of 20kV

Old product



Current product



[History of models]

Type	Manufacture year
(1) FM-74	1975 – 1979
(2) FM-80	1980 – 1983
(3) FM-84	1984 – 1985
(4) FM-NB	1986 – 1995
(5) FM-C □	1996 – Current model
(6) FM-EH	2005 – Current model

Advantages of renewal

Advantages of renewal

- Renewing an old transformer not only improves the transformer's reliability but also significantly increases its performance because the latest technology at the current moment is used for production.

Effects as shown below can be expected from renewal.

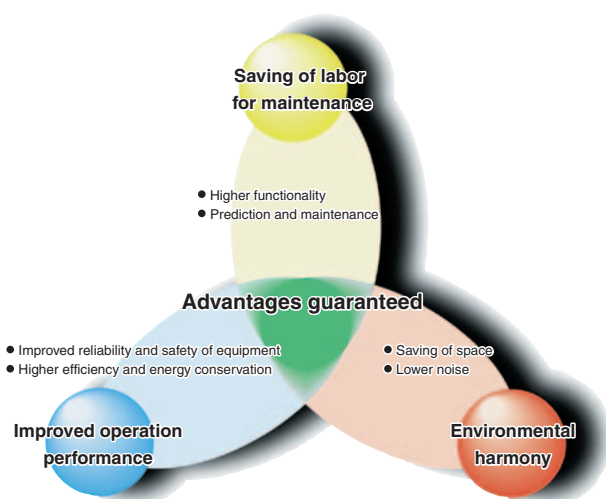
Lower noise

- A product that produces even less noise has been realized by upgrading the core material.

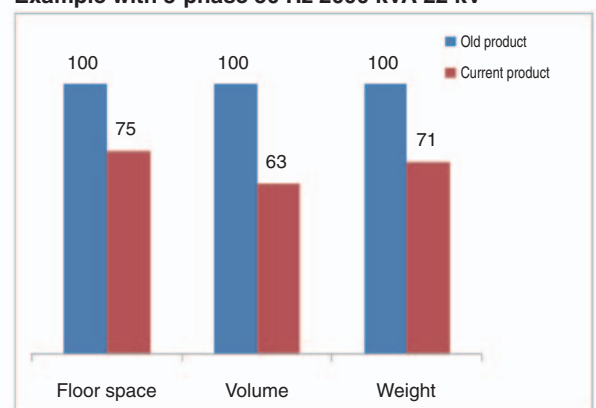
Saving of space

- The current products have been made smaller and lighter than the older products, allowing them to be smoothly replaced.

The capacity can be increased using the same space.




Example with 3-phase 50 Hz 2000 kVA 22 kV



Renewal of high-voltage equipment - 2

Protective relay


Old product



QH series

CO1 series

Current product



QHA series

F-MPC series
(digital multi-functional relay)

[History of models]

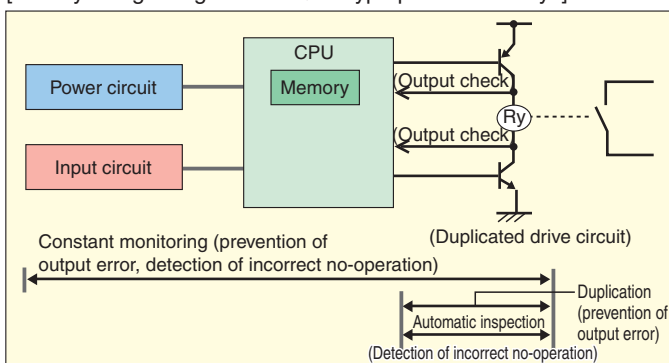
Type	Manufacture year
(1) CO1-53a, 63a, CH1-53a, 63a	– 1995
(2) QH-OC1, OC2	1990 – 2013
(3) QHA-OC1, OC2	2011 – Current models

* Shown in overcurrent relay types

Advantages of renewal

Safe design

["Safety design diagram" for QHA-type protective relays]

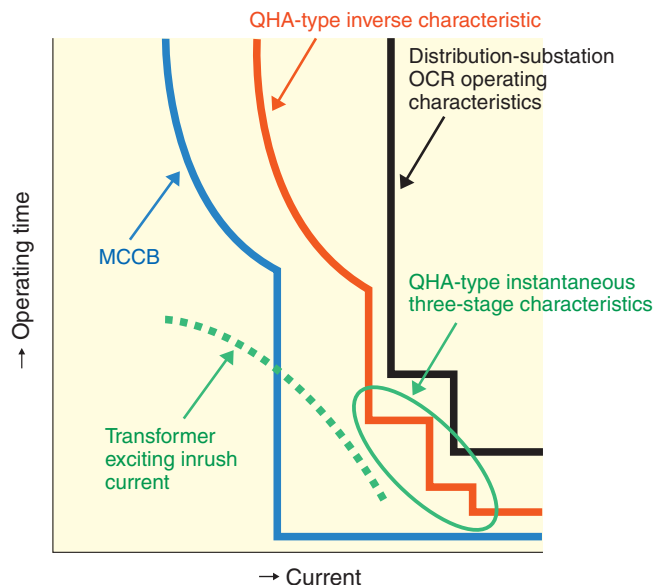


- Stable protective characteristics with digital calculations
- Improved reliability with duplicated output circuit (prevention of incorrect tripping)
- Self-diagnostic function with constant monitoring and automatic inspection

Installation interchangeability

- The QH series and the QHA series are completely interchangeable in installation.
- With the exclusion of some models, the terminal layout on the backside is also the same.

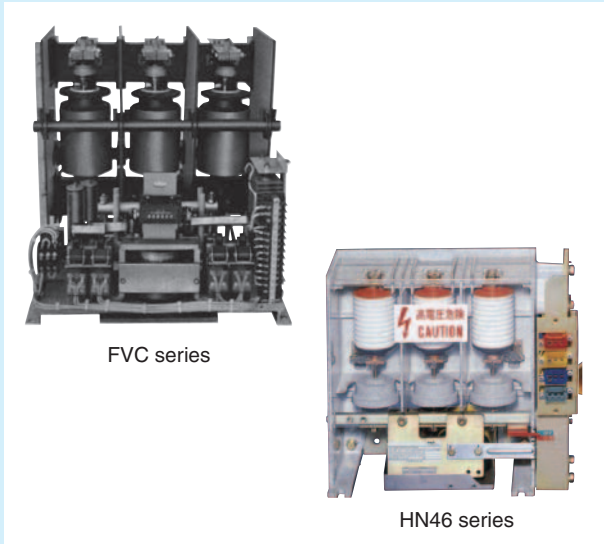
Enriched functionality



*Protective coordination with high-end and low-end equipment can be easily secured with four inverse characteristics and three instantaneous characteristics.

High-voltage vacuum magnetic contactor (VMC)

Old product



Current product



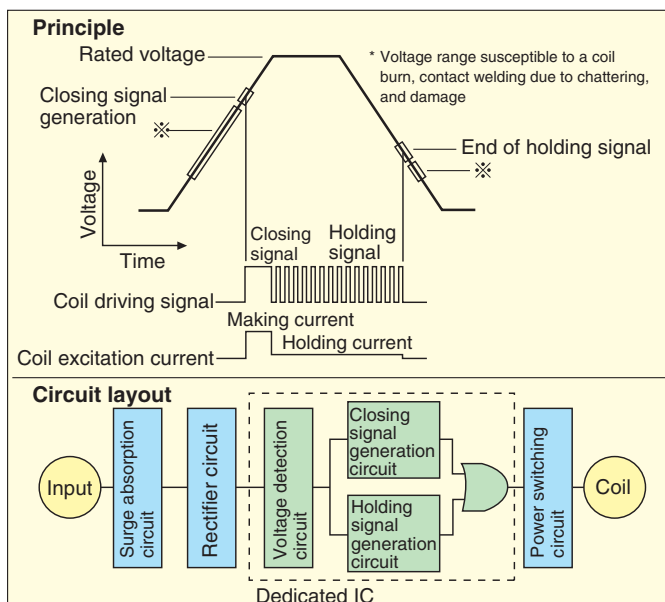
[History of models]

Type	Manufacture year
(1) FVC, VCM, VCF	1969 – 1980
(2) HR	1980 – 1987
(3) HN46	1987 – 2000
(4) HN46A	2000 – Current models

Advantages of renewal

Safe design

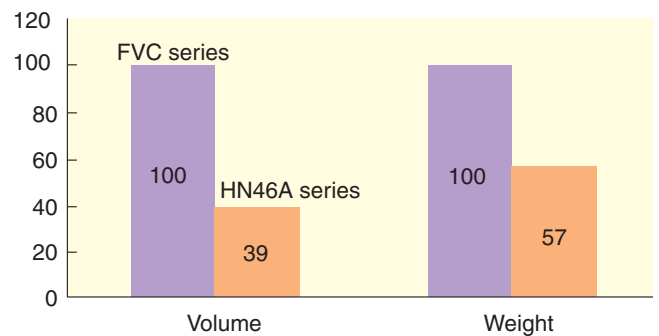
- With an SUPER MAGNET, IC, and built-in voltage detection function, stable operation and working are maintained.



Reduced size and weight

- The dimensions and volume of current products have been reduced to 40% of those of air-type products. Weight has also been greatly reduced.



* Example of HTT series used as a fixed index of 100



Longer life

- Adoption of vacuum types in place of air types has reduced wear of contacts caused by arcing to one-fifth and has extended the life expectancy up to 250,000 operations.
- Power consumption has also been reduced by 90% compared with previous products.

Transitions of Fuji Electric's Molded Case

Category	1968		1980	
	■ Start of manufacture and sale of circuit breakers		■ Depth 60-mm series	
		1970	1975	1980
Auto circuit breaker	30 years ago			
30AF 32AF	Economical type		E33 → EA33	EA33F
	General-purpose type	M33, N33 → S33	SA33	
	High performance type	L33		
50AF 60AF 63AF	Economical type			EA53A EA53F
	General-purpose type	E63 → EA63 → EA53, EA63		
		N53, N63 → S63 → S53, S63	S53H, S63H → SA53K, SA53H	
	High performance type	LA63 → LA53A		
L63 → L53A		H53		
100AF 125AF	Economical type			EA103F
	General-purpose type	E103 → EA103 → EA103A	EA103H → SA103K	
		N103 → S103 → SA103 → SA103A		
	High performance type	L103 → LA103 → SA103H		
H103				
225AF 250AF	Economical type	E203 → EA203 → EA203A	ST203 → SA203K	
	General-purpose type	N203 → S203 → SA203 → SA203A		
		L203 → LA203 → SA203H		
	High performance type	H203		
400AF	Economical type	E403 → EA403 → EA403A		
	General-purpose type	S403 → SA403 → SA403K		
		L403 → LA403 → SA403H → SA403 → SA403H		
	High performance type	H403 → SA403L		
600AF 630AF	Economical type	E603 → EA603 → EA603A		
	General-purpose type	S603 → SA603 → SA603H		
		L603 → LA603 → SA603L		
High performance type	H603			
800AF	Economical type		EA803 → EA803A	
	General-purpose type		S803 → SA803 → SA803H	
		L803 → LA803 → SA803L		
	High performance type	H803	H803	

Circuit Breakers

Current model

Discontinued model

1990

1992

2001

2007

2013

TWIN BREAKER

Super-TWIN

α -TWIN

G-TWIN

G-TWIN Λ



- 30-800 AF MCCBs/ELCBs with shared external dimensions
- Cassette-type accessories for 400-800 AF circuit breakers



- 30-100 AF circuit breakers reduced in size with adoption of shared external dimensions
- Cassette-type accessories for 30-800 AF circuit breakers
- Compliant with the CE, CCC, and UL international standards



- 30-800 AF circuit breakers compliant with CE, CCC, and UL in basic sizes
- Series products compliant with UL489 (480 V)



- 32-63 AF circuit breakers for control panels/machines
- Compact, compliant with international standards

1990

1995

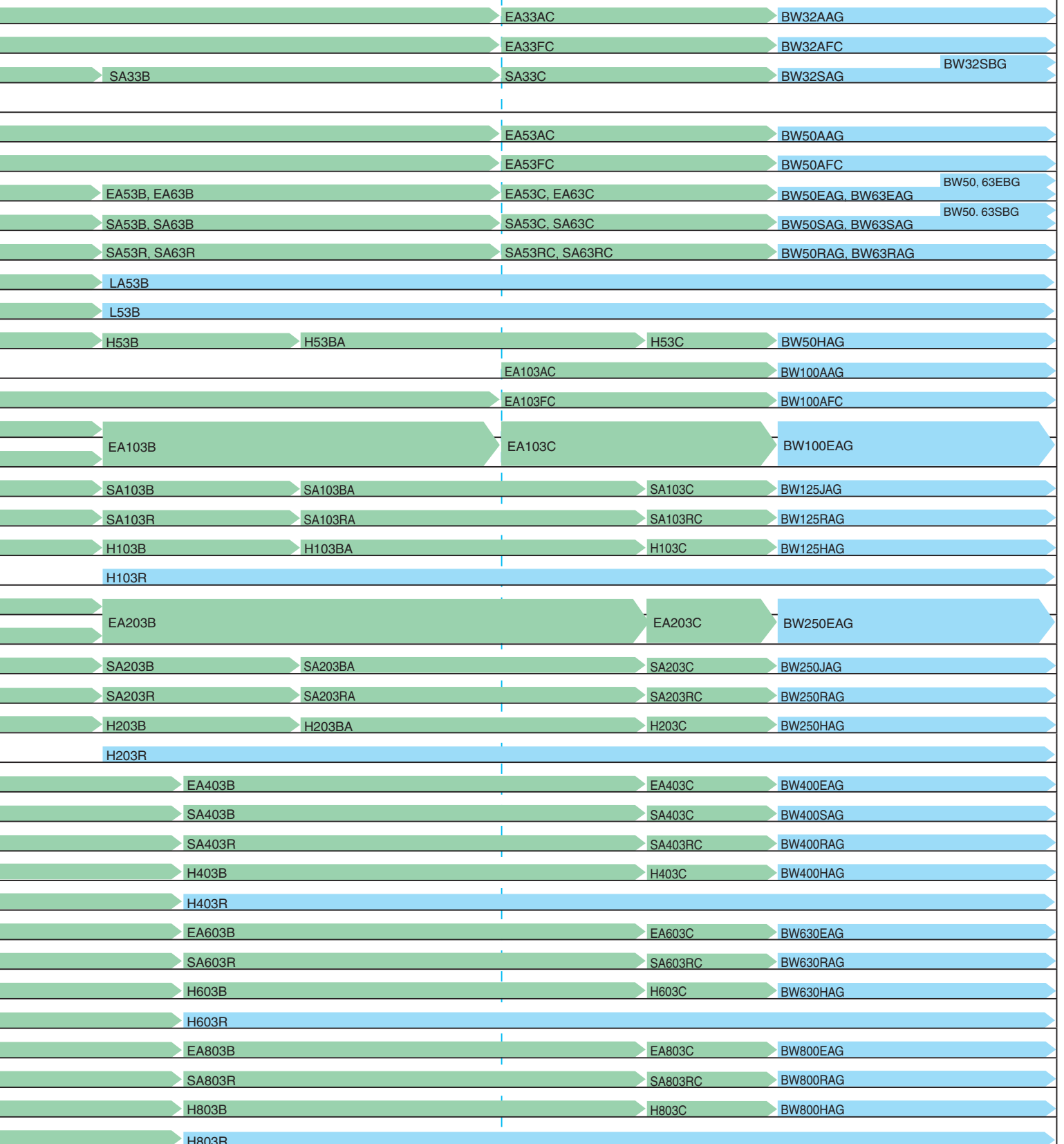
2000

2005



2010

NOW

15 years ago



Transitions of Fuji Electric's Earth Leakage

Category	1968		1980		1970		1975		1980		1985	
	<p>■ Start of manufacture and sale of circuit breakers</p> 		<p>■ Depth 60-mm series</p> <p>• The depth of 30-225 AF MCCBs/ELCBs reduced to 60 mm</p> 									
Earth leakage circuit breaker	30 years ago											
30AF 32AF	Economical type											EG33F
	General-purpose type			EG33	EG33A							
50AF 60AF 63AF	Economical type											EG53F
	General-purpose type			EG63	EG53A, EG63A							
						EG53AH, EG63AH						
				SG63	SG53A, SG63A							
High performance type					SGH63							
100AF 125AF	Economical type											EG103F
	General-purpose type			EG103A								
				SG103	SG103A		SGa103A					
High performance type					SG103H							
225AF 250AF	Economical type			SG203R	EG203A		EGa203A					
	General-purpose type					SG203A		SGa203A				
						SG203H						
400AF	Economical type			EG403R	EG403A		EGa403A					
	General-purpose type			SG403R	SG403A		SGa403A					
						SG403AH		SG403H				
600AF 630AF	Economical type					EG603A		EGa603A				
	General-purpose type					SG603A		SG603H				
	High performance type											
800AF	Economical type					EG803A		EGa803A				
	General-purpose type					SG803A		SG803H				
	High performance type											

Circuit Breakers

Current model

Discontinued model

1990

1992

2001

2007

2013

TWIN BREAKER

Super-TWIN

α -TWIN

G-TWIN

G-TWIN Λ



- 30-800 AF MCCBs/ELCBs with shared external dimensions
- TWIN series unified into one
- Cassette-type accessories for 400-800 AF circuit breakers



- 30-100 AF circuit breakers reduced in size with adoption of shared external dimensions
- Cassette-type accessories for 30-800 AF circuit breakers
- Compliant with the CE, CCC, and UL international standards



- 30-800 AF circuit breakers compliant with CE, CCC, and UL in basic sizes
- Series products compliant with UL489 (480 V)



- 32-63 AF circuit breakers for control panels/machines
- Compact, compliant with international standards

1990

1995

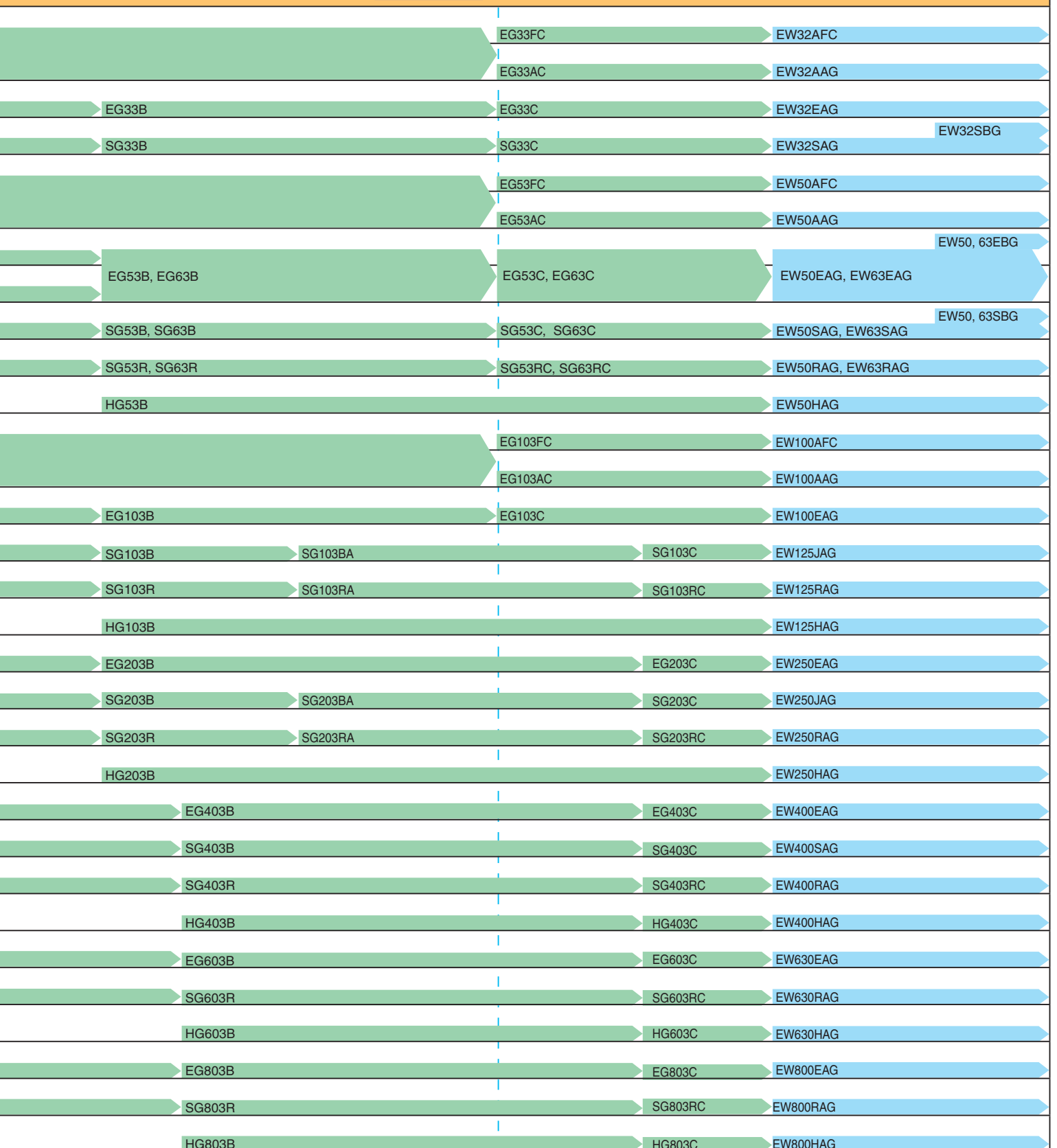
2000

2005

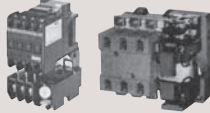
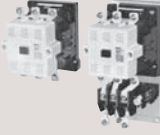
2010

NOW

15 years ago



Transitions of Fuji Electric's Magnetic Co

Category	1954 ■ Start of manufacture and sale	1965 ■ S series		1978 ■ SC series		1984 ■ NEW SC series
	• For 2.2-125 kw motors • Longer life (silver alloy adopted for contacts) • Improved durability to withstand inching			• Medium- and high-capacity magnetic contactors for 11-150 kW motors • Size reduction achieved by spatially arranging the electromagnet and arc-extinguishing unit		
1965 1970 1975 1980 19						

Magnetic contactor 30 years ago

Motor capacity 3ø220V [kW]	Auxiliary contact arrangement (typical)	Current series frame size	Series	Small capacity	S series	
				Medium and high capacity	S series	SC series
2.2	1a				SRC3631-02	
	1a	03				
2.7	1a	0			SRC3631-0	SRCa3631-0
	1a1b	05			SRC3631-05	
3.7	1a	4-0				
4	1a	4-1				
	1a1b	5-1			SRC3631-5-1	
	2a2b				SRC3631-5-1F	SRC3631-5-1N
5.5	2a2b	N1			SRC3631-5-2	
7.5	2a2b	N2			SRC3631-2	SRCa3631-2
11	2a2b	N2S			SRC3631-2T	SC-2S
15	2a2b	N3			SRC3631-3	SC-3
18.5	2a2b	N4			SRC3631-4	SC-4
22	2a2b	N5			SRC3631-4T	SC-4S
30	2a2b	N6			SRC3631-6	SC-6
37	2a2b	N7			SRC3631-8	
45	2a2b	N8			SC-8	
55	2a2b	N10			SRC3631-10	SC-10
75	2a2b	N11				
90	2a2b	N12			SRC3631-12	
110	2a2b				SC-12	
150	2a2b	N14			SRC3631-14	SC-14
200	2a2b	N16				

Magnetic starter

Motor capacity 3ø220V [kW]	Auxiliary contact arrangement (typical)	Current series frame size	Series	Small capacity	S series	
				Medium and high capacity	S series	SC series
2.2	1a				SRC3931-02	
	1a	03				
2.7	1a	0			SRC3931-0	SRCa3931-0
	1a1b	05			SRC3931-05	
3.7	1a	4-0				
4	1a	4-1				
	1a1b	5-1			SRC3931-5-1	
	2a2b				SRC3931-5-1F	SRC3931-5-1N
5.5	2a2b	N1			SRC3931-5-2	SRCa3931-5-2
7.5	2a2b	N2			SRC3931-2	SRCa3931-2
11	2a2b	N2S			SRC3931-2T	SW-2S
15	2a2b	N3			SRC3931-3	SW-3
18.5	2a2b	N4			SRC3931-4	SW-4
22	2a2b	N5			SRC3931-4T	SW-4S
30	2a2b	N6			SRC3931-6	SW-6
37	2a2b	N7			SRC3931-8	
45	2a2b	N8			SW-8	
55	2a2b	N10			SRC3931-10	SW-10
75	2a2b	N11				
90	2a2b	N12			SRC3931-12	
110	2a2b				SW-12	
150	2a2b	N14			SRC3931-14	SW-14

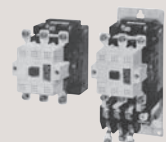
ntactors and Starters

Current model

Discontinued model

1988

New SC series



- Medium- and high-capacity magnetic contactors for 5.5-200 kW motors
- Size reduction
- Electronic control electromagnets

- Small-capacity magnetic contactors for 2.2-4 kW motors
- More options
- Longer life
- Compliant with the CE and UL international standards

1999

NEO SC series



- Medium- and high-capacity magnetic contactors for 5.5-200 kW motors
- Improved safety and environmental friendliness
- Compliant with the new JIS standard, and the CE, CCC, and UL international standards

80 1990 1995 2000 2005 2010 NOW

20 years ago

10 years ago

New SC series

New SC series

NEO SC series

SK12A

SC-03

SC-0

SC-05

SC-4-0

SC-4-1

SC-5-1

SC-1N

SC-2N

SC-2SN

SC-3N

SC-4N

SC-5N

SC-6N

SC-7N

SC-8N

SC-10N

SC-12N

SC-14N

SC-16N

SC-N1

SC-N2

SC-N2S

SC-N3

SC-N4

SC-N5

SC-N6

SC-N7

SC-N8

SC-N10

SC-N11

SC-N12

SC-N14

SC-N16

SC-N5A

New SC series

New SC series

NEO SC series

SK12AW

SW-03

SW-0

SW-05

SW-4-0

SW-4-1

SW-5-1

SW-1N

SW-2N

SW-2SN

SW-3N

SW-4N

SW-5N

SW-6N

SW-7N

SW-8N

SW-10N

SW-12N

SW-14N

SW-N1

SW-N2

SW-N2S

SW-N3

SW-N4

SW-N5

SW-N6

SW-N7

SW-N8

SW-N10

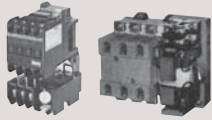
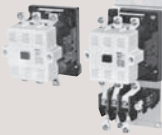
SW-N11

SW-N12

SW-N14

SW-N5A

Transitions of Fuji Electric's Magnetic Starters and

Category	1954 ■ Start of manufacture and sale	1965 ■ S series		1978 ■ SC series		1984 ■ NEW SC series
	• For 2.2-125 kw motors • Longer life (silver alloy adopted for contacts) • Improved durability to withstand inching			• Medium- and high-capacity magnetic contactors for 11-150 kw motors • Size reduction achieved by spatially arranging the electromagnet and arc-extinguishing unit		

Reversing type magnetic starter

Motor capacity 3φ220V [kW]	Auxiliary contact arrangement (typical)	Current series frame size	Series	Small capacity	Medium and high capacity
				S series	S series → SC series
2.2	1b×2	03			SRC3631-02
2.7	1b×2	0			
	1a1b×2 2a1b×2	05			SRC3631-05R → SRC3638-05R SRC3938-06RM
3.7	1a	4-0			
4	1a	4-1			
	1a1b 2a2b	5-1		SRC3938-5-1R	SRC3938-5-1R SRC3938-5-1FR → SRC3938-5-1NR
5.5	2a2b	N1			SRC3938-5-2R
7.5	2a2b	N2		SRC3938-2R	SRCa3631-2R
11	2a2b	N2S		SRC3938-2TR	SW-2SRM
15	2a2b	N3		SRC3938-3R	SW-3RM
18.5	2a2b	N4			SW-4RM
22	2a2b	N5		SRC3938-4TR	SW-4SRM
30	2a2b	N6		SRC3938-6R	SW-6RM
37	2a2b	N7		SRC3938-8R	
45	2a2b	N8			SW-8RM
55	2a2b	N10		SRC3938-10R	SW-10RM
75	2a2b	N11			
110	2a2b	N12			SW-12RM
150	2a2b	N14			SW-14RM

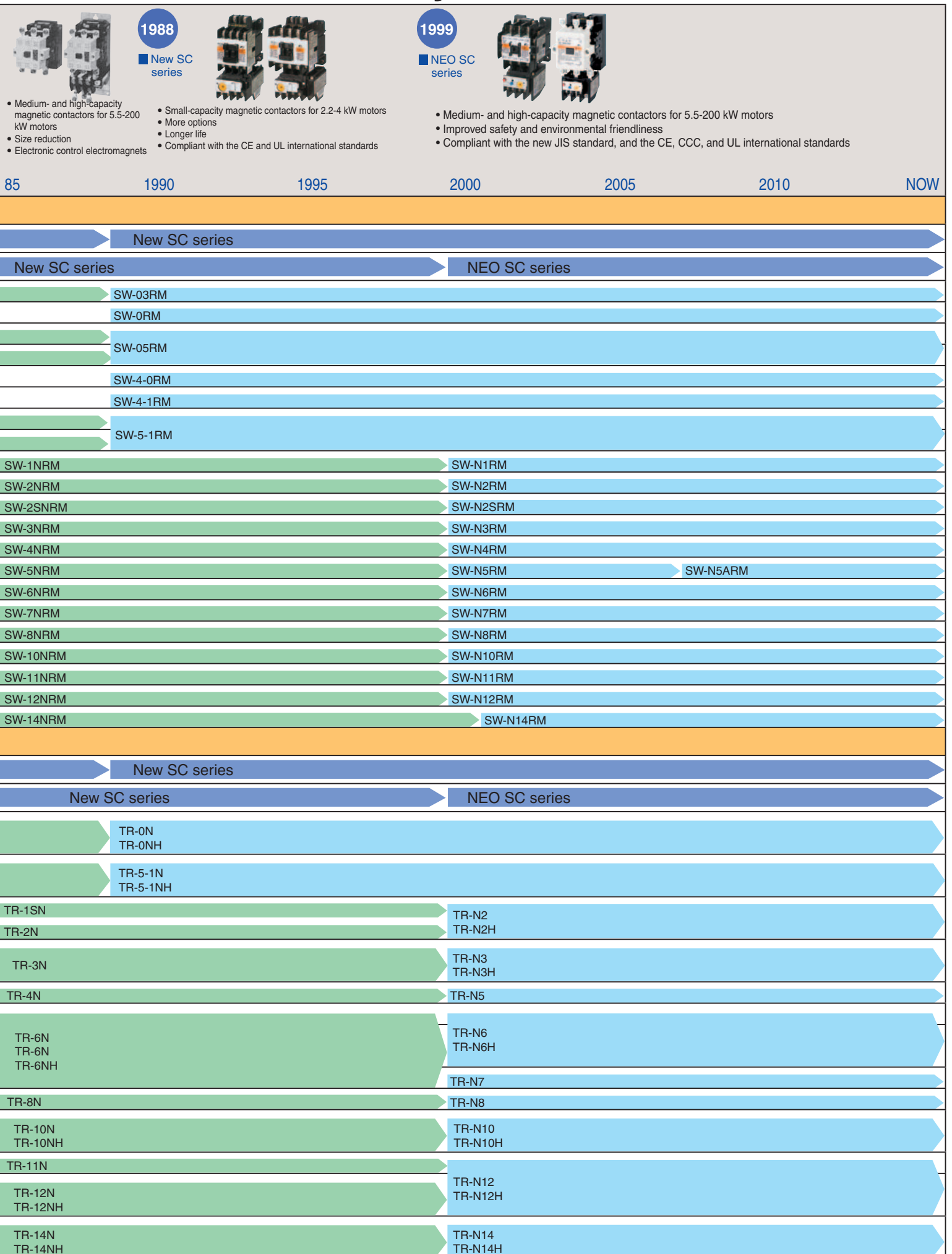
Thermal overload relay

Motor capacity 3φ220V [kW]	Current series frame size	Series	Small capacity	Medium and high capacity
			S series	S series → SC series
2.2	0N 0NH			TH-0 TH-0H → TR-0 TR-0H
3.7	5-1N 5-1NH		RCa3737-1 RCa3737-1H	RCa3737-1C RCa3737-1CH
5.5 7.5	N2 N2H		RCa3737-4 RCa3737-4H	TR-1S TR-2
11 15	N3 N3H			TR-3
18.5 22	N5 N5H			TR-4
30	N6 N6H		RCa3737-10T	TR-6 TR-6
37	N7			
45	N8			TR-8
55	N10 N10H		RCa3737-10 RCa3737-20N	TR-10 TR-10H
75 90 110	N12 N12 N12H			TR-12 TR-12H
132	N14		RC3737-30N	
160	N14H		RC3737-60N	TR-14 TR-14H

Thermal Overload Relays

Current model

Discontinued model



Fuji Electric's offer to renew low-voltage

Proposal of replacement of molded case circuit breaker

Year	Years used	Series
80	35	Depth 60-mm series
81	34	
82	33	
83	32	
84	31	
85	30	
86	29	
87	28	
88	27	
89	26	
90	25	TWIN Breaker
91	24	Super-TWIN
92	23	
93	22	
94	21	
95	20	
96	19	α-TWIN
97	18	
98	17	
99	16	
00	15	
01	14	
02	13	G-TWIN
03	12	
04	11	
05	10	
06	9	
07	8	
08	7	
09	6	
10	5	
11	4	
12	3	G-TWIN Λ
13	2	
14	1	



old-type MCCB



Depth 60-mm series
Manufacture date: 1980-2008



TWIN BREAKER series
Manufacture date: 1990-2006



Solid state trip E series
Manufacture date: 1992-

The products delivered in this era are entering into their renewal periods.

FUJI ELECTRIC
Renewal period recommended
15 years after start of use

Models recommended to be renewed



G-TWIN series
Manufacture date: 2007-



BX series
Manufacture date: 2013-

[Compliant with international standards]

- G-TWIN Compliant with the certifications and standards of chief regions of the world (JIS, CCC, CE, UL)
- BX series: IEC60947-2, EN60947-2, JIS C 8201-2-1

[Ease of use]

- G-TWIN: Usability improved by standardization and modularization of internal auxiliary accessories
- BX series: Control unit selectable according to protection and measurement needs

[Compact and high performance]

- G-TWIN: Japan's standard compact size and certified to UL489 480V

Proposal of replacement of earth leakage circuit breaker

Year	Years used	Series
80	35	Depth 60-mm series
81	34	
82	33	
83	32	
84	31	
85	30	
86	29	
87	28	
88	27	
89	26	
90	25	TWIN Breaker
91	24	Super-TWIN
92	23	
93	22	
94	21	
95	20	
96	19	α-TWIN
97	18	
98	17	
99	16	
00	15	
01	14	
02	13	G-TWIN
03	12	
04	11	
05	10	
06	9	
07	8	
08	7	
09	6	
10	5	
11	4	
12	3	G-TWIN Λ
13	2	
14	1	



old-type ELCB



Depth 60-mm series
Manufacture date: 1980-2008



TWIN BREAKER series
Manufacture date: 1990-2006



α-TWIN series
Manufacture date: 2001-2010

The products delivered in this era are entering into their renewal periods.

FUJI ELECTRIC
Renewal period recommended
15 years after start of use

Models recommended to be renewed



G-TWIN series
Manufacture date: 2007-

[Compliant with international standards]

- G-TWIN Compliant with the certifications and standards of chief regions of the world (JIS, CCC, CE, UL)

[Ease of use]

- Sensitive current, tripping time and switching range increased from conventional products
- Megger test selector switch incorporated to improve maintenance workability (125 AF or larger)

[Compact and high performance]

- Japan's standard compact size and certified to UL489 480V

[Safety]

- Three-phase power supply supported for improved leakage detection and operation functionality

equipment

Proposal of replacement of air circuit breaker

Year	Years used	Series
78	37	DA series
79	36	
80	35	
81	34	
82	33	
83	32	
84	31	
85	30	
86	29	
87	28	
88	27	
89	26	
90	25	
91	24	
92	23	
93	22	
94	21	
95	20	
96	19	
97	18	
98	17	
99	16	
00	15	
01	14	
02	13	
03	12	
04	11	
05	10	
06	9	
07	8	
08	7	
09	6	
10	5	
11	4	
12	3	
13	2	
14	1	



Air circuit breakers (ACB)



DA series
Manufacture date: 1978–1991



DB series
Manufacture date: 1992–2009

The products delivered in this era are entering into their renewal periods.

FUJI ELECTRIC
Renewal period recommended
15 years after start of use

Models recommended to be renewed



DW series
Manufacture date: 2013–



BT3 series
Manufacture date: 2014–

[Compact and high performance]

- DW series: Full ranges from 800 to 6300 AF covered by two frame sizes. Two breaking capacity classes (H1, H2) available
- BT3 series: Four frame sizes with smaller width available.

[Usability]

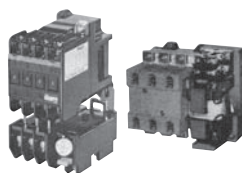
- Compliant with IEC60947-1,2
- Reversible
- Safety shutter default provided

Proposal of replacement of magnetic contactors and starters

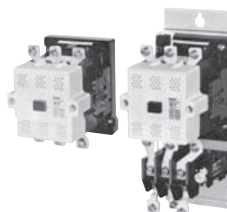
Year	Years used	Series
80	35	SC series
81	34	
82	33	
83	32	
84	31	
85	30	
86	29	
87	28	
88	27	
89	26	
90	25	
91	24	
92	23	
93	22	
94	21	
95	20	
96	19	
97	18	
98	17	
99	16	
00	15	
01	14	
02	13	
03	12	
04	11	
05	10	
06	9	
07	8	
08	7	
09	6	
10	5	
11	4	
12	3	
13	2	
14	1	



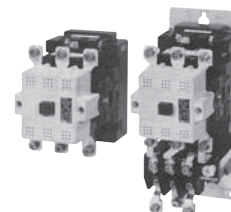
Old-type magnetic contactors and starters



S series
Manufacture date: 1965–1993



SC series
Manufacture date: 1978–1990



NEW SC series
Manufacture date: 1984–2003

The products delivered in this era are entering into their renewal periods.

FUJI ELECTRIC
Renewal period recommended
10 years after start of use

Models recommended to be renewed



New SC series
Manufacture date: 1988–



NEO SC series
Manufacture date: 1999–

[Energy conservation]

- Holding VA significantly reduced by adoption of SUPER MAGNET
- DC-operation specialized products made available, which greatly reduce the amount of power supplied and consumed

[Usability]

- A wide variety of optional units made available (auxiliary contact unit, surge absorption unit, reversible wiring kit)

Molded case circuit breaker

Old product



TWIN BREAKER series

Solid state trip E series

Current product



G-TWIN series

BX series

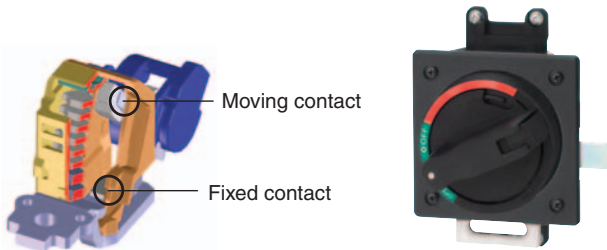
[History of models]

Series	Type	Manufacture year
(1) TWIN BREAKER series	EA203B	1990 – 2009
(2) Super TWIN series	EA403B	1992 – 2009
(3) α -TWIN series	EA33AC	2001 – 2010
(4) G-TWIN series	BW250EAG-3P	2007 – Current model

Advantages of renewal

G-TWIN series

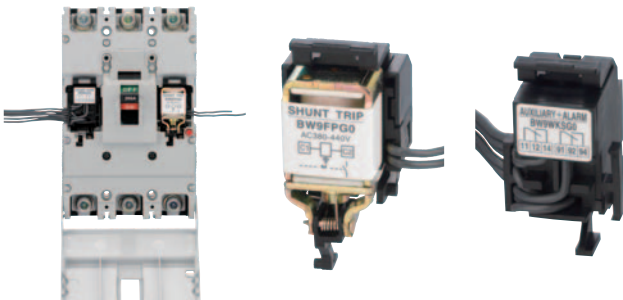
Environmental resistance



- For easy recycling, the names of materials used are indicated for major parts.
- Lead (Pb) free solder and cadmium (Cd) free contacts are used, and use of hexavalent chromium (Cr6+) has been discontinued.
- The external operating handle is compliant with IP54* (125, 250 AF).

*Type specification is required for the N type

Easier to use and more cost efficient



- Internal accessories are shared between frames and the number of types is reduced.
125, 250 AF: Types reduced from 16 to 8.
- 400 AF or more: W, K, F, and R are individually designed in modules. Types reduced from 26 to 6.
- Built-in undervoltage trip device (125/250 AF).

BX series

Compact design

- Full range from 100 to 1600 A covered by three frame sizes.

[Solid state trip E series]



225-400AF

600-800AF

1000-1600AF

[BX series]



100-250AF

400-630AF

800-1600AF

Various control units

- Different models selectable according to protection and measurement needs.
- Functionality easily enhanced by replacement of control units
- Five types for 100 to 630 AF
- Twelve types for 800 to 1600 AF



Earth leakage circuit breaker

Old product



Super TWIN series

α-TWIN series

Current product



G-TWIN series

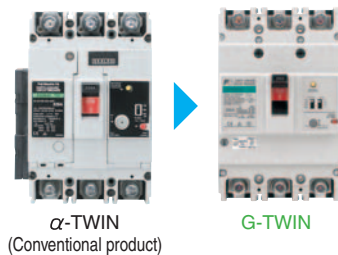
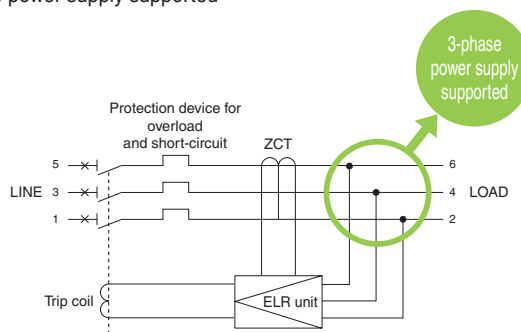
[History of models]

Series	Type	Manufacture year
(1) TWIN BREAKER series	EG203B	1990 – 2009
(2) Super TWIN series	EG403B	1992 – 2009
(3) α-TWIN series	EG33C	2001 – 2010
(4) G-TWIN series	EW250EAG-3P	2007 – Current model

Advantages of renewal

Improved safety

3-phase power supply supported



α-TWIN
(Conventional product)

G-TWIN

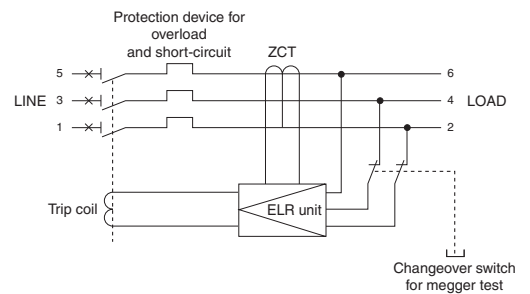
- In accordance with IEC60947-2, the earth leakage circuit breaker takes control power supply for the leakage detection circuit from a 3-phase power supply to realize a structure that allows the leakage detection and operation to function even if one phase is lost.

Transparent terminal cover



- In addition to the lineup of the same color as the main unit, a lineup of transparent terminal covers is provided. This makes it easier to check for loosened screws and permanent ink markings.

Improved maintainability



Changeover switch for megger test



- Equipped with changeover switch for megger test for maintenance.
- Maintenance workability has been greatly improved by eliminating the need for removing the ELCB wiring for dielectric testing during inspection. (For 125 AF or larger)

Improved usability

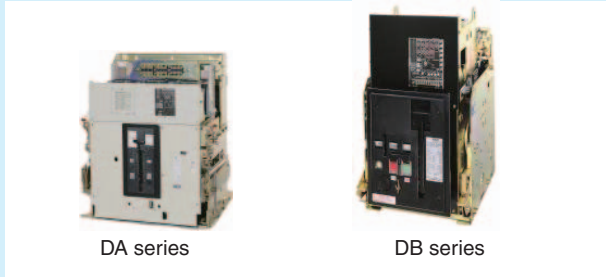
- The sensitive current, tripping time and switching range have been increased.
- Standard models are provided with high speed/time delay switching and earth leakage circuit breakers can be easily coordinated.

Selector switch (sensitive current & tripping time)

	Rated sensitive current	Maximum tripping time
α-TWIN	100/200/500mA	0.1 sec (high-speed type)
G-TWIN	100/200/500/1000mA	0.1/0.4/1/2 sec (selectable)

Air circuit breaker

Old product



DA series

DB series

Current product



DW series

BT3 series

[History of models]

Series	Type	Manufacture year
(1) DA series	DA50	1978 – 1991
(2) DB series	DB40	2001 – 2010
(3) DW series	DW40	2013 – Current model
(4) BT3 series	BT3-2500P	2014 – Current model

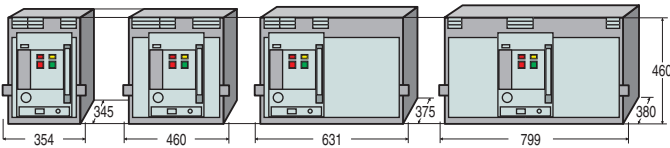
Advantages of renewal

DW series features

Compact design

- Full range from 800 to 6300A covered by two frame sizes.

[DH series]



Standard type

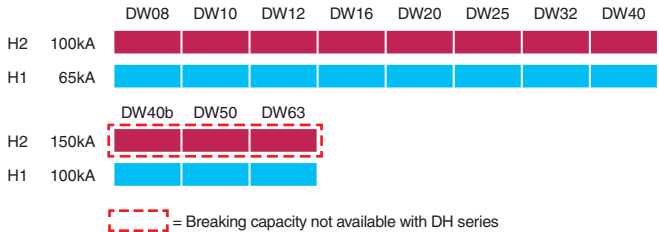
800 to 2000A 2500 to 3200A 4000A 5000 to 6300A

High breaking type

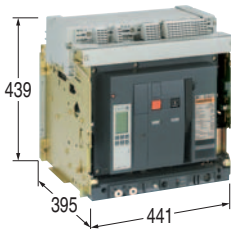
1250 to 2000A 1600 to 3200A

High breaking capacity

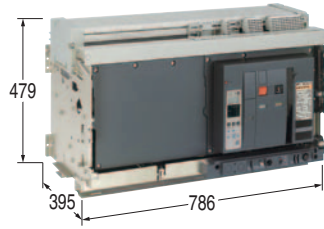
- Distribution market covered by two breaking capacity classes
H1: Plant facilities with large estimated short circuit currents, facilities with two parallel transformers, etc.
H2: Heavy industry facilities with very large estimated short circuit currents



[DW series]



DW08 to DW40



DW40b to DW63

Other features

Compliance with various standards

- IEC60947-1 and 2, IEC68230 for type2 tropicalisation
- French third-party certification ASEFA acquired

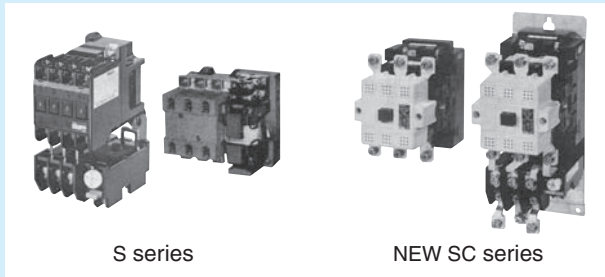


Standardization of panel design in progress

- Reverse connection possible
- No need for arc space
- Front connection to minimize depth
- Free combination of front and back connections
- Back-connected terminal direction (vertical/horizontal) changeable on site

Magnetic starter

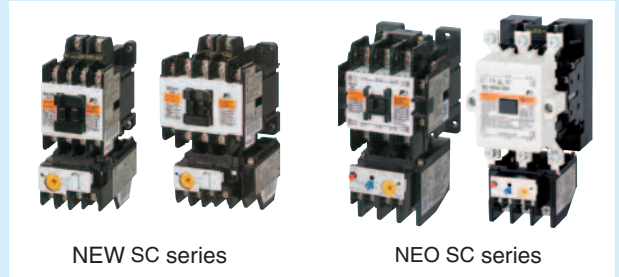
Old product



S series

NEW SC series

Current product



NEW SC series

NEO SC series

[History of models]

Series	Type *		Manufacture year
S series	SRC3631-5-1	SRC3631-3	1965 – 1993
SC series		SC-3	1978 – 1990
NEW SC series		SC-3N	1984 – 2003
NEW SC series	SC-5-1		1988 – Current models
NEO SC series		SC-N3	1999 – Current models

* Comparison of current series frame sizes 5-1 and N3

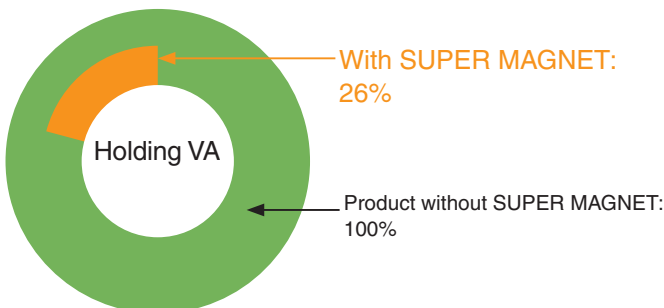
Advantages of renewal

NEW SC/NEO SC series

Reduction of holding VA

- Adoption of a SUPER MAGNET with full use of three-dimensional electromagnetic field analysis has greatly reduced holding VA. (SC-N1/SE to N4/SE, SC-N5 to N16)

Comparison with and without SUPER MAGNET of frame sizes N1 to N5



Averages of SC-N1/SE to N5 (comparison between Fuji Electric's products)

Electricity: 0.555 kg CO₂/kWh (From the manual for calculating and reporting greenhouse gas emissions Ver 2.4, Ministry of the Environment)

Addition of products specialized for DC operation

- DC-operation specialized products, which greatly reduce the amount of power supplied and consumed, are available.



DC operated SC-□/G type

	03/G to 5-1/G	N1/G	N2/G	N2S/G	N3/G	N4/G	N5/G
Power supplied	7W	9W	9W	12W	12W	20W	20W
Power consumed	7W	9W	9W	12W	12W	20W	20W

Variety of optional units



Auxiliary contact block (front mounting) SZ-A □ type

2-contact and 4-contact auxiliary contact blocks with bifurcated contacts adopted for all contacts. The block can snap in place on a magnetic contactor with a single motion.



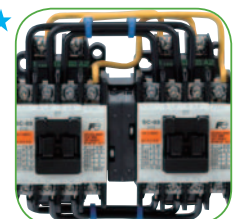
Auxiliary contact block (side mounting) SZ-AS □ type

A 2-contact (1NO+1NC) auxiliary contact block with high-reliability auxiliary contacts adopted. The block can snap in place on a magnetic contactor with a single motion.



Main circuit surge suppression unit (front mounting, side mounting) SZ-ZM □ type

A CR device for absorbing switching surges of three-phase motors is incorporated.



Interlock unit SZ-RM type

Mechanical interlock operation is performed with two magnetic contactors linked.



Power connection kit for reversing SZ-RW □ type

A reversible circuit wiring kit for use between main circuit terminals of two magnetic contactors.



Three-phase parallel terminal plate SZ-SP □ type

A magnetic contactor for single-phase resistance loads can be configured by attaching this plate to a main circuit terminal.

★ : Shared in SC-03 to N3 types

★ : Shared in SC-03 to N3 types, and SC-N4 to N12 types, respectively

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