

Expanded Product Line of G-TWIN Series Breakers with Accessories to Enhance Functionality

Yasuhiro Takahashi †
Yukata Sato †
Hideki Ishido †

1. Introduction

Standards for individual equipment and products have recently been incorporating international standards at an accelerating rate, and in December 2004, the JIS (Japanese Industrial Standard) for molded case circuit breakers (MCCB) and earth leakage circuit breakers (ELCB) was issued as a new JIS that was consistent with IEC standards, further defining the trend toward globalization. Meanwhile, based on its existing series of twin breakers, Fuji Electric has responded to market needs by expanding its lineup of products conforming to and certified for various standards. With a larger number of product varieties, however, product selection and purchasing become more complicated, and requests for improvement had also increased.

In consideration of these circumstances, Fuji Electric has developed standard and derivative models of 125 to 400 AF (ampere frame) G-TWIN series breakers, a truly global series of twin breakers that conforms to each of the new JIS/IEC (Japan, Europe), GB (China) and UL (United States) standards, as well as accessories for this series.

This paper presents an overview and describes features of the derivative models of the G-TWIN series breakers and their accessories.

2. G-TWIN Series Breakers Accessories

Accessories attachable to the G-TWIN series breakers can be classified as external accessories mounted on the exterior of breakers and internal accessories mounted inside breakers. Figure 1 shows the types of accessories that can be mounted on G-TWIN series breakers.

2.1 External accessories

Some of the external accessories for the G-TWIN series breakers support connection to various types of electrical wiring, some support diverse operation methods, some provide protection and include insulation, and so on.

Fig.1 Accessory variations

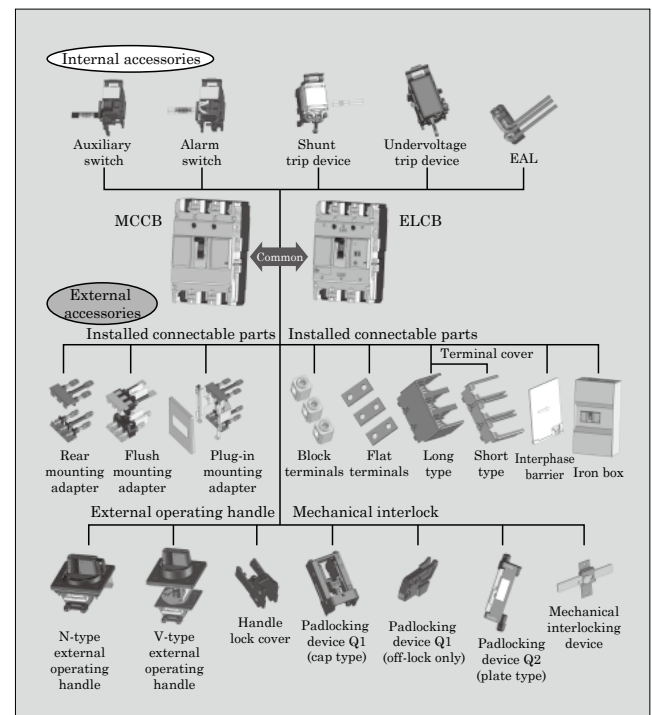
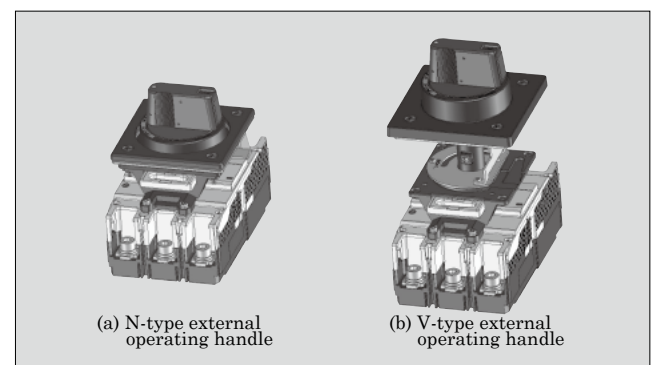


Fig.2 Appearance of external operating handle



(1) External operating handle

External operating handles are used for opening and closing the main power source in such equipment as semiconductor production equipment, machine tools and automotive production equipment. The sale of

† Fuji Electric FA Components & Systems Co., Ltd.

which is expanding to global markets. There is increasing request for certification and compliance with the major global standards, and for improved safety. Therefore, this handle is standardized internationally and incorporates safety and operational improvements into its specifications. Two variations have been developed: an N-type mounted directly on the main breaker unit and a panel-mount V-type that enables the depth direction to be adjusted using an extension shaft and is provided with a panel opening and closing function. Figure 2 shows the appearance of the external operating handle.

(a) Support of international standardization

1) So that a single product can be deployed in Japan, Europe, Asia including China, and North America, certification was acquired for CE marking (TÜV certification), CCC marking and UL/cUL listing marking, and all of these standards are displayed on the product.

2) With an isolation function enabled by combination with a breaker, an interlock function that prevents breaker turn-on when the switchboard panel is open, and the like, this external operating handle complies with the requested items for an external operating handle as specified in EN 60204-1, IEC 60204-1 and “Electrical Standards for Industrial Machinery” NFPA 79 (US).

3) In accordance with the RoHS^{*1} directive, the burden on the environment has been reduced.

(b) Improved safety

1) While coordinating the design with that of the existing “α-TWIN series,” consideration was given to preventing short circuits and earth faults during maintenance, and molded material was used for the installation frame to increase the insulation strength.

2) Protective structure (IEC 60529, JIS C 0920)
 ○ N-type handle: IP20 (IP50 with dustproof packing)
 ○ V-type handle: IP54

(c) Improved ease of use

1) OFF locking mechanism

Employing a one-touch pull-out system for the lock plate has improved the ease of use. Specifically, when the lock plate is pressed down at the OFF position, the lock plate will automatically protrude outward, thereby facilitating the locking operation. To return the lock plate, the lock plate is pressed down and is housed and retained at the middle of the grip. Locking devices used throughout the world, such as padlocks (3 padlocks having diameters of 4 to 8 mm), hasps (scissor locks)

used in the United States, and so on can be attached.

2) Lock lever self-retaining function when opening the panel

When the lock plate is pressed down at the open position, a retaining mechanism holds the lock lever. As a result of this function, the panel can be opened freely even when multiple handles are installed on the same board. Figure 3 shows the structure of the external operating handles.

3) Mounting compatibility with existing products

Panel drilling and installation height size

Fig.3 Structure of external operating handles

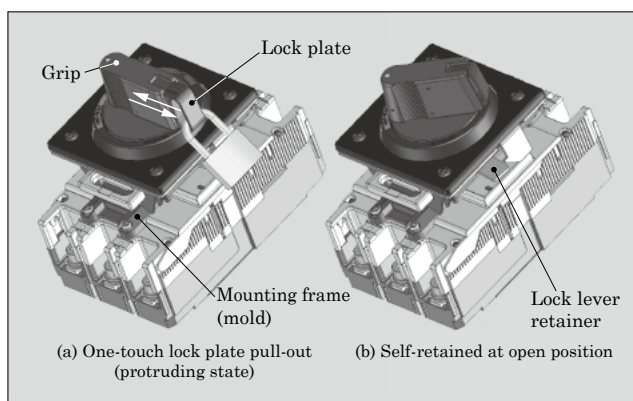


Fig.4 Terminal cover for 250 AF

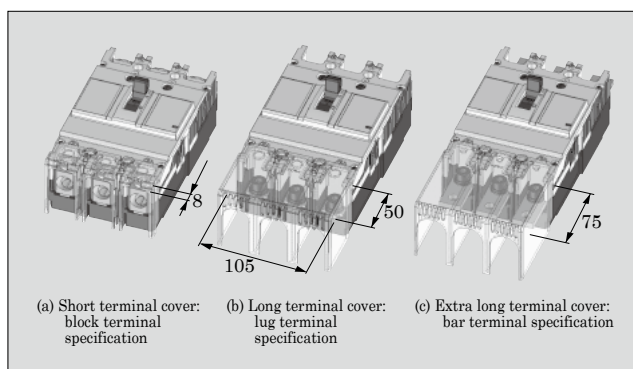
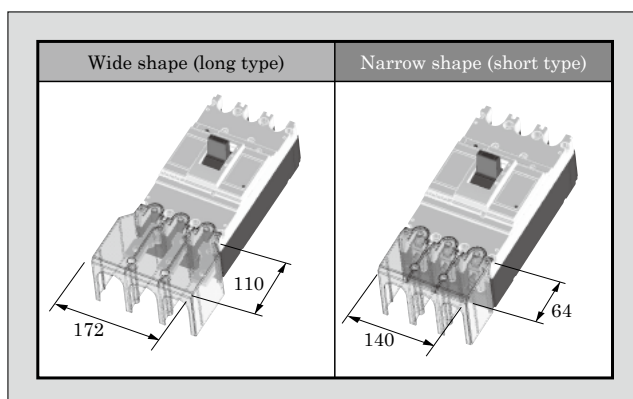


Fig.5 Terminal cover for 400 AF



*1: RoHS is restriction of the use of certain hazardous substances electrical and electronic equipment in the EU (European Union).

were unified with the corresponding specifications of the existing α -TWIN series. With ensured compatibility for mounting, panel design and production were made more efficient.

(2) Terminal cover

The terminal cover for the G-TWIN series breakers was structured to be easily attachable and can be attached with a one-touch operation. The structure can also be fastened with screws (included in the package) so as to comply with the IEC standard safety requirement mandating that a tool be used for attaching the terminal cover.

The 250 AF terminal cover is available as a short-type for connecting screw terminals directly or for connection to a pillar terminal, a long-type for connecting lug terminals, and an extra long-type for bar terminals (Fig. 4). The 125 AF terminal cover also has the same

Fig.6 External appearance of off-lock only padlocking device Q1 (125 to 250 AF)

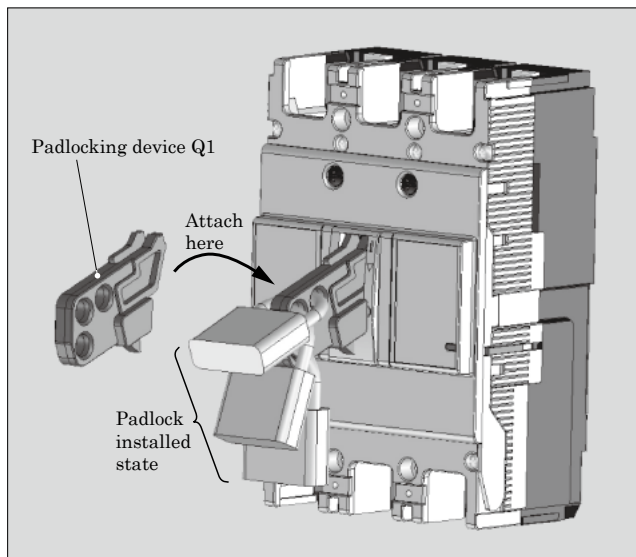
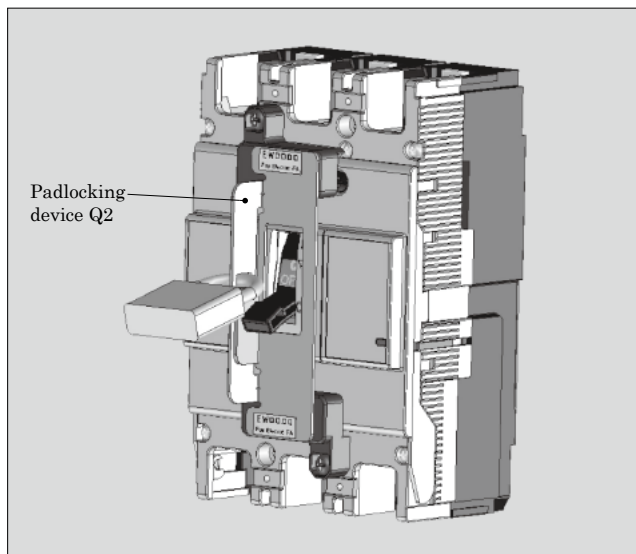


Fig.7 External appearance of padlocking device Q2 (250 AF)



structure as the 250 AF terminal cover. The 400 AF terminal cover is available in a wide shape for connecting lug terminals or a bus bar to a flat bar, and a narrow shape for connecting a block terminal or for detaching the flat bar and connecting a bus bar directly (Fig. 5). Both of these structures provide protection for electrically charged parts.

(3) Handle lock

In order to satisfy requirements of IEC 60204-1, "Electrical Equipment of Machines," the standard handle lock is an off-lock only handle. The cap-method handle lock Q1 shown in Fig. 6 is an off-lock only product that is compatible with overseas specifications for equipment and machinery. Also, the existing plate-type handle lock Q2 product had to be arranged with the breaker itself as a dedicated product, but the Q2 for the G-TWIN series breakers shown in Fig. 7 is configured so as to be mountable in the main unit of the standard product.

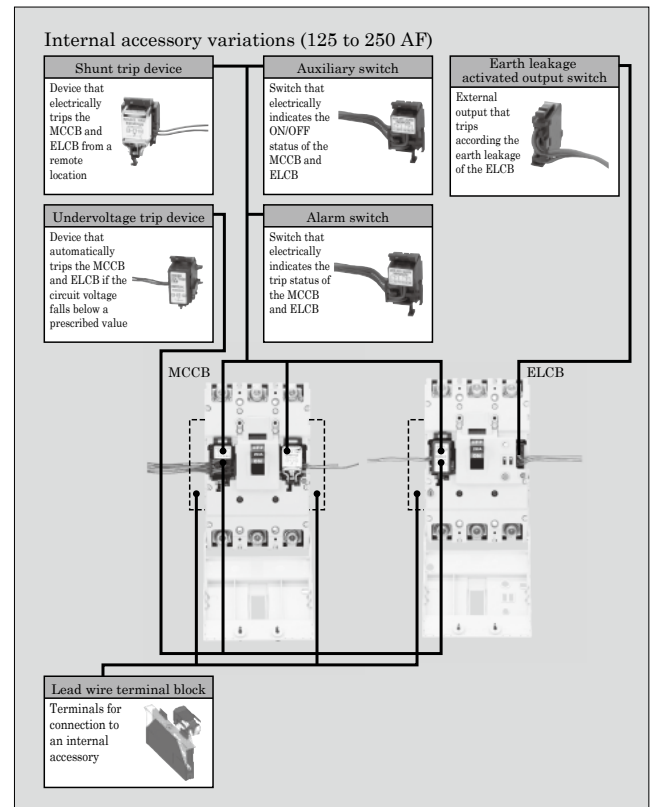
2.2 Internal accessories

As in the case of the main unit, internal accessories

Table 1 Number of varieties of interior accessories (comparison with existing α -TWIN)

AF	α -TWIN	G-TWIN
100/125	8	8
225/250	8	
400	26	6

Fig.8 Varieties of internal accessories (125 to 250 AF)



of the G-TWIN series breakers have also acquired new JIS, IEC, GB and UL certification, so that the same model may be used in all countries.

The internal accessories utilize a mountable cassette, attachable by the customer, so as to flexibly support changes in specifications. With the G-TWIN series breakers, the internal accessories also employ a structure that prevents mis-mounting and improves the ease of attaching by a customer, and as shown in Table 1, there are fewer model varieties since the internal accessories can be shared among frames. Figure 8 shows the internal accessories common to the 125 AF and the 250 AF.

Features of the internal accessories are summarized below.

- (a) New JIS, IEC, GB and UL standard certifications have been acquired for the same structure.
- (b) A structure that prevents mis-mounting improves the ease of attaching by the customer.
- (c) The internal accessories can be used commonly with both the 125 AF and 250 AF, and as a result, the number of varieties has been halved.
- (d) A shunt/undervoltage trip device for the ELCB can be installed inside the main unit.
- (e) The number of varieties has been reduced considerably since the internal accessories are for specific 400 AF products.
- (f) The earth leakage activated output switch for the ELCB is implemented as an internal cas-

sette instead of an externally attached structure.

- (g) Internal accessories also conform to the RoHS directive, an environmental regulation of the EU.

3. Derivative Models of the G-TWIN Series Breakers

A product line of derivative models, shown in Table 2, was organized in consideration of unique applications in Japan. As representative examples, an earth leakage alarm breaker and a non-auto switch are described below.

3.1 Earth leakage alarm breaker

The earth leakage alarm breaker is a compact breaker equipped with both an MCCB function and an earth leakage protection relay function, and as shown in Fig. 9, the existing product was constructed with an earth leakage alarm unit added onto the side of the breaker. With the G-TWIN series breakers, the earth leakage detection unit is miniaturized and installed internally so that the earth leakage alarm breaker has the same appearance as a standard product. Also, in consideration of safety, the method of indicating earth leakage was changed from LED indication, as in the existing product, to mechanical type indication so that a record of the earth leakage history will be maintained

Table 2 List of G-TWIN series breakers derivative models

	Motor protection type	Protection for neutral line failure in single-phase three-wire system	Instantaneous trip	Primary side of transformer type	Non-auto switch	Earth leakage alarm type
MCCB	○	○	○	○	○	○
ELCB	○	○	—	—	—	—
Summary	MCCB/ELCB providing overload protection for motor and overcurrent protection for winding	MCCB/ELCB having neutral line failure protection function for single-phase three-wire circuit	Used in a motor circuit in combination with an MCCB electromagnetic switch having only instantaneous trip characteristics, or used by itself in a semiconductor circuit	Set to a higher instantaneous trip current than a breaker having general characteristics, for the rated current of the transformer, the closest upper level can be selected	Has the structure of a standard MCCB minus the overcurrent trip element, and is used as a switch-disconnector	Compact breaker providing both an MCCB function and an earth leakage protection relay function

Fig.9 Appearance of existing product and G-TWIN earth leakage alarm breaker

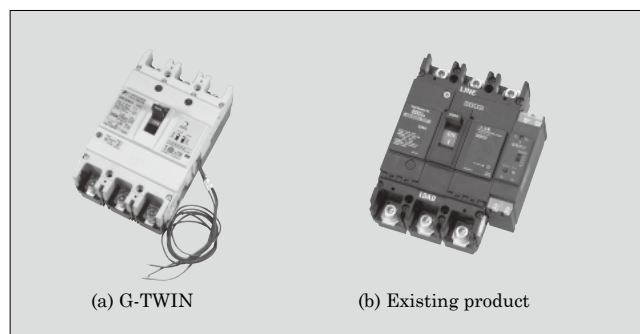
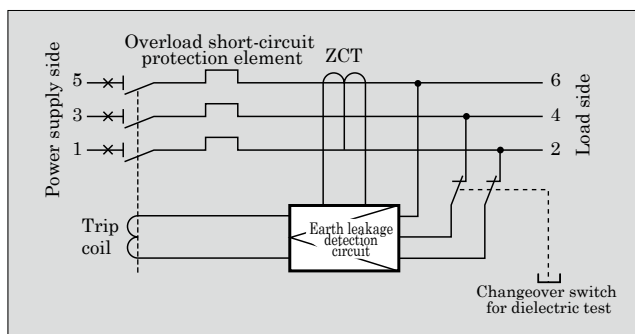


Fig.10 Internal connection wiring diagram for earth leakage circuit breaker



in the case of failure of the line voltage.

Additionally, new functions of the G-TWIN ELCB are also incorporated. Specifically, the G-TWIN ELCB conforms to the revised IEC standard. In order to provide the requested performance level of earth fault operation even in cases where one phase is open in a three-phase circuit, the power supply to the earth leakage detection unit was changed from the previous two-phase implementation to a three-phase implementation. Figure 10 shows the circuit diagram. Also, the provision of a changeover switch for dielectric testing has resulted in a significant improvement in operability since there is no need to remove the ELCB wiring for a dielectric test during an inspection.

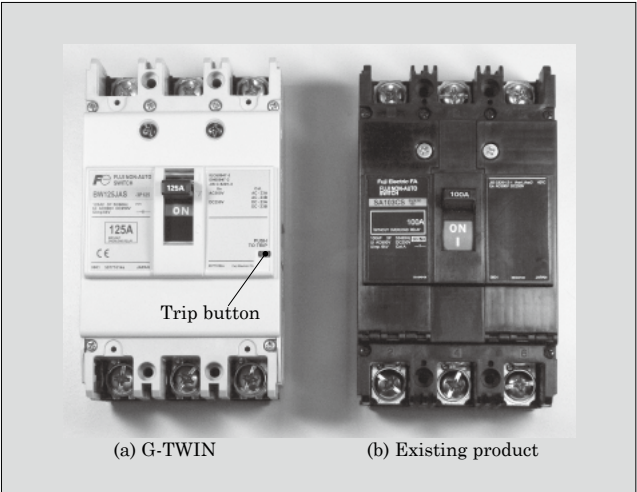
3.2 Non-auto switch

The non-auto switch has the structure of a standard MCCB minus the overcurrent trip element, and is used as a switch. With the G-TWIN series breakers, products were built to comply with IEC 60947-3 so as to be usable overseas as a switch-disconnector. Figure 11 compares the appearance of the G-TWIN series breakers and an existing product. With the G-TWIN series breakers, a trip button is provided on the main unit, and the same internal accessories as used with a standard breaker can be used.

4. Postscript

Accessories and derivative models of the G-TWIN

Fig.11 Appearance of non-auto switch



series breakers have been introduced above. In the future, improving the efficiency of equipment design and production, including domestic electric equipment, and the consideration of safety factors will become increasingly important. The G-TWIN series breakers supports the various diverse requests of customers who have anticipated these needs. In the future, Fuji Electric intends to continue to consult with customers, to further the expansion of accessories and derivative models matched to market needs, and to enhance the G-TWIN series breakers.





* All brand names and product names in this journal might be trademarks or registered trademarks of their respective companies.