Roll-in replacement circuit breakers
Low and Medium Voltage Service
Roll-in replacement circuit breakers

ABB is a leading producer of aftermarket low and medium voltage roll-in direct replacement circuit breakers. Roll-in replacement breakers are interchangeable and can be inserted directly into existing switchgear, minimizing downtime in critical applications. ABB offers a comprehensive portfolio of pre-engineered, quick turnaround breakers for most major manufacturers, such as:

- ABB/ITE/BBC/Gould/Brown Boveri
- Siemens/Allis-Chalmers
- Federal Pacific
- General Electric
- McGraw-Edison
- Westinghouse

It has been ABB’s experience that the mechanical nature of circuit breakers deteriorate long before the switchgear in which they are installed. Therefore, circuit breakers typically drive the repair versus replacement decisions for customers. Many circuit breaker factors must be evaluated such as:

- Age
- Duty cycle
- Availability of spare parts
- Reliability
- Application criticality
- Qualified maintenance personnel
- Environmental conditions
- Safety
- System changes that increase the available fault current
- Maintenance practices
- Operating costs

The frequent maintenance needs of older breakers expose technicians to potential hazard risks, such as arc flashes and asbestos arc chutes. New replacement circuit breakers keep technicians safer by incorporating the latest proven technologies to extend maintenance intervals, simplify maintenance, and eliminate environmental liabilities. ABB also ensures that the switchgear safety interlocks operate properly with the new replacement breakers and provides onsite training during installation to make sure technicians know how to safely install, operate, and maintain the new circuit breakers.

ABB roll-in replacement circuit breakers provide customers with the most cost effective way to upgrade switchgear without completely replacing it. These circuit breakers are installed with minimal to no modifications to the switchgear. All roll-in replacement designs are ANSI/IEEE tested - interface/interlocks, dielectric, momentary, temperature rise, and mechanical life in accordance with ANSI C37.59, C37.50, and C37.09. Nuclear certification is available when required.
ABB, recognized as a world leader in electrical equipment, also maintains leadership in customer service by offering exactly the right support for each application. ABB has both the specialized equipment and personnel to help customers find the best solutions. Exceptional customer service is provided by ABB throughout the entire roll-in replacement process.

Initial Assessment
ABB’s Business Development Managers meet with customers to discuss the condition of the switchgear, evaluate the after-market alternatives, and answer any questions. ABB prepares a detailed proposal defining the roll-in replacement offering taking into account scheduled outages and timelines.

Verification Process
Once an order is placed, ABB technical personnel works with customers to get required technical information and may visit the switchgear installation to take photographs and measurements, check for frame modifications, and verify the switchgear interlocks. This technical information ensures proper circuit breaker design and allows for an easy installation. ABB also requests a copy of the circuit breaker control scheme to make sure the new controls are properly configured.

Robust Design
ABB takes pride in the success of each roll-in replacement circuit breaker design. This success comes from teaming expert design engineers with the latest design technologies, such as Solidworks 3-dimensional modeling. This modeling provides different views to ensure all of the components fit together before production starts. This allows for the development and manufacturing of quality roll-in replacement circuit breakers.

Each roll-in replacement circuit breaker is “type tested” meaning that the breaker is inserted in a matching switchgear cubicle and tested according to all applicable standards. “Type testing” insures that the roll-in replacement circuit breaker meets or exceeds the required ratings of the original circuit breaker.

Production
As the roll-in replacement order goes through production, customers are kept informed with milestone schedules and contact from a dedicated customer service team. Customers are welcomed and encouraged to visit the factory to witness ABB’s centers of excellence.

Aftermarket Support
After the roll-in replacement circuit breakers ship, ABB supports customers with instruction manuals and installation and commissioning instructions. ABB also provides optional technical supervision and training on new roll-in-replacement circuit breaker types. ABB knows that orienting customers to the technology, operation, and maintenance of roll-in replacement circuit breakers saves time and money. Additional services such as complete turnkey installations are also available.

The ABB support continues after installation with the availability of a complete line of renewal parts and components, along with a technical team to address any operational questions. ABB aftermarket service teams are also available to provide field maintenance and support.

ABB continually develops new roll-in replacement designs to meet customer needs.
ABB incorporates proven technologies for medium voltage roll-in replacement circuit breakers, such as vacuum interrupters and operating mechanisms. Operating mechanisms that are specifically designed to operate with vacuum interrupters include the ADVAC® spring charged mechanism and the AMVAC™ magnetic operating mechanism. The AMVAC magnetic operating mechanism has quickly become the operating mechanism of choice because of its reduced number of parts, simple operation, and extended maintenance intervals.

Magnetically actuated breaker
ABB roll-in replacement circuit breakers utilize the ABB AMVAC medium voltage circuit breaker as the primary operating element. This roll-in replacement circuit breaker brings all the benefits of increased performance, with reduced maintenance intervals. It features encapsulated vacuum interrupter assemblies, providing maximum protection from dust and humidity, greatly reducing the potential for tracking and partial discharge (corona). The need for lubrication is virtually eliminated, while providing the capability of performing over 100,000 mechanical operations without replacement of mechanism parts and 30,000 operations before the interrupter assemblies need attention.

Magnetic Actuators
The AMVAC magnetic operating mechanism uses a simple electromagnetic flux shifting device to change the position of an armature rod. The armature rod extends through a laminated core which has top and bottom electric coils. Rare earth permanent magnets are located between the rod and core that hold the armature rod in a fixed position. One coil is energized and its magnetic field exceeds that of the magnets retaining force and moves the rod. Energizing the opposite coil moves the armature rod in the opposite direction. The armature rod is connected to the operating arm that opens and closes the circuit breaker vacuum interrupter contacts.

Operating System
The AMVAC operating system is rugged, yet simple with only seven moving parts (90% fewer parts than spring charged mechanisms). Fewer parts make the design inherently more reliable. The mechanism is capable of over 100,000 mechanical operations at 25 kAIC. It requires minimal maintenance, and the recommended maintenance interval is greatly extended compared to spring charged mechanisms, making it less costly and safer to operate.
Controller
Operation of the AMVAC is controlled with a robust electronic controller that operates on AC or DC control power because of its internal converter. The controller is very flexible and only has two voltage range options: LV: 38-56 VDC or HV: 100-280 VDC and 104-254 VAC.

Stored energy to operate the circuit breaker is provided by special capacitors that charge in as little as 7 seconds after control power is available. At 50° centigrade, the capacitor lifetime is approximately 45 years.

The controller handles all capacitor charging, open/close coil switching, anti pumping, interlocking, and armature position details. Self-monitoring functions are programmed to monitor for proximity sensors, the microprocessor, and other key functions with annunciation and/or breaker trip by using only 4 amperes continuous and 10 amperes peak during capacitor charging, less than 10 watts of power are needed to maintain controller functions and capacitor full charge.

Vacuum Interrupter
The AMVAC operating mechanism was specifically designed to operate with vacuum interrupter technology. ABB's vacuum interrupters use the latest technology in rotating spiral contact design to maximize contact life, and are rated for 30,000 full load operations and over 100 full short circuit operations.

The vacuum interrupters and current carrying assemblies are fully encapsulated in a proprietary epoxy, for most frame sizes, achieving excellent thermal and dielectric capabilities. The encapsulation also provides maximum protection from dirt and humidity, greatly reducing the potential for tracking and partial discharge.

Benefits of ABB medium voltage roll-In replacement circuit breakers:
- Uses AMVAC magnetic operating mechanism
- An electromagnetic flux shifting device that exceeds the retaining force of permanent magnets to change the position of the operating shaft
- Capable of performing 100,000 mechanical operations at 25 kAIC
- Minimal lubrication required and extended maintenance intervals
- Specifically designed to operate with vacuum interrupters
- Uses ABB vacuum interrupters
- Incorporates the latest technology in rotating spiral contact designs to maximize contact life, and are rated for 30,000 full load operations and over 100 full short circuit operations
- Vacuum interrupter and current carrying assemblies are fully encapsulated in epoxy, for most frame sizes, to provide maximum protection from dirt and humidity, greatly reducing the potential for tracking and partial discharge
- Built with all new parts
- Modification of the existing circuit breaker switchgear compartment is usually not necessary
- Switchgear interlocking safeguards are incorporated
- Circuit breaker frame is constructed of rugged steel and counter weighted as required to easily and safely connect during the racking process
- Able to incorporate AMVAC across different manufacturers switchgear
- Standardization of AMVAC operating mechanism reduces inventory and training costs and increases safety with product familiarization
- 3 to 5 cycle operating times available
- New circuit breaker warranty
- Exceptional customer support throughout the roll-in replacement lifecycle
ABB provides modern components and services to extend the service life of old or retired equipment, and upgrade switchgear and breaker ratings to handle increased load and fault currents. All replacement circuit breakers carry the same ABB warranty as new equipment. One of the most cost-effective low voltage solutions is provided by the ABB line of ANSI designed and tested replacement circuit breakers.

Low Voltage Breakers
ABB offers a complete line of low voltage direct replacement breakers based on the world class EMAX breaker technology. Modern interrupting technology, modular and compact design innovations, and extensive switchgear experience provide a solution to extend the life of aging switchgear.

The EMAX circuit breaker:
- Self-contained air magnetic breaker with stored energy operating mechanism
- Safe breaker with double insulated live parts and total phase segregation
- Built with sturdy components, including a metal frame structure
- Rated at 20,000 mechanical operations and 10,000 electrical operations at 800 amperes
- There are various levels of circuit breaker microprocessor trip units available with the EMAX circuit breaker, including:
  - Complete set of protection and control functions
  - Measurements signaling and data storage
  - Communication capabilities for use in automation and control systems
  - Bluetooth capabilities providing safe remote circuit breaker interrogation
  - Operate without external power supply

Benefits of ABB low voltage roll-In replacement circuit breakers:
- ABB replacement circuit breakers provide increased:
  - Safety
  - Reliability
  - Convenience
  - Cost effectiveness
- Replacement breakers are interchangeable and can be inserted directly into existing switchgear, minimizing downtime in critical applications with minimal cubical modifications
- New, low maintenance, circuit breaker elements offer greater reliability than older power circuit breaker technology
- New breaker elements with new trip units:
  - Improve interruption performance
  - Increase interval required to perform preventive maintenance
  - Improve equipment protection
- Easy to perform maintenance due to innovative design
- All electrical accessories are AC and DC powered, allowing reduced stock levels and avoids costly mistakes during installation
- Current transformers are extremely easy to replace
- Each element pole is independently isolated, guaranteeing total isolation between phases, phases and neutral, and to earth
- ANSI C37.50 compliant
- UL listing available for low voltage replacement circuit breakers

1 Low voltage roll-in replacement for ABB/ITE Type LK (front view) | 2 Low voltage roll-in replacement for ABB/ITE Type LK (rear view)
Cradle-in-Cradle

The cradle-in-cradle replacement is an increasingly popular low voltage option, because it provides the ability to standardize on the ABB EMAX circuit breaker for all low voltage replacements regardless of the switchgear manufacturer. The ABB unique proprietary cradle-in-cradle insertion system is a double interface frame with inner and outer interfaces. The outer interface easily mounts physically and electrically in the switchgear cubicle minimizing downtime. The inner interface matches up with the EMAX draw out breaker, allowing for quick and easy installation and removal.

The benefits of the ABB low voltage cradle-in-cradle replacement circuit breakers include:
- Easy to standardize on EMAX and reduce inventory across different switchgear types
- Simplifies personnel training and increases personnel safety through standardization
- Fits into and strengthens breaker cubicles that may have settled or shifted over time
- Allows for the replacement EMAX breaker to easily rack into and out of the cubicle
- Avoids misalignments of circuit breaker connections

Trip Units

The EMAX comes in three versions of trip units that are interchangeable and are equipped with a variety of specific functions as follows:

<table>
<thead>
<tr>
<th>Protection functions</th>
<th>PR121</th>
<th>PR122</th>
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<tbody>
<tr>
<td>Protection against overload with inverse long time-delay trip</td>
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<tr>
<td>Selective protection against short circuit inverse or definite short term-delay trip</td>
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<tr>
<td>Second selective protection against short circuit inverse or definite short term-delay trip</td>
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<tr>
<td>Protection against instantaneous short circuit with adjustable trip current threshold</td>
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<td>Protection against ground fault (residual)</td>
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<td>Protection against ground fault (source ground return)</td>
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<td>Protection against directional short circuit with adjustable time-delay</td>
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<td>Protection against phase unbalance</td>
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<tr>
<td>Protection against over temperature (check)</td>
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<td>Undervoltage protection</td>
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<td>Overvoltage protection</td>
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<td>Residual voltage protection</td>
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<tr>
<td>Thermal memory for functions L and S</td>
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<tr>
<td>Underfrequency protection</td>
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<tr>
<td>Overfrequency protection</td>
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Direct Replacement

A direct replacement low voltage circuit breaker uses an EMAX circuit breaker that is mounted directly into the existing switchgear cubicle. The mounting is a “fixed in place” physical mount, both electrically and mechanically. Direct replacement circuit breakers of the same type are interchangeable with each other.

New Switchgear Doors

New low voltage replacement circuit breakers are provided with new switchgear doors that fit the dimensions of the EMAX circuit breaker.

ABB replacement doors meet or exceed the original switchgear designed doors and include:
- Original door ventilation provisions
- Standard door mounted escutcheon that frames the circuit breaker
- Optional lockable hinged clear acrylic cover available to go over the EMAX circuit breaker front panel

1 EMAX Cradle-in-Cradle replacement breaker for ITE Type MB16 | 2 EMAX direct replacement breaker for GE Type AKK | 3 RMAX AKR 800 replacement breaker shown with (top) and without (bottom) optional cover
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