Moulded-case circuit-breakers overview
SACE Tmax
A single family of moulded-case circuit-breakers up to 3200 A

Tmax moulded-case circuit-breakers guarantee an extremely high performance level while being progressively smaller in size, simple to install and able to provide increasingly better safety guarantees for the operator. In addition to being ideal for the secondary distribution of alternating and direct current, they feature dedicated solutions for all application requirements.

Moulded-case circuit-breakers can be used in low voltage civil and industrial installations with 1 to 3200 A operating current. The Tmax family includes 9 circuit-breaker sizes in three- or four-pole versions:
- XT1, XT2, XT3 and XT4 up to 250A;
- T4, T5 and T6 up to 1000A;
- T7 and T8 up to 3200A.

The ultimate short-circuit breaking capacity (Icu) at 415V ranges from 18kA to 200kA, or up to 100kA for 690V.

The following ranges are available:
- Circuit-breakers for AC and DC power distribution;
- Circuit-breakers for zone selectivity;
- Circuit-breakers for motor protection;
- Circuit-breakers for up to 1150V AC and 1000V DC applications;
- Switch-disconnectors.

All Tmax circuit breakers can be enhanced with a vast range of standardized accessories. This convenience not only cuts down on inventory, but creates an extremely flexible and easily managed solution.

Tmax circuit-breakers can be equipped with thermomagnetic, solely magnetic or electronic trip units; all of which are interchangeable. Since assembly instructions are simple, trip units can quickly and easily be replaced; even in the field.

All this makes the circuit-breakers very easy to operate with considerable savings due to rationalized stock management.
<table>
<thead>
<tr>
<th></th>
<th>SACE Tmax Moulded-case circuit-breakers</th>
<th>ABB</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Up to 250 A</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SACE Tmax</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td>3p, 4p</td>
<td></td>
</tr>
<tr>
<td>Current rating</td>
<td>100 (1000) / 160 (2000)</td>
<td></td>
</tr>
<tr>
<td>Rated service voltage, Ue (AC) [V] 50-60Hz</td>
<td>690</td>
<td>690</td>
</tr>
<tr>
<td>Rated ultimate short-circuit breaking capacity, Icu [kA]</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Rated service short-circuit breaking capacity, Ics [kA]</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Breaking capacity according to IEC 60947-2</td>
<td>50% for T5 630</td>
<td>50% for T5 630</td>
</tr>
<tr>
<td>Breaker types</td>
<td>Fixed, Withdrawable (5)</td>
<td>Fixed, Withdrawable (5)</td>
</tr>
<tr>
<td>Dimensions (Width/Depth/Height)</td>
<td>101 x 70 x 130</td>
<td>140 x 70 x 150</td>
</tr>
<tr>
<td>Icu @ 690V 50-60Hz (AC) [kA]</td>
<td>30</td>
<td>42</td>
</tr>
<tr>
<td>Ics @ 690V 50-60Hz (AC) [kA]</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Up to 1000 A</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SACE Tmax</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td>4p, 5p</td>
<td></td>
</tr>
<tr>
<td>Current rating</td>
<td>800/1000/1250/1600</td>
<td></td>
</tr>
<tr>
<td>Rated service voltage, Ue (AC) [V] 50-60Hz</td>
<td>690</td>
<td>690</td>
</tr>
<tr>
<td>Rated ultimate short-circuit breaking capacity, Icu [kA]</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Rated service short-circuit breaking capacity, Ics [kA]</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Breaking capacity according to IEC 60947-2</td>
<td>50% for T5 630</td>
<td>50% for T5 630</td>
</tr>
<tr>
<td>Breaker types</td>
<td>Fixed, Withdrawable (5)</td>
<td>Fixed, Withdrawable (5)</td>
</tr>
<tr>
<td>Dimensions (Width/Depth/Height)</td>
<td>101 x 70 x 130</td>
<td>140 x 70 x 150</td>
</tr>
<tr>
<td>Icu @ 690V 50-60Hz (AC) [kA]</td>
<td>30</td>
<td>42</td>
</tr>
<tr>
<td>Ics @ 690V 50-60Hz (AC) [kA]</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Up to 3200 A</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SACE Tmax</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td>6p, 8p</td>
<td></td>
</tr>
<tr>
<td>Current rating</td>
<td>2000/2000/2400/3200</td>
<td></td>
</tr>
<tr>
<td>Rated service voltage, Ue (AC) [V] 50-60Hz</td>
<td>690</td>
<td>690</td>
</tr>
<tr>
<td>Rated ultimate short-circuit breaking capacity, Icu [kA]</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Rated service short-circuit breaking capacity, Ics [kA]</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Breaking capacity according to IEC 60947-2</td>
<td>50% for T5 630</td>
<td>50% for T5 630</td>
</tr>
<tr>
<td>Breaker types</td>
<td>Fixed, Withdrawable (5)</td>
<td>Fixed, Withdrawable (5)</td>
</tr>
<tr>
<td>Dimensions (Width/Depth/Height)</td>
<td>101 x 70 x 130</td>
<td>140 x 70 x 150</td>
</tr>
<tr>
<td>Icu @ 690V 50-60Hz (AC) [kA]</td>
<td>30</td>
<td>42</td>
</tr>
<tr>
<td>Ics @ 690V 50-60Hz (AC) [kA]</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>
A single family of moulded-case circuit-breakers up to 3200 A

Distribution solutions

Tmax moulded-case circuit-breakers are the ideal solution for all distribution levels, from the main low voltage switchboard to the sub-switchboards in the installation. They feature high peak current and specific let-through energy-limiting characteristics that allow the circuits and equipment on the load side to be sized in an optimum way.

The SACE Tmax family of moulded-case circuit-breakers is available with:

- thermomagnetic trip units for protecting direct and alternate current networks. These trip units use the physical properties of a bimetal and an electromagnet to detect the overloads and short-circuits;
- electronic trip units for protecting alternate current networks. These trip units use microprocessor technology to obtain protection functions that make the operations extremely reliable and accurate.

Due to dedicated devices, the SACE Tmax family of moulded-case circuit-breakers allows the insulation state of the installation to be monitored and ensures that people are protected against direct and indirect contacts, in accordance with the reference standards.

Selectivity and back-up

Selective coordination can be used among various protection devices in an installation when it is necessary to minimize the problems associated with faults and abnormal service conditions.

If selective coordination is not a requirement, back-up protection can be used. This method implies that the supply side device provides protection during a short-circuit, allowing the use of a lower breaking capacity device on the load side.

Selectivity

As can be seen from the selectivity tables, there is total selectivity (T), equal to 50 A, between a Tmax XT4S TM and T5S EL.

Advantages:
- Continuity of service
- Rapid identification of the fault zone

Back-up

As can be seen from the back-up tables, the back-up value between a Tmax XT1C and a T5S is 50 kA.

Advantages:
- Financial savings
A single family of moulded-case circuit-breakers up to 3200 A
Solutions for energy measurement and communication

A low voltage electrical installation is similar to an industrial process for electricity distribution and needs a supervisory and monitoring system that is able to increase reliability and optimize management.

To achieve integration between conventional plant engineering techniques and control systems for the purpose of running, controlling and monitoring civil and industrial installations in a centralized and automatic way, one can consider the electrical installation as being affected by two flows:
- a main flow (energy flow) formed by the power and energy supplied to the users and loads of an installation through the line conductors and control and protection devices;
- an information flow (digital flow) formed by all the information, data and commands required to control and manage the installation.

The supervisory system handles the flow of information that transits through the communication network.

Circuit-breakers for energy measurement and communication

In this type of installation, the circuit-breaker acts as both sensor and actuator. As a sensor, it collects sensitive information and data and sends them to the supervision system. As an actuator, it executes the command received from the control device (e.g. PC or PLC). These characteristics are of particular importance since they meet the growing demands for circuit-breaker integration into latest generation networks (Smart Grid).
A single family of moulded-case circuit-breakers up to 3200 A

Automatic network-generator transfer solutions

The ATS (Automatic Transfer Switch) is the network-generator transfer unit used in installations where switching the main power line to an emergency one is required in order to ensure power supply to the loads in the case of anomalies in the main line.

The new generation of ATS (ATS021 and ATS022) offers the most advanced and complete solutions to guarantee service continuity. The ATS021 and ATS022 can be used both with all the circuit-breakers in the SACE Tmax XT family and with the switch-disconnectors. Reliable, safe and smart, the new ATS family conforms to international standards, is easy to configure and is suitable for all applications.

Fully coordinated systems are ensured, since ATS integrates perfectly with the entire range of ABB circuit-breakers and switch-disconnectors.

Multi-function logic meets all requirements:

- standard switching logic that allows normal and emergency lines to be monitored, commands to be transmitted to the generator and verification that the circuit-breakers have been switched (ATS021, ATS022);
- control of the two lines, both of which are non-priority (ATS021, ATS022);
- control of a third, bus-tie breaker (ATS022);
- non-priority load disconnection management (ATS022).

The ATS022 device monitors both the supply lines and analyzes phase, frequency imbalance and phase loss. In addition to the standard control functions, ATS022 allows you to:

- select the priority line, control a third circuit-breaker, integrate the device into a supervision system with Modbus communication, read and enter the parameters, display measurements and alarms using a graphic display.

To achieve a correct configuration, each circuit-breaker connected to the ATS must be accessorized with:

- mechanical interlock;
- motor operator for opening and closing;
- key lock against sole manual operation for MOE motor operators;
- state (open/closed) and tripped contact signalling contact;
- connected contact (for the withdrawable circuit-breaker version).

The ATS (Automatic Transfer Switch) is the network-generator transfer unit used in installations where switching the main power line to an emergency one is required in order to ensure power supply to the loads in the case of anomalies in the main line.

The new generation of ATS (ATS021 and ATS022) offers the most advanced and complete solutions to guarantee service continuity. The ATS021 and ATS022 can be used both with all the circuit-breakers in the SACE Tmax XT family and with the switch-disconnectors. Reliable, safe and smart, the new ATS family conforms to international standards, is easy to configure and is suitable for all applications.

Fully coordinated systems are ensured, since ATS integrates perfectly with the entire range of ABB circuit-breakers and switch-disconnectors.

Multi-function logic meets all requirements:

- standard switching logic that allows normal and emergency lines to be monitored, commands to be transmitted to the generator and verification that the circuit-breakers have been switched (ATS021, ATS022);
- control of the two lines, both of which are non-priority (ATS021, ATS022);
- control of a third, bus-tie breaker (ATS022);
- non-priority load disconnection management (ATS022).

The ATS022 device monitors both the supply lines and analyzes phase, frequency imbalance and phase loss. In addition to the standard control functions, ATS022 allows you to:

- select the priority line, control a third circuit-breaker, integrate the device into a supervision system with Modbus communication, read and enter the parameters, display measurements and alarms using a graphic display.

To achieve a correct configuration, each circuit-breaker connected to the ATS must be accessorized with:

- mechanical interlock;
- motor operator for opening and closing;
- key lock against sole manual operation for MOE motor operators;
- state (open/closed) and tripped contact signalling contact;
- connected contact (for the withdrawable circuit-breaker version).
A single family of moulded-case circuit-breakers up to 3200 A
Motor protection solutions

Start-up is a particularly critical phase for the motor itself and for the installation powering it. Even rated service needs to be adequately monitored and protected in order to respond to any faults that might occur.

When it comes to direct starting, ABB SACE proposes two different solutions:

- a conventional system with three poles circuit-breaker equipped with a magnetic only trip unit for protection against short-circuits, a thermal relay for protection against overloads and phase failure or imbalance, and a contactor to operate the motor;
- an advanced protection system which integrates all the protection and monitoring functions, and a contactor for operating the motor, in the circuit-breaker itself.

Circuit-breakers for motor protection

**T8 2000A 3 poles with PR232 LSIG**
General circuit-breaker used for protecting the load side circuit-breakers dedicated to motor protection.

**T8 800A 3 poles with PR221-1**
Circuit-breaker used for motor protection in conjunction with a thermal relay and a contactor. Instantaneous short-circuit protection (I) can be adjusted from 1 to 10xIn.

**XT4 250A 3 poles with Ekip M-LRIU**
Circuit-breaker used for integrated motor protection. Ekip M-LRIU is fitted with the following protections:
- against overload (L): threshold adjustable from 0.4...1xIn. The tripping time is established by choosing the tripping class defined by standard IEC 60947-4-1.
- motor locking (R), with threshold adjustable in OFF or from 3...9xI1, with adjustable tripping time;
- against instantaneous short-circuit (I), with threshold adjustable from 6...13xI1 and instantaneous tripping time;
- against phase imbalance (U), with threshold adjustable in ON or OFF.

**XT2 160A 3 poles with MA**
Circuit-breaker used for motor protection in conjunction with a thermal relay and a contactor. Instantaneous short-circuit protection (I) can be adjusted from 6...14xIn.

### Coordination tables
Suitable devices for protection and motor operation can be identified, given the type of starting, the electrical characteristics of the installation and the characteristics of the motor.

<table>
<thead>
<tr>
<th>Motor power</th>
<th>MCCB</th>
<th>Contactor</th>
<th>Thermal relay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Type</td>
<td>Type</td>
<td>Setting range</td>
</tr>
<tr>
<td>5.50</td>
<td>11.50</td>
<td>XT2S 160 MA-10</td>
<td>110</td>
</tr>
<tr>
<td>7.50</td>
<td>15.50</td>
<td>XT2S 160 MA-20</td>
<td>240</td>
</tr>
<tr>
<td>9.00</td>
<td>18.60</td>
<td>XT2S 160 MA-30</td>
<td>280</td>
</tr>
<tr>
<td>11.00</td>
<td>22.00</td>
<td>XT2S 160 MA-50</td>
<td>320</td>
</tr>
</tbody>
</table>
A single family of moulded-case circuit-breakers up to 3200 A

Certifications and Shipping Registers
The moulded-case circuit-breakers and their accessories comply with IEC60947-2 international standards and conform to EC directive "Low Voltage Directives (LVD) N° 73/23 EEC" and "Electromagnetic Compatibility Directives (EMC) N° 89/336 EEC".

There is also an entire range of moulded-case circuit-breakers conforming to UL/CSA standards, with rated current values ranging from 1 to 3000 A and breaking capacities, at 600 V AC, that can reach 100 kA.

All the equipment also conforms to the specifications for installations on board and to those of RINA, DNV, BV, GL, LRS, PRS, RMRS, NKK type-approvals.

Corporate Quality System
The ABB SACE Quality System conforms with the following Standards:
- ISO 9001 International Standard;
- EN ISO 9001 (equivalent) European Standards;
- UNI EN ISO 9001 (equivalent) Italian Standards;
- IRIS International Railway Industry Standard

The ABB SACE Quality System attained its first certification with the RINA certification body in 1990.

The ABB laboratory
The ABB S.p.A - ABB SACE Division Laboratory develops, certifies and performs follow-up activities for the production of switchgear and controlgear designed and manufactured in various different ABB plants. The Laboratory provides a vast range of installations and experience with regard to the electrical, mechanical, climatic and functional tests required for low and medium voltage operating, control, safety and measuring mechanisms.

ABB’s respect for the environment
Attention to protection of the environment is a priority commitment for ABB SACE. Confirmation of this is the realisation of an Environmental Management System certified by RINA (ABB SACE was the first industry in the electromechanical sector in Italy to obtain this recognition) in conformity with the International ISO14001 Standard.

In 1999 the Environmental Management System was integrated with the Occupational Health and Safety Management System according to the OHSAS 18001 Standard and later, in 2005, with the SA 8000 (Social Accountability 8000) Standard, committing itself to respect of business ethics and working conditions.

The commitment to environmental protection becomes concrete through:
- selection of materials, processes and packaging which optimise the true environmental impact of the product
- use of recyclable materials
- voluntary respect of the RoHS directive

ISO 14001, 18001 and SA8000 recognitions together with ISO 9001 made it possible to obtain RINA BEST FOUR CERTIFICATION.

The Laboratory has been certified in Italy by ACCREDIA and, due to acknowledgements from important international certification bodies such as ACAE/LOVAG, ANCE, ASTA, ETL SEMKO, UL, CSA and Shipping Registers, offers ABB and external customers a qualified certification test service for low and medium voltage electrical devices and equipment, in accordance with the respective product standards.