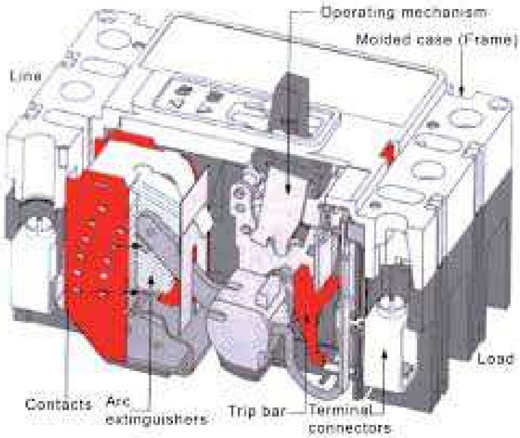
MCCB – MOULDED CASE CIRCUIT BREAKER



An MCCB provides protection by combining a temperature sensitive device with a current sensitive electromagnetic device. Both these devices act mechanically on the trip mechanism.

Depending upon the application and required protection, an MCCB will use one or a combination of different trip elements that protect against the following conditions:

- Thermal overloads
- Short circuits
- Ground faults

Thermal Overload

In an overload condition, there's a temperature build-up between the insulation and conductor. If left unchecked, the insulation's life will drastically reduce, ultimately resulting in a short circuit. This heat is a function of the square of the rms current (I squared), the resistance in the conductor (R), and the amount of time the current flows (t).

If you monitor current flow and time, you can somewhat predict and detect overload conditions. By using a time-current curve, you can see the boundary between the normal and overload conditions. Here, we see that the thermal or overload element of the MCCB will initiate a trip in 1,800 sec at 135% of rating or in 10 sec at 500% of rating

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Short-Circuit Condition

Usually, a short circuit occurs when abnormally high currents flow as a result of the failure of an insulation system. This high current flow, termed short-circuit current, is limited only by the capabilities of the distribution system. To stop this current flow quickly so that major damage can be prevented, the short circuit or instantaneous element of an MCCB is used.

Ground Fault Condition

A ground fault actually is a type of short circuit, only it's phase-to-ground, which probably is the most common type of fault on low-voltage systems (600V or less).

Usually, arcing ground-fault currents are not large enough to be detected by the standard MCCB protective device. But, if left undetected, they can increase sufficiently to trip the standard protective device. When this happens, it usually is too late, and the damage is already done. An example of this is a motor having an internal insulation failure. While the current flow may be small, it must be detected and eliminated before major motor damage takes place.

Prior to the introduction of electronic CBs, separate ground fault protection devices were used to provide this additional level of protection. Today's modern electronic CB has the ground fault protection as an integral part of the trip unit.

Overload Trip Action

Overload or thermal trip action uses a piece of bimetal heated by the load current. This bimetal is actually two strips of metal bonded together, with each having a different thermal rate of heat expansion. They are factory-calibrated and not field-adjustable.

Heat will cause the bimetal to bend. That part of the bimetal having the greater rate of expansion is on the outside of the bend curve. To trip the CB, this bimetal must deflect enough to physically push the trip bar and unlatch the contacts.

Short-Circuit Trip Action

Short-circuit trip action uses an electromagnet having a winding that's in series with the load current. When a short circuit occurs, the current flowing through the circuit conductor causes the magnetic field strength

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of the electromagnet to increase rapidly and attract the armature. When this happens, the armature rotates the trip bar, causing the CB to trip.

The only time delay factor involves the time it takes for the contacts to physically open and extinguish the arc; this usually is less than one cycle.

Magnetic elements are either fixed or adjustable, depending upon the type of CB and frame size. For example, most thermal magnetic breakers above the 150A frame size have adjustable magnetic trips.

Thermal Magnetic Trip Action

As the name implies, a thermal magnetic trip unit combines the features of a thermal unit and a magnetic unit. As a result, the time current curve combines the performance characteristics. Here, Points 1 and 2 show both the thermal and magnetic action for a typical 100A MCCB. A 250% overload will take approximately 60 sec before the bimetal will bend far enough to trip the CB. If there is a short circuit, 400% of the CB's rating, instead of an overload, however, the electromagnet will attract the armature and trip the breaker in less than one cycle

A thermal magnetic trip unit is best suited to most general-purpose applications as its temperature sensitive and automatically will follow safe cable and equipment loadings. These loadings will vary with ambient temperatures. Thermal magnetic units don't trip if the overload isn't dangerous, but will trip instantly with heavy short-circuit currents.

Electronic Trip Units

Electronic trip units typically consist of a current transformer (CT) for each phase, a printed circuit board, and a shunt trip. The CTs monitor current and reduce it to the required ratio for direct input into the printed circuit board, the brains of the electronic trip unit. The circuit board then interprets current flow information, makes trip decisions based on predetermined parameters, and tells the shunt trip unit to trip the breaker.

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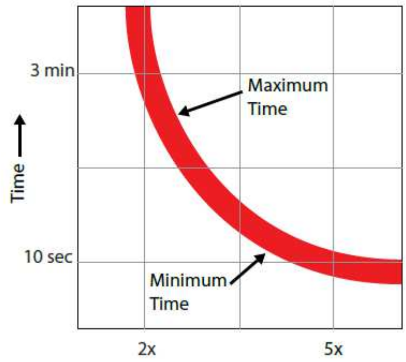
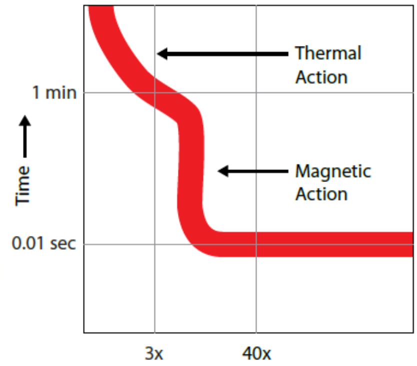
Trip Curve



Using the bimetallic model, we can provide a thermal protection curve as shown at left.



Combining the short-circuit and overcurrent protection provides us with a protection curve that looks like this.

Trip Curve for a Thermal Magnetic MCCB The most commonly selected form of thermal protection is the bimetallic version. This works similarly to a traditional overload relay in which a bimetallic element is heated, causing a deflection, which then exerts pressure on a trip bar and causes the circuit breaker to trip. Trip Curve for an Electronic MCCB An alternative to using fixed-thermal protection is to use electronic overcurrent protection, which can electronically replicate the function of the mechanical overcurrent device. One of the benefits of using electronic trip units is their ability to tailor the tripping characteristics of the circuit breaker for the application. The electronic trip unit has the ability to provide advanced protection in the form of additional trip functionality such as adjustable: Long Time – Allows the long time between 1.05 and ~1.3 x the thermal rating to be delayed, similar to how an adjustable relay changes classes Short Time – Adjustable short time between thermal and short-circuit Instantaneous Trip – Adjustable instantaneous short-circuit trip time Ground Fault – Adjustable time and value of ground fault tripping In the application section of this introduction we will examine trip curves in greater detail. For now, we are presenting the electronic trip units for the purpose of understanding the scope of a Molded Case Circuit Breaker offering. Electronic trip units are available in a variety of trip settings. The most common combinations are LSI, LSIG and M-LIV trip settings; therefore a wide variety of options exist for customizing the protection the circuit breaker provide within the control panel. Rockwell Automation offers a full range of Allen-Bradley Molded Case Circuit Breakers for use in industrial control panel applications. In an effort to simplify the application of MCCBs and their complimentary products, this application guide will help you properly select and apply circuit breakers used in an industrial control panel.

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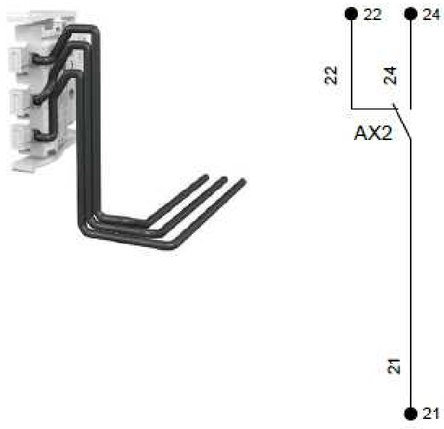
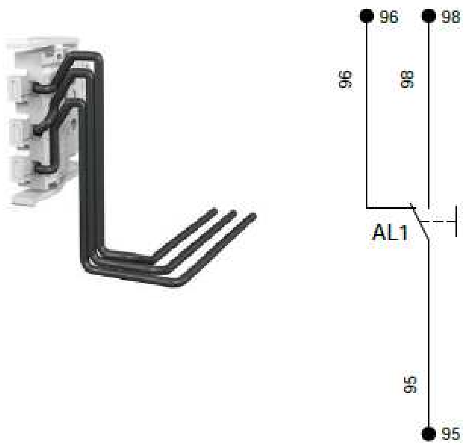
Auxiliary Contacts (AX)



Auxiliary contacts perform the function of electrically signalling the circuit breaker's operating status. The auxiliary contacts change state when the circuit breaker is opened, closed, or tripped.

Auxiliary contacts indicate the ON/OFF status of the MCCB. The 140G auxiliary contacts are changeover contacts (Form C).

Alarm Contacts (AL)



Alarm Contacts (AL) are a special form of auxiliary contacts that indicate the trip status of the MCCB due to:

- Trip due to overload
- Trip due to short circuit
- Trip due to residual current (if equipped)

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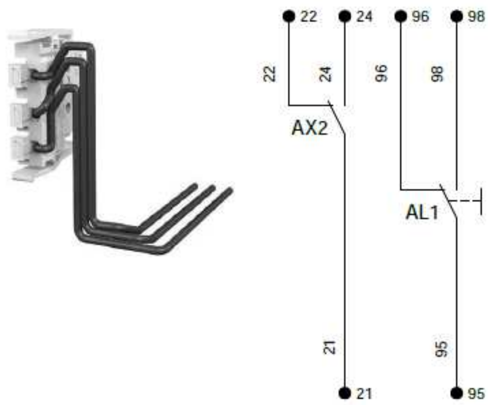
- Trip due to shunt trip and/or under voltage release (if equipped)
- Trip initiated by pressing the “test” button

After initial alarm contact change of state, the Alarm Contacts (AL) change state only when one of the above conditions occur. Manual operation of the breaker to Off does not affect the state of these contacts. The 140G Alarm contacts are changeover contacts (Form C).

Combination Auxiliary Alarm Contacts

Auxiliary/Alarm contacts include contacts to perform both the Auxiliary Contact (AX) function and the Alarm Contact (AL) function.



Shunt Trip

Shunt trips allow the circuit breaker to be opened using an electric command (opening release). The shunt trip is housed and fitted in a slot within the circuit breaker.

Shunt trips are used in applications where a remote signal to open or isolate a circuit is required.

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Under voltage Release

Under voltage releases allow the circuit breaker to be opened using a change in the voltage of the power supply to the circuit breaker terminals. The under voltage release is fitted in a slot within the circuit breaker. Under voltage releases work when the application voltage is reduced below 75% of the rating of the release unit voltage rating.

Use of under voltage releases can protect a system against low voltage, particularly when running or starting motors, by removing power to the circuit by opening the circuit breaker in low-voltage situations. In some applications, the under voltage release can be used to quickly remove power to a machine or machines by opening a push button contact, wired in series with the under voltage releases.

Rotary Operators

When MCCBs are installed as the main or feeder circuit breaker in an industrial control panel and a non-flanged enclosure is used, a common means for operating the circuit breaker is through the use of a rotaryoperator mechanism. The use of a rotary operator converts a rotary motion to a vertical motion that “toggles” the MCCB. In this situation, the rotary operator kit would consist of:

- External operating handle
- Operating shaft
- Circuit breaker mounted rotary operating mechanism

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Using these kits allows external operation of the circuit breaker with the capability of turning the circuit breaker on/off, and even resetting the circuit breaker without having to open the enclosure. Traditionally, these kits are sold with an operating shaft that allows the customer to use the kit with enclosures of various depths. The operating handles will also provide status indication when the circuit breakers trip.

For further information please do call us.....

Also we request you to kindly share your valuable comments, suggestions and feedback to improve us

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