How to Choose: Air Circuit Breaker or Moulded Case Circuit Breaker

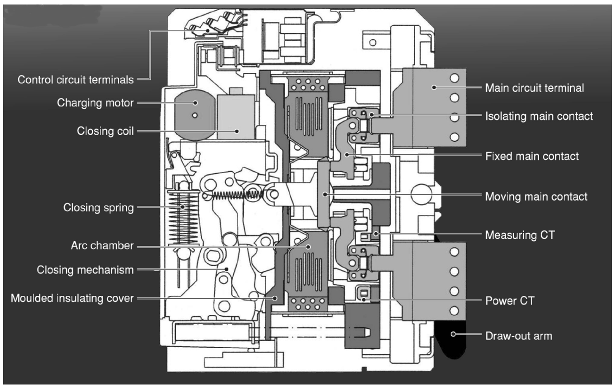
About This Guide

This guide introduces the factors which affect circuit breaker selection:

- Load
- Fault level
- Discrimination

Its purpose is to prompt further investigation rather than to provide a calculational procedure. Terasaki offer detailed training and further information on circuit breaker selection.

The construction and operation of air circuit breakers (ACBs) and moulded case circuit breakers (MCCBs) have common features.
A contact system with arc-quenching, a mechanism to operate the breaker, a system to provide a means of protection, control and indication. However, there are some fundamental differences in application that should be considered.



Load

The current-carrying capacity (In, A) of the breaker should be higher than the expected load in the circuit. MCCBs are available up to 4000A from Terasaki, but become less cost-effective for very large ratings (2000A and above). The advantage of MCCBs for very large ratings is their compact size. An ACB is physically larger, but more cost-effective for higher ratings.

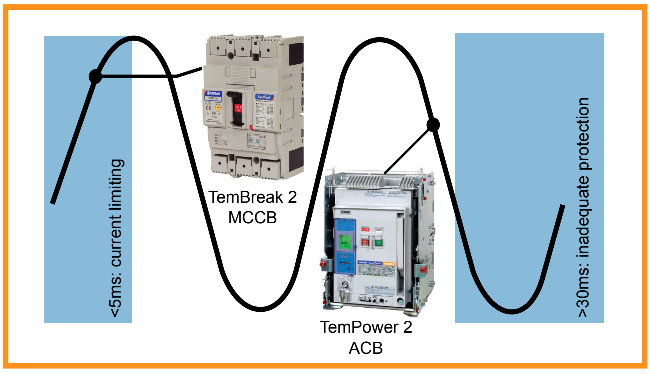
Current-carrying capacity

In (A) according to IEC 60947-2

Fault Limitation

In a short circuit the contacts of Terasaki MCCBs open before the first peak of the current waveform (within five milliseconds in a 50 Hz system). The fault current flowing through the MCCB never reaches its peak, and the fault energy allowed downstream is limited. This fault limitation protects sensitive equipment which is not rated to withstand faults.

ACBs are selected for their ability to withstand fault current rather than limit it - (see Discrimination - Selectivity). A typical ACB will open a short-circuit in between twenty-five and thirty milliseconds, allowing between one and two cycles of fault current through before opening. The load protected by an ACB (transformers, busbars for example) should be rated to withstand fault current for a short duration.



Fault Interruption Times

Historical Note

Terasaki developed the world's first current limiting circuit breaker in 1965. Previous to this, fuses were always installed in series with circuit breakers to provide the current limitation. Hence the first name of Terasaki in the UK "The No-Fuse Circuit Breaker Company"

Fault Level

Circuit breakers must be capable of safely interrupting the maximum potential short-circuit current at their location in the circuit. The circuit breaker must have a breaking capacity higher than the potential short-circuit current. Note that the cost of circuit breakers becomes lower with lower breaking capacity. Potential short-circuit current is determined by:

1. The available power from the transmission network
2. Transformer characteristics
3. Impedance of conductors in the distribution system.

A fault level study which accounts for transformer characteristics and conductor impedance at all circuit breaker installation points will allow selection of breakers with optimum breaking capacity, saving money. Terasaki's Application Team provide this service.

Ultimate Breaking Capacity (two short-circuit interruptions): Icu (kA) according to IEC 60947-2

Service Breaking Capacity (three short-circuit interruptions): Ics (kA) according to IEC 60947-2

Terasaki's Application Team:

- Fault level studies
- Discrimination studies
- Breaker selection

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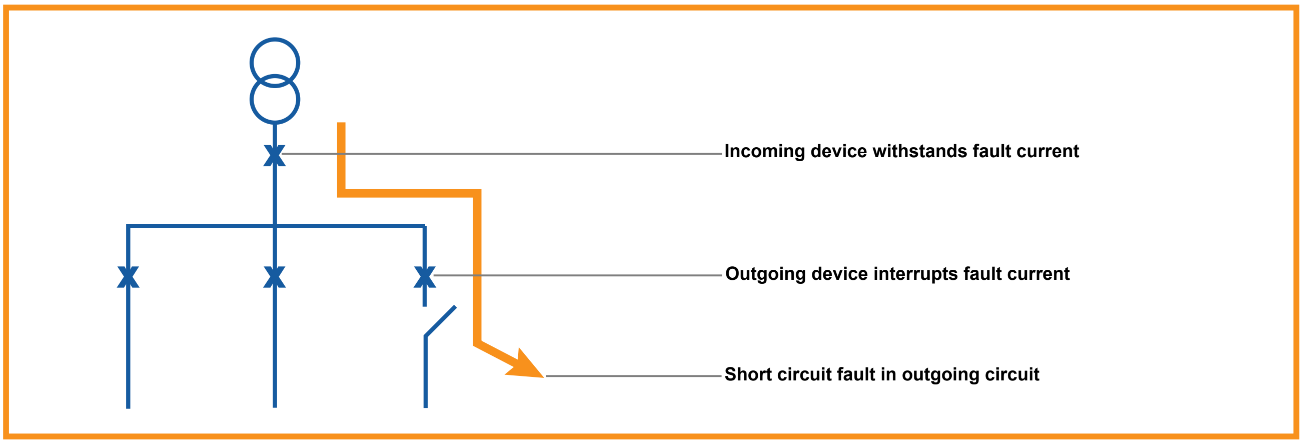
Discrimination (Selectivity)

The *incoming device* to the low voltage system is the first line of protection downstream of the transformer, it protects:

- the transformer windings;
- the conductors between transformer and switchboard; and
- the switchboard main busbars

A fault current in an *outgoing circuit* could also cause the *incoming device* to open, interrupting power to the entire system. To avoid this interruption the designer should ensure *discrimination* between the *incoming device* and *outgoing* circuit breakers.

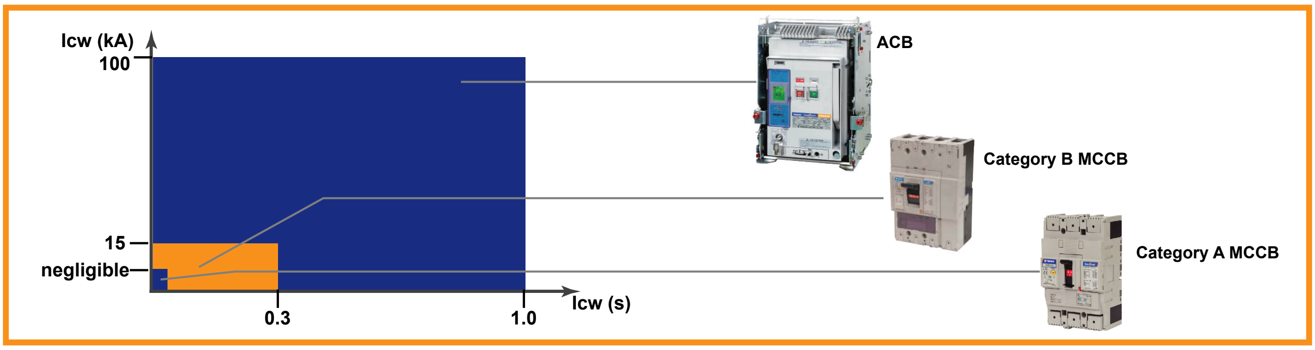


Fault in Outgoing Circuit

Discrimination relies on the incoming device withstanding the fault - without opening or sustaining damage - for as long as it takes for the outgoing breaker to open. The easiest way to guarantee discrimination without further calculation is to ensure that incoming breakers can stay closed and withstand the maximum potential short-circuit current for at least one second. The protection setting should include a time-delay in the short-circuit characteristic.

Short-Circuit Withstand

Icw (kA, s) according to IEC 60947-2



Typical Withstand Ratings

It is obvious from the above why most incoming devices are ACBs! To make selection even easier, all Terasaki ACBs can withstand fault currents up to their breaking capacity (Icw, (1s) = Ics). This means that if the ACB is correctly selected according to fault level, as described above, discrimination is guaranteed with no further checks (provided the relay settings are correct).

Withstand = Fault Level = Guaranteed Discrimination

Icw (1s) = Ics = Guaranteed Discrimination

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