

Let me first explain the difference between discrimination, cascading and discrimination-enhanced-by-cascading

Discrimination

It is the coordination of automatic cut-off devices for a fault that occurs at any point in the network to be eliminated by the upstream circuit breaker, the circuit breaker that is immediately upstream of the fault and by that circuit breaker alone! This ensures service continuity.

Classification of discrimination:

Discrimination involves ensuring coordination between two circuit breakers in series, so that, in the event of a fault, only one circuit breaker, located immediately upstream of the fault, trips.

Discrimination current I_s is defined so that:

1. $I_{\text{fault}} < I_s$: only D2 eliminates the fault, discrimination is ensured,
2. $I_{\text{fault}} > I_s$: both circuit breakers may trip, discrimination is not ensured.

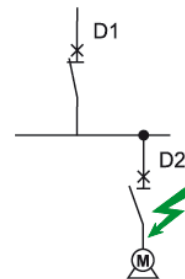
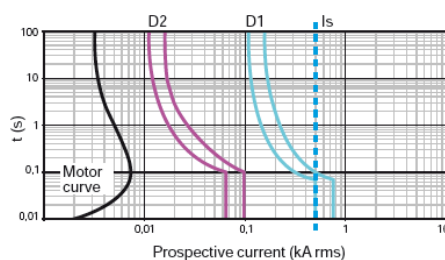


Figure (1)

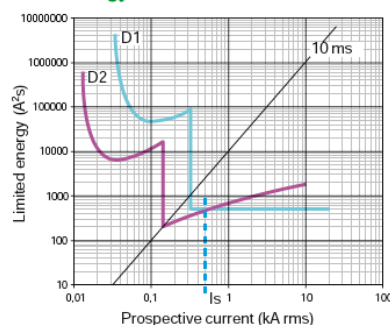
Discrimination can be classified into 2 classifications; according to

- i. Type (current, energy or time)
 - ii. Capacity (total/partial).
- i. Discrimination has 3 types; current discrimination for slight overcurrents or overloads, energy discrimination for short circuits that require magnetic protection and finally if the breakers involved in the protection have adjustable time-delayed setting for the magnetic curve, time discrimination is also available. Please check the figures below that illustrate the above mentioned explanations.

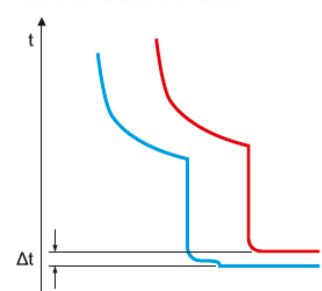
This is current discrimination



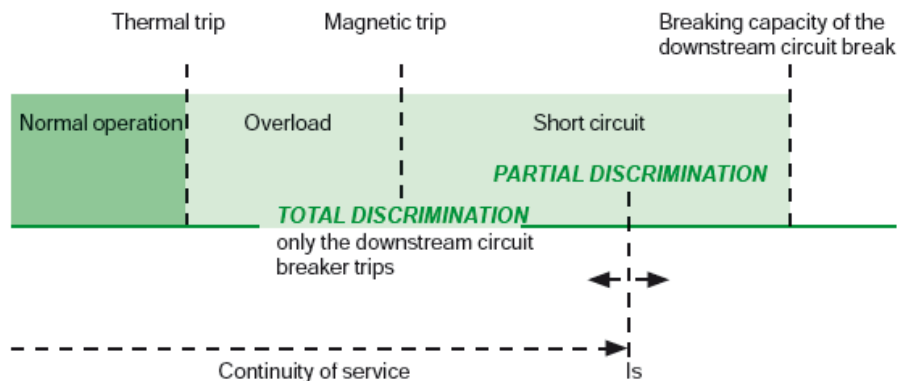
This is energy discrimination



This is time discrimination



- ii. Discrimination may be partial or total (up to the breaking capacity of the downstream circuit breaker). For total discrimination, the characteristics of the upstream device must be higher than those of the downstream device (higher than the breaking capacity of the downstream circuit breaker MCCB).

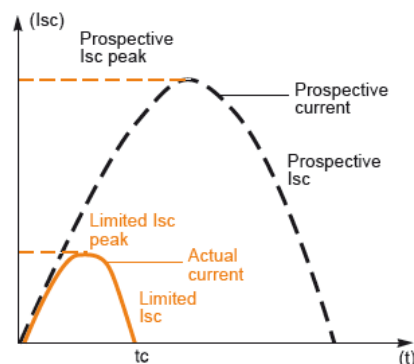


Current and Energy discriminations are available for modular circuit breakers as well as MCCBs and ACBs. Time discrimination is not available in modular devices (MCBs). However, discrimination between Compact NSX circuit breakers includes all 3 types of discriminations, thanks to the Roto-Active breaking principle in the Compact NSX.

Cascading

Cascading is the use of the current limiting capacity of circuit breakers at a given point to permit installation of lower-rated and therefore lower-cost circuit breakers downstream. The upstream Compact circuit breakers acts as a barrier against short-circuit currents. In this way, downstream circuit breakers with lower breaking capacities than the prospective short-circuit (at their point of installation) operate under their normal breaking conditions.

The limiting capacity of a circuit breaker is its aptitude to let through a current, during a short circuit, that is less than the prospective short-circuit current. So again, cascading is a technique directly derived from current limiting. Circuit breakers with breaking capacities less than the prospective short-circuit current may be installed downstream of a limiting circuit breaker. The **breaking capacity is reinforced** by the **limiting capacity** of the **upstream** device. It follows that substantial savings can be made on downstream equipment and enclosures. For more illustrations, kindly check the figure below



Discrimination-enhanced-by-cascading

As illustrated above, there is a difference between discrimination and coordination. But with traditional modular circuit breakers, cascading between two devices generally results in the look of discrimination. The opposite is not applicable however. Discrimination does not result in cascading.

So since the cascading results in discrimination in traditional modular devices, the effect of cascading on Compact NSX breakers is that the discrimination characteristics in the tables remain applicable and in some cases they even get enhanced. Protection discrimination is ensured for short-circuit currents greater than the rated breaking capacity of the circuit breaker and even, in some cases, for its enhanced breaking capacity. In the later case, protection discrimination is total, i.e. only the downstream device trips for any and all possible faults at its point in the installation.

The Discrimination-enhanced-by-cascading can occur when generally the upstream is Compact NSX and when there is total discrimination between the upstream and downstream devices.

Example from the Complementary Technical information guide:

Consider a combination between:

- Compact NSX250H with trip unit TM250D
- Compact NSX100F with trip unit TM25D.

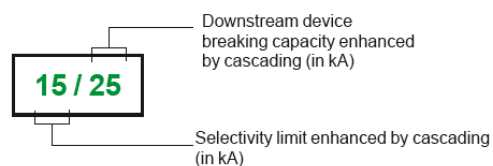
The discrimination tables indicate total discrimination. Protection discrimination is therefore ensured up to the breaking capacity of the NSX100F, i.e. 36kA.

The cascading tables indicate an enhanced breaking capacity of 70 kA.

The enhanced discrimination tables indicate that in a cascading configuration, discrimination is ensured up to 70 kA, i.e. for any and all possible faults at that point in the installation.

Enhanced discrimination tables - 380-415 V

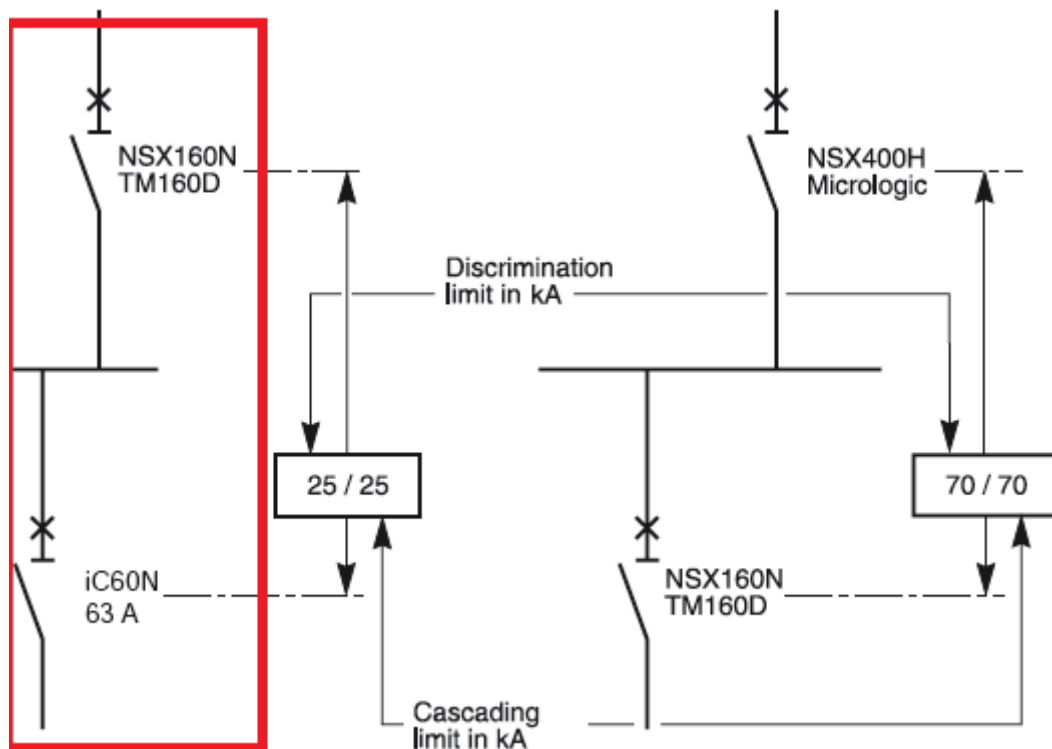
For each combination of two circuit breakers, the tables indicate the:



In a table, a box containing two equal values indicates that discrimination is provided up to the reinforced breaking capacity of the downstream device. These tables apply only to cases with combined discrimination and cascading between two devices. For all other cases, refer to the normal cascading and discrimination tables.

The first value stands for I_s discussed on page 1, and the second value is the value of enhanced breaking capacity in kA.

Example:



The upstream breaker in the red box is the NSX160N TM160D 50kA and the downstream is iC60N 10kA. By checking the discrimination tables we'll find that there is total discrimination between the upstream and downstream. And total discrimination means protection up to the breaking capacity of the downstream circuit breaker which is 10kA.

Since total discrimination is present, and at the same time, the upstream circuit breaker is Compact NSX, therefore the Discrimination-enhanced-by-cascading can occur and the value of the discrimination can be improved. So according to the Discrimination-enhanced-by-cascading tables, we'll find that the discrimination value has increased from 10kA to 25kA. This is Discrimination-enhanced-by-cascading.

Q: When to use normal cascading/discrimination tables and when to use the enhanced discrimination tables?

A: These tables apply ONLY to cases with combined discrimination and cascading between two devices. For all other cases, refer to the normal cascading and discrimination tables.