MEDIUM VOLTAGE PRODUCTS

Fault Current Limiters – I_s-limiter™ and FC-Protector®

The world’s fastest switching devices

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The world's fastest switching devices

ABB's fault current limiters disconnect the fault affected part of the system extremely fast so that the short-circuit withstand capability of the system is not violated.

Why are short-circuit fault levels increasing?
The growing energy demand and the need for stable power supply are one of the major challenges faced by consumers, power producers and network operators. With the rising demand for energy worldwide, existing power distribution systems and power grids are being expanded and get more and more meshed. This might be a possible solution for reliable supply but the short-circuit fault levels increase, causing another challenge for all concerned parties.

How is the short-circuit current characterized?
Short-circuit currents can be defined by the initial three-phase symmetrical short-circuit current, also referred to as I''_k, and the peak short-circuit current, also referred to as i_p.
The thermal stress to which electrical system components are exposed to is associated with the initial three-phase symmetrical short-circuit current. The dynamical-mechanical stress to which these are exposed is associated with the peak short-circuit current.

Why do short-circuit currents occur?
There are several reasons for short-circuits to occur. The most common reasons are human errors, defective equipment, overvoltage, pollution and animals. Short-circuits can happen anywhere without advance intimation.

Why must short-circuit currents be limited?
Each equipment in an electrical network has a certain permissible short-circuit withstand capability, which if exceeded will have hazardous consequences for equipment, personnel and environment. If electrical equipment like switchboards, switches, transformers or cables are subjected to short-circuit currents higher than their withstand capability they can be destroyed by the dynamic and thermal stresses.

Does my equipment withstand a short-circuit fault?
Electrical equipment is usually tested according to the relevant standards to withstand the permissible short-circuit currents. Those are the rated peak withstand current, the short-time withstand current and the rated short-circuit duration. If one of these parameters is exceeded, the equipment will most probably face severe destruction.

Flexibility as well as reliability of systems can be increased manifolds with the application of ABB's fault current limiters.

What do ABB's fault current limiters do?
The I_s-limiter™ and the FC-Protector® limit the short-circuit current before the first current peak is reached such that the equipment rating is not exceeded. They isolate the fault affected part of the network within micro seconds (µs) and ensure that the short-circuit level is not exceeding the systems' withstand capability. They facilitate flexible power distribution, power system expansion, independent power production, reactor replacement and many more such applications without considering the equipment short-circuit withstand capability as a constraint.

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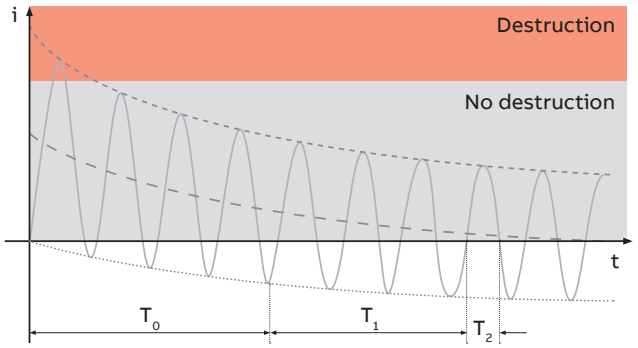
01 Total operating time of a conventional circuit-breaker indicated on short-circuit current waveform



Relay time	Breaking time	Arcing time
T_0	T_1	T_2
40 - 60 ms	40 - 80 ms	10 - 20 ms

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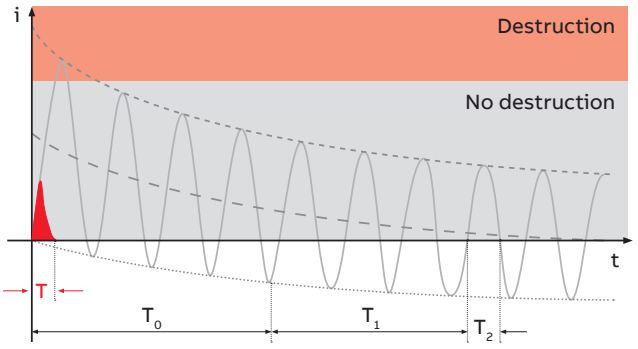
02 Total operating time of ABB's FCL indicated on short-circuit current waveform



Current flow time by use of ABB's FCL: T = 5 - 10 ms

The I_S-limiter™ and FC-Protector® will limit the short-circuit current in less than 1 ms after detection!

With ABB's FCL customer has an option to decide for which current direction or protection area tripping is required.

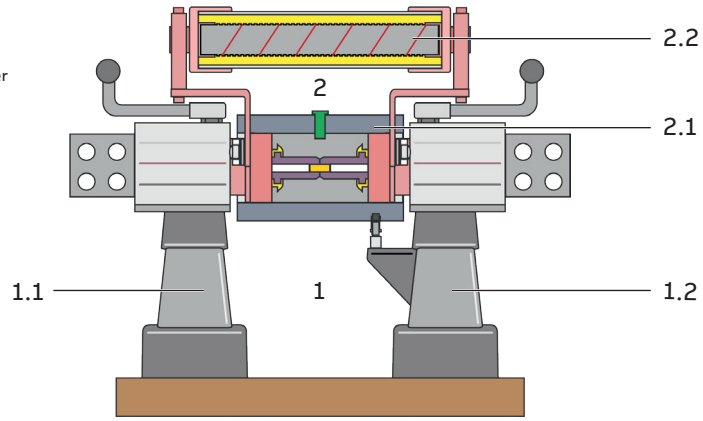
Why are circuit-breakers not able to mitigate the fault level?
The highest dynamical force and stress on the system is caused by the first peak of the short-circuit current.
Circuit-breakers do not operate fast enough to protect the electric system from first short-circuit current peak.
Under consideration of the relay operating time (T_0), the circuit-breaker breaking (T_1) and arcing (T_2) a circuit-breaker can only interrupt the short-circuit current after the first peak, in approx. 40 - 80 ms. By the time a circuit-breaker interrupts, irreversible damage has already been done.
The solution to this problem is the installation of a fault current limiter (FCL) in a system that is able to detect a fault current during its first rise and limit the fault current before the peak is reached.

Why are reactors not sufficient?
Reactors are impedances that are aimed to limit the current to a certain value in case of a short-circuit fault. As they are in the main current path in normal operation, they continuously generate power losses. This will cause high operating costs and undesired voltage drops for the customer.
Since reactors do not interrupt the current but only reduce them, their fault current limiting capability is very restricted. They cannot be used in systems in which no fault level margin is left.
Each reactor is designed for the existing short-circuit currents of a system. This means that in case of later extension the reactor must probably be replaced, whereas ABB's FCLs can be easily modified for such changes.

Fault Current Limiters – I_s-limiter™ and FC-Protector®

The world's fastest switching devices

1 Insert holder
1.1 Insulator
1.2 Insulator with impulse transformer
2 Insert
2.1 Main current path
2.2 HV HRC fuse



I_s-limiter™ and FC-Protector® – Operating principle

The I_s-limiter™ and the FC-Protector® consist of a tailor made application based control unit that detects the short-circuit. The main current path (hollow copper bus) inside a detachable insert carries the continuous current in normal operating condition. In case of a short-circuit the main current path is immediately opened by a charge element, which is triggered by the control unit. The short-circuit current commutates to a parallel fuse with high breaking capacity, which limits the short-circuit current during the first rise before the first current peak is reached.

Our major customers

ABB's fault current limiters, the I_s-limiter™ and the FC-Protector® provide a large range of solutions for various applications and industries. Our main customers are:

- **High power industries** such as refineries, chemical plants, paper mills, steel or aluminum mills, cement plants, oil and gas,
- **Utilities** such as energy suppliers and power plants,
- **"Green energy"** such as waste heat recovery plants, combined heat production, hydro power, biomass generators, wind mills and solar plants,
- **Highly sensitive systems** such as data centers, offshore installations, platforms, laboratories, banks and hospitals.

Fault Current Limiters – I_s-limiter™ and FC-Protector®
Typical applications

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01 I_s-limiter™ installed on oil platform
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02 I_s-limiter™ installed as data center solution for higher reliability
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03 I_s-limiter™ especially certified for marine application

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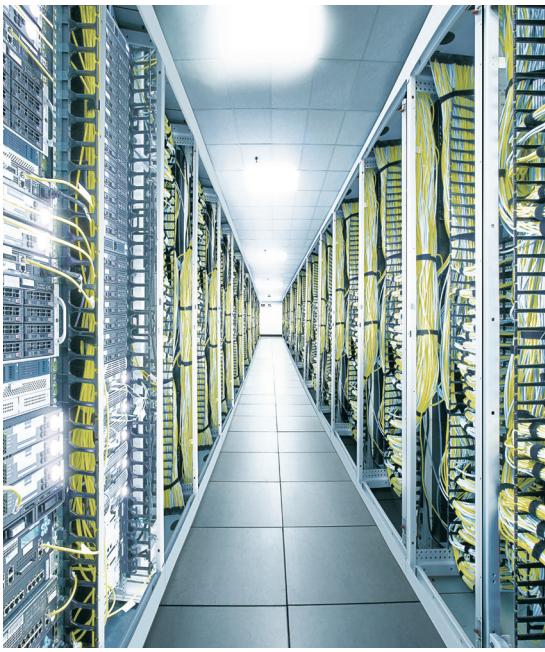

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Fault Current Limiters – I_s-limiter™ and FC-Protector®
Typical applications

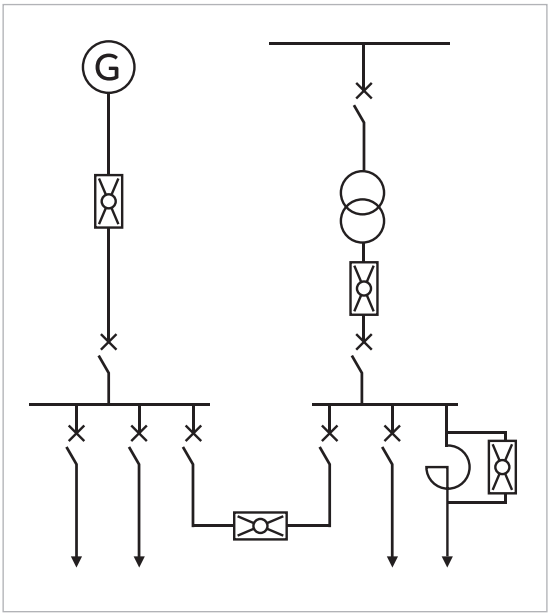
Typical applications
The I_s-limiter™ and FC-Protector® can be used in various applications providing very high and fast fault current breaking capability at high operating currents. The most common applications are:
- Connecting two independent systems without exceeding equipment short-circuit rating
- Bypassing a reactor
- Connecting an additional power source (e.g. generator or grid connection)
- Interfacing public networks and consumer owned power supply systems

ABB will support you to identify the place of installation which provides most effective fault current limitation while maintaining operational reliability.

Coupling of independent systems
ABB's fault current limiters are frequently used to connect two systems which would exceed their short-circuit withstand capability when connected through a coupling circuit-breaker. The main advantages of using ABB's fault current limiters in a coupling are:
- Increased operational flexibility by connecting independent systems
- Flexibility to choose low impedance equipment (e.g. transformers or generators) and reducing losses
- Optimized load flow with higher availability of systems and processes
- Increased reliability of the power supply
- Improved voltage stability when large motors are started
- Reduction of energy released in case of a fault
- System extension without replacing existing electrical equipment such as circuit-breaker, busbar, cable system.

Bypassing a reactor
ABB's fault current limiters are used to eliminate the negative impacts of reactors where reactors cannot be avoided, as mentioned below:
- Avoiding copper losses and the associated operating costs of the reactor
- No voltage drop at the reactor
- Ensuring continuous power supply through reactor in case of FCL tripping

Connection of an additional power source (e.g. generator or grid connection)
ABB's fault current limiters are frequently used in case adding an additional power source would lead to a violation of the system short-circuit withstand capability. The main advantages of using ABB's fault current limiters are:
- System extensions without replacing electrical equipment such as circuit-breakers, switchgear, cable or transformers
- Improving availability of the power supply



Fault Current Limiters – I_s-limiter™ and FC-Protector®

ABB's reliable solution for short-circuit current challenges

I_s-limiter™ and FC-Protector®

ABB's fault current limiter portfolio includes the I_s-limiter™ and FC-Protector®. Together these two products cover a wide range of low and medium voltage applications, indoor as well as outdoor.

As every customer system is different it is possible to provide a tailor made solution. Both fault current limiters are available as loose components and in a panel configuration. ABB has experience in delivering fault current limiting solutions since 1958, having more than 3,000 installations in more than 85 countries.

Main technical parameters

	ABB's FCL	
Installation	Outdoor	Indoor
Rated voltage	7.2 kV ... 17.5 kV	0.75 kV ... 40.5 kV
Rated current	... 2500 A	... 5000 A
Breaking capacity	... 63 kA_{RMS}	... 210 kA_{RMS}

Optimizing your investments

- Eco- and cost-efficient fault current limiters
- Optimized load flow behavior
- Reduction of energy losses in the system

Maximizing your output

- Increase uptime and redundancy of the power distribution systems
- Flexible connection to new and existing switchboards
- Installation in greenfield and brownfield projects

Protecting your assets

- Type tested equipment
- Redundant control unit for additional safety
- World's fastest fault current limiters to protect systems and processes
- Fault current limitation in harsh environments
- More than 3,000 installations in more than 85 countries

Additional information

www.abb.com/medium-voltage/apparatus/fault-current-limiting

Contacts

Feel always welcome to contact us if you have any questions.

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