I_s-limiter™
The world's fastest limiting and switching device
The world’s fastest limiting and switching device

Customers

Function: Insert-holder with insert

Comparison: $I_s$-limiter – Circuit-breaker

Breaking of a short-circuit current with $I_s$-limiter

Detection of short-circuit currents

Reliability: $I_s$-limiter as protection device at highest level

Applications

Technical data

Unbeatable advantages

Summary
The world’s fastest limiting and switching device

ABB’s solution for complex application engineered according to customer’s project specification

– Solves short-circuit current problems in electrical networks before peak short-circuit current is reached

– Reliability and function proofed in thousands of installations

– Experiences since 1958 with more than 3,000 $I_s$-limiters in service in 80 countries
The world’s fastest limiting and switching device

I₅-limiter™
The world’s fastest limiting and switching device

Customers

Industry
- Paper mills
- Refineries
- Chemical industries
- Car industries
- Power stations
- Steel-, Aluminum mills
- On- / Offshore platforms
- Ships / Vessels
- Data center

Town’s utilities

Utilities

Test-laboratories
**Iₙ-limiter™**

Function: Insert-holder with insert
**I₅-limiter™**

Comparison: I₅-limiter – Circuit-breaker

- **T₀**: Response time of protection relay: 10 - 20 ms
- **T₁**: Operating time of protection relay: 30 - 40 ms
- **T₂**: Operating time of circuit-breaker: 40 - 80 ms
- **T₃**: Arc duration: 10 - 20 ms
  
  90 - 160 ms
Breaking of a short-circuit current with $I_S$-limiter

$T_0$: Response time of protection relay: $10 - 20$ ms
$T_1$: Operating time of protection relay: $30 - 40$ ms
$T_2$: Operating time of circuit-breaker: $40 - 80$ ms
$T_3$: Arc duration: $10 - 20$ ms

Current flow time by use of $I_S$-limiter: $T = 5 - 10$ ms
**I_s-limiter™**

Breaking of a short-circuit current with I_s-limiter

\[
I_k = 50 \text{ kA}
\]

\[
I_k \text{ perm.} = 50 \text{ kA}
\]

Current curve at the short-circuit location

\[
i \quad 250 \text{ kA}
\]

\[
u \quad 125 \text{ kA}
\]

\[
50 \text{ kA} \times X \times \sqrt{2}
\]

6 kV / 5 kA
**Iₜ-limiter™**

Breaking of a short-circuit current with Iₜ-limiter

\[ I_k = 50 \text{ kA} \]

\[ I_{k_{\text{perm}}} = 50 \text{ kA} \]

\[ i = i_1 + i_2 \]

Current curve at the short-circuit location
**Iₜ-limiter™**

Breaking of a short-circuit current with Iₜ-limiter

![Diagram showing breaking of a short-circuit current with Iₜ-limiter](attachment:image.png)

\[ i = i_1 + i_2 \] without Iₜ-limiter

Current curve at the short-circuit location
**Iₘ-limiter™**

Breaking of a short-circuit current with Iₘ-limiter

\[ I_k = 50 \text{kA} \]

\[ I_{k,\text{perm}} = 50 \text{kA} \]

\[ i = i_1 + i_2 \]

Current curve at the short-circuit location

\[ i = i_1 + i_2 \text{ without Iₘ-limiter} \]

\[ i = i_1 + i_2 \text{ with Iₘ-limiter} \]
Detection of short-circuit currents

1 Short-circuit current without $I_s$-limiter
Detection of short-circuit currents

1. Short-circuit current without $I_s$-limiter
Detection of short-circuit currents

\[ i_{\text{limit}} \land \left( \frac{di}{dt} \right) \]

\( \land \) is logical “and“

1. Short-circuit current without \( I_s\)-limiter
2. Short-circuit current - \( I_s\)-limiter tripped -
**I_s-limiter™**

Detection of short-circuit currents

\[ i_{\text{lim}it} \wedge \left( \frac{di}{dt} \right) \]

\( \wedge \) logical "and"

1. Short-circuit current without I_s-limiter
2. Short-circuit current - I_s-limiter tripped -
3. Overcurrent - I_s-limiter not tripped -
4. Peak value of service current
Reliability

**Iₕ-limiter™**

Reliability

**Iₕ-limiter as protection device at highest level**

**Self monitoring**

**Redundancy** – Separate independent system for each phase

**Protection** against EMI

- EMC tested according to IEC 61000
- Special current transformers –
  Low impedance shield between primary and secondary winding
- Filters for incoming / outgoing wires
- Special tripping and measuring wires –
  Each pair tightly twisted and protected by steel conduit

**Test equipment** – Quick, complete and easy test by user
**Iₚ-limiter™**

Application: Iₚ-limiter mounted in bus section

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**Advantages**

- Improving “power quality” by gaining higher voltage stability
- Higher availability of the system and processes
- Increased reliability of power supply
- Optimizing load flow
- Reduction of energy released in case of a fault
- No need to change existing busbar system and cabling
**Iₜ-limiter™**

Application: Iₜ-limiter in generator feeder

**Advantages**

Generator can be connected independent of the short-circuit capability of the system

Higher availability of existing or new system

System extension without replacing existing electrical equipment such as circuit-breaker, busbar or cable system
**Iₚ-limiter™**

Application: Iₚ-limiter in parallel to reactor

### Advantages

- Eco- and cost-efficient due to reduction of ohmic losses of the reactor

- Increased power quality due to avoidance of voltage drop through reactor

- Ensuring continuous power supply through reactor in case of Iₚ-limiter tripping
**I₂ₗ-limiter™**

Application: Connection of a generator to a Network with current-direction comparison

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**Advantages**

Connect private / industrial generator feeder to the fully loaded grid

No conflict to Grid Code

Selective tripping of the I₂ₗ-limiter
(Tripping only at faults within grid section ①, not at faults within grid sections ②)

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10 kV 3~50 Hz

Iₘ = 16 kA

1: Tripping I₂ₗ-limiter

2: No Tripping I₂ₗ-limiter

Iₘ = 15 kA

Iₘ = 25 kA

Iₘ = 3 kA
**Iₜ-limiter™**

**Application:** Iₜ-limiter with summation of currents

**Advantages**

- Only Iₜ-limiter(s) close to fault location trip
- Limitation of short-circuit affected area due to isolation of fault
- Nearly no voltage dip in large healthy area in case of short-circuit fault
- Higher availability of system and processes
### Technical data

For higher rated currents $I_s$-limiter can be connected in parallel

<table>
<thead>
<tr>
<th>Rated voltage</th>
<th>Rated current</th>
<th>Switching capability</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.75 kV</td>
<td>... 5000 A</td>
<td>... 140 kA&lt;sub&gt;RMS&lt;/sub&gt;</td>
</tr>
<tr>
<td>12.00 kV</td>
<td>... 4000 A</td>
<td>... 210 kA&lt;sub&gt;RMS&lt;/sub&gt;</td>
</tr>
<tr>
<td>17.50 kV</td>
<td>... 4000 A</td>
<td>... 210 kA&lt;sub&gt;RMS&lt;/sub&gt;</td>
</tr>
<tr>
<td>24.00 kV</td>
<td>... 3000 A</td>
<td>... 140 kA&lt;sub&gt;RMS&lt;/sub&gt;</td>
</tr>
<tr>
<td>36.00 kV</td>
<td>... 2500 A</td>
<td>... 140 kA&lt;sub&gt;RMS&lt;/sub&gt;</td>
</tr>
<tr>
<td>40.50 kV</td>
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<td>... 140 kA&lt;sub&gt;RMS&lt;/sub&gt;</td>
</tr>
</tbody>
</table>
**I_{S}-limiter™**

Unbeatable advantages

**Individual solution**

Individual solution – From loose components to fully type tested panels

Project related **detailed engineering** according to customer’s application

**Measuring of current rise di/dt** – Optimized tripping value based on instantaneous current plus current rise measuring

**Selective tripping** in predefined areas of the network avoiding of unnecessary downtime and repair cost
**Iₚ-limiter™**

**Unbeatable advantages**

**Equipment and process protection**

**Safe protection of...**

- Electrical installations and equipment
- Critical applications such as data center, chemical industry or refineries
- Processes and systems
- Auxiliary supply in power plants

... by immediate separation from the fault affected network

**Leading to...**

**Minimization of damage** by reducing short-circuit current energy and respectively limiting stress on network components

**Improving “power quality”** by reducing voltage dip
**Iₚ-limiter™**

Unbeatable advantages

**Cost and eco-efficient solution**

Protection of customer’s investment

**System extension** without replacing existing electrical equipment such as circuit-breaker, busbar, cable system ...

**Cost- and eco-efficient** due to minimization of electrical losses and refurbishment of tripped inserts

**Cost-efficient** due to minimized down time

**Cogeneration** – Integration of distributed power generation to fully loaded system

**Downsizing** of the system by using lower rated equipment
**Summary**

**ABB’s solution for complex applications engineered according to customer’s project specification**

- Solves short-circuit current problems in electrical networks before peak short-circuit current is reached
- The world’s fastest limiting switching device