Eaton's Bussmann® series

Battery storage application guide

BUSSMANN SERIES

Powering Business Worldwide

Eaton has more than 100 years of proven technical innovation to help make your operation more productive while protecting your equipment.

Energy storage is a necessity as the world is becoming more electrified, leading to changes in system architectures and their overcurrent protection needs.
Eaton is continually developing designs to meet these ever changing requirements.
Battery storage systems scale from residential to commercial and utility scale applications.
The experience and expertise of Eaton in protecting DC applications and semiconductor devices is proving invaluable in the development of fusible circuit protection for battery storage systems.

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Introduction

As power demand continues to rise, renewable energy sources like solar and wind have increasingly supplemented traditional generation. To ensure reliable power delivery, energy storage, particularly modular and easily deployable battery systems, has become essential.

Fuses play a vital role in battery energy storage systems (BESS) by safeguarding components against overcurrent events that could lead to equipment failure, fire hazards, or system downtime. As BESS designs evolve to support higher power and voltage levels, selecting the right fuse becomes increasingly complex. Engineers must consider a range of factors, including varying system voltage levels, expected operational lifetime, and coordination with other protective devices such as contactors and circuit breakers.

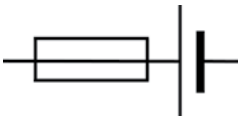
This guide aims to support engineers and system designers in making informed fuse selection decisions to ensure safe, reliable, and efficient BESS operation. By addressing key challenges, such as voltage compatibility, coordination requirements, and long-term performance, this application guide provides practical insights for achieving robust protection in modern energy storage applications.

IEC 60269-7 and draft UL 248-21 battery fuse standards

The protection requirements within battery storage systems are quite different when compared to typical grid connected AC systems. In battery systems the protective devices are required to operate in DC systems which may have high faults currents and a number of lower over current situations. For this reason, Eaton has conducted extensive research and development of its Eaton's Bussmann series fuse links that are specifically designed and tested to safely protect battery storage systems with high DC voltages and low fault currents.

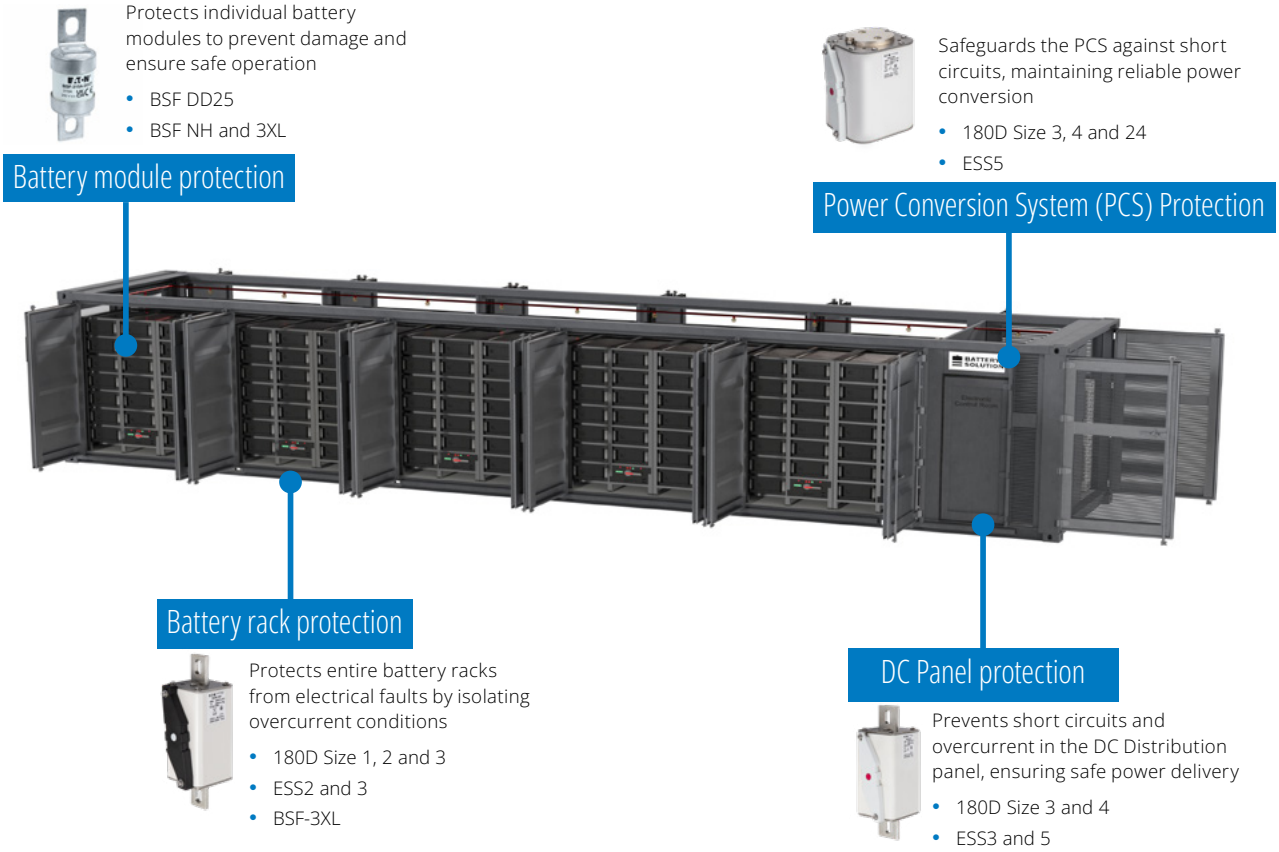
The International Electrotechnical Commission (IEC) and Underwriters Laboratories (UL) have recognised the protection of Battery Storage systems is different to standard electrical installations.This is reflected in the standard IEC 60269-7 and in the proposed UL 248-21 which defines specific characteristics that a fuse link is required to meet for protecting Battery Storage Systems, with the inclusion utilisation classes gBat and aBat. The two classes reflect the configurations where full range or partial range protection is required. The standard also reflects the battery storage systems may have high fault currents. Eaton's range of Bussmann series battery storage fuse links has been specifically designed to meet this standard.

Contact our team of Field Application team for further information bulehighspeedtechnical@eaton.com



To identify fuse links to the standard the combination of the symbols for fuse-link and a single cell are used to indicate a fuse-link is suitable for protecting batteries, particularly in storage systems, see Figure 1.

Eaton's Bussmann series fuse links offering for battery storage containers

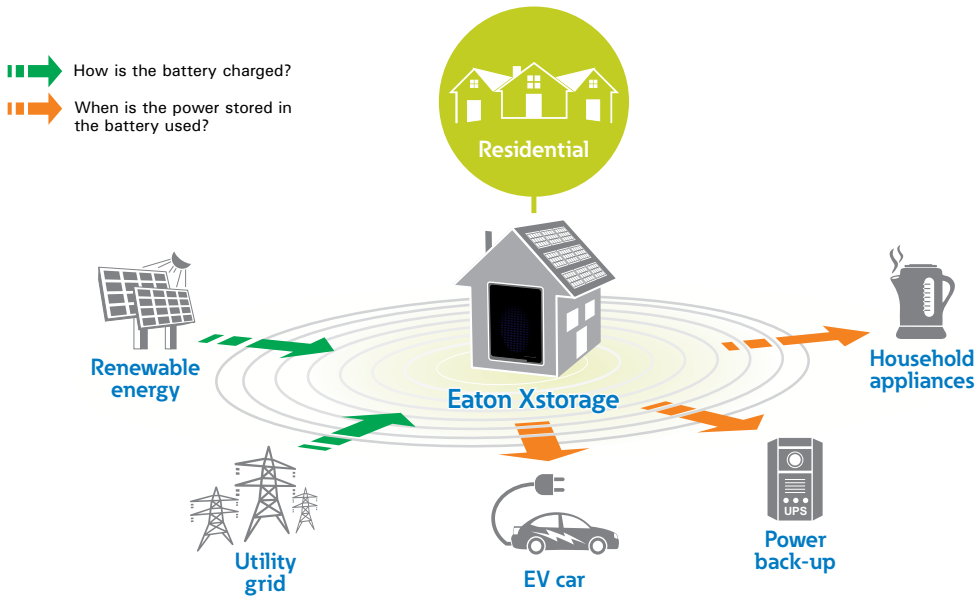


Residential, commercial and utility scale battery storage applications

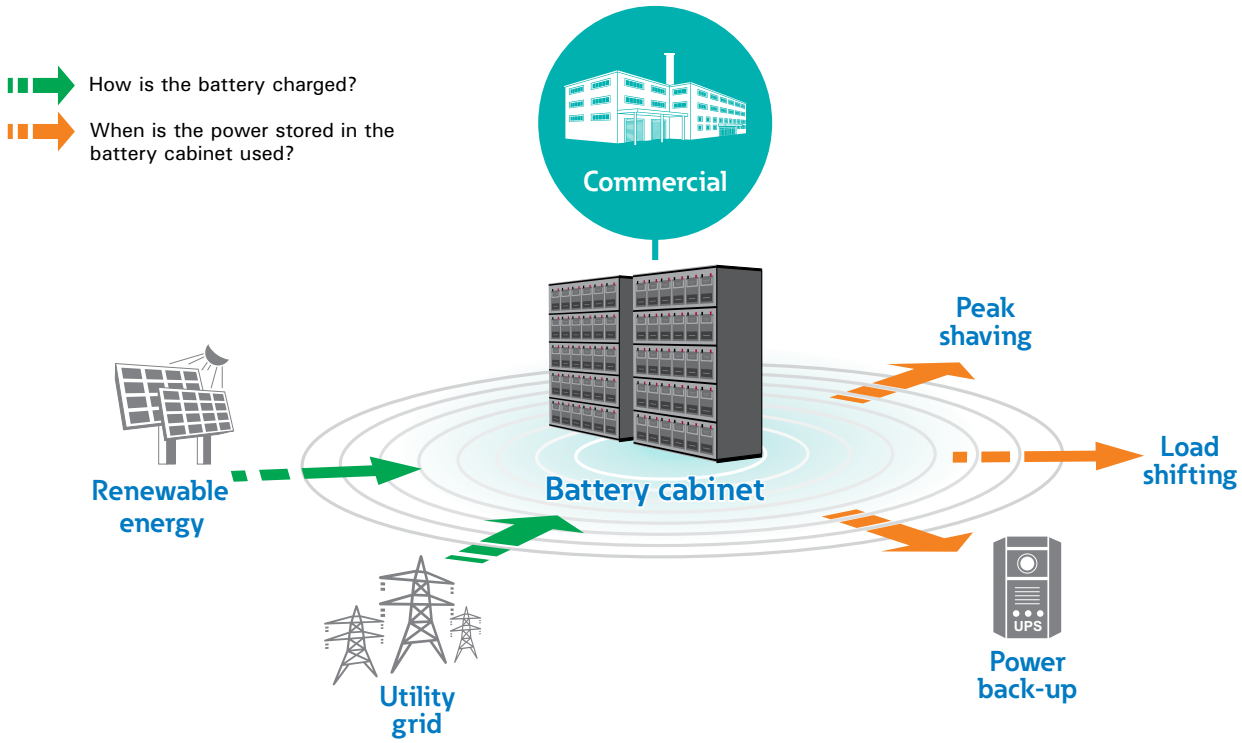
Battery storage systems have become one of the most common form of electrical energy storage that converts electrical energy from the grid, solar and wind farms into a stored form for later use in residential homes, commercial buildings industrial sites,

Eaton's Bussmann series has a vast array of fuse links able to support your applications. **Contact our team of Field Application team for further information bulehighspeedtechnical@eaton.com**

Residential battery storage applications

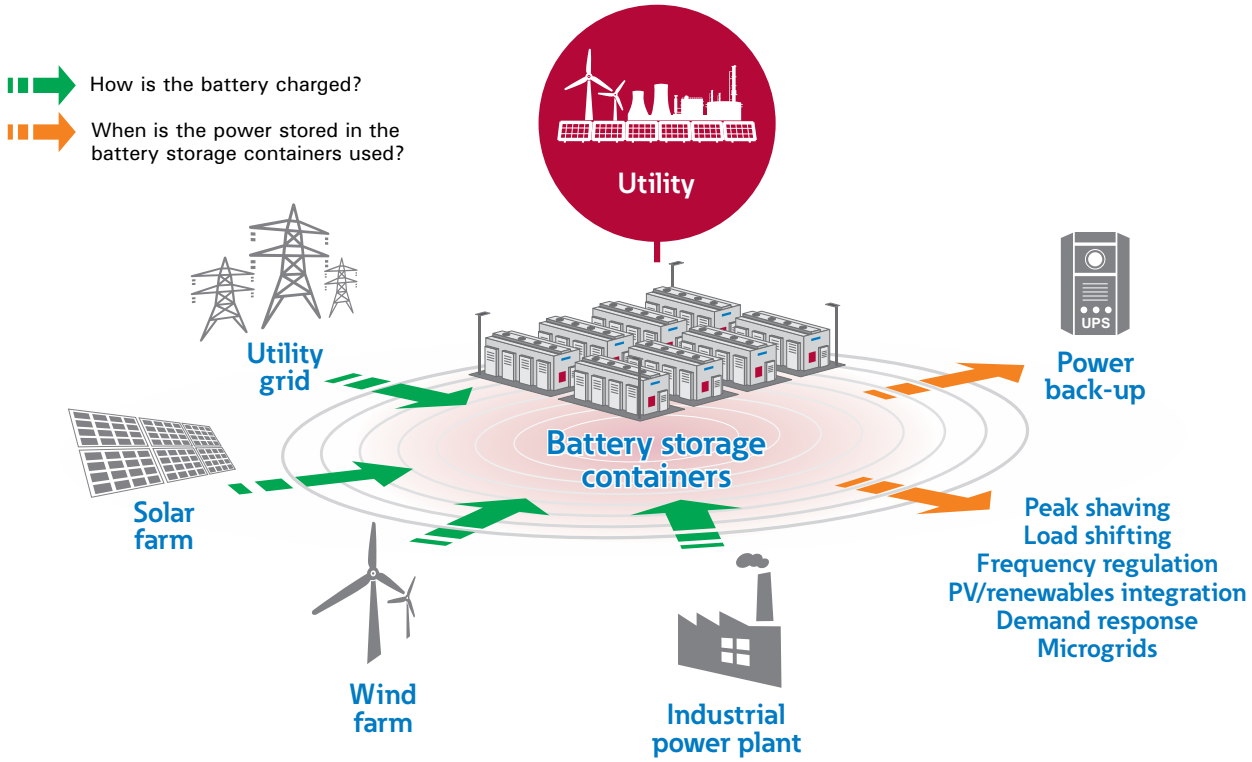


Commercial scale battery storage applications

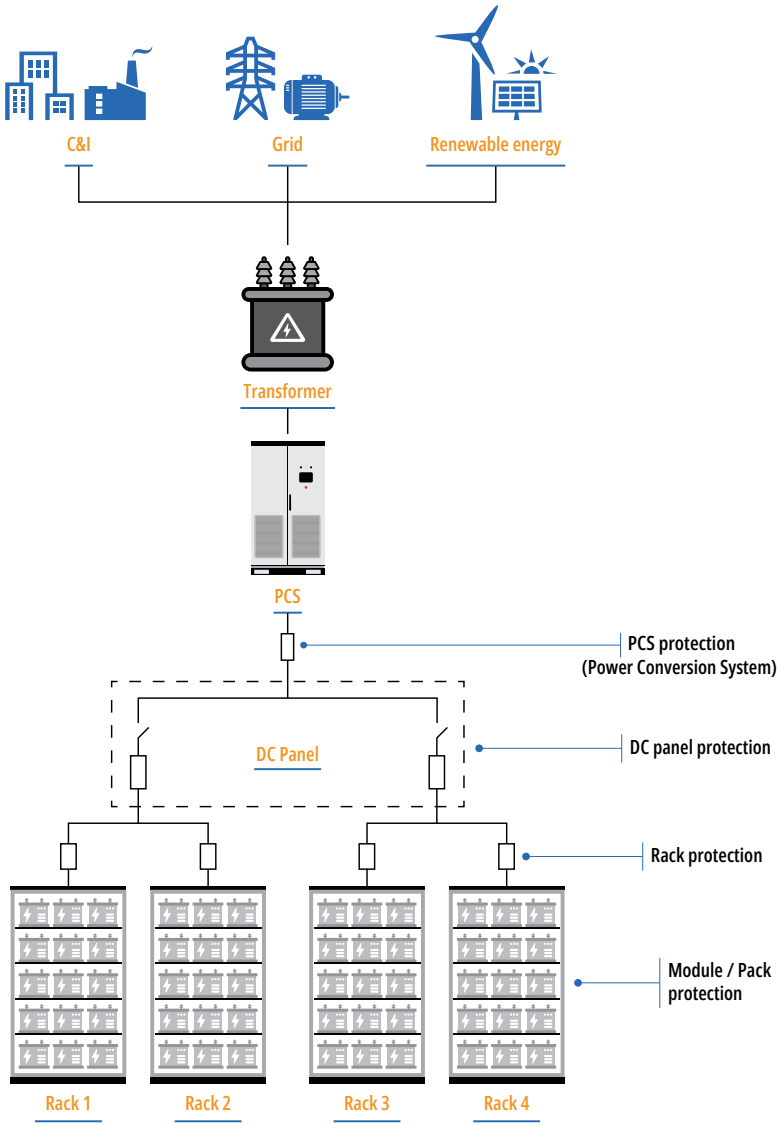


Residential, commercial and utility scale battery storage applications

Utility scale battery storage applications



Typical battery storage system topology



Module/pack protection:

The primary purpose of module fuses is to protect against internal faults within a rack and to ensure the safety of the battery during transportation. To minimize transportation risks, UN 38.3 mandates thorough testing of lithium batteries. Proper fuse selection within battery modules is a critical factor in mitigating operational hazards during transportation. Ideally, a module fuse should be fast enough to protect the battery module from overcurrents, yet slow enough to coordinate effectively with the rack fuse. Low power dissipation is crucial to prevent thermal runaway of the battery and to minimize battery cell degradation over time due to elevated temperatures.
Typical nominal voltage and current levels: 50 V DC – 400 V DC, 100A – 500A

Rack protection:

The rack fuse safeguards the battery rack from external faults. Ideally, it operates in coordination with both the module fuses and the contactors.
Typical nominal voltage and current levels: 800 V DC – 2000 V DC, 100A - 500A

DC Panel protection:

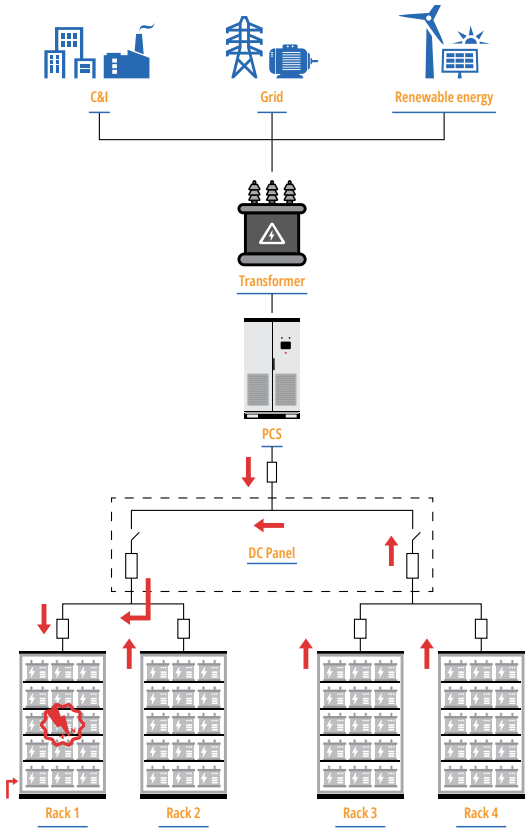
A DC Isolation Panel typically contains DC switch disconnects and fuses. The switch disconnects can be used to isolate battery rack groups, while the fuses are employed to limit the peak short circuit current, thereby protecting the switches.
Typical nominal voltage and current levels: 800 V DC – 2000 V DC, 630A - 2000A

PCS protection:

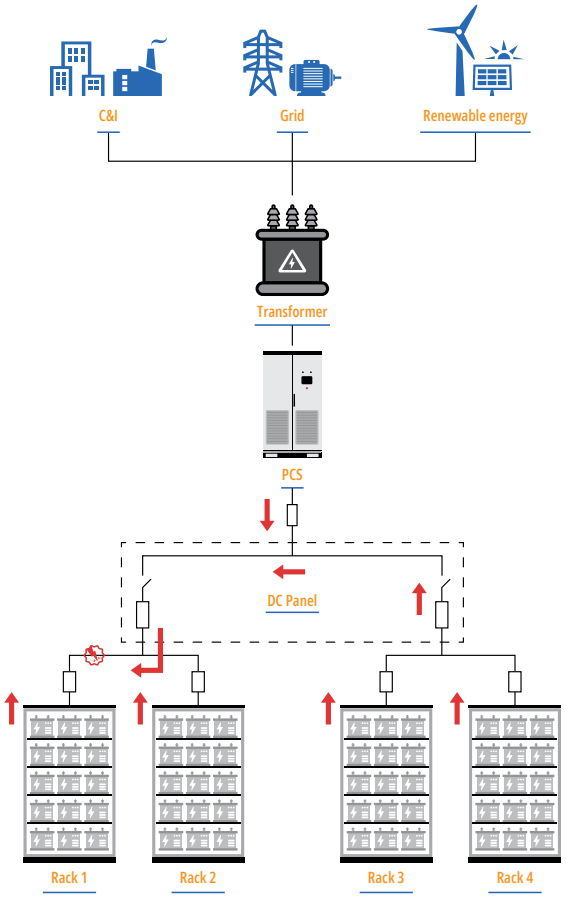
The power conversion or conditioning system facilitates the connection and power conversion between the DC battery side of the system and the other side which can be AC or DC. The PCS includes overcurrent-sensitive semiconductors that require high-speed overcurrent protection.
Typical nominal voltage and current levels: 800 V DC – 2000 V DC, 1000A - 3000A

Typical battery storage system topology

Internal fault scenario



External fault scenario



Battery storage fuse links selection criteria

How to select a fuse for battery storage applications

Various type of batteries are used in storage systems: Lead acid, lithium-ion, AGM, Nicad. These batteries have varying characteristics based on chemistry, construction and manufacturer. The Battery Management System (BMS) will ensure the battery health and that the battery cannot be over charged or over discharged. The BMS together with a suitable overcurrent protection device such as a fuse link will provide protection to the battery.

The selection of an appropriate fuse link should consider the maximum open circuit voltage of the system, the circuit time constant and short circuit current as they will vary depending on the battery state of charge.

To select the correct fuse link for battery storage systems the criteria below need to be considered

1.1 Voltage dimensioning

The voltage rating of a battery fuse link indicates the maximum DC it has been designed to operate. In order to properly protect the battery system, the fuse link voltage rating must be at least equal to the maximum open circuit voltage of the battery.

One fuse link on its own should be able to operate at the maximum open circuit voltage of the battery, if two or more fuse links are in series in a short-circuit path, each fuse link should be rated above the maximum open circuit voltage of the battery.

According to UL 1973 7.9.11 "Protective components of battery modules intended for series connection in battery systems shall be rated for the maximum voltage of the intended battery system."

According to IEC 60269-7 BB2.1 Rated voltage "In case of polarity inversion protection one fuse link must be installed for each battery polarity.

Each single fuse must be able to interrupt the short circuit current under maximum voltage of the system."

The fuse links should be selected to ensure the circuit time constant is less than that the fuse links are tested to.

1.2 Current dimensioning

The fuse link rated current is the RMS current that it can continuously carry without degrading or exceeding the applicable temperature rise limits of the fuse-link under well-defined and steady-state conditions.

1.2.1 Basic selection

This section covers the basic selection criteria only for the fuse links' rated current and not the influence from overload and cyclic loading. To avoid premature operation, the fuse link current rating when modified for external influences on the rating should be greater than the calculated RMS current of the application.

$$\text{Fuse current rating selected } (I_n) \geq \frac{I_b}{K_t \times K_e \times K_v \times K_a \times K_b}$$

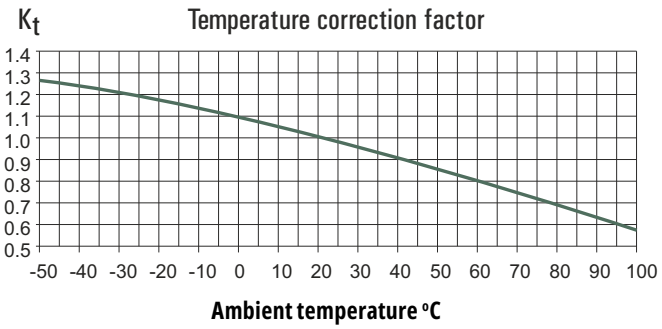
- I_n: Rated current of a selected fuse
- I_b: The continuous RMS load current through the fuse in actual application
- K_t: Ambient temperature correction factor
- K_e: Thermal connection factor
- K_v: Air cooling correction factor
- K_a: Correction factor for high altitude
- K_b: Fuse link case correction: 1.0 for ceramic, 0.8 for non-ceramic

Battery storage fuse links selection criteria

1.2.2 Temperature derating K_t

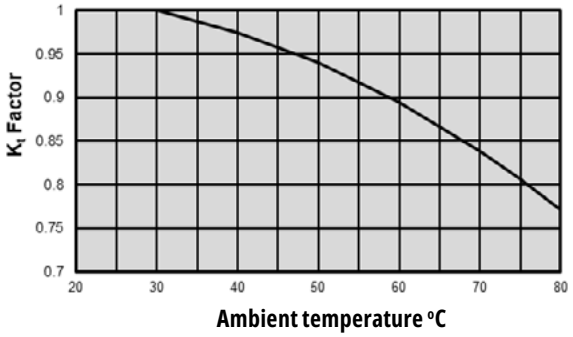
The fuse link current rating is confirmed at an ambient test temperature of 20°C. Higher ambient air temperature will influence the fuse links ability to dissipate heat by convection.
For ambient temperature above 20°C, a de-rating factor K_t should be applied to de-rate the fuse link current rating.

Fig 1 . Battery energy storage fuse links - factor for derating with increased temperature



For aR/ aBat fuses

Fig 2 . Battery energy storage fuse links - factor for derating with increased temperature



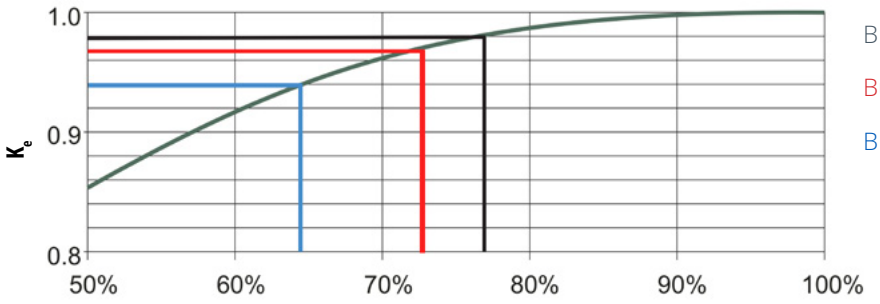
For 1000 & 1500Vdc gR/gBat fuses

1.2.3 Thermal connection derating K_e

The busbar and cabling attached to the fuse link help to conduct heat generated by the fuse link away from the fuse link itself. Eaton recommends the current density of the busbar, on which the fuse links are mounted ,should be 1.3 A/mm^2.
If the busbar carries a current density more or less than 1.3, then the fuse needs to be de-rated as per illustration below.

For example:, a 200 A rated fuse link is to be mounted onto a busbar with cross sectional area of 120 mm^2. The recommended busbar size for a 200 A fuse is 154 mm^2 (200/1.3 A/mm^2), but the actual busbar size is only 78% (120 mm^2 /150 mm^2) of the recommended size; so the fuse link should be de-rated according to the thermal de-rating factor shown in the graph below (black lines), in this case K_e=0.98.

Fig 3. Thermal correction factor



The percentage of the recommended copper busbar size (100% = 1.3 amp/mm^2)

Busbar 78% (0.78), K_e Factor = 0.98

Busbar 74% (0.74), K_e Factor = 0.97

Busbar 66% (0.66), K_e Factor = 0.95

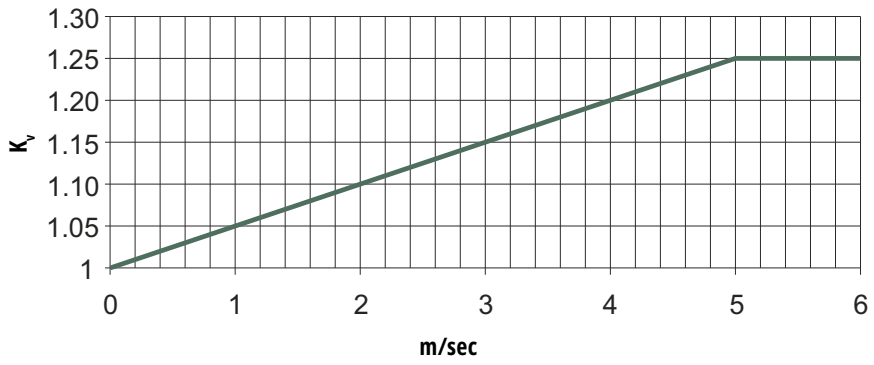
For full range fuse links, the fuse links are rated based on the connections being standard cross section PVC cable sizes .

For ALU busbar derating please contact bulehighspeedtechnical@Eaton.com

1.2.4 Cooling air correction K_v

When there is additional forced air cooling available it helps to dissipate the heat from the system, including from the fuse links.
A factor K_v can be applied to the fuse link current carrying capability based on the cooling air speed measured across the fuse link.

Fig 4. Cooling air correction factor



1.2.5 High altitude derating K_a

When fuse links are installed at high altitude, the air density is lower than at ground level, so the natural cooling effect of air is reduced. Correction factor K_a should be applied to the fuse link's continuous rating when the application is above 2000 meters.

$$K_a = 1 - \left(\frac{h - 2000}{100} \times \frac{0.5}{100}\right)$$

h = altitude in meters

1.2.6 Overload

In many systems a fuse link will be subjected to currents above the stated rated current for short durations as part of the normal system operation, e.g.motor starting conditions. These may be referred to as expected overloads. By knowing the details listed below it is possible to check if the selected fuse link can or cannot withstand the overload.

- Overload current
- Overload duration
- How often does the overload happen?

1.2.7 Cyclic loading

Whilst standard tests confirm a given fuse link capabilities with specific overcurrent and duration, situations that differ from the standard should be considered as cyclic loading and the fuse link selection should be based on the criteria below.

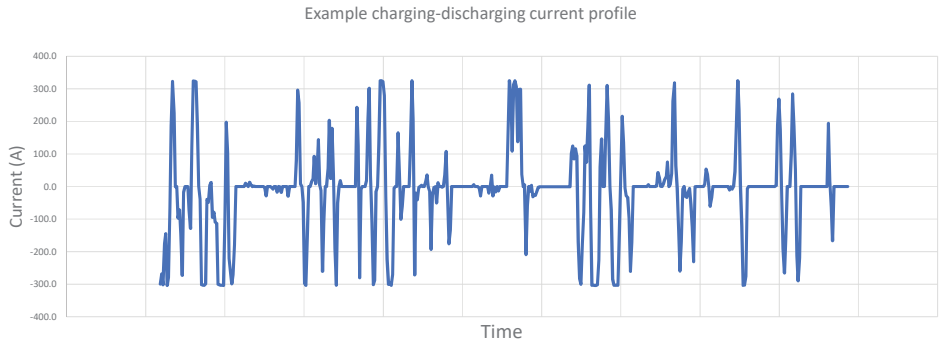
In many circuits with cyclic currents, the RMS current will be relatively low compared to the peak currents in the cycle, if the time when the current is high is short compared to when the current is low, see example current profile below.
In such cases, selection of the fuse link based on RMS current alone will result in a fuse link that will suffer premature operation. In order to select an appropriate fuse link current rating the equation to select the correct rated fuse link (see section 1.2.1 page 8) will require modification to compensate for the cyclic nature.

$$\text{Fuse current rating selected } (I_n) \geq \frac{I_b \times G}{K_t \times K_e \times K_v \times K_a \times K_b}$$

G: Correction factor for cyclic applications. Please note G factor can vary between 1.5 and 2 depending on the load cycle.

Please contact our Field Application Engineering team for further information on cyclic loading bulehighspeedtechnical@eaton.com

While using the empirical rules will cover many cyclic loading conditions, it is impossible to set up general rules for all applications, please consult Eaton Field Application Engineering Team at bulehighspeedtechnical@eaton.com for guidance on any specific cyclic loading profile.



1.2.8 Fuse and contactor coordination in battery energy storage system

In modern DC applications such as Battery Energy Storage Systems (BESS), load currents can vary significantly due to changes in the battery's state of charge (SOC). These currents must be effectively managed using overcurrent protection devices to ensure system safety and reliability. Typically, contactors are used in series with fuses within battery racks. While contactors handle switching of nominal load currents and interruption of low-level faults, fuses are responsible for clearing high short-circuit currents.

Achieving proper coordination between fuses and contactors is essential to prevent damage and ensure uninterrupted operation.

The following requirements must be met:

- • Fuse Minimum Breaking Capacity (MBC) must be lower than the Contactor Maximum Breaking Capacity, ensuring the fuse operates before the contactor is exposed to damaging fault levels.
- • The fuse must protect the contactor from short-circuit currents that could cause contact welding or arcing damage, preserving the integrity of the switching device.

Indicative Coordination Analysis

In the absence of certified or pre-tested fuse–contactor combinations, theoretical analysis using characteristic curves can provide guidance:

- **Overload protection:** The fuse's time-current characteristic (TCC) should overlap with the contactor's current-carrying capability curve to ensure full protection during overload conditions.
- **Short-circuit coordination (Type 2**): The fuse TCC should be sufficiently separated from the contactor's welding and repulsion damage curves. This ensures the fuse clears the fault before the contactor reaches its mechanical or thermal failure limits.
- **Contactor withstand ratings:** The short-circuit current withstand capability of the contactor is a critical parameter in evaluating coordination feasibility.

If you require assistance for a contactor coordination study, please contact bulehighspeedtechnical@eaton.com.

1.2.9 Fuse coordination

Fuse coordination is crucial in BESS for several reasons. Improper fuse coordination can lead to excessive fault currents, causing battery thermal runaway, fires, or explosions. These failures result in expensive downtime, equipment replacement, and even potential legal liabilities.

- Downtime equals lost revenue in applications like grid support, peak shaving, or energy arbitrage.
- Fast, selective fuse operation allows the BESS to continue running with minimal impact, preserving profitability.
- Coordinated fusing reduces nuisance tripping, minimizing unnecessary maintenance interventions.
- Fewer site visits for fuse replacements mean lower operational expenses (OPEX).
- Proper fault protection prevents excessive current surges that degrade battery cells prematurely.
- Extending battery life reduces capital expenditure (CAPEX) on replacements.

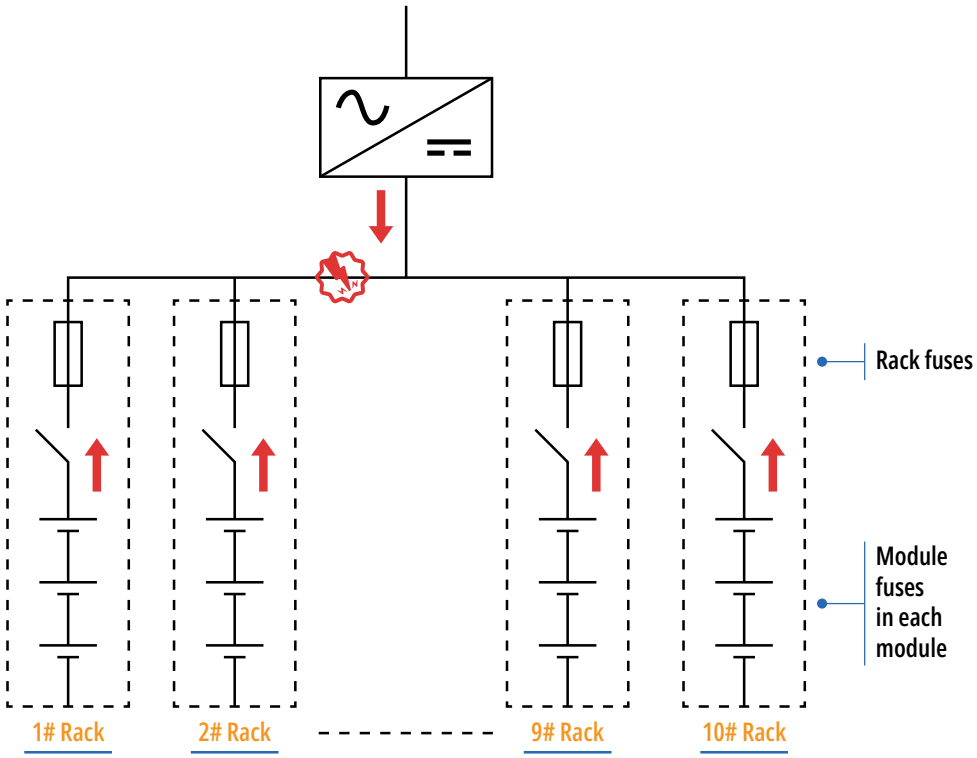
Fuse coordination in BESS ensures optimized protection, lower replacement costs, reduced downtime, and maximized revenue generation, making it a critical factor in cost management.

As modern BESS applications continue to demand higher power outputs, the required module voltages have increased accordingly. This escalation necessitates the use of fuses with higher voltage ratings, which are typically larger in physical size. The increased size and rating of these fuses introduce greater complexity in achieving proper protection coordination, making it more challenging to meet design and safety requirements effectively.

A comprehensive fuse coordination study is illustrated in section 1.3 worked example.

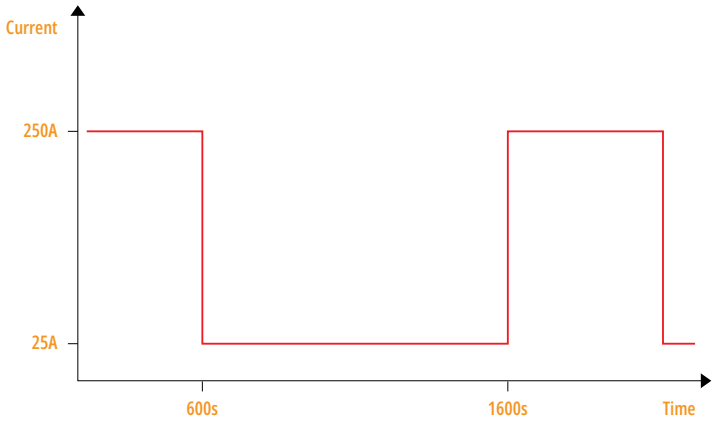
For further information on fuse coordination, please contact our Field Applications Engineering team at bulehighspeedtechnical@eaton.com.

1.3 Worked example



Application requirements

There are 10 battery racks in parallel. Polarity inversion is required; therefore, each rack is protected by a fuse in both poles, ideally an aBat fuse. Each rack contains 8 modules in series, with each module protected by a module fuse, ideally a gBat fuse. Each module has a maximum open-circuit voltage of 160 VDC, resulting in a maximum rack voltage of 1280 VDC when eight modules are connected in series (8 × 160 VDC).



Maximum short circuit current coming from the modules is 11kA at 100% SOC.

Minimum short circuit current coming from the modules is 6kA at 30% SOC.

Time constant is 3ms.

Max ambient temperature is 40C.

Busbar cross section is 180mm2.

No forced air cooling.

Coordination requirement: Short circuit fault between poles of the DC bus. Rack fuses have to clear the fault before the module fuses melt.

Battery storage fuse links selection criteria

Selection process

Voltage dimensioning: To ensure the safe operation of the rack and module fuses, each fuse must have a voltage rating at least equal to the maximum battery rack voltage – 1280 VDC. The next higher fuse rating is 1500 VDC.

Current dimensioning:

- Ib = 250A
- Kt = 0.9 for rack fuse and 0.975 for module fuse
- Ke = 1
- G = 1.8

Inrack=Ib*G/(Kt*Ke)=250*1.8/(0.9*1)=500A → 180D5707 500A 1500Vdc aBat fuse

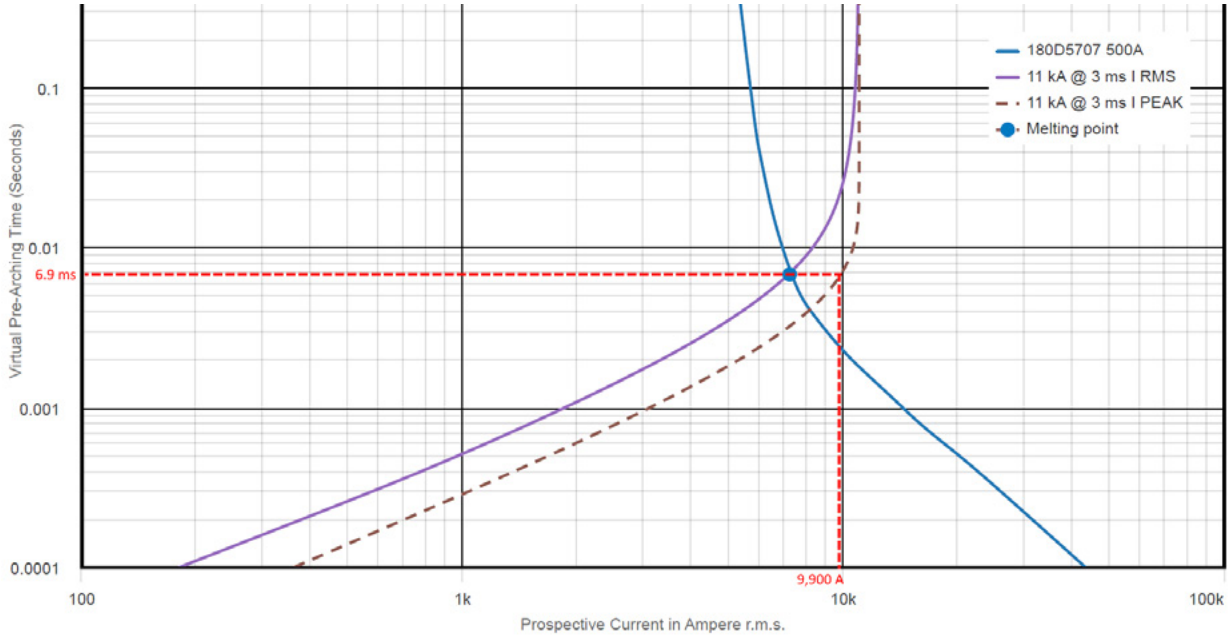
Inmodule=Ib*G/(Kt*Ke)=250*1,8/(0,975*1)=461A → BSF-500G-3XL15-B

Short-circuit and fuse coordination study

Performance of fuses at 11 kA:

180D5707:

- Melting time: 6,9 ms
- Melting I^2t: = Melting current^2 * melting time= 7200A^2 * 6.9 ms = 358 kA^2s
- Total clearing time: approx. 12 ms
- Total clearing I^2t: approx. 450 kA^2s
- Peak let through current: 9900 A

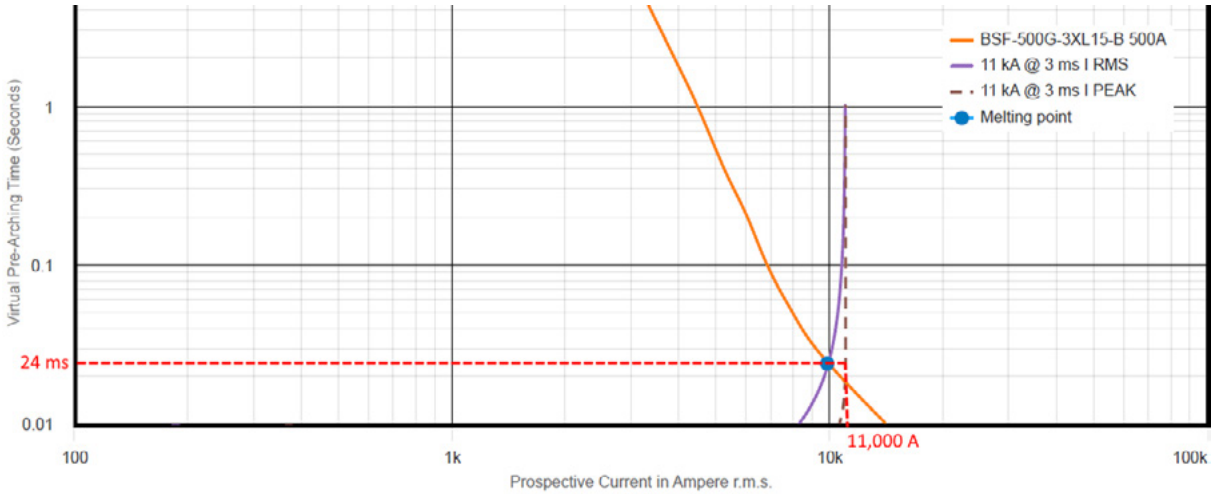


The melting time and current can be determined by identifying the intersection point between the fuse curve and the RMS fault current.

Battery storage fuse links selection criteria

BSF-500G-3XL15-B:

- Melting time: 24ms
- Melting I^2t: =Melting current^2 * melting time= 9900A^2 * 24ms = 2.35MA^2s
- Total clearing time: approx. 30 ms
- Peak let through current: 11000 A



The total clearing I^2t of the 180D5707 is 80% less than the melting I^2t of the BSF fuse, providing a significant safety margin. our dedicated Bussmann series Field Application Engineering (FAE) team can assist customers in estimating the total clearing I^2t value.

Performance of fuses at 6 kA:

180D5707:

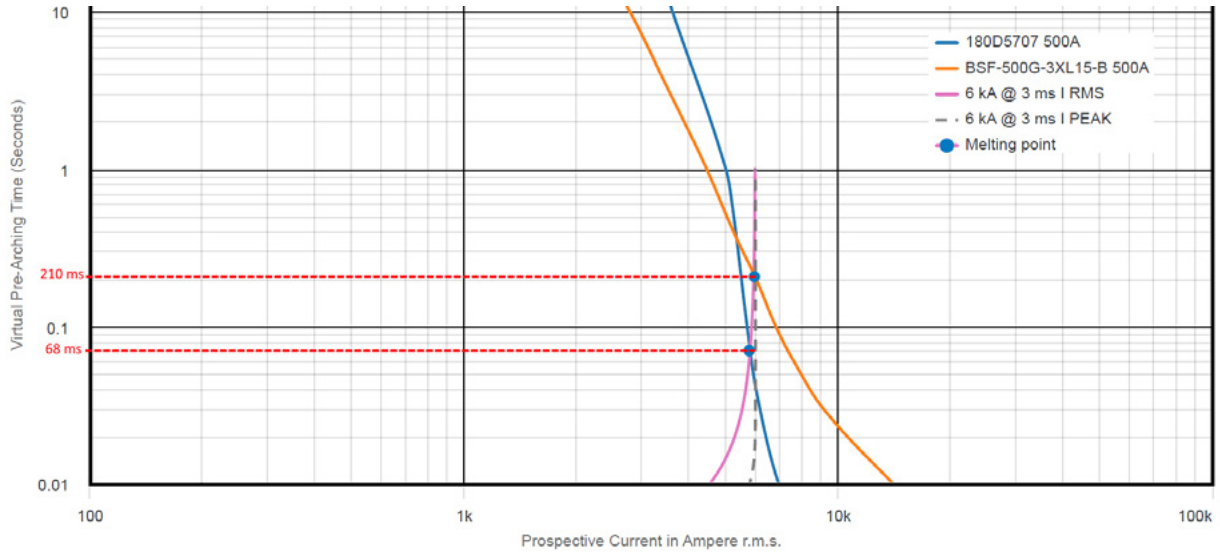
- Melting time: 68 ms
- Melting I^2t: =Melting current^2 * melting time= 5800A^2 * 68 ms = 2.29 MA^2s
- Total clearing time: approx. 74 ms
- Total clearing I^2t: approx. 2.35 MA^2s
- Peak let through current: 6000 A

BSF-500G-3XL15-B:

- Melting time: 210ms
- Melting I2t: =Melting current^2 * melting time= 5900A^2 * 210ms = 7.31MA2s
- Total clearing time: approx. 220ms
- Peak let through current: 6000A

The fuses meet the requirement of coordination at 6 kA as well.

(Total clearing I^2t of 180D5707 < melting I^2t of BSF-500G-3XL15-B and total clearing time of 180D5707 < melting time of BSF-500G-3XL15-B).



Custom solutions

Our Field Applications Engineering Team can offer tailored fuse solutions designed specifically for the unique demands of battery energy storage systems. The FAE team work closely with clients to deliver optimized, application-specific protection that meets performance, safety, and integration requirements.

Lifetime simulation of fuses in battery energy storage systems

Conducting lifetime simulations on fuses is a critical practice for ensuring the long-term reliability, safety, and performance of battery energy storage systems. These simulations enable engineers to evaluate how fuses will behave under varying electrical loads and thermal conditions throughout the system's operational life.

Technical benefits

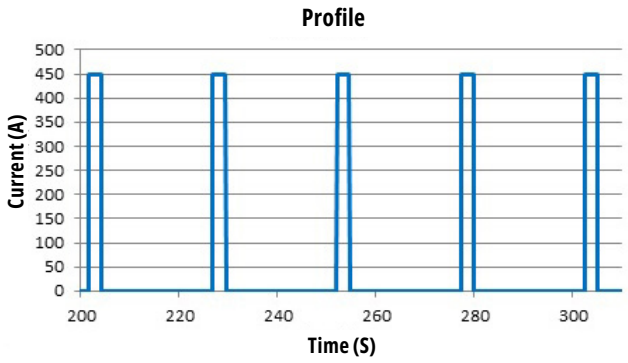
Lifetime simulation provides valuable insights into potential failure modes, allowing engineers to proactively address risks before they impact system performance. It supports optimized fuse selection by validating the correct rating for the intended application, thereby reducing the likelihood of nuisance tripping and ensuring consistent protection.

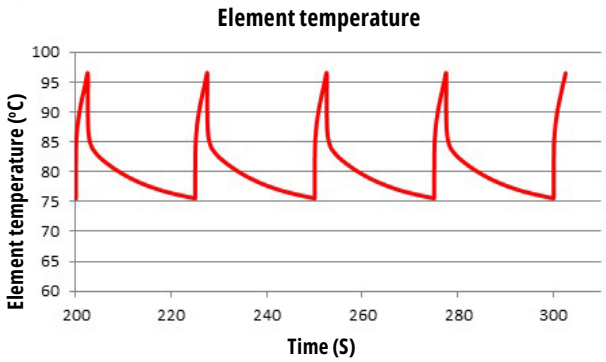
Financial advantages

From a financial perspective, lifetime simulation contributes to reduced maintenance costs by enabling the selection of components with proven durability. This minimizes unplanned downtime and the need for frequent fuse replacements. Additionally, it lowers the risk of failures that could result in warranty claims or liability issues, ultimately improving the system's cost-efficiency and reliability.

Benefits for designers

For system owners and engineers, lifetime simulation offers a data-driven approach to component selection and system design. It enhances confidence in the long-term performance of protective devices and supports strategic planning for maintenance and operational continuity.

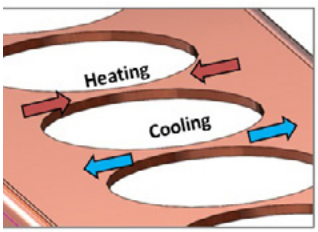


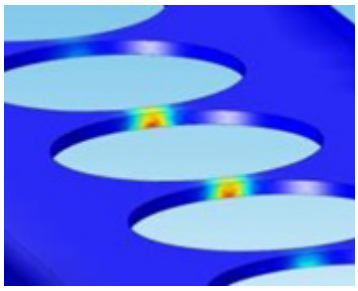


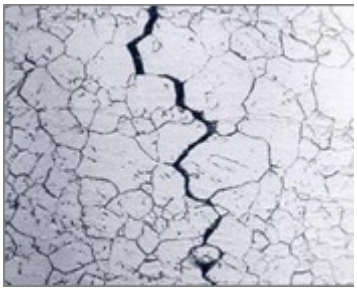
Simulation capabilities

Battery storage applications experience cyclic loading currents during charging and discharging activities. Current cyclic causes the temperature fluctuation of fuse elements as shown in the figure below

Repeated high current pulses lead to metal fatigue from gain boundary disruption followed by crack propagation and failure. The thermal-mechanical stress accumulation will promote abnormal fuse melting.

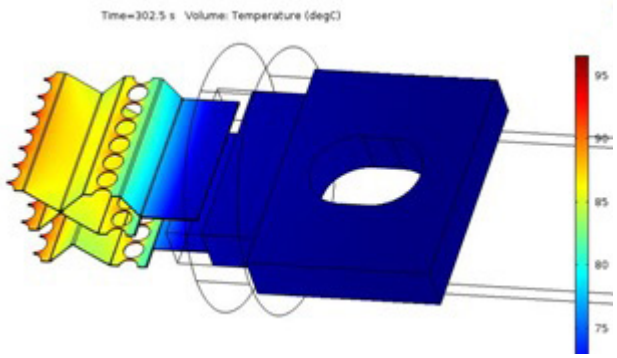






Custom solutions and simulation capabilites

Hence lifetime prediction of the fuse link has become a popular topic for battery storage protection. Eaton has developed the Life Prediction Model to estimate the number of current cycles that fuse link could withstand based on customers' specific cycling loading profile. We also analyse the temperature of the fuse element and connection tags to give accurate prediction.



Repeated high current pulses lead to metal fatigue from gain boundary disruption followed by crack propagation and failure. The thermal-mechanical stress accumulation will promote abnormal fuse melting.

Our new simulation tool will help us to predict the lifetime of the battery storage applications:

- Repetitive current cycling load profile
- Ambient temperature around the fuse
- Busbar material and size
- Air cooling speed
- Maximum altitude
- If the fuse link is installed in sealed enclosures

For simulation request, please contact Eaton's Field Application Engineering team on bulehighspeedtechnical@eaton.com

Battery storage fuse links, fuse bases and microswitches overview

Battery storage fuse links offering specifications

For detailed installation instructions, please refer to our High speed fuse application guide

						Applications			
Rated voltage (V DC)	**Rated current (A)**	**Body type**	**Body size**	**Fuse type**	**Data sheet number**	**Battery module protection**	**Power Conversion System (PCS)**	**Battery rack protection**	**DC Panel protection**
250	80 to 315	**BSF-DD25**	Round body	Bolted	TD135001	•			
1000	63 to 400	**BSF-NH**	NH1, NH2 and NH3	NH Bladed	TD135001	•			
1000	63 to 200			NH Bolted	TD135001	•			
1500	100 to 315	**180D**	1	Flush end, DIN, US Style	TD135025EN			•	
1500	100 to 450	**ESS2**	2	Dual slotted, US Style, Flush end, DIN 43653	TD135030EN			•	
1500	125 to 500	**180D**	2	Flush end, DIN, US Style	TD135026EN			•	
1500	100 to 630	**ESS3**	3		TD135031EN			•	•
1500	350 to 1400	**180D**	3	Flush end, DIN, US Style	TD135027EN		•	•	•
1500	250 to 500	**BSF-3XL**	3L	XL Bladed	TD135002EN	•		•	
1500	250 to 500			XL Bolted	TD135002EN	•		•	
1500	800 to 1800	**180D**	4	Flush end	TD135028EN		•		•
1500	630 to 1800	**ESS5**	4	Flush end	TD135032EN		•		•
1500	1600 to 3000	**180d**	24	Flush end	TD135029EN		•		

Fuse bases and microswitches

		Fuse bases		**Microswitches**
Fuse size	**Fuse type**	**Catalog number**	**Data sheet**	**Catalog number**
NH1	Bladed	SD1-D-PV	720149	170H0236 and 170H0238
	Bolted	N/A	N/A	N/A
NH2	Bladed	SD2-D-PV	720149	170H0236 and 170H0238
	Bolted	N/A	N/A	N/A
NH3	Bladed	SD3-D-PV	720149	170H0236 and 170H0238
	Bolted	N/A	N/A	N/A
XL	Bladed	SD3L-S-PV (up to 400 A)	10685	170H0236 and 170H0238
	Bolted	N/A	N/A	170H0069

250 V DC, 80 to 315 A, BSF-DD25 Round body battery storage fuse links

Description

Eaton's Bussmann series BSF-DD25 centre bolted tags 250 V DC fuse links are specifically designed to protect battery modules and DC rated applications

Fuse size

See dimension drawing

Catalog number

BSF-(amps)A-DD25

Technical data

- Rated voltage: 250 V DC
- Rated current: 80 to 315 A
- Breaking capacity: 100 kA
- Class of operation: gR/gBat for full range fuse links for protection of battery storage systems
- Time constant: 10 ms and 3 ms tested (suitable for most DC applications)

Standards/Approvals

- Designed and tested to IEC 60269 Part 4 and Part 7
- CE/UKCA Compliant
- UL 248-13 Recognised
- RoHS compliant

Packaging

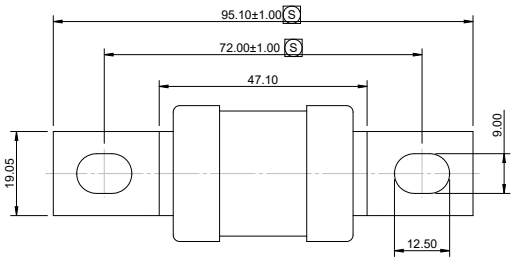
MOQ: 5

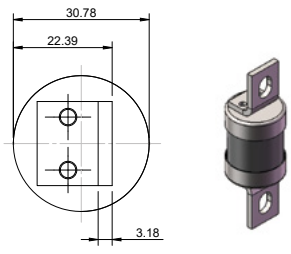
Packaging 100% recyclable

Catalog numbers

Catalog number with bolted blade	Rated current (Amps)	Rated voltage (V DC)	Minimum Pre-arcing I²t A² Sec	Clearing I²t at 250 V DC 100 kA 10 ms L/R	Power loss In at 100%
BSF-080A-DD25	80	250	7200	18,000	8
BSF-100A-DD25	100	250	20,000	48,000	10
BSF-125A-DD25	125	250	29,500	71,000	11
BSF-160A-DD25	160	250	57,000	136,000	13
BSF-200A-DD25	200	250	120,000	285,000	14
BSF-250A-DD25	250	250	200,000	475,000	18
BSF-315A-DD25	315	250	265,000	630,000	25

Dimensions - mm

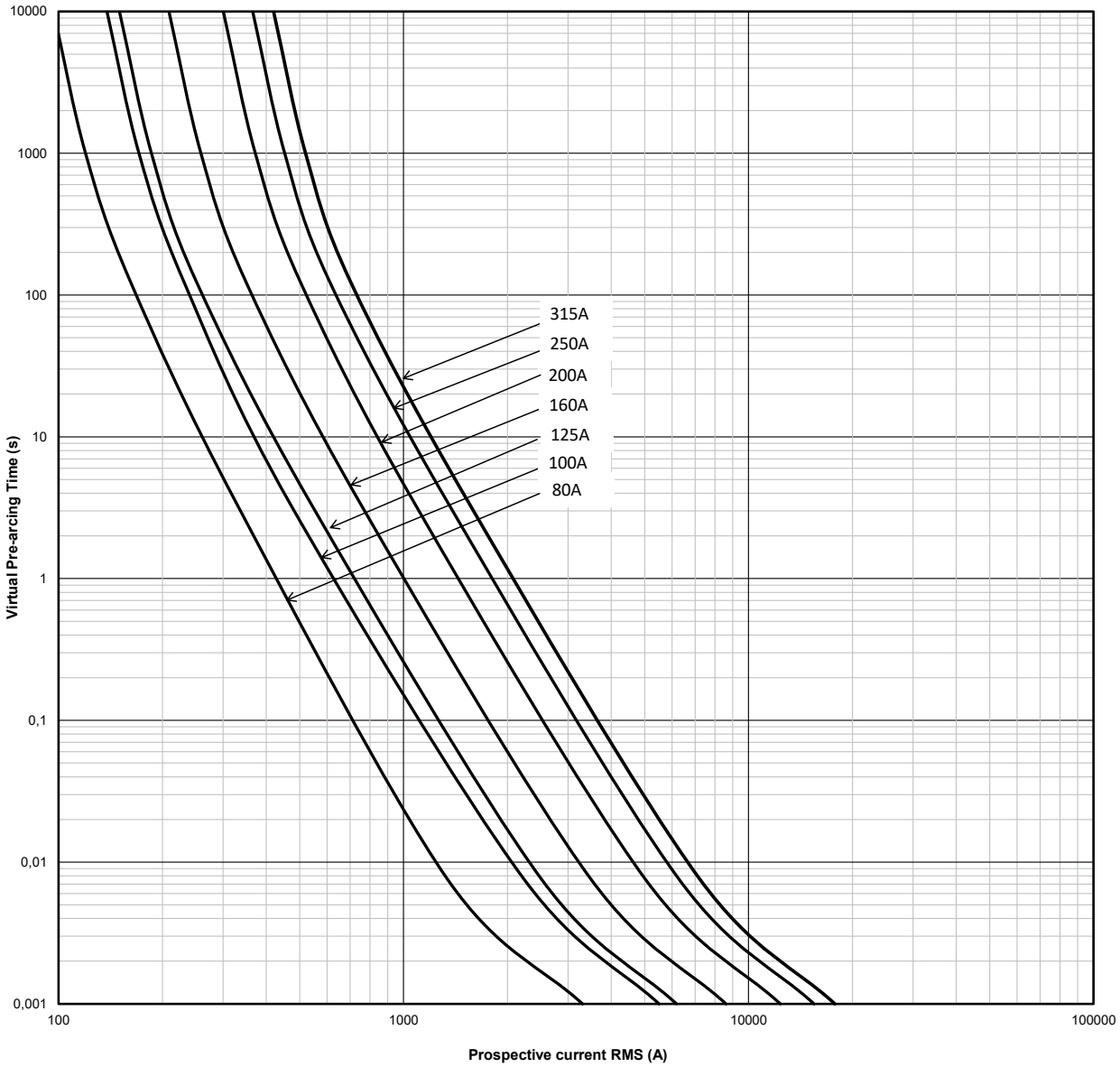




Data sheet: TD135011

250 V DC, 80 to 315 A, BSF-DD25 Round body battery storage fuse links

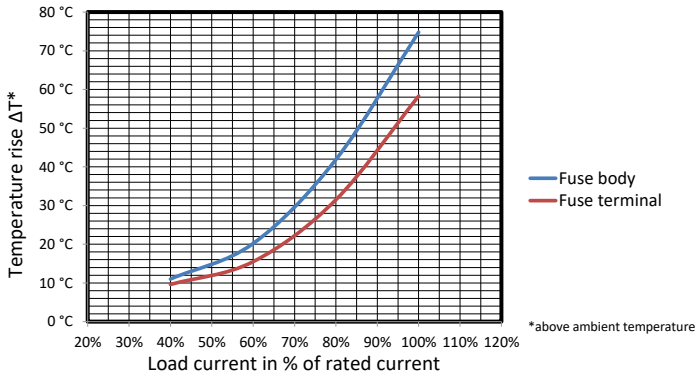
Time-current curve



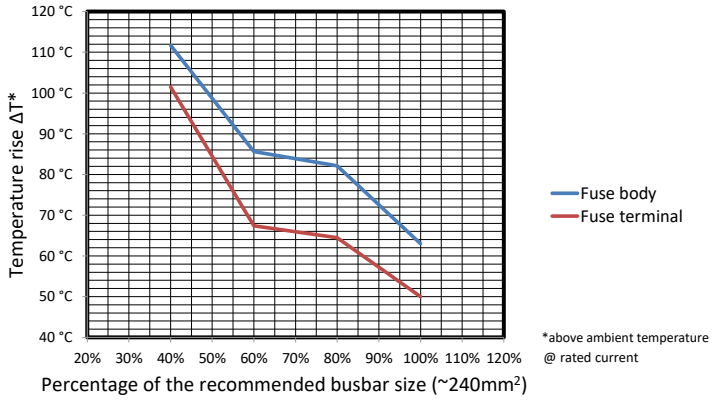
Data sheet: TD135011

250 V DC, 80 to 315 A, BSF-DD25 Round body battery storage fuse links

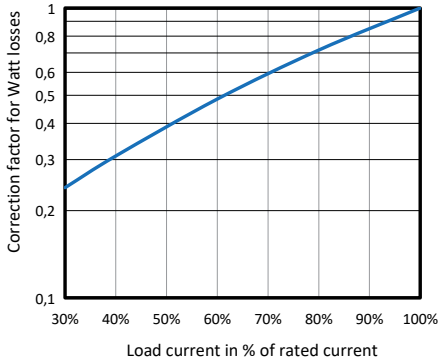
Temperature rise caused by different load currents



Temperature rise for various busbar sizes



Power dissipation at different load currents



Data sheet: TD135011

1000 V DC, 63 to 400 A, BSF-NH NH battery storage fuse links

Description

Eaton's Bussmann series NH battery storage fuse links are specifically designed to protect and isolate battery array combiners and disconnects. These fuse links are capable of interrupting low overcurrents associated with faulted battery storage systems.

Fuse size

NH1, NH2 and NH3

Catalog number

Knife blade fuse links: BSF-(amps)G-NH(Body size)10

Bolted fuse links: BSF-(amps)G-NH(body size10-B

Bladed fuse links

Bolted fuse links

Technical data

- Rated voltage: 1000 V DC
- Rated current: 63 to 400 A
- Breaking capacity: 100 kA
- Class of operation: gBat for full range fuse links for protection of battery storage systems
- Time constant: 4.5 ms at 100 kA

Standards/Approvals

- IEC 60269-7
- RoHS and REACH compliant

Packaging

MOQ: 3

Packaging 100% recyclable

Catalog numbers

Catalog number with knife blade	Catalog number with bolted blade	Fuse body size	Rated current (Amps)	Rated voltage (V DC)	Pre-arcing I2t	Total I2t @ 1000 V DC	Power loss at 0.7 x In (W)	Power loss at In (W)
BSF-063G-NH110	BSF-063G-NH110-B	1	63	1000	470	4300	5	12
BSF-080G-NH110	BSF-080G-NH110-B	1	80	1000	640	5760	6	15.5
BSF-100G-NH110	BSF-100G-NH110-B	1	100	1000	1300	11,700	7	16.5
BSF-125G-NH110	BSF-125G-NH110-B	1	125	1000	2600	23,400	7	17.5
BSF-160G-NH110	BSF-160G-NH110-B	1	160	1000	5200	46,800	11	27.5
BSF-160G-NH210	BSF-160G-NH210-B	2	160	1000	4600	37,000	11	28
BSF-200G-NH210	BSF-200G-NH210-B	2	200	1000	9500	76,000	13	32
BSF-250G-NH210	BSF-250G-NH210-B	2	250	1000	17,000	136,000	15	38
BSF-315G-NH310	BSF-315G-NH310-B	3	315	1000	32,000	260,000	18	44
BSF-355G-NH310	BSF-355G-NH310-B	3	355	1000	44,500	370,000	18	46
BSF-400G-NH310	BSF-400G-NH310-B	3	400	1000	67,500	550,000	21	52

Data sheet: 135001EN

1000 V DC, 63 to 400 A, BSF-NH NH battery storage fuse links

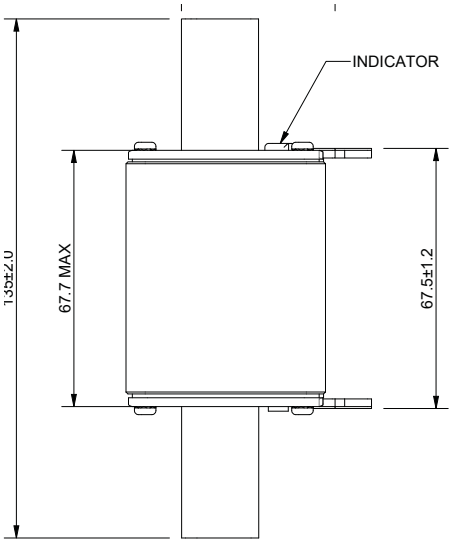
Microswitches for NH knife blade fuse links

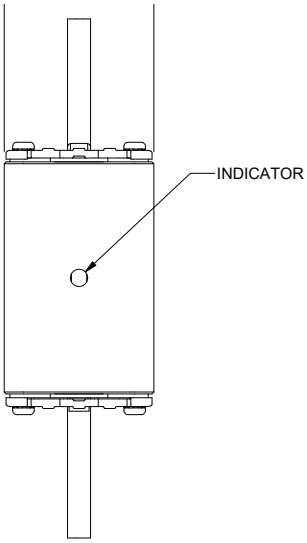
Catalog number	Fuse type	Fuse body size	Microswitches	Terminal size	Rated Voltage	Rated current
BSF-(amps)G-NH	Knife blade	1 to 3	170H0236	6.3 x 0.8 mm	250 V a.c.	5 A
			170H0238	2.8 X 0.5 mm	250 V a.c.	5 A

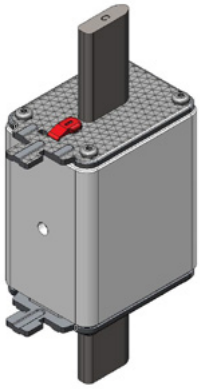
NH Bases for NH knife blade fuse links

Catalog number with knife blade	Fuse body size	NH Bases
BSF-(amps)G-NH110	1	SD1-D-PV
BSF-(amps)G-NH210	2	SD2-D-PV
BSF-(amps)G-NH310	3	SD3-D-PV

Dimensions - NH1 Bladed fuse links



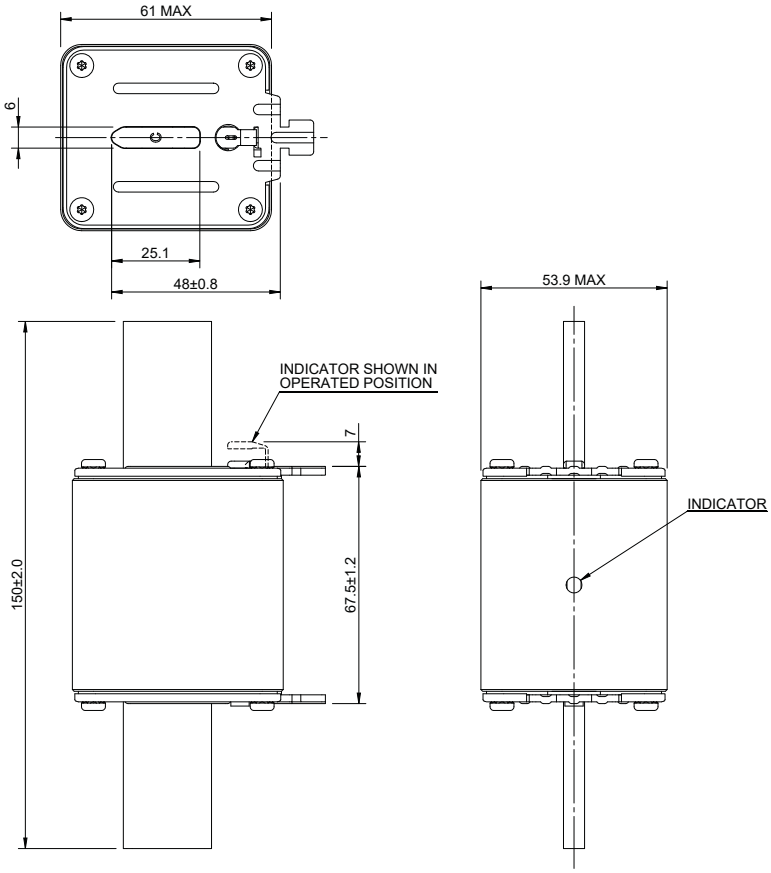




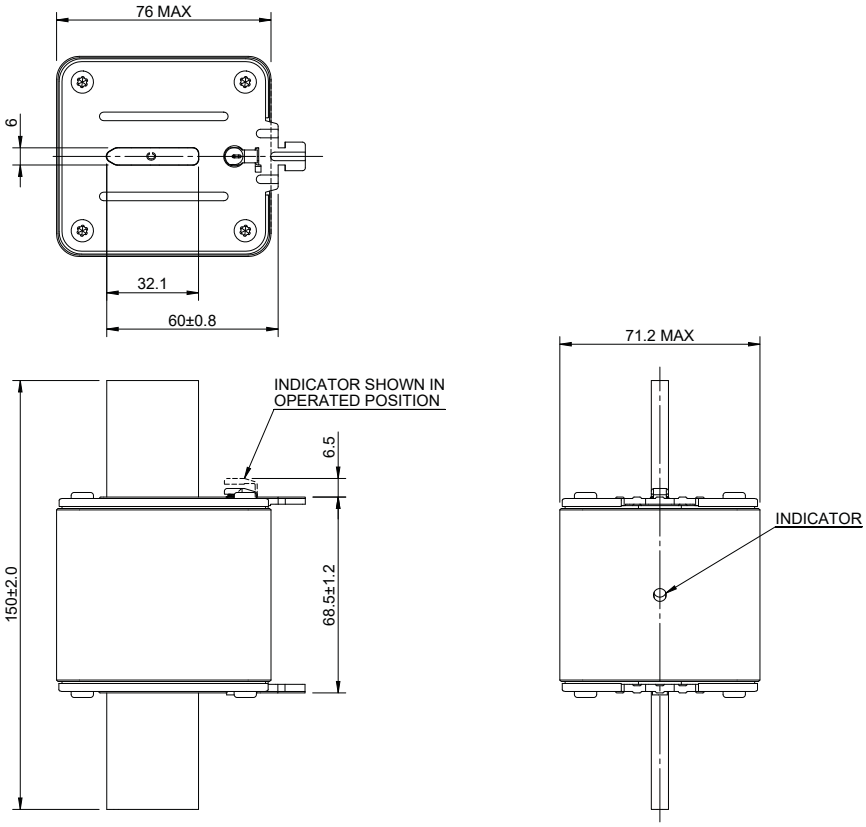
Data sheet: 135001EN

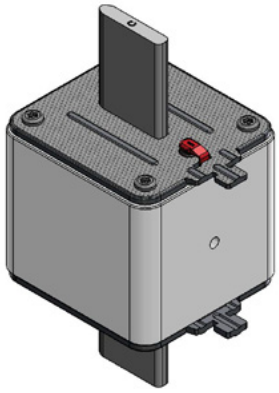
1000 V DC, 63 to 400 A, BSF-NH NH battery storage fuse links

Dimensions mm - NH2 Bladed fuse links



Dimensions mm - NH3 Bladed fuse links

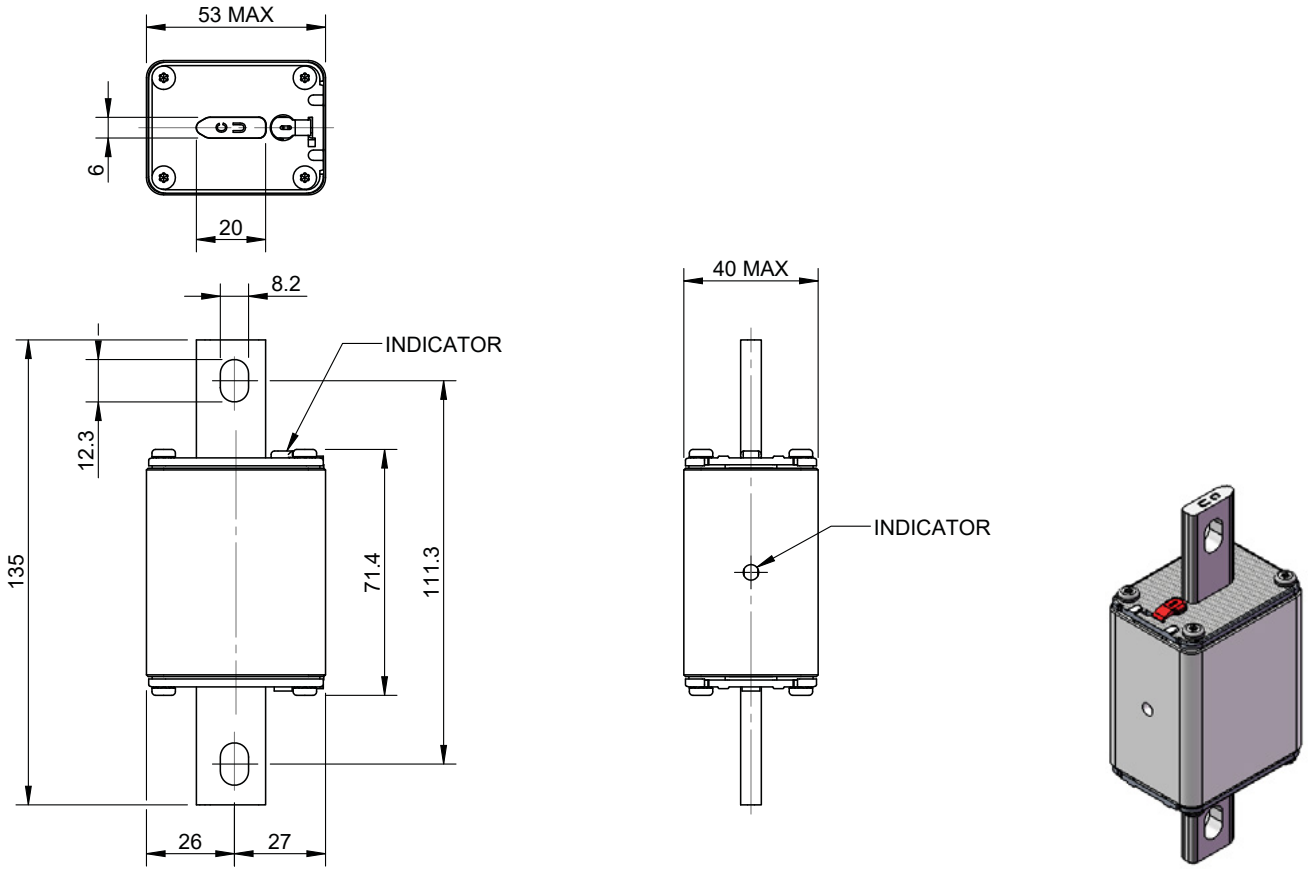




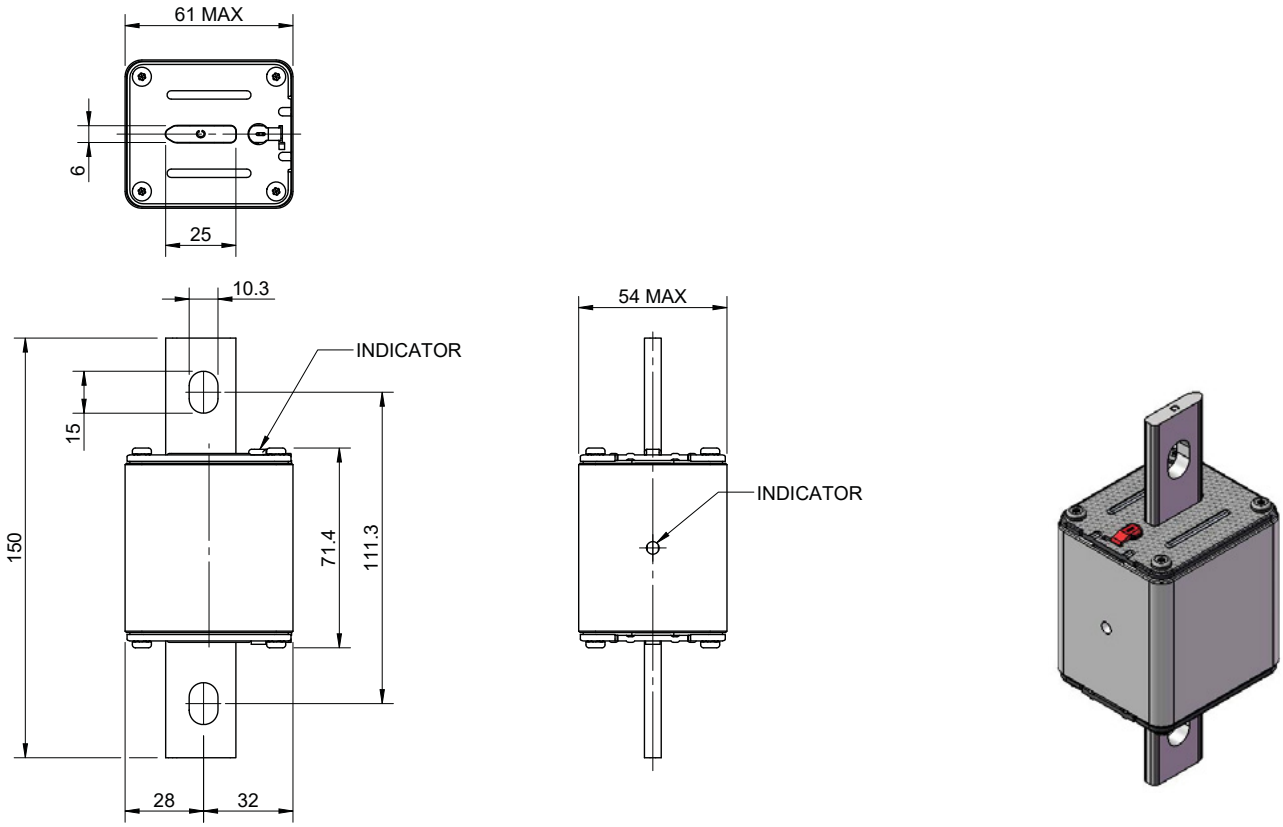
Data sheet: 135001EN

1000 V DC, 63 to 400 A, BSF-NH NH battery storage fuse links

Dimensions mm - NH1 Bolted fuse links



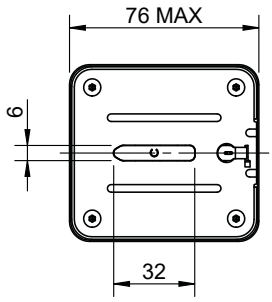
Dimensions mm - NH2 Bolted fuse links

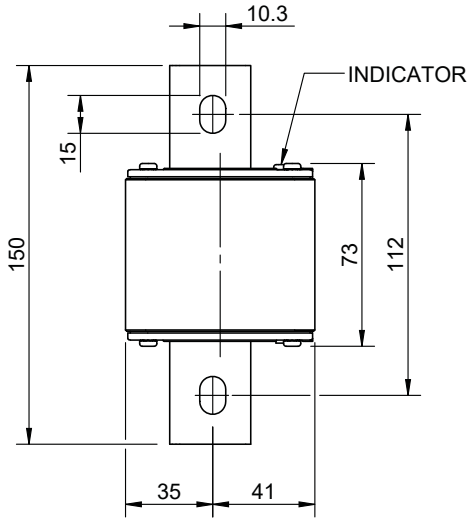


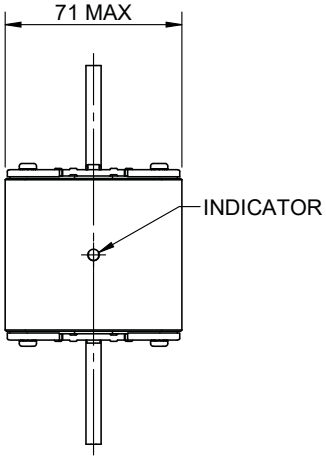
Data sheet: 135001EN

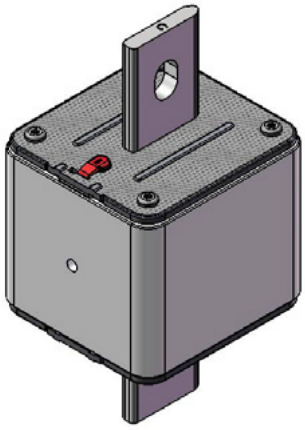
1000 V DC, 63 to 400 A, BSF-NH NH battery storage fuse links

Dimensions mm - NH3 Bolted fuse links

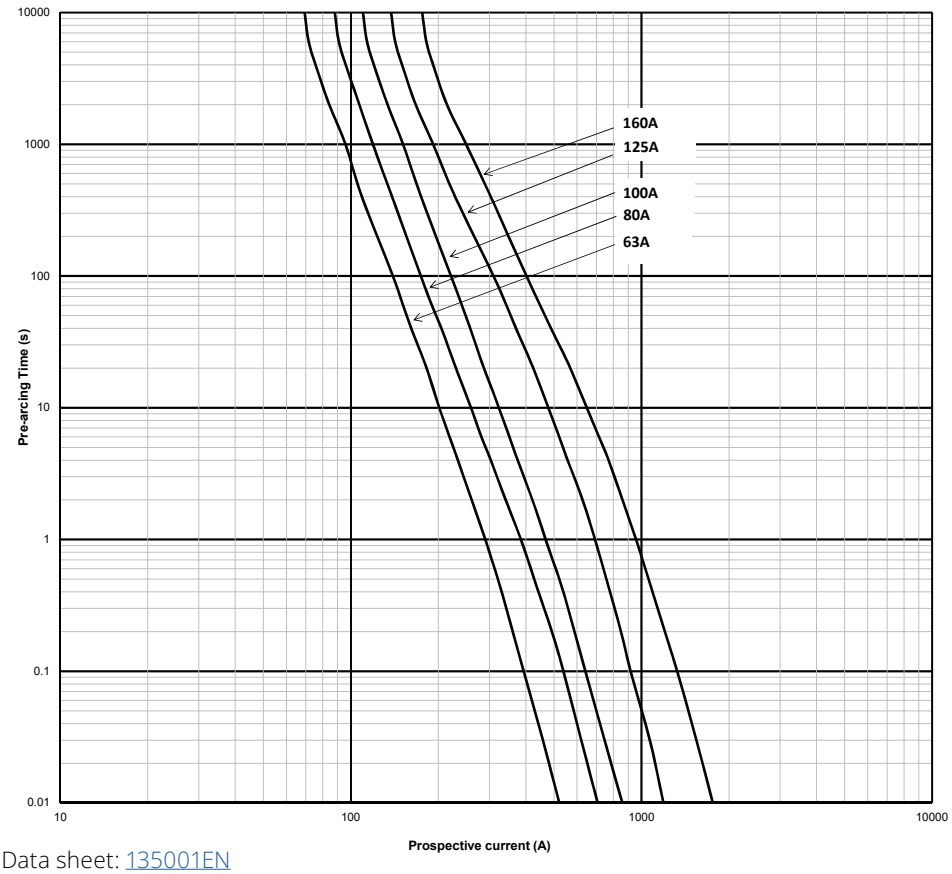








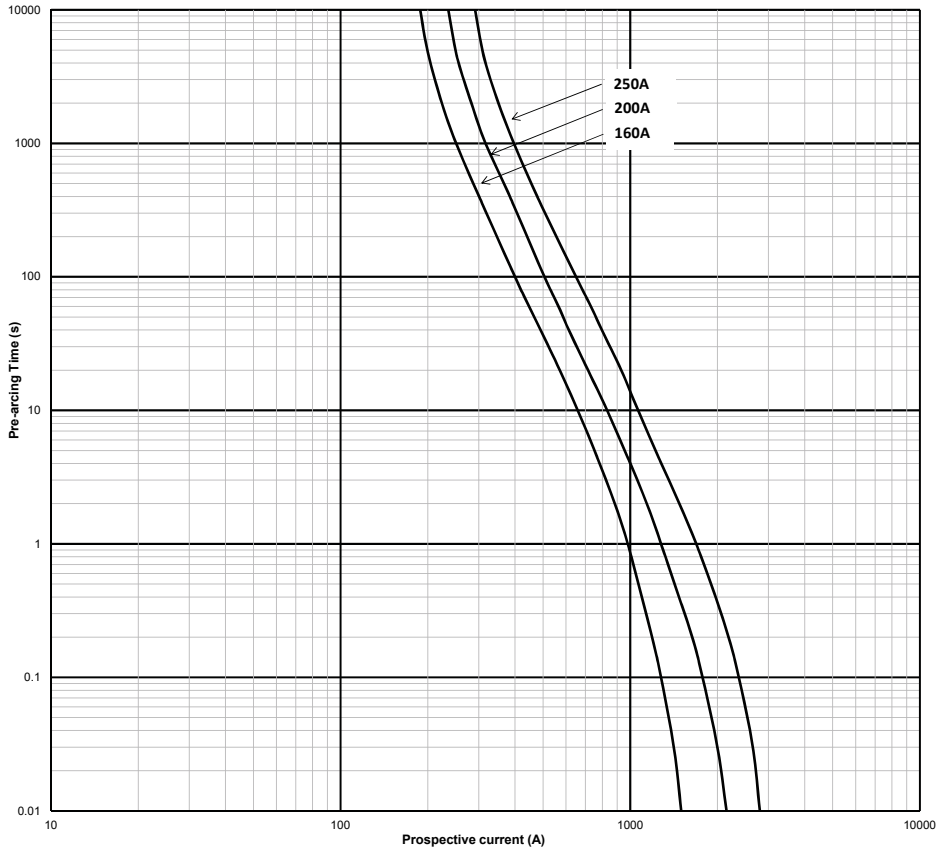
Time-current curve - NH1 fuse links



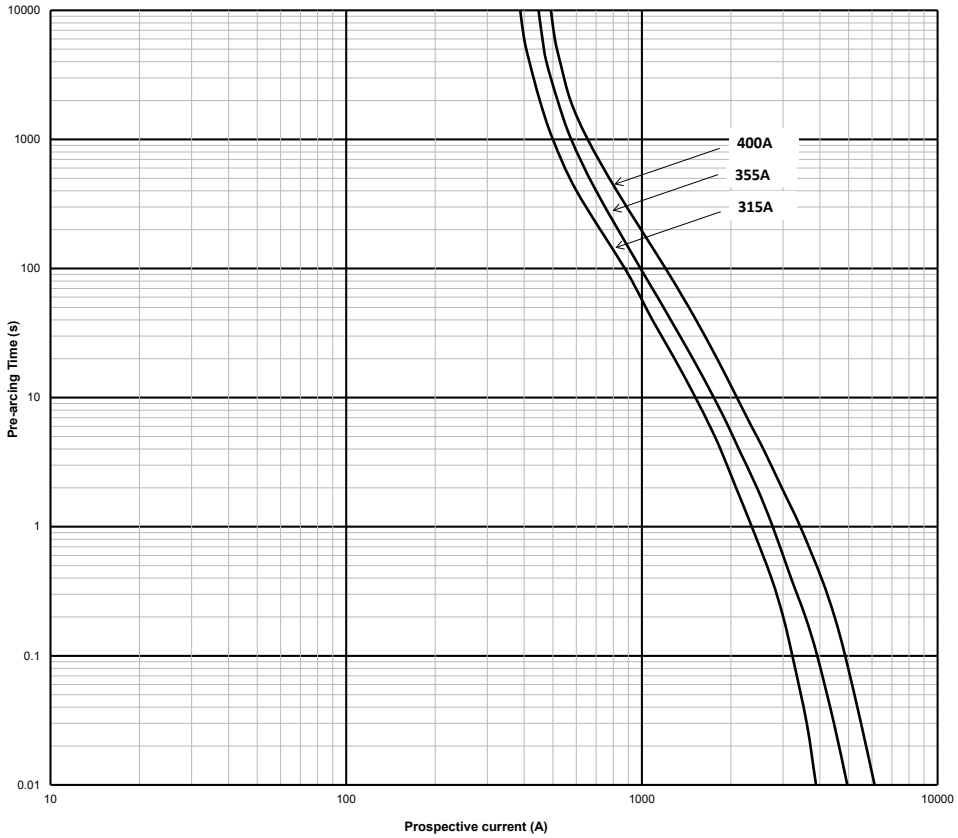
Data sheet: 135001EN

1000 V DC, 63 to 400 A, BSF-NH NH battery storage fuse links

Time-current curve - NH2 fuse links



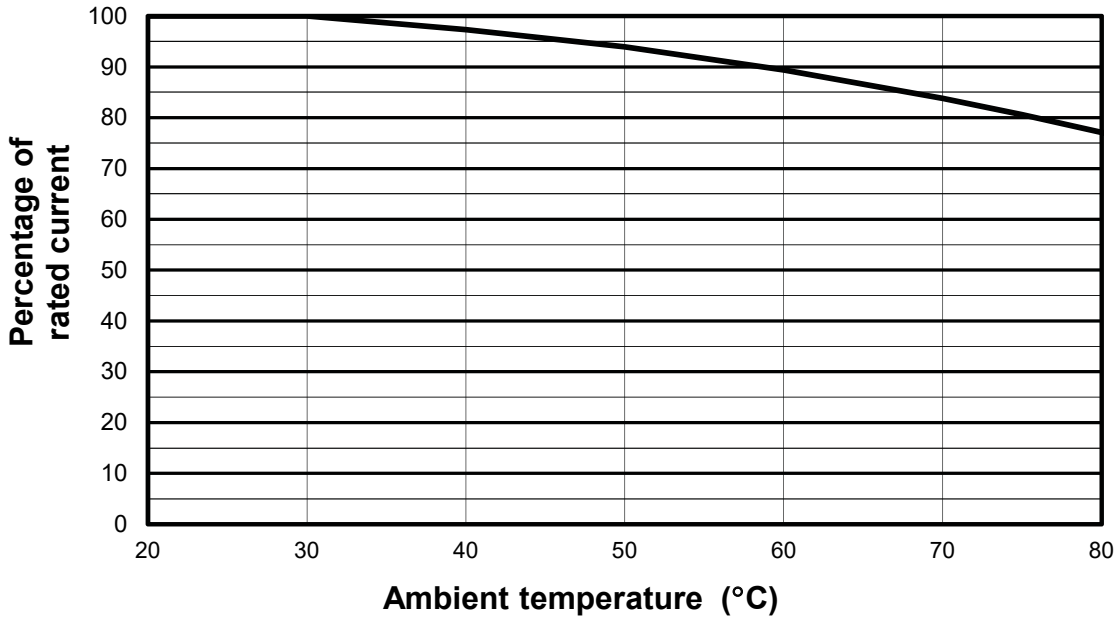
Time-current curve - NH3 fuse links



Data sheet: 135001EN

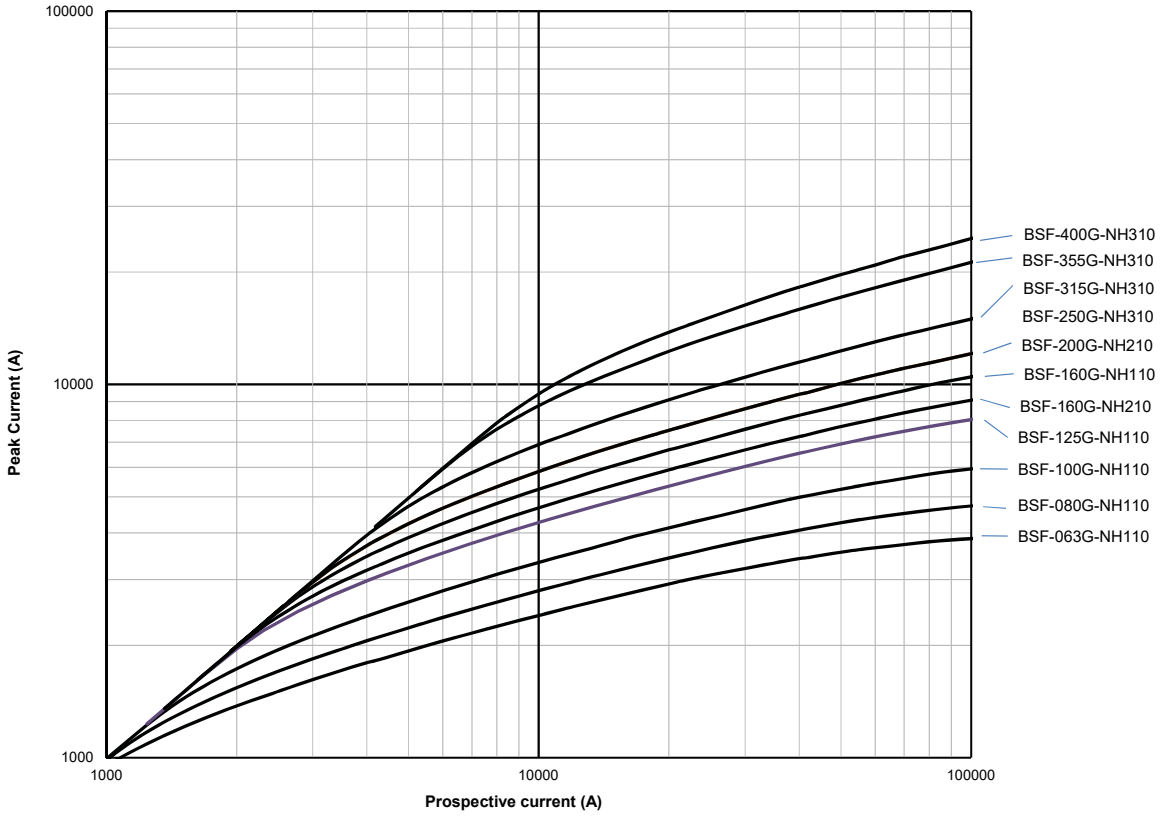
1000 V DC, 63 to 400 A, BSF-NH NH battery storage fuse links

Temperature derating curve



(The ambient temperature is that local to the fuse link)

Peak let-through curve



Data sheet: 135001EN

NH Bases, SD-D-PV

Catalog number

- SD1--D-PV
- SD2-D-PV
- SD3-D-PV

Technical data

- Rated voltage:
  - 1500 V DC (IEC)
  - 1000 V DC (UL)
- Rated current:
  - 250 A (SD1)
  - 400 A (SD2)
  - 630 A (SD3)
- Withstand: 50 kA
- Power acceptance
  - SD1 - 32W
  - SD2 - 45W
  - SD3 - 60W
- Protection level:

IEC - IP20 with shroud kit installed and shielding of any exposed terminal lugs

UL - Installation of shroud kit decreases the likelihood of incidental terminal contact. To ensure compliance to IP20 specifications per UL the installer must make additional provisions.

- Temperature range

Operating - IEC Standards -20°C to 70°C

- UL-20°C to 90°C Max*

Storage - IEC and UL: -40°C to 90°C

* Dependant upon rating of customer supplied lugs

- Derating factors for maximum current

Ambient	Derating factor
35°C	1.00
40°C	0.95
50°C	0.85

- Terminal/Lug mounting torque: 32N•m (283.2 Lb-In)
- Mounting
  - 35 mm DIN-Rail
  - Panel
- Flammability rating: UL 94V0
- Materials
  - Base: Glass filled PBT
  - Contacts: Silver plated copper
  - Hardware: Clear zinc-plated steel

Standards/Approvals

- IEC 60269-1
- UL Listed (UL file E348242)
- CSA file 47235

Packaging: MOQ: 3

Accessories

Fuse extraction handle

NH fuse link body size	Current (Amps)	Catalog Numbers	Pack Quantity
NH1-3	250- 630	FEH	1

Shroud kits

Fuse Base Series	Fuse size	Current (Amps)	Catalog Numbers	Description
SD1	NH1	250	SD12-SK	Kit includes 2 shrouds and 1 fuse cover
SD2	NH2	400	SD12-SK	
SD3	NH3	630	SD3-SK	

Phase Barrier Kit

NH fuse link body size	Current (Amps)	Catalog Numbers	Pack Quantity	Description
NH1	250	SD12-PB	1	2-Phase barriers and 2 ganging links
NH2	400	SD12-PB	1	
NH3	630	SD3-PB	1	

Phase barrier

Ganging link

Microswitch

Catalog Numbers	Pack Quantity	Ratings
170H0236	12	2 A 250 V a.c.
170H0238	12	2 A 250 V a.c.

1-pole changeover microswitch suitable for the following NH Battery storage bladed fuse links:

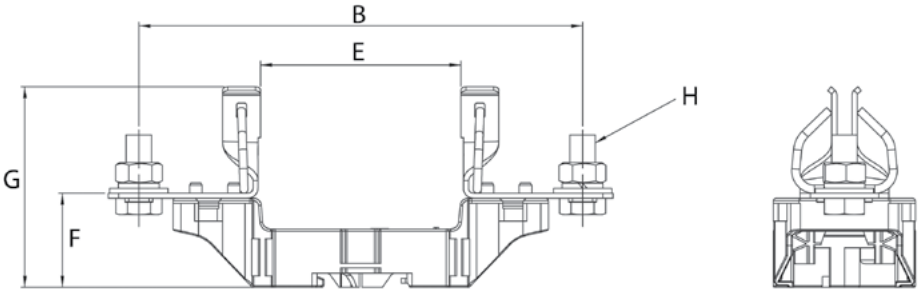
Neutral links

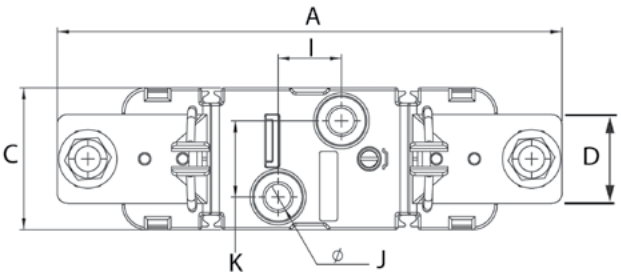
NH fuse link body size	Current (Amps)	Catalog Numbers	Pack Quantity
NH1	250	SDL-1	3
NH2	400	SDL-2	3
NH3	630	SDL-3	3

Data sheet: 720149

NH Bases, SD-D-PV

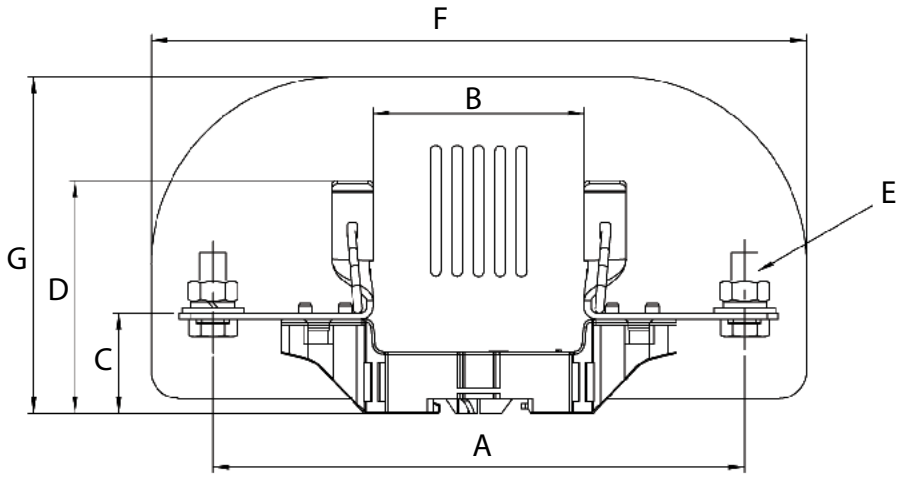
Dimensions - mm 1-pole, Sizes 1, 2 and 3





Catalog numbers	NH Fuse link body size	A	B	C	D	E	F	G	H	I	J	K
SD1	NH1	199	175	56	35	79	37	78	M10x25	25	10	30
SD2	NH2	224	199	56	35	79	37.5	86	M10x25	25	10	30
SD3	NH3	239	209	56	36	82	37.5	88	M12x30	25	10	30

Dimensions - mm With phase barriers 1-pole sizes 1, 2 and 3



Catalog numbers	NH Fuse link body size	A	B	C	D	E	F	G
SD1	NH1	175	79	37	78	M10 x 25	245	125.5
SD2	NH2	199	79	37.5	86	M10 x 25	245	125.5
SD3	NH3	209	82	37.5	88	M12 x 30	260	137.5

Data sheet: 720149

1500 V DC , 100 A to 315 A, 180D Flush end, DIN and US Style contact size 1 fuse links

Description

Eaton's Bussmann series 180D aR and aBAT size 1 square body fuse links, are specifically designed for the protection of inverters, converters and battery racks.

Technical data

- Rated voltage: 1500 V DC (IEC/UL)
- Rated current: 100 A to 315 A
- Breaking capacity:
  - 100 kA at 10 ms L/R
  - 250 kA at 3ms L/R
- Operating class: aR and aBat

Compatible microswitch

- 170H0069

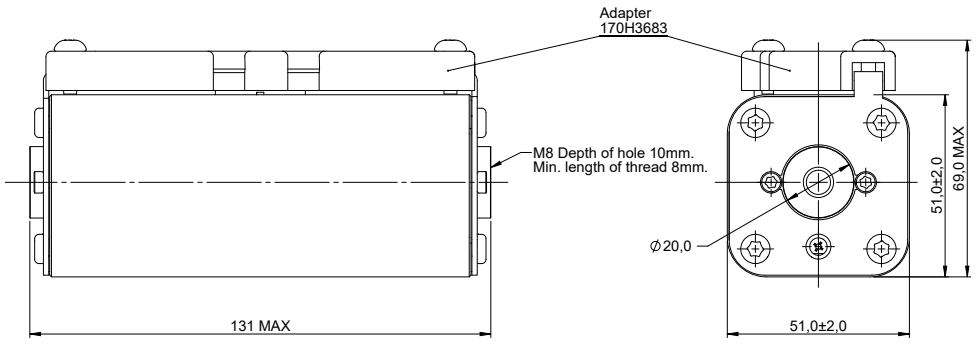
Standards / Agency information

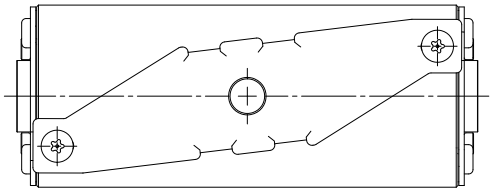
Designed and tested to IEC 60269 part 4 and 7, UL 248-13
Recognised, RoHS compliant

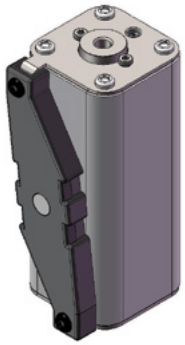
Catalog numbers

							Catalog number		
Fuse body size	**Rated voltage**	**Rated current (Amps)**	**Minimum breaking capacity (A)**	**Maximum breaking capacity**	**Pre-arcing I^2t (A^2 Sec)**	**Power loss at In (W)**	**Fuse type: 1BKN/130 (Flush end)**	**Fuse type: 1KE/160 (DIN)**	**Fuse type: 1FKE/170 (US Style)**
1	1500 V DC (IEC/UL)	100	205	100kA at 10ms L/R	815	56	180D7420	180D7426	180D7432
		125	300	250kA at 3ms L/R	1700	65	180D7421	180D7427	180D7433
		160	435		3800	70	180D7422	180D7428	180D7434
		200	605		7300	80	180D7423	180D7429	180D7435
		250	875		15,000	90	180D7424	180D7430	180D7436
		315	1245		31,000	100	180D7425	180D7431	180D7437

Dimensions (mm) - 1BKN/130 (Flush end)



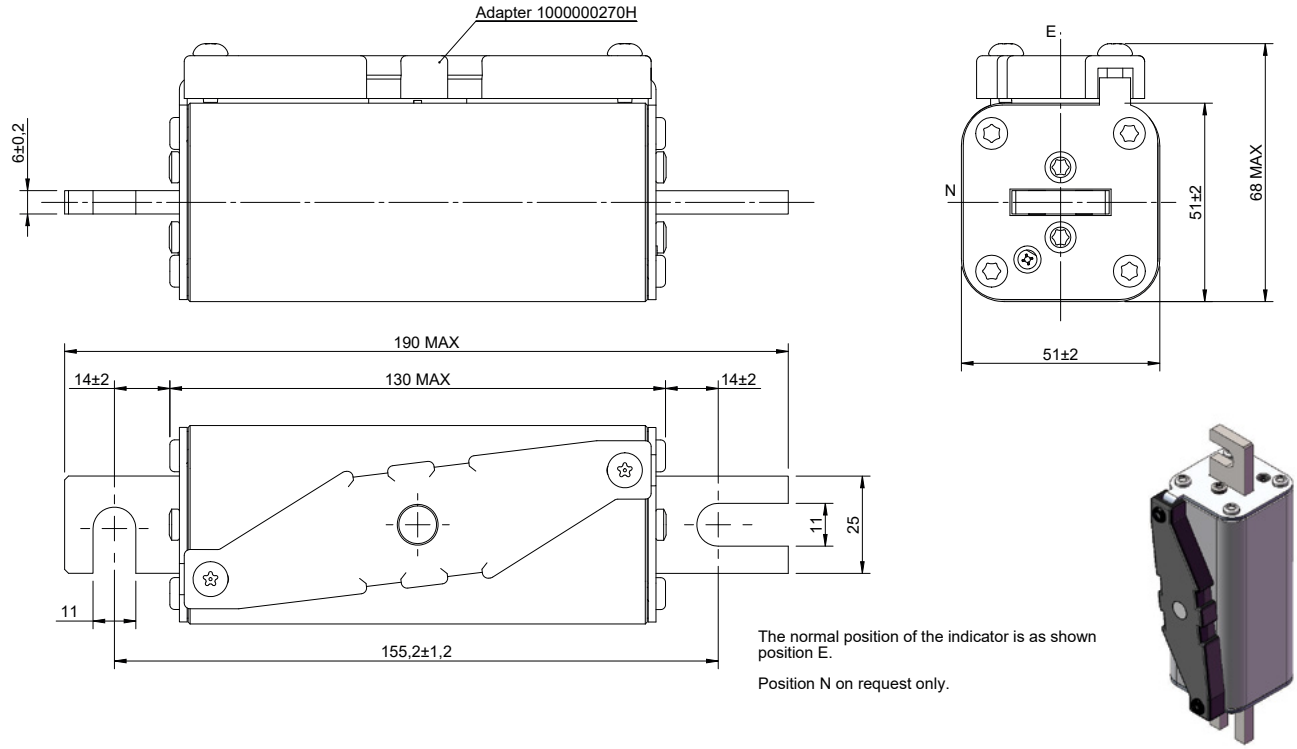




Data sheet: TD135025EN

1500 V DC , 100 A to 315 A, 180D Flush end, DIN and US Style contact size 1 fuse links

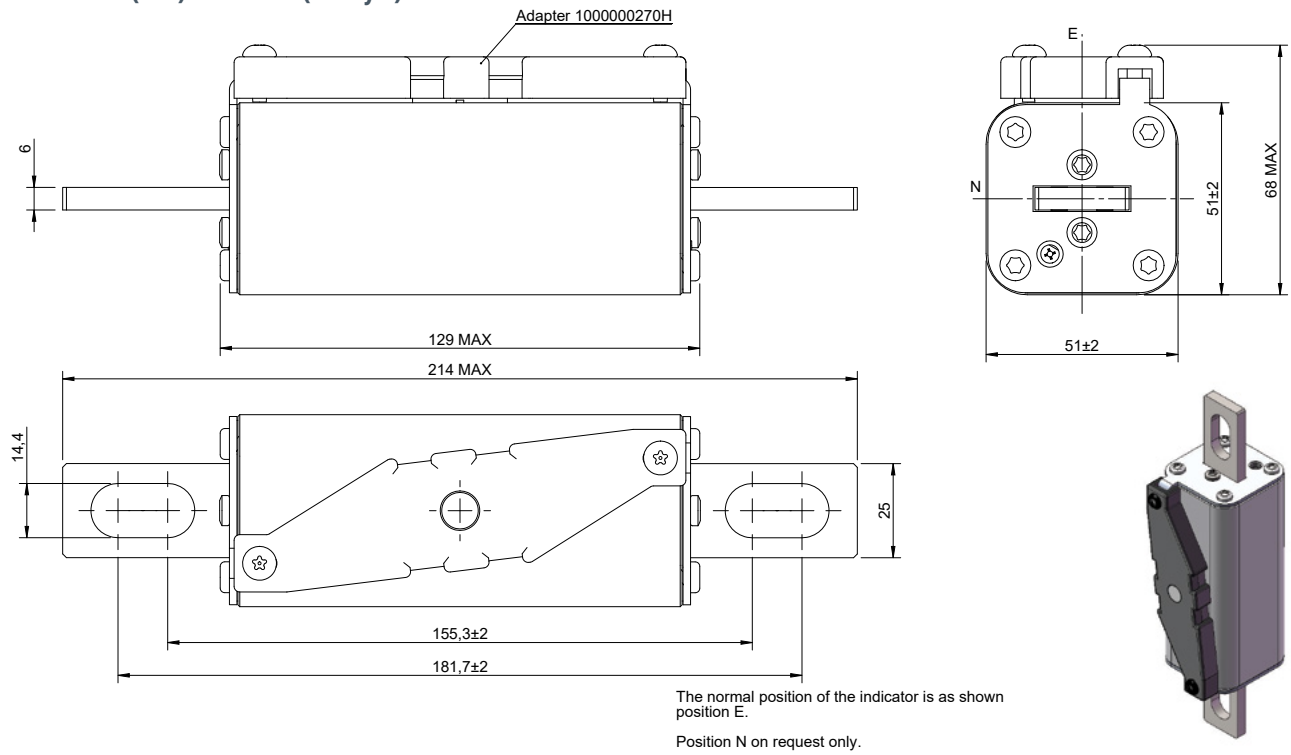
Dimensions (mm) - 1KE/160 (DIN)



The normal position of the indicator is as shown position E.

Position N on request only.

Dimensions (mm)- 1FKE/170 (US Style)



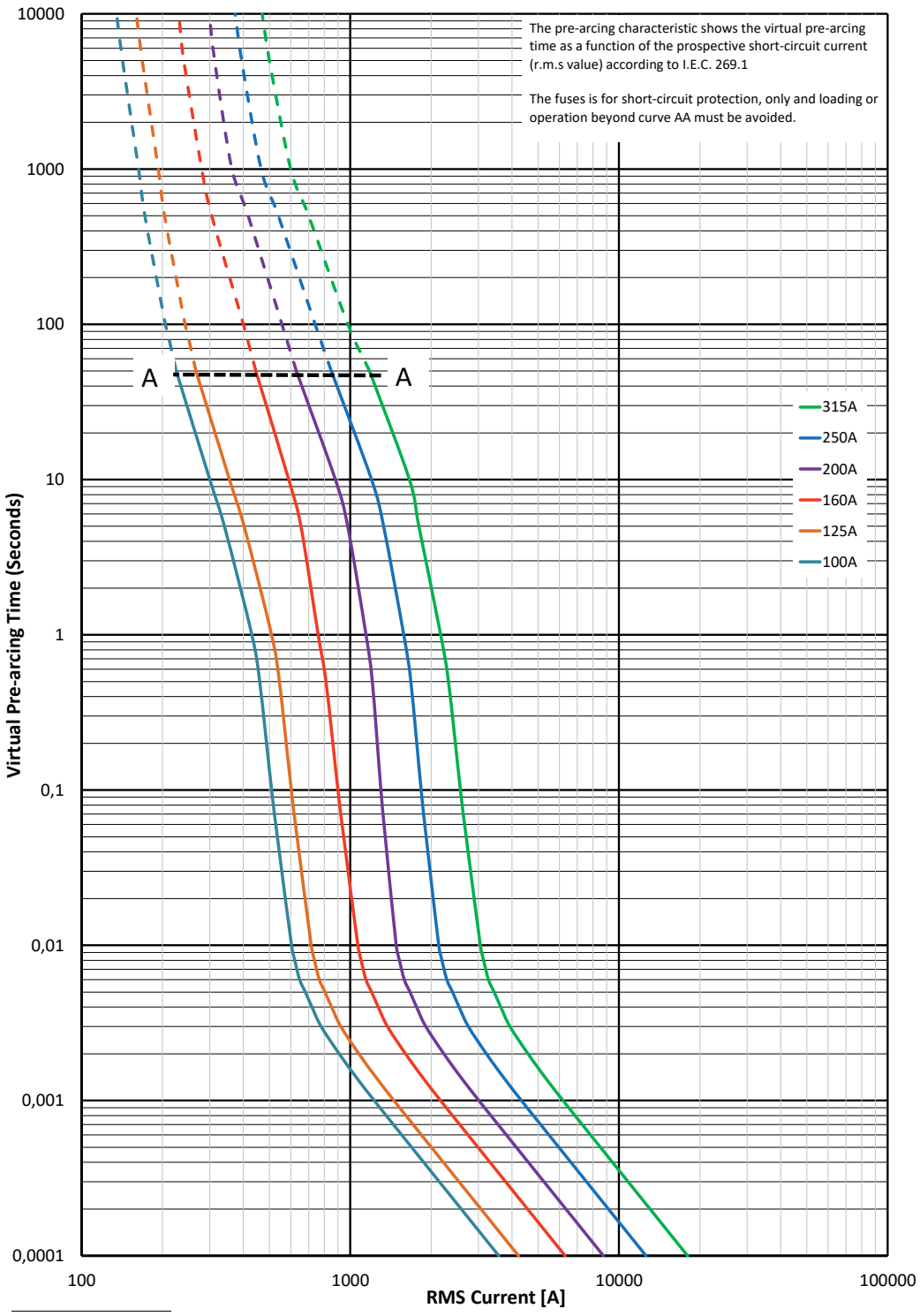
The normal position of the indicator is as shown position E.

Position N on request only.

Data sheet: TD135025EN

1500 V DC , 100 A to 315 A, 180D Flush end, DIN and US Style contact size 1 fuse links

Time-current curve

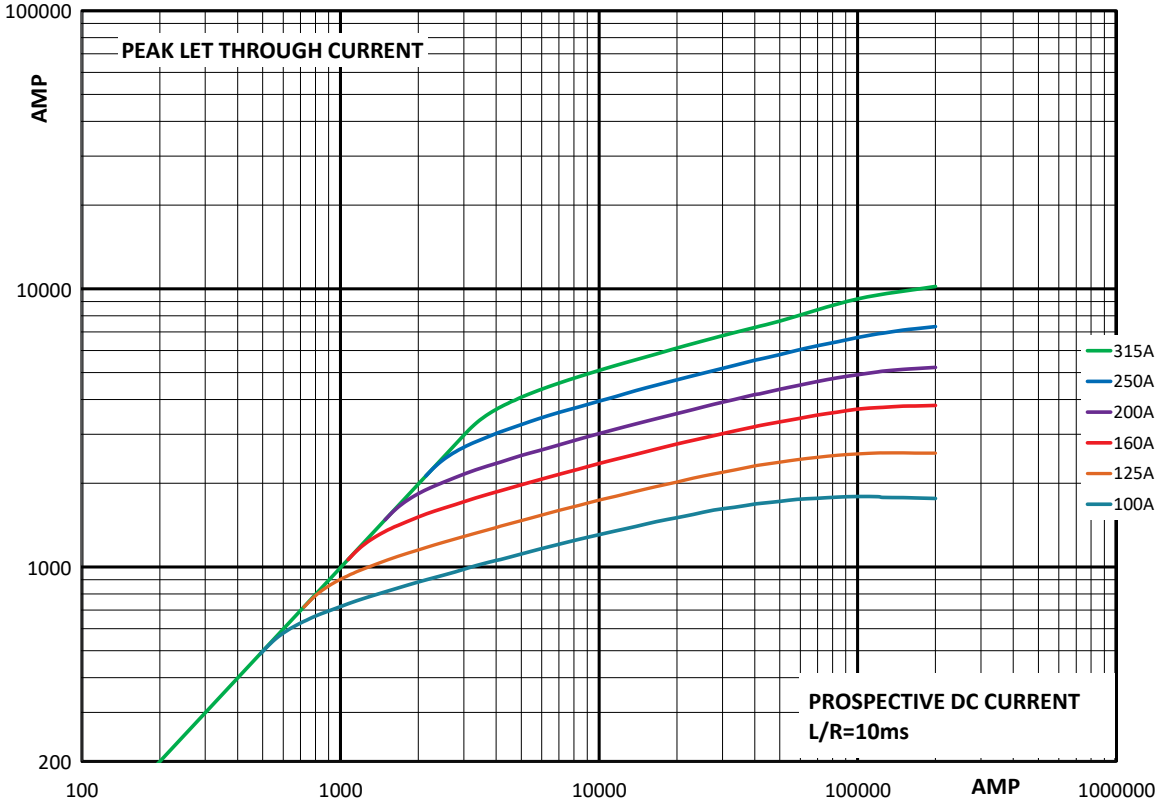


$K_b = \frac{1}{\quad}$

Data sheet: TD135025EN

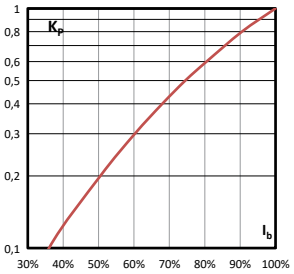
1500 V DC , 100 A to 315 A, 180D Flush end, DIN and US Style contact size 1 fuse links

Peak let-through curve



Watts losses

Watts loss at rated current is given in the electrical characteristics. The curve allows the calculation of the watts losses at load currents lower than the rated current. The correction factor, K_p , is given as a function of the RMS load current, I_b, in percent of the rated current.



Data sheet: TD135025EN

1500 V DC, 100 A to 450 A, ESS2 and ESS2-NI Size 2 fuse links

Description

Eaton's Bussmann series ESS2 and ESS2-NI aR size 2 square body fuse links, are specifically designed for the protection of inverters, converters and battery racks.

Technical data

- Rated voltage: 1500 V DC (IEC/UL)
- Rated current: 100 A to 450 A
- Breaking capacity:
  - 150 kA at 10ms L/R
  - 250 kA at 4ms L/R
- Operating class: aR and aBat

Standards / Agency information

Designed and tested to IEC 60269 part 4 and part 7, UL 248-13
Recognised, RoHS compliant

Catalog numbers - ESS

							Catalog number				
Fuse body size	**Rated voltage**	**Rated current (Amps)**	**Breaking capacity**	**Minimum breaking current (Amps)**	**Pre-arcing I^2t (A^2 Sec)**	**Power loss at In (W)**	**Fuse type: 2L (Dual slotted)**	**Fuse type: 2H (US Style)**	**Fuse type: 2B (Flush end)**	**Fuse type: 2J (DIN 43653)**	**Fuse type: 2J-L (DIN 43653)**
2	1500 V DC (IEC/UL)	100	150 kA at 10ms L/R 250 kA at 4ms L/R	500	1000	50	ESS2L-100	ESS2H-100	ESS2B-100	ESS2J-100	ESS2J-100L
		125		625	3000	60	ESS2L-125	ESS2H-125	ESS2B-125	ESS2J-125	ESS2J-125L
		160		800	5300	74	ESS2L-160	ESS2H-160	ESS2B-160	ESS2J-160	ESS2J-160L
		200		1000	10,000	87	ESS2L-200	ESS2H-200	ESS2B-200	ESS2J-200	ESS2J-200L
		250		1250	19,000	94	ESS2L-250	ESS2H-250	ESS2B-250	ESS2J-250	ESS2J-250L
		315		1575	38,000	113	ESS2L-315	ESS2H-315	ESS2B-315	ESS2J-315	ESS2J-315L
		350		1750	53,000	117	ESS2L-350	ESS2H-350	ESS2B-350	ESS2J-350	ESS2J-350L
		400		2000	79,000	129	ESS2L-400	ESS2H-400	ESS2B-400	ESS2J-400	ESS2J-400L
		450		2250	111,000	139	ESS2L-450	ESS2H-450	ESS2B-450	ESS2J-450	ESS2J-450L

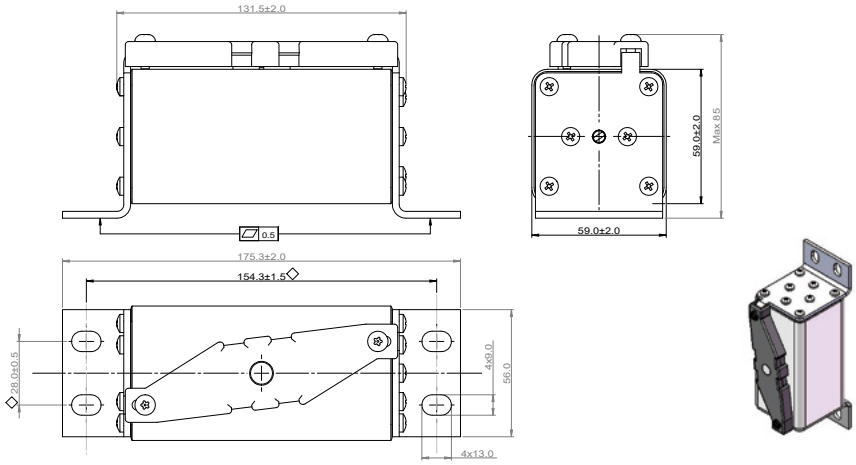
Catalog numbers - ESS-NI

							Catalog number				
Fuse body size	**Rated voltage**	**Rated current (Amps)**	**Breaking capacity**	**Minimum breaking current (Amps)**	**Pre-arcing I^2t (A^2 Sec)**	**Power loss at In (W)**	**Fuse type: 2L (Dual slotted)**	**Fuse type: 2H (US Style)**	**Fuse type: 2B (Flush end)**	**Fuse type: 2J (DIN 43653)**	**Fuse type: 2J-L (DIN 43653)**
2	1500 V DC (IEC/UL)	100	150 kA at 10ms L/R 250 kA at 4ms L/R	500	1000	50	ESS2L-100-NI	ESS2H-100-NI	ESS2B-100-NI	ESS2J-100-NI	ESS2J-100L-NI
		125		625	3000	60	ESS2L-125-NI	ESS2H-125-NI	ESS2B-125-NI	ESS2J-125-NI	ESS2J-125L-NI
		160		800	5300	74	ESS2L-160-NI	ESS2H-160-NI	ESS2B-160-NI	ESS2J-160-NI	ESS2J-160L-NI
		200		1000	10,000	87	ESS2L-200-NI	ESS2H-200-NI	ESS2B-200-NI	ESS2J-200-NI	ESS2J-200L-NI
		250		1250	19,000	94	ESS2L-250-NI	ESS2H-250-NI	ESS2B-250-NI	ESS2J-250-NI	ESS2J-250L-NI
		315		1575	38,000	113	ESS2L-315-NI	ESS2H-315-NI	ESS2B-315-NI	ESS2J-315-NI	ESS2J-315L-NI
		350		1750	53,000	117	ESS2L-350-NI	ESS2H-350-NI	ESS2B-350-NI	ESS2J-350-NI	ESS2J-350L-NI
		400		2000	79,000	129	ESS2L-400-NI	ESS2H-400-NI	ESS2B-400-NI	ESS2J-400-NI	ESS2J-400L-NI
		450		2250	111,000	139	ESS2L-450-NI	ESS2H-450-NI	ESS2B-450-NI	ESS2J-450-NI	ESS2J-450L-NI

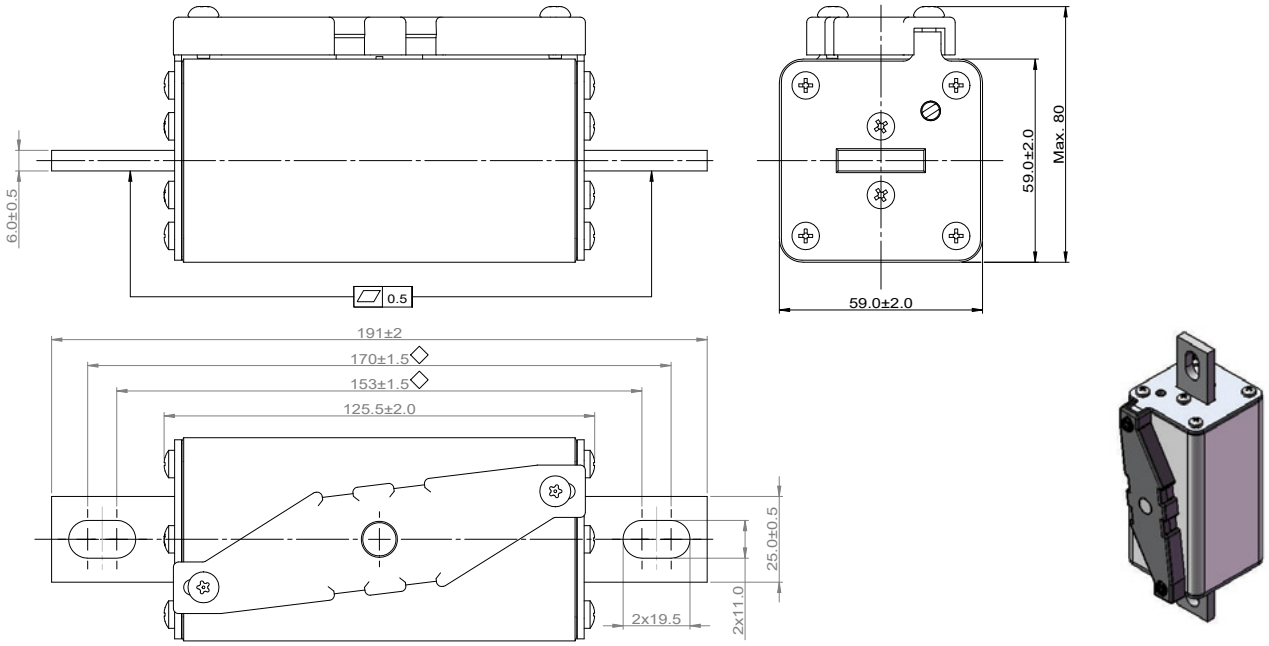
Data sheet: TD135030EN

1500 V DC, 100 A to 450 A, ESS2 and ESS2-NI Size 2 fuse links

Dimensions (mm) - ESS 2L (Dual slotted)



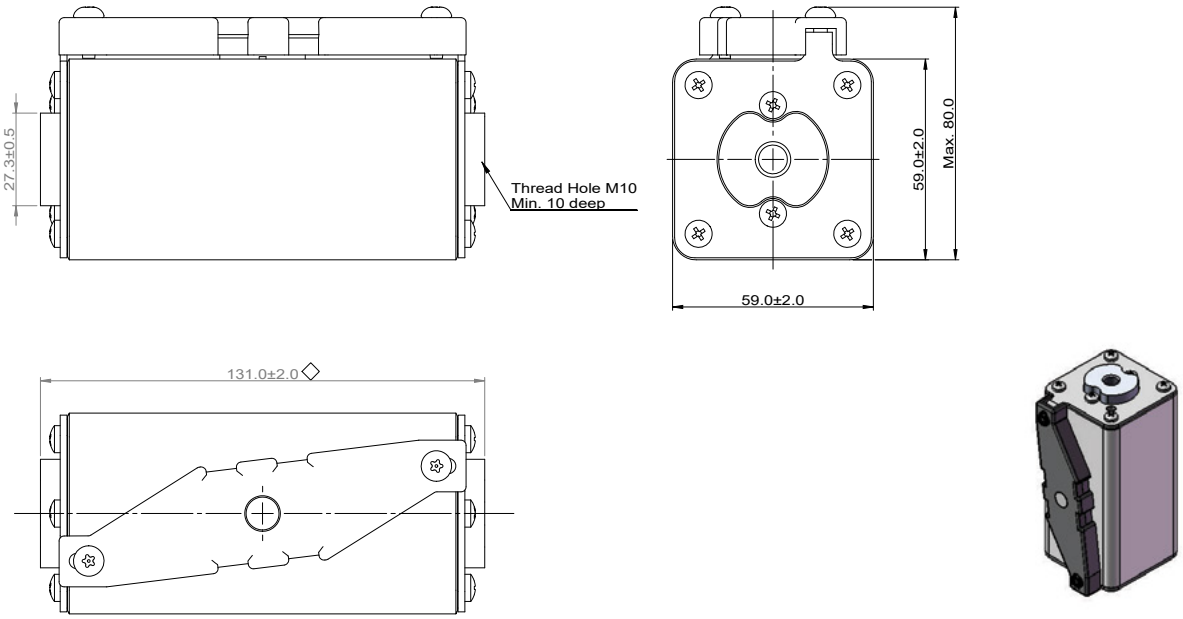
Dimensions (mm) - ESS 2H (US Style)



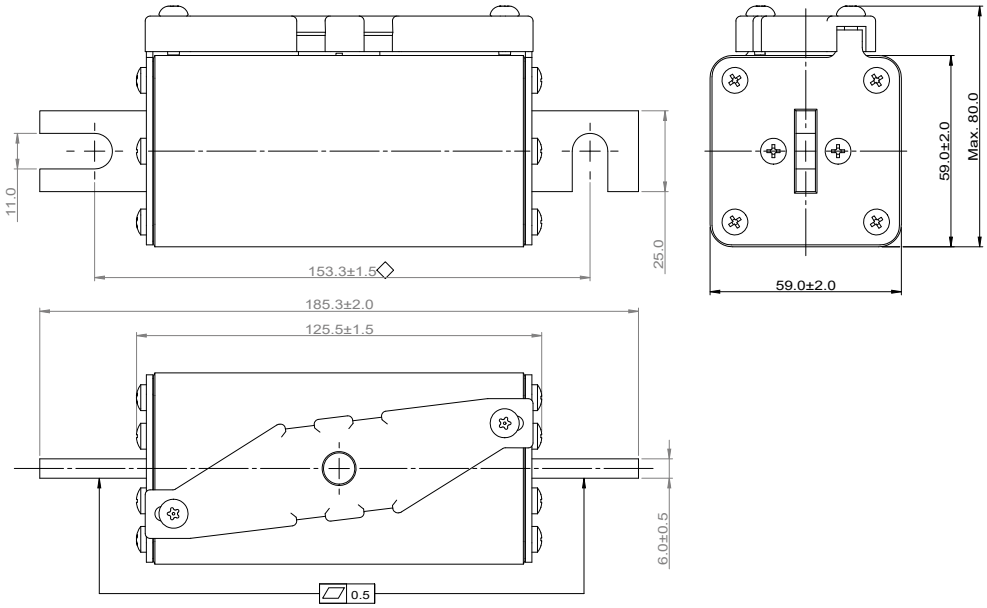
Data sheet: TD135030EN

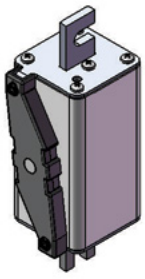
1500 V DC, 100 A to 450 A, ESS2 and ESS2-NI Size 2 fuse links

Dimensions (mm) - ESS 2B (Flush end)



Dimensions (mm) - ESS 2J (DIN 43653)

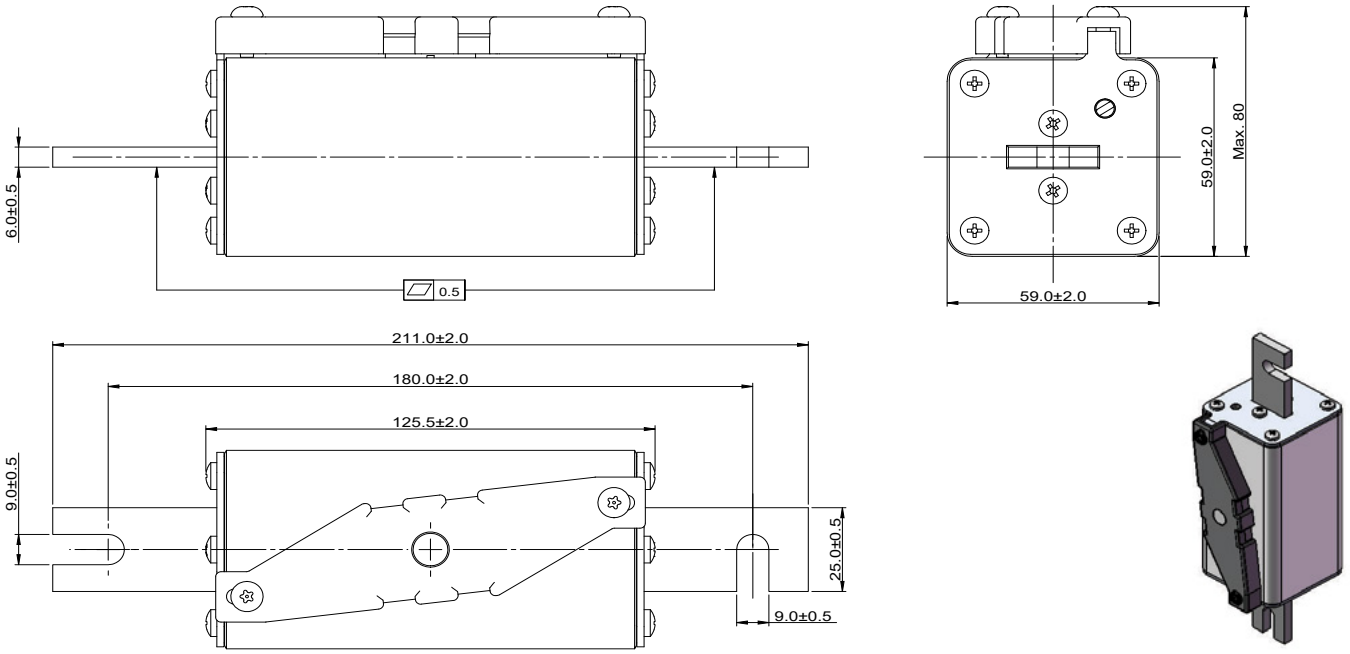




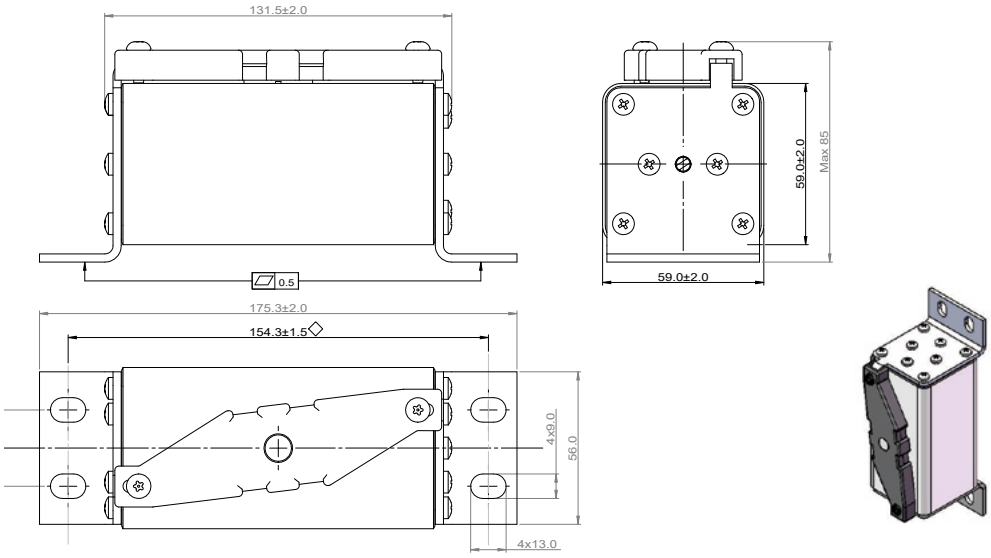
Data sheet: TD135030EN

1500 V DC, 100 A to 450 A, ESS2 and ESS2-NI Size 2 fuse links

Dimensions (mm) - ESS 2J-L (DIN 43653)



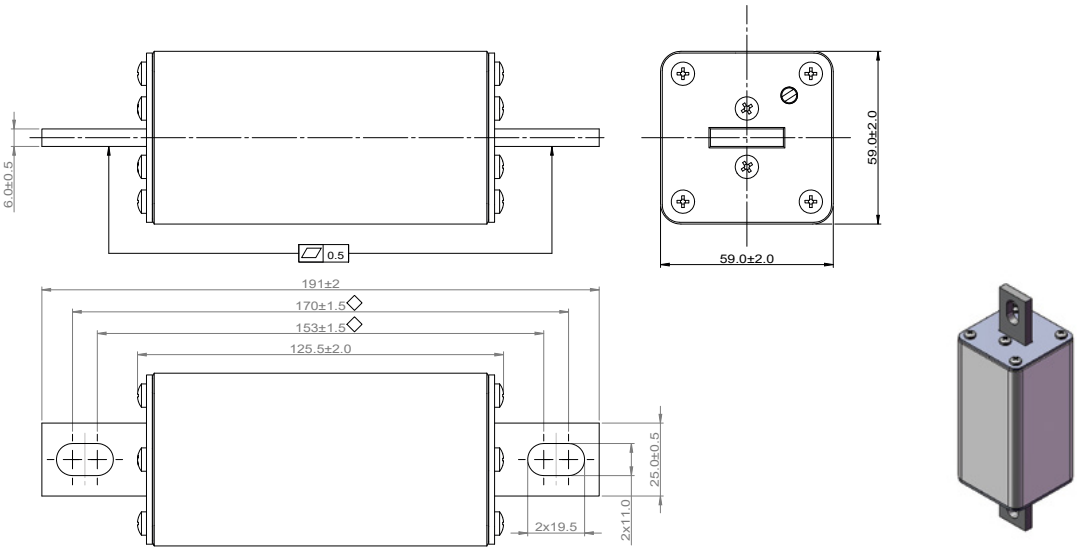
Dimensions (mm) - ESS-NI 2L (Dual slotted)



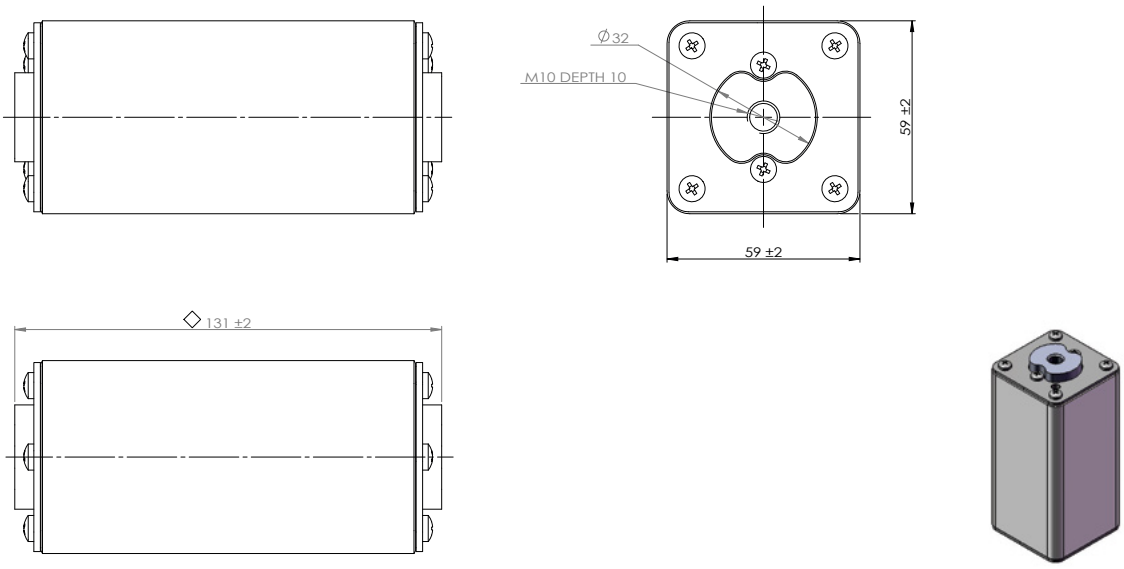
Data sheet: TD135030EN

1500 V DC, 100 A to 450 A, ESS2 and ESS2-NI Size 2 fuse links

Dimensions (mm) - ESS-NI 2H (US Style)



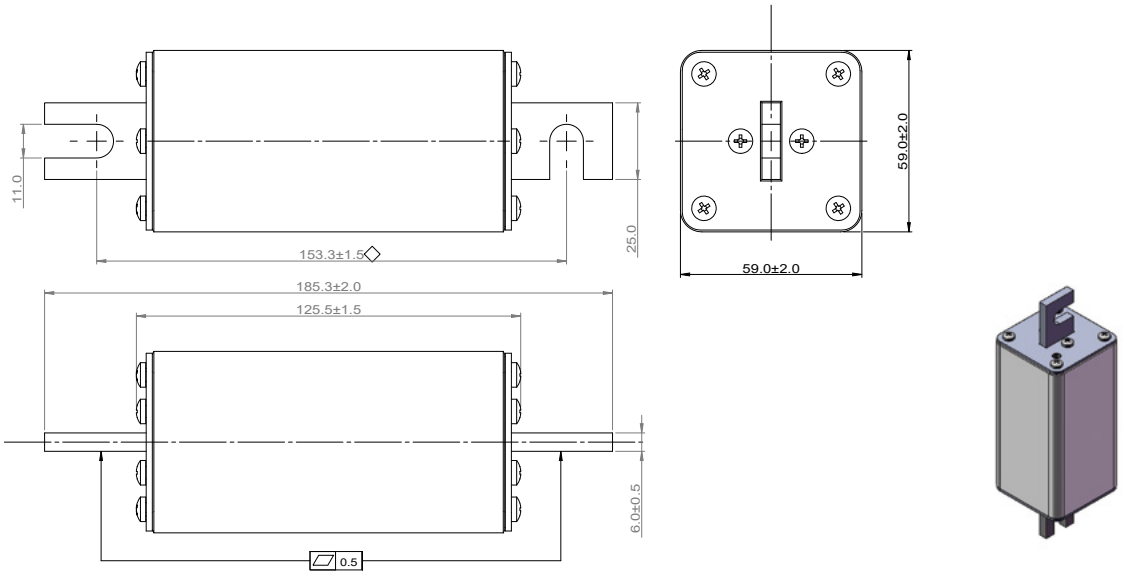
Dimensions (mm) - ESS-NI 2B (Flush end)



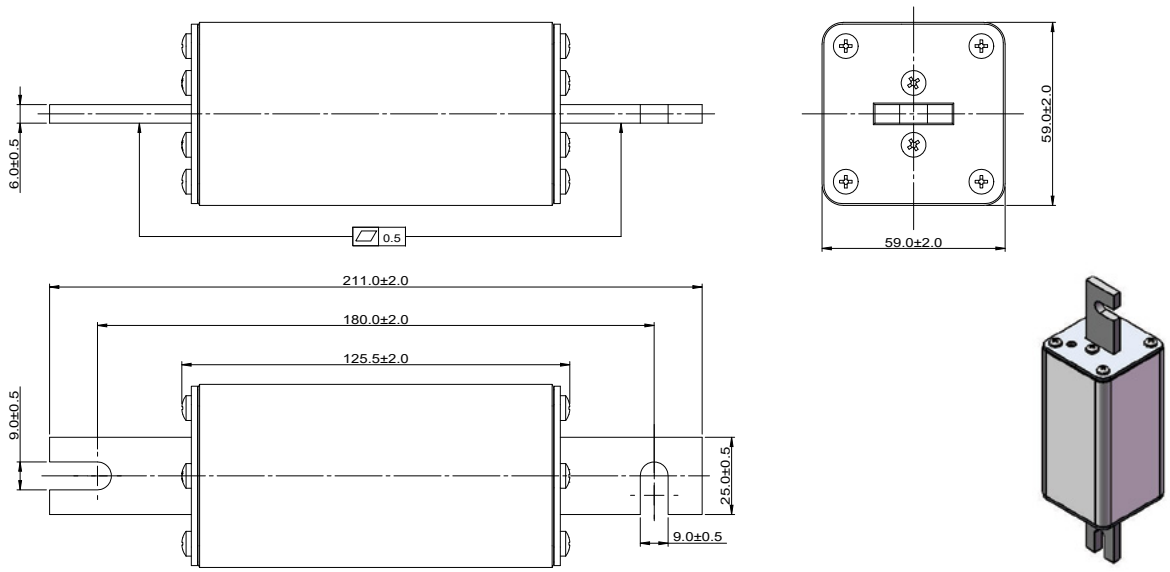
Data sheet: TD135030EN

1500 V DC, 100 A to 450 A, ESS2 and ESS2-NI Size 2 fuse links

Dimensions (mm) - ESS-NI 2J (DIN 43653)



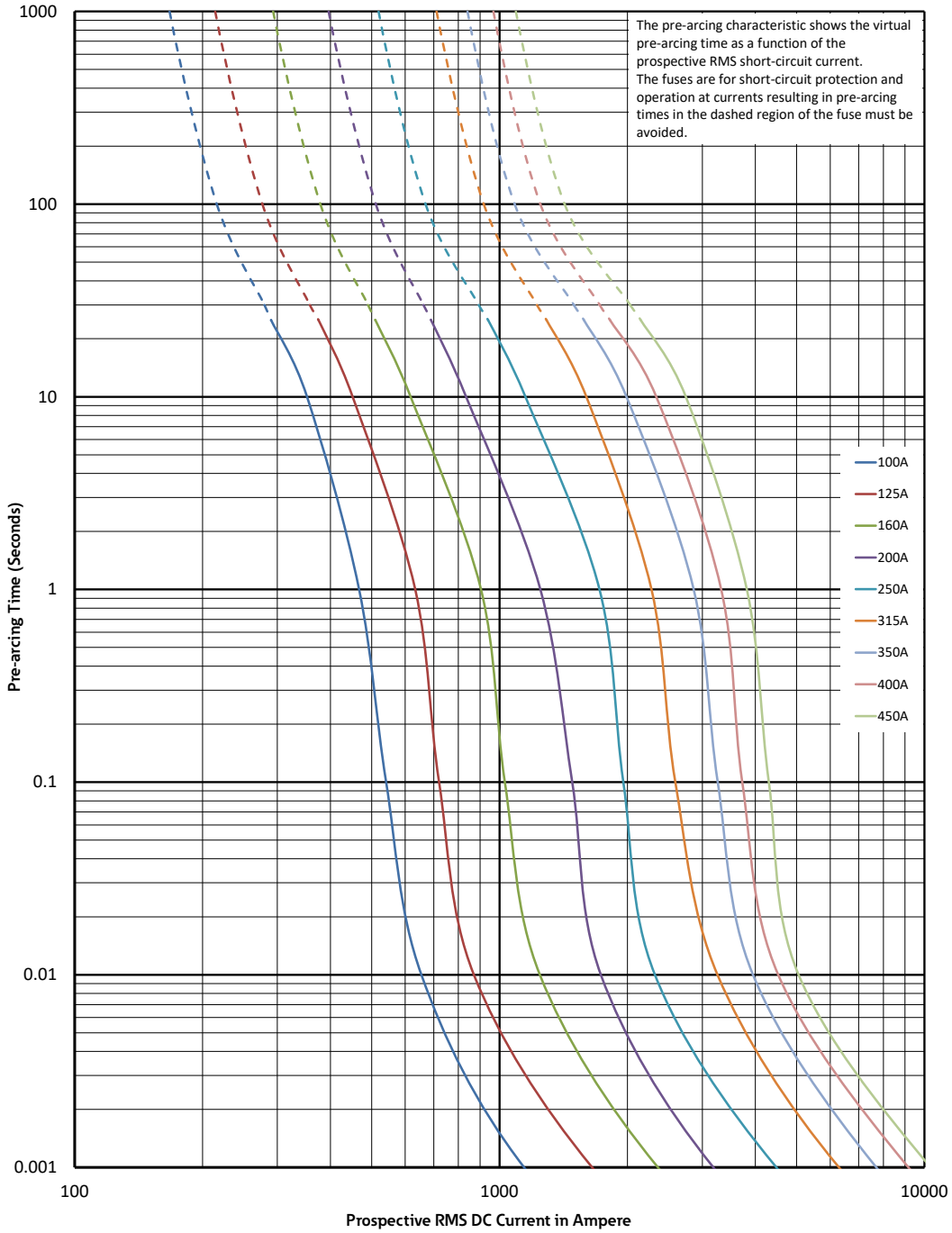
Dimensions (mm) - ESS-NI 2J-L (DIN 43653)



Data sheet: TD135030EN

1500 V DC, 100 A to 450 A, ESS2 and ESS2-NI Size 2 fuse links

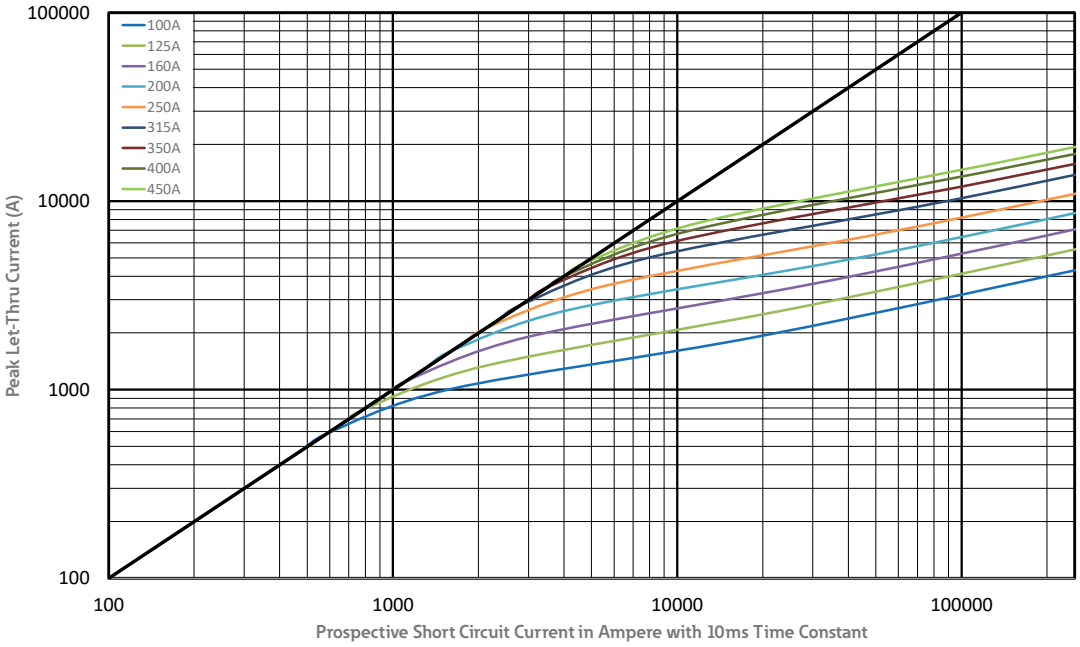
Time-current curve



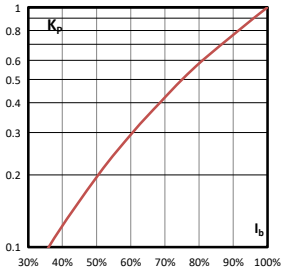
Data sheet: TD135030EN

1500 V DC, 100 A to 450 A, ESS2 and ESS2-NI Size 2 fuse links

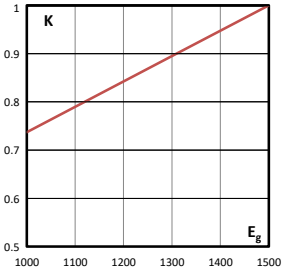
Peak let-through



Watts losses
Watts loss at rated current is given in the electrical characteristics. The curve allows the calculation of the watts losses at load currents lower than the rated current. The correction factor, K_p, is given as a function of the RMS load current, I_b, in percent of the rated current.



Total clearing I^2t
The total clearing I^2t at rated voltage and tested DC time constant are given in electrical characteristics. For other voltages the clearing I^2t is found by multiplying by correction factor, K, given as a function of applied working voltages, E_g.



Data sheet: TD135030EN

1500 V DC, 125 A to 500 A, 180D Flush end, DIN and US Style contact size 2 fuse links

Description

Eaton's Bussmann series 180D aR and aBAT size 2 square body fuse links, are specifically designed for the protection of inverters, converters and battery racks.

Technical data

- Rated voltage: 1500 V DC (IEC/UL)
- Rated current: 125 A to 500 A
- Breaking capacity:
  - 100 kA at 10 ms L/R
  - 250 kA at 3ms L/R
- Operating class: aR and aBat

Compatible microswitch

- Flush end: 170H0069
- DIN and US Style tag: 170H0235

Standards / Agency information

Designed and tested to IEC 60269 part 4 and 7, UL 248-13
Recognised, RoHS compliant

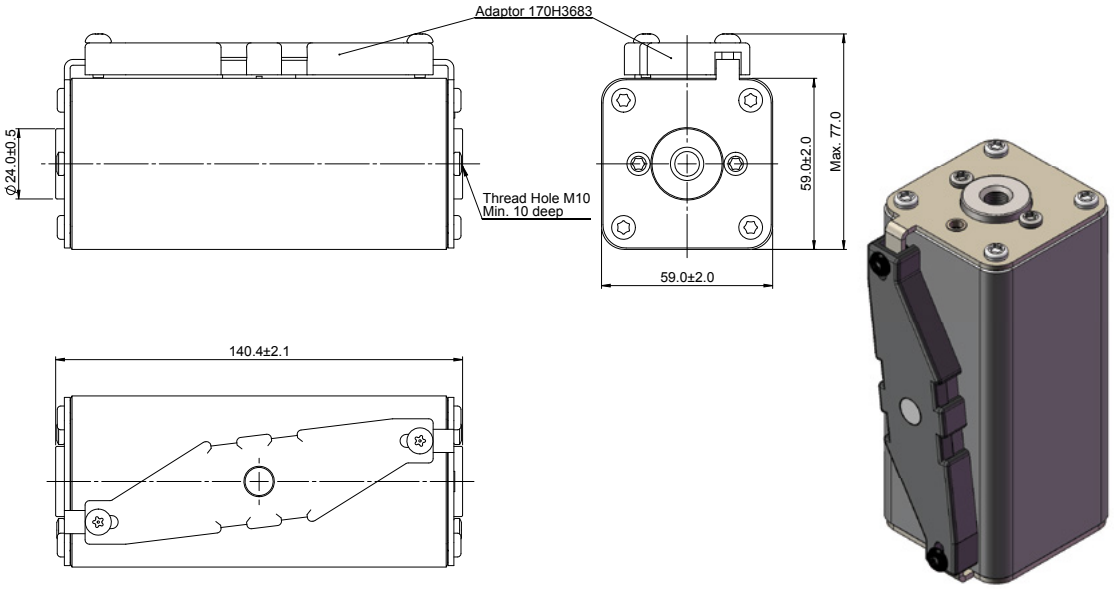
Catalog numbers

							Catalog number		
Fuse body size	**Rated voltage**	**Rated current (Amps)**	**Breaking capacity**	**Minimum breaking current**	**Pre-arcing I^2t (A^2 Sec)**	**Power loss at In (W)**	**Fuse type: 2BKN/140**	**Fuse type: 2TN/170**	**Fuse type: 2FTN/180**
2	1500 V DC (IEC/UL)	125	100 kA at 10ms L/R 250 kA at 3ms L/R	400	1500	71	180D5699	180D5849	180D5949
		160		600	3500	77	180D5700	180D5850	180D5950
		200		800	6000	90	180D5701	180D5851	180D5951
		250		1250	24,000	56	180D5702	180D5852	180D5952
		315		1750	48,500	63	180D5703	180D5853	180D5953
		350		2050	67,000	70	180D5704	180D5854	180D5954
		400		2450	94,500	79	180D5705	180D5855	180D5955
		450		3200	138,000	83	180D5706	180D5856	180D5956
		500		3430	190,000	88	180D5707	180D5857	180D5957

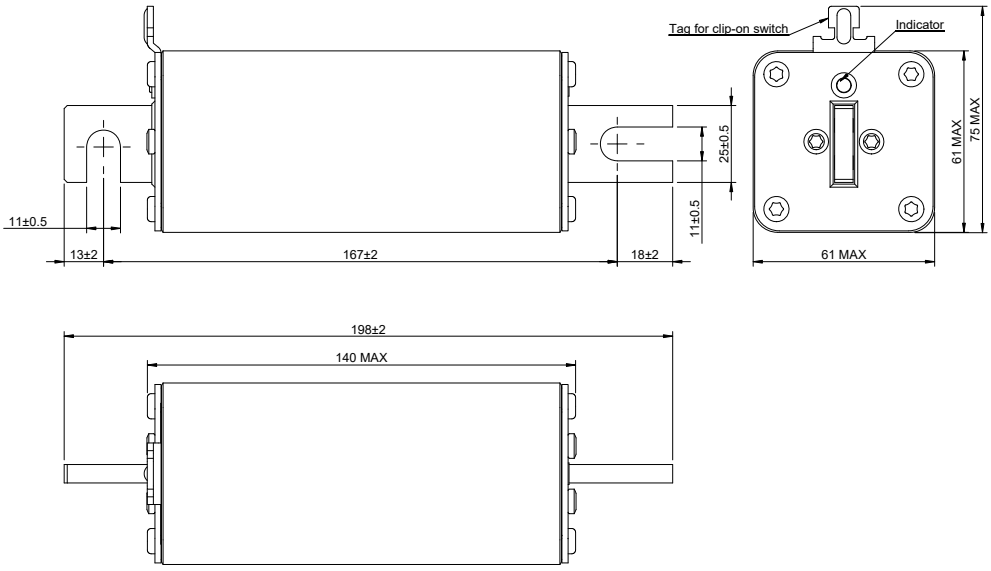
Data sheet: TD135026EN

1500 V DC, 125 A to 500 A, 180D Flush end, DIN and US Style contact size 2 fuse links

Dimensions (mm) - 2BKN/140 (Flush end)



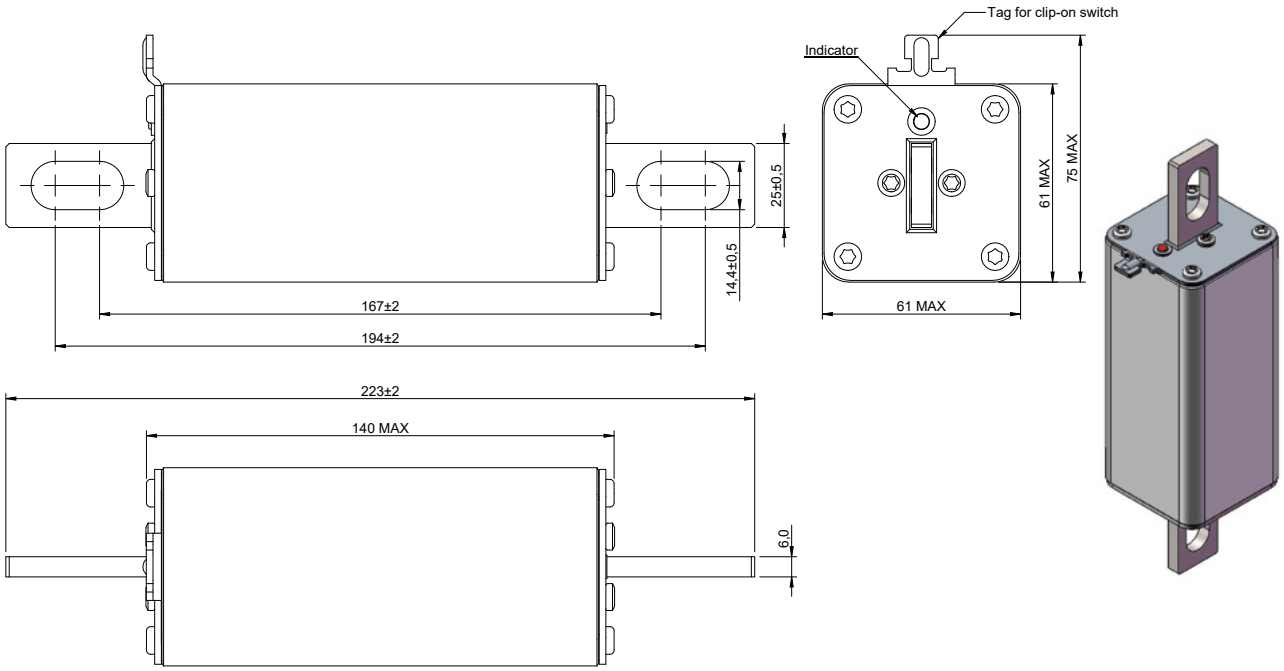
Dimensions (mm) - 2TN/170 (DIN)



Data sheet: TD135026EN

1500 V DC, 125 A to 500 A, 180D Flush end, DIN and US Style contact size 2 fuse links

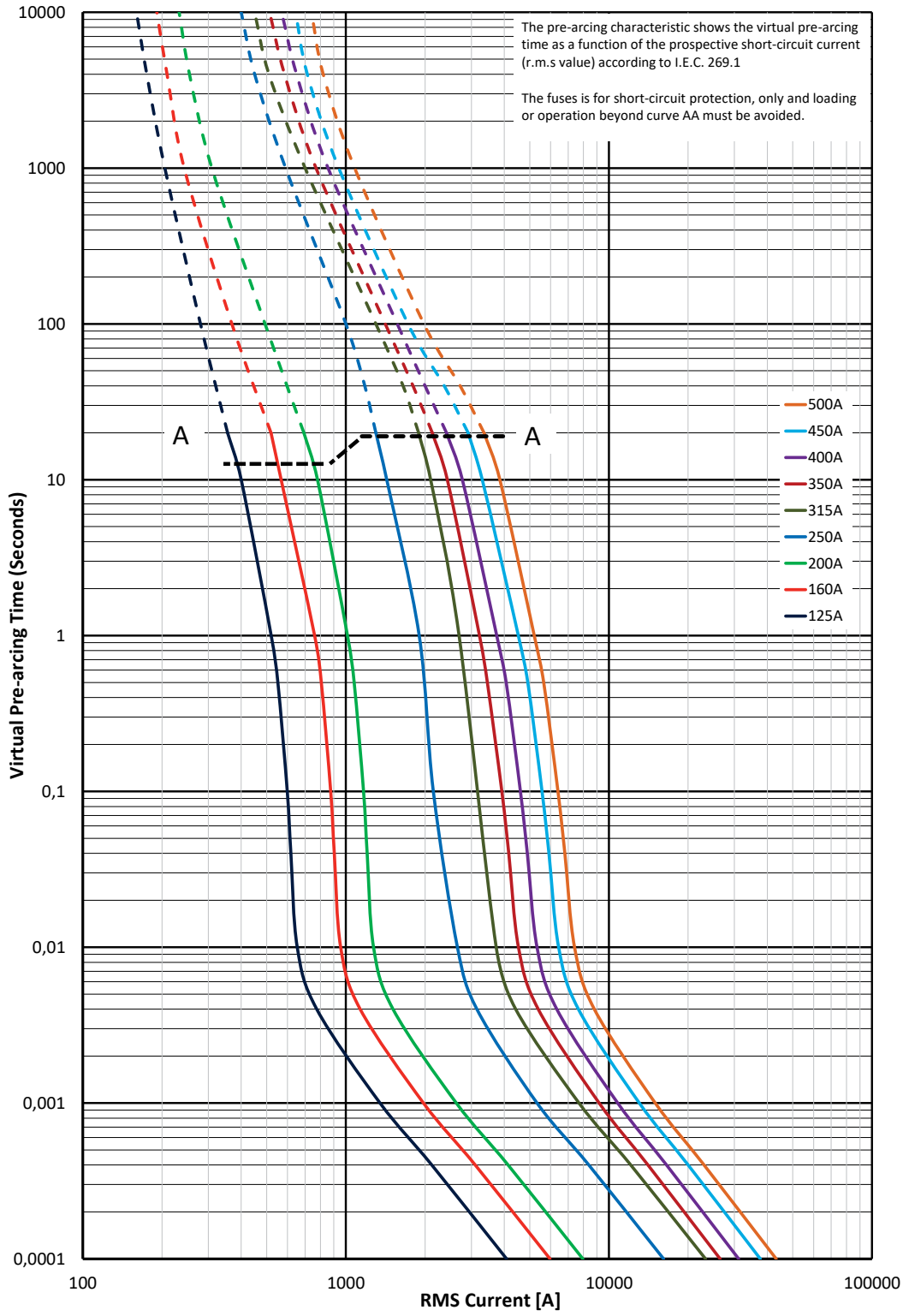
Dimensions (mm) - 2FTN/180 (US Style)



Data sheet: TD135026EN

1500 V DC, 125 A to 500 A, 180D Flush end, DIN and US Style contact size 2 fuse links

Time-current curve

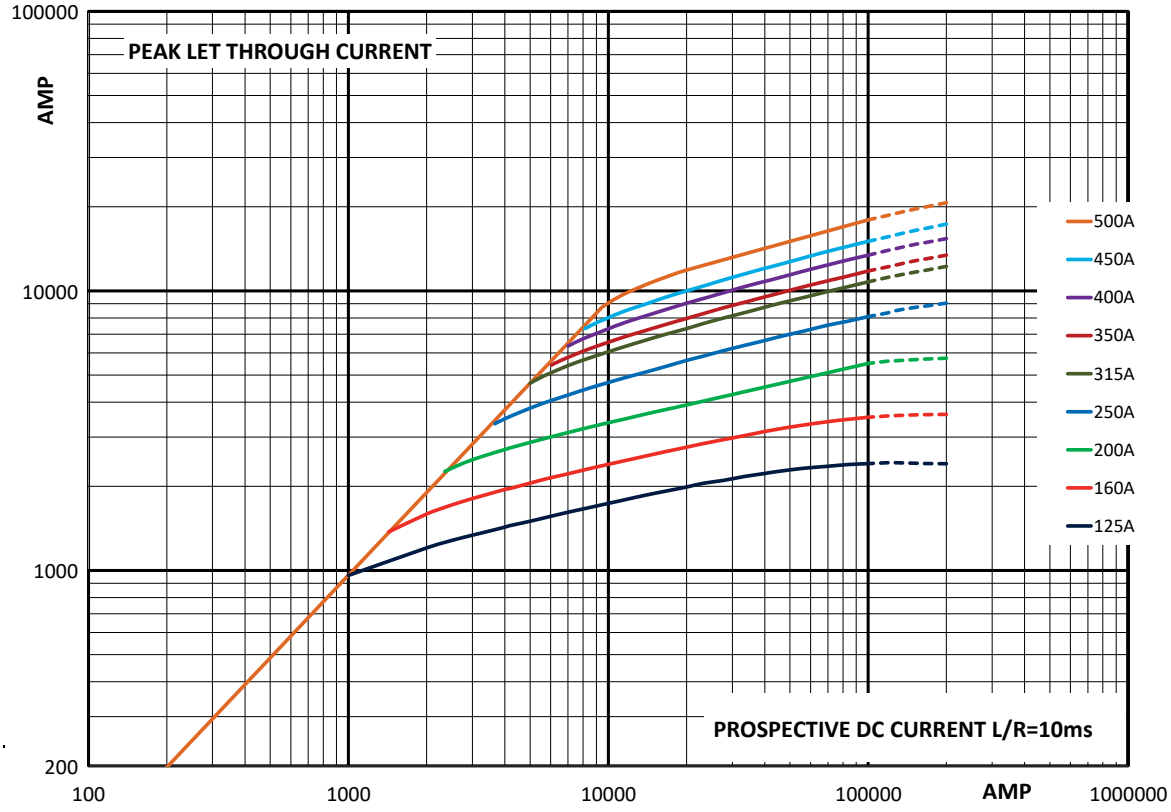


K_b = 1

Data sheet: TD135026EN

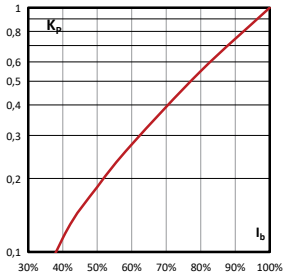
1500 V DC, 125 A to 500 A, 180D Flush end, DIN and US Style contact size 2 fuse links

Peak let-through curve



Watts losses

Watts loss at rated current is given in the electrical characteristics. The curve allows the calculation of the watts losses at load currents lower than the rated current. The correction factor, K_p , is given as a function of the RMS load current, I_b, in percent of the rated current.



Data sheet: TD135026EN

1500 V DC, 100 A to 630 A, ESS3 and ESS3-NI size 3 fuse links

Description

Eaton's Bussmann series ESS3 and ESS3-NI aR size 3 square body fuse links, are specifically designed for the protection of inverters, converters and battery racks.

Technical data

- Rated voltage: 1500 V DC (IEC/UL)
- Rated current: 100 A to 630 A
- Breaking capacity: 250 kA at 4ms L/R
- Operating class: aR and aBat

Standards / Agency information

Designed and tested to IEC 60269 part 4 and part 7, UL 248-13
Recognised, RoHS compliant

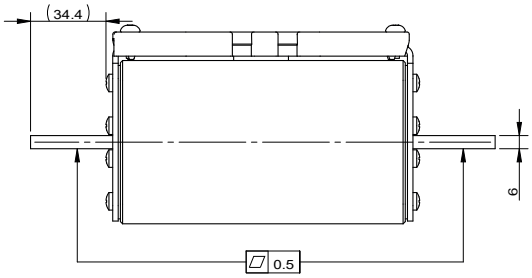
Catalog numbers

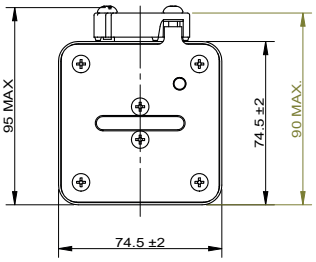
Fuse body size	Rated voltage	Rated current (Amps)	Breaking capacity (kA at 4ms)	Minimum breaking current (A)	Pre-arcing I^2t (A^2 Sec)	Power loss at In (W)	Catalog number	
3	1500 V DC (IEC/UL)	100	250	500	1200	55	ESS3-100	ESS3-100-NI
		125	250	625	2200	70	ESS3-125	ESS3-125-NI
		160	250	800	3900	85	ESS3-160	ESS3-160-NI
		200	250	1000	6600	90	ESS3-200	ESS3-200-NI
		250	250	1250	13,600	115	ESS3-250	ESS3-250-NI
		315	250	1575	24,100	120	ESS3-315	ESS3-315-NI
		350	250	1750	34,700	125	ESS3-350	ESS3-350-NI
		400	250	2000	60,000	135	ESS3-400	ESS3-400-NI
		450	250	2250	78,000	150	ESS3-450	ESS3-450-NI
		500	250	2500	96,000	170	ESS3-500	ESS3-500-NI
		550	250	2750	112,000	185	ESS3-550	ESS3-550-NI
		630	250	3150	172,000	198	ESS3-630	ESS3-630-NI

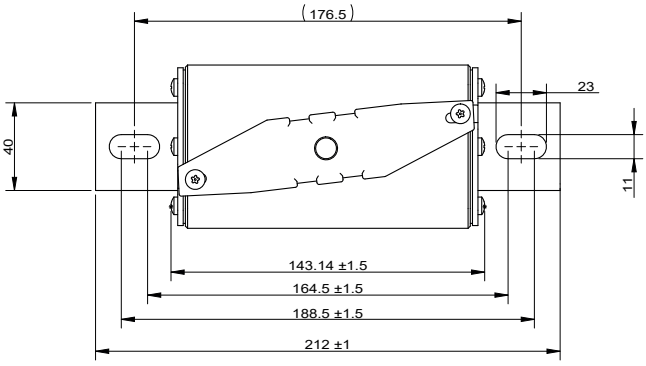
Data sheet: TD135031EN

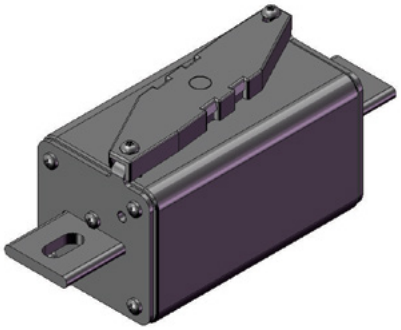
1500 V DC, 100 A to 630 A, ESS3 and ESS3-NI size 3 fuse links

Dimensions (mm) - ESS3

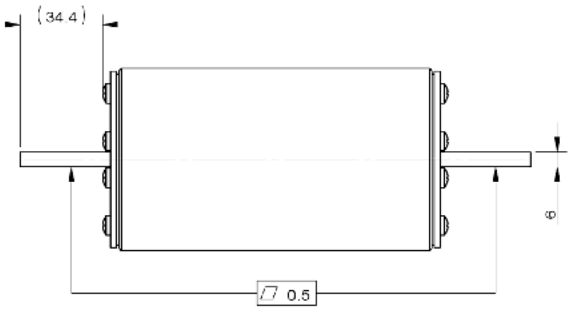


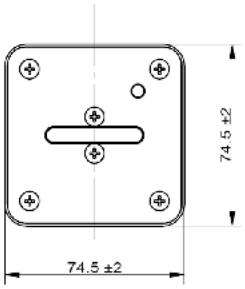


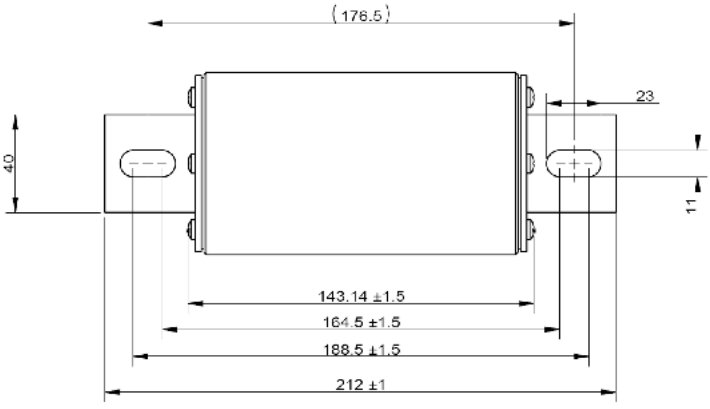


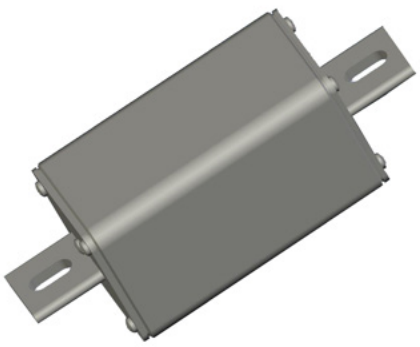


Dimensions (mm) - ESS3-NI





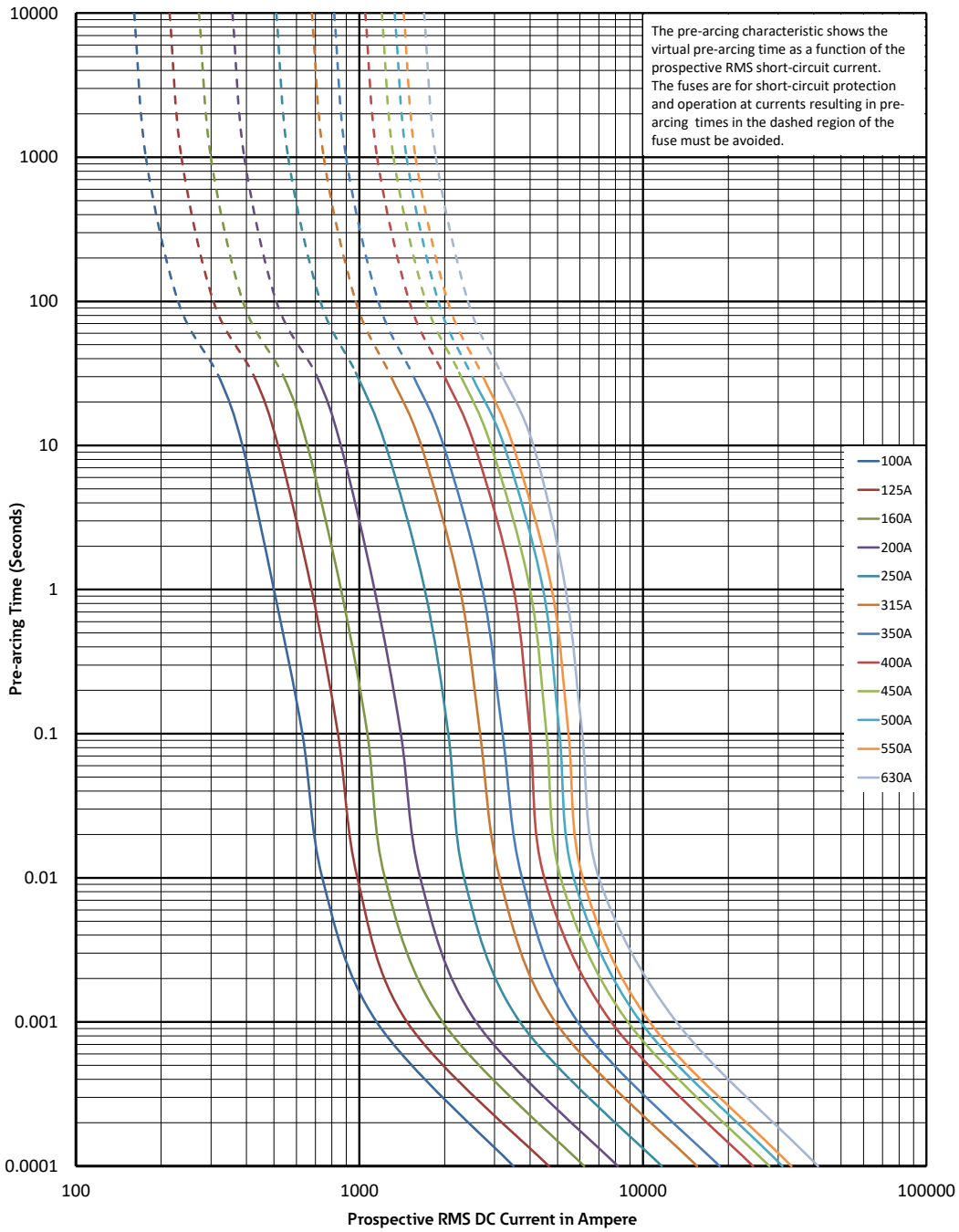




Data sheet: TD135031EN

1500 V DC, 100 A to 630 A, ESS3 and ESS3-NI size 3 fuse links

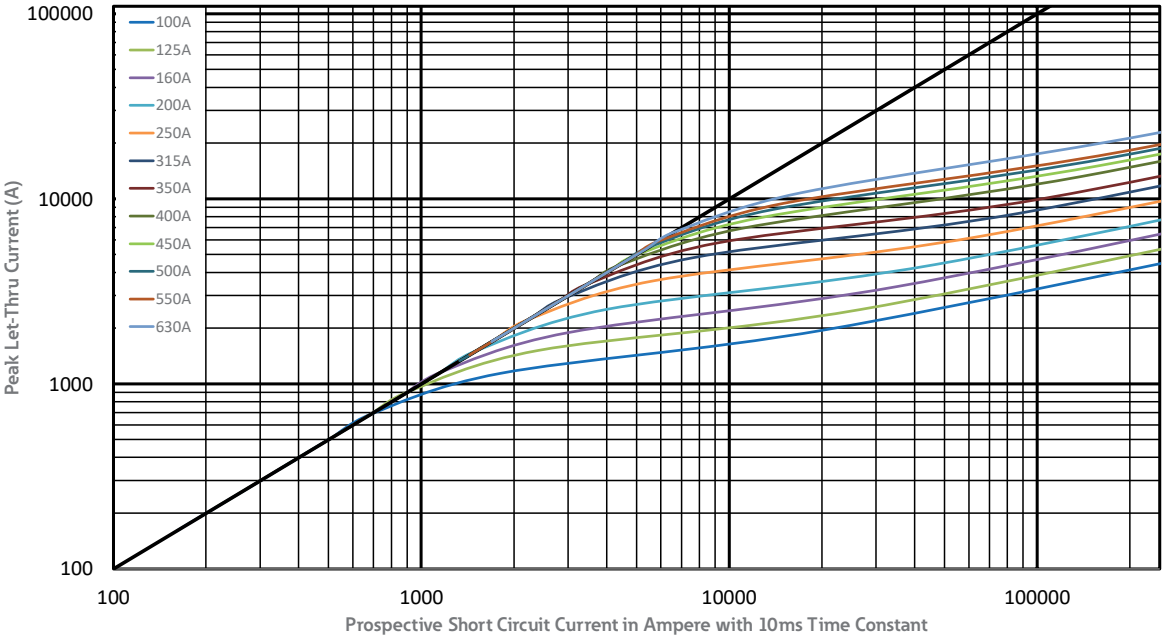
Time-current curve



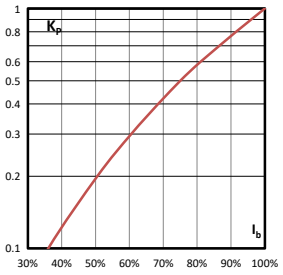
Data sheet: TD135031EN

1500 V DC, 100 A to 630 A, ESS3 and ESS3-NI size 3 fuse links

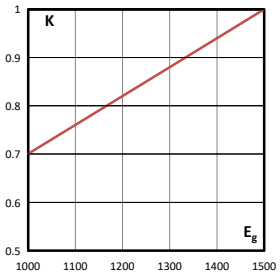
Peak let-through curve



Watts losses
Watts loss at rated current is given in the electrical characteristics. The curve allows the calculation of the watts losses at load currents lower than the rated current. The correction factor, K_p , is given as a function of the RMS load current, I_b, in percent of the rated current.



Total clearing I^2t
The total clearing I^2t at rated voltage and tested DC time constant are given in electrical characteristics. For other voltages the clearing I^2t is found by multiplying by correction factor, K, given as a function of applied working voltages, E_g.



Data sheet: TD135031EN

1500 V DC, 350 A to 1400 A, 180D Flush end, DIN and US Style contact size 3 fuse size links

Description

Eaton's Bussmann series 180D aR and aBAT size 3 square body fuse links, are specifically designed for the protection of inverters, converters and battery racks.

Technical data

- Rated voltage: 1500 V DC (IEC/UL)
- Rated current: 350 A to 1400 A
- Breaking capacity:
  - 100 kA at 10ms L/R
  - 250 kA at 3ms L/R
- Operating class: aR and aBat

Compatible microswitch

- 170H0069

Standards / Agency information

Designed and tested to IEC 60269 part 4 and 7, UL 248-13
Recognised, RoHS compliant

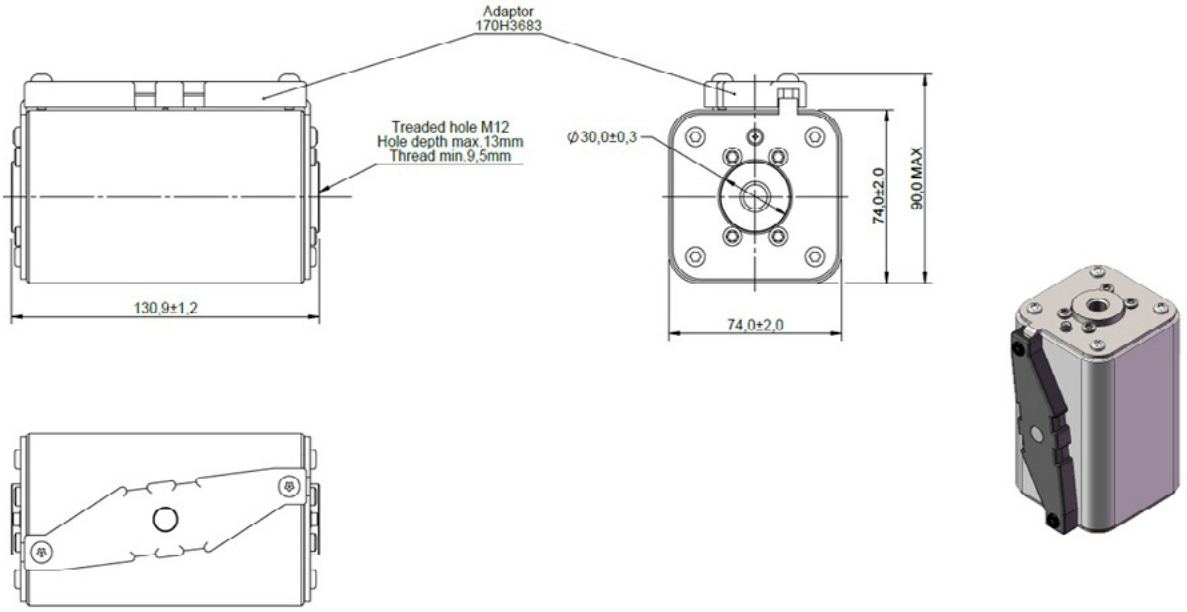
Catalog numbers

							Catalog numbers		
Fuse body size	**Rated voltage**	**Rated current (Amps)**	**Breaking capacity**	**Minimum breaking current (A)**	**Pre-arcing I^2t (A^2 Sec)**	**Power loss at In (W)**	**Fuse type: 3BKN/130**	**Fuse type: 3KN/160**	**Fuse type: 3FKN/170**
3	1500 V DC (IEC/UL)	350	100 kA at 10ms L/R 250 kA at 3ms L/R	1400	25,000	132	180D8722	180D8735	180D8748
		400		1700	35,000	160	180D8723	180D8736	180D8749
		450		2000	45,000	175	180D8724	180D8737	180D8750
		500		2400	65,000	180	180D8725	180D8738	180D8751
		550		2750	85,000	190	180D8726	180D8739	180D8752
		630		3400	130,000	200	180D8727	180D8740	180D8753
		700		4000	180,000	203	180D8728	180D8741	180D8754
		800		4850	265,000	205	180D8729	180D8742	180D8755
		900		5700	375,000	225	180D8730	180D8743	180D8756
		1000		6650	510,000	238	180D8731	180D8744	180D8757
		1100		7750	695,000	247	180D8732	180D8745	180D8758
		1250		9500	1,030,000	262	180D8733	180D8746	180D8759
		1400		11,100	1,420,000	267	180D8734	180D8747	180D8760

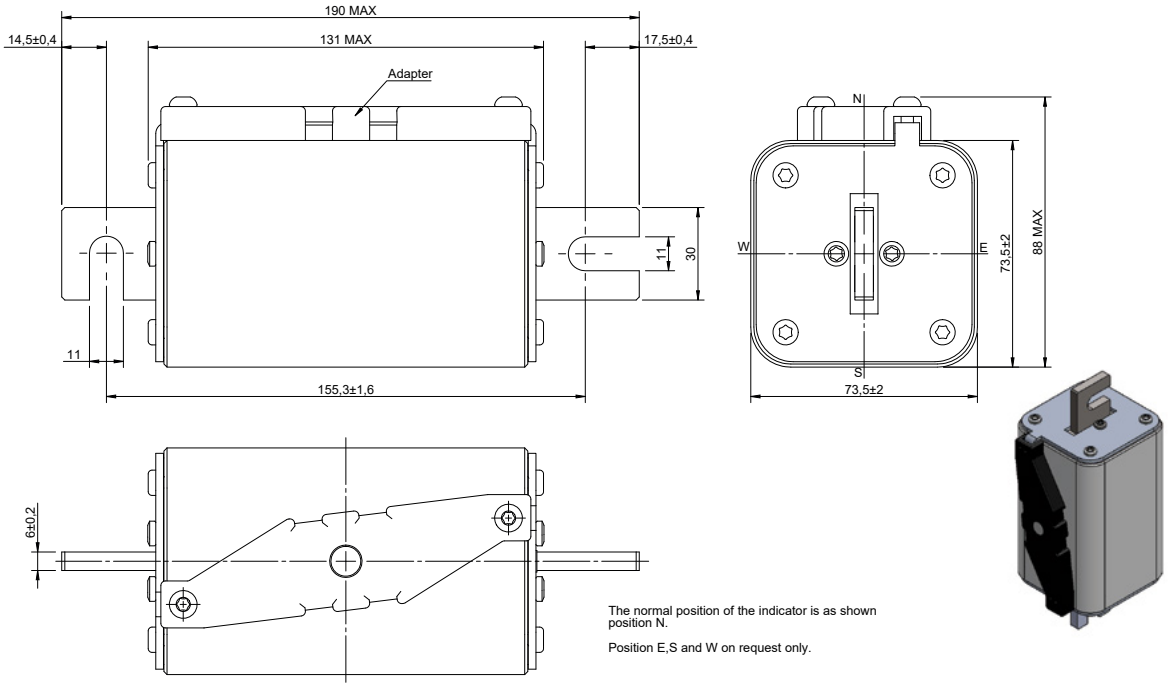
Data sheet: TD135027EN

1500 V DC, 350 A to 1400 A, 180D Flush end, DIN and US Style contact size 3 fuse links

Dimensions (mm) - 3BKN/130



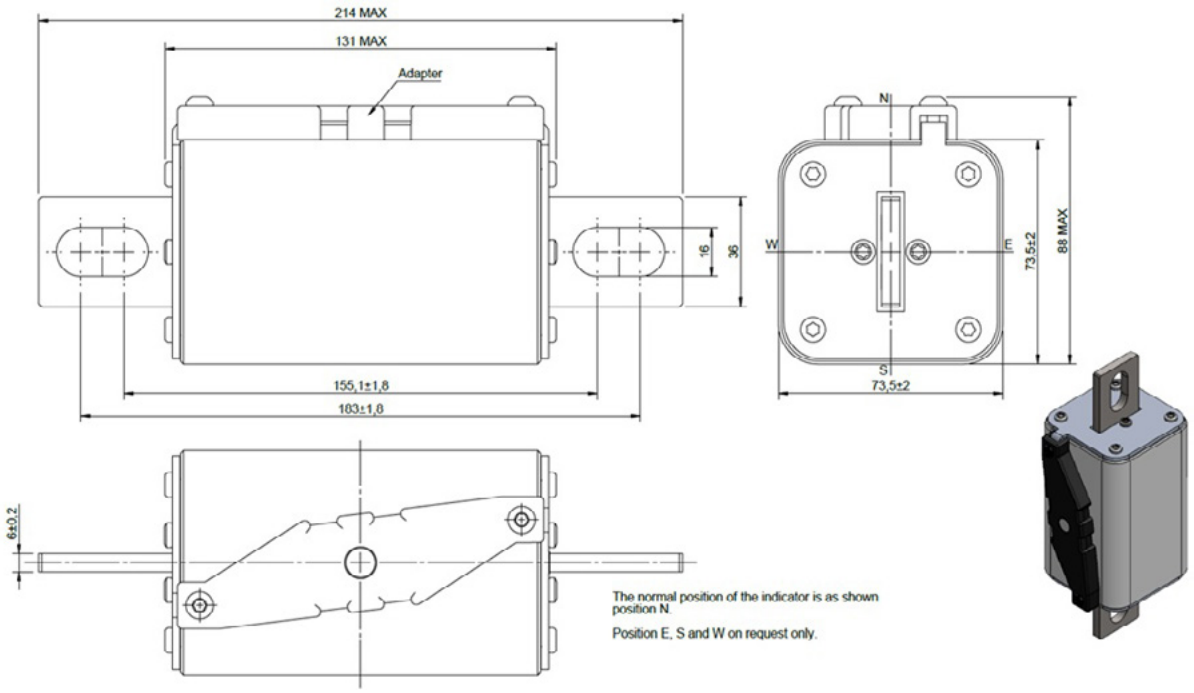
Dimensions (mm) - 3BKN/160



Data sheet: TD135027EN

1500 V DC, 350 A to 1400 A, 180D Flush end, DIN and US Style contact size 3 fuse links

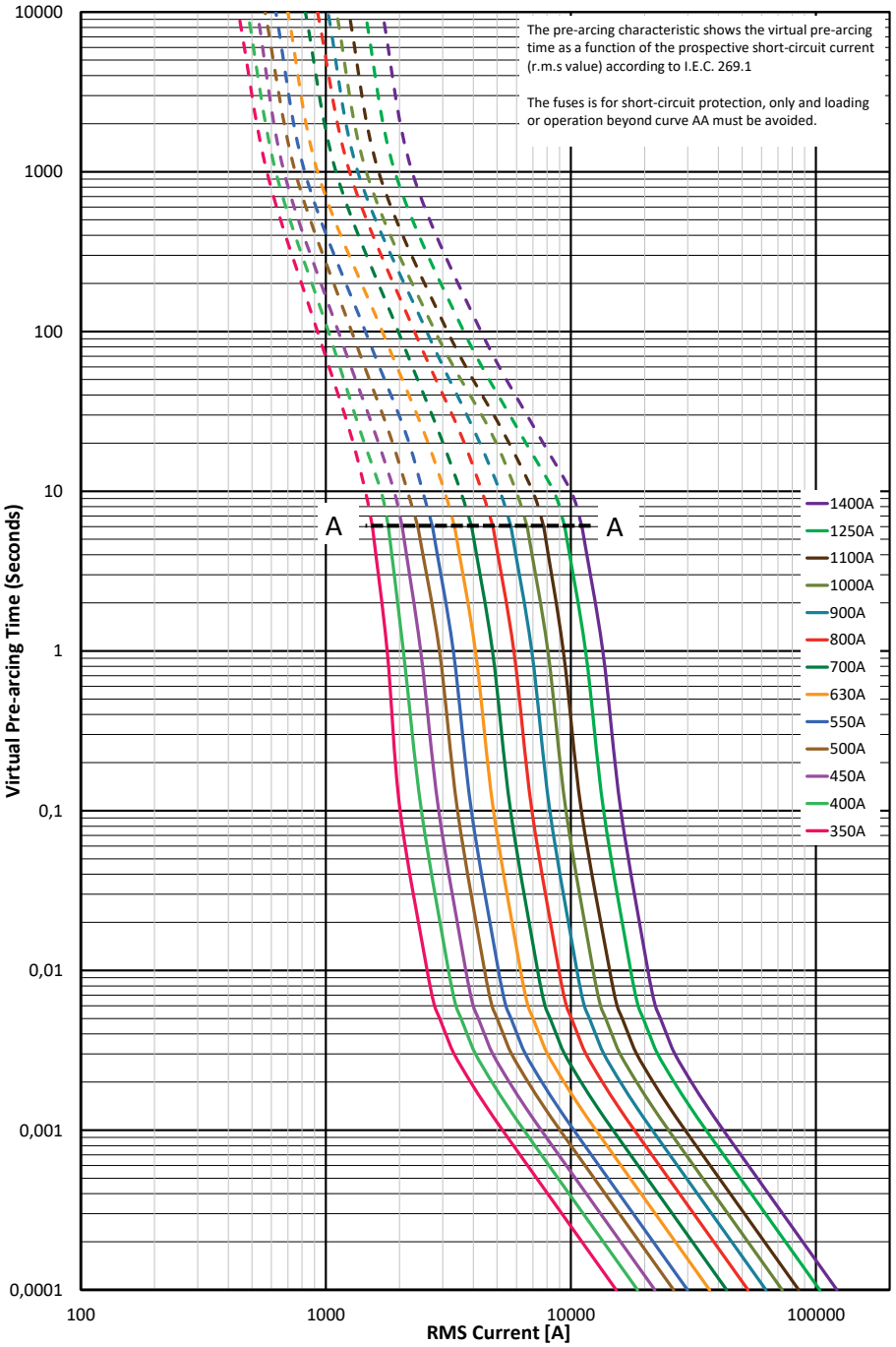
Dimensions (mm) - 3FKN/170



Data sheet: TD135027EN

1500 V DC, 350 A to 1400 A, 180D Flush end, DIN and US Style contact size 3 fuse links

Time-current curve

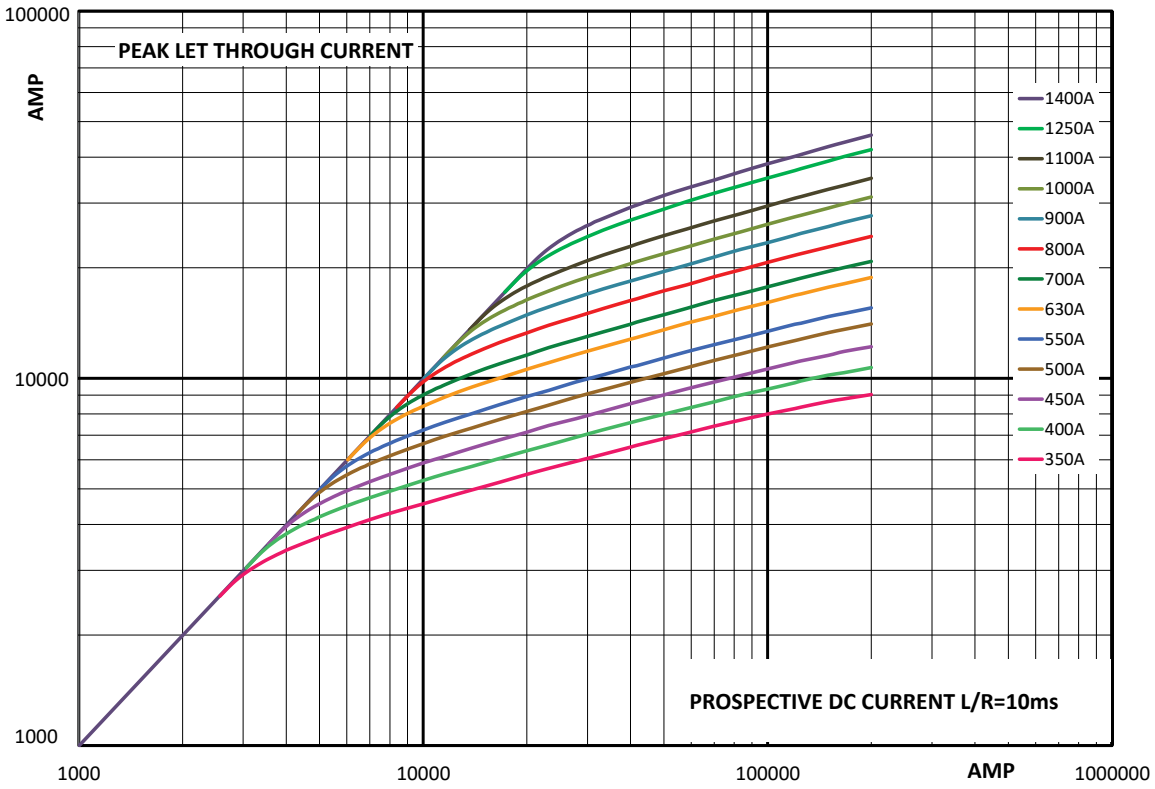


K_h = 1

Data sheet: TD135027EN

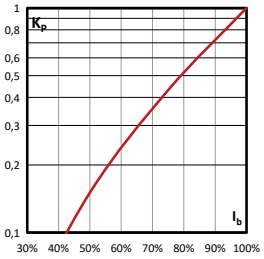
1500 V DC, 350 A to 1400 A, 180D Flush end, DIN and US Style contact size 3 fuse links

Peak let-through curve



Watts losses

Watts loss at rated current is given in the electrical characteristics. The curve allows the calculation of the watts losses at load currents lower than the rated current. The correction factor, K_p , is given as a function of the RMS load current, I_b, in percent of the rated current.



Data sheet: TD135027EN

1500 V DC, 250 A to 500 A, BSF-3XL XL Style fuse links

Description

Eaton's Bussmann series XL battery storage fuses are specifically designed to protect and isolate battery array combiners and disconnects. These fuse links are capable of interrupting low overcurrents associated with faulted battery storage systems (reverse current, multi-array fault).

Technical data

- Rated voltage: 1500 V DC
- Rated current: 250 A to 500 A
- Operating class: gBat proposed for full range fuse links for protection of battery storage systems
- Breaking capacity: 100 kA
- Time constant: 4.5ms at 100 kA

Microswitches

- For bladed fuse links
  - 170H0236
  - 170H0238
- For bolted fuse links
  - 170H0069

Compatible fuse bases

- SD3L-S-PV

Standards / Agency information

IEC 60269-7 for battery storage fuse links is under preparation.

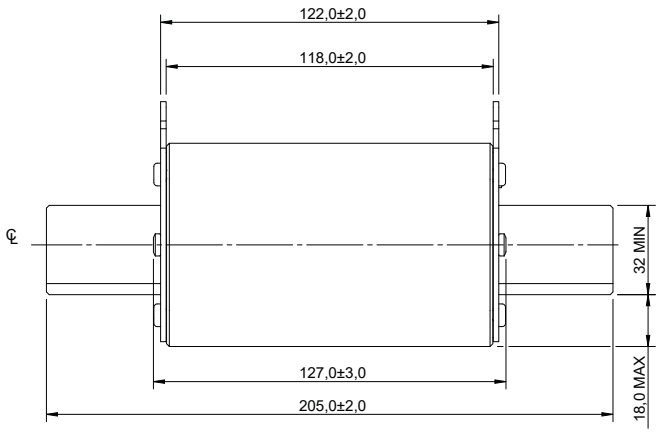
Catalog numbers

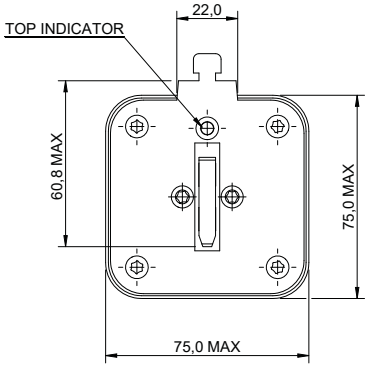
			I^2t (A^2 Sec)		Watts loss (W)		Catalog numbers	
Fuse link body size	Rated voltage	Rated current (Amps)	Pre-arcing	Total at 1500 V DC	0.7 I_n	I_n	Bladed version	Bolted version
3	1500 V DC	250	74,000	263,000	20	49	BSF-250G-3XL15	BSF-250G-3XL15-B
		315	150,000	533,000	21	52	BSF-315G-3XL15	BSF-315G-3XL15-B
		355	195,000	693,000	24	59	BSF-355G-3XL15	BSF-355G-3XL15-B
		400	296,000	1,060,000	24	61	BSF-400G-3XL15	BSF-400G-3XL15-B
		450	412,000	1,470,000	27	67	BSF-450G-3XL15	BSF-450G-3XL15-B
		500	532,000	1,890,000	29	73	BSF-500G-3XL15	BSF-500G-3XL15-B

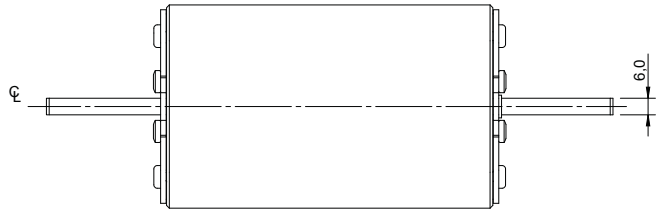
Data sheet: 135002

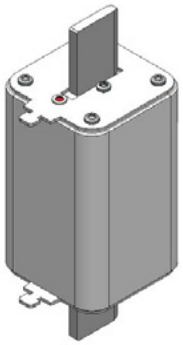
1500 V DC, 250 A to 500 A, BSF-3XL XL Style fuse links

Dimensions (mm) - Size 3, bladed

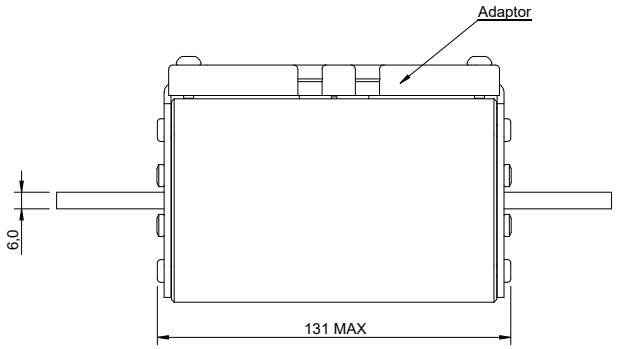


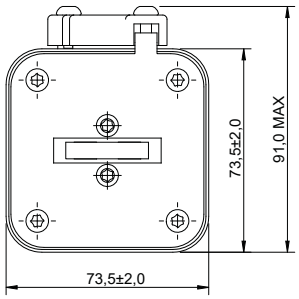


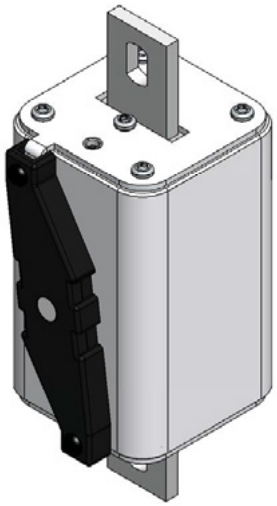


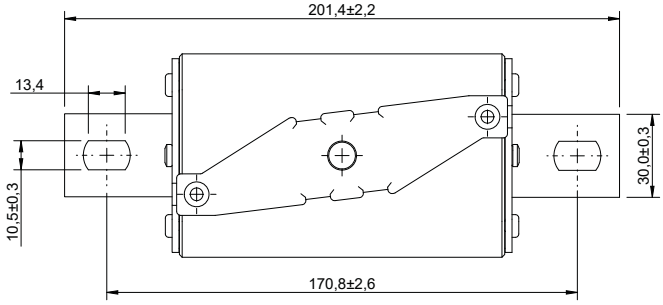


Dimensions (mm) - Size 3, bolted





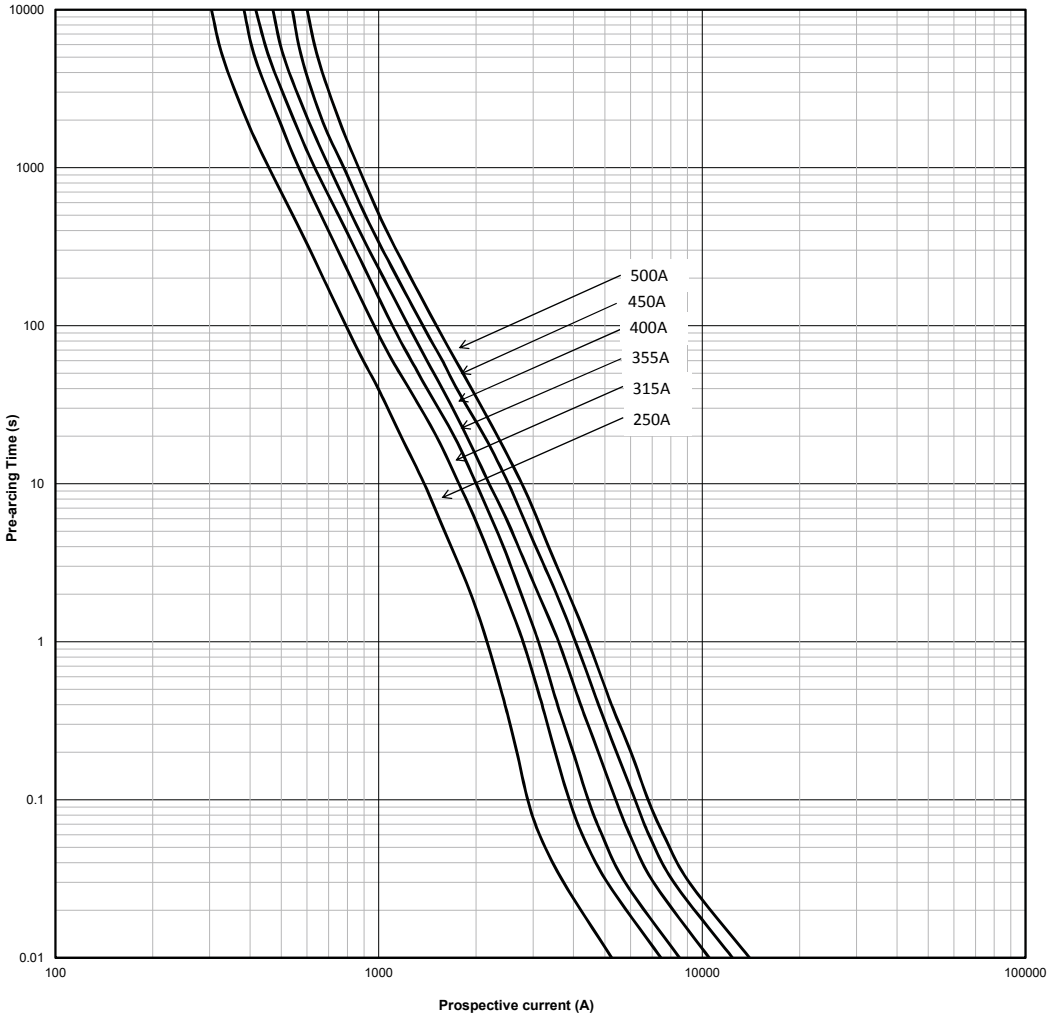




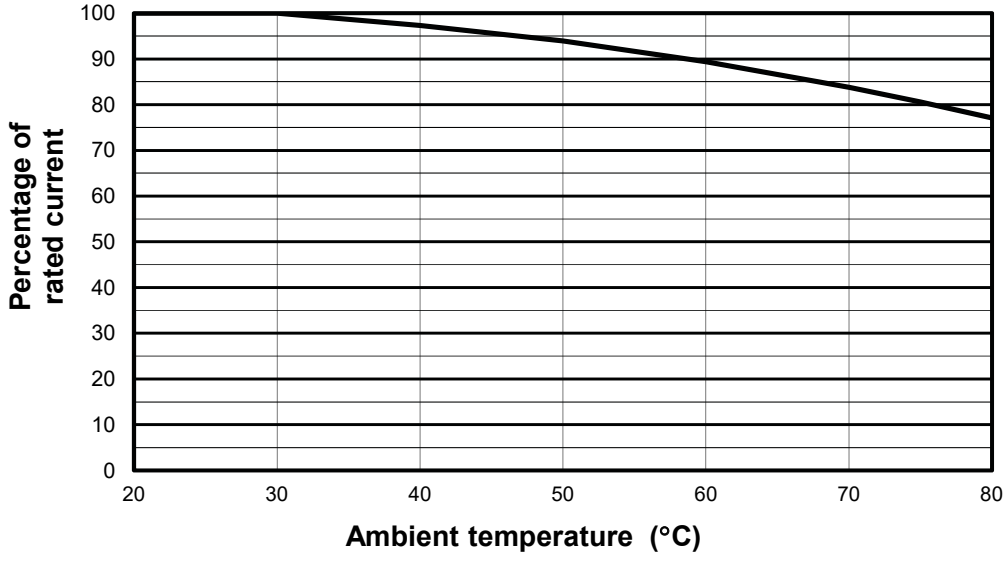
Data sheet: 135002

1500 V DC, 250 A to 500 A, BSF-3XL XL Style fuse links

Time-current curve



Temperature derating



Data sheet: 135002

1500 V DC, 800 A to 1800 A, 180D Flush end contact size 4 fuse links

Description

Eaton's Bussmann series 180D aR, aBat DC flush end fuse links for the protection of inverters and converters.

Technical data

- Rated voltage: 1500 V DC (IEC/UL)
- Rated current: 800 A to 1800 A
- Breaking capacity:
  - 100 kA at 10ms L/R
  - 250 kA at 3ms L/R
- Operating class: aR and aBat

Compatible microswitch

- 170H0069

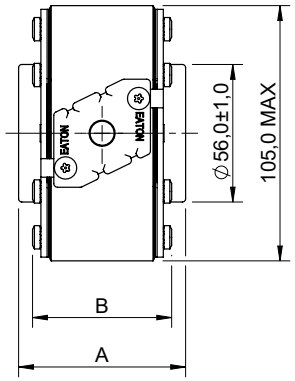
Standards / Agency information

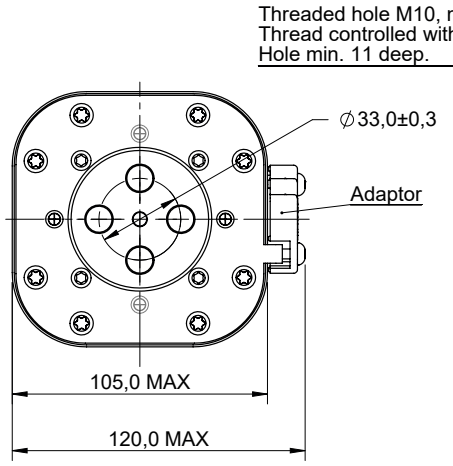
Designed and tested to IEC 60269 part 4 and 7, UL 248-13
Recognised, RoHS compliant

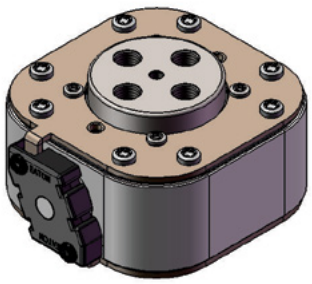
Catalog numbers

Fuse body size	Rated voltage	Rated current (Amps)	Breaking capacity (kA at 10ms)	Pre-arcing I^2t (A^2 Sec)	Power loss at In (W)	Catalog number
4	1500 V DC (IEC/UL)	800	100	512,000	111	180D7462
		900	100	776,000	120	180D7463
		1000	100	1,000,000	164	180D7620
		1250	100	1,400,000	185	180D7698
		1500	100	2,500,000	228	180D7627
		1800	100	3,500,000	313	180D7477

Dimensions (mm)





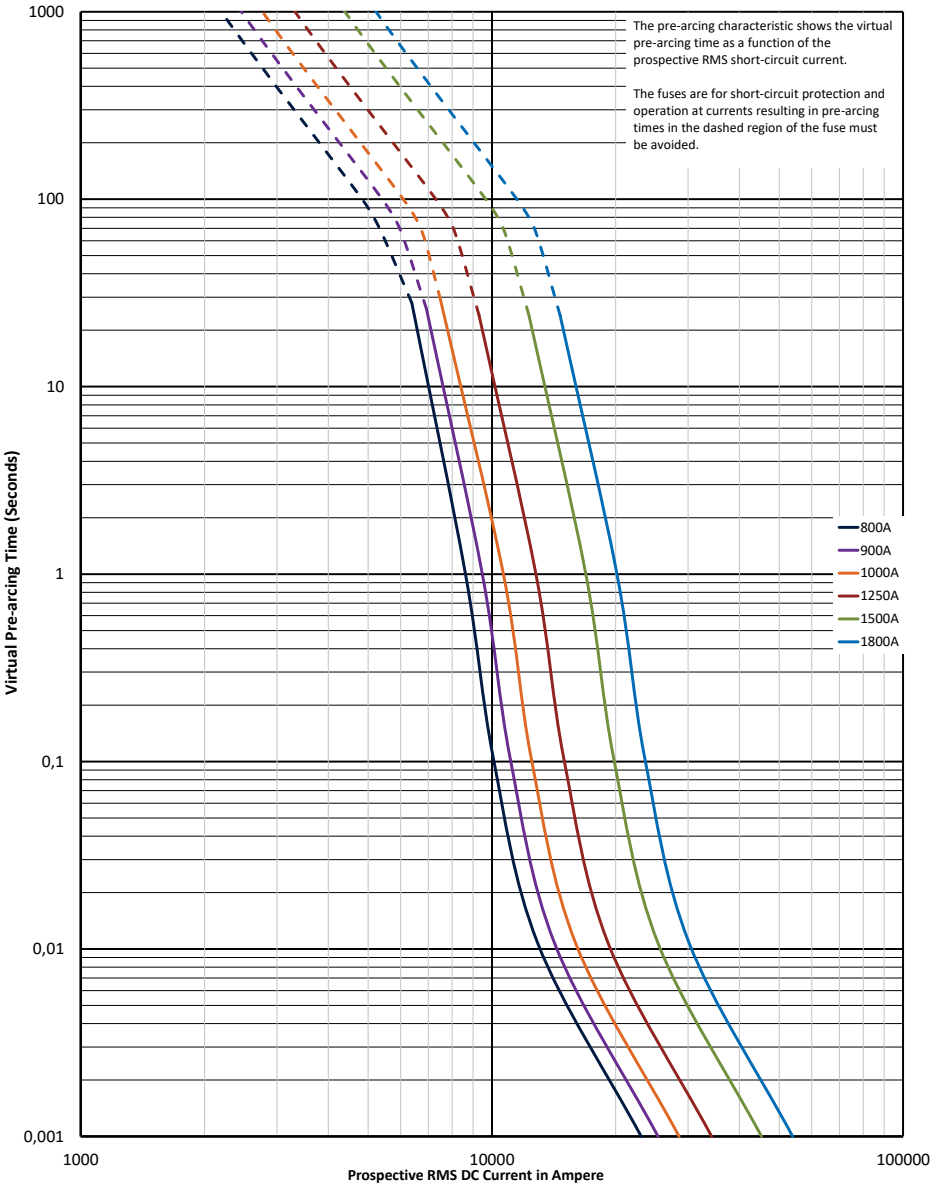


A	B
153.6 ± 2.4	142.6 ± 2.7

Data sheet: TD135028EN

1500 V DC, 800 A to 1800 A, 180D Flush end contact size 4 fuse links

Time-current curve

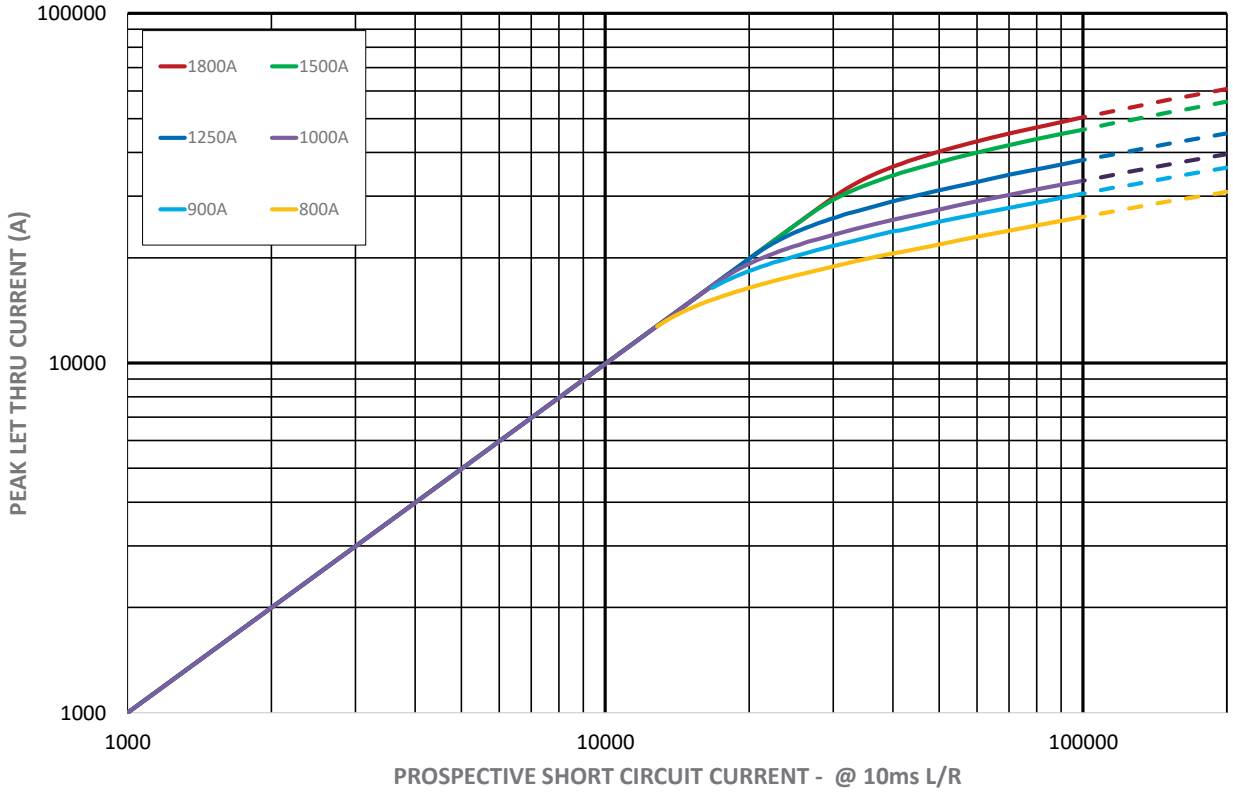


K_b = 1 N = 1,5

Data sheet: TD135028EN

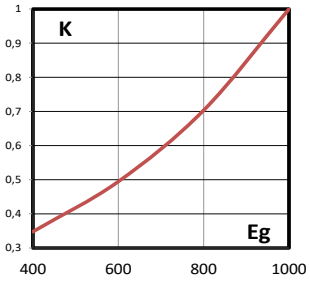
1500 V DC, 800 A to 1800 A, 180D Flush end contact size 4 fuse links

Peak let-through curve



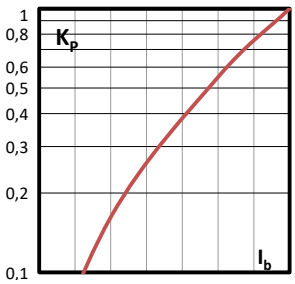
Total clearing I²t

The total clearing I²t at rated voltage and tested DC time constant are given in electrical characteristics. For other voltages the clearing I²t is found by multiplying by correction factor, K, given as a function of applied working voltages, E.



Watts losses

Watts loss at rated current is given in the electrical characteristics. The curve allows the calculation of the watts losses at load currents lower than the rated current. The correction factor, K_p , is given as a function of the RMS load current, I_b, in percent of the rated current.



Data sheet: TD135028EN

1500 V DC, 630 A to 1800 A, ESS5 Size 4 fuse links

Description

Eaton's Bussmann series ESS5 aR size 4 square body fuse links, are specifically designed for the protection of inverters, converters and battery racks.

Technical data

- Rated voltage: 1500 V DC (IEC/UL)
- Rated current: 630 A to 1800 A
- Breaking capacity: 250 kA at 4ms L/R
- Operating class: aR and aBat

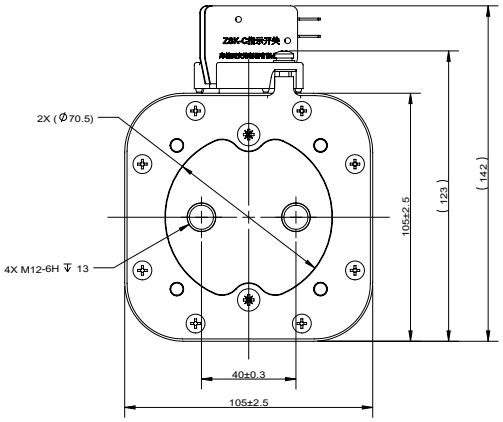
Standards / Agency information

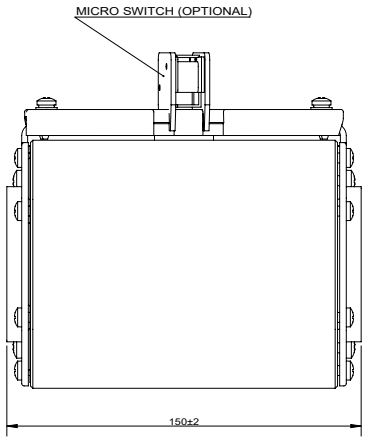
Designed and tested to IEC 60269 part 4 and part 7, UL 248-13
Recognised, RoHS compliant

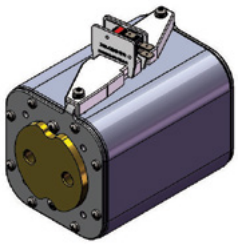
Catalog numbers

Fuse body size	Rated voltage	Rated current (Amps)	Breaking capacity (kA at 4ms)	Minimum breaking current (A)	Pre-arcing I^2t (A^2 Sec)	Power loss at In (W)	Catalog number
4	1500 V DC (IEC/UL)	630	250	5040	169,000	183	ESS5-630
		700	250	5600	200,000	192	ESS5-700
		800	250	6400	320,000	202	ESS5-800
		900	250	7200	467,000	212	ESS5-900
		1000	250	8000	658,000	233	ESS5-1000
		1100	250	8800	804,000	241	ESS5-1100
		1250	250	10,000	1,140,000	262	ESS5-1250
		1350	250	10,800	1,430,000	273	ESS5-1350
		1500	250	12,000	1,870,000	286	ESS5-1500
		1600	250	12,800	2,450,000	284	ESS5-1600
		1800	250	14,400	3,170,000	315	ESS5-1800

Dimensions (mm)



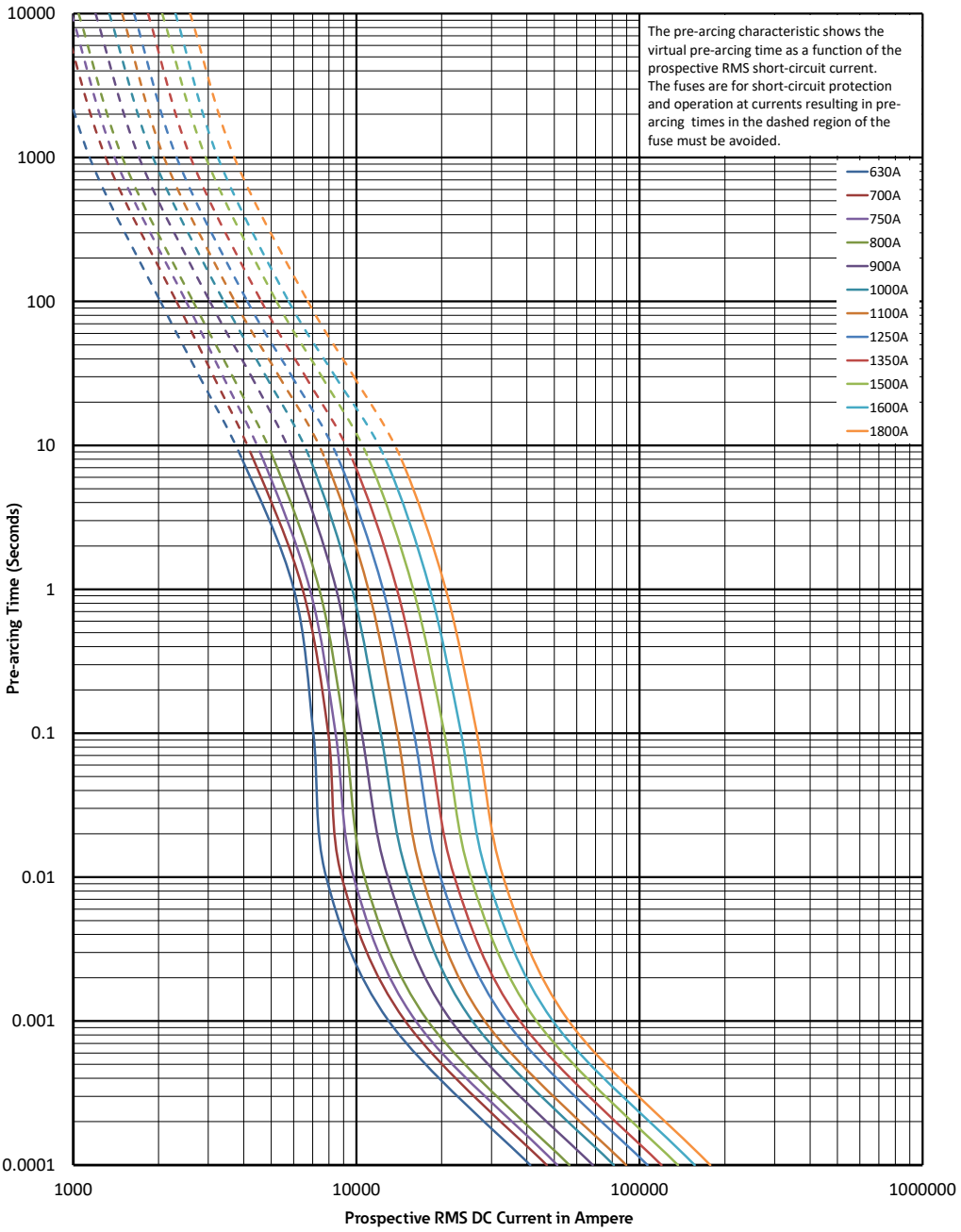




Data sheet: TD135032EN

1500 V DC, 630 A to 1800 A, ESS5 Size 4 fuse links

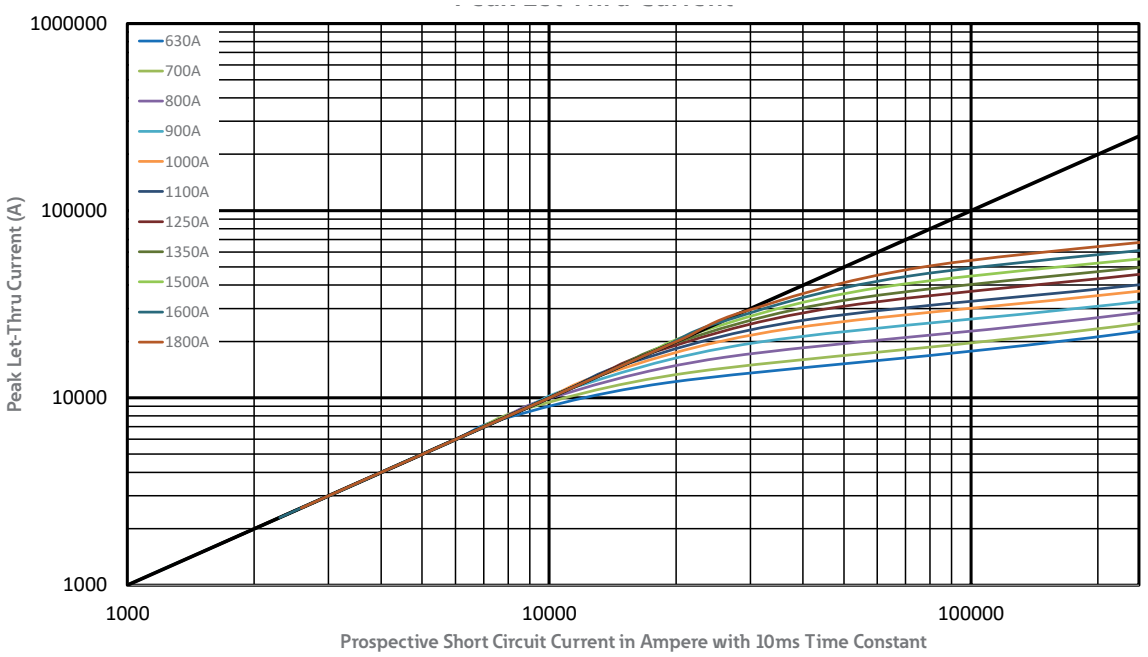
Time-current curve



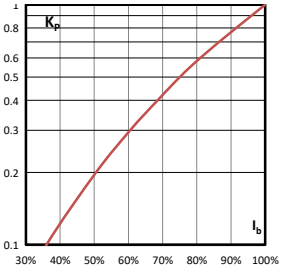
Data sheet: TD135032EN

1500 V DC, 630 A to 1800 A, ESS5 Size 4 fuse links

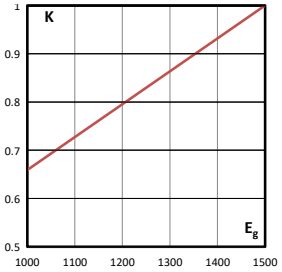
Peak let-through



Watts losses
Watts loss at rated current is given in the electrical characteristics. The curve allows the calculation of the watts losses at load currents lower than the rated current. The correction factor, K_p , is given as a function of the RMS load current, I_b, in percent of the rated current.



Total clearing I^2t
The total clearing I^2t at rated voltage and tested DC time constant are given in electrical characteristics. For other voltages the clearing I^2t is found by multiplying by correction factor, K, given as a function of applied working voltages, E_g.



Data sheet: TD135032EN

1500 V DC, 1600 A to 3000 A, 180D Size 24 fuse links

Description

Eaton's Bussmann series 180D aR, aBat size 24 square body fuse links, are specifically designed for the protection of inverters, converters and battery racks.

Technical data

- Rated voltage: 1500 V DC (IEC/UL)
- Rated current: 1600 A to 3000 A
- Breaking capacity: 250 kA at 3ms L/R
- Operating class: aR and aBat

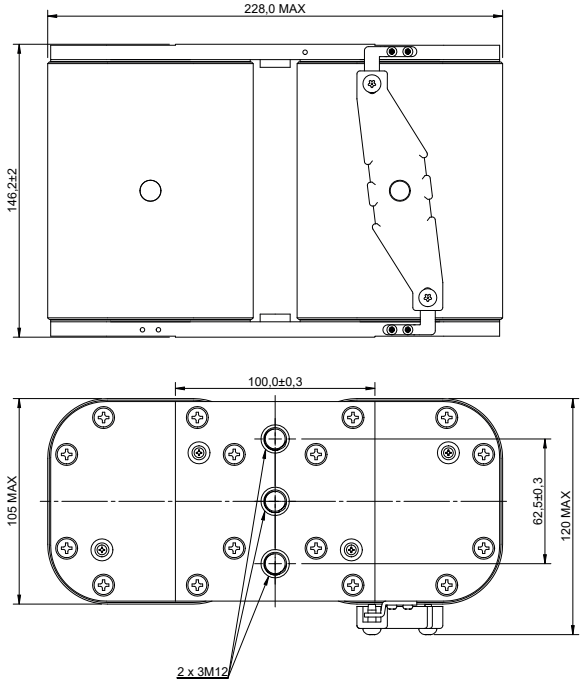
Standards / Agency information

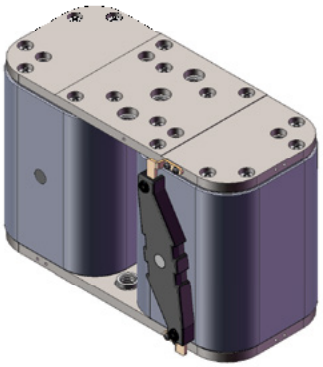
Designed and tested to IEC 60269 part 4, UL 248-13-Recognised, RoHS compliant

Catalog numbers

Fuse body size	Rated voltage	Rated current (Amps)	Breaking capacity (kA at 3ms)	Minimum breaking current (A)	Pre-arcing I^2t (A^2 Sec)	Power loss at In (W)	Catalog number
24	1500 V DC (IEC/UL)	1600	250	23,000	2,139,000	270	180D7739
		1800	250	27,500	3,044,000	300	180D7740
		2000	250	32,500	4,251,000	315	180D7741
		2200	250	37,500	5,660,000	330	180D7742
		2500	250	45,000	8,100,000	390	180D7743
		2800	250	53,500	11,407,000	410	180D7744
		3000	250	59,100	14,021,000	425	180D7745

Dimensions (mm)

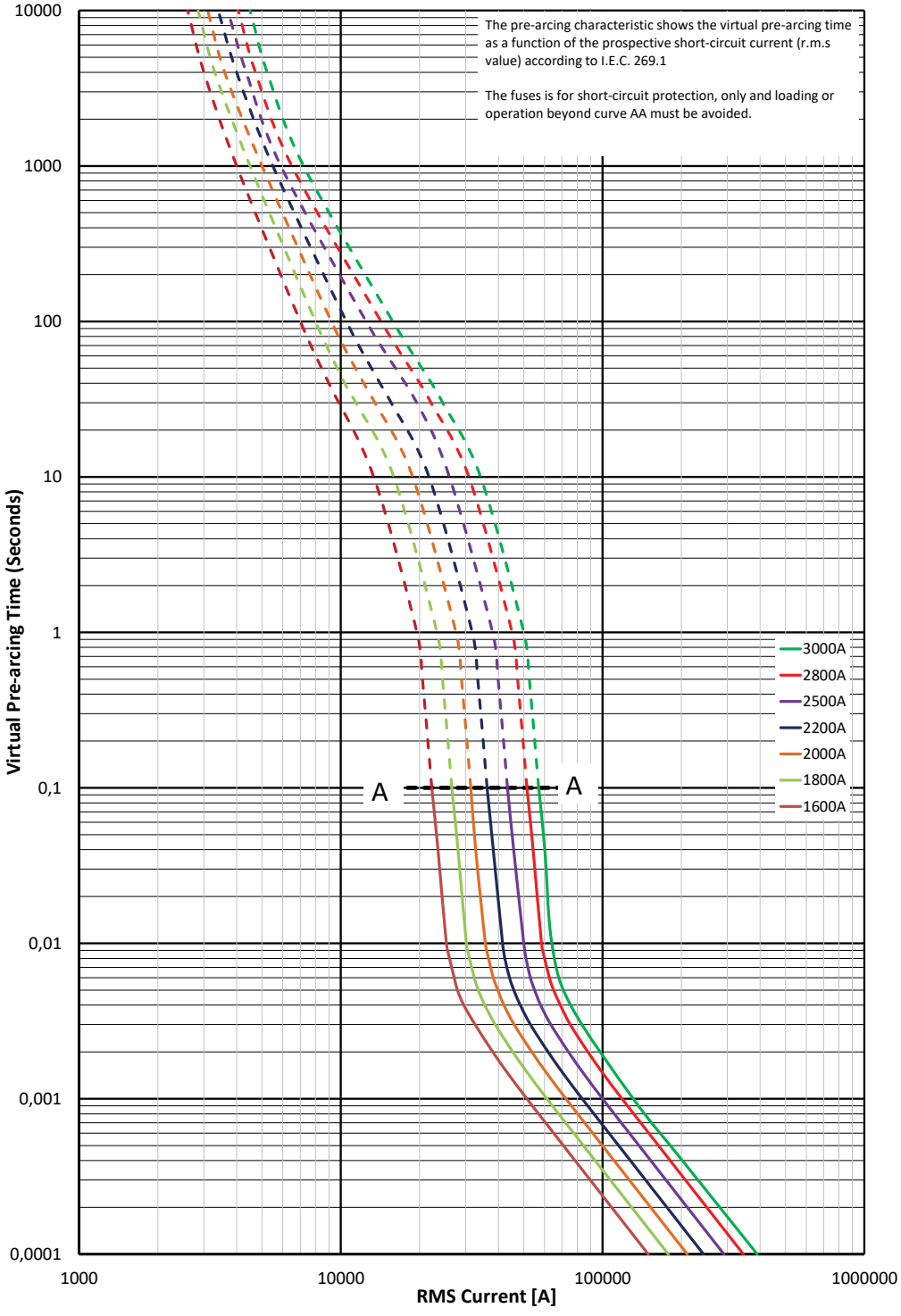




Data sheet: TD135029EN

1500 V DC, 1600 A to 3000 A, 180D Size 24 fuse links

Time-current curve

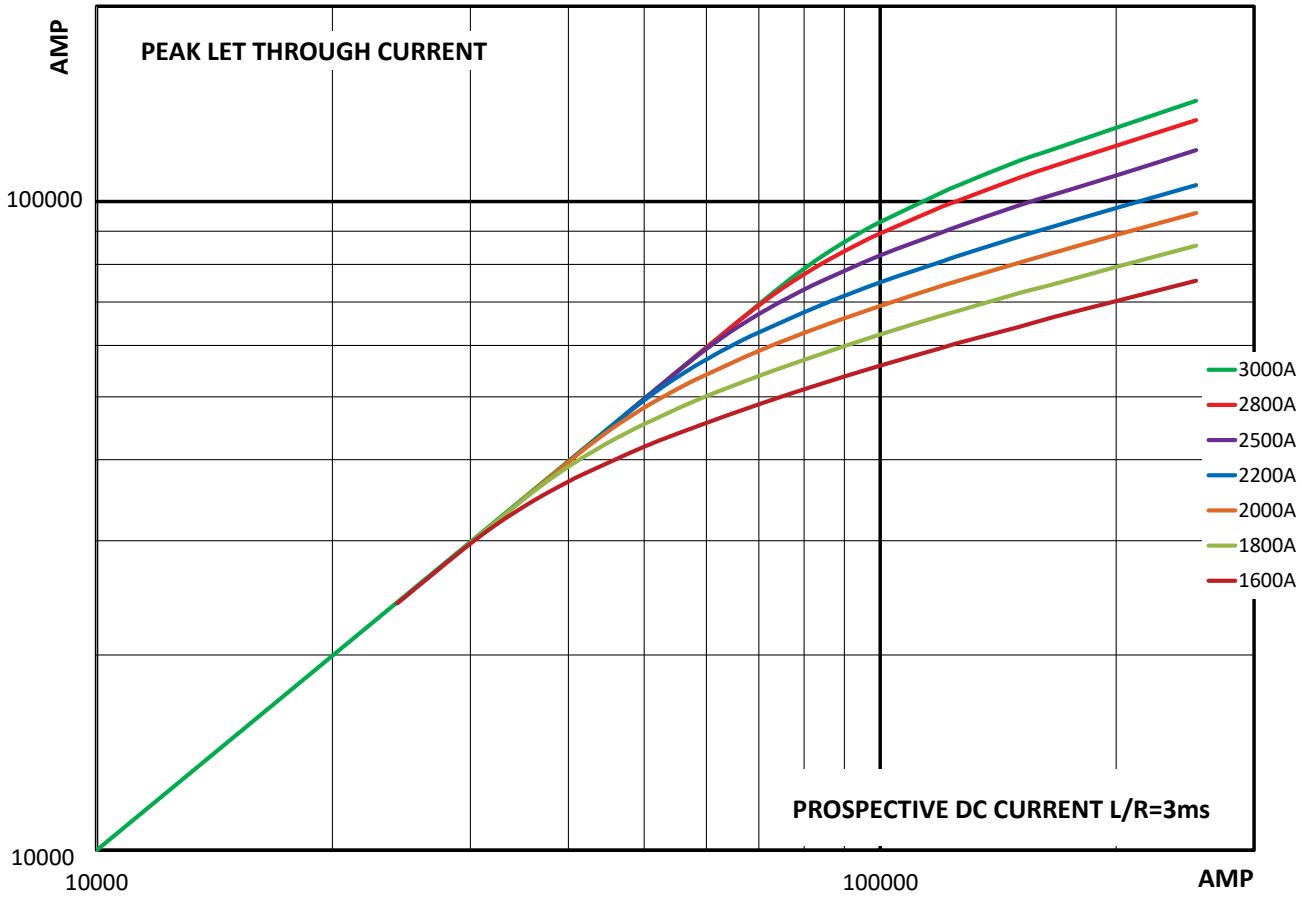


K_b = 1

Data sheet: TD135029EN

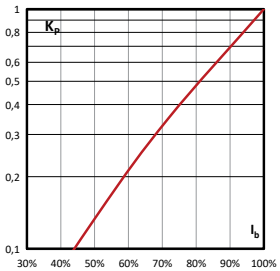
1500 V DC, 1600 A to 3000 A, 180D Size 24 fuse links

Peak let-through curve



Watts losses

Watts loss at rated current is given in the electrical characteristics. The curve allows the calculation of the watts losses at load currents lower than the rated current. The correction factor, K_p , is given as a function of the RMS load current, I_b, in percent of the rated current.



Data sheet: TD135029EN

SD3L-S-PV XL Bases

Catalog number

SD3L-S-PV to fit 3L NH Battery storage fuse links

Technical data

- Rated voltage: 1500 V DC
- Rated current: 500 A
- Power acceptance (Watts): Size 3L: 108W
- Degree of protection level: IP20 with terminal covers in place and shielding of any exposed part of the terminal lugs
- Operating temperature range: -45°C to 80°C (with fuse link derating above 30°C)
- Screw mounting, dimensions and spacing of screw holes are shown on drawing and dimension
- Terminal/Lug mounting torque: 32N•m
- Fuse terminals mounting terminals: 12 N•m
- Silver plated copper fuse clips
- UL94 Flammability rating: base V-0, terminal cover V-0
- Glow wire test (IEC-695) 960°C
- Multiple poles can be configured with use of phase barrier accessory kit (SDsize-PB)
- Weight:SD3L-S-PV: 0.65 kg

Standards/Approvals

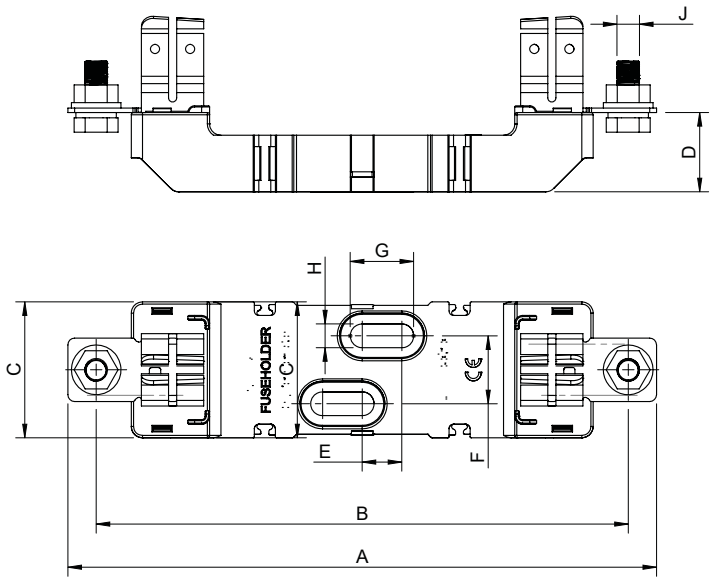
- IEC 60269-1
- UL Listed (file number E348242)

Packaging

MOQ: 1

Dimensions - mm

Catalog numbers	XL Style fuse link size	Maximum fuse rated current (Amps)	Power acceptance	A	B	C	D	E	F	G	H	J
SD3L-S-PV	3L	500	108W	300	270	60	35	17.5	30	28	10.5	M12



Data sheet: 10685

Contact details

Customer Satisfaction team

Eaton's Customer Satisfaction team is available to answer questions regarding Bussmann series products.

Calls can be made between:

Monday - Friday 7.30 a.m. - 5.00 p.m. GMT

The Customer Satisfaction team can be reached via:

Phone: 00 44 (0) 1509 882 600

Email: GBBURsales@eaton.com

Online resources

Visit www.eaton.com for the following resources:

- Product cross reference
- Product profiles
- Online catalogues for the latest United States and European catalogues.

Application engineering

Application Engineering assistance is available to all customers. The Application Engineering team is staffed by university-qualified electrical engineers who are available with technical and application support.

Calls can be made between:

Monday - Thursday 8.30 a.m. - 4.30 p.m. GMT

Friday 8.30 a.m. - 4.00 p.m. GMT

Application Engineering can be reached via:

- Phone: 00 44 (0) 1509 882 699
- General technical enquiries: buletechnical@eaton.com
- Enquiries related to High speed fuses: bulehighspeedtechnical@eaton.com

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Founded in 1911, Eaton has continuously evolved to meet the changing and expanding needs of our stakeholders. With revenues of nearly $25 billion in 2024, the company serves customers in more than 160 countries.

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