



GREEN PROTECT

Protection of Renewable Resources

Cylindrical fuses for PV applications

Cylindrical fuses for battery storage applications

NH fuses for PV applications

NH fuses for PV inverters' protection

NH fuses for battery storage applications

NH fuses for protection of high power DC EV chargers

Lightning and Surge Arresters for PV applications

Switch disconnectors for PV applications

Ready made DC-junction boxes

f @ in v
/etigroup

ETI
SWITCH TO
A SAFE FUTURE



Table of contents

DC - distribution and protection components	5
Cylindrical fuse-links for PV applications	7
Cylindrical fuse-links for battery storage applications	17
Fuseholders and accessories for cylindrical fuse-links	25
NH fuse-links for PV applications	37
NH fuse-links for PV inverters' protection	57
NH fuse-links for battery storage applications	75
NH fuse-links for protection of high power DC EV chargers	103
NH fuse bases for DC applications	109
NH fuseholders and disconnectors for DC applications	119
Lightning and Surge Arresters for PV applications	141
Switch disconnectors for PV applications	159
Distribution boards	169
Ready made DC-junction boxes	170

DC Distribution and Protection Components

Introduction

Photovoltaic systems are composed by photovoltaic panels, cables, fuses, switches, overvoltage arresters and power inverter. Photovoltaic panels utilise the power of sun light to converters photons to DC current.

Electricity generated by solar panels is then fed into a power inverter that converts DC current to AC current. gPV fuse has been developed to protect cable and panel against "reverse" overcurrent.

ETITEC B, C-PV series of over voltage surge protective devices has been developed to protect against direct and indirect lightning discharges and is intended to protect photovoltaic systems.

The circuit topology consists of two varistors stages each protected by a thermal disconnection device.

Overcurrent protection

PV module protection from »DC REVERSE« current on DC side

Array with three or more strings of panels:

PV systems that have three or more strings connected in parallel need to have each string protected by fuses.

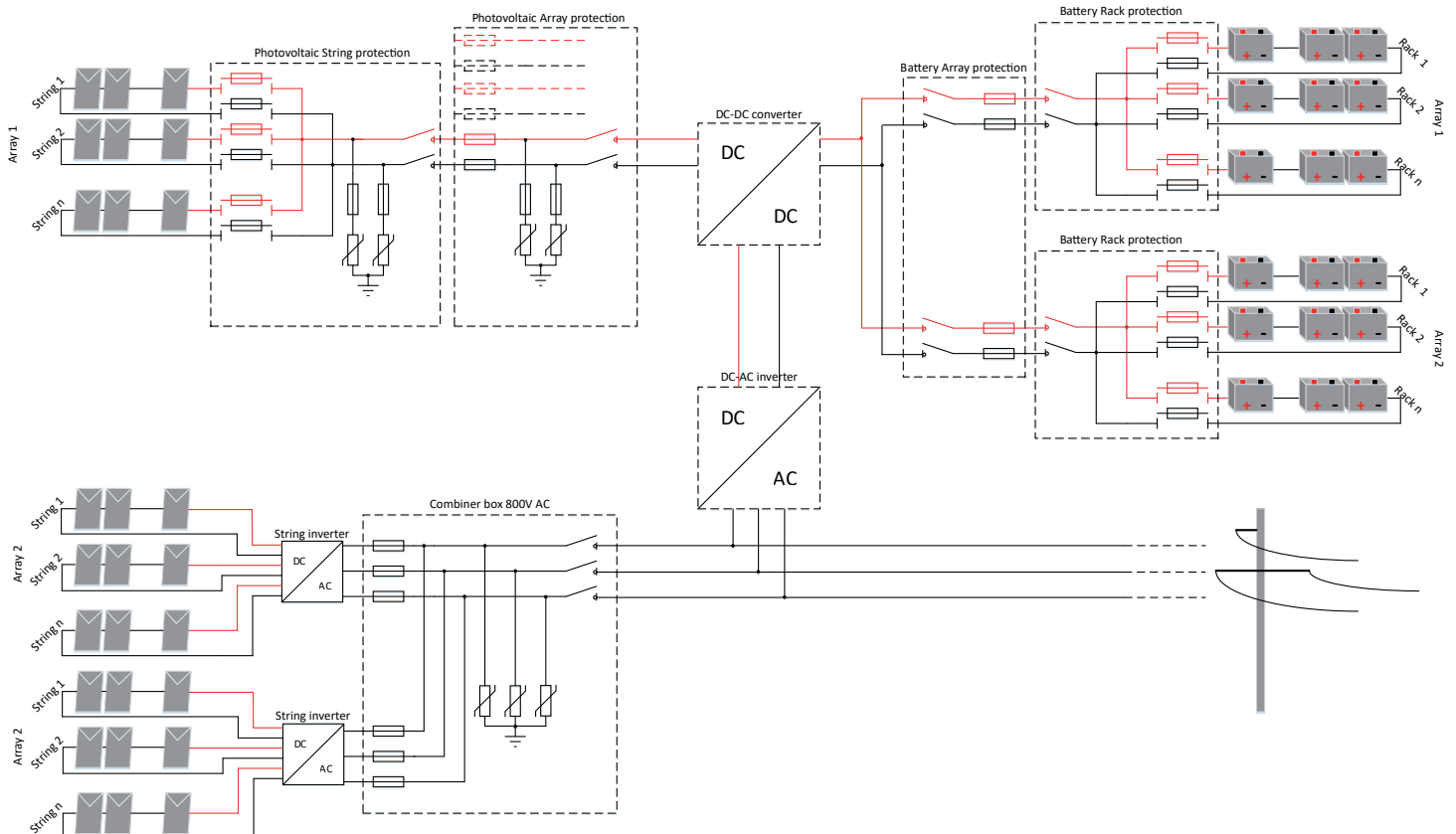
Systems that have less than three strings will not generate enough fault current to damage the conductors/solar panels.

Normally there are two gPV fuses connected on each string (+ and - pole), that protect conductors/solar panels from damage and eliminate any safety hazards.

Fuses isolate the faulted string. The rest of PV system can continue to generate electricity.

PV module protection from »AC REVERSE« current caused by defective inverter

If an inverter becomes defective (transformerless...), AC reverse current can feed into DC strings and destroy PV modules.



Applications



PROTECTION OF PV SYSTEMS

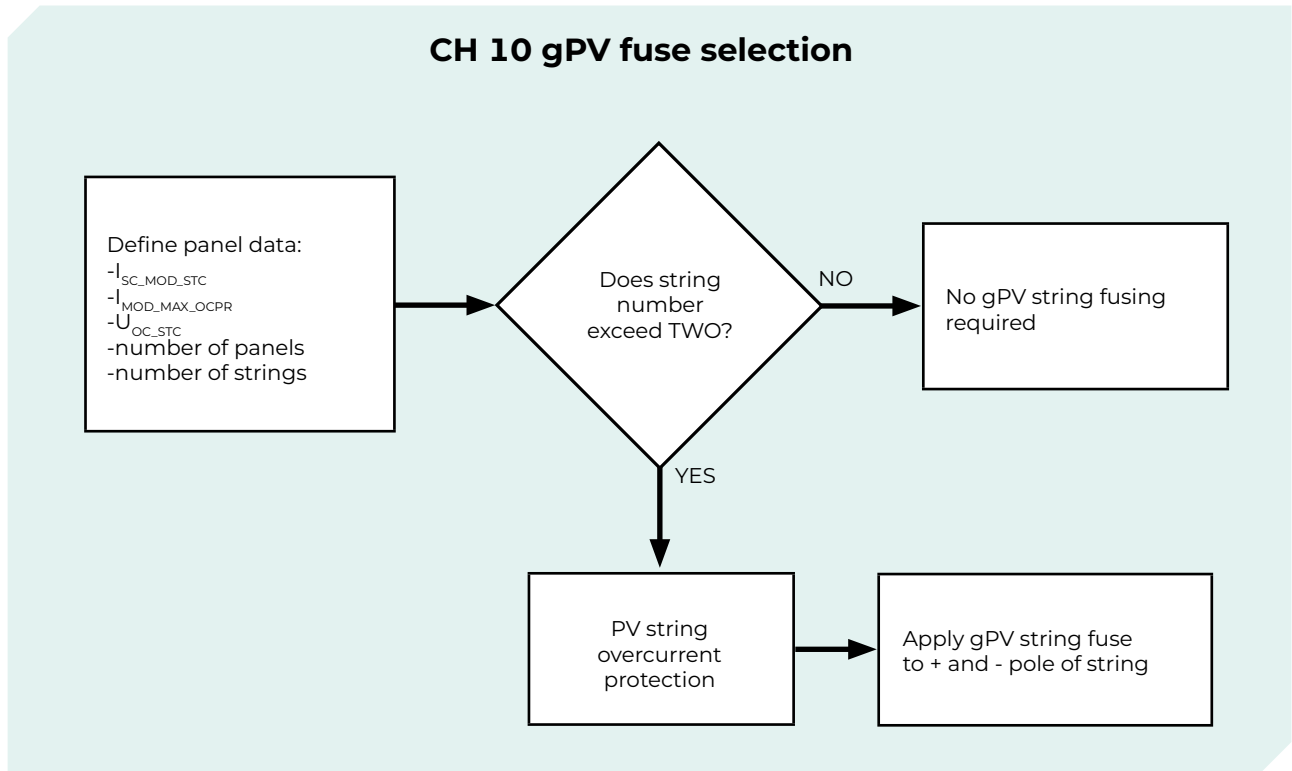


 etigroup
www.etigroup.eu

**Cylindrical Fuse-links
with gPV Characteristic**

ETI
SWITCH TO
A SAFE FUTURE

Photovoltaic String Protection



PV string overcurrent protection:

$I_n > 1,5 \times I_{sc_MOD_STC}$ – the short circuit current of a PV module or PV string at STC

$I_n < 2,4 \times I_{sc_MOD_STC}$

$I_n \leq I_{MOD_MAX_OCPR}$ – the PV module max. overcurrent protection rating

$U_n \geq 1,2 \times U_{OC_STC} \times \text{No. of PV modules}$

I_n – nominal overcurrent protection rating

U_n – nominal overcurrent protection voltage

Use temperature derating factor.

ETI as one of the most important European producer of overcurrent protection equipment and devices participating in many working groups for standards development at International Electrotechnical Commission (IEC). ETI is member of maintenance team MT9 belonging to the 32B group, working on the part 6 of the IEC 60269 dealing with supplementary requirements for fuse-links for the overcurrent protection of solar photovoltaic energy systems.

gPV fuse-link must be selected acc. standard IEC 62548

CH10 gPV 1000V - Fuse-links

General characteristics

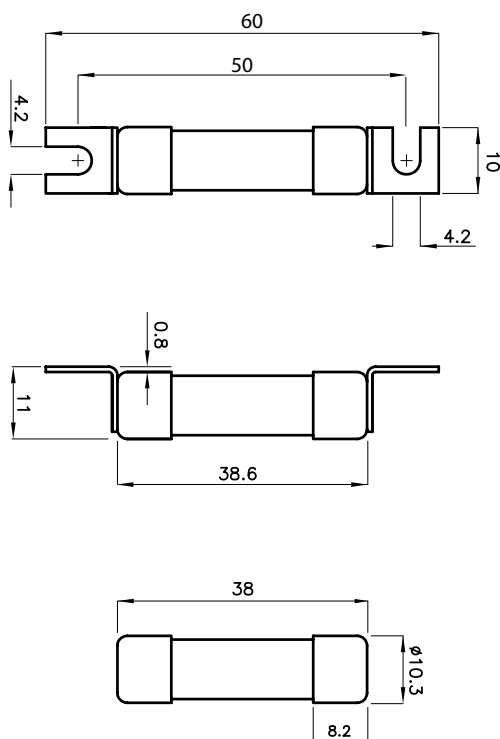
UL file: E347771

Rated voltage	1000V d.c. L/R=2ms
Rated current	0,5 - 25A
Breaking capacity	10kA d.c. UL / 30kA d.c. IEC
Standards	IEC 60269-6, UL 248-19
Application	For protection of photovoltaic modules.

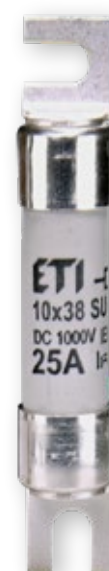


CH10x38 gPV 1000V d.c.

Size	Breaking capacity [kA]	I _n [A]	Code No. "standard contacts" 10kA UL	Code No. "standard contacts" 30kA IEC	Code No. "type SU contacts" 30kA IEC	Pre-arcing Joule integral [A ² s] L/R=2ms	Operating Joule integral [A ² s] L/R=2ms	Power dissipation [0,7 x I _n ²] Pd [W]	Power dissipation [I _n ²] Pd [W]		
0,5	/	/	/	002625134	002625131	0,02	0,07	0,2	0,5		
1	/	/	/	002625138	002625129	1,5	3	0,4	1,0		
2	002625101		002625101	002625065	002625115	1,7	2,3	0,5	1,1		
3	002625100		002625100	002625067	002625113	2,8	5,4	0,7	1,6		
3,5	002625135		002625135	002625068	002625127	2,5	7	0,6	1,4		
4	002625102		002625102	002625069	002625116	3,9	11,7	0,5	1,3		
5	002625111		002625111	002625070	002625124	8	21	0,6	1,5		
6	002625103		002625103	002625071	002625117	10,6	34,6	0,7	1,8		
7	002625110		002625110	002625072	002625114	16	60	0,7	1,7	10	10/500
8	002625104		002625104	002625073	002625118	17	65	0,8	1,9	SU: 12	SU: 10/380
10	002625105		002625105	002625075	002625119	8,3	33	1,0	2,4		
12	002625106		002625106	002625077	002625120	22	73	0,8	1,9		
13	002625137		002625137	002625078	002625128	21	70	1,0	2,3		
14	002625136		002625136	002625079	002625126	28	92	1,3	3,0		
15	002625112		002625112	002625080	002625125	49	145	1,0	2,2		
16	002625107		002625107	002625081	002625121	48	147	1,1	2,6		
20	002625108		002625108	002625085	002625122	86	245	1,3	3,2		
25	/	/	/	002625139	002625140	110	470	1,7	4,1		

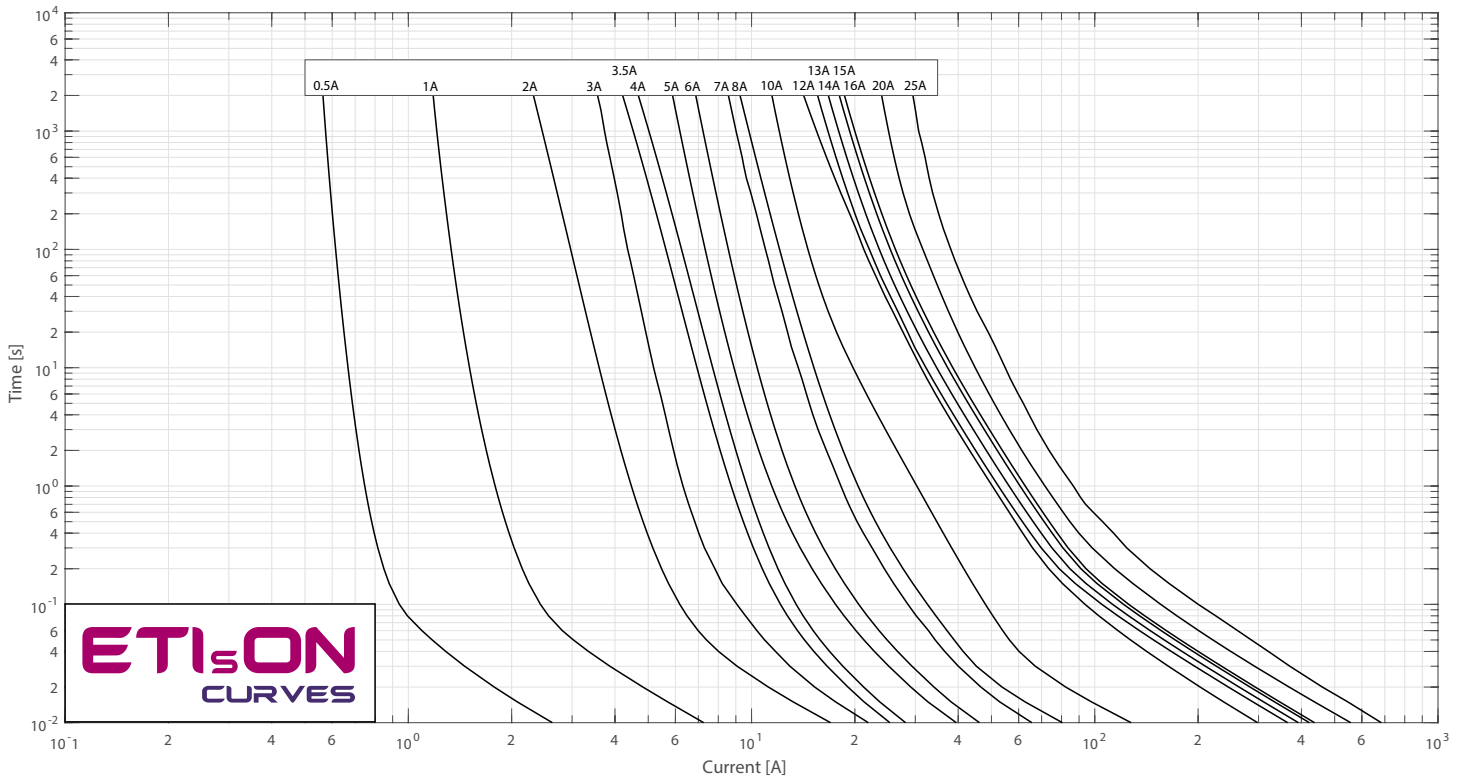


Standard Contacts

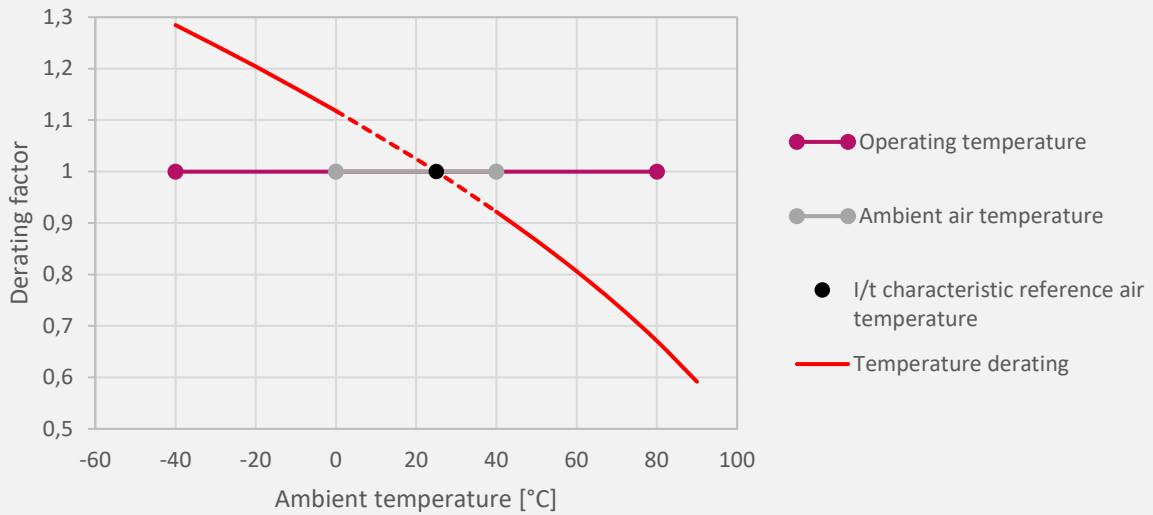


Type SU Contacts

Time current characteristics I/t



Ambient air temperature of fuse-link



Legend:

T_{amb} – Ambient Temperature

TDF – Temperature Derating Factor

I_N – Nominal Current of Fuse-link

I_{TDF} – Nominal Current Including Temperature Derating Factor

Current calculation: $I_{TDF} = I_N \times TDF$

1500V Cylindrical gPV Fuse-links

ETI developed a new generation of PV cylindrical fuse-links with nominal currents up to 63A and rated voltage up to 1500V, with gPV characteristic for protecting solar panels against the reverse current. New fuse-links have a lower power dissipation and higher breaking capacity up to 50 kA. Size 10/14x85 has a patented design for interrupting in case of short circuit conditions. All current range of fuse-links can be mounted in EFH 10/14x85 fuse-holder.

VERSION UP TO 40A 1500V



UL certified with breaking capacity 50kA



VERSION UP TO 63A 1500V



Pure silver melting-element

Silver plated contacts



Parallel connection - lower temperature rise



Perfect length for 1500V, enough of space for 63A

Entire 1500V current range can be mounted in the same fuse-holder.



Environment-friendly ceramic fuse-link body



Patented design for interrupting in case of short circuit conditions



CH10 gPV 1500V - Fuse-links

	1500V d.c. L/R=2ms
	2 - 63A
	50kA d.c.
	IEC 60269-6, UL 248-19



CH10x85 & CH10/14x85 gPV 1500V d.c.

Size	Breaking capacity [kA]	I _n [A]	Code No. "standard contacts" UL	Code No. "type SU contacts"	Code No. "In-Line"	Pre-arcing Joule integral [A ² s] L/R=2ms	Operating Joule integral [A ² s] L/R=2ms	Power dissipation [0,7 x I _n] Pd [W]	Power dissipation [I _n] Pd [W]	g	Box
10x85	50kA	2	002625200	002625210	002626300	0,8	2,3	1,0	2,4	15	10/210
		3	002625241	002625245	002626301	2,9	5,2	1,1	2,7		
		4	002625274	002625211	002626302	11,4	16,9	1,1	2,7		
		5	002625276	002625209	002626303	7,0	25,9	1,2	3,0		
		6	002625277	002625212	002626304	14,5	50,6	1,2	3,0		
		8	002625279	002625213	002626306	36,1	106,9	1,5	3,6		
		10	002625280	002625214	002626307	7,0	116,6	1,2	2,8		
		12	002625282	002625215	002626308	10,3	152,0	1,4	3,3		
		15	002625285	002625219	002626309	28,2	307,4	1,5	3,6		
		16	002625286	002625216	002626310	34,2	352,1	1,5	3,6		
10/14x85	50kA	20	002626234	002625217	002626311	48,4	462,2	2	4,8	28	10/230
		25*	002625500	/	/	100,0	750,0	2,4	5,7		
		25	002626235	/	/	72,3	633,1	2,3	5,6		
		30	002626236	/	/	143,8	959,2	2,6	6,4		
		32	002626237	/	/	158,5	938,7	3,0	7,4		
		35*	002626238	/	/	260	1.500	2,9	7		
10/14x85T	50kA	40*	002626239	/	/	400	2.500	3,2	7,7	56	5/115
		50	002626240	/	/	350	2.000	5,3	13		
		63	002626241	/	/	770	4.300	5,6	13,7		

* Self certified



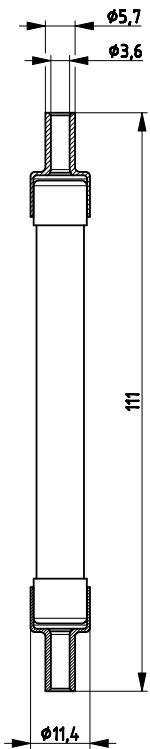
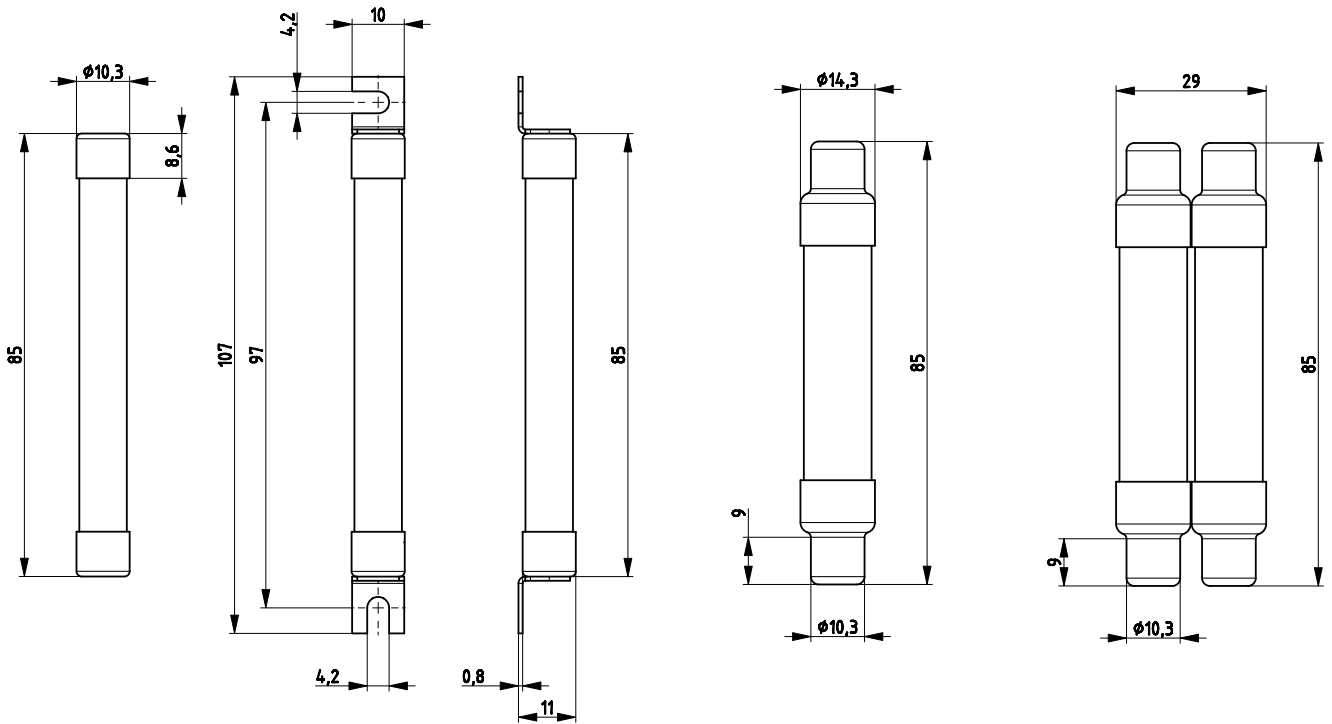
10x85

SU contacts

In-Line

10/14x85

10/14x85 T

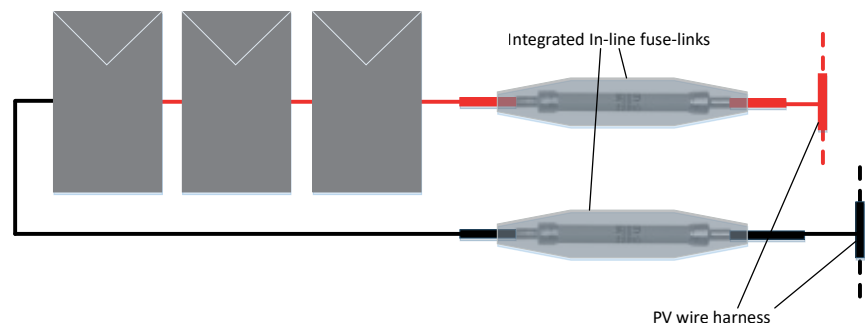


CH In-Line

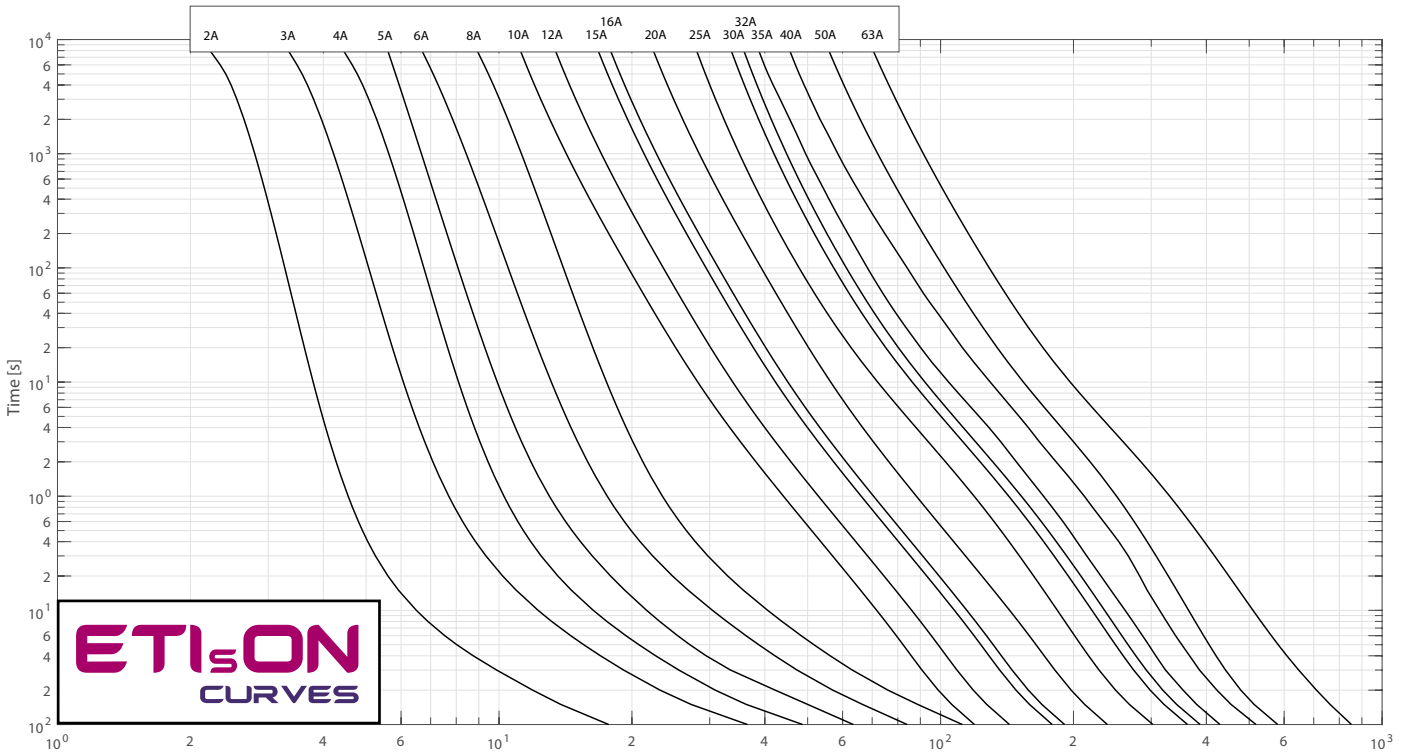
Fuse-links in accordance with TUV 2 PfG 2380:2014-02

Crimp connection: 4-6mm²

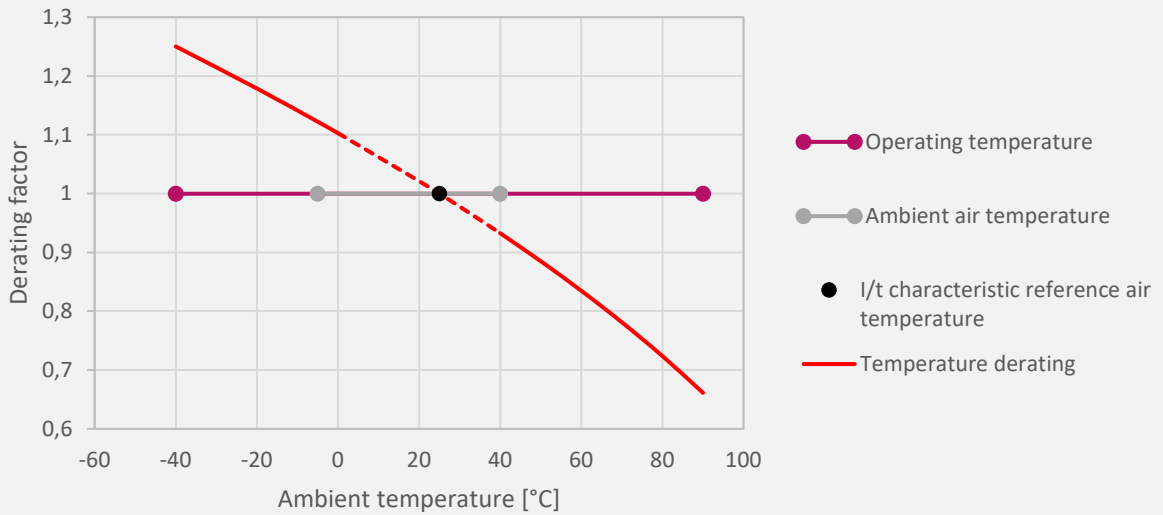
Recommended crimping tool: Amphenol Helios H4



Time current characteristics I/t



Ambient air temperature of fuse-link



Legend:

T_{amb} – Ambient Temperature

TDF – Temperature Derating Factor

I_N – Nominal Current of Fuse-link

I_{TDF} – Nominal Current Including Temperature Derating Factor

Current calculation: $I_{TDF} = I_N \times TDF$

CH14 gPV 1000V, 1100V - Fuse-links

General characteristics

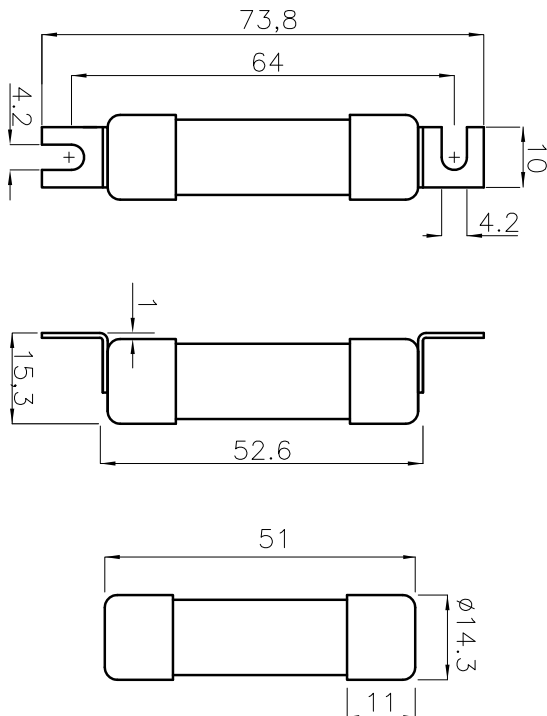
Rated voltage	1000V d.c. L/R=2ms (1100V d.c. for 002637185)
Rated current	15-36A
Breaking capacity	30kA d.c.
Standards	IEC 60269-6
Application	For protection of photovoltaic modules



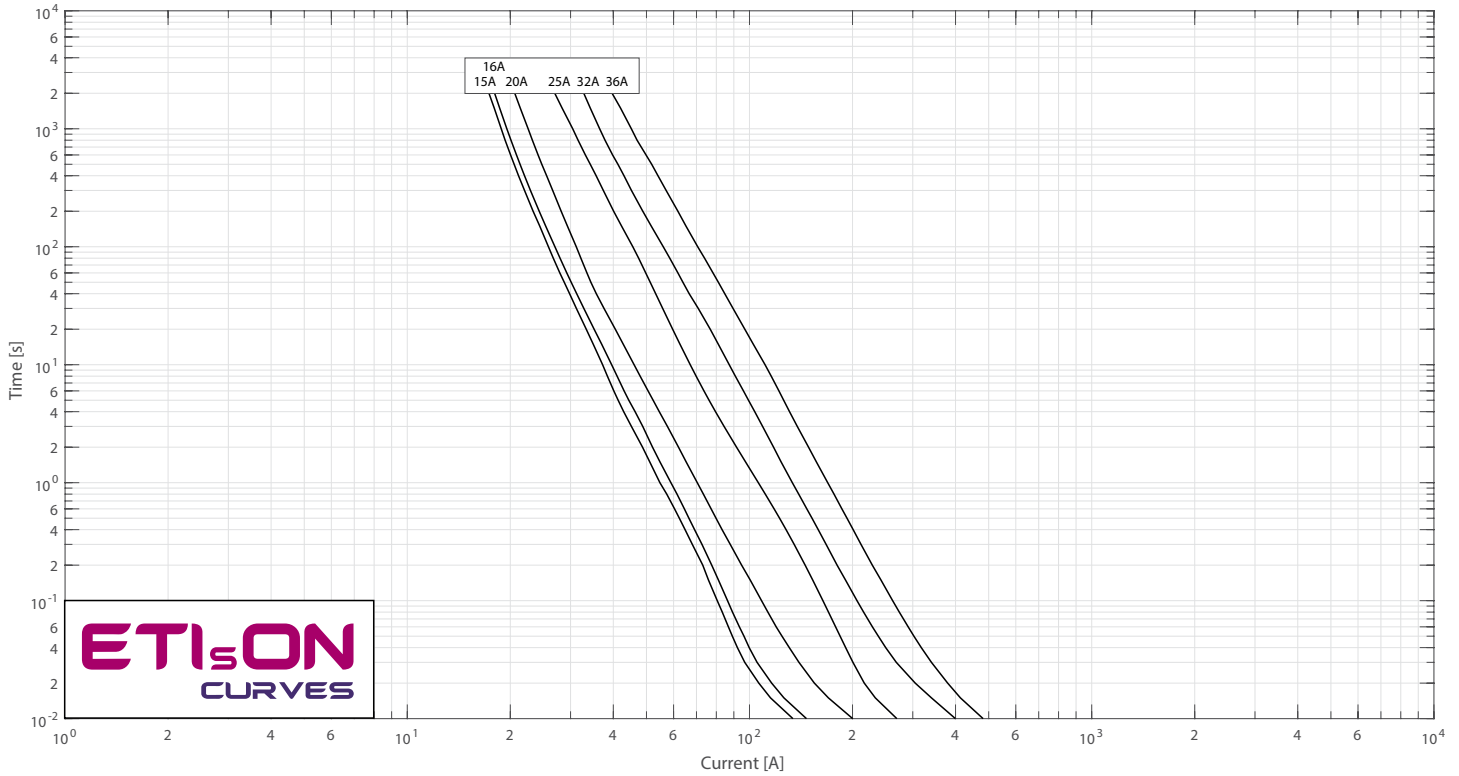
CH14x51 gPV 1000V d.c.

Size	Breaking capacity [kA]	I _n [A]	Code No. "standard contacts" 30kA IEC	Code No. "type SU contacts" 30kA IEC	Pre-arcing	Operating	Power	Power	g	Box
					Joule integral [A ² s] L/R=2ms	Joule integral [A ² s] L/R=2ms	dissipation [0,7 x I _n] Pd [W]	dissipation [I _n] Pd [W]		
14x51	30kA	15	002637140	002637340	22	237	1,4	3,1	19 SU: 21	10/200 SU:10/260
		16	002637105	002637305	55	155	1,4	3,1		
		16*	002637185	/	55	220	1,4	3,1		
		20	002637107	002637307	130	330	1,5	3,2		
		25	002637109	002637309	180	360	2	4		
		32	002637111	002637311	297	1.290	2,1	5,1		
		36	002637115	002637315	450	1.190	2,3	5,6		

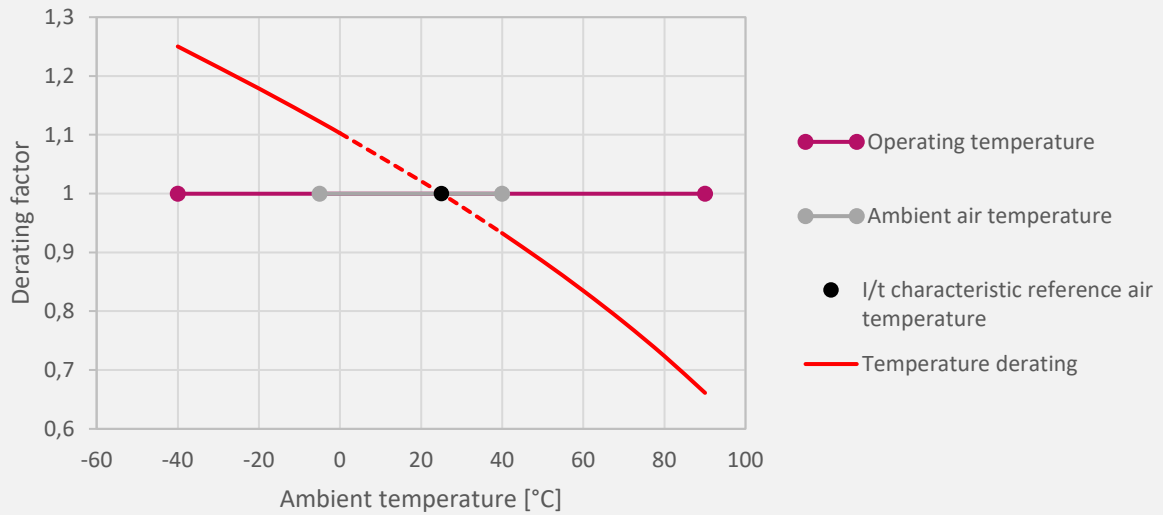
*Rated voltage 1100V d.c.



Time current characteristics I/t



Ambient air temperature of fuse-link



Legend:

T_{amb} – Ambient Temperature

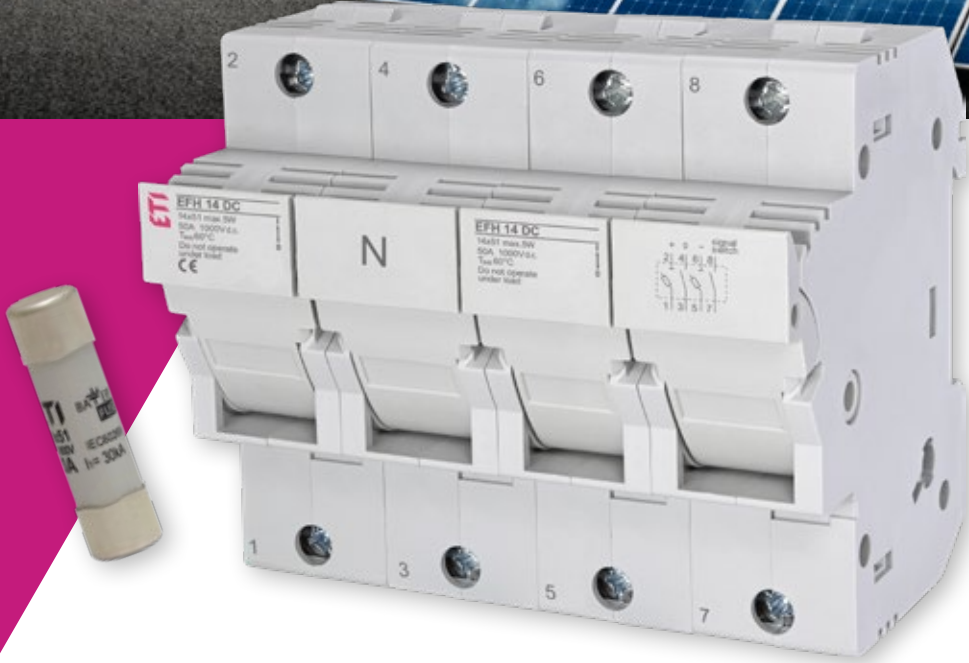
TDF – Temperature Derating Factor

I_N – Nominal Current of Fuse-link

I_{TDF} – Nominal Current Including Temperature Derating Factor

Current calculation: $I_{TDF} = I_N \times TDF$

BATTERY FUSE



 etigroup
www.etigroup.eu

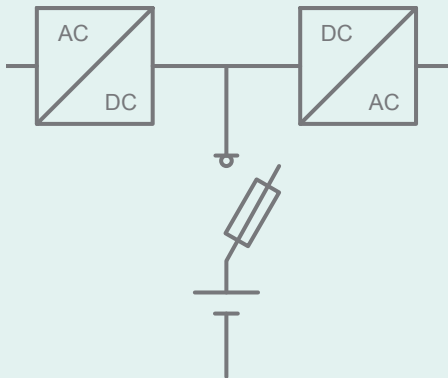
$\frac{\perp}{+}$
BATTERY
FUSE

BECAUSE EVERY
SECOND COUNTS

**Cylindrical Fuse-links
with gBat Characteristic**

ETI
SWITCH TO
A SAFE FUTURE

Battery Storage Fuse Selection

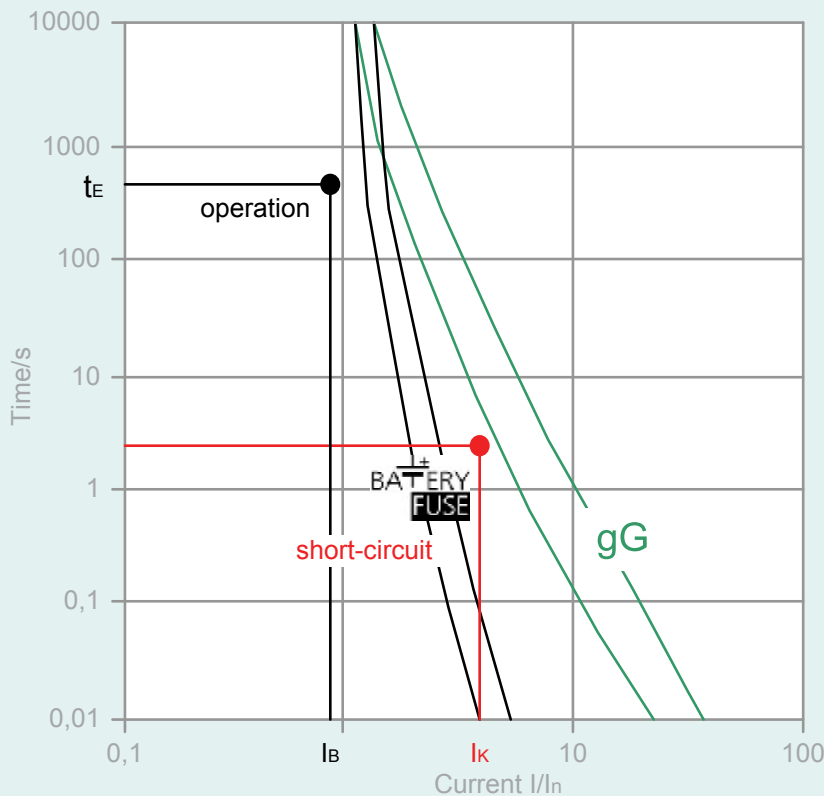


Short circuit current

- Short circuit current depending on battery model, type and capacity, low compared to operating current
- Short circuit current has to be interrupted in <5 seconds
- Required steep characteristics: protection with Battery fuse-link required!

Operating current

- Operating current depends on battery storage specification
- Battery operation: voltage of DC link circuit decreases to the final discharge voltage
- Consider maximum current at final discharge voltage for fuse-link selection



In accordance with IEC 60269-7

Short circuit point (I_k)

- Short circuit current depending on battery model and type
- Manufacturer datasheets to include short circuit current according to IEC896
- Operating point has to be in adequate distance below the curve
- Short-circuit point has to be above the range of tolerance of the curve

Operating point (t_E/I_B)

- maximum operating current I_B has to be calculated from battery storage true power and final discharge voltage U_E : $I_B = P_W/U_E$
- t_E is the back-up time of battery storage system

When choosing fuse switch disconnecter consider fuse-link power dissipation!

$$P_d(I_B) < P_y$$

Power dissipation of fuse-link at maximal operating current (I_B):

$$P_d(I_B) = (I_B/I_n)^2 \times P_d(I_n)$$

I_B - maximal operating current

$P_d(I_B)$ - power dissipation of fuse-link at maximal operating current

$P_d(I_n)$ - power dissipation of fuse-link at nominal current



P_y - maximal permissible fuse-link power dissipation mounted in fuse switch disconnecter

CH 10x38 gBat Fuse-link 550V d.c.

General characteristics

Rated voltage	550V d.c. (L/R=10ms)
Breaking capacity	30kA d.c.
Standard	IEC 60269-7
Application	Battery protection
Fuse base	EFH 10 DC

CH gBat fuse-link

Size	I_n	Code No. "standard contacts" 550V DC	Code No. "type SU contacts" 550V DC	Pre-arcing Joule integral L/R=10ms	Operating Joule integral L/R=10ms	Power dissipation [0,7 x I_n] Pd	Power dissipation [1x I_n] Pd		
	[A]	30kA	30kA	[A ² s]	[A ² s]	[W]	[W]		
10x38	2	002626002	002626102	1,1	1,8	0,47	1,12	10/12	10/500 SU: 10/380
	4	002626004	002626104	3,0	7,8	0,52	1,25		
	6	002626006	002626106	14,1	27,3	0,73	1,75		
	8	002626008	002626108	25,1	53,4	0,8	1,9		
	10	002626010	002626110	8,0	18,8	0,97	2,4		
	12	002626012	002626112	18,5	41,5	0,8	1,9		
	16	002626016	002626116	42	88	1,1	2,6		
	20	002626020	002626120	86	166	1,3	3,2		
	25	002626025	002626125	140	270	1,65	4,1		



Note:
CH Battery fuse-links are used in combination with fuse
disconnecter EFH 10 DC

Application



- /// in battery storage systems
- /// in UPS systems
- /// in e-mobility

CH 10x38 gBat Fuse-link 800V d.c.

General characteristics

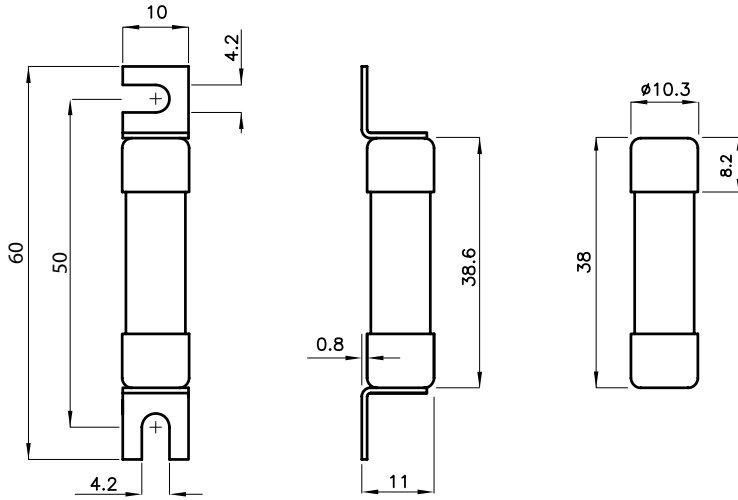
Rated voltage	800V d.c. (L/R=10ms)
Breaking capacity	30kA d.c.
Standard	IEC 60269-7
Application	Battery protection
Fuse base	EFH 10 DC

CH gBat fuse-link

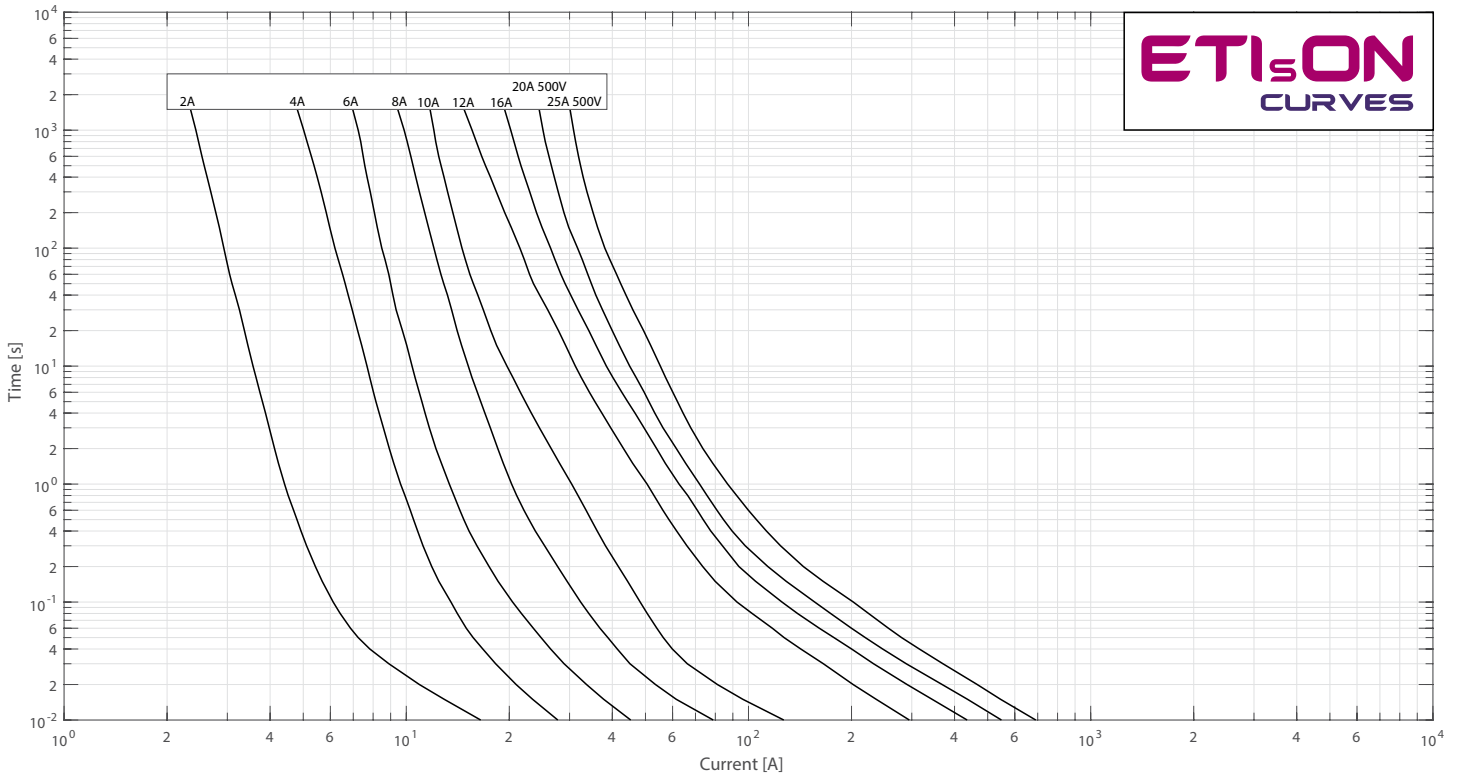
Size	I_n [A]	Code No. "standard contacts" 800V DC	Code No. "type SU contacts" 800V DC	Pre-arcing Joule integral L/R=10ms	Operating Joule integral L/R=10ms	Power dissipation [0,7 x I_n] Pd	Power dissipation [1x I_n] Pd		
		30kA	30kA	[A ² s]	[A ² s]	[W]	[W]		
10x38	2	002626030	002626130	1,2	1,6	0,47	1,12	10/12	10/500 SU: 10/380
	4	002626032	002626132	3,6	8,9	0,52	1,25		
	6	002626034	002626134	9,5	27,2	0,73	1,75		
	8	002626036	002626136	27,3	65,8	0,8	1,9		
	10	002626038	002626138	8,2	26,6	0,97	2,4		
	12	002626040	002626140	20,6	54,6	0,8	1,9		
	16	002626042	002626142	44,4	109,3	1,1	2,6		



Note:
CH Battery fuse-links are used in combination with fuse
disconnecter EFH 10 DC



Time current characteristics I/t





CH 14x51 gBat Fuse-link 800V d.c.

General characteristics

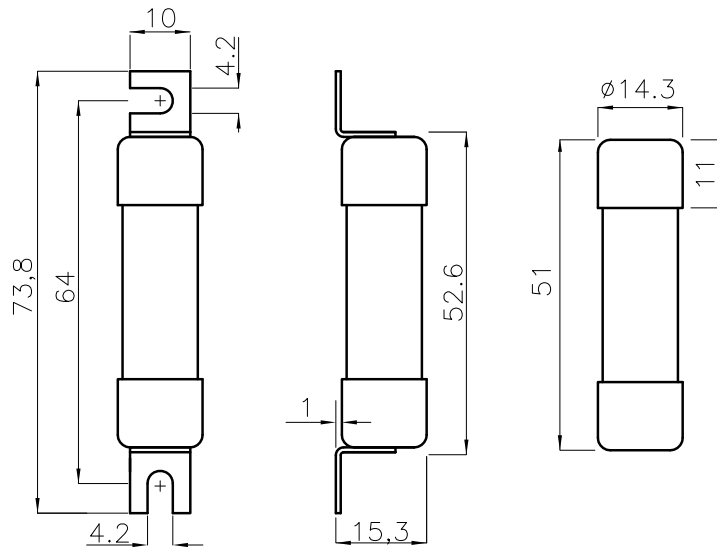
Rated voltage	800V d.c. (L/R=10ms)
Breaking capacity	30kA d.c.
Standard	IEC 60269-7
Application	Battery protection
Fuse base	EFH 14 DC

CH gBat fuse-link

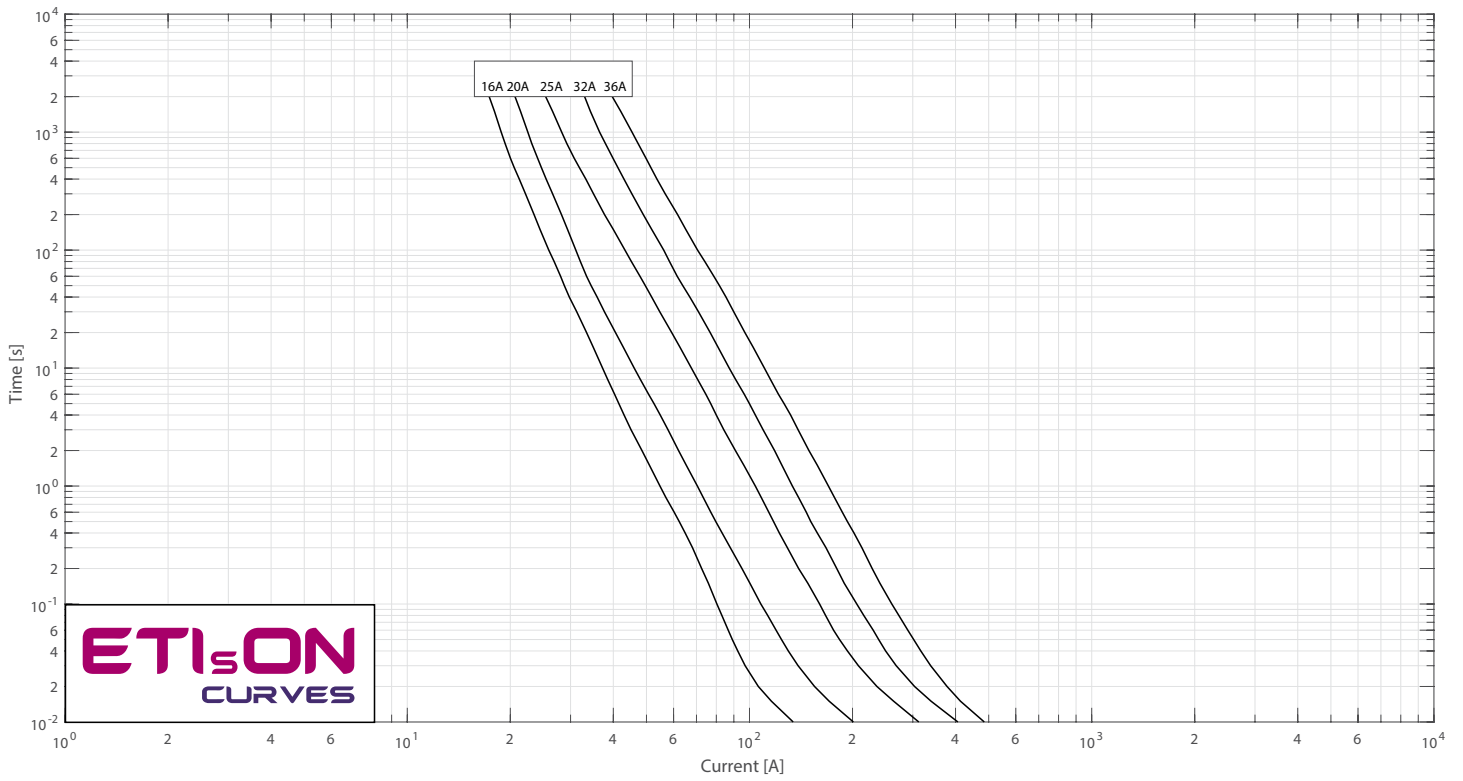
Size	I_n [A]	Code No. "standard contacts" 800V DC	Code No. "type SU contacts" 800V DC	Pre-arcing Joule integral L/R=10ms	Operating Joule integral L/R=10ms	Power dissipation [0,7 x I_n] Pd	Power dissipation [1x I_n] Pd		
		30kA	30kA	[A ² s]	[A ² s]	[W]	[W]		
14x51	16	002637405	002637505	37	136	1,4	3,1	19/21	10/200 SU: 10/260
	20	002637407	002637507	80	284	1,5	3,2		
	25	002637409	002637509	128	438	2	4		
	32	002637411	002637511	296	1050	2,1	5,1		
	36	002637412	002637512	370	1160	2,3	5,6		



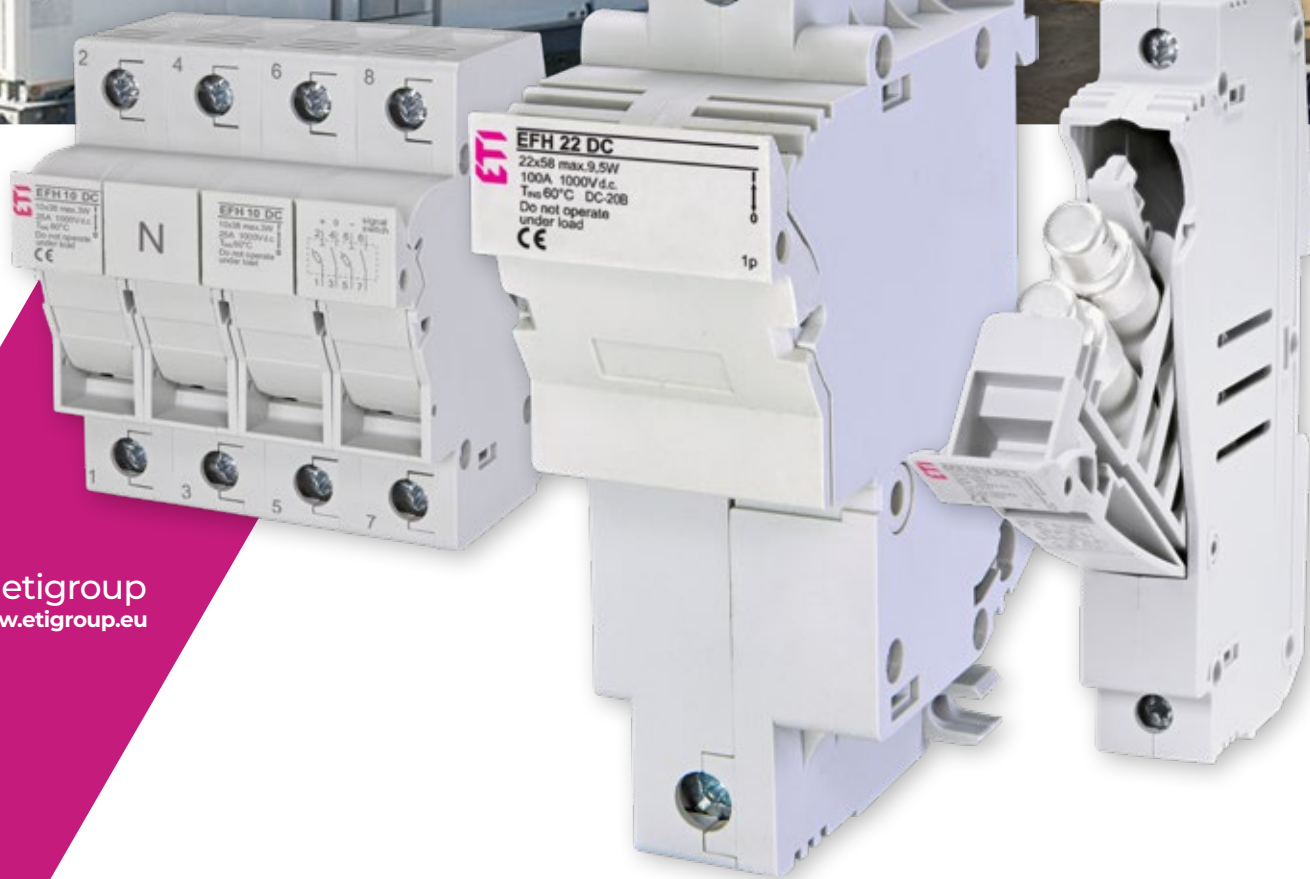
Note:
CH Battery fuse-links are used in combination with fuse
disconnecter EFH 14 DC



Time current characteristics I/t



FUSEHOLDERS FOR CYLINDRICAL DC FUSE-LINKS



 etigroup
www.etigroup.eu

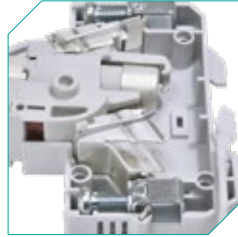
ETI
SWITCH TO
A SAFE FUTURE

Fuse holder EFH 1000V d.c.

/// All plastic parts are made of material resistant to extremely high temperatures



/// All contact surfaces are silver plated and fuse carrier assures that a fuse-link is not in touch with the housing



/// Compliance with IEC 60947-1, IEC 60947-3, UL 4248-1, UL 4248-19



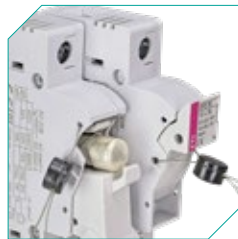
/// Safe replacement of the fuse-link without touching live parts



/// Modular design – assemble multi-pole versions at the installation site



/// Possibility of sealing in ON or OFF positions



/// Increased grip area for easier opening of fuse carrier



/// Mounting on standard DIN 35 mm rail (DIN EN60715)

/// **ELECTRONIC INDICATION VERSION**
EFH L has a built-in LED diode which blinks after the fuse-link operates. Operating voltage ranges from 50V to 1000V d.c.



/// Complete protection against touch according to IP20



/// EFB input terminals can be used for power supply, and busbars can be used for grouping



Fuse holder EFH 10, 14, 22 1000V d.c.

General characteristics



Rated voltage	1000V d.c.
Rated current	25A, 50A, 100A
Utilization category	DC-20B (Do not operate under load)
Degree of protection	IP20
Standards	IEC 60947-1, IEC 60947-3, UL 4248-1, UL 4248-19

Technical data

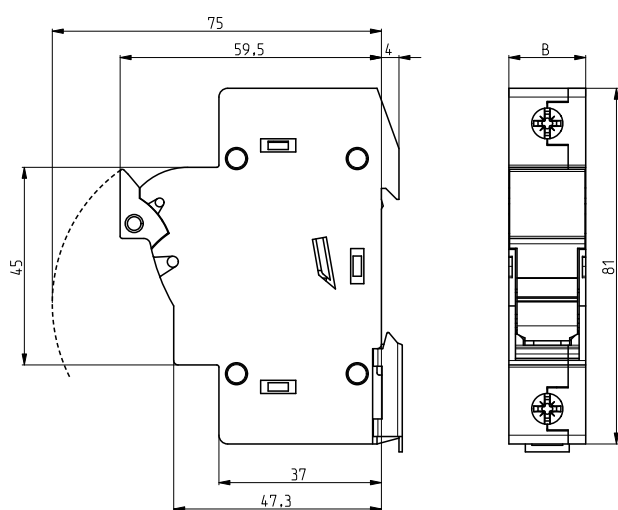
		EFH 10 DC	EFH 14 DC	EFH 22 DC
Fuse type		CH 10x38	CH 14x51	CH 22x58
Versions		Without indicator, LED indicator		
Number of poles		1p, 2p, 2p+N+S		
Rated operational voltage Ue		1000V d.c.		
Rated operational current Ie		25A	50A	100A
Rated conditional short-circuit current		IEC 30kA, UL 10kA		30kA
Rated insulation voltage Ui		1000V		
Rated imp. withstand voltage Uimp		8kV		
Max power dissipation of the fuse-link		3W	5W	9,5W
Derating factor of current In for different ambient temperatures	20°C	1		
	30°C	0,95		
	40°C	0,9		
	50°C	0,8		
	60°C	0,7		
Derating factor of current In for side by side mounting fuse holders (nr. of poles)	70°C	0,5		
	1-4	1		
	5-6	0,8		
	7-9	0,7		
	≥10	0,6		
LED indicator operating range		80V-1000V d.c.		
Utilization category		DC-20B (Do not operate under load)		
Operational performance (cycles with current)		0		
Operational performance (cycles without current)		2000		
Inclined Plane Tracking (IPT)		60min at 1kV		
Humidity		90% at 20°C		
Ambient air temperature		-5°C ... +40°C		
Operating ambient air temperature		-40°C ... +90°C		
Storage ambient air temperature		-25°C ... +55°C		
Degree of protection (IEC 60529)		IP 20		
Terminal capacity		1-25mm ² AWG 18-8 solid&stranded Cu only	1,5-35mm ² AWG 16-6 solid&stranded Cu only	4-50mm ²
Screw		PZ M5		
Torque		2Nm 17,7 lb-in	2Nm 17,7 lb-in	2,5-3Nm
Mounting on EN 60715 rail		35mm rail		
Sealing possibility		ON and OFF		
Standards - fuse-links		IEC 60269-2, IEC 606269-6, IEC 60269-7 UL, 248-1, UL 248-19		IEC 60269-2, IEC 606269-6, IEC 60269-7
Standards - fuse holders		IEC 60947-1, IEC 60947-3 UL 4248-1, UL 4248-19		IEC 60947-1, IEC 60947-3
Test reports		UL		Internal
Certificates		UL Listed		

GREEN PROTECT / Fuseholders for Cylindrical DC Fuse-links

EFH 10 d.c.

Number of poles	U_c/U_i [V]	I_{max} [A]	Code No.	Max. power dissipation of the fuse-link per pole [W]	Indicator	 g	
1p	1000	25	002540201	3	-	63	12/108
			002540211		LED	64	
002540203			-		124	6/54	
002540213			LED		125		
2p+N+S*			002540204		-	257	3/27



*Only IEC certified



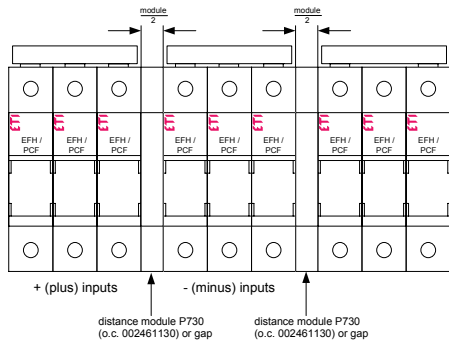
	B
1p	17,5
2p	35
2p+N+S	70



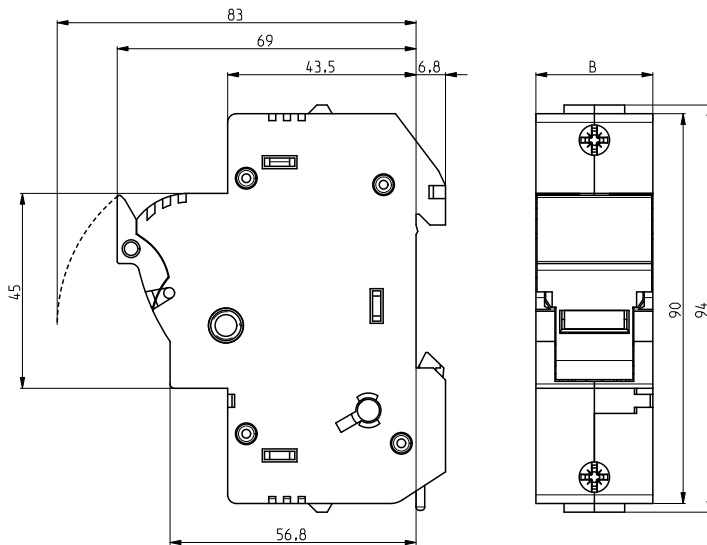
EFH 14 d.c.

Number of poles	U_e/U_i [V]	I_{max} [A]	Code No.	Max. power dissipation of the fuse-link per pole [W]	Indicator		
1p	1000	50	002560201	5	-	102	12/96
			002560211		LED	103	
002560203			-		206	6/48	
002560213			LED		208		
2p+N+S*			002560205		-	452	3/24

*Only IEC certified



- * keep distance between group of three fuse holders
- ** put together up to three fuse holders in one group
- *** keep groups of + (plus) poles together and groups of - (minus) poles together but separated
- **** tighten contact screws using suggested torque and test torque again after some period of use





	B
1p	27
2p	54
2p+N+S	108

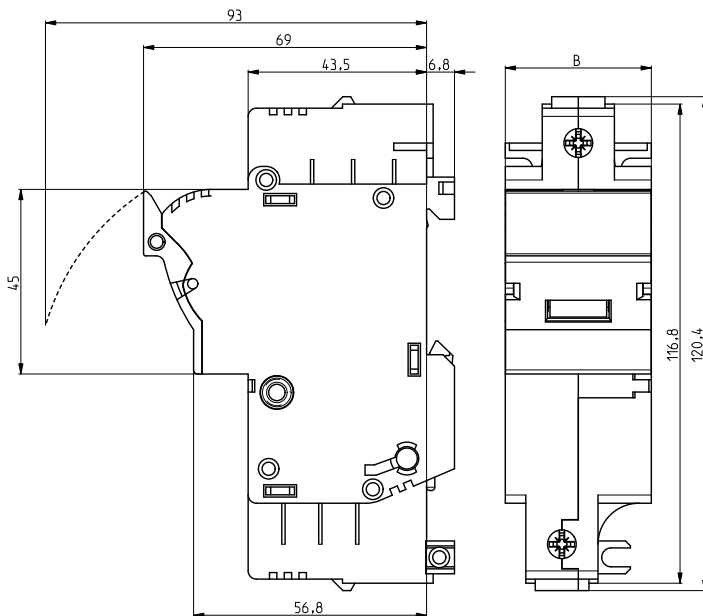


GREEN PROTECT / Fuseholders for Cylindrical DC Fuse-links

EFH 22 d.c.

Number of poles	U_c/U_i [V]	I_{max} [A]	Code No.	Max. power dissipation of the fuse-link per pole [W]	Indicator	 g	
1p	1000	100	002570201	9,5	-	156	3/105
			002570211		LED	158	
			002570203		-	317	
2p			002570213		LED	321	2/34

Type	Dimensions [mm]
	B
1 pole	35,6
2 pole	71,2

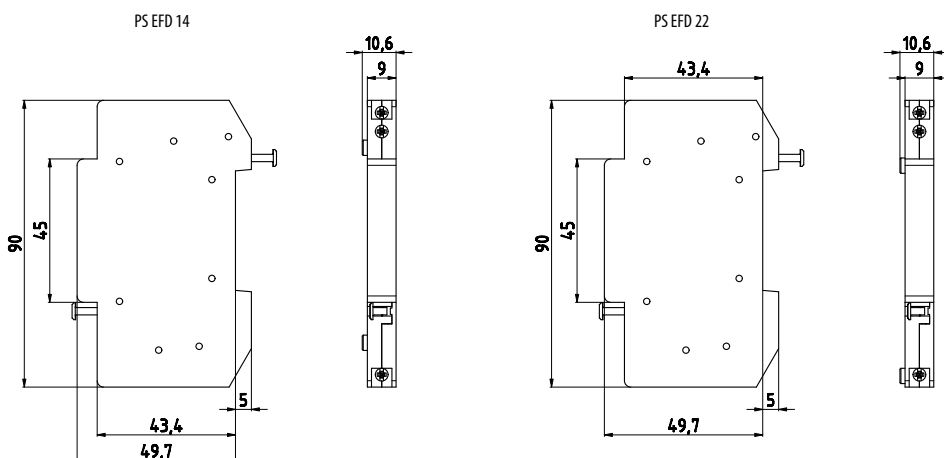


Accessories

Auxiliary switch PS EFD is intended to be mounted with fuseholders EFH 14 and EFH 22 for all versions (1p, 2p, 1p+N, 3p, 3p+N). The width of apparatus is 9 mm, other dimensions comply with EFH 14 and EFH 22 series. Auxiliary switch PS EFD signals the operation of CH14 or CH 22 fuse-links only in the case a fuse-link is fitted with striking pin - see IEC 60 269-2 Figure 1a (III).

Auxiliary switch PS EFD

U _n [V]	I _n [A]	Code No.	Code No.	g	1/10	Contact
		EFD14	EFD22			
250	5	002569001	002579001	50	1/10	1 x make 1 x break



Connection kit

Description	Code No.	For use with	g	1/20
Connection kit 2p	002540948	EFD 8, EFD 10, EFH 10, PCF 8, PCF 10	96	1*/20
Connection kit 3p	002540949	EFD 8, EFD 10, PCF 8, PCF 10	162	1*/20
Connection kit 2p	002560948	EFH 14, EFH 14	144	1*/20
Connection kit 3p	002560949	EFH 14	217	1*/20
Connection kit 2p	002570948	EFD 22, EFD J30	191	1*/20
Connection kit 3p	002570949	EFD 22, EFD J30	300	1*/20



*Note: 1 kit suffices for the assembly of 50 sets

1500V

Photovoltaic fuseholder EFH DC

✓ Versatility - the same type of combiner boxes for different systems



✓ LED indication with possibility of remote signalization



✓ Special design of the housing's outer part, providing distance for natural ventilation



✓ The same size of fuse-holders 10/14 up to 40A and 10/14 T up to 63A



✓ Safe replacement of the fuse-link without touching live parts



✓ Printing on the front side



✓ Ease of installation using IZ35 busbars



✓ Sealing possibilities



✓ Compliance with IEC 60947-1, IEC 60947-3, UL 4248-1, UL 4248-19

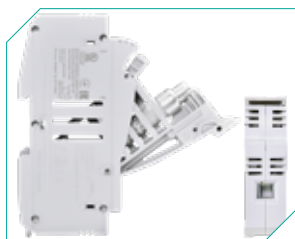
✓ Silver-plated contacts

✓ Complete protection against touch according to IP20

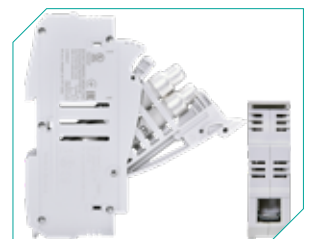
✓ Two-position snapper



✓ Regular version:
For 10x85 and 10/14x85 fuse-links
Up to 40A 1500V
Max. permissible power dissipation of fuse-link 8,5W



✓ T version:
1 1/4 standard module width
The most compact design on the market (35% less needed space in combiner box)



EFH 10/14x85 DC - Photovoltaic fuseholder

General characteristics



Rated voltage	1500V d.c.
Rated current	40, 63A
Utilization category	PV-0
Degree of protection	IP20
Standards	IEC 60947-1, IEC 60947-3, UL 4248-1, UL 4248-19

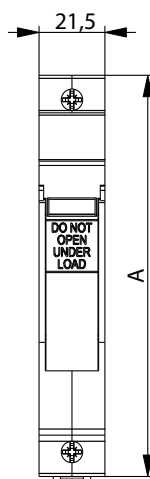
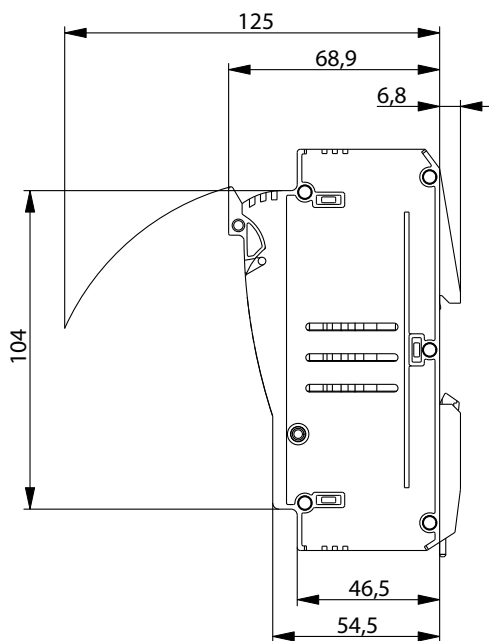
Technical data

	EFH 10/14x85	EFH 10/14x85 T
Fuse type	CH 10x85, CH 10/14x85	CH 10/14x85 T
Versions	Without indicator, LED indicator	
Rated operational voltage U _e	1500V d.c.	
Rated operational current I _e	40A	63A
Rated conditional short-circuit current	50kA	
Max. power dissipation of the fuse-link	8,5W	14,5W
LED indication operating range	80V - 1500V d.c.	
Utilization category	PV-0	
Operational performance (cycles with current)	Do not operate under load	
Operational performance (cycles without current)	2000	
Humidity	90% at 20°C	
Ambient air temperature	-5°C ... +40°C	
Operating ambient temperature	-40°C ... +90°C	
Store ambient temperature	-25°C ... +55°C	
Degree of protection (IEC 60529)	IP 20	
Terminal capacity	0,75-16mm ² AWG 18-6 solid&stranded Cu only	0,75-50mm ² AWG 18-2 solid&stranded Cu only
Screw	PZ M5	PZ M6
Torque	2 Nm 17,7 lb-in	2,5 Nm 22,2 lb-in
Mounting on EN 60715 rail	35mm rail	
Sealing possibility	ON and OFF	
Standards - fuse-links	IEC 60269-2, IEC 60269-6, IEC 60269-7 UL 248-1, UL 248-19	
Standards - fuse holders	IEC 60947-1, IEC 60947-3, UL 4248-1, UL 4248-19	
Test reports	UL	UL
Certificates	UL Listed	UL Listed

GREEN PROTECT / Fuseholders for Cylindrical DC Fuse-links

CH EFH 1500V d.c.

Type	I_{max} [A]	No. of poles	Code No.	Max. power dissipation of the fuse-link per pole [W]	Indicator	 g	
EFH 10/14x85	40	1p	002580001	8,5	-	94	10/160
			002580011		LED	97	
EFH 10/14x85 T	63		002580006	14,5	-	125	
			002580016		LED	128	



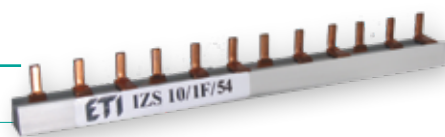
	A
EFH 10/14	131
EFH 10/14 T	135,6

Section rail

EFH 10 DC

Type	Description	Code No.	Cross section [mm ²]	Length [m]	g	Box
IZS10/1F/54	10 mm ² , 1 pole, 54 mod	002921101	10	1	150	40
IZS16/1F/54	16mm ² , 1 pole, 54 mod	002921111	16	1	220	40

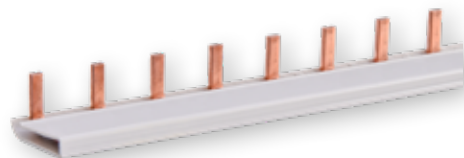
For use with EFH10 DC, more info in B&I catalogue



EFH 14 DC

Type	Description	Code No.	Cross section [mm ²]	Length [m]	g	Box
IZS16/1F/36	16mm ² , 1 pole, 36 mod	002921121	16	1	280	40

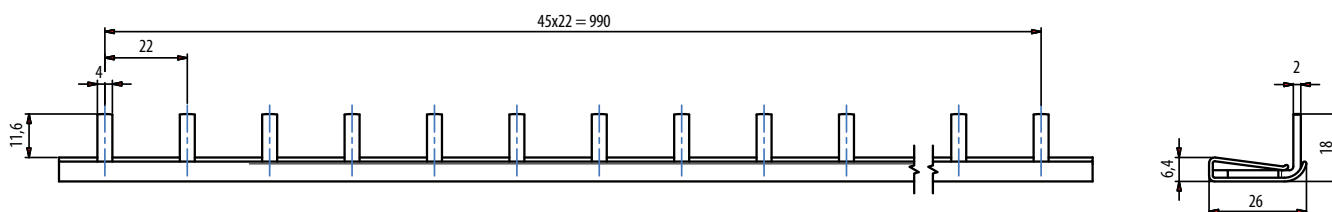
For use with EFH14 DC, more info in B&I catalogue



EFH 10/14x85 DC



Type	Description	Code No.	Cross section [mm ²]	Length [m]	g	Box
IZS35/1F/46	35mm ² , 1 pole, 46 mod, T=22mm, 1500 VDC, 125A	002921292	35	1,016	400	10

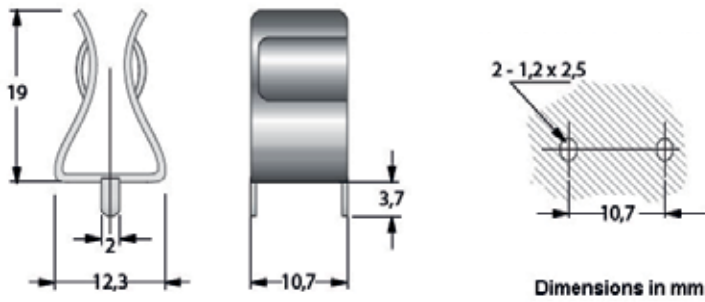
Use end cover Z-50/1F/28 (002921263), under 1 reference code = 1 pair
Feeding at beginning/ending rail = 125A, feeding in middle of rail = 200A



Clip contact for CH fuse-links



Clip contact for CH10 fuse-links

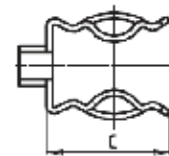
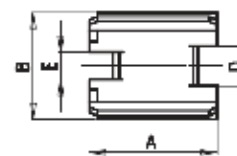
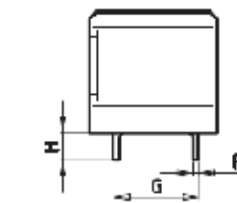
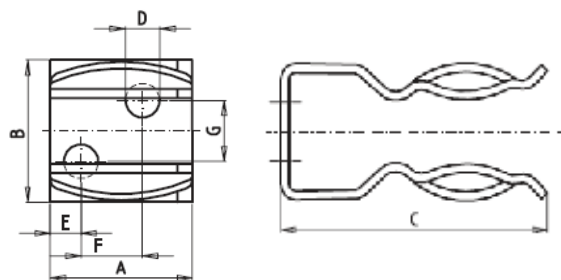
Code	Type	 g	
006710335	CH10-PCB	1	250



Type	Dimensions [mm]							
	A	B	C	D	E	F	G	H
CH10-PCB	12,3	9,8	19,0	2,0	2,0	0,75	11,0	4,0

Clip contact for CH14 fuse-links

Code	Type	 g	
006710340	CH14-PCB	5	100
006710341	CH14-SCR	5	100



Type	Dimensions [mm]						
	A	B	C	D	E	F	G
CH14-SCR	16	16	23	4,2	6,5	0	0

Type	Dimensions [mm]							
	A	B	C	D	E	F	G	H
CH14-PCB	16	14	15,5	5	3,5	0,75	10,7	3,5

PROTECTION OF PV SYSTEMS



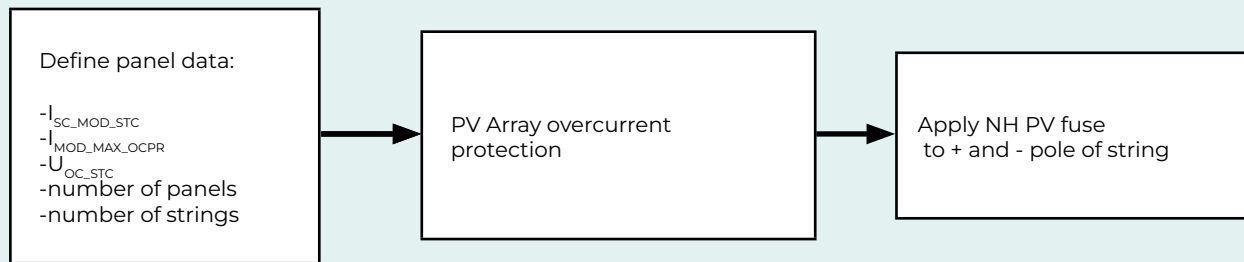
 etigroup
www.etigroup.eu

**NH Fuse-links with
gPV Characteristic**

ETI
SWITCH TO
A SAFE FUTURE

Photovoltaic Array Overcurrent Protection

NH gPV fuse selection



PV array overcurrent protection:

$$I_n > 1,25 \times I_{SC_ARRAY} \text{ - the short circuit current of the PV array at STC}$$

$$I_n \leq 2,4 \times I_{SC_ARRAY}$$

$$I_{SC_ARRAY} = I_{SC_MOD_STC} \times \text{No. of PV strings}$$

ETI as one of the most important European producer of overcurrent protection equipment and devices participating in many working groups for standards development at International Electrotechnical Commission (IEC). ETI is member of maintenance team MT9 belonging to the 32B group, working on the part 6 of the IEC 60269-7 dealing with supplementary requirements for fuse-links for the overcurrent protection of solar photovoltaic energy systems.

gPV fuse-link must be selected acc. standard IEC 62548

NH gPV 1000V - Fuse-links

General characteristics

Rated voltage	1000V d.c. (NH1, 2, 3: L/R=1ms; NH0, 1C: L/R=2ms)
Breaking capacity	30kA d.c. (NH1, 2, 3), 20kA d.c. (NH0, 1C)
Standards	IEC 60269-6
Application	Fuse-link for DC application. Applied in fuse base PK1, 2, 3 1000V d.c..

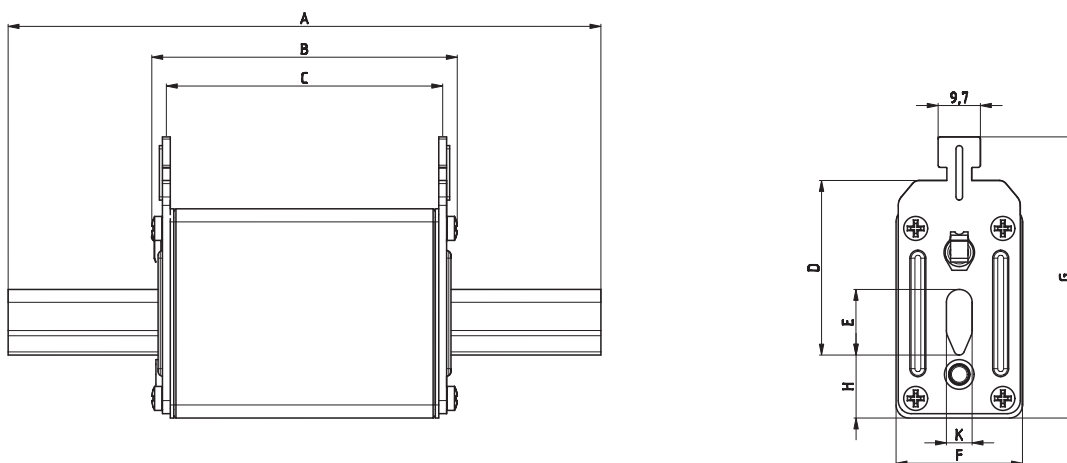


NH gPV 1000V d.c.

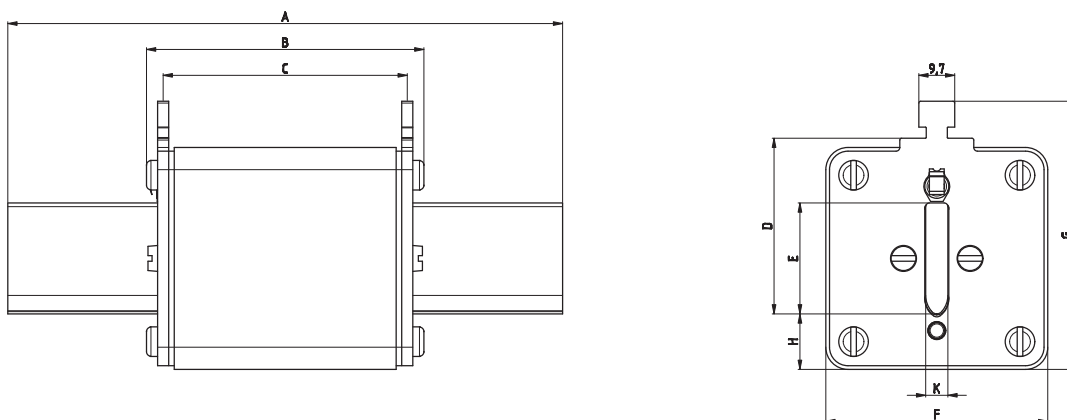
Size	I _n [A]	gPV Standard indicator	gPV S ₁₁₀ screw contact	gPV U ₁₁₀ screw contact	gPV G screw contact with centre trip indicator for microswitch MK	Power dissipation (0,7 x I _n) [W]	Power dissipation [W]	Pre-arcing Joule integral [I ² t] (L/R = 1ms)	Operating Joule integral [I ² t] (L/R = 1ms)	g	Box
		Code No. Pic.1	Code No. Pic.2	Code No. Pic.3	Code No. Pic.4						
0	32	004110381	-	-	-	-	7,6	52	430	280	3/45
	40	004110383	-	-	-	-	8,8	96	730		
	50	004110384	-	-	-	-	11,0	155	920		
	63	004110385	-	-	-	-	13,5	290	1.760		
	80	004110386	-	-	-	-	17,0	520	3.160		
	100	004110387	-	-	-	-	21,0	1.110	5.280		
	125	004110388	-	-	-	-	22	2.800	11.340		
1C	32	004110371	-	-	-	-	7,6	52	430	300	3/45
	40	004110373	-	-	-	-	8,8	96	730		
	50	004110374	-	-	-	-	11,0	155	920		
	63	004110375	-	-	-	-	13,5	290	1.760		
	80	004110376	-	-	-	-	17,0	520	3.160		
	100	004110377	-	-	-	-	21,0	1.110	5.280		
	125	004110378	-	-	-	-	22	2.800	11.340		
160	004110379	-	-	-	-	32	5.950	20.750			
1	200	004110342	-	-	-	11	27	4.400	29.000	500	3/24
2	200	004110343	004110292	004110296	004110346	11	26	4.400	29.000	650	1/16 (G screw contact: 2/16)
	250	004110344	004110293	004110297	004110347	15	36	6.000	38.000		
3	160	004110456	-	-	-	15	38	5.000	10.000	1200	3/15 (G screw contact: 2/8)
	200	004110455	-	-	-	18	45	10.000	20.000		
	250	004110458	-	-	-	18	44	20.000	40.000		
	315	004110460	004110294	004110298	004110232	24	54	40.000	80.000		
	350	004110459	004110348	004110349	004110233	25	55	45.000	90.000		
	400	004110457	004110295	004110299	004110234	24	58	46.000	138.000		



Standard indicator

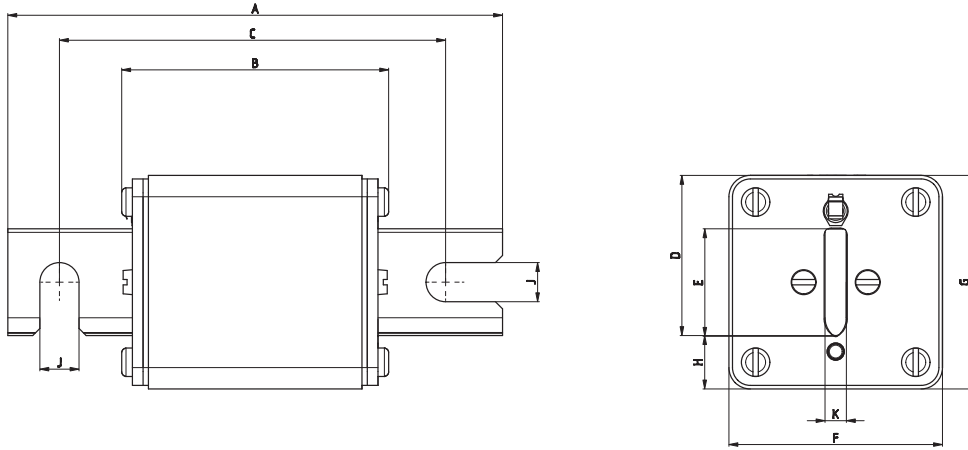


Size	A	B	C	D	E	F	G	H	K
0	125	72	66	35	15	30	60	15	6
1C	135	72	66	40	15	30	65	15	6

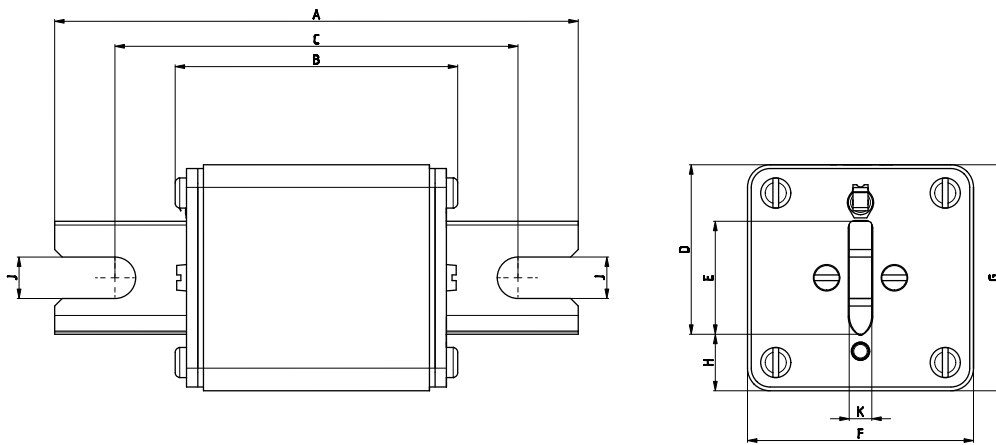


Size	A	B	C	D	E	F	G	H	K
1	135	74	70	42	24	51	67	13,5	6
2	150	74	70	48	30	61	71	15	6
3	150	74	70	60	37	73	87	18	6

S₁₁₀ screw contact

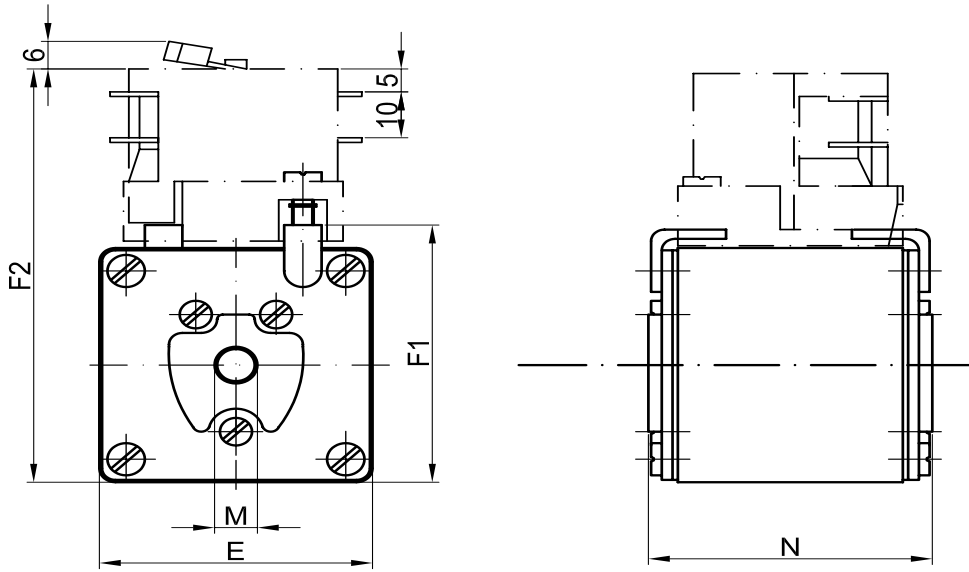


U₁₁₀ screw contact



Size	A	B	C	D	E	F	G	H	K	J - NHS	J - NHU
2 S,U	140	73	110	45	30	60	60	15	6	11	13
3 S,U	140	73	110	55	37	73	73	18	6	11	13

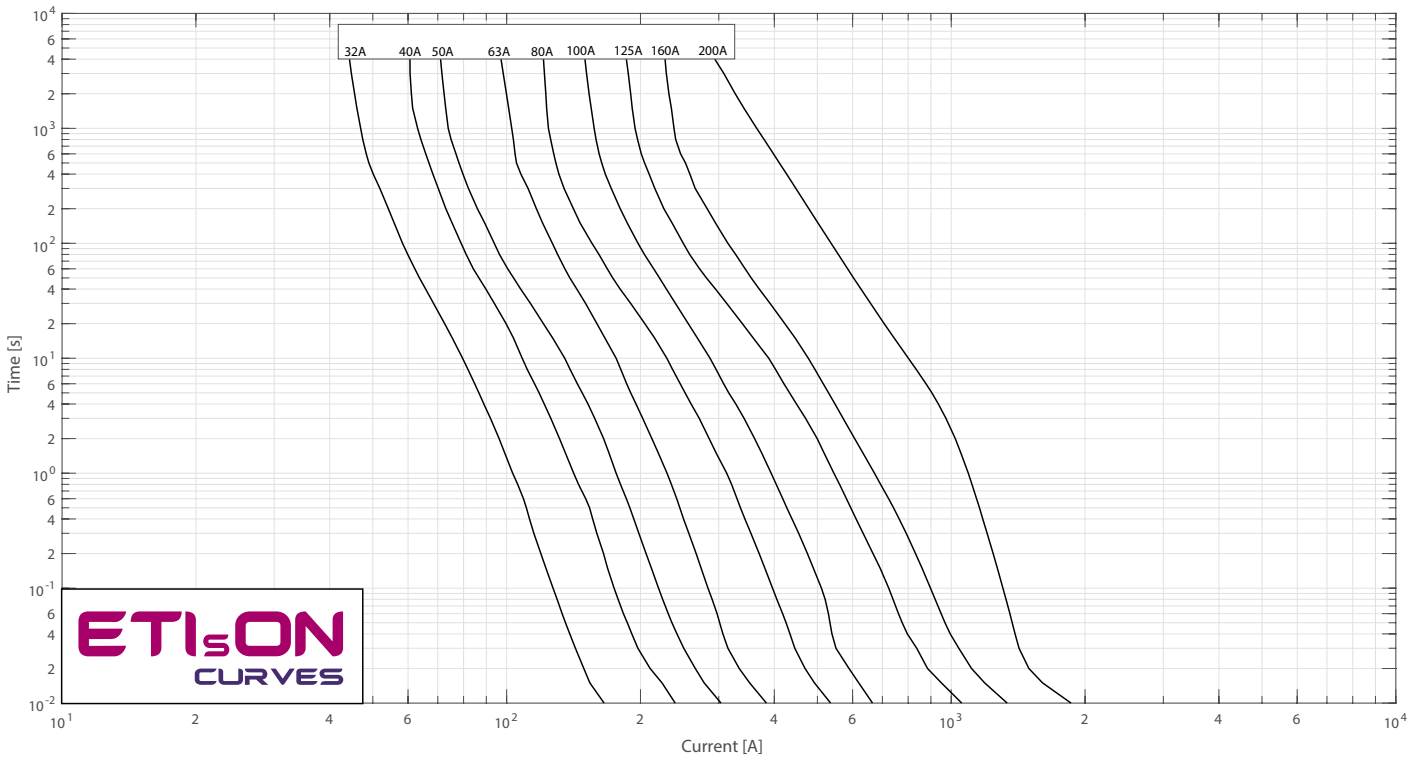
G screw contact



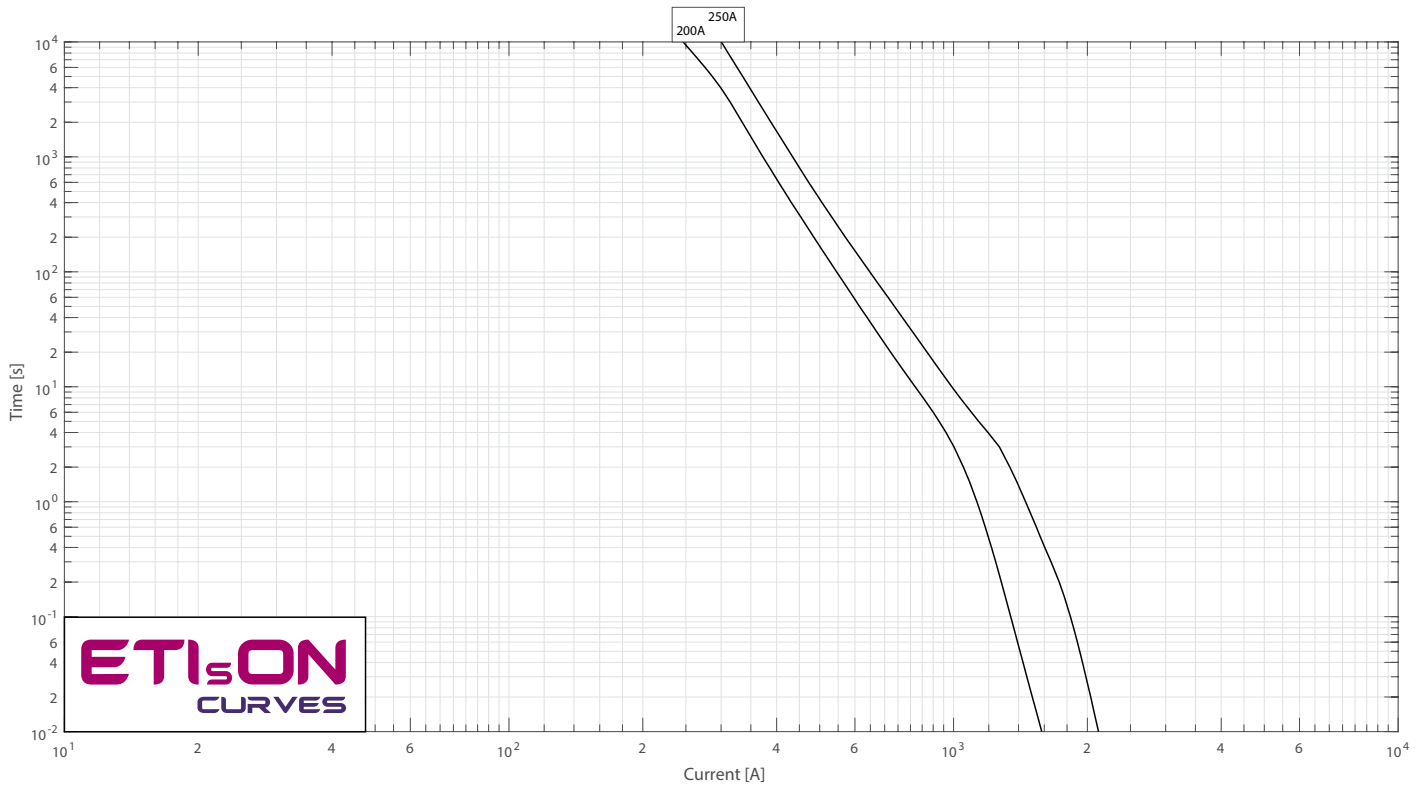
Size	D	E	F1	F2	M	N
2	60	60	65	99	M10	75
3	75	75	80	114	M12	75

Time current characteristics I/t

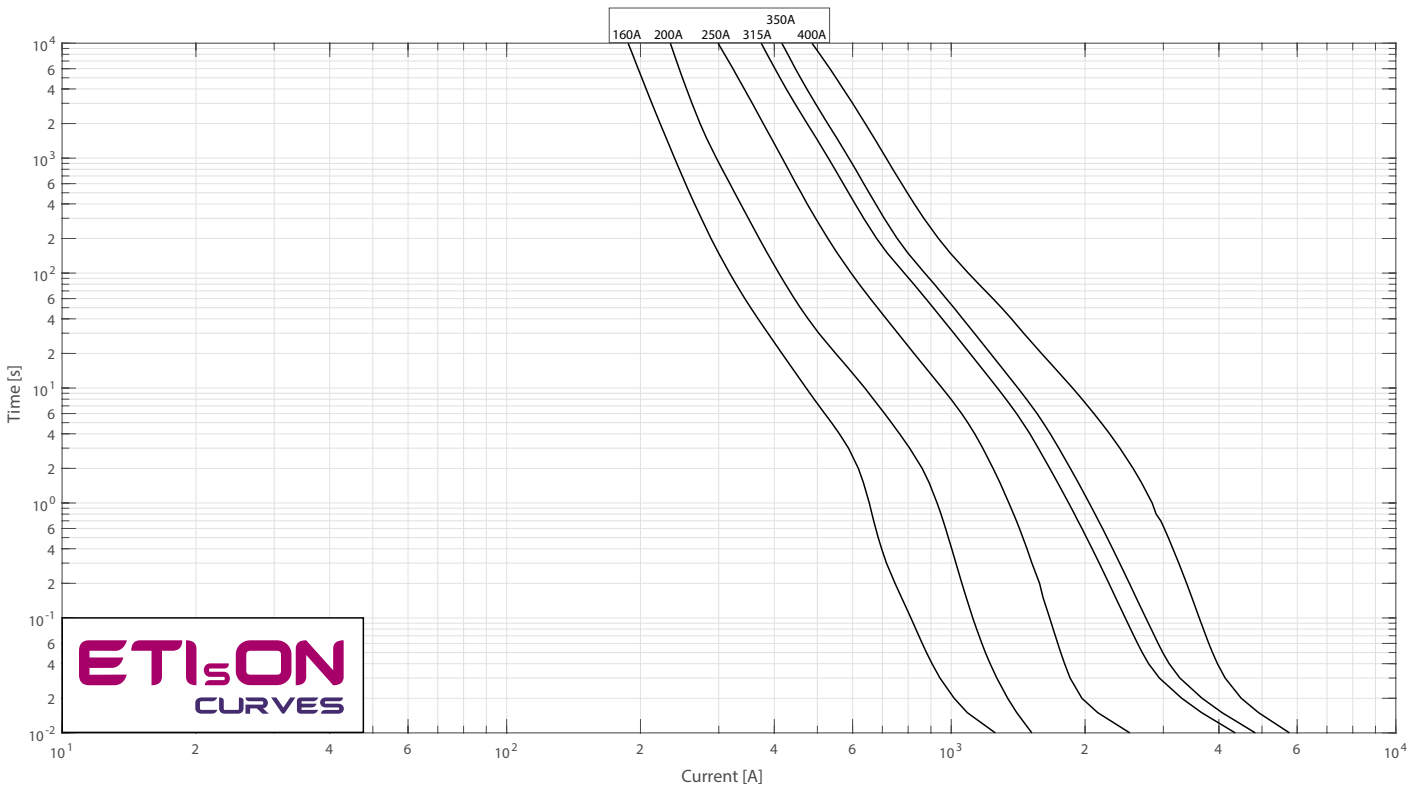
NH0, 1C, 1 gPV 1000V



NH2 gPV 1000V



NH3 gPV 1000V



NH gPV 1100V - Fuse-links

General characteristics

UL file: E347771

Rated voltage	1100V d.c. (L/R = 2ms)
Breaking capacity	10 kA d.c. (NH 3L 630A: 30kA d.c.)
Standards	IEC 60269-6, UL 248-19
Application	Fuse-link for DC application. Applied in fuse base PK XL 1500V.



NH gPV 1100V d.c.

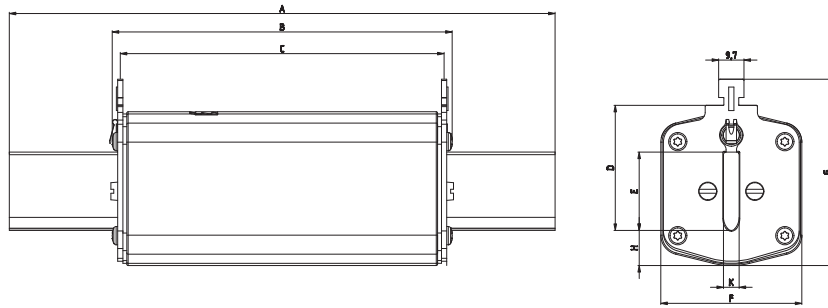
Size	I _n [A]	Standard indicator	gPV		Power dissipation (0,7xI _n) Pd [W]	Power dissipation [W]	Pre-arcing Joule integral [I ² t] (L/R = 2ms)	Operating Joule integral [I ² t] (L/R = 2ms)	g	Box
			S ₁₇₀ screw contact	U ₁₇₀ screw contact						
1XL	63	004110391	004110472	004110487	7	15,7	2.800	3.500	750	1/17
	80	004110392	004110473	004110488	7	16	4.500	5.500		
	100	004110393	004110474	004110489	8,3	19	7.500	9.000		
	125	004110394	004110475	004110490	9,7	22	13.000	15.000		
	160	004110395	004110476	004110491	13,2	30	25.000	30.000		
2XL	200	004110396	004110477	004110492	15	34,8	39.000	80.000	1050	1/15
	200	004110397	004110478	004110493	15,9	36	55.000	75.000		
	250	004110398	004110479	004110494	19,3	44	90.000	120.000		
3L	315	004110399	004110480	004110495	23	53,6	170.000	230.000	1360	1/10
	350	004110400	004110481	004110496	26	58	195.000	260.000		
	400	004110401	004110482	004110497	28	64,8	250.000	350.000		
	450	004110485	004110486	004110498	34	85	130.000	250.000		
	500*	004110629	004110628	004110627	37	98	150.000	370.000		
	630**	004110449	/	004110484	46	119	180.000	450.000	1970	1/10

*size 73x73; dimensions on page 52 (3L).

** 30kA, not UL certified

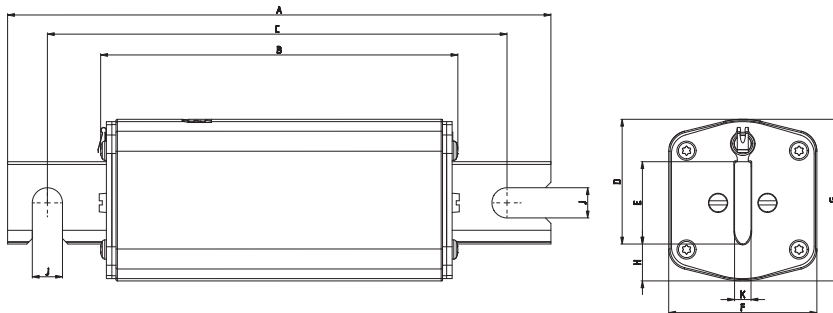


NH 1XL, 2XL, 3L

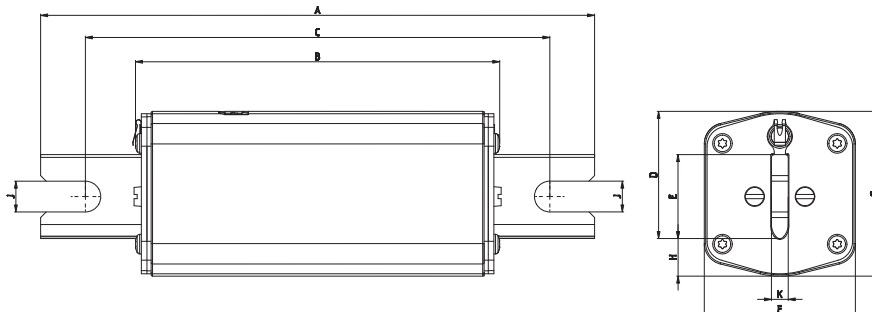


Size	Dimensions [mm]								
	A	B	C	D	E	F	G	H	K
1XL	194	129	124	40	24	46	62	12	6
2XL	209	129	124	48	30	54	71,5	13,5	6
3L	209	129	124	60	37	64	83,5	13,5	6

NHS 1XL, 2XL, 3L



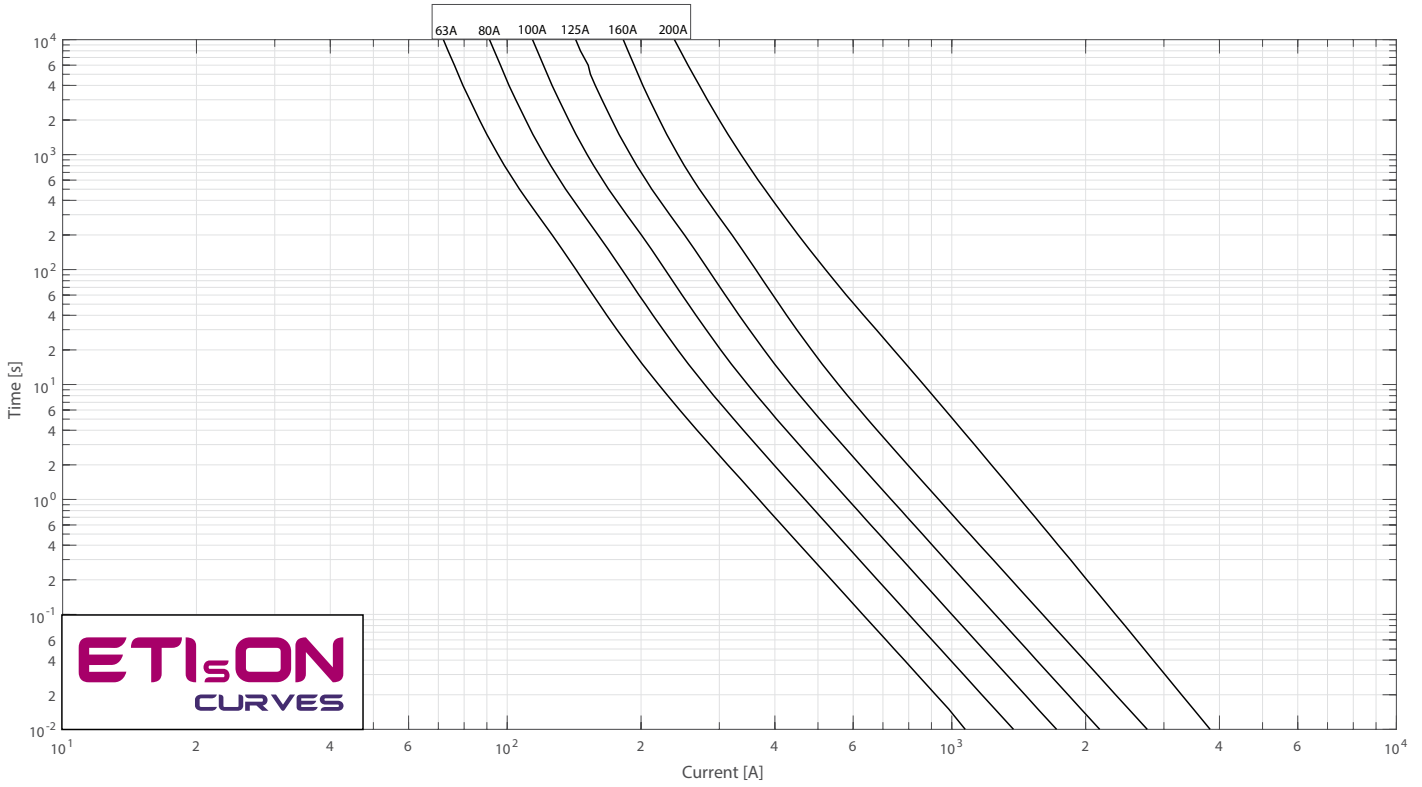
NHU 1XL, 2XL, 3L



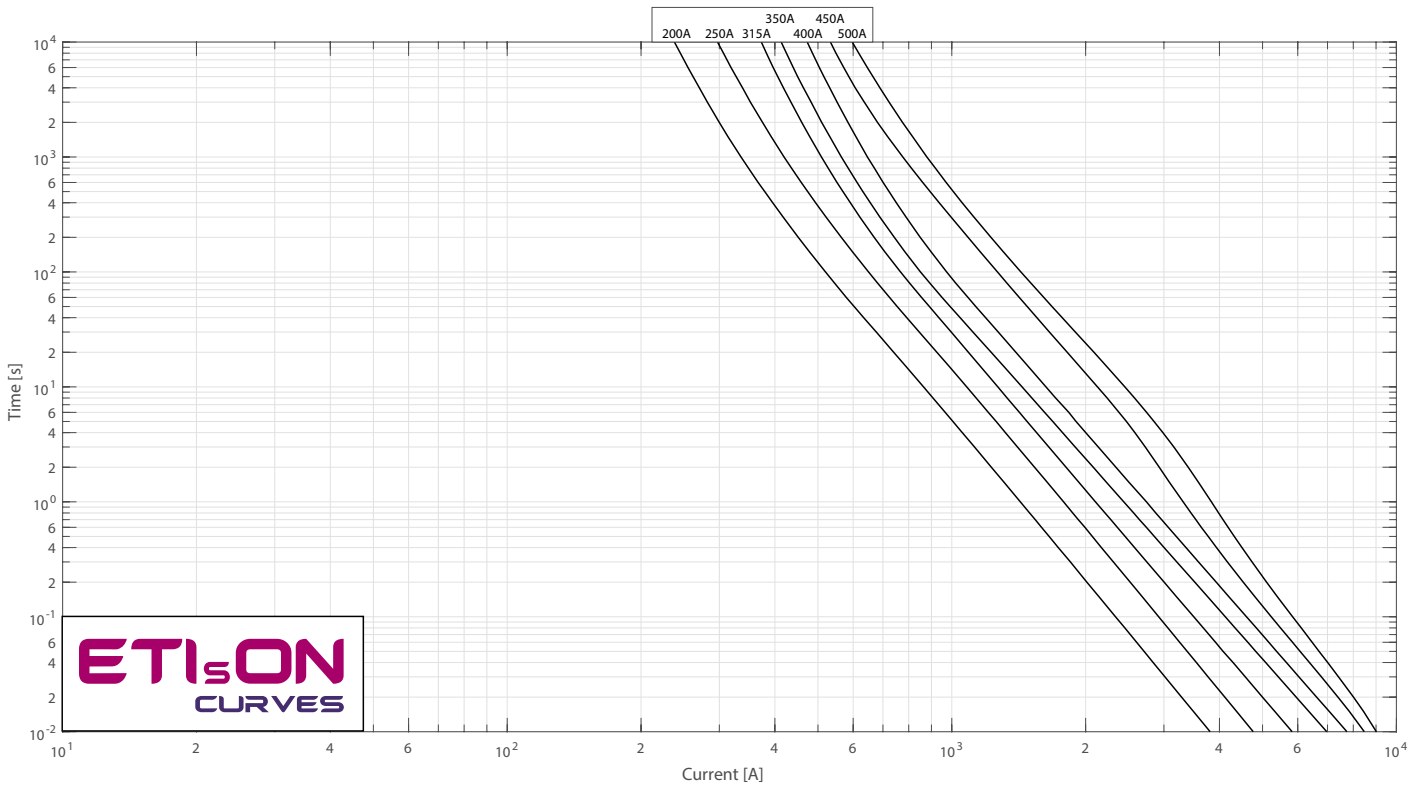
Size	Dimensions [mm]										
	A	B	C	D	E	F	G	H	K	J-NHS	J-NHU
1XL S,U	197	170	124	40	24	46	50	12	6	11	11
2XL S,U	200	170	124	48	30	54	59	13,5	6	11	13
3L S,U	200	170	124	60	37	64	70	13,5	6	11	13

Time current characteristics I/t

NH1XL



NH2XL, NH3L



NH 01XL gPV 1500V - Fuse-links



General characteristics

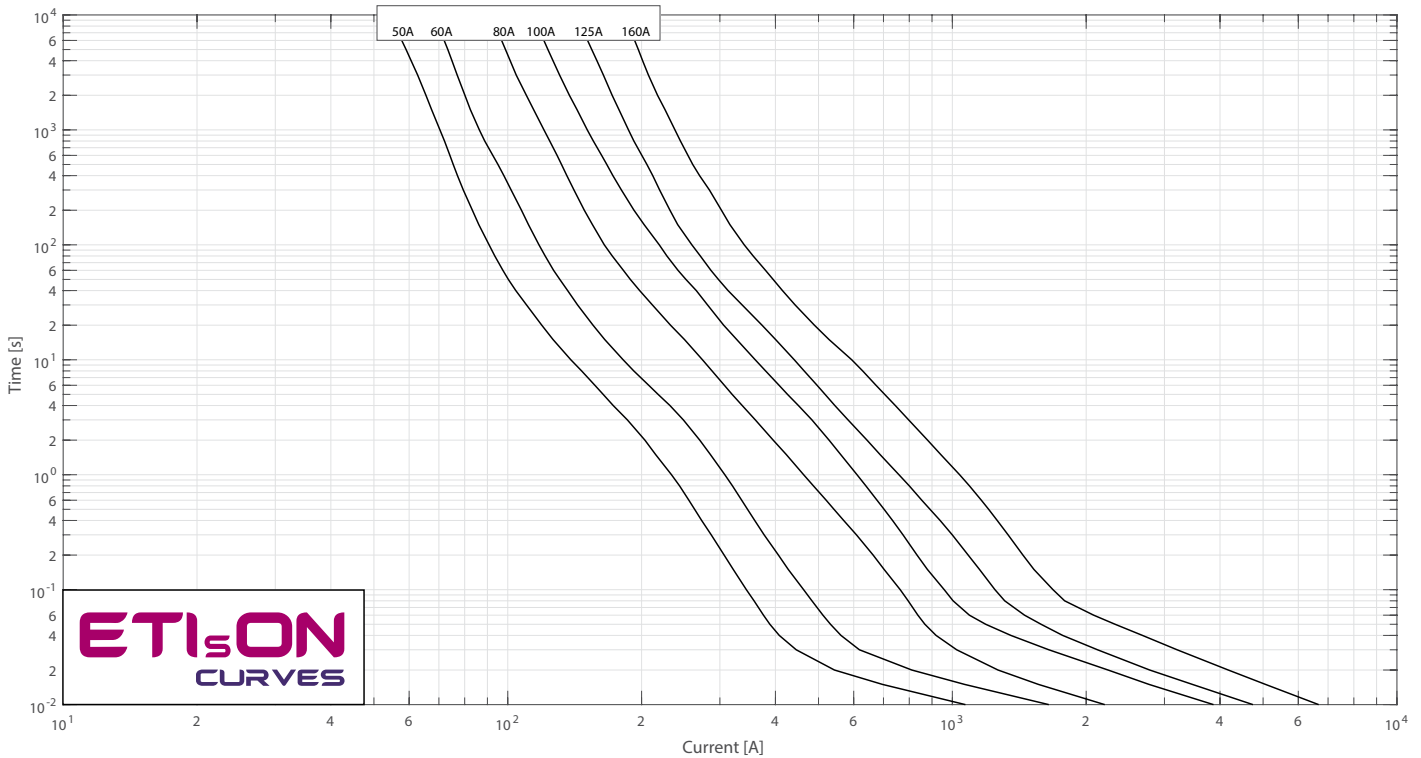
Rated voltage	1500V d.c. (L/R=3ms)
Breaking capacity	30kA d.c.
Standards	IEC 60269-6, UL248-19
Application	Fuse-link for DC application. Applied in fuse base PK1XL.



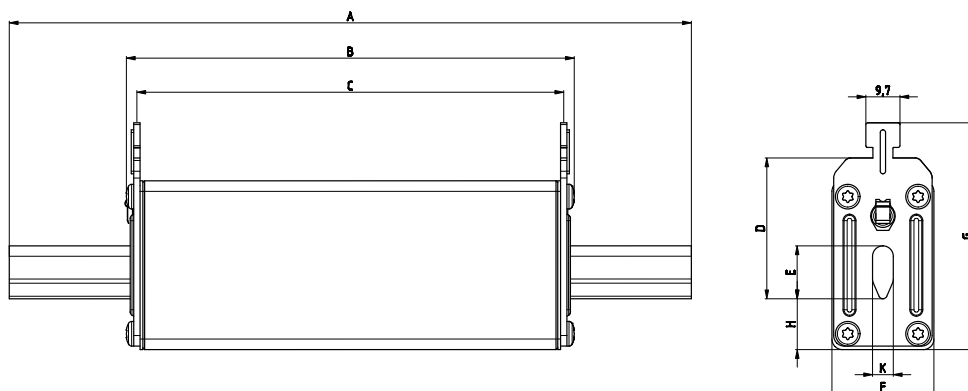
NH gPV 1500V d.c.

Size	I_n [A]	gPV Standard indicator	gPV S_{150} screw contact	gPV U_{150} screw contact	Power dissipation (0,7xI _n) Pd [W]	Power dissipation [W]	Pre-arcing Joule integral [I ² t] (L/R = 3ms)	Operating Joule integral [I ² t] (L/R = 3ms)		
01XL	50	004110692	004110743	004110749	7	18	500	3.000	450	3/30
	63	004110693	004110744	004110750	8,5	22	1.000	6.000		
	80	004110694	004110745	004110751	9	21	2.000	15.000		
	100	004110695	004110746	004110752	11	29	3.500	25.000		
	125	004110696	004110747	004110753	13	36	4.000	30.000		
	160	004110697	004110748	004110754	17	46	6.000	48.000		

Time current characteristics I/t

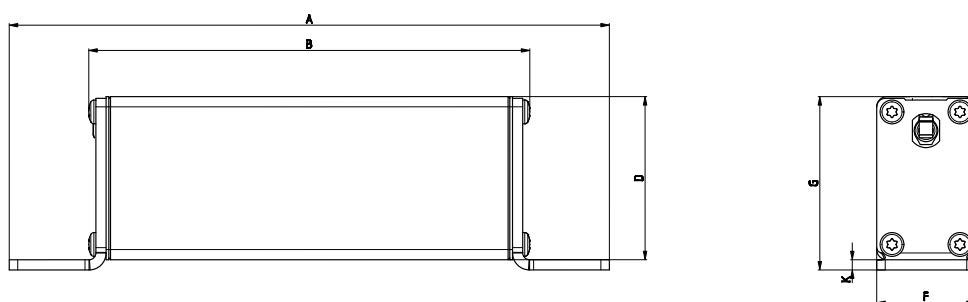


NH 01XL

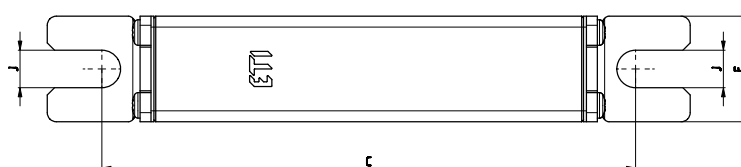
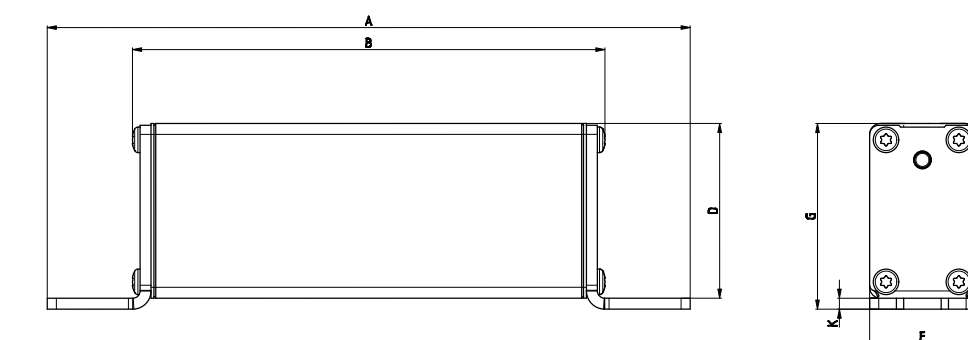


	A	B	C	D	E	F	G	H	K
01XL	194	128	123,2	40	15	29	65	15	6

NHS 01XL



NHU 01XL



	A	B	C	F	G	K	J
01XL S,U	177	130	150	29	51	3	10

NH gPV 1500V - Fuse-links



General characteristics

UL file E347771

Rated voltage	1500V d.c. (L/R=3ms)
Breaking capacity	30kA d.c. NH1,2XL; 50kA d.c. NH3L
Standards	IEC 60269-6, UL 248-19
Application	Fuse-link for PV applications. Applied in fuse base PK XL 1500V.



NH gPV 1500V d.c.

Size	I_n [A]	Standard indicator	gPV		Power dissipation (0,7xl) Pd [W]	Power dissipation [W]	Pre-arcing Joule integral [I²t] (L/R = 3ms)	Operating Joule integral [I²t] (L/R = 3ms)		
			S_{170} screw contact	U_{170} screw contact						
1XL	50	004110621*	004110622	004110623	6	14	800	3500	950	1/15
	63	004110560*	004110591	004110606	6,2	14	1.500	6.000		
	80	004110561*	004110592	004110607	7	16	5.000	15.000		
	100	004110562*	004110593	004110608	8,3	19	10.000	26.000		
	125	004110563*	004110594	004110609	9,7	22	15.000	37.000		
	160	004110564*	004110595	004110610	13,2	30	19.000	48.000		
	200	004110565*	004110596	004110611	13,7	32,5	22.000	75.000		
2XL	200	004110566*	004110597	004110612	15,9	36	42.000	75.000	1350	1/9
	250	004110567*	004110598	004110613	19,3	44	73.000	132.000		
	315	004110630*	004110635	004110640	22,2	57	65.000	300.000		
	350	004110631*	004110636	004110641	23,7	61	75.000	350.000		
	400	004110632*	004110637	004110642	26,8	67	85.000	450.000		
3L	450	004110633*	004110638	004110643	29	75	130.000	600.000	1970	1/9
	500	004110634*	004110639	004110644	44,3	79	160.000	700.000		
	630	004110647*	004110648	004110649	40	102	280.000	1.600.000		



* possible to mount microswitch NV55





General characteristics

UL file E347771

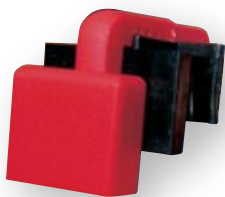
Rated voltage	1500V d.c. (L/R=3ms)
Breaking capacity	50kA d.c.
Standards	IEC 60269-6, UL 248-19
Application	Fuse-link for PV applications. Applied in fuse base PK XL 1500V.



NH gPV 1500V d.c.

Size	I _n [A]	gPV		Power dissipation (0,7xI _n ²) Pd [W]	Power dissipation [W]	Pre-arcing Joule integral [I ² t] (L/R = 3ms)	Operating Joule integral [I ² t] (L/R = 3ms)	g	Box
		S ₁₇₀ screw contact (pic.4)	U ₁₇₀ screw contact (pic.5)						
3L MS	315	004110729	004110734	22,2	57	65.000	300.000	1970	1/9
	350	004110730	004110735	23,7	61	75.000	350.000		
	400	004110731	004110736	26,8	67	85.000	450.000		
	450	004110732	004110737	29	75	130.000	600.000		
	500	004110733	004110738	44,3	79	160.000	700.000		

It is possible to mount microswitch NVS5 to all fuse-links in the above table.



General characteristics

Rated voltage	1500V d.c. (L/R=3ms)
Breaking capacity	70kA d.c. (IEC 60947-3: test sequence IV) / 50kA d.c. (IEC 60269-6), UL 248-19
Standards	IEC 60269-6, IEC 60947-3: test sequence IV, UL 248-19
Application	Fuse-link for PV applications. Applied in fuse base PK XL 1500V.



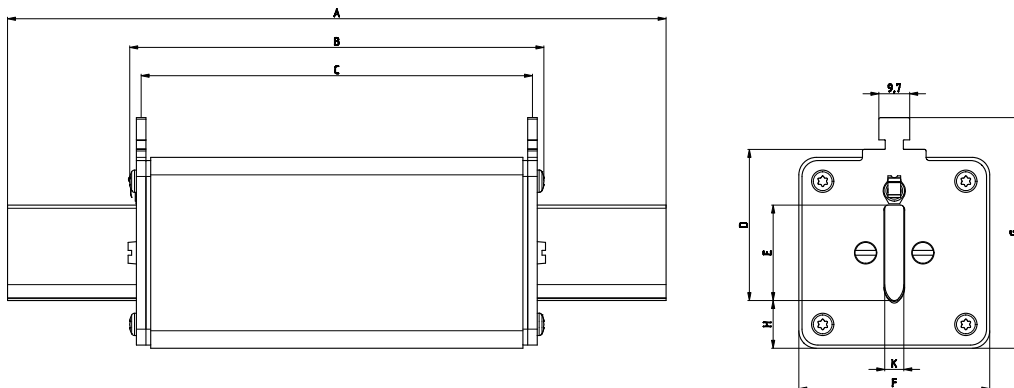
NH gPV 1500V d.c.

Size	I _n [A]	Standard indicator	gPV		Power dissipation (0,7xI _n) Pd [W]	Power dissipation [W]	Pre-arcing Joule integral [I²t] (L/R = 3ms)	Operating Joule integral [I²t] (L/R = 3ms)	g	1/9
			S ₁₇₀ screw contact	U ₁₇₀ screw contact						
3L	315	004110714*	004110719	004110724	22,2	57	65.000	300.000	1970	1/9
	350	004110715*	004110720	004110725	23,7	61	75.000	350.000		
	400	004110716*	004110721	004110726	26,8	67	85.000	450.000		
	450	004110717*	004110722	004110727	29	75	130.000	600.000		
	500	004110718*	004110723	004110728	44,3	79	160.000	700.000		

* possible to mount microswitch NV55

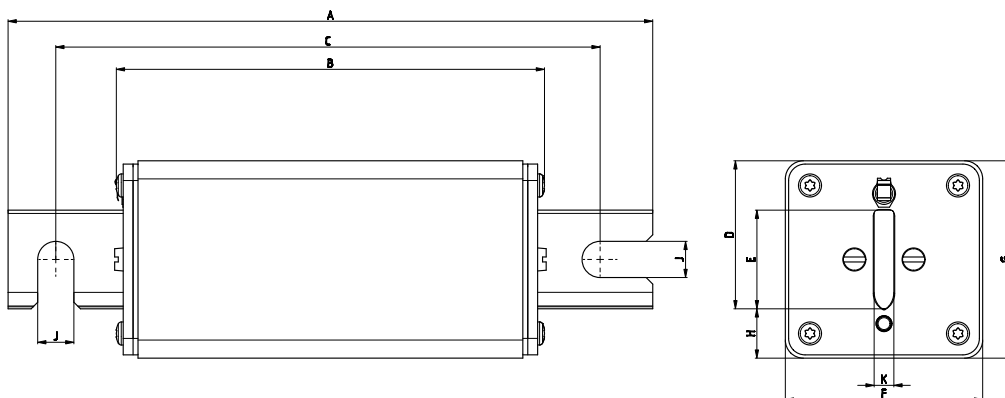


NH 1XL, 2XL, 3L

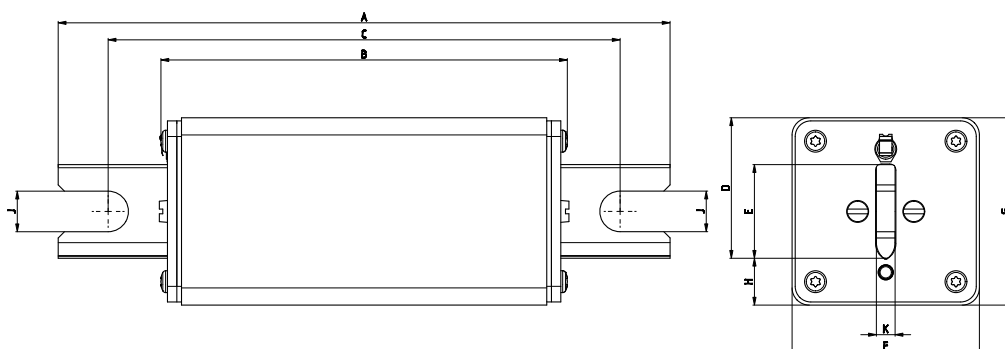


	A	B	C	D	E	F	G	H	K
1XL	192	131	125	42	24	51	67	13,5	6
2XL	208	130	126	48	30	61	71	15	6
3L	208	130	126	60	37	73	87	18	6

NHS 1XL, 2XL, 3L



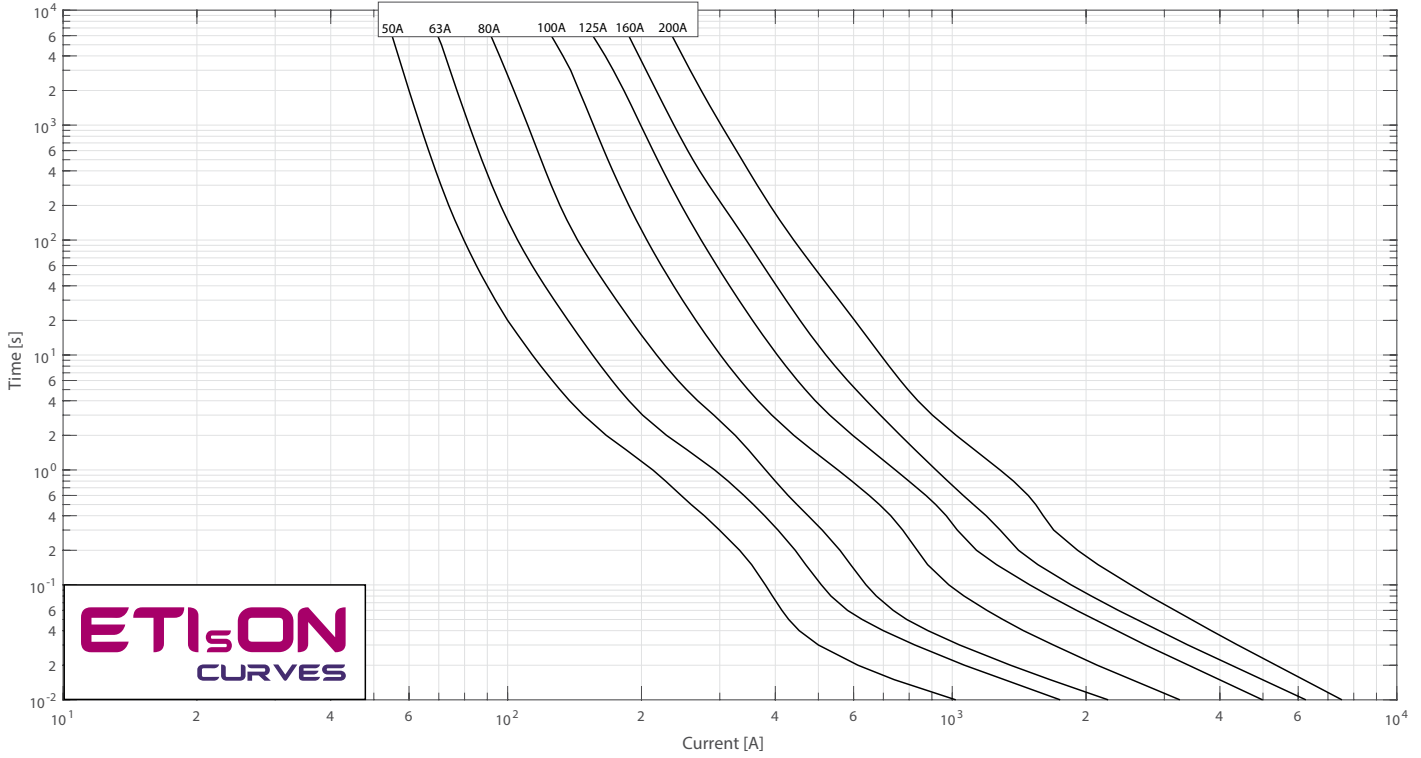
NHU 1XL, 2XL, 3L



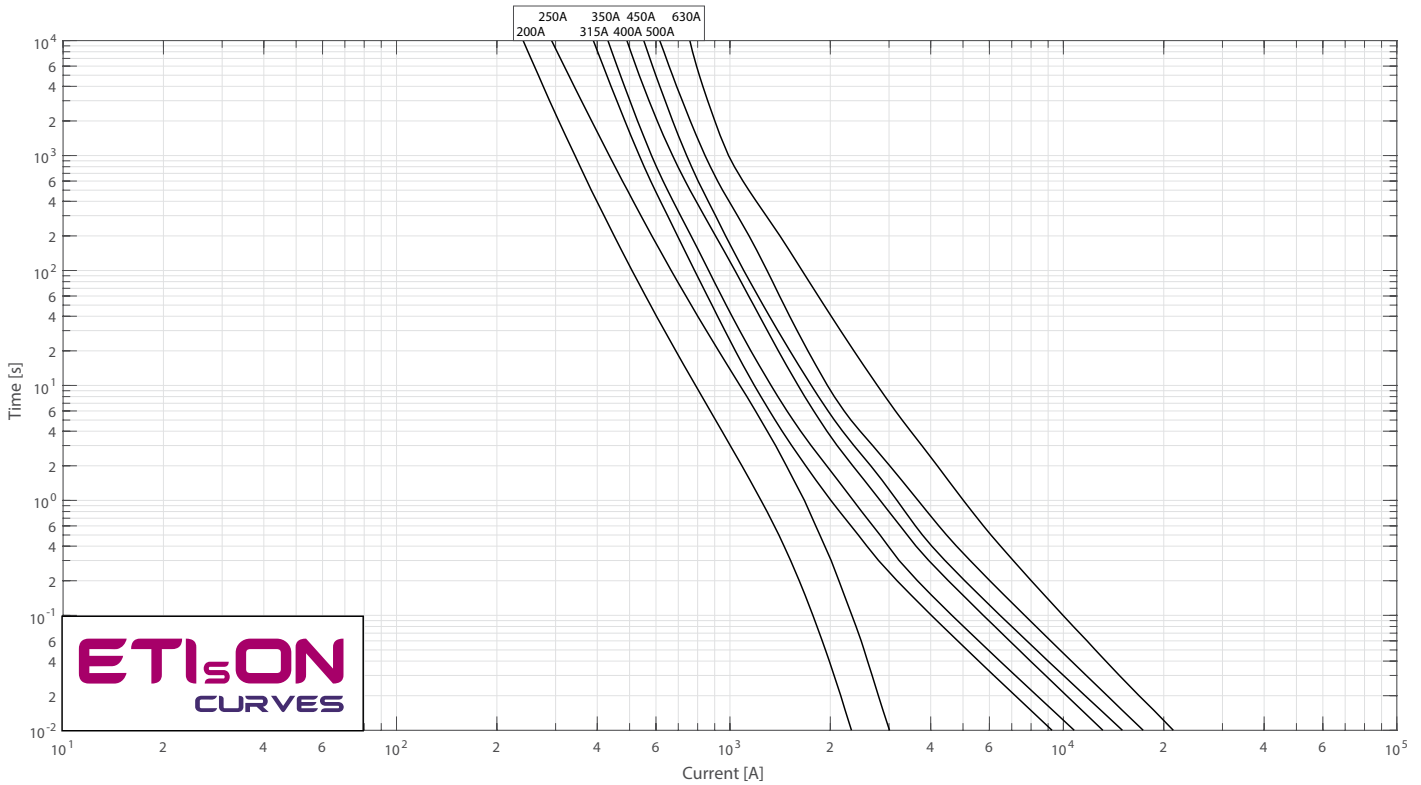
	A	B	C	D	E	F	G	H	K	J-NHS	J-NHU
1XL S,U	200	130	170	40	30	51	51	13,5	6	11	11
2XL S,U	200	130	170	45	30	61	61	15	6	11	13
3L S,U	200	130	170	55	37	73	73	18	6	11	13

Time current characteristics I/t

NH 1XL



NH 2XL & NH 3L



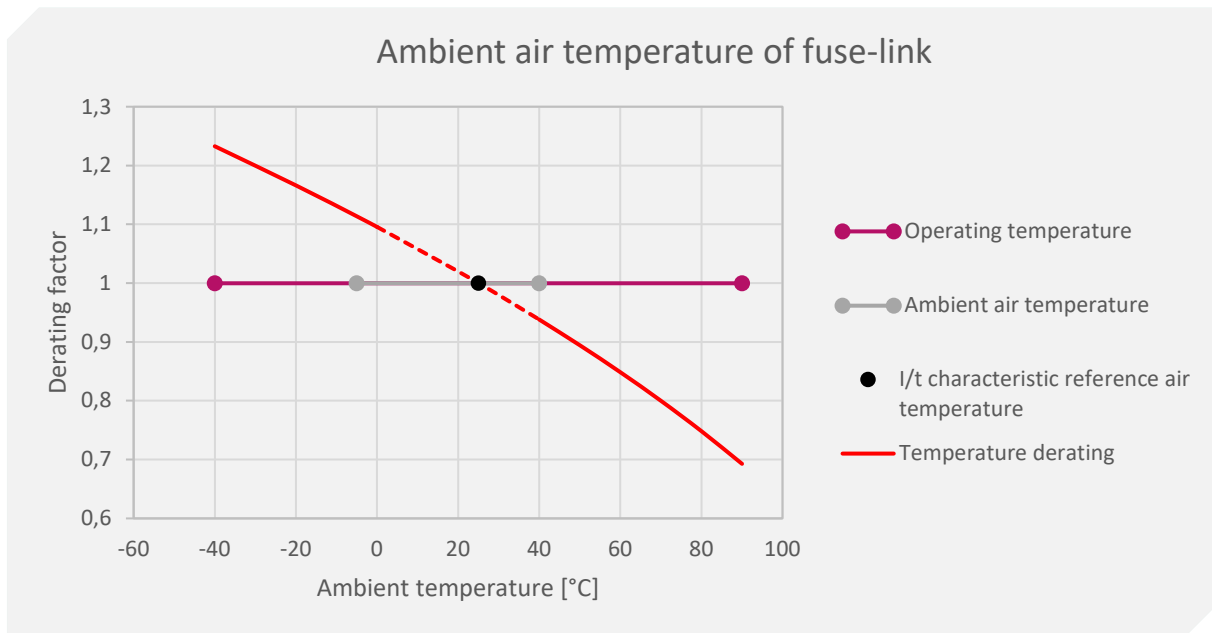
315 A							
cut-off	L/R						
Ip/kA	0,1 ms	0,5 ms	1 ms	1,5 ms	2 ms	2,5 ms	3 ms
10	10 kA	9 kA	9 kA	8 kA	8 kA	8 kA	8 kA
20	17 kA	13 kA	12 kA	11 kA	11 kA	10 kA	10 kA
30	22 kA	16 kA	14 kA	13 kA	12 kA	12 kA	12 kA
40	25 kA	19 kA	16 kA	14 kA	14 kA	13 kA	13 kA
50	28 kA	20 kA	17 kA	16 kA	15 kA	14 kA	14 kA
60	30 kA	21 kA	18 kA	17 kA	16 kA	16 kA	15 kA
70	33 kA	22 kA	19 kA	18 kA	17 kA	17 kA	16 kA
80	36 kA	26 kA	23 kA	20 kA	19 kA	19 kA	18 kA
90	38 kA	28 kA	24 kA	22 kA	20 kA	20 kA	19 kA
100	41 kA	30 kA	25 kA	23 kA	21 kA	21 kA	20 kA

350 A							
cut-off	L/R						
Ip/kA	0,1 ms	0,5 ms	1 ms	1,5 ms	2 ms	2,5 ms	3 ms
10	10 kA	10 kA	9 kA	9 kA	9 kA	8 kA	8 kA
20	18 kA	14 kA	13 kA	12 kA	12 kA	11 kA	11 kA
30	23 kA	17 kA	15 kA	14 kA	13 kA	13 kA	12 kA
40	27 kA	19 kA	17 kA	16 kA	15 kA	14 kA	14 kA
50	31 kA	21 kA	18 kA	17 kA	16 kA	16 kA	15 kA
60	32 kA	24 kA	19 kA	18 kA	17 kA	17 kA	16 kA
70	34 kA	25 kA	21 kA	20 kA	19 kA	18 kA	17 kA
80	38 kA	27 kA	24 kA	23 kA	21 kA	20 kA	20 kA
90	40 kA	30 kA	26 kA	24 kA	22 kA	21 kA	21 kA
100	43 kA	32 kA	27 kA	25 kA	23 kA	22 kA	22 kA

400 A							
cut-off	L/R						
Ip/kA	0,1 ms	0,5 ms	1 ms	1,5 ms	2 ms	2,5 ms	3 ms
10	10 kA	10 kA	10 kA	10 kA	9 kA	9 kA	9 kA
20	19 kA	16 kA	14 kA	13 kA	13 kA	12 kA	12 kA
30	24 kA	19 kA	17 kA	16 kA	15 kA	14 kA	14 kA
40	29 kA	21 kA	19 kA	18 kA	16 kA	16 kA	15 kA
50	33 kA	23 kA	21 kA	19 kA	18 kA	17 kA	16 kA
60	36 kA	25 kA	22 kA	20 kA	19 kA	19 kA	18 kA
70	38 kA	28 kA	23 kA	21 kA	20 kA	20 kA	19 kA
80	41 kA	30 kA	26 kA	25 kA	24 kA	23 kA	22 kA
90	45 kA	33 kA	29 kA	27 kA	25 kA	24 kA	23 kA
100	48 kA	35 kA	30 kA	28 kA	26 kA	25 kA	24 kA

450 A							
cut-off	L/R						
Ip/kA	0,1 ms	0,5 ms	1 ms	1,5 ms	2 ms	2,5 ms	3 ms
10	10 kA	10 kA	10 kA	10 kA	9 kA	9 kA	9 kA
20	20 kA	17 kA	16 kA	15 kA	14 kA	13 kA	13 kA
30	26 kA	21 kA	19 kA	18 kA	17 kA	16 kA	15 kA
40	32 kA	24 kA	21 kA	20 kA	18 kA	18 kA	17 kA
50	36 kA	27 kA	24 kA	22 kA	20 kA	19 kA	18 kA
60	41 kA	29 kA	25 kA	23 kA	22 kA	21 kA	19 kA
70	44 kA	32 kA	27 kA	25 kA	23 kA	22 kA	22 kA
80	48 kA	35 kA	30 kA	29 kA	27 kA	26 kA	25 kA
90	52 kA	37 kA	33 kA	30 kA	28 kA	27 kA	26 kA
100	55 kA	40 kA	35 kA	31 kA	29 kA	28 kA	27 kA

500 A							
cut-off	L/R						
Ip/kA	0,1 ms	0,5 ms	1 ms	1,5 ms	2 ms	2,5 ms	3 ms
10	10 kA	10 kA	10 kA	10 kA	9 kA	9 kA	9 kA
20	20 kA	17 kA	16 kA	15 kA	14 kA	14 kA	13 kA
30	28 kA	23 kA	20 kA	18 kA	17 kA	17 kA	16 kA
40	35 kA	27 kA	23 kA	21 kA	20 kA	19 kA	18 kA
50	40 kA	30 kA	26 kA	24 kA	22 kA	21 kA	20 kA
60	47 kA	33 kA	28 kA	26 kA	24 kA	23 kA	21 kA
70	50 kA	35 kA	30 kA	28 kA	26 kA	24 kA	23 kA
80	55 kA	39 kA	34 kA	31 kA	30 kA	28 kA	27 kA
90	59 kA	41 kA	36 kA	33 kA	32 kA	31 kA	29 kA
100	61 kA	44 kA	39 kA	35 kA	33 kA	32 kA	30 kA



Legend:

T_{amb} – Ambient Temperature

TDF – Temperature Derating Factor

I_N – Nominal Current of Fuse-link

I_{TDF} – Nominal Current Including Temperature Derating Factor

Current calculation: $I_{TDF} = I_N \times TDF$

PROTECTION OF PV INVERTERS



 etigroup
www.etigroup.eu

**Fuses for cable
protection on a.c.
side of PV inverters**

ETI
SWITCH TO
A SAFE FUTURE

New directions in PV inverters' development

New Directions in PV Inverters Development...

PV inverters are becoming larger and smarter. Their characteristics are continuously improving, making them smart, safe, reliable, and efficient.

Higher yields are achieved by utilizing dynamic system efficiency optimization with intelligent technology. The achieved efficiency currently exceeds 98.5%. One of the most important technical features of the new generation of PV inverters is the 800V a.c. output voltage, an increase from the standard 400V a.c. This increase in output voltage results in a 75% decrease in a.c. connection wire losses. However, due to the increased output voltage, modern PV central inverters require specially designed fuse-links for reliable short-circuit and over-current protection.

... And New Fuse-Links to Meet the Increased Demands of Their Output Protection

ETI is one of the first among the producers of NH fuse-links to have developed a new generation of NH gG fuse-links, specifically designed for cable protection in 800V a.c. systems. Featuring an innovative design of melting elements and the adoption of high-temperature and internal pressure-resistant ceramic material, these NH fuse-links' constructions can now be incorporated into standard NH size dimensions.

Currently, ETI offers NH00, NH1, NH2, NH3C, and NH3 gG fuse-links, with rated currents ranging from 6A to 400A, designed and tested for 800V a.c. systems. These fuse-links have very low dissipation and high breaking capacity. Upon customer request, we are also prepared to develop fuse-links for even higher rated currents.

Features and Benefits

- // Load switching capacity up to 800V a.c.
- // Compliance with IEC photovoltaic standards
- // In standard NH size dimensions
- // Extremely low power dissipation
- // High breaking capacity
- // Designed to protect against a full range of overcurrents
- // High temperature and internal pressure-resistant ceramic material
- // Innovative design of melting elements

Applications

For cable protection on the a.c. side of 1500V PV inverters



NH gG 800V a.c. Fuse-links

General characteristics

Rated voltage	800V a.c.
Rated current	6A - 400A
Breaking capacity	120kA
Characteristic	gG
Standards	IEC 60269-2
Application	For cable protection on a.c. side of PV inverter

NV/NH gG 800V a.c.

Size	Breaking capacity [kA]	I_n [A]	Standard indicator	Pre-arcing Joule integral [A ² s]	Operating Joule integral [A ² s]	Power dissipation [0,7 x I _n] Pd [W]	Power dissipation [W]	g	Box
NH00	120	6	004184512	63	650	0,8	1,9	173	3/90
		10	004184513	35	850	0,6	1,3		
		16	004184514	120	1.800	1,1	2,4		
		20	004184515	225	4.000	1,1	2,6		
		25	004184516	300	6.500	1,2	2,7		
		35	004184518	1.800	10.000	1,5	3,3		
		40	004184519	2.100	13.500	1,8	4,0		
		50	004184520	4.300	27.000	2,1	4,8		
NH1	120	63	004184521	7.000	43.000	2,6	6,0	420	3/24
		25	004184482	600	14.000	1,4	3,2		
		35	004184483	2.400	35.000	1,5	3,4		
		40	004184484	3.200	50.000	1,8	4,0		
		50	004184485	3.500	70.000	1,9	4,4		
		63	004184486	5.500	120.000	2,4	5,5		
		80	004184487	11.000	145.000	3,0	6,9		
		100	004184488	18.000	185.000	3,8	8,6		
NH2	120	125	004184489	27.000	260.000	4,3	9,7	580	3/15
		160	004184490	45.000	475.000	5,5	12,4		
		60	200	004184463	55.000	410.000	8,3		
	60	80	004184531	11.000	145.000	3,1	6,9		
		100	004184532	18.000	185.000	3,9	8,6		
		125	004184533	27.000	260.000	4,4	9,7		
NH3C	60	160	004184534	45.000	450.000	5,6	12,4	580	3/12
		200	004184535	65.000	400.000	8,6	19,0		
NH3	120	250	004184536	130.000	650.000	10,4	23,0	785	3/12
		200	004184545	65.000	400.000	8,6	19,0		
		250	004184546	130.000	650.000	10,4	23,0		
	60	160	004184524	28.000	400.000	6,3	14,4		
		200	004184525	70.000	690.000	6,4	14,5		
NH3	60	250	004184526	110.000	1.100.000	9,7	22,0	1270	3/15
		315	004184498*	140.000	1.340.000	12,8	29,0		
		355	004184528*	280.000	1.700.000	12,5	27,5		
		400	004184529*	350.000	2.100.000	14,7	32,5		

*Top visual indicator

Recommended Accessories

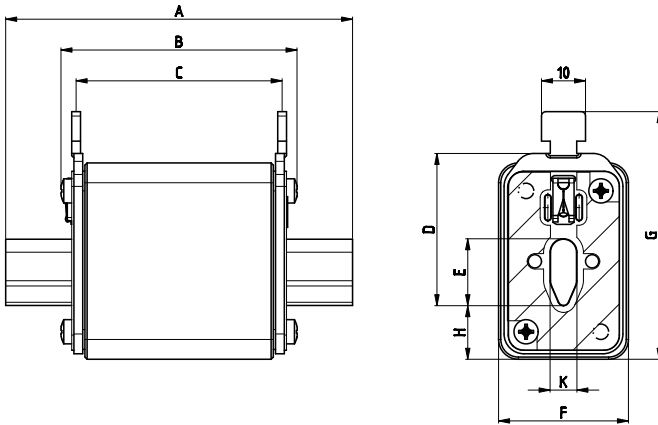
- /// Ceramic fuse bases
- /// Plastic fuse bases
- /// Fuse disconnectors



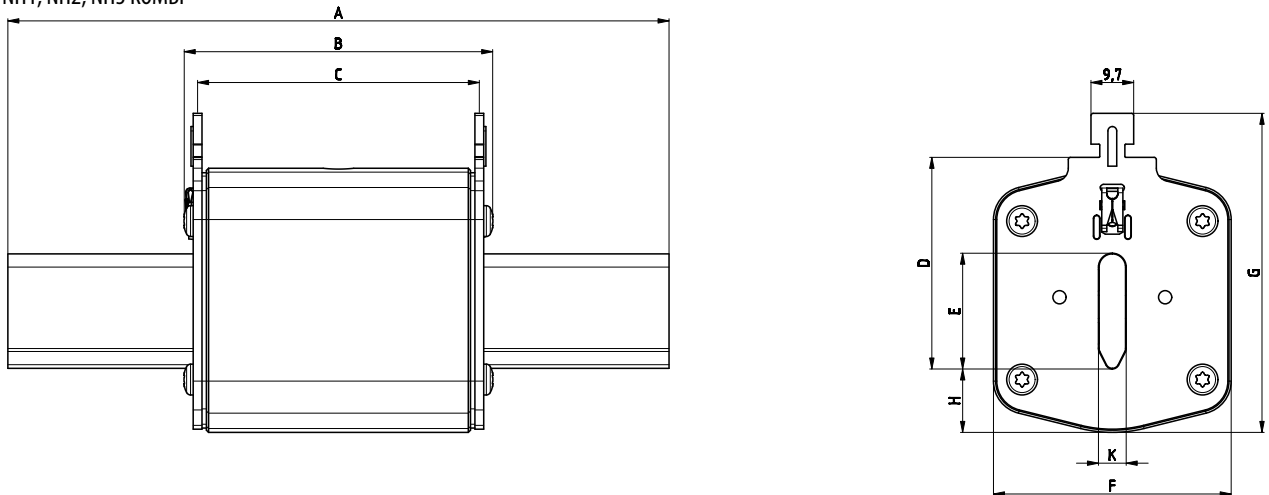
Size	Dimensions [mm]								
	A	B	C	D	E	F	G	H	K
00	79	53	47	35	15	28	56	12	6
1	135	72	65	40	20	46	65	14	6
2	150	72	65	48	26	54	73	14	6
3C	150	72	65	60	26	54	84	14	6
3	150	72	65	60	33	65	84	14	6
3*	150	74	70	60	37	73	87	13	6

*Top visual indicator

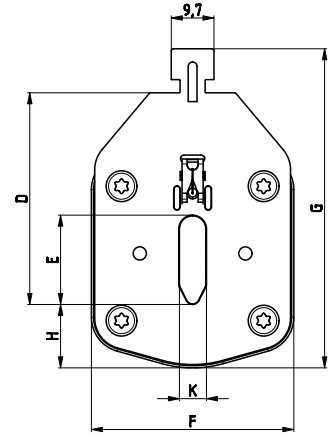
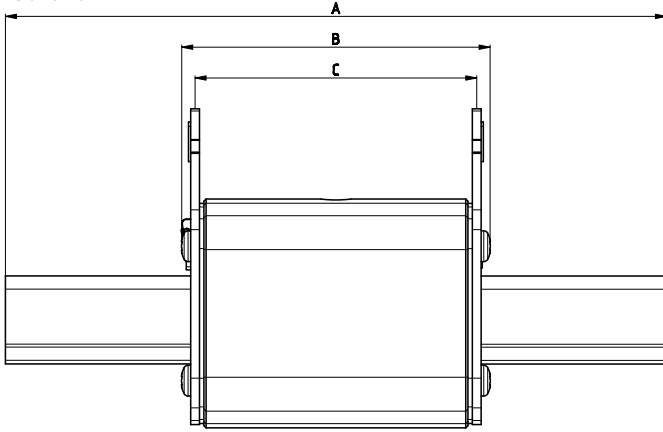
NH00 KOMBI



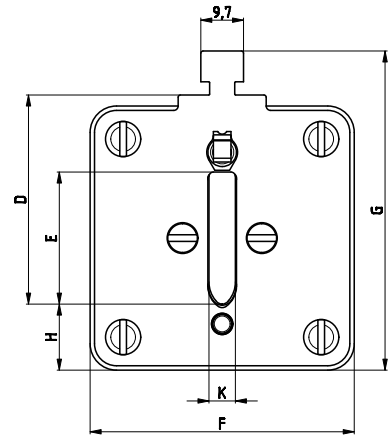
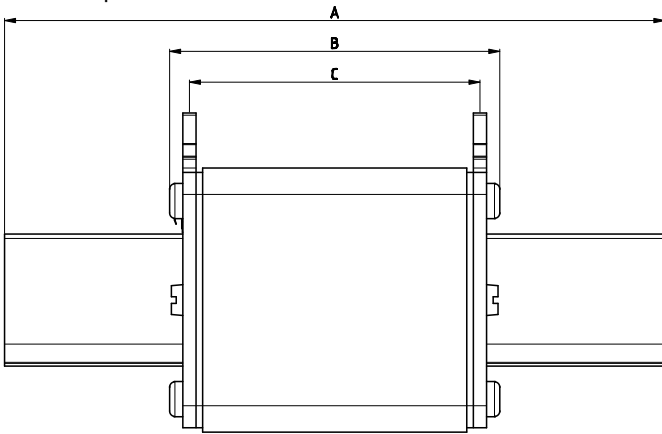
NH1, NH2, NH3 KOMBI



NH3C KOMBI

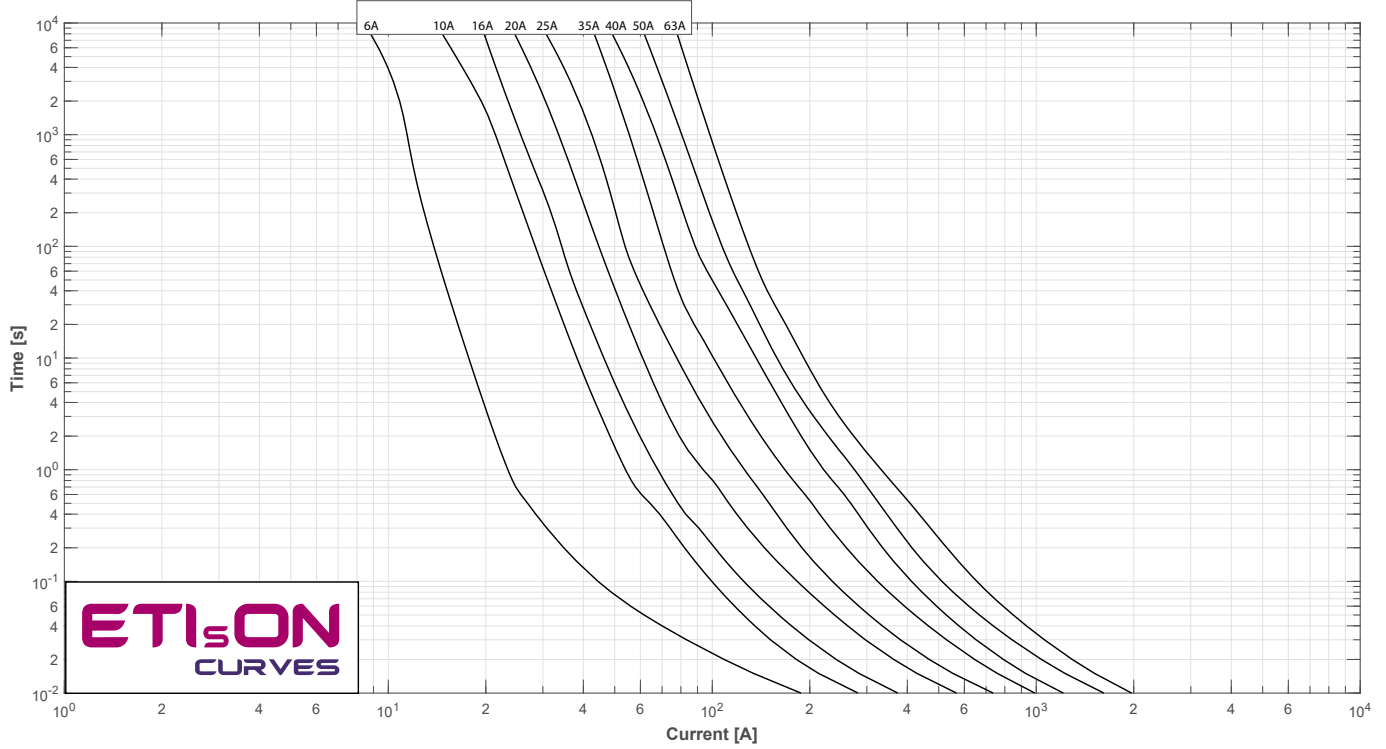


NH3 with top visual indicator

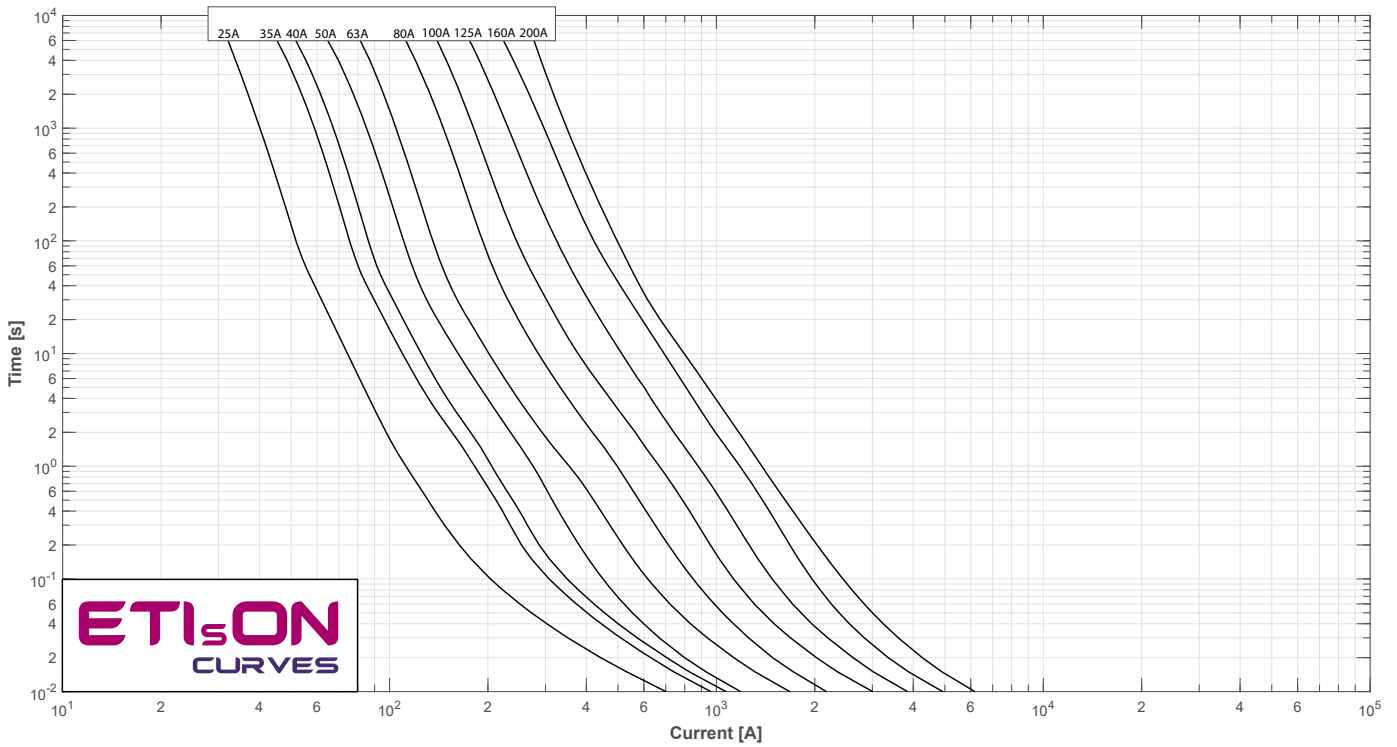


Time current characteristics I/t

NH00 KOMBI

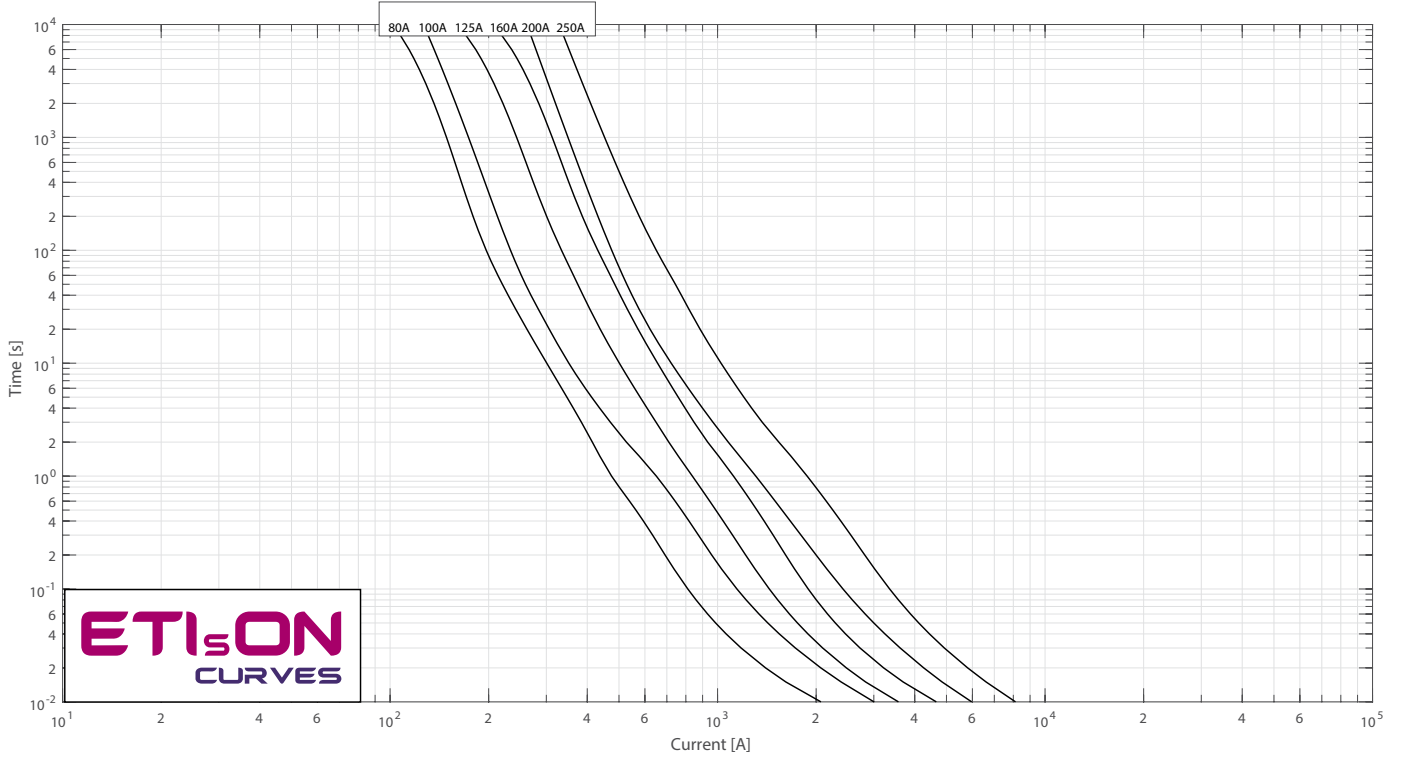


NH1 KOMBI

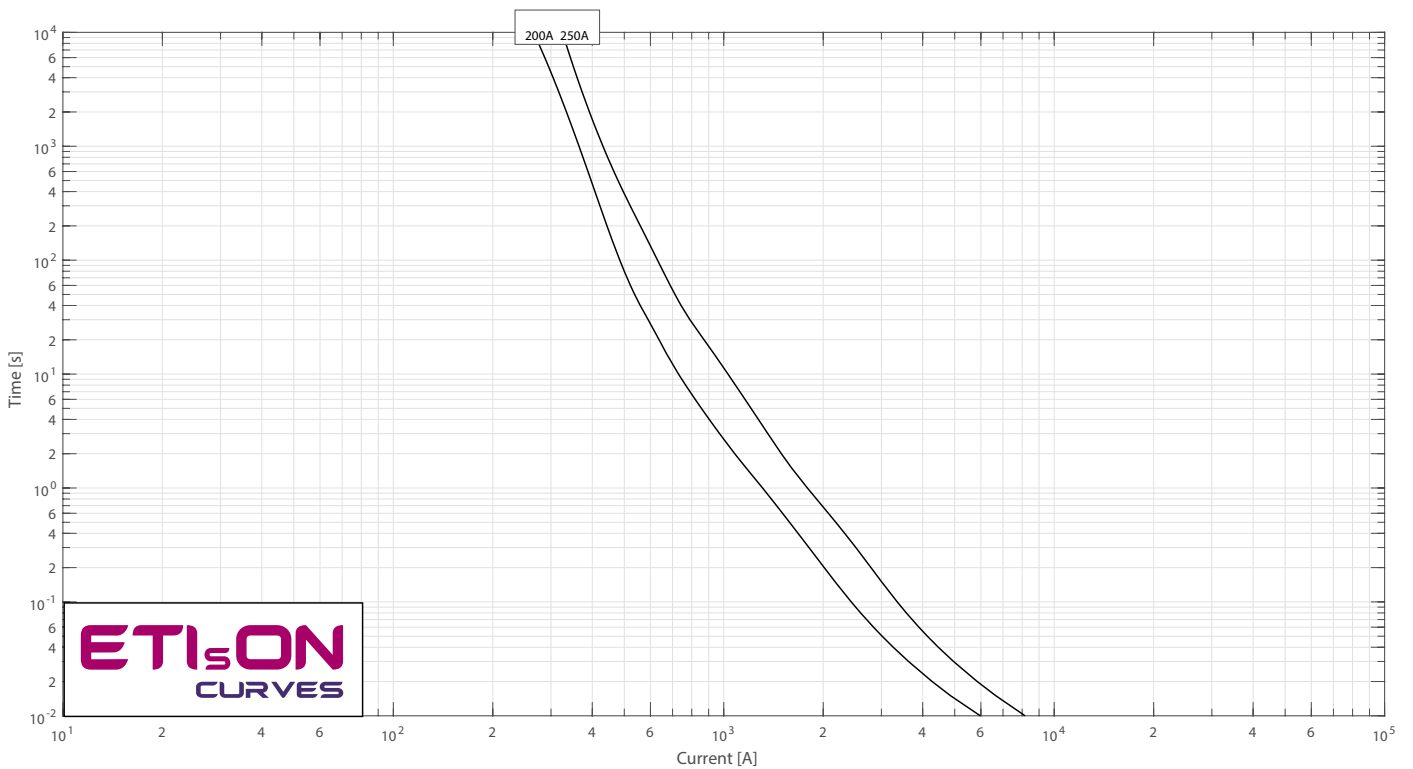


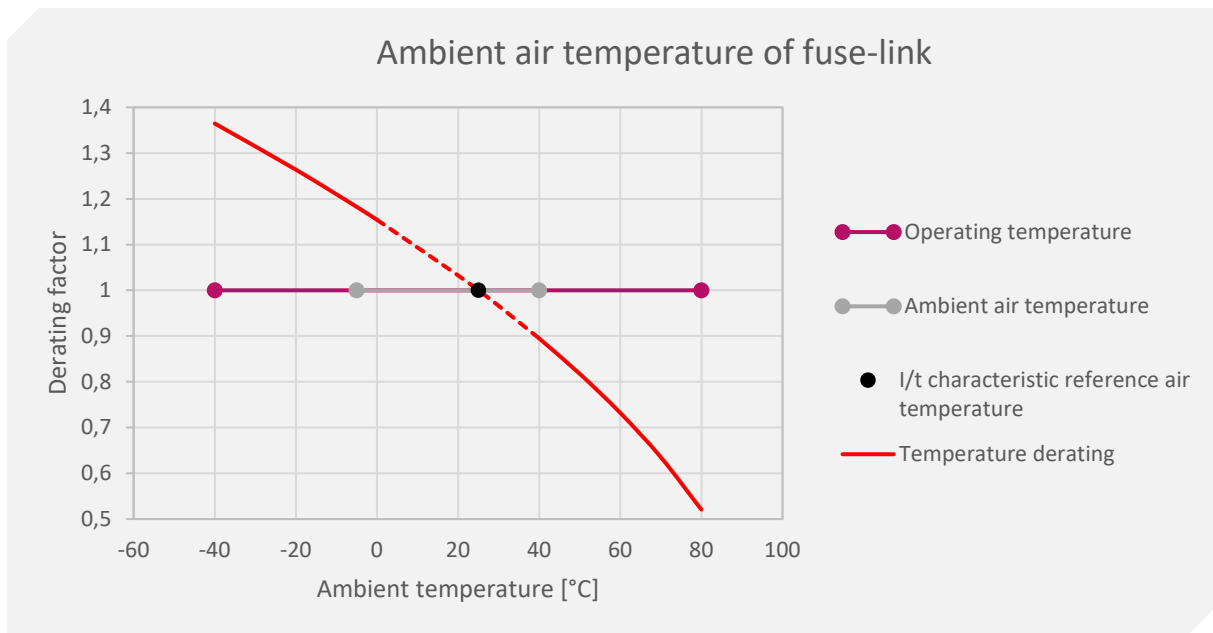
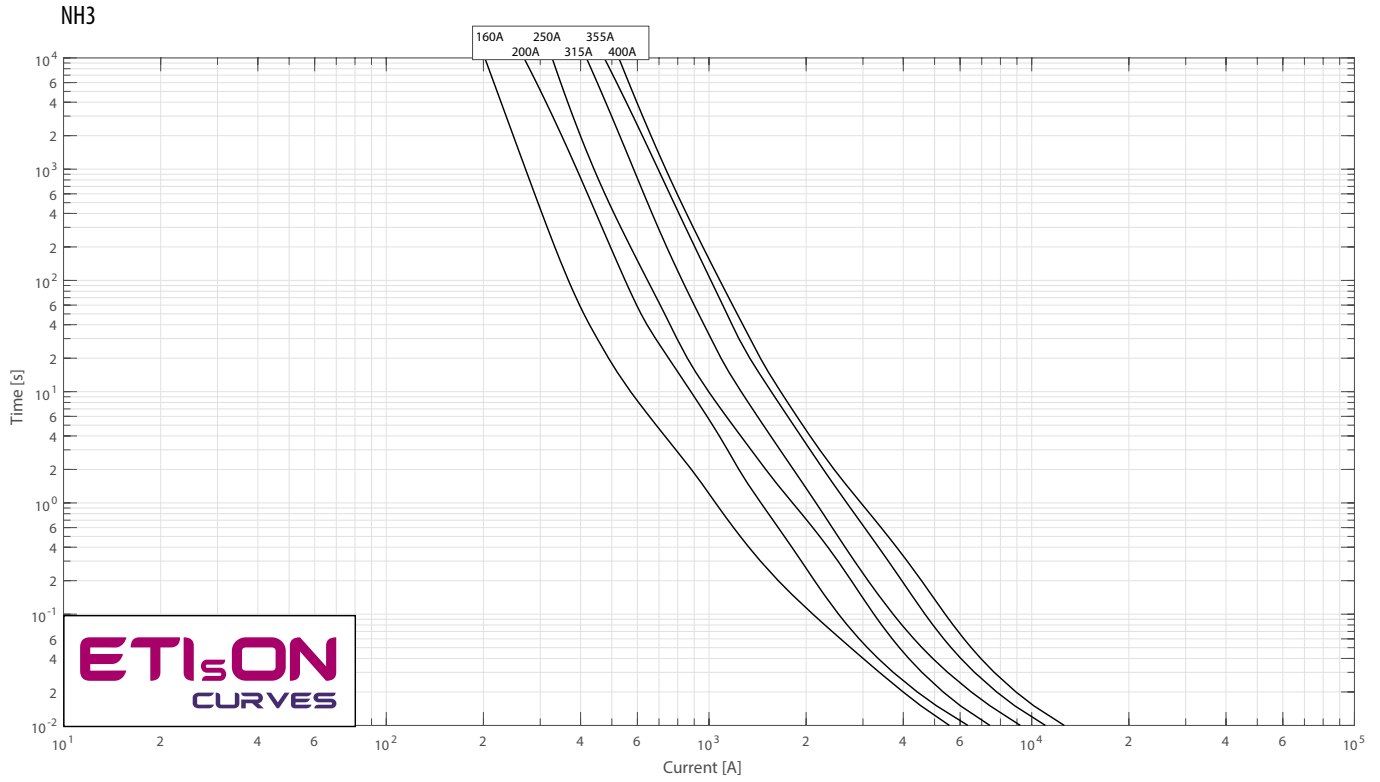


NH2 KOMBI



NH3C KOMBI





Legend:

T_{amb} – Ambient Temperature

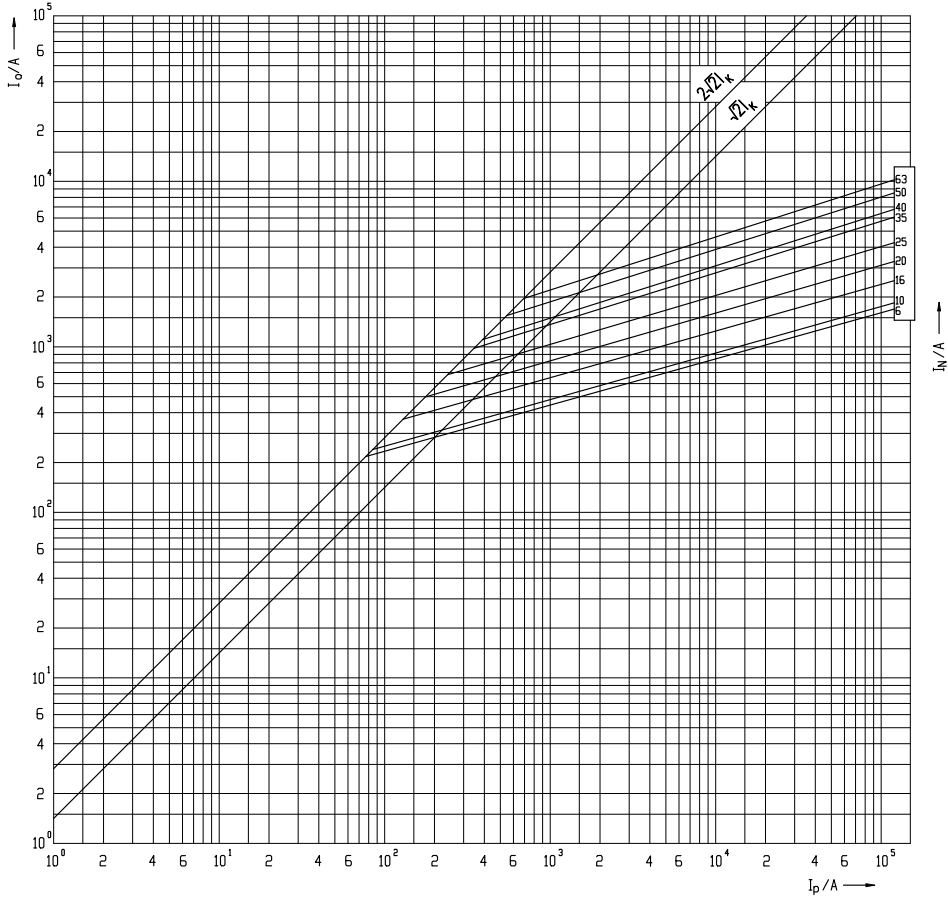
TDF – Temperature Derating Factor

I_N – Nominal Current of Fuse-link

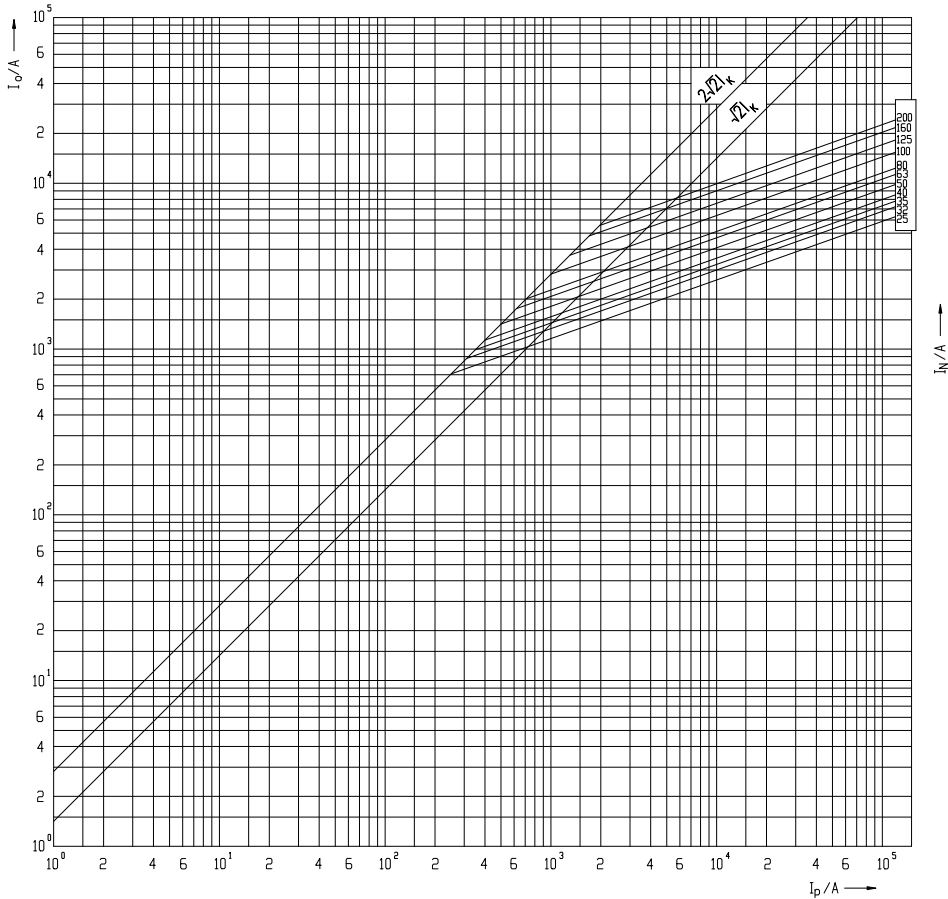
I_{TDF} – Nominal Current Including Temperature Derating Factor

Current calculation: $I_{TDF} = I_N \times TDF$

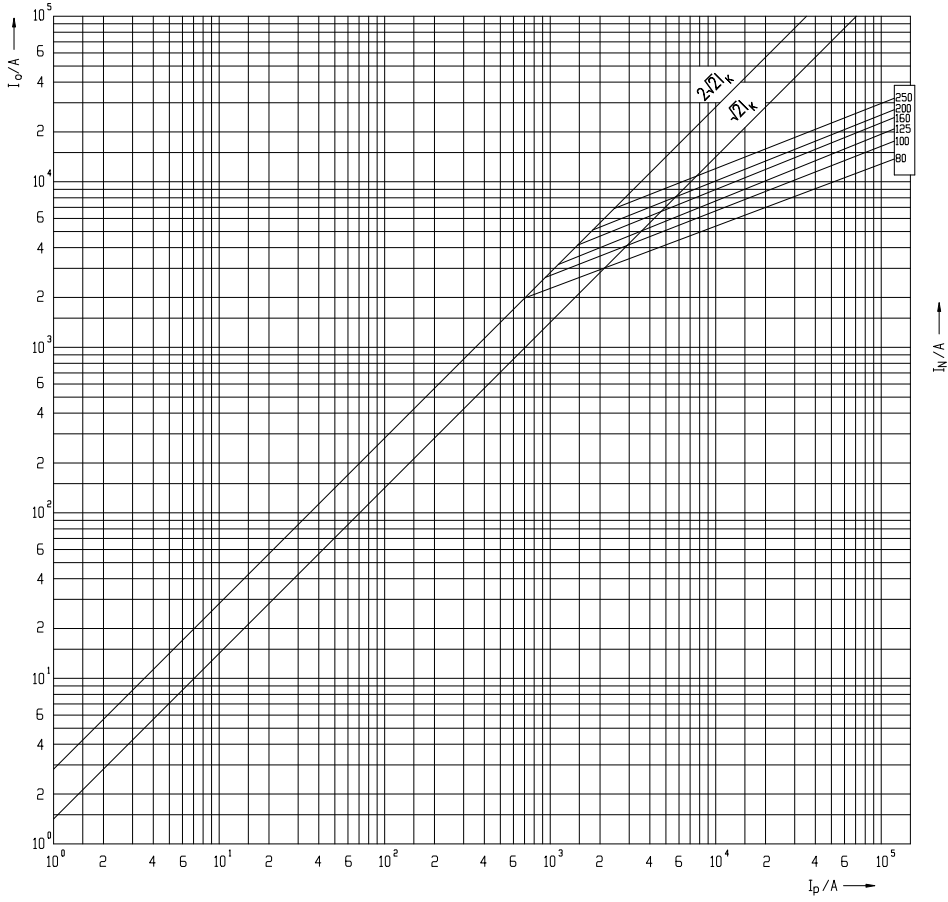
Cut-off current characteristics



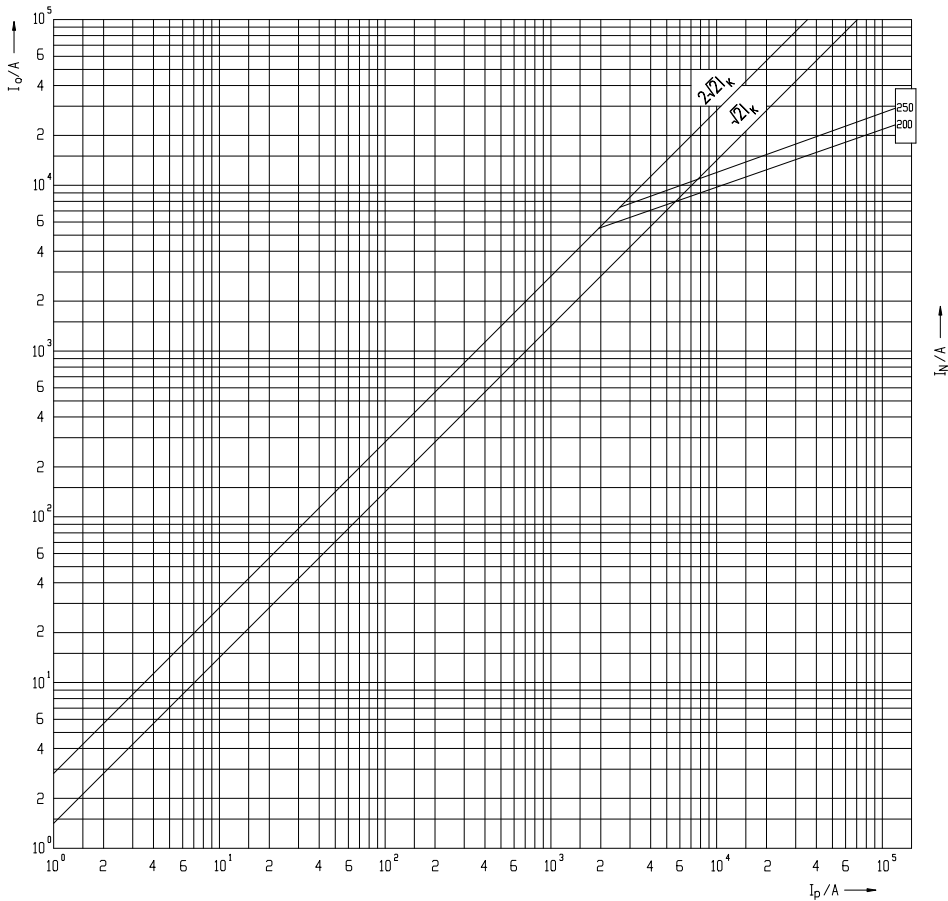
NH00



NH1



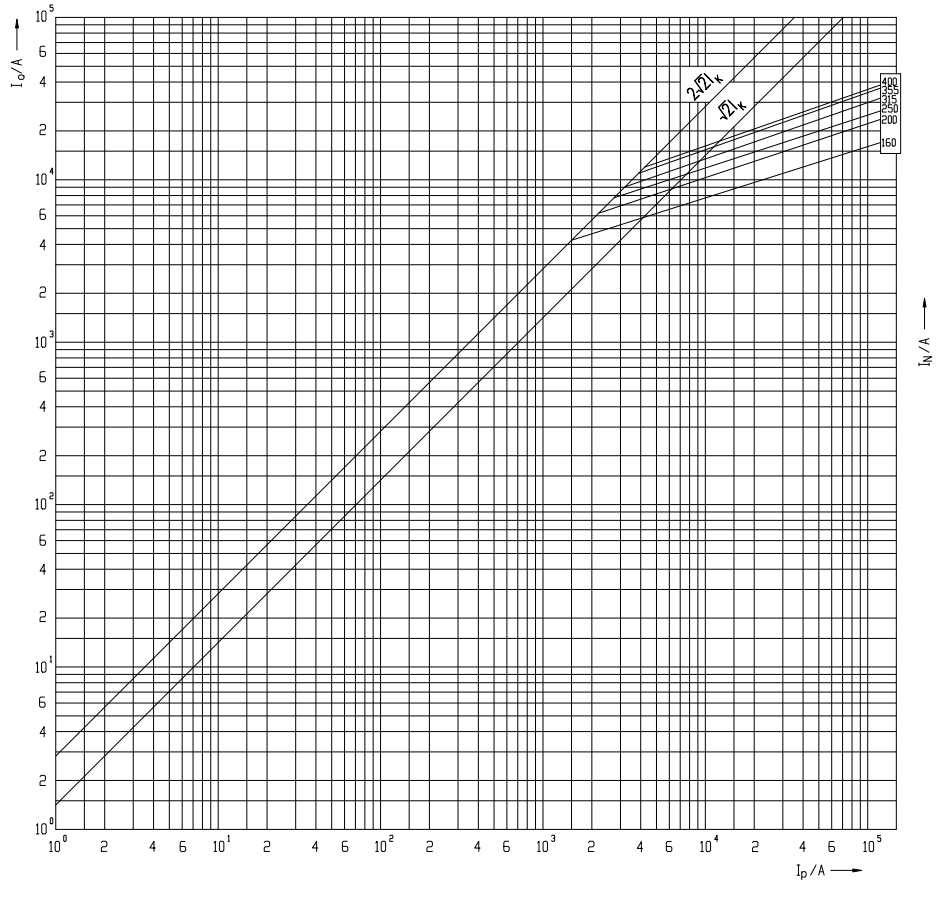
NH2



NH3C



NH3





NH gS 800V a.c. Fuse-links

General characteristics

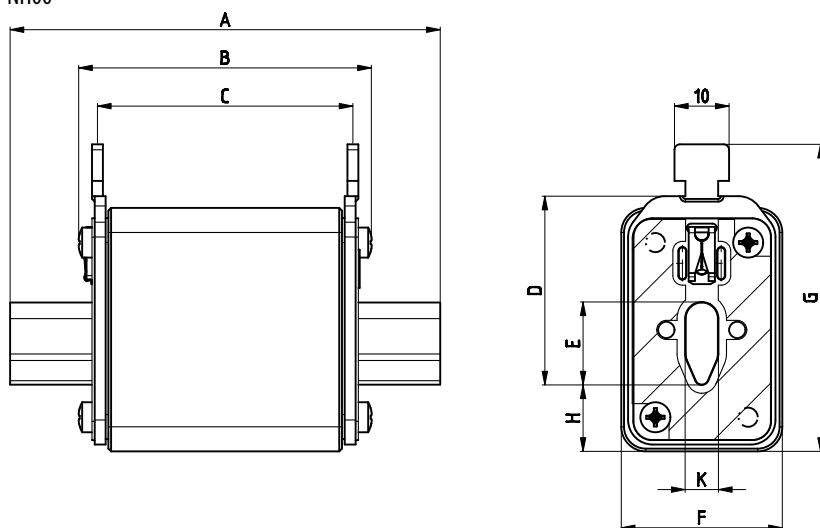
Rated voltage	800V a.c.
Rated current	16 - 500A
Breaking capacity	30kA (NH00), 120kA (NH1-3)
Characteristic	gS
Standards	IEC 60269-4
Application	For cable protection on a.c. side of PV inverter

NV/NH gS 800V a.c.

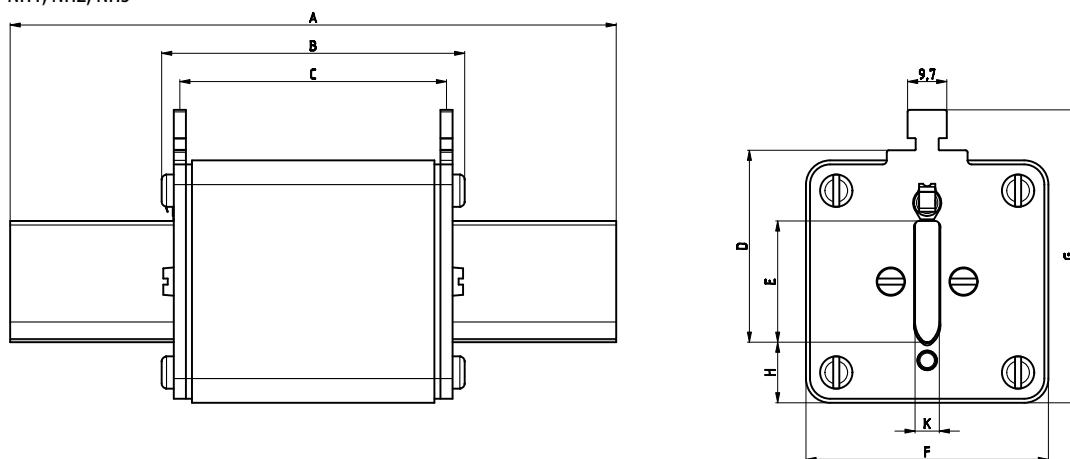
Size	Breaking capacity [kA]	I_n [A]	Standard indicator	Pre-arcing Joule integral [A ² s]	Operating Joule integral [A ² s]	Power dissipation [0,7 x I _n] Pd [W]	Power dissipation [W]		
NH00	30	16	004184504	15	1000	1,3	3,1	173	3/90
		20	004184505	32	1200	1,3	3,2		
		25	004184506	54	1600	1,8	4,3		
		35	004184507	250	5500	1,8	4,3		
		40	004184508	390	6300	1,9	4,5		
		50	004184509	460	9500	2,4	5,7		
		63	004184502	510	18.400	2,6	6,2		
		80	004184501	1.360	32.000	2,8	6,7		
		100	004184500	3.000	60.000	3,8	9		
		125	004184503	4.000	72.000	5,4	12,9		
NH1		160	004723234	3.500	110.000	7,1	17	500	3/24
		200	004723235	9.000	145.000	8,0	19		
		250	004723236	18.000	275.000	9,2	22		
		315	004723237	35.000	490.000	11,7	28		
NH2	120	350	004724234	70.000	825.000	10,5	25	660	1/16
		400	004724235	95.000	1.020.000	12,6	30		
NH3		350	004725232	85.000	980.000	10,5	25	1200	3/15
		400	004725233	105.000	1.200.000	12,6	30		
		450	004725234	170.000	1.750.000	13,3	31,7		
		500	004725235	220.000	2.100.000	14,0	33,5		



NH00



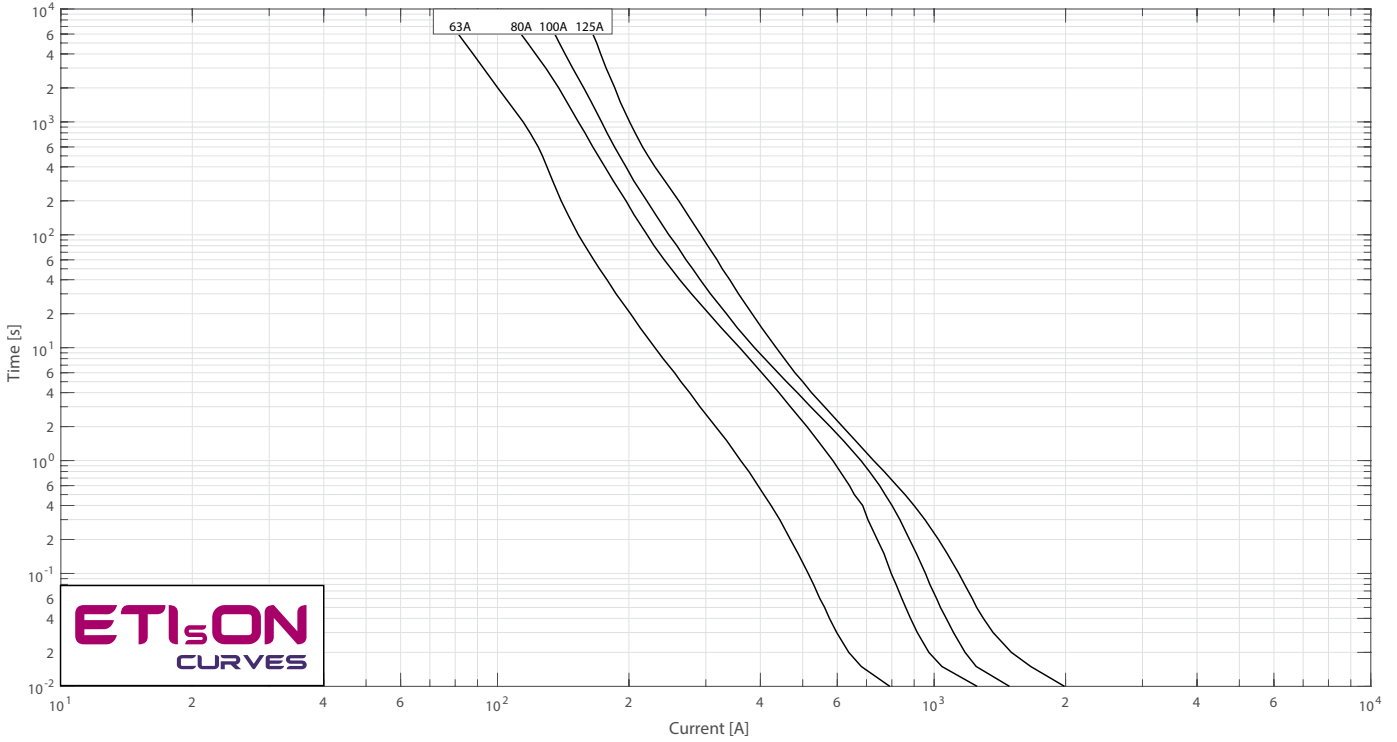
NH1, NH2, NH3



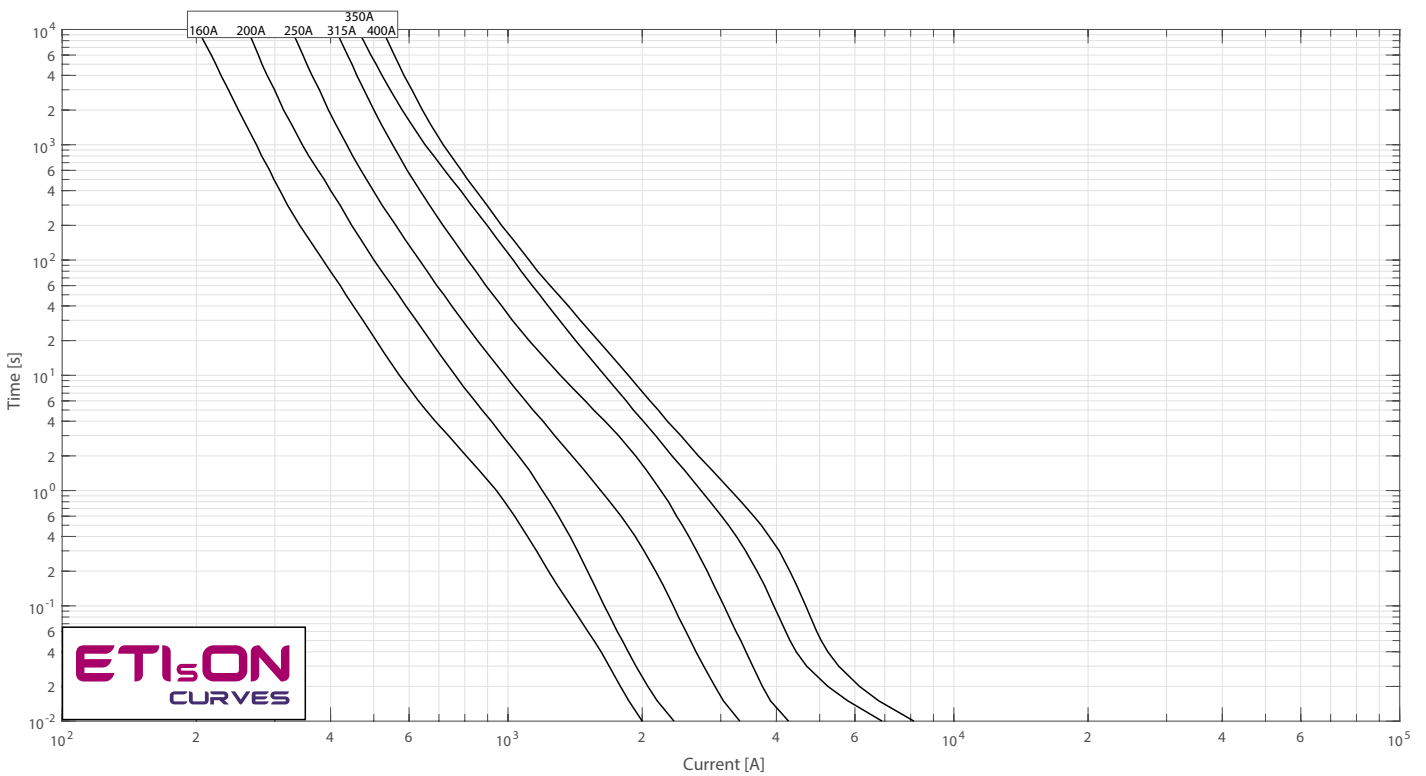
Size	Dimensions [mm]								
	A	B	C	D	E	F	G	H	K
00	79	53	47	35	15	28	56	12	6
1	135	72	65	40	24	46	62	12	6
2	150	72	65	48	30	54	71	12	6
3	150	72	65	60	37	64	84	12	6

Time current characteristics I/t

NH00

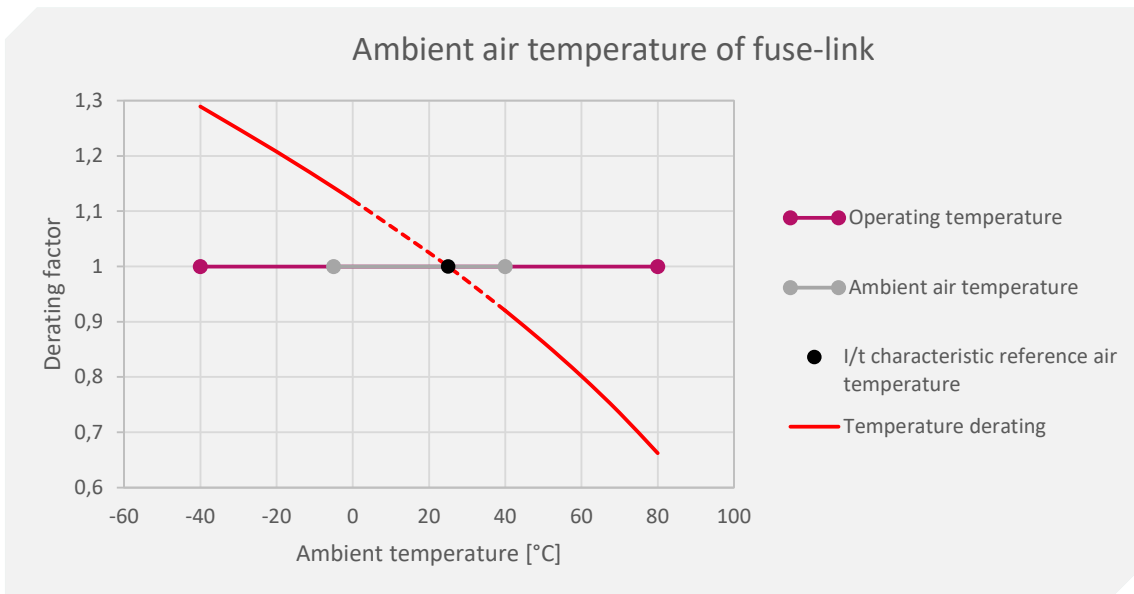
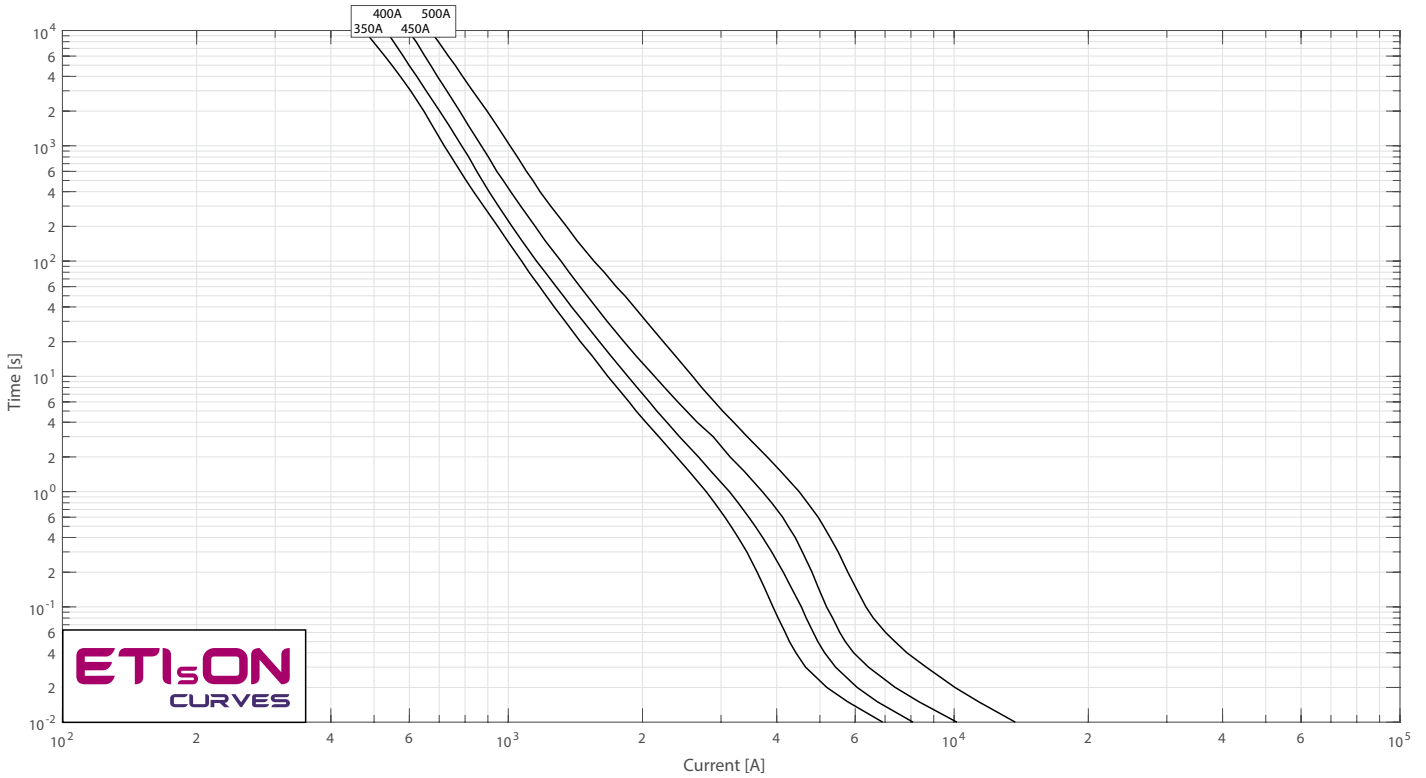


NH1, NH2





NH3



Legend:

T_{amb} – Ambient Temperature

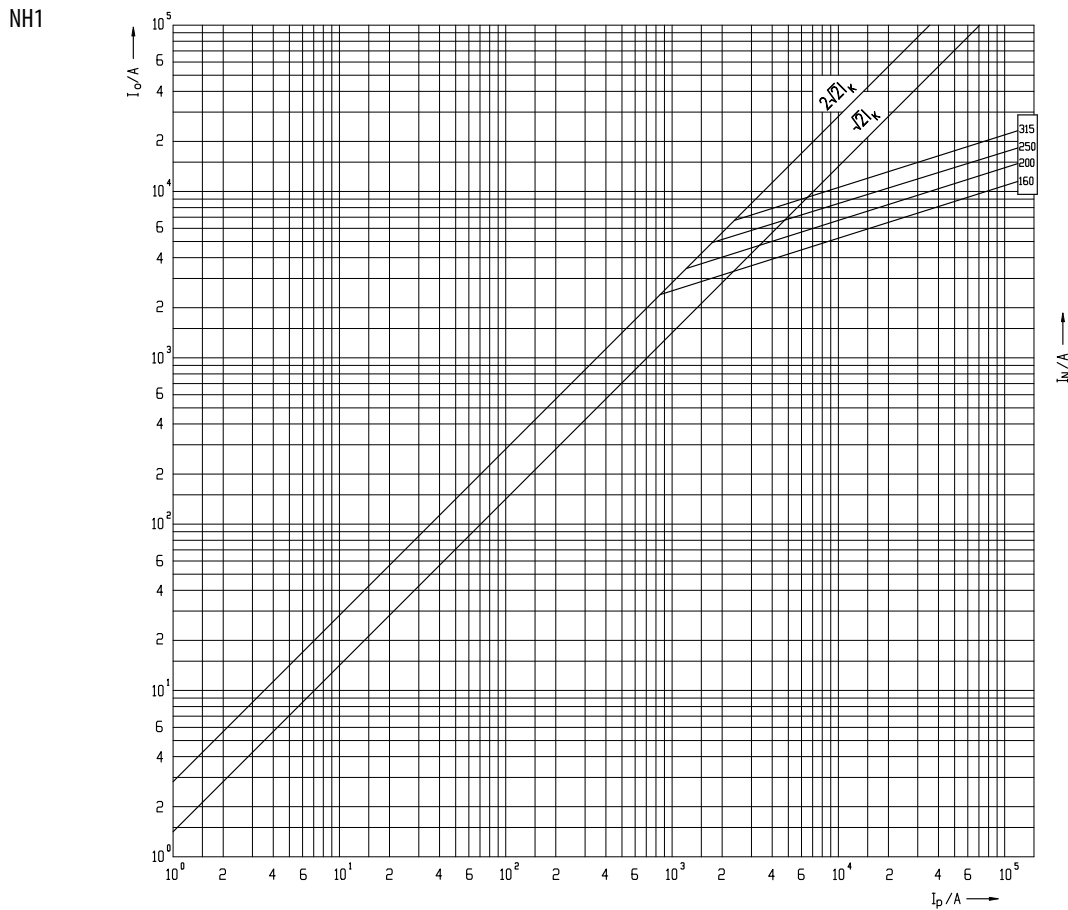
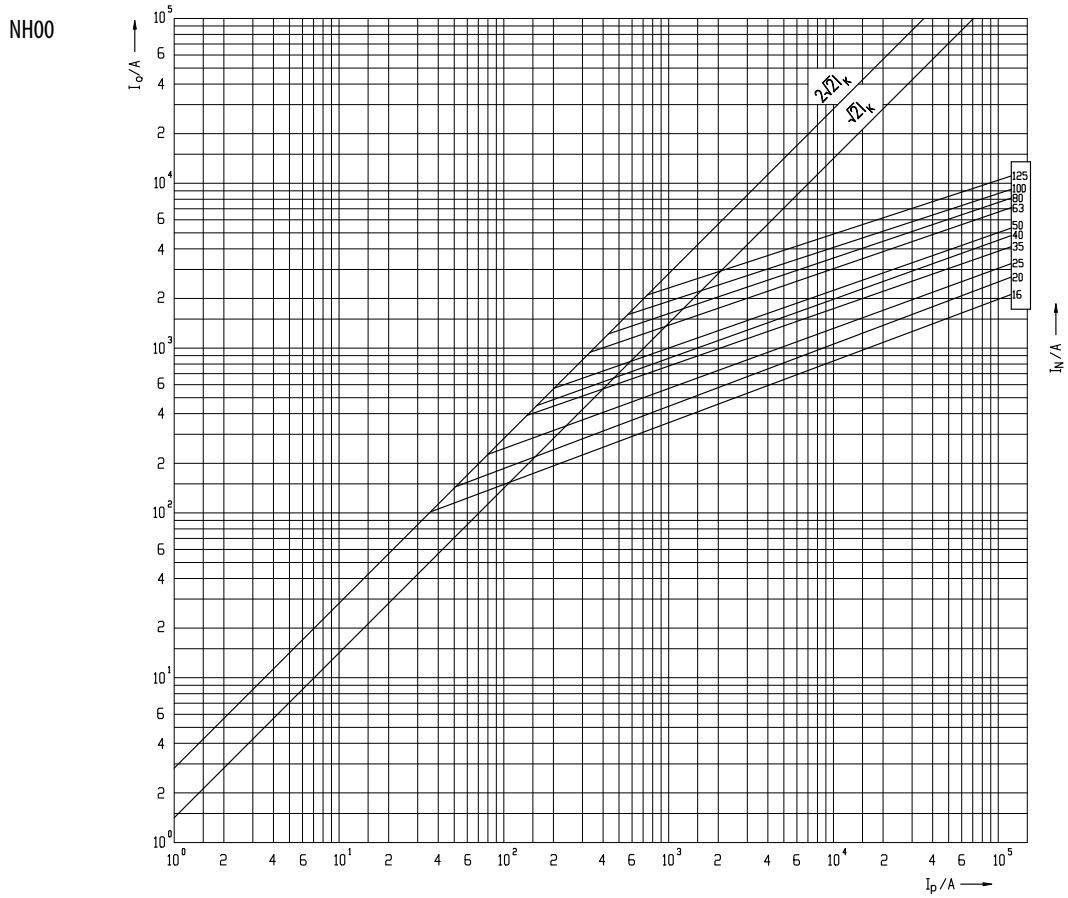
TDF – Temperature Derating Factor

I_N – Nominal Current of Fuse-link

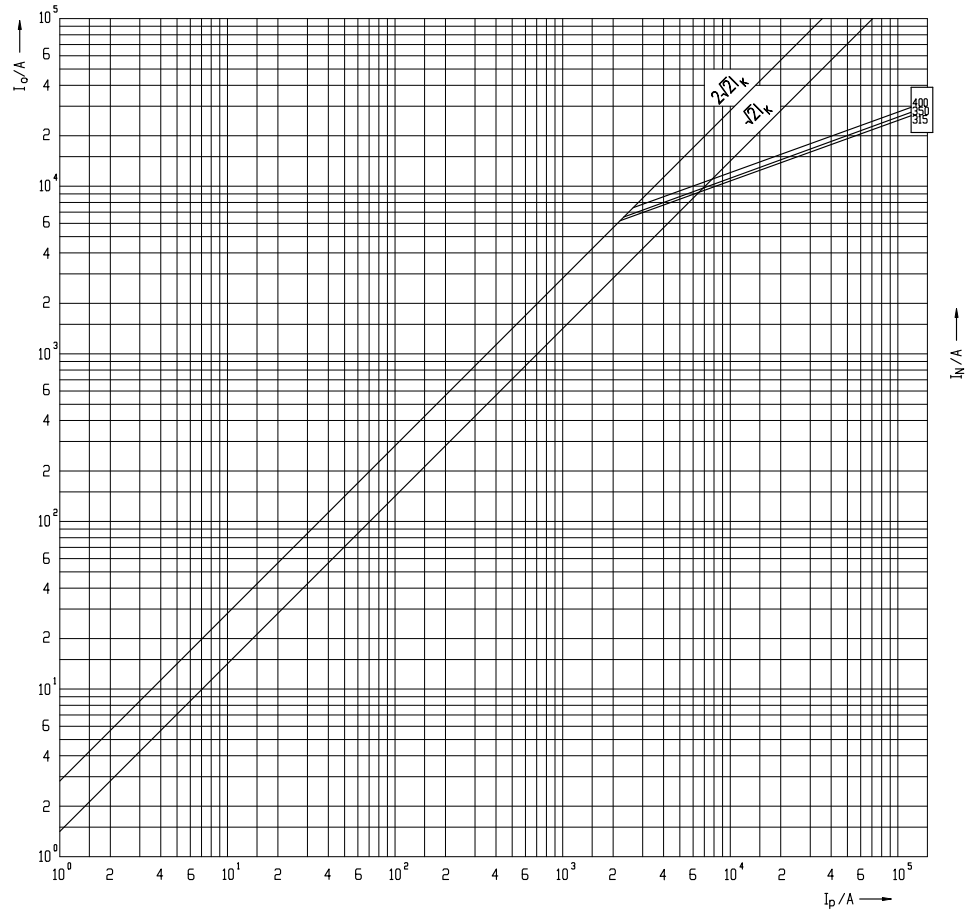
I_{TDF} – Nominal Current Including Temperature Derating Factor

Current calculation: $I_{TDF} = I_N \times TDF$

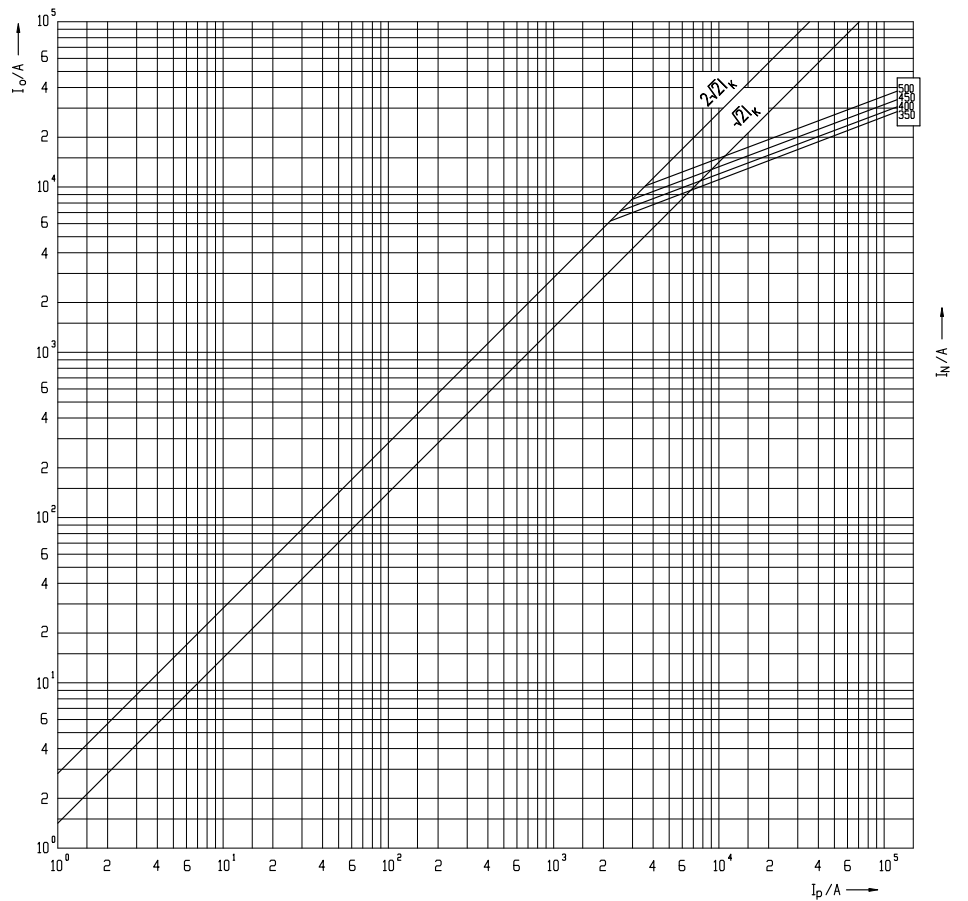
Cut-off current characteristics



NH2



NH3



BATTERY FUSE



ETI BATTERY FUSE
Class B
91-1411 10kV
NH3L
630A
1500V d.c.
LR=3ms IEC 60269-7
004110779
RoHS ENEC CE
Made in Slovenia

BATTERY FUSE

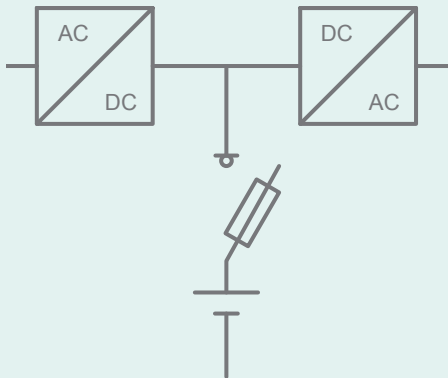
BECAUSE EVERY SECOND COUNTS

NH Fuse-links with gBat Characteristic

 [etigroup](https://www.etigroup.eu)
www.etigroup.eu

ETI
SWITCH TO
A SAFE FUTURE

Battery Storage Fuse Selection

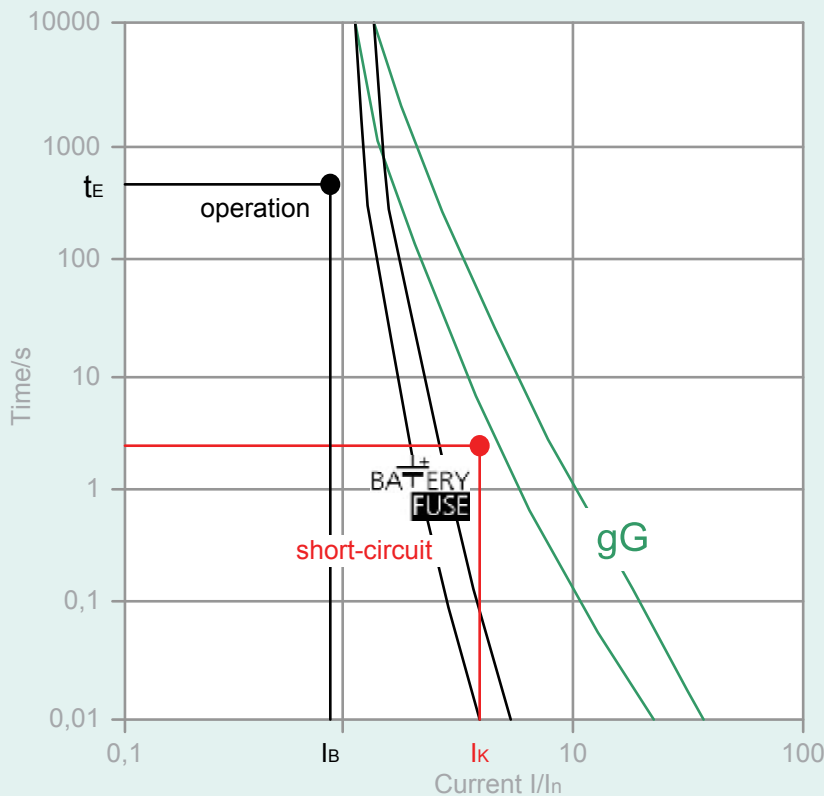


Short circuit current

- Short circuit current depending on battery model, type and capacity, low compared to operating current
- Short circuit current has to be interrupted in <5 seconds
- Required steep characteristics: protection with Battery fuse-link required!

Operating current

- Operating current depends on battery storage specification
- Battery operation: voltage of DC link circuit decreases to the final discharge voltage
- Consider maximum current at final discharge voltage for fuse-link selection



In accordance with IEC 60269-7

Short circuit point (I_k)

- Short circuit current depending on battery model and type
- Manufacturer datasheets to include short circuit current according to IEC896
- Operating point has to be in adequate distance below the curve
- Short-circuit point has to be above the range of tolerance of the curve

Operating point (t_E/I_B)

- maximum operating current I_B has to be calculated from battery storage true power and final discharge voltage U_E : $I_B = P_w/U_E$
- t_E is the back-up time of battery storage system

When choosing fuse switch disconnector consider fuse-link power dissipation!

$$P_d(I_B) < P_y$$

Power dissipation of fuse-link at maximal operating current (I_B):

$$P_d(I_B) = (I_B/I_n)^2 \times P_d(I_n)$$

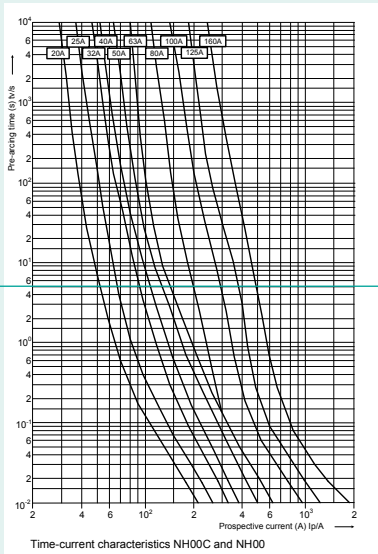
I_B - maximal operating current

$P_d(I_B)$ - power dissipation of fuse-link at maximal operating current

$P_d(I_n)$ - power dissipation of fuse-link at nominal current

P_y - maximal permissible fuse-link power dissipation mounted in fuse switch disconnector

Low Power Dissipation and Fast Characteristic in Time Range of 5s!

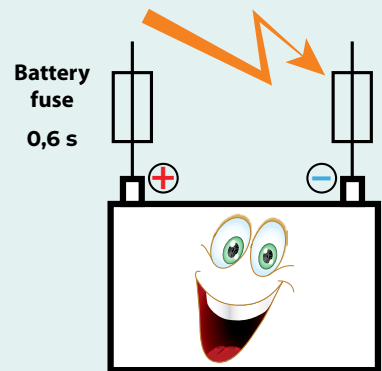
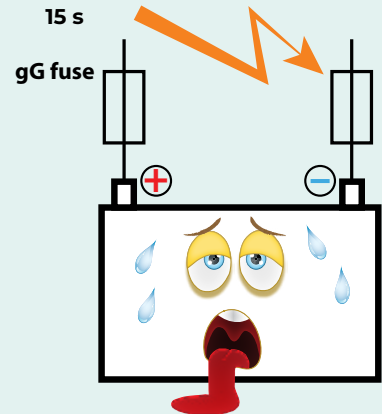
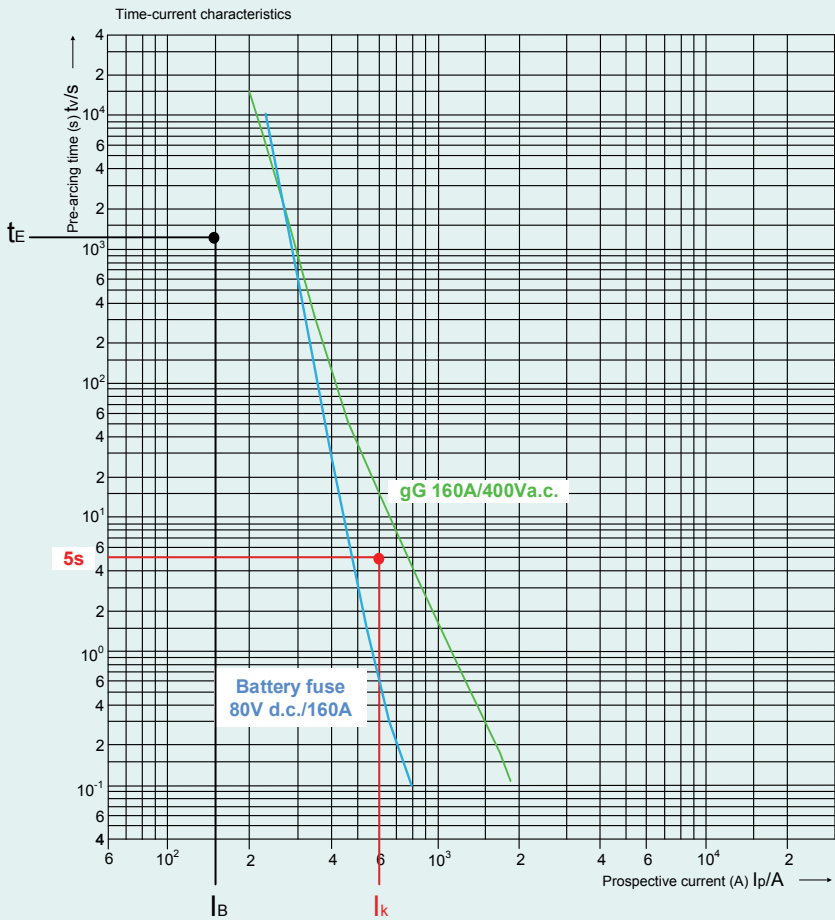


Discharge	-20~60°C
Charge	-10~60°C
Storage	-20~60°C
Max. Discharge Current 77°F(25°C)	1000A(5s)
Short Circuit Current	3300A
Charge Methods: Constant Voltage Charge 77°F(25°C)	
Cycle use	14.4-14.7V
Maximum charging current	60A
Temperature compensation	-30mV/°C

5s

I_k

Better protection of battery cells on overheating in case of short circuit comparable to standard gG characteristic



NH gBat fuse-link 80V d.c.

General characteristics

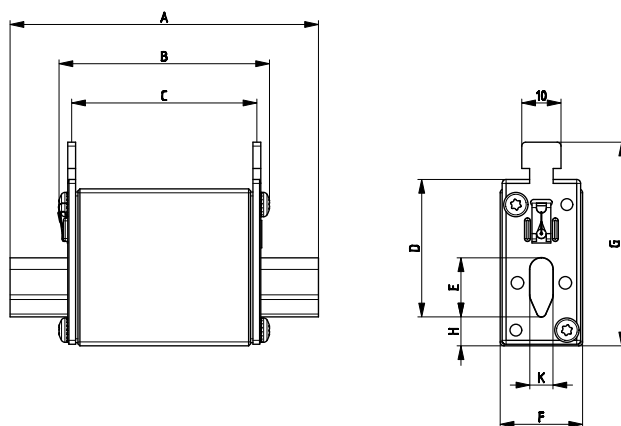
Rated voltage	80V d.c., L/R=10ms
Breaking capacity	50kA d.c.
Standard	IEC 60269-7
Application	Battery protection
Fuse base	NH00C, NH00: 004123001 PK00 NH1C, NH1: 004123100 PK1

NH gBat fuse-link 80V d.c.

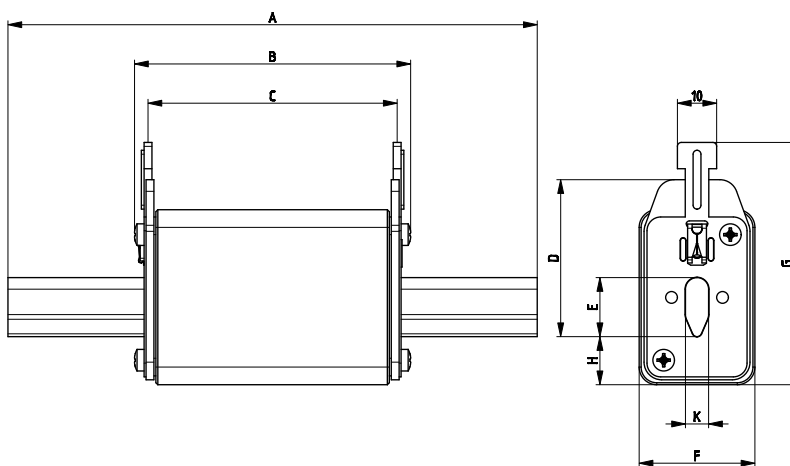
Size	I _n [A]	Standard indicator	Power dissipation [W]	Power dissipation 0,7xI _n [W]	Pre-arcing Joule integral [A ² s]	Operating Joule integral [A ² s]	g	Box
00C pic. 1	20	004110075	4,6	2	360	414	125	3/120
	25	004110076	5,8	2,6	710	817		
	32	004110077	6,6	3	920	1.058		
	40	004110078	9,4	4,2	1.440	1.656		
	50	004110079	11,1	5	2.820	3.243		
00 pic. 1	63	004110080	11,7	5,2	4.160	4.784	173	3/90
	80	004110081	10,4	4,7	4.670	5.371		
	100	004110082	11,1	5	9.360	10.764		
	125	004110083	13,4	6	14.750	16.963		
	160	004110084	15,5	7	27.880	32.062		
1C pic. 2	20	004110085	6,3	2,8	360	414	233	3/45
	25	004110086	7,3	3,3	710	817		
	32	004110087	9	4	920	1.058		
	40	004110088	11,2	5	1.440	1.656		
	50	004110089	14,5	6,5	2.820	3.243		
	63	004110090	16,8	7,5	4.160	4.784		
	80	004110091	11,4	5,1	4.670	5.371		
1 pic. 3	100	004110092	12	5,4	9.360	10.764	430	3/24
	125	004110093	14,8	6,6	14.750	16.963		
	160	004110094	17,6	7,9	27.880	32.062		
	200	004110095	26,6	11,9	41.990	48.289		
	250	004110096	31	13,9	81.000	93.150		



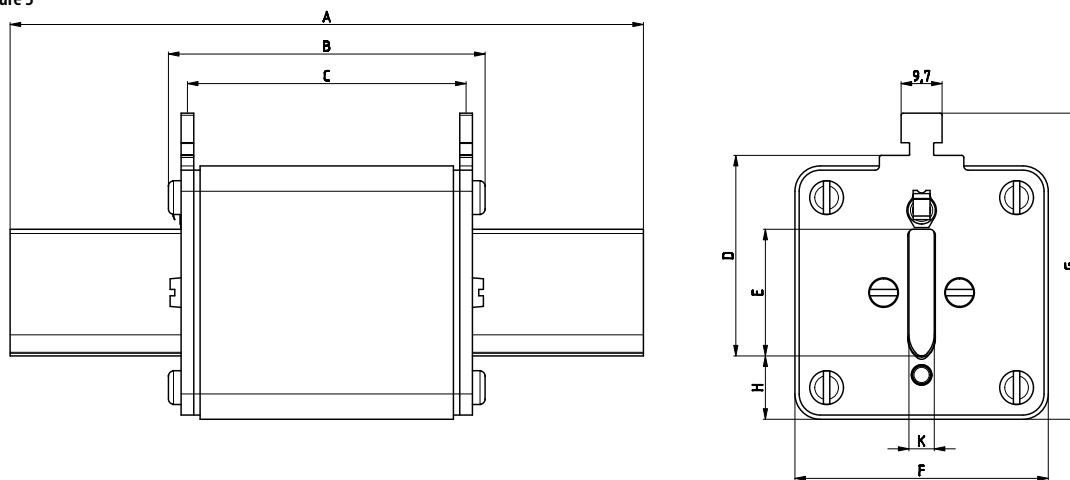
Picture 1



Picture 2



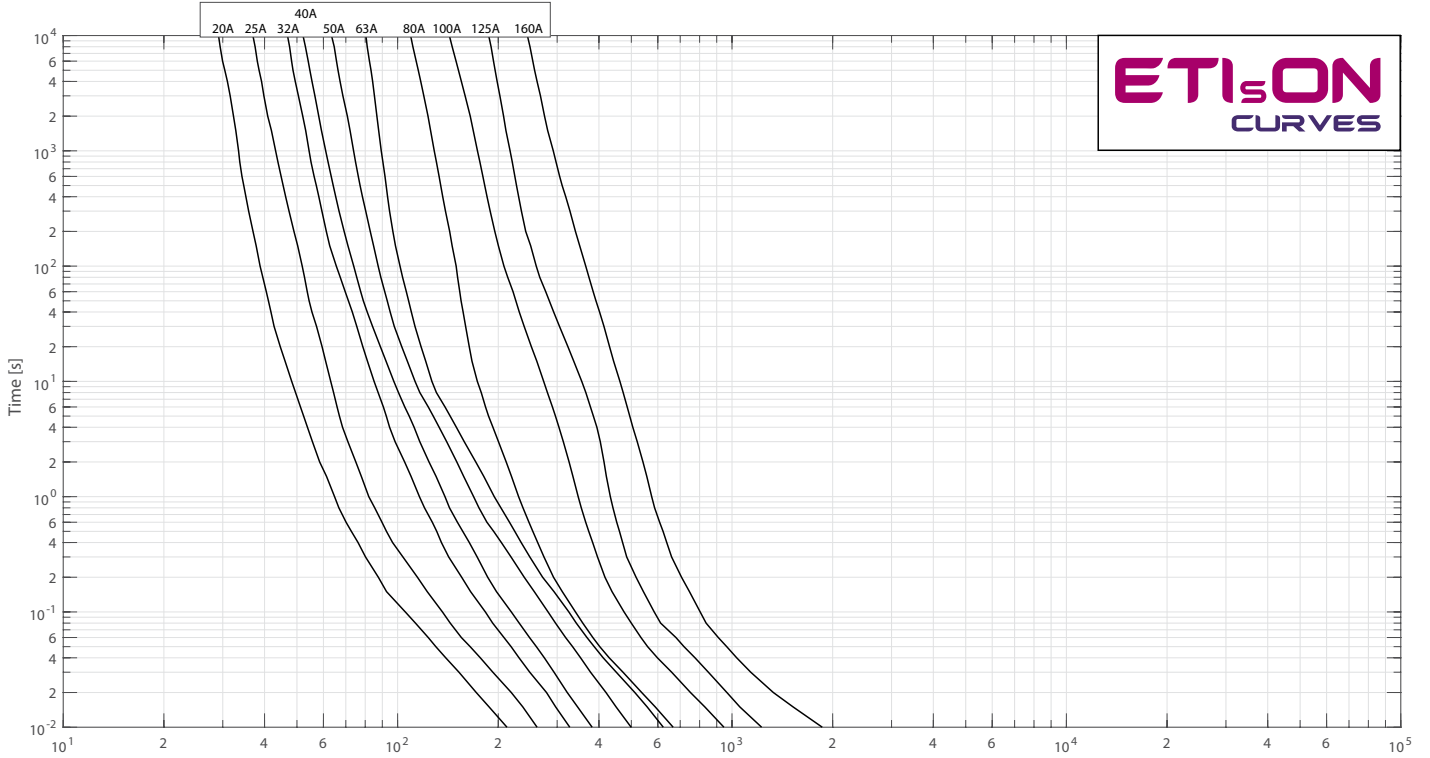
Picture 3



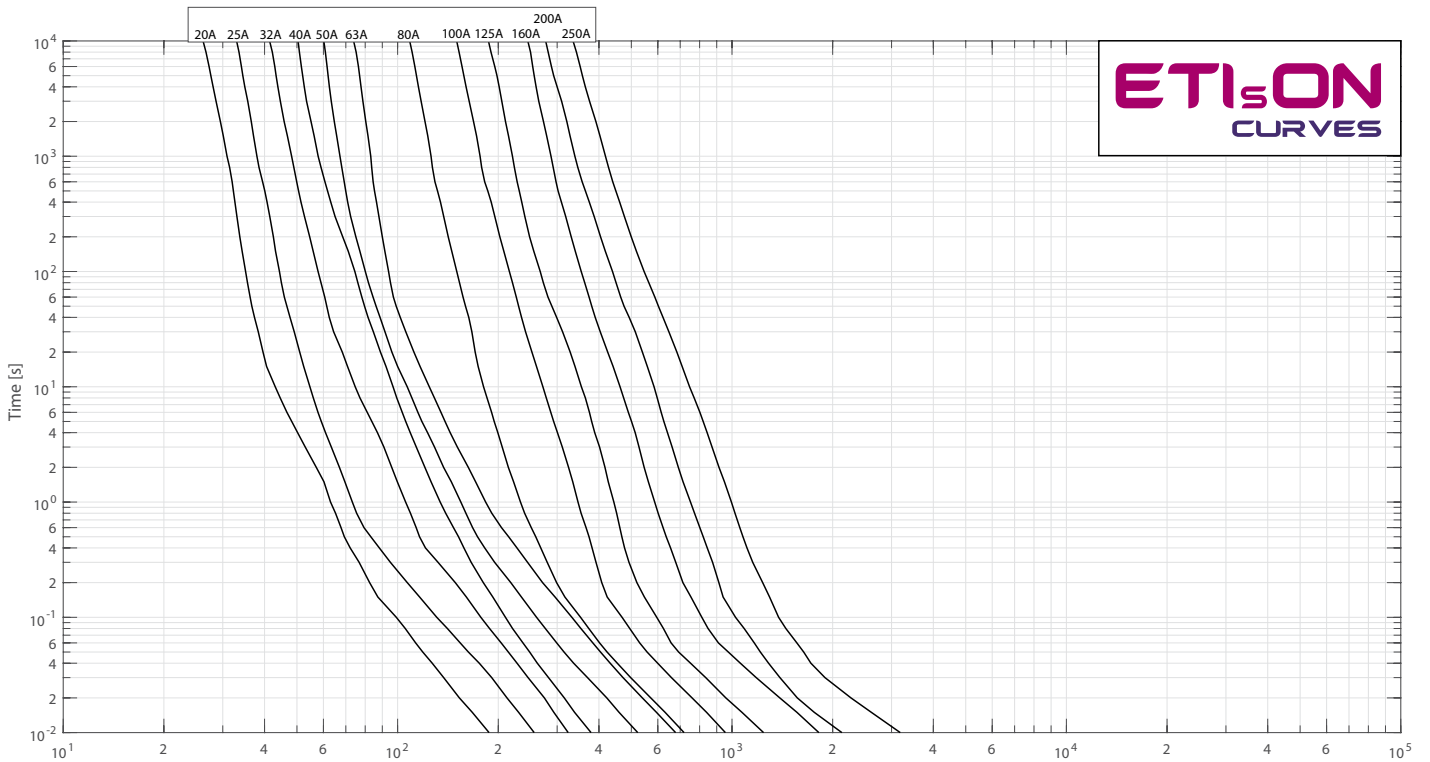
Size	A	B	C	D	E	F	G	H	K
00 C	79	53	47	35	15	21	52	7,5	6
00	79	53	47	35	15	28	56	12	6
1 C	135	68	65	40	15	28	61	12	6
1	135	72	65	40	20	46	65	14	6

Time current characteristics I/t

NH00C & NH00



NH1C & NH1



NH gBat fuse-link 440V d.c.

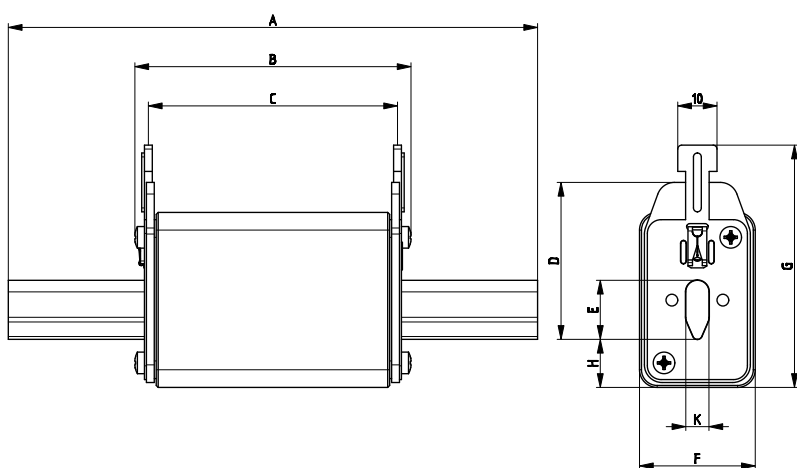
General characteristics

Rated voltage	440V d.c., L/R=10ms
Breaking capacity	30kA d.c.
Standard	IEC 60269-7
Application	Battery protection



NH gBat fuse-link 440 V d.c.

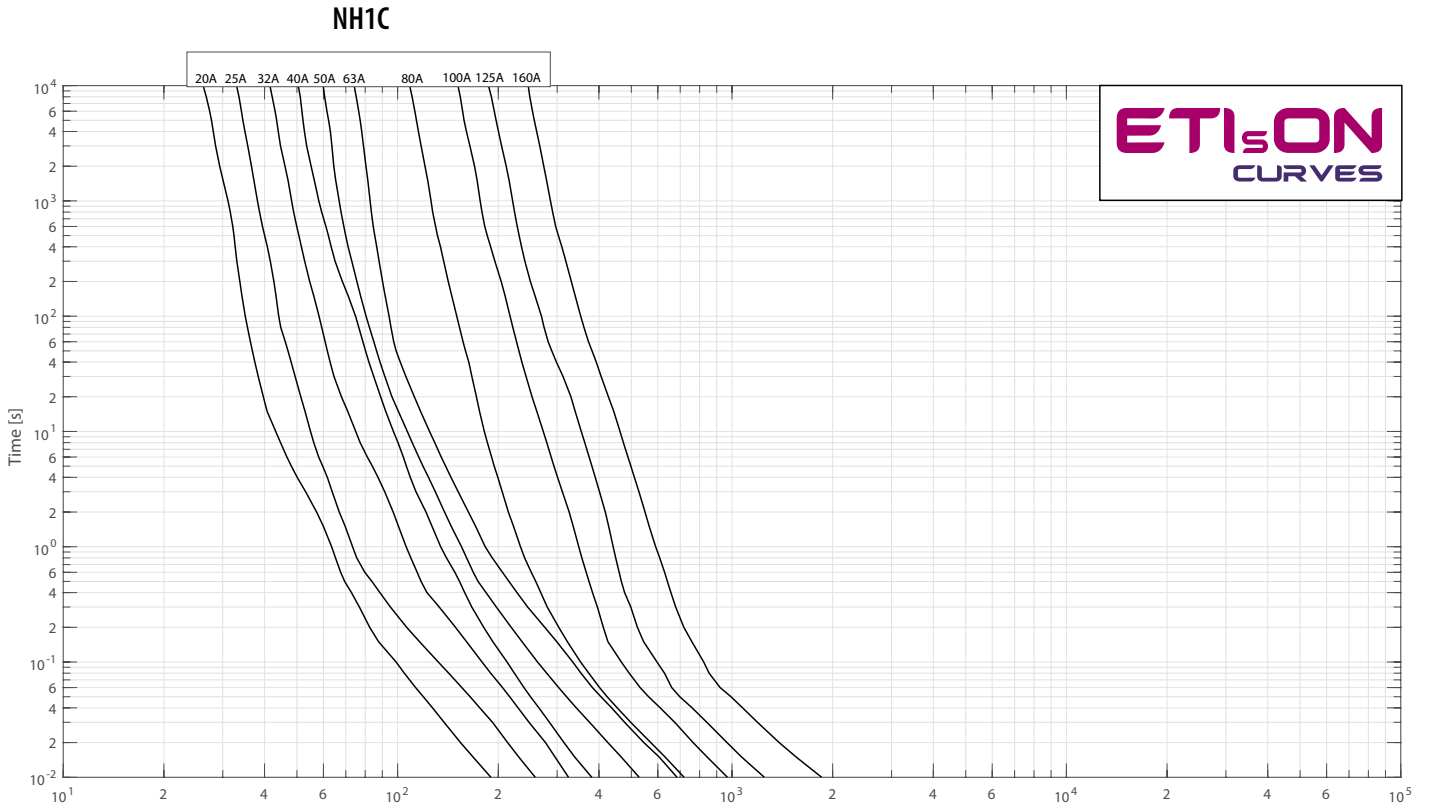
Size	I_n [A]	Standard indicator	Power dissipation [W]	Power dissipation $0,7 \times I_n$ [W]	Pre-arcing Joule integral L/R=10ms [A ² s]	Operating Joule integral L/R=10ms [A ² s]	For use with		
1C pic. 2	20	004723103	6,3	2,8	360	648	PK1 004123100	233	3/45
	25	004723104	7,3	3,3	710	1.278			
	32	004723105	9	4	920	1.656			
	40	004723106	11,2	5	1.440	2.592			
	50	004723107	14,5	6,5	2.820	5.076			
	63	004723108	16,8	7,5	4.160	7.488			
	80	004723109	11,4	5,1	4.670	8.406			
	100	004723110	12	5,4	9.360	16.848			
	125	004723111	14,8	6,6	14.750	26.550			
	160	004723112	17,6	7,9	27.880	50.184			



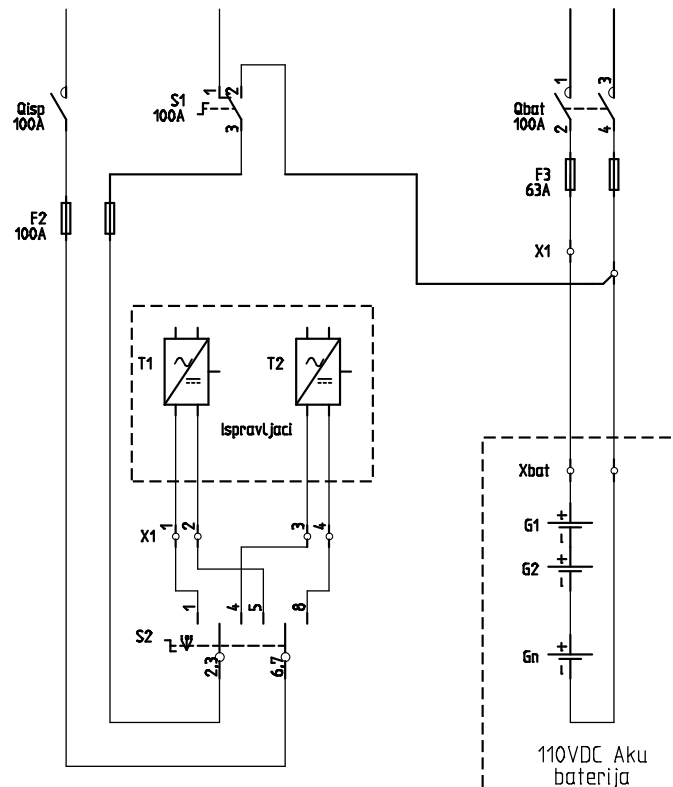
	A	B	C	D	E	F	G	H	K
1C	135	68	65	40	15	28	61	12	6



Time current characteristics I/t



Application



NH gBat fuse-link 550V d.c.

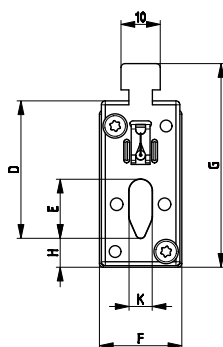
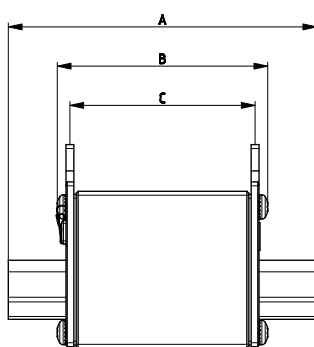
General characteristics

Rated voltage	550V d.c. (L/R=3ms)
Breaking capacity	30kA d.c.
Standard	IEC 60269-7
Application	Battery protection



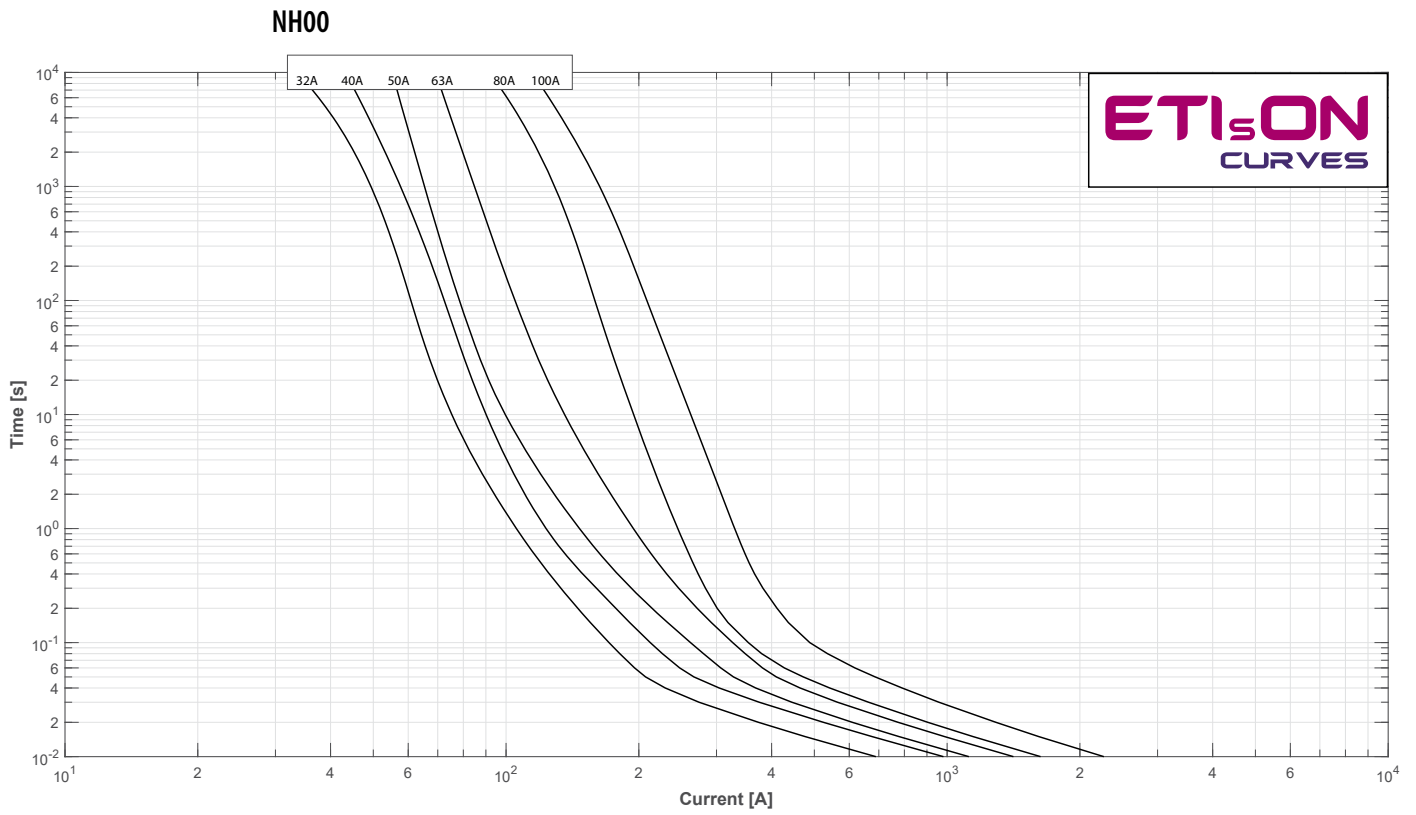
NH gBat fuse-link 550 V d.c.

Size	I_n [A]	Standard indicator	Power dissipation [W]	Power dissipation $0,7 \times I_n$ [W]	Pre-arcing Joule integral L/R=3ms [A ² s]	Operating Joule integral L/R=3ms [A ² s]	For use with		
00	32	004110209	7,0	2,9	500	2.000	PK00 004123001	190	3/90
	40	004110219	7,3	3,1	1.000	3.000			
	50	004110218	11,5	4,8	1.700	5.300			
	63	004110217	11,8	4,9	3.000	9.200			
	80	004110216	9,8	4,1	3.100	12.000			
	100	004110215	11,8	4,9	4.500	20.000			





	A	B	C	D	E	F	G	H	K
00	79	53	47	35	15	28	56	12	6

Time current characteristics I/t



NH gBat fuse-link 550 V d.c.

Size	I_n [A]	Standard indicator pic. 1	Striker indicator pic. 2	Standard indicator S_{110mm} pic. 3	Power dissipation [W]	Power dissipation $0,7 \times I_n$ [W]	Prearcing Joule integral L/R=3ms [A ² s]	Operating Joule integral L/R=3ms [A ² s]	For use with		
1	40	004723259	004723279	004723269	6	2,7	250	833	PK1DC 004122025	420	3/24
	50	004723260	004723280	004723270	7	3,1	449	1.495			
	63	004723261	004723281	004723271	9	4	700	2.331			
	80	004723262	004723282	004723272	12	5,4	1.200	3.996			
	100	004723263	004723283	004723273	15	6,7	1.650	5.495			
	125	004723264	004723284	004723274	20	9	2.200	7.326			
	160	004723265	004723285	004723275	26	11,7	4.300	14.319			
	200	004723266	004723286	004723276	32	14,4	8.500	28.305			
	224	004723267	004723287	004723277	37	16,6	10.000	33.300			
	250	004723268	004723288	004723278	43	19,3	15.000	50.000			
2	125	004724260	004724280	004724270	20	9	2.200	10.296	PK2DC 004122024	660	3/24
	160	004724261	004724281	004724271	26	11,7	4.300	20.124			
	200	004724262	004724282	004724272	32	14,4	8.500	39.780			
	224	004724263	004724283	004724273	37	16,6	10.000	46.800			
	250	004724264	004724284	004724274	43	19,3	15.000	70.200			
	315	004724265	004724285	004724275	57	26,6	20.000	93.600			
	350	004724266	004724286	004724276	67	30	28.000	131.040			
3	250	004725260	004725280	004725270	43	19,3	15.000	65.550	PK3DC 004122023	870	3/24
	315	004725261	004725281	004725271	57	26,6	20.000	87.400			
	350	004725262	004725282	004725272	67	30	28.000	122.360			
	400	004725263	004725283	004725273	76	34,2	32.000	139.840			
	425	004725264	004725284	004725274	84	37,8	40.000	174.800			
	500	004725265	004725285	004725275	110	49,5	44.000	192.280			
	630	004725266	004725286	004725276	160	72	80.000	350.000			



NH gBat fuse-link 700V d.c.

General characteristics

Rated voltage	700V d.c. (L/R=3ms)
Breaking capacity	30kA d.c.
Standard	IEC 60269-7
Application	Battery protection



NH gBat fuse-link 700 V d.c.

Size	I_n [A]	Standard indicator pic. 1	Striker indicator pic. 2	Standard indicator S_{110mm} pic. 3	Power dissipation [W]	Power dissipation $0,7 \times I_n$ [W]	Pre-arcing Joule integral L/R=3ms [A ² s]	Operating Joule integral L/R=3ms [A ² s]	For use with		
1	40	004723289	004723309	004723299	6	2,7	250	1.000	PK1DC 004122025	420	3/24
	50	004723290	004723310	004723300	7	3,1	449	1.796			
	63	004723291	004723311	004723301	9	4	700	2.800			
	80	004723292	004723312	004723302	12	5,4	1.200	4.800			
	100	004723293	004723313	004723303	15	6,7	1.650	6.600			
	125	004723294	004723314	004723304	20	9	2.200	8.800			
	160	004723295	004723315	004723305	26	11,7	4.300	17.200			
	200	004723296	004723316	004723306	32	14,4	8.500	34.000			
	224	004723297	004723317	004723307	37	16,6	10.000	40.000			
2	250	004723298	004723318	004723308	43	19,3	15.000	60.000	PK2DC 004122024	660	3/24
	125	004724290	004724310	004724300	20	9	2.200	11.682			
	160	004724291	004724311	004724301	26	11,7	4.300	22.833			
	200	004724292	004724312	004724302	32	14,4	8.500	45.135			
	224	004724293	004724313	004724303	37	16,6	10.000	53.100			
	250	004724294	004724314	004724304	43	19,3	15.000	79.650			
	315	004724295	004724315	004724305	57	26,6	20.000	106.200			
	350	004724296	004724316	004724306	67	30	28.000	148.680			
3	400	004724297	004724317	004724307	76	34,2	32.000	170.000	PK3DC 004122023	870	3/24
	250	004725290	004725304	004725297	43	19,3	15.000	75.000			
	315	004725291	004725305	004725298	57	26,6	20.000	100.000			
	350	004725292	004725306	004725299	67	30	28.000	140.000			
	400	004725293	004725307	004725300	76	34,2	32.000	160.000			
	425	004725294	004725308	004725301	84	37,8	40.000	200.000			
	500	004725295	004725309	004725302	110	49,5	44.000	220.000			
	630	004725296	004725310	004725303	160	72	80.000	400.000			



NH gBat fuse-link 800V d.c.

General characteristics

Rated voltage	800V d.c. (L/R=3ms)
Breaking capacity	30kA d.c.
Standard	IEC 60269-7
Application	Battery protection
Fuse base	NH1: 004122025 PK1DC NH2: 004122024 PK2DC NH3L: 004132023 PK3L 1500V

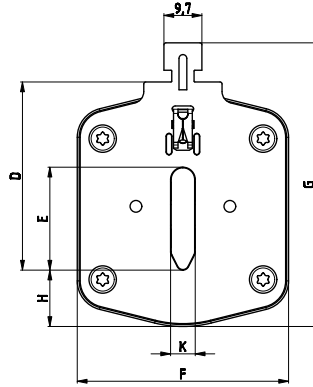
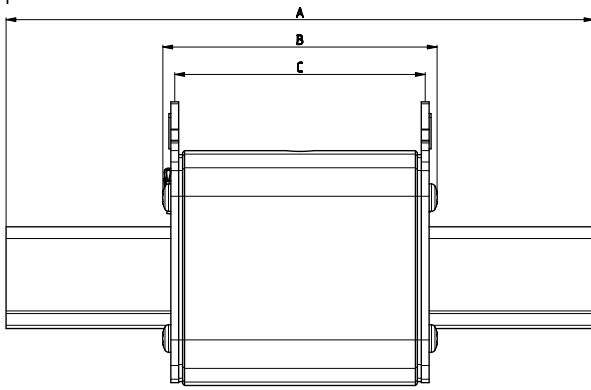


NH gBat fuse-link 800 V d.c.

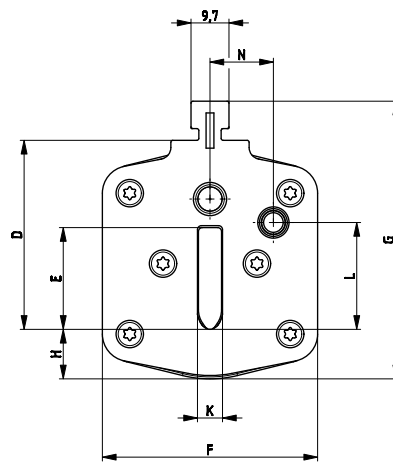
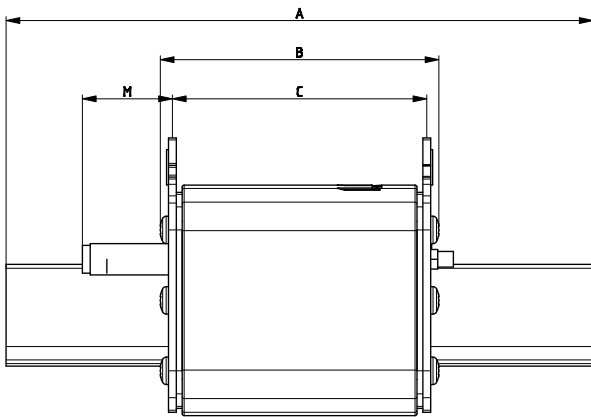
Size	I_n [A]	Standard indicator pic. 1	Striker indicator pic. 2	Standard indicator S_{110mm} pic. 3	Power dissipation [W]	Power dissipation $0,7 \times I_n$ [W]	Pre-arcing Joule integral L/R=3ms [A ² s]	Operating Joule integral L/R=3ms [A ² s]		
1	40	004723320	004723330	004723340	6	2,7	250	1.750	420	3/24
	50	004723321	004723331	004723341	7	3,1	449	3.143		
	63	004723322	004723332	004723342	9	4	700	4.900		
	80	004723323	004723333	004723343	12	5,4	1.200	8.400		
	100	004723324	004723334	004723344	15	6,7	1.650	11.550		
	125	004723325	004723335	004723345	20	9	2.200	15.400		
	160	004723326	004723336	004723346	26	11,7	4.300	30.100		
	200	004723327	004723337	004723347	32	14,4	8.500	60.000		
2	125	004724320	004724330	004724340	20	9	2.200	13.046	660	3/24
	160	004724321	004724331	004724341	26	11,7	4.300	25.499		
	200	004724322	004724332	004724342	32	14,4	8.500	50.405		
	224	004724323	004724333	004724343	37	16,6	10.000	59.300		
	250	004724324	004724334	004724344	43	19,3	15.000	88.950		
	315	004724325	004724335	004724345	57	26,6	20.000	118.600		
	350	004724326	004724336	004724346	67	30	28.000	166.040		
3L*	500	004110350	-	-	112	50	150.000	300.000	1970	1/10



pic.1

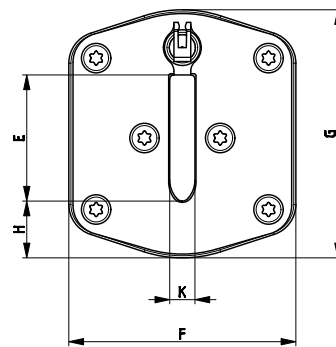
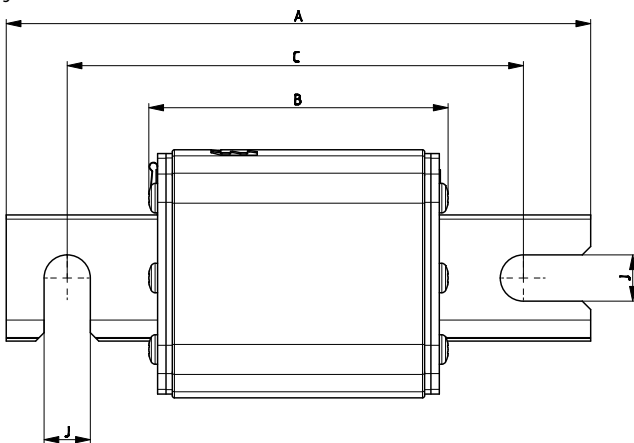


pic.2



Size	A	B	C	D	E	F	G	H	K	L	M	N
1	135	73	65	40	24	46	62	12	6	20,5	27,5	13,7
2	150	73	65	48	30	54	71	13	6	27,3	27,5	16,2
3	150	73	65	60	37	64	84	14	6	35,6	27,5	17

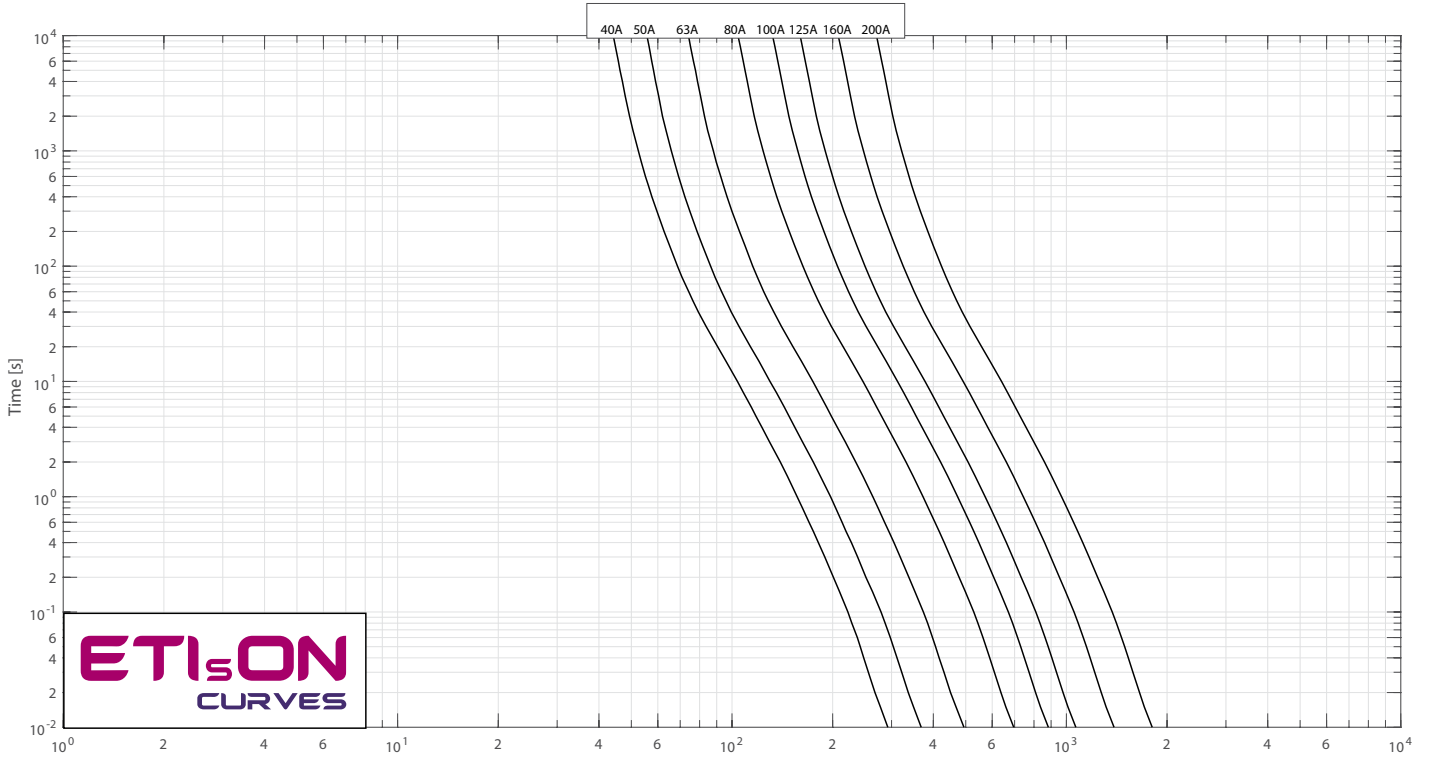
pic.3



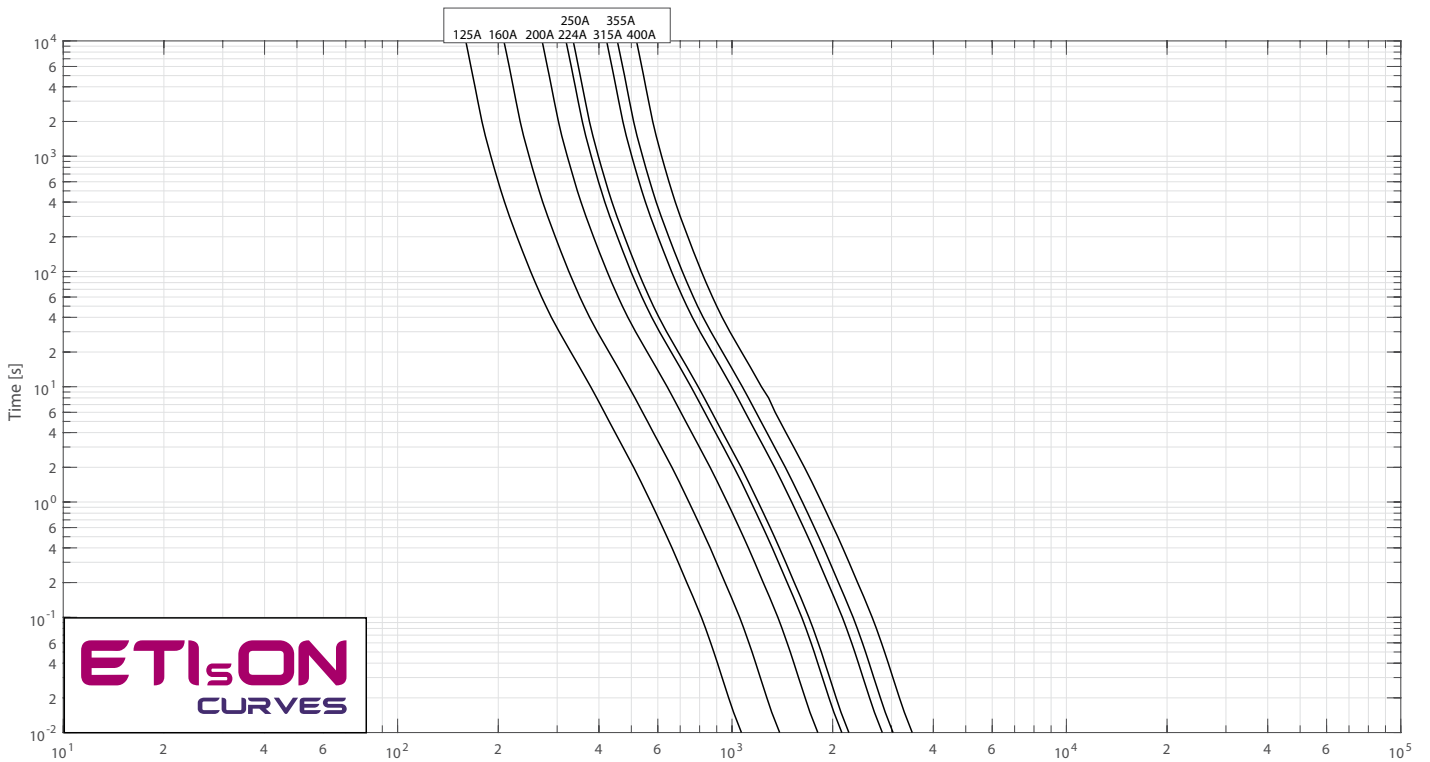
Size	A	B	C	E	F	G	H	J	K
1	140	72	110	24	46	51	12	11	6
2	140	72	110	30	54	59	13	11	6
3	140	72	110	37	64	70	14	11	6

Time current characteristics I/t

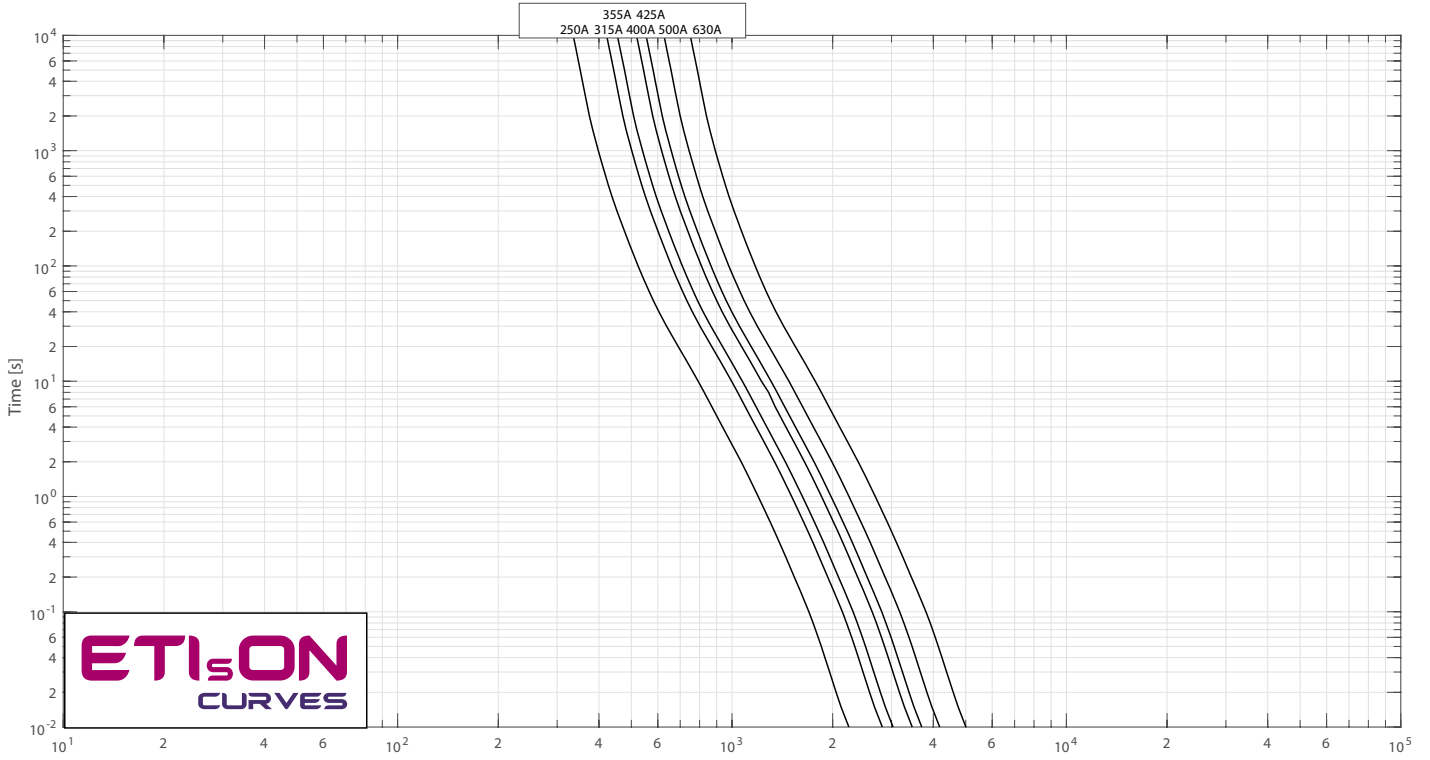
NH1 550V, 700V, 800V



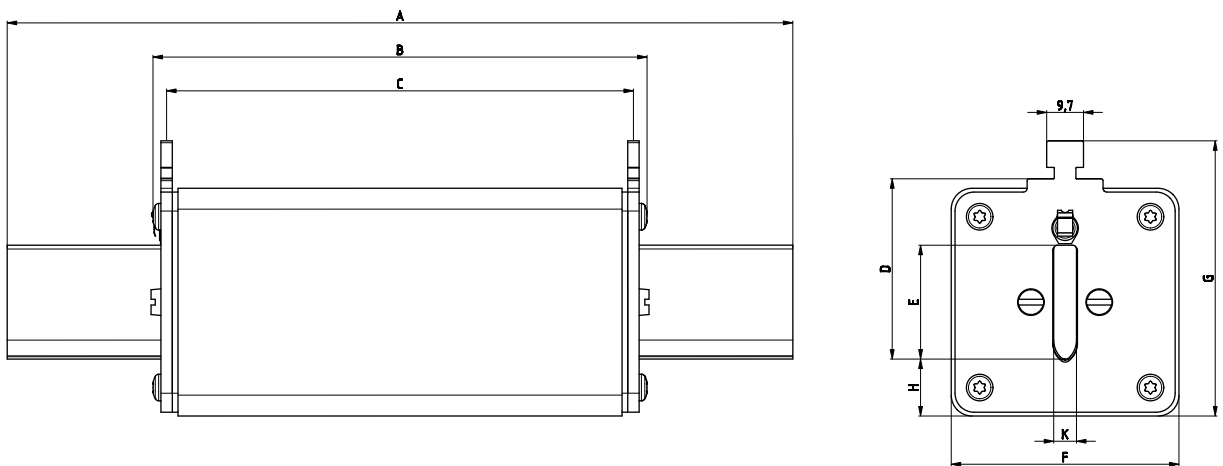
NH2 550V, 700V, 800V



NH3 550V, 700V



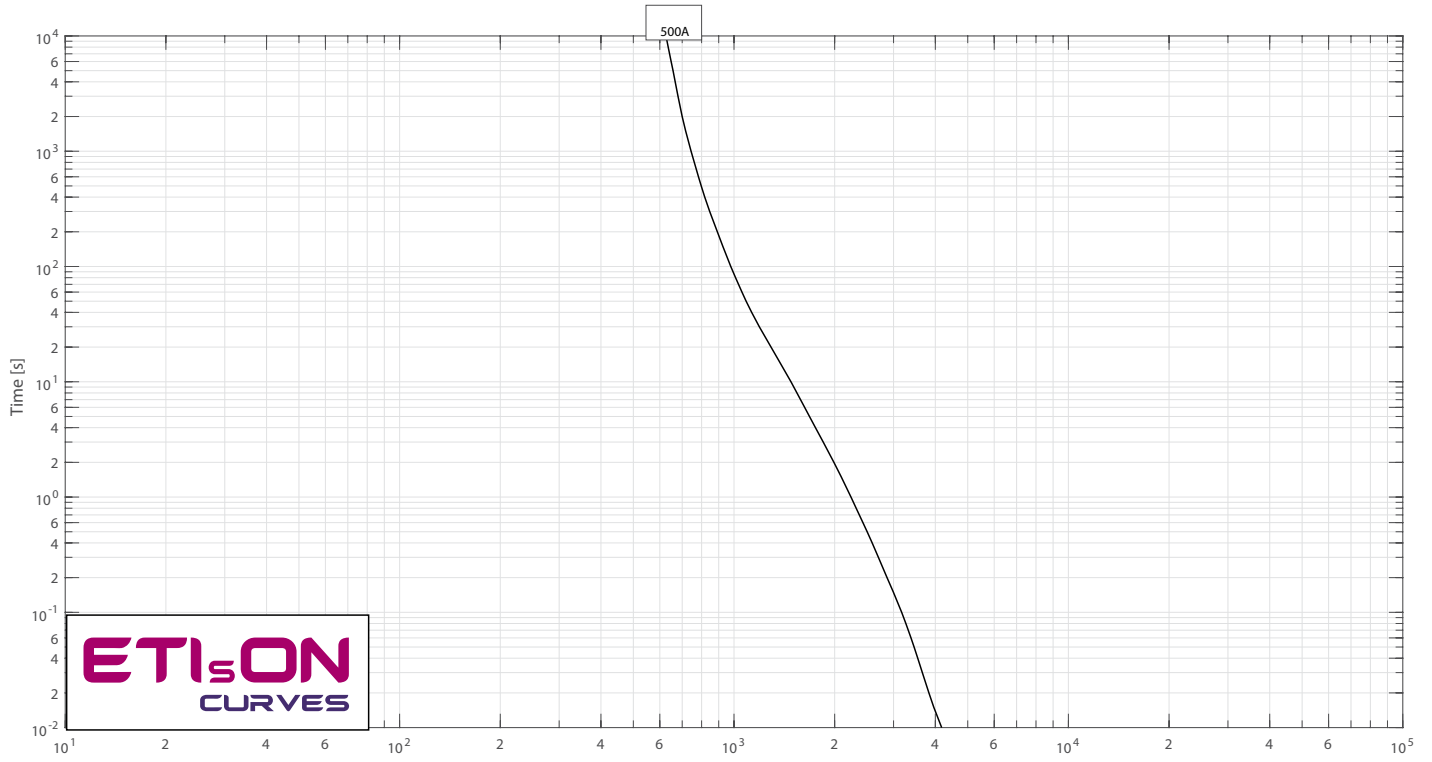
pic. 4



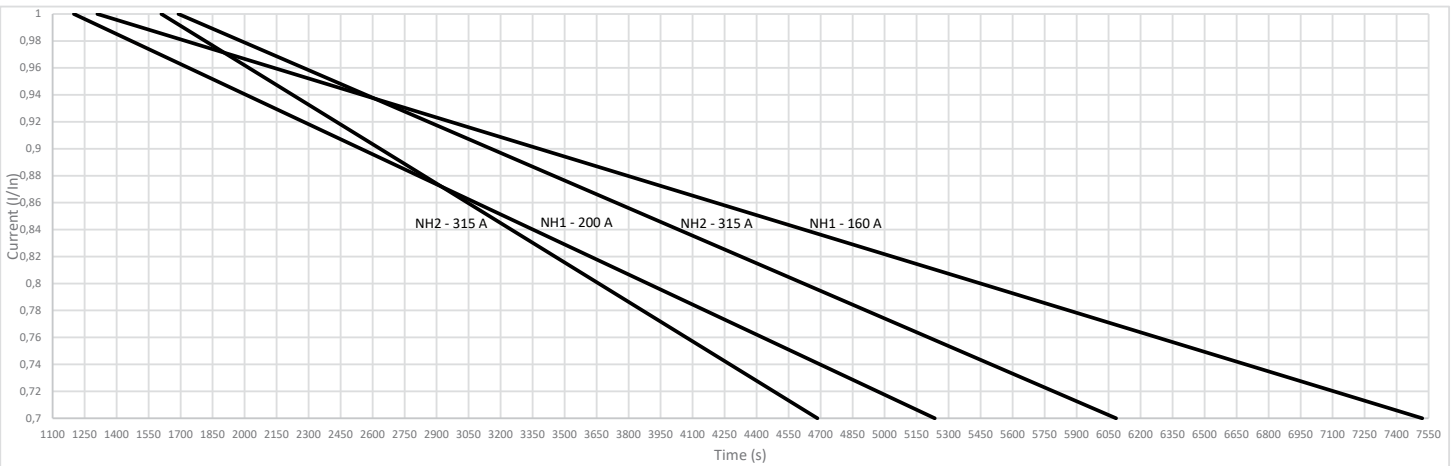
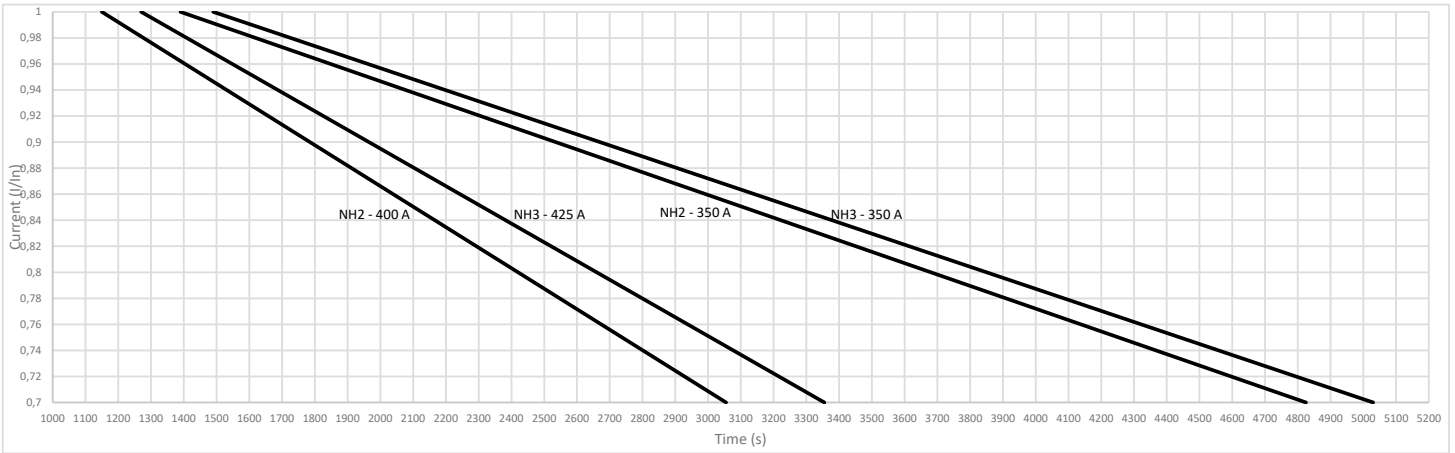
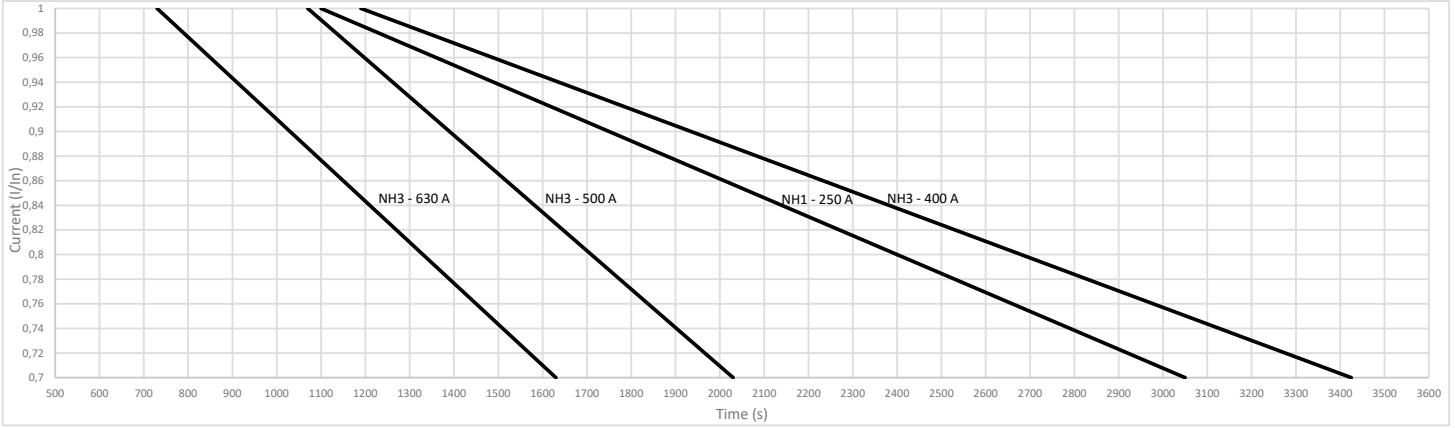
	A	B	C	D	E	F	G	H	K
3L	208	130	126	60	37	73	87	18	6

Time current characteristics I/t

NH3L 800V



Battery fuse NH1,2,3 550V, 700V, 800V d.c.-current loading derating factor in disconnectors



NH gBat fuse-link 1000V d.c.

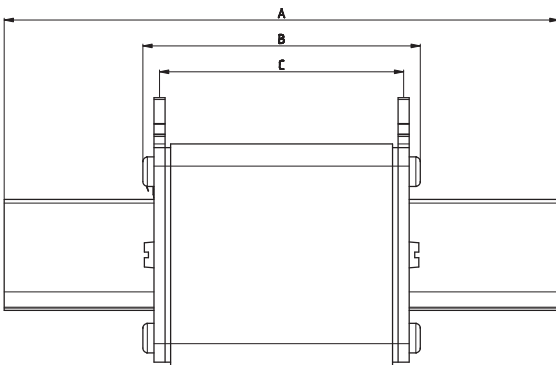
General characteristics

Rated voltage	1000V d.c. (L/R=1ms)
Breaking capacity	30kA d.c.
Standard	IEC 60269-7
Application	Fuse-link for battery protection.

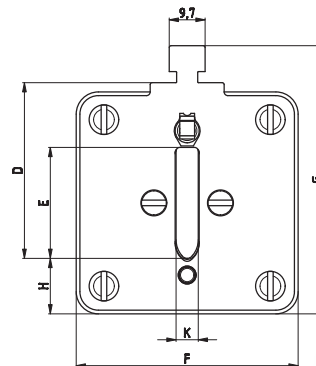


NH gBat fuse-link 1000V d.c.

Size	I_n	Standard indicator	S_{110} screw contact	U_{110} screw contact	G screw contact with centre trip indicator for microswitch MK	Power dissipation	Power dissipation $0,7 \times I_n$	Pre-arcing Joule integral	Operating Joule integral		
	[A]					[W]	[W]	[A ² s]	[A ² s]		
1	200	004110760	/	/	/	27	11	4.400	29.000	500	3/24
2	200	004110761	004110769	004110774	004110755	26	11	4.400	29.000	650	1/16 (G type 2/32)
	250	004110762	004110770	004110775	004110756	36	15	6.000	38.000		
3	160	004110763	/	/	/	38	15	5.000	10.000	1200	3/15 (G type 2/9)
	200	004110764	/	/	/	45	18	10.000	20.000		
	250	004110765	/	/	/	44	18	20.000	40.000		
	315	004110766	004110771	004110776	004110757	54	24	40.000	80.000		
	350	004110767	004110772	004110777	004110758	55	25	45.000	90.000		
	400	004110768	004110773	004110778	004110759	58	24	46.000	138.000		



Standard indicator

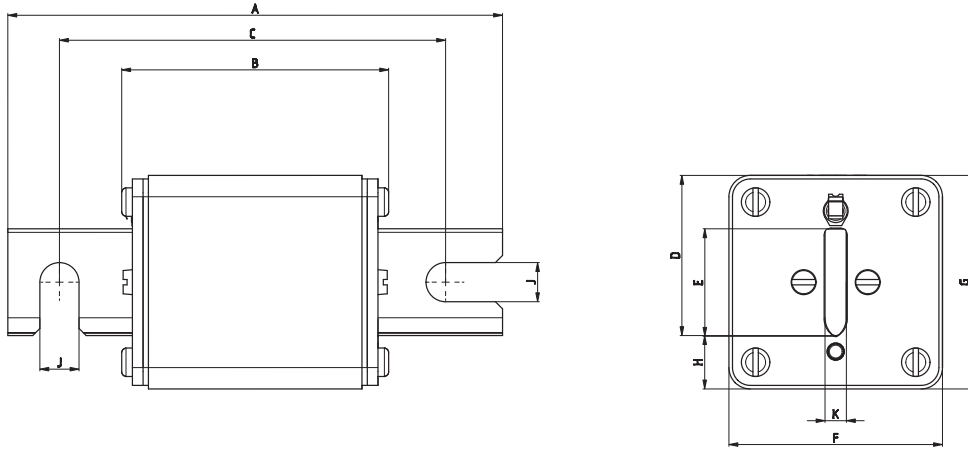


Size	A	B	C	D	E	F	G	H	K
1	135	74	70	42	24	51	67	13,5	6
2	150	74	70	48	30	61	71	15	6
3	150	74	70	60	37	73	87	18	6

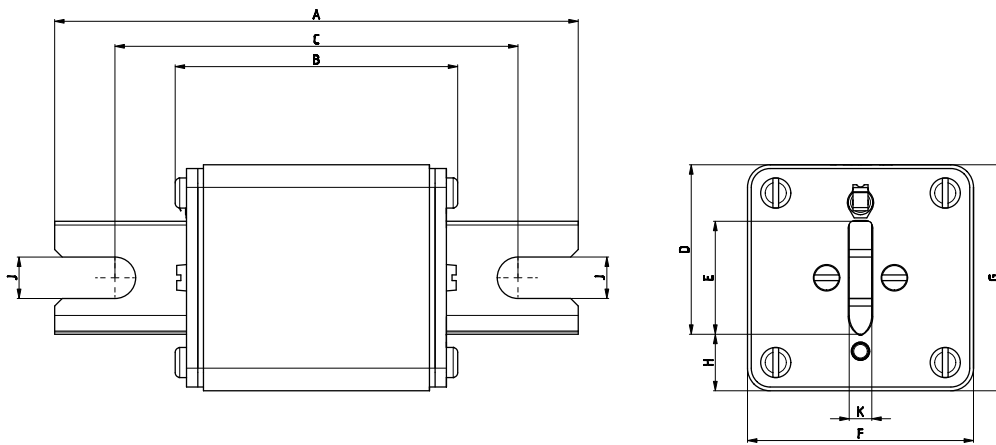


GREEN PROTECT / Battery Fuse

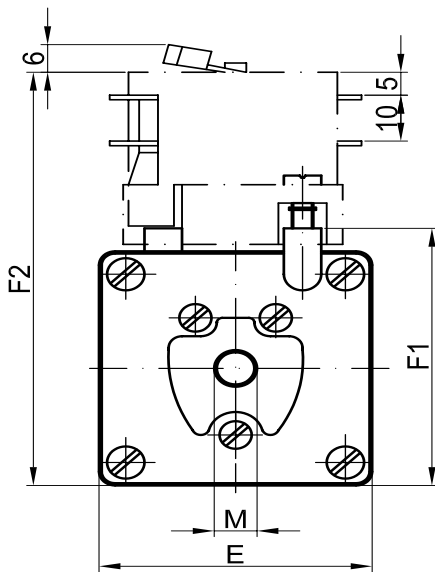
S₁₁₀ screw contact



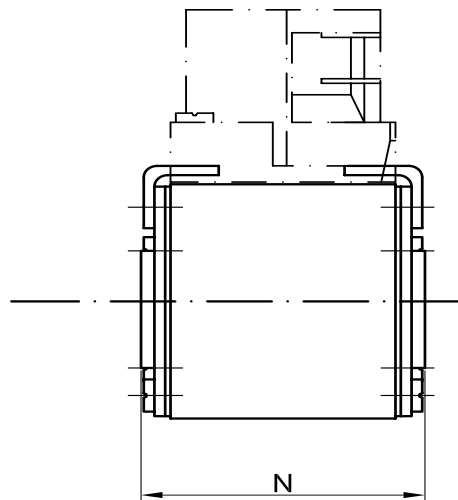
U₁₁₀ screw contact



Size	A	B	C	D	E	F	G	H	K	J - NHS	J - NHU
2S,U	140	73	110	45	30	60	60	15	6	11	13
3S,U	140	73	110	55	37	73	73	18	6	11	13



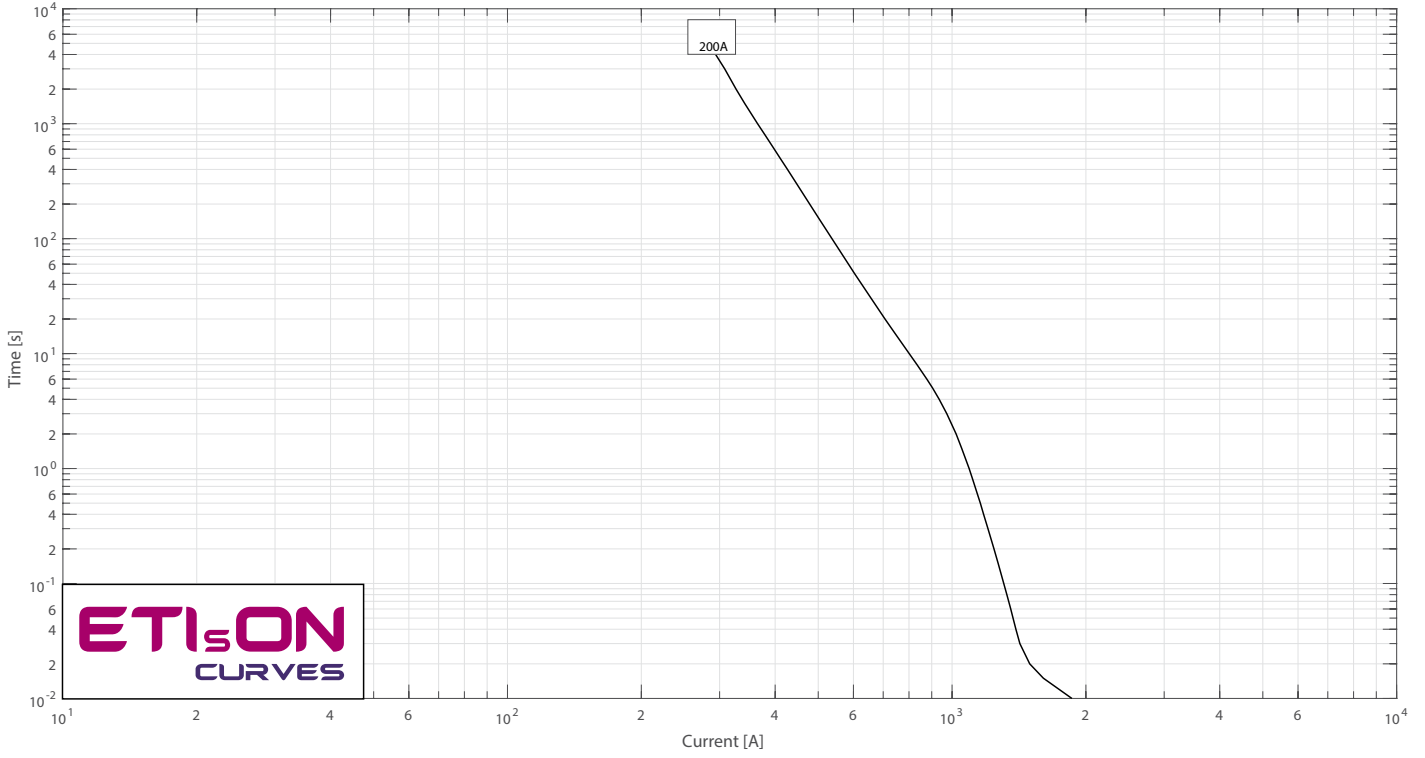
G screw contact



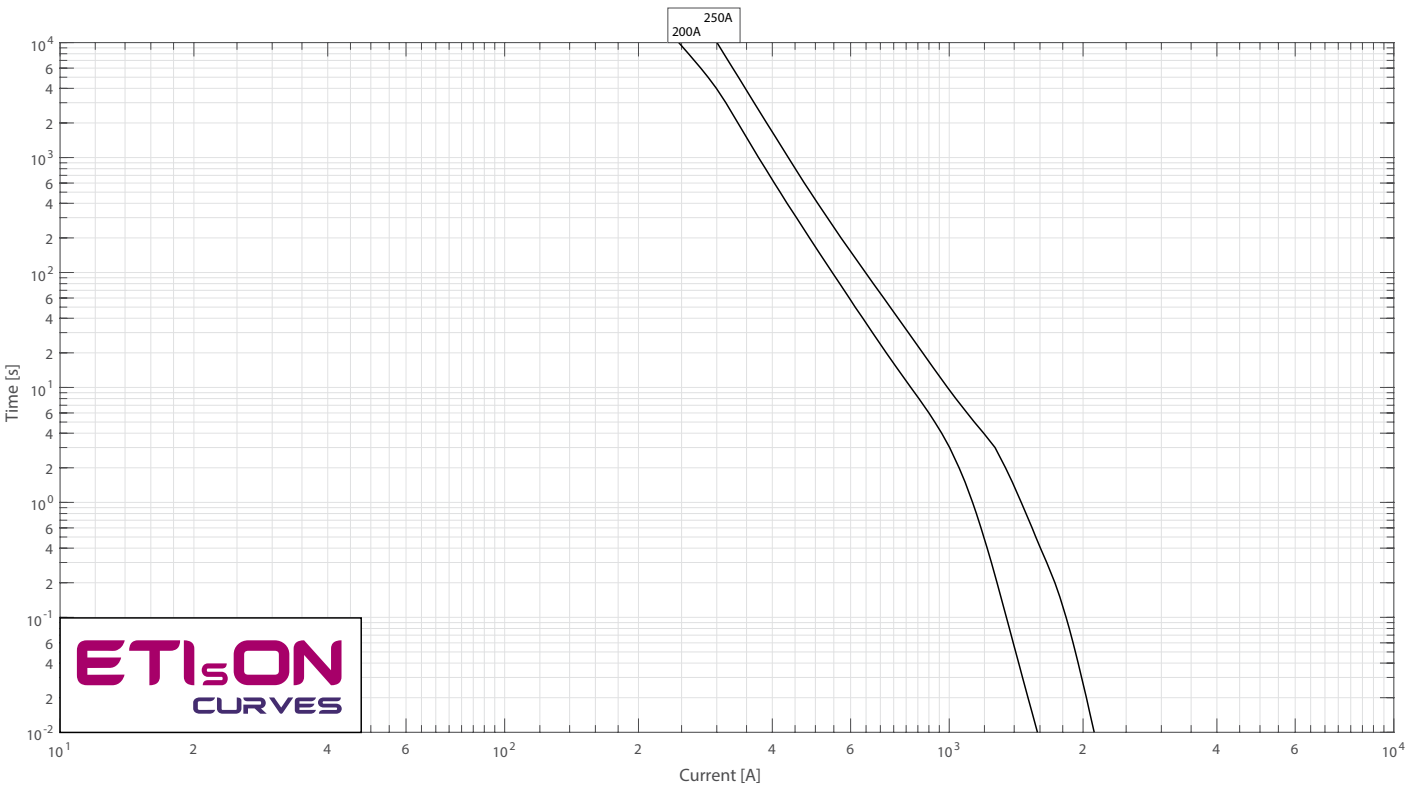
Size	D	E	F1	F2	M	N
2	60	60	65	99	M10	75
3	75	75	80	114	M12	75

Time current characteristics I/t

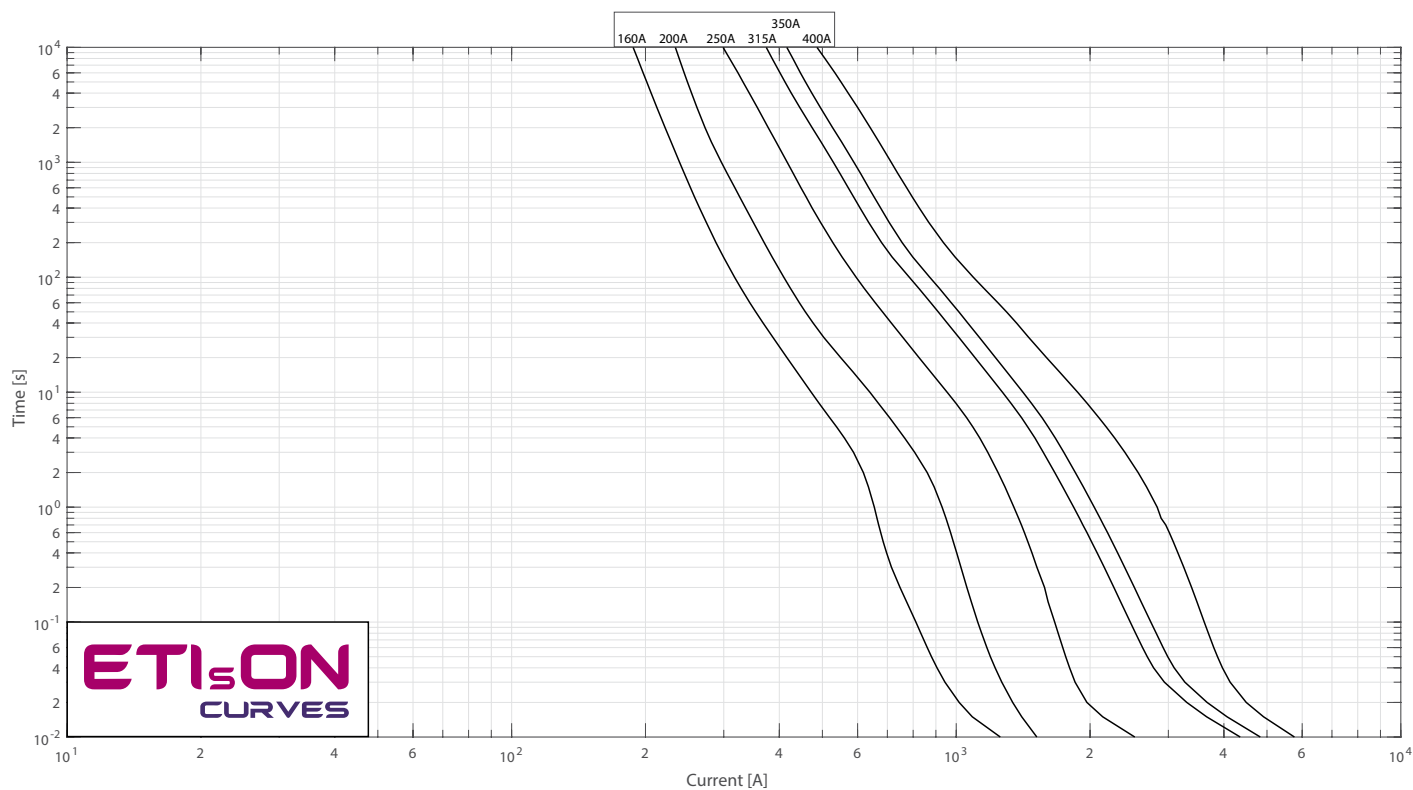
NH1 1000V



NH2 1000V



NH3 1000V



NH XL gBat fuse-link 1500V d.c.

General characteristics

Rated voltage	1500V d.c. (L/R=3ms)
Rated current	50 - 630A
Breaking capacity	100kA d.c.
Standard	IEC60269-7
Application	For battery protection. Applied in fuse base PK XL 1500V.



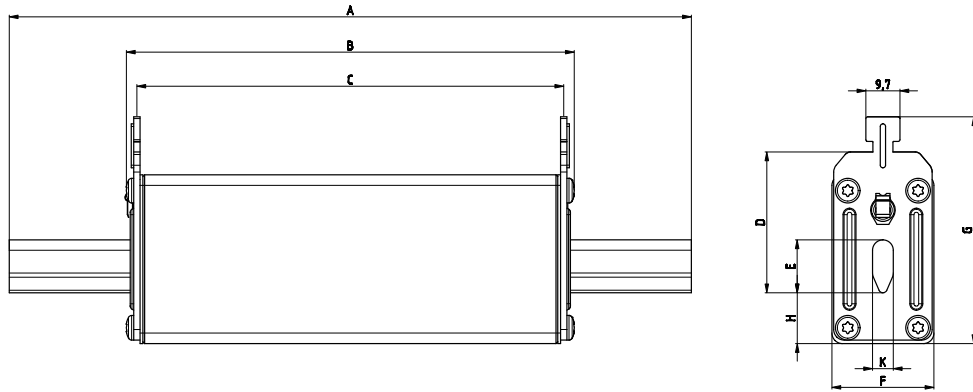
NH gBat fuse-link 1500V d.c.

Size	I_n [A]	Standard indicator	S_{170} screw contact	U_{170} screw contact	Power dissipation [W]	Power dissipation $0,7 \times I_n$ [W]	Pre-arcing Joule integral L/R=3ms [A ² s]	Operating Joule integral L/R=3ms [A ² s]	For use with		
01XL	50	004110698	004110782	004110788	18	7	1.100	6.500	PK1XL 1500V	450	3/30
	63	004110699	004110783	004110789	22	8,5	2.500	13.000			
	80	004110700	004110784	004110790	21	9	4.500	32.500			
	100	004110701	004110785	004110791	29	11	7.500	54.000			
	125	004110702	004110786	004110792	36	13	9.000	65.000			
	160	004110703	004110787	004110793	46	17	13.000	104.000			
1XL	50	004110650	004110657	004110664	14	6	1.000	8.000	PK1XL 1500V	950	1/15
	63	004110651	004110658	004110665	14	6,2	2.000	13.000			
	80	004110652	004110659	004110666	16	7	6.000	32.000			
	100	004110653	004110660	004110667	19	8,3	12.500	56.000			
	125	004110654	004110661	004110668	22	9,7	19.000	80.000			
	160	004110655	004110662	004110669	30	13,2	24.000	104.000			
2XL	200	004110671	004110673	004110675	36	15,9	50.000	165.000	PK2XL 1500V	1350	1/9
	250	004110672	004110674	004110676	44	19,3	90.000	286.000			
	315	004110677	004110682	004110687	57	22,2	60.000	350.000			
3L	350	004110678	004110683	004110688	61	23,7	70.000	400.000	PK3L 1500V	1970	1/9
	400	004110679	004110684	004110689	67	26,8	80.000	550.000			
	450	004110680	004110685	004110690	75	29	120.000	700.000			
	500	004110681	004110686	004110691	79	44,3	150.000	850.000			
	630	004110779	004110780	004110781	102	40	280.000	1.600.000			



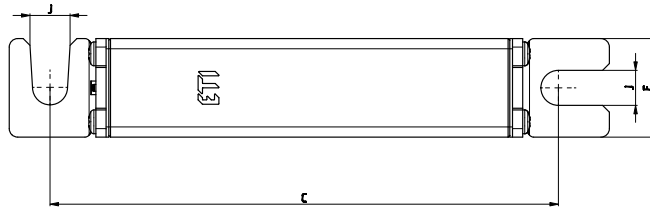
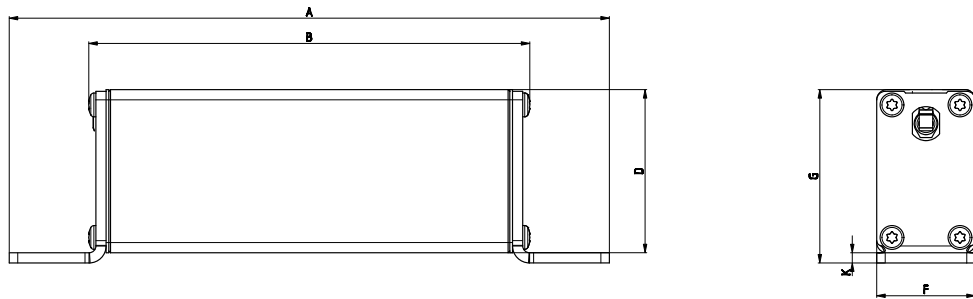
GREEN PROTECT / Battery Fuse

NH 01XL

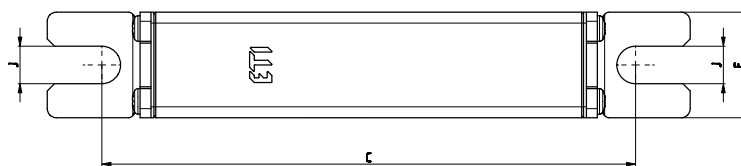
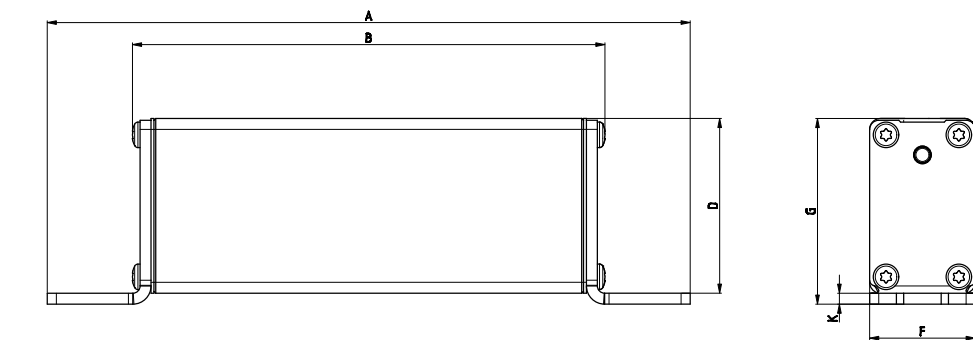


	A	B	C	D	E	F	G	H	K
01XL	194	128	123,2	40	15	29	65	15	6

NHS 01XL

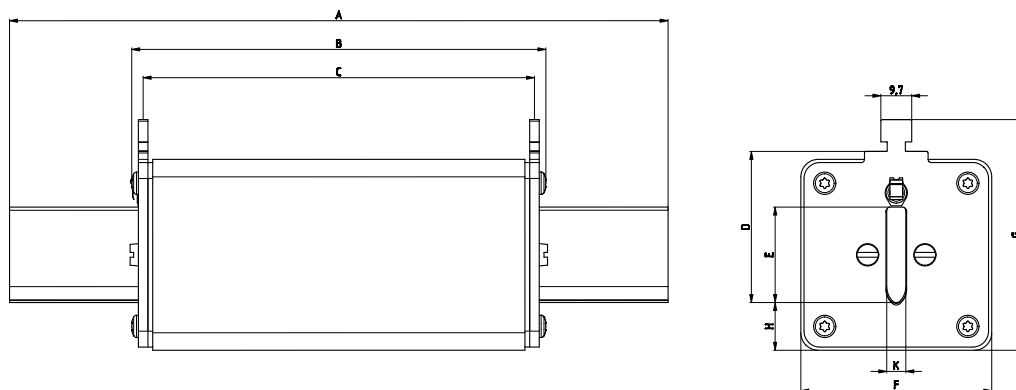


NHU 01XL



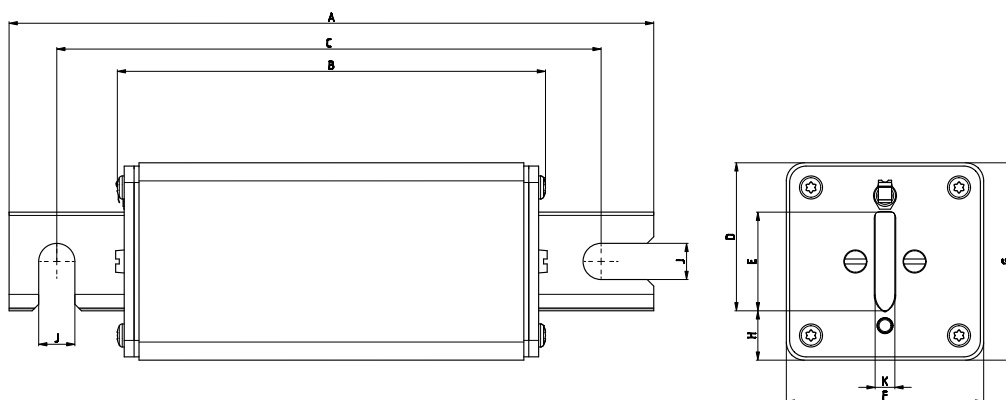
	A	B	C	F	G	K	J
01XL S,U	177	130	150	29	51	3	10

NH 1XL, 2XL, 3L

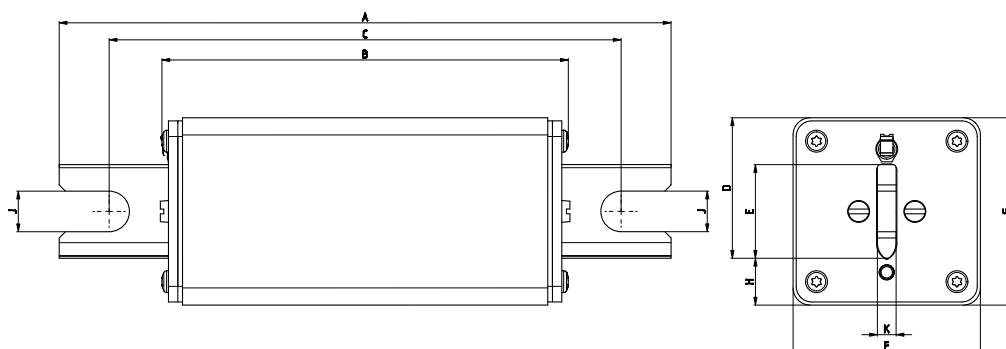


	A	B	C	D	E	F	G	H	K
1XL	192	131	125	42	24	51	67	13,5	6
2XL	208	130	126	48	30	61	71	15	6
3L	208	130	126	60	37	73	87	18	6

NHS 1XL, 2XL, 3L

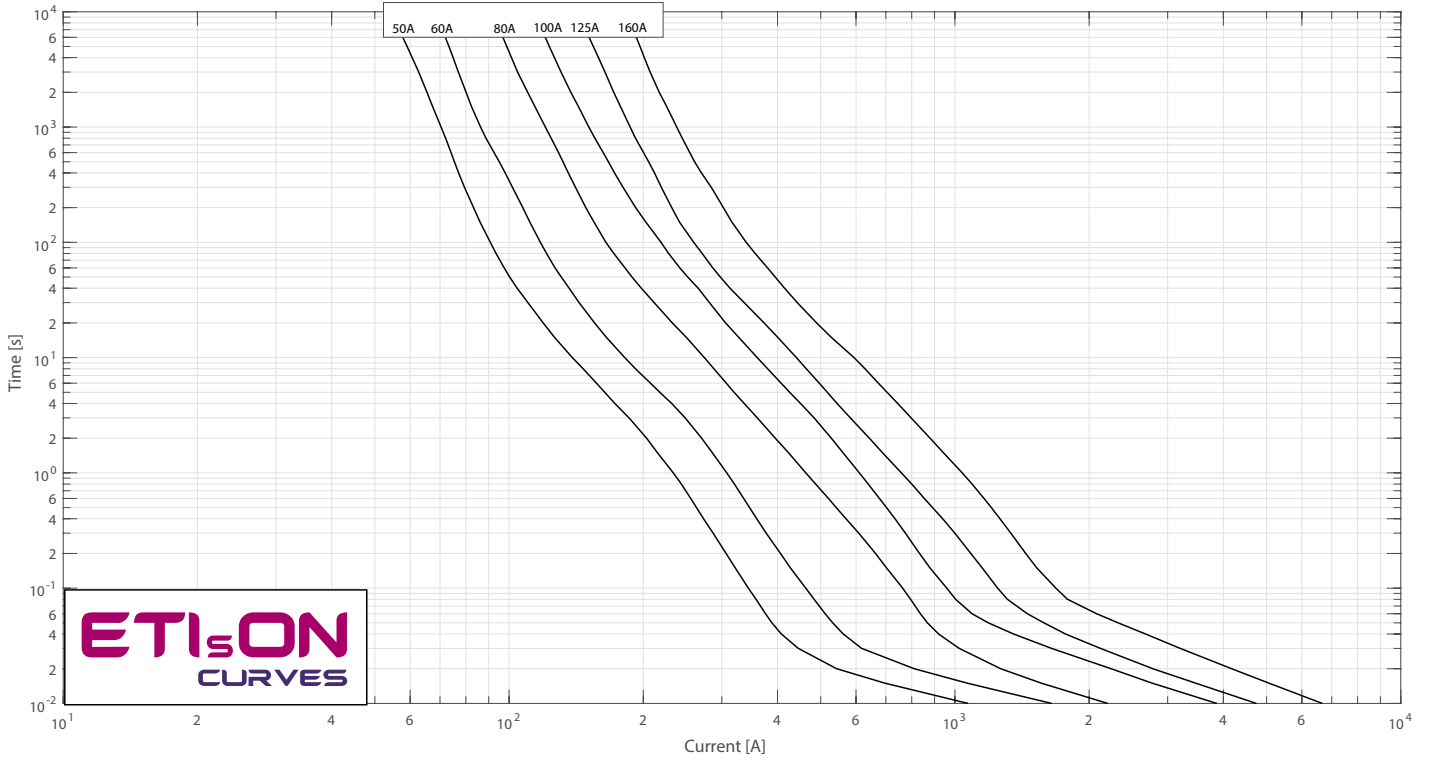


NHU 1XL, 2XL, 3L

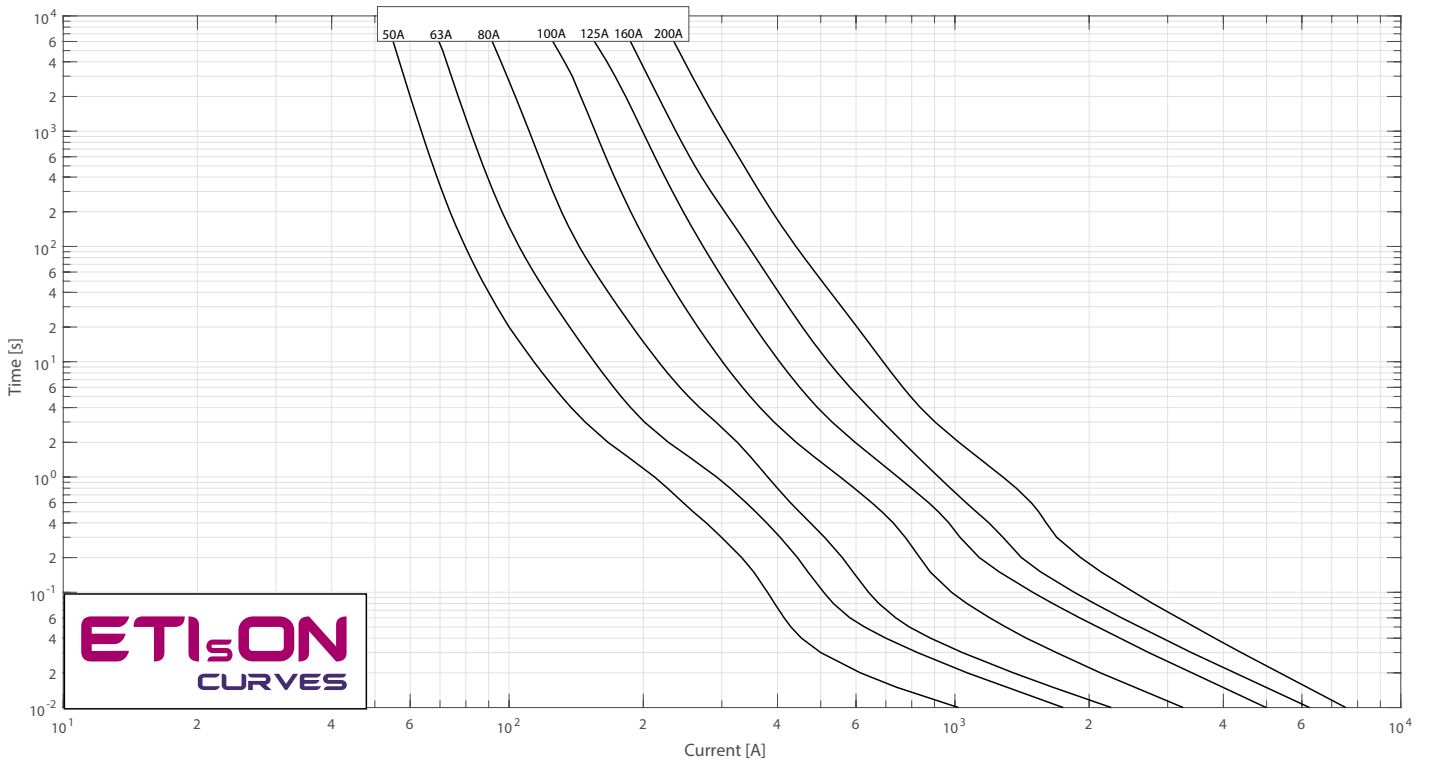


	A	B	C	D	E	F	G	H	K	J-NHS	J-NHU
1XL S,U	200	130	170	40	30	51	51	13,5	6	11	11
2XL S,U	200	130	170	45	30	61	61	15	6	11	13
3L S,U	200	130	170	55	37	73	73	18	6	11	13

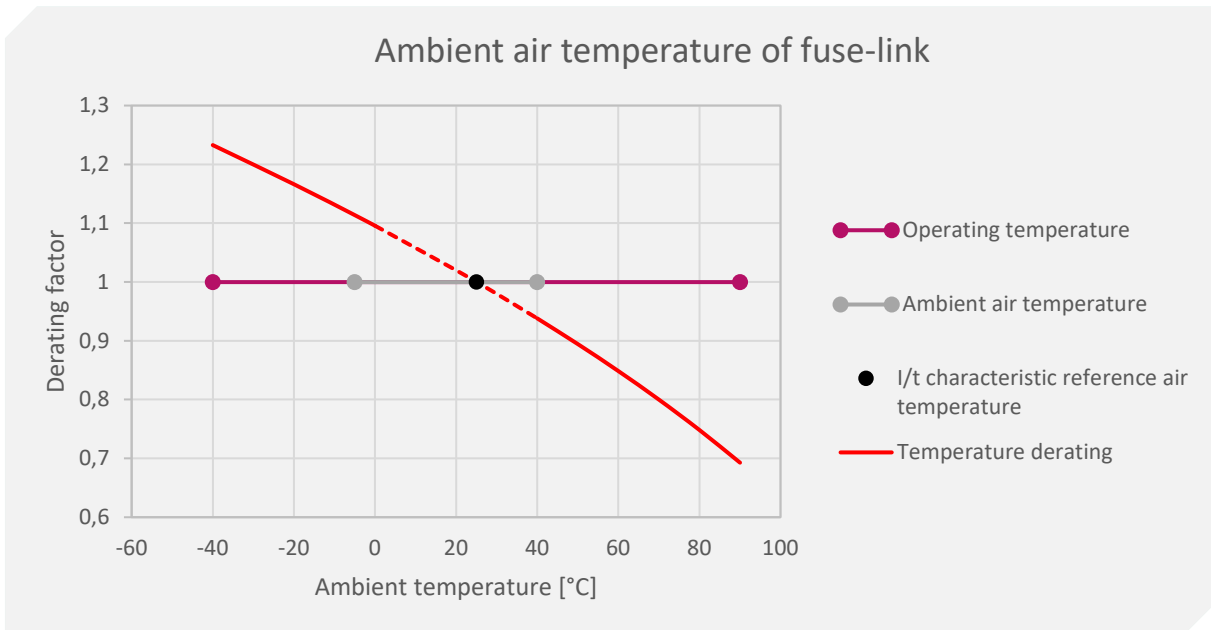
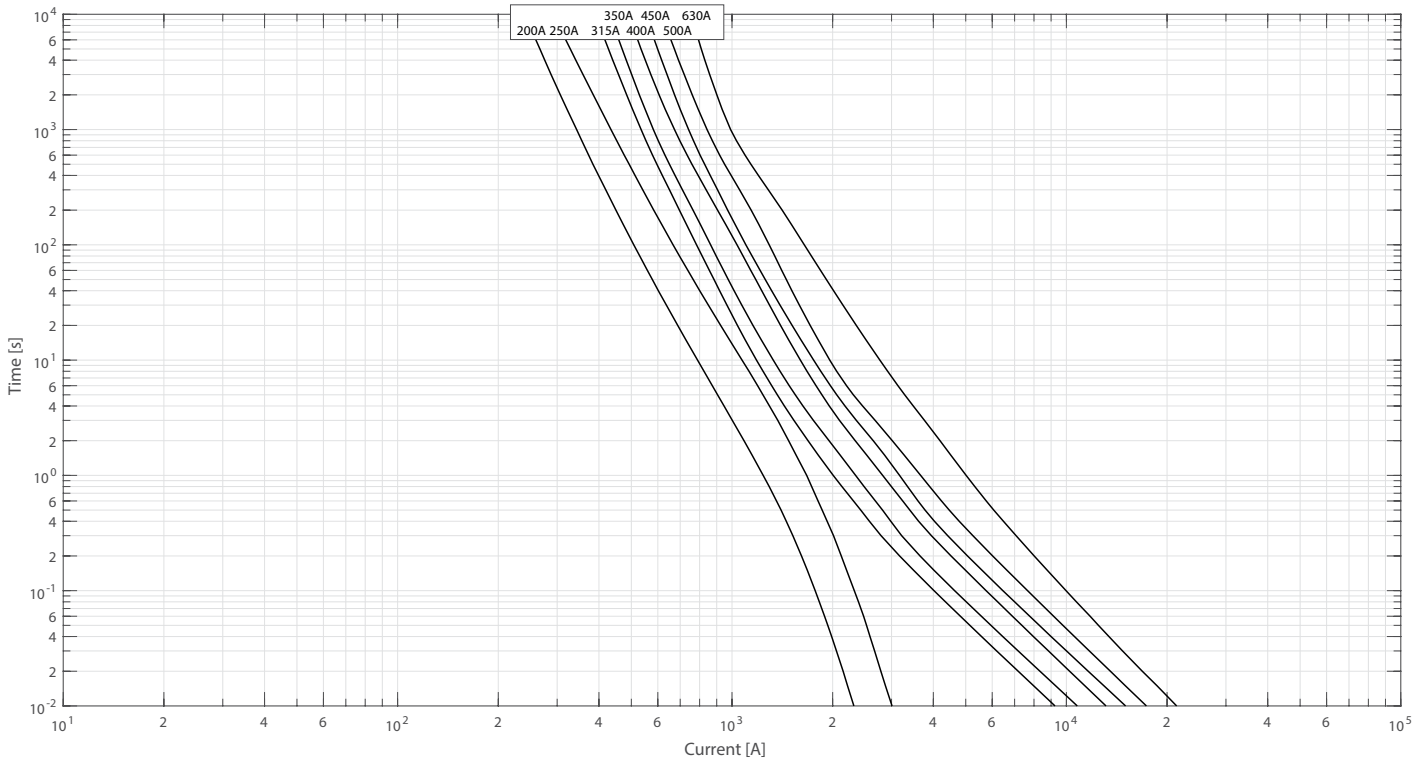
NH01XL



NH1XL



NH2XL, NH3L



Legend:

T_{amb} – Ambient Temperature

TDF – Temperature Derating Factor

I_N – Nominal Current of Fuse-link

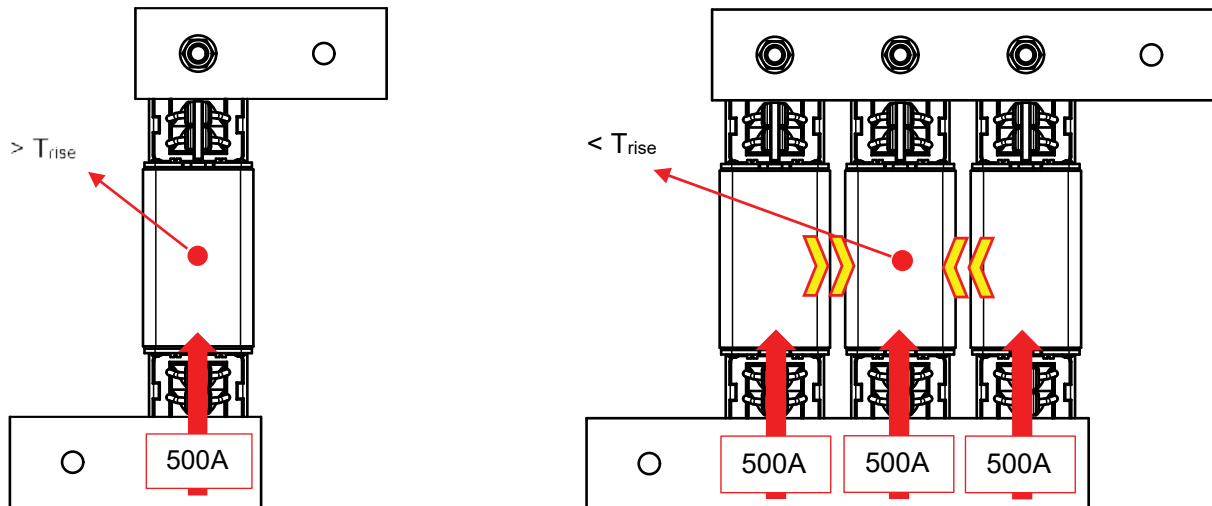
I_{TDF} – Nominal Current Including Temperature Derating Factor

Current calculation: $I_{TDF} = I_N \times TDF$

Parallel connection of fuse-links to increase the rated current

Rules for parallel connection of fuse-links:

- // The fuse-links have to be the same type, size, and rating.
- // The combination of parallel fuses must be selected by the manufacturer.
- // The current rating of parallel-connected fuse-links is lower than the sum of the single fuse-links ($n \times I_n > I_{n \text{ parallel}}$).
- // The current distribution on all parallel fuse-links must be the same.
- // Parallel fuse-links must be connected as prescribed by the manufacturer.
- // The incoming and outgoing connection must have prescribed cross-section.
- // The values of power dissipation are equal to the sum of values of power dissipation of a single fuse-link.
- // The Pre-arcing
- // Joule integral is approximately equal to $n^2 \times I^2 t_{\text{[single fuse-link]}}$
- // Breaking capacity is not larger than I1 of a single fuse-link.
- // The cut-off current is approximately equal $n \times I_{\text{cut-off [single fuse-link]}}$
- // The temperature rise of each parallel fuse-links is higher than the temperature rise of single fuse-link.



Parallel solutions

Type	Code No.
NH 550V	On request
NH 700V	
NH 800V	
NH 1000V	
NH 1100V	
NH 1500V	

CHARGER FUSE



 etigroup
www.etigroup.eu

**For protection of high
power DC EV chargers**

ETI
SWITCH TO
A SAFE FUTURE

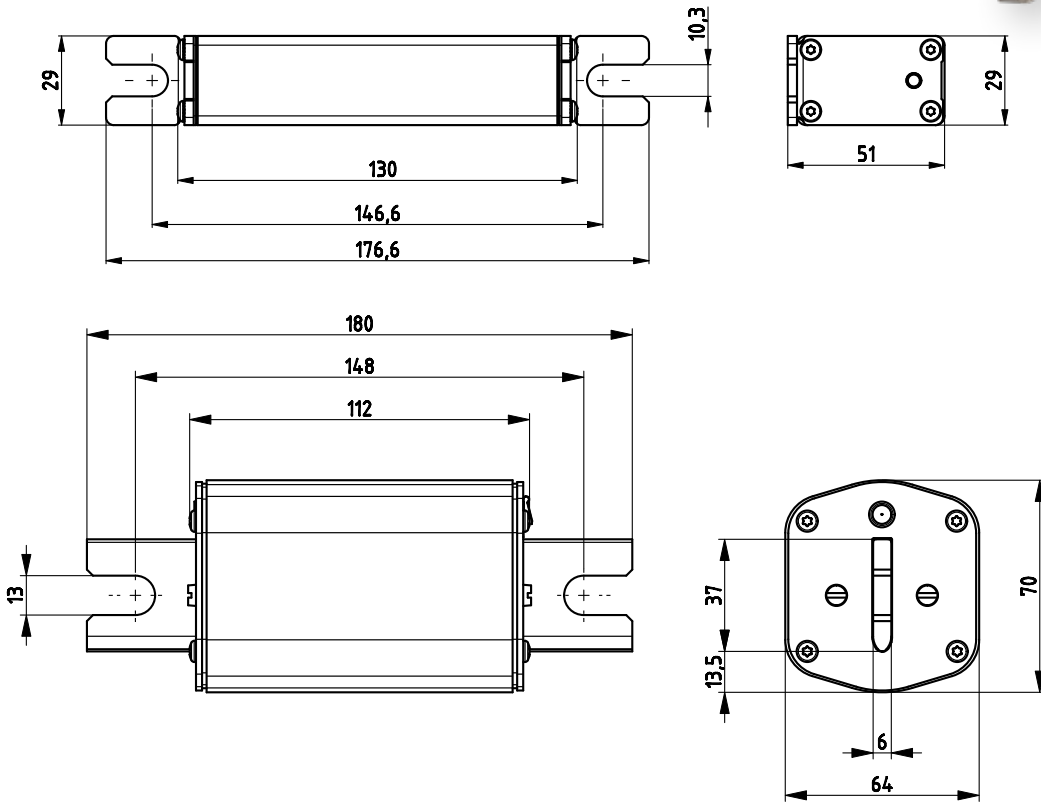
NH XL Charger fuse-link 1000V d.c.

General characteristics

Rated voltage	1000V d.c. L/R=3ms
Rated current	50 - 600A
Breaking capacity	30kA
Characteristic	aR, gPV
Standard	IEC 60269-4, IEC 60269-6
Application	For protection on DC side of EV chargers

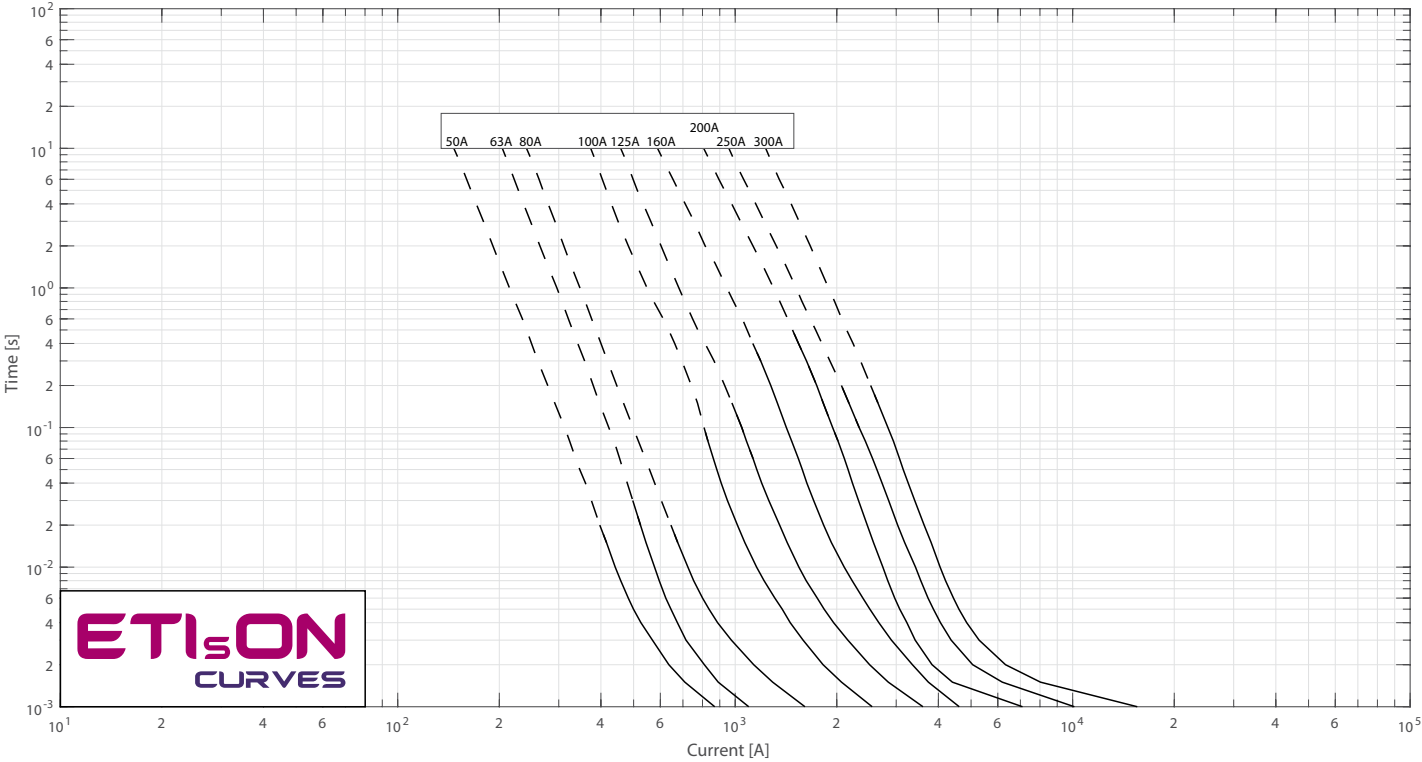
NH Charger Fuse 1000V d.c.

Size	Characteristic	I_n [A]	Code No.	Pre-arcing Joule integral [A ² s]	Operating Joule integral [A ² s]	Power dissipation (0,7 x I_n) Pd [W]	Power dissipation (I_n) Pd [W]	g	Box
NHU01XL/150	aR	50	004110809	280	2.000	8	17	450	3/30
		63	004110810	500	3.000	9	19		
		80	004110811	770	5.000	13	28		
		100	004110812	2.000	15.000	10	25		
		125	004110813	3.300	25.000	12	31		
		160	004110814	5.800	48.000	15	38		
		200	004110815	10.500	60.000	18	46		
		250	004110816	16.200	75.000	23	62		
NHU3L/150	gPV	300	004110800	30.500	150.000	19	47	1200	1/9
		350	004110801	48.000	170.000	22	54		
		400	004110802	65.300	220.000	24	63		
		450	004110803	89.000	300.000	26	65		
		500	004110804	120.000	450.000	29	72		
		500	004110805	350.000	870.000	32	83		

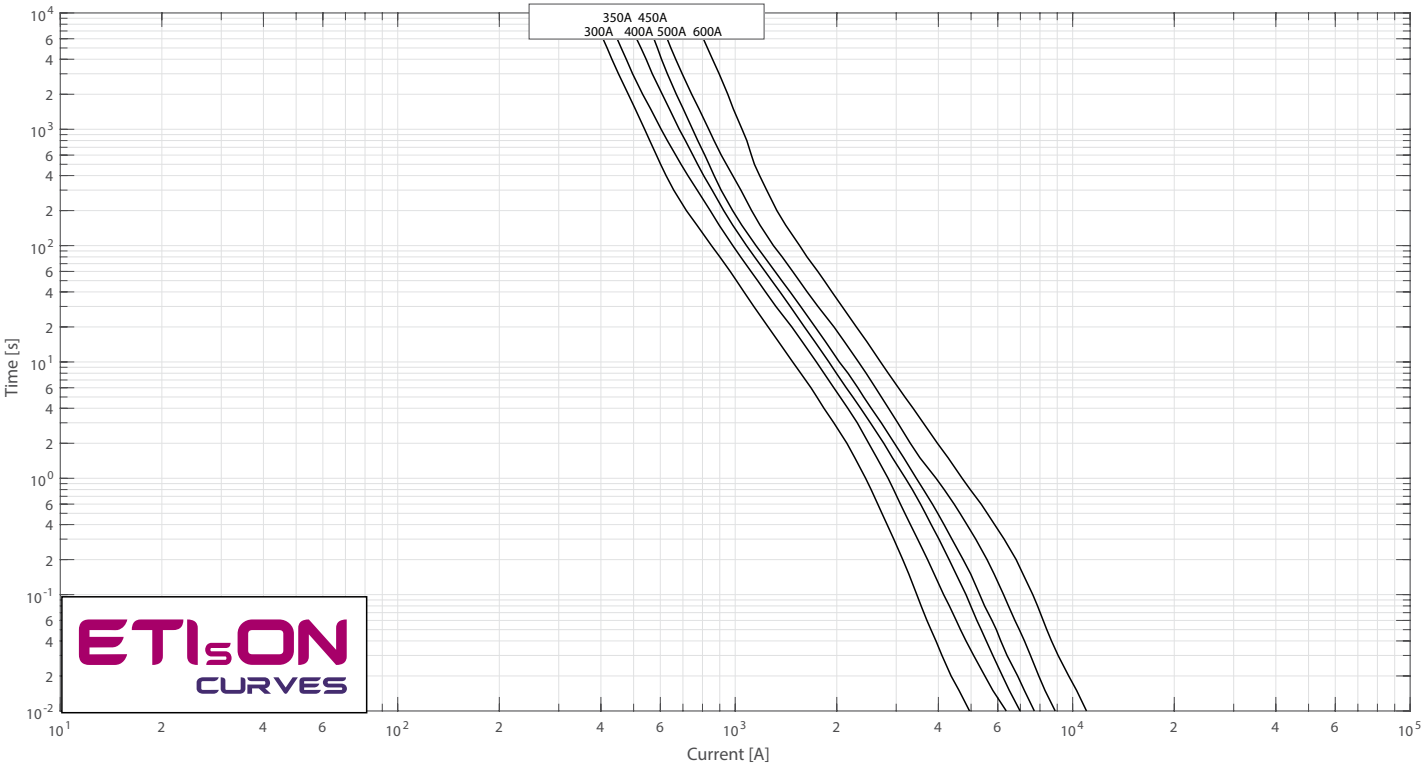


Time current characteristics I/t

NHU01XL 150 aR



NHU3L 150 gPV





NH Charger fuse-link 1000V d.c.

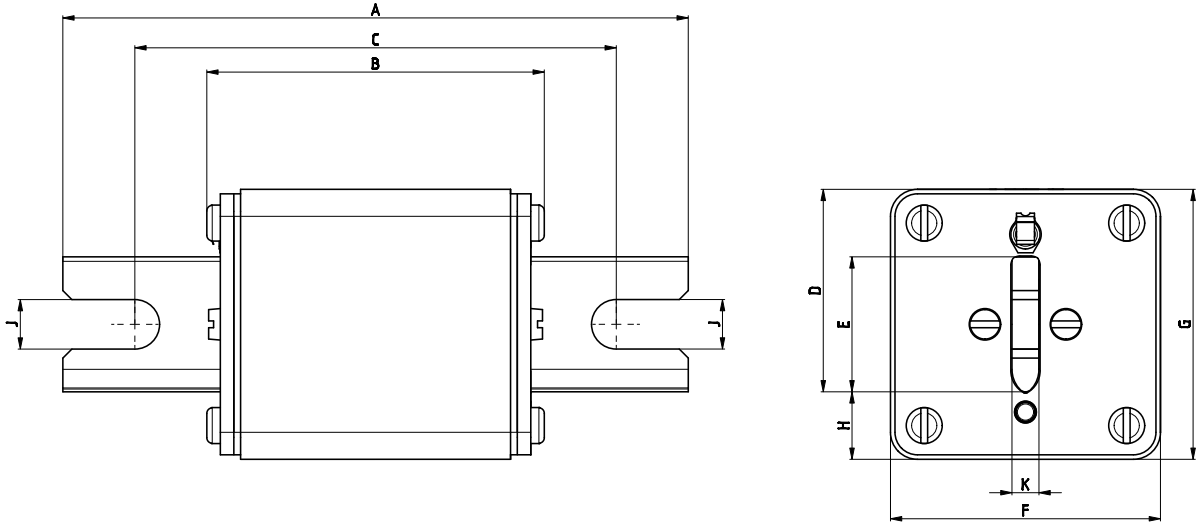
General characteristics

Rated voltage	1000V d.c. (L/R=2ms)
Rated current	63 - 630A
Breaking capacity	30kA
Characteristic	aR
Standard	IEC 60269-4
Application	For protection on DC side of EV chargers

NH Charger Fuse 1000V d.c.

Size	I _n [A]	Code No.	Type with MK	Pre-arcing Joule integral [A ² s]	Operating Joule integral [A ² s]	Power dissipation (0,7 x I _n) Pd [W]	Power dissipation (I _n) Pd [W]		
NHU1/110	63	004110840	004110860	200	5.500	5,5	12,9	500	1/26
	80	004110841	004110861	300	11.500	6,9	17,1		
	100	004110842	004110862	500	19.000	9,2	24,1		
	125	004110843	004110863	1.000	27.000	10,8	28,1		
	160	004110844	004110864	2.000	31.000	14,9	41,8		
	200	004110845	004110865	4.000	70.000	16,7	45,4		
	250	004110846	004110866	9.000	80.000	21,0	53,7		
	315	004110847	004110867	16.000	130.000	25,8	66,2		
	350	004110848	004110868	23.500	170.000	25,2	69,3		
	400	004110849	004110869	31.000	245.000	28,8	83,2		
NHU3 /110	500	004110880	004110890	50.000	315.000	37,4	109	1250	3/15
	630	004110881	004110891	89.000	420.000	48,5	153		

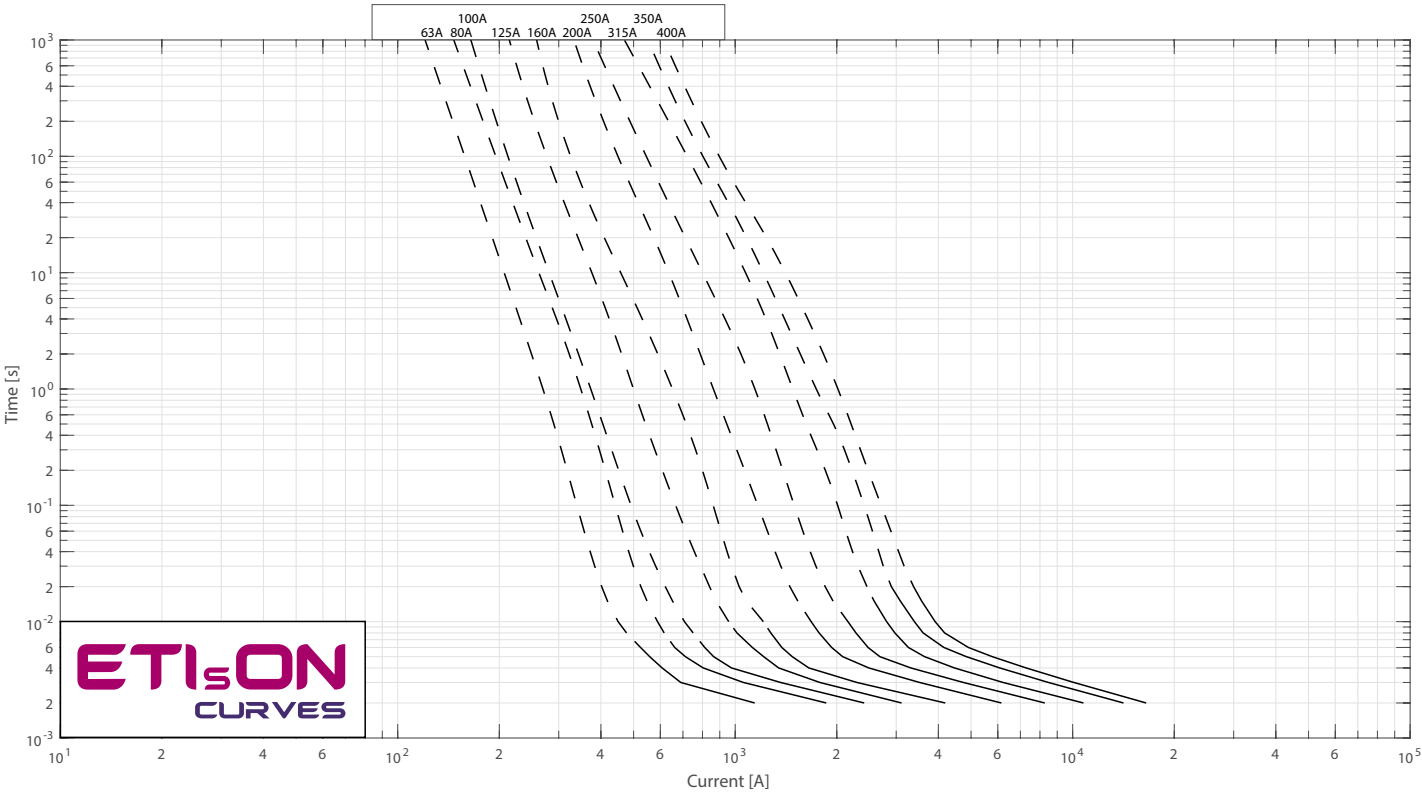




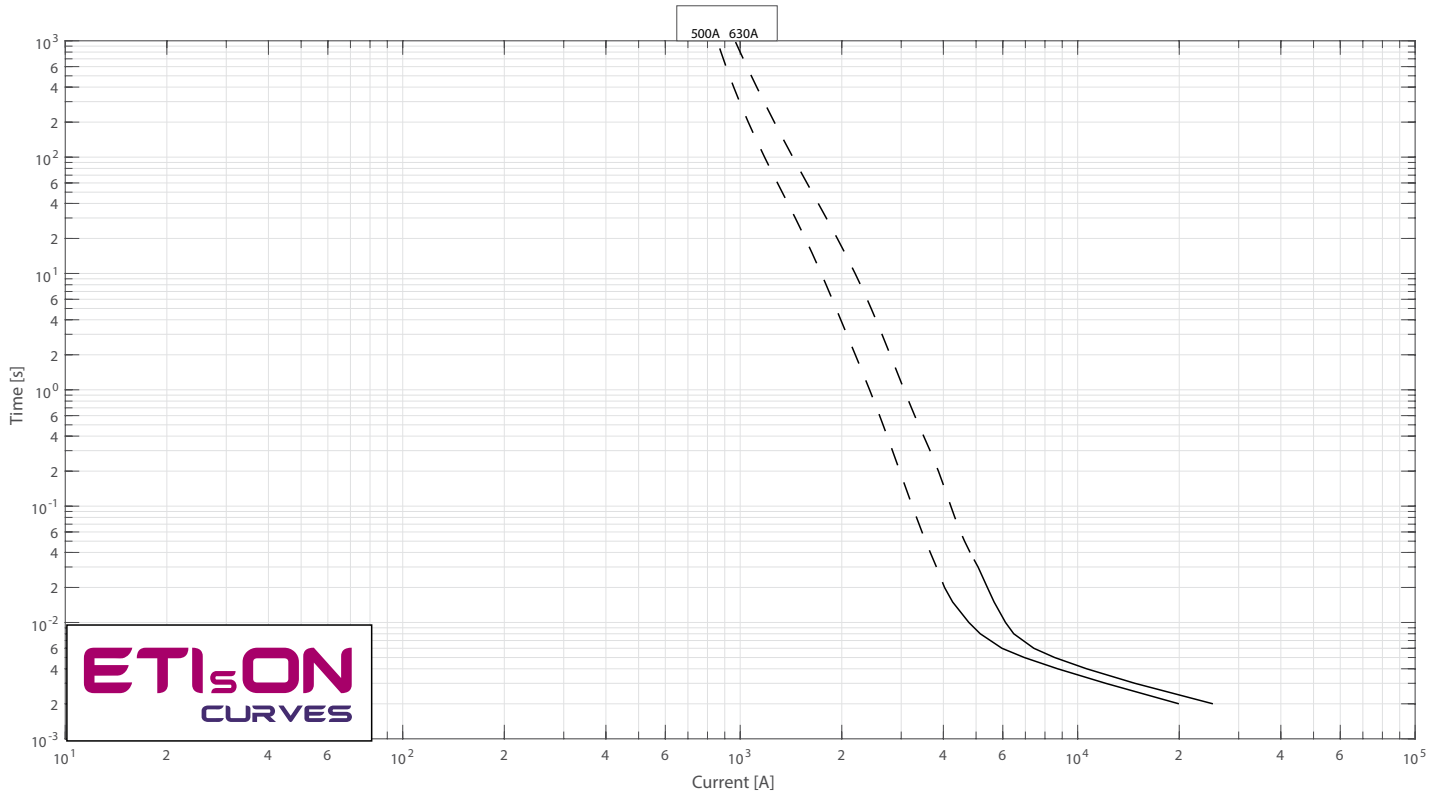
Size	Dimensions [mm]									
	A	B	C	D	E	F	G	H	K	J
1	140	73	110	38	24	51	51	12	6	11
3	140	73	110	55	37	73	73	18	6	11

Time current characteristics I/t

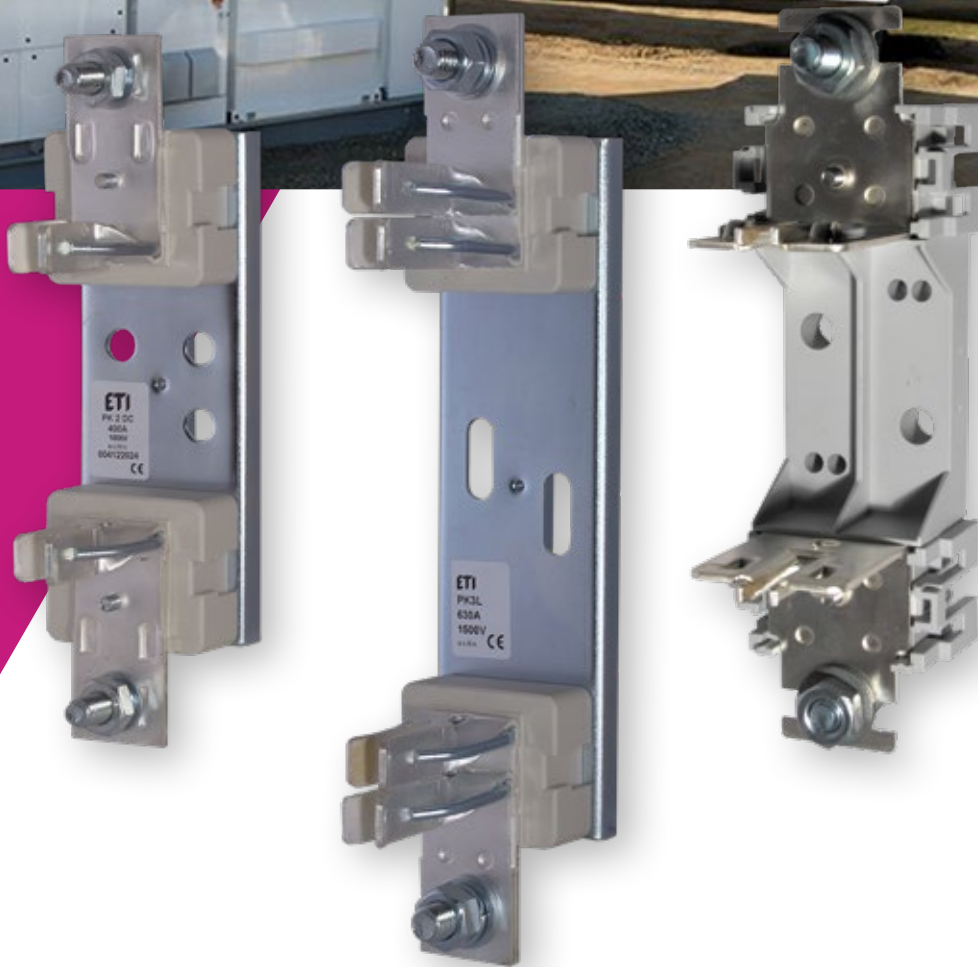
NHU1 110 aR



NHU3L 150 gPV



DC FUSE BASES



 etigroup
www.etigroup.eu

**Fuse Bases for
NH DC Fuse-links**



ETI
SWITCH TO
A SAFE FUTURE

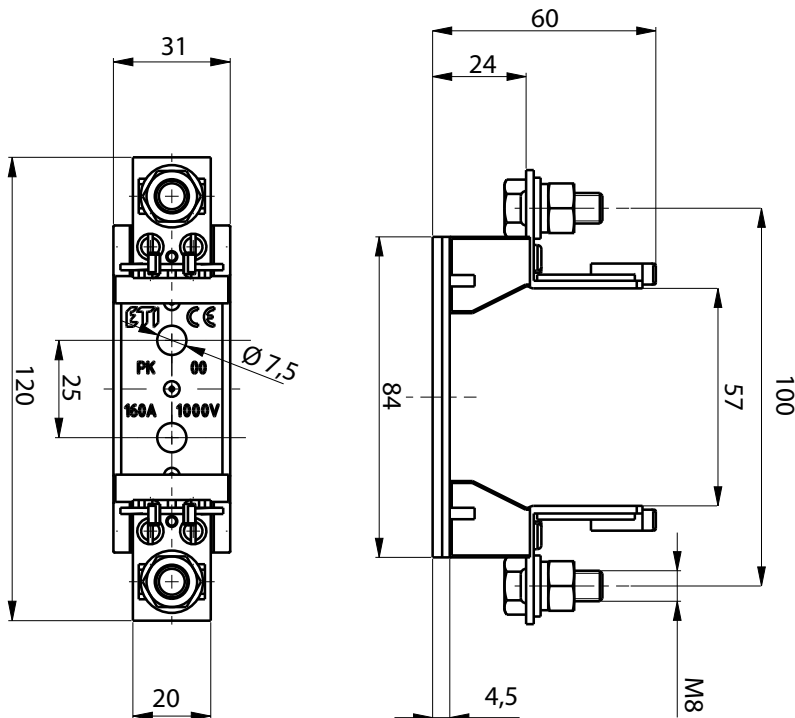
Fuse base PK 00, 0, 1, 2, 3 1000V a.c./d.c.

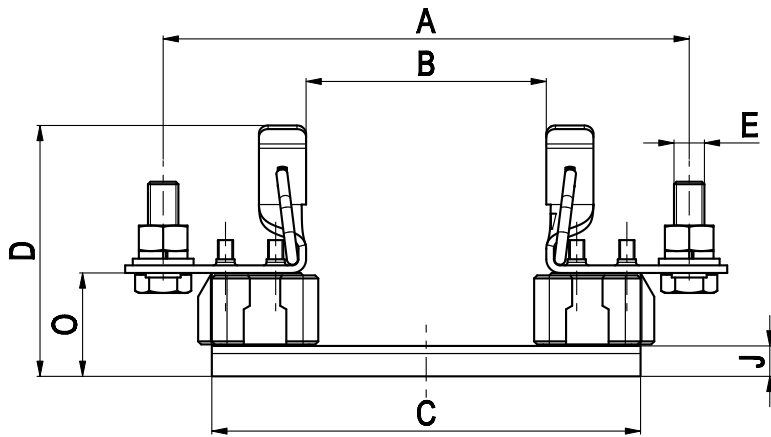
General characteristics

Rated voltage	1000V a.c./d.c.
Rated current	160A, 250A, 400A, 630A
Insulation class	C-VDE 0110
Degree of protection	IP00
Standards	IEC 60269, DIN VDE 0636, DIN 43620, DIN 43623

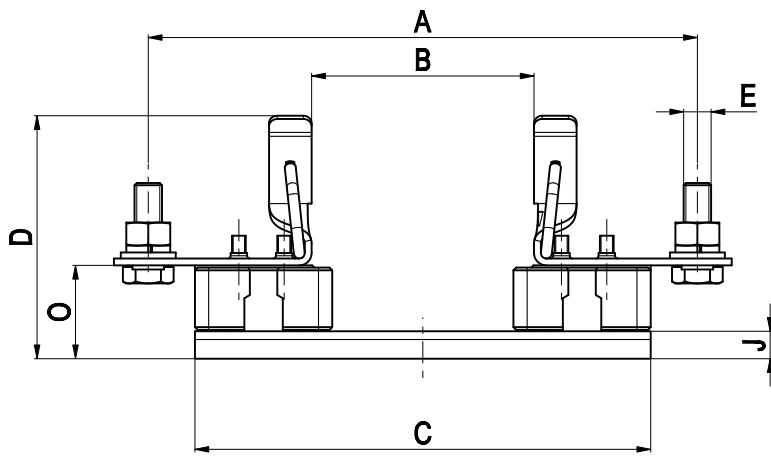
Fuse base PK 1000V a.c./d.c.

Size	I_n [A]	No. of poles	Code No.	Cable lugs according to DIN 46235 [mm ²]	Tightening torque [Nm]	Max. power dissipation of the fuse-link per pole [W]	 g	
PK 00 M8-M8 DC 1000V 1p	160A	1p	004122044	6 - 95	10	12	173	3/75
PK 0 M8-M8 DC 1000V 1p	160A		004122033	6 - 95	10	12	258	3/90
PK 1 M10-M10 DC 1000V 1p	250A		004122025	25 - 150	32	32	605	3/18
PK 2 M10-M10 DC 1000V 1p	400A		004122024	25 - 240	32	45	845	3/15
PK 3 M12-M12 DC 1000V 1p	630A		004122023	25 - 300	32	60	1110	3/12



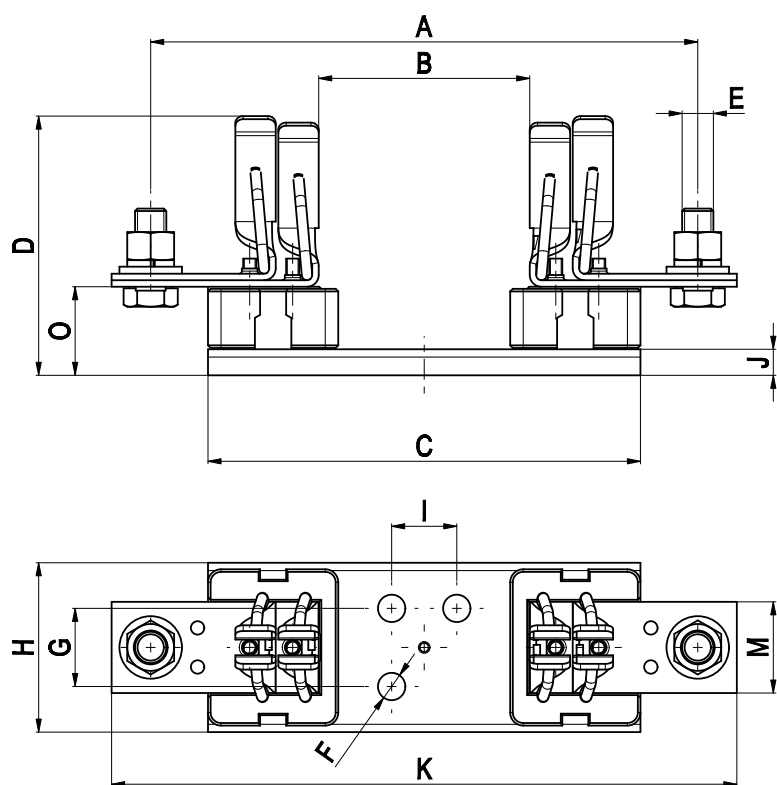


PK0,1 DC



PK2 DC





PK3 DC





Type	Dimensions [mm]												
	A	B	C	D	E	F	G	H	I	J	K	M	O
PK 00	100	57	84	60	M8-M8	Ø7,5	-	31	25	4,5	120	20	24
PK 0	150	74	130	60	M8-M8	Ø7,5	-	33	25	4,5	170	20	25
PK 1	175	80	141	82	M10-M10	Ø10,5	30	55,5	25	10	200	35	35
PK 2	200	80	166	87	M10-M10	Ø10,5	30	65	25	10	225	35	35
PK 3	210	80	166	99	M12-M12	Ø10,5	30	65	25	10	240	35	35

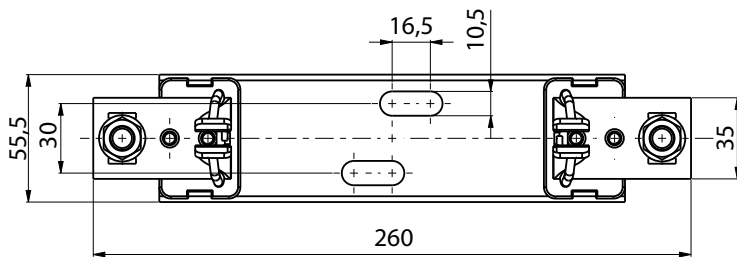
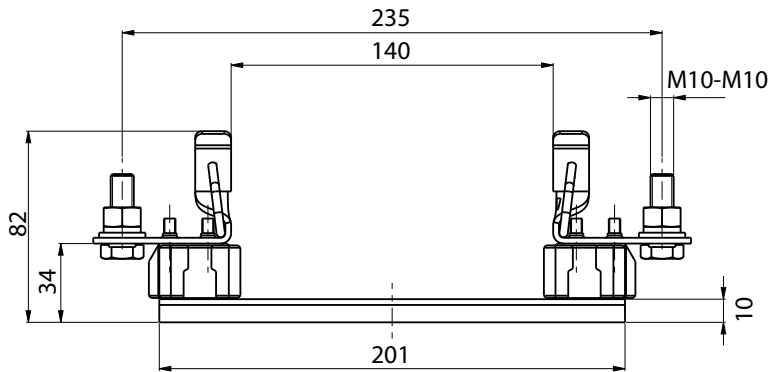
Fuse base PK XL 1500V d.c.

General characteristics

Rated voltage	1500V d.c.
Rated current	160A, 250A, 400A, 630A
Insulation class	C-VDE 0110
Degree of protection	IP00
Standards	IEC 60269, DIN VDE 0636, DIN 43620, DIN 43623

Fuse base PK XL 1500V d.c.

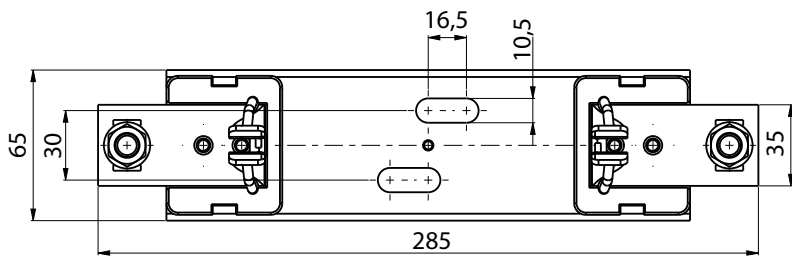
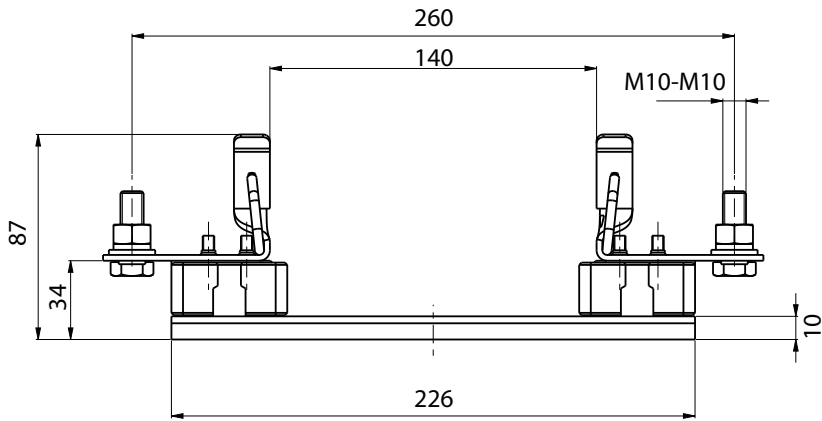
Size	I_n [A]	No. of poles	Code No.	Cable lugs according to DIN 46235 [mm ²]	Tightening torque [Nm]	Max. power dissipation of the fuse-link per pole [W]		
PK 01XL M8-M8 1500V 1p	160A	1p	004132029	6 - 95	10	12	300	3/75
PK 1XL M10-M10 1500V 1p	250A		004132017	25 - 150	32	32	675	3/90
PK 2XL M10-M10 1500V 1p	400A		004132019	25 - 240	32	45	921	3/18
PK 3L M12-M12 1500V 1p	630A		004132023	25 - 300	32	60	1184	3/15



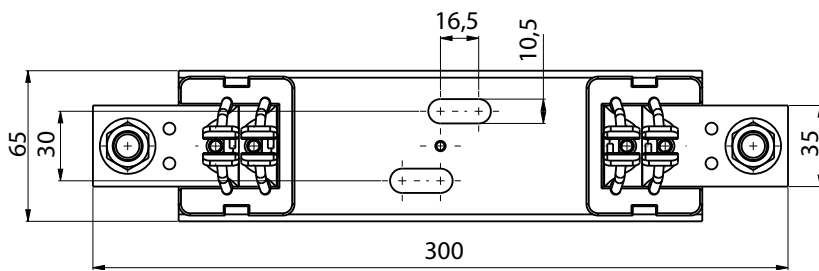
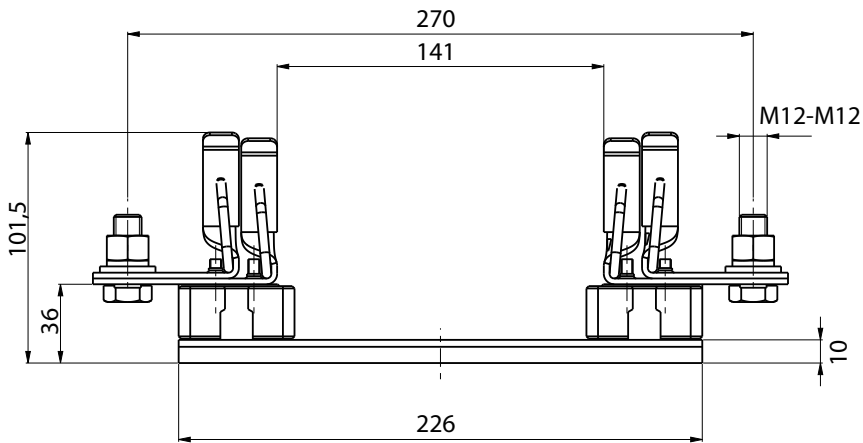
PK1XL



GREEN PROTECT / Fuse bases for NH DC fuse-links



PK2XL



PK3L



Fuse base U1...3/GZ/1500/H



General characteristics

Type		U1XL-1IGZ/1500/H	U2XL-1IGZ/1500/H	U3L-1IGZ/1500/H	
Size		NH1XL	NH2XL	NH3L	
Rated voltage	V	1500	1500	1500	
Rated current	A	250	400	630	
Conv. free air thermal current with fuse-links	A	200	315	630	
Conv. free air thermal current with solid links	A	325	400	1000	
Rated frequency	Hz	40-60	40-60	40-60	
Max. permis. power dissipation per fuse-link	W	35	35*	70	
Cable terminal - Flat terminal	Screw	–	M10	M12	
	Cable lug (DIN 46235)	mm ²	25-240	25-240	25-300
	Flat termination	mmxmm	30x10	30x10	40x10
	Rated torque	Nm	30-35	30-35	30-35
Cable terminal - Terminal	Cross-section	mm ²	KM2G	KM2G	P32
	Rated torque	Nm			
Degree of protection - Front side, device fitted	Operating conditions	–	IP00	IP00	IP00
	Gripping lug cover A-U... (available separately) applied	–	IP2X	IP2X	IP2X
Operating conditions	Ambient temperature**	°C		-25 ... +55	
	Rated operating mode	–		Uninterrupted duty	
	Actuation	–		–	
	Mounting position	–		Vertical, horizontal	
	Altitude	m		< 2000	
	Pollution degree	–		3	
Overvoltage category	–		III		



* with application of gPV fuse-links max. 250A: 46W

** 35°C normal temperature, at 55°C with reduced operating current

Fuse base U1...3/GZ/1500/H

Type	I _n [A]	Code No.	Max. Connection [mm ²]		
U1XL-1IGZ/1500/H	250	004122060	240	600	1
U2XL-1IGZ/1500/H	400	004122061	240	600	1
U3L-1IGZ/1500/H	630	004122062	300	1000	1

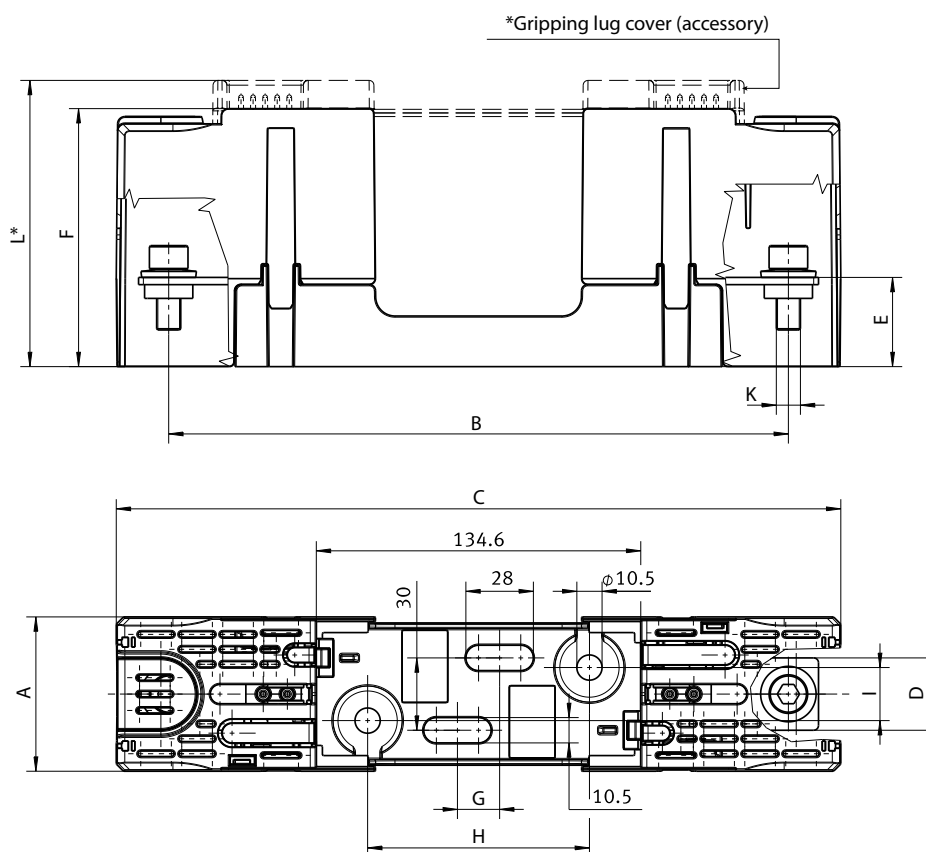
Accessories

Type	Code No.	Description		
K-U1XL-3L	004122063	Mechanical fuse monitoring	9	1
A-U1XL-2XL	004122064	Gripping lug cover	13	1
A-U3L	004122065	Gripping lug cover	32	1



GREEN PROTECT / Fuse bases for NH DC fuse-links

Size	Dimensions [mm]										
	A	B	C	D	E	F	G	H	I	K	L*
U1XL-1IGZ/1500/H	59	257	300,5	30	37	102,5	175	92	22	M10	111
U2XL-1IGZ/1500/H	64	257	300,5	30	37	107	175	92	22	M10	119
U3L-1IGZ/1500/H	80	270	328	40	38	122,5	25	96	26	M12	1.345



Fuse base U1-1/GZ/PV

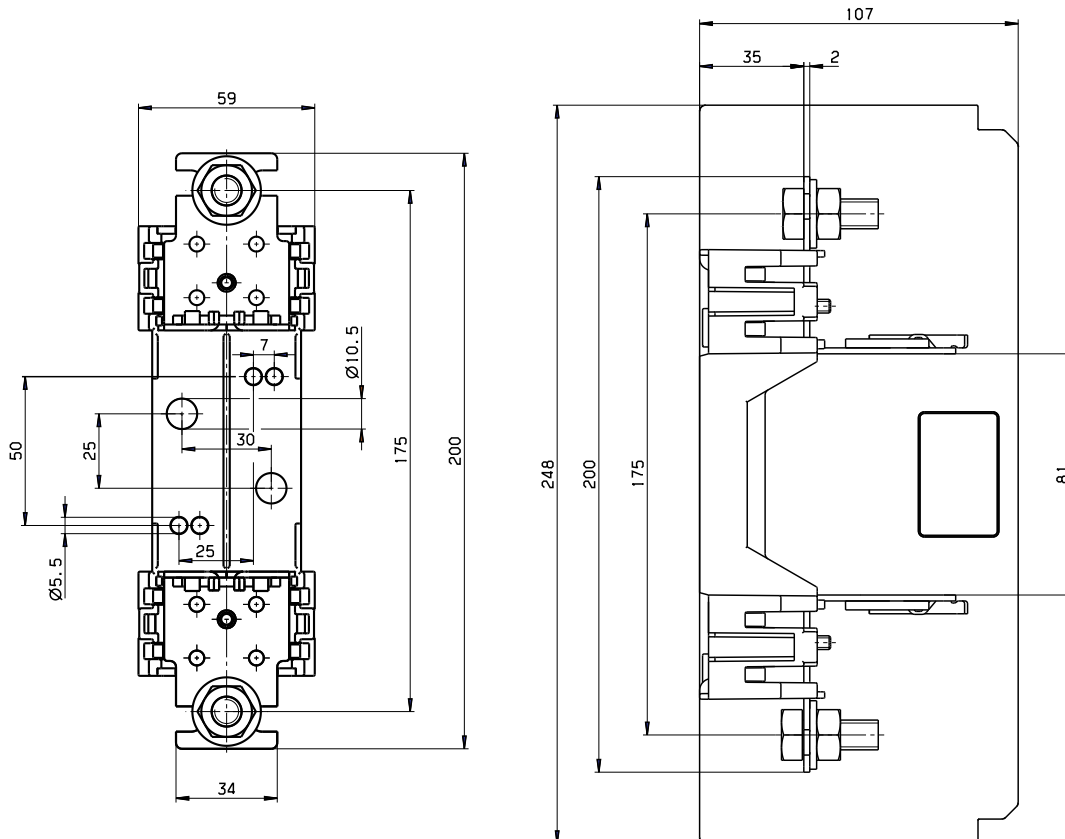
General characteristics

Rated voltage	1000V d.c.	
Rated current	160A	
Fuse-link size	1C, 1	
Conv. free air thermal current with fuse-links	160A	
Conv. free air thermal current with solid links	325A	
Max. permis. power dissipation per fuse-link	31W	
Cable terminal - Flat terminal	Screw	M10
	Cable lug (DIN 46235)	25-150 mm ²
	Flat termination	30x10 mmx-mm
	Rated torque	30-35 Nm



Fuse base U1-1/GZ/PV

Type	I _n [A]	Code No.	Max. Connection [mm ²]	g	Box
U1-1/GZ/PV	160	004122035	150	387	1



DC FUSEHOLDERS & DISCONNECTORS



 etigroup
www.etigroup.eu

**Fuseholders & Disconnectors
for NH DC Fuse-Links**

ETI
SWITCH TO
A SAFE FUTURE

Photovoltaic fuseholder TL1-1/9/1000V/PV



General characteristics

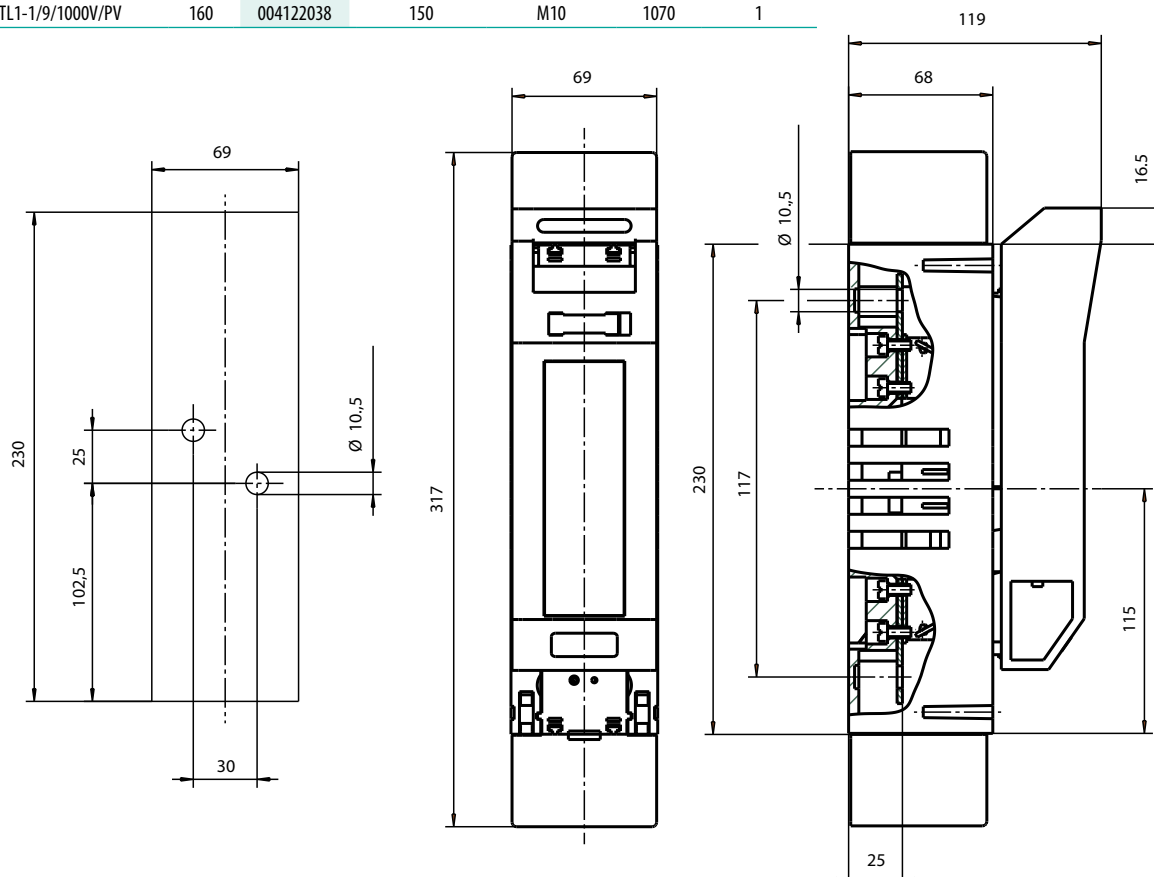
Number of poles	1	
Rated voltage	1000V d.c.	
Rated current	160A	
Conv. free air thermal current with fuse-links	160A	
Utilization category	DC-20B	
Fuse-links	Size to DIN 43620	1C, 1
	Max. rated current (gL/gG)	160A
	Max. permis. power loss per fuse-link	25W
Cable terminal - Flat terminal	Screw	M10
	Cable lug (DIN 46235)	25-240 mm ²
	Flat termination	30x10 mm
	Rated torque	30-35 Nm
Type of protection - front side, device fitted	IP20, IP10	
Operating conditions	Ambient temperature*	-25 ... +55
	Rated operating mode	Cont. operation
	Actuation	Dependent manual actuation
	Mounting position	Vertical, horizontal
	Altitude	≤ 2000 m
	Pollution degree	3
	Overvoltage category	III

*35°C normal temperature, 55°C with reduced operating current



Photovoltaic fuseholder TL1-1/9/1000V/PV

Type	I _n [A]	Code No.	Max. Connection [mm ²]	Terminal		
TL1-1/9/1000V/PV	160	004122038	150	M10	1070	1





Photovoltaic fuseholder TL1,3-1/9/1200V

General characteristics

Type		TL1/1200V	TL3/1200V
For NH fuse-links/extended length/acc. to DIN VDE 0636-2	Size	a1=194mm, a4=124mm	a1=209mm, a4=124mm
Rated voltage		1200V a.c. / 1000V d.c.	1200V a.c. / 1000V d.c.
Rated current		250A	630A
fuse-link size		1XL	2XL, 3L
Conv. free air thermal current with fuse-links		250A	630A
Conv. free air thermal current with solid links		325A	1000A
Rated frequency		40-60 Hz	40-60Hz
Utilization category		AC-20B, DC-20B	AC-20B, DC-20B
Max. permis. power loss per fuse-link		25W	48W
Cable terminal - Flat terminal	Bolt diameter	M10	M12
	Cable lug (DIN 46235)	25-150 mm ²	25-300 mm ²
	Flat bar	30x10 mm	40x10 mm
	Rated torque	30-35 Nm	30-35 Nm
Type of protection - front side, device fitted	Switching cover close	IP20	IP20
	Switching cover open	IP10	IP10
Operating conditions	Ambient temperature*	-25 ... +55	
	Rated operating mode	Cont. operation	
	Actuation	Dependent manual operation	
	Mounting position	Vertical, horizontal	
	Altitude	≤ 2000 m	
	Pollution degree	3	
Overvoltage category	III		

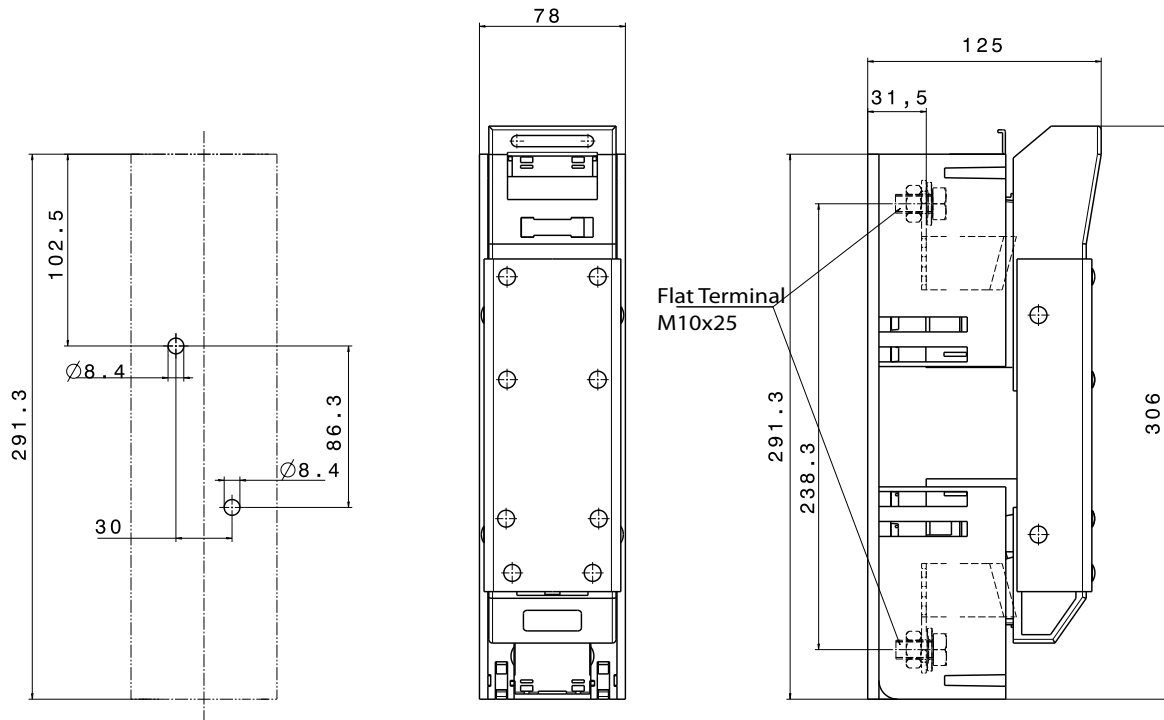
*35°C normal temperature, 55°C with reduced operating current

Photovoltaic fuseholder TL1,3-1/9/1200V

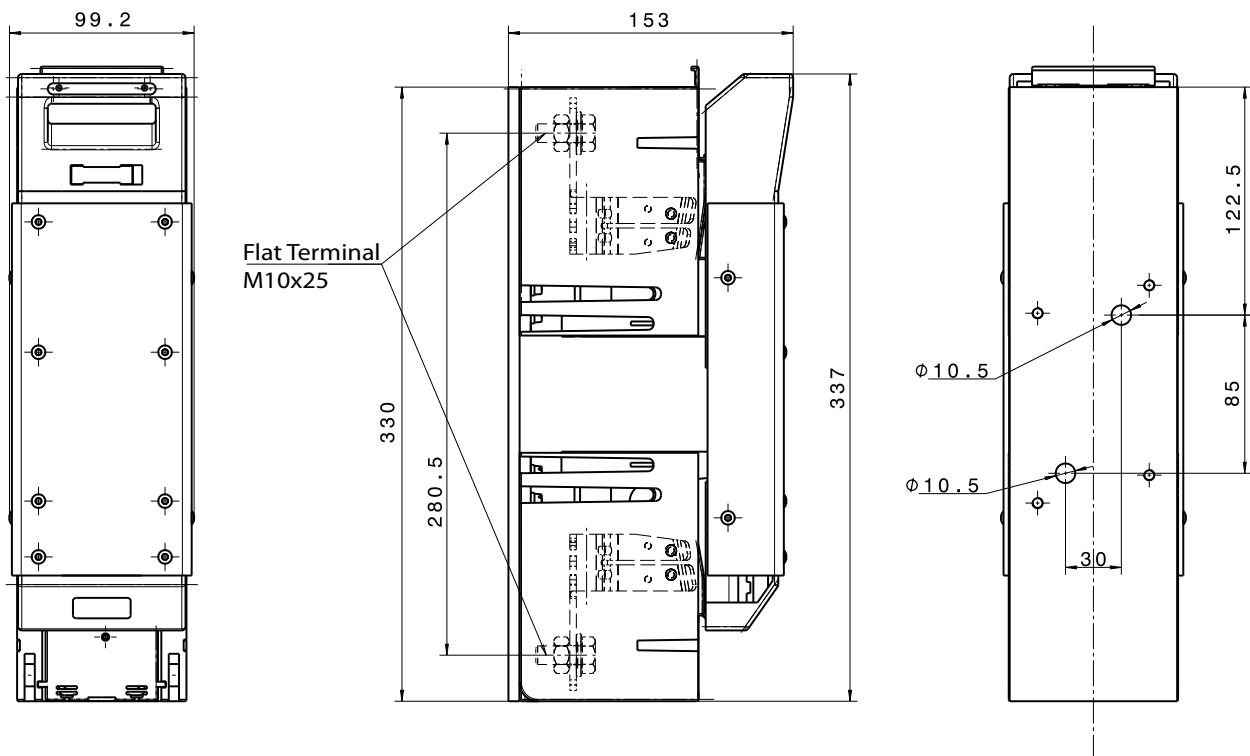
Type	I _n [A]	Code No.	Max. Connection [mm ²]	Terminal		
TL1-1/9/1200V	250	004122036	150	M10	1485	1
TL3-1/9/1200V	630	004122037	300	M12	2535	1



TL1-1/9/1200V



TL3-1/9/1200V





NH strip-fuseways L2,3-2/1500V

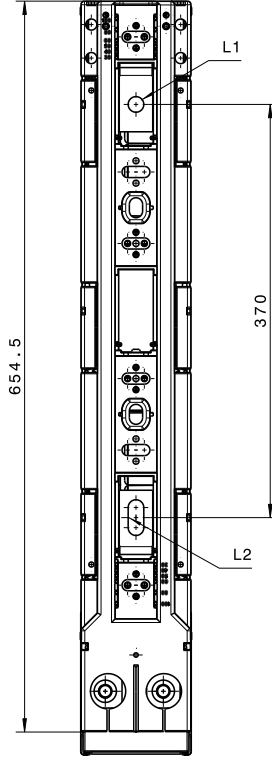
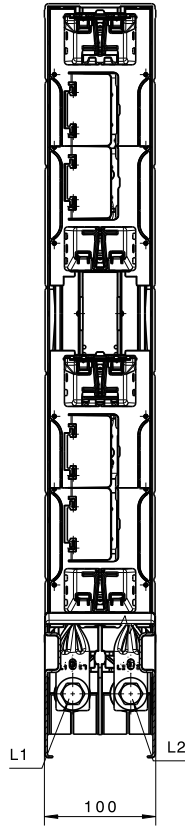
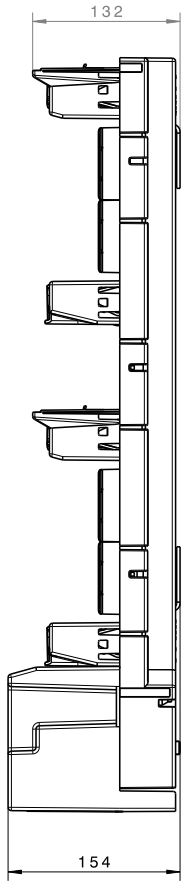
General characteristics

Type		L2	L3
For NH fuse-links acc. to IEC 60269-6	Size	2 (extended body)	3 (extended body)
Rated voltage		1500V d.c.	1500V d.c.
Rated current		250A	500A
fuse-link size		1XL, 2XL	3L
Conv. free air thermal current with fuse-links		250A	500A
Rated insulation voltage		1500V d.c.	1500V d.c.
Max. permis. power loss per fuse-link		46W	75W
Cable terminal	Flat terminal	Bolt diameter	M12
		Cable lug (DIN 46235)	1 x 25-240 mm ²
		Flat bar	30x10 mm
		Tightening torque	35-40 Nm
	Clamp KM2G	Clamping cross-section	25-150mm ² /185-300mm ²
		Tightening torque	32 Nm
	Clamp KM2G-F	Clamping cross-section	25-240 mm ²
		Tightening torque	32 Nm
Type of protection - front side, device fitted - with front side strip cover		IP10	IP10
Operating conditions	Ambient temperature*	-25 ... +55	
	Rated operating mode	Cont. operation	
	Actuation	Dependent manual operation	
	Mounting position	Vertical	
	Altitude	≤ 2000 m	
	Pollution degree	3	
	Overtoltage category	III	

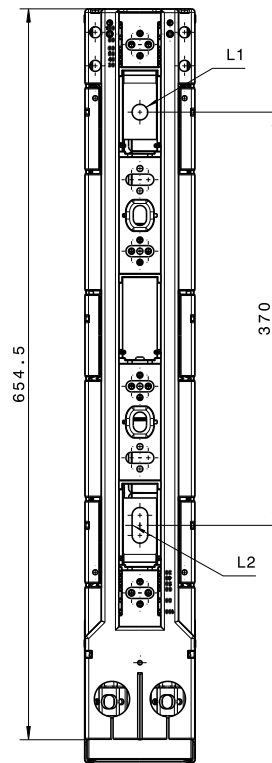
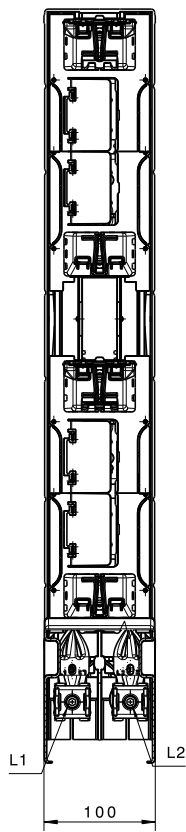
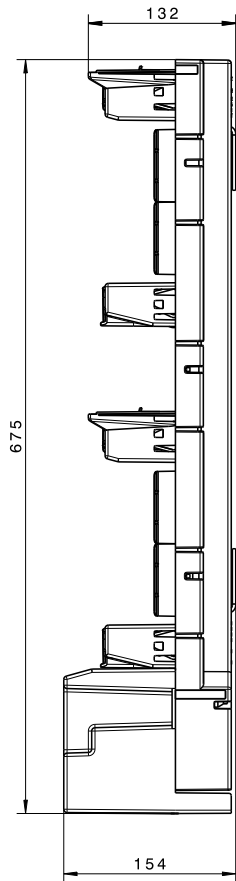
*35°C normal temperature, 55°C with reduced operating current

NH strip-fuseways L2,3-2/1500V

Type	I _n [A]	Code No.	Max. Connection [mm ²]	Terminal	 g	
L2-2/1500/3A/HA/PV	250	004122039	25-240	Flat terminal M12	3500	1
L2-2/1500/9/KM2G-F/HA/PV	250	004122040	25-240	Steel-frame clamp KM2G-F	3650	1
L3-2/1500/3A/HA/PV	500	004122041	25-240	Flat terminal M12	4110	1
L3-2/1500/9/KM2G-F/HA/PV	500	004122042	25-240	Steel-frame clamp KM2G-F	4260	1



Flat terminal M12



Steel-frame clamp KM2G-F



Horizontal fuse-switch disconnecter type KVL

General characteristics

Size	00									
Technical Characteristics										
Rated operational voltage	U_e	V	400 a.c.	500 a.c.	690 a.c.	800 a.c.	1000 a.c.	250 d.c.	1000 d.c.	
Rated operational current*	I_e	A	160	160	160	63	160	160	160	
Conv. free air thermal current with fuse-links*	I_{th}	A	160							
Conv. free air thermal current with solid-links*	I_{th}	A	210							
Rated frequency	f	Hz	40-60							
Rated insulation voltage	U_i	V	Baseplate mounting 1000 a.c., Busbar mounting 800 a.c.							
Total power loss (without fuse)	P_v	W	1Pole - 3W, 3Pole - 9W							
Power loss at 80% I_m (without fuse-links), **	P_v	W	1Pole - 1,9 W, 3Pole - 5,8 W							
Rated impulse withstand voltage	U_{imp}	kV	8							
Utilization category***			AC-23B	AC-22B	AC-21B	AC-21B	AC-20B	DC-22B	DC-20B	
Rated conditional short-circuit current****		kA	120 (500 a.c.), 100 (690 a.c.), 10 (800 a.c.), 35 (250 d.c.)							
Rated short-time withstand current	I_{cw}	kA	5/1s							
Fuse-links										
Size - DIN VDE 0636-2	-	-	000/00							
Max. permissible power loss per fuse-link	P_a	W	12							
Cable terminal										
Flat terminal-Screw			M8							
Tightening torque	Ma	Nm	12-15							
Clip terminal, Clamping cross-section		mm ²	(SP KVL00) Round conductor: 1,5-70 Cu, Strip conductor: 6 x 9 x 0,8 Cu							
Tightening torque	Ma	Nm	2,6							
Prism Clamp, Clamping cross-section		mm ²	(SP KVL00 P1) 10-70 Al/Cu, 35-95 Al/Cu							
Tightening torque	Ma	Nm	2,6							
Prism Clamp, Clamping cross-section		mm ²								
Tightening torque	Ma	Nm								
Frame clamp, Clamping cross-section		mm ²	1,5-95 Al/Cu, (Al 95: max. 125A), *****							
Torque	Ma	Nm	4,5							
Degree of Protection, front side device										
Front cover closed	-	-	IP20							
Front cover open	-	-	IP10							
With clamp- and lateral cover	-	-	IP2XC							
Operating condition										
Ambient temperature *****	T_{amb}	°C	-25 ... +55							
Operating condition	-	-	Continuous operation							
Mounting	-	-	vertical, horizontal							
Altitude	-	m	≤ 2000							
Pollution degree	-	-	3							
Overvoltage category	-	-	IV							
Endurance										
Mechanical cycles			1600							
Electrical cycles			200							

* Mounting of several units in low voltage switchgear-combinations, please think about rated diversity factors acc. to DIN EN 61439.

** Reference value for replacement of devices acc. to DIN EN 61439-1 clause 10.10.4.2.

*** minimum distance to earthed, conductive parts: Lateral: 20mm/Above: 50mm

**** Type tested with NH fuse-links characteristic gG

***** 35°C Normal temperature, at 55°C with reduced operating current

General characteristics

Size	1										
Technical Characteristics											
Rated operational voltage	U_e	V	400 a.c.	500 a.c.	690 a.c.	800 a.c.	1000 a.c.	250 d.c.	440 d.c. [‡]	1000 d.c.	
Rated operational current*	I_e	A	250	250	250	250	250	250	250	250	
Conv. free air thermal current with fuse-links*	I_{th}	A	250								
Conv. free air thermal current with solid-links*	I_{th}	A	350								
Rated frequency	f	Hz	40-60								
Rated insulation voltage	U_i	V	Baseplate mounting 1000 a.c., Busbar mounting 800 a.c.								
Total power loss (without fuse)	P_v	W	1Pole - 5W, 3Pole - 15W								
Power loss at 80% I_m (without fuse-links), **	P_v	W	1Pole - 3,2 W, 3Pole - 9,6 W								
Rated impulse withstand voltage	U_{imp}	kV	8								
Utilization category***			AC-23B	AC-22B	AC-21B	AC-21B	AC-20B	DC-22B	DC-21B	DC-20B	
Rated conditional short-circuit current****		kA	120 (500 a.c.), 100 (690 a.c.), 10 (800 a.c.), 35 (440 d.c.)								
Rated short-time withstand current	I_{cw}	kA	8,6/1s								
Fuse-links											
Size - DIN VDE 0636-2	-	-	1								
Max. permissible power loss per fuse-link	P_a	W	23								
Cable terminal											
Flat terminal-Screw			M10								
Tightening torque	M_a	Nm	30-35								
Clip terminal, Clamping cross-section		mm ²	0(SP KVL1)								
			Round conductor: 25-150 Cu, Strip conductor: 6 x 16 x 0,8 Cu0								
Tightening torque	M_a	Nm	9,5								
Prism Clamp, Clamping cross-section		mm ²	0(SP KVL1 P1)								
			10-150 Al/Cu0								
Tightening torque	M_a	Nm	4,5								
Prism Clamp, Clamping cross-section		mm ²	(SP KVL1 P2); 2 x (10-150) Al/Cu								
Tightening torque	M_a	Nm	4,5								
Frame clamp, Clamping cross-section		mm ²	35-150 Al/Cu								
Torque	M_a	Nm	12								
Degree of Protection, front side device											
Front cover closed	-	-	IP20								
Front cover open	-	-	IP10								
With clamp- and lateral cover	-	-	IP2XC								
Operating condition											
Ambient temperature *****	T_{amb}	°C	-25 ... +55								
Operating condition	-	-	Continuous operation								
Mounting	-	-	vertical, horizontal								
Altitude	-	m	≤ 2000								
Pollution degree	-	-	3								
Overvoltage category	-	-	IV								
Endurance											
Mechanical cycles			1600								
Electrical cycles			200								

* Mounting of several units in low voltage switchgear-combinations, please think about rated diversity factors acc. to DIN EN 61439.

** Reference value for replacement of devices acc. to DIN EN 61439-1 clause 10.10.4.2.

*** minimum distance to earthed, conductive parts: Lateral: 20mm/Above: 50mm

**** Type tested with NH fuse-links characteristic gG

***** 35°C Normal temperature, at 55°C with reduced operating current

3-pole only

General characteristics

Size	2								
Technical Characteristics									
Rated operational voltage	U_e	V	400 a.c.	500 a.c.	690 a.c.	1000 a.c.	250 d.c.	440 d.c.#	1000 d.c.
Rated operational current*	I_e	A	400	400	400	400	400	400	400
Conv. free air thermal current with fuse-links*	I_{th}	A	400						
Conv. free air thermal current with solid-links*	I_{th}	A	500						
Rated frequency	f	Hz	40-60						
Rated insulation voltage	U_i	V	Baseplate mounting 1000 a.c. , Busbar mounting 1000 a.c.						
Total power loss (without fuse)	P_v	W	1Pole - 9W, 3Pole - 28W						
Power loss at 80% I_m (without fuse-links), **	P_v	W	1Pole - 6 W, 3Pole - 17,9 W						
Rated impulse withstand voltage	U_{imp}	kV	8						
Utilization category***			AC-23B	AC-22B	AC-21B	AC-20B	DC-22B	DC-22B	DC-20B
Rated conditional short-circuit current****		kA	120 (500 a.c.), 100 (690 a.c.), 35 (440 d.c.)						
Rated short-time withstand current	I_{cw}	kA	15/1s						
Fuse-links									
Size - DIN VDE 0636-2	-	-	2						
Max. permissible power loss per fuse-link	P_a	W	34						
Cable terminal									
Flat terminal-Screw			M10						
Tightening torque	M_a	Nm	30-35						
Clip terminal, Clamping cross-section		mm ²	0(SP KVL2) Round conductor: 25-185 Cu , Strip conductor: 10 x 16 x 0,8 Cu0						
Tightening torque	M_a	Nm	23,0						
Prism Clamp, Clamping cross-section		mm ²	0(SP KVL2 P1) 120-240 Al/Cu0						
Tightening torque	M_a	Nm	11						
Prism Clamp, Clamping cross-section		mm ²	(SP KVL2 P2); 2 x (120-150) Al/Cu						
Tightening torque	M_a	Nm	11						
Frame clamp, Clamping cross-section		mm ²	95-300 Al/Cu						
Torque	M_a	Nm	20						
Degree of Protection, front side device									
Front cover closed	-	-	IP20						
Front cover open	-	-	IP10						
With clamp- and lateral cover	-	-	IP2XC						
Operating condition									
Ambient temperature *****	T_{amb}	°C	-25 ... +55						
Operating condition	-	-	Continuous operation						
Mounting	-	-	vertical, horizontal						
Altitude	-	m	≤ 2000						
Pollution degree	-	-	3						
Overvoltage category	-	-	IV						
Endurance									
Mechanical cycles			1000						
Electrical cycles			200						

* Mounting of several units in low voltage switchgear-combinations, please think about rated diversity factors acc. to DIN EN 61439.

** Reference value for replacement of devices acc. to DIN EN 61439-1 clause 10.10.4.2.

*** minimum distance to earthed, conductive parts: Lateral: 20mm/Above: 50mm

**** Type tested with NH fuse-links characteristic gG

***** 35°C Normal temperature, at 55°C with reduced operating current

3-pole only

General characteristics

Size	3									
Technical Characteristics										
Rated operational voltage	U_e	V	400 a.c.	500 a.c.	690 a.c.	800 a.c.	1000 a.c.	250 d.c.	440 d.c. [#]	1000 d.c.
Rated operational current*	I_e	A	630	630	630	315	630	630	630	630
Conv. free air thermal current with fuse-links*	I_{th}	A	630							
Conv. free air thermal current with solid-links*	I_{th}	A	785							
Rated frequency	f	Hz	40-60							
Rated insulation voltage	U_i	V	Baseplate mounting 1000 a.c. , Busbar mounting 1000 a.c.							
Total power loss (without fuse)	P_v	W	1Pole - 17W, 3Pole - 51W							
Power loss at 80% I_n (without fuse-links), **	P_v	W	1Pole - 10,9 W, 3Pole - 32,6 W							
Rated impulse withstand voltage	U_{imp}	kV	8							
Utilization category***			AC-23B	AC-22B	AC-21B	AC-21B	AC-20B	DC-22B	DC-22B	DC-20B
Rated conditional short-circuit current****		kA	120 (500 a.c.), 100 (690 a.c.), 10 (800 a.c.), 35 (440 d.c.)							
Rated short-time withstand current	I_{cw}	kA	15/1s							
Fuse-links										
Size - DIN VDE 0636-2	-	-	3							
Max. permissible power loss per fuse-link	P_a	W	48							
Cable terminal										
Flat terminal-Screw			M10 / M12							
Tightening torque	M_a	Nm	30-35							
Clip terminal, Clamping cross-section		mm ²	(SP KVL3) Strip conductor: 11 x 21 x 1 Cu							
Tightening torque	M_a	Nm	23							
Prism Clamp, Clamping cross-section		mm ²	(SP KVL3 P1); 120-300 Al/Cu							
Tightening torque	M_a	Nm	11							
Prism Clamp, Clamping cross-section		mm ²	(SP KVL3 P2); 2 x (120-240) Al/Cu							
Tightening torque	M_a	Nm	11							
Frame clamp, Clamping cross-section		mm ²	95-300 Al/Cu							
Torque	M_a	Nm	20							
Degree of Protection, front side device										
Front cover closed	-	-	IP20							
Front cover open	-	-	IP10							
With clamp- and lateral cover	-	-	IP2XC							
Operating condition										
Ambient temperature *****	T_{amb}	°C	-25 ... +55							
Operating condition	-	-	Continuous operation							
Mounting	-	-	vertical, horizontal							
Altitude	-	m	≤ 2000							
Pollution degree	-	-	3							
Overvoltage category	-	-	IV							
Endurance										
Mechanical cycles			1000							
Electrical cycles			200							

* Mounting of several units in low voltage switchgear-combinations, please think about rated diversity factors acc. to DIN EN 61439.

** Reference value for replacement of devices acc. to DIN EN 61439-1 clause 10.10.4.2.



*** minimum distance to earthed, conductive parts: Lateral: 20mm/Above: 50mm

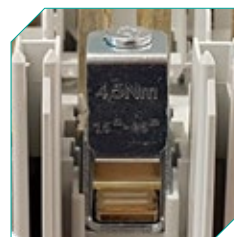
**** Type tested with NH fuse-links characteristic gG

***** 35°C Normal temperature, at 55°C with reduced operating current

3-pole only

3-pole, Baseplate mounting



Size	Code No.	Type		
00	001690870	KVL-00 3p M8-M8	630	1
	001690871	KVL-00 3p BC95-BC95	670	1
1	001690872	KVL-1 3p M10-M10	2030	1
2	001690873	KVL-2 3p M10-M10	3420	1
3	001690874	KVL-3 3p M10-M10	3950	1



BC95-BC95





1-pole, Baseplate mounting

Size	Code No.	Type		
00	001690890	KVL-00 1p M8-M8	310	2
1	001690891	KVL-1 1p M10-M10	930	1
3	001690892	KVL-3 1p M10-M10	1570	1





2-pole, Baseplate mounting

Size	Code No.	Type		
00	001690895	KVL-00 2p M8-M8	720	1
1	001690896	KVL-1 2p M10-M10	1880	1
3	001690897	KVL-3 2p M10-M10	3190	1




4-pole, Baseplate mounting

Size	Code No.	Type		
00	001690900	KVL-00 4p M8-M8	1190	1
1	001690901	KVL-1 4p M10-M10	2910	1
3	001690902	KVL-3 4p M10-M10	5760	1



Accessories

Type	Code No.	Description	
SP KVL00	001692701	Clip terminal, 1,5 – 70 mm ² Cu	set=3
SP KVL1	001692702	Clip terminal, 25– 150 mm ² Cu	set=3
SP KVL2	001692703	Clip terminal, 25– 240 mm ² Cu	set=3
SP KVL3	001692704	Clip terminal, 11x21 mm ² Cu	set=3
SP KVL00 P1	001692760	Prism clamp, 10 – 70 mm ² Al/Cu	set=3
SP KVL1 P1	001692761	Prism clamp, 70 – 150 mm ² Al/Cu	set=3
SP KVL2 P1	001692762	Prism clamp, 120 – 240 mm ² Al/Cu	set=3
SP KVL3 P1	001692763	Prism clamp, 120 – 300 mm ² Al/Cu	set=3
SP KVL1 P2	001692764	Prism clamp for 2-conductors connection, 2x70 – 95 mm ² Al/Cu	set=3
SP KVL2 P2	001692765	Prism clamp for 2-conductors connection, 2x120 – 150 mm ² Al/Cu	set=3
SP KVL3 P2	001692766	Prism clamp for 2-conductors connection, 2x120 – 240 mm ² Al/Cu	set=3
SP KVL-1 V	001690940	Frame clamp, 35-150mm ² Al/Cu	set=3
SP KVL-23 V	001690941	Frame clamp, 95-300mm ² Al/Cu	set=3
SP KVL-00 FC95	001690942	Feeding clamp, 25-95mm ² Cu/Al, isolated, terminal M8,*	set=3
I2Z KVL-00 3p	001690943	Phase busbars, 2 x 3pole KVL-00 50mm ²	5
I23 KVL-00 3p	001690944	Phase busbars, 3 x 3pole KVL-00 50mm ²	5
I24 KVL-00 3p	001690945	Phase busbars, 4 x 3pole KVL-00 50mm ²	3
I25 KVL-00 3p	001690946	Phase busbars, 5 x 3pole KVL-00 50mm ²	3
MST KVL-00 1p	001690947	Switch position indicator, 1-pole, size 00, **	1
MST KVL-00 3p	001690948	Switch position indicator, 3-pole, size 00, **	1
MST KVL-123 1p/2p/3p	001690949	Switch position indicator, 1/2/3 -pole, size 1, 2, 3, **	1
MFM KVL-00 1p/2p/3p	001690950	Mechanical fuse monitor, size 00, **	3
MFM KVL-123 1p/2p/3p	001690951	Mechanical fuse monitor, size 1, 2, 3, **, ****	3
PRS KVL-00 3p L	001690952	Terminal cover, 3-pole, variable to open, Length 66mm, size 00	2
PRS KVL-00 3p S	001690953	Terminal cover, 3-pole, variable to open, Length 36mm, size 00	2
PRS KVL-1 3p	001690954	Terminal cover, 3-pole, variable to open, Length 42mm, size 1	2
PRS KVL-2 3p	001690955	Terminal cover, 3-pole, variable to open, Length 42mm, size 2	2
PRS KVL-3 3p	001690956	Terminal cover, 3-pole, variable to open, Length 42mm, size 3	2
PRS KVL-00 1p L	001690957	Terminal cover, 1-pole, variable to open, Length 66mm, size 00	2
PRS KVL-00 1p S	001690958	Terminal cover, 1-pole, variable to open, Length 36mm, size 00	2
PRS KVL-1 1p	001690959	Terminal cover, 1-pole, variable to open, Length 42mm, size 1	2
PRS KVL-3 1p	001690960	Terminal cover, 1-pole, variable to open, Length 42mm, size 3	2
DIN KVL-00 100-150	001690964	DIN rail fixing parts, For mounting on DIN rails, size 00	1
DIN KVL-1 100-150	001690965	DIN rail fixing parts, For mounting on DIN rails, size 1	1
EFMU KVL-00 3p	001690966	Electronic fuse monitoring unit, 3-pole, size 00, ****	1
EFMU KVL-1 3p	001690967	Electronic fuse monitoring unit, 3-pole, size 1, ****	1
EFMU KVL-2 3p	001690968	Electronic fuse monitoring unit, 3-pole, size 2, ****	1
EFMU KVL-3 3p	001690969	Electronic fuse monitoring unit, 3-pole, size 3, ****	1
MPF MU KVL-00 3p	001690974	Elektromechanical fuse monitoring unit (AM), 3-pole, size 00, ****	1
MPF MU KVL-1 3p	001690975	Elektromechanical fuse monitoring unit (AM), 3-pole, size 1, ****	1
MPF MU KVL-2 3p	001690976	Elektromechanical fuse monitoring unit (AM), 3-pole, size 2, ****	1
MPF MU KVL-3 3p	001690977	Elektromechanical fuse monitoring unit (AM), 3-pole, size 3, ****	1
CK KVL-00 2p/4p	001690970	Connecting kit 2- and 4-pole, For making of 2- and 4-pole disconnectors, size 00	1
CK KVL-123 2p/4p	001690971	Connecting kit 2- and 4-pole, For making of 2- and 4-pole disconnectors, size 1, 2, 3	1
LP KVL-00123	001690972	Interlock device, locking with padlock, diameter 6mm max., size 00, 1, 2, 3	10
IC KVL-00123	001690973	Contact cover interlock, only be operated by tool, size 00-3	10

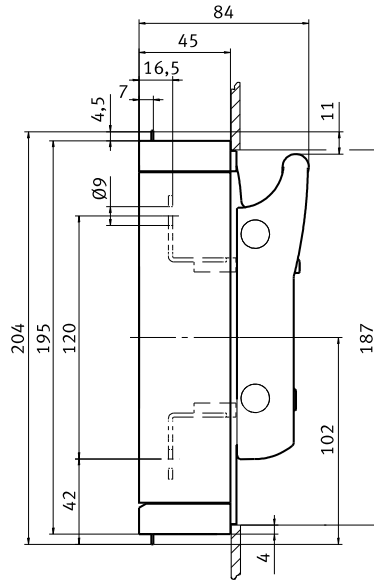
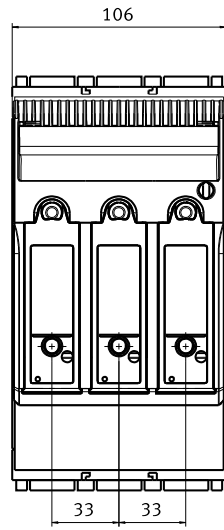
* Feeding clamp, AC690V/DC1000V-250A

** 1 Changeover, AC250V, 10/3A (ohmic/ind.)

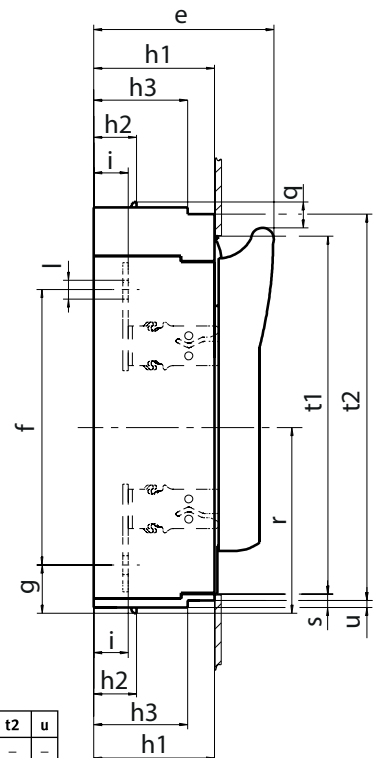
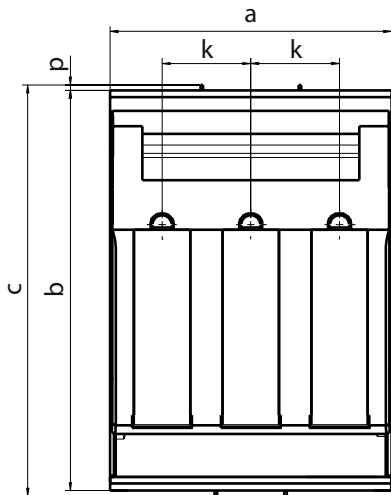
*** Only in combination with ETI fuse-links with striker-pin; not in combination with frame-clamp or 2-wire-prism clamp.

**** For monitoring of fuse-links with live gripping lugs

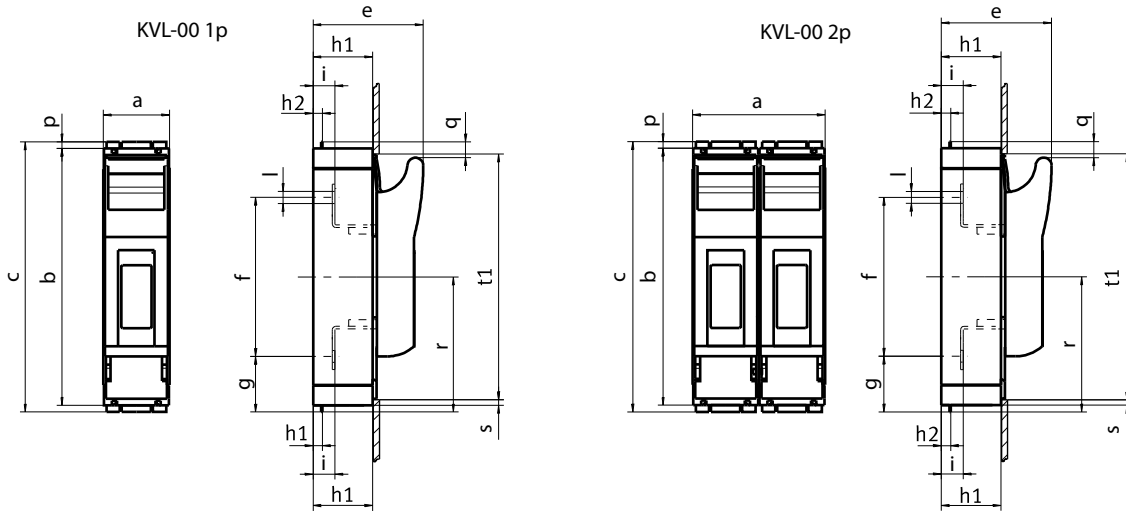




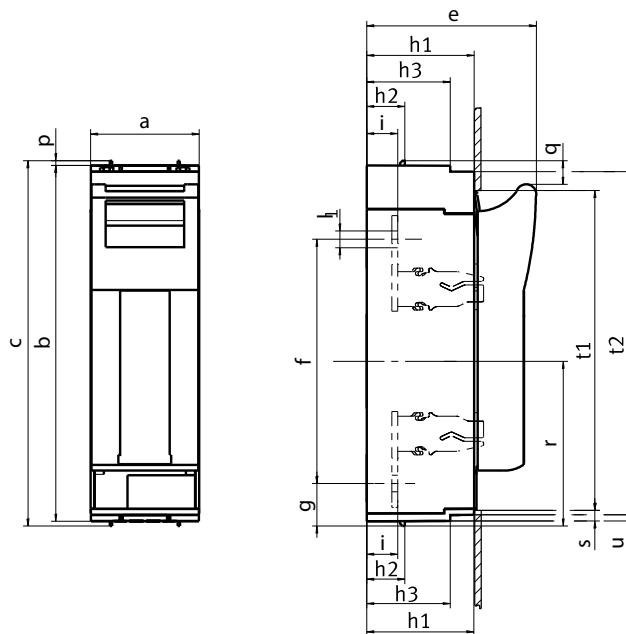
KVL-00 3p M8-M8
KVL-00 3p BC95-BC95
KVL-00 3p M8-M8 LED
KVL-00 3p BC95-BC95 LED



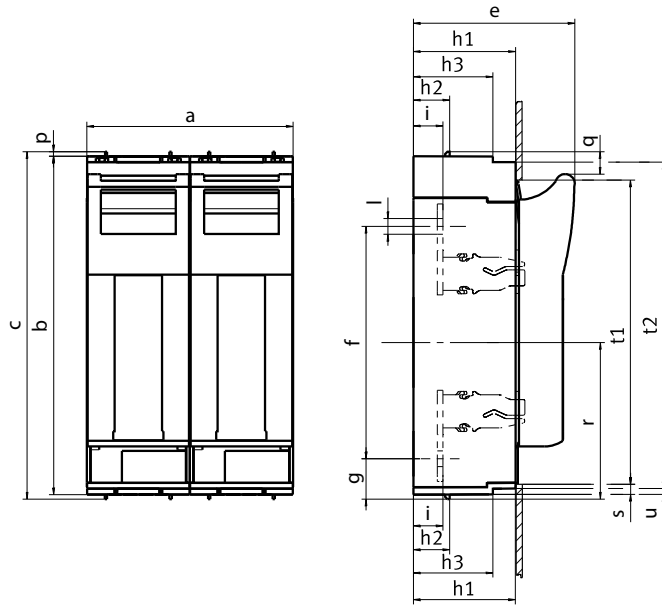
	a	b	c	e	f	g	h1	h2	h3	i	k	l	p	q	r	s	t1	t2	u
KVL-1 3p M10-M10 (LED)	184	298	306	117	185	46	70	32	-	25	58	Ø10,5	4	19	138	5	272	-	-
KVL-2 3p M10-M10 (LED)	210	298	306	134	205	36	90	32	70	26	66	Ø14	4	19	138	10	268	288	5
KVL-3 3p M10-M10 (LED)	250	298	306	143	205	36	90	32	70	26	82	Ø14	4	19	138	10	268	288	5



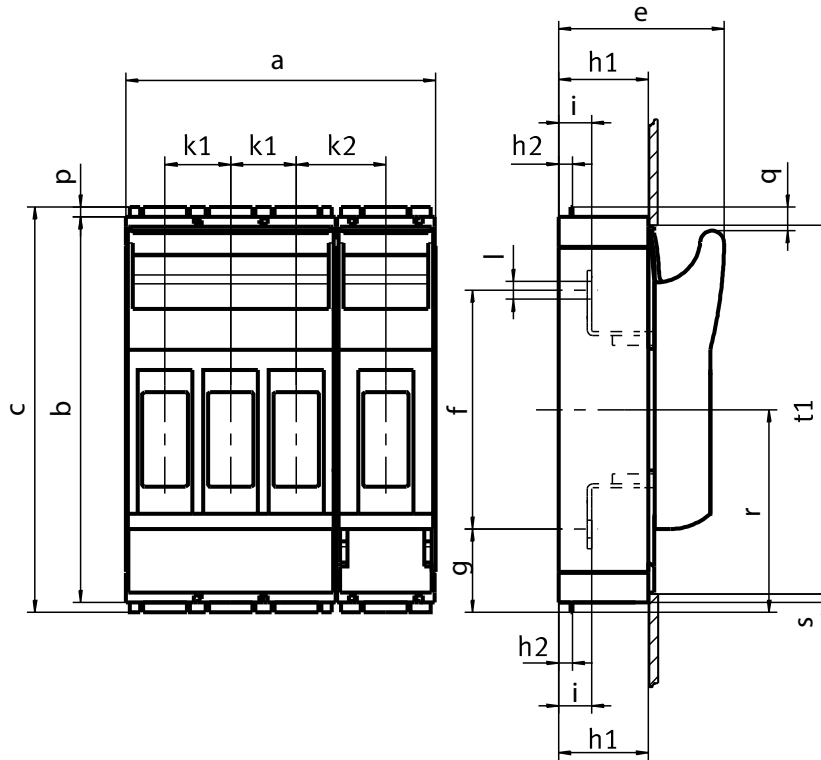
	a	b	c	e	f	g	h1	h2	h3	i	l	p	q	r	s	t1
KVL-00 1p M8-M8	50	195	204	84	120	42	45	7	-	16,5	∅9	4,5	12	102	5	187
KVL-00 2p M8-M8	100	195	204	84	120	42	45	7	-	16,5	∅9	4,5	12	102	5	187

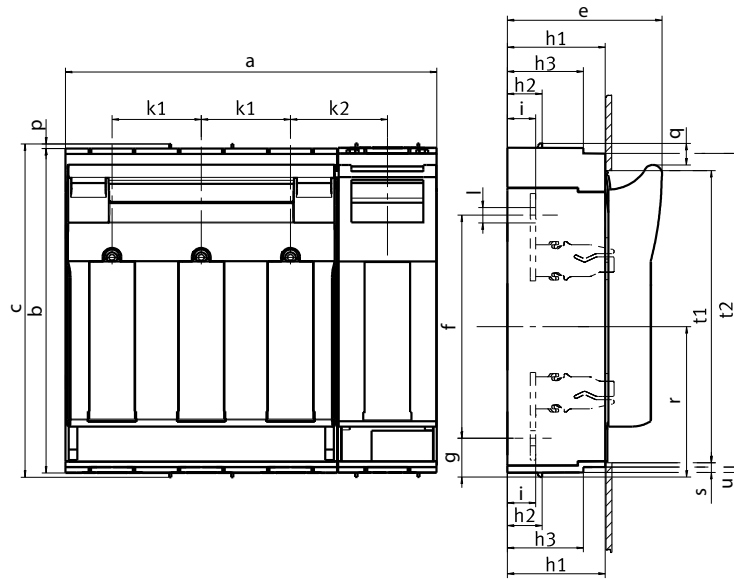


	a	b	c	e	f	g	h1	h2	h3	i	l	p	q	r	s	t1	t2	u
KVL-1 1p M10-M10	69	298	306	117	185	46	70	32	-	25	∅10,5	4	19	138	5	272	-	-
KVL-3 1p M10-M10	91	298	306	143	205	36	90	32	70	26	∅14	4	19	138	10	268	288	5



	a	b	c	e	f	g	h1	h2	h3	i	l	p	q	r	s	t1	t2	u
KVL-1 2p M10-M10	138	298	306	117	185	46	70	32	-	25	∅10,5	4	19	138	5	272	-	-
KVL-3 2p M10-M10	182	298	306	143	205	36	90	32	70	26	∅14	4	19	138	10	268	288	5





	a	b	c	e	f	g	h1	h2	h3	k1	k2	i	l	p	q	r	s	t1	t2	u
KVL-1 4p	254	298	306	117	185	46	70	32	-	58	69	25	∅10,5	4	19	138	5	272	-	-
KVL-3 4p	341,5	298	306	143	205	36	90	32	70	82	89	26	∅14	4	19	138	10	268	288	5

Technical data - Feeding clamps

Technical Characteristics			
Max. electrical load			690V a.c. / 1000V d.c. -250A
Heat deflection temp.			125°C UL94: V0
Comparative tracking index			600
Cross sections			
Conductor - Max. Diameter ∅14 mm			
single wire		mm ²	25 - 95
multi wire		mm ²	25 - 95
fine wire (with end sleeve)		mm ²	25 - 70
Torque	Ma	Nm	13
Degree of protection			IP20
Regulations			EN 60998-1:2004; EN 60998-2:2004; EN 60999-1:2000; EN 60999-2:2003

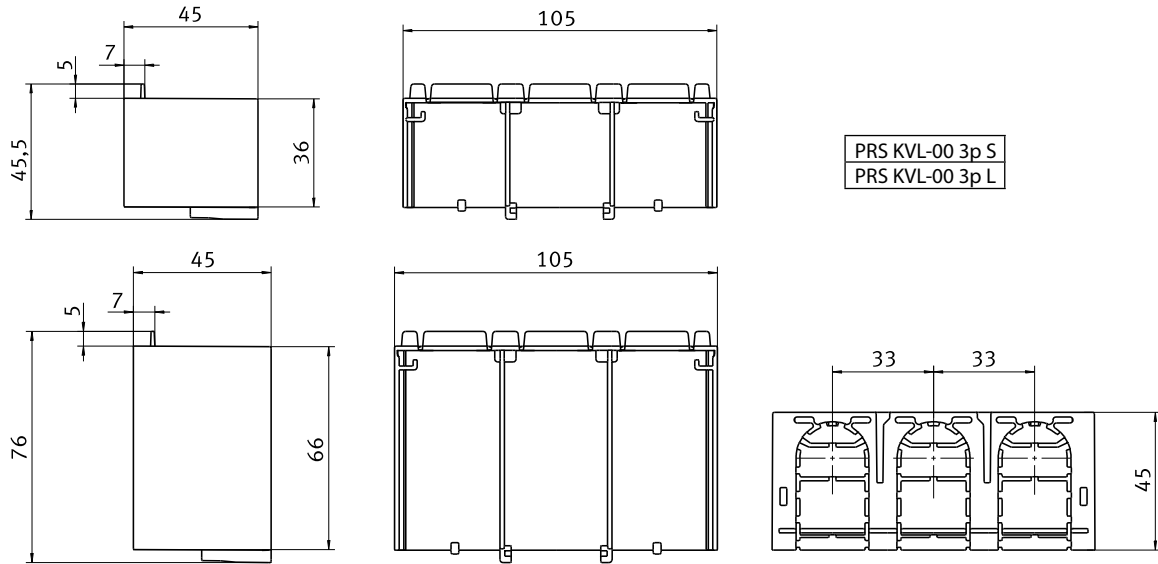
Important

This Terminal is suitable for Al and Cu conductors. Please pay attention to the common handling guidelines when connecting the Aluminium conductors. Clean and brush the contact surfaces and lubricate them with an appropriate grease.

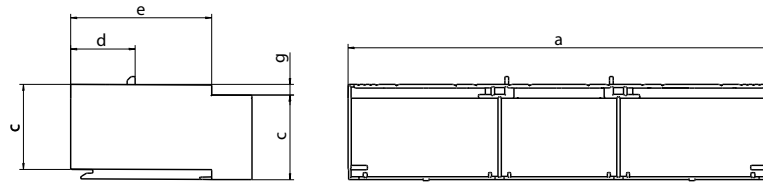
Technical data - Phase busbars

Technical Characteristics			
Rated operational voltage		mm ²	50
Impulse voltage strenght		kV	≥8,5
Min. air distance		mm	>8
Min. creeping distance		mm	>9
Max. operating voltage		V	AC690
Protection class			IP20
Short circuit rating			I _{pk} =25kA/0,1s, Surge energy capacity I _{pk} , I _{cc} 100kA - NH3 355A gG 500V
Dielectric strenght		kV/mm	≥32
Capacity at 35°C ambient temperature depending of feeding point cross section		mm ²	50
Busbar lenght		mm	Max. 300
Feeding at beginning/ending			
Max. current I _s /Phase		A	250
Connection cross current		mm ²	95
Other feedings			
Max. feeding current I _e /Phase		A	250
Connection cross current		mm ²	95
Insulation coordination			III / 2
Regulations			IEC 60947-1:2007

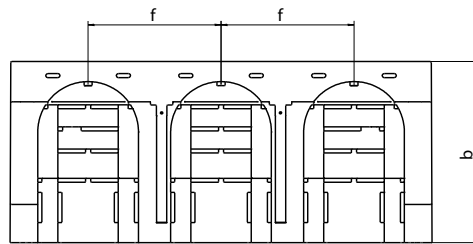
GREEN PROTECT / Fuse bases for NH DC fuse-links



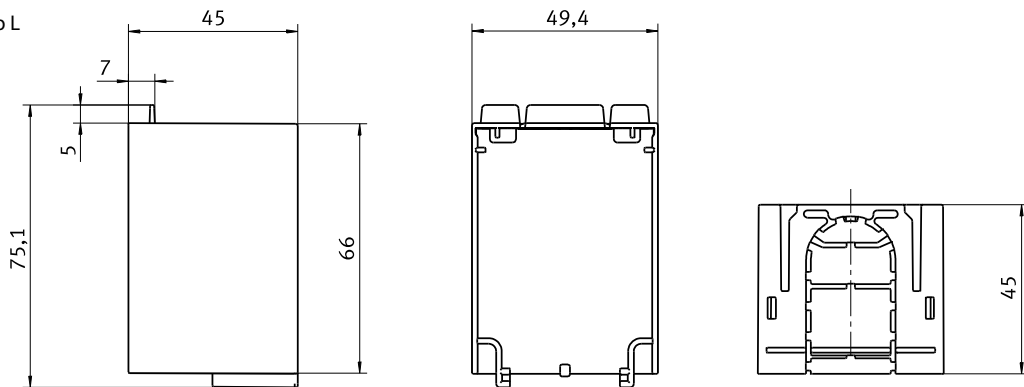
PRS KVL-00 3p S
PRS KVL-00 3p L



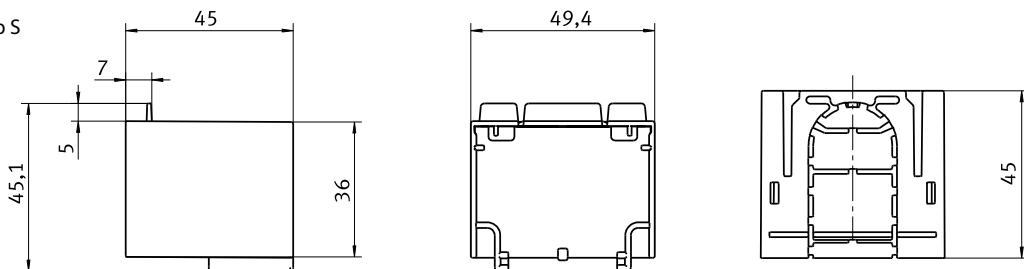
	a	b	c	d	e	f	g
PRS KVL-1 3p	184	70	42	32	-	58	-
PRS KVL-2 3p	210	90	42	32	70	66	5
PRS KVL-3 3p	250	90	42	32	70	82	5



PRS KVL-00 1p L

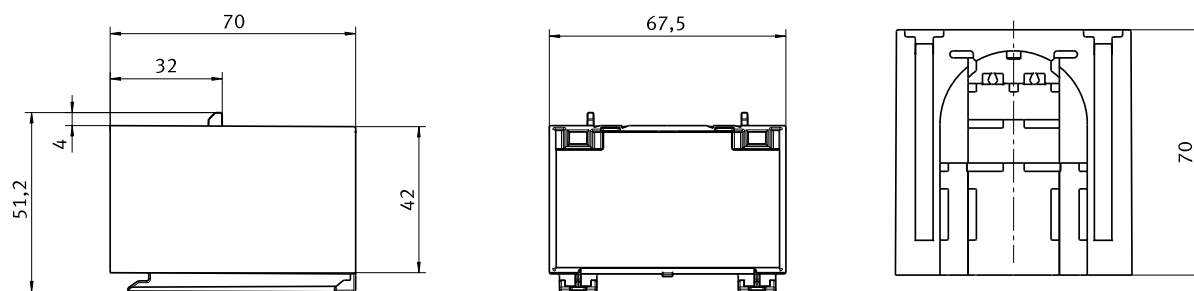


PRS KVL-00 1p S

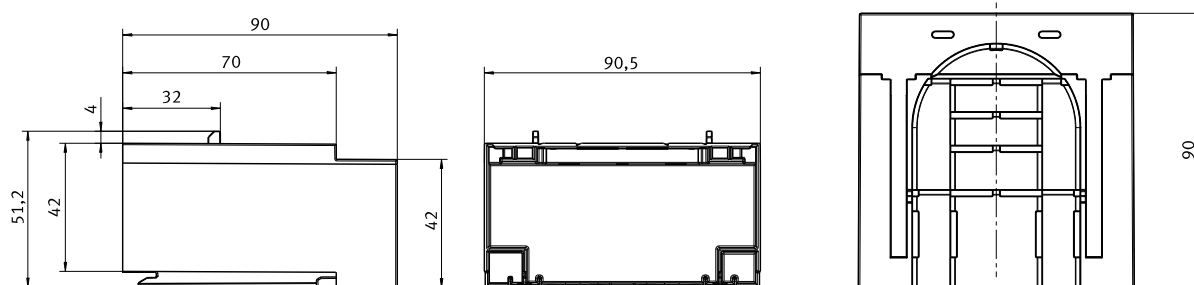


GREEN PROTECT / Fuse bases for NH DC fuse-links

PRS KVL-1 1p



PRS KVL-3 1p





Fuse-switch disconnecter type SL 800V

General characteristics

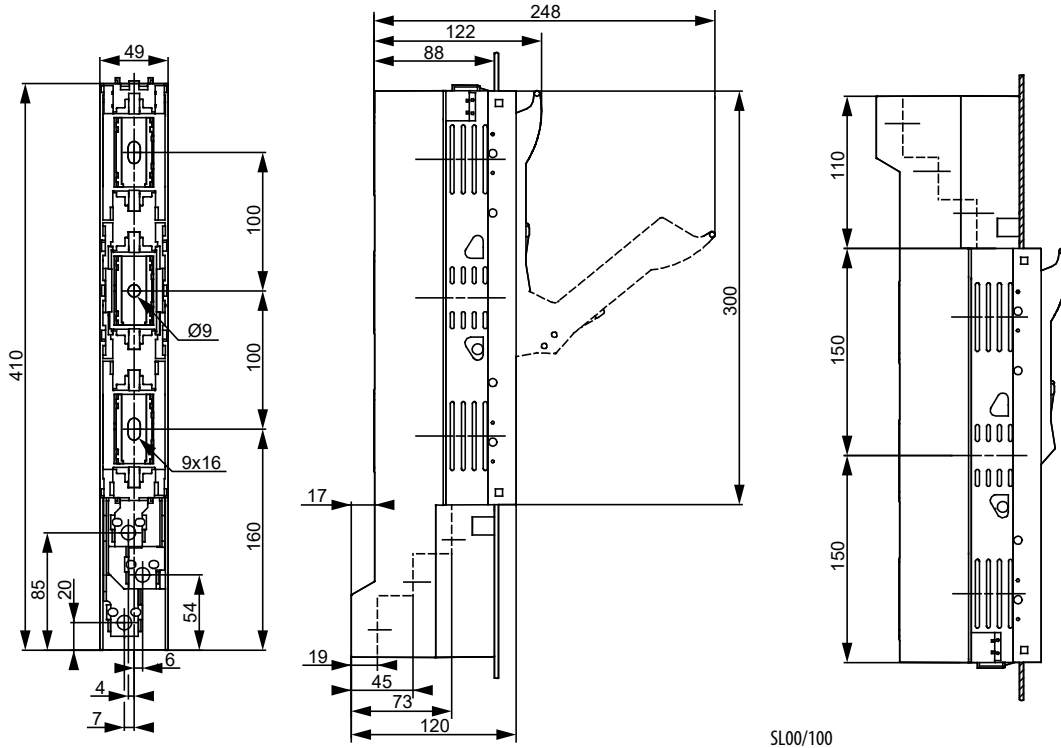
Size			SL00/100	SL00/185	SL1	SL3
Technical Characteristics						
Rated operational voltage	U_e	V	800 a.c.	800 a.c.	800 a.c.	800 a.c.
Rated operational current	I_e	A	160	160	250	630
Rated frequency	f	Hz	40-60	40-60	40-60	40-60
Rated insulation voltage	U_i	V	800 a.c.	800 a.c.	1000 a.c.	1000 a.c.
Total power loss at I_n (without fuse)	P_v	W	18	23	23	115
Utilisation category			AC-21B (160A/800V)	AC-21B (160A/800V)	AC-21B (250A/800V)	AC-21B (315A/800V)
Fuse-links						
Size - DIN 43620, IEC 60269-2	-	-	000/00		1	3
Max. permissible power loss per fuse-link	P_a	W	12		32	48
Dimensions						
Mass	-	kg	100mm=0,85	185mm=1,79	4,66	5,48
Bubars (distance)	-	mm	100	185	185	185
Cable connection						
Screw			M8		M10	M12
Protection						
Operational state	-	-	IP30		IP30	IP30
Cover open	-	-	IP10		IP10	IP10
Operating condition						
Ambient temperature	T_{amb}	°C	-25 ... +55		-25 ... +55	-25 ... +55
Operating condition	-	-	Continuous operation			
Mounting	-	-	vertical, horizontal			
Altitude	-	m	≤ 2000			
Pollution degree	-	-	3			
Overvoltage category	-	-	III	III	III	III

SL 800V

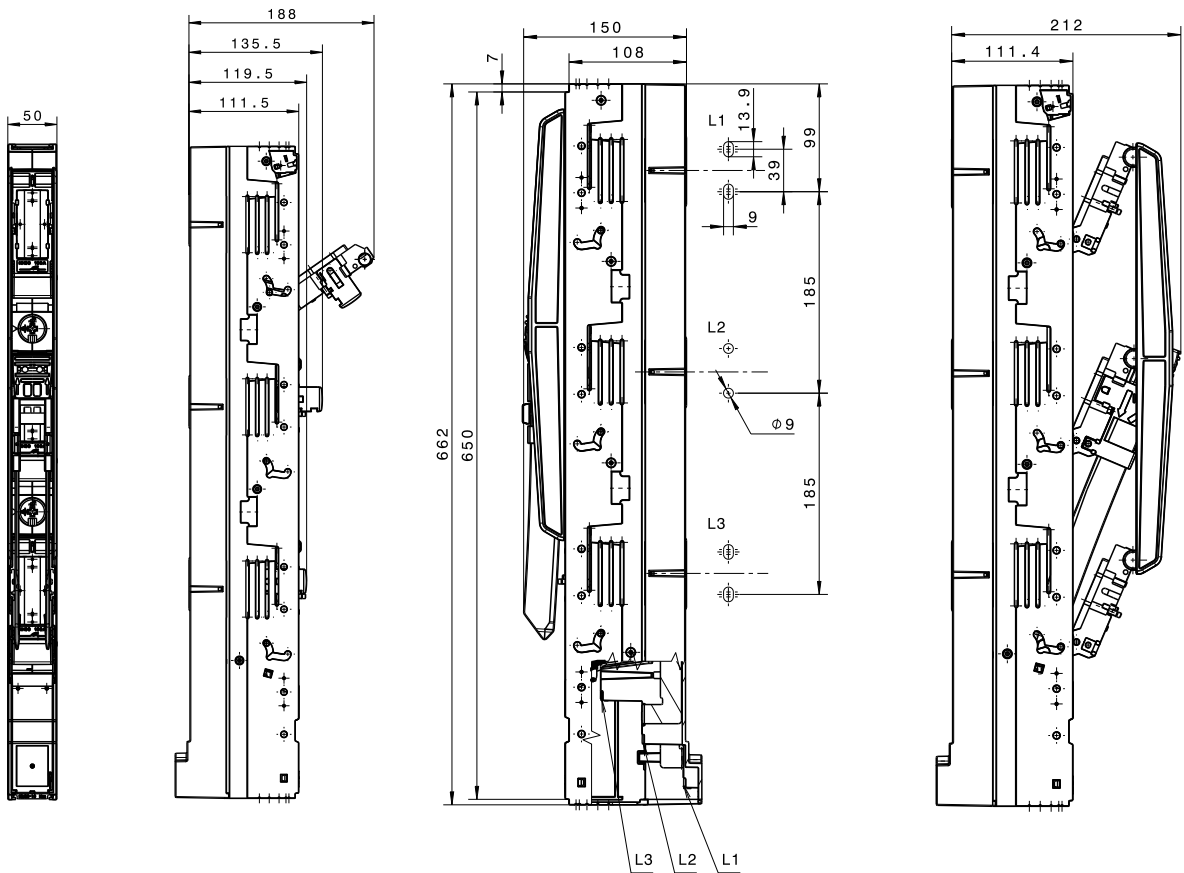
Size	Code No.	Busbar system	Type	Connection description		
00	001690860	100	SL00/100 3P M8 800AC	flat connection – screw M8	850	1
	001690861	185	SL00 3P M8 800AC	flat connection – screw M8	1790	1
1	001690862	185	SL1 3P M10 800AC	flat connection – screw M10	4660	1
3	001690863	185	SL3 3P M12 800AC	flat connection – screw M12	5480	1



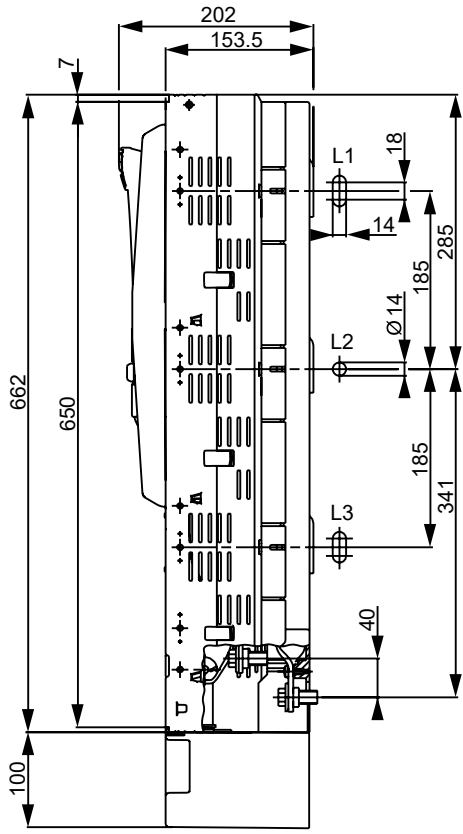
GREEN PROTECT / Fuse bases for NH DC fuse-links



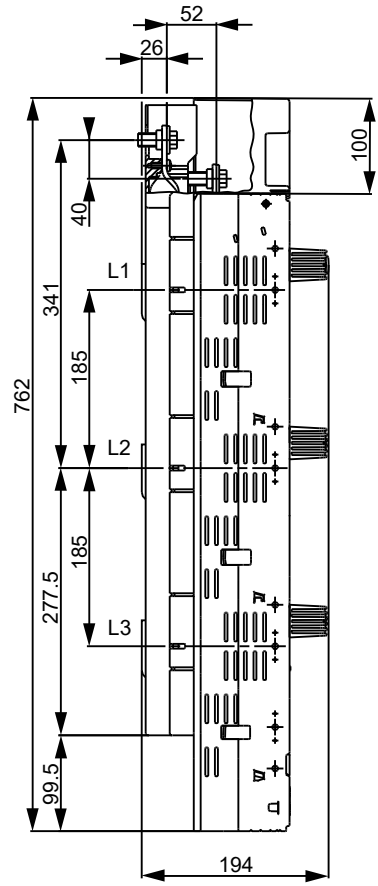
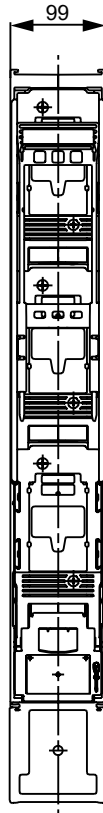
SL00/100



SL00/185





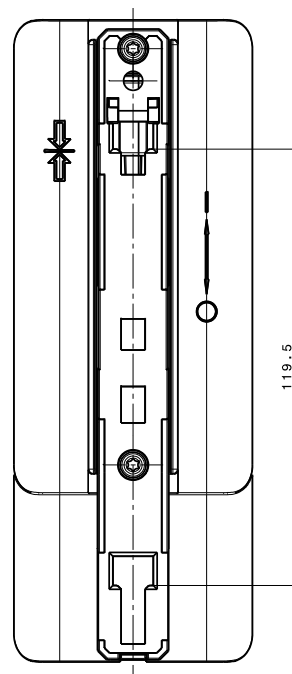
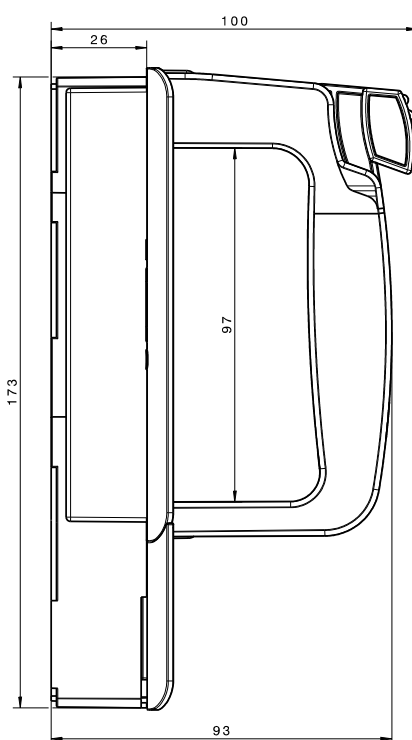
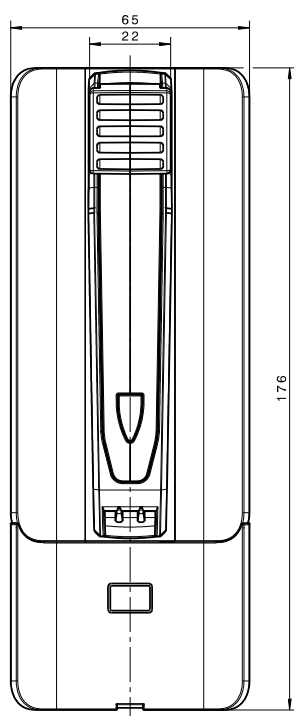
SL1, SL3



NH handle

NH handle for fuse-link DC 1100V and DC 1500V

Code	Type	 g	
001691062	GPN 1500	590	1



OVERVOLTAGE PROTECTION FOR PV SYSTEMS

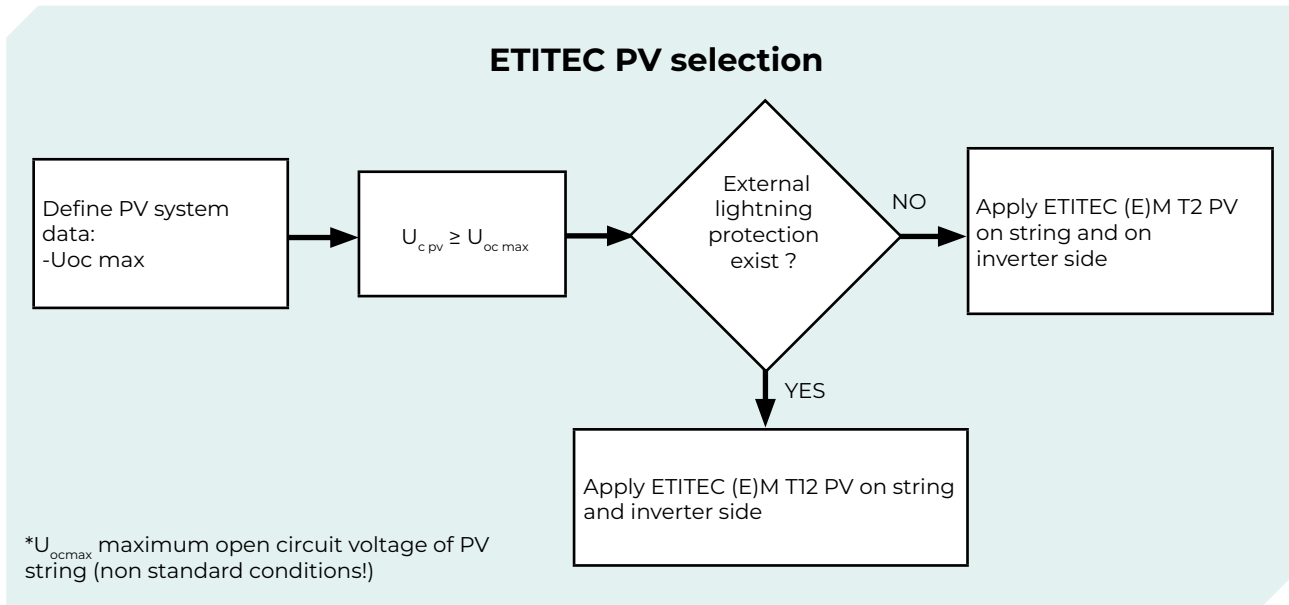


 etigroup
www.etigroup.eu

**Lightning and Surge
Arresters ETITEC**

ETI
SWITCH TO
A SAFE FUTURE

Overvoltage protection selection



PV surge arrester comparison according to IEC/EN 61643-31:2018

Type	ETITEC M T12 PV		ETITEC EM T12 PV		ETITEC M T2 PV				ETITEC EM T2 PV	
	1100/12,5 Y	1500/12,5 Y	1100/6,25 Y	1500/5 Y	250/20 Y	600/20 Y	1100/20 Y	1500/20 Y	1100/20 Y	1500/15 Y
Class (IEC/EN/VDE)	T1, T2 / I, II / B, C				T2 / II / C					
Max Continuous Operating DC Voltage U _{cpv}	1100 V	1500 V	1100 V	1500 V	250 V	600 V	1100 V	1500 V	1100 V	1500 V
Nominal discharge current I _n (8/20)	20 kA		20 kA		20 kA				20 kA	15 kA
Total discharge current I _{total} (8/20)	50 kA	60 kA	65 kA	50 kA	50 kA	40 kA	30 kA	40 kA		
Impulse Discharge Current I _{imp} (10/350)	6,25 kA	6,25 kA	6,25 kA	5 kA	-	-	-	-	-	-
Total Discharge current I _{total} (10/350)	12,5 kA	6,25 kA	6,25 kA	5 kA	-	-	-	-	-	-
Specific energy W/R	9,77 kJ/Ω		9,77 kJ/Ω		6,25 kJ/Ω		-	-	-	-
Charge	3,125 As	2,5 As	3,125 As	2,5 As	-	-	-	-	-	-
Max discharge current I _{max} (8/20)	40 kA	60 kA	40 kA	30 kA	50 kA	40 kA	30 kA	40 kA		
Voltage Protection Level U _p at I _n (8/20)	< 3,8 kV	< 5 kV	< 3,8 kV	< 5 kV	< 1 kV	< 2 kV	< 3,8 kV	< 5 kV	< 4,2 kV	< 4,8 kV
Response time t _a	< 25 ns									
Thermal protection	✓									
Short-Circuit Current Rating SCCR I _{scpv}	11 kA	30 kA	11 kA		6 kA		11 kA		9 kA	
Operating temperature range Ta	- 40°C ... +85°C									
Permissible Operating Humidity RH	5% ... 95%									
Altitude (max)	4000 m							2000 m		
Operating State / Fault Indication	working - green flag / faulty - red flag									
Cross section of conductors	35 mm ² (Solid, Stranded) / 25 mm ² (Flexible)									
Terminal Screw Torque Mmax	max. 4,5 Nm							max. 3 Nm		
Mounting	35 mm DIN Rail, EN 60715									
Degree of protection	IP20									
Housing Material	Thermoplastic: Extinguishing Degree UL 94 V-0									
Size	3 modules									
Standards	IEC 61643-31:18+A1:20144									
Installation in boards/cabinets	ECH, EPC, GT, SOLID GSX, HXS					ECH, EPC, GT, SOLID GSX, HXS, ECM, ECT, ACT				

Each arrester is equipped with thermal protection, which disconnects it from the electrical network in case of exceeding the permissible value



Quick module replacement with a latch lock to prevent accidental removal of the module and resistance to vibration



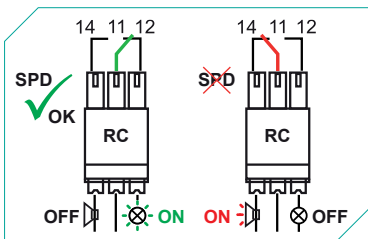
Additional protection against contact with current-carrying parts and conductors contacting each other



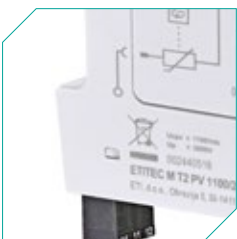
Protection against installation of incompatible modules



Spring-loaded retainer for quick mounting on a DIN rail



Remote signaling (RC) contacts of varistor damage (screwless)



All important technical data is printed on the front and side of the arrester



Visual indicator of varistor failure (red flag - damage; green flag - OK)



ETITEC (E)M T12 PV

ETITEC (E)M T12 PV Y series of overvoltage surge protective devices has been developed to protect against direct and indirect discharges and is intended to protect photovoltaic systems.

The circuit topology consist of three varistors stages each protected by a thermal disconnection device.

Advantages:

- // optical indication of faulty device (green ok, red false)
- // remote signalisation (RC version only)
- // DIN rail mounting (EN 60715)
- // high discharge currents and high degree of protection
- // MOV varistor is the protective element
- // metal snapper, new way of mounting on DIN rail (easier, quicker)
- // modular design
- // RoHS compliant
- // connection up to 35mm²

ETITEC M T12 PV

Suitable for green field installations (IEC/EN 61643-32)

Location of Use: String box, Inverter

Mode of Protection:(+) - PE, (-) - PE, (+) - (-)

Surge Ratings: I_{Total} = up to 12.5 kA (10/350 μ s)

I_{Total} = up to 60 kA (8/20 μ s)

EN Category: Type 1+2

Protective Elements: High Energy MOV

Housing: Pluggable Design

Compliance: IEC 61643-31:2018+A1:2014

ETITEC EM T12 PV

Suitable for roof installations (IEC/EN 61643-32)

Location of Use: String box, Inverter

Mode of Protection:(+) - PE, (-) - PE, (+) - (-)

Surge Ratings: I_{Total} =up to 6.25 kA (10/350 μ s)

I_{Total} =up to 65 kA (8/20 μ s)

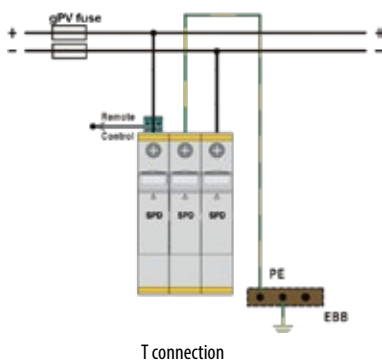
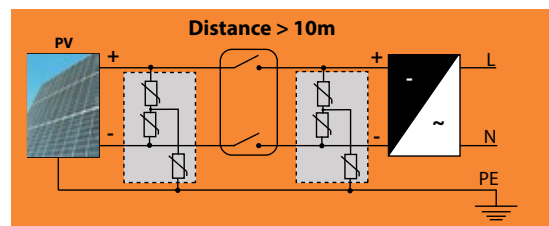
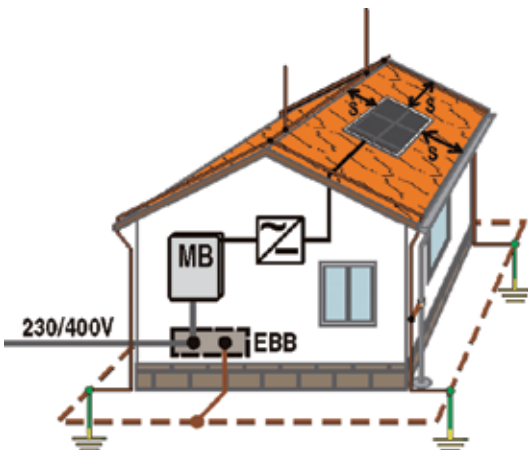
EN Category: Type 1, Type 2

Protective Elements: High Energy MOV

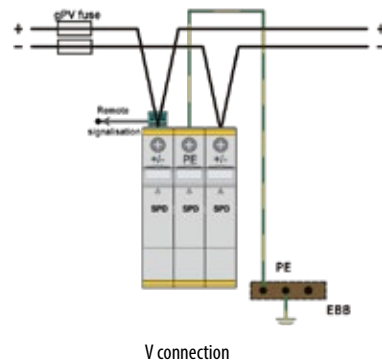
Housing: Pluggable Design

Compliance: IEC 61643-31:2018+A1:2014

ETITEC (E)M T12 PV Y for photovoltaic system on a building with External Lightning Protection



T connection

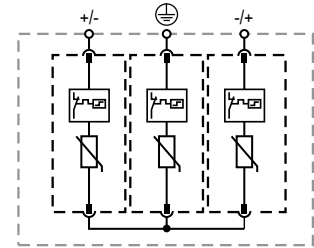


V connection

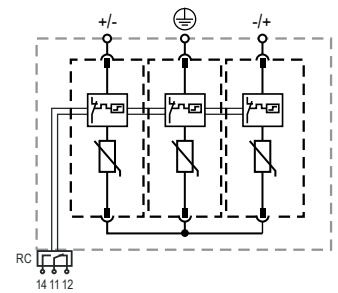
Note: If distance between string and inverter is less than 10 m, then you need only one ETITEC.

ETITEC M T12 PV technical data

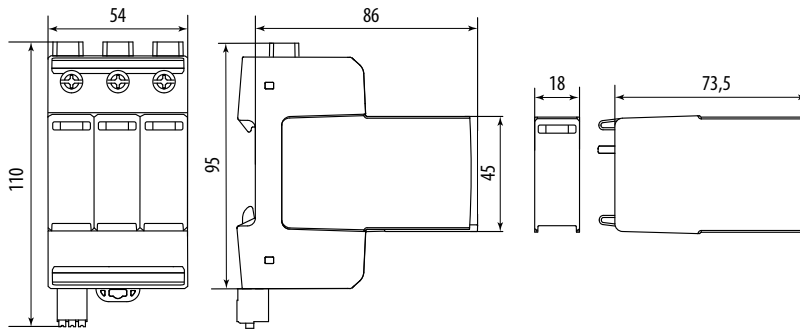
Type	ETITEC M T12 PV 1100/12,5 Y	ETITEC M T12 PV 1500/12,5 Y
	T1,T2 / I,II / B,C	
Maximum Continuous Operating DC Voltage U_{CPV}	1100 V	1500V
Nominal Discharge Current (8/20 μ s) I_n	20 kA	20 kA
Total Discharge Current (8/20 μ s) I_{total}	50 kA	60 kA
Impulse Discharge Current (10/350)	6,25 kA	5 kA
Total Discharge Current (10/350 μ s) I_{total}	12,5 kA	10 kA
Specific Energy W/R	9,77 kJ/ Ω	9,77 kJ/ Ω
Charge	3,125 As	2,5 As
Voltage Protection Level U_p	< 3,8 kV	< 5 kV
Response Time t_A	< 25 ns	
Number of Ports	1	
Thermal Protection	✓	
Short-Circuit Current Rating $SCCR I_{SCPV}$	11 kA	
Operating Temperature Range T_a	- 40°C ... +85°C	
Permissible Operating Humidity R_h	5% - 95%	
Altitude (max)	4000 m	
Operating State / Fault Indication	Green Flag / Not Green Flag	
Conductor Cross Section (max)	35 mm ² (Solid, Stranded) / 25 mm ² (Flexible)	
Terminal Screw Torque Mmax	max. 4,5 Nm	
Mounting	35 mm DIN Rail, EN 60715	
Degree Of Protection	IP20	
Housing Material	Thermoplastic: Extinguishing Degree UL 94 V-0	
Size	3 modules	
Remote contacts - type ...RC		
Contacts ratings	AC: 250V/1A; 125V/1A; DC: 48V/0,5A, 24V/0,5A, 12V/0,5A	
Terminal cross section	Max. 1,5 mm ²	
Terminal Screw Torque Mmax	0,25 Nm	
Standards	IEC 61643-31:2018+A1:2014	



ETITEC MT12 PV ... Y



ETITEC M T12 PV ... Y RC





ETITEC M T12 PV 1500/12,5 Y

ETITEC M T12 PV

Type	Code No.	Max PV voltage U_{gr} [V DC]	I_{SCPV} [kA]	I_{total} (10/350) [kA]	I_{imp} [kA]	I_n [kA]		
ETITEC M T12 PV 1100/12,5 Y	002440511	1100	11	12,5	6,25	20	453	1/5
ETITEC M T12 PV 1100/12,5 Y RC	002440512	1100	11	12,5	6,25	20	462	1/5
ETITEC M T12 PV 1500/12,5 Y	002440513	1500	30	12,5	6,25	20	488	1/5
ETITEC M T12 PV 1500/12,5 Y RC	002440514	1500	30	12,5	6,25	20	497	1/5

*RC - remote contact for remote signalisation of bad module (to be replaced)

Spare (replacement) modules

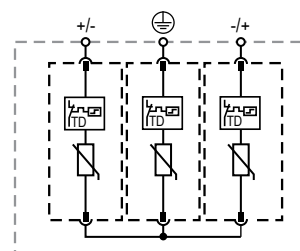
Type	Code No.	Compatible with		
MOD. MT12 PV 550/12,5	002440519	ETITEC MT12 PV 1100/12,5 Y (RC)	71	1/28
MOD. MT12 PV 550/6,25*	002440520	ETITEC MT12 PV 1100/12,5 Y (RC)	127	1/28
MOD. MT12 PV 750/10	002440521	ETITEC MT12 PV 1500/10 Y (RC)	87	1/28
MOD. MT12 PV 750/5*	002440522	ETITEC MT12 PV 1500/10 Y (RC)	130	1/28

*left or right module (Y connection)

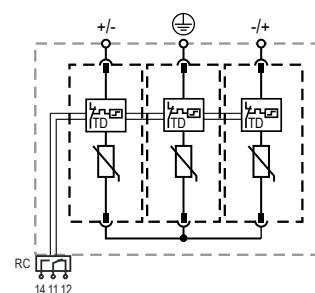
Due to serial connection of modules (Y topology), U_{cpv} voltage of single module is 1/2 of total U_{cpv} between each pole

ETITEC EM T12 PV technical data

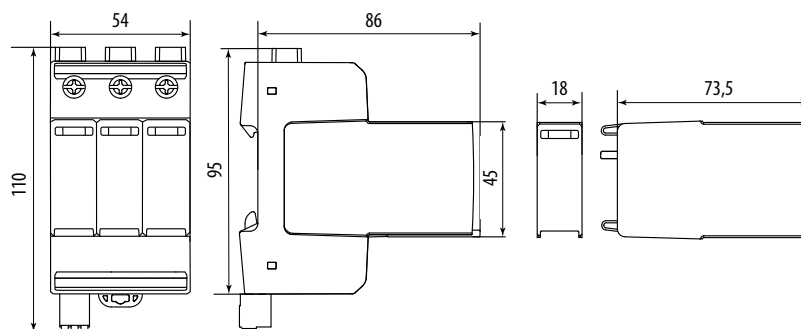
Type	ETITEC EM T12 PV 1100/6,25 Y (RC)	ETITEC EM T12 PV 1500/5 Y (RC)
	T1,T2 / I,II / B,C/1CA	
Maximum Continuous Operating DC Voltage U_{cpv}	1100 V	1500V
Nominal Discharge Current (8/20 μ s) I_n	20 kA	20 kA
Total Discharge Current (8/20 μ s) I_{total}	65 kA	50 kA
Impulse Discharge Current (10/350)	6,25 kA	5 kA
Total Discharge Current (10/350 μ s) I_{total}	6,25 kA	5 kA
Specific Energy W/R	9,77 kJ/ Ω	6,25 kJ/ Ω
Charge	3,125 As	2,5 As
Maximum Discharge Current (8/20 μ s) I_{max}	40 kA	30 kA
Voltage Protection Level U_p	3,8 kV	5 kV
Response Time t_A	< 25 ns	
Number of Ports	1	
Thermal Protection	✓	
Short-Circuit Current Rating $SCCR I_{scpv}$	11 kA	
Maximum Permitted DC Voltage V_{pvdcc}	1100 V	1500 V
Voltage Protection Rating V_{pr}	2500 V	4000 V
Nominal Discharge Current (8/20 μ s) I_n	20 kA	20 kA
Short-Circuit Current Rating $SCCR I_{scpv}$	50 kA	65 kA
Operating Temperature Range T_o	- 40°C ... +85°C	
Permissible Operating Humidity R_h	5% - 95%	
Altitude (max)	4000 m	
Operating State / Fault Indication	Green Flag / Not Green Flag	
Conductor Cross Section (max)	35 mm ² (Solid, Stranded) / 25 mm ² (Flexible)	
Terminal Screw Torque M_{max}	max. 4,5 Nm	
Mounting	35 mm DIN Rail, EN 60715	
Degree Of Protection	IP20	
Housing Material	Thermoplastic: Extinguishing Degree UL 94 V-0	
Size	3 modules	
Remote contacts - type ...RC		
Contacts ratings	AC: 250V/1A; 125V/1A; DC: 48V/0,5A, 24V/0,5A, 12V/0,5A	
Terminal cross section	Max. 1,5 mm ²	
Terminal Screw Torque M_{max}	0,25 Nm	
Standards	IEC 61643-31:2018+A1:2014	



ETITEC EM T12 PV ... Y



ETITEC EM T12 PV ... Y RC



ETITEC EM T12 PV

Type	Code No.	Max PV voltage U_{cpv} [V DC]	I_{sgv} [kA]	I_{total} (10/350) [kA]	I_{imp} [kA]	I_n [kA]	g	Box
ETITEC EM T12 PV 1100/6,25 Y	002440580	1100	11	6,25	6,25	20	397	1/5
ETITEC EM T12 PV 1100/6,25 Y RC	002440581	1100	11	6,25	6,25	20	406	1/5
ETITEC EM T12 PV 1500/5 Y	002440582	1500	11	5	5	20	488	1/5
ETITEC EM T12 PV 1500/5 Y RC	002440583	1500	11	5	5	20	497	1/5

*RC - remote contact for remote signalisation of bad module (to be replaced)

Spare (replacement) modules

Type	Code No.	Compatible with	g	Box
MOD. EM T12 PV 550/6,25	002440584	ETITEC EM T12 PV 1100/6,25 Y (RC)	79	1/28
MOD. EM T12 PV 750/5	002440585	ETITEC EM T12 PV 1500/5 Y (RC)	87	1/28

Due to serial connection of modules (Y topology), U_{cpv} voltage of single module is 1/2 of total U_{cpv} between each pole



ETITEC EM T12 PV 1100/6,25 Y RC

ETITEC (E)M T2 PV

ETITEC (E)M T2 PV Y series of overvoltage surge protective devices has been developed to protect against indirect discharges and is intended to protect photovoltaic systems.

The circuit topology consist of two (three) varistors stages each protected by a thermal disconnection device.

Advantages:

- // optical indication of faulty device (green ok, red false)
- // remote signalisation (RC version only)
- // DIN rail mounting (EN 60715)
- // high discharge currents and high degree of protection
- // MOV varistor is the protective element
- // metal snapper, new way of mounting on DIN rail (easier)
- // modular design
- // IEC 61643-31:2018
- // RoHS compliant
- // connection up to 35mm²

ETITEC (E)M T2 PV

Suitable for installations (IEC/EN 61643-31:2018)

Location of Use: String box, Inverter

Mode of Protection:(+) - PE, (-) - PE, (+) - (-)

Surge Ratings: I_{Total} = up to 20 kA (8/20 μ s)

I_{Total} = up to 50 kA (8/20 μ s)

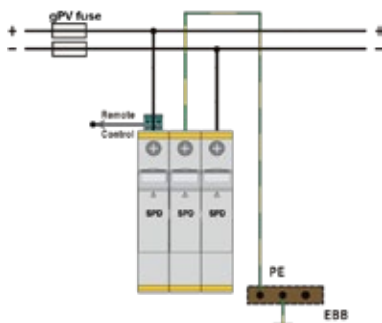
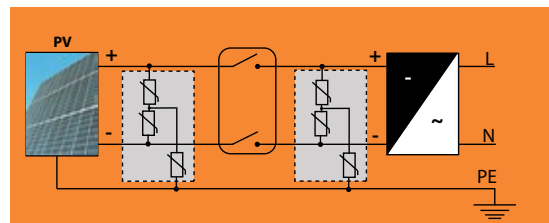
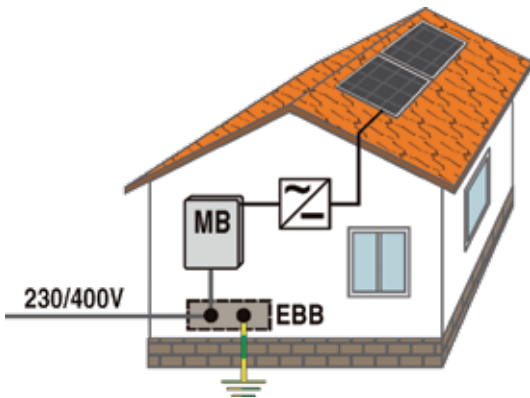
EN Category: Type 2

Protective Elements: High Energy MOV

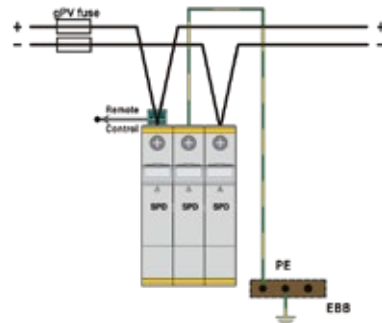
Housing: Pluggable Design

Compliance: IEC 61643-31:2018+A1:2014

ETITEC (E)M T2 PV Y for photovoltaic system on a building without External Lightning Protection



T connection



V connection

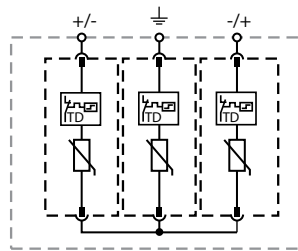
Note: If distance between string and inverter is less than 10 m, then you need only one ETITEC.

Difference between ETITEC M T2 PV and ETITEC EM T2 PV
 ETITEC EM T2 PV is the economic version without module latching mechanism, easily distinguishable from ETITEC M T2 PV by the grey color of ETI logo on the device.

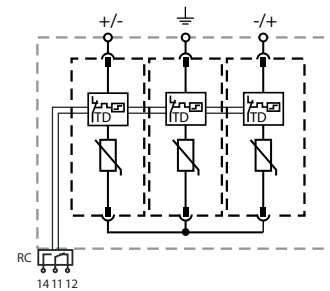
ETITEC M T2 PV technical data

Type	ETITEC M T2 PV 250/20 Y	ETITEC M T2 PV 600/20 Y	ETITEC M T2 PV 1100/20 Y	ETITEC M T2 PV 1500/20 Y
	T2 / II / C			
Maximum Continuous Operating DC Voltage U_{CPV}	250 V	600 V	1100 V	1500V
Nominal Discharge Current (8/20 μ s) I_n	20 kA			
Maximum Discharge Current (8/20 μ s) I_{max}	50 kA		40 kA	30 kA
Total Discharge Current I_{total}	50 kA		40 kA	
Voltage Protection Level U_p	1 kV	2 kV	< 3,8 kV	< 5 kV
Response Time t_A	< 25 ns			
Number of Ports	1			
Thermal Protection	✓			
Short-Circuit Current Rating I_{SCPV}	11 kA			
Operating Temperature Range T_a	- 40°C ... +85°C			
Permissible Operating Humidity R_H	5% - 95%			
Altitude (max)	4000 m			
Operating State / Fault Indication	Green Flag / Not Green Flag			
Conductor Cross Section (max)	35 mm ² (Solid, Stranded) / 25 mm ² (Flexible)			
Terminal Screw Torque Mmax	max. 4,5 Nm			
Mounting	35 mm DIN Rail, EN 60715			
Degree Of Protection	IP20			
Housing Material	Thermoplastic: Extinguishing Degree UL 94 V-0			
Size	3 modules			
Remote contacts - type ...RC				
Contacts ratings	AC: 250V/1A; 125V/1A; DC: 48V/0,5A, 24V/0,5A, 12V/0,5A			
Terminal cross section	Max. 1,5 mm ²			
Terminal Screw Torque Mmax	0,25 Nm			
Standards	IEC 61643-31:2018+A1:2014			

- Legend
- +/-, -/+ Terminal for +/-, -/+ Conductor
 - ⊥ Terminal for PE /G Conductor
 - RC Remote Contacts Optional
 - TD Thermal Disconnecter

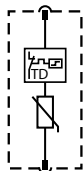


ETITEC M T2 PV ... Y

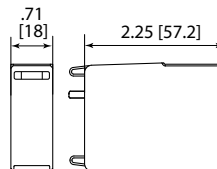


ETITEC M T2 PV ... Y RC



Plug Internal Configuration



Spare Plug





ETITEC M T2 PV

Type	Code No.	Max PV voltage U_{opv} [V DC]	I_{sgv} [kA]	I_n/I_{max} [kA]		
ETITEC M T2 PV 250/20 Y	002440732	250	11	20/50	294	1/5
ETITEC M T2 PV 250/20 Y RC	002440733	250	11	20/50	300	1/5
ETITEC M T2 PV 600/20 Y	002440735	600	11	20/50	347	1/5
ETITEC M T2 PV 600/20 Y RC	002440736	600	11	20/50	353	1/5
ETITEC M T2 PV 1100/20 Y	002440515	1100	11	20/40	396	1/5
ETITEC M T2 PV 1100/20 Y RC	002440516	1100	11	20/40	406	1/5
ETITEC M T2 PV 1500/20 Y	002440517	1500	11	20/30	444	1/5
ETITEC M T2 PV 1500/20 Y RC	002440518	1500	11	20/30	454	1/5

*RC - remote contact for remote signalisation of bad module (to be replaced)

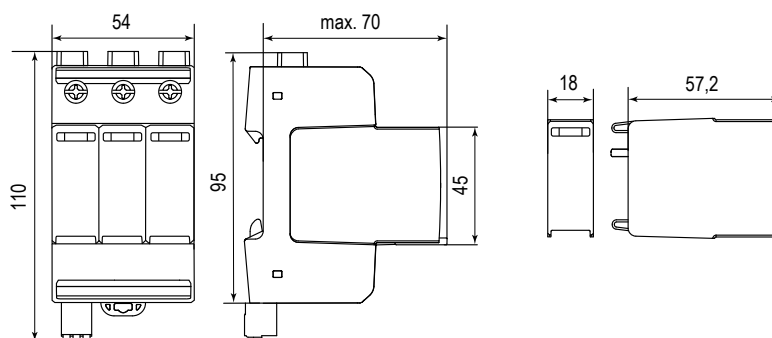
Spare (replacement) modules

Type	Code No.	Compatible with		
MOD. M T2 PV 125/20	002440734	ETITEC M T2 PV 250/20 Y (RC)	50	1/24
MOD. M T2 PV 300/20	002440737	ETITEC M T2 PV 600/20 Y (RC)	61	1/24
MOD. M T2 PV 550/20	002440523	ETITEC M T2 PV 1100/20 Y (RC)	0,071	1/28
MOD. M T2 PV 750/20	002440524	ETITEC M T2 PV 1500/20 Y (RC)	0,087	1/28

*Due to serial connection of modules (Y topology), U_{opv} voltage of single module is 1/2 of total U_{opv} between each pole

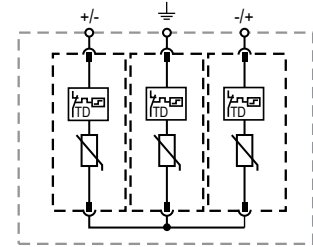


ETITEC M T2 PV 1100/20 Y

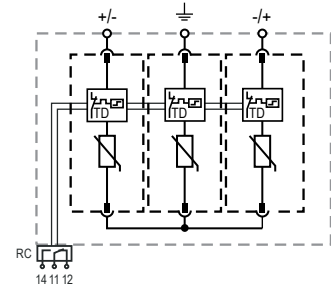


ETITEC EM T2 PV technical data

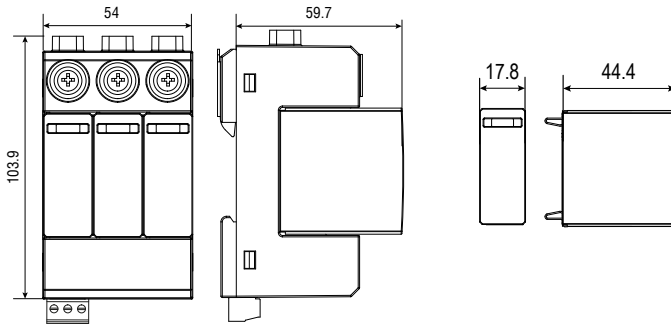
Type		ETITEC EM T2 PV 1100/20 Y	ETITEC EM T2 PV 1500/15 Y
		T2 / II / C	
Maximum Continuous Operating DC Voltage U_{CPV}		1100 V	1500V
Nominal Discharge Current (8/20 μ s) I_n		20 kA	15 kA
Maximum Discharge Current (8/20 μ s) I_{max}		40 kA	40 kA
Total Discharge Current I_{total}		40 kA	40 kA
Voltage Protection Level U_p	(+)(-)	< 4,2 kV	< 4,8 kV
	(+)(-)-PE	< 4,2 kV	< 4,8 kV
Response Time t_A		< 25 ns	
Thermal Protection		✓	
Number of Ports		1	
Short-Circuit Current Rating I_{SCPV}		9 kA	
Maximum Permitted DC Voltage V_{pVDC}		1000V	1500V
Voltage Protection Rating V_{PR}		2500V	3000V
Short-Circuit Current Rating $SCCR I_{SCPV}$		50kA	65kA
Operating Temperature Range T_a		- 40°C ... +85°C	
Permissible Operating Humidity R_h		5% - 95%	
Altitude (max)		2000 m	
Operating State / Fault Indication		Green Flag / Not Green Flag	
Conductor Cross Section (max)		35 mm ² (Solid) / 25 mm ² (Stranded)	
Terminal Screw Torque M_{max}		max. 4,5 Nm	
Mounting		35 mm DIN Rail, EN 60715	
Degree Of Protection		IP20	
Housing Material		Thermoplastic: Extinguishing Degree UL 94 V-0	
Size		3 modules	
Remote contacts - type ...RC			
Contacts ratings		AC: 250V/1A; 120V/1A; DC: 48V/0,5A, 24V/0,5A, 12V/0,5A	
Terminal cross section		Max. 1,5 mm ²	
Terminal Screw Torque M_{max}		0,25 Nm	
Standards		IEC 61643-31:2018+A1:2014	



ETITEC EM T2 PV ... Y



ETITEC EM T2 PV ... Y RC



ETITEC EM T2 PV

Type	Code No.	Max PV voltage U_{CPV} [V DC]	I_{SPV} [kA]	I_n / I_{max} [kA]		
ETITEC EM T2 PV 1100/20 Y	002440623	1100	9	20/40	329	1/5
ETITEC EM T2 PV 1100/20 Y RC	002440624	1100	9	20/40	333	1/5
ETITEC EM T2 PV 1500/20 Y	002440625	1500	9	20/40	358	1/5
ETITEC EM T2 PV 1500/20 Y RC	002440626	1500	9	20/40	363	1/5

*RC - remote contact for remote signalisation of bad module (to be replaced)

Spare (replacement) modules

Type	Code No.	Compatible with		
MOD. EM T2 PV 550/20	002440627	ETITEC EM T2 PV 1100/20 Y (RC)	60	1/12
MOD. EM T2 PV 750/20	002440628	ETITEC EM T2 PV 1500/20 Y (RC)	71	1/12



ETITEC EM T2 PV 1500/15 Y

Overvoltage protection of PV inverters

ETITEC M T12 950/12,5 4Y

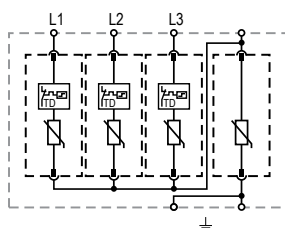
ETITEC M T12 950/12,5 4Y series of overvoltage surge protective devices has been developed to protect against direct and indirect discharges the new generation of PV inverters with an output voltage of 800V AC (line voltage).
Class I · Class II · Type 1 · Type 2

Features:

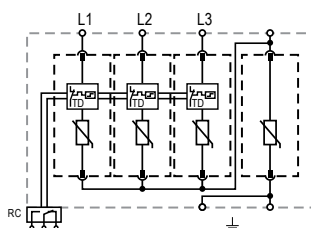
- // Type 1 and Type 2 SPD
- // Uc up to 950V
- // Discharge capacity – Iimp 12,5 kA
- // Discharge capacity - I_{max} up to 50 kA
- // Housing: Pluggable Design
- // Compliance: IEC 61643-11:2011, EN 61643-11:2012+A11:2018

Technical data

Type	ETITEC M T12 950/12,5 4Y T1,T2 / I,II / B,C
Nominal AC voltage (50/60Hz)	800 V
Maximum Continuous Operating Voltage (AC)	950 V
Nominal Discharge Current (8/20 μs)	20 kA
Maximum Discharge Current (8/20 μs)	50 kA
Impulse Discharge Current (10/350)	12,5 kA
Specific Energy W/R	39 kJ/Ω
Charge	6,25 As
Voltage Protection Level	4000 V
Residual voltage at 5kA (8/20 μs)	3100 V
Response Time	< 25 ns
Number of Ports	1
Overcurrent protection (max)	160 A gG
Short-Circuit Current Rating	25 kA
Operating Temperature Range	- 40°C ... +85°C
Permissible Operating Humidity	5% - 95%
Altitude (max)	2000 m
Terminal screw torque	4,5Nm
Conductor Cross Section (max)	35 mm ² (Solid, Stranded) / 25 mm ² (Flexible)
Mounting	35 mm DIN Rail, EN 60715
Degree Of Protection	IP20
Housing Material	Thermoplastic: Extinguishing Degree UL 94 V-0
Thermal protection	✓
Operating state / fault indication	Green Flag / Not Green Flag
Remote contacts - type ...RC	
RC switching capacity	AC: 250V/1A; 125V/1A; DC: 48V/0,5A, 24V/0,5A, 12V/0,5A
Terminal cross section	Max. 1,5 mm ²



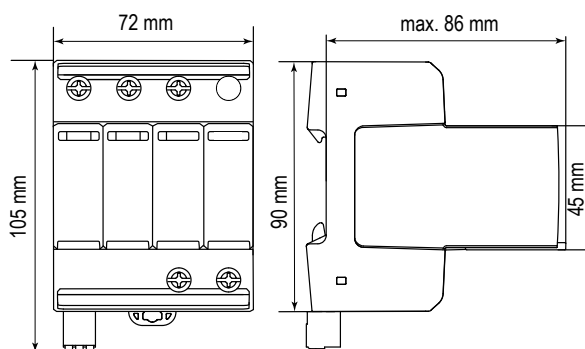
ETITEC M T12 950/12,5 4Y



ETITEC M T12 950/12,5 4Y RC

Legend

- L Line Conductor Terminal
- N Neutral Conductor Terminal
- ⊥ PE /G Conductor Terminal
- RC Remote Contacts (Optional)Terminal
- TD Thermal Disconnecter



ETITEC M T12 950/12,5 4Y

Type	Code No.	I_{imp} (10/350) [kA]	I_{IT}^{max} (8/20) [kA]	U_c [V AC]	Network	g	Box
ETITEC M T12 950/12,5 4Y	002440810	12,5	20 / 50	950	TNC / IT	775	1 / 4
ETITEC M T12 950/12,5 4Y RC	002440811	12,5	20 / 50	950	TNC / IT	78	1 / 4

Spare (replacement) modules

Type	Code No.	Compatible with	g	Box
MOD.ETITEC M T12 400/12,5	002440812	ETITEC M T12 950/12,5 4Y (RC)	13	1 / 28
MOD.ETITEC M T12 550/12,5 PE/N*	002440813	ETITEC M T12 950/12,5 4Y (RC)	128	1 / 28

*4th pole without indication window, needs to be replaced each time as any of other modules is being replaced



ETITEC M T12 950/12,5 4Y

ETITEC M T2 950/12,5 4Y

ETITEC M T2 950/20 4Y series of overvoltage surge protective devices has been developed to protect against indirect discharges the new generation of PV inverters with an output voltage of 800V AC (line voltage).

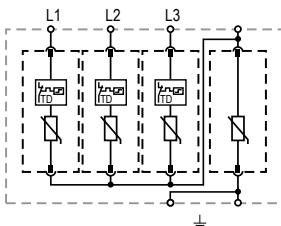
Class II · Type 2

Features:

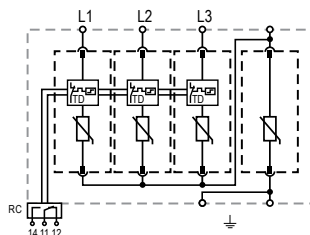
- // Type 2 SPD
- // Uc up to 950V
- // Discharge capacity - I_{max} up to 40 kA
- // Housing: Pluggable Design
- // Compliance: IEC 61643-11:2011, EN 61643-11:2012+A11:2018

Technical data

Type	ETITEC M T2 950/20 4Y T2 / II / C
Nominal AC voltage (50/60Hz)	800 V
Maximum Continuous Operating Voltage (AC)	950 V
Nominal Discharge Current (8/20 μs)	20 kA
Maximum Discharge Current (8/20 μs)	40 kA
Total Discharge Current (10/350)	5 kA
Voltage Protection Level	4500 V
Residual voltage at 5kA (8/20 μs)	3400 V
Response Time	< 25 ns
Number of Ports	1
Overcurrent protection (max)	160 A gG
Short-Circuit Current Rating	25 kA
Operating Temperature Range	-40°C ... +85°C
Permissible Operating Humidity	5% - 95%
Altitude (max)	2000 m
Terminal screw torque	4,5Nm
Conductor Cross Section (max)	35 mm ² (Solid, Stranded) / 25 mm ² (Flexible)
Mounting	35 mm DIN Rail, EN 60715
Degree Of Protection	IP20
Housing Material	Thermoplastic: Extinguishing Degree UL 94 V-0
Thermal protection	✓
Operating state / fault indication	Green Flag / Not Green Flag
Remote contacts - type ...RC	
RC switching capacity	AC: 250V/1A; 125V/1A; DC: 48V/0,5A, 24V/0,5A, 12V/0,5A
Terminal cross section	Max. 1,5 mm ²



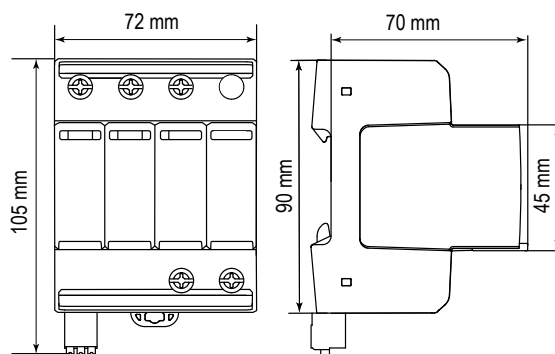
ETITEC M T12 950/12,5 4Y



ETITEC M T12 950/12,5 4Y RC

Legend

- L Line Conductor Terminal
- N Neutral Conductor Terminal
- ⊥ PE /G Conductor Terminal
- RC Remote Contacts (Optional) Terminal
- TD Thermal Disconnect



ETITEC M T2 950/20 4Y

Type	Code No.	I_n/I_{max} (8/20) [kA]	U_c [V AC]	Network	g	Box
ETITEC M T2 950/20 4Y	002440820	20 / 40	950	TNC / IT	759	1 / 4
ETITEC M T2 950/20 4Y RC	002440821	20 / 40	950	TNC / IT	764	1 / 4

Spare (replacement) modules

Type	Code No.	Compatible with	g	Box
MOD.ETITEC M T2 400/20 PE/N *	002440822	ETITEC M T2 950/20 4Y (RC)	93	1 / 28
MOD.ETITEC M T2 550/20	002440823	ETITEC M T2 950/20 4Y (RC)	75	1 / 28

*4th pole without indication window, needs to be replaced each time as any of other modules is being replaced



ETITEC M T2 950/20 4Y

ETITEC V T2 690V (EN/IEC/VDE: T2/II/C)

ETITEC V series of overvoltage surge protective devices has been developed to protect the new generation PV network inverters with an output voltage of 800V (line voltage). The circuit topology consist of three (four) parallel-connected varistor modules. Each pole is equipped with a visual indication.

Advantages:

- // Type 2 AC Surge Protector
- // I_n : 20 kA
- // I_{max} : 40 kA
- // Pluggable module for each phase
- // Remote signaling option
- // IEC 61643-11 and EN 61643-11 compliance
- // UL1449 ed.4

Designation:

ETITEC V T2 xxx/20 p+c RC

xxx - voltage U_c (max. operating voltage AC), must be above the mains voltage

20 - 20kA (8/20us)

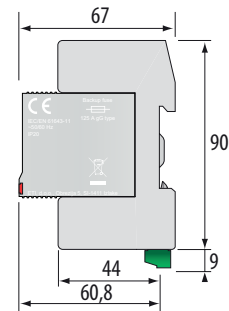
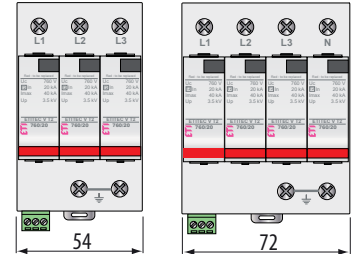
p - number of poles with varistors MOV

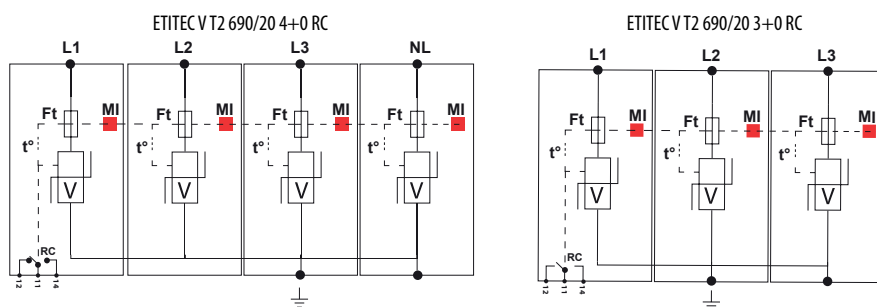
c - 0 varistors MOV at the NPE pole, 1 gas-discharge GDT (TT systems)

RC - Remote signaling contact



Technical data

Type	ETITEC V T2 690/20
Class (IEC/EN/VDE)	II/T2/C
Network (TN)	690 V/1f
Max. AC operating voltage (AC) U_c	760 V
Temporary Over Voltage Characteristics (TOV) U_T (AC)	1000V/5s withstand 1300V/120 min safe turn off
Residual current I_{pe}	< 1 mA
Follow current I_f	none
Nominal discharge current I_n (15 imp. x 8/20)	20 kA
Max. discharge current I_{max} (8/20)	40 kA
Protection level U_p	3,5 kV
Admissible short-circuit current I_{SCCR}	25 000A
Thermal disconnecter	internal
Fuses	125 A gG
Installation ground fault breaker	Type «S» or delayed
Connection to Network	By screw terminals: 2,5-25 mm ² / by bus
Disconnection indicator	1 mechanical indicator
Remote signaling of disconnection (RC)	✓
Mounting	Symmetrical rail 35 mm (EN60715)
Operating temperature	- 40°C ...+85°C
Protection rating	IP 20
Housing material	Thermoplastic UL94-V0
Standards	IEC 61643-11 / EN 61643-11





ETITEC V T2

Type	Code No.	$I_n / I_{n\max}$ [kA]	U_c [V AC]	Network	 g	 1/24
ETITEC V T2 690/20 3+0 RC	002442988	20/40	750	TNC	319	1/24
ETITEC V T2 690/20 4+0 RC	002442989	20/40	750	TNC-S	420	1/18



ETITEC V T2 690/20 3+0 RC

SWITCH DISCONNECTORS



 etigroup
www.etigroup.eu


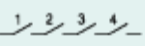
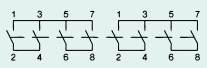
**PV Switch
Disconnectors**

ETI
SWITCH TO
A SAFE FUTURE

PV switch disconnecter LS DC

The construction of the switch ensures reliable switching up to 1500V. The design of the contacts and the choice of materials prevent oxidation and inadmissible heating-up, even with a low switching frequency. The switch disconnecter is available with 2, 4, or 4+2 contacts. By wiring the contacts in series or parallel, the contact rating can be increased. Additionally, the switching speed of the manually operated handle does not affect the performance of the contacts.

Technical data

Type			LS16 [A]		LS25 [A]		LS32 [A]	
			DC21B	DC22B	DC21B	DC22B	DC21B	DC22B
	2 pole in series A2	500V DC	16	7	25	8	32	9
		600V DC	16	5,5	25	6	32	6,5
		800V DC	16	2	20	2,5	21	3
		1000V DC	9	1	11	1,5	13	2
		1200V DC	6	-	8	-	10	-
		1500V DC	3	-	4	-	5	-
	4 poles in series A4	500V DC	16	16	25	25	32	32
		600V DC	16	16	25	25	32	27,5
		800V DC	16	11,5	25	12	32	12,5
		1000V DC	16	8	25	9	32	10
		1200V DC	16	-	25	-	32	-
		1500V DC	16	-	20	-	23	-
	4 poles in series + 2 poles parallel A4+2	500V DC	-	-	-	-	58	-
		600V DC	-	-	-	-	58	-
		800V DC	-	-	-	-	58	-
		1000V DC	-	-	-	-	58	-
		1200V DC	-	-	-	-	50	-
		1500V DC	-	-	-	-	23	-
Rated conditional short-circuit current		kAeff	5					
Max. fuse size gG (gG)		A	40		63		80	
Mechanical life		x10 ³	10					
Rated short-time withstand current (1s) I _{cw}	A2, A4, A6, A8	A	800		900		1000	
	A2+2, A3+2, A4+2	A	1300		1500		1700	
Short circuit making capacity I _{cm}	A2, A4, A6, A8	A	800		900		1000	
	A2+2, A3+2, A4+2	A	1300		1500		1700	
Maximum cable cross sections including jumper LSV-B1	solid or stranded	mm ²	4 - 16					
	flexible	mm ²	4 - 10					
	flexible (+ multicore cable end)	mm ²	4 - 10					
	Size of terminal screw		M4 Pz2					
Maximum cable cross sections 2 cables per clamp without jumper LSV-B1 / LSV-B2	solid or stranded	mm ²	16+(1,5-2,5) / 10+(1,5-6) / 6+(1,5-10) / 4+(1,5-10)					
	flexible & flexible + multicore cable end	mm ²	16+(1,5-2,5) / 10+(1,5-4) / 6+(1,5-6)					
	stranded	AWG	8+(16-12) / 10+(16-10) / 12+(16-8) 14+(16-8)					
	solid	AWG	10+(16-12) / 12+(16-10) 14+(16-10)					
Maximum ambient temperature	Operation	open	°C -40 ... +65					
		closed	°C -40 ... +45					
	Storage		°C -50 ... +90					
Power loss per switch at I _e max	A2	(A)/W	(16) / 1		(25) / 2,3		(32) / 3,7	
	A4	(A)/W	(16) / 2		(25) / 4,6		(32) / 7,4	
	A6	(A)/W	(16) / 3		(25) / 6,9		(32) / 11,1	
	A8	(A)/W	(16) / 4		(25) / 9,2		(32) / 14,8	
	A2+2	(A)/W	(29) / 1,5		(45) / 3,7		(58) / 6	
	A3+2	(A)/W	(29) / 2,3		(45) / 5,6		(58) / 9	
	A4+2	(A)/W	(29) / 3		(45) / 7,4		(58) / 12	
Contact resistance per pole		mΩ	1,75					

Because of very high breaking point capacity, switch disconnectors "LS..." are suitable for many different operating conditions.

General characteristics

Rated voltage	≤ 1500V d.c.
Rated current	≤ 58A
Standards	IEC 60364-7-712
Application	For interrupting the DC/AC inverter from the solar panels



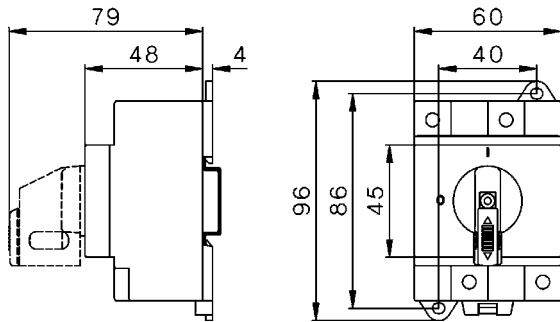
PV switch disconnector for photovoltaic systems

Code	Type	g	Box
004660060	LS16 SMA A2		
004660061	LS25 SMA A2	2-pole	
004660062	LS32 SMA A2		
004660063	LS16 SMA A4	150	1
004660064	LS25 SMA A4	4-pole	
004660065	LS32 SMA A4		
004660066	LS32 SMA A4+2	4+2 pole	430
004660067*	LSV-B1	-	6,6

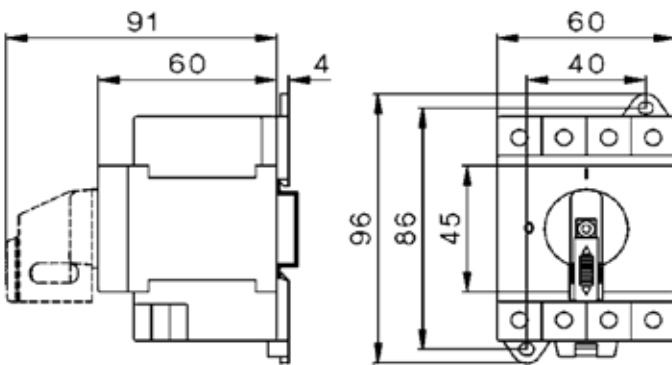
Switch disconnectors "LS.." are switch gears for interrupting DC/AC-inverter from the solar-panels. Photovoltaic-installations have to be equipped with DC-isolators according to IEC 60364-7-712.

*Insulated Jumper

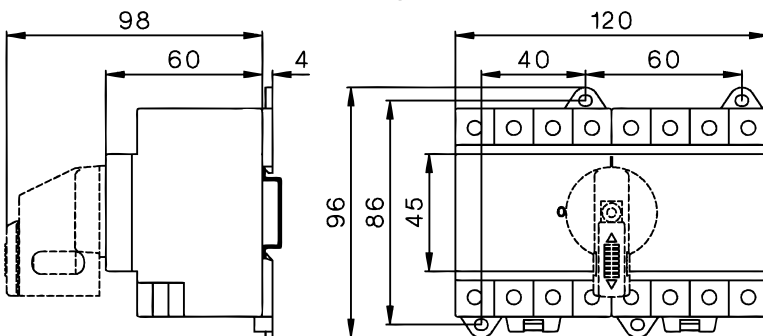
LS32 SMA A4+2 has already installed jumpers for series and parallel connection.



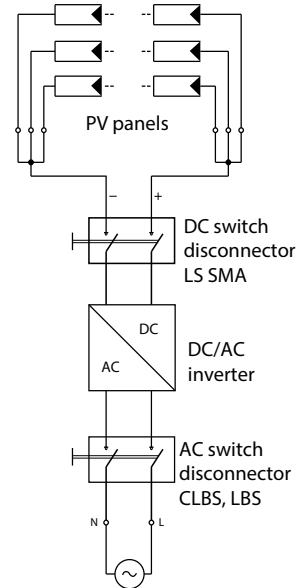
LS16, 25, 32 2p



LS16, 25, 32 4p



LS32 A4+2



PV switch disconnecter LBS DC

LBS DC are manually operated multipolar load break switches with making and breaking capacity under load conditions up to 1000 VDC. These extremely durable switches have been tested and approved for use in the most demanding applications. They are designed and tested for all types of applications: earthing, floating, and bipolar.

- // Thanks to a reduced number of bridging bars, you can limit your costs and save mounting time
 - // A 2 pole switch has reduced warming and can be placed in a smaller enclosure
 - // tested to critical currents and at 10kA short circuit during 50 ms without specific protection
- High quality materials glass fibre reinforced polyester frame provide:
- // high mechanical strength,
 - // stability to temperature variations (RTI of 130°C)
 - // high dielectric strength (high CTI / tested as per standard ASTM D 2303)

// Mounting system provides better cooling



// Handle position indicates true position of switch.



// Perforated protection covers enable measuring the contacts' temperature without removing covers.



// → Indicator provides contacts position.



// Possible to lock handle with 3 locks.



// Package includes connection screws.





// Indicator provides contacts position.



General characteristics

Rated voltage	1000 VDC (500 VDC/pole) IEC 60947-3
Rated current	≤ 250A
Standards	IEC 60947-3, IEC 60364-7-712
Application	For interrupting DC circuits (PV, battery storage systems, etc.)

1 PV circuit 1000 V DC

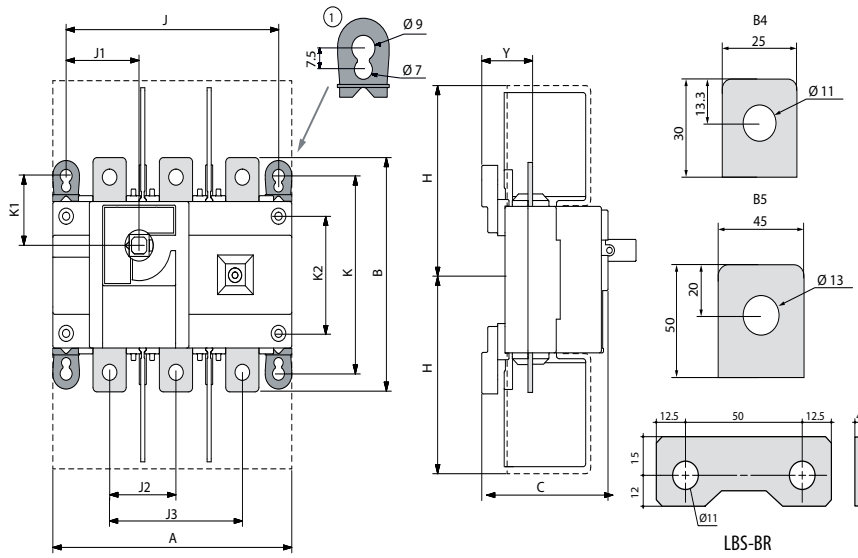
Type	Code No.	Nr. Of poles	Description	Current [A] / pole		
LBS 100 2P DC1000	004661853	2		100	1850	1
LBS 160 2P DC1000	004661854	2	500 V DC / pole	160	1870	1
LBS 250 2P DC1000	004661855	2		250	1850	1

Connect poles in series for 1000 VDC, or in parallel for higher nominal current (2x at 2 pole and 4x at 4 pole)



Technical data (according to IEC 60947-3):

Type	LBS 100 DC				LBS 160 DC				LBS 250 DC					
Rated current I_n	100 A				160 A				250 A					
Thermal current at 40 °C	100 A				160 A				250 A					
Thermal current at 50 °C	100 A				160 A				250 A					
Thermal current at 60 °C	100 A				160 A				250 A					
Rated insulation voltage U_n	1000 V DC				1000 V DC				1000 V DC					
Rated impulse withstand voltage U_{imp}	12kV				12kV				12kV					
Number of circuits	Rated insulation voltage	Util. category	I_e [A]	Number of poles in series per circuit	Number of poles of the device	Frame size	I_e [A]	Number of poles in series per circuit	Number of poles of the device	Frame size	I_e [A]	Number of poles in series per circuit	Number of poles of the device	Frame size
1	1000V DC	DC-21B	100	1P+ ; 1P-	2	B4	160	1P+ ; 1P-	2	B4	250	1P+ ; 1P-	2	B4
Rated short-term withstand current 0,3s (rms)			10 kA				10 kA				10 kA			
Rated short-term withstand current 1s (rms)			5 kA				5 kA				5 kA			
Rated short-circuit making capacity I_{cm} (50ms)			10 kA				10 kA				10 kA			
Connection														
Nominal Cu cable section			35 mm ²				70 mm ²				120 mm ²			
Nominal Cu busbar width			32 mm				32 mm				32 mm			
Max Cu rigid cable cross-section			35 mm ²				70 mm ²				120 mm ²			
Max Cu busbar width			32 mm				32 mm				32 mm			
Tightening torque min			20 Nm				20 Nm				20 Nm			
Tightening torque max			26 Nm				26 Nm				26 Nm			
Durability (number of operating cycles)							10.000							
Operating effort							10 Nm							
Weight of a 2 pole device							1,8 kg							
Power dissipation per poles of the PV switch (W/P) @ 40°C			0,8				2				4,7			

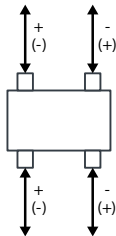


Frame size	Nr. Of poles	Dimensions (mm)											
		A	B	C	H	J	J1	J2	J3	K	K1	K2	Y
B4	2	180	160	95	132,5	160	55	-	100	135	48	80	38,5

Pole connections in series LBS DC

1000 V DC (1 PV circuit)

Frame size B4, 2P



LBS AC1000 load break switches (IEC 69047-3)

For heavy duty applications up to 1000 VAC - AC 22

Advantages

Improved performance

The rapid opening and closing, combined with the arcing chambers, ensure improved breaking performance.

Harsh service categories AC-22 under 1000 VAC.

Robustness

Double breaking per pole (proven sliding system) offering durability and high short-circuit current withstand.

Made of glass fiber reinforced polyester for maximum thermal and mechanical resistance.

Safe operation

The position indicator is directly on the bar housing the moveable contacts, ensuring it can be seen in all circumstances.

Ease of installation

Connection facilitated by the design of the external terminals:

good centre-to-centre distance (up to 65 mm),

copper connection up to 240 mm²,

large range of accessories to facilitate integration and operation.

Applications

LBS AC1000 load break switches can be used in applications with non standard voltage levels. There are many PV inverters today on the market with higher output voltages (up to 800V AC).

Can be also used in applications with harsh operating conditions such as paper mills or the metallurgy, chemical, petrochemical or mining industries.

LBS AC is designed for all heavy duty applications up to 1000 VAC - AC 22. It offers a total adaptability to any environment thanks to a wide variety of accessories.

Technical data (according to IEC 60947-3):

Type	LBS 200 3P AC1000	LBS 400 3P AC1000
Conventional free air thermal current I_m at 35 °C	200 A	400 A
Rated insulation voltage U_i	1250 V	1200 V
Rated impulse withstand voltage U_{imp}		12 kV
Rated operational voltage U_e		1000 V
Utilisation category		AC-22B
Rated operational current I_c	200 A	400 A
Rated frequency		50 / 60 Hz
Rated short-time withstand current I_{sw} 1s		8 kA
Rated short-circuit making capacity I_m		13,6 kA peak





LBS 200 3P AC1000

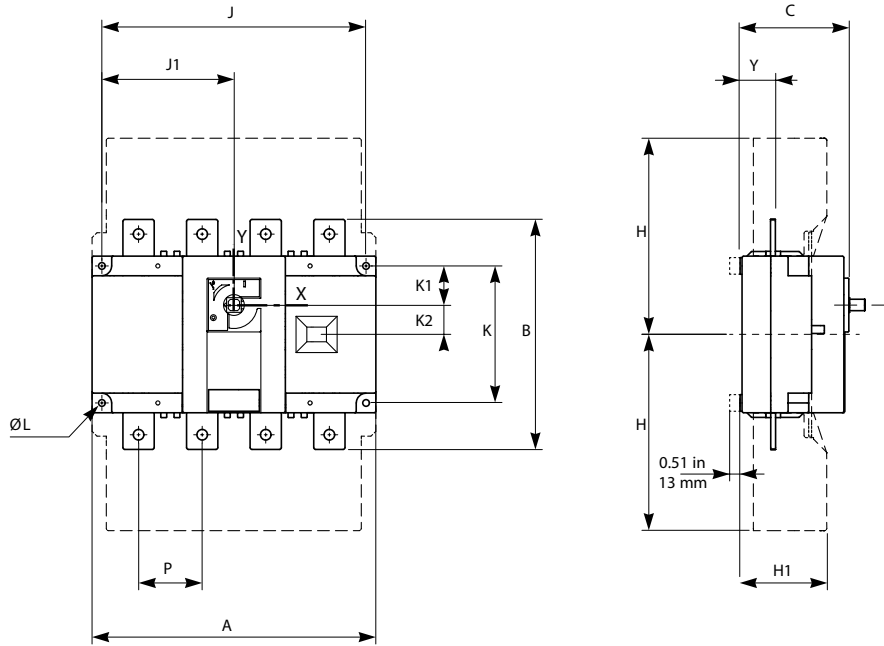


LBS 400 3P AC1000

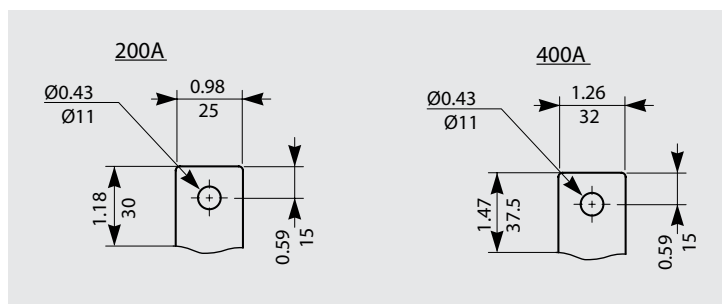
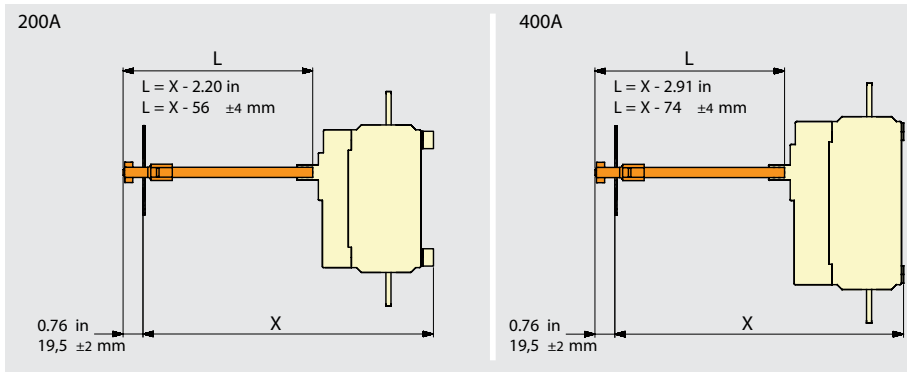
LBS AC1000 load break switches (IEC 69047-3)

Type	Code No.	Nr. Of poles	I_e [A]	 g	
LBS 200 3P AC1000	004661923	3	275	1850	1/1
LBS 400 3P AC1000	004661924	3	400	4550	1/1

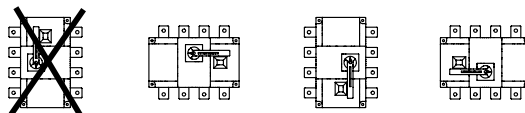
GREEN PROTECT / PV Switch Disconnectors



Type	Dimensions (mm)												
	A	B	C	H	H1	J	J1	K	K1	K2	ØL	P	Y
LBS 200 3P AC1000	180	160	78,5	145	56	160	55	80	20	20	5,5	50	22
LBS 400 3P AC1000	230	235	111	201	85,5	210	75	140	40	30	7	65	36



Mounting orientation



Accessories for LBS DC and LBS AC1000 switches

Direct handle for direct operation LBS

Type	Code No.	Description	For use with		
LBS-DH630/B	004661481	Direct handle black	LBS100-500DC (1000V, 1500V), LBS 200 3P	100	1/25
LBS-DH630/R	004661861	Direct handle red	AC1000, LBS 400 3P AC1000	100	1/80



Door interlocked handle IP65

Type	Code No.	Description	For use with		
LBS-EH630/G ... 400/G FLBS	004661483	Door handle Black	LBS100-500DC (1000V, 1500V), LBS 200 3P	250	1/20
LBS-EH630/YR	004661486	Door handle Red	AC1000, LBS 400 3P AC1000	250	1/20



*shaft not included

Shaft for door interlocked handle

Type	Code No.	Description	For use with		
LBS-S200/630 (CO) .../400 FLBS	004661490	Shaft 200mm	LBS100-500DC (1000V, 1500V), LBS 200 3P	160	1/25
LBS-S320/630 (CO) .../400 FLBS	004661493	Shaft 320mm	AC1000, LBS 400 3P AC1000	250	1/50
LBS-S500/630 (CO) .../400 FLBS	004661496	Shaft 500mm		390	1/10



Terminal screen

Type	Code No.	Description	For use with		
LBS-TS250 2P DC	004661862	Terminal screen, 2P	LBS ... 2P	40	1/30
LBS-TS500 4P DC	004661863	Terminal screen, 4P	LBS ... 4P	50	1/20
LBS-TS500 3P DC	004661865	Terminal screen, 3P	LBS ... 3P	60	1/100

1 reference includes 1pc for top or bottom contacts, to protect all, 2 references shall be ordered



Terminal shrouds

Type	Code No.	Description	For use with		
LBS-TS250 3P (CO)	004661501	Terminal shrouds, 3P	LBS 200 3P AC1000	121	1/10
LBS-TS630 3P (CO)	004661502		LBS 400 3P AC1000	242	1/5

One reference includes 3 pcs (3pole) for top or bottom contacts, to protect all 2 references shall be ordered



Bridging bars

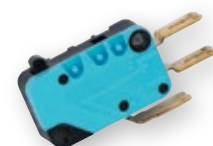
Type	Code No.	Description	For use with		
LBS-BR500 1P DC	004661864	Bridging bars, 1pole	LBS ... DC 1000	60	1/100
LBS-BR400 1P DC	004661866		LBS ... DC 1500	210	1/50

1 reference includes connection for 1 pole

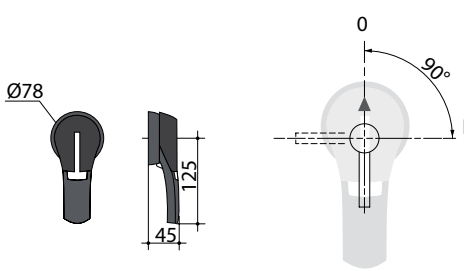


Auxiliary contact

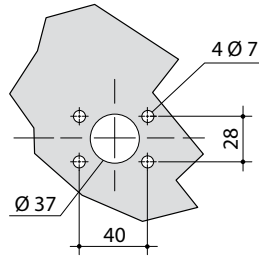
Type	Code No.	Description	For use with		
LBS-PS11	004661499	Auxiliary contact (CO)	LBS ... DC1000, DC1500, LBS 200 3P AC1000, LBS 400 3P AC1000	26	1/30



Handle type LBS-EH630

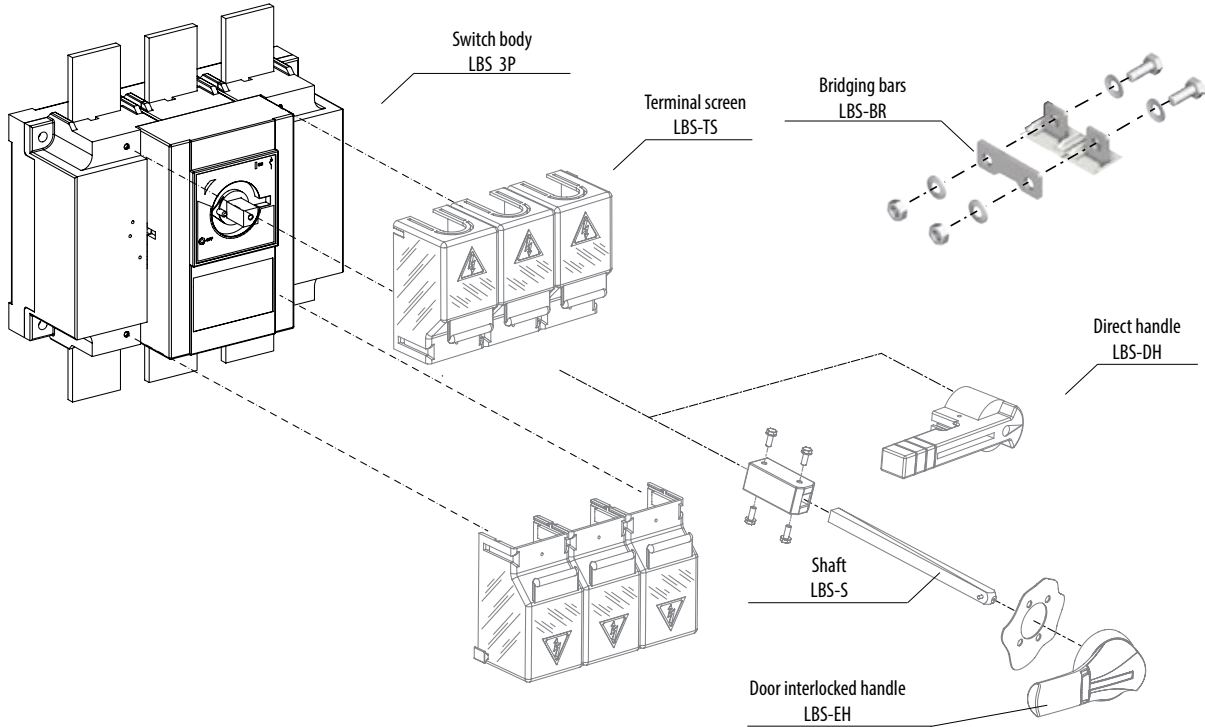
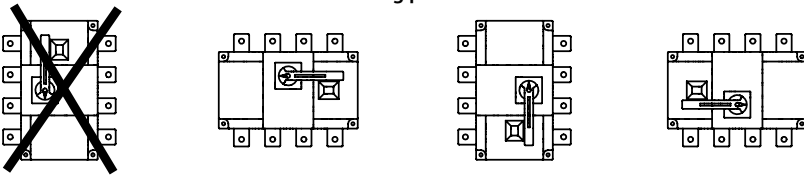


Door drilling



Direct front operation

Mounting position LBS DC



IP65 Wall mounted distribution boards ECH

Available in 4, 6, 8, 12, 18, 24, 36,48 modules

Applications:

Watertight wall-mounted distribution boards apply in domestic and industry architecture for mounting modular equipment for protection (IP65) against wet, dust and other dirt.

Structure:


Enclosure is made of high thermal stability material - ASA (Acrylonitrile-Acrylic-Styrene), plastic with good dielectrical and mechanical attributes, UV resistant (colour stability)

Advantages: Aesthetic and attractive look, easy and quick montage

Main elements:

- // Bottom cover with DIN rail, PE and N bars and holes for PG cable inlets properly marked
- // Top cover with seal of the door
- // Transparent door made of polycarbonate (PC) with plastic lock (in standard) or metal lock with key (optional)

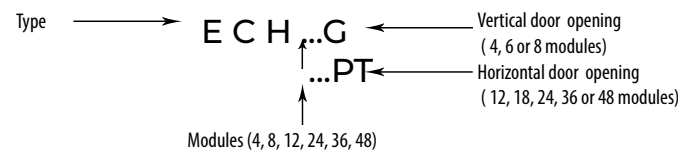
Technical data

Protection class	IP65
Isolation class	II □
Impact kit	IK08
Nominal voltage	400V AC / 1500 V DC
Rated current	63A
Temperature range	-25 °C do +60 °C
IEC compatibility	IEC 62208, IEC 60670-24 



Type	Code number	Description	Number of terminals at PE/N	Dimensions [H x W x D] [mm]	Power dissipation [W]		
ECH-4G	001101060	Wall mounted enclosure, IP-65 transparent door	4/4	201x128x120	10	0,46	1/5
ECH-6G	001101176		6/6	201x165x120	10	0,46	1/5
ECH-8G	001101061		8/8	201x202x120	13	0,68	1/5
ECH-12PT	001101062		10/10	259x319x144	16	1,24	1/5
ECH-18PT	001100350		18/18	259x428x144	20	1,7	1/5
ECH-24PT	001101063		15/15	384x319x144	24	1,7	1/5
ECH-36PT	001101064		15/15	535x319x144	26	2,31	1/5
ECH-48PT	001100304		20/20	664x319x144	28	3,22	1/5
Accessories							
ECH-L2K	001100204	Lock with key for ECH	-	-	0,017	1	

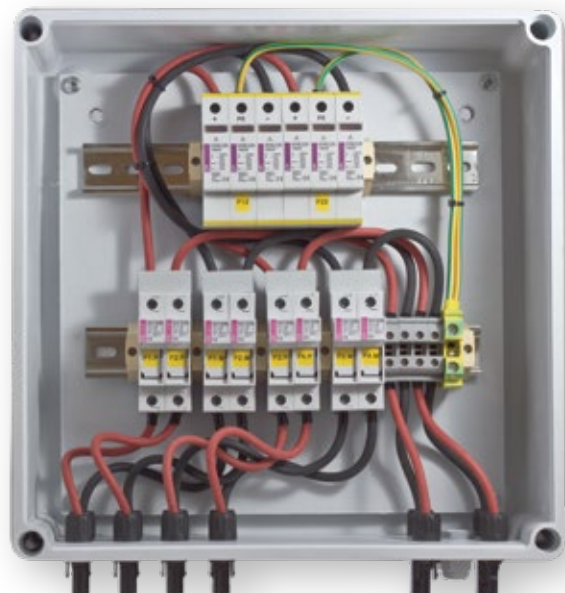
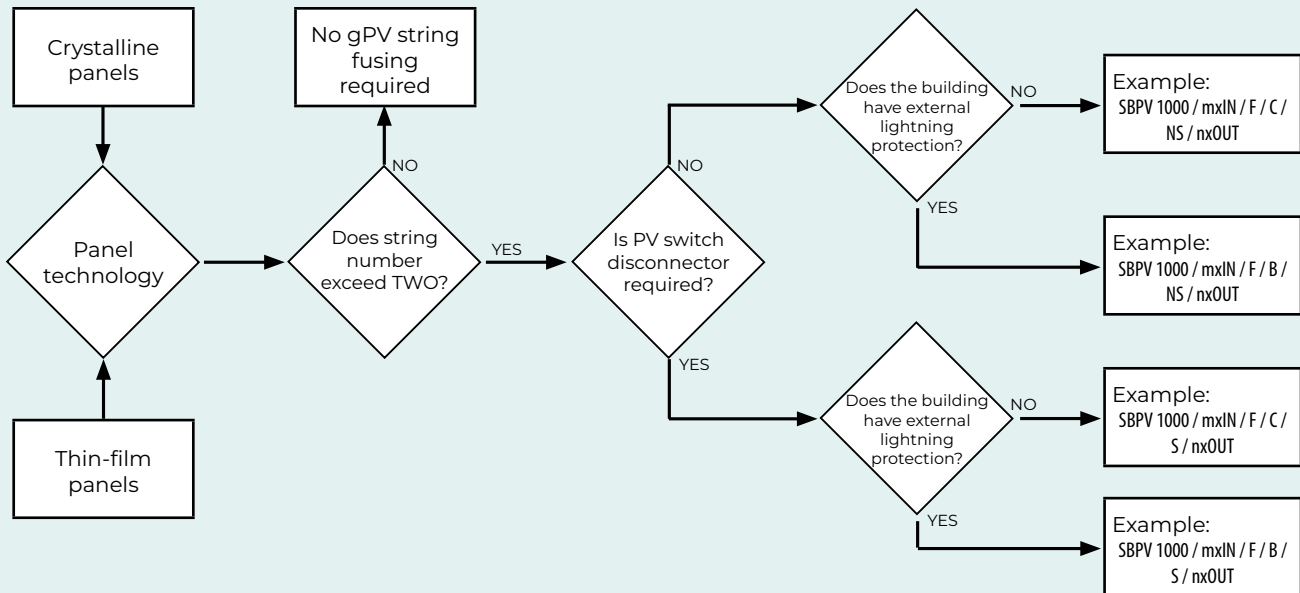
Enclosure designation



Ready made DC-junction boxes

For more technical, ordering and other information, please see our catalogue [Solutions](#)

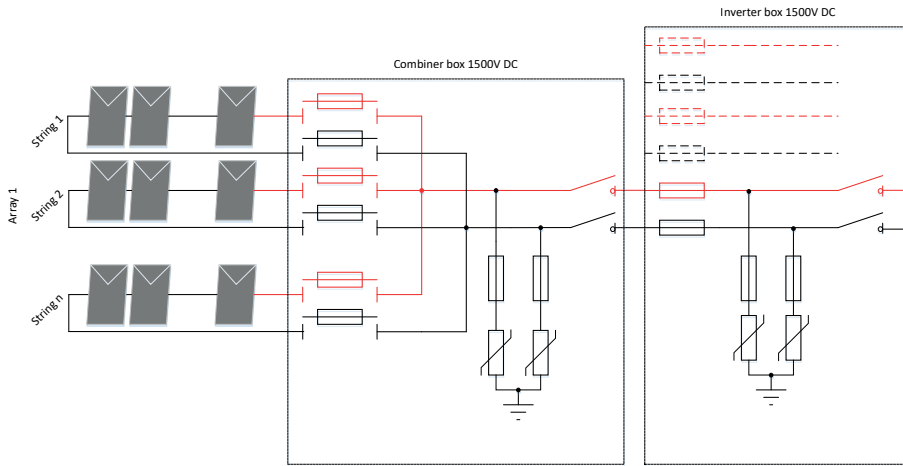
How to choose correct protection for PV junction boxes



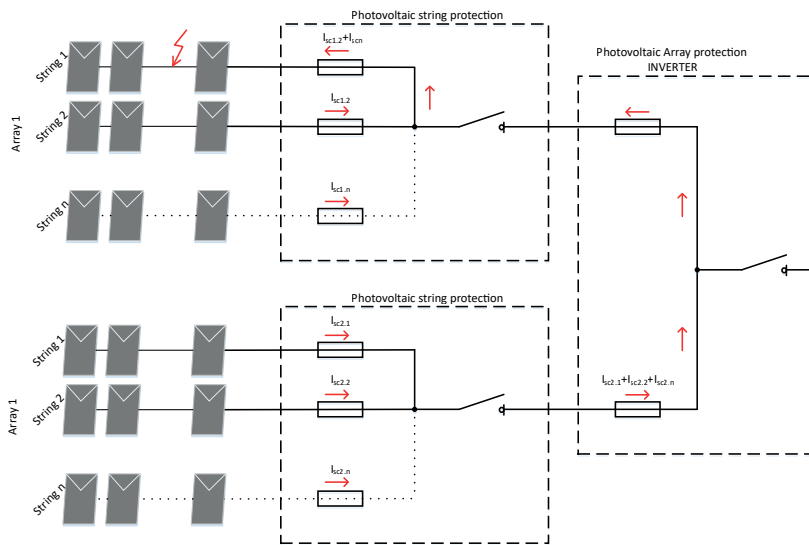
Design recommendations

Central inverter - PV system

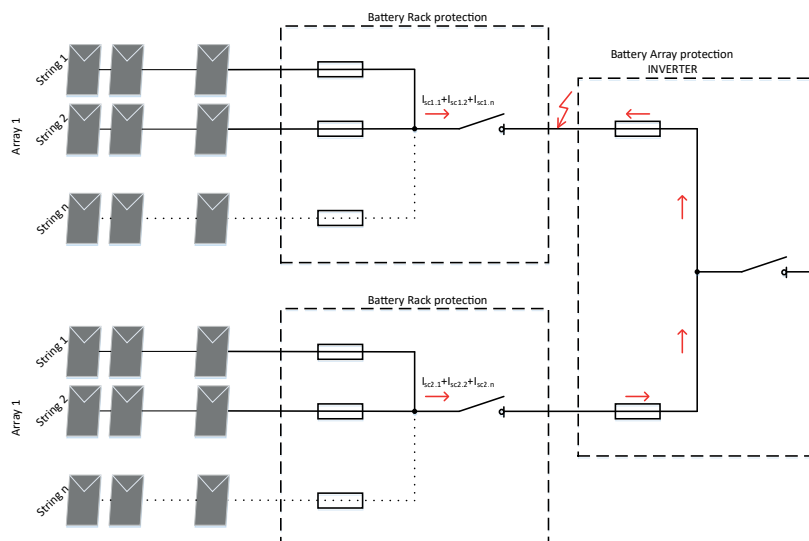
Photovoltaic modules are protected against reverse currents with cylindrical gPV fuse-links inserted in cylindrical fuse holders. Photovoltaic arrays are then connected to the central inverters protected with NH gPV fuse-links inserted in NH fuse bases or direct mounted on the busbar system. On the combiner and the inverter level, SPDs and switch disconnectors are used.



Basic scheme of central inverter PV system



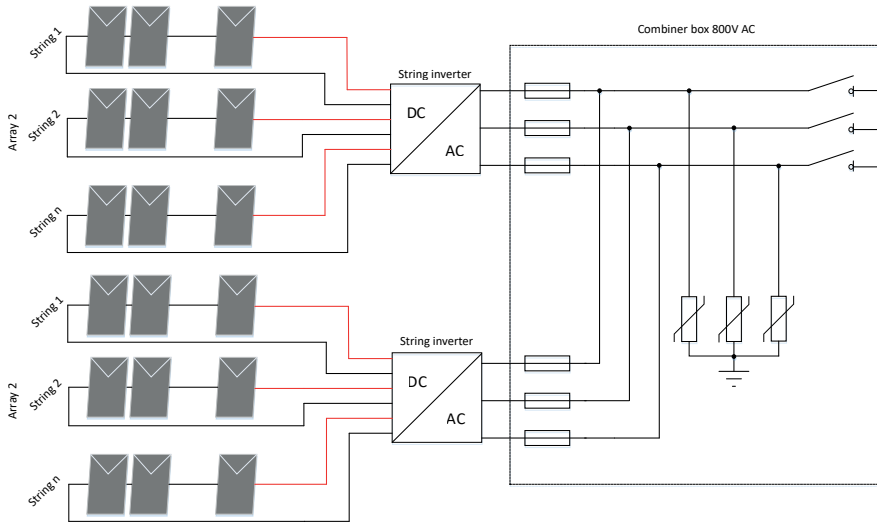
Protection of reverse current by CH gPV fuse-link



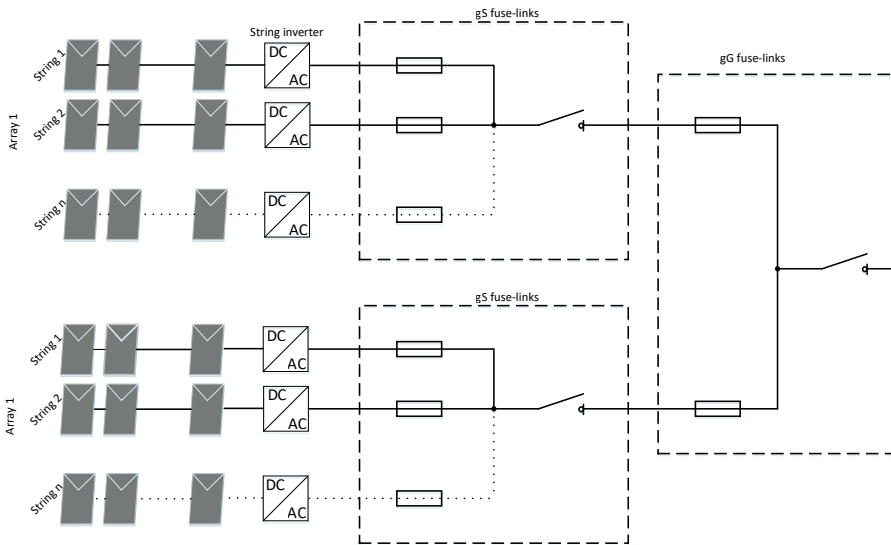
Protection of PV array by NH gPV fuse-link

String inverter - PV system

Photovoltaic modules are connected to string inverter. On a.c. side of string inverter there are gG or gS NH fuse-links inserted in NH fuse bases or disconnectors. On the combiner level, SPDs and switch disconnectors are used.



Basic scheme of string inverter PV system



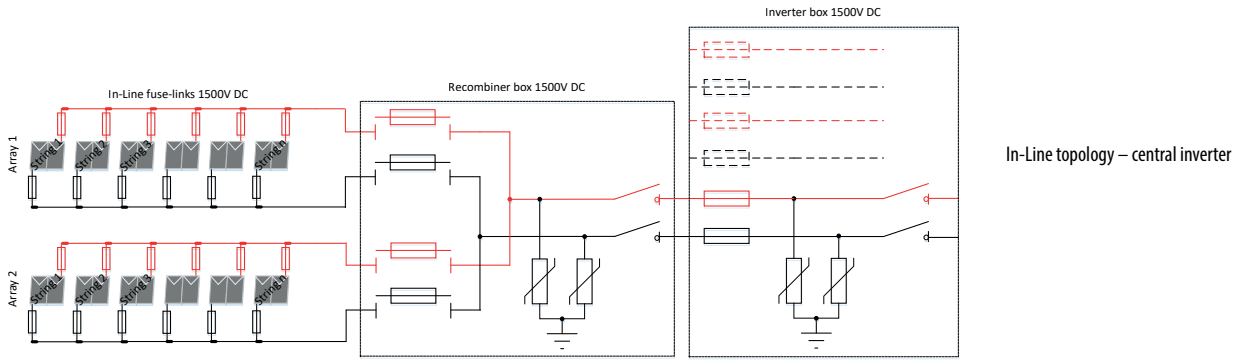
Protection on combiner level with gS and recombiner level with gG characteristic fuse-links

In-Line PV system

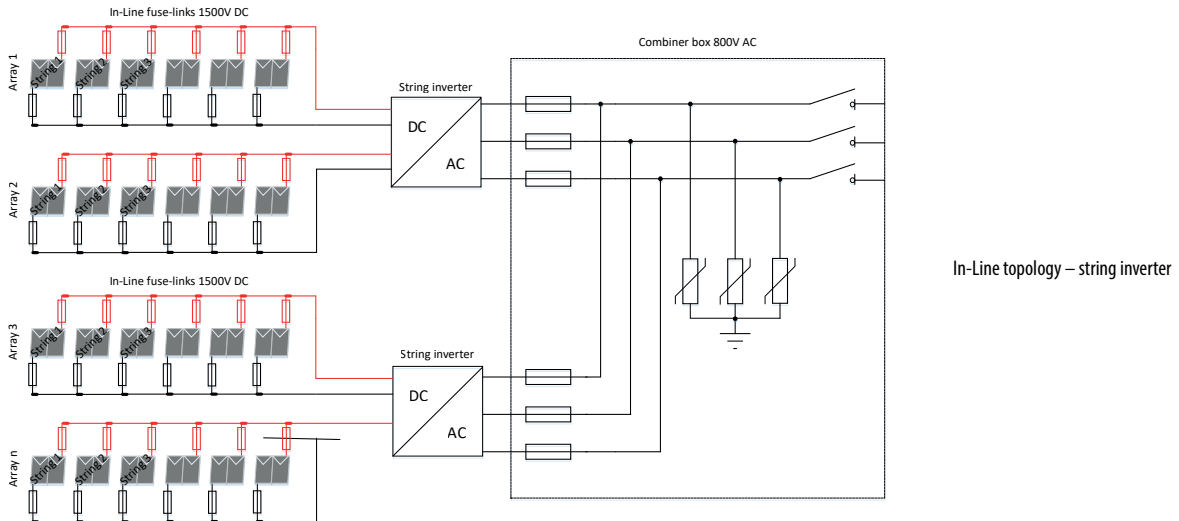
In-Line PV systems could be used in central or string inverter systems.

Photovoltaic modules are protected against reverse currents with cylindrical In-Line gPV fuse-links.

Photovoltaic strings are on array level combined in recombiner boxes protected with cylindrical gPV fuse-links inserted in cylindrical fuse holders. Recombiner boxes are then connected to the central inverters protected with NH gPV fuse-links inserted in NH fuse bases or direct mounted on the busbar system. On the recombiner and the inverter level, SPDs and switch disconnectors are used.

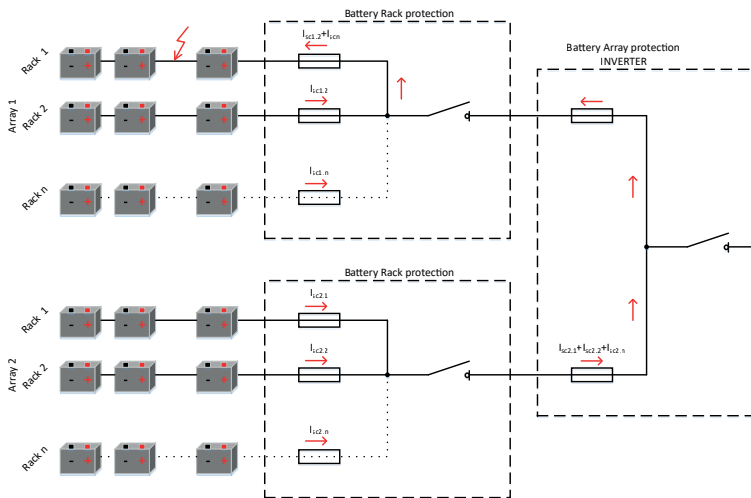
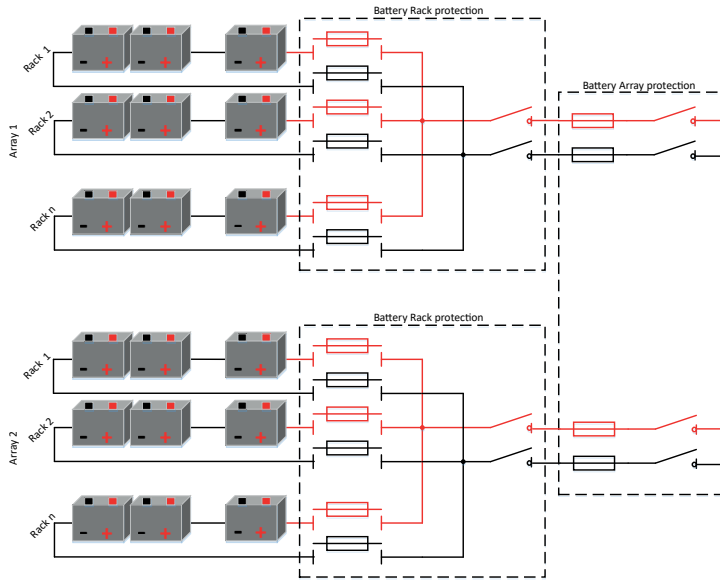


Photovoltaic strings are on array level combined in the wire harness. Wire harnesses are then connected to the string inverters. On a.c. side of string inverter there are gG or gS NH fuse-links inserted in NH fuse bases or disconnectors. On the combiner level, SPDs and switch disconnectors are used.

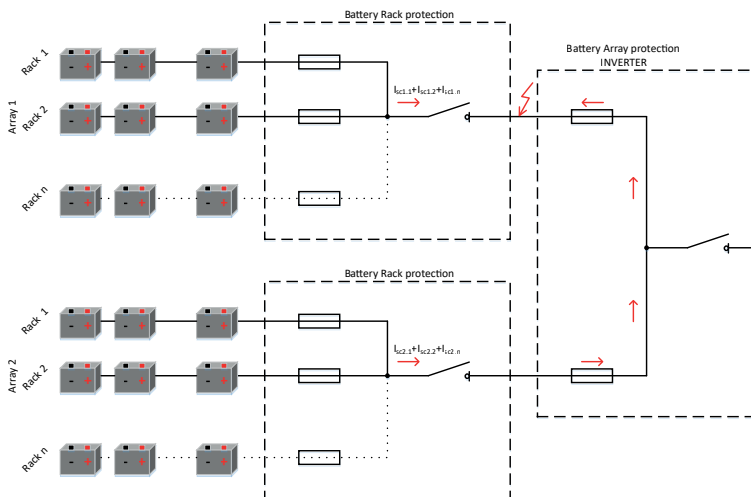


Battery system

Battery modules are in series connected in battery racks. Battery racks are protected with battery fuse-links in d.c. combiner boxes. D.c. combiner boxes are then connected to the battery inverter protected with NH fuse-links inserted in NH fuse bases.

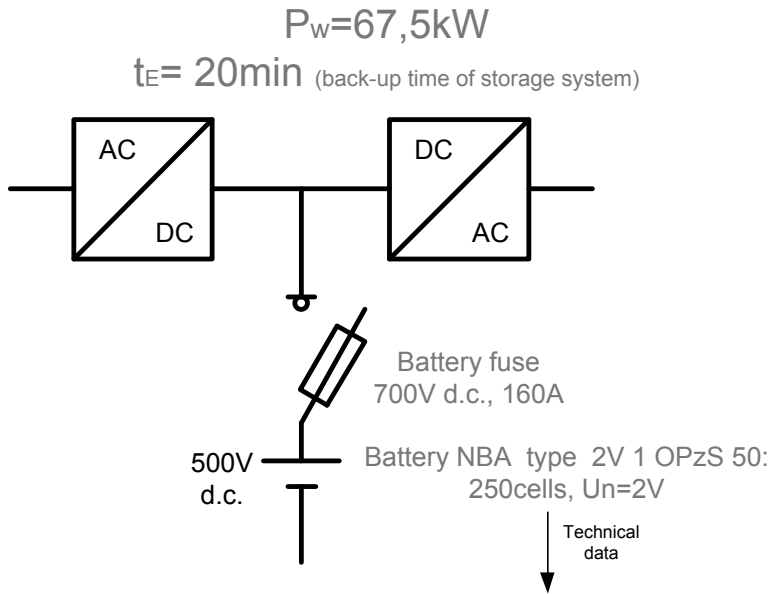


Protection of battery racks



Protection of battery array

How to choose the correct Battery fuse - example



1. Short circuit point (I_k):

2. Types, capacities, dimensions, mass

Type	C10	C5	C3	C1	Ri 1)	I_k 2)	length	width	height max	mass 3)	mass 4)
	Ah	Ah	Ah	Ah	mΩ	kA	mm	mm	mm	kg	kg
U_e (V/cell)	1,80	1,77	1,75	1,67							
2V 1 OPzS 50	50	45	36	24	3,96	0,58	103	206	426	4,5	7
2V 2 OPzS 100	100	85	66	48	1,98	1,16	103	206	426	7,5	6,5
2V 3 OPzS 150	150	125	102	72	1,27	1,74	103	206	426	10	6
2V 4 OPzS 200	200	170	138	96	0,81	2,06	103	206	426	12	6
2V 5 OPzS 250	250	210	171	120	0,81	2,57	124	206	426	14	7,5
2V 6 OPzS 300	300	250	204	144	0,69	3,14	145	206	426	16	9
6V 3 OPzS 150	150	125	107	75	3,71	0,62	233	224	426	23,5	13,5

1, 2) internal resistance and short - circuit - current according to IEC 886-1 3) dry-charged 4) filled and charged



$I_k = 580A$

2. Operating point (t_E/I_B):

$t_E = 20 \text{ min}$ (1200s)

$U_E = 250 \text{ cells} \times 1,8V = 450V \text{ d.c.}$

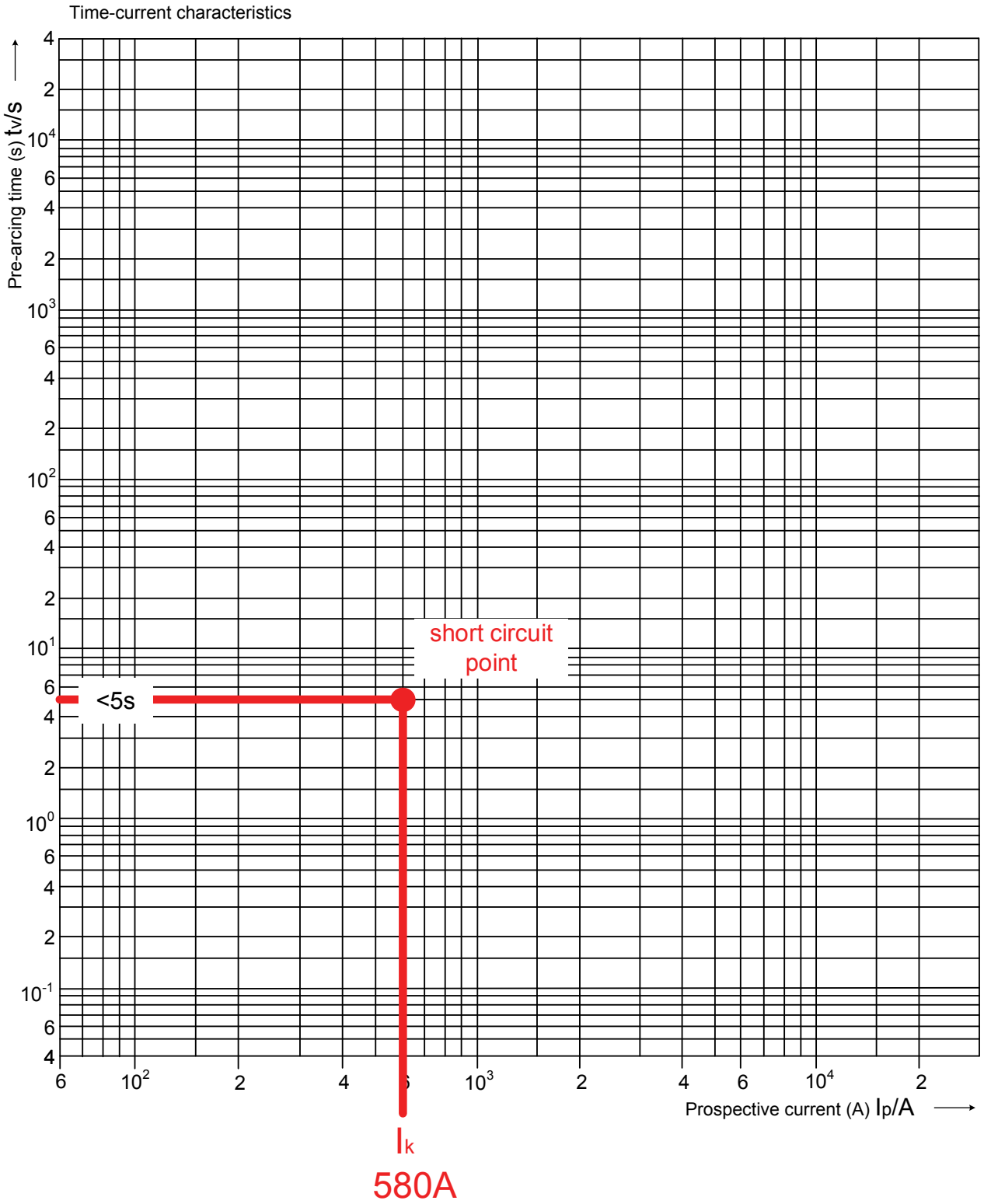
$I_B = P_w / U_E = 67,5 \text{ kW} / 450V = 150A$

3. DC rated fuse link:

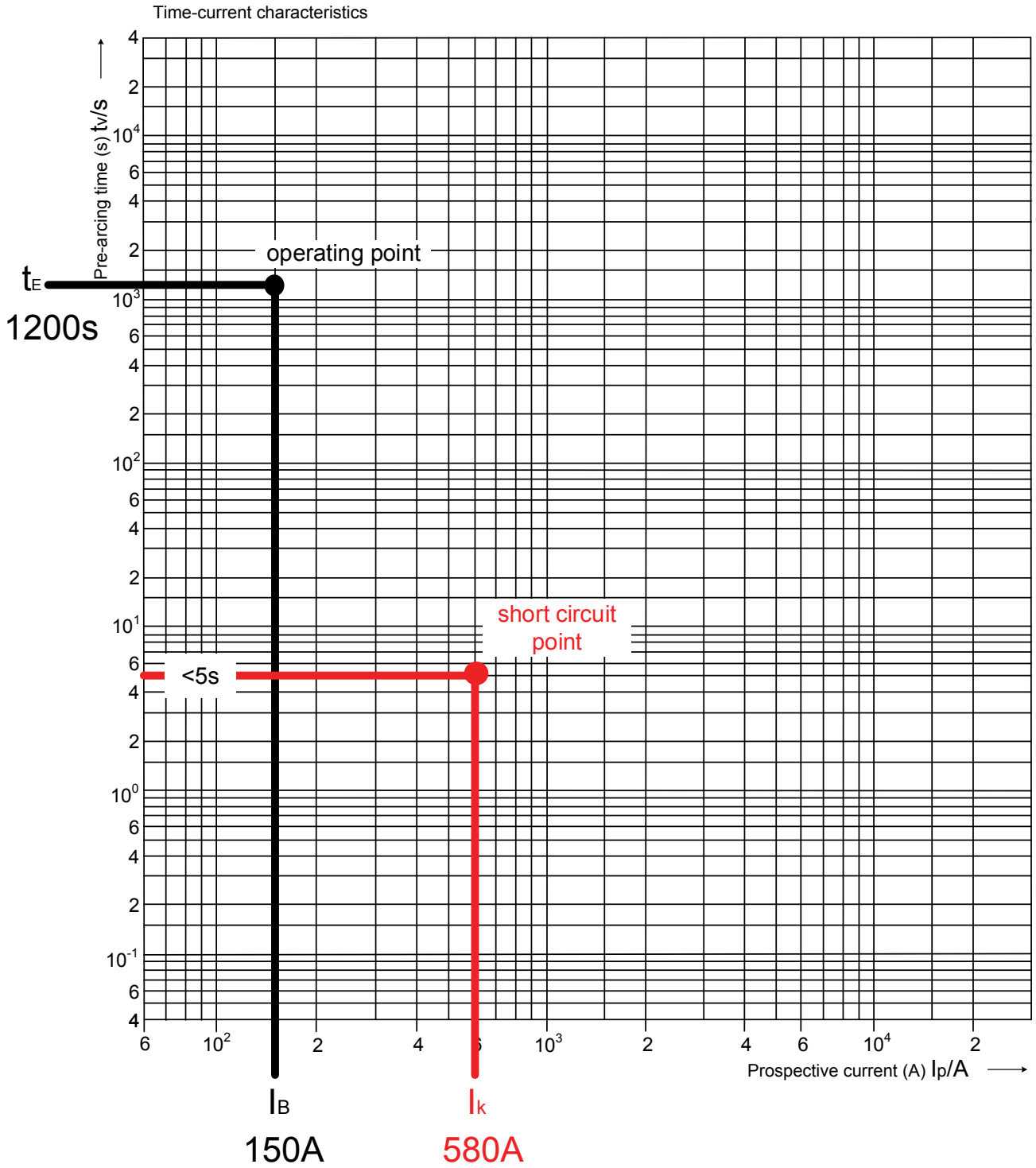
Battery fuse 700V d.c., $L/R = 10 \text{ ms}$

NH00 gG 160A 690V a.c. **problem DC rating at min. breaking capacity $\sim 2 \times I_n$???**

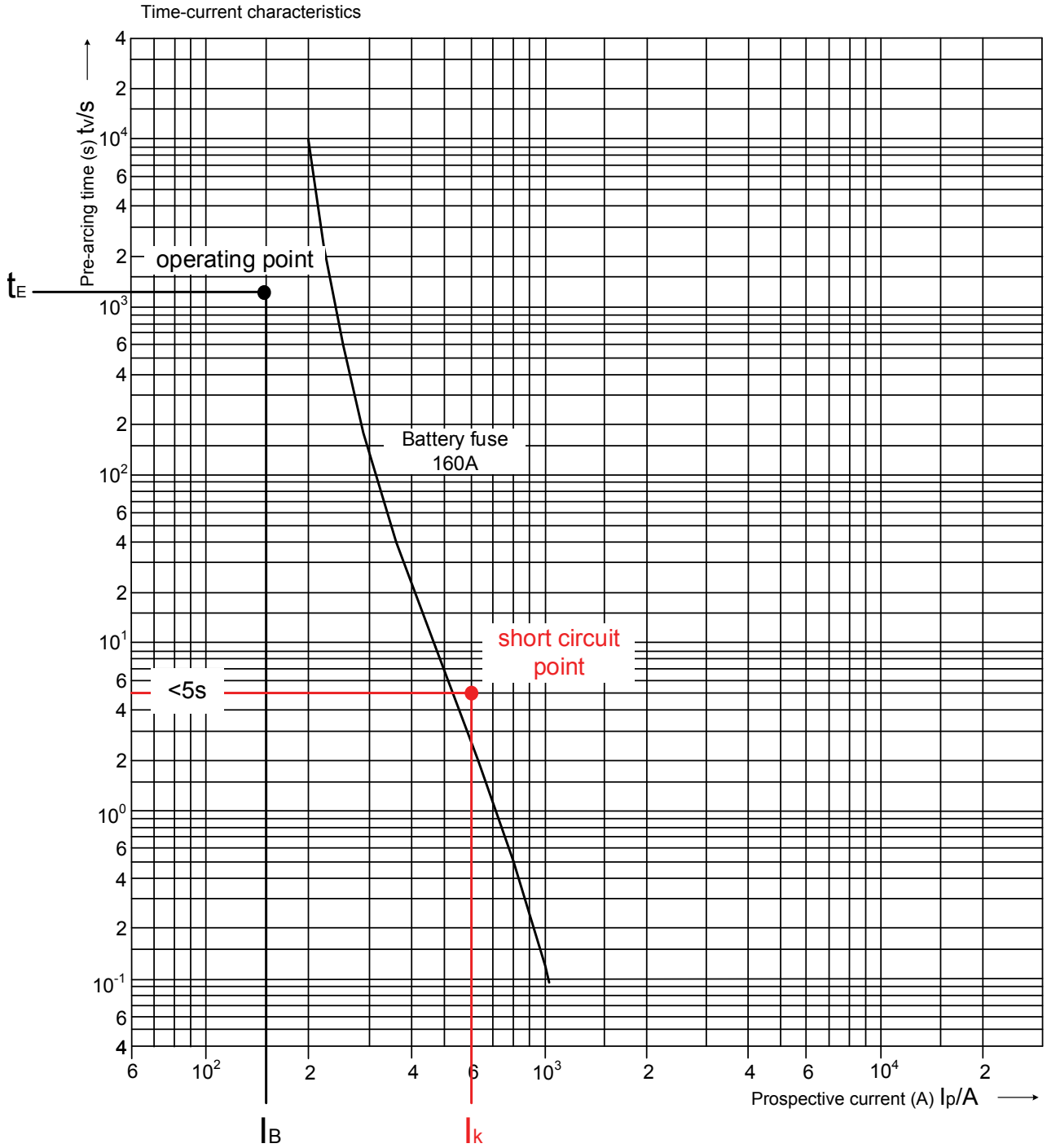
1. Short circuit point (I_k)

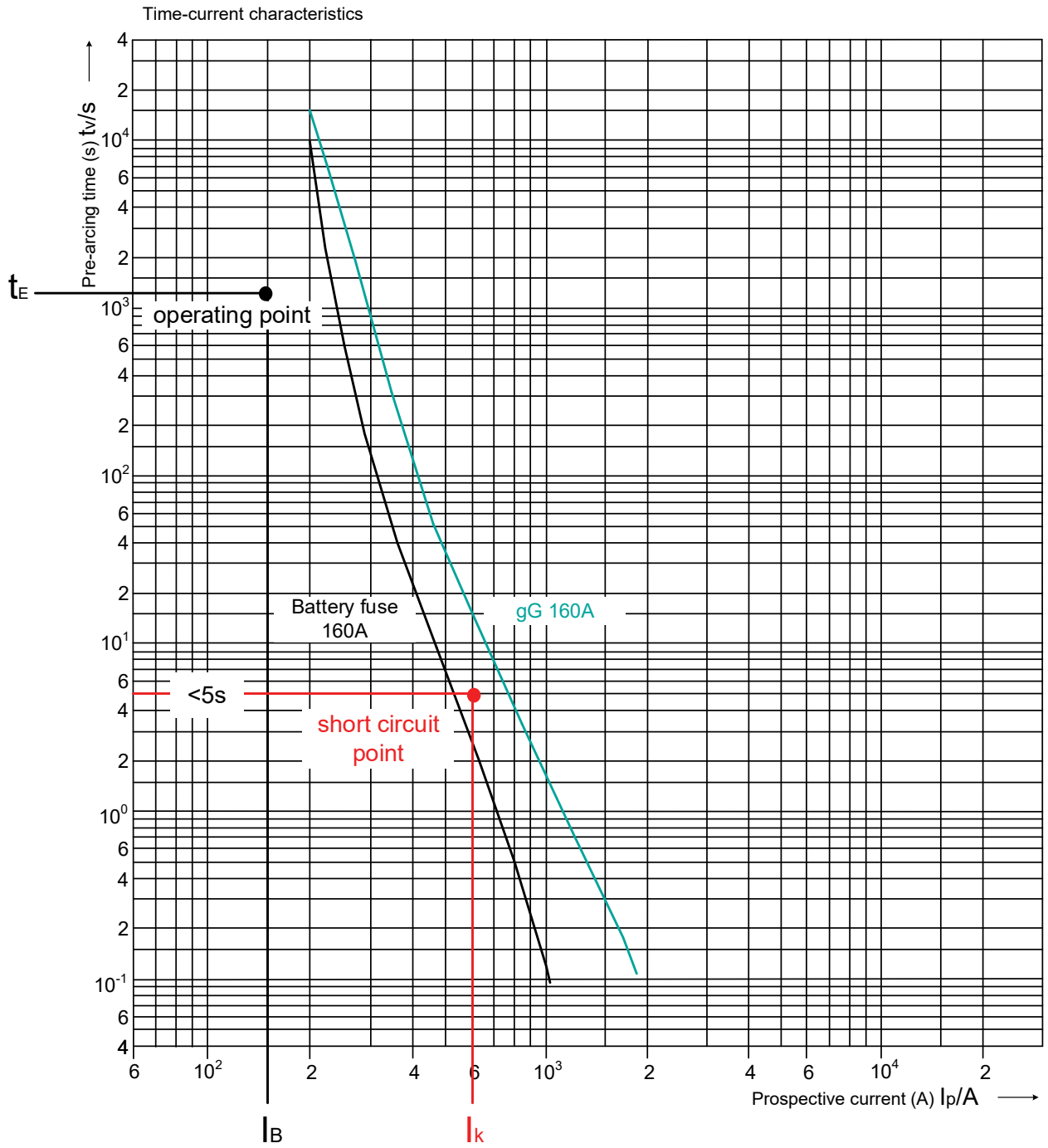


2. Operating point (t_E/I_B)



Battery fuse selection - I/t characteristic





Required operating time

<5s

Battery fuse 700V d.c.
160A
operating time

2,5s



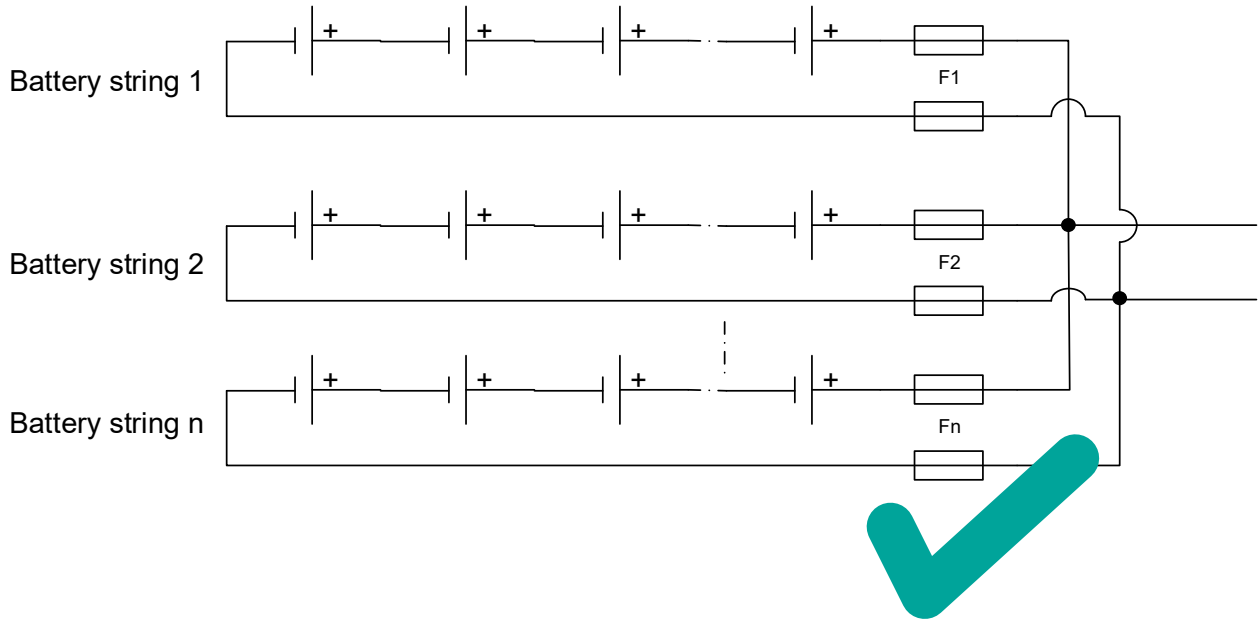
~~gG fuse 160A
operating time~~

~~15s~~

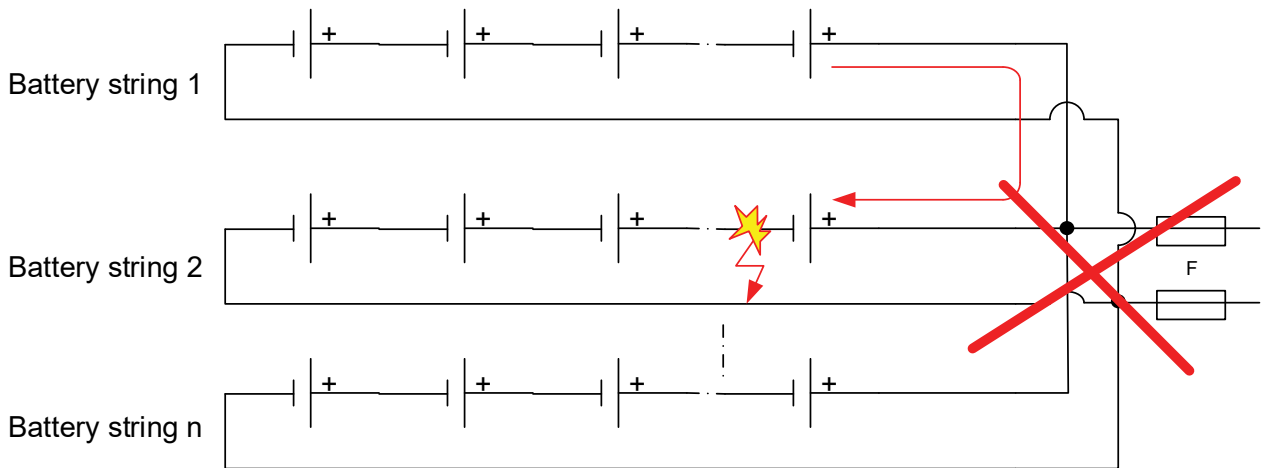
~~MCB 160A
operating time~~

~~~30s~~

Battery array



Battery array



For battery banks with parallel strings, a good practice is to include overcurrent protection for each battery string. This minimizes the potential of the bank backfeeding a single shorted battery, which can lead to fires and property damage.

Battery-string fusing is best accomplished with appropriately sized dc-rated fuses secured in bolt-in fuse holders that are housed in a single enclosure. This arrangement makes it easy to isolate one battery string for testing or maintenance while allowing the system to continue operation. Individual battery-string fuses can provide protection against catastrophic failure in the event of major fault in the main disconnect breaker panel or elsewhere in the battery bank. Series fuses on each battery string also reduce the available shortcircuit current levels, allowing for the use of lower ampere interrupting current rated circuit breakers for the inverter/ charger disconnects. Without the fuses, the amount of current that the circuit breaker has to interrupt during a fault could potentially exceed its rating.

## Ratings for Li-ion batteries

### Burst discharge (pulse) ratings for Li-ion batteries:

The first set of C ratings on a Li-ion tells us how fast the battery can be discharged.

30C / 60C  
 translates to  
 (maximum constant discharge rate) / (Burst discharge rate)

Bursts can last for less than 5 seconds. To determine the amp rate, you need to know the capacity of the battery pack. If the pack indicates that it has a capacity of 2.3Ah, take the number before 'Ah' and multiply it by 30 to find the number of amps. In this case, it would be 69A. This represents a rating of 30C for that pack.

Therefore, the burst rate would be 2.3 x 60 = 138A for up to 5 seconds.



**Specifications: Hypersonic 2300 6.6V**

|                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Product Summary:</b><br>2S1P cell configuration Li Ion<br>Deans Ultra output/charge connector Balancing connector (Balancing only with Sonic Charge™) | <b>Voltage:</b> 6.6V<br><b>Capacity:</b> 2300 mAh<br><b>Max C-rate cont.</b> 30C<br><b>Max C-rate pulse</b> 60C<br><b>Max Current cont.</b> 69A (limited by connector)<br><b>Max Current pulse</b> 138A<br><b>Max temperature*</b> 160F/71°C<br><b>Size (length x diam)</b> 135mm x 28mm<br><b>Weight:</b> 155g |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

### Product Specifications

|                                |                       |
|--------------------------------|-----------------------|
| Type:                          | Lithium Ion           |
| Capacity:                      | 2300 mAh              |
| Voltage:                       | 6.6V                  |
| Connector Type:                | Deans Ultra (WSD1300) |
| Number of Cells:               | 2                     |
| Weight:                        | 155g                  |
| Configuration:                 | 2S1P                  |
| Length:                        | 5.31 in (135mm)       |
| Width:                         | 1.10 in (28.0mm)      |
| Height:                        | 1.10 in (28.0mm)      |
| Maximum Continuous Discharge : | 30C                   |
| Maximum Burst Discharge :      | 60C                   |

### Examples of maximum discharge current for Lead-acid and Li-ion batteries:

|                                             |        |
|---------------------------------------------|--------|
| Internal Resistance (Fully Charged Battery) | <12m Ω |
| Maximum Discharge Current For 5 sec.(A)     | 180A   |

|                                   |           |
|-----------------------------------|-----------|
| Storage                           | -20~60°C  |
| Max. Discharge Current 77°F(25°C) | 1000A(5s) |
| Short Circuit Current             | 3300A     |

|                             |                    |
|-----------------------------|--------------------|
| Capacity                    | 200 Ah(200Ah)      |
| Weight                      | Approx. 5.9 Kg     |
| Max. Discharge Current      | 200 A (5 sec)      |
| Internal Resistance         | Approx. 12 m Ω     |
| Operating Temperature Range | Discharge: -20°C → |

|                                            |                                |                                |
|--------------------------------------------|--------------------------------|--------------------------------|
| Continuous discharge current               | 100 A                          | 100 A                          |
| Max discharge impulse current:<br>(10 min) | 200 A (temperature controlled) | 200 A (temperature controlled) |
| (5 sec.)                                   | >500 A                         | >500 A                         |
| (1 sec.)                                   | >1000 A                        | >1000 A                        |
| Continuous charge current                  | 100 A                          | 100 A                          |

|                       |                                                                                                                                                                       |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Max. Discharging Rate | <ul style="list-style-type: none"> <li>• 66A (30.0C), Maximum continuous discharge, Recommended</li> <li>• 132A (60.0C), Maximum Burst rate &lt; 5 seconds</li> </ul> |
| Dimensions (LxWxH)    | 116mm(4.6") x 38mm(1.5") x 40mm(1.6")                                                                                                                                 |
| Weight                | 10.8 Oz (300 g)                                                                                                                                                       |

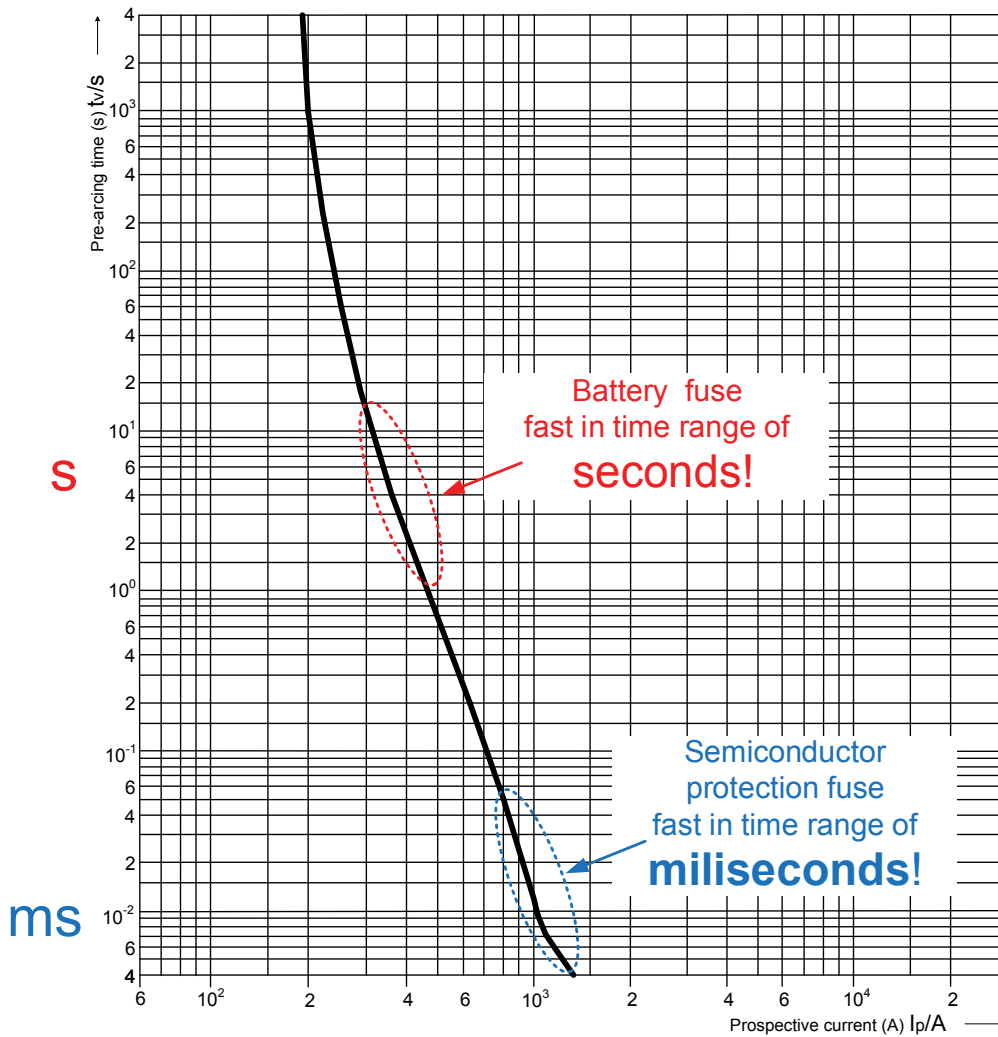
A few reasons why protection of batteries with simple fuse link is not OK:

- Flammable hydrogen gas is always present during battery recharging. Hydrogen gas is potentially explosive if allowed to accumulate in a closed area.
- Prevent open flames, sparks, or **electrical arcs** in the battery charging area to minimize the danger of explosion.
- Breaking capacity of »fork lift fuse link« is less than 1kA at nominal voltage!



Comparison characteristics

Battery fuse ← → Semiconductor protection fuse



S

ms

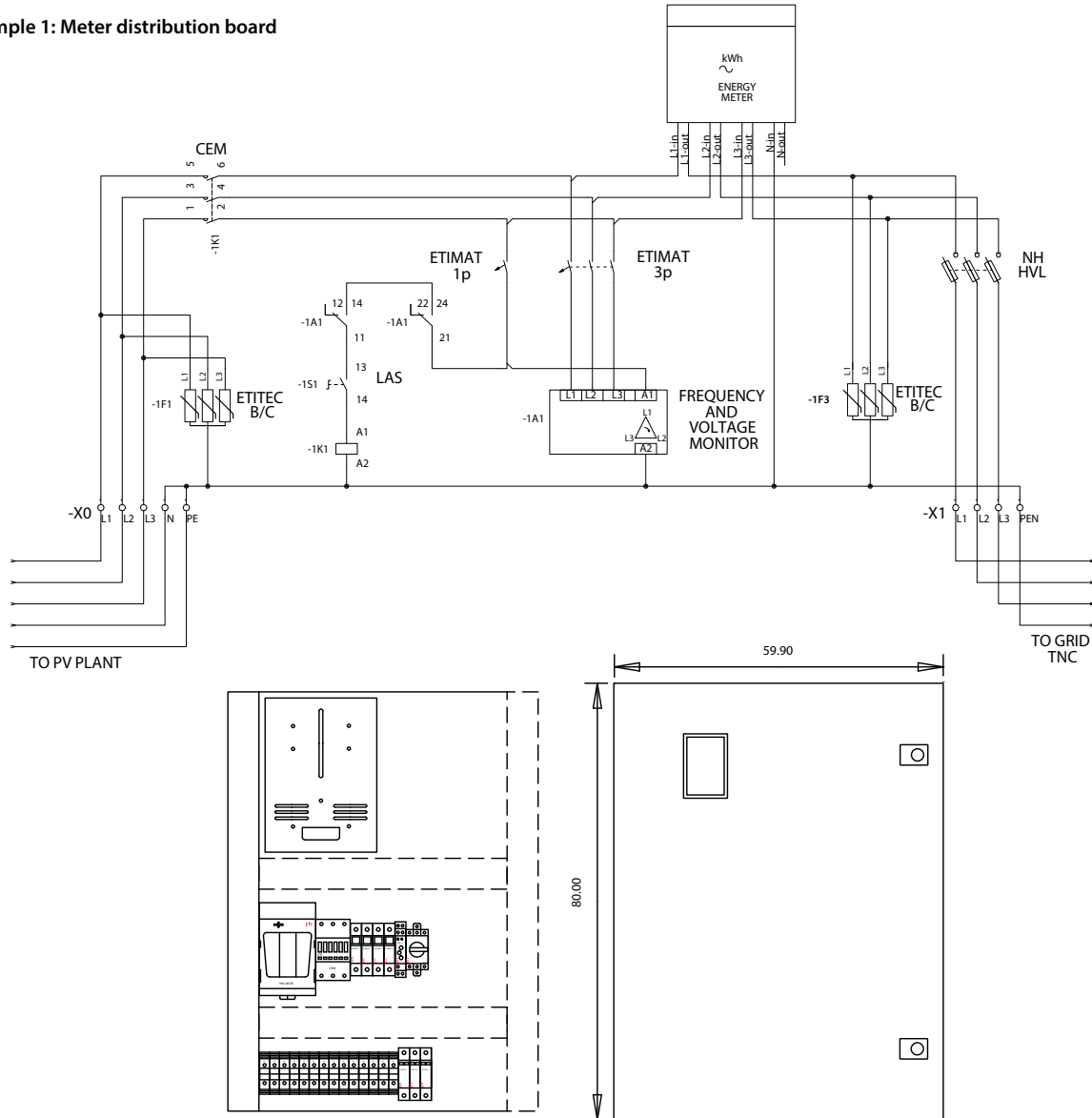
DC breaking voltage

2x  $I_n$

10x  $I_n$

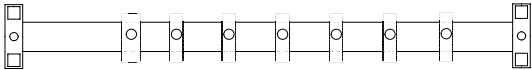
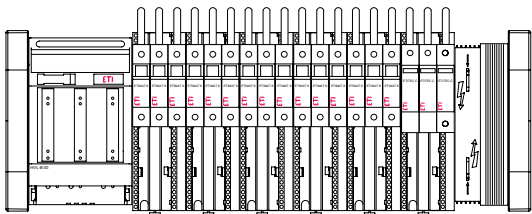
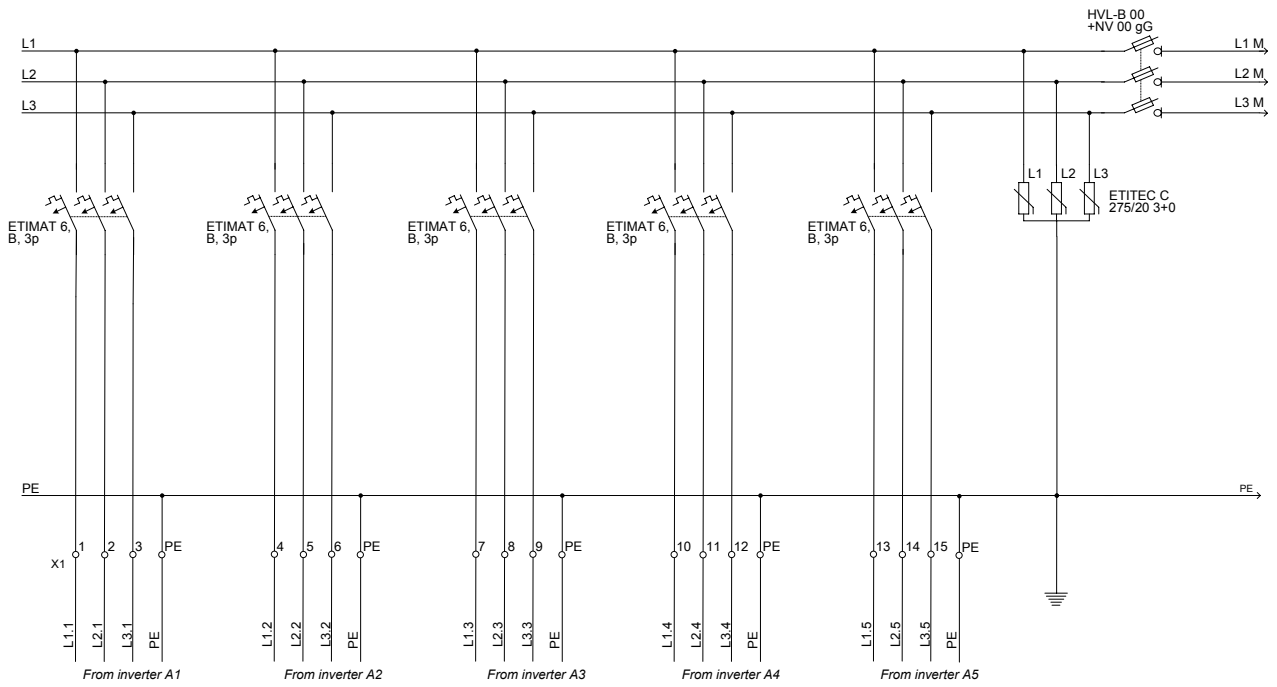
# Solutions

Example 1: Meter distribution board



| Quantity [pcs] | Code No.  | Description                  |
|----------------|-----------|------------------------------|
| 1              | 001102133 | GT 80-60-25                  |
| 1              | 002440141 | ETITEC B-F 320/12,5 F 3+0    |
| 1              | 004648103 | ETICON CEM 50.00 230V        |
| 1              | 002115512 | ETIMAT 6, B, 6A, 3P          |
| 1              | 002111512 | ETIMAT 6, B, 6A, 1P          |
| 1              | 001701250 | HVL EK 00, 3p                |
| 3              | 004181213 | NH 00 C KOMBI 80 A, gG 500 V |
| 1              | 004660011 | ETISWITCH LAS 1              |
| 2              | 002911001 | 35 mm TH rail NVS35/7,5 1m   |
| 1              | 001117002 | 3F, VPO                      |
| 1              | 002471416 | HRN-54                       |
| 10             | 003901157 | VS 35 PA                     |
| 2              | 003901539 | VS 35 PE                     |
| 2              | 003901158 | VS 35 PAN                    |
| 6              | 003901000 | VS 2,5 PA                    |
| 3              | 003901911 | IKP S 6060                   |

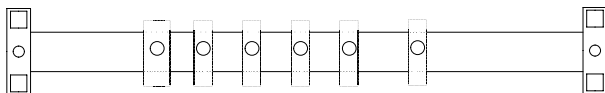
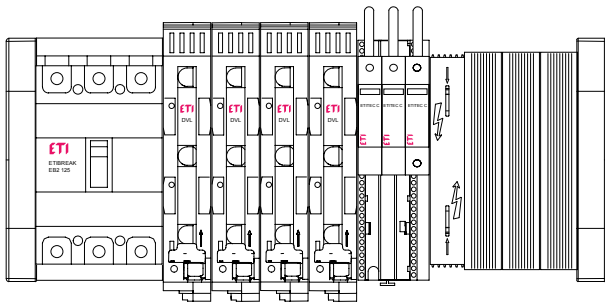
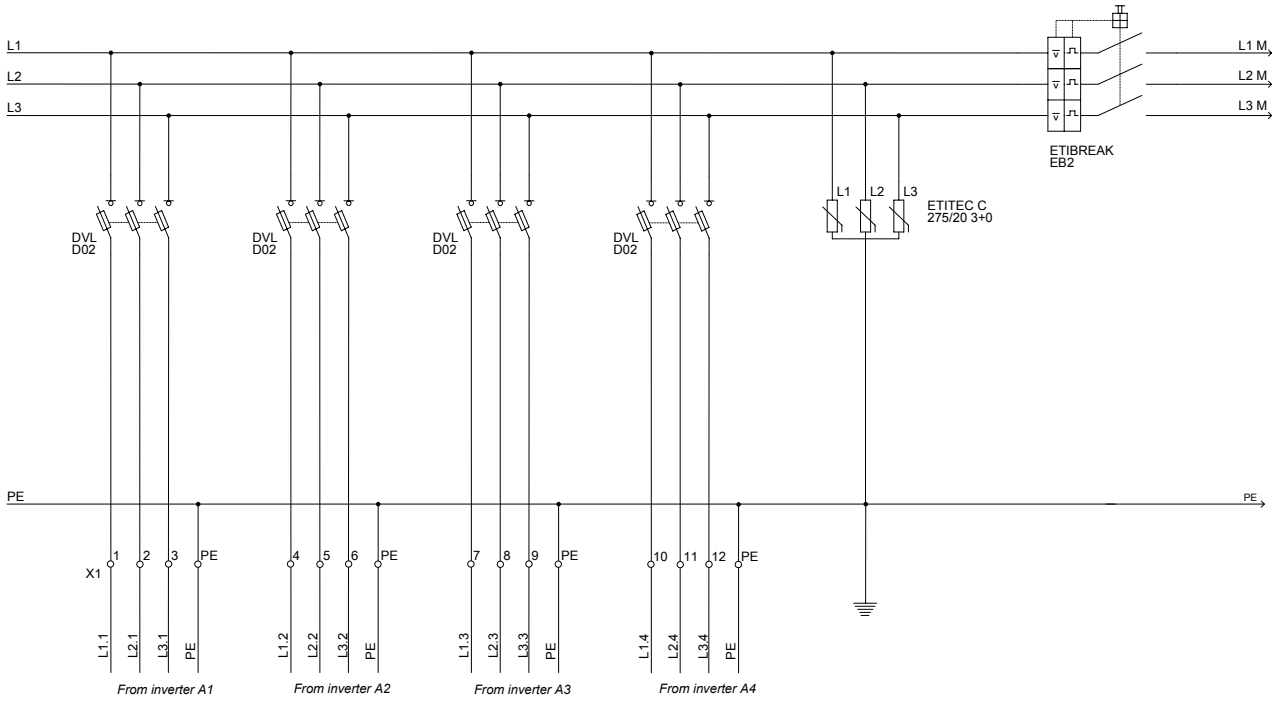
Example 2: AC collector



| Quantity [pcs] | Code No.  | Description         |
|----------------|-----------|---------------------|
| 2              | 001696001 | BBS-60/3            |
| 2              | 001696006 | L-BBS-60/3          |
| 1              | 001696009 | BBC-60/3            |
| 6              | 001696083 | DA-60/32/72/1       |
| 1              | 001696042 | HVL-B 00 3p M8      |
| 5              | 002111516 | ETIMAT 6, B, 3p     |
| 1              | 002441522 | ETITEC C 275/20 3+0 |
| 3              | 004183214 | NH 00, 100A, gG     |
| 2              | 001696000 | BBS-60/1            |
| 6              | 001696019 | CT-5/16             |
| 1              | 001696021 | CT-5/50             |

\* see general catalogue about 60mm busbar system

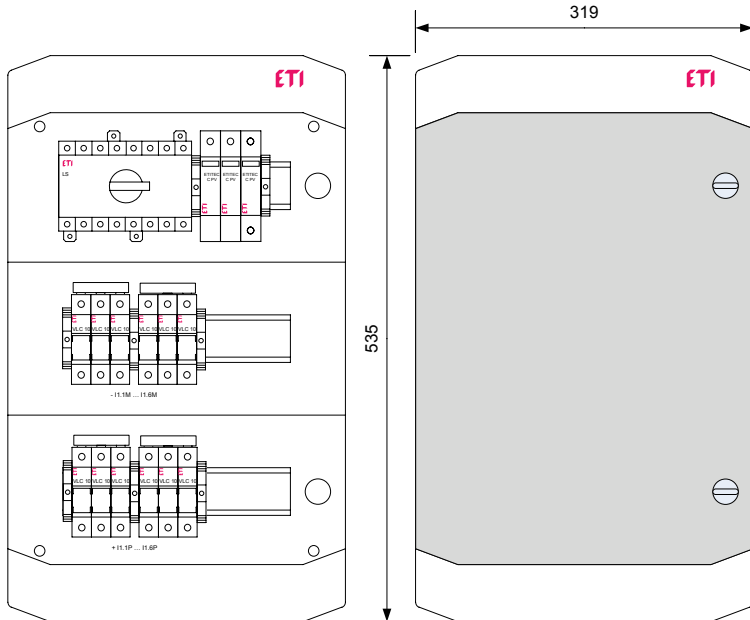
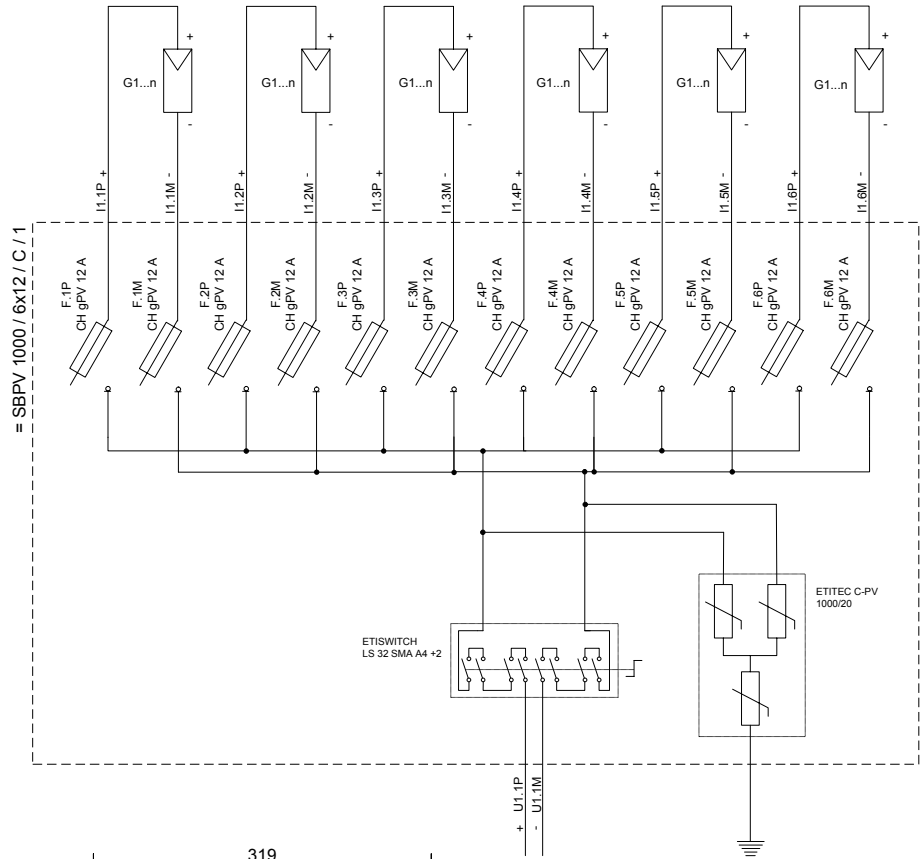
Example 3: AC collector



| Quantity [pcs] | Code No.  | Description                                                 |
|----------------|-----------|-------------------------------------------------------------|
| 2              | 001696001 | BBS-60/3                                                    |
| 2              | 001696006 | L-BBS-60/3                                                  |
| 3              | 001696009 | BBC-60/3                                                    |
| 1              | 001696083 | DA-60/32/72/1                                               |
| 4              | 001696050 | DVL-60/183                                                  |
| 12             | 002212006 | D02, 32A                                                    |
| 1              | 002441522 | ETITEC C 275/20 3+0<br>universal MCCB adapter,<br>frame 125 |
| 1              | 004671046 | ETIBREAK EB2 125/3S<br>125A 3p                              |
| 2              | 001696000 | BBS-60/1                                                    |
| 5              | 001696019 | CT-5/16                                                     |
| 1              | 001696021 | CT-5/50                                                     |

\* see general catalogue about 60mm busbar system

Example 4: DC junction box

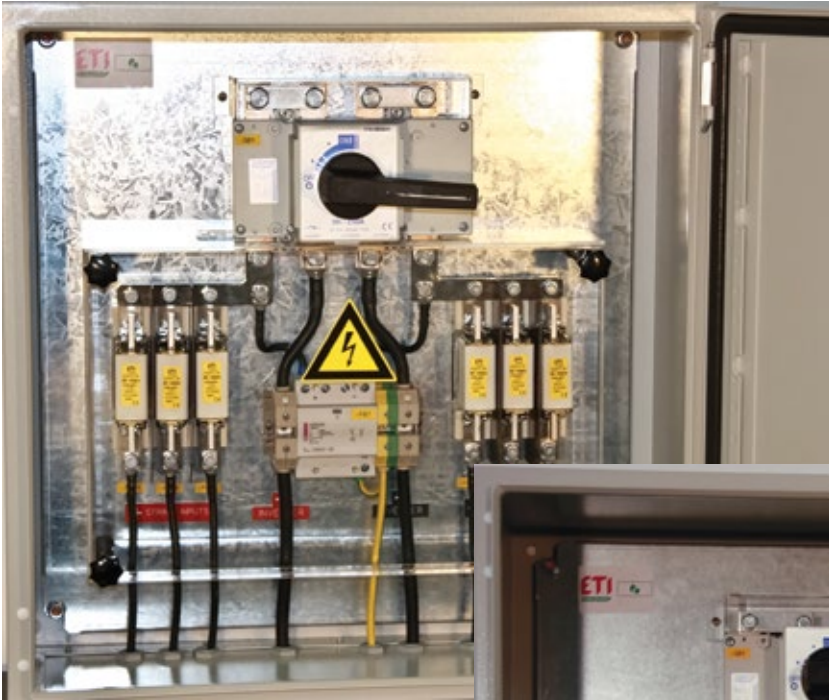


| Quantity [pcs] | Code No.  | Description         |
|----------------|-----------|---------------------|
| 1              | 001101064 | ECH-36PT            |
| 12             | 002540201 | EFH 10 1p DC 1000V  |
| 0,25           | 002921101 | I2S10/1F/54         |
| 12             | 002625106 | CH10 gPV 1000V 12A  |
| 1              | 002445208 | ETITEC C-PV 1000/20 |
| 1              | 004660066 | LS32 SMA A4+2       |
| 8              | 003901016 | PKPA 35 end bracket |



## Design on customer's request

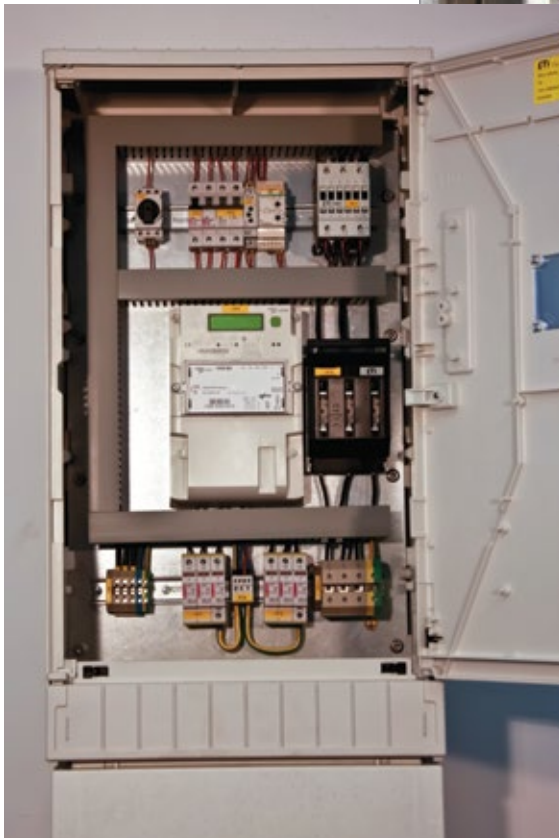
DC junction box (NH gPV fuses)



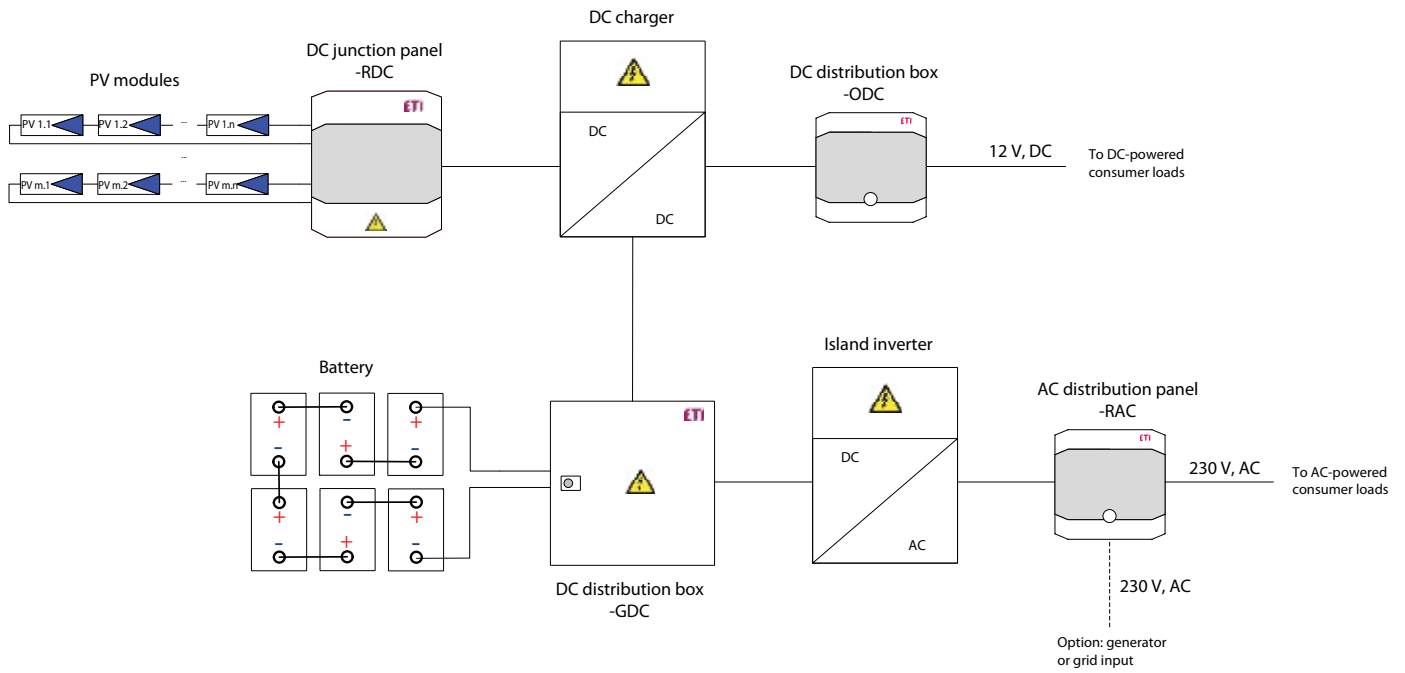
DC junction box (CH gPV fuses)



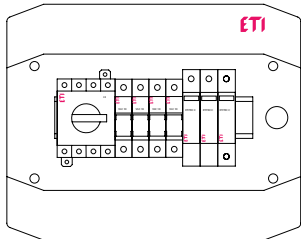
Meter distribution cabinet



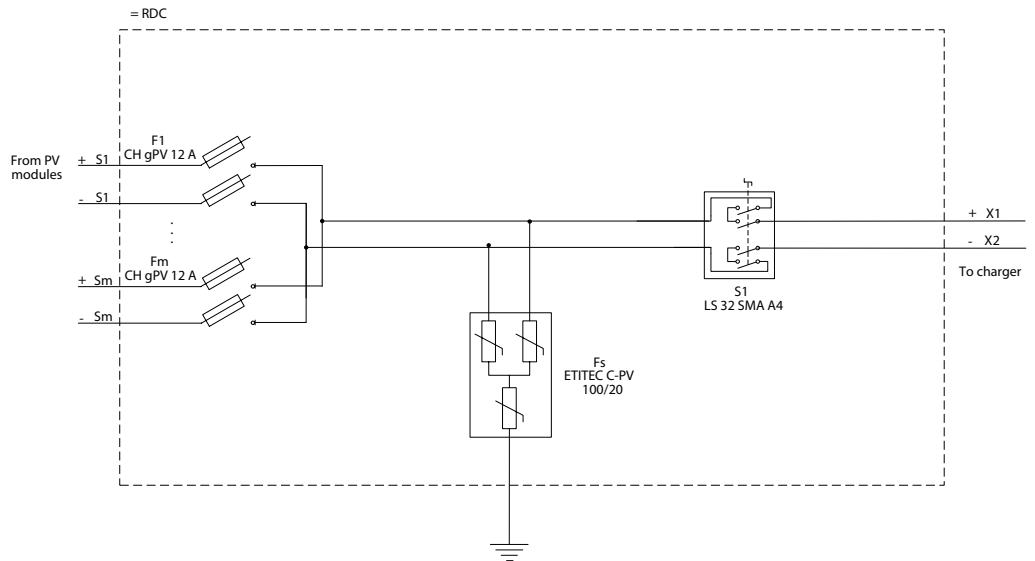
PV off-grid system protection



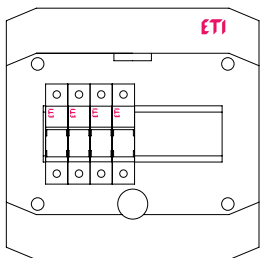
PROTECTING DC SIDE OF ISLAND PV PLANT.



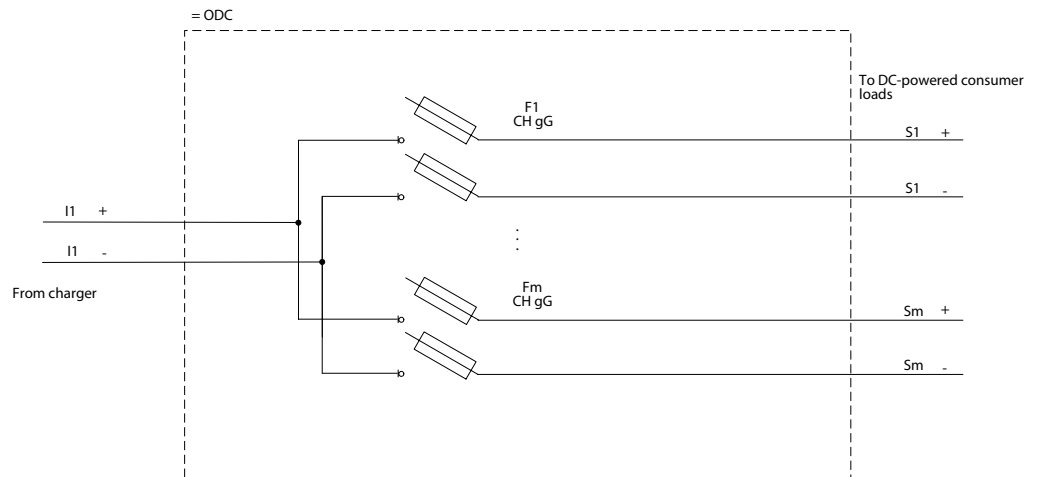
Panel type ECH-12  
Fuse disconnecter type: VLC 10 PV  
Switch disconnecter: LS  
Surge arrester: ETITEC C, PV



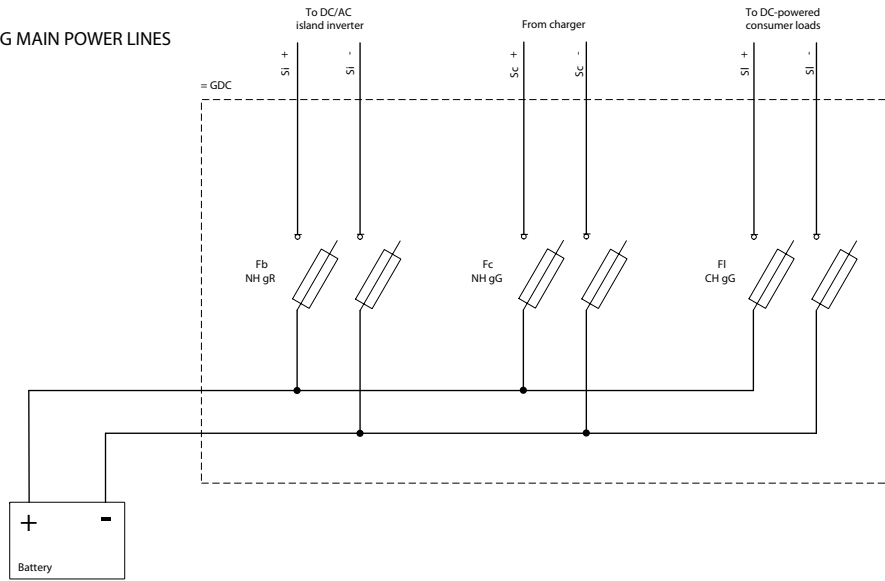
PROTECTING DC-POWERED CONSUMER LOADS DIRECTLY FROM CHARGES.



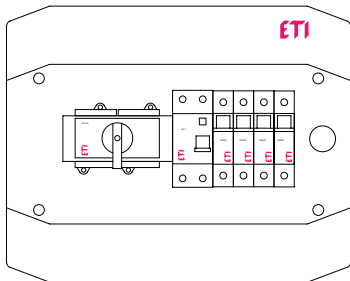
Panel type ECH-8  
Fuse disconnecter type: VLC 10



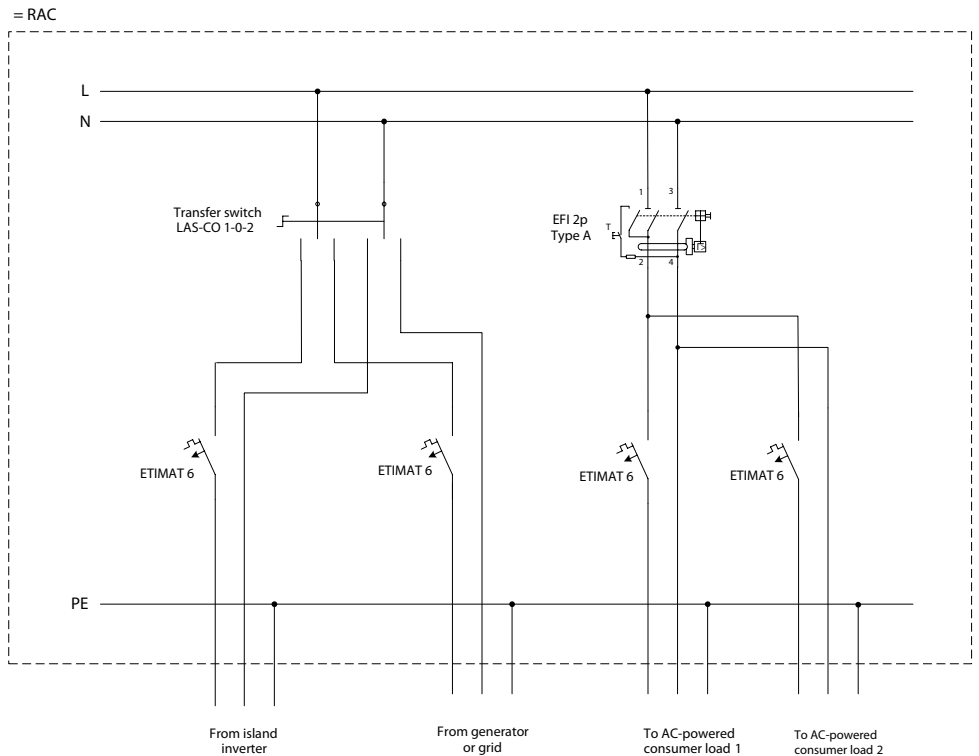
PROTECTING MAIN POWER LINES



AC DISTRIBUTION BOX



Panel type: ECH-12  
RCB: EFI 2, type A  
MCB: ETIMAT 6  
Transfer switch: LAS CO





| Code No     | Page |
|-------------|------|
| <b>0016</b> |      |
| 001690860   | 137  |
| 001690861   | 137  |
| 001690862   | 137  |
| 001690863   | 137  |
| 001690870   | 129  |
| 001690871   | 129  |
| 001690872   | 129  |
| 001690874   | 129  |
| 001690880   | 129  |
| 001690881   | 129  |
| 001690882   | 129  |
| 001690884   | 129  |
| 001690890   | 129  |
| 001690891   | 129  |
| 001690892   | 129  |
| 001690895   | 129  |
| 001690896   | 129  |
| 001690897   | 129  |
| 001690900   | 129  |
| 001690901   | 129  |
| 001690902   | 129  |
| 001690940   | 130  |
| 001690941   | 130  |
| 001690942   | 130  |
| 001690943   | 130  |
| 001690944   | 130  |
| 001690945   | 130  |
| 001690946   | 130  |
| 001690947   | 130  |
| 001690948   | 130  |
| 001690949   | 130  |
| 001690950   | 130  |
| 001690951   | 130  |
| 001690952   | 130  |
| 001690953   | 130  |
| 001690954   | 130  |
| 001690955   | 130  |
| 001690956   | 130  |
| 001690957   | 130  |
| 001690958   | 130  |
| 001690959   | 130  |
| 001690960   | 130  |
| 001690964   | 130  |
| 001690965   | 130  |
| 001690966   | 130  |

| Code No     | Page |
|-------------|------|
| 001690967   | 130  |
| 001690968   | 130  |
| 001690969   | 130  |
| 001690970   | 130  |
| 001690971   | 130  |
| 001690972   | 130  |
| 001690973   | 130  |
| 001690974   | 130  |
| 001690975   | 130  |
| 001690976   | 130  |
| 001690977   | 130  |
| 001691062   | 140  |
| 001692701   | 130  |
| 001692702   | 130  |
| 001692703   | 130  |
| 001692704   | 130  |
| 001692760   | 130  |
| 001692761   | 130  |
| 001692762   | 130  |
| 001692763   | 130  |
| 001692764   | 130  |
| 001692765   | 130  |
| 001692766   | 130  |
| <b>0024</b> |      |
| 002440511   | 145  |
| 002440512   | 145  |
| 002440513   | 145  |
| 002440514   | 145  |
| 002440515   | 150  |
| 002440516   | 150  |
| 002440517   | 150  |
| 002440518   | 150  |
| 002440519   | 146  |
| 002440520   | 146  |
| 002440521   | 146  |
| 002440522   | 146  |
| 002440523   | 150  |
| 002440524   | 150  |
| 002440580   | 147  |
| 002440581   | 147  |
| 002440582   | 147  |
| 002440583   | 147  |
| 002440584   | 147  |
| 002440585   | 147  |
| 002440623   | 151  |
| 002440624   | 151  |

| Code No     | Page |
|-------------|------|
| 002440625   | 151  |
| 002440626   | 151  |
| 002440627   | 151  |
| 002440628   | 151  |
| 002440732   | 150  |
| 002440733   | 150  |
| 002440734   | 150  |
| 002440735   | 150  |
| 002440736   | 150  |
| 002440737   | 150  |
| 002440810   | 153  |
| 002440811   | 153  |
| 002440812   | 153  |
| 002440813   | 153  |
| 002440820   | 155  |
| 002440821   | 155  |
| 002440822   | 155  |
| 002440823   | 155  |
| 002442988   | 157  |
| 002442989   | 157  |
| <b>0025</b> |      |
| 002540201   | 28   |
| 002540203   | 28   |
| 002540204   | 28   |
| 002540211   | 28   |
| 002540213   | 28   |
| 002540948   | 31   |
| 002540949   | 31   |
| 002560201   | 29   |
| 002560203   | 29   |
| 002560205   | 29   |
| 002560211   | 29   |
| 002560213   | 29   |
| 002560948   | 31   |
| 002560949   | 31   |
| 002569001   | 31   |
| 002570201   | 30   |
| 002570203   | 30   |
| 002570211   | 30   |
| 002570213   | 30   |
| 002570948   | 31   |
| 002570949   | 31   |
| 002579001   | 31   |
| 002580001   | 34   |
| 002580006   | 34   |
| 002580011   | 34   |

| Code No     | Page |
|-------------|------|
| 002580016   | 34   |
| <b>0026</b> |      |
| 002625065   | 9    |
| 002625067   | 9    |
| 002625068   | 9    |
| 002625069   | 9    |
| 002625070   | 9    |
| 002625071   | 9    |
| 002625072   | 9    |
| 002625073   | 9    |
| 002625075   | 9    |
| 002625077   | 9    |
| 002625078   | 9    |
| 002625079   | 9    |
| 002625080   | 9    |
| 002625081   | 9    |
| 002625085   | 9    |
| 002625100   | 9    |
| 002625101   | 9    |
| 002625102   | 9    |
| 002625103   | 9    |
| 002625104   | 9    |
| 002625105   | 9    |
| 002625106   | 9    |
| 002625107   | 9    |
| 002625108   | 9    |
| 002625110   | 9    |
| 002625111   | 9    |
| 002625112   | 9    |
| 002625113   | 9    |
| 002625114   | 9    |
| 002625115   | 9    |
| 002625116   | 9    |
| 002625117   | 9    |
| 002625118   | 9    |
| 002625119   | 9    |
| 002625120   | 9    |
| 002625121   | 9    |
| 002625122   | 9    |
| 002625124   | 9    |
| 002625125   | 9    |
| 002625126   | 9    |
| 002625127   | 9    |
| 002625128   | 9    |
| 002625129   | 9    |
| 002625131   | 9    |

# index

# index

| Code No   | Page | Code No   | Page | Code No      | Page | Code No   | Page |
|-----------|------|-----------|------|--------------|------|-----------|------|
| 002625134 | 9    | 002626104 | 19   | 002637340    | 15   | 004110233 | 39   |
| 002625135 | 9    | 002626106 | 19   | 002637405    | 22   | 004110234 | 39   |
| 002625136 | 9    | 002626108 | 19   | 002637407    | 22   | 004110292 | 39   |
| 002625137 | 9    | 002626110 | 19   | 002637409    | 22   | 004110293 | 39   |
| 002625138 | 9    | 002626112 | 19   | 002637411    | 22   | 004110294 | 39   |
| 002625139 | 9    | 002626116 | 19   | 002637412    | 22   | 004110295 | 39   |
| 002625140 | 9    | 002626120 | 19   | 002637505    | 22   | 004110296 | 39   |
| 002625200 | 12   | 002626125 | 19   | 002637507    | 22   | 004110297 | 39   |
| 002625209 | 12   | 002626130 | 20   | 002637509    | 22   | 004110298 | 39   |
| 002625210 | 12   | 002626132 | 20   | 002637511    | 22   | 004110299 | 39   |
| 002625211 | 12   | 002626134 | 20   | 002637512    | 22   | 004110342 | 39   |
| 002625212 | 12   | 002626136 | 20   | <b>0029</b>  |      | 004110343 | 39   |
| 002625213 | 12   | 002626138 | 20   | 002921101    | 35   | 004110344 | 39   |
| 002625214 | 12   | 002626140 | 20   | 002921111    | 35   | 004110346 | 39   |
| 002625215 | 12   | 002626142 | 20   | 002921121    | 35   | 004110347 | 39   |
| 002625216 | 12   | 002626234 | 12   | 002921292    | 35   | 004110348 | 39   |
| 002625217 | 12   | 002626235 | 12   | <b>00411</b> |      | 004110349 | 39   |
| 002625219 | 12   | 002626236 | 12   | 004110075    | 78   | 004110350 | 87   |
| 002625241 | 12   | 002626237 | 12   | 004110076    | 78   | 004110371 | 39   |
| 002625245 | 12   | 002626238 | 12   | 004110077    | 78   | 004110373 | 39   |
| 002625274 | 12   | 002626239 | 12   | 004110078    | 78   | 004110374 | 39   |
| 002625276 | 12   | 002626240 | 12   | 004110079    | 78   | 004110375 | 39   |
| 002625277 | 12   | 002626241 | 12   | 004110080    | 78   | 004110376 | 39   |
| 002625279 | 12   | 002626300 | 12   | 004110081    | 78   | 004110377 | 39   |
| 002625280 | 12   | 002626301 | 12   | 004110082    | 78   | 004110378 | 39   |
| 002625282 | 12   | 002626302 | 12   | 004110083    | 78   | 004110379 | 39   |
| 002625285 | 12   | 002626303 | 12   | 004110084    | 78   | 004110381 | 39   |
| 002625286 | 12   | 002626304 | 12   | 004110085    | 78   | 004110383 | 39   |
| 002625500 | 12   | 002626306 | 12   | 004110086    | 78   | 004110384 | 39   |
| 002626002 | 19   | 002626307 | 12   | 004110087    | 78   | 004110385 | 39   |
| 002626004 | 19   | 002626308 | 12   | 004110088    | 78   | 004110386 | 39   |
| 002626006 | 19   | 002626309 | 12   | 004110089    | 78   | 004110387 | 39   |
| 002626008 | 19   | 002626310 | 12   | 004110090    | 78   | 004110388 | 39   |
| 002626010 | 19   | 002626311 | 12   | 004110091    | 78   | 004110389 | 39   |
| 002626012 | 19   | 002637105 | 15   | 004110092    | 78   | 004110391 | 44   |
| 002626016 | 19   | 002637107 | 15   | 004110093    | 78   | 004110392 | 44   |
| 002626020 | 19   | 002637109 | 15   | 004110094    | 78   | 004110393 | 44   |
| 002626025 | 19   | 002637111 | 15   | 004110095    | 78   | 004110394 | 44   |
| 002626030 | 20   | 002637115 | 15   | 004110096    | 78   | 004110395 | 44   |
| 002626032 | 20   | 002637140 | 15   | 004110209    | 83   | 004110396 | 44   |
| 002626034 | 20   | 002637185 | 15   | 004110215    | 83   | 004110397 | 44   |
| 002626036 | 20   | 002637305 | 15   | 004110216    | 83   | 004110398 | 44   |
| 002626038 | 20   | 002637307 | 15   | 004110217    | 83   | 004110399 | 44   |
| 002626040 | 20   | 002637309 | 15   | 004110218    | 83   | 004110400 | 44   |
| 002626042 | 20   | 002637311 | 15   | 004110219    | 83   | 004110401 | 44   |
| 002626102 | 19   | 002637315 | 15   | 004110232    | 39   | 004110449 | 44   |

| Code No   | Page |
|-----------|------|
| 004110455 | 39   |
| 004110456 | 39   |
| 004110457 | 39   |
| 004110458 | 39   |
| 004110459 | 39   |
| 004110460 | 39   |
| 004110472 | 44   |
| 004110473 | 44   |
| 004110474 | 44   |
| 004110475 | 44   |
| 004110476 | 44   |
| 004110477 | 44   |
| 004110478 | 44   |
| 004110479 | 44   |
| 004110480 | 44   |
| 004110481 | 44   |
| 004110482 | 44   |
| 004110484 | 44   |
| 004110485 | 44   |
| 004110486 | 44   |
| 004110487 | 44   |
| 004110488 | 44   |
| 004110489 | 44   |
| 004110490 | 44   |
| 004110491 | 44   |
| 004110492 | 44   |
| 004110493 | 44   |
| 004110494 | 44   |
| 004110495 | 44   |
| 004110496 | 44   |
| 004110497 | 44   |
| 004110498 | 44   |
| 004110560 | 49   |
| 004110561 | 49   |
| 004110562 | 49   |
| 004110563 | 49   |
| 004110564 | 49   |
| 004110565 | 49   |
| 004110566 | 49   |
| 004110567 | 49   |
| 004110591 | 49   |
| 004110592 | 49   |
| 004110593 | 49   |
| 004110594 | 49   |
| 004110595 | 49   |
| 004110596 | 49   |

| Code No   | Page |
|-----------|------|
| 004110597 | 49   |
| 004110598 | 49   |
| 004110606 | 49   |
| 004110607 | 49   |
| 004110608 | 49   |
| 004110609 | 49   |
| 004110610 | 49   |
| 004110611 | 49   |
| 004110612 | 49   |
| 004110613 | 49   |
| 004110621 | 49   |
| 004110622 | 49   |
| 004110623 | 49   |
| 004110627 | 44   |
| 004110628 | 44   |
| 004110629 | 44   |
| 004110630 | 49   |
| 004110631 | 49   |
| 004110632 | 49   |
| 004110633 | 49   |
| 004110634 | 49   |
| 004110635 | 49   |
| 004110636 | 49   |
| 004110637 | 49   |
| 004110638 | 49   |
| 004110639 | 49   |
| 004110640 | 49   |
| 004110641 | 49   |
| 004110642 | 49   |
| 004110643 | 49   |
| 004110644 | 49   |
| 004110647 | 49   |
| 004110648 | 49   |
| 004110649 | 49   |
| 004110650 | 97   |
| 004110651 | 97   |
| 004110652 | 97   |
| 004110653 | 97   |
| 004110654 | 97   |
| 004110655 | 97   |
| 004110656 | 97   |
| 004110657 | 97   |
| 004110658 | 97   |
| 004110659 | 97   |
| 004110660 | 97   |
| 004110661 | 97   |

| Code No   | Page |
|-----------|------|
| 004110662 | 97   |
| 004110663 | 97   |
| 004110664 | 97   |
| 004110665 | 97   |
| 004110666 | 97   |
| 004110667 | 97   |
| 004110668 | 97   |
| 004110669 | 97   |
| 004110670 | 97   |
| 004110671 | 97   |
| 004110672 | 97   |
| 004110673 | 97   |
| 004110674 | 97   |
| 004110675 | 97   |
| 004110676 | 97   |
| 004110677 | 97   |
| 004110678 | 97   |
| 004110679 | 97   |
| 004110680 | 97   |
| 004110681 | 97   |
| 004110682 | 97   |
| 004110683 | 97   |
| 004110684 | 97   |
| 004110685 | 97   |
| 004110686 | 97   |
| 004110687 | 97   |
| 004110688 | 97   |
| 004110689 | 97   |
| 004110690 | 97   |
| 004110691 | 97   |
| 004110692 | 47   |
| 004110693 | 47   |
| 004110694 | 47   |
| 004110695 | 47   |
| 004110696 | 47   |
| 004110697 | 47   |
| 004110698 | 97   |
| 004110699 | 97   |
| 004110700 | 97   |
| 004110701 | 97   |
| 004110702 | 97   |
| 004110703 | 97   |
| 004110714 | 51   |
| 004110715 | 51   |
| 004110716 | 51   |
| 004110717 | 51   |

| Code No   | Page |
|-----------|------|
| 004110718 | 51   |
| 004110719 | 51   |
| 004110720 | 51   |
| 004110721 | 51   |
| 004110722 | 51   |
| 004110723 | 51   |
| 004110724 | 51   |
| 004110725 | 51   |
| 004110726 | 51   |
| 004110727 | 51   |
| 004110728 | 51   |
| 004110729 | 50   |
| 004110730 | 50   |
| 004110731 | 50   |
| 004110732 | 50   |
| 004110733 | 50   |
| 004110734 | 50   |
| 004110735 | 50   |
| 004110736 | 50   |
| 004110737 | 50   |
| 004110738 | 50   |
| 004110743 | 47   |
| 004110744 | 47   |
| 004110745 | 47   |
| 004110746 | 47   |
| 004110747 | 47   |
| 004110748 | 47   |
| 004110749 | 47   |
| 004110750 | 47   |
| 004110751 | 47   |
| 004110752 | 47   |
| 004110753 | 47   |
| 004110754 | 47   |
| 004110755 | 93   |
| 004110756 | 93   |
| 004110757 | 93   |
| 004110758 | 93   |
| 004110759 | 93   |
| 004110760 | 93   |
| 004110761 | 93   |
| 004110762 | 93   |
| 004110763 | 93   |
| 004110764 | 93   |
| 004110765 | 93   |
| 004110766 | 93   |
| 004110767 | 93   |

# index

# index

| Code No   | Page | Code No      | Page | Code No     | Page | Code No     | Page |
|-----------|------|--------------|------|-------------|------|-------------|------|
| 004110768 | 93   | 004110845    | 106  | 004184482   | 59   | 004660063   | 161  |
| 004110769 | 93   | 004110846    | 106  | 004184483   | 59   | 004660064   | 161  |
| 004110770 | 93   | 004110847    | 106  | 004184484   | 59   | 004660065   | 161  |
| 004110771 | 93   | 004110848    | 106  | 004184485   | 59   | 004660066   | 161  |
| 004110772 | 93   | 004110849    | 106  | 004184486   | 59   | 004660067   | 161  |
| 004110773 | 93   | 004110860    | 106  | 004184487   | 59   | 004661481   | 168  |
| 004110774 | 93   | 004110861    | 106  | 004184488   | 59   | 004661483   | 168  |
| 004110775 | 93   | 004110862    | 106  | 004184489   | 59   | 004661486   | 168  |
| 004110776 | 93   | 004110863    | 106  | 004184490   | 59   | 004661490   | 168  |
| 004110777 | 93   | 004110864    | 106  | 004184498   | 59   | 004661493   | 168  |
| 004110778 | 93   | 004110865    | 106  | 004184500   | 68   | 004661496   | 168  |
| 004110779 | 97   | 004110866    | 106  | 004184501   | 68   | 004661499   | 168  |
| 004110780 | 97   | 004110867    | 106  | 004184502   | 68   | 004661501   | 168  |
| 004110781 | 97   | 004110868    | 106  | 004184503   | 68   | 004661502   | 168  |
| 004110782 | 97   | 004110869    | 106  | 004184504   | 68   | 004661853   | 163  |
| 004110783 | 97   | 004110880    | 106  | 004184505   | 68   | 004661854   | 163  |
| 004110784 | 97   | 004110881    | 106  | 004184506   | 68   | 004661855   | 163  |
| 004110785 | 97   | 004110890    | 106  | 004184507   | 68   | 004661861   | 168  |
| 004110786 | 97   | 004110891    | 106  | 004184508   | 68   | 004661862   | 168  |
| 004110787 | 97   | <b>00412</b> |      | 004184509   | 68   | 004661863   | 168  |
| 004110788 | 97   | 004122023    | 110  | 004184512   | 59   | 004661864   | 168  |
| 004110789 | 97   | 004122024    | 110  | 004184513   | 59   | 004661865   | 168  |
| 004110790 | 97   | 004122025    | 110  | 004184514   | 59   | 004661866   | 168  |
| 004110791 | 97   | 004122033    | 110  | 004184515   | 59   | 004661923   | 166  |
| 004110792 | 97   | 004122035    | 117  | 004184516   | 59   | 004661924   | 166  |
| 004110793 | 97   | 004122036    | 121  | 004184518   | 59   | <b>0047</b> |      |
| 004110800 | 104  | 004122037    | 121  | 004184519   | 59   | 004723103   | 81   |
| 004110801 | 104  | 004122038    | 120  | 004184520   | 59   | 004723104   | 81   |
| 004110802 | 104  | 004122039    | 123  | 004184521   | 59   | 004723105   | 81   |
| 004110803 | 104  | 004122040    | 123  | 004184524   | 59   | 004723106   | 81   |
| 004110804 | 104  | 004122041    | 123  | 004184525   | 59   | 004723107   | 81   |
| 004110805 | 104  | 004122042    | 123  | 004184526   | 59   | 004723108   | 81   |
| 004110809 | 104  | 004122044    | 110  | 004184528   | 59   | 004723109   | 81   |
| 004110810 | 104  | 004122060    | 115  | 004184529   | 59   | 004723110   | 81   |
| 004110811 | 104  | 004122061    | 115  | 004184531   | 59   | 004723111   | 81   |
| 004110812 | 104  | 004122062    | 115  | 004184532   | 59   | 004723112   | 81   |
| 004110813 | 104  | 004122063    | 115  | 004184533   | 59   | 004723234   | 68   |
| 004110814 | 104  | 004122064    | 115  | 004184534   | 59   | 004723235   | 68   |
| 004110815 | 104  | 004122065    | 115  | 004184535   | 59   | 004723236   | 68   |
| 004110816 | 104  | <b>00413</b> |      | 004184536   | 59   | 004723237   | 68   |
| 004110817 | 104  | 004132017    | 113  | 004184545   | 59   | 004723259   | 85   |
| 004110840 | 106  | 004132019    | 113  | 004184546   | 59   | 004723260   | 85   |
| 004110841 | 106  | 004132023    | 113  | <b>0046</b> |      | 004723261   | 85   |
| 004110842 | 106  | 004132029    | 113  | 004660060   | 161  | 004723262   | 85   |
| 004110843 | 106  | <b>00418</b> |      | 004660061   | 161  | 004723263   | 85   |
| 004110844 | 106  | 004184463    | 59   | 004660062   | 161  | 004723264   | 85   |



| Code No   | Page |
|-----------|------|
| 004723265 | 85   |
| 004723266 | 85   |
| 004723267 | 85   |
| 004723268 | 85   |
| 004723269 | 85   |
| 004723270 | 85   |
| 004723271 | 85   |
| 004723272 | 85   |
| 004723273 | 85   |
| 004723274 | 85   |
| 004723275 | 85   |
| 004723276 | 85   |
| 004723277 | 85   |
| 004723278 | 85   |
| 004723279 | 85   |
| 004723280 | 85   |
| 004723281 | 85   |
| 004723282 | 85   |
| 004723283 | 85   |
| 004723284 | 85   |
| 004723285 | 85   |
| 004723286 | 85   |
| 004723287 | 85   |
| 004723288 | 85   |
| 004723289 | 86   |
| 004723290 | 86   |
| 004723291 | 86   |
| 004723292 | 86   |
| 004723293 | 86   |
| 004723294 | 86   |
| 004723295 | 86   |
| 004723296 | 86   |
| 004723297 | 86   |
| 004723298 | 86   |
| 004723299 | 86   |
| 004723300 | 86   |
| 004723301 | 86   |
| 004723302 | 86   |
| 004723303 | 86   |
| 004723304 | 86   |
| 004723305 | 86   |
| 004723306 | 86   |
| 004723307 | 86   |
| 004723308 | 86   |
| 004723309 | 86   |
| 004723310 | 86   |

| Code No   | Page |
|-----------|------|
| 004723311 | 86   |
| 004723312 | 86   |
| 004723313 | 86   |
| 004723314 | 86   |
| 004723315 | 86   |
| 004723316 | 86   |
| 004723317 | 86   |
| 004723318 | 86   |
| 004723320 | 87   |
| 004723321 | 87   |
| 004723322 | 87   |
| 004723323 | 87   |
| 004723324 | 87   |
| 004723325 | 87   |
| 004723326 | 87   |
| 004723327 | 87   |
| 004723330 | 87   |
| 004723331 | 87   |
| 004723332 | 87   |
| 004723333 | 87   |
| 004723334 | 87   |
| 004723335 | 87   |
| 004723336 | 87   |
| 004723337 | 87   |
| 004723340 | 87   |
| 004723341 | 87   |
| 004723342 | 87   |
| 004723343 | 87   |
| 004723344 | 87   |
| 004723345 | 87   |
| 004723346 | 87   |
| 004723347 | 87   |
| 004724234 | 68   |
| 004724235 | 68   |
| 004724260 | 85   |
| 004724261 | 85   |
| 004724262 | 85   |
| 004724263 | 85   |
| 004724264 | 85   |
| 004724265 | 85   |
| 004724266 | 85   |
| 004724267 | 85   |
| 004724270 | 85   |
| 004724271 | 85   |
| 004724272 | 85   |
| 004724273 | 85   |

| Code No   | Page |
|-----------|------|
| 004724274 | 85   |
| 004724275 | 85   |
| 004724276 | 85   |
| 004724277 | 85   |
| 004724280 | 85   |
| 004724281 | 85   |
| 004724282 | 85   |
| 004724283 | 85   |
| 004724284 | 85   |
| 004724285 | 85   |
| 004724286 | 85   |
| 004724287 | 85   |
| 004724290 | 86   |
| 004724291 | 86   |
| 004724292 | 86   |
| 004724293 | 86   |
| 004724294 | 86   |
| 004724295 | 86   |
| 004724296 | 86   |
| 004724297 | 86   |
| 004724300 | 86   |
| 004724301 | 86   |
| 004724302 | 86   |
| 004724303 | 86   |
| 004724304 | 86   |
| 004724305 | 86   |
| 004724306 | 86   |
| 004724307 | 86   |
| 004724310 | 86   |
| 004724311 | 86   |
| 004724312 | 86   |
| 004724313 | 86   |
| 004724314 | 86   |
| 004724315 | 86   |
| 004724316 | 86   |
| 004724317 | 86   |
| 004724320 | 87   |
| 004724321 | 87   |
| 004724322 | 87   |
| 004724323 | 87   |
| 004724324 | 87   |
| 004724325 | 87   |
| 004724326 | 87   |
| 004724327 | 87   |
| 004724330 | 87   |
| 004724331 | 87   |

| Code No   | Page |
|-----------|------|
| 004724332 | 87   |
| 004724333 | 87   |
| 004724334 | 87   |
| 004724335 | 87   |
| 004724336 | 87   |
| 004724337 | 87   |
| 004724340 | 87   |
| 004724341 | 87   |
| 004724342 | 87   |
| 004724343 | 87   |
| 004724344 | 87   |
| 004724345 | 87   |
| 004724346 | 87   |
| 004724347 | 87   |
| 004725232 | 68   |
| 004725233 | 68   |
| 004725234 | 68   |
| 004725235 | 68   |
| 004725260 | 85   |
| 004725261 | 85   |
| 004725262 | 85   |
| 004725263 | 85   |
| 004725264 | 85   |
| 004725265 | 85   |
| 004725266 | 85   |
| 004725270 | 85   |
| 004725271 | 85   |
| 004725272 | 85   |
| 004725273 | 85   |
| 004725274 | 85   |
| 004725275 | 85   |
| 004725276 | 85   |
| 004725280 | 85   |
| 004725281 | 85   |
| 004725282 | 85   |
| 004725283 | 85   |
| 004725284 | 85   |
| 004725285 | 85   |
| 004725286 | 85   |
| 004725290 | 86   |
| 004725291 | 86   |
| 004725292 | 86   |
| 004725293 | 86   |
| 004725294 | 86   |
| 004725295 | 86   |
| 004725296 | 86   |

# index

# index

| Code No     | Page |
|-------------|------|
| 004725297   | 86   |
| 004725298   | 86   |
| 004725299   | 86   |
| 004725300   | 86   |
| 004725301   | 86   |
| 004725302   | 86   |
| 004725303   | 86   |
| 004725304   | 86   |
| 004725305   | 86   |
| 004725306   | 86   |
| 004725307   | 86   |
| 004725308   | 86   |
| 004725309   | 86   |
| 004725310   | 86   |
| <b>0067</b> |      |
| 006710335   | 36   |
| 006710340   | 36   |
| 006710341   | 36   |