Battery technology calls for the best protection there is

Fotos: ads-tec/Sicherungen: Siba/Montage Gestaltmanufaktur

MADE IN GERMANY

Perfect solutions for your energy storage units

SIBA fuses in battery installations

Our Protection. Your Benefit.

SIBA
Sicherungen | Fuses

Storage units supply only as long as they are in operation

- The applications of systems taking over when the mains fail range from small UPS installations to company-wide battery racks. Therefore it is critical for the emergency system not to become a case of worry itself. Fuses made by SIBA provide protection for installations supplying vital energy consumers in cases of mains failure.

- More and more often, controlling the mains frequency in power plants operating with renewable energies is performed by stationary power storage units with capacities of several megawatts which are correspondingly designed to be redundant. However, here, too, powerful protective installations are required to safeguard the systems against damage. This function can be fulfilled by SIBA fuses.

- Industrial plants use battery installations as network components to control their interaction with the public power network. Failure of these components can have negative consequences for production. This can be avoided, however – with fuses made by SIBA

Photographs: ads-tec, istockphoto/lunarchy, fotolia/Pavel Losevsky

Fuses are useful only as long as they are suitable

- Unless the data sheet explicitly allows for it, fuses designed for alternating currents cannot readily be used in DC current circuits. When, in the case of mains failure, the system changes to battery operation, this results in discharge currents whose magnitudes and temporal characteristics are similar to those of short-circuit currents. This requires faster and more specific fuses.

- Its extensive experience with ultrafast fuse solutions in comparable technical constellations, such as in power electronics, puts SIBA in a position to optimally safeguard also complex combinations of battery and mains current circuits.

- Even the standard programme of fast full-range and back-up fuses is so large that SIBA can supply you with suitable off-the shelf solutions. And SIBA's in-house R & D department is ready to help when more special solutions are called for.

Finding the correct fuse in four steps

Being a manufacturer of electrical fuses, SIBA has a portfolio which has grown over decades and comprises the most diverse products for protection against overloads and short circuits in electrical networks. While, for most areas of the installations, the fuses' applications have been standardized, it is particularly the sensitive battery circuits where the protective device is often still determined based on „best knowledge". As far as the fuses' dimensioning is concerned, a frequently heard opinion is: „rated current and rated voltage are sufficient".

With the emergence of photovoltaics, SIBA has begun to deal not only with developing special photovoltaics fuses but also with the battery circuits used in this field and requiring protection. Following technical discussions with battery manufacturers and with the help of technical universities covering this subject, SIBA has developed a rating scheme which can be applied extensively to the most common battery circuits.

This calculation scheme shows that, in addition to operating voltage and operating current, further factors have to be taken into consideration in order to be able to really interrupt the fault current in cases of fault before the installation is damaged.

Step 1:

Determination of the fuse's rated voltage

The rated DC voltage of the fuse is derived from the highest voltage occurring in the DC circuit, i.e. the battery charging voltage U_l.

$$U_{n\ sich} \geq U_l$$

In the data sheets it is stated whether the fuses have AC and/or DC breaking capacity. In cases where only a rated AC voltage is given, the fuses are only under certain conditions suitable for use in DC voltage circuits. The manufacturer should be consulted as to whether the commonly known statement "rated DC voltage = 0,7 x rated AC voltage" applies. Actually he should also be asked for the allowable time constant of the shorted circuit. Since, however, relatively small time constants (often less than 2 ms) are to be expected particularly in battery circuits, this is superfluous in most cases.

Step 2:

Determination of the fuse's lowest rated current

The relevant value in determining the fuse's lowest rated current $I_{n\ min}$ is the highest current value occurring in the battery discharge circuit, i.e. the battery discharge current I_e present at the end of the specified discharge duration t_e. This can be calculated from the inverter's input power S_n [kVA] and the end-of-discharge voltage U_e as well as from the power factor (e.g. 0.8) and the efficiency η (0,85 – 0,97 %).

$$I_e = S_n \times \cos\varphi / U_e / \eta\ \eta$$
$$I_{n\ min} \geq I_e$$

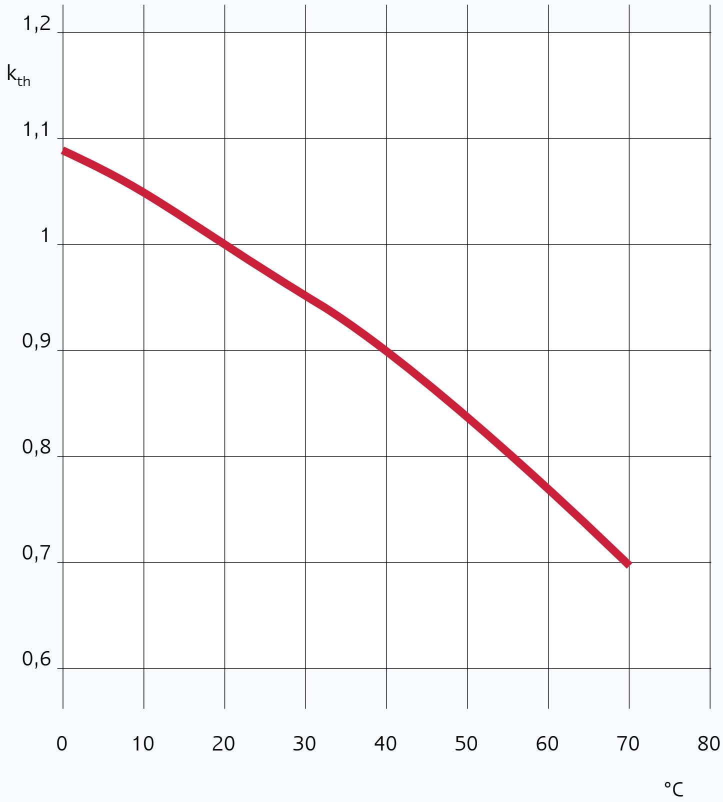
Table 1: Factor k_{Batt}

Charging/ dis-charging cycles	For the respect	
several times per day	0,7	0,7
daily	1	0,85
weekly	1	1
monthly or longer	1	1
Discharge durations	10 min	30 min

for cycles and discharge time

Factor k_{Batt} tive combination of cycle and discharge time					Application in e.g.
0,6	0,6	-	-	-	PV storage unit
0,85	0,7	0,7	0,6	0,6	Storage unit
0,85	0,85	0,7	0,7	0,6	UPS
1	0,85	0,85	0,7	0,7	UPS
60 min	3 h	5 h	10 h	20 h	

Taking the ambient temperature into consideration



Step 3: Taking secondary conditions into consideration

The intended use of the storage unit can be as influential on the selection of the fuse's rated current as are the ambient conditions present when the fuses are built into housings or control cabinets. As is generally known, there is not the ONE discharge duration, the ONE discharge current or the ONE charging/discharging frequency. Different applications are taken into consideration based on applying coefficient k_{Batt} to the minimum rated current. After all, a discharge duration of 30 minutes, combined with one single charging/discharging cycle per month, has to be regarded as different from the situation present in a PV storage unit where several cycles take place per day. In Table 1 (see above) factors k_{Batt} are given for the different applications in battery installations. In applying these factors, some required overload capability is accepted.

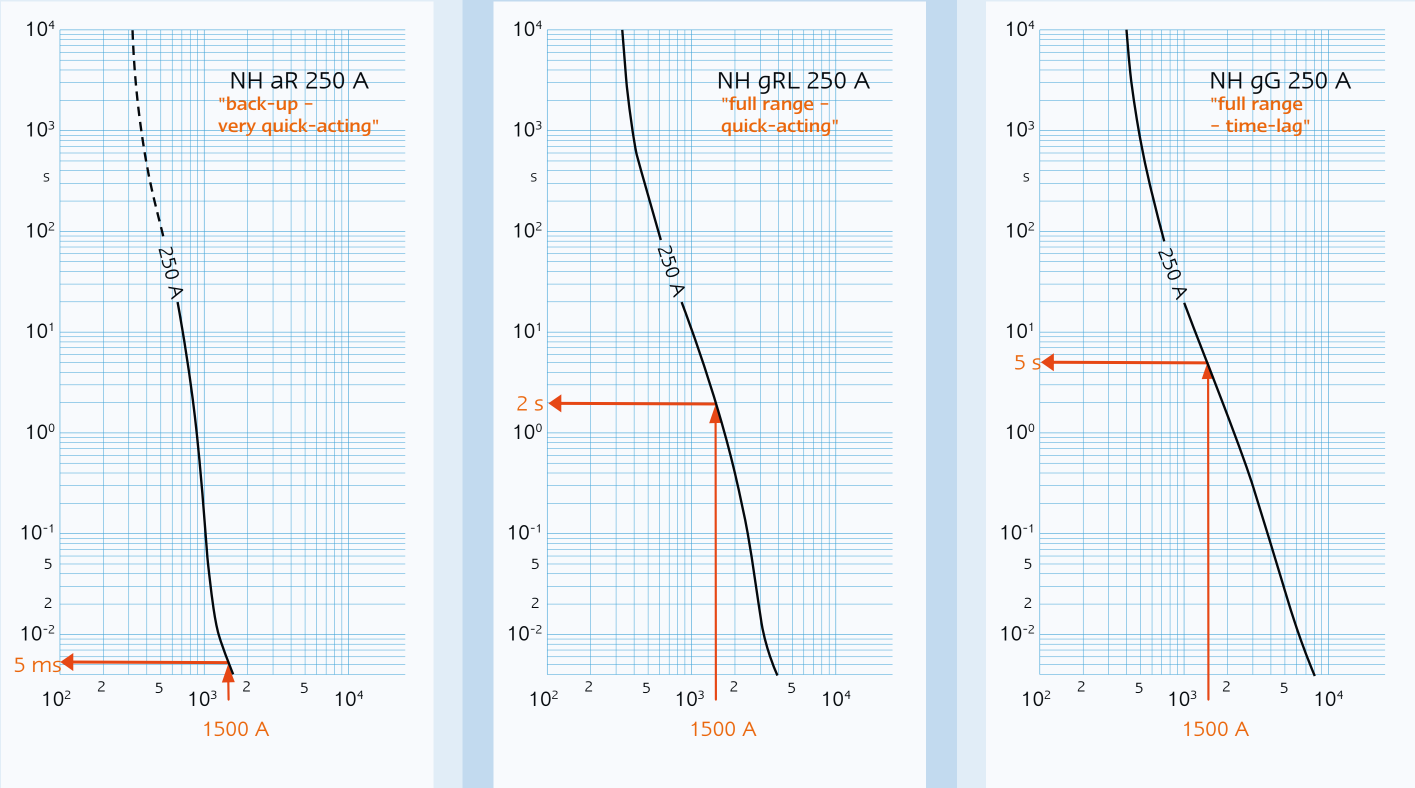
$$I_n \geq I_{n\,min} / k_{Batt}$$

An ambient temperature considerably deviating from 30 °C can also have an influence on the selection of the rated current. Here, the typical derating diagram for fuse-links can be used.

$$I_n \geq I_{n\,min} / k_{Batt} / k_{th}$$

As shown in the diagram (see above), an ambient temperature of e.g. 70 °C in the control cabinet can result in a fast reduction of a rated current of 100 A down to 70 A.

Operating classes and their time/current characteristics



Step 4: Selection of the operating class

The following operating classes are applicable for use in DC discharge circuits (see the above diagrams):
aR – back-up fuses for semiconductor protection ("back-up – very quick-acting")
gRL – full-range fuses for semiconductor and line protection ("full range – quick-acting")
gG –full-range fuses for general applications ("full range – time-lag")

Which operating class will be used in the end can be decided based upon the maximum melting time required in the case of a short circuit. To do so, first the maximum short-circuit current I_{kB} of the charged battery is calculated from the open-circuit voltage U_B and the battery's internal resistance R_B:

$$I_{kB} = 0{,}95 \times U_B / R_B$$

This value is plotted as the vertical line in the fuses' time/current diagram, then a point of interception with the selected rated current is created, now the melting time can be read off the vertical scale on the left-hand side.
If lower fault currents are to be taken into consideration, the value is plotted on the curve in the same manner, then the melting time can be read off. In the case of fault currents exceeding six to ten times the fuse's rated current also back-up fuses can be used; for fault currents below this value full-range fuses are indispensable. If the short-circuit current falls within the dashed part of the curve of a back-up fuse, this solution is not permitted.

Thus, the selection of the operating class (gG, aR, gRL) determines how fast the short-circuit current I_{kB} is interrupted.

Overview of SIBA's battery portfolio for direct current

Protection	80 V	440 V	550 V	720 V	1000 V	1500 V
Back-up protection “very quick-acting”	NH000 ... NH00 AC 690 V DC 240 V aR 6-160 A		NH1 ... NH3 AC 690 V DC 550 V aR 40-630 A	NH1 ... NH3 AC 1000 V DC 800 V aR 40-630 A	NH1 ... NH3 DC 1000 V aR 40-400 A	
	SLCT AC 240 V DC 150 V aR 5-20 A	SCT, SET, SMT, SMMT, AC 690 V DC 450 V aR, 8-710 A	14x51mm, DC 700 V aR 8—63 A		20x127mm, 27x60mm DC 1000 V aR/gR 1-170 A	
Full-range protection “quick-acting”	NH000 ... NH00 AC 690 V DC 240 V gRL 6-160 A		NH1 ... NH3 AC 690 V DC 500 V gRL 40-630 A		NH1XL ... NH3L DC 1100 V gRL 40-400 A	NH1XL ... NH3L DC 1500 V gRL 100-400 A
		14x51mm, 22x58 mm AC 690 V DC 440 V gRL, 6-100 A			14x51mm DC 1000 V gRL 20-25A	10/14x85mm DC 1500 V gRL 10-30 A
Full-range protection “time-lag”	NH000 ... NH00 AC 500 V DC 240 V gG 6-160 A	NH1 ... NH3 AC 500 V DC 440 V gG 40-630 A				
	14x51mm AC 500/400 V DC 220 V gG 1-40 A					

In the “DC lines” of the overview table given above, we present our portfolio of fuses of the applicable operating classes for different voltage ranges.

Although, in this prospectus, we describe a four-step approach to finding the suitable protection for battery circuits, the relationships between complex power storage systems are not always easy to understand, and the input quantities for calculation not always easy to determine. Our competent consulting team is happy to help you with any special requirements. Do not hesitate either to contact SIBA's team in cases of doubt concerning your calculation.

Disclaimer:

The fuses described in this document have been developed to fulfil safety-relevant functions as components of a machine or full installation. Usually, a safety-relevant system comprises signal units, sensors, evaluation units, and concepts for safe interruption. The manufacturer of an installation or machine is responsible for ensuring the correct overall function. SIBA GmbH and its selling agencies (in the following referred to as “SIBA”) are not in a position to guarantee all properties of a full installation or machine which has not been designed by SIBA. Any product selected should be tested by the user for all its intended applications. Neither does SIBA assume liability for recommendations based on or implied by the above description. No guarantee, warranty or liability claims going beyond SIBA's general terms of delivery may be derived from the description.

State of technology and standardization:

Both technology and technical standards are subject to permanent further development. Thus, this document represents the state of technology available at the time of printing. This shall be taken into consideration when using the information and the types listed in the product programme.

Hauptsitz / Head Office

SIBA GmbH
Borker Straße 20-22
D-44534 Lünen
Postfach 1940
D-44509 Lünen
Tel.: +49-2306-7001-0
Fax: +49-2306-7001-10
info@siba.de
www.siba.de

SIBA Unit Miniature Fuses
Tel.: +49-2306-7001-290
Fax: +49-2306-7001-99
elu@siba.de

Deutschland / Germany

SIBA Vertriebsbüro Freiberg
Untergasse 12
D-09599 Freiberg
Tel.: +49-3731-202283
Fax: +49-3731-202462
alexander.kolbe@siba.de

SIBA Vertriebsbüro Rhein/Ruhr
Espelweg 25
D-58730 Fröndenberg
Tel.: +49-2373-1753141
Fax: +49-2373-1753142
joerg.mattusch@siba.de

SIBA Vertriebsbüro Süd-West
Germersheimer Str. 101a
D-67360 Lingenfeld
Tel.: +49-6344-937510
Fax: +49-6344-937511
erwin.leuthner@siba.de

SIBA Vertriebsbüro Kassel
Sieberweg 20
D-34225 Baunatal
Tel.: +49-5601-965300
Fax: +49-5601-965301
achim.fischer@siba.de

SIBA Vertriebsbüro Bayern
Kirchstraße 12
D-86316 Friedberg
Tel.: +49-821-58955260
Fax: +49-821-58955261
guenther.heinz@siba.de

International

SIBA Sicherungen- und Schalterbau Ges.m.b.H & Co. KG (Austria)
Ortsstraße 18 · A-2331 Vösendorf bei Wien
Tel.: +43-1-6994053 und 6992592
Fax: +43-1-699405316 und 699259216
info.siba@aon.at
www.siba-sicherungen.at

SIBA GmbH Beijing Rep. Office (China)
Rm 1609, Block B, Lucky Tower
No. 3, Dongsanhuan Beilu , Chaoyang district
Beijing 100027
Tel.: +86-10-65817776
Fax: +86-10-64686648
siba_china@sibafuse.cn
www.sibafuse.cn

SIBA Písek s.r.o. (Czech Rep.)
U Vodárny 1506 · 397 01 Písek
Tel.: +420-38-2265746
Fax: +420-38-2265746
sibacz@iol.cz · www.siba-pojistky.cz

SIBA Sikringer Danmark A/S (Denmark)
Lunikvej 24 B
DK-2670 Greve
Tel.: +45-86828175 · Fax: +45-86814565
info@sikringer.dk · www.siba-sikringer.dk

SIBA Nederland B.V. (Netherlands)
Van Gentstraat 16
NL-5612 KM Eindhoven
Tel.: +31-40-2467071
Fax: +31-40-2439916
info@sibafuses.nl · www.siba-zekeringen.nl

SIBA Polska sp. z o.o. (Poland)
ul. Grzybowa 5G
05-092 Łomianki Dąbrowa Leśna
Tel.: +48-22-8321477
Fax: +48-22-8339118
siba@siba-bezpieczniki.pl
www.siba-bezpieczniki.pl

„SIBA GmbH“ (Russia)
ul. Petrovka 27
Moskva 107031
Tel.: +7-495-9871413
Fax: +7-495-9871774
info@siba-predohraniteli.ru
www.siba-predohraniteli.ru

SIBA Fuses SA PTY. LTD. (South Africa)
P.O. Box 34261
Jeppestown 2043
Tel.: +27-11334-6560 / 4
Fax: +27-11334-7140
sibafuses@universe.co.za
www.siba-fuses.co.za

SIBA Far East Pte. LTD. (South East Asia)
24 Sin Ming Lane, # 07 – 105
Midview City, Singapore 573970, Republic of Singapore
Tel.: +65-66599449
Fax: +65-66594994
info@sibafuse.com.sg
www.sibafuse.com.sg

SIBA (UK) LTD. (United Kingdom)
19 Duke Street
Loughborough. Leics. LE11 1ED
Tel.: +44-1509-269719
Fax: +44-1509-236024
siba.uk@btconnect.com
www.siba-fuses.co.uk

SIBA Fuses LLC (United States of America)
29 Fairfield Place
West Caldwell, NJ 07006
Tel.: +1-973575-7422 (973-575-SIBA)
Fax: +1-973575-5858
info@sibafuses.com
www.sibafuses.com

Weitere Vertriebspartner weltweit / Further distribution partners worldwide: www.siba.de / www.siba-fuses.com

Stand 4/2016

SIBA
Sicherungen | Fuses

Our Protection. Your Benefit.