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LV-
HRC fuse-
links

HV-
HRC fuse-
links

D-
type fuse-
links

D-
type fuse-
bases

Switch-dis-
connector-fuses
(SASIL) LV HRC
system

Switch-
disconnecter-
fuses (SASIL)
BS system

Terminals

LV
HRC strip-
fuseways

LV HRC
strip-type fuse
switch-disconnectors

LV HRC
fuse-
bases

LV HRC
fuse switch-
disconnectors

Busbar system
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Consumer
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Distribution
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Semiconductor protection fuse-links

Information on semiconductor protection fuse-links

<p>Semiconductor (protection) fuse-links are fuse-links whose fusing and suppressor characteristics (fusing + suppression = breaking) are specially designed for the protection of semiconductor components. Semiconductor fuse-links have lower breaking integrals than line protection fuse-links (gL; gG) or transformer protection fuse-links (gTr).</p> <p>Since the limit integrals of semiconductor components, i.e. their maximum permissible resistive loads, have been constantly reduced, semiconductor fuse-links with ever faster characteristics</p>	<p>(quick acting → very quick acting / high speed → super quick acting → hyper quick acting) have been designed.</p> <p>The faster semiconductor fuse-links protect semiconductor components only against short-circuit currents and are not capable of breaking overload currents until a sufficient overcurrent level called minimum breaking current has been reached (partial breaking capacity).</p> <p>Overload currents, i.e. currents greater than the rated current and less than the minimum breaking current, must be bro-</p>	<p>ken by other overcurrent protective devices, which is usually easy to achieve.</p> <p>The power dissipation of a semiconductor fuse-link is influenced by its characteristic.</p> <p>Semiconductor fuse-links generally have lower power dissipation values than gL/gG or gTr fuse-links, which makes it necessary to improve their heat dissipation. They are thus preferably equipped with screw or threaded contacts. When using semiconductor fuse-links with blade contacts, it must be ensured that the power dissipation of each fuse-link does not</p>	<p>exceed the rated power input of the base or fuse switch-disconnector. As a general rule, faster fuses have higher power dissipation values.</p> <p>The recent use of more "robust" semiconductor components with higher limit integrals has led to applications in which the feeder cable is to be protected against overcurrents in addition to the semiconductor component, i.e. in which overload protection is required. Less fast, or slow fuse-links have therefore been developed which are capable of breaking all melting currents (full breaking capacity).</p>
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Here is a general overview of all characteristics of our semiconductor fuse-links:

üf2	Quick acting	Overload protection	gR	Silica sand	Art. No.: Rx2xxxxx
üf1	Very quick acting	Short-circuit protection	aR	Silica sand	Art. No.: Rx1xxxxx
üfo1	Super quick acting	Short-circuit protection	aR	Solid filler	Art. No.: Rx0xxxxx
üfo2	Hyper quick acting	Short-circuit protection	aR	Solid filler	Art. No.: Rx3xxxxx
üf3	Slow (less fast)	Overload protection	gR	Silica sand	Art. No.: Rx5xxxxx

Quick acting breaking capacity is achieved by the use of pure silver fuses with special bottleneck dimensioning and/or special quenching sand properties (e.g. solid filler). Slow fuse-links have silver fuses with solder coatings. The 5 characteristics specific of JEAN MÜLLER are summarized in the utilization categories gR (full breaking capacity) and aR (partial breaking capacity) in accordance with VDE standards.

JEAN MÜLLER equivalence lists allow users to find the corresponding JM article number where the type ID of a competitor is known. Equivalence in this context means that a JM fuse-link has technical data at least equivalent to those of a competitor.

The rated voltage of semiconductor fuse-links is generally stated in accordance with the switching capacity tests for alternating current.

The corresponding rated voltage for direct current applications, for which semiconductor fuse-links are frequently used due to their higher breaking capacity, generally must be determined by switching capacity tests. Such a test will focus on the circuit inductance, which must correspond to the application at hand, e.g. in a DC intermediate circuit or for the protection against IGBT short circuits.

Higher inductance is associated with a higher time constant L/R and a lower breaking capacity or rated DC voltage. As a rule of thumb, at least 50% of the maximum rated AC voltage of a fuse-link may be assumed for its rated DC voltage if the time constant is not greater than 20msec.

A higher breaking capacity can only be guaranteed on the strength of a practical test.

Distribution and instrument cabinets

Current carrying capacity of distribution and instrument cabinets for outdoor use

Determination of the nominal power dissipation P_V and the rated current I_e of standard cable distribution cabinets, "KVS/222" and "KVS/10" series, equipped with LV HRC strip-fuseways, types L and SL. Temperature-rise tests were conducted at the standard cable distribution cabinet of the "10" series, size 0, type KVS0-10/SV/5L2, equipped with 5 size 2 (400A) LV HRC strip-fuseways in accordance with VDE 0660 Part 503. The load current I_B was set to the limit current of the LV HRC fuse-links. Temperatures were measured at the following locations:

Test values:

I_e	Rated current	315 A
T1	Surface of the central top LV HRC fuse-links	120 °C
T2	Internal temperature of cabinet below top	75 °C
T3	Max. connection temperature of the central strips	60 °C
T4	Exhaust air temperature at cabinet	70 °C
T5	Surface temperature, top, external	46 °C
T6	Surface temperature, door, external	36 °C
Room temperature		25 °C

1. Nominal power dissipation P_V of KVS0-10: 550 W.
 2. Rated current I_e of KVS0-10: 315A.
 Nominal power dissipation values P_V for maximally equipped standard cable distribution cabinets of all sizes:

KVS-222 size ^{*)}	Surface m ²	Nominal power dissipation P_V (W)
KVS 00/222	1.26	400
KVS 0/222	1.46	470
KVS 1/222	2.01	650

^{*)} DIN 43629 / T.4

KVS-10 size ^{**)}	Surface m ²	Nominal power dissipation P_V (W)
KVS 00-10	1.50	490
KVS 0-10	1.75	550
KVS 1-10	2.15	700
KVS 2-10	2.82	900
NKVS 3-850	3.49	1110

^{**)} DIN 43629, Parts 1 and 2

Evaluation: The nominal power dissipation P_V of equipped JEAN MÜLLER standard cable distribution cabinets is determined by the continuous loading capability of the LV HRC fuses, not by overheating. If the individual power dissipation values of the built-in devices are known, the rated currents I_e can be calculated.

LV-HRC fuse-links

HV-HRC fuse-links

D-type fuse-links

D-type fuse-bases

Switch-disconnector-fuses (SASIL) LV HRC system

Switch-disconnector-fuses (SASIL) BS system

Terminals

LV HRC strip-fuseways

LV HRC strip-type fuse switch-disconnectors

LV HRC fuse-bases

LV HRC fuse switch-disconnectors

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Distribution and instrument cabinets

Electronic monitoring devices

Measurement data acquisition systems

Software

Distribution and instrument cabinets

Avoiding condensation in distribution and instrument cabinets

Due to the outdoor atmospheric conditions, condensed water develops in cable and distribution cabinets and precipitates at the inner surfaces. This humidity may lead to the corrosion of the metal parts and to the formation of creepage currents.

Measures for avoiding excessive condensation:

1. Ventilation of the cabinet through existing ventilation slots in accordance with IP44

The existing ventilation slots in the lower part of the door and the rear panel and in the upper area between the top plate and door or rear panel are capable of dehumidifying the cabinet interior with the support of the heat produced by the power dissipation of fuse elements under the condition that the size of the ventilation slots is proportional to the width of the cabinet. This condition is fulfilled by the

design of JEAN MÜLLER distribution and instrument cabinets, whose ventilation slots are located at the lower and upper sides of the door and rear panel.

2. Protection against ground moisture

An effective dehumidification of the cabinet interior can only be

achieved if the latter is protected against rising ground moisture. Such a protection can be implemented by filling in fine-grained sand up to the ground surface level.

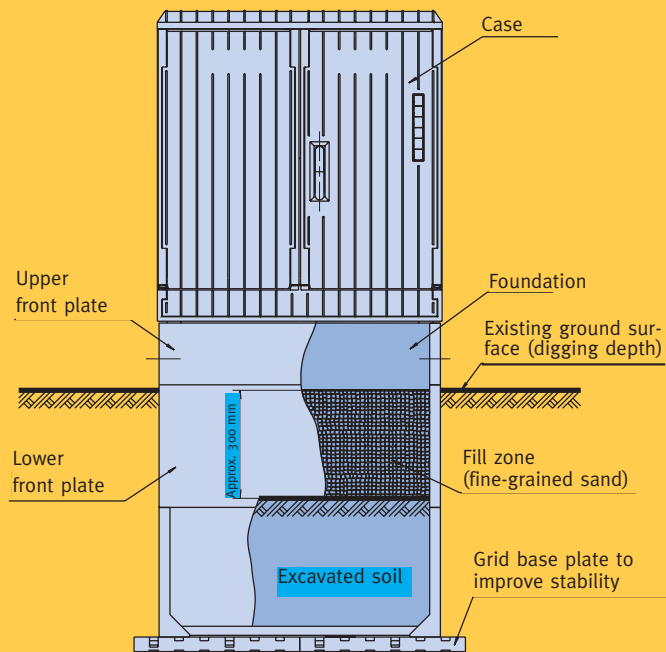
Application:

The foundation is filled with excavated soil up to a height of approx. 300 mm below the

ground surface level. A layer of sand of approx. 300 mm height is filled above this. This sand layer effectively prevents the rising of moisture, as has been proven many times in practice.

Filling cross-section of the base:

- see illustration -



Distribution and instrument cabinets

UV protection of cabinets made of glass-fibre-reinforced polyester

Depending on the site and climatic zone, the surface of a distribution and instrument cabinet is more or less damaged by UV radiation. Such damage takes the form of surface erosion. This particularly affects surfaces facing the sun. The reduction in material thickness involved is very low (50 µm in 20 years), so that the mechanical properties of the case are not impaired.

After a number of years, the glass fibres immediately below the surface will be exposed. Skin contact may thus produce irritations. In addition, the increased roughness will accelerate the development of moss.

Effective protection against UV radiation and thus surface erosion is provided by coating with UV varnish.

1. Surface coating is to ensure the following:

- a) Prevention of surface erosion of the cabinet as a consequence of UV radiation.

- b) UV protection as sub a) with an additional anti-adhesive for spray varnishes (graffiti).

- c) UV protection as sub a) with an additional anti-adhesive for posters.

2. Potential measures for new cabinets:

- a) Surface coating with a two-component acrylic resin: This surface coating effectively prevents the yellowing and subsequent erosion of the glass-fibre-reinforced polyester resin. Depending on the site, surfaces with a poly-acrylic coating are protected against UV radiation for a period of 15 to 20 years. After that period, the cabinet may be revarnished if a loss of brilliance has occurred.

- b) Surface coating with a two-component acrylic resin which comprises an additional anti-adhesive for spray varnishes (anti-graffiti coating). This provides the same

- UV protection as sub a) but with an option to remove spray varnishes with a cleaning paste.

- c) Surface coating with a two-component acrylic resin which comprises an anti-adhesive for posters (anti-poster coating).

3. Potential measures for secondary treatment:

- a) Coating with a single-component acrylic resin. This provides effective protection against UV radiation, but has to be repeated after a short period of time (8 - 10 years) because of the low durability of the varnish.

- b) Coating with a two-component acrylic resin. This provides the same protection as sub 2a).

- c) Surface coating with a two-component acrylic resin which comprises an anti-adhesive for spray varnishes

- (anti-graffiti coating). This provides the same protection as sub 2b).

- d) Surface coating with a two-component acrylic resin which comprises an anti-adhesive for posters (anti-poster coating). This provides the same protection as sub 2c).

4. Required surface preparation for secondary treatment:

Degreasing by washing with a detergent dissolved in water. Subsequently, removal of dirt and loose material particles with a cleaning brush or fleece. To ensure good adhesive properties of the surface coating, the varnish must be pigmented (coloured), generally light grey (RAL7035), as the polyester used. Transparent varnishes are not capable of filtering UV radiation. The surface below the varnish will thus erode, which will deteriorate the adhesive properties.

LV-HRC fuse-links

HV-HRC fuse-links

D-type fuse-links

D-type fuse-bases

Switch-disconnector-fuses (SASIL) LV HRC system

Switch-disconnector-fuses (SASIL) BS system

Terminals

LV HRC strip-fuseways

LV HRC strip-type fuse switch-disconnectors

LV HRC fuse-bases

LV HRC fuse switch-disconnectors

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IP types of protection

IP types of protection given to electrical equipment by cases and covers, in accordance with IEC/EN 60529 (extract)

1st numeral		2nd numeral
Protection against contact	Protection against foreign bodies	Protection against water
IP00 No special protection	No special protection	No special protection
IP20 With fingers	Solid particles, $\varnothing > 12\text{mm}$	No special protection
IP41 With tools etc.	Solid particles, $\varnothing > 1\text{mm}$	No harmful effect from water dripping vertically
IP43 With tools etc.	Solid particles, $\varnothing > 1\text{mm}$	No harmful effect from spray water (any direction up to 60° from the vertical)
IP54 Complete protection	Harmful dust deposits in interior	No harmful effect from splashing water (any direction)
IP55 Complete protection	Harmful dust deposits in interior	No harmful effect from hosed water
IP65 Complete protection	Dust protection (dust-proof)	No harmful effect from hosed water
IP66 Complete protection	Dust protection (dust-proof)	No harmful effect from temporary flooding
IP67 Complete protection	Dust protection (dust-proof)	No harmful effect from temporary immersion
IP68 Complete protection	Dust protection (dust-proof)	No harmful effect from permanent immersion
IP69 K Complete protection	Dust protection (dust-proof)	No harmful effect from water directed against the case under very high pressure and from any direction (high pressure / steam jet hoses, 80 – 100 bar)

Protection against electric shock in accordance with IEC 60536 and VDE 0106 Part 100

IEC 60536 covers the erection of electrical equipment and its arrangement in electrical systems with rated voltages of up to 1000 VAC ~ and 1500 VDC, with regard to protection against direct contact where actuators such as push-buttons and toggle switches are located in the vicinity of live

parts. "Finger-proofing" relates only to the actuator, and only to the normal direction of operation. A clearance of at least 30 mm radius must be ensured from the centre point of the actuator to any live parts. Type of protection IP20 is superior to "finger-proofing" in that it embodies

protection against contact with electrical equipment in any direction. Devices which are "finger-proof" and are protected to IP00 can be provided with further protection against contact in the form of covering if required.

Utilization categories

Utilization categories for fuse combination units in accordance with IEC/EN 60947-3 and VDE 0660 Part 107

AC

Utilization category	Typical applications	Verification of electrical endurance						Verification of making and breaking capacities								
		Make			Break			Make			Break					
		I_e A	$\frac{I}{I_e}$	$\frac{U}{U_e}$	$\cos \varphi$	$\frac{I_c}{I_e}$	$\frac{U_f}{U_e}$	$\cos \varphi$	I_e A	$\frac{I}{I_e}$	$\frac{U}{U_e}$	$\cos \varphi$	$\frac{I_c}{I_e}$	$\frac{U_f}{U_e}$	$\cos \varphi$	
AC-20A(B) ¹⁾	Connecting and disconnecting under no-load conditions	3)	2)	2)	2)	2)	2)	2)	2)	3)	2)	1.05	2)	2)	1.05	2)
AC-21A(B) ¹⁾	Switching of resistive loads, including slight overloads	3)	1	1	0.95	1	1	0.95	3)	1.5	1.05	0.95	1,5	1.05	0.95	
AC-22A(B) ¹⁾	Switching of mixed resistive and inductive loads, including slight overloads	3)	1	1	0.8	1	1	0.8	3)	3	1.05	0.65	3	1.05	0.65	
AC-23A(B) ¹⁾	Switching of motor loads and other highly inductive loads	3)	1	1	0.65	1	1	0.65	4)	10	1.05	0.45	8	1.05	0.45	
									5)	10	1.05	0.35	8	1.05	0.55	

DC

Utilization category	Typical applications	Verification of electrical endurance						Verification of making and breaking capacities								
		Make			Break			Make			Break					
		I_e A	$\frac{I}{I_e}$	$\frac{U}{U_e}$	L/R ms	$\frac{I_c}{I_e}$	$\frac{U_f}{U_e}$	L/R ms	I_e A	$\frac{I}{I_e}$	$\frac{U}{U_e}$	L/R ms	$\frac{I_c}{I_e}$	$\frac{U_f}{U_e}$	L/R ms	
DC-20A(B) ¹⁾	Connecting and disconnecting under no-load conditions	3)	2)	2)	2)	2)	2)	2)	2)	3)	2)	1.05	2)	2)	1.05	2)
DC-21A(B) ¹⁾	Switching of resistive loads, including slight overloads	3)	1	1	1	1	1	1	3)	1.5	1.05	1	1,5	1.05	1	
DC-22A(B) ¹⁾	Switching of mixed resistive and inductive loads, including overloads (e.g. shunt motors)	3)	1	1	2	1	1	2	3)	4	1.05	2.5	4	1.05	2.5	
DC-23A(B) ¹⁾	Switching of highly inductive loads (e.g. series motors)	3)	1	1	0.75	1	1	7.5	3)	4	1.05	15	4	1.05	15	

I = Making current
 I_c = Breaking current
 I_e = Rated operational current
 U = Voltage
 U_e = Rated operational voltage

¹⁾ A: frequent actuation, B: occasional actuation.
²⁾ If the switching device has a making and/or breaking capacity, the values for the current and the power factor (time constants) must be stated by the manufacturer.
³⁾ All values
⁴⁾ $I_e \leq 100$ A
⁵⁾ $I_e > 100$ A

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Temperature-rise limits

Temperature-rise limits of fuse combination units in accordance with IEC/EN 60 947-1 and VDE 0660 Part 100

a) Temperature-rise limits of connections

Connection material	Temperature-rise limit in K
Copper, blank	60
Copper-zinc alloy, blank	65
Copper or copper-zinc alloy, tin-plated	65
Copper or copper-zinc alloy, silver-plated or tin-plated	70
Other metal parts	65

b) Temperature-rise limits of accessible parts

Accessible part	Temperature-rise limit in K
Manually operated actuators:	
• Metallic	15
• Non-metallic	25
Parts which are touched but not gripped:	
• Metallic	30
• Non-metallic	40
Parts which need not be touched during normal actuation:	
Outside surface of cases, near the cable inlet	
• Metallic	40
• Non-metallic	50
Outside surface of cases which contain resistors	200
Air from ventilation apertures of cases which contain resistors	200

Temperature-rise limits of low voltage assemblies in accordance with IEC/EN 60 439-1 and VDE 0660 Part 500

Assembly components	Temperature-rise limit in K
Built-in equipment	In accordance with the relevant standards, if such standards exist, or in accordance with the manufacturer's specifications taking into account the internal temperature of the assembly.
• Conventional switchgear	
• Electronic modules	
• Equipment components	
Connections for insulated conductors introduced from the outside	70
• Busbars	Limiting factors: <ul style="list-style-type: none"> • Mechanical strength of the conductor materials • Potential influence on neighbouring equipment • Permissible temperature-rise limit of the insulating material touched by the conductor • Effects of the conductor temperature on connected devices • Type and surface of the contact material for plug-in contacts
• Conductors	
• Plug-in contacts of removable parts	
Actuators which are accessible from the outside	
• Metallic	15
• Insulating material	25
External surfaces of cases or covers which are accessible from the outside	
• Metallic	30
• Insulating material	40
External surfaces of cases or covers which are accessible from the outside but need not be touched during normal operation	
• Metallic	40
• Insulating material	50
Plug-in connections	Limiting factors are the values for the equipment of which they form part

Low voltage assemblies

TTA/PTTA verification

Verification and testing of type-tested and partially type-tested assemblies

Ser. no.	Requirement	TTA	PTTA
1	Temperature-rise limit	Verification of compliance by - (Type) testing	Verification of compliance by - (Type) testing - Extrapolation/calculation in accordance with VDE 0660 Part 507; 1997-11
2	Insulation properties	Verification by - (Type) testing	Verification by - Testing or - Verification of the insulation resistance
3	Short-circuit strength	Verification by - (Type) testing	Verification by - Testing or - Extrapolation of similar type-tested assemblies / calculation in accordance with VDE 0660 Part 509; 1993-09
4	Effectiveness of the protective-conductor circuit Correct connection between the assembly components and the protective-conductor circuit Short-circuit strength of the protective-conductor circuit	Verification of correct connection between the assembly components and the protective-conductor circuit by - Inspection or - Resistance measuring (type testing) Verification by - (Type) testing	Verification of correct connection between the assembly components and the protective-conductor circuit by - Inspection or - Resistance measuring Verification by - Testing or - Corresponding design and arrangement of the protective conductor
5	Clearances and creepage distances	Verification by - (Type) testing	Verification by - Testing
6	Mechanical function	Verification by - (Type) testing	Verification by - Testing
7	IP type of protection	Verification by - (Type) testing	Verification by - Testing
8	Wiring and electrical function	Verification by - Inspection of the assembly including the wiring and electrical function testing (if required) (routine testing)	Verification by - Inspection of the assembly including the wiring and electrical function testing (if required)
9	Insulation	Verification by - Insulation testing (routine testing)	Verification by - Insulation testing or - Verification of the insulation resistance
10	Protective measures	Verification by - Checking of the protective measures and the continuous protective-conductor circuits (routine testing)	Verification by - Checking of the protective measures
11	Insulation resistance		Verification of the insulation resistance if no insulation property test has been conducted (see ser. nos. 2 and 9)

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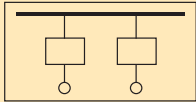
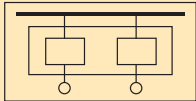
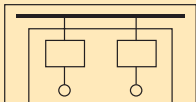
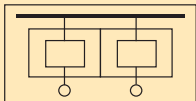
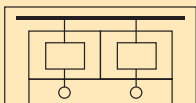
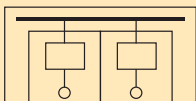
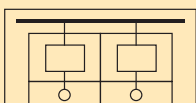
Software

Low voltage assemblies

Compartmentalization of assemblies in accordance with DIN/EN 60 439-1:2000-08

<p>Modern low voltage assemblies must comply with operational safety and personnel protection requirements.</p> <p>The division of switchgear cabinets into separate function sections and their compartmentalization are prerequisites for:</p> <ul style="list-style-type: none"> - High availability 	<ul style="list-style-type: none"> - Exchangeability of the built-in switchgear under operational conditions, i.e. while the system is energized - Short downtimes for maintenance and testing. <p>A switchgear cabinet is divided into the following function sections:</p>	<ul style="list-style-type: none"> - Device compartment - Busbar compartment (main and field distributor busbar system) - Cable compartment <p>Type of protection IP2X or above is required to prevent the ingress of solid foreign bodies from a function unit into an adjacent unit. In addition,</p>	<p>type of protection IPXXB or above is required to prevent contact with live parts of an adjacent unit.</p> <p>The compartmentalization design and higher protection than described above must be agreed between the manufacturer and the user.</p>
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Compartmentalization by covers or barriers

Design	Main characteristic	Connections	Image
Design 1	No compartmentalization		
Design 2a	Compartmentalization between the busbars and function units	External conductor connections not separated from the busbars	
Design 2b	Compartmentalization between the busbars and function units	External conductor connections separated from the busbars	
Design 3a	Compartmentalization between the busbars and function units and between the function units	External conductor connections not separated from the busbars	
Design 3b	Compartmentalization of the external conductor connections and function units, but no compartmentalization between the conductor connections	External conductor connections not separated from the busbars	
Design 4a	Compartmentalization between the busbars and function units and between the function units including the external conductor connections which are an integral part of the function units.	External conductor connections in the same compartment as the corresponding function unit	
Design 4b	Compartmentalization between the busbars and function units and between the function units including the external conductor connections which are an integral part of the function units.	External conductor connections not in the same compartment as the corresponding function units, but in a separate enclosed and protected section or compartment.	

Current carrying capacity / aluminium busbars

Continuous currents in accordance with DIN 43 670 for rectangular E-Al busbars used in indoor systems at 35°C air temperature and 65°C busbar temperature

			Continuous current in A							
			AC up to 60 Hz				DC/AC up to 16 ^{2/3} Hz			
			Painted		Blank		Painted		Blank	
			Number of busbars		Number of busbars		Number of busbars		Number of busbars	
Width x thickness [mm]	Cross-section [mm ²]	Weight ¹⁾ [kg/m]	I	II	I	II	I	II	I	II
12 x 2	23.5	0.0633	97	160	84	142	97	160	84	142
15 x 2	29.5	0.0795	118	190	100	166	118	190	100	166
15 x 3	44.5	0.120	148	252	126	222	148	252	126	222
20 x 2	39.5	0.107	150	240	127	206	150	240	127	206
20 x 3	59.5	0.161	188	312	159	272	188	312	159	272
20 x 5	99.1	0.268	254	446	214	392	254	446	214	392
20 x 10	199	0.538	393	730	331	643	393	733	331	646
25 x 3	74.5	0.201	228	372	190	322	228	372	191	322
25 x 5	124	0.335	305	526	255	460	305	528	255	460
30 x 3	89.5	0.242	267	432	222	372	268	432	222	372
30 x 5	149	0.403	356	606	295	526	356	608	296	528
30 x 10	299	0.808	536	956	445	832	538	964	447	839
40 x 3	119	0.323	346	550	285	470	346	552	285	470
40 x 5	199	0.538	456	763	376	658	457	766	376	662
40 x 10	399	1.08	677	1180	557	1030	682	1200	561	1040
50 x 5	249	0.673	556	916	455	786	558	924	456	794
50 x 10	499	1.35	815	1400	667	1210	824	1440	674	1250
60 x 5	299	0.808	655	1070	533	910	658	1080	536	924
60 x 10	599	1.62	951	1610	774	1390	966	1680	787	1450
80 x 5	399	1.08	851	1360	688	1150	858	1390	694	1180
80 x 10	799	2.16	1220	2000	983	1720	1250	2150	1010	1840
100 x 5	499	1.35	1050	1650	846	1390	1060	1710	858	1450
100 x 10	999	2.70	1480	2390	1190	2050	1540	2630	1240	2250
100 x 15	1500	4.04	1800	2910	1450	2500	1930	3380	1560	2900
120 x 10	1200	3.24	1730	2750	1390	2360	1830	3090	1460	2650
120 x 15	1800	4.86	2090	3320	1680	2850	2280	3950	1830	3390
160 x 10	1600	4.32	2220	3470	1780	2960	2380	4010	1900	3420
160 x 15	2400	6.47	2670	4140	2130	3540	2960	5090	2370	4360
200 x 10	2000	5.40	2710	4180	2160	3560	2960	4940	2350	4210
200 x 15	3000	8.09	3230	4950	2580	4230	3660	6250	2920	5350

¹⁾ Weight calculated with a density of 2.7kg/dm³

- LV-HRC fuse-links
- HV-HRC fuse-links
- D-type fuse-links
- D-type fuse-bases
- Switch-disconnector-fuses (SASIL) LV HRC system
- Switch-disconnector-fuses (SASIL) BS system
- Terminals
- LV HRC strip-fuseways
- LV HRC strip-type fuse switch-disconnectors
- LV HRC fuse-bases
- LV HRC fuse switch-disconnectors
- Busbar system components
- Consumer supply technology
- Distribution and instrument cabinets
- Electronic monitoring devices
- Measurement data acquisition systems

Current carrying capacity/copper busbars

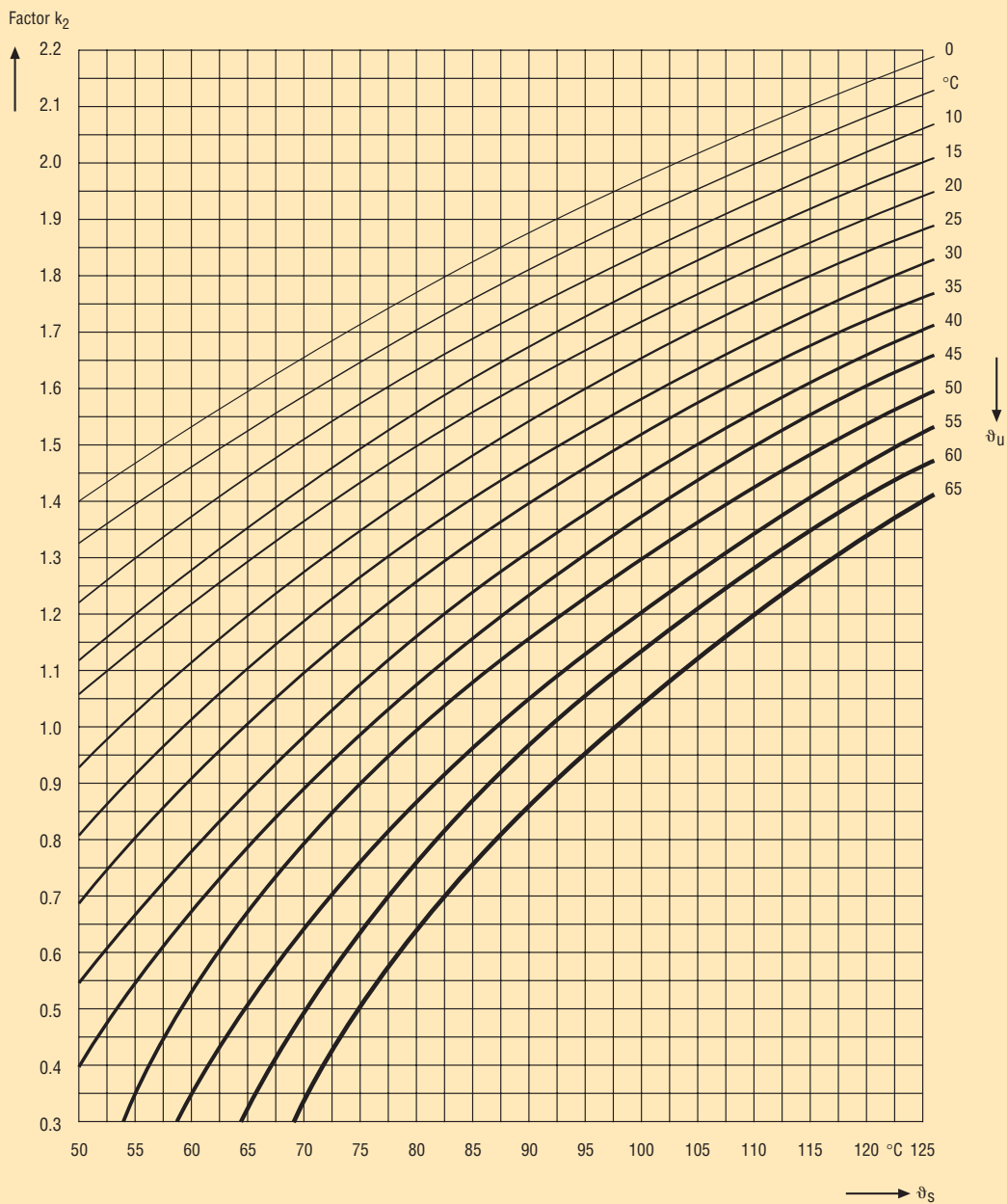
Continuous currents in accordance with DIN 43 670 for rectangular E-Cu busbars used in indoor systems at 35°C air temperature and 65°C busbar temperature

			Continuous current in A							
			AC up to 60 Hz				DC/AC up to 16 ^{2/3} Hz			
			Painted Number of busbars		Blank Number of busbars		Painted Number of busbars		Blank Number of busbars	
Width x thickness [mm]	Cross- section [mm ²]	Weight ²⁾ [kg/m]	I	II	I	II	I	II	I	II
12 x 2	23.5	0.209	123	202	108	182	123	202	108	182
15 x 2	29.5	0.262	148	240	128	212	148	240	128	212
15 x 3	44.5	0.396	187	316	162	282	187	316	162	282
20 x 2	39.5	0.351	189	302	162	264	189	302	162	266
20 x 3	59.5	0.529	237	394	204	348	237	394	204	348
20 x 5	99.1	0.882	319	560	274	500	320	562	274	502
20 x 10	199	1.77	497	924	427	825	499	932	428	832
25 x 3	74.5	0.663	287	470	245	412	287	470	245	414
25 x 5	124	1.11	384	662	327	586	384	664	327	590
30 x 3	89.5	0.796	337	544	285	476	337	546	286	478
30 x 5	149	1.33	447	760	379	672	448	766	380	676
30 x 10	299	2.66	676	1200	573	1060	683	1230	579	1080
40 x 3	119	1.06	435	692	366	600	436	696	367	604
40 x 5	199	1.77	573	952	482	836	576	966	484	878
40 x 10	399	3.55	850	1470	715	1290	865	1530	728	1350
50 x 5	249	2.22	697	1140	583	994	703	1170	588	1020
50 x 10	499	4.44	1020	1720	852	1510	1050	1830	875	1610
60 x 5	299	2.66	826	1330	688	1150	836	1370	696	1190
60 x 10	599	5.33	1180	1960	985	1720	1230	2130	1020	1870
80 x 5	399	3.55	1070	1680	885	1450	1090	1770	902	1530
80 x 10	799	7.11	1500	2410	1240	2110	1590	2730	1310	2380
100 x 5	499	4.44	1300	2010	1080	1730	1340	2160	1110	1810
100 x 10	999	8.89	1810	2850	1490	2480	1940	3310	1600	2890
120 x 10	1200	10.7	2110	3280	1740	2860	2300	3900	1890	3390
160 x 10	1600	14.2	2700	4130	2220	3590	3010	5060	2470	4400
200 x 10	2000	17.8	3290	4970	2690	4310	3720	6220	3040	5390

²⁾ Weight calculated with a density of 8.9 kg/dm³

Current carrying capacity / correction factor for busbar/air temperatures

Correction factor k₂ for copper busbars at varied busbar and air temperatures



Factor k_2 to determine the conductor cross-section of copper busbars at ambient temperatures ϑ_u of 0 to 60°C and/or operating temperatures ϑ_s up to 125°C

Current carrying capacity/insulated cables

Current carrying capacity of insulated cables in accordance with DIN VDE 0100 Part 523

Nominal cross-section [mm ²]	Group 1		Group 2		Group 3	
	One or more single-core cables installed in conduits		Multi-core cables, e.g. light plastic-sheathed cables, pipelines, flat webbed cables and flexible cables		Single-core, in free air, spacing of the cables corresponds at least to their diameter	
	Cu conductor [A]	Al conductor [A]	Cu conductor [A]	Cu conductor [A]	Cu conductor [A]	Al conductor [A]
0.75	-	-	12	-	15	-
1.0	11	-	15	-	19	-
1.5	15	-	18	-	24	-
2.5	20	15	26	20	32	26
4	25	20	34	27	42	33
6	33	26	44	35	54	42
10	45	36	61	48	73	57
16	61	48	82	64	98	77
25	83	65	108	85	129	103
35	103	81	135	105	158	124
50	132	103	168	132	198	155
70	165	-	207	163	245	193
95	197	-	250	197	292	230
120	235	-	292	230	344	268
150	-	-	335	263	391	310
185	-	-	382	301	448	353
240	-	-	453	357	528	414
300	-	-	504	409	608	479
400	-	-	-	-	726	569
500	-	-	-	-	830	649

Correction factor for cables in accordance with DIN VDE 0298 Part 4

Ambient temperature [°C]	Isolierung			
	PVC	VPE and EPR	PVC-sheathed 70°C sheathing	Blank 105°C sheathing
10	1.2	1.15	1.25	1.15
15	1.15	1.1	1.2	1.1
20	1.1	1.1	1.15	1.05
25	1.05	1.05	1.05	1.05
30	1	1	1	1
35	0.95	0.95	0.95	0.95
40	0.85	0.9	0.85	0.9
45	0.8	0.85	0.75	0.9
50	0.7	0.8	0.65	0.85
55	0.6	0.75	0.55	0.8
60	0.5	0.7	0.45	0.75
65	-	0.65	-	0.7
70	-	0.6	-	0.65
75	-	0.5	-	0.6
80	-	0.4	-	0.55
85	-	-	-	0.45
90	-	-	-	0.4
95	-	-	-	0.3

Power cables / designation

Designation of power cables

Harmonized design in accordance with DIN VDE 0281

Standard code:	
Harmonized standard	H
Recognized national type	A
Nominal voltage U_0/U:	
300V/300V	03
300V/500V	05
450V/750V	07
Insulating material:	
PVC	V
Natural caoutchouc or styrene-butadiene rubber	R
Silicone rubber	S
Sheath material:	
PVC	V
Natural caoutchouc or styrene-butadiene rubber	R
Polychloroprene	N
Glass-fibre braid	J
Textile braid	T
Design characteristics:	
Fan-out ribbon cable	H
Other ribbon cable	H2
Type of cable:	
Single-core	-U
Multi-core	-R
Flexible, for fixed installation	-K
Flexible, for flexible cables	-F
Highly flexible, for flexible cables	-H
Tinsel	-Y
Number of cores	

Protective conductor:	
Without protective conductor	X
With protective conductor	G
Nominal conductor cross-section	

Example (sequence as given above)

H05VRH-U3G1,5

LV-
HRC fuse-
links

HV-
HRC fuse-
links

D-
type fuse-
links

D-
type fuse-
bases

Switch-dis-
connector-fuses
(SASIL) LV HRC
system

Switch-
disconnector-
fuses (SASIL)
BS system

Terminals

LV
HRC strip-
fuseways

LV HRC
strip-type fuse
switch-disconnectors

LV HRC
fuse-
bases

LV HRC
fuse switch-
disconnectors

Busbar system
components

Consumer
supply technology

Distribution
and instrument
cabinets

Electronic
monitoring
devices

Measurement
data acquisition
systems

Software

Cable and line protection / gL/gG fuses

Overload protection of cables and lines using gL/gG fuses in accordance with VDE 0100 Part 430 and supplement

For overload protection of cables and lines, the nominal current I_n of the fuse principally must be less than or equal to the current carrying capacity I_z of the cable or line. The following formula applies to the tripping current I_2 of gL/gG fuses:

$I_2 = 1,45 \cdot I_n$ · With $I_2 \leq 1,45 \cdot I_z$ for overload protection in accordance with VDE 0100 Part 430, the following formula for the selection of the protective device "gL/gG fuse" results: $I_n \leq I_z$!

Cross-section	Current carrying capacity I_z		gL/gG fuse		Current carrying capacity I_z	gL/gG fuse
	0.6/1kV cable ¹⁾		Nominal current I_n ²⁾		conductor ³⁾	Nominal current I_n ²⁾
	Cu	Alu	Cu	Alu	Cu	Cu
1,5 mm ²	27 A		25 A		18,5 A	16 A
2,5 mm ²	36 A		35 A		25 A	25 A
4 mm ²	47 A		40 A		35 A	35 A
6 mm ²	59 A		50 A		43 A	40 A
10 mm ²	79 A		63 A		63 A	63 A
16 mm ²	102 A		100 A		81 A	80 A
25 mm ²	133 A	102 A	125 A	100 A	102 A	100 A
35 mm ²	159 A	123 A	160 A	100 A	126 A	125 A
50 mm ²	188 A	144 A	160 A	125 A	142 A	125 A
70 mm ²	232 A	179 A	224 A	160 A	181 A	160 A
95 mm ²	280 A	215 A	250 A	200 A	219 A	200 A
120 mm ²	318 A	245 A	315 A	224 A	253 A	250 A
150 mm ²	359 A	275 A	355 A	250 A		
185 mm ²	406 A	313 A	400 A	315 A		

¹⁾ Cable in earth; insulating material: PVC; 4-conductor three-phase cable With 3 loaded cores: VDE 0276 Part 603.

²⁾ gL/gG fuses disconnect at $1,45 \cdot I_n$ within the normal test duration.

³⁾ Installation method C according to Supplement 1 to VDE 0100 Part 430

Cable and line protection / gL/gG fuses

Nominal current of gL/gG fuses for overload protection of cables and lines

VDE 0636 and EN 60269 specify LV HRC fuses of the utilization category gL/gG for cable and line protection. Taking into account the relevant standards for overheating protection of cables and lines and for the current carrying capacity of cables,

the following fuse currents have been found suitable in power supply applications (urban networks and cable distribution cabinets) to protect cables and lines (low voltage circuits) against overloading using LV HRC gL/gG fuses:

Installation method	Conductor material	Cross-section mm ²	Nominal current of the LV HRC gL/gG fuse-links
In earth	Copper	16 mm ²	100 A
		25 mm ²	125 A
		35 mm ²	160 A
		50 mm ²	200 A
		70 mm ²	224 A
		95 mm ²	250 A
		120 mm ²	315 A
In earth	Aluminium	25 mm ²	80 A
		35 mm ²	100 A
		50 mm ²	125 A
		70 mm ²	160 A
		95 mm ²	200 A
		120 mm ²	224 A
		150 mm ²	250 A
In air	Copper	16 mm ²	100 A
		25 mm ²	125 A
		35 mm ²	160 A
		50 mm ²	200 A
In air	Aluminium	25 mm ²	80 A
		35 mm ²	100 A
		50 mm ²	125 A
		70 mm ²	160 A

LV-HRC fuse-links

HV-HRC fuse-links

D-type fuse-links

D-type fuse-bases

Switch-disconnector-fuses (SASIL) LV HRC system

Switch-disconnector-fuses (SASIL) BS system

Terminals

LV HRC strip-fuseways

LV HRC strip-type fuse switch-disconnectors

LV HRC fuse-bases

LV HRC fuse switch-disconnectors

Busbar system components

Consumer supply technology

Distribution and instrument cabinets

Electronic monitoring devices

Measurement data acquisition systems

Software

Transformers

Nominal and short-circuit currents of standard transformers

Nominal voltage U _N	400V/231V			525V			690V/400V		
Short-circuit voltage U _K		4%	6%		4%	6%		4%	6%
Rating [kVA]	Nominal current I _N [A]	Short-circuit current I _K [A]		Nominal current I _N [A]	Short-circuit current I _K [A]		Nominal current I _N [A]	Short-circuit current I _K [A]	
50	72	1805	-	55	1375	-	42	1042	-
100	144	3610	2406	110	2750	1833	84	2084	1392
160	230	5776	3850	176	4400	2933	133	3325	2230
200	288	7220	4812	220	5500	3667	168	4168	2784
250	360	9025	6015	275	6875	4580	210	5220	3560
315	455	11375	7583	346	8660	5775	263	6650	4380
400	578	14450	9630	440	11000	7333	336	8336	5568
500	722	18050	12030	550	13750	9166	420	10440	7120
630	910	22750	15166	693	17320	11550	526	13300	8760
800	1156	-	19260	880	-	14666	672	-	11136
1000	1444	-	24060	1100	-	18333	840	-	13920
1250	1805	-	30080	1375	-	22916	1050	-	17480
1600	2312	-	38530	1760	-	29333	1330	-	22300
2000	2888	-	48120	2200	-	36666	1680	-	27840

$$I_k = \frac{I_N}{U_{K[\%]}} * 100$$

U_K = Short-circuit voltage in %

Transformers / protection proposals

Protection proposals for 400V mains transformers, 3.6kV to 36kV....

3.6 kV 400 V								
Transformer data			HV HRC fuse Type IKUS 3-...		LV HRC fuse Type M00-M4agL/gG		LV HRC fuse Type M2-M4agTr in accordance with VDE 0636/22	
Rating kVA	Nominal current		Nominal current			Nominal current		kVA
	Primary A	Secondary A	Minimum A	Maximum A	Minimum A	Maximum A		
50	10	72	16	16	63	80	50	
75	14	108	25	32	100	125	75	
100	19	144	32	40	125	160	100	
125	24	180	40	50	160	200	125	
160	31	231	50	63	200	250	160	
200	39	289	63	100	250	315	200	
250	48	361	80	125	315	400	250	
315	61	455	100	125	400	500	315	
400	77	577	125	160	500	630	400	
500	96	722	125	160	630	800	500	
630	121	909	160	200	800	1000	630	
800	154	1155	160	250	1000	1250	800	
1000	192	1443	200	250	1250	-	1000	
1250	241	1804	250	250	1250	-	-	
1600	308	2309	250	250	1250	-	-	

LV
HRC fuse-
links

HV-
HRC fuse-
links

D-
type fuse-
links

D-
type fuse-
bases

Switch-dis-
connector-fuses
(SASIL) LV HRC
system

Switch-
disconnecter-
fuses (SASIL)
BS system

Terminals

LV
HRC strip-
fuseways

LV HRC
strip-type fuse
switch-disconnectors

LV HRC
fuse-
bases

LV HRC
fuse switch-
disconnectors

Busbar system
components

Consumer
supply technology

Distribution
and instrument
cabinets


Electronic
monitoring
devices

Measurement
data acquisition
systems


Software

7.2 kV 400 V									
Transformer data			HV HRC fuse Type IKUS 6-...			LV HRC fuse Type M00-M4agL/gG		LV HRC fuse Type M2-M4agTr in accordance with VDE 0636/22	
Rating kVA	Nominal current		Nominal current			Nominal current		kVA	
	Primary A	Secondary A	Minimum A	Recom. A	Maximum A	Minimum A	Maximum A		
50	5	72	10	-	16	63	80	50	
75	7	108	16	-	20	100	125	75	
100	10	144	16	20	25	125	160	100	
125	12	180	20	25.32	40	160	200	125	
160	15	231	25	32.40	50	200	250	160	
200	19	289	32	40.50	63	250	315	200	
250	24	361	40	50	63	315	400	250	
315	30	455	50	63	80	400	500	315	
400	39	577	63	80	100	500	630	400	
500	48	722	80	100	125	630	800	500	
630	61	909	100	125	160	800	1000	630	
800	77	1155	125	160	160	1000	1250	800	
1000	96	1443	125	160	200	1250	-	1000	
1250	120	1804	160	160	200	1250	-	-	
1600	154	2309	160	160	200	1250	-	-	


Nominal currents shown in bold comply with VDE 0670/402 recommendations.

12 kV  400 V								
Transformer data			HV HRC fuse Type IKUS 10-...			LV HRC fuse Type M00-M4agL/gG		LV HRC fuse Type M2-M4agTr in accordance with VDE 0636/22
Rating	Nominal current		Nominal current			Nominal current		kVA
	Primary	Secondary	Minimum	Recom.	Maximum	Minimum	Maximum	
kVA	A	A	A	A	A	A	A	
50	3	72	6	-	10	63	80	50
75	4	108	10	-	16	100	125	75
100	6	144	10	16	16	125	160	100
125	7	180	16	16	20	160	200	125
160	9	231	20	25	25	200	250	160
200	12	289	25	32	32	250	315	200
250	14	361	25	32	40	315	400	250
315	18	455	32	40	50	400	500	315
400	23	577	40	50	63	500	630	400
500	29	722	50	63	80	630	800	500
630	36	909	63	80	100	800	1000	630
800	46	1155	80	180	125	1000	1250	800
1000	58	1443	100	125	160	1250	-	1000
1250	72	1804	125	-	160	1250	-	-
1600	92	2309	125	-	160	1250	-	-

Nominal currents shown in bold comply with VDE 0670/402 recommendations.

24 kV  400 V								
Transformer data			HV HRC fuse Type IKUS 20-...			LV HRC fuse Type M00-M4agL/gG		LV HRC fuse Type M2-M4agTr in accordance with VDE 0636/22
Rating	Nominal current		Nominal current			Nominal current		kVA
	Primary	Secondary	Minimum	Recom.	Maximum	Minimum	Maximum	
kVA	A	A	A	A	A	A	A	
50	1	72	6	-	6	63	80	50
75	2	108	6	-	6	100	125	75
100	3	144	6	10	10	125	160	100
125	4	180	10	10	10	160	200	125
160	5	231	10	16	16	200	250	160
200	6	289	16	16	20	250	315	200
250	7	361	16	16	20	315	400	250
315	9	455	20	25	25	400	500	315
400	12	577	25	25	32	500	630	400
500	14	722	25	32	40	630	800	500
630	18	909	32	40	50	800	1000	630
800	23	1155	40	40	63	1000	1250	800
1000	29	1443	50	63	80	1250	-	1000
1250	36	1804	63	-	80	1250	-	-
1600	46	2309	80	-	100	1250	-	-

Nominal currents shown in bold comply with VDE 0670/402 recommendations.

36 kV  400 V								
Transformer data			HV HRC fuse Type IKUS 30-...			LV HRC fuse Type M00-M4agL/gG		LV HRC fuse Type M2-M4agTr in accordance with VDE 0636/22
Rating kVA	Nominal current		Nominal current			Nominal current		kVA
	Primary A	Secondary A	Minimum A	Recom. A	Maximum A	Minimum A	Maximum A	
50	1	72	6	-	6	63	80	50
75	1	108	6	-	6	100	125	75
100	2	144	6	6	6	125	160	100
125	2	180	6	10	10	160	200	125
160	3	231	10	10	10	200	250	160
200	4	289	10	16	16	250	315	200
250	5	361	10	16	20	315	400	250
315	6	455	16	20	25	400	500	315
400	8	577	16	25	25	500	630	400
500	10	722	20	25	32	630	800	500
630	12	909	25	-	32	800	1000	630
800	15	1155	25	-	40	1000	1250	800
1000	19	1443	32	-	40	1250	-	1000
1250	24	1804	-	-	40	1250	-	-
1600	31	2309	-	-	-	1250	-	-

Nominal currents shown in bold comply with VDE 0670/402 recommendations.

LV-
HRC fuse-
links

HV-
HRC fuse-
links

D-
type fuse-
links

D-
type fuse-
bases

Switch-dis-
connector-fuses
(SASIL) LV HRC
system

Switch-
disconnector-
fuses (SASIL)
BS system

Terminals

LV
HRC strip-
fuseways

LV HRC
strip-type fuse
switch-disconnectors

LV HRC
fuse-
bases

LV HRC
fuse switch-
disconnectors

Busbar system
components

Consumer
supply technology

Distribution
and instrument
cabinets

Electronic
monitoring
devices

Measurement
data acquisition
systems

Software

Three-phase motors / protection proposals

Minimum short circuit protection for three-phase motors

The maximum size is governed by the requirements of the associated switchgear or overload relay.

The nominal motor currents apply to normal internally ventilated and enclosed fan-cooled three-phase motors at 1500 rpm.

D.O.L. starting: Maximum starting current: 6 x nominal motor current; maximum starting time: 5 s.

Y/Δ starting: Maximum starting current: 2 x nominal motor current; maximum starting time: 15 s.

Set the overload relay in the phase lead to 0.58 x nominal motor current.

Nominal fuse currents for Y/Δ starting also apply to three-phase motors with slip-ring rotors.

Use a larger fuse if the nominal current or starting current is higher and/or if the starting time is longer.

The table applies to "slow" or "gL/gG" fuses (VDE 0636 and EN 60269).

For LV HRC fuses with aM characteristics. select the nominal fuse current to match the nominal motor current.

Motor rating			230 V			400 V			500 V			690 V		
kW	cosφ	η %	Nominal motor current A	Fuse		Nominal motor current A	Fuse		Nominal motor current A	Fuse		Nominal motor current A	Fuse	
				Starting D.O.L.	Y/Δ		Starting D.O.L.	Y/Δ		Starting D.O.L.	Y/Δ		Starting D.O.L.	Y/Δ
0.06	0.7	58	0.39	2	-	0.23	2	-	0.17	2	-	0.13	2	-
0.12	0.7	60	0.75	4	2	0.43	2	-	0.33	2	-	0.25	2	-
0.18	0.7	62	1.1	4	2	0.64	2	-	0.48	2	-	0.36	2	-
0.25	0.7	62	1.4	4	2	0.8	4	2	0.6	2	-	0.5	2	-
0.55	0.75	69	2.7	10	4	1.6	4	2	1.2	4	2	0.9	4	2
0.75	0.8	74	3.4	10	4	2	6	2	1.5	4	2	1.1	4	2
1.1	0.83	77	4.5	10	6	2.6	6	4	2	6	4	1.5	4	2
2.2	0.83	81	8.7	20	10	5	10	6	3.7	10	4	2.9	10	4

Motor rating			230 V			400 V			500 V			690 V		
kW	cosφ	η %	Nominal motor current A	Fuse		Nominal motor current A	Fuse		Nominal motor current A	Fuse		Nominal motor current A	Fuse	
				Starting D.O.L.	Y/Δ		Starting D.O.L.	Y/Δ		Starting D.O.L.	Y/Δ		Starting D.O.L.	Y/Δ
3	0.84	81	11.5	25	16	6.6	16	10	5	16	6	3.5	10	4
4	0.84	82	15	32	16	8.5	20	10	6.4	16	10	4.9	16	6
7.5	0.86	85	27	50	32	15.5	32	16	11.5	25	16	9	20	10
11	0.87	87	39	80	40	22.5	40	25	17	35	20	13	25	16
15	0.86	87	52	100	63	30	63	32	22.5	50	25	17.5	35	20
22	0.87	89	75	125	80	43	80	50	32	63	32	25	50	25
30	0.87	90	100	200	100	58	100	63	43	80	50	33	63	35
37	0.87	90	124	200	125	72	125	80	54	100	63	42	80	50
55	0.88	91	180	250	200	104	200	125	78	160	80	60	100	63
75	0.88	91	246	315	250	142	200	160	106	200	125	82	160	100
90	0.88	92	292	400	315	169	250	200	127	200	160	98	160	100
110	0.88	92	357	500	400	204	315	200	154	250	160	118	200	125
132	0.88	92	423	630	500	243	400	250	182	250	200	140	250	160
160	0.88	93	500	630	630	292	400	315	220	315	250	170	250	200
200	0.88	93	620	800	630	368	500	400	283	400	315	214	315	250
250	0.88	93	-	-	-	465	630	500	355	500	400	268	400	315
315	0.88	93	-	-	-	580	800	630	444	630	500	337	500	400
400	0.89	96	-	-	-	720	1000	800	534	800	630	410	630	400
500	0.89	96	-	-	-	-	-	-	-	-	-	515	630	630
600	0.90	97	-	-	-	-	-	-	-	-	-	600	800	630

North American conductor cross-sections /conversion

North American conductor cross-sections – Conversion into mm²

USA / Canada	Europe		USA / Canada	Europe	
AWG	mm ² (exact)	mm ² (nearest standard value)	circular mills	mm ² (exact)	mm ² (nearest standard value)
1	0.823	0.75	250,000	127	120
1	1.04	1	300,000	152	150
16	1.31	1.5	350,000	177	185
15	1.65	-	400,000	203	-
14	2.08	-	450,000	228	-
13	2.62	2.5	500,000	253	240
12	3.31	4	550,000	279	-
11	4.17	-	600,000	304	300
10	5.26	6	650,000	329	-
9	6.63	-	700,000	355	-
8	8.37	10	750,000	380	-
7	10.50	-	800,000	405	400
6	13.30	16	850,000	431	-
5	16.80	-	900,000	456	-
4	21.20	25	950,000	481	-
3	26.70	-	1,000,000	507	500
2	33.60	35	1,300,000	659	625
1	42.40	-	-	-	-
1/0	53.50	50	-	-	-
2/0	67.40	70	-	-	-
3/0	85	-	-	-	-
4/0	107	95	-	-	-

LV-
HRC fuse-
links

HV-
HRC fuse-
links

D-
type fuse-
links

D-
type fuse-
bases

Switch-dis-
connector-fuses
(SASIL) LV HRC
system

Switch-
disconnector-
fuses (SASIL)
BS system

Terminals

Transformers / terminal studs

Terminal studs for transformers in accordance with DIN 42530

Transformer size / rating [kVA]	Male thread
100	M12
160	M12
250	M20
400	M20
630	M30 x 2
800	M42 x 3
1000	M42 x 3

LV
HRC strip-
fuseways

LV HRC
strip-type fuse
switch-disconnectors

LV HRC
fuse-
bases

LV HRC
fuse switch-
disconnectors

Busbar system
components

Consumer
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Distribution
and instrument
cabinets

Electronic
monitoring
devices

Measurement
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systems

Software

Sector-shaped copper conductors / dimensions

Dimensions of stranded sector-shaped copper conductors in accordance with VDE 0295



Nominal cross-section mm ²	h	d		b	r ₁	r ₂	a
	Approx. value mm	Nominal value mm	Permissible deviation mm	Approx. value mm	Approx. value mm	Approx. value mm	Approx. value mm

Basic angle $\alpha = 120^\circ$							
35	6.1	5.9	± 0.7	9.5	35	35	35
50	7.1	6.8	± 0.7	10.9	50	50	50
70	8.6	8.2	± 0.7	13.1	70	70	70
95	10.0	9.6	± 0.7	15.6	95	95	95
120	11.2	10.8	± 0.8	17.7	120	120	120
150	12.6	12.2	± 0.8	20.3	150	150	150
185	14.0	13.6	± 0.8	23.1	185	185	185
240	16.0	15.6	± 0.8	26.7	240	240	240
300	17.8	17.4	± 0.8	29.5	300	300	300
400	20.5	20.1	± 0.9	34.4	400	400	400

Basic angle $\alpha = 100^\circ$							
50	8.1	7.6	± 0.7	11.0	50	50	50
70	9.5	8.8	± 0.7	12.5	70	70	70
95	11.2	10.5	± 0.8	15.3	95	95	95
120	12.5	11.6	± 0.8	17.0	120	120	120
150	14.0	13.2	± 0.8	19.4	150	150	150
185	15.5	14.6	± 0.8	22.0	185	185	185
240	17.8	16.9	± 0.8	25.5	240	240	240
300	20.0	19.2	± 0.8	29.1	300	300	300
400	23.1	22.2	± 0.9	33.8	400	400	400

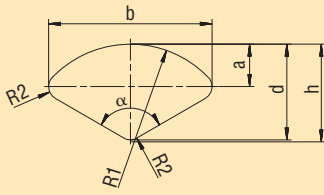
Basic angle $\alpha = 90^\circ$							
35 ¹⁾	7.2	6.5	± 0.7	8.9	35	35	35
50	8.3	7.6	± 0.7	10.4	50	50	50
70	10.0	9.0	± 0.7	12.1	70	70	70
95	11.7	10.7	± 0.8	14.7	95	95	95
120	13.2	12.1	± 0.8	16.4	120	120	120
150	14.6	13.5	± 0.8	18.4	150	150	150
185	16.2	15.1	± 0.8	20.8	185	185	185
240	18.6	17.4	± 0.8	24.3	240	240	240
300	20.6	19.4	± 0.8	27.3	300	300	300
400	24.0	22.8	± 0.9	32.1	400	400	400

Basic angle $\alpha = 60^\circ$							
35 ¹⁾	9.2	7.6	± 0.7	7.9	35	35	35
50	10.9	9.2	± 0.7	9.6	50	50	50
70	13.2	10.9	± 0.8	11.4	70	70	70
95	15.2	12.9	± 0.8	13.5	95	95	95
120	17.0	14.3	± 0.8	14.9	120	120	120
150	19.0	16.3	± 0.8	16.9	150	150	150
185	20.5	17.8	± 0.8	18.7	185	185	185

¹⁾ For copper conductors

Sector-shaped aluminium conductors / dimensions

Dimensions of solid sector-shaped aluminium conductors in accordance with VDE 0295



Nominal cross-section mm ²	h	d		b		r ₁	r ₂	a
	Approx. value mm	Nominal value mm	Permissible deviations mm	Nominal value mm	Permissible deviations mm	Approx. value mm	Approx. value mm	Approx. value mm

Basic angle $\alpha = 120^\circ$								
50	6.5	6.2	± 0.5	9.8	± 0.6	8.1	1.8	2.6
70	8.1	7.7	± 0.5	10.9	± 0.6	9.8	2.8	3.3
95	9.3	8.9	± 0.5	13.5	± 0.6	11.2	2.8	3.8
120	10.5	10.0	± 0.6	15.5	± 0.6	12.3	3.0	4.3
150	11.5	11.0	± 0.6	17.5	± 0.6	13.6	3.0	4.7
185	12.8	12.3	± 0.6	20.1	± 0.7	15.1	3.0	5.3
240	14.5	14.0	± 0.6	23.4	± 0.7	17.0	3.0	6.0

Basic angle $\alpha = 90^\circ$								
50	7.6	6.9	± 0.5	9.1	± 0.5	9.6	1.8	2.3
70	9.5	8.3	± 0.5	10.4	± 0.6	11.5	2.8	3.1
95	10.9	9.7	± 0.5	12.7	± 0.6	13.3	2.8	3.4
120	12.3	11.1	± 0.6	14.5	± 0.6	14.5	3.0	3.8
150	13.4	12.2	± 0.6	16.2	± 0.6	15.9	3.0	4.1
185	15.0	13.8	± 0.6	18.7	± 0.6	17.8	3.0	4.4
240	17.0	15.8	± 0.6	21.9	± 0.6	20.1	3.0	4.9

LV-
HRC fuse-
links

HV-
HRC fuse-
links

D-
type fuse-
links

D-
type fuse-
bases

Switch-dis-
connector-fuses
(SASIL) LV HRC
system

Switch-
disconnector-
fuses (SASIL)
BS system

Terminals

LV
HRC strip-
fuseways

LV HRC
strip-type fuse
switch-disconnectors

LV HRC
fuse-
bases

LV HRC
fuse switch-
disconnectors

Busbar system
components

Consumer
supply technology

Distribution
and instrument
cabinets

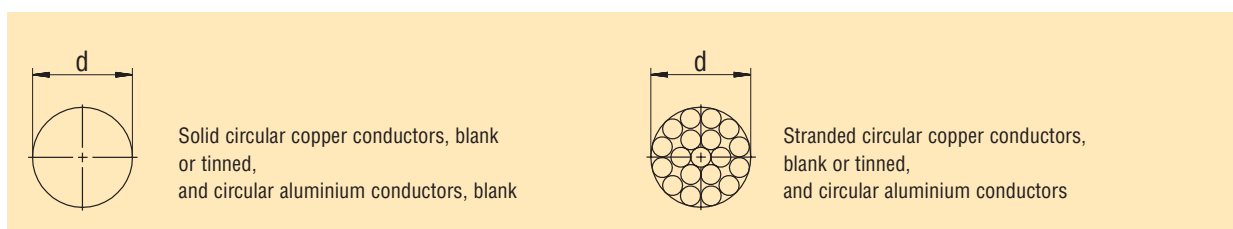
Electronic
monitoring
devices

Measurement
data acquisition
systems

Software

Circular copper conductors / dimensions

Diameters of circular conductors in accordance with VDE 0295



Solid circular copper conductors, blank or tinned, and circular aluminium conductors, blank

Stranded circular copper conductors, blank or tinned, and circular aluminium conductors

Nominal cross-section mm ²	Solid circular conductors				Stranded circular conductors			Flexible circular conductors	
	Diameter d of circular copper conductors		Diameter d of circular aluminium conductors		Diameter d of non-compacted circular aluminium conductors	Diameter d of compacted circular copper and aluminium conductors		Diameter d of flexible and highly flexible copper conductors	
	Minimum mm	Maximum mm	Minimum mm	Maximum mm	Maximum mm	Minimum mm	Maximum mm	Minimum mm	Maximum mm
0.5	– ¹⁾	0.9	–	–	1.1	–	–	1.1	0.9
0.75	–	1.0	–	–	1.2	–	–	1.3	1.0
1	–	1.2	–	–	1.4	–	–	1.5	1.2
1.5	–	1.5	–	–	1.7	–	–	1.8	1.5
2.5	–	1.9	–	–	2.2	–	–	2.6	1.9
4	–	2.4	–	–	2.7	–	–	3.2	2.4
6	–	2.9	–	–	3.3	–	–	3.9	2.9
10	–	3.7	–	–	4.2	–	–	5.1	3.7
16	–	4.6	–	–	5.3	–	–	6.3	4.6
25	–	–	5.2	5.7	6.6	5.6	6.5	7.8	–
35	–	–	6.1	6.7	7.9	6.6	7.5	9.2	–
50	–	–	7.2	7.8	9.1	7.7	8.6	11.0	–
70	–	–	8.7	9.4	11.0	9.3	10.2	13.1	–
95	–	–	10.3	11.0	12.9	11.0	12.0	15.1	–
120	–	–	11.6	12.4	14.5	12.5	13.5	17.0	–
150	–	–	12.9	13.8	16.2	13.9	15.0	19.0	–
185	–	–	–	–	18.0	15.5	16.8	21.0	–
240	–	–	–	–	20.6	17.8	19.2	24.0	–
300	–	–	–	–	23.1	20.0	21.6	27.0	–
400	–	–	–	–	26.1	22.9	24.6	31.0	–
500	–	–	–	–	29.2	25.7	27.6	35.0	–
630	–	–	–	–	33.2	29.3	32.5	39.0	–
800	–	–	–	–	37.6	–	–	–	–
1000	–	–	–	–	42.2	–	–	–	–

¹⁾ Values not specified

²⁾ Minimum not specified

Cables / outside diameters

Outside diameters of lines and cables (average values of various brands)

Cable cross-section mm ²	NYM	NYY	NYCY NYCWY	H05RR-F	H07RN-F
	in mm				
3 x 1.5	10	11	13	11	12.5
3 x 2.5	11	13	14	13	14.5
3 x 4	12.5	15	16	–	16
3 x 6	14	16	17	–	20
3 x 10	17	19	18	–	25.5
3 x 16	20	21	21	–	29
3 x 35 / 16	–	26	25	–	–
3 x 50 / 25	–	30	32	–	–
3 x 70 / 35	–	31	32	–	–
3 x 95 / 50	–	36	37	–	–
3 x 120 / 70	–	39	39	–	–
3 x 150 / 70	–	43	43	–	–
3 x 185 / 95	–	48	50	–	–
3 x 240 / 120	–	53	55	–	–
3 x 300 / 150	–	59	64	–	–
4 x 1.5	10.5	13	14	12.5	13.5
4 x 2.5	12	14	15	14	15.5
4 x 4	14	16	17	–	18
4 x 6	15	17	18	–	22
4 x 10	18	20	20	–	28
4 x 16	23	23	23	–	32
4 x 25	27.5	27	28	–	37
4 x 35	31	30	29	–	42
4 x 50	–	35	34	–	48
4 x 70	–	40	37	–	54
4 x 95	–	45	42	–	60
4 x 120	–	50	47	–	–
4 x 150	–	53	52	–	–
4 x 185	–	60	60	–	–
4 x 240	–	71	70	–	–
5 x 1.5	11	13.5	15	13.5	15
5 x 2.5	13	15	17	15.5	17
5 x 4	15	16.5	18	–	19
5 x 6	18	19	20	–	24
5 x 10	20	21	–	–	30
5 x 16	24	23	–	35	–

NYM Light plastic-sheathed cable
 NYN Heavy plastic-sheathed cable
 NYCY Plastic-sheathed cable with concentric conductors

NYCWY Plastic-sheathed cable with concentric rippled conductors
 H05RR-F Light rubber-sheathed cable
 H07RN-F Heavy rubber-sheathed cable

LV-HRC fuse-links

HV-HRC fuse-links

D-type fuse-links

D-type fuse-bases

Switch-disconnector-fuses (SASIL) LV HRC system

Switch-disconnector-fuses (SASIL) BS system

Terminals

LV HRC strip-fuseways

LV HRC strip-type fuse switch-disconnectors

LV HRC fuse-bases

LV HRC fuse switch-disconnectors

Busbar system components

Consumer supply technology

Distribution and instrument cabinets

Electronic monitoring devices

Measurement data acquisition systems

Software

Glossary of Standard Terms

This Glossary offers brief explanations the standard terms used in this Catalogue. However, it must not be regarded as a substitute for the actual text of the standard, especially where the new terms used in

IEC/EN 60 947 are concerned. Reference is therefore made alongside each such term to the relevant section of the standard, e.g. IEC/EN 60 947-1.

In addition, IEV numbers are given to enable you to find foreign language equivalents in the International Electrotechnical Vocabulary (IEC 50) if required, e.g. IEV 441-17-31.

Terms	Brief explanations
Rated breaking capacity (see also IEC/EN 60 947-1)	The r.m.s. value of the current which a switching device is capable of breaking according to its utilization category. This information refers to the rated operational voltage and the rated operational current. The switching device must be capable of breaking any value of current up to and including its rated breaking capacity stated.
Rated operational voltage U_e (see also IEC/EN 60 947-1)	The voltage to which the characteristics of a switching device are referred. The maximum rated operational voltage must not be higher than the rated insulation voltage.
Rated operational current I_e (see also IEC/EN 60 947-1)	The current which a switching device is capable of carrying taking into account the rated operational voltage, duration of operation, utilization category and ambient temperature.
Rated uninterrupted current I_u (see also IEC/EN 60 947-1)	The current which a switching device is capable of carrying in uninterrupted duty (i.e. for weeks, months or years).
Rated making capacity (see also IEC/EN 60 947-1)	The current which a switching device is capable of making in accordance with the utilization category and the rated operational voltage.
Rated frequency (see also IEC/EN 60 947-1)	The frequency for which a switching device is designed and to which the other characteristics are referred.
Rated insulation voltage U_i (see also IEC/EN 60 947-1)	The voltage to which insulation tests and creepage distances of a switching device are referred. The maximum rated operational voltage must not be higher than the rated insulation voltage.
Rated short-circuit breaking capacity I_{cn} (see also IEC/EN 60 947-1)	The maximum current which a switching device is capable of breaking at rated operational voltage and rated frequency, and without sustaining damage. It is expressed as r.m.s. value.
Rated short-circuit making capacity I_{cm} (see also IEC/EN 60 947-1)	The maximum current which a switching device is capable of making at rated operational voltage and rated frequency, and without sustaining damage. Unlike for other characteristics, this is expressed as maximum prospective peak value.
Rated short-time withstand current I_{cw} (see also IEC/EN 60 947-1)	The short-time withstand current which a switching device is capable of carrying for a specified time without damage, e.g. due to excessive heating.
Motor rating (see also IEC/EN 60 947-1)	Power output of a motor at the associated rated operational voltage.
Rated impulsewithstand voltage U_{imp} (see also IEC/EN 60 947-1)	Measures the stability of the internal clearances of a switching device against overvoltage peaks. The utilization of suitable switchgear can ensure that overvoltages are prevented from transferring from the mains to de-energized system sections within it.
Protection against direct contact	Design measures incorporated into switching devices in order to prevent direct contact, i.e. without tools, with live parts of a system (finger-proof, back-of-hand proof).

Terms	Brief explanations
Damp heat, constant	This test subjects a switching device to an ambient temperature of 40 °C at a constant humidity of 93 %. At set intervals during the test, the electrical and mechanical function of the switching device are examined.
Damp heat, cyclic	This test subjects a switching device to cyclically changing climatic conditions. A cycle applies 40°C ambient temperature at 93% relative humidity for 12 hours, followed by 12 hours of 25°C at 95 % relative humidity. At set intervals during this test, the electrical and mechanical function of the switching device are examined.
Finger-proof	A switching device whose live parts cannot be touched by the operator during actuation is termed finger-proof. This also affects operator activity on neighbouring switching devices. The finger-proof area of a push-actuated switching device is a circular area of at least 30mm radius around the actuator, and vertical to the direction of actuation. Within this circular area, live parts must be located at no less than 80mm depth under the actuating level.
Utilization category (see also IEC/EN 60 947-1/ IEV 441-17-19)	A combination of specified requirements relating to the operating conditions in which a switching device or fuse fulfils its purpose, selected to represent a characteristic group of practical applications. The specified requirements may concern, for example, the values of making capacity, breaking capacity and other characteristic values, data concerning associated circuits, and the relevant conditions of use and behaviour.
Back-of-hand proof	A switching device whose live parts cannot be touched by a sphere of 50 mm diameter is regarded as back-of-hand proof.
Altitude	The density of air decreases with increasing altitude, and this reduces its insulating capacity as well as its heat transfer capability. The rated operational voltage and current of switching devices, conductors and motors as well as the tripping behaviour of thermal overload relays are affected by this. Upon request, JEAN MÜLLER will supply information as to the suitability or otherwise of switchgear for operation at altitudes above the 2000m limit specified by the standard.
Conventional thermal current I_{th} (see also IEC/EN 60 947-1; 4.3.2.1)	The maximum current which a switching device is capable of carrying for a minimum of eight hours without thermal overloading. As a rule, it corresponds to the maximum rated operational current.
Creepage distance (see also IEC/EN 60 947-1; 2.5.51/ IEV 151-03-37)	The shortest distance along the surface of the insulating material between two conductive parts. The creepage distance is determined by the rated insulation voltage, the pollution degree and the creep resistance of the material used.
Clearance (see also IEC/EN 60 947-1; 2.5.46/ IEV 441-17-31.	The distance between two conductive parts along a string stretched the shortest way between these parts. The clearance is determined by the rated impulse withstand voltage, the overvoltage category and the pollution degree.

LV-
HRC fuse-
links

HV-
HRC fuse-
links

D-
type fuse-
links

D-
type fuse-
bases

Switch-dis-
connector-fuses
(SASIL) LV HRC
system

Switch-
disconnector-
fuses (SASIL)
BS system

Terminals

LV
HRC strip-
fuseways

LV HRC
strip-type fuse
switch-disconnectors

LV HRC
fuse-
bases

LV HRC
fuse switch-
disconnectors

Busbar system
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Consumer
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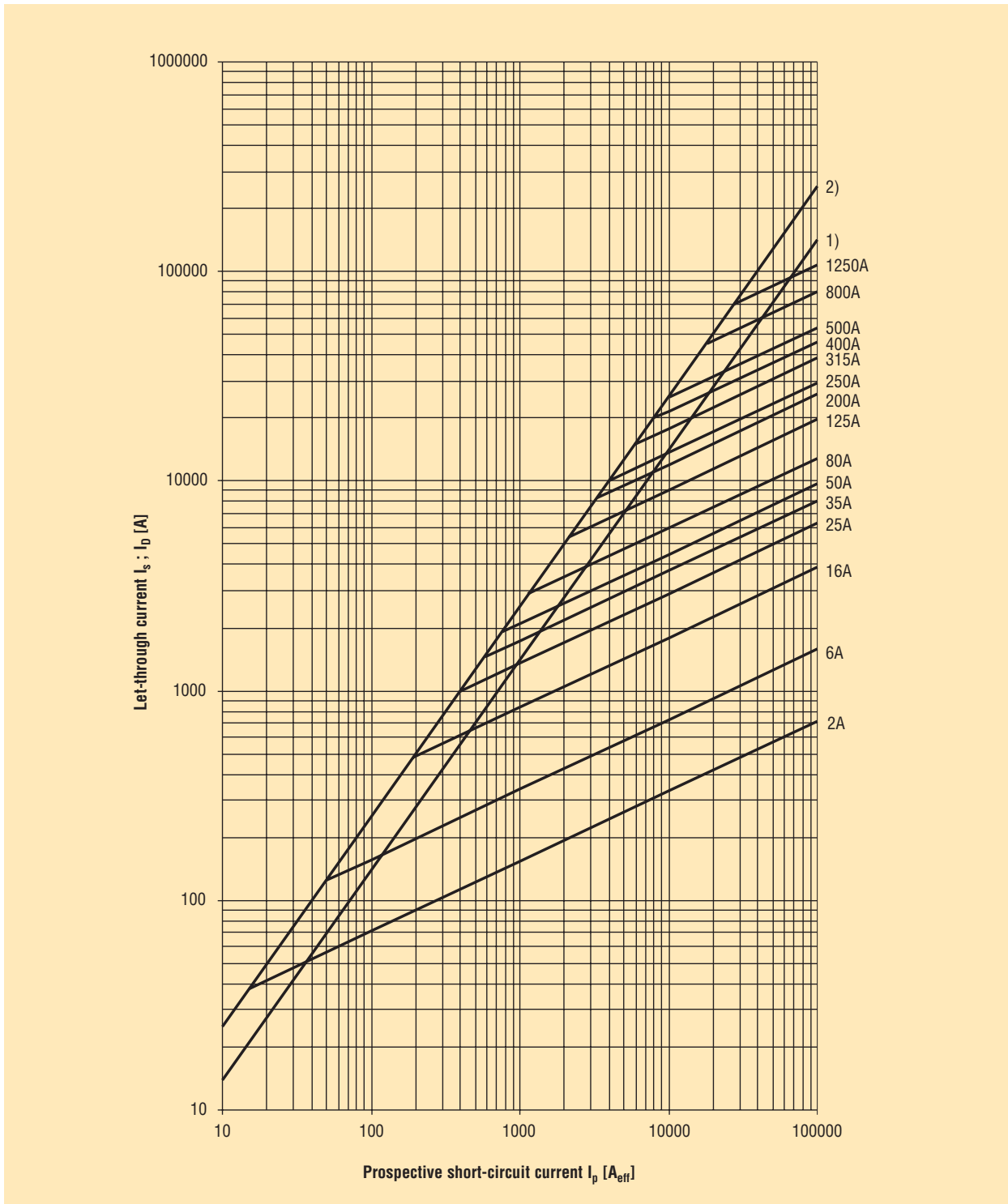
Software

Current limitation / LV HRC fuse-links

Current limitation for LV HRC fuse-links, 500V/690V (Table 1)

Characteristic: gG

Sizes 00 to 4a, 2A to 1250A



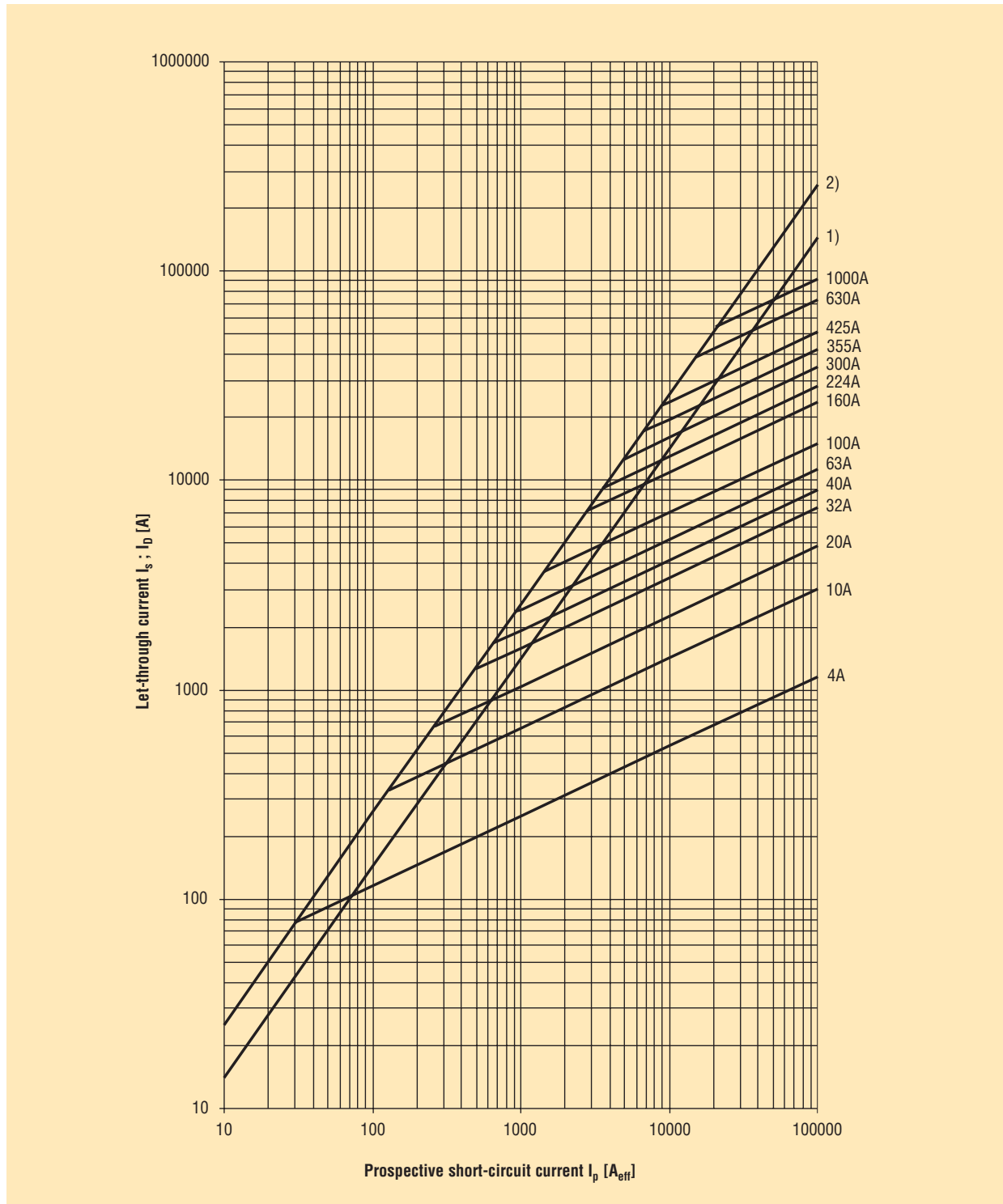
¹⁾ Peak short-circuit current without DC component

²⁾ Peak short-circuit current with largest DC component

Current limitation for LV HRC fuse-links, 500V/690V, Table 2

Characteristic: gG

Sizes 00 to 4a, 4A to 1000A



¹⁾ Peak short-circuit current without DC component

²⁾ Peak short-circuit current with largest DC component

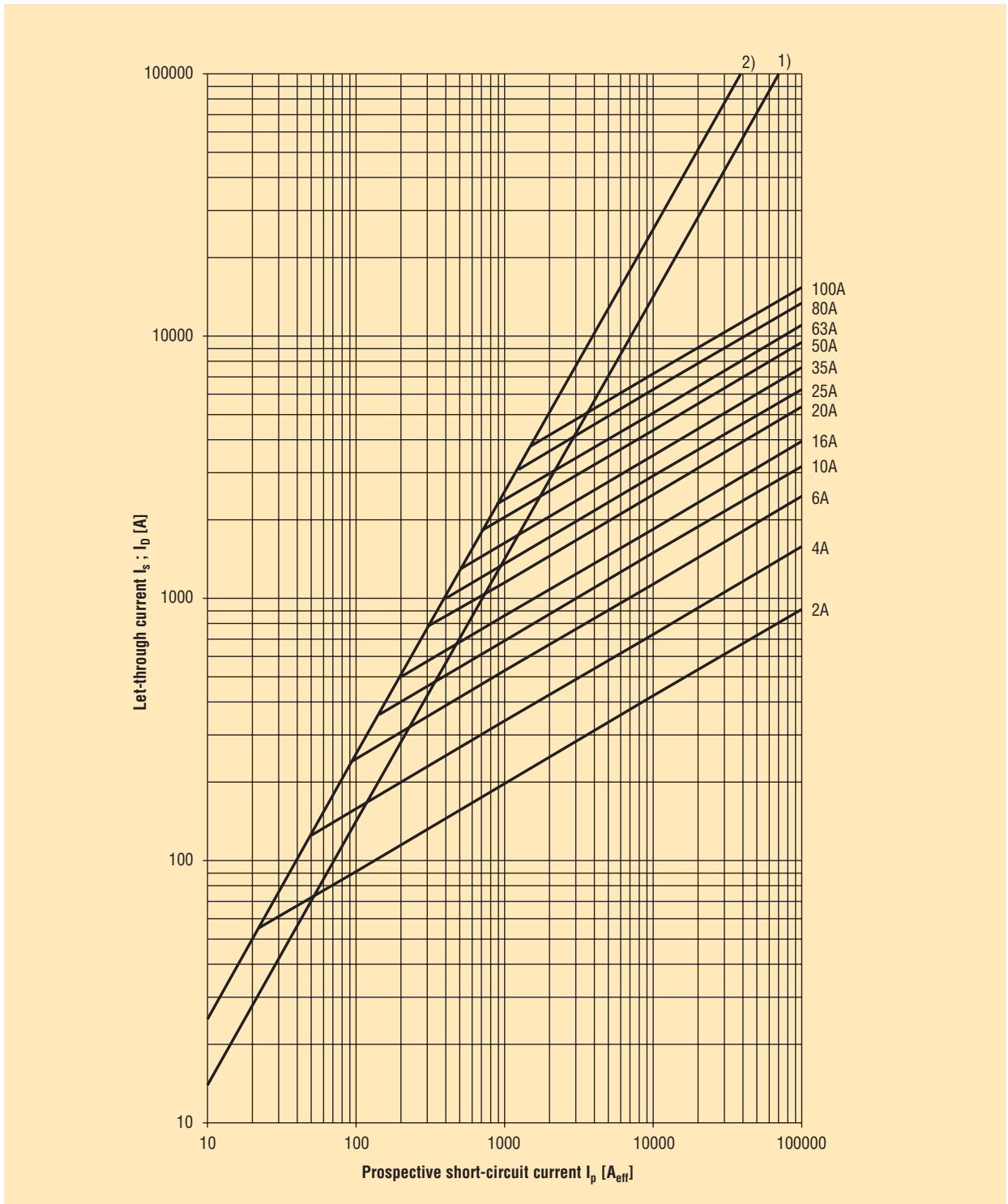
- LV-HRC fuse-links
- HV-HRC fuse-links
- D-type fuse-links
- D-type fuse-bases
- Switch-disconnector-fuses (SASIL) LV HRC system
- Switch-disconnector-fuses (SASIL) BS system
- Terminals
- LV HRC strip-fuseways
- LV HRC strip-type fuse switch-disconnectors
- LV HRC fuse-bases
- LV HRC fuse switch-disconnectors
- Busbar system components
- Consumer supply technology
- Distribution and instrument cabinets
- Electronic monitoring devices
- Measurement data acquisition systems
- Software

Current limitation / D type fuse-links

Current limitation for LV HRC fuse-links, 500V

Characteristic: gG

Sizes DII/DIII, 2 to 100A



¹⁾ Peak short-circuit current without DC component

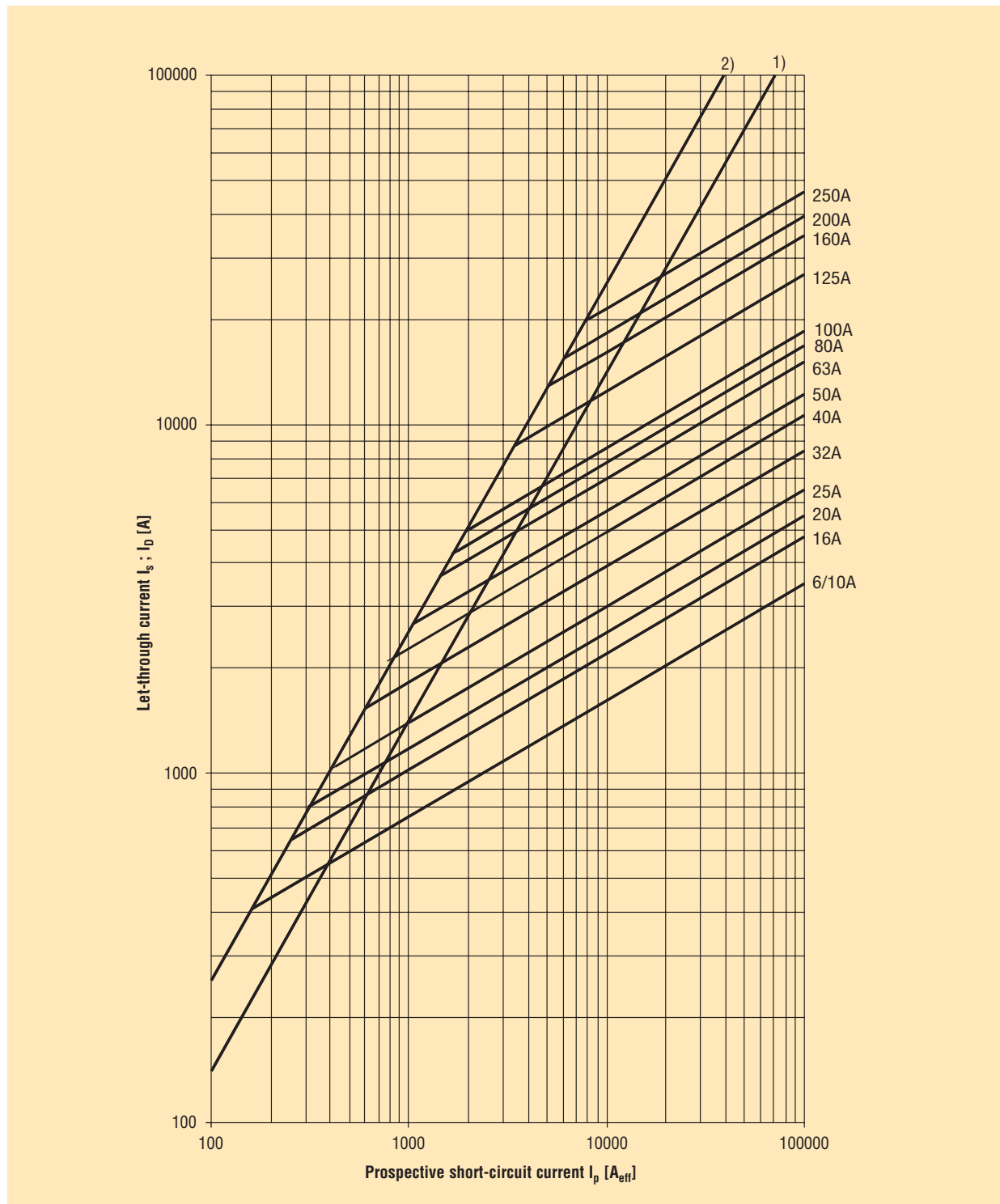
²⁾ Peak short-circuit current with largest DC component

Current limitation / HV HRC fuse-links

Current limitation for HV HRC fuse-links, 3.6 to 36kV

Characteristic: in accordance with VDE 0670

6A to 250A



¹⁾ Peak short-circuit current without DC component

²⁾ Peak short-circuit current with largest DC component

- LV-HRC fuse-links
- HV-HRC fuse-links
- D-type fuse-links
- D-type fuse-bases
- Switch-disconnector-fuses (SASIL) LV HRC system
- Switch-disconnector-fuses (SASIL) BS system
- Terminals
- LV HRC strip-fuseways
- LV HRC strip-type fuse switch-disconnectors
- LV HRC fuse-bases
- LV HRC fuse switch-disconnectors
- Busbar system components
- Consumer supply technology
- Distribution and instrument cabinets
- Electronic monitoring devices
- Measurement data acquisition systems
- Software

Power dissipation / fuse-links

Power dissipation of fuse-links

Rated current	D-System								
	D01 gL/gG	D02 gL/gG	NDZ gF	NDZ gT	DII gL/gG	DIII gL/gG	DIII gL/gG	DIII gF	three channel slow
[A]	400V	400V	500V	500V	500V	500V	690V	750V	1200V
2	0.5		2.6	2.7	2.8		1	1.9	1.1
4	0.9		2	2.2	2.3		1.1	3.3	1.8
6	1.7		3.4	2.6	2.4		1.8	4.7	2.1
10	1.1		3.5	1.6	1.7		2	5.5	2.9
16	1.8		4.5	2.7	2.6		3	6.3	2.6
20		2.3	5	2.8	2.6		2.5	8.3	2.9
25		2.9	5.5	3.4	3.4		2.8	9.3	3.2
35		3.8				3.5	4.2	10.5	
50		4.8				5.6	5.1	13	
63		5.8				7	6.9	14.5	
80									
100									

Data in watts

Rated current	Characteristic gG													
	LV HRC system													
	NH00			NH1			NH2			NH3			NH4a	
[A]	400V	500V	690V	400V	500V	690V	400V	500V	690V	400V	500V	690V	500V	690V
2	0.5	0.5	1											
4	0.6	0.6	1.3											
6	0.8	0.8	1.5											
10	1.1	1.1	1.6	1.4	1.4	2.3								
16	1.5	1.5	2	1.8	1.8	2.8								
20	1.7	1.7	2.2	2	2	3.4								
25	1.8	1.8	2.8	2.2	2.2	2.6								
35	2.7	2.7	3.8	4.2	4.2	4.4								
40	3.2	3.2	4.1	6	6	6.4								
50	3	3	5.6	4.6	4.9	5.2	4.6	4.9	5.2					
63	3.6	3.6	5.9	5.2	5.9	6.2	5.2	5.9	6.2					
80	4.6	4.6	6.6	6	7.2	7.9	6	7.2	7.9					
100	5.4	5.4	7.3	7.6	8.6	10.2	7.6	8.6	10.2	7.6	8.6	10.2		
125	6.8	6.8	10.2	9.9	11	13	9.9	11	13	9.9	11	13		
160	8.3	8.3		12	14	16.2	12	14	16.2	12	14	16.2		
200				12	15.2	17	12	15.2	17	12	15.2	17		
224				14	18	19	14	18	19	14	18	19		
250				16	21.8		16	21.8	22.7	16	21.8	22.7	20	18
315							21	22.7	26.8	21	22.7	26.8	24	21
400							25	34		25	34	40	28	31
500										32.8	39	40.3	36	38
630										41	45		43	50
800													59	62
1000													84	90
1250													104	

Data in watts

LV HRC fuse-links / influence of ambient temperature

Influence of ambient temperature on the function of fuse-links in accordance with EN 60 269-1:1998 (Annex D)

D.1 Influence of an increase in ambient temperature

D.1.1 On the rated current

Where fuses must operate at full load and for long periods of time at ambient temperatures whose average value exceeds the value specified in section 3.1, it may be necessary to reduce the nominal current. The reduction factor should be agreed between the

the manufacturer and the user taking into account all conditions of use.

D.1.2 On heating

An increase in the average ambient temperature causes relatively low heating.

D.2 Influence of a decrease in ambient temperature

A decrease in ambient temperature below the value specified in section 3.1 may allow an increase

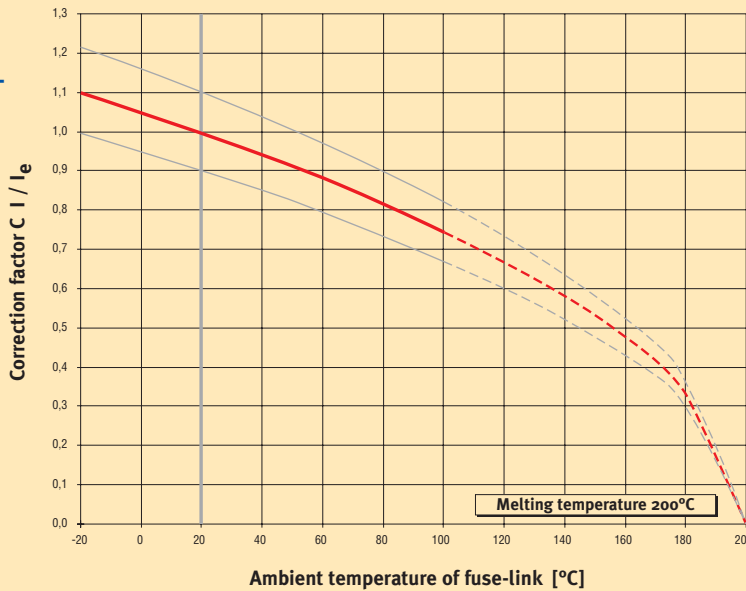
in the rated current, but it may also cause an increase in the conventional fusing and non-fusing current and in melting times in the event of small overcurrents. The extent of the individual increases depends of the actual temperature and the design of the fuse-link. Relevant information must be obtained from the manufacturer.

D.3 Influence of fitting conditions

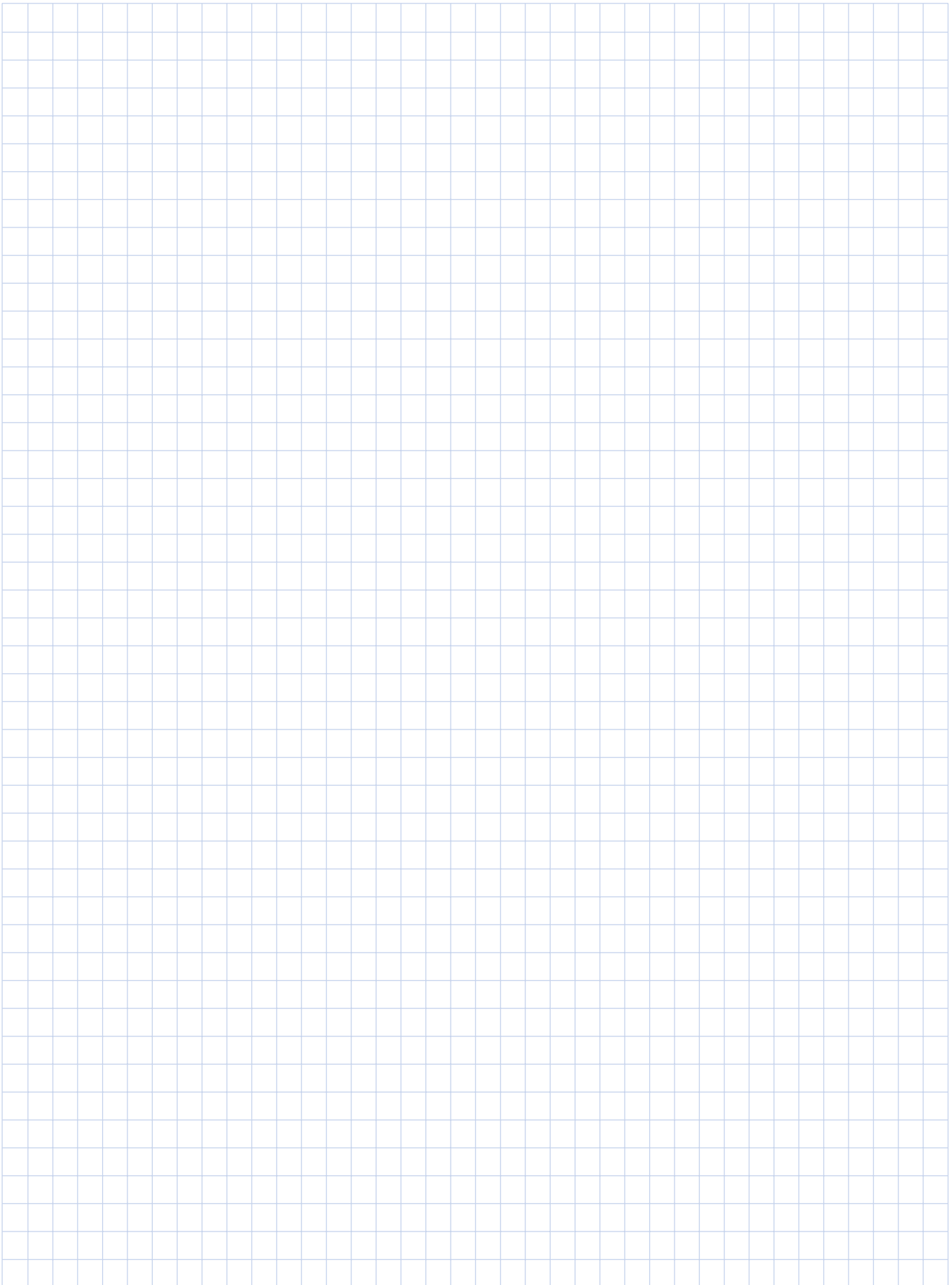
Fitting conditions such as:

- Fitting in a box or open fitting;
- Properties of the mounting area;
- Number of fuses fitted in a box;
- Cross-section and insulation of connections may influence the functional conditions and should therefore be taken into account.

Influence of ambient temperature on the rated current of LV HRC fuse-links of the characteristic gG



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- D-type fuse-bases
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- Terminals
- LV HRC strip-fuseways
- LV HRC strip-type fuse switch-disconnectors
- LV HRC fuse-bases
- LV HRC fuse switch-disconnectors
- Busbar system components
- Consumer supply technology
- Distribution and instrument cabinets
- Electronic monitoring devices
- Measurement data acquisition systems
- Software



General conditions for the supply of products and services of the electrical and electronics industry^{*)}

(Model form recommended by the Zentralverband Elektrotechnik- und Elektronikindustrie (ZVEI) e.V. – June 1997 –

I. General conditions

1. The scope of the supplies or services (hereinafter called "supplies") shall be defined by the written declarations of both parties to the contract. General terms and conditions of the purchaser shall apply only where expressly accepted in writing by the supplier or service provider (hereinafter called "supplier").
2. For cost estimates, drawings and other documents (hereinafter called "documents"), the supplier reserves all rights, right, title and interest in the property and the copyright. Such documents may not be made available to third parties without the prior consent of the supplier and they shall, upon request, be immediately returned to the supplier if he is not awarded the contract. Sentences 1 and 2 shall apply reciprocally to purchaser's documents; however, these may be made available to those third parties to whom the supplier may transfer supplies.
3. The purchaser shall have the non-exclusive right to use standard software in unchanged form with the stipulated performance

characteristics for the agreed equipment. The purchaser is allowed to make two back-up copies without the supplier's express consent.

4. Partial supplies shall be permissible where they can be reasonably expected of the supplier.

II. Prices and terms of payment

1. Prices shall be ex works and exclude packing and shall exclude the sales tax payable under the applicable law.
2. If the supplier has undertaken the assembly or erection, the purchaser shall bear all required incidental costs in addition to the agreed contract price unless otherwise agreed.
3. Payments shall be made free at supplier's paying office.
4. The purchaser may set off only those claims that are undisputed or have been finally determined in a legally binding manner.

III. Retention of title

1. The items of supplies (Secured Goods) shall remain the property of the supplier until each and every claim against the purchaser to which the supplier is entitled under this business relationship

has been duly satisfied. If the value of all security rights of the supplier exceeds the value of all secured claims by more than 20 percent, the supplier shall release a corresponding part of the security rights at the purchaser's request.

2. For the duration of the retention of title, the purchaser is prohibited from giving the items of supplies in pledge or as security, and resale shall be permissible only to resellers in the ordinary course of business and only on condition that the reseller receives payment from his customer or retains title so that the property is transferred to the customer only after fulfilment of his obligation to pay.
3. In case of seizure or other acts or interventions by third parties, the supplier shall be immediately informed thereof in writing by the purchaser.
4. In cases of fundamental non-performance of contractual obligations by the purchaser, especially a delay in payment, the supplier shall be entitled to take back the goods following a demand for payment. The purchaser shall be obliged to return the purchased goods. The taking back, the assertion of the retention of title or the seizure of the Secured Goods by the supplier does not

mean termination of the contract except if expressly stated by the supplier.

IV. Time for delivery and delay

1. Observance of the stipulated time for delivery is conditional upon the timely receipt of all documents, necessary permits and releases, especially of plans to be provided by the purchaser, as well as fulfilment of the agreed terms of payment and other obligations by the purchaser. Unless these conditions are fulfilled on time, the time for delivery will be extended accordingly except where the supplier is responsible for the delay.
2. If non-observance of the time for delivery is due to force majeure such as mobilization, war, riot, or similar events, e.g. strike or lockout, such time shall be extended accordingly.
3. If the supplier is responsible for a delay in delivery, the purchaser who can establish credibly that he suffered a loss from such delay may claim agreed compensation of 0.5 percent for every completed week of delay but in no event shall the aggregate of such compensation exceed a total of 5 percent of the price of that part of the supplies which, because of the delay, could not be

LV-
HRC fuse-
links

HV-
HRC fuse-
links

D-
type fuse-
links

D-
type fuse-
bases

Switch-dis-
connector-fuses
(SASIL) LV HRC
system

Switch-
disconnector-
fuses (SASIL)
BS system

Terminals

LV
HRC strip-
fuseways

LV HRC
strip-type fuse
switch-disconnectors

LV HRC
fuse-
bases

LV HRC
fuse switch-
disconnectors

Busbar system
components

Consumer
supply technology

Distribution
and instrument
cabinets

Electronic
monitoring
devices

Measurement
data acquisition
systems


Software

<p>output to the intended use.</p>	<p>been agreed, the risk shall pass to the purchaser as follows:</p>	<p>other ancillary services not specific to the supplier's trade as well as the necessary skilled and unskilled labour, materials, and tools,</p>	<p>installations as well as the required data concerning statics and underlying conditions of the site.</p>
<p>4. purchaser's claims for compensation which exceed the limits specified in clause IV para 3 shall be excluded in all cases of delayed delivery even after expiry of an extension of time that may have been granted to the supplier. This exclusion shall not apply where in cases of wilful misconduct or gross negligence there is a legally binding liability on the part of the supplier. No change in the burden of proof to the detriment of the purchaser is involved. purchaser's right to terminate the contract shall remain unaffected after the expiry of an extension granted to the supplier that did not result in delivery.</p>	<p>a) If the supply does not include assembly or erection, when goods have been delivered to or picked up by carrier. At the purchaser's request and expense, supplies shall be insured by the supplier against the ordinary risks of transport.</p> <p>b) If the supply includes assembly or erection, the day on which they are taken over into purchaser's own service or, if so stipulated, after a satisfactory trial run.</p> <p>2. If the dispatch, the delivery, the beginning or completion of assembly or erection, the taking over into purchaser's own service or the trial run is delayed for reasons within the purchaser's responsibility, or if the purchaser has failed for other reasons to accept delivery, the risk shall pass to the purchaser.</p>	<p>b) the equipment and materials necessary for assembly, erection, and commissioning such as scaffolds, lifting equipment etc., fuels, and lubricants,</p> <p>c) energy and water at the point of use, including connections, heating, and lighting,</p> <p>d) suitable, dry, and lockable rooms of sufficient size at the site for the storage of machine parts, apparatus, materials, tools etc. and adequate working and recreation rooms for the assembly personnel including appropriate sanitary facilities. Furthermore, the purchaser shall take all measures he would take for the protection of his own property to safeguard the property of the supplier and of the assembly personnel,</p>	<p>3. Before the beginning of assembly or erection, the necessary materials and equipment to start work must be provided at the site and all preparations must have advanced to such a point that the assembly or erection can be started as agreed and carried out without interruption. Access roads and the site itself must be level and clear.</p> <p>4. If the assembly, erection or commissioning is delayed by circumstances for which the supplier is not responsible, the purchaser shall bear an appropriate amount of the costs of waiting periods and of any additional travelling of the supplier or the assembly personnel that may be necessary.</p>
<p>5. If dispatch or delivery is delayed at purchaser's request by more than one month after notice was given of the readiness for dispatch, the purchaser may be charged storage costs for each month thereafter to the amount of 0.5 percent of the price of the supplied goods but in no event shall the aggregate storage charges exceed a total of 5 percent of the price. The parties to the contract are at liberty to furnish proof of higher or lower storage costs.</p>	<p>VI. Assembly and election</p> <p>Unless otherwise agreed in writing, assembly, and erection shall be subject to the following provisions:</p> <p>1. The purchaser shall provide at his own expense and in a timely manner:</p>	<p>e) protective clothing and protective devices which are needed because of particular conditions on the site.</p> <p>2. Before the start of assembly or erection, the purchaser shall make available of his own accord all necessary information concerning the location of concealed electric power, gas and water lines or of similar</p>	<p>5. The purchaser shall attest to the supplier at weekly intervals the hours worked by the assembly personnel and he shall immediately confirm in writing the completion of assembly, erection or commissioning.</p> <p>6. If, after completion, the supplier requests acceptance of the supplies, it shall be carried out by the purchaser within two weeks of the supplier's request,</p>
<p>V. Transfer of risk</p>			
<p>1. Even where "carriage paid" delivery has</p>	<p>a) all earth-moving and construction work and</p>		

<p>failing which acceptance is deemed to have taken place. Acceptance is also deemed to have taken place if after completion of any agreed test phase the supplies are put to use.</p>	<p>portion to the noticed defect. If the contract pertains to the conduct of a purchaser's business, the purchaser can withhold payments only if the legitimacy of the asserted complaint can be established beyond doubt.</p>	<p>later of: (1) 6 months from the date of repair or replacement; or (2) the remaining length of the original warranty period for the supplies. For those parts which cannot be put to the intended use because of the interruption of service, the warranty period shall be extended by the period of service interruption caused by the repair or replacement supply.</p>	<p>shall either obtain a right to use the product, modify the product so as not to infringe the Property Rights or replace the product. If this is not possible to the supplier on acceptable terms, he shall have to take back the product and refund the purchase price.</p>
<p>VII. Taking delivery</p> <p>Deliveries, even with minor defects, have to be accepted by the purchaser.</p>	<p>4. The supplier shall be given adequate time and opportunity to remedy the defect. If he is refused these, the supplier shall have no liability for the defect.</p>	<p>8. The periods specified in paras 1, 2 and 7 shall not apply where longer periods are provided by law according to § 638 BGB.</p>	<p>b) supplier's aforesaid obligations shall exist only on condition that the purchaser immediately notifies the supplier in writing of the claims asserted by the third party, that he does not acknowledge an infringement and that all countermeasures and settlement negotiations are reserved to the supplier. If the purchaser stops using the product to reduce the damage or for other important reasons, he shall be obliged to make it clear to the third party that the suspended use does not mean acknowledgment of an infringement of Property Rights.</p>
<p>VIII. Warranty</p> <p>For defects which include the absence of expressly warranted characteristics, the supplier shall be liable as follows:</p>	<p>5. If an adequate extension granted to the supplier expires without the defect being remedied, the purchaser shall have the right to demand cancellation of the contract or a reduction of the purchase price.</p>	<p>9. Except as provided above, any other warranty claims of the purchaser against the supplier and the supplier's agent shall be excluded. However, clause XI (Further liability) shall remain unaffected.</p>	<p>2. Claims of the purchaser shall be excluded if he is responsible for an infringement of Property Rights.</p>
<p>1. The supplier shall, at his option and expense, repair, replace, or newly provide any parts or services whose usefulness is impaired more than insignificantly within 12 months from the date of the transfer of risk – regardless of the period of operation – owing to circumstances that existed before the transfer of risk.</p>	<p>6. The warranty does not cover natural wear and tear or damage arising, after the transfer of risk, from faulty or negligent handling, excessive strain, unsuitable equipment, defective workmanship, inappropriate foundation soil or from particular external influences not assumed under the contract, or from non-reproducible software errors. The warranty does not cover modifications or repairs carried out improperly by the purchaser or by third parties.</p>	<p>IX. Industrial property rights and copyright</p>	<p>3. Claims of the purchaser shall also be excluded if the infringement of Property Rights was caused by specific demands of the purchaser, by a use of the product not foreseeable by the supplier or by the product being altered by the</p>
<p>2. Warranty claims are subject to a limitation period of 12 months after notification of the defect. Notice in writing shall be given to the supplier immediately after discovery of the defect.</p>	<p>7. The warranty period for repairs or replacement supplies (of goods or services) shall be 6 months. It shall be the</p>	<p>1. If a third party, because of an infringement of an industrial property right or copyright (hereinafter called "Property Rights") by products furnished by the supplier and used in conformity with the contract, asserts legitimate claims against the purchaser, the supplier shall be liable to the purchaser as follows:</p>	<p>3. Claims of the purchaser shall also be excluded if the infringement of Property Rights was caused by specific demands of the purchaser, by a use of the product not foreseeable by the supplier or by the product being altered by the</p>
<p>3. In case of notification of a defect, purchaser's payments may be withheld in reasonable pro-</p>	<p>portion to the noticed defect. If the contract pertains to the conduct of a purchaser's business, the purchaser can withhold payments only if the legitimacy of the asserted complaint can be established beyond doubt.</p>	<p>a) At his own option and expense, the supplier</p>	<p>shall either obtain a right to use the product, modify the product so as not to infringe the Property Rights or replace the product. If this is not possible to the supplier on acceptable terms, he shall have to take back the product and refund the purchase price.</p>

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Distribution and instrument cabinets
Electronic monitoring devices
Measurement data acquisition systems

<p>purchaser or being used together with products not provided by the supplier.</p> <p>4. Further claims against the supplier shall be excluded. However, clause XI (Further liability) shall remain unaffected and so shall be purchaser's right to terminate the contract.</p>	<p>purchaser's right to terminate the contract shall remain unaffected.</p> <p>2. Where unforeseeable events as described in clause IV para 2, substantially change the economic importance or the contents of the supplies or considerably affect the supplier's business, the contract shall be adapted accordingly with due regard to the principle of good faith. Where this is not economically reasonable, the supplier shall have the right to terminate the contract. If the supplier wants to make use of this right of termination, he shall notify the purchaser in writing immediately after becoming aware of the significance of the event. This shall apply even where at first an extension of the delivery time had been agreed with the purchaser.</p>	<p>regardless of whether they are based on positive breach of contractual obligations, violation of obligations in contract negotiations, breach of warranty, tort or other legal theory. This exclusion shall not apply where e.g. under the product liability law or in cases of wilful misconduct, of gross negligence, of the absence of warranted characteristics, or of the fundamental non-performance of contractual obligations, there is a legally binding liability. However, liability for damages arising from the fundamental non-performance of contractual obligations shall be limited to the foreseeable damage normally covered by a contract except in cases of wilful misconduct or gross negligence. This limitation does not imply a change in the burden of proof to the detriment of the purchaser.</p>	<p>of the supplier's head or branch office at the supplier's option.</p> <p>2. All relations arising out of the contract shall be governed by German law not including the United Nations Convention on Contracts for the International Sale of Goods (CISG).</p>
<p>X. Impossibility of performance, contract adaptation</p> <p>1. If it is impossible for the supplier to carry out the supplies for reasons for which he is responsible, the purchaser shall be entitled to claim damages but the purchaser's claim for damages shall be limited to 10 percent of the value of that part of the supplies which, owing to the impossibility, cannot be put to the intended use. This shall not apply where in cases of wilful misconduct, of gross negligence or of initial impossibility, there is a legally binding liability. No change in the burden of proof to the detriment of the purchaser is involved.</p>	<p>XI. Further liability</p> <p>Except as provided herein, any other claims for damages of the purchaser shall be excluded</p>	<p>XII. Choice of forum</p> <p>1. If the purchaser is a businessman, the sole forum for all disputes arising directly or indirectly out of the contract shall be the place</p>	<p>XIII. Validity of the contract</p> <p>Even in case of legal invalidity of individual items, the remaining parts of the contract shall remain binding save where adherence to the contract would mean an undue hardship on one of the parties.</p> <p>*) Translation of the German edition of June 1997 published in the Bundesanzeiger Nr. 115, 26.6.1997, by the Bundeskartellamt (Federal Cartel Office) as a recommendation of the Zentralverband Elektrotechnik- und Elektronikindustrie (ZVEI) e.V. (German Electrical and Electronic Manufacturers' Association)</p>



Eignungsbestätigung
zur Qualitätssicherung gemäß Regel KTA 1401

Wir bestätigen der Firma

Jean Müller GmbH Elektrotechnische Fabrik
Friedrichstraße 21, 65343 Eltville/Rhein

Standorte:
Werk 1 und Werk 4, Eltville/Rhein

die Eignung zur system- und produktbezogenen Qualitätssicherung für den nachfolgenden Geltungsbereich:

LIEFER-/LEISTUNGSUMFANG:

Planung, Fertigung und Vertrieb von HH-, NH- und D-Sicherungen mit Zubehör, Sicherungsschaltgeräte, Stromverteiler und -Schränke, NS-Isolatoren sowie Klemmen

Die Beurteilung erfolgte am 21.09.1999 im Auftrag der PreussenElektra Kernkraft GmbH & Co. KG auf der Grundlage der Regel KTA 1401 und der Beurteilungsunterlagen der VGB-Arbeitsgemeinschaft Auftragnehmerbeurteilung unter Berücksichtigung der produktbezogenen Erfordernisse und erstreckt sich auf

<input checked="" type="checkbox"/> ORGANISATION	<input checked="" type="checkbox"/> KENNZEICHNUNG, HANDHABUNG, LAGERUNG, TRANSPORT, VERPACKUNG
<input checked="" type="checkbox"/> PLANUNG UND AUSLEGUNG	<input type="checkbox"/> INBETRIEBSETZUNG
<input checked="" type="checkbox"/> BESCHAFFUNG	<input checked="" type="checkbox"/> MESS- UND PRÜFEINRICHTUNGEN
<input checked="" type="checkbox"/> FERTIGUNG	
<input type="checkbox"/> MONTAGE/SERVICE	

Einzelheiten der Beurteilung sind im Bericht Nr.: 1999/013 von
Die Bestätigung gilt bis zum
20. September 2002

unter der Bedingung, dass sich die bei der Beurteilung zugrunde nicht geändert haben. Änderungen an den system- und produktbe ggf. Statusänderungen bei einer Zertifizierung/Akkredit PreussenElektra Kernkraft GmbH & Co. KG unverzüglich

DUISBURG, den 25.10.1999 *Rudemacher*



CERTIFICATE

DQS Deutsche Gesellschaft zur Zertifizierung von Managementsystemen mbH

hereby certifies that the company

Jean Müller GmbH
Elektrotechnische Fabrik
Friedrichstr. 21
D-65343 Eltville / Rhein

with the plant D-09376 Oelsnitz

Design, production and sale of fuses, switches and switchgear - assemblies

has implemented and maintains a

Quality Management System.

A quality audit, documented in an audit report, has verified that this quality system fulfills the requirements of the following standard:

DIN EN ISO 9001
August 1994 edition

This certificate is valid until 2002-10-03
Certificate Registration No.: 774-03
Frankfurt am Main, Berlin 1999-10-04

Dr.-Ing. K. Petrick *Dipl.-Ing. J. Pansch*
MANAGING DIRECTORS

Offices: D-60433 Frankfurt am Main, August-Schanz-Strasse 21
D-10787 Berlin, Burggrafenstrasse 6




LV-HRC fuse-links

HV-HRC fuse-links

D-type fuse-links

D-type fuse-bases

Switch-disconnector-fuses (SASIL) LV HRC system

Switch-disconnector-fuses (SASIL) BS system

Terminals

LV HRC strip-fuseways

LV HRC strip-type fuse switch-disconnectors

LV HRC fuse-bases

LV HRC fuse switch-disconnectors

Busbar system components

Consumer supply technology

Distribution and instrument cabinets

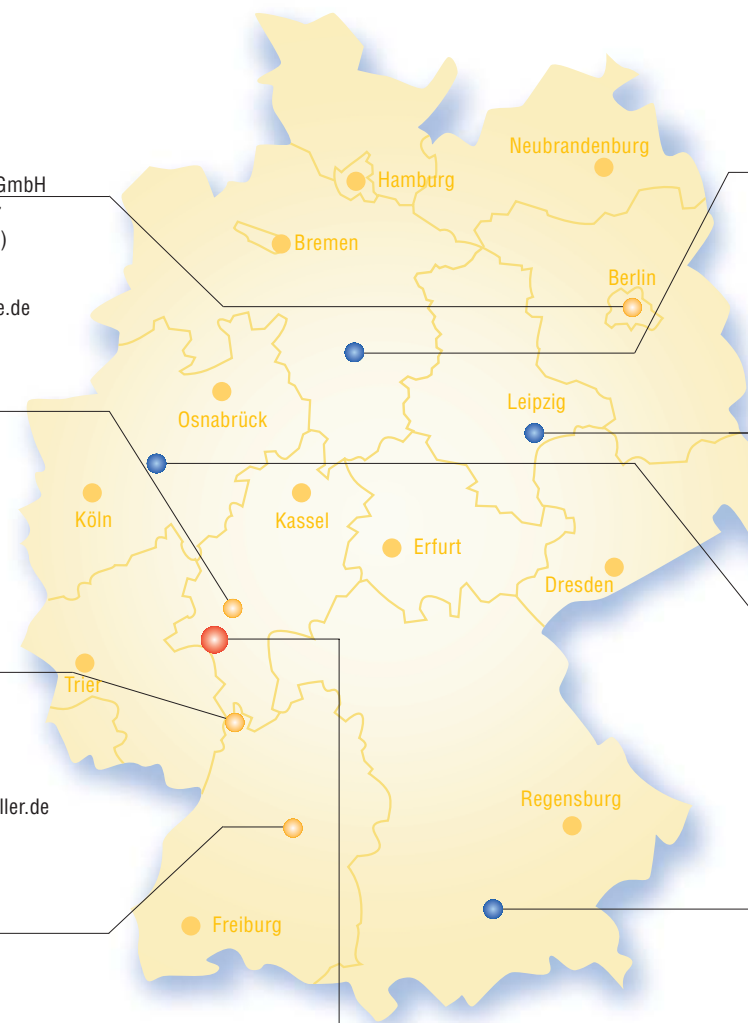
Electronic monitoring devices

Measurement data acquisition systems

Software

Contact Addresses

JEAN MÜLLER – Company Headquarters and Offices



The map shows Germany divided into regions with callouts to various contact points. A red dot is located in the southwest, and a blue dot is in the center. Orange dots are scattered across the map, representing other locations.

Agents

IGVG
Industriegüter-Vertriebs-GmbH
Kaiser-Wilhelm-Straße 17
D-12247 Berlin (Lankwitz)
Tel.: +49 (30) 76 89 13-22
Fax: +49 (30) 76 89 13-24
E-Mail: igvgmbh@t-online.de

Dieter Eidt GmbH
Im Gäuchen 3
D-65604 Elz
Tel.: +49 (64 31) 5 49 27
Fax: +49 (64 31) 5 49 33
E-Mail: eidtgmbh@t-online.de

Ingenieur-Büro
Henry Wollschläger
Seckacher Straße 158
D-68259 Mannheim
Tel.: +49 (6 21) 7 14 04 27
Fax: +49 (6 21) 7 14 05 27
E-Mail: hwollschlaeger@jeanmueller.de

Fritz Huber
Technische Vertretungen
Weidenstraße 20
D-72666 Neckartailfingen
Tel.: +49 (71 27) 3 21 03
Fax: +49 (71 27) 2 10 42
E-Mail: fhuber@jeanmueller.de

Sales Offices

Vertriebsbüro Nord (VBN)
Riepener Straße 19
D-31542 Bad Nenndorf
Tel.: +49 (57 25) 63 87
Fax: +49 (57 25) 75 61
E-Mail: wbiesterfeld@jeanmueller.de
lkreck@jeanmueller.de

Vertriebsbüro Leipzig (VBL)
Wurzner Straße 151
D-04318 Leipzig
Tel.: +49 (3 41) 2 44 44-0
Fax: +49 (3 41) 2 44 44-40
E-Mail: vbl@jeanmueller.de

Vertriebsbüro West (VBW)
Lerchenstraße 44
D-58285 Gevelsberg
Tel.: +49 (23 32) 91 48 30
Fax: +49 (23 32) 91 48 31
E-Mail: tkrugmann@jeanmueller.de
jschweitzer@jeanmueller.de

Vertriebsbüro Bayern (VBB)
Poinger Straße 18
D-85551 Kirchheim-Heimstetten
Tel.: +49 (89) 90 05 02-0
Fax: +49 (89) 90 05 02-20
E-Mail: vbb@jeanmueller.de

Company Headquarters

Jean Müller GmbH
Elektrotechnische Fabrik
Friedrichstraße 21
D-65343 Eltville am Rhein
P.O. Box 13 64
D-65333 Eltville am Rhein
Tel.: +49 (61 23) 6 04-0
Fax: +49 (61 23) 6 04-7 30
http:www.jeanmueller.de
E-Mail: sales@jeanmueller.de

Contact Addresses in Europe

Belgium

GE POWER CONTROLS
BELGIUM N.V.
Nieuvevaart 51
9000 GENT
BELGIUM
Tel.: +32 9 265 21 11
Fax: +32 9 265 28 00

Denmark

Siemens A/S
Borupvang 3
2750 BALLERUP
DENMARK
Tel.: +45 44 77 44 77
Fax: +45 44 77 40 20

Dansk Metalvare Fabrik
Frederiksborgvej 300
4000 ROSKILDE
DENMARK
Tel.: +45 46 75 76 77
Fax: +45 46 75 71 58

United Kingdom

Moeller Electric Ltd.
P.O. Box 35, Gatehouse Close
Aylesbury
BUCKS HP19 3TL
UNITED KINGDOM
Tel: +44 1296 3933 22
Fax: +44 1296 31 03 94

Estonia

Harju Elekter
Elektriseadmete Tehas
Paldiski Mnt.31
3053 KEILA
ESTONIA
Tel.: +372 674 74 49
Fax: +372 674 74 41

Finland

GE Power Controls Finland OY
Teltie 2A, OVI 8
04300 TUUSULA
FINLAND
Tel.: +358 9 2745 400
Fax: +358 9 2745 4040

France

SERMES Société D'Etudes
et des Répresentation
en Matériel Électrique
Boîte Postale No. 177
Rue des Frères Eberts, 14
67025 STRASBOURG-CEDEX
FRANCE
Tel.: +33 3 88 40 72 00
Fax: +33 3 88 79 45 51

Greece

Markides Michelis and Co
IMP. & Trading of Elekt. Company
8 Makris Str.
12241 AEGALEO/ATHEN
GREECE
Tel.: +301 59 80 145
Fax: +301 59 09 833

Ireland

Hellerman Tyton
Unit 77
Cherry Orchard Ind. Est.
Ballyfermot
DUBLIN 10
IRELAND
Tel.: +353 1 6268 267
Fax: +353 1 6268 022

Iceland

REYKJAFELL LTD.
Skiopholti 35
P.O. Box 5008
125 REYKJAVIK
ICELAND
Tel.: +354 5 88 60 10
Fax: +354 5 88 60 88

Italy

Herbert Fischer
J. Kravogelstraße Nr. 3 / II
39020 MARLING
ITALY
Tel.: +39 473 220 834
Fax: +39 473 220 854

S.I.E.I. PETERLONGO S.P.A.
Casella Postale 1851
Via Lomellina, 41
20100 MILANO
ITALY
Tel.: +39 2 75 22 1
Fax: +39 2 75 22 222

Volta
Weinbergweg, 23
39100 BOZEN
ITALY
Tel.: +39 0471 56 1172
Fax: +39 0471 56 127

Croatia

Koncar Niskonaponski
Aparati D.D.
Zagrebacka 31
49250 ZLATOR HRVATSKA
CROATIA
Tel.: +385 49 446 070
Fax: +385 49 466 246

Lithuania

UAB Elera
Jeruzales 21
2021 VILNIUS
LITHUANIA
Tel.: +370 2 79 64 62
Fax: +370 2 79 64 61

LV-
HRC fuse-
links

HV-
HRC fuse-
links

D-
type fuse-
links

D-
type fuse-
bases

Switch-dis-
connector-fuses
(SASIL) LV HRC
system

Switch-
disconnector-
fuses (SASIL)
BS system

Terminals

LV
HRC strip-
fuseways

LV HRC
strip-type fuse
switch-disconnectors

LV HRC
fuse-
bases

LV HRC
fuse switch-
disconnectors

Busbar system
components

Consumer
supply technology

Distribution
and instrument
cabinets

Electronic
monitoring
devices

Measurement
data acquisition
systems

Software

Contact Addresses in Europe

Luxembourg

Herrn Fernand Proess
6, Rue Gustav Kahnt
1851 LUXEMBURG
LUXEMBOURG
Tel.: +352 44 62 73
Fax: +352 44 62 73

Netherlands

GE Power Controls Nederland
ODINK & KOENDERINK
Postbus 4 -
7480 AA HAAKSBERGEN
NETHERLANDS
Tel.: +31 53 573 03 03
Fax: +31 53 573 03 59
E-Mail: InfoNL@gepc.ge.com

Norway

Moeller Electric AS
Postboks 160
2020 SKEDSMOKORSET
NORWAY
Tel.: +47 63 87 02 00
Fax: +47 63 87 02 01

Austria

ROCKWELL
AUTOMATION GMBH
Kotzinastr. 9
4030 LINZ/DONAU
AUSTRIA
Tel.: +43/732 38 909-13
Fax: +43/732 38 909-61
E-Mail: amarks@ra.rockwell.com

Portugal

Iso Sigma
Energia e Gestao LDA
Rua Faria Quimaraes, 121
4000 PORTO
PORTUGAL
Tel.: +351 22 507 4590
Fax: +351 22 502 4895

Poland

JEAN MÜLLER GMBH
BIURO-POLSKA
ul. Bialostocka 24/113
03741 WARSCHAU
POLAND
Tel.: +48 22-670 26 95
Fax: +48 22-619 21 67
Mobile: +48 604-472914
E-Mail: LKarauda@jeanmueller.de

Romania

Business for Business SRL
4A Serghei Rahmaninov str.
Ap.3, sect.2
BUKAREST
ROMANIA
Tel.: +40 1 679 27 08
Fax: +40 1 230 02 41

Goelco Trade S.R.L.

Bd. Iuliu Maniu 19
77534 BUKAREST 6
ROMANIA
Tel.: +40 1 411 96 21
Fax: +40 1 411 97 81

Sweden

MOELLER ELECTRIC AS
Box 11 71
16422 KISTA
SWEDEN
Tel.: +46 8 632 30 00
Fax: +46 8 750 66 66

Switzerland

ROCKWELL AUTOMATION AG
P.O. Box 64
Gewerbepark
Hintermättlistraße 3
5506 MÄGENWIL
SWITZERLAND
Tel.: +41 62 88 97 777
Fax: +41 62 88 97 767

Spain

ZABALA
Landabarri Bidea,
4, Ed. Gobelas
48940 LEJONA-VIZCAYA
SPAIN
Tel.: +34 94 464 1622
Fax: +34 94 464 6228

Czech Republic

OEZ Letohrad, s.r.o.
Sedivska 339
56151 LETOHRAD
CZECH REPUBLIC
Tel.: +42 446 92 11 11
Fax: +42 446 92 17 31

Hungary

Energia Konzult Kft
Lotz Karoly Utca 18
1026 BUDAPEST
HUNGARY
Tel.: +36 1200 4155
Funk.: +36 309 622 338
Fax: +36 1200 8609

Contact Addresses Overseas

Argentina

Reproel S.A.
Zamudio 4623
1419 BUENOS AIRES
ARGENTINA
Tel.: +54 11 45 74 21 52
Fax: +54 11 45 74 14 02-3

Australia

Kilmore Agencies
PTY LTD
Att: Mr David Kilmore
Unit 2, 91 Orsmond Street
HINDMARSH SA 5007
AUSTRALIA
Tel.: +61 8 8340 7079
Fax: +61 8 8340 7081

Alstom Australia LTD
Industrial Products Division
25 Princess Road
REGENTSPARK NSW 2143
AUSTRALIA
Tel.: +61 2 964 50 777
Fax: +61 2 964 51 608

Brazil

Holec
Indústrias Eléctricas Ltda
Rua Antonio Galvao Pacheco, 185
18550-000 BOITUVA S.P.
BRAZIL
Tel.: +55 152 63 2444
Fax: +55 152 63 1024

Israel

ARCO ELECTRICAL
INDUSTRIES LTD.
7 Shapiro St.,
New Industrial Park
P.O. Box 4565
RISHON LE-ZION 75144
ISRAEL
Tel.: +972 3 963 0844
Fax: +972 3 961 4675

Japan

Naigai Engineering Inc
4-1-1 Takaida hon-dori
Higashi-Osaka City
577 8551 OSAKA
JAPAN
Tel.: +81 6 6783 00 44
Fax: +81 6 678 32 800

Korea

MS INDUSTRIAL CO., LTD.
395-178 Seokyo-Dong
Mapu-GU
SEOUL
KOREA
Tel.: +82 2 334 05 77
Fax: +82 2 334 44 60

Malaysia

Combi Letrik SDN BHD
20 Jalan Tembaga SD5/2C
Bandar Baru Sri Damansara
52290 KUALA LUMPUR
MALAYSIA
Tel.: +60 3 632 0911
Fax: +60 3 635 7875

New Zealand

EMF Industrial Ltd
P.O. Box 907
508 St. Aubyn Street
NEW PLYMOUTH
NEW ZEALAND
Tel.: +64 6 75 14 491
Fax: +64 6 75 14 492

Nigeria

Mane Ltd
Plot 5, Block K
Apapa-Oshodi Expressway
P.O. BOX 68, EBUTE METTA
LAGOS
NIGERIA
Tel.: +234 1 45 27 022
Fax: +234 1 45 27 632

Oman

VOLTAMP
MANUFACTURING CO. LLC
P.O. Box 75
124 RUSAYL
SULTANATE OF OMAN
Tel.: +968 626 501
Fax: +968 626 502

Saudi Arabia

East & West Factory
P.O. Box 718
31421 DAMMAM
SAUDI ARABIA
Tel.: +966 3 847 29 56
Fax: +966 3 847 39 09

Singapore

SINGAWAY INTERNATIONAL
PTE. LTD.
Att: Mr Richard Phoa
3 Pemimpin Drive 05-01
Lip Hing Industrial Building
SINGAPORE 576147
SINGAPORE
Tel.: +65 3 54 01 19
Fax: +65 3 54 00 98

South Africa

Sabelco Electrical Industries Ltd.
10 Stella Road Montaque
Gardens 7441
P.O. Box 36631
7442 CHEMPET
SOUTH AFRICA
Tel.: +27 21 551 21 90
Fax: +27 21 551 65 13

Alstom South Africa Ltd
P.O. Box 13900
1467 WITFIELD
SOUTH AFRICA
Tel.: +27 11 82 05 313
Fax: +27 11 82 05 013

Fusecomp
3, Jukskei Ave, Gallo Manor 2052
P.O. Box 4170
2128 RIVONIA
SOUTH AFRICA
Tel.: +27 11 80 27 072
Fax: +27 11 80 43 098

Cable and Power Supplies
P.O. Box 324
2153 JUKSKEI PARK
SOUTH AFRICA
Tel.: +27 11 794 56 72
Fax: +27 11 794 56 76

Thailand

TEC Tang Enterprise CO., Ltd
3/2 Moo 1 Petch Kasem Road
Bang Wha Phasri Charoen
10160 BANGKOK
THAILAND
Tel.: +66 2 458 2000
Fax: +66 2 458 2001

Uruguay

Compañía de Tornillos S.A.
F. Martinez Nieto 5630
11.0 MONTEVIDEO
URUGUAY
Tel.: +598 290 85 385
Fax: +598 251 33 611

LV-
HRC fuse-
links

HV-
HRC fuse-
links

D-
type fuse-
links

D-
type fuse-
bases

Switch-dis-
connector-fuses
(SASIL) LV HRC
system

Switch-
disconnector-
fuses (SASIL)
BS system

Terminals

LV
HRC strip-
fuseways

LV HRC
strip-type fuse
switch-disconnectors

LV HRC
fuse-
bases

LV HRC
fuse switch-
disconnectors

Busbar system
components

Consumer
supply technology

Distribution
and instrument
cabinets

Electronic
monitoring
devices

Measurement
data acquisition
systems

Software