Rittal – The System.

Faster – better – worldwide.

Technical System Catalogue Ri4Power

ENCLOSURES · POWER DISTRIBUTION · CLIMATE CONTROL · IT INFRASTRUCTURE · SOFTWARE & SERVICES

RITTAL

FRIEDHELM LOH GROUP

Order information Catalogue 33, from page 327

Ri4Power Form 1-4

Ri4Power Form 1-4 – An individual system for the configuration of tested low-voltage switchgear with inner form separation. The flexible combination of Ri4Power field types supports optimum configuration for a wide range of applications.
Ri4Power Form 1-4 offers a very high level of operator protection. Thanks to extensive busbar insulation and subdivision of the compartments, the occurrence and spread of accidental arcs is largely prevented.

Tested safety

- Design verification to the internationally valid standard IEC 61 439-1
- Tests with ASTA certification
- Protection category up to IP 54
- Tested accidental arcing protection to IEC 61 641
- Additional preventative accidental arcing protection

A list of planning instruction contents may be found on page 27.

Ri4Power Form 1-4

Modular system

- For low-voltage switchgear with design verification to IEC/EN 61 439-1/-2.
- For control systems and power distribution.
- Structured system solution for switchgear with Form separation 1-4b.
- Simple, installation-friendly system assembly.

Busbar systems up to 5500 A

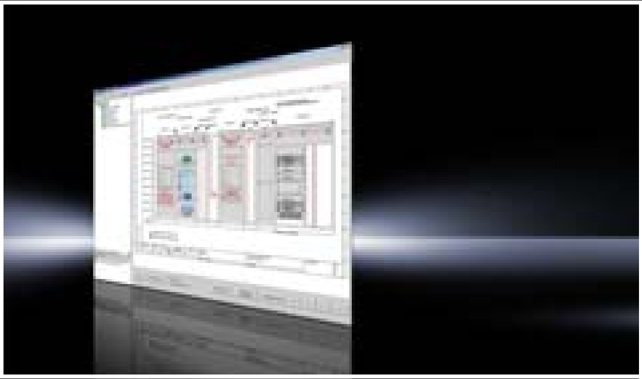
- RiLine60 – The compact busbar system up to 1600 A.
- Maxi-PLS – The assembly-friendly system.
- Flat-PLS – The flat bar system for high power requirements.
- Tested PE conductor system.
- High levels of short-circuit resistance up to 100 kA for 1 sec./220 kA.

Modular enclosure system

- Based on enclosure platform TS 8.
- Flexible, modular front design.
- Roof plates to suit every requirement.
- Modular compartment configuration for internal compartmentalisation up to Form 4b.
- Internal cover plates, contact hazard protection for circuit-breaker and NH fuse-switch disconnector sections.
- Accessories for Ri4Power.

Simple planning

- **Power Engineering Software** SV 3020.500.
- Configuration of low-voltage switchgear with design verification.
- Simple, fast assembly with automatically generated assembly plan.
- Generation of parts lists with graphical output.

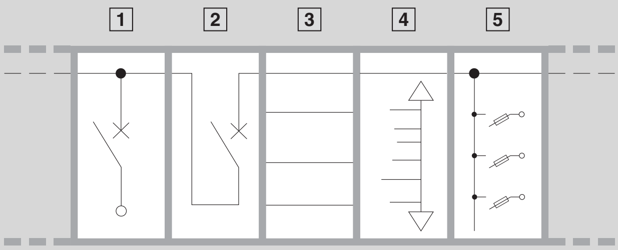


Ri4Power Form 1-4 – Universal design at its best

Order information Catalogue 33, from page 327

Benefits at a glance:

- Exceptional flexibility with the selection of modules and fields
- Simple, safe, tried-and-tested assembly
- High quality solution offering excellent value for money
- Fast, reliable system planning with the Rittal Power Engineering software



Thanks to the large number of different modules and fields plus form separation 1-4, Ri4Power offers the right solution for every application.

Be it in the process industry, industrial plant, energy generation or infrastructure, the Ri4Power system solution is at home in every environment.

Process industry

- Sewage treatment plants
- Heavy industry (mining, iron, steel)
- Cement works
- Waste disposal industry
- Paper industry
- Chemicals, petrochemicals
- Pharmaceutical industry

Industrial plants

- Automotive industry
- Mechanical engineering
- Shipbuilding, marine engineering

Energy generation

- Small power plants
- Wind and solar power
- Biomass power plants

Buildings, infrastructure

- Schools
- Banks
- Insurance companies
- Data centres
- Football stadiums
- Hospitals
- Festival halls and exhibition buildings
- Airports

Ri4Power Form 1-4

1 Circuit-breaker section

- For switchgear from all well-known manufacturers such as Siemens, ABB, Mitsubishi, Eaton, Terasaki, Schneider Electric and General Electric.
- Use of air and moulded case circuit-breakers.

2 Coupling section

- Combination of a circuit-breaker section with a space-saving, side busbar riser.
- Reliable separation into individual busbar sections to boost equipment availability.

3 Outgoing section

- Flexible design of the interior installation.
- Fully insulated distribution busbars with extensive connection system.
- For compact circuit-breaker and motor starter combinations.

4 Cable chamber

- Available from a field width of 300 mm.
- Optional cable entry from above or below.
- Flexible installation with Rittal system accessories.
- Highest design concordance 4b thanks to optimum terminal compartments.

5 Fuse-switch disconnector section

- For switchgear from Jean Müller, ABB, Siemens.
- Alternatively also suitable for installation of equipment modules from Jean Müller.

Circuit-breaker section

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Benefits at a glance:

- Consistently modular layout.
- Fast, time-saving assembly technique.
- To fit circuit-breakers from well-known manufacturers including ABB, Eaton, General Electric, Mitsubishi, Schneider Electric, Siemens and Terasaki

The circuit-breaker section is used as the power infeed to switchgear and to output large currents from the switchgear. Busbar systems up to 5500 A with Maxi-PLS or Flat-PLS are dimensioned and individually configured according to requirements. The integrated modular concept and high manufacturing quality ensure fast, time-saving configuration. The Ri4Power Form1-4 system technology is designed to fit air circuit-breakers from all well-known manufacturers.

Finally, the compartment divider is assembled, ensuring optimum access to all connection points throughout the entire assembly process.

Circuit-breaker section

Terminal space

1 Stepped, assembly-friendly arrangement of the connection bars.

2 Cable connection system for optimum connection of all conductor types.

3 Flexible positioning of the bars in the connection space, thanks to the modular side panel system.

Circuit-breaker

4 Circuit-breakers available as fixed or rack-mounted, allowing free choice of positioning.

5 Complete, matching connection system for air circuit-breakers (ACB) from all well-known manufacturers.

6 Modular configuration of the compartments, for circuit-breakers and function groups, in accordance with your requirements.

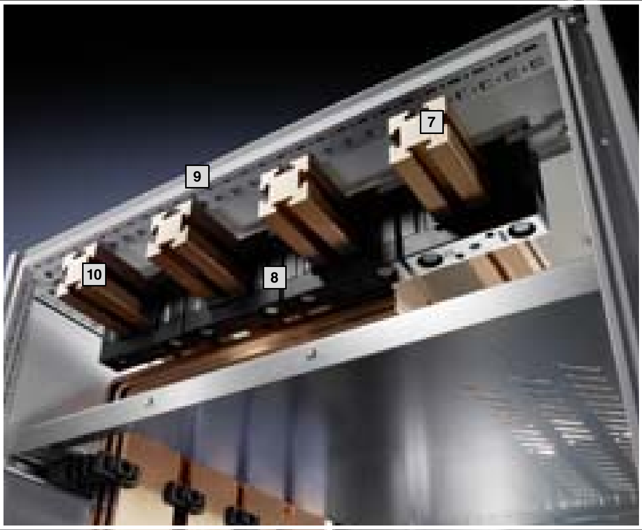
Busbar system

7 Maxi-PLS up to 4000 A, alternatively Flat-PLS up to 5500 A.

8 Main busbar system 3- or 4-pole.

9 Busbar positioning optionally in the roof, bottom or upper or lower rear section.

10 “Section to section connection system” for all busbar systems, with no drilling required.

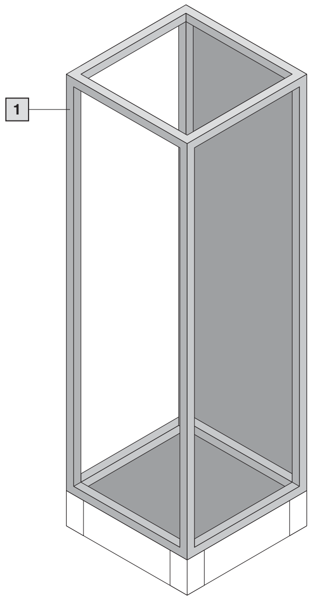


System example of a circuit-breaker section

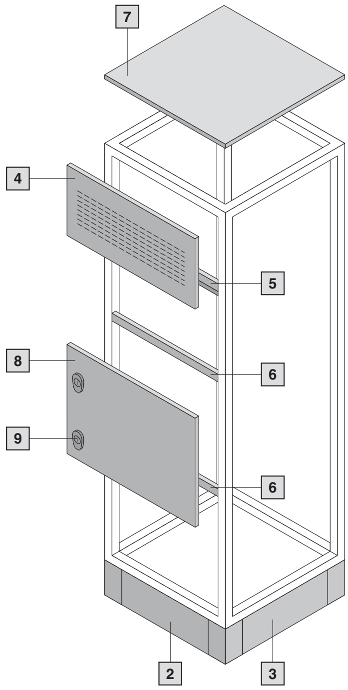
Overview of components

The components required for an air circuit-breaker section are comprised of the enclosure, the enclosure system accessories, the compartment and the busbar systems.

Enclosure



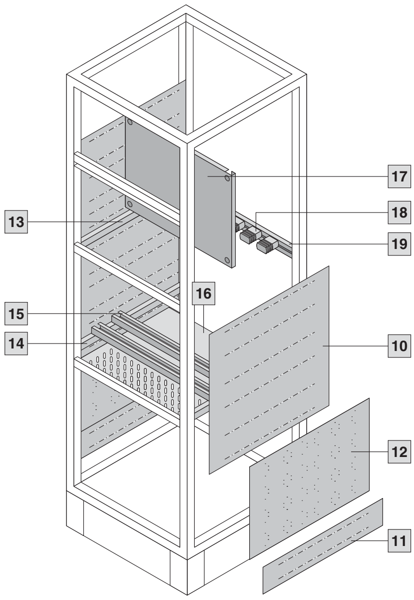
Enclosure system accessories



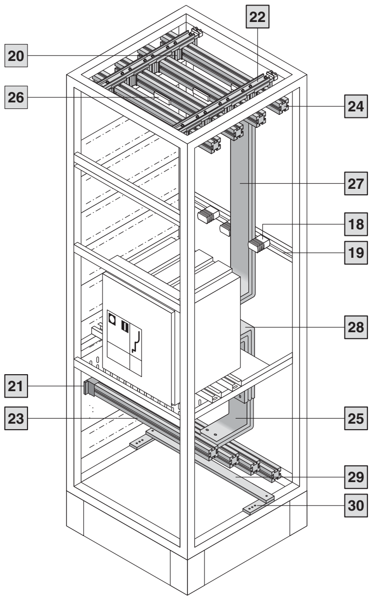
Rittal Power Engineering

The software Rittal Power Engineering is highly recommended for easy, fast configuration of section types and systems. This continuously updated, graphics oriented software tool supports customer-specific configuration and automatically produces bills of materials, CAD drawings and order lists of equipment and panels. The export interfaces mean that data and drawings are easily transmitted to other programs such as Word or Excel, or to Eplan Electric P8.

Compartment configuration



Busbar systems



System example of a circuit-breaker section

Bill of materials

Configuration parameters:

Enclosure dimensions
W x H x D:
800 x 2200 x 800 mm,
with base/plinth 200 mm

Roof plate IP 54
Front trim panel IP 2X
Form 4b

Busbar system, top
Maxi-PLS 3200, 4-pole,
in roof area, without cover

PE busbar design 80 x 10 mm

For air circuit-breaker (ACB)
Mitsubishi AE, 3200 A, 4-pole,
rack-mounted system,
positioned behind the door,
with cable connection system
Maxi-PLS 3200 A, 4-pole

Compartment divider, vented

	Enclosure	Qty.[1]	Packs of	**Model No.**
1	TS 8 modular enclosure, W/H/D: 800 x 2200 x 800 mm	1	1	**9670.828**
	Enclosure system accessories			
2	Base/plinth components, front and rear, 200 mm high	1	1	**8602.800**
3	Base/plinth trim, side, 200 mm high	1	1	**8602.080**
4	Front trim panel kit, IP 2X, W/H: 800 x 300/100 mm	1	1	**9672.038**
5	Horizontal roof frame bar, W: 800 mm	1	2	**9672.008**
6	Cross member for compartment divider, W: 800 mm	3	5	**9671.008**
7	Solid roof plate, W/D: 800 x 800 mm	1	1	**9671.688**
8	Partial door, W/H: 800 x 600 mm	3	1	**9671.186**
9	Lock with double-bit insert	6	1	**9671.130**
	Compartment configuration			
10	Compartment side panel module, H/D: 600 x 800 mm	4	2	**9673.086**
11	Compartment side panel module, H/D: 150 x 800 mm	2	6	**9673.085**
12	Compartment side panel module connection space, H/D: 450 x 800 mm	2	2	**9673.089**
13	Mounting bracket for compartment divider for enclosure depth 800 mm	4	8	**9673.408**
14	Mounting bracket for ACB + compartment divider for enclosure depth 800 mm	2	2	**9673.428**
15	Air circuit-breaker support rail Form 2-4 for enclosure width 800 mm	2	2	**9673.008**
	Attachment set for air circuit-breaker	1	1	**9660.970**
16	Compartment divider for busbar system gland, vented, W/D: 800 x 800 mm	3	4	**9673.478**
	Gland plate for compartment divider, W: 800 mm	3	4	**9673.508**
17	Partial mounting plate, W/H: 800 x 600 mm	1	1	**9673.686**
18	Stacking insulator	25	6	**9660.200**
19	Support rail for stacking insulator for enclosure width 800 mm	5	2	**9676.198**
	Busbar systems			
20	Busbar support Maxi-PLS 3200	8	1	**9659.000**
21	End support Maxi-PLS 3200	8	2	**9659.010**
22	System attachment, Maxi-PLS 3200, 4-pole, in roof area	2	2	**9650.080**
23	Busbars Maxi-PLS 3200, 691 mm	4	1	**9650.231**
24	Busbars Maxi-PLS 3200, 799 mm	4	1	**9650.251**
25	Connection bracket for Maxi-PLS 3200, 3-pole, 3 x 100 x 10 mm, for D: 800 mm	2	1	**9659.483**
	Connection bracket for Maxi-PLS 3200, for N, 3 x 100 x 10 mm, for D: 800 mm	2	1	**9659.484**
26	U contact makers Maxi-PLS 3200, W: 100 mm	4	1	**9650.181**
	Sliding blocks Maxi-PLS 3200, M12	8	15	**9650.990**
27	Connection kit, top, for ACB, design code 828F8J1H8H6F16	1	1	**9676.910**
28	Connection kit, bottom, for ACB, design code 828F8J1H8H6F16	1	1	**9676.912**
	Screw connection for connection bracket	2	8	**9676.963**
29	Busbars 80 x 10 mm, 792 mm	1	2	**9661.180**
30	PE/PEN combination angles, flat, 40 x 10 mm	2	4	**9661.240**

[1] Required quantity.

Coupling section

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Benefits at a glance:

- Reliable separation of the busbar sections thanks to extensive, stable compartmentalisation
- Total failures are prevented in the event of a malfunction
- Option of reducing the requirements of overall short-circuit resistance

Reliable disconnecting and connecting of the main busbar systems in low-voltage switchgear is the task of a coupling section. For systems with several infeeds, this prevents total failure and helps to reduce costs in the event of a malfunction. (Similarly, the requirements governing overall short-circuit resistance may be reduced).
Overall, investment, operating and servicing costs are reduced with rising levels of reliability, since in the event of servicing, individual busbar sections may be de-energised without having to switch off the entire system.

The coupling section is a combination of a circuit-breaker section with a busbar riser optionally arranged on the left or right. The large number of identical parts and work stages therefore also translates into convincing cost and time benefits during assembly.

Coupling section

Coupling switch

1 Complete, matching connection system for air circuit-breakers (ACB) from all well-known manufacturers.

2 The same system architecture as the circuit-breaker section reduces the number of different items and the required assembly work.

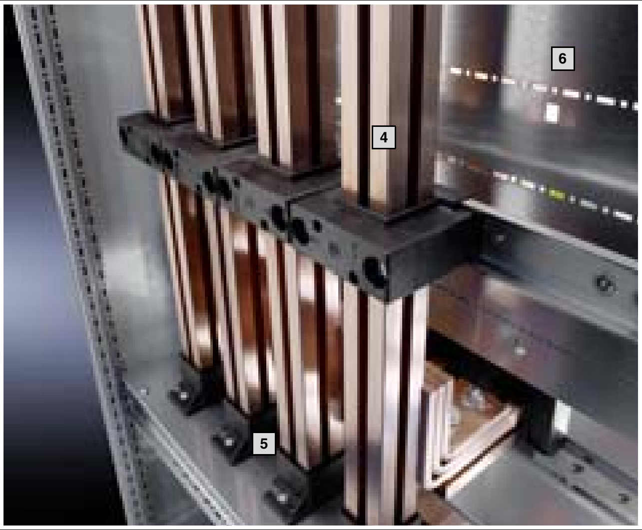
3 Standardised system accessories facilitate fast population.

Busbar riser

4 Version with Maxi-PLS or alternatively Flat-PLS.

5 Space-saving, modular and flexible arrangement of the busbar riser (on the left, right, or both sides).

6 Solid compartmentalisation provides a high level of safety for humans and equipment.



Busbar configuration

7 Main busbar routing in the rear panel area. Alternatively, other positions are also supported.

8 Option of using the other compartments separately. Flexible design with standard items e.g. for controlling and monitoring the coupling switch.

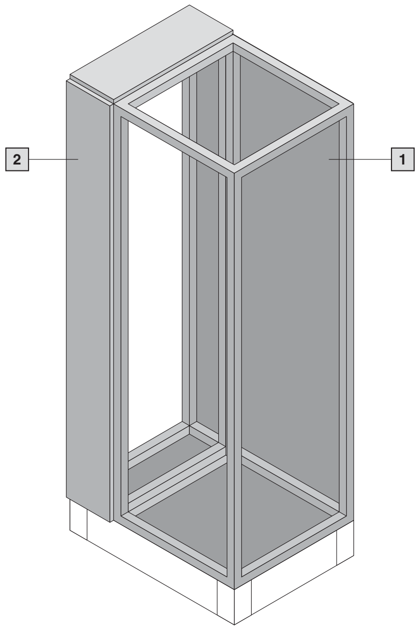
9 Individual selection of the roof plate and front trim panel allows process-optimised population of the switchgear.

System example of a coupling section

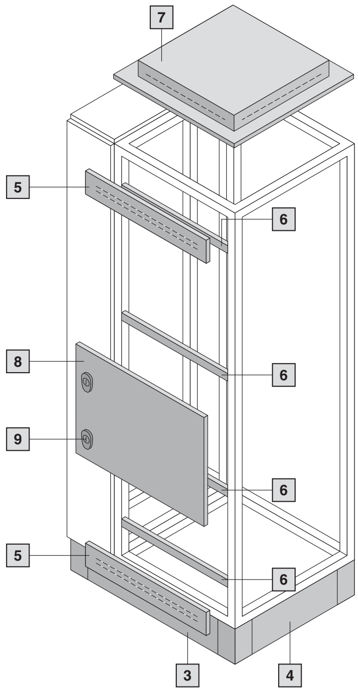
Overview of components

The components required for a coupling section are comprised of the enclosure, the enclosure system accessories, the compartment and the busbar systems.

Enclosure



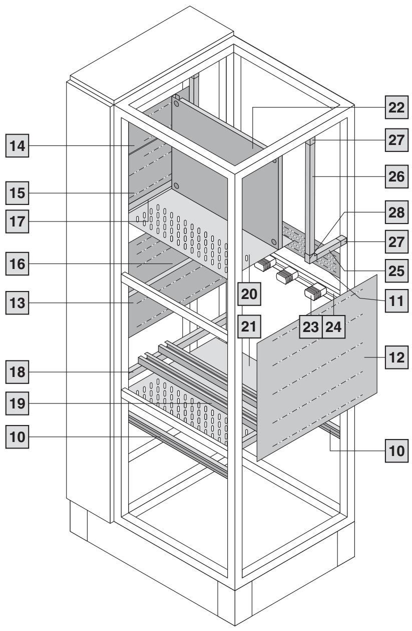
Enclosure system accessories



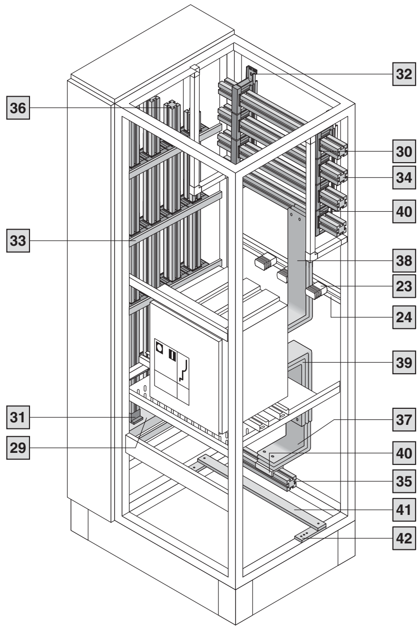
Rittal Power Engineering

The Rittal Power Engineering software is highly recommended for easy, fast configuration of section types and systems. This continuously updated, graphics oriented software tool supports customer-specific configuration and automatically produces bills of materials, CAD drawings and order lists of equipment and panels. The export interfaces mean that data and drawings are easily transmitted to other programs such as Word or Excel, or to Eplan Electric P8.

Compartment configuration



Busbar systems



System example of a coupling section

Bill of materials

Configuration parameters:

Enclosure dimensions
W x H x D:
800 x 2200 x 800 mm,
200 x 2200 x 800 mm,
with base/plinth 200 mm

Roof plate IP 2X vented
Front trim panel IP 2X vented
Form 4b

Busbar system, top
Maxi-PLS 2000, 4-pole,
in rear area, without cover

PE busbar design 80 x 10 mm

For air circuit-breakers (ACB)
ABB, E2, 2500 A,
static installation, 4-pole,
positioned behind the door

Busbar system, bottom
Maxi-PLS 2000, 4-pole,
directly underneath the
circuit-breaker

Compartment divider, vented

	Enclosure	Qty.[1]	Packs of	Model No.
1	TS 8 modular enclosure, W/H/D: 800 x 2200 x 800 mm	1	1	**9670.828**
2	TS 8 busbar enclosure, W/H/D: 200 x 2200 x 800 mm	1	1	**9670.228**

	Enclosure system accessories			
3	Base/plinth components, front and rear, 200 mm high	1	1	**8602.000**
4	Base/plinth trim, side, 200 mm high	1	1	**8602.080**
5	Front trim panel kit, IP 2X, W/H: 800 x 100 mm	1	1	**9671.038**
6	Cross member for compartment divider, W: 800 mm	6	5	**9671.008**
7	Roof plate, vented, IP 2X, W/D: 800 x 800 mm	1	1	**9659.535**
	Partial door, W/H: 800 x 200 mm	1	1	**9671.182**
	Partial door, W/H: 800 x 300 mm	2	1	**9671.183**
8	Partial door, W/H: 800 x 600 mm	2	1	**9671.186**
9	Lock with double-bit insert	7	1	**9671.130**
	Baying connectors, external	6	6	**8800.490**
	Angular baying bracket TS/TS	4	4	**8800.430**

	Compartment configuration			
10	Punched section with mounting flange for coupling section, for enclosure width 800 mm	2	2	**9674.058**
11	TS punched section with mounting flange, 23 x 73 mm, for enclosure width 800 mm	1	4	**8612.580**
12	Compartment side panel module, H/D: 200 x 800 mm	2	6	**9673.082**
12	Compartment side panel module, H/D: 600 x 800 mm	3	2	**9673.086**
13	Compartment side panel module, H/D: 300 x 800 mm	2	2	**9673.083**
14	Compartment side panel module, H/D: 200 x 600 mm	2	6	**9673.062**
15	Compartment side panel module, H/D: 300 x 600 mm	2	2	**9673.063**
16	Mounting bracket for compartment divider for enclosure depth 800 mm	2	8	**9673.408**
17	Mounting bracket for compartment divider for enclosure depth 600 mm	6	8	**9673.406**
18	Mounting bracket for ACB + compartment divider for enclosure depth 800 mm	2	2	**9673.428**
19	Air circuit-breaker support rail Form 2-4 for enclosure width 800 mm	2	2	**9673.008**
	Attachment set for air circuit-breaker	1	1	**9660.970**
20	Compartment divider, vented, W/D: 800 x 600 mm	3	4	**9673.485**
21	Compartment divider for busbar system gland, vented, W/D: 800 x 800 mm	2	4	**9673.478**
	Gland plate for compartment divider, W: 800 mm	2	4	**9673.508**
22	Partial mounting plate, W/H: 800 x 200 mm	1	1	**9673.682**
	Partial mounting plate, W/H: 800 x 300 mm	2	1	**9673.683**
23	Stacking insulator	5	6	**9660.200**
24	Support rail for stacking insulator for enclosure width 800 mm	1	2	**9676.198**
25	Mini-TS profile, 17 x 15.5 mm, L: 137.5 mm	2	12	**9673.920**
26	Mini-TS profile, 17 x 15.5 mm, L: 487.5 mm	2	12	**9673.953**
27	Frame connector piece for Mini-TS profile	4	24	**9673.901**
28	Corner connector for Mini-TS profile	2	10	**9673.902**
29	Coupling set mounting kit for enclosure depth 800 mm	1	1	**9674.198**

[1] Required quantity.

System example of a coupling section

Bill of materials

Configuration parameters:

Enclosure dimensions
W x H x D:
800 x 2200 x 800 mm,
200 x 2200 x 800 mm,
with base/plinth 200 mm

Roof plate IP 2X vented
Front trim panel IP 2X vented
Form 4b

Busbar system, top
Maxi-PLS 2000, 4-pole,
in rear area, without cover

PE busbar design 80 x 10 mm

For air circuit-breakers (ACB)
ABB, E2, 2500 A,
static installation, 4-pole,
positioned behind the door

Busbar system, bottom
Maxi-PLS 2000, 4-pole,
directly underneath the
circuit-breaker

Compartment divider, vented

	Busbar systems	Qty.[1]	Packs of	**Model No.**
	Busbar support Maxi-PLS 2000	24	1	**9649.000**
30	Busbar support Maxi-PLS 2000, suitable for top-mounting	8	1	**9649.160**
31	End support Maxi-PLS 2000	4	2	**9649.010**
32	System attachment Maxi-PLS 2000/4, rear section, frame chassis	2	2	**9640.098**
	System attachment Maxi-PLS 2000/4, in the roof area	2	2	**9640.088**
33	System attachment Maxi-PLS 2000/4, coupling section	6	2	**9649.078**
34	Busbars Maxi-PLS 2000, 725 mm	4	1	**9640.241**
35	Busbars Maxi-PLS 2000, 799 mm	4	1	**9640.251**
36	Busbars Maxi-PLS 2000, special length 1299 mm	1	1	**9640.368**
	Busbars Maxi-PLS 2000, special length 1399 mm	1	1	**9640.368**
	Busbars Maxi-PLS 2000, special length 1499 mm	1	1	**9640.368**
	Busbars Maxi-PLS 2000, special length 1599 mm	1	1	**9640.368**
37	Connection bracket for Maxi-PLS 1600/2000, 3-pole, 2 x 100 x 10 mm	1	1	**9640.473**
	Connection bracket for Maxi-PLS 1600/2000, for N, 2 x 100 x 10 mm	1	1	**9640.474**
38	Connection kit, top, for ACB, design code 828D9A2G4H6D26	1	1	**9676.910**
39	Connection kit, bottom, for ACB, design code 828D9A2G4H6D26	1	1	**9676.912**
	Terminal studs for connector kit	8	8	**9676.976**
	Screw connection for connection bracket	8	8	**9676.962**
40	U contact makers Maxi-PLS 2000, W: 100 mm	8	1	**9640.181**
	Corner bracket Maxi-PLS 2000	4	1	**9640.700**
	Sliding blocks Maxi-PLS 2000, M10	16	15	**9640.980**
	Connection kit Maxi-PLS 2000/3, coupling set in the rear section	1	1	**9660.313**
	Connection kit Maxi-PLS 2000/N, coupling set in the rear section	1	1	**9660.314**
41	Busbars 80 x 10 mm, 992 mm	1	2	**9661.100**
42	PE/PEN combination angles, flat, 40 x 10 mm	2	4	**9661.240**

[1] Required quantity.


Offener Leistungsschalter
Air circuit breaker
SIEMENS
ABB
E·T·N
Offener Leistungsschalter
Air circuit breaker
SIEMENS
ABB
E·T·N

Outgoing section

Order information Catalogue 33, from page 327

Benefits at a glance:

- For use with control units and power distribution
- Individual, targeted configuration of the compartments
- Simple, secure connection of the distribution bar system to the main bar system
- Flexible planning, simple adaptation, fast assembly and a high level of security are convincing features

Installation of switchgear, power supply outlets or controllers – the application areas of the outgoing section are very versatile. With multifunctional components, the individual compartments may be quickly assembled and configured to suit your requirements.
The busbar distribution system may be positioned adjacent to, behind or directly in the compartments and is easily and safely connected to the main busbar systems using system components.

The benefits are impressive, both during assembly and subsequent operation: simple assembly, flexible adaptation and a high level of security.

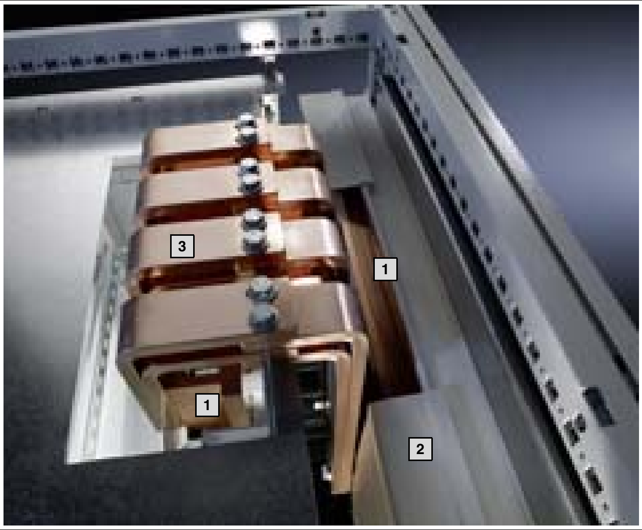
Outgoing section

Distribution busbars

1 RiLine60 is ideal for small rated currents. Alternatively, for higher currents, Maxi-PLS or Flat-PLS may be used for the main busbar.

2 Simple insulation and cover with standard parts.

3 T-connection kits for connecting main and distribution busbar systems.



Compartments with power outlet

4 Interior installation is individual, flexible and tailored to your requirements.

5 Arrangement of the distribution busbar in the indoor busbar system, alternatively:
– Behind the compartments/partial mounting plates
– At the side adjacent to the modular outgoing section to the side infeed into the compartments.

6 RiLine60 circuit-breaker adaptor for time-saving, maintenance-friendly installation of circuit-breakers up to 630 A.

Compartments with control units

7 Use of control units to suit individual requirements.

8 For all well-known brands of switchgear and control devices from Siemens, ABB, Mitsubishi, Eaton, Schneider Electric, General Electric and Terasaki.

9 Space-optimised configuration thanks to graduation of the compartment heights.

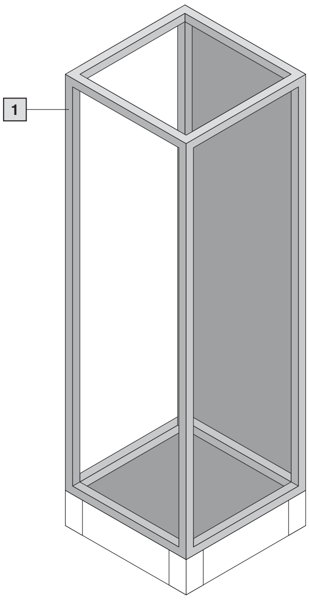
10 Rittal system accessories offer comprehensive configuration options and numerous design variants depending on the intended application.

System example of an outgoing section

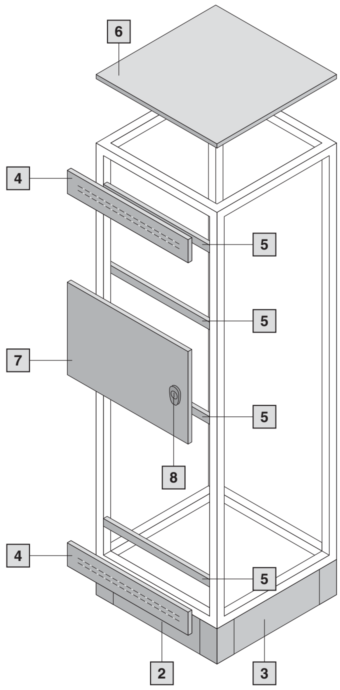
Overview of components

The components required for an outgoing section are comprised of the enclosure, the enclosure system accessories, the compartment and the busbar systems.

Enclosure



Enclosure system accessories



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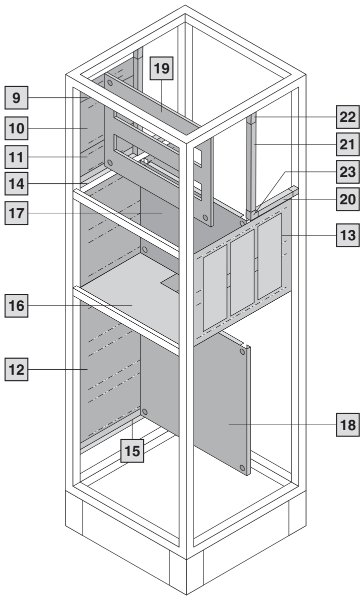
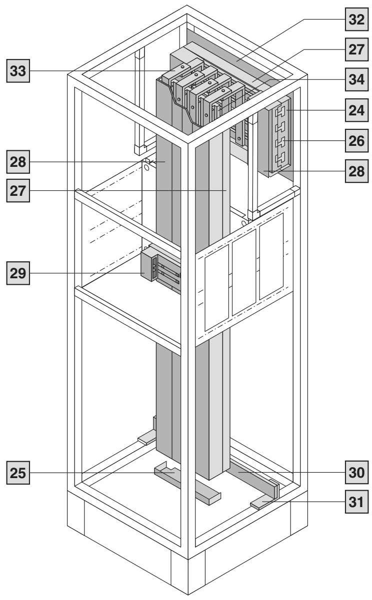
Compartment configuration



Busbar systems



System example of an outgoing section

Bill of materials

Configuration parameters:

Enclosure dimensions
W x H x D:
600 x 2200 x 600 mm,
with base/plinth 200 mm

Roof plate IP 54, solid
Front trim panel IP 54, solid
Form 4a

Main busbar system RiLine60, PLS 1600, 4-pole,
in rear section, top,
with busbar cover

PE busbar design 30 x 10 mm

Distribution busbar system RiLine60, PLS 1600, 4-pole,
in compartment (indoor),
with cover

Compartment divider for RiLine60, solid

Device-specific design of the compartments and adaptors

	Enclosure	Qty.[1]	Packs of	Model No.
1	TS 8 modular enclosure, W/H/D: 600 x 2200 x 600 mm	1	1	**9670.626**

	Enclosure system accessories			
2	Base/plinth components, front and rear, 200 mm high	1	1	**8602.600**
3	Base/plinth trim, side, 200 mm high	1	1	**8602.060**
4	Front trim panel kit IP 54, W/H: 600 x 100 mm	1	1	**9671.016**
5	Cross member for compartment divider, W: 600 mm	7	5	**9671.006**
6	Solid roof plate, W/D: 600 x 600 mm	1	1	**9671.666**
	Partial door, W/H: 600 x 150 mm	1	1	**9671.161**
7	Partial door, W/H: 600 x 300 mm	2	1	**9671.163**
	Partial door, W/H: 600 x 400 mm	1	1	**9671.164**
	Partial door, W/H: 600 x 600 mm	1	1	**9671.166**
	Partial door, W/H: 600 x 250 mm	1	1	**9671.167**
8	Lock with double-bit insert	7	1	**9671.130**

	Compartment configuration			
9	Compartment side panel module, H/D: 100 x 425 mm	2	6	**9673.051**
10	Compartment side panel module, H/D: 200 x 425 mm	2	6	**9673.052**
11	Compartment side panel module, H/D: 150 x 425 mm	2	6	**9673.055**
	Compartment side panel module, H/D: 100 x 600 mm	2	6	**9673.061**
12	Compartment side panel module, H/D: 600 x 600 mm	2	2	**9673.062**
	Compartment side panel module, H/D: 150 x 600 mm	2	6	**9673.065**
	Compartment side panel module, H/D: 300 x 600 mm	2	2	**9673.063**
	Compartment side panel module, H/D: 400 x 600 mm	2	2	**9673.064**
13	Gland plate for compartment side panel modules	3	4	**9673.194**
14	Mounting bracket for compartment divider for enclosure depth 425 mm	6	8	**9673.405**
15	Mounting bracket for compartment divider for enclosure depth 600 mm	8	8	**9673.406**
16	Compartment divider for RiLine60, W/D: 600 x 401 mm	7	4	**9673.454**
	Partial mounting plate, W/H: 600 x 150 mm	1	1	**9673.661**
17	Partial mounting plate, W/H: 600 x 300 mm	2	1	**9673.663**
	Partial mounting plate, W/H: 600 x 400 mm	1	1	**9673.664**
18	Partial mounting plate, W/H: 600 x 600 mm	1	1	**9673.666**
	Partial mounting plate, W/H: 600 x 250 mm	1	1	**9673.667**
19	Support frame for DIN rail-mounted devices, W: 600 mm, 2-row	1	1	**9674.762**
20	Mini-TS profile, 17 x 15.5 mm, L: 62.5 mm	2	12	**9673.915**
21	Mini-TS profile, 17 x 15.5 mm, L: 487.5 mm	2	12	**9673.953**
22	Frame connector piece for Mini-TS profile	4	24	**9673.901**
23	Corner connector for Mini-TS profile	2	10	**9673.902**

	Busbar systems			
24	RiLine60 busbar support PLS 1600 PLUS	7	4	**9342.004**
25	RiLine60 end cover for PLS 1600 PLUS	1	2	**9342.074**
26	Busbar PLS 1600 A, 495 mm long	4	3	**3527.000**
27	RiLine60 base tray for PLS 1600 PLUS	2	2	**9342.134**
28	RiLine60 cover section, L: 1100 mm	2	2	**9340.214**
	RiLine60 support panel	14	5	**9340.224**
	Circuit-breaker component adaptor 160 A, 690 V, outlet at bottom, 3-pole	1	1	**9342.510**
29	Circuit-breaker component adaptor 160 A, 690 V, outlet at bottom, 4-pole	2	1	**9342.514**
	Circuit-breaker component adaptor 250 A, 690 V, outlet at bottom, 4-pole	2	1	**9342.614**
	Circuit-breaker component adaptor 630 A, 690 V, outlet at bottom, 3-pole	3	1	**9342.710**
	Insert strip, W: 25 mm, for SV 9342.700/.710	4	4	**9342.720**
30	Busbar, 30 x 10 mm, for enclosure width 600 mm	1	2	**9661.360**
31	PE/PEN combination angles, 30 x 10 mm	2	4	**9661.230**
32	System attachment for RiLine60 for enclosure width 600 mm	1	1	**9674.006**
33	T-connector RiLine60, 1600 A, 4-pole, indoor, PLS 1600	1	1	**9675.166**
34	Distribution busbar PLS 1600, indoor, for enclosure height 2200 mm	4	1	**9675.242**

[1] Required quantity.

Cable chamber

Order information Catalogue 33, from page 327

Benefits at a glance:

- Versatile range of system accessories for optimum cable routing
- Cable entry optionally from below, from above, or from below and above
- Choice of various different cable entry glands
- Finger-proof construction

The distribution of cables into and out of the individual compartments is the task of the cable chamber. Depending on the main busbar system chosen, cable entry may be either from below, above, or below and above. Choose from a range of cable entry glands for the roof plate. The main busbar system is covered in a contact hazard-proof way, depending on the type and configuration.

Ri4Power offers every conceivable option for designing PE and N distribution busbars. In each case, the panel builder's requirements are effectively met to perfection.

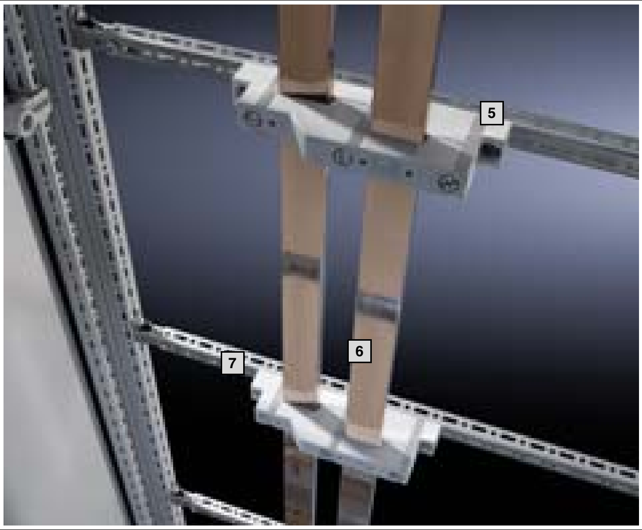
Cable chamber

TS 8 cable chamber enclosure

1 Roof plate for cable gland plates, cable entry glands.
2 Covering of the main busbar system.
3 Mini-TS sections as an auxiliary construction.
4 Main busbar system with RiLine60, alternatively with Maxi-PLS or Flat-PLS.

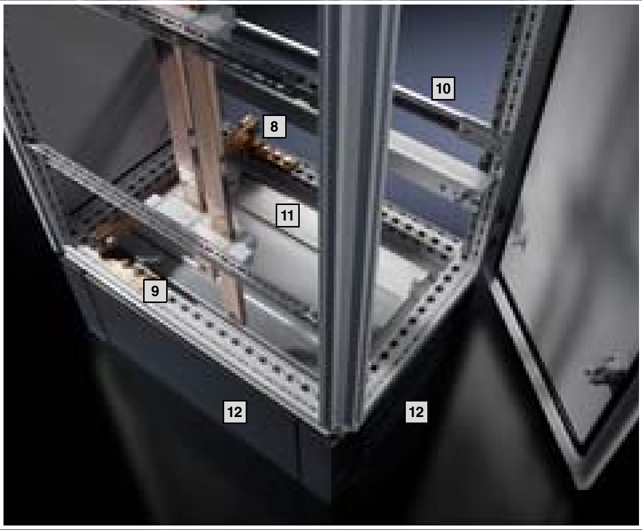
PE and N distribution busbars

5 Busbar supports for PE and N distribution busbars.
6 Distribution busbar to match the enclosure heights.
7 Supporting structure of Mini-TS sections for individual attachment.



PE/PEN, cable entry, base/plinth

8 PE/PEN busbar tailored to the enclosure width. Configurable in various cross-sections.
9 PE/PEN combination angles for attaching the PE busbar and incorporating the TS 8 enclosure into the protective measure.
10 C rails for cable attachment, alternatively cable clamp rail from the mounting angle.
11 Gland plates divided in the depth.
12 Base/plinth components, front and rear plus base/plinth trim, side.

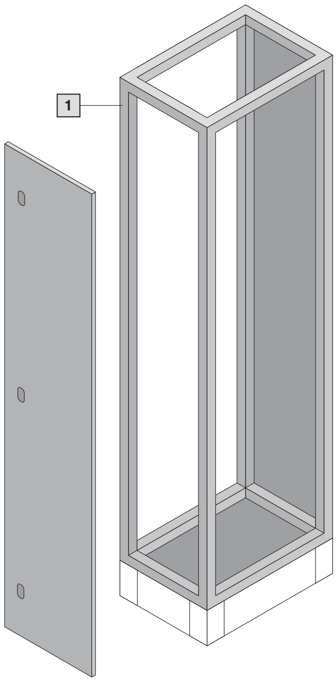


System example of a cable chamber

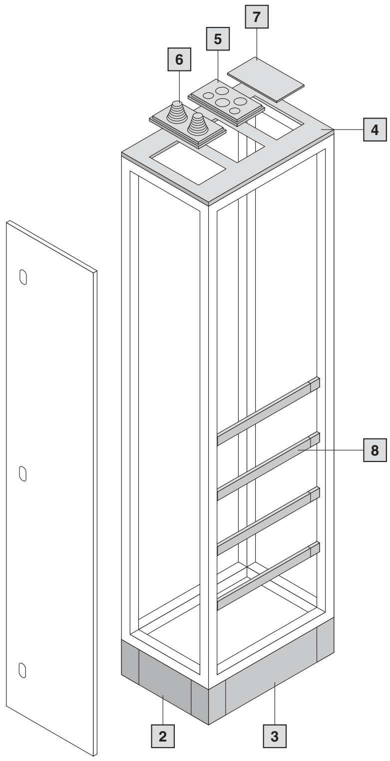
Overview of components

The components required for a cable chamber are comprised of the enclosure, the enclosure system accessories, the compartment and the busbar systems.

Enclosure



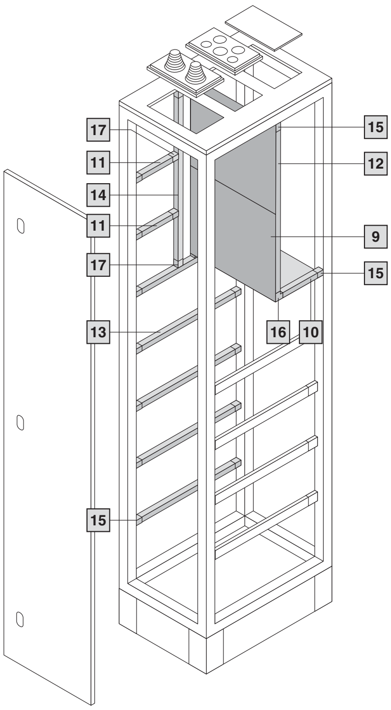
Enclosure system accessories



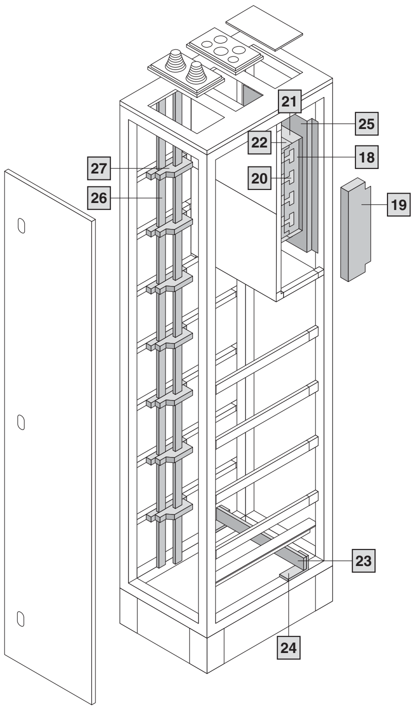
Rittal Power Engineering

The Rittal Power Engineering software is highly recommended for easy, fast configuration of section types and systems. This continuously updated, graphics oriented software tool supports customer-specific configuration and automatically produces bills of materials, CAD drawings and order lists of equipment and panels. The export interfaces mean that data and drawings are easily transmitted to other programs such as Word or Excel, or to Eplan Electric P8.

Compartment configuration



Busbar systems



System example of a cable chamber

Bill of materials

Configuration parameters:

Enclosure dimensions
W x H x D:
400 x 2200 x 600 mm,
with base/plinth 200 mm

Roof plate for cable gland plates
Form 4a

Main busbar system RiLine60, PLS 1600, 4-pole,
in rear section, top,
with busbar cover

PE busbar design 30 x 10 mm

PE/N distribution busbar version
PE + N
PE 30 x 10 mm
N 30 x 10 mm

Cable clamp rail
C rail

	Enclosure	Qty.[1]	Packs of	Model No.
1	TS 8 cable chamber enclosure, W/H/D: 400 x 2200 x 600 mm	1	1	**9670.436**
	Enclosure system accessories			
2	Base/plinth components, front and rear, 200 mm high	1	1	**8602.400**
3	Base/plinth trim, side, 200 mm high	1	1	**8602.060**
4	Roof plate for cable gland plates, W/D: 400 x 600 mm	1	1	**9671.546**
5	ISV cable entry gland, M25/32/40/50/63	1	1	**9665.760**
6	ISV cable entry gland, with entry fittings	1	1	**9665.780**
7	ISV cable entry gland, solid	1	4	**9665.785**
8	Support rails for TS 8, W/D: 600 mm	4	2	**9676.196**
	Compartment configuration			
9	Cover plate for main busbar system, W: 400 mm	1	2	**9673.540**
10	Mini-TS profile, 17 x 15.5 mm, L: 62.5 mm	2	12	**9673.915**
11	Mini-TS profile, 17 x 15.5 mm, L: 262.5 mm	2	12	**9673.940**
12	Mini-TS profile, 17 x 15.5 mm, L: 487.5 mm	2	12	**9673.953**
13	Mini-TS profile, 17 x 15.5 mm, L: 462.5 mm	5	12	**9673.960**
14	Mini-TS profile, 17 x 15.5 mm, L: 712.5 mm	1	12	**9673.981**
15	Frame connector piece for Mini-TS profile	17	24	**9673.901**
16	Corner connector for Mini-TS profile	2	10	**9673.902**
17	T-connector piece for Mini-TS profile	3	24	**9673.903**
	Busbar systems			
18	RiLine60 busbar support PLS 1600 PLUS	2	4	**9342.004**
19	RiLine60 end cover for PLS 1600 PLUS	1	2	**9342.074**
20	Busbar PLS 1600 A, 495 mm long	4	3	**3527.000**
21	RiLine60 base tray for PLS 1600 PLUS	1	2	**9342.134**
22	RiLine60 cover section, L: 1100 mm	1	2	**9340.214**
	RiLine60 support panel	2	5	**9340.224**
23	Busbar, 30 x 10 mm, for enclosure width 400 mm	1	2	**9661.340**
24	PE/PEN combination angles, 30 x 10 mm	2	4	**9661.230**
25	System attachment for RiLine60 for enclosure width 400 mm	1	1	**9674.004**
26	Distribution busbar 30 x 10 mm, indoor, for enclosure height 2000 mm	2	1	**9675.220**
27	Busbar support N/PE, 2-pole	7	4	**9340.040**

[1] Required quantity.

Fuse-switch disconnector section

Order information Catalogue 33, from page 327

Benefits at a glance:

- Compact, variable distribution of power specifically for fused switchgear
- Suitable for switchgear enclosure technology
- Short-circuit-rating to 100 kA, also for the distribution busbar system
- Internal separation according to customer requirements, from Form 1 to 4b

The compact, variable distribution of electrical power with fused switchgear can be achieved with a fuse-switch disconnector section.
The modular Ri4Power configuration system allows you to fully prepare for the installation of NH slimline fuse-switch disconnectors sizes 00 to 3 from Jean Müller or ABB/Siemens.
With device modules from Jean Müller, live-interchangeable control units may also be integrated into the fuse-switch disconnector section.

The distribution busbars are selectively and economically dimensioned according to requirements. The main and the distribution busbar system can be configured for short-circuit rating of up to 100 kA.
Internal sub-division in the fuse-switch disconnector section is from Form 1 to Form 4b, depending on customer requirements, thanks to the optional selection of components.

Fuse-switch disconnector section

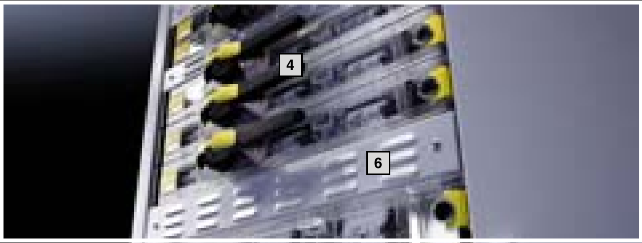
Busbar system

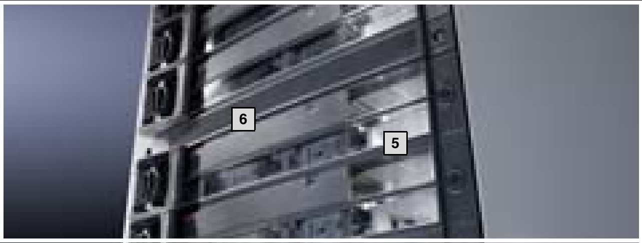
1 Accommodates standard commercially available flat copper bars from 50 x 10 to 100 x 10 mm for rated currents up to 2100 A.

2 Connection of the distribution busbars with terminal block, no drilling required.

3 Flexible busbar support arrangement on a 25 mm pitch pattern for optimum fuse-switch disconnector configuration.

Switchgear area





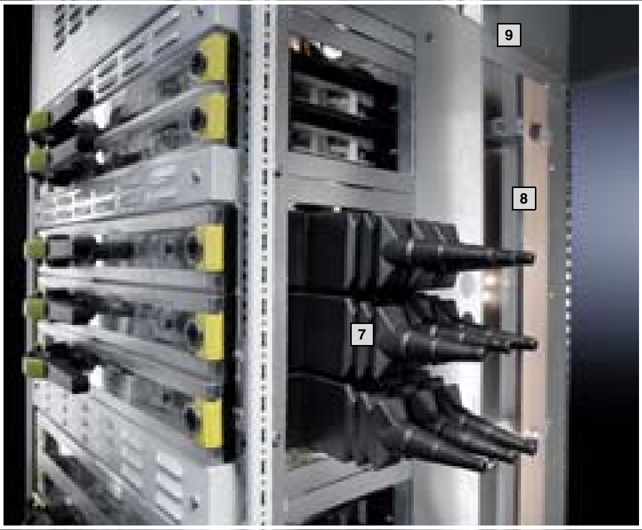
Individual interior configuration for:

4 a) Jean Müller Sasil fuse-switch disconnectors, Jean Müller device modules

5 b) ABB SlimLine fuse-switch disconnectors/ Siemens 3NJ62 fuse-switch disconnectors

6 Variable positioning of ventilation trim panels between the fuse-switch disconnector according to manufacturer's instructions.

Cable connection space



7 Upgradable to Form 4b with device-specific terminal covers.

8 Application-specific design of PE and N for the distribution busbar system.

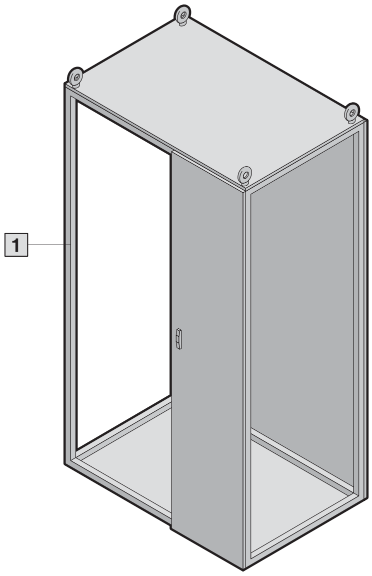
9 Optional contact hazard protection even without form separation.

System example of a fuse-switch disconnector section

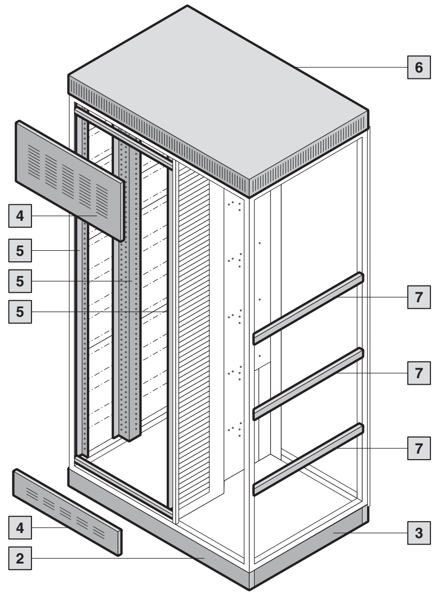
Overview of components

The components required for a fuse-switch disconnector section are comprised of the enclosure, the enclosure system accessories, the compartment and the busbar systems.

Enclosure



Enclosure system accessories



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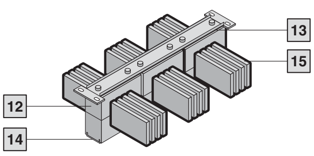
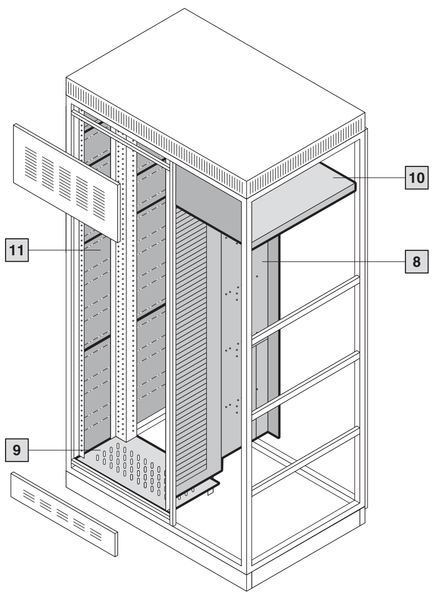
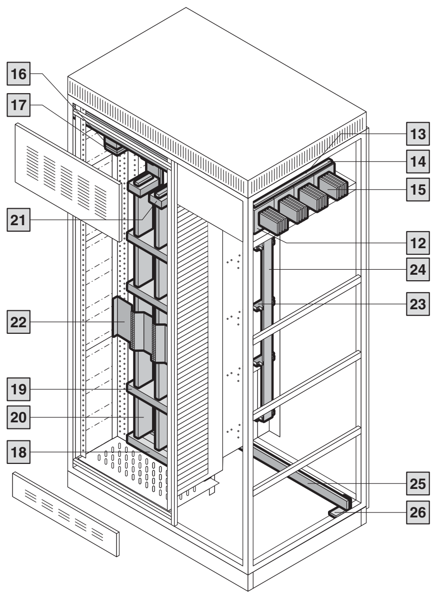


Compartment configuration



Busbar systems



System example of a fuse-switch disconnector section

Bill of materials

Configuration parameters:

Enclosure dimensions
W x H x D:
1200 x 2200 x 800 mm,
with base/plinth 200 mm

Roof plate IP 2X vented
Front trim panel IP 2X vented
Form 4b

Busbar system, top
Flat-PLS 100, 4-pole,
4 x 100 x 10 mm,
reinforced,
in roof section with cover

PE busbar design 80 x 10 mm

For Jean Müller (JM)
NH slimline fuse-switch
disconnectors, type Sasil

	Enclosure	Qty.[1]	Packs of	Model No.
1	TS 8 fuse-switch disconnector enclosure, W/H/D: 1200 x 2200 x 800 mm	1	1	**9670.128**

	Enclosure system accessories			
2	Base/plinth components, front and rear, 200 mm high	1	1	**8602.200**
3	Base/plinth trim, side, 200 mm high	1	1	**8602.080**
4	Front trim panels, fuse-switch disconnector section, top 350 mm/bottom 150 mm	1	1	**9674.340**
5	Assembly kit for fuse-switch disconnector section JM, H: 2200 mm	1	1	**9674.352**
6	Maxi-PLS roof plate, vented, W/D: 1200 x 800 mm, 50 mm high, RAL 7035	1	1	**9659.555**
	Baying connector, external	6	6	**8800.490**
	Angular baying bracket TS/TS	4	4	**8800.430**
7	Support rails for TS 8, W/D: 800 mm	4	2	**9676.198**

	Compartment configuration			
8	Divider panel, fuse-switch disconnector section JM/ABB, H/D: 2200 x 800 mm	1	1	**9674.328**
9	Dividing plate for fuse-switch disconnector section section for JM	2	1	**9674.346**
10	Contact hazard protection, fuse-switch disconnector section, W/D: 1200 x 800 mm	1	1	**9674.368**
11	Compartment side panel module, H/D: 200 x 800 mm	4	6	**9673.082**
11	Compartment side panel module, H/D: 600 x 800 mm	4	2	**9673.086**

	Busbar systems			
12	Busbar support Flat-PLS 100 suitable for stabiliser bar	12	1	**9676.021**
13	System attachment for busbar support Flat-PLS 100, in roof/bases, 3-/4-pole, D: 800 mm	3	2	**9674.184**
14	Busbar stabiliser bar, 4-pole	3	2	**9676.025**
15	Busbars E-Cu, 100 x 10 x 2400 mm	8	1	**3590.015**
	Busbar claws up to 4 x 100 x 10 mm, 1-pole	12	1	**9676.019**
	Screw connections M10 x 120	12	8	**9678.812**
16	Contact piece for Flat-PLS, 4 bars, W: 60 mm	4	1	**9676.546**
17	Connection bracket, fuse-switch disconnector section, Flat-PLS 100, L1 – 3, D: 800 mm	1	1	**9674.457**
	Connection bracket, fuse-switch disconnector section, Flat-PLS 100, N, D: 800 mm	1	1	**9674.458**
18	End support for fuse-switch disconnector section, 3-/4-pole, bar width: 100 mm	1	1	**9674.430**
19	Busbar support for fuse-switch disconnector section, 3-/4-pole, bar width: 100 mm	6	1	**9674.410**
20	Distribution busbar for fuse-switch disconnector section, W/H: 100/2200 mm	4	1	**9674.420**
21	Terminal block, distribution busbar for fuse-switch disconnector section, 80/100 mm	4	1	**9674.488**
22	Cover for distribution busbar, fuse-switch disconnector section JM, enclosure height: 2000/2200 mm	1	1	**9674.380**
	Punched rail for attaching the distribution busbar cover of the JM fuse-switch disconnector section, enclosure height: 2000/2200 mm	1	1	**9674.381**
23	Busbar support up to 1600 A, 3-pole, 185 mm bar centre distance for busbars E-Cu 50 x 10 to 80 x 10 mm	2	2	**3052.000**
24	Distribution busbar for fuse-switch disconnector section, W/H: 80/2000 mm	1	1	**9674.408**
25	Busbars, 1192 x 80 x 10 mm, for enclosure width 1200 mm	1	2	**9661.120**
26	PE/PEN combination angles, flat, E-Cu 40 x 10 mm	2	4	**9661.240**

[1] Required quantity.

List of contents – Planning instructions

List of contents – Planning instructions

Tables

Busbar system Maxi-PLS

Order information Catalogue 33, from page 328

Benefits at a glance:

- High productivity, thanks to simple project planning and fast assembly of the system technology.
- Cable and busbar connections are achieved with the tried-and-trusted sliding block technique, no drilling required.
- Compact busbar design.
- Standardised connection components throughout.
- High standard of safety.
- All you have to do is make your selection, plan and install!

The innovative Maxi-PLS busbar system allows customer-oriented configuration of Motor Control Centres and low-voltage switchgear in building technology, industry and regenerative energy recovery. The standardised Maxi-PLS busbar systems feature an exceptionally compact design and ingeniously simple assembly technology. The Maxi-PLS system with stepped arrangement is particularly ideal for the connection of external cables.

All system components are standardised, inexpensively mass-produced, and supplied ready for configuration. This makes Maxi-PLS the ideal link between the power supply and power distribution to the smallest piece of equipment.

Busbar system Maxi-PLS

Beneficial system technology

- Beneficial system technology and coordinated dimensional pitch patterns for precise-fit, fast installation of Maxi-PLS holders and bars.
- Compact design with square profile cross-section (45 x 45 mm to 2500 A, 60 x 60 mm to 4000 A).
- The section lengths are sized to match the enclosure widths.
- Individual contact hazard protection with simple clip-on mounting of covers.

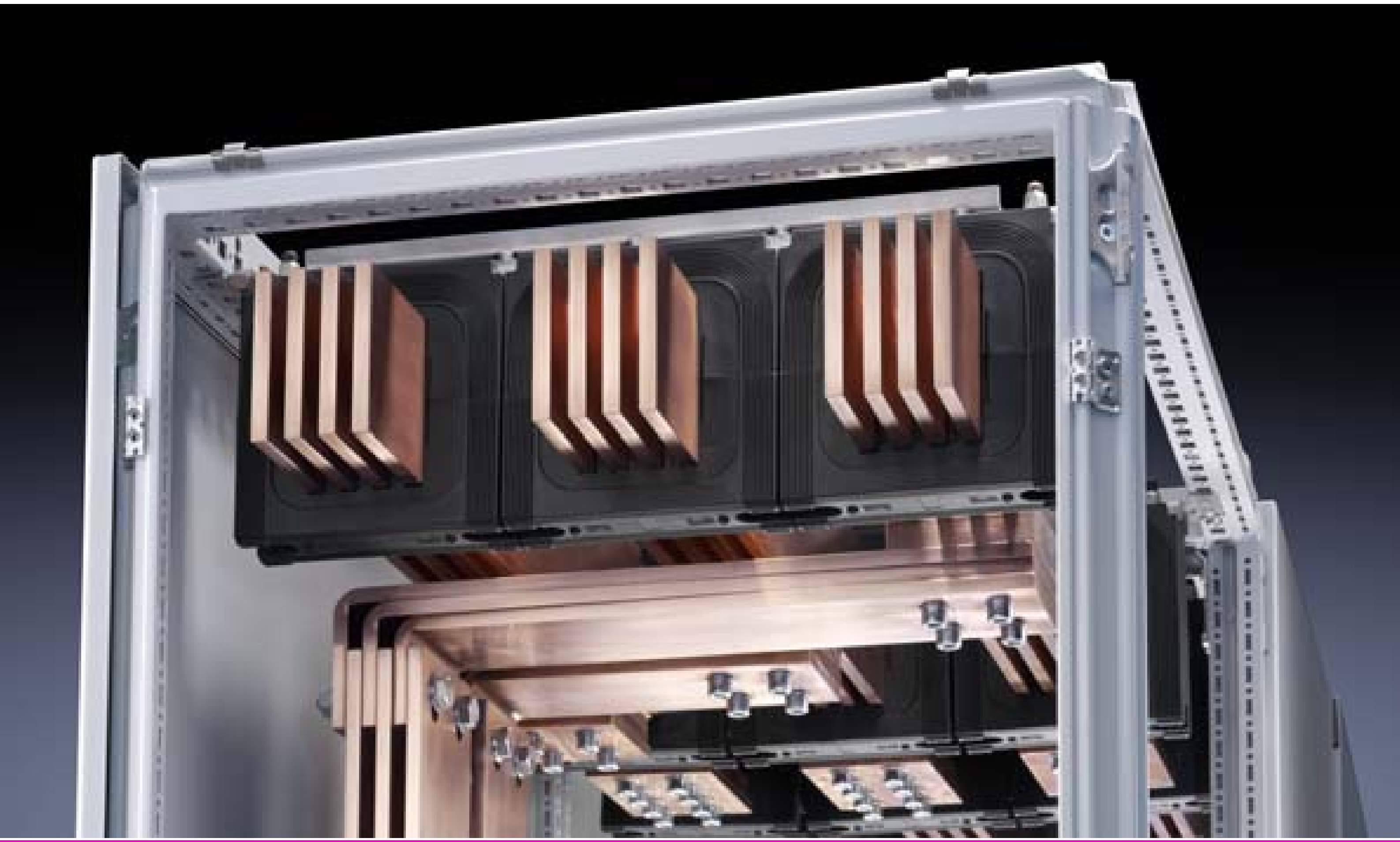
Four attachment levels

- The four attachment levels of Maxi-PLS busbars facilitate attachment and contacting on all sides with no drilling required.
- Contact makers facilitate the direct connection of intersecting bars.

Simple, practical connection

- Linear contacting of cables, laminated flat copper, connection brackets and connection kits.
- Terminal studs and connection plates for ring terminals, as well as all variants of cables and flat bars.
- Stepped arrangement ensures simple, clear assembly of cables and laminated flat copper.

Busbar system Flat-PLS



Order information Catalogue 33, from page 332

Benefits at a glance:

- Busbar system up to 5500 A/100 kA 1 sec.
- For standard commercially available flat copper bars.
- Extremely flexible and assembly-friendly.
- Short-circuit ratings is inexpensively enhanced.
- Effective contact hazard protection.
- High standard of safety.

In order to meet global rising demands for energy, low-voltage switchgear needs to become ever more powerful and larger. These days, there are a growing number of installations with rated currents of 3200 to 4000 A or even higher. In order to meet these requirements, with Flat-PLS, Rittal offers a busbar system for rated currents of up to 5500 A load capacity.

The Flat-PLS busbar system significantly broadens the tried-and-trusted modular range for switchgear manufacturers, and the Ri4Power is therefore available as a low-voltage switchgear system with design certificate up to 5500 A with commercially available flat copper bars.

Busbar system Flat-PLS

Dimensioning in numerous variants

- Dimensioning of busbars in numerous variants with just two busbar support variants for bar formats ranging from 40 x 10 to 60 x 10, as well as 80 x 10 and 100 x 10 mm.
- Also suitable for aluminium and copper-plated aluminium bars.
- Every support can accommodate 2, 3 or 4 bars per phase.
- Optimum adaptation to the corresponding rated current.
- Very flexible and assembly-friendly, thanks to the 4-part support design.

Connection with no drilling required

- Connection of Flat-PLS busbar systems with no drilling required, thanks to longitudinal connectors.
- Adapted to your requirements.
- Enhanced short-circuit ratings, thanks to 3-phase installation concept with busbar claws and stabiliser bars.

All-round contact hazard protection

- All-round contact hazard protection thanks to a variable range of precise-fit cover sections and cover components for busbars and connection kits.
- Reduces the potential for accidents and accidental arcing.
- Significantly enhances the reliability of low-voltage switchgear.
- The optional busbar claws may also be integrated into contact hazard protection.

Busbar systems (100/185/150 mm)

Order information Catalogue 33, from page 340

Benefits at a glance:

- Tested busbar systems for use in power distribution.
- Suitable for the assembly of NH slimline fuse-switch disconnectors (100/185 mm) and NH fuse-switch disconnectors (100 mm).
- Assembly on a mounting plate or mounting frame.

These systems are designed for mounting NH fuse-switch disconnectors and fuse-switch disconnectors, and for safe power transmission and distribution.

Busbar systems (100/185/150 mm)

1 Busbar system 100 mm bar centre distance

- The busbar support is designed to accommodate bars up to 60 x 10 mm
- Tested for applications with rated operating currents of up to 1250 A and max. 110 kA peak short-circuit current.

The busbar system with 100 mm bar centre distance is used for mounting NH fuse-switch disconnectors, sizes 00, 1, 2 and 3, as well as NH slimline fuse-switch disconnectors, size 00. When using inserts, this can be reduced to 50 x 10 mm, 40 x 10 mm or 30 x 10 mm.

2 Busbar system 185 mm bar centre distance

- The busbar support is designed to accommodate bars up to 80 x 10 mm
- Tested for applications with rated operating currents of up to 1600 A and max. 155 kA peak short-circuit current.

The busbar system with 185 mm bar centre distance is mainly used for mounting NH slimline fuse-switch disconnectors, sizes 00, 1, 2 and 3. Inserts enable this to be reduced to 60 x 10 mm or 50 x 10 mm. The special design of the busbar support facilitates seamless top mounting in the vicinity of the support. In addition, the individual modules of the busbar support can also be used as single-pole supports for PE, PEN or neutral conductor applications.

3 Busbar system 150 mm bar centre distance

- Multi-terminal busbar system for two conductors running parallel to one another. This facilitates the connection of cables, lines and laminated busbars using connection plates, with no drilling required.
- Tested for applications with rated operating currents of up to 3000 A and max. 155 kA peak short-circuit current.

The busbar system is the simplest way of distributing high currents up to 3000 A over two parallel flat copper bars. Thanks to the 10 mm spacing pieces, flat copper bars 60 x 10 mm may alternatively be used. This system is used primarily in systems where no direct mounting of equipment or adaptors is required.

Two support variants are available with 150 mm bar centre distance:

- 2 x 3-pole up to 2500 A
- 2 x 3-pole up to 3000 A

Connection system

Order information Catalogue 33, from page 338

Benefits at a glance:

- Standardised system packages for leading manufacturers of air circuit-breakers.
- Simple, fast assembly with standard components and ready-to-install connection components.
- Compact, parallel bar arrangement, with positioning of the connections tailored to the respective air circuit-breaker.
- Standardised, tested connections
- High standard of safety.
- All you have to do is make your selection, plan and install!

Ingeniously simple assembly of Motor Control Centres and switchgear in the heavy current range. The various Rittal components are supplied ready to configure.
The same applies to the entire connection system. Complete system packages, customised for all leading manufacturers of air circuit-breakers, NH switchgear or other conductor versions, ensure optimum connection with standardised components.

Connection system

Connector kits

- Connected to Maxi-PLS and Flat-PLS busbar systems using standardised components tailored to the respective air circuit-breaker.
- Standardised, tested connections ranging from the incoming cable connection of the switch panel, to the air-circuit-breaker connections, through to the main busbar.
- To fit all standard air circuit-breakers.
- Pre-assembled connection brackets, ready to install.

Connection system

- All busbar systems have connection components that allow simple, secure connection for the respective conductor type.
- With contact makers or copper spacers, even solid copper bars are easily connected to the main busbars without conflict.
- When connecting to the Maxi-PLS busbar system, isolator chassis may optionally be used to increase the clearance and creepage distance.

Design certificate/type-tested

- Type-tested to EN 60 439-1/IEC 60 439-1.
- Design certificate to IEC 61 439.
- Special testing under accidental arcing conditions to EN 61 641/IEC 61 641.
- ASTA certificates.

Application

This planning handbook should be used to create low-voltage switchgear and controlgear assemblies with the Ri4Power modular system from Rittal, as the basis for planning and configuration.

The explanations in this handbook apply to the creation of low-voltage switchgear and controlgear assemblies that must meet the requirements of IEC/EN 61 439-1/-2. Where necessary, the requirements of the predecessor standard IEC 60 439-1 are also met.

Definitions and basic principles

Before starting to plan a low-voltage switchgear, the following parameters should be agreed with the subsequent user of the low-voltage switchgear:

Rated data	Standard IEC 61 439 Clause	see page
Rated voltage U_n	5.2.1	37
Rated operating voltage U_e	5.2.2	37
Rated insulation voltage U_i	5.2.3	38
Rated surge voltage resistance U_{imp}	5.2.4	38
Rated current of switchgear assemblies I_{nA}	5.3.1	38
Rated currents of circuits I_{nc}	5.3.2	38
Rated diversity factor RDF	5.3.3	38
Rated peak withstand current I_{pk}	5.3.4	39
Rated short-time withstand current I_{cw}	5.3.5	39
Conditional rated short-circuit current I_{cc}	5.3.6	39
Rated frequency f_n	5.4	39

Other technical features	Standard IEC 61 439 Clause	see page
Pollution degree	7.1.3	39
Material group	Table 2	40
Conditions of installation of assemblies	7.1	40
Stationary/movable installation	3.5.3 – 3.5.4	40
Protection category	8.2	40
Use by skilled persons or ordinary persons	8.4.5	40
Classification according to electromagnetic compatibility (EMC)	9.4	41
Special operating conditions	7	41
External design	3.3	41
Protection from mechanical impact	8.2.1	41
Type of layout	8.5	41

A list of the maximum values of the Ri4Power systems in table form may be found on the Rittal website under “Technical details” for Catalogue 33, page 166.

Rated voltage U_n

Standard reference chapter 5.2.1 [to IEC 61 439-1]

This is the highest rated a.c. voltage (root-mean-square value) or d.c. voltage for which the main circuits of the switchgear enclosure are designed [pursuant to IEC 61 439-1 section 3.8.9.1].

The maximum possible rated value with the Ri4Power system is 690 V AC.

Dimensioning to a lower rated value is possible. In this connection, it is important to ensure that all operating equipment connected to the main circuit is suitable for this rated value.

Rated operating voltage U_e

Standard reference chapter 5.2.2 [to IEC 61 439-1]

If the rated voltage of an outgoing circuit deviates from the specified rated voltage U_n, a separate rated operating voltage must be given for that circuit.

This value must not exceed the maximum rated voltage of the Ri4Power system of 690 V AC.

Rated insulation voltage U_i

Standard reference chapter 5.2.3 [to IEC 61 439-1]

Withstand voltage (root-mean-square value) specified for a piece of operating equipment or part of the low-voltage switchgear indicating the specified withstand capacity of the affected isolator [to IEC 61 439-1 section 3.8.8.3].

The maximum possible rated value with the Ri4Power system is 1000 V AC.

A smaller rated value may be specified for the low-voltage switchgear or a part thereof. It is important to ensure that all operating equipment connected to the circuit meets this rated value and that this rated value is greater than or equal to the rated voltage U_n and the rated operating voltage U_e of this circuit.

Rated surge voltage resistance U_{imp}

Standard reference chapter 5.2.4 [to IEC 61 439-1]

Withstand surge voltage indicating the isolator's ability to withstand a transient overvoltage [to IEC 61 439-1 section 3.8.8.4].

The maximum possible rated value with the Ri4Power system is 8 kV.

A smaller rated value may be specified. Measures must be taken to ensure that the surge voltage resistance of all operating equipment connected to the circuit is greater than or equal to the transient overvoltage that may arise in this system.

Rated current of switchgear assemblies I_{nA}

Standard reference chapter 5.3.1 [to IEC 61 439-1]

The rated current of switchgear assemblies is the current that is fed into a low-voltage switchgear via one infeed or several parallel infeeds and is distributed via the main busbar system.

No maximum possible value is specified for the Ri4Power system, since the breakdown into multiple busbar sections and the associated addition of busbar currents allows a multiple of the admissible currents to be achieved for the system current.

Dimensioning to a lower rated voltage is possible by selecting smaller bubar systems.

Note:
The rated current of a busbar system in a switchgear may be smaller than the rated current of a switchgear, provided measures are taken to ensure that the maximum admissible current is not exceeded at any point in the busbar. For example, this is possible with a centre infeed or several infeeds distributed over the low-voltage switchgear.

Rated current of circuits I_{nc}

Standard reference chapter 5.3.1 [to IEC 61 439-1]

The rated current of a circuit is the value which may be routed via this circuit, while adhering to all overtemperatures. The rated currents of the devices used in this circuit may well have higher values. For each circuit, the rated currents must be defined by the user. By selecting suitable devices, the switchgear manufacturer must ensure that these are capable of carrying the requisite rated current I_{nc} under the conditions in the switchgear.

The maximum admissible rated currents of a circuit, with due regard for the device types and device systems of the different switchgear brands and the protection category achieved, are detailed in the tables from page 77.

Rated diversity factor RDF

Standard reference chapter 5.3.3 [to IEC 61 439-1]

The rated diversity factor is the factor with which the outgoing feeders of a low-voltage switchgear may be continuously and simultaneously operated, with due regard for reciprocal thermal influences. This factor may be given for groups of circuits as well as for the entire low-voltage switchgear system.

The rated diversity factor refers to the rated currents of the circuits, and not to the rated currents of the switchgear.

In Ri4Power, this rated diversity factor depends on the system design. Further details may be found in the descriptions of the switchgear field types.

Rated peak withstand current I_{pk}

Standard reference chapter 5.3.4 [to IEC 61 439-1]

The peak withstand current of the low-voltage switchgear must be greater than or equal to the specified peak value of the uninfluenced peak current that may flow through the low-voltage switchgear.

With RiPower, this value may be adjusted by selecting the different busbar systems to meet requirements. In this connection, please also refer to page 44, Design of the busbar systems.

Rated short-time withstand current I_{cw}

Standard reference chapter 5.3.5 [to IEC 61 439-1]

The rated short-time withstand current of the low-voltage switchgear shall be equal to or higher than the prospective rms value of the short-circuit current of the supply system to which the circuit is designed to be connected. When defining the rated short-time withstand current I_{cw}, a period of time must always be given. Generally speaking, the rated short-time withstand current I_{cw} is given for a period of 1 second.

With Ri4Power, this value may be adjusted by selecting the different busbar systems to meet requirements. By means of various measures, such as the use of busbar claws or stabilisers, the short-circuit resistance may be additionally increased. In this connection, please also refer to page 44, Design of the busbar systems.

Conditional rated short-circuit current I_{cc}

Standard reference chapter 5.3.6 [to IEC 61 439-1]

The rated short-circuit current of the low-voltage switchgear must be greater than or equal to the prospective root-mean-square value of the short-circuit current that may be fed in via the supply to the low-voltage system, but for a limited time via the initiation of a short-circuit protection device (fuse, air circuit-breaker etc.)

Rated frequency f_n

Standard reference chapter 5.4 [to IEC 61 439-1]

The rated frequency of a circuit is given for the operating condition. If circuits with different frequencies are used in a low-voltage switchgear, separate values must be given for each circuit.

All Ri4Power components are designed for a nominal value of 50 Hz. Any uses that deviate from this should be agreed with the Rittal Technical Support team.

Pollution degree

Standard reference chapter 7.1.3 [to IEC 61 439-1]

The pollution degree is a ratio indicating the influence of dust, gas, dirt, salt etc. on reducing dielectric strength and/or surface resistance. The admissible creepage distances and minimum gap widths of the operating equipment are dependent on this value.

The Ri4Power system including all busbar and connection components is designed for pollution degree 3. Hence, the requirements of pollution degrees 1 and 2 are also met.

Material group

Standard reference to Table 2, IEC 61 439-1

To define the creepage distances on insulating components, it is necessary to stipulate the material group as well as the pollution degree.

The insulating materials of the busbar supports used in Ri4Power all meet material group IIIa with a CTI of between 175 and 400 (CTI = comparative tracking index).

All Ri4Power components, provided they are used correctly, meet the minimum creepage distance of 16 mm required in conjunction with pollution degree 3 and a rated insulation voltage U_i of 1000 V.

Conditions of installation of assemblies

Standard reference chapter 7.1 [to IEC 61 439-1]

When installing the system, we distinguish between interior installation and exterior installation.

Ri4Power low-voltage systems are designed for interior installation and all tightening torques and corrosion resistance have been calculated accordingly.

For installation conditions that deviate from this, where applicable, the torques will need to be adjusted. However, the maximum admissible torques for the connection components must not be exceeded.

Stationary/movable installation of the low-voltage switchgear

Standard reference chapter 3.5.3 – 3.5.4 [to IEC 61 439-1]

A low-voltage switchgear may be described as mobile if it is easily moved from one installation site to another.

If a low-voltage switchgear is fixed installed and operated, it is described as stationary.

Ri4Power low-voltage switchgear may be used for both types of operation. However, for mobile use, special measures must be taken by the manufacturer of the switchgear enclosure, such as stable, torsionally stiff transport plinths, defined servicing intervals for screw connections etc.

Protection category

Standard reference chapter 8.2 [to IEC 61 439-1]

The protection category of an enclosure describes the protection requirements from solid and liquid media coming into contact with the low-voltage switchgear. The different requirements and test methods are described in IEC 60 529.

Ri4Power offers 3 different protection categories as standard: IP 54, IP 43 and IP 2X.

The higher the chosen protection category, the higher the reduction factors that reduce the rated currents of the operating equipment used. Furthermore, at high protection categories, high interior temperatures arise in the low-voltage switchgear, which may adversely affect the service life of the operating equipment.

For this reason, where possible according to the usage options, low-voltage systems should be designed with low protection categories, in order to ensure the best possible heat dissipation.

If a low-voltage system is placed in an electrical operating room, a protection category of IP 54 is not necessarily required, and greater attention should be devoted to the leak-tightness of the cable entry into this operating room.

Use by skilled persons or ordinary persons

Standard reference chapter 8.4.5 [to IEC 61 439-1]

A skilled person is an individual whose training and experience enables them to identify the risks and potential dangers associated with electricity [pursuant to IEC 61 439-1 section 3.7.12].

An ordinary person is a person who is not a qualified electrician and does not have any training in electrical engineering.

The suitability of low-voltage switchgear for use by ordinary persons ends at a rated current of 250 A and is limited to a maximum short-circuit resistance of 10 kA.

Classification according to electromagnetic compatibility (EMC)

Standard reference chapter 9.4 [to IEC 61 439-1]

Electromagnetic compatibility refers to the freedom from emitted interference and immunity to interference of electrical and electronic equipment in relation to their environment. With EMC, we distinguish bewtween 2 different environments:
Environment A refers to non-public or industrial low-voltage networks/areas/equipment, including powerful sources of interference.
Environment B refers to public low-voltage networks to supply residential buildings, commercial premises or small industrial operations.

The required operating environment should be specified by the user.

The Ri4Power system is suitable for both environments. When using equipment that may cause electromagnetic interference, always follow the equipment manufacturer's instructions regarding installation and connection of the device.

Special operating conditions

Standard reference chapter 7 [to IEC 61 439-1]

Under special operating conditions, the parameters for ambient temperature, relative humidity and/or altitude should be separately defined if these deviate from the relevant provisions in the product standard (IEC 61-439-2).
This also includes information such as:

- Rapid changes in temperature or air pressure
- Special atmospheres (smoke, corrosive gases, special dust)
- Effect of powerful electrical or magnetic fields
- Effect of extreme climatic conditions
- Effect of fungi or small animals (protection from gnawing)
- Installation in areas at risk of fire or explosion
- Occurrence of heavy vibrations and impact
- Special installation locations (wall niches) that may influence current-carrying capacity
- Operational interference from external EMC influences
- Exceptional occurrence of overvoltage

The Ri4Power system has been designed for the temperatures and atmospheric conditions outlined in standard IEC 61 439-1.

Operating condition	Admissible value range
Max. ambient temperature	< = +40 °C, whereby the mean over 24 h must not exceed 35 °C
Min. ambient temperature	> = –5 °C
Relative humidity	< = 50% (at max. +40 °C)
Relative humidity	< = 90% (at max. +20 °C)
Altitude	< = 2000 m asl

Any requirements deviating from this can be achieved with additional special measures and deratings.

External design

Standard reference chapter 3.3 [to IEC 61 439-1]

Extensive testing of the Ri4Power system always applied to a single enclosure or a multiple enclosure design.

Protection from mechanical impact

Standard reference chapter 8.2.1 [to IEC 61 439-1]

When testing protection against mechanical impact on the enclosure, the IK protection category is specified. This value defines the enclosure cover's resistance to mechanical damage.

For Rittal Ri4Power enclosures, a protection category of IK10 has been verified, and therefore all lower IK protection categories IK00 – IK09 are likewise covered.

Type of layout

Standard reference chapter 8.5 [to IEC 61 439-1]

This parameter defines the design of active operating equipment. A distinction is made between "inserts" and "removable parts".

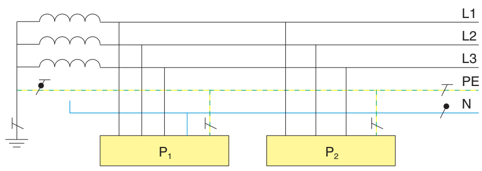
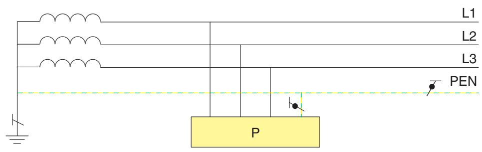
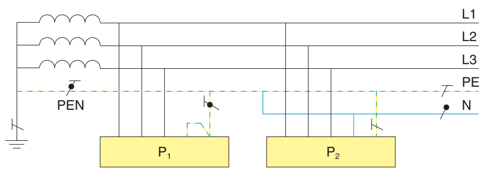
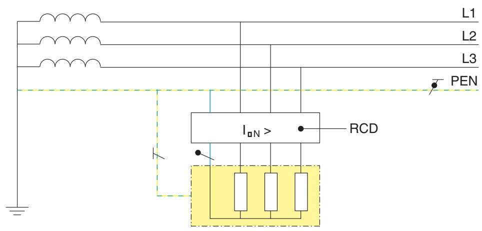
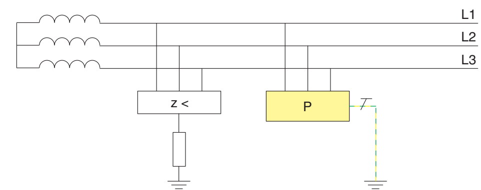
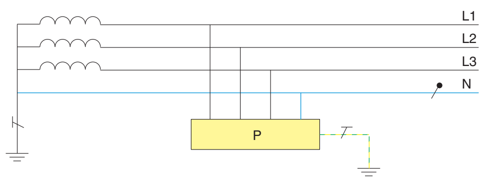
An insert is an assembly of operating equipment that is assembled/wired onto a shared supporting structure (e.g. mounting plate) and may only be installed/connected to the low-voltage switchgear in a de-energised state with the use of tools.

A removable part is distinguished by the fact that the assembly may be installed and removed with the low-voltage switchgear live. This is possible, for example, with switchgear designed as rack-mounted equipment, or slide-in modules.

With the Rittal Ri4Power system, both options may be achieved with different field types.

Forms of power supply net TN, IT, TT

The Ri4Power system is suitable for different network configurations. The different designs of the PE conductor system and the system assembly allow various network configurations to be realised.

<table>
<tr><th>Designation</th><th>Circuitry</th></tr>
<tr><td>TN-S system
(TN-S network)</td><td>
</td></tr>
<tr><td>TN-C system
(TN-C network)</td><td>
</td></tr>
<tr><td>TN-C-S system
(TN-C-S network)</td><td>
</td></tr>
<tr><td>TN system
(TN network)
with residual-current circuit-breaker
(FI circuit-breaker RCD)</td><td>
</td></tr>
<tr><td>IT system
(IT network)</td><td>
</td></tr>
<tr><td>TT system
(TT network)</td><td>
</td></tr>
</table>

Source: Tabellenbuch Elektrotechnik

Selection and dimensioning of the main busbar system

Parameters for selection of the main busbar system

The core element for the distribution of electrical power in low-voltage switchgear is generally the main busbar system. Several points must be taken into account when selecting the busbar system.

The decisive criteria for selection of a main busbar system are:

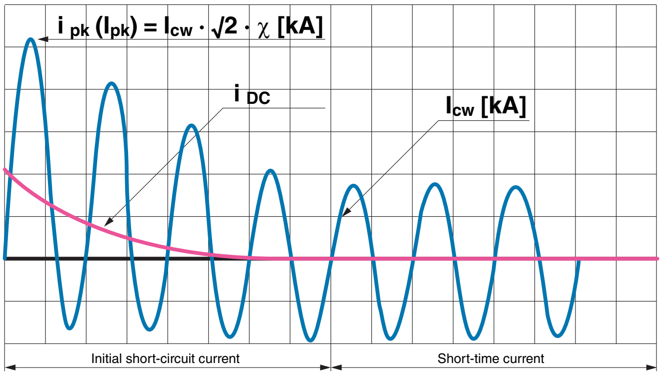
- The rated current of the system I_{nA} [5.3.1], see page 38
- The rated peak withstand current I_{pk} [5.3.4], see page 39
- The rated short-time withstand current I_{pk} [5.3.5], see page 39
- The degree of protection [8.2], see page 40.

In most cases, the external dimensions of the low-voltage switchgear are decisive. Due to the model-based design of the main busbar system, in some main busbar system variants, a restricted range of dimensions are available.

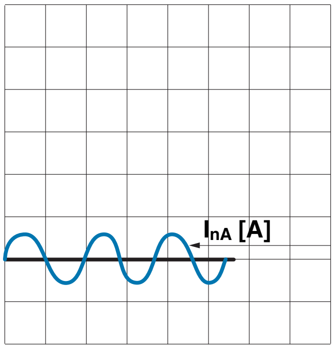
After selecting a busbar system, it is necessary to check that the other criteria for the busbar system are also met, such as rated voltage etc.

Rated peak withstand current I_{pk} and rated short-time withstand current I_{cw}

Short-circuit response



Rated current I_{nA}



Compared with short-circuit currents, the rated current I_{nA} shown on the left is several times smaller.

The rated peak withstand current I_{pk} [5.3.4] and the rated short-time withstand current I_{cw} [5.3.5] are the principal values for making a statement on the mechanical stability of a busbar system during an electrical short-circuit.

The forces arising during a short-circuit are generally several times higher than the actual weight force of the busbar system. For one thing, different force effects occur during the short-circuit which may act between the individual strands, conductors and the enclosure. The above diagram shows the development of a short-circuit current with indication of the various current values.

At the start of the short-circuit, the peak short-circuit current I_{pk} generates the greatest force effect acting between the components of the busbar system. Once the initial short-circuit current has receded, only the root-mean-square value of the short-circuit current can be measured. The ratio between the peak short-circuit current and the continuous short-circuit current depends inter alia on the level of short-circuit current. The Table 1 indicates the ratio pursuant to Table 7 of IEC 61 439-1. This ratio between the surge current and the short-time current applies to most application cases.

Table 1: Root-mean-square value of the short-circuit current

Root-means-square value I_{cw} of the short-circuit current			cos φ	n
–	/ <=	5 kA	0.7	1.5
5 kA	< / <=	10 kA	0.5	1.7
10 kA	< / <=	20 kA	0.3	2
20 kA	< / <=	50 kA	0.25	2.1
50 kA	< /	–	0.2	2.2

The short-time current stresses the busbar system by causing a large temperature rise in the busbars, as well as via the interaction between the magnetic field and the associated interaction between the attracting and repelling forces resulting from this. The rated short-time withstand current I_{cw} is generally given as a value relating to a short-circuit period of 1 second. In some cases or countries, the data may also need to be given for 3 or 5 seconds. In such cases, a 3-second value may be calculated from the available data using the formula $I_1^2 \cdot t_1 = I_2^2 \cdot t_2$.

Using the values rated peak withstand current I_{pk} and rated short-time withstand current I_{cw} it is possible to define the mechanical and thermal stability of a busbar system subjected to the short-circuit.

Installation instructions

Ri4Power switchgear combinations may be installed either directly in front of a wall or free-standing in the room. When installing in front of a wall, a distance of 50 mm from the wall must be maintained. Free-standing switchgear must be adequately secured to the floor. If opting for free-standing installation, a back-to-back design is also supported. Here too, there must be 50 mm of free space to the left and right of a switchgear.

Care must be taken to ensure that the switchgear enclosure is installed on a level surface. Suitable measures should be taken to compensate for uneven surfaces. Before baying the busbar systems, the individual switch panels should be aligned so that the busbar connections can be fitted properly and without mechanical stresses.

The substructure must be suitably prepared to support the weight of the switchgear enclosure.
Particularly with raised floor constructions or suspended ceilings, the weights of the switchgear enclosures must be taken into account in the static calculations.

Design of the busbar systems with regard to infeed and rated current I_{nA} and rated short-time withstand current I_{cw}

There are various options for feeding the rated current I_{nA} into a low-voltage switchgear enclosure.

With many applications, the switchgear may only be adequately supplied with one infeed, and the infeed point is on the left or right of the switchgear enclosure. This means that the main busbar and the main switch of the switchgear enclosure must carry the entire current. Alternatively, a switchgear may infeed into the central area and distribute the currents evenly to the left and right via the busbar system. With this arrangement, the heat loss arising in the busbar system can be reduced compared with a one-sided infeed, and the cross-section of the main busbar systems may be reduced to the maximum current flowing to the left or right on the main busbar.

Multiple infeed points:
If two or more parallel infeeds are required, care should be taken to ensure that the chosen transformers are suitable in terms of their technical specifications.

The infeeds should be arranged inside the low-voltage switchgear enclosure in such a way that the distances between the largest pieces of equipment and the infeed points are as short as possible. Only in this way is it possible to achieve a low-loss, optimum design in terms of the busbar cross-sections.

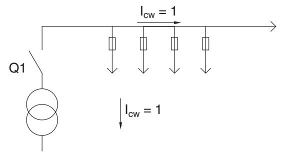
With a parallel infeed from several transformers, however, it should be noted that the short-circuit output that can be supplied per transformer must be added together, provided the upstream medium-voltage network can supply this energy.

This can be avoided by dividing the switchgear into various busbar sections, if the various busbar sections are separated via coupling switches in normal operation and only need to be connected for servicing purposes. Since an increase in the required short-circuit withstand capability may entail huge additional costs for the main busbar system and the connected equipment, under some circumstances it may be more cost-effective to sub-divide the busbar into separate sections and use coupling switches. This additionally increases the system's operational reliability in the event of a malfunction.

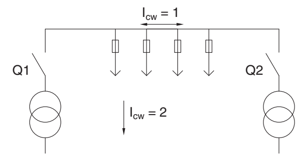
In the case of ring shaped systems, the infeeds of the short-circuit currents and the rated currents are added together.

Short-circuit current distribution with various infeed variants (disregarding impedance)

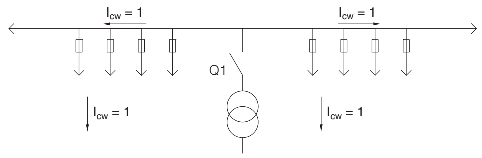
Side infeed



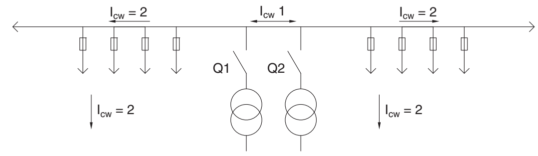
Double infeed left/right



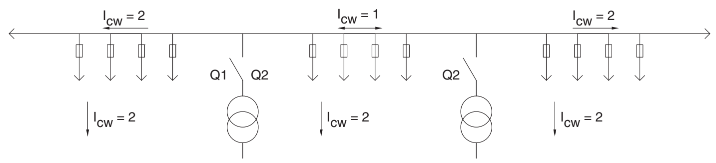
Central infeed



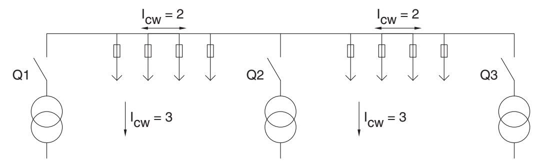
Double central infeed



Double infeed



Triple infeed



Rated current of switchgear assemblies I_{nA}

The rated current I_{nA} of the low-voltage switchgear describes the admissible continuous current with which low-voltage switchgear is operated. This rated current is not necessarily the rated current of a busbar system; instead, this value describes the sum total of currents fed into and distributed in this low-voltage switchgear system.

Consequently, it is also possible that the rated currents of the main busbar may be less than the rated current of the low-voltage switchgear, for example with a central infeed or several small, distributed infeeds.

Rated current of the busbar system I_{nc}

In accordance with IEC 61 439, the busbar system is referred to as a circuit I_{nc} in the low-voltage switchgear and controlgear assembly. As described under "Rated current of switchgear and controlgear assemblies" on page 45, particularly with low-voltage switchgear with a high rated current I_{nA}, the rated current of the busbar system may be lower. However, for such a design to be admissible, it is necessary to prove with a load flow calculation that the admissible rated current of the busbar system is not exceeded in any operating scenario. If a busbar system is designed on the basis of the maximum possible current load, measures must be taken to ensure that the chosen busbar system also meets the required short-circuit withstand capability.

When calculating the requisite busbar cross-sections for a low-voltage switchgear with design certificate, it is not sufficient to merely design to DIN 43 671.

According to DIN 43 671, a rated current is calculated for various copper sections and cross-sections with reference to a busbar system and measured in the open air. The admissible current of a busbar was calculated at an ambient temperature of 35 °C and a busbar temperature of 65 °C. Using the correction factor diagram mentioned in this DIN standard, this can also be converted to different ambient temperatures and different busbar temperatures.

Within a switchgear housing, however, other factors may occur that influence the admissible busbar current. For example, if a busbar system with a high current passes close by a steel strut, this will cause the steel strut to heat up, which in turn will cause additional warming of the busbar at this point. This effect is generated in the sheet steel by induced circulating currents and ring currents and can actually only be minimised by the use of non-ferro-magnetic materials in the immediate vicinity of the busbars. As a result of these additional heating effects, the admissible busbar current compared with a busbar system measured in the open air may be reduced.

If a busbar system with a higher rated current is fitted in an enclosure with a protection category of IP 54 without the possibility for air convection, the interior temperature inside the enclosure will be significantly increased. The ambient temperature around the enclosure may still correspond to the normal conditions, but the interior temperature of the switchgear is likely to increase significantly depending on the current. If the heating effects from induction are disregarded, a comparable figure can be achieved, as demonstrated by a calculation using a correction factor diagram. The direct ambient temperature around the busbar inside the switchgear is used instead of the ambient temperature around the switchgear.

As an effect in the opposite direction, it is possible to improve the admissible rated busbar current by means of forced convection. In contrast to a busbar system in the open air, a higher airflow can be achieved in switchgear with the same fan output, which cools the individual busbars and therefore supports a higher current-carrying capacity.

In order to incorporate all the aforementioned effects within a low-voltage switchgear mathematically, major calculations are needed. The additional temperature rise caused by eddy currents or ring currents are particularly difficult to determine.

In accordance with IEC 61 439-1, the admissible values for all busbar systems for the Ri4Power System have been determined by testing with different busbar cross-sections inside the enclosure and different protection categories and cooling. The protection categories were selected in accordance with the possible protection categories with Ri4Power.
In these tests, the admissible rated busbar currents were calculated for two different temperature increases (30 K, 70 K). They included a maximum busbar temperature of 65 °C at 35 °C ambient temperature around the switchgear. Hence it is possible to achieve a comparable value to the aforementioned DIN 43 671 and hence also to use the correction factor diagram. The admissible rated busbar currents were calculated for a busbar temperature considered by Rittal to be the maximum permissible of 105 °C at an ambient temperature around the switchgear of 35 °C. This maximum value of 105 °C for the busbars is significantly below the temperature at which the copper material would soften.

In most cases, the external dimensions of the low-voltage switchgear are also decisive. Given the model-based design of the main busbar system, in some main busbar system variants, a restricted range of dimensions is available.

By testing the possible busbar systems, all the possible influences described in this chapter from the enclosure itself, the protection category, the influence of the materials surrounding the busbar system and the devices used have been taken into account, thus guaranteeing reliable operation.

If the requisite rated currents I_{nc} of the busbar systems are known, with due regard for the protection category and the type of cooling, it is possible to select the required busbar system from Tables 41 – 43 (see page 88). Once a busbar system has been selected, in a second stage it is necessary to check whether the short circuit withstand capability requirements are met.

Table 2: Determination of selection parameters pursuant to standard IEC/EN 61 439-1, Annex C

Functions and features to be determined by the user in accordance with IEC/EN 61 439-1	Reference to chapter	Standard specification[1]	User requirements[2]
Electrical system			
System according to type of earth connection	5.5, 8.4.3.2.3, 8.6.2, 10.5, 11.4		
Rated voltage U_n (V)	3.8.8.1, 5.2.1, 8.5.3		
Overvoltage category	5.2.4, 8.5.3, 9.1 Annex G		
Special transient voltages, voltage stresses, temporary overvoltages	9.1	No	
Rated frequency f_n (Hz)	3.8.11, 5.4, 8.5.3, 10.10.2.3, 10.11.5.4		
Additional requirements for on-site testing: Wiring, operating response and function	11.10		
Short-circuit resistance			
Prospective short-circuit current at supply terminals I_{cp} (kA)	3.8.6		
Prospective short-circuit current in the neutral	10.11.5.3.5	60% of the external conductor value	
Prospective short-circuit current in the protective circuit	10.11.5.6	60% of the external conductor value	
SCPD in the incoming functional unit requirement	9.3.2		
Co-ordination of short-circuit protective devices including external short-circuit protective device details	9.3.4		
Data associated with loads likely to contribute to the short-circuit current	9.3.2		
Protection of persons against electric shock in accordance with IEC 60 364-4-41			
Type of protection against electric shock – Basic protection (protection against direct contact)	8.4.2	Basic protection	
Type of protection against electric shock – Fault protection (protection against indirect contact)	8.4.3		
Installation environment			
Location type	3.5, 8.1.4, 8.2		
Protection against the ingress of solid foreign bodies and liquids	8.2.2, 8.2.3	Open-air: IP X3	
External mechanical impact (IK)	8.2.1, 10.2.6		
Resistance to UV radiation (only applies to open-air installation unless otherwise specified)	10.2.4	Standard specification	
Corrosion resistance	10.2.2	Standard specification	
Ambient temperature – Lower limit	7.1.1	Indoors: –5 °C Open air: –25 °C	
Ambient temperature – Upper limit	7.1.1	40 °C	
Ambient temperature – Maximum daily mean	7.1.1	35 °C	
Maximum humidity	7.1.2	Indoors: 50% at 40 °C Open-air: 100% at 25 °C	
Pollution degree	7.1.3	Industrial 3	
Altitude	7.1.4	< 2000 m	
EMC environment (A or B)	9.4, 10.12 Annex J		
Special service conditions (e.g. vibration, exceptional condensation, heavy pollution, corrosive environment, strong electric or magnetic fields, fungus, small creatures, explosion hazards, heavy vibration and shocks, earthquakes)	7.2, 8.5.4, 9.3.3, Table 7		

[1] A grey cell means that there is no standard requirement for functions or features, and users should specify their requirements.
[2] With exceptionally difficult applications, it may be necessary for the user to specify more stringent requirements than those set out in this standard.

Functions and features to be determined by the user in accordance with IEC/EN 61 439-1	Reference to chapter	Standard specification[1)]	User requirements[2)]
Installation method			
Type	3.5, 5.5		
Movable or stationary	3.5		
Maximum overall dimensions and mass	6.2.1		
Type(s) of conductor inserted from outside	8.8		
Location of conductors inserted from outside	8.8		
Material of conductors inserted from outside	8.8		
External phase conductor, cross sections, and terminations	8.8	Standard specification	
External PE, N, PEN conductors, cross sections, and terminations	8.8	Standard specification	
Special terminal identification requirements	8.8		
Storage and handling			
Maximum dimensions and mass of transport units	6.2.2, 10.2.5		
Type of transport (e.g. crane, fork-lift)	6.2.2, 8.1.7		
Ambient conditions that deviate from the operating conditions	7.3		
Packaging details	6.2.2		
Operating arrangements			
Access to manually operated devices	8.4, 8.5.5		
Isolation of load installation equipment items	8.4.2, 8.4.3.3, 8.4.5.2		
Maintenance and upgrade capabilities			
Requirement concerning accessibility during operation for untrained persons, requirement to operate devices or replace components whilst the switchgear enclosure is live	8.4.5.1	No	
Requirements related to accessibility for inspection and similar operations	8.4.5.2.2	No	
Requirements related to accessibility for maintenance in service by authorized persons	8.4.5.2.3	No	
Requirements related to accessibility for extension in service by authorized persons	8.4.5.2.4	No	
Type of electrical connection of functional units	8.5.1, 8.5.2		
Protection against electric shock via direct contact with active interior parts during servicing or extension (e.g. functional units, main busbars, multiterminal busbars)	8.4	No	
Current-carrying capability			
Rated current of switchgear enclosure I_{nA} (A)	3.8.9.1, 5.3, 8.4.3.2.3, 8.5.3, 8.8, 10.10.2, 10.10.3, 10.11.5, Annex E		
Rated current of circuits I_{nc} (A)	5.3.2		
Rated diversity factor	5.3.3, 10.10.2.3, Annex E	In accordance with product standards	
Ratio of the neutral conductor cross-section to the phase conductor cross-section: Phase conductor up to and including 16 mm^2	8.6.1	100%	
Ratio of the neutral conductor cross-section to the phase conductor cross-section: Phase conductor greater than 16 mm^2	8.6.1	50% (min. 16 mm^2)	

1) A grey cell means that there is no standard requirement for functions or features, and users should specify their requirements.
2) With exceptionally difficult applications, it may be necessary for the user to specify more stringent requirements than those set out in this standard.

Taken from standard DIN EN 61 439-1.

Description of switchgear section types

Air circuit-breaker sections

The following parameters must be known for dimensioning of the air circuit-breaker sections (ACB):

- The rated current of the circuit I_{nc} which the ACB outlet must be able to carry under the chosen conditions
- The rated diversity factor RDF for this outgoing feeder or the system
- The protection category of the enclosure and type of cooling
- The design of the ACB: Rack-mounted or static installation
- The number of poles in the ACB outgoing feeder (with switched or unswitched neutral conductor)
- The make and model of the ACB
- The mounting position of the ACB
- The rated voltage of the circuit
- The required short-circuit withstand capacity for the ACB outgoing feeder.

With the rated current and the rated load factor of the circuit, the protection category and type of cooling, together with the make and model of the ACB, you can calculate the required unit size from Tables 29 – 34, see page 77.

With the choice of unit and other mechanical parameters, this produces the minimum size of the enclosure for the ACB outlet. This information can likewise be found in Tables 29 – 34, see page 77, in the Appendix. For enclosures with internal form separation, the minimum compartment height is derived from the rated voltage of the unit.

The mounting position of the ACB is divided into:

- Position VT (in front of door), i. e. the control components are facing outwards from the enclosure door, thus allowing the ACB to be operated without opening the enclosure door.
- Position HT (behind the door) means that the ACB including the control components are completely inside the enclosure.

This means that for some switchgear positioned in front of the door, a version with a 600 mm enclosure depth would be possible, whereas for versions behind the door, only 800 mm deep enclosures are possible. A further restriction arises when using busbar systems in the rear section. Due to the set forward position of the connection kit of the main busbar system in relation to the ACB, some versions might only be possible in 800 mm deep enclosures, whereas with main busbar systems in the roof or base section, a 600 mm deep enclosure would also be possible.

In addition to the ACB, control and measurement equipment with a maximum heat loss of 50 W may be installed in the ACB section.

ACB sections from the modular Ri4Power system are comprised of TS 8 enclosures with form-separated, variable configuration with partial doors and inner compartmentalisation in a modular design and other required system accessories. Testing has verified that air circuit-breakers from ABB, Eaton, General Electric, Mitsubishi, Schneider Electric, Siemens and Terasaki may be used. The information provided in Tables 29 – 34, see page 77, apply to the choice of connection cross-sections. If Rittal has not made any particular stipulations regarding the required clearance at the sides, above and below the ACBs, the equipment manufacturer's specifications should be observed.

The main busbar system may optionally be installed in the roof, base or rear section at the top, centre or bottom. When using partial doors, front trim panels with a protection category as per the technical specifications should be used for the upper and lower termination of the modular equipment. The cable connection system as an incoming/outgoing circuit, 3/4 pole, with compact, square profile is installed in a stepped arrangement above and/or below the ACB.

The detailed configuration of the ACB sections can be found in the valid Ri4Power assembly instructions.

Coupling switch section

Coupling switch sections (also known as busbar couplings) separate or connect different busbar systems in low-voltage switchgear and controlgear assembly. In the Ri4Power modular system, these coupling switch sections are comprised of a riser section and a circuit-breaker section for ACBs. If two busbar sections are connected with a coupling switch section, with one positioned above and one below the ACB, a separate riser section will not be required.

Due to the similarity of the two section types, the following selection criteria are virtually identical to those for an ACB section.

The following parameters must be known for dimensioning of the coupling switch sections for air circuit breakers (ACBs):

- The rated current of the circuit I_{nc} which the coupling switch section must carry under the chosen conditions
- The rated diversity factor RDF for this outgoing feeder or the system
- The protection category of the enclosure and type of cooling
- The design of the ACB: Rack-mounted or static installation
- The number of poles in the coupling switch (with switched or unswitched neutral conductor)
- The make and model of the ACB
- The mounting position of the ACB
- The rated voltage of the circuit
- The required short-circuit withstand capacity for the coupling switch.

With the rated current of the circuit, the protection category and type of cooling, together with the make and model of the ACB, you can calculate the required unit size from Tables 29 – 34, see page 77.

With the choice of unit and other mechanical parameters, this produces the minimum size of the enclosure for the ACB section. This information can likewise be found in Tables 29 – 34, see page 77. For enclosures with internal form separation, the minimum compartment height is derived from the rated voltage of the unit.

The mounting position of the ACB is divided into:

- Position VT (in front of door), i. e. the control components are facing outwards from the enclosure door, thus allowing the ACB to be operated without opening the enclosure door.
- Position HT (behind the door) means that the ACB including the control components are completely inside the enclosure.

This means that for some switchgear positioned in front of the door, a version with a 600 mm enclosure depth would be possible, whereas for versions behind the door, only 800 mm deep enclosures are possible. A further restriction arises when using busbar systems in the rear section. Due to the set forward position of the connection kit of the busbar system in relation to the ACB, some versions might only be possible in 800 mm deep enclosures, whereas with main busbar systems in the roof or base section, a 600 mm deep enclosure would also be possible.

In addition to the ACB, control and measurement equipment with a maximum heat loss of 50 W may be installed in the coupling switch section.

The size of the riser section is derived from the chosen main busbar system.

For busbar system types Maxi-PLS, a minimum enclosure width of 200 mm should be chosen. For the busbar system types Flat-PLS 60 and Flat-PLS 100, a minimum enclosure width of 300 mm or 400 mm should be chosen.

When choosing an enclosure width of 200 mm, the base/plinth of the ACB section should be widened by 200 mm, and the riser section and the ACB section are positioned on a shared base/plinth. Riser sections with a width of 300 mm or 400 mm are on separate enclosure base/plinths.

Coupling switch sections from the modular Ri4Power system are comprised of TS 8 enclosures with form-separated, variable configuration with partial doors and inner compartmentalisation in a modular design and other required system accessories.
Testing has verified that air circuit-breakers from ABB, Eaton, General Electric, Mitsubishi, Schneider Electric, Siemens and Terasaki may be used. The information provided in Tables 29 – 34, see page 77 in the Appendix, apply to the choice of connection cross-sections. If Rittal has not made any particular stipulations regarding the required clearance at the sides, above and below the ACBs, the equipment manufacturer's specifications should be observed.

The main busbar system may optionally be installed in the roof, base or rear section at the top, centre or bottom. When using partial doors, front trim panels with a protection category as per the technical specifications should be used for the upper and lower termination of the modular equipment.

The detailed configuration of the coupling switch sections can be found in the valid Ri4Power assembly instructions.

Modular outgoing feeder section

Modular outgoing feeder sections are used for the installation of circuits with

- Switchgear
- Power supply outgoing feeders
- Controllers, switchgear units
- Fused outgoing feeders
- etc.

in different compartments. The rated currents can be distributed via integrated distribution busbar systems.

The following bar systems, see Table 3, are available for selection as distribution busbar systems. The rated currents I_{nc} of the distribution busbar systems are likewise dependent on the protection category and the type of cooling.

Table 3: Rated current I_{nc} of the distribution busbar system in modular outgoing feeder sections

Bar type	Minimum enclosure width		Rated current I_{nc} of the distribution busbar system				
	3-pole	4-pole	IP 2X forced ventilation	IP 2X	IP 43	IP 54 forced ventilation	IP 54
E-Cu 30 x 5 mm	400 mm	600 mm	400 A	400 A	400 A	400 A	400 A
E-Cu 30 x 10 mm	400 mm	600 mm	800 A	800 A	760 A	800 A	700 A
PLS 1600	400 mm	600 mm	1600 A	1600 A	1400 A	1600 A	1300 A

The distribution busbar system may optionally be positioned in the compartment (indoor arrangement) or behind the compartment. With the indoor version, the switchgear may be mounted and connected directly onto the busbar system via the RiLine60 component adaptor system, whilst retaining form separation. Access to the connections on the adaptor and on the switchgear is always possible from the front.

When configuring the compartment in a modular outgoing feeder section, care should be taken to ensure that the maximum admissible rated current I_{nc} of the distribution busbar system is not exceeded by the sum total of simultaneously loaded outgoing feeder circuits connected to that distribution busbar system. If equipment is used within the compartment that produces a higher additional heat loss (frequency converters, power converters etc.), a separate heat loss and cooling calculation should be prepared for that compartment. This calculation must provide evidence of heat dissipation via an additional cooling device.

The main busbar system may optionally be installed in the roof, base or rear section at the top or bottom. When using partial doors, front trim panels with a protection category as per the technical specifications should be used for the upper and lower termination of the modular equipment.

The detailed configuration of the modular outgoing feeder panels should be taken from the valid Ri4Power assembly instructions.

Busbar routed behind the compartment

Busbar routed in the compartment (indoor)

Modular outgoing feeder section

Selection and installation of moulded-case circuit-breakers (MCCB)

The following parameters must be known for the selection of MCCBs:

- The rated current of the circuit I_{nc} which the MCCB must carry under the chosen conditions
- The rated diversity factor RDF for this outgoing feeder or the system
- The protection category of the enclosure and type of cooling
- The design of the MCCB:
  Rack-mounted, plug-in or static installation
- The number of poles in the MCCB (with switched or unswitched neutral conductor)
- The make and model of the MCCB
- The rated voltage of the circuit
- The required breaking capacity of the MCCB.

With the rated current, the protection category and type of cooling, together with the make and model of the circuit-breaker, you can calculate the required unit size from Tables 35 – 40, see page 80 – 87.

With the choice of unit and other mechanical parameters, this produces the minimum size of the enclosure/compartment for installation of the MCCB. This information can likewise be found in Tables 35 – 40, see page 80 – 87. For enclosures with internal form separation, the minimum compartment size is derived from the rated voltage of the circuit.

Testing has verified that moulded-case circuit-breakers from ABB, Eaton, General Electric, Mitsubishi, Schneider Electric, Siemens and Terasaki may be used. The information provided in Tables 35 – 40, see page 80 – 87, applies to the choice of connection cross-sections. If Rittal has not made any particular stipulations regarding the required clearance at the sides, above and below the CBs, the equipment manufacturer's specifications should be observed.

A detailed diagram showing connection options for MCCBs can be found in the valid Ri4Power assembly instructions.

Selection and installation of switchgear units

The following parameters must be known for the selection of switchgear units:

- The rated current of the circuit I_{nc} which the switchgear unit must carry under the chosen conditions
- The rated diversity factor RDF for this outgoing feeder or the system
- The protection category of the enclosure and type of cooling
- The design of the switchgear unit
  (direct starter, stardelta starter, reversing starter)
- The make and model of the switchgear unit
- The rated voltage of the circuit
- The required breaking capacity of the protective device.

Testing has verified that switchgear units from ABB, Eaton, General Electric, Mitsubishi, Schneider Electric, Siemens and Terasaki may be used. If Rittal has not made any particular stipulations regarding the required clearance at the sides, above and below the switchgear, the equipment manufacturer's specifications should be observed. The choice of unit is specific to each brand.

Switchgear units:
The protective device for a switchgear unit should be selected as follows in order to comply with testing requirements:
The rated current I_{nc} of the chosen switchgear enclosure must not exceed 80% of the rated current of the protective gear. The breaking capacity of the protective device must be greater than or equal to the possible short-circuit current at the connection point.

The connection cable of the switchgear to the superordinate busbar system must be 2 cross-sectional sizes greater than that designed for a purely thermal current load as per Appendix H of IEC 61 439-1. The choice of cables and laying conditions must be designed as short circuit-protected wiring in accordance with IEC 61 439-1 (cf. also Table 14, page 62). Insulation of the connection cables between the protective device and the superordinate busbar system and the other devices in the main circuit must withstand an overtemperature of 70 K.

The switchgear must correspond to the connected equipment as per their switching category. The rated current I_{nc} of the chosen switchgear enclosure must not exceed 80% of the rated current of the switchgear. The switching capacity of the switchgear must be greater than or equal to the on-state values of the corresponding protective device. The connection cable of the switchgear to the terminal connection must be one cross-sectional size greater than that designed for a purely thermal current load as per Appendix H of IEC 61 439-1.

The connection clamps must be designed for the inner and outer wiring of the switchgear unit.

Testing has verified that switchgear and protective gear from ABB, Eaton, General Electric, Mitsubishi, Schneider Electric and Siemens may be used. If Rittal has not made any particular stipulations regarding the required clearance at the sides, above and below the switchgear and protective gear, the equipment manufacturer's specifications should be observed.

A detailed diagram showing connection options for switchgear and protective gear can be found in the valid Ri4Power assembly instructions.

Fuse-switch disconnector section with vertical distribution busbar system for horizontally arranged NH slimline fuse-switch disconnectors and device modules

The fuse-switch disconnector sections with vertical distribution busbar systems are suitable for accommodating plug-type NH slimline fuse-switch disconnectors of the following brands:

- ABB, type Slimline XR
- Jean Müller, type Sasil
- Siemens, type 3NJ and
- Device modules from Jean Müller

The distribution busbar system may be configured with the following bar dimensions, see Table 4. Resulting from this, the allocated rated currents I_{nc} with a maximum protection category IP 3X for this section type may be used:

Table 4: Rated current I_{nc} and short-circuit withstand capacity I_{cw} of the vertical distribution busbar in the NH slimline fuse-switch disconnector section

Dimensions of busbars	Max. rated current I_{nc}	Rated short-circuit withstand capacity I_{cw} with support spacing 300 mm	Rated short-circuit withstand capacity I_{cw} with support spacing 500 mm
50 x 10 mm	1000 A	70 kA, 1 sec.	50 kA, 1 sec.
60 x 10 mm	1250 A	75 kA, 1 sec.	50 kA, 1 sec.
80 x 10 mm	1600 A	85 kA, 1 sec.	60 kA, 1 sec.
100 x 10 mm	2100 A	100 kA, 1 sec.	70 kA, 1 sec.

The rated currents I_{nc} also apply to the protection category IP 2X. For the maximum packaging density when populated with NH slimline fuse-switch disconnectors, the current specifications of the respective switchgear manufacturers shall apply. The NH slimline fuse-switch disconnectors sizes 00 to 3 should be arranged from top to bottom (top = small sizes).

The maximum admissible rated operating current of the NH slimline fuse-switch disconnectors with due regard for the NH fuse insert used and the minimum connection cross-section may be taken from Table 5.

Table 5: Rating data for NH slimline fuse-switch disconnectors from ABB/Jean Müller

Size	Max. device rated current I_n	Rated current of fuse I_{n1}	Max. rated current I_{nc}	Minimum connection cross-section
Size 00	160 A	to 20 A	$= I_{n1}$	2.5 mm^2
Size 00	160 A	25 A	$= I_{n1}$	4 mm^2
Size 00	160 A	35 A	$= I_{n1}$	6 mm^2
Size 00	160 A	50 A	$= I_{n1}$	10 mm^2
Size 00	160 A	63 A	$= I_{n1}$	16 mm^2
Size 00	160 A	80 A	$= I_{n1}$	25 mm^2
Size 00	160 A	100 A	$= I_{n1}$	35 mm^2
Size 00	160 A	125 A	$= I_{n1}$	50 mm^2
Size 00	160 A	160 A	$= I_{n1}$	70 mm^2
Size 1	250 A	160 A	$= I_{n1}$	Cf. size 00
Size 1	250 A	224 A	$= I_{n1}$	95 mm^2
Size 1	250 A	250 A	$= I_{n1}$	120 mm^2
Size 2	400 A	200 A	$= I_{n1}$	Cf. size 00 – 1
Size 2	400 A	224 A	$= I_{n1}$	120 mm^2
Size 2	400 A	250 A	$= I_{n1}$	120 mm^2
Size 2	400 A	315 A	$= I_{n1}$	185 mm^2
Size 2	400 A	400 A	$= I_{n1}$	240 mm^2
Size 3	630 A	315 A	$= I_{n1}$	Cf. size 00 – 2
Size 3	630 A	400 A	$= I_{n1}$	240 mm^2
Size 3	630 A	500 A	$= I_{n1}$	2x 150 mm^2
Size 3	630 A	630 A	$= I_{n1}$	2x 185 mm^2

The rated diversity factors should be determined according to the number of outgoing feeders used per section (in accordance with IEC 61 439-2, Table 101).

Table 6: Rated diversity factor RDF of NH slimline fuse-switch disconnectors from ABB/Jean Müller depending on the number of NH slimline fuse-switch disconnectors per section

No. of NH slimline fuse-switch disconnectors	Rated diversity factor RDF
2 and 3	0.9
4 and 5	0.8
6 to 9	0.7
10 or more	0.6

The enclosure depth and enclosure height are irrelevant to the diversity of the section outgoing feeders. Consequently, the section dimensions and the width of the cable chamber may be selected independently of the section diversity.

Depending on the main busbar system chosen, it may be necessary to use enclosures with an enclosure depth of 800 mm.

Fuse-switch disconnector sections with a vertical distribution busbar system from the modular Ri4Power system are comprised of TS 8 enclosures with form-separated, variable configuration and inner compartmentalisation in a modular design and other required system accessories.

In according with testing to the valid standard, only the aforementioned brands may be used.

The main busbar system may optionally be installed in the roof or rear section at the top or bottom.

The detailed configuration of the fuse-switch disconnector sections with vertical distribution busbar system may be found in the valid Ri4Power assembly instructions.

Fuse-switch disconnector section with Rittal NH slimline fuse-switch disconnectors

The fuse-switch disconnector sections for NH slimline fuse-switch disconnectors with 185 mm bar centre distance on horizontal busbar systems in the centre rear section have only been tested by Rittal with Rittal NH slimline fuse-switch disconnectors and meet the requirements of IEC 61 439-2.

It is possible to use NH slimline fuse-switch disconnectors from other manufacturers. However, these have not been tested to the standard by Rittal.

The maximum admissible rated operating current of the NH slimline fuse-switch disconnectors with due regard for the NH fuse insert used and the minimum connection cross-section may be taken from Table 7.

Table 7: Rating data for Rittal NH slimline fuse-switch disconnectors

Size	Max. device rated current I_n	Rated current of fuse I_{n1}	Max. rated current I_{nc}	Minimum connection cross-section
Size 00	160 A	to 20 A	$= I_{n1}$	2.5 mm^2
Size 00	160 A	25 A	$= I_{n1}$	4 mm^2
Size 00	160 A	35 A	$= I_{n1}$	6 mm^2
Size 00	160 A	50 A	$= I_{n1}$	10 mm^2
Size 00	160 A	63 A	$= I_{n1}$	16 mm^2
Size 00	160 A	80 A	$= I_{n1}$	25 mm^2
Size 00	160 A	100 A	$= I_{n1}$	35 mm^2
Size 00	160 A	125 A	$= I_{n1}$	50 mm^2
Size 00	160 A	160 A	$= I_{n1}$	70 mm^2
Size 1	250 A	160 A	$= I_{n1}$	Cf. size 00
Size 1	250 A	224 A	$= I_{n1}$	95 mm^2
Size 1	250 A	250 A	$= I_{n1}$	120 mm^2
Size 2	400 A	200 A	$= I_{n1}$	Cf. size 00 – 1
Size 2	400 A	224 A	$= I_{n1}$	120 mm^2
Size 2	400 A	250 A	$= I_{n1}$	120 mm^2
Size 2	400 A	315 A	$= I_{n1}$	185 mm^2
Size 2	400 A	400 A	$= I_{n1}$	240 mm^2
Size 3	630 A	315 A	$= I_{n1}$	Cf. size 00 – 2
Size 3	630 A	400 A	$= I_{n1}$	240 mm^2
Size 3	630 A	500 A	$= I_{n1}$	2x 185 mm^2
Size 3	630 A	630 A	$= I_{n1}$	2x 240 mm^2

The rated diversity factors should be determined according to the number of outgoing feeders used (in accordance with IEC 61 439-2, Table 101).

Table 8: Rated diversity factor RDF_1 for NH slimline fuse-switch disconnectors depending on the number per section

No. of NH slimline fuse-switch disconnectors	Rated diversity factor RDF_1
2 and 3	0.9
4 and 5	0.8
6 to 9	0.7
10 or more	0.6

In addition to the quantity-dependent rated load factor, a second rated diversity factor must be taken into account depending on the protection category.

Table 9: Rated diversity factor RDF_2 for NH slimline fuse-switch disconnectors depending on the enclosure protection category

Enclosure protection category	Rated diversity factor RDF_2
IP 2X with forced ventilation	1.0
IP 2X	0.95
IP 43	0.8
IP 54 with forced ventilation	1.0
IP 54	0.8

The admissible rated operating current I_{nc1} of an NH slimline fuse-switch disconnector is calculated from the product of I_{nc} from Table 7 on page 54, RDF_1 from Table 8 and RDF_2 from Table 9.

$$I_{nc1} = I_{nc} \cdot RDF_1 \cdot RDF_2$$

The enclosure depth and enclosure height are irrelevant for the diversity of the outgoing units from the section, and the section dimensions may therefore be selected independently of the diversity.

Fuse-switch disconnector sections with horizontal busbar system in the centre-rear section from the Ri4Power modular system, consisting of TS 8 enclosures and other required system accessories.

The main busbar system may only be installed in the centre rear section. The neutral conductor should always be positioned offset from the main busbar system in the lower or upper enclosure section.

The detailed configuration of the fuse-switch disconnector sections with horizontal busbar system in the centre rear section may be found in the valid Ri4Power assembly instructions.

Cable chamber

The cable chamber is designed for the cable management of outgoing feeder sections. Bayed to the side of the modular enclosure, it is used to route the cables and also for insertion into the individual compartments. The cable chamber may also be used independently of the modular enclosure inside Ri4Power systems for general cable management.

For compliance with Form 4b, the use of Form 4b connection spaces is mandatory. Form 4b connection spaces are fitted onto the side panel modules of the compartments of modular outgoing feeder sections. For this reason, when planning a combination of a modular outgoing feeder section and a cable chamber, it is expedient to consider them as one transport unit.

For inner compartmentalisation with Form 2b, 3b, 4a and 4b, the main busbar system routed through the cable chamber should be separated by covers. Depending on the configuration of the entire system, the main busbar system of the cable chamber may be routed in the top or bottom of the roof section, base section or rear section.

The optional selection of a roof plate for cable gland plates additionally allows cables to be fed in from above. However, this option is not admissible when configuring the main busbar system in the roof section.

If an enclosure variant with forced ventilation is chosen, with a cable chamber bayed to the side of a modular enclosure, a vented roof plate must not be used, because otherwise, ventilation of the modular enclosure compartment cannot be achieved.

The detailed configuration of the cable chambers can be found in the valid Ri4Power assembly instructions.

Corner section

The corner section is designed for right-angled deflection of the main busbar system. The main busbar system may optionally be arranged in the roof section, base section, rear section top, centre or bottom, depending on the system configuration.

For the deflection of main busbar systems in the rear section top, centre or bottom, the busbar systems are butted together and connected using the corner brackets of the busbar systems.

For the deflection of main busbar systems in the roof or base section, a busbar system is routed across the entire width in the corner section, and terminated at the enclosure end at a distance from the side panel. The second busbar system ends with the enclosure to be bayed. The busbar systems are connected using contact makers/copper rolls and flat bar pieces, see Table 10. The screw connections must be made in accordance with the generally valid data for the screw connection of items in the valid Ri4Power assembly instructions.

Table 10: Horizontal rails and contact makers for main busbar systems in the roof section

Busbar system	Contact makers	No. of contact makers per conductor	No. and cross-section of busbars
Maxi-PLS 1600	9640.171	2	2 x 60 x 10 mm
Maxi-PLS 2000	9640.171	2	3 x 60 x 10 mm
Maxi-PLS 3200	9650.181	2	3 x 80 x 10 mm
Flat-PLS 60 to 2 x 40 x 10 mm	9676.504[1)]	2	2 x 40 x 10 mm
Flat-PLS 60 to 2 x 60 x 10 mm	9676.526	2	2 x 60 x 10 mm
Flat-PLS 60 to 4 x 40 x 10 mm	9676.548	2	2 x 80 x 10 mm
Flat-PLS 60 to 4 x 60 x 10 mm	9676.548	2	3 x 80 x 10 mm
Flat-PLS 100 to 2 x 100 x 10 mm	9676.528	2	2 x 80 x 10 mm
Flat-PLS 100 to 4 x 80 x 10 mm	9676.540	2	2 x 100 x 10 mm
Flat-PLS 100 to 4 x 100 x 10 mm	9676.540	2	3 x 100 x 10 mm

[1)] Copper roll

Distribution busbar section

The distribution busbar section with a vertically routed distribution busbar system can only be fitted with a distribution busbar system of an identical design to the main busbar system. Furthermore, this section type is only possible for low-voltage systems with a main busbar system in the roof or base section.

For Flat-PLS busbar systems, however, variation in the configuration of busbars in terms of quantity and cross-section is admissible.

The following table shows the admissible combinations of main and distribution busbar systems in this section type:

Table 11: Selection of distribution busbar system in the distribution busbar section

Main busbar system	Possible distribution busbar systems		Minimum section width
Maxi-PLS 1600	Maxi-PLS 1600	Maxi-PLS 2000	200 mm
Maxi-PLS 2000	Maxi-PLS 2000	Maxi-PLS 1600	200 mm
Maxi-PLS 3200	Maxi-PLS 3200	–	200 mm
Flat-PLS 60	Flat-PLS 60	–	300 mm
Flat-PLS 100	Flat-PLS 100	–	400 mm

For dimensioning of the distribution busbar section with a vertically routed distribution busbar system, the following parameters must be known:

- Model and configuration of the main busbar system
- The rated current I_{nc} which the vertical distribution busbar system must be able to carry under the chosen conditions
- The protection category of the enclosure and type of cooling
- The required short-circuit withstand capacity of the distribution busbar system

When designing the short-circuit withstand capacity for the distribution busbar system, it is admissible according to the standard to reduce the short-circuit withstand capacity compared with the main busbar system, so that it is still greater than the on-state values of the protective devices connected downstream.

For the rated current I_{nc} of the distribution busbar system, the specified rated values should be applied for use as a main busbar system, with due regard for the enclosure protection category and cooling.

The detailed configuration of the distribution busbar sections may be found in the valid Ri4Power assembly instructions.

Busbar riser

The busbar riser section type is used to relocate the position of the main busbar system from a standard busbar position to another standard busbar position. This is necessary, for example, with the coupling switch section, and is automatically taken into account during configuration with the Power Engineering software. The busbar riser section type may also be used separately for other requirements. For example, if the main busbar system is routed in the roof section, the outgoing feeders are routed downwards, and infeed is to be from above. With this arrangement, it is necessary to change the busbar position for the infeed.

The size of the riser section is derived from the chosen main busbar system. For busbar types Maxi-PLS, a minimum enclosure width of 200 mm should be chosen. For the busbar systems Flat-PLS 60 and Flat-PLS 100, a minimum enclosure width of 300 mm or 400 mm should be chosen.

When selecting an enclosure width of 200 mm, the base/plinth of the adjacent section should be widened by 200 mm. The riser section and the adjacent section are on a joint base/plinth. Riser sections with widths of 300 mm or 400 mm are on separate base/plinths.

For dimensioning of the busbar riser, the rated values of the main busbar system under the chosen ambient conditions shall apply.
The cross-sections of the vertical bar section are identical to those of the horizontal bar sections to be connected.
The following parameters must be known:

- Model and configuration of the main busbar system
- The protection category of the enclosure and type of cooling.

Busbar risers from the modular Ri4Power system are comprised of TS 8 enclosures with inner separation in a modular design and other required system accessories.

With this section type, the main busbar system can link the standardised busbar positions in the roof section, base section, rear section top, centre or bottom.

The detailed configuration of the busbar riser can be found in the valid Ri4Power assembly instructions.

General remarks and recommendations

Making busbar connections and connections to copper busbars

When making connections to busbar systems or interconnecting copper busbar systems, extra care should be taken when working on contact points.

The copper components supplied by Rittal may be used directly. It is important to check that the copper components do not have any contamination caused by dust, heavy oxidation or contaminants such as coolant residues before installing in the switchgear. If there is contamination, the component or contact point must be cleaned.

To clean contact points and remove oxidation or mechanical contamination, we recommend use of a nonwoven fabric or similar. In the case of contamination from coolants or similar, an alcohol-based detergent should be used. All screw connections of connection points should be tightened with the requisite torque. Information on the requisite torques may be taken from the valid Ri4Power assembly instructions. If no additional information is provided by Rittal regarding the installation of third-party devices, the manufacturers' specifications should be observed.

Choice of internal connections

The correct dimensioning and engagement of the connections is particularly important for correct functioning of the switchgear enclosure. The switchgear manufacturer must follow the original manufacturer's specifications. Installation and assembly must always be carried out in compliance with the assembly instructions. As a general rule, the torques and dimensions specified in the assembly instructions for the Ri4Power system should be observed. If there are no special instructions on the installation or connection of a device given in the Ri4Power assembly instructions, the device manufacturer's assembly instructions must be observed.

If insulated cables are used to connect the main circuits, these should be chosen for temperature resistance up to 105 °C. This results from an ambient temperature of 35 °C and a maximum admissible overtemperature of 70 K at the device connections of the equipment.

Air circuit-breakers (ACB)

For air circuit-breakers, the choice of connection material is limited to copper bar version "half hard (HB)". The use of laminated copper bars to connect ACBs within the Ri4Power system is not admissible.

The dimensioning of the busbar cross-sections and the number of busbars to be used may be taken from Tables 29 – 34, page 77 – 79. However, Rittal recommends that you use the latest version of its Power Engineering software, which automatically calculates the corresponding cross-sections for all admissible switches.

Moulded-case circuit-breakers (MCCB)

For connecting MCCBs, the information given in Tables 35 – 40, page 80 – 87 of this handbook should be used as the minimum cross-section. The prescribed conductor types may be used, such as round conductors, laminated copper bars or solid copper bars, as per the switchgear manufacturer's specifications. When using Rittal circuit-breaker adaptors, the corresponding Rittal connection brackets should be used.

Furthermore, for devices greater than 100 A and for busbar connection, conductor materials should be designed with a 105 °C temperature-resistant insulation. When using 80% current load of the the device current, the connected conductors must be designed for the maximum current of the devices. For devices below 100 A rated current, conductors with a temperature resistance of 90 °C may be used.

NH fuse-switch disconnectors

The connection cross-sections of NH fuse-switch disconnectors should be dimensioned in accordance with the device size and the fuse insert used, as per the following table:

Table 12: Admissible rated current I_{nc} and connection cross-section for NH fuse-switch disconnectors

Size	Max. device rated current I_n	Rated current of fuse I_{n1}	Max. rated operating current I_{nc}	Minimum connection cross-section
Size 00	160 A	to 20 A	$= I_{n1}$	2.5 mm²
Size 00	160 A	25 A	$= I_{n1}$	4 mm²
Size 00	160 A	35 A	$= I_{n1}$	6 mm²
Size 00	160 A	50 A	$= I_{n1}$	10 mm²
Size 00	160 A	63 A	$= I_{n1}$	16 mm²
Size 00	160 A	80 A	$= I_{n1}$	25 mm²
Size 00	160 A	100 A	$= I_{n1}$	35 mm²
Size 00	160 A	125 A	$= I_{n1}$	50 mm²
Size 00	160 A	160 A	$= I_{n1}$	70 mm²
Size 1	250 A	160 A	$= I_{n1}$	Cf. size 00
Size 1	250 A	224 A	$= I_{n1}$	95 mm²
Size 1	250 A	250 A	$= I_{n1}$	120 mm²
Size 2	400 A	200 A	$= I_{n1}$	Cf. size 00 – 1
Size 2	400 A	224 A	$= I_{n1}$	120 mm²
Size 2	400 A	250 A	$= I_{n1}$	120 mm²
Size 2	400 A	315 A	$= I_{n1}$	185 mm²
Size 2	400 A	400 A	$= I_{n1}$	240 mm²
Size 3	630 A	315 A	$= I_{n1}$	Cf. size 00 – 2
Size 3	630 A	400 A	$= I_{n1}$	240 mm²
Size 3	630 A	500 A	$= I_{n1}$	2x 185 mm²
Size 3	630 A	630 A	$= I_{n1}$	2x 240 mm²

However, this specification only applies to fuse inserts of the type gg/gL. For other fuse types, the specifications of the fuse manufacturers should additionally be observed.

The rated current of the fuses is used for dimensioning the cross-sections. Additionally, the next largest cable cross-section is used. From 63 A, the temperature resistance of the cables should be 105 °C.

The maximum current of the device should not exceed 80%. In a horizontal mounting position, the NH devices should only be used as fuse holders and must not be used as switchgear. This should be labelled e.g. with a sticker (Do not open under load).

Motor-starter combinations (MSC)

Wiring of the main circuit

The cross-sections of the main circuit should always be dimensioned one cross-section step larger than that calculated on the basis of rated current. If the switchgear manufacturer requires a larger cross-section, this should be followed. The insulation of the conductor material of the main circuits must be designed for an overtemperature of 70 K.

Wiring for auxiliary circuits

General wiring should be selected in conformity with Annex H of IEC 61 439-1. The type of wiring must withstand a maximum temperature of 60 °C if the plate is in an area with a maximum ambient temperature of 35 °C. If the ambient temperature is higher, the insulation material must meet a higher temperature resistance.

General wiring

General wiring should be selected in conformity with Annex H of IEC 61 439-1.

Operation and maintenance

The manufacturer of the low-voltage switchgear combination must define the required measures for installation, commissioning and maintenance of the low-voltage switchgear enclosure in writing and give it to the operator.

Notes on the use of aluminium cables

Aluminium cable on terminal SV 9650.325/9640.325

The conductor connection clamp may be used for connecting single- and multi-wire round conductors of copper or aluminium from 95 – 300 mm^2. For connecting aluminium conductors, the following work steps must be observed:

Step 1:
The surface of the aluminium conductor should be cleaned to remove any dirt and, above all, the oxide layer.

Step 2:
Immediately after removing the oxide layer, the clean conductor surface is coated using an acid- and alkaline-free grease such as technical vaseline (e.g. contact protection paste P1 made by Pfisterer). This prevents the formation of a new layer of oxide.

Step 3:
Immediately after preparing the conductor, it should be connected to the conductor connection clamp using the rated torque.

Step 4:
One day later, check the connected conductors to ensure that they are firmly seated, and if necessary, check the torque.

Step 5:
The connection points must be monitored with recurrent inspections of the entire switchgear. It is expedient, for example, to use thermographic images or resistance measurements for monitoring purposes.

List of design verifications to be obtained

Table 13: Design verifications in detail

No.	Features to be verified	IEC/EN 61 439-1 Chapter	Available verification choices		
			Verification by testing	Verification by calculation	Verification by design rules
1	Strength of materials and parts	10.2			
	Corrosion resistance	10.2.2	Yes	No	No
	Properties of insulating materials	10.2.3			
	Thermal stability	10.2.3.1	Yes	No	No
	Resistance to abnormal heat	10.2.3.2	Yes	No	No
	Resistance to exceptional heat and fire due to internal electrical effects	10.2.3.3	Yes	No	No
	Resistance to UV radiation	10.2.4	Yes	No	No
	Lifting	10.2.5	Yes	No	No
	Mechanical impact test	10.2.6	Yes	No	No
	Markings	10.2.7	Yes	No	No
2	Degree of protection of enclosures	10.3	Yes	No	No
3	Clearance and creepage distances	10.4	Yes	Yes	Yes
4	Protection against electric shock and integrity of protective circuits	10.5			
	Effective continuity between the exposed conductive parts of the ASSEMBLY and the protective circuit	10.5.2	Yes	No	No
	Short-circuit withstand strength of the protective circuit	10.5.3	Yes	Yes	Yes
5	Incorporation of switching devices and components	10.6	No	No	Yes
6	Internal electrical circuits and connections	10.7	No	No	Yes
7	Terminals for external conductors	10.8	No	No	Yes
8	Dielectric properties	10.9			
	Power-frequency withstand voltage	10.9.2	Yes	No	No
	Impulse withstand voltage	10.9.3	Yes	No	Yes
9	Temperature-rise limit	10.10	Yes	Yes	Yes
10	Short-circuit withstand strength	10.11	Yes	Yes	Yes
11	Electromagnetic compatibility (EMC)	10.12	Yes	No	Yes
12	Mechanical operation	10.13	Yes	No	No

Switchgear installation types

The switchgear should always be installed horizontally.

Rittal switchgear may be positioned back to back or directly against the wall without derating the busbar systems and switchgear. This is based on the tests and test results. All switchgear is insulated at the rear, as well as the side panels.

This applies to the installation of switchgear in the middle of the room, back against the wall, side panels without convection, and the option of baying other enclosure panels.

Conductor cross-section in relation to short-circuit withstand capacity (unprotected active conductors)

Standard reference IEC 61 439-1

Active conductors in switchgear enclosures that are not protected by short-circuit protection devices (see IEC 61 439, chapters 8.6.1 and 8.6.2) must be selected and laid throughout their entire route in the switchgear enclosure to prevent the likelihood of short-circuits between the phase conductors or between the phase conductors and earthed parts.

Examples of conductors, selected and installed according to the table below, with an SCPD (short-circuit protection device) on the load side, must not exceed a length of 3 m. The conductor cross-section should be dimensioned such that, firstly, the rated current can be carried and secondly, if there is a short-circuit, the conductor will not overheat inadmissibly until the downstream protection device is deactivated (cf. also VDE 0298 Part 4: 2003-08).

Table 14: Conductor selection and laying conditions (IEC 61 439, chapter 8.6.4)

Type of conductor	Requirements
Uncoated conductor or single-wire conductor with basic insulation e.g. to IEC 60 227-3	Mutual contact or contact with conductive parts must be prevented, e.g. via the use of spacer supports
Single-wire conductors with basic insulation and an admissible operating temperature of the conductor of at least 90 °C, e.g. cables to IEC 60 245-3 or heat-resistant thermoplastic (PVC)-insulated cables to IEC 60 227-3	Mutual contact or contact with conductive parts is admissible without the external influence of pressure. Contact with sharp edges is to be avoided. These conductors must only be loaded in such a way that an operating temperature of 80% of the maximum admissible operating temperature on the conductor is not exceeded.
Conductors with basic insulation, e.g. cables to IEC 60 227-3 with an additional second insulation, such as cables with an individual shrink sleeve or cables laid individually in plastic tubes	No additional requirements
Conductors insulated with a material of very high mechanical strength, such as ethylene-tetrafluoroethylene (ETFE) insulation, or double-insulated conductors with a reinforced outer coating, dimensioned for use up to 3 kV, e.g. cables to IEC 60 502	
Single- or multi-wire light plastic-sheathed cables, e.g. cables to IEC 60 245-4 or IEC 60 227-4	

Cable routing or cable entry

The corresponding preparations stipulated by or agreed with the manufacturer of the low-voltage switchgear enclosure should be made with regard to cable entry and attachment.

The requisite bending radii of the cables used should also be taken into account. Adequate cable clamp rails should be provided to secure them. Adequate quantities of terminal connections should be provided for all cables.

Neutral conductors – Requirements

General
Dimensioning of the neutral conductor is described in IEC 61 439-1, chapter 8.6. The following minimum requirements apply to the neutral conductor in 3-phase circuits.

- In circuits with a phase conductor cross-section up to and including 16 mm^2 , the neutral conductor must correspond to 100% of the corresponding phase conductors.
- In circuits with a phase conductor cross-section of more than 16 mm^2, the neutral conductor must correspond to 50% of the corresponding phase conductors, but at least 16 mm^2.

The current in the neutral conductor is assumed to be no more than 50% of a phase conductor current. The dimensioning of the neutral conductor should be agreed in advance with the end client.

Explanation of the neutral conductor
In systems that simultaneously have ohmic, capacitive and inductive loads on the phase conductors, more than 100% load of the neutral conductor is possible.

Neutral conductor in the main busbar system
Assembly of the main busbar system in a 4-pole version is dependent on the type of bar system used, the network configuration, the enclosure dimensions and the busbar arrangement.

If the neutral conductor is to be routed separately, this can be achieved with the busbars (with RiLine60, Maxi-PLS and Flat-PLS) in 600 mm and 800 mm deep enclosures.

If the neutral conductor is to be routed together with the phase conductors, the enclosures for Flat-PLS 100 and Maxi-PLS 3200 should have a depth of at least 800 mm. All other bar systems may be installed in 600 mm deep enclosures as a 4-pole busbar assembly.

The chosen network configuration (TN-C, TN-CS, ...), see page 42, defines the design of the neutral conductor.

In Ri4Power section types, the following additional requirements should be observed for the neutral conductor:

ACB air circuit-breaker sections
When using a switched neutral conductor or a 4th pole routed with the phase conductors, this is assembled in exactly the same way as a regular 4-pole ACB section. If the fourth pole is not switched, the neutral conductor rises parallel to the phases via stacking insulators.

If the anticipated current in the neutral conductor is greater than 50%, the neutral conductor should be dimensioned in the phase conductor cross-section of the connection kit. If the neutral conductor current is less than 50%, the cross-section may be halved. If the neutral conductor is not switched, the cross section may be designed to IEC 61 439-1.

Modular outgoing feeder section
If a 4-pole distribution busbar system is used, the enclosure width must be at least 600 mm.

NH slimline fuse-switch disconnector section
When using 4-pole NH slimline fuse-switch disconnectors from ABB (Slimline) or Jean Müller (Sasil), the neutral conductor should be routed in the main conductor cross-section. The busbar support is unable to accommodate different busbar designs, compared with the phase conductors. If the neutral conductor is routed in the cable outgoing feeder section, this should be designed in accordance with standard IEC 61 439-2.

Cable outgoing feeder section
No particular requirements.

Neutral conductors for switchgear
Neutral conductors for 4-pole switchgear that have not already been described in this chapter must be dimensioned and connected in accordance with the original device manufacturer's specifications. If there is no clear definition given in the original device manufacturer's specifications, the neutral conductor should be dimensioned in conformity with the general rules of this chapter and Annex H of IEC 61 439-1.

Notes on the positioning and design of N, PE and PEN conductors

N, PE and PE conductors are to be dimensioned in accordance with IEC/EN 61 439-2.

For dimensioning of the minimum cross-section of the PE conductor or PEN conductor for the PE conductor function, we would refer you to chapter 5.3.1.

The PE/PEN system solutions offered by Rittal have been tested as follows:

Table 15: Selection of PE/PEN conductors on the basis of rated short-term withstand current

Busbar cross-section	Test values	For rated short-term withstand current I_{cw} of the main busbar system
E-Cu 30 x 5 mm	18 kA, 1 sec.	30 kA, 1 sec.
E-Cu 30 x 10 mm	30 kA, 1 sec.	50 kA, 1 sec.
E-Cu 40 x 10 mm	42 kA, 1 sec.	70 kA, 1 sec.
E-Cu 80 x 10 mm	60 kA, 1 sec.	100 kA, 1 sec.
Maxi-PLS 1600	60 kA, 1 sec.	65 kA, 1 sec.
Maxi-PLS 2000	60 kA, 1 sec.	70 kA, 1 sec.
Maxi-PLS 3200	60 kA, 1 sec.	100 kA, 1 sec.

Additionally, when dimensioning the PEN conductor, it should be noted that the minimum cross-section must also satisfy the requirement for the N function.

Dimensioning of the neutral conductor or the neutral conductor function of the PEN conductor depends on the anticipated load and should be agreed between the user and the manufacturer. If no specifications have been made by the user in this connection, the following regulations should be used for the minimum cross-section in accordance with IEC/EN 61 439-1, chapter 8.6.1.

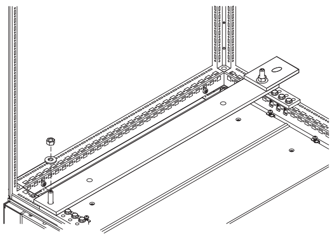
In circuits with a phase conductor cross-section up to and including 16 mm^2, the neutral conductor should be designed with the same cross-section (100% of the phase conductor cross-section).

In circuits with a phase conductor cross-section of more than 16 mm^2, the neutral conductor should be designed with half the cross-section (50% of the phase conductor cross-section), but with a minimum cross-section of 16 mm^2.

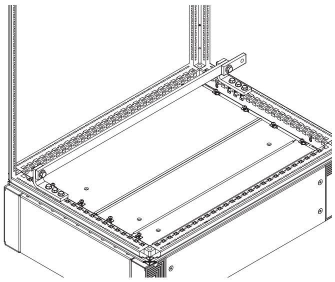
These regulations should be applied for all internal conductors in a switchgear.

However, they only apply under the assumption that the current of the neutral conductor is no more than 50% of the phase conductor current. For higher currents on the neutral conductor or high harmonic contents, the cross-sections should be defined correspondingly higher.

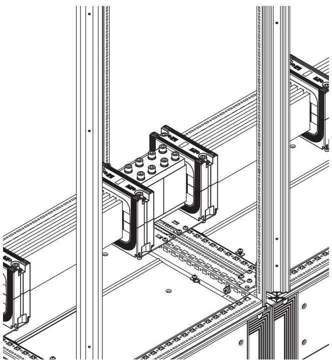
The PE, PEN and N conductors should be fitted in accordance with the position shown in the Ri4Power assembly instructions.



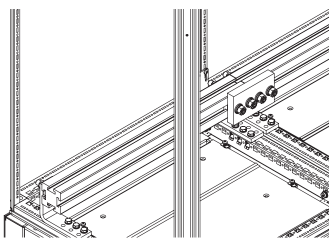
PE bar version, flat copper bar, horizontal



PE bar version, flat copper bar, upright



PE bar version with Flat-PLS



PE bar version with Maxi-PLS

Dimensioning of the PE with the aid of calculation I^2txsec. Appendix B (normative)

Procedure for calculating the cross-section of PE conductors with regard to thermal stresses from short-term currents.

The cross-section of PE conductors that must withstand the thermal stresses of currents for a duration of 0.2 s to 5 s is calculated using the following equation:

$$S_p = \frac{\sqrt{I^2 t}}{k}$$

whereby

S_p is the cross-section in mm^2

I is the value of the short-circuit AC current (root-mean-square value) for a malfunction with negligible impedance that can flow through the short-circuit device, in amperes

t is the cut-out time of the disconnecting device in seconds[1)]

k is the factor depending on the material of the PE conductor, the insulation and other parts, as well as on the starting and final temperature; see table opposite

1) The current-limiting effect of the circuit impedances and the current-limiting properties of the protective device (I^2t) should be taken into account.

Values for factor k for insulated PE conductors not contained in cables, or for uncoated PE conductors where in contact with cable covers

Table 16: Factor k depending on the conductor material and insulating material

	Insulation of the PE conductor or cable cover		
	Thermoplastic (PVC)	VPE EPR Uncoated conductors	Butyl rubber
Final temperature of conductor	160 °C	250 °C	220 °C
Conductor material	Factor k		
Copper	143	176	166
Aluminium	95	116	110
Steel	52	64	60

The starting temperature of the conductor has been assumed at 30 °C.

For further details see IEC 60 364-5-54.

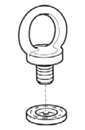
Transport units and weights

Details may be found in the TS 8 load brochure (available to download at www.rittal.com).

Transportation by crane

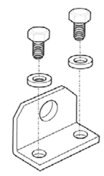
All TS 8 enclosures are suitable for crane transportation, either as free-standing enclosures or bayed suites.

Eyebolt PS 4568.000



For crane transportation of the enclosures if not already included with the supply (based on DIN 580).

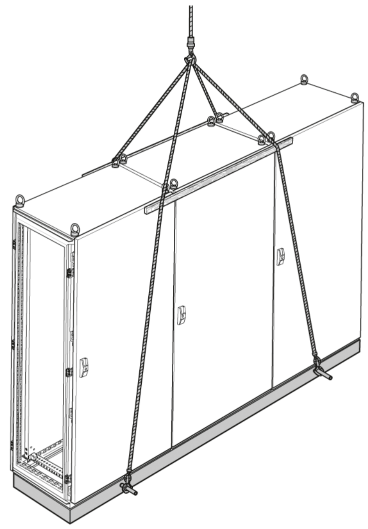
Combination angle PS 4540.000



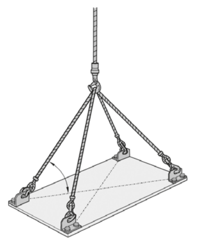
For optimum distribution of tensile forces during transportation of bayed enclosures by crane.

Transport plinth for TS SO 1228.XXX

For the transportation of heavy, bayed enclosure suites. Available in 200 mm increments from 2 to 5 m. Transport plinths may be supplied with two welded tubes at right-angles to accommodate transport bars. Variable punchings to suit all enclosure widths from 600 mm.



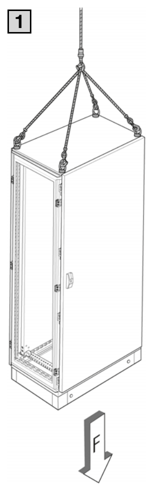
∢ Cable pull angle



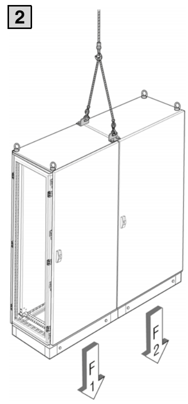
1 Individual enclosures may be safely transported using the eyebolts included with the supply. For symmetrical loads, the following maximum permissible overall loads apply:
for 45° cable pull angle 4800 N,
for 60° cable pull angle 6400 N,
for 90° cable pull angle 13600 N.

2 For the enclosure combination with angular baying brackets, quick-fit baying clamps and combination angles shown here, the load capacity with a cable pull angle of 60° is as follows:
F1 = 7000 N,
F2 = 7000 N.

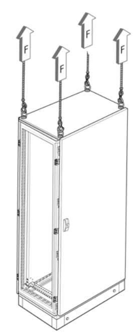
1

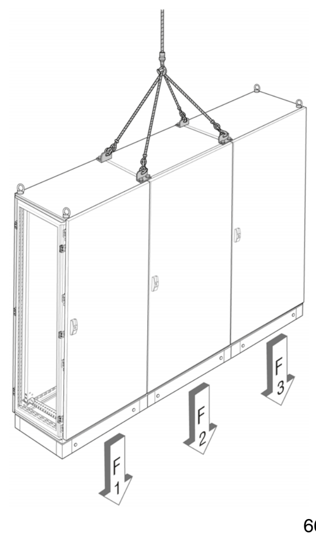


2



For the enclosure combination with angular baying brackets, quick-fit baying clamps and combination angles shown here, the load capacity with a cable pull angle of 60° is as follows:
F1 = 7000 N,
F2 = 14000 N,
F3 = 7000 N.





Accidental arcing protection for human safety

The Ri4Power system meets the requirements for accidental arcing protection to IEC 61 641. The tested, permitted technical data and the approved busbar systems may be found in the current technical specifications or on our website www.rittal.com.

The basic requirement for compliance is the use of pressure relief flaps instead of roof plates. To ensure correct functioning, the latch mechanism of the flap as per the enclosed assembly instructions should be adjusted precisely to the system installation and tested for function. The function and test result should be documented.

Built-in equipment such as indicator lights, test equipment or display devices should be covered by a viewing window. A preventative accidental arcing protection may be operated in addition to this. The preventative measures limit the potential for an accidental arc occurring. Dropped screws or tools cannot strike active conductors and trigger an accidental arc. In order to achieve the preventative measures for avoiding accidental arcs, the busbar systems used should be covered as far as possible using the accessory materials from the Ri4Power modular system.

For further information, please contact our system advisors for power distribution.

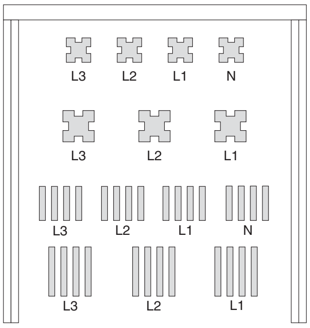
System overview of the standard main busbar routing in Form (1) 2-4

Diagram shows side view.
The fronts of the enclosures are on the right.

D = Enclosure depth
D2 = Busbar centre-to-centre spacing

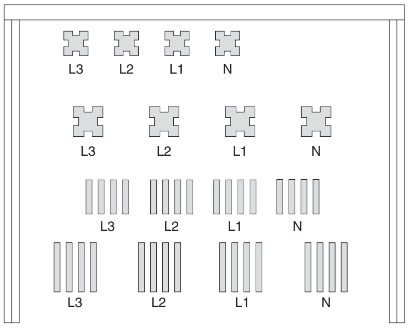
Busbar routing in roof section, top

Enclosure depth D = 600 mm



System	D2 mm
Maxi-PLS 1600/2000	100
Maxi-PLS 3200	150
Flat-PLS 60	120
Flat-PLS 100	165

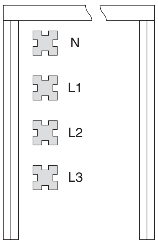
Enclosure depth D = 800 mm



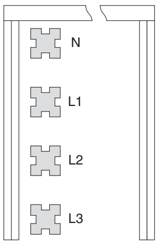
System	D2 mm
Maxi-PLS 1600/2000	100
Maxi-PLS 3200	150
Flat-PLS 60	120
Flat-PLS 100	165

Busbar routing in rear section, top

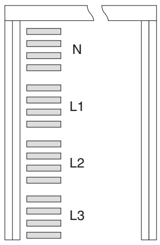
System	D mm	D2 mm
Maxi-PLS 1600/2000	600/800	100



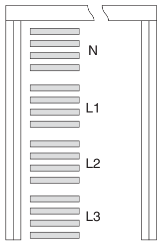
System	D mm	D2 mm
Maxi-PLS 3200	800	150



System	D mm	D2 mm
Flat-PLS 60	800	120

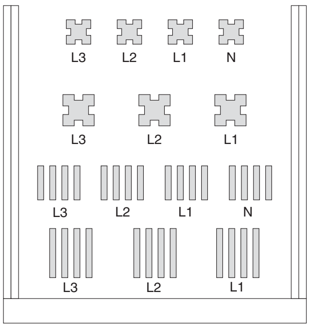


System	D mm	D2 mm
Flat-PLS 100	800	165



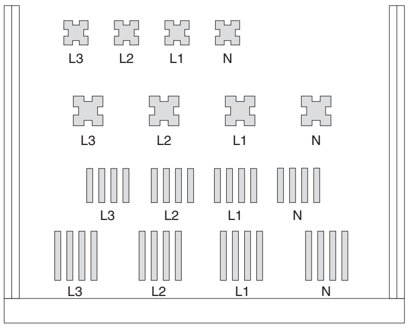
Busbar routing in base, bottom

Enclosure depth D = 600 mm



System	D2 mm
Maxi-PLS 1600/2000	100
Maxi-PLS 3200	150
Flat-PLS 60	120
Flat-PLS 100	165

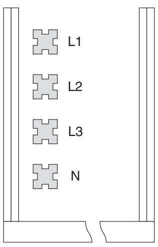
Enclosure depth D = 800 mm



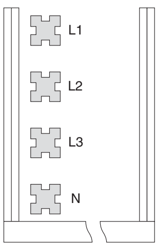
System	D2 mm
Maxi-PLS 1600/2000	100
Maxi-PLS 3200	150
Flat-PLS 60	120
Flat-PLS 100	165

Busbar routing in rear section, bottom

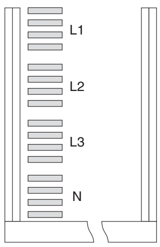
System	D mm	D2 mm
Maxi-PLS 1600/2000	600/800	100



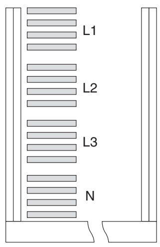
System	D mm	D2 mm
Maxi-PLS 3200	800	150



System	D mm	D2 mm
Flat-PLS 60	800	120

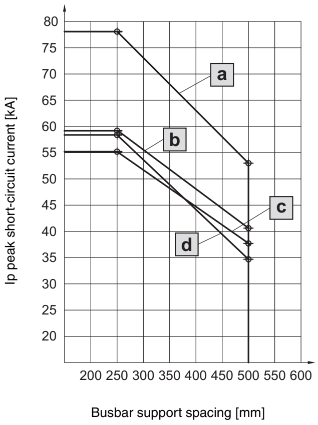


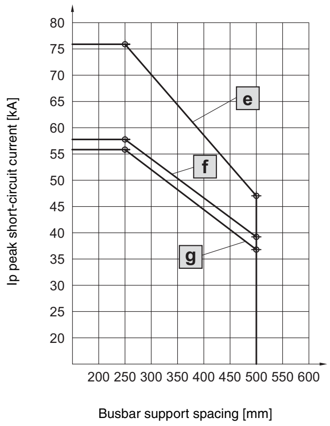
System	D mm	D2 mm
Flat-PLS 100	800	165



Short-circuit rating diagram for busbar supports RiLine60, Flat-PLS 60/100 and Maxi-PLS 3200

The busbar supports in the section types of the Ri4Power modular system should be arranged in accordance with the valid assembly instructions. The assembly types shown there may differ from the information given in the short circuit-resistance diagrams, in some cases, but have been verified by testing. If alternative section assemblies are needed, the required support spacing may be calculated using the short circuit-resistance diagrams. Below, we give the example of the short circuit-resistance diagram for the RiLine60 busbar support SV 9340.000/SV 9340.010. The currently valid details may be found online in the technical details for Catalogue 33.





Busbar supports up to 800 A, 3-pole

Model No. SV 9340.000/SV 9340.010

60 mm bar centre distance,
for busbars 15 x 5 – 30 x 10 mm.

Rated operating voltage: up to 690 V AC
Rated insulation voltage: 1000 V AC
Rated surge voltage: 8 kV

Overvoltage category: IV
Level of contamination: 3
Rated frequency: 50/60 Hz

Test implemented:
- Rated peak withstand current I_{pk} (see diagram)
- Rated short-time withstand current I_{cw}

Table 17: Rated short-time withstand current I_{cw} for SV 9340.000/SV 9340.010

Busbar mm	l mm	I_{cw}[1) kA
30 x 10	250	37.6
30 x 5	250	25.4
20 x 10	250	29.0

1) For 1 sec.

Note:
More short-circuit diagrams may be found on the Internet under the technical details for Catalogue 33, page 158 – 164.

Table 18: Characteristic curve allocation for SV 9340.000/SV 9340.010

Busbar mm	Curve
30 x 10	a
20 x 10	b
25 x 5	c
15 x 5	d
30 x 5	e
20 x 5	f
15 x 10	g

Admissible heat losses within compartments

For verifying the admissibility of individual mounting parts in compartments with and without distribution busbar systems, the following table may be used. To this end, the sum total of actual heat losses of the devices and wiring must be calculated.

Configuration without additional climate control or cooling is admissible, provided the calculated value is <= the admissible value for the compartment, and the sum total of heat losses arising in this compartment is <= the maximum total heat loss. The calculation should be enclosed with the plant documentation.

Table 19: Heat loss table for compartment with distribution busbar

Compartment width mm	Compartment height mm	Compartment depth mm	Max. heat loss specification of switchgear in W (uninstalled heat loss)			Comments
			IP 2X	IP 43	IP 54/55	
400/600/800	150	401/425/600/800	33	28	20	
400/600/800	200	401/425/600/800	33	30	27	
400/600/800	250	401/425/600/800	33	30	27	
400/600/800	300	401/425/600/800	76	76	76	
400/600/800	400	401/425/600/800	76	76	76	
400/600/800	600	401/425/600/800	193	193	151	
400/600/800	800	401/425/600/800	193	193	151	
400/600/800	1000	401/425/600/800	193	193	151	
400/600/800	1600	401/425/600/800	193	193	151	
400/600/800	Section height 1800	401/425/600/800	218	218	218	Max. total heat loss of section
400/600/800	Section height 2000	401/425/600/800	218	218	218	Max. total heat loss of section
400/600/800	Section height 2200	401/425/600/800	245	245	245	Max. total heat loss of section
Each device module Form 1			50	50	50	
Mounting plates Form 1[1)]	Section height 1800		218	218	218	
	Section height 2000		218	218	218	
	Section height 2200		245	245	245	

1) In Form 1 (open design without internal separation), the figure for the complete section height should always be used. This also applies if the heat loss producers are divided among several small partial mounting plates within the section.

Busbar temperature increase and heat loss

Note:
Continuous currents for busbars may be found on the Internet under the technical details for Catalogue 33, page 152.

Note:
Rated AC currents of the Flat-PLS busbar system up to 60 Hz for uncoated copper bars (E-Cu F30) in A may be found on the Internet under the technical details for Catalogue 33, page 153.

Note:
Calculation of heat loss for busbars may be found on the Internet under the technical details for Catalogue 33, page 154.

Explanation of TSK versus design verification

The terms TSK and PTSK are defined in standard IEC 60 439-1 or in the respective national versions. Version TSK (type-tested switchgear enclosure) satisfies the required proof of temperature rise and short-circuit resistance via testing or a type-testing report.

The PTSK version satisfies the required proof via calculation or derivation from a tested variant.

The design verification to IEC 61 439-1 makes no distinction between the type of proof, and considers all approved methods to be equivalent. Standard IEC 60 439-1 is expected to be withdrawn as of 1 November 2014. As a result, the terms TSK and PTSK will likewise be withdrawn and replaced entirely by the terminology of IEC 61 439-1.

The central earth point (CEP) in TN-S supply net

The CEP should be generated in the main low-voltage distribution. The connection should be a solid copper bar with the minimum cross-section of the PEN/N conductor. If possible, the connection should be made in the centre of the main low-voltage distribution.

No other connections should exist between the PEN and the N, and also no connection between the NE and P conductor in the entire downstream wiring. The CEP should be clearly labelled. We recommend voltage and current monitoring in the CEP connection for this network configuration.

PE conductor connection and current carrying capacity of PE conductor connections within a Ri4Power switchgear

For covers, doors, trim panels etc. with no electrical operating equipment attached, the usual metal screw connections and hinges are considered adequate for continuous connection as potential equalisation. This applies to all specified connections on the TS system enclosure. If other operating equipment is connected to these parts or if there is a risk of a potential transfer to these parts, a PE conductor must be carefully connected, whose cross-section should be based on the largest cross-section of the supply cable to the corresponding operating equipment.

Generally speaking, the manufacturer of the switchgear enclosure must ensure that the PE conductor circuit is capable of withstanding the highest thermal and dynamic loads occurring at the installation site.

In principle, all PE conductors should be dimensioned using the calculation I^2txsec. See also page 65 for further details. For constructional PE conductor connections, further information can also be found in the technical documentation on “PE conductor connection, current carrying capacity”, see www.rittal.com.

Internal separation of switchgear enclosures

Internal separation of a switchgear enclosure increases the level of safety for individuals and the system itself.

The areas to be separated are the busbar compartments, function units and connection areas. The degree of internal separation should be agreed between the manufacturer of the switchgear enclosure and the user.

Meaning

- a Enclosure
- b Internal compartmentalisation
- c Main or multi-terminal busbar
- d Function units
- e External connections

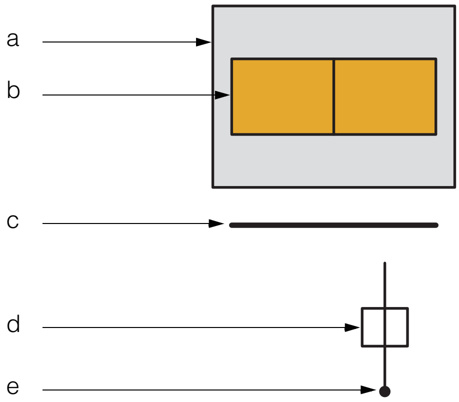
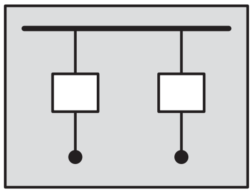
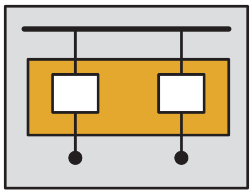
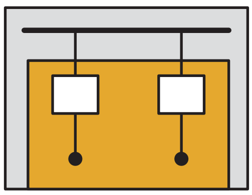
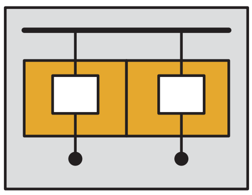
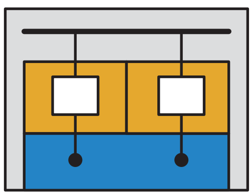
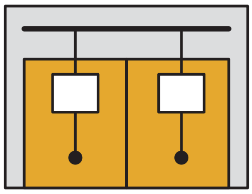
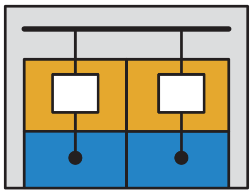


Table 20: Forms of internal separation

Standard IEC/EN 61 439-2 defines the following forms of internal separation (cf. section 8.101, DIN EN 61 439-2)

Form 1 No internal separation. There is no separation between the individual areas.	
Form 2a Separation between the busbars and function units, but no separation between the connections and busbars.	
Form 2b Separation between the busbars and function units, and separation between the connections and busbars.	
Form 3a Separation between the busbars and function units and separation between the individual function units and separation between the connections for conductors fed in from the outside and the function units, but not between the connections themselves. However, with Form 3a there is no separation between the connections and busbars.	
Form 3b Separation between the busbars and function units and separation between the individual function units and separation between the connections for conductors fed in from the outside and the function units, but not between the connections themselves. With form 3b there is separation between the connections and busbars.	

Form 4a Separation between the busbars and function units and separation between the individual function units and separation between the connections for conductors fed in from the outside that are assigned to a function unit, and the connections of all other function units, as well as the busbars. With Form 4a, however, the connections and the function unit are in one compartment.	
Form 4b Separation between the busbars and function units and separation between the individual function units and separation between the connections for conductors fed in from the outside that are assigned to a function unit, and the connections of all other function units, as well as the busbars. With Form 4b, however, the connections and the function unit are likewise separated.	

Explanation:
Internal separation is met via compliance with protection category IP XXB.
For protection against the ingress of solid foreign bodies, protection category IP 2X is a minimum requirement.

Fuse designations, operating categories

D systems
DIAZED = diametrically graduated two-piece Edison fuse
- DII fusible element has an E27 electrical thread and currents up to 25 A
- DIII fusible element has an E33 electrical thread and currents up to 63 A
- Application range RiLine60

D0 system
NEOZED is a Siemens registered trademark
- D01 fusible elements have an E14 up to 16 A (with featherkey, may also be used in D02 elements)
- D02 fusible elements have an E18 electrical thread and can protect against short-circuits with currents up to 63 A
- Application range RiLine60

NH system
Low-voltage high-performance fuse
- The sizes of the fuses are as follows:
  - NH 000 from 6 – 100 A
  - NH 00 from 6 – 160 A
  - NH 0 from 6 – 160 A (must no longer be used in new systems)
  - NH 1 from 80 – 100 A
  - NH 2 from 125 – 400 A
  - NH 3 from 315 – 630 A
  - NH 4 from 500 – 1000 A
  - NH 4a from 500 – 1250 A
- Application range RiLine60 and Ri4Power

Table 21: Operating categories of fuse inserts

Designations	
gG/gL	All-range fuse –> Overcurrent cable protection and short-circuit protection
gM	All-range fuse inserts for protecting motor circuits
aM	Back-up fuse short-circuit protection for motor circuits in circuits
gD	All-range breaking capacity with delay
gN	All-range breaking capacity without delay
aR	Back-up fuse, only short-circuit protection for semi-conductor protection, high-speed
gS	All-range fuse, semi-conductor elements, high-speed
gR	All-range fuse, semi-conductor protection high-speed, faster than gS
gTr	Transformer protection
gB	Protection for mining systems

Table 22: Colour code for fuse inserts

Current	Colour
2 A	Pink
4 A	Brown
6 A	Green
10 A	Red
16 A	Grey
20 A	Blue
25 A	Yellow
35 A	Black
50 A	White
63 A	Copper
80 A	Silver
100 A	Red
125 A	Yellow
160 A	Copper
200 A	Blue

Connection of busbars to DIN 43 673

Busbars should be connected in accordance with DIN 43 673. Alternative busbar connections may be made, provided they are type-tested. All connections within the Ri4Power system are confirmed by type testing or design verification tests and therefore comply with the standard specifications to IEC 61 439-1.

Note:
Busbar screw connections to DIN 43 673 may be found on the Internet under the technical details for Catalogue 33, page 155.

Protection categories IP

Table 23: Positioning of the IP code

IP	Code letter	
Item 1	0 – 6	First code number for protection against contact and foreign bodies:
Item 2	0 – 8	Second code number for level of protection against water
Item 3	A – D	Additional letter
Item 3/4	H, M, S, W	Supplementary letter

Table 24: Item 1, protection against contact and foreign bodies:

Code	Equipment	Persons
X	Not given	Not given
0	Non-protected	Non-protected
1	> = 50 mm diameter	Back of the hand
2	> = 12.5 mm diameter	Safe from finger contact
3	> = 2.5 mm diameter	Tool
4	> = 1 mm diameter	Wire
5	Dust-protected	Wire, dust
6	Dust-tight	No dust

Table 25: Item 2, level of protection against water

Code	Equipment	Persons
X	Not given	–
0	Non-protected	–
1	Vertical drops	–
2	Drops at a 15° angle	–
3	Sprayed water	–
4	Splashed water	–
5	Water jets	–
6	Powerful water jets	–
7	Occasional submersion	–
8	Continuous submersion	–

Table 26: Item 3, additional letter

Code	Equipment	Persons
Against access to dangerous parts with		
A	–	Back of the hand
B	–	Finger
C	–	Tool
D	–	Wire
Supplementary information specifically for		
H	High-voltage appliances	–
M	Movement during water test	–
S	Motionless during water test	–
W	Weather conditions	–

Table 27: Levels of protection against access to hazardous live parts, code number 1

Code	Definition
0	Non-protected
1	The probe, a 50 mm diameter sphere, must have adequate distance from dangerous parts
2	The articulated test finger, 12 mm diameter, 80 mm length, must have adequate distance from dangerous parts
3	The probe, 2.5 mm diameter, must not penetrate
4	The probe, 1.0 mm diameter, must not penetrate
5	
6	

Table 28: Levels of protection against solid bodies, code number 1

Code	Definition
0	Non-protected
1	The object probe, a sphere 50 mm in diameter, must not penetrate fully.
2	The object probe, a sphere 12.5 mm in diameter, must not penetrate fully.
3	The object probe, a sphere 2.5 mm in diameter, must not penetrate fully.
4	The object probe, a sphere 1.0 mm in diameter, must not penetrate fully.
5	Dust may ingress, but is OK in non-hazardous quantities (no influence of equipment)
6	No dust may ingress

Project checklist for Rittal Ri4Power low-voltage switchgear and controlgear assemblies

Project	
Project name	
Switchgear manufacturer	
End client/customer number	
Field service employee	
In-house employee	
Completion by	

System specifications				
1.	Climatic conditions			
2.	Altitude above sea level	m		
3.	Average ambient temperature over 24 h	°C		
4.	Special conditions			
5.	Max. plant dimensions	Height mm	Depth mm	Base/plinth mm
6.	Switch room features			
7.	Standards and provisions			

Mains infeed data		
1.	Power supply	
2.	Short-circuit current of infeeding supply grid I_{cw}/1 sec.	kA
3.	No. of transformers	Transformer capacity

Assembly and installation				
1.	Type of installation			
2.	Restriction to overall length	☐ Yes	☐ No	mm
3.	Base/plinth	☐ 100 mm	☐ 200 mm	☐ No
4.	Cover plate, contact hazard protection	☐ Yes	☐ No	
5.	Maximum length per transport unit	mm		

Busbar systems and field equipment				
1.	Rated current of main busbar, horizontal I_{nc}/RDF			
2.	Rated current of distribution busbar, vertical I_{nc}/RDF			
3.	No. of poles, main busbar	☐ 3-pole	☐ 4-pole	☐ 3-pole + separately routed N
4.	No. of poles, distribution busbar	☐ 3-pole	☐ 4-pole	
5.	Protection category	Roof plate	Front trim panel	
6.	Form separation, incoming sections	☐ 1 ☐ 2a ☐ 2b ☐ 3a ☐ 3b ☐ 4a ☐ 4b		
7.	Form separation, module sections	☐ 1 ☐ 2a ☐ 2b ☐ 3a ☐ 3b ☐ 4a ☐ 4b		
8.	Form separation, fuse-switch disconnector sections	☐ 1 ☐ 2a ☐ 2b ☐ 3a ☐ 3b ☐ 4a ☐ 4b		
9.	Extraordinary enclosure requirement	RAL colour		
10.	Deviant definitions or standards			
11.	PE conductor/neutral conductor	☐ PE ☐ 30 x 10 mm ☐ 40 x 10 mm ☐ 80 x 10 mm	☐ PEN ☐ 25% ☐ 50% ☐ 100%	☐ N ☐ 25% ☐ 50% ☐ 100%
12.	PE/N-PEN cable chambers	☐ PE ☐ 30 x 10 mm ☐ 40 x 10 mm ☐ 80 x 10 mm	☐ PEN ☐ 25% ☐ 50% ☐ 100%	☐ N ☐ 25% ☐ 50% ☐ 100%

Devices circuit-breakers				
1.	Manufacturer	Model		
2.	Size/device rated current I_n	A		
3.	Design	☐ Rack-mounted unit	☐ Static installation unit	
4.	Rated current I_{nc}/RDF	A		
5.	Switch position	☐ VT (in front of door)	☐ HT (behind the door)	
6.	Neutral conductor	☐ Switched	☐ Unswitched	☐ No neutral conductor
7.	Device modules for air circuit-breaker section	☐ Yes	☐ No	
8.	Cable connection/busbar connection	Outgoing	Infeed	
9.	Supply leads per phase	Qty.	Cross-section mm^2	

Devices coupling switch				
1.	Manufacturer	Model		
2.	Size/device rated current I_n	A		
3.	Design	☐ Rack-mounted unit	☐ Static installation unit	
4.	Rated current I_{nc}/RDF	A		
5.	Switch position	☐ VT (in front of door)	☐ HT (behind the door)	
6.	Neutral conductor	☐ Switched	☐ Unswitched	☐ No neutral conductor

Note:
Please enclose a meaningful sketch of the low-voltage switchgear and controlgear assembly with this checklist.

Rated currents I_{nc} ACB (air circuit-breakers)

Table 29: Rated currents I_{nc} for air circuit-breakers – ABB

Brand	ABB											
Type	I_n air circuit-breaker	Rated current I_{nc} with consideration of protection category and cooling					Minimum compartment dimensions				Connection cross-section, connection kits	
		Forced ventilation			Forced ventilation		3-pole version		4-pole version			
		IP 2X	IP 2X	IP 43	IP 54	IP 54	Width	Height	Width	Height	Top	Bottom
	A	A	A	A	A	A	mm	mm	mm	mm	mm	mm
Sace E 1	800	800	800	800	800	800	600	600[1)]	600	600[1)]	1 x 60 x 10	1 x 60 x 10
Sace E 1	1000	1000	1000	1000	1000	1000	600	600[1)]	600	600[1)]	1 x 60 x 10	1 x 60 x 10
Sace E 1	1250	1250	1250	1125	1250	1125	600	600[1)]	600	600[1)]	2 x 60 x 10	2 x 60 x 10
Sace E 1	1600	1600	1600	1440	1600	1440	600	600[1)]	600	600[1)]	2 x 60 x 10	2 x 60 x 10
Sace E 2	800	800	800	800	800	800	600	600[1)]	800	600[1)]	1 x 60 x 10	1 x 60 x 10
Sace E 2	1000	1000	1000	1000	1000	1000	600	600[1)]	800	600[1)]	1 x 60 x 10	1 x 60 x 10
Sace E 2	1250	1250	1125	1000	1125	1000	600	600[1)]	800	600[1)]	2 x 60 x 10	2 x 60 x 10
Sace E 2	1600	1600	1360	1152	1360	1152	600	600[1)]	800	600[1)]	2 x 60 x 10	2 x 60 x 10
Sace E 2	2000	2000	1626	1440	1620	1440	600	600[1)]	800	600[1)]	3 x 60 x 10	3 x 60 x 10
Sace E 3	800	800	800	800	800	800	600[2)]	600[1)]	800	600[1)]	1 x 60 x 10	1 x 60 x 10
Sace E 3	1000	1000	1000	1000	1000	1000	600[2)]	600[1)]	800	600[1)]	1 x 60 x 10	1 x 60 x 10
Sace E 3	1250	1250	1250	1250	1250	1250	600[2)]	600[1)]	800	600[1)]	2 x 60 x 10	2 x 60 x 10
Sace E 3	1600	1600	1600	1440	1600	1440	600[2)]	600[1)]	800	600[1)]	2 x 60 x 10	2 x 60 x 10
Sace E 3	2000	2000	1800	1600	1800	1600	600[2)]	600[1)]	800	600[1)]	2 x 100 x 10	2 x 100 x 10
Sace E 3	2500	2500	2031	1641	2031	1800	600[2)]	600[1)]	800	600[1)]	2 x 100 x 10	2 x 100 x 10
Sace E 3	3200	3200	2600	2100	2600	2100	600[2)]	600[1)]	800	600[1)]	3 x 100 x 10	3 x 100 x 10
Sace E 4	3200	3040	2560	2240	2560	2240	800	600[1)]	1000	600[1)]	3 x 100 x 10	3 x 100 x 10
Sace E 4	4000	3600	2800	2400	2800	2400	800	600[1)]	1000	600[1)]	3 x 120 x 10	3 x 120 x 10

1) For the switch version as static installation variant, a minimum compartment height of 800 mm must be observed due to safety clearances.
2) When connecting to a Flat-PLS busbar system, a minimum enclosure width of 800 mm is required.

Table 30: Rated currents I_{nc} for air circuit-breakers – Eaton

Brand	Eaton											
Type	I_n air circuit-breaker	Rated current I_{nc} with consideration of protection category and cooling					Minimum compartment dimensions				Connection cross-section, connection kits	
		Forced ventilation			Forced ventilation		3-pole version		4-pole version			
		IP 2X	IP 2X	IP 43	IP 54	IP 54	Width	Height	Width	Height	Top	Bottom
	A	A	A	A	A	A	mm	mm	mm	mm	mm	mm
IZM 20	800	800	800	800	800	800	600	800	600[1)]	800	1 x 60 x 10	1 x 60 x 10
IZM 20	1000	1000	1000	1000	1000	1000	600	800	600[1)]	800	1 x 60 x 10	1 x 60 x 10
IZM 20	1250	1250	1250	1250	1250	1250	600	800	600[1)]	800	2 x 60 x 10	2 x 60 x 10
IZM 20	1600	1600	1600	1600	1600	1600	600	800	600[1)]	800	2 x 60 x 10	2 x 60 x 10
IZM 20	2000	1900	1800	1600	1600	1600	600	800	600[1)]	800	3 x 60 x 10	3 x 60 x 10
IZM 32	800	800	800	800	800	800	600	800	800	800	1 x 60 x 10	1 x 60 x 10
IZM 32	1000	1000	1000	1000	1000	1000	600	800	800	800	1 x 60 x 10	1 x 60 x 10
IZM 32	1250	1250	1250	1250	1250	1250	600	800	800	800	2 x 60 x 10	2 x 60 x 10
IZM 32	1600	1600	1600	1600	1600	1600	600	800	800	800	2 x 60 x 10	2 x 60 x 10
IZM 32	2000	1900	1800	1600	1600	1600	600	800	800	800	3 x 60 x 10	3 x 60 x 10
IZM 32	2500	2375	2250	2000	2000	2000	600[1)]	800	800	800	2 x 100 x 10	2 x 100 x 10
IZM 32	3200	2650	3200	2560	2560	2048	600[1)]	800	800	800	3 x 100 x 10	3 x 100 x 10

1) When connecting to a Flat-PLS busbar system, a minimum enclosure width of 800 mm is required.

Table 31: Rated currents I_{nc} for air circuit-breakers – Mitsubishi

Brand	**Mitsubishi**											
Type	I_n air circuit-breaker	Rated current I_{nc} with consideration of protection category and cooling					Minimum compartment dimensions				Connection cross-section, connection kits	
		Forced ventilation			Forced ventilation		3-pole version		4-pole version			
		IP 2X	IP 2X	IP 43	IP 54	IP 54	Width	Height	Width	Height	Top	Bottom
	A	A	A	A	A	A	mm	mm	mm	mm	mm	mm
AE1000	1000	1000	1000	1000	1000	1000	600	600[1)]	600	600[1)]	1 x 60 x 10	1 x 60 x 10
AE1250	1250	1250	1250	1250	1250	1250	600	600[1)]	600	600[1)]	2 x 60 x 10	2 x 60 x 10
AE1600	1600	1600	1600	1600	1600	1600	600	600[1)]	600	600[1)]	2 x 60 x 10	2 x 60 x 10
AE2000	2000	2000	1900	1600	1600	1600	600[2)]	600[1)]	800	600[1)]	3 x 60 x 10	3 x 60 x 10
AE2500	2500	2500	2375	2000	2000	2000	600[2)]	600[1)]	800	600[1)]	3 x 100 x 10	3 x 100 x 10
AE3200	3200	3110	2880	2560	2560	1950	600[2)]	600[1)]	800	600[1)]	3 x 100 x 10	3 x 100 x 10

[1)] For the switch version as rack-mounted variant, a minimum compartment height of 800 mm must be observed due to safety clearances.
[2)] When connecting to a Flat-PLS busbar system, a minimum enclosure width of 800 mm is required.

Table 32: Rated currents I_{nc} for air circuit-breakers – Schneider Electric

Brand	**Schneider Electric**											
Type	I_n air circuit-breaker	Rated current I_{nc} with consideration of protection category and cooling					Minimum compartment dimensions				Connection cross-section, connection kits	
		Forced ventilation			Forced ventilation		3-pole version		4-pole version			
		IP 2X	IP 2X	IP 43	IP 54	IP 54	Width	Height	Width	Height	Top	Bottom
	A	A	A	A	A	A	mm	mm	mm	mm	mm	mm
NW08	800	800	800	800	800	800	600	600	800	600	1 x 60 x 10	1 x 60 x 10
NW10	1000	1000	950	850	950	850	600	600	800	600	2 x 60 x 10	1 x 60 x 10
NW12	1250	1250	1130	770	1130	770	600	600	800	600	2 x 60 x 10	2 x 60 x 10
NW16	1600	1600	1520	1120	1280	1120	600	600	800	600	2 x 60 x 10	2 x 60 x 10
NW20	2000	1900	1720	1600	1900	1700	600	600	800	600	2 x 80 x 10	1 x 60 x 10
NW25	2500	2500	2150	1900	2150	1900	600[1)]	600	800	600	2 x 100 x 10	2 x 60 x 10
NW32	3200	3200	2500	2180	2500	2180	600[1)]	600	800	600	3 x 100 x 10	2 x 60 x 10
NW40	4000	3400	3120	2000	3120	1920	800	600	1000	600	3 x 120 x 10	3 x 60 x 10
NW40b	4000	4000	3320	3010	3320	3010	1000	600	1200	600	2 x 3 x 80 x 10	2 x 3 x 80 x 10

[1)] When connecting to a Flat-PLS busbar system, a minimum enclosure width of 800 mm is required.

Table 33: Rated currents I_{nc} for air circuit-breakers – Siemens

Brand	Siemens											
Type	I_n air circuit-breaker	Rated current I_{nc} with consideration of protection category and cooling					Minimum compartment dimensions				Connection cross-section, connection kits	
		Forced ventilation			Forced ventilation		3-pole version		4-pole version			
		IP 2X	IP 2X	IP 43	IP 54	IP 54	Width	Height	Width	Height	Top	Bottom
	A	A	A	A	A	A	mm	mm	mm	mm	mm	mm
3WL11	630	630	630	630	630	630	600	600	600	600	1 x 60 x 10	1 x 60 x 10
3WL11	800	800	800	720	800	720	600	600	600	600	1 x 60 x 10	1 x 60 x 10
3WL11	1000	1000	1000	850	1000	850	600	600	600	600	1 x 60 x 10	1 x 60 x 10
3WL11	1250	1250	1250	1000	1250	1000	600	600	600	600	2 x 60 x 10	2 x 60 x 10
3WL11	1600	1540	1360	1232	1360	1232	600	600	600	600	2 x 60 x 10	2 x 60 x 10
3WL11	2000	[2]	[2]	[2]	[2]	[2]	600	600	600	600	3 x 60 x 10	3 x 60 x 10
3WL12	800	800	800	624	800	624	600[1]	600	800	600	1 x 60 x 10	1 x 60 x 10
3WL12	1000	1000	1000	780	1000	777	600[1]	600	800	600	1 x 60 x 10	1 x 60 x 10
3WL12	1250	1250	1250	975	1250	975	600[1]	600	800	600	2 x 60 x 10	2 x 60 x 10
3WL12	1600	1540	1520	1248	1520	1232	600[1]	600	800	600	2 x 60 x 10	2 x 60 x 10
3WL12	2000	1965	1900	1560	1900	1574	600[1]	600	800	600	3 x 60 x 10	3 x 60 x 10
3WL12	2500	2500	2325	1950	2375	1950	600[1]	600	800	600	3 x 100 x 10	3 x 100 x 10
3WL12	3200	2912	3040	2496	2784	2112	600[1]	600	800	600	3 x 100 x 10	3 x 100 x 10
3WL13	4000	4000	3400	2720	3760	2600	800	600	1000	600	3 x 120 x 10	3 x 120 x 10

[1] When connecting to a Flat-PLS busbar system, a minimum enclosure width of 800 mm is required.
[2] Values on request.

Table 34: Rated currents I_{nc} for air circuit-breakers – Terasaki

Brand	Terasaki											
Type	I_n air circuit-breaker	Rated current I_{nc} with consideration of protection category and cooling					Minimum compartment dimensions				Connection cross-section, connection kits	
		Forced ventilation			Forced ventilation		3-pole version		4-pole version			
		IP 2X	IP 2X	IP 43	IP 54	IP 54	Width	Height	Width	Height	Top	Bottom
	A	A	A	A	A	A	mm	mm	mm	mm	mm	mm
AR208S	800	800	720	520	720	520	600	600	600	600	1 x 60 x 10	1 x 60 x 10
AR212S	1250	1250	1125	815	1125	815	600	600	600	600	2 x 60 x 10	2 x 60 x 10
AR216	1600	1600	1440	1040	1440	1040	600	600	600	600	2 x 60 x 10	2 x 60 x 10
AR220	2000	2000	1700	1300	1700	1300	600	600	600	600	3 x 60 x 10	3 x 60 x 10
AR316H	1600	1600	1440	1040	1440	1040	600	600	800	600	2 x 60 x 10	2 x 60 x 10
AR320H	2000	2000	1700	1300	1700	1300	600	600	800	600	3 x 60 x 10	3 x 60 x 10
AR325	2500	2500	2125	1625	2125	1625	600[1]	600	800	600	2 x 100 x 10	2 x 100 x 10
AR332	3200	3200	2720	2080	2560	2080	600[1]	600	800	600	3 x 100 x 10	3 x 100 x 10

[1] When connecting to a Flat-PLS busbar system, a minimum enclosure width of 800 mm is required.

Rated currents I_{nc} for moulded-case circuit-breakers MCCB

Table 35: Rated currents I_{nc} for moulded-case circuit-breakers ABB

Brand	ABB										
Type	I_n circuit-breaker	Rated current I_{nc} with consideration of protection category and cooling					Minimum compartment dimensions				Minimum connection cross-section
		Forced ventilation			Forced ventilation		3-pole version		4-pole version		
		IP 2X	IP 2X	IP 43	IP 54	IP 54	Width	Height	Width	Height	Top
	A	A	A	A	A	A	mm	mm	mm	mm	mm^2
Tmax T1	16	14	14	14	14	14	400	150	400	150	2.5
Tmax T1	20	18	17	17	18	17	400	150	400	150	4
Tmax T1	25	23	22	22	23	22	400	150	400	150	6
Tmax T1	32	29	28	28	29	28	400	150	400	150	6
Tmax T1	40	36	35	35	36	35	400	150	400	150	10
Tmax T1	50	45	44	44	45	44	400	150	400	150	10
Tmax T1	63	57	55	55	57	55	400	150	400	150	16
Tmax T1	80	72	70	70	72	70	400	150	400	150	25
Tmax T1	100	90	87	87	90	87	400	150	400	150	30
Tmax T1	125	113	109	109	113	109	400	200	400	200	50
Tmax T1	160	144	139	139	144	139	400	250	400	250	70
Tmax T2	1	1	1	1	1	1	400	150	400	150	1.5
Tmax T2	1.6	1	1	1	1	1	400	150	400	150	1.5
Tmax T2	2	2	2	2	2	2	400	150	400	150	1.5
Tmax T2	2.5	2	2	2	2	2	400	150	400	150	1.5
Tmax T2	3.2	3	3	3	3	3	400	150	400	150	1.5
Tmax T2	4	4	3	3	4	3	400	150	400	150	1.5
Tmax T2	5	5	4	4	5	4	400	150	400	150	1.5
Tmax T2	6.3	6	6	6	6	6	400	150	400	150	1.5
Tmax T2	8	7	7	7	7	7	400	150	400	150	1.5
Tmax T2	10	9	9	9	9	9	400	150	400	150	1.5
Tmax T2	12.5	11	11	11	11	11	400	150	400	150	2.5
Tmax T2	16	14	14	14	14	14	400	150	400	150	2.5
Tmax T2	20	18	17	17	18	17	400	150	400	150	4
Tmax T2	25	23	22	22	23	22	400	150	400	150	4
Tmax T2	32	29	28	28	29	28	400	150	400	150	6
Tmax T2	40	36	35	35	36	35	400	150	400	150	10
Tmax T2	50	45	44	44	45	44	400	150	400	150	10
Tmax T2	63	57	55	55	57	55	400	150	400	150	16
Tmax T2	80	72	70	70	72	70	400	150	400	150	25
Tmax T2	100	90	87	87	90	87	400	150	400	150	35
Tmax T2	125	113	109	109	113	109	400	200	400	200	50
Tmax T2	160	144	139	139	144	139	400	300	400	300	95
Tmax T3	63	57	55	55	57	55	400	200	400	200	16
Tmax T3	80	72	70	70	72	70	400	200	400	200	25
Tmax T3	100	90	87	87	90	87	400	200	400	200	35
Tmax T3	125	113	109	109	113	109	400	200	400	200	50
Tmax T3	160	144	139	139	144	139	400	200	400	200	70
Tmax T3	200	182	174	174	182	174	400	250	400	250	95
Tmax T3	250	228	218	218	228	218	600	300	600	300	120
Tmax T4	20	18	17	17	18	17	600	200	600	200	4
Tmax T4	32	29	28	28	29	28	600	200	600	200	6
Tmax T4	50	45	44	44	45	44	600	200	600	200	10
Tmax T4	80	72	70	70	72	70	600	200	600	200	25
Tmax T4	100	90	87	87	90	87	600	200	600	200	35
Tmax T4	125	113	109	109	113	109	600	200	600	200	50
Tmax T4	160	144	139	139	144	139	600	200	600	200	70
Tmax T4	200	182	174	174	182	174	600	200	600	200	95
Tmax T4	250	228	218	218	228	218	600	250	600	250	120

Table 35: Rated currents I_{nc} for moulded-case circuit-breakers ABB

Brand	ABB										
Type	I_n circuit-breaker	Rated current I_{nc} with consideration of protection category and cooling					Minimum compartment dimensions				Minimum connection cross-section
		Forced ventilation			Forced ventilation		3-pole version		4-pole version		
		IP 2X	IP 2X	IP 43	IP 54	IP 54	Width	Height	Width	Height	Top
	A	A	A	A	A	A	mm	mm	mm	mm	mm^2
Tmax T4	320	291	278	278	291	278	600	300	600	300	150
Tmax T5	320	291	278	278	291	278	600	200	600	200	240
Tmax T5	400	368	356	356	368	356	600	300	600	300	2 x 150
Tmax T5	500	450	400	400	450	400	600	300	600	300	2 x 185
Tmax T5	630	567	504	504	567	504	600	300	600	300	2 x 240
Tmax T6	630	567	504	504	567	504	600	300	600	300	1 x 40 x 10
Tmax T6	800	720	640	640	640	640	400	600	600	600	2 x 50 x 10
Tmax T6	1000	900	800	800	800	800	400	600	600	600	2 x 50 x 10
Tmax T7	400	368	356	356	368	356	600	300	600	300	1 x 50 x 10
Tmax T7	630	567	504	504	567	504	600	300	600	300	1 x 50 x 10
Tmax T7	800	720	640	640	640	640	400	600	400	600	2 x 50 x 10
Tmax T7	1000	900	800	800	800	800	400	600	400	600	2 x 50 x 10
Tmax T7	1250	1125	1000	1000	1000	1000	400	600	400	600	2 x 50 x 10
Tmax T7	1600	1440	1280	1280	1440	1280	400	600	400	600	2 x 50 x 10

Table 36: Rated currents I_{nc} for moulded-case circuit-breakers Eaton

Brand	Eaton										
Type	I_n circuit-breaker	Rated current I_{nc} with consideration of protection category and cooling					Minimum compartment dimensions				Minimum connection cross-section
		Forced ventilation			Forced ventilation		3-pole version		4-pole version		
		IP 2X	IP 2X	IP 43	IP 54	IP 54	Width	Height	Width	Height	Top
	A	A	A	A	A	A	mm	mm	mm	mm	mm²
NZM..1	20	18	17	17	18	17	400	150	400	200	4
NZM..1	25	23	22	22	23	22	400	150	400	200	4
NZM..1	32	29	28	28	29	28	400	150	400	200	6
NZM..1	40	36	35	35	36	35	400	150	400	200	10
NZM..1	50	45	44	44	45	44	400	150	400	200	10
NZM..1	63	57	55	55	57	55	400	150	400	200	16
NZM..1	80	72	70	70	72	70	400	150	400	200	25
NZM..1	100	90	87	87	90	87	400	150	400	200	35
NZM..1	125	113	109	109	113	109	400	200	400	200	50
NZM..1	160	144	139	139	144	139	400	200	400	250	95
NZM..2	160	144	139	139	144	139	400	150	400	200	70
NZM..2	200	182	174	174	182	174	400	150	400	200	95
NZM..2	250	228	218	218	228	218	600	200	600	300	150
NZM..2	300	273	261	261	273	261	600	300	600	300	240
NZM..3	320	291	278	278	291	278	600	200	800	250	240
NZM..3	350	322	312	312	322	312	600	300	–	–	2 x 150
NZM..3	400	368	356	356	368	356	600	300	600	600	2 x 150
NZM..3	450	405	360	360	405	360	600	600	–	–	2 x 185
NZM..3	500	450	400	400	450	400	600	600	600	600	2 x 185
NZM..3	550	495	440	440	495	440	600	600	–	–	2 x 185
NZM..3	630	567	504	504	567	504	600	600	600	600	2 x 240
NZM..4	800	720	640	640	640	640	400	600	400	600	1 x 50 x 10
NZM..4	875	788	700	700	700	700	400	600	400	600	1 x 50 x 10
NZM..4	1000	900	800	800	800	800	400	600	400	600	1 x 50 x 10
NZM..4	1250	1125	1000	1000	1000	1000	400	600	400	600	2 x 50 x 10
NZM..4	1400	1260	1120	1120	1260	1120	400	600	–	–	2 x 50 x 10
NZM..4	1600	1440	1280	1280	1440	1280	400	600	400	600	2 x 50 x 10

Table 37: Rated currents I_{nc} for moulded-case circuit-breakers Mitsubishi

Brand	Mitsubishi										
Type	I_n circuit-breaker	Rated current I_{nc} with consideration of protection category and cooling					Minimum compartment dimensions				Minimum connection cross-section
		Forced ventilation			Forced ventilation		3-pole version		4-pole version		
		IP 2X	IP 2X	IP 43	IP 54	IP 54	Width	Height	Width	Height	Top
	A	A	A	A	A	A	mm	mm	mm	mm	mm^2
NF1000-SEW	1000	900	800	800	800	800	600	600	600	600	2 x 60 x 10
NF1250-SEW	1250	1125	1000	1000	1000	1000	600	600	600	600	2 x 60 x 10
NF125-HGW RE	32	29	28	28	29	28	400	200	400	200	6
NF125-HGW RE	63	57	55	55	57	55	400	200	400	200	16
NF125-HGW RE	100	90	87	87	90	87	400	200	400	200	35
NF125-HGW RE	125	113	109	109	113	109	400	200	400	200	50
NF125-HGW RT	25	23	22	22	23	22	400	200	400	200	4
NF125-HGW RT	40	36	35	35	36	35	400	200	400	200	10
NF125-HGW RT	63	57	55	55	57	55	400	200	400	200	16
NF125-HGW RT	100	90	87	87	90	87	400	200	400	200	35
NF125-HGW RT	125	113	109	109	113	109	400	200	400	200	50
NF125-HGW RT	25	23	22	22	23	22	600	200	600	200	4
NF125-HGW RT	40	36	35	35	36	35	600	200	600	200	10
NF125-HGW RT	63	57	55	55	57	55	600	200	600	200	16
NF125-HGW RT	100	90	87	87	90	87	600	200	600	200	50
NF125-SGW RE	32	29	28	28	29	28	400	200	400	200	6
NF125-SGW RE	63	57	55	55	57	55	400	200	400	200	16
NF125-SGW RE	100	90	87	87	90	87	400	200	400	200	35
NF125-SGW RE	125	113	109	109	113	109	400	200	400	200	50
NF125-SGW RT	25	23	22	22	23	22	400	150	400	200	4
NF125-SGW RT	40	36	35	35	36	35	400	150	400	200	10
NF125-SGW RT	63	57	55	55	57	55	400	150	400	200	16
NF125-SGW RT	100	90	87	87	90	87	400	200	400	200	35
NF125-SGW RT	125	113	109	109	113	109	400	200	400	200	50
NF125-UGW RT	25	23	22	22	23	22	400	200	400	200	4
NF125-UGW RT	40	36	35	35	36	35	400	200	400	200	10
NF125-UGW RT	63	57	55	55	57	55	400	200	400	200	16
NF125-UGW RT	100	90	87	87	90	87	400	200	400	200	35
NF1600-SEW	1600	1440	1280	1280	1440	1280	600	600	600	600	3 x 60 x 10
NF160-HGW RE	160	144	139	139	144	139	400	200	400	200	95
NF160-HGW RT	160	144	139	139	144	139	400	200	400	200	95
NF160-SGW RE	160	144	139	139	144	139	400	200	400	200	95
NF160-SGW RT	160	144	139	139	144	139	400	200	400	200	95
NF250-HGW RE	250	228	196	196	228	218	600	300	600	300	150
NF250-RGW RT	160	144	139	139	144	139	600	300	600	300	95
NF250-RGW RT	225	205	196	196	205	196	600	300	600	300	150
NF250-SGW RE	160	144	139	139	144	139	600	200	600	200	95
NF250-SGW RE	250	228	218	218	228	218	600	300	600	300	150
NF250-SGW RT	160	144	139	139	144	139	400	200	400	200	95
NF250-SGW RT	250	228	218	218	228	218	600	300	600	300	150
NF250-UGW RT	160	144	139	139	144	139	600	300	600	300	95
NF250-UGW RT	225	205	196	196	205	196	600	300	600	300	150
NF32-SW	3	3	3	3	3	3	400	150	400	150	1.5
NF32-SW	4	4	3	3	4	3	400	150	400	150	1.5
NF32-SW	6	6	5	5	5	5	400	150	400	150	1.5
NF32-SW	10	9	9	9	9	9	400	150	400	150	1.5

Table 37: Rated currents I_{nc} for moulded-case circuit-breakers Mitsubishi

Brand	Mitsubishi										
Type	I_n circuit-breaker	Rated current I_{nc} with consideration of protection category and cooling					Minimum compartment dimensions				Minimum connection cross-section
		Forced ventilation			Forced ventilation		3-pole version		4-pole version		
		IP 2X	IP 2X	IP 43	IP 54	IP 54	Width	Height	Width	Height	Top
	A	A	A	A	A	A	mm	mm	mm	mm	mm^2
NF32-SW	16	14	14	14	14	14	400	150	400	150	2.5
NF32-SW	20	18	17	17	18	17	400	150	400	150	2.5
NF32-SW	25	23	22	22	23	22	400	150	400	150	4
NF32-SW	32	29	28	28	29	28	400	150	400	150	6
NF400-HEW	400	368	356	356	368	356	600	300	600	300	2 x 150
NF400-REW	400	368	356	356	368	356	600	300	600	300	2 x 150
NF400-SEW	400	368	356	356	368	356	600	300	600	300	2 x 150
NF400-UEW	400	368	356	356	368	356	600	600	800	600	2 x 150
NF63	3	3	3	3	3	3	400	150	400	150	1.5
NF63	4	4	3	3	4	3	400	150	400	150	1.5
NF63	6	5	5	5	5	5	400	150	400	150	1.5
NF63	10	9	9	9	9	9	400	150	400	150	1.5
NF63	16	14	14	14	14	14	400	150	400	150	2.5
NF63	20	18	17	17	18	17	400	150	400	150	4
NF63	25	23	22	22	23	22	400	150	400	150	6
NF63	32	29	28	28	29	28	400	150	400	150	6
NF63	40	36	35	35	36	35	400	150	400	150	10
NF63	50	45	44	44	45	44	400	150	400	150	10
NF63	63	57	55	55	57	55	400	150	400	150	16
NF630....	630	567	504	498	567	504	600	600	600	600	2 x 240
NF800-UEW	800	720	640	640	640	640	600	600	600	600	50 x 10

Table 38: Rated currents I_{nc} for moulded-case circuit-breakers Schneider Electric

Brand	**Schneider Electric**										
Type	I_n circuit-breaker	Rated current I_{nc} with consideration of protection category and cooling					Minimum compartment dimensions				Minimum connection cross-section
		Forced ventilation			Forced ventilation		3-pole version		4-pole version		
		IP 2X	IP 2X	IP 43	IP 54	IP 54	Width	Height	Width	Height	Top
	A	A	A	A	A	A	mm	mm	mm	mm	mm^2
NSX100	16	14	14	14	14	14	400	150	400	200	2.5
NSX100	25	23	22	22	23	22	400	150	400	200	4
NSX100	32	29	28	28	29	28	400	150	400	200	6
NSX100	40	36	35	35	36	35	400	150	400	200	10
NSX100	50	45	44	44	45	44	400	150	400	200	10
NSX100	63	57	55	55	57	55	400	150	400	200	16
NSX100	80	72	70	70	72	70	400	150	400	200	25
NSX100	100	90	87	87	90	87	400	150	400	200	50
NSX160	80	72	70	70	72	70	400	200	400	300	35
NSX160	100	90	87	87	90	87	400	200	400	300	50
NSX160	125	113	109	109	113	109	400	200	400	300	70
NSX160	160	144	139	139	144	139	400	200	400	300	95
NSX250	125	113	109	109	113	109	400	300	400	300	70
NSX250	160	144	139	139	144	139	400	300	400	300	95
NSX250	200	182	174	174	182	174	400	300	400	300	120
NSX250	250	228	218	218	228	218	600	300	600	300	150
NSX400	400	368	356	356	368	356	600	300	600	300	2 x 150
NSX630	630	567	504	498	567	504	600	400	600	400	2 x 150

Table 39: Rated currents I_{nc} for moulded-case circuit-breakers Siemens

Brand	Siemens										
Type	I_n circuit-breaker	Rated current I_{nc} with consideration of protection category and cooling					Minimum compartment dimensions				Minimum connection cross-section
		Forced ventilation			Forced ventilation		3-pole version		4-pole version		
		IP 2X	IP 2X	IP 43	IP 54	IP 54	Width	Height	Width	Height	Top
	A	A	A	A	A	A	mm	mm	mm	mm	mm^2
VL160 H	20	18	17	17	18	17	400	200	400	200	4
VL160 H	25	23	22	22	23	22	400	200	400	200	6
VL160 H	32	29	28	28	29	28	400	200	400	200	6
VL160 H	40	36	35	35	36	35	400	200	400	200	10
VL160 H	50	45	44	44	45	44	400	200	400	200	10
VL160 H	63	57	55	55	57	55	400	200	400	200	16
VL160 H	80	72	70	70	72	70	400	200	400	200	25
VL160 H	100	90	87	87	90	87	400	200	400	200	35
VL160 H	125	113	109	109	113	109	400	300	400	300	70
VL160 H	160	144	139	139	144	139	400	300	400	300	95
VL160X	16	14	14	14	14	14	400	200	400	200	2.5
VL160X	20	18	17	17	18	17	400	200	400	200	4
VL160X	25	23	22	22	23	22	400	200	400	200	6
VL160X	32	29	28	28	29	28	400	200	400	200	6
VL160X	40	36	35	35	36	35	400	200	400	200	10
VL160X	50	45	44	44	45	44	400	200	400	200	10
VL160X	63	57	55	55	57	55	400	200	400	200	16
VL160X	80	72	70	70	72	70	400	200	400	200	25
VL160X	100	90	87	87	90	87	400	200	400	200	35
VL160X	125	113	109	109	113	109	400	300	400	300	6
VL160X	160	144	139	139	144	139	400	300	400	300	95
VL250	80	72	70	70	72	70	400	200	400	300	25
VL250	100	90	87	87	90	87	400	200	400	300	35
VL250	125	113	109	109	113	109	400	300	400	300	50
VL250	160	144	139	139	144	139	400	300	400	300	95
VL250	200	182	174	174	182	174	400	300	400	300	120
VL250	250	228	218	218	228	218	600	300	600	300	185
VL400	160	144	139	139	144	139	600	300	600	300	95
VL400	200	182	174	174	182	174	600	300	600	300	120
VL400	250	228	218	218	228	218	600	300	600	300	185
VL400	315	287	274	274	287	274	600	400	600	400	240
VL630	250	228	218	218	228	218	600	300	600	400	240
VL630	315	287	274	274	287	274	600	300	600	400	240
VL630	400	368	356	356	368	356	600	300	600	400	2 x 150
VL630	500	450	400	395	450	400	600	400	600	400	2 x 185
VL630	630	567	504	498	567	504	600	400	600	400	2 x 185

Table 40: Rated currents I_{nc} for moulded-case circuit-breakers Terasaki

Brand	Terasaki										
Type	I_n circuit-breaker	Rated current I_{nc} with consideration of protection category and cooling					Minimum compartment dimensions				Minimum connection cross-section
		Forced ventilation			Forced ventilation		3-pole version		4-pole version		
		IP 2X	IP 2X	IP 43	IP 54	IP 54	Width	Height	Width	Height	Top
	A	A	A	A	A	A	mm	mm	mm	mm	mm²
125	20	18	17	17	18	17	400	150	400	200	4
125	32	29	28	28	29	28	400	150	400	200	6
125	50	45	44	44	45	44	400	150	400	200	10
125	63	57	55	55	57	55	400	150	400	200	16
125	100	90	87	87	90	87	400	200	400	200	35
125	125	113	109	109	113	109	400	300	400	300	50
250	20	18	17	17	18	17	400	200	400	200	4
250	32	29	28	28	29	28	400	200	400	200	6
250	50	45	44	44	45	44	400	200	400	200	10
250	63	57	55	55	57	55	400	200	400	200	16
250	100	90	87	87	90	87	400	200	400	200	35
250	125	113	109	109	113	109	400	200	400	200	50
250	160	144	139	139	144	139	400	200	400	200	95
250	200	182	174	174	182	174	400	300	400	300	120
250	250	228	218	218	228	218	600	300	600	300	185
400	250	228	218	218	228	218	600	300	600	300	150
400	400	368	356	356	368	356	600	600	600	600	2 x 150
630	630	567	504	498	567	504	600	600	600	600	2 x 240
800	630	567	504	498	567	504	600	600	600	600	2 x 185
800	800	640	640	640	640	640	600	600	600	600	2 x 300

Busbar rated currents

The admissible rated operating currents I_{nc} of the usable busbar systems have been tested with the following values, with due regard for the enclosure, the installation situation inside the enclosure, the protection category and cooling. Based on the extended test conditions compared with the test conditions in DIN 43 671 (busbars laid in free air), this produces rated values that deviate from standard DIN 43 671.

Table 41: Busbar rated currents RiLine60

Rated AC currents of RiLine60 busbar system up to 60 Hz for uncoated copper bars (E-Cu F30) in A										
Busbar system	Ri4Power DIN 43 671 in free air	Protection category of enclosure								
		IP 2X with forced ventilation[1)]		IP 2X		IP 43		IP 54 with forced ventilation[2)]		IP 54
	ΔT=30 °K	ΔT=30 °K	ΔT=70 °K	ΔT=30 °K	ΔT=70 °K	ΔT=30 °K	ΔT=70 °K	ΔT=30 °K	ΔT=70 °K	ΔT=30 °K	ΔT=70 °K
RiLine60 30 x 5 mm	379	415	650	370	580	350	550	370	580	325	510
RiLine60 30 x 10 mm	573	635	1000	575	900	550	860	575	900	510	800
RiLine60 PLS 1600	1368[3)]	1020	1600	895	1400	830	1300	895	1400	735	1150

Table 42: Rated busbar currents Maxi-PLS

Rated AC currents of Maxi-PLS busbar system up to 60 Hz for uncoated copper bars in A											
Busbar system	Ri4Power DIN 43 671[3)] in free air	Protection category of enclosure									
		IP 2X with forced ventilation[1)]		IP 2X		IP 43		IP 54 with forced ventilation[2)]		IP 54	
	ΔT=30 °K	ΔT=30 °K	ΔT=70 °K	ΔT=30 °K	ΔT=70 °K	ΔT=30 °K	ΔT=70 °K	ΔT=30 °K	ΔT=70 °K	ΔT=30 °K	ΔT=70 °K
Maxi-PLS 1600	1480	1145	1800	1020	1600	925	1450	1050	1650	890	1400
Maxi-PLS 2000	1700	1590	2500	1275	2000	1180	1850	1335	2100	1145	1800
Maxi-PLS 3200	2300	2550	4000	1910	3000	1850	2900	1910	3000	1780	2800

1) For I_n < = 2000 A using fan-and-filter unit SK 3243.100,
for I_n > = 2000 A using fan-and-filter unit SK 3244.100.
2) For I_n < = 2000 A using fan-and-filter unit SK 3243.100 and outlet filter SK 3243.200,
for I_n > = 2000 A using fan-and-filter unit SK 3244.100 and outlet filter SK 3243.200.
3) Tested on the basis of DIN 43 671.

Table 43: Rated busbar currents Flat-PLS

Rated AC currents of Flat-PLS busbar systems up to 60 Hz for uncoated copper bars (E-Cu F30) in A											
Busbar system	Ri4Power DIN 43 671 in free air	Protection category of enclosure									
		IP 2X with forced ventilation[1)]		IP 2X		IP 43		IP 54 with forced ventilation[2)]		IP 54	
	ΔT=30 °K	ΔT=30 °K	ΔT=70 °K	ΔT=30 °K	ΔT=70 °K	ΔT=30 °K	ΔT=70 °K	ΔT=30 °K	ΔT=70 °K	ΔT=30 °K	ΔT=70 °K
2 x 40 x 10 mm	1290	1780	2640	1180	1900	1080	1720	1680	2440	1040	1640
3 x 40 x 10 mm	1770	2240	3320	1420	2320	1280	2040	1980	2960	1200	1920
4 x 40 x 10 mm	2280	2300	3340	1460	2380	1320	2100	2080	3020	1260	2000
2 x 50 x 10 mm	1510	2200	3260	1340	2140	1200	1920	1980	2920	1140	1800
3 x 50 x 10 mm	2040	2660	3900	1580	2540	1400	2240	2320	3440	1320	2100
4 x 50 x 10 mm	2600	2700	4040	1640	2660	1440	2340	2360	3500	1380	2220
2 x 60 x 10 mm	1720	2220	3340	1440	2300	1280	2060	2020	2940	1200	1920
3 x 60 x 10 mm	2300	2700	4120	1720	2440	1540	2280	2400	3520	1440	2260
4 x 60 x 10 mm	2900	2740	4220	1740	2840	1580	2540	2420	3580	1460	2360
2 x 80 x 10 mm	2110	2760	4160	1740	2840	1600	2560	2540	3720	1480	2360
3 x 80 x 10 mm	2790	3300	5060	2000	3260	1840	2960	3060	4520	1680	2700
4 x 80 x 10 mm	3450	3680	5300	2060	3440	1900	3060	3220	4880	1780	2820
2 x100 x 10 mm	2480	3240	4840	1920	3200	1800	2880	2900	4340	1660	2660
3 x100 x 10 mm	3260	3650	5400	2200	3720	1980	3240	3320	4880	1920	2980
4 x100 x 10 mm	3980	4020	5500	2320	3820	2000	3400	3380	4900	1960	3120

1) For I_n < = 2000 A using fan-and-filter unit SK 3243.100,
for I_n > = 2000 A using fan-and-filter unit SK 3244.100.
2) For I_n < = 2000 A using fan-and-filter unit SK 3243.100 and outlet filter SK 3243.200,
for I_n > = 2000 A using fan-and-filter unit SK 3244.100 and outlet filter SK 3243.200.

In accordance with IEC/EN 61 439-1 the ambient temperature is defined as 35 °C (average), or a short-term maximum of 40 °C. If different absolute temperature requirements apply to the system under construction, this may be interpolated using the correction factor diagrams to DIN 43 671 within the admissible temperature increase (max. ΔT = 70 °K), or up to a maximum absolute busbar temperature of 105 °C (see Internet, technical details for Catalogue 33, page 153). Requirements above and beyond the cited temperatures by request only.

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RITTAL GmbH & Co. KG
Postfach 1662 · D-35726 Herborn
Phone +49(0)2772 505-0 · Fax +49(0)2772 505-2319
E-mail: info@rittal.de · www.rittal.com

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