

## General notes

Wöhner busbar systems and components are the result of expert development based on many years of experience. They have been exhaustively tested and hold many approvals. The correct selection of busbars and components is the responsibility of a system's planner.

Planning, construction requirements and the required test certifications are prescribed in the parts of the IEC or DIN EN 61439 standard "Low-voltage switchgear and control-gear assemblies".

To avoid hazards to people and materials which can arise when working with electricity, these systems and components should only be used by suitably trained personnel, and relevant regulations must be observed.

In particular, installation, maintenance, modifications and additions must only be carried out by qualified personnel in accordance with the general construction and safety regulations applicable to high-current electrical systems. Modern technological developments and the way in which

Provide further separation of this line from the paragraph above.

Detailed technical information is available on the internet at: [www.woehner.com](http://www.woehner.com)

the components of the system interact must be taken into account. It is essential that all accessible parts are electrically isolated during installation and maintenance.

All connections must be correctly tightened with the specified torque (Md), correct gauges must be used and components that provide protection against accidental contact with live parts must be fitted. After transportation, all connections must be checked and, if necessary, re-tightened.

Products are to be used and operated correctly in the manner intended.

The technical information contained in the product manual and the installation instructions should be observed and retained for future modifications, maintenance or additions to the installation. Wöhner reserves the right to make modifications to its components, as the result of developments and technical advances.

## Operating conditions

Unless special instructions are given, the information contained in the documentation applies for the recommended mounting position and the ambient conditions of indoor installation (contamination level 3; 2 in exceptional cases) according to IEC 61439-1/2/3.

Plant-specific reduction factors must be considered, depending on the exact conditions of use.

The rated loading factors listed below represent guide values and refer to a maximum +35°C temperature of the air directly surrounding the products.

Number of main circuits	Rated diversity factor	
	to IEC/EN 61439-2	to IEC/EN 61439-2
2 and 3	0.9	0.8
4 and 5	0.8	0.7
6 to 9 inclusive	0.7	0.6
10 and more	0.6	0.5

IEC 61439

Part 2: Power switchgear and controlgear assemblies

Part 3: Installation distributor for operation by lay people

In products intended to hold fuse links, please observe the requirements governing connected cross-sections from the relevant product standards. Comply with the stated temperature specifications of all plastics used. Some of the material properties described here refers to several products.

In isolated cases, values may exceed the levels stated.

See [www.woehner.com](http://www.woehner.com) for further information.

We recommend vertically mounting the device on a horizontal busbar system. The fixing handle must be placed on top for switchgears mounted vertically. For this mounting position, the rated diversity factors contained in Table 1 or Table 101 apply to components with permitted dissipation in the worst-case scenario and with ambient conditions in conformity with IEC/EN 61439-2/3, section 7.1.1.1.

In case of deviating mounting positions and conditions, all influencing factors are on maximum temperature such as:

- Power output per fuse and the device in operation,
  - Simultaneous full and partial load cycles,
  - Alignment in the system, devices affecting each other,
  - Busbar cross-section, conductor cross-section,
  - Ambient temperature, current conditions, require the observation of additional correction factors
- by additional correction factors.

Mounting positions are prohibited where gravity and the contact direction of motion are opposed.

Air and creepage distances must be calculated in compliance with EN 60664-1 (VDE 0110 part 1). For values of 12mm and greater, these requirements are automatically satisfied up to 690V AC in compliance with IEC. Additional specifications, such as the minimum distance to earthed parts, must be observed. This is especially relevant for applications in compliance with UL.

Detrimental effects from chemical substances during storage, processing and operation must be prevented.

In order to ease the locking of the busbar components and the insertion of the NH fuse units, the spring clips will be lubricated with special grease during manufacturing.

On other parts, especially on screw threads, it must be ensured that no supplementary change of the friction coefficient takes place.

### Conductor connections

Specifications regarding conductor terminals are only valid for copper conductors. The maintenance-free resistance to ageing for selected connections has been verified by testing.

If the standards-compliant connection of aluminium conductors has been confirmed for connection terminals, this is stated expressly.

Before connecting aluminium conductors, any oxide deposits must be removed from the conductor surfaces and further oxidation prevented.

After removal of the oxide deposit, chips and abrasives cannot be permitted to damage the contacting.

Multiwire conductors should be shortened and exposed to the bare metallic conductor section.

The contact points are to be sealed (e.g. using acid-free contact grease) so that they airtight to protect them against further oxidation.

The terminal points need to be checked, taking operating conditions into account.

For normal ambient conditions and loads, we recommend inspections at 6-month intervals. In case of unfavourable operating conditions or frequent temperature fluctuations at the terminal points, a shorter interval may be necessary. It is possible to place temperature measuring strips and a record of the maximum values in the immediate vicinity of the terminal points, which may be useful for an objective assessment during regular tests.

All contact positions are suitable for connecting one conductor, unless expressly otherwise indicated. Double-function terminals are characterised by 2 contact positions.

In principle, the tightening torques specified on the device, the installation instructions or on the Internet are to be applied. Where no limits are specified, the tolerance on the tightening torque  $M_d$  of screw and clamp connections may be a maximum of +/-20% of the nominal value.

The relationship between conductor cross-sections in mm<sup>2</sup> and AWG / MCM sizes are subsequently listed:

0.75mm <sup>2</sup>	18 AWG	(0.82mm <sup>2</sup> )
1.5mm <sup>2</sup>	16 AWG	(1.3mm <sup>2</sup> )
2.5mm <sup>2</sup>	14 AWG	(2.1mm <sup>2</sup> )
4mm <sup>2</sup>	12 AWG	(3.3mm <sup>2</sup> )
6mm <sup>2</sup>	10 AWG	(5.3mm <sup>2</sup> )
10mm <sup>2</sup>	8 AWG	(8.4mm <sup>2</sup> )
16mm <sup>2</sup>	6 AWG	(13.3mm <sup>2</sup> )
25mm <sup>2</sup>	4 AWG	(21.2mm <sup>2</sup> )
35mm <sup>2</sup>	2 AWG	(33.6mm <sup>2</sup> )
50mm <sup>2</sup>	0 AWG	(53.5mm <sup>2</sup> )
70mm <sup>2</sup>	2/0 AWG	(67.4mm <sup>2</sup> )
95mm <sup>2</sup>	3/0 AWG	(85.0mm <sup>2</sup> )
120mm <sup>2</sup>	250 MCM	(127mm <sup>2</sup> )
150mm <sup>2</sup>	300 MCM	(152mm <sup>2</sup> )
185mm <sup>2</sup>	350 MCM	(177mm <sup>2</sup> )
240mm <sup>2</sup>	500 MCM	(253mm <sup>2</sup> )
300mm <sup>2</sup>	600 MCM	(304mm <sup>2</sup> )

Conductor types are designated as follows:

	Abbreviation	Standard name
solid round	sol(r)	Class 1 (IEC/EN 60228)
stranded round	s(r)	Class 2 (IEC/EN 60228)
solid sectored	sol(s)	Class 1 (IEC/EN 60228)
stranded sectored	s(s)	Class 2 (IEC/EN 60228)
flexible	f	Class 5 (IEC/EN 60228)
stranded	str	Class B (UL 486E)

The following abbreviations are also used:

laminated flexible	
copper busbar	fl. Cu
wire-end ferrules	AE

Wire-end ferrules are only permitted for applications in compliance with IEC/EN standards. Wöhner has tested the use of wire end ferrules. This does not result in a general approval for different ferrules and crimping methods. The maximum conductor cross-sections may need to be reduced.

Lead connections are to be set up with consideration given to the requirements as per IEC/EN 60999-1 or -2.

Lead connections set-up is to be such that no tension load and – with respect to the application – no alternating bending load develop.

## Notes for the dimensioning of AC string collectors

When AC string collectors are used, a few strings supply one inverter. The power of several string inverters is pooled on the alternating current side, e.g. via a 60mm busbar system.

When dimensioning components for a busbar system of this kind, the direction of the energy – which is inverted to that of industrial applications – is unimportant. The same types of fuse (gG) are also used. It is the cables and leads going to the inverter that have to be protected from overload and short circuit. However, the rated diversity factor of the switchgear and the simultaneity factor of this application (= 1) do not match.

If, for example, a SECUR® 60Classic, PowerLiner is equipped with 35A-D02 fuses in a power distribution unit, the switchgear device will be able to carry its nominal current of 35A continuously on its own. However, this value must be reduced through thermal interaction with neighbouring devices.

The standard takes account of this situation by means of a switchgear assembly's rated diversity factor (RDF). This states the factor of the rated current to which all power circuits of a power distribution unit in a switchgear assembly can be permanently and simultaneously subjected. Here, the values from the table on page 8/1 apply, in accordance with IEC 61439-2:2011 and IEC 61439-3:2011.

At any rate, care must be taken to ensure that the rated diversity factor is always based on the fuse that is used, not the rated current of the switch disconnecter or fuse holder. Furthermore, the use of fuse links with silver-plated contacts is recommended. The size of the copper conductors is determined on the basis of the applicable product standard, e.g. IEC/EN 60947-3 for SECUR® 60Classic, PowerLiner.

For the above example, this means that from 10 devices or more, the SECUR® 60Classic, PowerLiner (rated current 63A) with side-mounted module and 35A fuse links may be operated at 21A maximum. Here, the rated current of the fuse is reduced to 60%. If the maximum current of the inverter does not exceed this value, and if fuse protection at 35A is permitted by the wiring and the inverter datasheet, the dimensions are correct.

If higher power ratings with correspondingly higher currents need to be pooled, there are two choices for adaptation:

With the right lead dimensions, the nominal current of the fuse links can be increased. However, this must fit in with the requirements for inverter fuse protection. Thus, in this example the use of a 50A fuse permits a maximum current of 30A.

Alternatively, the thermal influence of the switchgear is reduced by modifying the layout. With the SECUR® 60Classic, PowerLiner fuse switch disconnecter, in a test with 6 power circuits, a distance equal to the width of two devices (54mm) between the switchgear devices increased the rated diversity factor from 0.7 to 0.9. This is only possible because the distance considerably reduces the thermal influence of the fuse links. Based on the example with the 35A fuse, the new arrangement would enable an inverter current of 31A.

The rated diversity factors must always be selected in conformity with the application of the switch fuse unit, in accordance with IEC 61439-2 or IEC 61439-3. See table on page 8/1. Non-compliance with these reduction factors leads to unacceptably high temperatures in switchgear assemblies. This may in turn result in damaged or incorrectly triggered switchgear devices. Both fuse links and cable insulation age when exposed to high temperatures. In all cases, failures in photovoltaic systems can be expected.

For the correct design and layout of cables and leads, accumulation – as well as the ambient temperature – need to be taken into consideration. Here too, mutual thermal influence leads to raised temperatures and so to lower permitted currents. It is important to consider size and the corresponding factors. If the leads to the inverters in the AC string collector are routed in a cable duct (routing method F), and ambient temperatures of 50°C are anticipated there, when 6 conductors are used the permitted current capacity slashed to less than 50% of the nominal current.

When cables and fuses have the correct dimensions, they also produce less dissipation, and therefore less waste heat. This in turn facilitates cabinet selection or thermal management.

**Note on operating NH fuse switch disconnectors and NH in-line fuse switch disconnectors**

NH fuses are only intended for use by authorized electricians or trained electrical personnel, see IEC 60269-2. When switching devices observe the following instructions:

- Operation (release, switching on, switching off and fuse replacement) only permitted for authorized electricians or trained electrical personnel in accordance with VDE 0105-100.

- Quick activation of fuse cover using the relevant operating handle.
- Before switching on, care must be taken that the fuse cover is mounted or guided exactly into the open position.
- If the cover is only partially open, the fuse links may still be energized. Only open and close the cover using the handle.

**Using busbars**

To ensure that single and multi-pole busbar components are securely mounted and contacts are firmly connected, the busbars in question must comply with the required tolerances shown here.

- Tensile strength: min. 300N/mm<sup>2</sup>
- Permitted tolerances:
- Radius R 0.3 ... 0.7
- Width: + 0.1 / - 0.5
- Thickness: + 0.1 / - 0.1
- Centre distance:
- + 0.5 / - 0.5 (60mm system)
- + 1.0 / - 1.0 (100mm system, 185mm system)
- Deviation in the contact level: 0.4

**Using comb-type busbars**

A range of Wöhner fuse holders and switches are suitable for use with comb-type busbars. We recommend that you used the comb-type busbars listed on the corresponding pages in the current Wöhner catalogue (IEC/EN 61439-1/2, level of soiling: 2).

Ensure that the required air and creepage distances left in standard installation positions are observed (comb-type busbars are angled towards the operator). Power must be supplied via the connection terminals sold separately by Wöhner. The additional connection terminal is not required for Wöhner products with double-function terminals. Connect terminals using the maximum torque stated on the fuse holder.

**Processing and using plastic profiles**

The mechanical, thermal and electric properties of the profiles, which are listed in the Wöhner catalogue, are optimised for covering busbars or busbar systems and bottom troughs. Take particular care when mechanically processing the profiles to avoid the formation of cracks (narrow saw blade, high speed of cutting, low tooth advance and strong saw guiding).

The cutting of profiles with a cap circular saw and an AKE circular saw blade for plastics is reliable with the following specific values:  
D = 300mm, B = 2.2mm, Z = 120W  
with 5° negative tooth change (w),  
cutting speed of 50 - 65m/s,  
tooth feed 0.05 - 0.1mm.  
The plastic parts must be fixed in order to exclude vibrations.

When processing and using plastic profiles, contact with oil, grease and other chemicals must be avoided.

## Dimensions

All lengths are given in millimetres, unless otherwise stated.

Mounting rails of adapters and clip-on fixings generally comply with EN 60715.

## CE marking

In association with the 2006/95/ EG low voltage directive, Wöhner products are subject to the CE marking commitment.

The CE mark is applied to the individual packing units. Even some of the products are marked accordingly. In doing so, Wöhner confirms that the products comply with the valid regulations.

Wöhner holds the corresponding conformity declarations.

## Additional requirements for compliance with UL



Components that have also been tested for feeder circuits up to 600V AC in compliance with UL 508A are labelled in the approval overview.

## ROHS, WEEE and REACH

Currently, Wöhner products do not come under the scope of ROHS Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment, or WEEE Directive 2002/96/EG governing waste electrical and electronic equipment.

Irrespective of these directives, measures have been initiated, which ensure that the use of pollutant-free plastics complies with the ROHS Directive.

The metallic surface coatings shall correspond to the substance ban in accordance with the ROHS Directive.

Fuse links may contain function-specific components which do not comply with the ROHS Directive.

According to current knowledge, there are no substances in our products or their packaging with a concentration above 0.1 percent by mass, in accordance with the candidate list (as of 16.06.2014), article 59 (1, 10) of Regulation (EC) no. 1907/2006 ("REACH").

We are in constant contact with our suppliers as regards substances subject to registration and information relevant to REACH is forwarded without delay to our customers.

You will find further information in the download area under Service at [www.woehner.com](http://www.woehner.com)