

General technical notes

Useful tips from planning through to installation

As a system planner, you bear the responsibility for the correct selection of solutions and components. The IEC standard and the DIN EN 61439 "Low-voltage switchgear and controlgear assemblies" standard support you here. They stipulate the planning and construction requirements, as well as the necessary design verifications. The essential prerequisites are, of course, professional handling of equipment and observance of the rules in force. Only in this way can hazards to persons and property be avoided when they are dealing with electrical energy. In particular, installation, maintenance work, modifications and retrofitting may only be carried out by qualified personnel and in compliance with the general installation and safety regulations for work on power installations.

Our promise

Connections in the panel have to satisfy numerous rules and conditions. Whether installing terminal strips and terminal blocks or using aluminium conductors – we provide you with useful tips that make your work easier.

Operating conditions

The specifications contained in the documentation apply, insofar as no separate stipulations apply, for the recommended installation position and for environmental conditions in the case of indoor installation (pollution severity 3, in exceptional cases 2) in accordance with IEC 60439-1 and IEC 61439-1/2/3. The user has to refer to the manufacturer for special operating conditions deviating from this standard! You have to provide for installation-specific reduction factors depending on the actual operating conditions. The load factors listed in the table below constitute guidelines.

Number of main circuits	Rated load factor	
	acc. to IEC 61439-2	acc. to IEC 61439-3
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: Distribution boards intended to be operated by ordinary persons

What you have to observe for installation

In the case of products containing cartridge fuses, you have to follow the specifications from the associated product standards with regard to the wire cross-sections to be connected. The specified temperature resistance of the plastics used has to be observed.

Here, we recommend installing the products vertically on horizontal terminal rail systems. The rated load factors in the table are applicable for this installation position and also for components with permissible power losses. This also pertains to the environmental conditions in accordance with IEC 60439-1, section 6.1.1.1 and IEC 61439-2/3, section 7.1.1.1.

And what if the conditions deviate

In case of a deviation in the installation position and operating conditions, you have to consider all the factors influencing the maximum temperature. These include, for example:

- Power output of the cartridge fuses and the devices in operation
- Timings, full and partial load, concurrency
- Arrangement in the system, mutual interaction between the devices
- Rail cross-section, conductor cross-section
- Ambient temperature, flow conditions, ventilation and cooling through additional correction factors

Installation positions are inadmissible in which gravity works against the direction of contact movement. Clearance and creepage distances have to be measured in accordance with IEC 60664-1 (VDE 0110 Part 1). Above 12 mm, all IEC requirements are met up to 690 V AC. You also have to consider further factors, such as minimum distances to grounded parts. This particularly applies for UL applications. You also need to avoid the harmful influences of chemical substances during storage, processing and operation.

CE marking

Our products are subject to mandatory CE-marking in conjunction with Low Voltage Directive 73/23/EEC, as amended by Directive 2014/35/EU. We have affixed the CE mark on the individual packing units and partly on the products themselves. We hereby confirm to you that our products comply with the applicable regulations. We would be pleased to provide you with the relevant declarations of conformity at our company.

RoHS Directive

The restriction on lead and five further potentially hazardous substances used in electrical and electronic equipment is defined by the EU RoHS Directive. You will find more information at:

www.weidmueller.com/rohs

REACH Regulation

The European chemical regulation REACH stands for the Registration, Evaluation, Authorisation and restriction of Chemicals. You will find current information at:

www.weidmueller.com/reach

Our tips for you

It always has to be ensured that ...

- all accessible parts are deactivated during installation and maintenance work
- connections are made with the prescribed torque, suitable fitted parts are used and parts are completely installed for touch-safe protection
- connections are checked and, if necessary, tightened after transportation
- the products are used and operated according to the intended purpose
- the technical description in the product manual and the installation instructions are observed and the documents are kept accessible for subsequent maintenance work, modifications and retrofitting
- modifications that serve for advancement and technical progress are reserved

Mounting of terminal strips

Always a secure connection

Terminal strips are used for quick installation of cables and conductors. They are the interface from the panel to the outside world. Below, you will find some useful tips, information and binding rules to support you in mounting terminal strips.

Combinations of different terminal blocks

In case of a contour change, you have to use end plates and partition plates (WAP/TW, ZAP/TW and IAP). If terminal blocks with different rated voltages are arranged next to one another, you need end plates or partition plates (WAP/TW, ZAP/TW). Good to know: when arranging the PE terminal block next to, or between the associated feed-through terminals blocks of the same series and size, the rated voltage and the rated impulse voltage of the feed-through terminal blocks are not influenced.

Dimensions

The dimension of the housing enclosing the terminal blocks and fastening components is specified, but without tolerances. Please consider a mounting tolerance of 0.2 mm to the specified terminal width in your project design.

Partition plate

You use a partition plate for visual separation of circuits or for electrical isolation from neighbouring cross-connectors.

Small partition

In the case of terminal blocks, up to a terminal width of max. 12 mm, you can retroactively insert small partitions between cross-connections or sockets.

Compliance with the rated insulation voltage

We specify the required stripping length for all our products in mm. These lengths, e.g. $6\text{ mm} \pm 0.5\text{ mm}$, $\geq 10\text{ mm} \pm 1\text{ mm}$ are absolutely binding. This is also the case if you use wire-end ferrules. IEC 60947-1 applies for the outside dimension of crimped wire-end ferrules.

Working on electrical connectors with non-insulated screwdrivers

The following five rules apply for working on electrical systems and equipment with non-insulated screwdrivers:

- Disconnect the electrical systems
- Prevent from being switched back on
- Ascertain absence of voltage
- Earth and short-circuit
- Cover or block off neighbouring parts under voltage

Tightening torque range for clamping screws

The test torque according to IEC 60947-1 or the torque according to the manufacturer's specifications is the lower value of the torque range. With this, all tests are passed. The upper value of the torque range is the maximum torque that may be applied.

Preferably set the electrical torque screwdriver to the midpoint torque of the terminal torque range. We have assigned product-specific data directly to the respective products.

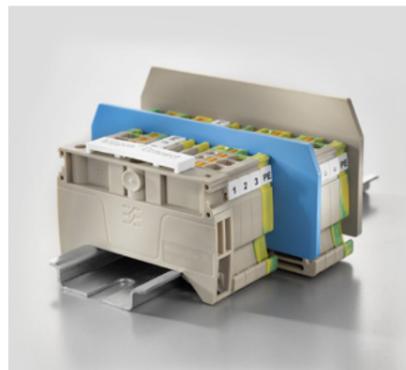
Tightening the clamping screw in the specified torque ranges ensures:

- Reliable and gas-tight clamping
- No mechanical destruction of the clamping yokes
- Voltage drop well below the required limit value

End bracket at the beginning and end of the terminal strip



Partition plates improve the overview



Troubleshooting with bipolar voltage tester incl. measurement probe according to IEC 61243-3



Please find the individual measures to be taken in consideration of the operational and local conditions, for example high voltage and low voltage lines, cables or switchgear systems, in VDE 0105 Part 100.

Unused contact points under voltage

Protect unused contact points that may be live against inadvertent touching by using suitable covers, such as ADP 1 to 4. The clamping screws of unused contact points that are not live must also be tightened.

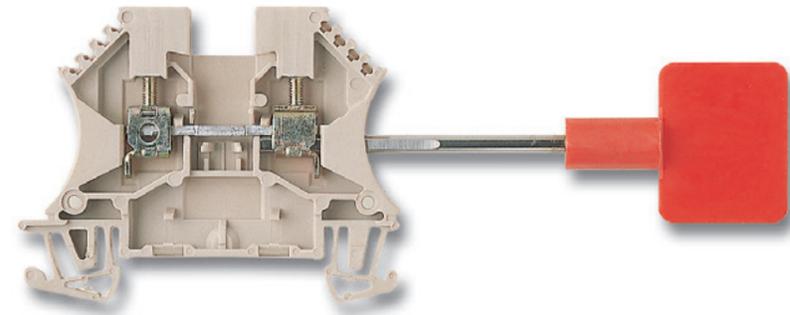
Our installation tips for you

- The terminal strip structure is from left to right
- Place the closed side to the left, the open side to the right
- Always close the open side of the terminal strip with end plates or separation plates (WAP/TW, ZAP/TW)
- End brackets have to be placed at the beginning and end of a terminal strip

Connecting terminal blocks

With the right torque

The right torque is a decisive factor in professional connection of terminal blocks in order to avoid damage to the electrical systems. Therefore, always apply the tightening torque specified in the installation instructions or on the Internet for the product.



Unless limits are specified, the deviation of the tightening torque for screw and clamp connections may be a maximum of ± 20 percent of the rated value. If no range is specified for clamping cross-sections, the lower clamping range is

limited to two levels below the rated cross-section. Please find the relationships between the wire cross-sections in mm^2 and AWG/MCM sizes in the table below.

General technical data for conversion AWG* conductor to mm^2

AWG	mm^2
28	0.08
26	0.13
24	0.20
22	0.33
20	0.52
19	0.65
18	0.82
17	1.04
16	1.31
15	1.65
14	2.08
13	2.63
12	3.31
11	4.17
10	5.26
9	6.63
8	8.37
7	10.55
6	13.30
5	16.77
4	21.15
3	26.67
2	33.63
1	42.41
0	53.48

* AWG is the abbreviation for "American Wire Gauge".

Plug gauge according to IEC 60947-1: insertability of unprepared round conductors with the largest defined cross-section

Test with the defined gauge, insertion under own weight

Cable diameter		Gauge						
		Shape A			Shape B			
Flexible conductors mm^2	Solid conductors (one or more wires) mm^2	Designation	Diameter a mm	Width b mm	Designation	Diameter a mm	Permissible deviation for a and b mm	
1.5	1.5	A 1	2.4	1.5	B 1	1.9	0 - 0.05	
2.5	2.5	A 2	2.8	2.0	B 2	2.4		
2.5	4	A 3	2.8	2.4	B 3	2.7		
4	6	A 4	3.6	3.1	B 4	3.5	0 - 0.06	
6	10	A 5	4.3	4.0	B 5	4.4		
10	16	A 6	5.4	5.1	B 6	5.3		
16	25	A 7	7.1	6.3	B 7	6.9	0 - 0.07	
25	35	A 8	8.3	7.8	B 8	8.2		
35	50	A 9	10.2	9.2	B 9	10.0		
50	70	A 10	12.3	11.0	B 10	12.0	0 - 0.08	
70	95	A 11	14.2	13.1	B 11	14.0		
95	120	A 12	16.2	15.1	B 12	16.0		
120	150	A 13	18.2	17.0	B 13	18.0		

Approval of wire-end ferrules

Wire-end ferrules are only ever approved for applications according to IEC/EN standards. We tested examples for the application of wire-end ferrules; this does represent any form of general approval for different ferrule pressings. You may have to reduce the maximum wire cross-sections. Conductors have to be manufactured taking into consideration the requirements of IEC/EN 60999-1 and -2 and have to be configured such that there is no tensile loading.

Two conductors at a contact point

You achieve assignment to individual circuits, identification and division of individual functional units optimally by only connecting one conductor to each contact point. Terminal blocks with screw connection (W-Series) are available to you should two conductors of the same cross-section be connected to a contact point. The connection of two cables with screwless contact points is forbidden according to DIN IEC 60999-1. Connection of two conductors is possible in the tension-clamp system, however, by using twin wire-end ferrules.

Continuous current for two conductors

The total current of two conductors must not exceed the continuous current of the terminal block. The continuous current is the maximum current a terminal block can carry without exceeding a temperature increase of 45 K.

Rated voltage

The rated voltage of the terminal block does not change with the proper connection of two conductors.

Use of aluminium conductors

Very secure contact

Aluminium conductors have many advantages. However, various conditions must be met in order to achieve secure contact with these conductors. The specifications for the conductor connections for terminal blocks only apply for copper conductors. They do not apply to aluminium conductors.



Why is the use of aluminium conductors so attractive?

The use of aluminium conductors is becoming increasingly attractive, especially when conductors with cross-sections over 16 mm² are used. One advantage of aluminium as a wire material is its favourable price as compared with copper. Aluminium also weighs significantly less. This makes routing cables much easier.

Properties and physical influences of aluminium

The direct contact of aluminium as an electrical conductor is essentially determined by three physical influences:

- Exposure to oxygen immediately forms a non-conducting oxide layer on the surface of the aluminium conductor. The result is an increase in the contact resistance between the connection system and the aluminium conductor. In the worst case, this can lead to the terminal block catching fire.
- The conductivity of aluminium is one-third lower than that of copper. For this reason, the selection of the right cross-section should always be dependent on the maximum anticipated current. When using aluminium conductors, we therefore recommend always selecting one conductor size larger for the same current carrying capacity.
- Aluminium has a tendency to flow under mechanical pressure loading. This necessitates checking the specified torque prior to initial use and monitoring the torque applied after approx. 200 operating hours.

Professional processing and handling of aluminium conductors for direct connection

In order to ensure optimal connection of solid and sectional core aluminium conductors, the stripped end of the conductor must be cleaned of the oxide layer immediately by scraping, e.g. with a knife. Please note that no brushes, files or sandpaper may be used, as aluminium particles could be stuck and thus transferred to other conductors.

Immediately after removing the oxide layer, the end of the conductor has to be rubbed with neutral grease (for example with acid and alkali free vaseline) and connected in the terminal immediately. If the conductor has been disconnected and reconnected, the work steps have to be repeated.

Terminal blocks for aluminium conductors			
WDU 2.5	20 A	solid 2.5 mm ²	0.4 NM
WDU 4	27 A	solid 4 mm ²	0.5 NM
WDU 6	35 A	solid 6 mm ²	0.8 NM
WDU 10	48 A	solid and stranded with 10 mm ² wire-end	1.2 NM
WDU 16	50 A	solid "re" 16 mm ²	3.0 NM
WDU 35	60 A	solid 35 mm ²	4.0 NM
WDU 50N	118 A	solid and sector-shaped 50 mm ²	6.0 NM
WDU 70N	150 A	solid and sector-shaped 70 mm ²	12.0 NM
WDU 120	290 A	sector-shaped 150 mm ²	15.0 NM
WDU 240	415 A	solid and sector-shaped 240 mm ²	30.0 NM
WPD × 01 ...	152 A	25 mm ² solid, stranded and sector-shaped in acc. with IEC 61238-1	4 NM
WPD × 02 ...	202 A	35 mm ² solid, stranded and sector-shaped in acc. with IEC 61238-1	16 ² = 4.0 NM 25 ² = 6.0 NM 35 ² = 8.0 NM
WPD × 03 ...	300 A	70 mm ² solid, stranded and sector-shaped in acc. with IEC 61238-1	16 ² = 4.0 NM 25 ² = 6.0 NM 35 ² = 8.0 NM 50 ² = 10.0 NM 70 ² = 18.0 NM

In case of WDU 240, the manufacturer's specifications concerning current-carrying capacity of the aluminium conductor used have to be observed. This is usually well below 400 A.

Professional preparation and handling of aluminium conductors with indirect connection

Indirect connection of aluminium conductors is the safest choice. This can be enabled through the use of connecting elements, such as Al/Cu ring cable lugs or compression bolts. Nevertheless, the relevant manufacturer's specifications must also be observed here and the contact point checked according to the operating instructions.

For normal environmental conditions and load cases, we recommend checking at intervals of six months. With unfavourable operating conditions or frequent temperature changes at the contact points, a shorter interval may be necessary. Temperature measurement strips with storage of maximum values can be attached in the immediate vicinity of the contact points and may be useful for objective assessment with regular tests. All contact points are suitable for the connection of one conductor, unless noted otherwise.

Installation instructions for flat cable lugs

When tightening the terminals, it is recommended to apply a counter-force on the conductor to avoid deformation of the terminal rail and to keep the foot of the terminal free of torsion forces. Connection of stranded aluminium conductors to terminal blocks is achieved with the aid of an aluminium cable lug. This is selected according to the shape of the conductor and is connected to the cable lug manufacturer's specifications. Cu/Al washers are required at the junction of aluminium cable lugs to the terminal block current bar. Only then is a smooth transition from copper to aluminium ensured. They are fitted such that the copper side of the current bar and the aluminium side make contact with the aluminium cable lug.

