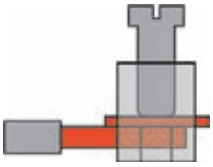
Technical appendix

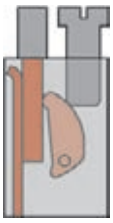
Technical appendix

The connection systems – it's your choice



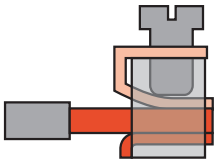
Clamping yoke

The **Weidmüller clamping yoke system** is an optimum combination of the specific properties of steel and copper. This clamping yoke system has proved its worth in billions of Weidmüller products over many decades. Both the clamping yoke and the clamping screw are made from hardened steel. This clamping yoke arrangement generates the necessary contact force. The clamping yoke presses the incoming conductor against a current bar made of copper or high-quality brass. The hardened Weidmüller clamping yoke ensures a gas-tight, vibration-resistant connection between conductor and current bar.



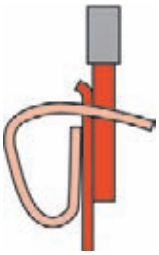
TOP connection

The Weidmüller **TOP connection system** ensures that the conductor can be inserted and the clamping screw tightened from the same direction. Such an arrangement eases the wiring work in certain installations, e.g. when there is little space at the sides in terminal boxes. The TOP connection system combines the specific properties of steel and copper. The hardened steel lever presses the conductor directly against a current bar made of copper or high-quality brass. The high contact force guarantees a gas-tight connection between conductor and current bar.



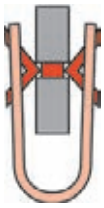
Leaf clamp connection

Weidmüller's patented **leaf clamp connection system** is a screw connection system for large conductor cross-sections. The insertion of large conductors into the clamping point is made easier here by the fact that the clamping unit can be removed first. The conductor can then be placed directly on the current bar before re-inserting the clamping unit and tightening the screw to grip the conductor.



Tension clamp connection

The **Weidmüller tension clamp system** functions similarly to the tried-and-tested clamping yoke. Here again, the mechanical and electrical functions are kept separate. The spring made from high-quality rustproof and acid-proof steel pulls the conductor against the tin-plated copper current bar. Treating the copper in this way ensures low contact resistance and high corrosion resistance. The compensating effect of the spring ensures a secure contact for the lifetime of the terminal.

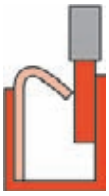


IDC system

The **IDC** (Insulation Displacement Connection) **system** is a type of connection for copper conductors that does not require the conductor to be prepared in any way – so no stripping and no crimping.
When connecting the conductor, the insulation of the conductor is penetrated and an electrically conductive contact between conductor and current bar produced at the same time.

The Weidmüller IDC principle, like Weidmüller's other types of connection, again keeps mechanical and electrical functions separate.

A spring made from rustproof stainless steel presses the current bar onto the conductor and therefore guarantees a low contact resistance and a gas-tight, vibration-resistant connection.



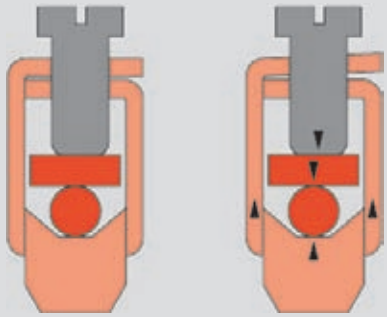
Push In system

In the **Push In system** the stripped solid conductor is simply inserted into the clamping point as far as it will go. And that completes the connection! No tools are required and the result is a reliable, vibration-resistant and gas-tight connection. Even flexible conductors with crimped wire end ferrules or ultrasonic-welded conductors can be connected without any problems. A stainless steel spring, which is fitted in a separate housing, guarantees a high contact force between the conductor and the current bar (tin-plated copper). The conductor pull-out force for this system is even higher than that for the tension clamp system. Spring stop plus conductor stop in a steel housing ensure optimum connection conditions and a guide for the screwdriver needed to detach the conductor.

The principle of vibration resistance

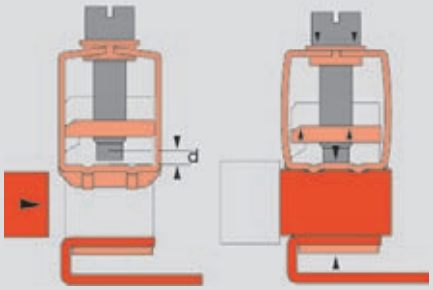
Clamping yoke connection

As the clamping screw is tightened, the ensuing force causes the upper threaded part to spring back and exert a locknut effect on the screw.
The Weidmüller clamping yoke system is vibration-resistant. The relaxation of the conductor is compensated for by the elastic behaviour of the Weidmüller clamping yoke.
It is therefore not necessary to retighten the clamping screw.



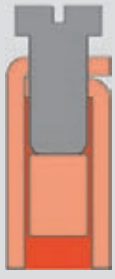
Leaf clamp connection

The distance “d” between the shaft of the clamping screw and the leaf clamp causes elastic deformation of the spring as the screw is tightened. The vibration resistance depends on the magnitude of the spring force of the leaf clamp, and this force also compensates for relaxation phenomena in the conductor.
It is therefore not necessary to retighten the clamping screw.



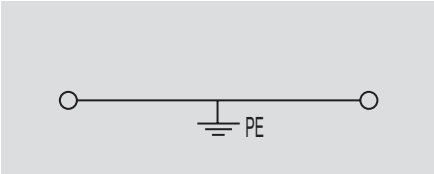
TOP connection

Like with the clamping yoke, the force exerted by the steel lever as the screw is tightened forces apart the two threaded parts of the TOP connection. This exerts a locking effect on the screw and guarantees excellent vibration resistance.



Definitions of the various types

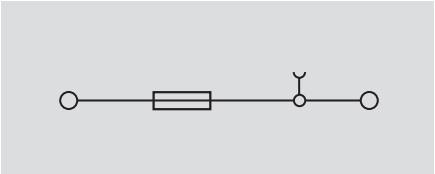
PE terminals



A PE terminal is a component with one or several clamping points for connecting and/or branching PE conductors (PE and PEN conductors) with a conductive connection to their mountings. Partly insulated PE terminals are insulated from adjacent live parts of terminals; the partial insulation is coloured green/yellow.

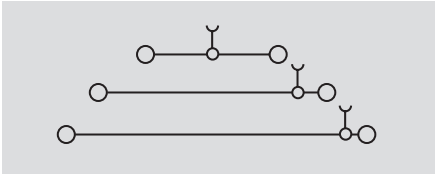
Applications (IEC 60947-7-2)
This standard applies to PE terminals with PE function up to 120 mm^2 and to PE terminals with PEN function for sizes upwards of 10 mm^2 with clamping points with or without screws for connecting round copper conductors with a cross-section between 0.2 and 120 mm^2 (AWG 24/250 kcmil) for circuits up to 1000 Vac 1000 Hz or up to 1500 Vdc. PE terminals are used to produce the electrical and mechanical connections between copper conductors and the mounting.

Fuse terminals



Fuse terminals consist of a terminal base and a cartridge fuse holder. In the case of fuse terminals for low-voltage cartridge fuses (D-system), the technical data are defined by IEC 60947-7-3 in conjunction with VDE 0636 part 301.
In the case of fuse terminals for device protection cartridge fuses, the technical data are defined by IEC 60947-7-3, which covers the range of applications of such products.
Fuse terminals for protecting devices are rated for a certain maximum power loss on the basis of IEC 60127-2, which covers G-type cartridge fuses.
The product pages contain details of the maximum power loss for individual or group arrangements for short-circuit and/or overload protection.

Multi-level distribution terminals

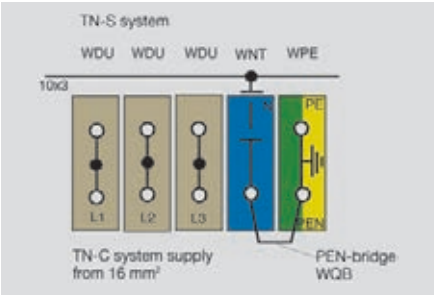


A multi-level distribution terminal is a unit with clamping points for connecting and/or linking phase, neutral and PE conductors to their mountings with a conductive PE connection. They have several connection levels, all isolated from each other.

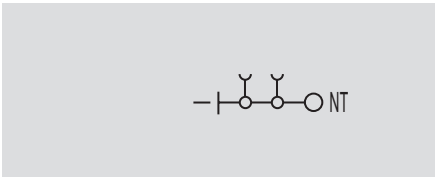
Applications IEC 60947-7-1 / IEC 60947-7-2
DIN VDE 0611-4 (partly)
These standards apply to multi-level distribution terminals with clamping points with/without screws for connecting or linking solid, stranded or flexible copper conductors. In distribution terminals, phase conductor and/or N and PE conductor connections are all realised in a compact space.
The N-conductor can be disconnected for insulation measurements; it is not used for disconnecting or switching.

PEN function
According to IEC 60947-7-2, only copper terminal rails may be used for the PEN function. Steel terminal rails may not be used.

Use of TS 35 x 15
In order to comply with the current-carrying ability required by IEC 60947-7-2, the TS 35 x 15 terminal rail must be used for PE terminals with a rated cross-section of 16 mm^2 and upwards.



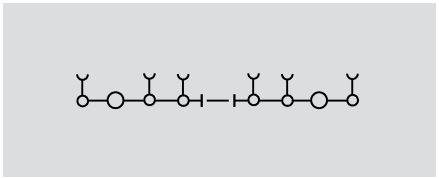
N-conductor disconnect terminals



An N-conductor disconnect terminal is a unit with clamping points for connecting and/or linking neutral conductors but with a detachable connection. These terminals can be fitted on next to each other to form terminal strips.

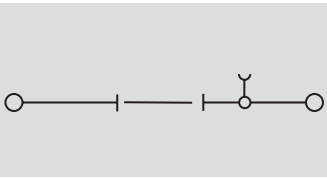
Rated voltages
IEC 60947-7-1
IEC 60947-1
The rated voltage given conforms to IEC 60947-7-1. It is the rated insulation voltage and is defined according to IEC 60947-1 or IEC 60947-7-1.
400 V applies to
phase conductor–phase conductor
250 V applies to
phase conductor–N-conductor
phase conductor–PE conductor
N-conductor–PE conductor

Disconnect test terminals



Disconnect test terminals are used for disconnecting circuits temporarily for measuring purposes in the off-load state. The rated voltage of the disconnect test terminal is the rated insulation voltage, and the insulation tests and creepage distances refer to this. The voltage is defined according to IEC 60664-1 and is marked on the terminal.
The opened disconnect point is dimensioned according to the associated rated impulse withstand voltage.

Disconnect terminals



Disconnect terminals are used for operational disconnection of circuits in the off-load state.
The rated voltage of the disconnect terminals is the rated insulation voltage, and the insulation tests and creepage distances refer to this. The voltage is defined according to IEC 60664-1.
The opened disconnect point is dimensioned according to the associated rated impulse withstand voltage for devices with disconnect function to DIN VDE 0100-537 and IEC 60947-7-1.
The disconnectors of the disconnect terminals are rated for off-load operation (service category AC20 to IEC 60947-1) and are used to isolate an installation or part thereof.

Insulating materials

In order to do justice to the most diverse requirements placed on our products, it is necessary to use different insulating materials tailored to the needs of the applications. None of the insulating materials used by Weidmüller contain any hazardous substances. Above all, the use of cadium-free materials is very high on our agenda. Furthermore, our insulating materials contain neither pigments based on heavy metals nor any substances that lead to the formation of dioxin or furan.

		Ceramics	Thermosetting plastics	
Plastic Abbreviation		**Ceramics**	**Gemin KrG**	**Epoxy resin EP**
		Ceramics are excellent materials for electrical engineering because they fulfil all the requirements. Ceramics are resistant to heat, fluids and sparks, and are tested for leakage currents. Thanks to their high mechanical strength, low losses and good heat resistance, these materials have a very high chemical stability and are preferred because of their very low wear.	Thermosetting plastics exhibit high dimensional stability, low water absorption, extremely good tracking resistance and excellent fire resistance. The continuous operating temperatures are higher than those of thermoplastics. At higher thermal loads the deformation resistance of thermosetting plastics is better than that of thermoplastics. The disadvantage in comparison with thermoplastics is the reduced flexibility of thermosetting plastics.	
		Insulating material	Melamine resin moulding compound, MF type 156 (DIN EN ISO 14 528) inorganic filler	Epoxy resin with inorganic filler
Colour		white	medium yellow	black
Description		highest continuous operating temperature high fire resistance fluids-repellent high tracking resistance inherently flame-retardant	high continuous operating temperature high fire resistance high tracking resistance inherently flame-retardant	very good electrical properties very high continuous operating temperature resistant to high-energy radiation halogen- and phosphor-free flame-retardant agent
Properties				
Specific volume resistance to IEC 93	Ω x cm	–	10^{11}	10^{14}
Electric strength to IEC 243-1	kV / mm	>10	10	160
Tracking resistance (A) to IEC 112	CTI	≥ 600	≥ 600	≥ 600
Upper max. permissible temperature	°C	250	130	160
Lower max. permissible temperature, static	°C	–60	–60	–60
Flamability class to UL 94		V-0 (5 V-B)	V-0 (5 V-A)	V-0
Fire behaviour to railway standard				

Thermoplastics

Wemid	Polyamide PA	Polyamide PG GF	Polybutylene-terephthalate PBT	Polycarbonate PC
Wemid is a modified thermoplastic whose properties have been specially devised to suit the requirements of Weidmüller connectors. The advantages in comparison with PA are the better fire protection and the higher continuous operating temperature. Wemid fulfils the strict requirements placed on applications for railway rolling stock to NF F 16-101.	**Polyamid (PA)** is one of the most common commercial plastics. The advantages of this material are its very good electrical and mechanical properties, its flexibility and resistance to breakage. Furthermore, owing to its chemical structure PA achieves good fire resistance even without the use of flame-retardant agents.	**Glass fibre-reinforced polyamide (PG GF)** offers excellent dimensional stability and very good mechanical properties. That makes this material ideal for use in end brackets. Compared with unreinforced PA, this material can achieve UL 94 flammability class HB.	**This thermoplastic polyester (PBT)** offers excellent dimensional stability (and is therefore ideal for plug-in connectors) and a high continuous operation temperature. But the tracking resistance is lower than other insulating materials.	
special Weidmüller insulating material	insulating material	insulating material	with or without glass fibre reinforcement depending on application	with or without glass fibre reinforcement depending on application
dark beige	beige	beige	orange	grey
higher continuous operating temperature improved fire resistance halogen- and phosphor-free flame-retardant agent low smoke development in fire certified for railway applications to NF F 16-101	flexible, virtually unbreakable good electrical and mechanical properties self-extinguishing behaviour	excellent dimensional stability very good mechanical properties	high dimensional stability good electrical and mechanical properties flame-retardant substances do not lead to the formation of dioxin or furan	high dimensional stability high continuous operating temperature high electrical insulation capacity halogen-free flame-retardant agent
10^{12}	10^{12}	10^{12}	10^{13}	10^{16}
25	30	30	28	≥ 30
600	600	500	200	≥ 175
120	100	100	115 / 130	115 / 125
–50	–50	–50	–50	–50
V-0	V-2	HB	V-0	V-2 / V-0
I2 / F2 *)				I2 / F2
*) also certified to LUL E 1042				

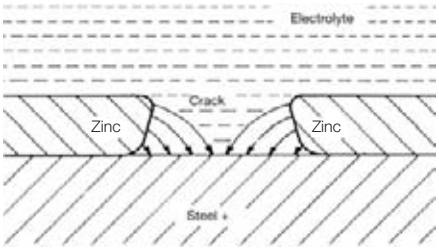
Metals

Only materials that have proved suitable for electrical engineering applications are used in Weidmüller products.
All materials are subjected to the rigorous quality control measures of a QM system certified to DIN EN ISO 9001.
Environmental compatibility plays a crucial role in the selection of materials.

The selection, processing and surface treatment of all the metals used by Weidmüller are carried out according to the latest technical standards.

Steels

Steel parts required to maintain the contact force permanently are electro-galvanised and treated with an additional passivation technique.
The surface protection conforms to the highest standards. Experience gained from laboratory tests has been incorporated into the design of the surface protection.
Zinc protects against corrosion for a long time even after the zinc coating has been partially damaged by scratches or pores. In the presence of an electrolyte, zinc acts as a cathode (i.e. negative) with respect to steel. The metal ions of the zinc migrate to the steel, which provides long-term protection for the parent metal.



Conductive materials

The current-carrying materials copper, brass and bronze are characterised by their high conductivity and good mechanical properties.
The surfaces are usually given a coating of tin, which creates an extremely good, “malleable” contact with a low contact resistance. Apart from ensuring consistently good electrical properties, the tin coating provides excellent protection against corrosion.
Solder connections are also given a coating of tin. In order to guarantee the long-term solderability (shelf life), brass parts are given an additional nickel coating as a diffusion barrier.
The nickel coating provides effective protection against the loss of zinc atoms from the brass.

Derating curve

The maximum current that a modular terminal can accommodate depends on:
- the temperature rise in the terminal
- the ambient temperature
- the cross-section of the conductor connected to the terminal

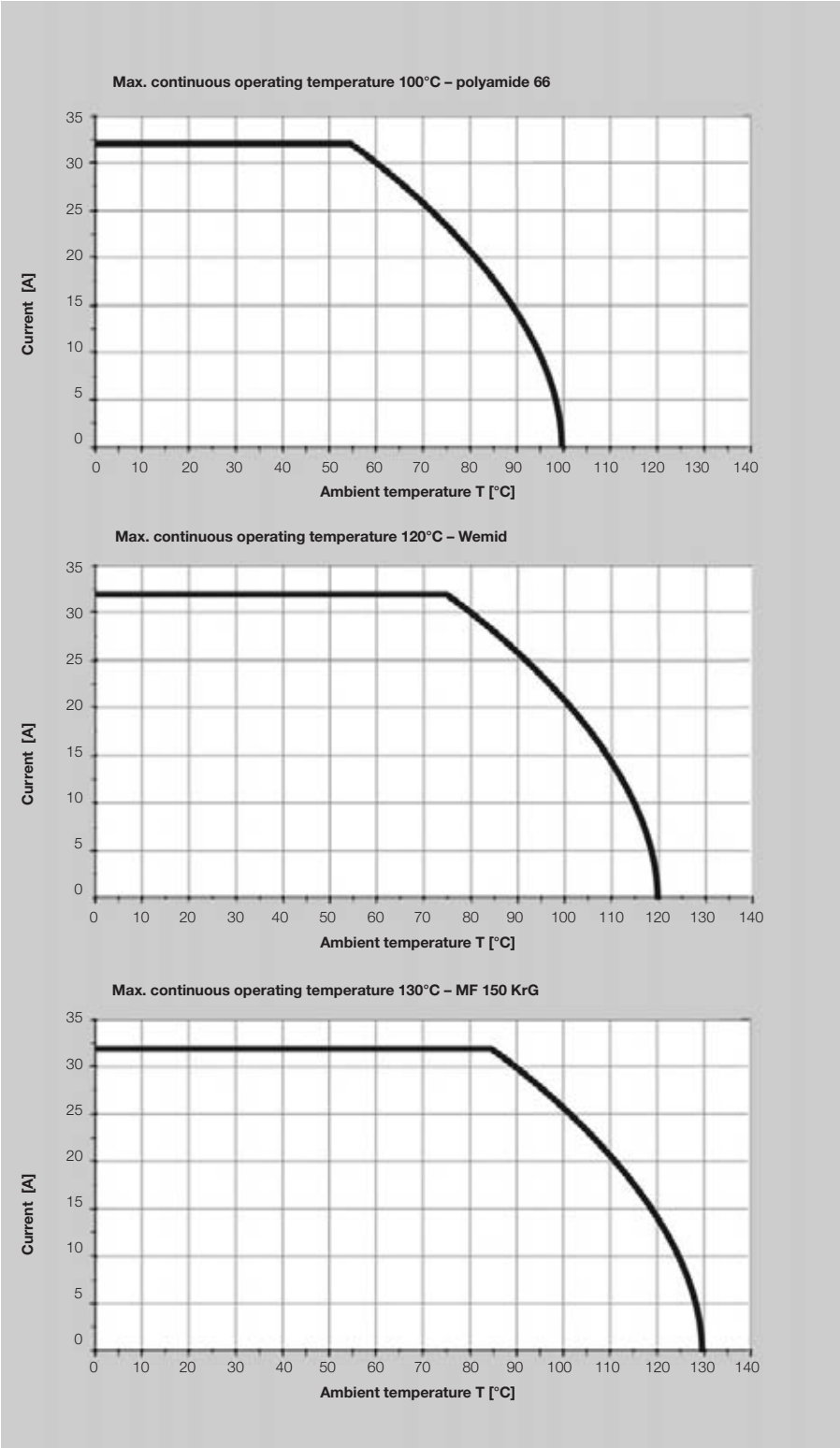
An upper limit temperature that may not be exceeded in continuous operation is specified for every Weidmüller modular terminal.
The continuous operating temperature depends on the insulating material used for the modular terminal. According to EN 60 947-7-1 the maximum permissible temperature rise of a modular terminal is 45 K.

The continuous operating temperature governed by the insulating material, reduced by the maximum permissible temperature rise in the terminal as given by EN 60 947-7-1, results in a maximum ambient temperature in which the modular terminal can be loaded with its rated current at least. The graphs on the right are typical current-temperature rise curves for a rated current of 32 A and the following three insulating materials:

- thermoplastic (polyamide 66)
- Wemid
- thermosetting plastic (MF 150 KrG)

Depending on the insulating material used, the rated current can be carried up to an ambient temperature of 55 °C for PA 66, 75 °C for the Weidmüller insulating material Wemid, or 85 °C for the thermosetting plastic insulating material (KrG). Above these temperature limits, the current should be reduced as shown on these graphs.

Derating curve



Standards, directives, terminology, CE marking

Modular terminals to VDE 0611-1

This standard was published in Germany in August 1992.
It corresponds with the following international standard (dating from 1989):
IEC 60947-7-1 Low-voltage switchgear and controlgear; Part 7: Ancillary equipment; Section one – terminal blocks for copper conductors.

CENELEC has ratified this standard at European level. Therefore, the standard is valid in the following countries:
Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom.
In conjunction with this and having an overriding importance:
IEC 60947-1
Low-voltage switchgear and controlgear;
Part 1: General Rules
EN 60947-1
VDE 0660 part 100
Low-voltage switchgear;
Part 1: General provisions

Applications
VDE 0611-1

(EN 60947-7-1)
(IEC 60947-7-1)
This standard specifies requirements for modular terminals with clamping points with or without screws which are primarily intended for industrial or similar applications and are mounted on a supporting rail that creates the electrical and mechanical connections between copper conductors. The standard is valid for modular terminals for connecting round copper conductors with a cross-section between 0.2 und 300 mm^2
(AWG 24/600 kcmil), for electric circuits up to 1000 V AC/1000 Hz or up to 1500 V DC.
Note:
This standard also serves as a guide for certain types of modular terminal, e.g. disconnect terminals, which are not covered by their own standards.

Modular terminal /
Modular feed-through terminal

An insulating component that supports one or more clamping arrangements insulated from one another and which is designed to be fixed to a supporting rail.

Rated cross-section

The rated cross-section of a modular terminal is the size – as specified by the manufacturer – of the conductor cross-section that can be connected to the terminal, on which certain thermal, mechanical and electrical requirements are based, and which is intrinsic to the marking on the terminal.
The rated cross-section is selected from the following standard cross-sections:
0.2 - 0.5 - 0.75 - 1.0 - 1.5 - 2.5 - 4.0 - 6.0 - 10 - 16 - 25 - 35 - 50 - 70 - 95 - 120 - 150 - 240 - 300 mm^2.

The modular terminals possess a rated connection capacity that is at least two steps smaller than the rated cross-section. The conductors may be solid, stranded or flexible, if necessary with the ends of the conductors prepared for the connection. Verification of the rated cross-section is carried out with plug gauges to VDE 0660 part 100 table 7.

Rated current

Test currents to VDE 0611-1 are assigned to the rated cross-sections. There should be no unacceptable temperature rise in the terminal at these rated currents:

mm^2	1.5	2.5	4.0	6.0
A	17.5	24	32	41
mm^2	10	16	25	35
A	57	76	101	125
mm^2	50	70	95	120
A	150	192	232	269
mm^2	150	185	240	300
A	309	353	415	520

Rated voltage
VDE 0611-1 / VDE 0660 part 100

The rated voltage of a modular terminal is the rated insulation voltage on which the insulation tests and creepage distances are based. They are determined according to DIN VDE 0110-1. The rated voltage is intrinsic to the marking on the terminal.

Rated impulse withstand voltage DIN VDE 0110-1 / VDE 0660 part 100

This is the peak value of a surge voltage to which the modular terminals can be subjected and on which the clearances to VDE 0660 part 100 or DIN VDE 0110-1 are based.

Pollution severity DIN VDE 0110-1 / VDE 0660 part 100

The pollution severity specifies the influence of solid, liquid or gaseous foreign matter that could reduce the electric strength or the specific surface resistance.
Pollution severity 3 has been specified for modular terminals for industrial applications: the occurrence of conductive contamination or dry, non-conductive contamination which becomes conductive because condensation is expected. The minimum clearance is defined in VDE 0660 part 100 or DIN VDE 0110-1 in conjunction with the rated impulse withstand voltage.

Operating conditions DIN VDE 0110-1 / VDE 0660 part 100

The modular terminals can be used in the following standard conditions:
- Ambient temperature -5 °C...+40 °C, average value over 24 h: +35 °C
- Altitudes up to 2000 m above sea level
- Relative humidity 50 % at +40 °C, 90 % at +20 °C
- Pollution severity 3

Operating conditions for Weidmüller modular terminals

Depending on material and requirements, Weidmüller modular terminals can also be used in environments where the normal operating conditions are exceeded:

- static operation: –60 °C ... +250 °C
- dynamic operation: –25 °C ... +125 °C
- relative humidity of 93 % at +40 °C

CE marking

The CE marking, seen on various products and their packagings, is neither a sign of quality nor safety. The CE marking is a conformity marking that was introduced to ensure the unhindered movement of goods throughout the European Single Market.
It is not intended to be a reference for end consumers. The CE marking merely shows that the manufacturer has complied with all the EU directives applicable to that product. Therefore, the CE marking should be regarded as verification of conformity with the relevant directives and is aimed at the monitoring authorities responsible. For goods crossing the political borders of the European Union, the CE marking is like a “passport”. Weidmüller takes into account all the relevant EU directives according to the best of its knowledge and belief.
Conductor connectors ≥ 50 V~/75 V- comply with the fundamental safety requirements specified in the Low-voltage Directive 73/23/EEC (as amended by 93/68/EEC).
The CE marking according to the CE Marking Directive 93/68/EEC has been compulsory since 1 Jan 1997.

Currently the following directives apply:
73/23 EWG – Electrical equipment for use within specific voltage ranges (Low-voltage Directive)
89/336 EWG – Electromagnetic compatibility (EMC Directive)
98/37 EG – Safety of machines (Machinery Directive)

The standards cited in the directives have long since been intrinsic to Weidmüller’s development standards. This provides the guarantee of conformity with the EU directives. Our testing laboratory, accredited to EN 45001, performs the tests in accordance with the standards. The test reports are recognised within Europe within the framework of the accreditation process.

73/23 EWG – Electrical equipment in the meaning of this directive is all electrical equipment operated with a nominal voltage between 50 and 1000 V AC and between 75 and 1500 V DC. For an electrical product to be given the CE marking, it must fulfil the requirements of the EMC Directive and, if applicable, the Low-voltage Directive (50 V AC or 75 V DC).

According to the Low-voltage Directive, a conformity assessment procedure has to be carried out for the product. Conformity with the directive is deemed to be given if there is a reference to a harmonised European standard or another “technical specification”, e.g. IEC standards or national standards.

EMC directives

With the decree of the directive of the European Council dated 3 May 1989 for the alignment of the legal requirements of the member states concerning „**E**lectro**m**agnetic **C**ompatibility“ (89/336/EEC), the European Union has declared **EMC** as a protection objective.

The protection objectives are defined in Article 4 of the EMC Directive dated 19 November 1992 and state the following:
– “The electromagnetic disturbance it generates does not exceed a level allowing radio and telecommunications equipment and other apparatus to operate as intended.”
– “The apparatus has an adequate level of intrinsic immunity to electromagnetic disturbance to enable it to operate as intended.”

“Apparatus” is defined in the EMC Directive as follows:
– “all electrical and electronic appliances together with equipment and installa tions containing electrical and/or electronic components.”

This applies to the active/passive components and intelligent modules produced and stocked by Weidmüller.

Compliance with this directive is deemed to be given for apparatus that conforms with the harmonised European standards that are published in, for example, in Germany the Gazette of the Federal Minister for Post and Telecommunications.

Such apparatus is utilised in the following areas:
– industrial installations,
– medical and scientific equipment and devices,
– information technology devices.

Weidmüller tests its electronic products according to the relevant standards in order to fulfil the agreed protection objectives.

Electronic products from Weidmüller with respect to EMC directives

Category 1
All passive components such as:
– terminals with status displays
– fuse terminals with status indicators
– passive interface units with and without status indicators
– overvoltage protection
These products cause no interference and they have a suitable immunity to interference. These products are not labelled with the CE marking concerning the EMC Directive or the German EMC Act.

Category 2
These products are labelled with the CE marking after the conformity assessment procedure has been carried out which includes the reference to the harmonised European standards.
The following are harmonised standards:
EN 50081-1
Generic Emission Standard – Part 1: residential, commercial and light industry
EN 50082-1
Generic Immunity Standard – Part 1: residential, commercial and light industry
EN 50081-2
Generic Emission Standard – Part 2: industrial environment
EN 50082-2
Generic Immunity Standard – Part 2: industrial environment
EN 55011
Industrial, scientific and medical (ISM) radio-frequency equipment – Radio disturbance characteristics – Limits and methods of measurement
EN 55022
Information technology equipment –Radio disturbance characteristics –Limits and methods of measurement
EN 61000-3-2
Electromagnetic compatibility (EMC) – Part 3-2: Limits for harmonic current emissions (equipment input current up to and including 16 A per phase).
EN 61000-3-3
Electromagnetic compatibility (EMC) – Part 3-3: Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current less than or equal to 16 A per phase and not subject to conditional connection
EN 61000-4-x
approx. 10 tests for interference immunity (some tests not ratified)

Use of Tests
Generic standards are always used when standards specific to a product do not exist. The generic standards EN 50081-2 and EN 50082-2 are used as the basis for Weidmüller products.

Note:
The relevance of EN 50082-1 for certain products must be checked as well as how far generic standards EN 50081-1 or EN 50082-1 were considered during testing.
The environment phenomena and test interference levels are specified in the generic immunity standards.
In addition, Weidmüller considers the assessment criteria A, B and C.

Extract from the generic standard EN 50082-2:

Criterion A
The equipment shall continue to operate as intended.
No degradation of performance or loss of function is allowed below a minimum performance level as specified by the manufacturer, when the equipment is used as intended.
In certain cases the nominal performance level can be replaced by a permissible loss of performance. If the minimal performance level or permissible loss of performance is not specified by the manufacturer, both of these specifications can be derived from the description of the product, the relevant documentation and from what the operator expects from the equipment during its intended operation.

Criterion B
The equipment shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed below a minimum performance level as specified by the manufacturer, when the equipment is used as intended.
In certain cases the minimal performance level can be replaced by a permissible loss of performance. During testing degradation of the performance level is permitted; however, changes to the specified operation mode or data loss are not permitted.
If the minimal performance level or permissible loss of performance is not specified by the manufacturer, both of these specifications can be derived from the description of the product, the relevant documentation and from what the operator expects from the equipment during its intended operation.

Criterion C
Temporary loss of function is allowed, provided the loss of function is self-recoverable or can be restored by the operation of the controls.

Criterion B is most frequently specified in the generic standards and is used by Weidmüller.

Taking the example of a WAVEANALOG analogue coupler:
During testing, the analogue coupler may convert values that lie outside the permissible tolerances.
After testing, however, the values must lie within the given tolerances.

General installation instructions
In conformity with the performance level and criteria A and B, the products may and can be affected by external influences during a fault. However, the aim should be to suppress this as far as possible by means of an optimum installation.

Measures:
- Install the products in a metal enclosure (control cabinet, metal housing).
- Protect the voltage supply with an overvoltage protection device (a PU model for a 230/400 V AC mains supply or an EGU or LPU model for 24 V DC).
- Use only shielded cables for analogue data signals.
- Apply ESD measures during installation, maintenance and operation.
- Maintain min. 200 mm clearance between electronic modules and sources of interference (e.g. inverters) or power lines.
- Ensure ambient temperature and relative humidity values do not exceed those specified.
- Protect long cables with overvoltage protection devices.

For safety reasons, do not operate walkie-talkies and mobile telephones within a radius of 2 m of the equipment.

IP class of protection to DIN EN 60529

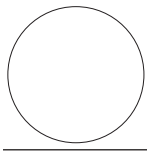
The ingress protection class or IP rating is indicated by a code consisting of the two letters IP and two digits representing the class of protection.

Example: **I P 6 5**

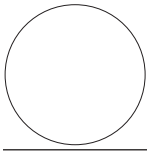
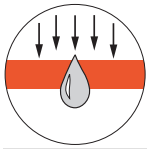
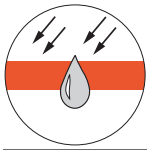
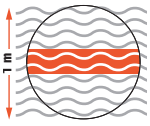
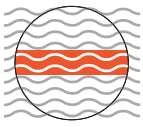
2nd digit: protection from liquids

1st digit: protection from solid bodies

Protection against intrusion of external particle matter (1st digit)

Digit		
0		No protection
1		Protection against ingress of large solid bodies with diameter > 50 mm. (Protection to prevent dangerous parts being touched with the back of the hand.)
2		Protection against ingress of large solid bodies with diameter > 12.5 mm. (Protection to prevent dangerous parts being touched with the fingers.)
3		Protection against ingress of large solid bodies with diameter > 2.5 mm. (Protection to prevent dangerous parts being touched with a tool.)
4		Protection against ingress of large solid bodies with diameter > 1 mm. (Protection to prevent dangerous parts being touched with a piece of wire.)
5		Protection against harmful deposits of dust, which cannot enter in an amount sufficient to interfere with satisfactory operation.
6		Complete protection against ingress of dust.

Protection against penetration of liquids (2nd digit)

Digit		
0		No protection
1		Protection against drops of condensed water falling vertically.
2		Protection against drops of liquid falling at an angle of 15° with respect to the vertical.
3		Protection against drops of liquid falling at an angle of 60° with respect to the vertical.
4		Protection against liquids splashed from any direction.
5		Protection against water jets projected by a nozzle from any direction.
6		Protection against water from heavy sea on ships' decks.
7		Protection against immersion in water under defined conditions of pressure and time.
8		Protection against indefinite immersion in water under defined conditions of pressure (which must be agreed between manufacturer and user and must be more adverse than number 7).

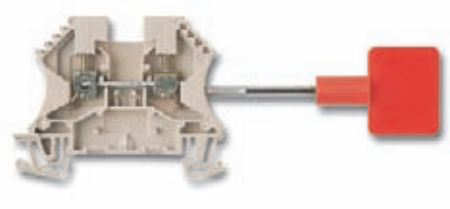
Conversion table for AWG to mm² conductors

AWG

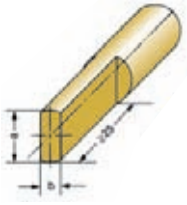
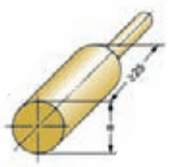
AWG is the abbreviation for „**A**merican **W**ire **G**auge“. This designation bears no resemblance to the actual cross-section of the conductor.
The relationship between AWG and mm² is shown in the following table.

Plug gauge to IEC 60947-1 section 8.2.4.5.2 table 7

Insertion of unprepared round conductors with the largest prescribed cross-section
Test with defined gauge, insertion simply under self-weight



AWG	mm²
28	0.08
26	0.13
24	0.21
22	0.22
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

Conductor cross-section		Plug gauge					
		Form A			Form B		
							
Flexible conductor mm²	Rigid conductor (solid or stranded) mm²	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	
2.5	2.5	A 2	2.8	2.0	B 2	2.4	0 – 0.05
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	
6	10	A 5	4.3	4.0	B 5	4.4	0 – 0.06
10	16	A 6	5.4	5.1	B 6	5.3	
16	25	A 7	7.1	6.3	B 7	6.9	
25	35	A 8	8.3	7.8	B 8	8.2	0 – 0.07
35	50	A 9	10.2	9.2	B 9	10.0	
50	70	A 10	12.3	11.0	B 10	12.0	
70	95	A 11	14.2	13.1	B 11	14.0	0 – 0.08
95	120	A 12	16.2	15.1	B 12	16.0	
120	150	A 13	18.2	17.0	B 13	18.0	

Design of the clearances and creepage distances in electrical equipment – general

Since April 1997 the sizing of clearances and creepage distances has been covered by DIN VDE 0110, part 1 “Insulation coordination for electrical equipment in low-voltage systems”.

DIN VDE 0110, part 1 contains the modified edition of IEC Report 664-1 (see also IEC 664-1/Oct 1992).

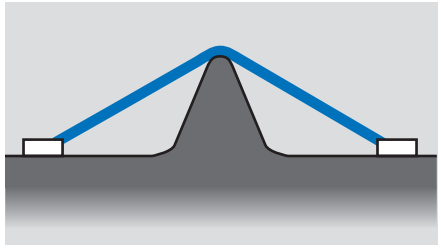
The design data resulting from these provisions is – if applicable – specified in this catalogue for each product.

For the design of clearances and creepage distances, application of the regulations for insulation coordination produces the following interrelationships:

Clearances

Clearances are rated in accordance with the following factors:

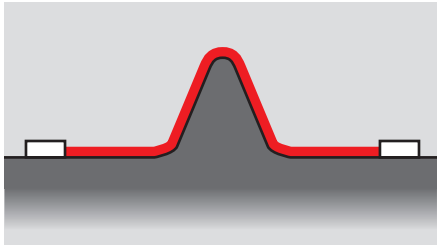
- Anticipated overvoltage
  rated impulse withstand voltage
- Used
  overvoltage protection precaution
- Measures to prevent pollution
  pollution severity

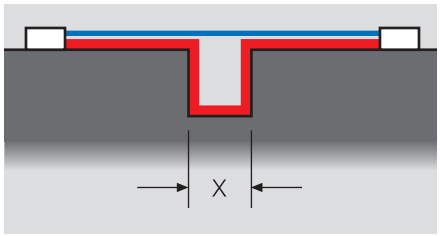


Creepage distances

Creepage distances are rated in accordance with the following factors:

- Planned
  rated voltage
- Insulation materials used
  insulation group
- Measures to prevent pollution
  pollution severity





Slots are taken into account when measuring creepage distances if their minimum width x is dimensioned according to the following table:

Pollution severity	min. width X [mm]
1	0.25
2	1.0
3	1.5
4	2.5

If the associated clearance in air is less than 3 mm, the minimum slot width can be reduced to 1/3 of the clearance.

Design of clearances and creepage distances in electrical equipment – influencing factors

Rated impulse withstand voltage

The rated impulse withstand voltage is derived from:

- **Voltage conductor – earth** (the rated voltage of the network, taking into account all networks)
- **Overvoltage category**

Table 1: Rated impulse withstand voltages for electrical equipment

Rated voltage of power supply system *) in V		Rated impulse withstand voltage in kV			
Three-phase systems	Single-phase systems with neutral point	Electrical equipment at the supply point of the installation **(Overvoltage category IV)**	Electrical equipment as part of the permanent installation **(Overvoltage category III)**	Electrical equipment to be connected to the permanent installation **(Overvoltage category II)**	Specially protected electrical equipment **(Overvoltage category I)**
	120 to 240	4.00	2.50	1.50	0.80
230/400 277/480		6.00	4.00	2.50	1.50
400/690		8.00	6.00	4.00	2.50
1000		Values depend on the particular project or, if no values are available, the values above for 400/690 V can be used.			

*) to IEC 38

Overvoltage categories

are stipulated in accordance with the German standard DIN VDE 0110-1 (for electrical equipment fed directly from the low-voltage network).

Overvoltage I

- Equipment that is intended to be connected to the permanent electrical installation of a building. Measures to limit transient overvoltages to the specific level are taken outside the equipment, either in the permanent installation or between the permanent installation and the equipment.

Overvoltage II

- Equipment to be connected to the permanent electrical installation of a building, e.g. household appliances, portable tools, etc.

Overvoltage III

- Equipment that is part of the permanent electrical installation and other equipment where a higher degree of availability is expected, e.g. distribution boards, circuit-breakers, wiring systems (including cables, busbars, junction boxes, switches, power sockets) in the permanent installation, and equipment for industrial use and some other equipment, e.g. stationary motors with permanent connections to the permanent installation.

Overvoltage IV

- Equipment for use at or near the power supply in the electrical installations of buildings, between the principal distri bution and the mains, e.g. electricity meters, circuit-breakers and centralised ripple controllers.

Pollution severity categories

Pollution severity category 1

- No pollution, or only dry, non-conductive pollution that has no influence.

Pollution severity category 2

- Non-conductive pollution only; occasional condensation may cause temporary conductivity.

Pollution severity category 3

- Conductive pollution, or dry, non-conductive pollution that is liable to be rendered conductive through condensation.

Pollution severity category 4

- Contamination results in constant conductivity, e.g. caused by conductive dust, rain or snow.

Unless explicitly stated otherwise, the dimensioning of clearance and creepage distances and the resulting rating data for electromechanical products (terminals, terminal strips, PCB connection terminals and plug-in connectors) is based on pollution severity 3 and overvoltage category III, taking account of all network types.

Design of clearances and creepage distances in electrical equipment – influencing factors

Rated voltage

The rated voltage is derived from the nominal voltage of the power supply and the corresponding network type.

Single-phase
2- or 3-wire AC or DC systems

Rated voltage of the power supply (mains)*)	Voltages for table 4	
	For insulation phase-to-phase 1)	For insulation phase-to-earth 1)
	All systems	3-wire systems neutral pt. earthing
V	V	V
12.5	12.5	–
24 / 25 30	25 32	– –
42 / 48 / 50**) 60	50 63	– –
30–60	63	32
100**)	100	–
110 / 120 150**)	125 160	– –
220	250	–
110–220 120–240	250	125
300**)	320	–
220–440	500	250
600**)	630	–
480–960	1000	500
1000**)	1000	–

3-phase
3- or 4-wire AC systems

Rated voltage of the power supply (mains)*)	Voltages for table 4		
	For insulation phase-to-phase	For insulation phase-to-earth	
	All systems	3-phase 4-wire systems with earthed neutral wire2)	3-phase 3-wire systems unearthed1) or phase-earthed
V	V	V	V
60	63	32	63
110/120/127	125	80	125
150**)	160	–	160
208	200	125	200
220/230/240	250	160	250
300**)	320	–	320
380/400/415	400	250	400
440	500	250	500
480/500	500	320	500
575	630	400	630
600**)	630	–	630
660/690	630	400	630
720/830	800	500	800
960	1000	630	1000
1000**)	1000	–	1000

1) Phase-to-earth insulation levels for unearthed or impedance-earthed systems are equal to those of phase-to-phase because the operating voltage to earth of any phase can, in practice, reach full phase-to-phase voltage. This is because the actual voltage to earth is determined by the insulation resistance and capacitive reactance of each phase to earth; thus, a low (but acceptable) insulation resistance of one phase can earth it and raise the other two to full phase-to-phase voltage to earth.

2) For electrical equipment for use in both 3-phase 4-wire and 3-phase 3-wire supplies, earthed and unearthed, use the values for 3-wire systems only.

*) It is assumed that the rated voltage of the electrical equipment is not lower than the nominal voltage of the power supply.

**) Because of the common changes, the meaning of the ** symbol has not been used in table 1; i.e. the / symbol indicates a 4-wire 3-phase distribution system. The lower value is the phase-to-neutral voltage, while the higher value is the phase-to-phase voltage. Where only one value is indicated, it refers to 3-wire 3-phase systems and specifies the value phase-to-phase.
The values given in table 1 are still taken into account in tables 3a and 3b by the ** symbol.

Insulating material group

The insulating materials are divided into four groups depending on the comparative figures for creepage distance (CTI = comparative tracking index):

Insulating material group	
I	600 ≤ CTI
II	400 ≤ CTI < 600
III a	175 ≤ CTI < 400
III b	100 ≤ CTI < 175

The comparative tracking index must be determined using special samples produced for this purpose with test solution A in compliance with IEC 60112 (DIN IEC 60112/DIN VDE 0303-1).

Derating curve (current-carrying capacity curve)

The **Derating curve** shows which currents may flow continuously and simultaneously via all possible connections when the component is subjected to various ambient temperatures below its upper limit temperature.

The current-carrying capacity is determined empirically according to DIN IEC 60512-3. To do this, the resulting component temperatures t_{b1}, t_{b2} , … and the ambient temperatures t_{u1}, t_{u2} , … are measured for three different currents I_1, I_2 , … .

The values are entered on a graph with a system of linear coordinates to illustrate the relationships between the currents, the ambient temperatures and the temperature rise in the component.

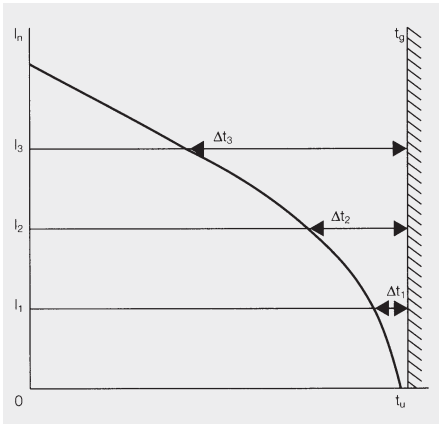
The **loading currents** are plotted on the y-axis, the **component ambient temperatures** on the x-axis.

A line drawn perpendicular to the x-axis at the upper limit temperature t_g of the component completes the system of coordinates.

The associated average values of the temperature rise in the component $\Delta t_1 = t_{b1}-t_{u1}$, $\Delta t_2 = t_{b2}-t_{u2}$, … are plotted for every current I_1, I_2 ... to the left of the perpendicular line.
The points generated in this way are joined to form a roughly parabolic curve.

Base curve

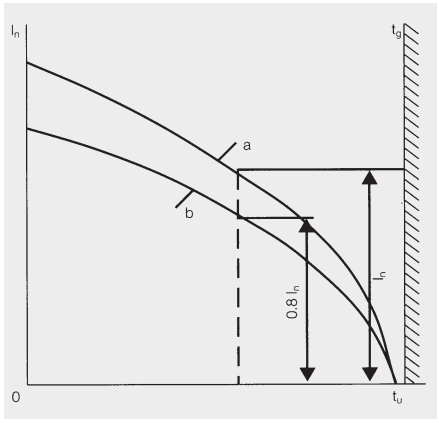
upper limit temperature of component



t_g = upper limit temperature of component
t_u = ambient temperature
I_n = current

As it is practically impossible to choose components with the maximum permissible volume resistances for the measurements, the base curve must be reduced. Reducing the currents to 80 % results in the "**derating curve**", in which the maximum permissible volume resistances and the measuring uncertainties in the temperature measurements are taken into account.

Derating curve

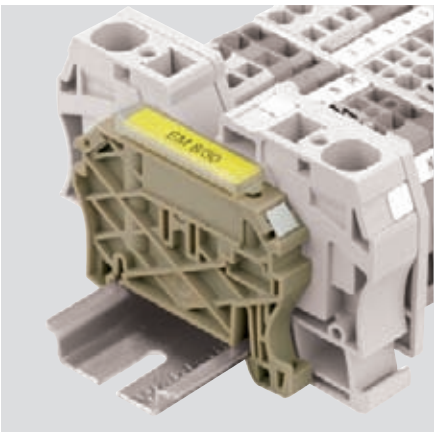


t_g = upper limit temperature of component
t_u = ambient temperature
I_n = current
a = base curve
b = reduced base curve (derating curve)

The installation of terminal strips

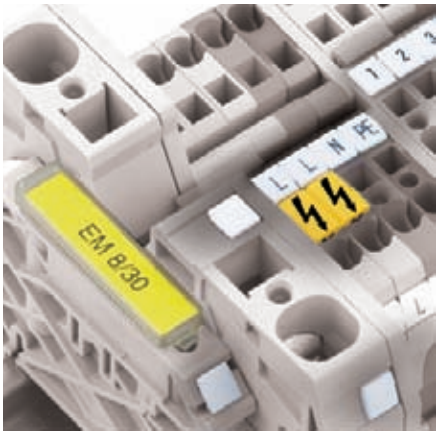
Assembly and end brackets

- Assemble terminal strips from left to right.
- Closed side on the left, open on the right.
- Always close off the open side of a modular terminal with an end plate or partition plate (WAP/TW, ZAP/TW and IAP).
- Fit end brackets to both ends of a terminal strip.
- End brackets can be omitted adjacent to PE terminals, with the exception of WDK/PE and ZPE + WPE 1.5 / R 3.5.



Combinations of various terminals

- Always fit an end plate or partition plate (WAP/TW, ZAP/TW and IAP) at changes of profile.
- Always fit end plates or partition plates (WAP/TW, ZAP/TW and IAP) between adjacent terminals with different rated voltages in order to maintain the respective voltages.
- When a PE terminal is required adjacent to or between associated feed-through terminals of the same series and size, the rated voltage and rated impulse withstand voltage of the feed-through terminals are not affected.



Dimensions

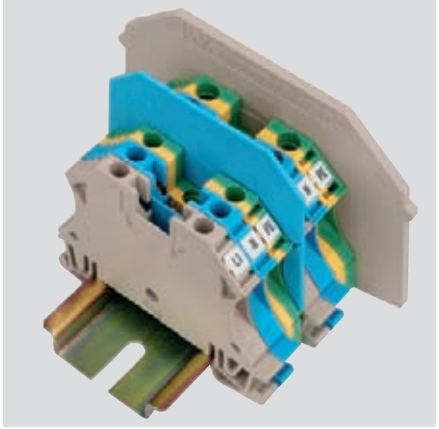
The dimensions specified are those of the enclosing housing to the modular terminal, including fixing components but excluding tolerances. A mounting tolerance of 0.2 mm on the specified terminal width should be allowed for in the planning.

Partition plate

A partition plate is required to create a visual distinction between electric circuits, or to ensure electrical isolation between neighbouring cross-connections.

Separation plate

Separation plates can be retrofitted between cross-connections or sockets on modular terminals up to a terminal width of max. 12 mm.



Maintaining the rated insulation voltage

The required stripping length is specified in mm for every Weidmüller product. These lengths, e.g. 6 ± 0,5 mm, ≥ 10 ± 1 mm, must be maintained. This also applies when using wire end ferrules. The outside dimensions of crimped wire end ferrules must comply with IEC 60947-1, 1999 edition.

Working on electrical connections with non-insulated screwdrivers

The use of non-insulated screwdrivers is only permitted on electrical systems that have been isolated. To ensure that the electrical components have been dis-

connected from the power supply, the following five safety rules must be adhered to before carrying out any work and guaranteed for the duration of the work:

- **isolation**
- **prevention of reconnection**
- **verification of disconnection**
- **earthing and short-circuiting**
- **covering or guarding of adjacent parts still connected to the power supply**

These five safety rules represent the safety measures to be taken when working on electrical systems and equipment. The individual measures to be carried out taking into account the operational and local conditions, e.g. exposed high- or low-voltage lines, cables or switchgear, are specified in VDE 0105 part 100.

Unused clamping points connected to the power supply

Suitable covers, e.g. ADP 1…4, must be fitted to prevent electrical shock caused through accidental contact with unused clamping points that could conduct electricity. The clamping screws of all unused clamping points, even those isolated from the electricity supply, must be screwed fully home.

VDE 0105 part 100
Operation of power supplies: work on such systems

Perform troubleshooting operations with a 2-pole voltage tester including test prod to IEC 61243-3.

Tightening torques for clamping screws

Tightening the clamping screw with the appropriate torque guarantees:

- a secure and gas-tight connection
- no mechanical damage to the clamping parts
- a voltage drop well below the permissible limit

The test torque to IEC 60947-1 supplemented by Appendix C1 of IEC 60947-1-7, or the torque as specified by the manufacturer is the lower value of the permissible torque range.
This ensures that all tests are satisfied.

The upper value of the permissible torque range is the maximum torque that may be applied by the user.

An electric screwdriver should preferably be set to a torque in the middle of the range. The values given in the table are general figures. Torques specific to the products have been specified directly for each product.

Products with screw with slotted head

Thread	Tightening torque	
	Steel screws	
	min. 8.8	A 2/A 4-80
	[Nm]	[Nm]
M 2.5	0.4…0.8	0.4…0.8
M 3	0.5…1.0	0.5…1.0
M 3.5	0.8…1.6	0.8…1.6
M 4	1.2…2.4	…
M 5	2.0…4.0	…
M 6	2.5…5.0	…

Products with screw with hexagon socket

Thread	Tightening torque	
	Non-ferrous screws	
	Cu 2 (CuZn)	Cu 5 (CuNi 60)
	[Nm]	[Nm]
M 2.5	0.4…0.45	…
M 3	0.5…0.6	0.5…1.0
M 3.5	…	0.8…1.6
M 4	1.2…1.9	1.2…2.4
M 5	2.0…3.0	2.0…4.0
M 6	…	2.5…5.0

Products with screw with hexagon socket

Thread	Tightening torque
	Steel screws
	[Nm]
M 4	1.2…2.4
M 5	2.0…4.0
M 6	3.0…6.0
M 8	6.0…12
M 10	10.0…20
M 12	14.0…31
M 16	25.0…60

Connecting the terminals

Two conductors at one clamping point

The optimum solution for allocation of individual circuits, labelling and the breakdown into separate functional units is best achieved by connecting just one conductor at every clamping point.

However, if it is necessary to connect two conductors with the same cross-section at one clamping point, then this is possible with the modular terminals of the W-Series (screw connection).

According to DIN IEC 60999-1, twin wire end ferrules must be used when connecting two conductors at one clamping point in modular terminals of the Z-Series (tension clamp).

But DIN IEC 60999-1 prohibits the connection of two conductors at one point in the screwless IDC system (I series).

▪ Continuous current rating with two conductors

The total current of two conductors may not exceed the continuous current rating of the modular terminal. The continuous current rating is the maximum current that a modular terminal can accommodate without the temperature rise exceeding 45 K.

▪ Rated insulation voltage

The rated insulation voltage of the modular terminal does not change when two conductors are connected properly.

Cross-connections systems

Weidmüller can supply the cross-connections WQV and ZQV – fully insulated against electric shock – with various numbers of poles (2- to 20-pole).
Please note that the rated voltage is reduced when using cross-connections.

Protection against electric shock is not provided at the ends of shortened cross-connections.

Such cross-connections must be used with partition plates or end plates in order to maintain the rated voltage.

Leaf clamp conductor connection for large cross-sections

It is no longer the case that conductors with large cross-sections have to be forced into the clamping point. Instead, they can now be easily laid in the modular terminal.
In addition to the individual form, every type of terminal can also be supplied in the form of 3-, 4- and 5-pole blocks. All the blocks are permanently screwed together and therefore guarantee additional rigidity.
Direct mounting is possible thanks to the elongated holes on the underside of the terminals. Terminal blocks can be screwed directly to mounting plates with a 25 mm pitch.

The other advantages are:

- Constant force transfer through self-adjusting connection system
- Mounting in any direction
- Electric shock protection (finger-proof) to German standard VBG 4, also with cross-connections
- Extremely resistant to distortion

Open cover and remove screw assembly.

Insert conductor and replace screw assembly.

Close cover and tighten screw with Allen key.

The use of aluminium conductors

Weidmüller modular terminals are suitable for the direct connection of **solid round and sector aluminium conductors**.
In contrast to copper, aluminium exhibits certain characteristics that must be taken into account when using this material as a conductor in electrical engineering.

A thin, non-conductive layer of oxide forms immediately on the unprotected surface of the aluminium as soon as it is exposed to the air.
This layer increases the contact resistance between the aluminium conductor and the current bar of the modular terminal. And that, in unfavourable conditions, can lead to poor contact.
And in stranded conductors the contact resistances of the individual strands are added together. Despite these disadvantages, aluminium conductors can be connected to Weidmüller modular terminals, provided the reduced rated currents for aluminium conductors and the following installation conditions are adhered to.

1. Scrape the stripped end of the conductor carefully, e.g. with a knife, to remove the layer of oxide.
   Caution: Do not use brushes, files or emery paper because particles of aluminium can be deposited on other conductors.

2. After removing the layer of oxide, coat the end of the conductor immediately with a neutral grease, e.g. acid- and alkali-free Vaseline, and connect it to the terminal immediately.

3. Repeat the above procedure if at any time the conductor is disconnected and reconnected.

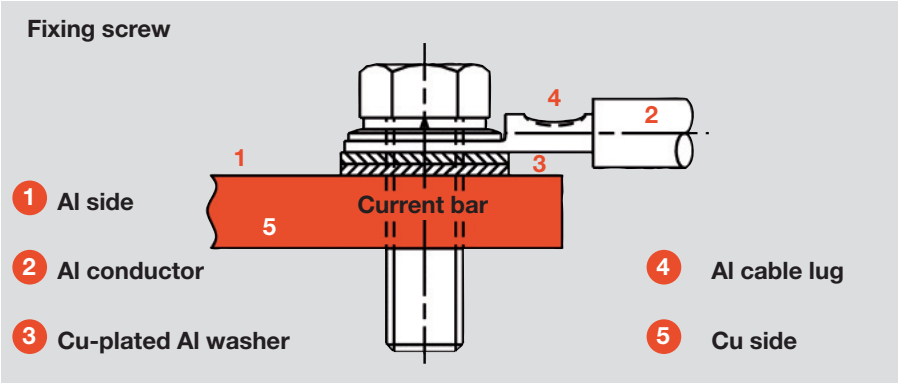
4. The above installation instructions are valid for solid round or sector aluminium conductors only.

Solid round and sector conductors				
Terminal type	Rated cross-section	Reduced rated current when connecting an aluminium conductor	Clamping screw thread size	Tightening torque
W-Series	mm²	„A“		Nm
WDU 2.5	2.5	20	M 2.5	0.5-0.8
WDU 4	4	27	M 3	0.6-1.0
WDU 6	6	35	M 3.5	1.2-1.6
WDU 10	10	48	M 4	2.0-2.4
WDU 16	16	64	M 5	3.0-4.0
WDU 35	35	105	M 6	4.0-6.0
WDU 70	70	163	M 8	10.0-12.0
WDU 120	120	230	M 10	15.0-20.0
SAK-Series				
SAK 2.5	2.5	20	M 2.5	0.5-0.8
SAK 4	4	27	M 3	0.6-1.0
SAK 6	6	35	M 3.5	1.2-1.6
SAK 10	10	48	M 4	2.0-2.4
SAK 16	16	64	M 4	2.0-2.4
SAK 35	35	105	M 6	4.0-6.0

Stranded conductors				
W-Series				
WFF 35	35	105	M 6	3.0-6.0
WFF 70	70	163	M 8	6.0-12.0
WFF 120	120	230	M 10	10.0-20.0
WFF 185	185	300	M 12	15.5-31.0
WFF 300	300	409	M 16	30.0-60.0

Installation advice when using flat cable lugs

When tightening the terminal it is advisable to hold the conductor to prevent deformation of the terminal rail and to avoid twisting the foot of the terminal. When connecting **stranded aluminium conductors** to modular terminals, it is advisable to use an aluminium cable lug chosen to match the type of conductor and connected according to the instructions of the cable lug manufacturer. It is necessary to fit a copper-plated aluminium washer between the aluminium cable lug and the copper current bar of the modular terminal. This is the only way of guaranteeing a reliable transition between the copper and the aluminium. Fit the washer in such a way that the copper side is in contact with the current bar, and the aluminium side in contact with the cable lug.



Modular terminals for explosive conditions

Modular terminals for explosive conditions – complying with the European ATEX Directive 94/9/EC

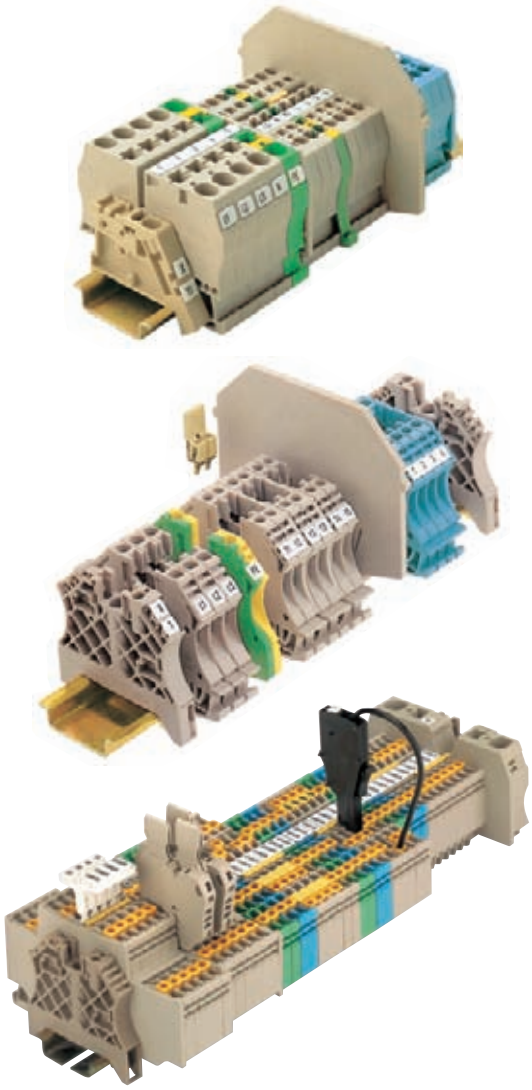
Principles

IEC 60947-7-1 (EN 60 947-7-1/VDE 0611pt.1) and
IEC 60 947-7-2 (EN 60 947-7-2/ VDE 0611pt.3) specify the basic provisions for modular terminals or PE terminals.
In addition, EN 60079-0 and for increased safety „e“ EN 60079-7, cover their use in potentially explosive areas.
According to EN 60079-0 modular terminals for explosive conditions are so-called explosion-proof components. Components are those parts and assemblies that are necessary for the safe operation of devices and protective systems without themselves fulfilling an autonomous function.
According to the European ATEX Directive 94/9/EC, modular terminals for explosive areas are not marked with the CE symbol. Modular terminals for explosive areas are certified for the increased safety “e” type of protection.

The European offices nominated in the ATEX Directive 94/9/EC, have been issuing EC Type Examination Certificates for the so-called ATEX generation complying with EN 60079-0/60079-7 and the ATEX Directive 94/9/EC since 1997. The condition for this is registration of the manufacturer’s quality control system. Weidmüller has been registered since 1997. Copies of the EC Type Examination Certificate, the certification document and the declaration of conformity can be supplied in electronic format upon request.

The earlier certificates (A to D generations) issued according to the Explosive Atmospheres and Gassy Mines Directive 76/117/EEC have not been valid since 1 July 2003. However, existing installations are not affected by this.

The clamping yoke, tension clamp and IDC systems of the modular terminals ensure enhanced protection against gradual loosening and are designed in such a way that the ends of flexible conductors do not need to be prepared.



Marking

ATEX Directive 94/9/EC: Ⓔx II 2 G D

Ⓔx	Equipment for explosive conditions
II 2 G	Equipment group II category 2 (Zone 1 equipment)
II 2 D	Equipment group II category 2 (Zone 21 equipment)
EN	**60079-0/-7:** Ex e II
E	Conformity with EN standards
Ex	Explosion protection
e	Increased safety
II	Equipment group
KEMA	**97ATEX4677U** (example)
KEMA	Notified body
ATEX	Conformity with 94/9/EG
U	Component

Confirmed according to European ATEX Directive 94/9/EC

Electrical data

The values for current-carrying capacity as stated in the catalogue are based on an ambient temperature of 40°C. When loaded with the rated current + 10%, the temperature of the current bar of the modular terminal may not rise more than 40 K.
Taking into account a further safety factor according to EN 60079-0, we reach the following definitions:

Temperature class	Ambient temperature
T6, T5	–50°C to +40°C
T4 to T1	–50°C to +55°C

If the actual ambient temperature is higher, then the permissible rated current must be reduced accordingly.
The continuous operating temperature according to EN 60079-0 is 130°C for the Wemid and KrG materials, 80°C for PA.

Accessories

The accessories listed can be used and included in the ATEX certification. In order to maintain the creepage distances and clearances for the Ex e category, end plates and/or partition plates should be used as specified.

Design for EEx i

Modular terminals for intrinsically safe circuits “i” are said components whose temperature rise behaviour is specified just like their electrical data. Therefore, they do not need an EC Type Examination Certificate when used in intrinsically safe circuits.
To enable unambiguous marking and ready identification, the use of blue terminals is recommended. These terminals comply with the requirements of category Ex e.

Accessories

The accessories listed can be used and comply with EN 60079-11 (IEC 60079-11/VDE 0170/0171 part 7).

Installation

The general statements regarding standard applications are also valid for EEx i applications. In particular, the EEx i requirements always apply to the entire circuit, i.e. also to parts in areas not at risk of explosion.

Clamping of two conductors in Ex e applications

It is generally permitted to connect two conductors per clamping point in all the terminals of our W-Series. However, please make sure that these have the same cross-section and do not exceed the rated cross-section.

Current-carrying capacity of cables and lines

Rated currents

Cross-sect.	VDE 0298 part 4 (IEC364-5-523) Current-carrying capacity of lines		EN 60079-7 2nd edition Type of ignition “increased safety” Connection terminals Ambient temperature 40°C, 40 K temperature rise Current equivalent to the conductor connected A
	Ambient temperature 30°C Factor 1.0 - Installation type C + 3 current-carrying wires PVC 70 °C A	Ambient temperature 40°C Factor 0.87 - Installation type C + 3 current-carrying wires PVC 70 °C A	
1.5	17.5	15.225	15
2.5	24	20.88	21
4	32	27.84	28
6	41	35.67	36
10	57	49.59	50
16	76	66.12	66
25	101	87.87	88
35	125	108.75	109
50	150	130.5	131
70	192	167.04	167
90	232	201.84	202
120	269	234.03	234
150	309	268.83	267
185	353	307.11	307
240	415	361.05	361
300	520	452.4	452

The current-carrying capacity of cables and lines in the installation is defined by VDE 0298 part 4 as normal at an ambient temperature of 30°C. At 40°C the operating current must be reduced by a factor of 0.87.

ATEX directives

The old directive – Explosive Atmospheres and Gassy Mines Directive 76/117/EEC – was superseded by the new directive 94/9/EC, also known as ATEX 95 (ATEX: ATmosphère EXplosive = potentially explosive atmosphere), on 1 July 2003. Only the new directive is now valid, which is one of the so-called "New Approach" directives. It applies in all the countries of the European Union plus Iceland, Liechtenstein and Norway. In all these countries the directive applies to the sale and operation of products that have been specially developed for use in potentially explosive atmospheres in which gases, vapours, mists or dusts prevail. A new development is the inclusion of mining operations and purely mechanical devices.

The ATEX directive has been in force since March 1996, and its use up until 30 June 2003 (transitionary period) was optional and existing directives remained applicable as well. But since 1 July 2003 all new installations and equipment for use in potentially explosive areas must comply with the ATEX directive and be certified accordingly. However, the previous breakdown into zones (Zone 0, 1 or 2) and classes of protection (e.g. "i": intrinsic safety, "e": increased safety) still remains in force.

Class of protection

Type of protection	Code	CENELEC EN	IEC	Product category explosion protect.
General requirements	–	60079-0	60079-0	–
Oil immersion	o	50015	60079-6	2
Pressurised apparatus	p	60079-2	60079-2	2
Powder filling	q	50017	60079-5	2
Flameproof enclosure	d	60079-1	60079-1	2
Increased safety	e	60079-7	60079-7	2
Intrinsic safety	ia	50020	60079-11	1
Intrinsic safety	ib	50020	60079-11	2
Equip. for zone 2 (EEx n)	n	60079-15	60079-15	3
Encapsulation	m	60079-18	60079-18	2

Classification for potentially explosive areas

CENELEC classification IEC60079-10	Presence of potentially explosive atmosphere	Product category	US classification NEC 500	Combustible media
Zone 0	permanent, long-term	1G	Class I, Div 1	gases, vapours
Zone 20	or frequently	1D	Class II, Div 1	dust
Zone 1	occasionally	2G	Class I, Div 1	gases, vapours
Zone 20		2D	Class II, Div 1	dust
Zone 2	rarely and	3G	Class I, Div 2	gases, vapours
Zone 22	briefly	3D	Class II, Div 2	dust

Explosion groups

Gas (e.g.)	CENELEC	NEC 500
Propane	IIA	D
Ethylene	IIB	C
Hydrogen	IIC	B
Acetylene	IIC	A
Methane (mining)	I	mining (MSHA)

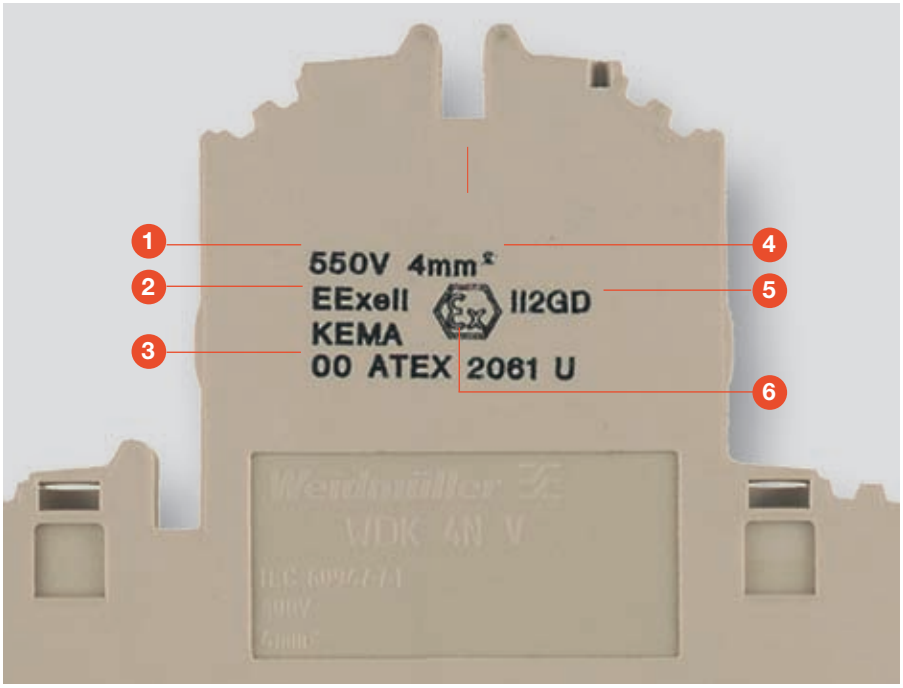
Temperature classes

Max. surface temperature (°C)	Temperature class CENELEC	Temperature class NEC 500-3
450	T1	T1
300	T2	T2
280	–	T2A
260	–	T2B
230	–	T2C
215	–	T2D
200	T3	T3
180	–	T3A
165	–	T3B
160	–	T3C
135	T4	T4
120	–	T4A
100	T5	T5
85	T6	T6

ATEX codes

Example of marking – modular terminal WDK 4 N V

1. Rated voltage
2. CENELEC type of protection “e” – increased safety
   - Equipment group II – above ground (gases, vapours, mists, dusts)
3. Certificate number
4. Rated conductor cross-section
5. Equipment group II – above ground (gases, vapours, mists, dusts)
   - Product category 2 – for use in zone 1 or 2
   - Approved for use in gases “G” and/or dusts “D”
6. European symbol for explosion protection

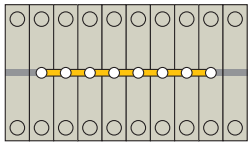


ATEX cross-connection instructions

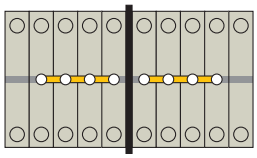
Arrangements of terminals and cross-connections

The maximum voltages for Ex e applications given below are determined on the basis of the terminals used, their cross-connections and which of the arrangements (A to J) is used.

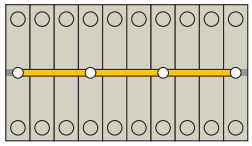
A Continuous



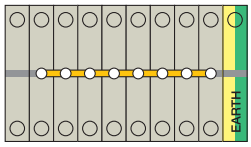
C Adjacent (used with QV)
separated by a partition plate or end plate



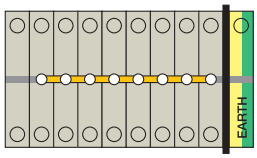
D Bypassing
bridging one or several unconnected terminals (e.g. every third)



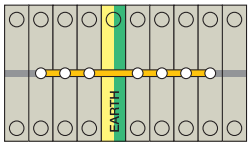
E Adjacent to a PE terminal (earth)
without partition plate or end plate



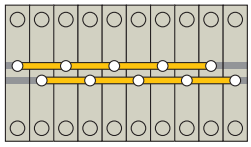
F Adjacent to a PE terminal (earth)
with partition plate or end plate



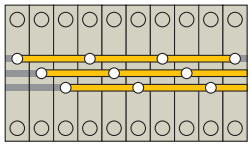
G Bypassing a PE terminal (earth)



H 2 parallel cross-connections



I 3 parallel cross-connections



Maximum voltage

Range [1]	Certificate No.	Rated voltage	Rated current	Nominal cross-section	Maximum voltage (V) (letters refer to the above diagrams)							
AKZ ...		V	A	mm²	A	C	D	E	F	G	H	I
AKZ 1.5	SIRA 02ATEX3001 U	176	15	1.5	176	176	176	176	176	176	–	–
AKZ 2.5	SIRA 02ATEX3001 U	176	21	2.5	176	176	176	176	176	176	–	–
AKZ 4	SIRA 02ATEX3001 U	275	28	4	275	275	275	275	275	275	–	–
BK ...												
BK 2/E ... BK 12/E	SIRA 01ATEX3247 U	275	28	4	176	176	176	–	–	176	–	–
DK 4 ...												
DK 4	SIRA 02ATEX3316 U	275	28	4	275	275	275	275	275	–	–	–
DK 4Q	SIRA 02ATEX3316 U	275	28	4	275	275	275	275	275	–	–	–
DK 4QV	SIRA 02ATEX3316 U	275	28	4	275	275	275	275	275	–	–	–
I ... Series												
IDK 1.5N	KEMA 02ATEX2241 U	275	15	1.5	275	275	275	–	–	–	–	–
IDK 1.5N/V	KEMA 02ATEX2241 U	275	15	1.5	275	275	275	–	–	–	–	–
IDU 1.5N	KEMA 02ATEX2241 U	275	15	1.5	275	275	275	275	275	275	275	–
IDU 1.5N/ZF	KEMA 02ATEX2241 U	275	15	1.5	275	275	275	275	275	275	275	–
IDU 1.5N/ZB	KEMA 02ATEX2241 U	275	15	1.5	275	275	275	275	275	275	275	–
IDU 2.5N	DEMKO 03ATEX134054 U	550	21	2.5	550	550	550	550	550	550	550	–
IDU 2.5N/ZF	DEMKO 03ATEX134054 U	550	21	2.5	550	550	275	275	550	275	550	–
IDU 2.5N/ZB	DEMKO 03ATEX134054 U	550	21	2.5	550	550	275	275	550	275	550	–
MK ...												
MK 3/ … /E	SIRA 01ATEX3248U	275	21	2.5	176	176	176	–	–	–	–	–
MK 6/ … /E	SIRA 01ATEX3249U	440	36	6	275	275	275	–	–	–	–	–
SAK ... TS 32/TS 35												
SAK 2.5	KEMA 97ATEX1798 U	550	21	2.5	550	550	176	550	550	176	–	–
SAK 4	KEMA 97ATEX1798 U	550	28	4	550	550	176	550	550	176	–	–
SAK 6N	KEMA 97ATEX1798 U	550	36	6	550	550	176	550	550	176	–	–
SAK 10	KEMA 97ATEX1798 U	550	50	10	550	550	176	550	550	176	–	–
SAK 16	KEMA 97ATEX1798 U	690	66	16	550	550	176	550	690	176	–	–
SAK 35	KEMA 97ATEX1798 U	550	109	35	550	550	176	550	550	176	–	–

1) Please refer to the catalogue and the certificate for details of precisely which article is approved.

Maximum voltage

Range [1]	Certificate No.	Rated voltage	Rated current	Nominal cross-section	Maximum voltage (V) (letters refer to the diagrams on page W.28)							
					A	C	D	E	F	G	H	I
SAK ... EN on TS32		V	A	mm²								
SAK 2.5 EN	KEMA 97ATEX1798 U	440	21	2.5	440	440	176	440	440	176	–	–
SAK 4 EN	KEMA 97ATEX1798 U	440	28	4	440	440	176	440	440	176	–	–
SAK 6N EN	KEMA 97ATEX1798 U	440	36	6	440	440	176	440	440	176	–	–
SAK 10 EN	KEMA 97ATEX1798 U	440	50	10	440	440	176	440	440	176	–	–
SAK 16 EN	KEMA 97ATEX1798 U	440	66	16	440	440	176	440	440	176	–	–
SAK 35 EN	KEMA 97ATEX1798 U	440	109	35	440	440	176	440	440	176	–	–
SAK ... EN on TS35												
SAK 2.5 EN	KEMA 97ATEX1798 U	690	21	2.5	440	440	176	440	440	176	–	–
SAK 4 EN	KEMA 97ATEX1798 U	690	28	4	690	690	176	690	690	176	–	–
SAK 6N EN	KEMA 97ATEX1798 U	690	36	6	690	690	176	690	690	176	–	–
SAK 10 EN	KEMA 97ATEX1798 U	690	50	10	690	690	176	690	690	176	–	–
SAK 16 EN	KEMA 97ATEX1798 U	690	66	16	690	690	176	690	690	176	–	–
SAK 35 EN	KEMA 97ATEX1798 U	690	109	35	690	690	176	690	690	176	–	–
SAKK ...												
SAKK 4	SIRA 03 ATEX3425 U	275	28	4	275	275	275	275	275	275		
SAKK 10	SIRA 03 ATEX3425 U	275	50	10	275	275	275	275	275	275		
W ...												
WDK 1.5/R3.5	KEMA 99ATEX6545 U	275	15	1.5	176	275	176	176	–	–	–	–
WDK 2.5	KEMA 98ATEX1687 U	275	21	2.5	275	275	60	275	275	60	–	–
WDK 2.5V	KEMA 98ATEX1687 U	275	21	2.5	275	275	60	275	275	60	–	–
WDK 2.5DU-PE	KEMA 98ATEX1687 U	275	21	2.5	275	275	60	275	275	60	–	–
WDK 2.5/EX	KEMA 98ATEX1687 U	440	21	2.5	440	440	176	440	440	176	–	–
WDK 2.5N	KEMA 00ATEX2061U	550	21	2.5	550	550	275	550	550	275	–	–
WDK 4N	KEMA 00ATEX2061U	550	28	4	550	550	275	550	550	275	–	–
WDU 1.5/ZZ	KEMA 98ATEX1685 U	550	14	1.5	550	550	110	550	550	110	110	–
WDU 2.5/1.5/ZR	KEMA 98ATEX1685 U	550	15	1.5	550	550	110	550	550	110	110	–
WDU 2.5/TC	SIRA 02ATEX3153 U	50	15	1.5	–	–	–	–	–	–	–	–
WDU 1.5/R3.5	KEMA 99ATEX6545 U	275	1	2.5	176	275	176	176	–	–	–	–
WDU 2.5N	KEMA 98ATEX1683 U	440	21	2.5	440	440	110	440	440	110	–	–
WDU 2.5	KEMA 98ATEX1683 U	550	21	2.5	550	550	110	440	550	110	110[2]	60
WDU 2.5 TC		50	1	2.5	–	–	–	–	–	–	–	–
WDU 4	KEMA 98ATEX1683 U	690	28	4	690	690	110	440	690	110	–	–
WDU 4 SL		275	28	4	275	275	176	275	275	176	–	–
WDU 4N	TÜV 04ATEX2630 U	440	27	4	440	275	69	440	440	69	69	–
WDU 6	KEMA 98ATEX1683 U	550	36	6	550	550	110	440	550	110	–	–
WDU 6 SL		275	36	6	275	275	176	275	275	176	–	–
WDU 10	KEMA 98ATEX1683 U	550	50	10	550	550	110	440	550	110	–	–
WDU 10 SL		275	50	10	275	275	176	275	275	176	–	–
WDU 16	KEMA 98ATEX1683 U	690	66	16	690	690	110	690	690	110	–	–
WDU 35	KEMA 98ATEX1683 U	690	109	35	690	690	110	690	690	110	–	–
WDU 50N	KEMA 98ATEX1683 U	690	126	50	550	550	–	550	550	–	–	–
WDU 70N	KEMA 98ATEX1683 U	690	167	70	550	550	–	550	550	–	–	–
WDU 70/95	KEMA 98ATEX1686 U	690	202	95	690	690	–	690	690	–	–	–
WDU 95N/120N	KEMA 98ATEX1683 U	880	243	120	880	880		880	880	–	–	–
WDU 120/150	KEMA 98ATEX1686 U	1100	234	120	1100	1100	–	1100	1100	–	–	–
WDU 240	KEMA 01ATEX2186 U	690	300	240	–	–	–	–	–	–	–	–
WDU 4 SL	SIRA 02ATEX3242 U	275	28	4	275	275	176	275	275	176	176	–
WDU 6 SL	SIRA 02ATEX3242 U	275	36	6	275	275	176	275	275	176	176	–
WDU 10 SL	SIRA 02ATEX3242 U	275	50	10	275	275	176	275	275	176	176	–
WFF 35	KEMA 98ATEX1684 U	1100	109	35	1100	1100	–	1100	1100	–	–	–
WFF 70	KEMA 98ATEX1684 U	1100	167	70	1100	1100	–	1100	1100	–	–	–
WFF 120	KEMA 98ATEX1684 U	1100	234	120	1100	1100	–	1100	1100	–	–	–
WFF 185	KEMA 98ATEX1684 U	1100	307	185	1100	1100	–	1100	1100	–	–	–
WFF 300	KEMA 98ATEX1684 U	1100	452	300	1100	1100	–	1100	1100	–	–	–
Z ...												
ZDK 2.5/1.5	KEMA 97ATEX4677 U	275	18	2.5	275	275	275	275	275	275	–	–
ZDK 2.5-2	KEMA 97ATEX4677 U	550	20	2.5	440	440	275	440	440	275	–	–
ZDK 2.5-2V	KEMA 97ATEX4677 U	550	22	2.5	440	440	275	440	440	275	–	–
ZDK 2.5-2DU-PE	KEMA 97ATEX4677 U	550	20	2.5	440	440	275	440	440	275	–	–
ZDU 1.5	KEMA 01ATEX2106 U	550	15	1.5	275	275	176	275	550	176	275	–

1) Please refer to the catalogue and the certificate for details of precisely which article is approved.

2) The outer cross-connection openings must be used for type ZQV.

Maximum voltage

Range [1]	Certificate No.	Rated voltage	Rated current	Nominal cross-section	Maximum voltage (V) (letters refer to the diagrams on page W.28)							
Z...		V	A	mm²	A	C	D	E	F	G	H	I
ZDU 1.5/3AN	KEMA 01ATEX2106 U	550	15	1.5	275	275	176	275	550	176	275	–
ZDU 1.5/4AN	KEMA 01ATEX2106 U	550	15	1.5	275	275	176	275	550	176	275	–
ZDU 2.5	KEMA 97ATEX2521 U	550	21	2.5	275	275	275	275	275	275	275	–
ZDU 2.5/2X2AN	KEMA 97ATEX2521 U	550	21	2.5	–	–	–	–	–	–	–	–
ZDU 2.5/3AN	KEMA 97ATEX2521 U	550	21	2.5	275	275	275	275	275	275	–	–
ZDU 2.5/4AN	KEMA 97ATEX2521 U	550	21	2.5	275	275	275	275	275	275	–	–
ZDU 4	KEMA 97ATEX2521 U	550	28	4	275	275	275	275	275	275	275	–
ZDU 6	KEMA 97ATEX2521 U	550	36	6	275	275	275	275	275	275	275	–
ZDU 6/3AN	KEMA 00ATEX2107 U	550	36	6	275	275	275	275	275	275	–	–
ZDU 10	KEMA 99ATEX5514 U	550	50	10	550	550	–	550	550	–	–	–
ZDU 10/3AN	KEMA 00ATEX2107 U	550	50	10	550	550	275	550	550	–	–	–
ZDU 16	KEMA 99ATEX5514 U	550	66	16	550	550	–	550	550	–	–	–
ZDU 16/3AN	KEMA 00ATEX2107 U	550	66	16	–	–	–	–	–	–	–	–
ZDU 35	KEMA 00ATEX2107 U	690	109	35	550	550	–	550	550	–	–	–
ZDU 2.5-2	KEMA 97ATEX4677 U	550	21	2.5	440	440	275	550	550	275	110	
ZDU 2.5-2/3AN	KEMA 97ATEX4677 U	550	21	2.5	440	440	275	550	550	275	110	–
ZDU 2.5-2/4AN	KEMA 97ATEX4677 U	550	21	2.5	–	–	–	–	–	–	–	–
ZDU 4-2	KEMA 97ATEX4677 U	550	28	4	440	440	275	550	550	275	110	
ZDU 4-2/3AN	KEMA 97ATEX4677 U	550	28	4	440	440	275	550	550	275	110	
ZDU 4-2/4AN	KEMA 97ATEX4677 U	550	28	4	440	440	275	550	550	275	110	
ZDU 6-2	KEMA 97ATEX4677 U	550	36	6	440	440	275	550	550	275	110	
ZDU 6-2/3AN	KEMA 97ATEX4677 U	550	36	6	440	440	275	550	550	275	110	
ZDUA 2.5-2	KEMA 97ATEX4678 U	275	20	2.5	275	275	110	275	275	110	–	–
ZDUB 2.5-2/...	KEMA 97ATEX2755 U	550	21	2.5	–	–	–	–	–	–	–	–

1) Please refer to the catalogue and the certificate for details of precisely which article is approved.