Weidmüller Service

Best advice, best solutions

Services tailored to customers' needs

Service – at Weidmüller that means diversity. And it also means that you can take advantage of our comprehensive resources:

- Production of terminal rails and enclosures fitted with our modular terminals and other modules, and prewired
- Fitting of cable glands and the marking of terminals, conductors and enclosures according to your specification
- Competence in the processing of enclosure materials such as aluminium, plastics, sheet steel and stainless steel
- Flexibility in the product selection: besides Weidmüller products we can also integrate yours and even those of other manufacturers

This range of services enables Weidmüller to act as an external service provider to increase your capacities. And demanding standards guarantee a high level of quality every time.

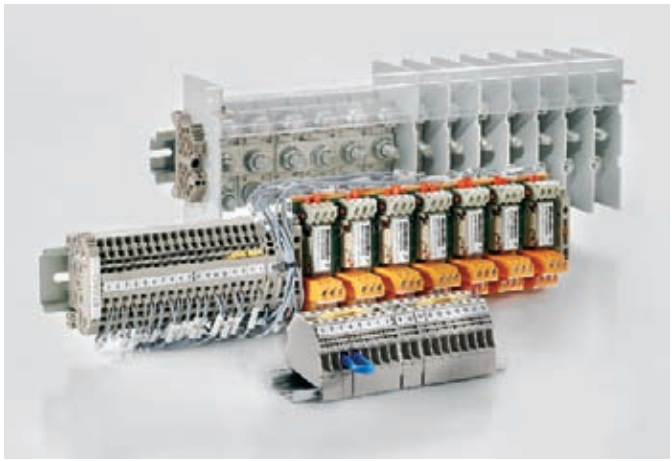
The best advice for the best solutions

The start of a good partnership is always characterised by an intensive exchange of information to define the respective positions. Our contribution focuses on detailed advice with respect to:

- Optimum choice of products
- Practical pre-assembly
- Integration into your systems
- Consideration of requirements such as certification, classes of protection or hazard protection as required by your industry

That avoids mistakes right from the start – totally in keeping with the effective handling of the project, totally in keeping with perfect results. Our experience helps you create the foundation for good business and satisfied customers.

Overview of services



Production of terminal rails

Terminal rails are manufactured from steel, stainless steel, aluminium or copper to suit the diverse applications. And we can produce terminal rails with elongated or round holes, or in other forms to suit your requirements exactly. Terminal rails are fitted with modular terminals or electronic products, prewired and marked according to your specification.

The benefits for you

- No need to procure individual components
- No need to mount individual components
- No unnecessary stocks
- Just one order number for your pre-assembled terminal rail
- Constant high quality

Production of enclosures

High-tech brings benefits. Our state-of-the-art production methods open up new options for you:

- Inclusion of holes and threads in the enclosure
- Enclosure cover with hinges and other accessories if required
- More complex machining such as milling of contours or reaming of holes
- Special paint finishes: To protect against the effects of the weather, your enclosures can be painted individually. Simply specify the colour and printing you require. Special paint finishes and powder coating are also possible.

Enclosures are adapted to suit the intended application exactly. You get a tailored, individual product and the quality is guaranteed by our adherence to demanding standards. Does your product require a special approval? Our accredited laboratory can test the complete product and confirm that its design complies with the standards! With every delivery we document the corresponding approvals (e.g., ATEX, GL, UL, GOST, etc.).

The benefits for you

- Enclosures in various sizes and materials
- Inclusion of optional accessories such as hinges and locks
- Complex machining processes and special packaging
- Ready-to-use, certified products for all types of applications.

Overview of services

Electronics production

We manufacture according to your specifications: ranging from PCB assembly to 100%-tested component assemblies. We bring the individual parts together according to your documents: whether for materials procurement, provision, or withdrawal from our stock. All production processes and the entire range of qualified expertise are at our disposal: from hand assembly to SMD assembly. Our state-of-the-art production and testing facilities guarantee consistent quality.

The benefits for you

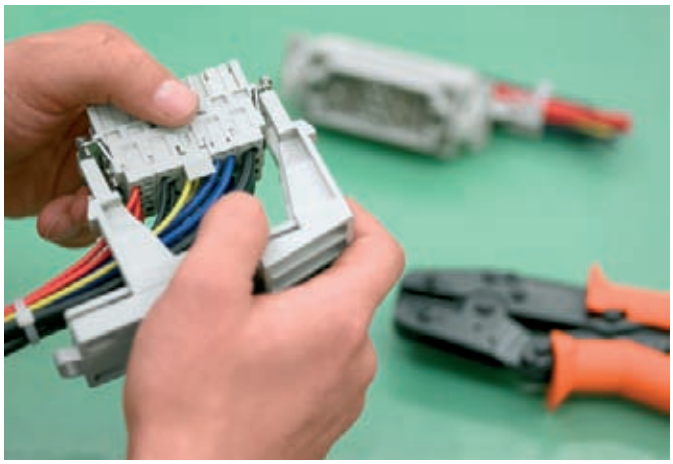
- Solutions for custom tasks
- Complex component assemblies including enclosures from a single-source supplier
- Reduction of your procurement and storage of individual parts

„RockStar“ heavy-duty connectors and cable assembly

To help ensure that your switchgear cabinets and installations are put into operation without delay, Weidmüller can supply pre-fabricated components such as heavy-duty connectors. These are assembled and prewired according to your specification and are supplied ready to connect. If required, we can also supply the finished enclosure with the heavy-duty connectors already integrated. An entire spectrum of application possibilities are available with our ConCept modular connector system. This modular system enables the flexible combination of diverse modules. Custom crimping and cabling is included on request! Do you prefer a personal touch? We can laser-label your company logo and article number onto our RockStars! In total compliance with your requirements.

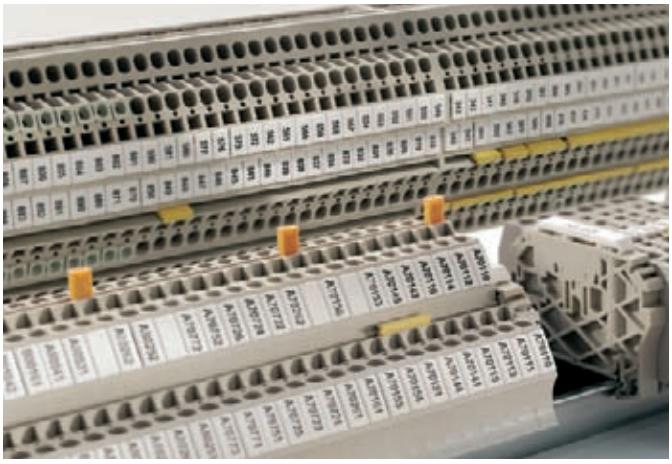
The benefits for you

- Special requirements with respect to font, number of characters, material and printing durability for your markers
- Prewiring of connectors saves you valuable installation time
- Modular connector system can be ordered pre-crimped



Marking

Whether multi-line labelling, white or coloured terminal markers or group designations, the Weidmüller range can cater for every marking task – fast, clear and according to European standards. However, we can also supply you with preprinted markers to match your specification. Simply tell us the type of marker you require, the colour, the printing sequence and the text, and we'll look after the rest. If required, we can also install the finished markers during assembly.



Equipment labelling

Device markers are essential for marking your electrical installations. Therefore, Weidmüller can supply rating plates designed specially for your application. A wide range of different shapes, colours, materials and fixings – riveted, screwed or bonded with adhesive – are available from which to choose. And a whole range of different fonts mean that we can handle every request.

Integration of special accessories

IIn some cases it is necessary to integrate special accessories. This is no problem for Weidmüller because we can integrate buttons, switches, warning lamps, plugs or couplings – all properly planned, fitted, connected and tested. And that includes the products of other manufacturers as well as our own. We shall also be happy to advise you on standard accessories such as hinges.

The benefits for you

- Rating plates in various materials
- Individual printing or laser engraving
- Equipment and accessories to your specification

Digital support

RailDesigner®

RailDesigner® is a Weidmüller program for planning, assembling and ordering both terminal rails and enclosures. And it's so easy to use:

- Fast acquisition of all necessary data
- Realistic-looking graphic user interface and ideal conditions for simple assembly of your terminal rails and enclosures with all the necessary components
- Simply clip on all the products you need and add accessories such as markers or cross-connectors
- To configure an individual enclosure, simply choose an enclosure type from a standard range and then add holes and other accessories to suit your requirements

These parameters form the foundation for a perfect software assistant. You can view the enclosure on the screen complete with all the configured products, and print out a hardcopy, or simply send the file to Weidmüller via e-mail in the form of an order. RailDesigner® provides you with optimum planning security and clarity during the design phase. And hence simplifies the ordering process enormously.

M-Print® PRO label designer

The comprehensive range of Weidmüller services includes the M-Print® PRO software.
This is a professional-standard, Windows®-based program for printing and ordering labels and markers that is coordinated with our current printing systems and marking materials.

M-Print® PRO enables you to design your labelling materials professionally and quickly. Texts, borders, lines, graphics, barcodes, serial numbers and photographs are all possible. The interface to RailDesigner® or your CAE system enables the transfer of all your configured data.

Online catalogue

If you have questions about the specifications and details of our products, perhaps even outside normal business hours, then our online catalogue at **http://catalog.weidmueller.com** open 24 hours a day, 365 days a year – is the perfect source of information. Besides product features and part numbers, it contains extensive additional information on all product groups. And for further information, offers and your personal contact, simply consult the Weidmüller website at **www.weidmueller.com**.

Technical appendix

Technical appendix

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 IEC 60664-1 “Insulation coordination for electrical equipment in low-voltage systems”.

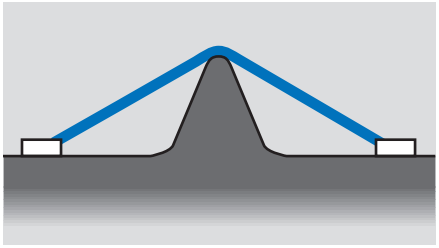
The design data resulting from these provisions is – if applicable – specified in this catalogue for each product.

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:

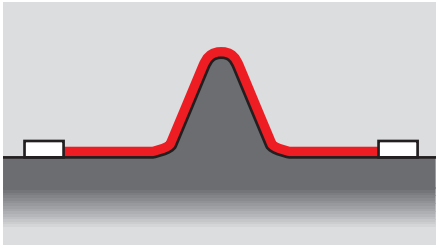
- Anticipated overvoltage
  rated impulse withstand voltage
- Used
  surge protection devices
- Measures to prevent pollution
  pollution severity

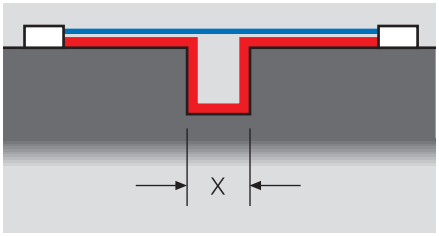


Creepage distances

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)
- **Surge category**

Table 1: Rated impulse withstand voltages for electrical equipment

Rated voltage of power supplies system *) in V		Rated impulse withstand voltage in kV			
Three-phase systems	Single-phase systems with neutral point	Electrical equipment at the supplies point of the installation **(Surge category IV)**	Electrical equipment as part of the permanent installation **(Surge category III)**	Electrical equipment to be connected to the permanent installation **(Surge category II)**	Specially protected electrical equipment **(Surge category I)**
	120 bis 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 of, if no values are available, the values of the preceding line apply.			
*) to IEC 38					

Surge categories

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

Surge category I

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

Überspannungskategorie II

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

Surge category 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.

Surge category VI

- Equipment for use at or near the power supplies in the electrical installations of buildings, between the principal distribution 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 surge 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 supplies and the corresponding network type.

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

Rated voltage of the power supplies system (mains)*)	Voltages for table 4	
	For insulation phase-to-phase[1)]	For insulation phase-to-earth[1)]
	All systems	3-wire systems neutr. point earthing
V	V	V
12.5	12.5	–
24 / 25	25	–
30	32	–
42 / 48 / 50**)	50	–
60	63	–
30–60	63	32
100**)	100	–
110 / 120	125	–
150**)	160	–
220	250	–
110–220	250	125
120–240		
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 supplies system (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 wire[2)]	3-phase 3-wire systems unearthed[1)] 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 supplies system.

**) 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 **upper limit temperature** of a component is the rated value determined by the materials used. The total of the ambient temperature plus the temperature rise caused by the current load (power loss at volume resistance) may not exceed the upper limit temperature of the component, otherwise it will be damaged or even completely ruined.

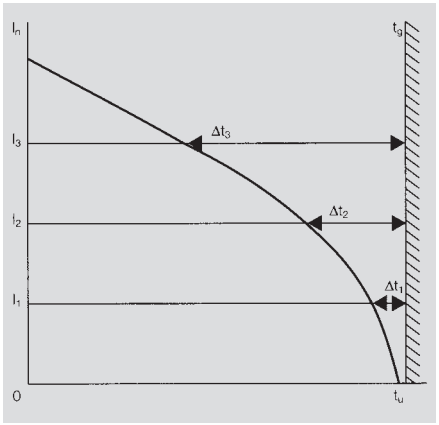
The current-carrying capacity is hence not a constant value, but rather decreases as the component ambient temperature increases. Furthermore, the current-carrying capacity is influenced by the geometry of the component, the number of poles and the conductor(s) connected to it.

The current-carrying capacity is determined empirically according to DIN IEC 60512-3. To do this, the resulting component temperatures t_{b1}, t_{b2}, t_{b3} and the ambient temperatures t_{u1}, t_{u2}, t_{u3} are measured for three different currents I_1, I_2, I_3.

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.

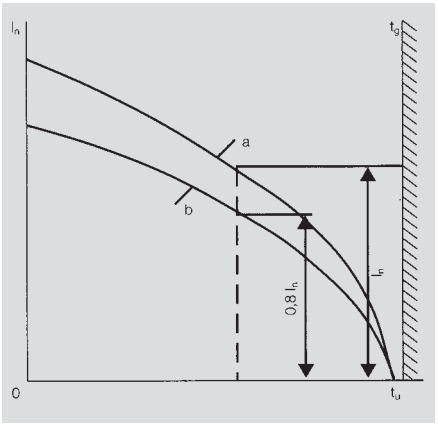
Base curve

max. temperature of component



t_g = maximum temperature of component
t_u = ambient temperature
I_n = current

Derating curve



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

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, $\Delta t_1 = t_{b1}-t_{u1}$, $\Delta t_2 = t^{b2}-t_{u2}$, $\Delta t_3 = t_{b3}-t_{u3}$ are plotted for every current I_1, I_2,I_3 to the left of the perpendicular line. The points generated in this way are joined to form a roughly parabolic curve.

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 in such a way that they are suitable for practical applications, as experience has shown. If the derating curve exceeds the currents in the low ambient temperature zone, which is given by the current-carrying capacity of the conductor cross-sections to be connected, then the derating curve should be limited to the smaller current in this zone.

CE marking

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.

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

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 installations 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
- surge 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 charac-teristics – 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 supplies 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 an 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 supplies with a surge protection device (a PU model for a 230/400 V AC mains supplies 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 surge protection devices.

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

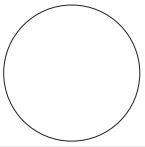
IP class of protection to DIN EN 60529

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

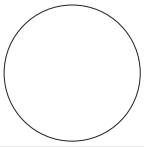
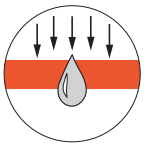
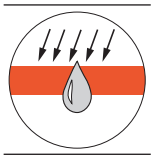
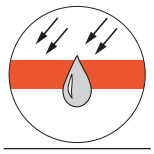
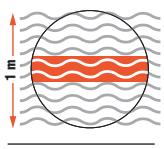
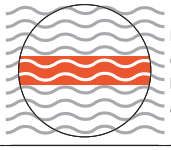
Example: **I P 6 5**

- 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

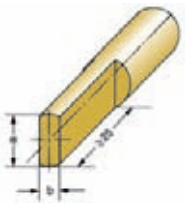
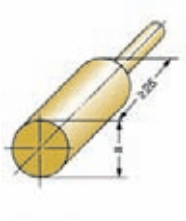
AWG

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.

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

Plug gauge to IEC 60947-1

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

Cond. cross-sect.	Plug gauge					
	Form A			Form B		
						
Rigid conductor (solid or stranded) mm²	Designation	Diameter a mm	Width b mm	Designation	Diameter a mm	Permissible deviation for a and b
1.5	A 1	2.4	1.5	B 1	1.9	
2.5	A 2	2.8	2.0	B 2	2.4	0 – 0.05
4	A 3	2.8	2.4	B 3	2.7	
6	A 4	3.6	3.1	B 4	3.5	
10	A 5	4.3	4.0	B 5	4.4	0 – 0.06
16	A 6	5.4	5.1	B 6	5.3	
25	A 7	7.1	6.3	B 7	6.9	
35	A 8	8.3	7.8	B 8	8.2	0 – 0.07
50	A 9	10.2	9.2	B 9	10.0	
70	A 10	12.3	11.0	B 10	12.0	
95	A 11	14.2	13.1	B 11	14.0	0 – 0.08
120	A 12	16.2	15.1	B 12	16.0	
150	A 13	18.2	17.0	B 13	18.0	

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 150 (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 halogen-free flame-retardant agent	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 60093	Ω x cm	–	10^{11}	10^{14}
Electric strength to IEC 60243-1	kV / mm	>10	10	160
Tracking resistance (A) to IEC 60112	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	Polyamid PA	Polyamid PAGF	Polybutylene-terephthalate PBT	Polycarbonat 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 (PAGF)** 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 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 halogen-free flame-retardant agent	excellent dimensional stability very good mechanical properties halogen-free flame-retardant agent	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

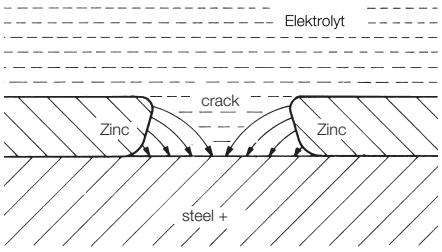
*) also certified to LUL E 1042

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 curves

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

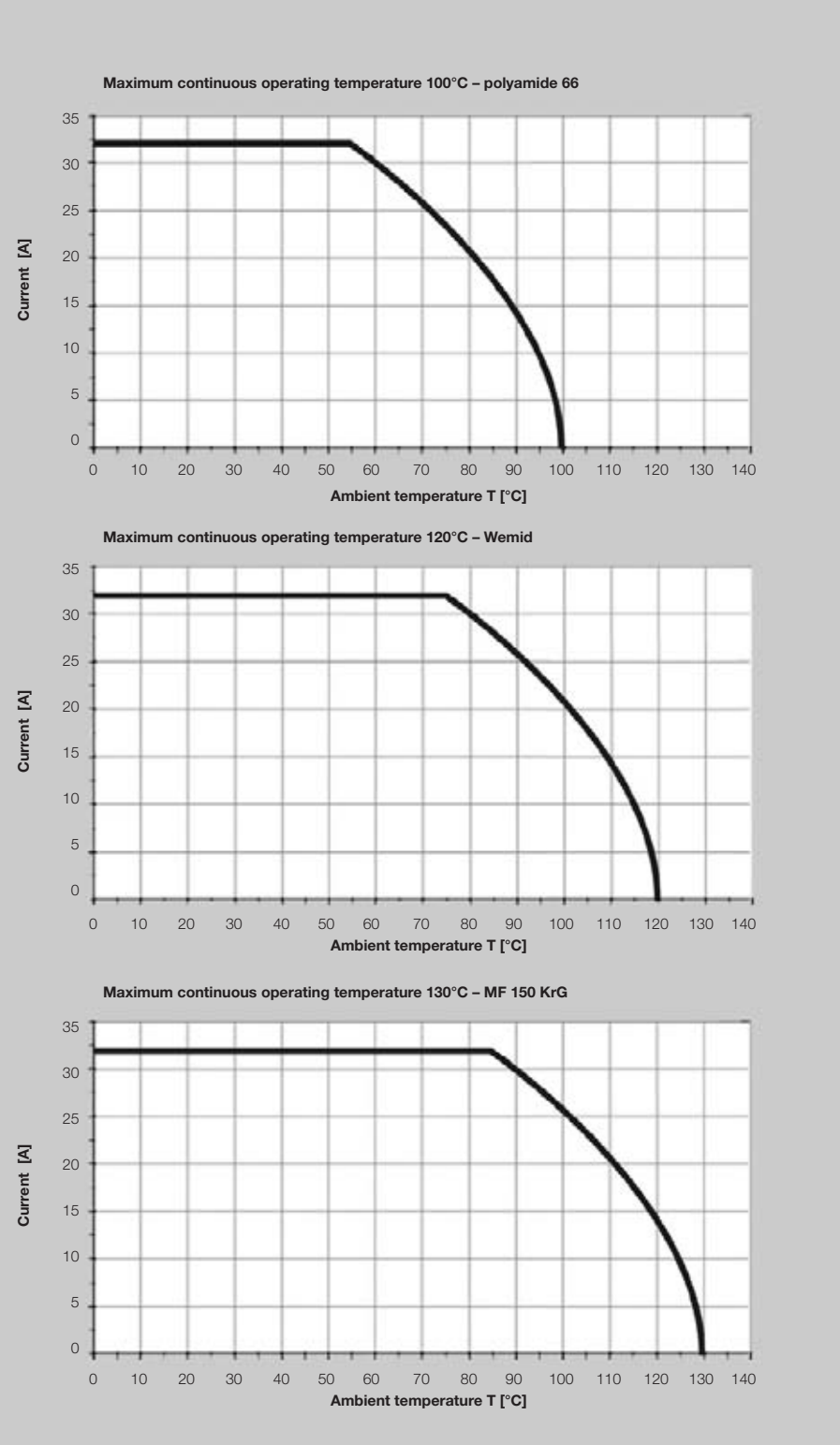
An upper limit temperature that may not be exceeded in continuous operation is specified for every Weidmüller modular terminal.
The continuous operating temperature depends on the insulating material used for the modular terminal. According to EN 60947-7-1 the maximum permissible temperature rise of 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 60947-7-1 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 the current–temperature rise curves for a rated current of 32 A and the following three insulating materials:

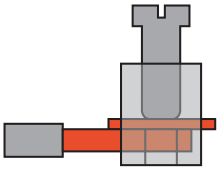
- Thermoplastic (polyamide 66)
- WEMID
- Thermosetting plastic (MF 150 KrG)

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 thermosetting plastic insulating materials (KrG). Above these temperature limits, the current should be reduced as shown on these graphs.

Derating curves

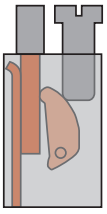


Free choice of connection technology



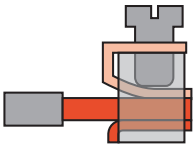
Clamping yoke connection technology

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.



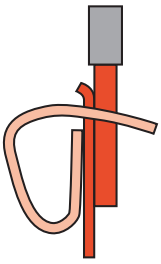
TOP connection technology

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.



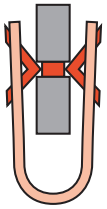
Leaf spring connection technology

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.



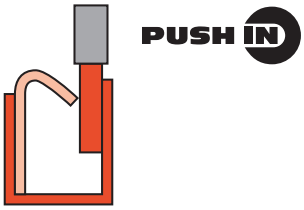
Tension clamp connection technology

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 connection technology

The **IDC connection technology** (Insulation Displacement Connection) 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.



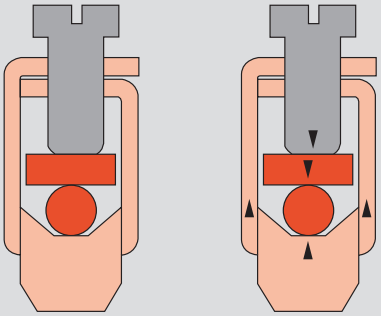
Push In-Connection technology

In the **Push In connection technology** 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

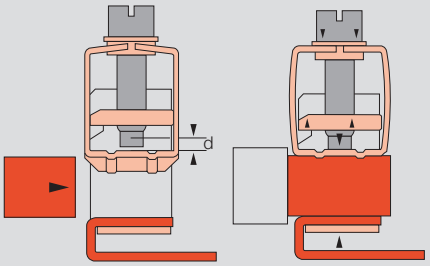
Clamping yoke

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.



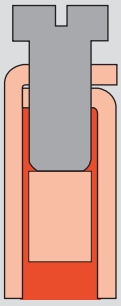
Leaf clamp

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

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.



ATEX directives

Since July 1, 2003, all new facilities in explosion risk zones must be certified according to ATEX Directive 94/9/EG or ATEX 95 (ATEX: ATmosphère EXplosive = explosive atmosphere). This directive is one of the "New-Approach" directives. It is valid in all European Union countries, as well as Iceland, Lichtenstein and Norway. In these countries, the directive refers to the sale and commissioning of products which have been designed particularly for high explosion risk environments (where explosive atmospheres exist due to gases, vapours, mists, or dusts). It now also covers the mining sector and purely mechanical devices.

Class of protection

Type of protection	Code	CENELEC EN	IEC	Product category explosion protect.
General requirements	–	60079-0	60079-0	–
Oil immersion	o	60079-6	60079-6	2
Pressurised apparatus	p	60079-2	60079-2	2
Powder filling	q	60079-5	60079-5	2
Flameproof enclosure	d	60079-1	60079-1	2
Increased safety	e	60079-7	60079-7	2
Intrinsic safety	ia	60079-11	60079-11	1
Intrinsic safety	ib	60079-11	60079-11	2
Intrinsic safety	ic	60079-11	60079-11	3
Type n (Ex 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

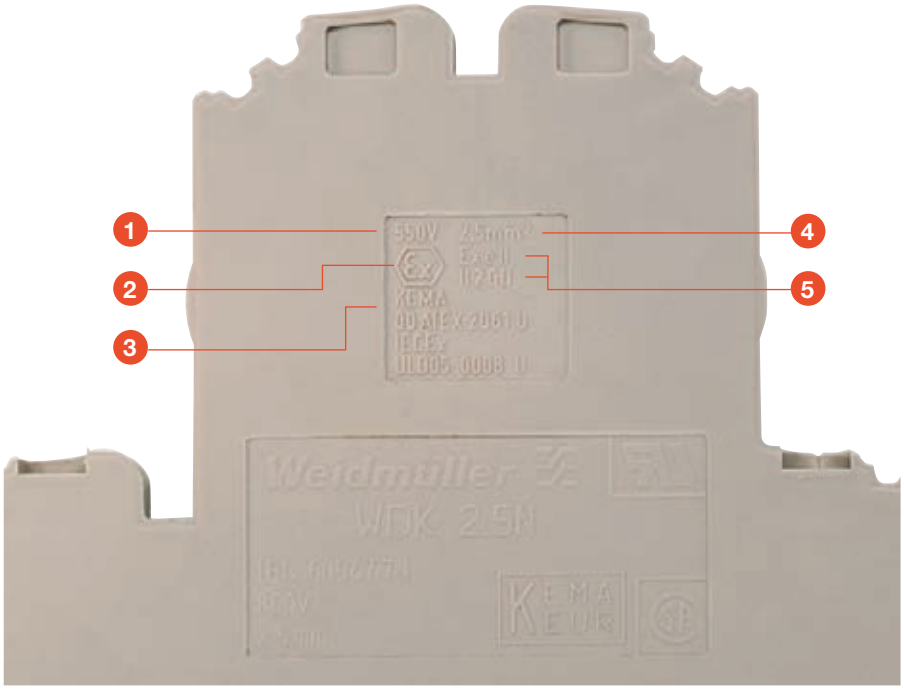
Gas (e.g.)	CENELEC	NEC 500
Propane	IIA	D
Ethylene	IIB	C
Hydrogen	IIC	B
Acetylene	IIC	A
Methane (mining)	I	mining (MSHA)

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

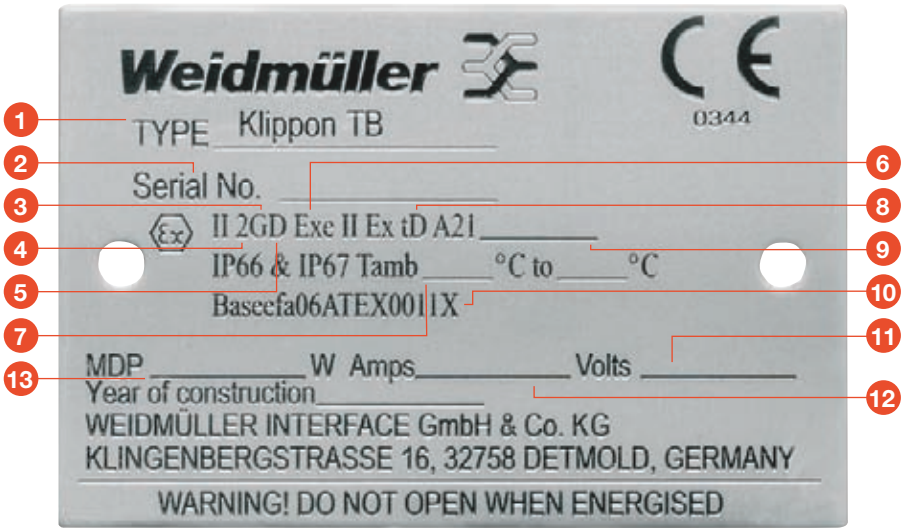
ATEX codes

Example of marking – modular terminal WDK 4 N V



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

Example of marking – enclosure fitted with components for enhanced safely



1. • Type designation
2. • Serial number
3. • Approved for use in gases “G”
4. • Product category 2 – for use in zone 1 or 2
5. • Approved for use in dusts “D”
6. • CENELEC protection type “e” – increased safety
7. • Ambient temperature range deviating from the standard
8. • CENELEC protection type tD
9. • Temperature class, e.g. T6 (gas), and max. surface temperature (dust) (for example T6 T85 °C)
10. • Certificate number
11. • Rated voltage
12. • Rated current
13. • Power loss

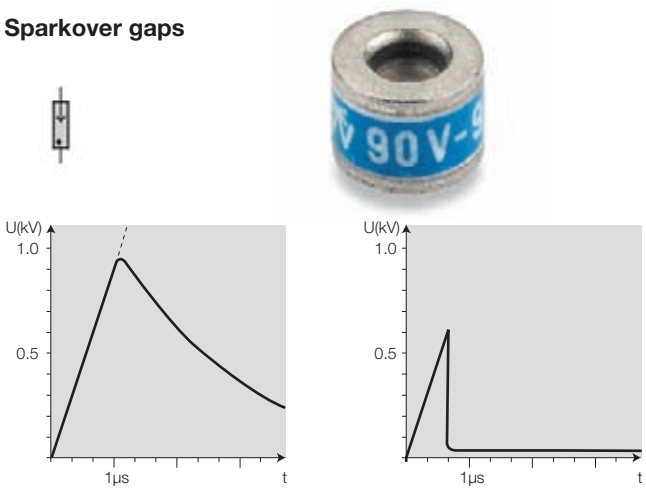
Components for Surge protection

Es gibThere is no ideal component that can fulfil all the technical requirements of surge protection equally effectively. Instead, we use a variety of components whose different physical methods of operation complement each other; these possess distinct protective effects. Super-fast reaction time, high current-carrying capacity, low residual voltage and long service life cannot be found in one single component.

In practice we use three principal components:
1. sparkover gaps
2. varistors
3. suppression diodes

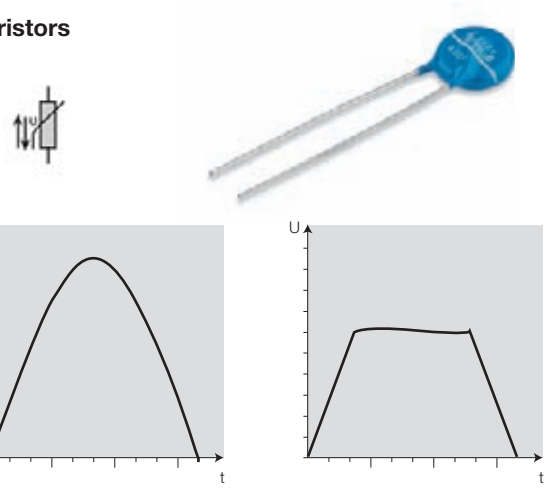
Therefore, to optimise the surge protection, carefully matched groups of these components are often combined in one protective module.
4. Combination circuits

1. Sparkover gaps



The name says it all. High voltages are discharged to earth via a spark gap (e.g. gas discharge tube) that has been fired. The discharge capacity of sparkover gaps is very high – up to 100 kA depending on type.
Gas sparkover gaps are incorporated in insulating glass or ceramic (aluminium oxide) housings. The electrodes of the sparkover gap are made from a special alloy and placed in housings which are vacuum seald and filled with a noble gas such as argon or neon. The shape and spacing of the electrodes of the sparkover gap are such that the applied voltage results in a field strength distribution which has a fairly exact voltage for firing the sparkover gap. Bipolar operation is typical of sparkover gaps. This firing voltage value depends, however, on the steepness of the applied surge.
The characteristic curve for the firing of a gas-filled sparkover gap reveals that the response time shortens as the surge rise becomes steeper. The firing voltage is thus correspondingly higher. The outcome of this is that with very steep surge rises, the firing voltage – i.e. the protection level – is relatively high and can lie considerably higher than the rated voltage of the sparkover gap (approx. 600-800 V).
The problematic quenching behaviour of the fired sparkover gap can be a disadvantage. The arc has a very low voltage and is only extinguished when the value drops below this. Therefore, when designing the geometry of a sparkover gap, care is taken to ensure that – through long distances and also through cooling – the voltage of the arc remains as high as possible and so is quenched relatively quickly. Nevertheless, a longer follow current can ensue. This can draw its energy, in addition, from the incoming supply of the circuit to be protected. One effective solution is to wire a sparkover gap and a fast-acting fusible link in series.

2. Varistors



The varistors used in surge protection (MOV – Metal Oxide Varistor) are voltage-dependent resistors in the form of discs of zinc oxide. Just above their rated voltage the resistance becomes so small that they become conductive. The surge is limited by the varistor allowing the current to pass. Bipolar operation is typical of varistors.

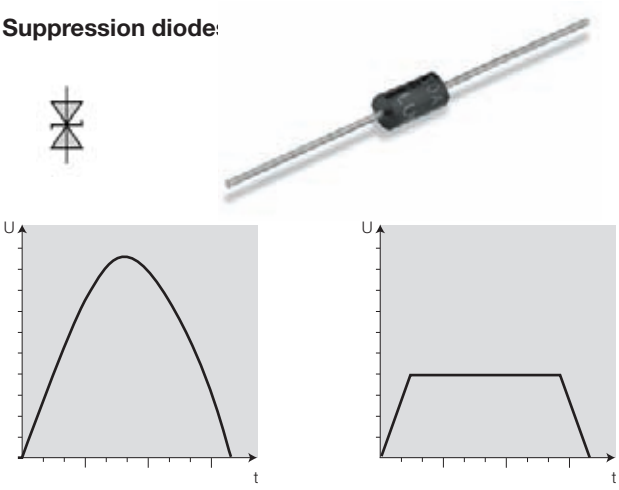
Varistors have a medium to high discharge capacity; this lies in the region of 40-80 kA depending on type. The response time is less than 25 ns. Residual voltages are significantly lower than those of sparkover gaps. The lower protection level achieves better surge protection and no power follow currents are drawn from the power supplies.

However, varistors also have their disadvantages. Their ageing phenomena and relatively high capacitance must be taken into account.

Leakage currents occur over time, depending on the frequency of the triggering, because individual resistance elements break down. This can cause temperature rise or even destroy them completely.

The high capacitance of varistors causes problems in circuits with high frequencies. Attenuation of the signals must be reckoned with for frequencies above about 100 kHz. Therefore, varistors are not recommended for use in data transmission systems.

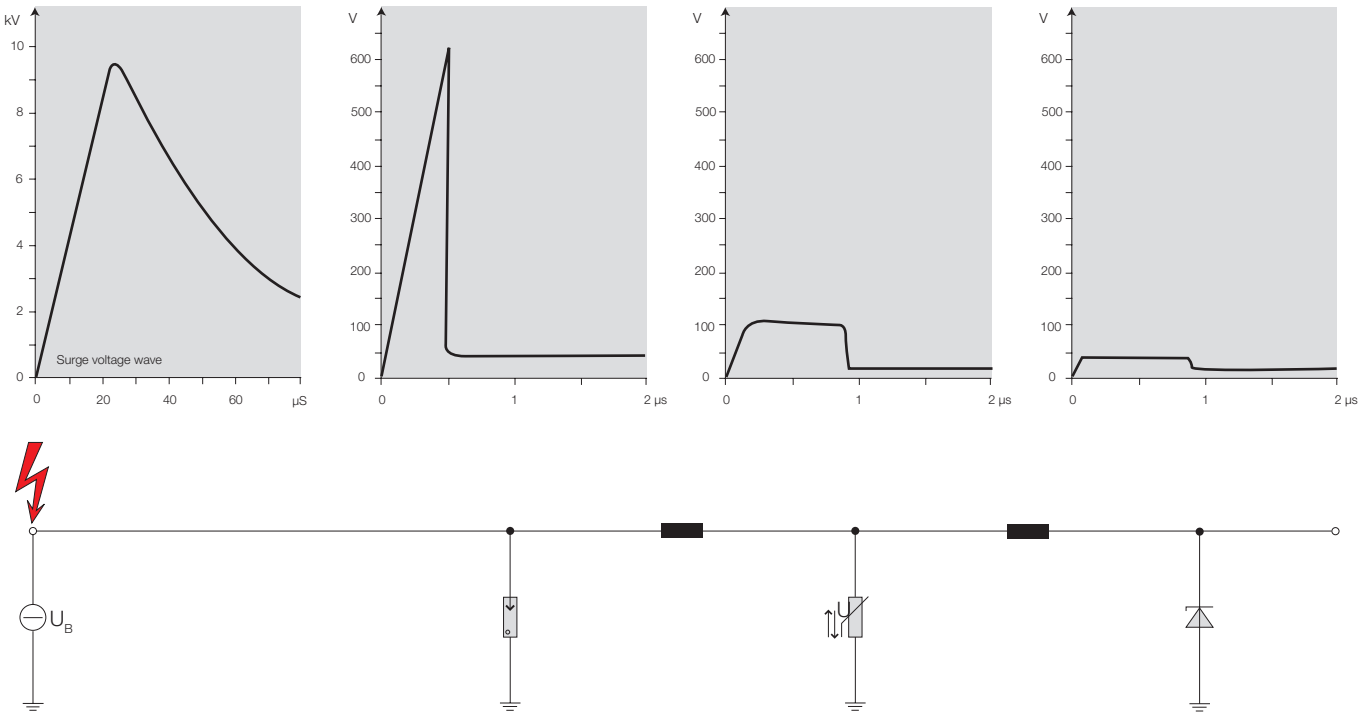
3. Suppression diode



A suppression diode operates in a similar manner to a Zener diode. Unidirectional and bidirectional versions are available. The unidirectional suppression diode is often used in d.c. circuits. Compared to conventional Zener diodes, suppression diodes have a higher current-carrying capacity and are considerably faster. They very quickly become conductive above a defined breakdown voltage and hence discharge the surge. However, their current-carrying capacity is not very high – less than 1800 W/ms. On the other hand, they exhibit an extremely fast response time, lying in the picoseconds range. And the low protection level of suppression diodes is another advantage. Unfortunately, suppression diodes possess a significant inherent capacitance. Therefore, like with varistors, their possible attenuation effect on high frequencies must be taken into account.

4. Combination circuits

Combining the components described above results in surge fine protection products that can match individual requirements. If a voltage pulse reaches the input of such a combination circuit, then the gas discharge tube is fired and discharges high current. The residual pulse is attenuated by a downstream inductance and subsequently received and limited by the varistor and/or suppression diode. If the gas discharge tube is not triggered, i.e. in the case of a slower voltage rise, then the pulse is discharged by the varistor or the suppression diode alone.
The sequence of the individual components results in an increasing response sensitivity towards the output.
An interference voltage with a rise of 1 kV/µs and a peak value of 10 kV at the input is limited by a gas-filled surge arrester to approx. 600-700 V. The second stage, decoupled from the first by means of an inductance, suppresses this value to approx. 100 V. This voltage pulse is then reduced to approx. 35 V (in a 24 V protective combination) by the suppression diode. Therefore, the downstream electronics need only be able to cope with a voltage pulse of approx. 1.5 x UB.

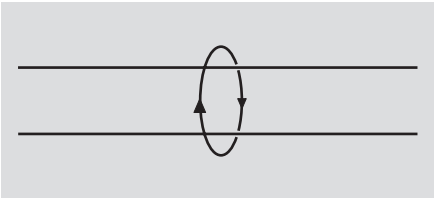


Installation of Surge protection circuits

Surge fine protection components should be installed in the immediate vicinity of the devices to be protected.
The PE connection of the device must be connected to the surge fine protection component.

- Use conductors with a cross-section of 2.5 – 4 mm² for the earthing lines.
- Keep the connections as short as possible.
- Avoid wiring several earthing lines in series.
- Design the earthing installation according to VDE 0100, VDE 0185, VDE 0800 and FBO 14 (Deutsche Telekom code).

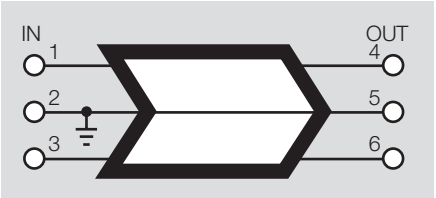
Laying the lines



Within the installation, the signal lines should take the shortest route to the surge fine protection components and the electronics. Avoid laying the lines parallel to other lines, also avoid laying protected and unprotected lines together (take special care with cable ducts and cable trays).

If parallel routing is unavoidable, the distance between the lines should be at least 0.5 m.

Marking of components



Surge protection components are to be marked with an arrow or the letters “IN”. The arrow must point towards the protected side of the component, i.e. a surge is diminished in this direction (see “Combination circuit”).

Glossary

3+1 circuit	Surge protection for TT/TNS systems with three varistors and one N-PE spark-over gap; avoids accidental energisation in the case of defective varistors.
ageing	A change in the original performance data caused by interference pulses, operation or unfavourable ambient conditions.
arrester	Protective device that discharges energy symmetrically between the conductors or asymmetrically between the conductors and earth.
arrester disconnector	Device to isolate an arrester from the mains power supplies in the case of a failure and also to indicate this.
asymmetric interference voltage	Voltage between DC offset and reference potential (earth).
Backup fuse	Max. fuse rating to be provided depending on conductor cross-section and/or longitudinal decoupling.
binary signals	Switching signals with the status ON and OFF
capacitive coupling	Coupling of interference circuit and useful circuit via coupling capacitances owing to a difference in potential.
class B/ T1/ Kl.I (previously class B)	Prescribed for the purpose of lightning protection equipotential bonding to DIN VDE 0185 part 1 (see also class I).
class C/ T2/ Kl.II (previously class C)	Prescribed for the purpose of surge protection in a permanent installation, preferably for use in impulse test voltage category III (see also class II).
class D/ T3/ Kl.III (previously class D)	Prescribed ribed for the purpose of surge protection in a permanent installation, preferably for use in impulse test voltage category II (see also class III).
class I	Prescribed for the purpose of lightning protection equipotential bonding to IEC 37A/44/CDV (see also class B).
class II	Prescribed for the purpose of surge protection in a permanent installation, preferably for use in impulse test voltage category III (see also class B).
class III	Prescribed for the purpose of surge protection in a permanent installation, preferably for use in impulse test voltage category II (see also class D).
class of protection of housing (IP code)	Degree of protection that the housing provides against coming into contact with conductive parts as well as the ingress of solid foreign bodies or water; tested according to IEC 529 section 7.4.
combined circuit	Protective circuit comprising, for example, gas discharge tube, varistor and/or suppression diode.
combined surge	The hybrid generator generates a 1.2/50 µs pulse during no-load operation and an 8/20 µs pulse during a short-circuit; the ratio of no-load peak voltage Uoc to shortcircuit peak current Isc is 2 W.
common-mode interference	Interference source lies between signal wire and reference conductor (e.g. capacitive coupling or increase in potential of separate earths).
conductive coupling	Interference circuit and useful circuit have a common impedance (conducted).
continuous operating current Ic	Current per protective path at continuous voltage Uc.
DK4U	Slimline modular protective terminal with varistor or gas discharge tube or suppression diode.
DK5U	Slimline modular protective terminal with combined circuit for current loops, with screw connection.
DK6U	Slimline modular protective terminal with combined circuit for 120 and 230 V current loops, with screw connection.
DKU	Slimline modular protective terminal with combined circuit for binary signals, with screw connection.

EGU 1	Surge protection in build-in housing with gas discharge tube and varistor for binary signals, with fuse and voltage indicator.
EGU 2	Surge protection in build-in housing with gas discharge tube, varistor and suppression diode for binary signals, with fuse and voltage indicator.
EGU 3	Surge protection in build-in housing with gas discharge tube and varistor for 50 mA and 1.5 A current loops.
EGU 4	Surge protection in build-in housing with gas discharge tube, varistor and suppression diode for 100 mA and 1.5 A current loops.
EMV EMC	Electromagnetic Compatibility
follow current If	Current that flows through a surge protection device after the discharge process and is fed from the mains power supplies.
gas discharge tube (GDT)	Enclosed switch with high current-carrying capacity depending on voltage.
inductive coupling	Coupling through two or more conductor loops through which current is flowing.
insertion loss	Attenuation in decibels added to a circuit by inserting a four-pole network.
Insta	Installation housing to DIN 43880, suitable for incorporating in a distribution board.
insulation coordination	Current impulse strength of the insulation in installation sections, to DIN VDE 0110 part 1.
Ipeak = I_{imp}	Peak current value of test impulse.
Isn	Peak value of rated discharge current.
IT system	Network with three phase conductors insulated with respect to earth potential; the PE of the building is not connected to the network.
leakage current	Current discharged to PE at rated voltage.
LEMP	Lightning Electromagnetic Pulse
lightning surge current Iimp	Defined by the peak current value Ipeak and the charge Q in the test according to class I with 10/350 µs pulse.
limit frequency	Specifies the maximum frequency at which transmission still functions; at higher frequencies the protective circuit attenuates so severely that transmission is no longer possible.
longitudinal voltage	Interference voltage between active conductor and earth.
LPZ	Lightning Protection Zone
max. continuous voltage Uc	Maximum effective AC voltage or maximum DC voltage that may be applied continuously to the protective path of a surge protection device; continuous voltage = design voltage.
max. discharge current Imax	Peak value of 8/20 µs current in class II (type 40 kA) operating duty test.
MCZ sp	Slimline modular protective terminal with tension spring connection and mounting rail contact for PE.
measured limiting voltage	Maximum voltage during the action of surges with a predefined impulse wave shape and amplitude in a test.
MOV	see “varistor”.
normal-mode interference	Interference source and useful source are in series (e.g. magnetic or conductive coupling).
PE	Protective and earthing system to which energy is discharged.
protection level Up	Specifies the residual voltage that can still be measured at the terminals during a surge impulse (preferred value – larger than maximum measured limiting voltage); key parameter characterising the performance of a surge protection device.

Glossary of Surge protection terms

protective path	Circuit of the components of a surge protection device; conductor to conductor, conductor to earth, conductor to neutral conductor, and neutral conductor to earth are designated as protective paths.
PU BC	Combined surge arrester of classes I and II in an Insta housing for discharging high pulses in power systems.
PU II	Surge arrester of class II in an Insta housing for extracting pulses in power systems.
radiation coupling	Electromagnetic field coupled in one or more conductor loops.
rated discharge current In	Peak value of 8/20 µs surge current in class II (type 20 kA) test.
RCD	see “residual current circuit-breaker”
residual current circuit-breaker	If a fault current exceeds a certain threshold, the residual current circuit-breaker is tripped within 0.2 s.
RSU	Surge protection on clip-on base, with gas discharge tube, varistor and suppression diode for 6 and 10 A current loops.
short-circuit strength	Maximum non-influenced short-circuit current that a surge protection device can withstand.
SPD	Surge Protection Device
suppression diode	Fast-acting (depending on voltage) semiconductor diode.
Surge (overvoltage)	Unwanted continuous or brief potential difference between conductors or between conductor and earth that causes interference or damage.
surge current 8/20 µs	Lightning test current with a front time of 8 µs and a time to half-value of 20 µs.
surge current 10/350 µs	Lightning test current with a front time of 10 µs and a time to half-value of 350 µs.
Surge protection (SP)	Circuit or wiring in a circuit to limit the output voltage.
Surge protection classes	Classification of electrical equipment according to its voltage strength related to the rated voltage (EN 50178).
Surge protection device	Unit with at least one non-linear component for limiting transient surges and discharging surge currents.
Surge protection installation	Device(s), including lines, to protect against surges.
surge voltage 1.2/50 µs	Surge voltage with a front time of 1.2 µs and a time to half-value of 50 µs.
symmetric interference voltage	Voltage between forward and return conductor (normal-mode voltage).
TAZ	see “suppression diode”
time to sparkover	Reaction times vary from a few microseconds to picoseconds depending on type and structure of protective module.
TN system	Network consisting of four or five conductors; three phase conductors and PEN enter the building; PE of building and PE of mains are connected together.
transverse voltage	Interference voltage between two conductors of a circuit.
triggered sparkover gap	A gas-filled sparkover gap that is fired at a preset voltage value by a capacitive discharge device.
TT system	Network consisting of four conductors, three phase conductors and N conductor enter the building; PE of building is not connected to mains.
unsymmetrical interference voltage	Voltage between conductor and reference potential (earth).
varistor	Voltage-dependent metal oxide resistor whose resistance decreases as the voltage increases.

Installation specification for Weidmüller PU II-Surge protection in power supplies networks

The surge protection device may only be installed by a qualified technician. Make sure you take account of your national connection conditions when installing.

1. Use

The PU II surge protection devices of class C (class II) are for protecting low-voltage consumer installations and electronic devices from voltage surges arising through atmospheric dis-charge (lightning) or switching activities. The PU II conforms to VDE 0675, part 6, class C (Dec 2002), IEC 61643-1 (03/2005), and ÖVE SN 60 part 4 and part 1. The voltage limiting function is performed by high-power metal oxide varistors.
The PU BC is a lightning arrester of class B/C (class I/II) to DIN VDE 0675, pt 6 (Nov 1989) and IEC61643-1 (03/2005), ENV 61024-1 (Jan 1995) and IEC 1312-1 (Feb 1995).
Integrated varistors guarantee the necessary equipotential bonding in the event of lightning strikes (lightning protection equipotential bonding in accordance with DIN VDE 0185, part 1 (Nov 1982)) between the building lightning protection system and the earthing system of the power supplies.
The PU III and PU D surge protection devices of class D (class III) protect low-voltage consumer installations and electronic devices from voltage surges and switching activities. The PU III and PU D are also installed after the PU C in small/storey distribution boards. The PU III and PU D satisfy the requirements of DIN VDE 0675, part 6, class C (Nov 1989), draft, DIN VDE 0675, part 6, A2 (Oct 1996) and IEC61643-1 (03/2005).

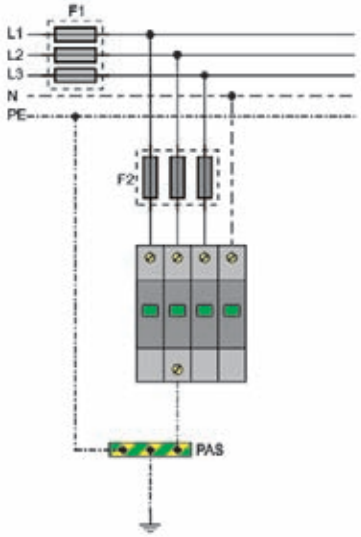
2. Installation specifications

2.1 Place of installation

The PU II must be installed in the meter cabinet or in a distributing cabinet in such a way that the terminal space is inaccessible to unauthorised persons. The PU BC is installed close to the feed in order to establish the necessary lightning protection equipotential bonding between the lighting protection system and the power distribution board. All arresters must be installed by a qualified electrician. The installation of systems with surge protection devices is described in VDE 0100 part 534 (Apr 1999) “Selection and erection of equipment”. This pre-standard is related to the following standards:

1. **IEC 60364-4-43**
   “Protection against surge resulting from atmospheric conditions and switching activities”
2. **IEC60364-5-53**
   “Selection and installation of electrical equipment”
3. **IEC 61024-1**
   “Protection of buildings against lightning strike”
4. **IEC 61312-1**
   “Protection against electromagnetic lightning impulse”

2.2 Electrical connection



The PU II surge protection device and PU BC lightning arrester should be connected between the phase conductors (L1, L2, L3) or, as the case may be, the neutral conductor (N) and earth (PE) of the consumer installation. The connecting conductors should be kept as short as possible. Ensure that unprotected conductors are not run parallel to protected wires.

2.2.1 Connection to the phase conductors and neutral conductor

As a rule, the same conductor cross-section is used for the connecting lines to the PU II or PU BC arrester as for the phase conductors (L1, L2, L3) and the neutral conductor (N). In the event of a reduction of the cross-section, a protective device (e.g. main terminal fuse) must be provided for short-circuit protection of the connecting lines. The arrester terminals must not be used as tee-off terminals. The back-up fuse used for the PU II can be up to a maximum of 125 A gL and for the PU BC, up to 160 A gL. Series connected residual-current devices (RCD) of type S (3 kA, 8/20 µs) must be surge proof.

Notes:
In the TN-CS system, 3-pole PU II devices are used. If the PEN conductor is run individually as PE and N, a 4-pole PU II must be used. According to DIN VDE 0100-534/A1 (Oct 1996), it is permissible in a TT system to install a PU II 3+1 280 V protection device. In the IT system with 400 V phase conductors, the PU II 3+1 385 V is installed for 385 V.

2.2.2 Installation of D arresters

The PU III and PU D arrester are installed in a similar way to the PU II. The PU III and PU D are integrated into the line to be protected and can protect electrical circuits of up to 16 A. Installation can be done in consumer units for a electrical circuit that protects, for example, monitors. The PO DS is suitable for local installation in devices or in cable ducts.

2.2.3 Connecting to earth

The arrester's earthing conductor must be connected by the shortest possible route (≤ 0.5m) to the earthing terminal of the consumer installation. Longer connection lines reduce the efficiency of the surge protection. Parallel routing with other electrical lines must be avoided. In electrical consumer installations with equipotential bonding, the earthed equipotential bonding strip can be used as connection point.
It must always be ensured that the arrester earth is connected to the earth of the consumer installation. For TN systems, the PEN conductor and the earthing conductor of the arrester must be connected to each other. The PEN conductor of the electricity supplies company must not be used as an earth electrode. Where the PE rail or PEN rail of a distribution board is used as an earthing terminal, these rails must be connected to the earth electrode of the consumer installation via a separate earthing conductor.
Two earthing terminals are provided on the PU BC. Both terminals must be used. One goes to the equipotential bonding terminal of the building, the other to the PE conductor of the installation. The cross-section of the earthing conductor of the arrester to the main equipotential bonding conductor is determined in accordance with Table 1, as for the phase conductors. This must be at least 0.5 x cross-section of the main protective conductor, although 25 mm² Cu is defined as the upper limit. 10 mm² Cu is required as the lower limit.

Earth line	Cross-section mm²		
Main protective conductor – coming from current source or protective conductor leaving – incoming service box or – main distribution board	≤ 16	25	≤ 35
Phase conductor	≤ 35	50	≥ 70
Earth line of arrester	10	26	25

Table 1

3. Functional check

PU surge protection devices and lightning arresters must be subjected to a visual check especially during periods of thunderstorms. If the colour of the sight window changes or the LED is red, the surge protection device must be replaced. Varistors can exhibit high temperatures as a result of ageing. In low-voltage systems, this can result in fire. The integrated temperature monitoring device therefore automatically disconnects the varistor from the power supplies in the event of danger. On the PU III or PO DS, this disconnection is indicated by the warning lamp/LED being extinguished. PU III and PU DS devices have an additional switching contact that indicates this disconnection. The back-up fuses you install depend on the conductor cross-section and type of routing. For the PU D arrester, the back-up fuse rating is 16 A.

3.1 Replacement

When an arrester shows a red sight window or the red LED is lit as mentioned in point 3, the arrester must be replaced by a qualified electrician. The individual class I and II arresters are of plug-in type and coded according to their voltage rating.
When testing insulation resistance in accordance with DIN VDE 0100 part 610, varistor-type arresters must be removed – by pulling off the top section, for example. The correct arrester for the rated voltage of the system must be re-installed.

4. Connecting the remote signalling modules

4.1 Remote signalling by means of monitoring modules Type PU II, PUBCR, PU III or PU D

The signal contact of the PU II and PUBCR is designed as a change-over contact and is connected to terminals 11 and 14. In normal operation (green flag) terminals 11 and 12 are closed. In this situation terminals 11/14 are open. In the event of a malfunction (red flag), terminals 11/14 are closed and terminals 11/12 are open. On the PU III and PU D, the responding of the disconnection device is indicated by the opening of a non-reversible thermal release. The signalling circuit is connected with stranded conductors (e.g. NYM); parallel routing of the conductors with the supplies and earthing conductors must be avoided. Replacing a suppressor circuit with a surge fine protection appropriate for the voltage level reduces interference in and around the analysing unit.

4.2 Approvals

The PU II series has been issued a CB report and can therefore be transferred to country-specific approvals.
PU II devices are provided with the CE mark.

Accessories

A system marker is available from LogiMark with the text **“Warning!** System protected by surge arresters”. Lift off plug-in top section for insulation measurements. This yellow card (Part No. 175184 1687) can be affixed with self-adhesive tape. Installation specification for PU1 TSG “Surge protection in power supplies networks”.

1. Application

According to the requirements of class I (DIN VDE 0675 part 6 (draft Nov 1989)/A1 Mar 1996) and class I in accordance with IEC 61643-1 (Feb 1998), the arrester is for lightning protection equipotential bonding at the junction of interface 0 to 1 (as per IEC 1312-1).
In TN, TT and IT systems, combinations of several surge arresters are frequently used as N-PE arresters. In networks rated for a short-circuit current of 500 A, the PU 1 TSG 50 kA / 1.5 kV-260 V can be used in a combination circuit as 50 kA sparkover gap between L and N. The use of a non-blowout sparkover gap satisfies the inspection requirements for surge protection devices of class B from the VDEW (Association of German Power Stations) directive (1st edition 1998).

2. Backup fuse

The surge protection devices of the PU series exhibit passive behaviour in normal operation; no current is consumed. The necessary protection against short-circuits and overloads is thus provided by a fuse designed for the type of installation and the cross-section of the connecting lines.
In addition, the products of the PU series are tested with a maximum backup fuse (refer to technical data for details).

If the fuse used in the installation is less than or equal to this value (125 A), then this can be used as the line protection in the incoming supplies. However, if the fuse is larger than that given in the technical specification, additional fuses to suit the connecting line must be incorporated in the line to the PU module.

2.2 Application

PU 1 TSG (+) modules provide the necessary lightning protec-tion equipotential bonding for existing lightning protection systems and incoming supplies.
Enclosed PU 1 TSG modules are preferably installed in the distribution boards of the building's electrical installation.
Unenclosed PU 1 TSG+ modules with voltages of 330 or 440 V are frequently installed in industrial applications.

3. Maintenance

According to their applications, PU 1 TSG(+) modules are designed for high electrical mechanical loads. Faulty arresters must be replaced immediately. The arresters may not be opened.
Installation specification for PU 1 TSG(+) surge protection in power supplies networks. May only be installed by qualified personnel. During the installation, please observe the connection conditions specific to the country of application.