## Technical dictionary

### General data

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</table>
Product certificates create trust

Certification documents verify the quality of our products. They are issued following suitable tests by independent institutes and are the prerequisite for use in certain markets or fields of application.

The accredited test laboratory has its expertise endorsed

The reliability of technical data is of great importance for the user. In confirming the accredited status, officially approved authorities have certified the organisation in accordance with EN 45 001 as well as its expertise in defined assessment of terminals, plug-in connectors, relays and electronic equipment.

Certification as documentation of managed quality

Quality management in the Weidmüller companies is based on ISO 9000 ff. The corresponding certificates from acknowledged, accredited authorities also simplify your supplier appraisal procedures.

Verification of Weidmüller’s quality also includes contracts with independent institutions covering the regular monitoring of production facilities, quality management and the laboratory.

Excellent environmental management testifies to our total commitment.
**Electrical data**

**Rating the clearance and creepage distances of electrical equipment**

**General information**

Since April 1997, clearance and creepage distances have been rated according to the regulations of DIN VDE 0110-1, “Insulation coordination for equipment in low voltage systems”. DIN VDE 0110-1 contains the modified version of the IEC report 664-1 (see IEC 664-1/10.92).

The latest catalogue gives the rating data obtained for each product in compliance with the provisions of this standard, where applicable.

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

---

**Clearance distances**

Clearance distances are rated in accordance with the following factors:

- Anticipated overvoltage
- Rated impulse voltage
- Used overvoltage protection precaution
- Measures to prevent soiling

**Diagram showing clearance distance**

---

**Creepage distance**

Creepage distances are rated in accordance with the following factors:

- Intended rated voltage
- Used insulation materials
- Insulation materials group
- Measures to prevent soiling

**Diagram showing creepage distance**

---

**Grooves** are taken into account when measuring creepage distances if their minimum width X is rated according to the following table:

<table>
<thead>
<tr>
<th>Degree of soiling</th>
<th>Minimum width X in mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.25</td>
</tr>
<tr>
<td>2</td>
<td>1.0</td>
</tr>
<tr>
<td>3</td>
<td>1.5</td>
</tr>
<tr>
<td>4</td>
<td>2.5</td>
</tr>
</tbody>
</table>

If the corresponding clearance distance is less than 3 mm, the smallest groove width may be reduced to 1/3 of this clearance distance.
### Electrical data

**Rating the clearance and creepage distances of electrical equipment**

**Influential factors**

**Rated impulse voltage**

The rated impulse voltage is derived from:

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

- **Overvoltage category**

<table>
<thead>
<tr>
<th>Overvoltage category</th>
<th>Rated impulse voltage in kV for</th>
</tr>
</thead>
<tbody>
<tr>
<td>III</td>
<td>6.00 4.00 2.50 1.50 0.80</td>
</tr>
<tr>
<td>II</td>
<td>120 to 240</td>
</tr>
<tr>
<td>I</td>
<td>230/400 277/480 400/690 1000</td>
</tr>
</tbody>
</table>

*) acc. to IEC 38

**Table 1: Rated impulse voltage for electrical equipment**

<table>
<thead>
<tr>
<th>Rated voltage of the power supply system T in V</th>
<th>Rated impulse voltage in kV for</th>
</tr>
</thead>
<tbody>
<tr>
<td>Three-phase systems</td>
<td>T acc. to IEC 38</td>
</tr>
<tr>
<td>One-phase systems with mid-point (Overvoltage category IV)</td>
<td>6.00 4.00 2.50 1.50 0.80</td>
</tr>
<tr>
<td>Electrical equipment as part of the permanent installation (Overvoltage category III)</td>
<td>6.00 4.00 2.50 1.50</td>
</tr>
<tr>
<td>Electrical equipment for connection to the permanent installation (Overvoltage category II)</td>
<td>6.00 4.00 2.50 1.50</td>
</tr>
<tr>
<td>Specially protected electrical equipment (Overvoltage category I)</td>
<td>6.00 4.00 2.50 1.50</td>
</tr>
</tbody>
</table>

**Degrees of soiling**

**Degree of soiling I**

- No or only dry non-conductive soiling. Soiling has no influence.

**Degree of soiling II**

- Only non-conductive soiling. Temporary conductivity must be expected occasionally as a result of condensation.

**Degree of soiling III**

- Devices which are an integral part of the permanent installation, and other devices expected to have a higher degree of availability.
  - e.g. distribution boards, circuit breakers, distribution devices (including cables, busbars, distribution boxes, switches, sockets) in the permanent installation and devices for industrial use, and other devices such as stationary motors with continuous connection to the permanent installation.

**Degree of soiling IV**

- Devices for use at or near the power supply in the electrical installation of buildings, between the principal distribution and the mains, e.g. electricity meters, overcurrent protection switches and centralised controllers.

**Stipulating the overvoltage categories**

according to national standard DIN VDE 0110-1 (for electrical equipment fed directly from the low voltage network)

**Overvoltage category I**

- Devices for connection to the permanent electrical installation of a building.
  - Outside the device, measures have been taken either in the permanent installation, or between the permanent installation and the device, to limit the transient overvoltage to the relevant value.

**Overvoltage category II**

- Devices for connection to the permanent electrical installation of a building.
  - e.g. domestic appliances, portable tools.

**Overvoltage category III**

- Devices for connection to the permanent electrical installation of a building.
  - e.g. distribution boards, circuit breakers, distribution devices (including cables, busbars, distribution boxes, switches, sockets) in the permanent installation and devices for industrial use, and other devices such as stationary motors with continuous connection to the permanent installation.

**Overvoltage category IV**

- Devices for use at or near the power supply in the electrical installation of buildings, between the principal distribution and the mains, e.g. electricity meters, overcurrent protection switches and centralised controllers.
Electrical data

Rating the clearance and creepage distances of electrical equipment

Influence factors

Rated voltage

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

Table 3a:
Single phase 3 or 2 conductor a.c. or d.c. networks

<table>
<thead>
<tr>
<th>Rated voltage of the power supply system (network)*</th>
<th>V</th>
<th>V</th>
<th>V</th>
</tr>
</thead>
<tbody>
<tr>
<td>for insulation conductor–conductor</td>
<td>12.5</td>
<td>12.5</td>
<td>–</td>
</tr>
<tr>
<td>for insulation conductor – earth</td>
<td>24 / 25</td>
<td>25</td>
<td>–</td>
</tr>
<tr>
<td>all systems</td>
<td>42 / 48 / 501</td>
<td>50</td>
<td>–</td>
</tr>
<tr>
<td>60</td>
<td>63</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>20-40</td>
<td>63</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>1001</td>
<td>100</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>110 / 120</td>
<td>125</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>150</td>
<td>160</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>220</td>
<td>250</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>220-240</td>
<td>250</td>
<td>125</td>
<td></td>
</tr>
<tr>
<td>300</td>
<td>320</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>380 / 400</td>
<td>500</td>
<td>250</td>
<td></td>
</tr>
<tr>
<td>600</td>
<td>630</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>480-960</td>
<td>1000</td>
<td>500</td>
<td></td>
</tr>
<tr>
<td>10001</td>
<td>1000</td>
<td>–</td>
<td></td>
</tr>
</tbody>
</table>

Table 3b:
Three-phase 4 or 3 conductor a.c. networks

<table>
<thead>
<tr>
<th>Rated voltage of the power supply system (network)*</th>
<th>V</th>
<th>V</th>
<th>V</th>
</tr>
</thead>
<tbody>
<tr>
<td>for insulation conductor–conductor</td>
<td>60</td>
<td>63</td>
<td>32</td>
</tr>
<tr>
<td>for insulation conductor – earth</td>
<td>110 / 120 / 127</td>
<td>125</td>
<td>80</td>
</tr>
<tr>
<td>all systems</td>
<td>1501</td>
<td>160</td>
<td>–</td>
</tr>
<tr>
<td>220 / 230 / 240</td>
<td>250</td>
<td>160</td>
<td>250</td>
</tr>
<tr>
<td>300</td>
<td>320</td>
<td>–</td>
<td>320</td>
</tr>
<tr>
<td>380 / 400 / 415</td>
<td>400</td>
<td>250</td>
<td>400</td>
</tr>
<tr>
<td>440</td>
<td>500</td>
<td>250</td>
<td>500</td>
</tr>
<tr>
<td>480 / 500</td>
<td>500</td>
<td>250</td>
<td>500</td>
</tr>
<tr>
<td>575</td>
<td>630</td>
<td>400</td>
<td>630</td>
</tr>
<tr>
<td>6001</td>
<td>630</td>
<td>–</td>
<td>630</td>
</tr>
<tr>
<td>660 / 690</td>
<td>630</td>
<td>400</td>
<td>630</td>
</tr>
<tr>
<td>720 / 830</td>
<td>800</td>
<td>500</td>
<td>800</td>
</tr>
<tr>
<td>960</td>
<td>1000</td>
<td>630</td>
<td>1000</td>
</tr>
<tr>
<td>10001</td>
<td>1000</td>
<td>–</td>
<td>1000</td>
</tr>
</tbody>
</table>

1) Conductor-earth insulation levels for unearthed or impedance earthed systems are the same as those for conductor-conductor insulation because, in practice, the operating voltage of every conductor to earth can match the conductor-conductor voltage. This is because the actual voltage to earth is defined by the insulation resistance and by the capacitive blind resistance of every conductor to earth. This means that a low (but tolerated) insulation resistance of a conductor can effectively earth it and raise the other two to the value of the conductor-conductor voltage against earth.

2) For electrical equipment intended both for use in three-phase 4-conductor and in three-phase 3-conductor systems, both earthed and unearthed, only the values for the 3-conductor systems should be used.

*) It is presumed that the value of the rated voltage of the electrical equipment is not below the value of the rated voltage of the power supply system.

**) Following jointly undertaken alterations, the meaning of the “)” marking has not been adopted in Table 1. Its definition: the “)” dash refers to a three-phase 4-conductor system. The lower value is the voltage “external to neutral conductor”, the higher value is the voltage “external to external conductor”. If only one value is stated, it refers to three-phase 3-conductor systems and refers to the voltage “external to external conductor”.

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

Insulation material group

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

- I: \(600 \leq \text{CTI} \)
- II: \(400 \leq \text{CTI} < 600 \)
- III a: \(175 \leq \text{CTI} < 400 \)
- III b: \(100 \leq \text{CTI} < 175 \)

Table 3a and 3b still refer to the values in Table 1 by using the “)” marking.
The derating curve shows which currents can flow continuously and simultaneously across all possible connections when the component is exposed to various ambient temperatures below its upper temperature limit.

The upper temperature limit of a component is a rating value which depends on the used materials. The sum of ambient temperature and overtemperature produced by the current load (power loss at the forward resistance) must not exceed the upper temperature limit of the component, so as not to damage or destroy it. The current loading ability is therefore not a constant value but falls with increasing component ambient temperature. In addition, the power loading ability is influenced by component geometry, number of pins and connected conductor.

The current loading ability is empirically determined acc. to DIN IEC 60152-3. For this purpose, the corresponding component temperatures $t_{b1}$, $t_{b2}$ and the ambient temperatures $t_{U1}$, $t_{U2}$ are measured for three different loading currents $l_1$, $l_2$ ...

The values are entered in a linear system of coordinates (as shown in Fig. 1) to illustrate the relationships between the loading currents, the component ambient temperature and the component overtemperature.

The Y-axis is used for the loading currents and the X-axis for the ambient temperatures. A perpendicular on the X-axis at the component’s upper temperature limit $t_g$ completes the coordinate system.

For every current $l_1$, $l_2$ ..., the corresponding mean values for component overtemperatures $\Delta t_{b1} = t_{b1} - t_{U1}$, $\Delta t_{b2} = t_{b2} - t_{U2}$, are entered starting from the perpendicular and working to the left. The points found in this way are connected to form a parabolic curve.

In view of the fact that it is effectively not possible to select components with maximum permissible forward resistances for measurement purposes, the basic curve has to be reduced. A reduction of the loading currents to 80% results in the power loading curve. Here allowance has to be made for the maximum tolerable forward resistances and inaccuracies incurred in measuring the temperatures, so that these curves are adequate for practical use as indicated by experience.

If, within the low ambient temperature range, the current loading curve exceeds the current permissible as based on the current loading ability of the conductor cross-sections requiring connection, then the current loading curve is limited to the smaller current for this temperature range.
General technical data

General information about CE marking

The CE mark on various products and their packaging is neither a quality feature nor an indication of quality or safety.

The CE mark is a control sign that was created and brought into effect for open trading within the European market. It does not refer to the address of the end consumer. The CE mark only confirms that a manufacturer has complied with all of the directives of the European Union (EU) that are applicable to this product. Therefore the CE mark is proof of directive conformity and is directed towards the responsible control authorities.

The CE mark can be said to be the passport for products that are to be traded within Europe.

Weidmüller considers all relevant EU directives to the best of its knowledge. The currently applicable directives are as follows:

- **73/23/EEC**
  - Electrical equipment for use within specific voltage ranges (Low-voltage directive)
- **89/336/EEC**
  - Electromagnetic compatibility (EMC directive)
- **98/392/EEC**
  - Safety of machines (Machinery directive)

The standards mentioned in the directives have been an element of Weidmüller’s standard development for a considerable time. This provides the guarantee of conformity to the European directives. Our testing laboratory, accredited according to EN 45001, performs the standard conformity testing. The testing reports are recognised within Europe within the framework of the accreditation process.

**73/23 EEC**

**Low-Voltage Directive (LVG)**

Electrical equipment in the sense of this directive are all electrical equipments that are used with a nominal voltage between 50 and 1000 Vac and between 75 and 1500 Vdc.

If an electrical product has the CE mark, it must fulfill the requirements of the EMC directive and if necessary the low-voltage directive (above 50 Vac and above 75 Vdc).

According to the low-voltage directive, a conformity evaluation process must be performed on the product whereby conformity to the directive is assumed where a reference to the harmonised European standards or to the other technical specifications, e.g. IEC standards or national standards, is made.

With the decree of the Directive of the council dated 3rd. May 1989 for the alignment of the legal requirements of the member states concerning electromagnetic compatibility (89/336/EEC), the European Union (EU) has declared EMC as a protection objective.

The protection objectives are defined in article 4 of the EMC directive dated 19th. November 1992, and state the following:

- the generation of electromagnetic interference must be so reduced so that the intended operation of radio, telecommunications and other devices is possible.
- the devices must have a suitable resistance to electromagnetic interference in order to ensure intended operation.

Devices are defined in the EMC directive as:

- all electrical and electronic equipment, installations and systems that contain electrical and electronic components
- all active/passive components and intelligent modules that are produced and stored by Weidmüller.

The adherence to this directive is assured for the devices that conform with the harmonised European standards that, for example, are released in the gazette from the Federal Minister for Post and Telecommunications.

The devices are 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 fulfill the agreed protection objectives.

**EMC directives**

**Electronic Products from Weidmüller**

**Regarding EMC Guidelines**

**Category 1**

All passive components such as:

- terminals with status displays
- protection terminals with status displays
- passive interface elements with and without status displays
- overvoltage protection

These products cause no interference and they have a suitable immunity to interference. These products are not labelled with the CE mark concerning the EMC directive or the EMC guideline.

**Category 2**

These products are labelled with the CE mark after the conformity evaluation process has been performed which contains the reference to the harmonised European standards.

The following are harmonised standards:

- **EN 50081-1** Generic Emission Standard for residential, commercial and light industrial environments
- **EN 50082-1** Generic Immunity Standard for residential, commercial and light industrial environments companies
- **EN 50081-2** Generic Emission Standard for heavy industrial environments
- **EN 50082-2** Generic Immunity Standard for heavy industrial environments
- **EN 55011** Radio Interference for ISM Devices
- **EN 55022** Radio Interference for Information Technology Facilities
- **EN 61000-3-2** Harmonics
- **EN 61000-3-3** Voltage Fluctuations
- **EN 61000-4-x** approx. 10 partial tests for interference immunity; partly not ratified.
General technical data

EMC directives

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

Remark:
The relevance of EN 50082-1 for certain products must be checked as well as how far EN 50081-1 or 50082-1 was considered during testing.
The environment phenomenon and test interference levels are specified in the generic immunity standard. Additionally, Weidmüller considers the evaluation criteria A, B and C.

Text 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 an 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 extracted 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 extracted from the description of the product, the relevant documentation and from what the operator expects from the equipment during its intended operation.

Criterion C
A temporary loss of function is permitted, 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.

An example of an analogue coupler EMA: During testing, the analogue coupler can convert values that are outside the permissible tolerances.

After testing however, the values must be within the available tolerances.

General Installation Instructions
In agreement with the performance level and the criteria A and B, the products are allowed and can be affected externally during the occurrence of a fault.

It should be attempted, as far as possible, to prevent this with an optimal installation.

Measures:
- installation of the products in an enclosed metal box (control cabinet, metal housing)
- protect the voltage supply with an overvoltage protection device.
  (For mains supply of 230/400 Vac with a PU type and for 24 Vdc with an EGU or LPU.)
- only use shielded cables for analogue data signals
- follow ESD measures during installation, maintenance and operation
- distance between electronic modules and interference sources (e.g. invertors) and power lines should be at least 200 mm.
- maintenance of ambient temperature and relative humidity
- long cables are to be protected by over-voltage protection devices.

For safety reasons, the operation of walkie-talkies and mobile telephones should only be performed outside a radius of 2 m.
## General technical data

### Protection rating according to EN 60 529 / DIN 0470

The protection ratings are indicated by a code consisting of the two invariable letters IP and two digits representing the degree of protection.

**Example:**  
\[ IP \ 6 \ 5 \]

- **1st digit:** protection from solid bodies  
- **2nd digit:** protection from water

### Degrees of protection from solid foreign bodies (1st digit)

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Not protected</td>
</tr>
<tr>
<td>1</td>
<td>Protected from solid foreign bodies 50 mm in diameter and above. Protection to prevent dangerous parts being touched with the back of the hand.</td>
</tr>
<tr>
<td>2</td>
<td>Protected from solid foreign bodies 2.5 mm in diameter and above. Protection to prevent dangerous parts being touched with a tool.</td>
</tr>
<tr>
<td>3</td>
<td>Protected from solid bodies 1 mm in diameter and larger. Protection to prevent dangerous parts being touched with a piece of wire.</td>
</tr>
<tr>
<td>4</td>
<td>Dust protected. Penetration of dust is not completely prevented, but dust must not penetrate in quantities that would impair satisfactory working of the device or safety.</td>
</tr>
<tr>
<td>5</td>
<td>Dust-proof, no penetration by dust.</td>
</tr>
</tbody>
</table>

### Degrees of protection from water (2nd digit)

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Not protected</td>
</tr>
<tr>
<td>1</td>
<td>Vertically falling drops must not have any harmful effect.</td>
</tr>
<tr>
<td>2</td>
<td>Vertically falling drops must not have any harmful effect if the housing is inclined at an angle of up to 15° to the vertical on both sides.</td>
</tr>
<tr>
<td>3</td>
<td>Water sprayed at an angle of up to 60° to the vertical on both sides must not have a harmful effect.</td>
</tr>
<tr>
<td>4</td>
<td>Water splashing against the housing from any direction must not have a harmful effect.</td>
</tr>
<tr>
<td>5</td>
<td>Water sprayed against the housing from any direction must not have a harmful effect.</td>
</tr>
<tr>
<td>6</td>
<td>Water aimed in a strong jet against the housing from any direction must not have a harmful effect.</td>
</tr>
<tr>
<td>7</td>
<td>Water must not penetrate in any quantity which causes harmful effects if the housing is temporarily submerged in water under standard pressure and time conditions.</td>
</tr>
<tr>
<td>8</td>
<td>Water must not penetrate in any quantity which causes harmful effects if the housing is permanently submerged in water under conditions which must be agreed between manufacturer and user. However, the conditions must be more adverse than under number 7.</td>
</tr>
</tbody>
</table>
**General technical data**

Converting AWG conductors to mm²

**AWG** is the abbreviation for “American Wire Gauge”. This gives no indication of the actual conductor cross-sectional area. The relationship between AWG and mm² is shown in the following table.

Possibility of inserting unprepared round conductors with the largest stipulated cross-sectional area

Testing with stipulated gauge, inserted under own weight.

<table>
<thead>
<tr>
<th>AWG</th>
<th>mm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>28</td>
<td>0.08</td>
</tr>
<tr>
<td>26</td>
<td>0.13</td>
</tr>
<tr>
<td>24</td>
<td>0.21</td>
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<td>22</td>
<td>0.22</td>
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<td>20</td>
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<tr>
<td>19</td>
<td>0.65</td>
</tr>
<tr>
<td>18</td>
<td>0.82</td>
</tr>
<tr>
<td>17</td>
<td>1.04</td>
</tr>
<tr>
<td>16</td>
<td>1.31</td>
</tr>
<tr>
<td>15</td>
<td>1.65</td>
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<tr>
<td>14</td>
<td>2.08</td>
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<tr>
<td>13</td>
<td>2.63</td>
</tr>
<tr>
<td>12</td>
<td>3.31</td>
</tr>
<tr>
<td>11</td>
<td>4.17</td>
</tr>
<tr>
<td>10</td>
<td>5.26</td>
</tr>
<tr>
<td>9</td>
<td>6.63</td>
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<tr>
<td>8</td>
<td>8.37</td>
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<td>7</td>
<td>10.55</td>
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<td>6</td>
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<tr>
<td>5</td>
<td>16.77</td>
</tr>
<tr>
<td>4</td>
<td>21.15</td>
</tr>
<tr>
<td>3</td>
<td>26.67</td>
</tr>
<tr>
<td>2</td>
<td>33.63</td>
</tr>
<tr>
<td>1</td>
<td>42.41</td>
</tr>
<tr>
<td>0</td>
<td>53.48</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rigid conductor (single- or multi-core) mm²</th>
<th>Designation</th>
<th>Diameter a mm</th>
<th>Width b mm</th>
<th>Designation</th>
<th>Diameter a mm</th>
<th>Tolerable deviations for a and b mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5</td>
<td>A 1</td>
<td>2.4</td>
<td>1.5</td>
<td>B 1</td>
<td>1.9</td>
<td>0 – 0.05</td>
</tr>
<tr>
<td>2.5</td>
<td>A 2</td>
<td>2.8</td>
<td>2.0</td>
<td>B 2</td>
<td>2.4</td>
<td>0 – 0.06</td>
</tr>
<tr>
<td>4</td>
<td>A 3</td>
<td>2.8</td>
<td>2.4</td>
<td>B 3</td>
<td>2.7</td>
<td>0 – 0.07</td>
</tr>
<tr>
<td>6</td>
<td>A 4</td>
<td>3.6</td>
<td>3.1</td>
<td>B 4</td>
<td>3.5</td>
<td>0 – 0.08</td>
</tr>
<tr>
<td>10</td>
<td>A 5</td>
<td>4.3</td>
<td>4.0</td>
<td>B 5</td>
<td>4.4</td>
<td>0 – 0.09</td>
</tr>
<tr>
<td>16</td>
<td>A 6</td>
<td>5.4</td>
<td>5.1</td>
<td>B 6</td>
<td>5.3</td>
<td>0 – 0.10</td>
</tr>
<tr>
<td>25</td>
<td>A 7</td>
<td>7.1</td>
<td>6.3</td>
<td>B 7</td>
<td>6.9</td>
<td>0 – 0.11</td>
</tr>
<tr>
<td>35</td>
<td>A 8</td>
<td>8.3</td>
<td>7.8</td>
<td>B 8</td>
<td>8.2</td>
<td>0 – 0.12</td>
</tr>
<tr>
<td>50</td>
<td>A 9</td>
<td>10.2</td>
<td>9.2</td>
<td>B 9</td>
<td>10.0</td>
<td>0 – 0.13</td>
</tr>
<tr>
<td>70</td>
<td>A 10</td>
<td>12.3</td>
<td>11.0</td>
<td>B 10</td>
<td>12.0</td>
<td>0 – 0.14</td>
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<tr>
<td>95</td>
<td>A 11</td>
<td>14.2</td>
<td>13.1</td>
<td>B 11</td>
<td>14.0</td>
<td>0 – 0.15</td>
</tr>
<tr>
<td>120</td>
<td>A 12</td>
<td>16.2</td>
<td>15.1</td>
<td>B 12</td>
<td>16.0</td>
<td>0 – 0.16</td>
</tr>
<tr>
<td>150</td>
<td>A 13</td>
<td>18.2</td>
<td>17.0</td>
<td>B 13</td>
<td>18.0</td>
<td>0 – 0.17</td>
</tr>
</tbody>
</table>
Materials

Insulation materials

In order to satisfy all the different requirements made of our products, we have to use various insulation materials tailor-made to each specific application.

All insulation materials used by Weidmüller are free from harmful substances. It is especially important that these materials contain no cadmium. In addition, they are free from heavy metal colour pigments, dioxin and furan-forming substances.

### Thermosetting plastics

<table>
<thead>
<tr>
<th>Plastic Abbreviation</th>
<th>Germin KrG</th>
<th>Stamin KrS</th>
<th>Epoxy resin EP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colour</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mid-yellow</td>
<td></td>
<td>anthracite</td>
<td>black</td>
</tr>
<tr>
<td>Description</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>high continuous service temperature</td>
<td>10¹¹</td>
<td>1⁰</td>
<td>10⁷</td>
</tr>
<tr>
<td>high fire resistance</td>
<td>10³</td>
<td>12.5</td>
<td>180</td>
</tr>
<tr>
<td>high creepage current resistance</td>
<td>≥ 600</td>
<td>≥ 600</td>
<td>≥ 600</td>
</tr>
<tr>
<td>inherent flammability protection</td>
<td>130</td>
<td>140</td>
<td>160</td>
</tr>
<tr>
<td>Fire behaviour acc. to railways standard</td>
<td>V-0 (5 V-A)</td>
<td>V-0 (5 V-A)</td>
<td>V-0</td>
</tr>
</tbody>
</table>

Thermosetting plastics have outstanding dimensional stability, low water absorption, excellent creepage current resistance and outstanding fire resistance.

Their continuous service temperature is higher than that of thermoplastics. Under high thermal load, thermosetting plastics have better dimensional strength than thermoplastics. Thermosetting plastics are, however, inferior to thermoplastics in terms of their flexibility.
### Materials

#### Thermoplastics

<table>
<thead>
<tr>
<th>Wemid</th>
<th>Polyamide PA</th>
<th>Polyamide PG GF</th>
<th>Polybutylene terephthalate PBT</th>
<th>Polycarbonate PC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wemid is a modified thermoplastic whose properties are especially tailored to make it suitable for use in our power connectors. Advantages over PA include enhanced fire protection and higher continuous service temperature. Wemid fulfils the strict requirements for use in railway vehicles according to NF F 16-101.</td>
<td>Polyamide (PA) is one of the most frequently used technical plastics. The advantages of this material includes its very good electrical and mechanical properties, flexibility and resistance to breakage. In addition, its chemical structure gives PA good fire resistance even without the use of flame retardants.</td>
<td>Glass-fibre reinforced polyamide (PG GF) offers excellent dimensional stability and very good mechanical properties. This makes it ideal for use as end bracket. Unlike PA, this material in unreinforced state comes under combustibility class HB in accordance with UL 94.</td>
<td>Thermoplastic polyester (PBT) offers excellent dimensional stability (which is why it is used for plug-in connectors) and high continuous service temperature. It has lower creepage current resistance than other insulation materials.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>special Weidmüller insulating material</th>
<th>insulating material</th>
<th>insulating material</th>
<th>with or without glass-fibre reinforcement, depending on use</th>
<th>with or without glass-fibre reinforcement, depending on use</th>
</tr>
</thead>
<tbody>
<tr>
<td>dark beige</td>
<td>beige</td>
<td>dark beige</td>
<td>orange</td>
<td>grey</td>
</tr>
<tr>
<td>higher continuous service temperature</td>
<td>flexible, resistant to breakage</td>
<td>excellent dimensional stability</td>
<td>very good mechanical properties</td>
<td>high dimensional stability</td>
</tr>
<tr>
<td>enhanced fire resistance</td>
<td>good electrical and mechanical properties</td>
<td>flame retardant, without dioxin and furan-forming substances</td>
<td>flame retardant, without dioxin and furan-forming substances</td>
<td>high continuous service temperature</td>
</tr>
<tr>
<td>halogen- and phosphorous-free; flame retardant</td>
<td>self-extinguishing properties</td>
<td></td>
<td></td>
<td>high electrical insulating power</td>
</tr>
<tr>
<td>low smoke</td>
<td></td>
<td></td>
<td></td>
<td>halogen-free; flame retardant</td>
</tr>
<tr>
<td>permitted for use in railways acc. to NF F 16-101</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>10^{12}</th>
<th>10^{12}</th>
<th>10^{12}</th>
<th>10^{13}</th>
<th>10^{16}</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>30</td>
<td>30</td>
<td>28</td>
<td>≥ 30</td>
</tr>
<tr>
<td>600</td>
<td>600</td>
<td>500</td>
<td>200</td>
<td>≥ 175</td>
</tr>
<tr>
<td>120</td>
<td>100</td>
<td>120</td>
<td>115 / 130</td>
<td>115 / 125</td>
</tr>
<tr>
<td>– 50</td>
<td>– 50</td>
<td>– 50</td>
<td>– 50</td>
<td>– 50</td>
</tr>
<tr>
<td>V-0</td>
<td>V-2</td>
<td>HB</td>
<td>V-0</td>
<td>V-2 / V-0</td>
</tr>
<tr>
<td>12 / F2 *</td>
<td></td>
<td></td>
<td></td>
<td>12 / F2</td>
</tr>
</tbody>
</table>

*) also qualified acc. to LUL E 1042
Weidmüller uses only tried and tested materials for the electrical components in its products.

All materials are subjected to rigorous quality monitoring under a quality management system certified to DIN EN ISO 9001.

Environmental compatibility plays a crucial role in the selection of materials.

All metals used by Weidmüller are selected, processed and surface-treated according to the very latest technical findings.

**Metals**

Steels
Steel parts whose function is to permanently maintain contact force are zinc electroplated, with an additional chromate layer added to provide additional passivation.

Surface protection complies with the very highest standards. Results from laboratory tests are incorporated in producing the surface finish.

Zinc still offers corrosion protection over a longer period of time even if the zinc coating is partially damaged by scratches or pores.

Zinc acquires a negative charge in relation to steel under the influence of an electrolytic fluid. The metal ions in the zinc migrate to the steel giving the base material lasting protection against corrosive attack.

Conductive materials
The current-carrying materials copper, brass and bronze are characterised by both high conductivity and good mechanical properties.

The surfaces are usually finished with tin plating. This guarantees that the contact has outstanding “adaptive” properties with low transition resistance. The tin plating not only gives consistently good electrical properties but also affords excellent protection from corrosion.

Soldered connections are also provided with tin plating. To safeguard soldering ability over longer periods of time (storage periods), brass parts are also given an additional nickel layer to serve as a diffusion barrier.

The nickel layer is highly effective in preventing zinc atoms from diffusing out of the brass.
Materials

Current loading curves

The maximum current which a terminal can carry depends on:
• the inherent temperature rise of the terminal
• the ambient temperature
• the cross-sectional area of the connected conductor
An upper service temperature has been defined for every Weidmüller terminal, and this must not be exceeded in continuous operation.

The continuous service temperature depends on the insulation material used in the terminal. According to EN 60 947-7-1, a terminal may not heat up by more than 45 K.

When the input current is at least equivalent to the rated current, the maximum ambient temperature to which a terminal may be subjected is equal to the continuous service temperature for the insulation material used, less the maximum tolerable temperature rise of the terminal acc. to EN 60 947-7-1.

Figs. 1–3 show examples of current heating curves (in this case for a rated current of 32 A) for three different insulating materials:
• Thermoplastic (polyamide 66)
• WEMID
• Duroplastic (MF 150 KrG)

Depending on the insulation material used, the rating current can be conducted up to an ambient temperature of 55 °C for PA 66, 75 °C for Weidmüller’s insulation material WEMID, or up to 85 °C for duroplastic insulation materials (KrG).

Above these temperature limits, the current is to be reduced in accordance with the current expectancy curves.
Weidmüller's tension clamp system optically combines the specific properties of steel and copper. The system has proven its worth billions of times over in various Weidmüller products. Both the tension clamp and the clamping screw consist of hardened steel. This clamping yoke unit generates the necessary contact force. Connection of the conductor involves the tension clamp pressing the conductor against the busbar, which is made of copper or high-quality brass. Weidmüller's tension clamp produces a gas-tight, vibration-resistant connection between the conductor and the busbar.

**Vibration resistance**
The force generated by turning the clamping screw means that the upper thread overlap springs back and exerts a counter-effect on the screw.

Weidmüller's tension clamp system is vibration-resistant.

**Any settling of the connected conductor is counteracted by the elastic behaviour of Weidmüller's tension clamp. This means it is not necessary to “tighten” the clamping screw.**

Weidmüller's TOP connection system fulfills the requirement that conductor insertion and screw actuation take place in parallel. This brings wiring advantages in certain installation situations, for example with close lateral spacing in installation boxes. The TOP connection system combines the special properties of steel and copper. The hardened steel pressure clamp presses the conductor directly against the copper or brass busbar. The high contact force guarantees a gas-tight connection between conductor and busbar.

**Vibration resistance**
The force exerted by the steel pressure clamp when the screw is tightened pulls the two halves of the TOP connection thread apart, as in the tension clamp. This exerts a braking effect on the screw and guarantees outstanding vibration resistance.
## Connection types

<table>
<thead>
<tr>
<th>Tension clamp connection</th>
<th>IDC technology</th>
<th>Direct push in technology</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Weidmüller’s tension clamp system</strong> functions in similar fashion to the tried and tested clamping yoke. As with the latter, the tension clamp preserves the separation of mechanical and electrical functions. The tension clamp of high-quality rust- and acid-resistant steel pulls the conductor against the galvanised copper busbar. The surface-treated busbar has low contact resistance and is highly resistant to corrosion. These properties are preserved by the balancing effect of the tension clamp.</td>
<td><strong>IDC (insulation displacement connection) technology</strong> is a means of connecting copper conductors which involves absolutely no preparation of the conductor – in other words, no stripping and no crimping. When the conductor is connected, its insulation is penetrated and, at the same time, the electrical contact is produced between the conductor and the busbar. As with the other types of connection, Weidmüller’s IDC principle ensures separation of mechanical and electrical functions. A stainless steel spring presses the busbar against the conductor, thus guaranteeing low contact resistance and a gas-tight, vibration-resistant connection.</td>
<td><strong>Direct push in technology</strong> involves the stripped solid conductor simply being pushed into the terminal as far as it will go – that’s all there is to it. No tools are required, and a reliable, vibration-resistant and gas-tight connection is produced. Even flexible conductors with crimped wire end ferrules or ultrasonic welded conductors can be connected without any problems. A stainless steel spring, held in a separate cage, guarantees that the conductor exerts a strong contact force on the busbar (copper- and tin coated). The conductor pull-out forces are even higher here than in the tension spring system. In the steel cage, a spring and a conductor stopper guarantee optimum conditions for connection and guide the screwdriver for the purpose of releasing the conductor.</td>
</tr>
</tbody>
</table>
ATEX

ATEX 95 (formerly ATEX 100a)

The former directive for Ex protection issued by the European Council under 76/117 EEC became invalid with effect from 1 July 2003. Now only directive 94/9/EEC or ATEX 95 applies (ATEX: Atmosphère Explosive); this is one of the so-called "new approach" directives. It applies in all countries of the European Union together with Iceland, Liechtenstein and Norway.

In these countries it refers to the sale and commissioning of products which have been specially developed for areas in which the presence of gases, vapours, fog or dust give rise to a potentially explosive atmosphere. It now also covers the mining industry and purely mechanical devices.

The ATEX directive has been in force since March 1996. It was valid on an optional basis through to 30 June 2003 (interim period) in parallel to the existing directives. As of this date, all new systems and devices for installation in explosion-risk areas must conform with the ATEX directive and be certified accordingly. The former categorisation into zones (zone 0, 1 or 2) and protection classes (e.g. "i": inherent safety, "e" enhanced safety) still apply.

Protection class

<table>
<thead>
<tr>
<th>Protection</th>
<th>Code</th>
<th>CENELEC</th>
<th>IEC</th>
<th>Device category</th>
<th>Explosion-protected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gen. requirements</td>
<td>–</td>
<td>50014</td>
<td>60079-0</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Oil encapsulation</td>
<td>o</td>
<td>50015</td>
<td>60079-6</td>
<td>2</td>
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<tr>
<td>Overpressure encapsulation</td>
<td>p</td>
<td>50016</td>
<td>60079-2</td>
<td>2</td>
<td></td>
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<tr>
<td>Sand encapsulation</td>
<td>q</td>
<td>50017</td>
<td>60079-5</td>
<td>2</td>
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<td>Pressure-resistant encapsulation</td>
<td>d</td>
<td>50018</td>
<td>60079-1</td>
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<tr>
<td>Increased safety</td>
<td>e</td>
<td>50019</td>
<td>60079-7</td>
<td>2</td>
<td></td>
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<tr>
<td>Inherent safety</td>
<td>ia</td>
<td>50020</td>
<td>60079-11</td>
<td>1</td>
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</tr>
<tr>
<td>Inherent safety</td>
<td>ib</td>
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<td>60079-11</td>
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<td>Type n (EEEx n)</td>
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<td>60079-15</td>
<td>3</td>
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<tr>
<td>Sealing encapsulation</td>
<td>m</td>
<td>50028</td>
<td>60079-18</td>
<td>2</td>
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</table>

Classification for explosion-risk areas

<table>
<thead>
<tr>
<th>CENELEC classification</th>
<th>Presence of a potentially explosive atmosphere</th>
<th>Device category</th>
<th>US Classification NEC 500</th>
<th>Flammable media</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC60079-10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zone 0</td>
<td>constant, long-term or frequent</td>
<td>1G</td>
<td>Class I, Div 1</td>
<td>Gases, vapours</td>
</tr>
<tr>
<td>Zone 20</td>
<td>occasional</td>
<td>2G</td>
<td>Class I, Div 1</td>
<td>Gases, vapours</td>
</tr>
<tr>
<td>Zone 2</td>
<td>rare and short-term</td>
<td>3G</td>
<td>Class I, Div 2</td>
<td>Gases, vapours</td>
</tr>
<tr>
<td>Zone 22</td>
<td></td>
<td>3D</td>
<td>Class II, Div 2</td>
<td>Dust</td>
</tr>
</tbody>
</table>

Explosion groups

<table>
<thead>
<tr>
<th>Gas (e.g.)</th>
<th>CENELEX</th>
<th>NEC 500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propane</td>
<td>IA</td>
<td>D</td>
</tr>
<tr>
<td>Ethylene</td>
<td>IE</td>
<td>C</td>
</tr>
<tr>
<td>Hydrogen</td>
<td>IC</td>
<td>B</td>
</tr>
<tr>
<td>Acetylene</td>
<td>IC</td>
<td>A</td>
</tr>
<tr>
<td>Methane (mining)</td>
<td>I</td>
<td>Mining (MSHA)</td>
</tr>
</tbody>
</table>

Temperature classes

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

ATEX 95 (formerly ATEX 100a)

Marking example
Terminal WDK 4 N V

Example of marking
Assembled enclosure for enhanced safety
### Technical dictionary

#### Terminals

**Regulations / definitions**

Terminals acc. to VDE 0611-1

This standard was published in Germany in August 1992:

- **VDE 0611-1** Low-voltage switchgear part 7: Ancillary equipment section 1 – Terminal blocks for copper conductors.

The contents of this standard correspond to the international standard:

- **IEC 60947-7-1**: 1989 Low voltage switchgear and control gear part 7: Ancillary equipment section 1 – Terminal blocks for copper conductors.

At the European level this standard has been ratified by CENELEC, making it valid in the following countries:

- Austria, Belgium, Denmark, Finland, France, Germany, Greece, Holland, Iceland, Ireland, Italy, Luxembourg, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom.

Combined application in order of priority:

- **IEC 60947-1** Low-voltage switchgear and control gear part 1: General Rules
- **EN 60947-1** VDE 0660 part 100
- **Low-voltage switchgear part 1**: General Rule

**Scope VDE 0611-1**

(EN 60947-7-1) (IEC 60947-7-1)

This standard stipulates the requirements for terminals with screwed or screwless terminal strips intended primarily for industrial or similar use, with the terminals fastened to a carrier to produce both electrical and mechanical connections between copper conductors. It applies to terminals used for connecting round copper conductors with a cross-section between 0.2 mm² and 300 mm² (AWG 24/600 kcmil), and for electronic circuits up to 1000 Vac 1000 Hz or up to 1500 Vdc.

**Remarks:**

This standard is also used as guide for special kinds of terminals (e.g. isolating terminals) for which no special standards are available.

#### Terminals / feed-through terminals

An insulating part which carries one or several mutually insulated terminal arrays intended for fastening to a carrier.

**Rated cross-section**

The rated cross-section of a terminal is the cross-section of the conductor to be connected by the terminal as stated by the manufacturer. It is determined by certain thermal, mechanical and electrical requirements, and is one of the specifications marked on the terminal.

The rated cross-section is selected from the following standard cross-sections:

- 0.2 – 0.5 – 0.75 – 1 – 1.5 – 2.5 – 4 – 6 – 10 – 16 – 25 – 35 – 50 – 70 – 95 – 120 – 150 – 240 – 300 mm².

The terminals have a rated connection capability, which is at least two stages smaller than the rated cross-section. The conductors may be solid, stranded or flexible and, if necessary, may have their ends pre-treated. The rated cross-section is verified using the gauges stipulated by VDE 0660 part 100 table 7 (see page W.14).

**Rated current**

Each rated cross-section is assigned a particular test current stipulated by VDE 0611-1. At these rated currents, terminals are not subject to non-permissible increases in temperature.

<table>
<thead>
<tr>
<th>mm²</th>
<th>1.5</th>
<th>2.5</th>
<th>4.0</th>
<th>6.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>17.5</td>
<td>24</td>
<td>32</td>
<td>41</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>mm²</th>
<th>10</th>
<th>16</th>
<th>25</th>
<th>35</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>57</td>
<td>76</td>
<td>101</td>
<td>125</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>mm²</th>
<th>50</th>
<th>70</th>
<th>95</th>
<th>120</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>150</td>
<td>192</td>
<td>232</td>
<td>269</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>mm²</th>
<th>150</th>
<th>185</th>
<th>240</th>
<th>300</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>309</td>
<td>353</td>
<td>415</td>
<td>520</td>
</tr>
</tbody>
</table>

**Rated surge voltage**

VDE 0611-1 / VDE 0660 part 100

The rated voltage of a terminal is the rated insulation voltage to which the insulation tests and creepage distances refer. It is defined analogously to DIN VDE 0110-1, and is one of the specifications marked on the terminal.

**CE mark**

A directive stipulates that labelling with the CE mark is carried out by the manufacturer. The mark indicates to the state authorities that the item complies with the relevant directives. It thus guarantees free trade within Europe.

Conductor connectors from ≥ 50 V – / 75 V- comply with the basic safety requirements stated in the low-voltage directive 73/23/EEC (amended by 93/68/EEC).

CE marking acc. to the marking directive 93/68/EEC has been mandatory since 1 January 1997. It is affixed to the packaging.

Declarations of conformity are kept available for inspection by the relevant national supervisory agencies as part of the technical documentation.

---

**Remarks:**

• Relative humidity 50% at + 40 °C, 90% at 20 °C.

**Degree of soiling**

VDE 0110-1 / VDE 0660 part 100

The degree of soiling stipulates the influence of solid, liquid or gaseous foreign particles, which may reduce the dielectric strength or specific surface resistance (see also page W.5).

Terminals for use in the industrial field of application are assigned degree of soiling 3: either conductive contamination may occur or, alternatively, dry, non-conductive contamination which becomes conductive in the likely event of condensation.

The minimum clearance distance is stipulated in combination with the rated surge voltage in VDE 0660 part 100 or DIN VDE 0110-1.

**Operating conditions**

Terminals can be operated under the following normal conditions:

- Ambient temperature – 5 °C ... +40 °C, mean temperature 24 h + 35 °C
- Altitude up to 2000 m a.s.l.
- Relative humidity 50% at + 40 °C, 90% at 20 °C.

**CE mark**

A directive stipulates that labelling with the CE mark is carried out by the manufacturer. The mark indicates to the state authorities that the item complies with the relevant directives. It thus guarantees free trade within Europe.

Conductor connectors from ≥ 50 V – / 75 V- comply with the basic safety requirements stated in the low-voltage directive 73/23/EEC (amended by 93/68/EEC).

CE marking acc. to the marking directive 93/68/EEC has been mandatory since 1 January 1997. It is affixed to the packaging.

Declarations of conformity are kept available for inspection by the relevant national supervisory agencies as part of the technical documentation.
**Terminals**

**Assembling terminal strips**

**Mounting and end brackets**
- Terminal strips mounted from left to right
- Closed side on the left, open side on the right
- Open side of the terminal always closed using end plates or partition plates (WAP/TW, ZAP/TW and IAP)
- End brackets placed at the beginning and end of the terminal strip
- End bracket not required next to PE terminals. Exceptions: WDK/PE and ZPE

**Combinations of different terminals**
- End plates or partition plates (WAP/TW, ZAP/TW and IAP) must be used when the contour changes.
- For adjacent terminals with differing rated voltages, end plates or partition plates (WAP/TW, ZAP/TW and IAP) must be used in order that the respective rated voltages are adhered to.
- When the PE terminal is positioned next to or between corresponding feed-through terminals of the same series and size, this does not influence the rated voltage or rated surge voltage of the feed-through terminals.

**Dimensions**
The overall dimensions of the terminals with fastening parts are stipulated, but without tolerances. A mounting tolerance of 0.2 mm must be added to the terminal width when planning projects.

**Partition plate**
The partition plate is necessary for visual separation of circuits or for electrical separation of neighbouring cross-connections.

**Partition disc**
Partition discs can be retrofitted between cross connectors or sockets in terminals up to a max. terminal width of 12 mm.

**Compliance with the rated insulation voltage**
The required stripping length for every Weidmüller product is stated in mm. These lengths, such as < 6 mm ± 0.5 mm, > 10 mm ± 1 mm, must be adhered to. This also applies when using ferrules. The external dimensions of crimped ferrules must comply with IEC 60947-1 (1999 version).

**Working on electrical connection elements with non-insulated screwdrivers**
Work using non-insulated screwdrivers may only be carried out in disconnected systems.

The following five safety rules must be observed when disconnecting a system before beginning work and in order to ensure the system remains disconnected at the working site for the duration of this work:
- Disconnect
- Secure to prevent the system from being switched on again
- Ascertain that the system is not live
- Earth and short circuit the system
- Cover or cordon off any neighbouring live parts

These five rules constitute the safety precautions for working with electrical systems and equipment. The measures to be taken in accordance with operating and local conditions, e.g. for high- and low-voltage overhead lines, cables or switchgear, are stipulated in detail in VDE 0105 part 100.

**Live terminals which are not in use**
Any terminals which are not in use and which could carry live voltage are to be fitted with suitable covers (e.g. ADP 1...4) to prevent them from being inadvertently touched. The clamping screws of terminals, which are not in use, are to be screwed tight.

**VDE 0105 part 100 Operation of electrical installations:**
Work
Troubleshooting with two-pole voltage detectors including voltage tester acc. to IEC 61243-3.
**Terminals**

**Connecting terminals**

**Two conductors in one terminal**

The optimum solution in terms of allocating conductors to individual circuits and marking and organising individual functional units involves just one conductor being connected to each terminal.

If it is necessary to connect two conductors with the same cross-section in one terminal, then this may be carried out using W-series terminals (screw connection).

DIN IEC 60999-1 does not prohibit the use of twin ferrules for connecting two conductors in one terminal point using Z-series terminals (tension spring technology).

DIN IEC 60999-1 prohibits the use of screwless IDC terminals (I-series) for connecting two conductors.

- **Continuous current for two conductors**
  
The total current of two conductors must not exceed the continuous current of the terminal. The continuous current is the maximum current, which a terminal can carry without the increase in temperature exceeding 45 K.

- **Rated insulation voltage**
  
The rated insulation voltage of the terminal does not change when two conductors have been connected correctly.

**Cross-connection systems**

Weidmüller’s WQV and ZQV cross-connectors are systems which are fully insulated and finger-safe in the event that they are directly (and inadvertently) touched; they are available with different numbers of poles (2-pole to 50-pole).

Note: the rated voltage is always reduced when using cross-connections.

Cross-connections which have been cut off do not, however, offer this protection if the cut edge is directly (inadvertently) touched.

Partition plates or end plates must be used with these cross-connections to preserve the rated voltage.

**Conductor connection with pressure clamp for large cross-sections**

It is now no longer necessary to force conductors with large cross-sections into the terminal: they can be inserted simply and easily into the terminal block. All terminal types are available not only as individual terminals but also in block versions with three-, four- and five-pole blocks. All blocks are firmly screwed together to offer additional distortion resistance. Longitudinal holes in the bottom of the terminals allow for direct assembly.

Terminal blocks can be screwed directly to mounting plates with a 25 mm grid.

Other advantages include:

- constant transfer of forces with self-adjusting connection system
- any mounting direction possible
- finger-safe (VBG 4) even with cross-connection
- extremely distortion-proof

**Torque ranges for clamping screws**

 Tightening the clamping screws in this torque range guarantees:

- secure, gas-proof clamping
- no mechanical destruction of the tension clamp
- voltage drop far below the required limit

The test torque acc. to IEC 60947-1 (supplemented by Annex C1 of IEC 60947-1-7 or the torque stated by the manufacturer) is the lower value of the torque range, at which all tests are successfully passed.

The upper value of the torque range is the maximum torque to be applied by the user.

The electric screwdriver should preferably be set to the middle torque of the clamping torque range.

The table gives the generally applicable values. Product-specific data are listed elsewhere for the respective products.

**Products with head screw with slotted head**

<table>
<thead>
<tr>
<th>Thread</th>
<th>Torque range Steel screws</th>
<th>Torque range A 2/A 4-80</th>
</tr>
</thead>
<tbody>
<tr>
<td>M 2.5</td>
<td>0.4...0.8</td>
<td>0.4...0.8</td>
</tr>
<tr>
<td>M 3</td>
<td>0.5...1.0</td>
<td>0.5...1.0</td>
</tr>
<tr>
<td>M 3.5</td>
<td>0.8...1.6</td>
<td>0.8...1.6</td>
</tr>
<tr>
<td>M 4</td>
<td>1.2...2.4</td>
<td></td>
</tr>
<tr>
<td>M 5</td>
<td>2.0...4.0</td>
<td></td>
</tr>
<tr>
<td>M 6</td>
<td>2.5...5.0</td>
<td></td>
</tr>
</tbody>
</table>

**Products with head screw with slotted head**

<table>
<thead>
<tr>
<th>Thread</th>
<th>Torque range NE screws</th>
<th>Torque range Cu 2 (CuZn)</th>
<th>Torque range Cu 5 (CuNi 60)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M 3</td>
<td>0.5...0.6</td>
<td>0.5...1.0</td>
<td>0.8...1.6</td>
</tr>
<tr>
<td>M 4</td>
<td>1.2...1.9</td>
<td>1.2...2.4</td>
<td>2.0...4.0</td>
</tr>
<tr>
<td>M 5</td>
<td>2.0...3.0</td>
<td>2.0...4.0</td>
<td>2.5...5.0</td>
</tr>
<tr>
<td>M 6</td>
<td>2.5...5.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Products with head screw with hexagon**

<table>
<thead>
<tr>
<th>Thread</th>
<th>Torque range Steel screws</th>
</tr>
</thead>
<tbody>
<tr>
<td>M 4</td>
<td>1.2...2.4</td>
</tr>
<tr>
<td>M 5</td>
<td>2.0...4.0</td>
</tr>
<tr>
<td>M 6</td>
<td>3.0...6.0</td>
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<td>M 12</td>
<td>14.0...31</td>
</tr>
<tr>
<td>M 16</td>
<td>25.0...60</td>
</tr>
</tbody>
</table>
Use of aluminium conductors

Weidmüller terminals are suitable for the direct connection of solid round and sector-shaped aluminium conductors. Unlike copper, aluminium has certain material properties, which have to be taken into consideration when it is used as a conductor in electrical systems.

When exposed to air, the bare surface of the aluminium immediately becomes covered with a thin, non-conductive layer of oxide. This increases the contact resistance between the aluminium conductor and the busbar in the terminal. In the worst case, this may develop into a so-called glowing contact.

In the case of stranded conductors, this phenomenon is exacerbated by the contact resistance of the individual wires.

Despite these disadvantageous properties, aluminium conductors can be connected to Weidmüller terminals if the reduced rating currents for aluminium conductors and the following assembly instructions are observed:

1. Carefully clean the oxide layer from the stripped end of the conductor, for example using a knife.

Caution: do not use brushes, files or sandpaper, to which aluminium particles may adhere and be transferred to other conductors.

2. Immediately after removing the oxide layer, rub neutral grease – such as acid- and alkali-free Vaseline – into the end of the conductor and connect it directly to the terminal.

3. After disconnecting the conductor, repeat 1 and 2 prior to reconnection.

4. The instructions only apply to solid round or sector-shaped aluminium conductors.

Tips during installation:
When tightening the terminals, it is advisable to hold up the conductor to avoid deformation to the mounting rail and to keep the foot of the terminal free of torsion forces.

Stranded aluminium conductors are connected to terminals using an aluminium cable lug selected according to its conductor shape and connected by following the instructions issued by the cable lug manufacturer.

Copper-plated aluminium washers are necessary for the transition from aluminium cable lugs to the busbar of the terminals. This is the only way to ensure reliable transition from copper to aluminium. The washers are fitted so that the copper side is in contact with the busbar and the aluminium side with the aluminium cable lug.
A PE terminal is a component with either one or several clamping positions for connecting and/or branching PE conductors (PE and PEN conductors) with a conductive connection to their support. Partially insulated PE terminals are insulated from adjacent live parts of terminals; the partial insulation is marked green/yellow.

Scope (IEC 60947-7-2)
This standard applies to PE terminals (with PE function) up to 120 mm² and to PE terminals (with PEN function) for sizes upwards of 10 mm² with screw clamping points or screwless clamping points for connecting round copper conductors with a cross-section between 0.2 mm² and 120 mm² (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 connection between copper conductors and the fastening base.

PEN function
Acc. to IEC 60947-7-2, only copper mounting rails may be used for application of the PEN function. Steel mounting rails must not be used.

Fuse terminals consist of a terminal base and a fuse insert holder.
In the case of fuse terminals for low-voltage fuse inserts (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 fuse inserts, the technical data are defined by standard IEC 60947-7-3 pertaining to the specific range of applications of these products.
Fuse terminals for device protection are rated for a certain maximum power loss on the basis of standard IEC 60127-2 valid for G-fuse inserts.
The product pages contain details about the maximum power loss for individual or composite arrangements for short-circuit and/or overload protection.

A multi-storey distribution terminal is a unit with clamping points for connecting and/or linking external, neutral and PE conductors to their fastening support with a conductive PE connection.
These terminals can be fitted on top of or next to each other and assembled to form terminal strips.
They have several connection levels, all of which are isolated from each other.

Use of TS 35 x 15
In order to comply with the current capability required by IEC 60947-7-2, the TS 35 x 15 mounting rail must be used for PE terminals with a rated cross-section of 16 mm² and upwards.
Terminals

Definition of the various types

Neutral conductor isolating terminals

Measuring and isolating terminals

Isolating terminals

A neutral conductor disconnect terminal is a unit with clamping points for connecting and/or linking neutral conductors with disconnect connection. These terminals can be fitted on top of or next to each other and assembled to form terminal strips.

Rated voltage

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 acc. to IEC 60947-1 or IEC 60947-7-1.

400 V applies to
- external conductor / external conductor
250 V applies to
- external conductor / N-conductor
- external conductor / PE conductor
- N-conductor / PE conductor

Measuring and isolating terminals are used for partial disconnection of circuits for measuring purposes in unloaded state. The rated voltage of the measuring and isolating terminal is the rated insulation voltage, to which the insulation tests and creepage distances refer. It is defined acc. to IEC 60664-1 and is one of the specifications marked on the terminal.

The opened disconnect point is dimensioned according to the allocated rated surge voltage.

Isolating terminals are used for operational disconnection of circuits in unloaded state. The rated voltage of the isolating terminals is the rated insulation voltage to which the insulation tests and creepage distances refer, and is defined acc. to IEC 60664-1.

The opened disconnect point is dimensioned acc. to the rated surge voltage allocated for devices with disconnect function acc. to DIN VDE 0100-537 and IEC 60947-7-1.

The disconnects of the isolating terminals are rated for unloaded actuation (use category AC20 acc. to IEC 60947-1) and used to clear a system or part of a system.
**Terminals**

**Ex terminals**

Confirmed according to the new European Ex-Directive 94/9/EC – ATEX –

**Basic specifications**

IEC 60947-7-1 (EN 60947-7-1/ VDE 0611P.1) and IEC 60947-7-2 (EN 60947-7-2/ VDE 0611P.3) are the basic specifications for terminals, and also protective conductor terminals.

For use in potentially explosive atmospheres the following standards also apply: EN 50014 (IEC 60079-0/ VDE 0170/0171 P.1) and for increased safety “e” EN 50019 (IEC 60079-7/ VDE 0170/0171 P. 6). Ex terminals are so-called Ex-components according to EN 50014.

Components means any item essential to the safe functioning of equipment and protective systems, but with no autonomous function.

Components according to the Ex-directive 94/9/EC are not marked with CE.

Ex terminals are certified for the type of protection increased safety “e”.

According to the directive 94/9/EC, the European notified bodies have been issuing EC-type examination certificates of the so-called ATEX-Generation since 1997 in accordance with EN 50014 / 50019 and the Ex directive 94/9/EC.

A prerequisite is a notification of the manufacturer’s quality system. This exists for Weidmüller since 1997. Copies of these type examination certificates, the notification document and the declarations of conformity are available on request in electronic form.

The former component certifications (A to D generation) according to the Ex directive 76/117/EEC are still valid until 30/6/2003.

The clamping yoke, tension clamp and IDC clamping system of the terminals provide increased protection against self-release, and are so designed that conductor ends of flexible conductors do not have to be pre-prepared. The cross-sections and connection data specified in the selection tables are included in the certification.

**Marking**

**Ex-R9/9EG**: ☑ II 2 G D

☑ Ex electrical equipment

II 2 G Equipment group II category 2 (zone 1 electrical equipment)

II 2 D Equipment group II category 2 (zone 21 electrical equipment)

EN 50014/19: EEx 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/EC

U Component
Ex terminals
Confirmed according to the new European Ex-Directive 94/9/EC – ATEX –

Electrical data
The specified values of the current carrying capacity are related to an ambient temperature of 40 °C. At rated current load (+ 10%), the temperature of the currentbar of the terminal increases by a maximum of 40 K.

Recognizing an additional factor of safety according to EN 50 014, gives the following results:

<table>
<thead>
<tr>
<th>Temperature class</th>
<th>Ambient temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>T6, T5</td>
<td>– 50 °C to + 40 °C</td>
</tr>
<tr>
<td>T4 to T1</td>
<td>– 50 °C to + 55 °C</td>
</tr>
</tbody>
</table>

If the real ambient temperature is higher, the permitted operating current must be reduced accordingly. As defined in EN 50 014, the continuous operating temperature for Wemid and KrG is 100 °C, for PA material 80 °C.

Terminals

Design for EEx i
Terminals for “i” intrinsically-safe circuits are passive components, whose temperature-rise behaviour and the electrical characteristics are known.
Therefore, there is no requirement for certification when being used in intrinsically-safe circuits.
The terminals are light blue to ensure clear identification and easy recognition.
These terminals conform to the construction type as terminals corresponding to the EEx e specifications.

Accessories
The accessories listed in the tables can be used and conform to EN 50 020 (IEC 60 079-11/VDE 0170/0171 P . 7).

Mounting
The general statements also apply here for EEx i applications. Additionally, the EEx i requirements always apply to the complete circuit, therefore also for parts in non-potentially explosive atmospheres.

Clampability of 2 conductors in EExe
For our W-series terminals, it is fundamentally permitted to connect 2 wires to each clamping point. It is, however, necessary to use the next size down from the rated wire cross-section. For detailed information see section “Terminals”.

Current carrying capacity of cables and conductors

| Cross-section | VDE 0298 Part 4 (IEC364-5-523) Current carrying capacity of conductors | EN 50019 2nd. ednt. edition Increased-safety type of protection connection terminals | Ambient temperature 40 °C Ambient type C + 3 for PVC 70 °C conductors Ambient temperature 40 °C Ambient type C + 3 for PVC 70 °C conductors Current equivalent to connect conductor
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5</td>
<td>17.5</td>
<td>15.225</td>
<td>15</td>
</tr>
<tr>
<td>2.5</td>
<td>24</td>
<td>20.88</td>
<td>21</td>
</tr>
<tr>
<td>4</td>
<td>32</td>
<td>27.84</td>
<td>28</td>
</tr>
<tr>
<td>6</td>
<td>41</td>
<td>35.67</td>
<td>36</td>
</tr>
<tr>
<td>10</td>
<td>57</td>
<td>49.59</td>
<td>50</td>
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<tr>
<td>16</td>
<td>76</td>
<td>66.12</td>
<td>66</td>
</tr>
<tr>
<td>25</td>
<td>101</td>
<td>87.87</td>
<td>88</td>
</tr>
<tr>
<td>35</td>
<td>125</td>
<td>108.75</td>
<td>109</td>
</tr>
<tr>
<td>50</td>
<td>150</td>
<td>130.5</td>
<td>131</td>
</tr>
<tr>
<td>70</td>
<td>192</td>
<td>167.04</td>
<td>167</td>
</tr>
<tr>
<td>90</td>
<td>232</td>
<td>201.84</td>
<td>202</td>
</tr>
<tr>
<td>120</td>
<td>269</td>
<td>234.03</td>
<td>234</td>
</tr>
<tr>
<td>150</td>
<td>309</td>
<td>268.83</td>
<td>267</td>
</tr>
<tr>
<td>185</td>
<td>353</td>
<td>307.11</td>
<td>307</td>
</tr>
<tr>
<td>240</td>
<td>415</td>
<td>361.05</td>
<td>361</td>
</tr>
<tr>
<td>300</td>
<td>520</td>
<td>452.4</td>
<td>452</td>
</tr>
</tbody>
</table>

The current carrying capacity of cables and conductors in the installation is normally specified at 30 °C ambient temperature according to VDE 0298 Part 4. At 40 °C, the operating current shall be reduced by a factor of 0.87.
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-connection and which of the arrangements A-J is used.

A Continuous

B Adjacent

Not separated by a partition plate or end plate

C Adjacent

Separated by a partition plate or end plate

D Skipping

Bridging one or several not connected 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 Bridging a PE terminal (earth)

H 2 parallel cross-connections

I 3 parallel cross-connections

Maximum voltage

<table>
<thead>
<tr>
<th>Family</th>
<th>Certificate no.</th>
<th>Rated voltage (V)</th>
<th>Rated current (A)</th>
<th>Nominal cross-section (mm²)</th>
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1) Please refer to the catalogue and the certificate showing precisely which article is approved.
Maximum voltage

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W-series / WDU ...

| WDU 1.5/5 | KEMA 97ATEX6545 U | 275 | 15 | 1.5 |
| WDU 2.5 | KEMA 97ATEX1687 U | 275 | 21 | 2.5 |
| WDU 2.5/2 | KEMA 97ATEX2061 U | 550 | 21 | 2.5 |
| WDU 4 | KEMA 97ATEX2061 U | 550 | 28 | 4.0 |

W-series / WDU ...

| WDU 1.5/2.22 | KEMA 97ATEX1685 U | 550 | 14 | 1.5 |
| WDU 2.5/1.22 | KEMA 97ATEX1685 U | 550 | 15 | 1.5 |
| WDU 2.5/TC | SIRA 02ATEX3153 U | 50 | 15 | 1.5 |

W-series / WDU ...

| WDU 1.5/5SLS | KEMA 97ATEX6545 U | 275 | 1 | 2.5 |
| WDU 2.5N | KEMA 97ATEX1683 U | 420 | 21 | 2.5 |
| WDU 2.5 | KEMA 97ATEX1683 U | 550 | 21 | 2.5 |

W-series / WDU ...

| WDU 6 | KEMA 97ATEX1683 U | 750 | 22 | 4.0 |
| WDU 8 | KEMA 97ATEX1683 U | 550 | 36 | 6.0 |
| WDU 10 | KEMA 97ATEX1683 U | 550 | 50 | 10.0 |
| WDU 18 | KEMA 98ATEX1064 U | 750 | 66 | 16.0 |
| WDU 35 | KEMA 97ATEX1683 U | 750 | 109 | 35.0 |
| WDU 70N/35 | KEMA 97ATEX1683 U | 750 | 167 | 70.0 |
| WDU 70/90 | KEMA 97ATEX1683 U | 750 | 202 | 70.0 |
| WDU 120/100 | KEMA 97ATEX1683 U | 1100 | 234 | 120 |
| WDU 240 | KEMA 97ATEX1064 U | 750 | 300 | 240 |
| WDU 4 SL | SIRA 02ATEX3242 U | 275 | 28 | 4 |
| WDU 6 SL | SIRA 02ATEX3242 U | 275 | 36 | 6 |
| WDU 10 SL | SIRA 02ATEX3242 U | 275 | 50 | 10 |

Stud terminals / WFF ...

| WFF 35 | KEMA 98ATEX1684 U | 1100 | 109 | 35.0 |
| WFF 70 | KEMA 98ATEX1684 U | 1100 | 167 | 70.0 |
| WFF 120 | KEMA 98ATEX1684 U | 1100 | 234 | 120 |
| WFF 180 | KEMA 98ATEX1684 U | 1100 | 307 | 185 |
| WFF 300 | KEMA 98ATEX1684 U | 1100 | 452 | 300 |

Z-series / ZDK ...

| ZDK 2.5/1.5 | KEMA 97ATEX4677 U | 275 | 18 | 2.5 |

Technical dictionary

General data

Maximum voltage (V) (letters refer to the above diagrams)

<table>
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<th>B</th>
<th>C</th>
<th>D</th>
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</tbody>
</table>

1) Please refer to the catalogue and the certificate showing precisely which article is approved.

2) For ZDQ, the outer channels must be used in these cases.

3) Only possible with ZDQ.
Owing to their universal foot design, Weidmüller relay modules can be fitted together on the TS 32, TS 35 x 7.5 and TS 35 x 15 mounting rails in accordance with the European standards EN 50 035 and EN 50 022. In the coil circuit of the relay module, an LED status display indicates the switching state of the relay.

**Contact types**

Several types of contact and combinations are available ex stock.

1 NCC  
EGR EG2, EGR EG7, RS 30

1 NOC  
EGR EG2, EGR EG7, DKR, RS 30

1 NCC and 1 NOC  
EGR EG2, WRS

2 NOCs  
WRS

3 NOCs  
WRS

1 change-over contact  
EGR EG2, EGR/RST EG7, WRS, DKR, PRS/PRZ MCZ R, RS 30, RS 31

2 change-over contacts  
EGR EG2, WRS, RS 32, PRS/PRZ

4/8/16 change-over contacts  
RSM

**Arrangement of the contacts in a protective circuit**

When switching inductive or capacitive loads, switching functions occur which influence the electrical service life of the relays. Wear in the contacts can be reduced by using the following protective circuits:

**Diode:**

- **Advantage:** Can be used for all power ratings, low overvoltage, minimum space required, low cost
- **Disadvantage:** Very considerable release delay

**Diode and Z-diode:**

- **Advantage:** Low overvoltage (as determined by Z-diode), only slight release delay
- **Disadvantage:** Cannot be used for large power ratings

**RC combination:**

- **Advantage:** Low overvoltage, only slight release delay
- **Disadvantage:** Higher current load on contacts when switching on, more complicated and expensive at higher power ratings

**Varistor:**

- **Advantage:** Only slight release delay, low cost
- **Disadvantage:** Cannot be used for all operating voltages and power ratings

**Switching small and large power ratings**

For automation technology, Weidmüller supplies EGR EG7 relay couplers for switching the smallest power ratings (up to 40 µW) under resistive load, so that the signals can be reliably transferred to controllers.

The RS31 relay coupler is used for switching large power ratings in the energy and supply industry. It guarantees a switching power rating of up to 3.5 kVA under resistive load.

**Switching times of the relay modules**

- **Response delay typically < 10 ms**
- **Release delay typically < 12 ms**

**Switching behaviour/load limit curves (depending on type)**

- **Contact service life under resistive load**
- **dc load limit curve under resistive load**
- **Reduction factor**

\[
\text{Reduction factor} \quad \text{under inductive load } \cos \varphi < 1
\]

\[
\text{No. of cycles}_{\text{eff}} = \text{no. of cycles (at } \cos \varphi < 1) \times \text{reduction factor } F
\]
Relay couplers with plugged relay
Relay couplers with plugged relay are of only limited suitability in an environment subject to extreme vibrations. Preference should be given to relay couplers with soldered relay.

Derating curve
The contact resistance of the relay contacts is a key factor contributing to temperature increase inside relay modules. This relationship is illustrated by a derating curve, produced by plotting tolerable current against ambient temperature.

The current (Curve a) is determined for the following operating conditions:
- Continuous operation
- Rated input voltage +10%
- Several relay modules working under load without any spacing, mounted horizontally on a mounting rail

When the modules are mounted with spacing > 20 mm, this results in a higher current load (Curve “b”). The function “b” also indicates the maximum values for switching or short-term operation in the horizontally mounted state.

Notes on application
The triggering parameters must be precisely adhered to when using UC versions in dc circuits. Owing to their pre-circuitry, UC versions consume more current at the moment they are switched on. The internal current limit of the standard initiators available may mean that the triggered relay couplers are not switched through.

Relay couplers with 24 V ac/dc input are not suitable for triggering by initiators. Here we recommend using a purely dc version.

RC combinations
Long leads are particularly prone to electrical and electromechanical influences.

This may lead to malfunctions and even failure of the relay module. An upstream RC combination can prevent this by filtering out the interference.

RC combinations are available for all common relay couplers, either plug types (PLUGSERIES) or as terminals WDU 12C and DKU 12C.
**Opto-couplers**

Uning to the increasing degree of automation, the electrical isolation between control circuits (control side / field side) is becoming increasingly significant. The connection between the controller, which is the key component of every automated system, and the various sensors and actuators must be electrically safe and free of any feedback. Opto-couplers are finding increasing use here. They provide the necessary degree of safety and have additional beneficial features such as:

- Low power consumption on the controller side
- High switching frequency
- Wear-free switching
- Insensitive to vibrations
- Can be used position insensitivity
- No mechanical parts
- Long service life
- High insulation voltage

These properties make opto-couplers a good alternative to the classical, mechanical relay interface.

Weidmüller offers modules with different input voltages and enclosure technologies for industrial use.

---

**Basic structure of the opto-coupler interface:**

The key component is the actual optoelectronic component (opto-coupler), which is responsible for the coupling.

![Opto-coupler interface diagram](image)

One important variable of this component is the current transfer rate (CTR).

The CTR factor is stated as a percentage and describes the relationship between dispensed input current IF and the maximum available output current IC.

Example: IF = 10 mA; CTR = 100 % => IC = 10 mA.

However, the CTR is influenced by certain parameters, which cause it to decrease over time, such as:

- Ambient temperature
- Degree of efficiency of the luminescence diode
- Geometric dimensions within the component

In consequence, the switching thresholds also change over time (although this is partly the result of aging).

---

**CTR curve over operating time**

To eliminate this effect as far as possible, Weidmüller almost exclusively uses optoelectronic semi-conductors with high long-term stability in terms of CTR behaviour.

The insulation strength of the component is also important, because this is where the actual coupling of the input and output circuits takes place by optical transfer. This means that even in the event of a fault, the optical component must guarantee separation of both circuits.

By using opto electronic coupling elements in accordance with DIN VDE 0884, Weidmüller’s opto-couplers offer the highest possible safety standards.

The circuitry within the module as a whole must also be considered, so that the entire module complies with DIN VDE 0106 part 101, for example in terms of “protective separation”.

---

**Opto-couplers for galvanic or “protective separation”**

The chief prerequisite for “protective separation” with optoelectronic coupler modules is the partial discharge level test acc. to DIN VDE 0884. Double or reinforced insulation for “protective separation” must be resistant to partial discharge. High-voltage testing, a standard procedure for relays, is not possible with semi-conductors because it may actually destroy them. In the case of coupler modules with integrated opto-couplers, “protective separation” for the stated rated voltage is achieved when the following requirements are satisfied:

- Opto-couplers tested to DIN VDE 0884
- Creepage and clearance distances on circuit boards and connection elements comply with EN 50 178, DIN VDE 0106 or 0109
Opto-couplers

Controller side of the opto-coupler interface
A distinction is made between three basic circuits on the input side of the opto-coupler interfaces:

- Pure dc input: Here there is a polarity reversal protection diode, which prevents damage to the module in the case of reversed input polarity.

- ac/dc input: Here it is not possible to reverse the polarity of the dc input signal. The disadvantage of the ac/dc input circuit (with dc signal trigger) is the lower switching frequency of the module, because the charge capacitor (CL, necessary for ac input signals) reduces the maximum switching frequency.

- AC input:

Here again, the charging capacity has a major influence on the maximum switching frequency of the module as a whole.

Weidmüller Opto-couplers with ac/dc or ac input signals are rated for mains frequencies of approx. 40 ... 60 Hz. In the case of ac input signals, the maximum switching frequency of the opto-coupler module is less than half the mains frequency. A higher switching frequency is not possible, because this would result in constant switching in the rhythm of the mains frequency.

Load side of the opto-coupler interface

Weidmüller opto-coupler modules have been rated and developed for various different applications.

Possible demands made of the load side of the opto-coupler modules include:

- power amplification
- ac/dc and dc/ac signal conditioning
- short-circuit protection
- interference immunity.

To meet these requirements, the modules are assembled with additional electronic elements, which then define the overall functioning of the opto-coupler module.

Accordingly, there are always two versions of the load side of the opto-coupler: output as

- 2-pole or
- 3-pole circuit

2-pole dc output

The 2-pole dc output can be compared with a conventional switch. In this version, it does not matter where the load is located (in the output circuit), although the necessary output supply voltage must be available with the right polarity.

Opto-coupler modules are usually specified as having an output supply voltage range such as 5 ... 48 Vdc. The voltage should on no account ever be higher or lower than these values. The load current should not be higher than the stated maximum output current. If this value were constantly exceeded, the output level would be destroyed.

Derating diagrams show the relationship of output current to ambient temperature (indicated for the products on the following pages).

2-pole ac output

A special semi-conductor module (TRIAC) is used for switching ac voltages in the output level of the optocoupler. Here, as with the dc output, consideration must also be given to the key data (voltage, frequency, maximum load current, ambient temperature, etc.).

Use of the zero voltage switch ensures that load is only switched on at the zero crossover of the voltage. The modules are always equipped with suitable protection elements (varistor, RC combination) as protection from non-permissible voltage peaks.
3-pole dc output

In order to function safely, this kind of output level required potential-related output supply voltage with a single output. It is rated for either positive switching (joint reference potential: GND or 0V) or negative switching (joint reference potential: positive voltage pole).

Standards:
The following standards are complied with:

EN 50178: Electronic equipment for use in power installations
DIN VDE 0106 part 101 Protection from dangerous body currents, basic requirements for “protective separation” in electrical equipment
DIN VDE 0884 Optoelectronic couplers for “protective separation”
DIN VDE 0109 Insulation coordination for equipment within low-voltage systems, including clearance and creepage distances for configured printed circuit boards

Protection circuits
All opto-coupler modules have a protection circuit in the output (usually with a recovery diode).
The load side must be protected to prevent interference signals from coupling into other lines.

Application examples

Monitoring an actuator

Position message with Namur initiator
Overvoltage protection

The electronic equipment of electrical systems is becoming increasingly complex. Programmable logic controls and PC applications are replacing connection-programmed controls (relay technology). Faults caused by overvoltage or switching operations in the systems may cause failure or damage of the system parts. Suitable overvoltage protection measures can almost fully eliminate such problems.

**Protective elements**
- Voltage-limiting protective elements:
  - Gas-filled gas charge eliminators
  - Voltage-dependent resistances (varistors)
  - Voltage-dependent diodes (suppressor diodes)

**Gas charge eliminator**
- The gas charge eliminator consists of an insulating body (a metallised aluminium oxide tube or glass tube), with vacuum-tight connections to two or three electrodes made of special alloys. The gas charge eliminator, which is filled with inert gas, conducts to earth the energy associated with the overvoltage and, at connection voltages < 100 V and short-circuit currents < 0.1 A, reverts to its high-resistive state once the overvoltage has subsided. A pre-fuse is required.
- The gas charge eliminators used by Weidmüller are not tritium-doped.
- In compliance with CCITT (Volume IV, K.12) and DIN 57845/VDE 0845, the nominal data for the gas charge eliminator are given in the catalogue.
- **DC operating voltage**: This is determined at a du/dt of approx. 100 V/s (static behaviour), with a tolerance of up to + 20 %.
- **Impulse sparkover voltage**: This is determined at a du/dt of approx. 1000V/µs (dynamic behaviour). Typical values are < 800V.
- **Leakage current**: Here two procedures are used:
  - DIN VDE 0432 part 2, IEC 68 and CCITT. CCITT: 10 loads (8/20 µs) at 3-minute intervals or acc. to VDE: 5 loads (8/20 µs) at 30 s intervals.
  - Typical values are 5, 10, 20 kA.
  - DIN IEC 68 states the mechanical/climatic conditions under which the mechanical conditions are verified. These include vibrations, shock, and the climatic conditions for the gas charge eliminators, e.g. part 2-3: humidity/temperature for 21 days, 40 °C, 93 % rel. hum., operating temperature range – 40 °C ... + 90 °C.
  - The typical capacity of the gas charge eliminator is several pF.

**Varistors**
- These voltage-dependent resistors consist of zinc oxide. Varistors are available in different types, with disk varistors the preferred form. If the varistor is connected to the maximum tolerable voltage, then a fault current of just a few µA flows through it.
- Varistors are tested by the manufacturer to DIN IEC 68 and according to the quality confirmation system CECC 42000 (DIN 45923).
- DIN IEC 68 names the mechanical/climatic conditions according to which the mechanical conditions are verified. These include for example vibrations and shock, together with the climatic conditions for the varistors, e.g. part 2-3: humidity/temperature for 56 days, 40 °C, 93% rel. hum., operating temperature range – 40°C ... + 90°C.
- Storage temperature to + 125°C.
- CECC 4200 covers specifications such as voltage strength (> 2.5 kW), surge current derating (8/20 µs), insulation resistance > 1 GOhm and the typical response time < 25 ns.

When the varistor is operated at standard mains impedances, varistor types S14 or S20 should be used.
- S14 can be protected by a fuse of max. 10A, S20 with max. 16A.
- The energy absorption (2ms) of the varistors ranges from 0.3J to approx. 200J depending on the type.
- The capacity of the varistors depends on the type, ranging from 0.1 to 37 nF at 1 kHz.
Overvoltage protection

Varistor approvals
- Underwriters Laboratories, Inc. (UL)
  - UL 1414 across-the-line components:
    - File E77005 (N) for type series S05/S07/S10/S14/S20, in voltage stages K130 to K300
  - UL 1449 transient voltage suppressors:
    - File E77005 (M): all disk types preferably integrated within DKU, EGU, PLU, RSU
- Canadian Standards Association (CSA)
  - Class 221 01 Accessories and Parts for Electronic Products
    - All disk types with a voltage > 115 V; for use as across-the-line transient protectors: file LR 63184
  - Schweizerischer Elektrotechnischer Verein SEV
    - Protection class I, protection rating IP00, test regulations CECC 42200, test report no. 90.1 02484.01 dated 17.7.91 for type series S05/S07/S10/S14/S20

Suppressor diodes
Suppressor diodes work similarly to zener diodes, but in this application they work much faster than zener diodes, with response times ranging from a few ps to 5 ns. Energy absorption (1 ms) of the suppressor diodes ranges from 0.3 J to 1.5 J depending on the type.

The typical capacity of the diodes at 1 MHz ranges from 9500 pF to 360 pF. Depending on the type, the suppressor diodes can convert max. 1500 W into heat for power of 1 ms duration. If the diode is overloaded, the P-N contact closes briefly. If the energy supply continues, the P-N contact self-destructs.

These diodes can be used in applications such as protective circuits for coils or in combination with gas charge eliminators and varistors.

Suppressor diodes are supplied as uni-directional and bi-directional types. In the 24 Vdc overvoltage protection module, Weidmüller frequently uses the uni-directional diodes. This adjusts the typical voltage values in the blocked direction to 29 A and 0.7V in the passage direction.

Combination circuits
Combinations of the above mentioned individual components result in fine overvoltage protection modules which can be customised to meet individual demands. If a voltage pulse reaches the input of this unit, then the gas charge eliminator ignites and discharges a high current. The remaining pulse is attenuated by a downstream inductor and then taken up and limited by the varistor or suppression diode. If the gas charge eliminator does not respond, i.e. voltage increases more slowly, then the pulse is processed only by the varistor or diode.

The sequence of individual components results in an increase in response sensitivity in the output direction. An interference voltage with an increase of 1 kV/µs and a peak of 10 kV at the input is limited to approx. 600 – 700 V by a gas-filled surge arrester.

The second stage, which is decoupled from the first by an inductor, then limits this value to approx. 90 V. The voltage pulse is reduced by the suppression diode to approx. 35 V for a 24 V module.

The following electronic component is therefore only required to withstand a voltage pulse of approx. 1.5 x U_b.
Overvoltage protection

Applications for fine overvoltage protection in instrumentation and control engineering

Overvoltages on instrumentation and control signals and on data and power supply lines can cause considerable interference with operations. Under certain circumstances, failure of the electronic systems or entire installations may have serious consequences, even including personal injury.

Among the causes of overvoltages are atmospheric discharge and switching procedures. Overvoltages are relevant in the following areas:
- Remote engineering
- Signalling systems
- Data processing systems
- Process terminals
- Control engineering
- Meteorological stations

These installations must be protected from overvoltage.

Application areas for fine overvoltage protection:
- In instrumentation and control stations, field lines coming in from sensors and actuators have to be protected from overvoltage, as do the sensors themselves.
- Power stations, water treatment plants or sewage plants must be protected not only from direct lightning strikes but also from the remote effects of lightning. The large area covered by the plant and the extensive electrical installations used to encompass this area must be equipped with fine overvoltage protection.
- It is essential in the interests of safety that traffic engineering systems, such as locks and signal systems, be equipped with overvoltage protection modules.
- Machines controlled by frequency converters modulate mains voltages with high-frequency interference, thus influencing other electronic modules.
- Power supply lines and data lines from computers and their peripheral equipment must be protected to allow for safe, reliable operation.
Overvoltage protection

Introduction:
Overvoltage protection in terminal format:
Mini-conditioner

Use
A protection concept for the installation must involve all leads being protected with overvoltage protection products.
Overvoltage protection for power networks (PU B / PU C)

Combination circuits
The above components can be combined to produce highly effective overvoltage protection terminals (MCZ OVP). The gas charge eliminators can discharge high currents.
The varistors and suppressor diodes absorb the residual voltage, and the integrated inductors are responsible for de-coupling.
The energy is discharged via a TS contact. In addition, a tension clamp is available for PE connection.

Mounting rail contact
Contact with the mounting rail is produced automatically by snapping the components on.
The TS 35 must be earthed for energy discharge of up to 10 kA (8/20µs) via the MCZ terminals. For EMC-related reasons, the mounting rail is screwed to the earthed mounting plate. In addition, the PE contact can be produced by the tension clamp of the MCZ OVP.

Application
The MCZ OVP 24 Vdc CL, an overvoltage protector for current loops, has a fast-switching (10-100 ps) suppression diode in its output. When overvoltage occurs, this diode clamps the voltage within the current loop, thus preventing damage to the sensor or actuator.

Installation of overvoltage protection circuits
The fine overvoltage protection modules must be installed in the immediate vicinity of the devices being protected. The protective earth of the device must be connected to the fine overvoltage protection modules.

- A cross-section between 2.5 mm² and 4 mm² should be used for routing the earth leads.
- The connections should be kept as short as possible.
- Avoid switching several earth lines in series.
- The earthing systems should be rated according to VDE 0100, VDE 0185, VDE 0800 and the Deutsche Telekom telecommunications directive FBO 14.

Routing lines
The signal lines should be routed in the installation by the shortest route to the fine overvoltage protection and then to the electronic device. Avoid parallel routing with other lines and avoid routing protected and unprotected lines together. (Caution is required with cable harnesses and cable conduits!)

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

Marking the module
The overvoltage protective module is marked with an arrow or labelled “IN”.

The arrow points to the protected side of the module, i.e. overvoltage is discharged in the direction of the arrow (see combination circuit).
Overvoltage protection

Requirement “for energy systems”
Overvoltage protection for 230 / 400 V electricity mains

Eliminators for electricity mains (230/400 V) are divided into four requirement categories. Weidmüller has three groups of eliminators in its product range:

**Eliminators in requirements class B**
Eliminators installed for the purpose of lightning protection equipotential bonding, capable of coping with direct strikes of lightning. These eliminators are tested with a simulated lightning test current/imp wave form 10/350 µs.

**Eliminators in requirements class C**
Eliminators installed for the purpose of overvoltage protection in stationary installations, e.g. distributors. These eliminators are tested using a rated leakage current $i_{\text{sp}}$, wave form 8/20 µs.

**Eliminators in requirements class D**
Eliminators installed for the purpose of overvoltage protection in stationary or mobile installations, particularly for mains sockets or terminal devices.

**Basic feed diagram**

Eliminator (according to draft VDE 0675 part 6)

- **B**
  - 160 A
  - 160 A
  - 160 A
  - 160 A

Insulation coordination is rated for **6 kV** in the 230/400 V mains. According to DIN VDE 0110, the overvoltage protection must not be lower than **class IV**.

The B-eliminator is used for lightning protection equipotential bonding when a lightning eliminator is fitted to the building.

Eliminator (according to draft VDE 0675 part 6)

- **C**
  - 125 A
  - 125 A
  - 125 A
  - 125 A

KWh $3 \approx$

Insulation coordination is rated for **4 kV** in the 230/400 V mains. According to DIN VDE 0110, the overvoltage protection must not be lower than **class III**.

The C-eliminator is used for discharging to earth the energy coupled into the mains feed line. Used in switchboards.

Eliminator (according to draft VDE 0675 part 6)

- **D**
  - 16 A

Insulation coordination is rated for **2.5/1.5 kV** in the 230/400 V mains network. DIN VDE 0110 stipulates that the overvoltage protection must not be lower than **class II**.

The D-eliminator is used for discharging to earth the energy coupled into the mains feed line. Used in switchboards or sub-distributions.
Overvoltage protection

3+1 circuit
Overvoltage protection for TT networks with 3 varistors and one discharger. Prevents voltage entrainment when varistors are defective.

Eliminator
Protective element which discharges energy symmetrically or asymmetrically.

Disconnect device
Device which disconnects the eliminator from the mains in the event of a fault and indicates that a fault has occurred.

Ageing
Change in the original rating data caused by interference, operation or unfavourable ambient conditions.

Requirements class B
Stipulates the purpose of lightning protection equipotential bonding acc. to DIN VDE 0185-1; see also class 1.

Requirements class C
Stipulates the purpose of overvoltage protection in stationary installations, preferably for use in impulse withstand voltage category III; see also class II.

Requirements class D
Stipulates the purpose of overvoltage protection in stationary installations, preferably for use in impulse withstand voltage category II; see also class III.

Response time
Reaction speed ranges from a few µs to times in the order of ps, depending on the type and structure of the protection module.

Asymmetrical interference voltage
Voltage between the “electric mid-point” and reference potential (earth).

Binary signals
Switching signals with the status on and off.

Lightning surge current Iimp
Defined by the peak current Ipeak and the load Q, when testing according to class I.

Continuous operating current Ic
Current per protection path under operating voltage Uc.

Insertion loss
Attenuation additionally contributed by an inserted four-pole.

EMC
Electromagnetic compatibility.

FI protection switch
If a fault current exceeds a certain limit, the FI switches off within 0.2 sec.

Subsequent current Ir
Current flowing from the mains through the overvoltage protection device immediately after a discharge.

Galvanic coupling
Interference source and use source have the same impedance (line connected).

Gas charge eliminator
Voltage-dependent encapsulated switch with high current-carrying capacity.

Push-pull interference
The interference source and source of use are connected in series (e.g. magnetic or galvanic coupling).

Measured voltage limit
Maximum voltage level during application of surges of prespecified form and attitude in testing.

Triggered discharger
A gas-filled discharger ignited by a capacitive attenuator at a preset voltage level.

Common-mode interference
The interference source is between the signal wire and reference conductor (e.g. capacitive coupling or potential increase of physically separated earths).

Frequency limit
Indicates the frequency up to which successful transfer occurs. At higher frequencies, the protective circuit attenuates to such an extent that transfer is no longer possible.

Maximum operating voltage Uc
Highest effective value of ac voltage or highest value of dc voltage tolerated continuously on the protection path of the overvoltage protection device. Operating voltage = rated voltage.

Inductive coupling
Coupling through two or three live conductor loops.

Insta
Installation enclosure acc. to DIN 43880, suitable for integration of installation distributors.

Ipeak
Peak current of a test pulse.

Isn
Peak value of the nominal leakage current.

Insulation coordination
Peak withstand current capacity of the insulation in installation components according to DIN VDE 0110 part 1.

IT network
Network system with 3 external conductors insulated to earth potential. The PE of the building is not connected to the network system.

Capacitive coupling
Coupling of interference circuit and use circuit via coupling capacitors caused by a difference in potential.

Class I
Stipulates the purpose of lightning protection equipotential bonding acc. to IEC 37A/44/CDV; see also requirements class B.

Class II
Stipulates the purpose of overvoltage protection in stationary installations, preferably for use in impulse withstand voltage category III; see also requirements class C.

Class III
Stipulates the purpose of overvoltage protection in stationary installations, preferably for use in impulse withstand voltage category II; see also requirements class D.

Combination circuit
Protection circuit made up (for example) of gas charge eliminator, varistor and/or suppressor diode.
Overvoltage protection

**Combined surge**
The hybrid generator generates a 1.2/50 µs pulse in idle mode and a 8/20 µs pulse in short-circuit. The ratio of peak value idle voltage $U_{oc}$ to peak value short circuit current $I_{sc}$ is 2 ohms.

**Short-circuit strength**
Highest non-influenced short-circuit current which the overvoltage protection device can withstand.

**Longitudinal voltage**
Interference voltage between active conductor and earth.

**Leakage current**
Current which flows to PE under rated voltage.

**Maximum discharge surge current $I_{max}$**
Peak value of current $8/20$ µs during trial run of operational test acc. to class II.

**MCZ ovp**
Narrow protective terminal with tension spring connection and mounting rail contact for PE.

**MOV**
See varistor

**MSR**
Instrumentation and control technology

**Nominal discharge surge current $I_{n}$**
Peak value of surge current $8/20$ during test acc. to class II.

**PE**
Protection and earthing system to which the energy is discharged.

**PU**
Overvoltage protection for high pulses in energy systems in installation enclosures.

**Transverse voltage**
Interference voltage between two conductors of a circuit

**RCD**
See FI protection switch

**RSU**
Overvoltage protection on the clip-on base profile with gas charge eliminator, varistor and suppressor diodes for 6A and 10 A current loops.

**Degree of protection of the enclosure (IP code)**
Degree of protection afforded by the enclosure to prevent contact with live parts and to prevent penetration of solid particles or water. Tested acc. to IEC 529 section 7.4

**Protection level $U_{p}$**
Indicates the residual voltage measured for an overvoltage pulse at the terminals (preferential value as highest measured voltage limit). Important parameter characterising the efficiency of the overvoltage protection device.

**Protection path**
Circuit of the components of an overvoltage protection device; “conductor to conductor”, “conductor to earth”, “conductor to neutral” and “neutral to earth” are all protection paths.

**SPD**
Surge protection device

**Surge voltage 1.2/50µs**
Surge voltage with a head time of 1.2 µs and a time to half value of 50 s

**Surge current 10/350 µs**
Lightning test current with a head time of 10 µs and a time to half value of 350 µs.

**Surge current 8/20 µs**
Lightning test current with a head time of 8 µs and a time to half value of 20 µs.

**Radiation coupling**
Electromagnetic field coupled in one or several conductor loops.

**Suppressor diode**
Voltage-dependent, fast-switching semi-conductor diode.

**Symmetric interference voltage**
Voltage between push and pull conductor (push-pull voltage).

**TAZ**
See suppressor diode.

**TN-Netz**
Netzsystem als 4 oder 5 Leiter System, 3 Aussenleiter und der PEN kommen in das Gebäude. PE vom Gebäude und der PEN sind miteinander verbunden.

**TN mains**
Mains system as 4 or 5 conductor mains; 3 external conductors and PEN are installed within the building, PE from the building and the PE from the mains are connected.

**TT mains**
Mains system with 4 conductors. Three external conductors and the neutral conductor are installed within the building. The PE of the building is not connected to the mains system.

**Overvoltage**
Unwanted continuous or short difference in potential between conductors, or between conductor and earth, which causes interference or destruction.

**Overvoltage protection**
Circuit/wiring of an electric circuit to limit the output voltage.

**Overvoltage protection installation**
Devices and installations included in a system for purposes of overvoltage protection, including the leads that form part of such equipment.

**Overvoltage protection device**
Device with at least one non-linear module for limiting transient overvoltages and discharging surge currents.

**Overvoltage protection classes**
Classification of electrical equipment according to its voltage strength with reference to the nominal voltage. EN 50178.

**Non-symmetrical interference voltage**
Voltage between conductor and reference potential (earth).

**Varistor**
Voltage-dependent metal oxide resistance; resistance decreases with increasing voltage.

**Back-up fuse**
Max. fuse to be provided depending on connection cross-section and/or longitudinal decoupling.
Tools

Cutting

Weidmüller uses the term “cutting” to refer to the severing of cables, leads and conductors made of copper or aluminium with a tool specially designed for this purpose.

The requirement for all cutting tools is to perform a straight cut without deforming the conductor.

Movement of the blades

Cutting can be categorised based on the method used. There are basically two cutting methods:

- **squeezing cut**,  
- **pulling cut**.

In the squeezing cut, the cutting movement is perpendicular between the tool and the work piece. In the pulling cut, the cutting movement is diagonal to the tool.

Position of the blades

In position 1, the blades act directly and along the whole length, requiring considerable force.

In position 2, the blades cross as in a pair of scissors; the cut is therefore “offset” in time and requires less force.

According to DIN 8588, experts differentiate between shear cutting, wedge cutting, tearing and breaking.

Shear cutting is used especially for cutting cables, leads and conductors. Cutting tools with cross blades should perform a pulling cut without any play.

One prime quality feature makes professional cutting tools stand out from the rest: the shape of the blades corresponds to, and is optimised for, the specific intended use. The manual force required for cutting is relatively small, so that the cutting tool can be used with just one hand.

Another quality feature is cutting sharpness, i.e. the cutting angle and presence of a facet. A facet produces a specific slight increase in the cutting angle, increasing the service life of the blade and the cutting sharpness.

Tools by Weidmüller fulfil all the requirements made of professional cutting tools.

Clean cut  
An “unclean” cut may look like this:

- Insulation
- Conductor
- Conductor sheared off
- Conductor pulled out
- Squeezed cable
Tools

Stripping

Stripping refers to the cutting and removal of insulation. Compliance with the stripping size must be guaranteed. Neither the conductor nor the remaining insulation must be damaged. DIN IEC 352 part 2 (previously DIN IEC 48/290) refers to stripping faults which must be avoided:

- To avoid these faults, it is important for the stripping tool to be adjusted to the insulation and to the cross-section of the conductor.
- Cable knives (penknives) should certainly not be used, because the stripping quality then depends on the manual skills of the user – and even when the user is highly skilled, it is not possibly to achieve uniform high quality.
- Preference should be given to manual tools which adjust automatically to the cross-section of the conductor. They do not cause any damage to the conductor during stripping, and prevent all the above-mentioned stripping faults.
- stripax® stripping tools guarantee work of constant and uniformly high quality which complies with the DIN regulations. The tools are rated for standard PVC insulation. Any PVC insulation thicknesses deviating from the norm are adjusted manually. The conductor stopper and integrated wire cutter allow for highly versatile use of the tools.
- Special insulation such as Teflon, silicone and Kapton require special stripping tools. They strip the conductor using punch blades.

Correctly stripped conductor

Possible stripping faults:

- Insulation has not been cut properly
- Insulation remnants are still on the stripped conductor
- The conductor insulation has been damaged by the stripping tool
- Individual wires have been damaged or cut off by the stripping tool
- Individual wires have been twisted too hard afterwards
- Individual wires are no longer twisted
Tools

Crimping wire end ferrules

Optimum crimp of different cross-sections to serve as a quality template

Examples of the visual appraisal of a crimp connection with manual and automatic crimping tools by Weidmüller:

The conductor insulation must be pushed into the plastic collar.
The ferrule pipe must be completely filled by the conductor.
Depending on the cross-section, the conductor should protrude approx. 0...0.5 mm from the ferrule pipe.

Faulty crimping connections with wrong combinations of conductor and wire end ferrule:

It is not possible for a tool to work reliably with every possible combination of conductors and crimping material.

It is possible that the standard requirements for the crimped article may not be met, although both conductor and crimping material comply with the relevant standards when considered individually. The individual production tolerances of conductors and crimping materials do not allow every conductor to be combined with every contact.

The combination of conductors, crimping material and crimping tool must be coordinated: this is all the more difficult to achieve given the diversity of products on the market.

Therefore, the material must be defined and the crimping result tested, ensuring that both the test and (later on) the tool satisfy the same conditions.

Faults occurring during crimping:

- Cracks along the edges and punch impressions
- Splitting of the wire end ferrules
- Asymmetrical crimping shape
- Extreme burrs formed along the edges
- Ferrule not filled by conductor
- Single conductors pushed back, protruding from the collar
- Single conductors squeezed off
- Plastic collar damaged by the crimping punch
- Conductor insulation not pushed into the plastic collar
- Wire end ferrule bent longitudinally after crimping

Note:
The ferrule must not split open after it has been connected in any Weidmüller terminal corresponding to the conductor cross-section (with tightening torques acc. to IEC 60947-1)

Cross-section diagram:

For cross-sections of 6 ... 50 mm², the crimping shape is about the same.

Front view:

- 0.5 mm²
- 0.75 mm²
- 1.0 mm²
- 1.5 mm²
- 2.5 mm²
- 4.0 mm²

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