Safety relay

SAFESERIES SIL relays

Functional safety for process applications

Whether for a burner control system, secure emergency shut down or, for example, for pump controllers – our safety relay guarantees safe conditions and encompasses highly superior and significant features.

Their integration into distributed control systems (DCSs) is even better, with an input filter which makes the SIL circuit immune to the test impulse which is typically used by a DCS. You will also benefit from simple maintenance: the fuses are accessible from the outside and can easily be changed. You can see the status of the safety and the monitoring devices clearly on the displays mounted directly to the device.

All devices are accredited though certification by the internationally recognised TÜV-NORD group – for secure process applications around the globe. Let's connect.

Safe control of back-up systems
Equipped with wide range input voltages in the monitoring circuit from 24 V AC/DC to 230 V AC/DC, the relay is designed for individual use, e.g. in back-up systems or the overfill prevention devices of tank farms.

Safe monitoring of furnace firing systems
The feed-in of fuel must be interrupted as soon as a boiler plant reaches any safety criterion limits. The SAFESERIES offers you a safety switch-off for the feed-in of fuel to furnace firing systems up to safety integrity level (SIL) 3.

Safe activation and deactivation
This universal device can be used for either the energise-to-safe or de-energise-to-safe operation modes, as you wish. This makes it suitable, e.g. for pump controllers or extinguishing systems.

You have strict requirements for the functional reliability of your systems

We connect your safety-related applications reliably

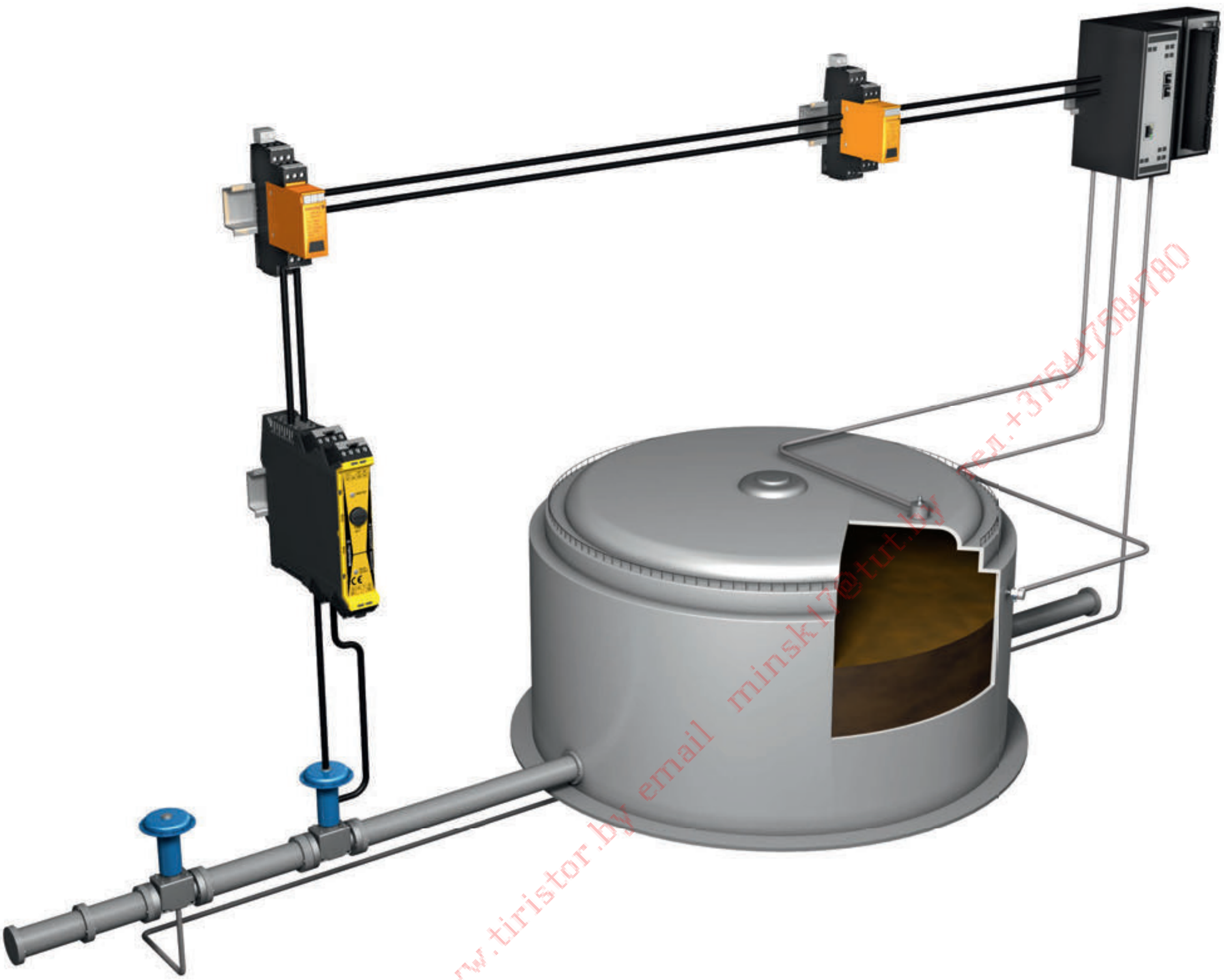
Safe process and power technology is a top priority for you. For example, a reliable emergency shutdown, which initiates appropriate countermeasures in hazardous situations, is indispensable. These might extend to the automatic shutdown of the system or subsystems within it.

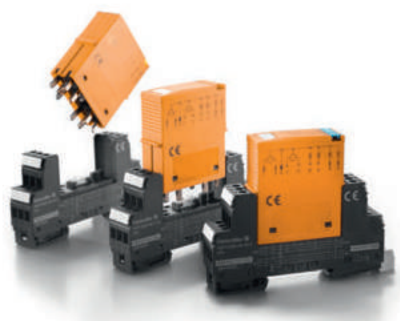
As a specialist in industrial connectivity, we offer a comprehensive solution for safety-sensitive areas, from the control room through to the field.

The SAFESERIES SIL relay is ideally suited for use in safety-related applications. It is designed for low and high demand modes.

With the wide range input voltage in the protective circuit of 24 V UC to 230 V UC, for example, you can control back-up systems with high DC voltage. You get additional flexibility for your applications with the optional "G3" coating for use in harsh environments.

The safe and reliable coupling of measuring instruments, actuators and sub-assemblies to the safety-relevant signal circuit is handled by our VARITECTOR SPC, the lightning and surge protection for signal circuits. Certified for safety requirement level SIL 3 according to EN 61508, and accredited by TÜV NORD, it can easily be incorporated into your safety calculations.





SAFESERIES

- Certified to EN 61508 for SIL3
- Wide voltage input from 24 to 230 V AC/DC for the monitoring of field signals
- Variant with G3 protection for extreme conditions
- Other variants for burner management or on/off switching

VARITECTOR SPC

- 2 analogue or 4 digital signals on a width of just 17.8 mm
- Monitoring with status indicator and message function
- Testable with V-TEST according to IEC62305
- Variants with SIL certification or EX approval

SIL3 relays

- With and without monitoring circuit
- Wide-range input voltage in the monitoring circuit
- Externally accessible fuse
- TÜV certified “Approved Safety Function”

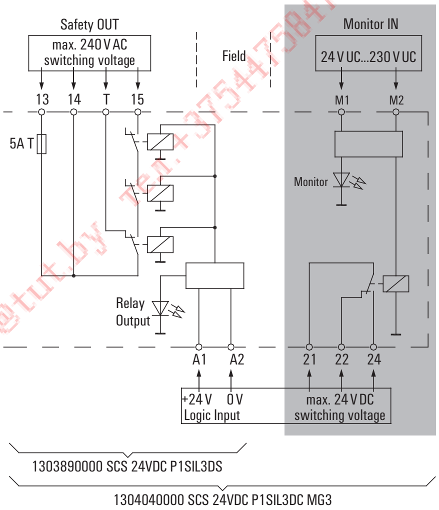
SCS 24 V DC P1SIL3DS

The SCS 24VDC P1SIL3DS safety relay is used in areas that require a functionally safe shutdown. This component fulfils the requirements of EN 61508, SIL 3.

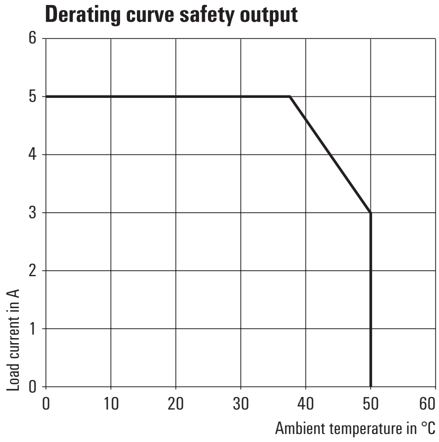
Technical data

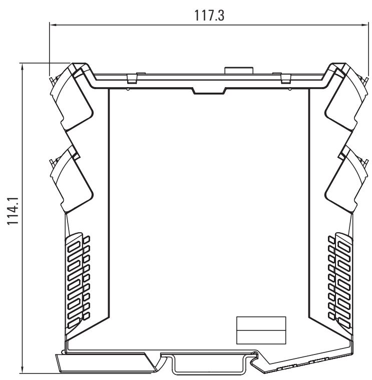
Temperatures	
Ambient temperature (operational)	-25...50 °C
Storage temperature	-40...85 °C
General data	
Noxious gas resistance to EN 60068-2-60	Yes (art. No.: 1304040000 only)
Input (safety circuit)	
Rated control voltage	24 V DC ± 20%
Guaranteed current consumption of 24 VDC -10%	35 mA
Power consumption	42 mA
Status indicator	LED yellow
Input (monitor circuit)	
Rated control voltage	24 V UC...230 V UC ±10 %
Current consumption	23 mA @ 24 V DC, 4,4 mA @ 230 V AC
Status indicator	LED yellow
Output (safety circuit)	
Contact design	NO contact
max. switching current, internal fuse	5 A (refer to derating curve)
max. switching current, external fuse	5 A (refer to derating curve)
max. permitted switching voltage	250 V AC / 30 V DC
max. permitted switching current	8 A
min. switching power	10 mA @ 12 V
max. switching power	2000 VA
Switch-on time	typ. 7 ms
Base material of the contact	AgNi 0.15 gold flashed
Internal fuse	5 A time-lag
External back-up fuse	5 A time lag
Short-circuit-proof	No
Output (monitor circuit)	
Contact design	CO contact
max. permitted switching voltage	24 V DC
max. permitted switching current	30 mA
min. switching power	1 mA @ 1 V
Base material of the contact	AgNi 5µm Au
Switch-on time	typ. 17 ms
Short-circuit-proof	No
Insulation coordination	
Rated voltage	300 V
Creepage and clearance distance input – output	≥ 5.5 mm
Creepage and clearance distance output – output	≥ 5.5 mm
Dielectric strength input – output	4 kV_{eff} / 1 min
Dielectric strength output – output	4 kV_{eff} / 1 min
Dielectric strength to mounting rail	4 kV_{eff} / 1 min.
Impulse withstand voltage	6 kV (1.2/50 µs)
Overvoltage category	III
Pollution degree	2
Further details of approvals / standards	
Standards	EN 50178, EN 61000, EN 61326-3-2

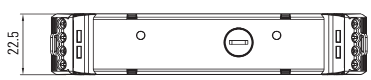
Dimensions		**Dimensions**
Clamping range (nominal / min. / max.)	mm²	1.5 / 0.13 / 2.5
Depth x width x height	mm	114.1 / 22.5 / 117.3
Note		



Derating curve safety output







Ordering data

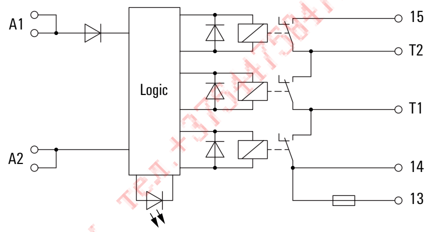
	Type	Qty.	Order No.
with monitoring	SCS 24VDC P1SIL3DS M	1	1303760000
without monitoring	SCS 24VDC P1SIL3DS	1	1303890000
with monitoring and G3 gas-corrosion resistant	SCS 24VDC P1SIL3DS MG3	1	1304040000
Note			

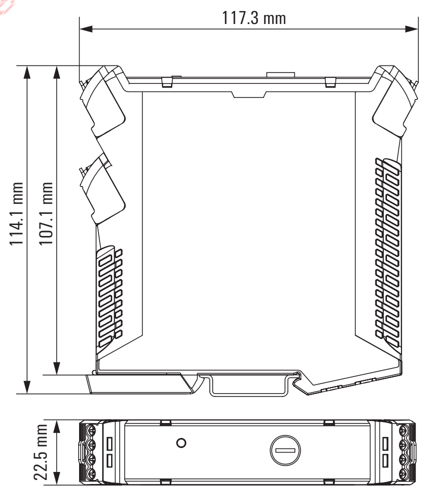
SIL3 relay

- Immune against test pulses from Triconex® output modules
- For the use with the systems Tricon™, Trident™ und Tri-GP™ a proof of compatibility is available
- Externally accesible fuse
- TÜV certified "Approved Safety Function"

SCS 24 V DC P1SIL3DS I

The SCS 24VDC P1SIL3DS I safety relay is used in areas that require a functionally safe shutdown. This component fulfils the requirements of EN 61508, SIL 3.





Technical data

Temperatures	
Ambient temperature (operational)	-25...50 °C
Storage temperature	-40...85 ° C
Input (safety circuit)	
Rated control voltage	24 V DC (16...36 V DC)
Power consumption	50 mA
Status indicator	LED yellow
Output (safety circuit)	
Contact design	NO contact
max. switching current, internal fuse	5 A
max. switching current, external fuse	5 A
max. permitted switching voltage	250 V AC / 30 V DC
max. permitted switching current	5 A
min. switching power	10 mA @ 12 V
max. switching power	2000 VA
Switch-on time	≤ 25 ms
Base material of the contact	AgNi
Internal fuse	5 A time-lag
External back-up fuse	5 A time lag
Short-circuit-proof	No
Insulation coordination	
Rated voltage	300 V
Creepage and clearance distance input – output	≥ 6 mm
Dielectric strength input – output	3.51 kV_{eff}/5 s
Dielectric strength to mounting rail	
Impulse withstand voltage	6 kV (1.2/50 µs)
Overvoltage category	III
Pollution degree	2
Further details of approvals / standards	
Standards	EN 61010-2-201:2013 + AC:2013, EN 61326-1:2013, EN 61326-3-1:2008, EN 61326-3-2:2008

Dimensions		**Dimensions**
Clamping range (nominal / min. / max.)	mm²	1.5 / 0.13 / 2.5
Depth x width x height	mm	114.1 / 22.5 / 117.3
Note		

Ordering data

	Type	Qty.	Order No.
with monitoring	SCS 24VDC P1SIL3DS I	1	**2500980000**

Note	

SIL3 relays

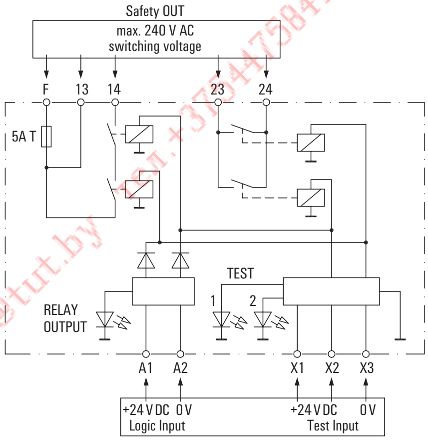
- Energised / de-energised to safe
- All pins can be disconnected
- Test inputs for testing the relay contacts
- Externally accessible fuse
- TÜV certified "Approved Safety Function"

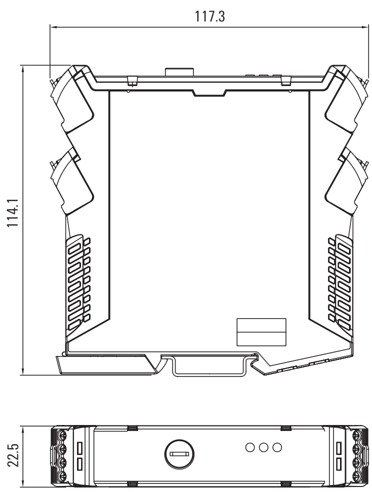
SCS 24 V DC P2SIL3DSES

The safety relay SCS 24VDC P2SIL3DSES is used in areas that require functionally safe deactivation or activation. The requirements according to EN 61508, SIL3 can be fulfilled with this module.

Technical data

Temperatures	
Ambient temperature (operational)	-25 °C...50 °C
Storage temperature	-40 °C...85 °C
Input (safety circuit)	
Rated control voltage	24 V DC -15 / +20%
Guaranteed current consumption of 24 VDC -10%	35 mA
Power consumption	45 mA
Status indicator	LED yellow
Test inputs	
Rated control voltage	24 V DC
Status indicator	LED red flashing: test input is triggered
Number of test inputs	2
Output (safety circuit)	
Contact design	1 x de-energised to safe (NO contact), 1 x energised to safe (NO contact)
max. switching current, internal fuse	5 A (refer to derating curve)
max. switching current, external fuse	5 A (refer to derating curve)
max. permitted switching voltage	250 V AC
max. permitted switching current	8 A
min. switching power	10 mA @ 12 V
max. switching power	2000 VA
Switch-on time	< 5.5 ms (DTS), < 5 ms (ETS)
Base material of the contact	AgNi 0.15 gold flashed
Internal fuse	5 A time-lag
External back-up fuse	5 A time lag
Short-circuit-proof	No
Insulation coordination	
Rated voltage	300 V
Creepage and clearance distance input – output	≥ 5.5 mm
Creepage and clearance distance output – output	≥ 5.5 mm
Dielectric strength input – output	4 kV_{eff} / 1 min
Dielectric strength output – output	4 kV_{eff} / 1 min
Dielectric strength to mounting rail	4 kV_{eff} / 1 min.
Impulse withstand voltage	6 kV (1.2/50 µs)
Overvoltage category	III
Pollution degree	2
Further details of approvals / standards	
Standards	EN 50178, EN 61000, EN 61326-3-2





Dimensions		Dimensions
Clamping range (nominal / min. / max.)	mm²	1.5 / 0.13 / 2.5
Depth x width x height	mm	114.1 / 22.5 / 117.3
Note		

Ordering data

Type	Qty.	Order No.
SCS 24VDC P2SIL3DSES	1	**1319270000**

Note

SIL3 relays

- Positively-driven contacts
- 2-channel design
- Insert according to EN 50156
- TÜV certified "Approved Safety Function"

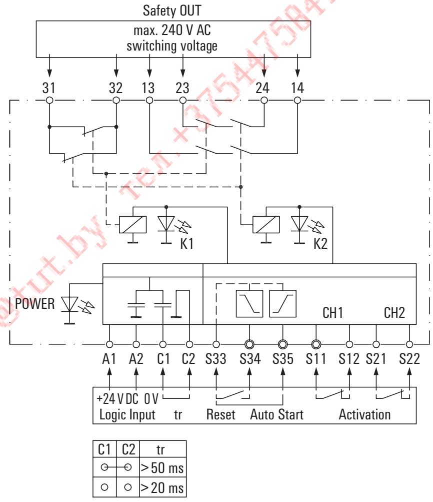
SCS 24 V DC P2SIL3ES

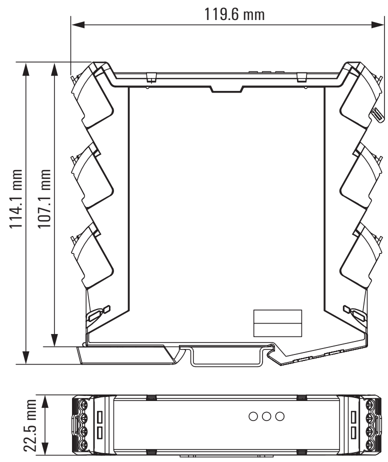
The feed-in of fuel must be interrupted as soon as a boiler plant reaches any safety criterion limits. The safety relay SCS 24VDC P2SIL3ES enables you to carry out a safety shutdown of the fuel supply, to safety level SIL 3.

Technical data

Temperatures	
Ambient temperature (operational)	-25 °C...55 °C
Storage temperature	-40 °C...85 °C
Start circuit	
Operating voltage	22 V DC, from internal power supply
Function	falling edge (button via S33/S34), rising edge (permanent bridge via S33/S35)
Input (supply)	
Rated control voltage	24 V DC ±15 %, 24 VDC +15% / -10% during auto-start
Current consumption	55 mA (release circuit enabled), 6 mA (release circuit not enabled)
Guaranteed current consumption at 24 V DC -10%	35 mA
Response time	with bridge via C1/C2: typ. 50 ms, without bridge via C1/C2: typ. 20 ms
Status display	LED green, power, LED yellow, signal
Short-circuit detection	Yes, max 4 s up to switch-off (Polyfuse)
Monitoring circuit	
Operating voltage	22 V DC, from internal power supply
Input	2, each externally bridgeable
Output (release circuit)	
Contact version	2 NO positively-driven (EN 50205 type B)
Switching voltage AC, max.	250.000000 V
max. permitted switching current	6 A
min. switching power	10 mA @ 12 V
max. switching power	2000 VA
Switch-on time	55 ms (C1/C2 bridged, switched via A1/A2), 30 ms (opening/closing of monitoring circuit)
Switch-off time	20 ms (C1/C2 bridged, switched via A1/A2), 15 ms (opening/closing of monitoring circuit)
Contact base material	AgSnO
max. switching current, external fuse	5 A
external back-up fuse	5 A time lag
Feedback output	
Contact version	1 NC positively-driven (EN 50205 type B)
Switching voltage AC, max.	250 V
Max. switching current	1 A
Insulation coordination	
Rated voltage	300 V
Creepage and clearance distance input – output	≥ 5.5 mm
Creepage and clearance distance output – output	≥ 5.5 mm
Dielectric strength input – output	4 kV_{eff} / 1 min
Dielectric strength output – output	4 kV_{eff} / 1 min
Dielectric strength to mounting rail	4 kV_{eff} / 1 min.
Impulse withstand voltage	6 kV (1.2/50 µs)
Overvoltage category	III
Pollution degree	2
Further details of approvals / standards	
Standards	EN 50178, EN 61000, EN 61326-3-2, EN ISO 13849-1 (PLe)

Dimensions		**Dimensions**
Clamping range (nominal / min. / max.)	mm^2	1.5 / 0.13 / 2.5
Depth x width x height	mm	114.1 / 22.5 / 119.6
Note		





Ordering data

Type	Qty.	Order No.
SCS 24VDC P2SIL3ES	1	**1319280000**

Note

Timer

Timer

Compact timing relay for easy adjustment of the control signals

IT-TIMER multi-functional timing relay with multi-voltage input

Timing relays are frequently used in automation engineering in order to compensate malfunctions caused by high cycle rates. Short pulses are extended and hence are reliably identified by downstream control components.

The timing relay offers high functionality on a small footprint. Due to the flat front panel, an easy-to-read LED display as well as operating elements adjustable by standard tools, the configuration is particularly straightforward.

With the IT-TIMER, Weidmüller offers a highly efficient multi-functional timing relay with multi-voltage input, which fulfils the product standards in accordance with IEC 61812-1.

The IT-TIMER timing relays are used in factory automation for easy adjustment of the control signals.

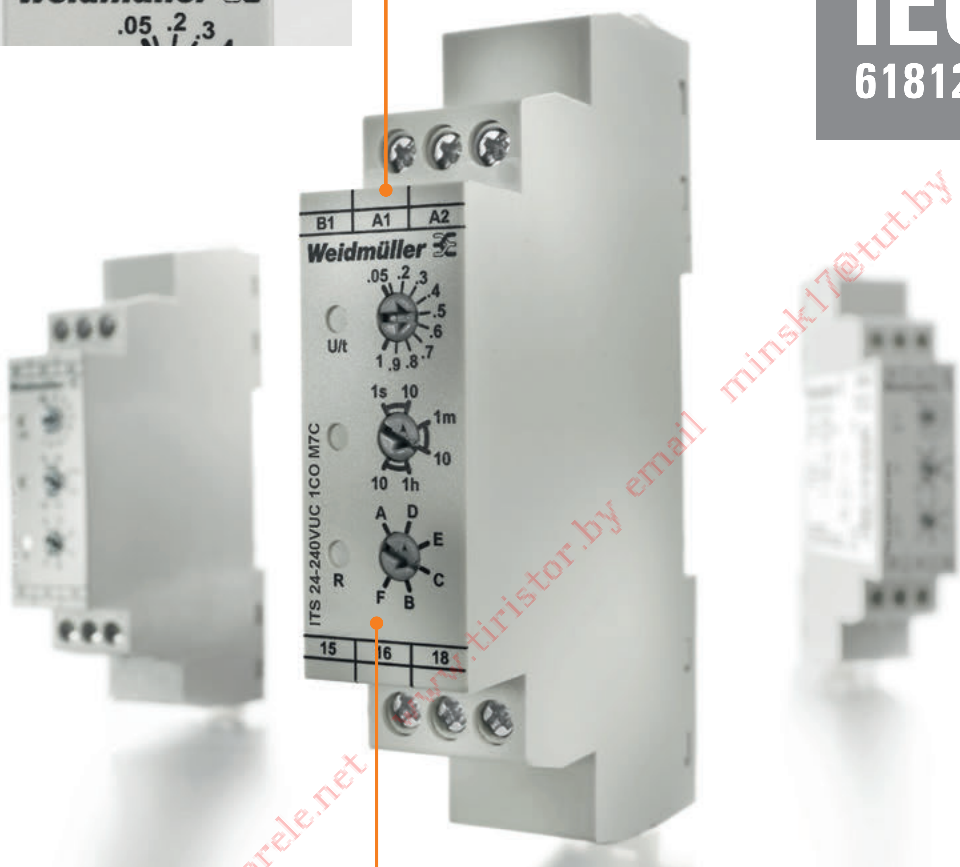
Your special advantages:

A compact device with easy configuration of the time functions
Its compact size, the multi-voltage input and an easy configuration of the time functions make the IT-TIMER a smart solution for your application.

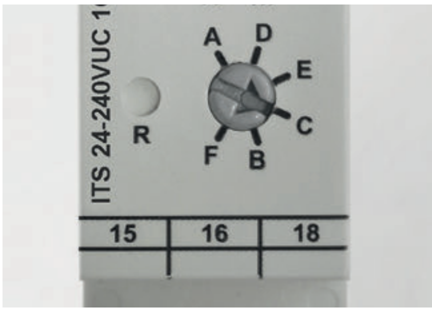
Multi-voltage input
The timing relay operates from 24 V DC up to 48 V DC and from 24 V AC up to 240 V AC. It can therefore be used in a wide range of applications.

Global standard
International usage is guaranteed in accordance with the standard IEC 61812-1.

IEC
61812-1



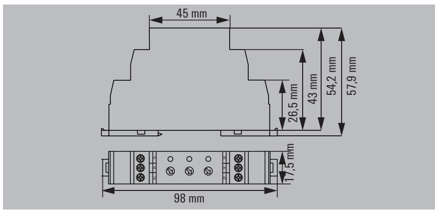
Seven timing functions
Due to its multi-functional concept, the IT-TIMER covers a broad range of typcially needed time functions.

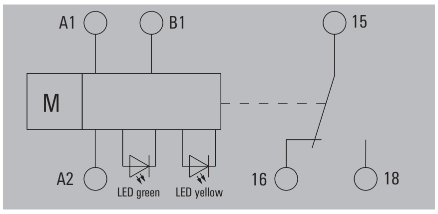


Timing relay

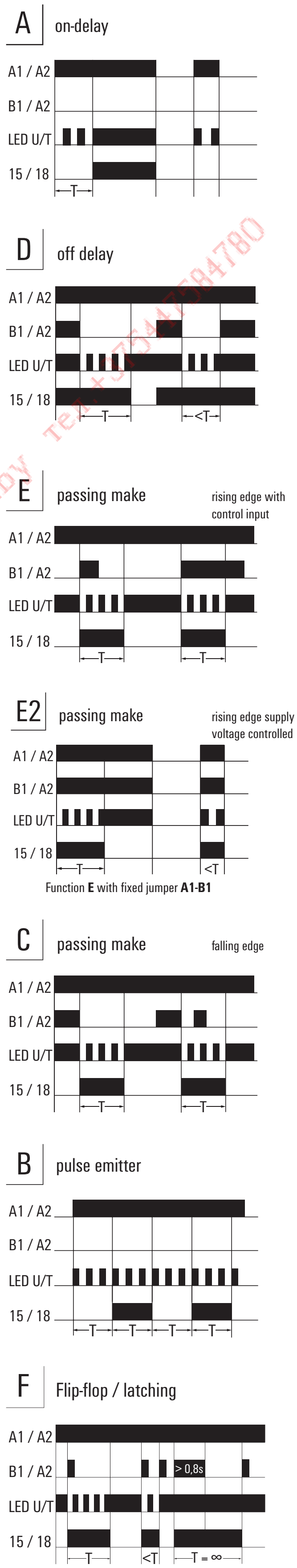
- Multi-voltage input:
  24...48 V DC
  24...240 V AC
- Space-saving construction
- 7 time functions with separate control input

ITS 24-240 V UC 1 CO M7C





Time functions



Technical data

Input	
Rated control voltage	24...48 V DC - 15 % / + 10 % / 24...240 V AC - 15 % / + 10 %
Power rating	8 VA @ 230 V AC, 0.4 W at 24 V DC
Status indicator	LED green (U/t): flashes when time runs, lights permanently with supply voltage applied, LED yellow (R): relay closed
Repeat accuracy	< 0.5 % or ±5 ms
Basic accuracy	< 1.5 % (of scale-end value)
Setting tolerance	5 %
Min. pulse duration	50 ms
Time ranges	0.05 s - 1 s, 0.5 s - 10 s, 3 s - 60 s, 0.5 min - 10 min, 3 min - 1 h, 0.5 h - 10 h
Max. reset time after voltage interruption	100
Output	
Rated switching voltage	250 V AC
Max. switching voltage, AC	250
Max. switching voltage, DC	30 V
Continuous current	5 A
AC switching capacity (resistive), max.	1250 VA
DC switching capacity (resistive), max.	90 W
Max. switching frequency at rated load	0.1 Hz
Contact material	AgNi
Mechanical service life	1 x 10^6 switching cycles
General data	
Ambient temperature (operational)	-25 °C...50 °C
Storage temperature	-40 °C...70 °C
Humidity	25 - 75%, no condensation
Version	with separate control input
Resistance to vibration EN 61812-1	10 Hz...60 Hz: 0.15 mm, 60 Hz...150 Hz: 2 g
Approvals	CE
Insulation coordination	
Rated voltage	300 V
Creepage and clearance distance input – output	≥ 1.5 mm
Dielectric strength input – output	1.6 kV
Impulse withstand voltage	2.5 kV
Protection degree	IP20
Dimensions	
Clamping range (nominal / min. / max.) mm^2	2.5 / 0.25 / 2.5
Depth x width x height mm	57.9 / 17.5 / 98
Note	

Ordering data

	Type	Qty.	Order No.
Screw connecion	ITS 24-240VUC 1CO M7C	1	**2496190000**
Screw connecion	ITS 24-240VUC M7C PU10	10	**2545120000**

Note

Accessories

Note

Installation timer

The electronic timer from the BT product range offers ideal solutions for industrial applications.

The BT product range provides the following functions:

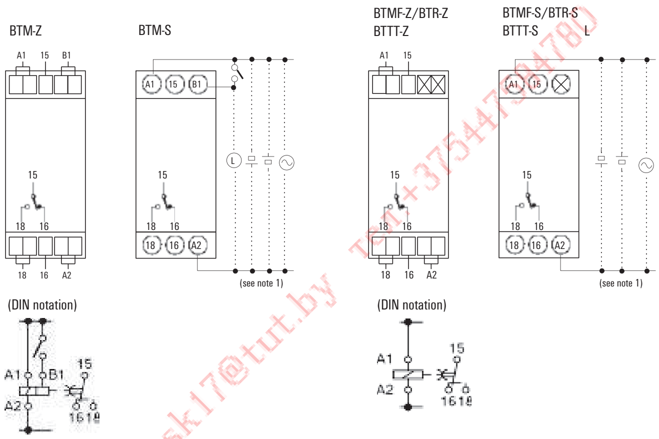
- Pick-up delay (BTR)
- Pulse emitter (BTTT)
- Multifunction with control input (BTM)
- Multifunction without control input (BTMF)
- Star-delta change-over

Time ranges and power supplies for timer

Using the central button, you can select the functions of the modules over either 4 or 8 time ranges.

The multi-voltage supply range offers a wide bandwidth for industrial use (see technical data).

Connection of the timer



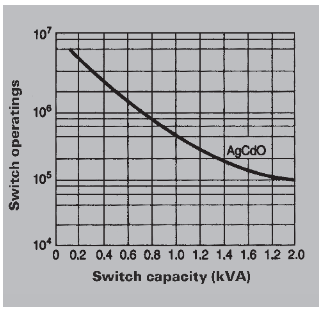
Note: 1. Pole numbers are not necessary for DC voltage supply.

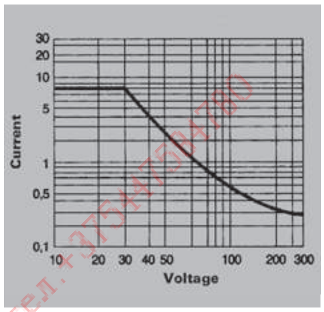
2. The contact symbol of BTM is marked with as it provides serveral operating modes and differs from the delayed contacts of conventional timer.

Time ranges

Display of time scale	Time ranges
0.1 s	0.1 to 1.2 s
1 s	1 to 12 s
0.1 min	0.1 to 1.2 min
1 min	1 to 12 min
0.1 h	0.1 to 1.2 h
1 h	1 to 12 h
10 h	10 to 120 h

Note:
If the rotary button for time adjustment is set to "0", the output will be switched without delay.





Choosing the time range

The time range is chosen by turning the rotary switch for the ON-time scale and OFF-time scale. The time scales are visible in the display to the left of the rotary switch in the following order: 0.1 s, 1 s, 0.1 m, 1 m, 0.1 h, 1 h.

Note:
The time scales "1 s" and "0.1 h" are given twice.
Both adjustments represent the same time scale.

Locking/unlocking of selectors and time setting dial

The rotary switches for the ON/OFF time adjustment and the option selector for the time scale can be locked with the locking key.
This pen-style special tool is available separately. To lock either rotary switches or the option selector, simply insert the locking key into the keyhole bottom right of the rotary switch/option selector and turn it clockwise until the button/switch is totally covered by the red cover. To unlock, simply turn the key in the opposite direction.

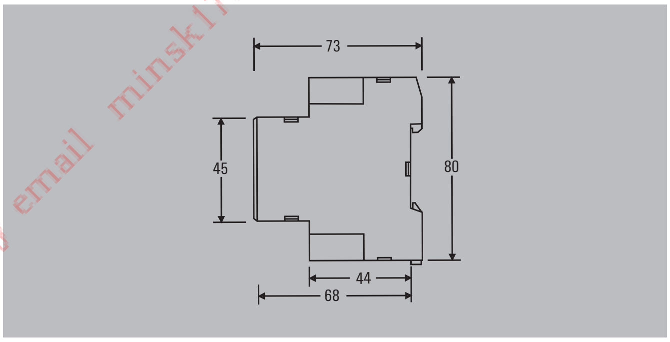
Connection system

The units offers the following connection technologies:

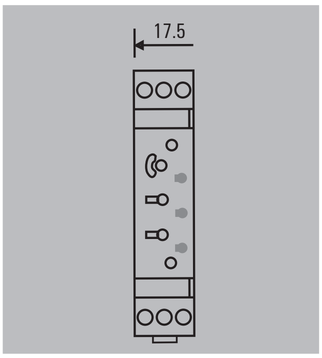
Screw connection
- 2 x 1.5 mm² with wire end ferrule,
- 2 x 2.5 mm² without wire end ferrule

Tension clamp connection
- 2 x 1.5 mm² with wire end ferrule,
- 2 x 1.5 mm² without wire end ferrule

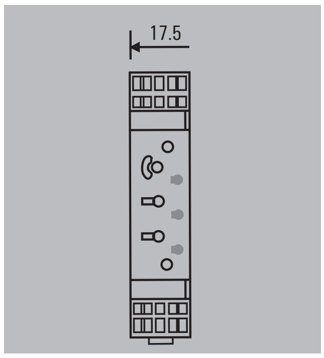
Dimensions



Screw connection



Tension clamp connection



Timer

Installation timer

- Screw or tension clamp connection
- LED status indicator Input: voltage present
  Output: output active
- Approvals cURus 508 / CSA 22.2 Nr. 14
  EN 61812-1 / IEC 60664-1
  IEC 60947-5-1 / EN 61812-1
  IEC 60664-1 / IEC 60947-5-1
  EN 55011 / EN 50082-2

E

Type designation:

B	=	**Building**
T	=	**Timer**
R	=	**R**esponse Delay
TT	=	**T**wo **T**imes
M	=	**M**ultifunction, 8 ranges
MF	=	**M**ultifunction, 4 ranges
DS	=	**D**elta, **S**tar
S	=	**S**crew
Z	=	**T**ension

Input		**Contacts hard gold plated**	
Rated voltage		24 ... 230 V AC, 50/60 Hz, 24 ... 48 V DC	
Voltage tolerance		85 ... 110 % of rated voltage	
Breaking voltage		Max. 2.4 V AC/DC	
Power consumption per type	V AC	21...33 VA at 230 V	
	V DC	0.6...1.3 W at 24 V	
Reset time		Min. 0.1 s (BTDS: 0.5 s)	
Insulation			
Insulation resistance		100 MΩ min., at 500 V DC	
Insulation test voltage			
	between input and output, to enclosure	2000 V AC, 50/60 Hz, 1 min	
	between non-adjacent contacts	1000 V AC, 50/60 Hz, 1 min	
Ingress protection class		IP30, terminal block IP20	
Output			
Contact/contact material		1 change-over contact (BTDS 2 NOC) / AgNi 90/10	
Switch output		5 A at 250 V AC, resistive load (cos φ=1)	
Service life	mechanical min.	10^7 switching cycles (no load, 1800/h)	
	electrical min.	10^5 switching cycles (5A at 250 V AC, resistive load at 1800/h)	
Time range		0,10 s...120 h	
Repetition accuracy		± 1 %	
Other data			
Flammability class as per UL94		V-2	
Ambient temperature/storage temperature		–10...+55 °C / –25...+65 °C (without condensation)	
Humidity		35...85 % rel. humidity, no condensation	
		Screw connection	**Tension clamp connection**
Clamping range (nominal/min/max)	mm^2	1.5 / 0.5 / 2.5	1.5 / 0.2 / 1.5
Depth x Width x Height	mm	73.0 x 17.5 x 80.0	

Accessories

Designation	Type	Qty.	Order No.
Locking and adjusting key	BT Lock Pen	1	**8659840000**

Multifunction relay with control input (BTM)

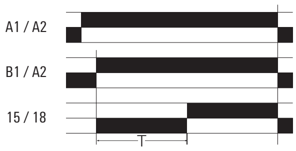
Ordering data

Connection system	Type	Qty.	Order No.
Screw connection	BTM-S	1	8647700000
Tension clamp	BTM-Z	1	8647710000

Functions

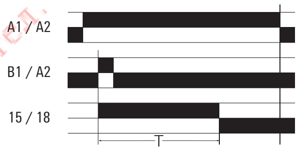
Function A – on-delay

Connect power supply (A1/A2). When the input signal (B1/A2) is applied, the set time T begins to delay. After the time has expired, the output R (15/18) disconnects the load. To reset, the input signal needs to be switched off.



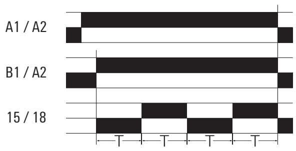
Function E – passing make function (Watchdog)

Connect power supply (A1/A2). After applying the input signal (B1/A2), output R (15/18) connects the load immediately. At the end of the set delay time T, output R (15/18) switches the load off again.



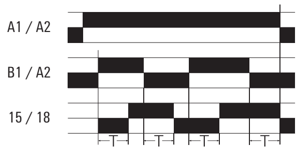
Function B – pulse emitter (starting at normal position)

Connect power supply (A1/A2). After applying the input signal (B1/A2), output R (15/18) switches the load synchronously and alternately between the normal and operated positions within the set time T. In this function, the cycle starts at the normal position.



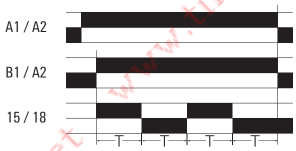
Function G – on and off-delay function

Connect power supply (A1/A2). Time delay T begins after applying the input signal (B1/A2). At the end of this time, output R (15/18) connects the load (on-delayed). After the input signal (B1/A2) has been switched off again, the output switches the load off again after the set time (off-delayed).



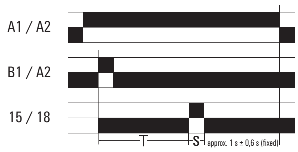
Function B2 – pulse emitter (starting at operated position)

Connect power supply (A1/A2). After applying the input signal (B1/A2), output R (15/18) switches the load synchronously and alternately between the normal and operated positions within the set time T. In this function, the cycle starts at the operated position.



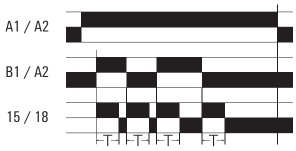
Function J – on-delay with pulse

Connect power supply (A1/A2). Time delay T begins after applying the input signal (B1/A2). At the end of this time, the output R (15/18) connects the load for 1 second.



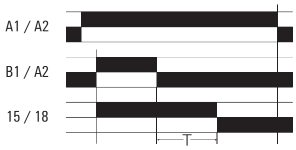
Function C – interval time-delay

Connect power supply (A1/A2). After applying the input signal (B1/A2), output R (15/18) connects the load for the set time T. Output R (15/18) switches the load off again at the end of time T.
After switching off the input signal (B1/A2), output R (15/18) connects the load again for the set time T. Output R (15/18) switches the load off again at the end of time T.



Function D – off-delay function

Connect power supply (A1/A2). After applying the input signal (B1/A2), output R (15/18) connects the load.
The time delay T begins after the input signal (B1/A2) has been switched off. At the end of time T, output R (15/18) switches the load off again.



Multi-function relay without control input (BTMF)

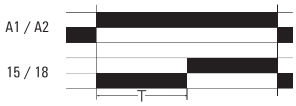
Ordering data

Connection system	Type	Qty.	Order No.
Screw connection	BTMF-S	1	8647680000
Tension clamp	BTMF-Z	1	8647690000

Functions

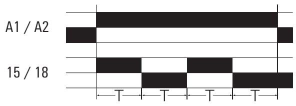
Function A – on-delay

When the input signal (A1/A2) is applied, the on-delay lasting for the set time T starts. The output R (15/18) connects the load at the end of the set time. To reset, the power supply has to be switched off.



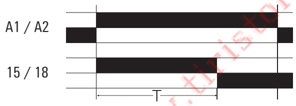
Function B2 – pulse emitter (starting at operated condition)

After applying the input signal (A1/A2), output R (15/18) switches the load synchronously and alternately between the normal and operated positions within the set time T. In this function, the cycle starts at the operated position.



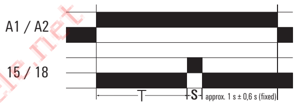
Function E – passing make function

After applying the input signal (A1/A2), output R (15/18) connects the load immediately. At the end of the set delay time T, output R (15/18) switches the load off again.



Function J – on-delay with pulse

Time delay T begins after applying the input signal (A1/A2). At the end of this time, the output R (15/18) connects the load for 1 second.



Timer (BTR)

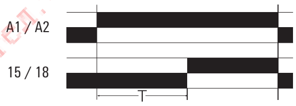
Ordering data

Connection system	Type	Qty.	Order No.
Screw connection	BTR-S	1	8647720000
Tension clamp	BTR-Z	1	8647730000

Functions

Function A – on-delay

When the power supply is connected (A1/A2), the on-delay lasting for the set time T starts. The output R (15/18) connects the load at the end of the set time.



Timer (BTTT)

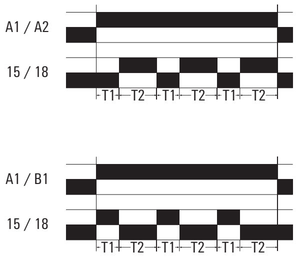
Ordering data

Connection system	Type	Qty.	Order No.
Screw connection	BTTT-S	1	8647740000

Functions

Function BTTT – pulse emitter

When the power supply is connected (A1/A2), the repeat cycle begins with two independently adjustable times. The standard setting is to start at the normal position. A bridge between connections A1 and A2 allows the module to start at the operated position.



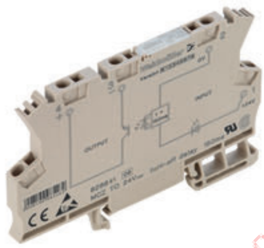
Timer

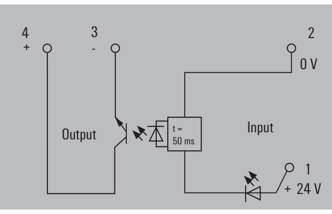
E

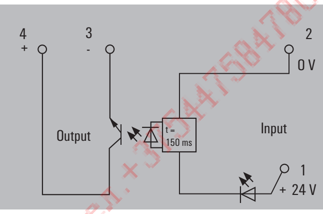
Miniconditioner MCZ TO

- Components for lengthening short pulses for the PLC
- Fixed switch-off delay
- Low input power
- Screw connection system
- Width 6 mm
- For mounting on TS 35

	24 V DC 50 ms	24 V DC 150 ms







Technical data

	24 V DC 50 ms	24 V DC 150 ms
Input		
Rated control voltage	24 V DC ±10 %	24 V DC ±10 %
Rated current AC / DC	/ 6.7 mA ±10 %	/ 6.7 mA ±10 %
Power rating	160 mW	160 mW
Min. pulse duration	2 ms	3.5 ms
Status indicator	Green LED	Green LED
Output		
Rated switching voltage	5...48 V DC	5...48 V DC
Continuous current	20 mA	20 mA
Switch-off delay	50 ms	150 ms
Max. switching frequency at rated load	5 Hz	3 Hz
Rated data		
Ambient temperature (operational)	-25 °C...50 °C	-25 °C...50 °C
Storage temperature	-40 °C...85 °C	-40 °C...85 °C
Humidity	40 °C / 93 % rel. humidity, no condensation	40 °C / 93 % rel. humidity, no condensation
Approvals	CE; CSA; cURus; EAC	CE; CSA; cURus; EAC
Insulation coordinates		
Rated voltage	300 V	300 V
Overvoltage category	IV	IV
Dielectric strength input – output	1 kV_{eff} / 1 s	1 kV_{eff} / 1 s
Dielectric strength to mounting rail	4 kV_{eff} / 1 min.	4 kV_{eff} / 1 min.
Creepage and clearance distance input – output	≥ 5.5 mm	≥ 5.5 mm
Impulse withstand voltage	6 kV (1.2/50 µs)	6 kV (1.2/50 µs)
Pollution degree	2	2
Dimensions		
Clamping range (nominal / min. / max.) mm²	1.5 / 0.5 / 1.5	1.5 / 0.5 / 1.5
Depth x width x height mm	63.2 / 6.1 / 91	63.2 / 6.1 / 91
Note	For mounting on TS 35 rail	For mounting on TS 35 rail

Ordering data

	Type	Qty.	Order No.	Type	Qty.	Order No.
Tension-clamp connection	MCZ TO 24VDC/50MS	10	**8324590000**	MCZ TO 24VDC/150MS	10	**8286410000**
Note						

Accessories

	24 V DC 50 ms	24 V DC 150 ms
Note	AP MCZ end plate 8389030000	AP MCZ end plate 8389030000

Technical appendix/Glossary

Technical appendix/Glossary

Relay modules and solid-state relays – Comparison

Advantages of electromechanical relay modules (EMR)

+ AC and DC operation in load circuit possible
  Versatile (advantage as interface between different plant equipment)

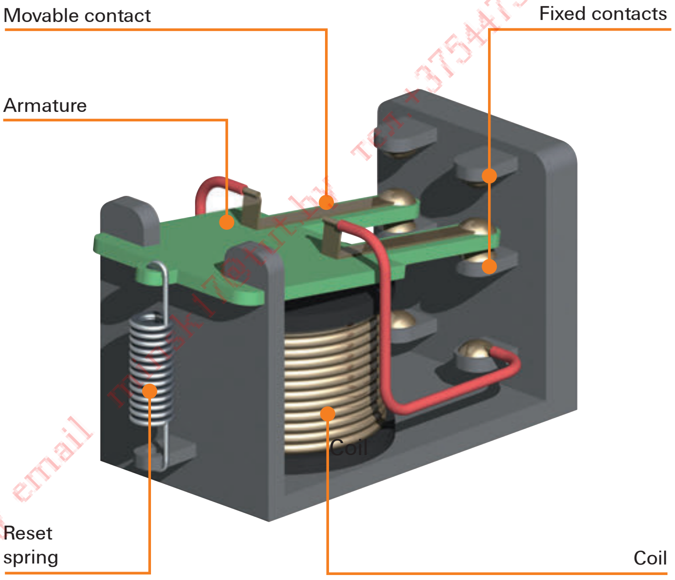
+ No leakage current in the load circuit
  A semi-conductor does not achieve 100 % isolation

+ Low residual voltage in the load circuit
  Low voltage drop

+ No power loss in the load circuit
  In contrast to the semi-conductor in opto modules there is no electrical resistance in the contacts of the electromechanical relay modules that can lead to a rise in temperature when under load. Therefore, heat sinks are not necessary.

+ Multiple contacts possible
  A single control signal can switch several load circuits.

+ Control circuit less sensitive to *transients*)*
  Unwanted switching operations caused by voltage fluctuations are prevented by the make capacity of the magnetic coil.



**) Refer to page W.8 in the Glossary for a detailed explanation of this term.*

Depending on the requirements, the choice between electromechanical and solid-state relays is made based on the different advantages that the different versions offer:

Advantages of solid-state relays (SSR)

+ Long operational lifetime and reliability
  No moving parts or contact wear

+ Small dimensions
  Saves space on the PCB and mounting rail

+ Low control power
  An LED is activated - no mechanical parts are moved

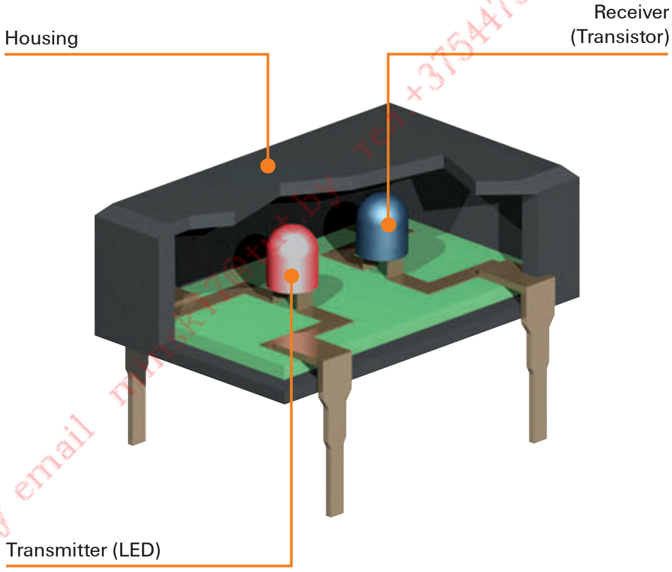
+ Fast response times
  Fast switching, which allows high frequencies to be achieved

+ No contact bounce
  Reduces switching delays

+ No switching noise
  Suitable for use in noise-sensitive environments

+ Not susceptible to shock and vibration
  Prevents unwanted switching statuses

+ No electromagnetic radiation due to switching sparks or coils
  No interference of adjacent assemblies or electronics components



Relay modules – an overview

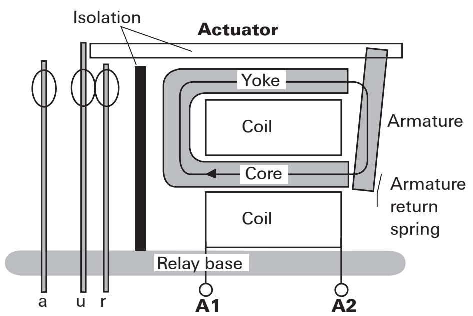
Historical background

The term 'relay' was originally used for a station where stagecoaches were able to change their tired horses for fresh ones. The term 'relay' was given a totally different meaning by the English physicist Charles Wheatstone (1802–1875). In Wheatstone's times, departing trains were advised of by a bell ringing at the next railway station up the line.

This was achieved by connecting a battery in the first station to a bell in the second. However, as the railway stations were generally several kilometres apart the power arriving at the second station was often insufficient to ring the bell. Wheatstone invented a switchgear apparatus that was installed at the second railway station. This continued to function even with low power supply levels. The switchgear apparatus switched a second electrical circuit that actuated the bell. This was the birth of the electromagnetic relay.

How a relay functions

A relay is an electromagnetic switch comprising of two galvanically isolated circuits. Firstly the control circuit and secondly the open circuit with the normally open contact. As soon as the control circuit is energised, the coil creates a magnetic field in the core/yoke and attracts the armature. The actuator now actuates the switch at the output, the normally open contact (make contact) closes and the normally closed contact (break contact) opens. When the control circuit is turned off, the magnetic field diminishes and the return spring returns the armature to its initial position. The actuator moves the normally open (make contact) back to its normal position, the normally open contact opens, the normally closed contact (break contact) closes.



Consequently, with low power input – battery power for example – a relay provides the option of switching heavy loads as well as being able to serve as a switching amplifier. Thanks to the isolation between the input and output, relays are also suitable for providing separation when the power of the control and the open circuits differ. Equipped with several NO (make) contacts, a relay can also be utilised for multiplying signals.

From relay to relay module

There are two alternative methods that make a relay module suitable for use in industrial applications: mounting onto a PCB – in combination with the corresponding assembly techniques and circuitry – or plugging onto a specially designed relay base.

Generally, the design and rating data determine if a relay coupler is or is not suitable for a particular application.

For example, relay modules with plugged on relays are only partly suitable for use in applications subjected to heavy vibrations. In this case, relay modules with soldered relays should be preferred. Low, compact designs such as those provided by the RIDERSERIES are utilised in small consumer units where the overall available height is limited. Conversely, the compact design of the TERMSERIES helps to save space in electrical cabinets.

Protective separation

It is essential that all electrical equipment required to provide protective separation be designed in such a manner that the insulation cannot be impaired, for example by mechanical errors. If a mechanical error occurs in a relay (bent soldering pin, broken winding wire or broken spring), 'protective separation' must be guaranteed. Relays are specified and tested in accordance with EN 61810-1. However, the standard makes no reference to EN 50178 (Electronic equipment for use in power installations); equally no definition is given for the term 'protective separation'. Things are made worse by the fact that different measurement conditions are given for the test voltages stipulated for relays. As a consequence, the test voltages cannot be applied to the standards EN 50178 or EN 61140. And because the user is nevertheless increasingly deploying electrical equipment that is supposed to guarantee 'protective separation', a large number of manufacturers of relays point to the EN 61140 and carry out the tests accordingly. And of course the values are then 'protective separation' conform.

Standards

The following individual standards are applied in accordance with the corresponding requirements:

Relay modules
- DIN EN 50178:
  Electronic equipment for use in power installations

Relays
- DIN EN 61810-1:
  Electromechanical elementary relays (electromechanical elementary relays without specified time response characteristics)
  Part 1: General and safety requirements

Relay base
- DIN EN 61984
  Connectors - Safety requirements and tests

EMC – Electromagnetic compatibility

DIN EN 61000-6-1
Part 6-1: Generic standards; Immunity for residential, commercial and light-industrial environments

DIN EN 61000-6-2
Part 6-2: Generic standards - Immunity for industrial environments

DIN EN 61000-6-3
Part 6-3: Generic standards - Emission standard for residential, commercial and light-industrial environments

DIN EN 61000-6-4
Part 6-4: Generic standards - Emission standard for industrial environments

Coil suppression circuit

In DC circuits, the inductance of the relay coil generates a release voltage when de-energised that is capable of damaging or destroying the connected control electronics. A free wheel diode connected in parallel to the coil limits the release voltage, protects the control electronics and prevents induction of the cut-off voltage to other signal lines.

Large circuits or long cable runs are subjected to increased electrical and electromechanical interference and damage. Malfunctions or even total failure of the relay module can result. The radiated interference, and not to forget leakage currents emanating from trigger modules, can also mean that a triggered relay does not drop out. As standards specify that the drop-out voltage is limited to about 15 percent of the rated voltage, the interference voltage generated can be sufficient to prevent the relay from opening. One way of resolving this problem is to connect an RC combination line side to filter out disturbances and provide capacitive suppression of interference voltages.

TERMSERIES products are supplied ex works with these protective circuits already integrated in the electronics; for the RIDERSERIES these are available as modular series electronics.

The same principles apply as with contact protection circuits.

Relay modules – an overview

Switching large and small capacities

Basically, the reliability of the contacts in a relay reaches a maximum at a medium current load thanks to the continuous self-cleaning effect. As the contact load increases and hence leads to more severe erosion of the contacts, the switching reliability decreases with an increasing number of switching operations. This reduces the service life of the contacts. Although at very low loads the minimal erosion of the contacts does raise the service life more or less to the level of the mechanical service life, the lack of a self-cleaning effect contributes to a lower contact reliability.

Reliable contact at low currents, especially when only small voltages are involved as well, depends on the choice of contact material. Contacts of silver-nickel, which is standard for the majority of Weidmüller relays, are generally suitable for currents of approx. 10 mA and higher. Such large-surface contacts can switch both low and high currents. However, at low currents occasional failures can occur due to erosion and the lack of the self-cleaning effect. The higher the current, the more reliable is the contact – thanks to the self-cleaning. Silver-nickel is suitable as a contact material for low currents/voltages. It provides, however, only **moderate switching reliability**. If this is acceptable, then conventional standard relays represent an inexpensive solution.

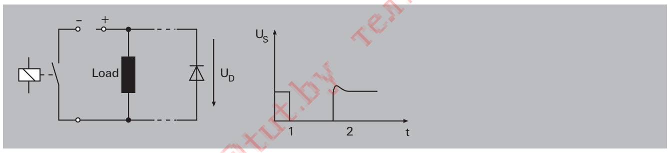
For applications that call for **improved contact reliability** or low currents/voltages, conventional relays with hard-plated gold contacts are preferable because they do not erode and therefore operate more reliably.

If **maximum switching reliability** is necessary, especially for low currents/voltages, a relay should not be your first choice. In these instances Weidmüller advises the use of solid-state relays. Wear and abrasion caused by mechanical movements are non-existent in solid-state relays.

Protective circuits for the contacts

The switching of inductive or capacitive loads produces switching sparks which can influence the electrical service life of the relays. The following protective circuits for the contacts reduce contact wear:

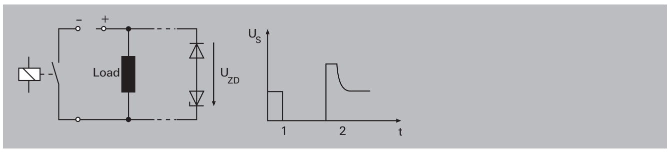
Diode



Free-wheeling diodes (DC)
Free-wheeling diodes are used primarily to protect against overvoltages, which occur through self-induction when switching off inductive DC loads (electric motors, relay coils). Voltage spikes are limited to the equivalent value of the diode forward voltage and excess voltage is discharged via the diode. However, this leads to a delay in the voltage drop and as such also delays the switching operation.

Advantage:	Can be used for all capacities, low surge, minimum space required, low price
Disadvantage:	Very long release delay

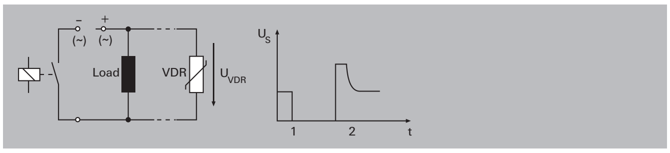
Diode and Z-diode



Zener diode / suppressor diode (DC)
These function as normal diodes in the forward conducting direction. In the blocking direction they become low resistant at a certain voltage (breakdown voltage).
High levels of overvoltages can lead to the destruction of the zener diode / suppressor diode.

Advantage:	Low surge (defined by Z-diode), short release delay
Disadvantage:	Cannot be used for large capacities

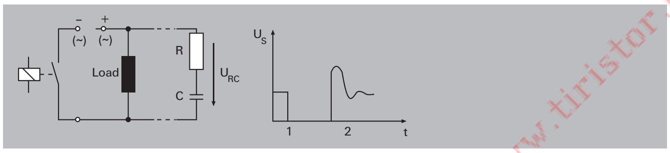
Varistor



Varistor (AC/DC)
The functional principle of the varistor is also based on a breakdown voltage, but with faster reaction times. This allows higher levels of energy to be shunted, however, these lead to the component aging. This in turn reduces the breakdown voltage over time and increases the leakage current.

Advantage:	Low surge, short release delay
Disadvantage:	High current load on the contacts when switching on; more complicated and expensive at greater capacities

RC combination



RC-element (AC)
The RC element compensates voltage spikes by means of a capacitor. Due to the charging and discharging characteristics interference pulses are filtered out when the voltage is rising and not first when overload is reached. For this reason, RC elements are used to protect against interference pulses and exclude faulty switching operations.

Advantage:	Short release delay, low price
Disadvantage:	Cannot be used for all operating voltages and capacities

U_S = Voltage progression 1 = Closing 2 = Opening

Glossary: Relay modules

A

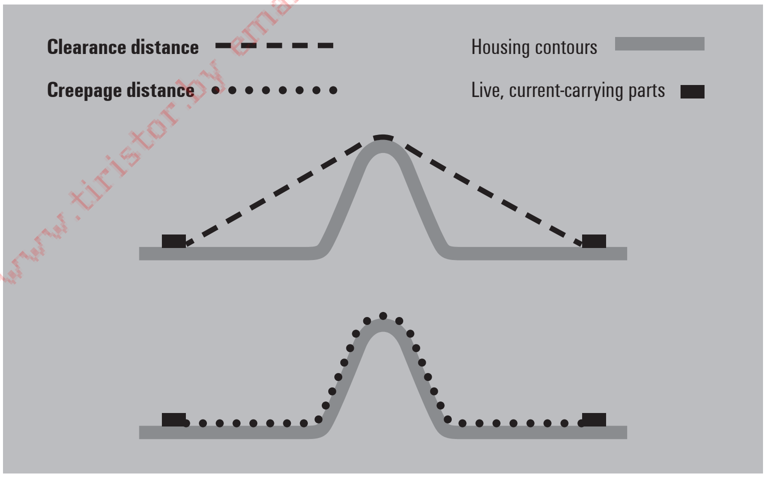
AC	Refers both to alternating values (such as voltage or current) as well as to those devices and variables which reference these devices. Specifications are valid for 50 Hz, unless otherwise indicated.
AC coil, alternating current coil	Relay; excitation with alternating current (AC). Specifications are valid for 50 Hz, unless otherwise indicated.
Adhesion (contacts)	This refers to when the relay armature does not return back to its starting position after the coil voltage has been turned off. The armature can get stuck if there is too much retentivity in the iron core or if the reset force is too small.
Approvals and testing marks	Testing approvals are independent confirmation from governmental or private registration services and testing facilities. They certify that the product complies with the relevant regulations and maintains the specified product characteristics. Note: The ordering scheme gives you the choice of many variations, but not all variations are established as standard types (order numbers). Therefore, they may not be included in the list of approved relays. Technical specifications and list of approved types are available on request. CSA Canadian Standards Association, Canada GL Germanischer Lloyd, Germany TÜV Technical Monitoring Association, Germany UL Underwriters Laboratories, Inc., USA; UR Component Recognition Mark for the United States cUR UL Component Recognition Mark for Canada cURus UL Component Recognition Mark for the United States and Canada cULus UL Component Listing Mark for the United States and Canada VDE VDE testing location, Germany (advisory reports with production monitoring)

B

B10	The number of switching cycles for a load where 10 % of the relays fail. This value is used to determine the probability of system failure.
Bounce (chatter)	An unintended phenomenon that may arise during the closing or opening of a contact circuit when the contact elements touch and separate again before they have reached their final positions.
Bounce times	The time (average value) between the first and last closing (or first and last opening) of a relay contact. These times are valid when the rated voltage is used for excitation, without other components in series or in parallel to the coil, and at the reference temperature.
Breaking capacity	Maximum switching current that a relay contact can switch off under specified conditions, whereby the switching current must not be greater than the nominal current.
Burn-off	Loss of contact material due to switching electrical arcs.

C

CE	Abbreviation for Communauté Européenne (the European Community). Manufacturers use the CE label to confirm that their products comply with the corresponding EC directives and the “essential requirements“ therein. The EMC Directive 2004/108/EC and Low Voltage Directive 2006/95/EC are currently binding.
Clearance and creepage distances	Clearance and creepage distances are critical factors that affect the insulating capacity of electrical components. The creepage distance denotes the minimum clearance that two live parts along a surface must have in order to prohibit a flow of current across the insulating material at the specified operating voltage The operating voltage, the choice of insulation material (material group) and the protective measures taken against contamination (pollution degree) all influence the creepage distance. The clearance distance denotes the minimum direct clearance (through the air) that two live parts must have to one another in order to prohibit a charge passing through the air (an arc). The expected surge voltage (rated impulse voltage) forms the basis for calculating the distances. The surge protection category and pollution severity are further factors that influence dimensional design considerations.



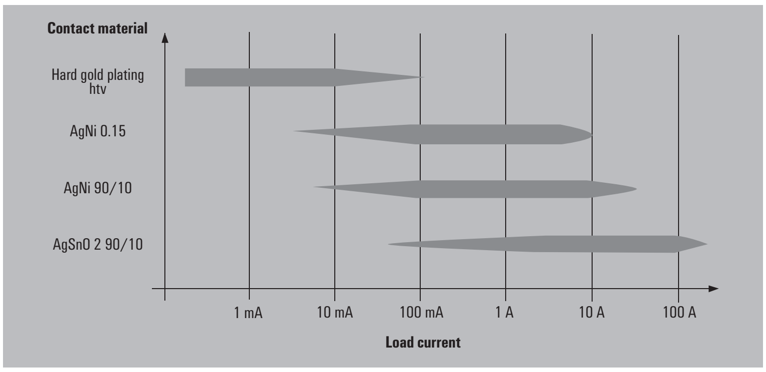
Coil resistance	DC resistance of a relay coil at the reference temperature (+20 °C); Higher coil temperatures increase the resistance value by 0.4 % / K. For actual operations, the excitation voltage should be adjusted accordingly (> sparkover value). For AC coils, the inductive resistance is much greater than the DC value. This is why the current consumption of the coil is also specified at nominal excitation.
Coil specifications	The coil specifications are specified according to IEC 61810-1. Unless otherwise specified, these values apply under the following conditions: ambient temperature 23 °C; coil at ambient temperature (cold coil, without pre-excitation); 50 Hz for AC voltage excitation; operating range of class 2; densely assembled (mounting gap of 0 mm). A relative duty cycle of 100 % (continuous excitation) is permitted.

Combination of relay and plug-in socket, Insulation requirements	The combination of relay and plug-in socket is described in the new relay standard IEC 61810-1. The relay sockets must meet the requirements of IEC 61984 and the insulation requirements of IEC 60664-1. Even if the socket itself already meets (or surpasses) the insulation requirements, there may still be reduced clearance and creepage distances (and thus reduced insulation rated voltage) for the combination of the relay and plug-in socket. Restrictions – such as a reduced voltage range or reduced pollution degree – should be expected for the relay/socket combination. This should be taken into consideration for miniature multi-pole relays with plug-in sockets which have minimal gaps between the contact circuits. In addition to the insulation properties, the thermal properties of the combined relay/socket are very important (refer to the derating curves). The plug-in frames from different manufacturers cannot be compared directly, which is why the technical specifications are only guaranteed for approved relay/socket combinations. Possible risks of fire or reduced dielectric strength may result when non-approved combinations are in use.

Contact material

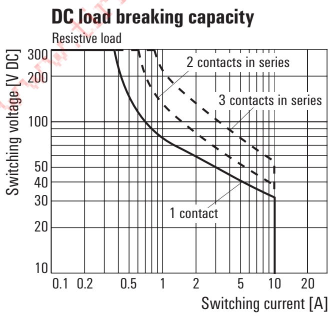
The list below provides an overview of the most important performance coatings and contact materials. The load capacity of the contacts and their life span can vary depending on the contact material and construction used. It is important to achieve the best combination of relay function and contact material. The specifications for individual relay types are only partially valid for other variants.

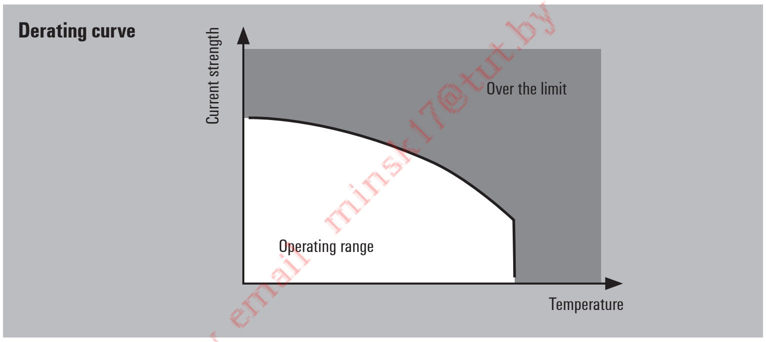
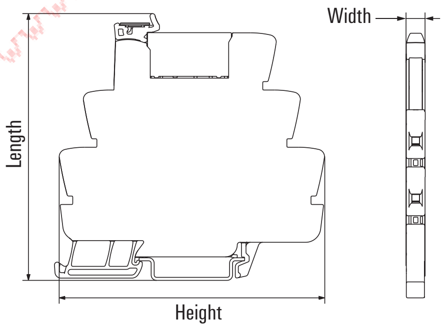
1) Performance coatings:
   Pure gold – the best corrosion resistance but too soft when used as solid metal; high tendency toward cold welding in layer thickness > 1 µm (gold-flashed); only functions as a gold gilding and does not protect against corrosive gases.
2) Contact material:
   Hard gold (hard gold-plated) - Very good corrosion resistance for dry loads; measuring and switching circuits; control inputs (1 mV – 10 V, 0.1 mA – 100 mA); low and constant contact resistance with the smallest switching power; low cold-welding tendency and low current/voltage switching; recommended operating range > 1 V, 1 mA, 50 mW. After switching higher loads (>10 V, 100 mA), small loads can no longer be switched.
   Silver Nickel AgNi90/10 - High resistance to burn-off; minimal tendency towards cold welding; higher contact resistance than AgNi0,15; circuits with medium to high loads; DC and AC circuits (solenoid valves, fans, heaters); not suitable for high capacitive in-rush currents; range of use > 12 V, 10 mA.
   Fine-grain silver AgNi0,15 - Relatively low contact resistance; low resistance to corrosive gases; all-purpose use for average loads and low loads; preferably in DC circuits (solenoid valves, fans, heaters); not suitable for hight currents; range of use > 12 V, 10 mA.
   Silver-tin-oxide AgSnO2 - Minimal tendency to weld; high resistance to burn-off at high switching capacity; low material migration; circuits with high input and output loads; DC and AC circuits (lamp loads, capacitive loads, fluorescent tubes, switching power supplies, etc.). Well suited for resistive, inductive and capacitive DC applications due to low occurrence of material migration, range of use > 12 V, 100 mA..
   Silver-cadmium oxide AgCdO – minimal tendency to weld; high resistance to burn-off; especially suitable for switching inductive loads; AC circuits, range of use > 12 V, 100 mA.
   Tungsten W – highest melting point; for high switching frequency at minimal duty cycle; as a lead contact in circuits with high in-rush and switch-off loads.



Continuous current limit	The highest current value (RMS value for AC) which a closed contact can continuously conduct at specified temperature limits; this corresponds to the thermal continuous current limit Ith. Unless otherwise specified, the data refers to the following conditions: equal load on all contact circuits, input voltage is 110 % of rated coil voltage, maximum ambient temperature, opened vent, dense mounting (mounting clearances of 0 mm), and test conditions according to the positioning for the heating test in IEC EC 61810-1 Appendix B.
Continuous current	The current that can be continuously conducted without exceeding the contact-overheating values under defined conditions.
Continuous operation	Operating mode in which a relay remains energised until it reaches thermal equilibrium.

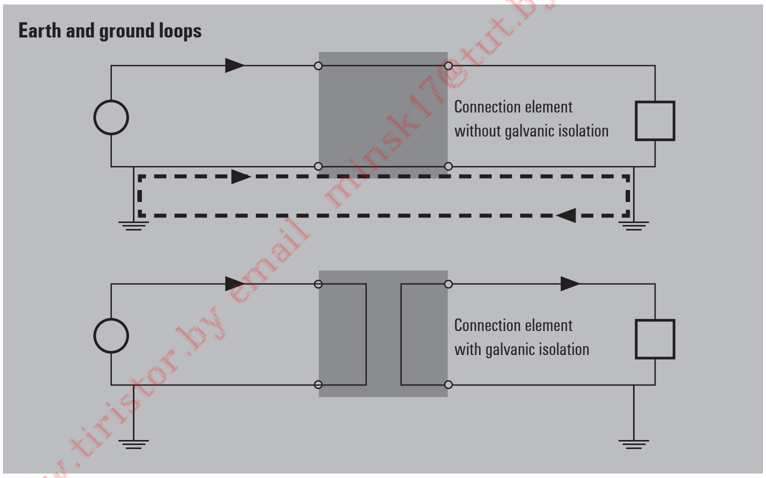
D

DC	Refers to the electrical variables such as voltage or current (DC, DC voltage) that are not dependent on time.
DC switch-off capacity, Direct-current switch-off capacity	Values below the DC switch-off capacity curve (for max. permitted switching voltage/current at resistive load) can be switched on and off reliably; e.g. an arc is extinguished (max. arc duration is 10 ms at resistive load). The position and shape of the load-limit curve is influenced by the contact material and relay construction (contact gap, opening speed of the contacts, etc.). Information about the electrical lifespan should not be derived from these curves! 

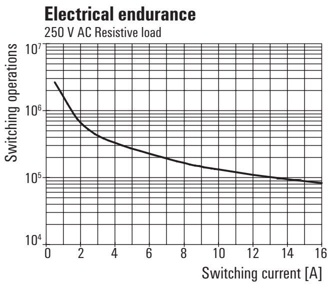
Derating / derating curve	The continuous current is reduced at higher ambient temperatures; this is shown using a derating curve (a load reduction curve). Current flow generates heat, which increases as the current increases. Electrical components have an upper temperature limit which limits their ability to function. The temperature influencing the components is a combination of the ambient temperature and the heat generated by the current. So to ensure that the limit temperature is not exceeded, the current must be reduced when the overall temperature rises. The derating curve depicts the relationship between the prevailing temperature and the resulting maximum amperage with regards to the temperature limit. 
Dielectric strength, test voltage	Voltage (RMS value for AC voltage, 50 Hz, 1 min) which can be applied between mutually insulated relay components during the voltage test.
Dimensions	Dimensions in millimetres. 
DIN rail	Unless otherwise noted, Weidmüller's products are built and tested for mounting on DIN rail (rails according to TH35-7.5 / EN60175). Other installations (e.g. TH35-15)may function but have not been tested or approved.
Duty cycle, relative duty cycle	Describes the ratio of the excitation duration of a relay (duty cycle) to the entire cycle time in intermittent, continuous or short-time operations. The duty cycle is expressed as a percentage of the total cycle duration.

E

Earth and ground loops	Denotes the connection of two potentials via their earth or ground connection. A potential difference between the earth or ground connection of two devices (for example, a sensor and controller) that are directly wired to one another causes current flow via the earth of the shared housing. These interference currents can lead to different problems, for example in the acquisition of measurement signals or when controlling actuators. When transmitting switching or measurement signals using a device with electrical isolation between the control and load circuits, it is important that a closed circuit via the earth or ground connection can never occur – so that no interference currents are generated.



Electrical lifespan curve	The curve for the electrical lifespan specifies the typical lifespan as the mean cycles to failure (MCTF) and is based on the Weibull distribution. No guaranteed minimum values can be interpreted from this statistical data. Note: The curve for the electrical lifespan applies only to the specified contact materials (or those in the datasheet). The lifespans for other contact materials cannot be derived from this curve. It is also not possible to derive information about the electrical lifespan by extrapolating the curve.



Electrical lifespan, lifespan of contact	Number of switching cycles for a relay with electrical contact load under full operational capacity (according to IEC 61810-1 and IEC 61810-2). Unless indicated otherwise, the contact data and electrical lifespan are valid under the following conditions: • On NO contact, • AC mains frequency of 50 Hz, • 50 % relative duty cycle, • Nominal switching frequency, • Contact load, schedule A, • Resistive load, • Rated voltage (coil), • Ambient temperature 23 °C, • Protection degree RTII - flux-proof • Individual assembly • Vertically installed (the connections of a PCB relay point downwards). The electrical lifespan is specified according to the criteria for “useful life”, severity level B according to IEC 61810-2. The data does not cover all usage beyond the specified electrical lifespan. The user is obliged to avoid such situations. Experience shows that the electrical lifespan remains relatively constant up to a 0.8 power factor. When working with loads that have a power factor less than 0.8, we recommend consulting with the user.
Error, relay failure	According to IEC 61810, a relay failure is defined as the occurrence of malfunctions that exceed a certain number: • Malfunction On contact closing • Malfunction on contact opening (contact bridging for CO contact, as special type of malfunction during contact opening) or as • Insufficient dielectric strength. Such malfunctions must be considered in the scope of the application – they should not create any risks. Depending on the specific loads and the contact power, a malfunction can cause excessive heat or even a fire. The user is responsible for taking the necessary precautions in accordance with the relevant regulations.

F

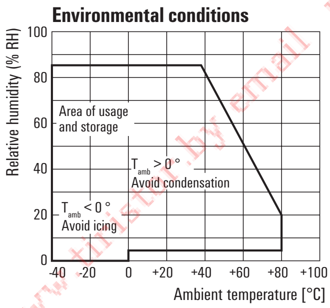
Flammability according to UL	Indicates the flammability class according to the specification from UL 94 (Underwriters Laboratories, Inc., USA). Flammability tests according to UL 94: for testing plastic materials and classifying the propagation/extinction characteristics when the material burns. The UL 94 flammability classes which are relevant to relays are V-0, V-1, V-2 and HB.

G

Galvanic isolation	Potential-free isolation between electrical components. Electrical (or galvanic) isolation means that no charge can flow from one circuit to another. There is no conductive electrical connection between the circuits. The circuits can nevertheless exchange electrical power or signals via magnetic fields, infrared radiation or by charge displacements.

H

Humidity / condensation	Standard conditions: annual average relative humidity > 75 % at an ambient temperature of 21 °C, in 30 days, evenly distributed throughout the year, and 95 % at ambient temperature w of 25 °C. On other days: occasionally 85 % at 23 °C. No icing or condensation is allowed - affects storage and/or operation. When storing or operating under other conditions, you must take steps to avoid temperature changes which could cause icing or condensation. Operating and storage should be within the limits specified in the graphic.



I

Impulse withstand voltage	The highest withstand voltage of a specified shape and polarity that does not lead to an insulation breakthrough or flash-over, under the specific conditions.
Inductive loads	Refer to usage categories.
Inrush current	Specified as the switching current by resistive loads that can turn on a relay under defined conditions. The data refers to the NO contact, nominal voltage, and a current value for a duration of max. 20 ms for at least 100 switching cycles, or 4 seconds with a relative duty cycle of 10 %, unless otherwise indicated.

Insulating material group	According to their CTI (comparative tracking index) values, the insulating materials are categorised in one of the following four groups: Group I 600 CTI Group II 400 CTI < 600 Group IIIa 175 CTI < 400 Group IIIb 100 CTI < 175 The figures for the comparative tracking index, according to IEC 60112 (DIN IEC 60112 / DIN VDE 0303-1) are determined using special samples prepared for this purpose with test solution A.
Insulation according to EN 50178	Specifications for insulation coordination with: • Type of insulation • Nominal voltage of the supply system • Pollution severity level • Impulse withstand voltage • Surge voltage category

M

Max. switching current	The max. switching current indicates the maximum level of current that can be switched.
Max. switching frequency at rated load	The number of switching operations that occur in a specific unit of time. The maximum switching frequency for average loads may be higher than the value specified for the nominal load when the switching characteristics of the load (such as arcing) do not cause the contact temperature to increase. The maximum switching frequency for no-load switching can also be used for loads where no arcing will take place (purely resistive loads cause no significant arcs up to 12 V or 50 mA at 12 – 250 V, because the arc breaks off fairly quickly through the contact opening (insulation)).
Max. switching power	The switching capacity is calculated as the product of the switching voltage and the switching power (in VA for AC; in W for DC).
Mechanical service life	Number of switching cycles for de-energised relay contacts, where a relay must remain functional within specific conditions.
Micro-switch-off	Reasonable contact opening in at least one contact that ensures functional safety. Note: The contact opening has a requirement for the dielectric strength but not for the dimensions.
Minimum switching capacity	Calculated product of switching current and switching voltage – a measure of reliable switching. Low contact resistance values are realised only above a certain load. Greatly increased resistances may occur at lower switching loads which can prevent the load circuit from being safely switched. The minimum contact loads for different contact materials should also be taken into account.
Mono-stable relay, switching behaviour	A relay is referred to as mono-stable when its contacts return to the idle state automatically after the energising parameter (the input voltage) is switched off.
Mono-stable, non-polarized relay, neutral relay	The switch position change in a neutral, mono-stable relay does not depend on the polarity of its excitation.

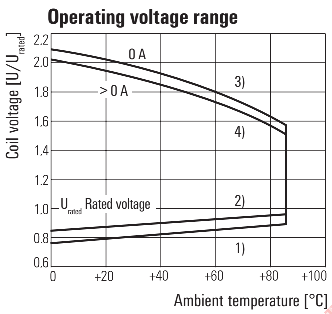
Mounting distance	Distance between two adjacent components when using parallel, uni-directional positioning; or the distance to other electrical components. Because of the insulation requirements, you may need to increase the minimum gap between the components or select a different positioning. These values refer to components in “single-file arrangement“, unless otherwise indicated. Also relevant for this definition: • Density of assembly: assembled with minimum mounting clearances; this minimum distance is determined by the insulation requirements at 230 V AC and/or mechanical requirements for the installation(e.g. use of sockets), • Individual installation: components are mounted with gaps so that there is NO thermal influences from adjacent components.
Mounting position	Mechanical and electronic relays can usually be installed in any position when there are no qualifying limitations. To ensure the proper current flow and heat dissipation, the connections must be properly contacted and the cross-sections must be adequate. Several factors must be taken into consideration when positioning: including the insulation requirements, heat dissipation and the possible mutual magnetic influence.

N

Nominal current (contact)	Current that a relay contact can switch off or on under specific conditions, or the current that the relay accessories can conduct. The nominal current specification covers the following data, unless otherwise specified: • Contact current, switching current • Continuous current limit The conditions for the relay are specified under the contact lifespan; For accessories, the nominal current is specified for a relative duty cycle of 50 %, at the nominal switching frequency, and for an ambient temperature of 23 °C.
Nominal switching voltage (contact)	Voltage between the switching contacts - before the contact closes or after it opens.
Nominal torque	The specified value for the torque of the screws (screw connection) must not be exceeded.
Number of contacts	Number of working contacts in a relay (normally-open, normally-closed or change-over)

O

Operating temperature	Permissible ambient temperature – relative to a specific relative humidity – at which a product should be operated at nominal load.

Operational voltage range	Allowable input voltage range – depending on the ambient temperature. The top part of the range is specified by the maximum voltage; the lower part of the range is specified by the response/minimum voltage. Curve 1: response time/minimum voltage U0 (without pre-excitation) Curve 2: response time/minimum voltage U1 (after pre-excitation) Curve 3: maximum voltage U2, contact current = 0 A Curve 4: maximum voltage at contact current I_{nom} 

P

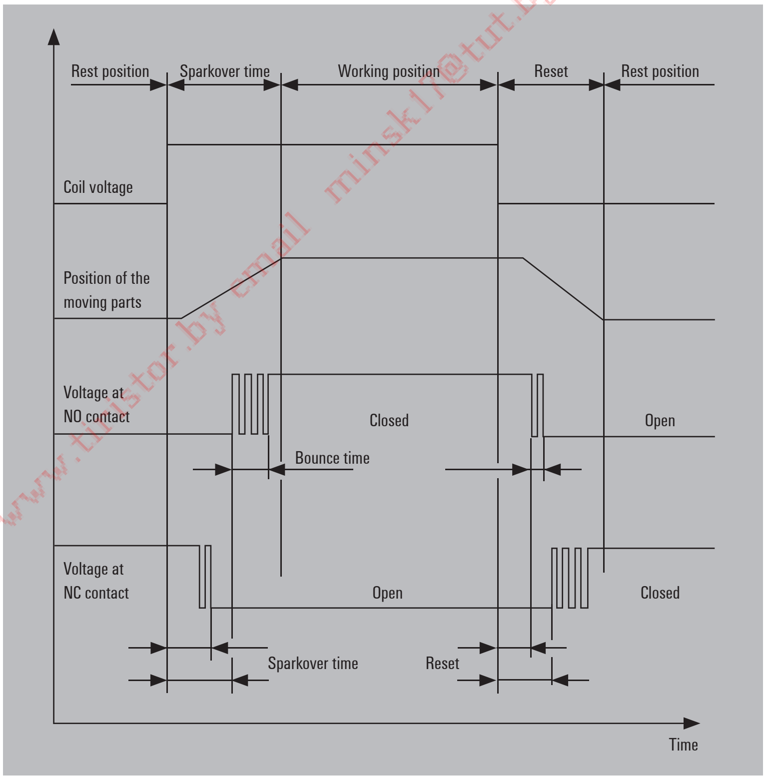
Packing unit	Indicates the smallest amount (a pack, for example) or the quantity per carton.
Plug-in cycles	Sockets and accessories are designed for 10 insertion cycles without electrical load – unless otherwise specified.
Pollution severity level	Pollution (contamination) includes any foreign material – whether it is solid, liquid or gaseous (ionised gas) – which is capable of influencing the surface resistance of the insulating material. The standard defines four degrees of pollution. Their numbering and classification is based on the quantity of the contaminant or the frequency with which the contaminant reduces the dielectric strength and/or surface resistance. Pollution degree 1: • there is no contamination or only dry occurrences of non-conductive pollution. The pollution has no influence. Pollution degree 2: • there is only non-conductive pollution. Temporary occurrences of conductivity caused by condensation may also occur. Pollution degree 3: • conductive pollution or dry, non-conductive pollution that can become conductive due to condensation is likely to occur. Pollution degree 4: • the contamination leads to continual conductivity which can be caused by contaminants such as conductive dust, rain or snow. Note: Pollution degree 3 is typical for industrial environments and similar settings; pollution degree 2 is typical for households or similar.

Positively-driven contacts	Arrangement of contacts in accordance with EN 50205, with at least one NO and one NC contact; mechanically constructed so that the NO and NC contacts of the entire contact system can never (even in the event of a malfunction) be closed at the same time. Such relays are used in safety engineering controls in order to prevent injury and property damage.
Power rating	The nominal value of the power that is converted when the nominal control voltage is applied.
Protection degree - (IEC 60529), IP	The degree of protection afforded by an enclosure is indicated by the IP Code (IP = International Protection). This specification is equally valid for industrial relays and accessories. For the purposes of "component" relays(such as PCB relays), refer to the RT protection degree. A two-digit number is used to indicate the protection provided against touch contact and foreign bodies (the first number) and against humidity (the second number). Protection levels for touch contact and foreign bodies (the first digit): the first digit indicates the degree of protection inside the housing against ingress of solid foreign objects and against any human access to hazardous parts. 0: no protection 1: protection for large body parts with a diameter > 50 mm 2: finger protection (diameter 12 mm) 3: tools and wires (diameter > 2.5 mm) 4: tools and wires (diameter > 1 mm) 5: full protection against touch contact 6: full protection against touch contact Degree of water protection (the second digit) The second digit indicates the degree of protection provided against the ingress of water into the housing: 0: no protection 1: protection against vertically falling drops of water 2: protection against water droplets falling diagonally (up to 15°) 3: protection against water spray that falls at an angle up to 60° from vertical 4: protection against splashed water from all sides 5: protection against water jets 6: protection against powerful jets of water (flooding) 7: protection against sporadic submersion 8: protection against constant submersion
Pull-in / drop-out current, AC/DC coil	Value of the coil current at which a relay responds (spark-over) or drops out.

R

Rated control voltage	The nominal value of the sparkover voltage for the relay.
Rated voltage (Isolation)	Voltage level at which the insulation specifications are measured – this is the basis for sizing the creepage distance.

Relay times (time response)	Because of the self-inductance of the coil and the inertia of the moving parts, the steps involved in operating a relay do not occur instantaneously. The following chart illustrates several time-function terms for the main contact variants of non-delayed switching relays. These specified times are valid when the rated voltage is used for excitation, without other components in series or in parallel to the coil, and at the reference temperature. • Sparkover time • Drop-out/reset time • Bounce time • Min. excitation period



Relays and sockets	The relays in this catalogue have been designed, specified and tested in accordance with the relay standard IEC 61810-1 "Electro-mechanical elementary relays - part 1: General considerations and safety-related requirements". Where the appropriate approvals have been specified in the data sheet, the relays and sockets have been tested according to IEC 61810 or EN 61984 and UL 508.
Reliability	Electro-mechanical components such as relays are subject to wear (both mechanical and electrical). A typical "bathtub curve" depicts the reliability. This means that there may be isolated statistical exceptions which are below the typical levels of reliability.
Reset	Process in which a mono-stable relay resets from the working position to the rest position.

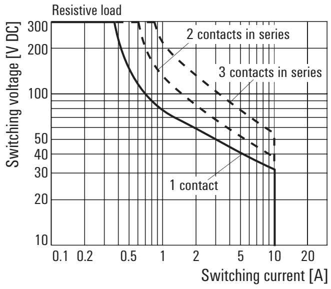
Reset time	Time interval (average) between when a mono-stable relay is in its working state with the coil voltage switched off and the time at which the final output circuit is closed or opened (not including the bounce time). These specified times are valid when the rated voltage is used for excitation, without other components in series or in parallel to the coil, and at the reference temperature.
Reset voltage	Value of the input voltage at which a mono-stable relay reliably returns to the rest position while at the reference temperature.
Response	The process in which the relay transitions from the normally-closed (break) contact position into the normally-open (make) contact position.
Response voltage / drop-out voltage AC/DC coil	Value of the coil voltage at which a relay responds (spark-over) or drops out.
Rest position	The switched position of a mono-stable relay in its unexcited state.
RoHS Directive 2002/95/EC	RoHS stands for “Restriction of (the use of certain) Hazardous Substances”. According to the EU Directive 2002/95/EC from 01.07.2006, all EU member nations must forbid the use of hazardous substances which damage human health and the environment (including mercury (Hg), cadmium (Cd), lead (Pb), hexavalent chrome (Cr6), polybrominated biphenyls (PBB) and polybrominated diphenyl ethers (PBDE)) in new electrical and electronic devices. The term “compliant” means that the entire product group meets the requirements of the RoHS Directive. The maximum weight percentage in homogeneous materials is below the limits specified in the directive: 0.1 % for lead, hexavalent chrome, mercury, PBB and PBDE; and below 0.01 % for cadmium, or qualifies for an exemption in accordance with the annex to the RoHS Directive .

S

Self-heating	The heating up of an operational component based on the power loss from the relay coil and the switching contacts.
Series-circuit relay contacts	When two or more NO contacts in a relay are connected in series, the contact opening is increased while switching off. Arcs which occur from DC loads are cleared more quickly which results in reduced burn-off on the contact. This increases the electrical lifespan and the breaking (switch-off) capacity.

DC load breaking capacity

Resistive load



SIL	Safety Integrity Level. The components must meet the requirements of IEC 61508 is order to reduce risk. This standard provides general requirements for avoiding and minimising device and equipment outages. It stipulates organisation and technical requirements concerning device design and operation. Four safety levels are defined (from SIL1 for minimal risk to SIL4 for very high risk) for classifying facilities and risk-reduction measures. Measures taken to reduce risk must be more reliable when the classified risk level is higher.
Standardised labelling of connections	A1, A2: coil 13, 14: NO contact (contact closes when applying a voltage to the coil) 11, 12: NC contact 11, 12, 14: CO contact (11 is the common contact, i.e. the root)
Status indicator	The status LED display on the input control circuit can differ from the state of the contact circuit in the following cases: • when there are welded-together or broken switching elements, • when there is interference or residual voltages On the signal lines. A reduction in light intensity may result when the ambient temperatures are greater than 50 °C.
Storage temperature	The permitted ambient temperature, related to a specific relative humidity level, for which the product should be stored while in a current-free state.
Surge voltage category	The overvoltage category of a circuit or an electrical system is numbered conventionally (from I to IV) and is based on limiting the assumed surge voltage values that can occur in a circuit (or electrical system with different mains voltages). The assignment to a particular overvoltage category is dependent on the measures which are used to influence (reduce) the surge voltages. Overvoltage category I • Devices that are intended to be connected to the permanent electrical building installation. The measures for limiting transient surge voltages to the proper level are taken outside of the device. The protective mechanisms can either be in the permanent installation or between the permanent installation and the device. Overvoltage category II • Devices that are intended to be connected to the permanent electrical building installation (such as a household appliances or portable tools). Overvoltage category III • Devices that are a part of the permanent installation and other devices where a higher degree of availability is required. This includes the distributor panels, power switches, distribution systems (including cable, busbars, distributor boxes, switches and outlets) that are part of the permanent installation, devices intended for industrial use, and devices that are continually connected to the permanent installation (such as stationary motors). Overvoltage category IV • Devices that are intended to be used on or near the power feed in a building's electrical installation – ranging from the main distribution to the mains power system. This includes electrical meters, surge protection switches and ripple control equipment.

Switch-off delay	Usual time interval from switching off the coil voltage of a switched relay until the first opening or closing of the last output circuit (not including the bounce time).
Switch-on delay	Usual time interval from switching on the coil voltage of an idle relay until the first opening or closing of the last output circuit (not including the bounce time). Coil voltage: pulse or square wave excitation, with rated voltage at the reference temperature of 20 °C.
Switching capacity	The calculated product of the switching current and switching voltage (in W for DC, in VA for AC).
Switching current	Current strength required to switch a relay on or off.
Switching cycle	A single occurrence of the sparkover and subsequent reset.
Switching voltage	The voltage between the switch contacts (contact elements) that is applied prior to the closing or after the opening of the contact (DC for DC voltage; AC for AC voltage).
Switching voltage, max.	The maximum allowable voltage between the contact elements prior to closing and after opening a relay contact.

T

Test button, manual operation	For operating the relay manually: the test button is used only for test purposes during the initial commissioning and testing of equipment. The test button is not appropriate for normal on/off switching and has not been designed for continuous electrical load while in the mechanical ON position. The button should also not be used as a switch. Before pressing the test button, make sure there is no danger posed by loads or other connected devices. Only trained personnel should operate the test button. This prevents the facility's safety mechanisms from being circumvented and the insulation requirements from being compromised.
Transients	Transients are short-term current or voltage spikes caused by interferences in the mains supply grid or by electromagnetic radiation. On the control side of the optocoupler these can trigger unintended switching operations or, in extreme cases, cause the destruction of the component. In an AC-driven load circuit, transients can lead to the maximum permissible forward voltage being exceeded, which in turn can activate the thyristor or Triac. As these operate at quite high switching speeds, even very short pulses can suffice to falsely trigger a switching operation.
Type code	The ordering scheme gives you the choice of many variations, but not all possible variations in the current product line are established as standard types (building codes, ordering designations). Special versions are available on request to meet customer specifications.

Type of contact	DIN 41020 describes various switching functions of the relay contacts and the specific contact configurations, constructions and descriptions based on these functions. • NO (normally open) contact: contact which is closed in the relay's operating position and open in its rest position. • NC (normally closed) contact: contact which is closed in the relay's rest position and open in its working position. • CO (change-over) contact: a CO consists of an NO and an NC contact with a common terminal (root) connection. When changing the switch position, first the previously closed contact opens and then the previously opened contact closes. Note: A temporary electrical connection may be established between the NC and NO contacts due to the switch-off arc.
Type of insulation	Quality of the insulation system, depending on the design and application conditions: • Functional insulation: insulation between live components – necessary so the relay functions properly. • Basic insulation: insulation of live parts to provide basic protection against electrical shock. • Doubled insulation: consisting of a base insulation and additional insulation. • Reinforced insulation: a single "enhanced" insulation of active components, which ensures the same protection against electric shock as doubled insulation. The doubled insulation is composed of a base insulation and an additional insulation; the extra insulation protects against electric shock if the basic insulation fails.

U

Usage category according to EN 60947 (mechanical relays)	AC1: non-inductive or slightly inductive load, such as heating elements AC14: small electro-magnetic loads (< 72 VA), such as mini-contactors AC15: small electro-magnetic loads (< 72 VA), such as power contactors DC1: non-inductive or slightly inductive load, such as heating elements DC13: electro-magnetic loads, such as solenoid valves

W

Wash resistant	Wash-resistant relays can withstand a washing process. During the wash process, none of the cleaning agent should be able to penetrate inside the relay.
Withstand test voltage	The voltage applied to a device under specific test conditions which causes no breakthrough or flash-over of the test piece.

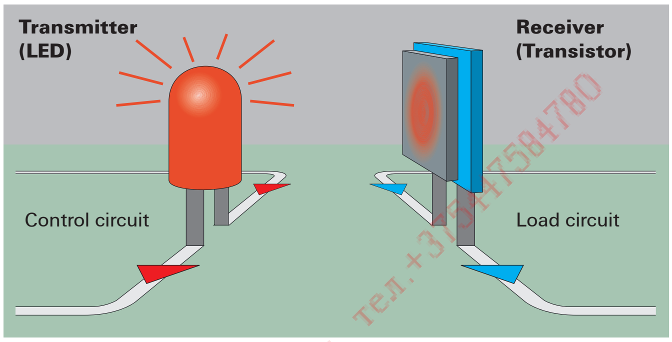
Definition / mode of operation

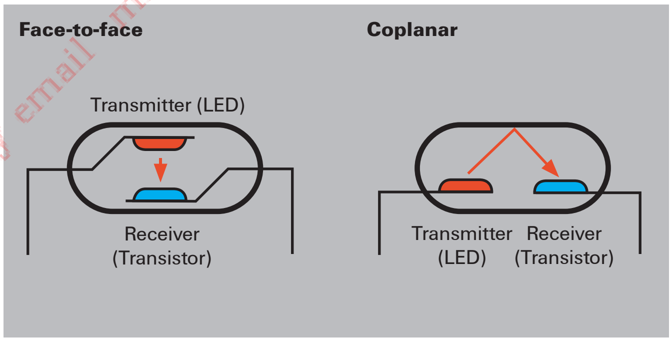
Opto modules – mode of operation

Opto modules are electronic components for switching load circuits by means of a control circuit. On the one hand this allows applications with different performance ratings to be operated by relatively low switching currents. And on the other *electrical isolation**) between control and load circuits is provided to assure protection of components should a malfunction occur.

In contrast to electromechanical relay modules opto modules do not have any mechanical parts that are prone to wear. To enable the switching operation a light signal is triggered via an LED in the control circuit that causes a light-sensitive semiconductor receiver to complete a connected load circuit. Transmitter (LED) and receiver (for example a phototransistor) are embedded in a light conducting plastic material and encased in a light-proof casing that protects against outside influences.

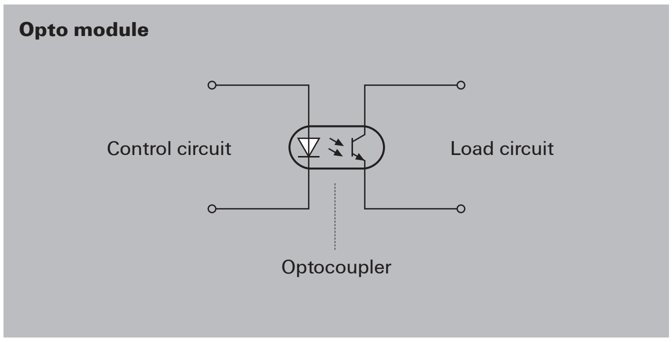
Two design types are differentiated:
Face-to-face design with LED and transistor mounted across from each other with direct light contact
Coplanar design with LED and transistor on the same level. In this case the beam of light is transferred by reflection according to the principle of fibre-optics.





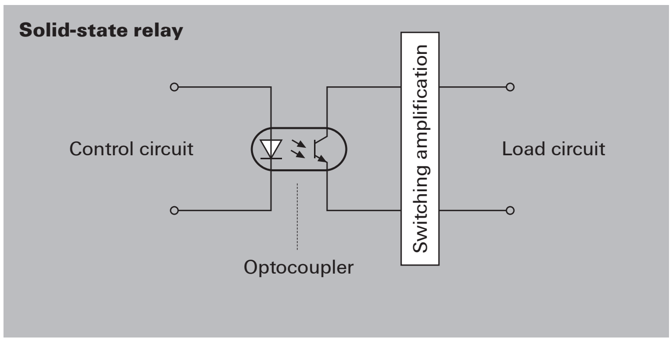
Opto module

The voltage, which can be applied to the opto output itself, is restricted by the sensitivity of the semiconductor receiver (phototransistor). In applications in which only low currents or voltages are required in the load circuit it is possible to use the component without an additional auxiliary circuit in an opto module.



Solid-State Relay

In order to switch higher currents it is necessary to make adaptations to accommodate the different performance levels of the phototransistor and the load circuit (switching amplification).
Modules other than optos equipped with a switching amplifier are called **solid-state relays** (SSR).



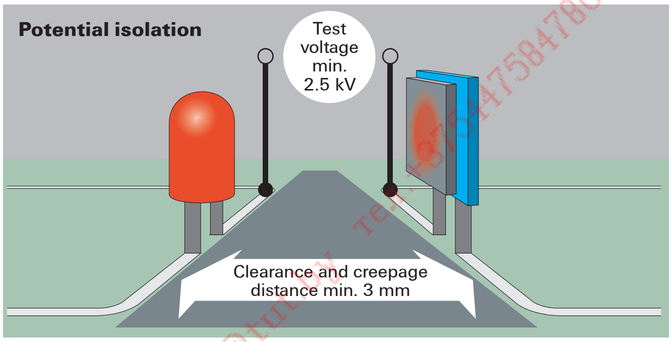
* *Refer to page W.36 in the Glossary for a detailed explanation of this term.*

Basic functions

Opto modules and solid-state relays are generally used in the following fields of applications:

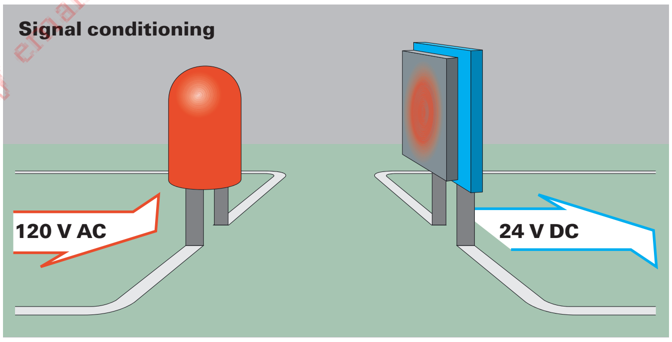
Potential isolation
Many applications require that the control circuit is electrically isolated from the load circuit. This primarily protects the control level from interference from the field, such as:

- Interference currents e.g. from *earth and ground loops*)*
- Interference pulses e.g. from inductive effects of *transients*)*



The separation of the control and load circuits in the opto module provides the required isolation.
However, this must withstand an isolation test of at least 2.5 kV in all opto modules and solid-state relays.
To guarantee isolation it is necessary that a minimum of 3 mm clearance and *creepage distance*)* be maintained in all components.

Signal conditioning
The separation of the load and control circuits, in conjunction with the variety of options this offers to configure both circuits separately, means that opto modules are often used for signal conditioning purposes.
This allows the different electrical potentials of signals from the control and load circuits (for example sensors and control) to be equalised.



Switching amplification
Applications with current and voltage values that exceed the capacity of the phototransistor require an auxiliary circuit on the output side of the opto module for switching amplification purposes. During the switching operation the opto module LED activates a base current in the phototransistor. This activates a second semiconductor (transistor, thyristor) selected to meet application requirements which then becomes conductive for the load current.

** Refer to page W.36 in the Glossary for a detailed explanation of this term.*

Control circuit

The input circuits (control circuit)

Most industrial applications cannot be connected directly to an opto module, generally requiring voltage regulation by means of series-connected resistances or capacitors.
To obtain exact-as-possible switching points a *Schmitt Trigger*)* can be used to assign the control signals an unambiguous status (0 - 1) when moving from high to low or low to high, which is then passed on to the opto module.

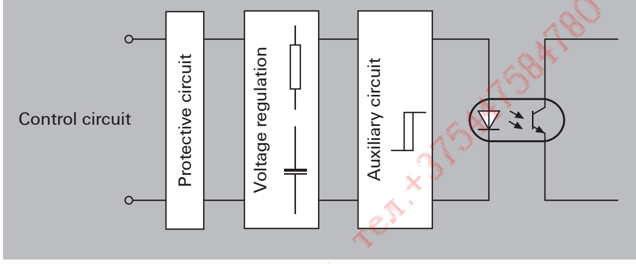
Depending on the design, all Weidmüller opto modules and solid-state relays are equipped with suitable protective devices (varistors, diodes) and filters to protect against interference pulses from the control circuit.

DC input:
An additional reverse-polarity protection diode guarantees protection against the opto module being destroyed if the control voltage is incorrectly wired. The switching status of the control circuit is signalised by a status indicator.

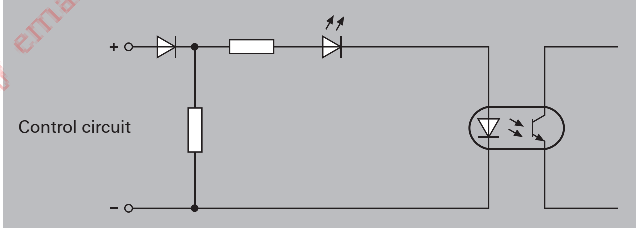
AC/DC input:
A rectifier with smoothing capacitor is connected in series for AC control voltages. Reverse polarity protection for DC current is not necessary. The following construction corresponds to a DC circuit.
Due to the smoothing capacitor the switching frequency of AC control signals is fundamentally less than half the mains frequency. A higher switching frequency would result in the control signal being constantly switched through in rhythm with the mains frequency.
The advantage of being able to choose between an AC or a DC current input contrasts with the disadvantage that the smoothing capacitor also restricts the switching frequency of the DC control signal.

AC input:
The circuit diagram corresponds in principle with an AC/DC circuit. Instead of series resistors it is possible to use capacitors to regulate the voltage in a purely AC operation. In contrast to resistors there is no power loss with capacitors and as a result no heat that needs to be dissipated.

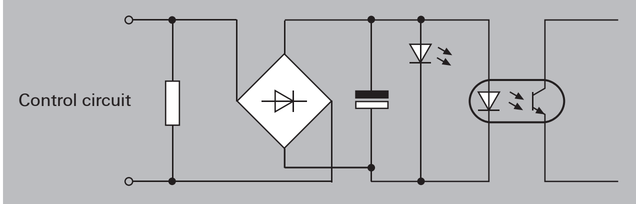
Input configuration



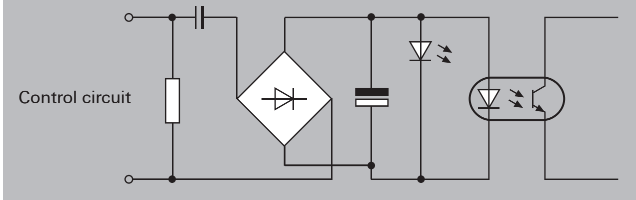
DC input



AC/DC input



AC input



* *Refer to page W.36 in the Glossary for a detailed explanation of this term.*

Load circuit

The output circuit (load circuit)

As a rule, an operating voltage range is stated for the rated switching voltage of opto modules and solid-state relays (for example 5 ... 48 V DC); it is not permitted to exceed or fall below this value.

The same applies to continuous current. Exceeding this value too often can result in premature wear-out and destruction of the opto modules semiconductor.
As a direct correlation exists between the current and ambient temperature a *derating curve*)* is provided for all opto modules and solid-state relays.

Overvoltages are shunted by protective devices such as diodes or varistors.
To prevent damage caused by current spikes (for example starting or off pulses) some modules are equipped with a *power boost*)* which is capable of carrying higher levels of current than the maximum stated for a short period of time.

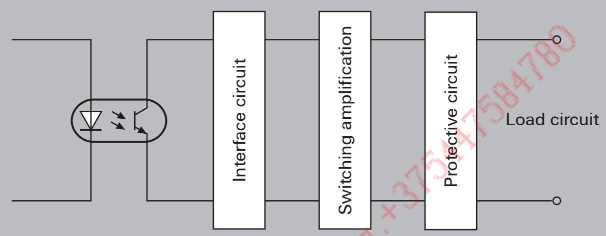
It is possible to connect AC or DC loads subject to the output circuit having corresponding amplifier semiconductors.

DC output:
With a 2-pole DC output the connection terminals are to be considered in the same manner as with a conventional switch. All that is required is that care is taken to observe the predetermined polarity.

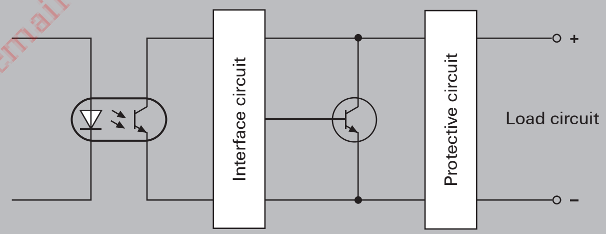
With a 3-pole DC connection an auxiliary voltage assists the output circuit to control the amplifying transistor more precisely. Several applications also require this auxiliary voltage for short-circuit protection in the interface or protective circuitry.

AC output:
To activate AC switching and control devices a semiconductor is connected on the load side of the opto module component to switch the AC voltage (TRIAC or thyristor).

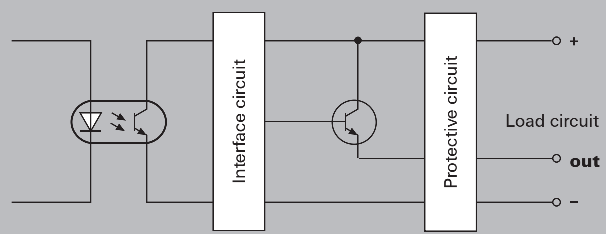
Output circuit



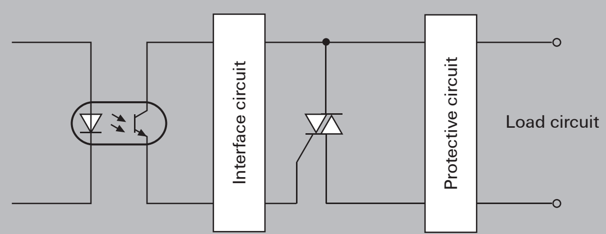
2-wire DC output



3-wire DC output



AC output

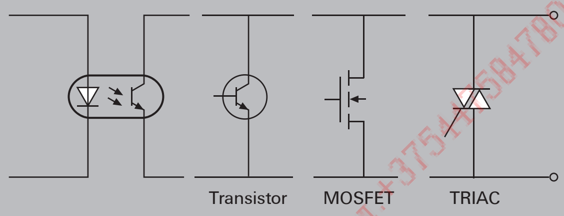


** Refer to page W.36 in the Glossary for a detailed explanation of this term.*

Switching amplification

The phototransistor of the opto module has a low current and voltage rating. As a consequence, an additional semiconductor element is accessed for larger output loads that is capable of switching the corresponding rated switching voltages and rated switching currents.

Switching amplification



Bipolar Transistor (DC)
Used for low currents (0.5 A).
The bipolar transistor has short response times, which makes high switching frequencies possible as a result.

MOSFET (DC)
Used for high load currents (up to 10 A).
The low contact resistance of the MOSFET create only very small leakage currents (< 10 μA) with low power loss.

Triac (AC)
A Triac combines the functional principle of antiparallel connected thyristors in a single component.
The mode of function of a thyristor is comparable with that of a one-way diode. Therefore, an opposing parallel circuit configuration consisting of two thyristors is used for AC currents.

Switching diverse loads

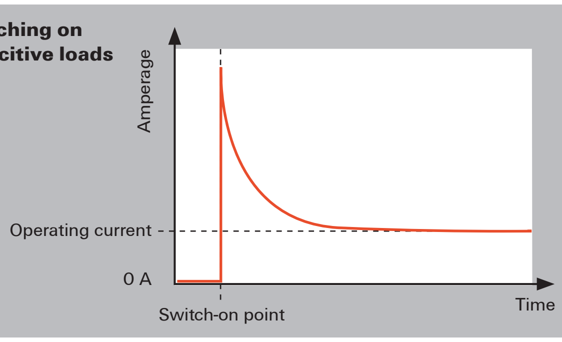
The different types of loads resulting from the possible applications (resistive, inductive, capacitive loads) represent a particular challenge for the load circuit arrangements of opto modules and solid-state relays. With reference to the planned application, one should always be aware of what effects the loads will have on the modules and how the corresponding protective devices have to be designed.

Generally speaking, it must be ensured that the power loss at the amplifier semiconductor does not exceed the permitted limit for any length of time. This would lead to overheating and finally to the destruction of the component.

Switching resistive loads
Due to the fact that in resistive loads the amperage in the load circuit and the voltage across the amplifier semiconductor are inversely proportional to one another these do not generally pose a problem. It is sufficient to adhere to the maximum current and voltage ratings of the modules.
Switching glow lamps represents a special case. It is possible that when being switched on that overcurrents 10 to 20 times the operating current can occur due to the low cold resistance.
Therefore, the components must be designed to cope with these possible overloads situations which correspond to the effect of capacitive loads.

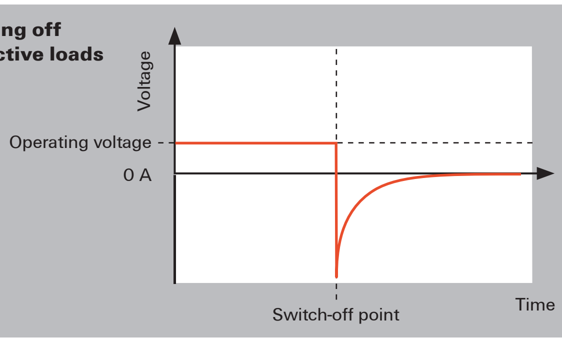
Switching capacitive loads
Capacitive loads occur if there is a capacitor in the load circuit. The effect is similar to to a short-circuit at the point of activation and results in a high inrush current.
If this current is not limited it can lead to the destruction of the amplifier semiconductor.

Switching on capacitive loads



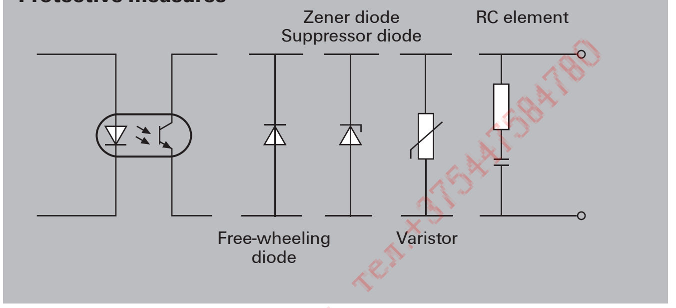
Switching inductive loads
Problems can arise with inductive loads when they are being switched off, in particular when coils are used in the load circuit. The flow of current in the coil builds up a magnetic field that suddenly collapses and creates a high induction voltage.
This voltage spike has to be short-circuited via a diode connected in parallel (free-wheeling diode). However, the time required leads to delayed release.

Turning off inductive loads



Protective measures

The construction of the opto module enables fast and sensitive switching, however, the component is also more prone to interference. For this reason, all Weidmüller opto modules and solid-state relays are equipped with a variety of measures to protect against overloading and interference pulses.



Free-wheeling diodes (DC)
Free-wheeling diodes are used primarily to protect against overvoltages, which occur through self-induction when switching off inductive DC loads (electric motors, relay coils). Voltage spikes are limited to the equivalent value of the diode forward voltage and excess voltage is discharged via the diode. However, this leads to a delay in the voltage drop and as such also delays the switching operation.

Zener diode / suppressor diode (DC)
These function as normal diodes in the forward conducting direction. In the blocking direction they become low resistant at a certain voltage (breakdown voltage).
High levels of overvoltages can lead to the destruction of the zener diode / suppressor diode.

Varistor (AC/DC)
The functional principle of the varistor is also based on a breakdown voltage, but with faster reaction times. This allows higher levels of energy to be shunted, however, these lead to the component aging. This in turn reduces the breakdown voltage over time and increases the leakage current.

RC-element (AC)
The RC element compensates voltage spikes by means of a capacitor. Due to the charging and discharging characteristics interference pulses are filtered out when the voltage is rising and not first when overload is reached.
For this reason, RC elements are used to protect against interference pulses and exclude faulty switching operations.

Glossary: Solid-state relays

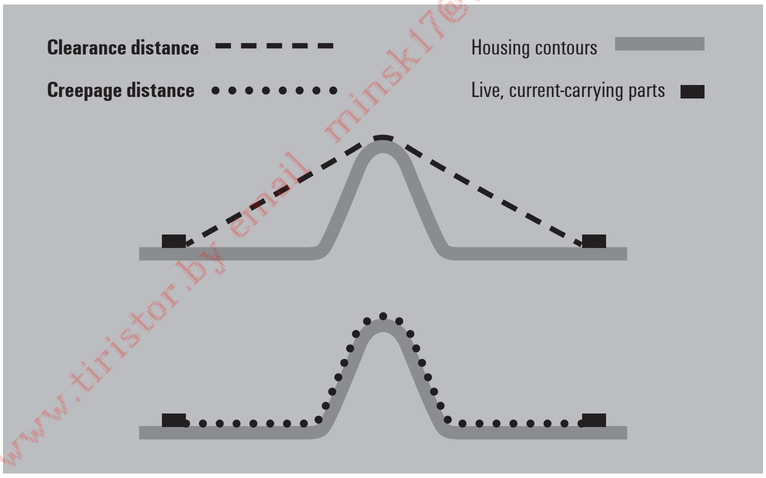
A

AC	Refers both to alternating values (such as voltage or current) as well as to those devices and variables which reference these devices. Specifications are valid for 50 Hz, unless otherwise indicated.
Approvals and testing marks	Testing approvals are independent confirmation from governmental or private registration services and testing facilities. They certify that the product complies with the relevant regulations and maintain the specified product characteristics. Note: The ordering scheme gives you the choice of many variations, but not all variations are established as standard types (order numbers). Therefore, they may not be included in the list of approved relays. Technical specifications and list of approved types are available on request. CSA Canadian Standards Association, Canada GL Germanischer Lloyd, Germany TÜV Technical Monitoring Association, Germany UL Underwriters Laboratories, Inc., USA; UR Component Recognition Mark for the United States cUR UL Component Recognition Mark for Canada cURus UL Component Recognition Mark for the United States and Canada cULus UL Component Listing Mark for the United States and Canada VDE VDE testing location, Germany (advisory reports with production monitoring)

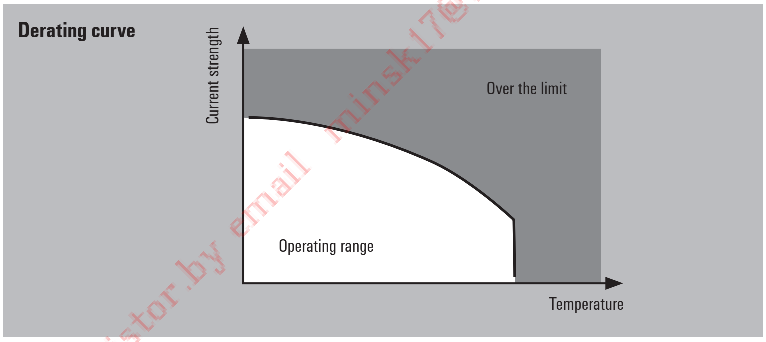
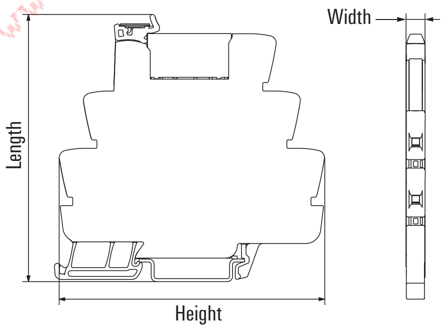
C

CE	Abbreviation for Communauté Européenne (the European Community). The CE marking is a way for the manufacturer to confirm that their product complies with the relevant EC directives and the “essential requirements“ contained therein. The EMC Directive 2004/108/EC and Low Voltage Directive 2006/95/EC are currently binding.

Clearance and creepage distances	Clearance and creepage distances are critical factors which influence the insulation capability of electrical components. The creepage distance denotes the minimum clearance that two live parts along a surface must have in order to prohibit a flow of current across the insulating material at the specified operating voltage. In addition to the operating voltage, the choice of insulating material (material group) and the protective measures to counteract pollution (pollution severity) affect the creepage distance. The clearance distance denotes the minimum direct clearance (through the air) that two live parts must have to one another in order to prohibit a charge passing through the air (an arc). The expected surge voltage (rated impulse voltage) forms the basis for calculating the distances. The surge protection category and pollution severity are further factors that influence dimensional design considerations.
Continuous current	The current can be continuously conducted without exceeding the overheating values under defined conditions.
Cut-in (switch-on) voltage	The voltage level at which an opto module or solid-state relay is conductive.



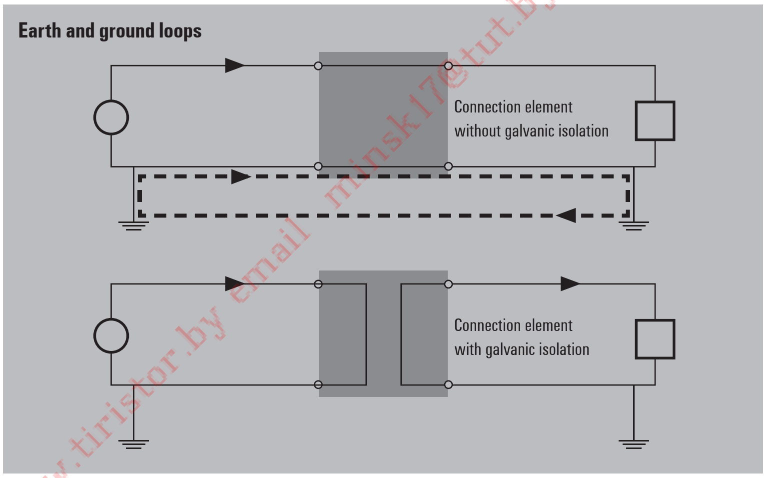
D

DC	Refers to the electrical variables such as voltage or current (DC, DC voltage) that are not dependent on time.
Derating / derating curve	The continuous current is reduced at higher ambient temperatures; this is shown using a derating curve (a load reduction curve). Current flow generates heat, which increases as the current increases. Electrical components have an upper temperature limit which limits their ability to function. The temperature influencing the components is a combination of the ambient temperature and the heat generated by the current. So to ensure that the limit temperature is not exceeded, the current must be reduced when the overall temperature rises. The derating curve depicts this relationship between the prevailing temperature and the resulting maximum amperage with regard to the limit temperature. 
Dimensions	Dimensions in millimetres. 
DIN rail	Unless otherwise noted, Weidmüller's products are built and tested for mounting on DIN rail (rails according to TH35-7.5 / EN60175). Other installations (e.g. TH35-15)may function but have not been tested or approved.
Dropout voltage	The voltage level at which an opto module or solid-state relay blocks itself.

E

Earth and ground loops

Denote the connection of two potentials via their earth or ground connection. A potential difference between the earth or ground connection of two devices (for example, a sensor and controller) that are directly wired to one another causes current flow via the earth of the shared housing. These interference currents can lead to different problems, for example in the acquisition of measurement signals or when controlling actuators. When transmitting switching signals or measurement signals using a device with electrical isolation between the control and load circuits, it is important that a closed circuit via the earth or ground connection can never occur – so that no interference currents are generated.



F

Flammability according to UL

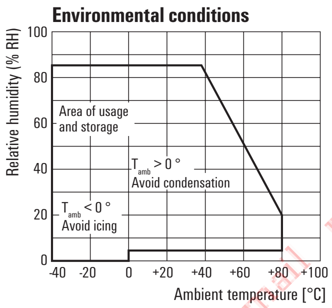
Indicates the flammability class according to the specification from UL 94 (Underwriters Laboratories, Inc., USA). Flammability tests according to UL 94: for testing plastic materials and classifying the propagation/extinction characteristics when the material burns. The UL 94 flammability classes which are relevant to the relay are V-0, V-1, V-2 and HB.

G

Galvanic isolation

Potential-free isolation between electrical components. Electrical (or galvanic) isolation means that no charge can flow from one circuit to another. There is no conductive electrical connection between the circuits. The circuits can nevertheless exchange electrical power or signals via magnetic fields, infrared radiation or by charge displacements.

H

Humidity / condensation	Standard conditions: annual average relative humidity > 75 % at an ambient temperature of 21 °C, in 30 days, evenly distributed throughout the year, and 95 % at ambient temperature w of 25 °C. On other days: occasionally 85 % at 23 °C. No icing or condensation is allowed - affects storage and/or operation. When storing or operating under other conditions, you must takes steps to avoid temperature changes which could cause icing or condensation. Operating and storage should be within the limits specified in the graphic. 

I

Impulse withstand voltage	The highest withstand voltage of a specified shape and polarity that does not lead to an insulation breakthrough or flash-over, under the specific conditions.
Inductive loads	Refer to load category
Input frequency	The number of switching operations that occur in a specific unit of time. The maximum switching frequency for medium loads may be higher than the value specified for the nominal load, as long as the switching of the load does not result in an increased temperature.
Insulating material group	According to their CTI (comparative tracking index) values, the insulating materials are categorised into one of the following four groups: Group I 600 CTI Group II 400 CTI < 600 Group IIIa 175 CTI < 400 Group IIIb 100 CTI < 175 The figures for the comparative tracking index, according to IEC 60112 (DIN IEC 60112 / DIN VDE 0303-1) are determined using special samples prepared for this purpose with test solution A.
Insulation according to EN 50178	Specifications for insulation coordination with: • Type of insulation • Nominal voltage of the supply system • Pollution severity level • Impulse withstand voltage • Surge voltage category

L

Leakage current	The current on the load side of an opto module or solid-state relay that flows towards the output stage while in a blocked state.
Load category (solid-state relay)	Classification of the load of a solid state relay, in accordance with EN 62314 LC A – resistive loads or minimally inductive loads LC B – motor loads LC C – electrical discharge lamps LC D – incandescent filament lamps LC E – transformers LC F – capacitive loads

M

Max. switching current	The max. switching current indicates the maximum level of current that can be switched.
Max. switching power	The switching capacity is calculated as the product of switching voltage and switching current (in VA for AC / in W for DC).
Mounting distance	Distance between two adjacent components in parallel, uni-directional positioning; or the proximity to other electrical components. Because of the insulation requirements, you may need to increase the minimum distance between the components or select a different positioning. These values refer to components in "single-file arrangement", unless otherwise indicated. Also relevant for this definition: • density of assembly: assembled with minimum mounting clearances; this minimum distance is determined by the insulation requirements at 230 V AC and/or mechanical requirements for the installation(e.g. use of sockets), • individual installation: components are mounted with gaps so that there are no thermal influences from adjacent components.
Mounting position	Mechanical and electronic relays can usually be installed in any position when there are no qualifying limitations. To ensure the proper current flow and heat dissipation, the connections must be properly contacted and the cross-sections must be adequate. Several factors must be taken into consideration when positioning: including the insulation requirements, heat dissipation and the possible mutual magnetic influence.

N

Nominal control current	Input current that is required, under specific conditions, to switch the output.
Nominal switching voltage	Voltage at the output - before the closing or opening of the contact.
Nominal torque	The specified value for the torque of the screws (screw connection) must not be exceeded.

O

Operating temperature	Permissible ambient temperature – relative to a specific relative humidity – at which a product should be operated at nominal load.

P

Packing unit	Indicates the smallest amount (a pack, for example) or the quantity per carton.
Plug-in cycles	Sockets and accessories are designed for 10 insertion cycles without electrical load – unless otherwise specified.
Pollution severity level	Pollution (contamination) includes any foreign material – whether it is solid, liquid or gaseous (ionised gas) – which is capable of influencing the surface resistance of the insulating material. The standard defines four degrees of pollution. Their numbering and classification is based on the quantity of the contaminant or the frequency with which the contaminant reduces the dielectric strength and/or surface resistance. Pollution degree 1: • there is no contamination or only dry occurrences of non-conductive pollution. The pollution has no influence. Pollution degree 2: • there is only non-conductive pollution. Temporary occurrences of conductivity caused by condensation may also occur. Pollution degree 3: • conductive pollution or dry, non-conductive pollution that can become conductive due to condensation is likely to occur. Pollution degree 4: • the contamination leads to continual conductivity which can be caused by contaminants such as conductive dust, rain or snow. Note: Pollution degree 3 is typical for industrial environments and similar settings; pollution degree 2 is typical for households or similar.
Power rating	The nominal value of the power that is converted when the nominal control voltage is applied.

Protection degree - (IEC 60529), IP	The degree of protection afforded by an enclosure is shown using the IP Code (IP = International Protection). This information is equally relevant for industrial relays and accessories. For the purposes of “component” relays (such as PCB relays), refer to the RT protection degree. A two-digit number is used to indicate the protection provided against touch contact and foreign bodies (the first number) and against humidity (the second number). Protection levels for touch contact and foreign bodies (the first digit): the first digit indicates the degree of protection inside the housing against ingress of solid foreign objects and against any human access to hazardous parts. 0: no protection 1: protection for large body parts with a diameter > 50 mm 2: finger protection (diameter 12 mm) 3: tools and wires (diameter > 2.5 mm) 4: tools and wires (diameter > 1 mm) 5: full protection against touch contact 6: full protection against touch contact Degree of water protection (the second digit) The second digit indicates the degree of protection provided against the ingress of water into the housing: 0: no protection 1: protection against vertically falling drops of water 2: protection against water droplets falling diagonally (up to 15°) 3: protection against water spray that falls at an angle up to 60° from vertical 4: protection against splashed water from all sides 5: protection against water jets 6: protection against powerful jets of water (flooding) 7: protection against sporadic submersion 8: protection against constant submersion

R

Rated control voltage	The nominal value of the sparkover (response) voltage for the solid-state relay
Rated voltage (Isolation)	Voltage level at which the insulation specifications are measured – this is the basis for sizing the creepage distance.
ROHS Directive 2002/95/EC	RoHS stands for the “Restriction of (the use of certain) Hazardous Substances” According to the EU Directive 2002/95/EC from 01.07.2006, all EU member nations must forbid the use of hazardous substances which damage human health and the environment (including mercury (Hg), cadmium (Cd), lead (Pb), hexavalent chrome (Cr6), polybrominated biphenyls (PBB) and polybrominated diphenyl ethers (PBDE)) in new electrical and electronic devices. The term “compliant” means that the entire product group meets the requirements of the RoHS Directive. The maximum weight percentage in homogeneous materials is below the limits specified in the directive: 0.1 % for lead, hexavalent chrome, mercury, PBB and PBDE; and below 0.01 % for cadmium, or qualifies for an exemption in accordance with the annex to the RoHS Directive .

S

Schmitt trigger	Strictly speaking, switching voltages for digital control follow an analogue pattern (no changeover from 0 to 1 between maximum and minimum voltages). This can lead to inaccuracies in switching results, above all when signals are being transmitted rapidly. In this case, the Schmitt trigger functions as a threshold switch. If the threshold voltage set in the Schmitt Trigger is exceeded, the output assumes the maximum possible output voltage (logic 1). Otherwise it is the minimum possible output voltage (logic 0). The Schmitt trigger is normally designed with a hysteresis. The threshold voltage set for activating is higher than that for deactivating. That prevents small irregularities from triggering a switching operation.
Self-heating	The heating up of an operational component based on the power loss from the relay coil and the switching contacts. For semiconductors (such as a transistor output), the increase in heat is caused by power loss.
Short-circuit-proof	Shuts off the output stage of a solid-state relay when there is a short circuit, in order to prevent the output circuit from being damaged.
Solid-state relay	Semiconductor relay that uses an electronic component as the switching mechanism, such as a transistor, thyristor or Triac. Semiconductor relays function with no wearing parts and have a high switching frequency compared with normal relays. But compared to normal relays they have a higher power loss in the load current circuit. An integrated optocoupler is used for galvanic isolation.
Status indicator	The status LED display on the input control circuit can differ from the state of the contact circuit in the following cases: • when there are welded-together or broken switching elements, • when there is interference or residual voltages on the signal lines. A reduction in light intensity may result when the ambient temperatures are greater than 50 °C.
Storage temperature	The permitted ambient temperature, related to a specific relative humidity level, for which the product should be stored while in a current-free state.

Surge voltage category	The overvoltage category of a circuit or an electrical system is numbered conventionally (from I to IV) and is based on limiting the assumed surge voltage values that can occur in a circuit (or electrical system with different mains voltages). The assignment to a particular overvoltage category is dependent on the measures which are used to influence (reduce) the surge voltages. Overvoltage category I • Devices that are intended to be connected to the permanent electrical building installation. The measures for limiting transient surge voltages to the proper level are taken outside of the device. The protective mechanisms can either be in the permanent installation or between the permanent installation and the device. Overvoltage category II • Devices that are intended to be connected to the permanent electrical building installation (such as household appliances or portable tools). Overvoltage category III • Devices that are a part of the permanent installation and other devices where a higher degree of availability is required. This includes the distributor panels, power switches, distribution systems (including cables, busbars, distributor boxes, switches and outlets) that are part of the permanent installation, devices intended for industrial use, and devices that are continually connected to the permanent installation (such as stationary motors).
Switch-off delay	The usual time interval from switching off the control voltage of a conducting solid-state relay to the time when the output circuit is blocked.
Switch-on delay	The usual time interval from switching on the control voltage of a closed solid-state relay to the time when the output circuit is conductive.

T

Transients	Transients are short-term current or voltage peaks caused by interferences in the mains supply grid or by electromagnetic radiation. On the control side of the optocoupler these can trigger unintended switching operations or, in extreme cases, cause the destruction of the component. In an AC-driven load circuit, transients can lead to the maximum permissible forward voltage being exceeded, which in turn can activate the thyristor or Triac. As these operate at quite high switching speeds, even very short pulses can suffice to falsely trigger a switching operation.
Type of insulation	Quality of the insulation system, depending on the design and application conditions: • Functional insulation: insulation between live components – necessary so the relay functions properly. • Basic insulation: insulation of live parts to provide basic protection against electrical shock. • Doubled insulation: consisting of a base insulation and additional insulation. • Reinforced insulation: a single "enhanced" insulation of active components, which ensures the same protection against electric shock as doubled insulation. The doubled insulation is composed of a base and an additional insulation; the extra insulation protects against electric shock if the basic insulation fails.

V

Voltage drop	The reduction of voltage via the opto module, when measured under full load

W

Withstand test voltage	The voltage applied to a device under specific test conditions which causes no breakthrough or flash-over of the test piece.