

## Electrical switch contacts

- **Model 821, magnetic snap-action contact**
- **Model 831, inductive contact**
- **Model 830 E, electronic contact**
- **Model 851, reed contact**

WIKA data sheet AC 08.01

### Applications

- Control and regulation of industrial processes
- Monitoring of plants and switching of circuits
- Indication of limit conditions
- Inductive contact for completely fail-safe switching, even in explosion hazardous areas
- Machine building, general plant construction, chemical industry, petrochemical industry, power plants, mining, on-/offshore and environmental technology

### Special features

- High reliability and long service life
- Can be incorporated within all relevant pressure and temperature measuring instruments
- Up to 4 switch contacts per measuring instrument
- Optionally with liquid-filled case for high dynamic pressure loads and vibrations
- Inductive contact also available in safety version and electronic contact for PLCs

### Description

Switch contacts (electrical switch contacts) make or break an electric control circuit dependent upon the pointer position of the indicating measuring instrument. The switch contacts are adjustable over the full extent of the scale range (see DIN 16085), and are mounted predominantly below the dial, though also partly on top of the dial.

The instrument pointer (actual value pointer) moves freely across the entire scale range, independent of the setting. The set pointer for the switch point of circular instruments and square panel-mounted instruments can be adjusted using a removable adjustment key in the window. Contacts in flush panel-mounted instruments are adjustable using a screwdriver through the window.



**Pressure gauge model 212.20.100  
with switch contact model 821**



**Bimetal thermometer model 55 with  
inductive contact model 831**

Contact actuation is made when the actual value pointer travels beyond or below the desired switch point. Instruments with electrical switch contacts can also be delivered with optional special approvals. Depending on the instrument model, e.g. approvals for hazardous areas are available.

## Magnetic snap-action contact model 821

### Application

These contacts can be used in almost all operating conditions, and even in liquid-damped instruments. The set pointer has an adjustable permanent magnet attached, giving a snap-action characteristic to the contacts, which, furthermore, strengthens the contact pressure. This snap action widely protects the contacts against harmful arc influences, but increases the switching switch hysteresis to 2 % up to 5 % of the measuring span. The switch hysteresis is the difference of the displayed values, measured by reversing the direction of movement and leaving the switch point unchanged. The signal output is achieved either ahead of or behind the movement of the actual value pointer.

Especially in temperature measurement technology, where bimetal measuring systems have only very small actuating forces, and when operating conditions exist in which no vibrations occur, **model 811 sliding contacts** are used. This contact type is not suitable for liquid-damped measuring instruments.

### Specifications and loading tables

If the specified data are observed, the switch contacts ensure perfect operation for many years. For higher loads (max. 1,840 VA) and also with instruments with liquid filling, we recommend our model 905.1x contact protection relay (page 9).

In accordance with DIN 16085, requirements on pressure measuring instruments with contacts for switching currents less than 24 V should be agreed specifically between the user and the manufacturer.

**For low switching voltages, to maintain switching reliability, the current to be switched should not be less than 20 mA. In order to ensure a high switching reliability of the contacts, even taking ambient influences into account, the switching voltage should not be below 24 V.**

When switching inductive or capacitive loads, the usual contact protection measures against contact erosion should be made.

For programmable logic controllers (PLCs), the model 830 E electronic contact is recommended (see page 14 ff.).

## Specifications

Limit values for the contact load with resistive load	Magnetic snap-action contact model 821		Sliding contact model 811
	unfilled instruments	filled instruments	unfilled instruments
Rated operating voltage $U_{\text{eff max.}}$	250 V	250 V	250 V
Rated current: <sup>1)</sup>			
- Switch-on current	1.0 A	1.0 A	0.7 A
- Switch-off current	1.0 A	1.0 A	0.7 A
- Continuous current	0.6 A	0.6 A	0.6 A
Switching power max.	30 W / 50 VA	20 W / 20 VA	10 W / 18 VA
Contact material	Silver-nickel (80 % silver / 20 % nickel / gold-plated)		
Ambient temperature	-20 ... +70 °C		
Number of contacts max.	4		

<sup>1)</sup> Values for current ratings shown in the above table apply to instruments with switch version S. For instruments with switch version L, the values should be halved. (For correlation, see Table, Page 3)

## Recommended contact load with resistive and inductive loads

Voltage in V (DIN IEC 38) DC / AC	Magnetic snap-action contact model 821						Sliding contact model 811		
	unfilled instruments			filled instruments			unfilled instruments		
	resistive load		inductive load	resistive load		inductive load	resistive load		inductive load
	Direct current	Alternating current	$\cos \phi > 0.7$	Direct current	Alternating current	$\cos \phi > 0.7$	Direct current	Alternating current	$\cos \phi > 0.7$
	mA	mA	mA	mA	mA	mA	mA	mA	mA
<b>220 / 230</b>	100	120	65	65	90	40	40	45	25
<b>110 / 110</b>	200	240	130	130	180	85	80	90	45
<b>48 / 48</b>	300	450	200	190	330	130	120	170	70
<b>24 / 24</b>	400	600	250	250	450	150	200	250	100

## Contact material

Depending upon the switching conditions, the switch contacts are subjected to greater or lesser erosion due to the effects of the unavoidable arcing and through mechanical stress. As a result, when selecting the contact material, attention should be paid to the predominant operating conditions.

The following contact materials are available:

### Silver-nickel composite material

(80 % silver / 20 % nickel / gold-plated)

Material properties:

- Higher hardness and rigidity
- Good erosion resistance
- Low inclination to fuse together
- Low contact resistance

Due to its good balance of properties and wide application possibilities, this composite is used as our standard material.

### Platinum-iridium alloy

(75 % platinum, 25 % iridium)

Platinum-iridium is exceptionally chemically resistant, and also hard and very resistant to erosion. It is used for high switching frequencies, high switching powers and in aggressive environments.

## Special versions

- Contacts with separate circuits
- Change-over contacts (break or make simultaneously at the set point)
- Contacts fixed
- Contacts coupled
- Contacts with parallel resistance 47 kΩ for cable break monitoring
- Contacts self-cleaning (only with NS 160)
- Contact adjustment lock leaded
- Contact adjustment key fixed
- Connector (instead of cable or cable socket)
- Special contact material platinum-iridium alloy

## Allocation of switch version to basic instruments and measuring ranges

(for the determination of limit values, see tables on page 2)

WIKA basic instrument model	Nominal size	Number of contacts in the instrument	Measuring spans	Switch version
2xx.xx	100 and 160	1	≤ 1 bar	L
2xx.xx	100 and 160	1	all others	S
2xx.xx	100 and 160	2	≤ 1.6 bar	L
2xx.xx	100 and 160	2	all others	S
2xx.xx	100	3 or 4	≤ 4 bar	L
2xx.xx	100	3 or 4	all others	S
2xx.xx	160	3 or 4	≤ 2.5 bar	L
2xx.xx	160	3 or 4	all others	S
3xx.xx	160	1 ... 4	all	L
4xx.xx	100 and 160	1 ... 4	all	L
5xx.xx	100 and 160	1 ... 4	all	L
6xx.50	100	1 or 2	≥ 100 mbar	L
7xx.xx	100 and 160	1 ... 4	all	L
55	100 and 160	1 ... 4	all	L
73	100 and 160	1 ... 4	all	L
74	100	1 ... 4	all	L
76	100 and 160	1 ... 4	all	L

## Switching functions

The following applies, as a general rule, to the switching functions of the model 821 magnetic snap-action contact and the model 811 sliding contact with our standard settings:



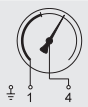

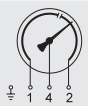


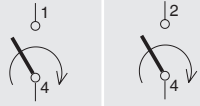



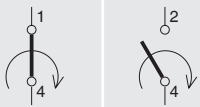




- Index 1** behind the contact model no. means:  
**Contact makes** the circuit when the set point is exceeded.
- Index 2** behind the contact model no. means:  
**Contact breaks** the circuit when the set point is exceeded.
- Index 3** behind the contact model no. means: When the set value is exceeded, one circuit breaks and one circuit makes **simultaneously** (change-over contact).

For switch contacts with multiple contacts, the 1st contact is the one closest to the left start of scale value or end value (for vacuum gauge).

**The switching function**, described in the following table, follows the **clockwise rotary motion** of the instrument pointer (actual value pointer).

If the actual value pointer moves **anticlockwise**, the **reverse switching function** occurs!

**Note:** If the switch contacts are to be set (adjusted) anticlockwise, the index figures in brackets must be used in accordance with DIN 16085. Combinations are possible.

Circuit diagram	Switching function on pointer movement in a clockwise direction	Contact model with switching function index for magnetic snap-action contacts and sliding contacts (special version)	
<b>Single contact <sup>1)</sup></b>			
	Contact makes when the set point is exceeded		821.1 and 811.1 (.5)
	Contact breaks when the set point is exceeded		821.2 and 811.2 (.4)
	Contact changes over (change-over contact), i.e. 1 contact breaks and 1 contact makes when the set point is exceeded		821.3 and 811.3 (.6)
<b>Double contact <sup>1)</sup></b>			
	1st and 2nd contact makes when the set points are exceeded		821.11 and 811.11 (.55)
	1st contact makes, 2nd contact breaks when the set points are exceeded		821.12 and 811.12 (.54)
	1st contact breaks, 2nd contact makes when the set points are exceeded		821.21 and 811.21 (.45)
	1st and 2nd contact breaks when the set points are exceeded		821.22 and 811.22 (.44)
<b>Triple contact <sup>1)</sup></b>			
	1st contact breaks, 2nd contact makes, 3rd contact breaks when the set points are exceeded		821.212 and 811.212 (.454)

<sup>1)</sup> When ordering, attach the corresponding index of the required switching functions (note order 1st, 2nd, 3rd contact) to the contact model no., see example 821.212.

The **connection terminals** and **connection wires** are marked in accordance with the table above. Protective conductors are always yellow-green. **Mounting options:** see page 20/21

## Reed contact model 851

### Application

Reed contacts are often used for switching small voltages and currents, since their hermetically sealed design, in combination with contacts in inert gas, cannot become corroded on the contact surfaces.

Their high reliability and low contact resistance make them suitable for a large number of applications. They include, for example, PLC applications, signal conversion in measuring instruments, signal lights, acoustic signal transmitters and many more.

Their hermetically sealed design makes these contacts ideally suited for use at high altitudes. However, the thinner the atmosphere, then the greater must be the contact clearance so that no contact burn occurs.

Reed contacts need no auxiliary power supply and are very insensitive to vibrations, due to their low weight. For 2 contacts, the individual switches are galvanically separated from each other.

### Note

Due to its ability to simultaneously switch both the smallest currents and voltages as well as powers of up to 60 watts, this contact form is ideal for applications in which the signal has not yet been exactly defined in the planning phase.

### Operating principle

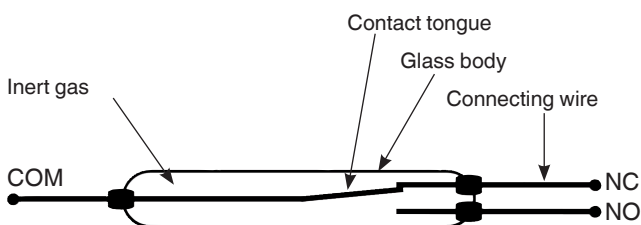
A reed contact consists of three contact tongues (change-over contact, SPDT), made of a ferromagnetic material, which are fused in a glass body under an inert gas atmosphere.

To minimise wear and guarantee a low contact resistance, the contact tongues are provided with a metallic coating in the area of the contact surfaces. The reed contact is actuated by an external magnetic field (for example a permanent magnet) with a sufficient field strength. The switching status is maintained until the magnetic field strength has fallen below a certain value.

Predominantly, WIKA uses mainly bistable and magnetically-biased reed contacts. The bias maintains the signal status until a magnetic field having the opposite magnetic polarity resets the contact.

### Functional diagram

Reed contact, SPDT (change-over contact), not activated



COM = common  
NC = normally closed  
NO = normally open

Due to the hard coating of the contact surface with, for example, ferromagnetic rhodium, the reed contact achieves a very long service life. The number of possible switching cycles of a reed contact depends largely on the level of the electrical load, but, based on experience, is in the range of  $10^6$  to  $10^7$ .

If only signal loads or small loads are switched, then switching operations in excess of  $10^8$  are easily achievable. With switching voltages below 5 V (arcing limit), switching operations beyond  $10^9$  can be achieved. For capacitive or inductive loads, the use of a protective circuit is required since the resulting current, or voltage spikes would destroy the reed contact or at least significantly reduce its service life. For this, see the chapter on contact protection measures on page 7.

If a magnetic field passes the reed contact, both contact tongues attract each other and close the contact. The electrical current can flow.

If the magnetic field moves away, the field strength drops with increasing distance. The contact remains closed through the bistability. Only a new traverse of the reed contact with a magnetic field in the opposite direction opens the two contact tongues again. The electrical current is interrupted.

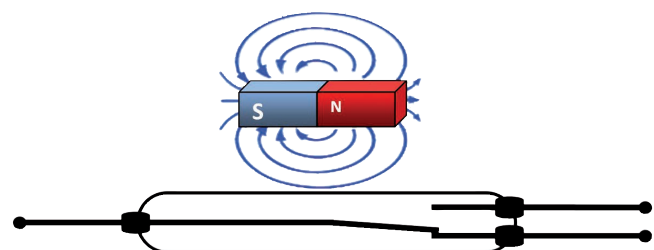
As with other mechanical switches, the reed contact is also not bounce-free. However, the bounce times are shorter than most other mechanical contacts. Nevertheless, this physical property should be considered, especially in PLC applications (keyword: software debounce / button debounce).

### Example:

If the switch point for a 10 bar switchGAUGE is set, for example, to 1 bar and the instrument pointer sweeps this value with the magnet in the positive direction, the reed contact will change state and maintain it, even if the pointer continues to 10 bar.

The reed contact will only further change its state if the pointer passes 1 bar in the direction of 0.

Reed contact, SPDT (change-over contact) activated



## Specifications, reed contact model 851

This contact can be built-in in the following models:

- 712.15.100
- 712.15.160
- 732.15.100
- 732.15.160
- PGS23.100
- PGS23.160
- PGS63HP.100
- PGS63HP.160
- PGS43,100
- PGS43.160
- PGS43HP.100
- PGS43HP.160
- DPGS43,100
- DPGS43.160
- DPGS43HP.100
- DPGS43HP.160
- APGS43.100
- APGS43.160

Limit values for the contact load with resistive load	
Contact version	Change-over contact
Type of contact	bistable
Max. switching voltage	AC 250 V / DC 250 V
Min. switching voltage	not required
Switching current	≤ 1 A
Min. switching current	not required
Transport current	≤ 2A
cos φ	1
Switching power	60 VA/W
Contact resistance (static)	100 mΩ
Insulation resistance	10 <sup>9</sup> Ω
Breakdown voltage	DC 1,000 V
Switching time incl. contact chatter	4.5 ms
Contact material	Rhodium
Switch hysteresis	3 ... 5 %

- The limit values presented here must not be exceeded independently of each other.
- When using two contacts, these cannot be set to the same point. In this case, a minimum clearance of approx. 30° is required.
- The adjustment range of the contacts is 10 ... 90 % of the scale.
- The Switch hysteresis can be set in manufacturing such that the reed contact will actuate exactly at the required switch point. For this, we need the switching direction to be specified on order.
- In the model 700.0x and 230.15 2" pressure gauges, further reed contacts are used. For the specifications, please refer to the data sheets.

## Reasons for an overload of magnetic snap-action or reed contacts

### General information

Each mechanical switch has 4 physical limits. These are:

- Maximum electrical switching voltage
- Maximum electrical switching current
- Maximum electrical load to be switched
- Maximum mechanical switching frequency

Outside these specified physical limits, the switch should not be operated. Should even only one of these limits be exceeded during operation, the service life of the switch will be shortened. The further that one or more limits are exceeded, the greater the shortening of the life of the switch - even as far as immediate failure.

### Causes of electrical overload

#### Maximum electrical switching voltage

When switching an electrical load, an arc may arise, more or less visible, between the contact surfaces. Due to the resulting, locally limited, high heat, the contact material gradually evaporates during each switching process (material loss, burn-off). The higher the voltage to be switched, the larger are the arcs and thus the contact material evaporates more and faster. The contact will be permanently damaged.

#### Maximum electrical switching current

When switching an electrical current, the contact surface will be heated through the charge carrier flow (contact resistance). If the maximum permissible switching current is exceeded, the contacts begin to fuse together. This can lead to the welding or sticking of the two contact surfaces. The contact will be permanently damaged.

#### Maximum electrical power

The maximum electrical power which a contact can switch is defined as the switching voltage multiplied by the switching current. This electrical power heats the contact and should not be exceeded (welding, sticking). The contact will be permanently damaged.

#### Maximum mechanical switching frequency

The maximum possible switching frequency is dependent upon the wear of the bearing points and also the material fatigue.

### Minimum electrical values

Each mechanical contact also has a contact resistance due to impurity layers (impurity-film resistance  $R_F$ ).

This impurity-film resistance exists through oxidation or corrosion on the contact surfaces and increases the electrical resistance of the switch.

With switching of small loads, this layer is not penetrated.

Only by switching higher voltages and currents is this destroyed. This effect is known as fritting, and the required minimum voltage is the fritting voltage.

If this voltage is not reached when switching, the impurity-film resistance will continue to increase and the switch will cease to work. This effect is reversible.

### Further notes

Such electrical overloads can be based, for example, on the following:

- Filament lamps absorb up to 15 times more current at the moment of switching-on than during operation (nominal value).
- Capacitive loads, at the moment of switching on, create a short circuit (long control lines, lines running parallel to each other).
- Inductive loads (relay, fuse, solenoid valve, rolled cable drum, electric motors) generate, on switching, very high voltages (up to 10 times the rated voltage).

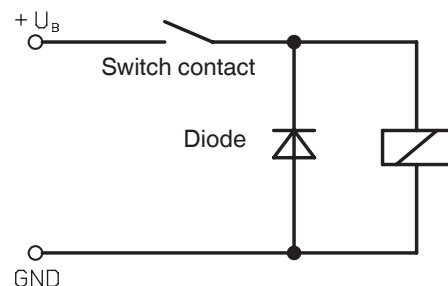
### Contact protection measures

Mechanical contacts must not exceed the specified electrical values for switching current and switching voltage, not even for a short time only.

For capacitive or inductive loads we recommend one of the following protective circuits:

#### 1. Inductive load with DC voltage

With DC voltage the contact protection can be achieved via a free-wheeling diode, connected in parallel to the load. The polarity of the diode must be arranged so that it closes when the operating voltage is on.

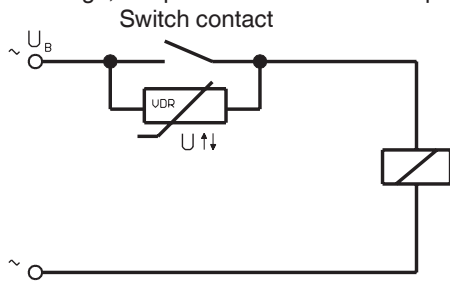


**Example: Contact protection measure with free-wheeling diode**

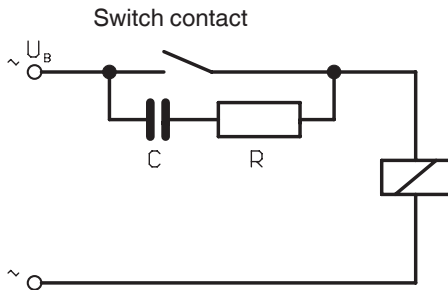


**2. Inductive load with AC voltage**

With AC voltage, two protection measures are possible.



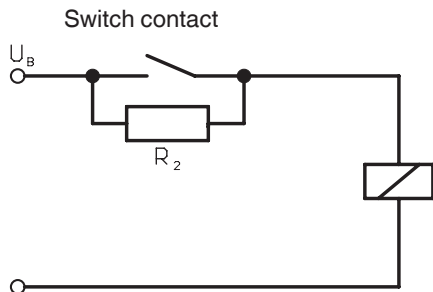
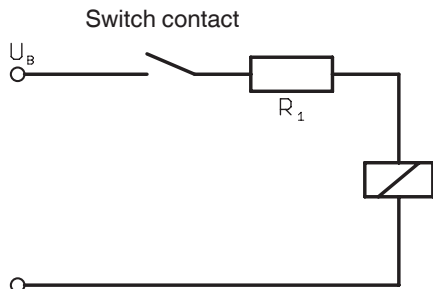
**Example: Contact protection measure with voltage-dependent resistor VDR**



**Example: Contact protection measure with RC element**

**3. Capacitive load**

With capacitive loads elevated make currents arise. These can be reduced by series-connecting resistors in the supply line.



**Example: Contact protection measure with current-limiting resistor**

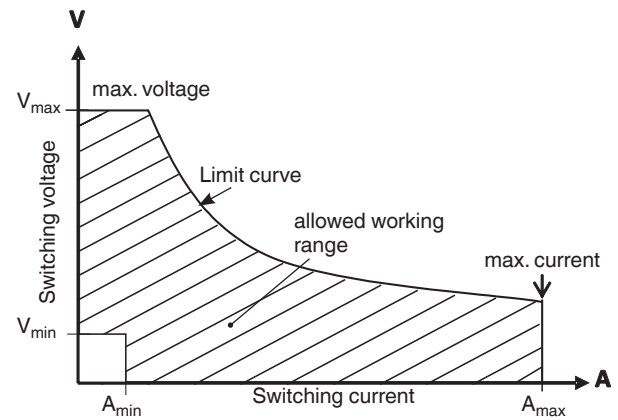
**Contact curve**

The hatched area of the contact curve shows the permissible electrical values for the respective contact.

The voltage to be switched must neither be above the maximum nor below the minimum switching voltage ( $V_{max} \leq U_s \leq V_{min}$ ).

The current to be switched must neither be above the maximum nor below the minimum switching current ( $A_{max} \leq I_s \leq A_{min}$ ).

The power to be switched may only lie below the limit curve.





## Contact protection relay

Contact protection relays are used for model 821 and model 811 switch contacts if the permissible switching power of the contacts is not sufficient.

The contact protection relays are controlled by the switch contacts and switch the load.

On the contact side, you are working with a low control voltage, but on the output side can be a high load.

Contact protection relays consist of a power supply, control unit, switching amplifier and relay output. The contacts are supplied with a clocked DC voltage of 35 ... 40 V from the control unit (i.e. only about every hundredth switching occurs under voltage). This way, optimal contact protection and switching reliability for several million switching cycles is achieved.

Liquid-filled measuring instruments with contacts, which switch frequently, should generally be operated with contact protection relays. Although the filling increases the service life of the mechanical measuring system, at the same time it increases the erosion of the contact pins.

In addition to the outputs for operating the contacts, an additional output with a DC voltage of 24 V (max. 20 mA) is available. With this, for example, control lamps or transmitters can be supplied.

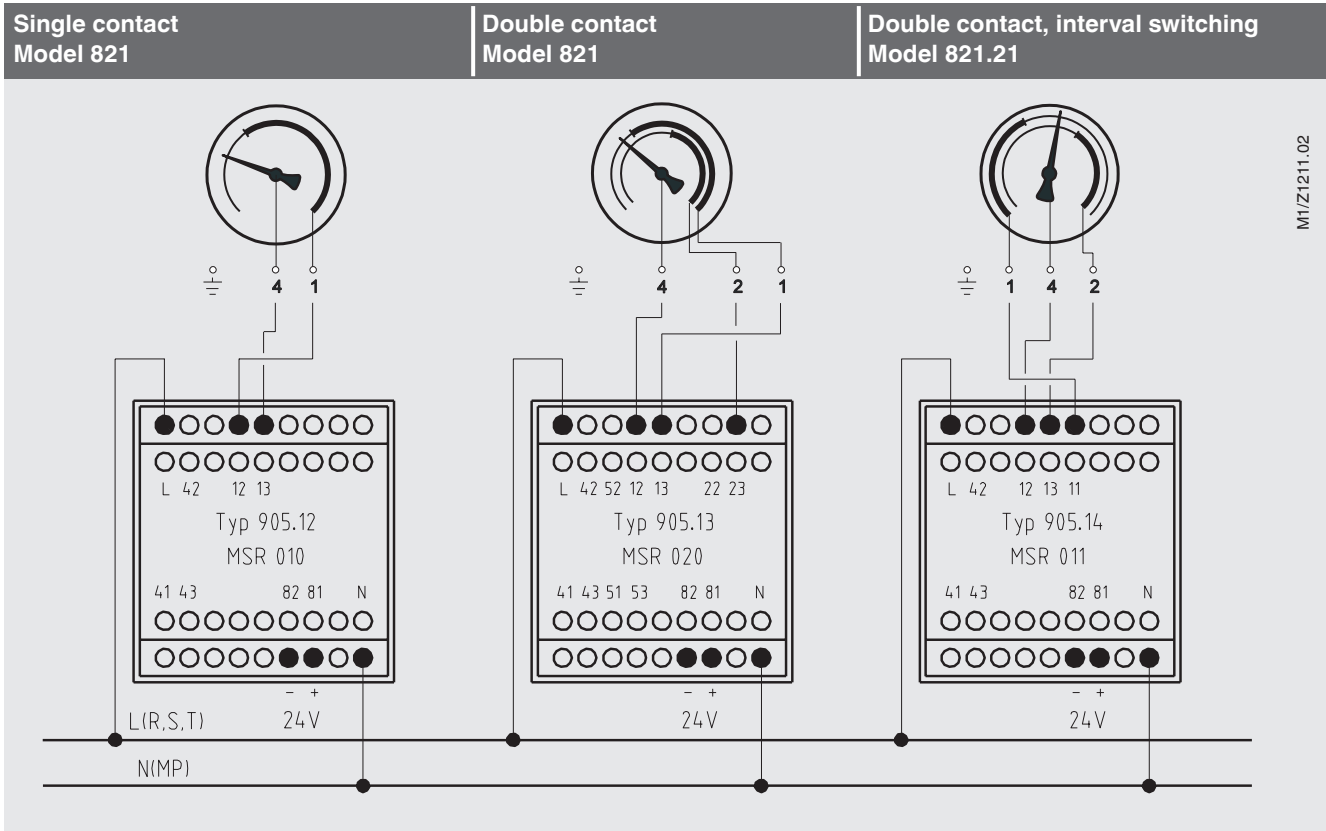
In order to suppress unintentional switching (e.g. vibration), the switching signal must apply for a min. 0.5 seconds, so that the output of the contact protection relay switches (fall delay).

## Model overview

Model	for connection to instruments	Function/output	
905.12 MSR 010	with 1 contact	1 switch contact / change-over contact	<p>Contact protection relay L - N 230 V 45...60 Hz</p> <p>MSR 010</p> <p>Permissible contact load: 1,840 VA, 250 V, 8 A</p> <p>DC voltage output: DC 24 V</p> <p style="text-align: right;">1036688</p>
905.13 MSR 020	with 2 contacts	2 switch contacts / change-over contacts	<p>Contact protection relay L - N 230 V 45...60 Hz</p> <p>MSR 020</p> <p>Permissible contact load: 1,840 VA, 250 V, 8 A</p> <p>DC voltage output: DC 24 V</p> <p style="text-align: right;">1036696</p>
905.14 MSR 011	with 2 contacts (Function 21 is essential)	Two-point controller / bistable change-over contact  (for interval switching with pump control)	<p>Contact protection relay L - N 230 V 45...60 Hz</p> <p>MSR 011</p> <p>Permissible contact load: 1,840 VA, 250 V, 8 A</p> <p>DC voltage output: DC 24 V</p> <p style="text-align: right;">1036700</p>

Specifications	Contact protection relay model 905.12 ... 14
Power connection	AC 230 V -10 % / +6 %, 45 ... 60 Hz
Power consumption	approx. 2.5 VA
Pulse control voltage	35 to 40 V; galvanically isolated from the mains
Pulse duration ratio: Pause	1 : 100 (typical)
Pulse width	250 µs (typical)
Fall delay	approx. 0.5 s
Relay output	potential-free, change-over contact or changeover - bistable - (see Model overview)
■ Permissible load	AC 250 V, 8 A, 1,840 VA
Voltage output	DC 24 V
■ Permissible load	20 mA
Pin assignment	DIN 45410
Ingress protection per IEC/EN 60529	Protective insulation
Isolation class	C/250 V per VDE 0110
Case - dimensions per drawing	Form C, page 15
Case - material	Polyamide 6.6, green
Protection class	Case: IP40, terminals: IP20
Temperature range	0 ... 70 °C
Mounting	Standard rail 35 x 7.5 mm per DIN 50022 (Adapter for individual mounting is included in the scope of delivery)

**Connection examples for the contact protection relay**



## Inductive contact model 831

### Application

Measuring instruments with WIKA inductive contacts may be used in zone 1 and 2 hazardous areas. Provided that they are supplied from a suitable and certified control circuit (e.g. WIKA model 904.28 control unit).

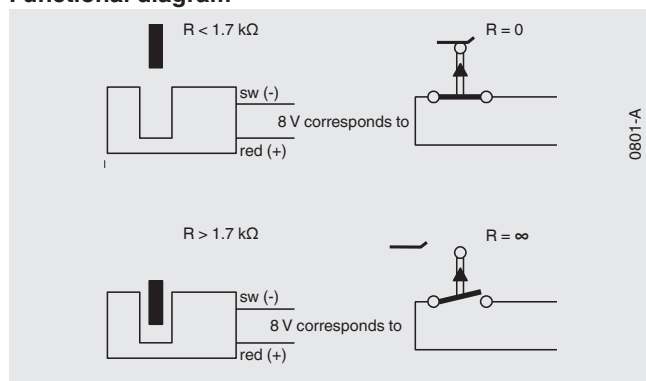
Outside of hazardous areas, these WIKA inductive contacts are primarily used where particularly safe switching at higher switching rates is important. Since the contacts also work in liquid filling, such instruments can even be used in very specific operating conditions. Some typical application areas are in chemical, petrochemical and nuclear plants.

### Operating principle

The WIKA inductive contact works in a non-contact way. Essentially, it consists of the control head (initiator), attached to the set pointer, with its fully potted electronics and the mechanical assembly with the moving flag. The flag is moved by the instrument pointer (actual value pointer).

The control head is supplied with a DC voltage. When the flag enters the slot in the control head, this then increases its internal resistance (= damped condition / the initiator has high impedance). The subsequent change in the current acts as the input signal for switching amplifiers of the control unit.

### Functional diagram



The control unit effectively works without influence on the measuring system. The non-contact “contact system” produces no wear within the electrical system. The assembly dimensions correspond to the model 821 contacts. Setting of the set points is carried out as for these contacts.

Ambient temperature:  $-25 \dots +70 \text{ }^{\circ}\text{C}$ <sup>1)</sup>

Control head used (slot sensor): Model 831

### Advantages of the WIKA inductive contact

- Long service life due to non-contact sensor
- Low influence on the display
- Universal application, even with filled instruments
- Insensitive against aggressive environments (potted electronics, non-contact contact operation)
- Explosion-protected, can be used in zone 1 and 2

### Design concept of the WIKA inductive system

The WIKA inductive system consists of the WIKA inductive contact built in to the measuring instrument (as already described) and the WIKA control unit (see page 15 ff.).

The **control unit** consists of

- Power supply unit
- Switching amplifier
- Output relay

The power supply unit converts the AC mains voltage into a DC voltage. The switching amplifier supplies the control head and switches the output relay. Via the output relay, high electrical powers can be switched.

There are two **designs for the WIKA control unit**:

- with **intrinsically safe** control circuit (Ex version)
- with **non-intrinsically safe** control circuit (non-Ex version)

The **intrinsically safe control units** conform to EN 50014 / EN 50020 and are type tested. With them, inductive contacts can be used in zone 1 or 2 hazardous areas.

**Note:** The control unit itself must be installed outside the hazardous area!

The switch behaviour of the control unit can be manipulated by inserting wire bridges or through slide switches. A reversal of the direction of action can be achieved: e.g. due to the flag in the slot sensor, the output relay is either de-energised or energised. In addition, line break monitoring can be switched on.

With the **non-intrinsically safe control unit**, inductive contacts should not be used in hazardous areas. Their direction of action is fixed. The output relay is de-energised when the flag passes through the air gap. The line break monitoring is in series. In addition to the outputs for operating the switch contacts, an additional output with a DC voltage of 24 V (max. 20 mA) is available. Thus, for example, control lamps can be powered.

1) With use in hazardous areas, the upper limit values for the ambient temperature, specified in the test certificate, must be observed! These are dependent upon the voltage, current, power and temperature class.

## Switching functions

The following applies, as a general rule, to the switching functions of the model 831 inductive contacts in connection with our standard settings:

**Index 1** behind the inductive contact model no. means: **Contact makes** the control circuit when the set point is exceeded (flag **leaves control head**).

**Index 2** behind the inductive contact model no. means: **Contact breaks** the control circuit when the set point is exceeded (flag **enters control head**).

For inductive contacts with multiple contacts, the 1st contact is the one closest to the left start of scale value or end value (be careful with vacuum gauges).

**The switching function**, described in the following table, follows the **clockwise rotary motion** of the instrument pointer (actual value pointer). If the actual value pointer moves **anticlockwise**, the **reverse switching function** occurs!

**Note:** If the inductive contacts are to be set (adjusted) anticlockwise, the index figures in brackets must be used in accordance with DIN 16085. Combinations are possible.

Circuit diagram <sup>2)</sup>	If the pointer of the measuring instrument moves clockwise, on exceeding the defined set point, the flag is driven:	Switching function (illustration of the principle)	Inductive contact model with function index of the switching function
<b>Single contact <sup>1)</sup></b>			
	out of the control head	Contact makes	831.1 (.5)
	into the control head	Contact breaks	831.2 (.4)
<b>Double contact <sup>1)</sup></b>			
	the 1st and 2nd contacts from the control head	1st and 2nd contact makes	831.11 (.55)
	of the 1st contact from the control head, of the 2nd contact into the control head	1st contact makes 2nd contact breaks	831.12 (.54)
	of the 1st contact into the control head, of the 2nd contact from the control head	1st contact breaks, 2nd contact makes	831.21 (.45)
	of the 1st and 2nd contacts into the control head	1st and 2nd contacts break	831.22 (.44)
<b>Triple contact <sup>1)</sup></b>			
A number of instruments can be fitted with up to 3 inductive contacts (see page 20/21). Technical notes page 13. Switching and switch behaviour in principle as in the previous table.			

1) When ordering, attach the corresponding index of the required switching functions (note order 1st, 2nd, 3rd contact) to the inductive contact model no.

2) Thin line means: Flag in control head, control circuit open. Thick line means: flag out of the control head, control circuit closed

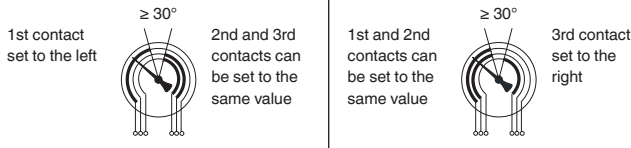
The **connection terminals** and **connection wires** are marked in accordance with the table above.

**Mounting options:** see page 20/21

**Triple contact**

With inductive contacts in the triple design, the setting of all three contacts to the same set point is not physically possible. Either the left (= no. 1 contact) or the right contact (= no. 3 contact) must be separated by  $\geq 30^\circ$  to the left or the right of the two set pointers, which may be set to the same value:

**Examples**



**Combination of all triple contacts**

The 1st set pointer is set approx.  $30^\circ$  to the left

The 3rd set pointer is set approx.  $30^\circ$  to the right

Model	Model
831.1.11	831.11.1
831.1.12	831.11.2
831.1.21	831.12.1
831.1.22	831.12.2
831.2.11	831.21.1
831.2.12	831.21.2
831.2.21	831.22.1
831.2.22	831.22.2

**Special versions with inductive contacts**

■ **Safety inductive contact, model 831 SN and 831 S1N**

For safety-critical applications, such as for the construction of self-monitoring controls, type-tested components must be used. Corresponding certifications are available for the model 831 SN and model 831 S1N safety inductive contacts. The pre-condition is operation with a similarly certified fail-safe control unit (isolating amplifier), e.g. model 904.30 KHA6-SH-Ex1 (see page 16).

Measuring instruments with safety inductive contacts may be used in zone 1 hazardous areas. Control head used (SN/S1N slot sensor): Model 831 from Pepperl & Fuchs

**Switch behaviour, model 831 SN**

If the flag is in the slot sensor, then the output of the downstream control unit (0 signal) is **inhibited**, i.e. the output relay is **de-energised** (= safe state).

For the function index of the switching functions, the emergence of the flag from or insertion into the control head and also the installation options, the same information applies as for model 831 inductive contacts (see page 12).

**Switch behaviour, model 831 S1N**

If the flag is not in, but rather **outside** the slot sensor, then the output of the downstream control unit (0 signal) is inhibited, i.e. the output relay is **de-energised** (= safe state).

For the function index of the switching functions, the same information applies as for model 831 inductive contacts with the following difference:

**Index 1** behind the inductive contact model no. means: **Contact breaks** the control circuit when the set point is exceeded in the clockwise direction (flag enters control head).

**Index 2** after the inductive contact model no. means: **Contact breaks** the control circuit when the set point is exceeded in the clockwise direction (flag moves out of the control head).

Mounting options in accordance with table on page 20/21.

■ **Triple contact NS 160, settable to one set point**

If the setting of 3 contacts to a single set point is absolutely needed, then this can be achieved with NS 160 through the use of a smaller control head. This must be defined on ordering.

■ **Quadruple contacts**

With NS 144 x 72 panel-mount pressure gauges with a single measuring system, up to 4 inductive contacts are possible (see page 20).

## Electronic contact model 830 E

### Description, application

Direct switching of small capacities which are usually required in connection with a PLC can be realised by this inductive contact with integrated amplifier model 830 E which is factory-installed directly into the measuring instrument.

The usual advantages of inductive contacts, such as fail-safe contact operation, no wear due to proximity contact operation as well as practically no effect on the measuring system, also apply here.

### No additional control unit is required.

The electronic contact can be selected with 2- or 3-wire design and is implemented with PNP output. The operating voltage is DC 10 ... 30 V. The maximum switching current is 100 mA.

The model 830 E electronic contact is **not intrinsically safe** and therefore not suitable for applications in hazardous areas!

For further specifications, see page 15.

For the function index of the switching functions, the same information applies as for model 831 inductive contacts with the following difference:

**Index 1** behind the inductive contact model no. means: **Contact breaks** the control circuit when the set point is exceeded in the clockwise direction (flag enters control head).

**Index 2** after the inductive contact model no. means: **Contact breaks** the control circuit when the set point is exceeded in the clockwise direction (flag moves out of the control head).

**Note:** The direction of the action of the flag is also reversible, as with model 831!

### Electrical connection

Control and switching electronics in the sensor, electrical connection via cable socket

- To connect a PLC control unit or for direct switching of small capacities

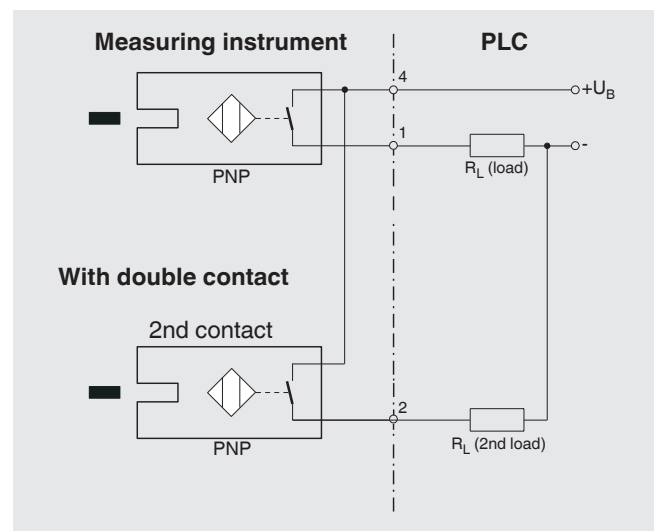
- PNP transistor

With PNP switching instruments, the switched output is a connection towards PLUS. The load  $R_L$  between the switched output and the MINUS should be selected in a way not to exceed the maximum switching current of 100 mA.

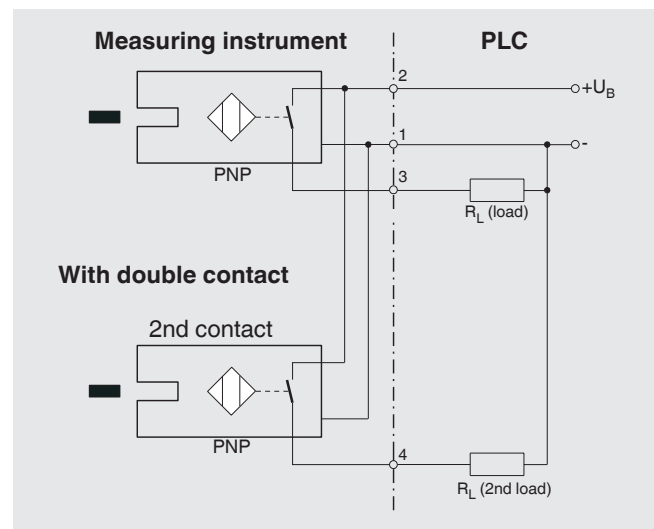
- Flag emerges from slot sensor:  
Contact open (output not active)

- Flag retreats into slot sensor:  
Contact closed (output active)

### 2-wire system (standard)

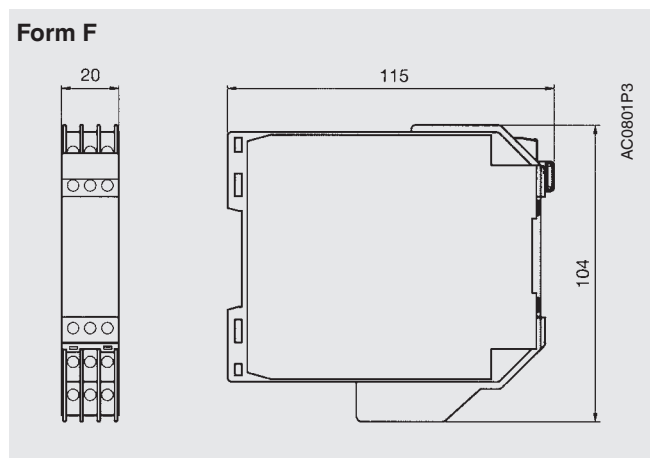
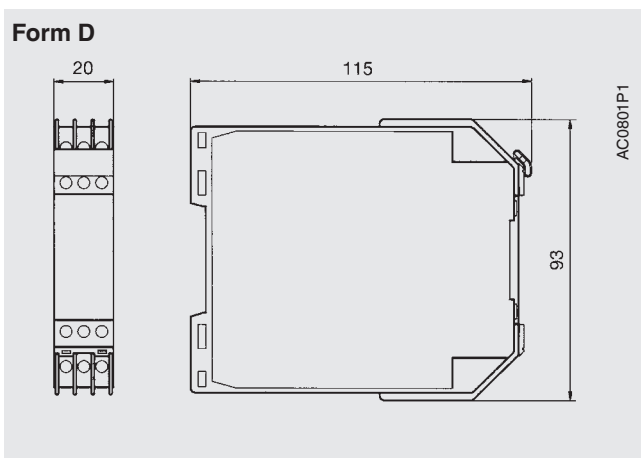
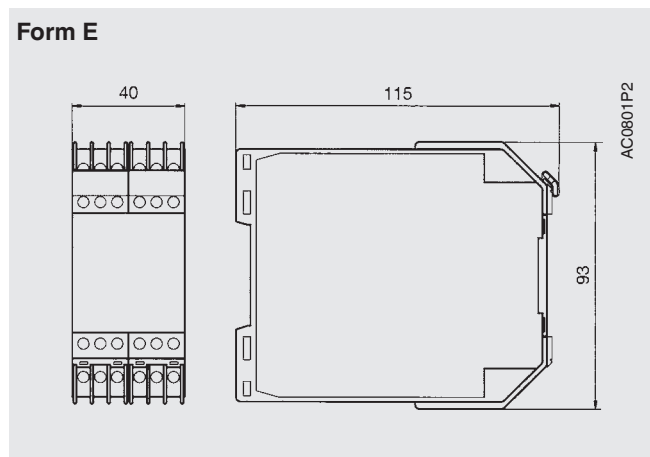
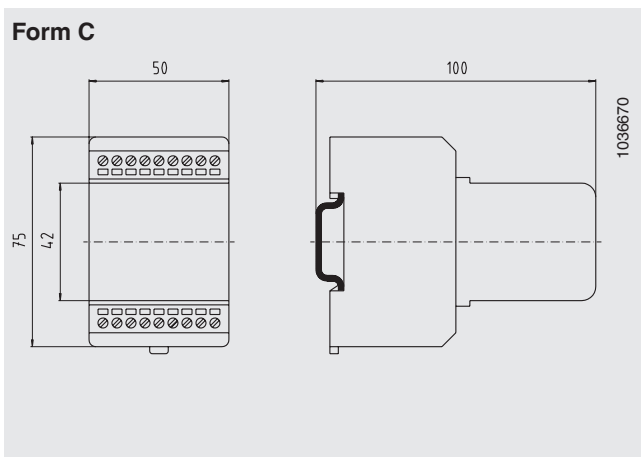


### 3-wire system



Specifications	Electronic contact model 830 E
Power supply	DC 10 ... 30 V
Residual ripple	max. 10 %
No-load current	≤ 10 mA
Switching current	≤ 100 mA
Residual current	≤ 100 μA
Function of switching element	Normally open
Type of output	PNP transistor
Voltage drop (with I <sub>max.</sub> )	≤ 0.7 V
Reverse polarity protection	conditional U <sub>B</sub> (the switched output 3 or 4 must never be set directly to minus)
Anti-inductive protection	1 kV, 0.1 ms, 1 kΩ
Oscillator frequency	Approx. 1,000 kHz
EMC	Per EN 60947-5-2
Ambient conditions and temperature	In accordance with measuring instrument
Installation	Direct in measuring instrument, maximum 2 inductive contacts possible

### Dimensions of the control units for inductive contacts





## Control units for inductive contacts

Ex versions (for connection example, see page 23)

### Control unit, model 904.28 KFA6-SR2-Ex1.W

- For operating one measuring instrument with one inductive contact
- Intrinsically safe control circuit [EEx ia] IIC in accordance with EN 50227 and NAMUR
- 1 relay output with change-over contact
- LED status display for mains (green), relay output (yellow) and line break (red)
- Add-on case form D

#### Note

Direction of action can be set with the slide switch, S1:

Operating current: Switch S1 in position I

Quiescent current: Switch S1 in position II

Line break detection: Switch S3 in position I

### Control unit model 904.29 KFA6-SR2-Ex2.W

- To operate one measuring instrument with two inductive contacts or for two measuring instruments with only one inductive contact
- Intrinsically safe control circuit [EEx ia] IIC in accordance with EN 50227 and NAMUR
- 2 relay outputs with 1 change-over contact each
- LED status display for mains (green), 2 x relay output (yellow) and 2 x line break (red)
- Add-on case, form F

#### Note

Direction of action can be set with the slide switches, S1 & S2:

Operating current: Switch S1 and S2 in position I

Quiescent current: Switch S1 and S2 in position II

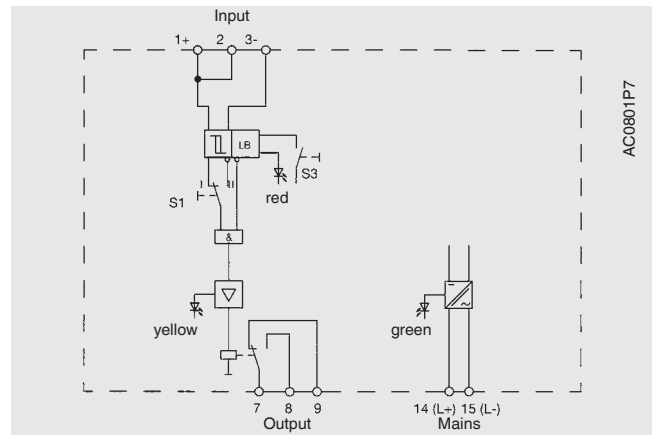
Line break detection: Switch S3 in position I

### Fail-safe control unit

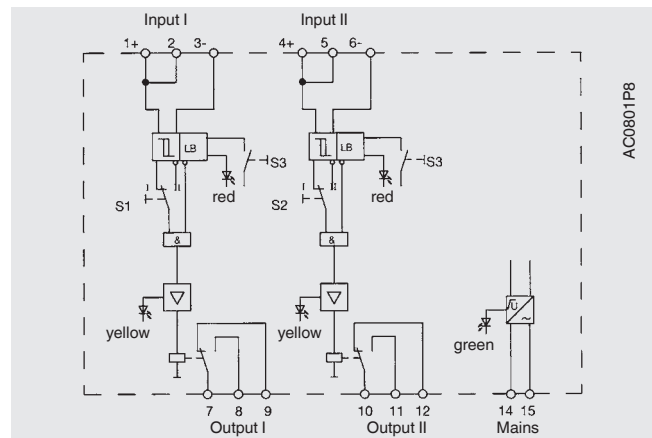
For safety-relevant circuits, type-tested parts are mandatory. Such approvals are provided by the **SN or S1N safety inductive contacts** (see page 13). If these inductive contacts are operated **together** with the **model 904.30 fail-safe control unit**, this arrangement corresponds to the TÜV safety requirements for important circuits and is self-monitoring. If an error occurs (mechanical damage, power failure, component failure, short circuit, line break) within the circuit, the safe state is always established at the output.

### Model 904.30 KHA6-SH-Ex1

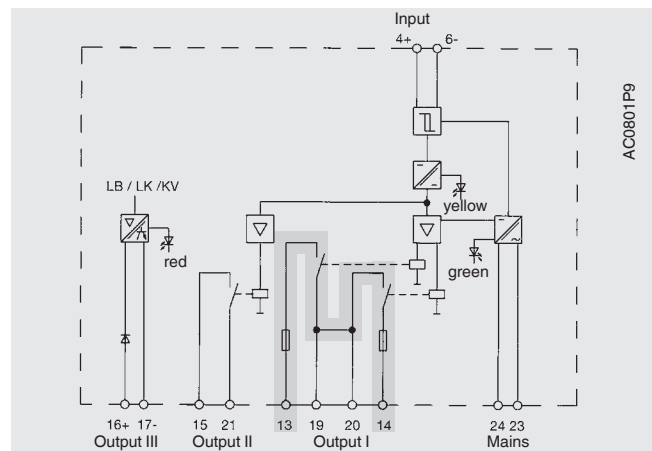
- Fail-safe control unit
- For operating one measuring instrument with one SN or S1N fail-safe inductive contact
- Control circuit intrinsically safe [EEx ia] IIC
- 1 safety-related relay output, 1 incrementing output and 1 passive electronic output



AC0801P7



AC0801P8



AC0801P9

- LED status display for mains (green), relay output (yellow) and line-break and short circuit (red)
- Add-on case form E

Specifications of the control units	Model 904.28 KFA6-SR2-Ex1.W	Model 904.29 KFA6-SR2-Ex2.W	Model 904.30 fail-safe KHA6-SH-Ex1
<b>Supply</b>			
Power supply	AC 230 V ± 0 %, 45 ... 65 Hz	AC 230 V ± 0 %, 45 ... 65 Hz	AC 85 ... 253 V, 45 ... 65 Hz
Power consumption	1 VA	1.3 VA	3 VA
<b>Input</b>			
Quantity	1	2	1
Open-circuit voltage	DC 8 V	DC 8 V	DC 8.4 V
Short-circuit current	8 mA	8 mA	11.7 mA
Switch point	$1.2 \text{ mA} \leq I_s \leq 2.1 \text{ mA}$	$1.2 \text{ mA} \leq I_s \leq 2.1 \text{ mA}$	$2.1 \text{ mA} \leq I_s \leq 5.9 \text{ mA}$
Switch hysteresis	approx. 0.2 mA	approx. 0.2 mA	
Control line resistance	100 Ohm	100 Ohm	50 Ohm
Voltage	$U_0 \leq \text{DC } 10,6 \text{ V}$	$U_0 \leq \text{DC } 10,6 \text{ V}$	$U_0 \leq \text{DC } 59,56 \text{ V}$
Current	$I_0 \leq 19,1 \text{ mA}$	$I_0 \leq 19,1 \text{ mA}$	$I_0 \leq 16,8 \text{ mA}$
Power	$P_0 \leq 51 \text{ mW}$	$P_0 \leq 51 \text{ mW}$	$P_0 \leq 41 \text{ mW}$
Ignition protection type	[EEEx ia] IIC	[EEEx ia] IIC	[EEEx ia] IIC
Perm. external capacitance	2.9 µF	2.9 µF	650 nF
Perm. external inductance	100 mH	100 mH	5 mH
<b>Output</b>			
Relay outputs	1 change-over contact	1 change-over contact each	1 safety-related relay output
Load capacity AC	253 V, 2 A, 500 VA, $\cos \varphi > 0.7$	253 V, 2 A, 500 VA, $\cos \varphi > 0.7$	250 V, 1 A, $\cos \varphi > 0.7$
Load capacity DC	40 V, 2 A; resistive load	40 V, 2 A; resistive load	24 V, 1 A; resistive load
Rise delay	approx. 20 ms	approx. 20 ms	20 ms
Fall delay	approx. 20 ms	approx. 20 ms	20 ms
Max. switching frequency	10 Hz	10 Hz	5 Hz
<b>Ambient conditions</b>			
Lower limit temperature	-20 °C	-20 °C	-20 °C
Upper limit temperature	+60 °C	+60 °C	+60 °C
Perm. relative humidity	max. 75%	max. 75%	max. 75%
Ingress protection per IEC/EN 60529	IP20	IP20	IP20
<b>Case</b>			
Form	Add-on case	Add-on case	Add-on case
Dimensions in accordance with the drawing	Form D, page 15	Form F, page 15	Form E, page 15
Mounting	on standard rail 35 x 7.5 mm (DIN EN 50022) or screw fixing		
Weight	approx. 0.15 kg	approx. 0.15 kg	approx. 0.28 kg
Order number	<b>2014505</b>	<b>2014521</b>	<b>2014548</b>

Further control units are available for operation with a voltage supply of DC 20 ... 30 V:

- Model 904.31 (KFD2-SR2- Ex1.W) - 1 relay output  
Order number: 2114003
- Model 904.32 (KFD2-SR2- Ex2.W) - 2 relay outputs  
Order number: 2143569
- Model 904.33 (KFD2-SH- Ex1) - 1 safety-related relay output (DC 20 ... 35 V)  
Order number: 2307618

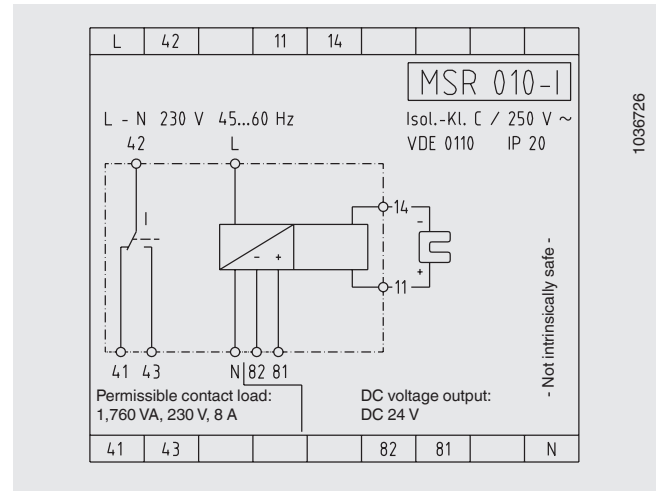
## Control units for inductive contacts

### Non-Ex versions

(for connection example, see page 23)

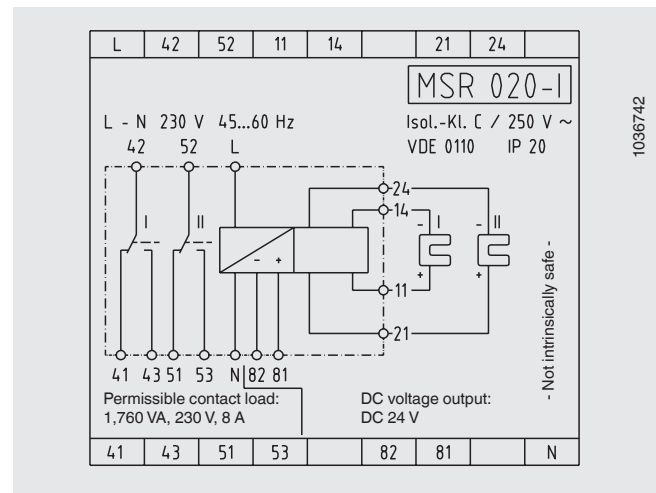
#### Control unit model 904.25 MSR 010-I

- For operating one measuring instrument with one inductive contact
- 1 relay output with 1 change-over contact
- Add-on case form C



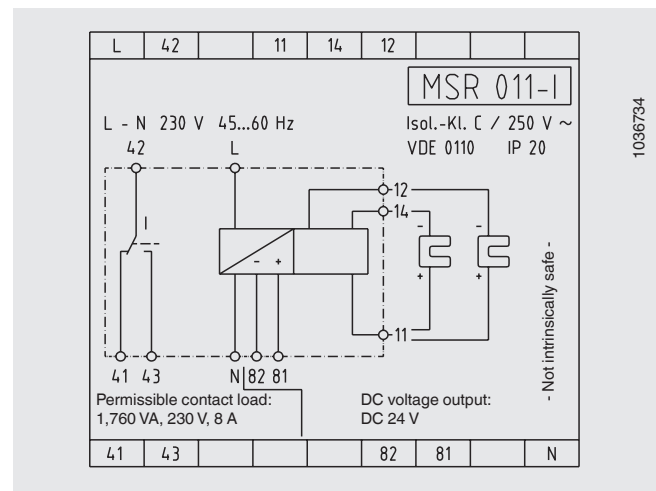
#### Control unit model 904.26 MSR 020-I

- To operate one measuring instrument with two inductive contacts or for two measuring instruments with only one inductive contact
- 2 relay outputs with 1 change-over contact each
- Add-on case form C



#### Control unit model 904.27 MSR 011-I

- For two-point control (interval switching in conjunction with model 831.12 inductive contacts)
- 1 relay output with 1 change-over contact
- Add-on case form C



Specifications of the control units	Model 904.25 MSR 010-I	Model 904.26 MSR 020-I	Model 904.27 MSR 011-I
<b>Supply</b>			
Power supply	AC 230 V -10 % / +6 %, 45 ... 60 Hz		
Power consumption	approx. 2.5 VA		
<b>Input</b>			
Quantity	1	2	2
Control voltage	DC 8.5 V (typical)		
Short-circuit current	$I_k$ approx. 5 mA		
Switch point	1.5 mA typical		
Switch hysteresis	approx. 0.2 mA		
<b>Output</b>			
Relay outputs	1 change-over contact	1 change-over contact each	2 change-over contacts
Load capacity	AC 230 V / 8 A / 1,760 VA		
Rise delay	approx. 10 ms		
Fall delay	approx. 10 ms		
Voltage output	DC 24 V max. 20 mA		
<b>Ambient conditions</b>			
Lower limit temperature	0 °C		
Upper limit temperature	+70 °C		
Perm. relative humidity	max. 75 %		
Ingress protection per IEC/EN 60529	Case: IP40 / terminals: IP20		
<b>Case</b>			
Dimensions in accordance with the drawing	Form C, page 15		
Material	Polyamide 6.6, colour green		
Mounting	on standard rail 35 x 7.5 mm (DIN EN 50022) or individual mounting with accompanying adapter		
Weight	approx. 0.24 kg	approx. 0.27 kg	approx. 0.24 kg

## Mounting possibilities for switch contacts in pressure gauges

Number of possible contacts in connection with the full scale value (= scale range)

Model	NS	Electrical connection	Magnetic snap-action contact model 821				Inductive contact model 831 Electronic contact model 830 E 1)			
			Number of contacts				Number of contacts			
			1	2	3	4 2)	1	2	3 3)	4
			Full scale value in bar				Full scale value in bar			
212.20	100, 160	A	1	1.6	4	4	1	1.6	1.6	-
232.50	100, 160	A	1	1.6	2.5	2.5	0.6	1	1.6	-
233.50	100, 160	A	1	1.6	2.5	2.5	0.6	1	1.6	-
232.30, 233.30	100	A	1	1.6	4	4	1	1.6	1.6	-
232.30, 233.30	160	B	1	1.6	2.5	2.5	0.6	1	1.6	-
232.36	100	A	1	1.6	4	4	1	1.6	1.6	-
312.20	160	A	1 5)	1 5)	1.6 5)	1.6 5)	1	1	1.6	-
332.30	160	B	1 5)	1 5)	1.6 5)	1.6 5)	1	1	1.6	-
333.30	160	B	-	-	-	-	1	1	1.6	-
4x2.12	100, 160	A	0.025	0.025	0.025	0.025	0.025	0.025	0.025	-
4x3.12	100, 160	A	0.025	0.025	0.025	0.025	0.025	0.025	0.025	-
422.20 4)	100, 160	A	0.025	0.025	0.04	0.04	0.025	0.025	0.025	-
423.20 4)	100, 160	A	0.025	0.025	0.04	0.04	0.025	0.025	0.025	-
4x2.30 4)	100	A	0.025	0.025	0.04	0.04	0.025	0.025	0.025	-
4x2.30 4)	160	B	0.025	0.025	0.04	0.04	0.025	0.025	0.025	-
4x3.30 4)	100	A	0.025	0.025	0.04	0.04	0.025	0.025	0.025	-
4x3.30 4)	160	B	0.025	0.025	0.04	0.04	0.025	0.025	0.025	-
4x2.50 4)	100, 160	A	0.025	0.025	0.04	0.04	0.025	0.025	0.025	-
4x3.50 4)	100, 160	A	0.025	0.025	0.04	0.04	0.025	0.025	0.025	-
432.36 4)	100	A	0.025	0.025	0.04	0.04	0.025	0.025	0.025	-
432.36 4)	160	B	0.025	0.025	0.04	0.04	0.025	0.025	0.025	-
433.36 4)	100	A	0.025	0.025	0.04	0.04	0.025	0.025	0.025	-
433.36 4)	160	B	0.025	0.025	0.04	0.04	0.025	0.025	0.025	-
432.56 4)	100, 160	A	0.025	0.025	0.04	0.04	0.025	0.025	0.025	-
433.56 4)	100, 160	A	0.025	0.025	0.04	0.04	0.025	0.025	0.025	-
532.52	100, 160	A	0.04	0.04	0.04	0.04	0.04	0.04	0.04	-
532.53	100, 160	A	0.04	0.04	0.04	0.04	0.04	0.04	0.04	-
532.54	100, 160	A	0.025	0.025	0.04	0.04	0.025	0.025	0.025	-
6xx.50	100	A	-	-	-	-	0.1	0.1	-	-
632.51	100, 160	A	0.0025	0.0025	-	-	0.0025	0.0025	0.0025	-
711.12	100, 160	A	1	1.6	4	-	1	1	-	-
732.02	100	A	1	1.6	4	-	1	1	-	-
732.14	100, 160	A	0.06	0.06	0.1	0.1	0.06	0.06	0.1	-
733.14	100, 160	A	0.06	0.06	0.1	0.1	0.06	0.06	0.1	-
732.51 4)	100, 160	A	0.025	0.025	0.04	0.04	0.025	0.025	0.025	-
736.51	100, 160	A	0.0025 6)	0.0025 6)	-	-	0.0025	0.0025	0.0025	-

1) Electronic contact model 830 E only 1 or 2 contacts

2) The setting of all four contacts to a single set point is not possible in the standard version.  
Either the left (= no. 1 contact) or the right contact (= no. 4 contact) must be separated by approx. 30° (for NS 100 instruments) and by approx. 15° (for NS 160 instruments) to the left or the right of the three other set pointers (which may be set to the same value). If the setting of all four contacts to a single set point is absolutely needed, then this is possible with NS 160 as a special case (using a smaller control head) and must be specified on ordering.

3) With circular instruments, the setting of all three contacts to a single set point is not possible in the standard design. Either the left (= no. 1 contact) or the right contact (= no. 3 contact) must be separated by approx. 30° to the left or the right of the two set pointers (which may be set to the same value). If the setting of all three contacts to a single set point is absolutely needed, then this is possible with NS 160 as a special case (using a smaller control head) and must be specified on ordering. See also page 13.

4) Scale range 0 ... 0.025 bar: Class 2.5

5) Without magnet

6) With flammable, explosive gases, after feasibility test

## Mounting possibilities for switch contacts in temperature measuring instruments

Temperature measuring instrument		Electrical connection	Magnetic snap-action contact Model 821			Sliding contact <sup>1)</sup> Model 811			Inductive contact model 831 Electronic contact model 830 E <sup>2)</sup>		
Model series	NS		Number of contacts			Number of contacts			Number of contacts		
			1	2	3	1	2	3	1	2	3
55	100	A	on request			x	x	-	x	x	-
55	160	B	on request			x	x	-	x	x	-
73	100	E	x	x	x	x	x	x	x	x	-
73	160	E	x	x	x	x	x	x	x	x	x

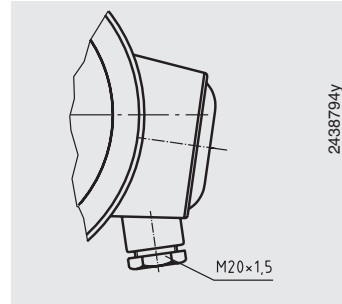
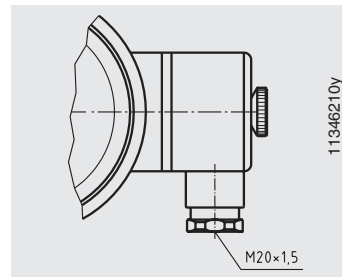
1) Not with liquid-damped instruments

2) Electronic contact model 830 E only 1 or 2 contacts

### Electrical standard connections

For instruments with switch contacts and a max. of 2 contacts, as seen from the front:

- A Cable terminal box from PA 6, black, ingress protection IP65, temperature resistance -40 ... +80 °C, per VDE 0110, Isolation group C/250 V, M20 x 1.5 cable gland (facing downwards), strain relief, 6 screw terminals + PE for conductor cross-section 2.5 mm<sup>2</sup>, fitted on the right-hand side of the case
- B Cable terminal box from PA 6, black, ingress protection IP65, temperature resistance -40 ... +80 °C, per VDE 0110, Isolation group C/250 V, M20 x 1.5 cable gland (facing downwards), strain relief, 4 mantle terminals + PE for conductor cross-section 2.5 mm<sup>2</sup>, fitted on the right-hand side of the case
- C Terminal block (Luster terminals), for conductor cross-section 2.5 mm<sup>2</sup>, mounted on the rear of the case
- D Rack-mounting terminals DIN 41611 in accordance with VDE 0110 Isolation group C, for conductor cross-section 2.5 mm<sup>2</sup>, mounted on the rear of the case



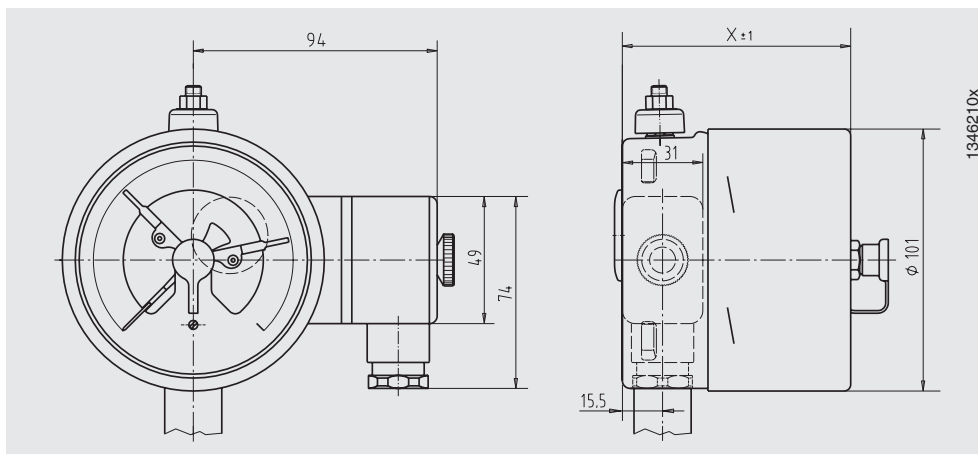
E As with A, but mounted on the left of the case.

For instruments with 3 or more contacts and also for special contacts, electrical connection on request

**Option:** Connectors (e.g. DIN 43650) on request

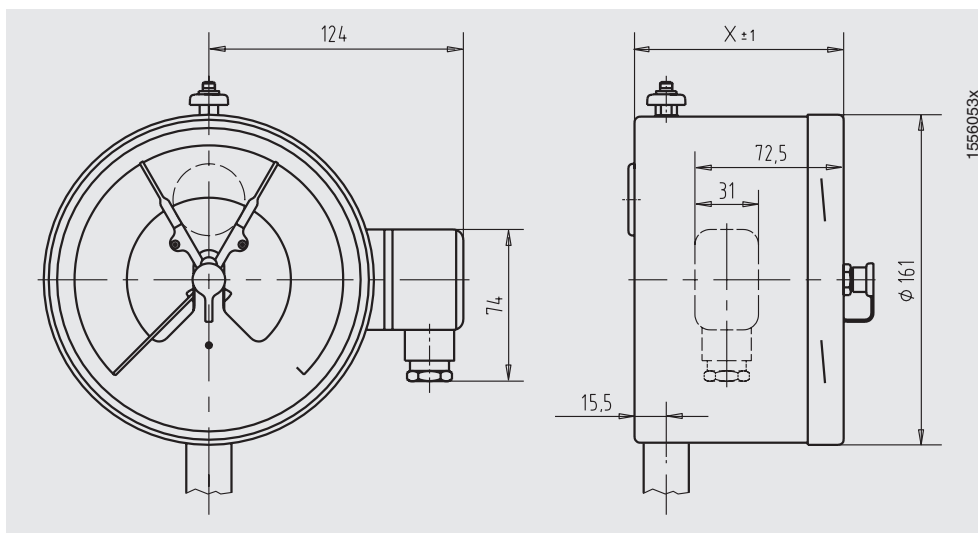
**Dimensions in mm (examples)**

**Contact instrument NS 100**



Type of contact	Dimension X in mm
Single or double contact	88
Double (change-over) contact	113
Triple contact	96
Quadruple contact	113

**Contact instrument NS 160**



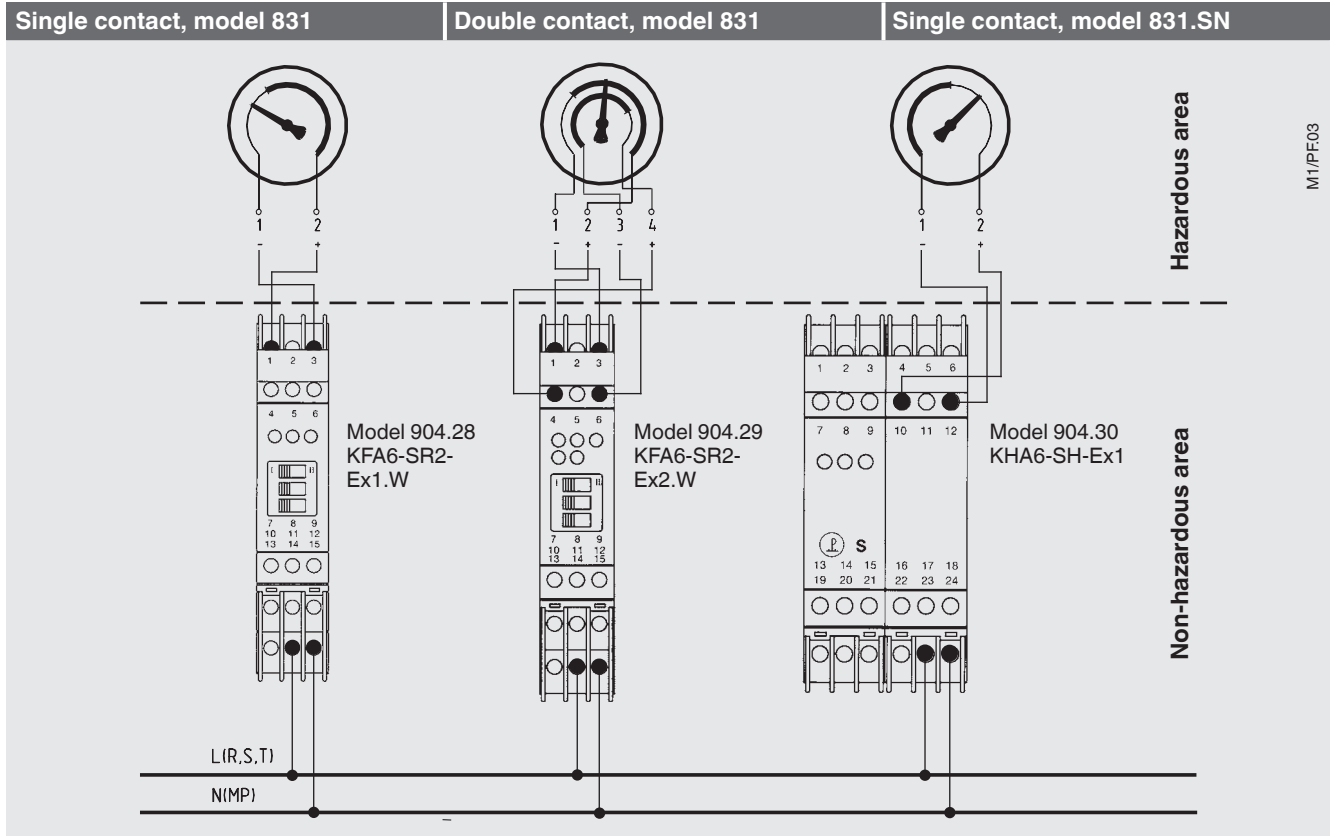
Type of contact	Scale range	Dimension X in mm
Single or double contact	to 0 ... 60 bar <sup>1)</sup>	102
Double contact	≥ 0 ... 100 bar	116
Triple or quadruple contact	to 0 ... 60 bar <sup>1)</sup>	116
	≥ 0 ... 100 bar	129.5

1) As well as with mechanical temperature measuring instruments.

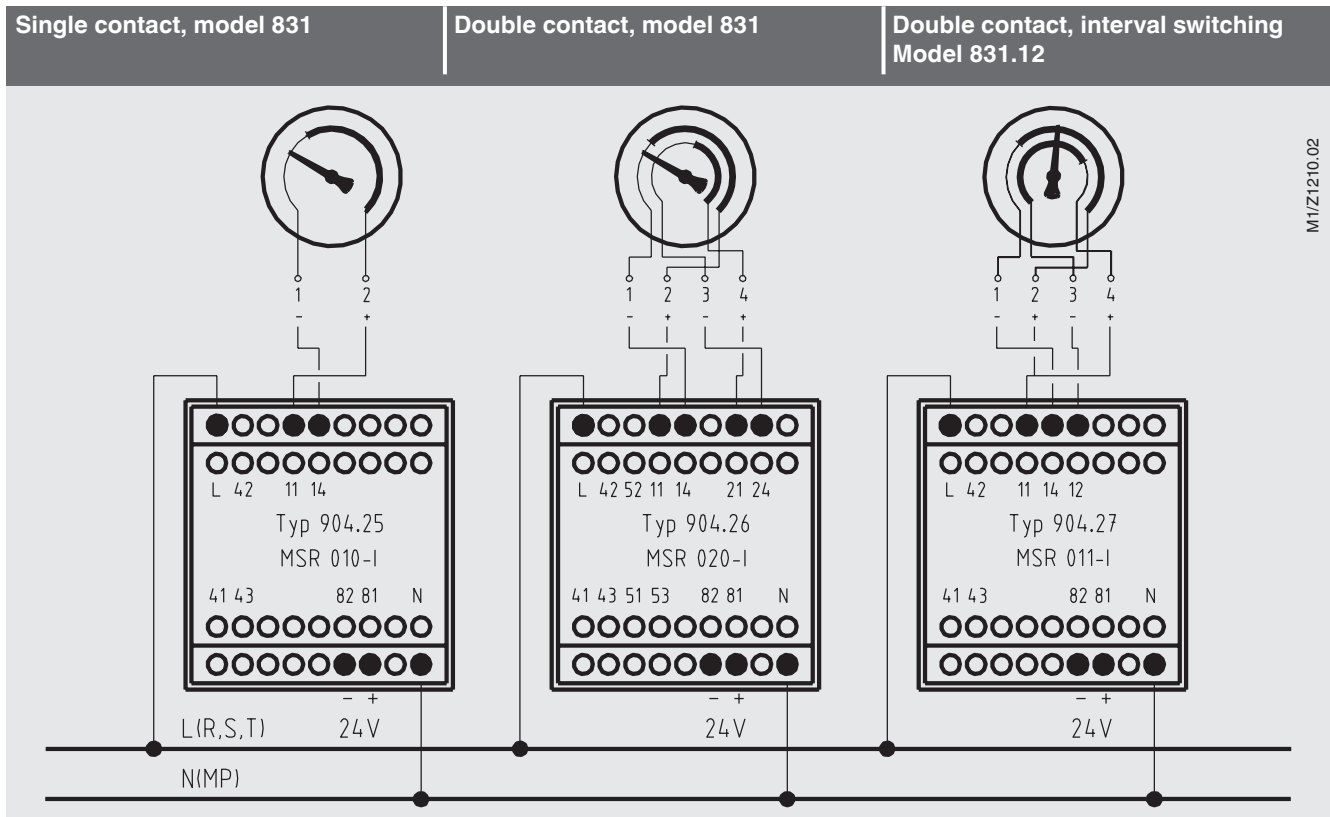


**Connection examples for inductive contacts**

Ex version, with model 904.28/29/30 control units, K\*A6-SR2(SH)-Ex



**Non-Ex version, with model 904.2x control units**



**OBSOLETE**

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**WIKAL Alexander Wiegand SE & Co. KG**

Alexander-Wiegand-Straße 30

63911 Klingenberg/Germany

Tel. +49 9372 132-0

Fax +49 9372 132-406

info@wika.de

www.wika.de