

Series 92

Characteristics

The Series 92 with its short stroke pushbuttons, making it especially suited for:

- PCB mounting

This series can be used to replace a membrane keypad if only a few buttons are needed.

Functions

The Series 92 incorporates the following functions:

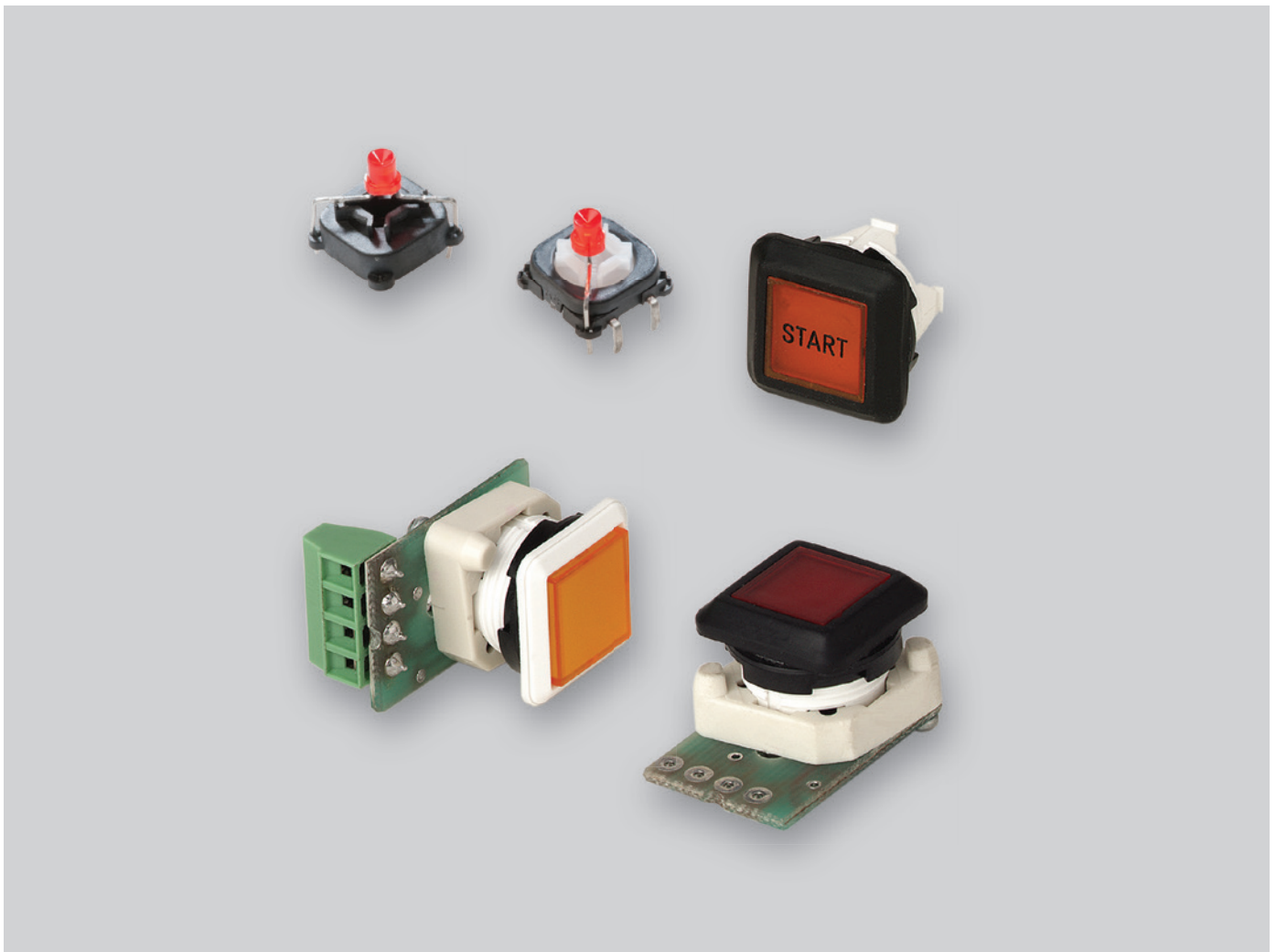
- Indicator
- Pushbutton
- Illuminated pushbutton

Market segments

The EAO Series 92 is especially suited for applications in the segments:

- Machinery and Automation
- Medicinal technology
- Laboratory and measuring equipment

Please refer to the EAO website to obtain detailed information regarding this series www.products.eao.com
Configure a product to your exact needs and request a quotation.



Overview**PCB pushbuttons**

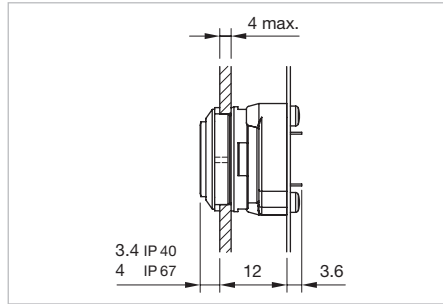
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Illuminated pushbutton	7
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Indicator



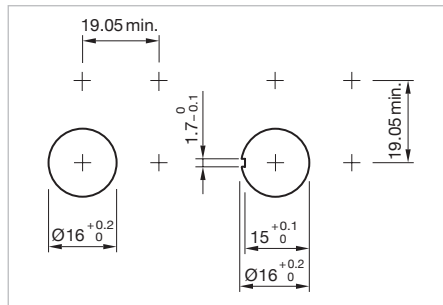
Product can differ from the current configuration.



Dimensions

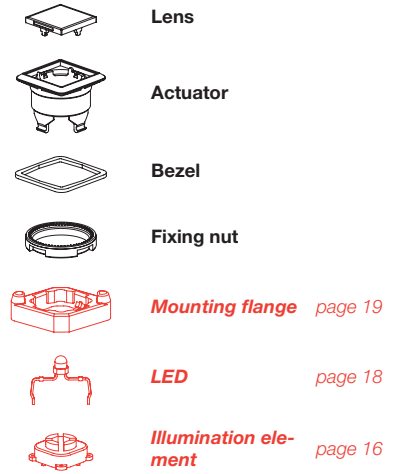
Additional Information

- Transparent lens and pressure plate
- IP 67 version without bezel





Mounting cut-outs

Equipment consisting of (schematic overview)



Each Part Number listed below includes all the black components shown in the 3D-drawing.

To obtain a complete unit, please select the red components from the pages shown.

Front protection	Front	Pressure plate	Lens	Part No.	Weight	
 <p>Indicator actuator, Front dimension 18.8 x 18.8 mm</p>						
IP 67	Plastic white	Plastic red		92-043.200	0.003 kg	
		Plastic orange		92-043.300	0.003 kg	
		Plastic yellow		92-043.400	0.003 kg	
		Plastic green		92-043.500	0.003 kg	
		Plastic blue		92-043.600	0.003 kg	
		Plastic colourless		92-043.700	0.003 kg	
		Plastic black	Plastic red		92-143.200	0.003 kg
	Plastic orange			92-143.300	0.003 kg	
	Plastic yellow			92-143.400	0.003 kg	
	Plastic green			92-143.500	0.003 kg	
	Plastic blue			92-143.600	0.003 kg	
	Plastic colourless			92-143.700	0.003 kg	
	 <p>Indicator actuator, Front dimension 18.4 x 18.4 mm</p>					
	IP 40	Plastic white		Plastic smoked	92-058.100	0.003 kg
			Plastic red	92-058.200	0.003 kg	
			Plastic orange	92-058.300	0.003 kg	
			Plastic yellow	92-058.400	0.003 kg	
			Plastic green	92-058.500	0.003 kg	
			Plastic blue	92-058.600	0.003 kg	
			Plastic colourless	92-058.700	0.003 kg	

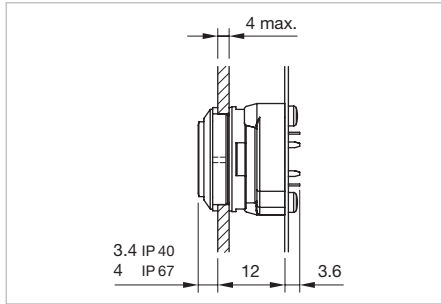
Front protection	Front	Pressure plate	Lens	Part No.	Weight
IP 40	Plastic black		Plastic smoked	92-158.100	0.003 kg
			Plastic red	92-158.200	0.003 kg
			Plastic orange	92-158.300	0.003 kg
			Plastic yellow	92-158.400	0.003 kg
			Plastic green	92-158.500	0.003 kg
			Plastic blue	92-158.600	0.003 kg
			Plastic colourless	92-158.700	0.003 kg

92 PCB pushbuttons

Pushbutton

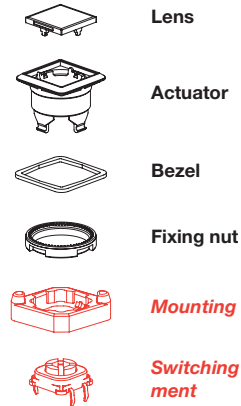


Product can differ from the current configuration.



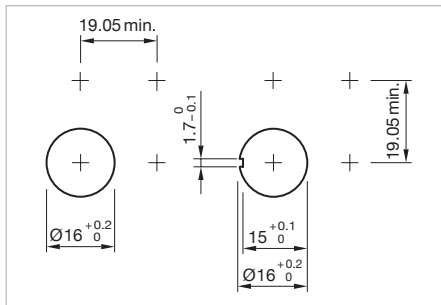
Dimensions

Equipment consisting of (schematic overview)



Additional Information



- Lens opaque
- IP 67 version without bezel



Mounting cut-outs

Each Part Number listed below includes all the black components shown in the 3D-drawing.

To obtain a complete unit, please select the red components from the pages shown.

Front protection	Front	Pressure plate	Lens	Switching action	Part No.	Wiring diagram	Weight
 <p>Pushbutton actuator, Front dimension 18.8 x 18.8 mm</p>							
IP 67	Plastic white	Plastic black		B	92-341.000	1	0.002 kg
		Plastic grey		B	92-341.800	1	0.002 kg
	Plastic black	Plastic black		B	92-441.000	1	0.002 kg
		Plastic grey		B	92-441.800	1	0.002 kg
 <p>Pushbutton actuator, Front dimension 18.4 x 18.4 mm</p>							
IP 40	Plastic white		Plastic black	B	92-356.000	1	0.002 kg
			Plastic grey	B	92-356.800	1	0.002 kg
			Plastic white	B	92-356.900	1	0.002 kg
	Plastic black		Plastic black	B	92-456.000	1	0.002 kg
			Plastic grey	B	92-456.800	1	0.002 kg
			Plastic white	B	92-456.900	1	0.002 kg





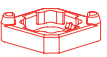


Switching action: B = Momentary



Wiring diagram 1

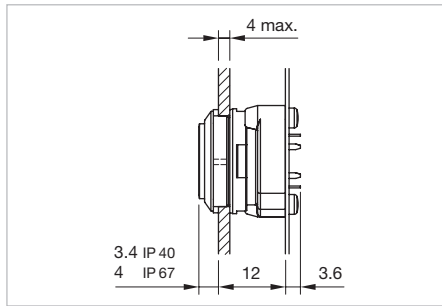
Illuminated pushbutton

Equipment consisting of (schematic overview)

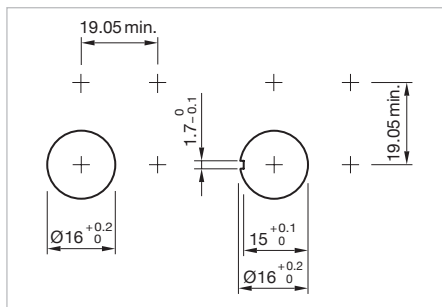
-  **Lens**
-  **Actuator**
-  **Bezel**
-  **Fixing nut**
-  **Mounting flange** *page 19*
-  **LED** *page 18*
-  **Switching element** *page 16*

Each Part Number listed below includes all the black components shown in the 3D-drawing.

To obtain a complete unit, please select the red components from the pages shown.



Dimensions





Mounting cut-outs



Product can differ from the current configuration.

Additional Information

- Transparent lens and pressure plate
- IP 67 version without bezel

Front protection	Front	Pressure plate	Lens	Switching action	Part No.	Wiring diagram	Weight
 <p>Illuminated pushbutton actuator, Front dimension 18.8 x 18.8 mm</p>							
IP 67	Plastic white	Plastic red		B	92-343.200	1	0.003 kg
		Plastic orange		B	92-343.300	1	0.003 kg
		Plastic yellow		B	92-343.400	1	0.003 kg
		Plastic green		B	92-343.500	1	0.003 kg
		Plastic blue		B	92-343.600	1	0.003 kg
		Plastic colourless		B	92-343.700	1	0.003 kg
	Plastic black	Plastic red		B	92-443.200	1	0.003 kg
		Plastic orange		B	92-443.300	1	0.003 kg
		Plastic yellow		B	92-443.400	1	0.003 kg
		Plastic green		B	92-443.500	1	0.003 kg
		Plastic blue		B	92-443.600	1	0.003 kg
		Plastic colourless		B	92-443.700	1	0.003 kg
	 <p>Illuminated pushbutton actuator, Front dimension 18.4 x 18.4 mm</p>						
IP 40	Plastic white		Plastic smoked	B	92-358.100	1	0.003 kg
			Plastic red	B	92-358.200	1	0.003 kg
			Plastic orange	B	92-358.300	1	0.003 kg
			Plastic yellow	B	92-358.400	1	0.003 kg
			Plastic green	B	92-358.500	1	0.003 kg
			Plastic blue	B	92-358.600	1	0.003 kg
			Plastic colourless	B	92-358.700	1	0.003 kg

92 PCB pushbuttons








Front protection	Front	Pressure plate	Lens	Switching action	Part No.	Wiring diagram	Weight
IP 40	Plastic black		Plastic smoked	B	92-458.100	1	0.003 kg
			Plastic red	B	92-458.200	1	0.003 kg
			Plastic orange	B	92-458.300	1	0.003 kg
			Plastic yellow	B	92-458.400	1	0.003 kg
			Plastic green	B	92-458.500	1	0.003 kg
			Plastic blue	B	92-458.600	1	0.003 kg
			Plastic colourless	B	92-458.700	1	0.003 kg

Switching action: B = Momentary



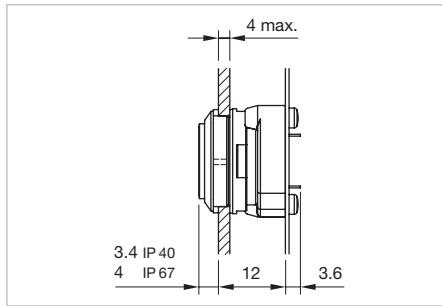
Indicator actuator IP 67

Equipment consisting of (schematic overview)

-  **Pressure plate** *page 14*
-  **Front bezel**
-  **Actuator**
-  **Fixing nut**
-  **Mounting flange** *page 19*
-  **LED** *page 18*
-  **Illumination element** *page 16*

Each Part Number listed below includes all the black components shown in the 3D-drawing.

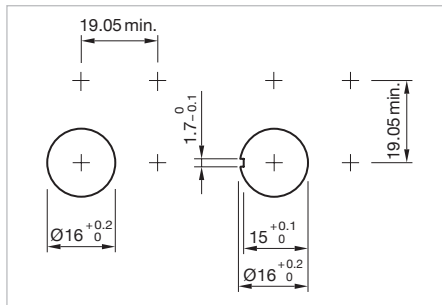
To obtain a complete unit, please select the red components from the pages shown.




Dimensions



Product can differ from the current configuration.



Mounting cut-outs

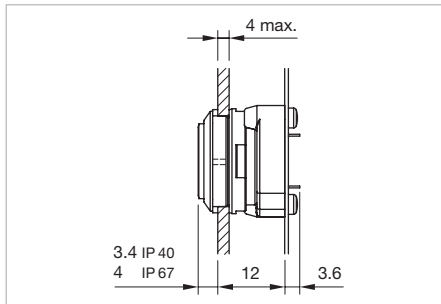
Front	Part No.	Weight
 <p>Indicator actuator IP 67, Front dimension 18.8 x 18.8 mm</p>		
Plastic black	92-140.000	0.003 kg

92 PCB pushbuttons

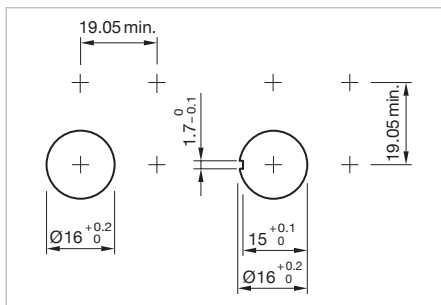
Pushbutton actuator IP 40



Product can differ from the current configuration.









Dimensions




Mounting cut-outs

Equipment consisting of (schematic overview)

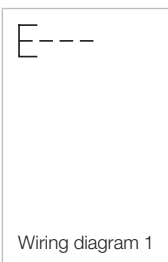
-  **Lens** page 14
-  **Actuator**
-  **Bezel** page 15
-  **Fixing nut**
-  **Mounting flange** page 19
-  **Switching element** page 16

Each Part Number listed below includes all the black components shown in the 3D-drawing.

To obtain a complete unit, please select the red components from the pages shown.







Front	Switching action	Part No.	Wiring diagram	Weight
 Pushbutton actuator IP 40, Front dimension 18.4 x 18.4 mm				
Plastic white	B	92-350.000	1	0.003 kg
Plastic black	B	92-450.000	1	0.003 kg

Switching action: B = Momentary



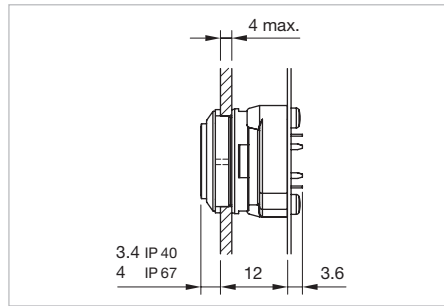
Pushbutton actuator IP 67

Equipment consisting of (schematic overview)

-  **Pressure plate** *page 14*
-  **Front bezel**
-  **Actuator**
-  **Fixing nut**
-  **Mounting flange** *page 19*
-  **Switching element** *page 16*

Each Part Number listed below includes all the black components shown in the 3D-drawing.

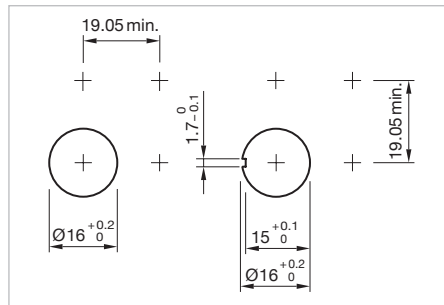
To obtain a complete unit, please select the red components from the pages shown.




Dimensions



Product can differ from the current configuration.



Mounting cut-outs

Front	Switching action	Part No.	Wiring diagram	Weight
				
Pushbutton actuator IP 67, square 18.8 x 18.8 mm				
Plastic white	B	92-340.000	1	0.003 kg
Plastic black	B	92-440.000	1	0.003 kg

Switching action: B = Momentary

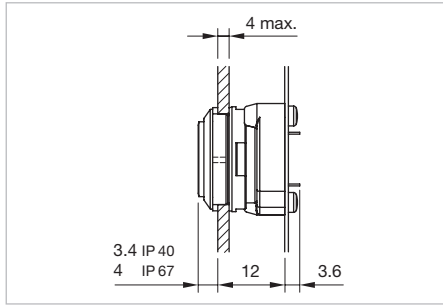


92 PCB pushbuttons

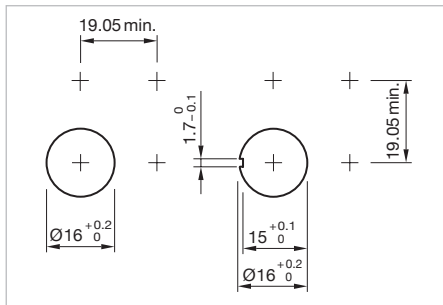
Illuminated pushbutton actuator IP 40



Product can differ from the current configuration.










Dimensions




Mounting cut-outs

Equipment consisting of (schematic overview)

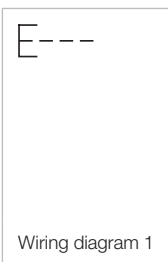
-  **Lens** page 14
-  **Actuator**
-  **Bezel** page 15
-  **Fixing nut**
-  **Mounting flange** page 19
-  **LED** page 18
-  **Switching element** page 16

Each Part Number listed below includes all the black components shown in the 3D-drawing.

To obtain a complete unit, please select the red components from the pages shown.








Front	Switching action	Part No.	Wiring diagram	Weight
 Illuminated pushbutton actuator IP 40, Front dimension 18.4 x 18.4 mm				
Plastic white	B	92-350.000	1	0.003 kg
Plastic black	B	92-450.000	1	0.003 kg

Switching action: B = Momentary



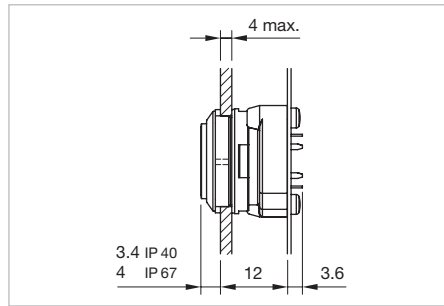
Illuminated pushbutton actuator IP 67

Equipment consisting of (schematic overview)

-  **Pressure plate** *page 14*
-  **Front bezel**
-  **Actuator**
-  **Fixing nut**
-  **Mounting flange** *page 19*
-  **LED** *page 18*
-  **Switching element** *page 16*

Each Part Number listed below includes all the black components shown in the 3D-drawing.

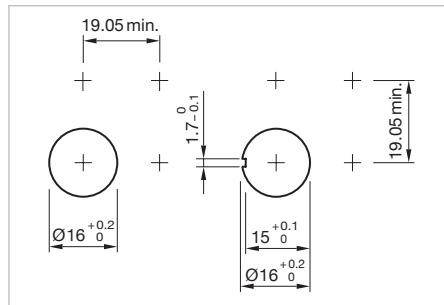
To obtain a complete unit, please select the red components from the pages shown.




Dimensions



Product can differ from the current configuration.



Mounting cut-outs

Front	Switching action	Part No.	Wiring diagram	Weight
				
Illuminated pushbutton actuator IP 40, square 18.8 x 18.8 mm				
Plastic white	B	92-340.000	1	0.003 kg
Plastic black	B	92-440.000	1	0.003 kg

Switching action: B = Momentary




Front

Lens plate IP 67

Additional Information


- Material plastic

Product attribute	Dimension	Pressure plate	Part No.	Weight
 <p>Lens plate for pushbutton and indicator IP 67</p>				
non-illuminative	12 x 12 mm	black opaque	92-941.000	0.001 kg
		grey opaque	92-941.800	0.001 kg
illuminative	12 x 12 mm	red transparent	92-941.200	0.001 kg
		orange transparent	92-941.300	0.001 kg
		yellow transparent	92-941.400	0.001 kg
		green transparent	92-941.500	0.001 kg
		blue transparent	92-941.600	0.001 kg
		colourless transparent	92-941.700	0.001 kg


Lens IP 40

Additional Information

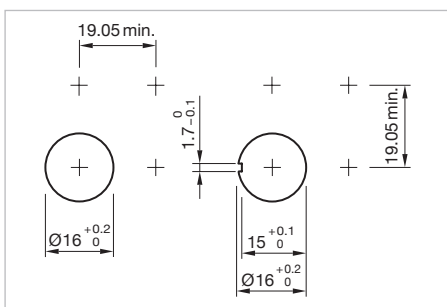
- Material plastic
- With white marking plate

Product attribute	Dimension	Lens	Part No.	Weight
 <p>Lens for pushbutton and indicator IP 40</p>				
non-illuminative	13.2 x 13.2 mm	black opaque	92-956.000	0.001 kg
		grey opaque	92-956.800	0.001 kg
		white opaque	92-956.900	0.001 kg
illuminative	13.2 x 13.2 mm	red translucent	92-956.200	0.001 kg
		orange translucent	92-956.300	0.001 kg
		yellow translucent	92-956.400	0.001 kg
		green translucent	92-956.500	0.001 kg
		blue translucent	92-956.600	0.001 kg
		smoked transparent	92-958.100	0.001 kg
		red transparent	92-958.200	0.001 kg
		orange transparent	92-958.300	0.001 kg
		yellow transparent	92-958.400	0.001 kg
		green transparent	92-958.500	0.001 kg
		blue transparent	92-958.600	0.001 kg
		colourless transparent	92-958.700	0.001 kg


Bezel IP 40

Material	Colour	Part No.	Weight
 <p>Front bezel for pushbutton and indicator IP 40</p>	black	92-912.0	0.001 kg
	white	92-912.9	0.001 kg

Blind plug



Mounting cut-outs

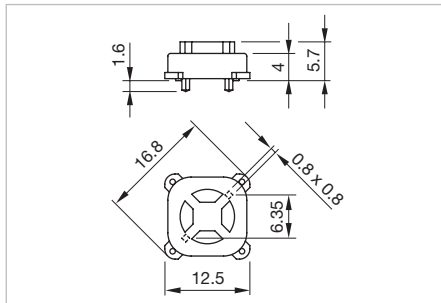
Dimension	Material	Colour	Part No.	Weight
 <p>Blind plug</p>	Plastic	black	51-948.0	0.003 kg
18 x 18 mm				

Rear side


Illumination element PCB

Additional Information

- The customer has to decide what series resistor shall be used to the LED



Dimensions

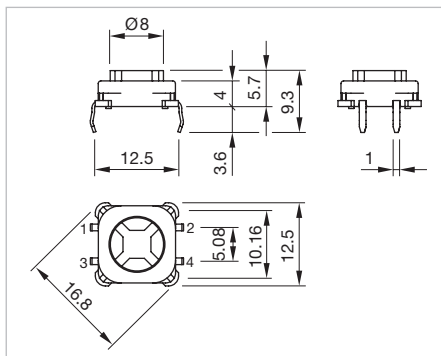
Terminal	Part No.	Component layout	Weight
 <p>Illumination element PCB mounting</p>			
PCB	92-800.042	1	0.001 kg

The component layouts you will find from page { $\$$ |-BR92_KAZE_Zeichnung}


Switching element PCB illuminative

Additional Information

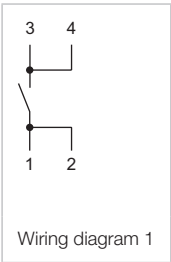
- The customer has to decide what series resistor shall be used to the LED



Dimensions


Contacts	Terminal	Part No.	Component layout	Wiring diagram	Weight
 <p>Switching element PCB mounting illuminative</p>					
1 NO	PCB	92-851.342	2	1	0.001 kg

The component layouts you will find from page { $\$$ |-BR92_KAZE_Zeichnung}




Spacer

- Additional Information**
- Adjustable for front plate thickness of 2/2.5/3/3.5/4 mm
 - When fitting, ensure that back of panel is free of grease and dirt

Part No.	Weight
 <p>Spacer</p>	
92-965.0	0.003 kg

PCB assembled

- Additional Information**
- For discrete switching applications including switching element and mounting flange, soldering terminal (assembled PCB incl. series resistor and LED on request)


Part No.	Weight
 <p>PCB assembled</p>	
92-981.0	0.003 kg

Illumination

Single-LED, T1 Bi-Pin

Additional Information

- The customer has to decide what series resistor shall be used to the LED
- Luminosity and wave length scattering caused by LED manufacturing processes may cause slight variations in the illumination

LED colour	Forward voltage typ.	Lumi. intensity	Dom. wavelength	Part No.	Weight
 <p>Single-LED</p>					
Single-LED red	2.1 VDC @ 20 mA	200 mcd	625 nm	10-2602.3202L	0.001 kg
Single-LED orange	2.1 VDC @ 20 mA	220 mcd	590 nm	10-2602.3203L	0.001 kg
Single-LED yellow	3.3 VDC @ 20 mA	500 mcd	570 nm	10-2602.3204L	0.001 kg
Single-LED green	3.5 VDC @ 20 mA	250 mcd	525 nm	10-2602.3205L	0.001 kg
Single-LED blue	3.5 VDC @ 20 mA	450 mcd	470 nm	10-2602.3206L	0.001 kg
Single-LED white	3.3 VDC @ 20 mA	600 mcd	x=0.29/y=0.31 nm	10-2602.3209L	0.001 kg

Mounting

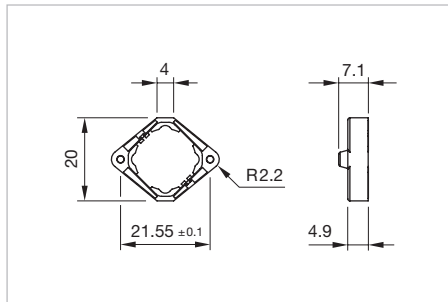
Anti-twist ring

Additional Information


- For front panel thickness max. 2 mm

Mounting cut-out	Part No.	Weight
 <p>Anti-twist ring</p>		
Ø 16 mm	51-910	0.001 kg

Mounting flange




Dimensions

Part No.	Weight
 <p>Mounting flange</p>	
92-960.0	0.001 kg

Lens remover

Additional Information


- For lens IP 40 only

Part No.	Weight
 <p>Lens remover</p>	
18-910	0.002 kg

Mounting tool

Additional Information


- For tightening or loosening of the fixing nut

Part No.	Weight
 Mounting tool	
01-907	0.020 kg

Dismantling tool

Additional Information

- For actuator dismantling of switching element, illumination element and mounting flange

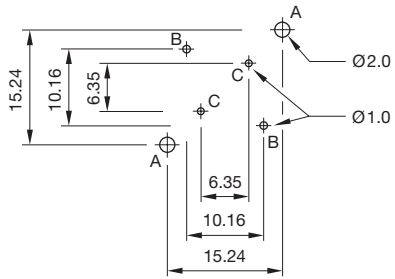
Part No.	Weight
 Dismantling tool	
92-971.0	0.002 kg

Drawings

Single-LED

Drilling plan (element side)

- A Fixing holes for mounting flange (92-960.0)
- B Holes for LED
- C Holes for centering pins

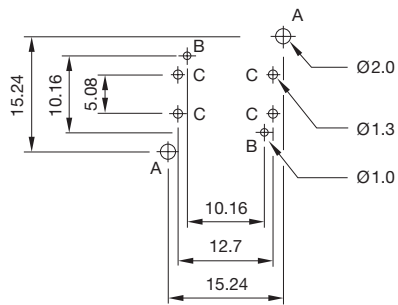


Bauteil layout 1

Single-LED

Drilling plan (element side)

- A Fixing holes for mounting flange (92-960.0)
- B Holes for LED
- C Holes for contact pins
Pad max. Ø 2.5 mm
Through-connection recommended



Bauteil layout 2

Pushbutton and Illuminated pushbutton

Switching system

Short-travel switching system with 2 independent contact points and tactile operation.

Guarantees reliable switching even of very light loads.
Fitted with 1 normally open contact.

Material

Lens

Polycarbonate (PC)

Front bezel

Thermoplastic Elastomer (TPE)

Frame

Thermoplastic Polyester (PBT)

Material of contact

Gold (Au)

Switching element

Thermoplastic Polyester (PET, PBT) and Polyacetale (POM)

Actuator housing

Thermoplastic Polyester (PBT)

Mechanical characteristics

Tightening torque

Fixing screw 40Ncm recommended
Fixing nut max. 50Ncm

Actuating force

2.7 N \pm 1 N measured at the switching element
5 N measured at the lens

Actuating travel

Switching element 0.4 mm

Rebound time

\leq 1 ms

Resistance to heat of soldering

250 °C, 3 s (PCB assembly)
320 °C, 3 s (when using a soldering iron)

Mechanical lifetime

\geq 1 Million operations as per IEC 60512-5-9a

Electrical characteristics

Contact resistance

Starting value (initial) \leq 100 m Ω as per IEC 60512-2-2b

Isolation resistance

\geq 10⁹ Ω between all terminals at 100VDC, as per IEC 60512-2-3a

Electrical life

\geq 500 000 operations at 42VDC, 50 mA as per IEC 60512-5-9c.
When attention is paid to the direction of current flow from terminal 3/4 to 1/2 the electrical life can be prolonged.

Electrostatic discharge (ESD)

15 kV

Switch rating

Switching voltage	min. 50 mV AC/DC max. 42 V AC/DC
Switching current	min. 10 μ A AC/DC max. 100 mA AC/DC
Power rating	max. 2 W

Electric strength

500 VAC, 50 Hz, 1 min, as per IEC 60512-2-4a

Environmental conditions

Storage temperature

-40 °C ... +80 °C

Operating temperature

-25 °C ... +70 °C

Front protection

Switching element IP 40 (fluxproof to DIN 41640 Part 84)
front IP 67 or IP 40

Shock resistance

(semi-sinusoidal)
max. 500 m/s², pulse width 11 ms, 3-axis,
as per EN IEC 60068-2-27

Vibration resistance

(sinusoidal)
max. 100 m/s² at 10 Hz ... 500 Hz, 10 cycles, 3-axis,
as per EN IEC 60068-2-6

Approvals

Declaration of conformity

CE

EAO reserves the right to alter specifications without further notice.

General notes

If desired, the actuators of the series 92 can be supplied ready marked. With your order please enclose a list of the desired markings or a drawing, showing the type or size of script or the symbols desired.

1. Laser engraving (Fig. 1)

In addition to the most commonly used world languages, in DIN1451-3 close spacing, other typefaces are available as Scandinavian, Slavic, Greek, Russian and Polish. Red, blue and black lenses are filled with white colour. Other colour lenses are filled in black. Standard height of letters is 2 mm. If the height is not specified, we will supply 2 mm engraved letters.

2. Hot stamping (Fig. 1)

For larger series it is worth considering markings by means of hot stamping. We will be pleased to advise you. For letters and figures, typefaces with 2.5 mm, 3 mm and 4 mm are available.

3. Film inserts (Fig. 2)

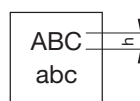
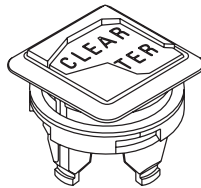
Instead of using engraving, the actuator can be fitted with transparent film inserts. However, for this purpose the use of transparent lens caps is recommended. If smoked lens caps are used the lettering does not become visible until the LED is alight. Max. size of film insert 11.4 x 11.4 mm for IP 40 10.4 x 10.4 mm for IP 67 Film thickness 0.2 mm.

All dimensions in mm

Height of letters h	Number of lines	Number of capital letters per line (target value)	Number of small letters per line (target value)
3	2	5-6	6
4	2	4	4
5	1	3	3-4
6	1	2-3	3
8	1	2	2

Fig. 1

Fig. 2



92 Application guidelines

Suppressor circuits

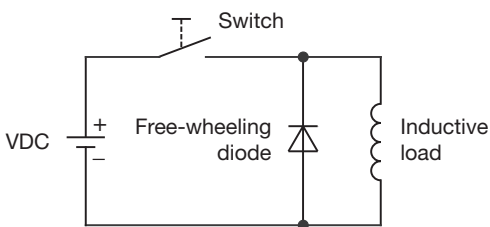
When switching inductive loads such as relays, DC motors, and DC solenoids, it is always important to absorb surges (e.g. with a diode) to protect the contacts. When these inductive loads are switched off, a counter emf can severely damage switch contacts and greatly shorten lifetime.

Fig. 1 shows an inductive load with a free-wheeling diode connected in parallel. This free-wheeling diode provides a path for the inductor current to flow when the current is interrupted by the switch. Without this free-wheeling diode, the voltage across the coil will be limited only by dielectric breakdown voltages of the circuit or parasitic elements of the coil. This voltage can be kilovolts in amplitude even when nominal circuit voltages are low (e.g. 12VDC) see Fig. 2.

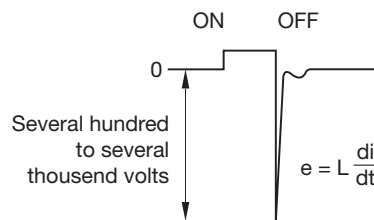
The free-wheeling diode should be chosen so that the reverse breakdown voltage is greater than the voltage driving the inductive load. The DC blocking voltage (VR) of the free-wheeling diode can be found in the datasheet of a diode. The forward current should be equal or greater than the maximum current flowing through the load.

To get an efficient protection, the free-wheeling diode must be connected as close as possible to the inductive load!

Switching with inductive load
Fig. 1



Counter EMF
over load without free-wheeling diode
Fig. 2



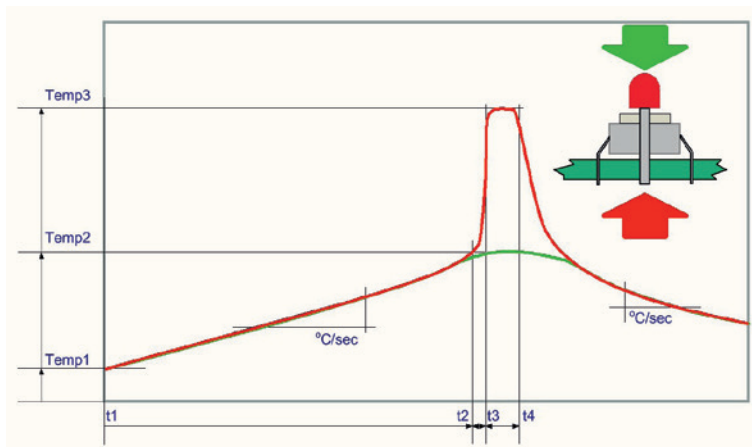
Note for soldering

Process parameter for wave soldering

Basic specification for wave soldering J-STD 75 W4C

Maximum temperature on the component side of the pcb (Temperature must not exceed during the entire processing)	120 °C
Preheating phase (t1 ... t2) Ramp up	70 ... 120 sec typ. + 1°C/sec
Ramp up to maximum temperature (t2 ... t3)	not defined
Maximum temperature on the soldering side (Temp 3) Maximum time of soldering process (t3 ... t4)	250 °C 3 sec
Ramp down at 170 °C:	typ. -2 °C/sec

Temperature curve wave soldering



Green curve: Temperature on the component side of the pcb
 Red curve: Temperature on the soldering side of the pcb

Room temperature: Temp 1

Preheating: Temperature process = Temp 1 ... Temp 2
 Process time = t1 ... t2

Ramp up to soldering temperature: Process time = t2 ... t3

Soldering phase: Temperature process = Temp 3
 Process time = t3 ... t4

Iron soldering

Basic specification for iron soldering IEC 60068-2-20

Maximum temperature at tip of iron: 320 °C

Maximum soldering time: 3 sec

Cleaning/Lacquering

The switching elements are not sealed. Cleaning up the PCB may damage the contacts in the switching elements. For this reason, the following points should be noted:

- When soldering make sure that the flux does not pass on the upper side of the PCB.
- When cleaning the PCB with detergents ensure that no dust or other debris may get inside of the switching elements.
- Ensure that no lacquer penetrates into the interior of the switching element when lacquering the PCB.

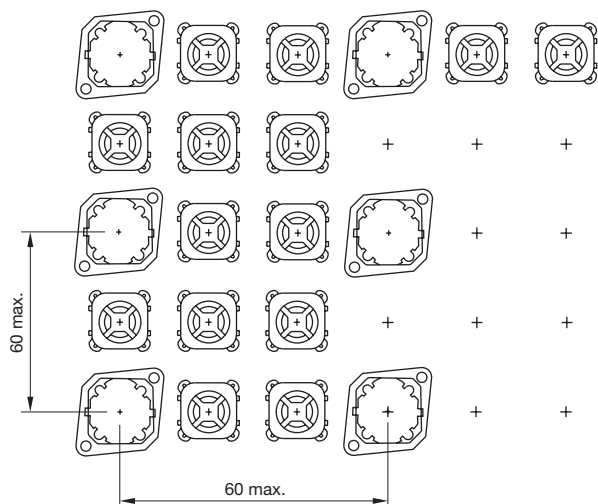
Storage of components

To obtain the optimum solderability of the components, the following points should be noted during storage:

- Do not store components in locations with high temperature or humidity.
- Do not expose components to corrosive gases.
- Avoid direct sunlight for a long period.

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Arrangement mounting flange



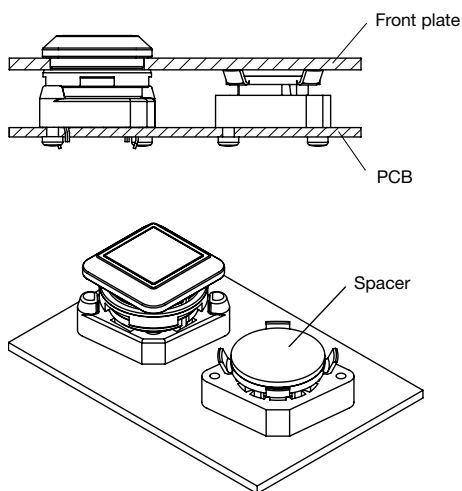
The arrangement of the mounting flanges and their number is determined by the size of the front panel or PCB. To ensure uniform, tactile switching, we recommend a layout of the flanges as per adjacent sketch.

For large PCBs with several switching elements we recommend the following procedure:

1. Fit the actuator to the front panel.
2. Clip the mounting flange to the rear of the intended actuator.
3. Screw the PCB with the components soldered to it to the assembled mounting flange.

This arrangement applies to PCBs 1.6 mm thick.

Dismantling mounting flange



The tool Part No. 92-971.0 must be used for removing the mounting flange from the actuator. Before removing the flange, the PCB fixing screws must be loosened.

If the number of actuators is insufficient, use the spacer Part. No. 92-965.0 which can be attached to the front panel.

The spacer can be adjusted to the following front panel thicknesses: 1.5/2.2/3/3.5/4 mm and can be stuck to the back of the panel free of dirt and grease.

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