

Non-contact safety switches CES-AP...

Your advantages

- ▶ High protection against tampering
- ▶ Category 4 / PL e in acc. with EN ISO 13849-1
- ▶ Integrated short circuit monitoring
- ▶ Large operating distance
- ▶ Connection via plug connectors
- ▶ Diagnostics using LED

The CES-AP... makes transponder technology available to protect even very small guards and doors. The typical CES features such as large read distance and center offset are naturally also offered by the CES-AP. What is more, mounting on profile rails couldn't be easier.

Design and functionality

The safety switch CES-AP... has two safety outputs. These outputs are connected directly to drives, downstream safety relays or safe control systems. The switch monitors itself for short circuits using pulsed signals. External clock signals are therefore not required.

Connection to safe control systems or safety relays

Do not use a control system or safety relay with pulsing for monitoring short circuits or switch off the pulsing function in these devices. The switch generates its own clock signals on the output lines OA/OB. A downstream device must tolerate these test pulses, which may have a length of up to 1 ms.

The inputs on the downstream device must be suitable for positive-switching devices (pnp outputs), as the two outputs on the safety switch deliver a level of +24 V in the switched-on state.

OUT output (depending on version)

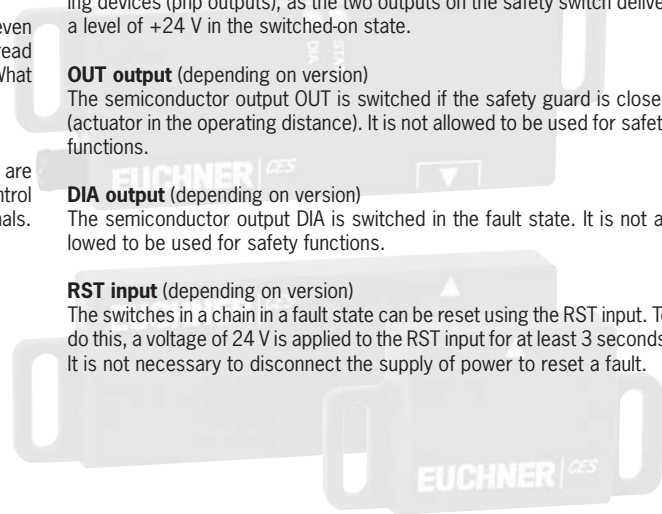
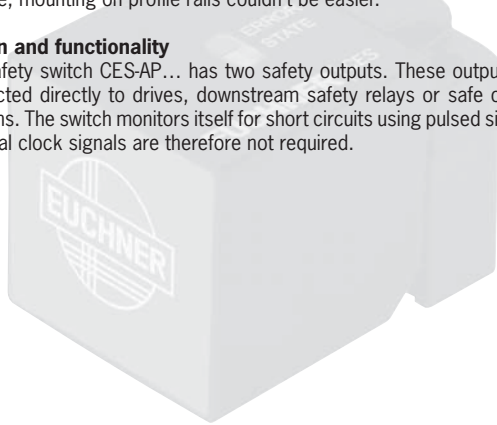
The semiconductor output OUT is switched if the safety guard is closed (actuator in the operating distance). It is not allowed to be used for safety functions.

DIA output (depending on version)

The semiconductor output DIA is switched in the fault state. It is not allowed to be used for safety functions.

RST input (depending on version)

The switches in a chain in a fault state can be reset using the RST input. To do this, a voltage of 24 V is applied to the RST input for at least 3 seconds. It is not necessary to disconnect the supply of power to reset a fault.



Typical system times CES-AP

Ready delay

After switching on, the unit carries out a self-test for 8 s (1 s for CES-AP-C01). The system is ready for operation only after this time.

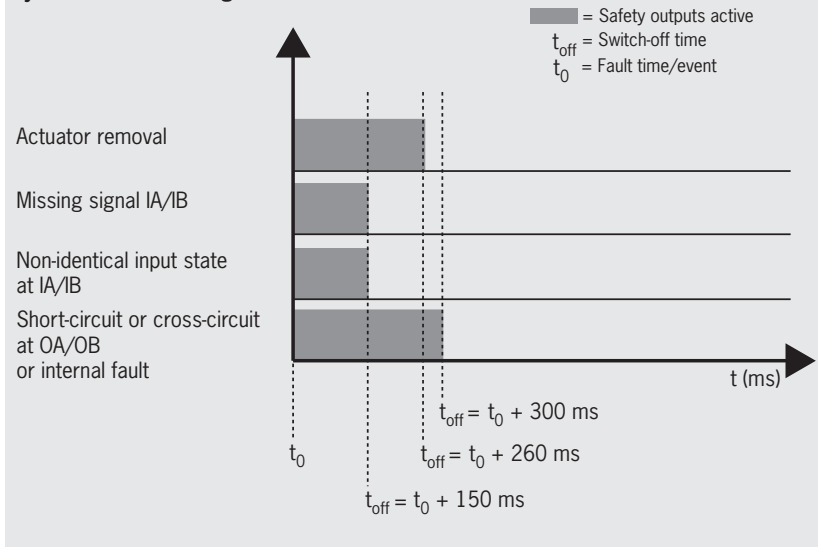
Risk time according to EN 60947-5-3

If an actuator leaves the operating distance, this situation is detected by the related switch after 260 ms at the latest. If more than one switch is used, the value increases correspondingly (see *System times for switch chains*).




Difference time

The safety outputs OA and OB switch with a slight time offset. They have the same signal state at the latest after a difference time of 10 ms.

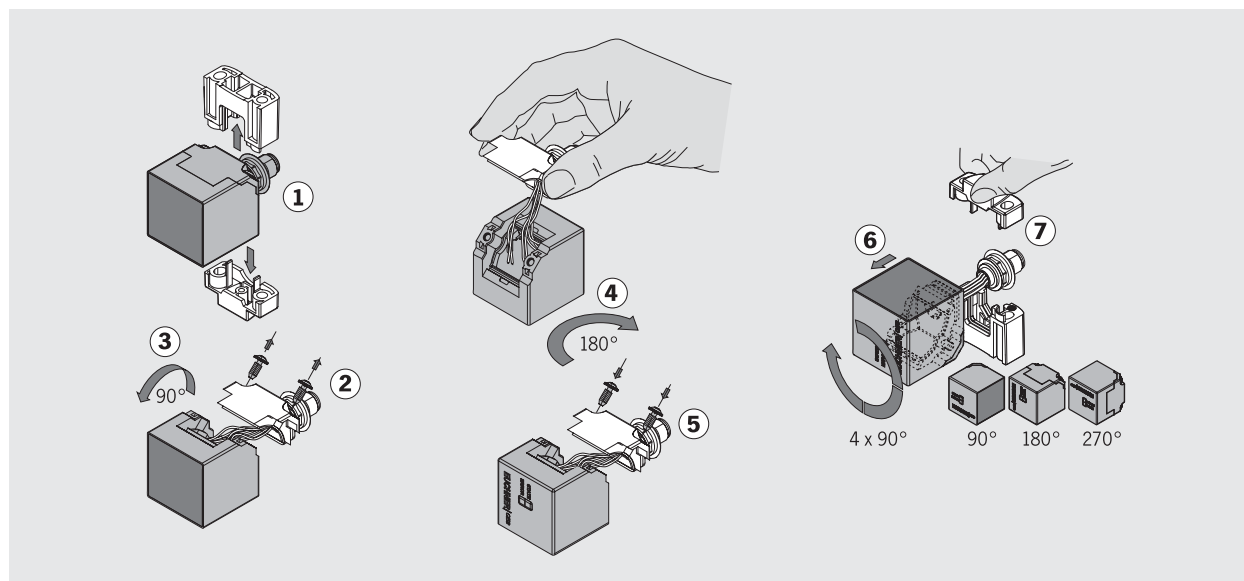
System times for a single switch



LED displays

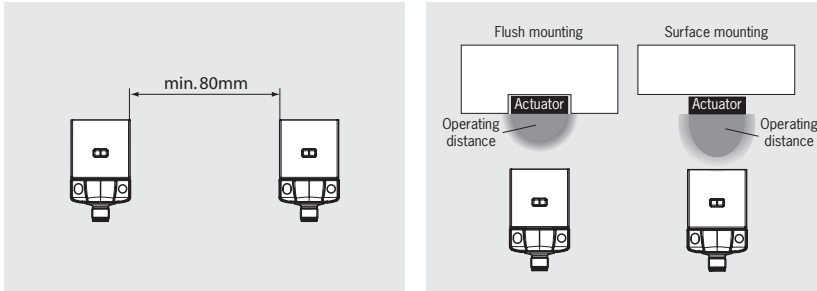
LED	Color	State	Significance
STATE	green	illuminated 	Normal operation
		flashing 	Teach-in operation or Power Up (for further signal function see status table in the system documentation)
DIA	red	illuminated 	- Internal electronics fault - Fault at the inputs/outputs

Changing the approach direction CES-AP-C01

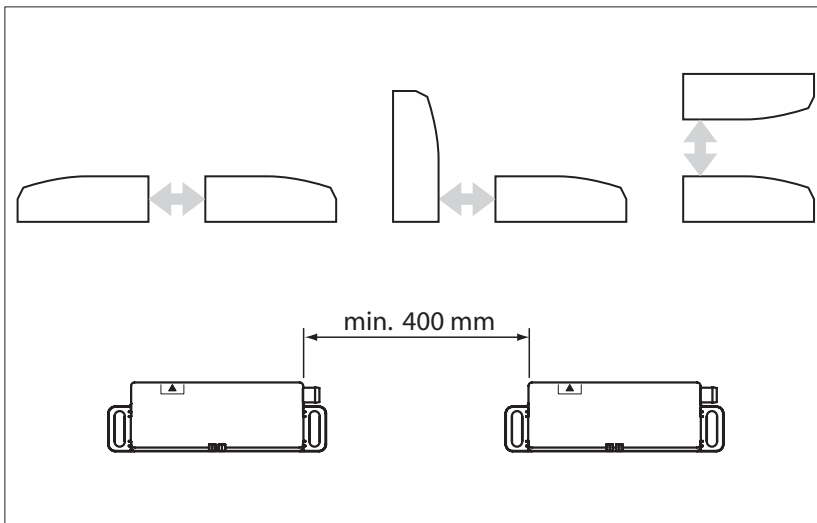


Installation CES-AP-C01

When mounting several safety switches, observe the stipulated minimum distance to avoid mutual interference. distance changes as a function of the installation depth and the safety guard material.

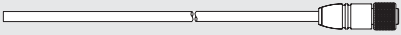





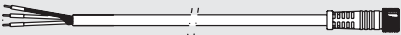
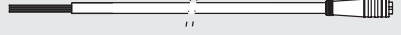
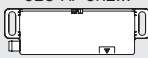









Approach direction and minimum distance CES-AP-C.2





Selection table for non-contact safety switches CES-AP



Connection cable	Safety switch	Actuator	Bolts
 <p>Page 118</p>	 <p>CES-AP-C01... Page 106</p>	<p>CES-A-BBA  Page 109</p> <p>CES-A-BCA  Page 109</p> <p>CES-A-BPA  Page 110</p> <p>CES-A-BRN  Page 111</p>	<p>Page 159/160</p>
 <p>Page 118</p>  <p>Page 118</p>	 <p>CES-AP-CR2... Page 112</p>	<p>CES-A-BLN-R2  Page 116</p> <p>CES-A-BLN-U2  Page 116</p> <p>CES-A-BDN  Page 117</p>	
	 <p>CES-AP-CL2... Page 112</p>	<p>CES-A-BLN-L2  Page 116</p> <p>CES-A-BLN-U2  Page 116</p> <p>CES-A-BDN  Page 117</p>	

Possible combinations for CES components

To give you a quick overview of which CES components can be combined with each other, there is a combinations table for each evaluation unit and for each safety switch. The table will answer the following questions:

- ▶ Which actuator can be read by the selected safety switch?
- ▶ What is the operating distance of this combination?
- ▶ Which type of guard locking can be realized with the selected combination?

Important: Only typical values are listed in the table. The minimum and maximum values are listed in the technical data for the related product.

Key to symbols	15	Combination possible, typ. switch-on distance 15 mm
		Combination possible, guard locking for process protection
		Combination possible, guard locking for personal protection
		Combination not permissible

Non-contact safety switches CES-AP

Safety switch	Actuator							
	CES-A-BLN-R2-100776 100 776	CES-A-BLN-L2-104510 104 510	CES-A-BLN-U2-103450 103 450	CES-A-BDN-06-104730 104 730	CES-A-BBA 071 840	CES-A-BCA 088 786	CES-A-BPA 098 775	CES-A-BRN 100 251
CES-AP-C01-...					18	18	22	27
CES-AP-CR2...	15		15	19				
CES-AP-CL2...		15	15	19				



Non-contact safety switches CES-AP-C01-...



- ▶ Read head with integrated evaluation electronics
- ▶ No series connection
- ▶ Short circuit monitoring
- ▶ 2 safety outputs (semiconductor outputs)
- ▶ Category 4 / PL e according to EN ISO 13849-1



For possible combinations see page 104

Approach direction

Can be adjusted in 90° steps

Short circuit monitoring

The switch generates its own clock signal on the output lines OA/OB. Pay attention to this aspect when connecting to control systems and relays.

Unicode evaluation

Each actuator is unique. The evaluation unit detects only the actuator that has been taught-in. Additional actuators can be taught-in. Only the last actuator taught-in is detected.

Multicode evaluation

Every actuator is detected by the evaluation unit.

Category in accordance with EN ISO 13849-1

Due to two redundant design semiconductor outputs (safety outputs) with internal monitoring suitable for:

- ▶ Category 4 / PL e in accordance with EN ISO 13849-1

Important: To achieve the stated category in accordance with EN ISO 13849-1, both safety outputs (OA and OB) must be evaluated.

LED display

STATE Status LED

DIA Diagnostics LED

Additional connections

DIA Diagnostics output (semiconductor), only CES-A-C01-CH-SA)

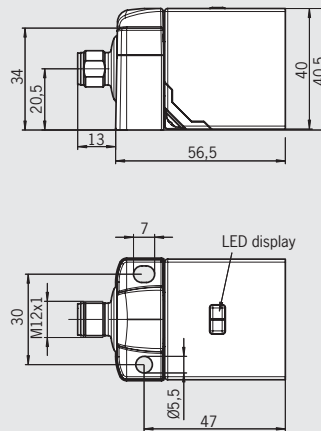
RST Reset input, only CES-A-C01-CH-SA

Non-contact safety switches CES-AP-C01-...

M12 plug, 8-pin

Cat. 4
PL e

Dimension drawing



For connection cable see page 118

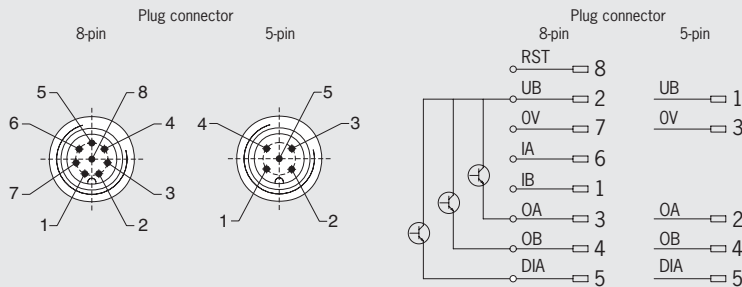
Block diagram

IB	UB	OA	OB	DIA	IA	OV	RST
1	2	3	4	5	6	7	8
M12 plug-connector (8-pin)							
CES-AP-C01-...-SA							

UB	OA	OV	OB	DIA
1	2	3	4	5
M12 plug-connector (5-pin)				
CES-AP-C01-...-SB				

Pin assignment

Pin plug connector		Designation	Beschreibung	Aderfarbe nach DIN 47100
8-pin	5-pin			
1	-	IB	Enable input for channel 2	white
2	1	UB	Power supply, DC 24 V	brown
3	2	OA	Safety output, channel 1	green
4	4	OB	Safety output, channel 2	yellow
5	-	DIA	Diagnostics output	gray
-	5	OUT	Monitoring output	gray
6	-	IA	Enable input for channel 1	pink
7	3	OV	Ground, DC 0 V	blue
8	-	RST	Reset input	red



Ordering table

Series	Category according to EN ISO 13849-1	Version	Order no.
CES-AP-C01-CH-SB Multicode	4 / PL e	M12 plug connector 5-pin	106 798 CES-AP-C01-CH-SB-106798
CES-AP-C01-CH-SA Multicode	4 / PL e	M12 plug connector 8-pin, special version	100 250 CES-AP-C01-CH-SA-100250

Technical data non-contact safety switches CES-AP-C01-...

Parameter	Value			Unit
	min.	typ.	max.	
Housing material	PBT V0 GF30			
Dimensions	According to EN 60947-5-2			mm
Weight	0.4			kg
Ambient temperature at $U_B = DC 24 V$	-20	-	+55	°C
Degree of protection	IP67			
Safety class	III			
Degree of contamination	3			
Installation position	Any			
Connection type	M12 plug connector, 5- and 8-pin			
Operating voltage U_B (reverse polarity protected, regulated, residual ripple < 5 %)	24 ± 15%			V DC
For the approval according to UL the following applies	Operation with UL-class 2 power supply only, or equivalent measures			
Current consumption	80			mA
Switching load according to UL	DC 24 V, class 2			
External fuse (operating voltage U_B)	0.25	-	8	A
Classification according to EN 60947-5-3	PDF-M			
EMC protection requirements	In acc. with EN 60947-5-3			
Safety outputs (OA/OB, 2 semiconductor outputs, p-switching, short circuit-proof)				
- Output voltage $U(OA)/U(OB)$ ¹⁾				
HIGH U(OA)	$U_B - 1.5$	-	U_B	V DC
HIGH U(OB)	$U_B - 1.5$	-	U_B	
LOW U(OA)/U(OB)	0	-	1	
Switching current per safety output	1	-	400	mA
Utilization category acc. to EN 60947-5-2	DC-13 24V 400mA Caution: outputs must be protected with a free-wheeling diode in case of inductive loads			
Off-state current I_i	≤ 0,25			mA
Rated insulation voltage U_i	-	-	75	V
Rated impulse withstand voltage U_{imp}	-	-	1.5	kV
Resilience to vibration	According to EN 60947-5-2			
Switching frequency	-	-	1	Hz
Repeat accuracy R	≤ 10			%
Monitoring output (OUT) (Semiconductor output, p-switching, short circuit-proof)				
Output voltage	$0.8 \times U_B$	-	U_B	V DC
Max. load	-	-	200	mA
In combination with actuator CES-A-BBA/CES-A-BCA				
Operating distance for center offset $m = 0$				
- Switch-on distance	-	18	-	mm
- Assured switch-on distance s_{so} ²⁾	15	-	-	
- Switching hysteresis ²⁾	1	3	-	
- Assured switch-off distance s_{sr}	-	-	45	
In combination with actuator CES-A-BPA				
Operating distance for center offset $m = 0$				
- Switch-on distance	-	22 ³⁾	-	mm
- Assured switch-on distance s_{so}	18	-	-	
- Switching hysteresis ²⁾	1	2	-	
- Assured switch-off distance s_{sr}	-	-	58	
In combination with actuator CES-A-BRN				
Operating distance for center offset $m = 0$				
- Switch-on distance	-	27 ⁴⁾	-	mm
- Assured switch-on distance s_{so}	20	-	-	
- Switching hysteresis ⁴⁾	-	3	-	
- Assured switch-off distance s_{sr}	-	-	75	
Reliability values according to EN ISO 13849-1				
Category	4			
Performance Level (PL)	e			
PFH_d	$2.1 \times 10^{-9} / h^{5)}$			
Mission time	20			years

1) Values at a switching current of 50 mA without taking into account the cable lengths.

2) Values apply for surface mounting of the actuator.

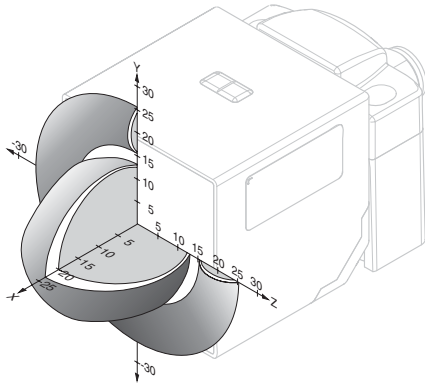
3) On surface mounting on aluminum, in a non-metallic environment the typical switching distance increases to 30 mm.

4) In case of surface mounting on steel.

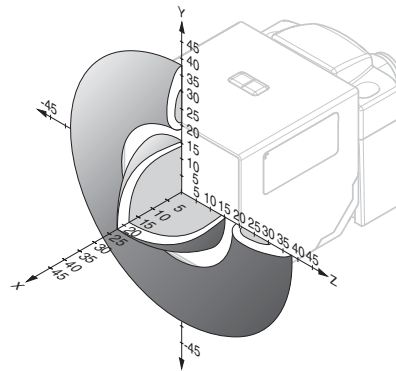
5) Applying the limit value from EN ISO 13849-1:2008, section 4.5.2 ($MTTF_d = \max. 100 \text{ years}$) BG certifies a PFH_d BG certifies a 2.47×10^{-9} .

Typical operating distance safety switch CES-AP-C01-...

With actuator CES-A-BBA

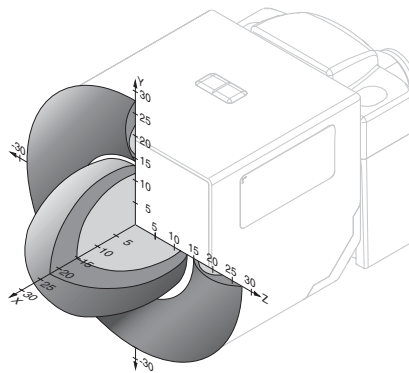


With actuator CES-A-BPA



For a side approach direction for the actuator and safety switch, a minimum distance of $s = 4 \text{ mm}$ must be maintained so that the operating distance of the side lobes is not entered.

With actuator CES-A-BRN



For a side approach direction for the actuator and safety switch, a minimum distance of $s = 4 \text{ mm}$ must be maintained so that the operating distance of the side lobes is not entered.

Actuator CES-A-BBA/CES-A-BCA

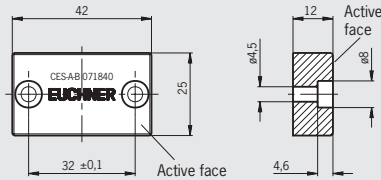
► Cube-shaped design 42 x 25 mm



For possible combinations see page 104

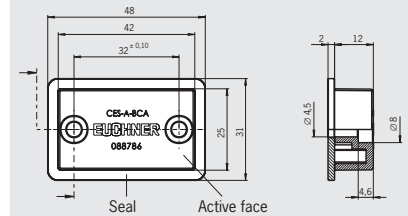
Actuator CES-A-BBA (Fortron)

Dimension drawing



2 safety screws
M4x14 are
supplied

Actuator CES-A-BCA (PE-HD) Housing material PE-HD



2 safety screws
M4x14 are
supplied

Ordering table

Series	Comment	Type	Order no.
CES-A-BBA	2 safety screws M4 x 14 are supplied	-	071 840 CES-A-BBA
CES-A-BCA	2 safety screws M4 x 14 are supplied Flat seal included	Housing material PE-HD ¹⁾	088 786 CES-A-BCA

1) Suitable for use in aggressive media (e. g. acids, alkalis)

Technical data

Parameter	Value			Unit
	min.	typ.	max.	
Housing material	Fortron, reinforced thermoplastic, fully encapsulated			
- CES-A-BBA				
- CES-A-BCA	Plastic PE-HD without reinforcement, fully encapsulated			
Flat seal material (CES-A-BCA only)	Fluororubber 75 FPM 4100			
Dimensions	42 x 25 x 12			mm
Weight	0.02			kg
Ambient temperature				
- CES-A-BBA	-25	-	+70	°C
- CES-A-BCA	-25	-	+50	
Degree of protection	IP67/IP69K			
Installation position	Active face opposite read head			
Power supply	Inductive via read head			

Actuator CES-A-BPA

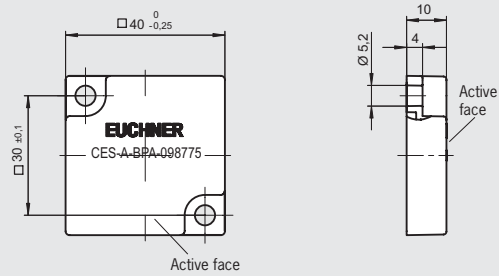
- ▶ Cube-shaped design 40 x 40 mm



For possible combinations see page 104

Actuator CES-A-BPA

Dimension drawing



2 safety screws
M4x14 are
supplied

Ordering table

Series	Comment	Type	Order no.
CES-A-BPA	2 safety screws M5 x 10 are supplied	-	098 775 CES-A-BPA

Technical data

Parameter	Value			Unit
	min.	typ.	max.	
Housing material	PBT			
Weight	0.025			kg
Degree of protection according to IEC 60529	IP67/IP69K			
Ambient temperature	-25	-	+70	°C
Installation position	Active face opposite read head			
Power supply	Inductive via read head			

Actuator CES-A-BRN

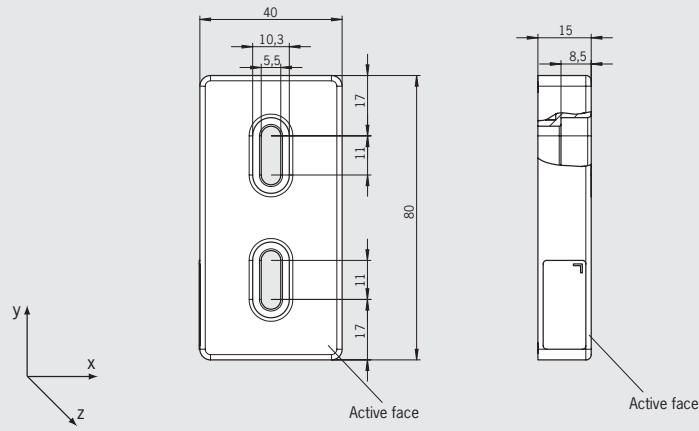
- ▶ Elongated operating distance in the y direction
- ▶ Cube-shaped design 80 x 40 mm



For possible combinations see page 104

Actuator CES-A-BRN

Dimension drawing



Ordering table

Series	Comment	Version / actuator number	Order no.
CES-A-BRN	2 safety screws M5 x 16 are supplied	-	100 251 CES-A-BRN-100251

Technical data

Parameter	Value			Unit
	min.	typ.	max.	
Housing material	PPS			
Dimensions	80 x 40 x 15			mm
Weight	0.06			kg
Ambient temperature	-25	-	+70	°C
Degree of protection acc. to EN IEC 60529	IP 67			
Installation position	Active face opposite read head			
Power supply	Inductive via read head			



Non-contact safety switches CES-AP-C.2-...

- ▶ Read head with integrated evaluation electronics
- ▶ No series connection
- ▶ Short circuit monitoring
- ▶ 2 safety outputs (semiconductor outputs)
- ▶ Category 4 / PL e according to EN ISO 13849-1



For possible combinations see page 104

Approach direction

For approach directions see illustration "Approach direction and minimum distance" on page 101.

Short circuit monitoring

The switch generates its own clock signal on the output lines OA/OB.

Pay attention to this aspect when connecting to control systems and relays.

Unicode evaluation

Each actuator is unique. The evaluation unit detects only the actuator that has been taught-in. Additional actuators can be taught-in. Only the last actuator taught-in is detected.

Multicode evaluation

Every actuator is detected by the evaluation unit.

Category in accordance with EN ISO 13849-1

Due to two redundant design semiconductor outputs (safety outputs) with internal monitoring suitable for:

- ▶ Category 4 in accordance with EN ISO 13849-1

Important: To achieve the stated category in accordance with EN ISO 13849-1, both safety outputs (OA and OB) must be evaluated.

LED display

STATE Status LED
DIA Diagnostics LED

Additional connections

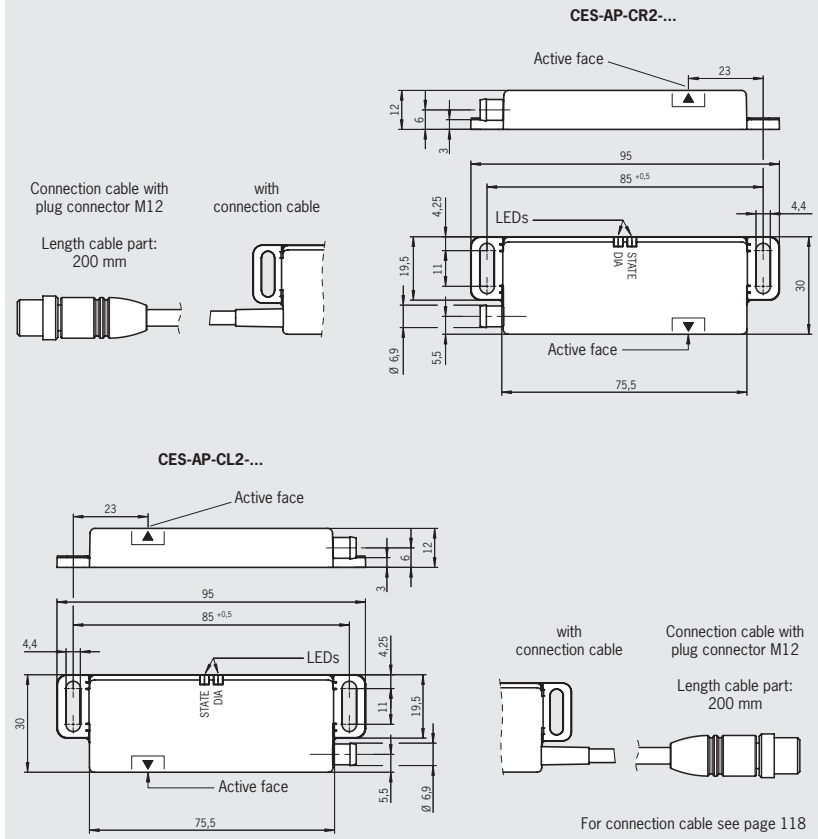
OUT Monitoring output (semiconductor)

Ordering table see page 114.

Non-contact safety switches CES-AP-C.2-...

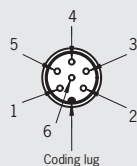
Cat. 4 PLe

Dimension drawing



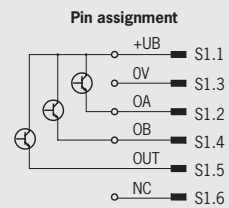
Pin assignment

Snap-on connector, 6-pin

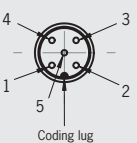


View on the connection side of the safety switch

Pin	Designation/description	Wire color
1	UB Power supply DC 24 V	BN
2	OA Safety output, channel 1	WH
3	OV Ground DC 0 V	BU
4	OB Safety output, channel 2	BK
5	OUT Monitoring output	GY
6	- Not used	PK

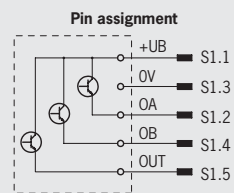


Connection cable with plug connector M12, 5-pin



View on the connection side of the safety switch

Pin	Designation/description	Wire color
1	UB Power supply DC 24 V	BN
2	OA Safety output, channel 1	WH
3	OV Ground DC 0 V	BU
4	OB Safety output, channel 2	BK
5	OUT Monitoring output	GY



Technical data non-contact safety switches CES-AP-C.2-...

Parameter	Value			Unit
	min.	typ.	max.	
Housing material	Plastic PBT			
Dimensions	95 x 30 x 12			mm
Weight	0.04			kg
Ambient temperature at $U_B = DC 24 V$	- 20	-	+ 55	°C
- For switches from serial number xxxxxx002000	- 40	-	+ 65	
Storage temperature	- 20	-	+ 70	
Degree of protection according to EN 60529	IP 69K (IP 67 on version with plug connector M12)			
Safety class	III			
Degree of contamination	3			
Installation position	Any			
Connection type	Plug connector or connection cable			
Operating voltage U_B (reverse polarity protected, regulated, residual ripple < 5 %)	24 ± 15%			V DC
For the approval according to UL_{cs} the following applies	Operation with UL-class 2 power supply only, or equivalent measures			
Current consumption	30			mA
Switching load according to UL_{cs}	DC 24 V, class 2			
External fuse (operating voltage)	0.25	-	1.5	A
Safety outputs OA/OB	Semiconductor outputs, p-switching, short circuit-proof			
- Output voltage $U(OA)/U(OB)$ ¹⁾				V DC
HIGH U(OA)	$U_B \cdot 1.5$	-	U_B	
HIGH U(OB)				
LOW U(OA)/U(OB)	0		1	
Switching current per safety output	1	-	150	mA
Utilization category to EN 60947-5-2	DC-13 24 V 150 mA Caution: outputs must be protected with a free-wheeling diode in case of inductive loads.			
Off-state current I_o	≤ 0,25			mA
Classification according to EN 60947-5-3	PDF-M			
Monitoring output OUT ¹⁾	Semiconductor output p-switching, short circuit-proof			
- Output voltage	$0.8 \times U_B$	-	U_B	V DC
- Max. load	-	-	100	mA
Rated insulation voltage U_i	-	-	30	V
Rated impulse withstand voltage U_{imp}	-	-	1.5	kV
Resilience to vibration	In acc. with EN 60947-5-2			
Switching frequency	-	-	1	Hz
Repeat accuracy R	≤ 10			%
EMC protection requirements	In acc. with EN 60947-5-3			
In combination with actuator CES-A-BLN... ²⁾				
Operating distance for center offset $m = 0$				
- Switch-on distance	-	15	-	mm
- Assured switch-on distance s_{so} ²⁾	10	-	-	
- Switching hysteresis ²⁾	1	2	-	
- Assured switch-off distance s_{sr} in x/z direction	-	-	40	
in y direction	-	-	60	
In combination with actuator CES-A-BDN... ²⁾				
Operating distance for center offset $m = 0$				
- Switch-on distance	-	19	-	mm
- Assured switch-on distance s_{so} ²⁾	14	-	-	
- Switching hysteresis ²⁾	-	2	-	
- Assured switch-off distance s_{sr} in x/z direction	-	-	40	
in y direction	-	-	60	
Reliability values according to EN ISO 13849-1				
Category	4			
Performance Level (PL)	e			
PFH_d	$1.8 \times 10^{-9} / h$ ³⁾			
Mission time	20			years

1) Values at a switching current of 50 mA without taking into account the cable lengths.

2) The operating distance may vary depending on the background material and installation situation

3) Applying the limit value from EN ISO 13849-1:2008, section 4.5.2 ($MTTF_d = \max. 100 \text{ years}$) BG certifies a PFH_d BG certifies a 2.47×10^{-8} .

Ordering table

Series	Comment	Type	Order no. / item
Safety switch CES-AP-C.2-... Unicode	2 safety screws M4 x 14 are supplied	Door hinge right, snap-on connector, 6-pin	105 295 CES-AP-CR2-AH-SF-105295
		Door hinge left, snap-on connector, 6-pin	105 294 CES-AP-CL2-AH-SF-105294
		Door hinge right, connection cable PUR, length 0.2 m, with plug connector M12, 5-pin	106 552 CES-AP-CR2-AH-SB-106552
		Door hinge left, connection cable PUR, length 0.2 m, with plug connector M12, 5-pin	106 553 CES-AP-CL2-AH-SB-106553
		Door hinge right, connection cable PVC, length 5 m	105 601 CES-AP-CR2-AH-L05-105601
		Door hinge left, connection cable PVC, length 5 m	105 603 CES-AP-CL2-AH-L05-105603
		Door hinge right, connection cable PVC, length 10 m	106 191 CES-AP-CR2-AH-L10-106191
		Door hinge left, connection cable PVC, length 10 m	106 192 CES-AP-CL2-AH-L10-106192
		Door hinge right, connection cable PVC, length 20 m	106 195 CES-AP-CR2-AH-L20-106195
		Door hinge left, connection cable PVC, length 20 m	106 196 CES-AP-CL2-AH-L20-106196
Safety switch CES-AP-C.2-... Multicode	2 safety screws M4 x 14 are supplied	Door hinge right, snap-on connector, 6-pin	100 775 CES-AP-CR2-CH-SF-100775
		Door hinge left, snap-on connector, 6-pin	104 509 CES-AP-CL2-CH-SF-104509
		Door hinge right, connection cable PUR, length 0.2 m, with plug connector M12, 5-pin	106 550 CES-AP-CR2-CH-SB-106550
		Door hinge left, connection cable PUR, length 0.2 m, with plug connector M12, 5-pin	106 551 CES-AP-CL2-CH-SB-106551
		Door hinge right, connection cable PVC, length 5 m	105 600 CES-AP-CR2-CH-L05-105600
		Door hinge left, connection cable PVC, length 5 m	105 602 CES-AP-CL2-CH-L05-105602
		Door hinge right, connection cable PVC, length 10 m	106 189 CES-AP-CR2-CH-L10-106189
		Door hinge left, connection cable PVC, length 10 m	106 190 CES-AP-CL2-CH-L10-106190
		Door hinge right, connection cable PVC, length 20 m	106 193 CES-AP-CR2-CH-L20-106193
		Door hinge left, connection cable PVC, length 20 m	106 194 CES-AP-CL2-CH-L20-106194