

The advantages of the CES system at a glance

- ▶ Uniquely coded actuator
- ▶ Maximum protection against tampering
- ▶ The actuator can be rotated within the read head's operating distance.
- ▶ Can be used in harsh environment
- ▶ Dirt on the surface does not reduce the switching distance
- ▶ Precise door guides are not required

General Information

According to EN 1088, interlocking devices are mechanical or electrical devices which are designed to prevent the operation of a machine element for as long as the movable safety guard is left open.

Non-contact safety switches and safety systems CES are interlocking devices which are designed to protect people and machines. Compared with electromechanical safety switches, they are used if:

- ▶ a high level of protection against tampering must be achieved
- ▶ extremely hygienic environmental conditions are required (e.g. in the food industry),
- ▶ a precise door guide is not possible,
- ▶ machine doors are subjected to heavy vibration.
- ▶ a high category according to EN ISO 13849-1 is stipulated during the risk analysis

The CES transponder technology

The non-contact safety systems described here operate on the basis of a uniquely electronically coded actuator (transponder). The name transponder is a combination of the two terms transmitter and responder. The function of a transponder is easily explained:

the transponder (actuator) receives and processes the electromagnetic field from a transceiver (read head), and the data signals are then sent back to the read head (evaluation unit) as a response depending on the transponder coding. Power is supplied and data transmitted to the coded actuator by induction using a read head. The major advantage of the system is that the actuator does not contain any batteries and is therefore maintenance-free giving the user many years of service-free operation. The best known application for transponder technology is, for instance, the electronic immobilizer in automotive applications.

The CES system

The Coded Electronic Safety system CES comprises three components:

- ▶ Coded actuator
- ▶ Read head
- ▶ Evaluation unit

In some systems, the read head and evaluation unit form a sealed unit, in this case the term safety switch is used, as all safety functions are integrated into one component (see section on safety switches further down).

The system then consists of the components:

- ▶ Coded actuator
- ▶ Safety switch (read head with integrated evaluation)

Coded actuators

Each actuator supplied has a unique code and is therefore a unique element. The code in an actuator cannot be reprogrammed.

Read heads

The read head is fastened to the fixed part of the safety guard and is connected to the evaluation unit via a two-core screened cable. The actuator fastened to the safety guard is moved towards the read head by closing the door. When the switch-on distance is reached, power is supplied to the actuator via the read head and the read head transfers the actuator's data to the evaluation unit.

Actuator and read head have a wide operating distance and a broad hysteresis. Misalignment of the door will therefore not result in the system switching off unintentionally. If the actuator is positioned exactly at the limit of the switch-on distance, vibration at the safety guard will not cause the machine to stop unintentionally.

EUCHNER provides read heads in a very wide range of designs with and without guard locking (see next section).

Read heads with guard locking

Guard locking is a feature that prevents the unintentional opening of a door as long as there is a hazard. For this purpose, EUCHNER has read heads with guard locking in its range. They function like any other CES read head, but also contain a guard locking mechanism. Depending on the read head series and the evaluation unit used, varying levels of safety can be achieved. You will find exact information on the level of safety that can be achieved in the combinations tables for each product.

Evaluation units

The read head is connected to a special CES evaluation unit. This unit checks the actuator's bit pattern. The data transmission from the read head to the evaluation unit is dynamic and single-channel. All potential faults (e.g. broken cable, short circuit, failure of the actuator) are reliably detected. The number of read heads that can be connected depends on the evaluation unit.

The evaluation units have enable paths with which e. g. relays or contactors can be switched. If the evaluation unit detects a valid actuator, the evaluation unit closes its enable paths.

How the evaluation is performed in detail depends on whether the evaluation unit is a unicode or multicode evaluation unit.

Unicode evaluation

With the unicode version, the actuators must be taught-in on the evaluation unit. During teach-in the actuator code is assigned to the evaluation unit. This code is saved in the evaluation unit. Whenever an actuator is read, the evaluation unit compares the code just read with the code saved. Only if the two bit patterns are identical, the actuator is recognized and the enable paths are closed. The number of possible teach-in operations is dependent of the evaluation unit used. Only the last actuator taught-in is detected. The unicode principle provides a high level of protection against tampering.

Fixcode evaluation

On version Fixcode devices, the teach-in operation is performed by EUCHNER before delivery. For this purpose, a specific actuator is allocated to the device. The device can only be operated with this particular actuator. No additional actuators can be taught.

Multicode evaluation

Unlike systems with unique code detection, with multicode evaluation a specific actuator code is not requested, instead it is only checked whether the actuator is of a type from EUCHNER that can be detected by the system (multicode detection). There is no exact comparison of the actuator code with the code saved in the evaluation unit. As a result a teach-in operation for actuators is not necessary.

Safety switch

On the safety switches, read head and evaluation unit are integrated into one housing. Their principle of operation does not differ from other CES systems. The safety switches are also available in unicode, multicode and fixcode versions. The advantage compared to evaluation with a separate evaluation unit is in the combination of the complete switch function in one compact housing. This feature makes possible decentral evaluation direct on-site.

Approvals

To demonstrate conformity, the Machinery directive also includes the possibility of type examination. Although all relevant standards are taken into account during development, we subject all our switches to additional type examinations by a notified body.

Many of the devices listed in this catalog have been tested by an employers' liability insurance association (BG) and are given in the lists from the BG.

Furthermore, numerous devices are listed by Underwriters Laboratories (UL). These devices can be used in countries in which this listing is required. The approval symbols on the individual pages of the catalog indicate which body tested the switchgear.

With the aid of the approval symbols listed below you can quickly see which approvals are available for the related devices:



Devices with this symbol are approved by an employers' liability insurance association (Berufsgenossenschaft, BG)



Devices with this symbol are approved by Underwriters Laboratories (UL, Canada and USA)

System families at a glance (see also page 8 and page 9)

System family	Locking	Guard locking	Guard lock monitoring	Monitored start button	Feedback loop	Switch chain	ATEX versions	Short circuit monitoring (own clock signal)	External clock signals allowed
Safety system CES-AZ-...	●	●	●	●	●		●		●
Safety switch CES-A-5-...	●						●		●
Safety switch CES-AH-...	●			●	●				
Safety switch	CES-AR-... ●					Max. 20 devices		●	
	CET-AR-... ●	●	●	●	●				
Safety switch CES-AP-...	●							●	
Key to symbols	●	Option available							

CES evaluation units combine transponder evaluation and a safety relay in one device

The CES evaluation units have two enable paths and monitoring outputs for each read head connected. The devices have additional monitoring outputs, as well as connections for a monitored start button and feedback loop.

Start button

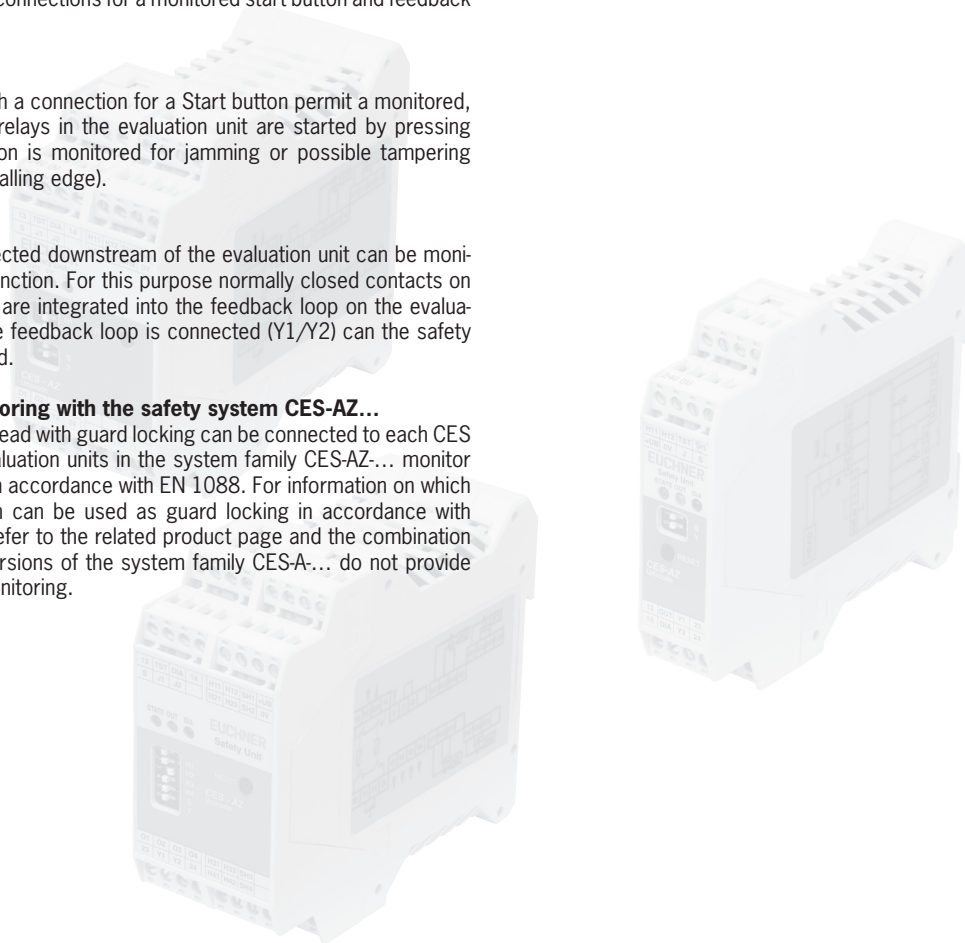
Evaluation units with a connection for a Start button permit a monitored, manual start. The relays in the evaluation unit are started by pressing a button. The button is monitored for jamming or possible tampering (monitoring of the falling edge).

Feedback loop

Components connected downstream of the evaluation unit can be monitored for correct function. For this purpose normally closed contacts on these components are integrated into the feedback loop on the evaluation unit. Only if the feedback loop is connected (Y1/Y2) can the safety outputs be switched.

Guard lock monitoring with the safety system CES-AZ...

In principle a read head with guard locking can be connected to each CES evaluation unit. Evaluation units in the system family CES-AZ-... monitor the guard locking in accordance with EN 1088. For information on which device combination can be used as guard locking in accordance with EN 1088, please refer to the related product page and the combination tables. Previous versions of the system family CESA-... do not provide safe guard lock monitoring.



Evaluation unit CES-AZ-AES-02B

- ▶ 2 read heads can be connected
- ▶ 2 safety outputs (relay contacts with 2 internally connected NO contacts per output)
- ▶ Start button and feedback loop can be connected
- ▶ Plug-in connection terminals
- ▶ Category 4 / PL e according to EN ISO 13849-1



For possible combinations see page 24

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. New actuators are taught-in by fitting a jumper.

Multicode evaluation

Every actuator is detected by the evaluation unit.

Guard lock monitoring

Evaluation units in the series CES-AZ make it possible to use read heads with integrated guard locking for the personal protection during overtravelling machine movements. For suitable read heads, please refer to the combinations table on page 24.

Category according to EN ISO 13849-1

Due to two redundant safety paths (relay contacts) with 2 internal, monitored NO contacts per safety path, suitable for:

- ▶ Category 4 / PL e according to EN ISO 13849-1

Each safety path is independently safe.

LED display

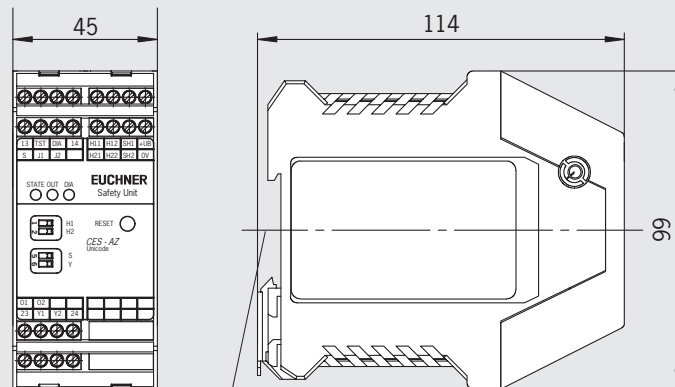
STATE Status LED
DIA Diagnostics LED
OUT Status safety output

Evaluation unit CES-AZ-AES-02B



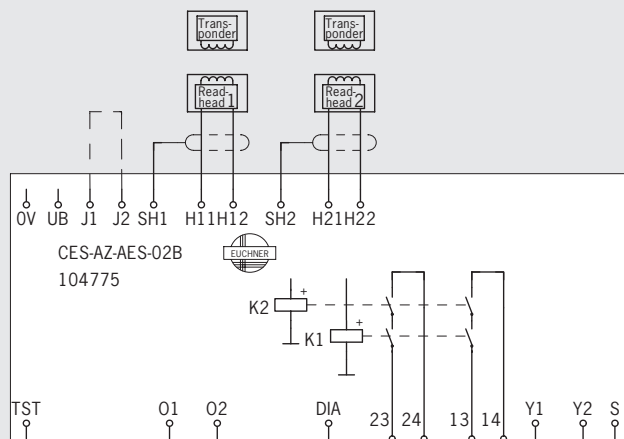
Cat. 4
 PL e
 2

Dimension drawing



Suitable for 35 mm DIN rail according to DIN EN 50022-35

Block diagram



Additional connections

TST Input for self-test
O1, O2 Monitoring outputs (semiconductor)
DIA Diagnostics output
Y1, Y2 Feedback loop
S Start button connection

Important: The plug-in connection terminals are not included and must be ordered separately.

Ordering table

Series	Category and PL according to EN ISO 13849-1	Number of read heads	Type	Order no. / item
CES-AZ-AES-02B Unicode	up to 4 / PL e	2		104 775 CES-AZ-AES-02B
CES-AZ-UES-02B Multicode	up to 4 / PL e	2		105 140 CES-AZ-UES-02B
Connection set for evaluation unit CES-AZ-ES-02B			Plug-in Screw terminals	104 771 CES-EA-TC-AK06-104771

1) BG approval pending

Technical data evaluation unit CES-AZ-AES-02B



Parameter	Value			Unit
	min.	typ.	max.	
Housing material	Plastic PA6.6			
Dimensions	114 x 99 x 45			mm
Weight	0.25			kg
Ambient temperature at U _B = DC 24 V	-20	-	+55	°C
Atmospheric humidity, not condensing	-	-	80	%
Degree of protection	IP20			
Degree of contamination	2			
Installation	DIN rail 35 mm according to EN 50022-35			
Number of read heads	Max. 2 read heads per evaluation unit			
Connection (plug-in screw terminals/coded)	0.14	-	2.5	mm ²
Operating voltage U _B (regulated, residual ripple < 5 %)	21	24	27	V DC
For the approval according to «UL» the following applies	Operation with UL-class 2 power supply only, or equivalent measures			
Current consumption I _B (with relay energized) ¹⁾	-	150	-	mA
External fuse (operating voltage U _B)	0.4	-	8	A
Safety contacts	2 (relays with internally monitored contacts)			
Switching current (relay outputs)				
- At switching voltage AC/DC 21 ... 60 V	1	-	300	mA
- At switching voltage AC/DC 5 ... 30 V	10	-	4000	
- At switching voltage AC 5 ... 230 V	10	-	2000	
Switching load according to «UL»	Max. AC 30 V, class 2 / max. DC 60 V, class 2			
External fuse (safety circuit) according to EN 60269-1	6 A gG or 6 A circuit breaker (characteristic B or C)			
Utilization category acc. to EN 60947-5-1	AC-12 60V 0.3A / DC-12 60V 0.3A AC-12 30V 6A / DC-12 30V 6A AC-15 230V 2A / DC-13 24V 3A			
Classification according to EN 60947-5-3	PDF-M			
Rated insulation voltage U _i	250			V
Rated impulse withstand voltage U _{imp}	4			kV
Rated conditional short-circuit current	100			A
Resilience to vibration	In acc. with EN 60947-5-2			
Mechanical operating cycles (relays)	10 x 10 ⁶			
Switching delay from state change ²⁾				
- 2 activated actuators	-	-	290	ms
- 1 activated actuator	-	-	210	
Time difference between the switching points of the two relays (with 2 activated actuators)	-	-	25	ms
Manual start operating mode				
- Duration of operation of start button	250	-	-	ms
- Start button response delay	-	200	300	
Current via feedback loop Y1/Y2	5	8	10	mA
Permissible resistance via feedback loop	-	-	600	Ω
Ready delay ³⁾	-	10	12	s
Dwell time ⁴⁾	3	-	-	s
Switching frequency max. ⁵⁾	-	-	0.25	Hz
Repeat accuracy R according to EN IEC 60947-5-3	≤ 10			%
Monitoring outputs (diagnostics DIA, release 01...02, semiconductor output, p-switching, short circuit-protected)				
- Output voltage	0.8 x U _B	-	U _B	V DC
- Max. load	-	-	20	mA
Start button input S, test input TST				
- Input voltage LOW	0	-	2	V DC
- Input voltage HIGH	15	-	U _B	
- Input current HIGH	5	8	10	mA
EMC protection requirements	In acc. with EN 60947-5-3			
Reliability figures according to EN ISO 13849-1 as a function of the switching current at 24 V DC	≤ 0.1 A	≤ 1 A	≤ 3 A	
Category	4			
Performance level (PL)	e			
PFH _d	1.9 x 10 ⁻⁸			
Mission time	20			years
Number of switching cycles/year	760 000	153 000	34 600	

1) Without taking into account the load currents on the monitoring outputs.

2) Corresponds to the risk time according to EN 60947-5-3. This is the maximum switch-off delay for the safety outputs following removal of the actuator. In case of EMC interference in excess of the requirements in accordance with EN 60947-5-3, the switch-off delay can increase to max. 430 ms. After a brief actuation < 0.4 s, the switch-on delay can increase to max. 3 s if this is followed immediately by further actuation.

3) After the operating voltage is switched on, the relay outputs are switched off and the monitoring outputs are set LOW during the ready delay. For the visual indication of the delay, the green STATE LED flashes at a frequency of approx. 15 Hz.

4) The dwell time is the time that the actuator must be inside or outside the operating distance.

5) In case of monitoring with feedback loop, the actuators must remain outside the operating distance, e.g. with a door open, until the feedback circuit is closed.