

## KA 970

### Text monitoring units





## Notes on Connecting and Operating Instructions

This connecting and operating instructions manual contains information on the proper use of test monitoring units KA 970 in accordance with its intended purpose.



All the information contained herein, in particular the safety notes, need to be carefully observed.

Notes regarding safety and warnings are marked by this symbol  .

Notes regarding important pieces of information are marked by the symbol  .

This connecting and operating instructions manual must be stored carefully. It must be available for the entire operating time of the test monitoring units KA 970.

**The Leuze electronic GmbH + Co. KG is not liable for damages caused by improper use. Acquaintance with these instructions is an element of the knowledge required for proper use.**

© Reprints and reproduction, in whole or in part, are permitted only with the explicit permission of

Leuze electronic GmbH + Co. KG  
In der Braike 1  
D-73277 Owen - Teck / Germany  
Telefon +49 (0) 7021 / 573-0  
Fax +49 (0) 7021 / 573-199  
info@leuze.de  
www.leuze.com

<b>1</b>	<b>General Information .....</b>	<b>4</b>
1.1	Certifications .....	4
1.2	General Information .....	4
1.3	Definition of Terms .....	4
1.4	Selection of Optical Electronic Protective Devices.....	5
<b>2</b>	<b>Safety Notices .....</b>	<b>7</b>
2.1	Safety Standard .....	7
2.2	Intended Use.....	7
2.2.1	Application requirements.....	7
2.2.2	Areas of application.....	7
2.3	Organizing Measures .....	8
<b>3</b>	<b>Mounting of the Safety System.....</b>	<b>9</b>
3.1	Mounting of the Protective Photoelectric Sensor .....	9
3.1.1	Multi-axle installation.....	10
<b>4</b>	<b>Function and Commissioning of the KA 970.....</b>	<b>12</b>
4.1	Function characteristics of the safety system .....	12
4.1.1	Display and Operating Instruments.....	12
4.2	Electrical Installation .....	13
4.2.1	Supply wiring.....	14
4.2.2	Start input wiring .....	15
4.2.3	Wiring of single-beam protective photoelectric sensors .....	17
4.2.4	Wiring of single-beam protective photoelectric sensors in series .....	18
4.2.5	Wiring safety output .....	19
4.2.6	Wiring of the message outputs.....	22
4.2.7	Setting of the operating mode.....	23
4.3	Operating states without start-/restart interlock.....	25
4.4	Operating states with start-/restart interlock without contactor monitoring (EDM) .....	28
4.5	Operating states with start-/restart interlock and with contactor monitoring (EDM) .....	32
4.6	Fault indication and device reset.....	35
4.7	Technical Data .....	36
<b>5</b>	<b>Applications.....</b>	<b>38</b>
5.1	Example with retro-reflective photoelectric safety sensor SRK 96.....	38
5.2	Example with a protective photoelectric sensor SLS 96 .....	40
<b>6</b>	<b>Appendix.....</b>	<b>41</b>
6.1	Remaining Risks (EN 292-1).....	41
<b>7</b>	<b>EC Declaration of Conformity .....</b>	<b>42</b>

## 1 General Information

### 1.1 Certifications

The KA 970 monitoring units have been developed and manufactured in accordance with the applicable European standards and directives.

The manufacturer of the product, Leuze electronic GmbH + Co. KG in D-73277 Owen - Teck, possesses a certified quality assurance system in accordance with ISO 9001.



### 1.2 General Information



**Note:**

*There are two device variations described in this connecting and operating instructions. The difference between the two devices is in their supply voltage. The KA 970 is intended for 24V DC operation. The KA 970 is intended for 24V AC operation. The basic remarks concerning the functioning and assembly of the safety system are valid for both device variations.*

An active optoelectronic protective device is part of the electrical equipment which has to be applied to those machines which contain the potential risk of bodily injury. They provide protection by causing the machine to move into a safe operating state before a person can get into a dangerous situation (EN 61496-1).

### 1.3 Definition of Terms

**AOPD type 2**

The EN 61496 describes two types of active optical electronic protective devices (AOPD) with respect to the requirements concerning safety relevant parts of control units (ISO 13849).

The AOPD type 2 fulfills the requirements of category 2 acc. to ISO 13849. A periodic function test has to detect malfunctions in the safety function. In case of a failure, the next machine cycle may not be released. A malfunction of the AOPD type 2 between the testings can cause the loss of the safety function. In normal function, at least one output switching element of the AOPD type 2 has to move into the OFF-position if the sensor reacts or if the power supply of the AOPD is interrupted.

**Active Opto-electronic Protective Device (BWS)**

Corresponds to AOPD

**Output switching element (OSSD)**

The part of the AOPD which is connected to the machine control and which moves into the OFF-position as soon as the sensor part reacts during normal operation.

**Start disable**

An equipment which disables the automatic machine start if the power supply of the contactless active protective device is switched on or if it had been interrupted and switched on again.

**Start testing**

A manual or automatic test which is performed after the contactless active protective device has been switched on. It tests the complete safety-relevant control system before the normal machine operation is induced.

**Contactors monitoring**

The contactor monitoring checks before every release of the switching outputs if the succeeding contactors are open. Only then, a new release is possible.

**Restart interlock**

A function which prevents an automatic restart of a machine after

- sensor detection during a potentially dangerous motion of the machine,
- a change in the operating mode of the machine and
- a change in the actuation mode of the machine.

## 1.4 Selection of Optical Electronic Protective Devices

The following strategy is to be applied (iterative process):

1. Determination of the protected area
2. Determination of the protective function
  - Finger or hand protection
  - Access protection for persons
  - Presence detection
3. Determination of the control category
4. Calculation of the safety distance

**Determination of the protected area**

Through risk calculation, the following has to be observed:

- the size of the safety field
- the access points
- the hazardous areas
- bypassing possibilities

**Determination of the protective function:**

Finger and hand protection:	The user is close to the hazardous area.
Access protection:	Access to the hazardous area is protected.
Presence detection:	A hazardous area which is completely surrounded by permanently installed protective devices is monitored for presence of objects or access protection and presence detection are combined.

## 2 Safety

Before using the Test Monitoring Unit, a risk evaluation must be performed according to valid standards (e.g. EN ISO 14121, EN ISO 12100-1, EN ISO 13849-1, IEC 61508, EN 62061). The result of the risk assessment determines the required safety level of the Test Monitoring Unit (see table 2.1-1). For mounting, operating and testing, document "KA 970 Test Monitoring Units" as well as all applicable national and international standards, regulations, rules and directives must be observed. Relevant and supplied documents must be observed, printed out and handed to the affected personnel.

Before working with the Test Monitoring Unit, completely read and understand the documents applicable to your task.

In particular, the following national and international legal regulations apply for the start-up, technical inspections and work with Test Monitoring Units:

- Machinery directive 2006/42/EC
- Low voltage directive 2006/95/EC
- Electromagnetic compatibility directive 2004/108/EC
- Use of Work Equipment Directive 89/655/EEC supplemented by Directive 95/63 EC
- OSHA 1910 Subpart O
- Safety regulations
- Accident-prevention regulations and safety rules
- Ordinance on Industrial Safety and Health and Labor Protection Act
- Device Safety Act



### **Notice!**

*For safety-related information you may also contact the local authorities (e.g., industrial inspectorate, employer's liability insurance association, labor inspectorate, occupational safety and health authority).*

## 2.1 Approved purpose and foreseeable improper operation



### **Warning!**

*A running machine can cause severe injuries!*

*Make certain that, during all conversions, maintenance work and inspections, the system is securely shut down and protected against being restarted again.*

### 2.1.1 Proper use

The Test Monitoring Unit must only be used after it has been selected in accordance with the respectively applicable instructions and relevant standards, rules and regulations regarding labor protection and occupational safety, and after it has been installed on the machine, connected, commissioned, and checked by a **competent person**.

*When selecting the Test Monitoring Unit it must be ensured that its safety-related capability meets or exceeds the required performance level  $PL_r$ , ascertained in the risk assessment.*

The following table shows the safety-related characteristic parameters of the KA 970 series.

<b>Safety-relevant technical data</b>	
Type in accordance with IEC/EN_61496	Type_2
Performance Level (PL) in accordance with EN_ISO_13849-1: 2008	PL_d
Category in accordance with EN_ISO_13849-1	Cat_2
Average probability of a failure to danger per hour (PFH <sub>d</sub> )	8.8 x 10 <sup>-8</sup> 1/h
Mean time to dangerous failure (MTTF <sub>d</sub> )	69 years
Degree of cover DC	90%
Number of cycles until 10 % of the components have a failure to danger (B <sub>10d</sub> )	DC 13 - 24 V: 10 million switching cycles (2 A) AC 15 - 230 V: 100,000 switching cycles (2 A) 600,000 switching cycles (1 A) 1.3 million switching cycles (0.5 A)
Service life (T <sub>M</sub> )	20 years

**Table 2.1-1:** Safety-related characteristic parameters of the KA 970 series

- The Test Monitoring Unit is used in combination with one or more Multiple Light Beam Safety Devices or Safety Light Curtains to safeguard danger zones or points of operation.
- The control of the machine or system that is to be safeguarded must be electrically influenceable. A switch command initiated by a KA 970 must result in an immediate shutdown of the dangerous movement.
- The "Reset" acknowledgment button for unlocking the start/restart interlock must be mounted in such a way that the entire danger zone can be seen from its mounting location.
- Message outputs (state outputs) must not be used for switching safety-relevant signals.
- The Test Monitoring Unit is designed for installation in a cabinet or a protective housing with a protection rating of at least IP 54.
- The 24 V DC ±20% power supply must guarantee safe isolation from the mains voltage and be able to bridge a power outage period of 20 ms.
- Depending on external wiring, dangerous voltages may be present at the switching outputs. In addition to the power supply, these must be switched off and safeguarded against being switched back on prior to all work on the KA 970.
- These operating instructions must be included with the documentation of the machine on which the protective device is installed so that they are available to the operator at all times.
- Manipulating the Test Monitoring Unit also voids all warranty claims against the manufacturer of the Test Monitoring Unit.
- The Test Monitoring Unit must be tested regularly by competent personnel.



- The safety distance between the AOPD and the point of operation is to be maintained. It is calculated according to the formulas for machine-specific C standards or given in the general B1 standard ISO 13855. The reaction time of the Test Monitoring Unit and the braking time of the machine must be taken into account.
- Two switching contacts must always be looped into the switch-off circuit of the machine. To prevent welding, relay switching contacts must be fused/protected externally according to the technical data.
- The Test Monitoring Unit must be exchanged after a maximum of 20 years. Repairs or the exchange of parts subject to wear and tear do not extend the service life.

### 2.1.2 Foreseeable misuse

Any use other than that defined under the "intended use" or which goes beyond that use is considered improper use!

e.g.

- applications in explosive or easily flammable atmospheres
- use on machines with long periods of downtime



#### **Attention!**

*Such instances can jeopardize the health and lives of the personnel operating the machinery and/or may cause damage to property.*

## 2.2 Competent personnel

Prerequisites for competent personnel:

- he has a suitable technical education
- he knows the rules and regulations for occupational safety, safety at work and safety technology and can assess the safety of the machine
- he knows the instructions for the Test Monitoring Unit and the machine
- he has been instructed by the responsible person on the mounting and operation of the machine and of the Test Monitoring Unit

## 2.3 Responsibility for safety

Manufacturer and operating company must ensure that the machine and implemented Test Monitoring Unit function properly and that all affected persons are adequately informed and trained.

The type and content of all imparted information must not lead to unsafe actions by users.

The manufacturer of the machine is responsible for:

- safe machine construction
- safe implementation of the Test Monitoring Unit
- imparting all relevant information to the operating company
- adhering to all regulations and directives for the safe starting-up of the machine

The company operating the machine is responsible for:

- instructing the operating personnel
- maintaining the safe operation of the machine
- adhering to all regulations and directives for occupational safety and safety at work  
*regular testing by competent personnel*

## 2.4 Exemption of liability

Leuze electronic GmbH + Co. KG is not liable in the following cases:

- Test Monitoring Unit is not used as intended
- safety notices are not adhered to
- reasonably foreseeable misuse is not taken into account
- mounting and electrical connection are not properly performed
- proper function is not tested
- changes are made to the Test Monitoring Unit

### 2.4.1 Areas of application

The test monitoring unit KA 970 may be used as disconnecting protective devices for the protection of hazardous areas on power-driven machines.

They are authorised for the following areas of application (extract):

- Edge, frame, star, and carcass presses in lumber industry acc. to prEN 691 resp. ZH 1/3.19
- Printing and paper processing machines acc. to prEN 1010
- Power driven windows, doors, and gates acc. to ZH 1/494
- Storage equipment and devices acc. to ZH 1/482 and DIN 15185 part 2
- Textile machines acc. to VBG and DIN EN ISO 11 111
- Food processing equipment acc. to prEN 1672-1 resp. VBG 77
- Packaging machinery acc. to prEN 415-1 to -7 resp. VBG 76
- Meat processing equipment acc. to prEN 12463 resp. VBG 79
- Machines of the chemical, rubber, and plastic industry acc. to VBG 22

## 2.5 Organizing Measures

Mounting, commissioning and maintenance of the device must only be carried out by qualified personnel. Electrical work must be carried out by a certified electrician.

Adjustment and change of the safety field for the protection of persons may only be carried out by an authorised person.

Repairs, in particular the opening of the housing, may only be carried out by the manufacturer or a person authorised by the manufacturer.

### 3 Mounting of the Safety System



**Note:**

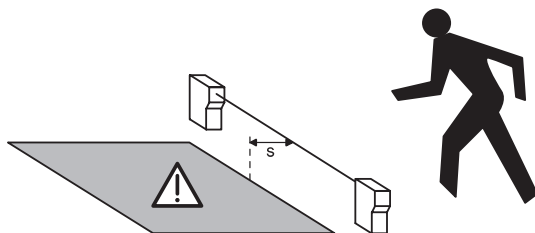
The mounting instructions in this chapter have to be heeded for fault-free functioning of the whole safety system.

#### 3.1 Mounting of the Protective Photoelectric Sensor

It is absolutely mandatory that the valid guidelines and standards are observed when mounting the protective photoelectric sensors.

**Safety distance**

A certain time delay applies between the interruption of the light beam of the protective photoelectric sensors and the stand-still of the machine. The photoelectric sensors have to be installed in such a way that the dangerous area cannot be reached within this time delay. The minimum distance for safeguarding the hazardous area is 850 mm.



**Fig. 3.1-1:** Safety distance S between photoelectric sensor and hazardous area

**Calculation of the safety distance**

The safety distance S between photoelectric sensor and hazardous area is calculated acc. to EN 999 using the following formula:

$$S = K * T + C$$

S = Safety distance between photoelectric sensor and hazardous area

K = Grip and approach speed

T = Time delay between interruption of the light beam and stand-still of the machine

C = Safety constant

1200 mm for single-axle arrangement,

850 mm for multi-axle arrangement

**Example for the calculation of the safety distance:**

A machine with a system response time of 100 ms has to be equipped with a two-beam safeguarding. The response time of the two-beam AOPD and the test monitoring unit KA 970 is 20 ms.

**Application of the formula:  $S = K * T + C$**

Where:

S = the minimum distance of the two-beam AOPD from the hazardous area

K = approach speed 1600 mm/s (EN 999)

T = sum of the system response time of the machine and response time of the AOPD  
850 mm with multi-axe installation

This results in:

**$S = (1600 \text{ mm/s} * (100 \text{ ms} + 20 \text{ ms})) + 850 \text{ mm}$**

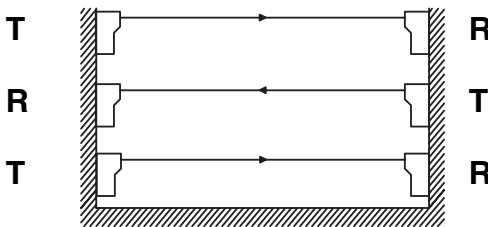
**S = 1042 mm**

**3.1.1 Multi-axe installation**

For the safeguarding of hazardous areas, the level of desired protection and the number of light beams are determined in EN 999 or through a risk analysis acc. to ISO 13849.

With multi-axe installation, parallel light beams always have to run in opposite directions. Otherwise the light beams can cause mutual interference and disturb proper functioning.

Depending on the number of photoelectric sensor pairs, the single systems have to be mounted at different heights acc. to EN 999. The number of needed systems results from the corresponding type C standard or risk evaluation.

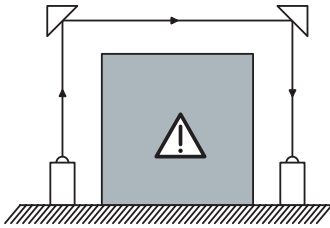


**Fig. 3.1-2:** Multi-axe installation

**Deflection mirrors**

A number of important factors have to be observed when using deflection mirrors:

- With any light beam deflection, a loss of operating range occurs. Per deflection mirror, the loss is approx. 15 %.
- Contamination of the deflection mirrors should be avoided.
- Environmental conditions such as steams and dust-containing air heavily limit the operating range.
- When installing deflection mirrors, the optical axis of the photoelectric sensor must be centered to the mirror.
- A laser alignment aid made by Leuze, e.g. ARH 2 facilitates alignment over large distances.

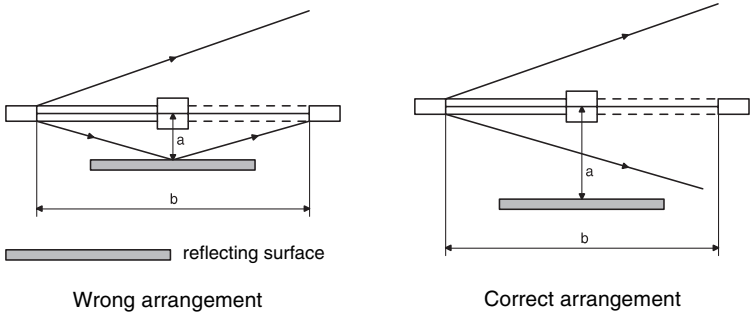


**Fig. 3.1-3:** Arrangement of the deflection mirrors

**Reflection bypass**

Surfaces located parallel to the light beam can cause a reflection bypass. An object within the light path is then no longer detected.

The photoelectric sensor has to be mounted with a minimum lateral distance to the reflecting surface. This distance results from the opening angle ( $\pm 4^\circ$ ) and the distance between transmitter and receiver.



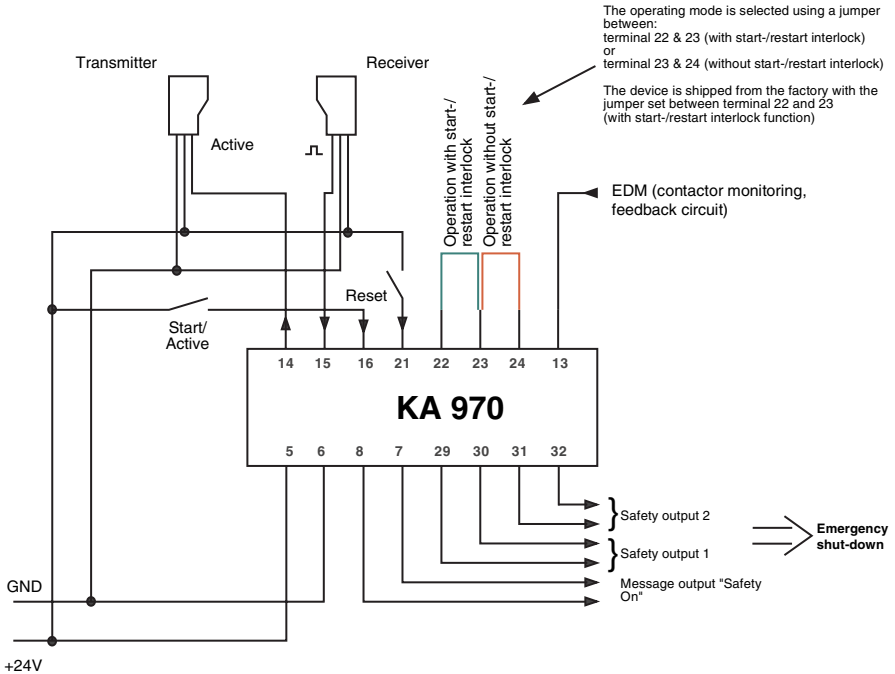
**Fig. 3.1-4:** Reflection bypass

<b>Minimum distance to the reflecting surface</b>						
Between transmitter and receiver (b)	2 m	3 m	4 m	5 m	6 m	10 m
To light beam (a) approx.	0.20 m	0.30 m	0.40 m	0.50 m	0.60 m	1.0 m

## 4 Function and Commissioning of the KA 970

### 4.1 Function characteristics of the safety system

The complete safety system consists of a KA 970 and accompanying protective photoelectric sensors or light barriers.



**Fig. 4.1-1:** Installation of the complete safety system

After the KA 970 is switched on via the start input, the functionality of the protective photoelectric sensors is monitored in two-second cycles.

The electrical integration into the controller has to be performed acc. to the corresponding safety category acc. to ISO 13849. The voltage free safety relay outputs can be directly used for shut-down of the dangerous movement.

Inside the monitoring unit KA 970, a selectable start-/restart interlock, as well as a selectable contactor monitoring are integrated.

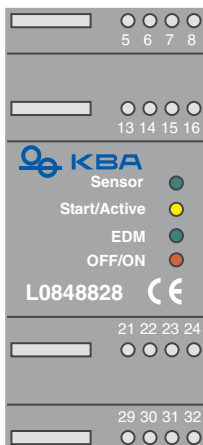
#### 4.1.1 Display and Operating Instruments

The test monitoring unit KA 970 features integrated LEDs to indicate the state of the system.

The start-/restart interlock, as well as the contactor monitoring functions are set on the KA 970 using the corresponding jumpers on the connection terminals.

**Overview - Display Elements**

- LED "Sensor"  
Status of the safety field state
- LED "Start/Active"  
Status of the start and activation input
- LED "EDM"  
Status of the contactor monitoring
- LED "OFF/ON"  
Status of the safety circuit (open or closed)



**Fig. 4.1-2:** Display elements KA 970

**4.2 Electrical Installation**



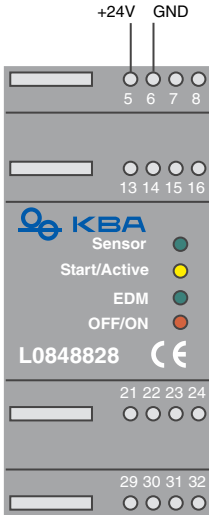
**Warning!**

*The electrical installation is only to be performed by specialised personnel. Supply and signal lines have to be installed separately from power lines during installation. Inside the switching cabinet, suitable spark extinction has to be provided if using contactors. When installing drive motors and brakes, the corresponding installation manuals have to be observed.*

The power supply for the KA 970 must be equipped with a protective mains separation device according to IEC 60742. The power supply unit used to operate the KA 970 has to be able to compensate for changes and interruptions of the supply voltage acc. to EN 61496-1.

### 4.2.1 Supply wiring

The test monitoring unit KA 970 is supplied with 24V DC +/- 15%. The max. current consumption is 200mA. The +24V supply voltage is connected to terminal 5 and the GND is connected to terminal 6.



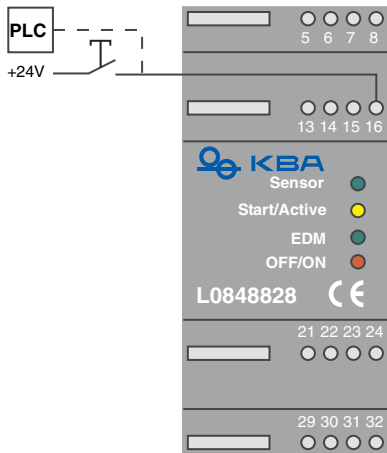
**Fig. 4.2-1:** Supply wiring



**4.2.2 Start input wiring**

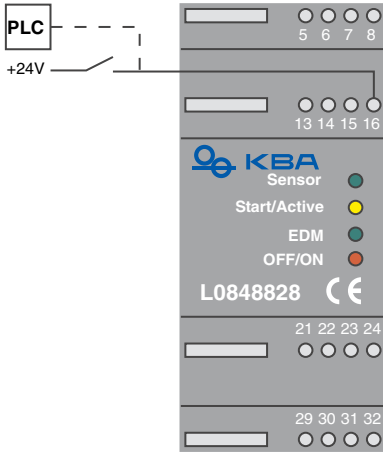
The Start input (terminal 16) works both in the operating mode "with start-/restart interlock" and "without start-/restart interlock" in different ways:

- In the operating mode with start-/restart interlock, the KA 970 expects two signal changes (push-button function) as switch-on signal. A failure in the start-/restart button, e.g. due to contact malfunction is safely detected by the KA 970.



**Fig. 4.2-2:** Wiring of the start input "with start-/restart interlock"

- In the operating mode without start-/restart interlock, the start input works as activation input. As soon as a HIGH active signal is present at the start input (terminal 16) and the safety field is free, the safety outputs are closed.

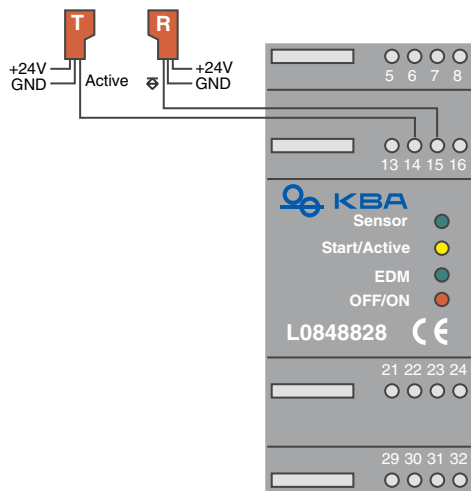


**Fig. 4.2-3:** Wiring of the start input "without start-/restart interlock"

**4.2.3 Wiring of single-beam protective photoelectric sensors**

The activation input of the protective photoelectric sensor can be directly connected to terminal 14 on the KA 970. The switching output of the receiver can be directly connected to terminal 15.

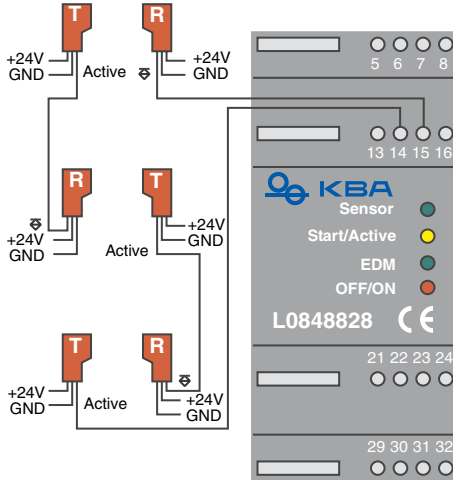
The GND potential present on terminal 6 serves as a reference potential for both signals. The supply of the protective photoelectric sensors comes directly from the 24V power supply unit.



**Fig. 4.2-4:** Wiring of single-beam protective photoelectric sensors

### 4.2.4 Wiring of single-beam protective photoelectric sensors in series

Several photoelectric sensor pairs can be connected in series with multi-axe arrangements on a machine or system. The adjacent picture shows a three-axe photoelectric sensor arrangement. It is possible to operate up to six photoelectric sensor pairs on one KA 970.



**Fig. 4.2-5:** Wiring of single-beam protective photoelectric sensors in series

#### Function characteristics:

The KA 970 (terminal 14) activates the first photoelectric sensor transmitter. The receiver is activated via the first optical path and, by using its output, activates the second photoelectric sensor transmitter. The supply has to be provided on each photoelectric transmitter and receiver. The feedback to the KA 970 (terminal 15) is done by the last photoelectric sensor receiver within the series connection.

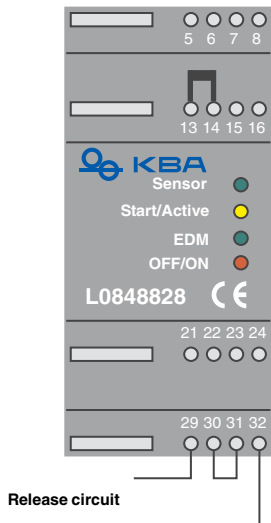
Any time the light axis is interrupted, a message is issued to the KA 970 through the series connection.

The series connection tests every transmitter and receiver for function capability while performing the testing procedure.

**4.2.5 Wiring safety output**

**Integration in a one-channel release circuit without contactor monitoring**

Two safety relay outputs are connected in series. The release circuit can be connected to further components which are then wired to a common EMERGENCY SHUT-DOWN device.



**Fig. 4.2-6:** Wiring safety output (one-channel release circuit)

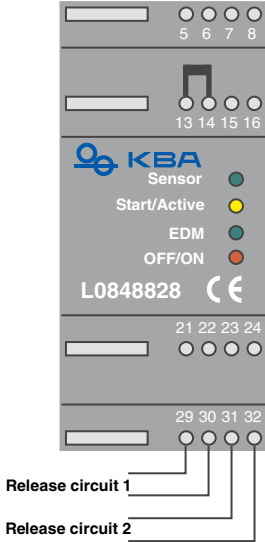


**Note:**

For the operating mode without contactor monitoring, the jumper that short-circuits terminals 13 and 14 must be set.

**Integration in a two-channel release circuit without contactor monitoring**

Both safety relay outputs are integrated separately into the release circuits. These circuits can be connected with additional components which trigger a common EMERGENCY SHUT-DOWN device.



**Fig. 4.2-7:** Wiring safety output (two-channel release circuit)

i

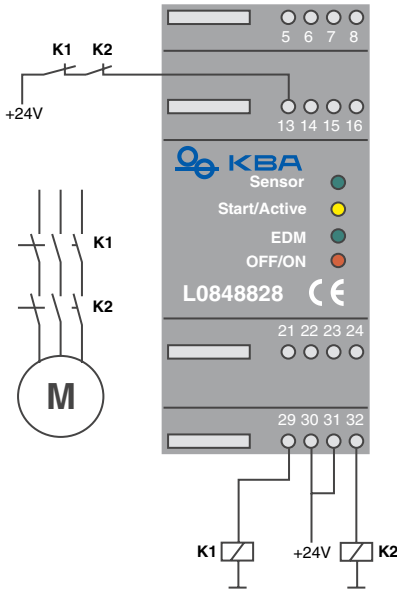
**Note:**

For the operating mode without contactor monitoring, the jumper that short-circuits terminals 13 and 14 **must** be set.

**Integration with contactor monitoring as EMERGENCY SHUT-DOWN device**

The motor contactors for dangerous movement are connected to both safety relay outputs. For this purpose, forced contactors have to be used. In the connection diagram, no fuses are included. However, for correct function fuses are absolutely required. The maximum contact load of the safety relay outputs is 4A with 24VDC.

Control of the motor contactors happens via K1 and K2. If a contact of K1 and K2 should weld, a message is issued to the KA 970 through the feedback circuit (EDM). A new start of the unit is possible only after removal of the failure in the output circuit.



**Fig. 4.2-8:** Wiring of the safety output with contactor monitoring

### 4.2.6 Wiring of the message outputs

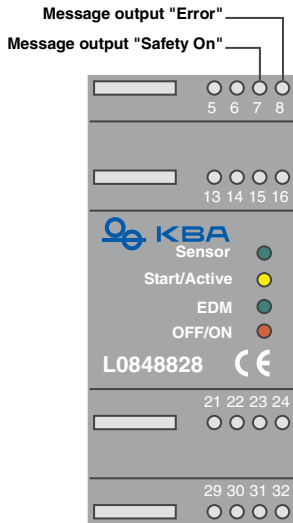
Two message outputs are integrated in the KA 970. Both are HIGH active, positive switching semiconductor outputs and can be either directly connected to a PLC or control a status display of a machine.

The message output "Safety on" is always active if the safety relay outputs are closed.

The message output "Error" is always active if the KA 970 detects an error. Those errors can be internal or external.

Through linking of the status outputs in the controller, the following system states can be detected:

1. "Safety on" active, "Error" inactive  
Normal operation of the KA 970, no error detected
2. "Safety on" inactive, "Error" active  
The KA 970 detected a safety relevant failure which led to the switching off of the safety outputs.



**Fig. 4.2-9:** Wiring of the message outputs



**4.2.7 Setting of the operating mode**

The start-/restart interlock function is selected on the device by setting a jumper between terminals 22 and 23 or terminals 23 and 24.

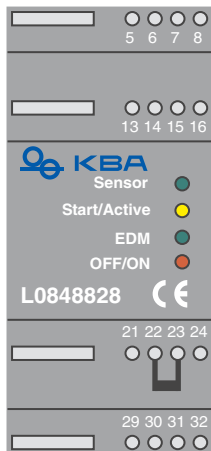


**Warning!**

*Terminals 22, 23 and 24 may only be used to for selecting the operating mode using the included short circuit jumpers.*

**With start-/restart interlock:**

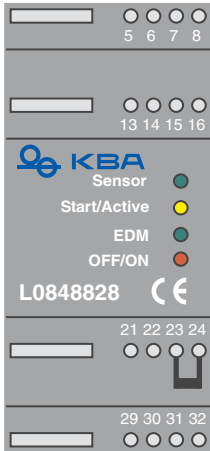
The device is shipped with a jumper between terminals 22 and 23, i.e. the start-/restart interlock is active.



**Fig. 4.2-10:** Operating mode "with start-/restart interlock"

**Without start-/restart interlock:**

The start-/restart interlock is set to inactive by connecting a jumper between terminals 23 and 24.



**Fig. 4.2-11:** Operating mode "without start-/restart interlock"

**Completing the setting:**

After the setting has been changed, the new device setting must be saved. This is done either by triggering the Reset input (terminal 21) or by switching the supply voltage on and off for a short time.

### 4.3 Operating states without start-/restart interlock

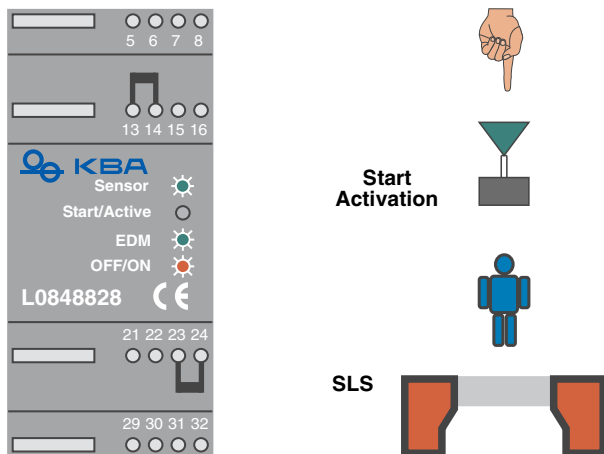
**Stand-by operation:**

The free light path is displayed by the green LED "Sensor".

Activation is not used.

The safety outputs are open. This state is displayed by the red LED.

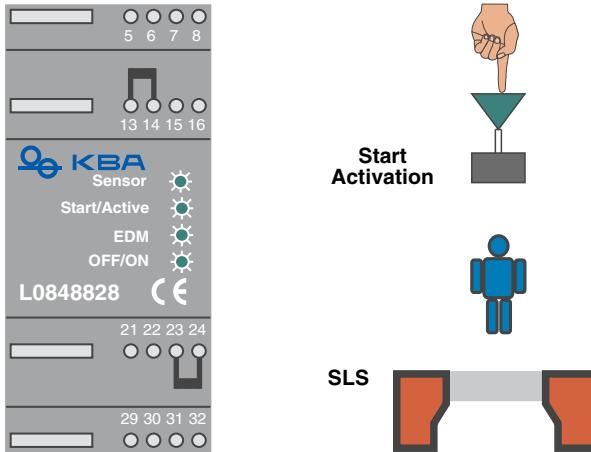
The display for the contactor monitoring (EDM) is active.



**Fig. 4.3-1:** Display of the KA 970 in stand-by operation

**Safety operation:**

In safety operation, the function of the protective photoelectric sensor is cyclically tested every two seconds. The free safety field is displayed by the green LED. Activation is used (green LED). The safety output is closed which is displayed by the green LED.

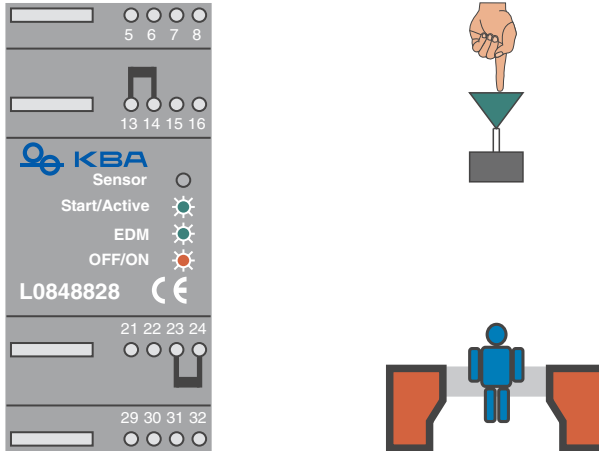


**Fig. 4.3-2:** Display of the KA 970 in safety operation

**Safety field interruption:**

If during safety operation the protective photoelectric sensor is interrupted or the +24V activation signal on the active input is switched off, then the safety output is opened.

After the safety field has been cleared again and the startup test has been completed successfully, the KA 970 automatically switches the safety relay output back on again.



**Fig. 4.3-3:** Display of the KA 970 during a safety field interruption



**Note:**

The input for the contactor monitoring (terminal 13) always must be wired. For operation without the contactor monitoring function, a jumper can be set between terminal 13 and terminal 14.

Connected relays can be monitored if the wiring of the input to terminal 13 is carried out according to the connection diagram "Operation with contactor monitoring as EMERGENCY SHUT-DOWN device".

Faulty wiring results in the the safety outputs not switching on. If a fault occurs, the safety outputs switch off with a maximum delay of two seconds.



**Note:**

The activation input must be wired with +24V in order for the safety inputs to switch on!

### 4.4 Operating states with start-/restart interlock without contactor monitoring (EDM)

**Stand-by operation:**

The free light path is displayed by the green LED "Sensor".

The start input has not been activated.

The safety output is open. This state is displayed by the red LED "OFF/ON". The yellow LED "Start" displays the lock of the start-/restart interlock.

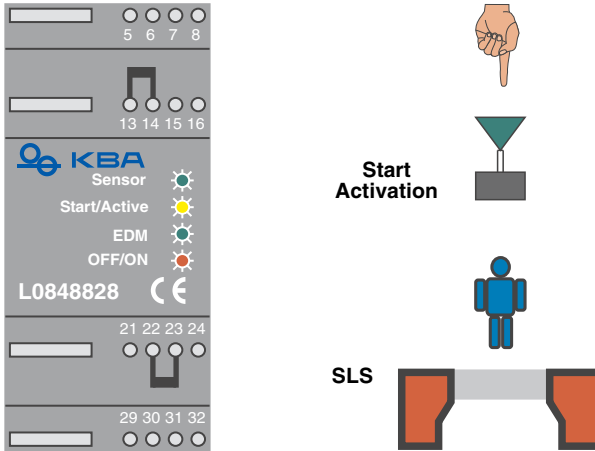


Fig. 4.4-1: Display of the KA 970 in stand-by operation

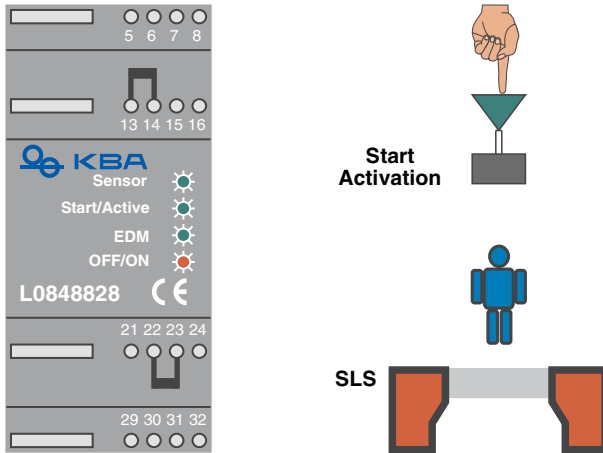
**Test operation:**

In test operation, the proper functioning of both the protective photoelectric sensor and the test monitoring unit is checked.

To induce the test operation, the start input is activated (green LED "Start").

As long as the start-/restart button is pressed, the test operation remains active.

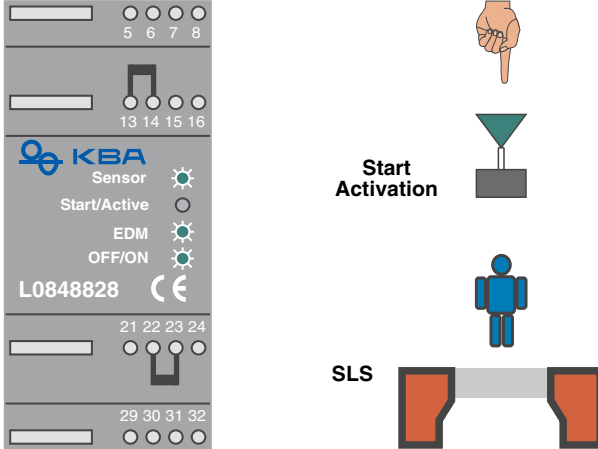
After release of the start-/restart button, the KA 970 changes from test operation to safety operation.



**Fig. 4.4-2:** Display of the KA 970 in test operation

**Safety operation:**

In safety operation, the function of the protective photoelectric sensor is cyclically tested every two seconds. The free safety field is displayed by the green LED "Sensor". The safety outputs are closed which is displayed by the green LED "OFF/ON".



**Fig. 4.4-3:** Display of the KA 970 in safety operation

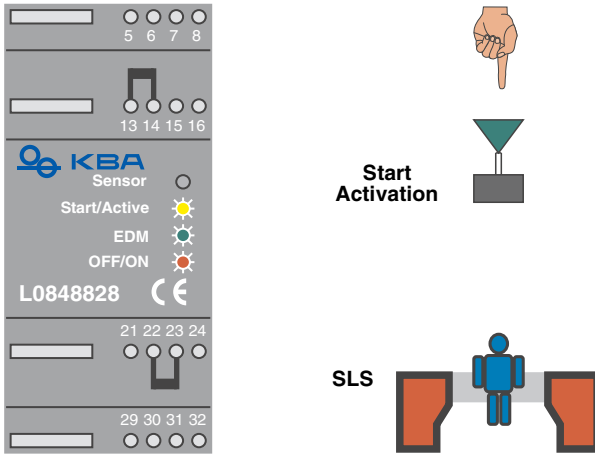


**Safety field interruption:**

The safety outputs of the KA 970 are opened (LED "OFF/ON" on red) if during safety operation the light beam of the protective photoelectric sensor is interrupted.

The restart interlock inside the KA 970 becomes active and prevents an automatic restart of the machine. The yellow LED "Start" displays the function of the restart interlock.

The KA 970 is in waiting state and can be restarted by pressing the start-/restart button after the safety field is free.



**Fig. 4.4-4:** Display of the KA 970 during a safety field interruption

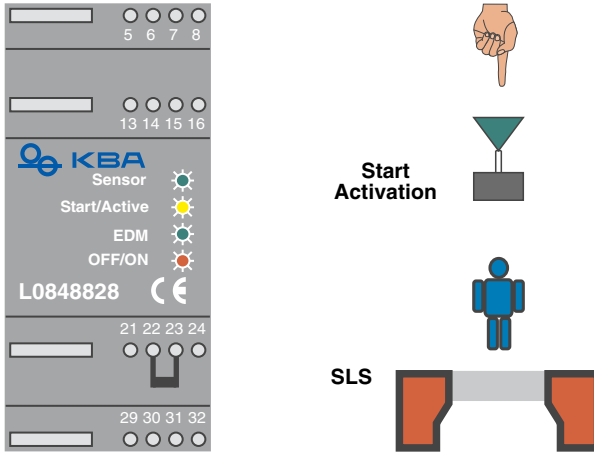
### 4.5 Operating states with start-/restart interlock and with contactor monitoring (EDM)

**Stand-by operation:**

The free light path is displayed by the green LED "Sensor".

The contactor monitoring (EDM) is active (green LED "EDM").

The safety output is open. This state is displayed by the red LED "OFF/ON". The yellow LED "Start" displays the lock of the start-/restart interlock.



**Fig. 4.5-1:** Display of the KA 970 in stand-by operation

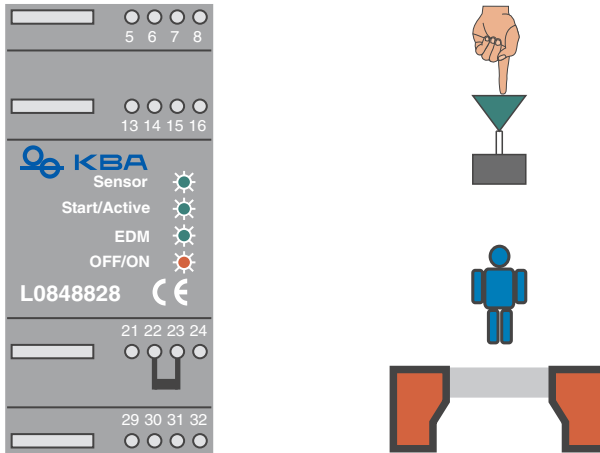
**Test operation:**

In test operation, the proper functioning of both the protective photoelectric sensor and the test monitoring unit is checked.

To induce the test operation, the start input is activated (green LED "Start").

As long as the start-/restart button is pressed, the test operation remains active.

After release of the start-/restart button, the KA 970 changes from test operation to safety operation.



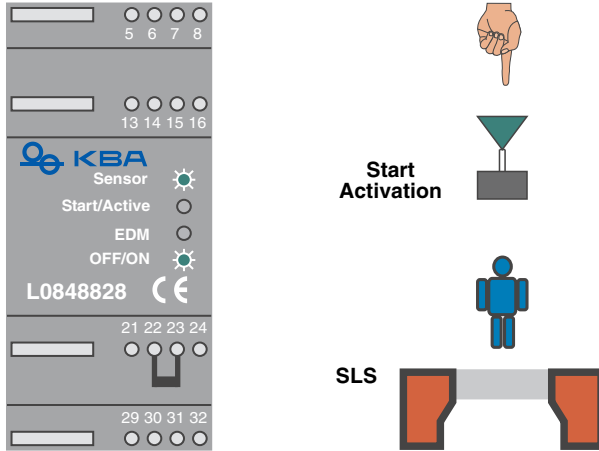
**Fig. 4.5-2:** Display of the KA 970 in test operation

**Safety operation:**

In safety operation, the function of the protective photoelectric sensor is cyclically tested every two seconds. The free safety field is displayed by the green LED "Sensor".

The contactor monitoring is inactive in safety operation (green LED "EDM" off).

The safety outputs are closed which is displayed by the green LED "OFF/ON".



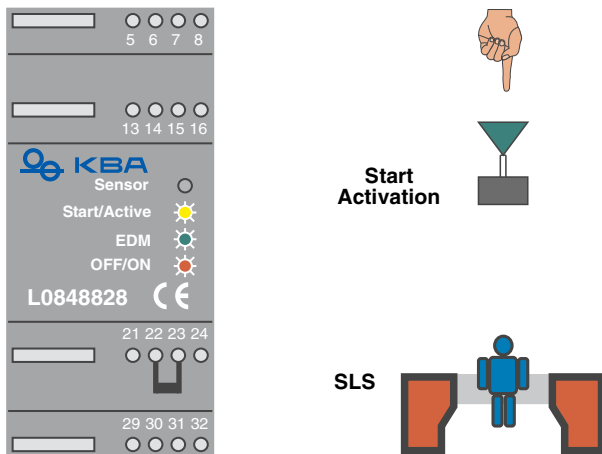
**Fig. 4.5-3:** Display of the KA 970 in safety operation

**Safety field interruption:**

The safety outputs of the KA 970 are opened (LED "OFF/ON" on red) if during safety operation the light beam of the protective photoelectric sensor is interrupted.

The restart interlock inside the KA 970 becomes active and prevents an automatic restart of the machine. The yellow LED "Start" displays the function of the restart interlock.

The KA 970 is in waiting state and can be restarted by pressing the start-/restart button after the safety field is free.



**Fig. 4.5-4:** Display of the KA 970 during a safety field interruption

**4.6 Fault indication and device reset**

Faults of the test monitoring unit KA 970 are indicated by the blinking of the red "ON/OFF" LED. The possible faults are:

**Fault in the operating mode selection:**

The selected operating mode of the device at startup (with/without start-/restart interlock) changed during operation. The jumper (terminal 22 to terminal 23 or terminal 23 to terminal 24) should be checked that it is set to the desired operating mode.

**Fault in the contactor monitoring:**

A fault in the wiring or soldered safety contacts was detected by the KA 970. The wiring and connected contacts should be checked.

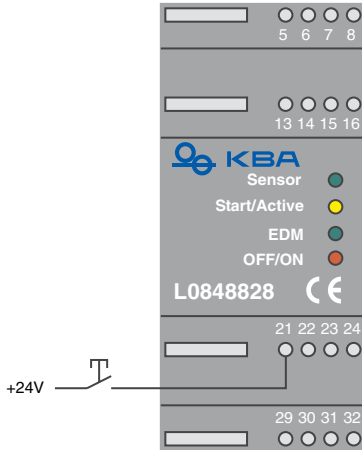
**Internal device failures:**

Equipment faults that are caused by an internal defect result in the unit going into locked state.

**Resetting from a locked state:**

Resetting from a locked state is carried out by disconnecting the supply voltage for a short time or by applying a reset signal (+24V potential) to the reset input (terminal 21).

The LED will stop blinking after the fault has been eliminated and the device reset from the locked state.



**Fig. 4.6-1:** Resetting from a locked state

**4.7 Technical Data**

Safety-relevant technical data	
Type in acc. with IEC/EN_61496	Type_2
Performance Level (PL) in acc. with EN_ISO_13849-1: 2008	PL_d
Category in accordance with EN_ISO_13849-1	Cat._2
Average probability of a failure to danger per hour (PFH <sub>d</sub> )	8.8 x 10 <sup>-8</sup> 1/h
Mean time to dangerous failure (MTTF <sub>d</sub> )	69 years
Degree of cover DC	90%
Number of cycles until 10 % of the components have a failure to danger (B <sub>10d</sub> )	DC 13 - 24 V: 10 million switching cycles (2 A) AC 15 - 230 V: 100,000 switching cycles (2 A) 600,000 switching cycles (1 A) 1.3 million switching cycles (0.5 A)
Service life (T <sub>M</sub> )	20 years

<b>Electrical data</b>	
<b>Supply voltage <math>U_b</math></b>	24V DC +/-15 %
<b>Residual ripple</b>	< 15 %
<b>Current consumption</b>	approx. 200 mA
<b>Response time</b>	< 20 ms
<b>Delay before start-up</b>	approx. 2 s

<b>Sensors</b>	
<b>Transmitter activation</b>	PNP (HIGH active)
<b>Receiver input</b>	optical coupler input, input current approx. 10 mA

<b>In- and outputs</b>	
<b>Start input</b>	optical coupler input (High active) input current approx. 10 mA
<b>Reset input</b>	optical coupler input (High active) input current approx. 10 mA
<b>Contact monitoring (EDM)</b>	optical coupler input (High active) input current approx. 10 mA
<b>Message output Safety on</b>	PNP transistor output, 100 mA short circuit- and polarity reversal protection
<b>Message output Error</b>	PNP transistor output, 100 mA short circuit- and polarity reversal protection
<b>Safety output</b>	voltage free make-contact max. switching voltage 250V AC max. current load 4 A
<b>Safeguarding</b>	externally with max. 4 A slow blow
<b>Overvoltage category</b>	2 for rating voltage 300V AC according to VDE 0110 part 1

<b>Environmental data</b>	
<b>Ambient temperature</b>	-20°C - +60°C
<b>Storage temperature</b>	-30°C - +70°C
<b>Protection class</b>	IP 40 (only for application in electrical operating rooms/switching cabinet with minimum protection class IP 54 is suitable)

<b>Impact resistance/Vibration resistance</b>	
<b>EMB/EMV</b>	acc. to EN 61496-1
<b>Contact protection</b>	acc. to VBG 4 and VDE 0106 part 100

<b>Mechanical data</b>	
<b>Housing</b>	Polyamide PA 6.6/grey
<b>Connection</b>	Screw terminals, connection cross-section 0.2 - 2.5 mm
<b>Mounting</b>	snap-on mounting for standard rail according to EN 50022
<b>Weight</b>	approx. 200 g
<b>Dimensions (WxHxD)</b>	45 mm x 100 mm x 115 mm



## 5 Applications

<b>Environmental data</b>	
<b>Ambient temperature</b>	-20°C - +60°C
<b>Storage temperature</b>	-30°C - +70°C
<b>Protection class</b>	IP 40 (only for application in electrical operating rooms/switching cabinet with minimum protection class IP 54 is suitable)

In the following chapter, a number of examples of applications are given, which illustrate the wide application areas of the KA 970.

### 5.1 Example with retro-reflective photoelectric safety sensor SRK 96

Up to three SRK 96 retro-reflective photoelectric safety sensors can be connected in series directly to the KA 970. The supply of the retro-reflective photoelectric safety sensors comes directly from the power supply of the installation/machine. Test monitoring of the photoelectric sensors is carried out by the KA 970.

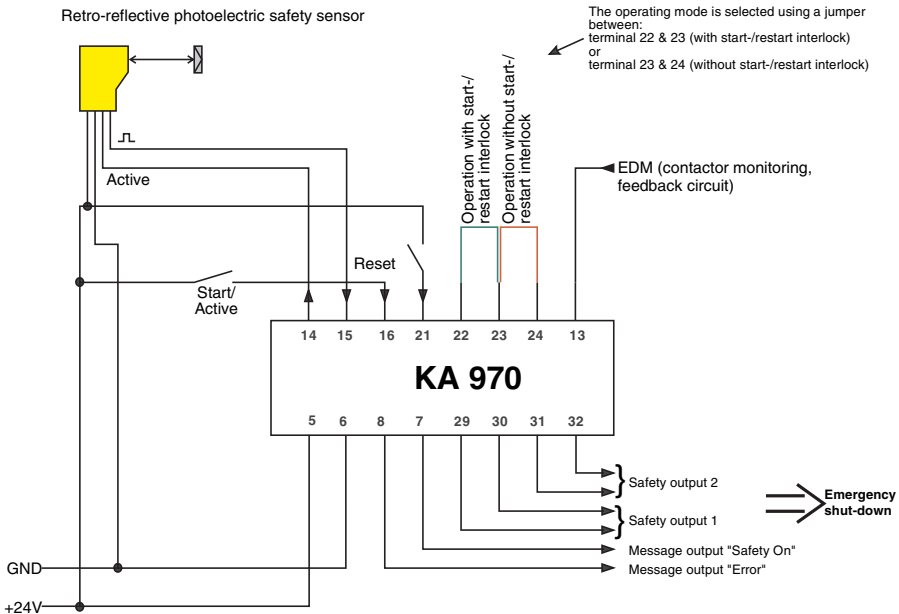


Fig. 5.1-1: Connection diagram for connecting an SRK 96

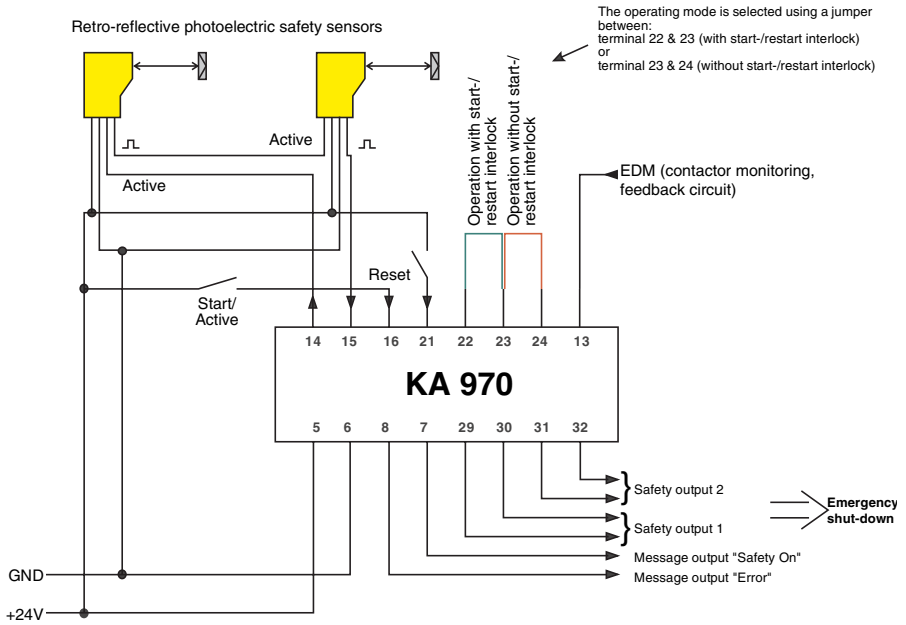
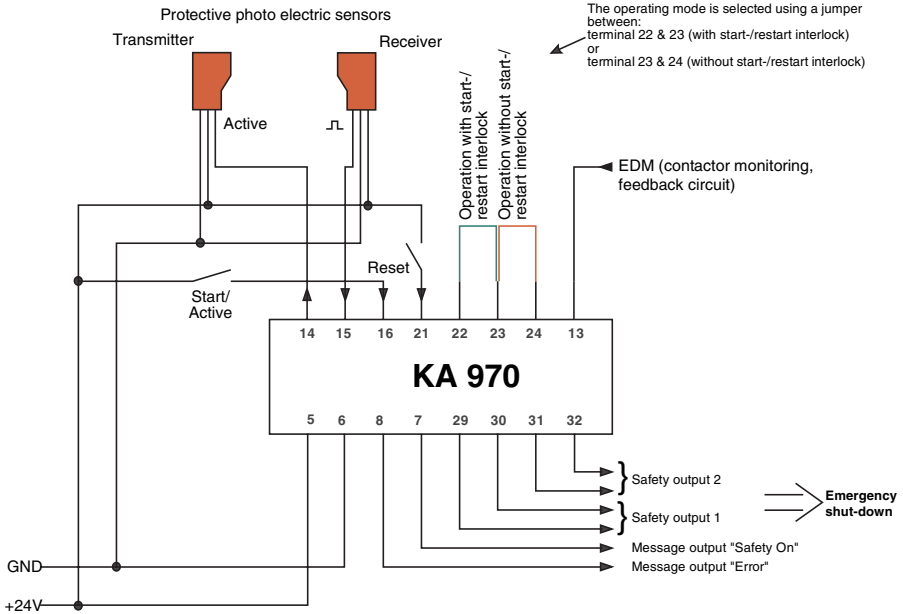


Fig. 5.1-2: Connection diagram for connecting two SRK 96s

**5.2 Example with a protective photoelectric sensor SLS 96 ...**

Up to six pairs of SLS 96 protective photoelectric sensors can be connected in series directly to the KA 970. The supply of the protective photoelectric sensors comes directly from the power supply of the installation/machine. Test monitoring of the photoelectric sensors is carried out by the KA 970.



**Fig. 5.2-1:** Connection diagram for a pair of SLS 96s

## 6 Appendix

### 6.1 Remaining Risks (EN 292-1)

The circuit proposals as shown in this manual have been tested and checked with the highest possible care. The current standards and guidelines are fulfilled if using the shown components and the corresponding wiring. Remaining risks are present if:

- the proposed circuit concept is changed and the connected safety-relevant components or protective devices are possibly not or insufficiently included in the safety circuit.
- the user did not comply with the current safety regulations for operation, adjustment and maintenance of the machine. Strict compliance with the intervals for checking and maintenance of the machine is mandatory.

**7 EC Declaration of Conformity**



the sensor people

**EG-KONFORMITÄTS-  
ERKLÄRUNG  
(ORIGINAL)**

**EC DECLARATION OF  
CONFORMITY  
(ORIGINAL)**

**DECLARATION CE DE  
CONFORMITE  
(ORIGINAL)**

Der Hersteller	The Manufacturer	Le constructeur
<p>erklärt, dass die nachfolgend aufgeführten Produkte den einschlägigen Anforderungen der genannten EG-Richtlinien und Normen entsprechen.</p>		
<p>declares that the following listed products fulfil the relevant provisions of the mentioned EC Directives and standards.</p>		
<p>déclare que les produits identifiés suivants sont conformes aux directives CE et normes mentionnées.</p>		
<p>Leuze electronic GmbH + Co. KG In der Braike 1, PO Box 1111 73277 Owen, Germany</p>		
<b>Produktbeschreibung:</b>	<b>Description of product:</b>	<b>Description de produit:</b>
<p>Test-Überwachungseinheit, Sicherheitsbauteil nach 2006/42/EG Anhang IV TNT 35.2 SW, Version 3.0, KA 970 Serienr. 10 01 50000 - 99 12 99999</p>	<p>Test Monitoring Unit, safety component in acc. with 2006/42/EC annex IV TNT 35 TNT-24V-SW, Version 1.3 TNT 35.2 SW, Version 3.0, KA 970 Serial no. 10 01 50000 - 99 12 99999</p>	<p>Unité de surveillance test, Élément de sécurité selon 2006/42/CE annexe IV TNT 35 TNT-24V-SW, Version 1.3 TNT 35.2 SW, Version 3.0, KA 970 N° série 10 01 50000 - 99 12 99999</p>
<b>Angewandte EG-Richtlinie(n):</b>	<b>Applied EC Directive(s):</b>	<b>Directive(s) CE appliquées:</b>
<p>2006/42/EG 2004/108/EG</p>	<p>2006/42/EC 2004/108/EC</p>	<p>2006/42/CE 2004/108/CE</p>
<b>Angewandte Normen:</b>	<b>Applied standards:</b>	<b>Normes appliquées:</b>
<p>EN 61496-1:2004 + A1:2008; EN ISO 13849-1:2008</p>		
<b>Benannte Stelle / Baumusterprüfbescheinigung:</b>	<b>Notified Body / Certificate of Type Examination:</b>	<b>Organisme notifié / Attestation d'examen CE de type:</b>
<p>TÜV NORD CERT GmbH Benannte Stelle 0044 Langemarckstr. 20 45141 Essen</p>	/	44 205 10 380092
<b>Bevollmächtigter für die Zusammenstellung der technischen Unterlagen:</b>	<b>Authorized person to compile the technical file:</b>	<b>Personne autorisée à constituer le dossier technique:</b>
<p>Robert Sammer; Leuze electronic GmbH + Co. KG, business unit safety systems Liebigstr. 4; 82256 Fuerstenfeldbruck; Germany</p>		

Owen, 10.11.10  
Datum / Date / Date Dr. Harald Grübel, Geschäftsführer / Director / Directeur

Leuze electronic GmbH + Co. KG  
In der Braike 1  
D-73277 Owen  
Telefon +49 (0) 7021 573-0  
Telefax +49 (0) 7021 573-199  
info@leuze.de  
www.leuze.com  
LEO-ZDM-149-01-FO

Leuze electronic GmbH + Co. KG, Sitz Owen, Registergericht Stuttgart, HRA 233042  
Persönlich haftendes Gesellschafter: Leuze electronic, Geschäftsführung-GmbH,  
Sitz Owen, Registergericht Stuttgart, HRB 236550  
Geschäftsführer: Dr. Harald Grübel (Vorsitzender), Karsten Just  
USt-IdNr: DE 145910221 | Zulassenummer 2554532  
Es gelten ausschließlich unsere aktuellen Verkaufs- und Lieferbedingungen  
Only our current Terms and Conditions of Sale and Delivery shall apply

Nr. 60956-201011

You can also download this EC Declaration of Conformity from the Internet under:  
<http://www.leuze.com/interfaces>