Description

Opto-BEROs react to changes of the received quantity of light. The emitted light beam will be interrupted or reflected by the object to be detected. Depending on the type of BERO the interruption or reflection of the light beam is evaluated.

Available functions

Opto-BEROs are available as thru-beam sensors, reflex sensors and diffuse sensors. Because of the different physical principles under otherwise identical exterior conditions thru-beam sensors have wider transmission ranges than reflex sensors. Diffuse sensors can react also to diffuse-reflecting materials. So their sensing range is shorter than the sensing range of reflex sensors.

Diffuse sensors (energetic sensor)

The pulsed light from the transmitter diode falls on an object. It is reflected in a diffuse pattern and part of the light reaches the light receiver located in the same unit. If the intensity of light is sufficient, the output is switched. The sensing range depends on the size and colour of the object involved as well as on its surface texture. The sensing range can be varied within a wide range by means of the built-in potentiometer. Therefore, the energetic sensor can be used for detecting different colours.

Diffuse sensors with background suppression

Diffuse sensors with background suppression can detect objects up to a certain sensing range. All further objects will be suppressed. The focus level can be changed. The background suppression is done by the geometrical constellation between transmitter and receiver.

Reflex sensors

The pulsed light from the transmitter diode is focused through a lens and directed via a polarization filter to a reflector (principle of a 3-way mirror). Part of the reflected light passes through another polarization filter and reaches the receiver. The filters are selected and adjusted in such a way that only the light reflected by the reflector reaches the receiver, not the light from other objects within the beam range. An object which interrupts the light beam from the transmitter through the reflector to the receiver causes the output to switch.

Light array (7-beam reflex sensor)

The light of the seven transmitters of this special Opto-BERO is directed to one reflector and reflected to the seven receivers of the BERO. An object which interrupts one of these seven light beams causes the output to switch. A line of 42 mm can be completely covered. This type of Opto-BERO can be used e.g. in conveyor systems.

Thru-beam sensors

They consist of a transmitter and a receiver. The transmitter is aligned in such a way that the greatest possible amount of pulsed light from the transmitter diode reaches the receiver. The receiver evaluates the incoming light to clearly separate it from the ambient light and other light sources. Any interruption of the light beam between transmitter and receiver causes the output to switch.

Sensors for fibre-optic conductors

The basic operation is the same for optical fibres made of glass or plastic. Optical fibres are fitted in front of the transmitter and receiver. They represent the "extended eye" of the Opto-BERO. As fibre-optic conductors are very small and flexible, they form a truly practical solution to the problem of sensing at points that are not easily accessible. Furthermore, no electrical potential is transferred.

Fork sensors

The object is introduced into the fork of the BERO. The light of the sensor penetrates the object. Different contrasts, cracks or holes alter the quantity of light which reaches the receiver. The BERO reacts to the change in the amount of light received.

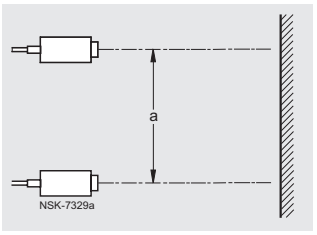
Colour sensor

The colour sensor works with three LED's in red, green and blue. This light shines onto the object. When configuring the BERO, the colour of the object is measured and an output status is allocated. During the learning phase, the BERO saves the colour recognised in non-volatile EEPROM. This means that the BERO does not need to be reset every time the operating voltage is switched back on again. A colour or a colour range can be set.

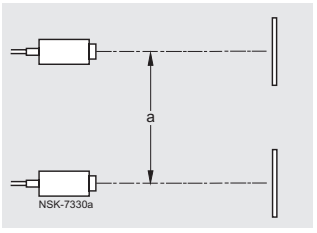
Print mark reader

The print mark reader works with a green or a red sender light. The colour is selected automatically as a function of the contrast. There are two sensors, so the colour of the mark and the colour of the background can be set separately.

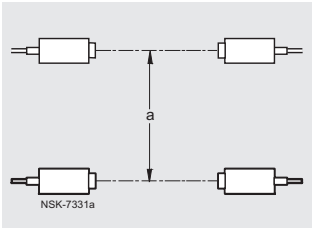
Diffuse sensor



Reflex sensor



Thru-beam sensor



Clearance

The Opto-BERO may not interfere with each other. For this reason a minimum distance **a** between 2 BEROs has to be observed.

The following distances are recommended values only. The values given are for maximum sensitivity.

BERO	distance **a**
D 4/M 5	50 mm
M 12	250 mm
M 18	250 mm
K 31	250 mm
K 30	500 mm
K 40	750 mm
K 80	500 mm
L 18	150 mm[1])
L 50 (diffuse sensor)	30 mm
L 50 (thru-beam sensor)	80 mm

1) For focussing to 50 m.

Opto-BERO dictionary

Adjustment (potentiometer)

Sensitivity is adjusted by means of the built-in multi-turn potentiometer. Turning it clockwise increases the sensitivity. The potentiometer cannot be overwound (no stops).

Diffuse sensors

Set the sensitivity and distance so that the object to be scanned is reliably detected. If required, the surplus light LED has to be activated. Now remove the object. If the output remains switched through, the sensitivity has to be reduced slightly.

Reflex sensors / Thru-beam sensors

The potentiometer is normally set to maximum (turned clockwise). This provides the maximum surplus light function. A reduction of sensitivity may be required if transparent objects are to be detected.

Alignment

Diffuse sensors

The BERO is to be aligned towards the object to be scanned in such a way as to ensure reliable switching. If the units have a surplus light function, the appropriate LED has to be activated.

Reflex sensors

- Place the reflector at the required location and secure it firmly.
- Cover the reflector all around with adhesive tape so that only the centre (approx. 25% of the surface) remains free.
- Install the reflex sensor so that it switches reliably.
- Now remove the adhesive tape from the reflector.

Thru-beam sensors

- Position the receiver as required and secure it firmly.
- Then align the transmitter accurately to the receiver.

Ambient light limit

Ambient light is the light produced by external light sources. The intensity of illuminance is measured on the light incidence surface. Due to the use of pulsating light the sensors are basically insensitive to ambient light. There is, nevertheless, an upper limit for the intensity of any external light which is referred to as the ambient light limit. It is indicated for sunlight (unmodulated light) modulated halogen light (light modulated at double system frequency). A reliable operation of the units is no longer possible if the illuminance is above the relevant ambient light limit.

Antivalent (outputs)

Opto-BEROs have two outputs. One switches **dark-ON**, the other **light-ON**. This configuration is called antivalent. Alternatively some of the devices are available with a different configuration of the outputs. One output switches light-ON, the other is for the surplus light function.

Autocollimation

For these units the optical axes of transmitter and receiver are the same. The device has only one optical system so that there is no close range in front of the BERO and the accuracy of the switching point is higher.

Cable length (maximum)

For the devices a long cable length causes:

- additional capacitive load (short-circuit protection)
- increased injection of interference signals.

Therefore the indicated maximum cable length may not be exceeded.

Connection to AS-Interface

Data and parameter bit allocation

Data bits	Meaning
D0	Switch signal
D1	Function reserve
D2	–
D3	Enabling input for testing 0: Transmitter on 1: Transmitter off
Parameter bits	**Meaning**
P0	–
P1	Inversion of D0 0: Transmitter on 1: Transmitter off
P2	–
P3	–

Correction factors (sensing range)

The specified sensing ranges of diffuse sensors are achieved with the given surfaces by using mat white standard paper. The correction factors stated below apply to other surfaces (guidance values).

Test card	100%
White paper	80%
Grey PVC	57%
Printed newspaper	60%
Light-coloured wood	73%
Cork	65%
White plastic	70%
Black plastic	22%
Black neoprene	20%
Automobile tires	15%
Untreated aluminium sheet	200%
Black anodized aluminium sheet	150%
Mat aluminium sheet (brush-finished)	120%
Stainless steel, polished	230%

Dark-ON

The “Dark-ON” function means that the output in question is switched through (current carrying), when light does **not** reach the receiver.

Enabling input

Some Opto-BEROs are provided with a test input. In these units the transmitter can be selectively switched on or off. Through appropriate evaluation of the output signal the functioning can be controlled. (reflex and thru-beam sensors: no obstruction of light beam/diffuse sensor: reflection object exists).

For disabling the BERO the enabling input must be set to 0 V. For operation of the BERO no switching of the enabling input is requiredysteresis

Hysteresis

Hysteresis (differential travel) causes a defined switching behaviour in the units. The specified transmission range always refers to the switching point when the sensor is being approached.

Installation

The units can be installed in any position. Care should be taken, however, to install units so as to prevent pollution. The accessories supplied with the units allow easy and perfect installation.

IR light

IR is the abbreviation for “infrared”. It refers to any electromagnetic radiation with a wavelength (780 to 1500 nm) longer than that of visible light (wavelengths of 380 to 780 nm).

Opto-BERO dictionary

LED

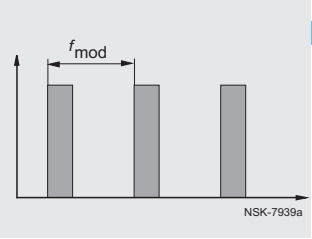
For Opto-BEROs, LEDs are used as radiation sources. They have a small emission spectrum, can be easily modulated and have a long lifetime. In Opto-BERO units they are also used to display the output state or the surplus light function.

Light-ON

"Light-ON" means that the output in question is switched through (carrying current) when light reaches the receiver.

Modulated light

Opto-BERO operate with modulated light, i.e. the light emitter is active during a short time only. Depending on the type, the modulation frequency f_{mod} of the modulated light is between 5 kHz and 30 kHz.



If an Opto-BERO is operated within the emission range of another Opto-BERO with the same modulation frequency, interference may occur (see minimum distance).

Operation with modulated light provides the following advantages:

- The units are largely insensitive to ambient light.
- Larger transmission/sensing ranges are possible.
- Reduced heating and therefore longer service life of the emitter diodes.

Optical fibres

Optical fibres consist of plastic or glass fibres in which light can be conducted even in bends. Optical fibres can be used for low-space applications and under critical environmental conditions.

Output current (maximum)

The units are designed for maximum output current (see Technical Data). If this current is exceeded even for a short time, the overload and short-circuit protection will be activated. Damage of the device is effectively avoided. Incandescent lamps, capacitors and other highly capacitive loads (e.g. long lines) will have results similar to an overload. A minimum output current is not necessary. Due to the built-in pull-up resistors an output signal is always available.

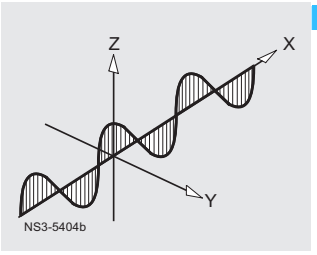
Parallel connection

To obtain logic operation the units can be easily connected in parallel. By a combination of light-ON and dark-ON outputs many different functions can be obtained.

Please note:
The power consumption increases. Reverse currents add up so that even in disabled state the load may cause impermissibly high current. Diodes in output lines are used to decouple the pull-up resistors. If a small quantity of units is switched in parallel they will not be required.

Polarized light

Natural light (including the light from the emitter or laser diodes) is not polarized. When the light has passed through a polarization filter only that part of the light is left which oscillates in the polarization direction of the filter.



Reflex sensors use this polarized light to minimize unintended reflexes. By polarization filters in front of the emitter and receiver the sensor reacts only to the light reflected by the so-called "triple-reflector". Other reflections will not cause a reaction.

Safety-related applications

The use of Opto-BEROs is not permissible for applications where the safety of personal depends on the function of these units!

Solid state lasers, injection laser diodes

Emit extremely high-intensity red light or infra-red light in a narrow light beam.

The lasers used meet the standards of protection class 2! They use visible red light.

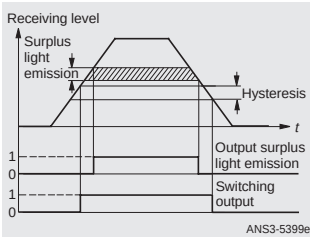
Spurious signal suppression

The units are equipped with a spurious signal suppression preventing the occurrence of spurious signals from the time of voltage application until availability is reached (approx. 5 ms).

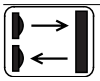
Surplus light function

The surplus light is the excess radiation power which falls onto the light incidence surface and is evaluated by the light receiver. The surplus light function can decrease in the course of time due to pollution, a change of the reflection factor of the object and aging of the emitter diode so that reliable operation is no longer guaranteed.

All units are therefore equipped with a surplus-light LED. Other units are available where this signal is switched to one of the outputs so that no longer reliable operation can be detected in time.



Selection

	Form	Sensing range
		50 mm · 120 mm · 150 mm · 50 cm · 60 cm · 1 m · 1.2 m · 2 m · 2.5 m · 4 m · 6 m · 12 m · 15 m · 50 m · 70 m
 **Diffuse sensors**	D 4/M 5	50 mm
	K 20	30 cm
	M 12	30 cm
	M 18P	30 cm
	M 18M	30 cm
	K 35	50 cm
	M 18	60 cm
	K 31	60 cm
	K 50	90 cm
	K 30	1.2 m
	K 40	2 m
	K 65	2 m
	K 80	2 m
 **Diffuse sensors with background suppression**	K 20	100 mm
	M 18 P	100 mm
	M 18	120 mm
	K 31	150 mm
	K 50	25 cm
	K 65	50 cm
	K 80	1 m
Laser	L 50	150 mm
 **Opto-BEROs with optical fibers**	K 35	
	KL 40	
	K 31	
	K 30	
	K 40	
 **Laser diffuse sensors with analog output**	L 50	45 to 85 mm

Selection

Voltage		Output					Connection					Features				
DC	AC/DC	PNP	NPN	Relay	AS-Interface	Analog output	M 8 plug	M 12 plug	Cable	Terminals	AS-Interface with FK terminal	Timing function	Test input	Moulded-plastic hous.	Metal housing	Page
10 to 30 V		■	■					■	■						■	10/134
10 to 30 V		■	■				■		■					■		10/146
10 to 36 V		■	■					■	■						■	10/135
10 to 30 V		■	■					■	■					■		10/142
10 to 30 V		■	■					■	■						■	10/139
10 to 30 V		■	■				■	■	■					■		10/152
10 to 36 V		■	■					■	■						■	10/137
10 to 36 V		■	■				■		■					■		10/148
10 to 30 V	15 to 264 V	■	■	■	■			■	■			■				10/157
10 to 36 V		■	■				■		■					■		10/150
10 to 36 V		■	■				■	■	■					■		10/155
10 to 30 V		■	■					■	■			■				10/162
10 to 36 V	20 to 320 V	■	■	■	■			■		■	■	■	■	■		10/164
10 to 36 V		■	■				■		■					■		10/146
10 to 36 V		■	■					■	■					■		10/143
10 to 36 V		■	■					■	■						■	10/137
10 to 36 V		■	■				■		■					■		10/148
10 to 36 V		■	■		■			■	■			■				10/158
10 to 36 V		■	■					■	■			■				10/162
10 to 36 V	20 to 320 V	■	■	■	■			■		■	■	■	■	■		10/165
10 to 36 V		■	■					■	■					■		10/173
10 to 30 V		■	■				■		■					■		10/154
10 to 30 V		■	■						■			■		■		10/168
10 to 36 V		■	■				■		■					■		10/149
10 to 36 V		■	■				■		■					■		10/151
10 to 36 V		■	■				■	■	■					■		10/156
18 to 28 V						■			■					■		10/174

Selection

		Form	Transmission range
			50 mm · 120 mm · 150 mm · 50 cm · 60 cm · 1 m · 1.2 m · 2 m · 2.5 m · 4 m · 6 m · 12 m · 15 m · 25 m · 50 m
 **Reflex sensors**		M 12	1.5 m
		M 18	2 m
		M 18M	2 m
		M 18P	2 m
		K 31	2 m
		K 20	2.5 m
		K 35	2.5 m
		K 30	4 m
		K 50	4 m
		K 40	6 m
		K 80	6 m
		K 65	8 m
	Laser	L 50	12 m
	Light grid		1.4 m
 **Thru-beam sensors**		D 4/M 5	25 cm
		M 12	4 m
		K 35	5 m
		K 50	5 m
		M 18	6 m
		K 31	6 m
		M 18M	12 m
		M 18P	12 m
		K 30	12 m
		K 40	15 m
		K 65	25 m
		K 80	50 m
	Laser	L 18	50 m
 **Fork sensors**		G 20	2 mm
 **Colour sensor**		CL 40	15 mm
 **Print mark reader**		C 80	18 mm

Selection

Voltage		Output				Connection					Features				
DC	AC/DC	PNP	NPN	Relay	AS-Interface	M 8 plug	M 12 plug	Cable	Terminals	AS-Interface with FK terminal	Timing function	Test input	Moulded-plastic hous.	Metal housing	Page
10 to 36 V		■	■				■	■						■	10/136
10 to 36 V		■	■				■	■						■	10/138
10 to 30 V		■	■				■	■					■		10/140
10 to 30 V		■	■				■	■					■		10/144
10 to 36 V		■	■			■		■					■		10/148
10 to 30 V		■	■			■		■						■	10/147
10 to 30 V		■	■			■		■					■		10/153
10 to 36 V		■	■			■		■					■		10/150
10 to 30 V	15 to 264 V	■	■		■		■	■			■				10/159
10 to 36 V		■	■			■	■	■					■		10/155
10 to 36 V	20 to 320 V	■	■	■	■		■		■	■	■	■			10/166
10 to 30 V		■	■				■	■			■		■		10/163
10 to 36 V		■	■				■	■					■		10/173
12 to 36 V		■				■							■		10/175
10 to 30 V		■	■			■		■				■		■	10/134
10 to 36 V		■	■				■	■				■		■	10/136
10 to 30 V		■	■			■		■					■		10/154
10 to 30 V	15 to 264 V	■	■		■		■	■			■				10/161
10 to 36 V		■	■				■	■				■		■	10/138
10 to 36 V		■	■			■		■				■	■		10/149
10 to 30 V		■	■				■	■					■		10/141
10 to 30 V		■	■			■		■						■	10/145
10 to 36 V		■	■			■		■				■	■		10/151
10 to 36 V		■	■			■	■	■				■	■		10/156
10 to 30 V		■	■				■	■			■				10/163
10 to 36 V	20 to 320 V	■	■	■	■		■		■	■	■	■	■		10/167
10 to 30 V		■					■	■						■	10/172
10 to 30 V		■	■			■					■			■	10/171
10 to 30 V		■	■			■					■			■	10/169
10 to 30 V		■	■			■					■			■	10/170