5

EGE

Brochure No. 5

# Opto-Sensors

## Special-Sensors for Automation

EE51120

# Technique & Application

## System description

The Opto Edge controller consists of an amplifier (1) to which two fibre-optic cables (2) of up to 10 m in length can be connected via a rapid action coupling. The first fibre-optic cable routes a send signal generated by the amplifier to a first optical converter (3), while the second fibre-optic cable returns a send signal detected by a second optical converter (4) to the amplifier as a receiving signal. This receiving signal is processed further in the amplifier into an output control signal.
The Opto Edge controller works with infra-red light which issues extremely short and fast impulse sequences which enable reliable recording of rapidly occurring processes, even in the presence of influences from external rays.
The process control system which is determined by the user, as well as the design of the optical converter, demands a high degree of flexibility from the system.

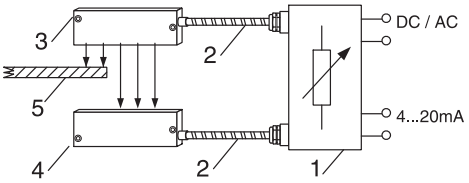


Fig. 1

## Structure of the opto edge controller

In the system structure illustrated in Fig. 1 the optical converters (3, 4) are configured in opposing positions to form a photoelectric barrier. The material (5) which, for example, may be paper or a metal edge, pushes into the light ray and, depending on the depth of insertion, reduces the ray path of the light flow detected by the converter (4). The amplifier (1) which is connected by means of the fibre-optic cable (2) supplies a control signal (4...20 mA) to its output which is proportional to the insertion depth of the material (5) depending on the formation of the optical converters (3,4) with a repeating accuracy of up to +/- 0.5 mm.
Opportunities for adjustment are provided on the amplifier (1) which ensure the exact adaptation of the fibre-optic cable types, optical converters or output signals, such as to discriminate digital switching or analog recording.

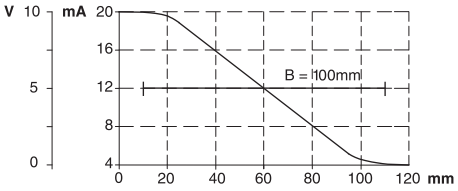


Fig. 2

A particular advantage of the system is that the fibre-optic cable and the optical converter for transmitting and receiving are identical and, thereby, interchangeable. As a result, modification of the recording arrangement is reduced to purely construction measures. The photoelectric barrier process can be changed to a reflex process by a simple modification.

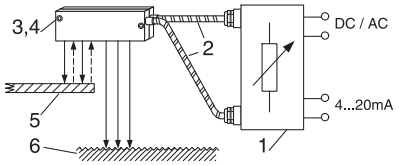


Fig. 3

In the reflex process illustrated in Fig. 3 the optical converters (3, 4) for the send and receive signals are arranged next to each other, e.g. above the material (5). With this arrangement the material does not interrupt the ray path between the sender and the receiver, but rather reflects a residual ray flow, which is detected by the receiver (4). The output corresponds to the distance of the materials. In this arrangement the result is also a current signal from the amplifier (1) which is proportional to the insertion depth of the material with high repeating accuracy.
In the case of the reflex process, however, accompanying conditions which are included in the measurement result have to be taken into account. In particular these include the reflection factor of the material (5) or the reflection due to the background (6) which is not covered by the material. Influences of this type have to be taken into account during installation.

## Recording of cracks, impact or non-homogeneity

Cracks or non-homogeneity in the area of the edges are principally recognised by the processes described in Fig. 1 or Fig. 3. In accordance with Fig. 1, cracks or non-homogeneity are recognized as short flashes of light while passing through, whereas in accordance with Fig. 3 depending on the background the reflection is briefly altered.

Recognition of cracks or irregularities in the material characteristics, e.g. also holes, is detpendent on high speed reception on the part of the recording system. If, for example, in accordance with Fig. 1 a crack approx. 2 mm wide moves past the optical converter at a belt speed of 10 m/s the duration of the flash amounts to 0.0002 s. In this case, the optical amplifier has to have a resolution of at least 5 kHz. Similar conditions exist if, for example, border recognition with an accuracy of only a few millimeters has to be carried out for rapid pipe throughput in a section reduction rolling mill.


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# Technique & Application

**High capacity amplifier URA 408**
This amplifier is intended for connection to a 24 V direct voltage power supply and has a 4....20 mA current output. The instantaneous current is displayed on a LCD display. The zero point (4 mA) and amplification can be adjusted independently enabling the characteristic curve to be shifted in parallel, as well as adjusting the slope. In order to span larger distances between photoelectric barriers or larger intervals between reflex scanning the send capacity can be switched to "long". These characteristics enable adaptation to a wide variety of opto-converters, fibre-optic cables or application requirements. The ultrared light generated by the amplifier has a high pulse rate of 50 kHz which enables reliable recording of rapid processes in the range of 8 - 10 kHz. In addition to this high input resolution the amplifier also has a high EMC tolerance which excludes the possibility of disruptive pulses being confused with event pulses.

**Universal high capacity amplifier URA 5001**
In addition to the basic characteristics which have been described for the URA 408 amplifier, this device has additional characteristics which make it universally deployable. It is also equipped for alternating current power supplies, has an additional 0...10 V Voltage output, as well as two PNP switch outputs. Upper and lower thresholds can be set for the entire characteristic curve range by means of a precision potentiometer. If the upper threshold is exceeded or the lower threshold not achieved the respective switch output closed and the corresponding LED is activated. If no threshold is affected the signal value is within specified limits. This is displayed by a third LED. This discrimination technology allows direct control or monitoring, e.g. that a belt is operating correctly, with pre-set permissible tolerances. For applications which require higher currents for switched mode operation or require a system control center which is without voltage the PNP outputs are switched to internally installed relays.

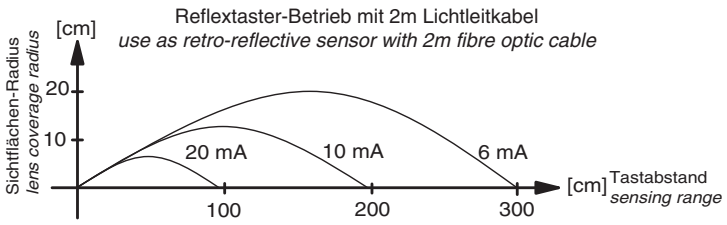
**Amplifier OKZ 550**
This amplifier is intended for use with the high performance trough beam sensors ULM... and ULL... A system consists of one transmitter, one receiver and one amplifier.

**Fibre-optic cable amplifier ULL**
The amplifiers are used especially in high-temperature light barriers. Fibre optic cables are attached directly by means of rapid-action coupling. The fibre optic cables are used primarily in high-temperature zones, while the amplifiers are installed in zones with normal operating temperatures. The amplifier signal is connected to the analyser by means of a PVC or PUR cable that is up to 50 meters long.

**Fibre-optic cable and optical converter**
The fibre-optic cables used are made of glass fibre bundles which are installed in flexible stainless steel tubing or in a metal housing to protect them against environmental influences. They can be subjected to 250 °C and in special applications up to 350 °C. If a high degree of moisture is expected the stainless steel tubing is enclosed in an additional silicon sheath. The greatest advantage of the fibre-optic cable is that it is absolutely insensitive to electrical and magnetic influences, resistant to high temperatures, does not require a power supply and, for this reason, can also be used in areas where there is a danger of explosion.

Optical cross section converters convert the round fibre bundle of the fibre-optic cable into a narrow high resolution light line which can either emit or receive optical signals. By means of this exclusively mechanical conversion a reaction sensitivity which has been achieved on one occasion is stable over time. For this reason electrical adjustment, such as that necessary for electro-optical systems, is not required. The optical cross section converters are supplied with a fixed pre-assembled fibre-optic cable and a rapid action coupling socket. This reduces losses along the optical transmission paths. Fibre-optic cables for connection to lens systems are equipped with rapid action coupling in both directions. It is possible to have fibre-optic cables up to 10 m long. The standard lengths are 2 m and 3 m. In order to achieve greater lengths fibre-optic cables can be connected by means of a coupler. The coupling loss consists of approx. 30 % and is permitted when there is sufficient light current.

**Attachment optics**
Attachment optics focus the infrared radiation that is transmitted by the fibre optic cable. The have an angle of aperture in the range of 2...15°, which ensures precise object acquisition. They increase the range when used in light barriers. Attachment optics with a slit-type angle of aperture are best for acquiring objects on an inlet level. For high-temperature applications, fibre optic cables and attachment optics designed for temperatures up to 250 °C (up to 350 °C upon request) are used.

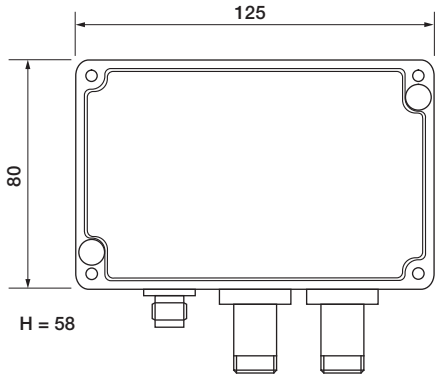


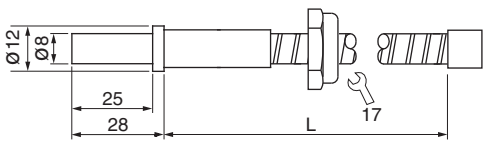
# Analog high-capacity amplifier

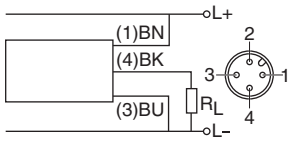
**4...20 mA output**

**10 kHz detection frequency**

**LCD display**


| *Design* | *URA 408 GI* | |
|---|---|---|
| *Dimensions* |   | |
| Sensitivity | adjustable | |
| Output |  | |
| **ID-No.** | **P51022** | |
| Type | URA 408 GI | |
| Supply voltage [V] | 24 DC ±10% | |
| Current consumption [mA] | <120 | |
| Current output [mA] | 4...20 | |
| Load resistance $R_L$ [Ω] | 200...500 | |
| Detection frequency [kHz] | 10 | |
| Accuracy [mA] | ±1 | |
| Ambient temperature [°C] | −20...+60 | |
| EMC-class | A | |
| Protection [EN60529] | IP 65 | |
| Display | LCD | |
| Housing material | aluminium | |
| Connection | fibre-optic cable rapid action coupling | M12 connector |




| Accessories | see page 5.11 |
|---|---|



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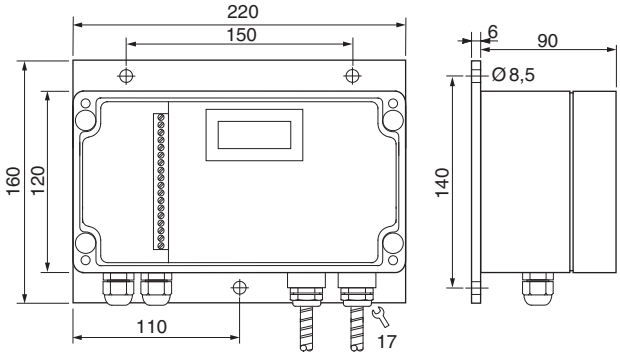
# Universal high-capacity amplifier

**Outputs**
**4...20 mA**
**0...10 V**
**Relay output**
**PNP output**
**Discriminator**

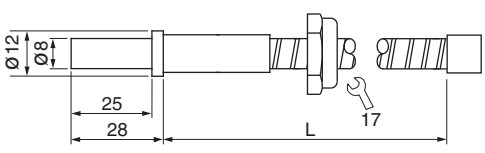

| *Design* | *URA 5001* |
|---|---|

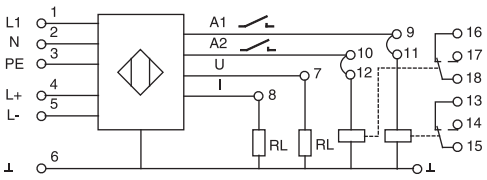
*Dimensions*




| | | | | | |
|---|---|---|---|---|---|
| **ID-No.** | | **P50029** | | | |
| Type | | URA 5001 | | | |
| **Supply voltage** | **[V]** | **24 DC / 230 AC ±10%** | | | |
| Current consumption | [mA] | 70 DC / 20 AC | | | |
| **Ambient temperature** | **[°C]** | **–20...+70** | | | |
| EMC-class | | A | | | |
| **Protection** | **[EN60529]** | **IP 65** | | | |
| Display | | LCD | | | |
| **Housing material** | | **aluminium** | | | |
| Output | | 4...20 mA | 0...10 V | PNP | Relay |
| **Switching current** | **[mA]** | – | – | 200 | 400 |
| Detection frequency | [kHz] | 8 | 8 | 6 | 0.01 |
| **Accuracy** | **[%]** | 3 | 3 | 5 | 5 |
| Load resistance RL | [Ω] | 200...500 | 500...5000 | – | – |
| **Connection** | | **terminal screws** | | | |

Fibre-optic cable rapid action coupling



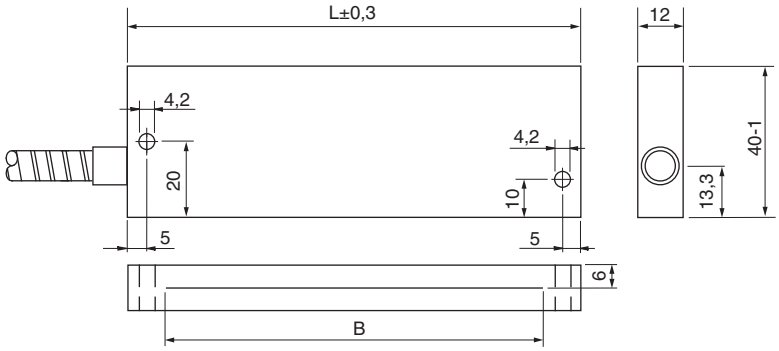

| | |
|---|---|
| **Accessories** | **see page 5.11** |

# Cross sectional converter

**Recording width up to 100 mm**

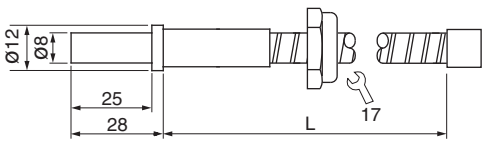
**Ambient temperature up to 200 °C**

**High resolution**

| *Design* | *ULW* | |
|---|---|---|
| *Dimensions* |  | |
| Recording width B [mm] | 50 | 100 |
| Length of converter L [mm] | 70 | 120 |
| **ID-No.** | **P51023** | **P51024** |
| Type | ULW 50-200 | ULW 100-200 |
| Length of light cable [cm] | 200 | |
| Temperature range [°C] | −25...+200 | |
| Detecrion tolerance [mm] | ±0.5 | |
| Protection [EN 60529] | IP 54 | |
| Material converter | aluminium | |
| Material cable | stainless steel * | |
| Connection | fibre-optic cable rapid action coupling | |



* Note:
For environments in which high humidity can be expected, we offer a stainless steel hose with a silicone sheathing.





| Accessories | see page 5.11 |
|---|---|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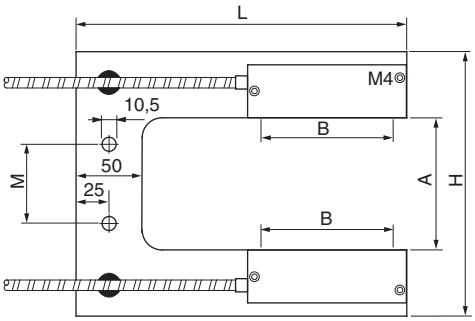
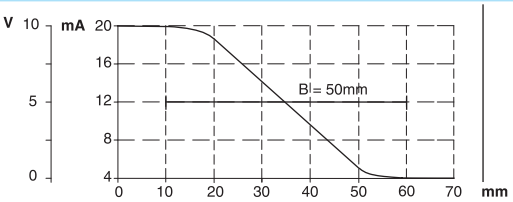
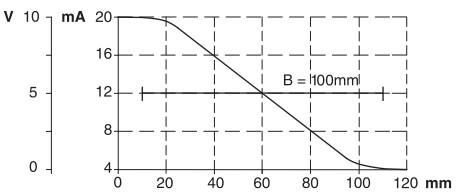
# Band-edge detector

**Light barrier technology**

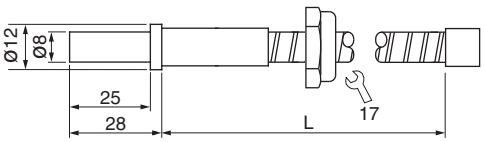
**Up to 100 mm sensing range**
**Up to 200 mm fork width**

| *Design* | *Light barrier fork* | | | |
|---|---|---|---|---|
| *Dimensions* |  | | | |
| Recording breadth B [mm] | 50 | 50 | 100 | 100 |
| **ID-No.** | **P51025** | **P51026** | **P51027** | **P51028** |
| Type | UBD 50-100 | UBD 50-200 | UBD 100-100 | UBD 100-200 |
| Fork width A [mm] | 100 | 200 | 100 | 200 |
| Mounting breadth M [mm] | 60 | 160 | 60 | 160 |
| Fork size L x H [mm] | 250 x 200 | 250 x 300 | 250 x 200 | 250 x 300 |
| Length of light cable [cm] | 200 | | | |
| Temperature range [°C] | −25...+200 | | | |
| Detection tolerance [mm] | 1 | | | |
| Protection [EN 60529] | IP 54 | | | |
| Material converter | aluminium | | | |
| Material cable | stainless steel | | | |
| Characteristics |  | |  | |



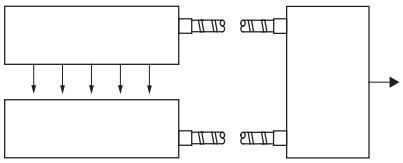


Fibre-optic cable rapid coupling





Set-up

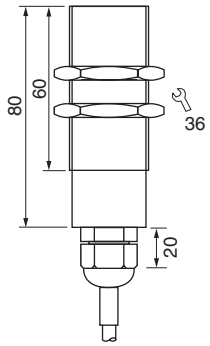


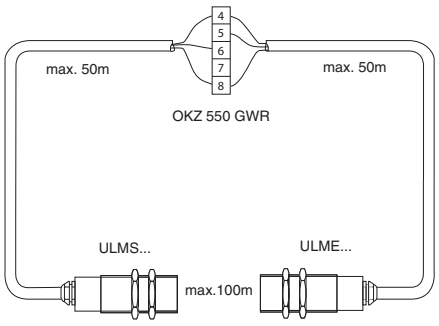


| Note | required amplifier series URA..., see page 5.04, 5.05 |
|---|---|

# High performance through beam sensors

**Range up to 100 m**

| *Design* | *M30x1.5* | |
|---|---|---|
| *Dimensions* |  | |
| Sensing range [m] | 100 | |
| Function | Transmitter | Receiver |
| ID-No. | P50001 | P50002 |
| Type | ULMS 030 VS | ULME 030 VS |
| Ambient temperature [°C] | –20...+70 | |
| Field of view [°] | 10 | |
| EMC-class [mm] | A | |
| Housing material | brass-nickel | |
| Protection [EN 60529] | IP 67 | |
| Connection | 5 m PVC-cable 4x0.34 mm² | |

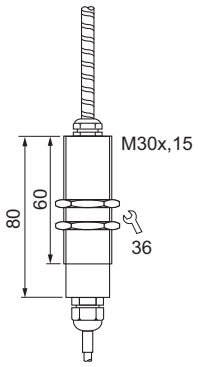
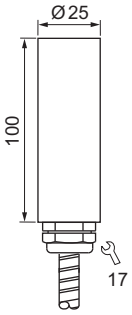
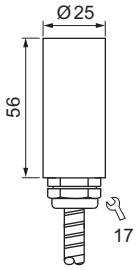



| Note | reqiured amplifier series OKZ 550 GWR, see page 5.10 |
|---|---|

# High temperature through beam sensors

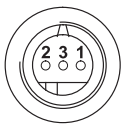
**To be used with fibre-optic up to 250 °C**

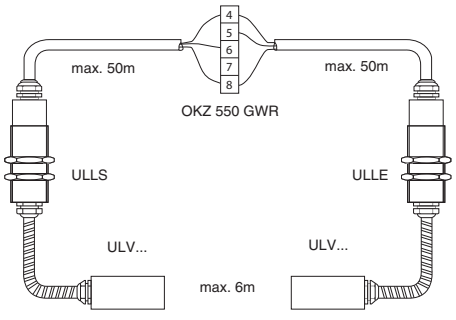
**With intermediate repeater**

| *Design* | *Fibre-optic amplifier* | | *Attachment optics* | |
|---|---|---|---|---|
| *Dimensions* |  | |  |  |
| Sensing range [m] | 6 | | | |
| Function | Transmitter | Receiver | Optic 4° | Optic 8° |
| ID-No. | P50003 | P50004 | P60150 | P60151 |
| Type | ULLS 030 VS | ULLE 030 VS | ULV 024 | ULV 028 |
| Ambient temperature [°C] | −20...+70 | | −40...+250 | −40...+250 |
| Field of view [°] | 90 | | 4 | 8 |
| EMC-class | A | | – | – |
| Housing material | brass-nickel | | brass-nickel | brass-nickel |
| Protection [EN 60529] | IP 67 | | IP 65 | IP 65 |
| Fibre-optic cable | LLKS... | | LLKS... | LLKS... |
| Connection | 5 m PVC-cable 4x0.34 mm² | | PG 9 | PG 9 |

PG-plug

**DC**
1: BN
2: BU
3: BK




| Note | required amplifier series OKZ 550 GWR, see page 5.10 |
|---|---|

# Amplifier

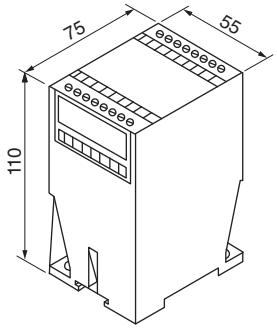
**AC-Voltage supply**
**DC-Voltage supply**

**LED indication**

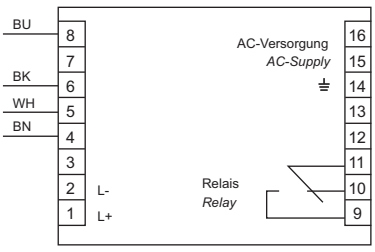
**Cable break and**
**short circuit monitoring**


| *Design* | *OKZ 550 GWR* |
|---|---|

*Dimensions*




| | | |
|---|---|---|
| **ID-No.** | | **P50030** |
| Type | | OKZ 550 GWR |
| | | |
| Supply voltage | [V] | 24 DC / 230 AC |
| Current consumption | [mA] | 60 / 10 |
| Sensing range | | adjustable |
| Hysteresis | | max. 10% |
| Light on / dark on | | switchable |
| Output | | relay with change-over conact |
| Switching current | | max. 4 A / 250 V AC |
| Switching power | | 1000 VA / cos φ > 0.7 / L/R < 200 ms |
| Switching frequency | [Hz] | 5 |
| Ambient temperature | [°C] | −20...+60 |
| EMC-class | | A |
| Protection | [EN60529] | screw terminals IP 20, housing IP 40 |
| Function indicator | | LED yellow |
| Housing material | | Polycarbonate |




| | |
|---|---|
| Connection | screw terminals |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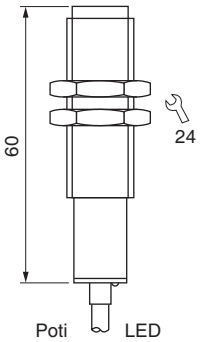
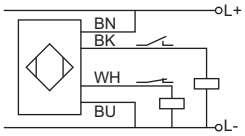
# Diffuse reflective photo sensor

**M18x1 plastic thread**

**DC 10...36 V**

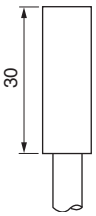
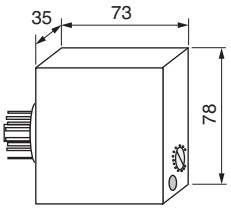
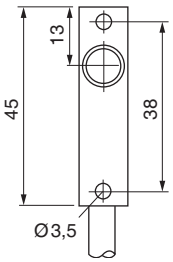
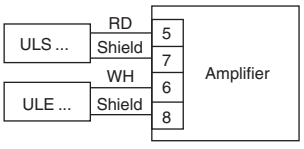
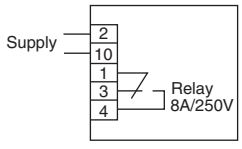
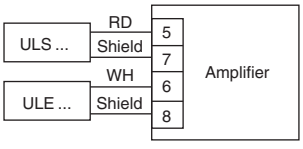
| *Design* | *M18x1* |
|---|---|
| *Dimensions* |   |
| Sensing range [mm] | 50...200 (adjustable) |
| Output |  |
| **ID-No.** | **P51008** |
| Type | UR 180 GSOP |
| Supply voltage [V] | 10...36 DC |
| Switching current [mA] | < 200 |
| Sensitivity adjustable | • |
| Light on | • |
| Dark on | • |
| Short circuit proof | • |
| Voltage drop [V] | 1.8 |
| Current consumption [mA] | max. 15 |
| Voltage drop [Hz] | max. 250 |
| Ambient temperature [°C] | 0...+70 |
| EMC-class | A |
| Protection [EN60529] | IP 67 |
| LED display | • |
| Housing material | PA 6 |
| Connection | 2 m PVC-cable 4x0.25 mm² |
| |   |
| Accessories | fixing nuts are part of delivery |

# Through-beam sensors

**20 m sensing range**

**Miniature design**

**Relay output**


| *Design* | *Through-beam sensor Ø 10 mm* | | *Amplifier* | | *Through-beam sensor 11x11 mm* | |
|---|---|---|---|---|---|---|
| *Dimensions* |   | |   | |   | |
| Sensing distance max. [m] | 20 | | 1...20 | | 20 | |
| Output | | |  | | | |
| **ID-No.** | **P51003** | **P51004** | **P51005** | **P51013** | **P51006** | **P51007** |
| Type | ULS 101 transmitter | ULE 101 receiver | UV 70 WR | UV 70 GR | ULS 111 transmitter | ULE 111 receiver |
| Supply voltage [V] | – | – | 230 AC | 24 DC | – | – |
| Switching current max. [mA] | – | – | 8 | | – | – |
| Sensitivity adjustable | – | – | • | | – | – |
| Light on | – | – | • | | – | – |
| Dark on | – | – | • | | – | – |
| Short circuit proof | – | – | – | | – | – |
| Response time [ms] | – | – | 25 | | – | – |
| Stromaufnahme max. [mA] | max. 15 | max. 15 | max. 20 | max. 60 | max. 15 | max. 15 |
| Switching frequency [Hz] | – | – | max. 10 | | – | – |
| Ambient temperature [°C] | –20...+50 | –20...+50 | –20...+50 | | –20...+50 | –20...+50 |
| EMC-class | – | – | A | | – | – |
| Protection [EN60529] | IP 67 | IP 67 | IP 50 | | IP 67 | IP 67 |
| LED display | – | – | • | | – | – |
| Housing material | ABS / Polycarbonate | | Polycarbonate | | ABS / Polycarbonate | |
| Connection | 15 m PVC-cable, shielded | | 11-pin socket | | 15 m PVC-cable, shielded | |
| |   | |   | |   | |
| Accessories | mounting clamp is part ov delivery | | adapter (Z01096) is part ov delivery | | RD = red; WH = white | |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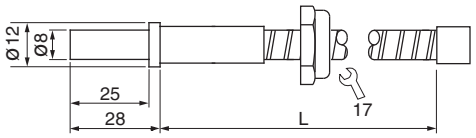
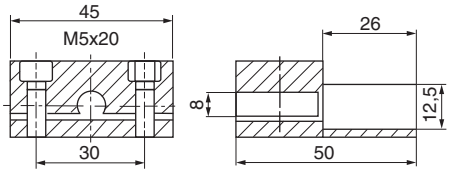
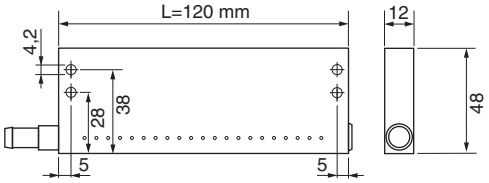
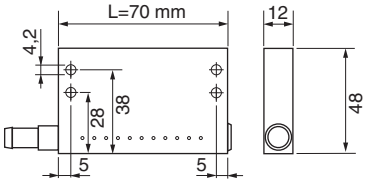
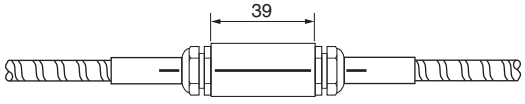
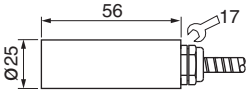
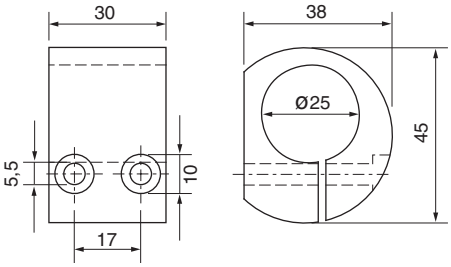
# Accessories

| Type | ID-No. | Dimensions | Design |
|---|---|---|---|
| LLKS-100-BE | P60101 |  | 1 m fibre-optic cable up to 250 °C |
| LLKS-200-BE | P60102 | | 2 m fibre-optic cable up to 250 °C |
| LLKS-300-BE | P60103 | | 3 m fibre-optic cable up to 250 °C |
| LLKS-500-BE | P60104 | | 5 m fibre-optic cable up to 250 °C |
| LLKS-1000-BE | S60001 | | 10 m fibre-optic cable up to 250 °C<br>Fibre-optic cable with increased lengths or with protection hose on request. |
| LLKM | Z01160 |  | Fibre-optic mounting clamp |
| UWB 100 | Z01161 |  | Air blower for optical converter<br>ULW 100-200, length L=120 mm |
| UWB 50 | Z01166 |  | Air blower for optical converter<br>ULW 50-200, length L=70 mm |
| ULK 20 | Z01162 |  | Fibre-optic coupling up to 250 °C |
| ULVW061 | P51029 |  | Optic converter 8° x 2° |
| Mounting clamp Ø25 | Z00126 |  | Mounting clamp for optic ULV |

# Notes



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# Process Sensors

## Flow sensors

- Electronical monitoring of flow
- Lubrication monitoring
- Measuring range 1 ml/min...100 l/min
- Detection range 1...300 cm/s
- Reaction time 0.5 s

## Ultrasonic sensors

- Switching distance up to 6000 mm
- Level monitoring
- Watertight housing
- Teach-in functions

## Pressure sensors

- Monitoring in pipes and containers
- Pressure up to 16 bar
- Level up to 10 m (±1 cm)
- Compact models
- Programmable

## Temperature sensors

- Monitoring in pipes and containers
- Temperature −40...+120 °C (±0,3 °C)
- Pressure up to 100 bar
- Compact models
- Multi use output NO/NC + analog

## Infrared detectors

- Measurement of temperature
- Monitoring of hot media
- Position control

## Metal detectors

- Detection of metal parts
- For harsh environment
- Large sensing range up to 400 mm
- Monitoring of bulk materials
- Machine protection

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