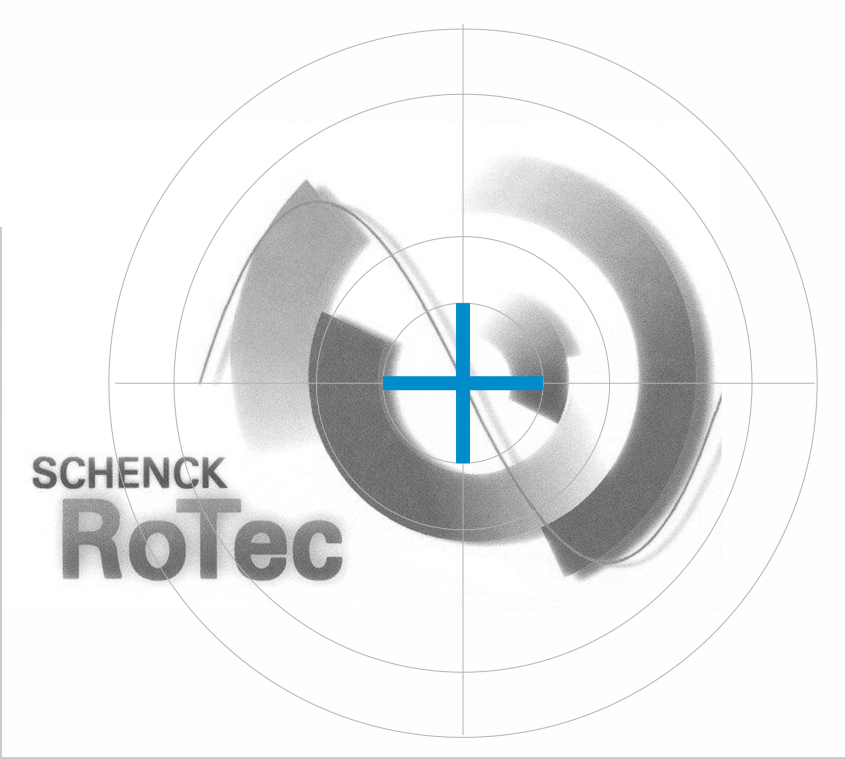
SCHENCK
Passion for Balancing

Technical Documentation
Reference sensor SR19



Read the instructions prior to performing any task!

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SR19, 1, en_GB

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1 Reference sensor SR 19

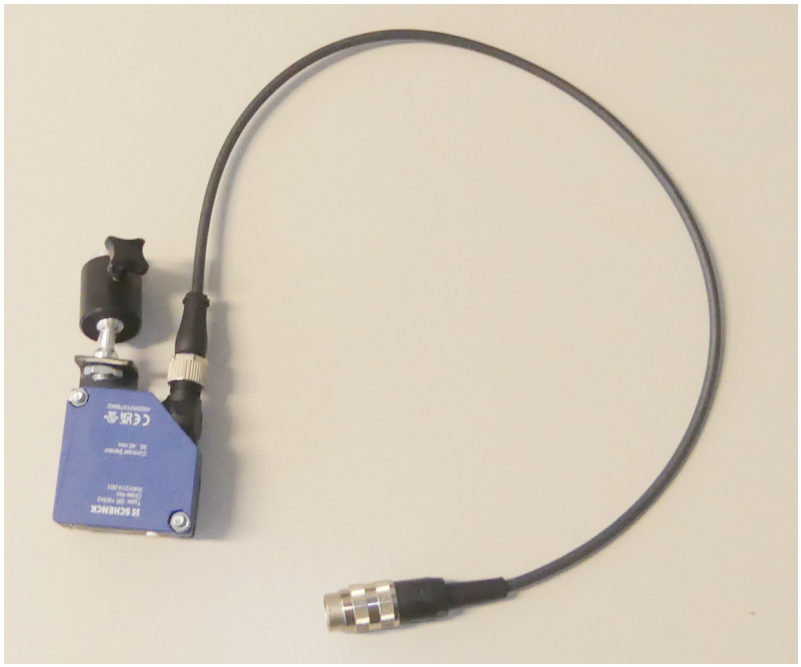


Fig. 1: Reference sensor with adapter cable

1.1 Instructions for use and safety

- The optical reference sensor is used for precise detection of angular positions by reflection of a light beam at a marking on the rotor.
- The reference sensor detects fine contrast differences.
- The product is not approved as a safety component in accordance with Machinery Directive 2006/42/EC and is not intended for potentially explosive atmospheres.
- Installation, start-up and maintenance may only be carried out by qualified personnel with electrotechnical training.
- The reference sensor must not come into contact with mechanically rotating machine parts.
- When changing rotors, ensure that the position of the reference sensor is not adjusted.

  If necessary, turn the rotor by hand to check that rotating parts do not collide with the reference sensor.

1.2 Functional principle

- The optical reference sensor sends a light beam to a marking (e.g. reflective film) on the rotating rotor.
  The marking reflects the light back to the reference sensor, which generates a pulsating signal from it.
- Per revolution of the rotor, a pulse is transmitted to the balancing machine, which serves as a reference angle.
- Recognition is carried out by teaching. Grayscale values of marking and background are saved.

1.3 Installation and adjustment

Assembly

1. Fasten the reference sensor securely with the holder supplied, so that no contact with rotating machine parts is possible.

   It is recommended to fix the screwed joint with a light screw locking adhesive.

2. Make sure that the assembly is not adjusted, especially when changing rotors.

   Use the intended fastening components (e.g. M4 screws, mounting brackets, ball joint).

   Maximum tightening torque: 0.5 Nm.

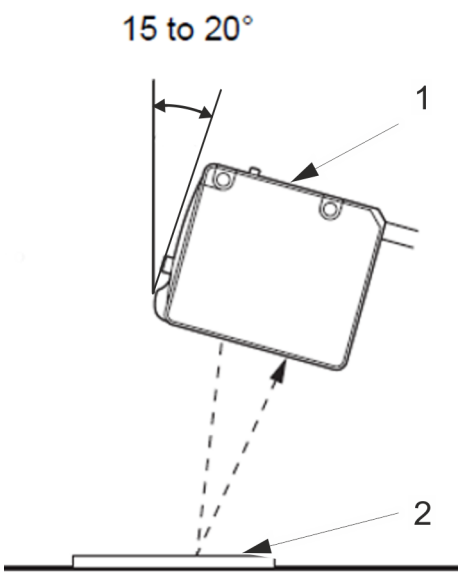
1.3.1 Mechanical adjustment

1. Position the reference sensor so that the light beam strikes the mark and is reflected. The distance should be 30–40 mm.

   Adjust the reference sensor so that

   - a sharp image of the light spot is created
   - the reference sensor is aligned parallel to the print mark

2. Slowly turn the rotor by hand and observe the change in brightness of the reflected surface.



1 Reference sensor
2 Surface

3. Direct the reference sensor as accurately as possible at the zero crossing (0° position) on the rotor. This allows the most accurate angle measurements possible.

An angle of attack of 15°-20° is recommended.

1.4 Electrical connection

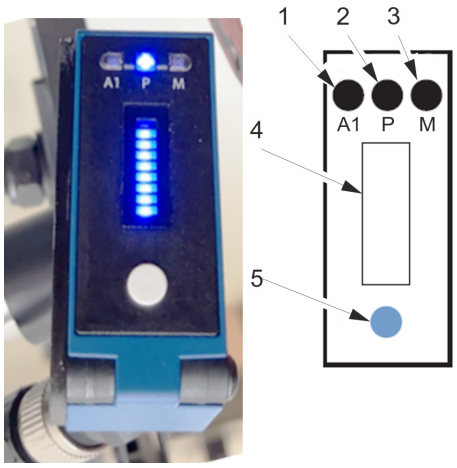
The 5-pin connection cable (M12 standard) on the reference sensor side must be connected. The reference sensor requires a voltage of 15–30 V DC.

1.

The reference sensor must be connected with the original adapter cable from Schenck RoTec.

2. Check the correct polarity and the tightness of the plug connection.

1.5 Control panel



1 Switching condition indicator (LED A1)
2 Supply voltage indicator (LED P)
3 Operating mode indicator (LED M)
4 9-point LED indicator *1.8.1 '9-point LED indicator' on page 10*
5 Teach-in button

1.6 Setting the operating mode

Mode

Mode	Teach-in button	LED M	Meaning
Indicate mode	Press briefly	Flashes 1x	Print mark mode (do not use)
		Flashes 2x	Contrast mode
		Flashes 3x	Colour mode
Set mode	Press for 8-10 seconds Press briefly	Flashes 1x	Print mark mode (do not use)
	Press briefly	Flashes 2x	Contrast mode
	Press briefly	Flashes 3x	Colour mode

1. Press and hold the teach-in button for 8-10 seconds until LED M starts flashing and LED A1 is off.

   The different operating modes are displayed in coded form via an extended flashing menu:

   - LED flashes 1 time:
     Print mark operating mode (do not use)
   - LED flashes 2 times:
     Contrast operating mode
   - LED flashes 3 times:
     Colour operating mode

2. You can press the button briefly to switch between the operating modes.

   If the button is not pressed and held for 10 seconds, the menu is exited and the setting is applied.

1.7 Teaching

Contrast and colour mode

Mode	Teach-in button	LED M	Meaning
Teach-in window	→ Align with object		flashes slowly (2Hz)
	Press for 2 seconds Release button		Flashes 2x

1.7.1 Contrast operating mode

- The reference sensor evaluates the RGB signals of the surface or the mark.
- An average contrast value is formed from the individual RGB signals and taught as a window.
  This window is then used to detect contrasts.
- For:
  – Detecting black contrast marks on patterned backgrounds,
  – Recognising marks and surfaces based on the contrast value.

The reference sensor is in contrast operating mode.

1. Press and hold the teach-in button or enter button for 2 seconds until LED A1 starts to flash.
2. Release the teach-in button.
3. Turn the rotor so that the light spot hits the surface to be taught on the rotor.
4. Press the teach-in button briefly.

   ⇨ The current contrast value is taught. The light spot on the surface flashes briefly twice to confirm successful teaching.

5. Turn the rotor so that the light point strikes the scanning mark.
6. Press the teach-in button briefly.
   ⇨ The current contrast value is taught. The light spot on the surface flashes briefly twice to confirm successful teaching.

   The teach-in quality is then displayed via the 9-point LED display. *1.8.1 '9-point LED indicator' on page 10*

Checking

1. Turn the rotor 360° once. The LED A1 may only go out once per revolution on the taught-in mark.
2. In the event of faults, repeat teach-in.

1.7.2 Colour operating mode

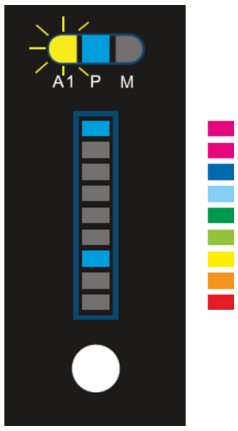
- The reference sensor evaluates the RGB signals of the surface or the mark.
- A color value is formed from the individual signals and each is taught as a window.
  This window is then used to recognise colours.
- For:
  – Detecting contrast marks on a background with a similar contrast value but different colours
  – Recognise and sort marks and surfaces by colour

The reference sensor is in colour operating mode.

1. Turn the rotor so that the light spot strikes the colour field/ scanning mark on the rotor to be taught.
2. Press and hold the teach-in button for 2 seconds until LED A1 starts to flash.
3. Release the teach-in button.
   ⇨ The current colour value is taught and the A1 LED flashes briefly twice to confirm successful teaching.

   The teach-in quality is then displayed via the 9-point LED display.

   The taught-in colour value is displayed.



Checking

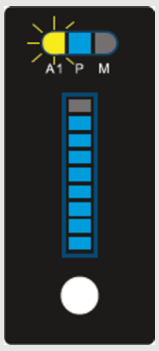
1. Turn the rotor 360° once. The LED A1 may only light up once per revolution on the taught-in mark.
2. In the event of faults, repeat teach-in.

1.8 Display

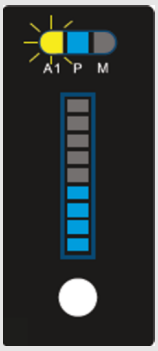
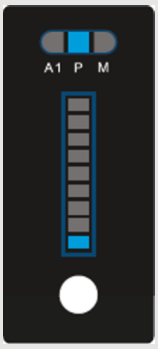
Display (*1.5 'Control panel' on page 7*)		Meaning	
LED P lights up		Reference sensor ready for operation	
LED P does not light up, no other LED is on		No voltage supply available	
LED P flashes orange		Warning The LED for the switching condition indicator A1 remains functional	See *1.11 'Diagnosis and fault removal' on page 16*
LED P flashes red		Fault The LED for switching condition indicator A1 is inoperative	See *1.11 'Diagnosis and fault removal' on page 16*
LEDs P (blue) and A1 (orange) light up permanently		Switching output active	
LED P lights up permanently blue, otherwise no LED on		Switching output not active	
LED P lights up permanently blue, LED M flashes	LED M flashes 1 time	Reference sensor in print mark mode (do not use)	
	LED M flashes 2 times	Reference sensor in contrast mode	
	LED M flashes 3 times	Reference sensor in colour mode	

1.8.1 9-point LED indicator

The quality of the signal is displayed in the running process with the LED indicator. The 9 LEDs are used to visualise how close the current signal of the detected object is to the taught-in signal. In the non-switched state, the display is held by the last detected object.



- Signal close to the taught-in signal
- Stable identification

	■ Signal reduced to the taught-in signal ■ Identification still possible ■ New teach-in recommended
	■ Signal too far away from the taught-in signal ■ No identification possible ■ New teach-in required

1.9 Scanning marks

- The colour intensity of the scanning mark and, if necessary, of the background are stored on the reference sensor. Almost all types of scanning marks are conceivable on the rotor.
- Strokes of foil pens, stickers or an existing keyway, such as boreholes and screw heads on the rotor, are used for scanning.
- In practice, reflective films have proven to be effective for adhesive bonding.

1.9.1 Reflective film as marking for the reference sensor

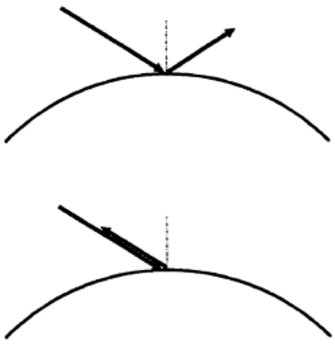


Fig. 2

The reflective film is very suitable as a marking for the reference sensor.

The light beam strikes the bare rotor and is reflected away (Fig. 2). When using the reflective film, the light beam is reflected back from the reflective film in the direction of the reference sensor.

The reflective film is therefore particularly suitable for glossy rotor surfaces:

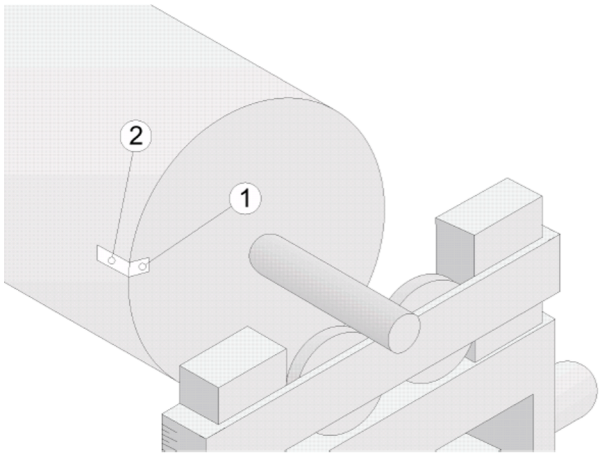


Fig. 3: Attaching the reflective film

The following must be observed during use:

→ Stick the reflective film to a grease-free area of the face (1) or circumferential side (2) of the rotor.

The reference sensor is mounted in such a way that the light beam strikes the rotor at an angle, ↳ *1.3.1 'Mechanical adjustment' on page 5*. An angle of 15° to 20° to the perpendicular on the rotor surface to be scanned is recommended. In this position, the light is reflected away from the reference sensor as long as it falls directly on the rotor. As soon as the film is under the light beam, the light is reflected back to the reference sensor - the output signal of the reference sensor generates a pulse.

Influence of external light

The influence of external light on the signal should be small due to the operational mode of the reference sensor. If problems nevertheless occur, please note the following:

Remedy:

1. → Change the position of the reference sensor to obtain a different scanning direction than the reflected external light.

2. → Bring the reference sensor closer to the rotor so that the reflected natural light becomes stronger.

3. → Reduce the external light radiation.

Scanning marks - Design instructions

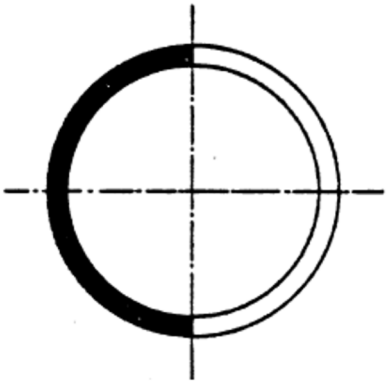


Fig. 4: 180° mark

A basic distinction is made between 180° light marks, in which 180° are reflective and 180° are non-reflective, and short marks, in which only a small part of the rotor circumference - for example 5° to 10° - produces the reflection contrast.

The short mark may consist of a short reflective area facing a long non-reflective part. Conversely, the short mark can also consist of a short non-reflective point, which is opposed by a long reflective part. The former is called "light mark", the other "dark mark".

Which of the marks is used is not important in principle, and may depend on the rotor to be scanned.

1.9.2 Scanning mark type

Dark mark

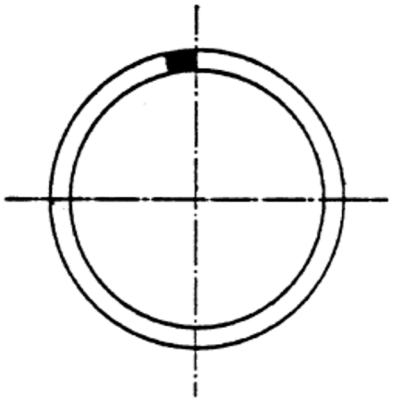


Fig. 5: Dark mark

When implementing scanning marks, it should be noted that it is not the colour that is important, but solely the reflectivity. A glossy, black colour may have a much greater reflectivity than a bright but rough surface of the rotor.

Light mark

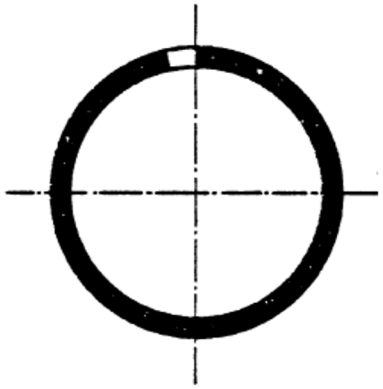


Fig. 6: Light mark

In the case of miniature rotors, it must be ensured that the mark is applied in such a way that it does not change during operation, e.g. detaching colour marking. This would create further unbalance.

1.9.3 Examples of scanning mark types

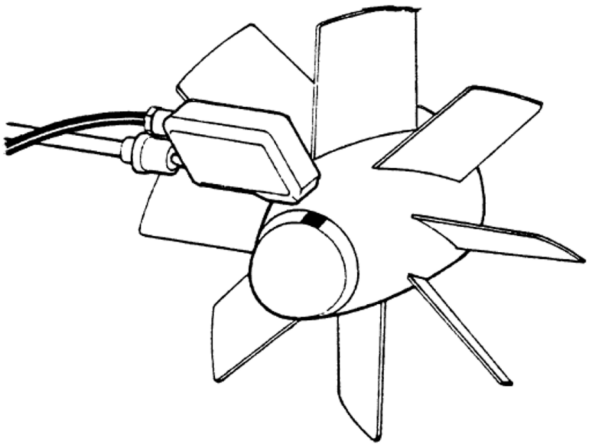


Fig. 7: Vertical scanning of a dark mark on an oblique surface

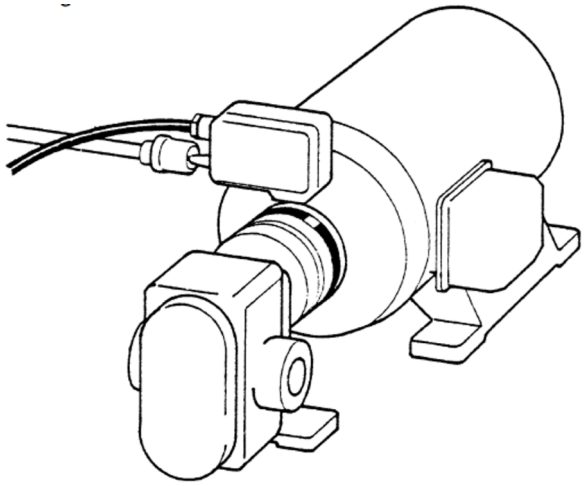


Fig. 8: Light mark applied to the circumference

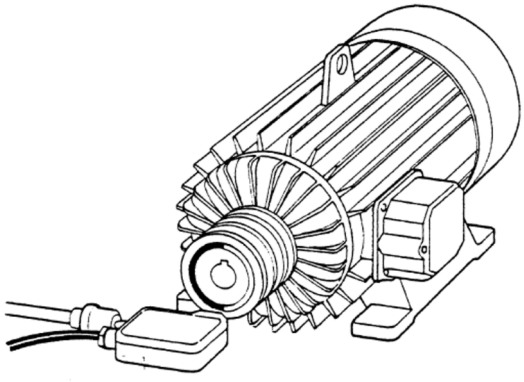


Fig. 9: Face-mounted mark

1.9.4 Adhesive marks

- The adhesive strips used for scanning are generally referred to as matt blank or 180° marks. These are mainly used on rotors with a poor, non-reflective rough surface, e.g. rotors produced by injection moulding or those made of plastic.
- A prerequisite for applying adhesive strips is a clean, oil-free surface and an exact adherence to the marking on the circumference of 180°.
- Adhesive strips are silver foil applied to strongly adhering, fully rubberised paper. Impurities within the mark, e.g. due to assembled adhesive tapes, must be avoided.
- The scanning mark should be at least as wide as the light spot on the rotor mapped by the reference sensor. This is about 3 - 4 mm wide. This also applies to short mark scanning.

1.9.5 Colour marks

- Colour marks are mostly used on rotors, e.g. blowers, fans, pump rotors, shafts and rollers, which have a good reflective, clean, corrosion-free and oil-free surface. The *non-reflective* portion must be applied.

1.9.6 Marks that are structurally present on the rotor

- These marks may already be present as reflective or non-reflective short marks - a milled spot, a hole, a groove, etc.
- Whether the marks are used as a reflective or non-reflective mark in individual cases depends on the angle of reflection of the mark surface and the rest of the surface.

1.9.7 Special types

Previous observations with a mark on the circumference apply to the display of the fundamental vibration of the body, as is the case with the unbalance.

If a harmonic is to be displayed, the circumference is divided by the atomic number of the harmonic oscillation. For example, when measuring the 3rd harmonic oscillation (2nd harmonic), the angle for the black and white marks is 60° and 120° distance for corresponding short marks, respectively.

In this case, the marks must be distributed very precisely on the circumference, otherwise the display will become unstable!

1.10 Searching for the unbalance on the rotor

1.10.1 Angular relationship between the black-and-white marking and the display on the measuring unit

Due to the reading and storage of the colour intensity of the background and the scanning mark, the trigger point is always the expiring scanning mark. This means that the beginning of the first taught grey grade corresponds to 0 degrees on the rotor.

In order to transfer the angle (unbalance position) displayed on the measuring unit to the rotor, the rotor is rotated with its **zero position** starting at the correction tool (usually vertically upwards) by the same angle in the direction of the previous measurement run. The unbalance is then in the correction position.

NOTICE!
Changing the position angle afterwards adds up directly to the angle of unbalance.

1.10.2 Checking the accuracy of the angular position

1. The unbalance display is set to zero by balancing the rotor or by simple compensation (simple compensation, see description of the measuring unit).
2. The rotor is then provided with a calibration weight at a precisely determinable angle (e.g. 0°).
3. The display must then be made at this angle. If this is not the case, the position of the reference sensor is corrected until the display and the actual angular position of the unbalance match.

1.11 Diagnosis and fault removal

Behaviour in the event of a fault

- *Stop the measuring run on the machine.*
- *Analyse and rectify the cause of the fault using the diagnostic information.*
- *If the fault cannot be corrected, contact the Schenck RoTec Service department.*
- *Do not operate if the fault behaviour is unclear.*
- *The machine must be put out of operation if the fault cannot be clearly assigned or can be safely remedied.*

Fault description	Cause	Remedy
LED P on the reference sensor does not light up	No supply voltage, incorrect setting	■ Check plug connections of the adapter cable from the reference sensor ■ Check supply voltage ■ Check setting
LED P flashes orange	Warning	■ Warning signal – Reference sensor distance – Reduce object – Reference sensor angle – Adjust object – Remove dirt, check optics for visible damage ■ Undervoltage – Increase power supply to min. 18 V DC ■ Temperature too high – Install mounting bracket as a cooling plate – Reduce load on the outputs ■ External light
LED P flashes red	Fault	■ Short-circuit – Check wiring and eliminate short circuit ■ Temperature fault – Disconnect reference sensor from the supply voltage and allow it to cool down – Install mounting bracket as a cooling plate – Reduce load on the outputs ■ Device fault – Disconnect reference sensor from the supply voltage and restart – Exchange reference sensor ■ Check distance to surface
LED lights up, no speed indicator	Optics dirty, reference sensor does not switch correctly, light beam misaligned,	■ Clean optics, ■ Repeat teach-in, ■ Adjust light beam exactly to mark
Measured values fluctuate greatly	Contaminated or unsuitable marking	■ Clean surfaces ■ Use matt lacquer or reflective film
Reference sensor does not respond reliably	Reference sensor fault, incorrect settings	■ Disconnect reference sensor from the supply voltage and restart ■ Exchange reference sensor if faulty

1.12 Maintenance and disposal

The reference sensor is maintenance-free.

→ Regular visual inspection and cleaning of the optics is recommended.

Clean only with a dry cloth, do not use solvents.

Dispose of in accordance with local regulations.

1.13 Technical data

Work area	30 mm to 40 mm
Working distance	35 mm
Resolution (grayscale)	100
Switching hysteresis	< 1%
Light type	White light
Wavelength	400 to 700 nm
Service life (Tu = +25 °C))	100,000 hrs
max. perm. external light	10,000 lux
Light spot diameter	1.1 × 3.5 mm
Supply voltage	15...30 V
Current consumption (Ub = 24 V)	< 50 mA
Switching frequency	50 kHz
Response time	13 µs
Jitter	5 µs
Temperature drift	< 6%
Temperature range	-25 to 60 °C
Switching output voltage drop	< 1.5 V
Short circuit-proof	Yes
Reverse polarity-proof	Yes
Lockable	Yes
Operating mode	Print mark
Interface	IO-Link V1.1
Protection class	III
IO-Link version	1.1

Reference sensor SR19
SR19-22.01.2026