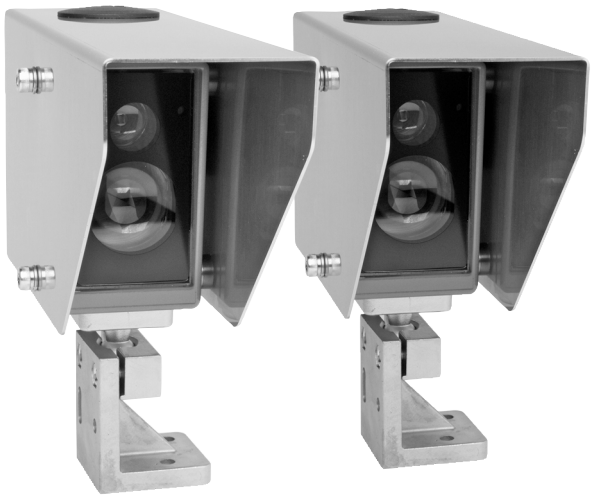
Operating Instructions
HISIC450

Overheight Detector



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Glossary

Skilled persons: Persons who, based on their technical training and knowledge as well as knowledge of the relevant regulations, can assess the tasks given and recognize the dangers involved.

Competent persons: Persons who, based on their technical training on, and knowledge concerning the specific device, as well as knowledge of the relevant regulations, can assess the tasks given and recognize the dangers involved.

Instructed persons: Persons properly instructed on the tasks assigned, possible risks and necessary protective measures.

Warning Symbols


Hazard (general)


Hazard by voltage

Signal words

DANGER
Immediate hazard which *will* result in severe personal injury or death.

WARNING
Risk or hazardous situation which *could* result in severe personal injury or death.

CAUTION
Hazard or unsafe practice which *could* result in less severe or minor injuries *and/or* property damage.

Information Symbols


Important technical information for this device


Important technical information on electrical or electronic functions


Supplementary information


Nice to know

HISIC450

1 For your Safety

Safety information
Intended use
Responsibility of the operator

1.1 Basic safety information

Read and always observe the safety and warning information in these Operating Instructions.

WARNING: Danger through defective device

The HISIC450 is likely to be unsafe when it:

- Shows visible damage on the outside.
- Has been penetrated by moisture.
- Has been stored or operated under irregular conditions.

In these cases:

► Put the HISIC450 out of operation, separate all connectors from the power supply and secure against unauthorized start-up.

WARNING: Risks through electric voltages

► Do not interrupt protective conductor connections.

1.2 Basic information

1.2.1 Detail level of these Operating Instructions

These Operating Instructions contain a fundamental description of the HISIC450 overheight detector and serve as guide for installation, operation and scheduled maintenance.

They also contain information on safe operation of the HISIC450.

Read and observe the corresponding Sections in these Operating Instructions.

1.2.2 Scope of application and identification of device version

These Operating Instructions are applicable for the HISIC450 as from date code 0807.

The date code of the HISIC450 is to be found on the type plate on the upper sides of the transmitter and of the receiver.

1.2.3 Designated users

The HISIC450 may only be installed by skilled persons who, based on their technical training and knowledge as well as knowledge of the relevant regulations, can assess the tasks given and recognize the dangers involved.

Responsibility of user

- Only operate the HISIC450 according to the intended use (→ § 1.2.4).
- Do not use the HISIC450 in potentially explosive atmosphere.
- Follow all specifications in these Operating Instructions and only operate the HISIC450 as described in these Operating Instructions.
- Keep these Operating Instructions for future use.
- Pass these Operating Instructions on to a new owner.
- Do not modify any components on and in the device.
- In addition to the Operating Instructions, follow local laws, regulations and operating directives applicable at the respective installation location.

1.2.4 Intended use

The HISIC450 serves for the detection of vehicles which are too high at tunnel portals, bridges, car parks or similar structures.

The device is not a safety component according to the EU Machinery Directive.

HISIC450

2 Product Description

Functional principle
Device features
Layout

2.1 Functional principle

The HISIC450 overheight detector comprises two photoelectric switches that are installed at the same height and whose beams run in opposite directions. Two photoelectric switches are used to reduce false alarms caused by birds, leaves or other objects. Reliability can be further increased when induction loops are used in addition to the photoelectric switches.

Some options for the evaluation of the signals of the photoelectric switches are described in → p. 17, § 4.

2.2 Special features

- High light intensity for use in almost any weather condition.
- Resistant to snow, rain and dust.
- Aluminium housing with anticorrosive coating.
- Heated front screens against icing or condensed moisture.
- Largely insensitive to residual light.
- Integrated optical alignment aid.
- Nearly maintenance-free.

2.3 Device variants

- HISIC450-R250
  - 24...240 V UC (+10% / –25%)
  - Relay output, 10 ms reaction time
  - Max. 10 switching operations per second
  - t = approx. 0.5...12 s
- HISIC450-P250
  - 10...60 V DC (limit values)
  - PNP output, 500 µs reaction time
  - Max. 1000 switching operations per second
  - Additional test input and soiling message
  - t = approx. 0.015...0.3 s or approx. 0.5...12 s
- HISIC450-N250
  - 10...60 V DC (limit values)
  - NPN output, 500 µs reaction time
  - Max. 1000 switching operations per second
  - Additional test input and soiling message
  - t = approx. 0.015...0.3 s or approx. 0.5...12 s

Assignment of transmitter/receiver types to the device variants

Device variant	Transmitter	Receiver
HISIC450-R	WS45-U250	WE45-R250
HISIC450-N	WS45-D250	WE45-N250
HISIC450-P	WS45-D250	WE45-P250

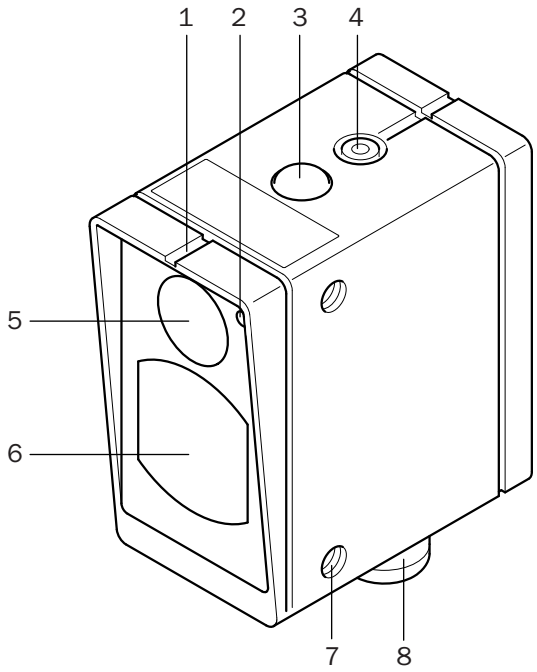
2.4 Scope of delivery

The scope of delivery of the HISIC450 includes:

- 2 transmitters (WS45) including fastening screws
- 2 receivers (WE45) including fastening screws
- 4 ball joint brackets made of stainless steel
- 4 hoods for weather protection made of stainless steel including fastening screws

2.5 Layout

Fig. 1 Layout



1	Sight slot
2	Reception indicator
3	Ocular for alignment aid (receiver only)
4	Operation indicator
5	View-finder lens for alignment aid
6	Reception aperture for infrared beam
7	Attachment thread M6 - 8 mm deep
8	Connection with cable gland

HISIC450

3 Installation

Project planning
Installation
Electrical installation
Adjustment

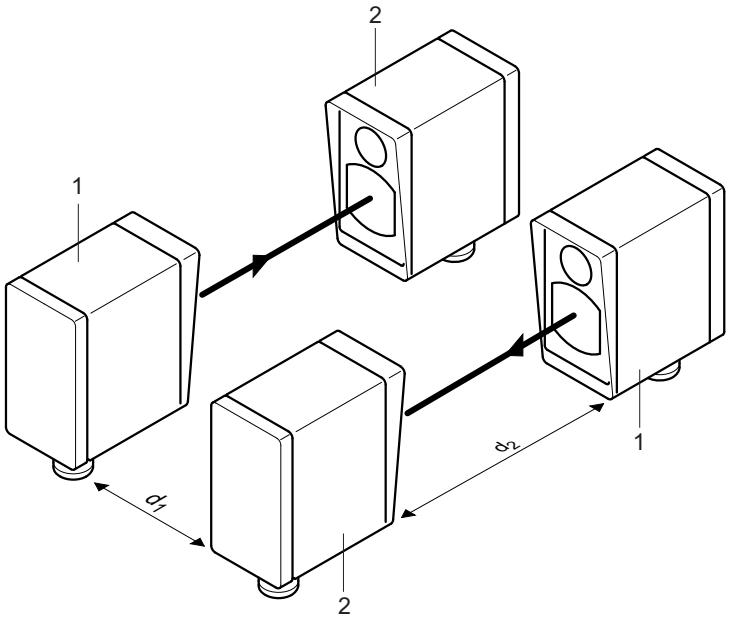
3.1 Project planning

3.1.1 Installation planning

Observe the following when planning installation:

- The distance between the two photoelectric switches (d_1 in → Fig. 2) is normally 1 m.
- Maximum measuring distance (d_2 in → Fig. 2) see → p. 30, §8.1.

Fig. 2 Distances and arrangement of photoelectric switches



1	Transmitter (WS45)
2	Receiver (WE45)

- The installation height (upper edge of housing) is equivalent to the maximum vehicle detection height.
- The two photoelectric switches have to be installed so that the direction of the light beams is in the opposite direction to each other. This means that a transmitter and a receiver must be installed on each side of the road (see → Fig. 2).
- Sunlight must not shine directly or via a reflection into the optics of the receiver.
- For photoelectric switches used outdoors, an overvoltage protector must be installed because overvoltage caused by thunderstorms can not be discharged within the devices.
- To increase reliability, it is recommended to use induction loops in addition to the photoelectric switches.

3.1.2 Object detection limits

Minimum object diameter

The prerequisite for the detection of objects is that they fully cover the receiver optical system of the photoelectric switches for the duration of the reaction time. This implies that moving objects must be larger the faster they move. The minimum size of an object thus depends on the speed of the object, the reaction time of the photoelectric switches and the size of the receiver optical system and results from the following formula:

$$D_{min} = W + t_R \cdot v$$

D_{min} = Minimum object diameter
W = Width of receiver optical system
t_R = Reaction time of photoelectric switch
v = Speed of object

Example:
- Width of receiver optical system: 35 mm
- Reaction time of photoelectric switch: 500 µs
- Maximum object speed: 100 km/h (≈ 27.8 m/s)

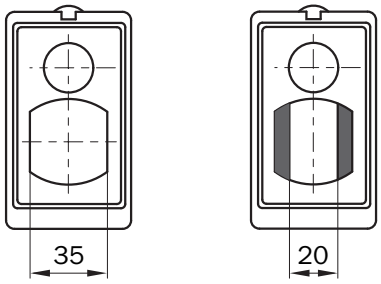
This results in the following minimum object diameter:

$$D_{min} = 35mm + 500\mu s \cdot 27.8\frac{m}{s} = 48.9mm$$

If smaller objects are also to be recognized, the width of the receiver optical system can be reduced to 20 mm by applying black paint (see → Fig. 3).

The application of black paint reduces the light intensity which could result in a higher error rate when the weather conditions are bad.

Fig. 3 Reduction of receiver optical system



Minimum object speed

To trigger an alarm, both photoelectric switches must detect the object within a predefined time interval. This requires a certain minimum speed of the object below which no alarm is triggered. This minimum speed depends on the distance between the two photoelectric switches (d_1 in → Fig. 2) and the time interval.

Example:
- Minimum object speed: 5 km/h (≈ 1.39 m/s)
- Distance between photoelectric switches: 1 m
- Time required for the distance between the two photoelectric switches: 1 m / 1.39 m/s = 0.72 s

This means that the time interval used in signal evaluation has to be 0.72 s minimum.

3.2 Preparation of installation location

- ► Secure the place of work.
- ► Provide electricity for the tools.
- ► Provide jack lift or stable ladder.

3.3 Assembly

Installation work must be carried out only by experienced skilled personnel.

Prerequisite: Suitable masts or similar with the desired measuring height and in the required distances (see → p. 12, Fig. 2) are available.

1 Install the four ball joint brackets at the desired measuring height.

2 Install transmitters and receivers on the ball joint brackets of the opposing masts and perform a rough alignment. Ensure that one transmitter and receiver each are installed on both sides of the road so that the light beams run in the opposite direction (see → p. 12, Fig. 2).

3.4 Electrical installation

WARNING: Danger through electrical voltage.

- ► Only allow an authorized electrician to work on the electric system.
- ► Observe the relevant safety regulations during all installation work.
- ► Take suitable protective measures against local risks and those arising from the equipment.

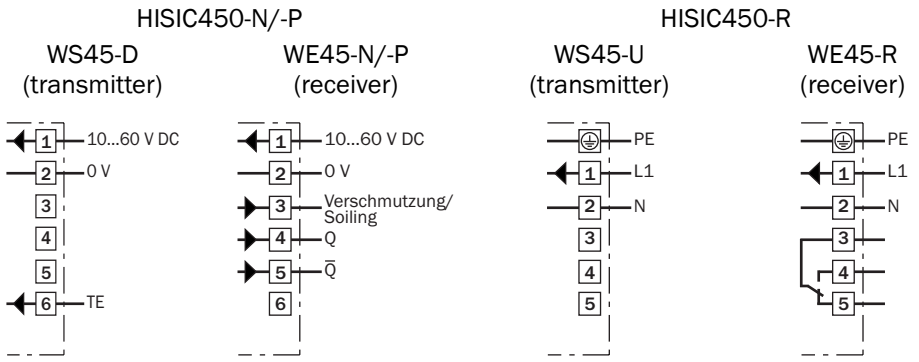
Prerequisite: Supply line is disconnected from the mains and potential-free.

1 Open the covers of the transmitter and the receiver. Ensure that no dirt enters the devices.

2 Loosen the cable gland and remove the sealing plug.

3 Route the supply line through the cable gland and connect it according to → Fig. 4.

Fig. 4 Connection diagram



The WE45-N/-P receivers have antivalent switching outputs (see also → p. 21, § 4.4):

Connection	WE45-N	WE45-P
$\overline{Q}$	Dark-On switched. Output is LOW when light is interrupted	Dark-On switched. Output is HIGH when light is interrupted
Q	Light-ON switched. Output is HIGH when light is received	Light-ON switched. Output is LOW when light is received
Soiling	When receiving signal is too low: Output pulsating 5/s	
TE	Test input: Transmitter is switched off.	

4 Apply mains voltage according to type plate.
Operation indicator on.

3.5 Adjustment

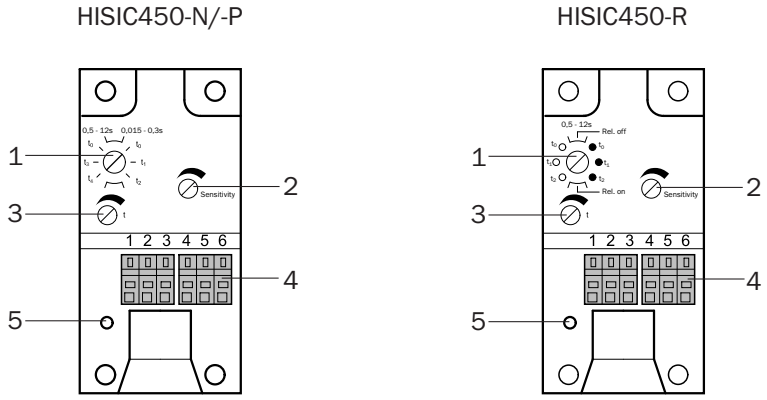
3.5.1 Manual alignment of transmitter and receiver

Alignment aids are integrated in the transmitter and the receiver. These consist of an ocular with a crosshair through which the opposite device can be seen.

1 Look through the ocular of the transmitter and adjust it to the receiver by swiveling it horizontally and vertically.
2 Look through the ocular of the receiver and adjust it to the transmitter by swiveling it horizontally and vertically.

3.5.2 Adjustment of light reception

Fig. 5 Possible adjustments



1	Delay mode adjusting screw
2	Sensitivity adjusting screw
3	Time fine adjustment adjusting screw
4	Terminal strip
5	Switch status indicator

1 Set the *Sensitivity* adjusting screw to Maximum.
The reception indicator at the receiver lights continuously.
2 If the reception indicator blinks or does not light, clean or readjust the transmitter and the receiver.
3 Interrupt the beam path with an object.
The reception indicator must go out.

4 If the reception indicator continues to light or blink, reduce sensitivity at the *Sensitivity* adjusting screw until it goes out.
5 Remove the object from the beam path.
The reception indicator must light again.
6 If it does not light, reduce sensitivity until the switch threshold is correctly set.

3.5.3 Adjustment of delay time

Criteria for selection of the delay time → p. 17, § 4.

1 Select the delay mode:
- HISIC450-R:
  t_1 right: Dark-ON with switch-on delay of 0.5…12 s
  t_2 right: Dark-ON with switch-off delay of 0.5…12 s
  t_1 left: Light-ON with switch-on delay of 0.5…12 s
  t_2 left: Light-ON with switch-off delay of 0.5…12 s
  t_0: Off
- HISIC450-N/-P:
  t_1: Switch-on delay of 0.015…0.3 s
  t_2: Switch-off delay of 0.015…0.3 s
  t_3: Switch-on delay of 0.3…12 s
  t_4: Switch-off delay of 0.3…12 s
  t_0: Off

2 Turn the *Time fine adjustment* adjusting screw clockwise/counterclockwise to increase/reduce the delay time.

3.6 Completion of installation

1 Check the sealing surfaces, seals and threaded attachment of the cover.
2 Position and screw on the cover.
3 Install a hood for weather protection on each transmitter and receiver.

HISIC450

4 Signal Evaluation

The photoelectric switch signals of the HISIC450 can be evaluated via an external PLC (not included in scope of delivery of HISIC450). This can be performed in many ways. The description of a simple hardware wiring in →§4.1 and →§4.2 and of two signal evaluation options by means of PLC in →§4.3 serve as examples.

4.1 Simple AND circuit

This evaluation is advisable only for device variant HISIC450-R.

1 For the first photoelectric switch in driving direction, set a switch-off delay that matches the minimum object speed (see →p. 13, §3.1.2; recommended are approx. 2 s) (see →p. 16, §3.5.3).

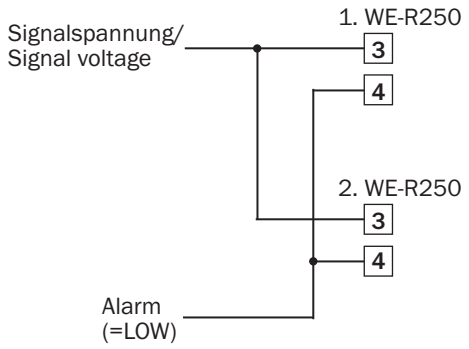
2 Set a switch-off delay of 0.5 s minimum for the second photoelectric switch.

3 Connect the outputs of both photoelectric switches in series on the hardware side.

With this evaluation, a reduction of false alarms by direction detection is not possible.

The wiring shown in →Fig. 6 for a light-ON photoelectric switch is a recommended solution for wire break protection.

Fig. 6 Wiring of AND circuit

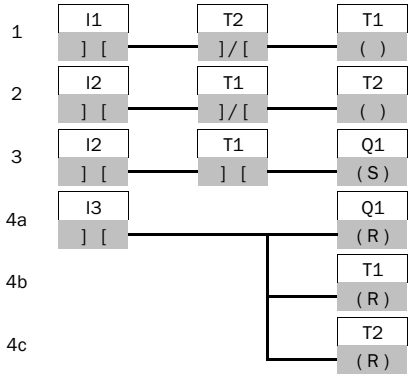


4.2 Direction-dependent evaluation

This evaluation can be performed with different PLC methods. As an example, a program is described in the following which is similar to the contact plan of the “easy” control relay by Moeller.

In this evaluation, the first signal has to come from the first photoelectric switch, the second signal from the second photoelectric switch. If a signal from the second photoelectric switch comes first, signals from the first photoelectric switch are suppressed until the second photoelectric switch is uncovered again and the delay time T2 has expired.

Fig. 7 Direction-dependent evaluation



I1	Signal from the first photoelectric switch in driving direction[1]
I2	Signal from the second photoelectric switch in driving direction[1]
I3	Acknowledgment input
Q1	Alarm output
T1	Off-delay relay for the first photoelectric switch in driving direction; minimum delay time according to → p. 13, §3.1.2
T2	Off-delay relay for the second photoelectric switch in driving direction; delay time = some seconds

[1]Recommendation for wire-break protection: Set the photoelectric switches to light-ON switching, invert the inputs I1 or I2 of the PLC and connect each with Q

Row 1: T1 is activated when T2 is not active, i.e. when the first photoelectric switch was first interrupted.

Row 2: T2 is activated when T1 is not active, i.e. when the second photoelectric switch was first interrupted.

Row 3: Overheight alarm (Q1) is triggered when I2 is output while T1 is still active, i.e. when the second photoelectric switch is interrupted before the delay time of the first photoelectric switch has expired.

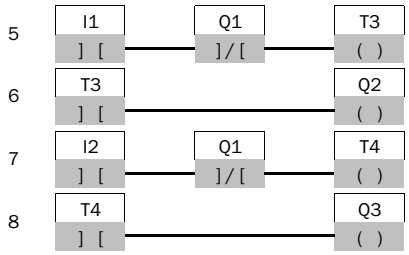
Rows 4a to 4c: The alarm is acknowledged when the light path of both photoelectric switches is uncovered again.

The delay time of the photoelectric switches (see → p. 16, §3.5.3) should be set high enough that the PLC can reliably read in the signals (depending on the PLC used and possibly its cycle time).

4.3 Direction-dependent evaluation with error message

This evaluation is an extension of the program lines shown under → § 4.2. It outputs an error message when the light beam is permanently interrupted.

Fig. 8 Extension of direction-dependent evaluation



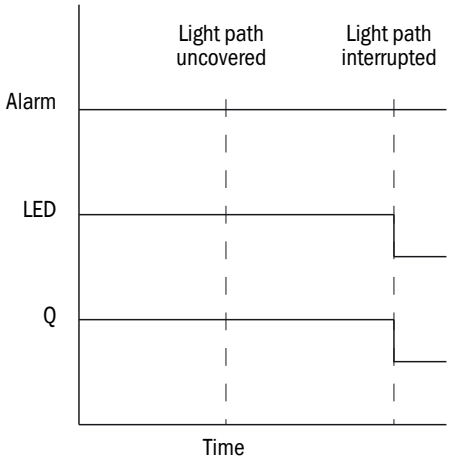
T3	On-delay relay for first photoelectric switch in driving direction
T4	On-delay relay for second photoelectric switch in driving direction
Q2	Error message for first photoelectric switch in driving direction
Q3	Error message for second photoelectric switch in driving direction

If one of the two photoelectric switches is interrupted for the duration of the reaction time of T3/T4 without an overheight alarm, an error message is output at Q2 or Q3.

4.4 Signal level of outputs

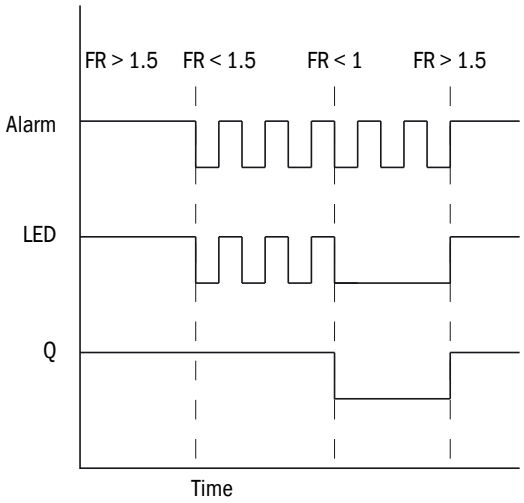
- In regular operation, the alarm output is “HIGH”.
- The alarm output pulsates (5/s) when the functional reserve “FR” (level of soiling) drops to <1.5.
- The alarm output goes to “LOW” when the connection of the alarm output is interrupted (wire break protection).

4.4.1 Detection of an object



Status	Light path	Q	Alarm	Condition
A	Not interrupted (uncovered)	HIGH	HIGH	OK
B	Interrupted	LOW	HIGH	OK

4.4.2 Functionality of alarm output



Status	Light path	Q	Alarm	Condition
C	FR[1] < 1.5	HIGH	Pulse 5/s	Soiling or fog
D[2] [3]	FR < 1	LOW	Pulse 5/s	Severe soiling or dense fog

[1] Functional reserve
[2] Condition “D” can occur only after condition “C”
[3] Condition “A” is reached again when FR > 1.5

HISIC450

5 Shutdown

Disassembly
Disposal

5.1 Disassembly

1 Disconnect the supply line from the mains.
2 Dismantle the transmitter and the receiver.
3 Remove the electronic components.

5.2 Disposal

Observe local regulations for waste disposal.

1 Dispose of electronic parts as electronics waste.
2 Dispose of metal parts as scrap metal.

HISIC450

6 Maintenance

Maintenance work

6.1 Maintenance work

- ► Clean the screens of the transmitter and the receiver when soiled.
- ► Check the screw connections once a year.

The device variants HISIC450-P and -N additionally have a test input and a soiling output:

- The transmitter can be switched off via the test input to check the function.
- The soiling output signals when the light reception is no longer optimal.

In device variant HISIC450-R, the relay can be set to pick up or drop out for test purposes with the delay mode adjusting screw.

HISIC450

7 Troubleshooting

Clearing malfunctions

7.1 Clearing malfunctions

Malfunction	Clearance
Soiling output signals an alarm (only for device variants HISIC450-P/-N).	► Clean the screens. ► Align and correct the optical alignment, if necessary.
False alarms occur repeatedly.	► Clean the screens. ► Align and correct the optical alignment, if necessary.

HISIC450

8 Technical Documentation

Operating data
Dimensions

8.1 Operating data

Transmitter	WS45-D	WS45-U
Maximum measuring distance:	300 m (reliably 50 m)	
Light spot diameter/ distance:	4.5 m/300 m	
Supply voltage:	DC 10…60 V [1]	UC 24…240 V [2]
Current input:	≤ 250 mA	
Power input:		≤ 6 VA
Degree of protection (IEC 144):	IP67	
Protection class (VDE):	I	
Protective circuits	Supply voltage connections protected against polarity reversal	–
Operating environment temperature:	–25…+55 °C	

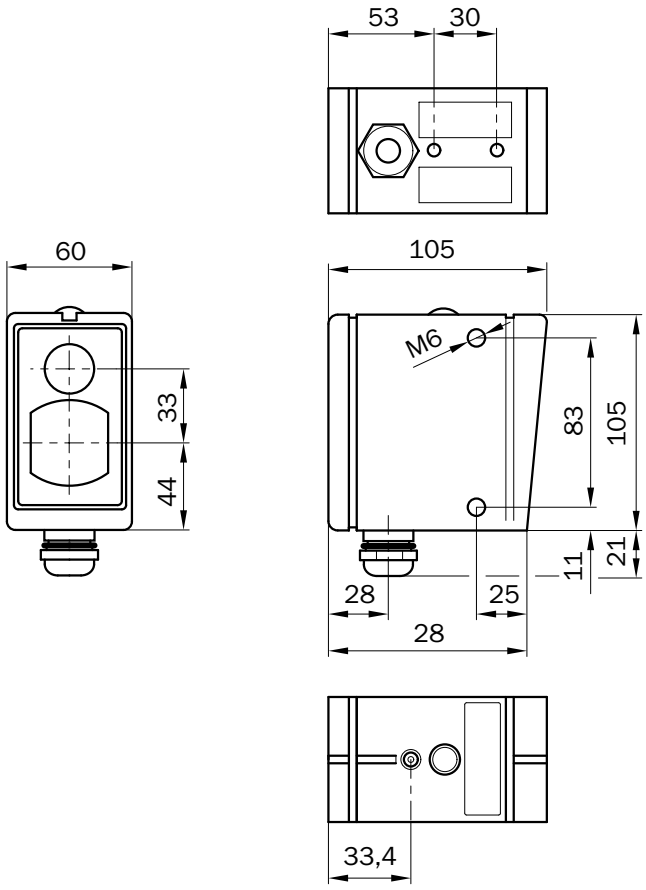
[1]Limit values for residual ripple max. 5 V_{SS}
[2]+10% / –25%

Receiver	WE45-N	WE45-P	WE45-R
Maximum measuring distance:	300 m (reliably 50 m)		
Supply voltage:	DC 10…60 V [1]	DC 10…60 V 1	UC 24…240 V [2]
Output current:	200 mA	200 mA	750 mA
Current input:	≤ 250 mA	≤ 250 mA	
Power input:			≤ 6 VA
Switching outputs:	NPN, Q and $\overline{Q}$	PNP, Q and $\overline{Q}$	Relay, 1 x SPDT, electrically isolated[3]
Maximum switching voltage:			AC: 250 V DC: 120 V
Maximum switching current:			4A / 240 V AC or 24 V DC
Maximum switching capacity:			AC: 1000 VA DC: 100 W
Maximum signal sequence:	1000/s	1000/s	10/s
Reaction time:	≤ 500 µs	≤ 500 µs	≤ 10 ms
Degree of protection (IEC 144):	IP67		
Protection class (VDE):	I		
Protective circuits:	– Supply voltage connections protected against polarity reversal – Outputs short-circuit-proof – Interference pulse suppression		–
Allowed ambient temperature in operation:	–25…+55 °C		

[1]Limit values for residual ripple max. 5 V_{SS}
[2]+10% / –25%
[3]Provide suitable spark suppression for inductive or capacitive load.

8.2 Dimensions

Fig. 9 Dimensioned drawing



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