Manual

Object Detector

S-SW-8

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S-SW-8 video: **http://www.ucma.de/schaltschwelle-s-sw-8/**

Warning! Advisement about the difference between S-SW-8 and S-SW-3:

Unlike the S-SW-3, the S-SW-8 must be calibrated in object free situation to the basic electrical conditions at its installation location (calibration). The detected operating parameters serve as reference for detecting objects (see Chapter 2.1). Calibration enables the S-SW-8 to compensate the changes in the ambient conditions (e.g. temperature fluctuations) and dynamically adjust its operating point. The S-SW-8 therefore works more reliably and precisely.
By inactive memory function (see Chapter 3.3.2), calibration always takes place automatically after the supply voltage is switched-ON. However, if an object is left in the sensor area by switch-OFF to be recognized in the next switch-ON, the memory function must be activated. In this case, however, a calibration process must be carried out once with empty sensor area when the device is put into operation for the first time.
Independent of the memory function, a calibration process can be started at any time by holding down the SW1 button for at least 5s (see Chapter 3.3).

1 Important Information

1.1 General Information about this document

This manual describes the installation, activation and operation of the device. It contains important information for proper installation and operation of the device, as well as for avoiding hazards. Then, first of all, it is necessary to read these instructions carefully, specially the safety instructions section.

The manual is part of the product and must be available at any time to anyone interacting with the device (installation, activation, operation, maintenance).

At any time all section of this manual must be intact and readable. Case necessary, replace this by a new one.

1.2 Intended Use

The S-SW-8 detector device is intended for detecting the presence of electrically conductive objects that are in the detection range of a specially designed sensor. Any unspecified use must be avoided.

The S-SW-8 devices are manufactured and tested according to the generally accepted technical standards of the electronics industry. When used as intended, the devices are safe to operate.

The device may only be installed in locations where it is not exposed to the direct influence of liquids (e.g. precipitation). The device must not be operated in potentially explosive areas and is not suitable for use in the medical technology sector.

UNICONTROL Electronic GmbH assumes no liability for damage caused by improper use.

1.3 Safety Instructions

Read and follow carefully the following safety instructions. They guaranty you and the other people safety and help to prevent damage to the device and external elements.

Please pay attention to the following safety instructions:

WARNING: Main voltage (100…400 V~, 50/60 Hz) can cause serious burn injuries and even life risk if not properly handled!

- Main supply cables are connected to connector X1. Depending on the type of the use, main supply cables can also be connected to the connector X2. Disconnect all main voltage supply lines before working on the device.
- Due to incorrect installation, activation, operation, configuration, maintenance or repair, it can arise the following:
  – Danger to body and life of the operator or users of the system.
  – Damage to the devices and other property of the operator.
  – Device or system malfunction.
- All people involved with the installation, activation, operation, maintenance and repair of the device must:
  – be appropriately qualified,
  – read these operating instructions and follow them carefully and
  – agree with the rules for safety work.
- The device may only be installed and put into operation by a qualified electrical engineer. Work on electrical parts must be carried out by trained electricians in accordance with the VDE.
- After activation, the correct functions of the entire system must be checked.
- If damage to the housing, connectors, cables (kinked, crushed), etc. is found, the power supply must be immediately turned off and the device secured set as out of use.
- The device must be protected against the penetration of liquids into its interior. If this happen, the power supply must be turned off immediately and the device secured set as out of use.
- The operator of the system in which the device is used must ensure that the operating mode does not result in damage to materials or endanger people.
- All protective and safety devices necessary for the operation of the system must be present and functional.
- Any malfunction that affects the safety of users or others must be corrected immediately.
- These instructions must always be available at the location of the used device.

2 Function, Purpose, Construction and Concepts

2.1 Operating Principle

The object detector S-SW-8 is a capacity sensor system with a differential signal evaluation to detect the presence of metallic and other conductive objects **contactlessly** with the help of connected sensor electrodes.

The object detector S-SW-8 is mainly used in conveyor technology to control roller conveyors. This sensor system offers particular advantages in heavily polluted environments like rolling mills, blasting systems, paint booths, etc. The reason is the insignificant effect on the functions from contamination of slag, metal dust or blasting media on its detection area.

On the first use, the unit must run the calibration process. Calibration means, the system scans for the best operating point of parameters. The detector area must be free of mobile objects and people during the calibration process. The bias point state is found and saved as a reference. After that, objects can enter the detection area. If the sensitivity is set appropriately, the presence of the new objects is detected. A potential-free contact relay turns ON/OFF according to the IN/OUT movement of objects over the sensing area (the switching position vary according to the type of objects and configured sensitivity).

2.2 Sensor, System and Concepts

2.2.1 Evaluation Unit

Correct connection of the reference potential in the evaluation unit is essential for the proper functionality – Connection of the earth potential (X1/3).

The evaluation unit uses sensor electrodes for detection. They are mounted in a ABS case (IP65) and placed near the electrodes.

2.2.2 Sensor Electrode

The sensor electrodes are not included in the delivery package. Their design depends on the specific user application and must be carried out in compliance with certain rules (see below) according to the technical requirements. The shape of the electrodes determines the detection area:

– **Narrow electrodes** cause **small switching hysteresis,**
– **wide electrodes** cause **large switching hysteresis.**

The electrodes are connected to the evaluation unit.

2.2.3 Concepts

Calibration means scanning the parameters for the optimal operation point, according to the size and format of the electrodes, their placement and the environment around the transport line (e.g. in a roller conveyor). The resulted signal is called “Reference”.

Sensitivity is the amount of variation signal, representing the detection object, necessary to turn the relay ON.

3 System

3.1 Evaluation Unit

The evaluation unit is built into an ABS housing (IP65). The electrical connections to the power supply, reference potential, sensor electrodes and relay contacts are established via three cable connections.

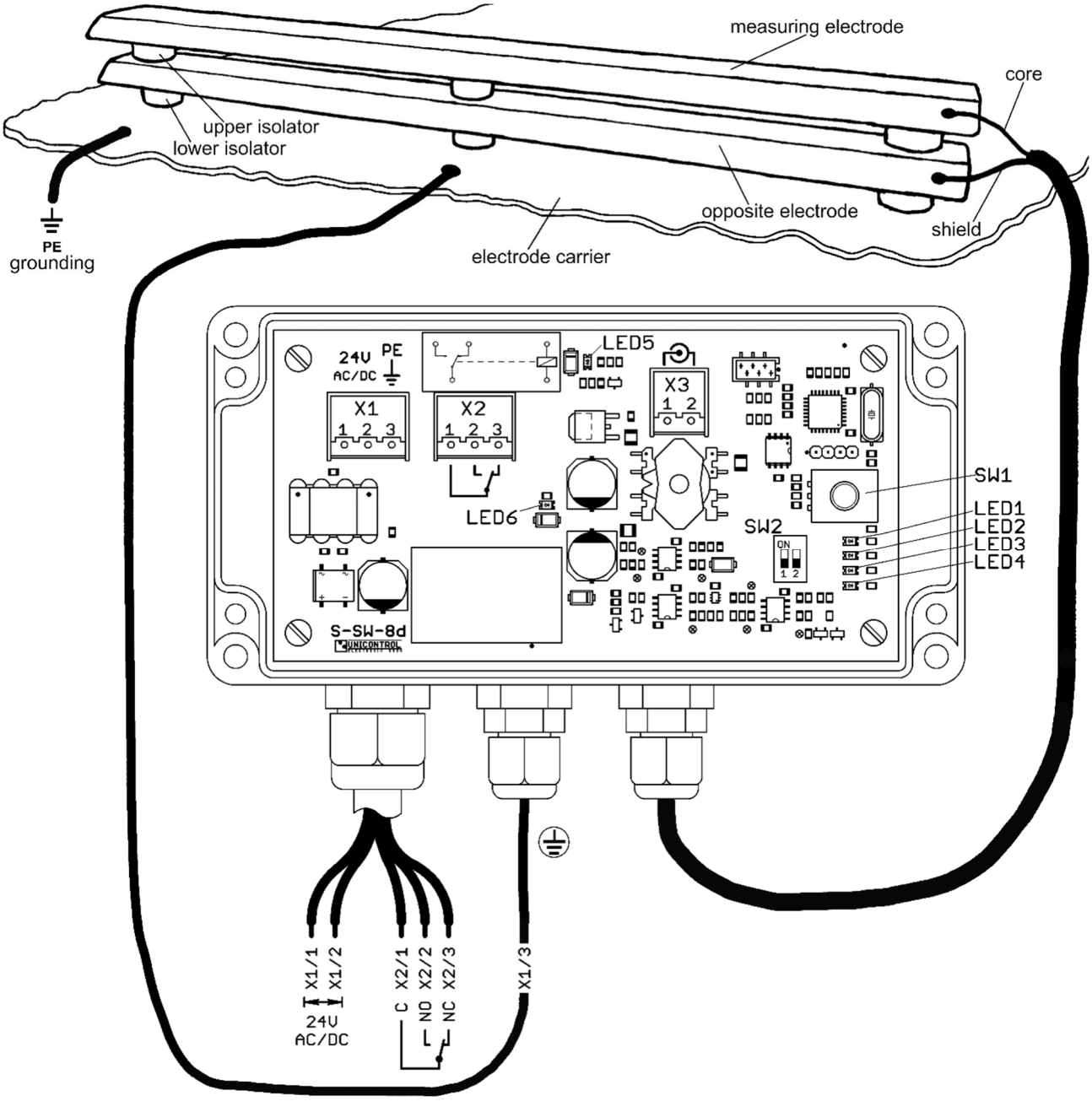


Figure 1

By inductive load connected on X2 (relay output), use spike suppression to prevent damage of the relay contacts.

The connection to the sensor electrodes is made by the 2-pole connector X3 and a coaxial cable. According to the drawing (see Figure 1), the core is connected to the left terminal X3/1 (measuring electrode) and the shield to the right terminal X3/2 (opposite electrode).

3.2 Sensor Electrodes

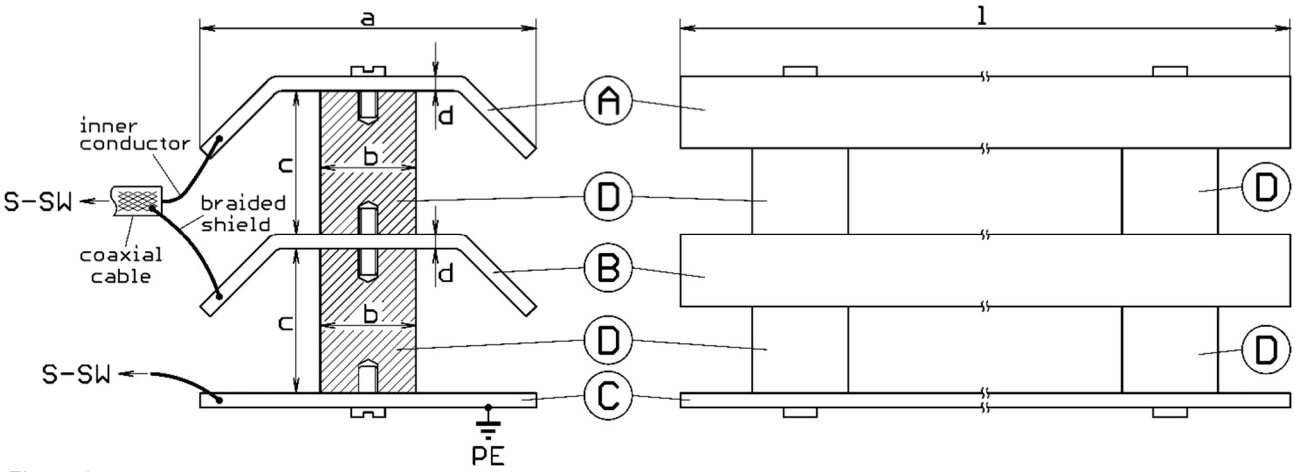


Figure 2

Basically: Narrow sensor electrodes → small switching hysteresis
wide sensor electrodes → large switching hysteresis

The sensor electrodes can have any geometric shape. It is only important that the two electrodes have approximately the same area and are fixed to a grounded structure.

Measurement electrode	**A:**	The measurement electrode is connected to X3/1 of the evaluation unit via the core conductor of the coaxial cable.
Opposite Electrode	**B:**	The opposite electrode is connected to X3/2 of the evaluation unit via the shield of the coaxial cable.
Montage structure	**C:**	The design of the mounting structure depends on the conditions at the installation place. It must be made of conductive material (e.g. metal). **The mounting structure must be connected to the earth potential!**
Spacers	**D:**	The spacers must be made with electrical insulation material (plastic / ceramic, see table below).

The measurement and opposite electrodes must be made of conductive material (sheet steel, aluminum, etc.). They should have the same design.

Electrodes Construction Rules

		min.	max.	Info
Electrodes wide	a	10 mm	200 mm	
Spacer diameter, Ø	b	no specification	no specification	Electrical insulation material (plastic / ceramic). The selected diameter must ensure sufficient mechanical stability. Spacers are available as accessories from UNICONTROL (UC spacer M4, M6, M10 and M12).
Electrodes gap	c	5 mm	80 mm	
Material mechanical capacity	d	no specification	no specification	The material mechanical capacity is not critical. It should be chosen considering that the electrodes have enough mechanical stability.
Electrodes length	l	100 mm	4000 mm	

Warning:

! The earthed mounting structure "C" must be connected to the reference potential of the evaluation unit (X1/3) via its own line!
The potential of the mounting structure (PE) serves as a reference potential for the evaluation unit.

! The number of spacers should be calculated and distributed over the length of the electrodes to guaranty reasonable mechanical stability.

! The measurement and opposite electrodes must be fixed on the mounting structure avoiding electrical contact. Ignoring this rule, will change the way the electrodes work and make them unusable for the application.

3.3 Configurations and Indication Elements

3.3.1 SW1: Set sensitivity (relay switching point) & start calibration

With the rotational selector SW1 the sensitivity (switching point of the relay) is set and a new adjustment of the bias point of the S-SW-8 can be triggered.

- **SW1 cw rotation** → **Increase** sensitivity
- **SW1 a-cw rotation** → **Decrease** sensitivity
- **SW1 > 5s pushing** → New calibration of the sensor is done. The LED4 blinks until the calibration process is completed (up to 60s). The settings of sensitivity, hysteresis and memory function are preserved.

3.3.2 SW2: Setting of functional properties

The 2-poles switch SW2, leads to the following behavior of the evaluation unit:

Hysteresis SW2-1	
ON	10 %
OFF	5 % ♥

Memory-Function SW2-2	
ON	active
OFF	inactive ♥

♥ = Default values

- **Hysteresis** (5% or 10%) **:** It is the difference in the sensor signal between the switch-on point (occupied) and the switch-off point (free) for the relay. The sensor signal level for the switch-ON point is stronger than the switch-OFF point. A larger hysteresis means that the switch ON/OFF points are distanced.
- **Memory Function OFF SW2-2 = OFF** **: Each time the power supply of the evaluation unit is switched ON, a new adjustment is started automatically.** The last set sensitivity and hysteresis are retained, but all other operating parameters are reset to the current operating situation – **Reference**.
  The readjustment means that any objects left in the detection area are "forgotten" and the relay is turned OFF, even if it was ON in the last power down. Only additional objects would switch the relay ON again!
  Error Correction: Touch the electrode (relay turns ON) until the working object moves out of detection area – the sensitivity is preserved.
- **Memory Function ON SW2-2 = ON** **: When the power supply of the evaluation unit is switched ON, no new adjustment is made.** The last valid operating parameters are restored from nonvolatile memory and used. Changes in the reference conditions in the meantime are taken into account by moving the reference point.
  This function is useful and recommended if there is a work-piece in the detection area at the time of switch-OFF and should be recognized when it is switched ON again. However, it must be the same object in the same position, otherwise the difference is treated as a change in the reference conditions. This would result in an invalid displacement of the reference point and thus a malfunction.
  ! Case a detected object is removed from the detection area while the sensor is turned-OFF, in the next turning-ON, the sensor will incorrectly behave as if the object is still there and the relay will switch-ON.
  This unexpected behavior can be easily corrected by touching

the main electrode (forcing over driven state – LED3 ON) for at least 4s when the relay goes OFF (LED 5 OFF) and the sensor recovers the operational state as soon as the electrode stay free again (untouched). **The sensitivity keep unmodified.**

3.3.3 Indication Elements

LED1 is active during the measurement process. Its activity allows an approximated idea of the signal intensity of the sensor electrodes caused by an object in the detection area.

- Slow blinking (1/s) : The sensor is free or only slightly occupied.
- Moderated blinking (2/s) : The sensor is moderately busy.
- Fast blinking (4/s) : The sensor is heavily occupied.
- Always ON (1) : The sensor is over-shoot and near or over the limit of the measurement range (see also LED3).

LED2 indicates how long the push button (SW1) is pressed:
0 s ... 2 s → LED2 **OFF**
2 s …3 s → LED2 **ON**
> 5 s → LED2 **OFF** and LED4 **ON**

LED3 lights up when the sensitivity range is exceeded (clipping).

LED4 indicates the error status or the adjustment process:

- Slowly blinking (1/s) : The sensor unit is in the adjustment mode.
- Always ON (1) : The unit is in the error state and cannot work. In this case a restart or re-calibration is necessary.

LED5 lights up when the relay is switched ON (sensor electrode busy).

LED6 is the <in operation> indicator and lights up when the supply voltage is switched ON.

3.4 Installation

1.: Produce and install the sensor electrodes as described in chapter "3.2 Sensor Electrodes".

2.: Place Electrodes and evaluation unit as close as possible. Connection cables may not exceed 100cm.

3.: Check and make sure that there is **NO**:
- short circuit between the electrodes,
- electrical connection between measuring or opposite electrodes and mounting structure.
- electrical connection to the machine ground.

4.: Connect the coaxial cable to the sensor electrodes. The core goes to the measurement electrode and the shield to the opposite one.

5.: Connect the reference potential of the evaluation unit X1/3 direct to the earthed mounting structure.

6.: Connect the supply voltage (24VAC / DC) to the evaluation unit (X1/1, X1/2).

7.: First operation
By the first operation an adjustment must be made. The state of the detect area will be evaluated and saved as a reference.

! The detection area must be free to process adjustment! No working pieces, stored objects or people may stay around, since they influence the adjustment signal.

a) Switch ON the evaluation unit. The green LED6 must light up.

b) Carry out adjustment
The adjustment behavior of the evaluation unit depends on the switch SW2-2 settings:

SW2-2 OFF After first switching ON, the evaluation unit starts an automatic adjustment.

SW2-2 ON The **adjustment is not automatically** carried out. Adjustment must be forced by pressing the SW1 button for at least 5s (LED4 ON).
The elapsed time can be seen on the behavior of LED2: After 2s, LED2 lights UP and after 5s it goes OFF again. The adjustment process starts shortly. The button SW1 can now be released.
With SW2-2 = ON, the operating parameters from the last application still apply. This can lead the unit changing to the error state. The red LED4 then indicates this state by permanently lighting.

– The red LED4 blinks during the adjustment process.
– The adjustment process has been successfully completed when LED1 blinks (1/s).
– If no working point is found during the adjustment, the evaluation unit changes to the error state. This is indicated by the constant lighting of the red LED4.

3.4.1 Sensitivity Setting (relay switching point)

The setting of the sensitivity with SW1 takes place basically with the smallest object that enters on the detection area. When setting, the object to be recognized must stay in the detection area.

Warning: People must not be near the sensor electrode!

In any case, the sensitivity must be set as follow described to match the detecting object

! To guaranty safe functionality, the sensitivity should only be set as high as necessary!

There are two possible configuration methods:

1. Automatic: The unit adjust the sensitivity to match the object in the detection area.
If the relay is OFF, it turns ON. If it is already ON, it stays ON until the object is removed from the detection area.
– Place the working object in the detection area.
– Push the SW1 button for 2s…3s.
After 2s the LED2 lights UP indicating the elapsed time.
– Release SW1 button (LED2 turns OFF)
You now have 3s to move away from the sensor area to avoid influencing the measurements of the working object.
When 3s has gone, the optimum sensitivity is set and LED2 flashes to confirm it.

2. Manual:
- **If the relay is OFF** (LED5 is OFF)
Rotate switch SW1 clock-wise until the relay switches ON, then go three points further.
- **If the relay is already ON** (LED5 ON)
Rotate switch SW1 anti-clock-wise until the relay switches OFF (LED5 OFF). Then return until the relay switches ON again (LED5 ON) plus three points.

If necessary, the sensitivity can be adjusted manually at any time by turning the switch SW1. The sensitivity setting is saved and valid even after unit power down.

3.5 Technical Data

Parameter	Sym	Condition		min	typ	max	Unit
Supply Voltage	V_S	AC/DC		18	24	30	V
Operation Power	P_O	18V ≤ V_S ≤ 30V				3	W
Environment Temperature	T_O	In operation		-15	+20	+55	°C
	T_S	Storage		-20		+60	°C
Switching point hysteresis		SW2-1 = OFF			5		%
		SW2-1 = ON			10		%
Conductor cross-section	Ø	X1 X2 X3 solid or flexible	Without termination	0,2		2,5	mm^2
				24		12	AWG
			Termination with cap	0,25		1,5	mm^2
			Termination without cap	0,25		2,5	mm^2
Isolation length		X1, X2, X3		9		10	mm
Relay contact		Voltage			250	300	VAC
					24	250	VDC
		Current (external protected)				10	A
		Contact resistance				0,1	Ω
Case	L	Length			160		mm
	W	Width			80		mm
	H	Height			55		mm
		Material		ABS			
		Protection level		IP65 / DIN 40050			
		Color		RAL 7035			

3.6 Disturbances

Disturbance	Possible Cause	Correction
If the memory function is active, the sensor status is reported as occupied after switching on, even though there is no object there.	The object was removed from the sensor area while the detector unit was switched off.	Touch the upper electrode of the sensor system directly with your hand (approx. 4…5s) until the relay switches off. Then take your hand off the electrode. The detector unit then automatically adjusts to the empty state. This function is only available once after switching on.
After switching-ON the detection device, the presence of object on the detection area is not recognized.	The detection device was switched-ON with deactivated memory function. Due to the power-ON automatic adjustment process, the object on the detection area is evaluated as environment.	Remove the object from the detection area. The detector device will automatically set its parameters to the free state.
Very low sensitivity with unstable function of the detector unit.	Short circuit of the opposite electrode to the reference potential (machine base).	Eliminate short circuit.
Exceeding the measuring range without an object on the detection area.	Short circuit of the measuring electrode to the reference potential (machine base).	Eliminate short circuit.

Disturbance	Possible Cause	Correction
When adjusting (LED4 flashes slowly), the detector unit does not find a working point (LED4 lights up permanently).	Short circuit of the measuring electrode to the reference potential (machine base).	Eliminate short circuit.
When occupied by an object, the detector unit shows implausible behavior, i.e. the function is reversed, for example, or a (large) object can react even at high sensitivity not be recognized.	Short circuit between measuring and opposite electrode.	Eliminate short circuit.
Exceeding the measurement range when an (large) object is present (LED3 is lit). Adjusting the sensitivity with the rotary switch SW1 has no effect on the switching point.	Overload of the sensor electronics due to an excessively large signal.	The sensor signal can be reduced by increasing the distance between the object and the measuring electrode (the upper electrode of the sensor rail) through a change in the position of the entire sensor. Note: The sensor signal increases in a quadratic relationship to the decrease of the distance between the object and the sensor rail.
Uncontrolled switching of the relay when the detection area is busy or free.	Induced interference from the roller platform driver.	● **Drive motors of the roller platform that are operated on frequency converters must be connected via shielded cables!** ● Interference coupling is more likely the closer the motor cables are laid to the sensor electrodes or the switching threshold. ● Motor cables running parallel to the sensor electrodes have a greater interfering effect than cables running along the front edges.
	Incorrect connection of the evaluation unit to the reference potential.	Only a separate cable must be laid from connection X1-3 to the sensor electrode carrier and connected there. No protective earth from the control cabinet may be connected to X1-3. See also "Figure 1" and section "3.2 Sensor Electrodes".

4 Montage & Cabling

4.1 System Arrangement

The sensor electrodes must be manufactured as described in chapter "3.2 Sensor Electrodes".

The following basic rules apply to the assembly of the system:

- Montage and adjustment should only be done by qualified person.
- The sensor electrodes should be installed in such a way that the measurement electrode stays as close as possible to the objects to be detected. This ensures safe switching behavior.
- The evaluation unit should be installed near the sensor electrodes. The sensor line (coaxial cable between the evaluation unit and sensor electrodes) should be limited to a maximum length of 100 cm.
- The device may only be operated with the plastic cover closed!

Before connecting the coaxial cable to the electrodes, check that:
– there is no short circuit between measurement electrode "A" and its opposite "B",
– there is no electrical connection between the electrodes and the mounting structure "C",
– there is no electrical connection to the machine ground.

4.2 Electrical Connections

- Sensor Electrodes:
  – Coaxial Cable Shield: from the evaluation unit X3/2 to the opposite electrode "B".
  – Coaxial Cable Core: from the evaluation unit X3/1 to the measurement electrode "A".
- Evaluation unit:
  – Connect X1/1 and X1/2 to the power supply (24V $_{AC/DC}$).
  The polarity ± doesn't matter.
  – **Connect X1/3 to the earth of mounting structure "C" using a separate cable.**
  No additional connection to the earth potential is admitted from here! X1/3 is not used for safety grounding, but exclusively for reference potential at the sensor electrodes.
  – Connect X2 (relay contacts) to the higher-level control system according to their function.
  – Connect X3/1 to the sensor electrode "A" through the internal conductor of the coaxial cable.
  – Connect X3/2 to the opposite electrode "B" through the shield of the coaxial cable.

Connector	Pin	Connection		
X1	1	24 $V_{AC/DC}$	Supply Voltage	Both polarity accepted
	2			
	3	PE	Reference Potential	Connected to the mounting structure of the sensor electrodes.
X2	1	C	Relay common contact	
	2	NO	Relay normally open contact	
	3	NC	Relay normally closed contact	
X3	1	Core	Connected to the measuring electrode.	Use coaxial cable.
	2	Shield	Connected to the opposite electrode.	