

## SINGLE-BEAM PHOTOELECTRIC SAFETY SWITCH TYPE 2

### SH2/\*-\*\*IC - SH3/\*-\*\*IC - TH2/\*-KIC - TH3/\*-KIC models

#### INSTALLATION MANUALS



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#### 1 About this document

Please read these operating instructions carefully before you work with, mount, operate or maintain the single-beam photoelectric safety switch SH-TH. Particularly observe chapter 2 "On safety".

#### 1.1 Function of this document

These operating instructions are designed to address the technical personnel of the machine manufacturer or the machine operator in regards to safe mounting, electrical installation, commissioning, operation and maintenance of the single-beam photoelectric safety switch SH-TH. However, the planning and use of protective devices such as the single-beam photoelectric safety switch SH-TH also require specific technical skills which are not detailed in this documentation. When operating the single-beam photoelectric safety switch SH-TH, the national, local and statutory rules and regulations must be observed.

#### 1.2 Symbols used



##### Warning!

A warning notice indicates an actual or potential risk or health hazard. They are designed to help you to prevent accidents. Read carefully and follow the warning notices.



##### Sender and receiver

The symbol denotes the sender and the symbol denotes the receiver.

#### 2 On safety



##### Warning!

During application of the device it is to be ensured that the combination of photoelectric switch and test device meets the requirements in accordance with IEC 61496 type 2.



##### Warning!

Pay attention to the safety instructions and warnings in the documentation for the test device connected.

#### 2.1 Specialist personnel

The single-beam photoelectric safety switch SH-TH must be installed, commissioned, tested, serviced and used only by specialist personnel. Specialist personnel are defined as persons who

- have undergone the appropriate technical training and
- have been instructed by the responsible machine operator in the operation of the machine and the current valid safety guidelines and
- have access to these operating instructions.

#### 2.2 Applications of the device

The single-beam photoelectric safety switch SH-TH is, in conjunction with an external test device as per IEC 61496 type 2, an item of electro-sensitive protective equipment (ESPE) type 2 in accordance with IEC 61496-1 and IEC 61496-2. In combination they can be used in safety applications up to category 2 as per EN ISO 13849, SIL CL 1 as per EN 62061 or up to PL c as per EN 13849. The switch meets the requirements of the Machinery Directive 2006/42/EC and is used for:

- Hazardous area protection
- Access protection

The photoelectric switches must be installed such that the hazardous area can only be reached by interrupting the light path between sender and receiver. It must not be possible to start the plant/system as long as personnel are within the hazardous area.

#### 2.3 Correct use

The single-beam photoelectric safety switch SH-TH must be used only as defined in chapter 2.2 "Applications of the device". If the device is used for any other purposes or modified in any way – also during mounting and installation – any warranty claim against M.D. Microdetectors, shall become void.

#### 2.4 GENERAL SAFETY NOTES AND PROTECTIVE MEASURES SAFETY NOTES!

Please observe the following items in order to ensure the correct and safe use of the single-beam photoelectric safety switch SH-TH.

- The national and international rules and regulations apply to the installation, commissioning, use and periodic technical inspections of the single-beam photoelectric safety switch SH-TH, in particular:
  - Machine Directive 2006/42/EC
  - Work Equipment Directive 89/655/EEC
  - The work safety regulations and safety rules
  - Other relevant health and safety regulations

- Manufacturers and operators of the machine on which the single-beam photoelectric safety switch SH-TH is used are responsible for ensuring that all applicable safety regulations and rules are agreed with the appropriate authorities and also observed.
- The test notes in these operating instructions (see chapter 6 "Commissioning") must be observed.
- The tests must be carried out by specialist personnel or specially qualified and authorised

personnel and must be recorded and documented to ensure that the tests can be reconstructed and retraced at any time.

- These operating instructions must be made available to the operator of the machine where the single-beam photoelectric safety switch SH-TH is fitted. The machine operator is to be instructed in the use of the device by specialist personnel and must be instructed to read the operating instructions.

#### 2.5 Disposal

Always dispose of unserviceable or irreparable devices in compliance with local/national rules and regulations on waste disposal.

#### 3 PRODUCT DESCRIPTION

The SH-TH single-beam photoelectric safety switch belongs to the SH-TH sensor family and is an optoelectronic sensor with a sender unit (SH-TH) and a receiver unit (SH-TH). M18 models are available (SH) with radial or axial optical and M30 models (TH) with axial optics, the flow rates are 5, 10 and 60m; For all models have two different frequencies modulation, models SH2 and TH2 using a frequency of 123KHz. The models SH3 and TH3 using a frequency of 83KHz\*. The different frequencies can be used to avoid interference between emitters and receivers do not belong to the same control unit.

The sender SH-TH has a test input (TEST) that can be used to check the correct function of the sensors. The photoelectric switch is suitable for safety applications when used in conjunction with an external test device category 2 (EN ISO 13849), SIL CL 1 (EN 62061) or PL c (EN ISO 13849). The inputs and outputs on the SH-TH single-beam photoelectric safety switch comply with the requirements of EN 61131.

\*Special model.

#### 4 MOUNTING

##### Safety distance for access:

A safety distance must be maintained between the beams of the photoelectric switch and the hazardous point. This safety distance ensures that the hazardous point can only be reached after the dangerous state of the machine has been completely stopped.

##### The safety distance as defined in EN 999+A1\*\* e EN ISO 13857 depends on:

- The stopping/run-down time of the machine or system (the stopping/run-down time is shown in the machine documentation or must be determined by measurements)
- The response time of the entire protective device
- The approach speed
- Number of beams/beam gap



##### Risk of failure to detect!!

Persons who are in the hazardous area but not in the light path between sender and receiver are not detected. It is therefore to be ensured that any dangerous state can only be initiated if there are no personnel in the hazardous area. The single-beam photoelectric safety switch SH-TH is not allowed to be used for hand and finger protection.



##### No protective function without sufficient safety distance!

The reliable protective effect of the photoelectric switches depends on the system being mounted with the correct safety distance from the hazardous point. The photoelectric switches are to be fitted such that when the light beam is interrupted, the hazardous point is only reached when the dangerous state is no longer present.

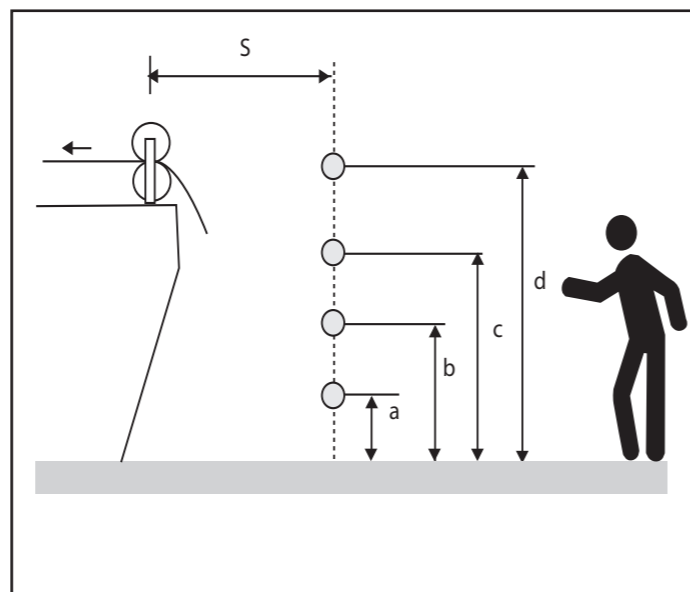


Fig. 1: Access protection using the single-beam photoelectric safety switch SH-TH

##### How to calculate the safety distance S according to EN 999+A1\*\* and EN ISO 13857

The following calculation shows an example calculation of the safety distance. Depending on the application and the ambient conditions, a different calculation may be necessary.

- Calculate S using the following formula:

$$S = K \cdot T + C \text{ [m]}$$

Where ...

S = Safety distance [m]

K = Approach speed 1.6 [m/s]

T = Stopping/run-down time of the machine + response time of the entire protective device

C = Supplement, depending on the number of beams (1, 2, 3 or 4) see Tab. 1.

\*\* future EN ISO 13855

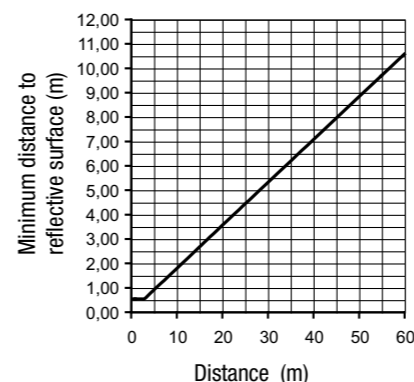
Nr. beams	a [m]	b [m]	c [m]	d [m]	Supplement C [m]
1	0,75				1,20
2	0,40	0,90			0,85
3	0,30	0,70	1,10		0,85
4	0,30	0,60	0,90	1,20	0,85

Tab. 1: Variables for calculating the safety distance

#### 4.1 Minimum distance to reflective surfaces

The light beams from the sender may be deflected by reflective surfaces. This problem can result in failure to detect people. All reflective surfaces (RS) and objects (e.g. material bins) must therefore be kept a minimum distance (a) from the photoelectric switch beams.

##### Minimum distance to reflective surface series TH



##### Minimum distance to reflective surface series SH

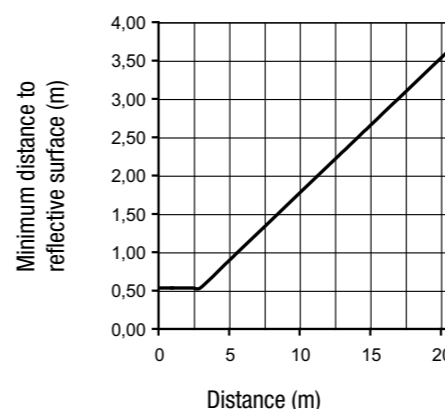


Fig. 2: Minimum distance to reflective surfaces

##### How to determine the minimum distance from reflective surfaces (RS):

- Measure the distance D [m] between sender and receiver.
- Read the minimum distance a [m] from the graph.

##### Note

The minimum distances to reflective surfaces only apply when the light path is clear. On the usage of transparent guard windows, these values may change. Please note the information from the related manufacturer.



##### Prevent that the safety light beams interfere each other!

- If more than one pair of single-beam sensors are connected in cascade, different beams of the same chain must not interfere each other.
- If more than one pair of single-beam sensors are connected to the same control unit and this unit does not prevent the mutual interference between different channels, the angle of emission / reception of a couple of sensors must not interfere with other sensors connected with the same unit
- If more control units are used in the same system it is possible that couples of sensors from different units can interfere, in this case systematic or sporadic errors may occur. Only in this case, to avoid interference can be used sensors with different frequency modulation.

#### 5 ELECTRICAL INSTALLATION



##### Secure the plant/system. No dangerous state possible!

Ensure that the dangerous state of the machine is (and remains) switched off. As per IEC 61496 type 2, the single-beam photoelectric safety switches must be monitored by an external test device. When connecting to the sensors, observe the related operating instructions for the external test device and higher level control.

##### 5.1 CONNECTION CONNECTOR VERSION

Connect and tighten electrically isolated cable socket.

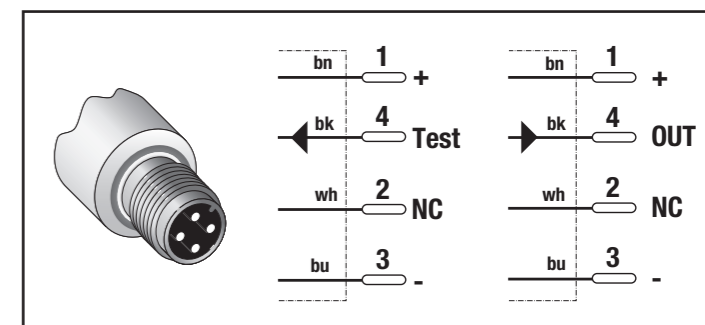


Fig. 3: Connection type plug, 4 pin, M12, e.g. SH-TH

#### 5.2 USAGE IN CASCADE

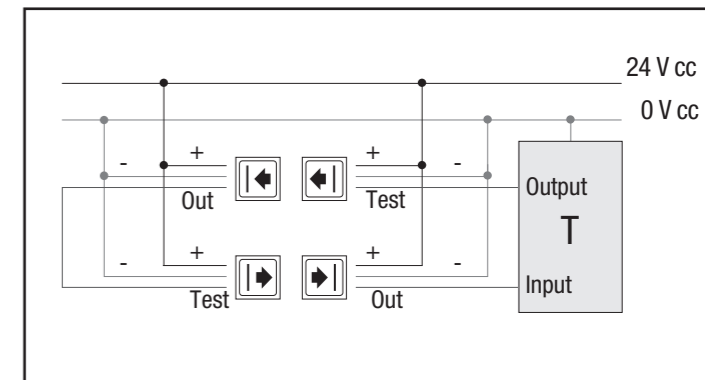


Fig. 4: Example for SH-TH connection in a two device cascade (T = test device)

#### 6 COMMISSIONING

##### 6.1 Alignment of sensors and LED display

##### 6.1.1 Alignment of sensors

Once mounted and connected all the components, emitter and receiver must be aligned between them.

- 1) Align emitter and receiver approximately and fix both temporarily.
- 2) Cascade connection : you must start with the alignment of the first pair in the chain, otherwise the following may not emit light correctly.
- 3) Use the voltage supply specified in table 4 (for alignment procedure, it is possible to supply only the sensors).
- 4) Attach a sheet of white paper (only for very short working distance) or better a sheet of reflective paper 100 mm x 100 mm with a hole (corresponding to the cross section of sensor) in the center of the receiver.
- 4') If deflector mirrors are installed, apply the sheet in the center of the mirrors.
- 5) Align the emitter so that the light reflected on the reflector, applied to the receiver or in the mirror, reaches its maximum intensity and the spot light is centered. When the emitter emits at its full power the orange LED will be ON.
- 5') If deflector mirrors are installed, remove the reflective paper from the mirror, put it on the receiver and align the mirror to the receiver until the light reflected on the reflector reaches maximum intensity.
- 6) Verify that the yellow LED on the receiver is ON or align better the receiver.
- 7) To check the light power received, partially cover the lens of the emitter and/or receiver. emitter and receiver are correctly aligned if the LED on the receiver begins to flash when at least half the surface of the lens is covered.
- 8) Fix sensors aligned in this position.
- 9) Proceed in the same way with other sensors or mirrors.



##### Pay attention to correct mounting!

Ensure the devices are correctly mounted and secured against moving after adjustment.

##### 6.1.2 LED indications

Display	status
□ does not illuminate	No voltage supply or in the test mode
● illuminates	Sender active

Tab. 2: Sender status indications (orange)

Display	status
□ does not illuminate	No voltage supply, light path interrupted or in the test mode
● flashes	Weak signal, e.g. due to contamination or poor alignment
● illuminates	Light path clear

Tab. 3: Receiver status indications (yellow)

## 6.2 Test notes

The purpose of the tests described in the following is to confirm the safety requirements specified in the national/international rules and regulations, especially in the Machine and Work Equipment Directive (EU directive conformity). These tests are also used to identify if the protection is affected by external light sources or other unusual ambient effects. These tests must therefore always be performed.

### 6.2.1 Tests before the first commissioning

- It must only be possible to access the hazardous area by interrupting the light path between sender and receiver.
- It must not be possible to climb over, to crawl beneath or to circumnavigate the light path between sender and receiver.
- Check also the effectiveness of the protective device mounted to the machine, using all selectable operating modes.
- Ensure that the operating personnel of the machine protected by the single-beam photoelectric safety switch SH-TH are correctly instructed by specialist personnel before being allowed to operate the machine. Instructing the operating personnel is the responsibility of the machine owner.
- To ensure correct function, check the related chapter 6.2.3 "Regular functional checks of the protective device".

### 6.2.2 Regular inspection of the protective device by qualified personnel

- Check the system following the inspection intervals specified in the national rules and regulations. This procedure ensures that any changes on the machine or manipulations of the protective device after the first commissioning are detected.
- If major changes have been made to the machine or the protective device, or if the single-beam photoelectric safety switch has been modified or repaired, check the system again in the same way as for initial commissioning.

### 6.2.3 Regular functional checks of the protective device

The effectiveness of the protective device must be checked on a regular basis, e.g. daily or prior to the start of work by a specialist or by authorised personnel, using the correct test object.

- Completely cover each light beam with a test rod that is not transparent to light (at least 30 mm diameter) at the following positions:
- Immediately in front of the sender
- In the middle between sender and receiver (or between the deflector mirrors)
- Immediately in front of the receiver
- When using deflector mirrors, immediately before and after the mirror

**This must produce the following result:**

- As long as the light beam is interrupted, it must not be possible to initiate the dangerous state.

### 6.2.4 EC declaration of conformity

Barriers Beam family of sensors SH TH tipo2 IC were produced in accordance with the following directives:

- The Machinery Directive 2006/42/EC
- The EMC Directive 2004/108/EC

Find the full version of the declaration of conformity in the internet site [www.microdetectors.com](http://www.microdetectors.com).

## 7 TECHNICAL SPECIFICATIONS

### 7.1 General system data

	Minimum	Typical	Maximum
scanning range M18 with axial optics (1)	0 m	10 m	16 m
scanning range M18 with radial optics (1)	0 m		5 m
scanning range M30 (axial optics) (1)	0 m		60 m
Wavelength		660 nm	
Aperture angle/receiving angle			± 5°
Beam diameter M18		12 mm	
Beam diameter M30		26 mm	
UB, supply voltage (2) (3) (4)	19,2 V	24 V	28,8V
Residual ripple (5)		≤ 5V	
Power consumption S/R (6)		≤ 20 mA / ≤ 30 mA	
Output (7)		PNP type	
Signal voltage output High	Va - 3,2 V	Va - 2,5 V	
Signal voltage output Low			5 V
Output current		50 mA	70 mA
Response time OFF (dark) (8)		200 µs, Dark to Out LOW	
Response time ON (light) (8)		400 µs, Light to Out HIGH	
Response time		Depend on the device used	
Test input for sender (dark)		Vin Test < 5 V	
Test input for sender (light)		Vin Test > 15 V	
Output signal receiver only		LOW: Dark; HIGH: Light	
VDE protection class		III (voltage supply max. 50Vcc)	
Type of protection		IP67	
Operation temperatura		-40 °C ... +55 °C	
storage temperatura		-40 °C ... +75 °C	
Air humidity	15 %		95 %
Weight M18 models (plastic/Metal)		30 / 67 g	
Weight M30 models		212 g	
Materials M18		Lens: glass with PBT ring; Housing: brass nickel-plated or PBT; M12 plug: PBT	
Materiali M30		Lens: glass with aluminium ring; Housing: brass nickel-plated; End cap: PC; M12 plug: PBT	

Tab. 4

- 1) Maximum scanning ranges as a function of temperature -20 °C ... -40 °C, see chapter 7.3.
- 2) The external voltage supply of the devices must be capable of buffering brief mains voltage failures of 20 ms as specified in EN 60204. Suitable power supplies are available as accessories (Siemens type series 6 EP 1).
- 3) Operation on short-circuit protected mains max. 8 A. The connections are reversed polarity protected.
- 4) The SH-TH and the higher level test device must be connected to the same GND (0 V).
- 5) May not exceed or fall below of UB tolerances.
- 6) Without load.
- 7) Switching output for the operation of the downstream test device, not an OSSD according to IEC 61496\_1. The output is short-circuit protected.
- 8) Response time with resistive load.

### 7.2 Safety specification

Type	Type 2 (IEC 61496)
Safety Integrity Level (SIL)	SIL1 (IEC 61508), SIL CL 1 (EN 62061)
Category	2 (EN/ISO 13849)
Performance Level	PL c (EN/ISO 13849)
PFH <sup>9)</sup>	1 x 10 <sup>-6</sup>
TM (life time)	20 years

Tab. 5

- 9) Average probability of failure per hour, due to a serious error.

**Nota: For detailed information on the exact design of your machine/system, please contact your M.D. Micro Detectors subsidiary.**

### 7.3 DIMENSIONAL DRAWING (all dimensions in mm)

#### SH\*/\*-0EIC, SH\*/\*-1EIC

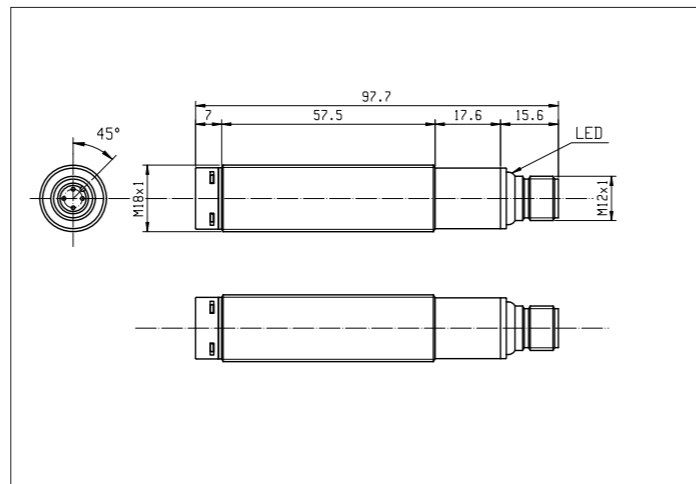


FIG. 5

#### SH\*/\*-2EIC, SH\*/\*-3EIC

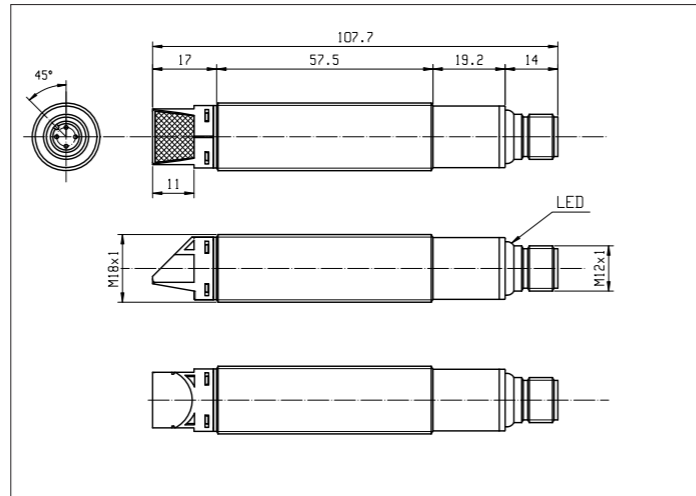


FIG. 6

#### TH\*/\*-KIC

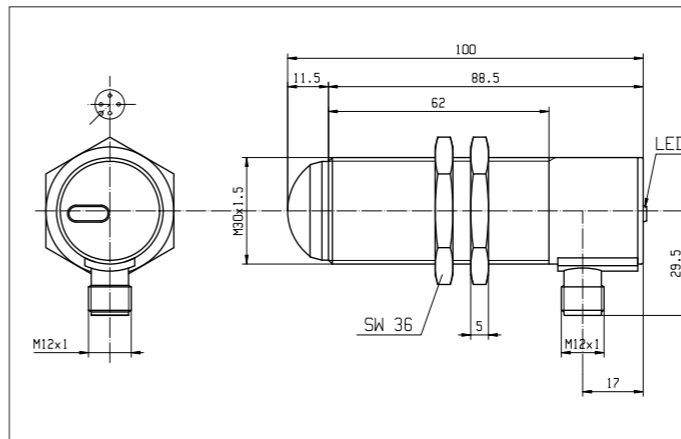


FIG. 7

#### SH\*/\*-0CIC SH\*/\*-1CIC

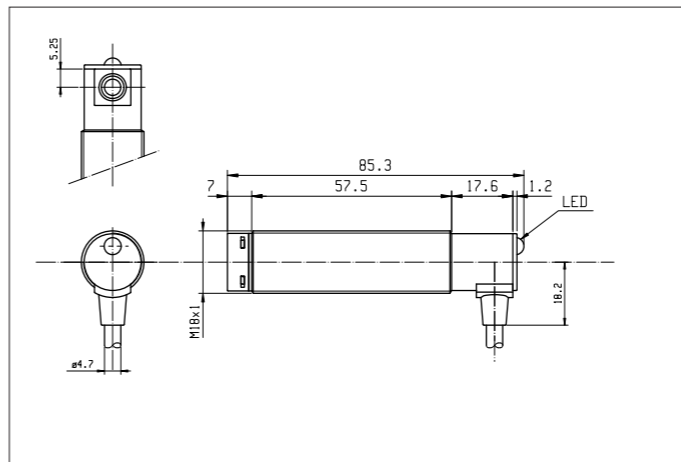


FIG. 8

#### SH\*/\*-0KIC SH\*/\*-1KIC

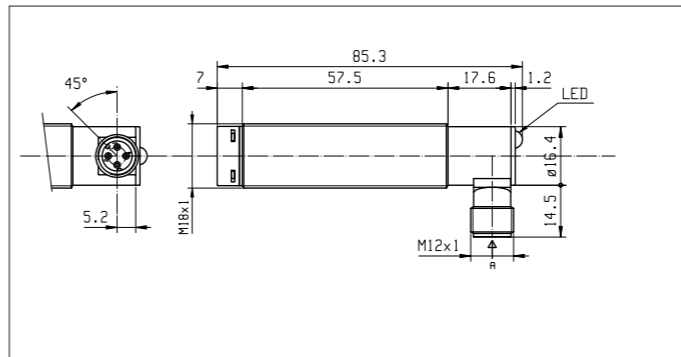
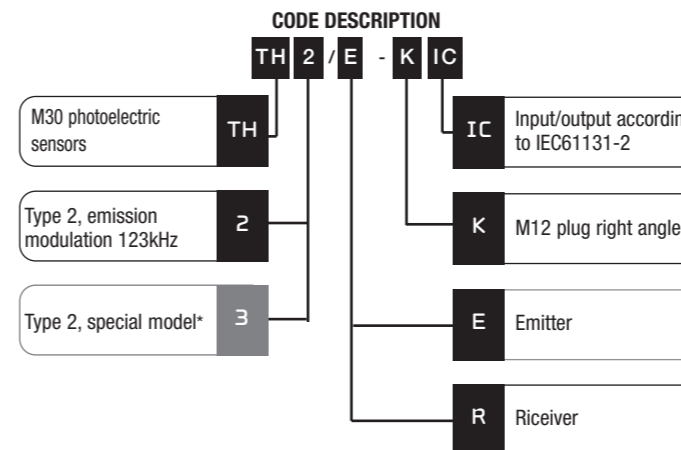


FIG. 9



### 7.4 Campi di lavoro massimi in funzione delle temperature -20 °C ... -40 °C

#### TH\*/\*-KIC

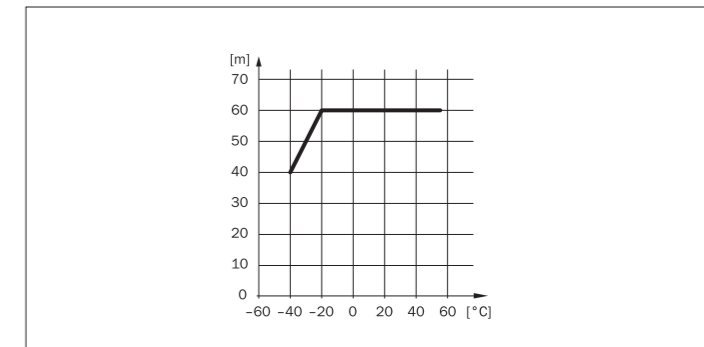


FIG. 10

#### SH\*/\*-0\*IC, SH\*/\*-1\*IC

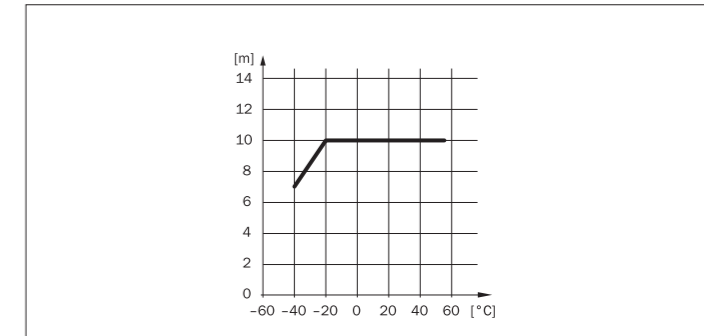


FIG. 11

#### SH\*/\*-2EIC, SH\*/\*-3EIC

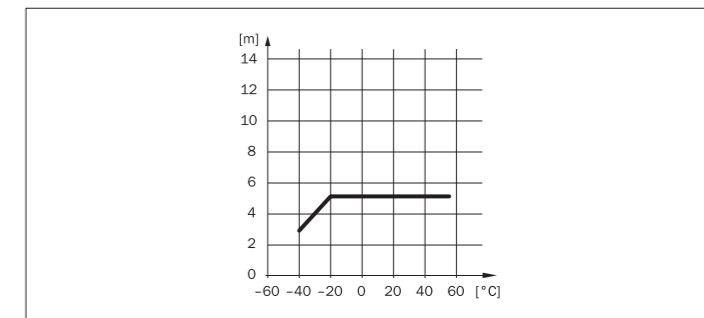


Fig. 12

