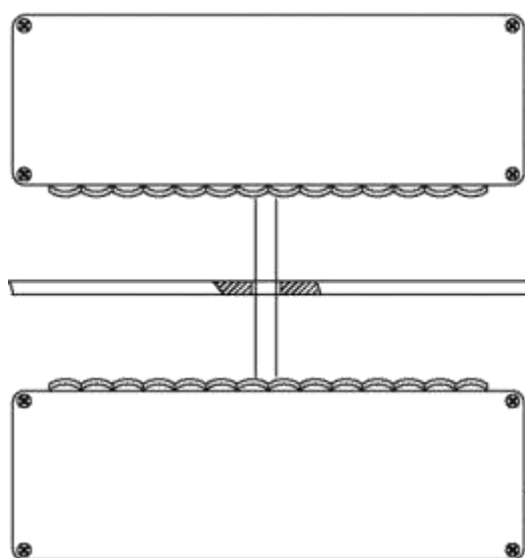


## Operating instructions

# Hole-detection instruments Type series PP2445

E\_435x2



### Characteristic features

- ✓ Application 1: Hole-marked weld seam or basted-seam detection
- ✓ Application 2: Pin-hole analysis in sheet metal inspection lines
- ✓ Excellent optical performance – reliable detection of the smallest holes
- ✓ Extensive ranges – up to 4 m with consistent monitoring width
- ✓ Robust design – especially developed for the steel processing industry
- ✓ Wide availability – also with dust and dirt
- ✓ Response time characteristics
  - Standard 12 ms
  - Quick 'q' 1,5 ms
  - Super quick 'qq' 0,5 ms
- ✓ Extensive operating temperature range -25°C to +60°C

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## 1 Identification

### 1.1 Manufacturer

Fotoelektrik Pauly GmbH

Wahrbrink 6  
59368 Werne  
Germany

### 1.2 Applied standards and technical specifications

|                  |                                                                                                                             |            |
|------------------|-----------------------------------------------------------------------------------------------------------------------------|------------|
| 2014/35/EU       | Low Voltage Directive                                                                                                       | 2014-02-26 |
| 2014/30/EU       | Directive relating to electromagnetic compatibility                                                                         | 2014-02-26 |
| DIN EN 60947-5-2 | Low-Voltage Switchgear and Control-gear,<br>Part 5-2 Control circuit devices and switching<br>elements – Proximity switches | 2014-01    |

### 1.3 Product types

| Type             | Equipment         | Type of equipment | Group-No. |
|------------------|-------------------|-------------------|-----------|
| PP2445/88        | PP2445/88S        | Transmitter       | 4351Sx01  |
|                  | PP2445/88E        | Receiver          | 4351Ex01  |
| PP2445/88 ...q   | PP2445/88S ...q   | Transmitter       | 4351Sx02  |
|                  | PP2445/88E ...q   | Receiver          | 4351Ex02  |
| PP2445/88 ...qq  | PP2445/88S ...qq  | Transmitter       | 4351Sx03  |
|                  | PP2445/88E ...qq  | Receiver          | 4351Ex03  |
| PP2445/154       | PP2445/154S       | Transmitter       | 4352Sx01  |
|                  | PP2445/154E       | Receiver          | 4352Ex01  |
| PP2445/154 ...q  | PP2445/154S ...q  | Transmitter       | 4352Sx02  |
|                  | PP2445/154E ...q  | Receiver          | 4352Ex02  |
| PP2445/154 ...qq | PP2445/154S ...qq | Transmitter       | 4352Sx03  |
|                  | PP2445/154E ...qq | Receiver          | 4352Ex03  |
| PP2445/220       | PP2445/220S       | Transmitter       | 4353Sx01  |
|                  | PP2445/220E       | Receiver          | 4353Ex01  |
| PP2445/220 ...q  | PP2445/220S ...q  | Transmitter       | 4353Sx02  |
|                  | PP2445/220E ...q  | Receiver          | 4353Ex02  |
| PP2445/220 ...qq | PP2445/220S ...qq | Transmitter       | 4353Sx03  |
|                  | PP2445/220E ...qq | Receiver          | 4353Ex03  |
| PP2445/308       | PP2445/308S       | Transmitter       | 4354Sx01  |
|                  | PP2445/308E       | Receiver          | 4354Ex01  |
| PP2445/308 ...q  | PP2445/308S ...q  | Transmitter       | 4354Sx02  |
|                  | PP2445/308E ...q  | Receiver          | 4354Ex02  |
| PP2445/308 ...qq | PP2445/308S ...qq | Transmitter       | 4354Sx03  |
|                  | PP2445/308E ...qq | Receiver          | 4354Ex03  |

| Type                            | Equipment       | Type of equipment | Group-No. |
|---------------------------------|-----------------|-------------------|-----------|
| PP2445/H ( $H \geq 330$ )       | PP2445/HS       | Transmitter       | 4355Sx01  |
|                                 | PP2445/HE       | Receiver          | 4355Ex01  |
| PP2445/H ...q ( $H \geq 330$ )  | PP2445/HS ...q  | Transmitter       | 4355Sx02  |
|                                 | PP2445/HE ...q  | Receiver          | 4355Ex02  |
| PP2445/H ...qq ( $H \geq 330$ ) | PP2445/HS ...qq | Transmitter       | 4355Sx03  |
|                                 | PP2445/HE ...qq | Receiver          | 4355Ex03  |
| PP83201/2                       | PP83201/2       | Power supply unit | 2420x...  |
| PP84201/2                       | PP84201/2       | Power supply unit | 2433x...  |
| PP85301                         | PP85301         | Power supply unit | 2431x...  |
| PP86301                         | PP86301         | Power supply unit | 2436x...  |

## 2 Intended use

These operating instructions contain important information about the intended use. It is included in the delivery scope and should always be read carefully before using the hole-detection instruments and components of the type series PP2445.

Knowledge of the contents of these operating instructions are part of the intended use. Advice and safety instructions must be observed in particular.

### 2.1 Purpose of the application of a hole detection instrument

A hole-detection instrument is used to typically inspect steel strips and other metal sheets for any light transmission.

#### 2.1.1 Application for hole-marked weld or basted-seam detection

A hole is deliberately punched for the weld or basted-seam detection, and thus a light transmission is forced. The hole is typically punched under consideration of the strip dimensions, stamping precision and strip flow tolerances in a certain area before the weld seam. Finding a hole is then always connected with the fact that a weld seam follows after a hole at a specific distance.

It has to be observed in this procedure that also other light transmission imperfections like a welded seam marking can be read. Process disturbances are thus to be intercepted by appropriate software aided plausibility checks. E.g. the probable place of a welded/ basted seam can be predicted on the basis of drive data. Then with this prediction, the evaluation of the hole-detection instrument can be carried out within an appropriate time frame.

#### 2.1.2 Application for pin-hole detection

An imperfection detection in a sheet inspection line is to prove that there are no places pervious to light – pin-holes – in a sheet. Pin-holes can have a negative impact on later strip processing processes. Imperfections can occur during the sheet production in rolling, drawing and quenching and tempering. Imperfections occur by chance and are not conditioned by place and time. That is why the attempt is made in a sheet inspection line to inspect the entire area of a sheet for light transmission.

## 2.2 Basic construction and function of hole detection instruments of the type series PP2445

Hole-detection instruments of the type series PP2445 consist of a transmitter unit, a receiver unit and an electric connector cables. A power supply and control device is available as an external additional component.

It is important for all model variations that the lens surfaces of the transmitter and receiver units directly face each other in the working mode.

The lens surfaces for the transmitter and receiver unit of a hole-detection instrument are produced by lining up square lenses. The individual square lenses have an edge length of approximately 22 mm. The monitoring width for a hole-detection instrument thus ensues from the total width of adjacent lenses. Monitoring widths of 88 mm to 1,980 are possible.

In the hole-detector mode, the entire monitoring width of a hole-detection instrument is taken up by the strip to be inspected. As soon as a place pervious to light in the strip passes the monitoring area of the hole-detection instrument, a switch signal shows up this event.

In general cases, holes with a diameter of 2 mm and even in the distance of 4 m between transmitter and receiver can be recognised. This recognition also functions with top strip speeds.

With special alignments of hole detection instruments, even holes with diameters of  $\leq 0,5$  mm are detectable.

## 2.3 Hole-marked welded / basted seam detection with hole detection instruments of the type series PP2445

Endless strips are typically produced in sheet production plants. Here sheets are connected with each other by a welded or basted seam. This connecting seam has to be recognised at the various process points in a sheet production plant.

Thus every connecting seam is marked with a hole. For this, a hole is punched in the sheet at a defined position before the connecting seam. With a hole-detection instrument of the type series PP2445, this hole is sought within the specific monitoring width of the device. Then the hole-detection instrument gives off a switch signal if a hole is detected.

The necessary monitoring width for a hole-detection instrument depends on the strip dimensions, the positioning precision of the punched hole and the side strip run movement tolerances. For a sure detection of the marked hole, the marked hole has to be run through the monitoring area.

Hole detection instruments with 3 different response time characteristics (standard, 'q' and 'qq') are available for the various applications. The necessary response time characteristics are determined by shape and size of the marked hole as well as according to the actual strip speed at the installation place of the hole-detection instrument. The diagram 'Hole-size versus strip speed' (in chapter 3.4) helps to correctly determine the necessary response time characteristic for a certain pairing of hole-size and strip speed.

## **2.4 Imperfection detector – pin-hole detector – with a hole detection instrument or a combination of hole detection instruments of the type series PP2445**

The impressive optical performance of the hole-detection instruments from the type series PP2445 is also suitable for seeking imperfections in sheet inspection lines.

Hole-detector instruments with application specific monitoring widths can be manufactured for this purpose. The monitoring widths and the response time characteristics for a hole-detection instrument are here to be aligned to the sheet dimensions, the size of the possible imperfections and the side strip movement tolerances.

### **2.4.1 Imperfections – larger than or the same as 3 mm**

To detect imperfections larger than 2 mm, a hole-detection instrument with appropriated monitoring width or a cascade of individual hole-detection instruments arranged next to each other is suitable. The monitoring width is to be selected in such a way, so that considering the side strip movement tolerances, the monitoring area cannot pass the outer edge of the strip.

The combination of side strip movement tolerance and selected monitoring width results in the actually inspected area of the strip.

The necessary response characteristic depends on the strip speed.

### **2.4.2 Imperfections – much smaller than 2 mm**

The detection of imperfections – smaller than 2 mm – is possible due to an alignment of two stand-alone transmitter and receiver units in the movement direction of the strip aligned one behind the other.

Moving the two transmitter receiver units by half a lens grid also causes the very smallest imperfection holes to be run through at least one lens grid with high performance. Thus the smallest holes are detected by either both hole-detection instruments, at least however by one.

By the combinatorial evaluation of both hole detection instruments, imperfections with hole sizes very much smaller than 2 mm can thus be found, and this even with high strip speeds and long light path distances.

The necessary response time characteristics are based on the strip speed.

## 2.5 Safety instructions

-  The operator/constructor has to inform himself about the provisions in force for his area of application and observe these, this also applies to the installation and laying of the cables and leads to be carried out.
-  Installation and connection work on the components of the hole-detection instruments type series PP2445 and the appropriate power supply devices may only be carried out in switched off condition.
-  Maintenance work may only be carried out by qualified electricians.
-  The device must be taken out of operation in the event of damage or leaks in the housing, in the plug connectors or in the cable glands.
-  For the intended use it is not permitted to operate without the housing cover closed.



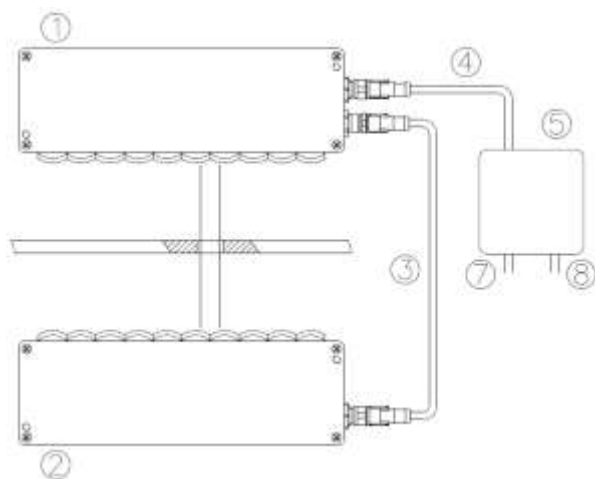
## 3 Operating instructions

### 3.1 System configurations

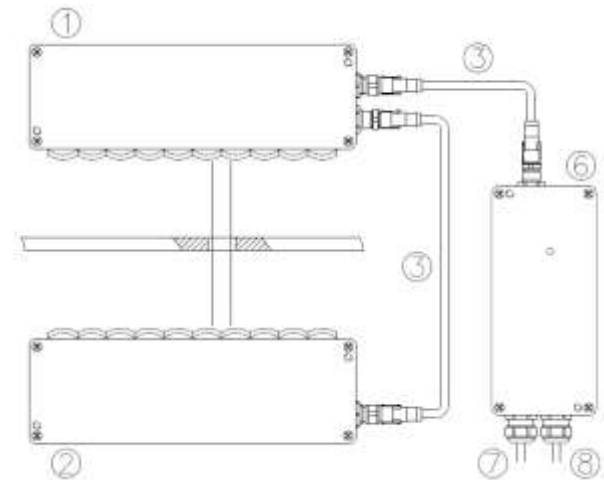
Diverse components are necessary for the different system configurations:

- ① Transmitter
- ② Receiver
- ③ Connector cable, preassembled, between transmitter and receiver, lead lengths selectable, usual lengths are 5 m and 10 m
- ④ Supply and output cable, preassembled, lead lengths selectable, usual lengths are 5 m and 10 m
- ⑤ Distributor box (not contained in the delivery scope)
- ⑥ Optional external power supply and control device with additional preassembled connection cable identically pos. "4"
- ⑦ Connection: voltage supply
- ⑧ Connection: switching output

#### 3.1.1 Overall view 3 part configuration



#### 3.1.2 Overall view 4 part configuration



### 3.2 Operating principle

The hole-detection instruments of the type series PP2445 are intended for the hole-detection in sheet metal. They operate according to the transmitted light principle: light from the transmitter source lights up the receiver positioned opposite by one or more holes in the sheet. In the receiver, a switching signal is created for the duration of the illumination. Via the electrical connecting cable to the transmitter, the status of the switch signal is conveyed to the transmitter, and from there on further to the power supply and control device. Then in the power supply and control device, the specific customer switching output is activated. The switching output of the power supply and control device is to be connected to the process plant control.

The signal function for the customer switching outputs are bright and dark switching. This means: the bright switching output has Function 1 when light illuminates the receiver through a hole, the dark switching output has Function 1, when the sheet clearly interrupts the light contact path between transmitter and receiver.

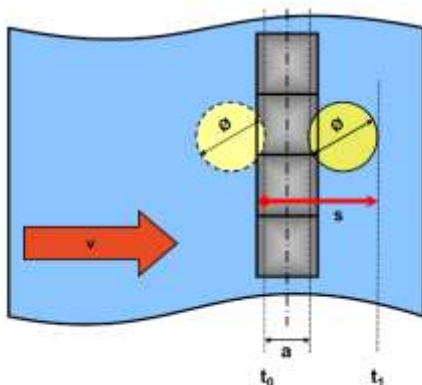
As a rule, the specific customer switching output of the hole-detection instrument remains activated only for the lighting duration of the receiver. A process plant control, however, can only read the switch status of the hole-detection instrument with discrete time filtering. For this reason, a suitable pulse prolongation – from 0 to 3 seconds, preset to 3 seconds – can be set for the switch status signals of the hole-detection instrument in the transmitter with a potentiometers. For adjusting the pulse prolongation, please read chapter 3.11.

Based on the very impressive optical performance, the hole-detection instruments of the type series PP2445 already work with a simple, directly facing transmitter/receiver configuration.

The distance between transmitter and receiver must be at least up to 4 m.

The detection of holes depends on the hole-size and the strip speed. On choosing the correct instruments, please read chapters 3.4, 3.6 and 4.

### 3.3 Response behaviour



The optical monitoring field of the hole-detection instruments of the type series PP2445 is made up by lining up square lenses with an edge length of  $\sim 22$  mm.

If a hole turns up in the lens row, the illumination of the receiver begins. The illumination ends when the hole leaves the lens row again.

During the illumination ' $t_1 - t_0$ ' the hole marking moves on with the specific strip speed ' $v$ ' via path ' $s$ '.

If with a known hole size ' $\varnothing$ ' and a strip speed ' $v$ ', the condition  $s/v = (a + \varnothing)/v = (t_1 - t_0) \geq t_{\text{Access}}$  is fulfilled, the switch output of the hole detector is set.

## 3.4 Response time characteristics

There are 3 different response time characteristics available:

| Response time characteristic and type |              | Work area                          |   |
|---------------------------------------|--------------|------------------------------------|---|
| Standard:                             | PP2445...    | $\geq 12$ ms/switching transition  | — |
| Option 'q':                           | PP2445... q  | $\geq 1,5$ ms/switching transition | — |
| Option 'qq':                          | PP2445... qq | $\geq 0,5$ ms/switching transition | — |

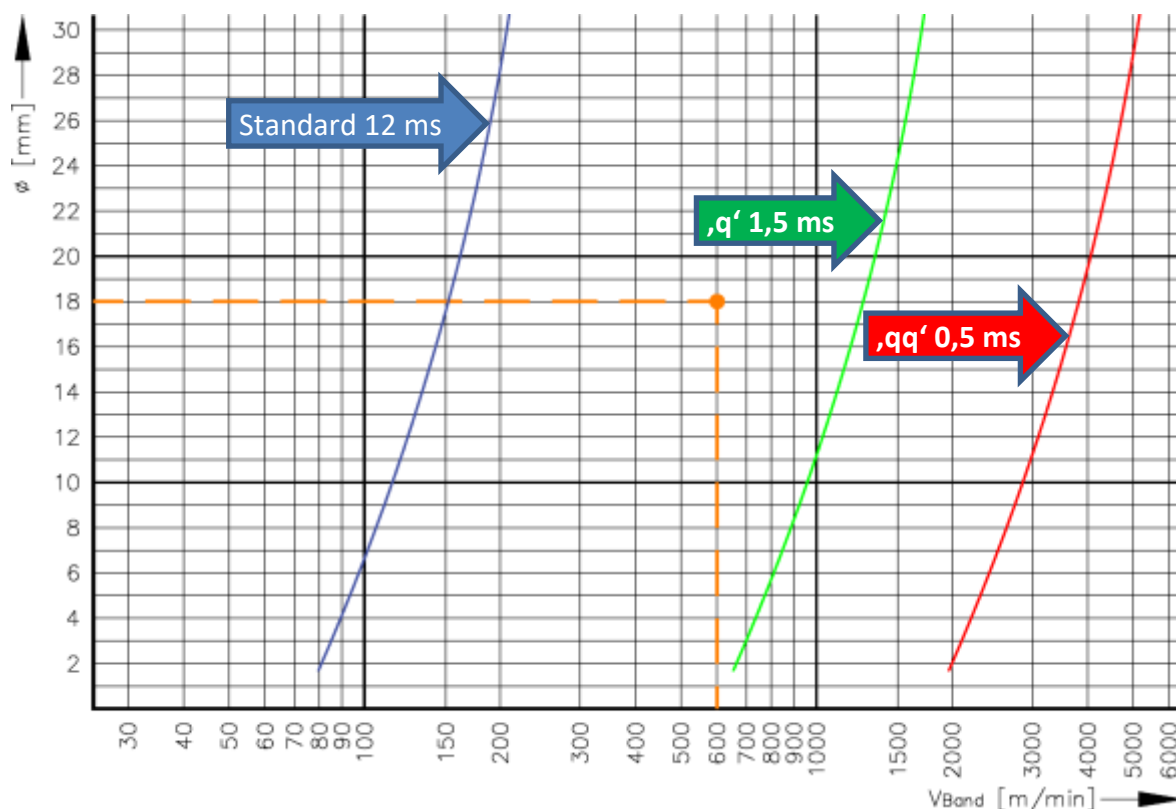


Diagram: Hole-size versus strip speed

Determining the necessary response time characteristic for a specific case of application is determined by the size of the hole marking ' $\varnothing$ ' and the strip speed.

### 3.5 Determination of the necessary response time characteristic for a specific case of application

For a known hole size and a known strip speed, the coordinate intersection is entered in the diagram: 'Hole-size versus strip speed'. A hole-detection instrument with a response time characteristic is to be selected for which the ascertained coordinate is left of a working area curve.

Example:

Hole marking, diameter 18 mm; strip speed 600 m/min;

The coordinate intersection is left of the green working area curve;

This means that a hole detection instrument with an access time characteristic 'q' is needed.

### 3.6 Monitoring widths of hole detection instruments

The correct choice of the response time characteristic ensures that with a given hole-size and strip speed, the hole is seen and reported.

However, detecting holes only works if the holes are also run procedurally through the monitoring area of the hole-detector.

For the various applications, hole detection instruments are available both with standardized as also for specific customer monitoring widths. As a reminder: a monitoring width is formed by the lining up of several square lenses with an edge length of ~ 22 mm. The following standard and customer specific hole-detection instruments can be deferred from this.

| Monitoring width H [mm] / number of lenses |      | Status            | Response time characteristic |                 |                  |
|--------------------------------------------|------|-------------------|------------------------------|-----------------|------------------|
|                                            |      |                   | Standard                     | Option 'q'      | Option 'qq'      |
| 88                                         | 4    | Standard          | PP2445/88                    | PP2445/88 ...q  | PP2445/88 ...qq  |
| 154                                        | 7    | Standard          | PP2445/154                   | PP2445/154 ...q | PP2445/154 ...qq |
| 220                                        | 10   | Standard          | PP2445/220                   | PP2445/220 ...q | PP2445/220 ...qq |
| 308                                        | 14   | Standard          | PP2445/308                   | PP2445/308 ...q | PP2445/308 ...qq |
| ≥ 330                                      | ≥ 15 | Customer specific | PP2445/H                     | PP2445/H ...q   | PP2445/H ...qq   |
| ≤ 1980                                     | ≤ 90 | Customer specific | PP2445/H                     | PP2445/H ...q   | PP2445/H ...qq   |

### 3.6.1 Determination of the monitoring width for a hole-detection instrument to find a hole marked welded /basted seam.

To be considered for determining the necessary monitoring width are:

|                                                                                         | Example                      |                  |
|-----------------------------------------------------------------------------------------|------------------------------|------------------|
| 1. How big is the side punch tolerance for the hole marking on the welded /basted seam? | $\pm 50 \text{ mm}$          | Absolute: 100 mm |
| 2. Which side strip movement tolerance is to be expected?                               | $\pm 55 \text{ mm}$          | Absolute: 110 mm |
| 3. Which various strip ranges are processed on the conveyor system?                     | Min: 900 mm<br>Max: 1,300 mm |                  |

The absolute sum from the punch tolerance and the strip movement tolerance results in the minimal monitoring width for a hole-detection instrument. Thus, selected is the next bigger standard or specific customer monitoring width as nominal monitoring width.

|                                                                | The result of the example is:                                             |
|----------------------------------------------------------------|---------------------------------------------------------------------------|
| Minimal monitoring width                                       | 210 mm                                                                    |
| Nominal monitoring width                                       | 220 mm                                                                    |
| Inspect: overhang of the monitoring width for narrowest sheets | $55 \text{ mm} << (900 \text{ mm} - 220 \text{ mm}) / 2 = 340 \text{ mm}$ |

After determining the nominal monitoring width, inspection now has to be carried out for the minimal range, so that the hole-detector cannot pass the strip edge also with the side strip movement tolerance of the monitoring area.

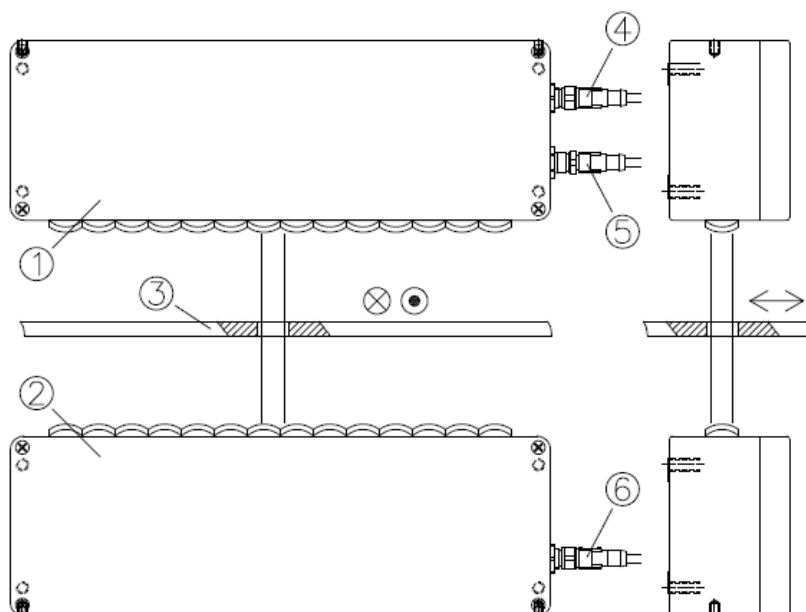
### 3.6.2 Determination of the monitoring width for a hole detection instrument for finding imperfections

To ascertain a hole-detection instrument for finding imperfections, the sheet width, the side strip movement tolerance and the strip speed have to be defined.

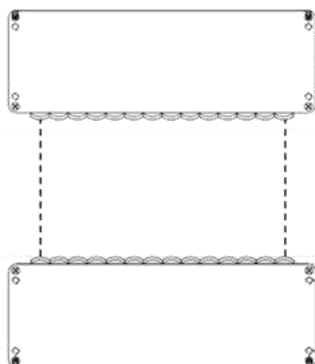
## 3.7 Installation recommendations and presets

### 3.7.1 General arrangement

- |                           |                                          |
|---------------------------|------------------------------------------|
| ① Transmitter unit        | ④ Connecting plug stLU5 (male in unit)   |
| ② Receiver unit           | ⑤ Connecting plug stLU5 (female in unit) |
| ③ Sheet with hole-marking | ⑥ Connecting plug stLU5 (male in unit)   |



### 3.7.2 Installation arrangement



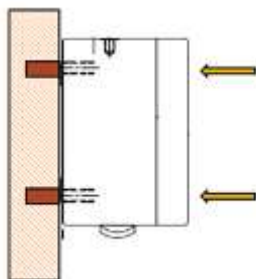
Transmitter and receiver are to be installed facing each other.

The distance between transmitter and receiver can be up to 4 m.

The horizontal and vertical alignment tolerance is to be  $\leq 3$  mm.

The lens surfaces of transmitter and receiver should face each other plane parallel.

## 3.7.3 Side floor assembly – from inside

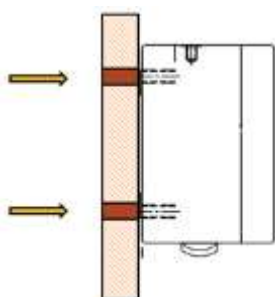


Screws 2x M4, if PP2445/88, .../154 or.../220; 4 x M6, if PP2445/308

Use of the inner casing through holes

Threaded blind holes or through holes in the mounting frame

## 3.7.4 Side floor assembly – from outside



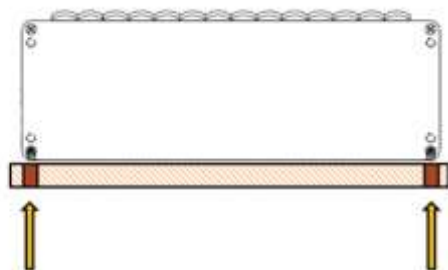
Screws 2x M6, if PP2445/88, .../154 or.../220; 4 x M8, if PP2445/308

Assembly from outside

Through holes in the installation plate

Threaded holes in the casing bottom

## 3.7.5 Rear panel assembly – from outside



Screws 2x M6, if PP2445/88, .../154, .../220 or .../308;  
8 x M5, if PP2445/H

Assembly from outside

Through holes in the installation plate

Threaded blind holes in the casing wall

## 3.8 Electric connection

### 3.8.1 General information / prerequisites

-  Installation and connection work on the components of the hole-detection instruments must only be carried out in switched off condition.
-  Type and highest rating of the external short-circuit protection devices:

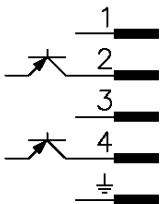
|                            |                                                                                |
|----------------------------|--------------------------------------------------------------------------------|
| Supply:                    | 2A                                                                             |
| PNP Output:                | Utilization categories DC-1; DC-13: 60mA                                       |
| Relay Output:              | Utilization categories AC-1; DC-1; DC-13: 6A<br>Utilization category AC-15: 2A |
| Triggering characteristic: | Circuit breaker: B or C<br>Fuse: slow                                          |
-  The relay contacts are to be operated with a minimum current of 20mA.
-  In switching inductive loads, e.g. relay or contactor, with the relay contacts quenching elements are to be switched directly parallel to the inductive load.
  - Switching voltage AC: quenching with an RC element
  - Switching voltage DC: quenching with a freewheeling diode
-  A protective conductor terminal is absolutely necessary for protection from electric shock by exposed conductive parts.
-  The PNP transistor outputs (option: 'e2') are current-limited (60mA) and short circuit proof. Output voltage: high state ~ 22V, low state = open

In the low state, the corresponding PLC input is to be pulled to reference potential OV with a suitable measure, e.g. a pull down resistor.
-  The optoelectronic coupler output is to be connected as NPN transistor. The collector and emitter of this transistor are potential free, and have to be supplied for an electronic function from outside with the supply voltage of the downstream control circuit.



## 3.8.2 Connection with connector 'stLU5'

|                                      |                                      |                                     |
|--------------------------------------|--------------------------------------|-------------------------------------|
| <input type="checkbox"/> PP2445/88S  | <input type="checkbox"/> PP2445/220S | <input type="checkbox"/> PP2445/H S |
| <input type="checkbox"/> PP2445/154S | <input type="checkbox"/> PP2445/308S |                                     |

| Connection diagram                                                                | Pin stLU5 | Conductor color code | Description                         |
|-----------------------------------------------------------------------------------|-----------|----------------------|-------------------------------------|
|  | 1         | BN (brown)           | +24VDC                              |
|                                                                                   | 2         | WH (white)           | PNP open collector dark switching   |
|                                                                                   | 3         | BU (blue)            | 0V                                  |
|                                                                                   | 4         | BK (black)           | PNP open collector bright switching |
|                                                                                   | PE        | GYNE (green/yellow)  | protective earth                    |

## 3.8.3 Supply and output cable transmitter

|                                                |                                                 |
|------------------------------------------------|-------------------------------------------------|
| <input type="checkbox"/> PP2445CC1 /5m /1stLU5 | <input type="checkbox"/> PP2445CC1 /10m /1stLU5 |
|------------------------------------------------|-------------------------------------------------|

|                                              |                  | Transmitter unit | Distributor box (provided by the customer) |
|----------------------------------------------|------------------|------------------|--------------------------------------------|
|                                              | Device connector | stLU5 male       | -                                          |
|                                              | Cable connector  | stLU5 female     | -                                          |
| Function                                     | Pin no.          | Wire color       | Wire color                                 |
| 24VDC                                        | 1                | Brown            | Brown                                      |
| Signal: PNP open collector, dark switching   | 2                | White            | White                                      |
| 0V                                           | 3                | Blue             | Blue                                       |
| Signal: PNP open collector, bright switching | 4                | Black            | Black                                      |
| PE                                           | PE               | Green/Yellow     | Green/Yellow                               |

### 3.8.4 Connector cable transmitter ↔ receiver

☐ PP2445CC2 /5m /2stLU5

☐ PP2445CC2 /10m /2stLU5

| C                          |                  |              | Receiver unit | Transmitter unit |
|----------------------------|------------------|--------------|---------------|------------------|
|                            | Device connector |              | stLU5 male    | stLU5 female     |
|                            | Cable connector  |              | stLU5 female  | stLU5 male       |
| Function                   | Pin no.          | Wire color   | Wire color    |                  |
| 24VDC'                     | 1                | Brown        | Brown         |                  |
| nc.                        | 2                | White        | White         |                  |
| 0V'                        | 3                | Blue         | Blue          |                  |
| Signal: PNP open collector | 4                | Black        | Black         |                  |
| PE                         | PE               | Green/Yellow | Green/Yellow  |                  |

### 3.8.5 Connector cable transmitter ↔ power supply and control device (optional)

☐ PP2445CC2 /5m /2stLU5

☐ PP2445CC2 /10m /2stLU5

|                                              |                  |              | Receiver unit | Power supply and control device (optional) |  |
|----------------------------------------------|------------------|--------------|---------------|--------------------------------------------|--|
|                                              | Device connector |              | stLU5 male    | stLU5 female                               |  |
|                                              | Cable connector  |              | stLU5 female  | stLU5 male                                 |  |
| Function                                     | Pin no.          | Wire color   | Wire color    | Terminal block                             |  |
| 24VDC                                        | 1                | Brown        | Brown         | 22                                         |  |
| Signal: PNP open collector, dark switching   | 2                | White        | White         | nc.                                        |  |
| 0V                                           | 3                | Blue         | Blue          | 23                                         |  |
| Signal: PNP open collector, bright switching | 4                | Black        | Black         | 21                                         |  |
| PE                                           | PE               | Green/Yellow | Green/Yellow  | PE                                         |  |

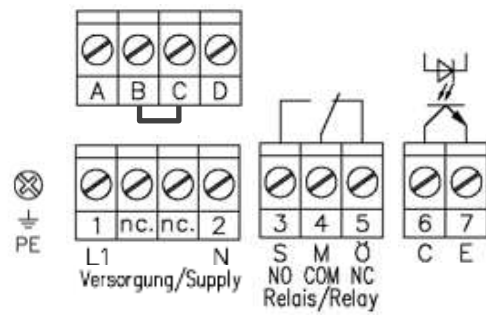
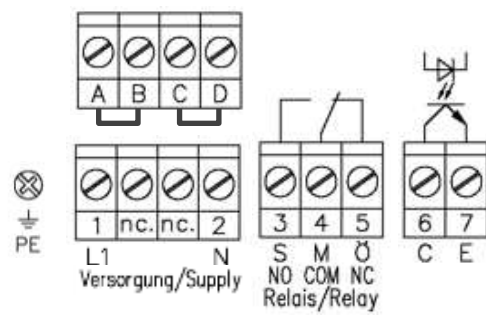
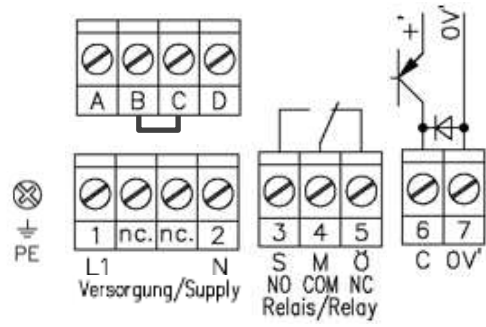
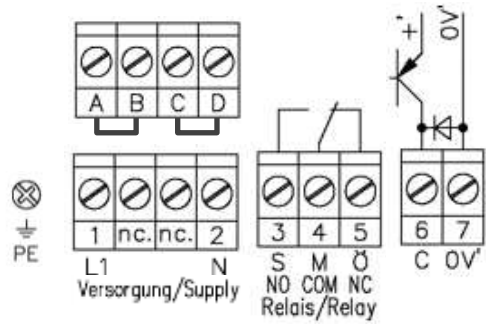
## 3.8.6 Connection with a terminal block (optional power supply and control device)

 The terminal block described are in the optional power supply and control device.

 Conductor cross section minimum: 0.25 mm<sup>2</sup> / AWG24  
Conductor cross section maximum: 2.5 mm<sup>2</sup> / AWG14

### 3.8.6.1 AC variants – instrument types and option identifications

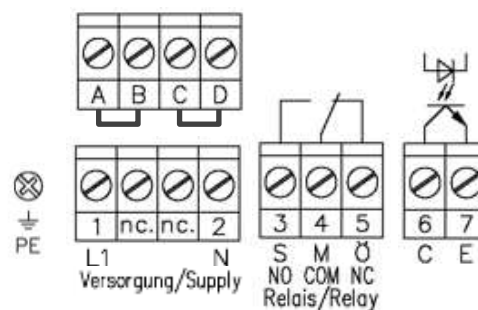
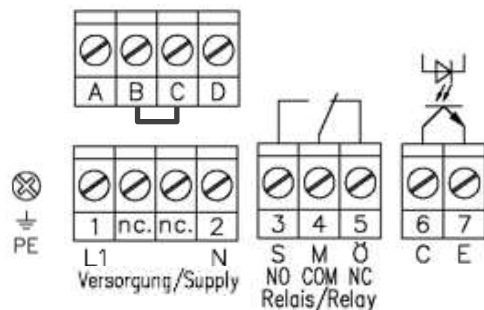
☐ PP83201/2

|                                                                                                  |                                                                                      |
|--------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| <input type="checkbox"/> .. /R /e1 .. /230VAC<br><input type="checkbox"/> .. /R /e1 .. /42-48VAC | <input type="checkbox"/> .. /R /e1 .. /115VAC                                        |
|                |   |
| <input type="checkbox"/> .. /R /e2 .. /230VAC<br><input type="checkbox"/> .. /R /e2 .. /42-48VAC | <input type="checkbox"/> .. /R /e2 .. /115VAC                                        |
|               |  |

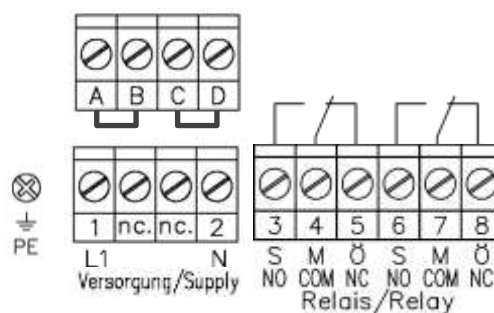
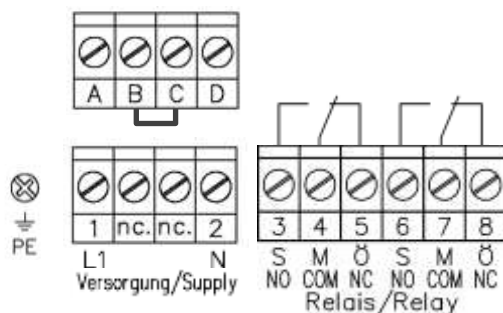
☐ PP85301

☐ PP86301

☐ .. /R /e1 .. /230VAC  
☐ .. /R /e1 .. /42-48VAC

☐ .. /R /e1 .. /115VAC

☐ PP83201/2U

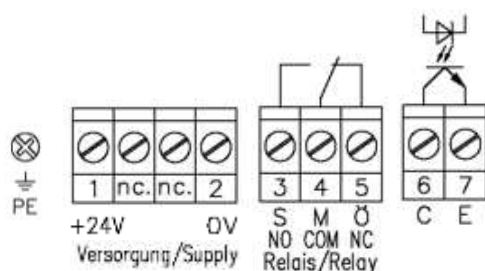
☐ .. /R .. /230VAC  
☐ .. /R .. /42-48VAC

☐ .. /R .. /115VAC


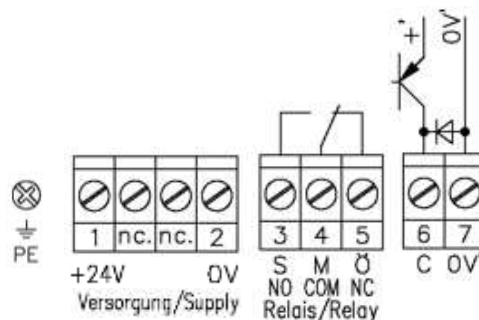
## 3.8.6.2 DC-Variants – instrument types and option identifications

□ PP83201/2

□ .. /R /e1 .. /24VDC

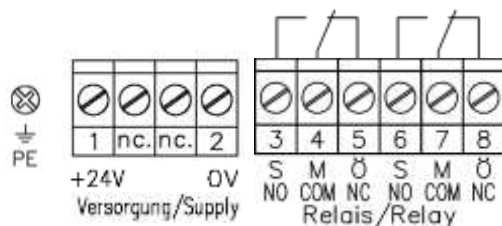


□ .. /R /e2 .. /24VDC



□ PP83201/2U

□ .. /R .. /24VDC



## 3.9 Operator control and indicating elements (overall view)

### 3.9.1 Transmitter and receiver unit

| Symbol                                                                                     | Operator control and indicating element                                                                                                                                                                                                            | Device      |
|--------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| LED<br> | Switch indicator LED red<br>LED on = hole<br>LED off = sheet                                                                                                                                                                                       | PP2445 ...S |
| LED<br> | Operating indicator LED green<br>LED on = in operation<br>LED off = non-working                                                                                                                                                                    | PP2445 ...E |
|         | Potentiometer to prolong the switching pulse with the output switching device. The pulse prolongation can be adjusted infinitely variable in the limits from 0 to 3 s ('z3s'), preset to 1 s. Optionally: 0 to 1 s ('z1s') or 0 to 10 s (',z10s'). | PP2445 ...S |

### 3.9.1 Power supply and control device (optional)

| Symbol                                                                                                                                                                                                                                                                                                       | Operator control and indicating element                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Device                                        |      |               |                  |                                      |                |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|------|---------------|------------------|--------------------------------------|----------------|
| <div>LED</div> <div></div>                                                                                                                                                                                                  | <p>Switch indicator LED red</p> <p>The display depends on the chosen operating mode:</p> <p>Bright switching    LED on   = hole<br/>                             LED off   = sheet</p> <p>Dark switching      LED on   = sheet<br/>                             LED off   = hole</p>                                                                                                                                                                                                                                                                                                                                           | PP83201/2<br>PP83201/2U<br>PP85301<br>PP86301 |      |               |                  |                                      |                |
| <div>d</div> <div></div> <div>h/b</div>                                                                                                                                                                                     | <p>Operating mode switch (b/d switch)</p> <p>b = bright switching</p> <p>d = dark switching</p> <p>Default setting:<br/>Operating mode = bright switching</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                               |      |               |                  |                                      |                |
| <div><div><div>Tein</div><div>Ton</div></div><div></div></div> <div><div>Taus</div><div>Toff</div></div> <div></div> <div>0...3s</div> | <p>Potentiometer to prolong the switching pulse with the output switching device. The pulse prolongation can be adjusted infinitely variable in the limits from 0 to 3 s ('z3s'), or optionally from 0 to 1 s ('z1s') or 0 to 10 s (,z10s').</p> <p>The respective potentiometer adjustment for the pulse prolongation time is dependent on the chosen operating mode: bright or dark switching.</p> <table><tr><th>Mode</th><th>Potentiometer</th></tr><tr><td>Bright switching</td><td>Ton    = 0 s !<br/>Toff    = 0 to 3 s</td></tr><tr><td>Dark switching</td><td>Ton    = 0 to 3 s<br/>Toff    = 0 s !</td></tr></table> |                                               | Mode | Potentiometer | Bright switching | Ton    = 0 s !<br>Toff    = 0 to 3 s | Dark switching |
| Mode                                                                                                                                                                                                                                                                                                         | Potentiometer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                               |      |               |                  |                                      |                |
| Bright switching                                                                                                                                                                                                                                                                                             | Ton    = 0 s !<br>Toff    = 0 to 3 s                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                               |      |               |                  |                                      |                |
| Dark switching                                                                                                                                                                                                                                                                                               | Ton    = 0 to 3 s<br>Toff    = 0 s !                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                               |      |               |                  |                                      |                |

## 3.10 Operating mode switch, switch display and switching output

The output to be used depends on signal processing in the subordinate PLC.

The output “bright switching” is to be used, if a logical 1 signal for the hole event and a logical 0 signal for the covered event (sheet without hole, thus receiver sees no light) is expected in the PLC.

The output “dark switching” is to be used, if a logical 1 signal in the PLC is expected for the covered event (sheet without hole, thus receiver does not see any light) and a logical 0 signal for the hole.

The following table explains the connections between output, event, significance in the PLC, and the relevant switch display.

| Output           | Event           | PLC      | LED red | PNP           |
|------------------|-----------------|----------|---------|---------------|
| Bright switching | Hole            | 1 signal | On      | + UB          |
|                  | Covered = sheet | 0 signal | Off     | Output ‘open’ |
| Dark switching   | Hole            | 0 signal | On      | Output ‘open’ |
|                  | Covered = sheet | 1 signal | Off     | + UB          |

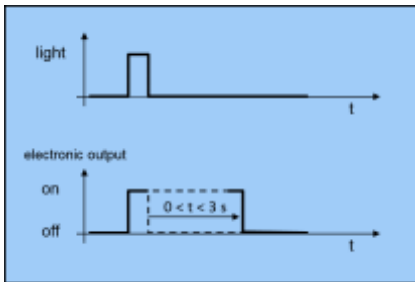
For using the respective switch outputs, the advice in chapter: Electric connection is to be heeded.

## 3.11 Adjustment of the switching pulse prolongation

### 3.11.1 Pulse prolongation at the bright switching output

The receiver is lighted up by the light of the transmitter through a hole and the switch output remains switched on without adjusted pulse prolongation only for the duration of the illumination. By way of a temporal stage, the duty cycle of the switch output can be appropriately prolonged (preset: 1 s), so that a subsequent evaluation logic can surely process the switching pulse.

For the adjustment the following steps must be carried out.

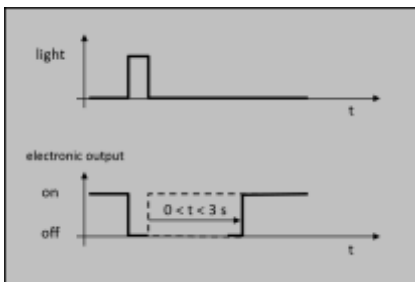


1. First set the potentiometer in minimum position (turn clockwise to stop position position).
2. After that set a time between 0 and 3 s on the potentiometer. Do this by turning the potentiometer anticlockwise to the desired position.

### 3.11.2 Pulse prolongation at the dark switching output

The switching output is standardly switched on. If the receiver is illuminated by a hole from the light of the transmitter, the switch output is switched off. The switch output remains switched off without adjusted pulse prolongation for the duration of the illumination. By way of a temporal stage, the turn off duration of the switching output can be appropriately prolonged (preset: 1 s), so that a subsequent evaluation logic can surely process the switching pulse.

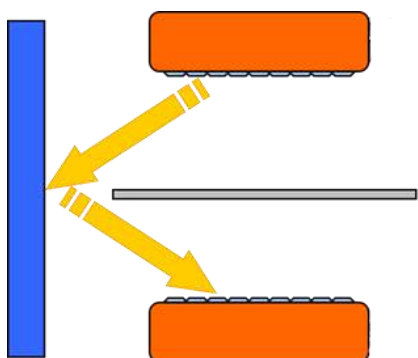
For the adjustment the following steps must be carried out.



1. First set the potentiometer in minimum position (turn clockwise to stop position position)
2. After that set a time between 0 and 3 s on the potentiometer. Do this by turning the potentiometer anticlockwise to the desired position.

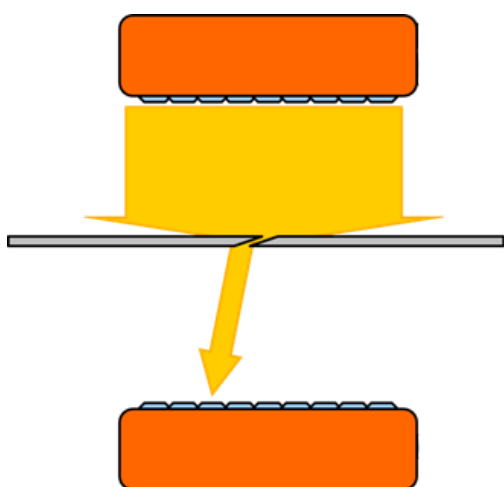


## 3.12 Avoiding optical disturbances



Lighting past the strip edges can cause deficiencies:

1. Allow no direct optical connection between transmitter and receiver past the strip edges.
2. Exclude reflections of the transmitted light over machine elements.



Light pervious places in the sheet, e.g. tears or pin holes can cause welded seam messages.

## 4 Technical data

### 4.1 Generally

|                                       | Transmitter; Receiver; Control Device     |
|---------------------------------------|-------------------------------------------|
| <i>Degree of protection</i>           | IP65                                      |
| <i>Protection class</i>               | Class I equipment                         |
| <i>Vibration and shock resistance</i> | According to EN 60947-5-2                 |
| <i>Pollution degree</i>               | 4<br>with mounted housing cover and plugs |
| <i>Rel. humidity</i>                  | ≤ 90 %                                    |
| <i>Operating temperature</i>          | -25...+60 °C                              |
| <i>Storage temperature</i>            | -30...+70 °C                              |

## 4.2 Transmitter units

| Hole-detection instrument type PP2445..S (transmitter) | <input type="checkbox"/> .../88        | <input type="checkbox"/> .../154 | <input type="checkbox"/> .../220 | <input type="checkbox"/> .../308 | <input type="checkbox"/> .../H (H ≥ 330mm)                                     |
|--------------------------------------------------------|----------------------------------------|----------------------------------|----------------------------------|----------------------------------|--------------------------------------------------------------------------------|
| Casing                                                 | Cast Aluminum                          |                                  |                                  |                                  | Aluminum                                                                       |
| Weight                                                 | 1,0 kg                                 | 1,1 kg                           | 1,25 kg                          | 2,6 kg                           | ~12 kg/m                                                                       |
| Connection                                             | Plug connections stLU5                 |                                  |                                  |                                  |                                                                                |
| Voltage supply                                         | 24 VDC -10...+20 %<br>≤ 10 VA          |                                  |                                  |                                  | 24 VDC -10...+20 %<br>≤ 528mm: ≤ 10 VA<br>≤ 704mm: ≤ 30 VA<br>> 704mm: ≤ 60 VA |
| Switch output                                          | 2x PNP transistor (e4)                 |                                  |                                  |                                  |                                                                                |
| Type of signal                                         | Bright and dark switching (antivalent) |                                  |                                  |                                  |                                                                                |
| Response time characteristic (turn on & off time)      | Recommended working area               |                                  |                                  |                                  |                                                                                |
| Standard                                               | ≥ 12 ms/switching transition           |                                  |                                  |                                  |                                                                                |
| Quick (option: /q)                                     | ≥ 1,5 ms/switching transition          |                                  |                                  |                                  |                                                                                |
| Very quick (option: /qq)                               | ≥ 0,5 ms/switching transition          |                                  |                                  |                                  |                                                                                |
| Switching frequency                                    | Standard                               |                                  |                                  |                                  |                                                                                |
| Standard                                               | ~40 Hz                                 |                                  |                                  |                                  |                                                                                |
| Quick (option: /q)                                     | ~333 Hz                                |                                  |                                  |                                  |                                                                                |
| Very quick (option: /qq)                               | ~1000 Hz                               |                                  |                                  |                                  |                                                                                |
| Switching pulse prolongation                           | 0 ... 3 s, preset to 1 s               |                                  |                                  |                                  |                                                                                |
| Working range                                          | 0...4 m, operating reserve ≥ 5000      |                                  |                                  |                                  |                                                                                |
| Light transmission                                     | LED; 850...880 nm (IR-A); invisible    |                                  |                                  |                                  |                                                                                |
| Interference suppression                               | Forced synchronization                 |                                  |                                  |                                  |                                                                                |
| Steady light resistance                                | > 80 kLx                               |                                  |                                  |                                  |                                                                                |
| Switching indicator                                    | LED red                                |                                  |                                  |                                  |                                                                                |
| Operating indicator                                    | LED green                              |                                  |                                  |                                  |                                                                                |

### 4.3 Receiver units

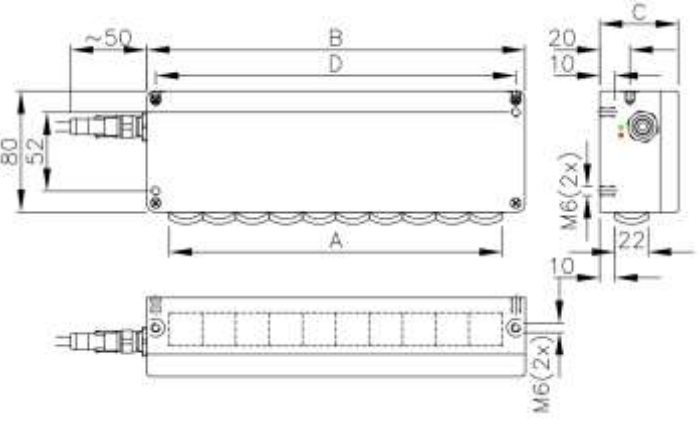
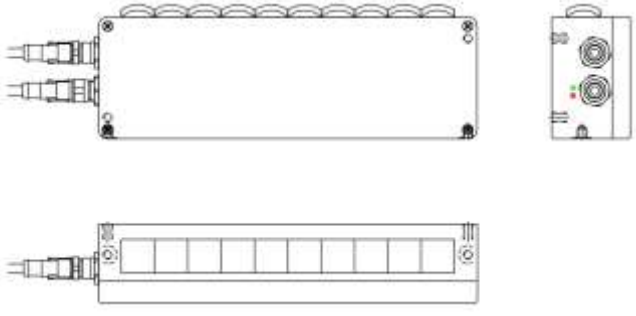
| Hole-detection instrument type<br>PP2445..E (Receiver)           | <input type="checkbox"/><br>.../88      | <input type="checkbox"/><br>.../154 | <input type="checkbox"/><br>.../220 | <input type="checkbox"/><br>.../308 | <input type="checkbox"/><br>.../H (H ≥ 330mm) |
|------------------------------------------------------------------|-----------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-----------------------------------------------|
| <i>Casing</i>                                                    | Cast Aluminum                           |                                     |                                     |                                     | Aluminum                                      |
| <i>Weight</i>                                                    | 0,8 kg                                  | 1,1 kg                              | 1,25 kg                             | 2,4 kg                              | ~12 kg/m                                      |
| <i>Connection</i>                                                | Plug connection stLU5                   |                                     |                                     |                                     |                                               |
| <i>Voltage supply</i>                                            | From the corresponding transmitter unit |                                     |                                     |                                     |                                               |
| <i>Response time characteristic<br/>(turn on &amp; off time)</i> | Working area                            |                                     |                                     |                                     |                                               |
| <i>Standard</i>                                                  | ≥ 12 ms/switching transition            |                                     |                                     |                                     |                                               |
| <i>Quick (option: /q)</i>                                        | ≥ 1,5 ms/switching transition           |                                     |                                     |                                     |                                               |
| <i>Very quick (option: /qq)</i>                                  | ≥ 0,5 ms/switching transition           |                                     |                                     |                                     |                                               |
| <i>Switching frequency</i>                                       |                                         |                                     |                                     |                                     |                                               |
| <i>Standard</i>                                                  | ~40 Hz                                  |                                     |                                     |                                     |                                               |
| <i>Quick (option: /q)</i>                                        | ~333 Hz                                 |                                     |                                     |                                     |                                               |
| <i>Very quick (option: /qq)</i>                                  | ~1000 Hz                                |                                     |                                     |                                     |                                               |
| <i>Signal output</i>                                             | PNP transistor; short circuit proof     |                                     |                                     |                                     |                                               |
| <i>Working range</i>                                             | 0...4 m, operating reserve ≥ 5000       |                                     |                                     |                                     |                                               |
| <i>Interference suppression</i>                                  | Forced synchronization                  |                                     |                                     |                                     |                                               |
| <i>Steady light resistance</i>                                   | > 80 kLx                                |                                     |                                     |                                     |                                               |
| <i>Switching indicator</i>                                       | LED red                                 |                                     |                                     |                                     |                                               |
| <i>Operating indicator</i>                                       | LED green                               |                                     |                                     |                                     |                                               |

#### 4.4 Power supply and control devices

| Power supply and control devices    | □ PP83201/2                                                                                                                                                                                        |                   | □ PP85301             |                                           | □ PP86301          |  |
|-------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-----------------------|-------------------------------------------|--------------------|--|
| Monitoring widths of hole detectors | Up to 528 mm                                                                                                                                                                                       |                   | Up to 704 mm          |                                           | Larger than 704 mm |  |
| Output                              | 10 VA                                                                                                                                                                                              |                   | 30 VA                 |                                           | 60 VA              |  |
| Casing                              | Cast Aluminum                                                                                                                                                                                      |                   |                       |                                           |                    |  |
| Weight                              | 0,8 kg                                                                                                                                                                                             |                   | 2,7 kg                |                                           | 2,8 kg             |  |
| Connection                          | Terminal blocks &<br>Plug connection stLU5 &<br>2x cable gland                                                                                                                                     |                   |                       |                                           |                    |  |
|                                     |                                                                                                                                                                                                    |                   |                       |                                           |                    |  |
| Voltage supply                      | Options :                                                                                                                                                                                          |                   |                       |                                           |                    |  |
|                                     | 230 VAC<br>± 10 %                                                                                                                                                                                  | 115 VAC<br>± 10 % | 42...48 VAC<br>± 10 % | 24 VDC<br>-10...+20 %<br>(only PP83201/2) |                    |  |
|                                     | AC: 50...60 Hz                                                                                                                                                                                     |                   |                       |                                           |                    |  |
|                                     |                                                                                                                                                                                                    |                   |                       |                                           |                    |  |
| Switch output                       |                                                                                                                                                                                                    |                   |                       |                                           |                    |  |
| Relay (option /R)                   | 1x Changeover<br>AC-1: 6 A / 1500 VA @ 250 VAC<br>AC-15: 2 A / 500 VA @ 230 VAC<br>DC-1: 6 A @ 30 VDC<br>DC-13: 6 A @ 30 VDC<br>(AC-15 or DC-13: snubber wired in parallel with the load required) |                   |                       |                                           |                    |  |
| PNP transistor (option: /e2)        | DC-1: 60 mA<br>DC-13: 60 mA<br>short circuit proof                                                                                                                                                 |                   |                       |                                           |                    |  |
| Optocoupler (option: /e1)           | DC-1: 50 mA @ 60 VDC<br>DC-13: 50 mA @ 60 VDC<br>short circuit proof                                                                                                                               |                   |                       |                                           |                    |  |
| Type of signal                      | Bright /dark switching (optional)                                                                                                                                                                  |                   |                       |                                           |                    |  |
|                                     |                                                                                                                                                                                                    |                   |                       |                                           |                    |  |
| Frequency of operating cycles       | Relay                                                                                                                                                                                              |                   |                       | Electronic                                |                    |  |
| Standard                            | 10 Hz                                                                                                                                                                                              |                   |                       | 40 Hz                                     |                    |  |
| Quick (option: /q)                  | 10 Hz                                                                                                                                                                                              |                   |                       | 333 Hz                                    |                    |  |
| Very quick (option: /qq)            | 10 Hz                                                                                                                                                                                              |                   |                       | 1000 Hz                                   |                    |  |
|                                     |                                                                                                                                                                                                    |                   |                       |                                           |                    |  |
| Time delay                          | 0 to 3 s; switch-on and off delayed; separately adjustable                                                                                                                                         |                   |                       |                                           |                    |  |
| Switching display                   | LED red                                                                                                                                                                                            |                   |                       |                                           |                    |  |

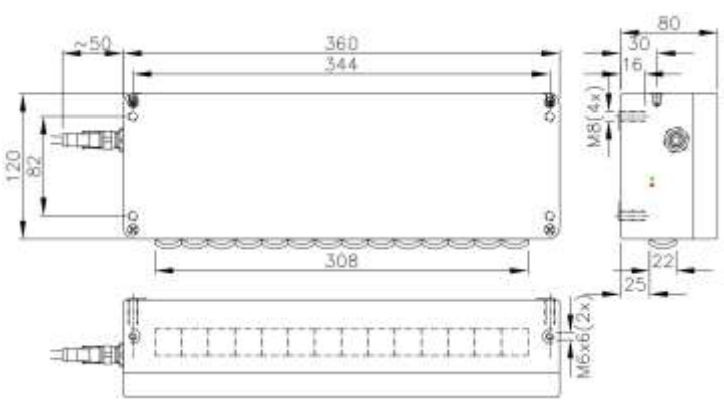
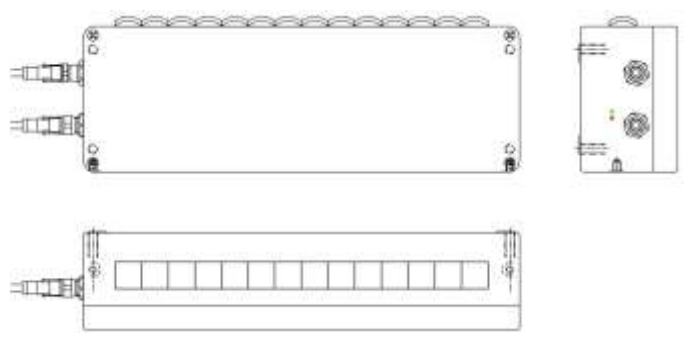
## 5 Dimensions

### 5.1 Hole detection instruments with monitoring width of 88 mm to 220 mm

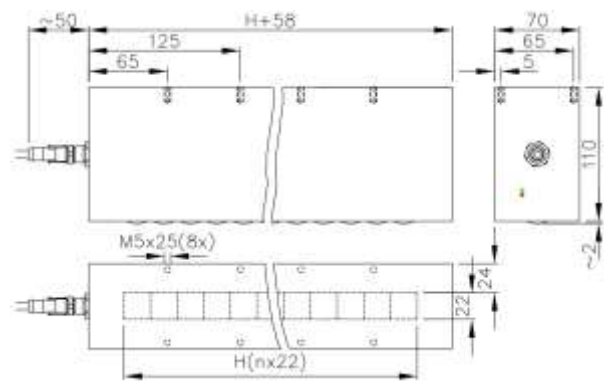
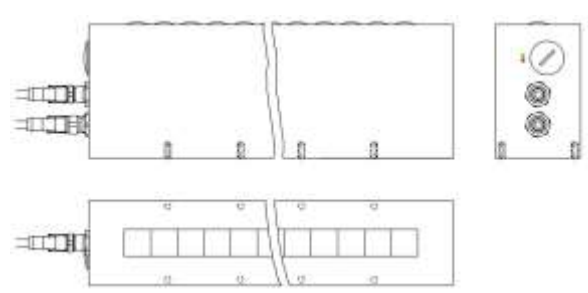
|             |                                                                                                                     |                                                                                     |
|-------------|---------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Receiver    | <input type="checkbox"/> PP2445/88E<br><input type="checkbox"/> PP2445/154E<br><input type="checkbox"/> PP2445/220E |   |
| Transmitter | <input type="checkbox"/> PP2445/88S<br><input type="checkbox"/> PP2445/154S<br><input type="checkbox"/> PP2445/220S |  |

| Type       | Dimension "A" | Dimension "B" | Dimension "C" | Dimension "D" | Number of optics |
|------------|---------------|---------------|---------------|---------------|------------------|
| PP2445/88  | 88            | 125           | 57            | 113           | 4 each           |
| PP2445/154 | 154           | 175           | 57            | 163           | 7 each           |
| PP2445/220 | 220           | 250           | 52            | 238           | 10 each          |

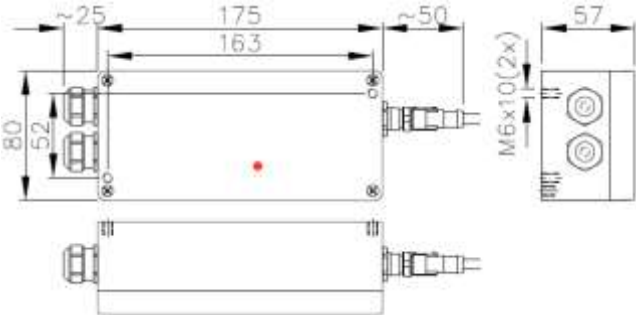
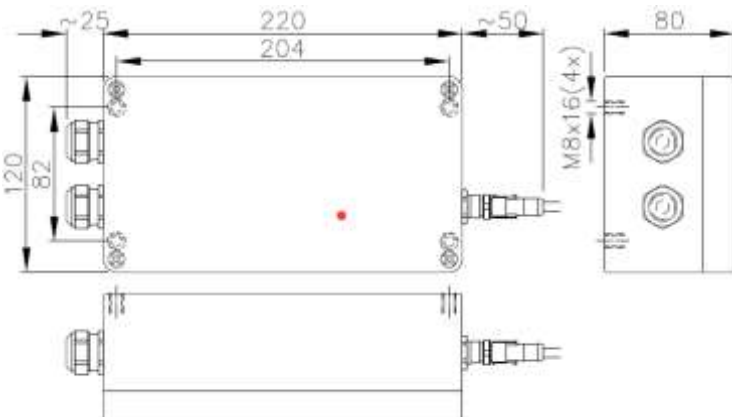
## 5.2 Hole detection instruments with monitoring width 308 mm

|             |                                      |                                                                                     |
|-------------|--------------------------------------|-------------------------------------------------------------------------------------|
| Receiver    | <input type="checkbox"/> PP2445/308E |   |
| Transmitter | <input type="checkbox"/> PP2445/308S |  |

## 5.3 Hole detection instruments with application specific monitoring widths larger than 308 mm to 1980 mm

|             |                                     |                                                                                      |
|-------------|-------------------------------------|--------------------------------------------------------------------------------------|
| Receiver    | <input type="checkbox"/> PP2445/H E |  |
| Transmitter | <input type="checkbox"/> PP2445/H S |  |

## 5.4 Power supply and control device

|                                  |                                                                      |                                                                                     |
|----------------------------------|----------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Power supply and control devices | <input type="checkbox"/> PP83201/2                                   |   |
|                                  | <input type="checkbox"/> PP85301<br><input type="checkbox"/> PP86301 |  |

## 6 Document collection

| Serial number | Type       | Description                            | Document    |
|---------------|------------|----------------------------------------|-------------|
| 2420          | PP83201/2  | Data sheet                             | E_24201.pdf |
| 2433          | PP84201/2  | Data sheet                             | E_24201.pdf |
| 2435          | PP85301    | Data sheet                             | E_24351.pdf |
| 2436          | PP86301    | Data sheet                             | E_24361.pdf |
| 4351          | PP2445/88  | Data sheet                             | E_43511.pdf |
| 4352          | PP2445/154 | Data sheet                             | E_43521.pdf |
| 4353          | PP2445/220 | Data sheet                             | E_43531.pdf |
| 4354          | PP2445/308 | Data sheet                             | E_43541.pdf |
| 4355          | PP2445/H   | Data sheet                             | E_43551.pdf |
| 4351...4355   | PP2445...  | Operating instructions (this document) | E_435x2.pdf |

## 7 Maintenance and cleaning



The cleaning of the optical surfaces and the testing of the functions must only be carried out by competent specialist personnel.

Depending on the dust accumulation in the company, the optical surfaces of the hole-detection instruments are to be cleaned in suitable time intervals.

For cleaning the optical surfaces, a soft lint-free cloth moistened with water is to be used. If necessary, a very small amount of a customary washing up liquid can be added to the cleaning water.



Don't use any cleansing agents which contain alcohol or solvents.



Don't scratch the optical surfaces.

## 8 Taking out of service

The equipment has to be disposed of appropriately after the expiry of its service life. In taking out of service, observe the local laws on disposal of electronic equipment.

## 9 Spare parts

On request.

PDF: E\_435x2.pdf

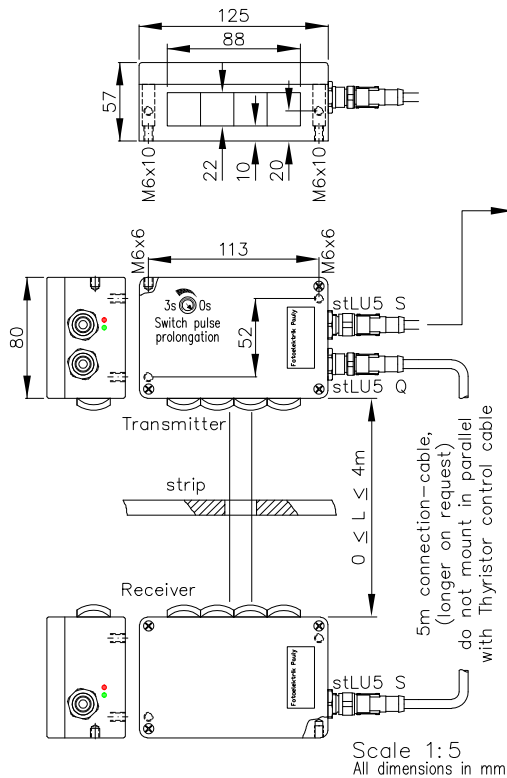
SRC: E\_435x2\_2020-04.docx

Date: 2020-08-04 tb

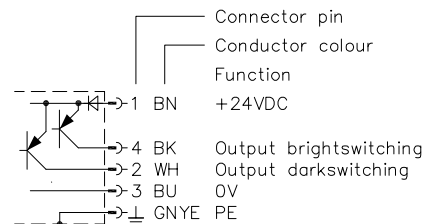
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## Hole Detector Type PP2445/88 for Detection of Welded Seams



### Connection diagram:

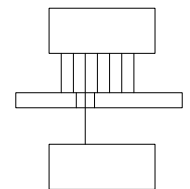


### Application:

Detection of hole-marked welded seams.

### Hints:

- Please refer the diagramm to find the required device. In case of faster strip speeds please contact us.
- The non-transparent strip must cover the device completely. In case of smaller strips the optical side areas of the device should be masked by non-transparent masks or devices with a smaller detection range should be used.



0 – 4m  
Ø ≥ 2mm

Hole Detector

PP2445/88

Order no.:

4351

### Technical Characteristics:

|                           |                                             |
|---------------------------|---------------------------------------------|
| Housing                   | Al-Cast                                     |
| Weight                    | approx. 2000g                               |
| Protection Mode           | IP65                                        |
| Connection                | 5-pin connector, 4+PE, stLU5                |
| Supply                    | 24VDC±10%/~0,09A                            |
| Output                    | 2x pnp 60mA antivalent, short-circuit proof |
| Switching Mode            | bright- and darkswitching                   |
| Transmitter Light         | 850 ... 880nm, invisible                    |
| Steady Light Resistance   | >80kLx                                      |
| Interference Suppressor   | forced synchronisation                      |
| Access Time               | Standard: ≥ 12ms/switch Transition          |
| Switching Frequency       | ~40/s                                       |
| Switch Indicator          | LED red                                     |
| Operating Indicator       | LED green                                   |
| Switch pulse prolongation | 0...3s, preset to 1s                        |
| Ambient Temperature       | -25...+60°C                                 |

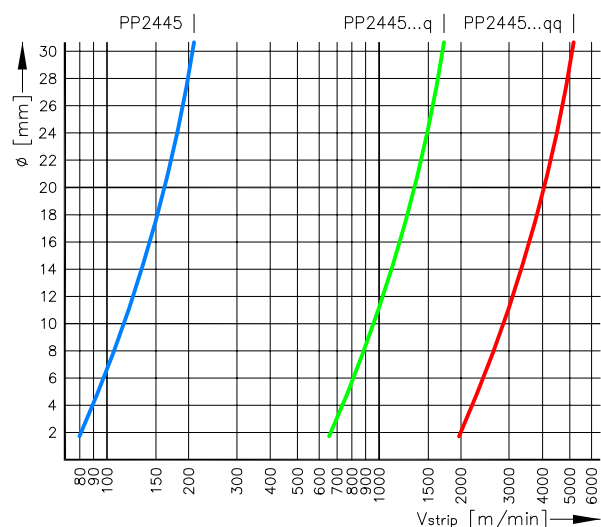
### Special Design:

|             |                               |
|-------------|-------------------------------|
| Access Time | q: ≥ 1,5ms/switch Transition  |
|             | qq: ≥ 0,5ms/switch Transition |

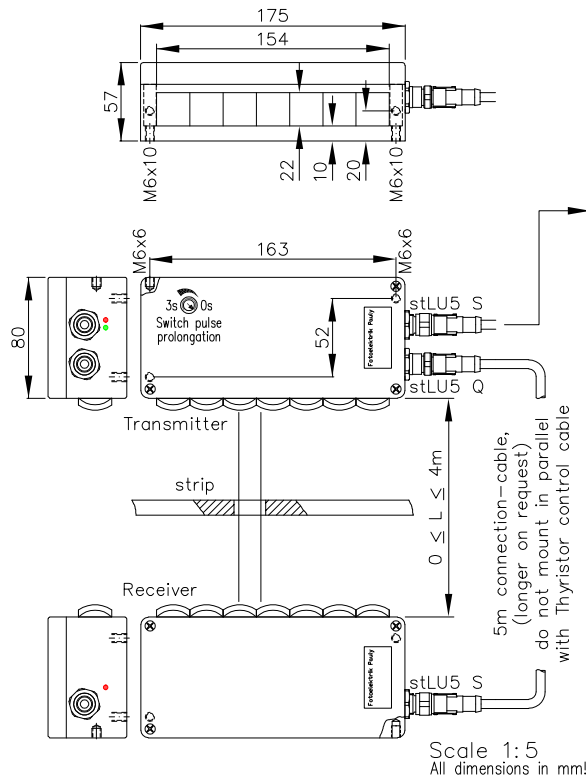
### Accessories:

Control Unit PP83201/2  
Cooling Water Flange 2xKW26 (then milled wall, y)

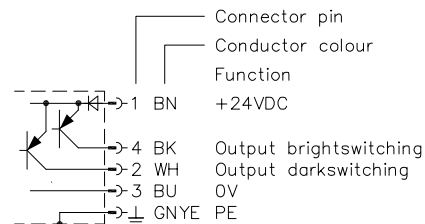
### Diagram: Hole-size versus strip speed:



## Hole Detector Type PP2445/154 for Detection of Welded Seams



### Connection diagram:

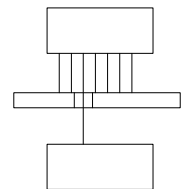


### Application:

Detection of hole-marked welded seams.

### Hints:

- Please refer the diagramm to find the required device. In case of faster strip speeds please contact us.
- The non-transparent strip must cover the device completely. In case of smaller strips the optical side areas of the device should be masked by non-transparent masks or devices with a smaller detection range should be used.



0 – 4m  
Ø ≥ 2mm

Hole Detector

PP2445/154

Order no.:

4352

### Technical Characteristics:

|                           |                                             |
|---------------------------|---------------------------------------------|
| Housing                   | Al-Cast                                     |
| Weight                    | approx. 2200g                               |
| Protection Mode           | IP65                                        |
| Connection                | 5-pin connector, 4+PE, stLU5                |
| Supply                    | 24VDC±10%/~0,1A                             |
| Output                    | 2x pnp 60mA antivalent, short-circuit proof |
| Switching Mode            | bright- and darkswitching                   |
| Transmitter Light         | 850 ... 880nm, invisible                    |
| Steady Light Resistance   | >80kLx                                      |
| Interference Suppressor   | forced synchronisation                      |
| Access Time               | Standard: ≥ 12ms/switch Transition          |
| Switching Frequency       | ~40/s                                       |
| Switch Indicator          | LED red                                     |
| Operating Indicator       | LED green                                   |
| Switch pulse prolongation | 0...3s, preset to 1s                        |
| Ambient Temperature       | -25...+60°C                                 |

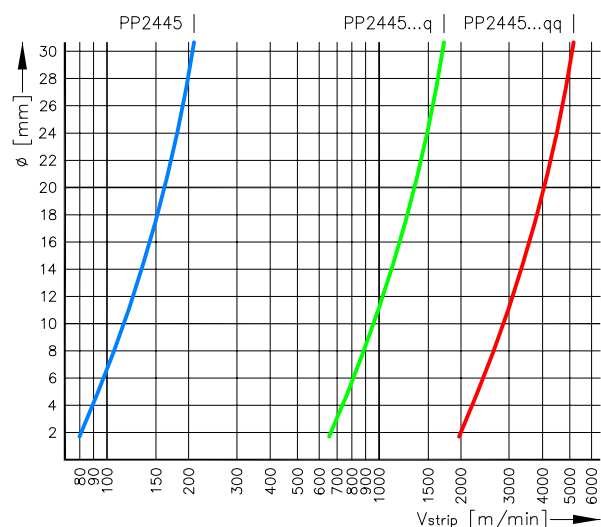
### Special Design:

|             |                               |
|-------------|-------------------------------|
| Access Time | q: ≥ 1,5ms/switch Transition  |
|             | qq: ≥ 0,5ms/switch Transition |

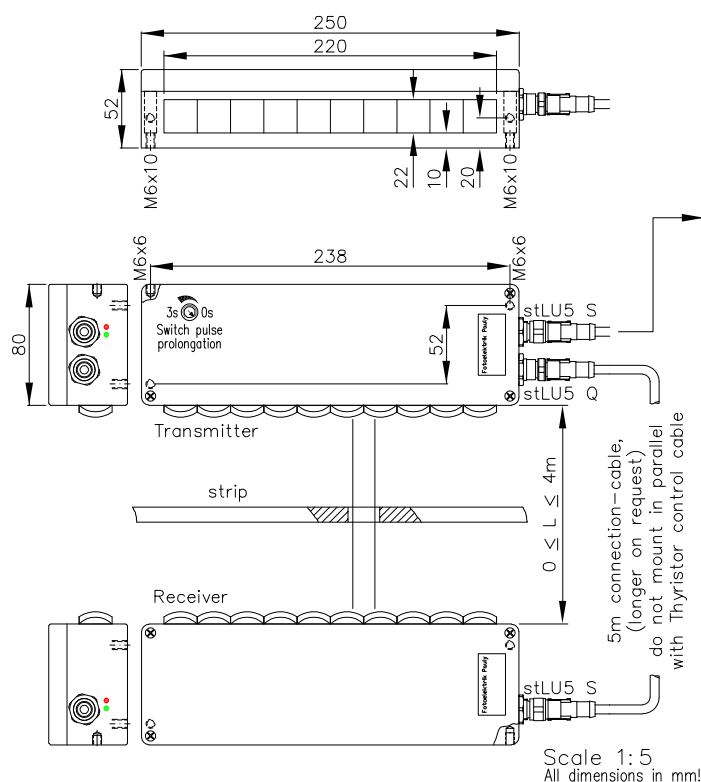
### Accessories:

Control Unit PP83201/2  
Cooling Water Flange 2xKW27 (then milled wall, y)

### Diagram: Hole-size versus strip speed:



Hole Detector Type PP2445/220  
for Detection of Welded Seams



### Technical Characteristics:

|                           |                                                |
|---------------------------|------------------------------------------------|
| Housing                   | Al—Cast                                        |
| Weight                    | approx. 2500g                                  |
| Protection Mode           | IP65                                           |
| Connection                | 5—pin connector, 4+PE, stLU5                   |
| Supply                    | 24VDC±10%/~0,12A                               |
| Output                    | 2x pnp 60mA antivalent,<br>short—circuit proof |
| Switching Mode            | bright— and darkswitching                      |
| Transmitter Light         | 850 ... 880nm, invisible                       |
| Steady Light Resistance   | >80kLx                                         |
| Interference Suppressor   | forced synchronisation                         |
| Access Time               | Standard: ≥ 12ms/switch Transition             |
| Switching Frequency       | ~40/s                                          |
| Switch Indicator          | LED red                                        |
| Operating Indicator       | LED green                                      |
| Switch pulse prolongation | 0...3s, preset to 1s                           |
| Ambient Temperature       | —25...+60°C                                    |

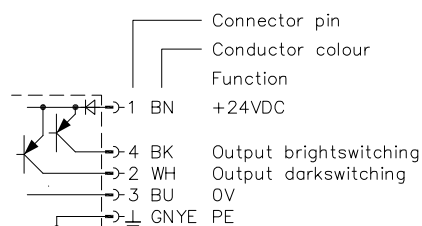
Special Design:

|             |                                |            |
|-------------|--------------------------------|------------|
| Access Time | q: $\geq 1,5\text{ms/switch}$  | Transition |
|             | qq: $\geq 0,5\text{ms/switch}$ | Transition |

## Accessories:

Control Unit PP83201/2  
Cooling Water Flange 2xKW28 (then milled wall, y)

Connection diagram:

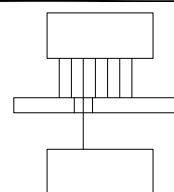


Application:

### Detection of hole-marked welded seams.

Hints:

- Please refer the diagram to find the required device. In case of faster strip speeds please contact us.
- The non-transparent strip must cover the device completely. In case of smaller strips the optical side areas of the device should be masked by non-transparent masks or devices with a smaller detection range should be used.



0 – 4m  
 $\phi \geq 2\text{mm}$

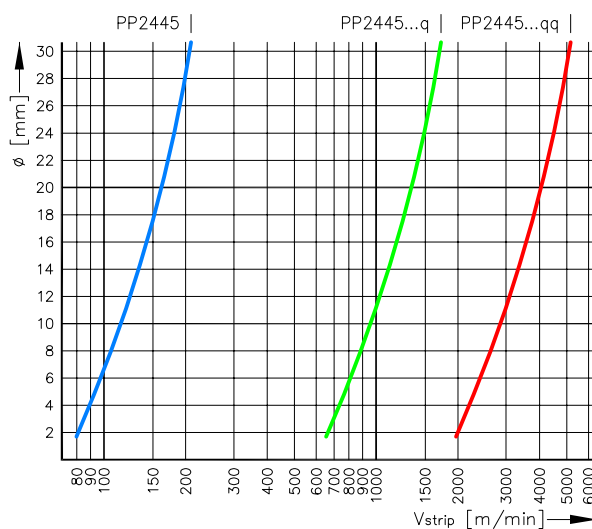
Hole Detector

PP2445/220

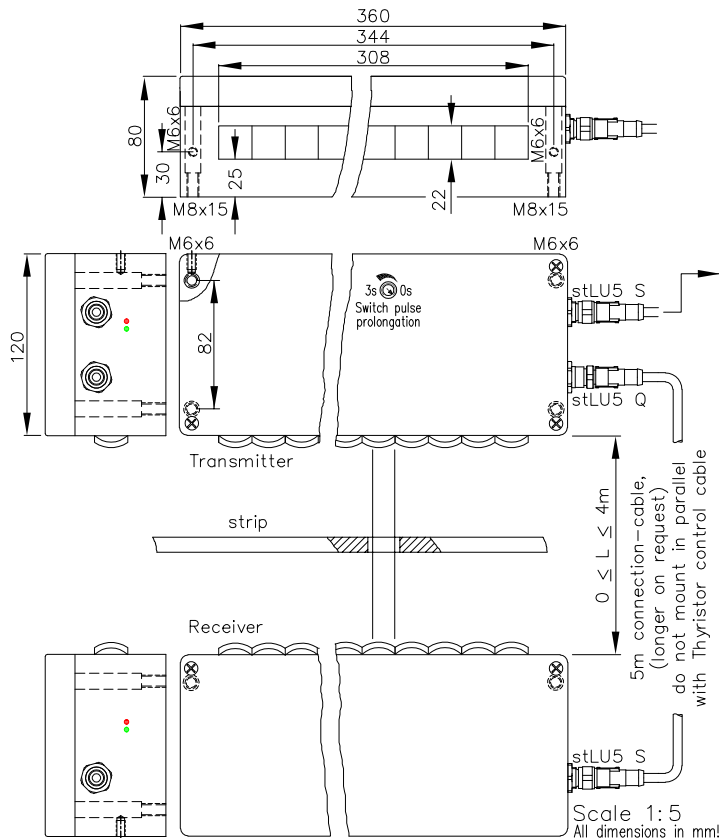
Order no.:

4353

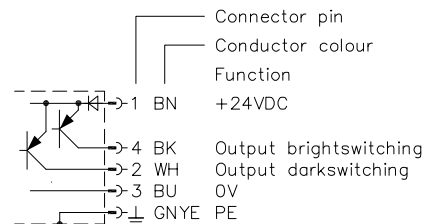
Diagram: Hole-size versus strip speed:



## Hole Detector Type PP2445/308 for Detection of Welded Seams



### Connection diagram:

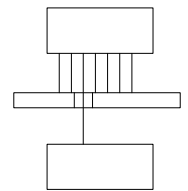


### Application:

Detection of hole-marked welded seams.

### Hints:

- Please refer the diagramm to find the required device. In case of faster strip speeds please contact us.
- The non-transparent strip must cover the device completely. In case of smaller strips the optical side areas of the device should be masked by non-transparent masks or devices with a smaller detection range should be used.



0 – 4m  
 $\phi \geq 2\text{mm}$

Hole Detector

PP2445/308

Order no.:

4354

### Technical Characteristics:

|                           |                                                 |
|---------------------------|-------------------------------------------------|
| Housing                   | Al-Cast                                         |
| Weight                    | approx. 5000g                                   |
| Protection Mode           | IP65                                            |
| Connection                | 5-pin connector, 4+PE, stLU5                    |
| Supply                    | 24VDC $\pm 10\%$ /~0,15A                        |
| Output                    | 2x pnp 60mA antivalent, short-circuit proof     |
| Switching Mode            | bright- and darkswitching                       |
| Transmitter Light         | 850 ... 880nm, invisible                        |
| Steady Light Resistance   | >80kLx                                          |
| Interference Suppressor   | forced synchronisation                          |
| Access Time               | Standard: $\geq 12\text{ms}$ /switch Transition |
| Switching Frequency       | $\sim 40/\text{s}$                              |
| Switch Indicator          | LED red                                         |
| Operating Indicator       | LED green                                       |
| Switch pulse prolongation | 0...3s, preset to 1s                            |
| Ambient Temperature       | -25...+60°C                                     |

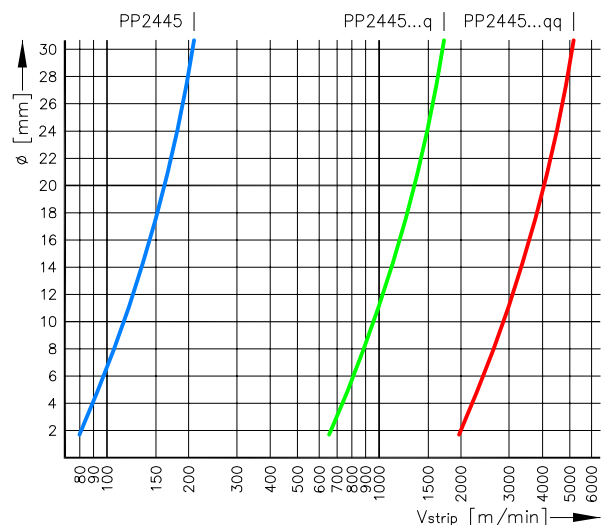
### Special Design:

|             |                                            |
|-------------|--------------------------------------------|
| Access Time | q: $\geq 1,5\text{ms}$ /switch Transition  |
|             | qq: $\geq 0,5\text{ms}$ /switch Transition |

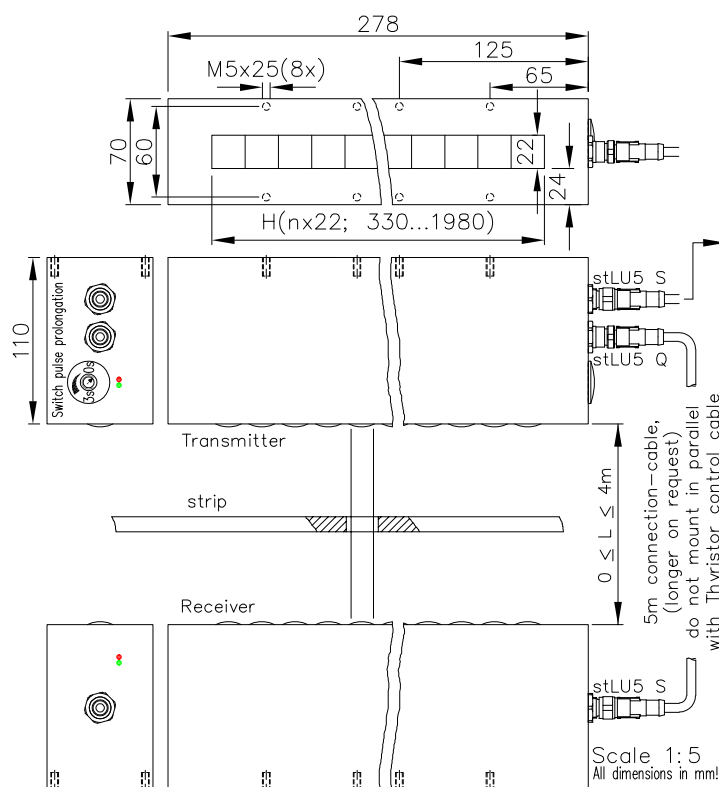
### Accessories:

- Control Unit PP83201/2
- Cooling Water Flange 2xKW153 (then milled wall, y)

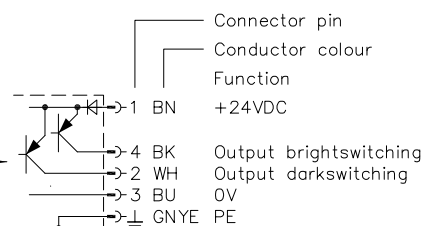
### Diagram: Hole-size versus strip speed:



Hole Detector Type PP2445/H  
for Detection of Welded Seams



Connection diagram:

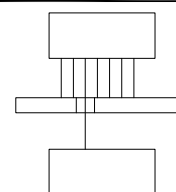


Application:

### Detection of hole-marked welded seams.

Hints:

- Please refer the diagram to find the required device. In case of faster strip speeds please contact us.
- The non-transparent strip must cover the device completely. In case of smaller strips the optical side areas of the device should be masked by non-transparent masks or devices with a smaller detection range should be used.



0 – 4m  
 $\phi \geq 2\text{mm}$

Hole Detector

PP2445/H

Order no.:

4355

### Technical Characteristics:

|                           |                                                |
|---------------------------|------------------------------------------------|
| Housing                   | Aluminium, anodized                            |
| Weight                    | approx. 2x12kg/m                               |
| Protection Mode           | IP65                                           |
| Connection                | 5-pin connector, 4+PE, stLU5                   |
| Supply                    | 24VDC±10%/<1A                                  |
| Output                    | 2x pnp 60mA antivalent,<br>short-circuit proof |
| Switching Mode            | bright- and darkswitching                      |
| Transmitter Light         | 850 ... 880nm, invisible                       |
| Steady Light Resistance   | >80kLx                                         |
| Interference Suppressor   | forced synchronisation                         |
| Access Time               | Standard: ≥ 12ms/switch Transition             |
| Switching Frequency       | ~40/s                                          |
| Switch Indicator          | LED red                                        |
| Operating Indicator       | LED green                                      |
| Switch pulse prolongation | 0...3s, preset to 1s                           |
| Ambient Temperature       | -25...+60°C                                    |

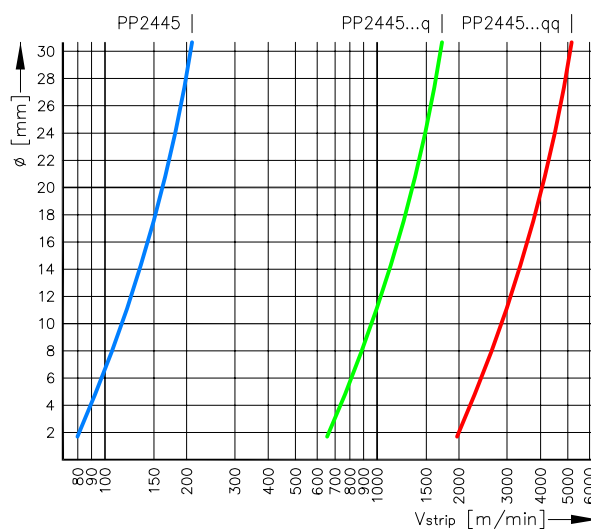
Special Design:

|             |                                |            |
|-------------|--------------------------------|------------|
| Access Time | $q: \geq 1,5\text{ms/switch}$  | Transition |
|             | $qq: \geq 0,5\text{ms/switch}$ | Transition |

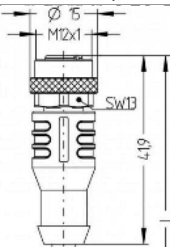
## 2 Accessories:

Control Unit, e.g. PP83201/2

Diagram: Hole-size versus strip speed:

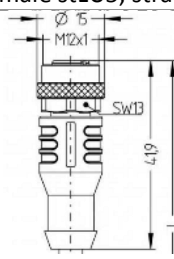
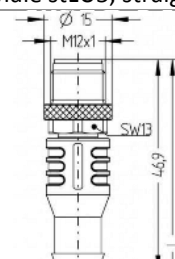
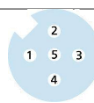
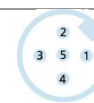


## Supply and output cable type PP2445CC1

| Technical characteristics               | Side 1                                                                                                                                                                                                                                                               | Side 2           |
|-----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| Connectors                              |                                                                                                                                                                                                                                                                      |                  |
| Type                                    | Female stLU5, straight                                                                                                                                                                                                                                               | Not preassembled |
| Dimensions                              |                                                                                                                                                                                     |                  |
| Number of pins                          | 4+PE                                                                                                                                                                                                                                                                 |                  |
| Pin assignment                          | <br>1 BN, 2 WH, 3 BU, 4 BK, 5 GNYE                                                                                                                                                  |                  |
| Coding                                  | A                                                                                                                                                                                                                                                                    |                  |
| Rated voltage                           | 60V                                                                                                                                                                                                                                                                  |                  |
| Insulation resistance                   | ≥10 <sup>8</sup> Ω                                                                                                                                                                                                                                                   |                  |
| Ambient temperature                     | -30°C...+90°C                                                                                                                                                                                                                                                        |                  |
| Contact material                        | CuSn gold plated                                                                                                                                                                                                                                                     |                  |
| Contact carrier material                | TPU black                                                                                                                                                                                                                                                            |                  |
| Grip body material                      | TPU black                                                                                                                                                                                                                                                            |                  |
| Coupling nut material                   | CuZn nickel plated                                                                                                                                                                                                                                                   |                  |
| Sealing material                        | FKM (only female)                                                                                                                                                                                                                                                    |                  |
| Standards                               | IEC 61076-2-101                                                                                                                                                                                                                                                      |                  |
| Degree of protection (mounted)          | IP65, IP67, IP68                                                                                                                                                                                                                                                     |                  |
| Mechanical life cycle                   | >100 mating cycles                                                                                                                                                                                                                                                   |                  |
| Degree of pollution                     | 3                                                                                                                                                                                                                                                                    |                  |
| Cable                                   |                                                                                                                                                                                                                                                                      |                  |
| Outer diameter of jacket                | ≤ 5,4 mm                                                                                                                                                                                                                                                             |                  |
| Length                                  | PP2445C1 /5m (#4350CC1x01): ~ 5 m<br>PP2445C1 /10m (#4350CC1x02): ~ 10 m                                                                                                                                                                                             |                  |
| Cable jacket material                   | PUR black                                                                                                                                                                                                                                                            |                  |
| Wire cross-section; conductor structure | 5 x 0,34 mm <sup>2</sup> ; 42 x 0,10 mm                                                                                                                                                                                                                              |                  |
| Wire insulation material                | PP (BN, WH, BU, BK, GNYE)                                                                                                                                                                                                                                            |                  |
| Bending radius (fixed/repeated)         | 5 x Ø-cable / 10 x Ø-cable                                                                                                                                                                                                                                           |                  |
| Temperature range (fixed/repeated)      | -40°C...+90°C / -30°C...+90°C                                                                                                                                                                                                                                        |                  |
| Temperature range (drag chain)          | -25°C...+60°C                                                                                                                                                                                                                                                        |                  |
| Special features                        | flame-retardant, seawater resistant, recyclable, LABS free, RoHS compliant, acid- and alkali resistant, ozone resistant, UV resistant, hydrolysis proof, drag chain-adapted, torsion resistant, welding sparks resistant, halogen free, silicone free, oil resistant |                  |

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## Connecting cable type PP2445CC2

| Technical characteristics               | Side 1                                                                                                                                                                                                                                                               | Side 2                                                                              |
|-----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Connectors                              |                                                                                                                                                                                                                                                                      |                                                                                     |
| Type                                    | Female stLU5, straight                                                                                                                                                                                                                                               | Male stLU5, straight                                                                |
| Dimensions                              |                                                                                                                                                                                     |  |
| Number of pins                          | 4+PE                                                                                                                                                                                                                                                                 |                                                                                     |
| Pin assignment                          |  <br>1 BN, 2 WH, 3 BU, 4 BK, 5 GNYE                                                              |                                                                                     |
| Coding                                  | A                                                                                                                                                                                                                                                                    |                                                                                     |
| Rated voltage                           | 60V                                                                                                                                                                                                                                                                  |                                                                                     |
| Insulation resistance                   | ≥10 <sup>8</sup> Ω                                                                                                                                                                                                                                                   |                                                                                     |
| Ambient temperature                     | -30°C...+90°C                                                                                                                                                                                                                                                        |                                                                                     |
| Contact material                        | CuSn gold plated                                                                                                                                                                                                                                                     |                                                                                     |
| Contact carrier material                | TPU black                                                                                                                                                                                                                                                            |                                                                                     |
| Grip body material                      | TPU black                                                                                                                                                                                                                                                            |                                                                                     |
| Coupling nut material                   | CuZn nickel plated                                                                                                                                                                                                                                                   |                                                                                     |
| Sealing material                        | FKM (only female)                                                                                                                                                                                                                                                    |                                                                                     |
| Standards                               | IEC 61076-2-101                                                                                                                                                                                                                                                      |                                                                                     |
| Degree of protection (mounted)          | IP65, IP67, IP68                                                                                                                                                                                                                                                     |                                                                                     |
| Mechanical life cycle                   | >100 mating cycles                                                                                                                                                                                                                                                   |                                                                                     |
| Degree of pollution                     | 3                                                                                                                                                                                                                                                                    |                                                                                     |
| Cable                                   |                                                                                                                                                                                                                                                                      |                                                                                     |
| Outer diameter of jacket                | ≤ 5,4 mm                                                                                                                                                                                                                                                             |                                                                                     |
| Length                                  | ~ 5 m                                                                                                                                                                                                                                                                |                                                                                     |
| Cable jacket material                   | PUR black                                                                                                                                                                                                                                                            |                                                                                     |
| Wire cross-section; conductor structure | 5 x 0,34 mm <sup>2</sup> ; 42 x 0,10 mm                                                                                                                                                                                                                              |                                                                                     |
| Wire insulation material                | PP (BN, WH, BU, BK, GNYE)                                                                                                                                                                                                                                            |                                                                                     |
| Bending radius (fixed/repeated)         | 5 x Ø-cable / 10 x Ø-cable                                                                                                                                                                                                                                           |                                                                                     |
| Temperature range (fixed/repeated)      | -40°C...+90°C / -30°C...+90°C                                                                                                                                                                                                                                        |                                                                                     |
| Temperature range (drag chain)          | -25°C...+60°C                                                                                                                                                                                                                                                        |                                                                                     |
| Special features                        | flame-retardant, seawater resistant, recyclable, LABS free, RoHS compliant, acid- and alkali resistant, ozone resistant, UV resistant, hydrolysis proof, drag chain-adapted, torsion resistant, welding sparks resistant, halogen free, silicone free, oil resistant |                                                                                     |

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