



RE – 428FR
RE – 428HR

Optical Beam Smoke Detector

**Installation, Commissioning &
Operating Manual**

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1 PURPOSE

The RE-428 Series Optical Beam Smoke Detector is designed for smoke detection at the early stage of fire. It is particularly suitable for protection of premises where smoke appearance is expected in the first phase of the fire and where installation of a large number of point smoke detectors would be necessary due to a large area. Compared to point smoke detectors, beam detectors are sensitive to a medium smoke density value on a long path of the infrared radiation beam. Therefore they are especially suitable for application under high ceilings/roofs or in those places, where smoke can be diffused over a large area before detection.

Examples of applications, where this type of detectors can be particularly useful, include: churches, cathedrals, monumental buildings with valuable historic ceilings, theatres, sports halls, industrial shops, very high rooms, in which point detectors would not be effective, and rooms with a differentiated ceiling or roof design.

A distinctive feature of the RE-428 Series beam detector is its arrangement of transmitter and receiver in one housing and interaction with a prism reflector or a reflector panel placed on the opposite wall. A single casing embraces a laser pointer that enables optical path axis alignment between the detector and the reflector/set of reflectors.

The RE-428 Series optical beam smoke detector is intended to interoperate with any fire detection and alarm control panel that ensures power supply in the range between 9.5 V and 28 V and current > 100 mA. The alarm signal is the relay non-potential contact switch over. The detector operates in closed premises at ambient temperatures ranging from -25°C to $+55^{\circ}\text{C}$ and relative humidity up to 95% at 40°C .

2 TECHNICAL SPECIFICATIONS

Operating voltage	: 24V
Quiescent current	: 20 mA
Alarm current	: 60 mA
Current at radiation beam interruption	: < 0.3 mA
Operating distance range for RE96FR reflector (Fig -7)	: 5 to 50 m
Operating distance range for 2XRE96FR reflector(Fig -8)	: 50 to 100 m
Sensitivity thresholds (optional)	: 18%, 30%, 50%
Power supply of laser target viewfinder (during alignment)	: 9 V (6F22) battery
Operating temperature range	: -25°C to 55°C
Relative humidity	: up to 95% at 40°C
Dimensions	: 128 x 79 x 84 mm
Mass	: 0.35 kg



Fig. 1 RE-428 Series beam detector with prism reflector

3 PRINCIPLE OF OPERATION

The RE-428 Series beam detector consists of an infrared (IR) light transmitter and a receiver located in a single housing and an interoperating separate RE96R prism reflector or 2XRE96R set of reflectors. The detector operation principle is based on continuous analysis of optical air transparency in the space between the detector and the reflector (set of reflectors).

The detector can operate in one of four modes: supervision, alarm, fault – light beam interruption, and fault – caused by contamination. If a certain, defined amount of aerosol (smoke) is found in the air, resulting in reduction of optical transparency below a given (adjustable) threshold, then the detector enters the alarm mode. Complete break of the beam (or its reflection due to an object occurrence in its optical path) is signaled as a fault, because even the largest smoke concentration in the air does not cause a total break of the detector optical path. When the air is clear, the detector is in the supervision mode.

Long lasting detector operation, especially in high dust level premises, may lead to contamination of optical parts of the detector and the reflector/reflector panel. In order to maintain constant sensitivity and fire detection ability during a long time, the detector is equipped with automatic compensation mechanism to monitor its contamination and environment impact conditions. The circuits guarantee the same sensitivity level in the whole compensation range. At a certain contamination level, the detector signals the fault mode denoting a necessity to undertake servicing and cleaning works. However, even in this mode, the detector is still able to detect smoke and trigger an alarm mode. A fault caused by high contamination requires cleaning works of the reflector/set of reflectors and the detector front surface. After cleaning, the detector adjusts to new conditions and automatically changes its mode from fault to supervision.

The RE-428 Series beam detector's analysis functions are executed by a microprocessor. After the initial detector optical path adjustment with built-in laser pointer is completed, the START button should be pressed. By pressing this button, precise adjustment is being performed. At the same time microprocessor is analyzing the ambient temperature and the settled sensitivity threshold. A self-adjustment program is switched on after entering these data into the detector memory. The self-adjustment process is completed after achieving a reference value with $\pm 5\%$ tolerance. Finally, the decision criteria for fire alarm are drawn up for various fire phenomena runs, for instance for fast or slow fire development. The data are kept in the detector non-volatile memory and periodically checked. Any measured value change (against the assumed decision thresholds) caused by a smoke, after triple verification, is treated by the microprocessor as a fire.

4 DESIGN

The RE-428 Series beam detector design is shown on Fig. 1 and Fig. 3. The detector housing, made of plastic, contains electronic circuits and optical elements of the transmitter and receiver as well as a laser diode that facilitates the detector easy optical alignment. The lenses for infrared beam focusing are covered with a detachable filter. There is a connecting block mounted on the detector back side, to connect power supply wires and terminal blocks for PU and PA relay contacts. The detector is fastened to the wall with a metal adjustment basis. START button that initiates the detector adjustment process as well as an optical fiber for illuminating diodes are located on the bottom of the detector.

The illuminating diode colour signals mean:

- green—detector self-adjustment to the distance between detector and reflector/set of reflectors is in progress and the signal level is too high;
- yellow—detector self-adjustment to the distance between detector and reflector/set of reflectors is in progress and the signal level is too low;
- red— detector is in the alarm mode;
- no light – detector is in the supervision mode after proper adjustment of the detector.

The START button enables initiation of the detector adjustment process (self-adjustment) and the re-set of detector's parameters after cleaning works of optical parts during detector's operation.

5 INSTALLATION

The RE-428 Series beam detector interoperates with a set of reflectors 2XRE96R (operating distance is from 50 m to 100 m), or with the RE96R prism reflector (operating distance is from 5 m to 50 m). Set of reflectors, single reflector, test foil and an adjustment mirror are not included in the detector standard pack and should be ordered separately.

In case the detector is hardly visible or is installed in a place with difficult access, it is possible to connect the additional operation response indicator RE-RI, placed in a convenient and visible location.

Before installation, it is necessary to declare an alarm mode and a sensitivity threshold. This can be done using appropriate jumpers located on the back side of the detector casing, as shown on Fig. 6. The distance between the detector and the reflector/set of reflectors shall be one of the key criteria taken into consideration when defining the sensitivity:

- for a distance from 5 m to 20 m – 18% sensitivity is recommended;
- for a distance from 20 m to 50 m – 30% sensitivity is recommended;
- for a distance from 50 m to 100 m – 50% sensitivity is recommended.

In case of the detector's hard operation conditions it is possible to set sensitivity level experimentally, adopting it to the particular environment. The RE-428 Series beam detector and the reflector/set of reflectors are mounted on opposite walls, pillars or other construction elements of the premises. Walls or pillars must be stable and vibration-free. The detector should be placed on the adjustment basis (Fig. 3) after preliminary connection of the wires to the connecting blocks in accordance with Fig. 4. The detector should be fixed to the basis with three screws that are accessible from the front side (after removing the cover). Then a 6F22 battery should be plugged to the laser pointer contacts.

Before alignment, the mirror should be placed on the set of reflectors and pressed down, as it is shown on Fig. 8. The detector laser beam should be aimed at the center of the reflector or the mirror using three positioning screws. The adjustment screws help in precise alignment so that the laser beam returns to the detector's front plate after being reflected from the reflector. The mirror should be removed after proper adjustment of the optical path between the detector and the reflector. The prism reflector's position cannot be adjusted and it is recommended to fix it to a flat surface with screws or glue.

The detector is properly aligned with the reflector/set of reflectors when the reflected laser light illuminates back the detector. In such case the external battery should be disconnected, the detector cover should be mounted and the START button should be pressed. As a result, the diode shall light in a pulse

manner with yellow or green colour. After ca. 40 sec. the diode should switch off automatically, what confirms the proper adjustment of the infrared beam to the distance between the detector and the reflector/set of reflectors. During this adjustment process, the detector signals a fault mode on the control panel. After the adjustment is done, the detector enters into the supervision mode.

Note:

The detectors should not be exposed to direct sunlight operation.

The detector/reflector alignment with a help of a laser beam should be carried out in a dark room wherever possible.



Fig. 2 RE-428 Series beam detector during optical path alignment

6 OPERATING CONDITIONS AND MAINTENANCE

The RE-428 Series optical beam smoke detector long-lasting operation, especially in dusty premises, may result in contamination (dust, dirt accumulation) of the optical part of the detector and of the reflector/set of reflectors. After exceeding a determined contamination compensation range, the detector transmits a fault signal to the control indicating the necessity to call a maintenance technician. The detector is still able to detect fire factors (smoke) and enter into the alarm mode. The fault caused by contamination entails the need of cleaning the reflector/set of reflectors and the front of the detector. After cleaning the above mentioned elements, the START button should be pressed in order to adjust the detector to new conditions. After the adjustment is completed, the detector automatically alters its mode from a fault into a supervision one.

It is possible to check proper operation of the RE-428 Series optical beam smoke detectors installed in fire detection systems during their maintenance inspection by concealing partly the detector's optical path. It can be carried out using a special plastic foil with overprints appropriate to the detector three sensitivity levels – 18%; 30%; 50% (Fig. 9). The foil should be placed at the front of detector and it should trigger an alarm mode. **During renovation or painting works carried out in the premises where detectors are installed, the detector and reflector/set of reflectors should be removed or protected with cover. Detectors damaged as a result of painting or renovation works are not subject to warranty repairs.**

7 SAFETY CONDITIONS

7.1 Repairs and maintenance

Any maintenance works or periodic inspection shall be carried out by skilled personnel employed by companies being authorized or trained by RAVEL . Any repairs must be carried out by the manufacturer. RAVEL do not carry responsibility for the operation of any device being serviced and repaired by unauthorized personnel.

7.2 Works at height

Any detector installation works carried out at height must be carried out with particular care and using tools and machinery in good working condition. Special attention shall be paid to the stability of ladders, platforms, etc. Any electric tool shall be used strictly obeying the safety rules specified in the manufacturer's instruction manuals.

7.3 Anti-dusting eye protection

It is obligatory to use protective anti-dusting glasses and masks during detector installation works that produce high amount of dust, such as hole drilling for detector base mounting on ceilings/walls.

7.4 Eye protection against laser beam operating equipment

During the alignment of the detector optical path with the reflector/set of reflectors using a laser viewfinder, special eye protection against direct laser exposure (3R class laser equipment) must be provided.

8 STORAGE AND TRANSPORT

The detectors should be stored in closed premises at ambient temperature ranging from 0°C to +40°C and relative humidity up to 80% at +35°C, free from volatile sulphur compounds as well as acid and alkaline vapors. The detectors should not be exposed to direct sun; heating devices should not directly influence the detectors or their packing.

The detectors transportation should be carried out in transport packing using any transport means and obeying the transport recommendations given on the packages and securing protection against possibility of mechanical damage and impact of temperatures lower than -40°C and higher than +70°C and relative humidity higher than 95%.

9 DESIGN RECOMMENDATIONS

The RE-428 Series beam smoke detector operates properly (like all other smoke detectors), in case it is installed at the height not exceeding 12 m. When it is mounted higher (up to 20 m), additional detectors shall be provided at an intermediate level.

Maximum width (2D) of an area protected by one detector depends on the room height, according to the following table:

Height H	Operation radius D	Distance from ceiling	
		At gradient up to 20°	At gradient over 20°
Up to 6 m	6 m	0.2 m to 0.5 m	0.3 m to 0.5 m
From 6 to 12 m	6.5 m	0.3 m to 0.7 m	0.4 m to 1.0 m
Over 12 m	7 m	0.6 m to 0.9 m	0.8 m to 1.2 m

In case the distance between detector and set of reflectors is 100 m, the maximum area protected by one detector for the 10 m ceiling height is ca. 1300 m², (2D x 100m) so the detector can replace a dozen of point smoke detectors.

The distance between the detector IR beam and a side wall of room should not exceed D value and between two adjacent detector beams – 2D. The distance from the IR beam to any obstacle (e.g. a wall, perpendicular to a side wall) shall not be shorter than 0.5 m.

The beam detector should constantly “see” the co-operating reflector. It is required to install it in such a way that its optical path is never – even temporarily – concealed by a moving object or equipment, such as cranes, hoists, etc. In the premises, where people are present, the minimum installation height is 2.7 m (outstretched upwards arms will not disturb the optical path). This limitation is not valid in case of low, long or narrow spaces where people are not present, e.g. cable channels, spaces above hanging ceilings, etc.

NOTE: The data listed in the table, especially the D operation radius value, come out from the calculations of the proportion of the beam detector arrangement versus spot detectors installed in a fire test chamber and comply with the data pursuant to VdS 2095:2005.

It differs from the data stated in the PKN-CEN/TS 54-14 technical specification in which the D radius is the same for all heights and is equal to 7.5 m.

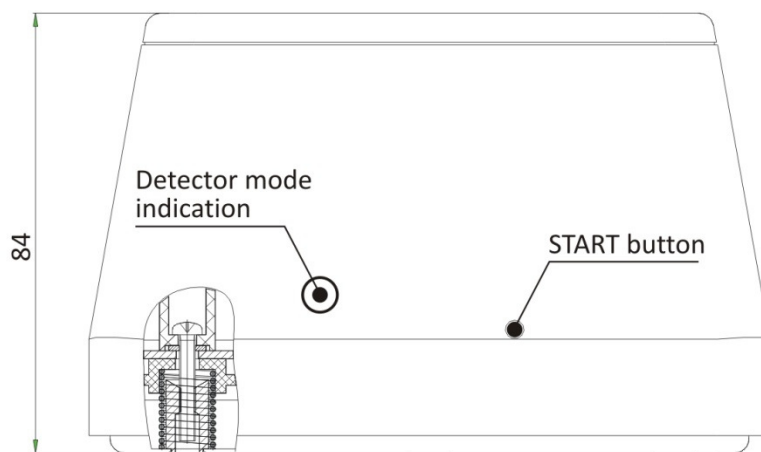
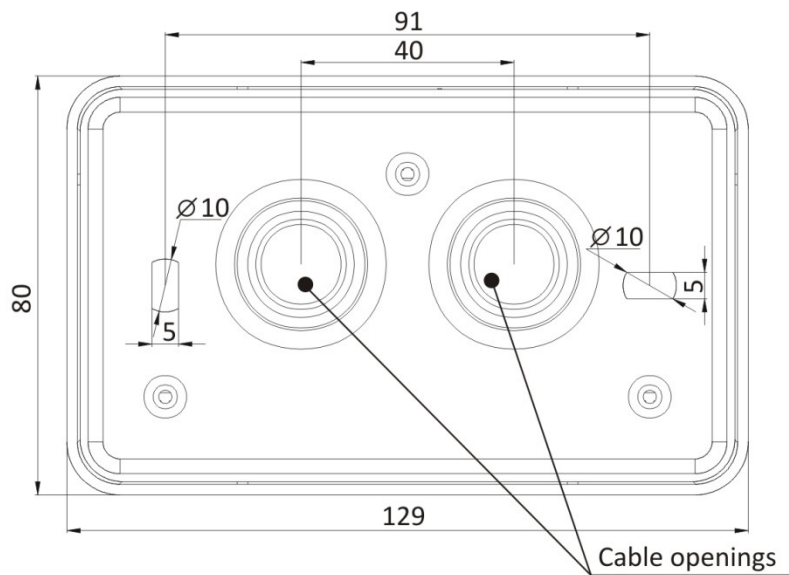
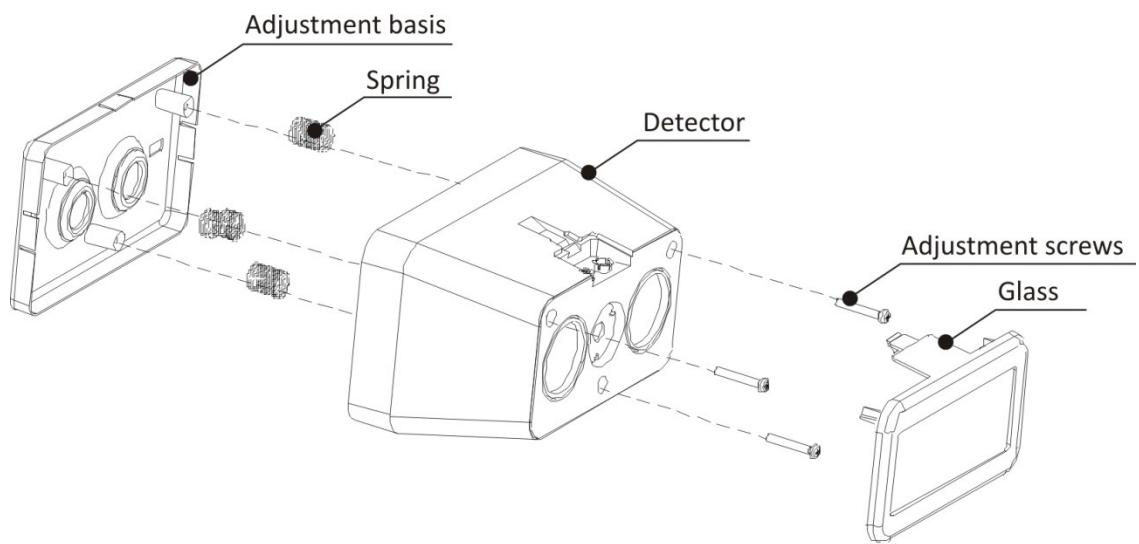


Fig. 3 RE-428 Series beam detector design and overall dimensions

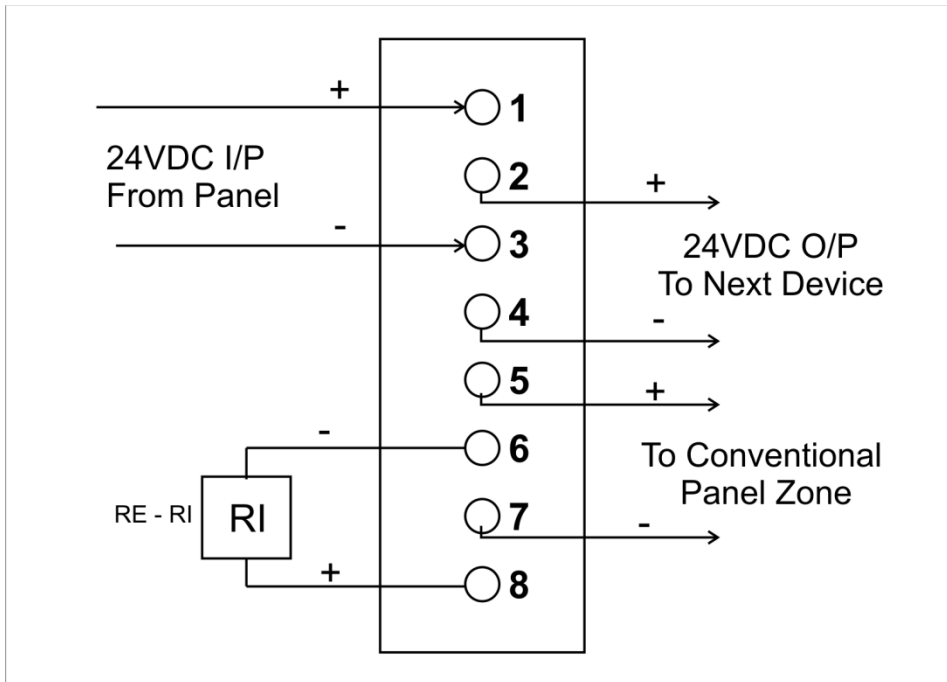


Fig. 4 RE-428 Series beam detector installation wires connection
 * RE-RI – Response Indicator

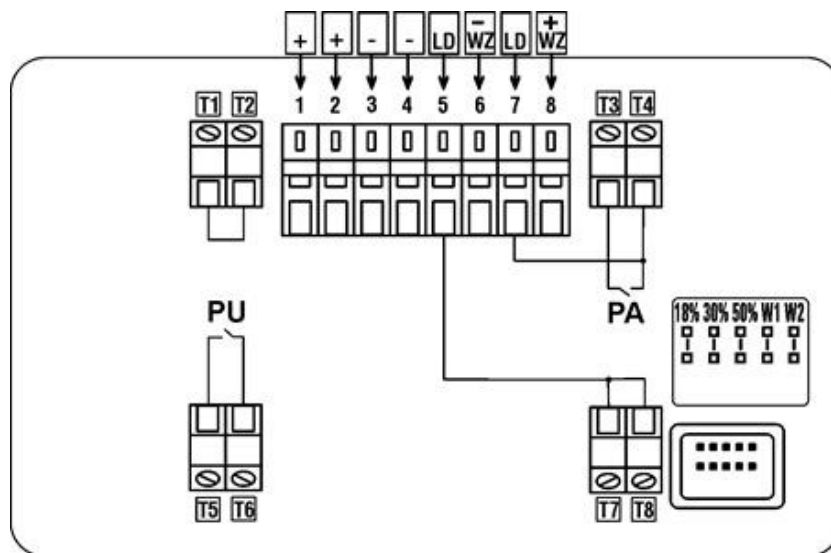


Fig. 5 RE-428 Series beam detector internal connections and output terminals diagram

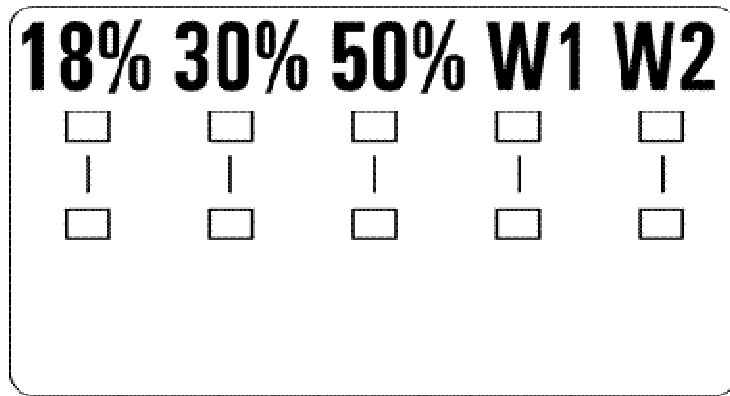


Fig. 6 Jumpers for detector operation declaration

Declared sensitivity levels:

- jumper in position 50% - low sensitivity
- jumper in position 30% - medium sensitivity
- jumper in position 18% - high sensitivity

Alarm mode declaration

Jumper in W1 position –sustain of alarm condition – after detector’s activation, the alarm relay changes its position and stay unchanged as long as the power supply is on. Short brake of power supply of the detector will reset the detector and make the relay returned to the standard position.

Jumper in W2 position –lack of sustain of alarm condition – after detector’s activation, the alarm relay changes its position and stay unchanged as long as detector detects fire factor. After fire factor disappeared, the alarm relay returns to the standard position.

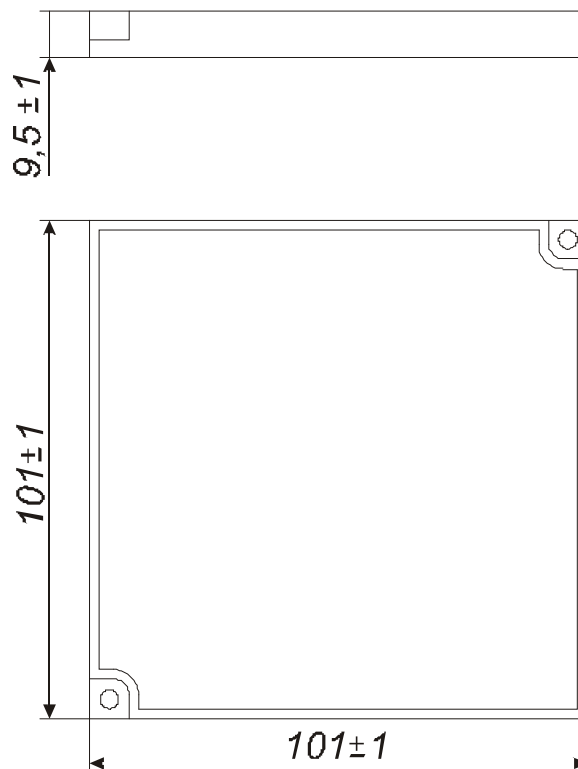


Fig.7 RE96R prism reflector

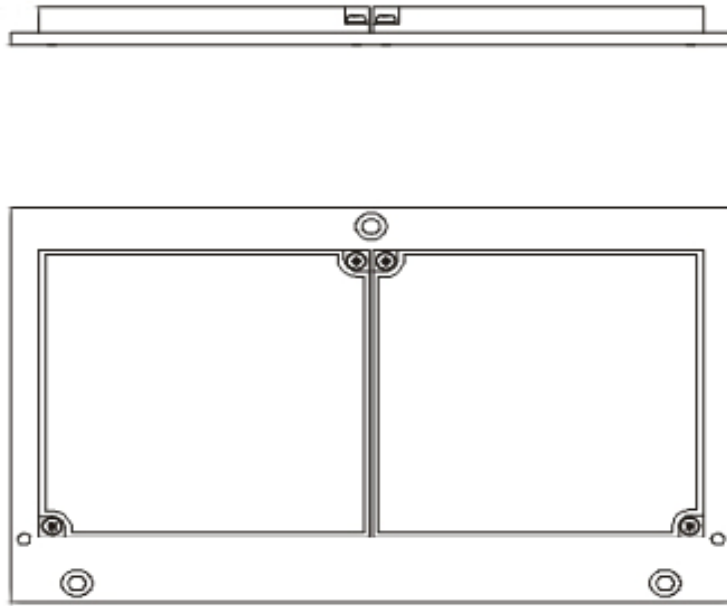


Fig. 8 2XRE96R set of reflectors

Note:

- 1) Operating distance range for RE-428FR reflector (Up to 50 meter) : 1 Prism Reflector
- 2) Operating distance range for RE-428HR reflector (Up to 100 meter) : 2 Prism Reflector
- 3) We can place the Prism Reflector either in Horizontal or Parallel both ways.

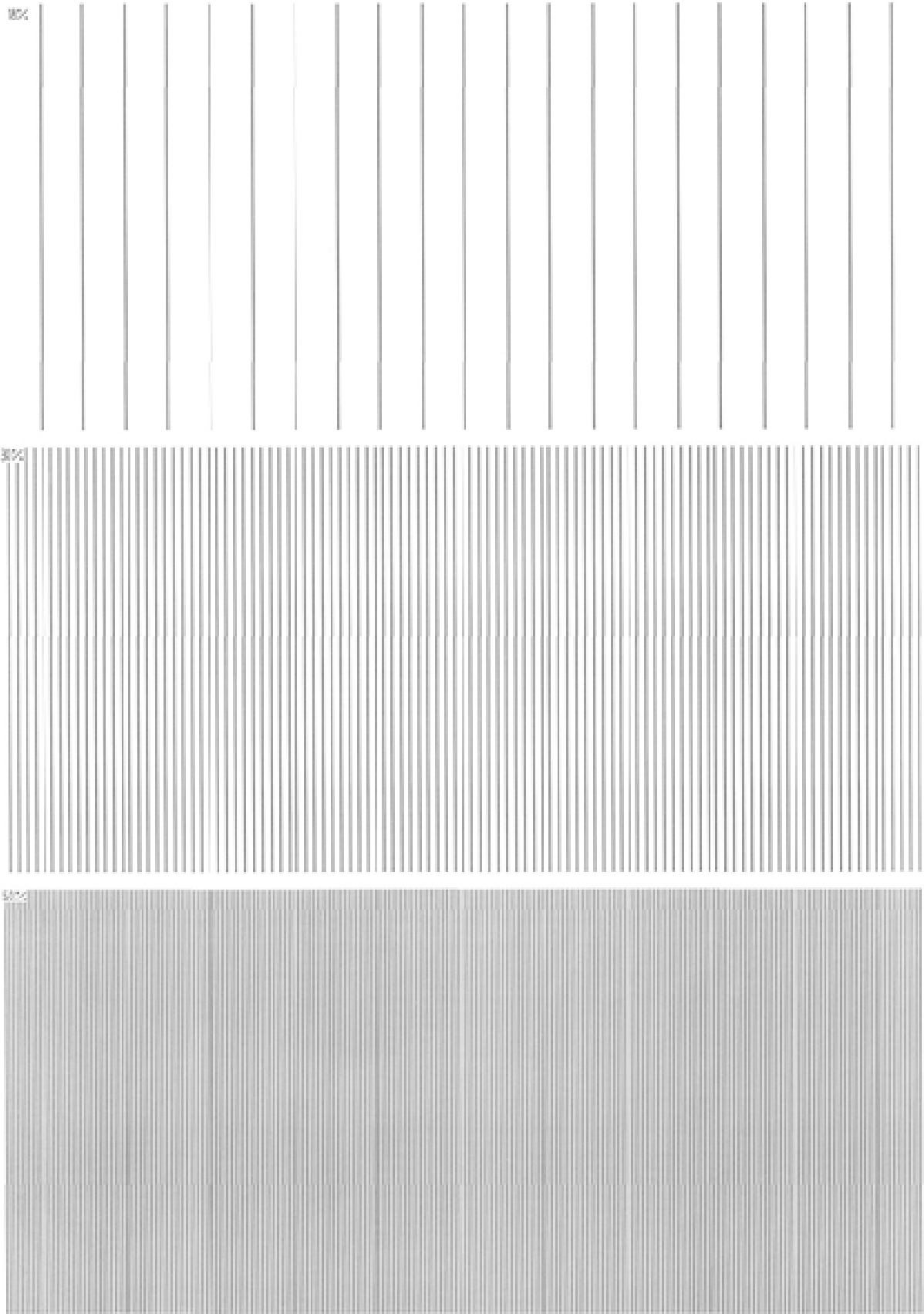


Fig. 9 RE-428 Series beam detector testing foil with overprints

10 Beam Detector Wiring Diagram

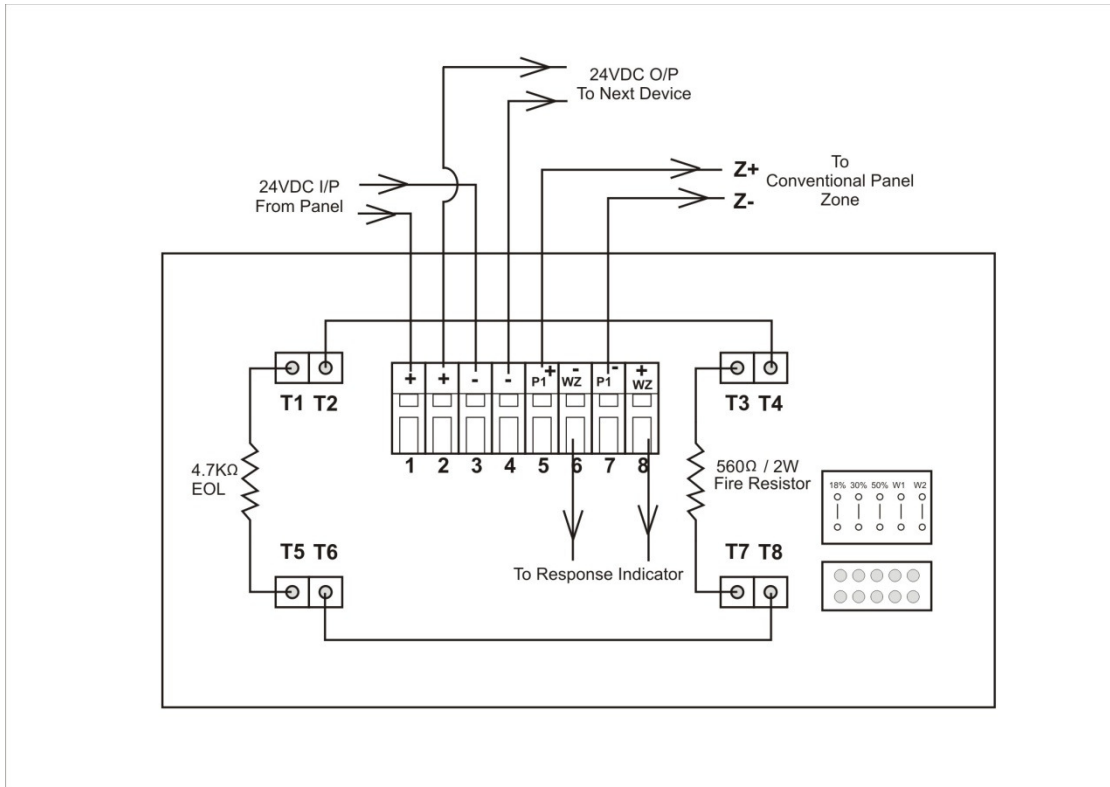


Fig. 10 RE-428 Series Optical Beam detector Wiring

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