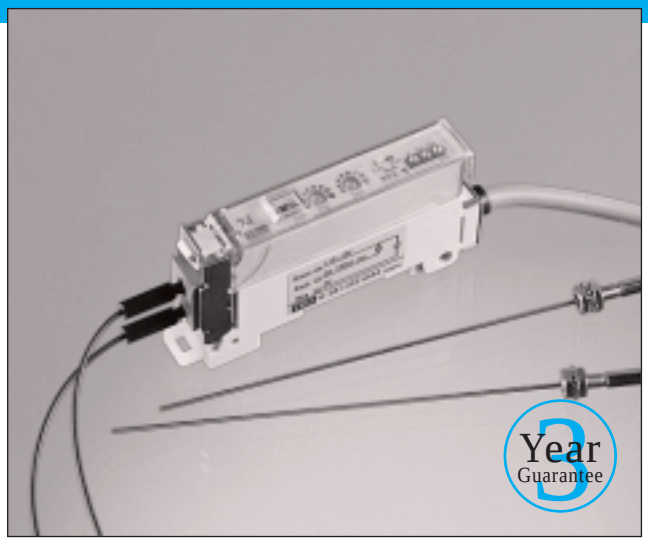
# Compact DC Optical Fibre Photoelectric Switches

PF

**Miniature 60x31x11mm optical fibre photoelectric switches for remote sensing in confined spaces or detection of small objects**

- Diffuse and separate (through-beam) models
- Red light emission models for most applications
- Green light to detect red marks on white backgrounds
- Coarse and fine sensitivity adjustments
- Light received and stability LEDs
- Fast response time – 1ms
- Switch selection of light on/dark on (NO/NC) output
- Protection up to IP66
- Fine tube types can be bent for positioning
- Fibres may be cut to suit applications
- Logic output (NPN models)
- Self-diagnostic (alarm) output models with off-delay timer
- Short-circuit protection




## Options and ordering codes

| P | F | A | – | N | T | G |
|---|---|---|---|---|---|---|

| | | | |
|---|---|---|---|
| Compact optical fibre photoelectric switches | PF | | |
| Amplifier | A | | |
| NPN output type | N | | |
| PNP output type | P | | |
| | | — | Red light emission |
| | | G | Green light emission |
| | | — | Without timer and diagnostic output |
| | | T | With timer and diagnostic output |

## Specifications

| **Type** | Photoelectric switch | | | | Photoelectric switch with timer and self-diagnosis | | | |
|---|---|---|---|---|---|---|---|---|
| **Models** | PFA-N | PFA-NG | PFA-P | PFA-PG | PFA-NT | PFA-NTG | PFA-PT | PFA-PTG |
| **Emission** | red | green | red | green | red | green | red | green |
| **Supply voltage** | 10-30VDC including peak ripple | | | | | | | |
| **Max. consumption** | ≤50mA | | | | | | | |
| **Response time** | ≤1ms operation/reset | | | | ≤1ms operation, 30 to 70ms reset | | | |
| **Output type** | NPN | | PNP | | NPN | | PNP | |
| **Output state** | light on/dark on (NO/NC) selectable by switch | | | | | | | |
| **Load current** | 100mA | | | | | | | |
| **Logic output** | 1.5mA | | – | | 1.5mA | | – | |
| **Self-diagnostic output current** | – | | | | 50mA | | | |
| **Residual output voltage** | 1.1V IL=100mA | | | | | | | |
| **Connection cable** | 2 metres long, 3-wire | | | | 2 metres long, 4-wire | | | |
| **Electrical protections** | against short circuit (autoreset) - polarity reversal - inductive loads | | | | | | | |
| **LED status indicators** | light received - red LED (light), stability - green LED (stab.) | | | | | | | |
| **Sensitivity adjustment** | coarse - 1 turn trimmer (sens.), fine - 1 turn trimmer (fine) | | | | | | | |
| **Insulation resistance** | > 20 MOhm to 500 VDC | | | | | | | |
| **Dielectric strength** | 1000VAC 50/60Hz for 1 min | | | | | | | |
| **Housing material** | ABS | | | | | | | |
| **Protection degree** | IEC IP66(1) | | | | | | | |
| **Operating temperature** | -25˚C +55˚C (avoid ice on amplifier)(2) | | | | | | | |
| **Storage temperature** | -40˚ +70˚C | | | | | | | |
| **Interference by artificial light** | 3000 lux | | | | | | | |
| **Interference by sunlight** | 10000 lux | | | | | | | |
| **Ambient humidity** | 35-85% r.h. operating, 35-95% r.h. storage | | | | | | | |
| **Vibration** | 10 to 55 Hz, 1.5mm double amplitude (x, y, z direction, respectively 2 hours) | | | | | | | |
| **Shock** | 500m/s² (approx. 50G) 3 times each in X, Y and Z directions | | | | | | | |
| **Weight (approx.)** | 100g | | | | | | | |

(1) Protection is IP50 when amplifier is used with fibres P2F-DF or P2F-SF. (2) Operating temperature range is -25˚C to +50˚C when amplifiers are mounted close together e.g. on DIN rail.

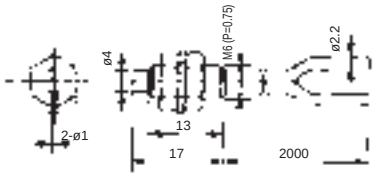
## Specifications

| Type | diffuse | | | separate (through-beam) | | |
|---|---|---|---|---|---|---|
| **Models** | PF/D0-20 PFU/D0-20 | PF/D0-21 | P2F-DF | PF/T0-20 PFU/T0-20 | PF/T0-21 | P2F-SF |
| **Style** | standard | fine head | fine stainless tube | standard | fine head | fine stainless tube |
| **Sensing range** | 80mm | 30mm | 20mm | 200mm-1.2m(1) | 100mm-400mm(1) | 60mm |
| **Detectable object** | transparent and opaque | | | opaque ø1mm-3mm | | opaque ø0.5mm |
| **Head thread size** | M6 | M3 | | M4 | M3 | |
| **Fibre size** | ø1mm active fibre | ø0.5mm active fibre | ø0.5mm active fibre | ø1mm active fibre | ø0.5mm active fibre | ø0.5mm active fibre |
| **Fibre length** | 2 metres(2) | | | | | |
| **Materials** | fibre: PMMA resin, sheath: polyester | | | | | |
| **Operating** | -25˚ to +60˚C | | -40˚ to +70˚C | -25˚ to +60˚C | | -40˚ to +70˚C |

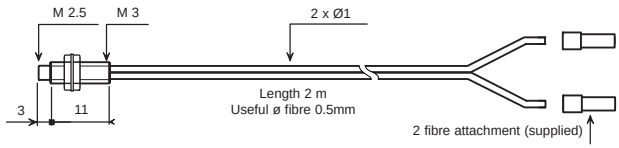
(1) Sensing range 1.2m for PF/T0-20 with PFL-1 lens (2) Longer fibres possible – contact IMO for availability

## Dimensions (mm)

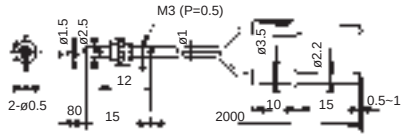
• Fibre unit – diffuse type – standard head
PF-D0-20 **PFU/D0-20 (high flexible cable)**



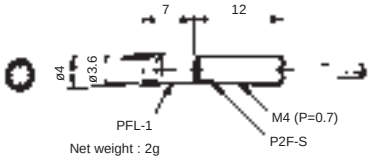

• Fibre unit – diffuse type – fine head
PF/D0-21



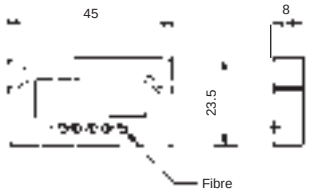

• Fibre unit – diffuse type – fine stainless-steel tube head
P2F-DF



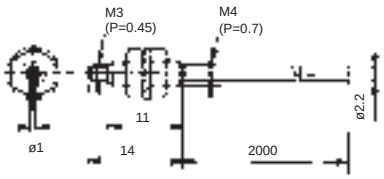

Lens: PFL-1 supplied separately (set of two)



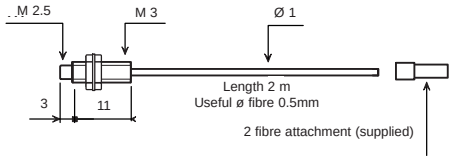

Fibre cutter PXC – supplied with all fibres



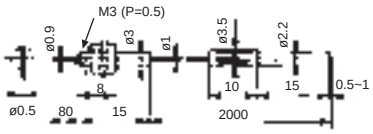

• Fibre unit – separate (through-beam) type - standard head
PF-T0-20 **PFU/T0-20 (high flexible cable)**



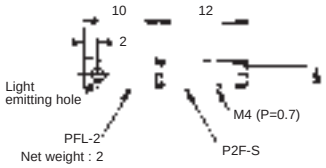

• Fibre unit – separate (through-beam) type - fine head
PF/T0-21




• Fibre unit – separate (through-beam) type – fine stainless-steel tube headP2F-SF




Right-angle beam adapter PFL-2 supplied separately (set of two)

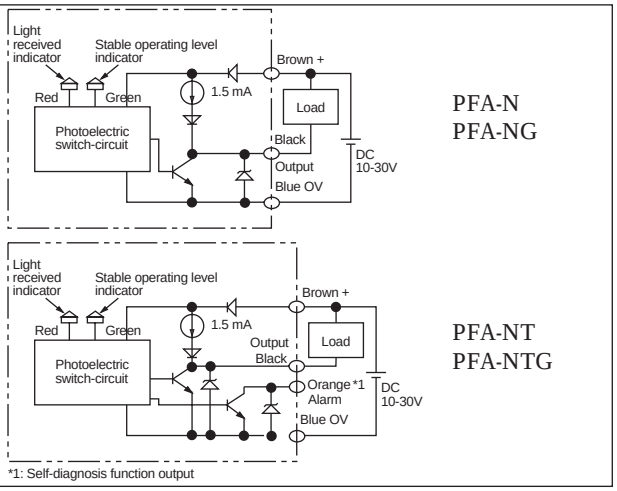


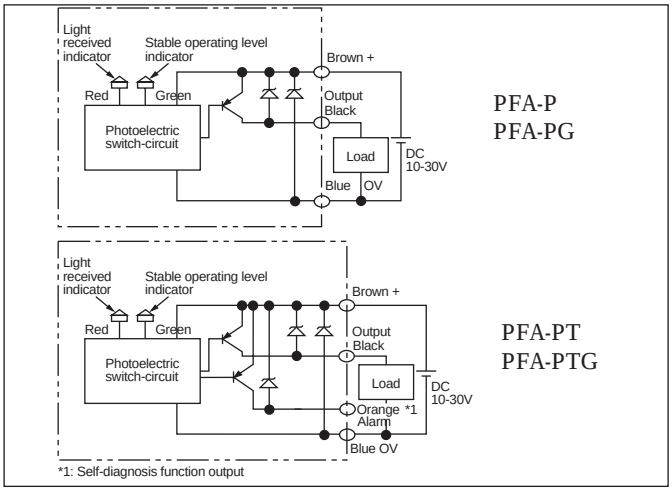

Note: PFL-1 consists of two lenses, one to be fitted to the light source fibre and one to the receiver fibre. (Only to be used with fibre PF/D0-20.)

PFL-2 consists of two right-angle beam adaptors, one to be fitted to either the light source fibre or the receiver fibre or both. (Only to be used with fibre P2F-S.)

Additional fibres available – see following pages – contact IMO for availability

# Wiring connections



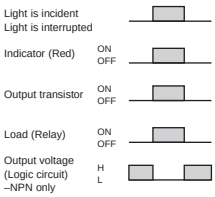

Note: the +V, output and OV (gnd) connections are also available on the top of the amplifier in the form of terminals, for operation check (test) purposes.

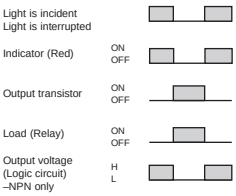
# Timing diagrams

## PFA-N, PFA-P, PFA-NG, PFA-PG

**• "LIGHT ON" mode**
Transistor ON when light is incident.

**• "DARK ON" mode**
Transistor ON when light is interrupted.

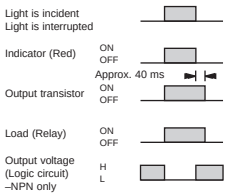


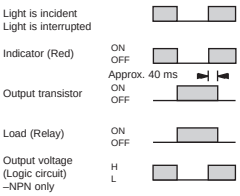




## PFA-NT, PFA-PT, PFA-NTG, PFA-PTG

**• "LIGHT ON" mode**
Transistor ON when light is incident.

**• "DARK ON" mode**
Transistor ON when light is interrupted.




## Indication lamps

**• Incident light indicator (red "Light" lamp)**
Lights upon exposure to incident light in either the LIGHT-ON or DARK-ON operating mode.

**• Stable operating level indicator (green "Stab" lamp)**
Indicates that the amount of light or shade for detection by the sensor is at a stable and suitable level for operation.

This lamp lights up when the quantity of light received has exceeded + 15% of the operating level or it has been lowered below -15% of the reset level.

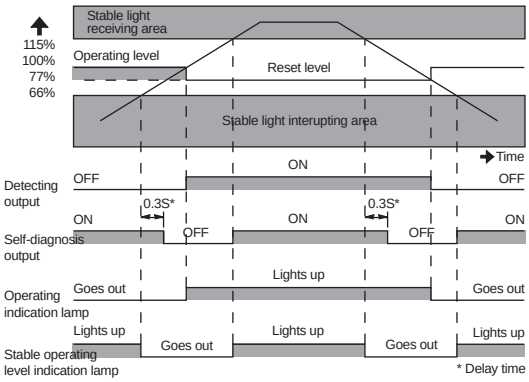
## Self-diagnosis function

The self-diagnosis function warns of the decrease in the light value received due to the deflection of the optical axis or dirty lens surfaces.

**■ Time chart of the self-diagnosis function**
The self-diagnosis output is OFF when the quantity of light received is between the range 66 to 115% of the operating level due to the deflection of the optical axis or buildup of dirt and this situation as continued over the delay time.

**Self-diagnosis function timing diagram (LIGHT-ON)**

Quality of light received




If the terminology NO and NC is used, the following conversion table applies:

| Detection mode | dark on | light on |
|---|---|---|
| Diffuse | NC | NO |
| Retro-reflective | NO | NC |
| Through beam | NO | NC |

NO: when detecting a target, the output switches to the ON state (conduction)

NC: when detecting a target, the output switches to the OFF state (isolation)

## Relationship between quantity of light received, output and indication lamps

**PFA-N, PFA-P, PFA-NG, PFA-PG**

| | | | | |
|---|---|---|---|---|
| Output transistor | LIGHT ON | ON | OFF | |
| | DARK ON | OFF | ON | |
| Light incident indicator lamp | LIGHT ON | Lights up | Goes out | |
| | DARK ON | Lights up | Goes out | |
| Stable operating level indication lamp | LIGHT ON | Lights up | Goes out | Lights up |
| | DARK ON | Lights up | Goes out | Lights up |
| Quantity of light received | | Stable light receiving area | 15 % | 15 % | Stable light interrupting area |

**PFA-NT, PFA-PT, PFA-NTG, PFA-PTG**

| | | | | | |
|---|---|---|---|---|---|
| Output transistor | light-level increasing | LIGHT ON | ON | OFF | |
| | light-level decreasing | LIGHT ON | ON | OFF | |
| | light-level increasing | DARK ON | OFF | ON | |
| | light-level decreasing | DARK ON | OFF | ON | |
| Self-diagnosis output | | LIGHT ON | ON | OFF | ON |
| | | DARK ON | ON | OFF | ON |
| Light incident indication lamp | light-level increasing | L ON OR D ON | Lights up | OFF | |
| | light-level decreasing | L ON OR D ON | ON | Goes out | |
| Stable operating level indication lamp | | LIGHT ON | Lights | Goes out | Lights |
| | | DARK ON | Lights | Goes out | Lights |

Quantity of light received

| Stable light receiving area | 15 % | Differ-ential travel | 15 % | Stable light inter-rupting area |
|---|---|---|---|---|

115% 100% 77% 66%

LIGHT ON: Operating level — Reset level

DARK ON: Reset level — Operating level

## Setting-up procedure

### Optical axis adjustment

■ **Diffuse type**
- Visually align the sensor position
- The characteristics of detection depend on the material and shape of the target object.
- Upon detection of the target object, the incident light indication lamp lights (red). Check also that the stable operating level indicator (green) lights.

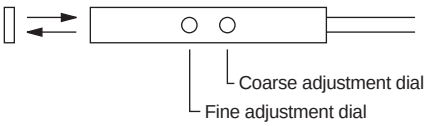
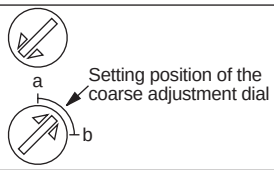
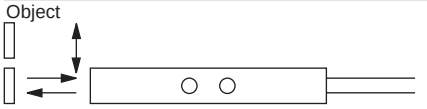
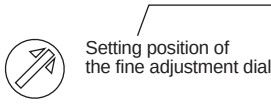
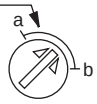
■ **Separate (through-beam) type**
- Position the tips of the optical fibres so that they face each other and encompass the sensing position.
- The incident light indication lamp lights (red) when the optical axes are aligned. Check also that the stable operating level indicator (green) lights.

### Sensitivity adjustment

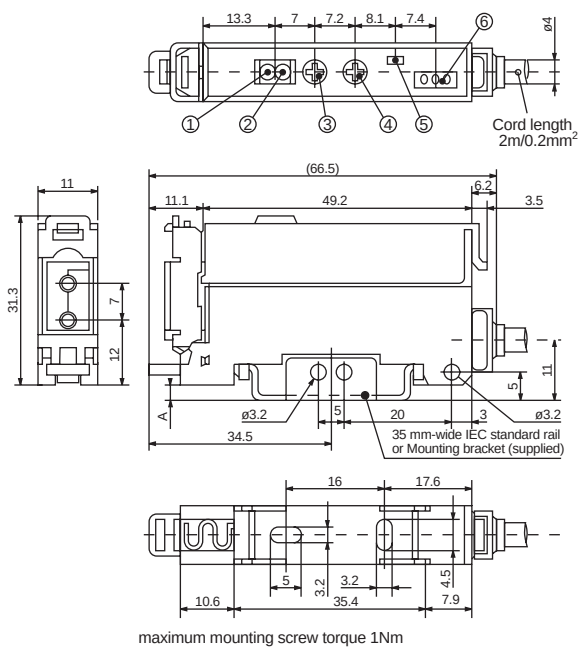
A fine and a coarse sensitivity adjustment permits accurate adjustment.

■ Procedure of sensitivity adjustment
- When carrying out a normal detection, set both dials at the maximum sensitivity value by turning them fully clockwise.
- When a photoelectric switch is used for detection of an object with inadequate contrast, sensitivity adjustment should be carried out.

Carry out the sensitivity adjustment as follows.

| State of detected object | | Coarse adjustment dial | Fine adjustment dial |
|---|---|---|---|
| Object<br>  | 1. Set the fine adjustment dial at the central position.<br>2. Set the coarse adjustment dial at approximate operating position. |  |  |
| Object<br>  | 3. Obtain the operating position at the time of presence or absence of the object to be detected by means of the fine adjustment dial, and set at the middle position. |  |  |

## Dimensions (mm)




maximum mounting screw torque 1Nm

① Light
Light-receiving indicator
② Stab
Stable light level indicator
③ Fine
Fine sensitivity adjustment
④ Sens
Coarse sensitivity adjustment
⑤ Logic changeover switch
⑥ Operation check terminals

| Rail type | Dimension A |
|---|---|
| 7.5mm high | 3.5 |
| 15mm high | 11 |
| Mounting bracket supplied | 2 |