

## Safety Single Beam Sensor & Controller

# E3FS series with F3SP-U3P-TGR and F3SP-U5P-TGR



## Features

The E3FS is a type 2 Safety Single beam sensor intended to be used with the control units F3SP-U3P -TGR and F3SP-U5P-TGR.

- Safety Single Beam (E3FS)
  - 1) Up to Category 2 (EN954-1)  
Type2 ESPE and Type2 AOPD.  
Approved by TÜV Product Service
- Muting Controller for Safety single beam sensor (F3SP-U3P-TGR and F3SP-U5P-TGR)
  - 1) Muting functions are integrated
    - Muting inputs
    - Override function
    - Muting Lamp output
    - Interlock function and Test Reset input
  - 2) 2 different model available
    - 2 beam unit (F3SP-U3P-TGR)
    - 4 beam unit (F3SP-U5P-TGR)
  - 3) Small Controller
    - 2 beam unit W=22.5 mm
    - 4 beam unit W=45.0 mm



## Ordering Information

### Safety Single beam Sensors (Type 2)

#### E3FS-10B4 series

| Appearance                                                                       | Case material | Operation distance                                                                          | Model      |                |
|----------------------------------------------------------------------------------|---------------|---------------------------------------------------------------------------------------------|------------|----------------|
|  | Plastic       |  0 to 10 m | Cable Type | E3FS-10B4      |
|                                                                                  | Nickel Brass  |                                                                                             | Plug Type  | E3FS-10B4-P1   |
|                                                                                  |               |                                                                                             | Cable Type | E3FS-10B4-M    |
|                                                                                  |               |                                                                                             | Plug Type  | E3FS-10B4-M1-M |

### Controller for Safety Single beam Sensors

#### F3SP-UxP series

| Appearance                                                                       | Sensors                                 | Output contacts | Width   | Model        |
|----------------------------------------------------------------------------------|-----------------------------------------|-----------------|---------|--------------|
|  | 1 to 2<br>Safety Single<br>beam sensors | 2 NO 2.5 A      | 22.5 mm | F3SP-U3P-TGR |
|  | 1 to 4<br>Safety Single<br>beam sensors |                 | 45 mm   | F3SP-U5P-TGR |

### Accessories

#### Muting Lamp

| Appearance                                                                         | Model   |
|------------------------------------------------------------------------------------|---------|
|  | F39-A11 |

#### Bulb for Maintenance

| Appearance                                                                         | Specification   | Model     |
|------------------------------------------------------------------------------------|-----------------|-----------|
|  | 24 V DC 3 W E14 | F39-A11MB |

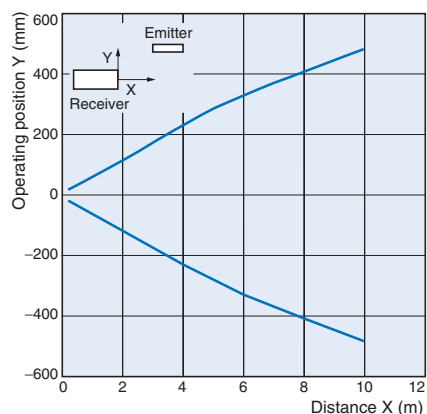
# Rating and Performance

## Sensors

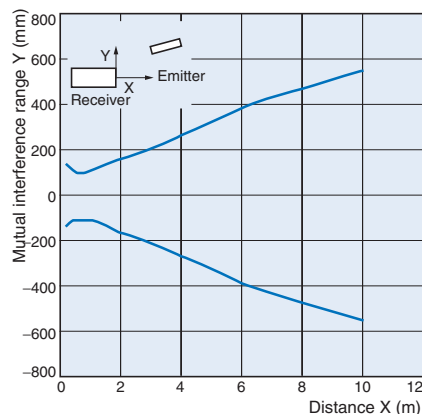
### E3FS-10B4 series

|                                |                 |                                                                                                                                                               |
|--------------------------------|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sensing method                 |                 | Through-beam                                                                                                                                                  |
| Controller                     |                 | F3SP-U3P-TGR, F3SP-U5P-TGR                                                                                                                                    |
| Supply voltage                 |                 | 24 VDC ± 10% (ripple p-p 10% max.)                                                                                                                            |
| Effective aperture angle (EAA) |                 | ±5° (at 3 m)                                                                                                                                                  |
| Current consumption            |                 | Emitter:50 mA max.<br>Receiver:25 mA max.                                                                                                                     |
| Sensing distance               |                 | 10 m                                                                                                                                                          |
| Standard sensing object        |                 | Opaque object: 11 mm min. in diameter                                                                                                                         |
| Response time                  |                 | 2.0 ms (E3FS only) Response time of controller = Response time of the system                                                                                  |
| Control output                 |                 | PNP transistor output, load current: 100 mA max., residual voltage: 2 V max. (Except for voltage drop due to cable extension)                                 |
| Test input (Emitter)           |                 | 21.5 to 24 VDC: Emitter OFF (source current: 3 mA max.)<br>Open or 0 to 2.5 V: Emitter ON (leakage current: 0.1 mA max.)                                      |
| Power supply reset time        |                 | 100 ms                                                                                                                                                        |
| Ambient light intensity        |                 | Incandescent lamp: 3,000 lx max. (light intensity on the receiver surface)<br>Sunlight: 10,000 lx max. (light intensity on the receiver surface)              |
| Ambient temperature            |                 | Operating: -10 to 55°C, storage: -30 to 70°C (with no icing or condensation)                                                                                  |
| Ambient humidity               |                 | Operating: 35% to 85%, storage: 35% to 95% (with no icing or condensation)                                                                                    |
| Insulation resistance          |                 | 20 MΩ min. (at 500 VDC)                                                                                                                                       |
| Dielectric strength            |                 | 1,000 VAC 50/60 Hz 1 min                                                                                                                                      |
| Vibration resistance           | Malfunction     | 10 to 55 Hz, double amplitude: 1.5 mm, 2 h each in the X, Y, and Z directions                                                                                 |
|                                | Operating limit | 10 to 55 Hz, double amplitude: 0.7 mm, 50 min each in the X, Y, and Z directions                                                                              |
| Shock resistance               | Malfunction     | 500 m/s² (approx. 50 G), 3 times each in the X, Y, and Z directions                                                                                           |
|                                | Operating limit | 100 m/s² (approx. 10 G), 1,000 times in the X, Y, and Z directions                                                                                            |
| Degree of protection           |                 | IP67 (IEC standard)                                                                                                                                           |
| Light source                   |                 | Infrared LED                                                                                                                                                  |
| Operation indicators           |                 | Emitter: Emitting (orange)<br>Receiver: Output ON (green), Output OFF (red)                                                                                   |
| Protection                     |                 | Output short-circuit protection, reverse polarity protection                                                                                                  |
| Weight (in packaging)          |                 | E3FS-10B4 2M (ABS resin case): approx. 150 g for 1 set (weight without cable: approx. 55 g)<br>E3FS-10B4-M1-M (metal case): approx. 125 g for 1 set           |
| Applicable standard            |                 | IEC61496-1, EN61496-1 Type 2 ESPE (Electro-Sensitive Protective Equipment)<br>IEC61496-2, prEN61496-2 Type 2 AOPD (Active Opto-electronic Protective Devices) |
| Accessories                    |                 | Emitter, Receiver, four nuts for mounting, and an instruction manual                                                                                          |

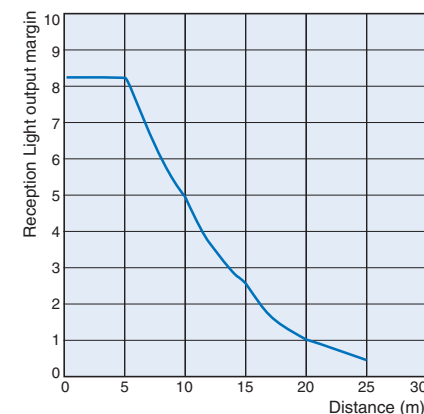
Parallel Operating Range



Mutual interference Range



Excess Gain Ratio



## Controllers

### F3SP-U series

|                         | F3SP-U3P                                                                                     | F3SP-U5P                                             |
|-------------------------|----------------------------------------------------------------------------------------------|------------------------------------------------------|
| Number of sensors       | 1 to 2 Safety Single beam sensor                                                             | 1 to 4 Safety Single beam Sensor                     |
| Width                   | 22.5 mm                                                                                      | 45 mm                                                |
| Muting Input            | 2 Inputs                                                                                     | 4 Inputs                                             |
| Safety related function | Override function<br>Muting Lamp Connection<br>Interlock System (Automatic and manual reset) |                                                      |
| Power supply voltage    | 24 VDC $\pm 10\%$                                                                            |                                                      |
| Power consumption       | 420 mA max.                                                                                  |                                                      |
| Output contacts         | 2 NO 2.5 A (protected by fuse), 115 V AC max.                                                | 2 NO 2.5 A (protected by fuse), 250 V AC max.        |
| Indicators              | 6 LED for status and diagnostics                                                             |                                                      |
| Enclosure rating        | IP20                                                                                         |                                                      |
| Terminal                | 16 screw terminals,<br>Detachable blocks with '4pin'                                         | 32 screw terminals,<br>Detachable blocks with '4pin' |
| Response time           | $\leq 30$ ms                                                                                 |                                                      |
| Ambient temperature     | Operation: $-10^{\circ}\text{C}$ $+55^{\circ}\text{C}$                                       |                                                      |
| Housing material        | Plastic; DIN rail mounting                                                                   |                                                      |
| Weight                  | 0.3 kg                                                                                       |                                                      |

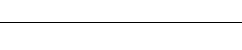
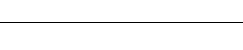
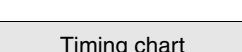
## Operating Instructions

### Output Circuit

| Model                                                                | Connection method               | Output transistor                      | Output circuit |
|----------------------------------------------------------------------|---------------------------------|----------------------------------------|----------------|
| E3FS-10DB4 2M<br>E3FS-10DB4-P1<br>E3FS-10DB4-M 2M<br>E3FS-10DB4-M1-M | Connect the pink and brown wire | ON when light is incident (Light-ON)   |                |
| Receiver circuit                                                     | Connect the pink and blue wire  | ON when light is interrupted (Dark-ON) |                |
| E3FS-10LB 2M<br>E3FS-10LB-P1<br>E3FS-10LB-M 2M<br>E3FS-10LB-M1-M     |                                 | Emitter circuit                        |                |

Timing Chart

Output mode and timing chart

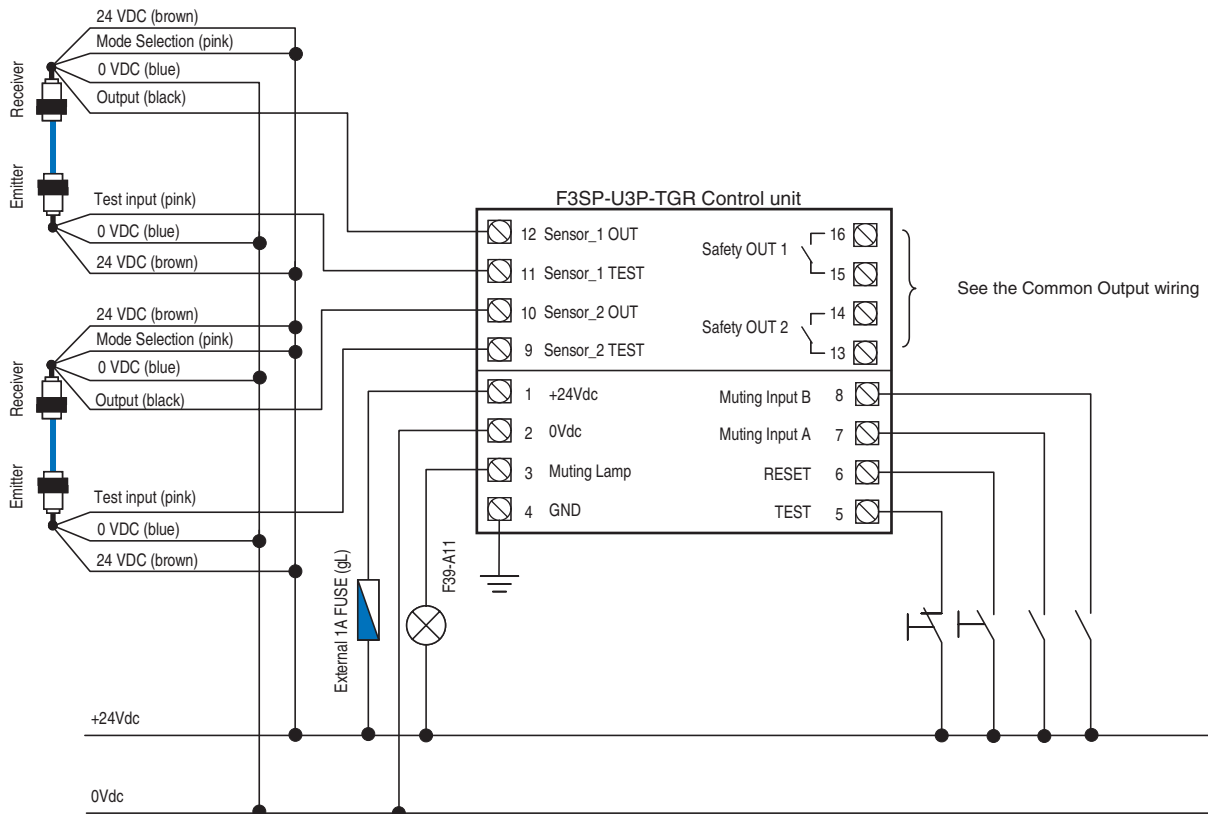
| Receiver connection                 |       | Connect Pink (2) to Brown(1)                                                      | Connect Pink (2) to Blue (3)                                                        |
|-------------------------------------|-------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Mode of output                      |       | ON when Incident (Light ON)                                                       | ON when interrupted (Dark ON)                                                       |
| Light Incident<br>Light interrupted |       |  |  |
| Indicator                           | Green |  |  |
|                                     | Red   |  |  |
| Control output                      | ON    |  |  |
|                                     | OFF   |  |  |
| Load (Relay)                        | ON    |  |  |
|                                     | OFF   |  |  |

Emitting timing chart

|                |     | Timing chart                                                                        |
|----------------|-----|-------------------------------------------------------------------------------------|
| Test input     | ON  |    |
|                | OFF |    |
| Light emission | ON  |  |
|                | OFF |  |
| Indicator      | ON  |  |
|                | OFF |  |

## Connection

### F3SP-U3P Manual Reset (Cat2)



**WARNING:** Both safety contacts OUT1 and OUT2 must be connected. If the machine has a single locking circuit, the two normally opened contacts must be connected in series.

**WARNING:** The power supply of Safety sensors must be taken from the same supply of F3S-U3P-TGR unit.

#### Dip Switch setting

|   | Function        | ON                              | OFF                                  |
|---|-----------------|---------------------------------|--------------------------------------|
| 4 | Not used        | -----                           | -----                                |
| 3 | Muting Activate | It will be muting Sensor_1 only | <u>It will be muting both Sensor</u> |
| 2 | Muting Duration | Infinite                        | <u>60 Second</u>                     |
| 1 | Reset mode      | <u>Auto Reset</u>               | Manual Reset                         |

ON OFF

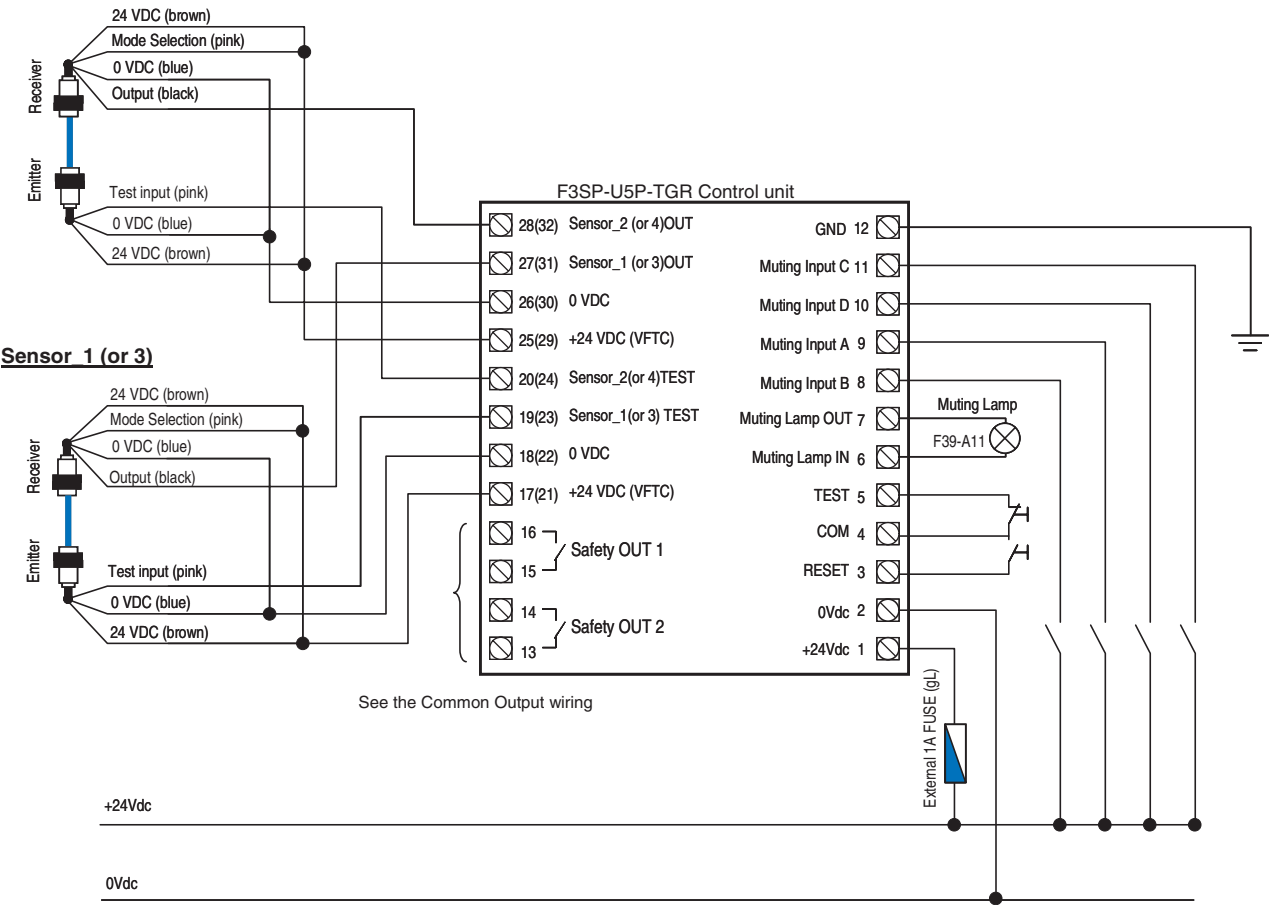


Factory setting

The underlines are initial setting (Factory setting)

F3SP-U5P Manual Reset (Cat 2)

Sensor 2 (or 4)

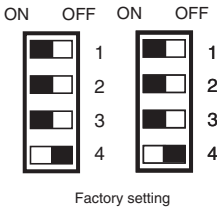


**WARNING:** Both safety contacts OUT1 and OUT2 must be connected. If the machine has a single locking circuit, the two normally opened contacts must be connected in series.

Dip Switch setting

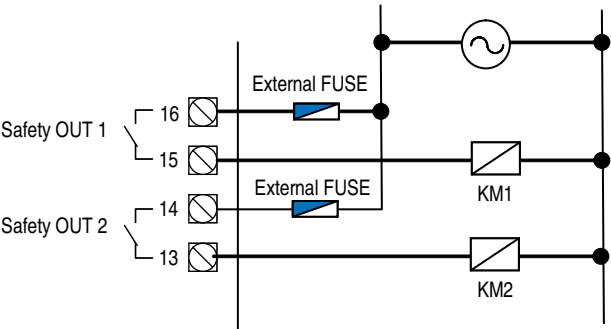
|   | Function        | ON                                                                                                                    | OFF                                                                                                        |
|---|-----------------|-----------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|
| 4 | Not used        | -----                                                                                                                 | -----                                                                                                      |
| 3 | Muting Activate | Muting inputs A-B act on the sensor_1.<br>Muting inputs C-D act on the sensor_2.<br>Other sensor 3-4 continue to work | <u>Muting inputs A-B act on the sensor 1 and 2.</u><br><u>Muting inputs C-D act on the sensor 3 and 4.</u> |
| 2 | Muting Duration | Infinite                                                                                                              | <u>60 Second</u>                                                                                           |
| 1 | Reset mode      | <u>Auto Reset</u>                                                                                                     | Manual Reset                                                                                               |

The underlines mean initial setting (Factory setting)

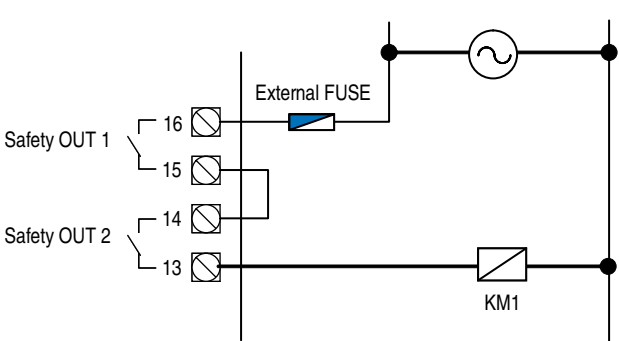


Common Output wiring

In case of 2 load



In case of 1 load



## Precautions for Correct Use

### Warning

OMRON's Single-beam Safety Sensor input Module (B1 Module) from the F3SX Series is the only controller that can be used for the E3FS-10B4□□□ (type 2). Normal operation may not be possible if another Single-beam Sensor Controller is used.



The Sensor cannot be used as part of a safety system when the mode selection input of the Single-beam Safety Sensor Receiver is connected to 0 V because the Sensor will turn ON when light is interrupted (Dark ON). Be sure to connect the mode selection input to 24 VDC if you want the Sensor to turn ON when light is incident (Light ON).



### Safety Distance

The safety distance is the minimum distance that must be maintained between the Sensor and a hazardous part of the machine in order to stop the machine before someone or something reaches it. The safety distance is calculated based on the following equation when a person moves perpendicular to the detection zone of the Sensor.

Safety distance (S) = Intrusion speed into the detection zone (K)  
 x Total response time for the machine and Sensor  
 + Additional distance calculated based on the detection capability of the Sensor (C)

The safety distance varies with the national standards and individual machine standards. The equation is also different if the direction of intrusion is not perpendicular to the detection zone of the Sensor. Be sure to refer to the related standards.

Here  $T = T_1 + T_2 + T_3$ , where

$T_1$  = Maximum machine stop time (s)

$T_2$  = Sensor response time (s)  
 (From ON to OFF: 2.0 ms for the E3FS)

$T_3$  = F3SP response time (s)  
 (From ON to OFF: Refer to Response Time.)

The maximum stop time for a machine is the time it takes to actually stop dangerous parts after the machine receives a stop signal from the F3SP.

### Warning

Measure the actual maximum stop time for the machine and the periodical check it to see if the time changes.



Reference: Method for Calculating Safety Distance as Defined in the European Standard EN999 (with Intrusion Perpendicular to the Detection Zone)

K and C are as follows for the Single-beam Safety Sensors.

1) When a Single-beam Safety Sensor is used alone (when the risk assessment indicates that a single beam is sufficient)

$K = 1600 \text{ mm/s}$

$C = 1200 \text{ mm}$

Height of the beam from the ground or from a reference surface: 750 mm (EN999 recommendation)

2) When multiple Single-beam Safety Sensors are installed at different heights.

$K = 1600 \text{ mm/s}$

$C = 850 \text{ mm}$

The beam heights in the following table are the EN999 recommendations.

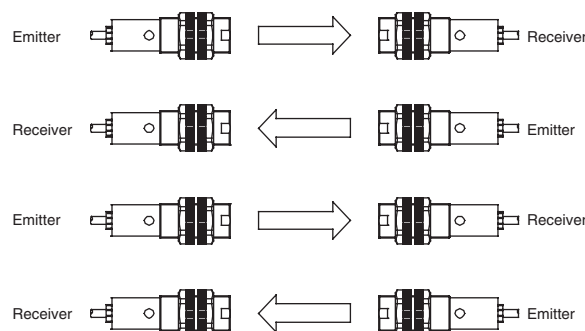
| No. of beams | Height from the reference surface (example: the floor) |
|--------------|--------------------------------------------------------|
| 2            | 400 mm, 900 mm                                         |
| 3            | 300 mm, 700 mm, 1,100 mm                               |
| 4            | 300 mm, 600 mm, 900 mm, 1,200 mm                       |

Note: Refer to the F3SN/F3SH instruction manuals for details on Safety Light curtains and Multi-beam Safety Sensor.

### Preventing Mutual Interference

Observe the following items during installation to prevent Single-beam Safety Sensors from interfering with each other or with Safety Light Curtains.

- Leave adequate space between the Sensors during installation. (Refer to the instruction manuals for the E3FS.)
- Use baffle plates to separate Sensors.
- Alternate Emitters and Receivers during installation. (See the figure below.)



Check for mutual interference between Single-beam Safety Sensors or Safety Light Curtains connected to the same or different Control Units before finalizing placement and starting normal operation.

### Warning

When installing multiple Safety Light Curtains, Multi-beam Safety Sensors, and Single-beam Safety Sensors, take necessary steps to prevent mutual interference. Otherwise detection may fail and serious injury may result.



## Dimensions

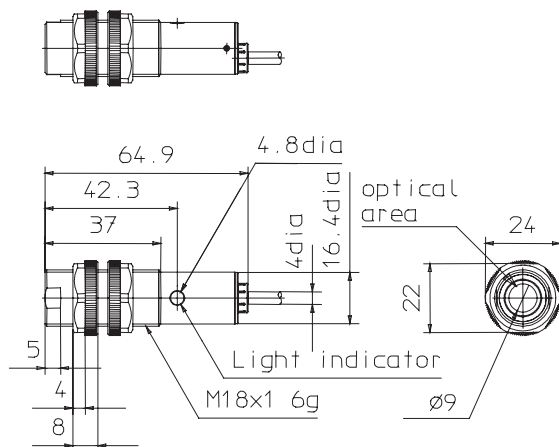
Note: All units are in millimeters unless otherwise indicated

## Plastic housing

Cable type:

E3FS-10LB

E3FS-10DB4

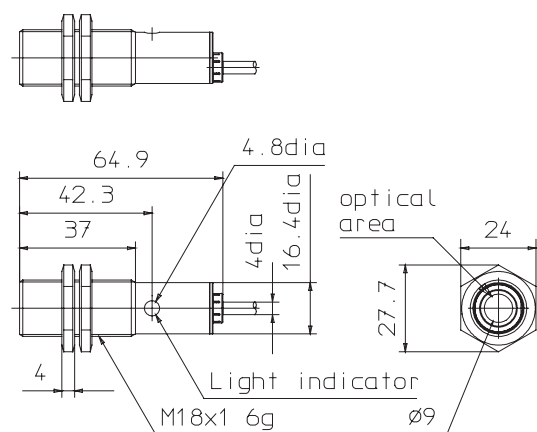


## Metallic housing

Cable type:

E3FS-10LB-M

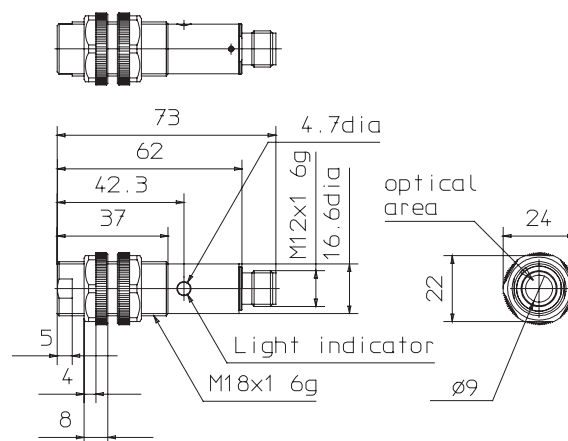
E3FS-10DB4-M



Connector type:

E3FS-10LB-P1

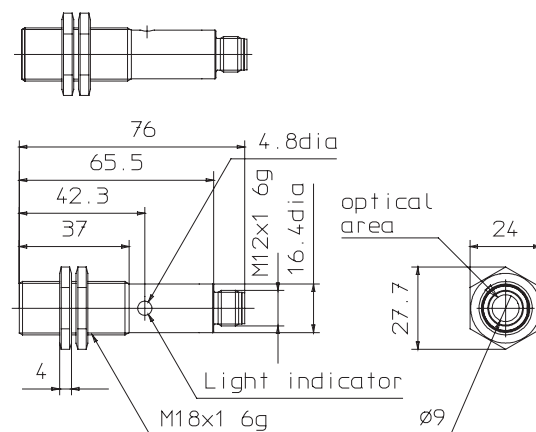
E3FS-10DB4-P1



Connector type:

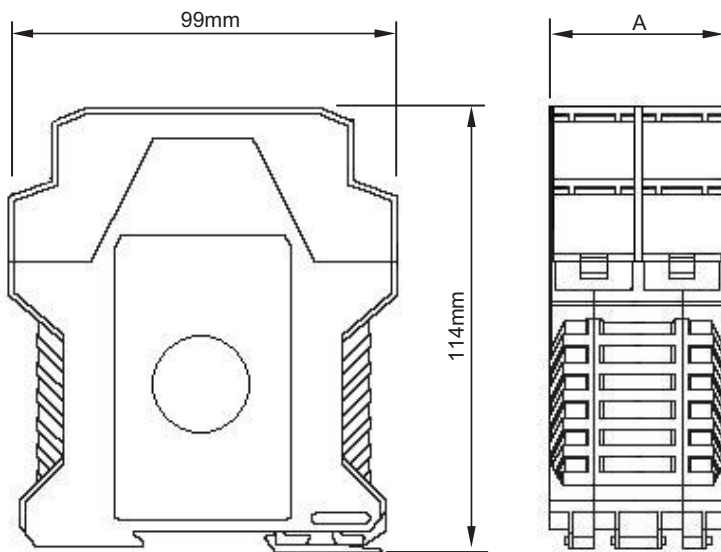
E3FS-10LB-M1-M

E3FS-10DB4-M1-M



# Controller

F3SP-U3P and F3SP-U5P



| Model        | A       |
|--------------|---------|
| F3SP-U3P-TGR | 22.5 mm |
| F3SP-U5P-TGR | 45 mm   |

ALL DIMENSIONS SHOWN ARE IN MILLIMETERS.

To convert millimeters into inches, multiply by 0.03937. To convert grams into ounces, multiply by 0.03527.