PHOTOELECTRIC SENSORS

MS-AJ | Sensor Mounting Stand

PM | Micro

PM2

NX5

VF | Multi-voltage Type

SU-7/SH | Amplifier-separated Type

SS-A5

CHX-SC2 | Sensor Checker

# VF SERIES

## Terminal Connection Type Multi-voltage Photoelectric Sensor
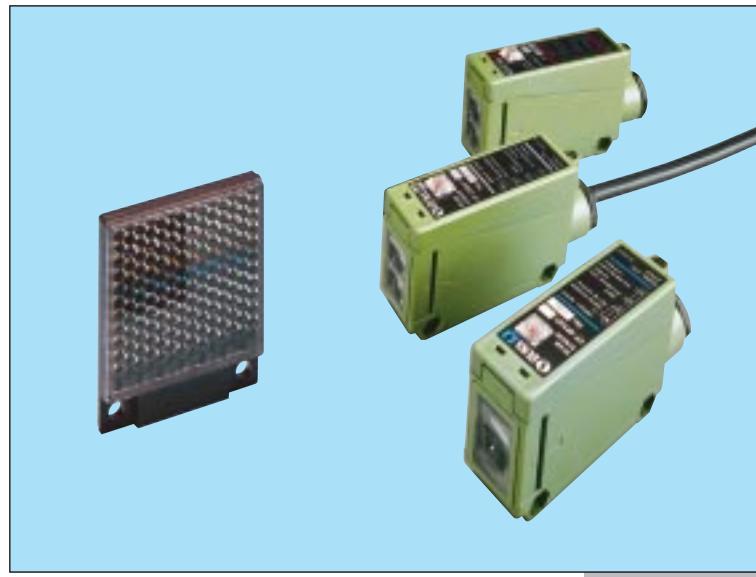
Easy to Use
Terminal Connection
Type

$C\epsilon$ **Marked**

**Conforming to Low Voltage and EMC Directives**

### New Convenient Construction

The slanting step-wise terminal enables quick and easy connection.

### Multi-voltage

The **VF** series can operate at 24 to 240V AC or 12 to 240V DC, which makes it suitable for supply voltages all over the world.

### Retroreflective Sensor with Polarizing Filters  VF-PRM3

**VF-PRM3** ensures reliable sensing even with shiny or specular objects traveling in any direction.
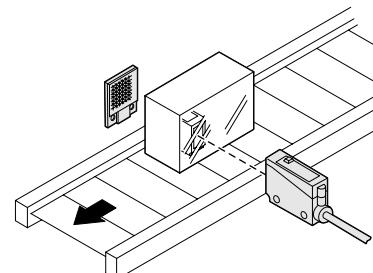
### Long Sensing Range

The **VF** series ensures stable detection with its long sensing range.

**Thru-beam type**

10m

**Retroreflective type**

5m
3m (With polarizing filters)

**Diffuse reflective type**

500mm, 1m
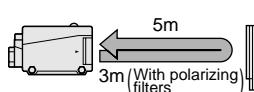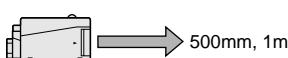
### Timer Function Models

The sensing signal can be easily converted into a signal suitable for your control process. It is also suitable for PLC input.

• Timer duration: 0.1 to 5 sec. (Variable)
• Operation: ON-delay
　　　　　　 OFF-delay
　　　　　　 ONE SHOT
　　　　　　 (Normal)

### Non-contact Output Type Available

The **VF2** series which incorporates a dual circuit transistor output (NPN and PNP) is also available in the same sensor body. It is suited for fast switching sensing, or applications requiring a fast response.

• Output: NPN universal transistor
　　　　　PNP open-collector transistor
• Power supply: 12 to 24V DC ± 10%

Please refer to P.798, and contact our office for further details.

## APPLICATIONS

### Car positioning at parking garage

**VF-M10**
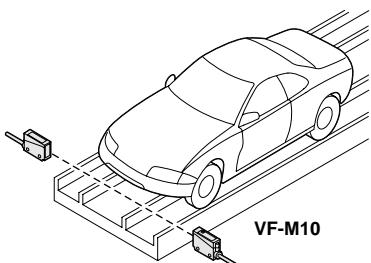
### Sensing traveling objects

**VF-PRM3**
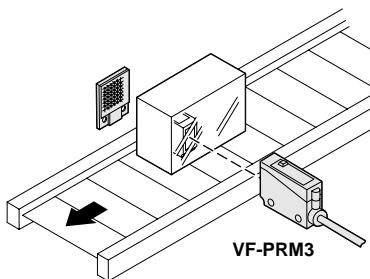
### Sensing coil wire end

The wire is wound once round a pole having a fin. The sensor detects the rotating fin. By using the OFF-delay timer, an OFF signal can be generated when the wire ends.

**VF-D500T**
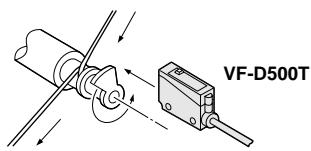
## ORDER GUIDE

| Type | Appearance | Sensing range | Model No. | Timer function | Supply voltage | Output |
|---|---|---|---|---|---|---|
| Thru-beam | | 10m | **VF-M10** | ——— | 24 to 240V AC ± 10% or 12 to 240V DC ± 10% (Note 2) | Relay contact 1a (Note 2) |
| | | | **VF-M10T** | Incorporated | | |
| Retroreflective | | 0.1 to 5m (Note 1) | **VF-RM5** | ——— | | |
| | | | **VF-RM5T** | Incorporated | | |
| With polarizing filters | | 0.2 to 3m (Note 1) | **VF-PRM3** | ——— | | |
| Diffuse reflective | | 500mm | **VF-D500** | ——— | | |
| | | | **VF-D500T** | Incorporated | | |
| Long sensing range | | 1m | **VF-D1000** | ——— | | |
| | | | **VF-D1000T** | Incorporated | | |

Notes: 1) The sensing range for the retroreflective type sensor is specified for the **RF-230** reflector. Further, the sensing range is the possible setting range for the reflector. The sensor can detect an object less than 0.1m (**VF-PRM3**: 0.2m) away.
   2) Non-contact output type [NPN universal transistor/PNP open-collector transistor (two outputs), supply voltage 12 to 24V DC] is available. (Four types: **VF2-M10**, **VF2-RM5**, **VF2-PRM3**, **VF2-D500**)
   Refer to P.798.

Reflector cannot be placed in this range

Actual sensing range of the sensor 0.1m (**VF-PRM3**: 0.2m)

Setting range of the reflector

5m (**VF-PRM3**: 3m)

Sensor    Reflector    Reflector
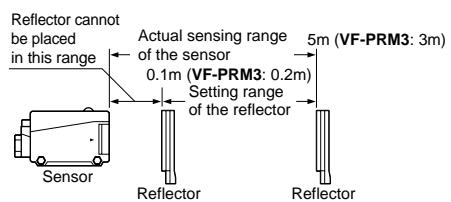
## OPTIONS

| Designation | Model No. | Description | | |
|---|---|---|---|---|
| Slit mask (For thru-beam type sensor only) | **OS-VF-3 ✕ 6** (Slit size 3 ✕ 6mm) | Slit on one side | • Sensing range: 2m • Min. sensing object: φ20mm | |
| | | Slit on both sides | • Sensing range: 1m • Min. sensing object: 3 ✕ 6mm | |
| | **OS-VF-6 ✕ 12** (Slit size 6 ✕ 12mm) | Slit on one side | • Sensing range: 4m • Min. sensing object: φ20mm | |
| | | Slit on both sides | • Sensing range: 3m • Min. sensing object: 6 ✕ 12mm | |
| Reflector (For retroreflective type sensor only) | **RF-220** | • Sensing range: 0.1 to 4m (**VF-RM5□**)   0.2 to 2m (**VF-PRM3**) • Sensing object: φ35mm, or more, opaque object | | |
| Reflector mounting bracket | **MS-RF22** | For **RF-220** | | |
| | **MS-RF23** | For **RF-230** | | |
| Sensor checker (Note) | **CHX-SC2** | It is useful for beam alignment of thru-beam type sensors. The optimum receiver position is given by indicators, as well as, an audio signal. | | |

Note: Refer to P.378〜 for details on the sensor checker **CHX-SC2**.

**Slit mask**
Fitted on the front face of the sensor with one-touch.
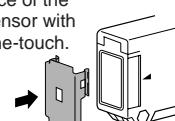
**Reflector**
35.3mm    8.3mm
42.3mm
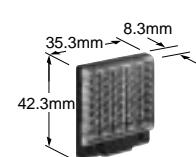
**Reflector mounting bracket**
• **MS-RF23**
Two M4 (length 10mm) screws with washers are attached.
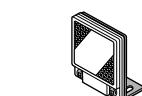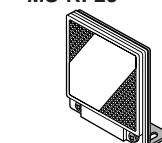
• **MS-RF22**
Two M3 (length 8mm) screws with washers are attached.

**Sensor checker**
Sensor checker

Sensor Mounting Stand MS-AJ
Micro PM
PM2
Multi-voltage Type NX5
VF
Amplifier-separated Type SU-7/SH
SS-A5
Sensor Checker CHX-SC2

PHOTOELECTRIC SENSORS

MS-AJ Sensor Mounting Stand

PM Micro

PM2

NX5

VF Multi-voltage Type

SU-7/SH Amplifier-separated Type

SS-A5

CHX-SC2 Sensor Checker

# VF

## SPECIFICATIONS

| | Type | Thru-beam | | Retroreflective | | | Diffuse reflective | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | With timer | | With timer | With polarizing filters | | With timer | | With timer |
| Item | Model No. | VF-M10 | VF-M10T | VF-RM5 | VF-RM5T | VF-PRM3 | VF-D500 | VF-D500T | VF-D1000 | VF-D1000T |
| Sensing range | | 10m | | 0.1 to 5m (Note 1) | | 0.2 to 3m (Note 1) | 500mm (Note 2) | | 1m (Note 2) | |
| Sensing object | | $\phi$20mm or more opaque object (Note 3) | | $\phi$50mm or more opaque or translucent object (Note 1) | | $\phi$50mm or more opaque, translucent or specular object (Note 1) | Opaque, translucent or transparent object | | | |
| Hysteresis | | | | | | | 15% or less of operation distance | | | |
| Supply voltage | | 24 to 240V AC $\pm$ 10% or 12 to 240V DC $\pm$ 10% | | | | | | | | |
| Power consumption | | Emitter: 3VA or less (Average: 1.5W or less) Receiver: 3VA or less (Average: 1.5W or less) | | 3VA or less (Average: 1.5W or less) | | | | | | |
| Output | | Relay contact 1a • Switching capacity: 250V 1A AC (resistive load) 30V 2A DC (resistive load) • Electrical life: 100,000 or more operations (at rated AC load) 500,000 or more operations (at rated DC load) • Mechanical life: 100,000,000 or more operations | | | | | | | | |
| | Utilization category | DC-12 or DC-13 | | | | | | | | |
| | Output operation | Switchable either Light-ON or Dark-ON | | | | | | | | |
| Response time | | 20ms or less | | | | | | | | |
| Operation indicator | | Red LED (lights up when the output is ON) | | | | | | | | |
| Sensitivity adjuster | | | | | | | Continuously variable adjuster | | | |
| Timer function (0.1 to 5 sec. variable) | | — | Selectable from ON-delay, OFF-delay & ONE SHOT | — | Selectable from ON-delay, OFF-delay & ONE SHOT | — | — | Selectable from ON-delay, OFF-delay & ONE SHOT | — | Selectable from ON-delay, OFF-delay & ONE SHOT |
| Environmental resistance | Pollution degree | 3 (Industrial environment) | | | | | | | | |
| | Protection | IP66 (IEC) | | | | | | | | |
| | Ambient temperature | $-$10 to $+$60°C (No dew condensation or icing allowed), Storage: $-$20 to $+$70°C | | | | | | | | |
| | Ambient humidity | 35 to 85% RH, Storage: 35 to 85% RH | | | | | | | | |
| | Ambient illuminance | Sunlight: 11,000 $\ell$x at the light-receiving face, Incandescent light: 3,500 $\ell$x at the light-receiving face | | | | | | | | |
| | EMC | Emission: EN50081-2, Immunity: EN50082-2 | | | | | | | | |
| | Voltage withstandability | 1,500V AC for one min. between the power supply and output terminals, 1,000V AC for one min. between the relay contact terminals | | | | | | | | |
| | Insulation resistance | 20M$\Omega$, or more, with 500V DC megger between the power supply and output terminals, and between the relay contact terminals | | | | | | | | |
| | Vibration resistance | 10 to 55Hz frequency, 1.5mm amplitude in X, Y and Z directions for two hours each | | | | | | | | |
| | Shock resistance | 100m/s$^2$ acceleration (10G approx.) in X, Y and Z directions for three times each | | | | | | | | |
| Emitting element | | Infrared LED (modulated) | | | | Red LED (modulated) | Infrared LED (modulated) | | | |
| Material | | Enclosure: PBT, Lens: Acrylic (front surface of **VF-PRM3**: Triacetate) | | | | | | | | |
| Connection method | | Screw-on terminal connection | | | | | | | | |
| Cable | | Suitable for round cable $\phi$6 to $\phi$10mm (Conductor cross section area: 0.25 to 0.75mm$^2$) | | | | | | | | |
| Cable length | | Total length up to 100m is possible with 0.3mm$^2$, or more, cabtyre cable (thru-beam type: both emitter and receiver). | | | | | | | | |
| Weight | | Emitter: 75g approx. Receiver: 95g approx. | | 95g approx. | | | | | | |
| Accessories | | **MS-N70** (Sensor mounting bracket): 1 set, Gland and gland washer: 1 set, Gland packing (large/small 1 No. each): 1 set **VF-SKG** (Short-circuit metal joint): 1 No., **RF-230** (Reflector): 1 No. for the retroreflective type sensor Adjusting screwdriver: 1 No. for the diffuse reflective type sensor and for sensors with timer functions (suffixed with '**T**') (2 sets of sensor mounting bracket, gland, gland washer and gland packing are attached for the thru-beam type sensors.) | | | | | | | | |

Notes: 1) The sensing range and the sensing object for the retroreflective type sensor are specified for the **RF-230** reflector. Further, the sensing range is the possible setting range for the reflector. The sensor can detect an object less than 0.1m (**VF-PRM3**: 0.2m) away.

2) The sensing range of the diffuse reflective type sensor is specified for white non-glossy paper (200 $\times$ 200mm) as the object.
3) If slit masks (optional) are fitted, even an object of 3 $\times$ 6mm can be detected.

Reflector cannot be placed in this range
Actual sensing range of the sensor
5m (**VF-PRM3**: 3m)
0.1m (**VF-PRM3**: 0.2m)
Setting range of the reflector
Sensor
Reflector
Reflector

SUNX

## I/O CIRCUIT DIAGRAM
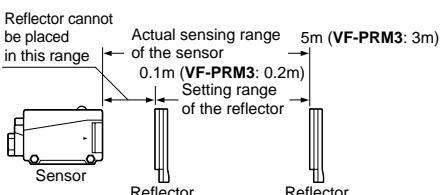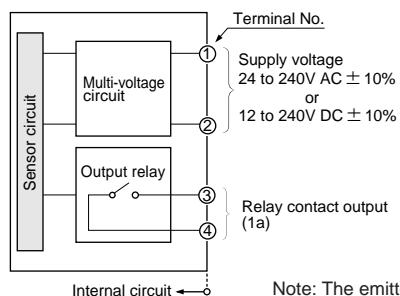
```
                    Terminal No.
                    ①  Supply voltage
                       24 to 240V AC ± 10%
                            or
                    ②     12 to 240V DC ± 10%

                    ③  Relay contact output
                    ④     (1a)

Internal circuit ←  Note: The emitter of the thru-beam type sensor has only two terminals for power supply (① and ②).
```

Sensor circuit | Multi-voltage circuit | Output relay

## SENSING CHARACTERISTICS (TYPICAL)

### All models

**Correlation between setting distance and excess gain**



VF-M10
VF-RM5
Excess gain vs Setting distance L (m) — 0 to 25

VF-PRM3
VF-D1000
Excess gain vs Setting distance L (m) — 0 to 5

VF-D500
Excess gain vs Setting distance L (mm) — 0 to 1,000
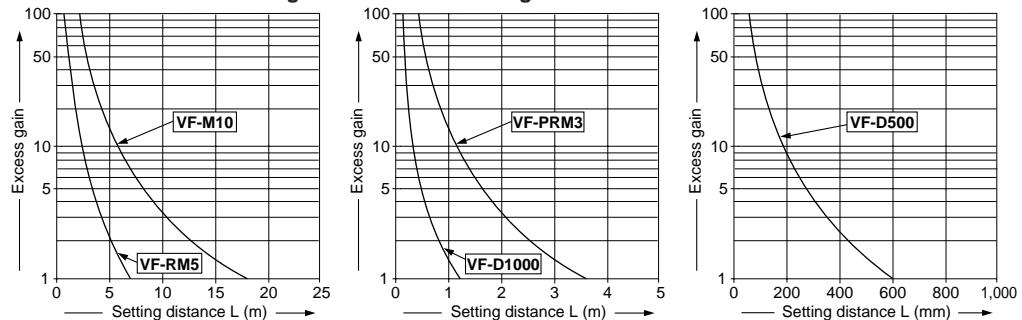
### VF-M10 / VF-M10T    Thru-beam type

**Parallel deviation**



Emitter / Receiver
$\ell$, L
Setting distance L (m)
Operating point $\ell$ (mm) — Left ← Center → Right, 400 200 0 200 400

**Angular deviation**



Emitter / Receiver
$\theta$, L
Setting distance L (m)
Operating angle $\theta$ (°) — Left ← Center → Right, 40 20 0 20 40

**Parallel deviation with slit masks (OS-VF-6 × 12)**



Slit on one side
Slit on both sides
Emitter / Receiver
$\ell$, L
Setting distance L (m)
Operating point $\ell$ (mm) — Left ← Center → Right, 400 200 0 200 400

**Angular deviation with slit masks (OS-VF-6 × 12)**



Slit on one side
Slit on both sides
Emitter / Receiver
$\theta$, L
Setting distance L (m)
Operating angle $\theta$ (°) — Left ← Center → Right, 40 20 0 20 40

**Parallel deviation with slit masks (OS-VF-3 × 6)**



Slit-on one side
Slit on both sides
Emitter / Receiver
$\ell$, L
Setting distance L (m)
Operating point $\ell$ (mm) — Left ← Center → Right, 400 200 0 200 400

**Angular deviation with slit masks (OS-VF-3 × 6)**



Slit-on one side
Slit-on both sides
Emitter / Receiver
$\theta$, L
Setting distance L (m)
Operating angle $\theta$ (°) — Left ← Center → Right, 40 20 0 20 40

Sensor Mounting Stand MS-AJ
Micro PM
PM2
Multi-voltage Type NX5
VF
Amplifier-separated Type SU-7/SH
SS-A5
Sensor Checker CHX-SC2

# VF

## SENSING CHARACTERISTICS (TYPICAL)

### VF-RM5 / VF-RM5T — Retroreflective type

**Parallel deviation**
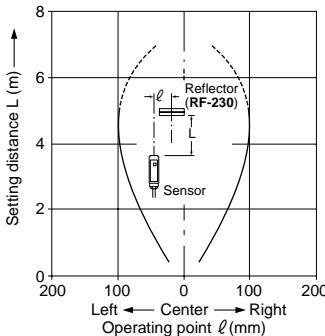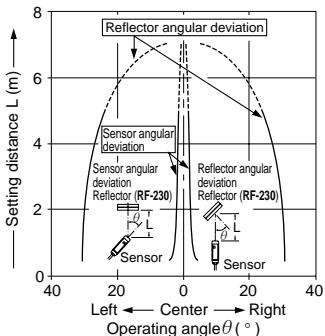


**Angular deviation**



### VF-PRM3 — Retroreflective type

**Parallel deviation**
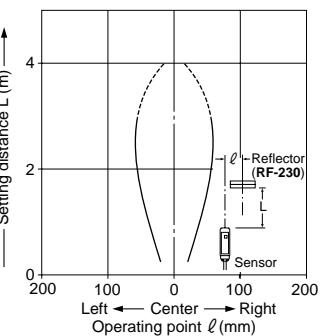


**Angular deviation**
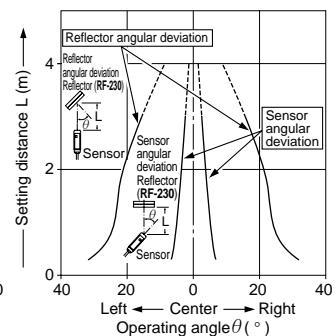


### VF-D500 / VF-D500T — Diffuse reflective type
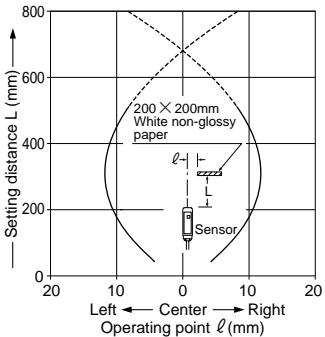
**Sensing field**



### VF-D1000 / VF-D1000T — Diffuse reflective type

**Sensing field**
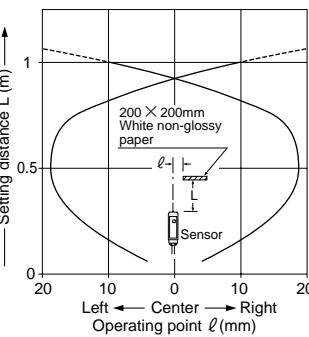


## PRECAUTIONS FOR PROPER USE

⚠ This product is not a safety sensor. Its use is not intended or designed to protect life and prevent body injury or property damage from dangerous parts of machinery. It is a normal object detection sensor.

### Mounting

• The tightening torque should be 0.78N·m or less.



Sensor mounting bracket **MS-N70** (Accessory)
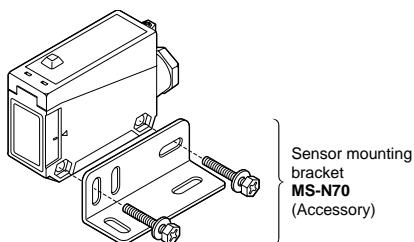
### Wiring

• Cable must be circular and φ6 to φ10mm in diameter. If the cable has a diameter other than the specified or is distorted, waterproofness cannot be maintained.

• Prepare the cable end as shown below.



Cable
Outer dia.: φ6 to φ10mm
Conductor cross section area: 0.25 to 0.75mm²

Gland
Gland washer

Gland packing (2 Nos. enclosed)
Small hole: For φ6 to φ8mm cable
Large hole: For φ8 to φ10mm cable

### Terminal position



Terminal No.

① ② ③ ④
Power supply = Output
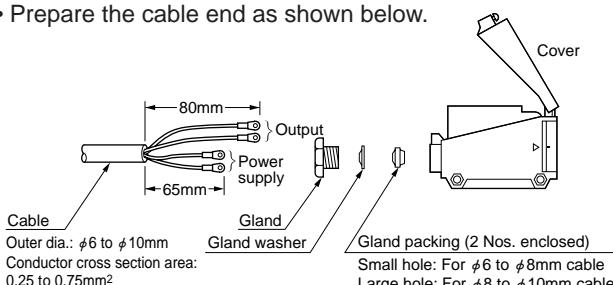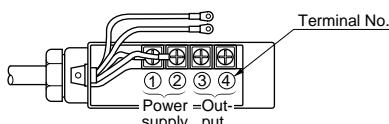
### Dimensions of the suitable crimp terminals

(Unit: mm)

| Round type | Y-shaped type |
|---|---|
| φ3.6 or more, 10 or less, 7 or less, 19 or less (After crimping) | 3.6 or more, 10 or less, 7 or less, 19 or less (After crimping) |

Note: Use crimp terminals with insulating sleeves.
Recommended crimp terminal: Nominal size 1.25 × 3.5

---

MS-AJ — Sensor Mounting Stand
PM — Micro
PM2
NX5 — Multi-voltage Type
VF
SU-7/SH — Amplifier-separated Type
SS-A5
CHX-SC2 — Sensor Checker

SUNX

## PRECAUTIONS FOR PROPER USE

### Mounting the short-circuit metal joint (VF-SKG)

• If the sensor and the load are supplied power from the same power supply, the number of wires can be reduced by one by using the enclosed short-circuit metal joint.

#### Connection example



Terminal No.

Multi-voltage circuit

Sensor circuit

Power supply

Output relay

Short-circuited by **VF-SKG**

Load
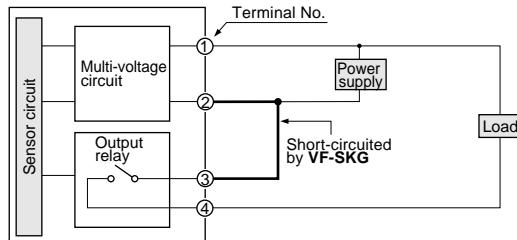
#### Mounting

• Loosen the screws on terminals ② and ③.
Mount the short-circuit metal joint **VF-SKG** on the terminals as shown on the right.

Short-circuit metal joint
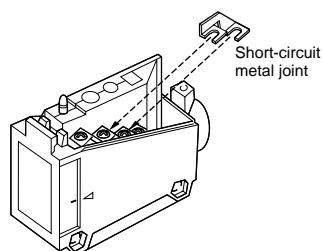
### Retroreflective type sensor (VF-RM5 and VF-RM5T)

• Please take care of the following points when detecting materials having a gloss.

① Make L, shown in the diagram, sufficiently long.
② Install at an angle of 10 to 30 degrees to the sensing object.

※ **VF-PRM3** does not need the above adjustment.

Make L sufficiently long

Sensing object

Reflector

10° to 30°
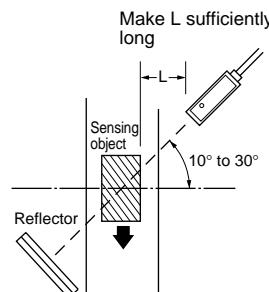
### Retroreflective type sensor with polarizing filters (VF-PRM3)

• If a shiny object is covered or wrapped with a transparent film, such as those described below, the retroreflective type sensor with polarizing filters may not be able to detect it.
In that case, follow the steps given below.

#### Example of sensing objects

• Can wrapped by clear film
• Aluminum sheet covered by plastic film
• Gold or silver color (glossy) label or wrapping paper

#### Steps

• Tilt the sensor with respect to the sensing object while fitting.
• Reduce the sensitivity.
• Increase the distance between the sensor and the sensing object.

### Timer functions and output operation

• The timer incorporated models have three types of convenient timer functions.

#### ON-delay (OND)

<Function>: Neglects short output signals.

<Application>: As only long signals are extracted, this function is useful for detecting if a line is clogged, or for sensing only objects taking a long time to travel.

#### OFF-delay (OFD)

<Function>: Extends the output signal for a fixed period of time.

<Application>: This function is useful if the output signal is so short that the connected device cannot respond.

#### ONE SHOT (OSD)

<Function>: Outputs a fixed width signal upon sensing.

<Application>: This function is useful when the input specifications of the connected device require a signal of fixed width. Of course, it is also useful for extending a short width signal to a desired width.

Various other applications are possible.

#### Selection switch and timer operation
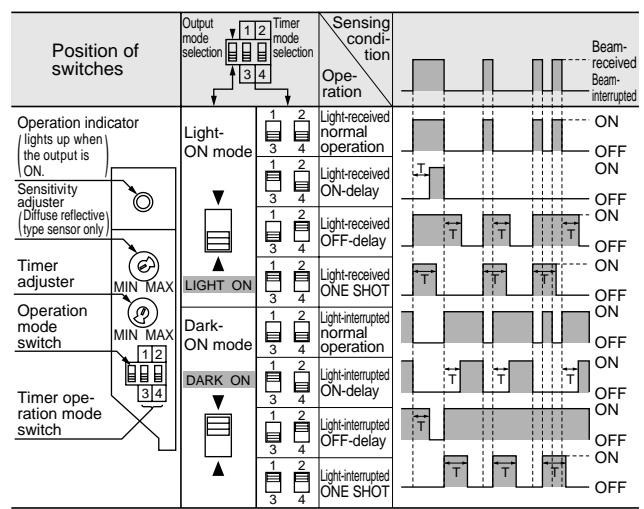


Timer period: T = 0.1 to 5 sec. (variable)

### Others

• Do not use during the initial transient time (200ms) after the power supply is switched on.

Sensor Mounting Stand MS-AJ

Micro PM

PM2

Multi-voltage Type NX5

VF

Amplifier-separated Type SU-7/SH

SS-A5

Sensor Checker CHX-SC2

PHOTOELECTRIC SENSORS

MS-AJ | Sensor Mounting Stand
PM | Micro
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CHX-SC2 | Sensor Checker

# VF

## DIMENSIONS (Unit: mm)

### VF-M10☐ VF-RM5☐ VF-D500☐ VF-D1000☐ — Sensor

Operation indicator (Red) (Note 1)
Sensitivity adjuster (Note 2)
Timer adjuster (Note 3)
Timer operation mode switch (Note 3)

Operation mode switch (Note 1)
Terminals

26
9
Center of sensing
26

(3) 20
75
11
4.5
Conduit PF1/2
55
φ25
21
6
10
55
2-M5 nut seats (on both sides)
2-φ5.3 thru-holes (for mounting)
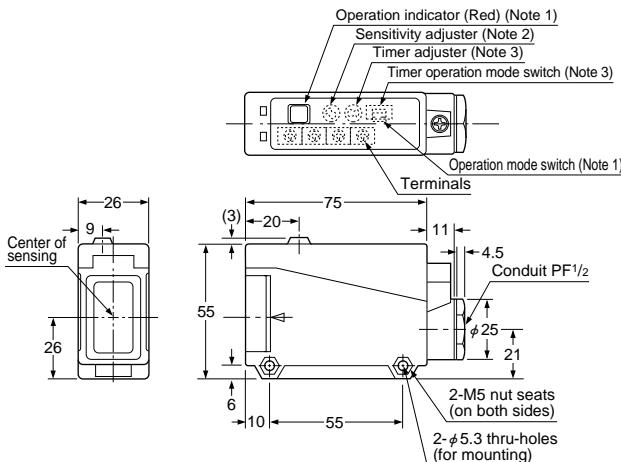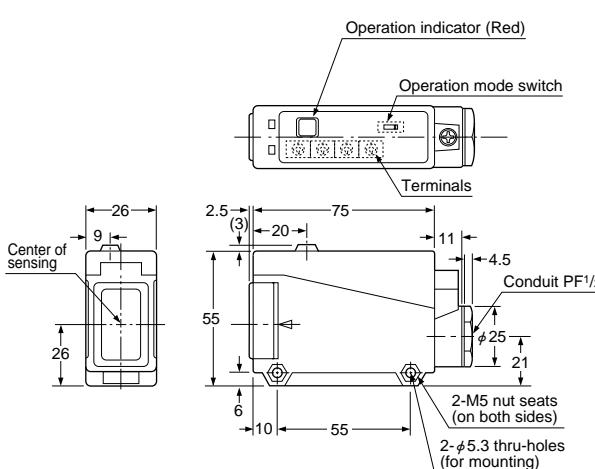
Notes: 1) All units, except emitters, are incorporated with operation indicators.
2) Only the diffuse reflective type sensor is incorporated with the sensitivity adjuster.
3) Only the timer incorporated type sensors have the timer adjuster.

### VF-PRM3 — Sensor

Operation indicator (Red)

Operation mode switch

Terminals

26
9
Center of sensing
26

2.5
(3) 20
75
11
4.5
Conduit PF1/2
55
φ25
21
6
10
55
2-M5 nut seats (on both sides)
2-φ5.3 thru-holes (for mounting)

### RF-230 — Reflector (Accessory for the retroreflective type sensor)

50.3
49.3
59.3
(30)
10
5
40
2-φ4.6 mounting holes
3.3
8.3
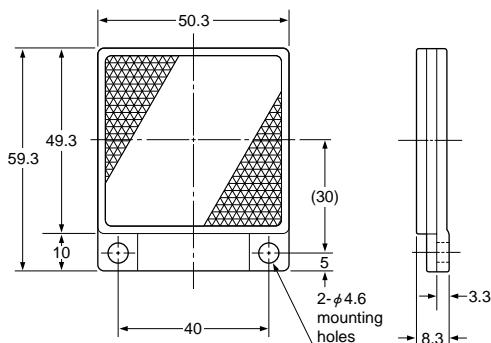
Material: Acrylic (Reflector)
ABS (Base)

### RF-220 — Reflector (Optional)

35.3
34.3
42.3
(21)
8
4
25
2-φ3.6 mounting holes
3.3
8.3
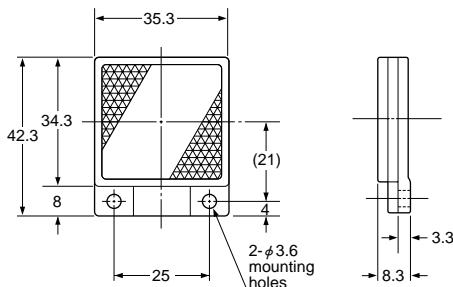
Material: Acrylic (Reflector)
ABS (Base)

### MS-N70 — Sensor mounting bracket (Accessory)

70
55
7.5
6 6
16
10
6
28
13 29 13
t 2
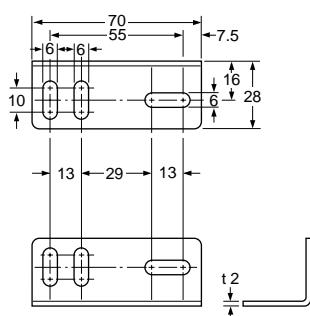
Material: Cold rolled carbon steel (SPCC)
(Uni-chrome plated)
Two M5 cross-recessed hexagon bolts
(with spring washers and plain washers)
and two M5 nuts are attached.

### Assembly dimensions
Mounting drawing with VF-PRM3

54 29
10
2.5 10 13 29 13

(68)
65
36
31

SUNX
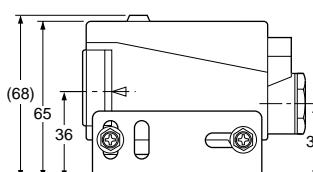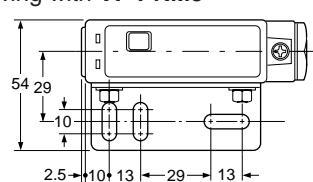
# DIMENSIONS (Unit: mm)

**MS-RF22**  Reflector mounting bracket for **RF-220** (Optional)

**Assembly dimensions**
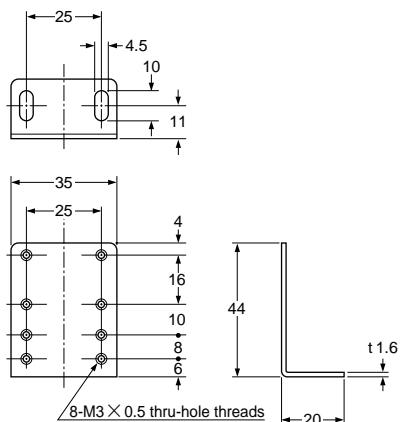
Matelial: Cold rolled carbon steel (SPCC)
(Uni-chrome plated)
Two M3 (length 8mm) screws with washers are attached.

8-M3 × 0.5 thru-hole threads
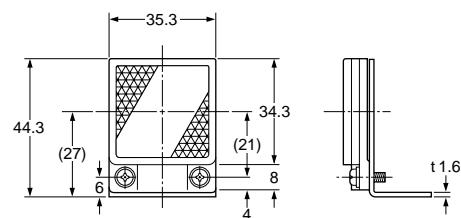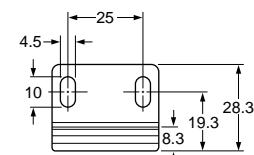
**MS-RF23**  Reflector mounting bracket for **RF-230** (Optional)

**Assembly dimensions**
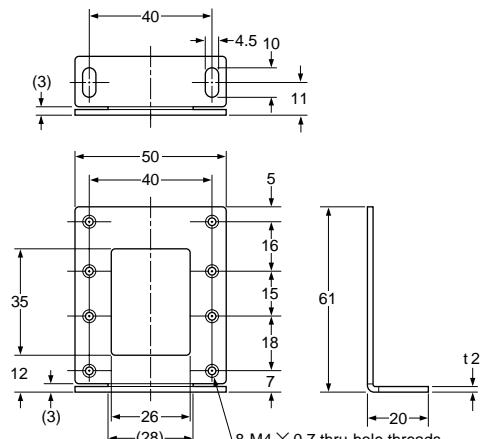
Matelial: Cold rolled carbon steel (SPCC)
(Uni-chrome plated)
Two M3 (length 10mm) screws with washers are attached.

8-M4 × 0.7 thru-hole threads