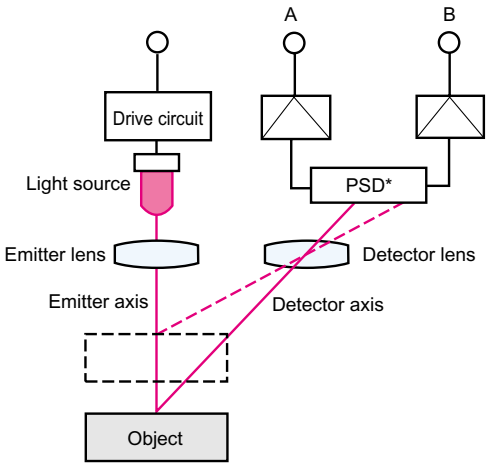
Principle of measurement of the optical displacement sensor

Light from the light source is condensed by the lens and directed onto the object.
Light reflected from the object is condensed onto a one-dimensional position sensing device (PSD)* by the receiving lens. If the position of the object (the distance to the measuring device) changes, the image formation positions on the PSD will differ, and if the balance of the two PSD outputs changes, the image formation positions on the PSD will differ and the balance of the two PSD outputs changes.
If the two outputs are A and B, calculate A/(A + B) and use appropriate values for the span coefficient "k" and the offset "C".

$$\text{Displacements} = \frac{A}{(A + B)} \cdot k + C$$

can be obtained.
The value measured is not the illuminance (brightness), but the two output displacements A and B, and thus even if the received light intensity changes because the distance to the object changes, the result is not affected and linear output proportional to the distance difference and position shift is obtained.

Optical system of the Displacement Sensor



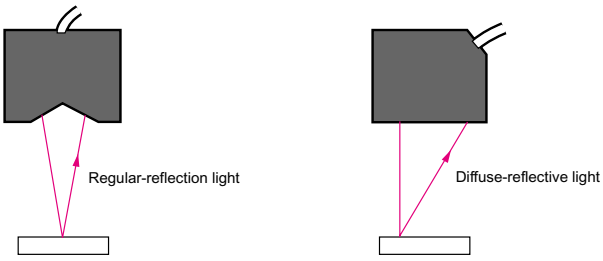
* PSD:Position Sensitive Device

Regular reflection model

Light from the object is directly received by regular reflection, and stable measurement is possible of metal and other objects with a glossy surface.

Diffuse reflection model

A light beam is projected perpendicularly onto the surface of the object, and the diffuse light that is reflected back is received for a wide measurement area.



In this way, the optical displacement sensor measures the distance to the object by the triangulation method.

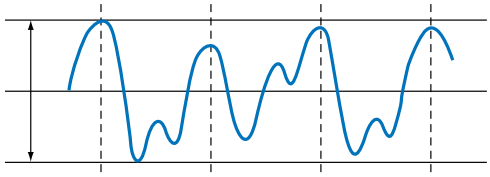
Explanation of terms

This page explains terminology for optical linear sensors.

For terminology of sensors based on other methods and principles, see the terminology page of the appropriate product.

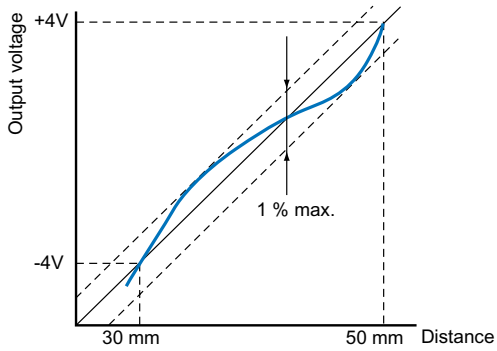
Resolution

This is the width, expressed in terms of the distance, of the fluctuation in the linear output when the measured object is still.



Linearity

Error with respect to ideal straight line of linear output
Normally the percentage of the measurement range (full scale: FS), expressed in the format "1%".

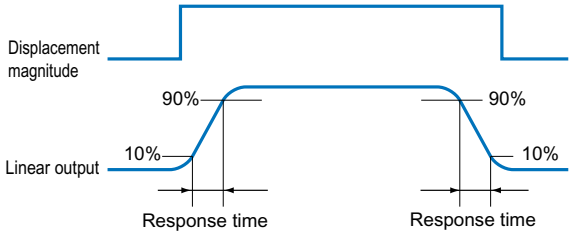


Temperature drift

The amount of variation of linear output with respect to changes in the ambient temperature.
Normally the percentage of the measurement range (full scale: FS), expressed in the format □%FS/°C.
Example: 0.03%FS/°C (FS = 20 mm)

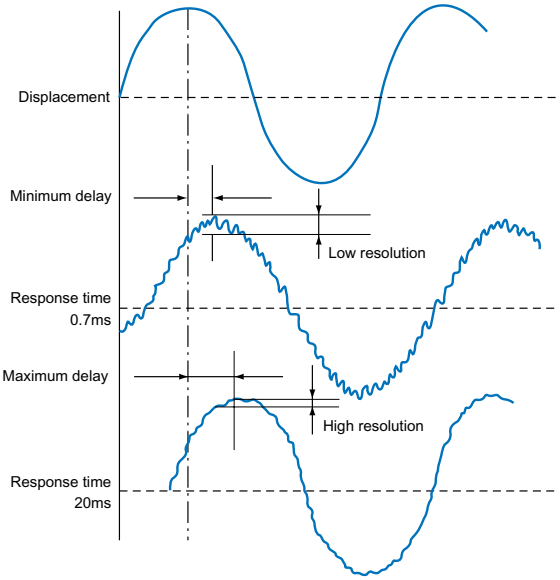
Response time

Linear output when the displacement and width of the object are changed to steps.
In analog output, the time required for 10% to 90% change is expressed in terms of the "response time".



Response time and resolution

In general the displacement, response time, and resolution are correlated as shown in the following diagram.



- When you wish to precisely measure displacement, select a slower response time setting. (This reduces responsiveness.)
- When you need a fast response, select a faster response time setting. (This reduces the resolution.)

General notes

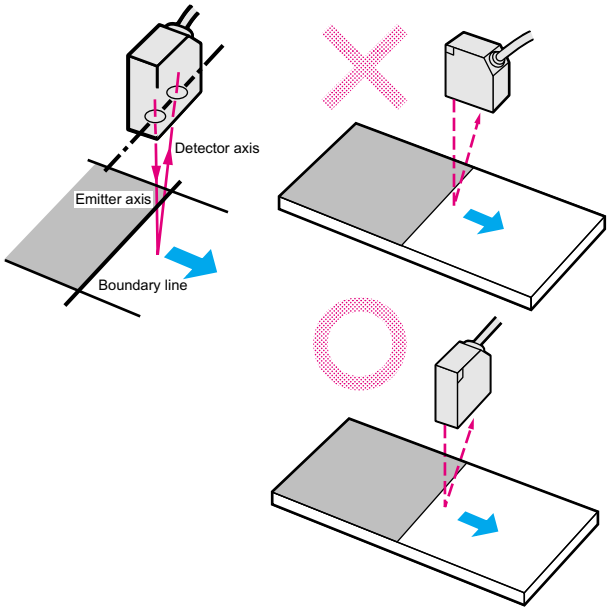
★ For notes for each product, see "Precautions" of each product.

Correct Use

● Mounting

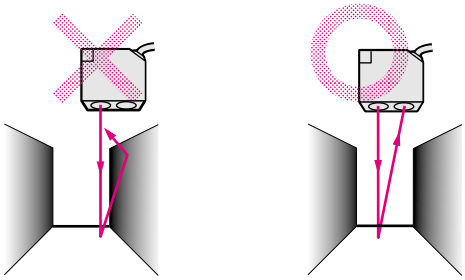
Displacement measurement of objects with differing materials and color.

If the material or color of objects is noticeably different, measurement error can be reduced by mounting the sensor so that the line joining the light projection axis and the light reception axis is parallel to the boundary line of the objects, as shown in the diagram below.



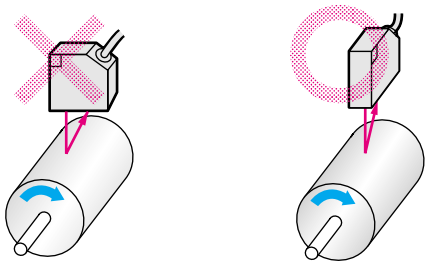
Measuring displacement in narrow grooves and depressions

If the object to be measured is in a depression or groove with wall-like sides, mount the sensor as shown in the diagram below so that the light projection axis and the light reception axis are not obstructed by the wall-like sides.



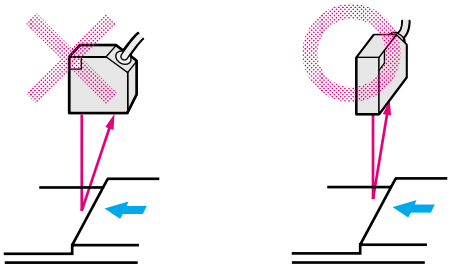
Displacement measurement of rotating objects

To measure rotating objects, the effects of vertical variations and positional variations can be minimized by mounting the sensor so that the line joining the light projection axis and the light reception axis is parallel to the axis of rotation.



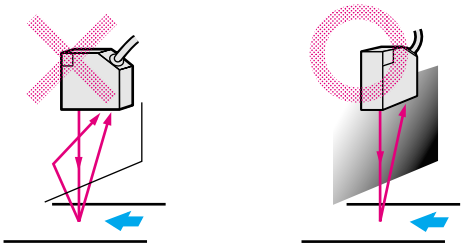
Displacement measurement of objects with a step-like level difference

If the object to be measured has a step-like level difference, the effects of the step edge can be minimized by mounting the sensor so that the line joining the light projection axis and the light reception axis is parallel to the step edge.



Sensor head and peripheral walls

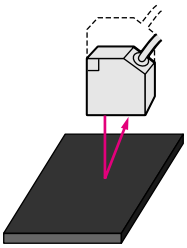
Light reflected from a wall will cause error. If the sensor must be mounted near a wall, mount the sensor so that the line joining the light projection axis and the light reception axis is parallel to the wall, as shown in the diagram below. Painting the wall a dull black will also help reduce reflection.



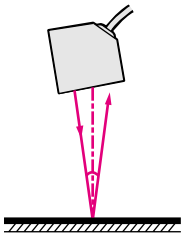
If the object is black

If the object is black, there will be little light reflection, the value from the PSD will decrease, and the resolution will decrease. The following mounting method is effective in increasing the absolute value of light reflected from the object.

- Move head closer: Move the sensor head as close as possible within the range of the measurement distance to increase the projected and reflected light.



- Receive light at the angle of regular reflection: Incline the sensor head when mounting so that the light reception axis is the same as the axis of regular reflecton with respect to the light projection axis.



● Wiring Considerations

About wiring

- Do not use a current in excess of the rated current. This will damage the product.
- Do not reverse the power supply connection or connect to an AC current.
- Do not short-circuit the load of an open collector output.
- Wire this product separately from high-voltage wires and power lines. If wired together or in the same conduit, induction may cause incorrect operation and damage.
- If a commercial switching regulator is used, ground the FG (frame ground) terminal.

● Operating Environment

Operating Environment

- Avoid use in locations where there is strong external stray light (laser light, arc welding light, etc.) or strong electromagnetic waves.
- Do not use for non-applicable materials (liquids, etc.), or for shape measurement.

Ambient Conditions

Do not install in the following locations.

- Locations subject to strong vibration.
- In locations exposed to direct sunlight or near heating equipment.
- Locations with high humidity.
- Locations where dust or metal powder will accumulate on the sensor.
- Locations where there are corrosive or combustible gas vapors.
- Locations where organic solvents, water, or oil will splash on the product.
- Locations subject to strong magnetic or electric fields.
- Locations subject to sudden temperature changes.
- Cold locations subject to icing.

● Maintenance and Inspection

- Be sure to turn the power off before adjusting or removing the sensor unit.
- Observe the following precautions when cleaning the optical filter on the sensor unit.
  - ① Use a blower brush (for camera lenses) to blow away large debris and dust. Avoid blowing with your own breath.
  - ② Carefully remove small debris and dust with a soft cloth (lens cleaner, etc.) that has been moistened with a small amount of alcohol. Do not wipe hard. Scratches or other lens damage will prevent the sensor from measuring correctly.
  - ③ Never use thinner or other solvents. Solvents will damage the optical properties of the filter.