Advanced Functions Photoelectric Sensors with Self-contained Amplifier CE

HPA Series

Strobe light emission, high margin regulation, incoming light display on the front, and output suppression functions allow sensing range to be quickly and reliably adjusted.

- **Strobe light emission permits easy confirmation of the sensing range** (advanced function thru scan and polarized retroreflective models)
- **The high margin regulation function permits adjustment of the sensing range at a margin three times greater than usual** (advanced function thru scan and polarized retroreflective models)
- **The front incoming light display facilitates adjustment of the sensing range** (thru scan)
- **The output suppression function permits secure adjustment of the sensing range while debugging the PLC** (advanced function thru scan and polarized retroreflective models)
- **An automatic pulse-phase shift system enhances mutual interference prevention** (polarized retroreflective and diffuse scan models)
- **Monoblock housing sealed to IP67**

A PHOTOELECTRIC SENSORS
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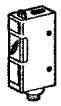
● **Preleaded type (2m cable)**

Model	Detection method		Scanning distance	Light-ON/dark-ON selectable	Sensitivity adjustment	Self-diagnostic indication	Self-diagnostic output	Triple alignment function*1	Front incoming light indication	Supply voltage	Output mode	Catalog listing
Horizontal	Thru scan	General use	10m	●	*2	●	—	—	●	10 to 30Vdc	NPN open collector	HPA-T11
							—	—			PNP open collector	HPA-T12
		Adv. function					●	●			NPN open collector	HPA-T13
							●	●			PNP open collector	HPA-T14
	Polarized retroreflective	General use	4m	●	●	●	—	—	—		NPN open collector	HPA-P11
							—	—			PNP open collector	HPA-P12
		Adv. function					●	●			NPN open collector	HPA-P13
							●	●			PNP open collector	HPA-P14
	Polarized retroreflective for transparent object detection		0.3 to 1m				—	—			NPN open collector	HPA-F11
	Diffuse scan		20cm	●	●	●	—	—	—		NPN open collector	HPA-D11
											PNP open collector	HPA-D12
			80cm								NPN open collector	HPA-A11
											PNP open collector	HPA-A12
Vertical	Thru scan	General use	10m	●	*2	●	—	—	●		NPN open collector	HPA-T21
							—	—			PNP open collector	HPA-T22
		Adv. function					●	●			NPN open collector	HPA-T23
							●	●			PNP open collector	HPA-T24
	Polarized retroreflective	General use	4m	●	●	●	—	—	—		NPN open collector	HPA-P21
							—	—			PNP open collector	HPA-P22
		Adv. function					●	●			NPN open collector	HPA-P23
							●	●			PNP open collector	HPA-P24
	Polarized retroreflective for transparent object detection		0.3 to 1m				—	—			NPN open collector	HPA-F21
	Diffuse scan		20cm	●	●	●	—	—	—		NPN open collector	HPA-D21
											PNP open collector	HPA-D22
			80cm								NPN open collector	HPA-A21
											PNP open collector	HPA-A22

*1. Triple alignment function for initial setup: stroboscopic light emission, high margin adjustment, output suppression.
*2. On advanced function models the emitter also has a variable adjustment potentiometer.

● Connector type

Model	Detection method		Scanning distance	Light-ON/dark-ON selectable	Sensitivity adjustment	Self-diagnostic indication	Self-diagnostic output	Triple alignment function*1	Front incoming light indication	Supply voltage	Output mode	Catalog listing
Horizontal 	Thru scan	General use	10m	●	*2 ●	●	—	—	●	10 to 30Vdc	NPN open collector	**HPA-T31**
							—	—			PNP open collector	**HPA-T32**
		Adv. function					●	●			NPN open collector	**HPA-T33**
							●	●			PNP open collector	**HPA-T34**
	Polarized retroreflective	General use	4m	●	●	●	—	—	—		NPN open collector	**HPA-P31**
							—	—			PNP open collector	**HPA-P32**
		Adv. function					●	●			NPN open collector	**HPA-P33**
							●	●			PNP open collector	**HPA-P34**
	Diffuse scan		20cm	●	●	●	—	—	—		NPN open collector	**HPA-D31**
											PNP open collector	**HPA-D32**
			80cm								NPN open collector	**HPA-A31**
											PNP open collector	**HPA-A32**
Vertical 	Thru scan	General use	10m	●	*2 ●	●	—	—	●		NPN open collector	**HPA-T41**
							—	—			PNP open collector	**HPA-T42**
		Adv. function					●	●			NPN open collector	**HPA-T43**
							●	●			PNP open collector	**HPA-T44**
	Polarized retroreflective	General use	4m	●	●	●	—	—	—		NPN open collector	**HPA-P41**
							—	—			PNP open collector	**HPA-P42**
		Adv. function					●	●			NPN open collector	**HPA-P43**
							●	●			PNP open collector	**HPA-P44**
	Diffuse scan		20cm	●	●	●	—	—	—		NPN open collector	**HPA-D41**
											PNP open collector	**HPA-D42**
			80cm								NPN open collector	**HPA-A41**
											PNP open collector	**HPA-A42**

*1. Triple alignment function for initial setup: stroboscopic light emission, high margin adjustment, output suppression.
*2. On advanced function models the emitter also has a variable adjustment potentiometer.

● Preleaded connector type (30cm lead)

Model	Detection method		Scanning distance	Light-ON/dark-ON selectable	Sensitivity adjustment	Self-diagnostic indication	Self-diagnostic output	Triple alignment function*1	Front incoming light indication	Supply voltage	Output mode	Catalog listing
Horizontal 	Thru scan	General use	10m	●	*2 ●	●	—	—	●	10 to 30Vdc	NPN open collector	**HPA-T51**
							—	—			PNP open collector	**HPA-T52**
		Adv. function					●	●			NPN open collector	**HPA-T53**
							●	●			PNP open collector	**HPA-T54**
	Polarized retroreflective	General use	4m	●	●	●	—	—	—		NPN open collector	**HPA-P51**
							—	—			PNP open collector	**HPA-P52**
		Adv. function					●	●			NPN open collector	**HPA-P53**
							●	●			PNP open collector	**HPA-P54**
	Diffuse scan		20cm	●	●	●	—	—	—		NPN open collector	**HPA-D51**
											PNP open collector	**HPA-D52**
			80cm								NPN open collector	**HPA-A51**
											PNP open collector	**HPA-A52**
Vertical 	Thru scan	General use	10m	●	*2 ●	●	—	—	●		NPN open collector	**HPA-T61**
							—	—			PNP open collector	**HPA-T62**
		Adv. function					●	●			NPN open collector	**HPA-T63**
							●	●			PNP open collector	**HPA-T64**
	Polarized retroreflective	General use	4m	●	●	●	—	—	—		NPN open collector	**HPA-P61**
							—	—			PNP open collector	**HPA-P62**
		Adv. function					●	●			NPN open collector	**HPA-P63**
							●	●			PNP open collector	**HPA-P64**
	Diffuse scan		20cm	●	●	●	—	—	—		NPN open collector	**HPA-D61**
											PNP open collector	**HPA-D62**
			80cm								NPN open collector	**HPA-A61**
											PNP open collector	**HPA-A62**

*1. Triple alignment function for initial setup: stroboscopic light emission, high margin adjustment, output suppression.
*2. On advanced function models the emitter also has a variable adjustment potentiometer.

SPECIFICATIONS

Detection method	Thru scan		Polarized retroreflective			Diffuse scan	
Model	General	Advanced function	General	Advanced function	Transparent object detection	Short distance	Long distance
Catalog listing	**HPA-T□1** **HPA-T□2**	**HPA-T□3** **HPA-T□4**	**HPA-P□1** **HPA-P□2**	**HPA-P□3** **HPA-P□4**	**HPA-F11** **HPA-F21**	**HPA-D□1** **HPA-D□2**	**HPA-A□1** **HPA-A□2**
Supply voltage	10 to 30Vdc (ripple not over 10%)						
Current consumption	50mA max.*1 Emitter 20mA max. Receiver 30mA max.		40mA max.*1				
Scanning distance	10m		4m (with **FE-RR8** reflector)		0.3 to 1m	20cm	80cm
Target object	Opaque object, 8mm dia. min.		Opaque object 80mm dia. min. (with **FE-RR8** reflector)			—	
Standard target object	—		—			10 x 10cm white paper*2	30 x 30cm white paper*2
Directional angle	2 to 20˚		Sensor body 1 to 5˚, reflector 40˚			—	
Differential travel	—					20%	
Operation mode	Light-operated/dark-operated, selectable by switch						
Output mode	NPN or PNP transistor open collector						
Control output	Switching current: 100mA max. (resistive load). Output dielectric strength: 30V max. Residual voltage: 1V max. (at 100mA switching current). Output short-circuit protection circuit						
Self-diagnostic output	No	Yes	No	Yes	No	No	No
	Switching current: 50mA max. (resistive load). Output dielectric strength: 30V max. Residual voltage: 1V max. (at 50mA switching current). Output short-circuit protection circuit						
Response time	0.5ms max. for both operation and reset		1ms max. for both operation and reset		0.5ms max. for both operation and reset		5ms max. for both operation and reset
Sensitivity adjustment	Potentiometer (2 revolutions) with indicator						
Light emitter	Red LED						Infrared LED
Indicator	Thru scan emitter: Power indicator (red while power is supplied); HPA-E13 has green SET mode indication Stability indication: Green during stable L.O. or D.O. operation, flashing during self-diagnostics Other indicators: Light-operated (L.O.) indicator (red).						
Ambient light immunity	Incandescent lamp: max. 5,000 lux. Sunlight: max. 20,000 lux.						
Operating ambient temp.	-25 to +60˚C*3						
Storage temperature	-40 to +70˚C						
Humidity range	35 to 85% RH (non-condensing)						
Insulation resistance	20MΩmin. (by 500Vdc megger)						
Dielectric strength	1,000Vac, 50/60Hz for 1min between case and electrically live metal						
Vibration	10 to 55Hz, 1.5mm peak-to-peak amplitude, 2 hours each in X, Y, and Z directions						
Shock	490m/s^2 repeated 10 times each in X, Y, and Z directions						
Protective structure	IP67 (IEC standard)						
Wiring type	Preleaded / preleaded connector / connector						
Weight	About 55g (body only), with 2m cable						
Other	Equipped with a power ON/OFF malfunction prevention circuit (about 100ms) and reverse connection protection circuit						

*1. During triple alignment current consumption increases about 30mA.
*2. Kodak 90% white paper is used.
*3. The triple alignment function should be used within a temperature range of 5 to 30˚C.

CATALOG LISTING

HPA-□□□

Ⅰ Ⅱ Ⅲ

Ⅰ Detection method:

T: Thru scan (E for emitter, R for receiver)

P: Polarized retroreflective

D: Short distance diffuse scan

A: Long distance diffuse scan

F: Polarized retroreflective

Ⅱ Body, wiring type:

1: Horizontal, preleaded

2: Vertical, preleaded

3: Horizontal, connector

4: Vertical, connector

5: Horizontal, preleaded connector

6: Vertical, preleaded connector

Ⅲ Output mode/function:

1: General purpose NPN transistor output

2: General purpose PNP transistor output

3: Advanced function NPN transistor output (with self-diagnostic and triple alignment functions)

4: Advanced function PNP transistor output (with self-diagnostic and triple alignment functions)

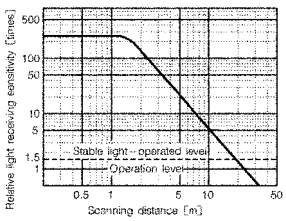
ACCESSORIES (sold separately)

Name	Appearance	Details	Catalog listing	Compatible models
Slit for thru scan model		One set of slits (2mm, 1mm, 0.5mm, 2mm dia., 1mm dia., and 0.5mm dia.) for emitter and receiver	**HPA-U01**	All thru scan models **HPA-T□□**
Mutual interference prevention filter for thru scan model		2 sets of filters (for emitter and receiver)	**HPA-U02**	All thru scan models **HPA-T□□**
Narrow view lens attachment		When lens is attached to the **HPA-D**, light focuses to a small spot 2mm in dia. at scanning distance of 30mm.	**HPA-U03**	All short distance diffuse scan models **HPA-D□□**
Small reflector for polarized retroreflective model		A small reflector used when mounting space for the reflector is tight. To be ordered separately from **HPA-P□□** and **HPA-F□□**.	**FE-RR15**	All polarized retroreflective models **HPA-P□□** **HPA-F□□**
Reflector for polarized retroreflective model		To be ordered separately from **HPA-P□□** and **HPA-F□□**.	**FE-RR8**	
Mounting bracket for vertical models		—	**HPA-B02**	All vertical models
Wraparound mounting bracket		—	**HPA-B03**	All models (cannot be used with a connector wiring type)

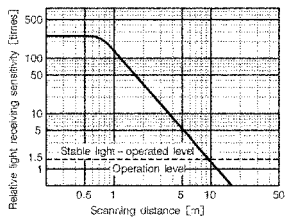
CHARACTERISTICS DIAGRAMS

● Excess gain (light received over required level) (typical)

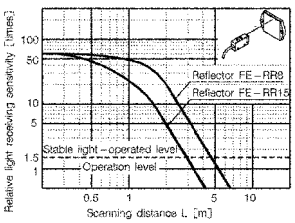
Thru scan model
HPA-T



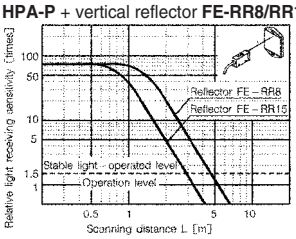
Thru scan model
HPA-T + mutual interference prevention filter **HPA-U02**



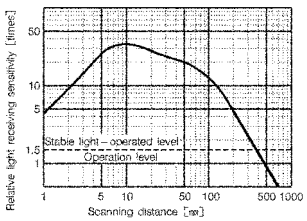
Polarized retroreflective model
HPA-P + horizontal reflector **FE-RR8/RR15**



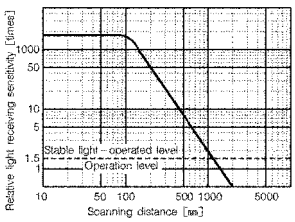
Polarized retroreflective model
HPA-P + vertical reflector **FE-RR8/RR15**



Short-distance diffuse scan model
HPA-D

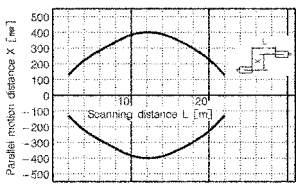


Long-distance diffuse scan model
HPA-A

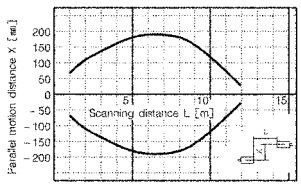


● PARALLEL DISPLACEMENT (typical)

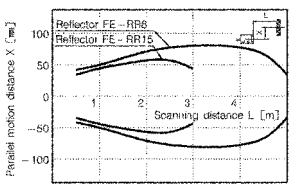
Thru scan model
HPA-T



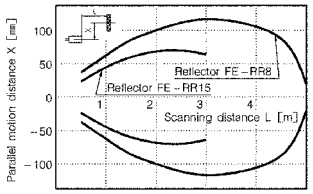
Thru scan model **HPA-T** + mutual interference prevention filter **HPA-U02** on receiver



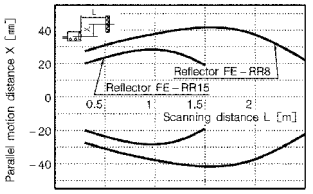
Polarized retroreflective model
HPA-P + reflector **FE-RR8/RR15** (vert. direction)



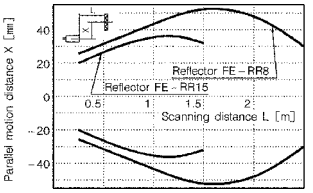
Polarized retroreflective model
HPA-P + reflector **FE-RR8/RR15** (horiz. direction)



Polarized retroreflective for transparent targets model
HPA-F + reflector **FE-RR8/RR15** (vert. direction)

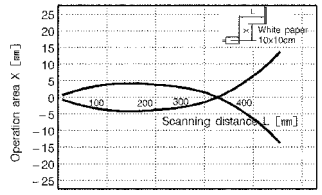


Polarized retroreflective for transparent targets model
HPA-F + small reflector **FE-RR15** (horiz. direction)

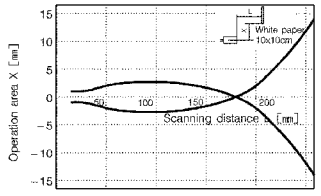


● DETECTION AREA CHARACTERISTICS (typical)

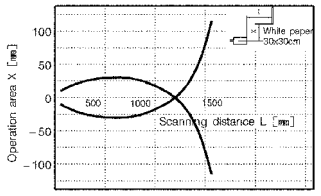
Short distance diffuse scan model
HPA-D



Short distance diffuse scan model
HPA-D + narrow view lens **HPA-U03**

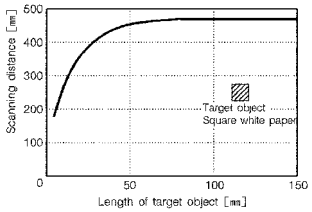


Long distance diffuse scan model
HPA-A

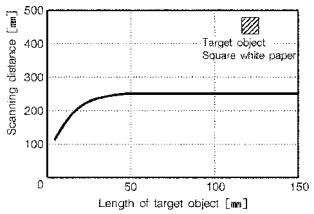


● TARGET OBJECT WIDTH VS. SCANNING DISTANCE (typical)

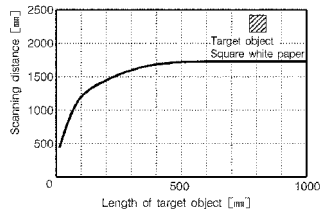
Short distance diffuse scan model
HPA-D



Short distance diffuse scan model
HPA-D + narrow view lens **HPA-U03**

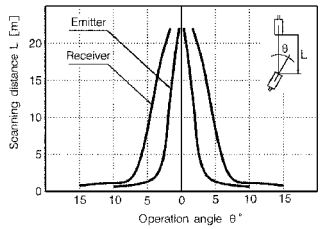


Long distance diffuse scan model
HPA-A

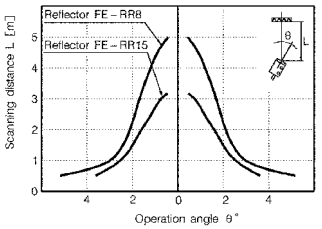


● ANGULAR CHARACTERISTICS (typical)

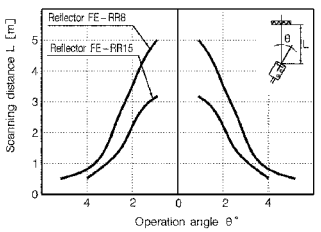
Thru scan model
HPA-T



Polarized retroreflective model
HPA-P + reflector **FE-RR8/RR15** (vert. direction)

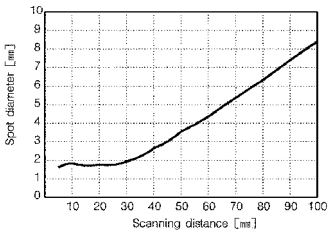


Polarized retroreflective model
HPA-P + reflector **FE-RR8/RR15** (horiz. direction)



● SCANNING DISTANCE VS. SPOT DIAMETER CHARACTERISTICS

Short distance diffuse scan model
HPA-D + narrow view lens **HPA-U03**



■ TYPICAL SCANNING DISTANCES WITH SLIT (relative to distances without slit)

Slit size	Slit used on emitter only	Slit used on receiver only	Slit used on emitter and receiver
2mm	46%	46%	18%
1mm	30%	32%	11%
0.5mm	16%	21%	3.6%
2mm dia.	15%	25%	3.6%
1mm dia.	4.8%	12%	0.6%

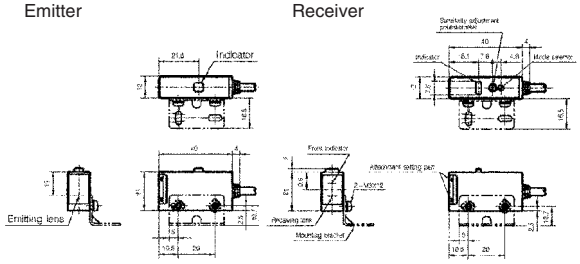
EXTERNAL DIMENSIONS

(unit: mm)

● General use thru scan model (preleaded, preleaded connector)

Horizontal type
HPA-T11, T12, T51, T52

Emitter Receiver

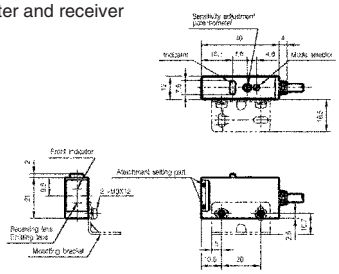


Polyvinyl chloride insulated cable (oil-resistant type: 0.2mm2), 4.2 dia.
Standard cable length 2m (preleaded)
Lead colors: Receiver: gray Emitter: black (preleaded), gray (preleaded connector)

● Advanced function thru scan model (preleaded, preleaded connector)

Horizontal type
HPA-T13, T14, T53, T54

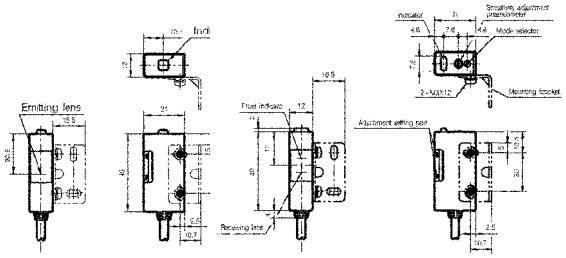
Both emitter and receiver



Polyvinyl chloride insulated cable (oil-resistant type: 0.2mm2), 4.2 dia.
Standard cable length 2m (preleaded)
Lead colors: Receiver: gray Emitter: black (preleaded), gray (preleaded connector)

Vertical type
HPA-T21, T22, T61, T62

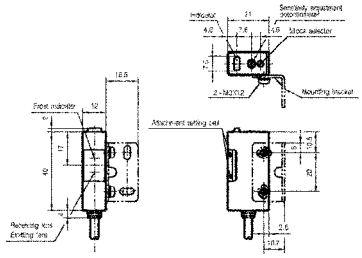
Emitter Receiver



Polyvinyl chloride insulated cable (oil-resistant type: 0.2mm2), 4.2 dia.
Standard cable length 2m (preleaded)
Lead colors: Receiver: gray Emitter: black (preleaded), gray (preleaded connector)

Vertical type
HPA-T23, T24, T63, T64

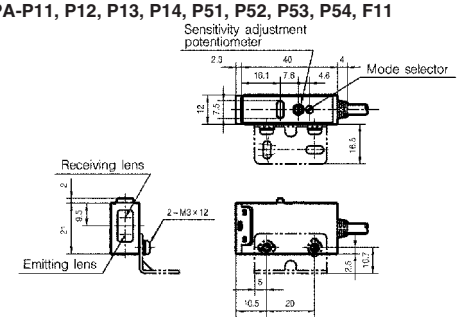
Both emitter and receiver



Polyvinyl chloride insulated cable (oil-resistant type: 0.2mm2), 4.2 dia.
Standard cable length 2m (preleaded)
Lead colors: Receiver: gray Emitter: black (preleaded), gray (preleaded connector)

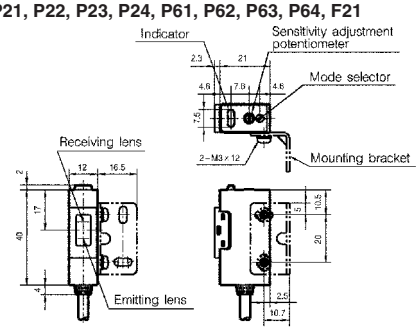
● Polarized retroreflective model (preleaded, preleaded connector)

Horizontal type
HPA-P11, P12, P13, P14, P51, P52, P53, P54, F11



Polyvinyl chloride insulated cable (oil-resistant type: 0.2mm2), 4.2 dia.
Standard cable length 2m (preleaded)
Lead color: gray

Vertical type
HPA-P21, P22, P23, P24, P61, P62, P63, P64, F21

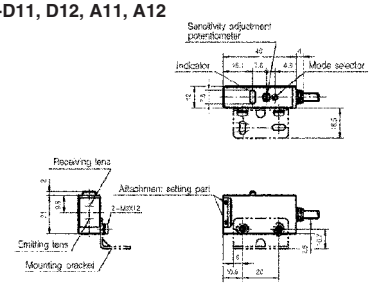


Polyvinyl chloride insulated cable (oil-resistant type: 0.2mm2), 4.2 dia.
Standard cable length 2m (preleaded)
Lead color: gray

● Diffuse scan model (preleaded, preleaded connector)

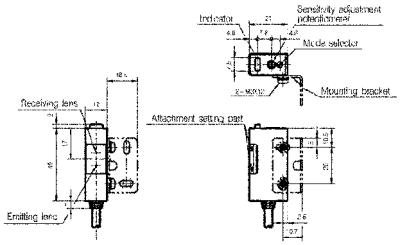
(unit: mm)

Horizontal type
HPA-D11, D12, A11, A12



Polyvinyl chloride insulated cable (oil-resistant type: 0.2mm2), 4.2 dia.
Standard cable length 2m (preleaded)
Lead color: gray

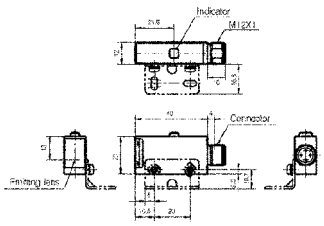
Vertical type
HPA-D21, D22, A21, A22



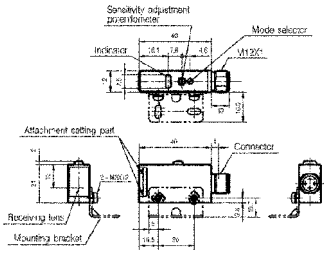
Polyvinyl chloride insulated cable (oil-resistant type: 0.2mm2), 4.2 dia.
Standard cable length 2m (preleaded)
Lead color: gray

● General use thru scan model (connector)

Horizontal type
HPA-T31, T32
Emitter

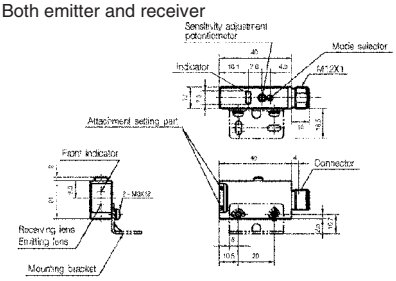


Receiver



● Advanced function thru scan model (connector)

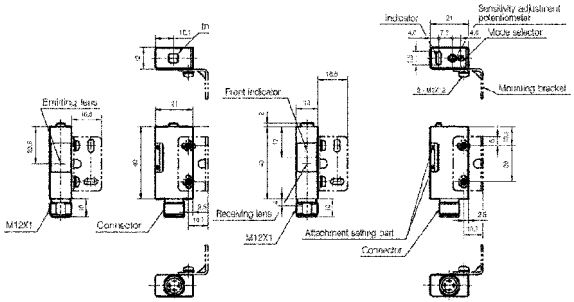
Horizontal type
HPA-T33, T34
Both emitter and receiver



● General use thru scan model (connector)

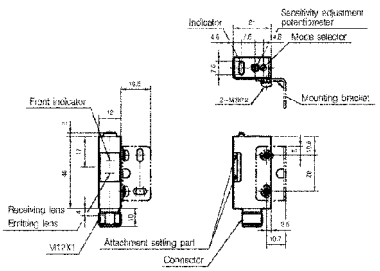
Vertical type
HPA-T41, T42
Emitter

Receiver



● Advanced function thru scan model (connector)

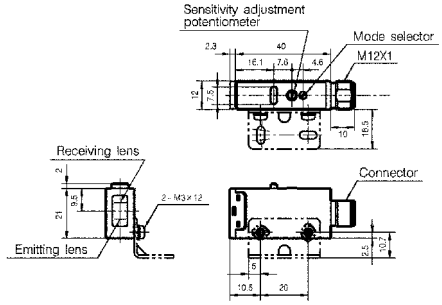
Vertical type
HPA-T43, T44
Both emitter and receiver



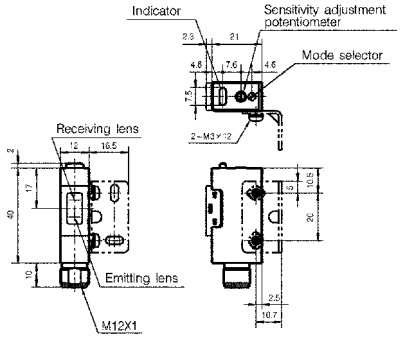
● Polarized retroreflective model (connector)

(unit: mm)

Horizontal type
HPA-P31, P32, P33, P34

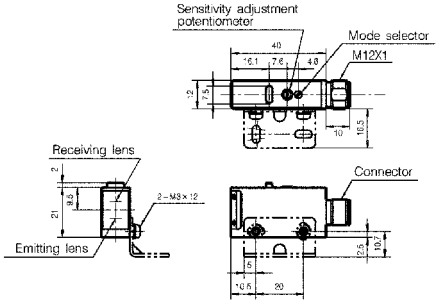


Vertical type
HPA-P41, P42, P43, P44

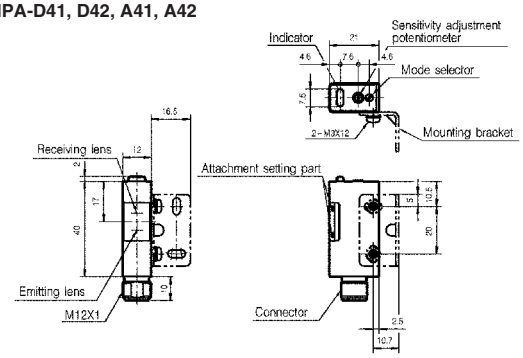


● Diffuse scan model (connector)

Horizontal type
HPA-D31, D32, A31, A32

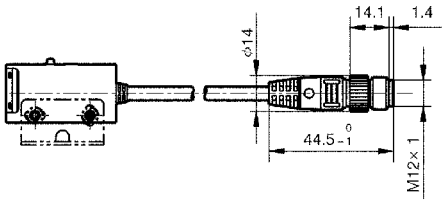


Vertical type
HPA-D41, D42, A41, A42



● Connector used in preleaded connector type

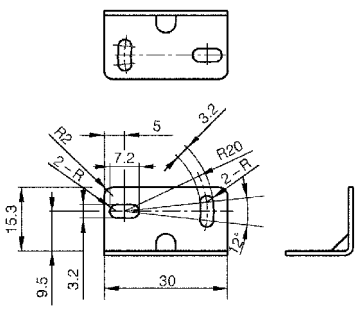
HPA-□5□, □6□



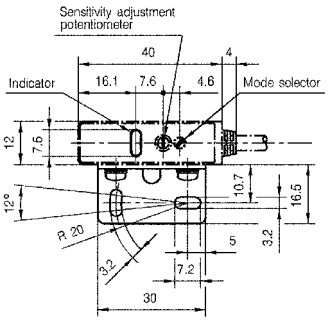
*Cable length 30cm

● Bracket

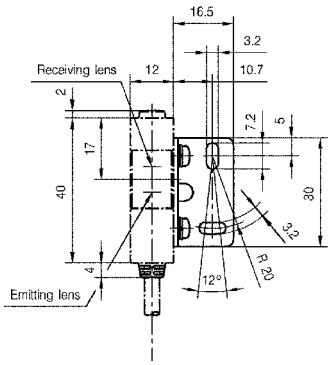
HPA-B01 mounting bracket (included as standard)



With horizontal model

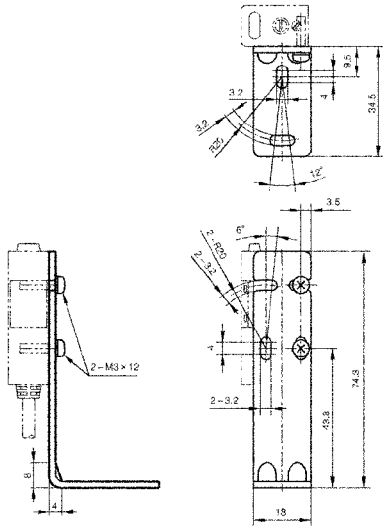


With vertical model



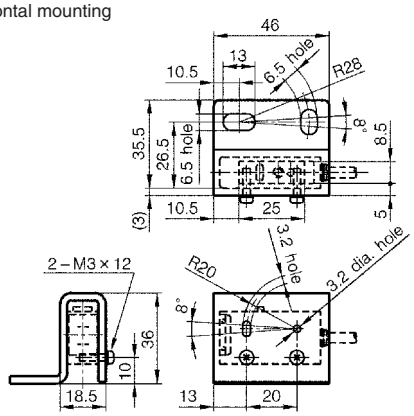
HPA-B02 mounting bracket for vertical model*
*Sold separately. Cannot be used for a connector model.

(unit: mm)

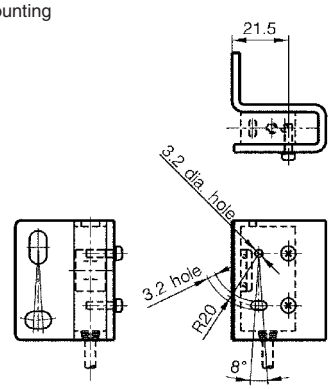


HPA-B03 wraparound mounting bracket*
*Sold separately. Cannot be used for a connector model.

Horizontal mounting

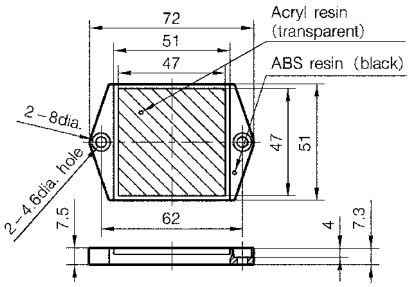


Vertical mounting

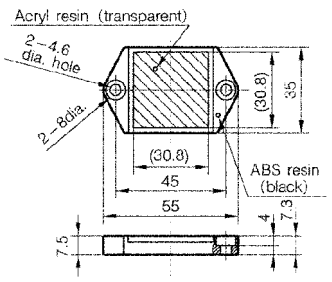


● Reflector

FE-RR8 reflector (sold separately)

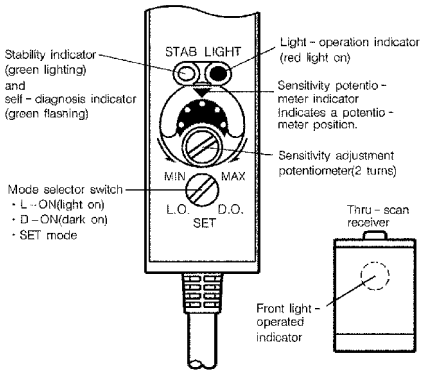


FE-RR15 small reflector (sold separately)

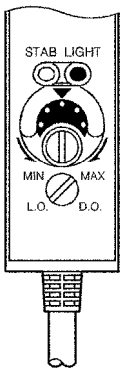


COMPONENT NAMES

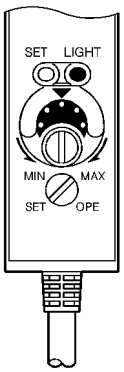
●Advanced function thru scan receiver
Advanced function polarized retroreflective model



●General use thru scan receiver
General use polarized retroreflective and diffuse scan models



●Advanced function thru scan emitter



TRIPLE ALIGNMENT FUNCTION (for initial setup)

Switch the mode selector switch to the SET position, and the system will enter the advanced-function mode. The three functions listed below are concurrently available.

1. Strobe Light Emission Function

A narrow beam strobe light with twice the usual luminosity.

2. High Margin Regulating Function

This function halves the quantity of light emitted. Use it in environments where the emitted light may not be transmitted reliably at normal levels. When switched back to the normal mode, the emitter generates triple the usual amount of light.

3. Output Suppression Function

Output is forced OFF irrespective of the sensor's ON/OFF status.

⚠ Important points to note

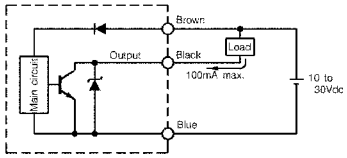
For thru scan models, a mode selector switch is built into both the emitter and receiver. When the mode selector switch on the emitter side is thrown to the SET position, the strobe light emission function and high margin regulating function modes are set. When the switch on the receiver side is thrown to the SET position, the output suppression function mode is set. Note that the L-ON mode may momentarily occur when throwing the mode selector switch from one position to the other. After completion of the optical axis adjustment or after maintenance, change the SET mode back to normal mode.

OUTPUT CIRCUIT DIAGRAM

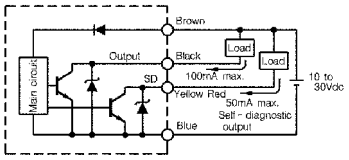
● NPN type

Thru scan receiver, polarized retroreflective and diffuse scan models

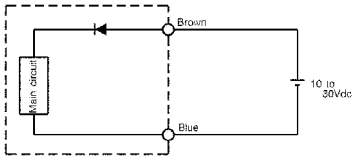
Without self-diagnostic output



With self-diagnostic output



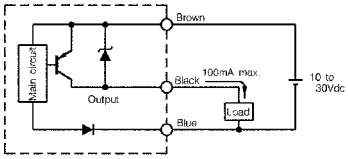
Thru scan emitter



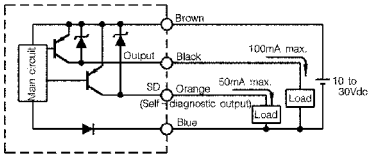
● PNP type

Thru scan receivers, polarized retroreflective and diffuse scan models

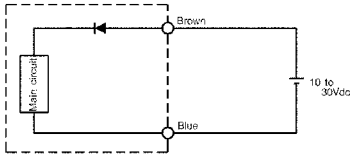
Without self-diagnostic output



With self-diagnostic output



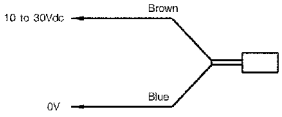
Thru scan emitter



WIRING DIAGRAM

● Preleaded models

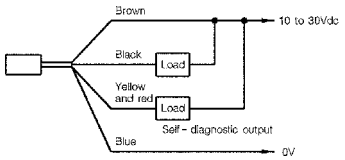
Thru scan emitter



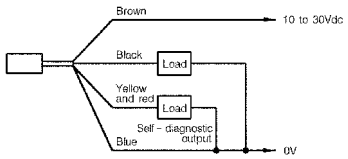
Thru scan receiver, polarized retroreflective and diffuse scan models

(When a load is directly applied)

NPN type

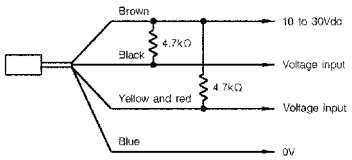


PNP type

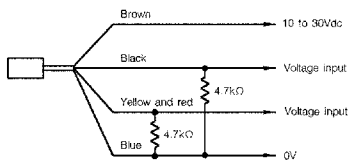


(When a voltage input device is connected)

NPN type

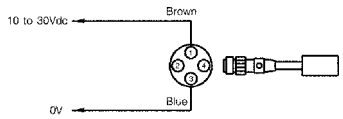


PNP type



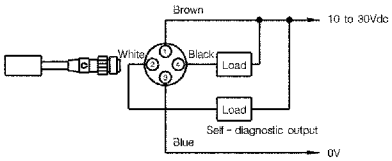
● Connector and preleaded connector models

Thru scan emitter

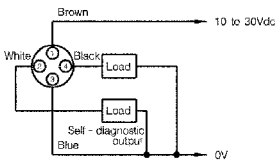


Thru scan receiver, polarized retroreflective and diffuse scan models

NPN type



PNP type



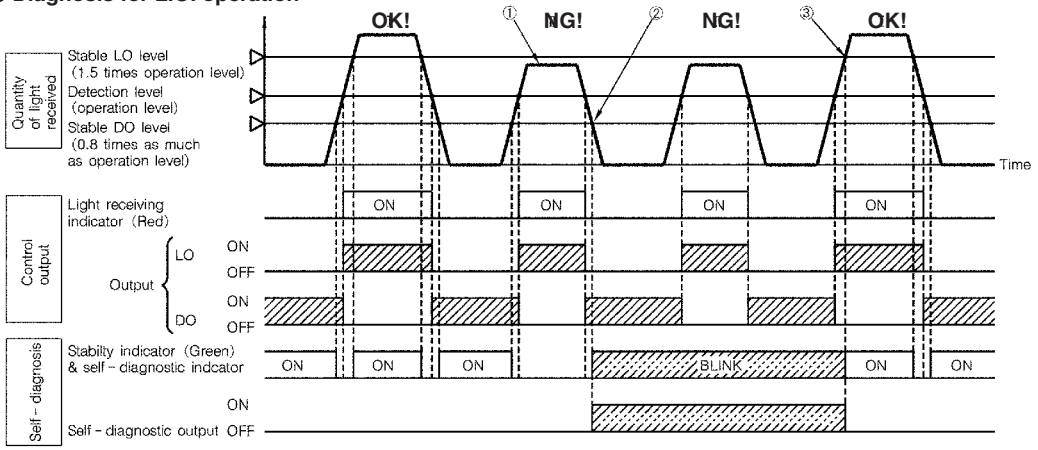
Note: Lead colors match the Yamatake PA5 Series cable with connector.

TIMING CHARTS FOR OUTPUT AND INDICATORS

The HPA's self-diagnostic output and indicators latch ON when there is:

① insufficient incoming light (due to a decrease in the quantity of light caused by dirt, etc.)
② incompletely blocked light (due to irregular position of a workpiece, etc.).They latch in either dark-ON (D.O.) or light-ON (L.O.) mode.

● Diagnosis for L.O. operation

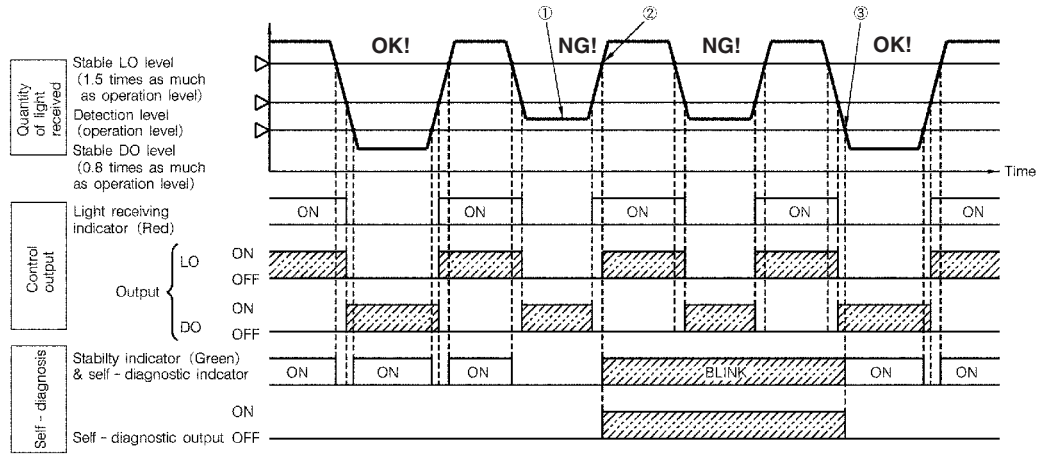


Ⓐ :The incoming light is sufficient for correct operation
Ⓑ : Incoming light is insufficient, making the self-diagnostic output and indicator go ON.

***Explanation of timing charts:**

1. If the photoelectric sensor returns to the stable D.O. level (above,①) without reaching the stable L.O. state (②) after the photoelectric sensor operates, the self-diagnostic output will latch ON and the stability indicator will start blinking.
2. Afterwards, the self-diagnostic output will go OFF, the latch will be cancelled, and the stability indicator will stop blinking when the quantity of light received reaches the stable L.O. level (③).

● Diagnosis for D.O. operation



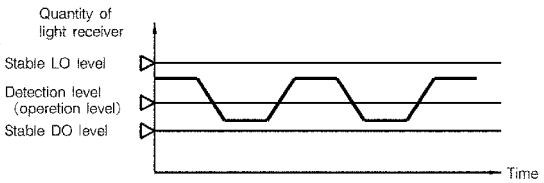
Ⓐ : The incoming light is sufficient for correct operation
Ⓑ : Incoming light is insufficient, making the self-diagnostic output and indicator go ON.

***Explanation of timing charts:**

1. If the photoelectric sensor returns to the stable L.O. level (above,) without reaching the stable D.O. state (②) after the photoelectric sensor operates, the self-diagnostic output will latch ON and the stability indicator will start blinking.
2. Afterwards, the self-diagnostic output will go OFF, the latch will be cancelled, and the stability indicator will stop blinking when the quantity of light received reaches the stable D.O. level (③).

⚠ Caution regarding a situation that may not be diagnosed:
Control output may be inverted in an unstable L.O. and D.O. state.

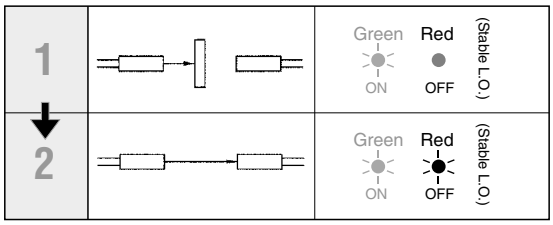
When a workpiece that is only slightly distinguished by the quantity of reflected of light is scanned, such as a transparent body, the quantity of light received may neither fall to the stable D.O. level nor rise to the stable L.O. level. In this case, neither the self-diagnostic output nor the indicating lamps go ON. (There is no indication or output unless①, for L.O. diagnosis, the light level falls to the stable D.O. level, or ②, for D.O. diagnosis, the light level rises to the stable L.O. level.)



SENSITIVITY ADJUSTMENT

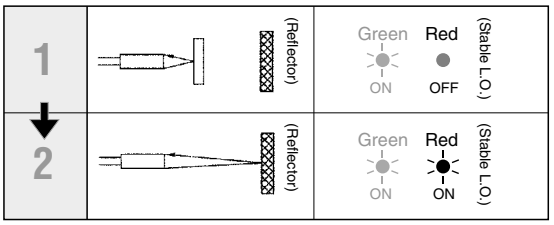
● Thru scan models

Adjust the optical axis and sensitivity until the indicators light in the following two conditions:

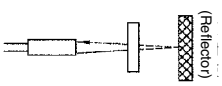
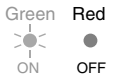
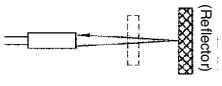
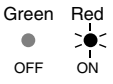
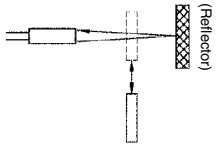
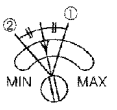
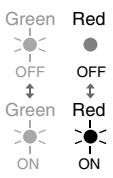


● Polarized retroreflective models

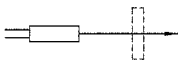
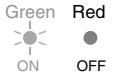
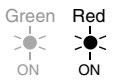
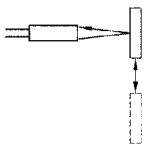
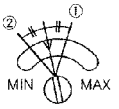
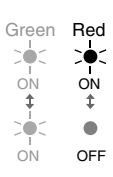
Basically, the adjustment is the same as thru scan models.



● Polarized retroreflective models

Work sequence	Placement of target object	Sensitivity adjustment potentionmeter	Indicators	Adjustment
1				With the target in position, turn the potentiometer counterclockwise from MAX until the red indicator goes off. This is point ①. If the red light is already off at MAX, MAX is point ①
2				With no target object present, turn the potentiometer clockwise from MIN to find point ② where the red indicator turns on.
3				Set the sensitivity potentiometer halfway between positions ① and ② . This is the optimal setting. Note: If the potentiometer has been turned completely once or more, make adjustment on the basis of the position of the indicator.

● Diffuse scan models

Work sequence	Placement of target object	Sensitivity adjustment potentionmeter	Indicators	Adjustment
1				With no target object present, turn the potentiometer counterclockwise from MAX until the red indicator goes off. This is point ① . If the red light is already off at MAX, MAX is point ② .
2				With the target object in position, turn the potentiometer clockwise from MIN to find point ② where the red indicator turns on.
3				Set the sensitivity potentiometer halfway between positions ① and ② . This is the optimal setting. Note: If the potentiometer has been turned completely once or more, make adjustment on the basis of the position of the indicator.

CONNECTOR SPECIFICATIONS *1

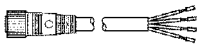
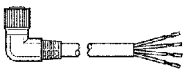
Item	Specifications
Insulation resistance	Max. 100MΩ(by 500Vdc megger)
Dielectric strength	1,500Vac for 1 minute (between contacts, and between contact and connector housing)
Initial contact resistance	Max. 40mΩ (with 3A current to connected male and female connectors. Semiconductor lead-specific resistance not included.)
Mating/unmating force	0.4 to 4.0 N per contact
Mating cycles	50
Connector nut tightening torque	Min. 0.8N·m*2
Cable pullout strength	Min. 100 N
Vibration resistance	10 to 55Hz, 1.5mm peak-to-peak amplitude, for 2 hours each in X, Y and Z directions
Impact resistance	300m/s^2, 3 times each in X, Y and Z directions
Protective structure	IP67
Ambient operating temperature	-10 to +70˚C
Ambient storage temperature	-20 to +80˚C
Ambient operating humidity	Max. 95% RH
Material	Contacts: Gold-plated brass Contact holder: Glass-lined polyester resin Housing: Polyester elastomer Coupling: Ni-plated brass O-ring: NBR

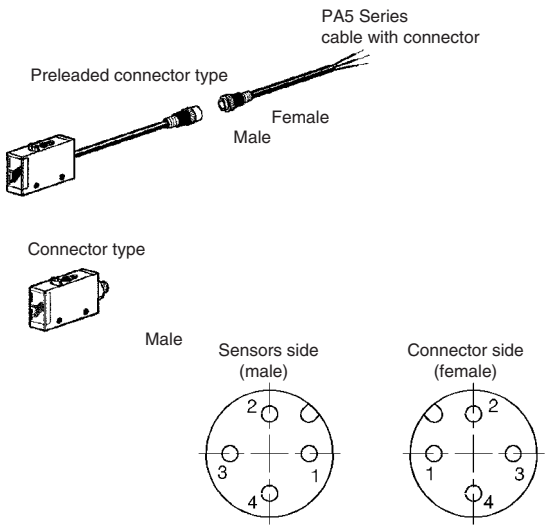
*1: Specifications assume Yamatake male/female connectors.
*2: The recommended torque is 0.4 to 0.6N-m. If fastened poorly, the IP67 protection is lost, or looseness occurs. Fasten the connector securely by hand.

CABLE WITH CONNECTOR

Be sure to use a PA5 Series cable with connector when connecting a preleaded connector or connector-type sensor.

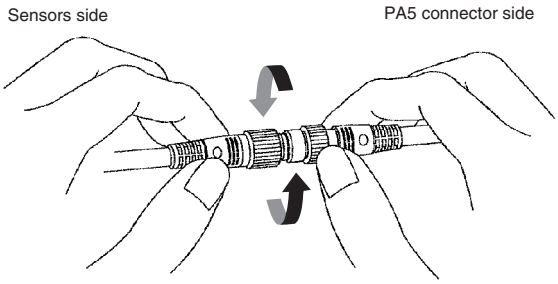
●PA5 Series cable with connector

Shape	Power supply	Cable properties	Cable length	Catalog listing	Lead colors
	DC	**Oil-resistant, flexible; UL2464; flame-resistant; EN-compliant**	2m	**PA5-4ISX2MK-E**	1: brown, 2: white, 3: blue, 4: black
			5m	**PA5-4ISX5MK-E**	1: brown, 2: white, 3: blue, 4: black
			2m	**PA5-4ILX2MK-E**	1: brown, 2: white, 3: blue, 4: black
			5m	**PA5-4ILX5MK-E**	1: brown, 2: white, 3: blue, 4: black



● Tightening the connector

Align the grooves and rotate the fastening nut on the PA5 connector by hand until it fits tightly with the connector on the sensors side.



PRECAUTIONS FOR USE

1. Wiring

- Be sure to connect the photoelectric sensor to its power supply and load correctly.
- If there is a high-voltage or power cable near the photoelectric sensor cable, route the sensor cable separately or put it in a separate conduit to prevent surge and noise influence.
- Connect the lead ends securely using crimp terminals.
- If extending the cable, use wire at least 0.3mm^2 in cross-sectional area. The length should not exceed 100m. Consider the effects of increased electrical noise due to cable extension.
- If a switching regulator is used, ground its frame.
- If a capacitive load is used, connect a current-limiting resistor to limit inrush current to 100mA max.

2. Handling

- Do not swing a photoelectric sensor by its cable.
- Do not pull the cable of a photoelectric sensor with excessive force. The pullout strength is 49N max.
- Do not strike or scratch the sensing head.
- Do not use a photoelectric sensor outdoors, in environments where chemicals (organic solvent, acid, alkali) are present, or where water or oil may splash onto the sensor.
- Fasten connectors firmly by hand.
- Do not bend the cable beyond the bend radius of 30mm.

3. Polarized retroreflective model

The polarized retroreflective model uses a light-polarizing filter, and employs a detection method intended to prevent reflection from mirror surfaces or shiny detection objects. For this reason, malfunction may occur when the characteristics of the target object are such that its surface polarizes light. Check this before use.

Examples:

Target objects covered in transparent film

Mirror surfaces with slight surface unevenness, or shiny target objects.