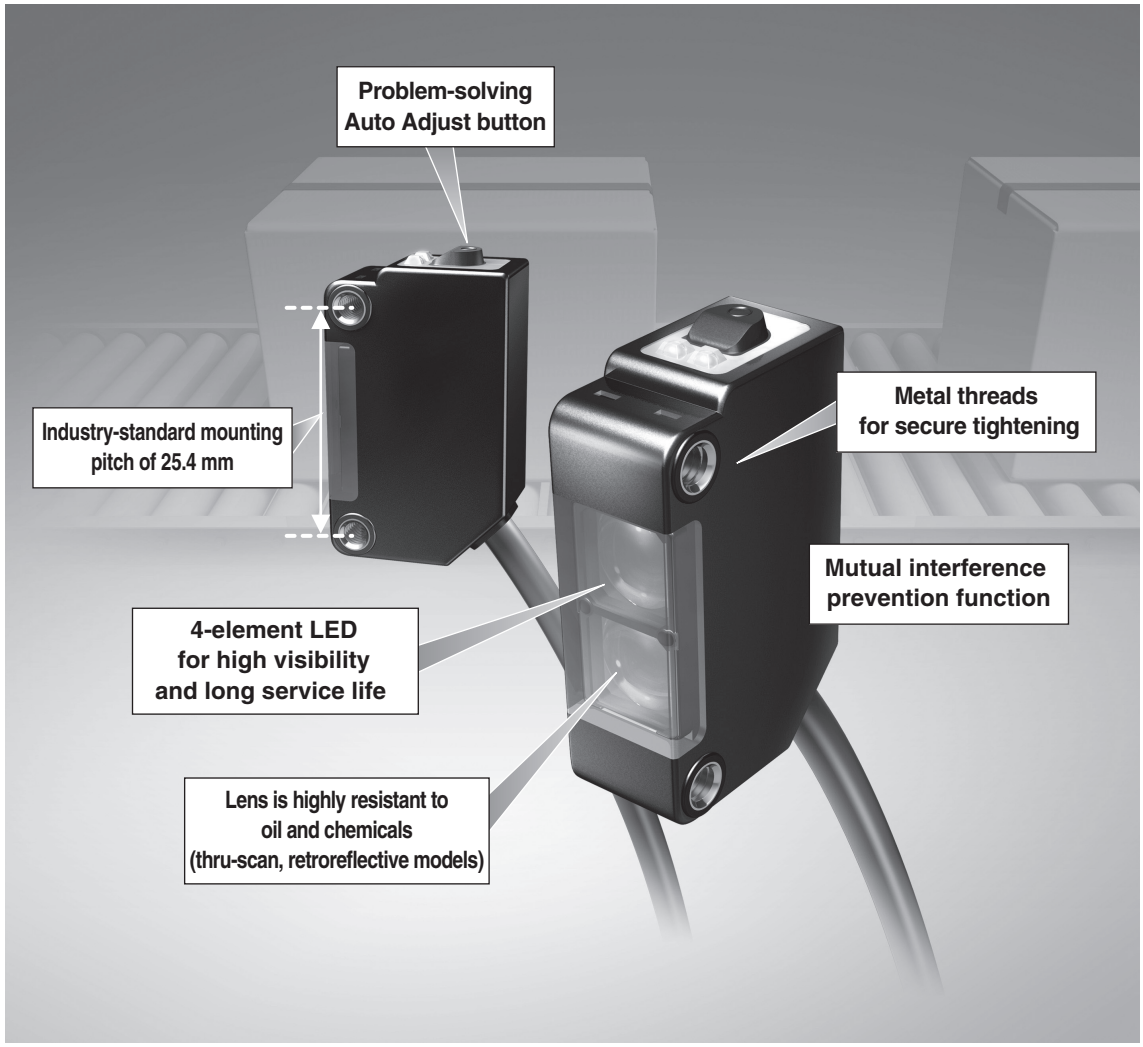
General-Purpose Photoelectric Switches with Self-Contained Amplifier

HP7 Series

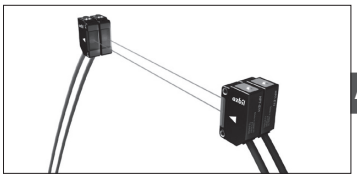
- Wide range of configurations and specifications
- Improved resistance to interference (e.g., fluorescent lights)
- Threaded metal mounting holes for more reliable installation
- Different frequency thru-scan model for stress-free installation
- Auto Adjust button for situations where detection is difficult
- The HP7-C1 series has been added to the product portfolio for the detection of transparent objects.

EXPLANATION OF MAJOR FUNCTIONS AND FEATURES



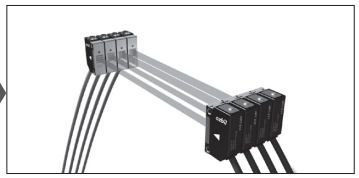
Interference suppression

The combination of a standard switch and a different frequency switch prevents interference without installing an mutual interference protection filter or reversing the orientation of one of the units. Effective for up to two units side by side.*1



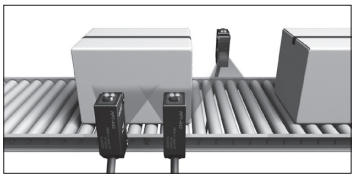
Two thru-scan switches (red and infrared)

Using an interference mutual protection filter, it is possible to install up to four units side by side*1 without changing the orientation of any of the units.



Four thru-scan switches (red)

Automatic interference suppression allows two units to be installed in close proximity.*1

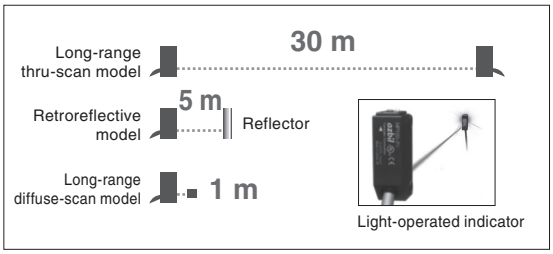


Diffuse-scan switch/retroreflective switch

*1. Subject to certain restrictions (see “Interference Suppression” in the specifications)

Simple to operate and delivers reliable detection

Long-range thru-scan models have a light-operated indicator on the front, and retroreflective models send out a visible red light beam for light axis alignment over long distances.
Diffuse-scan models offer the best long-distance detection standards in the industry along with consistent detection of darker colors.



▲ Secure operating margin over a long distance

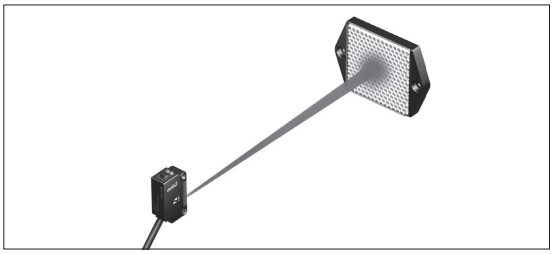
Designed for modern lighting

New algorithms achieve major improvement in resistance*2 to external optical interference.

*2. In tests conducted by the azbil Group.

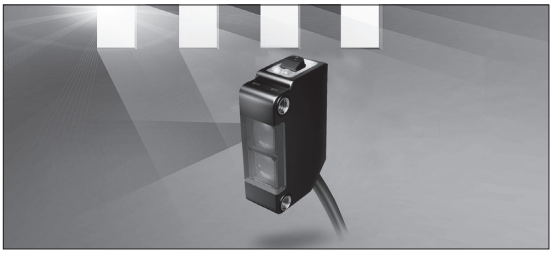
High-intensity red LED

Due to high-intensity four-element LED, light spot is easy to be recognized, helping to save time during light axis adjustment.



Excellent resistance to sunlight

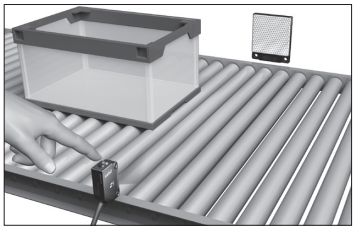
Switches are designed to provide a high level of resistance to sunlight (an industry-leading 40,000 lx) .



How to use the Auto Adjust button

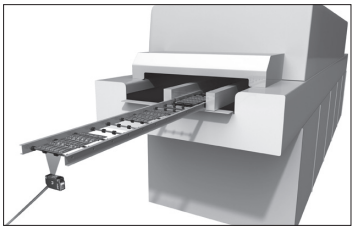
If switch operation is not consistent at factory default settings, press the Auto Adjust button to adjust sensitivity automatically.

Light seeps through semi-transparent target object



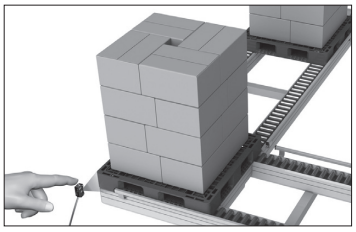
Tuning without a workpiece

False detection



Two-point tuning

Detection in a specific position

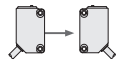
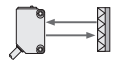
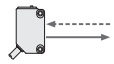
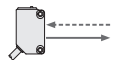
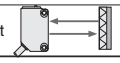


Position tuning

Note: Highly transparent objects cannot be detected. Check with actual target objects before running a machine.

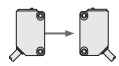
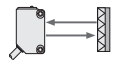
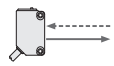
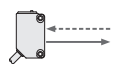
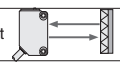
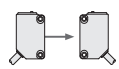
CATALOG LISTINGS

■ Base model number Connection: 2 m cable

Detection method / Configulation	Detection range / Light source	Catalog listing	Output	Different-frequency model No.	Different-frequency Output	Wiring method	
Thru-scan 	30 m / Infrared	**HP7-T41**	NPN	**HP7-T45**	NPN	cable	2 m
		HP7-T42	PNP	**HP7-T46**	PNP	cable	2 m
	15 m / Red	**HP7-T11**	NPN	**HP7-T15**	NPN	cable	2 m
		HP7-T12	PNP	**HP7-T16**	PNP	cable	2 m
	15 m / Infrared	**HP7-T21**	NPN	**HP7-T25**	NPN	cable	2 m
		HP7-T22	PNP	**HP7-T26**	PNP	cable	2 m
	4 m / Red	**HP7-T51**	NPN	**HP7-T55**	NPN	cable	2 m
		HP7-T52	PNP	**HP7-T56**	PNP	cable	2 m
Retroreflective 	5 m / Red	**HP7-P11**	NPN		–	cable	2 m
		HP7-P12	PNP		–	cable	2 m
	3 m / Red	**HP7-P51**	NPN		–	cable	2 m
		HP7-P52	PNP		–	cable	2 m
Diffuse-scan 	1 m / Infrared	**HP7-A43**	NPN		–	cable	2 m
		HP7-A44	PNP		–	cable	2 m
	0.5 m / Red	**HP7-A13**	NPN		–	cable	2 m
		HP7-A14	PNP		–	cable	2 m
Wide-beam diffuse scan 	100 mm / Infrared	**HP7-D23**	NPN		–	cable	2 m
		HP7-D24	PNP		–	cable	2 m
	50 mm / Infrared	**HP7-D63**	NPN		–	cable	2 m
		HP7-D64	PNP		–	cable	2 m
Retroreflective transparent object detection 	0.5 m / Red	**HP7-C11S**	NPN		–	cable	2 m
		HP7-C12S	PNP		–	cable	2 m

Note: **HP7- T** Thru-scan: Emitter model number is **HP7-E** and receiver model number is **HP7-R**.

■ Connection options

Type	Configuration Base model number	Catalog listing	HP7-P11-L050	HP7-P11-C003	HP7-P11-S003	HP7-P11-T
		Connection type	5 m cable	M12 preleaded*2 connector	Quick Lock*1*2	M8 connector
		Base model number	Base model number-L050	Base model number-C003	Base model number-S003	Base model number-T
Thru-scan 	30 m / Infrared	**HP7-T41**	✓	✓	–	–
		HP7-T42	✓	✓	–	–
	15 m / Red	**HP7-T11**	◎	◎	✓	✓
		HP7-T12	◎	✓	✓	✓
	15 m / Infrared	**HP7-T21**	✓	✓	–	–
		HP7-T22	✓	✓	–	–
	4 m / Red	**HP7-T51**	✓	✓	–	–
		HP7-T52	✓	✓	–	–
Retroreflective 	5 m / Red	**HP7-P11**	◎	◎	✓	✓
		HP7-P12	✓	✓	✓	✓
	3 m / Red	**HP7-P51**	✓	✓	–	–
		HP7-P52	✓	✓	–	–
Diffuse-scan 	1 m / Infrared	**HP7-A43**	✓	✓	✓	✓
		HP7-A44	✓	✓	✓	✓
	0.5 m / Red	**HP7-A13**	✓	–	–	–
		HP7-A14	✓	–	–	–
Wide-beam diffuse scan 	100 mm / Infrared	**HP7-D23**	✓	–	–	–
		HP7-D24	✓	–	–	–
	50 mm / Infrared	**HP7-D63**	–	–	–	–
		HP7-D64	–	–	–	–
Retroreflective transparent object detection 	0.5 m / Red	**HP7-C11S**	✓	✓	✓	✓
		HP7-C12S	✓	✓	✓	✓
Thru-scan Different frequency 	30 m / Infrared Different frequency	**HP7-T45**	✓	–	–	–
		HP7-T46	✓	–	–	–
	15 m / Red Different frequency	**HP7-T15**	✓	✓	✓	✓
		HP7-T16	✓	✓	✓	✓
	15 m / Infrared Different frequency	**HP7-T25**	✓	–	–	–
		HP7-T26	✓	–	–	–
	4 m / Red Different frequency	**HP7-T55**	✓	–	–	–
		HP7-T56	✓	–	–	–

✓: available ◎ : Always in stock; for other products, ask for delivery time.

Note: For models with SUS304 threaded metal mounting holes, the basic model number is **HP7-_ _ _S**.

*1. Interchangeable with OMRON Smart Click.

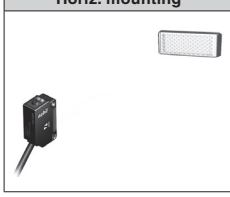
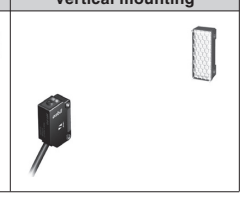
*2. Cable length is 300 mm.

ACCESSORIES

Name	Configuration	Description	Catalog listing	Compatible model
Reflector for retroreflective model		Reflector size 47 x 47 mm	**FE-RR22** (Scanning distance 0.05 to 5 m) *3	**HP7-P_**
		Reflector size 30.8 x 30.8 mm	**FE-RR18** (Scanning distance 0.05 to 3.3 m) *3	**HP7-P_**
		Reflector size 37 x 56 mm	**FE-RR21** Scanning distance: horiz. amounting 0.05 to 5 m, vertical mounting 0.05 to 4.8 m *3 *4	**HP7-P_**
		Reflector size 47 x 47 mm	**FE-RR8** (Scanning distance 0.05 to 5 m) *3	**HP7-P_**
		Reflector size 30.8 x 30.8 mm	**FE-RR15** (Scanning distance 0.05 to 3.3 m) *3	**HP7-P_**
		Reflector size 8.6 x 29.5 mm	**FE-RR23** Scanning distance: horiz. mounting 0.05 to 1.8 m, vertical mounting 0.05 to 1.3 m *3 *4	**HP7-P_**
		Reflector size 22.5 x 39.2 mm	**FE-RR24** (Scanning distance 0.05 to 2.5 m) *3	**HP7-P_**
Reflector (for retroreflective transparent object detection)		Reflector size 47 x 47 mm	**FE-RR17C** Scanning distance 0.05 to 0.5 m (in combination with **HP7-C1_S**)	**HP7-C1_S**
Standard bracket		Bottom-mounting L-bracket	**HP-B08**	**All models**
		Bottom-mounting L-bracket	**HP-B09**	**All models**
		Rear-mounting L-bracket	**HP-B10**	**All models**
Wraparound mounting bracket		Wraparound vertical mounting bracket	**HP-B11**	**All models**
		Wraparound horizontal mounting bracket	**HP-B12**	**All models**
Slit for thru-scan model		Vertical slit	**HP-SV05** **HP-SV10** **HP-SV20** *5	**HP7-T_**
		Horizontal slit	**HP-SH05** **HP-SH10** **HP-SH20** *5	**HP7-T_**
Mutual interference protection filter for thru-scan model		Mutual interference can beprevented by changing the polarizing direction of 2 adjacent emitter-receiver pairs	**HP-U02** *6	**HP7-T1_/T5_**

*3. Scanning distance when used with **HP7-P1**_.

*4.

Horiz. mounting	Vertical mounting
	

*5. Scanning distance of thru-scan switch with slit.

		Catalog listing of compatible switches	
		HP7-T1_ / HP7-T2_	HP7-T5_
Slit width	Catalog listing	Scanning distance	Scanning distance
0.5 × 6.4 mm	**HP-S_05**	1.2 m	0.4 m
1.0 × 6.4 mm	**HP-S_10**	3 m	0.7 m
2.0 × 6.4 mm	**HP-S_20**	5 m	1.5 m

*6. Scanning distance of thru-scan switch with mutual interference protection filter.

	Catalog listing of compatible switches	
	HP7-T1_	HP7-T5_
Catalog listing	Scanning distance	Scanning distance
HP-U02	7 m	1.8 m

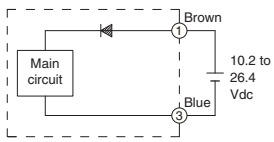
SPECIFICATIONS

Catalog listing	NPN	HP7-P51	HP7-P11	HP7-T51	HP7-T11 (Red) HP7-T21 (Infrared)	HP7-T41	HP7-A13	HP7-A43	HP7-D23	HP7-D63	HP7-C11S
	PNP	HP7-P52	HP7-P12	HP7-T52	HP7-T12 (Red) HP7-T22 (Infrared)	HP7-T42	HP7-A14	HP7-A44	HP7-D24	HP7-D64	HP7-C12S
Detection method		Retroreflective*2		Thru-scan			Diffuse-scan				Retroreflective transparent object detection
Power supply		10.2 to 26.4 Vdc (Ripple 10% max.)									
Power consumption		14 mA max.		22 mA max.	25 mA max. (Red) 30 mA max. (Infrared)	32 mA max.	14 mA max.	17 mA max.	17 mA max.		15 mA max.
Scanning distance		3 m (with **FE-RR8** reflector)	5 m (with **FE-RR8** reflector)	4 m	15 m	30 m	0.5 m	1 m	100 mm	50 mm	0.05 to 0.5 m (when combined with **FE-RR17C** reflector)
Target object		Opaque object 80 mm dia. min(with **FE-RR8** reflector)		Opaque object 12 mm dia. min.			Standard target object: 200 × 200 mm paper, 90 % reflectivity				10% light blockage or more, 50 × 50 mm or more (when combined with **FE-RR17C** reflector)
Differential travel		–		–			20% max. (at rated scanning distance)				–
Operation mode		Light-operate / Dark-operate selectable by operation button									
Output mode[*1]		NPN open collector / PNP open collector									
Control output		Switching current: preleaded. Preleaded connector type 100 mA (Resistance load) M8 connector type and low-temperature cable type 50 mA (Resistance load) Output withstand voltage: 30 V Residual voltage: 2 V or lower (at switching current of 100 mA/50 mA), 1.1 V or less (at switching current below 10 mA)									Switching current: 50 mA or lower (Resistive load) Output withstand voltage: 30 V Residual voltage: 1 V or less
Response time[*3]		1 msec		1 msec (Different frequency model: 3 ms)			1 msec				1 msec
Light source		Red, 4 elements (Wavelength approx. 645 nm)		Red, 4 elements (Wavelength approx. 645 nm)	Red, 4 elements (Wavelength approx. 645 nm) Infrared (Wavelength approx. 860 nm)	Infrared (Wavelength approx. 860 nm)	Red, 4 elements (Wavelength approx. 645 nm)	Infrared (Wavelength approx. 860 nm)			Red, 4 elements (Wavelength approx. 645 nm)
Scanning angle		0.5 to 10°		2 to 20°			–				Switch: 0.5° to 10°
Indicator		Output ON: orange indicator ON. At stable light and stable dark: green indicator Thru-scan emitter: power indicator, 30 m thru-scan receiver: light-operated indicator on front									
Ambient light immunity		Incandescent lamp: 10,000 lux max. Sunlight: 40,000 lux max. **HP7-T_**, **HP7-P_**, **HP7-C_**: Minimum angle of incidence of surrounding light = 5° **HP7-A_**: Minimum angle of incidence of surrounding light = 15° **HP7-D_**:Figures apply to indirect illumination.									
Operating temperature		-30 to + 55˚C (without freezing or condensation)*6									-10 to + 55˚C (without freezing or condensation)*6
Storage temperature		-40 to + 70˚C (without freezing or condensation)									
Operating humidity		35 to 85% RH (without freezing or condensation)									
Insulation resistance		20MΩ min. (at 500Vdc)									
Dielectric strength		1,000Vac 50/60Hz for one minute between electrically live metal and case									
Vibration resistance		10 to 55Hz, 1.5 mm peak-to-peak amplitude, 2 hours each in X, Y, and Z directions									
Shock resistance		500 m/s² 10 times each in X, Y and Z directions									
Sensitivity adjustment		Operation button									
Protective structure		IP67 (IEC standard)									
Wiring method		**HP7-**_ _: preleaded 2 m, **HP7-_-L050**: preleaded 5 m, **HP7-_-C003**: M12 preleaded connector 30 cm, **HP7-_-T**: M8 connector									
Circuit protection		Error prevention circuit at power on (max. 60 ms) Full wiring error protection									Error prevention circuit at power on (max. 80 ms) Power supply reverse polarity protection, output short-circuit protection
Interference suppression*5		Diffuse-scan, retroreflective, retroreflective transparent object detection models up to 2 units. Thru-scan models with different frequencies, up to 2 units. Thru-scan models with mutual interference prevention filter*4 (for red), up to 2 units. Different frequency models + mutual interference prevention filters (for red), up to 4 units.									

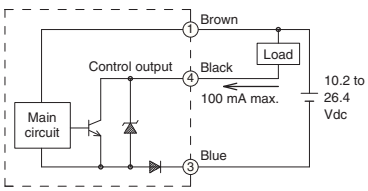
*1. An FET is used for output
*2. Retroreflective switches feature polarizing filters; however, performance may be affected by highly reflective objects and objects that interfere with polarization.
*3. Response time may be longer if affected by light from other switches.
*4. Mutual interference protection filters are for red light source.
*5. Avoid operating diffuse-scan switches head-on when using gang mounting.
*6. In a low-temperature environment (0° or below), the standard cable will harden. Low temperature cables are available. Contact our branch or sales office to order. (Not available for **HP7-C1_S**.)

OUTPUT CIRCUIT DIAGRAM (Note that a FET is used for output)

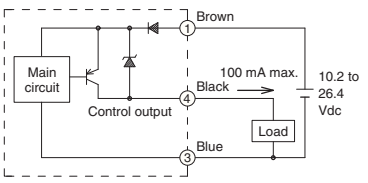
Thru-scan emitter



(NPN output type)
Polarized retroreflector model,
Thru-scan receiver, Diffuse-scan mode



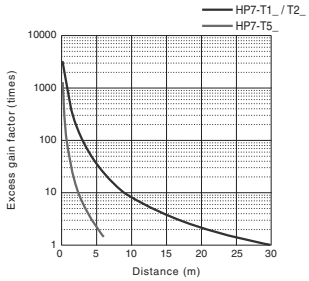
(PNP output type)
Polarized retroreflector model,
Thru-scan receiver, Diffuse-scan model

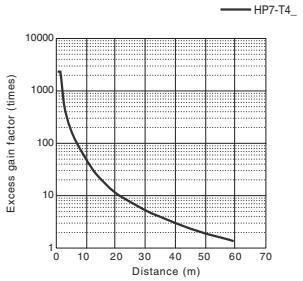


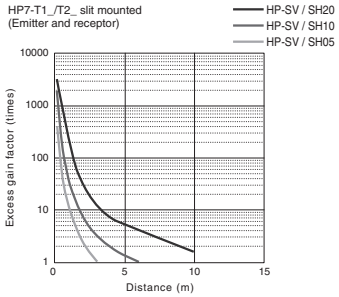
CHARACTERISTICS DIAGRAMS (typical examples)

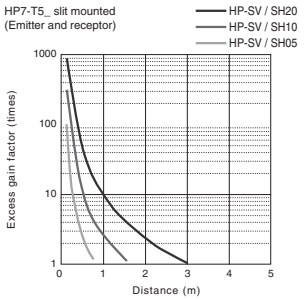
Thru-scan models (HP7-T1_/T2_/T5_)

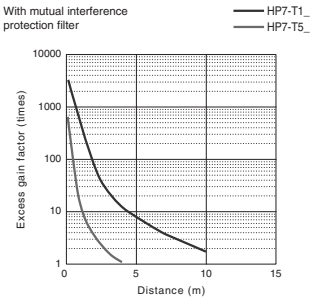
Excess gain (Light received over the required amount)



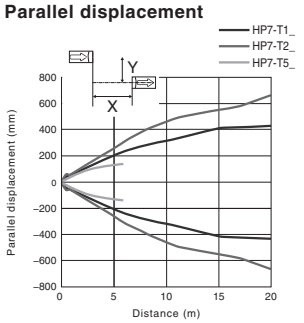


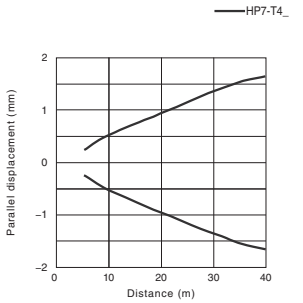


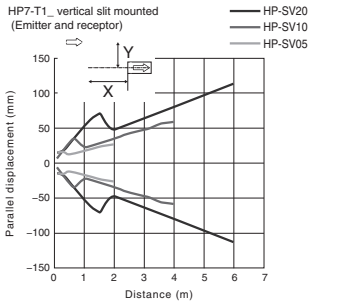


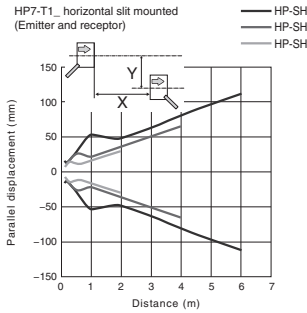


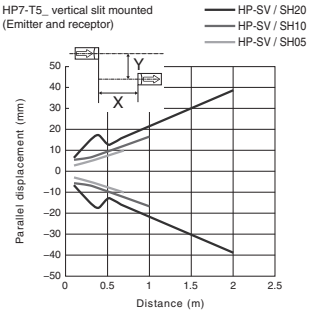
Parallel displacement

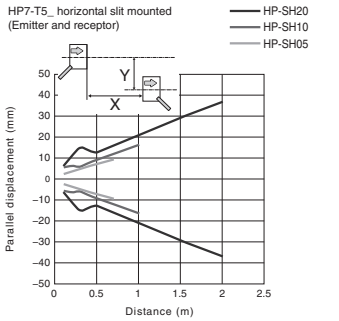


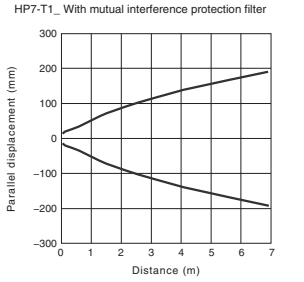


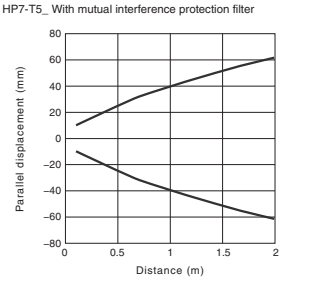








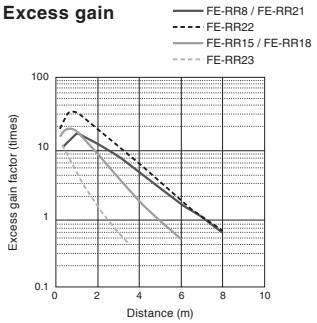




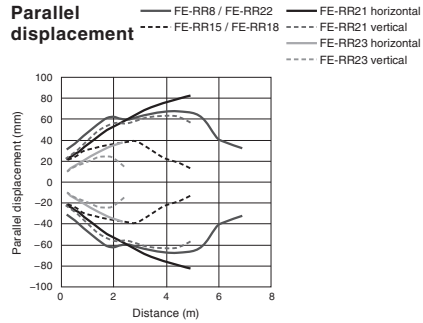
Note: The above summary of key characteristics should not be construed as a performance guarantee.
Always test first under actual conditions and allow leeway as appropriate.

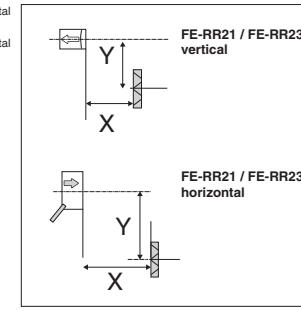
■ Retroreflective models (HP7-P1_)

Excess gain



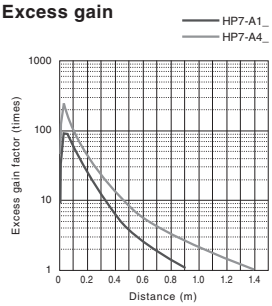
Parallel displacement



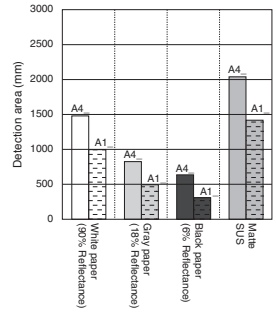


■ Diffuse-scan models (HP7-A1_ / A4_)

Excess gain

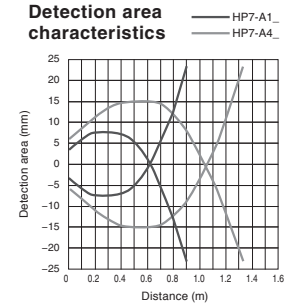


Target specifications



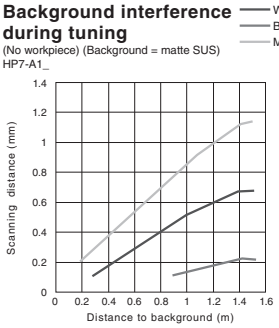
When used with highly reflective backgrounds, tilting the switch may improve background suppression.

Detection area characteristics



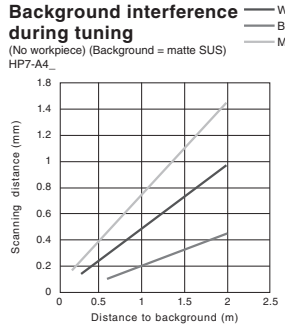
Background interference during tuning

(No workpiece) (Background = matte SUS)
HP7-A1_



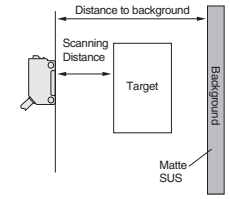
Background interference during tuning

(No workpiece) (Background = matte SUS)
HP7-A4_



How to interpret the table

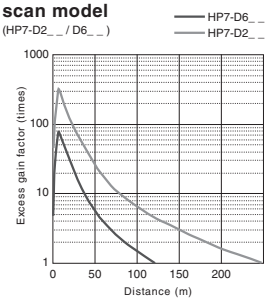
Example: Tuning (without a workpiece) of model HP7-A1_against a matte SUS background at 1 m where white paper target is detected at distances of up to approx. 0.5 m.



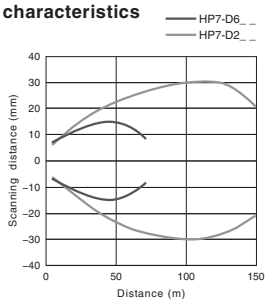
■ Wide-beam diffuse scan model (HP7-D2_ _ / D6_ _)

Wide-beam diffuse scan model

(HP7-D2_ _ / D6_ _)

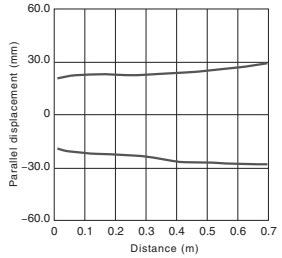


Detection area characteristics



■ Retroreflective transparent object detection model (HP7-C1_ S)

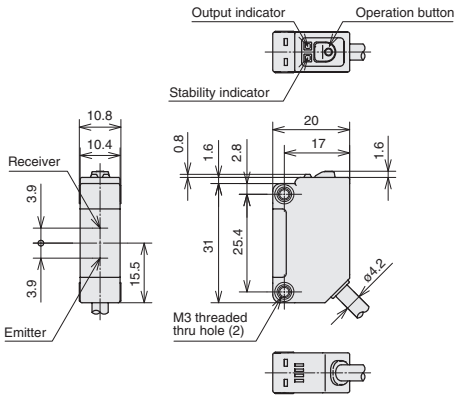
Parallel displacement



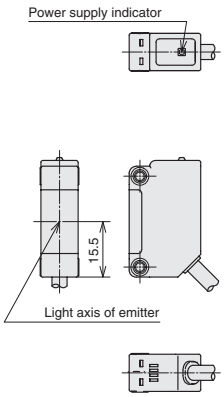
Note: The above summary of key characteristics should not be construed as a performance guarantee. Always test first under actual conditions and allow leeway as appropriate.

■ Pleleaded and M12 pleleaded connector types

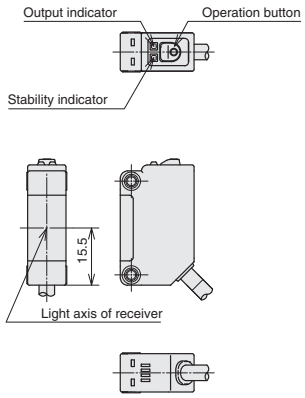
● **Retroreflective / Retroreflective transparent object detection model / Diffuse-scan**



● **Thru-scan emitter**

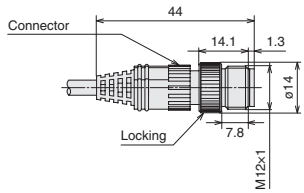


● **Thru-scan receiver**

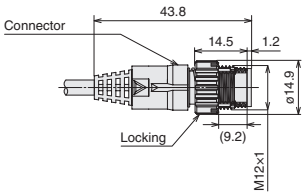


■ Connector part

HP7-_ _ _-C_ _ _
(M12 preleaded connector)

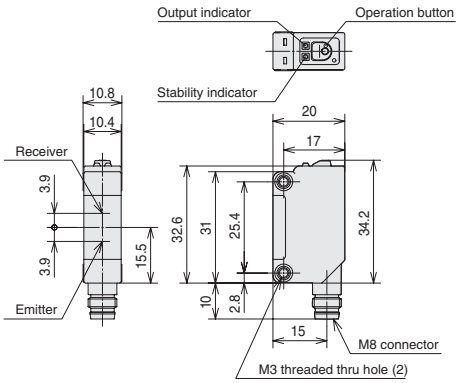


HP7-_ _ _-S_ _ _
(Quick Lock preleaded connector)

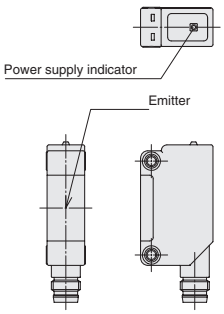


■ M8 connector types

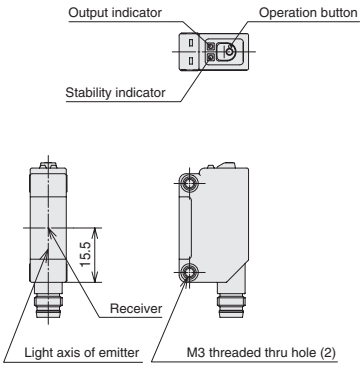
● **Retroreflective / Retroreflective transparent object detection model / Diffuse-scan**



● **Thru-scan emitter**

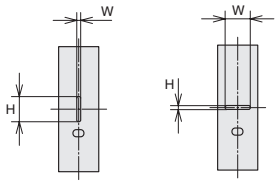


● **Thru-scan receiver**

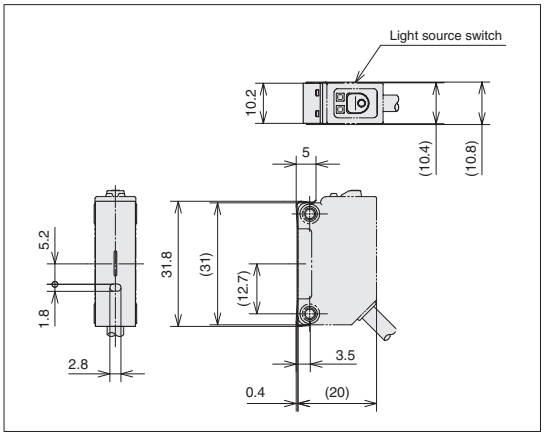


■ Slit

HP-SV_ _ HP-SH_ _

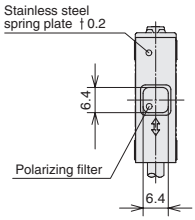


Catalog listing	Width (mm)	Height (mm)
HP-SV05	0.5	6.4
HP-SV10	1.0	6.4
HP-SV20	2.0	6.4
HP-SH05	6.4	0.5
HP-SH10	6.4	1.0
HP-SH20	6.4	2.0

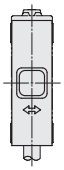


■ Filter

Polarizing direction: vertical

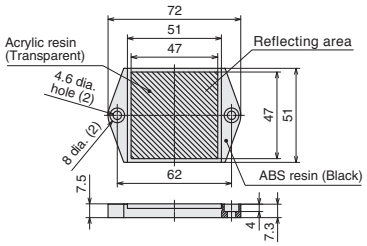


Polarizing direction: horizontal

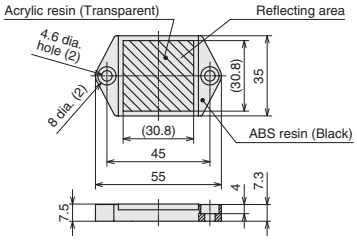


■ Reflector (Sold separately)

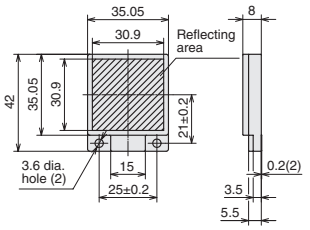
FE-RR8



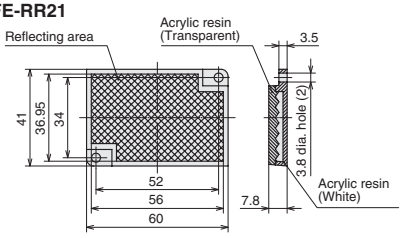
FE-RR15



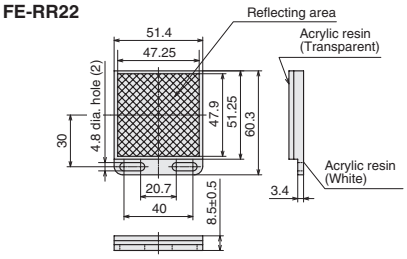
FE-RR18



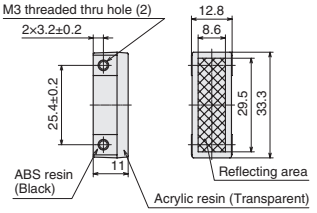
FE-RR21



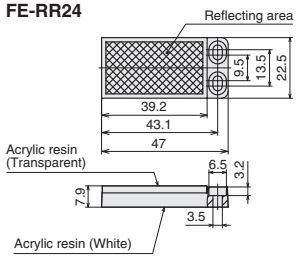
FE-RR22



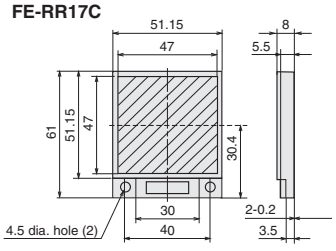
FE-RR23



FE-RR24

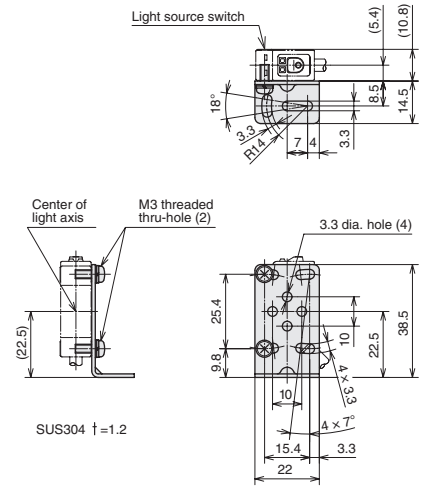


FE-RR17C

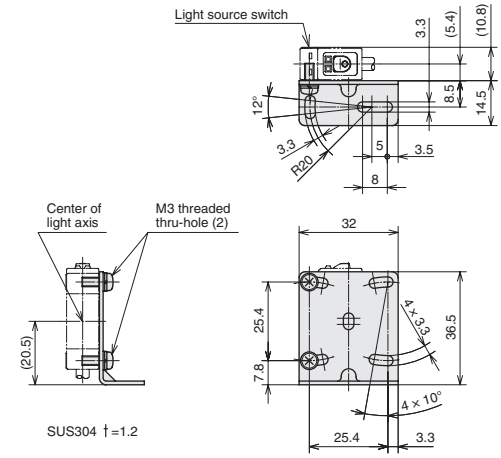


■ Bracket (sold separately)

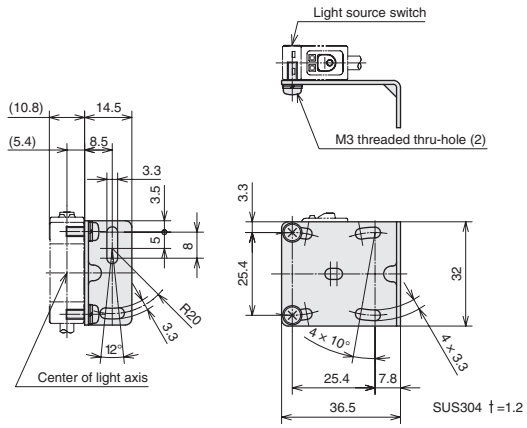
Button-mounting L-bracket (HP-B08)



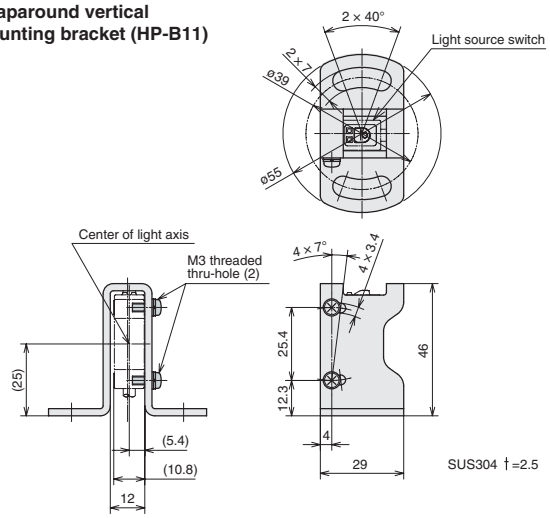
Button-mounting L-bracket (HP-B09)



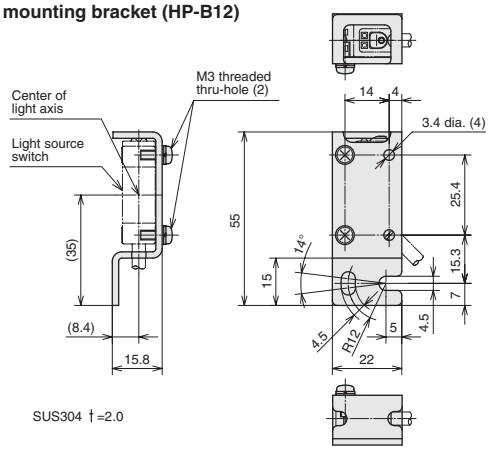
Rear-mounting L-bracket (HP-B10)



Wraparound vertical mounting bracket (HP-B11)



Wraparound horizontal mounting bracket (HP-B12)



The operation method

Tuning without a workpiece

After light axis adjustment, if target objects cannot be reliably detected at the factory default sensitivity (maximum sensitivity), adjust according to the instructions below.

(1) Thru-scan models and retroreflective models

Adjust in the following cases. Switch sensitivity will be set automatically so that it operates at about half the light intensity as when there is no target object.

- The objects are transparent or translucent
- The objects have holes or notches
- Not enough light is blocked by target objects because light reaches the switch from the surroundings.

Note: For thru-scan models, if the set scanning distance is shorter than the following amounts, light intensity may be too strong, causing the switch to enter the state described in "Indicator lamp flashes repeatedly."
HP7-T1□□□ and **HP7-T2□□□**: 1 m. **HP7-T5□□□**: 0.3 m.

(2) Diffuse-scan models

Adjust in the following cases. Switch sensitivity will be set automatically so that it operates at about twice the light intensity as when there is no target object.

- Because of light from the surroundings, the switch receives light even when there is no target object.

(3) Retroreflective transparent object detection models

Before adjusting, allow 3 minutes for warm-up after turning the power on.

Hold down the button for about 2 seconds until the orange indicator lamp starts flashing rapidly (at about 10 Hz), then release.

Switches to sensitivity adjustment mode.

Without a workpiece, give the button a short press. Both LEDs turn OFF.

Measures the light intensity without a target object and sets sensitivity as required.

Setup is complete

Normal operation will be restored automatically.*1

*1. If the indicator lamp flashes repeatedly, repeat the procedure as described under Indicator lamp flashes repeatedly.

2-point tuning

If target objects cannot be reliably detected even after tuning without a workpiece, adjust as shown below.

(1) Thru-scan models and retroreflective models

As a result of tuning without a workpiece, target objects do not block enough light.

(2) Diffuse-scan models

As a result of tuning without a workpiece, the switch does not receive enough light from target objects.
The switch will be set automatically so that it operates at a light intensity that is between the intensity with a target object and the intensity without a target object.

Hold down the button for about 2 seconds until the orange indicator lamp starts flashing rapidly (at about 10 Hz), then release.

Switches to sensitivity adjustment mode.

Without a workpiece, hold down the button until both*2 LEDs start blinking (about 2 seconds), and release it.

Measures light intensity without a target object.

With a workpiece in place, give the button a short press.*3

Measures light intensity with target present and sets sensitivity.

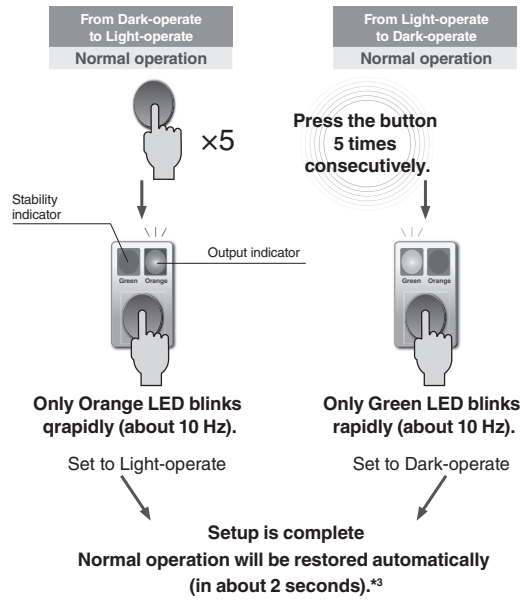
Setup is complete

Normal operation will be restored automatically (in about 2 seconds).*3

*2. It is OK to reverse the order of the two states (target present / target absent).
*3. If the indicator lamp flashes repeatedly, repeat the procedure as described under Indicator lamp flashes repeatedly

LO/DO Changeover

The operating mode is set to default at the factory, but can be changed as outlined below. Light-operate changes to Dark-operate, and Dark-operate changes to Light-operate.



Position tuning

For diffuse-scan detection at any desired specific position, use position tuning. (The positioning accuracy is 15 % at maximum.)

HP7-A1□□: Distance between 200 mm and 500 mm
HP7-A4□□: Distance between 200 mm and 1,000 mm

Hold down the button for about 2 seconds until the orange indicator lamp starts flashing rapidly (at about 10 Hz), then release.

Switches to sensitivity adjustment mode.

With the target in position, hold down the button for about 2 seconds until both indicator lamps start flashing rapidly (at about 10 Hz), then release.

Now press the button again briefly. Both indicator lamps will flash slowly (at about 1 Hz).*4

Press the button briefly.

Setup is complete
Normal operation will be restored automatically. (in about 2 seconds).

*4. If the orange light continues to flash slowly (at about 1 Hz), repeat the procedure as described under Indicator lamp flashes repeatedly.

Checking LO/DO

Use the procedure shown below to check the current operating mode.

Normal operation

Press the button 3 times consecutively.

Orange LED only blinks rapidly (about 10 Hz).

Indicates Light-operate status.

Green LED only blinks rapidly (about 10 Hz).

Indicates Dark-operate status.

Checking is complete
Normal operation will be restored automatically. (in about 2 seconds).

When confused, or to restore the default setting (max. sensitivity)

If you wish to restore the factory default sensitivity, or if you lose track of your progress while making adjustments, do the following to restore the factory default from any flashing status.

Hold down the button until the green LED starts blinking (about 7 seconds).

Sensitivity is restored to the factory default setting.

Setup is complete
Normal operation will be restored automatically. (in about 2 seconds).

Indicator lamp flashes repeatedly

The table below lists the various states indicated by repeated flashing together with suggested responses. If the problem is not resolved, it may be necessary to try a different model of switch.

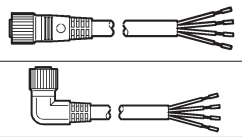
LED indicators	Status	Solution
 Orange indicator flashes rapidly or both indicators flash rapidly (at about 10 Hz)	**Tuning in progress**	Hold down the button until the green indicator flashes rapidly (about 7 seconds) to restore the factory default setting (Maximum sensitivity).
 Orange LED only blinks slowly. (at about 1 Hz)	**Tuning Without a tuning workpiece** Tuning failed - insufficient light	**Thru-scan and retroreflective models** Press the button once to revert to normal operation at the pre-tuning sensitivity. Adjust the light axis and then repeat the tuning procedure.
	2-point tuning Tuning failed - insufficient light at both points	Press the button once to revert to normal operation at the pre-tuning sensitivity. **Thru-scan and retroreflective models** Adjust the light axis and then repeat the tuning procedure. **Diffuse-scan models** Move the switch closer to the target to boost the reflected light intensity and then repeat the tuning procedure.
	2-point tuning Tuning failed - too much light at both points	**Thru-scan models** Press the button once to revert to normal operation at the pre-tuning sensitivity. Reduce the amount of light by using slits or tilting the optical axis, and then repeat the tuning procedure.
 Both LEDs blink slowly at the same time. (at about 1 Hz)	**Tuning without workpiece** Setup is done but light intensity is too high. Stability Indicator may not light up.	Press the button once to revert to normal operation based on the tuning results. Use a workpiece to verify that the switch works properly. **Thru-scan models** Reduce the amount of light by mounting slits or tilting the optical axis, and then repeat the tuning procedure. **Diffuse-scan models** Minimize the reflected light by painting the background black, and then repeat the tuning procedure.
	Tuning without workpiece Setup is done but light intensity is too low. The switch may not operate.	**Thru-scan and retroreflective models** Press the button once to revert to normal operation based on the tuning results. Adjust the light axis and then repeat the tuning procedure.
	2-point tuning After 2-point tuning, the difference in light intensity between the two points is too small. The switch may not operate.	**Thru-scan, retroreflective, and diffuse-scan models** Press the button once to revert to normal operation based on the tuning results. Check operation before use.

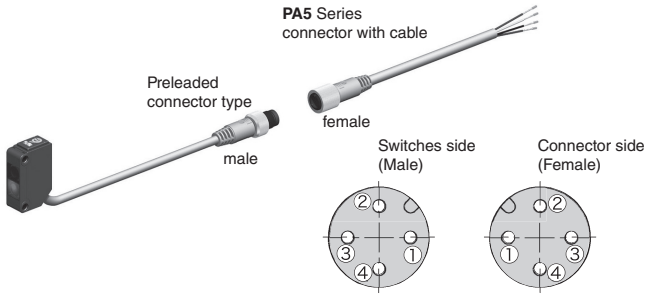
CONNECTOR WITH CABLE

PA5 Series cable

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

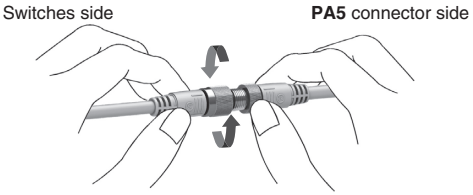
● PA5 Series connector with cable

Shape	Power supply	Cable properties	Cable length	Catalog	Lead colors
	DC	Vinyl-insulated cable with high resistance to oil and vibration (UL/NFPA79 CM, CL3)	2 m	**PA5-4I SX2SK**	1: brown, 2: white, 3: blue, 4: black
			5 m	**PA5-4I SX5SK**	1: brown, 2: white, 3: blue, 4: black
			2 m	**PA5-4I LX2SK**	1: brown, 2: white, 3: blue, 4: black
			5 m	**PA5-4I LX5SK**	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 switches side.

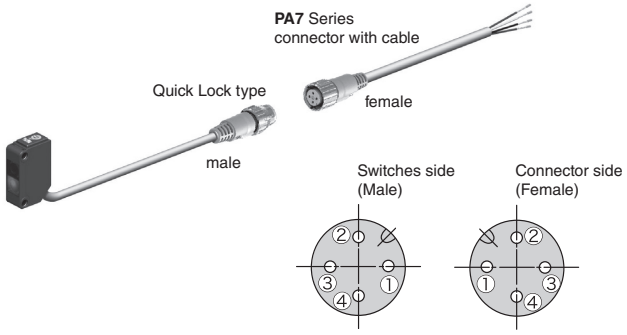


PA7 Series cable

Be sure to use a **PA7** Series connector with cable when connecting Quick Lock type switch.

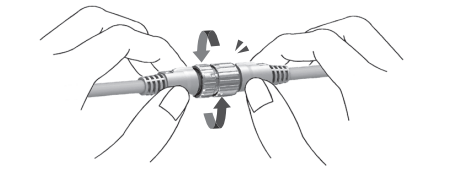
● PA7 Series connector with cable

Shape	Power supply	Cable properties	Cable length	Catalog	Lead colors
	DC	Vinyl-insulated cable with high resistance to oil and vibration (UL/NFPA79 CM)	2 m	**PA7-4I SX2SK**	1: brown, 2: white, 3: blue, 4: black
			5 m	**PA7-4I SX5SK**	1: brown, 2: white, 3: blue, 4: black



● Tightening the connector

Align the triangle mark and mate the male and female connector then rotate 45 degree to match the keys on the rings by hand.



Interchangeable with Smartclick made by OMRON Corporation.

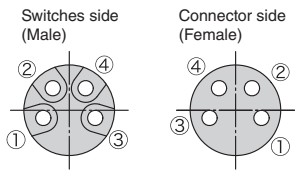
Smartclick Smartclick is trademark of OMRON Corporation.

PA8 Series cable

Be sure to use a **PA8** Series connector with cable when connecting a M8 preleaded connector or M8 connector type switch.

● PA8 Series connector with cable.

Shape	Power supply	Cable properties	Cable length	Catalog	Lead colors
	DC	Vinyl-insulated cable with high resistance to oil and vibration	2 m	**PA8-4I SX2MK**	1: brown, 2: white, 3: blue, 4: black
			5 m	**PA8-4I SX5MK**	1: brown, 2: white, 3: blue, 4: black



● Tightening the connector

Align the grooves and rotate the fastening nut on the **PA8** connector by hand until it fits tightly with the connector on the switches side.

Retroreflective transparent object detection

Tips for using the **HP7-C** retroreflective transparent object detection model

Reflector

- Use the switch in combination with the specified reflector.

Detectable objects

- Objects should block 10 % or more of the light.

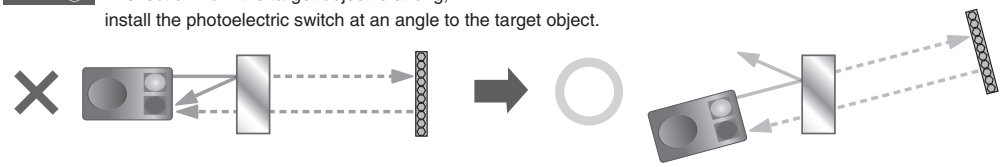
Setup method

- After adjusting the light axis, tune without a workpiece (not using a target object).
  The switch will be automatically set to the optimum sensitivity for detecting transparent objects.

Installation know-how

- Depending on the target object, detection may be unreliable even after performing tuning without a workpiece.
  If so, try the following.

CASE ① If reflection from the target object is strong,
install the photoelectric switch at an angle to the target object.



CASE ② If objects such as plastic bottles cannot be detected because the light passes through them or is intensified,
adjust the positions of the photoelectric switch and the reflector.

CASE ③ To detect round objects, install the switch as shown below.

- As light axis misalignment affects the temperature characteristic, move the photoelectric switch back and forth and up and down to locate the center of the range where the green indicator light turns on.
- When installing the **FE-RR17C** transparent object detection reflector, do not tighten to a torque of more than 1 N·m.

Notes for reliable detection

- Wait 3 minutes after power on before tuning or using the switch. This allows the internal temperature to stabilize.
- If the ambient temperature varies after tuning and detection becomes unreliable, retune the switch.
- Over the course of long-term use, variations in light intensity may be caused by factors such as dirt on the switch/reflector or light axis misalignment due to vibration. Regular maintenance and cleaning will prevent such problems.

HANDLING

Warning
- Designed for general industrial use, not for safety equipment.
- Do not connect this device to AC power. Doing so might cause rupture or burnout.

1. Handling precautions

- Tighten the mounting screws to a maximum torque of 0.8 N·m.
- After the power is turned on, the switch starts to operate in 60 ms at most (80 ms for **HP7-C**).
- For outdoor use, put inside a case, etc., To prevent direct exposure to sunlight and rain water.
- Avoid locations with strong vibration or impact. They may cause optical axis misalignment.
- Shield the lens from water and oil. Water or oil on the lens can cause faulty operation.
- Do not expose to chemicals (Organic solvents, acids, alkalis).
- Use a cover or change the mounting direction to ensure correct switch operation if there is heavy interference from ambient light.
- When used in a very dusty environment, be sure to take countermeasures to keep dust away from the lens surface by using a sealed case or air purging.
- Even when oil-resistant cable is used, do not use in a location subject to continuous splashing by water or oil, or where the unit is immersed in liquid. Ensure that the end of the cable is not subject to splashing by water or oil.
- A bend in the cable immediately after it exits the device should have a radius of a least 30 mm. Also, avoid use in which the cable receives repeated bending stress. Do not apply a force of 50 N or higher (30 N or higher for low-temperature cable types).
- Do not pull the cable with excessive force (> 50 N). cable disconnection can cause burnout. Do not apply a force of 50 N or higher (30 N or higher for low-temperature cable types).
- Photoelectric switches are assembled with precision. Never strike with another object. Especially if the lens surface is scratched or cracked, switch performance may decline.
  Handle with care.
- To clean the lens or reflector, wipe lightly with a soft, clean cloth or cloth moistened with water. Do not use an organic solvent such as alcohol, benzene, acetone, or thinner.
- When multiple photoelectric switches are used close together, mutual interference may occur. After installation, check the operation carefully before use.
- Standard cable might get hardened under 0°C. Do not bend or apply shock / vibration under 0°C. Low temperature cable is available.
- Switch might not reliably detect highly reflective objects or objects that disrupt polarization (ex.: Object covered with transparent film). In such a case try the following countermeasures:

Sample countermeasures
- Mount the switch at an angle to the target object.
- Increase the distance between the switch and the target object.
- Tune the switch without a workpiece.

2. Wiring precautions

- If a cable extension is necessary, use wire at least 0.3 mm^2 in cross-sectional area and at most 100 m long.
- If the cable of photoelectric switch are laid in the same conduit as high-voltage or power lines, inductance may cause malfunction or damage. Isolate the photoelectric switch's cable or lay it in a separate conduit.
- When using a commercially available switching regulator, ground the frame ground and ground terminals. If used without grounding, switching noise may cause faulty operation.
- When using a load which generates an inrush current above the switching capacity, such as a capacitive load or incandescent lamp, connect a current-limiting resistor between the load and the output terminals.
  Otherwise, the output short-circuit protection function may be activated.

3. Adjustment method

Thru-scan model and polarized retroreflective model

1. Move the emitter and receiver (Main body and reflector in case of a retroreflective model) up, down, right, and left, and then align them in the center of the area where the green stable-operation indicator lights up.
2. Check switch operation using a target object then use the Auto Adjust button to adjust the sensitivity setting.

Diffuse-scan model

1. Mount the photoelectric switch pointing toward the desired detection position.
2. Check switch operation using a target object then use the Auto Adjust button to adjust the sensitivity setting.