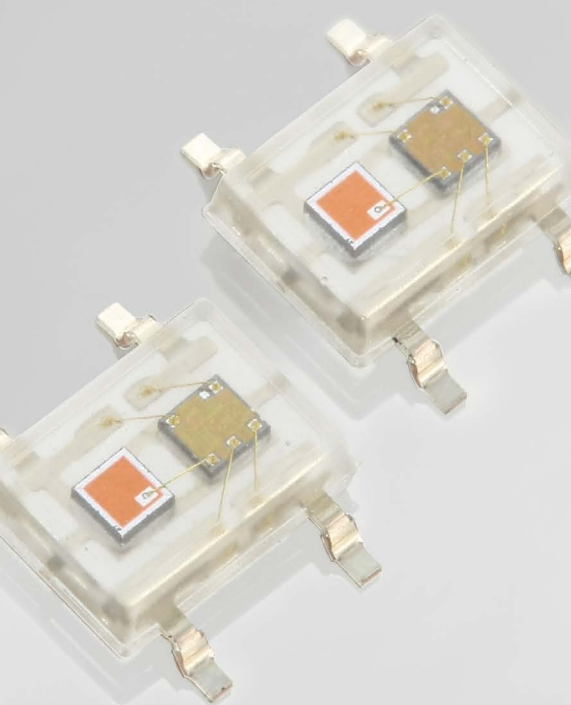
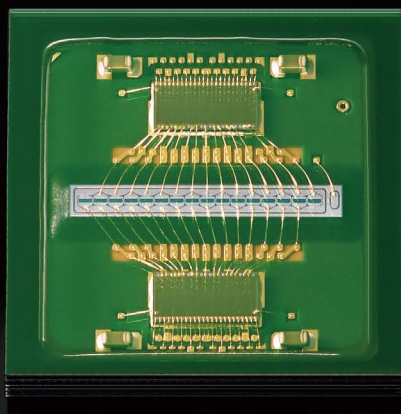


Photo IC

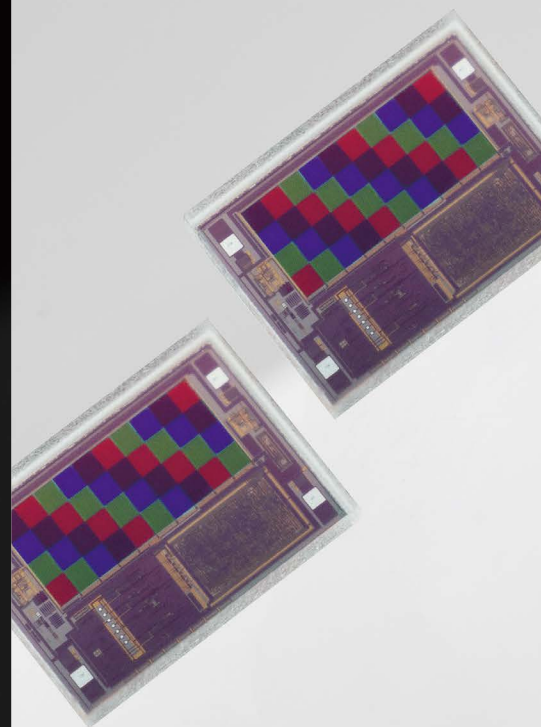
High performance sensor integrated with photosensitive element and signal processing circuit



■ Light-to-frequency converter photo IC
S9705-01DT



■ Photosensor with front-end IC
S16430-01CR



■ I²C compatible color sensor
S13683-02WT

Photo IC

Features

Photo IC is a photosensor that combines a photosensitive element and signal processing circuit in a single package. Photo IC has the following features compared with those combining individual parts such as a photodiode, op amp circuit, etc.

- (1) Compact and lightweight
- (2) Resistant to electromagnetic induction noise
- (3) High reliability
- (4) No troublesome amplifier wiring (excellent cost performance)

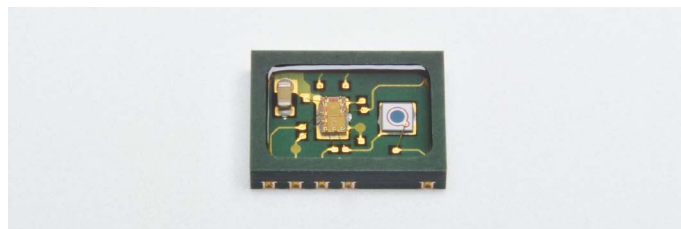
Combines a photosensitive element and signal processing circuit

Hamamatsu offers photo ICs that combine various types of photosensitive element and signal processing circuits (IC).

Si photodiode + IC

- Schmitt trigger circuit photo IC
- Light modulation photo IC
- Photo IC for optical switch, etc.

Si APD + IC



Photosensor with front-end IC
(for direct TOF)

Package lineup

We offer a lineup of packages to suit your mounting environment. Contact us regarding custom products.

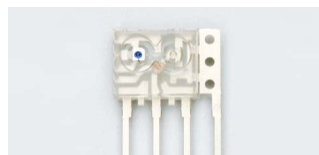
Through-hole mounting type



SIP
(single inline package)



With lens



With dual lens



DIP
(dual inline package)

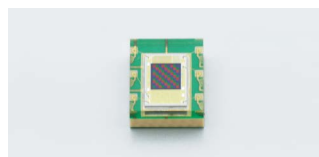
Surface mount type



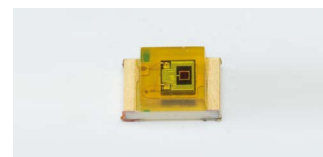
Premolded



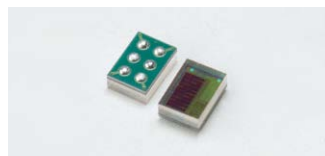
COB
(chip on board)



COB
(chip on board)



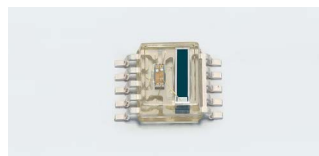
COB
(chip on board)



CSP
(chip size package)



Straight lead type



Gull wing type













With filter

Visit our website for datasheets containing more detailed information on the products shown in this catalog.
www.hamamatsu.com

Illuminance sensors

Analog/digital output

These are photo ICs with spectral response close to that of the human eye. The photo IC diodes are as easy to use as photodiodes while providing a large current output comparable to phototransistors. Light-to-frequency converter photo ICs are also available.



| Type no. | Product name | Output | Reverse voltage [Supply voltage] (V) | Spectral response range (nm) | Photocurrent 2856 K, 100 lx | Features | Package | Photo |
|------------------------------|---------------------------------------|--|--|---------------------------------------|--------------------------------|--|--------------------|---|
| S7183 | Photo IC diode | Analog | -0.5 to +16 | 300 to 1000 | 0.75 to 1.25 mA | With infrared sensitivity | SIP with lens |  |
| S7184 | | | | | 1.4 to 2.2 mA (1000 lx) | | Surface mount type |  |
| S9066-211SB | | | -0.5 to +12 | 300 to 820 | 0.19 to 0.35 mA | Reduces color temperature errors in the same illuminance | SIP |  |
| S9067-201CT | | | | | 0.18 to 0.34 mA | | COB |  |
| S11153-01MT | | | | | 0.325 to 0.495 mA | | Surface mount type |  |
| S10604-200CT | | | | | 0.21 to 0.39 mA | | COB |  |
| S13948-01SB | | | | | 0.18 to 0.34 mA | | Head-on |  |
| S11154-201CT | | | | 480 to 640 | 0.07 to 0.15 mA | Spectral response close to that of the human eye | COB |  |
| S9705 | Light-to-frequency converter photo IC | Digital (can be directly connected to your microcomputer) | [-0.3 to +6] | 380 to 660 | 50 kHz*1 | CMOS level digital output | Surface mount type |  |
| S9705-01DT | | | | 320 to 1000 | 40 kHz*1 (20 lx) | | |  |

*1: Output frequency

Color sensors

Digital output

These photo ICs have sensitivity to red, green, and blue respectively. Detected results are serially output in a digital value.

| Type no. | Product name | Peak sensitivity wavelength (nm) | | Operating supply voltage (V) | Photosensitive area All elements (mm) | Photosensitivity | | | Features | Photo |
|--------------------------------|--|----------------------------------|-----|------------------------------|---------------------------------------|------------------|------------------|------------------|--|---|
| | | | | | | Color | Low range | High range | | |
| S9706 *2 | Digital color sensor | B | 465 | 3.0 to 5.5 | 1.2 × 1.2 (9 × 9 elements) | B | 0.21 (LSB/lx) | 1.9 (LSB/lx) | 12-bit digital output, two-stage sensitivity switchable function*4 |  |
| | | G | 540 | | | G | 0.45 (LSB/lx) | 4.1 (LSB/lx) | | |
| | | R | 615 | | | R | 0.64 (LSB/lx) | 5.8 (LSB/lx) | | |
| | | B | 465 | | | B | 0.3 (LSB/lx) | 2.6 (LSB/lx) | | |
| S11012-01CR *3 | | G | 540 | | | G | 0.6 (LSB/lx) | 5.3 (LSB/lx) | | |
| | | R | 615 | | | R | 1.4 (LSB/lx) | 12.9 (LSB/lx) | | |
| S13683-02WT | I ² C compatible color sensor | B | 460 | 2.25 to 3.63 | 1.22 × 0.56 (10 × 4 elements) | B | 3.35 (counts/lx) | 31.7 (counts/lx) | 16-bit digital output, two-stage sensitivity switchable function*6 |  |
| | | G | 530 | | | G | 7.61 (counts/lx) | 76.2 (counts/lx) | | |
| | | R | 615 | | | R | 9.48 (counts/lx) | 94.5 (counts/lx) | | |
| | | - | - | | | *5 | 1.66 (counts/lx) | 15.3 (counts/lx) | | |
| S13683-03DT *2 | | B | 460 | 2.25 to 3.63 | 1.22 × 0.56 (10 × 4 elements) | B | 3.8 (counts/lx) | 40 (counts/lx) | | |
| | | G | 530 | | | G | 8.7 (counts/lx) | 86 (counts/lx) | | |
| | | R | 615 | | | R | 12.4 (counts/lx) | 122 (counts/lx) | | |
| | | - | - | | | *5 | 3.0 (counts/lx) | 30 (counts/lx) | | |

*2: The glass filter may fall if there are excessive forces or continuous vibration. Secure the glass filter with a holder and the like.

*3: Sensitive in the infrared range

*4: Uses a photosensitive area with 9 × 9 elements in the high range and 3 × 3 elements in the low range

*5: Correction channel. It detects the incident light that does not pass the filter.



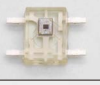

Highly precise data can be obtained by subtracting this value from the RGB data with internal processing.

*6: Uses a photosensitive area with 4 × 10 elements in the high range and 1 × 4 elements in the low range

Schmitt trigger circuit photo IC

Digital output

These photo ICs are comprised of a photodiode, amplifier, schmitt trigger circuit, output transistor, and the like, all integrated in one chip.







| Type no. | Peak sensitivity wavelength (nm) | Operating supply voltage (V) | Threshold illuminance*7 max. (μW/mm ²) | Features | Package | Photo |
|-----------------------------|----------------------------------|------------------------------|--|--|--------------------|---|
| S4810 | 850 | 2.2 to 7.0 | 1.5 | Open collector output, “H” level output at light input | SIP with lens |  |
| S6289 | | | | Open collector output, “L” level output at light input | | |
| S7610-10 | | | 0.25 | Open collector output, “L” level output at light input | SIP with lens |  |
| S12558-01DT | | | 2.0 | | Surface mount type |  |
| S12558-02DT | | | | | |  |

*7: $\lambda_p=890\text{ nm}$

Light modulation photo IC

Digital output

These photo ICs employ an optical synchronous detection that ensures stable output even under disturbance background light.

| Type no. | Peak sensitivity wavelength (nm) | Operating supply voltage (V) | Threshold illuminance*8 max. (μW/mm²) | Allowable background light level*9 (lx) | Features | Package | Photo |
|-----------------------------|----------------------------------|------------------------------|---------------------------------------|---|--|--------------------|---|
| S4282-51 | 800 | 4.5 to 16 | 2 | 10000 | High allowable background light level Output “L” at light input | DIP |  |
| S4289-61 | 850 | | 1 | 4000 | Asynchronous detection method Output “L” at light input | DIP |  |
| S6809 | | | | 3000 | High sensitivity Small hysteresis Output “L” at light input | SIP |  |
| S6846 | | | | | High sensitivity Output “L” at light input | | |
| S6986 | | | | 800 | 2 | 10000 | High allowable background light level Output “L” at light input |
| S7136 | 850 | | 1 | 3000 | High sensitivity Output “L” at light input | DIP |  |
| S7136-10 | | | | | High sensitivity Output “L” at light input | Surface mount type |  |
| S10053-01DT | 800 | | 2 | 10000 | High allowable background light level Output “L” at light input | Surface mount type |  |


*8: $\lambda_p=940\text{ nm}$

*9: Signal light= $5\text{ }\mu\text{W}/\text{mm}^2$, $\lambda_p=940\text{ nm}$, disturbance background light=A light source

Phototransistor

Analog output

This sensor amplifies and outputs current generated by incident light. Compared to photodiodes, a large output current can be derived even from a small photosensitive area.


| Type no. | Peak sensitivity wavelength (nm) | Photocurrent*10 (mA) | Dark current V _{CE} =20 V max. (nA) | Collector-emitter saturation voltage 1000 I _x max. (V) | Package | Photo |
|-----------------------|----------------------------------|----------------------|--|---|---------------|---|
| S2829 | 800 | 1.8 | 100 | 0.4 (I _c =0.3 mA) | SIP with lens |  |

*10: V_{CE}=5 V, 1000 I_x, CIE standard A light source 2856 K

Near infrared/proximity type sensor

Digital output





This reflective sensor houses an InGaAs PIN photodiode and 1.45 μm band LED in a compact package. The LED irradiates light on the target object, and the photodiode signal generated from the reflected light is output digitally through an I²C interface.

| Type no. | Structure | Photosensitive area (mm) | Emitter area (mm) | Spectral response range (μm) | Peak emission wavelength (μm) | Photo |
|--|--------------------------------------|--------------------------|-------------------|------------------------------|-------------------------------|---|
| NEW P13567-02CT | InGaAs PIN photodiode + infrared LED | φ0.3 | 0.31 × 0.31 | 0.9 to 1.7 | 1.45 |  |




Photosensors with front-end IC

Digital output

These are compact devices that integrate a Si APD and a front-end IC. They provide excellent noise and frequency characteristics suitable for measuring distance.

| Type no. | Structure | Photosensitive area (mm) | Spectral response range (nm) | Peak sensitivity wavelength (nm) | Photosensitivity (kV/W) | High cutoff frequency (MHz) | Photo |
|-----------------------------|---|--------------------------|------------------------------|----------------------------------|-------------------------|-----------------------------|---|
| S15597-01CT | Si APD + TIA*12 | φ0.2 | 400 to 1100 | 840 | 3200*11 (high gain) | 180 |  |
| S15658-01CT | | φ0.5 | | | | 150 |  |
| S13645-01CR | 16 ch Si APD array + TIA*12 (serial output) | 0.4 (H) × 1.0 (V)*13 | 400 to 1150 | | 900*14 (high gain) | 180 |  |
| S14137-01CR | 16 ch Si APD array + TIA*12 (parallel output) | 0.43 (H) × 0.15 (V)*13 | 420 to 1150 | | 36*14 | 180 |  |

By adopting a gain-stabilized Si APD, there is little gain fluctuation relative to temperature fluctuation. They have an increased high-band cutoff frequency of the transimpedance amplifier, realizing high-speed response.

| Type no. | Structure | Photosensitive area (mm) | Spectral response range (nm) | Peak sensitivity wavelength (nm) | Photosensitivity (kV/W) | High cutoff frequency (MHz) | Photo |
|--|---|--------------------------|------------------------------|----------------------------------|-------------------------|-----------------------------|---|
| NEW S16429-01CT | Si APD + TIA*12 | φ0.2 | 400 to 1000 | 840 | 0.5 A/W | 300 |  |
| NEW S16429-02CT | | φ0.5 | | | | 280 |  |
| NEW S16430-01CR | 16 ch Si APD array + TIA*12 (parallel output) | 0.45 (H) × 0.15 (V)*13 | | | | 300 |  |

*11: λ=905 nm, M=100 *12: Transimpedance amplifier *13: Per element *14: λ=905 nm, M=50

Photo IC for optical link

Digital output (receiver photo IC)

These are transmitter/receiver photo ICs for plastic optical fiber communication. The optical transceiver P16671-01AS with a built-in transmitter and receiver which is capable of serial data communication is also available.














| Product name/ Type no. | Data rate (Mbps) | Operating supply voltage (V) | Fiber coupling light output (dBm) | Reception level (dBm) | Operating temperature (°C) | Features | Photo |
|--|---------------------|--|---|--------------------------|----------------------------------|---|---|
| Receiver photo IC S12512-01SR | DC to 1 | 3.135 to 3.465 | – | -25 to 0 | -20 to +85 | Low current consumption |  |
| Transmitter photo IC L12422-01SR | DC to 10 | 3.135 to 3.465 | -10 to 0 | – | -20 to +85 | – |  |
| Transmitter photo IC L12557-01SR | | 4.75 to 5.25 | -10 to -1 | – | | Supports 5 V |  |
| Receiver photo IC S12423-01SR | | 3.135 to 3.465 | – | -20 to -2 | | – |  |
| Receiver photo IC S13174-01SR | | | | -24 to 0 | | |  |
| Receiver photo IC S7141-10 | DC to 50 | 4.75 to 5.25 | – | -17.5 to -5 | -10 to +70 | – |  |
| Receiver photo IC S8046 | 4 to 50 | 4.5 to 5.5 | – | -28 to -8 | -40 to +85 | With standby mode |  |
| Receiver photo IC S7727 | 4 to 156 | 4.5 to 5.5 | – | -22 to -2 | -20 to +70 | – |  |
| Transmitter photo IC L11354-02 | 4 to 150 | 3.135 to 3.465 | -7 to -1.5 | – | -40 to +95 | MOST-compliant (In-vehicle) |  |
| Receiver photo IC S11355-04 | | | – | -23.5 to -2.5 | | |  |
| Optical transceiver  P16671-01AS | 150 to 1250 | 3.135 to 3.465 (IC) 4.75 to 5.25 (PD) | -7 to -2.5 (POF) | 0 to -12 (POF) | -10 to +70 | POF, HPCF, Large diameter glass optical fiber |  |

Photo IC for encoder, Encoder module

Digital output

This photo IC for encoder is integrated with a 4-element photodiode. It can provide two-phase digital output, and the encoder can be easily configured.

| Type no. | Peak sensitivity wavelength (nm) | Operating supply voltage (V) | Element size Per element (mm) | Element pitch (mm) | Features | Package | Photo |
|-----------------------|--|------------------------------------|-------------------------------------|-----------------------|--------------------------|---------|---|
| S4506 | 870 | 4.5 to 5.5 | 0.31 (H) × 0.41 (V) | 0.39 | Two-phase digital output | SIP |  |

This encoder module consists of a photo IC for encoder and a red LED. The photo IC for encoder outputs the movement of the 0.2 mm pitch encoder slit as a 2-phase digital signal.





| Type no. | Operating supply voltage (V) | Maximum response frequency min. (kHz) | Phase difference (degrees) | Features | Photo |
|------------------------------|------------------------------------|---|-------------------------------|---------------------------|---|
| P11159-201AS | 3.0 to 7.0 | 50 | 60 to 120 | High resolution (0.05 mm) |  |

Photo IC for optical switch

Analog/digital output

These photo ICs include functions needed for industrial optical switches.




| Type no. | Spectral response range (nm) | Operating supply voltage (V) | Threshold illuminance max. ($\mu\text{W}/\text{mm}^2$) | Allowable background light level*15 (lx) | Features | Package | Photo |
|------------------------------|------------------------------|------------------------------|--|---|---|--------------------|---|
| S6841 | 380 to 1120 | 4.5 to 5.5 | 0.1 | 5000 | High sensitivity Digital output | Surface mount type |  |
| S8119 | | | 0.2 | 10000 | High allowable background light level Digital output | | |
| S11049-202SB | | | – | 6000 | Analog output | SIP |  |
| S11049-203DT | | | | | | Surface mount type |  |

*15: Photosensitive illuminance drops below 20% from disturbance background light.

Photo IC for laser beam synchronous detection

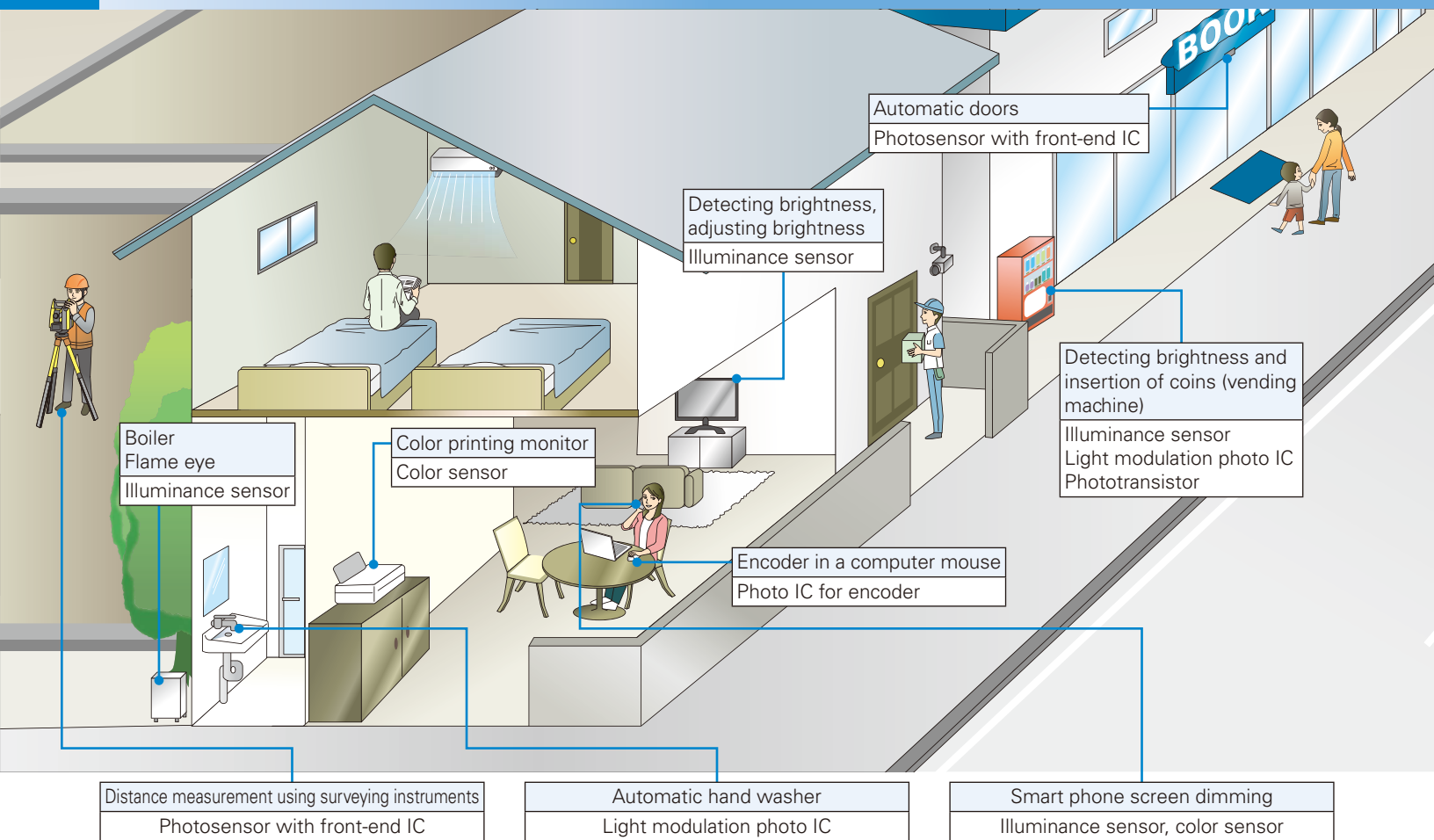
Digital output

These photo ICs detect timing to begin laser beam printing in laser beam printers and digital copiers. We also offer two-element photodiode types that ensure stable output against incident laser power and temperature fluctuations.

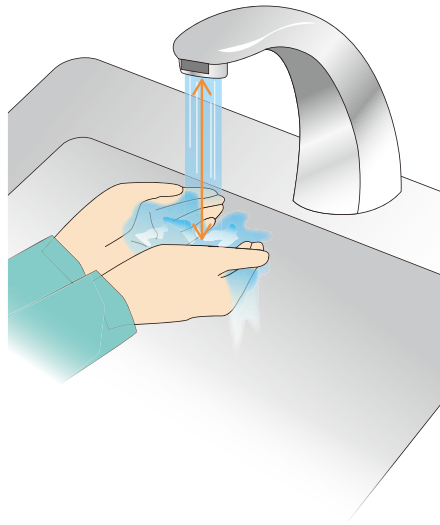
| Type no. | Photosensitive area (H) × (V) (mm) | | H→L propagation delay time variation (ns) | H→L propagation delay time (ns) | Threshold input power*16 (μW) | Features | Package | Photo |
|-----------------------------|--|-----------|--|--|-------------------------------------|--|-----------------------|---|
| S9684 | PD1 | 0.3 × 2.5 | ±5 | — | 10 | Dual-element type Current amplifier gain: 20 times For low laser powers | Surface mount type |  |
| | PD2 | 0.5 × 2.5 | | | | | | |
| S9684-01 | PD1 | 0.3 × 2.5 | | | 35 | Dual-element type Current amplifier gain: 6 times | | |
| | PD2 | 0.5 × 2.5 | | | | | | |
| S11282-01DS | PD1 | 0.3 × 2.5 | | | 14.5 | Dual-element type Current amplifier gain: 20 times Low voltage operation (3.3 V) | | |
| | PD2 | 0.5 × 2.5 | | | | | | |
| S11257-01DT | 0.25 × 2.84 | | — | 200 max. | 62 | Single-element type Current amplifier gain: 6 times Low voltage operation (3.3 V) | |  |
| S11257-02DT | | | | 250 max. | 19 | Single-element type Current amplifier gain: 20 times Low voltage operation (3.3 V) | | |
| S9703-11 | 0.5 × 2.84 | | — | 90 max. | 75 | Single-element type Current amplifier gain: 6 times | |  |
| S10317 | | | | 250 max. | 19 | Single-element type Current amplifier gain: 20 times Low voltage operation (3.3 V) | | |
| S10317-01 | | | | 200 max. | 62 | Single-element type Current amplifier gain: 6 times Low voltage operation (3.3 V) | | |

*16: Gain resistance=5.1 k Ω , λ =780 nm, incident light angle=normal line direction $\pm 0^\circ$

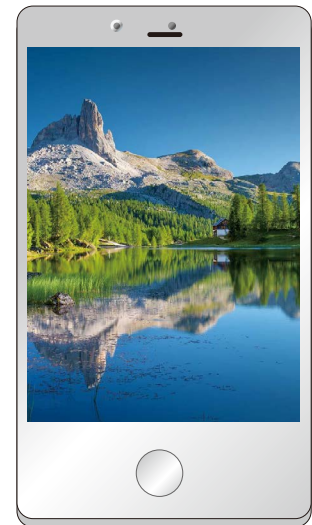
Application examples



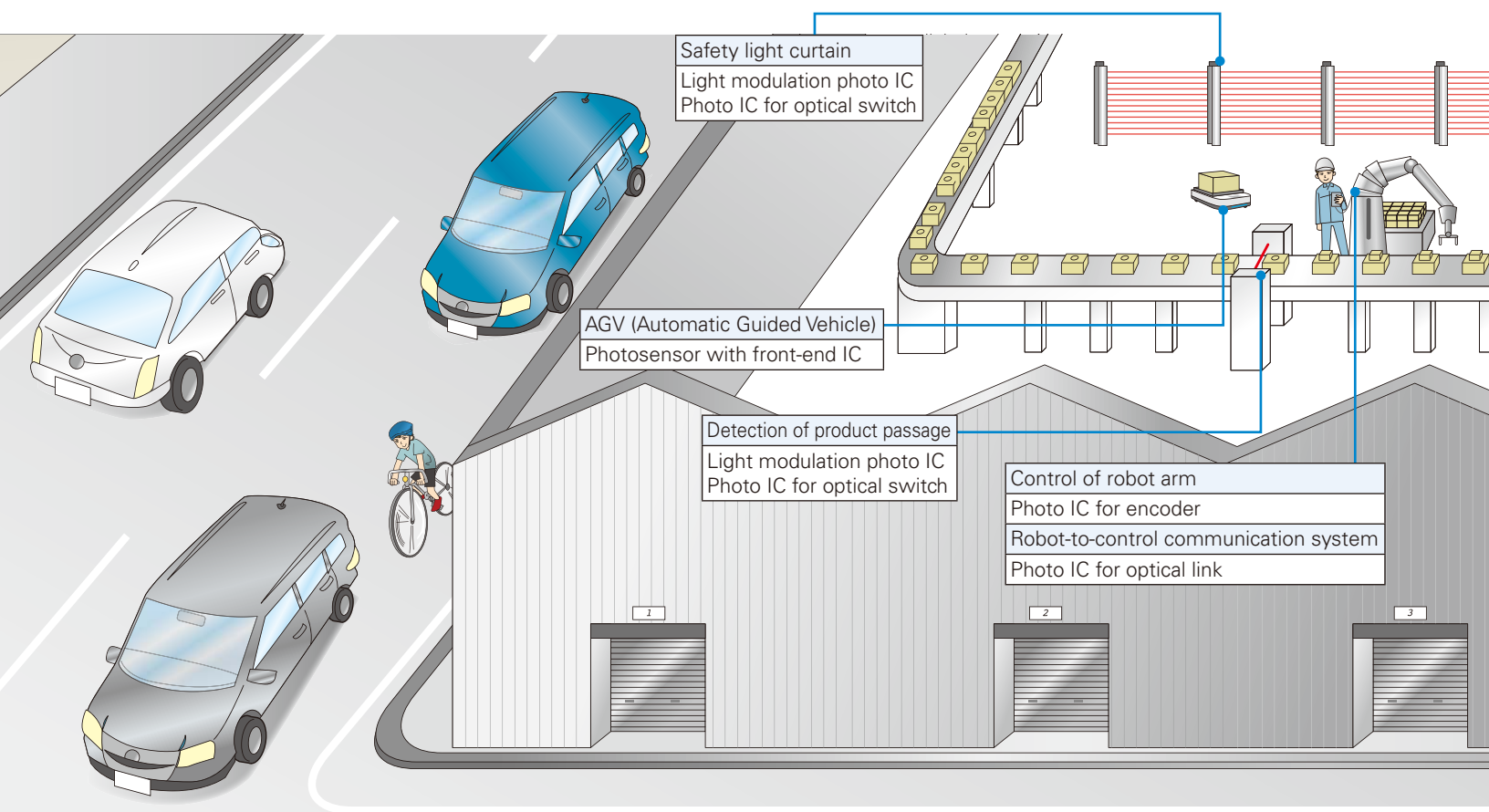
The measurement object is irradiated with laser light, and the reflected light is detected by a photosensor with front-end IC to measure distance.



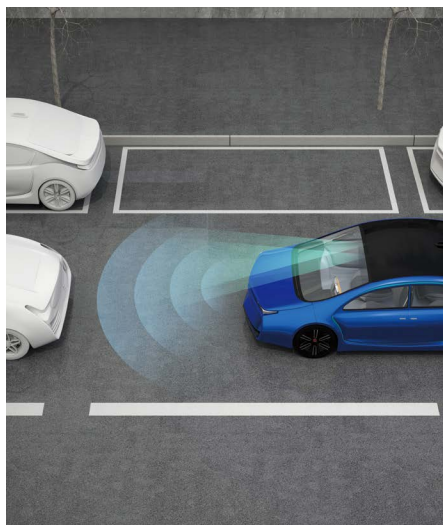
Reflected light from the light emitting diode is detected by the light modulation photo IC; water automatically comes out depending on the distance to your hand.



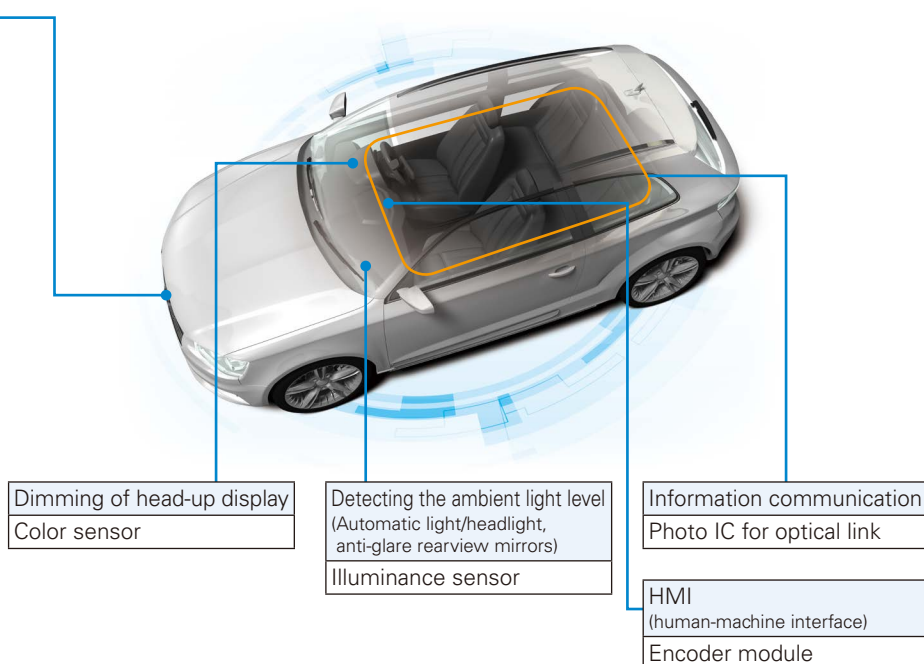
The illuminance or color sensors automatically adjust monitor brightness to match the ambient brightness.



(Front) Obstacle detection, collision avoidance
Photosensor with front-end IC



The photosensor with front-end IC optically measures the distance from the car in front of you based on the time it takes for the laser light to return and controls the distance between vehicles.



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