Universal AC/DC Photoelectric Sensors



BEN Series

PRODUCT MANUAL

For your safety, read and follow the considerations written in the instruction manual, other manuals and Autonics website.
The specifications, dimensions, etc. are subject to change without notice for product improvement. Some models may be discontinued without notice.

Features

- Small and power supply built-in type
- Easy installation with indicators on product
- Light ON/Dark ON mode selectable by switch
- Status and output indication
- Built-in IC photo diode for disturbing light and electrical noise

Safety Considerations

- Observe all 'Safety Considerations' for safe and proper operation to avoid hazards.
- ⚠ symbol indicates caution due to special circumstances in which hazards may occur.

⚠ Warning Failure to follow instructions may result in serious injury or death.

01. Fail-safe device must be installed when using the unit with machinery that may cause serious injury or substantial economic loss. (e.g., nuclear power control, medical equipment, ships, vehicles, railways, aircraft, combustion apparatus, safety equipment, crime/disaster prevention devices, etc.)
Failure to follow this instruction may result in personal injury, economic loss or fire.

02. Do not use the unit in the place where flammable/explosive/corrosive gas, high humidity, direct sunlight, radiant heat, vibration, impact or salinity may be present.
Failure to follow this instruction may result in explosion or fire.

03. Do not disassemble or modify the unit.
Failure to follow this instruction may result in electric shock or fire.

04. Do not connect, repair, or inspect the unit while connected to a power source.
Failure to follow this instruction may result in electric shock or fire.

05. Check 'Connections' before wiring.
Failure to follow this instruction may result in fire.

⚠ Caution Failure to follow instructions may result in injury or product damage.

01. Use the unit within the rated specifications.
Failure to follow this instruction may result in fire or product damage.

02. Use a dry cloth to clean the unit, and do not use water or organic solvent.
Failure to follow this instruction may result in electric shock or fire.

03. Do not use a load over the range of rated relay specification.
Failure to follow this instruction may result in insulation failure, contact melt, contact failure, relay broken, or fire

Cautions during Use

- Follow instructions in 'Cautions during Use'. Otherwise, It may cause unexpected accidents.
- When connecting an inductive load such as DC relay or solenoid valve to the output, remove surge by using diodes or varistors.
- Use the product after 0.5 sec of the power input.
  When using a separate power supply for the sensor and load, supply power to the sensor first.
- The power supply should be insulated and limited voltage/current or Class 2, SELV power supply device.
- Wire as short as possible and keep it away from high voltage lines or power lines to prevent surge and inductive noise.
- When using switching mode power supply (SMPS), ground F.G. terminal and connect a condenser between 0V and F.G. terminal to remove noise.
- When using a sensor with a noise-generating equipment (e.g., switching regulator, inverter, and servo motor), ground F.G. terminal of the equipment.
- This unit may be used in the following environments.
  - Indoors (in the environment condition rated in 'Specifications')
  - Altitude max. 2,000 m
  - Pollution degree 2
  - Installation category II

Product Components

Sensing type	Through-beam	Retroreflective	Polarized retroreflective	Diffuse reflective
Product components	Product, instruction manual			
Reflector	-	MS-2	MS-2	-
Adjustment screwdriver	× 1	× 1	× 1	× 1
Bracket	× 2	× 1	× 1	× 1
M4 bolt / nut	× 4	× 2	× 2	× 2

CE UKCA EAC

Ordering Information

This is only for reference, the actual product does not support all combinations.
For selecting the specified model, follow the Autonics website.

BEN ❶ - ❷ ❸

❶ Sensing distance
Number: Sensing distance (unit: mm)
Number+M: Sensing distance (unit: m)

❷ Sensing type
T: Through-beam
M: Retroreflective
P: Polarized retroreflective
D: Diffuse reflective

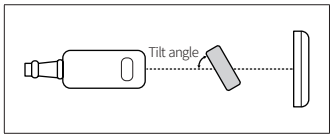
❸ Output method
FR: AC/DC power, relay conctact output
DT: DC power, solid state (transistor) output

Sold Separately

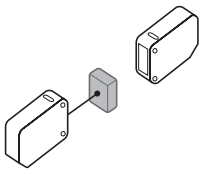
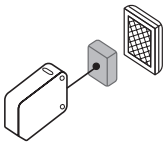
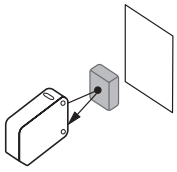
- Reflector: MS Series
- Retroreflective tape: MST Series

Cautions during Installation

- Be sure to install this product by following the usage environment, location, and specified ratings. Consider the listed conditions below.
  - Installation environment and background (reflected light)
  - Sensing distance and sensing target
  - Direction of target's movement
  - Characteristic curves
- When installing multiple sensors closely, it may result in malfunction due to mutual interference.
- Retroreflective: If the sensing target has a glossy surface or high reflection, tilt the sensing target with an angle from 30 to 45 degrees and install the sensor.



- For installation, tighten the screw with a torque of 1.2 N m. Mount the brackets correctly to prevent the twisting of the sensor's optical axis.
- Do not impact with a hard object or bend the cable excessively. That could decrease the product's water resistance.
- Use this product after the test. Check whether the indicator works appropriately for the positions of the detectable object.

Through-beam	Retroreflective	Reflective
		
Emitter - Receiver: Install to face each other	Sensor - Reflector: At least 0.1 m apart, install to face each other (parallel with the sensing side of the unit)	Sensor - Sensing target: Install to face each other (parallel with the sensing side of the unit)

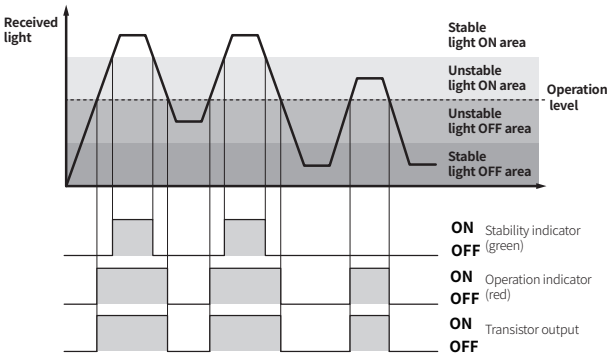
Setting Operation Mode

- Be sure to set the mode before power-on.
- Use the offered adjustment screwdriver. Do NOT turn with excessive force to prevent product damage.

L: Light ON mode	D: Dark ON mode
	

Operation Timing Chart and Indicators

■ Light ON mode

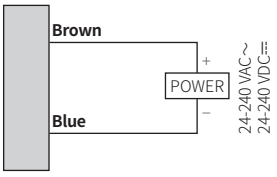


- In Dark ON mode, the waveforms are reversed.

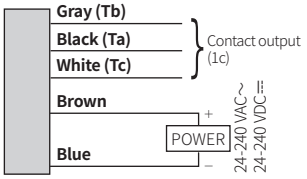
Connections

■ AC/DC power, relay conctact output

- Emitter

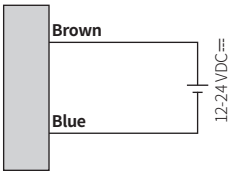


- Receiver, Retroreflective, Polarized retroreflective, Diffuse reflective type

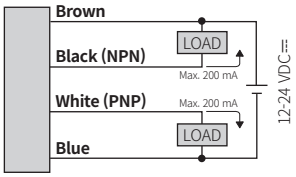


■ DC power, solid state (transistor) output

- Emitter

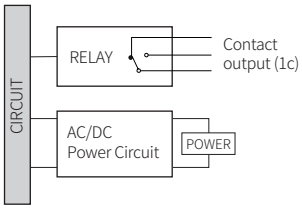


- Receiver, Retroreflective, polarized retroreflective, Diffuse reflective type

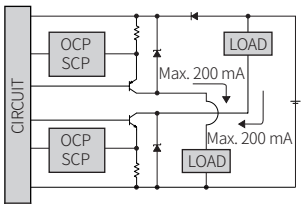


Circuit

■ AC/DC power, relay contact output



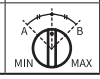
■ DC power, solid state (transistor) output



- OCP (over current protection), SCP (short circuit protection)
- If short-circuit the control output terminal or supply current over the rated specification, normal control signal is not output due to the protection circuit.

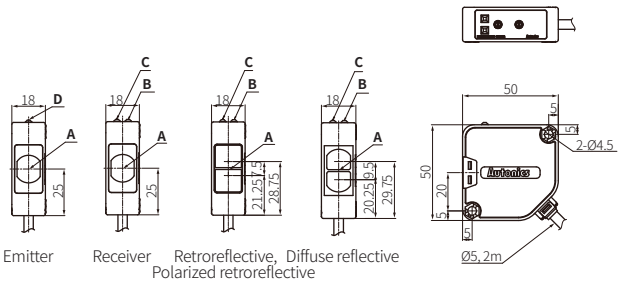
Sensitivity Adjustment

- Set the adjuster for stable Light ON area, minimizing the effect of the installation environment.
- Use the offered adjustment screwdriver. Do NOT turn with excessive force to prevent product damage.
- The steps below are based on Light ON mode.

STEP	Status	Description	
01	Received		Turn the adjuster from MIN to MAX sensitivity and check the position (A) where the operation indicator activates under the light ON area.
02	Interrupted		Turn the adjuster from (A) to MAX and check the position (B) where the operation indicator activates under the light OFF area. If the operation indicator does NOT activate at the MAX (maximum sensitivity): MAX = (B).
03	-		Set the adjuster at the mid position between (A) and (B) for optimal sensitivity.

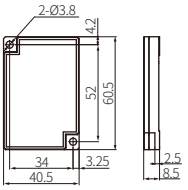
Dimensions

- Unit: mm, For the detailed drawings, follow the Autonics website.

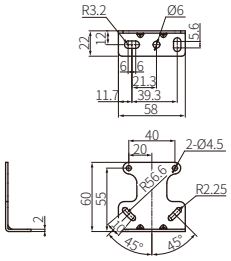


A	Optical axis	C	Stability indicator (green)
B	Operation indicator (red)	D	Power indicator (red)

■ Reflector (MS-2)



■ Bracket



Specifications

Model	BEN10M-T☐	BEN5M-M☐	BEN3M-P☐	BEN300-D☐
Sensing type	Through-beam	Retroreflective	Polarized retroreflective	Diffuse reflective
Sensing distance	10 m	0.1 to 5 m [01]	0.1 to 3 m [01]	300 mm [02]
Sensing target	Opaque materials	Opaque materials	Opaque materials	Opaque, translucent materials
Min. sensing target	≥ Ø 16 mm	≥ Ø 60 mm	≥ Ø 60 mm	-
Hysteresis	-	-	-	≤ 20 % of sensing distance
Response time	AC/DC power, relay contace output model: ≤ 20 ms DC power, solid state (transistor) output model: ≤ 1 ms			
Light source	Infrared	Infrared	Red	Infrared
Peak emission wavelength	850 nm	940 nm	660 nm	940 nm
Sensitivity adjustment	-	YES (Adjuster)	YES (Adjuster)	YES (Adjuster)
Operation mode	Light ON mode - Dark ON mode selectable (Adjuster)			
Indicator	Operation indicator (red), stability indicator (green), power indicator (red) [03]			
Approval	CE UK CA EAC			
Unit weight (AC/DC power)	≈ 354 g	≈ 208 g	≈ 208 g	≈ 195 g
Unit weight (DC power)	≈ 342 g	≈ 200 g	≈ 200 g	≈ 187 g

01) Reflector (MS-2)
02) Non-glossy white paper 100 × 100 mm
03) Only for the emitter

Output method	AC/DC power, relay conctact output	DC power, solid state (transistor) output
Power supply	24-240 VAC~ ± 10 % 50/60 Hz 24-240 VDC⎓ ± 10 % (ripple P-P: ≤ 10 %)	12-24 VDC⎓ ± 10 % (ripple P-P: ≤ 10 %)
Power / current consumption	≤ 4 VA	It depends on the sensing type
Through-beam	-	Emitter: ≤ 50 mA, receiver: ≤ 50 mA
Reflective	-	≤ 50 mA
Control output	Relay contact output	NPN open collector - PNP open collector simultaneous output
Contact capacity	250 VAC~ 3 A of resistance load, 30 VDC⎓ 3 A of resistance load	-
Conctact composition	1c	
Relay life cycle	Mechanical: ≥ 50,000,000 Electrical: ≥ 100,000	
Load voltage	-	≤ 30 VDC⎓
Load current		≤ 200 mA
Residual voltage		NPN: ≤ 1 VDC⎓, PNP: ≤ 2.5 VDC⎓
Protection circuit	-	Reverse power protection circuit, output short overcurrent protection circuit
Insulation resistance	≥ 20 MΩ (500 VDC⎓ megger)	
Insulation type	Double or strong insulation (dielectric voltage between the measured input and the power : 1 kV)	-
Noise immunity	± 1,000 VDC⎓ the square wave noise (pulse width: 1 μs) by the noise simulator	±240 VDC⎓ the square wave noise (pulse width: 1 μs) by the noise simulator
Dielectric strength	Between the charging part and the case: 1,000 VAC~ 50/60 Hz for 1 min	
Vibration	1.5 mm double amplitude at frequency of 10 to 55 Hz in each X, Y, Z direction for 2 hours	
Vibration (malfunction)	1.5 mm double amplitude at frequency of 10 to 55 Hz in each X, Y, Z direction for 10 min	-
Shock	500 m/s² (≈ 50 G) in each X, Y, Z direction for 3 times	
Shock (malfunction)	100 m/s² (≈ 10 G) in each X, Y, Z direction for 3 times	-
Ambient illuminance (receiver)	Sunlight: ≤ 11,000 lx, incandescent lamp: ≤ 3,000 lx	
Ambient temperature	-20 to 65 °C, storage: -20 to 70 °C (no freezing or condensation)	
Ambient humidity	35 to 85 %RH, storage: 35 to 85 %RH (no freezing or condensation)	
Protection rating	IP50 (IEC standard)	
Connection	Cable type	
Cable spec.	Ø 5 mm, Emitter: 2-wire, AC/DC power: 5-wire, DC power: 4-wire, 2 m	
Wire spec.	AWG22 (0.08 mm, 60-core), insulator outer diameter: Ø 1.25 mm	
Material	Case and case cover: heat resistant ABS, sensing part: PC (polarized retroreflective: PMMA)	

Sold Separately: Reflector MS Series

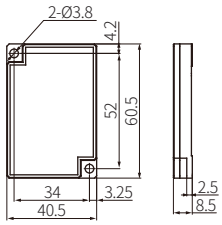
Appearance	Size (W × H)	Reflectance	Sensing type	Model
	40.5 × 60.5 mm	Typical reflectivity	Retroreflective	MS-2
		Typical reflectivity	Polarized retroreflective	MS-2A
		High reflectivity	Polarized retroreflective	MS-2S
	81.5 × 60.5 mm	Typical reflectivity	Retroreflective	MS-3
		High reflectivity	Polarized retroreflective	MS-3S
	29.3 × 38 mm	Typical reflectivity	Retroreflective	MS-4
	15.4 × 24 mm	Typical reflectivity	Retroreflective	MS-5
	13.7 × 23 mm	Typical reflectivity	Retroreflective	MS-6

- Material: PMMA / ABS (front part / rear part)
- Installation: Bolt mounting

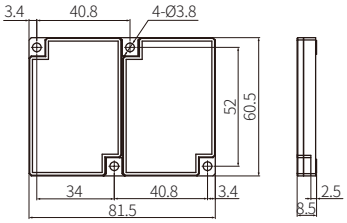
■ Dimensions

(Unit: mm)

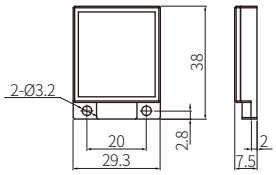
MS-2☐



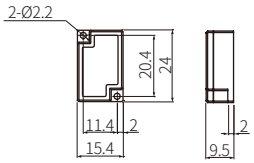
MS-3☐



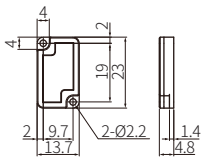
MS-4



MS-5



MS-6



■ Cautions during Installation

- Select a reflector size that is suitable for the installation space and operating environment of the sensors.
- In general, a bigger size of the reflector results in a longer sensing distance.
- Reflectors with high reflectivity increase the sensing distance compared to typical reflectors.
- The reflectance may vary depending on the operating environment for the sensors.

Sold Separately: Retroreflective Tape MST Series

Appearance	Size (W × H)	Approval	Packaged unit	Sensing type	Model
	50 × 50 mm	EAC	10	• Retroreflective • Polarized retroreflective	MST-50-10
	100 × 100 mm	EAC	5	• Retroreflective • Polarized retroreflective	MST-100-5
	200 × 200 mm	EAC	2	• Retroreflective • Polarized retroreflective	MST-200-2

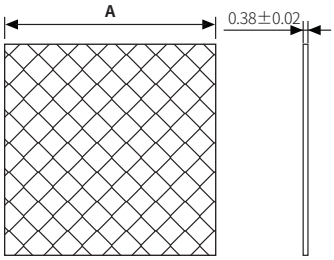
- Material: PMMA / PC / Acrylic (surface film / prism layer / adhesive layer)
- Ambient temperature: -35 to 65 °C (temperature for adhesion: 10 to 30 °C)
- Installation: Tape cutting (installation distance: ≥ 20 mm)

■ Reflectance of MST Series

Series	Sensing type	MST-50-10	MST-100-5	MST-200-2
BTS	Retroreflective	95%	100%	100%
BM		70%	110%	170%
BMS		90%	120%	190%
BEN		90%	130%	140%
BX		90%	100%	110%
BJ	Polarized retroreflective	40%	60%	100%
BJR		35%	45%	55%
BJX		35%	45%	55%
BH		60%	80%	140%
BEN		70%	90%	120%
BX		30%	40%	60%
BRQ		40%	50%	80%
BRQP (plastic material type)		40%	80%	85%
BRQPS (side sensing type)		25%	30%	35%

■ Dimensions

(Unit: mm)



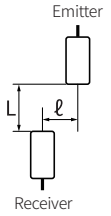
Model	A
MST-50-10	□ 50
MST-100-5	□ 100
MST-200-2	□ 200

■ Cautions during Installation

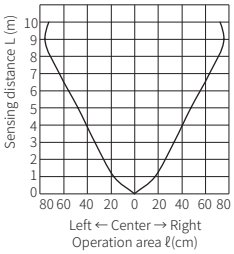
- Select a retroreflective tape that is suitable for the installation space and operating environment of the sensors.
- In general, a bigger size of retroreflective tape results in a longer sensing distance.
- Be sure to check the reflectance of the MST series for proper use.
- The reflectance may vary depending on the operating environment for the sensors.
- Before applying the tape, clean the adhesive side of the reflective tape with a dry cloth.
- Do not press or damage the surface of the retroreflective tape.
- Regularly clean the tape to maintain optimal performance, using only neutral detergents. Do not use chemical solvents.

Characteristic Curves: Through-beam Type

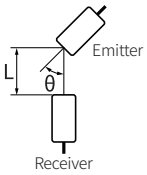
■ Sensing area



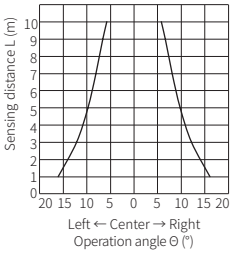
• BEN10M-TDT



■ Emitter angle

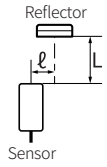


• BEN10M-TDT

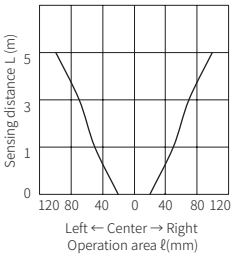


Characteristic Curves : Retroreflective Type

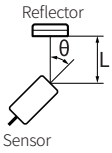
■ Sensing area



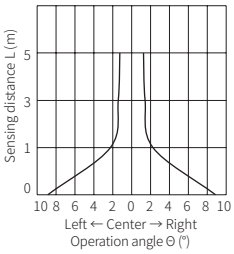
• BEN5M-MDT



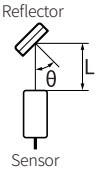
■ Sensor angle



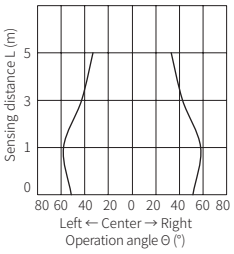
• BEN5M-MDT



■ Reflector angle

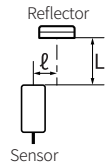


• BEN5M-MDT

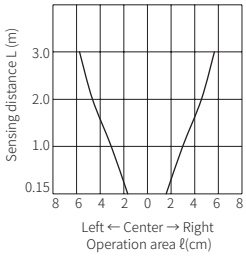


Characteristic Curves: Polarized Retroreflective Type

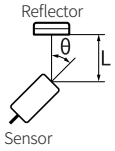
■ Sensing area



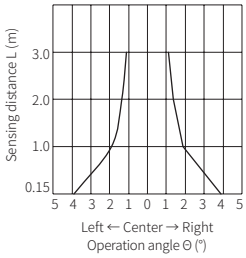
• BEN3M-PDT



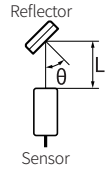
■ Sensor angle



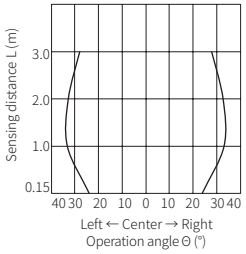
• BEN3M-PDT



■ Reflector angle

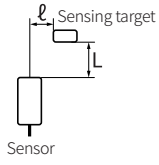


• BEN3M-PDT



Characteristic Curves: Diffuse Reflective Type

■ Sensing area



• BEN300-DDT

