

# Color Mark Photoelectric Sensors



## BC 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

- Outstanding color matching accuracy
  - R.G.B light emitting diodes and 12-bit resolution
  - 2 detection modes (color only / color + intensity)
  - 3-step sensitivity adjustment for each mode (fine, normal, rough)
- External light interference reduction minimizes errors and allows stable detection
- Check reference color with teaching indicator
- Operation indicator (red), stability indicator (green), timer indicator (orange)
- Configure operation functions with external input from wiring
- W 1.24 × L 6.7 mm spot size for detection of tiny targets and color marks
- IP67 protection rating (IEC standard)

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

- Product
- Bracket
- M3 bolt × 2
- Instruction manual
- Adjustment screwdriver

## Ordering Information

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

BC ① - ② ③ ④ - ⑤ - ⑥

- |   |   |
|---|---|
| <b>① Sensing distance</b><br>15: 15 mm            | <b>④ Output</b><br>T: Solid state (transistor)  |
| <b>② Sensing type</b><br>L: Convergent reflective | <b>⑤ Connection</b><br>C: Connector type  |
| <b>③ Power supply</b><br>D: 12 - 24 VDC           | <b>⑥ Control output</b><br>No mark: NPN open collector output<br>P: PNP open collector output |

## Sold Separately



- M12 connector cable: C□D(H)4-□-□

## 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 graphs
- When installing multiple sensors closely, it may result in malfunction due to mutual interference.
- If the sensing target has a glossy surface, high reflection or metal materials, tilt the sensor with an angle of from 10 to 20 degrees and install.
- For installation, tighten the screw with a torque of 0.8 N m. Mount the brackets correctly to prevent the twisting of the sensor's optical axis.
- Use this product after the test. Check whether the indicator works appropriately for color of the detectable object.

## Setting Operation Mode

- Use the offered adjustment screwdriver. Do NOT turn with excessive force to prevent product damage.

Operation mode	Description
 Color match mode (N.O.)	Target color matches reference color: Operation indicator (red) and transistor output ON
 Color mismatch mode (N.C.)	Target color does not match reference color: Operation indicator (red) and transistor output ON

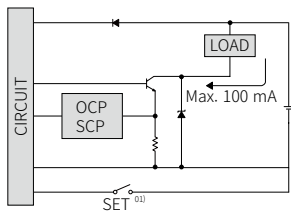
## Connections



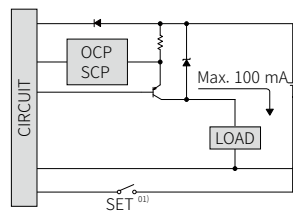
Pin	Color	Function
①	Brown	+V
②	White	SET
③	Blue	0V
④	Black	OUT

## Circuit

### NPN open collector output



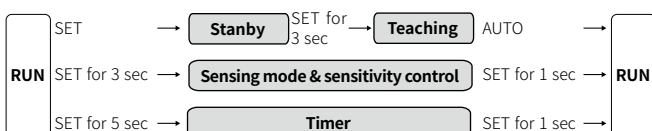
### PNP open collector output



- 01) The external input wire (white, connect with the pin 2) is same with the SET key function.
- 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 not output due to the protection circuit.

## Setting Mode

- Use the SET key on the front of the sensor or external input wire (white, connect with the pin 2).
- Check the operations of indicator under the setting status.
- When resetting the sensor, it starts from the previous settings. (factory reset: not supported)



## Teaching

Set the reference color with the teaching function. The operations of teaching indicator differ from the teaching status.

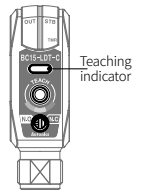
- Place the sensor and color of target object facing the each other.**  
Installation distance: 15±2 mm
- Press the SET key to enter the setting mode (teaching standby).**  
When there is no SET input for 10 seconds, the sensor will automatically return to RUN mode.
- Hold the SET key for 3 seconds to proceed with the teaching.**
- When the teaching is complete, the teaching indicator displays the set reference color (teaching color), and the sensor automatically return to the RUN mode.**

	Teaching indicator	Stability indicator (green)	Operation indicator (red)
Teaching standby	Flashing (orange)	OFF	OFF
Teaching complete	ON (teaching color)	ON	ON
Teaching error <sup>01)</sup>	Excess light intensity	ON (green)	OFF
	Insufficient light intensity	ON (red)	
	Fluctuating light intensity	ON (blue)	
			Flashing

01) Press the SET key to return the RUN mode.

## Teaching indicator

- With the ability to check the set reference color, you do not need to re-set the teaching color every time.
- Displays a similar color after successfully "teaching" the color
- The teaching color and the color displayed on the teaching indicator may differ depending on environment conditions (ambient light, reflection angle, material, etc.)
- It may difficult to check the similar colors when installing multiple sensors. Teaching indicator color is available only for reference.



## Sensing Mode and Sensing Sensitivity

Set the sensing mode and sensing sensitivity (fine-normal-rough). The operations of indicator differ from each sensing mode.

- C mode (Color): distinguishes by color rate
- C + I mode (Color + Intensity): distinguishes by color rate and contrast

- Hold the SET key for 3 seconds to enter the setting mode.**
- Press the SET key once to select the sensing mode and its sensitivity.**
- Hold the SET key over 1 seconds to return the RUN mode.**

Sensing mode	Sensing sensitivity	Teaching indicator	Stability indicator (green)	Operation indicator (red)
C mode	Fine	Flashing (red)	OFF	Flashing
	Normal	Flashing (green)		
	Rough	Flashing (blue)		
C + I mode	Fine	Flashing (red)	Flashing	OFF
	Normal	Flashing (green)		
	Rough	Flashing (blue)		

## Timer Setting

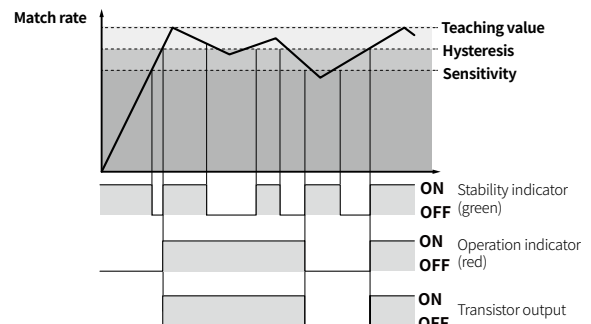
Timer (40ms OFF delay) function helps to prevent malfunction of output from target objects moving too rapidly. The operations of indicator differ from the setting mode.

- Hold the SET key for 5 seconds to enter the setting mode.**
- Press the SET key once to ON or OFF the timer.**
- Hold the SET key over 1 seconds to return the RUN mode.**

Setting mode	Timer ON	Timer OFF	Timer indicator (orange)	Stability indicator (green)	Operation indicator (red)
	ON	OFF	ON	Flashing	Flashing

## Operation Timing Chart and Indicators

### Color match mode (N.O.)

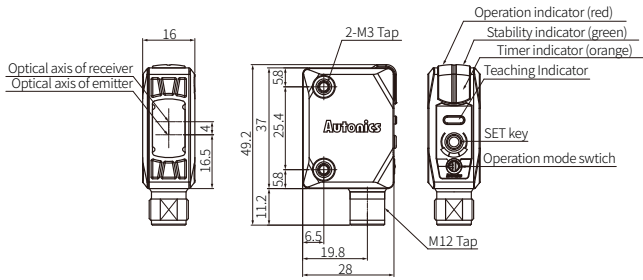


Status	Teaching indicator	Stability indicator (green)	Operation indicator (red)
Stable match		ON	ON
Unstable match	ON (teaching color)	OFF	ON
Unstable mismatch		OFF	OFF
Stable mismatch		ON	OFF

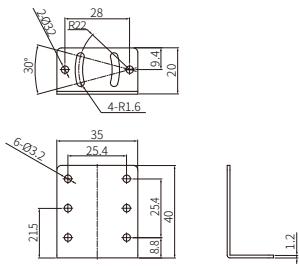
• In color mismatch mode (N.C.), the waveforms are reversed.

## Dimensions

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



## Bracket



## Specifications

<b>Model</b>	BC15-LDT-C-□
<b>Sensing type</b>	Convergent reflective
<b>Sensing distance</b>	15 mm ± 2 mm
<b>Sensing target</b>	Opaque materials, translucent materials
<b>Hysteresis</b>	≤ 20 % of sensing distance (may vary by sensing mode or sensitivity)
<b>Response time</b>	≤ 500 μs
<b>Light source</b>	Full Color (Red, Green, Blue)
<b>Min. spot size</b>	W 1.24 × L 6.7 mm
<b>Sensing mode</b>	C mode (color only) - C+I mode (color + intensity) selectable (SET key or SET cable)
<b>Sensitivity adjustment</b>	YES (SET key or SET cable)
<b>Operation mode</b>	Color match (Normally Open) - Color mismatch (Normally Closed) mode selectable (Adjuster)
<b>Teaching</b>	YES
<b>Timer</b>	OFF-delay mode: 40 ms
<b>Indicator</b>	Operation indicator (red), stability indicator (green), teaching indicator (full color), timer indicator (orange)
<b>Approval</b>	CE, RoHS
<b>Unit weight (packaged)</b>	≈ 14 g (≈ 80 g)
<b>Power supply</b>	12-24 VDC ≒ ± 10 % (ripple P-P: ≤ 10 %)
<b>Current consumption</b>	≤ 30 mA
<b>Control output</b>	NPN open collector output / PNP open collector output model
<b>Load voltage</b>	≤ 30 VDC ≒
<b>Load current</b>	≤ 100 mA
<b>Residual voltage</b>	NPN: ≤ 1 VDC ≒, PNP: ≤ 2.5 VDC ≒
<b>Protection circuit</b>	Reverse power protection circuit, output short overcurrent protection circuit
<b>Insulation resistance</b>	≥ 20 MΩ (500 VDC ≒ megger)
<b>Noise immunity</b>	± 240 VDC ≒: the square wave noise (pulse width: 1 μs) by the noise simulator
<b>Dielectric strength</b>	Between the charging part and the case: 1,000 VAC ~ 50/60 Hz for 1 min
<b>Vibration</b>	1.5 mm double amplitude at frequency of 10 to 55 Hz in each X, Y, Z direction for 2 hours
<b>Shock</b>	500 m/s <sup>2</sup> (≈ 50 G) in each X, Y, Z direction for 3 times
<b>Ambient illuminance (receiver)</b>	Incandescent lamp: ≤ 3,000 lx
<b>Ambient temperature</b>	-10 to 55 °C, storage: -25 to 75 °C (no freezing or condensation)
<b>Ambient humidity</b>	35 to 85 %RH, storage: 35 to 85 %RH (no freezing or condensation)
<b>Protection rating</b>	IP67 (IEC standard)
<b>Connection</b>	Connector type
<b>Connector</b>	M12 4-pin plug type
<b>Material</b>	Case: PC, sensing part: Acrylic, bracket: SUS304, bolt: Carbon Steel

## Troubleshooting

Problem	Cause	Troubleshooting
Does NOT operate	Power supply	Supply power within rated voltage.
	Open, connection error	Check the cable connections.
Does NOT operate occasionally	Excess light intensity alarm during teaching, output chattering	Install the sensor tilted with an angle of 10 to 20 degrees. (when sensing metal or glossy objects)
	Converter external light interference	Install a visor on the sensor or install the sensor away from the external light source.
	Contamination of sensor cover	Remove the substance using a soft brush or cloth and reset the sensitivity.
Operation/Stability indicator flash alternately every 0.5 seconds.	Connector error	Check connector assembly.
	Overcurrent input due to the input voltage and load	Supply power within rated voltage.

## Sold Separately: M12 Connector Cable

- For detailed information, refer to the 'M8/M12 Connector Cable' manual.

Appearance	Power	Connector 1	Connector 2	Length	Feature	Model				
	DC	M12 (Socket-Female) 4-pin	4-wire	2 m	Oil resistant PVC	CIDH4-2				
				3 m		CIDH4-3				
				5 m		CIDH4-5				
					DC	M12 (Socket-Female) 4-pin, L type	4-wire	7 m	Oil resistant PVC	CIDH4-7
								2 m		CIDH4-2-A
								3 m		CIDH4-3-A
									DC	M12 (Socket-Female) 4-pin
7 m	CIDH4-7-A									
1 m	CIDH4-1									
	DC	M12 (Socket-Female) 4-pin, L type	M12 (Plug-Male) 4-pin, L type							
				5 m	CIDH4-5					
				7 m	CIDH4-7					
					DC	M12 (Socket-Female) 4-pin	M12 (Plug-Male) 4-pin, L type			
								3 m	C2DH4-3	
								5 m	C2DH4-5	
									DC	M12 (Socket-Female) 4-pin, L type
1 m	C3DH4-1									
3 m	C3DH4-3									
	DC	M12 (Socket-Female) 4-pin, L type	M12 (Plug-Male) 4-pin							
				7 m	C3DH4-7					
				1 m	C4DH4-1					
					DC	M12 (Socket-Female) 4-pin, L type	M12 (Plug-Male) 4-pin			
								5 m	C4DH4-5	
								7 m	C4DH4-7	
									DC	M12 (Plug-Male) 4-pin
5 m	C1D4-5P									

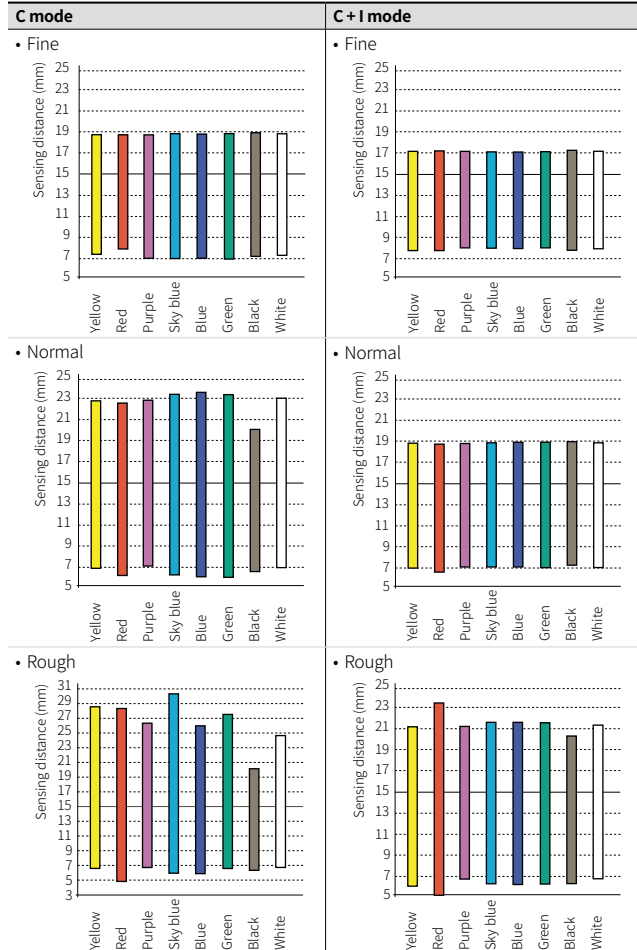
## Characteristic Graphs: Uncoated

### Standard sensing color

Reference color	PANTONE color code
Yellow	Yellow U
Red	Red032U
Purple	Purple U
sky blue	306U
Blue	Blue072U
Green	Green U
Black	405U
White	—

### Sensing distance by sensing color

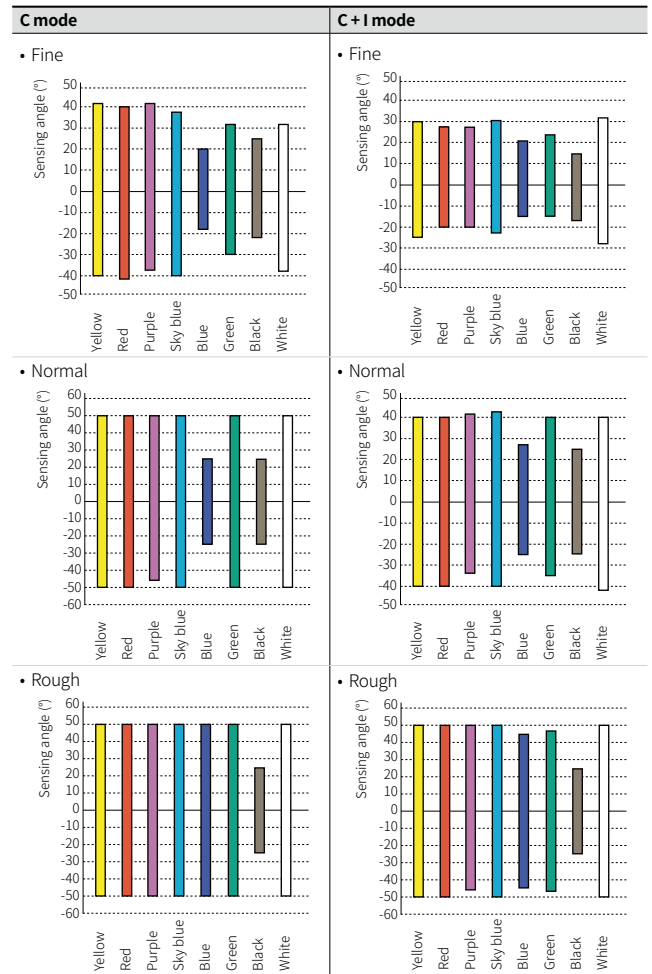
• BC15-LDT-C



## Characteristic Graphs: Uncoated

### Sensing angle by sensing color

• BC15-LDT-C



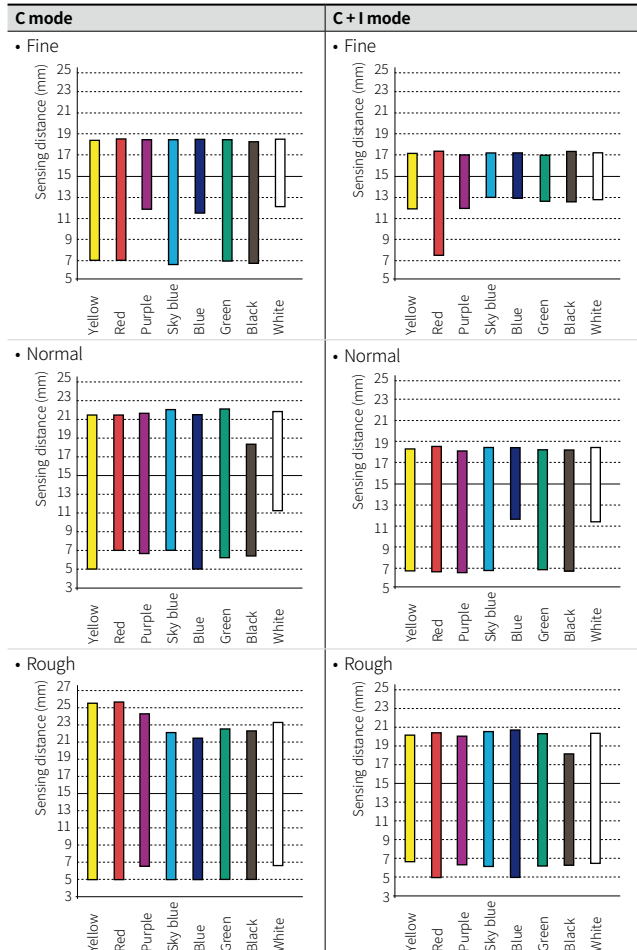
## Characteristic Graphs: Coated

### Standard sensing color

Reference color	PANTONE color code
Yellow	Yellow C
Red	Red032C
Purple	Purple C
Sky blue	306C
Blue	Blue072C
Green	Green C
Black	405C
White	—

### Sensing distance by sensing color

- BC15-LDT-C



## Characteristic Graphs: Coated

### Sensing angle by sensing color

- BC15-LDT-C

