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.
- 12-24 VDC⎓ 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	15	-	L	D	T	-	C	-	❶

❶ Control output
No mark: NPN open collector output
P: PNP open collector output

Sold Separately

• Connector cable, connector connection cable

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
  - Feature data
• 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
N.O. ⊕ N.C	Color match mode (N.O.)	Target color matches reference color: Operation indicator (red) and transistor output ON
N.O. ⊖ N.C	Color mismatch mode (N.C.)	Target color does not match reference color: Operation indicator (red) and transistor output ON

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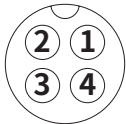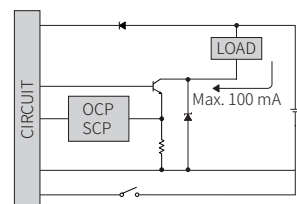
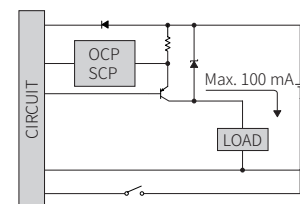| Pin	Color	Function
①	Brown	+V
②	White	SET
③	Blue	0 V
④	Black	OUT

Circuit

■ NPN open collector output

LOAD
Max. 100 mA
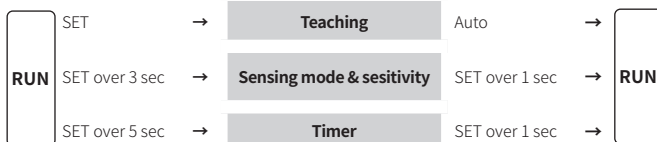CIRCUIT
OCP SCP

■ PNP open collector output

OCP SCP
Max. 100 mA
CIRCUIT
LOAD

• 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.

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)

RUN	SET →	**Teaching**	Auto →	
	SET over 3 sec →	**Sensing mode & sesitivity**	SET over 1 sec →	RUN
	SET over 5 sec →	**Timer**	SET over 1 sec →	

Teaching

Set the reference color with the teaching function. The operations of teaching indicator differ from the teaching status.
01. **Place the sensor and color of target object facing the each other.**
    Installation distance: 15±2 mm
02. **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.
03. **Hold the SET key for 3 seconds to proceed with the teaching.**
04. **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 [01]	Excess light intensity	ON (green)	OFF	Flashing
	Insufficient light intensity	ON (red)		
	Fluctuating light intensity	ON (blue)		

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.

Teaching indicator
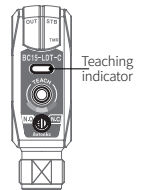
Sensing Mode and Sensing Sensitivity

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
01. **Hold the SET key for 3 seconds to enter the setting mode.**
02. **Press the SET key once to select the sensing mode and its sensitivity.**
03. **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.
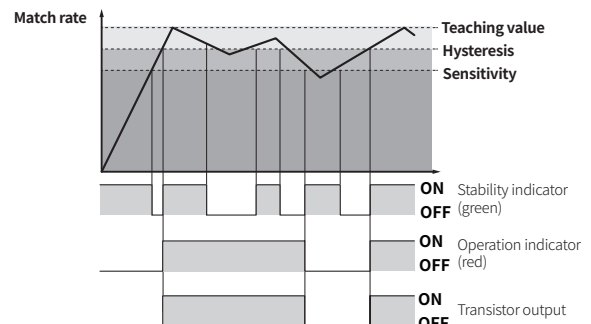01. **Hold the SET key for 5 seconds to enter the setting mode.**
02. **Press the SET key once to ON or OFF the timer.**
03. **Hold the SET key over 1 seconds to return the RUN mode.**

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

Operation Timing Chart

■ Color match mode (N.O.)

Match rate
Teaching value
Hysteresis
Sensitivity

ON / OFF Stability indicator (green)
ON / OFF Operation indicator (red)
ON / OFF Transistor output

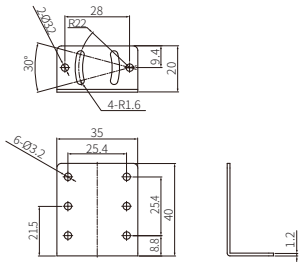| Status	Teaching indicator	Stability indicator (green)	Operation indicator (red)
Stable match		ON	ON
Unstable match	ON (teaching color)	OFF	ON
Unstable mismatch		OFF	OFF
Stable mismatch		ON	OFF

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

Dimensions

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

Optical axis of receiver
Optical axis of emitter
16
16.5, 4

2-M3 Tap
Operation indicator (red)
Stability indicator (green)
Timer indicator (orange)
Teaching Indicator
SET key
Operation mode swtich
M12 Tap

49.2, 37, 25.4, 5.8, 11.2, 5.8
6.5, 19.8, 28

■ Bracket

30°, R22, 28, 9.4, 20, 4-R1.6
6-Ø3.2, 35, 25.4, 25.4, 40, 21.5, 8.8, 1.2
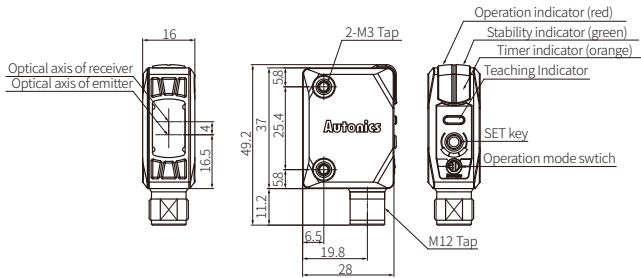
Specifications

Model	BC15-LDT-C-□
Sensing type	Convergent reflective
Sensing distance	15 mm ± 2 mm
Sensing target	Opaque materials, translucent materials
Hysteresis	≤ 20 % of sensing distance (may vary by sensing mode or sensitivity)
Response time	≤ 500 µs
Light source	Full Color (Red, Green, Blue)
Min. spot size	W 1.24 × L 6.7 mm
Sensing mode	C mode (color only) - C+I mode (color + intensity) selectable (SET key or SET cable)
Sensitivity adjustment	YES (SET key or SET cable)
Operation mode	Color match (Normally Open) - Color mismatch (Normally Closed) mode selectable (Adjuster)
Teaching	YES
Timer	OFF-delay mode: 40 ms
Indicator	Operation indicator (red), stability indicator (green), teaching indicator (full color), timer indicator (orange)
Approval	CE EAC
Unit weight (packaged)	≈ 14 g (≈ 80 g)

Power supply	12-24 VDC⎓ ±10 % (ripple P-P: ≤ 10 %)
Current consumption	≤ 30 mA
Control output	NPN open collector output / PNP open collector output model
Load voltage	≤ 30 VDC⎓
Load current	≤100 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)
Noise immunity	±240 VDC⎓ the square wave noise (pulse width: 1 µs) by the noise simulator
Dielectric strength	1,000 VAC~ 50/60 Hz for 1 min
Vibration	1.5 mm double amplitude at frequency of 10 to 55 Hz (for 1 min) in each X, Y, Z direction for 2 hours
Shock	500 m/s² (≈ 50 G) in each X, Y, Z direction for 3 times
Ambient illuminance (receiver)	Incandescent lamp: ≤ 3,000 lx
Ambient temperature	-10 to 55 °C, storage: -25 to 75 °C (no freezing or condensation)
Ambient humidity	35 to 85 %RH, storage: 35 to 85 %RH (no freezing or condensation)
Protection rating	IP67 (IEC standard)
Connection	Connector type
Connector	M12 4-pin plug type
Material	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.
	Connector error	Check connector assembly.
Operation/Stability indicator flash alternately every 0.5 seconds.	Overcurrent input due to the input voltage and load	Supply power within rated voltage.

Feature Data : 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

C mode	C + I mode
• Fine	• Fine

• Normal	• Normal

• Rough	• Rough
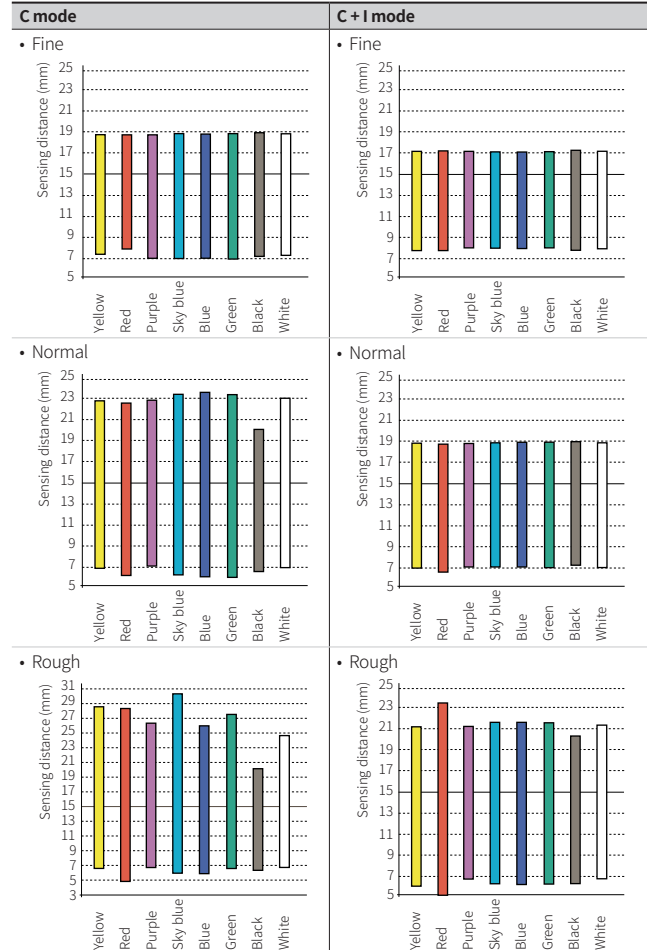
Feature Data: Uncoated

■ Sensing angle by sensing color

• BC15-LDT-C

C mode	C + I mode
• Fine	• Fine

• Normal	• Normal

• Rough	• Rough
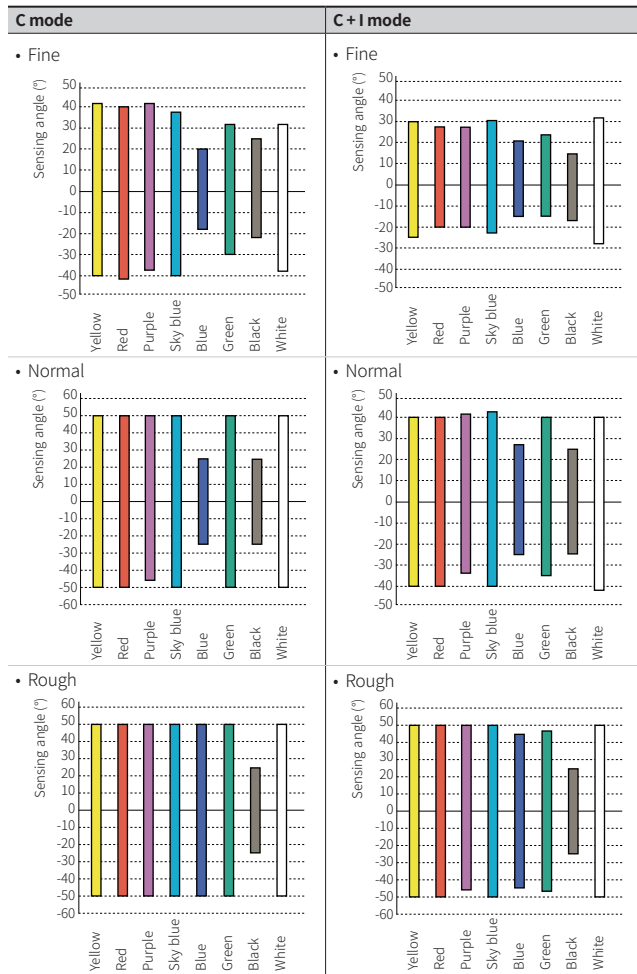
Feature Data: Coated

■ 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

C mode	C + I mode
• Fine	• Fine

• Normal	• Normal

• Rough	• Rough
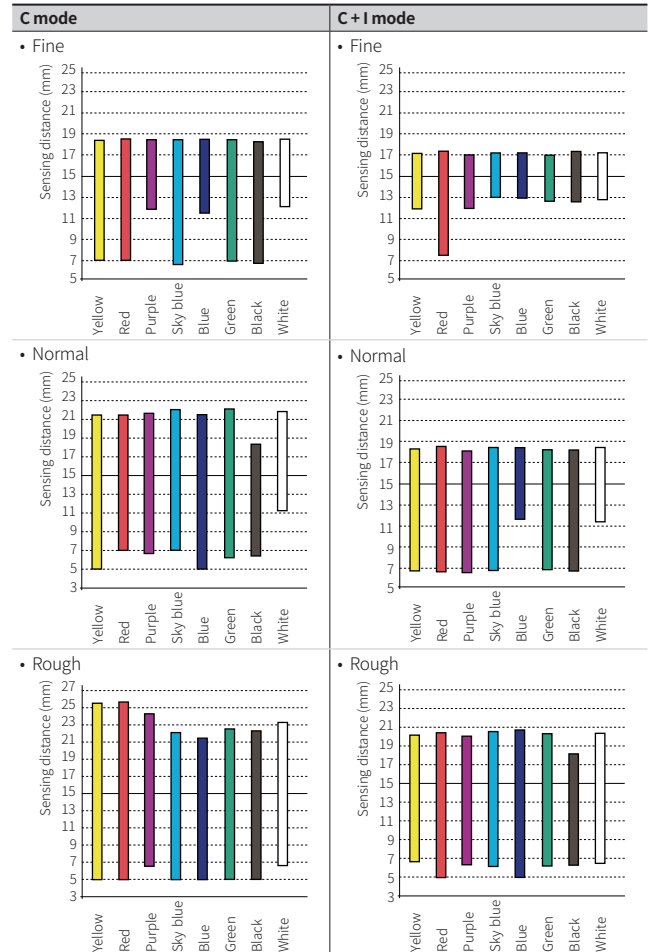
Feature Data : Coated

■ Sensing angle by sensing color

- BC15-LDT-C

C mode	C + I mode
• Fine	• Fine

• Normal	• Normal

• Rough	• Rough