TAKEX

COLOR SENSOR
built-in amplifier

CS-D3 SERIES Instruction Manual

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PRODUCT OUTLINE

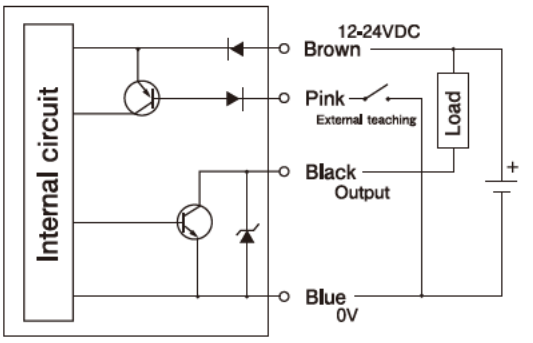
- The CS-D3 series color sensor is designed to discriminate the color which is registered by teaching.
- Equipped with 3-color memory bank and changeover switch.
- Mix teaching enables to create a reference color zone which is defined by the maximum and the minimum color value learned through the teaching.

SPECIFICATIONS (AMPLIFIER)

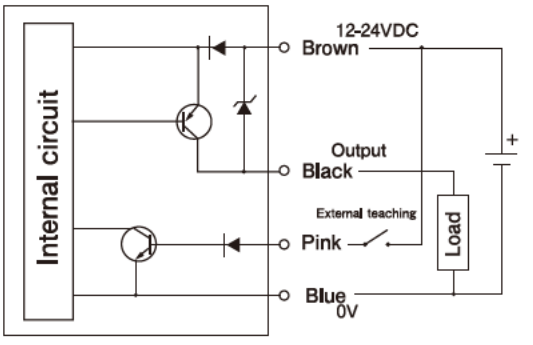
Rating / performance	Type	LED color sensor amplifier	
	Model	CS-D3	CS-D3PN
	Detection method	Spectroscopy measurement by red/green/blue LEDs	
	Power supply	12 - 24VDC ±10% Ripple: 10% or less	
	Power consumption	1.6W or less	
	Reference color	3 colors by teaching, one output	
	Response time	Normal detection (NML) mode: 1ms or less Averaging process (AVE) mode: 5ms or less	
	Control output	NPN open collector output	PNP open collector output
	Output rating	Sink current 100mA(30VDC)or less	Source current 100mA(30VDC)or less
	Operation mode	Conformity ON or OFF selectable	
	External input	No voltage input: input duration 60ms or more	
	Differentiation factor	COL(color component)/C+Y(color component and brightness)	
	Teaching	Auto(AUT)/Manual(MAN)/Mix(MIX)	
	Timer function	Timer disabled (NON)/Off-delay(OFD) approx. 50ms	
Specification	Light source	Red, green and blue LEDs (RGB composion)	
	Light-sensitive element	Photodiode	
	Indicator	Power indicator(RUN): Yellow LED illuminated while power is supplied, flashes during teaching Operation indicator(OP.): Orange LED illuminated when output is activated, flashes during mix teaching Stability indicator(STB.) : Green LED illuminated for stable detection, flashes during auto teaching Error indicator(ERR.) : Red LED illuminated to indicate teaching error, flashes to indicate sensor failure	
	Protective feature	Output short circuit protection, power supply protection against reverse connection	
	Protective structure	I P 65 (with fiber optic cable attached)	
	Case material	Case: heat-resistant ABS / Cover: polycarbonate	
	Connection	Attached cable (Outer dimension : dia.4.5mm) 0.2mm²× 4 cores, 2m	
	Weight	Approx. 100g	
	Accessory	1 mounting bracket, 1 screwdriver for setting, instruction manual	
Environmental specification	Ambient temperature	-10 - +55℃ (non-freezing)	
	Ambient humidity	35 - 85%RH (non-condensing)	
	Vibration	10 - 55Hz / 1.5mm double amplitude / 2 hours each in 3 directions	
	Shock	500m/s² / 3 times each in 3 directions	
	Dielectric withstanding	1,000VAC for 1 minute	
	Insulation resistance	500VDC, 20MΩ or more	

OUTPUT CIRCUIT & WIRING

・CS-D3 (NPN)



・CS-D3PN (PNP)



- Use open collector or contact input for external teaching input. The external teaching input has the same function as the SET button.
- Short circuit protection function is equipped. The output transistor turns off when a load short circuit occurs. Check the load then restore the power to reset the output.

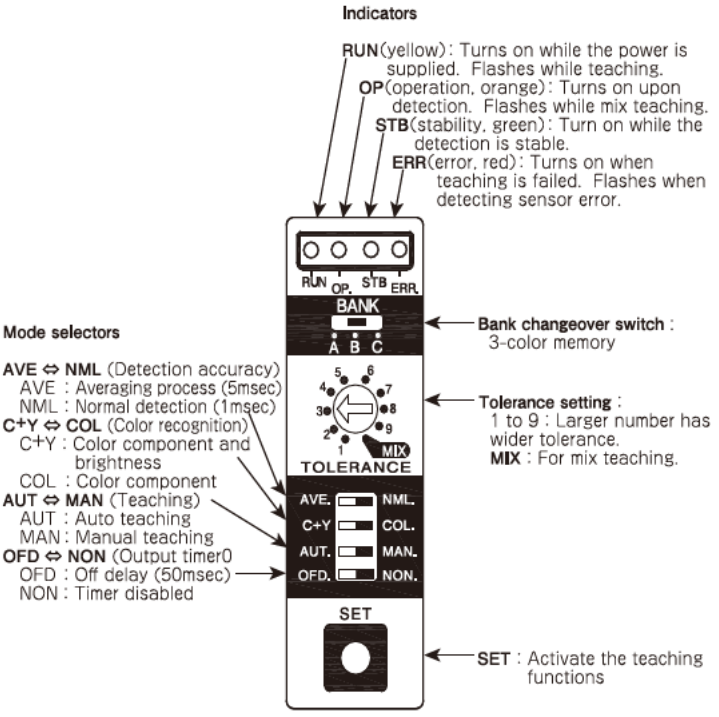
SPECIFICATIONS (FIBER OPTIC CABLE)

Rating / performance	Type	Short range	Long range
	Model	CS-DF10	CS-DF30
	Detection distance	13mm (10 - 16mm)	33mm (28 - 38mm)
	Fiber length	2m (free-cutting)	
	Spot diameter (at detecting distance)	φ3mm or less	φ5mm or less
	Allowable bending radius	R25mm min.	
	Fiber	Core diameter :φ1.5mm (receiver/transmitter)	
		Polyethylene cladding : φ2.2mm	
	Protective structure	I P54 (optical part waterproofed)	
	Weight	Approx. 40g	Approx. 50g
	Accessory	1 fiber cutter	
Environmental specification	Ambient light	illumination on light receiving surface : 5,000lx or less for incandescent lamp, 10,000lx or less for sunlight	
	Ambient temperature	-25 - +55℃ (non-freezing)	
	Ambient humidity	35 - 85%RH (non-condensing)	
	Vibration	10 - 55Hz / 1.5mm double amplitude / 2 hours each in 3 directions	
	Shock	500m/s² / 3 times each in 3 directions	

ACCESSORY

- **Amplifier**
  - Screwdriver : 1
  - Mounting bracket : 1
- **Fiber optic cable**
  - Fiber cutter : 1

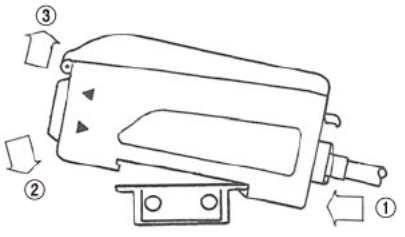
PANEL DESCRIPTION



- The learned 3 standard colors can be stored in the bank A, B or C separately.
- The stored 3 colors can be selected by Bank changeover switch when object color is changed in several times.
- Factory settings are :
  Detection accuracy : NML
  Color recognition : COL
  Teaching : MAN
  Output timer : NON

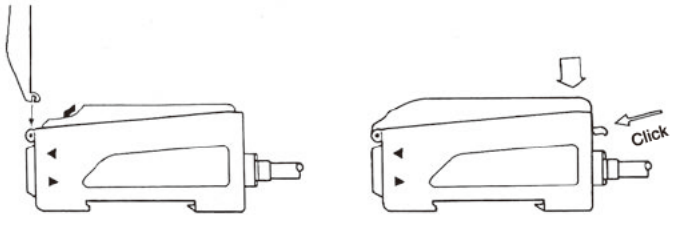
MOUNTING

1) DIN rail mount
   Hook the rear tab on the DIN rail (or mounting bracket), then press the front section down.
2) Removal
   Press the unit forward and pull up the front section.



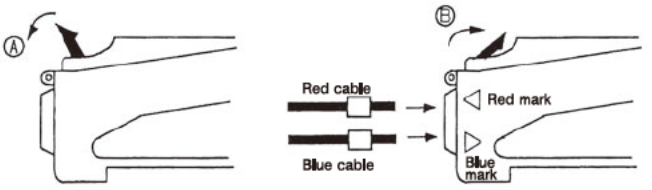
COVER

Fit the hinge of the cover on the pin of the sensor front as shown below. Close the cover and push until it clicks.



FIBER CABLE INSTALLATION

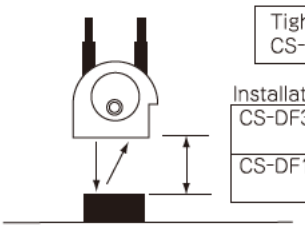
1) Pull the lock lever down (A).
2) Insert the fiber cables all the way matching the color of the cable and the mark on the sensor body.
3) Push the lock lever back (B).



FIBER HEAD INSTALLATION

Install the sensor head so that the distance to the detecting object is within the allowable distance shown in the below table.
At the standard distance the detection becomes most stable.

Tightening torque for fixing CS-DF10/ CS-DF30 should be 0.6Nm or less.

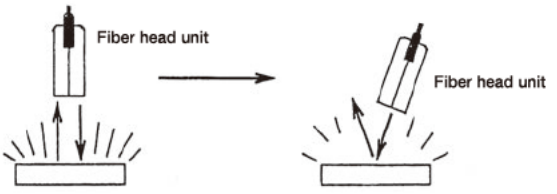


Installation distance reference

CS-DF30	Standard distance 33mm Allowable distance 28 to 38mm
CS-DF10	Standard distance 13mm Allowable distance 10 to 16mm

DETECTING GLOSSY OBJECTS

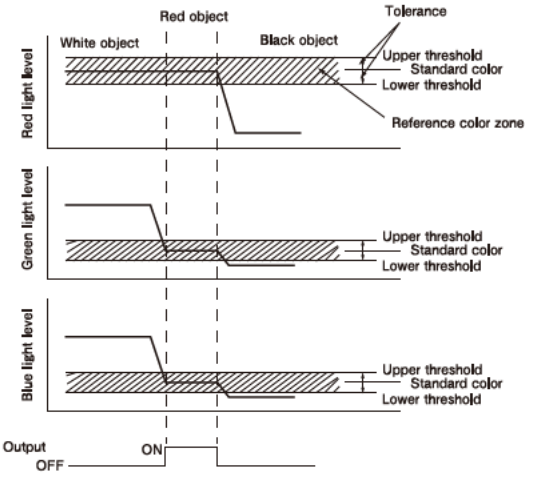
· Install the fiber head at a tilt angle of 10 to 15 degrees from the vertical line when detecting glossy objects to avoid unwanted light reflection.



BASIC OPERATION

Based on the standard color value learned by teaching, the upper and the lower threshold are set for three primary colors (red, green and blue) in accordance with the tolerance volume setting. When the receiving light intensity from an object falls within the reference color zone, the sensor recognizes that the object color matches with the reference color.

When teaching the red color ;



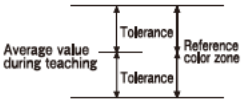
MODE SETTING

Tolerance volume

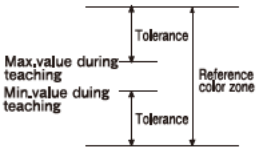
Tolerance can be selected between 1 (fine: narrow) and 9 (rough: wide) by the tolerance volume.

Detection accuracy

AVE (Averaging process):
The average color values during teaching is set as a standard. The Averaging process mode enables color detection with high accuracy. Response time is 5 msec.



NML (Normal detection):
The maximum and the minimum value during teaching are set as standards. The Normal detection mode enables high speed detection of 1 msec response time.



Color recognition

C+Y: Recognize an object by its color component and brightness. For detection of fine color difference or colors of same color component like white and gray.
COL: Recognize an object by its color component. Flapping object may be detected in this mode.

Output timer

OFD: Off delay (50 m sec) **NON:** Timer disabled

Fiber optic cable

CS-DF10 and CS-DF30 are dedicated fiber optic cables for CS-D3(PN) color sensors. Most of versatile fiber optic cables (through beam/reflective types) of 2.2 ㎜ in diameter are adaptable. When using versatile cables, perform tests to verify stable detection before actual operation.

Note that deep black color may not be detected. Perform detection test in the average detection mode.

TEACHING

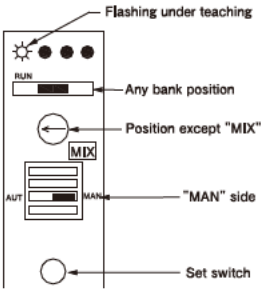
Manual, Mix and Auto teaching are available. A reference color learned through teaching is stored in the memory bank. Three memory banks A, B and C can be selected by the bank changeover switch.

LEDs in figures shown as ○=Lights ☼=Flashes ●=Remains Off

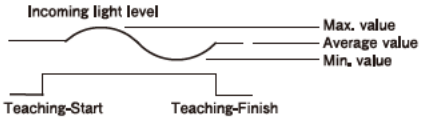
1. Manual teaching

Use the manual teaching when the color of the reference object is uniform.

1−1 : Teaching procedure
1)Select a memory bank to store the reference color by the bank changeover switch.
2)Switch the mode selector (teaching) to MAN (manual). Set the tolerance volume. MIX should not be selected.
3)Project the light spot on the object.
4)Push the SET button for activate teaching.

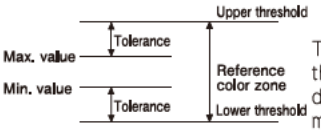


1−2 : Logic for manual teaching



In manual teaching mode, the sensor memorizes the maximum and the minimum color values during the SET button is pressed (minimum duration: 0.2 sec) and calculate the average. The upper and the lower thresholds are set based on the maximum and the minimum values and the tolerance setting for the Normal detection mode. The average value is used for setting the reference color zone for the Averaging process mode.

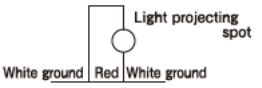
The range of the reference color becomes wider by moving the light spot to teach the color range of the detection object. When the object is flapping during the detection, make the reference object flapping during teaching. These procedure expands the reference color zone and enables stable detection.



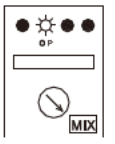
The above procedure enlarges the range (Max-Min) for stable detection at the Normal detection mode.

1−3 : Teaching error
When the received light intensity is excessive or insufficient, the teaching is failed and the error (ERR) and the stability (STB) indicator turn on and the projected light from the fiber head flashes.
Push the SET button or turn the bank changeover switch to reset the teaching error.

Notes : Teaching position and the reference color
If two colors are detected within the light spot during teaching, the reference color will be the mixture of the two colors. When the red part and the white background are detected by teaching as shown in the illustration, the reference color will be pink and the sensor triggers at the position in-between red and white just same as the teaching point. Note that under this setting the sensor also triggers when detecting pink color objects. When three or more colors pass under the light spot, perform detection test on all colors and confirm that the sensor detects right color objects.



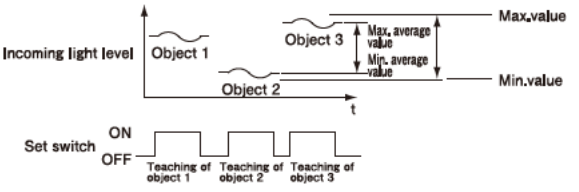
2. Mix teaching



Use the mix teaching when the reference object has wide range of color value.

2−1 : Teaching procedure
1)Select a memory bank to store the reference color by the bank changeover switch.
2) Set the tolerance volume to MIX. Select the teaching mode between AUT (auto) and MAN (manual).
3) The operation indicator (OP) flashes and mix teaching is ready. (Teaching is not activated in this state.)
4) Project the light spot on the object and push the SET button for activate mix teaching.
5) Mix teaching becomes ready again (returns to 3) when the SET button is released.
6) Repeat the procedure 3), 4) and 5) to teach colors to be detected.
7) Move the tolerance volume from MIX to another to exit the mix teaching mode.

2−2 : Logic for mix teaching



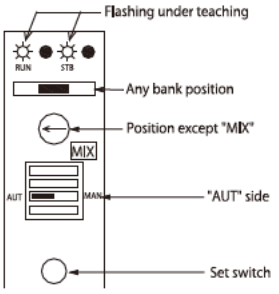
In mix teaching mode, the sensor memorizes the maximum and the minimum color values among the all teaching processes repeated in the teaching mode. The average of each maximum and minimum color values are also calculated. The maximum and the minimum values are set as the upper and the lower thresholds for the Normal detection mode. The average of the maximum and the minimum values are set as the upper and the lower thresholds for the Averaging process mode.

2−3 : Teaching error

When the brightness of the object under teaching is significantly different from that of the initially learned object, the teaching is failed and the error (ERR) and the stability (STB) indicators turn on and the projected light from the fiber head flashes. The color values learned before the error are stored and the mix teaching mode is continued. Switch the tolerance volume or the bank changeover switch to reset the teaching error.

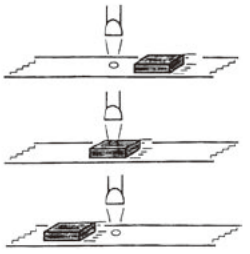
3. Auto teaching

Use the auto teaching when the detecting objects on a moving line can't be stopped for teaching.



3−1 : Teaching procedure

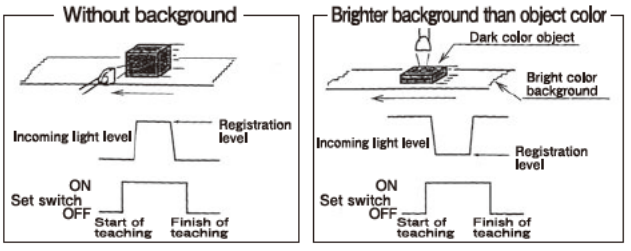
1) Select a memory bank to store the reference color by the bank changeover switch.
2) Switch the mode selector (teaching) to AUT (auto). Set the tolerance volume. MIX should not be selected.
3) Project the light spot on the moving background. Then push the SET button without detection object.
4) Hold the SET button and let a reference object pass under the light spot.
5) Release the button after the reference object passing through the light spot.



Notes : Auto teaching may not work when multiple colors are mixed in a reference object, reference objects are flapping, there's a small difference in brightness between reference objects and the background, or the background color is uneven.

3−2 : Logic for auto teaching

In auto teaching mode, the sensor memorizes the maximum or the minimum color value during the SET button is pressed.

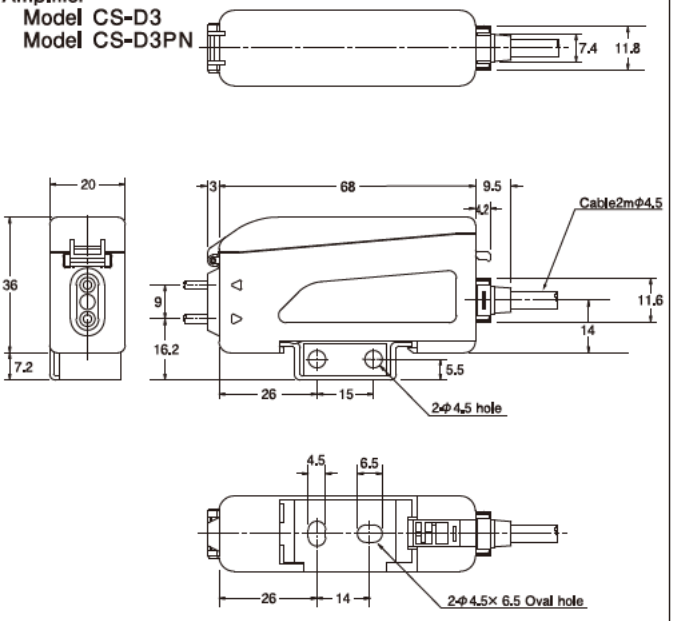


PRECAUTIONS DURING USE

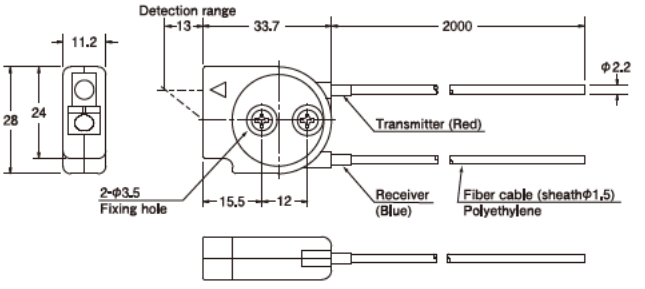
- Avoid turning the power on and off consecutively.
- When the ambient temperature exceeds the allowable range, the RUN and the ERR indicator turn on and the sensor stops the operation.
- When the ambient temperature is lower than the allowable range, the RUN and the ERR indicator turn on when power is supplied and teaching function may not work. Keep the power on and wait for 1 to 10 minutes to warm up the sensor.
- Be sure to route the sensor cables separate from any power transmission or high voltage line, or else use shielded cables. Using the same conduit or duct as high voltage or power lines will cause malfunctions or damage because of electromagnetic induction.
- When using a DC power unit with an insulated transformer or a switching regulator, be sure to ground the frame ground (FG) terminal.
- Do not bend the fiber cable with smaller diameter than the minimum bending radius. Fix the sensor unit and the optical fiber cable firmly.
- Clean the lens by a soft and dry cloth then conduct teaching when stains or dirt are stuck on the lens. Do not use organic solvent including alcohol and thinner.
- Close the cover when in operation.
- Connect unused external input cable with the power 12 to 24VDC.
- Use a new F-cutter to cut the optical fiber cable.
- The tightening torque of screws for fixing CS-DF10 and CS-DF30 is 0.6 N · m or less.
- Limit the current of the power supply to 2A.

EXTERNAL DIMENSIONS (Unit : mm)

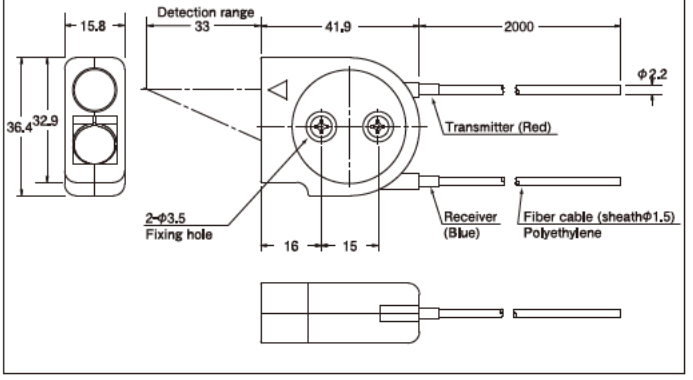
Amplifier
Model CS-D3
Model CS-D3PN



Fiber unit
Model CS-DF10



Fiber unit
Model CS-DF30



- The guarantee period of this product is one year after the delivery.
- If any defect is found during the guarantee period, Takenaka will repair or replace the defective product.
- This product is an industrial sensor which issue an output upon detecting an object. It does not have any function to prevent accidents, death or injuries.
- Takenaka will not held responsible for any damage or loss incurred due to accidents, faulty installation, abuse, misuse, improper maintenance or acts of God including lighting surge.