

R55 Color Mark Sensor



Datasheet

Color Registration Mark Sensor with Solid-State White Light Source



- Outstanding color contrast sensitivity; detects 16 gray scale changes
- Reliably detects the toughest color mark contrasts, including 20% yellow against white
- Totally solid-state: no bulbs to replace and no need to switch between different colored light sources
- Rugged zinc alloy die-cast housing with high-quality acrylic lens suitable for food processing applications; rated IP67, NEMA 6
- Fixed-convergent sensing at 10 ± 3 mm (0.39 ± 0.12 in); rectangular sensing image measures 1.2 mm x 3.8 mm (0.05 in x 0.15 in) at 10 mm from the lens
- 50 microsecond sensing response (10,000 operations per second)
- 10 V DC to 30 V DC operation; all models offer both NPN and PNP digital outputs, plus 0 to 10 mA analog output
- Switch-selectable light or dark operate; selectable output timing functions: 50 ms off-delay; 50 ms non-retriggerable one-shot, and 100 ms retriggerable one-shot
- 15-turn sensitivity control permits accurate setup; 10-element light bar signal strength display makes setup easy and fast
- Choose models with either horizontal or vertical sensing image
- 2 meter (6.5 ft) integral cable or 5-pin M12/Euro-style 300 mm (12 in) quick disconnect; 9 meter (30 ft) integral cable is also available



WARNING:

- **Do not use this device for personnel protection**
- Using this device for personnel protection could result in serious injury or death.
- This device does not include the self-checking redundant circuitry necessary to allow its use in personnel safety applications. A device failure or malfunction can cause either an energized (on) or de-energized (off) output condition.

Models

Models	Cable ¹	Focus	Supply Voltage	Output Type	Sensing Beam	Sensing Image Orientation
R55CW1	2 m (6.5 ft)	10 mm (0.39 in)	10 V DC to 30 V DC	Bipolar NPN/PNP Analog 0 mA to 10 mA	Visible white, 450 nm to 650 nm	Parallel to sensor length
R55CW1Q	5-pin M12/Euro-style male quick disconnect					
R55CW1QP	5-pin M12/Euro-style male quick disconnect					
R55CW2	2 m (6.5 ft)					Perpendicular to sensor length
R55CW2Q	5-pin M12/Euro-style male quick disconnect					
R55CW2QP	5-pin M12/Euro-style male quick disconnect					

Overview

The R55 offers maintenance-free solid-state reliability. The R55 reliably detects all color contrasts found in common product registration color mark applications—even extremely low contrasts such as 20 percent yellow printed on white. In addition, a white LED light source and hybrid optics eliminate the need to switch between different color light sources for different color contrasts.

Fifty microsecond sensing response produces excellent registration repeatability, even in ultra-high-speed applications. This fast response, coupled with the small 0.05 in x 0.15 in sensing image, allows color marks to be made small and inconspicuous.

The R55 has built-in pulse-stretching output timing logic to permit reliable interfacing to slower inputs, such as those associated with some programmable logic controllers (PLCs). A 4-position DIP switch is accessed beneath the tethered switch cap. Switch #1 selects light operate (outputs energize when the lighter of the two colors is sensed) or dark operate (outputs energize when the darker of the two colors is sensed). Switch #2 selects a 50 millisecond non-retriggerable one-shot pulse. Switch #3 selects a 50 millisecond off delay. When switches #2 and #3 are both turned to OFF, the output is a 100 millisecond retriggerable one-shot.

The R55 offers a 10-element moving LED light bar that displays signal strength, relative to the switch point setting. The display is invaluable during setup. Switch #4 is used to disable the light bar display during normal operation, if desired.

The sensor has two bipolar outputs: one sinking (NPN) and one sourcing (PNP). Both switching outputs switch loads up to 150 mA. A third, dedicated 0 mA to 10 mA analog output, may be used for applications such as measuring or monitoring surface brightness or texture. See specifications and wiring diagrams for more information.

The construction of the R55 is extremely robust with a die-cast metal housing, plastic optics, and IP67 and NEMA 6 leakproof design for harsh sensing environments.

¹ Integral 2 m (6.5 ft) unterminated cable models are listed.

- To order the 9 m (30 ft) PVC cable model, add the suffix "W/30" to the cabled model number. For example, **R55CW1 W/30**.
- Models with a quick disconnect require a mating cordset.



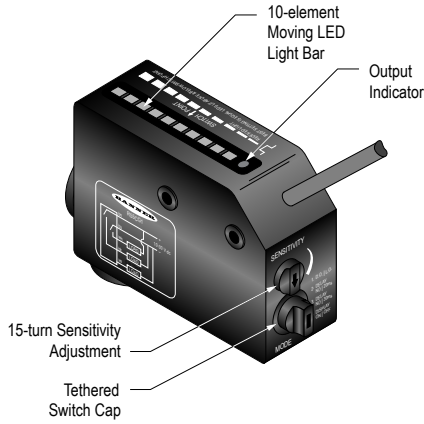


Figure 1. Features

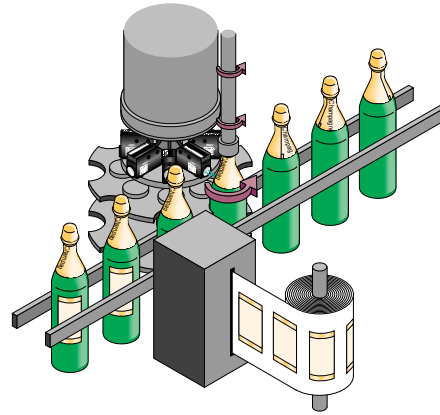


Figure 2. Example Application

Mode Settings

The four switches located behind the tethered cap labeled “MODE” are used to select the functions shown in Table 1 on p. 2.

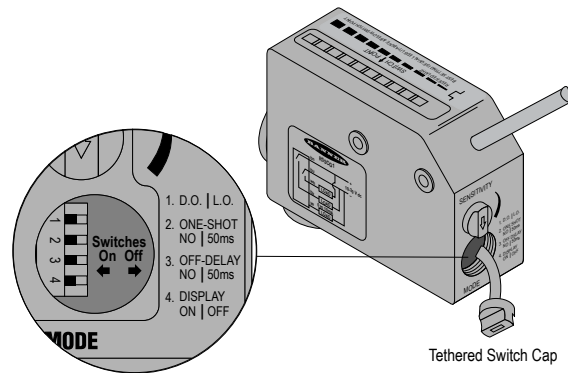


Figure 3. Mode Settings

Table 1: DIP Switch Setting Configurations

The factory default setting for all switches is the ON position.

Switch	Function	Description
1	ON = Dark Operate (D.O.) OFF = Light Operate (L.O.)	Switching outputs energize at transition from light to dark Switching outputs energize at transition from dark to light
2	ON = no one-shot timer OFF = 50 millisecond non-retriggerable one-shot	
3	ON = no off delay timer OFF = 50 millisecond off delay timer	
2 & 3	ON = no output timer OFF = 100 millisecond retriggerable one-shot	
4	ON = 10-element light bar display is enabled OFF = 10-element light bar display is disabled	

Installation

Install the Lens

The lens may be installed at either of two lens ports (see [Figure 4](#) on p. 3). The lens and the lens port cap are both threaded and may be exchanged by hand; no tools are required. The lens and cap both include an o-ring seal.

Mounting Considerations

The R55 includes a total of eight size M5 threaded holes used for mounting. These threaded holes are positioned to match the mounting hole patterns common to other color mark sensors. The R55 includes four M5 x 0.8 x 6 mm stainless steel cap screws and a hex key wrench.

The R55 focus is 10 mm (0.39 in) from the lens surface. The R55 must be mounted within 3 mm (0.12 in) of this distance from the surface of the material for reliable sensing ([Figure 4](#) on p. 3).

Consider the following when mounting the R55:

- When sensing a color mark on a reflective (shiny) material, mount the R55 at an angle that places the lens centerline at approximately 15° off perpendicular to the material's surface ([Figure 6](#) on p. 3). This minimizes strong direct reflections (which tend to overwhelm the sensor), and allows the sensor to discern the relatively small optical contrast offered by differences in colors.
- Clear materials are poor reflectors of light. When sensing a mark printed on a clear material (for example, a clear poly web), position a reflective surface directly behind the clear material to return light to the R55. The printed mark, regardless of its color, then becomes the dark condition, as it blocks the light from reaching the reflective surface. Most clear materials are also shiny; it is important to include a 15° skew angle when sensing clear materials ([Figure 6](#) on p. 3).
- Whenever possible, sense a web material at a location where it passes over a tension bar or roller, to minimize the adverse effects of web flutter or sag ([Figure 5](#) on p. 3).

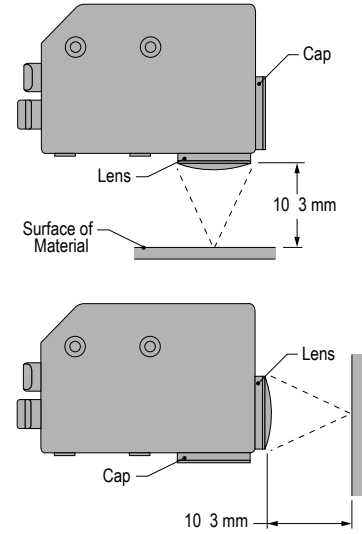


Figure 4. Mounting Distance and Lens Positions

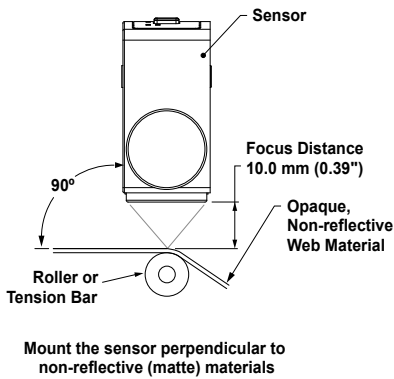


Figure 5. Mounting for Matte Material

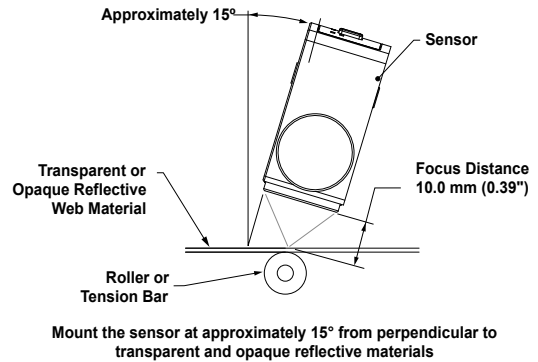
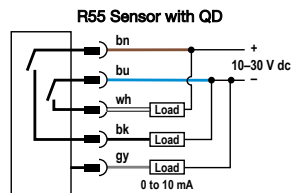
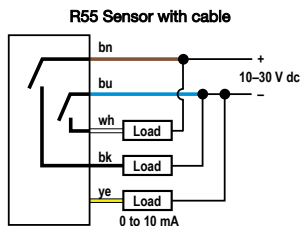
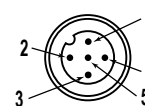


Figure 6. Mounting for Transparent and Opaque Material

Wiring Diagrams



R55 Sensor with 5-pin Euro-style QD



5-pin M12/Euro-style Model Key

- 1 = Brown
- 2 = White
- 3 = Blue
- 4 = Black
- 5 = Gray

Sensitivity Adjustment

The 10-element moving LED light bar displays received light signal strength, relative to the switch point setting. This display makes sensitivity adjustment easy and accurate.

Every color registration mark application involves sensing the difference between two colors, which relates, optically, to differentiating between two gray scale levels (one color returns more reflected light to the sensor than the other). The condition that returns the greater amount of light is referred to as the light condition. The light condition is usually obvious to the eye. However, the light bar displays exactly how the sensor sees the difference between the color mark and its background.

The switch point is electronically maintained between segments 5 and 6 of the 10-element moving LED light bar display. The digital outputs switch whenever there is a transition across the switch point (in either direction).

1. Mount the sensor.
2. Apply power to the sensor.
3. Alternately present the light and the dark conditions to the R55.
4. Adjust the sensitivity so that the light bar readings for the two sensing conditions (see the figures at right).



Note: The sensitivity adjustment is a 15-turn potentiometer which is clutched at both ends to prevent damage. It free-wheels at both the top and the bottom end of its adjustment range. (Clockwise rotation increases sensitivity.)

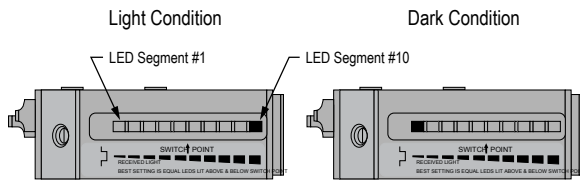


Figure 7. High Contrast (Best)

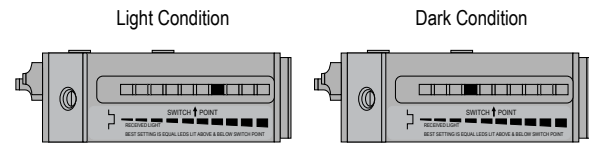


Figure 8. Minimum Recommended Contrast

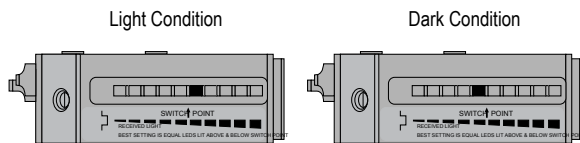


Figure 9. Low Contrast - All Sensing Variables Must Remain Stable

Sensing Contrast

In any photoelectric application, the difference in received light level between the light and dark conditions is called the optical contrast. In general, the greater the contrast, the more reliable the sensing application will be and the more forgiving the sensor will be to sensing variables such as vibration of the material being sensed.

Contrast is indicated on the light bar by the distance between the light condition and the dark condition; they should be equally spaced on either side of the switch point. The best possible contrast is displayed when the light condition displays at segment 10 (far right) and the dark condition displays at segment 1 (far left). The minimum recommended sensing contrast for most applications will display two segments above and below the switch point. Sensing for a contrast which registers at segments 5 and 6 should be reserved for applications which are perfectly stable (where no sensing variables such as vibration, color variations, surface variations, etc. are allowed). See [Figure 7](#) on p. 4, [Figure 8](#) on p. 4, and [Figure 9](#) on p. 4.

Specifications

Supply Voltage and Current

10 V DC to 30 V DC (including 10% maximum ripple) at less than 70 mA (exclusive of load)

Supply Protection Circuitry

Protected against reverse polarity and transient voltages

Output Configuration

Digital outputs are bipolar: one PNP (current sourcing) and one NPN (current sinking) open-collector transistor
Analog output is a current source which is proportional to the received light level

Output Rating—Digital

Digital outputs are 150 mA maximum (each)
Off-state leakage current <10 microamps at 30 V DC
Saturation voltage (NPN output) <2.0 V at 150 mA DC
Saturation voltage (PNP output) <1.5 V at 150 mA DC

Output Rating—Analog

Analog output: 0 mA to 10 mA
Maximum load voltage drop is V_{supply} minus 7 volts
(3 V at $V_{supply} = 10$ V; 23 V at $V_{supply} = 30$ V)

Output Protection Circuitry

Protected against output short-circuit, continuous overload, and false pulse on power-up

Output Response Time

<50 microseconds ON and OFF with no output delay timing selected



Note: 100 millisecond delay on power-up; NPN & PNP outputs are non-conducting at this time

Sensing Image

Rectangular: 1.2 mm x 3.8 mm (0.05 in x 0.15 in) at 10 mm (0.39 in) from face of lens; image oriented either parallel or perpendicular to sensor length, depending on model

Adjustments

15-turn Sensitivity control with external knob
Four DIP switches select the following functions:

- Switch #1: Light or dark operate
- Switch #2: 50 millisecond non-retriggerable one-shot
- Switch #3: 50 millisecond off delay
- Switches #2 and #3: 100 millisecond retriggerable one-shot
- Switch #4: Enable/disable for 10-element light bar

Indicators

10-element green moving LED light bar displays signal strength, relative to the switch point setting
Green LED output indicator

Construction

Zinc alloy die-cast housing with steel cover, both with black acrylic polyurethane finish
Lens, lens port cap, Sensitivity control, and Mode switch cap are o-ring sealed
Lens and light bar display window are acrylic
Lens port cap and lens holder are ABS
Mode switch cap is acetal
Sensitivity control knob is nylon

Environmental Rating

IEC IP67, NEMA 6

Connections

PVC-jacketed 5-conductor 2 m (6.5 ft) or 9 m (30 ft) attached cable, or 5-pin Euro-style quick disconnect on 300 mm (12 in) cable; mating quick-disconnect cables are purchased separately

Operating Conditions

Operating Temperature: -10 °C to +55 °C (+14 °F to +131 °F)
90% at +50 °C maximum relative humidity (non-condensing)

Vibration and Mechanical Shock

All models meet IEC 60068-2-6 and IEC 60068-2-27 testing criteria

Application Notes

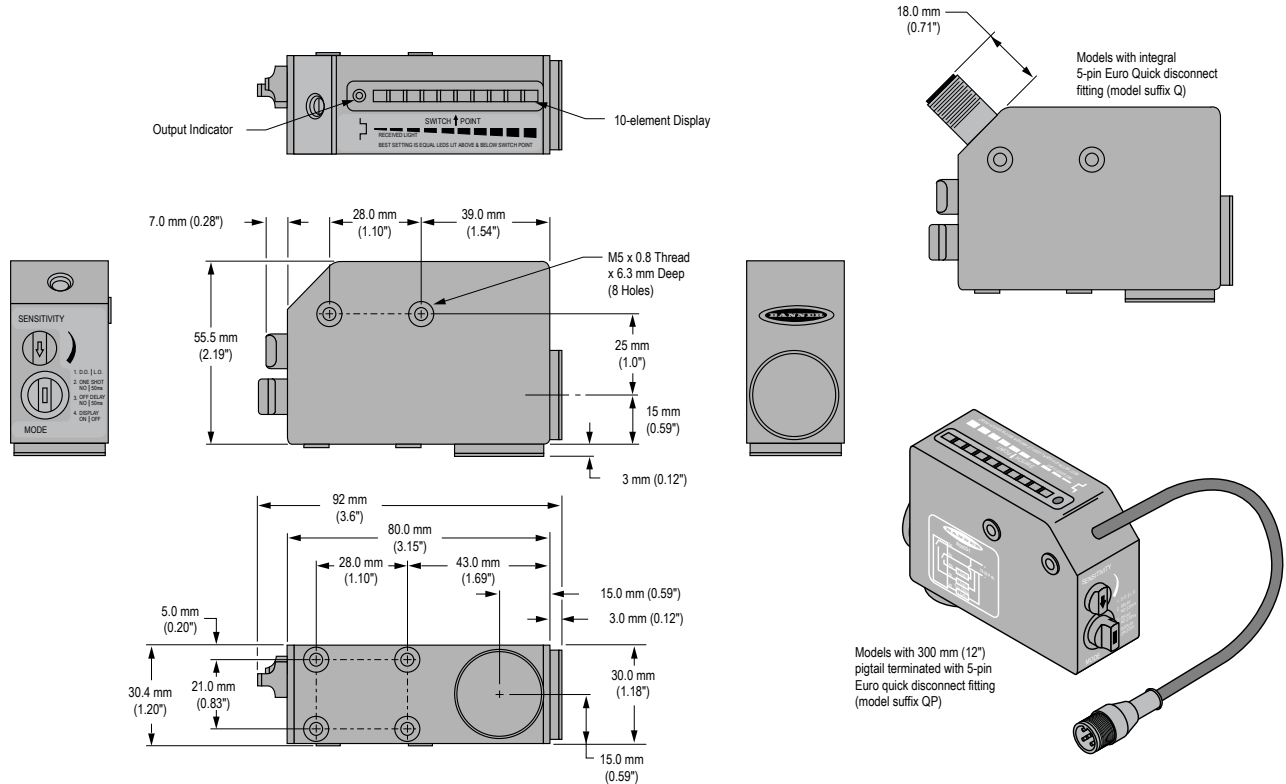
1. Mount sensor at approximately a 15° angle when sensing color marks on shiny, reflective materials (do not mount sensor exactly perpendicular to shiny material surfaces).
2. Minimize web or product flutter whenever possible for greatest sensing reliability.

Certifications



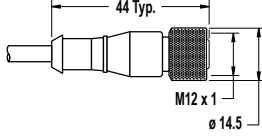
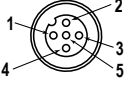
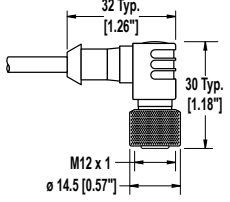
Dimensions

All measurements are listed in millimeters [inches], unless noted otherwise.



Accessories

Cordsets

5-Pin Threaded M12/Euro-Style Cordsets—Single Ended				
Model	Length	Style	Dimensions	Pinout (Female)
MQDC1-501.5	0.50 m (1.5 ft)	Straight		 <p>1 = Brown 2 = White 3 = Blue 4 = Black 5 = Gray</p>
MQDC1-506	1.83 m (6 ft)			
MQDC1-515	4.57 m (15 ft)			
MQDC1-530	9.14 m (30 ft)	Right-Angle		
MQDC1-506RA	1.83 m (6 ft)			
MQDC1-515RA	4.57 m (15 ft)			
MQDC1-530RA	9.14 m (30 ft)			

Brackets

SMB55F

- Flat-mount bracket
- 12-gauge stainless steel



SMB55A

- 15° offset bracket
- 12-gauge stainless steel



SMB55RA

- Right-angle bracket
- 12-gauge stainless steel



SMB55S

- 15° offset bracket
- 12-gauge stainless steel



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