R55 Expert™ Color Mark Sensors

Expert™ Color Mark Sensors

R55 Expert Features

• Outstanding color contrast sensitivity; detects 16 levels of gray scale.
• Reliably detects the toughest color mark contrasts, including 20% yellow against white.
• Choose from three LED colors: blue, green and white.
• Fast, 50-microsecond response.
• Easy push-button programming options include: Static TEACH, Static Single-Point TEACH, Dynamic TEACH and Remote TEACH; plus manual sensitivity adjustment.
• Non-volatile memory.
• Ten-element light bar clearly displays received signal strength.
• Fixed-convergent sensing at 10 ±3 mm (0.39" ±0.12"); rectangular sensing image measures 1.2 mm x 3.8 mm (0.05" x 0.15") at 10 mm from the lens.
• Choose models with either horizontal or vertical sensing image (see chart on page 2).
• Rugged zinc alloy die-cast housing with high-quality acrylic lens suitable for food processing applications; rated IP67, NEMA 6.
• Bipolar (NPN/PNP) discrete outputs with three Delay settings (0, 20 or 40 milliseconds), plus 0 to 10 mA analog output.
• Analog output value provides an indication of signal strength.
• Choice of integral cable or QD connector models.

R55 Expert Sensor Overview

R55 Expert (R55E) offers maintenance-free solid-state reliability for all color contrasts found in common product and material registration applications. Fast 50-microsecond sensing response produces excellent registration repeatability, even in ultra-high-speed applications. This fast response, coupled with the small 1.2 x 3.8 mm (0.05" x 0.15") sensing image, allows color marks to be made small and inconspicuous.

R55E sensors feature TEACH mode sensitivity adjustment, by presenting the light and the dark sensing conditions to the sensor. In addition, sensitivity may be fine-tuned at any time by simply clicking the “+” or “-” buttons on the sensor. The ten-element signal strength light bar clearly displays the relative received signal strength.

TEACH mode has two options: Static TEACH and Dynamic TEACH. Static TEACH is used to manually set the two sensing conditions individually or to program a specific condition to be sensed (single-point TEACH). Dynamic TEACH provides a means for teaching a series of conditions on-the-fly; the R55E samples the sensing events and automatically sets (and periodically updates via the adaptive threshold feature) the switch point between light and dark conditions.

The discrete bipolar (one NPN and one PNP) outputs may be programmed in SETUP mode to include a 20- or 40-millisecond pulse stretcher (OFF Delay), if required. A third, dedicated, 0 to 10 milliamp analog output may be used for applications such as measuring or monitoring of surface brightness or texture.

Both TEACH mode sensitivity and output SETUP are accomplished either by using the push buttons on the sensor, or by supplying input pulses via the Remote TEACH input. The construction of the R55E is extremely robust, with a die-cast metal housing, plastic optics, and IP67 and NEMA 6 leakproof design for harsh sensing environments.
## R55 Expert Color Mark Sensors

### R55 Expert Convergent Mode Sensor Models

<table>
<thead>
<tr>
<th>Models</th>
<th>Beam Color</th>
<th>Cable*</th>
<th>Focus</th>
<th>Supply Voltage</th>
<th>Output Type</th>
<th>Sensing Image Orientation</th>
</tr>
</thead>
<tbody>
<tr>
<td>R55ECG1</td>
<td>Green 525 nm</td>
<td>6-wire</td>
<td>2 m (6.5”)</td>
<td></td>
<td></td>
<td>Parallel to sensor length</td>
</tr>
<tr>
<td>R55ECG1Q</td>
<td></td>
<td>6-pin</td>
<td>Euro-Style QD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R55ECB1</td>
<td>Blue 475 nm</td>
<td>6-wire</td>
<td>2 m (6.5”)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R55ECB1Q</td>
<td></td>
<td>6-pin</td>
<td>Euro-Style QD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R55ECW1</td>
<td>White 450-650 nm</td>
<td>6-wire</td>
<td>2 m (6.5”)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R55ECW1Q</td>
<td></td>
<td>6-pin</td>
<td>Euro-Style QD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R55ECG2</td>
<td>Green 525 nm</td>
<td>6-wire</td>
<td>2 m (6.5”)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R55ECG2Q</td>
<td></td>
<td>6-pin</td>
<td>Euro-Style QD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R55ECB2</td>
<td>Blue 475 nm</td>
<td>6-wire</td>
<td>2 m (6.5”)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R55ECB2Q</td>
<td></td>
<td>6-pin</td>
<td>Euro-Style QD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R55ECW2</td>
<td>White 450-650 nm</td>
<td>6-wire</td>
<td>2 m (6.5”)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R55ECW2Q</td>
<td></td>
<td>6-pin</td>
<td>Euro-Style QD</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* 9 m (30’) cables are available by adding suffix “W/30” to the model number of the cabled version (e.g., R55ECG1 W/30). A model with a QD connector requires an accessory mating cable. See page 12.
**Lens Location**

The lens of the R55E may be installed at either of two lens ports (see Figure 1). 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.

NOTE: Lens port cap must be installed for reliable operation.

**Mounting**

The R55E includes a total of eight size M5 threaded holes used for mounting (see dimension drawing on page 9). These threaded holes are positioned to match the mounting hole patterns common to other color mark sensors. The R55E includes four M5 x 0.8 x 6 mm stainless steel cap screws and a hex key wrench.

The R55E focus is located at 10 mm (0.39") ahead of the lens surface. The R55E must be mounted within 3 mm (0.12") of this distance from the surface of the material for reliable sensing (Figure 1).

**Consider the following when mounting the R55E:**

1) Whenever possible, it is a good idea to 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 2).

2) When sensing a color mark on a reflective (shiny) material, mount the R55E at an angle which places the lens centerline at approximately 15° off perpendicular to the material’s surface (see Figure 3). This “skew angle” will minimize strong direct reflections (which tend to overwhelm the sensor), and allow the sensor to discern the relatively small optical contrast offered by difference in colors.

3) Clear materials are poor reflectors of light. When sensing a mark printed on a clear material (e.g., a clear poly web), position a reflective surface directly behind the clear material which will return light to the R55E. 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 also to include a 15° skew angle when sensing clear materials (Figure 3).
Using the R55 Expert Series Sensor

RUN Mode

Normal operation of the R55E is called RUN mode. The LED indicators (see Figure 4) operate as follows in RUN mode:

**Output Conducting LED:** ON when outputs are active

**Delay Configuration Indicator LED:** OFF No OFF Delay is programmed

ON 20- or 40-ms OFF Delay is programmed

**Light Operate LED:** ON to indicate Light Operate configuration

**Dark Operate LED:** ON to indicate Dark Operate configuration

(NOTE: Since either one of these is always ON when the sensor is operating, the combined Light/Dark Operate LEDs also provide a functional Power-ON indication.)

**10-Segment Light Bar:** indicates signal strength, with respect to the sensing threshold (“Switch Point”).

TEACH Modes

The sensitivity of the R55E may be quickly optimized by using one of two available TEACH modes: Static TEACH or Dynamic TEACH. Either may be performed using the push buttons on the sensor, or remotely, using a remote switch or process controller connected to the sensor’s gray wire (see page 8). Either a sensing window or a specific point may be taught.

**Static TEACH**

In Static TEACH mode, the sensor learns the light condition and the dark condition, after each is presented one time. Sensitivity is automatically set to place the switch point midway between the two conditions. In addition, the condition taught first becomes the output ON condition.

Sensitivity may be adjusted at any time when the sensor is in RUN mode by clicking the “+” and “-” buttons. Each click translates to 1/2 segment on the signal strength light bar. For best sensing reliability, the light and dark conditions should register equally distant from the switch point on the signal strength light bar.

**Single-Point TEACH**

The R55 Expert sensor also may be taught a single specific target, using an alternate Static TEACH procedure. The sensor will sense only the mark taught and will ignore signals both stronger and weaker. The sensitivity to the taught mark then may be adjusted up or down.

To perform single-point TEACH, place the target in front of the sensor. Press and hold the “Static” button until the LO and DO LEDs begin to flash, then double-click the Static button. If the single point was successfully taught, the two center sections of the bar graph will flash.

Manually adjust the sensitivity by clicking either the “+” or “-” button; the bar graph will flash two segments centered about the sensing point. If the sensitivity is increased (-), the two lighted segments will become closer together, and farther apart if the sensitivity is decreased (+). If the segments do not flash while the sensitivity is being adjusted, the setting has reached its maximum and cannot be adjusted further.
### Static TEACH Procedure - Push Button

<table>
<thead>
<tr>
<th>Push Button</th>
<th>Resulting Indicator Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Press and hold STATIC button until LO and DO indicators alternately flash, then release button.</td>
<td>LO and DO: Alternately flash green [\text{\textbullet}\text{\textbullet}] : ON amber (indicating ready to teach output ON condition) Light Bar: Goes OFF</td>
</tr>
<tr>
<td>TEACH Condition #1 (Output ON state) Present the output ON sensing condition and single-click STATIC button.</td>
<td>LO and DO: Alternately flash green [\text{\textbullet}\text{\textbullet}] : OFF (indicating ready to teach output OFF condition) Light Bar: Remains OFF</td>
</tr>
<tr>
<td>TEACH Condition #2 (Output OFF state) Present the output OFF sensing condition and single-click STATIC button.</td>
<td>Contrast accepted: one of the ten segments flashes for three seconds to indicate relative contrast, and then the sensor enters RUN mode. Contrast too low: every other segment flashes for three seconds to indicate low contrast, and the sensor returns to TEACH Condition #1.</td>
</tr>
</tbody>
</table>

**NOTES:**

1. The sensor will return to RUN mode if either TEACH condition is not registered within 90 seconds. Also, TEACH mode may be cancelled by pressing and holding the push button for ≥ 2 seconds. In either case, the sensor will revert to the previous conditions taught (i.e., exit without save).

2. If the sensing conditions are accepted at the end of TEACH Condition #2, the signal strength light bar flashes one of its ten segments for three seconds to indicate relative sensing contrast. The higher the flashing segment, the higher the measured sensing contrast. High contrast relates directly to sensing reliability. High-contrast sensing applications are most tolerant of sensing variables, such as web flutter or variations in color mark color or print density.

### Static Single-Point TEACH Procedure - Push Button

<table>
<thead>
<tr>
<th>Push Button</th>
<th>Resulting Indicator Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Press and hold STATIC button until LO and DO indicators alternately flash, then release button.</td>
<td>LO and DO: Alternately flash green [\text{\textbullet}\text{\textbullet}] : ON amber (indicating ready to teach output ON condition) Light Bar: Goes OFF</td>
</tr>
<tr>
<td>TEACH Condition to be Sensed (Output ON state) Present the output ON sensing condition and double-click STATIC button.</td>
<td>LO or DO: ON, depending on condition taught [\text{\textbullet}\text{\textbullet}] : OFF Light Bar: Two center segments are lit if TEACH was successful.</td>
</tr>
</tbody>
</table>
Dynamic TEACH

Dynamic TEACH is used to program sensitivity during actual machine run conditions. During Dynamic TEACH, the R55E takes multiple samples of the color mark against its background material and automatically sets the sensitivity at the optimum level. Dynamic TEACH activates the sensor's adaptive threshold system, which continuously tracks minimum and maximum signal levels, and automatically maintains centering of the switch point between the light and dark conditions. The adaptive threshold system remains in effect during RUN mode to automatically adjust for changes in the light or the dark conditions. The adaptive routine saves to non-volatile memory at least once per hour.

When Dynamic TEACH mode is used to program sensitivity, the output ON state (light or dark operate) will remain as it was last programmed. To change to either the light or the dark condition, use the SETUP mode (see page 7).

Sensitivity may be adjusted at any time when the sensor is in RUN mode by clicking the “+” and “-” buttons. However, when a manual adjustment is made, the adaptive threshold system is disabled (cancelled).

<table>
<thead>
<tr>
<th>Push Button</th>
<th>Resulting Indicator Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Press and hold DYNAMIC button until LO and DO indicators alternately flash.</td>
<td>Press and Hold ≥ 2 seconds</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Continue depressing the DYNAMIC button while sampling light and dark sensing conditions.</td>
<td>Continue to Depress While Sensor Samples Light and Dark Conditions</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Release the DYNAMIC button when finished sampling light and dark sensing conditions.</td>
<td>Release</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NOTES:

1) If the sensing conditions are accepted at the end of Dynamic TEACH, the signal strength light bar flashes one of its ten segments for three seconds to indicate relative sensing contrast. The higher the flashing segment, the higher the measured sensing contrast. High contrast relates directly to sensing reliability. High contrast sensing applications are most tolerant of sensing variables, such as web flutter or variations in color mark color or print density.

2) If the sensor does not measure enough contrast at the end of Dynamic TEACH, every other segment of the signal strength light bar flashes in unison for three seconds to warn of unacceptably low contrast, and the sensor returns to RUN mode with its previously taught conditions.
SETUP Mode

SETUP mode is used to configure discrete sensor output response for:
- Light or Dark operate
- 20- or 40-millisecond pulse stretcher (OFF delay), if required.

It will be necessary to access SETUP mode only if the settings which result from TEACH mode programming are not the settings required for the application. The status LEDs indicate the output response configuration when the sensor is in RUN mode, as follows:
- LO indicator ON = output is light operate
- DO indicator ON = output is dark operate
- OFF Delay indicator ON = either 20- or 40-millisecond delay is programmed
- OFF Delay indicator OFF = no output delay is programmed

To change the output response settings:
1) Press and hold BOTH push buttons for at least 2 seconds, until the signal strength light bar turns OFF.
2) Click EITHER push button to toggle through the six possible settings, indicated as follows:

<table>
<thead>
<tr>
<th>Output Configuration</th>
<th>Delay Indicator</th>
<th>LO Indicator</th>
<th>DO Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light operate with no delay</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>Light operate with 20 ms delay</td>
<td>Flashing</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>Light operate with 40 ms delay</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>Dark operate with no delay</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>Dark operate with 20 ms delay</td>
<td>Flashing</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>Dark operate with 40 ms delay</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
</tr>
</tbody>
</table>

3) Press and hold both push buttons until the signal strength light bar turns ON, indicating return to RUN mode.

NOTE: If SETUP mode programming is interrupted and remains inactive for 30 seconds, the sensor returns to RUN mode with the most recent settings (i.e., exit and save current selection).
Remote Programming

The gray wire of the R55E may be connected to a remote switch or to a process controller to:
- Set sensitivity via either Static or Dynamic TEACH mode
- Set output response via SETUP mode
- Disable the push button functions

A remote programming switch is connected between the gray wire and dc common (see Hookup diagrams on page 11). The switch may be either a normally-open contact, or an open-collector NPN transistor with its emitter connected to dc common.

Remote programming is accomplished using a specified sequence of input pulses. The duration of each pulse is defined as:

0.04 seconds < T < 0.8 seconds (40 ms < T < 800 ms).

Remote Static TEACH Mode

1) Present the Output ON condition to the sensor and pulse the Remote TEACH input once.
2) Wait at least 0.8 seconds, present the Output OFF condition, and pulse the Remote TEACH input once.

If sensing contrast is adequate, the sensor flashes one segment of the signal strength light bar for 3 seconds to indicate relative contrast, and then enters RUN mode.

If contrast is too low, the sensor flashes every other segment of the signal strength light bar in unison to warn of unacceptably low contrast, and returns to re-teach the Output ON condition (Step 1).

Remote Static Single-Point TEACH

Single-point TEACH may also be performed using the remote wire. Present the target and single-click the remote wire. Wait at least 0.8 second, then double-click the remote wire. If the TEACH is successful, the sensor will flash the middle two LEDs of the bar graph, and return to RUN mode.

Remote Dynamic TEACH Mode

1) Hold the TEACH input low for > 2 seconds
2) Continue holding the TEACH input low while presenting light and dark sensing conditions. Open switch when finished teaching.

If sensing contrast is adequate, the sensor flashes one segment of the signal strength light bar for 3 seconds to indicate relative contrast, and then enters RUN mode.

If contrast is too low, the sensor flashes every other segment of the signal strength light bar in unison to warn of unacceptably low contrast, and returns to RUN mode with its previously taught conditions.
Remote SETUP Mode

1) To enter SETUP mode, pulse once, wait 0.04 to 0.8 seconds, then pulse again.

2) Wait > 0.8 seconds, then enter sequential pulses to toggle between the six output configuration choices (see page 7). Spacing between sequential pulses must be > 0.8 seconds.

3) To exit SETUP mode, hold the TEACH input low for > 2 seconds.

Locking Out (Disabling) the Push Buttons

Pulse four times to disable (or to re-enable) the push buttons.

NOTE: Push buttons can be disabled/enabled from the remote line only.

R55 Expert Series Sensor Dimensions

![Illustration of R55 Expert Series Sensor Dimensions]
## R55 Expert Color Mark Sensors

### R55 Expert Sensor Specifications

| Supply Input | 10 to 30 V dc (10% maximum ripple) at less than 80 mA, exclusive of load |
| Supply Protection Circuitry | Protected against reverse polarity and transient voltages |
| Output Configuration | Digital outputs are bipolar: one current sourcing (PNP) and one current sinking (NPN) open-collector transistor. Analog output is a current source which is proportional to the received light level, updated in real time (every 50 microseconds) |
| Output Rating | Digital outputs are 150 mA maximum (each). Off-state leakage current < 10 microamps at 30 V dc. Saturation voltage (NPN output) < 1.5 V at 150 mA dc. Saturation voltage (PNP output) < 2.0 V at 150 mA dc. Current Sourcing Analog output: 0 to 10 mA. Maximum load voltage drop is ≤ 2 volts |
| Output Protection | Protected against false pulse on power-up and continuous overload or short-circuit of outputs. |
| Output Response | 50 microseconds. NOTE: 1 second delay on power-up; outputs do not conduct during this time. |
| Indicator LEDs | 10-segment (green) light bar indicates signal strength. Light Operate (green). Dark Operate (green). Outputs Conducting (yellow). OFF Delay (green): SETUP Mode: OFF — no delay. Flashing — 20 ms delay. ON — 40 ms delay. RUN Mode: OFF — no delay. ON — 20 or 40 ms delay |
| Construction | Zinc alloy die-cast and steel housing with black acrylic polyurethane finish. Lens, lens port cap, are o-ring sealed. Lens is acrylic. Lens port cap and lens holder are ABS |
| Environmental Rating | IEC IP67; NEMA 6 |
| Connections | PVC jacketed 6-conductor 2 m (6.5') or 9 m (30') attached cable with internal strain relief, or 6-pin Euro-style quick-disconnect. Mating QD cables are purchased separately. See Accessories section, page 12. |
| Operating Conditions | Temperature: -10° to +55° C (+14° to 131° F). Maximum Relative Humidity: 90% at 50° C (non-condensing) |
| Vibration and Mechanical Shock | All models meet IEC 68-2-6 and IEC 68-2-27 testing criteria. |
| Application Notes | • Do not mount the sensor directly perpendicular to shiny surfaces; position it at approximately a 15° angle in relation to the sensing target (see page 3). • Minimize web or product “flutter” whenever possible to maximize sensing reliability. • The analog output is proportional to the received light signal. The analog output is unaffected by + or – manual sensitivity adjustments. |
**R55 Expert Color Mark Sensors**

### R55 Expert Sensor Hookups

#### Cabled Models

- **bn**
- **bu**
- **wh**
- **bk**
- **pk**
- **gy**

10-30V dc

Remote Teach

#### Quick-Disconnect Models

- **bn**
- **bu**
- **wh**
- **bk**
- **pk**
- **gy**

10-30V dc

Remote Teach

### Mounting Brackets

<table>
<thead>
<tr>
<th>SMB55A</th>
<th>SMB55F</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 15° offset bracket</td>
<td>• Flat mount bracket</td>
</tr>
<tr>
<td>• 12-gauge stainless steel</td>
<td>• 12-gauge stainless steel</td>
</tr>
</tbody>
</table>

**SMB55A**

- 24.6 mm (0.97")
- 12 x R 3.3 mm (0.13")
- 8 x R 6.4 mm (0.25")
- 24.1 mm (0.95")
- 15.3 mm (0.60")
- 15.2 mm (0.60")
- 25.8 mm (1.01")
- 15.0 mm (0.59")

**SMB55F**

- 24.6 mm (0.97")
- 8 x R 3.3 mm (0.13")
- 15.3 mm (0.60")
- 15.2 mm (0.60")
- 24.6 mm (0.97")
- 15.2 mm (0.60")
- 25.8 mm (1.01")
- 15.0 mm (0.59")
- 8 x R 6.4 mm (0.25")
- 5.4 mm (0.21")
- 2 x 12.4 mm (0.49")
- 2 x 12.4 mm (0.49")
- 25.8 mm (1.01")
- 15.0 mm (0.59")
- 5.4 mm (0.21")
Mounting Brackets

| SMB55RA | - Right-angle bracket  
| SMB55S | - 15° offset bracket  

- 12-gauge stainless steel

Quick-Disconnect (QD) Cables

<table>
<thead>
<tr>
<th>Style</th>
<th>Model</th>
<th>Length</th>
<th>Connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-Pin Euro</td>
<td>MQDC-606</td>
<td>2 m (6.5')</td>
<td>Straight</td>
</tr>
<tr>
<td></td>
<td>MQDC-615</td>
<td>5 m (15')</td>
<td>Straight</td>
</tr>
<tr>
<td></td>
<td>MQDC-630</td>
<td>9 m (30')</td>
<td>Straight</td>
</tr>
<tr>
<td></td>
<td>MQDC-606RA</td>
<td>2 m (6.5')</td>
<td>Right Angle</td>
</tr>
<tr>
<td></td>
<td>MQDC-615RA</td>
<td>5 m (15')</td>
<td>Right Angle</td>
</tr>
<tr>
<td></td>
<td>MQDC-630RA</td>
<td>9 m (30')</td>
<td>Right Angle</td>
</tr>
</tbody>
</table>

Replacement Lens

<table>
<thead>
<tr>
<th>Models</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>UC-R55</td>
<td>Replacement lens for R55E</td>
</tr>
</tbody>
</table>

WARNING . . .

Not To Be Used for Personnel Protection

Never use these products as sensing devices for personnel protection. Doing so could lead to serious injury or death.

These sensors do NOT include the self-checking redundant circuitry necessary to allow their use in personnel safety applications. A sensor failure or malfunction can cause either an energized or de-energized sensor output condition. Consult your current Banner Safety Products catalog for safety products which meet C69A, ANSI and IEC standards for personnel protection.

WARRANTY: Banner Engineering Corp. warrants its products to be free from defects for one year. Banner Engineering Corp. will repair or replace, free of charge, any product of its manufacture found to be defective at the time it is returned to the factory during the warranty period. This warranty does not cover damage or liability for the improper application of Banner products. This warranty is in lieu of any other warranty either expressed or implied.