High Performance Sensor with "Enhanced Dynamic Range"
SMARTEYE® MARK II

High Performance Sensor

The SMARTEYE® MARK II sensor is one of TRI-TRONICS’ most popular photoelectric sensors. The SMARTEYE® MARK II features extremely high gain combined with high speed. These high performance sensors were designed to resolve the most difficult sensing tasks. In addition to superior high gain/high speed, the SMARTEYE® MARK II is equipped with many new improvements.

Among the many features included in the design of the SMARTEYE® MARK II, none is more important than the EDR® circuit. With EDR® (Enhanced Dynamic Range), the dynamic operating range has been extended and background suppression has been enhanced.

Also included in the design of the new SMARTEYE® MARK II are all of the proven features included in all SMARTEYE® sensors, including our unique Contrast Indicator. The SMARTEYE® MARK II sets a new standard of performance in photoelectric sensing. When the sensing task involves resolving critical identifying features such as size, texture, distance, opacity, depth, or color, the SMARTEYE® MARK II provides that extra measure of performance that is often required to ensure proper operation.

Features
- Response time (50 microseconds)
- Enhanced Dynamic Range
- Seven interchangeable optical blocks
- Clutched offset adjustment
- Operational from 12 to 24VDC...(polarity protected)
- Choice with infrared, red, white, or blue LED
- 10-LED CONTRAST INDICATOR
- Built-in connector
- Waterproof housing
- NPN and PNP output transistors
- Short circuit protection
- Light On/Dark on selector switch
- Anti-pulsing protection on power up

Benefits
- Accurate and repeatable
- Easy to setup
- Easy to maintain
- Lower maintenance costs
- Lower inventory costs
- Adaptable and flexible for many applications

Applications
- Printing/Coding/Marking
- Registration mark sensing
- High speed counting
- Low contrast inspection sensing
- Label applicator product detector
- Small parts detection

Typical Applications

Detection of fill level in container
Detection of reflective tape moving at high rapidity
Detection of objects moving at high velocity
**EDR® Enhanced Dynamic Range**

(Patent No. 5,621,205)

The EDR® circuit extends the dynamic operating range to provide unequaled performance at bright light levels.

**Eliminates Saturation**

Every photoelectric sensor has a saturation point – a point at which any further increase in received light level to its detector will not result in any further internal signal level increase. This is apparent on the SMARTYE® Contrast Indicator. For example, in an object sensing task, if the background (for example white conveyor belt) is reflecting enough light back to the sensor’s detector to reach the sensor’s saturation level, the arrival of an object will not result in any signal level increase as displayed on the Contrast Indicator. This undesirable condition is referred to as saturation.

To avoid saturation and enhance background suppression, the EDR® circuit monitors the offset adjustment during setup to determine when the sensor’s operating level is approaching the sensor’s light level saturation point. Before saturation occurs, the EDR® circuit adjusts the sensor in such a unique manner so as to prevent saturation and extends the overall dynamic range of the SMARTYE® MARK II sensor.

**Proximity Sensing Mode Advantages**

Another performance benefit provided by the EDR® circuit when operating in the proximity mode is that the SMARTYE® MARK II does not typically require the use of convergent or triangulating optics to resolve objects resting on shiny or highly reflective backgrounds. Instead, the optics can be divergent, allowing a wider field of view. The larger the area in view of the sensor’s optics, the greater the contrast deviation. Convergent or triangulating optics results in pinpoint spots of light. These optical sensing methods can result in falsely switching the sensor’s output by responding to minute surface variations or imperfections. A wider field of view offered by divergent optics allows the SMARTYE® MARK II to overlook most minor surface irregularities.

**Beam Break Sensing Mode Advantages**

When operating in the Beam Break mode of sensing, the EDR® circuit prevents saturation. This is particularly advantageous when attempting to detect the presence of splices, overlapping materials, container contents, or adhesive labels on backing materials.

Saturation can easily occur particularly when the materials involved are translucent or transparent. Example: In label detection, if the intensity of light penetrating through the label has reached the saturation level of the sensor, the arrival of the gap between labels will not increase the signal level as displayed on the Contrast Indicator making detection of the label is impossible. The new EDR® circuit built into the SMARTYE® MARK II prevents this from occurring by compensating during the setup procedure to prevent saturation.

**EDR® Benefits:**

- Extends dynamic operating range to include high light level operation without reducing amplifier gain
- Eliminates saturation, important for both Beam Make or Beam Break sensing modes
- Enhances background suppression
- When operating in the proximity mode, allows use of divergent, wide beam optics to increase contrast deviation and reduce the possibility of false response to minute surface irregularities or variations in position

**Features**

**LIGHT/DARK SWITCH**

Light ON/Dark ON selector switch

**OUTPUT STATUS INDICATOR**

Illuminates when outputs are ON.

**OFFSET ADJUSTMENT**

Sets initial level in relation to switch point of 5 on CONTRAST INDICATOR—also functions as a sensitivity adjustment

**CONNECTION**

M12 Connector

**10 LED CONTRAST INDICATOR**

Provides at-a-glance analysis of the sensor’s response to Light State vs Dark State sensing conditions

**INTERCHANGEABLE OPTICAL BLOCKS**

Choice of 7 Optical Blocks: O1, O1G, O2, R1, F1, V1, V1G

**EDR INDICATOR**

Intensity of GREEN LED provides indication of where in the dynamic operating range the offset, EDR® adjustment has been set

- FULLY LIT: Operating near saturation
- OFF: Operating near maximum sensing range
Optical Block Selection

Proximity Blocks

O1
Medium to Long Range Proximity
Medium to Long Range Proximity

O1G
Medium to Long Range Proximity (Glass)
Medium to Long Range Proximity

O2
Short Range Proximity
Useful for short-range sensing.

Focused V-Axis Blocks

V1
Focused Lens V-Axis

V1G
Focused Lens V-Axis (Glass)
Direct lens V-axis sensing at close ranges. Use for small part or precise leading edge sensing.

Retroreflective Blocks

R1
Retroreflective
Narrow beam optics designed to sense reflectors or reflective materials.

Fiber Optic Blocks

F1
Fiber Optic Adapter
Fiber optic quick connect

Sensing Range Guidelines

<table>
<thead>
<tr>
<th>Optical Blocks</th>
<th>IR</th>
<th>RED</th>
<th>BLUE</th>
<th>WHITE</th>
</tr>
</thead>
<tbody>
<tr>
<td>O1, O1G</td>
<td>6ft (1.83m)</td>
<td>5.5ft (1.68m)</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>O2</td>
<td>3.5in (88.9mm)</td>
<td>3.5in (88.9mm)</td>
<td>2in (50.8mm)</td>
<td>1.5in (38.1mm)</td>
</tr>
<tr>
<td>V1, V1G</td>
<td>4in (101.6mm)</td>
<td>4in (101.6mm)</td>
<td>2.25in (57.2mm)</td>
<td>2in (50.8mm)</td>
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<tr>
<td>R1</td>
<td>35ft (10.67m)</td>
<td>30ft (9.14m)</td>
<td>10ft (3.05m)</td>
<td>N/A</td>
</tr>
<tr>
<td>F1 (Prox)</td>
<td>5.5in (139.7mm)</td>
<td>4.5in (114.3mm)</td>
<td>1in (25.4mm)</td>
<td>0.5in (12.7mm)</td>
</tr>
<tr>
<td>F1(Prox w/lens)</td>
<td>1.5ft (0.46m)</td>
<td>14in (355.6mm)</td>
<td>5in (127.0mm)</td>
<td>2in (50.8mm)</td>
</tr>
<tr>
<td>F1Opposed</td>
<td>3.5ft (1.07m)</td>
<td>1.5ft (0.46m)</td>
<td>6in (152.4mm)</td>
<td>1.75in (44.5mm)</td>
</tr>
<tr>
<td>F1Opposed w/lens</td>
<td>20+ft (6+ m)</td>
<td>20+ft (6+ m)</td>
<td>6.5ft (1.98m)</td>
<td>6.5ft (1.98m)</td>
</tr>
</tbody>
</table>

NOTES:
• PROXIMITY tests utilized a 90% reflective target.
• RETROREFLECTIVE tests utilized a 3in diam. reflector Model AR3
• FIBER OPTIC tests utilized .125in diam. fiber bundles. Model UAC-15 Lens was used as indicated.

For more information on useful range, see Fundamentals, Section 1.
How to Specify

1. Select sensor model based on light source required:
   - SEI = Infrared
   - SER = Red
   - SEB = Blue
   - SEWL = White

2. Select adjustment type:
   - Blank = Potentiometer Adjust
   - K = Knob

3. Select Optical Block based on mode of sensing required:
   (see Range Guidelines).

Example:

```
SER K F1
```

**SMARTEYE® MARK II**

**Adjustment Type**

**Optical Block**

Hardware & Accessories

4-Wire Shielded MicroCable, M12

<table>
<thead>
<tr>
<th>Cable</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEC-6</td>
<td>6ft (1.8m) cable</td>
</tr>
<tr>
<td>SEC-15</td>
<td>15ft (4.6m) cable</td>
</tr>
<tr>
<td>SEC-25</td>
<td>25ft (7.62m) cable</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Connector</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RSEC-6</td>
<td>6ft (1.8m) right angle connector</td>
</tr>
<tr>
<td>RSEC-15</td>
<td>15ft (4.6m) right angle connector</td>
</tr>
<tr>
<td>RSEC-25</td>
<td>25ft (7.6m) right angle connector</td>
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4-Wire Extension Cable, M12

<table>
<thead>
<tr>
<th>Cable</th>
<th>Length</th>
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</thead>
<tbody>
<tr>
<td>BX-10</td>
<td>10ft (3.1m) extension cable</td>
</tr>
<tr>
<td>BX-25</td>
<td>25ft (7.62m) extension cable</td>
</tr>
</tbody>
</table>

4-Wire Unshielded Cable, M12

<table>
<thead>
<tr>
<th>Cable</th>
<th>Length</th>
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</thead>
<tbody>
<tr>
<td>SEC-2MU</td>
<td>6.5ft (2.0m) cable</td>
</tr>
<tr>
<td>SEC-5MU</td>
<td>16.4ft (5.0m) cable</td>
</tr>
</tbody>
</table>

**Mounting Brackets**

- SEB-1 Stainless L Bracket
- FMB-1 (8.4 mm diam.) Standard Fiber Optic
- FMB-2 (5.1 mm diam.) Mini Glass Fiber Optic
- FMB-3 (3.1 mm diam.) Mini Plastic Fiber Optic
Specifications

SUPPLY VOLTAGE
• 12 to 24VDC
• Polarity Protected

CURRENT REQUIREMENTS
• 85mA (exclusive of load)

OUTPUT TRANSISTORS
• (1) NPN and (1) PNP Output transistor:
  • NPN: Sink up to 150mA
  • PNP: Source up to 150mA
  • Momentary short circuit protected
  • Outputs protected from pulsing during power up
  • Light/dark switch determines Output Status:
    Light = Light ON operate
    Dark = Dark ON operate

RESPONSE TIME
• Minimum duration of input event
• Light state response = 50 microseconds
• Dark state response = 140 microseconds
• Leading edge Variation less than 20 microseconds

HYSTERESIS
• Less than 400 millivolts for maximum sensitivity and resolution

LED LIGHT SOURCE
• Pulse modulation rate 45 KHZ
• Choice of color:
  A. Infrared = 880nm
  B. Red = 660nm
  C. White = Broadband Color Spectrum
  D. Blue = 480nm

LIGHT IMMUNITY
• Responds to sensor’s pulsed modulated light source
• Immune to most ambient light

OFFSET/EDR® ADJUSTMENT
• Sets initial level on CONTRAST INDICATOR in relation to mid-scale switch point of 5 – functions as sensitivity adjustment
• Controls Enhanced Dynamic Range circuit (EDR®) which functions to avoid saturation

INDICATORS
• OUTPUT INDICATOR - Red LED illuminates and the NPN or PNP outputs switch to the opposite state when returned light level exceeds 5 on the CONTRAST INDICATOR
• EDR® INDICATOR - Intensity of GREEN LED provides indication of where in the dynamic operating range the offset, EDR® adjustment has been set
• FULLY LIT: Operating near saturation
• OFF: Operating near maximum sensing range
• CONTRAST INDICATOR – Displays scaled reading of sensor’s response to contrasting light levels (light vs. dark) on a ten bar LED display

AMBIENT TEMPERATURE
• -40°C to 70°C (-40°F to 158°F)

RUGGED CONSTRUCTION
• Chemical resistant, high impact polycarbonate housing
• Waterproof, NEMA 4X, 6P and IP67 enclosure ratings
• Epoxy encapsulated for mechanical strength

Connections and Dimensions

SMARTEYE® MARK II SENSOR

Power Cable with M12 Connector

6-32 x 1/4” socket hd. cap screw (7/64 hex key)

Optical Blocks

Optional Mounting Bracket

P/N SEB-1 With Hardware

Product subject to change without notice

RoHS Compliant

General Application Photoelectric Sensors