Enhanced Dynamic Range
Very High Speed, High Resolution
Featuring the patented EDR® — Enhanced Dynamic Range

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

Among the many features included in the design of the SMARTYE MARK II, none is more important than the addition of the EDR® circuit. Now, thanks to the addition of 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 SMARTYE MARK II are all of the proven features included in all SMARTYE sensors, including our famous Contrast Indicator. Without question, the SMARTYE 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 SMARTYE MARK II will give you that extra measure of performance that is often required to ensure proper operation. Marginal performance cannot be tolerated when the entire operation of an automated machine process relies on the ability of a photoelectric sensor to perform its sensing task.

CONTRAST INDICATOR™

The Contrast Indicator displays a scale reading of the level of light received by the sensor’s photo detector. The more light received, the higher the reading. The less light received, the lower the reading.

Contrast is a comparison of the lightest state reading versus the darkest state reading. The sensing task of any digital (switching) photoelectric sensor is to resolve the difference between these two light levels and switch the output accordingly. The SMARTYE® switches its output when the light level passes the midscale reading of “5”.

FIBEROPTIC LIGHT GUIDES

Flexible fiberoptic light guides are available in sizes small enough to fit into your tightest job sensing sites. There are models for inaccessible places, detection of extremely small parts, and high-vibration locations, plus straight light guides for thru-beam and bifurcated light guides for proximity sensing. Refer to Section 3 for details.
The EDR® circuit extends the dynamic operating range to provide unequaled performance at very 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 (from its own pulsing LED light source) will not result in any further internal signal level increase. This is apparent on the SMART Eye’s Contrast Indicator. For example, in an object sensing task, if the background (i.e., 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 (such as a cookie) 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 SMART Eye® Mark II sensor.

**Proximity Sensing Mode Advantages**
Another performance benefit provided by the EDR circuit when operating in the proximity mode is that the SMART Eye® 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 (i.e., wide angle proximity lens or large bundle fiberoptic guides) allows the SMART Eye® Mark II to overlook most minor surface irregularities.

**Beam Break Sensing Mode Advantages**
When operating in the Beam Break (opposed) mode of sensing, the EDR circuit once again 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. If this is allowed to occur, detection of the label is impossible. The new EDR circuit built into the SMART Eye® 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

**Typical Applications**
- Detection of fill level in container
- Detection of reflective tape moving at high rapidity
- Detection of objects moving at high velocity
Selection Guidelines  Opaque Object Sensing

Preferred Mode: Beam Break

- Fiberoptic opposed mode is best choice for detecting any opaque object
- Sensor: Model SEIF1 (IR Light Source)
- Cable: Shielded cable w/connector Model SEC-6 (6 ft.), SEC-15 (15 ft.), or SEC-25 (25 ft.)
- Fiberoptic Light Guides: (2) Model F-A-36T
- Sensing Range: Up to 3 ft
- Accessories: (2) Model UAC-15 lenses, extends sensing range to over 20 ft., Mounting bracket, Model SEB-1, FM B-1
- NOTE: Select smaller fiber bundle for small part detection. (See Fiber Optic Section)

Retroreflective mode. Use with reflector to detect medium to large size opaque objects
- Sensor: Model SERR1 (Red Light Source)
- Cable: Shielded cable w/connector Model SEC-6 (6 ft) or SEC-15 (15 ft.)
- Reflector: Model 78P, Plastic, 4.4 in. X 1.9 in. screw mounted. (See Accessories Section for complete listing of reflectors)
- Sensing Range: Up to 25 ft.
- Accessories: Mounting bracket, Model SEB-1
- NOTE: Not recommended for detecting highly reflective objects

Alternate Mode: Beam Make (Proximity)

- NOTE: Consider proximity mode when installation sensing site conditions preclude using the preferred Beam Break mode.

- Fiberoptic proximity is used to detect medium to large flat sided opaque objects
- Sensor: Model SEIF1 (IR Light Source)
- Cable: Shielded cable w/connector Model SEC-6 6ft.) or SEC-15 (15ft.)
- Fiberoptic Light Guides: Model BF-A-36T
- Sensing Range: Up to 4 in.
- Accessories: (1) Model UAC-15 lens. Use to extend sensing range up to 1 ft.
- Mounting bracket, Model SEB-1, FM B-1
- NOTE: Select smaller fiber bundle for small part detection. (See Fiber Optic Section)

Convergent/proximity mode is useful to detect opaque objects when there is little (if any) gap between objects.
- Sensor: Model SEIV1 (IR Light Source)
- Cable: Shielded cable w/connector Model SEC-6 (6 ft) or SEC-15 (15 ft.)
- Sensing Range: From 1 to 4 in.
- Accessories: Mounting bracket, Model SEB-1

Proximity (divergent beam) mode sensing is useful in detecting some large size opaque objects from longer range. Generally speaking, there must be substantial gaps between objects for this mode to be effective.
- Sensor: Model SEIO1 (IR Light Source)
- Cable: Shielded cable w/connector Model SEC-6 (6 ft) or SEC-15 (15 ft.)
- Sensing Range: From 6 in. to 5 ft.
- Accessories: Mounting bracket, Model SEB-1
Selection Guidelines Translucent/Transparent Object Sensing

Preferred Mode: Retroreflective Beam Break

Fiberoptic retroreflective is the best choice for detecting empty transparent or translucent objects. The SMARTEYE® MARK II featuring a unique blue LED light source is recommended for detecting transparent or translucent plastic or glass objects. A red light source is recommended when detecting translucent (non-transparent) objects only.

Sensor: Model SEBF1 (Blue Light Source) or Model SERF1 (Red Light Source)
Cable: Shielded cable w/connector Model SEC-6 (6 ft.) or SEC-15 (15 ft.)
Fiberoptic Light Guides: Model BF-A-36T
Reflector: Model 78P, plastic 4.4 in. x 1.9 in., screw mounted
Sensing Range: Up to 1 ft.
Accessories: (1) Model UAC-15 lens. Use to extend sensing range from 1 ft. maximum without lens to over 3 ft. with lens. Mounting bracket, Model SEB-1, FMB-1

Retroreflective (R1 optical block) is a good choice for detecting medium to large size empty transparent or translucent objects. The SMARTEYE® MARK II featuring a unique blue LED light source is recommended for detecting transparent or translucent plastic or glass objects. A red light source is recommended when detecting translucent (non-transparent) objects only.

Sensor: Model SEBR1 (Blue Light Source) or Model SERR1 (Red Light Source)
Cable: Shielded cable w/connector Model SEC-6 (6 ft.) or SEC-15 (15 ft.)
Reflector: Model 78P, plastic 4.4 in. x 1.9 in., screw mounted
Sensing Range: Up to 5 ft.
Accessories: Mounting bracket, Model SEB-1

Alternate Mode: Beam Make (Proximity)

NOTE: Consider proximity mode when translucent/transparent objects are containers filled with clear liquid or when site conditions preclude using the preferred retroreflective Beam Break mode.

Fiberoptic proximity mode is useful to detect transparent/translucent objects.
Sensor: Model SERF1 (Red light source)
Cable: Shielded cable w/connector Model SEC-6 (6 ft.) or SEC-15 (15 ft.)
Fiberoptic Light Guides: Model BF-A-36T
NOTE: Select smaller fiber bundle for small part detection. (See Fiberoptic Section)
Sensing Range: Up to 4 in.
Accessories: (1) Model UAC-15 lens. Use to extend sensing range up to 1 ft., Mounting bracket, Model SEB-1, FMB-1

Convergent/proximity mode is useful to detect most transparent/translucent objects when there is little (if any) gap between objects.
Sensor: Model SERV1 (Red Light Source)
Cable: Shielded cable w/connector Model SEC-6 (6 ft.) or SEC-15 (15 ft.)
Sensing Range: From 1 to 4 in
Accessories: Mounting bracket, Model SEB-1

Proximity (divergent beam) mode sensing is useful in detecting some large size translucent/transparent objects from longer range. Generally speaking, there must be substantial gaps between objects for this mode to be effective.
Sensor: Model SER01 (Red Light Source)
Cable: Shielded cable w/connector Model SEC-6 (6 ft.) or SEC-15 (15 ft.)
Sensing Range: From 6 in. to 4 ft.
Accessories: Mounting bracket, Model SEB-1
Interchangeable optical blocks provide for universal application of the SMARTEYE® MARK II to any sensing task from large object sensing to finite sensing of small parts. Plastic lenses standard. Glass lenses available. Consult factory.

**Type F1**
Fiberoptic Adapter
Type F1 adapts MARK II to any standard fiber optic light guide with .187” O.D. tips. The light guide is inserted and held in place with set screws. See Section 3 for selection.

**Type O1, O1G (Glass)**
Medium to Long Range Proximity
Type O1, O1G (glass) adapts the MARK II to the optical proximity mode of sensing. Range is dependent on size, shape, surface reflectivity of the object to be detected.

**Type O2**
Short Range Proximity
Type O2 also adapts the MARK II to the optical proximity mode of sensing, but on a sharp “V” axis to control depth of view. Range is dependent on model of the MARK II selected.

**Type V1, V1G (Glass)**
Focused Lens “V” Axis
Type V1, V1G (Glass) is for direct lens “V” axis sensing at close ranges. Used for small part or precise leading edge sensing. Range is dependent on model of the MARK II selected.

**Type R1**
Retroreflective
Type R1 turns the MARK II into a retroreflective sensor. Range is dependent on model of the MARK II selected and size of reflectors.

### 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>6 ft.</td>
<td>5.5 ft.</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>O2</td>
<td>3.5 in.</td>
<td>3.5 in.</td>
<td>2 in.</td>
<td>1.5 in.</td>
</tr>
<tr>
<td>V1, V1G</td>
<td>4 in.</td>
<td>4 in.</td>
<td>2.25 in.</td>
<td>2 in.</td>
</tr>
<tr>
<td>R1</td>
<td>35 ft.</td>
<td>30 ft.</td>
<td>10 ft.</td>
<td>N/A</td>
</tr>
<tr>
<td>F1 (Prox)</td>
<td>5.5 in.</td>
<td>4.5 in.</td>
<td>1 in.</td>
<td>0.5 in.</td>
</tr>
<tr>
<td>F1 (Prox w/lens)</td>
<td>1.5 ft.</td>
<td>14 in.</td>
<td>5 in.</td>
<td>2 in.</td>
</tr>
<tr>
<td>F1 Opposed</td>
<td>3.5 ft.</td>
<td>1.5 ft.</td>
<td>6 in.</td>
<td>1.75 in.</td>
</tr>
<tr>
<td>F1 Opposed w/lens</td>
<td>20+ ft.</td>
<td>20+ ft.</td>
<td>6.5 ft.</td>
<td>6.5 ft.</td>
</tr>
</tbody>
</table>

**NOTES:**
- For more information on useful range, see Fundamentals, Section 1.
- PROXIMITY tests utilized a 90% reflective target.
- RETROREFLECTIVE tests utilized a 3 in. diam. reflector Model AR3
- FIBER OPTIC tests utilized .125 in. diam. fiber bundles. Model UAC-15 Lens was used as indicated.
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

Accessories

Micro Cable Selection Guide, 4-wire M12

Yellow Shielded Cable Assemblies

SEC-6
6’ (1.8 m) cable with connector

SEC-15
15’ (4.6 m) cable with connector

SEC-25
25’ (7.62 m) cable with connector

RSEC-6
6’ (1.8 m) cable / right angle conn.

RSEC-15
15’ (4.6 m) cable / right angle conn.

RSEC-25
25’ (7.62 m) cable / right angle conn.

Black Shielded Cable Assemblies
(Lightweight)

BSEC-6
6’ (1.8 m) cable with connector

BSEC-15
15’ (4.6 m) cable with connector

BSEC-25
25’ (7.62 m) cable with connector

BRSEC-6
6’ (1.8 m) cable / right angle conn.

BRSEC-15
15’ (4.6 m) cable / right angle conn.

BRSEC-25
25’ (7.62 m) cable / right angle conn.

Grey Unshielded Cable Assemblies

GSEC-2MU
6.5’ (2.0 m) Low-cost

GSEC-5MU
16.4’ (5.0 m) Low-cost
Specifications

SUPPLY VOLTAGE
- 12 to 24 VDC
- Polarity Protected

CURRENT REQUIREMENTS
- 85 mA (exclusive of load)

OUTPUT TRANSISTORS
- (1) NPN and (1) PNP Output transistor:
  - NPN: Sink up to 150 mA
  - PNP: Source up to 150 mA
- 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 10 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

Product subject to change without notice. Consult Factory for RoHS Compliance.

Connections and Dimensions  SMARTEYE® MARK II PHOTOELECTRIC SENSOR

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