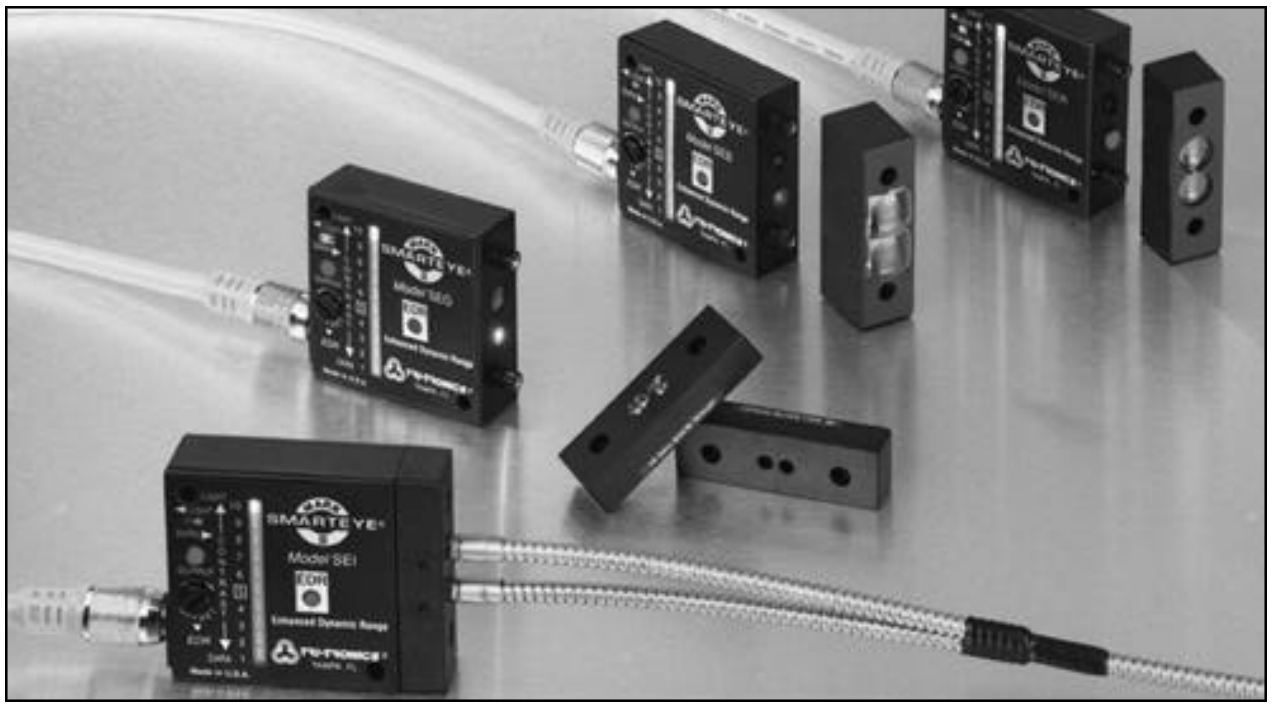
SMARTEYE® MARK II Featuring The Patented EDR®



Set a New Standard in Photoelectric Sensing!

Description

The SMARTEYE® MARK II sensor is one of TRI-TRONICS' growing family of high performance photoelectric sensors. Designed to outperform all of its predecessors as well as the competition, the 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 SMARTEYE sensors. In addition to superior high gain/high speed, the MARK II is equipped with many new improvements.

MARK II features ...

- Built-in connectors on all models.
- Improved waterproof housing.
- Light/dark operate switch.
- NPN and PNP output transistors on all models.

Among the many features included in the design of the 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 MARK II are all of the proven features included in all SMARTEYEs, including the now famous "CONTRAST INDICTOR." Without question the 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 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 SMARTEYE switches its output when the light level passes the midscale reading of "5."

Fiber Optic Light Guides

Flexible Fiber Optic Light Guides are available in sizes small enough to fit into your tightest job sensing sites. Models for inaccessible places, detection of extremely small parts, high- temperature applications, corrosive environments, or high-vibration locations. Straight light guides for thru-beam and bifurcated light guides for proximity sensing.

(Refer to Section 3 for details)

Patent No. 5,621,205

SMARTEYE® MARK II Featuring The Patented EDR®

EDR® "Enhanced Dynamic Range"

Description

The new and unique 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 SMARTEYE'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 set-up 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 new MARKII sensor.

• **Proximity Sensing Mode Advantages -** Another performance benefit provided by the EDR circuit. when operating in the proximity mode is that the 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 fiber optic guides) allows the 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 new MARK II prevents this from occurring by compensating during the set-up procedure to prevent saturation.

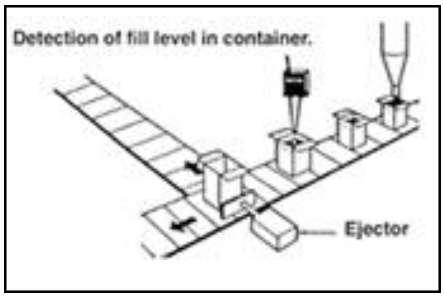
EDR Benefits:

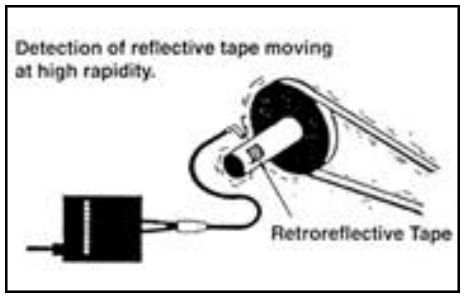
• Extends dynamic operating range to include high light level operation without reducing amplifier gain
• Eliminates saturation. This is important in both beam make or beam break sensing modes
• Enhances background suppres - sion
• When operating in the proximity mode, allows use of divergent, wide beam optics to increase con - trast deviation and reduce the pos - sibility of false response to minute surface irregularities or variations in postion

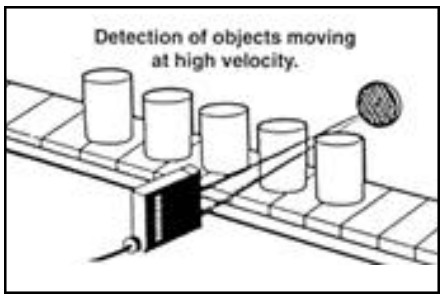
Standard Features:

• Very fast response time (50 microseconds) and operating speed while maintaining extremely high gain on all models
• Unique Enhanced Dynamic Range indicator (Patent Pending).
• Interchangeable optical blocks
• 4-Turn clutched offset adjustment.
• Operational from 12 to 24 VDC... reversed polarity protected
• Choice of models with infrared red, white or blue LED light source provides unique color perception, i.e., yellow vs. white
• 10-LED CONTRAST INDICATOR provides "at a glance" performance data during state set up as well as during dynamic conditions when input events are ongoing
• Built-in connectors
• Waterproof housing complies with NEMA and IP64 ratings
• Both NPN and PNP Output tran - sistors
• Short circuit protection for output transistors
• Light on/dark on selector switch
• Anti-pulsing protection on power up

Typical Applications







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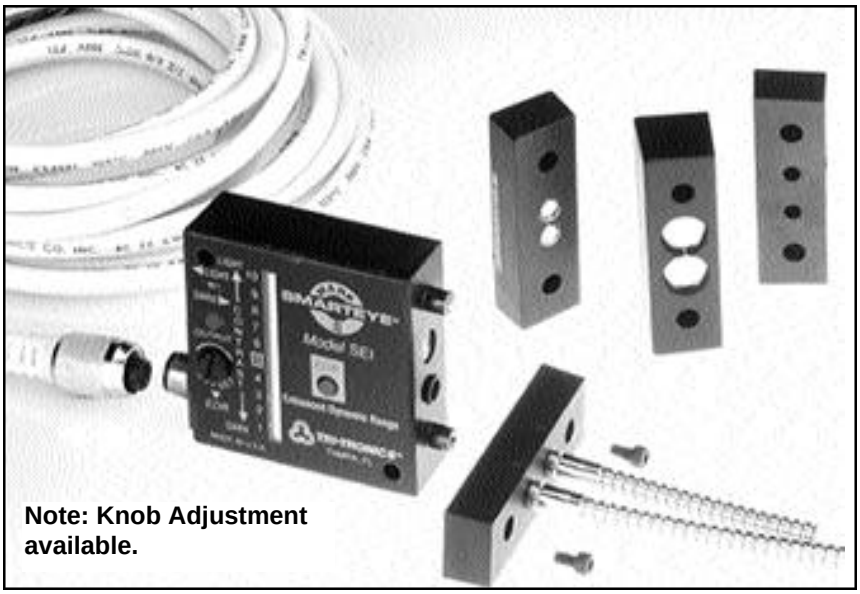
SMARTEYE® MARK II Featuring The Patented EDR®

The Patented EDR® Enhanced Dynamic Range Indicator

Please note that as the OFFSET/EDR adjustment is rotated in the counter-clockwise direction, the green EDR indicator LED will begin to turn on and glow dimly. As the counter clockwise rotation proceeds, the intensity of the EDR indicator will continue to increase. This indicator, **for the first time,** provides the installer an idea of just where in the overall dynamic operating range of the sensor the OFFSET/EDR adjustment has been set. For example, if after adjustment to obtain maximum contrast deviation the OFFSET/EDR indicator is "off" the sensor is operating under very low received light conditions. If the EDR indicator is fully lit, the sensor is operating under very high received light conditions. **The concept of how to interpret the green EDR indicator is simple. After adjustment this indicator should not be fully lit or completely off.** Anywhere in between indicates the sensor is operating within its dynamic operating range.



Note: Knob Adjustment available.

EDR INDICATOR STATUS	SENSING CONDITION	PERFORMANCE ENHANCEMENT
OFF	Operating near maximum sensing range	A. Move closer to target (proximity mode) B. Use larger diameter fiber optic light guides C. Use accessory lens D. Decrease sensing range
FULLY LIT	Operating near saturation	A. Move awayfrom target (proximity mode) B. Increase sensing range (beam break mode) C. Downsize diameter of fiber optic

* The suggested performance enhancements as listed above will ensure that contrast deviation response has been maximized.

LIGHT SOURCE GUIDELINES

INVISIBLE INFRARED LIGHT SOURCE (880 NM) MODEL SEI

A. Best choice in most opaque object sensing tasks.
B. Provides longest possible sensing range in either beam make or beam break sensing modes.
C. Best choice in hostile environments. Useful in penetrating lens contamination.
D. Preferred for use with small glass fiber optic light guides. Note: Do not use IR light with plastic fiber optic light guides.
E. Preferred when sensing dark colored objects in the proximity (beam make) mode, i.e.,black, blue, green, etc.
F. Useful in penetrating containers for verification of contents. Also useful in detecting overlapped splices in dense materials.
G. Color perception; tends to favor blue colored objects.

VISIBLE RED LIGHT SOURCE (660 NM) MODEL SER

A. Best choice for use with **plastic fiber optic light guides.**
B. Useful when sensing translucent objects in proximity (beam make) mode.
C. Useful when sensing transparent objects in **fiber-optic-retroreflective** (beam break) **mode**
D. Can be polarized for retroreflective (beam break) sensing to reduce proxing on shiny objects.
E. Opposed fiber optic light guides can be polarized for sensing some translucent plastic containers. Consult factory for details.
F. Used as red filter for color perception advantages.

NEW BLUE LIGHT SOURCE (480 NM) MODEL SEB

A. Best choice for detecting translucent or transparent, plastic or glass objects in the **retroreflective mode when using the R1 optical block.**
B. Used as blue filter for color perception advantages, i.e. resolving yellow vs. white colored objects or printed registration marks.

WHITE LIGHT SOURCE (BROADBAND COLOR SPECTRUM) Model SEWL

A. Best choice for detecting all printed registration marks on packing material.
B. Recommended for detecting dark colored objects in the proximity (Beam Make) mode.
C. Best choice for sortition of colored objects.

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SMARTEYE® MARK II Models

OPTICAL BLOCK SELECTION (Included with each SMARTEYE® MARK II)

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 Fiber Optic Adapter	Type O1, O1G (Glass) Medium to Long Range Proximity	Type O2 Short Range Proximity	Type V1, V1G Focused Lens "V" Axis	Type R1 Retroreflective
				
Type F1 adapts the MARK IIto any standard fiber optic light guide within 187" O.D. tips. The light guide is inserted and held in place with set screws.	Type O1, O1G adapts the MARK II to the optical proximity mode of sensing. Range is de-pendent on size, shape, surface reflectivity of the object to be detected.	Type O2 also adapts the MARK IIto 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 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 theMARK II selected.	Type R1 turns the MARK IIinto a retroreflective sensor. Range is de-pendent on model the MARK II selected and size of reflectors.

"QUICK REFERENCE" Range Guidelines

SMARTEYE® MARK II (SWITCHING) MODELS

Optical Block Types	IR	RED	BLUE	WHITE
O1, O1G	6 ft.	5.5 in.	N/A	N/A
O2	3.5 in.	3.5 in.	2 in.	1.5 in.
V1, V1G	4 in.	4 in.	2.25 in.	2 in.
R1	35 ft.	30 ft.	10 ft.	N/A

Optical Block Types	IR	RED	BLUE	WHITE
F1 (Prox)	5.5 in.	4.5 in.	1 in.	0.5 in.
F1 (Prox. w/lens)	1.5 ft.	14 in.	5 in.	2 in.
F1 Opposed	3.5 ft.	1.5 ft.	6 in.	1.75 in.
F1 Opposed w/lens	20+ ft.	20+ ft.	6.5 ft.	6.5 ft.

NOTES: PROXIMITY tests utilized a 90% Reflective while target. RETROREFLECTIVE tests utilized a 3" dia. round reflector Model AR-3. FIBEROPTIC tests utilized a .125" dia. fiber bundles. Model UAC-15 lens was used as indicated.

ORDERING INFORMATION

How To Specify:

1. Select Sensor Model based on light source required:
   SEI = Infrared; SER = Red; SEB = Blue;
   SEW = White.

2. Select Optical Block based on mode of operation required.

EXAMPLE: SERR4

SER — Red Light Source

R4 — Retroreflective Sensing Mode

SMARTEYE® MARK II Specifications

SUPPLY VOLTAGE
- 12 to 24 VDC
- Polarity Protected

CURRENT REQUIREMENTS
- 85 milliamps (exclusive of load)

OUTPUT TRANSISTORS
- (1) NPN AND (1) PNP Output transistors:
- NPN: Sink up to 150 milliamps
- PNP: Source up to 150 milliamps
- 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 sensors 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 outputs switch to 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 operation 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 sensors response to contrasting light levels (light vs. dark) on a 10 bar LED display

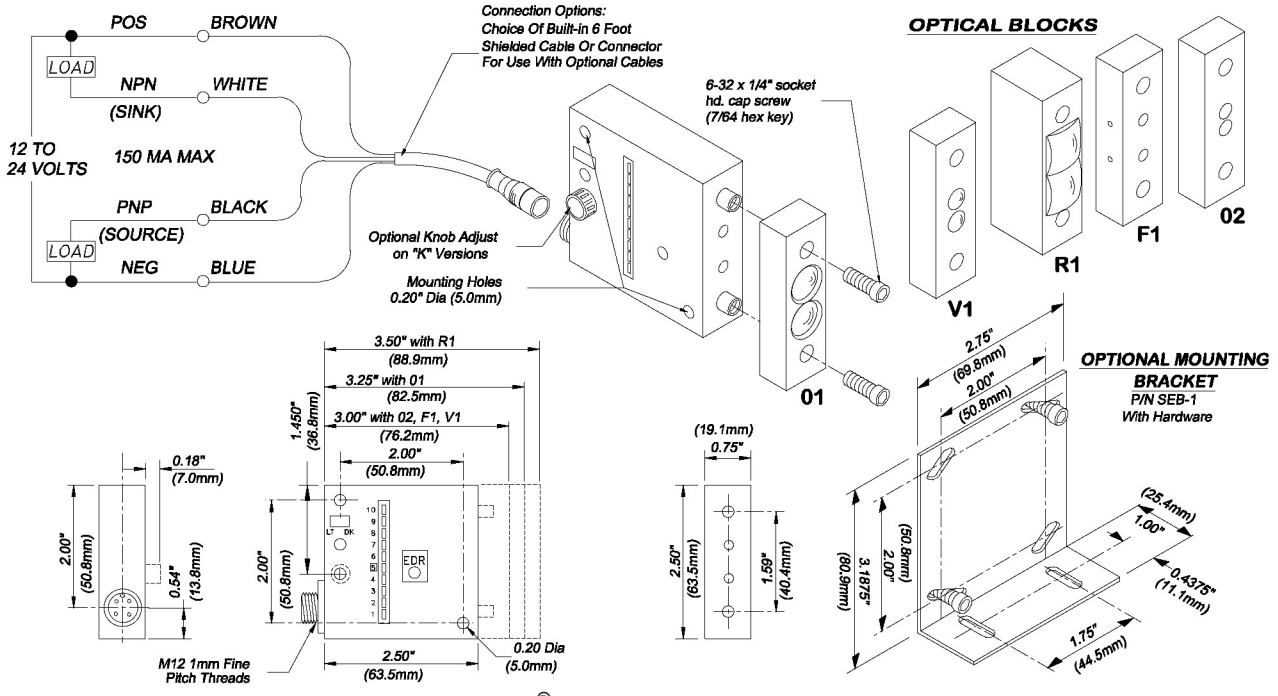
AMBIENT TEMPERATURE
- -40°C to 70°C (-40°F to 158°F)

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

NOTE: Products subject to change without notice.

EDR Patent No. 5,621,205

CONNECTIONS AND DIMENSIONS



SMARTEYE® PHOTOELECTRIC SENSOR

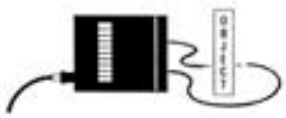
SMARTEYE® MARK II Selection Guidelines

OPAQUE OBJECT SENSING:

Preferred Mode:

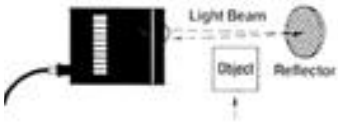
Beam Break

Option 1.



Fiber optic 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.) or SEC-15 (15 ft.)
Fiber optic light guides: (2) Model F-A-36T
NOTE: Select smaller fiber bundle for small part detection. (See Fiber Optic Section 3.)
Sensing range: Up to 3 ft
Accessories: (2) Model UAC-15 lenses, extends sensing range to over 20 ft.
Mounting bracket, Model SEB-1

Option 2.



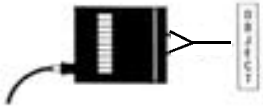
Retroreflective mode. Use with reflector to detect medium to large size opaque objects
NOTE: Not recommended for detecting highly reflective objects.
Sensor: Model SERR1 (Red light source)
Cable: Shielded cable w/connector Model SEC-6 (6 ft) or SEC-15 (15 ft.)
Reflector: Model 78P, Plastic, 4.4 in. X 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

Alternate Mode:

Beam Make (Proximity)

NOTE: Consider proximity mode when installation sensing site conditions preclude using the preferred beam break mode.

Option 1.



Fiber optic 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.)
Fiber optic light guide: Model BF-A-36T
NOTE: Select smaller fiber bundle for small part detection. (See Fiber Optic Section 3.)
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

Option 2.

Convergent/proximity mode is useful to detect opaque objects when there is little (if any) gap between objects.
Sensor: Model SEI02 (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

Option 3.

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

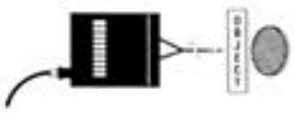
SMARTEYE® MARK II Selection Guidelines

TRANSLUCENT / TRANSPARENT OBJECT SENSING:

Preferred Mode:

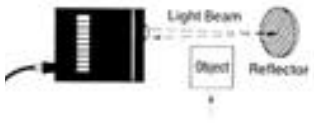
Retroreflective beam break

Option 1.



Fiber optic 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 (6ft.) or SEC-15 (15ft.)
Fiber optic light guide: 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

Option 2.



Retroreflective (R1 optical block) is a good choice for detecting medium to large size empty transparent or translucent objects. The SMARTEYE® MARKII 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 (6ft.) or SEC-15 (15ft)
Reflector: Model 78P, plastic 4.4 in. X 1.9 in., screw mounted.
Sensing range: Up to 5ft.
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.

Option 1.

Fiber optic 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.)
Fiber optic light guide: Model BF-A-36T
NOTE: Select smaller fiber bundle for small part detection. (See Fiber Optic Section 3.)
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

Option 2.

Convergent/proximity mode is useful to detect most transparent/translucent objects when there is little (if any) gap between objects
Sensor: Model SER02 (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

Option 3.

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

SMARTEYE® MARK II Models (Mating cable must be ordered separately)

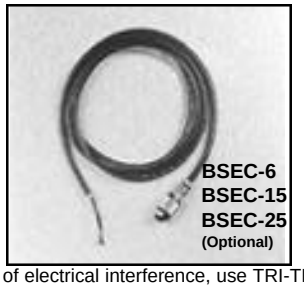
Model No. W/O Knob	Model No. With Knob	Light Source	Range*	Selection Guide
Beam Break Mode Retroreflective (Type R1 Optical Block)				
SEIR1	SEIKR1	Infrared	35 ft.	Maximum range in retroreflective mode.
SERR1	SERKR1	Visible Red	30 ft.	Visible beam aids alignment.
SEBR1	SEBKR1	Visible Blue	10 ft.	Best choise for clear/translucent object sensing.
Beam Make Mode Proximity, Diffused beam (Type 01 Optical Block, medium to long range proximity)				
SEIO1	SEIKO1	Infrared	6 ft.	Maximum range on dark colored objects. Best for most colors.
SERO1	SERKO1	Visible Red	5.5 ft.	Best choice for clear/translucent object sensing.
Beam Make Mode Proximity, Diffused Beam (Type 02 Optical Block, short range, wide beam proximity)				
SEIO2	SEIKO2	Infrared	3.5 in.	Maximum range on dark colored objects. Best for most colors.
SERO2	SERKO2	Visible Red	3.5 in.	Best choice for clear/translucent object sensing.
SEBO2	SEBKO2	Visible Blue	2 in.	Color perception advantages.
Beam Break Mode Convergent Beam "V" Axis (Type V1 Optical Block)				
SEIV1	SEIKV1	Infrared	4 in.	Best choice for small object and dark colored object sensing.
SERV1	SERKV1	Visible Red	4 in.	Best choice for clear/translucent object sensing.
SEBV1	SEBKV1	Visible Blue	2.25 in.	Color perception advantages.
SEWLV1	SEWLKV1	Visible White	1 in.	Color perception advantages.

Fiber Optic Mode (Type F1 Optical Block)

Model No. W/Out Knob	Model No. With Knob	Light Source	Beam Make Proximity Mode Range* W/O Lens	Beam Make Proximity Mode Range* With Lens	Beam Break Opposed Mode Range* W/O Lens	Beam Break Opposed Mode Range* With Lens	Selection Guide
SEIF1	SEIKF1	Infrared	5.5 in.	1.5 ft.	3.5 ft.	20+ ft.	Best choice for opaque objects.
SERF1	SERKF1	Red	4.5 in.	14 in.	1.5 ft.	20+ ft.	Clear/translucent objects.
SEBF1	SEBKF1	Blue	1 in.	5 in.	6 in.	6.5 ft.	Color perception advantages.
SEWLF1	SEWLKF1	White	.5 in.	1 in.	6 in.	1 ft.	Color perception advantages.

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

Mounting Options and Hardware: (order separately)



IMPORTANT: To reduce the possibility of electrical interference, use TRI-TRONICS molded plug / shielded cable assembly. Shield wire is internally connected through plug to the sensor via the threaded metal collar.

SMARTEYE® MARK II Accessories (Bracket and mating cable must be ordered separately)

Model No.	Description
F1	Fiber Optic Block
V1, V1G	"V" Axis Optical Block
UAC-5	Threaded Spot Focus Lens, Plastic
UAC-5G	Threaded Spot Focus Lens, Glass
UAC-12	Slip-On Long Range Lens, Plastic
UAC-15	Threaded Long Range Lens, Glass
SEB-1	SMARTEYE Bracket

Shielded Cable Assemblies		
Yellow	Black	Description
SEC-6	BSEC-6	6 ft. Cable w/connector
SEC-15	BSEC-15	15 ft. Cable w/connector
SEC-25	BSEC-25	25 ft. Cable w/connector
RSEC-6	BRSEC-6	6 ft. Cable, right angle
RSEC-15	BRSEC-15	15 ft. Cable, right angle
RSEC-25	BRSEC-25	25 ft. Cable, right angle
NEW!	BX-10	10 ft. Extension cable
NEW!	BX-25	25 ft. Extension cable

Connection Options: Choice of built-in 6´ Shielded Cable or connector for use with Optional Cables. ****For a lightweight more flexible option, order our New Black Shield cable assemblies***.