

August 2007

E51 Modular Limit Switch Style Photoelectric Sensors

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Cutler-Hammer® E51 Limit Switch Style Modular Sensors from Eaton’s electrical business are available in thru-beam, reflex, polarized reflex, diffuse reflective and fiber optic sensing modes to solve a wide variety of sensing applications. Modular, plug-in components are easy to maintain, meaning less downtime and reduced inventory. Choose between 2-wire sensors with AC/DC operation and 4-wire sensors in either AC or DC styles. Connection options include terminal, mini-connector and various lengths of cable. Sensors can be ordered in component form or as fully assembled units.

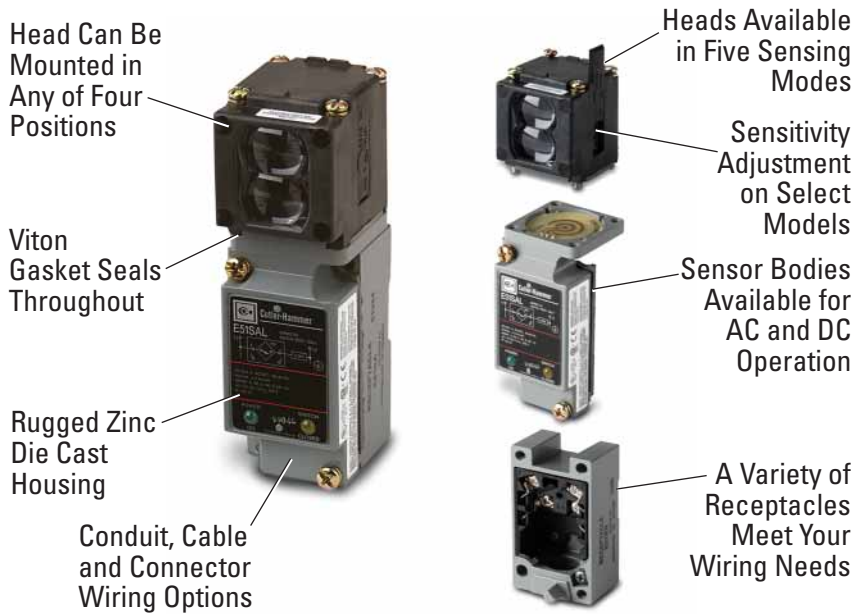
Approvals

- UL Listed
 - CSA Certified
- CE (where shown)



Unless otherwise noted, the products contained in this document are not designed or intended for use in human safety applications.

Modular Construction and a Variety of Operating Modes









Product Features

- Choose from five different sensing modes including fiber optic
- All heads feature a selector switch for light or dark operation
- Logic modules are available to provide additional control functions
- Rugged construction, ideal for industrial environments
- Viton gaskets ensure a positive seal and high chemical resistance
- Sensor heads can be rotated to any of four positions
- Components are interchangeable with E51 proximity sensors
- Sensors accommodate both U.S. and DIN mounting dimensions
- Sensor bodies feature bifurcated engagement prongs for a reliable electrical connection when plugging into receptacle stabs

For Customer Service in the U.S. call 1-877-ETN CARE (386-2273), in Canada call 1-800-268-3578.
 For Application Assistance in the U.S. and Canada call 1-800-426-9184.

Model Selection — Assembled Sensors — Reflex, Diffuse Reflective and Thru-Beam

Assembled Sensor		Sensor Body and Receptacle		2-Wire Sensors		4-Wire Sensors				
				Operating Voltage	20 – 264V AC/DC	120V AC	10 – 30V DC			
				Output	N.O. or N.C. ①	N.O. and N.C. Complementary		N.O. and N.C. Complementary		
				Sensor Body	E51SAL	E51SCL	E51SCN Accepts Logic Modules ②	E51SNL NPN	E51SPL PNP	
Receptacle ④	E51RA	E51RC	E51RCB	E51RN	E51RN					

Sensor Heads ①	Sensing Range	Response Time	Sensing Beam	Catalog Number Sensor Head Only	Catalog Number Assembled Sensors with Head, Sensor Body and Receptacle							
	18 feet (5.5m)	Standard Response	Infrared	E51DP1	E51ALP1	☐☐	E51CLP1	E51CNP1	E51NLP1	☐☐	E51PLP1	☐☐
	35 feet (10.7m)	Standard Response		E51DP3	—	E51CLP3	E51CNP3	E51NLP3	☐☐	E51PLP3	☐☐	
	15 feet (4.5m)	Standard Response	Visible Red	E51DP5	—	E51CLP5	E51CNP5	E51NLP5	☐☐	E51PLP5	☐☐	
	8 inches (200 mm)	Standard Response	Infrared	E51DP2	E51ALP2	☐☐	E51CLP2	E51CNP2	E51NLP2	☐☐	E51PLP2	☐☐
		Fast Response		E51DP22	—	E51CLP22	E51CNP22	E51NLP22	☐☐	E51PLP22	☐☐	
	18 inches (450 mm)	Standard Response		E51DP6	—	E51CLP6	E51CNP6	E51NLP6	☐☐	E51PLP6	☐☐	
	40 inches (1m)	Standard Response		E51DP4	—	E51CLP4	E51CNP4	E51NLP4	☐☐	E51PLP4	☐☐	
	300 feet (90m)	Standard Response	—	E51DC1	E51ALC1	☐☐	E51CLC1	E51CNC1	E51NLC1	☐☐	E51PLC1	☐☐
	300 feet (90m)	—	Infrared with visible red alignment aid	E51DEL	E51ELA (120V AC Operation)							
				E51DED	E51EDN (10 – 30V DC Operation)							

① All sensor heads feature a light or dark operation selector switch which reverses the output function.

② Logic modules must be ordered separately, see **Page 6**. These sensor bodies are rated NEMA 4, 4X and 13.

③ Includes sensor head mounted to sensor body. Head can be rotated to any of four discrete positions on body, 90° apart, but is not separate from body.

④ Receptacles feature terminal wiring with a 1/2" NPT thread at the conduit entrance. Other connection options are available (see below and **Page 7**).



Connection Option		Suffix	Example
20 mm thread at the conduit entrance		20	E51ALP120
Built-in Mini-Connector with epoxy filled receptacle	2-wire, 3-pin connector	P3	E51ALP1P3 ☐☐
	4-wire, 5-pin connector	P5	E51CLP1P5 ☐☐
Pigtail with Mini-Connector	2-wire, AC/DC	T3	E51RAP1T3 ☐☐
	4-wire, AC	T5	E51RCPT5 ☐☐
	4-wire, DC	T5	E51RNPT5 ☐☐
Pre-wired cable with epoxy filled receptacle	8 feet long	S	E51ALP1S
	12 feet long	S12	E51ALP1S12
	20 feet long	S20	E51ALP1S20



☐☐ Fast turn product with typical one business day lead-time to shipment.

☐☐☐ See listing of compatible connector cables on **Page 7**.

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Model Selection — Assembled Sensors — Glass Fiber Optic

Assembled Sensor		Sensor Body and Receptacle		2-Wire Sensors		4-Wire Sensors		
			Operating Voltage	20 – 264V AC/DC	120V AC		10 – 30V DC	
			Output	N.O. or N.C. ①	N.O. and N.C. Complementary		N.O. and N.C. Complementary	
		Sensor Body	E51SAL	E51SCL	E51SCN Accepts Logic Modules ②	E51SNL NPN	E51SPL PNP	
		Receptacle ⑥	E51RA	E51RC	E51RCB	E51RN	E51RN	

Sensor Heads ①	Sensing Range	Response Time	Catalog Number Sensor Head Only	Catalog Number Assembled Sensors with Head, Sensor Body and Receptacle						
Glass Fiber Optic, Standard Fiber Mounting Style ⑤ 	3 inches (75 mm) ③ 25 inches (650 mm) ④	Standard Response	E51DF1	—	E51CLF1	E51CNF1	E51NLF1	⊕	E51PLF1	⊕
	1 inch (25 mm) ③ 9 inches (225 mm) ④	Fast Response	E51DF11	—	E51CLF11	E51CNF11	E51NLF11	⊕	E51PLF11	⊕
Glass Fiber Optic, Collar Fiber Mounting Style ⑤ 	3 inches (75 mm) ③ 25 inches (650 mm) ④	Standard Response	E51DF3	—	E51CLF3	E51CNF3	E51NLF3	⊕	E51PLF3	⊕
	1 inch (25 mm) ③ 9 inches (225 mm) ④	Fast Response	E51DF33	—	E51CLF33	E51CNF33	E51NLF33	⊕	E51PLF33	⊕






- ① All sensor heads feature a light or dark operation selector switch which reverses the output function.
- ② Logic modules must be ordered separately, see **Page 6**. These sensor bodies are rated NEMA 4, 4X and 13.
- ③ Sensing range for diffuse reflective mode for 0.125 inch (3.2 mm) diameter fibers. See **Page 5** for complete sensing range specifications.
- ④ Sensing range in thru-beam mode for 0.125 inch (3.2 mm) diameter fibers. See **Page 5** for complete sensing range specifications.
- ⑤ Requires glass fiber optic cables for operation (not included), see **PG.05E.15.T.E.**
- ⑥ Receptacles feature terminal wiring with a 1/2" NPT thread at the conduit entrance. Other connection options are available (see below and **Page 7**).

Connection Option		Suffix	Example
20 mm thread at the conduit entrance		20	E51CLF120
Built-in Mini-Connector with epoxy filled receptacle	2-wire, 3-pin connector	P3	E51CLF1P3 ⊕
	4-wire, 5-pin connector	P5	E51CLF1P5 ⊕
Pigtail with Mini-Connector	2-wire, AC/DC	T3	E51RAPT3 ⊕
	4-wire, AC	T5	E51RCPT5 ⊕
	4-wire, DC	T5	E51RNPT5 ⊕
Pre-wired cable with epoxy filled receptacle	8 feet long	S	E51ALP1S
	12 feet long	S12	E51ALP1S12
	20 feet long	S20	E51ALP1S20

⊕ Fast turn product with typical one business day lead-time to shipment.

⊕ See listing of compatible connector cables on **Page 7**.

Model Selection — Sensor Heads — Reflex, Diffuse Reflective and Thru-Beam^①

	Sensing Range ^②	Field of View	Response Time				Sensing Beam	Adjustments	Input Voltage	Catalog Number
			ON		OFF					
			AC Sensor	DC Sensor	AC Sensor	DC Sensor				
Reflex 	18 feet (5.5m)	6 inch (152 mm) diameter at 15 feet (4.6m)	20 mS	20 mS	30 mS	22 mS	Infrared	—	—	E51DP1
	35 feet (10.7m)	12 inch (305 mm) diameter at 35 feet (10.7m)	20 mS	20 mS	30 mS	22 mS	Infrared	—	—	E51DP3
Polarized Reflex 	15 feet (4.5m)	6 inch (152 mm) diameter at 15 feet (4.6m)	20 mS	20 mS	30 mS	22 mS	Visible Red	—	—	E51DP5
Diffuse Reflective 	8 inches (200 mm)	1 inch (25 mm) diameter at 4 inches (101m)	20 mS	20 mS	30 mS	22 mS	Infrared	Near/Far ^③	—	E51DP2
			1 mS	0.5 mS	9 mS	0.5 mS	Infrared	Near/Far ^③	—	E51DP22
	18 inches (450 mm)	1 inch (25 mm) diameter at 9 inches (228m)	20 mS	20 mS	30 mS	22 mS	Infrared	Near/Far ^③	—	E51DP6
	40 inches (1m)	1.5 inch (38 mm) diameter at 40 inches (1m)	20 mS	20 mS	30 mS	22 mS	Infrared	—	—	E51DP4
Thru-Beam Detector 	300 feet (90m)	18 inch (457 mm) diameter at 20 feet (6.1m)	10 mS	5 mS	10 mS	5 mS	—	Sensitivity	—	E51DC1
Thru-Beam Source ^④ 	300 feet (90m)	36 inch (914 mm) diameter at 20 feet (6.1m)	—	—	—	—	Infrared with visible red alignment aid	—	120V AC	E51DEL
									10 – 30V DC	E51DED

- ① All sensor heads feature a light or dark operation selector switch.
 - ② Reflex ranges are based on a 3-inch retroreflector; diffuse reflective ranges are based on a 90% reflectance white card.
 - ③ These sensor heads have a mechanical Near/Far adjustment which adjust the head for optimum performance at the expected target distance. The adjustment, which move the optics and adjustment indicator, is made before the head is mounted on the sensor body. Excess gain graphs are shown in the "Far" setting.
 - ④ Includes sensor head mounted to sensor body. Use receptacles E51RA for AC or E51RN for DC sources. Head can be rotated to any of four discrete positions on body, 90° apart, but is not separate from the body.
- Fast turn product with typical one business day lead-time to shipment.

Excess Gain

Reflex
(3-inch diameter retroreflector)

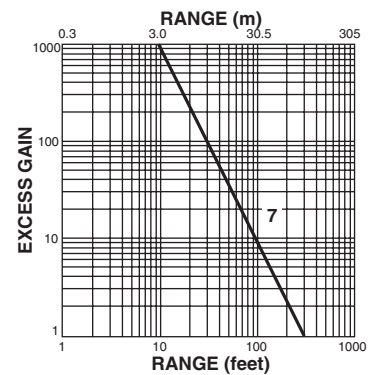
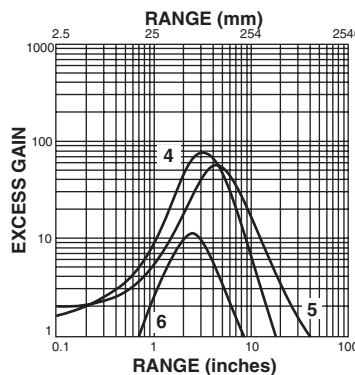
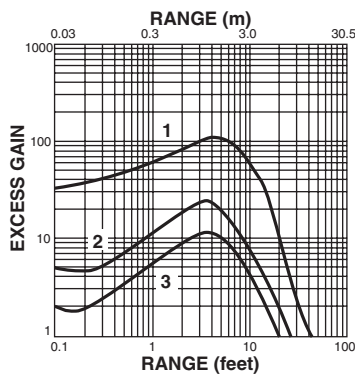
- 1. E51DP3
- 2. E51DP1
- 3. E51DP5

Diffuse Reflective
(90% reflective white card)

- 4. E51DP6
- 5. E51DP4
- 6. E51DP2 and E51DP22



Thru-Beam

- 7. E51DEL and E51DED Sources Using E51DC1 Detector



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Model Selection — Sensor Heads — Glass Fiber Optic^①

	Sensing Range ^②				Response Time				Sensing Beam	Adjustments	Catalog Number
	Thru-Beam Mode		Diffuse Reflective Mode		ON		OFF				
	0.063 Inch Diameter Fibers	0.125 Inch Diameter Fibers	0.063 Inch Diameter Fibers	0.125 Inch Diameter Fibers	AC Sensor	DC Sensor	AC Sensor	DC Sensor			
Standard Fiber Mounting Style ^③ 	8 inches (200 mm)	25 inches (650 mm)	0.6 inch (15 mm)	3 inches (75 mm)	20 mS	20 mS	30 mS	22 mS	Infrared	—	E51DF1
	3 inches (75 mm)	9 inches (225 mm)	0.25 inch (6 mm)	1 inch (25 mm)	0.5 mS	0.5 mS	9 mS	0.5 mS	Infrared	—	E51DF11
Collar Fiber Mounting Style ^③ 	8 inches (200 mm)	25 inches (650 mm)	0.6 inch (15 mm)	3 inches (75 mm)	20 mS	20 mS	30 mS	22 mS	Infrared	Sensitivity	E51DF3
	3 inches (75 mm)	9 inches (225 mm)	0.25 inch (6 mm)	1 inch (25 mm)	0.5 mS	0.5 mS	9 mS	0.5 mS	Infrared	Sensitivity	E51DF33
	10 inches (250 mm)	40 inches (1000 mm)	0.8 inch (20 mm)	4.5 inches (115 mm)	20 mS	20 mS	30 mS	22 mS	Infrared	—	E51DF4

- ① All sensor heads feature a light or dark operation selector switch.
- ② Diffuse reflective ranges are based on a 90% reflectance white card.
- ③ Requires glass fiber optic cables for operation (not included), see **PG.05E.15.T.E.**

 Fast turn product with typical one business day lead-time to shipment.

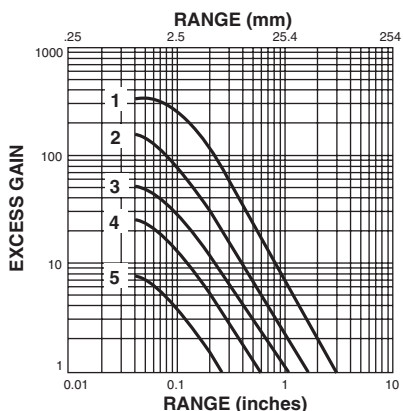
Excess Gain

Diffuse Reflective
(90% reflective white card)
E51DF1 and E51DF3 high power sensor head with:

- 1. 0.125" fiber bundle
- 2. 0.094" fiber bundle
- 4. 0.063" fiber bundle

E51DF33 fast response sensor head with:

- 3. 0.125" fiber bundle
- 4. 0.094" fiber bundle
- 5. 0.063" fiber bundle



Thru-Beam

E51DF4 extended range sensor head with:

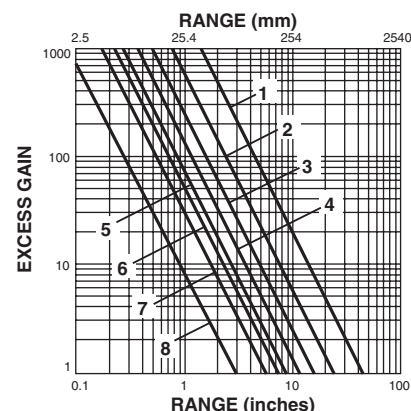
- 1. 0.125" fiber bundle
- 4. 0.063" fiber bundle

E51DF1 and E51DF3 high power sensor head with:







- 2. 0.125" fiber bundle
- 3. 0.094" fiber bundle
- 6. 0.063" fiber bundle

E51DF33 fast response sensor head with:

- 5. 0.125" fiber bundle
- 7. 0.094" fiber bundle
- 8. 0.063" fiber bundle




Model Selection — Sensor Bodies


	Operating Voltage	Output	Protection	Output Rating Continuous	Type	Catalog Number
2-Wire Sensors						
AC/DC 	20 – 264V AC/DC, 50/60 Hz	1 output, load powered, N.O. or N.C., programmable from head; OFF state leakage current: 1.7 mA at 120V AC/DC, <2.0 mA at 240V AC	Latching short circuit and overload	0.5A	—	E51SAL ^① 
4-Wire Sensors						
AC  E51SCN Shown	120V AC, 50/60 Hz	2 complementary outputs, line powered, N.O. and N.C.	—	1.0A to 158° (70°), linearly derated to 0.6A at 176° (80°)	—	E51SCL ^①
				1.0A to 113° (45°), linearly derated to 0.3A at 176° (80°)	Accepts Logic Modules (See chart below)	E51SCN ^②
DC 	10 – 30V DC	2 complementary outputs, line powered, N.O. and N.C. Burden Current: <25 mA OFF state leakage: <100 µA ON state: <2.5V DC Power-Up Delay: <150 mS	Reverse polarity	0.6A to 104° (40°), linearly derated to 0.36A at 176° (80°)	NPN	E51SNL ^① 
					PNP	E51SPL ^① 

① This sensor body is available in a factory-sealed, non plug-in configuration (with 8-foot cable), add **6P** to listed Catalog Number.
Example: E51SAL6P.


② Sensor body is black. E51SCN sensor bodies are rated NEMA 4, 4X and 13.

 Fast turn product with typical one business day lead-time to shipment.

Model Selection — Logic Modules (for E51SCN Sensor Body Only)





	Type	Description	Timing Range ^③	Catalog Number
 Reset time is 25 mS minimum. Rated NEMA 4, 4X and 13.	ON and OFF Delay	<ul style="list-style-type: none"> Adjustable delay between time object is sensed and time switch function occurs Adjustable delay between time object leaves sensing field and time switch transfers back to non-sensing state 	0.15 to 15.0 seconds	E51MTB

③ Repeatability of the timing cycle is ±1% at constant voltage, ambient temperature and reset time.

 Fast turn product with typical one business day lead-time to shipment.




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Model Selection — Receptacles

	Description	Style	Details	Cable Length	Catalog Number	
					Conduit Entrance	
					1/2" NPT	20 mm
	Conduit entrance, front or rear mounting	2-wire, AC/DC	—	—	E51RA	E51RA20
		4-wire, AC	Gray	—	E51RC	E51RC20
			Black ①	—	E51RCB	E51RCB20
		4-wire, DC	—	—	E51RN	E51RN20
	Epoxy filled receptacle with pre-wired Mini-Connector	2-wire, AC/DC	3-pin	—	E51RAP3 Ⓢ	—
		4-wire, AC	5-pin	—	E51RCP5 Ⓢ	—
		4-wire, DC	5-pin	—	E51RNP5 Ⓢ	—
	Epoxy filled receptacle with Mini-Connector mounted on 3 foot (900 mm) cable	2-wire, AC/DC	3-pin	3 feet (0.9m)	E51RAPT3 Ⓢ	—
		4-wire, AC	5-pin	3 feet (0.9m)	E51RCPT5 Ⓢ	—
		4-wire, DC	5-pin	3 feet (0.9m)	E51RNPT5 Ⓢ	—
	Epoxy filled receptacle with pre-wired 16 gauge, yellow jacketed, type SOOW-A cable. Cable enters through hole threaded for conduit	2-wire, AC/DC	3-conductor	8 feet (2.4m)	E51RAS	E51RA20S
				12 feet (3.6m)	E51RAS12	—
				20 feet (6m)	E51RAS20	—
		4-wire, AC	5-conductor	8 feet (2.4m)	E51RCS	E51RC20S
				12 feet (3.6m)	E51RCS12	—
				20 feet (6m)	E51RCS20	—
		4-wire, DC	5-conductor	8 feet (2.4m)	E51RNS	E51RN20S
				12 feet (3.6m)	E51RNS12	—
				20 feet (6m)	E51RNS20	—

- ① Black receptacle is for color compatibility with E51SCN sensor body.
- Fast turn product with typical one business day lead-time to shipment.
- Ⓢ See listing of compatible connector cables below.

Model Selection — Compatible Connector Cables ①

	Voltage Style	Number of Pins	Gauge	Length	Catalog Number	Pin Configuration/Wire Colors (Face View Female Shown)
Standard Cables — Mini Style						
 <p>Current Rating @ 600V 2-pin: 13A 3-pin: 13A 4-pin: 10A 5-pin: 8A</p>	—	3-pin	16 AWG	6 feet (2m)	CSMS3F3CY1602	 <p>1-Green 2-Black 3-White</p>
	—	5-pin	16 AWG	6 feet (2m)	CSMS5D5CY1602	 <p>1-White 2-Red 3-Green 4-Orange 5-Black</p>

- ① For a full selection of connector cables, see **PG.05.05.T.E.**
- Stocked product, typical order quantities guaranteed in stock.

Wiring Diagrams (Pin numbers are for reference, rely on pin location when wiring)

Operating Voltage	Output ^①	Terminal and Cable Models	Mini-Connector Models (Face View Male Shown)
2-Wire Sensors			
20 – 264V AC or DC 50/60 Hz	N.O. or N.C.		
4-Wire Sensors			
120V AC 50/60 Hz	N.O. and N.C.		
10 – 30V DC	N.O. and N.C. NPN		
	N.O. and N.C. PNP		

① Changing light/dark switch on sensor head will reverse output function (N.O. becomes N.C., and N.C. becomes N.O.).


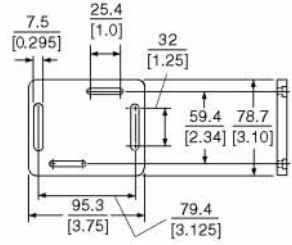

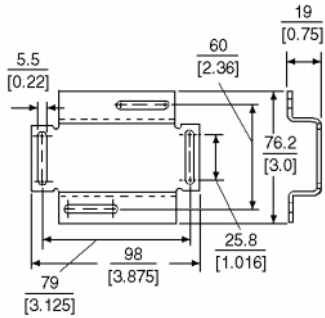

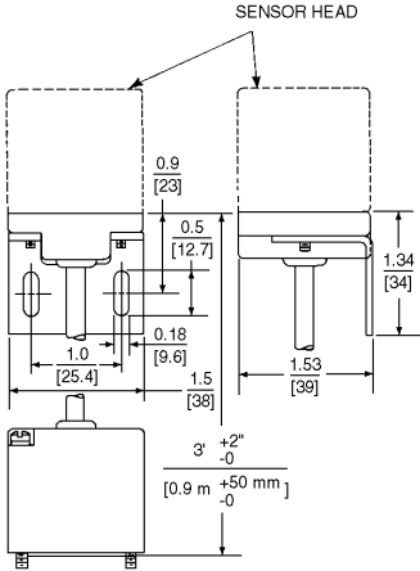
Model Selection — Accessories

	Description	Catalog Number	Approximate Dimensions in Inches [mm]
	1 hole, includes mounting hardware, stainless steel	E51KH2	
	2 hole, includes mounting hardware, steel	E51KH4	

■ Stocked product, typical order quantities guaranteed in stock.

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Model Selection — Accessories (Continued)

	Description	Catalog Number	Approximate Dimensions in Inches [mm] Except Where Noted
	Zinc die cast	E50KH3	<p>NOTE: Dimensions in mm [Inches]</p> 
	Steel	E51KH3	<p>NOTE: Dimensions in mm [Inches]</p> 
	Permits mounting sensor head up to 3 feet (0.9m) from sensor body	E51KRM	<p>SENSOR HEAD</p> 
Connector Cables	A variety of cables, connector blocks and accessories	See PG.05.05.T.E	

■ Stocked product, typical order quantities guaranteed in stock.

