

July 2005

**E51 Modular Limit Switch Style Photoelectric Sensors**

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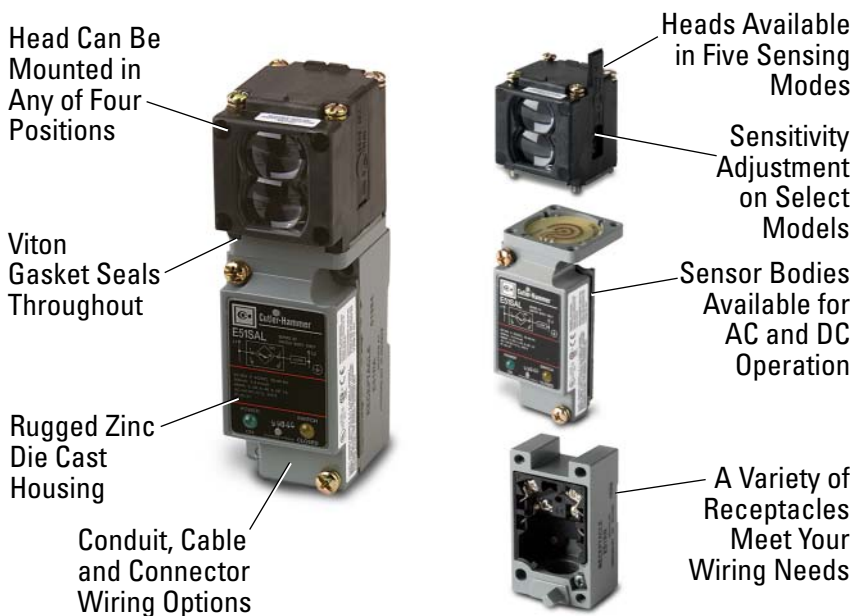
Cutler-Hammer® E51 Limit Switch Style Modular Sensors from Eaton’s electrical business are available in thru-beam, reflex, polarized reflex, diffuse reflective and fiber optic sensing modes to solve a wide variety of sensing applications. Modular, plug-in components are easy to maintain, meaning less 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)

For the most current information on this product, visit our web site: [www.EatonElectrical.com](http://www.EatonElectrical.com)

**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






PHOTOELECTRIC SENSORS

For Customer Service in the U.S. call 1-800-356-1243, 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**

			<b>2-Wire Sensors</b>		<b>4-Wire Sensors</b>	
	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	<b>E51SAL</b>	<b>E51SCL</b>	<b>E51SCN</b> Accepts Logic Modules ②	<b>E51SNL</b> NPN	<b>E51SPL</b> PNP
Receptacle ④	<b>E51RA</b>	<b>E51RC</b>	<b>E51RCB</b>	<b>E51RN</b>	<b>E51RN</b>	

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

- 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 6-88**. 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 6-89**).


Connection Option	Suffix	Example
20 mm thread at the conduit entrance	<b>20</b>	<b>E51ALP120</b>
Built-in Mini-Connector with epoxy filled receptacle	2-wire, 3-pin connector	<b>P3</b> <b>E51ALP1P3</b> ☹☹
	4-wire, 5-pin connector	<b>P5</b> <b>E51CLP1P5</b> ☹☹
Pigtail with Mini-Connector	2-wire, AC/DC	<b>T3</b> <b>E51RAPT3</b> ☹☹
	4-wire, AC	<b>T5</b> <b>E51RCPT5</b> ☹☹
	4-wire, DC	<b>T5</b> <b>E51RNPT5</b> ☹☹
Pre-wired cable with epoxy filled receptacle	8 feet long	<b>S</b> <b>E51ALP1S</b>
	12 feet long	<b>S12</b> <b>E51ALP1S12</b>
	20 feet long	<b>S20</b> <b>E51ALP1S20</b>

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



☹☹ See listing of compatible connector cables on **Page 6-89**.

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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	
			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 6-88**. 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 6-87** for complete sensing range specifications.
- ④ Sensing range in thru-beam mode for 0.125 inch (3.2 mm) diameter fibers. See **Page 6-87** for complete sensing range specifications.
- ⑤ Requires glass fiber optic cables for operation (not included), see **Section 9**.
- ⑥ Receptacles feature terminal wiring with a 1/2" NPT thread at the conduit entrance. Other connection options are available (see below and **Page 6-89**).

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

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

⊕ ⊕ See listing of compatible connector cables on **Page 6-89**.

Model Selection — Sensor Heads — Reflex, Diffuse Reflective and Thru-Beam<sup>①</sup>

	Sensing Range <sup>②</sup>	Field of View	Response Time				Sensing Beam	Adjustments	Input Voltage	Catalog Number
			ON		OFF					
			AC Sensor	DC Sensor	AC Sensor	DC Sensor				
	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
	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
	8 inches (200 mm)	1 inch (25 mm) diameter at 4 inches (101mm)	20 mS	20 mS	30 mS	22 mS	Infrared	Near/Far <sup>③</sup>	—	E51DP2
			1 mS	0.5 mS	9 mS	0.5 mS	Infrared	Near/Far <sup>③</sup>	—	E51DP22
	18 inches (450 mm)	1 inch (25 mm) diameter at 9 inches (228mm)	20 mS	20 mS	30 mS	22 mS	Infrared	Near/Far <sup>③</sup>	—	E51DP6
			20 mS	20 mS	30 mS	22 mS	Infrared	—	—	E51DP4
	300 feet (90m)	18 inch (457 mm) diameter at 20 feet (6.1m)	10 mS	5 mS	10 mS	5 mS	—	Sensitivity	—	E51DC1
	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

6 PHOTOELECTRIC SENSORS

- 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 day lead-time to shipment.

Excess Gain

**Reflex**  
(3-inch diameter retroreflector)

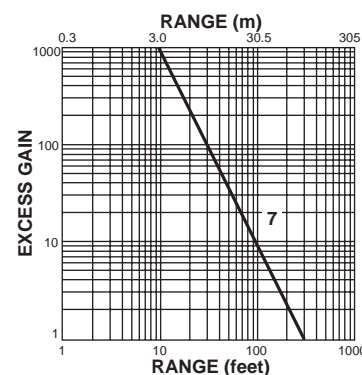
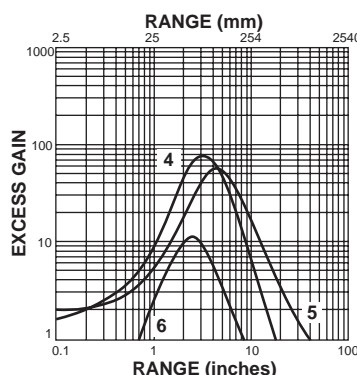
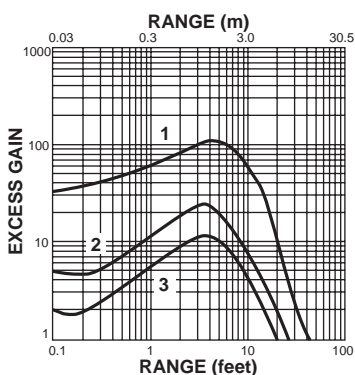
- 1. E51DP3
- 2. E51DP1
- 3. E51DP5

**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<sup>①</sup>**

	Sensing Range <sup>②</sup>				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 <sup>③</sup> 	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	—	<b>E51DF1</b>
	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	—	<b>E51DF11</b>
Collar Fiber Mounting Style <sup>③</sup> 	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	<b>E51DF3</b>
	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	<b>E51DF33</b>
	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	—	<b>E51DF4</b>

- 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 **Section 9**.
- Fast turn product with typical one day lead-time to shipment.

**Excess Gain**

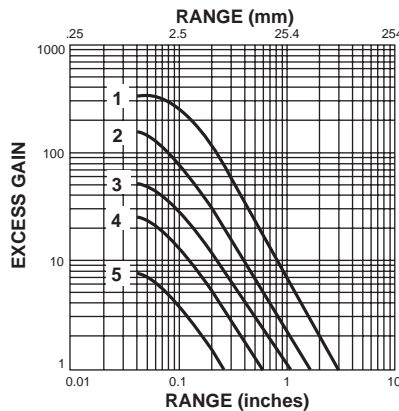
**Diffuse Reflective**  
(90% reflective white card)

**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:**

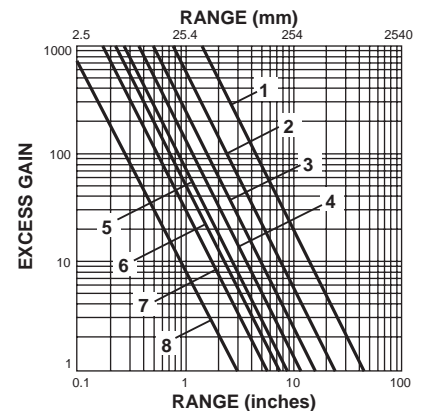
- 1. 0.125" fiber bundle
- 4. 0.063" fiber bundle

**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
<b>2-Wire Sensors</b>						
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	—	<b>E51SAL</b> <sup>①</sup> 
<b>4-Wire Sensors</b>						
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°)	—	<b>E51SCL</b> <sup>①</sup>
				1.0A to 113° (45°), linearly derated to 0.3A at 176° (80°)	Accepts Logic Modules (See chart below)	<b>E51SCN</b> <sup>②</sup>
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	<b>E51SNL</b> <sup>①</sup> 
					PNP	<b>E51SPL</b> <sup>①</sup> 

<sup>①</sup> 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.


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

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

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





	Type	Description	Timing Range <sup>③</sup>	Catalog Number
 Reset time is 25 mS minimum. Rated NEMA 4, 4X and 13.	ON Delay	Adjustable delay between time object is sensed and time switch function occurs	0.15 to 15.0 seconds	<b>E51MTE</b>
	OFF Delay	Adjustable delay between time object leaves sensing field and time switch transfers back to non-sensing state	0.15 to 15.0 seconds	<b>E51MTD</b>
	ON and OFF Delay	Combination of above	0.15 to 15.0 seconds	<b>E51MTB</b>

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

 Fast turn product with typical one 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	—	—	<b>E51RA</b>	<b>E51RA20</b>
		4-wire, AC	Gray	—	<b>E51RC</b>	<b>E51RC20</b>
			Black ①	—	<b>E51RCB</b>	<b>E51RCB20</b>
		4-wire, DC	—	—	<b>E51RN</b>	<b>E51RN20</b>
	Epoxy filled receptacle with pre-wired Mini-Connector	2-wire, AC/DC	3-pin	—	<b>E51RAP3</b> ☺	—
		4-wire, AC	5-pin	—	<b>E51RCP5</b> ☺	—
		4-wire, DC	5-pin	—	<b>E51RNP5</b> ☺	—
	Epoxy filled receptacle with Mini-Connector mounted on 3 foot (900 mm) cable	2-wire, AC/DC	3-pin	3 feet (0.9m)	<b>E51RAPT3</b> ☺	—
		4-wire, AC	5-pin	3 feet (0.9m)	<b>E51RCPT5</b> ☺	—
		4-wire, DC	5-pin	3 feet (0.9m)	<b>E51RNPT5</b> ☺	—
	Epoxy filled receptacle with pre-wired 16 gauge, yellow jacketed, type S00W-A cable. Cable enters through hole threaded for conduit	2-wire, AC/DC	3-conductor	8 feet (2.4m)	<b>E51RAS</b>	<b>E51RA20S</b>
				12 feet (3.6m)	<b>E51RAS12</b>	—
				20 feet (6m)	<b>E51RAS20</b>	—
		4-wire, AC	5-conductor	8 feet (2.4m)	<b>E51RCS</b>	<b>E51RC20S</b>
				12 feet (3.6m)	<b>E51RCS12</b>	—
				20 feet (6m)	<b>E51RCS20</b>	—
		4-wire, DC	5-conductor	8 feet (2.4m)	<b>E51RNS</b>	<b>E51RN20S</b>
				12 feet (3.6m)	<b>E51RNS12</b>	—
				20 feet (6m)	<b>E51RNS20</b>	—

① Black receptacle is for color compatibility with E51SCN sensor body.

☐ Fast turn product with typical one 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)
<b>Standard Cables — Mini Style</b>						
 <p>Current Rating @ 600V 2-pin: 13A 3-pin: 13A 4-pin: 10A 5-pin: 8A</p>	—	3-pin	16 AWG	6 feet (2m)	<b>CSMS3F3CY1602</b>	 <p>1-Green 2-Black 3-White</p>
	—	5-pin	16 AWG	6 feet (2m)	<b>CSMS5D5CY1602</b>	 <p>1-White 2-Red 3-Green 4-Orange 5-Black</p>

① For a full selection of connector cables, see **Section 10**.