



Installation Instructions— E51DP5 – Polarized Retro-reflective Photoelectric Sensor Head

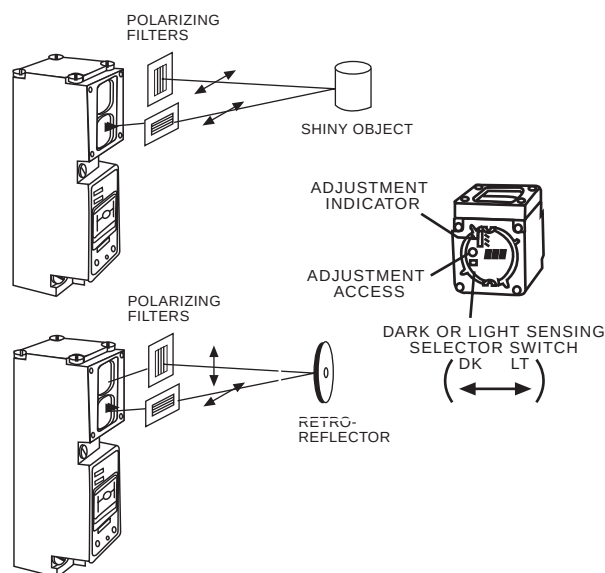
INTRODUCTION

The File E51 Polarized Photoelectric Sensor Head is a modular component of a sensor and is not an operative device by itself. The complete sensor is comprised of three components: the sensor head, a solid-state plug-in switch body and a wiring receptacle. The switch body and wiring receptacles are shared with other E51 sensors for other applications such as inductive proximity sensors. The components are readily assembled to form a complete, self-contained photoelectric sensor.

Solid-state plug-in switch bodies are available for use with the photoelectric sensor head in several configurations with different optional features.

OPERATION

Polarizing filters are cemented to the front of both the emitting lens (bottom) and receiving lens (top) in the sensor head. These filters are oriented such that the planes of polarization are at 90 degrees to one another. The emitted light is polarized horizontally. The plane of polarization of light striking the reflector is depolarized sufficiently allowing the reflected light to pass through the polarizing filter into the receiver. However, when the emitted polarized light strikes a shiny surface, the plane of polarization is not depolarized and the reflected light is blocked from entering the receiver by the polarizing filter. This is shown by the illustration below.



OPERATING CHARACTERISTICS

Ambient Temperature		-40°C (-40°F) to 70°C (158°F)	
Sensing Distance (See Excess Gain Curves)			
Polarized Retro-Reflective E51DP5			
with 1.25" dia. Reflector		2.4m (8 ft.)	
with 3" dia. Reflector		4.6m (15 ft.)	
Response Time		AC Switch	DC Switch
ON, milliseconds		<20	<20
OFF, milliseconds		<30	<22
Frequency			
Operations per second		15	22

NOTE: Mount the E51DP5 on line powered (3-wire AC or DC) switchbodies only.

The sensing distance for the **Polarized Retro-Reflective** head is 4.6 meters (15 feet). The reflector is a corner cube designed to depolarize the emitted light and reflect it back to the receiver. The following retro-reflectors are available:

Cutler-Hammer Catalog Number	Diameter
E51KR31	1.25 inch (32 mm.)
E51KR84	3.00 inch (76 mm.)

The retro-reflective sensor head has sights (similar to gun sights) which aid in the positioning of the reflector after the sensor has been installed. The reflector must be within $\pm 15^\circ$ perpendicular to the sensor beam in order for light to be reflected back to the receiver.

NOTE: Do not use retro-reflective tape with the E51DP5. Reflective tapes do not depolarize the emitted light sufficiently resulting in insufficient reflected light reaching the receiver.

SENSING MODE

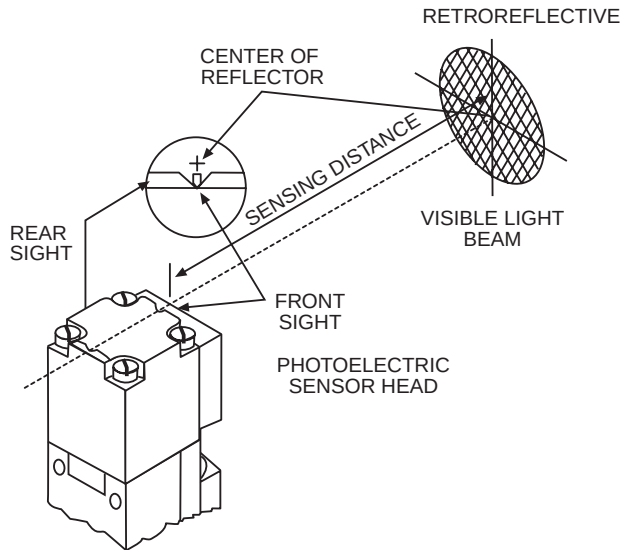
Dark Sensing – The sensor output will be energized when it detects an absence of light. The **Retro-Reflective** sensor is a dark sensing device when used with a normally open (NO) output type.

Light Sensing – The sensor output will be energized when it detects the presence of light. The **Retro-Reflective** sensor is a light sensing device when used with a normally closed (NC) output type.

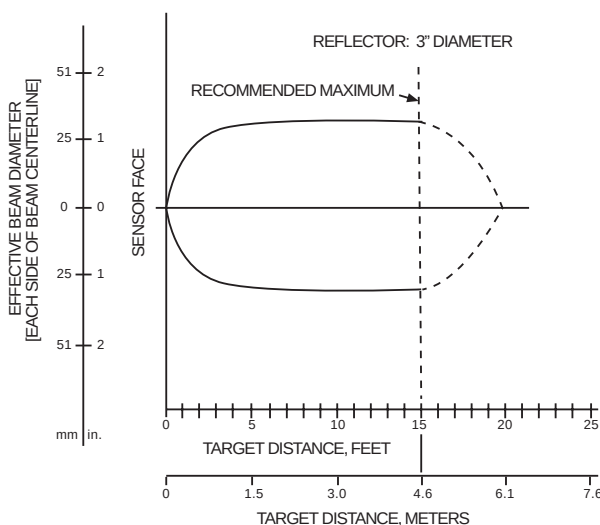
A sensor can be made to assume the opposite sensing mode by using a contact of the opposite output type.

ALIGNMENT

A visible light beam is produced by the E51DP5. When ambient light conditions are at a low-level, alignment of a visible LED photoelectric sensor is faster and correct alignment is assured. (The beam can then be seen on the retro-reflector). The accompanying illustration shows the method of sighting the retro-reflector. Line of sight must be along the optical axis of the beam, like sighting a shotgun. No reflected light should be seen if the eye is located more than an inch or two off this axis.



E51DP5 Visible Light Beam Alignment



E51DP5 Polarized Retro-Reflective
Typical Effective Beam Diameter



CAUTION

THIS INSTALLATION AND USE OF CUTLER-HAMMER PRODUCTS SHOULD BE IN ACCORDANCE WITH THE PROVISIONS OF THE U.S.. NATIONAL ELECTRICAL CODE AND /OR OTHER LOCAL CODES OR INDUSTRY STANDARDS THAT ARE PERTINENT TO THE PARTICULAR END USE. INSTALLATION OR USE NOT IN ACCORDANCE WITH THESE CODES AND STANDARDS COULD BE HAZARDOUS TO PERSONNEL AND /OR EQUIPMENT

Effective Beam Diameter

Effective Beam Diameter describes the envelope of the beam which must be penetrated to operate the sensor. This is not a description of the beam projected by the sensor but rather a description of the system of emitter /receiver. The beam envelope must be penetrated by an object in order for it to be detected. The beam envelope is shown for ideal conditions and a 3 inch diameter retro-reflective target.

Excess Gain

Excess Gain is a ratio of the amount of light available to the receiver compared to the minimum amount necessary to operate the detector circuits. It indicates the amount of extra light available to overcome contamination. This extra light strength permits detection despite the attenuation of smoke, fog, dirt or dust. The Excess Gain Curve show the relationship between Excess Gain and Scanning Distance – this curve is based on “clean air” and retro-reflectors with the indicated diameters in the Excess Gain Curve.

The Excess Gain chart expresses the gain required to overcome the effects of some commonly encountered environmental conditions. Using an excess gain slightly greater than the minimum amount needed is desirable. This will allow a safety factor to account for undetected variables such as gradual sensor misalignment, temperature extremes, long-term LED aging, etc. If the gain required is not available, the device can not be used under the conditions listed.

Maintenance

When the sensor is used under contaminating conditions, periodic cleaning of the lens and reflector with a clean, dry cloth is recommended.

EXCESS GAIN REQUIREMENTS ¹

Condition of environment where device is to be used.	Correction Factor
	Retro-Reflective
Clean Air (ideal conditions, climate controlled or sterile areas)	1.0
Relatively Clean (office buildings)	2.6 (1.6 each direction)
Lightly Dirty (warehouses, post offices, clean processes)	10.3 (3.2 each direction)
Dirty (steel mills, saw mills, paper plants)	4096 (64 each direction)

¹ Figures are approximate and average — may be subjectively varied by as much as $\pm 50\%$.



CAUTION

WHEN SENSOR HEADS ARE ADDED OR CHANGED, THE HEAD MUST BE SECURELY TIGHTENED TO THE SWITCHBODY ASSEMBLY. TO ASSURE AND MAINTAIN A GOOD SEAL, 16 INCH-POUNDS OF TORQUE ARE REQUIRED AT THE SENSOR HEAD SCREWS EXCEPT MAINTAIN 12 INCH-POUNDS FOR THE E51SCN BODY.



CAUTION

DO NOT APPLY POWER TO THE SWITCH WHILE THE HEAD IS NOT ATTACHED. DO NOT ATTACH THE HEAD WHILE POWER IS APPLIED TO THE SWITCH. LINE VOLTAGE WITH RESPECT TO GROUND IS PRESENT ON EXPOSED SWITCHBODY PRINTED CIRCUIT BOARD WITH HEAD REMOVED.

GLOSSARY

Ambient Light – Light in the area of a photoelectric sensor which does not originate with its lights source.

Infrared (IR) – An invisible light beyond the range of the visible spectrum in the red region.

Modulated Light – The emitter is pulsed at a specific frequency so that the photodetector, tuned to the same pulse frequency detects only the desired light source. This eliminates interference by ambient light.

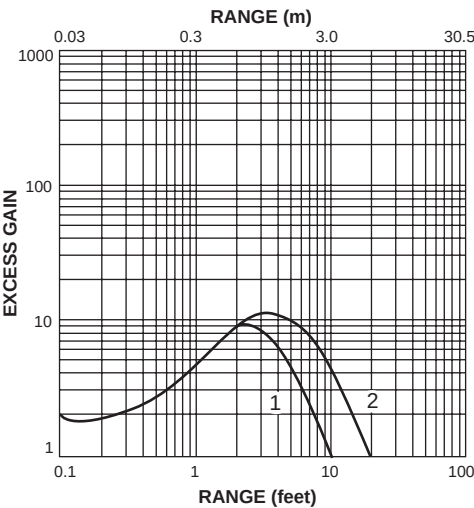
Retro-Reflective – The infrared beam is returned from a special reflector (see **Retro-Reflector**) to the detector at all times. The presence or absence of the beam produces an output change of state.

Retro-Reflector – A special reflective device which returns the beam aimed at it at the same angle it is received (over an incident angle of about 15° with the perpendicular). Also known as a **Corner Reflector**.

Line-Powered Sensor (3 wire) – A sensor that draws its operating current (burden current) directly from the line. Its operating current does not flow through the load.

Load-Powered Sensor (2 wire) – A sensor that draws its operating current (residual current) through the load. Load-powered sensors require only two connections and are always in series with the load.

Polarization – A phenomenon exhibited by transverse waves in which the displacement direction of the vibrations is constant or varies in some definite way.



Excess gain curve

E51DP5 Polarized Retro-Reflective Photoelectric Sensor

- 1.25" Diameter Retro-Reflector
- 3.0" Diameter Retro-Reflector

Still Need Help?

Contact the
Cutler-Hammer Sensor
Application Engineers

1-800-426-9184
Fax: 425-513-5356

Cutler-Hammer

720 80th Street SW
Everett, WA 98203-6299
425/513-5300 Fax: 425/513-5302
www.cutlerhammer.eaton.com

Effective 6/99
Printed in U.S.A.





Installation Instructions— E51DP5 – Polarized Retro-reflective Photoelectric Sensor Head

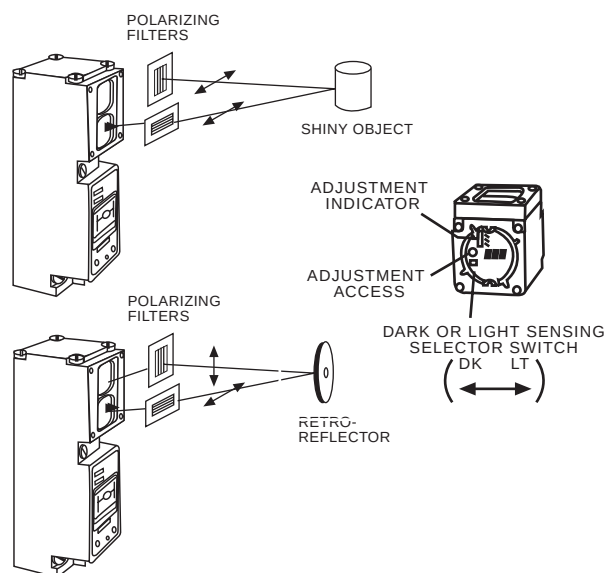
INTRODUCTION

The File E51 Polarized Photoelectric Sensor Head is a modular component of a sensor and is not an operative device by itself. The complete sensor is comprised of three components: the sensor head, a solid-state plug-in switch body and a wiring receptacle. The switch body and wiring receptacles are shared with other E51 sensors for other applications such as inductive proximity sensors. The components are readily assembled to form a complete, self-contained photoelectric sensor.

Solid-state plug-in switch bodies are available for use with the photoelectric sensor head in several configurations with different optional features.

OPERATION

Polarizing filters are cemented to the front of both the emitting lens (bottom) and receiving lens (top) in the sensor head. These filters are oriented such that the planes of polarization are at 90 degrees to one another. The emitted light is polarized horizontally. The plane of polarization of light striking the reflector is depolarized sufficiently allowing the reflected light to pass through the polarizing filter into the receiver. However, when the emitted polarized light strikes a shiny surface, the plane of polarization is not depolarized and the reflected light is blocked from entering the receiver by the polarizing filter. The is shown by the illustration below.



OPERATING CHARACTERISTICS

Ambient Temperature	-40°C (-40°F) to 70°C (158°F)	
Sensing Distance (See Excess Gain Curves)		
Polarized Retro-Reflective E51DP5		
with 1.25" dia. Reflector	2.4m (8 ft.)	
with 3" dia. Reflector	4.6m (15 ft.)	
Response Time	AC Switch	DC Switch
ON, milliseconds	<20	<20
OFF, milliseconds	<30	<22
Frequency		
Operations per second	15	22

NOTE: Mount the E51DP5 on line powered (3-wire AC or DC) switchbodies only.

The sensing distance for the **Polarized Retro-Reflective** head is 4.6 meters (15 feet). The reflector is a corner cube designed to depolarize the emitted light and reflect it back to the receiver. The following retro-reflectors are available:

Cutler-Hammer Catalog Number	Diameter
E51KR31	1.25 inch (32 mm.)
E51KR84	3.00 inch (76 mm.)

The retro-reflective sensor head has sights (similar to gun sights) which aid in the positioning of the reflector after the sensor has been installed. The reflector must be within $\pm 15^\circ$ perpendicular to the sensor beam in order for light to be reflected back to the receiver.

NOTE: Do not use retro-reflective tape with the E51DP5. Reflective tapes do not depolarize the emitted light sufficiently resulting in insufficient reflected light reaching the receiver.

SENSING MODE

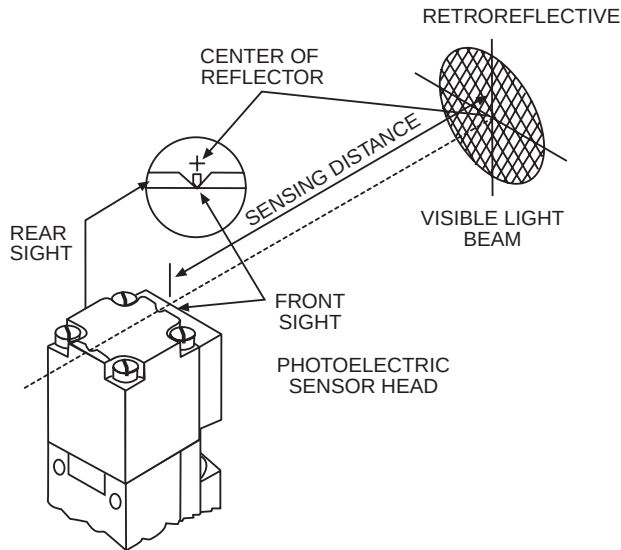
Dark Sensing – The sensor output will be energized when it detects an absence of light. The **Retro-Reflective** sensor is a dark sensing device when used with a normally open (NO) output type.

Light Sensing – The sensor output will be energized when it detects the presence of light. The **Retro-Reflective** sensor is a light sensing device when used with a normally closed (NC) output type.

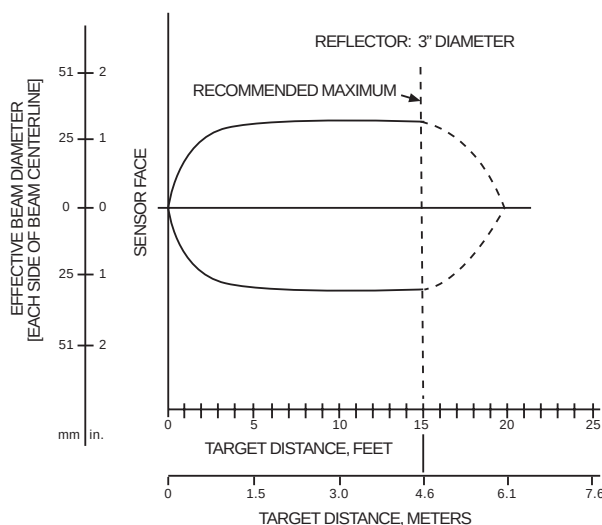
A sensor can be made to assume the opposite sensing mode by using a contact of the opposite output type.

ALIGNMENT

A visible light beam is produced by the E51DP5. When ambient light conditions are at a low-level, alignment of a visible LED photoelectric sensor is faster and correct alignment is assured. (The beam can then be seen on the retro-reflector). The accompanying illustration shows the method of sighting the retro-reflector. Line of sight must be along the optical axis of the beam, like sighting a shotgun. No reflected light should be seen if the eye is located more than an inch or two off this axis.



E51DP5 Visible Light Beam Alignment



E51DP5 Polarized Retro-Reflective
Typical Effective Beam Diameter



CAUTION

THIS INSTALLATION AND USE OF CUTLER-HAMMER PRODUCTS SHOULD BE IN ACCORDANCE WITH THE PROVISIONS OF THE U.S. NATIONAL ELECTRICAL CODE AND /OR OTHER LOCAL CODES OR INDUSTRY STANDARDS THAT ARE PERTINENT TO THE PARTICULAR END USE. INSTALLATION OR USE NOT IN ACCORDANCE WITH THESE CODES AND STANDARDS COULD BE HAZARDOUS TO PERSONNEL AND /OR EQUIPMENT

Effective Beam Diameter

Effective Beam Diameter describes the envelope of the beam which must be penetrated to operate the sensor. This is not a description of the beam projected by the sensor but rather a description of the system of emitter /receiver. The beam envelope must be penetrated by an object in order for it to be detected. The beam envelope is shown for ideal conditions and a 3 inch diameter retro-reflective target.

Excess Gain

Excess Gain is a ratio of the amount of light available to the receiver compared to the minimum amount necessary to operate the detector circuits. It indicates the amount of extra light available to overcome contamination. This extra light strength permits detection despite the attenuation of smoke, fog, dirt or dust. The Excess Gain Curve show the relationship between Excess Gain and Scanning Distance – this curve is based on “clean air” and retro-reflectors with the indicated diameters in the Excess Gain Curve.

The Excess Gain chart expresses the gain required to overcome the effects of some commonly encountered environmental conditions. Using an excess gain slightly greater than the minimum amount needed is desirable. This will allow a safety factor to account for undetected variables such as gradual sensor misalignment, temperature extremes, long-term LED aging, etc. If the gain required is not available, the device can not be used under the conditions listed.

Maintenance

When the sensor is used under contaminating conditions, periodic cleaning of the lens and reflector with a clean, dry cloth is recommended.

EXCESS GAIN REQUIREMENTS ¹

Condition of environment where device is to be used.	Correction Factor
	Retro-Reflective
Clean Air (ideal conditions, climate controlled or sterile areas)	1.0
Relatively Clean (office buildings)	2.6 (1.6 each direction)
Lightly Dirty (warehouses, post offices, clean processes)	10.3 (3.2 each direction)
Dirty (steel mills, saw mills, paper plants)	4096 (64 each direction)

¹ Figures are approximate and average — may be subjectively varied by as much as $\pm 50\%$.



CAUTION

WHEN SENSOR HEADS ARE ADDED OR CHANGED, THE HEAD MUST BE SECURELY TIGHTENED TO THE SWITCHBODY ASSEMBLY. TO ASSURE AND MAINTAIN A GOOD SEAL, 16 INCH-POUNDS OF TORQUE ARE REQUIRED AT THE SENSOR HEAD SCREWS EXCEPT MAINTAIN 12 INCH-POUNDS FOR THE E51SCN BODY.

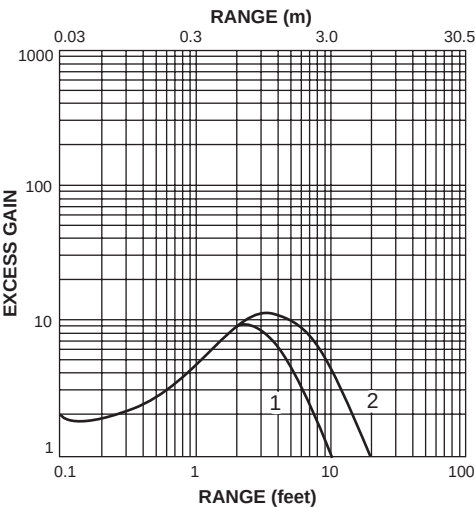


CAUTION

DO NOT APPLY POWER TO THE SWITCH WHILE THE HEAD IS NOT ATTACHED. DO NOT ATTACH THE HEAD WHILE POWER IS APPLIED TO THE SWITCH. LINE VOLTAGE WITH RESPECT TO GROUND IS PRESENT ON EXPOSED SWITCHBODY PRINTED CIRCUIT BOARD WITH HEAD REMOVED.

GLOSSARY

- Ambient Light** – Light in the area of a photoelectric sensor which does not originate with its lights source.
- Infrared (IR)** – An invisible light beyond the range of the visible spectrum in the red region.
- Modulated Light** – The emitter is pulsed at a specific frequency so that the photodetector, tuned to the same pulse frequency detects only the desired light source. This eliminates interference by ambient light.
- Retro-Reflective** – The infrared beam is returned from a special reflector (see **Retro-Reflector**) to the detector at all times. The presence or absence of the beam produces an output change of state.
- Retro-Reflector** – A special reflective device which returns the beam aimed at it at the same angle it is received (over an incident angle of about 15° with the perpendicular). Also known as a **Corner Reflector**.
- Line-Powered Sensor (3 wire)** – A sensor that draws its operating current (burden current) directly from the line. Its operating current does not flow through the load.



Excess gain curve

E51DP5 Polarized Retro-Reflective Photoelectric Sensor

- 1. 1.25" Diameter Retro-Reflector
- 2. 3.0" Diameter Retro-Reflector

- Load-Powered Sensor (2 wire)** – A sensor that draws its operating current (residual current) through the load. Load-powered sensors require only two connections and are always in series with the load.
- Polarization** – A phenomenon exhibited by transverse waves in which the displacement direction of the vibrations is constant or varies in some definite way.

Still Need Help?

Contact the
Cutler-Hammer Sensor
Application Engineers

1-800-426-9184
Fax: 425-513-5356

Cutler-Hammer

720 80th Street SW
Everett, WA 98203-6299
425/513-5300 Fax: 425/513-5302
www.cutlerhammer.eaton.com

Effective 6/99
Printed in U.S.A.

