Installation Instructions—Comet® Series Perfect Prox® Diffuse Reflective Sensors

MODELS COVERED IN THIS MANUAL

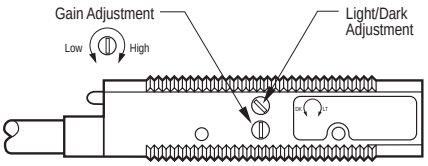
2-Wire Sensors				
Voltage Type	Connection	Viewing Style	Sensing Range	
			2-Inch	4-Inch
AC/DC	Potted Cable	Forward	13104A6515	13101AS6515
		Right Angle	13104R6515	13101RS6515
	Micro Connector	Forward	13104AQD05	13101ASQD05
		Right Angle	13104RQD05	13101RSQD05
	Mini Connector	Forward	13104AQD25	13101ASQD25
		Right Angle	13104RQD25	—

3-Wire & 4-Wire Sensors							
Voltage Type	Connection	Viewing Style	Sensing Range				
			2-Inch	Focused 2-Inch	4-Inch	6-Inch	9-Inch
AC/DC	Potted Cable	Forward	13104A6513	13105A6513	13101A6513	13108A6513	13103A6513
		Right Angle	13104R6513	—	13104RS5013	13108R6513	13103R6513
	Micro Connector	Forward	13104AQD03	13105AQD03	13101AQD03	13108AQD03	13103AQD03
		Right Angle	13104RQD03	—	13104RS5003	13108RQD03	13103RQD03
DC Only	Potted Cable	Forward	13104A6517	13105A6517	13101A6517	13108A6517	13103A6517
		Right Angle	13104R6517	—	13104RQD07	13108R6517	13103R6517
	Micro Connector	Forward	13104AQD07	13105AQD07	13101AQD07	13108AQD07	13103AQD07
		Right Angle	13104RQD07	—	13104RS5007	13108RQD07	13103RQD07

ATTENTION

SOME PERFECT PROX MODELS NOW INCLUDE A GAIN ADJUSTMENT

In some applications, shiny backgrounds (such as mirrors, polished metal, glass) may be detected beyond the sensor's rated range. To avoid this, dull the background surface to a matte finish, or angle the sensor or background to eliminate direct reflections. If this does not eliminate the condition, a slight reduction in gain will usually improve background rejection significantly with little effect on target detection. Reduce the gain only the minimum amount needed to ignore the shiny background. In most applications this adjustment should remain in its fully clockwise position (maximum gain).



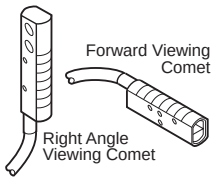
INTRODUCTION

A Perfect Prox diffuse reflective sensor operates by shining a beam of infrared light through the lens. When an object comes within the sensor's view, it reflects part of this beam of light back to the sensor. This causes the sensor to detect the object. The advanced optics and high power of Perfect Prox background rejection technology allow the sensor to reliably detect an object at maximum range regardless of the object's color or texture. In addition, the sensor has a unique ability to ignore objects just outside the maximum range. (This is known as the cutoff range.)

Page 2 and 3 of this manual provide a detailed explanation of how the Perfect Prox sensor operates and gives hints on how to properly apply the sensor.

This manual covers both forward viewing and right angle viewing models. Although the units differ in the location of the lenses, the basic fundamentals of installation, set-up, and operation are nearly identical.

WHY MAKE A PERFECT PROX?



Diffuse reflective mode photoelectric sensors require high excess gain to detect objects with low reflectance. When these objects need to be detected against backgrounds with higher reflectance, problems can occur. Examples of these problems, along with simple solutions, are shown on Page 2 and 3. We developed Perfect Prox sensors to have the high gain needed to detect low reflectance targets, but with a sharp cut-off to reject background reflections.

WARNING

USE #4 MOUNTING HARDWARE ONLY! LARGER HARDWARE WILL DAMAGE THE SENSOR AND MAY CREATE AN ELECTRICAL SHOCK HAZARD. TIGHTEN THE HARDWARE JUST TO THE SENSOR BODY SO THAT NO DEFLECTION OF THE BODY OCCURS.

DURING INSTALLATION, CORRECT POWER CONNECTIONS MUST BE MADE FIRST TO ENSURE FAIL-SAFE SHORT CIRCUIT PROTECTION OF THE OUTPUTS. REFER TO THE WIRING DIAGRAMS IN THIS MANUAL.

DO NOT USE TOOLS TO APPLY TORQUE DIRECTLY TO SENSOR BODY. ALIGN SENSOR BY HAND BEFORE TIGHTENING MOUNTING HARDWARE.

THE LIGHT/DARK ADJUSTMENT POT IS A 3/4 TURN POT. ANY RESISTANCE ENCOUNTERED WHILE ADJUSTING THE POT INDICATES YOU HAVE REACHED THE ADJUSTMENT LIMIT STOP. TURNING PAST THIS STOP WILL DAMAGE THE SENSOR.

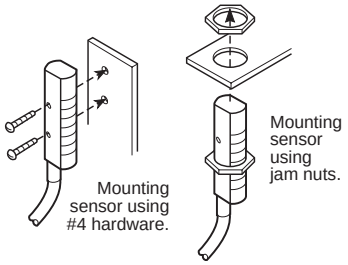
USE ONLY A SUITABLE ADJUSTMENT TOOL OR FLATBLADE SCREWDRIVER WHEN TURNING ADJUSTMENT POTS. SHARP OBJECTS CAN DAMAGE THE POT AND RESULT IN ELECTRICAL SHOCK.

AC/DC CONNECTOR VERSION SENSORS USE AN AC-TYPE CONNECTOR. TO CONFORM WITH ESTABLISHED STANDARDS, DO NOT USE DC POWER WITH AC/DC CONNECTOR VERSIONS OF COMET.

MOUNTING

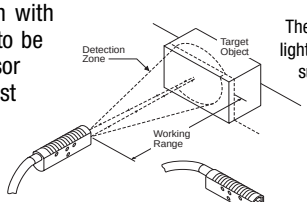
The Comet sensor features a threaded housing and includes jam nuts and washers. This allows mounting into any 0.75 inch hole, or one of our accessory brackets. Use caution to avoid cross-threading the jam nuts on the sensor body. Tighten nuts to less than 4 N•m (36 in.-lbs. or 3 ft.-lbs.) torque to avoid stripping threads.

A second mounting method is to use #4 hardware in the 0.125 inch diameter mounting holes in the flat sides of the sensor. This is ideal for mounting the Comet against a wall, piece of equipment, rail, mounting bracket, and so on.

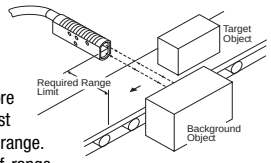


MOUNTING LOCATION AND SET-UP

Select a mounting location with a clear view of the object to be detected. Mount the sensor so that it points at the most suitable part of the target object.



The detector "sees" light when the target surface enters the Detection Zone.

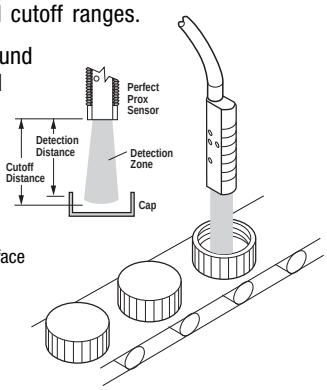


Perfect Prox sensors have the ability to ignore background objects just beyond the maximum range. This is known as cutoff range.

Be sure your power supply is off, then connect the sensor to the control circuit and power lines. Turn the power supply on and place a sample object in the beam. Slowly adjust the distance between the sensor and the target so that the target is detected each time and the background is not. The LED indicates output condition. See the "Optical Performance" section on page 4 of this manual for more information on maximum ranges and cutoff ranges.

NOTE: Be sure to check for background detection when the target is removed (hysterisis latch-up after sensing an object).

Tighten all mounting screws.

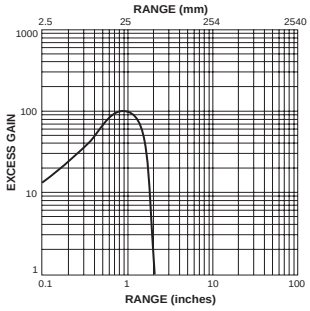


This is a typical example of the 2-inch range Perfect Prox. The sensor will detect the surface of the cap if it is on the top, and ignore the surface if it is on the bottom.

In this case, the sensor can inspect caps for proper orientation prior to entering an automated capping machine.

WHAT IS A PERFECT PROX?

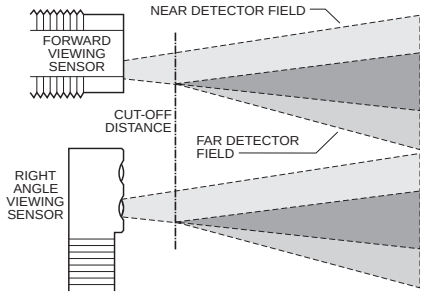
Perfect Prox has extremely high gain. In fact, most Perfect Prox models have as much gain as a 24-inch standard diffuse reflective sensor! But the Perfect Prox sensing ranges have extremely sharp cut-offs at much closer ranges. The following graph clearly shows this cut-off for a 2-inch forward viewing Perfect Prox.



HOW A PERFECT PROX WORKS

Let's look at how the 2-inch Perfect Prox works. To get the high gain and the sharp cut-off, the sensor has two different detectors. The first detector is the near detector with a range of 0 to 24 inches. The second is the far detector with a range of 2 to 24 inches (see the illustration below).

If the near signal is stronger than the far signal, the output of the sensor is "on". If the far signal is stronger than or equal to the near signal, the output is "off." The result is a sensor with high excess gain for 2 inches followed by a sharp cut-off.



Objects closer than 2 inches are detected by the near detector only. Objects at 2 inches or greater will be detected by both detectors.

PERFECT PROX APPLICATION HINTS

Perfect Prox sensors combine high excess gain with a sharp cut-off. The optics that provide this performance can also make it possible to misapply the sensor, giving the appearance of a malfunction. Simple adjustments alleviate these application problems. The following section gives a simplified description of how the Perfect Prox works, and tips on adjusting the sensor for proper performance.

APPLICATION DIFFICULTIES?

As you look at the sensor with the flat sides oriented vertically, the two detection fields are stacked one on top of the other as shown in the previous illustration. Application difficulties with Perfect Prox usually result from targets or backgrounds that reflect unequally on these two detectors. Fortunately, these kinds of problems are easily remedied by slight readjustment of the sensor's mounting. NOTE: Backgrounds that cause specular reflections, such as mirror-like surfaces, can sometimes reflect more light to the near detector than to the far detector. This will cause detection at distances greater than the sensor's cutoff range, resulting in a false "ON" condition. To avoid this, dull the surface to a matte finish, or angle the sensor or background to eliminate direct reflections.

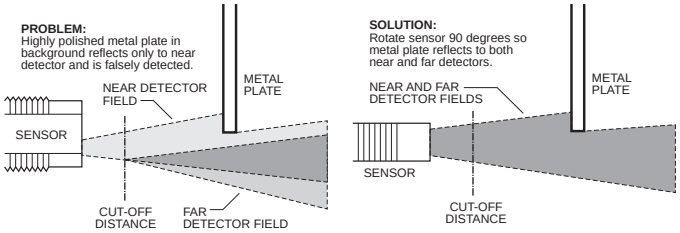
Following are simple solutions to three specific problems that can occur when installing the Perfect Prox sensor. All drawings exaggerate field placement for purposes of illustration.

BACKGROUND OBJECTS CAUSING UNEQUAL REFLECTIONS

Any background object that reflects light to only one detector can cause problems. Reflections to only the near detector can cause a false "on" condition. (Remember, these reflections can come from objects up to 2 feet away for diffuse objects, or 10 feet away for retroreflectors and mirrors.)

If the background object reflects only to the far detector, it may provide enough signal that the sensor cannot detect a near object. If the background object does not reflect enough light to be detected, it may reflect enough that the sensor will lock up and fail to turn "off" after a near target has left the sensor's field of view.

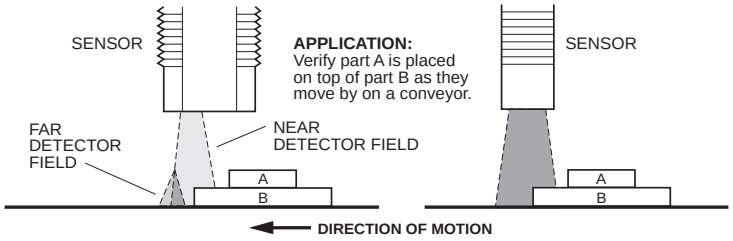
To solve these problems, rotate the sensor 90° to direct reflections to both detectors. Aiming the sensor at an angle to the background may also bring the background into the field of view of both detectors.



DETECTING TARGETS MOVING PARALLEL TO THE SENSOR'S LENS SURFACE

When one object is to be detected as it moves on a second "background" object, the background may cause a "false" pulse if the sensor is not oriented properly.

To avoid these pulses, the target must enter and leave both fields simultaneously. This is easily done by having the object approach the sensor toward either of the flat sides.



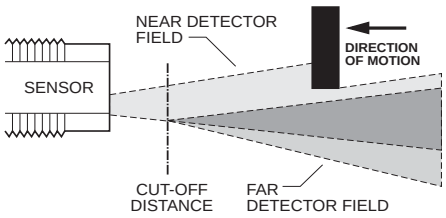
PROBLEM:
As part B enters the near field, the sensor turns on, giving a "false" pulse, until B enters the far field.

SOLUTION:
Rotate the sensor 90 degrees. Now part B enters the near and far fields simultaneously.

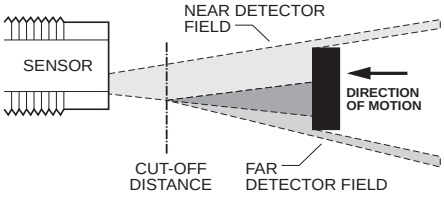
DETECTING TARGETS MOVING HEAD-ON TOWARDS THE SENSOR

Sometimes you need to detect an object as it approaches the sensor head on. If the object is not centered on the sensor's optical axis, it may reflect into just one of the detectors. The result is that the prox will either not sense at all, or will act as a regular proximity mode sensor and detect the object at too great a distance. Repositioning the sensor or the object so that the object travels on the sensor's optical axis will solve the problem. You may also relocate the sensor so that the object moves in a plane parallel to the sensor's lens surface.

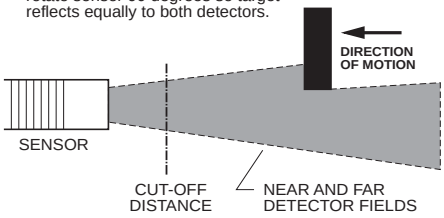
PROBLEM:
Target moving "off axis" toward sensor, reflects only to near detector and is detected too soon.



SOLUTION:
Reposition sensor or target so target moves on sensor's optical axis.



SOLUTION:
If sensor or target cannot be repositioned, rotate sensor 90 degrees so target reflects equally to both detectors.

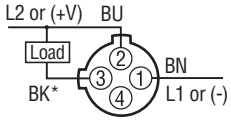


WIRING DIAGRAMS

Connections shown for both cable versions (cable and wire colors shown) and connector versions (connector face view shown).

3-Wire AC/DC Models
Micro-Connector
(see Warning, pg. 1)

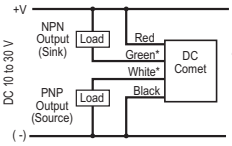
Face View Male



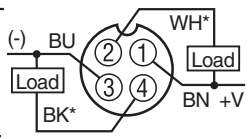
*No connection on TB source

4-Wire DC Models

Cable Version

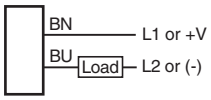


Face View Male



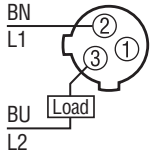
*No connection on TB source

2-Wire AC/DC Cable Version



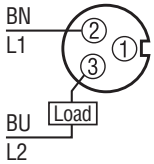
2-Wire AC Models
Micro-Connector

Face View Male



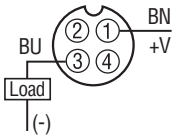
2-Wire AC Models
Mini-Connector

Face View Male



2-Wire DC Models
Micro-Connector

Face View Male

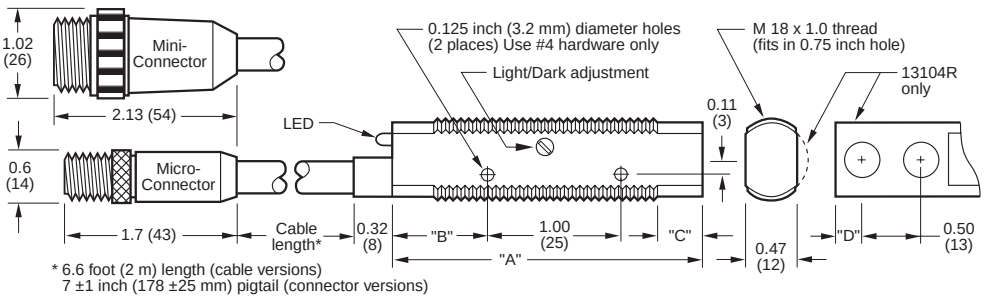


Pin numbers are for reference, rely on pin location when wiring.

APPROXIMATE DIMENSIONS

Shown in inches (mm)

Sensor Type	A	B	C	D
13101A, 13103A 13104A, 13105A 13108A	2.60 (66)	0.60 (15)	0.25 (6)	n/a
13104R 13103R 13106R 13109R	3.02 (77)	0.60 (15)	1.10 (28)	0.20 (5)



* 6.6 foot (2 m) length (cable versions)
7 ±1 inch (178 ±25 mm) pigtail (connector versions)

SPECIFICATIONS

	3-Wire and 4-Wire Sensors			2-Wire Sensors	
	AC/DC Models (AC Operation)	**AC/DC Models (DC Operation)**	**DC-Only Models**	**AC Models (AC Operation)**	**DC Models (DC Operation)**
Input Voltage	20 to 264 V ac, 50/60 Hz	15 to 30 V dc (15 to 24 Vdc (15 to 24 Vdc above 131° F/55° C)	10 to 30 V dc (10 to 24 Vdc above 131° F/55° C)	90 to 132 Vac, 50/60 Hz	18 to 50 Vdc
Power Dissipation	1.5 W maximum	1.5 W maximum	1 W maximum	2 W maximum	2 W maximum
Output Type	VMOS (bi-directional)	NPN (sink)	NPN and PNP (dual outputs)	DMOS	DMOS
Current Switching	300 mA maximum	300 mA maximum	PNP: 100 mA max.; NPN: 250 mA max. (NPN: 120 mA max. above 131° F/55° C)	300 mA	300 mA
Voltage Switching	375 V peak maximum	375 V peak maximum	30 VDC maximum	132 Vac maximum	50 Vdc maximum
Off-State Leakage	250 µA typical; 500 µA max.	250 µA typical; 500 µA max.	10 µA maximum	1.7 mA maximum	1.5 mA maximum
Surge Current	2 A maximum	2 A maximum	1 A maximum	1 A maximum	1 A maximum
On-State Voltage Drop	- - -	1.8 V at 10 mA; 3.5 V at 300 mA	NPN: 400 mV at 10 mA, 1.5 V at 250 mA; PNP: 2.4 V at 100 mA	10 Vac	8 Vdc
Response Time	10 mS		1 mS	32 mS	32 mS
Short Circuit Protection	Sensor will turn off immediately when short or overload is detected(Indicator LED flashes). IMPORTANT: During installation, correct power connections must be made first to ensure fail-safe short circuit protection of outputs.				
	Turn power OFF and back ON to reset.		Auto reset		
Temperature Range	Operating and Storage: -25° to +55° C (-13° to +131° F); -40° to +70° C (-40° to +158° F);				
Light/Dark Operation	Switch selectable				
Enclosure Material	Lens: Polycarbonate; Cable jacket: PVC; Body: Structural polyurethane foam (do not expose to concentrated acids, alcohols, or ketones)				
Cable/Connector	6-foot cable, Male mini and micro connectors (refer to wiring diagrams for number of pins per model)				
Vibration and Shock	Vibration: 30 g over 10 Hz to 2 kHz; Shock: 100 g for 3 mS 1/2 sinewave pulse				
Indicator LED	Lights steady when output is ON; Flashes when short circuit protection is in latch condition (except 2-wire models)				
Sunlight Immunity	5,000 foot-candles				
Enclosure Ratings	NEMA 1, 2, 3, 4, 4X, 6, 12, and 13 (see note below)				
Approvals	UL and C-UL Recognized (all models), CE Compliant (except 2-wire DC models)				

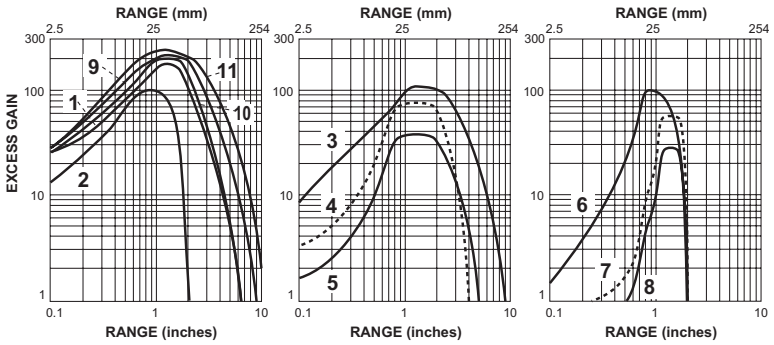
Note: These products conform to NEMA tests as indicated, however, some severe washdown applications can exceed these NEMA test specifications. For questions about a specific application, contact our Applications Department.

OPTICAL PERFORMANCE

All optical specifications are guaranteed to be the minimum performance under clean conditions of any product delivered from stock. Typical performance may be higher. Dirt in the environment will affect optical performance by reducing the amount of light the sensor receives. For best results, sensors should be used at distances where excess gain is higher than 1.5 (1.5 times the amount of sensing power required to detect an object under ideal conditions). Higher excess gain will allow the sensor to overcome higher levels of contamination on the lens.

1. 13108A
2. 13104A
3. 13103A
4. 13101A Typical
5. 13101A Min.
6. 13104R
7. 13105A Typical
8. 13101A Min.
9. 13103R
10. 13108R
11. 13109R

Ranges and excess gain graphs based on a 90% reflectance white card.



	13101A	13103A, 13103R	13104A, 13104R	13105A	13108A, 13108R	13118R	13128R	13109R
Source	Visible red, 680 nm	Infrared, 880 nm	Visible red, 680 nm	Visible red, 680 nm	Infrared, 880 nm	Infrared,880nm Visible red, 680 nm	Visible red, 680 nm	Infrared,880nm
Optimum Range	0.5-3 in. (13-76 mm)	0.1-6 in. (3-150 mm)	0.4-1.8 in. (10-45 mm)	0.9-1.8 in. (23-45 mm)	0.1-4 in. (3-100 mm)	0.1-4 in. (3-100 mm)	0.1-4 in. (3-100 mm)	0.5-10 in. (13-254 mm)
Nominal Range	4 in. (100 mm)	9 in. (225 mm)	2.0 in. (50 mm)	2.0 in.(50 mm)	6 in. (150 mm)	6 in. (150 mm)	6 in. (150 mm)	12in. (305 mm)
Cutoff Range	5 in. (127 mm) & beyond	12 in. (304 mm) & beyond	2.25 in.(57 mm) & beyond	2.25 in. (57 mm) & beyond	9 in. (228 mm) & beyond	9 in. (228 mm) & beyond	9 in. (228 mm) & beyond	18 in. (457 mm) & beyond
Field of View	0.35 in. (9 mm) diameter at 4 inches	0.9 in. (23 mm) diameter at 9 inches	0.25 in. (6.4 mm) diameter at 2 in.	0.05 in. (1.3 mm) at 1.7 in.(43 mm)	0.6 in. (15 mm) diameter at 6 in.	0.6 in. (15 mm) diameter at 6 in.	0.6 in. (15 mm) diameter at 6 in.	0.9 in. (23 mm) diameter at 6 in.

* Right Angle Models only: 50% of sensitivity occurs within a 0.10 inch (2.5 mm) circle at the center of the spot.

Still Need Help?

Contact the Cutler-Hammer Sensor Application Engineers

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