# Installation Instructions
# E56 Pancake Style Inductive Proximity Sensor

## WARNING

**IN ORDER TO AVOID ELECTRIC SHOCK OR OTHER POSSIBLE INJURY:**

- **DO NOT USE THIS PRODUCT FOR HUMAN SAFETY APPLICATIONS. IT WAS NOT DESIGNED, TESTED OR RECOMMENDED FOR THIS USE.**
- **DO NOT USE THIS PRODUCT IN HAZARDOUS LOCATIONS (E.G. EXPLOSIVE ATMOSPHERES). IT WAS NOT DESIGNED, TESTED OR RECOMMENDED FOR THIS USE.**
- **ENSURE THE PRODUCT IS PROPERLY WIRED TO THE CORRECT POWER SUPLLY FOR THE APPLICATION. REFER TO THE SPECIFICATIONS AND WIRING DIAGRAMS IN THIS MANUAL.**

## MODELS COVERED IN THIS MANUAL

**E56BAL70UAA01**

| Product Family | |
|---|---|
| E56 | E56 Series |

| Size | |
|---|---|
| A | Baseplate: 80 mm<br>Sensing Head: ø 74 mm |
| B | Baseplate: 110 mm<br>Sensing Head: ø 96 mm |
| C | Baseplate: 170 mm<br>Sensing Head: ø 152 mm |

| Voltage Type | |
|---|---|
| A | AC/DC 2-wire |
| D | DC 4-wire |

| Output Type | |
|---|---|
| L | 1 N.O./1 N.C. |
| M | 1 N.O. |
| N | 1 N.C. |

| Sensing Range | |
|---|---|
| 40 | 40 mm |
| 50 | 50 mm |
| 60 | 60 mm |
| 70 | 70 mm |
| 100 | 100 mm |

| Shielding | |
|---|---|
| U | Unshielded |
| S | Shielded |

| Output Mode | |
|---|---|
| A | Auto-Config (NPN/PNP) |
| N | NPN |
| P | PNP |

| Connection | |
|---|---|
| A01 | AC Micro, 3-Pin |
| B01 | AC Mini, 3-Pin |
| C02 | Cable, 2 m |
| D01 | DC Micro, 4-Pin |
| E01 | DC Mini, 4-Pin |
| | Screw Terminals |

***Note: Not all possible combinations shown in table are offered as standard.***

**Note: This installation manual only covers small-diameter pancake models (with model numbers beginning with E56A). For the installation manual covering medium- and large-diameter models, use P51895.**

## INTRODUCTION

The Cutler-Hammer E56 Pancake Style Inductive Sensor from Eaton is a top-sensing, solid-state device used to detect metal targets at range.

The E56 Series is available in three different sizes: small (ø 74 mm), medium (ø 96 mm), and large (ø 152 mm). Connectivity options include a factory-installed Mini Connector, Micro Connector or Screw Terminals. The E56 Series meets the requirements of NEMA Type 4, 4X, 6, 6P, 12 and 13 enclosures.

Each package style is available in either 4-wire DC or 2-wire AC/DC versions. Additional key features include complementary outputs (1NO/1NC) for DC models and two output status LEDs. The 4-wire DC models also feature Auto-Config Outputs, which automatically set the sensor to the correct output mode (NPN/sinking or PNP/sourcing) without user intervention.

## BASIC OPERATION

Inductive proximity sensors generate a high frequency oscillating magnetic field in the vicinity of the sensing head. When a metal object enters this field, it changes the field loading of the oscillator coil. This change is recognized by a detector circuit, which then energizes the output.

E56 Series sensors will detect all metals, but primarily steel. The exact distance at which a target is detected is determined by its size, thickness and type of metal.

To determine sensing distance with your target, see the *Sensing Field Diagrams* on Page 2. These diagrams serve as a reference point and show where the target will be detected for lateral (side or slide-by) and axial (head-on) approaches. These curves must be corrected for smaller-than-standard targets and other metals. (Standard target sizes are listed Page 2.)

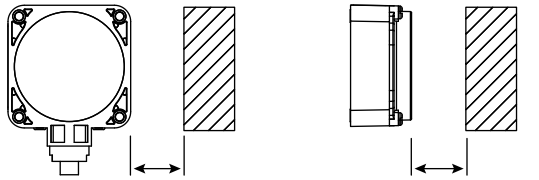
## MOUNTING CONSIDERATIONS

The sensor should be mounted using four 0.25-inch bolts through the mounting holes provided. Do not support the sensor by conduit alone. The sensor can be mounted to any surface without affecting sensor performance, but it is recommended to use a solid base to ensure reliable operation.

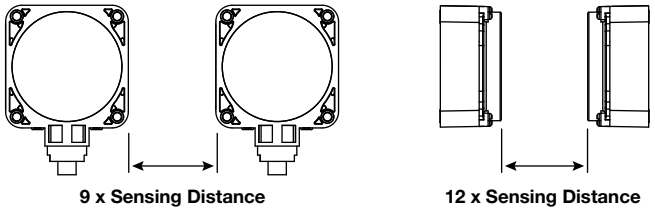
For all unshielded inductive sensors, ensure there is adaquate distance between the sensor face any adjacent metals. See the below diagram for isolation distances.

When E56 Series sensors are mounted side-by-side, there is the possibility of interaction between the magnetic fields of the sensors. This could cause unreliable operation. Follow the limitations noted in the below illustration when mounting sensors in the same location.

**Sensor Isolation Minimum Distances to Adjacent Metals**




**Sensor-to-Sensor Isolation Minimum Distances**




## SENSING

The sensing field for the E56 Series sensor is shown to the right. In addition to maximum sensing distance, this diagram also illustrates the performance of the sensor as the target approaches the sensing face in an axial (head-on) or lateral (side or side-by-side) manner.

In this diagrams, the sensing distances shown are base rated on standard target sizes. Sensing range will decrease if a target is used that is smaller than the standard target size. See the below table for standard target sizes for each style sensor.

| Sensor Model | Standard Target Size |
|---|---|
| Small Diameter (Both Shielded and Unshielded) | 3 x Sensing Range |

Detection for laterally approaching targets occurs at the point where the target first touches the envelope of the sensing curve depicted below. The curves must be corrected for smaller targets and other metals. The general correction factors for metals other than steel are shown below.

Maximum sensing distances are shown in the below diagrams, but for most reliable lateral operation, keep the sensor-to-target distance as short as possible. It is recommended that a lateral traveling target pass at no more than 75 percent of the maximum sensing distance.

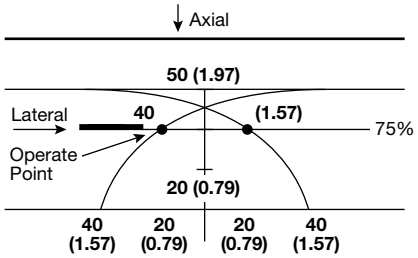
## CORRECTION FACTORS FOR METALS

Sensing range is determined by target size, thickness and metal type. See the below table for correction factors based upon standard target sizes.

| Target Material | Corrective Factor |
|---|---|
| Steel 1020 | 1.00 |
| Stainless Steel 400 | 0.90 |
| Stainless Steel 300 | 0.70 |
| Brass | 0.54 |
| Aluminum | 0.50 |
| Copper | 0.46 |

## SENSING FIELD DIAGRAM

**Small Diameter Pancake**



## TARGET POSITIONING

To ensure reliable sensing performance, it is recommended to follow the general guidelines regarding target positioning below.

**Axial (Head On) Approach** — The target must be positioned so that a projection of the target on the sensor face covers at least half of the indicator area. If the target is smaller than the indicator area, its axis should coincide with the sensor axis.

**Lateral (Side, Slide-By) Approach** — Position the target at a distance no greater than 75 percent of the rated axial sensing distance from the sensor face.

## SHORT CIRCUIT PROTECTION

Built-in short circuit protection prevents damage to the sensor when the load current exceeds an unsafe level. When this occurs with the target in the sensing zone, the load current will be reduced to a level that will not energize the load. Depending on the magnitude of the excessive load current, the sensor will manage its retry rate accordingly. The output will continually retry until the short condition is removed. For 2-wire AC/DC models, the LED indicator will flash green if the short condition persists, and the cycle will repeat until the load current returns or is corrected to normal. For DC models, there is no LED indication of a short condition.

## AUTO-CONFIG PNP/NPN OUTPUT DETECTION

Four-wire DC versions of the E56 Series feature Auto-Config outputs. This technology automatically determines how the sensor's output circuits have been wired and adjusts the outputs to either PNP (sourcing) or NPN (sinking) without any user intervention. The Auto-Config process takes place at sensor power-up. If the output is changed without power cycling the sensor, the Auto-Config process will not start and therefore the outputs will not change. To ensure your outputs are correct, always power down the sensor when making a change to the output configuration.

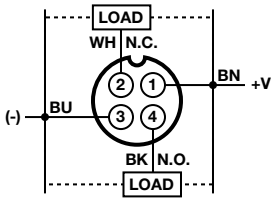
*Note: If Auto-Config detects one output as NPN, then both outputs will be set to NPN.*

## WIRING DIAGRAMS

The sensor should be mounted using four #10 bolts through the mounting holes provided. Do not support the sensor by conduit alone. The sensor can be mounted to any surface without affecting sensor performance, but it is recommended to use a solid base to ensure reliable operation.

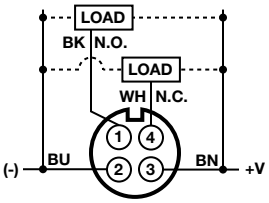
***Note: For AC/DC models, connected earth ground through pin one or to connector shell.***

**DC Micro Connector (Models Ending -D01)**



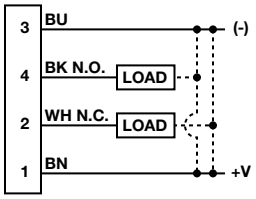

*Auto-Configure enables load to be wired to +V or (-)*

**DC Mini Connector (Models Ending -E01)**



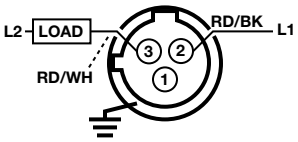

*Auto-Configure enables load to be wired to +V or (-)*

**DC Screw Terminal**

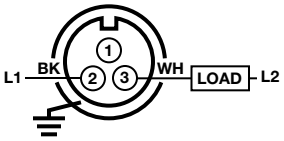



*Auto-Configure enables load to be wired to +V or (-)*

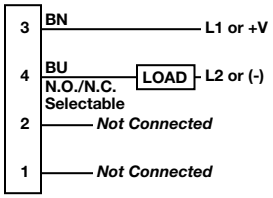
**AC/DC Micro Connector (Models Ending -A01)**




**AC/DC Mini Connector (Models Ending -B01)**



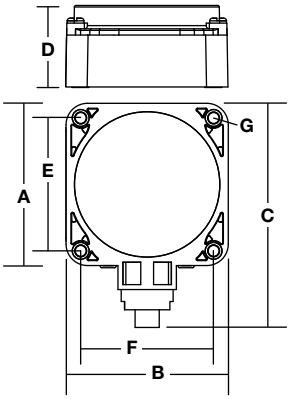

**AC/DC Screw Terminal**



## SPECIFICATIONS

| | AC/DC 2-Wire | | DC 4-Wire | |
|---|---|---|---|---|
| | **Shielded** | **Unshielded** | **Shielded** | **Unshielded** |
| Operating Voltage | 20-250V AC<br>20-60V DC | | 10-42V DC | |
| Load Current (Max.) | 400 mA | | 300 mA | |
| Burden Current | — | | < 25 mA | |
| Off-State Leakage | AC Operation:<br>At or Above 0°C: <1.7 mA Per Output<br>Below 0°C: 2.0 mA Per Output<br>DC Operation:<br><1.5 mA | | NPN Mode: < 400 µA<br>PNP Mode: < 1 µA | |
| Voltage Drop | < 10V (5V Nominal) | | < 2.5V | |
| Frequency of Operation | 30 Hz | | 70 Hz | |
| Outputs | N.O. or N.C. by Model | | Complementary (1N.O./1N.C.) with Auto-Config | |
| Maximum Sensing Distance | 40 mm | 50 mm | 40 mm | 50 mm |
| Standard Target Size (Mild Steel) | 120 x 120 mm | 150 x 150 mm | 120 x 120 mm | 150 x 150 mm |
| Repeatability | < 3% | | | |
| Hysteresis (Max.) | 15% | | | |
| Time Delay Before Availability | 300 msec | | | |
| Circuit Protection | Short Circuit Protection with Auto-Reset | | | |
| Operating Temperature | -40° to +70°C (-40° to + 158°F) | | | |
| Temperature Drift | ±10% | | | |
| Enclosure Rating | NEMA 4, 4X, 6, 6P, 12, 13 (IP67 and IP68) | | | |
| Approvals | CE | | | |
| Indicator LED | Green: Power<br>Red: Output | | | |

## APPROXIMATE DIMENSIONS




| Model | A (Depth) | B (Width) | C (Depth) | D (Height) | Mounting | | |
|---|---|---|---|---|---|---|---|
| | | | | | **E** | **F** | **G (ø)** |
| Micro Connector<br>(Models Ending -A01 or -D01) | 79<br>(3.13) | 79<br>(3.13) | 110<br>(4.32) | 39<br>(1.54) | 65<br>(2.56) | 65<br>(2.56) | 5<br>(0.21) |
| Mini Connector<br>(Models Ending -B01 or -E01) | 79<br>(3.13) | 79<br>(3.13) | 119<br>(4.67) | 39<br>(1.54) | 65<br>(2.56) | 65<br>(2.56) | 5<br>(0.21) |
| Screw Terminals<br>(Ending in -A, -N, or -P) | 79<br>(3.13) | 79<br>(3.13) | 92<br>(3.87) | 39<br>(1.54) | 65<br>(2.56) | 65<br>(2.56) | 5<br>(0.21) |