INSTALLATION INSTRUCTIONS
BULLETIN 875C, 875CP, 875L CAPACITIVE PROXIMITY SENSOR

IMPORTANT: SAVE THESE INSTRUCTIONS FOR FUTURE USE.

ATTENTION: Solid-state devices can be susceptible to radio frequency (RF) interference depending on the power and the frequency of the transmitting source. If RF transmitting equipment is to be used in the vicinity of the solid state devices, thorough testing should be performed to assure that transmitter operation is restricted to a safe operating distance from the control equipment and its wiring.

ATTENTION: If a hazardous condition can result from unintended operation of this device, access to the sensing area should be guarded.

Part Number Configuration

875 CP – D M 30 N P 34 – A 2

- 875: Capacitive Proximity Sensor
- CP:
  - C = Cylindrical metal body (shielded)
  - CP = Cylindrical plastic body (unshielded)
  - L = Limit switch style
- D:
  - A = AC
  - D = DC
- M: M = Smooth barrel
- 30: Nominal sensing distance (in mm)
  - 2, 5, or 10mm = shielded construction
  - 4, 8, 20, or 30mm = unshielded construction
- N:
  - N = Normally open
  - C = Normally closed
  - E = Selectable
- P:
  - P = PNP
  - N = NPN
  - E = Selectable
- 34: Housing diameter (mm) (cylindrical types); Head width (mm) (limit switch style types)
- A:
  - A = PVC cable
  - D = DC micro connector
  - P = Pico connector
  - R = AC micro connector
  - T = Terminal chamber
- 2: Cable length (m); Number of pins; Number of terminals

Specifications—AC Models

Max. Load Current	300mA	
Inrush Current	2A	
Leakage Current	3.5mA	
Operating Voltage	20–250V	
Voltage Drop	<10V	
Repeatability	≤10%	
Hysteresis	≤20%	
Max. Switching Frequency	15Hz	
Transient Noise Protection	Incorporated	
Enclosure	NEMA 12, IP65 (IEC 529) Plastic or nickel–plated brass	
Approval	CE marked	
Connections	Cable Quick-Disconnect	2-meter length 2-conductor PVC 3-pin micro
LEDs	Green: Power Yellow: Output	
Operating Temperature	–25°C to +70°C (–13°F to +158°F)	

Allen-Bradley capacitive sensors are manufactured and tested to the international standard IEC 947–5–2.

Specifications—DC Models

Max. Load Current	12, 18mm 30, 34mm, limit switch style	200mA 400mA
Leakage Current	12mm 18, 30, 34mm, limit switch style	0.3mA 0.1mA
Operating Voltage	12mm 18, 30, 34mm, limit switch style	10–36V 10–60V
Voltage Drop	12, 18mm 30, 34mm, limit switch style	<2V <3V
Repeatability	≤10%	
Hysteresis	≤20%	
Max. Switching Frequency	12, 18, 30, 34mm limit switch style	25Hz 40Hz
Transient Noise Protection	Incorporated	
Reverse Polarity Protection	Incorporated	
Short Circuit Protection	Incorporated	
Overload Protection	Incorporated	
Enclosure	NEMA 12, IP65 (IEC 529) Plastic or nickel-plated brass	
Approval	CE marked	
Connections	Cable Quick–Disconnect Conduit Opening	2-meter length 3-conductor PVC 4-pin micro 3-pin pico 1/2-14 NPT internal thread with screw terminals
LEDs	Green: Power Yellow: Output	
Operating Temperature	–25°C to +70°C (–13°F to +158°F)	

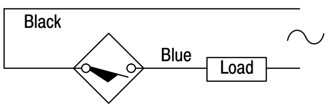
Wiring

All external wiring should conform to the National Electric Code and applicable local codes. Connect the proximity switch to the power supply and load as shown in the wiring diagrams below. If the positive (+) and negative (–) wires are reversed, the switch will not operate properly. The sensor will not be damaged because it is equipped with reverse polarity protection.

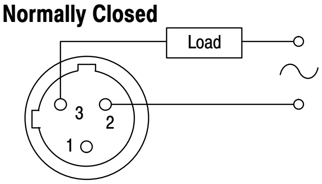
Wiring Diagrams for AC Switches

Cable **Micro-Connector**

Normally Open or Normally Closed



Note: Load can be switched to black wire.

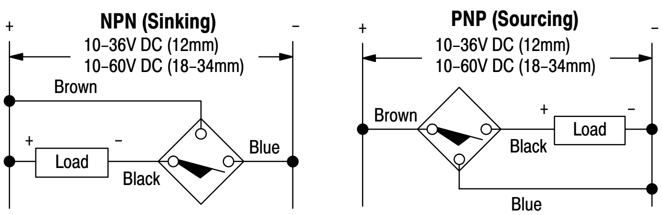


Note: Load can be switched to pin 2.

Wiring Diagrams for DC Switches

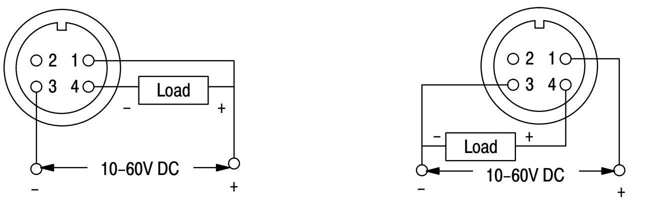
Cable

Normally Open or Normally Closed



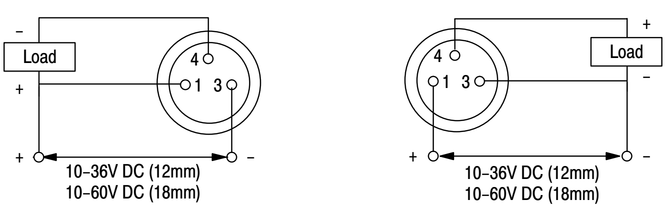
Micro-Connector

Normally Open or Normally Closed



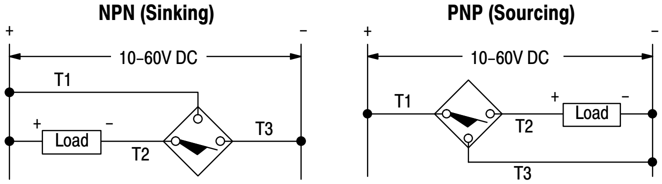
Pico-Connector

Normally Open or Normally Closed



Terminal Chamber

Normally Open or Normally Closed



Wiring Switches in Series

Switches can be connected in series with a load. For proper operation, the voltage across the energized load must be less than or equal to the minimum supply voltage minus the voltage drops across all sensors. The load will be energized only when all switches are closed.

Wiring Switches in Parallel

Switches can be connected in parallel to energize a load. The sum of the maximum leakage currents for the switches must be less than the maximum off-state current of the load device. The load will be energized when one or more of the switches are closed.

Sensing Distance Adjustment

The sensing distance of an Allen-Bradley capacitive proximity sensor can be adjusted via a twenty-turn potentiometer at the rear of the sensor housing. Although this is a clutched potentiometer, it does not emit an audible “click” when turned beyond its range.

The maximum sensing distance for each sensor can be determined using the part number configurator on page one. If the sensing distance is set higher than the maximum, the unit may lock in the triggered state. The minimum distance to which each sensor can be adjusted is listed in the table below. Nominal sensing distances are measured using a standard target (see Target Considerations).

Minimum Adjusted Sensing Distances

12mm metal housing:	0.4mm
18mm metal housing:	1.0mm
18mm plastic housing:	2.0mm
30mm metal housing:	2.0mm
30mm plastic housing:	5.0mm
34mm plastic housing:	7.0mm
limit switch style housing:	10.0mm

This unit is not designed for reliable operation when adjusted to distances shorter than those stated above.

Adjustment Procedure:

1. Mount the sensor on a stable surface or support (see Mounting Considerations).
2. Apply power to the sensor per wiring diagrams (see Wiring). Check that the green “power” LED turns on.
3. Determine a desired sensor-to-target distance which is between the unit’s rated minimum and maximum sensing distances (see Target Considerations and Dielectric Constants).
4. Multiply this desired sensing distance by 1.2 and place the target at the resulting new distance from the sensor. Check the yellow “output” LED status.

5A. (Normally Open Models Only) If the yellow LED is off, turn the potentiometer slowly clockwise until the LED turns on. If the yellow LED is already on, turn the potentiometer counterclockwise until the LED turns off, then slowly clockwise until the LED turns on again.

5B. (Normally Closed Models Only) If the yellow LED is on, turn the potentiometer slowly clockwise until the LED turns off. If the yellow LED is already off, turn the potentiometer counterclockwise until the LED turns on, then slowly clockwise until the LED turns off again.

6. Remove the target and check that the yellow LED turns off for normally open models and on for normally closed models.
7. Place the target at the original desired sensor-to-target distance determined in step 3. If the yellow LED turns on for normally open models and off for normally closed models, the sensor is correctly adjusted.

Target Considerations

Standard Target

The standard target is a grounded, 1mm-thick square of mild steel. The side lengths of a standard target are equal to either the diameter/width of the sensor face or three times the nominal sensing distance, whichever is greater.

Shielded vs. Unshielded

Shielded capacitive sensors can be used to sense either conductive (metal, water) or nonconductive (wood, paper, glass, plastic) materials. Their internal ground allows them to detect grounded or ungrounded targets. It also makes them more susceptible to dust and moisture in the environment than unshielded sensors.

Unshielded capacitive sensors are used primarily to sense grounded, conductive materials at maximum sensing distances. They are less sensitive to nonconductive materials than shielded sensors. This makes them able to detect conductive materials <u>through</u> a nonconductive material, such as water inside a plastic tank. In this case, the nonconductive material can be no thicker than the sensor's sensing distance. (Note: capacitive sensors cannot sense through metals.) Dust and moisture in the atmosphere have less effect on unshielded sensors than on shielded models.

Grounding

Targets should be grounded for most reliable sensing. If a ground path to the target is not available, shielded sensors are recommended. When attempting to detect nonconductive materials with an unshielded sensor, a path to ground is required.

Dielectric Constants

The dielectric constant is one of the material properties of a target. Materials with higher dielectric constants are more easily detected by capacitive sensors and are therefore detected at greater sensing distances than those with low constants. See page 4 for a list of common industrial materials and their dielectric constants.

Correction Factors

Correction factors are multipliers which are determined by a target's mass, material, and grounding state. To calculate an approximate sensing distance for an application, multiply the nominal sensing distance S_n by the correction factor for that application's target. The table below shows some typical correction factors.

Correction Factors for Common Materials

Grounded metals	1.0
Ungrounded metals	0.85
Water	1.0
Glass	0.55
Paper (1 ream, 500 sheets)	0.55
Wood	0.45
Stone	0.65
Ceramic tile	0.25
PVC	0.15

Environmental Factors

Capacitive sensors can be compromised by humidity as well as moisture on the sensor's face. Oil or water droplets on the sensor face can cause the unit to become unstable. Dust and moisture in the atmosphere have less of an effect on unshielded sensors than on shielded models.

Mounting Considerations

The control must be securely mounted on a firm, stable surface or support. A mounting configuration which is unstable or subject to excessive vibration may cause intermittent operation.

Shielded vs. Unshielded

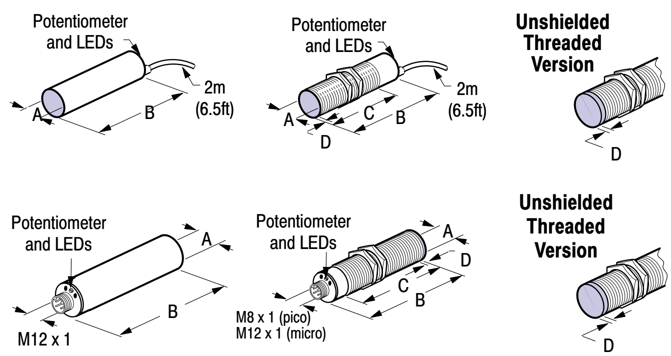
Shielded sensors can be mounted flush with surrounding materials. Unshielded sensors must be mounted such that the area around the sensing face is free of any material which could trigger the sensor. Minimum clearance in all directions should be equal to the diameter or width of the sensor.

Spacing Between Devices

When two shielded or unshielded sensors are facing each other, they must be mounted far apart to avoid interference. Minimum spacing should be eight times the housing diameter or width. When two *shielded* sensors are mounted side by side, the minimum distance between them must be greater than one diameter or width. When two *unshielded* sensors are mounted side by side, the distance between them should be at least four times their diameter or width. See Dimensions section for housing sizes.

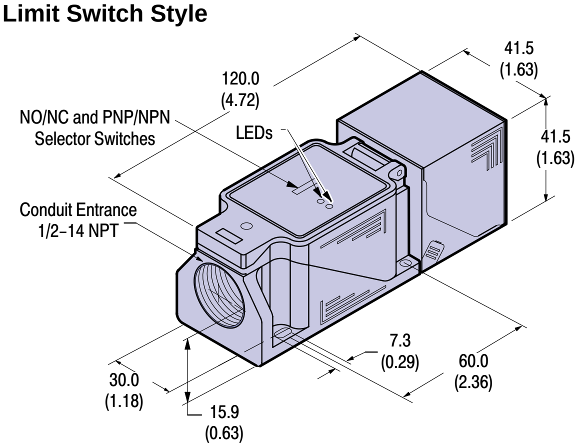
Dimensions

Cylindrical Style



Thread	Shld	Conn.	mm(inches)			
			A	B	C	D
M12x1	Y	cable	12(0.47)	61.5(2.42)	40.5(1.59)	N/A
M12x1	Y	pico	12(0.47)	63.5(2.50)	40.5(1.59)	N/A
M18x1	Y	cable	18(0.71)	81.7(3.22)	60.7(2.39)	N/A
M18x1	Y	pico	18(0.71)	81.7(3.22)	60.7(2.39)	N/A
M18x1	N	cable	18(0.71)	81(3.19)	60(2.36)	20(0.79)
M18x1	N	pico	18(0.71)	81(3.19)	60(2.36)	20(0.79)
M30x1.5	Y	cable	30(1.18)	82(3.23)	61(2.40)	N/A
M30x1.5	Y	micro	30(1.18)	82(3.23)	61(2.40)	N/A
M30x1.5	N	cable	30(1.18)	80.5(3.17)	59(2.32)	20(0.79)
M30x1.5	N	micro	30(1.18)	80.5(3.17)	59(2.32)	20(0.79)
N/A	N	cable	34(1.34)	85(3.35)	N/A	N/A
N/A	N	micro	34(1.34)	82(3.23)	N/A	N/A

Limit Switch Style



Note: Head can be rotated in 15° increments to provide 24 side-sensing positions or rotated for top sensing.

Dielectric Constants of Industrial Materials

This is a partial listing only. For more information, refer to the *CRC Handbook of Chemistry and Physics* (CRC Press), the *CRC Handbook of Tables for Applied Engineering Science* (CRC Press), or other applicable sources.

Acetone	19.5
Acrylic Resin	2.7–4.5
Air	1.000264
Alcohol	25.8
Ammonia	15–25
Aniline	6.9
Aqueous Solutions	50–80
Bakelite	3.6
Benzene	2.3
Carbon Dioxide	1.000985
Carbon Tetrachloride	2.2
Celluloid	3.0
Cement Powder	4.0
Cereal	3–5
Chlorine Liquid	2.0
Ebonite	2.7–2.9
Epoxy Resin	2.5–6
Ethanol	24
Ethylene Glycol	38.7
Fired Ash	1.5–1.7
Flour	1.5–1.7
Freon R22 & 502 (liquid)	6.11
Gasoline	2.2
Glass	3.7–10
Glycerine	47
Marble	8.0–8.5
Melamine Resin	4.7–10.2
Mica	5.7–6.7
Nitrobenzine	36
Nylon	4–5
Oil Saturated Paper	4.0
Paraffin	1.9–2.5
Paper	1.6–2.6
Perspex	3.2–3.5
Petroleum	2.0–2.2
Phenol Resin	4–12
Polyacetal	3.6–3.7
Polyamide	5.0
Polyester Resin	2.8–8.1
Polyethylene	2.3
Polypropylene	2.0–2.3
Polystyrene	3.0
Polyvinyl Chloride Resin	2.8–3.1
Porcelain	4.4–7
Powdered Milk	3.5–4
Press Board	2–5
Quartz Glass	3.7
Rubber	2.5–35
Salt	6.0
Sand	3–5
Shellac	2.5–4.7
Shell Lime	1.2
Silicon Varnish	2.8–3.3
Soybean Oil	2.9–3.5
Styrene Resin	2.3–3.4
Sugar	3.0
Sulphur	3.4
Teflon	2.0
Toluene	2.3
Transformer Oil	2.2
Turpentine Oil	2.2
Urea Resin	5–8
Vaseline	2.2–2.9
Water	80
Wood, Dry	2–7
Wood, Wet	10–30

Capacitive Proximity Sensor Accessories

Mating Cables

The following are straight connector, 2-meter cables. Refer to sensor catalog for other types.

AC Micro-Connector	871A–CS3–R2
DC Micro-Connector	871A–CS4–D2
DC Pico-Connector	871A–CS3–P2

Mounting Wells

12mm Delrin w/external thread	871A–WTD12
12mm Teflon w/external thread	871A–WTT12
18mm Delrin w/external thread	871A–WTD18
18mm Teflon w/external thread	871A–WTT18
30mm Delrin w/external thread	871A–WTD30
30mm Teflon w/external thread	871A–WTT30
30mm polyethylene, bolt-on type	871A–WSPE30
34mm Delrin w/external thread	871A–WTD34
34mm Teflon w/external thread	871A–WTT34

Mounting Brackets

Spring Return, stainless steel	
12mm	871A–BXS12
18mm	871A–BXS18
30mm	871A–BXS30
Spring Return, anodized aluminum	
12mm	871A–BXN12
18mm	871A–BXN18
30mm	871A–BXN30
Right Angle, stainless steel	
12mm	871A–BRS12
12mm w/spring return bracket	871A–BRS22
18mm	871A–BRS18
18mm w/spring return bracket	871A–BRS30
30mm	871A–BRS30
30mm w/spring return bracket	871A–BRS47
Right Angle, nickel-plated brass	
12mm	871A–BRN12
12mm w/spring return bracket	871A–BRN22
18mm	871A–BRN18
18mm w/spring return bracket	871A–BRN30
30mm	871A–BRN30
30mm w/spring return bracket	871A–BRN47
Clamp, plastic	
12mm	871A–BP12
18mm	871A–BP18
30mm	871A–BP30
34mm	871A–BP34
Swivel/Tilt, plastic	
30mm	60–2439

End Caps, plastic (unshielded models only)

12mm	871A–KP12
18mm	871A–KP18
30mm	871A–KP30

Conduit Adaptors, nickel-plated brass

12mm	871C–N13
18mm	871C–N19
30mm	871C–N31

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