Installation Instructions
Bulletin 873P Programmable Ultrasonic Proximity Sensor

IMPORTANT: Save these instructions for future use.

IMPORTANT: 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 sensor 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.

Description

Bulletin 873P Programmable Ultrasonic Sensors are self-contained solid-state devices designed for noncontact sensing of solid and liquid objects.

These sensors have two programmable setpoints with sourcing (PNP) outputs that can be configured for either normally open or normally closed operation. The setpoints can be programmed to switch the discrete output at any target position within the sensor's range. In addition, they also feature either a 4–20mA or 0–10V DC analog output depending on the model. The slope of the analog output is scaled between the limits of the setpoint values.

Programming of the setpoints and the output configuration is done using the setup pushbutton on the rear of the housing. These devices can be useful for many applications including: level control, diameter measurement, distance measurement, and presence detection.

873P Programmable Models

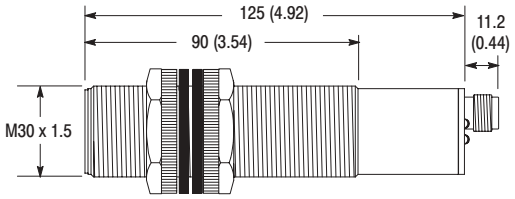
Sensing Range—mm (inches)	Output Configuration	Catalog Number
150 to 1500 (5.98 to 59.10)	2 PNP (NO or NC) with 4–20mA	**873P–DCAC1S–D5**
350 to 3500 (13.78 to 137.80)		**873P–DCAC2S–D5**
150 to 1500 (5.98 to 59.10)	2 PNP (NO or NC) with 0 – 10V DC	**873P–DCAV1S–D5**
350 to 3500 (13.78 to 137.80)		**873P–DCAV2S–D5**

Specifications

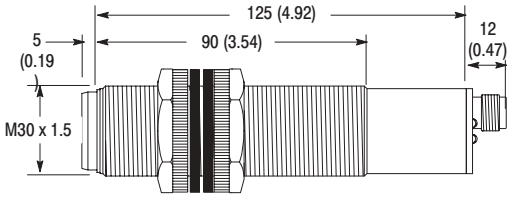
Output Configuration	Two discrete PNP (Programmable N.O./N.C.) Analog Current: 4–20mA Analog Voltage: 0–10V DC
Load Current	<100mA (Open collector)
Leakage Current	<0.5mA
Current Consumption	<45mA
Operating Voltage	19 to 30V DC
Voltage Drop	<5V DC
Repeatability	0.4%
Hysteresis	1% typical
Linearity	± 0.5%
Ultrasonic Frequency	130, 200kHz
Ultrasonic Beam Angle	8°
Short Circuit Protection	Incorporated
Overload Protection	Incorporated
False Pulse Protection	Incorporated
Transient Noise Protection	Incorporated
Reverse Polarity Protection	Incorporated
Approvals	cULus listed and CE marked for all applicable directives
Housing Material	Plastic – PBT
Enclosure Rating	IP67
Connection	Micro quick-disconnect
Output LED	Yellow: (2) P1, P2 output; Green: Alignment/echo
Adjustment	Via setup pushbutton
Operating Temperature	–15 to 70°C (5 to 158°F)
Shock	30g, 11ms
Vibration	55Hz, 1mm amplitude, 3 planes

Dimensions—mm (inches)

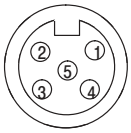
1500mm



3500mm

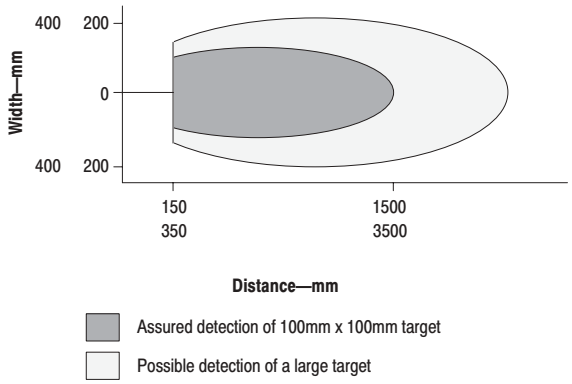


Wiring Diagram

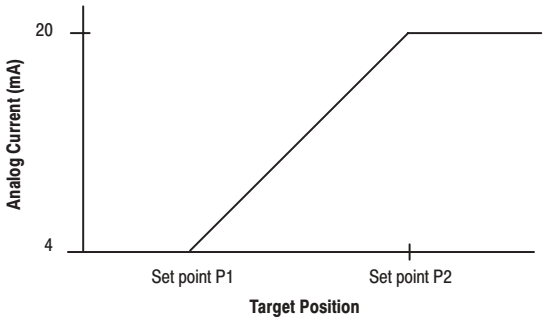


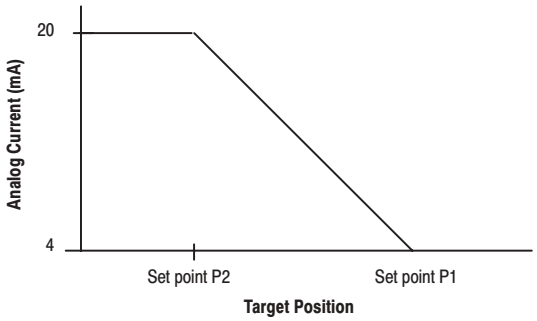
Pin	Function
1	19 to 30V DC Operating Voltage
2	Set point (P2)
3	0V DC
4	Set point (P1)
5	4–20mA or 0–10V DC (depending on model)

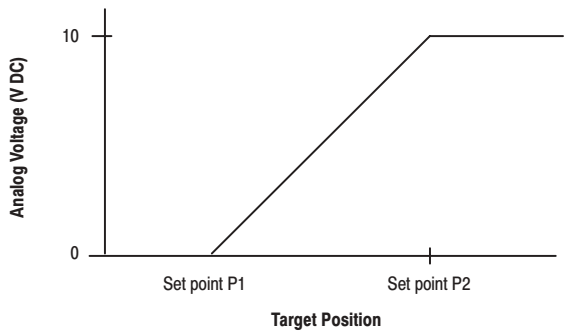
Beam Pattern

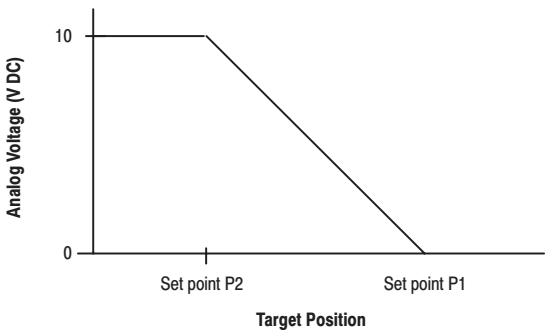


Analog Output







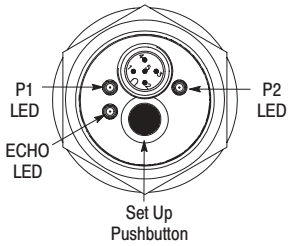


Programming

These sensors will require programming using the pushbutton at the rear of the sensor.

- Setpoint P1 indicator is the yellow P1 LED
- Setpoint P2 indicator is the yellow P2 LED
- Echo/Alignment indicator is the green LED and indicates that the sensor is receiving the proper signal from a target.

Connector View



- Setpoint (P1) corresponds to the 0V DC or 4mA analog output for Pin 5.
- Setpoint (P2) corresponds to the 10V DC or 20mA analog output for Pin 5.
- The analog output can be programmed with either a positive or negative slope depending on the position of these setpoints. For a positive slope setpoint P1 will be closer to the sensor than setpoint P2. For a negative slope setpoint P2 will be closer than setpoint P1.
- See the Analog Output graphs for details.
  - **Setpoint (P1)**—To set P1 depress the pushbutton until the P1 and Echo LEDs are blinking simultaneously. (See the pushbutton set time chart for the approximate duration the pushbutton should be depressed).
  - Release the pushbutton for setpoint P1 programming mode. After release, the yellow P1 LED should be blinking slowly.
  - Place the target at the P1 position and depress the pushbutton to program the P1 switchpoint. The output can be set for normally open or normally closed operation. For a normally open output depress with the P1 LED “ON”; for a normally closed output depress with the P1 LED “OFF.”
  - **Setpoint (P2)**—To set P2 depress the pushbutton until the P2 and Echo LEDs are blinking alternately. Note that the P1 and Echo LEDs will start blinking first and then the P2 and Echo LED will start blinking. (See the pushbutton set time chart for the approximate duration the pushbutton should be depressed.)
  - Release the pushbutton for setpoint P2 programming mode while the P2 and Echo LEDs are blinking. After release the yellow P2 LED should be blinking slowly.
  - Place the target at the P2 position and depress the pushbutton to set the P2 switchpoint. For a normally open output depress with the P2 LED “ON”; for a normally closed output depress with the P2 LED “OFF.”

	Pushbutton Set Time (Seconds)	
Model	**Setpoint (P1)**	**Setpoint (P2)**
873P–DCAV1S–D5	8	12
873P–DCAC1S–D5	8	12
873P–DCAV2S–D5	17	21
873P–DCAC2S–D5	17	21

Notes:

1. You have approximately one minute to set either P1 or P2 once you are in the programming mode. After one minute the sensor will exit the programming mode.
2. After the setpoints have been programmed into the sensor, they are stored in the sensor memory (EEPROM). Loss of power will NOT cause the sensor to lose these setpoints.
3. To change the setpoint distances after they have been programmed requires reprogramming the sensor. Reprogramming each set point can be done independent of the other.
4. The setpoints can be programmed in any order.

Operation Principle

Ultrasonic sensors utilize a transducer that emits bursts of high frequency sound waves in a cone shaped beam pattern. These pulses are reflected or “echoed” from the target back to the sensor and detected by the transducer. The device determines the distance from the sensor to the target by measuring the length of time for this echo to return. Programmable models have three outputs. The two discrete outputs compare this duration to that of the near and far limits as programmed by the user via the pushbutton. The sensor outputs are switched at these limits based on the time duration to receive the echo. The analog output converts the time value to a DC current or voltage (depending on the model) that is scaled between the switchpoints. There is an unusable area, or deadband, directly in front of the sensor since there is a necessary time interval between transmission and detection of the soundwave by the transducer. This is the minimum distance at which the target can be detected.

Sensing Distance

Bulletin 873P programmable ultrasonic sensors are available with the following sensing ranges: 150–1500mm and 350–3500mm. The sensing ranges are determined using an industry standard 100mm x 100mm flat steel target.

Target Considerations

Since the actual sensing distance to an object depends on a reflected sound wave, target material, shape, size, temperature, and position will influence operation; it is possible that the sensing distance can be reduced or the target may not be detected based on these characteristics. The ideal target is a smooth, flat surface. Target material that is not relatively sound reflective (fabric, foam rubber, etc.) may be difficult to detect depending on the application. Rounded or uneven objects can also be detected, but the sensing distance may be reduced. For best performance, the sensor should be aligned such that the sensor face is parallel to the target surface.

Environmental Factors

The velocity of sound in air is dependent upon temperature (sound waves travel faster at higher temperatures). Bulletin 873P ultrasonic sensors have internal temperature compensation to adjust the ultrasonic frequency to compensate for these changes in the ambient air temperature. However, while this feature does compensate for ambient temperature changes, temperature variations within the sensing range due to convection currents, heating/cooling elements, etc., may still divert or refract the sound wave and adversely affect sensor performance. Strong air turbulence can also influence the signal and adversely affect the stability and overall sensor operation. Humidity does not significantly affect ultrasonic sensor operation, but changes in humidity can have a slight affect in some instances due to the absorption of sound.

Mounting Considerations

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

A mounting location should be chosen such that the sensor faces directly toward the target's surface (perpendicular to the barrel axis of the sensor).

When using more than one 873P there is a potential for cross-talk (mutual interference) between the sensors. As a result, consideration should be given to the sensor spacing. See the beam pattern chart for the minimum acceptable distance between sensors that are mounted side by side. When the sensors must be mounted facing each other they should be separated by a distance at least four times the maximum sensing range for the model.

Background Suppression

The setpoint limits for the programmable sensor models can be set up to detect a target in a defined range within the sensor specifications. This includes the capability to ignore all objects beyond a specified distance (background suppression). The far limit of the sensing range can be adjusted to detect valid targets and ignore background targets such as the side of a conveyor.

Profile Reduction Beam Deflectors

Beam deflectors are available to reduce the mounting profile for applications that cannot accommodate the barrel length of the sensor. They can also be used to protect the sensor face from target collisions. These accessories deflect the ultrasonic beam at 90° and are available in plastic and stainless steel versions. In addition to the profile reduction, the stainless steel models provide mounting capability and also focus the ultrasonic beam.

Catalog Number	Description
60–2758	Stainless Steel beam deflector and mounting bracket for 30mm models
60–2760	Plastic beam deflector for 30mm models

Stilling Tubes

For applications where the target may be a liquid with a turbulent surface, a stilling tube can be used to diminish this instability. The tube should have a smooth inner diameter and its size should be a minimum of 50mm depending on the application. The sensor should be mounted such that the barrel is parallel to the sides of the tube but not touching.

Allen-Bradley

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