

Model SM606 Series



DeviceNet™

One tough little prox with an analog output

It is one of the smallest, fastest, most repeatable, analog sensors in the business. The SUPERPROX® Model SM606 series of analog sensors, incorporating the world's leading ultrasonic technology, offers reliable measurement and control of materials with fixed span limits within sensing ranges up to 254 mm (10"). These sensors continuously monitor the distance to an object and generate either a directly proportional or inversely proportional 0 to 10 volt or 4-20 mA output. The sensors detect objects of all colors and materials as small as 1.59 mm (0.0625") diameter, transparent or opaque, liquid or solid. The narrow 7° sonic beam allows the sensor to accurately detect levels in containers with openings as small as 9.52 mm (0.375").

With a response rate as fast as 2.0 ms on the 102 mm range model, the high resolution SM606 series sensors are capable of detecting rapidly changing object positions as small as 0.686 mm (0.027") at the rate of 667 samples per second. Typi-

cal applications include the checking and controlling of fluid levels, measuring speed and position of an object moving on a slide at rates in excess of 50 feet per second, and controlling a web of paper or fabric. Higher gain models can detect very thin materials like thread and wire.

The 18 mm barrel housing sensor is available in either ULTEM® plastic (standard) or SS303 stainless steel. The flat-profile housing is available in ULTEM® plastic only. The sensors are sealed to withstand dusty, dirty, clean-in-place, 100% humidity, high-pressure, and washdown environments.

For sensing applications requiring connection to a DeviceNet network, the flat-profile models in this series are available with this capability as an optional selection.

Operating on 15 to 24 VDC, the 500 kHz barrel housing/cable style sensors are equipped with an amber LED; the barrel housing/connector style sensors have two LEDs: amber and green. The flat-profile sensors, in both cable and connector style, have an amber LED. The amber LED increases in intensity as output voltage increases. The green LED indicates

SUPERPROX® Ultrasonic Analog Output Sensors

- **High repeatability**
500 kHz ultrasonic frequency
- **Fast response** - as fast as 2.0 ms sampling rate
- **Self-contained**, 18 mm barrel or flat-profile housing styles
- **Field programmable capability** in 18 mm and flat-profile models
- **DeviceNet capability available** in flat-profile models

• CE certified

power is being supplied. With protection ratings of NEMA 4X (indoor use only) and IP67, the sensors resist most acids and bases, including most food products. The transducer face is made of silicone rubber.

Operation

The Model SM606 series is a self-contained, pulse-echo device that both transmits and receives sonic energy within its programmed sensing range. These sensors use the latest ultrasonic technology with a discriminating microprocessor that

allows the sensor to ignore all surrounding sonic interference and detect only the designated object. When an object is within the fixed analog sensing span, the analog output changes proportionally in relation to the analog sensing span limits. For example, if the object is halfway between the analog span limits, the output is 5 volts.

As shown below, Hyde Park offers both direct and inverse proportional analog output models for continuous sensing applications.

How does it work?

During setup and operation, these SM606 series sensors continually and accurately measure the elapsed time of every pulse echo reception between each pulse transmission. The transmitted pulse begins a time clock to register the elapsed times for the received pulse echoes. Given the elapsed time, the sensor software calculates the distance traveled out to the object and back to the sensor, using the formula, $D = TVs/2$, where: D = distance from the sensor to the object; T = elapsed time between the pulse transmission and its echo receptions; Vs = the velocity of sound, approximately 1100 feet per second.

During operation, the calculated distance (D) between the sensor and the object is compared to the distances between the sensor and the fixed span limits. These limits are shown in the illustration at right as D_{wi} and D_{wo} . If D is at or within the fixed span limits, an output value for D , relative to the analog sensing span limits, is generated.

Model Reference Guide - SM606 Series

Use the guide below to ensure the correct model number is specified for the application. Please note that not all sensor model combinations are available.

EXAMPLE MODEL:

SM606A-448-00S

Ultrasonic Miniature Proximity Series

0...15 to 24 VDC / cable style

5...15 to 24 VDC / "micro" connector style

Sensing Function

6...Analog

Design Level

A...Applies to all models

Sensing Range (Far Limit)

1 to 9...inches, not in fractions

B...254 mm (10")

Sensing Span (Distance from Far Limit to Near Limit)**

08...13 mm (1/2")

16...25 mm (1")

32...51 mm (2")

48...77 mm (3")

80...127 mm (5")

96...152 mm (6")

OB...203 mm (8")

Output Configuration (4-20 mA must be in flat-profile model)

00...Inverse 0 to 10 volts

01...Direct 0 to 10 volts

03...Inverse 0 to 10 volts, loss of echo signal hold

06...Direct 0 to 10 volts, loss of echo signal hold

10...Inverse 4 - 20mA

11...Direct 4 - 20 mA

13...Inverse 4 - 20mA, loss of echo signal hold

16...Direct 4 - 20 mA loss of echo signal hold

Options

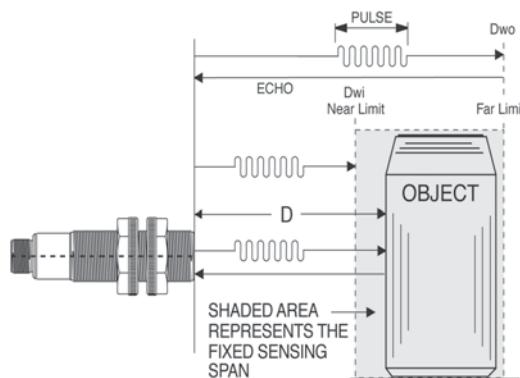
Contact factory for available options

Housing Types

...No letter indicates standard ULTEM® - 18 mm barrel housing

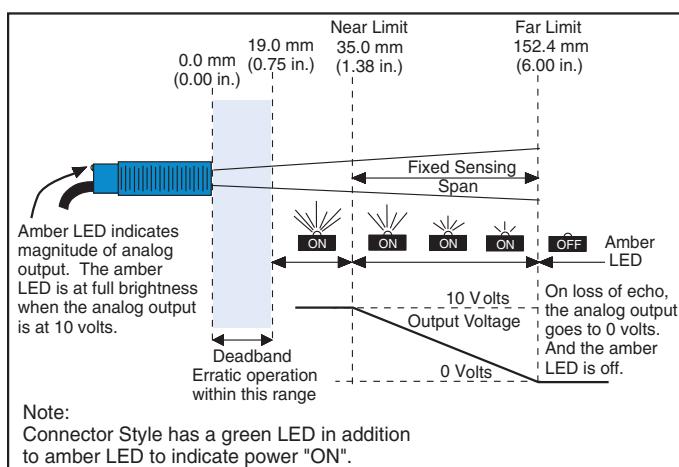
FP...ULTEM® flat-profile housing

Field-configurable and **DeviceNet** Model Reference Guides start on page 4-145.



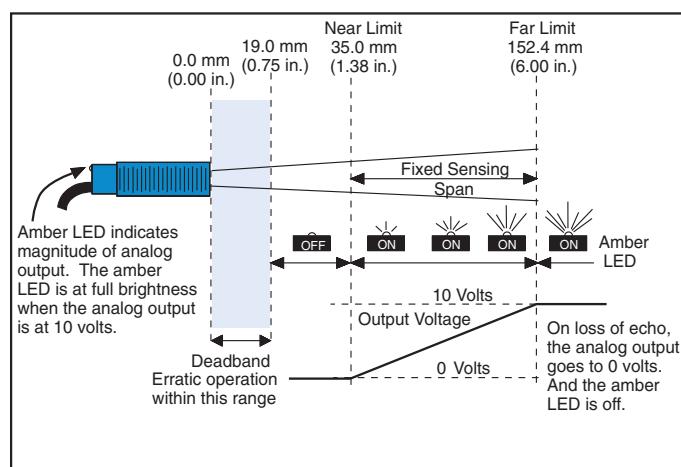
Direct Proportional Output

The analog signal value increases as the object moves closer to the near span limit.



Inverse Proportional Output

The analog signal value decreases as the object moves closer to the near span limit.



* Note: 4-20mA out put identical in Flat-Pack only.

** Available only in 102 mm (4") range models.

** Not allowed inside the deadband. Deadband is 0.75" for ranges < 7" and 1.25" for ranges > 7"

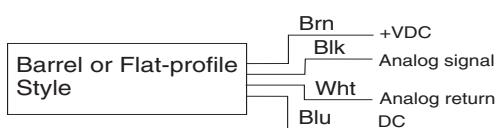
Loss of Echo Signal Hold Output Configuration

The sensor model with this configuration makes it possible, upon loss of echo signals, to hold at the analog signal value of the last echo received. When the sensor again receives echoes within its sensing range, the analog signal is updated to a value indicating the object's position at that moment relative to the span limits.

Electrical Wiring

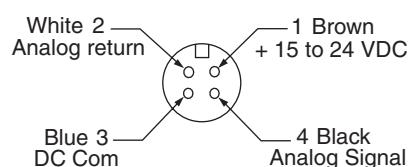
The sensor wires must be run in conduit free of any AC power or control wires.

Cable Style Model Wire Assignments

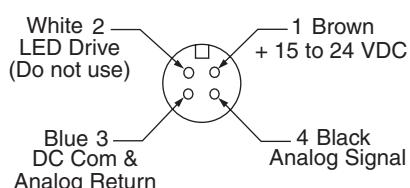


Connector Style Model Pin Assignments

"Flat-profile" style



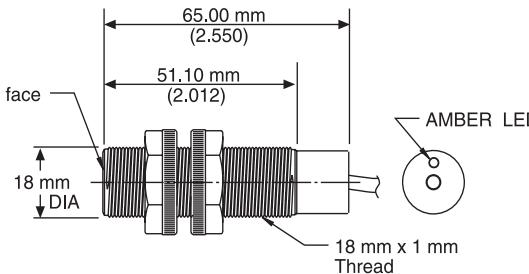
Barrel style



Dimensions

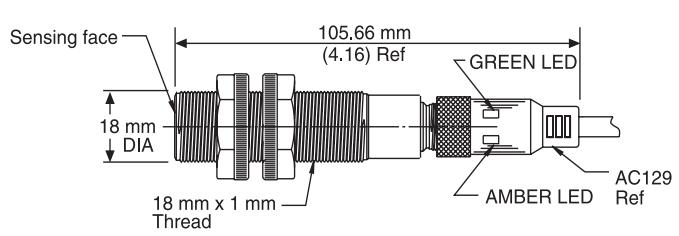
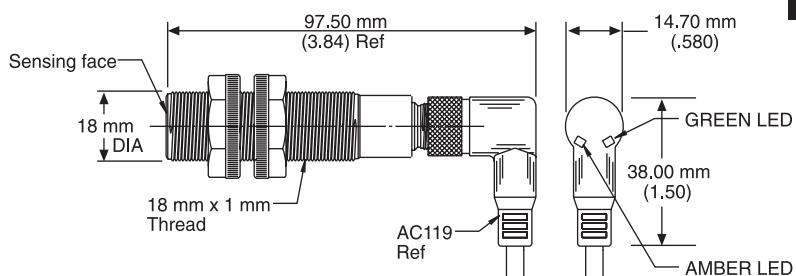
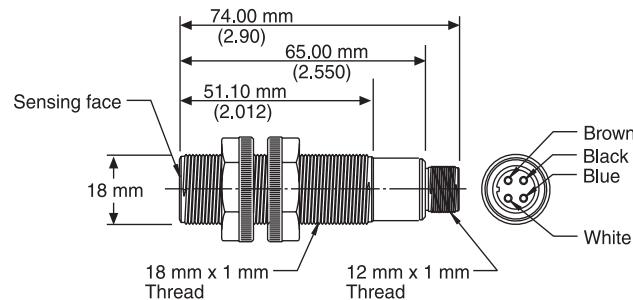
Barrel Cable Style

(ULTEM® plastic and stainless steel)
SM606A-444-XX, SM606A-444-XXS, SM606A-674-XX, SM606A-674-XXS



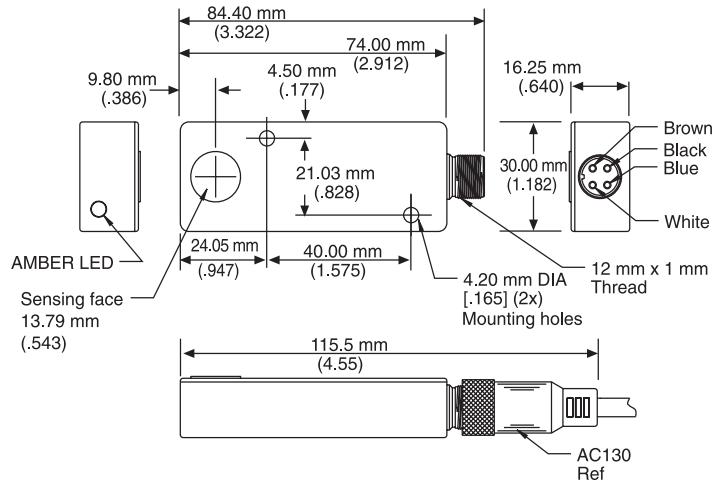
Barrel Connector Style

(ULTEM® plastic and stainless steel)
SM656A-444-XX, SM656A-444-XXS, SM656A-674-XX, SM656A-674-XXS

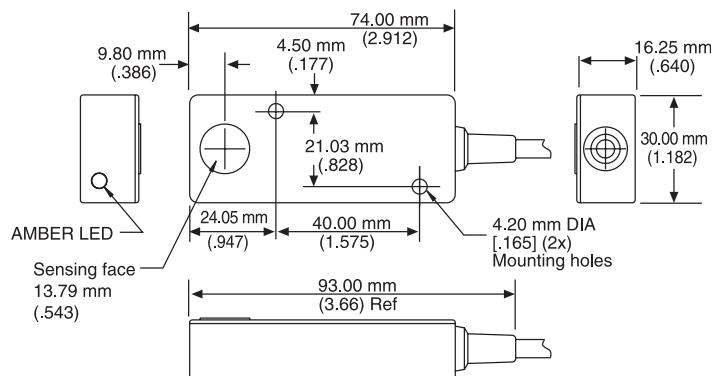


Dimensions

“Flat-profile” Connector Style (ULTEM® plastic)
SM656A-444-XXFP, 656A-674-XXFP

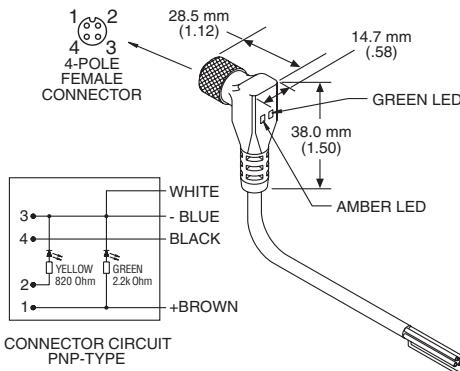


“Flat-profile” Cable Style (ULTEM® plastic)
SM606A-444-XXFP, 606A-674-XXFP

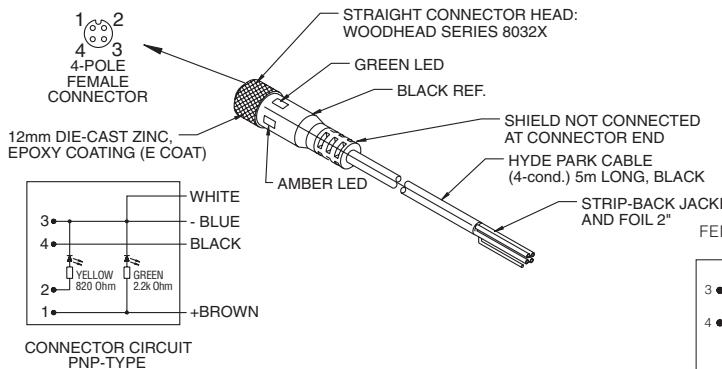


Mounting Accessories

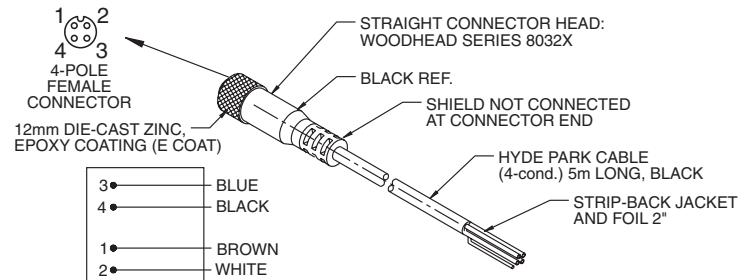
AC119 Right-angle, M12 micro, 4-conductor, connector/cable assembly, 5 m (16'), with built-in LEDs (for barrel connector-style sensors)



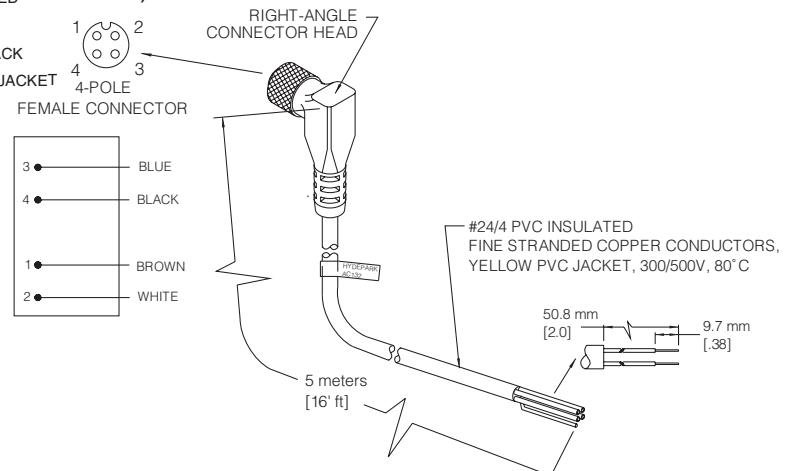
AC129 Straight, M12 micro, 4-conductor, connector/cable assembly, 5 m (16'), with built-in LEDs (for barrel connector-style sensors)



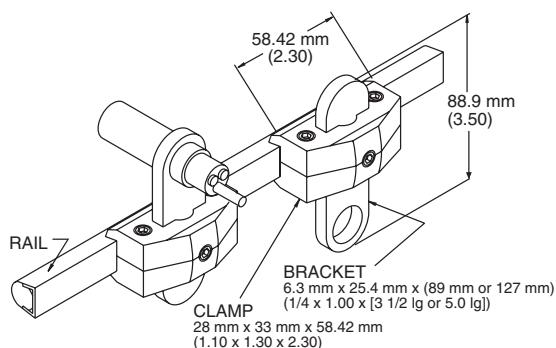
AC130 Straight, M12 micro, 4-conductor, connector/cable assembly, 5 m (16') (for flat-profile connector-style sensors)



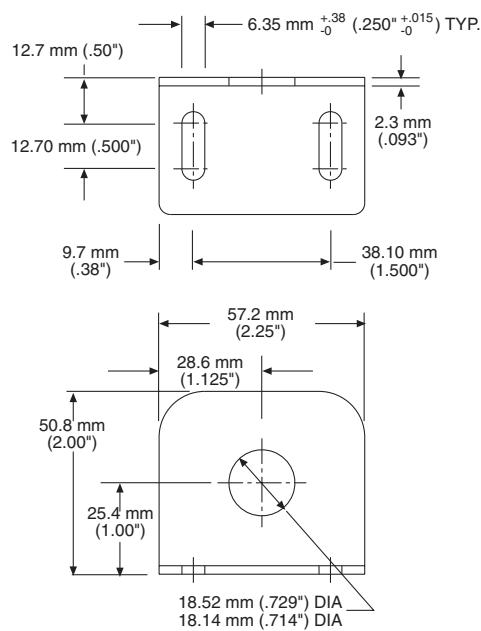
AC132 Right-angle, M12 micro, 4-conductor, connector/cable assembly, 5 m (16') (for flat-profile connector-style sensors)



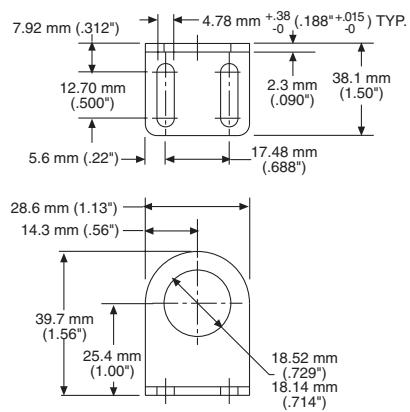
AC226 Stainless and polyamide conveyor-rail clamp/bracket set (for 18 mm barrel sensors)



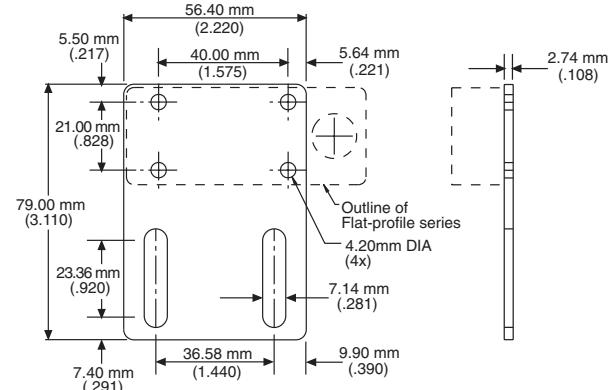
AC227 Large, right-angle, stainless, mounting bracket (for 18 mm barrel sensors)



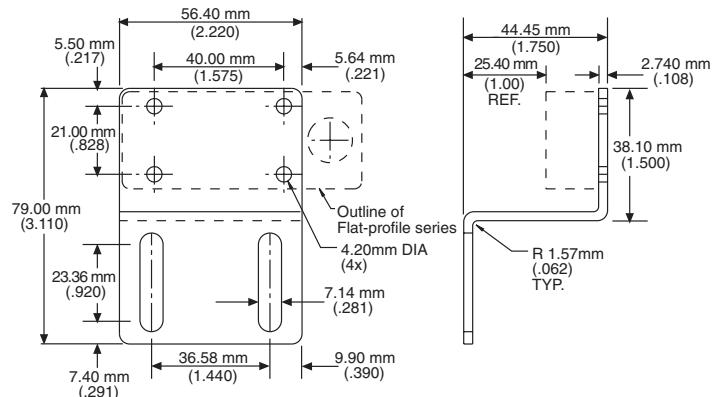
AC228 Small, right-angle, stainless, mounting bracket (for 18 mm barrel sensors)



AC231 Straight, stainless mounting bracket (for flat-profile sensors)



AC232 S-shaped, stainless mounting bracket (for flat-profile sensors)



General Specifications

Sensing

Ranges:
Up to 254 mm (10")
Spans:
From 3.18 mm (1/8") to 228.6 mm (9")
Detection Benchmarks:
Models with Ranges to 177.8 mm (7"):
1.59 mm (1/6") diameter rod at a distance of 63.5 mm (2.5")
Max. $\pm 10^\circ$ tilt of large flat object at a distance of 127 mm (5")
Models with Ranges from over 177.8 mm (7") to 254 mm (10"):
1.59 mm (1/6") diameter rod at a distance of 76.2 mm (3")
Max. $\pm 10^\circ$ tilt of large flat object at a distance of 203.2 mm (8")
Position Sensing @ 20°C
Resolution, Position:
Voltage Model span/1023
Current Model span/818
but never less than 0.043 mm (0.0017") for either type
Resolution, Output:
Voltage Model 9.775mV
Current Model 15.6uA
Window Edge Position (either edge):
Error, maximum ± 1.57 mm (0.062")
Repeatability, max. error ± 0.381 mm (0.015")
Zero Offset:
Voltage Model $+18mV/-11mV$
Current Model 4mA $+0.11mA/-0.141mA$
Full Scale Offset, maximum:
Voltage Model $\pm 43mV$
Current Model $+0.147mA/-0.300mA$
Slope Error, maximum: 0.59% of Span (1% to 99% of Span)
Non-linearity, maximum: 0.76 mm (.030")
Temperature Compensation: -20° to 60°C
Position Error Due to Temperature Shift:
 ± 01.59 mm (0.062")
Sonic Frequency: 500 kHz
Sonic Cone Angle: 7° (see beam plot, page 4-72)
Sensing Bandwidth (sinusoidal oscillation): 50 Hz

Power Requirements

Supply Voltage: 15 VDC to 24 VDC $\pm 10\%$, regulated supply
Current Consumption: 50 mA max. (excluding load)
Power Consumption: 1.2 W max. (excluding load)

Output

Voltage Model
Range: 0-10 VDC
Min. Load Resistance: 1000 Ohms
Current Model (flat-profile only)
Range: 4-20 mA (0-20 mA optional)
Load Resistance: 0.1 to 350 Ohms

Response Time

2.5 ms (Standard)
2.0 ms (Optional)

Indicators

Green LED (connector model only): power
Amber LED (connector & cable models):
intensity increases as output voltage increases

Connections

Cable Style Models:
24 AWG, foil shield, lead-free, PVC jacketed, 4-conductor, 3 meters (10') long
Connector Style Models:
4-pin, 12 mm "micro" style
LEDs not built into this sensor. Must use AC119 right-angle mating connector with built-in LEDs.
No other mating connector cable may be substituted due to unique LED circuit impedance.

Protection

Power Supply: current-limited over-voltage, ESD, reverse polarity
Outputs: current-limited over-voltage, ESD, over-current

Environmental

Operating Temperature Range:
0° to 60°C @ 15 VDC supply
0° to 50°C @ 24 VDC supply
Storage Temperature Range: -40° to 100°C (-40° to 212°F)
Operating Humidity: 100%
Protection Ratings: NEMA 4X (indoor use only), IP67
Chemical Resistance: Resists most acids and bases, including most food products.

Agency Approvals

CE Mark: CE conformity is declared to:
EN61326:1997 (annex A, industrial) including amendment A1:1998. EN55011 Group1 Class A.
Declaration of Conformity available upon request

Construction

Dimensions:
Barrel
Cable Model: 18 mm dia. x 1 mm threaded housing x 65 mm (2.55") long
Connector Model: 18 mm dia. x 1 mm threaded housing x 102 mm (4") long, including connector/cable assembly

Flat-profile

Cable Model: 30 mm (1.182") H x 16.25 mm (0.640") W x 93 mm (3.66") L
Connector Model: 30 mm (1.182") H x 16.25 mm (0.640") W x 84.40 mm (3.322") L

Housing:

Shock and vibration resistant
Case: ULTEM® plastic (FDA Approved)
(SS303 stainless steel available only in 18 mm barrel-style)
Transducer Face: Silicone rubber - gray
Sensor Cables: Nontoxic PVC jacket, food grade
LED: Polycarbonate

* ULTEM® is a registered trademark of The General Electric Co.

Accessories

18mm Barrel Mounting Hardware and Cables

Model AC119, Right-angle, M12 micro, 4-conductor, connector/cable assembly, 5 m (16'), with built-in LED's for connector-style prox sensors

Model AC129, Straight, M12 micro, 4-conductor, connector/cable assembly, 5 m (16'), with built-in LED's for connector-style prox sensors

Model AC226, Stainless and polyamide conveyor-rail clamp/bracket set

Model AC227, Large, right-angle, stainless, mounting bracket

Model AC228, Small, right-angle, stainless, mounting bracket

Flat-profile Mounting Hardware and Cables

Model AC130, Straight, M12 micro, 4-conductor, connector/cable assembly, 5 m (16'), for flat profile, connector-style prox sensors

Model AC132, Right angle, M12 micro, 4-conductor, connector/cable assembly, 5 m (16'), for flat-profile, connector-style sensors

Model AC231, Straight, stainless, mounting bracket

Model AC232, S-shaped, stainless, mounting bracket

See page 7-1 for accessory photos.

Selection Chart

SM606 Series Analog Output

Model No.	15/24 VDC Power Version	Cable Connection	Connector Style	Sensing		Output Configuration	Materials		Notes
				Range	Span		Transducer	Housing	
SM606A-444-00•	■ ■			102mm (4")	70mm (2.75")	Inv.0-10V, 2.5ms cycle	■	■	
SM606A-444-00FP•	■ ■			102mm (4")	70mm (2.75")	Dir.0-10V, 2.5ms cycle	■	■	
SM606A-444-00S•	■ ■			102mm (4")	70mm (2.75")	Inv.0-10V, 1.5ms cycle	■	■	
SM606A-444-01	■ ■			102mm (4")	70mm (2.75")	Inv.0-10V, 2.5ms cycle	■	■	
SM606A-444-01FP	■ ■			102mm (4")	70mm (2.75")	Dir.0-10V, 1.5ms cycle	■	■	
SM606A-444-01S	■ ■			102mm (4")	70mm (2.75")	■	■	■	
SM606A-444-02	■ ■			102mm (4")	70mm (2.75")	■	■	■	
SM606A-444-02FP	■ ■			102mm (4")	70mm (2.75")	■	■	■	
SM606A-444-02S	■ ■			102mm (4")	70mm (2.75")	■	■	■	
SM606A-444-03	■ ■			102mm (4")	70mm (2.75")	■	■	■	Loss of echo signal hold
SM606A-444-03FP	■ ■			102mm (4")	70mm (2.75")	■	■	■	Loss of echo signal hold
SM606A-444-03S	■ ■			102mm (4")	70mm (2.75")	■	■	■	Loss of echo signal hold
SM606A-444-04	■ ■			102mm (4")	70mm (2.75")	■	■	■	
SM606A-444-04FP	■ ■			102mm (4")	70mm (2.75")	■	■	■	
SM606A-444-04S	■ ■			102mm (4")	70mm (2.75")	■	■	■	
SM606A-674-00•	■ ■			152mm (6")	117mm (4.62")	■	■	■	
SM606A-674-00FP•	■ ■			152mm (6")	117mm (4.62")	■	■	■	
SM606A-674-00S•	■ ■			152mm (6")	117mm (4.62")	■	■	■	
SM606A-674-01	■ ■			152mm (6")	117mm (4.62")	■	■	■	
SM606A-674-01FP	■ ■			152mm (6")	117mm (4.62")	■	■	■	
SM606A-674-01S	■ ■			152mm (6")	117mm (4.62")	■	■	■	
SM606A-674-02	■ ■			152mm (6")	117mm (4.62")	■	■	■	
SM606A-674-02FP	■ ■			152mm (6")	117mm (4.62")	■	■	■	
SM606A-674-02S	■ ■			152mm (6")	117mm (4.62")	■	■	■	
SM606A-674-03	■ ■			152mm (6")	117mm (4.62")	■	■	■	Loss of echo signal hold
SM606A-674-03FP	■ ■			152mm (6")	117mm (4.62")	■	■	■	Loss of echo signal hold
SM606A-674-03S	■ ■			152mm (6")	117mm (4.62")	■	■	■	Loss of echo signal hold
SM606A-674-04	■ ■			152mm (6")	117mm (4.62")	■	■	■	
SM606A-674-04FP	■ ■			152mm (6")	117mm (4.62")	■	■	■	
SM606A-674-04S	■ ■			152mm (6")	117mm (4.62")	■	■	■	
SM656A-444-00•	■ ■	■		102mm (4")	70mm (2.75")	■	■	■	
SM656A-444-00FP•	■ ■	■		102mm (4")	70mm (2.75")	■	■	■	
SM656A-444-00S•	■ ■	■		102mm (4")	70mm (2.75")	■	■	■	
SM656A-444-01	■ ■	■		102mm (4")	70mm (2.75")	■	■	■	
SM656A-444-01FP	■ ■	■		102mm (4")	70mm (2.75")	■	■	■	
SM656A-444-01S	■ ■	■		102mm (4")	70mm (2.75")	■	■	■	
SM656A-444-02	■ ■	■		102mm (4")	70mm (2.75")	■	■	■	
SM656A-444-02FP	■ ■	■		102mm (4")	70mm (2.75")	■	■	■	
SM656A-444-02S	■ ■	■		102mm (4")	70mm (2.75")	■	■	■	
SM656A-444-03	■ ■	■		102mm (4")	70mm (2.75")	■	■	■	Loss of echo signal hold
SM656A-444-03FP	■ ■	■		102mm (4")	70mm (2.75")	■	■	■	Loss of echo signal hold
SM656A-444-03S	■ ■	■		102mm (4")	70mm (2.75")	■	■	■	Loss of echo signal hold
SM656A-444-04	■ ■	■		102mm (4")	70mm (2.75")	■	■	■	
SM656A-444-04FP	■ ■	■		102mm (4")	70mm (2.75")	■	■	■	
SM656A-444-04S	■ ■	■		102mm (4")	70mm (2.75")	■	■	■	
SM656A-674-00•	■ ■	■		152mm (6")	117mm (4.62")	■	■	■	
SM656A-674-00FP•	■ ■	■		152mm (6")	117mm (4.62")	■	■	■	
SM656A-674-00S•	■ ■	■		152mm (6")	117mm (4.62")	■	■	■	
SM656A-674-01	■ ■	■		152mm (6")	117mm (4.62")	■	■	■	
SM656A-674-01FP	■ ■	■		152mm (6")	117mm (4.62")	■	■	■	
SM656A-674-01S	■ ■	■		152mm (6")	117mm (4.62")	■	■	■	
SM656A-674-02	■ ■	■		152mm (6")	117mm (4.62")	■	■	■	
SM656A-674-02FP	■ ■	■		152mm (6")	117mm (4.62")	■	■	■	
SM656A-674-02S	■ ■	■		152mm (6")	117mm (4.62")	■	■	■	
SM656A-674-03	■ ■	■		152mm (6")	117mm (4.62")	■	■	■	Loss of echo signal hold
SM656A-674-03FP	■ ■	■		152mm (6")	117mm (4.62")	■	■	■	Loss of echo signal hold
SM656A-674-03S	■ ■	■		152mm (6")	117mm (4.62")	■	■	■	Loss of echo signal hold
SM656A-674-04	■ ■	■		152mm (6")	117mm (4.62")	■	■	■	
SM656A-674-04FP	■ ■	■		152mm (6")	117mm (4.62")	■	■	■	
SM656A-674-04S	■ ■	■		152mm (6")	117mm (4.62")	■	■	■	

• = Most commonly stocked sensors * = See definition in Sensing Terms.
All possible sensor configurations are not listed here.