◆DATALOGIC

SENSORS

Ultrasonic sensors for high precision detection of clear and transparent objects

- Clear object detection, inspection on transparent or highly reflective film and liquid level measurement
- Standard M18 tubular and M18 right angle mounting
- 50...500 mm Background and Foreground Suppression
- Teach-in push button or remote input for distance range setting
- Auto-Window function
- Standard M12 4-pole connector and M12 5-pole connector
- PNP or NPN outputs for object detection and 0-10 V or 4-20 mA analog outputs for distance measure
- IP67, NEMA 6P-rated

APPLICATIONS

- Packaging machines
- Beverage & Bottling
- Automotive assembling line

US18		
Tubular		30...300 mm Analog model resolution: 0,5 mm (SLOW mode), 1 mm (FAST mode)
Right angle		50...500 mm Repeatibility: 0,7 mm
Power supply	Vdc	10...30 V (US18 tubular), 12...30 V (US18 right angle)
	Vac	
	Vac/dc	
Output	PNP	.
	NPN	.
	NPN/PNP	.
	relay	
	other	0...10 V, 4...20 mA Analog (US18 tubular)
Connection	cable	
	connector	.
	pig-tail	
Housing material		Plastic
Mechanical protection		IP67, NEMA 6-P

TECHNICAL DATA

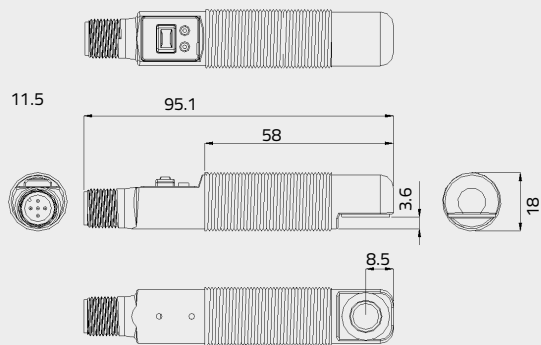|	US18-PA/PR-5-N03	US18-PL-5-N03
Operating distance	30…300 mm	50…500 mm
Housing Type	M18 tubular	M18 Right Angle
Power supply	10…30 Vdc	12…30 Vdc
Ripple	10% max.	
Current consumption	65 mA max.	25 mA max.
Output current	100 mA max.	
Output saturation voltage	1,6 V max.	3 V max.
Output	PNP and NPN 0…10 V or 4…20 mA analog output	PNP or NPN
Delay at powering	300 ms	
Response time	8 ms (NPN/PNP) 2,5 ms (Analog out. FAST mode) 30 ms (Analog out. SLOW mode)	15 ms
Switching frequency	62,5 Hz (NPN/PNP) 200 Hz (Analog out. FAST mode) 16 Hz (Analog out. SLOW mode)	32 Hz
Repeatability	0,5 mm	0,7 mm
Indicators	yellow/green OUTPUT LED red POWER LED	red/green RANGE LED yellow/red OUTPUT LED
Setting	Teach-in push-button or remote input	
Ultrasonic emission frequency	300 kHz	
Minimum detection window	5 mm	
Operating temperature	-25…+55 °C	-20…+60 °C
Vibration	0.5 mm amplitude, 10 … 55 Hz frequency, for every axis (EN60068-2-6)	
Shock resistance	11 ms (30 G) 6 shock for every axis (EN60068-2-27)	
Housing material	thermoplastic polyester	ABS
Protection class	IP67, NEMA 6-P rated	
Connections	M12 5-pole connector	M12 4-pole connector

DIMENSIONS
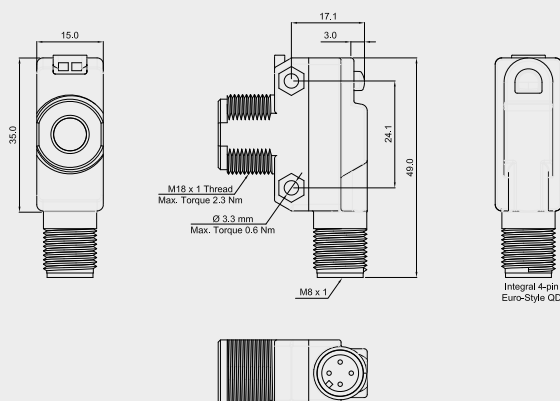
M18 Tubular

AXIAL VERSION - US18 PA-5-N03-XX
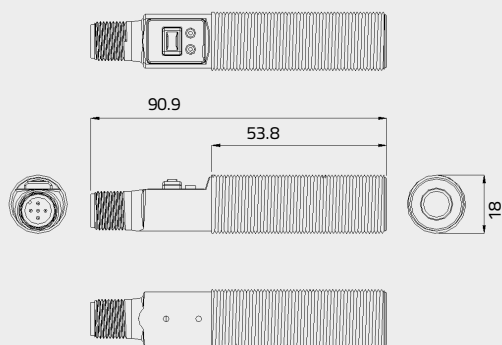
RADIAL VERSION - US18 PR-5-N03-XX

M18 Right Angle
US18 PL-5-N03-NH/PH

M18 x 1 Thread
Max. Torque 2.3 Nm
Ø 3.3 mm
Max. Torque 0.6 Nm

M8 x 1

Integral 4-pin
Euro-Style QD

mm

Ultrasonic Sensors – US18

◇ DATALOGIC

MAIN FEATURES

The US18 ultrasonic sensors detection is indipendent from the target color, reflectivity and transparency, making them suitable for critical material applications.

The US18 series is designed to withstand hostile enviroments. IP67 and NEMA 6-P rated guarantee protection against water, dust, oil or coolant, enabling either indoor or outdoor use.

PRINCIPLES OF OPERATION

Ultrasonic sensors emit one or multiple pulses of high frequency energy which travel through the air at the speed of sound. The sensor detects an object when a portion of this energy is reflected by the target and travels back to the sensor.

The sensor measures the total time required for the energy to reach the target and return to the sensor and the distance to the object is then calculated using the following formula

$$D = vt/2$$

D = distance from the sensor to the target

v = speed of sound in air

t = transit time for the ultrasonic pulse

The Ultrasonic technology is very precise and repeatable for detecting object but, the presence of very intense electromagnetic field and poor electric machine layout could affect the correct detection functionality.

TEMPERATURE COMPENSATION

The speed of sound is dependent upon the composition, pressure and temperature of the gas in which it is travelling. For most ultrasonic applications, the composition and pressure of the gas are relatively fixed, while the temperature may fluctuate.

Changes in air temperature affect the speed of sound, which in turn affects the distance reading measured by the sensor. An increase in air temperature shifts both sensing window limits closer to the sensor. Conversely, a decrease in air temperature shifts both limits farther away from the sensor. This shift is approximately 3,5% of the limit distance for a 20°C change in temperature.

The US18 ultrasonic sensors are temperature compensated. This reduces the error due to temperature by about 90%. The sensor will maintain its window limits to within 1,8% over the   –20° to +60°C range.

CONNECTIONS

M12 CONNECTOR
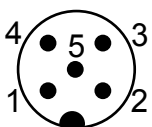
PIN	WIRE	TUBULAR DIGITAL VERSION US18 PA/PR...OH	TUBULAR ANALOG VERSION US18 PA/PR...IH/VH	RIGHT ANGLE US18 PL...NH/PH
1	Brown	10...30 Vdc	10...30 Vdc	12...30 Vdc
2	White	NPN OUTPUT	4...20 mA or 0...10 V	REMOTE TEACH (0...2 Vdc)
3	Blue	0 V	0 V	0 V
4	Black	PNP OUTPUT	5...30 Vdc (FAST mode) or 0...2 Vdc (SLOW mode)	OUTPUT (PNP or NPN)
5	Grey	REMOTE TEACH (0...2 Vdc)	REMOTE TEACH (0...2 Vdc)	–

TUBULAR

The **US18-PA/PR-5-N03 tubular** version sensors are excellent foreground and/or background suppressors and guarantee a small blind zone providing a wide operating range from 30 to 300 mm.

The standard M18 tubular shape and the two different directions of acoustic emission, axial and radial, offer comprhensive solutions of installation. Connecting properly the output pins is possible to set the sensor in FAST mode (down to 2,5 ms of response time) or in SLOW mode (30 ms). Speeding the output response means reduce the resolution. Slowest applications will allow to detect smaller objects.

The series offers models either with discrete or with analog output.

The Teach-in procedure is simple and allows to set the minimum and maximum values or to fix a switching window with 10 mm width in the models with discrete output (Auto-Window function).

The models with analog output are conceived as distance sensors and the output signal can be scaled on windows of any width inside the operating range or positioned at the centre of a detection window with a fixed width of 100 mm (Auto-window function).
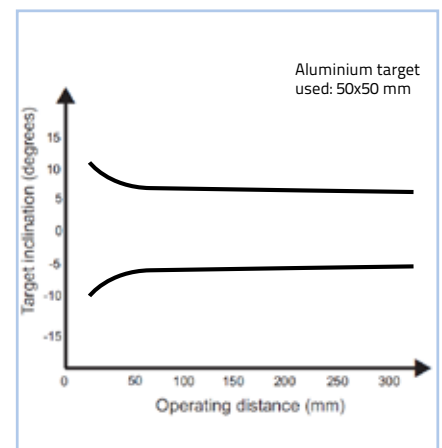
DETECTION DIAGRAM
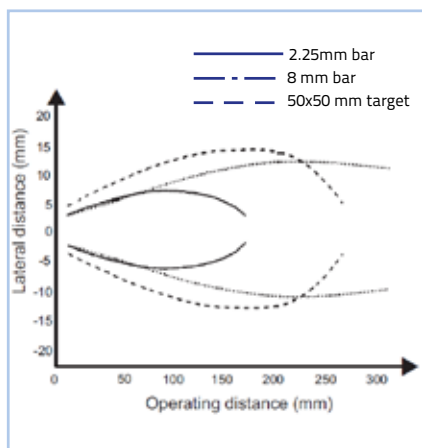
Beam - distance variation
(typical values)
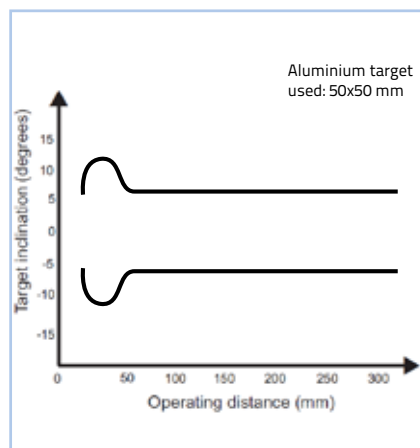
Maximum target inclination
(models with discrete output)

Maximum target inclination
(models with analog output)

RIGHT ANGLE

The **US18-PL-5-N03 right angle** sensor is able to detect directly the objects, without any separeted receiver unit, performing the foreground and the background suppression with an extremely reduced blind zone and operating distances from 50 to 500 mm.

This model provides discrete outputs (PNP or NPN) through a M12 4-pole standard connector, active when the maximum and minimum detection thresholds are exceeded, making this sensor very suitable for objects detection in limited space and very subject to light reflections.
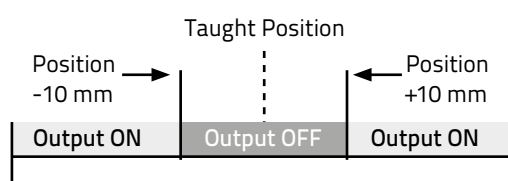
DETECTION DIAGRAM

Beam - distance variation
(typical values)

Maximum target inclination
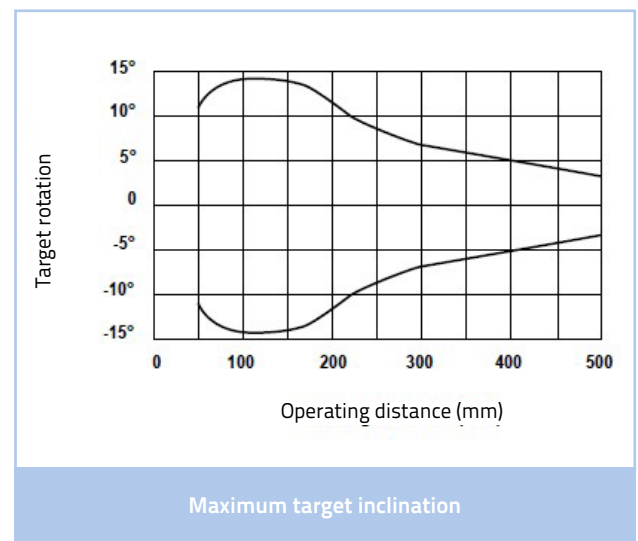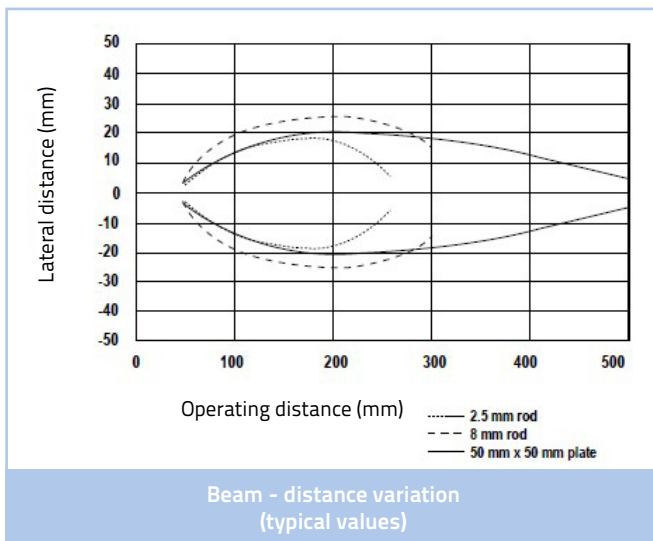
Normally Open operation
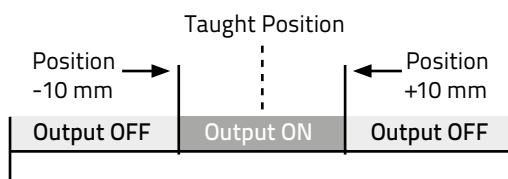
Normally closed operation

The sensors are easily configured through the Teach-in function, fixing the minimum and maximum limits in which the target has to be detected or centering a 20 mm window on the taught position when the Auto-Window feature is used.

SETTING

Two TEACH methods may be used to program the sensor:

- teaching individual minimum and maximum limits
- using Auto-Window feature to center a sensing window around the taught position

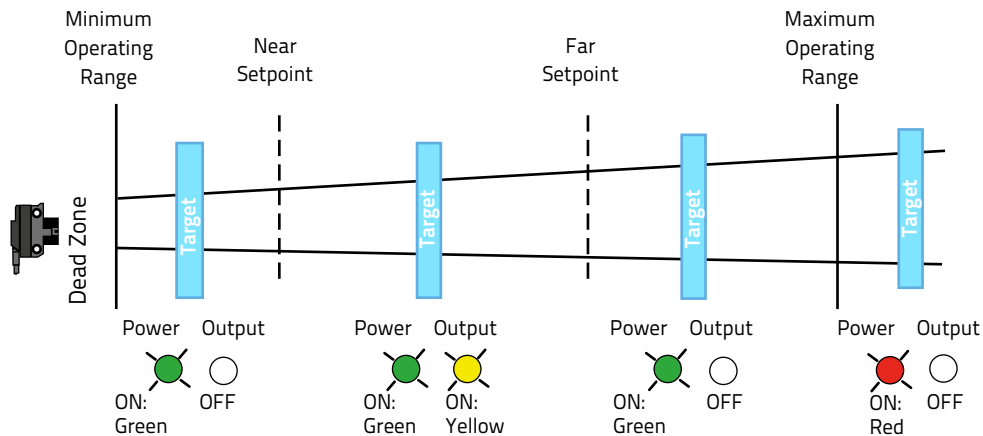The sensor may be programmed either via its push button, or via a remote switch.

Remote programming also may be used to disable the push button, preventing unauthorized personnel from adjusting the programming settings.

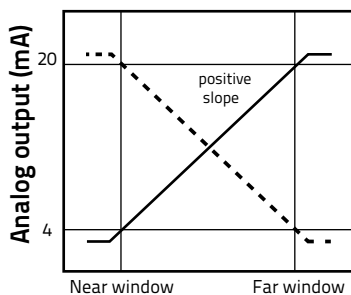The operating status is reported by two color LEDs:

red POWER LED when the target is weak or outside sensing range, green POWER LED when the target is good and the sensor is operating normally

yellow OUTPUT LED when the target is within the window limits, red OUTPUT LED when the sensor is in TEACH mode
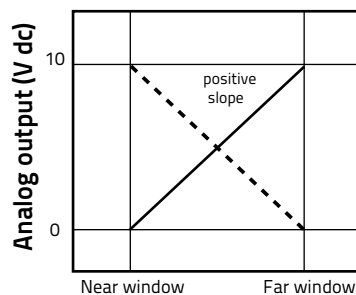
TEACH interface

M18 TUBULAR - ANALOG VERSION

The sensor may be programmed for either a positive or a negative output slope, based on which limit is taught first:

- if the Near limit is taught first, the slope will be positive
- if the Far limit is taught first, the slope will be negative

The analog output signal, is automatically distributed over the width of programmed sensing window (linearity: ±1 mm in FAST mode, ±0,5 mm in SLOW mode).

◆ DATALOGIC

MODEL SELECTION AND ORDER INFORMATION

FUNCTION	HOUSING TYPE	OPERATING DISTANCE	OUTPUT	MODEL	ORDER No.
Foreground and Background suppression	M18 Tubular, axial	30...300 mm	NPN and PNP	US18-PA-5-N03-OH	95B040000
	M18 Tubular, radial		NPN and PNP	US18-PR-5-N03-OH	95B040010
	M18 Tubular, axial		4-20 mA Analog	US18-PA-5-N03-IH	95B040020
	M18 Tubular, radial		4-20 mA Analog	US18-PR-5-N03-IH	95B040030
	M18 Tubular, axial		0-10 V Analog	US18-PA-5-N03-VH	95B040040
	M18 Tubular, radial		0-10 V Analog	US18-PR-5-N03-VH	95B040050
	M18 Right angle mounting	50...500 mm	NPN	US18-PL-5-N03-NH	95B040140
			PNP	US18-PL-5-N03-PH	95B040150

ACCESSORIES

SP-40
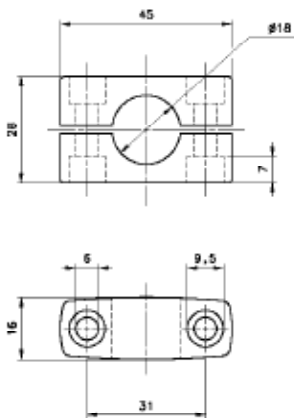
ST-5011
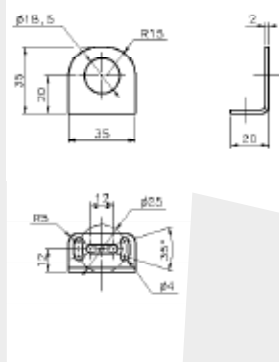
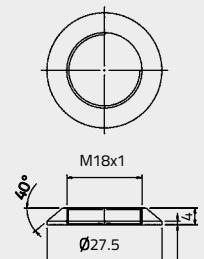### ST-5012
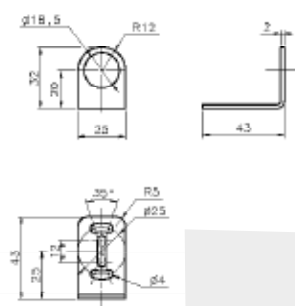
ST-5017
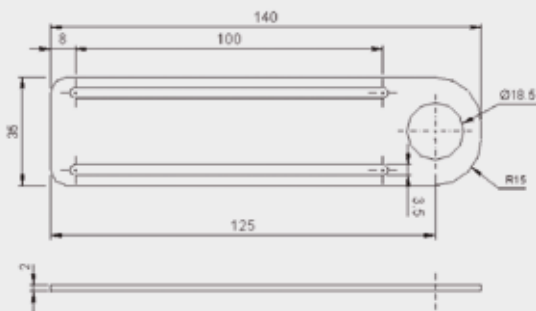
SWING-18
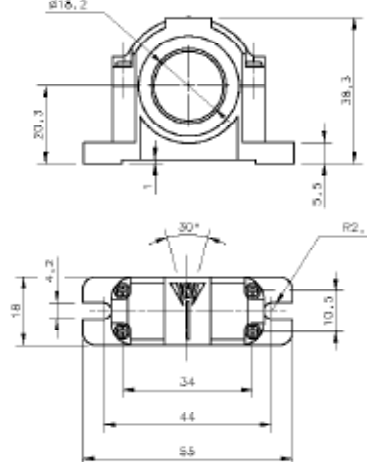
PLASTIC NUT

mm

ACCESSORIES SELECTION AND ORDER INFORMATION

DESCRIPTION	MODEL	ORDER No.
ST-5011	M18 mounting bracket short	95ACC5240
ST-5012	M18 mounting bracket long	95ACC5250
ST-5017	M18 mounting bracket standard profile	95ACC5270
SP-40	Mounting support for tubular M18 sensors	95ACC1370
Plastic Nut	Flared mounting nut	95ACC2630
SWING-18	Adjustable support for plastic tubolar M18 sensors	895000006

CABLES

CONNECTOR	DESCRIPTION	LENGTH	MODEL	ORDER No.
Axial M12 connector	4-pole, Grey, P.V.C.	3 m	CS-A1-02-G-03	95ACC1380
		5 m	CS-A1-02-G-05	95ACC1270
		7 m	CS-A1-02-G-07	95ACC1280
		10 m	CS-A1-02-G-10	95ACC1390
Radial M12 connector		3 m	CS-A2-02-G-03	95ACC1360
		5 m	CS-A2-02-G-05	95ACC1240
		7 m	CS-A2-02-G-07	95ACC1245
		10 m	CS-A2-02-G-10	95ACC1260
Axial M12 connector	5-pole, Grey, P.V.C.	3 m	CS-A1-03-G-03	95ACC2110
		5 m	CS-A1-03-G-05	95ACC2120
		10 m	CS-A1-03-G-10	95ACC2140

SWING-18

SP-40

www.datalogic.com

◆DATALOGIC
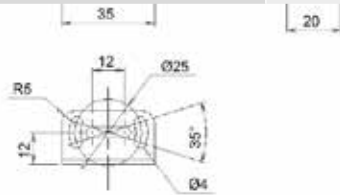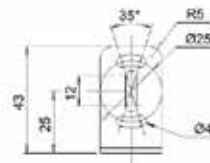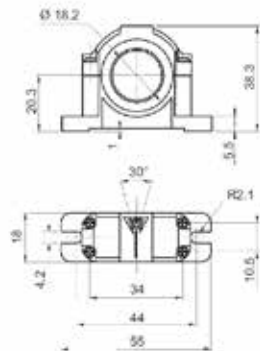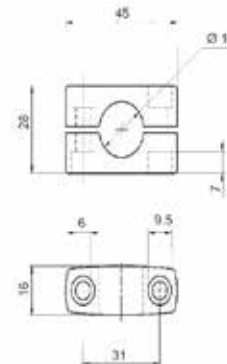
US18 SERIES
- analog output -
ultrasonic sensors

INSTRUCTION MANUAL

CONTROLS

Programming push-button (TEACH)
This push-button allows to program the reading points of the sensor.

PWR LED indicator	Indicates
OFF	Power is OFF.
ON Red	Target is weak or outside sensing range.
ON Green	Sensor is operating normally, good target.

OUT LED indicator	Indicates
OFF	Target is outside windows limits
ON Yellow	Target is within windows limits
ON Red (solid)	In TEACH mode, waiting for first limit
ON Red (flashing)	In TEACH mode, waiting for second limit

CONNECTIONS

BROWN **1** — 10 … 30 Vdc +

BLUE **3** — 0 V

WHITE **2** — 4…20 mA or 0…10 Vdc

BLACK **4** — 5…30 Vdc (fast) / 0…2 Vdc (slow)

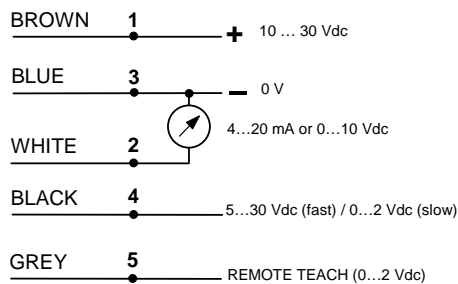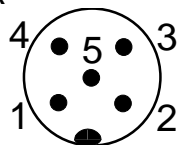GREY **5** — REMOTE TEACH (0…2 Vdc)

M12 - 5 POLE CONNECTOR

PRINCIPLES OF OPERATION

Ultrasonic sensors emit one or multiple pulses of ultrasonic energy, which travel through the air at the speed of sound. A portion of this energy reflects off the target and travels back to the sensor.
The sensor measures the total time required for the energy to reach the target and return to the sensor.
The distance to the object is then calculated using the following formula:

$$D = \frac{ct}{2}$$

- **D** = Distance from the sensor to the target
- **C** = Speed of sound in air
- **t** = Transit time for the ultrasonic pulse

To improve accuracy, an ultrasonic sensor may average the results of several pulses before outputting a new value.

Temperature Effects

The speed of sound is dependent upon the composition, pressure and temperature of the gas in which it is traveling. For most ultrasonic applications, the composition and pressure of the gas are relatively fixed, while the temperature may fluctuate.
In air, the speed of sound varies with temperature according to the following approximation:

$$C_{m/s} = 20 \sqrt{273 + T_C}$$

- **Cm/s** = Speed of sound in meters per second
- **Tc** = Temperature in °C

Temperature Compensation

Changes in air temperature affect the speed of sound, which in turn affects the distance reading measured by the sensor. An increase in air temperature shifts both sensing window limits closer to the sensor. Conversely, a decrease in air temperature shifts both limits farther away from the sensor.
This shift is approximately 3.5% of the limit distance for a 20° C change in temperature.
The US18 series ultrasonic sensors are temperature compensated. This reduces the error due to temperature by about 90%. The sensor will maintain its window limits to within 1.8% over the -20° to +60°C range.
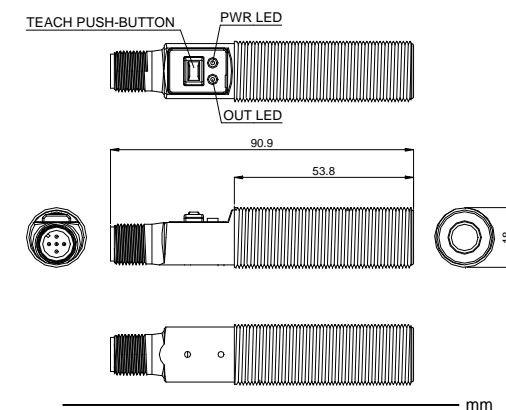
NOTES:
- Exposure to direct sunlight can affect the sensor's ability to accurately compensate for changes in temperature.
- If the sensor is measuring across a temperature gradient, the compensation will be less effective.
- The temperature warmup drift upon power-up is less than 1.7% of the sensing distance.
  After 10 minutes, the apparent distance will be within 0.3% of the actual position.
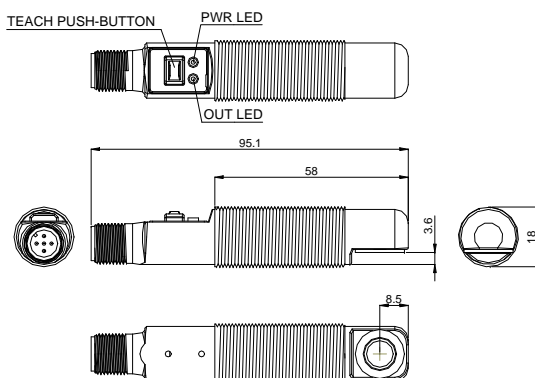 After 25 minutes, the sensing distance will be stable.

TECHNICAL DATA

	US18-PA AXIAL VERSION	US18-PR RADIAL VERSION
Power supply:	10 … 30 Vdc (limit values), reverse polarity protection	
Ripple:	≤ 2 Vpp	
Consumption (load current excluded):	65mA max., 40 mA typical @ 25 Vcc	
Output configurations:	0…10 Vcc (voltage output) or 4…20 mA (current output) overload and short circuit protection	
Outputs:	**Analog voltage output:** 2.5 KΩ minimum load resistance. Minimum supply for a full 10V output is 12Vdc (for supply voltages between 10 and 12V, out max is at least V supply - 2) **Analog current output:** 1KΩ max @ 24V input. Max load resistance = (Vcc-4)/0.02 ohms For current output (4-20mA) models, ideal results are achieved whwn the total load resistance R = [(Vin-3)/0.020]Ω. Example, at Vin = 24V, R ≈ 1KΩ (1watt) A worst case shift of 1% of sensing distance is caused by operating the sensor at Vin = 30Vdc and R = 0Ω	
Output Response time (for a 95% step change):	**2.5 ms (Fast):** pin 4 (black wire) at 5…30 Vdc **30 ms (Slow):** pin 4 (black wire) at 0…2 Vdc (or not connected)	
Max. switching frequency:	200 Hz (fast), 16 Hz (slow)	
Range indicator: (Red/Green)	**Green** Target is within sensing range **Red** Target is outside sensing range **OFF** Sensing power is OFF	
Teach/Output indicator: (Yellow/Red)	**Yellow** Target is within sensing range **OFF** Target is outside taught window limits **Red** Sensor is in Teach mode	
Setting:	Sensing window limits: TEACH-Mode programming of near and far window limits may be set using the push button or remotely via TEACH input	
Delay at Power-up:	300 ms	
Temperature effect:	0.02% of distance/°C	
Temperature warmup drift:	less than 1.7% of sensing distance upon power-up	
Linearity (note A):	**2.5 ms response:** ±1 mm **30 ms response:** ±0.5 mm	
Resolution (note A):	**2.5 ms response:** 1 mm **30 ms response:** 0.5 mm	
Minimum window size:	5 mm	
Ultrasonic emission:	300 KHz, rep. rate 2.5 ms	
Remote teach input:	Impedence: 12 KΩ	
Operating temperature:	-20 … 60 °C	
Storage temperature:	-25 … 70 °C	
Maximum relative humidity:	100%	
Electrical shock protection:	Class 2	
Operating distance (typical values):	30…300 mm	
Vibrations:	0.5 mm amplitude, 10…55 Hz frequency, for every axis (EN60068-2-6)	
Reference standard:	EN60947-5-2	
Shock resistance:	11 ms (30 G) 6 shock for every axis (EN60068-2-27)	
Housing material:	Thermoplastic polyester	
Threaded barrel material:	ABS/PC	
Push-button material:	Santoprene	
Light pipes material:	Acrylic	
Mechanical protection:	IP67	
Connections:	M12 - 5 pole connector	
Weight:	25 g	

DIMENSIONS

AXIAL VERSION

TEACH PUSH-BUTTON   PWR LED

OUT LED

90.9
53.8
18

mm

RADIAL VERSION

TEACH PUSH-BUTTON   PWR LED
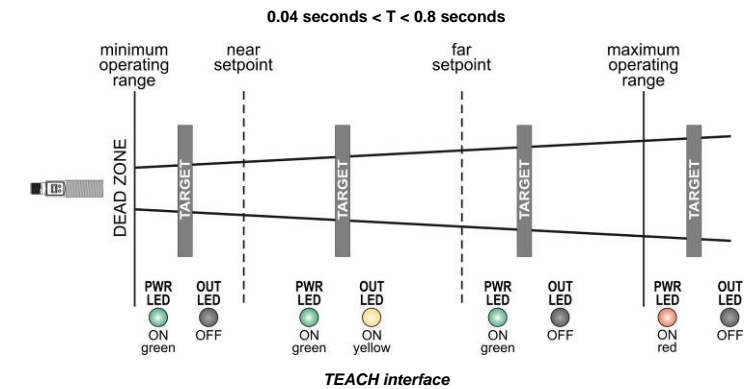
OUT LED

95.1
58
3.6
18
8.5

SENSOR PROGRAMMING

Two TEACH methods may be used to program the sensor:
- Teach individual minimum and maximum limits.
- Use Auto-Window feature to center a sensing window around the taught position.

The sensor may be programmed either via its push button, or via a remote switch.
Remote programming may be used to disable the push button, preventing unauthorized personnel from adjusting the programming settings. To access this feature, connect the Remote Teach wire of the sensor to 0 - 2V dc, with a remote programming switch between the sensor and the voltage.
NOTE: The impedance of the Remote Teach input is 12 KΩ.

Programming is accomplished by following the sequence of input pulses (see chap. "Normally Open/Normally Closed operation select"). The duration of each pulse (corresponding to a push button "click"), and the period between multiple pulses, are defined as "T":
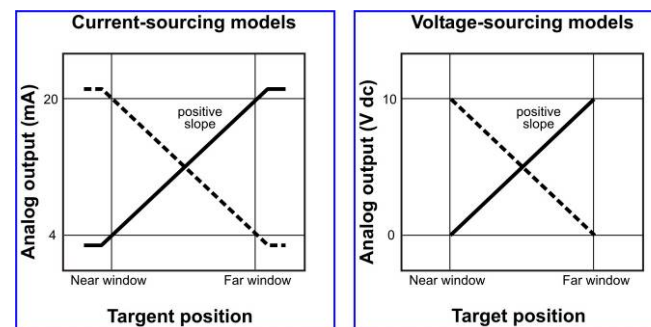
0.04 seconds < T < 0.8 seconds

minimum operating range   near setpoint   far setpoint   maximum operating range

DEAD ZONE   TARGET   TARGET   TARGET   TARGET

PWR LED	OUT LED	PWR LED	OUT LED	PWR LED	OUT LED	PWR LED	OUT LED
ON green	OFF	ON green	OFF	ON yellow	OFF	ON red	OFF

TEACH interface

Analog Output Slope

The sensor may be programmed for either a positive or a negative output slope, based on which limit is taught first (see pictures).
- If the Near limit is taught first, the slope will be positive.
- If the Far limit is taught first, the slope will be negative.

The analog output signal, is automatically distributed over the width of programmed sensing window.
In the event of signal loss, the analog output goes to 3.6mA or 0Vdc, which may be used to trigger an alarm.

Current-sourcing models

Analog output (mA) — 20, 4 — positive slope — Near window / Far window — **Target position**

Voltage-sourcing models

Analog output (V dc) — 10, 0 — positive slope — Near window / Far window — **Target position**

Teaching Minimum and Maximum Limits

	Programming procedure		Indicators LED
	TEACH push-button	Remote line (remote teach)	
Programming mode	Push and hold TEACH push-button	No action required; sensor is ready for 1st limit teach	**OUT LED:** ON, RED **PWR LED:** ON Green (good signal) ON Red (no signal)
TEACH First limit	Position the target for the first limit	Position the target for the first limit	**PWR LED:** must be ON Green
	"Click" the TEACH push-button	Single-pulse the remote line (0.04 s < T < 0.8 s)	**Teach accepted:** (Sensor learns the 0Vdc or 4mA limit) **OUT LED,** flashing Red **Teach unacceptable:** **OUT LED:** ON Red
TEACH Second limit	Position the target for the second limit	Position the target for the second limit	**PWR LED:** must be ON Green
	"Click" the TEACH push-button	Single-pulse the remote line (0.04 s < T < 0.8 s)	**Teach accepted:** (Sensor learns the 10Vdc or 20mA limit) **OUT LED,** Yellow or OFF **Teach unacceptable:** **OUT LED:** flashing Red

NOTE: The duration of each pulse (corresponding to a push button "click"), and the period between multiple pulses, are defined "T" (0.04 s < T < 0.8 s).

Teaching limits using the Auto-Window feature

Teaching the same limit twice for the same output automatically centers a 100mm window on the taught position (± 50 mm).
The analog output will be centered on the taught position at approximately 5V or 12mA.

	Programming procedure		Indicators LED
	TEACH push-button	Remote line (remote teach)	
Programming mode	Push and hold TEACH push-button	No action required; sensor is ready for 1st limit teach	**OUT LED:** ON, Red **PWR LED:** ON Green (good signal) ON Red (no signal)
TEACH Limit	Position the target for the center of window	Position the target for the center of window	**PWR LED:** must be ON Green
	"Click" the TEACH push-button	Single-pulse the remote line (0.04 s < T < 0.8 s)	**Teach accepted:** **OUT LED,** flashing, Red **Teach unacceptable:** **OUT LED:** ON Red
Re-TEACH Limit	Without moving the target, "click" the TEACH push-button again	Without moving the target, single-pulse the remote line again (0.04 s < T < 0.8 s)	**Teach accepted:** **OUT LED,** Yellow or OFF **Teach unacceptable:** **OUT LED,** flashing, Red

General Notes on Programming

The sensor will return to RUN mode if the first TEACH condition is not registered within 120 seconds.
After the first limit is taught, the sensor will remain in PROGRAM mode until the TEACH sequence is finished.
To exit PROGRAM mode without saving any changes, press and hold the programming push button > 2 seconds (before teaching the second limit). The sensor will revert to the last saved program.

TEACH push-button lockout

Enables or disables the push button to prevent unauthorized personnel from adjusting the program settings.

	Programming procedure		Enable/Disable Function
	TEACH push-button	Remote line (remote teach) 0.04 s < T < 0.8 s	
TEACH Push-button lockout	Not available via push-button	Four impulse the remote line	Push-button are either enabled or disabled, depending on condition..

⊙DATALOGIC

US18 SERIES
- Digital output-
ultrasonic sensors

INSTRUCTION MANUAL

CONTROLS

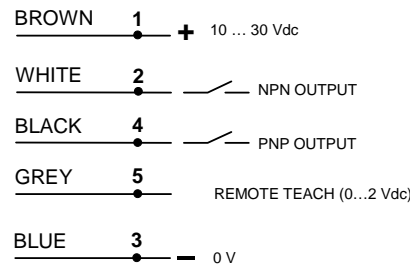**Programming push-button (TEACH)**
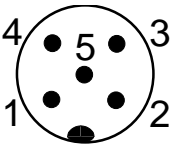This push-button allows to program the reading points of the sensor.

PWR LED indicator	Indicates
OFF	Power is OFF.
ON Red	Target is weak or outside sensing range.
ON Green	Sensor is operatine normally, good target.

OUT LED indicator	Indicates
OFF	Target is outside windows limits (normally open operation)
ON Yellow	Target is within windows limits (normally open operation)
ON Red (solid)	In TEACH mode, waiting for first limit
ON Red (flashing)	In TEACH mode, waiting for second limit

CONNECTIONS

BROWN **1** + 10 … 30 Vdc

WHITE **2** — NPN OUTPUT

BLACK **4** — PNP OUTPUT

GREY **5** REMOTE TEACH (0…2 Vdc)

BLUE **3** 0 V

M12 - 5 POLE CONNECTOR

PRINCIPLES OF OPERATION

Ultrasonic sensors emit one or multiple pulses of ultrasonic energy, which travel through the air at the speed of sound. A portion of this energy reflects off the target and travels back to the sensor.
The sensor measures the total time required for the energy to reach the target and return to the sensor.
The distance to the object is then calculated using the following formula:

$$D = \frac{ct}{2}$$

D = Distance from the sensor to the target
C = Speed of sound in air
T = Transit time for the ultrasonic pulse

To improve accuracy, an ultrasonic sensor may average the results of several pulses before outputting a new value.

Temperature Effects

The speed of sound is dependent upon the composition, pressure and temperature of the gas in which it is traveling. For most ultrasonic applications, the composition and pressure of the gas are relatively fixed, while the temperature may fluctuate.
In air, the speed of sound varies with temperature according to the following approximation:

$$C_{m/s} = 20\sqrt{273 + T_C}$$

Cm/s = Speed of sound in meters per second
Tc = Temperature in °C

Temperature Compensation

Changes in air temperature affect the speed of sound, which in turn affects the distance reading measured by the sensor. An increase in air temperature shifts both sensing window limits closer to the sensor. Conversely, a decrease in air temperature shifts both limits farther away from the sensor.
This shift is approximately 3.5% of the limit distance for a 20° C change in temperature.
The US18 series ultrasonic sensors are temperature compensated. This reduces the error due to temperature by about 90%. The sensor will maintain its window limits to within 1.8% over the -20° to +60° C range.
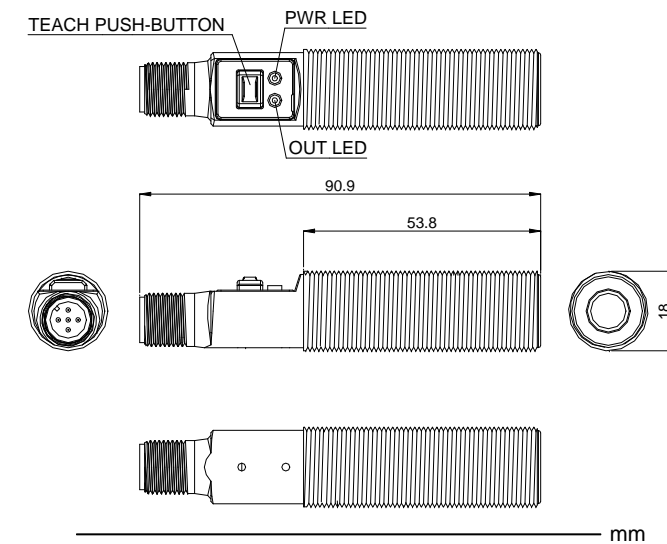
NOTE:
- Exposure to direct sunlight can affect the sensor's ability to accurately compensate for changes in temperature.
- If the sensor is measuring across a temperature gradient, the compensation will be less effective.
- The temperature warmup drift upon power-up is less than 1.7% of the sensing distance.
  After 10 minutes, the apparent switchpoint will be within 0.3% of the actual position.
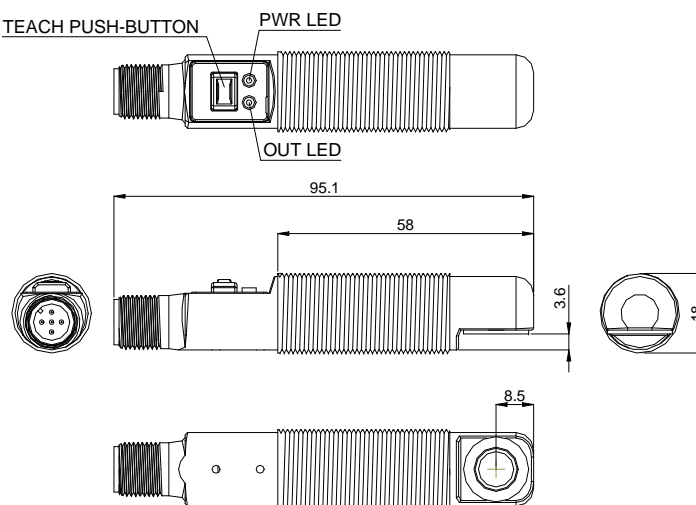 After 25 minutes, the sensing position will be stable.

TECHNICAL DATA

	US18-PA AXIAL VERSION	US18-PR RADIAL VERSION
Power supply:	10 … 30 VDC (limit values), Class 2 (Type 1) reverse polarity protection	
Ripple:	≤ 2 Vpp	
Consumption (load current excluded):	65 mA max., 40 mA typical @ 25 VDC	
Outputs:	NPN and PNP (N.O. or N.C. selectable)	
Output current:	100 mA max. overload and short circuit protection	
Output saturation voltage:	PNP < 1.2 V @ 10 mA, < 1.6 V @ 100 mA NPN < 200 mV @ 10 mA, < 600 mV @ 100 mA	
Response time:	8 ms	
Max. switching frequency:	100 Hz	
Range indicator: (Red/Green)	**Green** Target is within sensing range **Red** Target is outside sensing range **OFF** Sensing power is OFF	
Teach/Output indicator: (Yellow/Red)	**Yellow** Target is within sensing range **OFF** Target is outside taught window limits **Red** Sensor is in Teach mode	
Setting:	Sensing window limits: TEACH-Mode programming of near and far window limits may be set using the push button or remotely via TEACH input	
Delay at Power-Up:	300 ms	
Temperature effect:	0.02% of distance/°C	
Temperature warmup drift:	Less than 1.7% of sensing distance upon power-up	
Repeatability:	0.5 mm	
Minimum window size:	5 mm	
Hysteresis:	0.7 mm	
Ultrasonic emission:	300 KHz, rep. rate 2.5 ms	
Remote teach input:	Impedance: 12 KΩ	
Operating temperature:	-20 … 60 °C	
Storage temperature:	-25 … 70 °C	
Maximum relative humidity:	100%	
Electrical shock protection:	Class 2	
Operating distance (typical values):	30…300 mm	
Vibrations:	0.5 mm amplitude, 10…55 Hz frequency, for every axis (EN60068-2-6)	
Reference standard:	EN60947-5-2	
Shock resistance:	11 ms (30 G) 6 shock for every axis (EN60068-2-27)	
Housing material:	Thermoplastic polyester	
Threaded barrel material:	ABS/PC	
Push-button material:	Santoprene	
Light pipes material:	Acrylic	
Mechanical protection:	IP67	
Connections:	M12 - 5 pole connector	
Weight:	25 g	

DIMENSIONS

AXIAL VERSION

TEACH PUSH-BUTTON   PWR LED

OUT LED

90.9
53.8
18

mm

RADIAL VERSION

TEACH PUSH-BUTTON   PWR LED

OUT LED

95.1
58
3.6
18
8.5

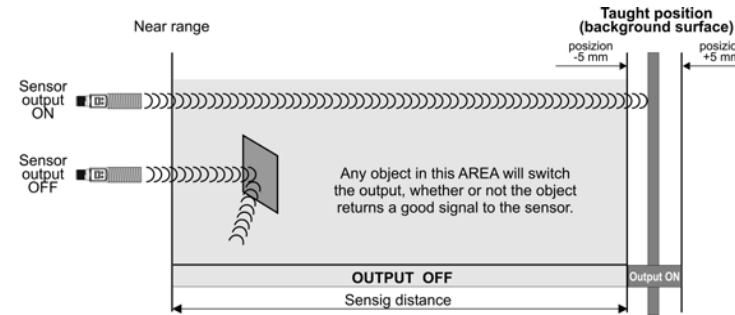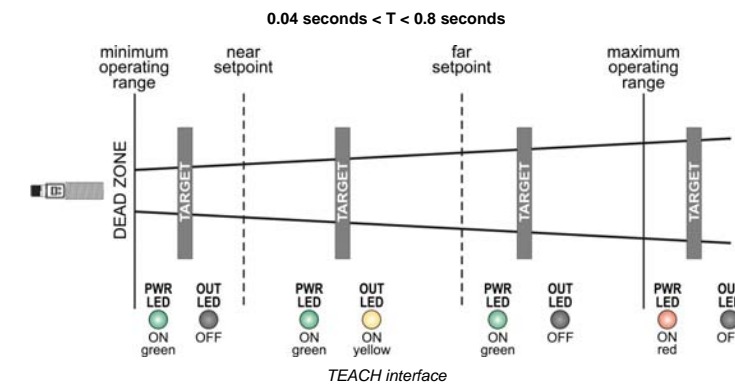## SENSOR PROGRAMMING

Two TEACH methods may be used to program the sensor:
- Teach individual minimum and maximum limits.
- Use Auto-Window feature to center a sensing window around the taught position.
  The sensor may be programmed either via its push button, or via a remote switch.

Any object in this AREA will switch the output, whether or not the object returns a good signal to the sensor.

TEACH interface

Remote programming may be used to disable the push button, preventing unauthorized personnel from adjusting the programming settings. To access this feature, connect the Remote Teach wire of the sensor to 0 - 2V dc, with a remote programming switch between the sensor and the voltage.
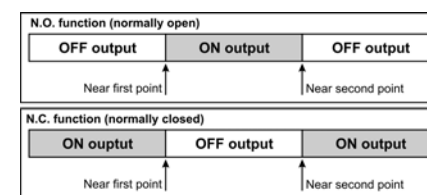NOTE: The impedance of the Remote Teach input is 12 KΩ.

Programming is accomplished by following the sequence of input pulses (see chap. "Normally Open/Normally Closed operation select"). The duration of each pulse (corresponding to a push button "click"), and the period between multiple pulses, are defined as "T":

0.04 seconds < T < 0.8 seconds

Teaching Minimum and Maximum Limits

	Programming procedure		Indicators LED
	TEACH push-button	**Remote line (remote teach)**	
Programming mode	Push and hold TEACH push-button	No action required; sensor is ready for 1st limit teach	**OUT LED:** ON, RED **PWR LED:** ON GREEN (good signal) ON RED (no signal)
TEACH First limit	Position the target for the first limit	Position the target for the first limit	**PWR LED:** must be ON GREEN
	"Click" the TEACH push-button	Single-pulse the remote line (0.04 s < T < 0.8 s)	**Teach accepted:** **OUT LED,** flashing RED **Teach unacceptable:** **OUT LED,** ON RED
TEACH Second limit	Position the target for the second limit	Position the target for the second limit	**PWR LED:** must be ON GREEN
	"Click" the TEACH push-button	Single-pulse the remote line (0.04 s < T < 0.8 s)	**Teach accepted:** **OUT LED,** YELLOW or OFF **Teach unacceptable:** **OUT LED,** flashing RED

NOTE: The duration of each pulse (corresponding to a push button "click"), and the period between multiple pulses, are defined "T" (0.04 s < T < 0.8 s).
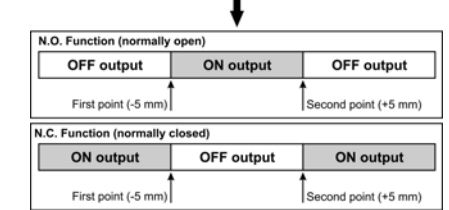
N.O. function (normally open)

OFF output	ON output	OFF output
Near first point		Near second point

N.C. function (normally closed)

ON ouput	OFF output	ON output
Near first point		Near second point

See chap. "Normally Open/Normally Closed Operation Select."

Teaching limits using the Auto-Window feature

Teaching the same limit twice for the same output automatically centres a 10 mm window on the taught position (± 5 mm).

	Programming procedure		Indicators LED
	TEACH push-button	**Remote line (remote teach)**	
Programming mode	Push and hold TEACH push-button	No action required; sensor is ready for 1st limit teach	**OUT LED:** ON, RED **PWR LED:** ON GREEN (good signal) ON RED (no signal)
TEACH Limit	Position the target for the center of window	Position the target for the center of window	**PWR LED:** must be ON GREEN
	"Click" the TEACH push-button	Single-pulse the remote line (0.04 s < T < 0.8 s)	**Teach accepted:** **OUT LED,** flashing, RED **Teach unacceptable:** **OUT LED,** ON RED
Re-TEACH Limit	Without moving the target, "click" the TEACH push-button again	Without moving the target, single-pulse the remote line again (0.04 s < T < 0.8 s)	**Teach accepted:** **OUT LED,** YELLOW or OFF **Teach unacceptable:** **OUT LED,** flashing, RED

TAUGHT POSITION

N.O. Function (normally open)

OFF output	ON output	OFF output
First point (-5 mm)		Second point (+5 mm)

N.C. Function (normally closed)

ON output	OFF output	ON output
First point (-5 mm)		Second point (+5 mm)

See chap. "Normally Open/Normally Closed Operation Select."

General Notes on Programming

The sensor will return to RUN mode if the first TEACH condition is not registered within 120 seconds. After the first limit is taught, the sensor will remain in PROGRAM mode until the TEACH sequence is finished.
To exit PROGRAM mode without saving any changes, press and hold the programming push button > 2 seconds (before teaching the second limit). The sensor will revert to the last saved program.

Normally Open/Normally Closed Operation Select

The sensor can be configured for either normally open or normally closed via the remote teach wire (gray).
A series of three pulses on the line will toggle between normally open and normally closed operation.
Normally open is defined as the output energizing when the target is present.
Normally closed is defined as the output energizing when the target is absent.

	Programming procedure		N.O./N.C. function
	TEACH push-button	**Remote line (remote teach) 0.04 s < T < 0.8 s**	
Toggle between N.O./N.C. operation	Not available via push-button	Triple-pulse the remote line	Either normally open or normally closed operation is selected, depending on previous condition.

TEACH push-button lockout

Enables or disables the push button to prevent unauthorized personnel from adjusting the program settings.

	Programming procedure		Enable/Disable Function
	TEACH push-button	**Remote line (remote teach) 0.04 s < T < 0.8 s**	
TEACH Push-button lockout	Not available via push-button	Four impulse the remote line	Push-button are either enabled or disabled, depending on condition..

The sensors are NOT safety devices, and so MUST NOT be used in the safety control of the machines where installed.