US18 SERIES
- analog output -
ultrasonic sensors

INSTRUCTION MANUAL

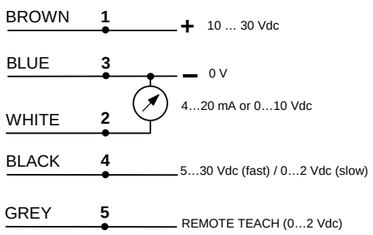
CONTROLS

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

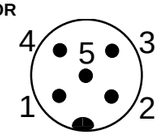
PWR LED indicator	Indicates
OFF	Power is OFF.
ON Red	Target is weak or outside sensing range.
ON Green	Sensor is operatine normally, good target.

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



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:

$$D = \frac{c\,t}{2}$$

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.

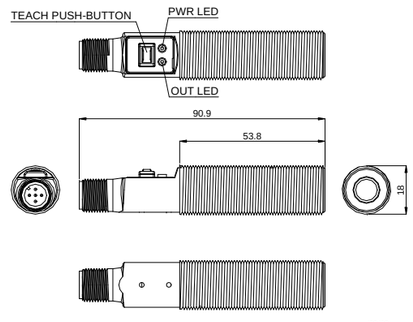
NOTES:
- Exposure to direct sunlight can affect the sensor's ability to accurately compensate for changes in temperature.
- If the sensor is measuring across a temperature gradient, the compensation will be less effective.
- The temperature warmup drift upon power-up is less than 1.7% of the sensing 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

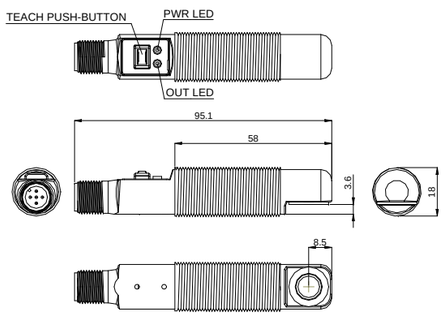
	US18-PA AXIAL VERSION	US18-PR RADIAL VERSION
Power supply:	10 … 30 Vdc (limit values), reverse polarity protection	
Ripple:	≤ 2 Vpp	
Consumption (load current excluded):	65mA max., 40 mA typical @ 25 Vcc	
Output configurations:	0…10 Vcc (voltage output) or 4…20 mA (current output) overload and short 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



RADIAL VERSION



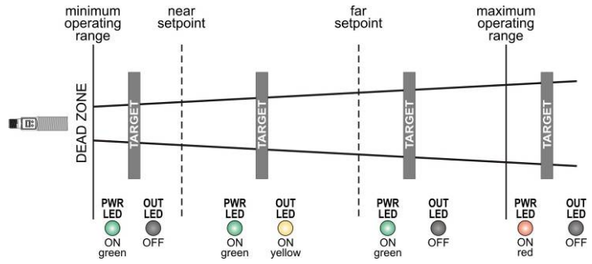
SENSOR PROGRAMMING

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

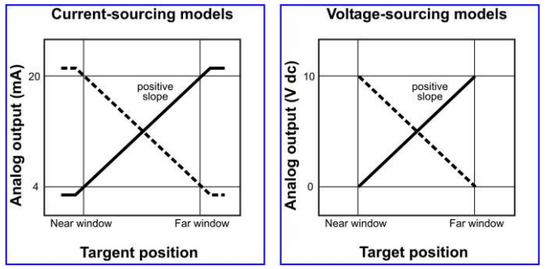


TEACH interface

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.



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

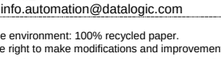
Teaching the same limit twice for the same output automatically centers a 100mm window on the taught position (± 50 mm).
The analog output will be centered on the taught position at approximately 5V or 12mA.

	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..

DECLARATION OF CONFORMITY
We DATALOGIC AUTOMATION declare under our sole responsibility that these products are conform to the 2004/108/CE and successive amendments.

WARRANTY
DATALOGIC AUTOMATION warrants its products to be free from defects.
DATALOGIC AUTOMATION will repair or replace, free of charge, any product found to be defective during the warranty period of 36 months from the manufacturing date.
This warranty does not cover damage or liability deriving from the improper application of DATALOGIC AUTOMATION products.

DATALOGIC AUTOMATION
Via Lavino 265 - 40050 Monte S.Pietro - Bologna – Italy
Tel: +39 051 6765611 - Fax: +39 051 6759324
www.automation.datalogic.com e-mail:info.automation@datalogic.com

DATALOGIC AUTOMATION cares for the environment: 100% recycled paper.
DATALOGIC AUTOMATION reserves the right to make modifications and improvements without prior notification.

826002203 Rev.C