US50 SERIES

Datalogic Automation **US50** is the new series of ultrasonic sensors with M50 plastic tubular housing. All models are provided with a radial emitting head and offer the following versions:

- Digital bipolar **PNP/NPN NO/NC** configurable output;
- Analogue **0-10V / 4-20m** configurable output.

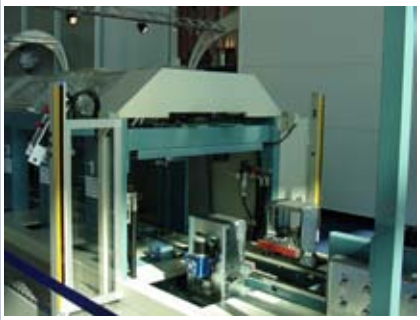
Operating distance from **200mm to 8m** makes US50 ideal solution for all industrial applications where the target must be detected or measured really far away from the sensor.
The sensor functions are set using DIP-switches located on the rear side. Electrical connection is obtained through a standard **M12 5-pole** connector Euro Style.
These new sensors can be easily configurable thanks to the **TEACH-IN procedure**, performed through two PUSH-BUTTONS located on the rear side of the device or through the connector's **REMOTE input.**
New Datalogic Automation US50 ultrasonic sensors can detect all objects independently from the material, transparency and/or colour.

HIGHLIGHTS

- Digital bipolar PNP/NPN NO/NC configurable output model
- Digital and 0-10V / 4-20mA configurable analogue output model
- Operating range of 200mm…8m
- Minimum resolution: 1mm
- Analogue output Linearity: +/- 0.2% of span from 200 to 8000 mm; +/- 0.1% of span from 500 to 8000 mm (1 mm minimum)
- Minimum window size : 20mm
- Repeatability: 1mm
- Hysteresis: 5mm
- Response Time: 100ms to 1600ms
- DIP SWITCH selectable
- Access to bank of 8 DIP switches through sealed cover for superior user functionality
- Fast, easy-to-use REMOTE TEACH-Mode programming; no potentiometer adjustments
- Wide operating range of -20° to +70°C with compensation function
- Rugged encapsulated design for harsh environments
- Unique housing design allows for multiple mounting configurations
- Euro-style quick-disconnect fitting

APPLICATIONS

Ceramics

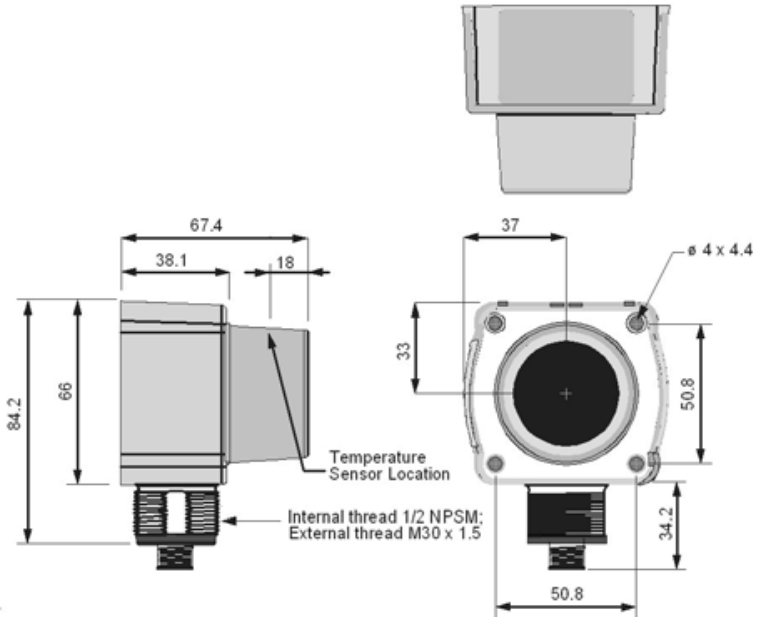


Beverage & Bottling

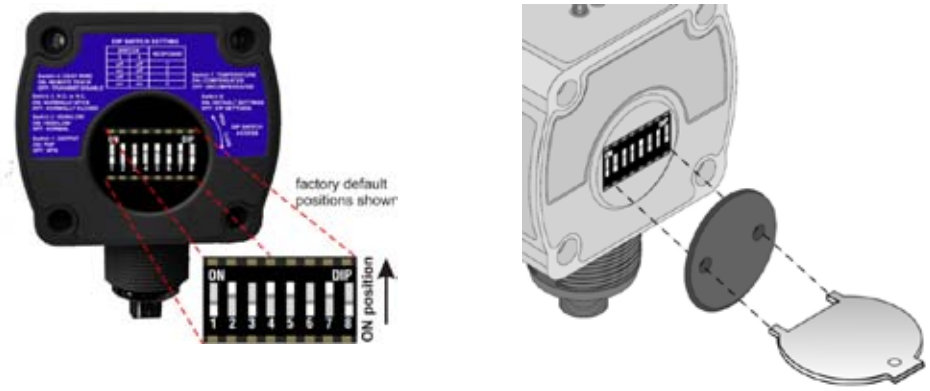
Transportation lines

Packaging lines

DIMENSIONS



SENSOR PROGRAMMING



Switch	Digital models - Functions	Analogue model - Functions
1	PNP or NPN select	Voltage/Current mode
2	Window / Fill level	Loss of echo
3	Output operation	Min-max
4	Teach/Disable control	Teach/Enable control
5 and 6	Response (100 ms/cycle) 1 cycle 4 cycles* 8 cycles 16 cycles	Analogue voltage output response for 95% of step change 100 ms with 100 ms update 500 ms with 100 ms update* 1100 ms with 100 ms update 2300 ms with 100 ms update
7	Temperature compensation	Temperature compensation
8	Factory calibration	Factory calibration

Note: for DIP-switches settings and corresponding factory defaults refer to the user manuals

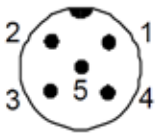
CE

CONNECTIONS

DIGITAL VERSION

5-POLE M12 CONNECTOR

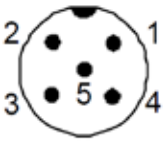
BROWN	1	+ 10 … 30 VDC
BLUE	3	– 0 V
WHITE	2	LOAD1 — Select NPN or PNP with Dipswitch
BLACK	4	LOAD2 — Select NPN or PNP with Dipswitch
GREY	5	REMOTE TEACH 0…2 VDC



ANALOGUE VERSION

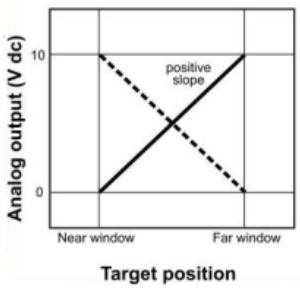
5-POLE M12 CONNECTOR

BROWN	1	+ 10 … 30 VDC
BLUE	3	– 0 V
WHITE	2	ANALOGUE OUTPUT (4…20 mA / 0…10 V)
BLACK	4	ANALOGUE OUTPUT (4…20 mA / 0…10 V)
GREY	5	REMOTE TEACH

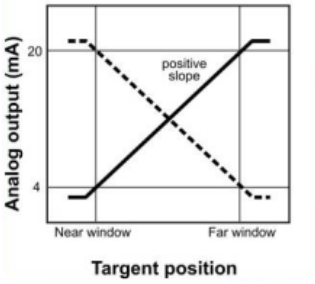


ANALOGUE OUTPUT DIAGRAMS

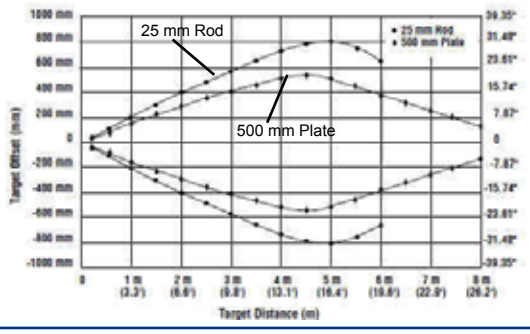
Voltage-sourcing models

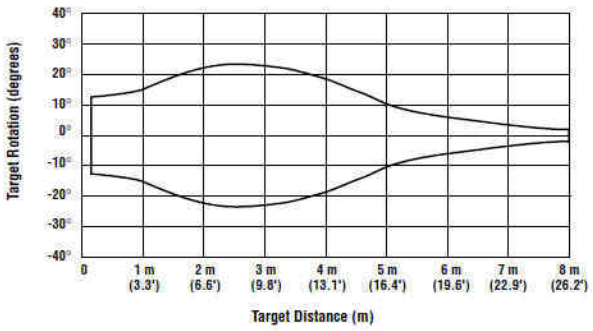


Current-sourcing models



READING DIAGRAMS





CONTROLS

DIGITAL CONTROLS

Signal LED (Red) – indicates the strength and condition of the sensor's incoming signal.

Output LEDs (Yellow or Red) – active when the target is inside to the window limits

Power ON LED (Green) – indicates the operating status of the sensor.

ANALOGUE CONTROLS

Signal LED (Red) – indicates the strength and condition of the sensor's incoming signal.

Limit LEDs (Red or Yellow) – indicate the position of the target relative to the window limits

Power ON LED (Green) – indicates the operating status of the sensor.

TECHNICAL DATA

	DIGITAL VERSION	ANALOGUE VERSION
Power supply:	10 … 30 VDC reverse polarity protection	10 … 30 VDC reverse polarity protection
Ripple:	≤ 2 VPP	≤ 2 VPP
Consumption (load current excluded):	100mA max. at 10V 40mA max. at 30V	100mA max. at 10V 40mA max. at 30V
Ultrasonic frequency:	75 kHz burst, rep. rate 96 ms	75 kHz burst, rep. rate 96 ms
Output configuration:	NPN or PNP, selectable via DIP switch	**Voltage sourcing: 0…10 VDC** (Short-circuit protection) **Current sourcing:** 4…20mA
Output ratings:	150 mA max. **OFF-state leakage current:** < 5 µA **Output saturation NPN:** < 200 mV @ 10 mA and <650 mV @ 150 mA **Output saturation PNP:** < 1.2V @ 10 mA and <1.65V @ 150 mA	-
Response time:	100 ms to 1600 ms	100 ms to 2300 ms
Indicators:	Power ON LED (GREEN), Signal LED (RED), Output LED (bicolour YELLOW/RED)	Power ON LED (GREEN), Signal LED (RED), Output LED (bicolour YELLOW/RED)
Setting:	Teach-in push-button or remotely via TEACH input	ANALOG push-button, remote command input (remote teach). Minimum and maximum detection limits can be programmed using the ANALOG push-button or remote input.
Remote Teach:	Connect grey wire to 0 to +2 VDC; impedence 12KΩ	-
Remote input levels:	-	Connect grey wire to 0 to +2 VDC; impedence 12KΩ
Delay at Power On:	1.5 sec	1.5 sec
Temperature effect:	Uncompensated: 0.2% of distance /°C Compensated: 0.02% of distance /°C	Uncompensated: 0.2% of distance /°C Compensated: 0.02% of distance /°C
Hysteresis:	5 mm	-
Linearity:	-	± 0.2% of span from 200 to 8000 mm; ± 0.1% of span from 500 to 8000 mm (1mm min.)
Resolution:	-	1 mm
Repeatability:	1 mm	-
Minimum reading window size:	20 mm	20 mm
Operating temperature:	-20 … 70 °C	-20 … 70 °C
Storage temperature:	-20 … 70 °C	-20 … 70 °C
Maximum relative humidity:	100%	100%
Operating distance (typical values):	200…8000 mm	200…8000 mm
Vibrations:	0.5 mm amplitude, 10…55 Hz frequency, for every axis (EN60068-2-6)	0.5 mm amplitude, 10…55 Hz frequency, for every axis (EN60068-2-6)
Shock resistance:	11 ms (30 G) shock for every axis (EN60068-2-27)	11 ms (30 G) shock for every axis (EN60068-2-27)
Reference standard:	EN60947-5-2	EN60947-5-2
Housing material:	ABS polycarbonate	ABS polycarbonate
Push-button material:	Polyester	Polyester
Mechanical protection:	IP67	IP67
Connections:	M12 5-poles connector	M12 5-poles connector
Weight:	260 g	260 g.

MODEL SELECTION AND ORDER INFORMATION

MODEL	DESCRIPTION	CODE N°
US50-PR-5-N43-OH	US50-PR-5-N43-OH RIGHT ANGLE B.PNP/NPN	95B040120
US50-PR-5-N43-IVH	US50-PR-5-N43-IVH RIGHT ANGLE B. AN. OUT	95B040130

ACCESSORY SELECTION AND ORDER INFORMATION

MODEL	DESCRIPTION	CODE N°
ST-30SC	ST-30SC US50 MOUNT. BRACKET ASSY	95ACC7820
ST-30MM	ST-30MM US50 STAINLESS STEEL BRACKET	95ACC7830

US50 SERIES
- analogue output -
ultrasonic sensors

INSTRUCTION MANUAL

CONTROLS

Power ON LED (Green) – indicates the operating status of the sensor.

Status	Indicates
OFF	Power is OFF
Blinking @ 2Hz	Transmit disabled
ON stable	Sensor is operating normally

Signal LED (Red) – indicates the strength and condition of the sensor's incoming signal.

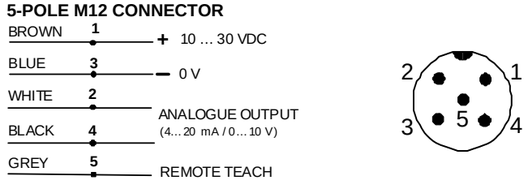
Status	Indicates
ON bright	Good signal
ON dim	Marginal signal strength
OFF	No signal is received, or target is beyond the sensor's range limitations

Output LEDs (Red or Yellow) – indicate the position of the target relative to the window limits.

Status	Indicates
ON Red (either)	In Teach mode; waiting for limit(s) to be taught
Min Analog ON yellow **Max Analog ON yellow**	Target is within analogue window limits
Min Analog ON yellow **Max Analog flashing yellow**	Target is outside max. window limit
Min Analog flashing yellow **Max Analog ON yellow**	Target is outside min. window limit
Min Analog OFF **Max Analog OFF**	No signal condition or outside operating limits

CONNECTIONS

5-POLE M12 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 the 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

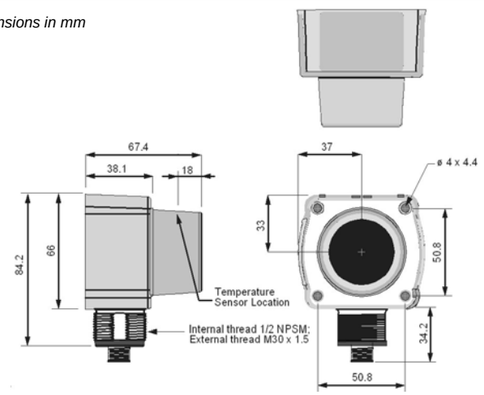
The speed of sound changes roughly 1% per 6° C (10° F).
US50 series ultrasonic sensors have temperature compensation available, via the 8-pin DIP switch.
Temperature compensation will reduce the error due to temperature by about 90%.
NOTE: If the sensor is measuring across a temperature gradient, the compensation will be less effective.

TECHNICAL DATA

Power supply:	10 … 30 VDC reverse polarity protection
Ripple:	≤ 2 Vpp
Consumption (load current excluded):	100mA max. at 10V 40mA max. at 30V
Ultrasonic frequency:	75 kHz burst, rep. rate 96 ms
Analogue output configuration:	**Voltage sourcing: 0…10 VDC** (Short-circuit protection) Min. load resistance = 500 Ω Min.required supply voltage for Full 0-10V Output Span = (1000/RLOAD +13) VDC **Current sourcing: 4…20mA** Max load resistance = 1KΩ or (V supply/0.02-5) Ω whichever is lower Min. required supply voltage for full 4…20mA output span = 10VDC or [(RLOADx0.02)+5] VDC, whichever is greater. 4…20mA output calibrated at 25°C with a 250Ω load.
Response time:	100 ms to 2300 ms
Operating distance (typical values):	200…8000 mm
Temperature effect:	Uncompensated: 0.2% of distance /°C Compensated: 0.02% of distance /°C
Linearity:	± 0.2% of span from 200 to 8000 mm; ± 0.1% of span from 500 to 8000 mm (1mm min.)
Resolution:	1 mm
Minimum reading window size:	20 mm
Indicators:	Power ON LED (GREEN), Signal LED (RED), Output LED (bicolour YELLOW/RED)
Setting:	ANALOG push-button, remote command input (remote teach). Minimum and maximum detection limits can be programmed using the ANALOG push-button or remote input.
Remote input levels:	Connect grey wire to 0 to +2 VDC; impedence 12KΩ
Delay at Power On:	1.5 sec
Operating temperature:	-20 … 70 °C
Storage temperature:	-20 … 70 °C
Maximum relative humidity:	100%
Vibrations:	0.5 mm amplitude, 10…55 Hz frequency, for every axis (EN60068-2-6)
Shock resistance:	11 ms (30 G) shock for every axis (EN60068-2-27)
Reference standard:	EN60947-5-2
Housing material:	ABS polycarbonate
Push-button material:	Polyester
Mechanical protection:	IP67
Connections:	M12 5-poles connector
Weight:	260 g.

DIMENSIONS

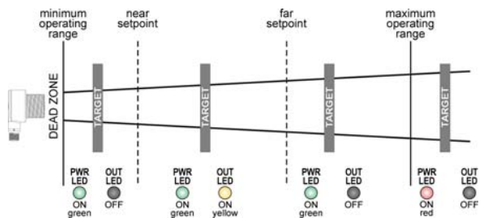
dimensions in mm



SENSOR PROGRAMMING

Two TEACH methods may be used to program the sensor: by teaching individual minimum and maximum limits, or by using the auto-window feature to center a sensing window around the taught position. The sensor may be programmed either via its two push buttons, or via a remote switch. Remote programming may also be used to disable the push buttons, preventing anyone on the production floor from adjusting any of the programming settings. To access this feature, connect the grey wire of the sensor to 0 - 2VDC, with a remote programming switch connected between them.
NOTE: The impedance of the Remote Teach input is 12 k_.Programming is accomplished by following the sequence of input pulses. 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



Positive or negative output slope programming

The sensor may be programmed for either a positive or a negative output slope, depending on which conditions are taught for the Min and Max Analog limits (Fig.1). If the Min Analogue limit is the Near Window setting and the Max Analogue limit is the Far Window setting, then the slope will be positive. If the opposite is true, then the slope will be negative.

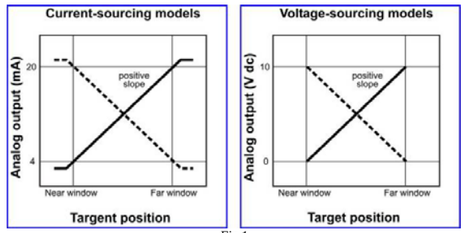


Fig.1

Configuration

The US50 features an 8-pin DIP switch bank for user setup.
The DIP switches are located behind the access cover on the back of the sensor as shown in Fig.2/3.
A spanner tool is included with each sensor for removing the cover.

Fig.2: DIP-switc location

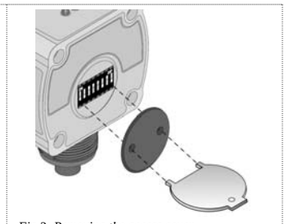


Fig.3: Removing the access cover

Tab.1: DIP Switch Settings

Switch	Function	Settings	
1	Voltage/Current mode	ON = Current mode: 4 to 20 mA OFF* = Voltage mode: 0 to 10 VDC	
2	Loss of echo	ON* = Min-Max mode OFF = Hold mode	
3	Min-max	ON = Default to maximum output value on loss of echo OFF* = Default to minimum output value on loss of echo	
4	Teach/Enable control	ON* = Configured for remote teach OFF = Configured for enable	
5 and 6	**Analogue voltage output response for 95% of step change** 100 ms with 100 ms update 500 ms with 100 ms update* 1100 ms with 100 ms update 2300 ms with 100 ms update	**Switch 5** OFF ON* OFF ON	**Switch 6** OFF OFF* ON ON
7	Temperature compensation	ON* = Enabled OFF = Disabled	
8	Factory calibration	ON = For factory calibration only; switch should be set to OFF for use OFF* = Dip-switch settings in control	

* Factory default settings.

DIP-Switch selectable functions

Switch 1: Output Mode Select
ON = 4 to 20 mA current output is enabled
OFF = 0 to 10 VDC voltage output is enabled
Switch 1 configures the sensor internally to use either the current output or voltage output configuration.

Switch 2: Loss of Echo Mode Select
ON = Min-Max Mode
OFF = Hold Mode
Switch 2 determines the output response to the loss of echo. "Min-Max Mode" (Switch 2 ON) drives the output to either the minimum value or the maximum value when the echo is lost. (Minimum or Maximum value is selected via Switch 3.)
"Hold Mode" (Switch 2 OFF) maintains the output at the value which was present at the time of echo loss.

Switch 3: Min-Max Default
ON = Default to maximum output value at loss of echo (10.5V dc or 20.8 mA)
OFF = Default to minimum output value at loss of echo (0V dc or 3.6 mA)
Switch 3 selects the output response to loss of echo when "Min-Max Mode" is selected via Switch 2. When Switch 2 is OFF, Switch 3 has no function.

Switch 4: Teach/Transmit Enable Control
ON = Grey wire configured for remote teach
OFF = Grey wire configured for transmit enable/disable
High (5 to 30 VDC): Transmit Enabled (Power LED stable ON Green)
Low (0 to 2 VDC): Transmit Disabled (Power LED blinks at 2 Hz)
When Switch 4 is ON, the grey wire is used to teach window limits to the sensors.
When Switch 4 is OFF, the grey wire is used to enable and disable the sensor's transmit burst. The sensor output will react as if a "loss of echo" occurred and either hold the output or change to minimum or maximum value (depending on switch 2 and 3 settings). This function may be used when multiple sensors are in close proximity, which may make them vulnerable to crosstalk interference. A PLC can be used to enable the sensors one at a time to avoid crosstalk.

Switches 5 and 6: Response Speed Adjustment
Switches 5 and 6 are used to set the speed of the output response. The four values for response speed (see DIP switch settings Tab.1) relate to the number of sensing cycles over which the output value is averaged.

Switch 7: Temperature Compensation
ON = Temperature compensation enabled
OFF = Temperature compensation disabled
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. With temperature compensation enabled (Switch 7 ON), the sensor will maintain the window limits to within 1.8 percent over the -20° to +70° C range.

The temperature sensor in the sensor's bezel cannot adapt to temperature change as quickly as an external temperature device can. When there are fast fluctuations in temperature, it may be best to use an external temperature monitor and feed its signal and the uncompensated distance measurement into a controller and perform the compensation calculations within the controller.
Consult the factory for details on performing temperature compensation calculations.

NOTES:
• If temperature compensation is enabled, exposure to direct sunlight can affect the sensor's ability to accurately compensate for changes in temperature.
• With temperature compensation enabled, the temperature warmup drift upon powerup is less than 0.8% of the sensing distance. After 15 minutes, the apparent distance will be within 0.5% of the actual distance. After 30 minutes, the apparent distance will be within 0.3% of the actual distance.

Switch 8: Factory Calibration
ON = Factory calibration only
OFF = Normal operation

Teaching minimum and maximum limits

	Push-button		Remote line	
	Procedure	**Result**	**Procedure** **0.04 s. < T < 0.8 s.**	**Result**
Min Analog Limit	• Push and hold **MIN ANALOG push-button**	- Min Analog LED turns ON Red; sensor is waiting for 0V or 4 mA limit.	- Position the target for the Min Analog limit - Single-pulse the remote line	- Sensor learns the 0V or 4 mA limit - Min Analog LED blinks red once
	• Position the target for the Min Analog limit • Press **MIN ANALOG push-button**	- Sensor learns Min limit; - Min LED changes from Red to Yellow or blinking Yellow		
Max Analog Limit	• Push and hold **MAX ANALOG push-button**	- Max Analog LED turns ON Red; sensor is waiting for 10 VDC or 20 mA limit.	- Position the target for the Max Analog limit - Double-pulse the remote line	- Sensor learns the 10 VDC or 20 mA limit - Max Analog LED blinks red once
	• Position the target for the Max Analog limit • Press **MAX ANALOG push-button**	- Sensor learns Max limit; - Max LED changes from Red to Yellow or blinking Yellow		

Using the Auto-Window feature

	Push-button		Remote line	
	Procedure	**Result**	**Procedure** **0.04 s. < T < 0.8 s.**	**Result**
Min Analog Limit	• Push and hold **MIN ANALOG push-button**	- Min Analog LED turns ON Red	- Position the target at thr location where the midpoint of the window should be. - Triple-pulse the remote line	- Min and Max LEDs both blink Red (0.5 second), then turn Yellow
	• Press **MAX ANALOG push-button**	- Max Analog LED turns ON Red (both the Min and Max Analog LEDs should now be ON)		
Max Analog Limit	• Position the target at the location where the midpoint or the windows should be. • Press either push-button	- Its LED will blink Red		
	• Press the other push-button	- The Red Teach LEDs will change to Yellow and the sensor will return to RUN mode		

Push-button lockout

	Push-button		Remote line	
	Procedure	**Result**	**Procedure** **0.04 s. < T < 0.8 s.**	**Result**
Push-button lockout	• Not available via push-button	- Not applicable	- Four-pulse the remote line	- Push-buttons are either enabled or disabled, depending on previous condition

General Notes on Programming
1. The sensor will return to RUN mode if the limit is not registered within 120 seconds after entering TEACH Mode.
2. Press and hold the programming push button > 2 seconds (before teaching the limit) to exit PROGRAM mode without saving any changes. The sensor will revert to the last saved program.
3. If push buttons do not respond, perform remote lockout procedure to enable push buttons.

CAUTION To avoid damage to the sensor caused by static discharge (ESD), observe proper ESD precautions (grounding) while adjusting the DIP switches.

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

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Helpful links at www.datalogic.com: **Contact Us, Terms and Conditions, Support**.

The warranty period for this product is 36 months. See General Terms and Conditions of Sales for further details.

Under current Italian and European laws, Datalogic is not obliged to take care of product disposal at the end of its life. Datalogic recommends disposing of the product in compliance with local laws or contacting authorised waste collection centres.

826006102 Rev.B

US50 SERIES

- digital output -

ultrasonic sensors

INSTRUCTION MANUAL

CONTROLS

Power ON/OFF LED (Green) – indicates the operating status of the sensor.

Power ON/OFF LED	Indicates
OFF	Power is OFF
ON Stable	Sensor is operating normally
Blinking @ 4Hz	Output is overloaded (RUN mode)
Blinking @ 2Hz	Transmit disabled

Signal LED (Red) – indicates the strength and condition of the sensor's incoming signal.

Signal status	Indicates
ON bright	Good signal
ON dim	Marginal signal strength
OFF	No signal is received*, or target is beyond the sensor's range limitations

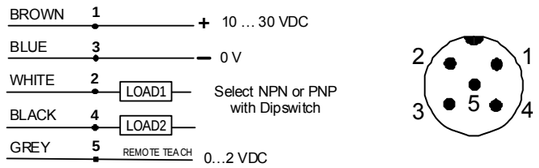
*if no signal is received, the output will react as if the target is beyond the far limit.
In normally open mode, the outputs will be OFF. In normally closed mode, the outputs will be ON.

Output LEDs (Yellow or Red) – indicate the position of the target relative to the window limits.

Output/Teach LED	Indicates
ON Red (stable)	In Teach mode; waiting for first limit to be taught
ON Red (blinking)	In Teach mode; waiting for second limit to be taught
ON Yellow	Target is within window limits (normally open mode)
OFF	Target is outside window limits (normally open mode)

CONNECTIONS

5-POLE M12 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 the 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

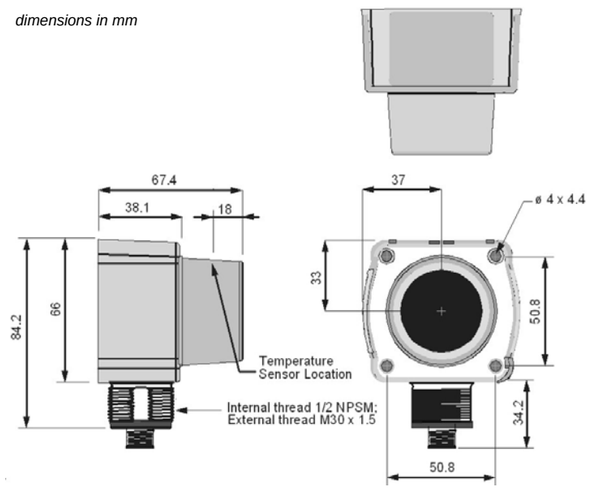
The speed of sound changes roughly 1% per 6° C (10° F). QT50U series ultrasonic sensors have temperature compensation available, via the 8-pin DIP switch.
Temperature compensation will reduce the error due to temperature by about 90%.
NOTE: If the sensor is measuring across a temperature gradient, the compensation will be less effective.

TECHNICAL DATA

Power supply:	10 … 30 VDC reverse polarity protection
Ripple:	≤ 2 Vpp
Consumption (load current excluded):	100mA max. at 10V 40mA max. at 30V
Ultrasonic frequency:	75 kHz burst, rep. rate 96 ms
Digital output configuration:	NPN or PNP, selectable via DIP switch
Output ratings:	150 mA max. **OFF-state leakage current:** < 5 µA **Output saturation NPN:** < 200 mV @ 10 mA and <650 mV @ 150 mA **Output saturation PNP:** < 1.2V @ 10 mA and <1.65V @ 150 mA
Response time:	100 ms to 1600 ms
Operating distance (typical values):	200…8000 mm
Temperature effect:	Uncompensated: 0.2% of distance /°C Compensated: 0.02% of distance /°C
Hysteresis:	5 mm
Repeatability:	1 mm
Minimum reading window size:	20 mm
Indicators:	Power On LED (GREEN), Signal LED (RED), Output LED (bicolour YELLOW/RED)
Setting:	Teach-in push-button or remotely via TEACH input
Remote Teach:	Connect grey wire to 0 to +2 VDC; impedence 12KΩ
Delay at Power On:	1.5 sec
Operating temperature:	-20 … 70 °C
Storage temperature:	-20 … 70 °C
Maximum relative humidity:	100%
Vibrations:	0.5 mm amplitude, 10…55 Hz frequency, for every axis (EN60068-2-6)
Shock resistance:	11 ms (30 G) shock for every axis (EN60068-2-27)
Reference standard:	EN60947-5-2
Housing material:	ABS polycarbonate
Push-button material:	Polyester
Mechanical protection:	IP67
Connections:	M12 5-poles connector
Weight:	260 g

DIMENSIONS

dimensions in mm



SENSOR PROGRAMMING

Three 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, or
- Simultaneously use Auto-Window and position a threshold for background suppression at the taught position.

The sensor may be programmed either via its two push-buttons, or via a remote switch. Remote programming also may be used to disable the push-buttons, preventing unauthorized personnel from adjusting the programming settings. To access this feature, connect the grey wire of the sensor to 0-2VDC, with a remote programming switch between the sensor and the voltage.
NOTE: The impedance of the Remote Teach input is 12 kohm. Programming is accomplished by following the sequence of input pulses. 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

Configuration

The US50 features an 8-pin DIP switch bank for user setup.
The DIP switches are located behind the access cover on the back of the sensor as shown in Fig.2/3. A spanner tool is included with each sensor for removing the cover.

Fig.1: DIP-switc location

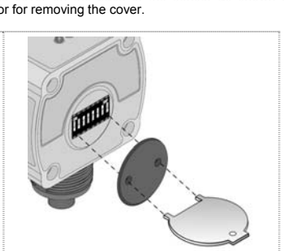


Fig.2: Removing the access cover

Tab.1: DIP Switch Settings

Switch	Function	Settings	
1	PNP or NPN select	ON = Both outputs set for PNP OFF* = Both outputs set for NPN	
2	Window / Fill level	ON = High / Low (fill level control) OFF* = ON/OFF (window)	
3	Output operation	**Window selected on Switch 2:** ON* = Normally open OFF = Normally closed **Fill selected on Switch 2:** ON = Pump-in OFF = Pump-out	
4	Teach/Disable control	ON* = Configured for remote teach OFF = Configured for transmit disable	
5 and 6	**Response (100 ms/cycle)** 1 cycle 4 cycles* 8 cycles 16 cycles	**Switch 5** OFF ON* OFF ON	**Switch 6** OFF OFF* ON ON
7	Temperature compensation	ON* = Enabled OFF = Disabled	
8	Factory calibration	ON = For factory calibration only; switch should be set to OFF for use OFF* = Dip-switch settings in control	

* Factory default settings.

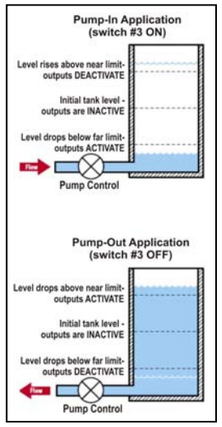
DIP-Switch selectable functions

Switch 1: Output Mode Select
ON = Both outputs set to PNP (current sourcing)
OFF = Both outputs set to NPN (current sourcing)
This switch configures the sensor internally to use either the PNP or NPN output configuration.

Switch 2: High/Low Level Control
ON = High/Low (fill level control)
OFF = ON/OFF (window)
This switch determines whether the sensor is in fill level control mode or ormal ON(OFF mode. The fill level control is shown in figure . When switch 2 is ON, the switch 3 setting will determine whether the sensor is set up for pump-in or pump-out operation.

Switch 3: ON/OFF Mode
ON = Normally open (output is energized when the target is within window)
OFF = Normally closed (output is energized when the target is outside window)

Switch 4: Teach/Transmit Enable Control
ON = Grey wire configured for remote teach
OFF = Grey wire configured for transmit disable
High (5…30 VDC or open): Transmit Enabled (Power LED stable ON Green)
Low (0…2 VDC): Transmit Disabled (Power LED blinks at 2 Hz)
When Switch 4 is ON, the grey wire is used to teach the sensor's window limits.
When Switch 4 is OFF, the grey wire is used to enable and disable the sensor's transmit burst. This function may be used when multiple sensors are operating I close proximity and may be vulnerable to cross-talk interference. A PLC can be used to enable the sensors one at time to avoid cross-talk. When disabled, the sensor outputs will react as if no target is being sensed.



Switches 5 and 6: Response Speed Adjustment
The speed of the output response is set using DIP-switch 5 and 6 (see DIP switch settings Tab.1). There are four values for response speed, which relate to the number of sensing cycles over which the output value is averaged.

Switch 7: Temperature Compensation
ON = Temperature compensation enabled
OFF = Temperature compensation disabled
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. With temperature compensation enabled (Switch 7 ON), the sensor will maintain the window limits to within 1.8 percent over the -20° to +70° C range.

Teaching minimum and maximum limits

The outputs are independent. To readjust minimum or maximum limits for either output, follow the teach procedure for that output only. Repeat the teach procedure for the other output, if used.

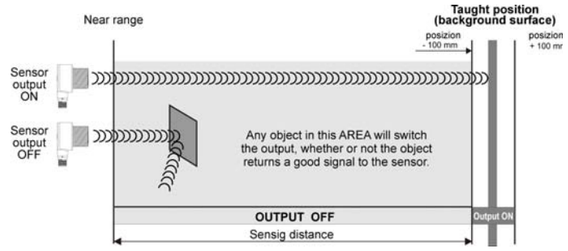
	Procedure		Result
	Push-button	**Remote Wire** **0.04 sec. < T < 0.8 sec.**	
Programming mode	• Push and hold push-button for selected output	No action required	• Corresponding output LED turns ON red • Sensor waits for first limit
Teach first limit	• Position the target for the first limit • "Click" the same push-button	- Position the target for the first limit **Output 1**: - Single-pulse the remote line **Output 2**: - Double-pulse the remote line	• Sensor learns the first limit position • LED for selected output changes to blinking red
Teach second limit	• Position the target for the second limit • "Click" the same push-button	- Position the target for the second limit - Single-pulse the remote line	• Sensor stores both limits • LED for selected output turns ON yellow

Teaching Limits Using the Auto-Window feature

Teaching the same limit twice for the same output automatically centers a 200 mm window on the taught position. The outputs are independent. To readjust a midpoint for either output, follow the teach procedure for that output only. Repeat the teach procedure for the other output, if used.

CAUTION
To avoid damage to the sensor caused by static discharge (ESD), observe proper ESD precautions (grounding) while adjusting the DIP switches.

	Procedure		Result
	Push-button	**Remote Wire** **0.04 sec. < T < 0.8 sec.**	
Programming mode	• Push and hold push-button for selected output	No action required	• LED for the selected output turns ON red • Sensor waits for first limit
Teach limit	• Position the sensor for the midpoint of the sensing window • "Click" the same push-button	- Position the target for the midpoint of the sensing window **Output 1**: - Single-pulse the remote line **Output 2**: - Double-pulse the remote line	• LED for the selected output blinks red
Re-Teach limit	• Without moving the target, "click" the button again	- Without moving the target, single-pulse the remote line again	• LED for the selected output turns ON yellow • Sensor stores window for the selected output • Sensor returns to RUN mode



Simultaneous Auto-Window/Background Suppression

Output 1: Auto-Window (automatically centers a 200 mm window on taught position)
Output 2: Background suppression (sensor ignores object beyond the taught position)
Taught position is identical for both outputs.
To adjust the background suppression limit (different from the limit for output 1), teach a new limit to output 2 using the Auto-Window. Output 2 will remain in background suppression mode until is taught new min/max limits.

	Procedure		Result
	Push-button	**Remote Wire** **0.04 sec. < T < 0.8 sec.**	
Programming mode	• Push and hold Output 1 push-button • "Click" Output 2 push-button	No action required	• Output 1 LED turns ON red • Output 2 LED turns ON red (both output LEDsshould be ON red)
Teach limits to both outputs simultaneously	• Position the target at the sensing window midpoint/suppression limit • "Click" either push-button again	- Position the target at the ensong window midpoint /suppression limit - Triple-pulse the remote line	• Both output LEDs blinks red
	• "Click" either button again	- Single-pulse the remote line	• Both output LEDs turn ON yellow • Sensor stores window on output 1 and suppression limit on output 2 • Sensor returns to RUN mode

Push-button Lockout

Enables or disables the Keypad to prevent unauthorized personnel from adjusting the programming settings.

	Push-button		Remote Line	
	Procedure	**Result**	**Procedure** **0.04 sec. < T < 0.8 sec.**	**Result**
Programming mode	• Not available via push-button	Not applicable	• Four-pulse the remote line	• Push-buttons are either enabled or disabled, depending on previous condition

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