Thank you for choosing NIVELCO instrument.

1. APPLICATION

The MICROSONAR proximity sensor works using the ultrasound echo principle and is suitable for measuring the distances of planar or cylindrical objects. The measurement can only be accomplished if the space between the unit and the target is free of obstacles and if the target has good reflection characteristics. The output of the unit is either an analogue signal depending on the distance, or a distance-controlled switch.

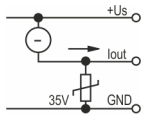
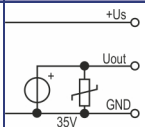
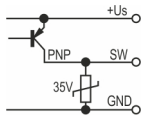
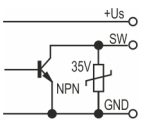
2. TECHNICAL DATA

2.1 GENERAL DATA

		UT□–211	UT□–212	UR□–213 UR□–214	UTP–261	UTP–262	URP–263 URP–264
Nominal range	X_{min}	0.2 m (7.85")			0.4 m (15.75")		
	X_{max}	1.0 m (3.3 ft)			6.0 m (20 ft)		
Ultrasound frequency		160 kHz			60 kHz		
Total beam angle		5					
Measurement cycle (T_p)		25 ms			80 ms		
Resolution		0.25 mm (.01")		0.1 mm (.004")	1.5 mm (.06")		0.1 mm (.004")
Output		4…20 mA	0…10 V	switch	4…20 mA	0…10 V	switch
Programming		Via contact with a PRG cable, or via magnet					
Ambient temperature		–20…+70 °C (–4…+158 °F)					
Power supply		10.8…30 V DC					
Consumption U_s = 12 V		< 55 mA	< 41 mA	< 31 mA (1)	< 54 mA	< 40 mA	< 30 mA*
Consumption U_s = 24 V		< 63 mA	< 49 mA	< 39 mA (1)	< 61 mA	< 47 mA	< 37 mA*
Input protection		Reverse polarity, surge, ESD					
Integrated cable		Shielded cable with PVC-coating L = 3 m (10 ft)					
Cable core		4 x 0.5 mm² (AWG20)					
Electric protection		Class III					
Ingress protection		U□S–21□: IP67, U□P–21□: IP68			IP68		
Housing material		U□S–: stainless steel with PP covering U□P–: PP housing			PP housing potted with resin		
Mass		400 g (0.88 lb)			530 g (1.15 lb)		

(1) Unloaded

2.2 OUTPUT DATA

	UT□–2□1–4	UT□–2□2–4	UR□–2□3–4	UR□–2□4–4
Output				
Voltage rating	-	-	Max. 30 V DC	
Current rating	-	-	Max. 200 mA	
Residual voltage	-	-	< 2,5 V	
Switching delay or Settling time Tb (2)	U□□–21□–4: 25, 100, 200, 400 ms (a=1, 4, 8, 16) (3)			
	U□□–26□–4: 80, 320, 640, 1280 ms (a=1, 4, 8, 16) (3)			
Temperature error	±0.02% / °C			
Linearity error	±0.35%		-	-
Repeatability	1.5 mm (.06")		1 mm (.04")	
Output signal	4...20 mA	0…10 V (U_s > 13 V)	-	-
Load resistance	≤ 500 Ω (U_s > 14 V)	≥ 1 kΩ	-	-
Output protection	EMC	Short circuit, EMC	Short circuit, overload, EMC	

(2) under good reflection conditions (3) value of **"a"** can be programmed (see under 5.1)

2.3 ACCESSORIES

- User's Manual,
- Warranty Card
- EU Declaration of Conformity
- Magnetic screwdriver

2.4 ORDER CODE (NOT ALL COMBINATIONS AVAILABLE)

MICROSONAR U □ □ – 2 □ □ – 4

Function	Code
Switch	R
Transmitter	T

Housing / Protection	Code
Plastic (PP) / IP68	P
Stainless steel	S

Range	Code
0.2…1.0 m	1
0.4…6 m	6

Output	Code
4…20 mA	1
0…10 V	2
PNP switch	3
NPN switch	4

NIVELCO

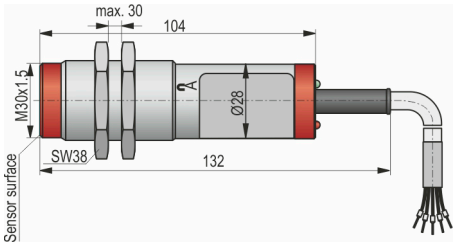
MICROSONAR

U-200
ULTRASONIC PROXIMITY SENSORIES

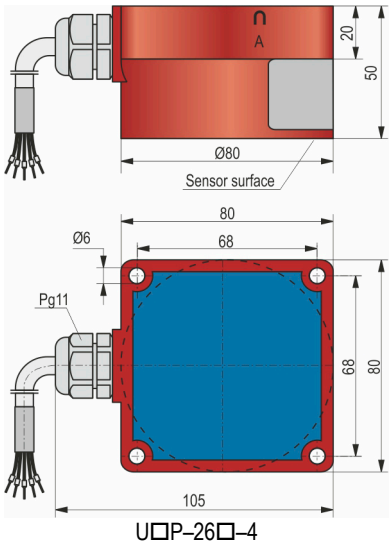
USER'S MANUAL

Manufacturer:
NIVELCO Process Control Co.
H-1043 Budapest, Dugonics u. 11.
Tel.: +36-1-889-0100
E-mail: sales@nivelco.com www.nivelco.com

2.5 DIMENSIONS



U□S–21□–4



U□P–26□–4

3. INSTALLATION

The unit should be installed stably and in a vibration-free manner, according to the recommended installation method.

Pipe-enclosure units should be fixed to a mounting plate with a hole of ∅31 mm (∅1.22") using the nuts supplied to hold the plate in the middle. Units with flat enclosure can be mounted to the wall or any flat surface laid on its backside, using the four nuts. Cables should be free of tension and LEDs should be visible.

In case of limited space, the path of the ultrasonic beam may be redirected by a metal sheet as below (Figure 1).

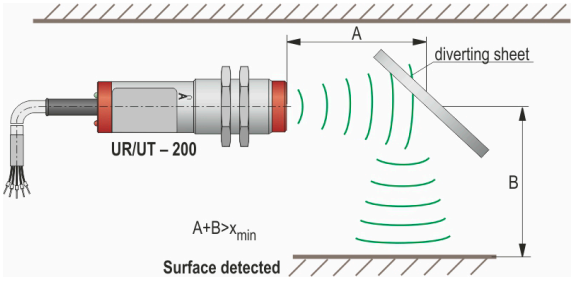
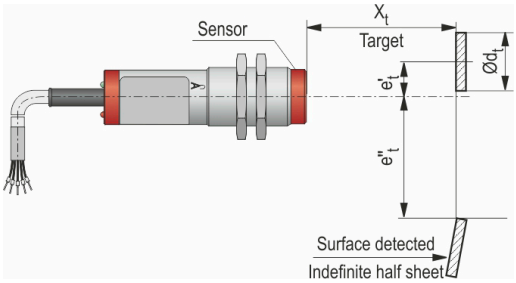
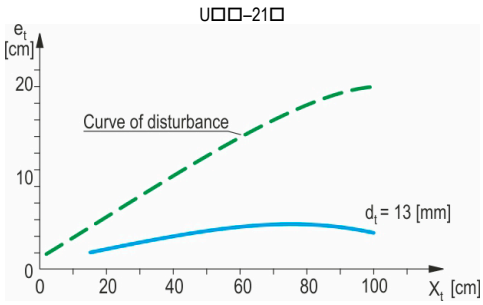


Figure 1
Redirection of the ultrasonic beam using a reflective surface





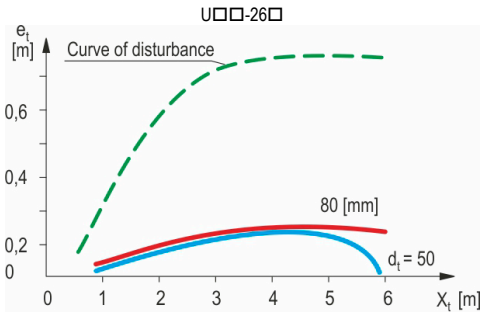
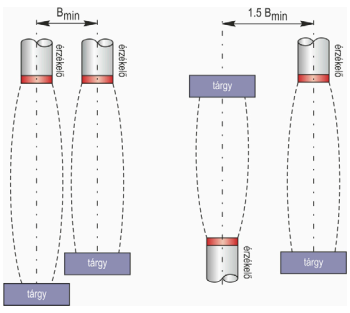


Figure 2
Limits of disturbance and sensing



	B_min [m]
U□□-21□	0.25
U□□-26□	0.75

Figure 3
Minimum distance of units working parallel next to each other

Figure 2 shows the distance (e't) within which the unit senses the target as well as the distance (e"t) outside of which disturbing objects do not disturb the operation of the unit. Units with the same frequency may mutually disturb each other as sent or reflected ultrasound may reach the other unit. To avoid such interference, units with parallel axes should be installed outside of the minimum distances as per Figure 3. Greater minimum distances might be required for applications with targets with round reflecting surfaces (like pipes) that involve side reflections.

4. WIRING

Wiring should be carried out in accordance with Figure 4 and Figure 5 taking into consideration the color of the wires as per Table 1.

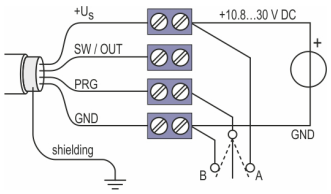


Figure 4
Wiring during programming

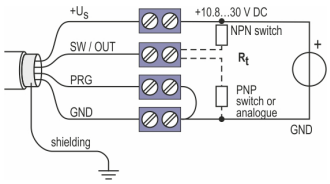


Figure 5
Wiring during operation

	Cable	Color*
UT□–2□1–4 UT□–2□2–4	+U_S	brown
	I_UOT or U_OUT	green
	PRG	white
	GND	yellow
	shielding	blue
UR□–2□3–4 UR□–2□4–4	+U_S	brown
	SW	green
	PRG	white
	GND	yellow
	shielding	blue

** The grey cable with isolated ending is only for service purposes*

Table 1
Cable colors

5. COMMISSIONING, OPERATION AND PROGRAMMING

5.1 COMMISSIONING, OPERATION

Following the power up, the unit will run a self-test routine for 5 seconds. During the self-test all three LEDs are lit. In the event of a failure all the LEDs will blink at the same rate.

Interpretation of the LED states during proper operation:

Green: Blinks at the rate of the measurement.
(lights continuously at high frequencies)

Yellow: Lights up continuously in the case of valid echo.

Red: Lights up if the unit senses a disturbance signal within the minimum measuring range (e.g., bad installation) or if the target is too close. In this case an error will be indicated by the output

The UR□–2□3–4 devices compare the measured distance with the two pre-programmed (X_A and X_B) distances and switch in accordance with Figure 6.

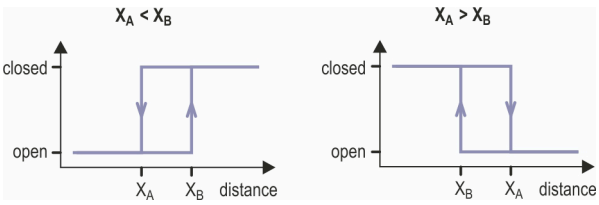


Figure 6
Transfer characteristic of units with switch output

Within the two pre-programmed distances the output signal of the UT☐–2☐1 –4 and the UT☐–2☐2–4 transmitters are proportional to the distance in accordance with Figures 7 and 8.

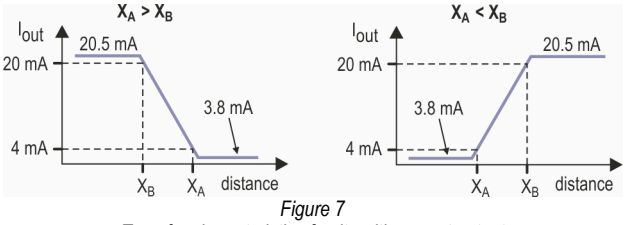


Figure 7
Transfer characteristic of units with current output

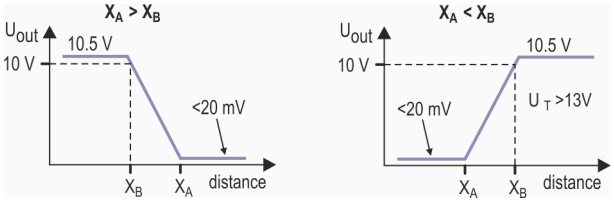


Figure 8
Transfer characteristic of units with voltage output

After the first power up the unit will work with the factory settings and afterwards the characteristic configuration is as can be seen below:

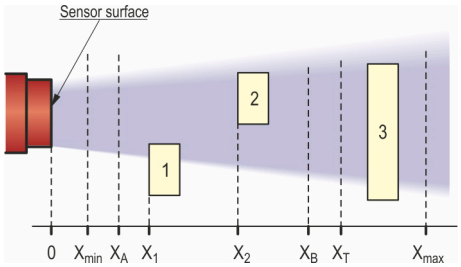
SWITCHES: $X_A = X_{max}/2$, $X_B = X_A + 0.1$ m

TRANSMITTERS: $X_A = X_{min}$, $X_B = X_{max}$

Distance parameters X_A, and X_B can be changed by programming by placing a good reflecting target at the distance to be programmed and by selecting the relevant menu. The unit will measure and store (learn) the distance.

MICROSONAR receives the echo coming from the nearest reflecting surface within the range. The range of the unit with Factory Setting is between X_{min} and X_{max}. (Nominal range)

If the target is moving within smaller range it is advisable to reduce the range by far-end blocking which should be done by programming the limit of X_T.
Factory default $X_T = X_{max}$



Targets present	Measured distance
1, 2, 3	X_1
2, 3	X_2
3	Error

Figure 9

Far-end blocking will prevent evaluation of echoes beyond X_T. Should the echo be lost for any reason (unstable echo, intensive movement of air), the object behind X_T will not be taken into consideration but an error will indicate the lack of a valid echo.

Error indication at the output of different units:

SWITCH STATUS: off (open)

TRANSMITTER I_{OUT} = 3.6 mA

TRANSMITTER U_{OUT} = 0 V

The signal processing of the unit can be adapted to the most diverse requirements and conditions of an application. The two programmable parameters influencing signal processing are the averaging number and the number of discarded echoes.

Averaging number: **a** (1, 4, 8, 16)

To reduce random measurement errors the unit will not provide output on the basis of a single measurement but by taking the average of the last **a** number of distance samples.

Increasing the averaging number reduces the small fluctuation of the output signal caused by the uncertain movement of the target or by measurement error (caused by noise). On the other hand, this will cause a speed-dependent target tracking error which disappears after a $\mathbf{a \cdot T_p}$ settling time or switching delay

Number of discarded echoes: **k** (1, 3, 5, 10)

Under disadvantageous conditions (air movement, not perpendicular or bad reflecting surfaces) some of the echoes may miss the sensor. Paying immediate attention to this, might lead to frequent error indication and big measurement errors. Therefore, the unit first checks the measured distance to verify that it is within range.

Measured distances outside the range will be disregarded during average calculation and the output signal maintains the former value. The unit can disregard **k** number of consecutive distance samples before an error will be indicated.
If due to bad reflection a substantial number of echoes are lost and the number of invalid (incorrect) echoes between two valid ones, is smaller than **k** the unit will maintain the output signal continuously. The greater the programmed value of **k**, the less sensitive the unit will be to invalid echoes but the reaction time for error indication will increase. To maintain continuous operation the programmed range should be kept as narrow as possible (with far-end blocking).
The greater the speed of the target the smaller the chosen averaging number should be. The worse the reflection of the target the higher the chosen value of **k** (number of discarded echoes) should be.

5.2 PROGRAMMING

1. Touch-Magnet Programming

The magnetic screwdriver (with its cap removed) should be used to touch the points on the enclosure marked **A** or **B** according to Figure 10. These steps will hence be indicated as **A** or **B**.

Touch-Magnet Programming is only possible if it is not disabled and the PRG wire is free. Disabling can be programmed by both Touch-Magnet Programming or by cable contacting, but it can only be undone by cable contacting.

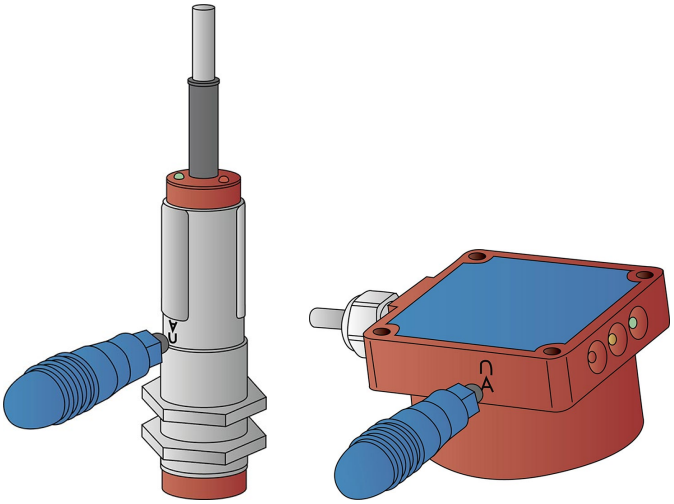


Figure 10
Position of the magnetic screwdriver during programming

2. Programming via cable contact

The steps **A** or **B** can be realized by connecting the PRG wire to $+U_S$ or GND respectively.

This can be done by using either the switch or two push buttons connected for the period of the programming, or by simply connecting the ends of the cables.

Different states in the programming procedure are indicated by the three LEDs. Steps **A** and **B** (magnet touch, wire connection) should be maintained till the effect will be indicated by the relevant change of the LED status.

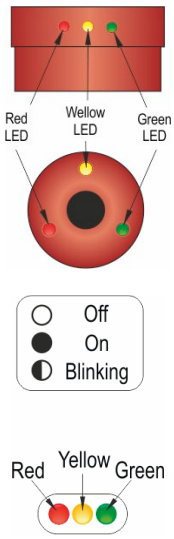


Figure 11
Arrangement of the LEDs and LED state interpretation in the manual

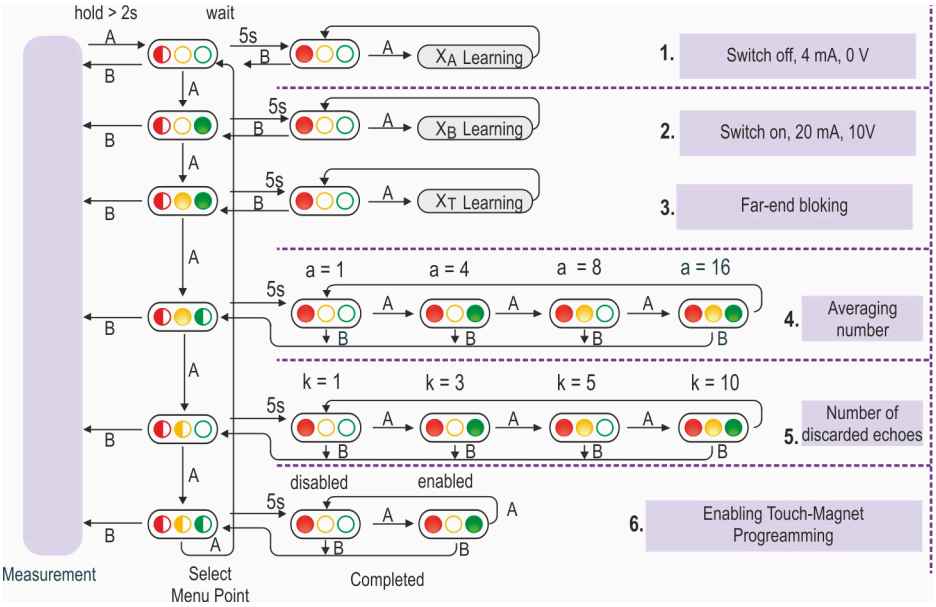


Figure 12
Procedure of the programming

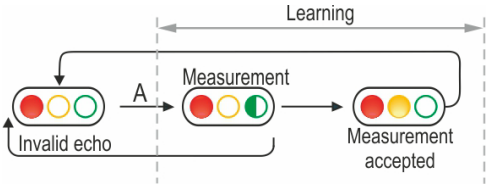


Figure 13
Indication while learning

To enter programming mode: hold step **A** for 2 s
To quit programming mode: hold step **B**
Once in Programming mode, the red LED will start blinking, and the yellow and green LED s go off.
While in programming mode (with the red LED blinking) every step **A** will move the device to the next Menu item. The six different Menu items are indicated by a combination of the states of the yellow and green LEDs.

About 5 seconds after selecting a Menu item and if there is no step **A** or **B**, then the unit will automatically start to execute the menu item. In this case, the red LED goes on continuously. In the first four Menu Points learning should be initiated by step **A**. Blinking of the green LED indicates measurement during learning. On getting a valid echo the yellow LED will light up and the relevant numeric value of the measured distance appears on the output (for instance with measured distance of 0.4 m the output will be 0.4 mA or 0.4 V!) With repeated step **A** a new distance can be learnt and the old one will be overwritten. Step **B** will finalize learning and result in return to the Menu item selection. Another Step **B** will make the device quit Programming Mode.
Parameters **a** and **k** can be programmed using Steps **A** and **B** in Menu item 4 and 5
Touch-Magnet programming can be enabled or disabled in Menu item 6 using step **A**. Disabling of the Touch-Magnet Programming by the use of the magnet will be completed after quitting Programming Mode.
During Touch-Magnet Programming the Wire-Contact Programming is disabled and vice versa.
If the unit is left in Programming Mode for more than 10 seconds, it will quit automatically. After programming is done connect the PRG wire to the GND.

Loading factory settings

Disconnect the unit's power supply. Before powering on again, connect the PRG wire to the +Us. After powering on first the green, then the yellow and then the red LEDs will start blinking one after another. Wait until all three LEDs stop blinking and disconnect the PRG wire from +Us. The device will now measure using the default factory settings. Reconnect the PRG wire to the GND.
In a very noisy environment, before powering on, make sure that the PRG wire is connected to the GND, otherwise on powering on, the device may load the default factory settings.

Example: assignment of X_B

Place a target at a distance (X_B) from the unit to which you want to assign 20 mA or 10 V or to trigger the switch-on. In the distance learning procedure, X_T will be disregarded.
Hold the magnet to point **A** till the red LED begins to blink (we are now in the first menu item in the Programming Mode). Remove the magnet and hold it to point **A** again to step to the second Menu item. The red LED will be blinking, the yellow one will go off and the green one go on (we have now stepped to the second menu item). Remove the magnet and wait (approximately 5s) until the red LED goes on continuously. (ready for learning). Hold the magnet again to point **A** (learning started). The green LED starts to blink (representing measurement) then goes off (measurement completed) and the yellow LED will light up for a short time (implying valid echo). After the learning process has been completed the green LED goes off. Then place, remove and place the magnet to point **B** again to quit the menu item selection and Programming Mode respectively.

6. MAINTENANCE, REPAIR

The device does not require regular maintenance. The warranty card contains the terms and conditions. In some very rare instances however, the deposited material on the transducer may need to be cleaned from the echo surface**.** This must be carried out gently, without scratching or pressing or hitting the surface of the transducer.
Before returning the device for repairs, it must be cleaned thoroughly. The parts in contact with the medium may contain harmful substances; therefore, they must be decontaminated.
Our official form (Returned Equipment Handling Form) must be filled and enclosed in the parcel. Download it from our website nivelco.com. The device must be sent back with a declaration of decontamination. A statement must be provided in the declaration that the decontamination process was successfully completed and that the device is clean from any hazardous substances.

7. STORAGE

Ambient temperature:	–20…+70 °C (–4…+158 °F)
Relative humidity:	max. 98%

urp263en06h02
September 2006