SONDAR 3000-S

Ultrasonic Sludge Level Meter

USER MANUAL V. 3.0

IS Technologies Co., Ltd.

SONDAR 3000

August 2003 Edition

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Chapter 1 Introduction

About SONDAR 3000

The Sondar3000 is a highly developed ultrasonic level measurement system which provides non-contacting sludge level measurement for a wide variety of applications.

The Sondar3000 measures and controls the solid/liquid interfaces in clarifiers, thickners, settling tanks and other similar vessels. It also provides a hinged swing bracket ("skimmer protector") that secures surface skimmer passage.

The graphic LCD display shows the echo profile as graphic image and the percentage of current value of span with bar graph. The Sondar3000 applies not only wastewater treatment plants (clarifiers) but also various slurry processes in most industries.

*Some of the features of **Sondar 3000** includes* ;

* Simple calibration
* Various kinds of sludge applicable
* 2 programmable set point relays
* Rag & Sludge level display
* Auto sensor cleaning (option)
* Multi-points measurement up to 2 channels

Product Specification

Physical

Dimensions	**controller**	192(Width). x 241(height) mm
	sensor	Refer to the drawing
	mounting	3/4 inch NPT
	weight	5.5kg
	sensor material	STS316

Environmental

IP Rating (electronics housing)	IP65 (Controller)
Max. & Min. temperature (electronics)	-20 ºC to +60 ºC (Controller), -20 to +70°C (Sensor)
Pressure	up to 2 Bar
RTX cable length	Max 100m (Consult with local engineer when extension is required)

Performance

Accuracy	Less than 1% at measured range or 2cm, which is greater.
Resolution	1mm
Measuring range	0~ 10 m (Distance is 0.5m~10m)
Beam Angle	14^{o} at -3dB.
Displayed value	Sludge Level, Rag Level, Percentage of Current Output, Relay status
Temperature Compensation	Fully compensated

Outputs

Analogue output	4-20mA into Max 600Ω (user adjustable) Fault condition Alarm 3.8mA /Hold/21mA
Setpoint Relay	2 SPDT Relays
Relay capacity	5A, AC250V

Programming

On-board programming via 5 tactile push button keys

Supply

Power supply AC 90 ~ 260V, Less than 15VA(50Hz ~ 60Hz), DC24V(Option)

Chapter 2 Installation

Sondar 3000-S is composed of a controller unit and one sensor

Power Supply Requirements

The **Sondar 3000** operates from a AC supply of 90 –260V, DC24V(Option)

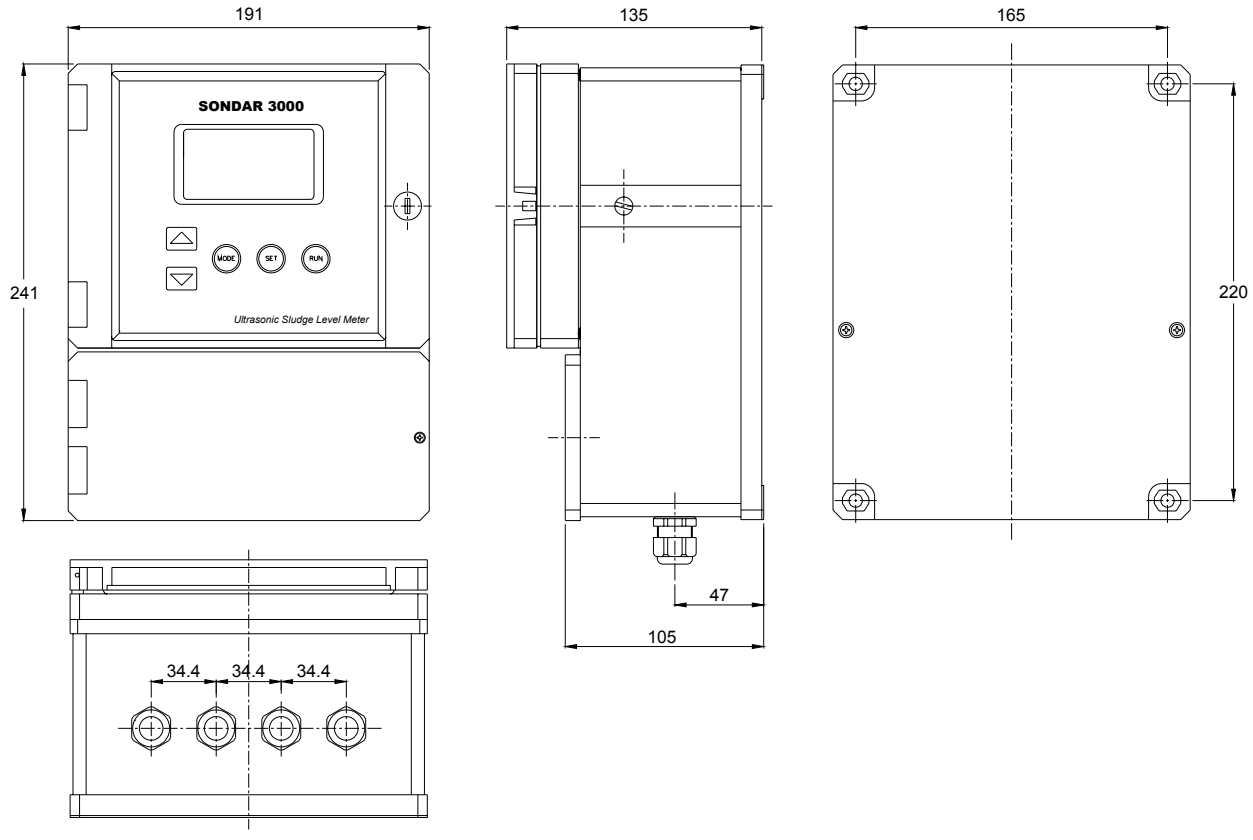
> *All electronic products are susceptible to electrostatic shock, so follow proper grounding procedures during installation.*

When choosing a location to mount the sensor, bear in mind the following:

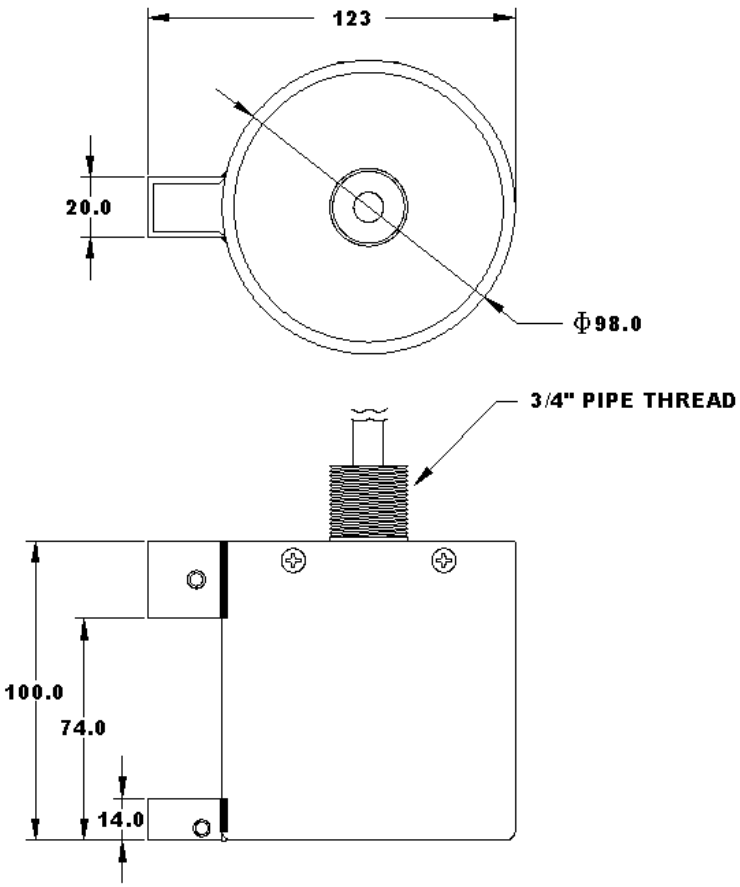
- For easy access to the LCD display and programming buttons mount it where it is easily accessible.
- The sensor should be mounted at least 50cm above the maximum level of the material and be perpendicular to the bottom of clarifier or tank sludge.
- The mounting surface should be vibration-free.
- The ambient temperature of the sensor is between -20ºC and 70ºC.
- There should be no high voltage cables or electrical inverters close by.

Dimensions

Controller



Sensor

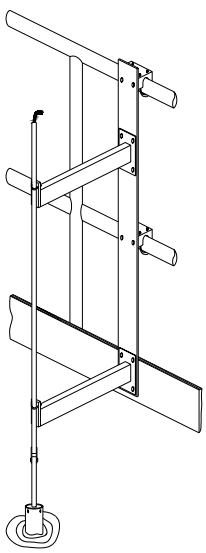


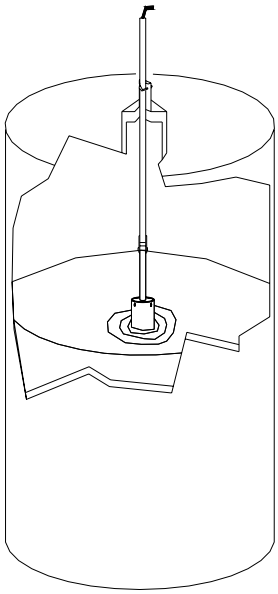
Sensor Installation

There are 4 basic conditions to avoid malfunction and to measure the sludge level correctly.

* The Sensor should be immersed into the liquid.
* Make sure there are no obstacles in the 14° beam path of the pulse.
* The sensor should be perpendicular to the bottom of clarifier/ tank of liquid
* Input the correct empty value.

Examples of typical installation





Important

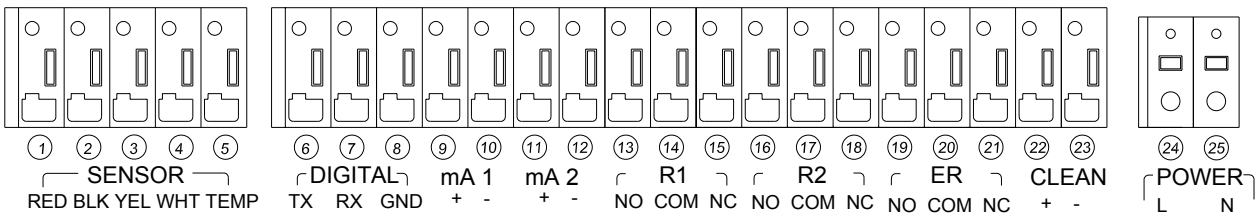
- In case the bottom of the sensor is shown by change in liquid level, please immerse the sensor into the liquid
- The sensor should be perpendicular to the bottom of clarifier / tank.

Distance from the sensor to the surface of sludge	Distance from the wall of tank to the sensor
2m	70cm
3m	100cm
4m	130cm
5m	160cm
6m	190cm
7m	210cm
8m	240cm
9m	270cm
10m	300cm

Terminal Connection

25 terminals are aligned inside the terminal box.

Input & Output Terminal

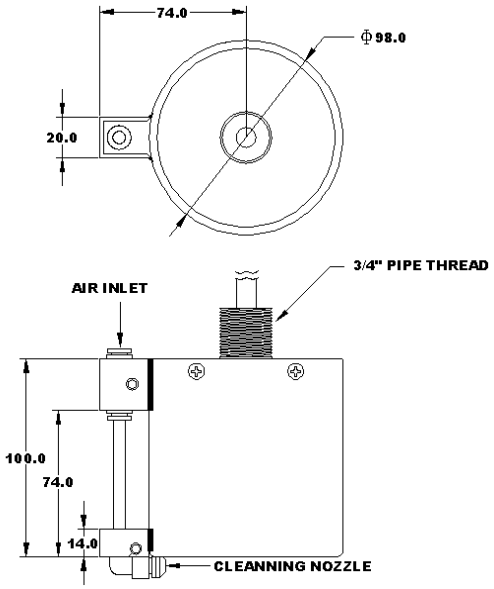


Function

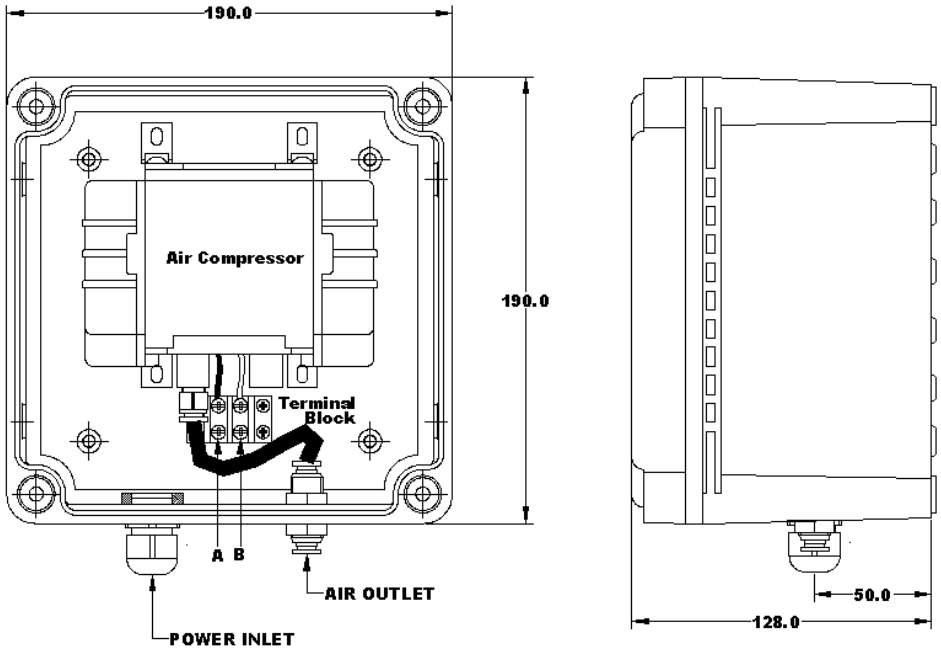
Terminal	Function	Note
	SENSOR	
①RED	Power supply	Red cable
②BLK	Ground	Black cable
③YEL	Operation signal	Yellow cable
④WHT	Signal reception	White cable
⑤TEMP	Temperature	Blue cable
	DIGITAL	
⑥TX	Transmission	RS232/485(Option)
⑦RX	Reception	RS232/485(Option)
⑧GND	Ground	RS232/485(Option)
	mA 1	
⑨+	Rag Level current output(+)	4~20mA outputs proportional to Rag level
⑩-	Rag Level current output(-)	
	mA 2	
⑪+	Sludge Level current output(+)	4~20mA outputs proportional to Sludge level
⑫-	Sludge Level current output(-)	
	R1	
⑬NO	Relay1 NO contact point. When the relay1 operates, NO and COM have a short circuit	High Alarm User programming
⑭COM	Relay1 COM contact point. When the relay1 is in operation, COM and CO have a short circuit. When the relay1 is not in operation, COM and NC have a short circuit	
⑮NC	Relay1 NC contact point. When relay1 is not in operation, NC and COM have a short circuit	
	R2	
⑯NO	Relay2 NO contact point. When the relay2 is in operation, NO and COM have a short circuit.	Low Alarm User programming
⑰COM	Relay2 COM contact point. When the relay2 is in operation, COM and CO have a short circuit. When relay2 is not in operation, COM and NC have a short circuit	
⑱NC	Relay2 NC contact point. When the relay2 is in operation, NC and COM have a short circuit.	
	ER	
⑲NO	Error relay NO contact point. When the error relay is in operation, NO and COM have a short circuit.	Fault Alarm User programming
⑳COM	Error relay COM contact point. When the error relay is in operation, COM and CO have a short circuit. When the error relay is not in operation, COM and NC have a short circuit.	
㉑NC	Error relay NC contact point. When error relay is not in operation, NC and COM have a short circuit.	
	CLEAN	
㉒+	Sensor cleaning	Option
㉓-	Sensor cleaning	Option
	POWER	
㉔L	AC power supply	
㉕N	AC power supply	

Cleaning Unit (Option) – CU412

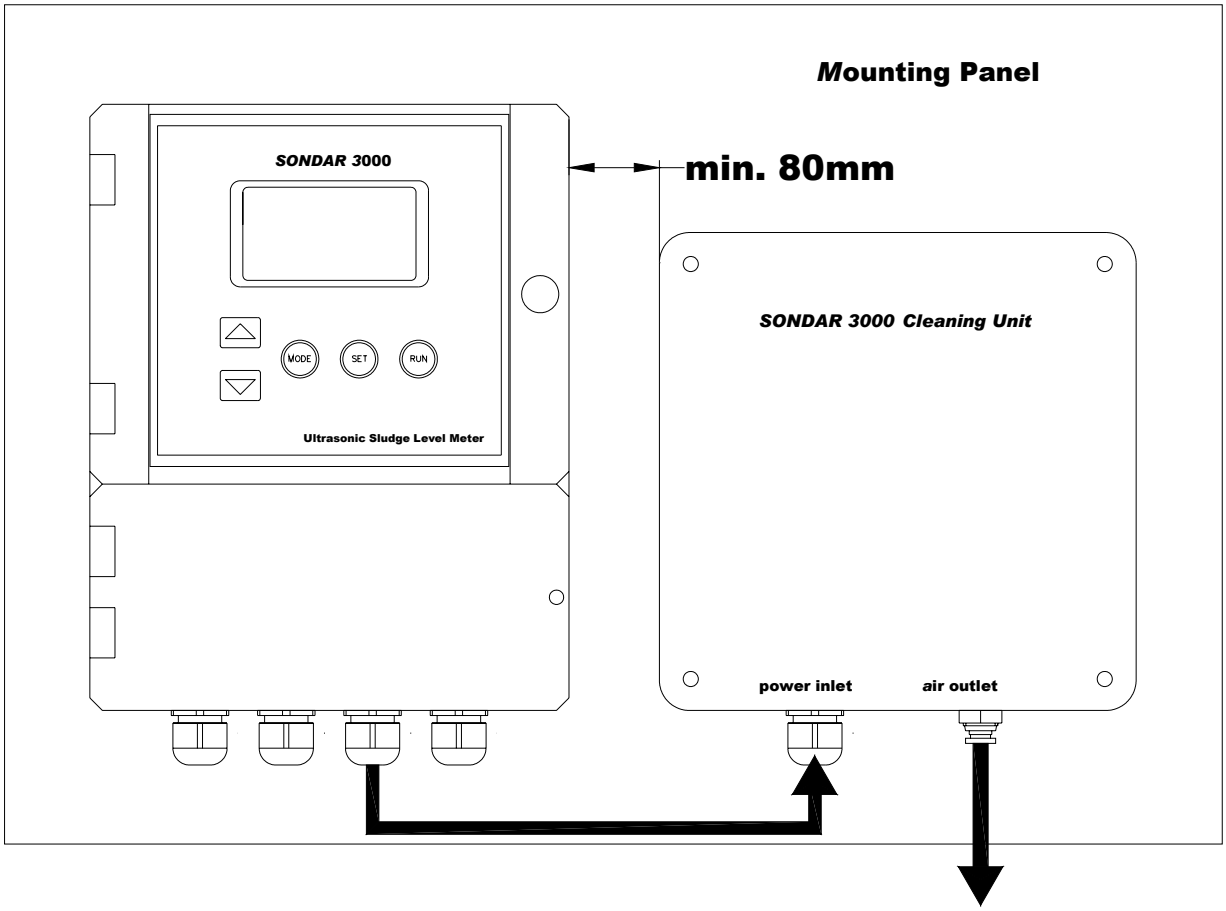
This unit prevents sensor from sticky sludge or air bubbles stuck on the surface of sensor by air-blow. This unit is useful in primary clarifier or where thick sludge or big air bubbles exists



Sensor with cleaning nozzle



Air compressor with terminal block

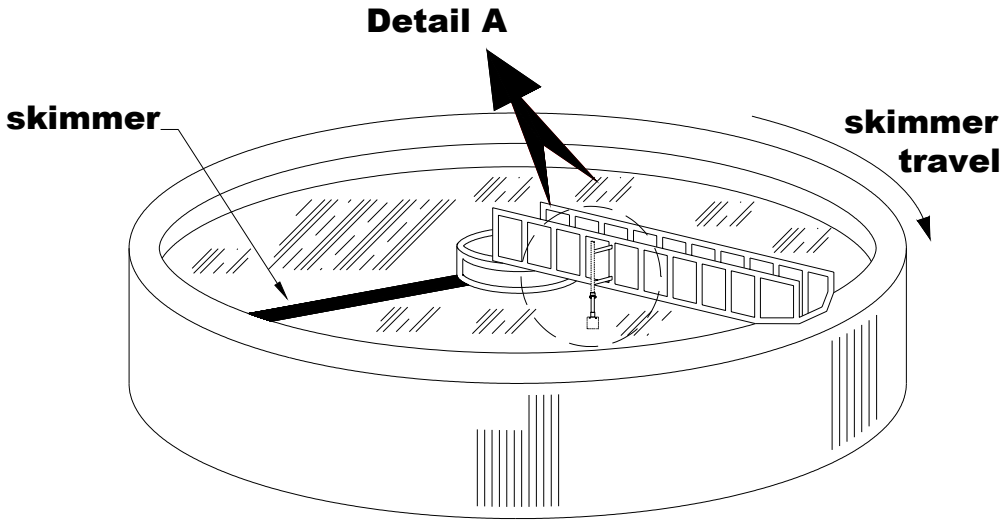


Panel Mounting

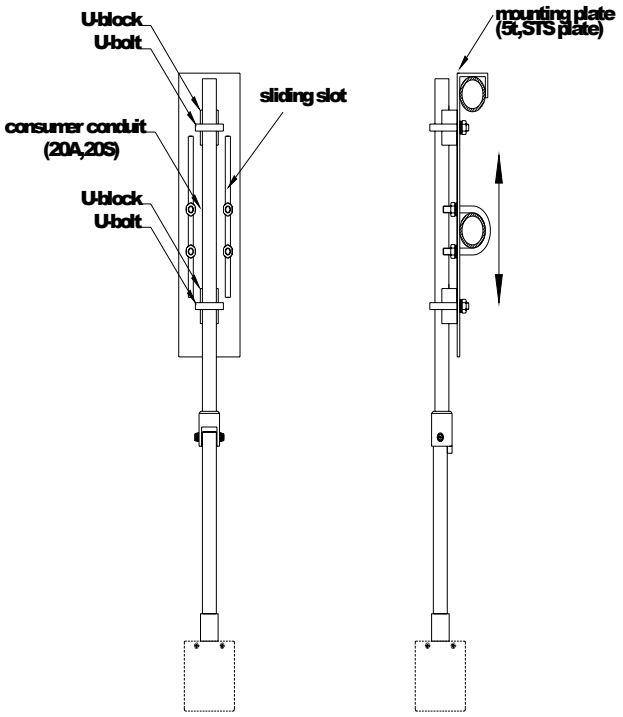
Skimmer Protector (Option) – SP413

- Skimmer Protector protects the sensor from circulating skimmer

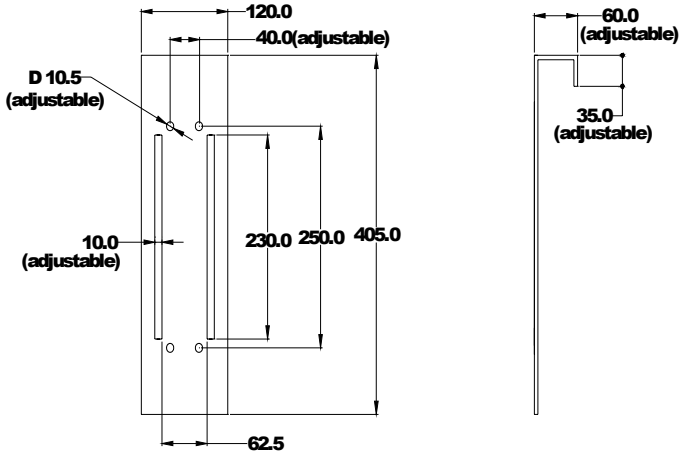
Installation Direction



Mounting Details

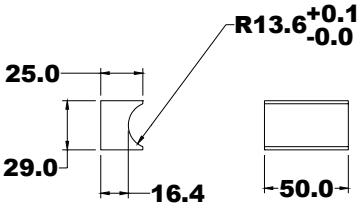


Detail A



o material : 5t, STS plate

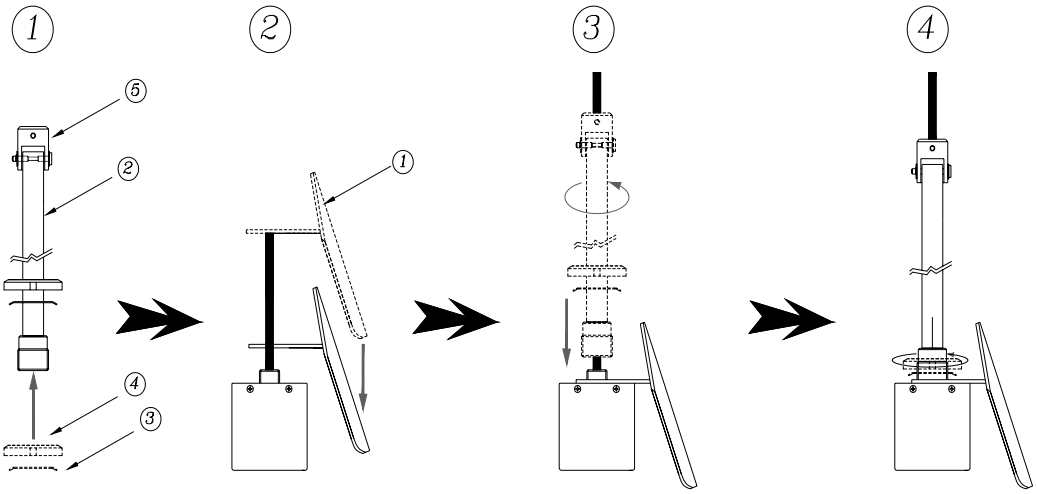
Mounting plate



o material : PVC or polymer

U-block

Assembling sequence



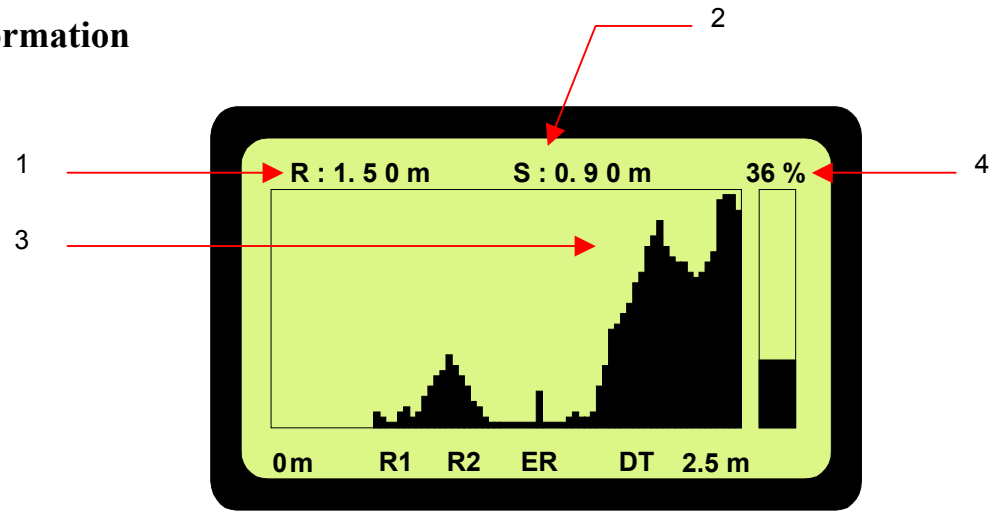
1) Insert a lock washer & nut through the sensor mounting pipe
2) Using the silicone RTV, mounting the protector temperally on the upper part of sensor
3) Assay the mounting pipe with sensor
4) Using the lock washer & nut, mounting the protector firmly.

Caution!

The sensor can be damaged in case installation is installed in reverse direction

Chapter 3 How To Use Controller

LCD information



LCD display at measurement mode

1 : Rag level displays the current Rag Level in 0.01m

2 : Sludge level displays the current Sludge Level in 0.01m

3 : Echo oscilloscopic image displays the signal of returned echo

4 : Percentage of current output displays.

Operational Status

R1 : Displays when High Alarm is in operation

R2 : Displays when Low Alarm is in operation

ER : Displays when the Fault Alarm is in operation

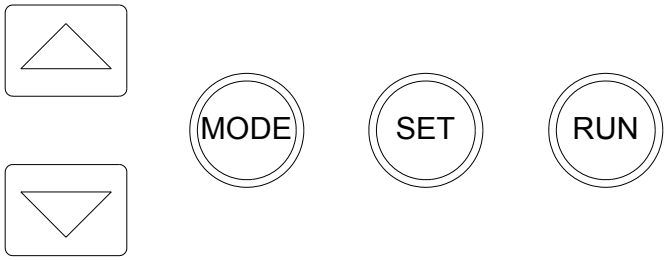
DT : Flickers when the measurement is okay

S : Displays when search the returned echo

Term

Rag : This is light layer that forms normally above sludge blanket. Rag layer is so thin that it's likely to disappear occasionally.

Button Function



MODE Button

Press this button to enter into the program mode

SET Button

Press this button to change or save the set value

RUN Button

Press this button to enter into measurement mode

UP / Down Button

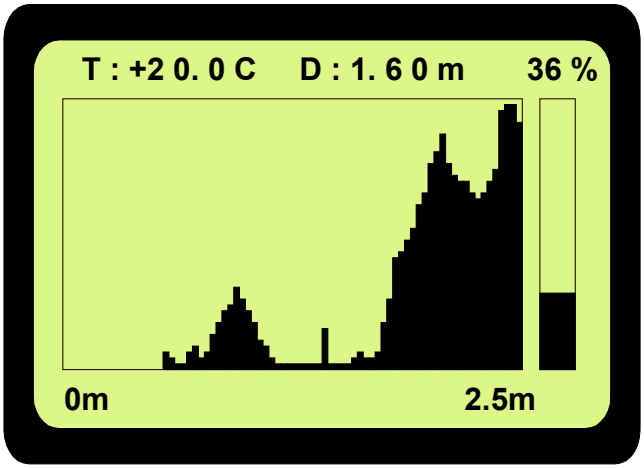
Press these buttons when change the set value at program mode

Pressing UP button at run mode shows enlarged scale, up to 10m.

<SET+DOWN> Button

Pressing SET/DOWN Buttons at the same time enters into temperature-distance mode as below picture

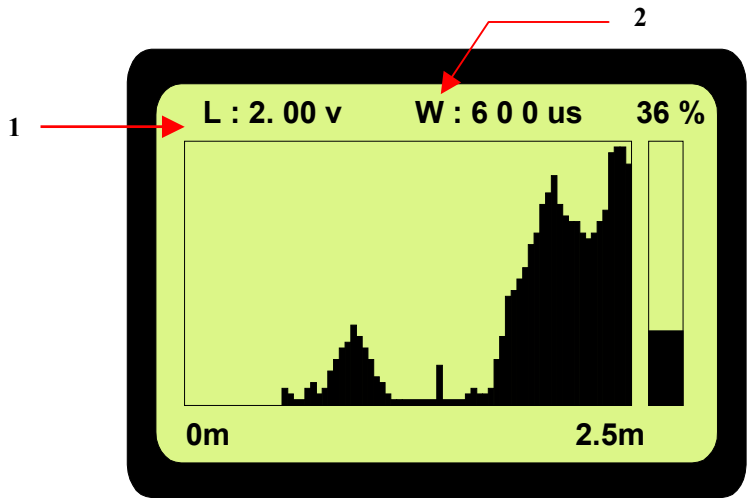
“D” represents distance from the sensor to the surface of sludge



Temperature-Distance Mode

<UP+DOWN> Button

Pressing UP/DOWN Buttons at the same time enters into level-width.



Level and Width mode

1 : Level of voltage of returned echo displays in 0.01V

2 : Width of time of returned echo displays in 1μs

Important

- After checking L and W, the threshold voltage can be adjusted at option menu No. 12.
- To measure the sludge correctly, the sludge echo height(L) should be lower than the set value of SLUDGE ECHO HEIGHT at engineer mode. If the “S” shows continuously at measurement mode, reset the sludge echo height at engineer mode.
- To measure the sludge correctly, the width of returned echo(W) should be lower than the set value of SLUDGE ECHO BOUND at engineer mode. If the “S” shows continuously at measurement mode, reset the SLUDGE ECHO BOUND value at engineer mode.(Refer to Chapter 5)

<SET+UP> Button

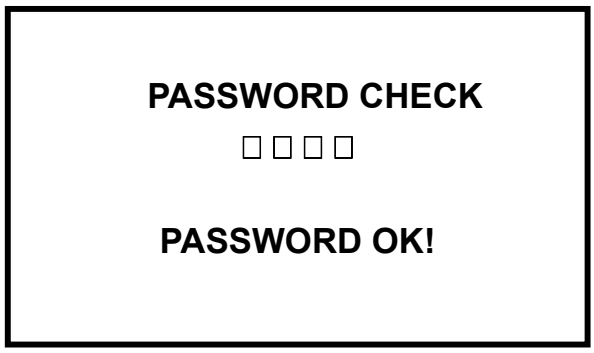
Pressing SET+UP buttons returns to run mode

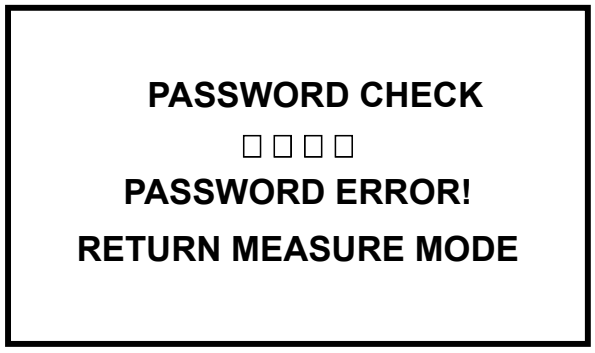
MODE →SET → <MODE+DOWN> Button (Engineer Menu)

Pressing buttons in sequence as mentioned above enters into engineer menu mode.

Password Check

Factory Set= 0

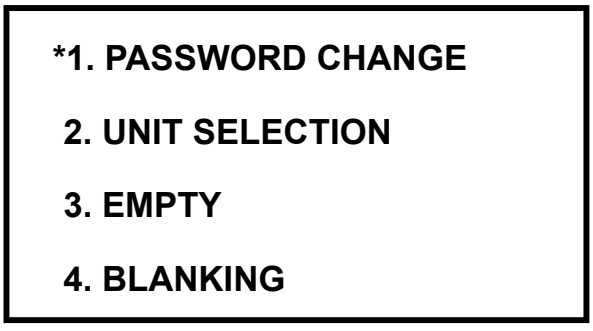




After pressing MODE button at measurement mode, the password checking is performed to prevent disqualified person from misuse or malicious use. After pressing the preset number, operators can enter the program mode by pressing SET button. If the password is wrong, the Sondar3000 automatically return to run mode.

☞*(Mode→ UP or DOWN→Set)*

Change Password

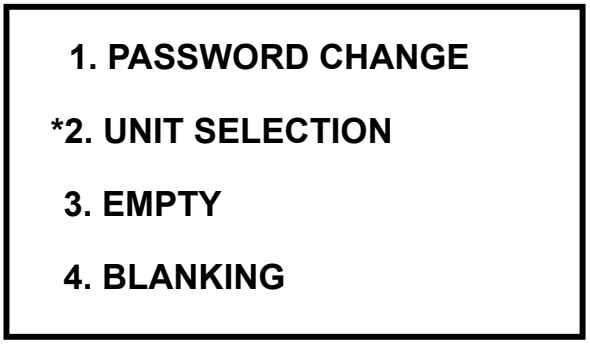


This option is for changing password.
The password setting range is 0 ~ 1000.

• *(Mode →Set→UP or DOWN→Set)*

System Unit

FactorySet=Meter



This option is for choosing system unit.

Operator can choose system unit between SI and US unit. The minimum set value is 0.01m/0.1ft

Bottom Set

FactorySet=5.00m

1. PASSWORD CHANGE

2. UNIT SELECTION

***3. EMPTY**

4. BLANKING

This option sets the maximum distance from the face of the sensor to the empty point. The bottom (empty) distance is important since all measurement is based on this value

Blanking Set

FactorySet=0.50m

1. PASSWORD CHANGE

2. UNIT SELECTION

3. EMPTY

***4. BLANKING**

This option is the distance from the face of the sensor that is not capable of being measured, and is preset to 50cm. It should not be set less than this figure, but can be increased if required. This option enables to ignore suspensions in the middle of the target material

4mA Point Set

Factory Set = 0.00m

***5. 4mA POINT**

6. 20mA POINT

7. ALARM1 ON

8. ALARM1 OFF

This option sets the sludge level at which the 4mA output will occur. By default 4mA will represent **Empty** (0% of Span). Use UP / DOWN button the set the value.

20mA Point Set

FactorySet=5.00m

5. 4mA POINT

***6. 20mA POINT**

7. ALARM1 ON

8. ALARM1 OFF

This option sets the level at which the 20mA output will occur. By default 20mA will represent **Full** (100% of Span). Use UP/DOWN bottom the set the value

Alarm 1 On Set

FactorySet = 2.00m

5. 4mA POINT

6. 20mA POINT

***7. ALARM1 ON**

8. ALARM1 OFF

This option determines the “ON” point for A1 relay. When the measure value is over the set value Relay1 activates

Alarm 1 Off Set

FactorySet = 1.90m

5. 4mA POINT

6. 20mA POINT

7. ALARM1 ON

***8. ALARM1 OFF**

This option determines the limit “OFF” point for A1 relay. When the measure value is less the set value Relay 1 deactivates

Alarm 2 On Set

FactorySet = 0.50m

***9. ALARM2 ON**
10. ALARM2 OFF
11. DAMPING RATE
12. TRANSMIT POWER

This option determines the limit “ON” point for A2 relay. When the measure value is over the set value Relay 2 activates

Alarm 2 Off Set

FactorySet = 0.60m

9. ALARM2 ON
***10. ALARM2 OFF**
11. DAMPING RATE
12. TRANSMIT POWER

This option determines the “ OFF” point for A2 relay. When the measure value is less the set value Relay 2 deactivates

Damping Rate

FactorySet = 2

9. ALARM2 ON
10. ALARM2 OFF
***11. DAMPING RATE**
12. TRANSMIT POWER

This option determines the maximum rate at which the unit will respond to an increase/decrease in sludge level.

- Setting Range : 1 = 0.1m/min
  2 = 0.5m/min
  3 = 1m/min
  4 = 10m/min

Transmit Power 1

FactorySet = 3

9. ALARM2 ON

10. ALARM2 OFF

11. DAMPING RATE

***12. TRANSMIT POWER 1**

This option determines the transmitting power of the ultrasonic pulse (Max. : 5, Min :1)**.**
In arduous conditions decrease the TX POWER value for accurate operations but unfavorable in long-range measurement. Increase the TX POWER value in long-range measurements but vulnerable to ringing and reverb ration.

Important

- Decrease the TX power value if there are obstacles in field. However, decreasing the TX power value is not recommendable when long-range measurement requires.
- Increasing TX power may cause reverberation or multi-path signal. Need to check the application site when increasing the power.
- Set option No.13 when the returned echo is not enough to detect.

Transmit Power 2

FactorySet = 20

***13. TRANSMIT POWER 2**

14. DETECT THRESHOLD

15. FAIL SAFE CURRENT

16. FAIL SAFE TIME

This option determines the voltage value of sensor transmission. Increase value in case the reception echo is not enough to detect after choosing the highest value at option12.TRANSMIT POWER 1. The set range is 1~100.

Important

- The supplied voltage range of sensor is V to 14V and the set value 0~100 is proportional to the voltage
- Please be careful when use this option at noisy environment.

Detect Threshold

FactorySet = 3

13. TRANSMIT POWER2

***14. DETECT THRESHOLD**

15. FAIL SAFE CURRENT

16. FAIL SAFE TIME

This option determines the detectable value of returned echo. The set range is 1~12.

• *(Mode→DOWN→Set→UP or DOWN→Set)*

Important

• In case the set value is high, it lessens measurement error. However, it may neglect weak returned echo.
• In case the set value is low, it makes easy to detect weak returned echo. However, it may cause error in noisy application. The below table is the voltage of each value

Threshold Value	1	2	3	4	5	6	7	8	9	10	11	12
Threshold Voltage	0.2	0.41	0.62	0.83	1.03	1.24	1.44	1.65	1.85	2.06	2.27	2.47

Fail Safe Current

FactorySet = HOLD

13. TRANSMIT POWER2

14. DETECT THRESHOLD

***15. FAIL SAFE CURRENT**

16. FAIL SAFE TIME

If the Sondar 3000 fails to receive a valid echo returned from the target, the current outputs to indicate a fault condition (Lost of Echo). 3.8mA, 21mA or HOLD is selectable at user's need.

Fail Safe Time

FactorySet = 120s

13. TRANSMIT POWER2

14. DETECT THRESHOLD

15. FAIL SAFE CURRENT

***16. FAIL SAFE TIME**

In case of a fail-safe condition occurring (Lost of Echo) the fail safe timer determines the time before the mA output indicates a fault condition (Lost of Echo).

The set range is 20~999sec

Cleaning Cycle

FactorySet = 5s

***17. CLEANING CYCLE**
18. CLEANING TIME
19. 12mA OUTPUT 1
20. 12mA OUTPUT 2

If the sludge sediments or bubbles lay on the transducer surface, it could lead to miscalculation. This option determines the cleaning cycle when the cleaning unit is in use. The set range is 0 ~10min. (Option)

Cleaning Time

FactorySet = 5s

17. CLEANING CYCLE
***18. CLEANING TIME**
19. 12mA OUTPUT 1
20. 12mA OUTPUT 2

This option determines the operation time of the sensor cleaning. The set range is 0 ~ 100sec.

12mA Output 1

FactorySet = 200

17. CLEANING TIME
18. CLEANING CYCLE
***19. 12mA OUTPUT 1**
20. 12mA OUTPUT 2

This option outputs 12mA(Rag level) regardless of measurement. In case of failure, calibrate the current output 1 at Engineer mode.

17. CLEANING TIME

18. CLEANING CYCLE

19. 12mA OUTPUT 1

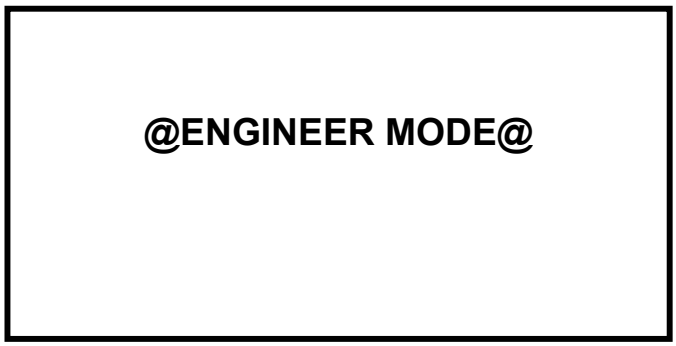
***20. 12mA OUTPUT 2**

This option outputs 12mA(Sludge level) regardless of measurement. In case of failure, calibrate the current output 2 at Engineer mode.

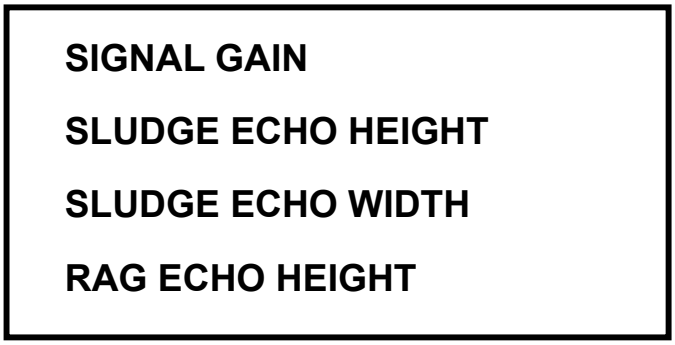
Chapter 5 Engineer Programming

ENGINEER MODE

At the programming menu, press **MODE** and **DOWN** buttons at the same time to enter this mode.

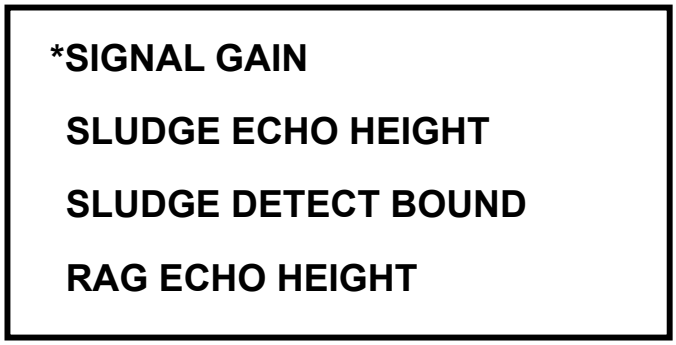


The below options is displayed after a few seconds



To enter the Signal Gain, press set button.

Signal Gain Setting



This option is related to density factor. This option determines the value that controls signal gain of sludge density. Increase the value when the sludge density is low. When “0” is displayed but returned echo is not seen, set the value around 50~100.

Sludge “L” & “W” Setting

At the programming menu, press **MODE** and **UP** buttons at the same time to enter this mode

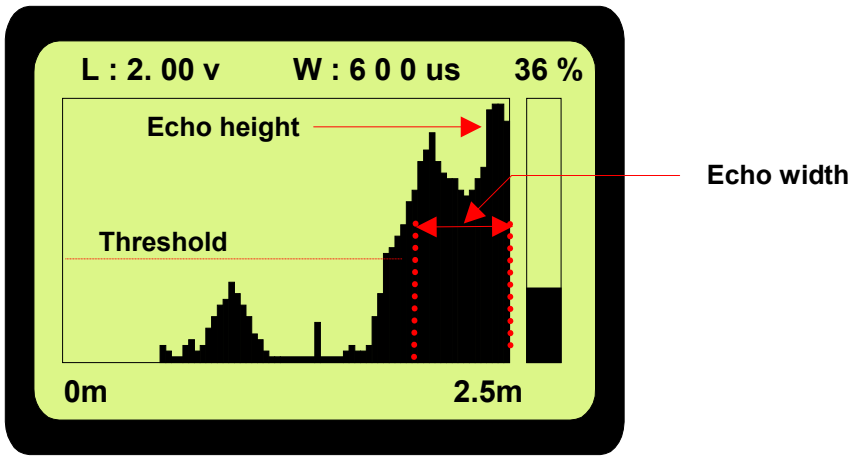
SIGNAL GAIN

***SLUDGE ECHO HEIGHT**

***SLUDGE DETECT BOUND**

RAG ECHO HEIGHT

These options determine the echo height and the width of returned sludge echo of threshold voltage (option No. 13. DETECT THRESHOLD). These options are for not only controlling potential noise and disturbance, but compensating the factors according to field condition and kinds of sludge. The below picture explain the terms of echo height and echo bound.



Example of option setting

In case “L” is 2.00V, the set range of sludge echo height should be around 0 ~ 2.00V.

In case “W” is 600μs, the set range of sludge echo width should be around 0 ~ 0.60ms.

Important

In real application, the “L” and “W” depend on the field condition and kinds of sludge. The factory setting value is “0”. Please consult with us when setting this option.

Rag "L" & "W" Setting

These options determine the echo height and the width of returned rag echo of threshold voltage (option No. 13. DETECT THRESHOLD)

SIGNAL GAIN

SLUDGE ECHO HEIGHT

SLUDGE ECHO WIDTH

***RAG ECHO HEIGHT**

The RAG ECHO HEIGHT (LOW) option determines the low value of echo bound.

The RAG ECHO HEIGHT (HIGH) option determines the high value of echo bound

* Generally the rag layer is so thin that it's easy to disappear in normal application.

Current Calibration 1&2 (Rag Level & Sludge Level)

At the programming menu, press **MODE** and **DOWN** buttons at the same time to enter this mode.

RAG ECHO WIDTH (LOW)

RAG ECHO WIDTH (HIGH)

***12mA Calibration1**

***20mA Calibration1**

4mA Calibration1

Connect the terminal mA1 +/- to an ammeter

Press SET button to select 12mA

RAG DETECT LOWER BD

RAG DETECT UPPER BD

12mA Calibration1

20mA Calibration1

4mA Calibration1

Check if 12mA outputs from an ammeter.

Press UP/Down buttons for calibration

After 12mA calibration, choose 20mA and then do the same as 12mA calibration

The 4mA will output correctly after calibrating 12mA and 20mA.

*** Sludge level mA calibration is the same as that of rag level (Calibration2)**

Chapter 6 Digital Communication

The Sondar3000 provides RS232/485 digital communication interface function as option

The kinds of data and its format are as follows;

Output Data

1. Rag Level
   Output rag level in cm/ft

2. Sludge Level
   Output sludge level in cm/ft

3. Temperature
   Temperature in °C/°F

Data Format

ASCII edits data and the following is its sequence

CR	LF	R				S				T	+,-			NUL
			100	10	1		100	10	1			10	1	

1. Baud Rate is 4800BPS

2. 1 Data Frame is composed of 15byte

3. Data Frame outputs on a second basis

4. The number located at 100 means hundred cm/ft unit.

5. +/- mean above/below zero in temperature. The number located at 10 means ten degree unit in °C/°F

Chapter 7 Troubleshooting

The below are the main symptoms, with suggestions as to how to solve

Symptom	Solution
Display no returned echo Sludge displays 0 (bottom distance indication)	• Change the distance in display by pressing UP/DOWN button at measurement mode • Make the transmit power(option No.12) 5 • Open the controller and turn the TVG_VR counterclockwise • Make the detect threshold(option No.13) 1~3 • Increase signal gain(option No.18)
Returned echo is not high enough “S” displays	• Decrease the detect threshold value • Make the sludge echo height and width smaller than the values of “L” and “W”
Suddenly no returned echo	• Use the above two methods • Use sensor cleaning unit

Chapter 8 Maintenance

Sondar3000 is designed for free of maintenance.

However, it would be helpful to use the cleaning unit in difficult applications such as bubbly water, floating material.

Menu Option Record

SONDAR 3000

Option Details		Entered Value					
No.	**Description**	**Factory Set**	**Value Range**	1	2	3	4
01	Password Change	0	0 ~ 1000				
02	Unit Selection	Meter	Meter/Feet				
03	Empty	5.00m/16.4ft	0 ~ 10.00m/32.8ft				
04	Blanking	0.50m/1.7ft	0 ~ 10.00m/32.8ft				
05	4mA SetPoint	0.00m/0ft	0 ~ 10.00m/32.8ft				
06	20mA SetPoint	5.00m/16.4ft	0 ~ 10.00m/32.8ft				
07	Alarm1 On	2.00m/6.6ft	0 ~ 10.00m/32.8ft				
08	Alarm1 Off	1.90m/6.2ft	0 ~ 10.00m/32.8ft				
09	Alarm2 On	0.50m/1.7ft	0 ~ 10.00m/32.8ft				
10	Alarm2 Off	0.60m/2.0ft	0 ~ 10.00m/32.8ft				
11	Overlap Weighting	80%	0 ~ 100%				
12	Transmit Power 1	3	1 ~ 5				
13	Transmit Power 2	20	1 ~ 100				
14	Detect Threshold	3	1 ~ 10				
15	Fail Safe Current	Hold	3.8mA/Hold/21mA				
16	Fail Safe Time	120	20 ~999				
17	Cleaning Cycle	Off	0 ~ 100min				
18	Cleaning Time	5	0 ~ 100sec				
19	12mA Output1						
20	12mA Output2						