Sonar Interface
Sludge Level Monitoring

Principle of Operations
The ORCA Sonar Series transducer emits a high powered acoustic pulse, which is reflected from the interface density selected. The reflected signal is processed using specially developed software algorithms, that eliminate lighter floating densities and stratified layers, allowing measurement of “RAS” or “BED” levels. It can be calibrated to measure lighter densities like “FLOC” or one of the outputs could be used for a “CLARITY” output, similar to a basic turbidity transmitter measuring solids in suspension.

By choosing the correct sonar transducer frequency, the Orca sonar guarantees the optimized performance when measuring both light and heavy density interfaces.

Primary Areas of Applications
**Sewage & Wastewater**
- Primary Sedimentation – Blanket level.
- Secondary and final Clarifiers – RAS Blanket and fluff/ pin floc layer.
- Thickeners and DAF – Bed level and clarity of water.
- Sequential Batch Reactors – Blanket monitoring (floating sonar).
- Lagoons – Bed sludge level.
- Lamella Clarifier – Bed level and floc level.

**Mining / Process**
- Clarifiers, thickeners, CCD’s, settling ponds/lagoons, water treatment, carbon columns.

**Function**
The ORCA Series Sonar, sludge blanket and interface controller, consists of a microprocessor based transmitter, with easy menu driven programming via keypad, PC combinations or GSM modem, COMMS, GSM interface. The Orca controller works together with appropriate sonar transducer and transducer cleaning mechanism.

**Features:**
- Dual independent analogue outputs to track two different interfaces, or clarity simultaneously, with the one sonar sensor.
- Full range of sonar transducers to optimize detection of heavy and light density interfaces.
- Widest range of sonar frequencies to optimize performance.
- Easy calibration to track specific density interfaces. eg: RAS blanket - 4g/l, floc/fluff layer - 1g/l.
- Industrial scum cleaning mechanisms, that do not require maintenance.
- No wiper blade assemblies.
- Control room graphics of tanks and interfaces.
- Wide range of communications: Devicenet, GosHawk, HART, Modbus, Profinus DP Foundation Fieldbus and Profinus PA
- CDMA/GSM remote support capability for calibration, commissioning or technical back-up.
- Relay alarms
Comparison between First Generation and Third Generation Sonar Technology

There are two major innovative changes between the First Generation instruments and the current Third Generation “ORCA” Hawk sonar range.

1. Sonar Transducer Frequencies
All other existing sonar transmitters are described as being First Generation technology. They utilize only one sonar transducer frequency and therefore have severe limitations in where they can be used successfully. An understanding of the Basic Physics of Sound Transmission, indicates that sound transmission through a liquid or gas, varies, based on the wavelength of the frequency transmitted.

When transmitting sound pulses through air, that may contain steam, condensation, dust etc the rule is to use a lower frequency, longer wavelength transducer to diffract the signal around particles in suspension. Its called the fog horn principle.

The same principle applies to transmitting sound through a liquid. When monitoring an interface in a process tank, like a secondary clarifier, the interface for controlling the RAS pumps, resides lower in the tank than the grey interface Fluff Layer. The First Generation sonar tries to stay on this heavier density RAS blanket by utilizing software algorithms. The problem is that as soon as the secondary tank has settling and bulking problems, the First Generation sonar monitors the interface going to the surface, so using software algorithms is not the total answer.

In our Third Generation Sonar range, the ORCA has “seven” different sonar transducer frequencies to choose from. Depending on the application at the Waste Treatment Plant, we select the appropriate sonar transducer frequency, according to the density of the interface we want to control and monitor off.

This means that instead of having small signals (300 millivolts) reflecting off the desired density interface, the ORCA range has signals as large as 2500 millivolts, almost 10 times greater, because of optimizing the sonar transducer frequency. It also means, that when the secondary clarifier has bulking and settling problems, the instrument continues to control off the RAS Blanket density, which still is at the bottom of the tank. It is only the lighter densities that are hydraulically lifted towards the launders at the top of the tank.

So we use a different sonar transducer frequency for each of the main applications at the Wastewater Treatment plant, Primary Sedimentation Tanks, Secondary/Final Clarifiers, Thickeners, and DAF Tanks.

Each ORCA sonar transducer has “smart” capability. They can be driven to output two different frequencies.

a. The Secondary Clarifier has two interfaces that are needed for optimizing the efficiency of the tank. The first is the RAS Blanket, that we generally monitor at a density of 4g/L, which guarantees a quality biomass return to the aeration lanes and to the Thickening area. This ensures that the RAS Blanket is not over pumped (over scavenged) and that we do not reduce the retention time in aeration by pumping in lower density biomass.

b. The second interface that we need to monitor is the Fluff Layer and we calibrate this density at 600 milligram/L. Under normal operating conditions in the Secondary Clarifier, the Fluff Layer at 600 milligrams/L sits about 1500mm above the RAS Density of 4g/L. By monitoring the two analogue outputs in the PLC we can identify how well the Secondary Clarifier is operating, because the two signals should rise and fall on the trend simultaneously if the tank is settling well. When a process problems occurs, perhaps caused by changing industrial effluent entering the plant, causing a biological instability, bulking and settling problems occur. The RAS Blanket density is heavy enough not to rise, but the lighter Fluff Layer interface will be hydraulically lifted in the tank. The second analogue will indicate a change in settling patterns and an alarm can be raised in the PLC that the tank is experiencing settling problems.

c. This ensures that we not only control and optimize the RAS and the WAS densities, but we also provide early feedback to the process engineers and operators that one or more tanks have a process problem.
2. Special algorithms for controlling sonar interfaces, special scum cleaning capabilities

a. Secondary Clarifiers can suffer with stratified interfaces, when process stability is lost. These stratified interfaces can confuse First Generation sonar transmitters into believing that the interface is higher in the tank than it really is. Our algorithms delete the stratified interface from being detected.

b. Some Secondary Clarifier tanks suffer from hydraulic imbalance to their inflow, when compared to other tanks close by. This causes a change in settling and monitoring of the interfaces, which the ORCA can handle with the minimum of calibration change. This is all the more reason that each Secondary Clarifier Tank should be treated as a sole stand alone process tank.

c. We have also developed a range of scum cleaners that are totally controlled by the ORCA transmitter. These cleaning mechanisms are an absolute necessity to our performance warranty. There is no known instrument that can survive, immersed in sewage media, that will work reliably without cleaning.

Glossary of Terms

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAS</td>
<td>Return Activated Sludge</td>
</tr>
<tr>
<td>WAS</td>
<td>Waste Activated Sludge</td>
</tr>
<tr>
<td>DAF</td>
<td>Dissolved Air Floatation</td>
</tr>
<tr>
<td>Lamella</td>
<td>Type of clarifier design</td>
</tr>
<tr>
<td>Fluff Layer</td>
<td>Light density interface secondary clarifier</td>
</tr>
<tr>
<td>SBR</td>
<td>Sequential Batch Reactor</td>
</tr>
<tr>
<td>Pinfloc</td>
<td>Particles in suspension</td>
</tr>
<tr>
<td>Clarity</td>
<td>Clearness of liquid</td>
</tr>
<tr>
<td>CCD</td>
<td>Type of thickener-mining</td>
</tr>
<tr>
<td>Floc Dosing</td>
<td>Chemical dosing to improve settling</td>
</tr>
</tbody>
</table>

Typical Applications

Typically, the most difficult task when wanting to determine the level of an interface, lies in the correct selection of the transducer frequency.

There are many other variables to consider. They include particle size, flow, velocity, material, air bubble retention etc.

In general, the following should be undertaken:

1. Identify a position away from direct inflow, where turbulence is minimized.
2. If air bubbles are present within heavy suspended solids, use the scum cleaner.
3. Position sonar transducer 1/3 radius from circumference of the tank away from the influence of the feed well.
4. Submerge the face of the selected transducer by a minimum of 20mm (0.79”).

The higher the transducer frequency, the easier it becomes to see smaller particle sizes. The disadvantage, is the lack of penetration and a higher likelihood of air bubbles forming on the sensor face, creating impedance to the transmit and received signals.

Lower transducer frequencies will not see such small particles, but will see a more clearly defined interface.

The frequency selection should be based upon the % solids, plus a logical position for the placement of the sensor. Please consult your local distributor for correct transducer selection.

All sonar transducers will be affected by air bubble accumulation on the sensor face. If the auto cleaner is used, the system will operate to ensure accumulation of air bubble interface does not cause operational problems.

<table>
<thead>
<tr>
<th>Area</th>
<th>Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Water Treatment Plant</strong></td>
<td></td>
</tr>
<tr>
<td>Primary Sedimentation Tank</td>
<td>Floc level / sludge blanket level</td>
</tr>
<tr>
<td>Sludge Thickener Tank</td>
<td>Sludge bed level / clarity suspended solids / floc level</td>
</tr>
<tr>
<td>Calcium Hydroxide Reactor</td>
<td>Sand/pellet bed level</td>
</tr>
<tr>
<td>Sodium Hydroxide Reactor</td>
<td>Sand/pellet bed level</td>
</tr>
<tr>
<td><strong>Sewage Treatment Plant</strong></td>
<td></td>
</tr>
<tr>
<td>Primary Sedimentation Tank</td>
<td>Sludge blanket level</td>
</tr>
<tr>
<td>Secondary / Final Clarifier</td>
<td>RAS blanket level / rag/pinfloc layer / clarity suspended solids</td>
</tr>
<tr>
<td>Sludge Thickener Tank</td>
<td>Sludge bed level / clarity suspended solids</td>
</tr>
<tr>
<td>“DAF” Tank</td>
<td>Sludge bed level / floating sludge level</td>
</tr>
<tr>
<td>Sequential Batch Reactor (SBR)</td>
<td>Settling bed level / RAS blanket level</td>
</tr>
<tr>
<td><strong>Industrial (food, paper etc.)</strong></td>
<td></td>
</tr>
<tr>
<td>Primary Sedimentation Tank</td>
<td>Sludge blanket level</td>
</tr>
<tr>
<td>Secondary Clarifier Tank</td>
<td>RAS blanket level / clarity suspended solids / rag/pinfloc layer</td>
</tr>
<tr>
<td>Thickener Tank</td>
<td>Sludge bed level / clarity suspended solids / floc level</td>
</tr>
<tr>
<td>“DAF” Tank</td>
<td>Sludge bed level / floating sludge level</td>
</tr>
<tr>
<td>Sequential Batch Reactor (SBR)</td>
<td>Settling blanket level / RAS bed level</td>
</tr>
<tr>
<td>Carbon Column</td>
<td>Carbon bed level</td>
</tr>
<tr>
<td><strong>Mining/Mineral processing</strong></td>
<td></td>
</tr>
<tr>
<td>Clarifier Tank</td>
<td>Blanket level / clarity suspended solids / stratified floc layers</td>
</tr>
<tr>
<td>Thickener Tank</td>
<td>Sludge bed level / clarity suspended solids / stratified floc layers</td>
</tr>
<tr>
<td>CCD’s Tank</td>
<td>Sludge bed level / clarity suspended solids / stratified floc layers</td>
</tr>
<tr>
<td>Settling Ponds</td>
<td>Sludge bed level</td>
</tr>
</tbody>
</table>
**Monitoring Settling Blanket in a SBR (Sequent Batch Reactor)**

**Application problem**
The client had blanket carry-over problems, which affected his EPA licence. The decant range was 0-1500 mm (0-60”)

**Wastewater treatment plant**
250 megalitre/day (65 million gallons/day)

**Comments**
We installed our floating sonar transmitter, with auto scum cleaner, close to one of seven launders in the tank. During aeration the sonar transmitter detected a high level blanket in suspension. Once the aeration period had stopped, the blanket settling was detected. Once the blanket had settled 1 m (3.2 ft) below the liquid height, the launders were introduced and decanting started.

**Solution**
Using the ORCA floating sonar stopped carry-over into the launders. Automating the decant phase, based on the blanket settling, increased efficiency and saved time during the settling phase.

**Ordering information**
Part numbers
OSIRDYX - Transmitter
OSIRT003S4XC6 - Sonar transducer
OSIRSCD - Sonar Cleanser/Float/Brackets
OSIRME - L5 - Sonar Transducer SS Pole 5 m (16.5 ft)
SONAR IMPACT PLATE

SONAR ACTUATOR CLEANER

FLOATING SONAR SENSOR

X - Pipe length to suit
* distance from safety rail or Bridge
may be varied

Note: Advise physical dimension of surface scum rake.

OSIR Transducer

OSIR Fibreglass Transducer

1" BSP Nipple

135 mm (5.3")

330mm (12.9")
## Dimensions

### RAIL BASE PLATE

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>610.00mm</td>
<td>24</td>
</tr>
<tr>
<td>305.00mm</td>
<td>12</td>
</tr>
<tr>
<td>165.00mm</td>
<td>6.5</td>
</tr>
<tr>
<td>190.00mm</td>
<td>7.5</td>
</tr>
<tr>
<td>160.00mm</td>
<td>6.3</td>
</tr>
<tr>
<td>190.00mm</td>
<td>7.5</td>
</tr>
<tr>
<td>160.00mm</td>
<td>6.3</td>
</tr>
<tr>
<td>54.00mm</td>
<td>2.1</td>
</tr>
<tr>
<td>151.00mm</td>
<td>5.9</td>
</tr>
<tr>
<td>69.00mm</td>
<td>2.7</td>
</tr>
<tr>
<td>127.50mm</td>
<td>5</td>
</tr>
</tbody>
</table>

### REMOTE ENCLOSURE

#### FRONT
- Radio link option
- 3 x 20mm, 1x16 mm Knock outs
- DIN Rail or screw mountable

#### BACK
- 190mm (7.5)'
- 145mm (5.7)'
- 160mm (6.3)'

#### SIDE
- 107mm (4.2)'
- 160mm (6.3)'
- 106mm (4.2)'
- 54mm (2.1)'
- 69mm (2.7)'

### Radio link option

RAIL BASE PLATE

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.00</td>
<td>0.1</td>
</tr>
<tr>
<td>28.75</td>
<td>1.1</td>
</tr>
<tr>
<td>29.25</td>
<td>1.1</td>
</tr>
<tr>
<td>20</td>
<td>0.7</td>
</tr>
<tr>
<td>111.50mm</td>
<td>4.3</td>
</tr>
<tr>
<td>8.50</td>
<td></td>
</tr>
<tr>
<td>59.25mm</td>
<td>2.3</td>
</tr>
<tr>
<td>211.50mm</td>
<td>8.3</td>
</tr>
<tr>
<td>51mm</td>
<td>2.0</td>
</tr>
<tr>
<td>51mm</td>
<td>0.2</td>
</tr>
</tbody>
</table>

### Knock outs

- 3 x 20mm
- 1x16 mm
GSM or CDMA Network

- Typically up to 31 transmitters or switches per string.
- Maximum 250 transmitters or switches.
- Using GSM/CDMA network, transmitters and switches can be monitored, calibrated remotely.
- Alarm status, diagnostics can be monitored.
- Support from factory engineering for customer application problems.

(Limited Modbus query rate for Switches only)
OSIR SONAR SERIES TRANSMITTER
Remote Version (3 Relays) (2 Analogues)

Refer to Graph 1 for cable selection
(See instruction manual)

Belden 3084A cable
Max 700 m (2000ft)

Modulating 4-20mA from PLC input
Driving 4-20mA from ORCA to user PLC

90 - 260vac
24vdc

Sonar 234 Remote Transmitter
- -
+ +

Relay 1 Relay 2 Relay 3 Actuator
NC COM NO NC COM NO NC COM NO
BLK BLU BRN GRN YEL SHLD

Analog 1 Transducer
COMMS DC-IN AC-IN

4-20mA 4-20mA

4-20mA
12-30Vdc
90-265 VAC
NC COM NO NC COM NO NC COM NO
BLK BLU BRN GRN YEL SHLD

Analog 2

Pot Cable
Motor Cable
Transducer Cable

Transducer

Junction Box

Test

TRANSDUCER

Sonar 234 Remote Transmitter
- -
+ +
**ORCA Sonar Electronics**

**Model**

**OSIR** ORCA Sonar Level Transmitter with 1 or 2 analogue outputs and 3 relay alarms

**Power Supply**
- B 24 Vdc
- D 90-250Vac and 24Vdc

**Output Configuration (PC comms GosHawk standard)**
- X 1 x 4-20mA analogue output modules with Modbus Comms
- Y 2 x 4-20mA analogue output modules with Modbus Comms
- I 1 x 4-20mA analogue output modules with Modbus and HART Comms
- J 2 x 4-20mA analogue output modules with Modbus and HART Comms
- W Modbus comms only
- P Profibus DP*
- A Profibus PA
- F Foundation Fieldbus
- E Ethernet
- D Devicenet
- Z Special Request

**Internal HawkLink Modem**
- X Not Required
- G2 GSM Frequency 800/1900 MHz/19200 Baud for USA, Canada
- G4 GSM Frequency 900/1800 MHz/192 Baud for Australia, Europe

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**ORCA Remote Transducer**

**Model**

**OSIRT** ORCA Remote Sonar Transducer

**Number of Crystals**
- 0 1 Crystal
- 3 3 Crystals Array
- 7 7 Crystals Array

**Transducer**

<table>
<thead>
<tr>
<th>Transducer</th>
<th>Blankling</th>
</tr>
</thead>
<tbody>
<tr>
<td>02 (150kHz)</td>
<td>450mm</td>
</tr>
<tr>
<td>03 (300kHz)</td>
<td>450mm</td>
</tr>
<tr>
<td>04 (450kHz)</td>
<td>450mm</td>
</tr>
<tr>
<td>05 (700kHz)</td>
<td>450mm</td>
</tr>
<tr>
<td>07 (30kHz)</td>
<td>600mm</td>
</tr>
</tbody>
</table>

**Temperature and Facing material selection**

- S Standard Temperature Version
- H Fibreglass High Temperature Version

**Transducer Housing Material**

- 4 Polypropylene
- H Fibreglass High Temperature Housing, must be used with fibreglass face
- Z Special

**Approval Standard**

- A0 ATEX Cat1 EEx_ia (Zone 0)
- A1 SAA Ex_m (Zone 1)
- X Not Required

**Connection**

- C IP68 Sealed unit with 6 metre cable

**Cables**

- 6 6m cable (Standard)
- 15 15m cable
- 30 30m cable
- 50 50m cable

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**Notes:**

* Can not be used with internal HawkLink. Can be used with remote HawkLink.
** Internal HawkLink cannot be used in Zone 0 / 20
*** Contact factory
Orca Accessories

Mounting Extension

Model

OSIRME  Mounting Extention Stainless Steel Pipe***

Length
L2  2 Meters (6.6ft)
L3  3 Meters (9.8ft)

*** Pole length must be specified. For example 1m (3.3ft) pole, L1.

OSIRME  L2

Automatic Scum Cleaner

Model

OSIRSC  Automatic Scum Cleaner

Type
A  24Vdc Electric Actuator with Mounting Accessories
B  Pneumatic Actuator (Please consult the factory)
C  Rotary Scum Brush Cleaner
D  Floating Sonar with 24Vdc Electric Actuator with Mounting Accessories
E  Impact Plate plus Mounting Bracket with Mounting Accessories

OSIRSC  A

Complete Part Number

<table>
<thead>
<tr>
<th>Electronics</th>
<th>Transducer</th>
<th>Accessories</th>
</tr>
</thead>
<tbody>
<tr>
<td>OSIR D Y X</td>
<td>+ OSIRT 002 S 4 X C 6</td>
<td>+ OSIRSC A</td>
</tr>
</tbody>
</table>

Radio Link

Model

OSIRRL  Radio Link Region

R1  USA, Canada
R2  Australia, Europe
R3  Japan
R4  China

OSIRRL  R1
Specifications

OSIR Transmitter

Measurement Range
• 0 to 30 metres (0-98.4ft)

Minimum Density Range
• <100mg/l

Accuracy
• ±0.25% of span

Temperature
• -20ºC to 70ºC
(-4ºF to 158ºF)

Display
• 2 x 8 digit LCD display.

Echo Processing
• Advanced Sparrow Hawk Algorithms

Outputs
• 2 x Analog 4-20mA (Isolated) max. 750 ohms
• Relays: 3 x SPDT 0.5Amp
• Power driver for Auto scum cleaner
• GosHawk, HART, Modbus, Profibus DP, DeviceNet
  Foundation Fieldbus & Profibus PA
Multidrop mode can address 1-250 units over 4 wire

Diagnostics
• Full operational diagnostics display

Sealing
• IP65

Option
• Reduced blanking distances
• Sun hood

Operating Voltage
• 90 - 260Vac 50/60Hz, 24Vdc

Power Consumption
• <18VA @ 240Vac, peak power 180VA during actuator operation
• <12VA @ 115Vac, peak power 170VA during actuator operation
• <3W @ 24Vdc, peak power of 130W during actuator operation

OSIRT Transducer

Transducer Selection
• See sonar transducer selection guidelines. (P2)

Housing
• Polypropylene, Fiberglas, PVDF (Kynar), Teflon and PVC

Sealing
• IP65 (Fully encapsulated)

Special Blanking
• 150mm (5.9”) minimum

Temperature Sensor
• Internal (max. 70ºC (158ºF) Standard)
• High temperature 150ºC (302ºF) with external pre-amp.

Mounting
• 1.00 inch BSP/NPT nipple

Cable
• Belden 3084A

Weight
• 3.5kg (7.7lb)

Approvals
• SAA. Class 1 Zone 1
• ATEX Cat.1 (Intrinsic Safe)

Auto Scum Cleaner

Construction
• Stainless Steel

Mounting
• Base mount x 4 holes. (See drawing)

Actuator
• Electric 24Vdc
• Pneumatic - Contact factory
• Brush Cleaner
• Impact Plate

Weight
• 5Kg (11lb)

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