Manual

Sultan
Acoustic Wave Series
Level, Flow, Positioning, Collision Protection

For more information, please visit >
www.hawkmeasure.com
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Remote systems consist of an amplifier and separate transducer of varying size & shape depending on frequency.

SMART & Integral units combine both the amplifier and transducer functions in a single housing.
Tighten the locking ring down to the flange to fix the components in place.

Screw the flange assembly fully down onto the cone (as far down as it will go until the parts are tightly fastened).

Screw the transducer tightly down onto the flange and cone assembly.

Remove red cap (including cardboard).

Note! Direction of flange, smallest ring this way up ↑

COMPLETE ASSEMBLY (appearance above flange may differ for integral and smart units).

User mountings should only connect to the larger (lower) isolated mounting flange. No other part of the sensor assembly should touch any other structure or object.
The Sultan Remote amplifier has wiring information printed inside the flip lid of the unit. Unscrew the lower flip lid to access the wiring terminals. Ensure your power source is deactivated before handling power wires. Pass cables through the cable entry gland before wiring into the terminal block.

To connect a wire, remove the required terminal block with pliers place the wire in firmly screw down the connection. The transducer terminals are labeled by colour on the PCB.

If you are connecting HawkLink communications, connect the blue wire to B and the white wire to A. The black wire can be connected to the DC- or GND terminal next to A. Tighten cable entry gland(s) and cover to ensure sealing is effective.

### 234 wire version

<table>
<thead>
<tr>
<th>RELAY 1</th>
<th>RELAY 2</th>
<th>RELAY 3</th>
<th>RELAY 4</th>
<th>RELAY 5</th>
</tr>
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<tbody>
<tr>
<td>NC</td>
<td>NC</td>
<td>NC</td>
<td>NC</td>
<td>NC</td>
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<tr>
<td>COM</td>
<td>COM</td>
<td>COM</td>
<td>COM</td>
<td>COM</td>
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<tr>
<td>NO</td>
<td>NO</td>
<td>NO</td>
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<td>NO</td>
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<tr>
<td>16</td>
<td>19</td>
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<td>1</td>
<td>4</td>
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<tr>
<td>2</td>
<td>5</td>
<td>8</td>
<td>11</td>
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<tr>
<td>3</td>
<td>6</td>
<td>9</td>
<td>12</td>
<td>15</td>
</tr>
</tbody>
</table>

**Is** + – 4-20mA from user device

**Test In**

**RED** BLACK BLUE WHITE TRANSODUCER

**COMMS**

**DC-In**

**AC-In**

**RELAY 1NC**

**RELAY 2NC**

**RELAY 3NC**

**RELAY 4NC**

**RELAY 5NC**

**OR**

Sourcing 4-20mA from Sultan

### 2 wire version

<table>
<thead>
<tr>
<th>Test In</th>
<th>COMMS A</th>
<th>B</th>
<th>Shld</th>
<th>Shld</th>
</tr>
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<tbody>
<tr>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
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<td>8</td>
<td>12</td>
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<td>3</td>
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<tr>
<td>9</td>
<td>10</td>
<td>5</td>
<td>6</td>
<td></td>
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</tbody>
</table>

**RED** BLACK BLUE WHITE TRANSODUCER

**+** – 4-20mA from user device

**AC-In** is replaced by 36-60VDC with Power Input Option ‘C’.

Use long nose pliers to extract terminals.
**Sultan Integral Units**

The Sultan Integral unit has wiring information printed inside the flip lid of the unit.

Unscrew the lid to expose the facia.

The lid can be snapped back to allow easier access for wiring. When finished, first re-snap the double hinge into position before closing the lid. The top half of the facia is a flip cover which exposes the wiring terminals.

Ensure your power source is deactivated before handling power wires.

Pass cables through the cable entry gland before wiring into the terminal block.

To connect a wire, push down on the button above the terminal with a small flat head screwdriver and place the wire in the terminal. Release the pressure on the button to close the terminal and then pull on the wire to check that it is secure.

If you are connecting HawkLink communications, connect the blue wire to B and the white wire to A. The black wire should be connected to the Shld terminal.

Tighten cable entry gland(s) and cover to ensure sealing is effective.

---

<table>
<thead>
<tr>
<th>234 wire version</th>
<th>2 wire version</th>
</tr>
</thead>
<tbody>
<tr>
<td>RELAY 1</td>
<td>COMMS</td>
</tr>
<tr>
<td>NC</td>
<td>A</td>
</tr>
<tr>
<td>COM</td>
<td>B</td>
</tr>
<tr>
<td>NO</td>
<td>Shld</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>AC-In</td>
<td>-</td>
</tr>
<tr>
<td>4-20mA</td>
<td>Is</td>
</tr>
<tr>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>DC-In</td>
<td></td>
</tr>
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</table>

Sinking 4-20mA from user device

OR

Sourcing 4-20mA from Sultan

Ensure that any unused cable gland entries are plugged or sealed.
The Sultan Panel Mount has wiring information printed on the back of the unit.

Terminal blocks can be removed during installation to allow easier wire connection. Take care to return them to the correct position.

Ensure your power source is deactivated before handling power wires.

Ensure terminals are open by screwing counter clockwise with a flat head screwdriver. Place the exposed wires into the open terminals and tighten until firm.

The transducer terminals are labeled by colour on the back panel.

If you are connecting HawkLink communications, connect the blue wire to B and the white wire to A. The black wire can be connected to the DC- or GND terminal next to A.

Sourcing 4-20mA from Sultan

Sinking 4-20mA from user device

OR

Sinking 4-20mA from user device

4-20mA

2 wire version

N/C N/C N/C N/C N/C

COMMS TRANSDUCER 4-20mA

234 wire version

+ – A B Test In RED BLACK BLUE WHITE – + Is

AC-In DC-In COMMS TRANSUDER 4-20mA
Sultan SMART Units

The Sultan SMART unit has wiring information printed inside the lid of the unit.

Screw Cap Version

Unscrew the lid to expose the terminals. It is recommended you remove the terminal block from the unit before wiring - to do this, insert a screw driver into one of the middle terminals to lever the block out.

Pass the cables through the cable entry gland before wiring in to the terminal block.

Ensure the terminal is open by screwing counter clockwise with a flat head screwdriver. Place the exposed wires into the open terminals and tighten until firm. Insert the block back into the unit when wiring is complete. Press firmly on the plug in terminal block to ensure it is fully home.

If you are connecting HawkLink communications, connect the blue wire to B and the white wire to A. The black wire can be connected to the DC- terminal next to B.

Tighten cable entry gland(s) and cover to ensure sealing is effective.

IP68 Sealed Cable Version

Connect the free ends of the cable following the wire colours as shown in the terminal diagrams.

**AWSTA version**

- **Test In**: A
- **B**: –
- **COMMS**: –
- **4-20mA**: +
- **Sinking 4-20mA from user device (loop powered)**

**AWSTC version**

- **Test In**: A
- **COMMS**: –
- **DC in**: +
- **Sinking 4-20mA from user device**

**AWSTD version**

- **Test In**: A
- **COMMS**: –
- **DC in**: +
- **4-20mA**: +
- **Sinking 4-20mA from user device**

Notes:

1. No internal connection
2. Single Modbus connection PC to unit only
Multidrop connection not recommended

For cable only models (without integrated junction box option), please use colors shown to denote wire functions.

For models with integrated junction box option, remove plug-in terminal blocks for easier wiring.
When connecting the 4-20mA output to a user device such as a PLC input, DCS or indicator, use a voltmeter to check the field wires to be used for the 4-20mA signal. If DC voltage around 24V is present, use sinking connection. If no voltage is present, use sourcing connection.

**SOURCING Type Output**

Sultan output is sourcing current and provides voltage to drive a passive load, PLC input, indicator or other user device.

NOTE: Isolated current output can be made common with +DC or GND if required. (e.g. RL – connected to GND)

**SINKING Type Output (also 2 wire loop powered)**

Sultan output is sinking current. Voltage to drive current loop must be provided by PLC, indicator, other user device or external DC supply.

NOTE: RL Max = 750Ω if user DC Supply 24V.

**Junction Box / Transducer Cable Extension**

Seperate cable shielding from black wire at junction box
The term crosstalk is used to refer to interference between acoustic wave units of the same frequency located near one another. The units can ‘hear’ direct or reflected signals from one another. This can cause randomly false measurements and outputs whilst giving correct performance at other times.

Crosstalk is more likely to exist when there are multiple units in a small enclosed area with highly reflective surfaces and with fast moving applications.

**Wiring for Anti Crosstalk**

1. Link all units to a common ground, or parallel connect their ‘GND’ or ‘DC-’ terminals.
   *GND and DC- terminals are electrically connected inside Sultan 234 units, so either one may be used.

2. At each individual unit, wire a connection between a Relay (eg Relay 1) ‘Common’ terminal and the ‘TEST’ terminal of the same amplifier.

3. Wire a connection between the chosen Relay ‘Normally Open’ terminals of all units to be linked (parallel connection of all units).

4. In the Output Adjust menu for each unit program the chosen Relay to ‘FS’ (Fail-safe) mode).
   The units will now be linked so that they cannot crosstalk.

5. **(UPDATE MARCH 2012).** New release software includes an additional menu in the ‘Output Adjust’ section called ‘test input’. The option ‘Synchronise’ improves the cross talk sequencing for larger amounts of units.

HAWK does not recommend more than 6 transducers in a single anti cross talk circuit.
A PLC/DCS with digital outputs can be used to control or sequence pulse rates.

**Sequence Timing**

<table>
<thead>
<tr>
<th>PLC / DCS</th>
<th>Sultan Terminal Rail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital Output</td>
<td>1 2 3 4 5 6 7 8 9 10 11 12 13 14 15</td>
</tr>
<tr>
<td>Relay On PLC / DCS Min 120mS</td>
<td>Test In COMMS DC-In AC-In</td>
</tr>
<tr>
<td>Running Minimum Time 250mS + M x 6mS</td>
<td>RED BLACK BLUE WHITE</td>
</tr>
<tr>
<td>AC-In</td>
<td>4-20mA TRANSUCER</td>
</tr>
<tr>
<td>Relay On PLC / DCS Min 120mS</td>
<td>Running Minimum Time 250mS + M x 6mS</td>
</tr>
</tbody>
</table>

**Collaborations**

1L

**Notes**

- Relay On PLC / DCS
- Running Minimum Time 250mS + M x 6mS
These are examples of common **INCORRECT** mountings which can prevent the unit from operating correctly.

Do **NOT** mount near infeed

Do **NOT** mount over or adjacent to any obstacles

Do **NOT** mount cone or transducer face above roofline

Do **NOT** mount on angle in liquid applications
Correct Mounting
Sultan Acoustic Wave Series

Mount away from infeed

Mount away from all obstacles

Mount cone / transducer face within the vessel

Mount perpendicular to liquids
Amplifier
Select a suitable mounting position that is protected from direct sunlight. If necessary, utilize a sun hood (HAWK supplies purpose made sun hoods). Observe the minimum and maximum temperature limits (-20°C/-4°F to 60°C/140°F) Do not mount near sources of electrical noise such as high current cables, motor starters, or variable speed drives. Avoid mounting in high vibration areas such as handrails and rotating plant. Use rubber absorption mounts if mounting in light vibration areas. Protect the PCB assembly before knocking out the cable and conduit entry holes.

Panel Mount
• Select a suitable position within a panel layout which allows clearance around the outside of the front panel of the unit and also behind the panel for clearance around the screw fixing clamps used to retain the unit.
• Ensure that sufficient space is available behind the panel to accommodate the depth of the amplifier housing, and also allow cable bend clearance for wiring to the terminals on the rear of the amplifier.
• Mark and cut a 90x90mm (3.54x3.54") square cut out through the panel in the desired position.
• Insert the Sultan amplifier through the panel and install supplied screw clamps into the slotted holes in the amplifier housing.
• Tighten the screws until just firm to secure the amplifier in place.
• Connect wiring as required to the correct terminals on the removable rear panel connectors. When plugging connectors in to the rear panel, ensure that they are re-installed in the correct position.

Transducer
Selecting a suitable position to mount the transducer on the vessel is the single MOST IMPORTANT step. Please read all of the installation guide and contact your HAWK representative if you have any doubts or questions. The transducer face MUST be at least the blanking distance away from highest product level in the vessel.

Use common sense when selecting the transducer mounting position. A clear line of sight from the transducer to the product being monitored is required.

Take into account the change in material shape and level. The acoustic pulse must reflect back to the transducer.

Incorrect Mounting
Failure to mount the unit suitably can result in incorrect measurement and may cause process issues such as overfilling or damage to critical components.

Process Conditions
Ensure the process conditions within the vessel such as temperature, pressure and chemical composition of contents are within the specifications Sultan unit. The unit should not normally come into contact with the measured content.
Minimum Insertion
The transducer face or cone must be at least 50mm (2 inches) inside the tank.
If the transducer needs to be mounted above the roof line, use an appropriate standpipe or nozzle.

Moisture Seal
Sultan Integral and Smart units have cable glands with a moisture seal which must be tightened around the cable. Any unused glands must be plugged and sealed.

Transducer Location
It is vital that the Transducer has a clear view of the product surface at all times and is kept away from the inflow to avoid interference.

Blanking Distance
The unit will ignore any echoes and will never measure within its Blanking distance.
Minimum values must be respected. Where possible use the conservative values and increase this distance by 50% if there is foam, dust, steam, or condensation in the vessel being monitored. (Refer to Blanking Distance table.)
If using a flange mounting, use a rubber or neoprene gasket and washers. If using a nipple mounting, ensure that the mounting bracket is >6mm (0.24 in) from the rear of the transducer. Do not over tighten the lock nuts.

<table>
<thead>
<tr>
<th>Transducer Frequency</th>
<th>Minimum</th>
<th>Nominal</th>
<th>Conservative</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWRT50 50kHz</td>
<td>0.25m (10&quot;)</td>
<td>0.3m (1ft)</td>
<td>0.35m (1.2ft)</td>
</tr>
<tr>
<td>AWRT40 40kHz</td>
<td>0.3m (1.1ft)</td>
<td>0.35m (1.2ft)</td>
<td>0.4m (1.4ft)</td>
</tr>
<tr>
<td>AWRT30 40kHz</td>
<td>0.35m (1.5ft)</td>
<td>0.4m (1ft)</td>
<td>0.5m (2.2ft)</td>
</tr>
<tr>
<td>AWRT20 20kHz</td>
<td>0.5m (2.2ft)</td>
<td>0.6m (1.3ft)</td>
<td>0.8m (2.6ft)</td>
</tr>
<tr>
<td>AWRT10 10kHz</td>
<td>1.0m (3.3ft)</td>
<td>1.1m (3.5ft)</td>
<td>1.3m (4.2ft)</td>
</tr>
<tr>
<td>AWRT5  5kHz</td>
<td>1.2m (3.9ft)</td>
<td>1.4m (4.6ft)</td>
<td>1.5m (5ft)</td>
</tr>
</tbody>
</table>

Always use conservative nominated distances if possible.
Installation Examples
Sultan Acoustic Wave Series

**SOLID (Granular)**
Aim transducer at point of outfeed.

**LIQUID**
Transducer should be vertical.

**DUAL OUTFEED**
Two transducers may require anti-crosstalk wiring setup (see manual).

**POWDER**
Mount away from infeed.

**MOUNTING POSITION**

**NOZZLE MOUNT**
Minimum 50mm

**FLUSH MOUNT**

**STAND PIPE MOUNT**
Minimum 50mm

**2” VERSION**

*Correct*
Threaded mounting should only be used where a flange/cone mounting is impossible. Hawk recommends & supplies focaliser cones for all transducers.

*Incorrect*
Face must not be inside mounting.

Infed Pipe

Vessel

2/3 1/3

Threaded mounting should only be used where a flange/cone mounting is impossible. Hawk recommends & supplies focaliser cones for all transducers.

Vessel roof

min 20mm inside tank
After the unit has been installed, mounted and powered you can now enter the Quickstart settings to get the unit operational in your application conditions.

Be sure to enter settings for High & Low level, App Type, Fill Rate and Empty Rate of your vessel.

If you are unsure of your specific fill & empty speed enter a value you are sure is faster than your process.

All of the mentioned settings (except Blanking) are in the ‘Quickset’ menu of the unit. You access this menu on the control pad by pressing CAL and entering Unlock code 0.

You may also need to set relay switch points. These are found in ‘Output Adjustment’. Relay alarms can be set on/off for hi/lo levels and failsafe.

![Diagram of tank and measurement points]

### Quickset

- **Unit**
  - Select unit of measurement from Feet Metres Centimeters Inches
  - Adjust vessel low level (maximum measured distance from transducer face)
  - Adjust vessel high Level (minimum measured distance from transducer face)

- **Low Level**
  - Position Slurry Solids Liquids
  - Select FailSafe mA output
  - Adjust vessel fill rate
  - Adjust vessel empty rate

- **High Level**
  - 3.50mA 3.80mA 20.20mA Last Known
  - Select FailSafe mA output
  - Adjust vessel fill rate
  - Adjust vessel empty rate

- **Fail Safe**
  - Adjust Fail time (seconds)

- **App Type**
  - Position Slurry Solids Liquids
  - Note: If using GosHawk PC comms you must change fill & empty rate AFTER selecting app type.

- **Display Mode**
  - Avg Matrl Diff Q/O/P Space Material
  - Material% Flow Volume Flow Tbl

### Output Adj

- **Fill Damp**
  - Filling damping. Number of pulses averaged for output

- **Empty Damp**
  - Adjust Empty Damping

- **Rly Mode 1**
  - DEN EN FS OFF
  - Relay Triggers - Denergise, Energise, Fail Safe, Off
  - Example EN L1 = relay OFF point
  - Example DEN L1 = relay ON point

- **Rly Modes 2-5**
  - RlyL1 RlyL2
  - Example RlyL1 = relay OFF point
  - Example RlyL2 = relay ON point

---

**Transducer Face - Top of Flange**

**End of Blanking Zone**

**High Level or 100% (20mA) position.**

**Low Level or 0% (4mA) position.**

High Level = Distance A to C

Low Level = Distance A to E
Dimensions
Sultan Acoustic Wave Series

Integral Units

Standard Type

Compact Type
(2” BSP / NPT)

Remote Transducers

Standard Type

Compact Type
(2” BSP / NPT)

All cones must protrude into the main volume of the vessel by at least 50 mm (2 inches) past the lower end of the mounting nozzle.

<p>| Cone / Transducer Dimensions Table |</p>
<table>
<thead>
<tr>
<th>Sensor Frequency</th>
<th>Selected Flange</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>mm</td>
<td>in.</td>
<td>mm</td>
<td>in.</td>
</tr>
<tr>
<td>5 kHz</td>
<td>10”</td>
<td>236</td>
<td>10.0</td>
<td>455</td>
<td>17.9</td>
</tr>
<tr>
<td></td>
<td>10”</td>
<td>236</td>
<td>10.0</td>
<td>455</td>
<td>17.9</td>
</tr>
<tr>
<td></td>
<td>8”</td>
<td>195</td>
<td>8.0</td>
<td>280</td>
<td>11.1</td>
</tr>
<tr>
<td>10 kHz</td>
<td>10”</td>
<td>236</td>
<td>10.0</td>
<td>455</td>
<td>17.9</td>
</tr>
<tr>
<td></td>
<td>8”</td>
<td>195</td>
<td>8.0</td>
<td>280</td>
<td>11.0</td>
</tr>
<tr>
<td>15 kHz</td>
<td>10”</td>
<td>236</td>
<td>10.0</td>
<td>455</td>
<td>17.9</td>
</tr>
<tr>
<td></td>
<td>8”</td>
<td>195</td>
<td>8.0</td>
<td>280</td>
<td>11.0</td>
</tr>
<tr>
<td>20 / 30 kHz</td>
<td>4”</td>
<td>98.5</td>
<td>3.9</td>
<td>280</td>
<td>11.0</td>
</tr>
<tr>
<td>30 / 40 / 50 kHz</td>
<td>4”</td>
<td>98.5</td>
<td>3.9</td>
<td>280</td>
<td>11.0</td>
</tr>
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</table>
Flanges

<table>
<thead>
<tr>
<th>Size</th>
<th>Flange Type</th>
<th>E (PCD)</th>
<th>F (OD)</th>
<th>G (ID)</th>
<th>H (Hole)</th>
<th>No. Holes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>mm in.</td>
<td>mm in.</td>
<td>mm in.</td>
<td>mm in.</td>
<td></td>
</tr>
<tr>
<td>4&quot;</td>
<td>FA4 ANSI class 150</td>
<td>190.5</td>
<td>7.5</td>
<td>229</td>
<td>9.0</td>
<td>19 0.75 8</td>
</tr>
<tr>
<td></td>
<td>FD4 DIN100 PN10/16</td>
<td>180</td>
<td>7.1</td>
<td>220</td>
<td>8.7</td>
<td>18 0.71 8</td>
</tr>
<tr>
<td></td>
<td>FJ4 JIS B2220-1984 10kg</td>
<td>175</td>
<td>6.9</td>
<td>210</td>
<td>8.4</td>
<td>19 0.75 8</td>
</tr>
<tr>
<td>6&quot;</td>
<td>FA6 ANSI class 150</td>
<td>241.5</td>
<td>9.5</td>
<td>279</td>
<td>11.0</td>
<td>22 0.87 8</td>
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<tr>
<td></td>
<td>FD6 DIN150 PN10</td>
<td>240</td>
<td>9.4</td>
<td>285</td>
<td>11.2</td>
<td>23 0.91 8</td>
</tr>
<tr>
<td></td>
<td>FJ6 JIS B2220-1984 10kg</td>
<td>240</td>
<td>9.4</td>
<td>280</td>
<td>11.0</td>
<td>23 0.91 8</td>
</tr>
<tr>
<td>8&quot;</td>
<td>FA8 ANSI class 150</td>
<td>298.5</td>
<td>11.8</td>
<td>343</td>
<td>13.5</td>
<td>22 0.85 8</td>
</tr>
<tr>
<td></td>
<td>FD8 DIN200 PN10</td>
<td>295</td>
<td>11.6</td>
<td>340</td>
<td>13.4</td>
<td>22 0.85 8</td>
</tr>
<tr>
<td></td>
<td>FJ8 JIS B2220-1984 10kg</td>
<td>290</td>
<td>11.4</td>
<td>330</td>
<td>13.0</td>
<td>20 0.91 12</td>
</tr>
<tr>
<td>10&quot;</td>
<td>FA10 ANSI class 150</td>
<td>362</td>
<td>14.3</td>
<td>406</td>
<td>16.0</td>
<td>25 1.02 12</td>
</tr>
<tr>
<td></td>
<td>FD10 DIN200 PN10</td>
<td>350</td>
<td>13.7</td>
<td>395</td>
<td>16.0</td>
<td>25 0.85 12</td>
</tr>
<tr>
<td></td>
<td>FJ10 JIS B2220-1984 10kg</td>
<td>355</td>
<td>14.0</td>
<td>400</td>
<td>15.7</td>
<td>25 0.99 12</td>
</tr>
</tbody>
</table>

Remote Amplifier
Each Transducer frequency has a different Blanking distance and recommended minimum distance (or high level) between the sensor face and measured product. This distance is measured from the sensor face or the bottom tip of flange down depending on model.

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Frequency</th>
<th>Minimum</th>
<th>Nominal</th>
<th>Conservative</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWRT50</td>
<td>50kHz</td>
<td>0.25m (10&quot;)</td>
<td>0.3m (1ft)</td>
<td>0.35m (1.2ft)</td>
</tr>
<tr>
<td>AWRT40</td>
<td>40kHz</td>
<td>0.3m (1ft)</td>
<td>0.35m (1.2ft)</td>
<td>0.4m (1.3ft)</td>
</tr>
<tr>
<td>AWRT30</td>
<td>30kHz</td>
<td>0.35m (1.2ft)</td>
<td>0.4m (1.3ft)</td>
<td>0.5m (1.6ft)</td>
</tr>
<tr>
<td>AWRT20</td>
<td>20kHz</td>
<td>0.45m (1.5ft)</td>
<td>0.6m (2ft)</td>
<td>0.7m (2.2ft)</td>
</tr>
<tr>
<td>AWRT15</td>
<td>15kHz</td>
<td>0.6m (2ft)</td>
<td>0.7m (2.2ft)</td>
<td>1.0m (3.2ft)</td>
</tr>
<tr>
<td>AWRT10</td>
<td>10kHz</td>
<td>0.75m (2.5ft)</td>
<td>1.1m (3.6ft)</td>
<td>1.3m (4.2ft)</td>
</tr>
<tr>
<td>AWRT05</td>
<td>5kHz</td>
<td>1.0m (3.2ft)</td>
<td>1.5m (4.9ft)</td>
<td>1.8m (5.9ft)</td>
</tr>
</tbody>
</table>

*Always use conservative nominated distances if possible*
### AWR Remote Transmitter

**AWR234**

<table>
<thead>
<tr>
<th>RELAY 1</th>
<th>RELAY 2</th>
<th>RELAY 3</th>
<th>RELAY 4</th>
<th>RELAY 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>NC 16</td>
<td>COM 17</td>
<td>NO 18</td>
<td>NC 19</td>
<td>COM 20</td>
</tr>
<tr>
<td>1 1</td>
<td>2 2</td>
<td>3 3</td>
<td>4 4</td>
<td>5 5</td>
</tr>
</tbody>
</table>

**Sourcing 4-20mA from Sultan**

**Sinking 4-20mA from user device**

**OR**

**Sourcing 4-20mA from Sultan**

*AC-In is replaced by 36-60VDC with Power Input Option ‘C’.*

### AWI Integral Transmitter

**AWI234**

<table>
<thead>
<tr>
<th>RELAY 1</th>
<th>RELAY 2</th>
<th>COMMS</th>
<th>RELAY 1</th>
<th>RELAY 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>NC 1</td>
<td>COM 2</td>
<td>A</td>
<td>NC 3</td>
<td>A</td>
</tr>
<tr>
<td>1 1</td>
<td>2 2</td>
<td>B</td>
<td>3 3</td>
<td>B</td>
</tr>
<tr>
<td>L1 4-20mA</td>
<td>+ +</td>
<td>Is</td>
<td>Test In 4-20mA</td>
<td>DC-In</td>
</tr>
<tr>
<td>AC-In</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Sinking 4-20mA from user device**

**OR**

**Sourcing 4-20mA from Sultan**

**AWI2**

<table>
<thead>
<tr>
<th>COMMS</th>
<th>RELAY 1</th>
<th>RELAY 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>NC 1</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>COM 2</td>
<td></td>
</tr>
<tr>
<td>Shld</td>
<td>NC 3</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COMMS</th>
<th>RELAY 1</th>
<th>RELAY 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>NC 4</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>COM 5</td>
<td></td>
</tr>
<tr>
<td>Shld</td>
<td>NC 6</td>
<td></td>
</tr>
</tbody>
</table>

**Sinking 4-20mA from user device**

**OR**

**Sourcing 4-20mA from Sultan**
During running mode the Sultan will always display the selected primary display mode. There are further options referred to as 'diagnostics' which can be accessed using the arrow buttons which give immediate information about unit performance.

If you press the pushbuttons while the unit is in normal operation mode (displaying Space, Material% etc) the following diagnostic are shown (example values).

- **E**: Echo 4.2 - Current distance the unit is detecting with each pulse (does not include output damping values)
- **S**: Size 1.11V - Echo size in volts - A high value (1.6-2V) indicates the unit may have too much gain for the current distance
- **Gn**: Gain 37.6% - Amount of gain applied at distance echo is detected
- **R**: Recover 2.3% - The amount of recover gain the unit is currently applying on top of normal gain to track the level
- **N**: Noise 1.9% - External noise level of similar frequency to Transducer (eg bulk solids filling)
- **T**: Temperature 23.2°C - Temperature at sensor face
- **Win Fwd**: 3.6m - Tracking Window starting distance
- **Win Bk**: 4.8m - Tracking Window finishing distance
- **Normal**: Normal - Unit operational mode:
  - **Normal** operation if tracked echo is above minimum threshold. Default minimum is 0.4V
  - **Recover** if below minimum threshold, the unit will search for an echo for as long as the fail time
Quickset Flow Chart

**Sultan Acoustic Wave Series**

- Select unit of measurement from:
  - Feet
  - Metres
  - Centimeters
  - Inches
- Adjust vessel low level (maximum measured distance from transducer face)
- Adjust vessel high Level (minimum measured distance from transducer face)
- Fail Safe
  - 3.50mA
  - 3.80mA
  - 20.20mA
- Last Known
- Fail Time
  - Adjust Fail time (seconds)
- App Type
  - See P20 App types
  - View or adjust fill rate (fast/med/slow/custom)
  - View or adjust empty rate (fast/med/slow/custom)
- Display Mode
  - Avg Matrl
  - Diff O/P
  - Space
  - Material
  - Material%
  - Flow
  - Volume
  - Flow Tbl
  - * See ‘Display Modes’ on page 27
- Offset
  - Adjust offset value
- Amp Reset
  - Resets Amplifier to default settings (quickset & output adj parameters)
- Lock Code
  - Set unlock code (default 0)

Note: If using GosHawk PC comms, after changing 'app type' you need to reset fill & empty rate to 1 and then enter your preferred values.

Amp Reset
- Resets Amplifier to default settings (quickset & output adj parameters).

Lock Code
- Set unlock code (default 0)
Quickset Parameters
Sultan Acoustic Wave Series

Quickset

To access the Quickset parameter menu, press and hold the CAL button until “Unlock 0” is displayed on the LCD. Then use the ↑ ↓ buttons to select the access code.

The factory default is 0.

Unit

Allows the user to select the units for display of measured distances and relay set point programming. The choices are metres / centimetres or feet / inches.

Low Level

Sets the distance from the face of the transducer that corresponds to the low level in the vessel being monitored (4mA analog output level).

High Level

Sets the distance from the face of the transducer that corresponds to the High level in the vessel being monitored (20mA analog output level).

Note: There must be a minimum span of 100mm between high & low levels.

Fail-Safe

Allows the user to select their preferred fail safe condition the 4-20mA output will transmit when the unit enters fail safe mode. There are 5 possible mA output failure values. They are: 20mA, 4mA, Last Known, <4.00mA and >20.00mA.

Application Type

Allows the user to select the type & speed of the customer application to automatically program unit settings. See dedicated ‘Application type’ on next page.

Display Mode

Allows the user to select the primary display mode reading. Options are average material, diff o/p, space, material, material%, flow, volume and flow tbl. ‘Space’ is default.

Lock Code

Allows the user to set an access code other than 0 to avoid unauthorised changes to the programming. Use the ↑ ↓ buttons to select the desired access code.
HAWK introduced additional application types to the Sultan series in software v5.78 (released 16 March 2012) along with a basic selection of process speed of ‘fast’, medium, or ‘slow’. You can also manually select and adjust the fill & empty speeds (in selected unit per hour eg metres per hour) by using the ‘Custom’ option.

The application types are selectable in the ‘Quickstart’ menu. After you select the application type the first menu you will see is ‘view’. To modify the settings use the arrows to scroll to ‘fast’, ‘medium’, ‘slow’ or ‘custom’. ‘View’ displays the currently selected speeds.

<table>
<thead>
<tr>
<th>Selected App Type</th>
<th>Custom</th>
<th>Fill / Empty Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bin Level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fast Fill</td>
<td>100m/h</td>
<td>Empty 100m/h</td>
</tr>
<tr>
<td>Med Fill</td>
<td>50m/h</td>
<td>Empty 50m/h</td>
</tr>
<tr>
<td>Slow Fill</td>
<td>10m/h</td>
<td>Empty 10m/h</td>
</tr>
</tbody>
</table>

| Cement            |        |                   |
| Fast Fill         | 20m/h  | Empty 20m/h       |
| Med Fill          | 10m/h  | Empty 10m/h       |
| Slow Fill         | 5m/h   | Empty 5m/h        |

| Coal               |        |                   |
| Fast Fill          | 100m/h | Empty 100m/h      |
| Med Fill           | 50m/h  | Empty 50m/h       |
| Slow Fill          | 10m/h  | Empty 10m/h       |

| Conveyor          |        |                   |
| Fast Fill          | 6000m/h| Empty 6000m/h     |
| Med Fill           | 3000m/h| Empty 3000m/h     |
| Slow Fill          | 1000m/h| Empty 1000m/h     |

| Crusher           |        |                   |
| Fast Fill         | 800m/h | Empty 800m/h      |
| Med Fill          | 200m/h | Empty 200m/h      |
| Slow Fill         | 20m/h  | Empty 20m/h       |

| Detection         |        |                   |
| Fast Fill         | 6000m/h| Empty 6000m/h     |
| Med Fill          | 3000m/h| Empty 3000m/h     |
| Slow Fill         | 1000m/h| Empty 1000m/h     |

| Iron Ore          |        |                   |
| Fast Fill         | 100m/h | Empty 100m/h      |
| Med Fill          | 50m/h  | Empty 50m/h       |
| Slow Fill         | 5m/h   | Empty 5m/h        |

| Liquids           |        |                   |
| Fast Fill         | 200m/h | Empty 200m/h      |
| Med Fill          | 50m/h  | Empty 50m/h       |
| Slow Fill         | 5m/h   | Empty 5m/h        |

| Agitated Liquids  |        |                   |
| Fast Fill         | 200m/h | Empty 200m/h      |
| Med Fill          | 60m/h  | Empty 60m/h       |
| Slow Fill         | 10m/h  | Empty 10m/h       |

| Ore                |        |                   |
| Fast Fill          | 100m/h | Empty 100m/h      |
| Med Fill           | 50m/h  | Empty 50m/h       |
| Slow Fill          | 5m/h   | Empty 5m/h        |

| Plastics           |        |                   |
| Fast Fill          | 20m/h  | Empty 20m/h       |
| Med Fill           | 10m/h  | Empty 10m/h       |
| Slow Fill          | 5m/h   | Empty 5m/h        |
## Application Types

### Sultan Acoustic Wave Series

<table>
<thead>
<tr>
<th>Positioning</th>
<th>Fast Fill</th>
<th>Empty Fill</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast Fill</td>
<td>4000m/h</td>
<td>4000m/h</td>
</tr>
<tr>
<td>Med Fill</td>
<td>2000m/h</td>
<td>2000m/h</td>
</tr>
<tr>
<td>Slow Fill</td>
<td>1000m/h</td>
<td>1000m/h</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Powder</th>
<th>Fast Fill</th>
<th>Empty Fill</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast Fill</td>
<td>30m/h</td>
<td>30m/h</td>
</tr>
<tr>
<td>Med Fill</td>
<td>15m/h</td>
<td>15m/h</td>
</tr>
<tr>
<td>Slow Fill</td>
<td>5m/h</td>
<td>5m/h</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reflective</th>
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<th>Empty Fill</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast Fill</td>
<td>20m/h</td>
<td>20m/h</td>
</tr>
<tr>
<td>Med Fill</td>
<td>10m/h</td>
<td>10m/h</td>
</tr>
<tr>
<td>Slow Fill</td>
<td>5m/h</td>
<td>5m/h</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ROM Bin</th>
<th>Fast Fill</th>
<th>Empty Fill</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast Fill</td>
<td>1200m/h</td>
<td>400m/h</td>
</tr>
<tr>
<td>Med Fill</td>
<td>700m/h</td>
<td>250m/h</td>
</tr>
<tr>
<td>Slow Fill</td>
<td>300m/h</td>
<td>100m/h</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Silo Level</th>
<th>Fast Fill</th>
<th>Empty Fill</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast Fill</td>
<td>100m/h</td>
<td>100m/h</td>
</tr>
<tr>
<td>Med Fill</td>
<td>50m/h</td>
<td>50m/h</td>
</tr>
<tr>
<td>Slow Fill</td>
<td>10m/h</td>
<td>10m/h</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Slurry</th>
<th>Fast Fill</th>
<th>Empty Fill</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast Fill</td>
<td>100m/h</td>
<td>100m/h</td>
</tr>
<tr>
<td>Med Fill</td>
<td>50m/h</td>
<td>50m/h</td>
</tr>
<tr>
<td>Slow Fill</td>
<td>20m/h</td>
<td>20m/h</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Solids</th>
<th>Fast Fill</th>
<th>Empty Fill</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast Fill</td>
<td>100m/h</td>
<td>100m/h</td>
</tr>
<tr>
<td>Med Fill</td>
<td>50m/h</td>
<td>50m/h</td>
</tr>
<tr>
<td>Slow Fill</td>
<td>10m/h</td>
<td>10m/h</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stockpile</th>
<th>Fast Fill</th>
<th>Empty Fill</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast Fill</td>
<td>200m/h</td>
<td>200m/h</td>
</tr>
<tr>
<td>Med Fill</td>
<td>50m/h</td>
<td>50m/h</td>
</tr>
<tr>
<td>Slow Fill</td>
<td>20m/h</td>
<td>20m/h</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sump</th>
<th>Fast Fill</th>
<th>Empty Fill</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast Fill</td>
<td>200m/h</td>
<td>200m/h</td>
</tr>
<tr>
<td>Med Fill</td>
<td>40m/h</td>
<td>40m/h</td>
</tr>
<tr>
<td>Slow Fill</td>
<td>10m/h</td>
<td>10m/h</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Process Sump</th>
<th>Fast Fill</th>
<th>Empty Fill</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast Fill</td>
<td>1000m/h</td>
<td>1000m/h</td>
</tr>
<tr>
<td>Med Fill</td>
<td>300m/h</td>
<td>300m/h</td>
</tr>
<tr>
<td>Slow Fill</td>
<td>20m/h</td>
<td>20m/h</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tank Level</th>
<th>Fast Fill</th>
<th>Empty Fill</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast Fill</td>
<td>200m/h</td>
<td>200m/h</td>
</tr>
<tr>
<td>Med Fill</td>
<td>50m/h</td>
<td>50m/h</td>
</tr>
<tr>
<td>Slow Fill</td>
<td>5m/h</td>
<td>5m/h</td>
</tr>
</tbody>
</table>
Non-standard display modes

AvgMatrl and Diff O/P are special operation modes which require two transducers connected to an amplifier via a junction box. Avg Matrl calculates the average level measured by the two transducers and Diff O/P calculates the difference in level between the two transducers. You will need to assign one transducer to ID2. To do this connect only one of the transducers, enter ‘Quickset’ and change the display mode to AvgMatrl or Diff O/P. Scroll down until you see 1:Sen Add 1 option, press CAL, select ‘1’ for current transducer and press CAL again. The menu then proceeds to Tx Add:, press CAL to edit, pres UP to scroll from 1 to 2 and press CAL to save. The currently connected transducer is now on ID2 - you can now connect the other transducer to the junction box which will be ID1 to complete the measurement pair required for Average & Differential measurement.

The Flow option can be used for basic open channel flow applications with a known Exponent value of the flume/channel/weir and the known max flow rate. Low & High level need to be set to represent the distance from the transducer face of 0-100% possible flow of the application. For more comprehensive flow measurement please see the dedicated flow measurement unit the Sultan Flow.

*Press RUN twice at any time to revert to normal operation*
Average Level
Sultan Acoustic Wave Series

Note: Average level requires a junction box AWRT-JB-01

What is Average Level?

Average Level (AvgMatrl) is used to measure the average of two levels using two Transducers and one amplifier providing one output. The Transducers are referred to as Sensor 1 and Sensor 2.

Average Material Calculation

The display mode ‘AvgMatrl’ (Average Material) gives a result calculated as follows:

\[
\text{AvgMatrl} = \text{LowLevel} - \text{AvgSpace} \]

where

\[
\text{AvgSpace} = \frac{\text{Space1} + \text{Space2} + \text{offset}}{2}
\]

Analog Output

Analog output is calculated based on the average material level.

The span of the analog output is defined by the LowLevel and HiLevel parameters. The analog output is calculated as follows:

\[
\text{Current (mA)} = 16 \times \frac{\text{AvgMatrl}}{\text{LowLevel-Hi Level}} + 4mA
\]

Relays

The relays are switched based on the average space value. The relay set points L1 and L2 should be set considering the average space values at which the relay is required to switch.

Setting Sensor ID

You will need to assign one transducer to ID2. To do this perform the following steps

1. Connect only one of the transducers
2. Enter ‘Quickset’ and change the display mode to AvgMatrl
3. Scroll down until you see 1:Sen Add 1 option.
4. Press CAL to edit. Select ‘1’ for current transducer and press CAL again.
5. The menu then proceeds to Tx Add;
6. Press CAL to edit, press UP to scroll from 1 to 2 and press CAL to save.

The currently connected transducer is now on ID2

You can now connect the other transducer to the junction box which will be ID1 to complete the measurement pair required.

Accessing both Sensors Parameters

Both Sensor 1 and Sensor 2 parameters can be accessed through the Keypad.

The parameter ‘Sensor’ in ‘Advanced’ determines which sensor (1 or 2) will be currently accessed if required to adjust settings.
What is Differential Level?

Differential Level (Diff O/P) is the term used to define the measured difference between two material levels using two Transducers. The Transducers are referred to as Sensor 1 and Sensor 2.

Diff Calculation

In differential Mode the material level measured by Sensor 1 is subtracted from the material level measured by Sensor 2. Negative results will be reset to zero. The differential value is calculated as follow:

\[
\text{Diff} = \text{MaterialLevel}_2 - \text{MaterialLevel}_1
\]

\[
\text{MaterialLevel}_2 = \text{LowLevel}_2 - \text{Space}_2
\]

\[
\text{MaterialLevel}_1 = \text{LowLevel}_1 - \text{Space}_1
\]

Analog Output

Analog output is calculated based on the differential value.

The span of the analog output is according to the Lowlevel1 and Hilevel1. The analog output is calculated according the following equation:

\[
\text{Current (mA)} = 16 \times \frac{\text{Diff}}{\text{LowLevel}_1 - \text{HiLevel}_1} + 4\text{mA}
\]

Setting Sensor ID

You will need to assign one transducer to ID2.

To do this perform the following steps

1. Connect only one of the transducers
2. Enter ‘Quickset’ and change the display mode to AvgMatrl
3. Scroll down until you see 1:Sen Add 1 option.
4. Press CAL to edit. Select ‘1’ for current transducer and press CAL again.
5. The menu then proceeds to Tx Add:, Press CAL to edit, press UP to scroll from 1 to 2 and press CAL to save.

The currently connected transducer is now on ID2.

You can now connect the other transducer to the junction box which will be ID1 to complete the measurement pair required.

Accessing both Sensors Parameters

Both Sensor 1 and Sensor 2 parameters can be accessed through the KeyPad.

The parameter ‘Sensor’ in ‘Advanced’ determines which sensor (1 or 2) will be currently accessed if required to adjust settings.
Advanced settings adjusts the transducer sensing characteristics. It is not recommended you adjust these settings unless you are familiar with the effect they will have on your unit.

**Advanced**

- **Gain4**
  - Adjust transducer start gain (sensitivity to echoes)

- **GainStep3**
  - Adjust gain step 3 %
  - *Press RUN twice to revert to normal operation*

- **DistStep3**
  - Adjust distance of gain step 3

- **EchoSize**
  - Unit attempts to maintain an echo strength of this value

- **Threshold**
  - Unit attempts to maintain an echo strength of this value

- **Blanking**
  - Adjust blanking from transducer face. Unit will not track within this distance

- **Empt Dist**
  - Vessel empty distance. Unit will not track beyond this distance

- **Temp Trim**
  - Adjust temperature trim compensation

- **Dist Trim**
  - Adjust distance trim compensation

- **Velocity**
  - Adjust sound velocity compensation for applications where speed of sound is different.

- **Map Dist**
  - Echo Mapping: Distance to be mapped from transducer face

- **Map Used**
  - Echo Mapping: On or Off
  - Map Echo

- **Map Marg**
  - Adjust mapping margin

- **TX Reset**
  - Restore Transducer settings to factory default
  - ‘App type’ settings will need to be re-selected

**Press CAL to pulse the unit while adjusting Tx settings. Distance to level will be shown.**
**Gain4 (Gn):**
This parameter is to increase or decrease the starting Gain4 value (sensitivity to return echoes). Gain4 is the primary gain control. The start point of this % is after Gain Step 3 / Distance Step 3.
The result of changes can be seen immediately by pressing CAL while adjusting the % (the unit will pulse once and display distance & echo size). A ‘good’ signal size is approximately 0.8V. A signal above 2V suggests Gain4 is too high.

**Gain Step 3 / Distance Step 3 (G3 / D3):**
Normally G3 and D3 are considered and adjusted as a pair, and should only need adjustment to assist in ‘high level’ lock ups or structures close to and around the transducer face (see troubleshooting / locking onto high level).
The result of changes can be seen immediately by pressing CAL while adjusting the % (the unit will pulse once and display distance & echo size).

**EchoSize**
The unit uses automatic gain control to maintain echo size to this value. While the unit is operating it is displayed as the diagnostic S:. The default settings for solid based applications is 0.6V and for Liquid based applications 0.8V.

**Threshold**
Threshold is the minimum echo size the unit will track. Any echo which passes this value (0.39V) the unit will use automatic gain control to track and hold to the EchoSize.

**Blanking**
The Blanking Distance is the minimum amount of space which should be between the transducer face and the product being monitored. This distance is a blank zone, the unit will not track anything within this distance.

Where possible use the conservative values and increase this distance by 50% if there is foam, dust, steam, or condensation.
See also ‘Minimum Measurement Range’

**Empty Distance**
The Empty Distance is similar to Blanking, the unit will not track any echoes beyond this distance. Be conservative with this value, any empty bin with a conical bottom may require additional distance due to pulses reflecting of the cone angle before returning to the sensor face.

**Digital Mapping**
Digital mapping is a process where the unit scans a vessel for all potential false echoes and applies a filter to ignore them. Mapping should be considered a last resort, it may interfere with the units ability to follow the process level if not applied correctly.

**Map Distance**
The total distance (measured from transducer face) the unit will map.

**Map Echo**
Commences mapping process.

**Map Used**
Select only a portion of the Map Distance to use parameter (measured from transducer face)

**Map Margin**
This value is the amount of gain applied to the mapped echoes. This value should be adjusted in small amounts, if the value is set too high the mapped echoes will be very large resulting in the unit struggling to correctly following process level while it passes the mapped area.
Output Adjustment Setup Menu

Sultan Acoustic Wave Series

---

**Output Adj**

- **Fill Damp**
  - CAL
  - Adjust Fill Damping
  - 0-999

- **Empty Damp**
  - CAL
  - Adjust Empty Damping
  - 0-999

- **4mA Adj**
  - CAL
  - Adjust 4.00mA for remote indicator

- **20mA Adj**
  - CAL
  - Adjust 20mA for remote indicator

- **Analog**
  - CAL
  - Flip the high/low output to 4-20mA or 20-4mA

- **Simulate**
  - CAL
  - Simulate distance with 4-20mA change

- **Comms Type**
  - CAL
  - See Comms Types on page 35

- **Rly Mode 1**
  - CAL
  - FS
  - DEN
  - EN
  - L1 = Relay ON dist.
  - L2 = Relay OFF dist

  Continues with Rly Modes 2-5 all with same menu as Rly Mode 1

- **Bk Light**
  - CAL
  - Switch on/off LCD backlight

- **DispChar**
  - CAL
  - Adjust number of characters per line on display 8 or 12

  When active the unit will switch to failsafe mode if input voltage drops below required power. When not active unit will display ‘V fail’ but not enter failsafe mode.

- **V in Chk**
  - CAL

**Press RUN twice to revert to normal operation**
Output Adjustment parameters configure Analog, Relay and communication settings. You can also adjust the fill and empty damping for smoother mA output readings.

**Fill & Empty Damping**

Allows the user to define how quickly the unit responds to changes in the measured level. A low damping value gives a fast response and a high damping gives a slow response. The damping limits are from 0 to 999. Eg: If you set the damping to a value of 10, the displayed distance will be a rolling average of the last 10 pulses. The displayed distance includes the 4-20mA output and the default display mode value. Generally it is recommended this value is not lower than 5-10 for fast filling applications.

**4mA Adj & 20mA Adj**

Whilst the display shows ‘4mA Adj’ or ‘20mA Adj’, the analog (4-20mA) current output will be forced to its respective 4mA or 20mA state. The actual loop current can be measured with an external meter and calibrated exactly by pressing the UP or DOWN arrows until the external meter reads exactly 4.000mA or 20.000mA. Pressing the CAL button will store the calibration in the instrument’s memory.

**Analog**

4-20/20-4mA The analog current output of the instrument can be set to act in the normal (4-20mA) or reverse (20-4mA). The default condition is 4-20mA, where the furthest distance from the transducer (low level) is output as 4mA, and current increases with filling to the closer (high level) span point of 20mA.

**Simulate**

(Y/N): Select Y to access measurement simulation mode. In simulation mode, the UP and DOWN arrow keys vary the distance on the display. The current output and any relays used will behave exactly as they should do if the measured distance (in SPACE mode without damping) was that shown on the display.

This mode can be used to test correct behavior of outputs, or externally connected equipment.

**Relays**

Allows the user to set the relays for switching. The relays are programmed in a distance from the transducer face to the position where switching is required. Relays work in the following manner:

- **OFF**: The relay will always remain off.
- **FS**: If FS is selected, the relay will operate as a fail safe relay. The relay will be energised at all times and will de-energise if the ultrasonic switch goes into failsafe condition or if anything interferes with the unit’s ability to keep the relay energised.

See also ‘Relay Functions’ for further information about the Relay switching on the next page.

**Bk Light**

Switch on/off LCD backlight

**DispChar**

Adjust number of characters per line 8 or 12. Some older units may have an 8 character display only.

**V in Chk**

The Sultan automatically detects if the input voltage below 9.5V for 234 wire units and 7V for 2 wire units. When this mode is active the unit will begin its failsafe routine and eventually display V fail. When not active the unit will still display the message ‘Input voltage too low’.
Relay Switch Actions
Sultan Acoustic Wave Series

Relay 1 - 5

<table>
<thead>
<tr>
<th>Sub-Menu</th>
<th>Description</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>RlyL1 1-5</td>
<td>Adjust Relay switch point (L1 must be &lt; L2)</td>
<td>Adjustable</td>
</tr>
<tr>
<td>RlyL2 1-5</td>
<td>Adjust Relay switch point (L2 must be &gt; L1)</td>
<td>Adjustable</td>
</tr>
</tbody>
</table>

- Set Relay Parameters in Output Adjustment menu
- The two relay levels are RlyL1 and RlyL2
- The display will show RlyL1 1, the last 1 indicated the Relay number (eg 1 to 5)
- L1 and L2 distances are measured from the transducer face
All HAWK products come standard with Modbus. If a unit supports additional communications protocols, it will be indicated on the wiring label inside the unit and the part number.

Foundation Fieldbus and Profibus PA have stand alone manuals located in the downloads-manuals section of www.hawkmeasure.com.
Modbus setup & basic spans & diagnostic registers for HAWK Sultan Series instruments v3.85 and later.

Protocol: Modbus RTU (2 wire)
Speed: 19200 Baud
Data bits: 8
Parity: None
Stop Bits: 1

HAWK Sultan series units act as ‘slave’ devices on a Modbus network.

Units are shipped from the factory with a default Modbus address of 1. The Modbus address of any unit can be changed individually if units are to be connected in a multi-drop network. Each address number must only be used once on any network (possible addresses are 1-255).

**Diagnostic Block** (Read Only): *Can be read as Singles or any Block wholly within the limits of this range of addresses*

- 40124 - LOW LEVEL span set point in mm
- 40125 - HIGH LEVEL span set point in mm
- 40126 - DISPLAYED DISTANCE (DISTANCE) in mm
- 40127 - NOT USED
- 40128 - NEW DISTANCE (E-DISTANCE) in mm
- 40129 - CONFIRM DISTANCE (C-DISTANCE) in mm
- 40130 - ECHO SIZE in Volts/102
- 40131 - GAIN at Echo detection point in %/7.5
- 40132 - NOT USED (Gain Limit)
- 40133 - RECOVER GAIN in %/7.5
- 40134 - NOISE in %/7.5
- 40135 - TEMPERATURE in Degrees K/10 ((DegreesC - 273.2)/10)
- 40137 - CONFIRM COUNTER current value
- 40138 - HOLD COUNTER current value
- 40140 - WINDOW FORWARD POSITION in mm
- 40141 - WINDOW BACK POSITION in mm

**Span Adjustment** (Read/Write) **MUST** Read/Write

- 40013 - LOW LEVEL span set point in mm
- 40014 - HIGH LEVEL span set point in mm

**Relay Function Adjustment** (Read/Write) **MUST** Read/Write

- 40052 - Relay 1 Mode setting
  - 0-OFF
  - 1-FS (Failsafe)
  - 2-EN (Energise on Level)
  - 3-DEN (De-Energise on Level)
- 40053 - Relay 2 Mode setting (see Relay 1)
- 40054 - Relay 3 Mode setting (see Relay 1)
- 40055 - Relay 4 Mode setting (see Relay 1)
- 40056 - Relay 5 Mode setting (see Relay 1)
- 40036 - Relay 1 L1 set point in mm
- 40037 - Relay 1 L2 set point in mm
- 40038 - Relay 2 L1 set point in mm
- 40039 - Relay 2 L2 set point in mm
- 40040 - Relay 3 L1 set point in mm
- 40041 - Relay 3 L2 set point in mm
- 40042 - Relay 4 L1 set point in mm
- 40043 - Relay 4 L2 set point in mm
- 40044 - Relay 5 L1 set point in mm
- 40045 - Relay 5 L2 set point in mm
Extended Parameters (Read/Write) *MUST Read/Write SINGLES-NOT BLOCKS*:

40060 - DISPLAY UNITS
3 - Millimetres
4 - Centimetres
5 - Metres
6 - Feet
7 - Inches

40015 - FAILSAFE MODE
0 - 3.5mA
1 - 3.8mA
2 - 20.2mA
3 - Last Known
4 - 4.0mA
5 - 20.0mA

40016 - FAILSAFE TIME (seconds)

40017 - APPLICATION TYPE
0 - Liquid
1 - Solid
2 - Slurry
3 - Position

40018 - FILL RATE (metres per hour/10)
40019 - EMPTY RATE (metres per hour/10)

40020 - DISPLAY MODE
1 - Volume
2 - Flow
3 - Material %
4 - Material
5 - Space
6 - Differential Output
7 - Average Material

40065 - FLOW UNITS
32 - Litres
33 - Kilolitres
34 - Megalitres
35 - Cubic Metres
36 - Cubic Feet

40031 - FLOW EXPONENT (in raw units/100)

40032 - FLOW MAX (selected flow units per second/10)

40033 - LOW CUT OFF (mm)

40033 - OFFSET (mm)

40021 - LOCK CODE

40022 - FILL DAMPING

40023 - EMPTY DAMPING

40064 - ANALOG
0 - 4-20mA (4mA low, 20mA high - standard)
1 - 20-4mA (20mA low, 4mA high - inverted)

40448 - GAIN parameter setting in %/7.5

40449 - GAIN STEP in %/7.5

40450 - DISTANCE STEP (mm)

40451 - THRESHOLD in Volts/100

40452 - BLANKING (mm)

40453 - EMPTY DISTANCE (mm)
Setting the Baud Rate and the DeviceNet Address

The DeviceNet factory default of Baud Rate and FBus Address are 125kbps and 63 in a Sultan unit with. To modify these values follow the instructions below.

1. Go to the ‘Output Ad’ menu
2. Use the Up and Down push buttons to reach the CommType parameter
3. Make sure that the CommType is set to ‘DeviceNet’
4. Press the CAL button twice
5. DeviceID will be displayed - this ID is for Modbus networking, do not adjust.
6. Use the Down push button to reach the BaudRate parameter
7. The default value for the BaudRate is 125kpbs. Press CAL button and use the Up and Down push buttons to modify this value
8. Press CAL button when finished
9. Use the Down push button to reach the FBusAdds. The default value of the FieldBus Address is 63. Press CAL button and use the Up and Down push buttons to modify this value
10. Press CAL button again when finished
11. Press RUN to save and several times again to return the unit to operating mode.

Output Data

Profibus/DeviceNet now transmit 18 bytes/9 words, description of the words is as follows (For firmware version 5.54 and above).

1. Displayed Distance
   (Space Distance is the Primary Variable)
2. Percentage (Percent of Range)
3. Hi Level (Upper Range)
4. Low Level (Lower Range)
5. Status Flags
   Bit0 = Echo was received inside the span.
   Bit1 = Echo is Confirmed.
   Bit3 = Searching is searching for an Echo.
   BitF = Unit has Failed to detect an Echo.
6. Displayed Distance2 (Second Variable)*
7. Percentage2 (Second Percent of Range)*

*Used for Differential output on a Sultan

<table>
<thead>
<tr>
<th>Bit F</th>
<th>Bit E</th>
<th>Bit 3</th>
<th>Bit 1</th>
<th>Bit 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failed</td>
<td>~~~~~~</td>
<td>Search</td>
<td>0</td>
<td>Echo Cfm : 1 = , True, 0 = False</td>
</tr>
</tbody>
</table>
Setting the Profibus DP Address

Factory defaults of FBusAdds is 126 in a Sultan unit with Profibus CommType. To modify this value follow the instruction below:

1. Go to the ‘Output Ad’ menu
2. Use the Up and Down push buttons to reach the CommType parameter
3. Make sure that the CommType is set to ‘Profibus’
4. Press the CAL button twice
5. DeviceID will be displayed - this ID is for Modbus networking, do not adjust.
6. Use the Down push button to view the BaudRate parameter. The value for the BaudRate is selected automatically and can not be modified.
8. Use the Down push button to reach the FBusAdds. The default value of the FieldBus Address is 126. Press CAL button and use the Up and Down push buttons to modify this value.
9. Press CAL button again when finish.
10. Press RUN several times to return the unit to operating mode.

Output Data

DeviceNet now transmits 18 bytes/9 words, description of the words is as follows (For firmware version 5.54 and above)

1. Displayed Distance
   (Space Distance is the Primary Variable)
2. Percentage (Percent of Range)
3. Hi Level (Upper Range)
4. Low Level (Lower Range)
5. Status Flags
   Bit0 = Echo was received inside the span.
   Bit1 = Echo is Confirmed.
   Bit3 = Searching is searching for an Echo.
   BitF = Unit has Failed to detect an Echo.
6. Displayed Distance2 (Second Variable)*
7. Percentage2 (Second Percent of Range)*

*Used for Differential output

Wiring

<table>
<thead>
<tr>
<th>Bit F</th>
<th>Bit E</th>
<th>Bit 3</th>
<th>Bit 1</th>
<th>Bit 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failed</td>
<td>~~~~~</td>
<td>Search</td>
<td>0</td>
<td>Echo Cfm : 1 = , True, 0 = False</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Echo R : 1 = , True, 0 = False</td>
</tr>
</tbody>
</table>
HAWK provides free in-house developed software called GosHawkII. This software is supported by all current products and is used by HAWK Engineers & HAWK authorised representatives during commissioning, testing and monitoring unit performance.

The software allows easy access to unit setup menus using a PC rather than the keypad and gives a visual representation of what the unit is seeing (all echoes which pass the unit filter), transmitting and displaying on the unit face.

The best and easiest way to set up, troubleshoot and monitor a HAWK unit is via GosHawkII.

To connect to a unit using this software you need either a HawkLink modem or HawkLink USB connector.

For a multidrop network GosHawkII uses a Modbus ID to identify each unit.
Sultan234 units can be switched to 2 wire loop mode by flipping a SMART card on the analogue module. The module is located behind the display and will have MOD-AN moulded on the plastic as well as a sticker indicating the orientation of the SMART card for both modes.

The card is secured by a small brown plastic lock. Gently lift both tips of the plastic lock until they click up to release the lock. Gently lift the card out and flip to the required mode. Place the card back in and re-lock down the plastic bracket.

The procedure is delicate, it is recommended to be performed in a workshop or lab and not in the field.
39. Unit displays or transmits distance that is higher than the actual level / unit is locking on high level
40. Output doesn’t match level during filling / emptying
40. Output is erratic / inconsistent
40. Replacing the amplifier or transducer
41. Hardware checks - Voltage & Resistance (Remote & Integral)
42. Error Codes
43. Contacting HAWK
Unit displays or transmits distance that is higher than the actual level / unit is locking on high level

1. Check the mounting conditions within the vessel. Are there any obstacles in front or near the front & side of the face of the transducer? If so, consider moving the unit to a different location.

2. Check the distance of the false echo. If this is above your high level you can change the unit sensitivity to the echo. In ‘Advanced’ change the ‘Dist Step3’ to a distance further than the echo, and lower the ‘Gain Step3’ to make the unit less sensitive for the ‘Dist Step’ distance.

   If the echo is below the ‘High Level’, you can still modify the Distance & Gain Steps3 to solve the problem. Consider lowering the ‘High Level’ value below the ‘Dist Step3’.

   If you cannot do this, lower the ‘Gain4’ value (also located in ‘Advanced’) incrementally until the unit cannot see the problem echo.

   Lowering the Gain4 % will affect overall sensitivity of the unit. It will reduce unit capability. If you need to lower this value by 5-10% to avoid the unit locking onto an obstacle you must consider step 1 (adjusting mounting location).

3. You can extend the ‘Blanking’ (TX Setup) distance to ‘blank’ the echo entirely. Anything within this ‘Blanking’ distance will NOT be tracked by the unit under any circumstances. Consider this in case of accidental over filling. Never have the ‘Blanking’ distance longer than the ‘High Level’.
Output doesn’t match level during filling / emptying

Ensure the span programmed into your PLC matches the span (high & low level) programmed into the unit.

Ensure the Fill Rate and/or Empty rate is set fast enough for your application.

If the unit is ‘locked’ showing a higher level than see ‘Unit displays or transmits distance that is higher than the actual level’.

Ensure resistance load is within HAWK specification on analog wires.

Output is erratic / inconsistent

Increase the ‘damping’ values to stabilise unit response times. The settings are in ‘Output Adjustment’ menu as ‘FillDamp’ and ‘EmtyDamp’.

If material being measured forms angle of repose try adjusting Transducer mounting angle to get better reflections.

For analogue output related problems it is important to isolate the Sultan (disconnect from the network) and use a multimeter to read the analogue terminals directly.

Replacing a Transducer or Amplifier

If replacing either the amplifier or transducer you must re-enter your application settings into the unit.

Consider stocking spare amplifiers and transducers to avoid potential down time.
Remote & Integral

**Sultan 234**

Specified ranges (supply dependent): 90-260VAC, 12-30VDC, 36-60VDC. For suspected power issues ensure user supply is appropriate & consistent.

If using AC power you can check the power supply for faults by reading the DC +/- terminals with a multimeter set to DC. This terminal will produce 15-16VDC stable. If this value is lower or inconsistent you may a problem with the internal power supply.

Unit performance will be affected if the unit detects voltage below 9VDC. If ‘V in chk’ is on the unit will trigger its failsafe routine. If V in chk is off the unit will display V fail on the LCD.

**Transducers**

The Transducer power (red wire) should draw 8-10VDC. If this figure is too high or too low check Sultan power & supplied power as above.

**Check Resistances between transducer wires (approximate values):**

- Black - Blue = 15.6Kohms
- Black - White = 15.6Kohms

** Resistances between transducer terminals (approximate values):**

- Black - Blue = 16.2Kohms
- Black - White = 16.2Kohms

**Sultan 2**

Specified ranges: 12-30VDC.

Unit performance will be affected if power drops below 7VDC. If ‘V in chk’ is on the unit will trigger its failsafe routine. If V in chk is off the unit will display V fail on the LCD.
Troubleshooting
Sultan Acoustic Wave Series

Error Codes 01 - 04

**Error 01**: Amplifier/Transmitter can not communicate with transducer.

**Wiring:**
Check the terminals for a loose or incorrect connection (including junction box/cable extensions). Check the cables for any signs of damage. Ensure any customer supplied cable meets HAWK specifications.

If using junction box extension trace the 8-9VDC from the red/black amplifier terminals to the transducer to ensure wires are correct. If using a junction box ensure you follow Hawk specification for extending cable.

When the unit powers up does the transducer pulse once? If it does this indicates the transducer has powered correctly (red/black terminals). Check the comms wiring (blue/white). If the transducer does not pulse once when the red/black wires are applied (wires must be the potted Transducer wires) the Transducer most likely has a fault or damage.

Has the transducer ID number been modified while connected to a different transmitter? Re-connect the unit to the previous transmitter and change the ID via Quickstart/SenAdd CAL TxAdds.

**Error 02:**
Communication data corruption between Transmitter and Transducer.

It can be a result of noise in data lines or one of data lines (white or blue) being open circuit.

Make sure wiring is correct especially look to the screen (earth).

Ensure you are using quality shielded instrument cable.

If using a junction box ensure you follow HAWK specification for extending cable.

Integral units with Error 02 will be an internal problem, contact your Hawk representative.

**Error 03**
Specific comms mode is selected (eg Profibus, FF) but comms module is not connected or responding. Check your unit part number to ensure it has correct comms. If you do not have additional comms (option X) then select Modbus.

**Error 04**
Amplifier is programmed with incorrect software. Contact your local support.

In general Error Code 01 indicates there is NO communication and Error Code 02 says there IS communication, but not of sufficient quality to be read reliably.
Before contacting Hawk for assistance please write down the ‘Diagnostics’ displayed on the unit to assist with support speed. See ‘DIAGNOSTICS & SOFTWARE OVERVIEW’ for further information.

Also include a diagram or drawing of the vessel marked with where the transducer is installed along with photographs of the installation and what is below the transducer.
Sultan Remote Transmitter

Model
AWR2   Remote 2 Wire, No relays, 12-30VDC only, Modbus
AWR234 Remote 2 / 3 / 4 Wire, 5 relays, Modbus

Housing
S  Polycarbonate

Power Supply
B  12-30VDC
C1  36-60VDC
U1  12-30VDC and 90-260VAC

Additional Communications (PC comms GosHawk standard)
S1  Switch only, 5 relays
W  Modbus only
X  4-20mA analogue
H2  4-20mA analogue with HART 2 wire
I1  4-20mA analogue with HART Isolated 4 wire
A  Profibus PA
P1  Profibus DP
F  Foundation Fieldbus
D1  DeviceNet

This option is no longer available
X  Option no longer available

Approval Standard
X  Not Required
i03  IECEx Zone 0 Ex ia IIA T4 IP67 Tamb -20°C to 70°C
A03  ATEX Grp II Cat 1 GD IP67 EEx ia IIA T4
i203  IECEx Zone 20 DIP A20 TA85C IP68 Tamb -20°C to 75°C
A203 ATEX Grp II Cat 1 D T85°C IP67 Tamb -20°C to 75°C
A22  ATEX Grp II Cat 3 GD T85°C IP67 Tamb -40°C to 70°C
GP  CSA Equip Class 2; Pollution deg 2; Tamb -20°C to 75°C (Ordinary Locations)
RN3  CSA Class I; Div 1/2; Group D; Zone 0; AEx / Ex ia IIA; T4

Position Slave / Crane Master
X  Not Required
PS1  Position Slave
CM1  Crane Master

AWR234 S U X X X X
### Sultan Remote Transducer 3” and 3.5”

<table>
<thead>
<tr>
<th>Model</th>
<th>AWRT</th>
<th>Acoustic Wave Remote Transducer</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Transducer Frequency</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>30kHz for applications up to 15m for 3” (Cone required)</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>20kHz for applications up to 20m, 3” only (Cone required)</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>15kHz for applications up to 30m, 3” only (Cone required)</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>10kHz for applications up to 40m, 3.5” only (Cone required)</td>
<td></td>
</tr>
<tr>
<td>09</td>
<td>9kHz Positioning / Position Slave applications up to 180m (Cone required)</td>
<td></td>
</tr>
<tr>
<td>05</td>
<td>5kHz for applications up to 60m, 3.5” only (Cone required)</td>
<td></td>
</tr>
<tr>
<td>04</td>
<td>4kHz Positioning / Position Slave applications up to 180m (Cone required)</td>
<td></td>
</tr>
</tbody>
</table>

**Process Temperature - Facing material selection**
- S Polyolefin 80°C (176°F)
- T Teflon 80°C (176°F)
- Y Titanium 80°C (176°F)

**Transducer Housing Material**
- 4 Polypropylene

**Back Cap Mounting Thread Standards**
- X Not Required (Standard Flange Mount)
- TB BSP

**Back Cap Mounting Thread Sizes**
- 30 3” BSP
- 50 3.5” BSP

**Approval Standard**
- X Not Required
- i0 IECEx Zone 0 Ex ia IIA T4 IP67 Tamb -20°C to 70°C
- A0 ATEX Grp II Cat 1 GD IP67 EEx ia IIA T4
- i1 IECEx Zone 1 Ex mb II IP68 T5(Tamb -20°C to 65°C) T6(Tamb -20°C to 50°C)
- A1 ATEX Grp II Cat 2 GD EEx m II IP68 T5(Tamb -20°C to 65°C) T6(Tamb -20°C to 50°C)
- i20 IECEx Zone 20 DIP A20 TA85C IP68 Tamb -20°C to 75°C
- A20 ATEX Grp II Cat 1 D T85°C IP67 Tamb -20°C to 75°C
- A22 ATEX Dust (Grp II Cat 3 D T85C IP67)
- GP CSA Equip Class 2; Pollution deg 2; Tamb -20°C to 75°C (Ordinary Locations)
- RN CSA Class I; Div 1/2; Group D; Zone 0; AEx / Ex ia IIA; T4
- KN CSA Class II; Div 2; Group F&G; Class III; T6 T85 for Tamb -20°C to 75°C
- QN CSA Class II; Div 1; Group E, F&G; Ex mb II; T5(T100) for Tamb -20°C to 65°C; T6(T85) for Tamb -20°C to 50°C

**Connection**
- C IP68 Sealed unit with cable

**Cable Length**
- 6 6m cable
- 15 15m cable
- 30 30m cable
- 50 50m cable

**Mounting Accessories**
- X Not Required
- CS End Cap Cable Suspension

**Software Options**
- X Not Required
- FP Fast Pulsing
- PS Position Slave (Requires Position Slave Amplifier)
### Sultan Remote Transducer 2” Version

<table>
<thead>
<tr>
<th>Model</th>
<th>Acoustic Wave Remote Transducer</th>
</tr>
</thead>
</table>
| Transducer Frequency
| 50 50kHz for liquid applications up to 5m (Cone required) |
| 40 40kHz for liquid applications up to 7m (Cone required) |
| 30 30kHz for liquid applications up to 11m (Cone required) |

**Process Temperature - Facing material selection**
- T Tefzel 80°C (176°F)

**Transducer Housing Material**
- 6 Tefzel

**Thread Standard**
- TB BSP
- TN NPT

**Thread Size**
- 20 2” thread

**Approval Standard**
- X Not Required
- i0 IECEx Zone 0 Ex ia IIA T4 IP67 Tamb -20°C to 70°C
- A0 ATEX Grp II Cat 1 GD IP67 EEx ia IIA T4
- i1 IECEx Zone 1 Ex mb II IP68 T5(Tamb -20°C to 65°C) T6(Tamb -20°C to 50°C)
- A1 ATEX Grp II Cat 2 GD EEx m II IP68 T5(Tamb -20°C to 65°C) T6(Tamb -20°C to 50°C)
- i20 IECEx Zone 20 DIP A20 TA85C IP68 Tamb -20°C to 75°C
- A20 ATEX Grp II Cat 1 D T85°C IP67 Tamb -20°C to 75°C
- A22 ATEX Grp II Cat 3 GD T85°C IP67 Tamb -40°C to 70°C
- GP CSA Equip Class 2; Pollution deg 2; Tamb -20°C to 75°C (Ordinary Locations)
- RN CSA Class I; Div 1/2; Group D; Zone 0; AEx/Ex ia IIA; T4
- KN CSA Class II; Div 2; Group F&G; Class III; T6 T85 for Tamb -20°C to 50°C
- QN CSA Class II; Div 1; Group E, F&G; Ex mb II; T5(T100) for Tamb -20°C to 65°C; T6(T85) for Tamb -20°C to 50°C

**Connection**
- C IP68 Sealed unit with cable

**Cable Length**
- 6 6m cable
- 15 15m cable
- 30 30m cable
- 50 50m cable

**Mounting Accessories**
- X Not Required
- CS Cable Suspension on end cap

**Software Options**
- X Not Required

| Model | 30 | T | 6 | TB | 20 | X | C | 6 | X | X |
Sultan Integral 3” and 3.5”

Model
AWI2  Integral 2 Wire, No relays, Modbus
AWI234  Integral 2 / 3 / 4 Wire, 2 relays, Modbus

Housing
S  Valox 357U

Power Supply
B  12-30VDC
U¹  12-30VDC and 90-260VAC

Transducer Frequency
30  30kHz for applications up to 11m for 2” and 15m for 3” (Cone required⁶)
20  20kHz for applications up to 20m, available in 3” only (Cone required⁶)
15  15kHz for applications up to 30m, available in 3” only (Cone required⁶)
10  10kHz for applications up to 40m, available in 3.5” only (Cone required⁶)
09  9kHz for Positioning / Position Slave applications up to 180m (Cone required⁶)
05  5kHz for applications up to 60m, available in 3.5” only (Cone required⁶)
04  4kHz for Positioning / Position Slave applications up to 180m (Cone required⁶)

Process Temperature - Facing material selection
S²  Polyolefin 80°C (176°F)
T³  Teflon 80°C (176°F)
Y⁴  Titanium 80°C (176°F)

Transducer Housing Material
4  Polypropylene

This option is no longer available
X  Option no longer available
This option is no longer available
X  Option no longer available

Additional Communication
S¹  Switch only, 2 relays
W  Modbus only
X  4-20mA analogue
H⁵  4-20mA analogue with HART 2 wire
I¹  4-20mA analogue with HART Isolated 4 wire
A  Proﬁbus PA
F  Foundation Fieldbus

Approval Standard
X   Not Required
i0⁵  IECEx Zone 0 Ex ia IIA T4 IP67 Tamb -20°C to 70°C
A0⁸  ATEX Grp II Cat 1 GD IP67 EEx ia IIA T4
i20⁵  IECEx Zone 20 DIP A20 TA85C IP68 Tamb -20°C to 75°C
A20⁸  ATEX Grp II Cat 1 D T85°C IP67 Tamb -20°C to 75°C
A22  ATEX Grp II Cat 3 GD T85°C IP67 Tamb -40°C to 70°C

Software Options
X   Not Required

¹Model AWI234 only
²Transducer Frequency 04, 05, 09, 10 only
³Transducer Frequency 10, 15, 20, 30 only
⁴Transducer Frequency 15 only
⁵Model AWI2 only. Communication Option W, X, H only
⁶See Transducer / Cone / Flange combination table

AWI234  S  U  10  S  4  X  X  X  X  X
## Sultan Integral 2”

### Model

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWI2</td>
<td>Integral 2 Wire, No relays, 12-30VDC only, Modbus</td>
</tr>
<tr>
<td>AWI234</td>
<td>Integral 2 / 3 / 4 Wire, 2 relays, Modbus</td>
</tr>
</tbody>
</table>

### Housing

<table>
<thead>
<tr>
<th></th>
<th>Valox 357U</th>
</tr>
</thead>
</table>

### Power Supply

<table>
<thead>
<tr>
<th></th>
<th>12-30VDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>12-30VDC and 90-260VAC</td>
</tr>
<tr>
<td>U</td>
<td>12-30VDC</td>
</tr>
</tbody>
</table>

### Transducer Frequency

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 kHz</td>
<td>50kHz for liquid applications up to 5m (Cone required&lt;sup&gt;6&lt;/sup&gt;)</td>
</tr>
<tr>
<td>40 kHz</td>
<td>40kHz for liquid applications up to 7m (Cone required&lt;sup&gt;6&lt;/sup&gt;)</td>
</tr>
<tr>
<td>30 kHz</td>
<td>30kHz for liquid applications up to 11m (Cone required&lt;sup&gt;6&lt;/sup&gt;)</td>
</tr>
</tbody>
</table>

### Process Temperature - Facing material selection

<table>
<thead>
<tr>
<th></th>
<th>Tefzel 80°C (176°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>Tefzel</td>
</tr>
</tbody>
</table>

### Transducer Housing Material

<table>
<thead>
<tr>
<th></th>
<th>Tefzel</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Tefzel</td>
</tr>
</tbody>
</table>

### Thread Standards

<table>
<thead>
<tr>
<th></th>
<th>TB  BSP</th>
</tr>
</thead>
<tbody>
<tr>
<td>TN</td>
<td>NPT</td>
</tr>
</tbody>
</table>

### Mounting Thread Sizes

<table>
<thead>
<tr>
<th></th>
<th>2” thread</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>2” thread</td>
</tr>
</tbody>
</table>

### Additional Communication

|       | Switch only                                                               |
|-------|                                                                          |
| S<sup>1</sup> | Modbus only                                                               |
| W<sup>2</sup> | 4-20mA analogue                                                          |
| X<sup>3</sup> | 4-20mA analogue with HART 2 wire                                          |
| H<sup>4</sup> | 4-20mA analogue with HART Isolated 4 wire                                |
| "I"    | 4-20mA analogue with HART Isolated 4 wire                                |
| A      | Profibus PA                                                               |
| F      | Foundation Fieldbus                                                      |

### Approval Standard

|       | Not Required                                                              |
|-------|                                                                          |
| X<sup>5</sup> | IECEx Zone 0 Ex ia IIA T4 IP67 Tamb -20°C to 70°C                        |
| A0<sup>6</sup> | ATEX Grp II Cat 1 GD IP67 EEx ia IIA T4                                  |
| i20<sup>7</sup> | IECEx Zone 20 DIP A20 TA85C IP68 Tamb -20°C to 75°C                      |
| A20<sup>8</sup> | ATEX Grp II Cat 1 D T85°C IP67 Tamb -20°C to 75°C                        |
| A22    | ATEX Grp II Cat 3 GD T85°C IP67 Tamb -40°C to 70°C                       |

### Software Options

|       | Not Required                                                              |
|-------|                                                                          |
| X<sup>9</sup> |                                                                   |

---

<sup>1</sup> Model AWI234 only

<sup>2</sup> Model AWI2 only

<sup>3</sup> Model AWI2 only. Communication Option W, X, H only

<sup>6</sup> See Transducer / Cone / Flange combination table

---

AWI234 | S | U | 40 | T | 6 | TB | 20 | X | X | X

---
### Flange Selection

<table>
<thead>
<tr>
<th>Flange</th>
<th>Dimension Standard</th>
<th>Flange Sizes</th>
<th>Flange Mounting Position¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>ANSI²</td>
<td>2N</td>
<td>Cone Mounted (standard)</td>
</tr>
<tr>
<td>D</td>
<td>DN²</td>
<td>2B</td>
<td>Angled flange piece only</td>
</tr>
<tr>
<td>J</td>
<td>JIS²</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>6</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>8</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

**Flange Material**
- 4 Polypropylene

**Focaliser Cone**
- C04 cone for 2” NPT transducer
- C04 cone for 2” BSP transducer
- 4” cone for 20kHz and 3" 30kHz transducers
- 8” cone for 15kHz
- 8” cone for 10kHz
- 10” cone for 15kHz
- 10” cone for 10kHz and 9Hz
- 10” cone for 5kHz and 4kHz

**Cone Material**
- Polypropylene
- Carbon Fibre. Includes matching ANSI Flange (4”, 8” or 10”)
- Carbon Fibre. Includes matching DN Flange (4”, 8” or 10”)
- Carbon Fibre. Includes matching JIS Flange (4”, 8” or 10”)
- Polyurethane

### Additional Flange Options¹
- FA8A-4-C4 8” ANSI, polypropylene
- FA10A-4-C4 10” ANSI, polypropylene
- FA6D50-4 6” ANSI, polypropylene
- FA8D50-4 6” ANSI, polypropylene
- FA10D50-4 6” ANSI, polypropylene

### Additional Cone Options¹
- C04-4-ZOD90 C04-4 trimmed to fit 90mm ID nozzle.
- C03-4-Z Cone and coupling to fit 72mm ID nozzle for 20kHz and 30kHz (T4).

¹ Important: See Transducer / Cone / Flange combination table for valid part combinations
² See ‘Flange Dimension Standards’ table for full Flange specification
### Transducer / Cone / Flange Combination Table

- Each line represents fitting combinations. Flange Dimension Standard A, D or J replaces underscore (_) position.

<table>
<thead>
<tr>
<th>Transducer</th>
<th>Cone</th>
<th>Flange Option 1</th>
<th>Flange Option 2</th>
<th>Flange Option 3</th>
<th>Flange Option 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 / 40kHz</td>
<td>C02</td>
<td>F_3A</td>
<td>F_4A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30kHz (T6)</td>
<td>C02</td>
<td>F_3A</td>
<td>F_4A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30kHz (T4)</td>
<td>C03-4-Z</td>
<td>F_3A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C04</td>
<td>F_3A</td>
<td>F_4A</td>
<td>F_6A</td>
<td>F_8A-4-C4</td>
</tr>
<tr>
<td>Back Cap Mount (TB30)</td>
<td></td>
<td>F_4A</td>
<td></td>
<td></td>
<td>FA6A</td>
</tr>
<tr>
<td>20kHz</td>
<td>C03-4-Z</td>
<td>F_3A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C04</td>
<td>F_3A</td>
<td>F_4A</td>
<td>F_6A</td>
<td>F_8A-4-C4</td>
</tr>
<tr>
<td>Back Cap Mount (TB30)</td>
<td></td>
<td>F_4A</td>
<td></td>
<td></td>
<td>F_6A</td>
</tr>
<tr>
<td>15kHz</td>
<td>C04</td>
<td>F_4A</td>
<td></td>
<td>F_6A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C08</td>
<td>F_8A</td>
<td>F_10A</td>
<td>F_6D50-4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C10</td>
<td>F_8A</td>
<td>F_10A</td>
<td>F_6D50-4</td>
<td></td>
</tr>
<tr>
<td>Back Cap Mount (TB30)</td>
<td></td>
<td>F_4A</td>
<td></td>
<td></td>
<td>F_6A</td>
</tr>
<tr>
<td>9 / 10kHz</td>
<td>C08</td>
<td>F_8A</td>
<td>F_10A</td>
<td>F_6D50-4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C10</td>
<td>F_8A</td>
<td>F_10A</td>
<td>F_6D50-4</td>
<td></td>
</tr>
<tr>
<td>Back Cap Mount (TB50)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>4 / 5kHz</td>
<td>C08</td>
<td>F_8A</td>
<td>F_10A</td>
<td>F_6D50-4</td>
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</tr>
<tr>
<td></td>
<td>C10</td>
<td>F_8A</td>
<td>F_10A</td>
<td>F_6D50-4</td>
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</tr>
<tr>
<td>Back Cap Mount (TB50)</td>
<td></td>
<td></td>
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</tbody>
</table>

### Accessories

#### HAWKLink Data Modem

<table>
<thead>
<tr>
<th>Model</th>
<th>remote stand alone HAWKLink USB PC connector for GosHawkII</th>
</tr>
</thead>
<tbody>
<tr>
<td>HLR</td>
<td>Acoustic Wave Series</td>
</tr>
</tbody>
</table>

**Power Supply**

| B     | 12-30VDC                                                   |
| U     | 12-30VDC and 90-260VAC                                    |

**Network Type**

- G3 3G Autoband
- S3 Australian Sim Card expires after 3 month
- S12 Australian Sim Card expires after 12 month
- X Not Required

<table>
<thead>
<tr>
<th>Model</th>
<th>Remote stand alone HAWKLink system</th>
</tr>
</thead>
<tbody>
<tr>
<td>HLR</td>
<td>Acoustic Wave Series</td>
</tr>
</tbody>
</table>

**HAWKLink-USB**

- Stainless Steel Sunhood
- SUNHOOD
- Junction Box for twin Transducer applications
- AWRT-JB-01
- AWRT-JB-06 (includes 6m cable)
- Extra Cable (Belden 3084A)
- CA-TXCC-R-C15 15m cable
- CA-TXCC-R-C30 30m cable
- CA-TXCC-R-C50 50m cable
- CA-TXCC-R-C100 100m cable

**Sim Card**

- Not Recommended
Specifications

Sultan Acoustic Wave Series

Frequencies

- 4kHz, 5kHz, 9kHz, 10kHz, 15kHz, 20kHz, 30kHz, 40kHz, 50kHz

Operating Voltage

- 12-30VDC (residual ripple no greater than 100mV)
- 90-265VAC 50/60Hz
- 36-60VDC

Power Consumption

- <10VA @ 240VAC
- <3W @ 24VDC
- <6W @ 48VDC

Analog Output

- 4-20mA (750 ohms @ 24Vdc User supply, 250 ohms internally driven)

Communications

- GosHawk, HART, Modbus, Profibus DP, DeviceNet, Foundation Fieldbus, Profibus PA. Multidrop mode can address 1-250 units over 4 wire

Relay Output

(2) Integral (5) Remote

- Form ‘C’ (SPDT) contacts, rated 0.5A at 240VAC non-inductive.
- All relays have independently adjustable dead bands.
- Remote fail-safe test facility for one relay.

Blanking Distance

See ‘Minimum Measurement Range’ on page 20

Maximum Range

- 5m (16ft) 50kHz liquids
- 7m (22ft) 40kHz liquids
- 10m (33ft) 30kHz liquids, 5m (16ft) solids
- 20m (65ft) 20kHz liquids/slurries, 10m (33ft) solids
- 30m (98ft) 15kHz liquids/slurries, 20m (65ft) solids
- 40m (165ft) 10kHz liquids/slurries/powders/solids
- 60m (196ft) 5kHz liquids/slurries/powders/solids
- 180m (588ft) 4/9 kHz for extended range

Resolution

- 1 mm (0.04") 50, 40, 30,20, 15, 10, 5kHz
- 4 mm (0.2") 9, 4kHz

Sensor Accuracy

- +/- 0.25% of measured range

Operating Temperature

- Integral System -40°C (-40°F) to 80°C (176°F)
- Remote electronics -40°C (-40°F) to 80°C (176°F)
- Remote transducer -40°C (-40°F) to 80°C (176°F)

Transducer / Amplifier Separation

- Up to 1000m using specified extension cable

Cable

- 4 conductor shielded twisted pair instrument cable.
- Conductor size dependent on cable length.
- BELDEN 3084A, DEKORON or equivalent.
- Max: BELDEN 3084A = 500m (1640 ft)
- Max: DEKORON IED183AA002 = 350m (980 ft)

Maximum Operating Pressure

- +/- 7.5 PSI (+/- 0.5 Bar)
Specifications / Approvals & Certification

Sultan Acoustic Wave Series

Beam Angle

- 7.5° without focaliser 50kHz/40kHz / 30kHz
- 4° with focaliser 50kHz/40kHz
- 6° with focaliser 30kHz/20kHz / 15kHz/10kHz/5kHz
- 10° with focaliser 9kHz/4kHz

Display

- 2 line x 12 digit alphanumeric LCD

Memory

- Non-Volatile (No backup battery required)
- >10 years data retention

Enclosure Sealing

- Integral System IP67
- Remote Electronics IP65 (NEMA 4x)
- Remote Transducer IP68

Cable Entries

- Integral: 3 x M16 Glands
- Remote: 3 x 20mm, 1 x 16mm knock outs.

Mounting

- ANSI, JIS or DIN Flange
- 4 in/100mm to 10 in/250mm
- 2in BSP Thread / NPT Thread

Typical Weight

<table>
<thead>
<tr>
<th>Component</th>
<th>kg</th>
<th>lb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remote Amplifier with 6m cable</td>
<td>1</td>
<td>2.2</td>
</tr>
<tr>
<td>Remote Amplifier with 15m cable</td>
<td>3</td>
<td>6.6</td>
</tr>
<tr>
<td>Remote Amplifier with 30m cable</td>
<td>6</td>
<td>13.2</td>
</tr>
<tr>
<td>Remote Amplifier with 50m cable</td>
<td>10</td>
<td>22.0</td>
</tr>
</tbody>
</table>

Approvals & Certification

For queries about certification please contact techsupport@hawk.com.au

See www.hawkmeasure.com for full safety instructions and installation requirements in hazardous environments.

- IECEx Zone 0 Ex ia IIA T4 IP67 Tamb -20°C to 70°C
- ATEX Gp II Cat 1 GD IP67 EEx ia IIA T4
- IECEx Zone 1 Ex mb II IP68 T5(Tamb -20°C to 65°C) T6(Tamb -20°C to 50°C)
- ATEX Gp II Cat 2 GD EEx m II IP68 T5(Tamb -20°C to 65°C) T6(Tamb -20°C to 50°C)
- IECEx Zone 20 DIP A20 TA85C IP68 Tamb -20°C to 75°C
- ATEX Gp II Cat 1 D T85°C IP67 Tamb -20°C to 75°C
- ATEX Gp II Cat 3 GD T85°C IP67 Tamb -40°C to 70°C
- CSA Equip Class 2; Pollution deg 2; Tamb -20°C to 75°C (Ordinary Locations)
- CSA Class I; Div 1/2; Group D; Zone 0; AEx/Ex ia IIA; T4
- CSA Class II; Div 2; Group F&G; Class III; T6 T85 for Tamb -20°C to 75°C
- CSA Class II; Div 1; Group E, F&G; Ex E, Ex mb II; T5(T100) for Tamb -20°C to 65°C; T6(T85) for Tamb -20°C to 50°C

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