INSTRUCTION MANUAL

GLADIATOR
Acoustic Switch Series
- Beam Blockage Detection -

A higher level of performance
INTRODUCTION

PROPRIETARY NOTICE
The information contained in this publication is derived in part from proprietary and patent data. This information has been prepared for the express purpose of assisting operating and maintenance personnel in the efficient use of the instrument described herein. Publication of this information does not convey any rights to use or reproduce it, or to use for any purpose other than in connection with the installation, operation and maintenance of the equipment described herein.

WARNING
This instrument contains electronic components that are susceptible to damage by static electricity. Proper handling procedures must be observed during the removal, installation, or handling of internal circuit boards or devices:

Handling Procedure:
1. Power to unit must be removed prior to commencement of any work.
2. Personnel must be grounded, via wrist strap or other safe, suitable means, before any printed circuit board or other internal devices are installed, removed or adjusted.
3. Printed circuit boards must be transported in a conductive bag or other conductive container. Boards must not be removed from protective container until the immediate time of installation. Removed boards must be placed immediately in a protective container for transport, storage, or return to factory.

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GENERAL DESCRIPTION

Principle of Operation
The Gladiator Acoustic Switch uses Acoustic Wave technology in a new Sender/Receiver form for blocked chute detection and anti collision for heavy machinery. The Gladiator Amplifier powers two Transducers which use special Hawk developed software where both units pulse & receive each others Acoustic echoes. When the path between the Transducers is blocked the units immediately detect the presence/absence change of the return signal and trigger a communications relay for indication or control purposes.

Hawk’s Acoustic Wave Transducers are self cleaning. The Acoustic Switch is designed for continuous operation in dusty, wet environments where other technologies fail. The power of each pulse (pressure wave) blows the water, moisture & build-up off the face of the diaphragm.

Typical Uses
- Blocked chute detection in wet or dry environments
- Wet screen blocked chute detection
- Nucleonic/tilt switch replacement
- Hi level alarm / Low level alarm
- Truck/machine detection (ROM bins, Primary Crusher Dump Pockets)
- Sewage sludge handling

Function
Detection of objects or material between two points. Can be used for blockage detection, barrier detection, machine detection / protection and point level detection.

FEATURES

- No contact with the product required
- Self cleaning Transducers
- Heavy duty titanium version available
- Designed for dusty, wet environments
- LCD setup/diagnostics on remote amplifier
- Blocked chute ranges up to 15 meters (50 ft)
- Simple ‘1-minute’ setup
- 2 Relay outputs
- Remote test function
- Adjustable ON and OFF delays
- Communication options: GosHawk, Modbus, HART, Profibus DP, DeviceNet
- Remote GSM connection option & support
- Remote Amplifier to Transducer separation up to 500 meters (1640 ft)
SYSTEM COMPONENTS

AMPLIFIER

JUNCTION BOX

Acoustic Switch Remote Transducers labeled TD1 and TD2 with UHMW flush mount sleeve FA4A 4” ANSI standard flange
GLADIATOR AMPLIFIER

Connect colour to colour

AMPLIFIER | TRANSUDCER 1 | TRANSUDCER 2

Relay 1 - Output Relay
Relay 2 - FailSafe Relay

HAWK
AWRT-JB-01
JUNCTION BOX
DIMENSIONS

AMPLIFIER

Remote Transducers with UHMW Sleeve

15kHz

350mm 13.8"

75mm 3"
MOUNTING DIMENSIONS

FLUSH MOUNT

FA4A-4 FLANGE

STANDARD 4" ANSI FLANGE DIMENSIONS

<table>
<thead>
<tr>
<th>SIZE</th>
<th>FLANGE TYPE</th>
<th>A (PCD) mm</th>
<th>B (OD) mm</th>
<th>C (ID) mm</th>
<th>D (Hole) mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>4&quot;</td>
<td>FA4A</td>
<td>190.5</td>
<td>228</td>
<td>100</td>
<td>19</td>
</tr>
</tbody>
</table>

Note: Other flange sizes available upon request.

*C* Interior diameter does not include Hawk's threaded decoupled connection flange
MOUNTING INSTRUCTIONS

FLUSH MOUNT

For closed vessels with falling product the transducers MUST be flush mount with the vessel wall. For heavy falling product chutes or chutes where product will rub the sensor face the titanium face 15kHz version is required.

Alignment - The transducers need to be as accurately facing each other as possible. This is imperative for long range / anti collision applications.

The transducer has a specially designed UHMW sleeve which must either be perfectly in line with the vessel wall interior or slightly (1-2mm) protruded. It cannot be recessed in the vessel wall. The Pipe Specification: 4-00” Z40 ID = 102mm Black Pipe

See page 7 ‘flush mount’ for mounting dimensions.
SETUP PROCEDURE
FACIA CONTROLS

GLADIATOR AMPLIFIER

1. Calibrate button
2. Run button
3. Down button
4. Up button
5. Relay LEDs 1 and 2
6. Display (LCD with backlight)
7. Status LEDs A and B
   - Status A blinking indicates units are pulsing correctly.
   - Status B is not used

All software adjustments can be made by the pushbuttons on the amplifier facia

In Run Mode
(A) Press and hold - interrupts normal operations and allows access to software menu headings.

In Calibrate Mode
(B) Steps into a menu selection to allow editing (down one level)
(C) Saves selected value and moves onto the next menu item.

In Run Mode
(A) Hides diagnostics if they are in view and returns to the standard running display.

In Calibrate Mode
(B) Steps out of a menu or selection (up one level). Parameter value will be stored automatically when stepping up.
(C) Returns to running mode from the top level menu.

In Run Mode
(A) Scrolls through operating diagnostics on display LCD.

In Calibrate Mode
(B) Scrolls through software parameters when browsing the menus.
(C) Changes display value when editing a parameter.
SETUP PROCEDURE

1. Mount the unit in its actual position (see mounting - pages 7-8)
2. Check where the actual level or target is relative to the sensors. Make sure that the material or target is not blocking the path between the transducers.
4. Turn the power on

The display will turn on and the fail-safe relay will switch. The display will scroll through the following messages: Hawk, Amp SerialNo, Type, Amp Soft Ver, Device ID, SensorSerial, SensorModel, Sens SoftVer, Sensor Addr, Gladiator System Amp. The unit will then go into operational mode displaying ‘Switch’ with a % value. This % value represents the changing amount of signal loss between the transducers.

If you see an error code, see ‘troubleshooting’.
5. Simple “1-minute” Setup - Follow the flow chart

Choose Application Type
Alignment - For transducer alignment at long range (boom protection applications)
Blocked Chutes - Configures the unit for blocked chute applications.
Boom Protection - For anti collision / machinery detection.
Other - If you have a light/low dielectric material which is failing to switch select this mode and enter a low or lower sens. % value.

Note: If prompted to ‘re-calc app params’ this means the unit is already set to that app type - the unit is asking if you wish to re-configure the settings.

Mounting Calibration
Do not proceed with this step unless the material or target position is well beneath the line between the sender and receiver.
Select ‘Yes’ to start the mounting calibration. ‘Wait’ will be displayed during the calibration for up to 30 seconds. Unit is now able to cancel the influence of the mounting. The % reading on the back lit display has been zeroed with the existing process conditions and the measurement history log has been cleared.
Always CAL MOUNT after changing application type or moving the transducers.

Select the Switch point
The output relay will switch at the entered % value. The default value of 75% will be suitable for detecting most media. For detection of lighter / fine products select a lower % value and vice versa. For heavy materials almost any setting will work a higher % setting may be required. When the level or target falls below the sensors the relay will switch back on.

Select the Switch Time Delay
Set the delay time for the relay switching on and off.

Select the required relay action
The Relay action can be defaulted to either ‘ON’ or ‘OFF’ and switch ‘ON’ or ‘OFF’ in response to an instrument failure.
Failsafe High - Relay is energised during normal operation and de-energised during blocked conditions or unit failure.
Failsafe Low - Relay is de-energised during normal operation and energised during blocked conditions or unit failure.
Acoustic Switch Series

Manual
Rev 1.4, Sept 2011

FLOW CHART
SOFTWARE TREE

Sensor Value 0.0%

Press CAL To Calibrate

Normal Running Display
Press ‼️ ‼️ to view unit operation diagnostics

On first start up there is no security code protection.

UnLock 0

Press CAL

QuickSet

Press ‼️ ‼️

QuickSet Menu covers all parameters required for standard setups.

Press CAL

Advanced

Press CAL

Advanced Menu covers less commonly used or advanced parameters.

Press to return to normal operation

Press RUN to return to normal operation
DIAGNOSTICS

While the unit is in RUN mode you can press ▼ ▲ to view information about current unit settings & operating characteristics.

Current detected signal in %
0% full signal
100% all signal blocked

Selected Application

Currently selected sensor for diagnostics
Press ▼ ▲ at the same time to switch between sensor 1 & 2 (in this menu only)

Distance between sensors. May be displayed as double or triple value depending on chute conditions.

Signal strength in voltage.
2.5V max

Current recover gain% of sensor. Unit applies recover gain to maintain maximum possible signal strength.

External noise interference % detected by sensor. Value may fluctuate during inactive process & empty chutes due to transducer ringing.

Total Gain% usage of sensor. Calibrated starting gain + recover gain.

Average signal strength between both sensors. 2.5V max

Unit Status
Normal / CommRetry

Ambient temperature at sensor

Current switch delay count down. Value will be slightly lower due to response time

Minimum recorded sensor value % in log

Maximum recorded sensor value % in log

Sensor value required for switch off condition

Sensor value required for switch on condition
QUICKSET FLOW CHART

1. **QuickSet**
   - **CAL**

2. **App Type**
   - **CAL**
   - **CAL**
   - **CAL**
   - **CAL**
   - **CAL**
   - **CAL**
   - **CAL**
   - **CAL**
   - **CAL**

3. **Cal Mounting**
   - **CAL**
   - **CAL**

4. **Switch Point**
   - **CAL**
   - **CAL**

5. **On Delay Adj**
   - **CAL**
   - **CAL**

6. **OffDelay Adj**
   - **CAL**
   - **CAL**

7. **Relay1 Action**
   - **CAL**
   - **RUN**

Select application type
- Alignment
- Blocked Chute
- Anti Collision
- Other

Calibrates unit gain to current conditions
- Yes / No

Switch point condition
- 0-100%
- High value recommended for blocked chutes.

Switch on time delay

Switch off time delay

Failsafe High - Relay1 is energised during normal operation and de-energised during blocked conditions.
Failsafe Low - Relay1 is de-energised during normal operation and energises during blocked conditions.

**Failsafe Conditions**
- Power / Comms problems
- Transducer failure
- Transducers stop communicating
QUICKSET PARAMETERS

**App Type**

**Alignment** - For Aligning the unit at long range (boom protection applications). Unit is set to 1.2V signal (~48% sw value). Move the unit face to get the sw value reading low (0% indicates perfect alignment at current gain setting). Calibrate & re-select this mode and repeat till you cannot improve the alignment. This mode is only for alignment, not for an active process.

**Blocked Chute** - Configures the unit for blocked chute applications

**Boom Protection** - Configures the unit for anti collision applications

**Other** - For blocked chute applications where you have a light/low dielectric material which is failing to trip enter select this mode and enter a low or lower sensitivity value.

**Cal Mounting**

Do not proceed with this step unless the material or target position is well beneath the line between the transducers.

Select ‘Yes’ to start the mounting calibration. ‘Wait’ will be displayed during the calibration during the procedure and the Status A & B lights will flash while the unit is pulsing. The unit then performs a final check. The Cal Mounting process configures the system to the optimum settings to achieve a 2.4V signal (signal in volts viewable in the diagnostics).

**Switch Point**

Auto: The output relay will switch on at displayed % value (default 75%) Auto settings will be suitable for detecting most media. Adjusting the switch on % will automatically adjust the switch off %. For blocked chute applications a higher % switch on value is recommend such as 90%.

Manual: To adjust both switch point values see ‘Switch Mode’ in the ‘Advanced’ menu.

**On & Off Delay Adjustment**

Set the time to be used for both switch on and switch off delays (default: 1 second).

**Relay1 Action**

Relay1 can be set to Low or High. When the Relay is in high mode it is always switched on (EN) and will switch off (DEN) when there is a blocked chute condition or unit failure. High is recommended. When in Low mode the Relay will be switched off (DEN) during normal operation and will switch on (EN) when there is a blocked chute condition or unit failure.
ADVANCED MENU FLOW CHART

Advanced
  CAL
Switch Mode
  CAL
  ↑ ↓
Relay2Action
  CAL
  ↑ ↓
View Log
  CAL
  ↑ ↓
Reset Log
  CAL
  ↑ ↓
Comms Type
  CAL
  ↑ ↓
ProbeAVG
  CAL
  ↑ ↓
Initilize TX
  CAL
  ↑ ↓
LoadDefaults
  CAL
  ↑ ↓
  RUN

Auto - Recommended setting
Manual - Manually select switch on & off % value

Failsafe - Relay2 is always energised and will de-energise in the event of unit failure.
Relay2 - Relay will operate same as Relay1 setting.

Yes - Displays recently logged data

Yes - Resets logged data

Devicenet
Profibus
HART
Modbus

Comms type will not work without correct module.
Different Comms types display all or two of the following.

The number of pulses the unit uses to average the display measurement.

Yes / No
Run Transducer initialisation sequence.
See page 19 for further information on transducer initialisation.

Yes / No
Restores the Transducer settings to factory default.
You will be prompted to reset each Transducer individually. Load defaults does not reset TX address.
ADVANCED MENU PARAMETERS

Switch Mode
Switch mode alters the switch on/off display % condition for the relay. **Auto** is the recommended Hawk default with switch on at 75% **Manual** mode allows you to specify the on & off % condition.

Relay2Action
The second relay can be set for failsafe conditions or as another switch. Usually failsafe is the preferred option. The relay will always be switched on but will switch off if there is a fail condition with the system.

Failsafe Conditions:
- Power / Comms problems
- Transducer failure
- Transducers stop communicating

The second relay2 action is relay2. This programs the relay to mirror the action of relay1.

View Log
View log displays the highest & lowest logged values for the display % and temperature since the last log reset.

Reset Log
Clears the logged data.

Comms Type
If your unit has an additional comms module (Modbus is standard with switch only units) such as Devicenet, Profibus PA or HART you can select and configure the address / ID / line speed for the comms option.

Back Light
The LCD back light can be switched on or off. The display will be bright green when switched on.

ProbeAVG
This setting is similar to a ‘damping’ setting. The unit display reading will be an average of the ProbeAVG figure. The figure is measured in transducer pulses. The default setting is 2. Increasing this setting will slow the unit response time for switching and give a more stable switch % value.

Initialize TX (see page 19)
If you need to re-initialize the transducer address connection sequence you can run this program. You will have the option to clear each transducer address. If the transducers are already correctly addressed within the amplifier the unit will cycle through and display ‘found’ and then ‘too many transducers’. In this event press and hold RUN firmly to return to the menus.

V In Chk
V in Chk ensures the minimum required voltage for unit operation (9.5V) is being supplied to the unit. If switched off the LCD will display ‘volt fail’ when voltage drops below 9.5V. When switched on the unit will enter failsafe mode and display volt fail when input voltage drops below 9.5V.

LoadDefaults
Restores factory default settings to amplifier, sensor 1 and sensor 2. You will be prompted to set each individually.
REMOTE COMMUNICATION

GSM/CDMA

HawkLink 3G/GPRS/GSM/CDMA communication device allows any authorized computer with a standard modem and GosHawkII software to dial in and calibrate, test or check in on the performance of the connected Hawk product. The HawkLink device can be wired to the standard communication terminals of the Hawk products.

Remote technical support and complete commissioning of equipment in applications is possible via this remote communications module and allows monitoring and adjustment of settings no matter what corner of the world.

Remote connection worldwide!
TROUBLESHOOTING

ERROR CODES

**Too Many Transducers** - This code can be displayed if both transducers are already **correctly** initialised when run the Initialise TX program. Press and hold the RUN button to exit this code loop.

**Com Retry** - Unit is attempting to communicate with a transducer.

**Failed** - Unit has failed to communicate with both transducers. Check amplifier & junction box wiring connections. Pull each wire to ensure they are locked in correctly.

**Error No 01** - Amplifier cannot communicate with transducer 1.

**Error No 11** - Amplifier cannot communicate with transducer 2.

Existing installation: For both error codes 1 and 11 the first thing to check is the amplifier & junction box wiring connections, both Hawk and customer supplied if applicable. Pull each wire to ensure they are locked in correctly. Check sensor for damage.

New installations: You may need to re-initialise the transducers. The re-initialisation sequence assigns each an ID which the amplifier is looking to communicate with.

The re-initialise program is in the ‘Advanced’ Menu. While an error code is on the screen you will need to push and firmly hold the CAL button to access the unlock screen. This may take 5-10 seconds.

**Error 02:** Amplifier can talk to transducer but transducer gives incorrect response. This can indicate a communication data corruption between Amplifier and Transducer. It can be a result of noise in data lines or one of data lines (blue or white) being open circuit.

**Error 03:** A communications option in output adjustment has been selected (eg Profibus, FF) but the module is not present, connected or responding.

**Error 04:** Amplifier is programmed with incorrect software.

**Error 08:** Incorrect transducer - ensure connected transducer is Acoustic Switch (AS).

POWER SUPPLY

**LCD / LEDs / Relays dimming or dropping out in non-blocked conditions.**

The GSASUS when powered by AC will output a DC voltage from the DC +/- terminals.

You should read approx 16V stable from DC +/- while under AC power. If your AC power is stable and the DC is outputting a lower or unstable value there is likely a problem with the internal AC power supply. You can use a 24DC regulator and power the unit via DC terminals.
TRANSDUCER RE-INITIALISATION

Error 01 - Error 11
If you are getting ‘Error 01 or Error 11 on the Gladiator display after installing a single transducer or full system you may need to re-initialise a transducer. If your system is displaying Error 01 or Error 11 after the system has been working correctly it is very likely there is a different problem. If Comm Err is displayed while navigating menus check your wiring, terminals, junction boxes and transducers for damage or connection problems.

Initilizing a Transducer
If you need to re-initialize the transducer address you can run this program. You will have the option to clear each & initialise transducer address.

First - Disconnect Transducer 2
Press and hold CAL to force the unit to open the ‘unlock’ menu. Navigate to the Initilize TX menu as per below

```
Unlock 0

Advanced

Initilize TX
```

During the boot sequence of the amplifier information about each transducer is cycled on the LCD. Each transducer will pulse once during this phase confirming power is present.

If both transducers pulse at the same time they have been assigned the same TX ID. You will need to re-initialise one of them.

T’ducer1 Initilize?
Transducer 1 is detected and has not been initialised. Press CAL to edit, press UP until you see ‘Yes’. Press CAL to select. Re-connect Transducer 2 and press RUN several times to re-activate the unit.

Plz connect Transducer 1
Press RUN firmly until it moves to 2nd Transducer. Display should read ‘T’ducer 2 Ready’. Press CAL to edit, press UP twice to display ‘Clear? Yes’. Press CAL. The unit will not have returned to the advanced menu. Press UP and re-enter TX initilize. You should now be prompted with T’ducer1 Initilize, refer to relevant steps.

T’ducer 1 Ready
Press CAL to edit, press UP twice to display ‘Clear? Yes’. Press CAL. The unit will cycle to T’ducer 2 displaying ‘Ready’. Re-connect Transducer 2 and press RUN several times to re-activate the unit.

After selecting ‘Yes’, you will see one of these messages:

<table>
<thead>
<tr>
<th>T’ducer1 Initilize?</th>
<th>Plz connect Transducer 1</th>
<th>T’ducer 1 Ready</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
PART NUMBERING

REMOTE AMPLIFIER

GSA  Remote Gladiator System Amplifier
Housing
  S  Standard polycarbonate electronics housing
Power Supply
  B  24 VDC standard (12-30VDC)
  C  48 VDC
  U  Universal AC power supply (90-260 VAC input) and 12-30VDC
Output Options
  S  Switch. 1 level relay, 1 failsafe relay, with Modbus
  Z  Special Request (Profibus, HART, Devicenet, FF)

GSA S U S

JUNCTION BOX

AWRT-JB-01  Hawk multi purpose junction box for dual transducer applications
           Includes 1m amplifier connection cable.

MOUNTING FLANGE

FA4A-4  Hawk Transducer body mounted 4” ANSI flange

EXTRA CABLE  (length in metres)

CA-TXCC-R-  C15
            C30
            C50
            C100
PART NUMBERING

REMOTE TRANSDUCER

AWRT  Acoustic Wave Remote Transducer
15  15kHz for chutes with heavy duty self cleaning requirements

Transducer Diaphragm Material
T  Teflon / UHMW
Y  Titanium face / UHMW for 15kHz only

Transducer Housing Material
4  Polypropylene

Thread Standards for End cap
X  Not Available (FA4A-4 Standard Flange Mount)

Mounting Thread Sizes
X  Not Available (FA4A-4 Standard Flange Mount)

Approval Standard
X  Standard CE approved
A0  IECEx Zone 0 (Ex ia IIA T4)
    ATEX (Grp II Cat 1 GD IP67 EEEx ia IIA T4)
A1  ATEX Encapsulated (Grp II Cat 2 GD EEEx m II IP68)
A20 ATEX Dust (Grp II Cat 1 D T85C IP67)
A21 ATEX Dust (Grp II Cat 2 D T85C IP67)
A22 ATEX Dust (Grp II Cat 3 D T85C IP67)
GP  CSA Equip Class 2; Pollution deg 2; measurement II (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

Connection
C  IP68 Sealed unit with cable

Cable Length
15  15m cable
30  30m cable
50  50m cable

Accessories
X  UHMW Sleeve

Software Options
AS  Gladiator Acoustic Wave Switch

AWRT 15 Y 4 X X X C 15 X AS
SPECIFICATIONS

Operating Voltage
- 12-30VDC (residual ripple no greater than 100mV)
- 90-260VAC

Power Consumption
- <0.8W @ 24VDC
- <5VA @ a240Vac
- <3VA @ 115Vac

Communications
- GosHawk, Modbus
- Multidrop mode can address 1-50 units over 4 wires

Relay Outputs: (2) Remote
- Form 'C' (SPDT) contacts, rated 5A at 240Vac resistive
- Remote fail-safe test facility for one relay.

Operating Temperature
- Remote electronics -40°C (-40°F) to 80°C (176°F)
- Remote Sensors -20°C (-4°F) to 80°C (176°F)*

Fail-Safe
- Selectable - presence or absence of material
- High level fail-safe: relay is activated when material is present.
- Low level fail-safe: relay is activated when no material is present.

Maximum Range
- Blocked Chutes: Under ideal conditions: 15m (50ft)

Minimum Range
400mm

Transducer to Amplifier Separation
- Up to 500m (1640ft) using specified extension cable (Belden 3084A)

Maximum Operating Pressure
- 2 BAR

Display
- 2 line x 12 character alphanumeric LCD
- Backlight standard

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

Enclosure Sealing
- Remote Electronics IP67 (Nema 4x)
- Remote Sensors IP68

Cable Entries
- Sensors
  - 1 x M20 Gland/3/4" NPTF threaded adaptor
  - 4 x 20mm (0.8"), 1 x 16mm (0.6") knock outs.

Mounting
- Transducer 4" ANSI flange
- Remote Amplifier Back mount, DIN rail mount
- Pipe Specification: 4-00” Z40 ID = 102mm Black Pipe