A Higher Level of Performance

User Manual

Senator

S60W Radar Series

Liquid Level Measurement





For more information, please visit >

www.hawkmeasurement.com

Contents

Overview 3

Applications, Dimensions, Wiring 4

Liquid Level Measurement 4
Wiring 4
Dimensions 4

Installation 5

Mounting 5

Configuration 7

Start up Sequence 7

Commissioning 8

Software 9

Setup Menu 9
Advanced Menu 10
Volume Table 12

HawkBTConnect App 13

Modbus 14

Output / Measurement Registers 14
Communications Registers 14

Troubleshooting & Maintenance 15

Using Check Echoes 15
Using Strength Dif 15
Using Blocked Dist / Blocked Size 16
Example of Errors in Trends & Unit Adjustments 17
Maintenance 18

Software Flow Chart 19

Setup Menu 19
Advanced Menu 20

Part Numbering 22

Part Numbering 22

Specifications 24

Contact Information 25

Overview

Offering a unique blend of compact design and efficiency, the Senator S60W is a radar level transmitter ideal for continuous liquid level measurement. It guarantees value without compromising quality and ease of operation. With its flexible mounting options, high chemical compatibility, and a 20m (65ft) measuring range, the Senator S60W is versatile enough to meet the demands of diverse industrial applications. Simple commissioning via Bluetooth HAWKBTConnect App (Android & iOS) plus a 4-20mA output with HART and Modbus.

The Compact Modbus version system is designed for ultra low power RTU & remote telemetry with remotely scheduled measurement intervals suitable for isolated installations.

Principle of Operation

The Senator S60W transmits a radar pulse at the speed of light, bouncing off the surface of the measured liquid. Proprietary software then analyzes the returned signal, enhancing the accurate reflection while eliminating any false ones.

Primary Areas of Application

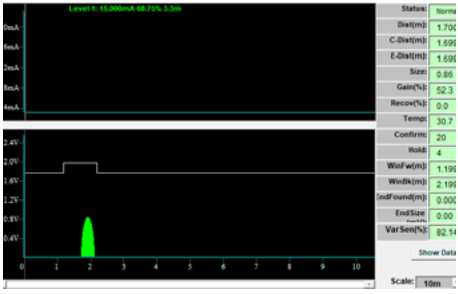
Liquid Level:

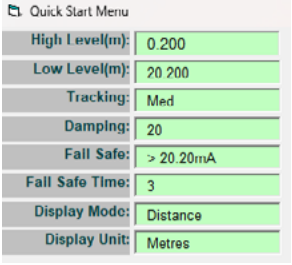
- River level
- Wet wells
- Inlet screens
- Tanks
- Sumps
- Pump stations
- Dams
- Chemical storage

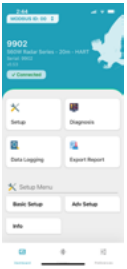
Model Types

- S60W Integral version with keypad, display & Bluetooth
- S60W Compact version with Bluetooth

Simple Commissioning via GoshawkII & Bluetooth App



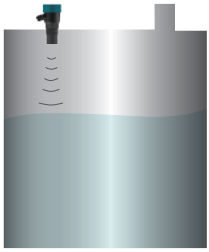
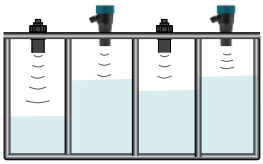
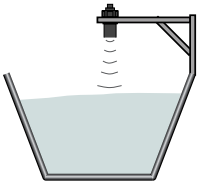




Features

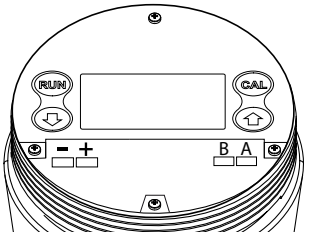
- 4-20mA HART with Modbus output
- Ultra low power Modbus version (5VDC)
- Bluetooth with HAWKBTConnect App
- Maximum range to 20m (65ft)
- Ingress protection class IP67
- 2” BSPT or NPT mount

Liquid Level Measurement

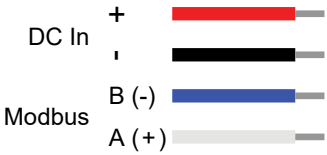




Wiring

Integral

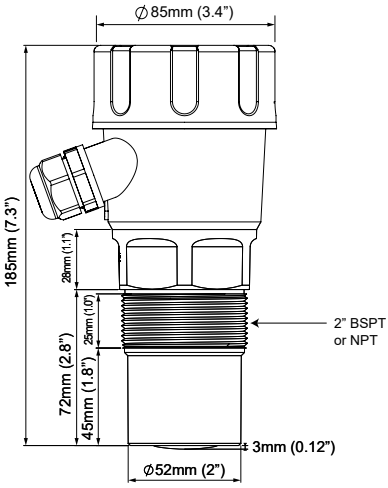


Compact

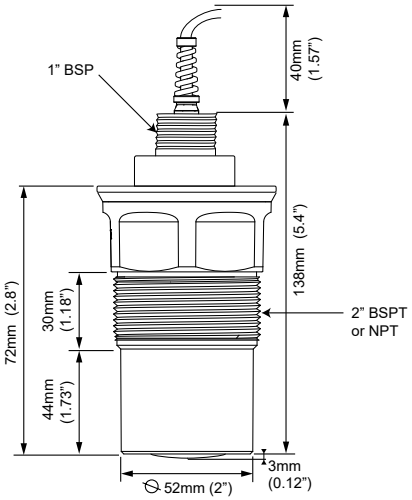


Dimensions

Integral



Compact



Mounting

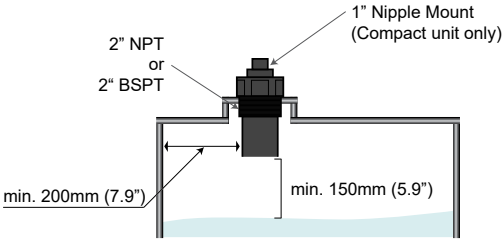
• Sensor should be mounted 1/3 the diameter of the vessel from the vessel wall

• Ideally the Sensor Face should protrude into the main vessel

• Sensor Face should never be closer than 150mm (5.9") to the liquid surface

• Do not mount over or near objects which can interfere with the unit measurement with consideration for the beam angle (10°). Refer to Beam Angle Table

• Do not mount in the centre of a curved roof to avoid the potential of parabolic echoes



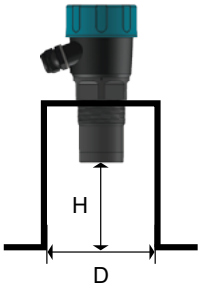
Beam Angle Table

Beam Angle	Beam Spread	
10°	87mm per m	1.05" per ft

Stand Pipe Considerations

Avoid mounting in a stand pipe where H height (from sensor face to nozzle base) exceeds the D (diameter) as per below table.

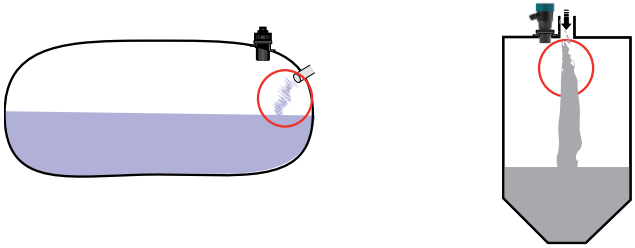
It is recommended to set Blanking for dimension H + 50% safety margin, or at least H and run Check Echoes function to see if the unit detects signals during normal operation. The signals may appear at a longer distance than the stand pipe. Blocked Step and Blocked Size may be appropriate to eliminate the false echoes (refer to Software / Advanced Menu). Ensure the signal size from the physical level is larger than the Blocked Size value if the level will pass into this distance.



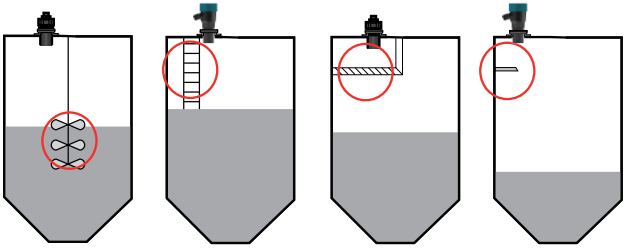
Diameter (D)		Height (H)	
40mm	1.5"	<150mm	<5.91"
50mm	2"	<200mm	<7.87"
80mm	3"	<300mm	<11.81"
100mm	4"	<400mm	<15.75"
150mm	6"	<600mm	<23.62"
200mm	8"	<800mm	<31.5"

Placement Considerations

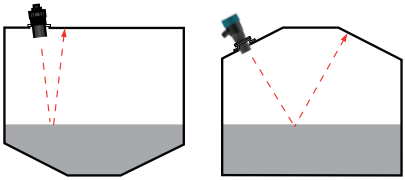
Do **NOT** mount near infeed



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



Do **NOT** mount on angle
in liquid applications



Configuration

Depending on the model type, the unit can be configured via:

- Keypad / display
- Android / iOS using HawkBTConnect Bluetooth app
- Goshawk (PC Software) via a Hawklink-USB Modbus communicator or HAWK-M195 HART communicator. Other Modus or HART modules may be supported however it is recommended to only use HAWK supplied modules. Goshawk is available free from https://hawkmeasurement.com/

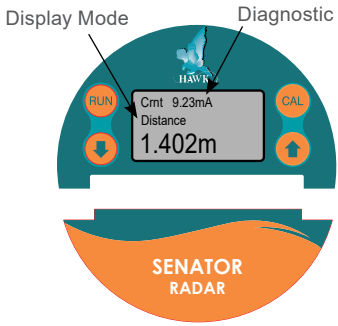
Keypad & Display

RUN Go back, return unit to operational mode

CAL Proceed, select, save

Navigate up, increase value

Navigate down, decrease value



Start up Sequence

When power is applied, the unit will start up automatically. The LCD will scroll through its device information displaying the model type, software version, hardware version and serial number. The unit will re-scan for the level whenever it is powered up.

The unit will then go through an initialization sequence with a count down timer. When complete the unit will scan for a level reading and when confirmed the selected Display Mode will be visible with a measurement.

The top line displays Diagnostic (signal size & distance of Largest and Smallest echoes), the current output. unit status or radar pulse charge (voltage).

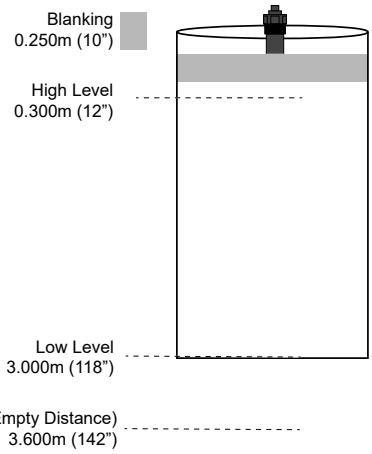


To access the menus, proceed passed the unlock code (default 0).



1. Set Span: Empty Distance, High and Low Level

Example values only



Menu Path: Advanced > Empty Distance
Menu Path: Setup > High Level
Menu Path: Setup > Low Level

a): Set Empty Distance (any signals beyond this distance will be ignored, so set with additional safety margin of approximately 20% where possible). For vessels with irregular shaped floor, set to a distance to account for multiple bouncing echoes
b): Set High (100% / full) and Low (0% / empty) **Note:** The distance for these parameters is measured from the Sensor face down.

2. Set Blanking:

Menu Path: Advanced > Blanking

a): A typical Blanking distance should be minimum 50mm (1.8") less than the High level.

The minimum is Blanking is 150mm (5.9").
If the level enters the Blanking distance, the unit will no longer report an accurate measurement and may read a double bounce, showing double the distance of the actual level.

3. Set Tracking Speed:

Menu Path: Setup > Tracking

Fast: Max 150mm/sec (5.9")

Medium: Max 100mm/sec (3.6")

Slow: Max 50mm/sec (1.8")

InstaTrack: A special mode which will respond immediately to any detected signal between Blanking and Empty Distance.

4. Damping:

Menu Path: Setup > Damping

a): Applies damping (smoothing) to the measurement output. A default value is applied by the selected Tracking speed. For smoother trend, increase the value. For a faster response time, decrease the value

Setup Menu

Parameter	Description	Options
Empty Dist	Sets the maximum possible measured range. The system will not accept any signals beyond this distance. The Low Level also cannot be set longer than the Empty Distance.	Adjustable
Display Mode	Set LCD measurement display mode	Level % Level Distance
Display Unit	Adjust displayed measurement unit	CenMetre Metres Feet Inches
High Level	Set High level measurement point (20mA) Minimum value is restricted by Blanking	Adjustable
Low Level	Set Low level measurement point (4mA) Maximum value is restricted by Empty Distance	Adjustable
Tracking	Program application process speed. **Slow:** Maximum 50mm/sec (1.8”) within a distance of 150mm (6”) of the last echo. If the unit has lost tracking the echo, the unit increases it’s search radius by 2.5mm* (0.1”)/sec. Damping: 50 **Medium:** Maximum 100mm/sec (3.6”) within a distance of 300mm (12”) of the last echo. If the unit has lost tracking the echo, the unit increases it’s search radius by 9mm* (0.35”)/sec. Damping: 20 **Fast:** Maximum 150mm/sec (5.9”) within a distance of 500mm (18”) of the last echo. If the unit has lost tracking the echo, the unit increases it’s search radius by 47mm* (1.85”)/sec. Damping: 5 **InstaTrack:** A special mode which we respond immediately to any detected reflection. Damping: 2 *Approximate values	Slow Medium Fast InstaTrack
Damping	Adjust output response time & smoothness	Adjustable (seconds)

Setup Menu (con't)

Failsafe	Set failsafe output	3.50mA 3.80mA >20.20mA LastKnown 4mA 20mA >21.50mA
FailTime	Set delay until Failsafe is activated	Adjustable (seconds)

Advanced Menu

Parameter	Description	Options
Comms	Select Comms output. The unit will be supplied default to Auto. Select either Modbus or HART depending on requirements. Auto will detect either HART or Modbus for Goshawk commissioning. However for best results select the protocol being used.	Modbus HART Auto
Device ID	Device ID	Adjustable Default: 0
Baud Rate	Baud Rate (HART is always 1200, Modbus is adjustable, and is 19200 by default).	1200 - 56000
Blanking	Blanking is a dead-band / non measured range. The unit cannot measure within this range. If the level passes into this range it will report a false distance.	Adjustable - minimum 150mm (5.9")
Check Echoes	Displays the distance and echo size (db) of the detected echoes. This can also be used to check the echo size (db) in conjunction with the Strength Dif parameter for nearest vs largest echo selection. See 'Troubleshooting - Using Check Echoes & 'Using Strength Dif' for more information.	
OffsetDist	Add or subtract an offset from the measured distance	Adjustable (Max +/- 0.500m (19.7")

Advanced Menu (con't)

Analog	Adjust Analog output. Switch from 4-20mA to 20-4mA and fine tune both 4mA current and 20mA current. Park current at selected range for testing or multi drop networking.	4-20mA 20-4mA 4mA Tuning 20mA Tuning Park 4/8/12/16/20mA
Blocked Size	Any echoes** smaller than Blocked Size will be ignored within distance of Blocked Dist	Adjustable (Volts)
Blocked Dist	Any echoes** smaller than Blocked Size voltage within within this distance will be ignored. Measured from the sensor face.	Adjustable (Distance)
Factry Reset	Restore all parameters to factory default. If adjusting via the HLI remote indicator, use Unlock Code 222	Yes / No
Language	Language Selection	English
Device Info	Displays product type, serial number & software revision.	
Lock Code	Enable / Disable lock code. The units are shipped with lock code 0	0-200
Flip LCD	Flips LCD text	Yes / No
BT Power	Enable or Distance the Bluetooth module. Can also sets how long the Bluetooth module remains powered after unit start up	Disable Enable - 15 mins / 30 mins - 1 hour / 2 hours - 4 hours / 8 hours - 15 hours / 18 hours - Always On
Strength Dif	The difference in echo* size (measured in db) for echo selection. If the difference between the nearest echo and the largest echo is smaller than this setting, the unit will track the nearest echo. If the difference is larger, it will track the largest echo. If set to 0, the unit will always track the largest echo. See 'Troubleshooting - Using Check Echoes & 'Using Strength Dif' for more information.	Adjustable (db) Default = 0

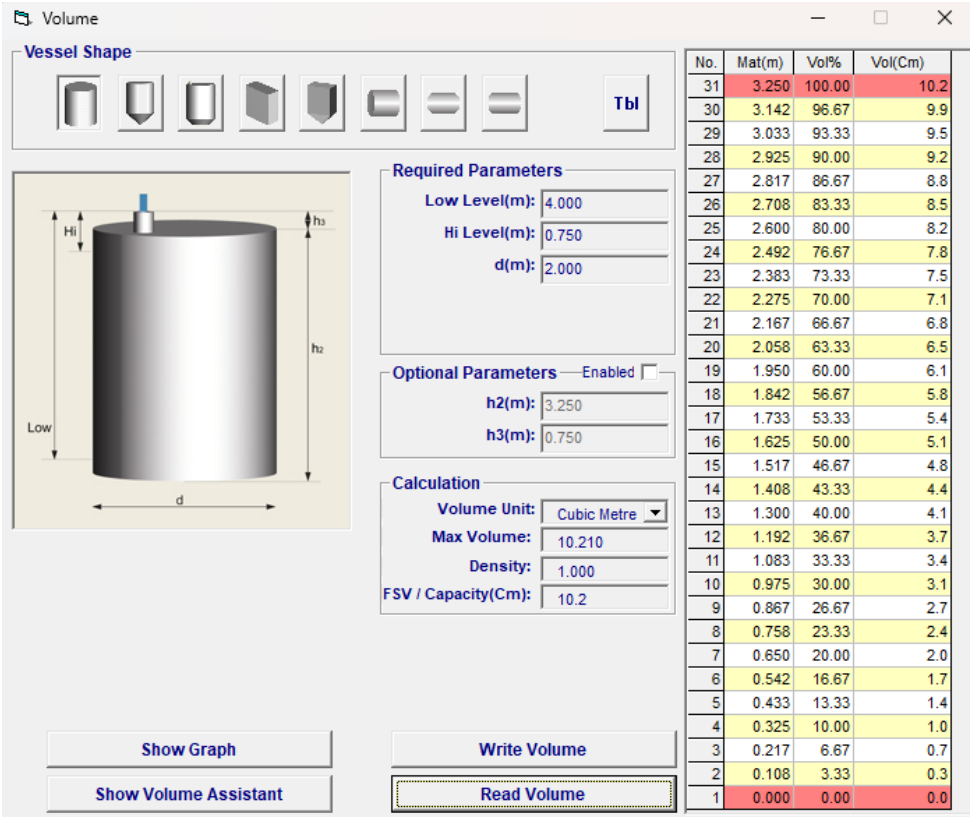
***The echo size (db) is visible using 'Check Echoes', top line Diagnostic or via HawkBTConnect App & Goshawk.**

****The echo size (V) is only available via HawkBTConnect & Goshawk**

Volume Table

Setting a Volume table requires a PC with Goshawk plus a Hawklink-USB or M195-HART.

There are pre-set tank shapes or a full custom strapping table.



No.	Mat(m)	Vol%	Vol(Cm)
31	3.250	100.00	10.2
30	3.142	96.67	9.9
29	3.033	93.33	9.5
28	2.925	90.00	9.2
27	2.817	86.67	8.8
26	2.708	83.33	8.5
25	2.600	80.00	8.2
24	2.492	76.67	7.8
23	2.383	73.33	7.5
22	2.275	70.00	7.1
21	2.167	66.67	6.8
20	2.058	63.33	6.5
19	1.950	60.00	6.1
18	1.842	56.67	5.8
17	1.733	53.33	5.4
16	1.625	50.00	5.1
15	1.517	46.67	4.8
14	1.408	43.33	4.4
13	1.300	40.00	4.1
12	1.192	36.67	3.7
11	1.083	33.33	3.4
10	0.975	30.00	3.1
9	0.867	26.67	2.7
8	0.758	23.33	2.4
7	0.650	20.00	2.0
6	0.542	16.67	1.7
5	0.433	13.33	1.4
4	0.325	10.00	1.0
3	0.217	6.67	0.7
2	0.108	3.33	0.3
1	0.000	0.00	0.0

HawkBTConnect

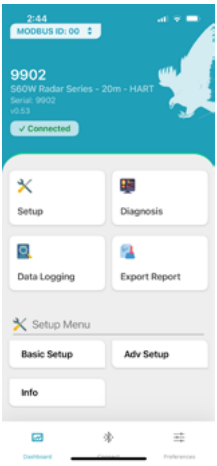
HawkBTConnect is available for Android & iOS devices.

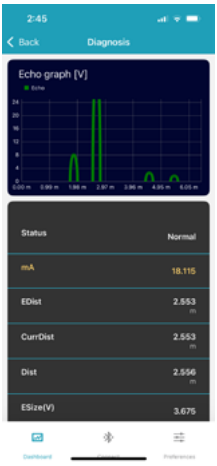
The App will only detect compatible Hawk Bluetooth devices.

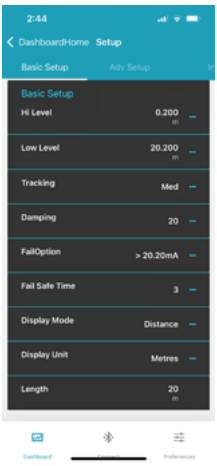
The device can be identified via it's serial number.

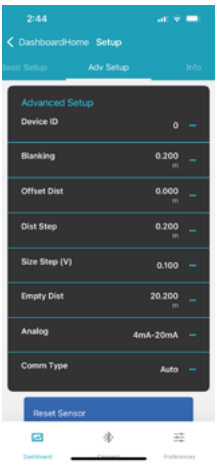
By default, the App will scan for units with device ID 0 through 5. For other IDs this can be adjusted in the App (Preferences - Bluetooth Connection - Lower & Upper search band).

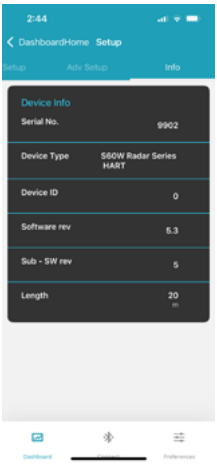












Output / Measurement Registers

Address (Zero-Based)	Address (One-Based)	Variable / Description	Data
3001	43002	Primary Measurement Output (Distance to material)	Distance in mm
3002	43003	Primary Measurement Output (Material height)	Height in mm
3003	43004	Temperature	Kelvin = /10 Celsius = -273.2 /100
3004	43005	Status	24 = Confirmed measurement 4 = No measurement confirmed

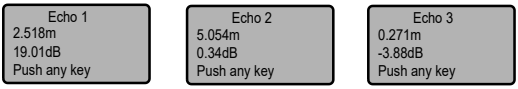
Communications Registers

48	40049	Comms Type (Ensure unit supports Comm type if adjusting)	0 = Modbus 1 = HART 2 = Auto
4	40005	Device ID	Adjustable
49	40050	Baud Rate	0 = 1200 1 = 4800 2 = 9600 3 = 19200 4 = 38400 5 = 57600

For a complete list of Modbus registers, consult the Modbus Supplementary Manual

Using Check Echoes

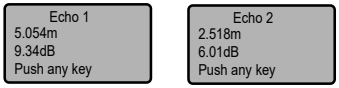
Check Echoes can be used to detect the signal size of the level plus any false readings. It will return the Echoes detected in dB from largest to smallest, plus the distance. Note that the Echo size of Largest and Smallest echo is always available on the top line of the display as a Diagnostic, plus all echoes are displayed in HawkBTConnect and Goshawk echo tables.



In this example, Echo 1 is the correct level, Echo 2 is approximately a double bounce echo from the level and Echo 3 is a false echo generated from mounting structure or similar interference.

Using Strength Dif

If the unit is reading an incorrect longer distance, and the correct distance is displayed using Check Echoes , you can set the Strength Dif to instruct the unit to ignore the larger echo.

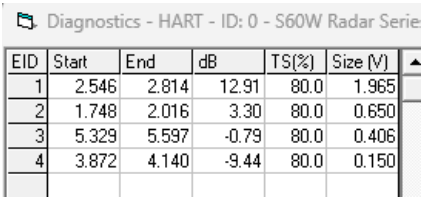


In this example, the false echo is a double bounce reading from the surface but is producing a larger echo. To tell the unit to accept the smaller, closer echo, set Strength Dif a value greater than the difference (9.34 - 6.01) with some safety margin, eg 7dB.

Strength Diff is disabled by default (set to 0).

The Echo Table showing the Signal Strength (dB) is available via the HawkBTConnect App Diagnosis screen, plus as dB in the Goshawk Diagnostics screen in (click on ‘show data’ to display the Echo Table).

Echo Table					
E#	**Start-m**	**End-m**	**dB**	**TS-%**	**ES-V**
1	2.544	2.812	12.54	80	1.883
2	1.754	2.022	3.02	80	0.629
3	5.343	5.611	-1.37	80	0.38
4	0	0	0	0	0
5	0	0	0	0	0



EID	Start	End	dB	TS(%)	Size (V)
1	2.546	2.814	12.91	80.0	1.965
2	1.748	2.016	3.30	80.0	0.650
3	5.329	5.597	-0.79	80.0	0.406
4	3.872	4.140	-9.44	80.0	0.150

Using Blocked Dist / Blocked Size

Blocked Dist / Blocked Size are used in tandem to eliminate false echoes within a certain distance based on the signal size (measured in Voltage). Signal Size (v) is available via the echo table in HawkBTConnect and Goshawk, but not the keypad.

Any echoes within Blocked Dist (measured from the sensor face) which are smaller than Blocked Size (v) will be ignored. Generally this can be used to eliminate false echoes generate from mounting or for build up which may occur on the sensor face.

If the Blocked Dist is within the actively measured range of the application ensure the correct level reading is a larger signal size than the Blocked Size setting or the unit will not read the level correctly.

The Echo Table showing the Signal Size (ES-V) is available via the HawkBTConnect App Diagnosis screen, plus as Size(V) in the Goshawk Diagnostics screen (click on 'show data' to display the Echo Table).

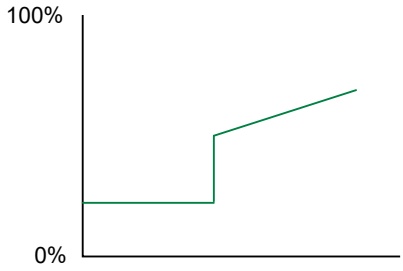
Echo Table					
E#	**Start-m**	**End-m**	**dB**	**TS-%**	**ES-V**
1	2.544	2.812	12.54	80	1.883
2	1.754	2.022	3.02	80	0.629
3	5.343	5.611	-1.37	80	0.38
4	0	0	0	0	0
5	0	0	0	0	0

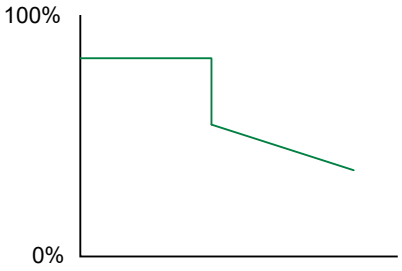
Diagnostics - HART - ID: 0 - S60W Radar Serie

EID	Start	End	dB	TS(%)	Size (V)
1	2.546	2.814	12.91	80.0	1.965
2	1.748	2.016	3.30	80.0	0.650
3	5.329	5.597	-0.79	80.0	0.406
4	3.872	4.140	-9.44	80.0	0.150

Example of Errors in Trends & Unit Adjustments

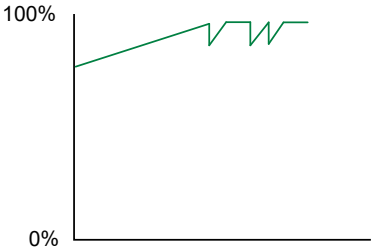
Unit not responding to Fill / Empty cycle





- The 'Tracking' speed may not be appropriate. Increase to faster Tracking speed

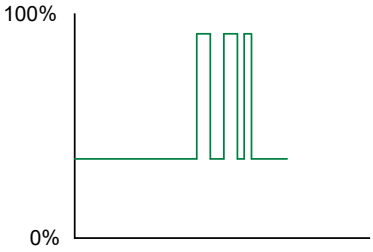
Unit dipping to <100%



- Ensure the vessel is not being filled above capacity.

- The level may have entered into the Blanking distance which can create a 'double bounce' echo effect. Ensure the Blanking distance is appropriate. Extend the High Level to control the level at a safer distance.

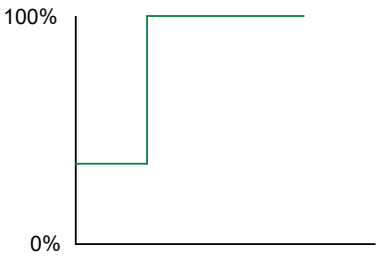
Level spiking to unexpected value



- There may be a mechanical structure creating a false echo. Use 'Check Echoes' to identify it the echo can be eliminated (Refer to 'Using Check Echoes').

- Move the mounting position of the unit to a difference location

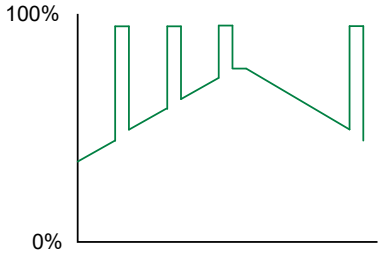
Unit Locking up to 100% or >100%



- The unit may be locked of a false echo >100% level. Refer to 'Using Check Echoes' to eliminate it as a valid target.

- The unit may be in FailSafe condition (this can be identified by the 4-20mA reading or the Diagnostic section of the display). Ensure there is a measurable path to the level. If the unit does not respond to testing it may need replacement.

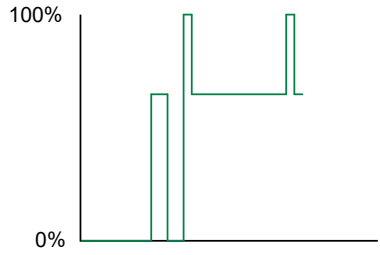
Unit is spiking during fill or emptying cycle



- There may be a mechanical structure creating a false echo. Use 'Check Echoes' to identify it the echo can be eliminated (Refer to 'Using Check Echoes').

- Move the mounting position of the unit to a difference location

Unit is spiking while the vessel is empty



- There may be a mechanical structure creating a false echo. Use 'Check Echoes' to identify it the echo can be eliminated (Refer to 'Using Check Echoes').

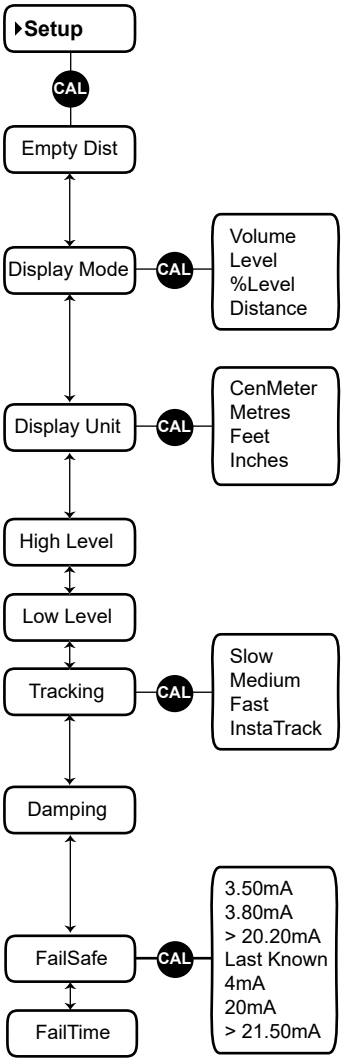
- If the base of the vessel is not flat, extend the Empty Distance. There may be a measurable echo beyond the Low Level.

Maintenance

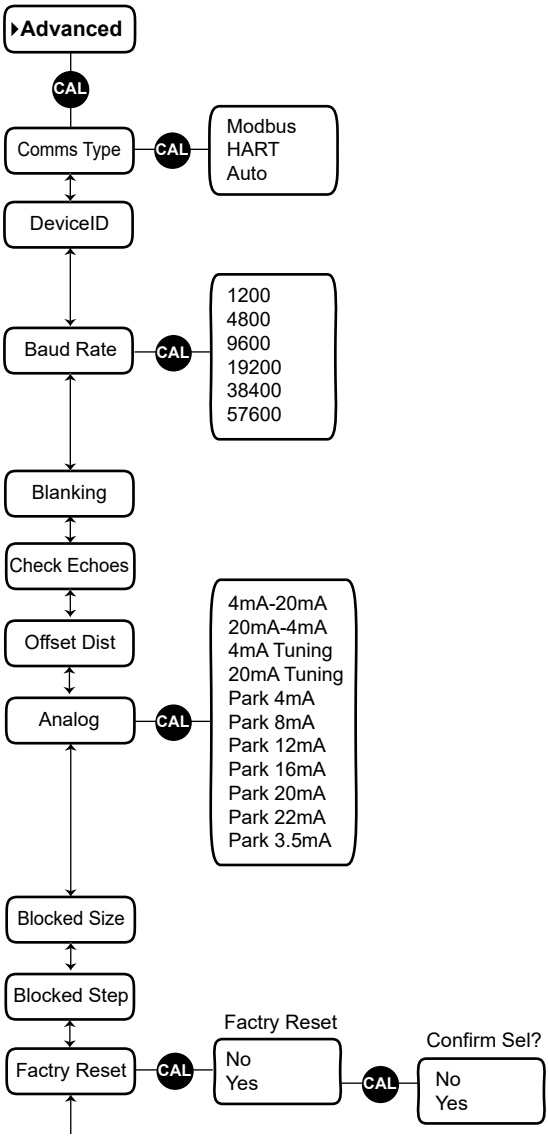
Generally no ongoing maintenance is required.

In applications where there is possibility of build up on the sensor face/antenna (particularly with high dielectric materials) then scheduled cleaning may be required. Build up can suppress the amount of transmitted and returned signal which can reduce performance or create false measurements.

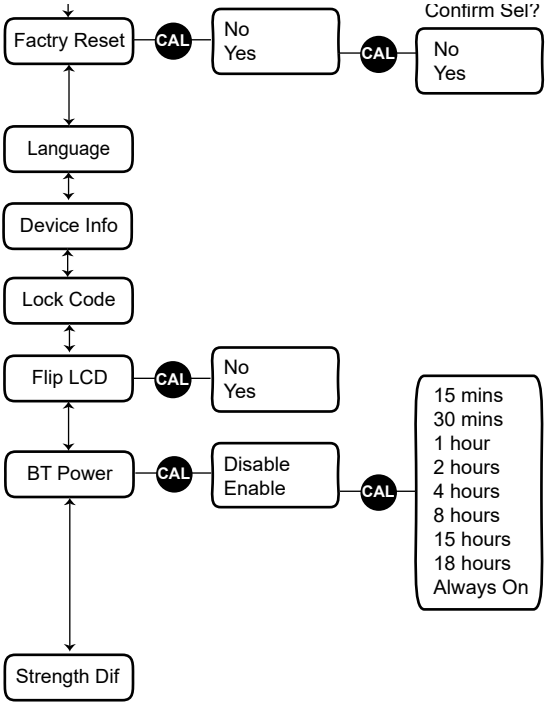
Setup Menu


Setup
CAL
Empty Dist
Display Mode
CAL
Volume
Level
%Level
Distance
Display Unit
CAL
CenMeter
Metres
Feet
Inches
High Level
Low Level
Tracking
CAL
Slow
Medium
Fast
InstaTrack
Damping
FailSafe
CAL
3.50mA
3.80mA
> 20.20mA
Last Known
4mA
20mA
> 21.50mA
FailTime

Advanced Menu



Advanced Menu (con't)



Part Numbering

Integral Version



Model
S60W Senator Radar

Version
H Standard

Variant
SB Integral / Keypad & Display, Bluetooth
SX Integral / Keypad & Display

Maximum Range
06 6m (19.7ft)
12 12m (39.4ft)
20 20m (65.6ft)

Housing / Cable Entry
AM Powder coating aluminium / M20 x 1.5

Approval
XX Not Required

Standard
XX Not Required

Output
H 4-20mA HART, Modbus

Mounting
TB20 2" BSPT
TN20 2" NPT

Cable Length
XXX Not Required

Accessory
X Not Required

Addition
X Not Required

S60W	H	SB	20	AM	XX	XX	H	TN20	XXX	X	X

Part Numbering

Compact Version



Model
S60W Senator Radar, Bluetooth

Version
H Standard

Variant
CB Compact / No keypad or display, Bluetooth

Maximum Range
06 6m (19.7ft)
12 12m (39.4ft)
20 20m (65.6ft)

Housing / Cable Entry
PX PVDF / None

Approval
XX Not Required

Standard
XX Not Required

Output
H 4-20mA HART, Modbus
M Modbus (Low power version)

Mounting
TB20 2” BSPT
TN20 2” NPT

Cable Length
C06 6m (19.7ft)
C15 15m (49.2ft)
C30 30m (98.4ft)
C50 50m (164ft)

Accessory
X Not Required

Addition
X Not Required

S60W	H	CX	20	PX	XX	XX	M	TN20	C06	X	X

Accessories

FA2BB-4:	2” ANSI Polypropylene Flange for BSPT units
FA2NB-4:	2” ANSI Polypropylene Flange for NPT units
RAD-BRKT-U:	Single axis aiming bracket
HART-USB-M195:	HART modem for PC GoshawkII
HAWKLINK-USB:	Modbus communicator for PC GoshawkII

Frequency

• 60 GHz

Operating Voltage

• 4-20mA Versions: 24VDC (14 to 28 VDC), 14V @ 0Ohm 19V @ 250Ohm
• Compact Modbus Version: 5 - 30VDC at the terminal
• Residual ripple no greater than 100mV

Power Consumption

4-20mA Versions
• <500mW@ 24VDC

Compact Modbus Version
• Average <75mW
Peak During Measurement
• Bluetooth Enabled: 300mW
• Bluetooth Disabled: 250mW
Idle Power
• Bluetooth Enabled 25mW
• Bluetooth Disabled 17mW

Communications

• Modbus
• HAWKBTConnect App (Bluetooth), iOS & Android
• GoshawkII via Modbus
• HawkEye365 via Hawklink IoT

Bluetooth Range

Compact
• Line of sight: 25m
• No line of sight: 10m
Integral
• 10m

Blanking Distance

• 150 mm (5.9”)

Maximum Range

• 20m (65ft)

Resolution

• 1 mm (0.04”)

Accuracy

• +/- 2mm

Startup Time

• 4-20mA Versions: <35 seconds
• Compact Modbus Version: <5 seconds

Response Time

• <1 second

Sample Rate

• <1 second

Memory

• Non-volatile

Operating Temperature

• -40°C to +80°C

Beam Angle

• 10°

Enclosure Material

• PVDF

Enclosure Sealing

• IP67

Mounting

• 2” BSPT Thread
• 2” NPT Thread

Typical Weight

• 0.3kg (0.66lb)

Cable

• 4 core shielded
• 6m (19.7ft), 15m (49.2ft), 30m (98.4ft), 50m (164ft)

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Technical data subject to change without notice.