



Product Overview

The AX-UL-SON48 provides accurate, reliable level measurement for liquids and slurries. It is a loop powered, ultrasonic transmitter which operates from a 24-38V D.C. voltage, thus enabling the 4-20mA signal produced to transmit over relatively long distances.

See Install Guide or Programming Manual available separately.

Products Features

- Simple setup procedure saves commissioning time
- Low power consumption gives economical operation
- Polypropylene casing for increased chemical resistance

Product Specifications

Measuring Range:	0.4 to 8m
Output:	4-20mA (into 250ohms at 24Vdc or 850ohms at 38Vdc) (Tolerance ± 0.1 mA loop, LE ± 0.2 mA)
Loop Voltage:	24-38Vdc (reverse polarity protected)
Power Required:	0.5Watt at 24V
Resolution:	1mm
Accuracy:	0.25% of measuring range (electronic)
Display:	4 digits
Minimum Span:	100mm
Lost Echo:	User programmable 4, 20, 21mA or last valid reading
Temperature Compensation:	Built-in digital sensor
Ultrasonic Core Angle:	12°
Ultrasound Frequency:	50KHz $\pm 10\%$
Max Static Operating Pressure:	-0.25 to 2 bar at 20°C
Operating Temperature:	-10°C to +60°C
Weatherproof:	IP66
Gland Thread:	M20
Cable:	2 core screened cable or twisted pair (1.5m fitted as standard)
Connection:	2" B.S.P.
Materials:	Casing: Polypropylene (glass filled) Transducer Housing: UPVC
Mounting Bracket:	Swing type bracket

Product Order Codes

AX-UL-SON48 Ultrasonic Level Sensor, 4-20mA, 0.4 to 8m



Product Overview

The AX-UL-SON48 provides accurate, reliable level measurement for liquids and slurries. It is a loop powered, ultrasonic transmitter which operates from a 24-38V D.C. voltage, thus enabling the 4-20mA signal produced to transmit over relatively long distances.

Programming the AX-UL-SON48

After applying power to the AX-UL-SON48, allow up to 5 seconds for the unit to stabilise. Following this the LCD will briefly show the temperature in degrees centigrade and then a measurement in metres. Whilst displaying a measurement, the decimal point will flash on and off, indicating to the user that the unit is running ('run' mode). Approximately every minute thereafter, the LCD will briefly show the temperature. The mA output current is not affected whilst the temperature is displayed.

Once the vessel dimensions and liquid levels are known, the unit can be programmed by entering into programme mode. Once in programme mode, there are 3 basic operations in setting up the AX-UL-SON48;

1. Scaling the Level

(A) MANUAL Mode (B) AUTO Mode

Entering the 4mA and 20mA values in metres

2. Setting the Display

Configure the LCD to show the depth or distance in metres or as a percentage

3. Setting the Lost Echo

The transmitter sends out a burst of energy then waits for the reflected pulse. If there are no reflected pulses, the LCD will read 'LE' (Lost Echo). Under LE conditions the output current will be forced to '4mA', '20mA', '21mA' or 'Hold' the last good reading, user programmable. In applications where intermittent foam is prevalent the Hold option may be the preferred option. Where a loss of reflected echo is usual, then it will be application specific as to the best choice. 21mA is outside the normal range so can be used to identify a Lost Echo condition by external equipment.

Note

Pressing the M key will jump back a level, several presses and it will return to 'run' mode, indicated by a flashing decimal point.

Keeping a record of the programming values will ease programming should it need to be repeated or checked at a later date.

Scaling the 4mA level

(A) Setting up in MANUAL Mode

Operation	Display	Notes
Press M	XX:XX	Decimal point disappears, LCD characters freeze and the colon is fixed
Press ↑↓↑↓	Ent	LCD reads - - - - when ↑↓ keys pressed
Press E	4mA	This is the low level setting (depth mode)
Press E	X.XXX	Set the 4mA point. Use the ↑↓ arrows until you reach the desired number
Press E	donE 4mA	LCD reads 'done' momentarily, then 4mA. Manually chosen empty value is now stored to the memory
Press M	Ent	Leaving the Manual Mode set up
Press M	X X:XX	
Press M	X.XXX	Flashing decimal point indicates system is running

(B) Setting up in AUTO Mode

Operation	Display	Notes
Press M	XX:XX	Decimal point disappears, LCD characters freeze and the colon is fixed
Press ↑↓↑↓	Ent	LCD reads - - - - when ↑↓ keys pressed
Press ↑	Auto	Entering Auto set up
Press E	4mA	This is the low level setting (depth mode)
Press E	X.XXX	Decimal point starts flashing; the sensor will begin ticking. Ensure the vessel is empty. Wait until the LCD displays a correct, stable measurement before pressing Enter
Press E	donE 4mA	LCD reads 'done' momentarily, then 4mA. Automatic empty value is now stored to the memory
Press M	Ent	Leaving the Manual Mode set up
Press M	X X:XX	
Press M	X.XXX	Flashing decimal point indicates system is running

Scaling the 20mA level

(A) Setting up in MANUAL Mode

Operation	Display	Notes
Press M	XX:XX	Decimal point disappears, LCD characters freeze and the colon is fixed
Press ↑↓↑↓	Ent	LCD reads - - - - when ↑↓ keys pressed
Press E	4mA	
Press ↑	20mA	This is the high level setting (depth mode)
Press E	X.XXX	Set the 20mA point. Use the ↑↓ arrows until the desired number is reached
Press E	donE 4mA	LCD reads 'done' momentarily, then 20mA. Manually chosen value of full vessel level is now stored in the memory
Press M	Ent	Leaving the Manual set up
Press M	X X:XX	
Press M	X.XXX	Flashing decimal point indicates system is running

(B) Setting up in AUTO Mode

Operation	Display	Notes
Press M	XX:XX	Decimal point disappears, LCD characters freeze and the colon is fixed
Press ↑↓↑↓	Ent	LCD reads - - - - when ↑↓ keys pressed
Press ↑	Auto	Entering Auto set up
Press E	4mA	
Press ↑	20mA	This is the high level setting (depth mode)
Press E	X.XXX	Decimal point starts flashing; the sensor will begin ticking. Ensure the vessel is empty. Wait until the LCD displays a correct, stable measurement before pressing Enter
Press E	donE 4mA	LCD reads 'done' momentarily, then 20mA. Automatic full value is now stored to the memory
Press M	Ent	Leaving the Manual set up
Press M	X X:XX	
Press M	X.XXX	Flashing decimal point indicates system is running

Setting the Display

Metres or Percentage

Operation	Display	Notes
Press M	XX:XX	Decimal point disappears, LCD characters freeze and the colon is fixed
Press ↑↓↑↓	Ent	LCD reads - - - - when ↑↓ keys pressed
Press ↑	Auto	
Press ↑	diSP	Set up for Display options
Press E	dEP / dISt or PerC	Will set the display to either <ol style="list-style-type: none">1. Depth or Distance (not both ¹)2. Percentage
Press ↑	PerC	Use the ↑↓ to choose the desired setting
Press E	donE dEP	LCD reads 'done' momentarily, then whichever setting was chosen. The chosen setting is now stored to memory, e.g. Depth
Press M	diSP	Leaving the Display set up
Press M	X X:XX	
Press M	X.XXX	Flashing decimal point indicates system is running

¹ If the 4mA setting is set closer to the sensor face than the 20mA, the menu will give the option of distance (dISt) or percentage (PerC).

If the 20mA setting is set closer to the sensor face than the 4mA, the display will give the option of depth (dEP) or percentage (PerC).

Setting the Lost Echo (LE)

Operation	Display	Notes
Press M	XX:XX	Decimal point disappears, LCD characters freeze and the colon is fixed
Press ↑↓↑↓	Ent	
Press ↑	Auto	
Press ↑	diSP	
Press ↑	LE	Set up menu for Lost Echo
Press E	dEP / dISt or PerC	Will set the display to either <ol style="list-style-type: none">1. Depth or Distance (not both ¹)2. Percentage
Press ↑	PerC	Use the ↑↓ to choose the desired setting
Press E	donE dEP	LCD reads 'done' momentarily, then whichever setting was chosen. The chosen setting is now stored to memory, e.g. Depth
Press M	diSP	Leaving the Display set up
Press M	X X:XX	
Press M	X.XXX	Flashing decimal point indicates system is running

When the AX-UL-SON48 is operating normally, the LCD will have a flashing decimal point. If the decimal point is not flashing and the unit is not under or over range, the unit will not take any measurements.

If the LCD shows an over-range signal `----` or an under-range signal `----`, the liquid measurement is outside the range programmed by the user. This may or may not be a problem, if only a few millimetres it can be ignored. However, if it is several centimetres the user may wish to consider re-programming the unit.

This happens when vessels are filled or emptied slightly more than usual. If left with existing settings, the system will automatically resume normal operation when normal conditions return. This can be eliminated during programming by allowing for variations in the specific application.

Generation of 4, 20 and 21mA signals using the AX-UL-SON48

This additional software feature can be accessed from the main menu under 'SEnd' sub menu.

To help calibrate any externally connected equipment to the AX-UL-SON48 such as an ammeter or BMS system, the unit can be used to generate 4, 20 and 21mA signals via its keypad. This feature effectively simulates an empty or full vessel removing any need to physically empty and fill the vessel during commissioning. Additionally the AX-UL-SON48 can generate a 21mA signal to simulate the Lost Echo function. This feature is accessed from 'SEnd' in the main menu.

Operation	Display	Notes
Press M	XX:XX	Decimal point disappears, LCD characters freeze and the colon is fixed
Press $\uparrow\downarrow\uparrow\downarrow$	Ent	LCD reads - - - - when $\uparrow\downarrow$ keys pressed
Press \downarrow	SEnd	Sub-menu to access current calibrator
Press E	4mA	4mA is sent to the loop
Press \uparrow	20mA	20mA is sent to the loop
Press \uparrow	21mA	21mA is sent to the loop
Press M	SEnd	Exiting the calibrator mode
Press M	X X:XX	
Press M	X.XXX	Flashing decimal point indicates system is running

Note:

Both \uparrow and \downarrow keys can be used to alter mA sent to the loop, i.e. it rotates up and down through the sequence.

Remember to disconnect any external equipment, e.g. pumps, motors, alarms etc from the main controller if you do not want them to operate whilst in 'SEnd' mode.

IMPORTANT

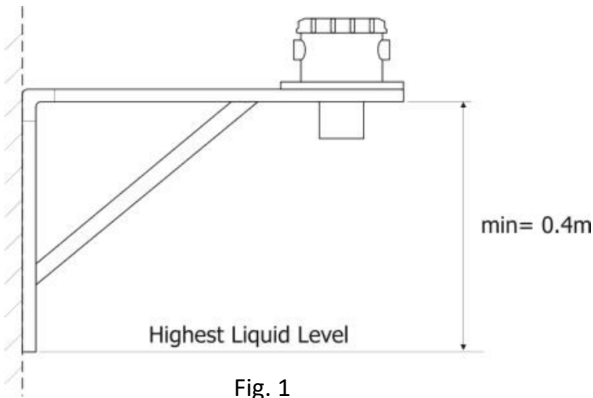
When scrolling through the menu options (LE, Display), the software allows the user to try the settings before committing to memory. For example if the Lost Echo has been stored as 20mA, but the user enters program mode and scrolls through the Lost Echo settings until 4mA is displayed, (Do Not Press Enter), then presses the 'M' key until the unit is back in 'RUN' mode, the unit will now drive to 4mA under Lost Echo conditions. This can be useful for diagnostic purposes or for temporarily driving external equipment to a different value than programmed. To resume the normal setting's return to the menu mode and leave it displaying the original setting or alternatively simply disconnect the power for a few seconds then re-apply the power.

Troubleshooting

Symptom	Cause	Action
Gives Lost Echo	Target out of range Application dusty or steamy Excess foam on liquid surface	Check system specification Check installation and vessel condition Re-locate the unit
Reading static when level changes	Unit processing wrong target	Move transducer to better location
No loop current output	Power failure	Check power supply and output to unit and load resistance isn't too high
Reading erratic False reading	Target unsteady Target within dead-band Fumes Electrical Noise Obstructions present Detecting the end of a guide tube or getting multiple echoes	Move transducer to better location Raise transducer >0.4m above top liquid level Check installation Check under target for obstruction, if guide pipe is used ensure it is clear
Reading ----- or -----	Target outside top or bottom liquid level, (outside the programmed values)	This may only be by a small amount, ~1mm, so check levels and re-calibrate system if necessary
Reading occasionally goes high when vessel is not full. Output current and LCD reading ramps up and down	Spurious echo detected Acoustic coupling to bracket Detecting the end of a stilling pipe or guide tube	Move transducer to better location Ensure the unit is not directly mounted to metal or that metal mounting bolts are not used Loosen nylon mounting bolts Use a foam gasket Alter guide tube arrangement
Failure to operate correctly at mid to high range current	Load resistance too great	Check load resistance isn't too high Check equipment connected in the loop
'Err' display on LCD whilst programming the 4mA & 20mA levels	4mA and 20mA levels are set too close	Re-calibrate unit so the range is >100mm
No measurement, LCD decimal point is stationary or stationary dash/digit on LCD	Unit is in Programme mode	Press the 'M' key repeatedly until the decimal point begins flashing

Installation Guide

The AX-UL-SON48 has a 'dead band' of 0.4m from its sensor face. Ensure that the highest liquid level does not enter this 'dead band'. Liquid closer than 0.4m will result in false measurements.

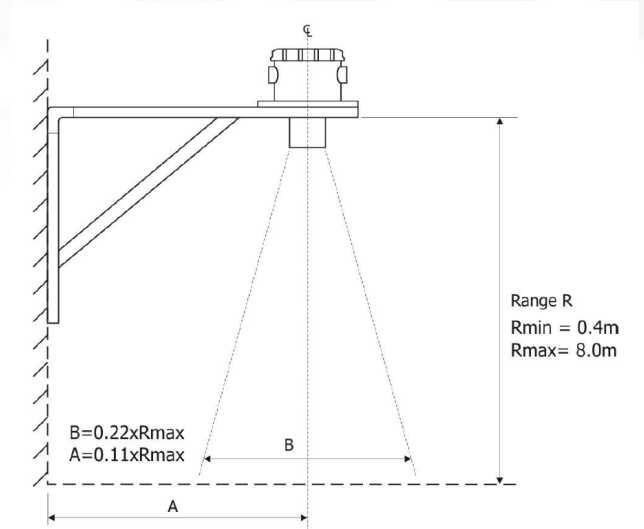


With the vessel empty ensure the signal path under the unit is clear of obstructions. Obstructions will provide return echoes and will be mistaken for the liquid level.

The AX-UL-SON48 has a beam angle of 12° to the half power point (3dB). The ultrasound is transmitted from the sensor in a cone shape, this inclusive cone shaped area must be clear of obstruction otherwise the sensor will receive echoes from the obstructions and not the liquid. The total beam coverage area can be calculated as shown in Fig 2 as measurement 'B'. Even small obstructions such as small diameter pipes, seams and protrusions can generate strong 'false' echoes.

If the ultrasonic signal overlaps the inside wall of the vessel the echo will still be valid but of a lower amplitude, however problems arise when the internal vessel wall is not smooth, it is advisable to mount so the beam does not overlap the vessel wall, see Fig 2. To avoid false echoes from the side wall or other obstructions the ultrasonic sensor should be mounted at least 0.11m per metre of maximum range away from the obstruction, measured from the centre line of the unit, see Fig 2 measurement 'A'. If this is not possible it may still be possible to obtain good measurements provided the liquid has a good reflective surface but there must always be a minimum spacing of 0.4m from the sensor to the tank wall.

It is important to visually inspect the vessel whilst empty to ensure there are no obstructions (i.e. pumps or stirrers) that would be unnoticeable when the vessel is full. If obstructions can't be avoided consider using a 'stilling pipe'.



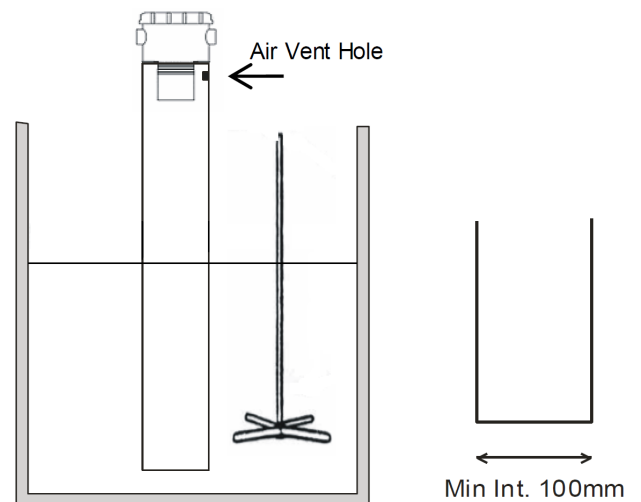
Using a Stilling Pipe

A stilling pipe can be used to overcome foaming liquids and obstructions which otherwise would be sensed by the AX-UL-SON48.

It is important that the internal wall of the stilling pipe is smooth and free from seams and protrusions.

When foam is present it is preferable that the end of the stilling pipe is never allowed to become uncovered thus preventing foam from entering the pipe. Where a stilling pipe is used to avoid an obstruction, the pipe must be at a lower level than the obstruction.

Stilling pipes can be used in clean liquids only as dirty liquids will contaminate the inside of the well. The pipe should have a minimum internal diameter of 100mm, and an air vent hole drilled at the top to relieve the pressure built up in the pipe as it fills with liquid.



Where possible always mount via a plastic fitting or other synthetic material, try to avoid mounting directly to a metal surface. Always use the supplied gasket between the body of the unit and the fitting.

Ensure there are no aggressive substances i.e. acidic liquids, vapours or gasses in the application that may attack the enclosure materials or PVC sensor.

Take care not to mount the AX-UL-SON48 over any inlet as incoming liquid will be sensed by the unit, resulting in a false reading.

Do not use the AX-UL-SON48 where condensation is present, as it may collect on the sensor and cause errors.

If the unit is mounted in an enclosed tank, do not mount the instrument in the centre of the tank as dished tank ceilings can act as parabolic reflectors. This means that the transducer will be the focal point and will receive amplified false echoes. It is usual to mount at about $\frac{1}{2}$ vessel radius from the centre.

Ultrasonic transmitters do not work well when foam is present, as it attenuates the ultrasound thus preventing a reasonable echo returning to the sensor. If foam is present, and it is not possible to avoid, then a 'stilling pipe' should be used.

Turbulence and splashing can result in erratic readings; if this cannot be avoided consider using a 'stilling' pipe.

Environments exposed to direct sunlight for long periods generate very hot surfaces; if the product is likely to be exposed to these conditions use a sun screen.

Environments exposed to rain or jet wash cleaning may increase the chance of liquid entering the product causing malfunction. Avoid this by fitting a rain/water shield. Always fit the products screw on top cap.

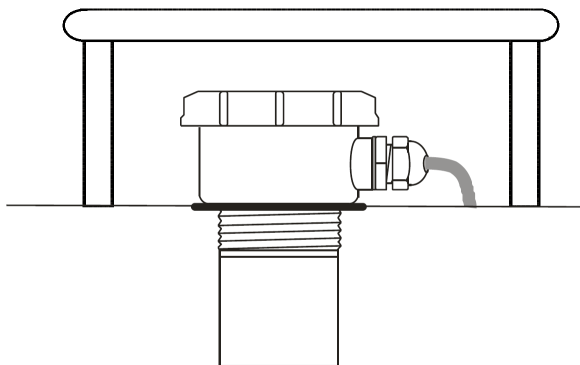


Fig. 4

Liquids will track along a downward going cable. To prevent liquid entering the product via its cable gland ensure a tight connection and always check the cable exiting the gland is in a general downward direction. Do

not put pressure on the cable where it exits the gland. Do not make sharp bends in the cable.

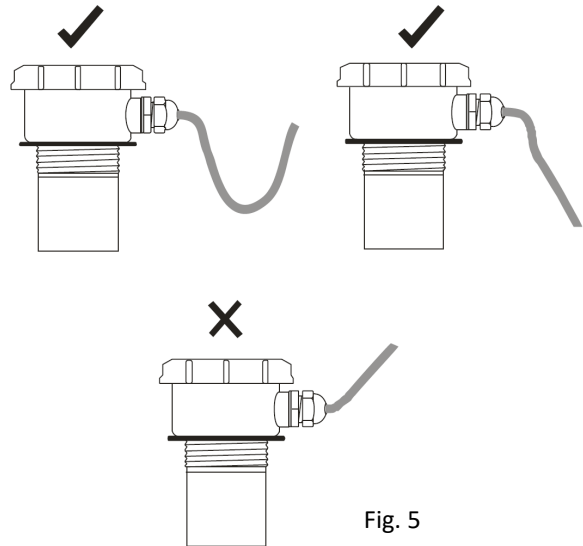


Fig. 5

If the vessel is being totally filled the 0.4m clearance requirement can be obtained by using a 'stand off' pipe, this moves the physical position of the AX-UL-SON48 above the vessel.

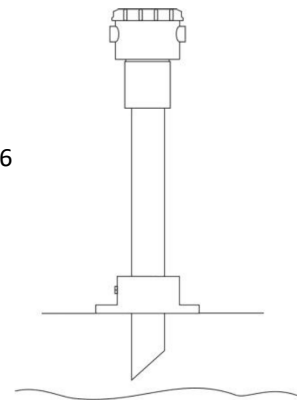


Fig. 6

When using a 'stand off' pipe, the following recommendations must be observed;

- Must be completely smooth inside with no seams or protrusions.

- Recommended minimum 100mm internal diameter

- End of pipe must be cut off at a 45° angle

- The maximum length is 0.5m

- Drill a small diameter hole at top of pipe to let any trapped air escape

Mounting

It is essential to mount the unit correctly to ensure reliable operation.

Metal nuts and bolts should not be used to fasten the AX-UL-SON48 to a vessel or mounting bracket as it may cause unwanted 'ringing' resulting in erratic operation, most often seen as the output current and LCD reading ramping up and down. The unit should be screwed into an intermediate non-metallic fitting. PTFE tape can be used on the thread if necessary and hand tight is sufficient, be careful not to over tighten.

Always ensure the sensor is perpendicular to the liquid surface to ensure the best possible quality of echo.

Electrical Connection

The AX-UL-SON48 has only 2 electrical connections these are +VDC and -VDC, which connect to the power supply.

The output current that represents the level in the vessel can be monitored in series with either of these leads.

Scaling The Level For Depth or Distance

Setting the values representing the lower and upper levels of the liquid can be carried out manually if the parameters are known; otherwise it may be necessary to fill and empty the vessel to calibrate in auto mode.

If the 4mA point is programmed closer to the sensor face than the 20mA point the display will show in distance. If the 20mA is programmed closer to the sensor face than the 4mA setting the display will show depth. Either depth or distance can be expressed as a percentage which is software programmable.

The AX-UL-SON48 measurement is always from the transmitter sensor face to the liquid. Depth is calculated

in software by subtracting the distance to the liquid from the user programmed maximum depth.

Datasheet Contents

Every effort has been taken in the production of this data sheet to ensure accuracy. Annicom do not accept responsibility for any damage, expense, injury, loss or consequential loss resulting from any errors or omissions. Annicom has a policy of continuous improvement and reserves the right to change this specification without notice.

