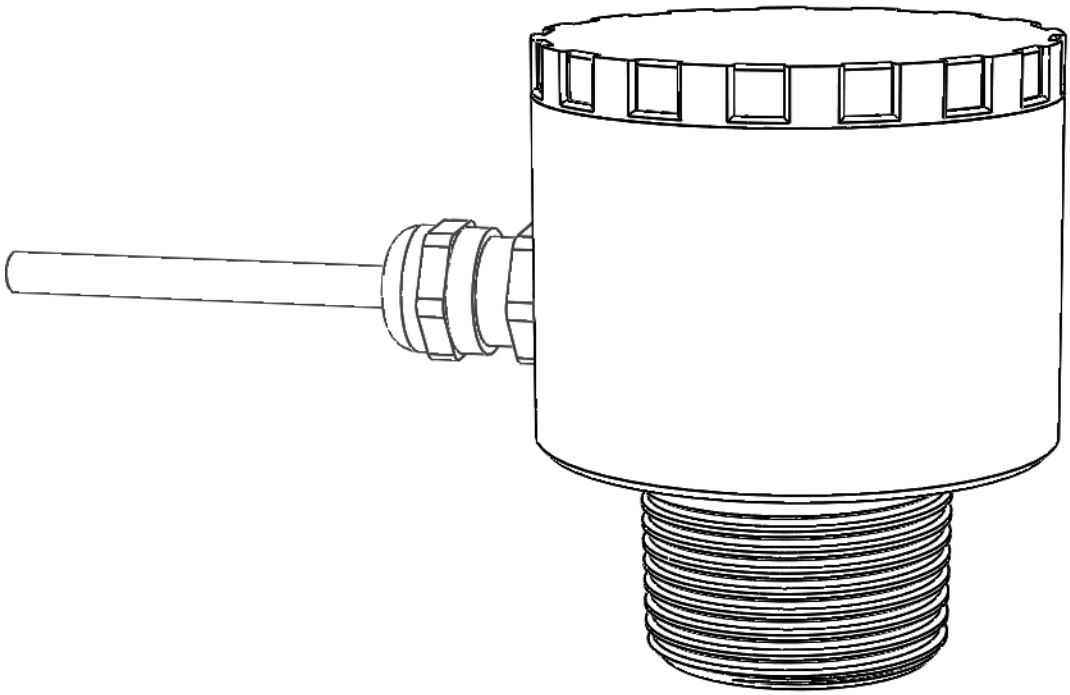
Quick Start

Ultrasonic Level Sensor
109671 Rev 1.16
Released: 06/2023



SAFETY INSTRUCTIONS

PLEASE READ THE ENTIRE MANUAL PRIOR TO INSTALLION OR USE OF THIS PRODUCT. Ensure that the product is suitable for your application without any restrictions.

Check the chemically compatibility of the product materials with the application liquids.

The sensor will not properly operate if fluid is present at sensor bottom. Ensure fluid does not enter minimum operating distance through proper mounting.

Use a proper sealant when installing the ULS. Never over tighten the sensor within the fitting (15 inlb to 20 inlb). Always check for leaks prior to startup.

A supply voltage of 10–30 VDC is used to power the sensor. The supply voltage should never exceed a maximum of 30 VDC. Electrical wiring of the sensor should be performed in accordance with all applicable national, provincial/state and local codes.

The sensor is designed to be used in application temperatures from 14 °F to 140 °F (-10 °C to 60 °C) and at atmospheric pressures.

The ULTRASONIC LEVEL SENSOR should **not** be used within classified hazardous environments.

Design a fail-safe system that accounts for the possibility of sensor or power failure. In critical applications, Anfield Sensors Inc. recommends the use of redundant backup systems and alarms in addition to the ULS.

The responsibility whether the measurement device is suitable for the respective application lies with the operator. The manufacturer assumes no liability for consequence of misuse by the operator. Improper installation and use of device results in loss of warranty claims.

Introduction

WARNING

Read the *Safety Instructions* in this document for product warning and important information.

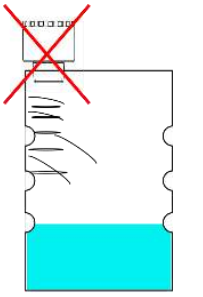
If you run into issues that are not addressed in the manual, please consult with your sales representative.

Getting Started

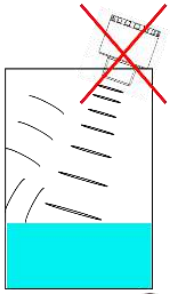
When using the device, you should thoroughly read through all the quick start to understand how to properly locate the sensor mount, install and mount the device, and operate the device.

Positioning the ULS

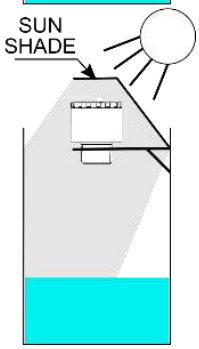
For ease of operation, install the ULS in such a way to avoid the following issues. If not possible a stilling well may resolve some positioning issues.



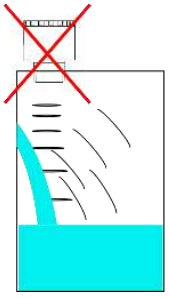
Avoid tank interference by placing the ULS away from the sides. **A distance of 10" away from tank wall is suggested for the sensor's maximum operating distance. See Beam Spread Data for smaller operating distances.**



Do not mount sensor at an angle. The sensor ideally should be mounted so that the axis of the port is perpendicular to the fluid. **It can accommodate a slight angle of up to ±3° from perpendicular.**



Do not expose the sensor to direct sunlight or localized heat. The level sensor cannot compensate for localized heating of the transducer which will cause measurement errors. **If sensor will be exposed to direct sunlight, use a radiant barrier. A radiant barrier is ideally thin, reflective and low emittance surface.**



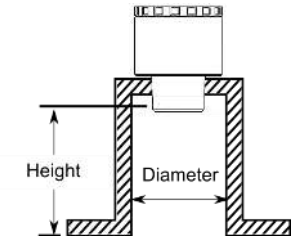
Do not mount the sensor close to obstructions or in-feeds. The obstructions or in feed may interfere with the level causing incorrect readings.

Risers

CAUTION

Fluid level should never enter the sensor deadband, or minimum distance. If the fluid level enters the deadband, the level sensor will measure incorrectly.

If your tank needs to be fully filled and the fluid will enter the sensor deadband, then the sensor needs to be mounted on a riser. The inner rim of the riser needs to be smooth, free of burrs and it needs to follows the dimensions listed in the table below.

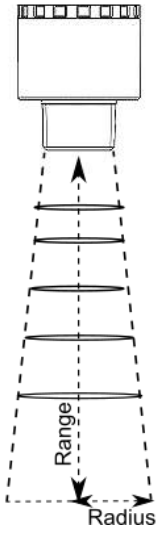


Inner Diameter	Maximum Standpipe Height
2 " (5 cm)	4" (10 cm)
4 " (10 cm)	8" (20 cm)
6 " (15 cm)	12" (30 cm)

Beam Spread Data

The following table indicates the suggested distance the sensor should be mounted away from obstruction and tank walls to avoid interface.

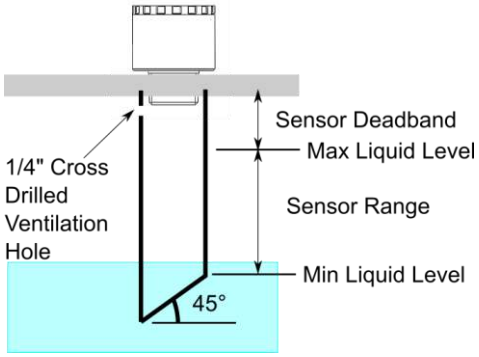
Maximum Operating Distance		Beam Radius	
[feet]	[cm]	[inch]	[cm]
0.33	10	1	2.5
0.66	20	1.4	3.6
1	30	2	5.1
2	61	3.5	8.89
3	91	5	12.7
4	122	6.5	16.5
5	152	8	20.3
6	183	9.5	24.1
6.56	200	10	25.4



Stilling Well

A stilling well eases the positioning requirements of the mount. It can be near a tank wall, at an angle, reduce sloshing noise and ensures obstructions do not interfere with the sensor.

The Ø2" ID stilling well should have a Ø1/4"cross drilled ventilation hole within the sensor deadband. If pipe bottom will be above the liquid surface, a 45° cut at the bottom is needed.



Mounting the ULS

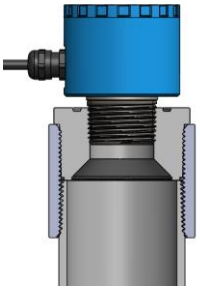
CAUTION

The ULS should ONLY be finger-tight (15 inlb to 20 inlb). Over-tightening of the sensor can cause sensor errors and will void warranty.

For optimal performance, the sensor should use one of the following mounts as threading directly into a metal fitting can cause noise issues. If you must mount into a metal fitting, use plenty of Teflon tape to isolate the sensor from the fitting.

Isolation Mount

The isolation mount, P/N: ULS-TM3216, provides excellent isolation between a metal fitting and the sensor. The isolation mount can be threaded directly into a 2” NPT adaptor or it can thread into a pipe adaptor to threaded pipe, see image to the right.



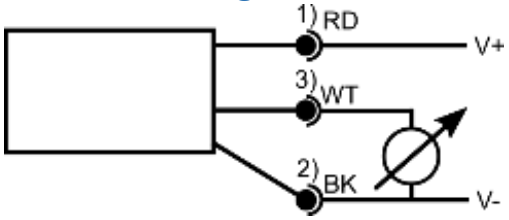
Flange Mount

The flange mount isolation fitting, P/N: ULS-FM16, uses a 4 bolt circle pattern at 3.125” [79.4 mm] and is used in mounting the ULS to a tank. Flange gaskets are available for the mount, see image to the right.

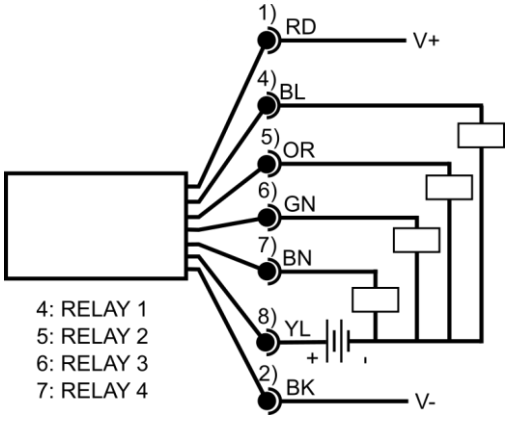
Wiring

NOTE: If your sensor does not include all features, please terminate unused wires.

Current Mode Wiring

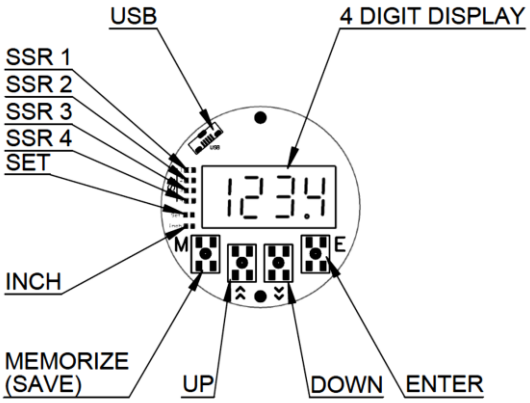


Relay Mode Wiring



Sensor Configuration

Operating and Display



M	Memorize	1	SSR1 Make Status LED
^^	Up	2	SSR2 Make Status LED
vv	Down	3	SSR3 Make Status LED
E	Enter	4	SSR4 Make Status LED
		Set	Settings Mode LED
		Inch	Inch Mode LED
		USB	USB Communication Port

Reading the Display

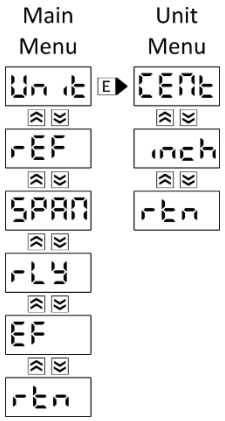
The 4 digit display indicates the current measurement or a parameter setting or parameter value.

1. If display is off, press any button to turn it on.
   - The measurement will be displayed using the current units.
   - [LOSS] indicates the ultrasonic echo was not received and may be a result of improper positioning, mounting or over-tightening.
   - [UL] indicates echo was received but measurement value is less than the minimum operating distance.
   - [OL] indicates echo was received but measurement was greater than max range of sensor.
2. To enter main menu, press E.

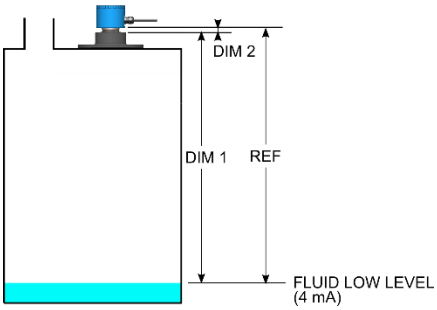
NOTE: Display will turn off after 120 seconds of inactivity. Menu will exit after 30 seconds of inactivity.

Setting up the Units

1. From the main menu, select Unit by pressing [E].
   - The current unit setting will be displayed.
2. Press [Up] or [Down] to select between metric [cent] and imperial [inch].
3. Select the desired unit by pressing [E] or select [rtn] to keep the old setting.



Setting up the Reference

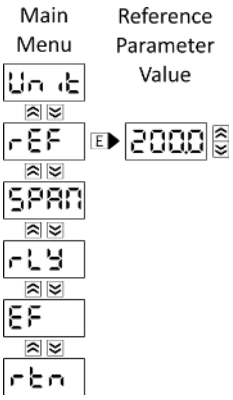


The zero reference setting, or the 4 mA output level, is required for sensor operation. To get an accurate zero reference, you will need to determine two dimensions: the fluid low level to the top of the mount (DIM 1), and a measurement from the top to the mount to the bottom of the ULS enclosure (DIM 2).

Once reference is calculated, adjust the reference setting by doing the following sequence:

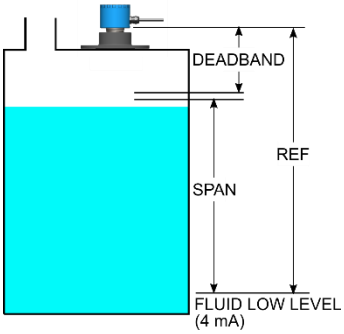
1. From main menu, select [ref] by pressing [E].
2. Adjust the reference parameter [Up] or [Down]
3. Press [E] or wait for menu exit parameter setting.

NOTE: Reference range: 5.4" – 79.25" [13.8 cm – 201.3 cm].



Setting up the Span

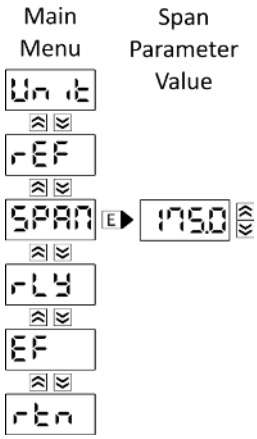
The span setting is the maximum fluid level or the 20 mA level. It uses the fluid low level, or ref, as a zero reference point. The span must be a positive number and cannot go into the deadband, or minimum operating distance, of the sensor.



To set the span using push buttons, follow this sequence:

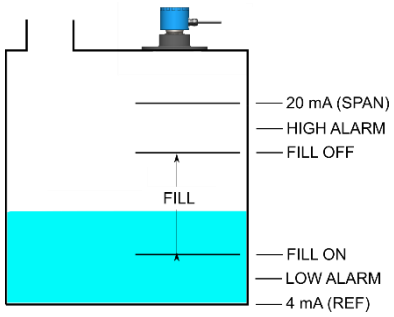
1. From main menu, select [SPAN] by pressing [E].
2. Adjust the span parameter value by pressing [Up] or [Down]
3. Press [E] or wait for menu exit parameter setting.

NOTE: Max Span equals ref - deadband



Setting up the Relays

The following list defines the common relay configurations for the level sensor:

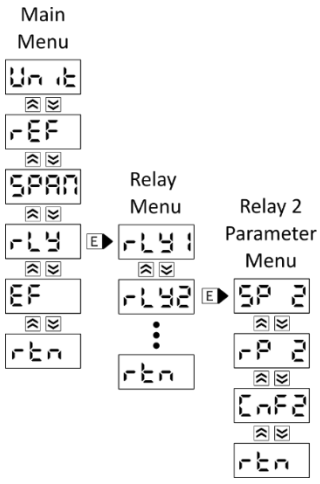


- **High Alarm** is on when the tank is full and turns off after the level drops. For a level sensor when the level rises past the rising level set point value, the electrical connection is made and the high alarm is ON. The relay will de-energize (OFF) when levels falls below the reset value and the high alarm turns OFF. It is in a normally open (NO) configuration.
- **Low Alarm** is the opposite of the high alarm relay. It is a NC configuration and it remains connected (ON) until the level rises above a set point value, which breaks the circuit (OFF). When the level falls below the falling level set point value, the switch connects the circuit (ON) again.
- **Fill** operations are used when the tank level is approaching empty. For a level sensor, the relay is set to a normally closed (NC) configuration. The circuit remains connected (ON) until the level reaches the fill off value, which breaks the circuit (OFF). When the level falls below the falling value, the relay returns to normally closed which makes the circuit (ON). This remains ON until the level again reaches the set point value.
- **Drain** is opposite of the fill operation. The relay is in the NO configuration. It makes the circuit (ON) when the level reaches the high point and is broken when the level reaches below the low setting.

NOTE: Relay settings are only available with select models. All relays are referenced to zero, or REF setting. If adjusting to a distance measurement mode , do so before setting relays

For example, to set the relay 2 settings using push buttons, follow this sequence:

1. From main menu, select [rly] by pressing [E] to enter the relay menu.
2. Scroll and select [rly2] to enter relay 2 parameter menu.
3. To adjust the set point distance for relay 2, press [E] on [SP 2].
4. The display will show the distance from reference that the switch will change state.



5. Press [Up] or [Down] to adjust set point 2 settings.
6. Press [E] to exit the relay 2 set point settings.
7. Press [Up] or [Down] until you see [rP 2] for reset point.
8. To adjust the reset point, press [E] on [rp 2]
9. The display will show the distance from reference that the switch will change state.
10. To adjust the switch configuration, Press [Up] or [Down] until you see [Cnf2] for switch configuration 2 and press [E].
11. Press [Up] or [Down] to change the switch configuration.
    - The switch configuration options are normally closed [NC], normally open [NO], or turn off relay [OFF].

Switching the Measurement Mode

The sensor allows changes to the measurement mode. The following commands will change from a height/level measurement mode (default) to distance measurement mode.

NOTE: All relays will be turned off when switching between modes. As well, when switching to distance mode the span will become 4mA and reference will be 20 mA.

To set the sensor to height or level measurement mode, follow this sequence:

1. From main menu, select extended functions [EF] by pressing [E].
2. Scroll to [Flip] and select to adjust measurement mode parameter.
3. Select between height/level mode and distance measurement mode and press [E].

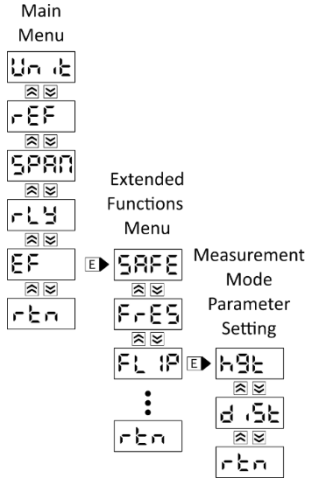
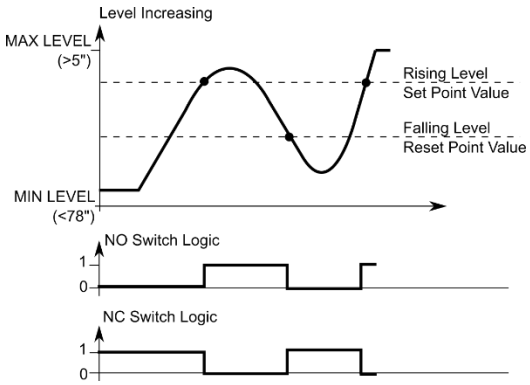


Table 1 and 2 describe the most common relay configurations for both level measurement and distance measurement modes.

Height Mode/Level Measurement

Table 1: Height Mode/Level Measurement Relay Configuration

Relay Configuration	Switch Configuration
High Alarm	Normally Open (NO)
Fill	Normally Closed (NC)
Drain	Normally Open (NO)
Low Alarm	Normally Closed (NC)

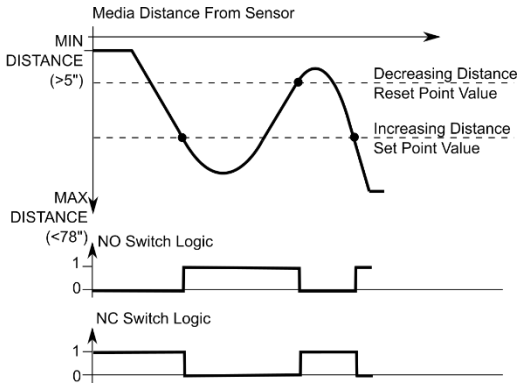


NOTE ON ANALOG OUTPUT FOR HEIGHT/LEVEL MEASUREMENT
When level measured is 0, the current output is 4 mA.
When level measured = SPAN, the current output is 20 mA.

Distance Measurement Mode

Table 2: Distance Measurement Relay Configuration

Relay Configuration	Switch Configuration
High Alarm	Normally Closed (NC)
Fill	Normally Open (NO)
Drain	Normally Closed (NC)
Low Alarm	Normally Open (NO)



NOTE ON ANALOG OUTPUT FOR DISTANCE MEASUREMENT
When distance measured = REF-SPAN, the output is 4 mA.
When distance measured = REF, the output is 20 mA.

Saving to Flash Memory

The parameters configured through pushbutton programming are retained in temporary memory which will be forgotten next power cycle. To save settings to permanent memory, you must save to flash memory.

1. To save settings to memory, press and hold [M] for 5 seconds.
    - The display will flash [EEPr] when saving.

NOTE: Saving to memory will overwrite all settings with current settings.

Specifications

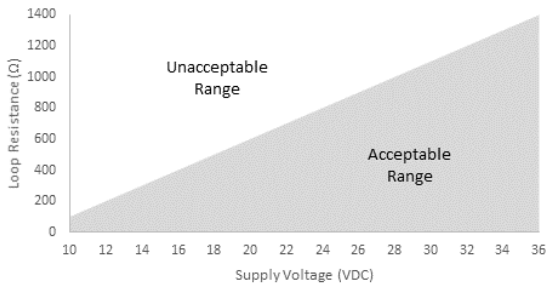
Minimum Operating Distance[1]	6.22” (15.8 cm)
Maximum Operating Distance[1]	82.68” (2.100 m)
Sensing Accuracy[2]	0.5% of maximum operating distance (perpendicular to surface)
Sensing Resolution	0.027” (0.67 mm)
Temperature Error[3]	2%
Beam angle	12° ± 2°
Deadband[1]	5.12” (13 cm)
Ultrasonic frequency	112 kHz ± 4.5 kHz
User interface	Field adjustable (push buttons and display), Software adjustable (Windows with USB connection)
Display Resolution	0.01 inch (0.1 cm)
Memory	Non-volatile
Supply voltage	10 – 30 VDC (100 mA maximum)
Maximum power consumption	1.2 W
Analog output	4-20 mA (error rate < 0.5%)
Signal fail-safe	2 mA , 4 mA, 20 mA, 22 mA or hold last
Hysteresis	Adjustable
Contact type	(4) NO SPST relays (48 V_{DC} 0.2 A peak load current)
Contact fail safe	Power loss: open
Ambient temperature	14 °F to 140 °F (-10 °C to 60 °C)
Enclosure rating	IP 65
Enclosure material	Powder coated aluminum
Transducer material	Glass reinforced epoxy
Cable jacket material	PVC
Cable type	8-conductor, shielded
Process connection	1” NPT (stainless steel)
Tightening torque	15 inlb to 20 inlb

[1] - Operating distances referenced from bottom of enclosure. Deadband referenced from sensor bottom.

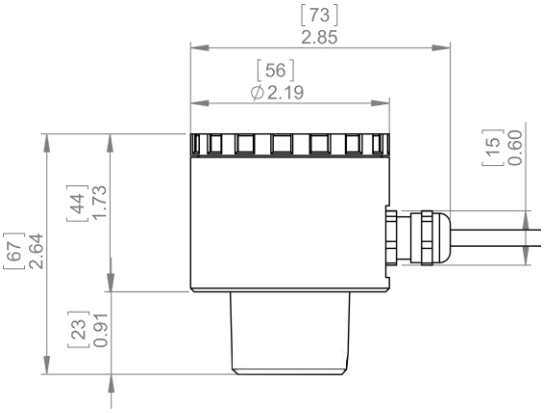
[2] - Accuracy specification in stable homogeneous standard environment (affected by temperature gradients, vapors, supply voltage).

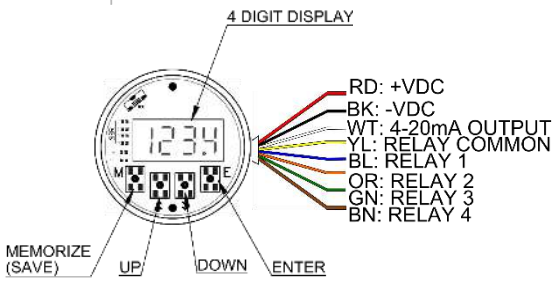
[3] - Thermal error specification defined for supply voltage of 12V and 24V. Error may be larger for other voltage inputs or due to localized heating of tank or sensor.

ULS 4 to 20 mA Electrical Loading Limits



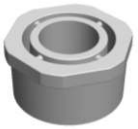
Dimensions





Fittings

For the best performance, install the ULS with the following recommended fittings.

	P/N	Description
	ULS-TM3216	2” NPT x 1” NPT, PVC, Schedule 40
	ULS-FM16	FLANGE CL150 PVC, SCHEDULE 80

Default Factory Settings[4]

Setting		Description
unit	cent	Centimeter setting
rEF	2050	Max range
SPAN	1900	Max span
rLY	Off and at 0	All relays off and at 0 for safety
SAFE	A1	2 mA fail safe analog output[4]
FL IP	hgt	Height Mode/Level Sensing
PASS	FLAT	Tight pass band filter[4]
F ILt	FASt	9 samples filter (3 seconds window)[4]
rdAP	rFST	Fast relay flipping (500 ms delay)
dc	12dc	Supply voltage of 12 V[4]

[4] - Settings selected for best performance