

FLX
Level / Flow
Sensor

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1. Introduction

FLX is used to measure level and flow in open channels in water treatment plants and applications.

2. A few words about this manual

This manual details installation procedures and operational features of the Flow sensors. Menu navigation and technical data for the BB2 control box can be found in the BB2 service manual.

3. Design

The FLX sensor is manufactured in SIS2343 (316SS) stainless steel and PVC. The sensor is mounted using PVC clamps. An adjustable stainless steel slide rail mounting assembly is available as an option.

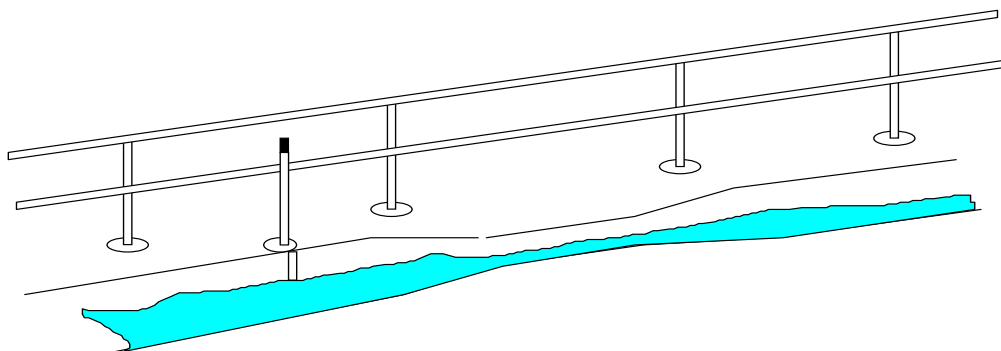
The sensor has a fixed, shielded 5 m (16') ventilated cable connecting the sensor to a ventilated junction box. A second 10 m (33') cable fixed to the junction box connects junction box and the BB2 control box.

4. Measuring principle

The FLX uses a pressure sensor to measure flow as a function of the level of the liquid in open channels. Different types of standardized weirs or flumes are used to achieve measurable rates of flow. The characteristics of these weirs and flumes are documented in a number of publications. Since this manual primarily describes the FLX, we will not provide in-depth descriptions of weirs or flumes, but refer to the sources listed below.

Most flumes and weirs can be bought directly from a supplier as a prefabricated product (assembled or partially assembled). It is also possible to construct flumes or weirs yourself. If you do, it is very important to follow the prescribed recommendations.

In order to achieve accuracy in measuring flows in open channels the correct installation of the flumes and weirs is crucial. Always follow the installation instructions. An improper installation may easily lead to a measuring error of 25% or more.



The central unit BB2 has built-in mathematical formulas for most flumes and weirs. When starting up, select the correct flume/weir and enter the specific parameters for that flume/weir. This primarily concerns actual dimensions.

All settings are made in the BB2 by using self-instructing menus controlled by just three keys. Metric or US units can be chosen. The output signals are frozen when the menus are open in order to avoid problems, e.g during calibration. BB2 provides two 4-20mA

outputs and two relay outputs for an external totalizer and for the built-in batcher, for controlling sampling.

The flow is presented continuously in a display window. By simultaneously pressing two keys the current water level as well as the internal totalizer value are displayed. The temperature is measured by the transmitter to be used for temperature compensation of the measured value. It can be read in the BB2 box, and like the level be used as secondary value when a transmitter is configured to use both analog outputs of the BB2. The temperature is not a precision measurement, but shall be seen as an indication

In-depth descriptions of weirs or flumes:

- ISO Standards Handbook 16, 1983.
- Water Measurement Manual - US Department of the Interior, Bureau of Reclamation, Denver, Colorado, USA, 1974.
- Parshall, R.L: Measuring water in irrigation channels with parshall flumes and small weirs. Soil conservation circular no 843, US Department of Agriculture, May 1950.

5. Unpacking the Sensor

The unit has been tested and approved before delivery from the supplier. Please check to confirm that no visible damages occurred during shipment.

Damages

If damages occurred during shipment, immediately contact UPS or other truck line as well as your Cerlic representative. The shipment can be returned only after contact has been made with Cerlic.

Packaging

The original packaging is designed to protect the equipment and should be used for storage or if the goods must be returned.

Content

Please check that the content corresponds to your order and packing list.

Every shipment should include:

- Sensor with 5 m (16') ventilated cable, a junction box and 10 m (33') signal cable.

Optional parts for FLX:

	P/N
• Slide rail for 28 mm Sensors	11205264
• 10m (33 ft.) extension cable with plug-in connectors.	20805510
• Y-Splitter for two sensors to one BB2 control box	21505534
• Connection box for two sensors to one BB2 control box with 1m (3 ft.) cable to connect to BB2	1505748
• Connection box for four sensors to one BB2 control box with 1m (3 ft.) cable to connect to BB2	11505785

6. Mounting

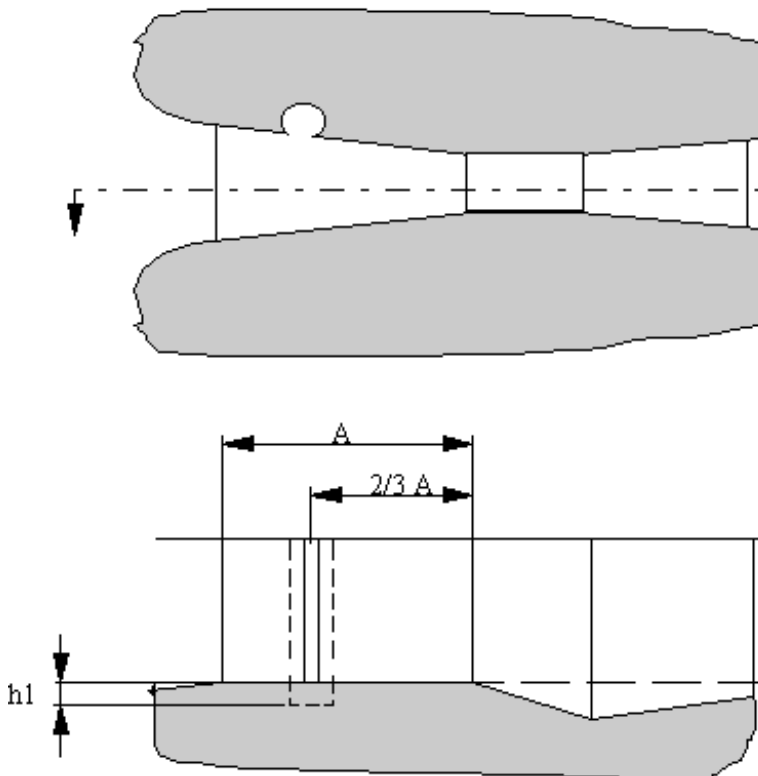
The sensor must be mounted perpendicular to the horizontal plane to measure accurately. It must be firmly mounted. From a maintenance and service point of view, it is advisable to mount it in such a manner that removal for inspection and cleaning is easy. It is important that the sensor, once it has been removed, is re-positioned at the right height. An adjustable slide rail mounting is available as an option. In strong current, hydrodynamic effects may influence the measurement; contact Cerlic service for advice on current protection if problems occur.

CAUTION!

**The sensor is fragile!!
Never drop a sensor on a hard surface!!**

Mounting a Sensor in a Flume

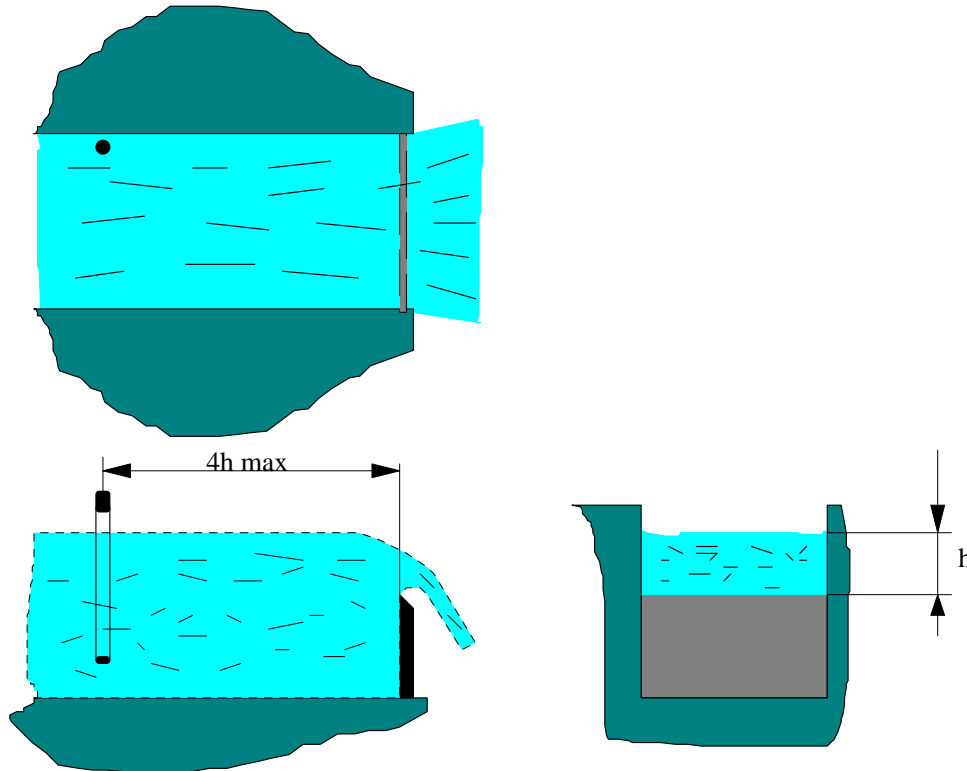
In flumes (Parshall/Venturi/Palmer-Bowlus), the sensor should be mounted in a measuring well. This is done to avoid sensor interference with the flow profile in the flume. Prefabricated flumes often have measuring wells as a standard feature, but this should be verified. Existing concrete flumes without a measuring well can almost always be retrofitted with one. One method would be to use a diamond-tipped hole saw to drill a hole in the side of the flume near the flume's edge, so that an opening is created between the drilled hole and the flume. Whenever possible the measuring well should be 50 mm (2") deeper than the highest part of the flume's bottom. (Refer to h1 on the illustration below.)



Sensor placement in a Parshall flume

Mounting a Sensor in a Weir

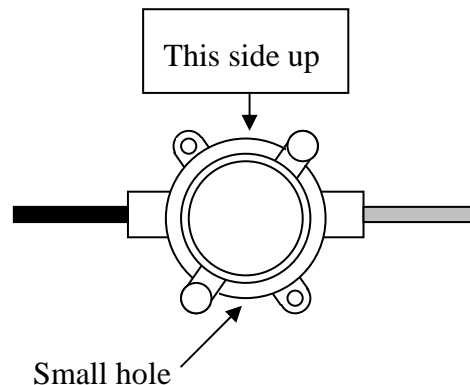
In a weir, the sensor should be placed at 4 times the maximum measuring height upstream from the overflow edge. If possible, measuring in a measuring well is preferably. However, this is not strictly necessary since the sensor ends up so far from the overflow that its interference with the flow profile is negligible.



Sensor placement when using a rectangular weir

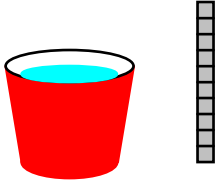
Electrical Connection

Connect the sensor to the BB2 central unit using the attached cable. The cable from the sensor to the junction box is ventilated to enable the sensor to compensate for changes in the atmospheric pressure. **The junction box has a small hole to let the air in and out, make sure to mount the junction box so this hole is pointing downwards.** If needed, the signal cable from the junction box to the BB2 can be extended using extension cables. Several sensors can be connected to one BB2 using Y-splitter or junction box. See “Technical description” for details.






Starting Up

Fill a bucket with approximately 25cm (10") water.



Connect the sensor to the BB2, let BB2 find the sensor, and select the slot to be used.

Select the sensor in the Measure display using  or .

Press  and ENTER at the same time to get the FLX info display.

If the sensor is held vertically in the air the level shall read zero (or close to zero). The FLX is pre-set at the factory, but sometimes the zero point still needs adjustment. (Refer "Adjusting the zero point"). NOTE, if an offset is entered in the sensors setting menu, the level shows the value of the offset instead of zero.

Carefully lower the sensor into the bucket until the sensor rests on the bottom of the bucket. Use the ruler and measure the water level. The level shall be 12 mm (1/2") more than the meter shows. The difference is the distance from the bottom of the sensor to the top of the holes where the pressure is measured. NOTE! If an offset is entered in the sensors setting menu, the meter adds the value of the offset to the measured level. That is, if an offset of 12 mm (1/2") is entered the sensor shows the total water level in the bucket.

If both the zero and the level is OK, the sensor is ready for use.

If they are not, please refer to the service and maintenance part of the manual.

7. Removing the sensor


The sensor is removed in the following steps:

- Disconnect the sensor cable from the BB2.
- Dismount the sensor.
- Clean the sensor with a brush or clean cloth. Do not use a wire brush!
- Mount the protective cap (or a small plastic bag) on the sensor cable connector.

If the sensor needs cleaning, use warm water and a bottle brush to clean the measure cell; do not use a metallic brush or sharp tools.

The sensor housing may not be opened except by Cerlic service personnel. Opening the sensor housing will void all warranty.

8. Maintenance

All sensors age, which eventually leads to inaccurate measurements. Check the sensor's zero point about once every six months by lifting the sensor into the air and observing the level the FLX registers. The level is shown in the sensors info display (opened by simultaneously pressing  and ENTER). If the sensor is held vertically in air, the sensor should give the same level as the offset level in the menu.


If it does not, you should calibrate the zero point. (See section "Calibration")

Incorrect Measurement



If the sensor gives incorrect measurements even though the zero point has been calibrated, the sensor may need a level calibration. A description of how to do this can be found in the section "Calibration"

If the sensor is mounted in a strong current, an under pressure may form around the sensor. This will lead to a faulty measurement. The easiest way to avoid this type of problem is to mount a tube around the sensor in order to form a calm measuring well. The tube may rest on the bottom of the flume, but there must be some holes below the surface of the fluid in order to get the same level in the tube as in the flume.

9. Sensor display

By simultaneously pressing  and ENTER you alter between BB2 main menu and the sensor information display for the selected sensor. On the sensor information page FLX shows in addition to the measured value, the current level, the totalizer, and the number of overflows.

10. Menu for FLX sensor

Use  or  to select the sensor in the main display. The menu for the selected sensor is accessed by pressing ENTER for five seconds. If the selected sensor is not active (the text **No transmitter** is shown) a warning is displayed that asks you to make another choice in order to show the sensor menu.

Settings

Tag	Name of the sensor (10 characters) shown in the main display.
Flume	"Parshall", "Thompson", "Rect. wier", "RWC", "P & B", "Cipoletti", "Sutro", "Venturi" or "Venturi U". One or more parameter questions will follow the choice of flume. The Flume selection is ignored when unit "mm" or "Inch" is used below.
# Flumes	0-255, the number of parallel flumes.
I-Time	Integration time or dampening - can be set up to 999 seconds
Unit	"Inch", "MGD", "GPH" or "GPS" if US units are used, "mm", "m ³ /h", "m ³ /s" or "l/s" if metric units are used.
Preset	0-9999.9, volume, in kilo Gallon if US units are used, or m3 if metric units are used, to give a pulse on the pulse relay.
Pulse Relay	"-" "#1", or "#2". Check that the relay is not being used for cleaning
Reset Sum	"Yes", or "No", reset the totalizer.
Overflow	"Yes", or "No", count overflows.
Auto Adj.	"Yes", or "No", Automatic zero calibration adjustment when overflow is selected above.
Reset Overfl.	"Yes", or "No", reset the overflow counter.
Analog	"None", "Out1", "Out2", "Out3", "Out4", "Out1+2", or "Out3+4". Pick which analog output(s) to be used with sensor
Second	"Level", "Temp" or "=Prim". If two channels are chosen above, the first will always give the primary value according to the sensors selected scale. The second will either give the level scaled 0-1000 mm, the temperature scaled 0-100°C, or the same signal as the first. The temperature is additional information, not a precision measurement.

Calibrate

At Zero	Set the offset (below) so the meter show zero at current level
Offset	+/- 0-99.9" if US units are used, +/- 0-999 mm if metric units are used. Defines how far above (positive value) or below (negative value) the sensor is placed vertically from the overflow edge. 0 means that the sensor is level with the overflow edge. When the automatic zero point adjustment of the overflow function is activated, the offset value is automatically set to 0.
Calibrate	"No", "Zero", or "Level". Refer to calibration instructions for details.
Cal. Level	0-99.9" if US units are used, 0-999 mm if metric units are used. Level when the level calibration was done. Forced value to adjust span of sensor.
0-Cal.	Date of last zero calibration.

Scale / Alarm

Max	Measured value corresponding to 100%, equal to 20 mA output signal (or 4 mA if 20-4 mA is used).
Min	Measured value corresponding to 0%, equal to 4 mA output signal (or 20 mA if 20-4 mA is used).
Hi Alarm	Level that activates an alarm when exceeded, 0 = not in use.
Low Alarm	Level that activates an alarm when underpassed, 0 = not in use.
Alarm Relay	"." "#1", "#2", or "#1 and #2". Check that the relay is not being used for cleaning

System

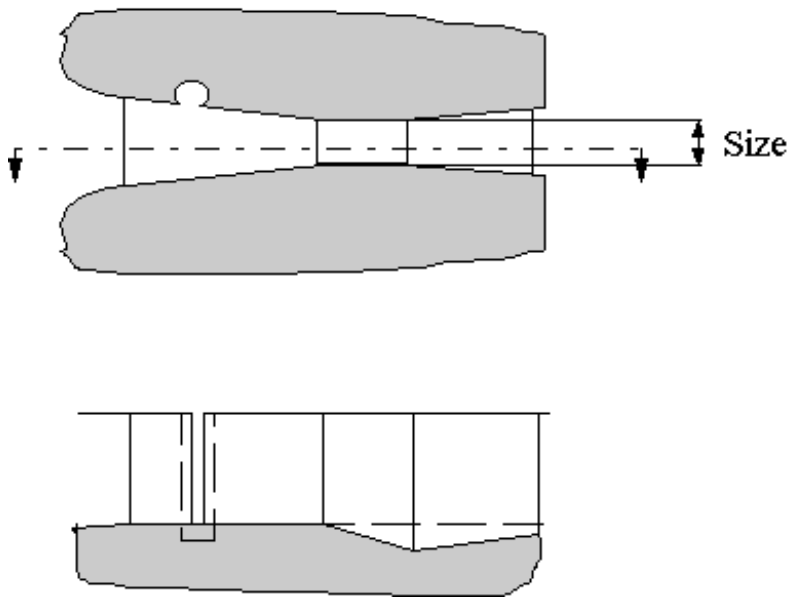
Type	Type of sensor, read only
Serial	Serial number of the sensor, read only
SoftW	Software version of the sensor, read only
Temp	Sensor temperature, read only
MaxTemp	The highest temperature the sensor has been exposed to, read only
Info	Press "ENTER" to go to "info" read only menu. <u>This menu is for Cerlic internal use.</u>
Sa 0	Raw value for the zero level
Sa 1	Raw value for the calibrated level
Level 1	The calibrated level
Ch1	Current raw value
Raw level	Level without any compensation
Reading	Current measure value
Samp/s	Number of messages per second from the sensor.
Service	Not accessible for users.

Level measurement

FLX can be configured for level measurement by selecting the unit "mm" or "inch" in the sensors settings menu. Type of flume, flume parameters and number of flumes selected are ignored. Preset, pulse relay and totalizer does not work for level measurement.

Parshall flume

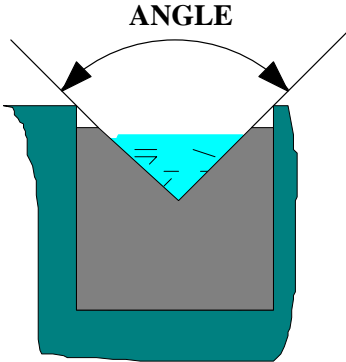
When you select a Parshall flume, you must specify the following parameters:



Size	1,2,3,6,9,12,18,24,36, 48,60,72,84,96 "	The size of the Parshall flume in inches (see picture above)
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Thompson Weir

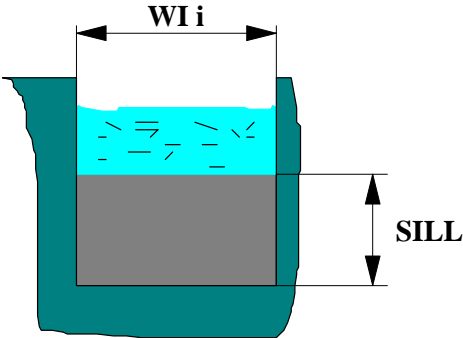
When you select a Thompson weir, you must specify the following parameters:



Angle	20.0 - 150.0 °	The weir's α -angle (see the illustration above)
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Rectangular Weir

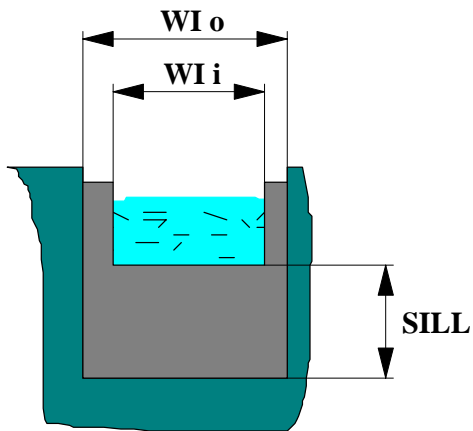
When you select a Rectangular weir, you must specify the following parameters:



Sill	50 - 8000mm (5.0 - 800.0 ")	The sill height of the weir (see the illustration above)
WI i	50 - 32 000mm (5.0 - 3200.0 ")	The width of the weir (see the illustration above)

Rectangular Weir with End Contractions

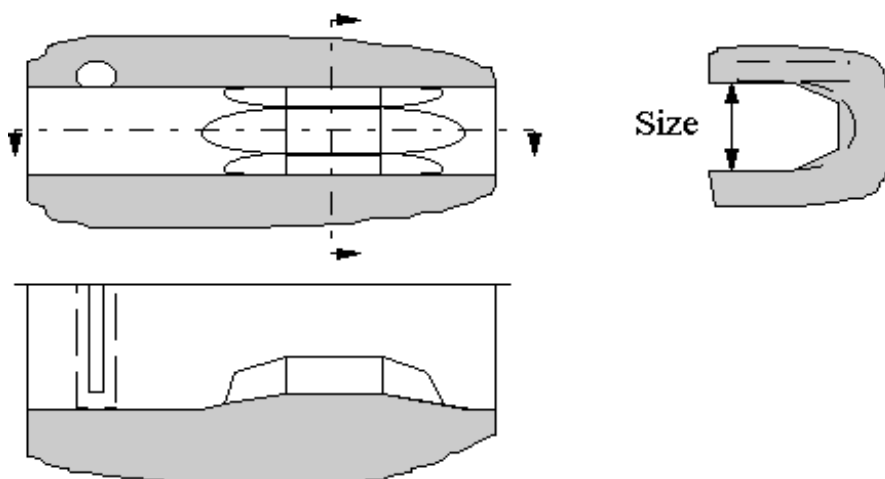
When you select a Rectangular weir with end contractions, you must specify the following parameters:



Sill	50 - 8000mm (5.0 - 800.0 ")	The sill height of the weir (see the illustration above)
WI i	50 - 32 000mm (5.0 - 3200.0 ")	The inner width of the weir (see the illustration above)
WI o	50 - 32 000mm (5.0 - 3200.0 ")	The outer width of the weir (see the illustration above)

Palmer-Bowlus Flume

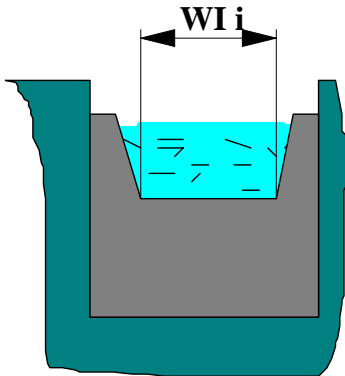
When you select a Palmer-Bowlus flume, you must specify the following parameters:



Size	1 - 22 "	The size of the Palmer-Bowlus flume in inches (see the illustration above)
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Cipoletti Weir

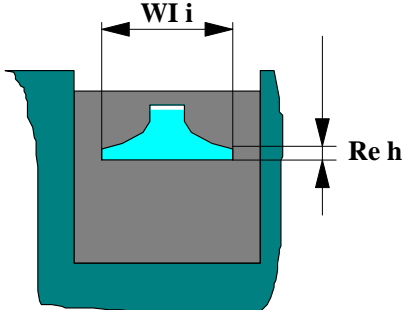
When you select a Cipoletti weir, you must specify the following parameters:



WI i	50 - 32 000mm (5.0 - 3200.0 ")	The inner width of the weir (see the illustration above).
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Sutros Weir

When you select a Sutros weir, you must specify the following parameters:

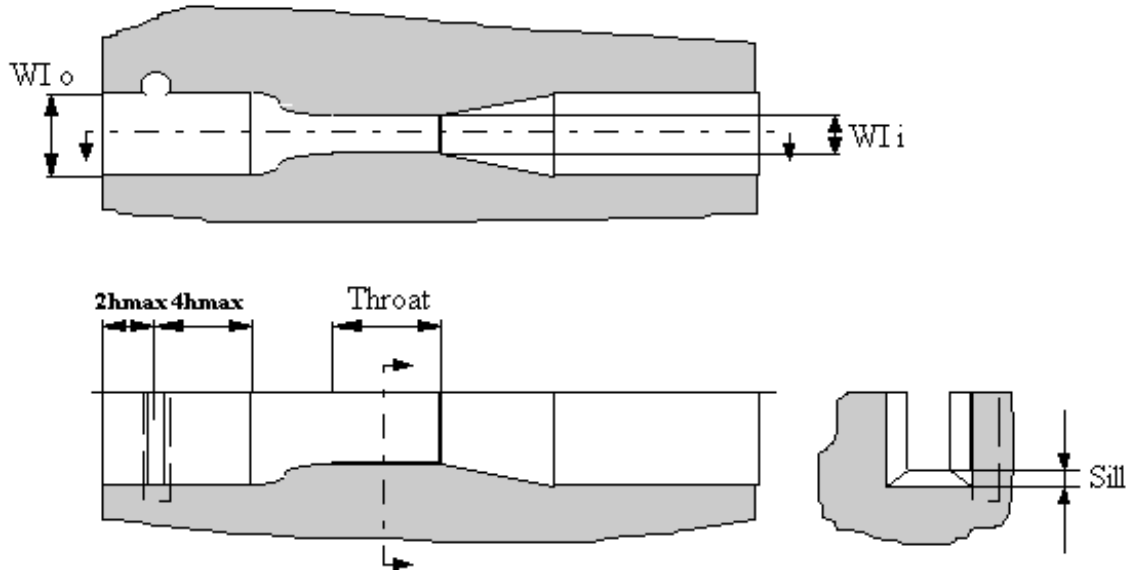


Re h	0 - 4000mm (0.0 - 400.0 ")	The sill height of the weir (see the illustration above).
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WI i	50 - 32 000mm (5.0 - 3200.0 ")	The width of the weir (see the illustration above).
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Venturi Flume with Rectangular Throat

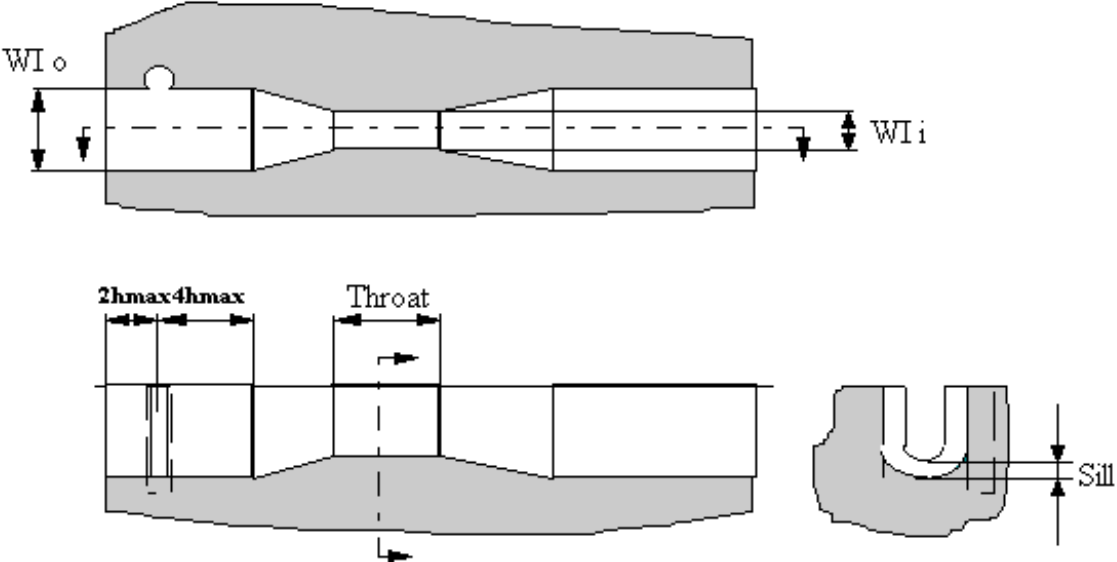
When you select a Venturi flume with rectangular throat, you must specify the following parameters:



Sill	0 - 4000mm (0 - 400.0 ")	Sill height of the flume (see the illustration above).
WI i	50 - 32 000mm (5.0 - 3200.0 ")	The throat width of the flume (see the illustration above).
WI o	50 - 32 000mm (5.0 - 3200.0 ")	The outer width of the flume (see the illustration above).
Throat	25 - 3000mm (2.5 - 300.0 ")	The length of the throat (see the illustration above).

Venturi Flume with U-shaped Throat

When you select a Venturi flume with U-shaped throat, you must specify the following parameters:



Sill	0 - 4000mm (0 - 400.0 ")	Sill height of the flume (see the illustration above).
WI i	50 - 32 000mm (5.0 - 3200.0 ")	The throat width of the flume (see the illustration above).
WI o	50 - 32 000mm (5.0 - 3200.0 ")	The outer width of the flume (see the illustration above).
Throat	25 - 3000mm (2.5 - 300.0 ")	The length of the throat (see the illustration above).

11. Calibration

The sensor is shipped pre-calibrated. The sensor will drift with time. Calibrations shall be done regularly following a maintenance schedule. Once every six months is recommended. Always leave the sensor in the measuring media with the power on for approximately 30 minutes before you begin calibrating. This allows the sensor to stabilize.

Zero calibration

The FLX has a zero point calibration function, which is based on lifting the sensor into the air (zero pressure) and pressing a key. The BB2 registers the signal from the sensor and bases all subsequent measuring on that signal level.

Follow these steps to calibrate the zero point:

- Enter the sensor menu. The output signal is frozen while the menus are open.
- Chose the sub menu "Calibrate".
- Chose " Calibrate ", then "Zero" and press ENTER.
- Place the sensor vertically, then press ENTER to start the sampling.
- A textbox will pop up saying "Standing by for stable signal ". When the textbox disappears, the calibration is done.
- Exit the menu.
- Date of last zero calibration is shown at the bottom of screen "0-Cal".

Do a zero calibration two times a year in order to maintain good accuracy.

Level calibration

After a zero calibration, it is easy to check the accuracy of the sensor. Fill a bucket with approximately 25cm (10") water. Carefully lower the sensor into the bucket until the sensor rests on the bottom of the bucket. Use a ruler and measure the water level. The level will be 12 mm (1/2") more than the meter shows due to black protective cap on end of sensor. NOTE! If an offset is entered in the sensors setting menu, the meter adds the value of the offset to the measured level. If the instrument shows a level different from the ruler then - a level calibration must be done.

Follow these steps to calibrate a level:

- Enter the sensor menu. The output signal is frozen while the menus are open.
- Chose the sub menu "Calibrate".
- Chose " Calibrate ", then ARROW UP to get"Level" and press ENTER.
- Carefully lower the sensor into the bucket, let the sensor rest on the bottom of the bucket, and hold it vertically, then press ENTER to start the sampling.
- A textbox will pop up saying "Standing by for stable signal ". When the textbox disappears, the calibration is done.
- Measure the water level in the bucket with a ruler.

- Subtract 12 mm (0,5") from the measured water level in the bucket and go to "Cal Level" in the Calibration menu and enter this value. (Example; water level in the bucket is 20.625". Subtract 0,5" = 20.125". Enter this value in "Cal level".)
- Exit the menu.
- In the display mode of BB2, press ARROW DOWN + ENTER to get to the FLX information window.
- Check that the level reading of the FLX corresponds to the water level in the bucket as per above.

12. Scaling

The "Scale / Alarm" menu allows the user to set the high and low boundaries for a 4-20mA output signal. In addition, this menu allows the user to set high and low alarms values that can be used to notify when the measurement has reached critical points.

Max sets the 20 mA point output

Min sets the 4 mA point output (may be a negative value)

Hi-Alarm sets the High Alarm set point

Low-Alarm sets the Low Alarm set point

13. Overflow functionality

When FLX is used to measure overflows, the number of overflows can be counted. The sensor must be leveled with the edge of the overflow threshold. By doing so, the automatic zero adjustment can be used. The positioning and mounting of the sensor shall with this exception be done in the same way as for normal flow measurement.

To make sure that the FLX registers overflows you can lift the sensor up and lower it into a bucket of water (200mm [7.8"]). Leave the sensor in the bucket for 1 minute, then check that the sensor information display in BB2 has registered an overflow. Make sure the level has been zero at least an hour prior to the overflow measure.

Automatic Adjustment

When registering overflows you can choose between calibrating the zero point manually, or selecting automatic adjustment of the zero point. We recommend that you use automatic adjustment of the zero point if that is possible. The automatic adjustment function is only available if you have activated the overflow registration function.

In order for automatic adjustment to work, the sensor must be placed in such a manner that its zero point is the same as the overflow edge.

The measuring point should be specified as zero and no overflow is permitted when you select automatic adjustment of the zero point.

Follow these steps to start automatic adjustment of the zero point:

- Make sure there is no overflow.
- Select the sensor in the measurement display
- Enter the sensor menu (press ENTER for approximately 5 seconds).
- Go to the "Settings" menu.

- Step down to "Offset" and enter 0.
- Step down to "Overflow" and select "Yes".
- Step down to "Autoadj." and select "yes".
- Exit the menu.

Automatic adjustment is now activated and will adjust for any zero point deviation in the sensor.

Resetting the overflow counter

Follow these steps to reset the overflow counter:

- Select the sensor in the measurement display
- Enter the sensor menu (press ENTER for approximately 5 seconds).
- Go to the "Settings" menu.
- Step down to "Clear Overfl." and select "Yes".
- Exit the menu.

14. Totalizer

FLX has a built in totalizer, that registers the volume in m³ if metric units are used or thousands of Gallons if US units are used. The value of the totalizer is shown in the sensor information display.

Resetting the internal totalizer:

- Select the sensor in the measurement display
- Enter the sensor menu (press ENTER for approximately 5 seconds).
- Go to the "Settings" menu.
- Step down to "Clear Sum" and select "Yes".
- Exit the menu.

Resetting the internal totalizer does not affect an externally connected totalizer.

15. Technical data FLX

FLX 1m	P/N 11305551
Material	
Tube and electrode holder:	SIS2343 (316SS)
Top	PVC
Dimensions	Ø28 x 1085 mm (Ø 1.1" x 43")
Weight	1,8 kg (4 lbs)
Process connection	Immersion sensor
Max immersion depth	94 cm (37")
Max temperature	60°C (140°F)
Measuring principle	Pressure sensor
Cable, connection	5-pin M12-plug
Cable, length	5 +10 m (16 + 33 ft)
Cable, material	Polyurethane
Enclosure	IP65

FLX 0.5m	P/N 11305569
Material	
Tube and electrode holder:	SIS2343 (316SS)
Top	PVC
Dimensions	Ø28 x 585 mm (Ø 1,1" x 23")
Weight	1,5 kg (4 lbs)
Process connection	Immersion sensor
Max immersion depth	43 cm (17")
Max temperature	60°C (140°F)
Measuring principle	Pressure sensor
Cable, connection	5-pin M12-plug
Cable, length	5 +10 m (16 + 33 ft)
Cable, material	Polyurethane
Enclosure	IP65

Certificate of conformity:

The FLX sensors along with their central unit BB2 are in conformance with the following EC Directive(s) when installed in accordance with the installation instructions contained in the product documentation:

73/23/EEC Low Voltage Directive as amended by 93/68/EEC
89/336/EEC EMC Directive as amended by 92/31/EEC and 93/68/EEC

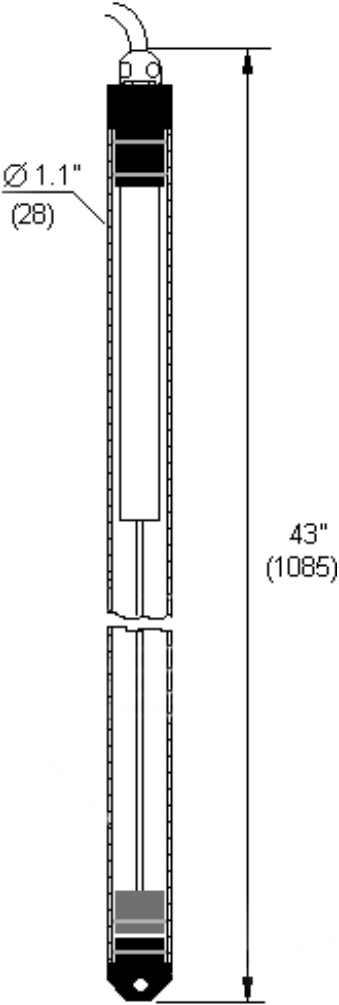
The following standards and/or technical specifications have been applied:

EN 61000-6-4:2001 Electromagnetic compatibility (EMC) Part 6-4
Generic standards – Emission standard for industrial environments

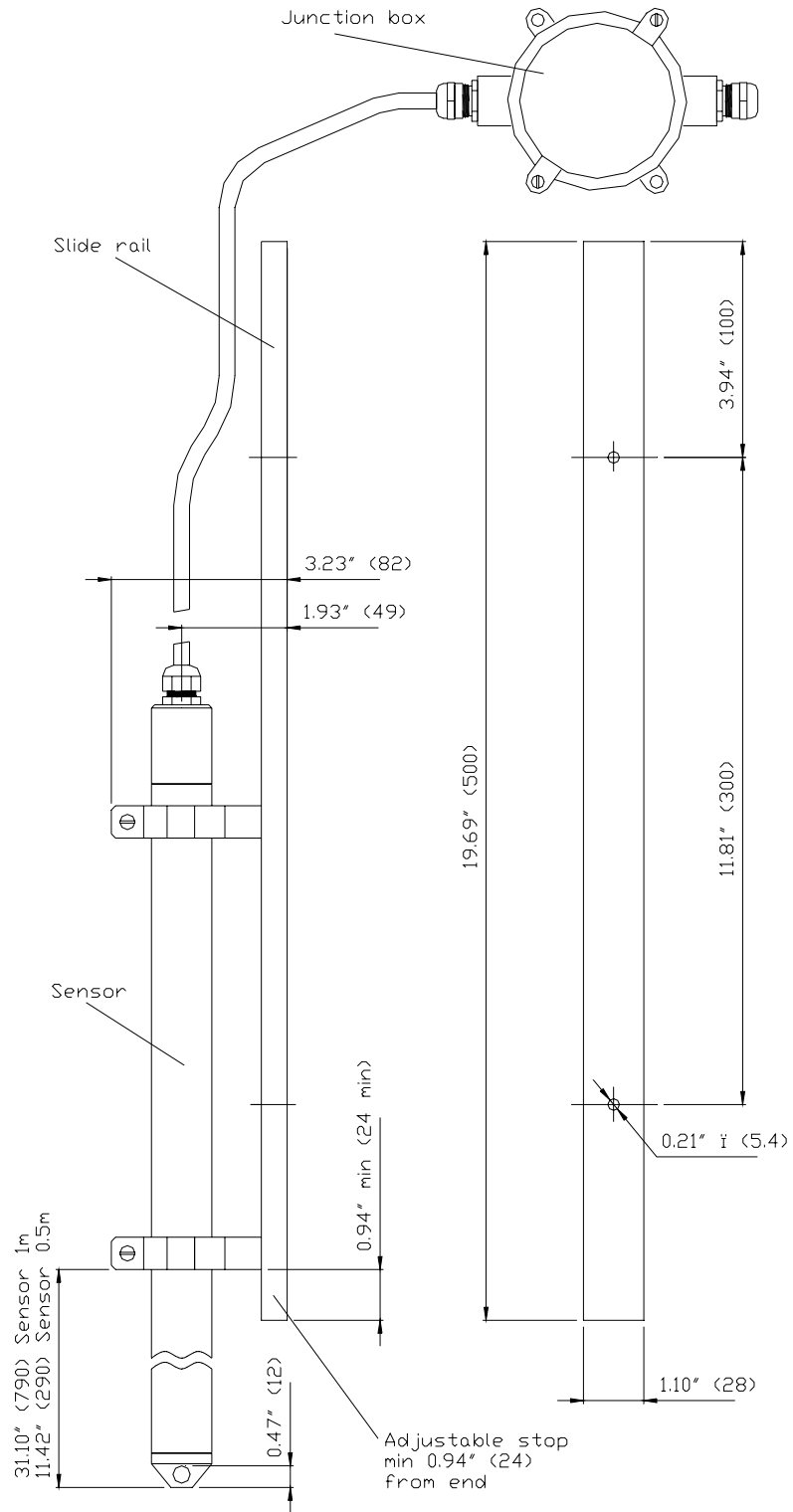
EN 61000-6-2:2001 Electromagnetic compatibility (EMC) Part 6-2
Generic standards - Immunity for industrial environments

EN 61010-1:2001 Safety requirements for electrical equipment for measurement, control, and laboratory use

Dimensions



Appendix 1, Optional slide rail





Appendix 2, Support information

Before calling Cerlic Support, please collect the following information and have it at hand.

Company _____

Name _____

Phone _____

E-mail _____

Sensor Type _____

Position / Tag _____

First go to the BB2 menu, it is accessed by pressing and ENTER at the same time for five seconds. Select "System" and press ENTER.

Version _____

Serial _____

Box temp _____

Leave the BB2 menu by pressing and ENTER at the same time. Use or to select the sensor in the main display. Go to the sensor menu, it is accessed by pressing ENTER for five seconds. Select "System" and press ENTER.

Type _____

Serial _____

SoftW _____

Select "Info", then press "ENTER" to go to the "info" menu.

SA 0 _____

SA 1 _____

Level 1 _____

Ch1 _____

Raw level _____

Reading _____

In the menu "Settings"

Flume _____

No. flumes _____

I-time _____

In the menu "Calibration"

Offset _____

Leave the BB2 menu by pressing and ENTER at the same time.

Appendix 3, Setup information

This sheet can be used to document the setup of a sensor.

Sensor Type _____

Position / Tag _____

In the System sub menu of the sensor menu the following information can be collected.

Serial _____

SoftW _____

In the Settings sub menu of the sensor menu the following parameters can be set.

Flume _____

Angle * _____

Inner width * _____

Outer width * _____

Sill * _____

Size * _____

Throat * _____

No. flumes _____

I-time _____

Analog _____

Second _____

* Depending on the type of flume one or more of these are used.

In the Scale / Alarm sub menu of the sensor menu the following parameters can be set.

Max _____

Min _____

High alarm _____

Low alarm _____

Alarm Relay _____

Leave the BB2 menu by pressing  and ENTER at the same time.

