ABM4xx-OCM-2-
OPEN CHANNEL METER

Where 4xx is either 400 (115 Vac) or
430 which is 230 Vac

Table of Contents

Table of Contents

Appendix

- Appendix.
- 1. Architecture of the ultrasonic sensor.

- 2. Sensor installations.
- 2.1 KPV flume.
- 2.2 Parshall flume.
- 2.3 Venturi flume.

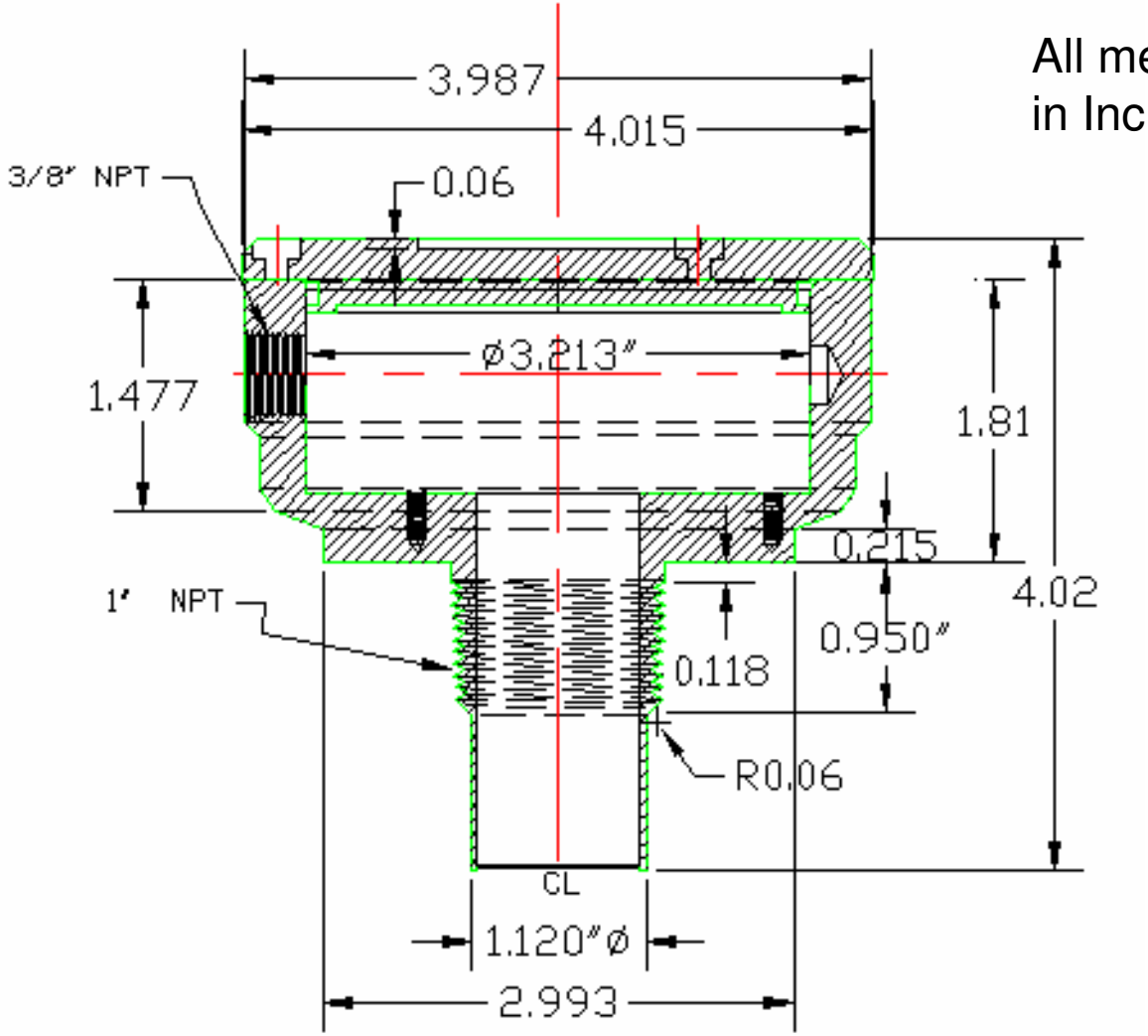
- 3.0 Positioning of the ultrasonic sensor against weirs and flumes.

- 4.0 Programming examples.

1.1 Specifications

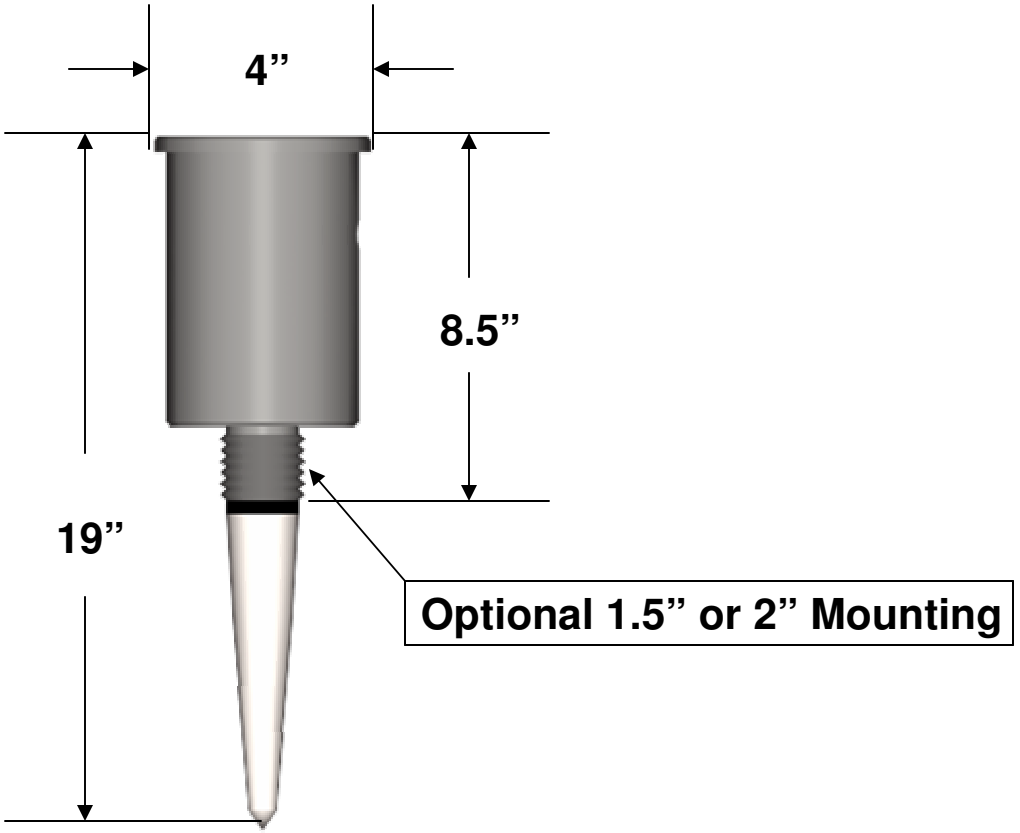
POWER SUPPLY: 115 Vac, 230 Vac, **max current-** 0.2 A
BEAM WIDTH OF THE ULTRASONIC TRANSDUCER: 10 to 12 deg., **Microwave:** 10 deg
ACCURACY: +/- 0.1% of max range for both ultrasonic and microwave
ACCURACY OF THE FLOW: 3 to 5%
PROGRAMMING: using 6 key-pads and display of 2 x 16 digits
CURRENT OUTPUT: 4mA to 20mA, **max load-** 750 Ohm
RELAYS: Two programmable relays and one alarm, **rating:** 5A/ 230 Vac
OPERATING TEMPERATURE OF THE ULTRASONIC AND RADAR LEVEL DEVICE: -40 deg. C to 60 deg. C NOTE**:** (Higher Temperature units also available)
ENCLOSURE OF THE ULTRASONIC LEVEL DEVICE: PVC
ENCLOSURE OF THE RADAR LEVEL DEVICE: Aluminum
ENCLOSURE OF THE CONTROLLER: PVC
ENCLOSURE PROTECTION: IP65 (Water Proof)
CONTROLLER PROTECTION: IP65
WEIGHT OF THE ULTRASONIC LEVEL DEVICE: 1 lb
WEIGHT OF THE RADAR LEVEL DEVICE: 3 lb
WEIGHT OF THE CONTROLLER: 2 lb

1.2 Dimensions of the Ultrasonic Level Device

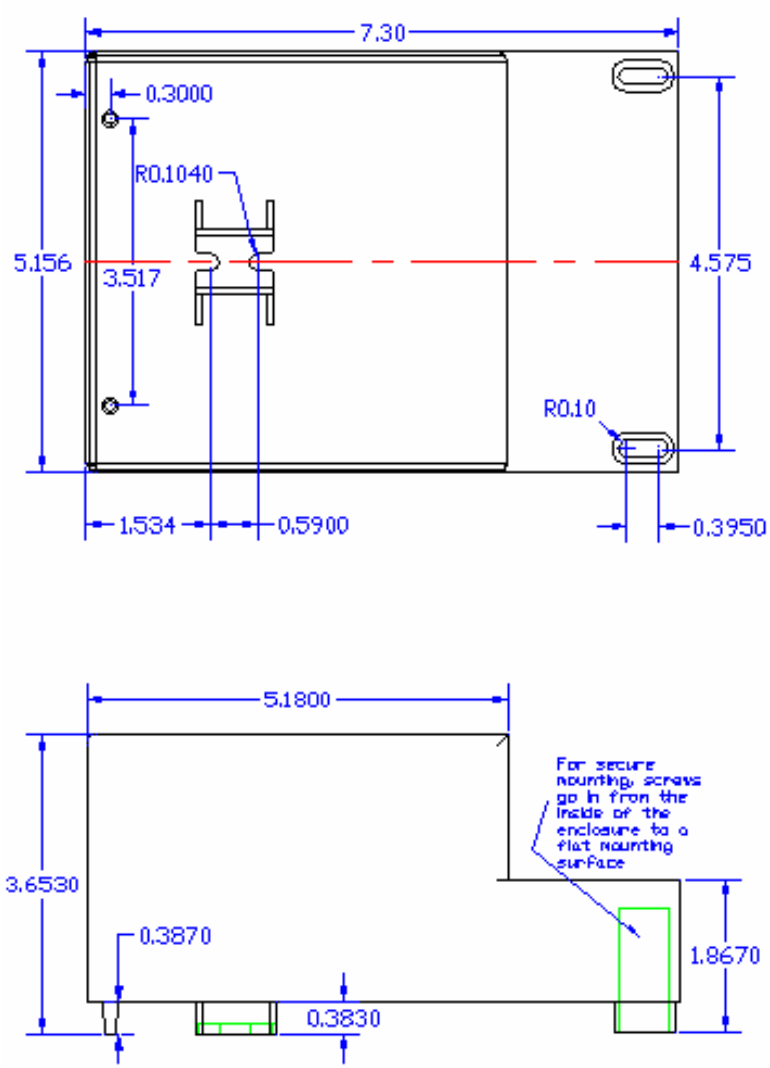


All measurements are in Inches.

1.3 Dimensions of the Radar Sensor



1.4 Dimensions of the Controller

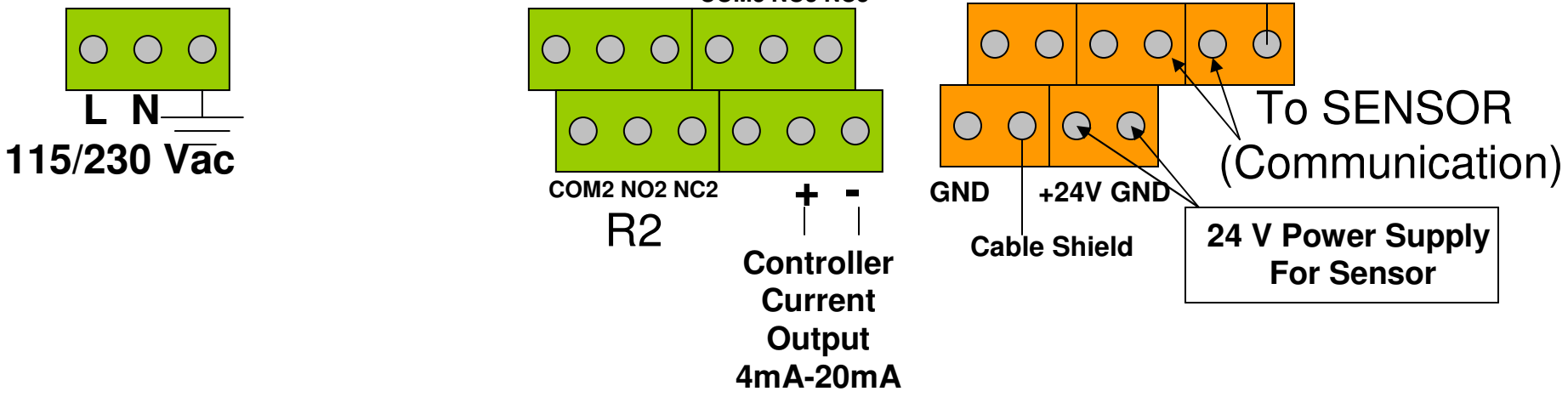


1.5 Mounting

The ultrasonic level device should be mounted above a channel, in it's center to avoid unwanted echoes from other objects. The ultrasonic sensor should be mounted vertically to the water surface. The minimum distance to the water is 12.5 (5 inch).

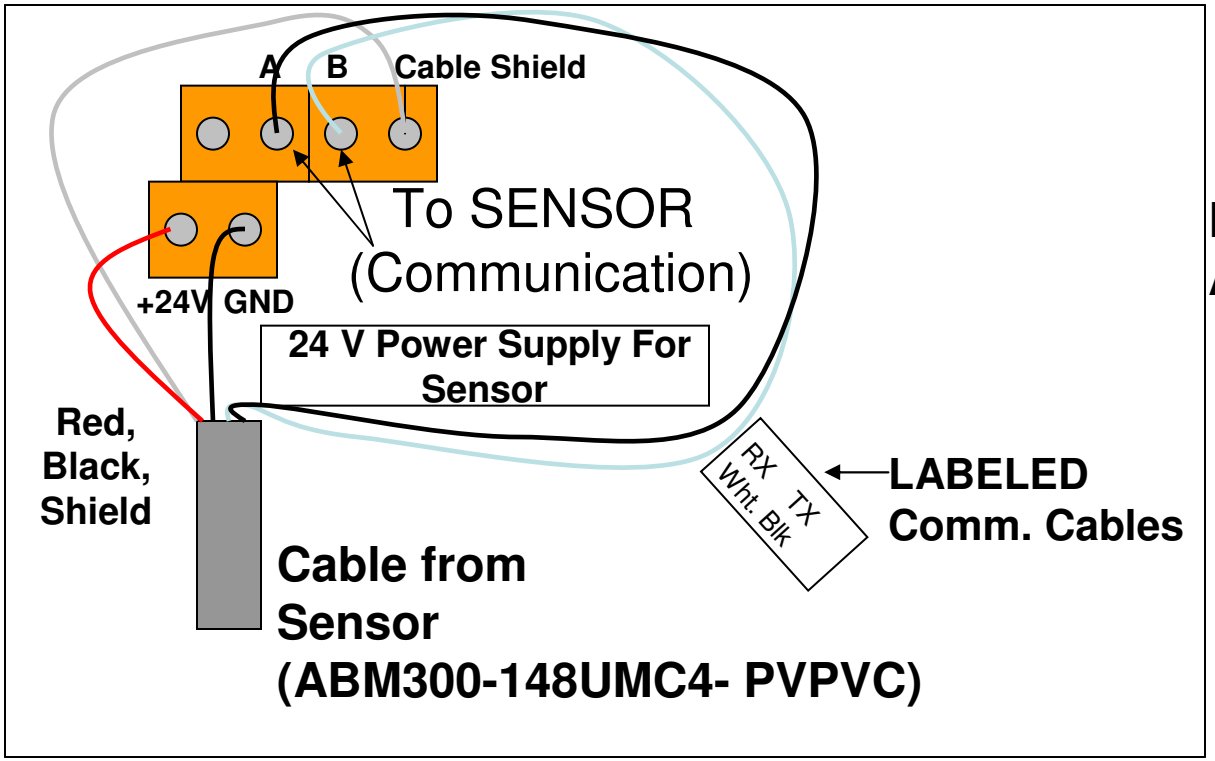
1.6 Wiring

Fig. 1 Controller Terminal Blocks



This Controller can be 115 Vac and 230 Vac supplied.

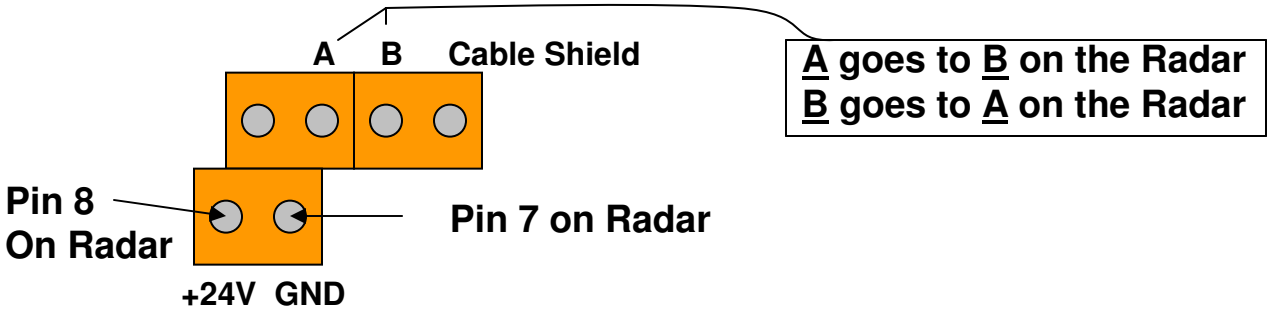
Fig. 2 Wiring Diagram for Ultrasonic Level Device



B Com RS485 (White) RX
A Com RS485 (Black) TX

To make OCM functional, the Ultrasonic sensor has to be connected to the Controller as shown in Fig. 1 and Fig. 2.

Fig. 3 Wiring Diagram for Radar Level Device



Note: To choose Radar or Ultrasonic sensors go to Application.

1.7 Keyboard operation

 - Search of programming menu's and in editing, “add next digits”.

 - Select parameters to edit and search measurement menu.

 - Enter, allows transition from Measurement Mode to Programming Mode.

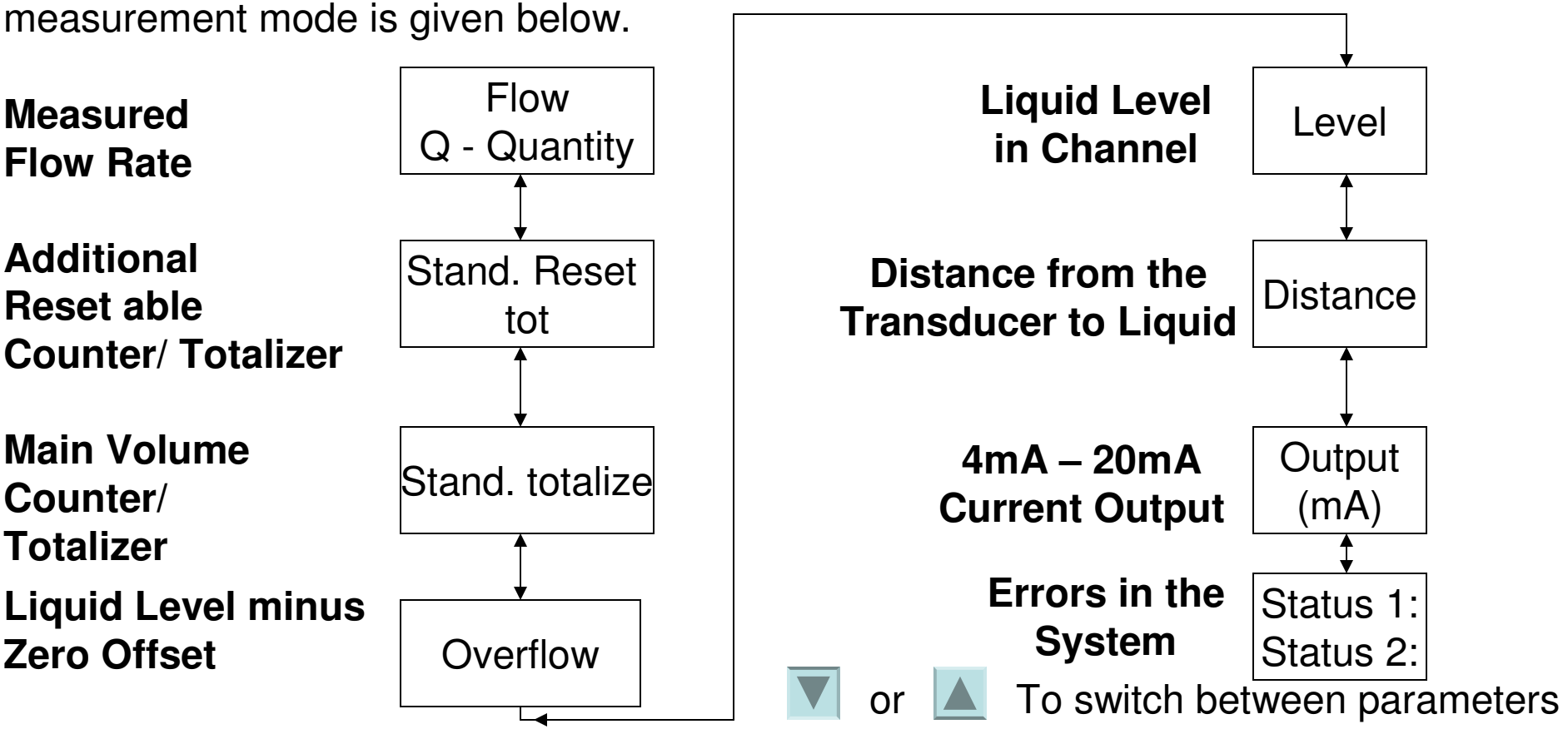
ESC - Allows escape from Programmable Mode to Measurement Mode.

2.0 Operational Instructions

ABM Flow Controller has two modes, one is Measurement and another one is Programming.

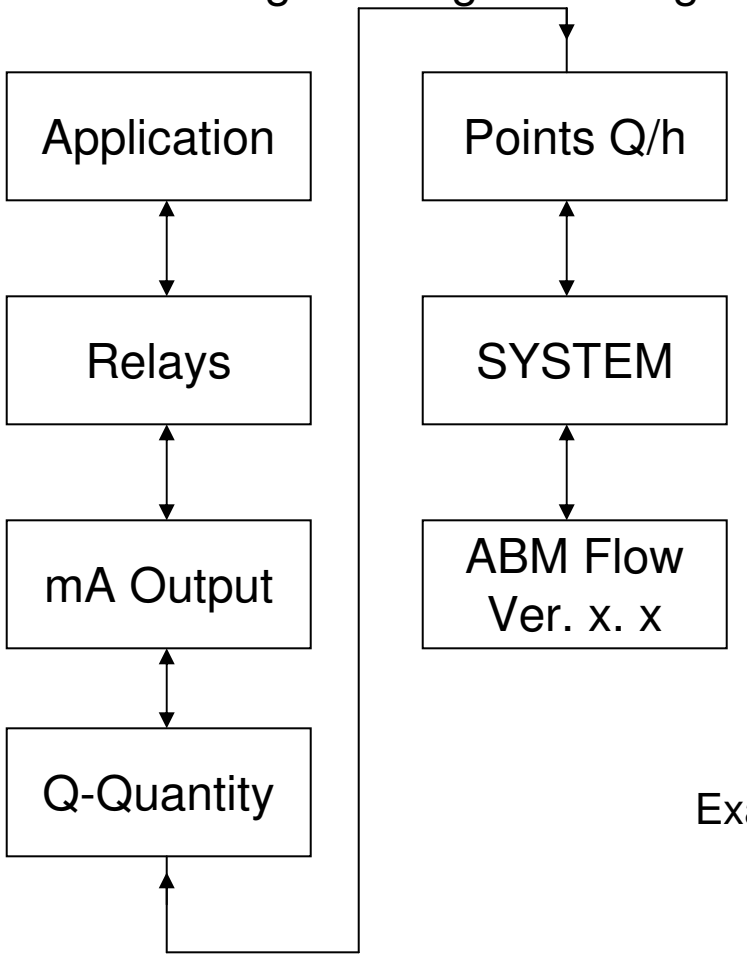
2.1 Measurement Mode

It is the main mode of the device. Measurement is taken every 1 sec, after each measurement the current output and relay states are up-dated. Menu in the measurement mode is given below.



2.2 Programming Mode

By pressing button (▶) a transfer from Measurement Mode to the Programming Mode is done. The Programming Mode is used to change parameters of OCM. Menu in the Programming Mode is given below.



From the above menu it is possible to go back to the Measurement Mode by pressing ESC key.

From the Measurement Mode to Programming Mode, pressing ▶ is required.

Before editing of any parameter, a correct password is required (go to SYSTEM, correct password is ABM1). Using ◀ ▶ choose a parameter from the programming Menu and then press ↵ to edit a parameter, press ↵ again to change values using first ▲ and ▶ for adding digits.

Example: ▲ Chooses values (0-9)

▶ Adding digits 1,2,3…

↵ Key is pressed after a parameter value is changed ; to store it.

2.2.1 Application

This menu consists of parameters related to the measurement of distance and level.

Empty Level:	This distance is to the bottom of a channel from the sensor
Range:	Maximum liquid level

This relation
Must be satisfied: Dead zone = Empty level – Range
The Dead Zone for ABM Flow is 12.5cm or 5 in
Program first Range and then Empty Level which must be greater then the Dead Zone of either Ultrasonic or Radar

IMPORTANT

Communication time out: in seconds
Specify Sensor: choice of Ultrasonic or Radar

2.2.2 Relays

A Relay can be in an active or passive state. Active state shorts COM to NO contacts and Opens COM to NC contacts. Passive state keeps open COM to NO and short COM to NC.

2.2.2.1 Relay 1 and 2 Functions

- Relay 1 (R1) has two functions: Totalizer and Quantity.
- Relay 2 (R2) has only one function: Quantity.
- Point 1 on Quantity of both relays sets threshold to change from passive to active state.
- Point 2 on Quantity of both relays sets threshold to change from active to passive state.
- Totalizer function is available only on R1 and for point 1 to change from passive to active state. This function allows calculation of volume. After a Programmed Volume, relay goes for 1 second to the active state, after that it comes back to the passive state.
- To prevent loss of information, the Programmed Volume has to be at least 4 times higher than the max volume that comes from the maximum flow.

2.2.2.2 Alarm Relay R3

- It is in an active state when a measurement is correct
- It is in passive state when: no power and the following errors appear:
  E00 – no communication
  E01 – wrong calculation
  E10 – default parameters are loaded
  E11 – characteristics Points Q/h is reset
  E12 – characteristics Points Q/h is not correct
  E13 – wrong reading from volume counters

2.2.3

mA Output

2.2.3.1

Minimum Flow gives 4 mA current output.

2.2.3.2

Maximum Flow gives 20 mA current output.

2.2.3.3

Failsafe mode has the current outputs: hold, 0 mA, 4 mA and 20 mA, that informs users about errors.

2.2.3.4

Trim function allows calibration of the current output. To do that a user should connect an ammeter to the current output and then using Trim 4mA and Trim 20mA adjust (calibrate) the current output.

2.2.4 System

2.2.4.1 Password

This function allows to program password. In case of correct password, a message OK is displayed.

Manufacture password is: **ABM1**

Password to set default parameters is: **DEFA** (a correct password has to be set first)

2.2.4.2 Change Password

This is possible after putting correct password.

2.2.4.3 Display continuously Standard Totalizer or Quantity.

2.2.5 Quantity (Flow Rate)

2.2.5.1

Calculation “I” function chooses different flumes and calculation method. “Lack” means no flow calculation.

There are the following setups: Exponent, partial flume, KPV flume, Palmer- Bowlus, Khafagi- Venturi, Universal.

In case of Universal, flow is calculated from characteristics flow/ level. These Characteristics have to be completed first by a user in Points Q/h.

Calculation I is related with Flume/weir Shape. Flume/weir shape chooses proper device for flow measurement as shown in Table below:

Possible set-ups

Calculation I	Flume/weir Shape
Exponent	Rectangular weir, V-weir, Trapezoidal weir (Cipoletti), Venturi flume, others
Parshall Flume	Flume. Nr:1 to Flume Nr: 21 (according to PN- ISO 9826)
KPV Flumes	KPV1 to KPV X1 (according to UNIKLAR 77)
Palmer Bowlus	DN 110mm, DN 160mm, DN 200mm, DN 250, DN 315mm, DN 400mm, DN 500mm, DN 630mm
Khafagi- Venturi	QV 302, QV 303, QV 304, QV 305, QV 306, QV 308, QV 310, QV 313, QV 316
Universal	--------

2.2.5.2

Calculation II is used to determine whether the flow is calculated using K-factor (set Calculation II to Calculated) or parameters h max and Qmax (set Calculation II to Empirial)

When Calculation II is set to Calculated, an equation for flow is: $Q = K * h^x$

Where: K – is the coefficient given by manufacturer

h – measured level range in channel (measurement is level) or overflow (measurement is overflow)

x exponent - is coefficient for weir or flume

When Calculation II is set to Empirial, flow is calculated from:

$$Q = \frac{Qmax}{h^x \, max} * h^x$$

Where: h and x exponent are as in the previous equation

Qmax [m^3/s]- max. flow rate for a given flume or weir, it is set by a parameter Max- quantity

h max – max. level in channel set by a parameter Max._level.

2.2.5.3

Zero Offset determines distance from the bottom of the channel to the beginning of overflow. To use this parameter one should be put in Calculation I = Exponent and Flume/weir shape = Rectangular weir, V weir or Trapezoidal weir

2.2.5.4

Max. Level is used to determine maximum level h max of flume or weir in relation with parameter Zero Offset that gives max flow (Max. quantity).
Max. level is used when Calculation I = Exponent and calculation II = Empirial

2.2.5.4

Max. Quantity is max flow rate when level of liquid in channel is maximum

2.2.5.5

Quantity Units – gives user choice of the volume (litre, m^3,gallons)

2.2.5.6

Time Units – gives user choice of the time units used in measurement of the flow intensity

2.2.5.7

Decimal Places – the accuracy of the flow

2.2.5.8

Flow Cutoff is a percent of the max flow (Max. quantity) below which the volume is not calculated in Standard totalizer and Standard reset totalizer.

2.2.5.9

- **Exponent** of the exponential function, used in Calculation I = Exponent and Flume/weir Shape = Others for not typical applications.
- K – factor is a parameter of a flume or weir given by producer or calculated from a type of flume and its dimension.
- Angle – notch angle for a weir.
- Standard reset totalizer: Reset? It resets totalizer

2.2.6. Points Q/h

When a flume or weir is different from standard ones then someone can make a characteristics of flow (Q) and level (h) using dimensions of a flow device or sometimes producers provide that.
To do the above, one should set in Calculation I = Universal

2.2.6.1 Number of points

Gives number of points of characteristics flow – level, maximum 30 points can be used.
< marker on display shows which parameter is edited, to move it up and down use  and  .

2.2.6.2

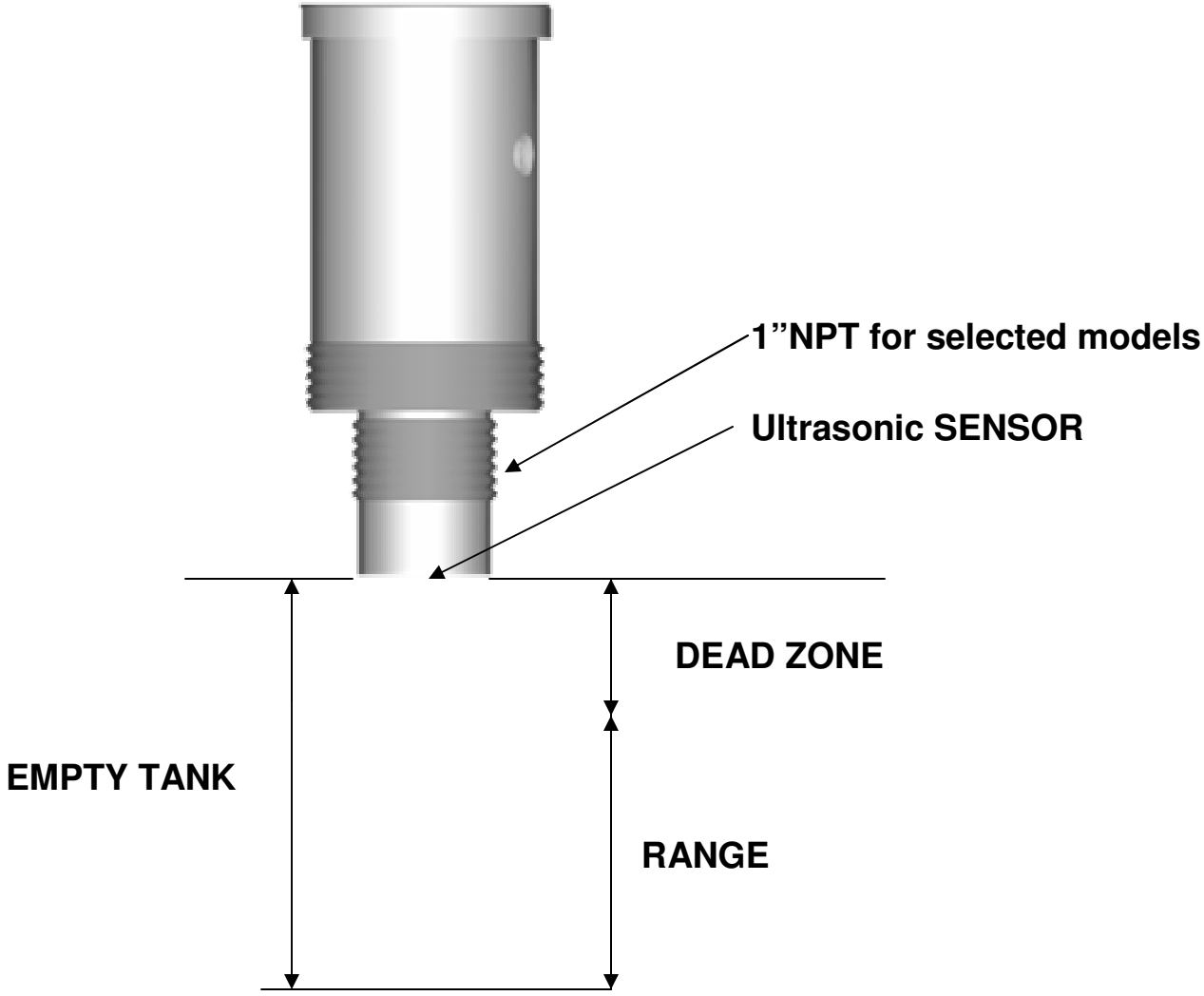
Set points – supports to build flow-level characteristics, ABM – OCM1 allows ten points of the flow-level characteristics for one range. There are three ranges of set points: 1-10,
11-20 and 21-30.

2.2.6.3 Points H and Q

Points H and Q of the flow-level characteristics can be introduced by positioning < marker using  ,  keys and pressing enter  , set values with  ,  ,  ,  keys, enter with  or cancel with ESC.

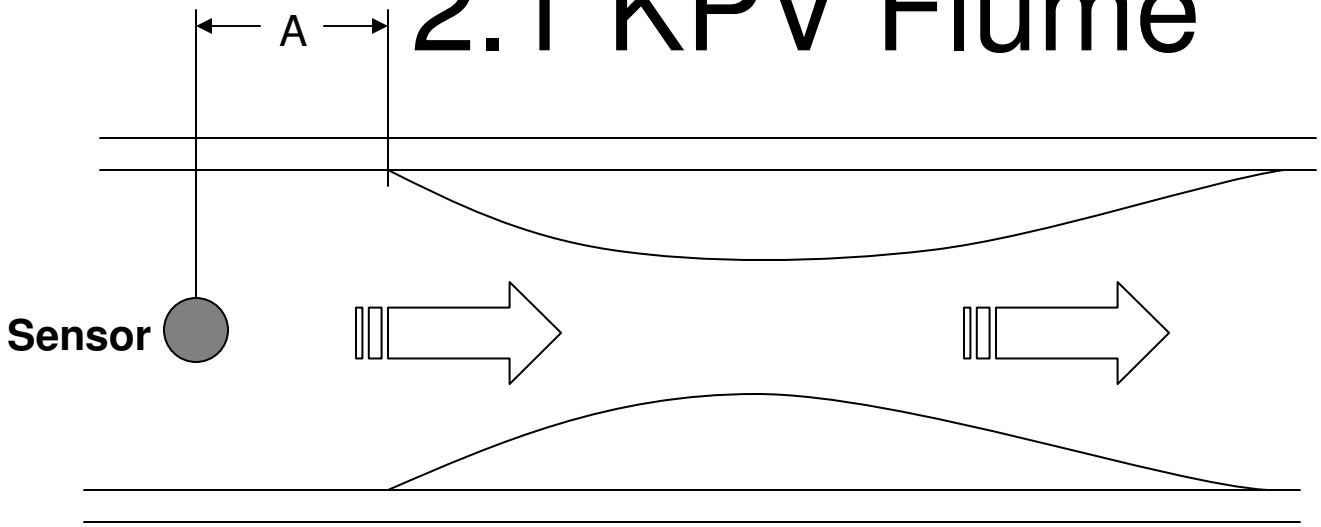
Appendix

1. Architecture of Ultrasonic Sensor



2. Sensor installations

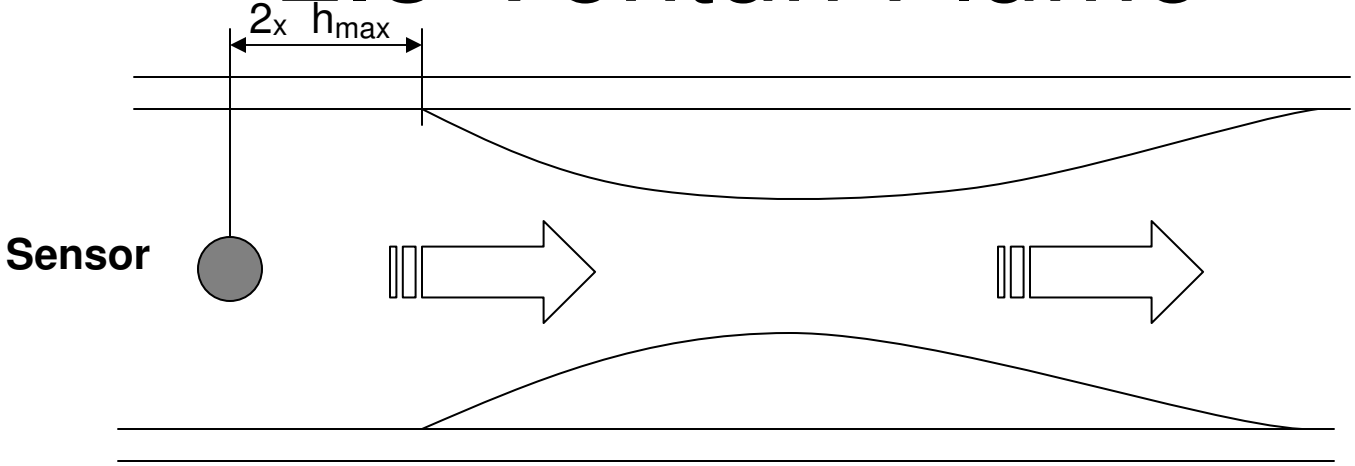
2.1 KPV Flume



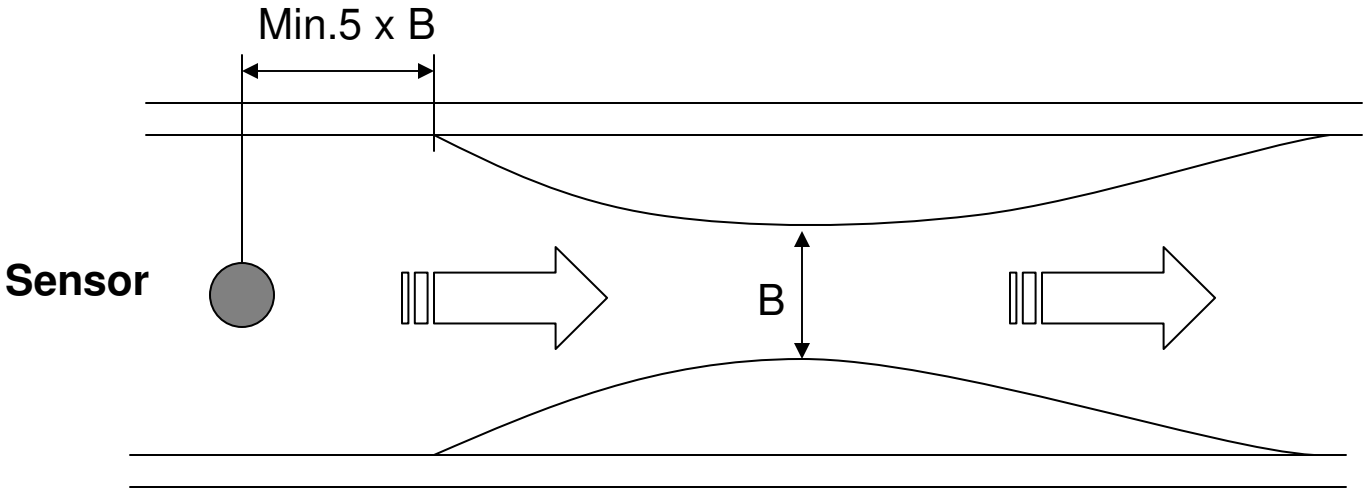
FLUME TYPE	A [cm]
KPV 1	60
KPV 2	60
KPV 3	60
KPV 4	60
KPV 5	100
KPV 6	100
KPV 7	120
KPV 8	200
KPV 9	225
KPV 10	225
KPV 11	270

For inches divide by 2.54.

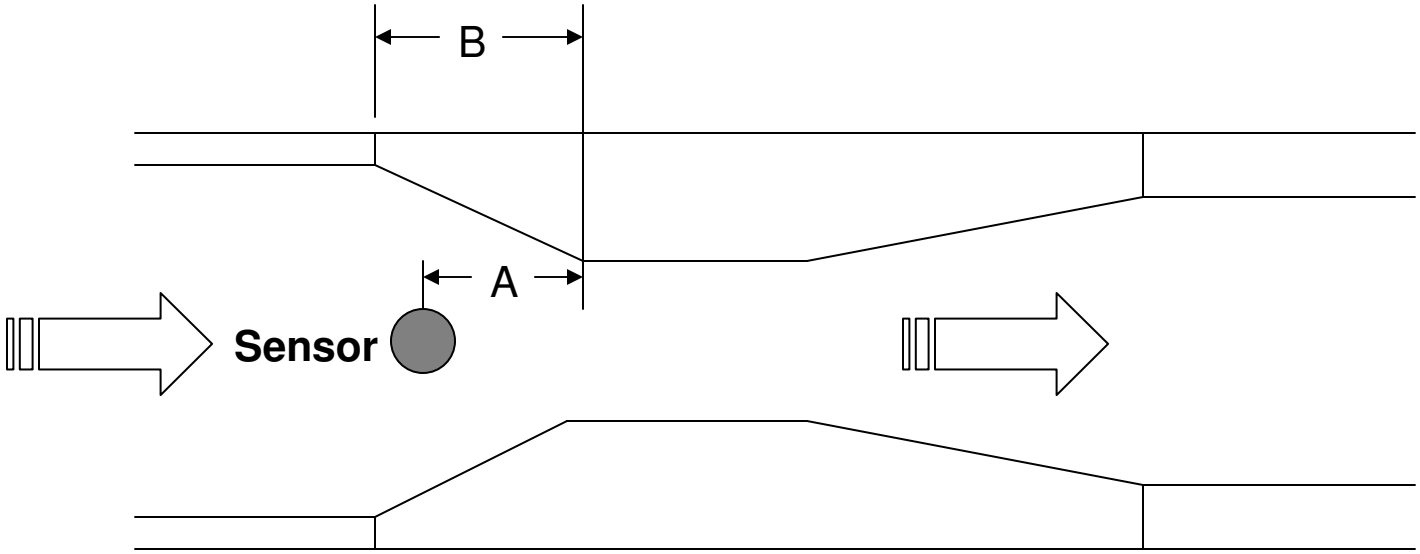
2.3 Venturi Flume



h_{max} - max level

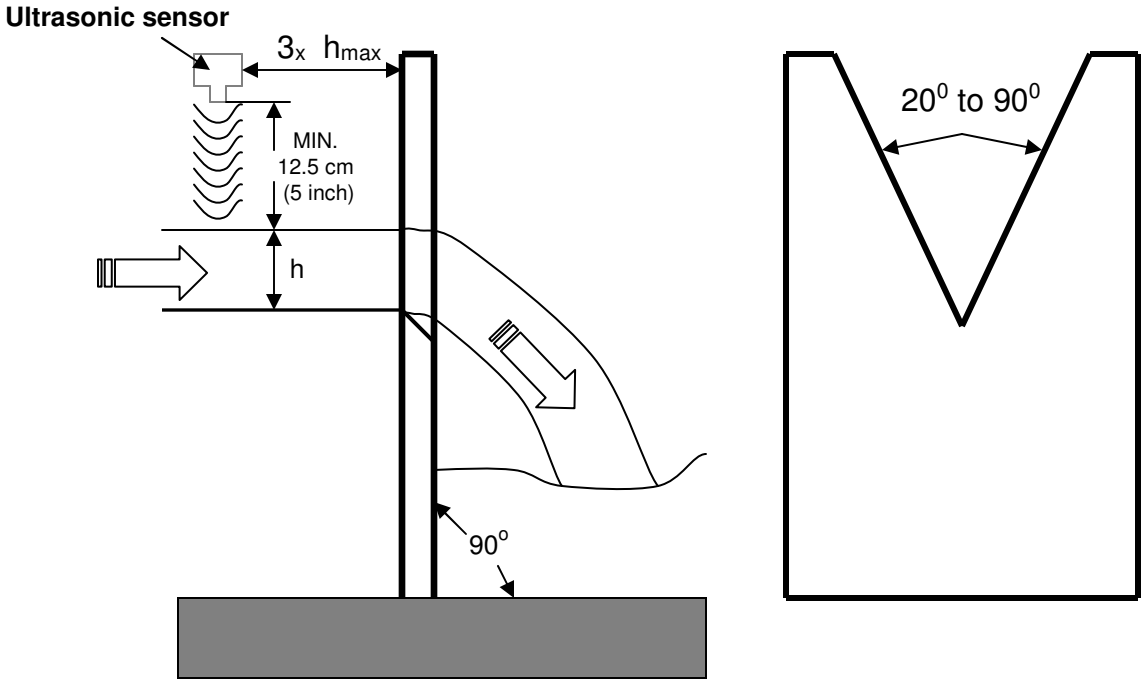


2.2 Parshall Flume



A=2/3 * B

3.0 Positioning of the Ultrasonic sensor against Weirs and Flumes



4.0 Programming Examples:

Example 1:

Flow measurement using Venturi flume, when K-factor is known.

Parameter	Settings	Description
Empty Level	150cm	Distance from the ultrasonic transducer to Bottom of channel
Range	138cm	Max level of liquid in channel

In the above parameters it has to be satisfied, the relation: **Dead Zone = Empty Level - Range**

Calculation I	Exponent	
Flume/weir shape	Venturi Flume	
Calculation II	Calculated	Flow is calculated from the equation $Q = K * h^x$
Max quantity	0.28 m^3/s	Q max
Flow cutoff	5%	No flow below 5% of max flow
K - factor	0.321	Given by a producer

R1 function	Totalizer	After 2000L, relay goes for 1 sec to the active state and then comes back to the passive state.
R1 set point 1	2000L	
R2 Function	Quantity	Relay 2 is in the active state when flow is below 80 L/s, in passive state when flow is above 90L/s
R2 set point 1	80 L/s	
R2 set point 2	90L/s	
Min. Flow	10L/s	For flow below or equal to 10 L/s current Output is 4mA, for flow greater or equal to 200 L/s, the current output is 20 mA in the range between 10 L/s and 200 L/s current Changes between 4 mA and 20mA
Max. Flow	200L/s	
Failsafe mode	0 mA	When an error happens the current output is 0mA

Example 2:

Flow measurement using Venturi Flume when hmax and Qmax are known.

Parameter	Settings	Description
Empty Level	150 cm	Distance from the transducer face to bottom of channel
Range	138 cm	Max level in channel
Calculation I	Exponent	
Flume/weir shape	Venturi Flume	
Calculation II	Empirial	$Q= (Qmax / h^x max)* h^x$
Max. Level	0.75 m	hmax
Max. Quantity	0.25 m^3/s	Qmax

Example 3:

Flow measurement using rectangular weir when K factor is known.

Parameter	Setting	Description
Empty Level	180cm	Distance from the transducer face to channel bottom
Range	120cm	Max. level in channel
Calculation I	Exponent	
Flume/weir shape	Rectangular Weir	
Calculation II	Calculated	Flow is calculated from the equation: $Q = K^* h^x$
Zero Offset	0.4 m	Distance from the channel bottom to beginning of flow
Max Quantity	0.58 m^3/s	Qmax
Flow Cutoff	5 %	No flow below 5% of max flow
K-factor	0.7	Factor given by producer
Relays	Look at Example 1	

Example 4

Flow measurement in V-weir when angle is known

Parameter	Setting	Description
Empty Level	198cm	Distance from the transducer face to channel bottom
Range	160cm	Max. level in channel
Calculation I	Exponent	
Flume/weir shape	V weir	
Calculation II	Calculated	Flow is calculated from the equation: $Q= K* h^x$
Zero Offset	0.43 m	Distance from the channel bottom to beginning of flow
Max Quantity	1.50 m^3/s	Qmax
Flow Cutoff	5 %	No flow below 5% of max flow
Angle	60^o	Weir angle

Example 5

K_factor Flume Exponent

Parameter	Setting	Description
Empty Level	150cm	Distance from the transducer face to channel bottom
Range	120cm	Max. level in channel
Calculation I	Exponent	
Flume/weir shape	Others	
Calculation II	Calculated	Flow is calculated from the equation: $Q= K^* h^x$
Max Quantity	0.28 m^3/s	Qmax
Flow Cutoff	5 %	No flow below 5% of max flow
K_factor	0,321	Factor given by producer
Exponent	1.5	

Example 6

H_{max} i Q_{max} and Flume Exponent

Parameter	Setting	Description
Empty Level	150cm	Distance from the transducer face to channel bottom
Range	120cm	Max. level in channel
Calculation I	Exponent	
Flume/weir shape	Others	
Calculation II	Imperial	Flow is calculated from the equation: $Q= K* h^x$
Max. level	0.19 m	
Max Quantity	0.28 m^3/s	Qmax
Flow Cutoff	5 %	No flow below 5% of max flow
Exponent	1.5	

Example 7

Flow measurement using Parshall's Flume

Parameter	Setting	Description
Empty Level	90cm	Distance from the transducer face to channel bottom
Range	60cm	Max. level in channel
Calculation I	Parshall flume	
Flume/weir shape	Flume Nr 2	
Max Quantity	0.25 m^3/s	Qmax
Flow Cutoff	5 %	No flow below 5% of max flow

Example 8

Flow using Palmer Bowlus.

Parameter	Setting	Description
Empty Level	60cm	Distance from the transducer face to channel bottom
Range	30cm	Max. level in channel
Calculation I	Palmer-Bowlus	
Flume/weir shape	DN = 250mm	
Max Quantity	0.035 m^3/s	Qmax
Flow Cutoff	5 %	No flow below 5% of max flow

Example 9

Parameter	Setting	Description
Empty Level	90cm	Distance from the transducer face to channel bottom
Range	60cm	Max. level in channel
Calculation I	KPV flume	
Flume/weir shape	KPV IV	
Max Quantity	0.15 m^3/s	Qmax
Flow Cutoff	5 %	No flow below 5% of max flow

Example 10

Flow using Khafagi Venturi

Parameter	Setting	Description
Empty Level	82cm	Distance from the transducer face to channel bottom
Range	50cm	Max. level in channel
Calculation I	Khafagi-Venturi	
Flume/weir shape	QV 305	
Max Quantity	0.09 m^3/s	Qmax
Flow Cutoff	5 %	No flow below 5% of max flow

Example 11

Flow Measurement using Q/h Characteristics

Parameter	Setting	Description
Empty Level	166cm	Distance from the transducer face to channel bottom
Range	100cm	Max. level in channel
H1	0.0 m	First point of the characteristic
Q1	0.0 m^3/s	
H 23	1.12 m	The characteristic consists of 23 points
Q 23	0.3476 m^3/s	
Number of pts.	23	Number of points used to convert Level to Flow
Calculation I	Universal	
Max Quantity	0.3476 m^3/s	Qmax
Flow Cutoff	5 %	No flow below 5% of max flow

NOTE: All points must be in order from the smallest to the biggest.