



million  
in one

**open channel**

OCM III

**SIEMENS**

**Safety Guidelines:** Warning notices must be observed to ensure personal safety as well as that of others, and to protect the product and the connected equipment. These warning notices are accompanied by a clarification of the level of caution to be observed.

**Qualified Personnel:** This device/system may only be set up and operated in conjunction with this manual. Qualified personnel are only authorized to install and operate this equipment in accordance with established safety practices and standards.

**Unit Repair and Excluded Liability:**

- The user is responsible for all changes and repairs made to the device by the user or the user's agent.
- All new components are to be provided by Siemens Milltronics Process Instruments Inc.
- Restrict repair to faulty components only.
- Do not reuse faulty components.

**Warning:** This product can only function properly and safely if it is correctly transported, stored, installed, set up, operated, and maintained.

**Note:** Always use product in accordance with specifications.

<b>Copyright Siemens Milltronics Process Instruments Inc. 2005. All Rights Reserved</b>	<b>Disclaimer of Liability</b>
This document is available in bound version and in electronic version. We encourage users to purchase authorized bound manuals, or to view electronic versions as designed and authored by Siemens Milltronics Process Instruments Inc. Siemens Milltronics Process Instruments Inc. will not be responsible for the contents of partial or whole reproductions of either bound or electronic versions.	While we have verified the contents of this manual for agreement with the instrumentation described, variations remain possible. Thus we cannot guarantee full agreement. The contents of this manual are regularly reviewed and corrections are included in subsequent editions. We welcome all suggestions for improvement.  Technical data subject to change.

MILLTRONICS® is a registered trademark of Siemens Milltronics Process Instruments Inc.

Contact SMPI Technical Publications at the following address:

Technical Publications  
Siemens Milltronics Process Instruments Inc.  
1954 Technology Drive, P.O. Box 4225  
Peterborough, Ontario, Canada, K9J 7B1  
Email: [techpubs.smpi@siemens.com](mailto:techpubs.smpi@siemens.com)

- For a selection of Siemens Milltronics level measurement manuals, go to: [www.siemens.com/processautomation](http://www.siemens.com/processautomation). Under Process Instrumentation, select *Level Measurement* and then go to the manual archive listed under the product family.
- For a selection of Siemens Milltronics weighing manuals, go to: [www.siemens.com/processautomation](http://www.siemens.com/processautomation). Under Weighing Technology, select *Continuous Weighing Systems* and then go to the manual archive listed under the product family.

# TABLE OF CONTENTS

---

---

TITLE	PAGE
<b>ABOUT THIS ...</b>	
About This Manual	7
About the OCM-3	7
<b>SPECIFICATIONS</b>	<b>9</b>
Programmer	10
Transducer	11
Temperature Sensor	11
Cabling	11
Communication Software	11
<b>INSTALLATION</b>	
Installing the OCM-3	13
Outline and Mounting	13
OCM-3 Layout	14
System Diagram	15
Installing the Transducer	16
Installing the Temperature Sensor	16
mA Output	17
Relays	17
Synchronization	18
Power Connections	19
Installing the Memory Back-up Battery	20
Communicating Via Computer	20
Installing the Programmer	20

## **START UP**

<b>General</b>	<b>21</b>
<b>Keypad</b>	<b>21</b>
<b>Legend</b>	<b>22</b>
<b>Initial Start Up</b>	<b>22</b>
<b>Fundamental Checks</b>	<b>25</b>

## **OPERATION**

<b>Memory</b>	<b>27</b>
<b>Security</b>	<b>27</b>
<b>Units</b>	<b>27</b>
<b>Flow Calculation</b>	<b>28</b>
<b>Display</b>	<b>28</b>
<b>Damping</b>	<b>29</b>
<b>Relays</b>	<b>30</b>
<b>mA Output</b>	<b>30</b>
<b>Fail-Safe</b>	<b>31</b>
<b>Flow rate and Totalizing</b>	<b>31</b>
<b>Logging</b>	<b>32</b>
<b>Blanking</b>	<b>34</b>
<b>Temperature</b>	<b>34</b>
<b>Time and Date</b>	<b>34</b>
<b>Emulation Mode</b>	<b>35</b>
<b>Reset</b>	<b>35</b>
<b>Flow Velocity Input</b>	<b>36</b>
<b>Auxiliary Head Input</b>	<b>36</b>
<b>DC Output</b>	<b>37</b>
<b>Diagnostic Aids</b>	<b>37</b>

<b>'D' PARAMETER LISTING</b>	<b>39</b>
<b>'F' PARAMETER LISTING</b>	<b>41</b>
<b>'P' PARAMETER LISTING</b>	<b>43</b>
<b>'U' PARAMETERS FOR P3 PRIMARY ELEMENT</b>	<b>51</b>
Simple Exponential Devices, P3 = 0	53
BS-3680 Rectangular Flume, P3 = 1	58
BS-3680 Round Nose Horizontal Crest Weir, P3 = 2	60
BS-3680 Trapezoidal Flume, P3 = 3	62
BS-3680 U - Flume, P3 = 4	64
BS-3680 Finite Crest Weir, P3 = 5	66
BS-3680 Thin Plate Rectangular Weir, P3 = 6	68
BS-3680 Thin Plate V-Notch Weir, P3 = 7	70
Rectangular Weir (Contracted), P3 = 8	72
Round Pipe, P3 = 9	74
Palmer-Bowlus Flume, P3 = 10	76
H - Flume, P3 = 11	78
Universal Head vs. Flow, P3 =12	80
Rectangular Area x Velocity, P3 = 13	82
Trapezoidal Area x Velocity, P3 =14	84
Modified Trapezoidal Area x Velocity, P3 = 15	86
U Channel Area x Velocity, P3 = 16	88
Circular Area x Velocity, P3 = 17	90
Gull-Wing Area x Velocity, P3 = 18	92
Egg-Shaped Area x Velocity, P3 =19	94
Universal Area x Velocity, P3 = 20	96

## **APPENDICES**

Maintenance	99
Error Codes	100
Communications	101



# ABOUT THIS ...

---

---

## ABOUT THIS MANUAL

Although the OCM-3 is very 'approachable' due its dialogue capabilities and intuitive operation, the user should be familiar with this manual. This manual provides the user with the necessary information required to install, start up and operate the OCM-3.

As the OCM-3 prompts the user with specific messages in a step-by-step fashion during programming, the Start Up section serves essentially to compliment the OCM-3. Start Up provides the user with instructions on the use of the programmer and an overview of the programming requirements.

The 'D', 'F', 'P' and 'U' parameters listed in the Parameters section provide a quick reference of the available programming and display parameters and their options. The 'U' parameter listing also provides mathematical and graphical details as a reference to assist the user in programming the OCM-3 to the primary element being used. The user is urged to rely on the manufacturer's specification for obtaining and identifying the primary element to which the OCM-3 is being applied.

In short,

<i>If you want to know about</i>	<i>Read</i>
the product	About This . . . Specifications
getting started	Installation Start Up
how it works	Operation Parameters Appendices

## ABOUT THE OCM-3

The OCM-3 is to be used only in the manner outlined in this instruction manual.

The Milltronics OCM-3, Open Channel Meter, is an electronic instrument designed to measure flow in open channels. It is housed in a polycarbonate enclosure and comes with a removable programmer. As a system, it is used in conjunction with a remote ultrasonic transducer (or auxiliary head measurement device) and a temperature sensor.

The OCM-3 transmits a pulse signal to the transducer which is then emitted as ultrasonic pulses. The pulses echo off the water surface and are then sensed by the transducer. The time for a pulse to echo back from the water surface is temperature compensated and converted into a measurement of head.

The OCM-3 converts the head measurement into flow rate, but also provides a velocity sensor input for applications where a flow velocity measurement is required to perform the flow calculation. The flow rate is totalized and stored in a comprehensive data log to provide detailed flow analysis.

Programming of the OCM-3 allows the operator to select the flow calculation specific to the primary measuring device (flume, weir or pipe). Special emphasis has been placed on providing the most accurate flow calculations possible. To this end, specific routines have been written to comply with the British Standards Institute's Specifications BS-3680. These routines calculate correction factors taking into account second order effects such as approach velocity and boundary layer. In the event that flow measurement is not covered by one of the flow calculations provided, the OCM-3 can be programmed for flow measurement using one of the universal flow calculations.

The OCM-3 provides serial communication for remote programming, data log retrieval and print out for devices such as computers, PLCs and printers. Milltronics provides a standard utilities software package for OCM-3 programming, remote display and data retrieval. However, the user is not limited to the software provided. The user can develop his own software program to perform tasks suited to his specific needs.

The OCM-3 features:

- ✓ multi field illuminated LCD, for 'Flow and Total' and 'Relay Status' display
- ✓ 0 or 4 to 20 mA output
- ✓ three multipurpose relays, including remote totalization
- ✓ 1 to 24 months data log, subject to logging rate
- ✓ extensive serial communication, including RS-232
- ✓ removable infra-red programmer
- ✓ AC and DC (bi-current) operation.

# SPECIFICATIONS

---

---

- Power:**
- » dc supply: » 9 to 30 V DC, 8 W max *and / or*
  - » ac supply: » 100/115/200/230 V ac  $\pm 15\%$ , 50/60 Hz, 20 VA max
- Environmental:**
- » location » indoor /outdoor
  - » altitude: » 2000 m max
  - » ambient temperature »  $-20$  to  $50\text{ }^{\circ}\text{C}$  ( $-5$  to  $122\text{ }^{\circ}\text{F}$ )
  - » relative humidity » suitable for outdoor (Type 4X/Nema 4X IP65 enclosure)
  - » installation category » II
  - » pollution degree » 4
- Memory back-up:**
- » 3 V lithium battery (NEDA 5003LC or equivalent)
  - » operating life 1 year
  - » 'SuperCap' capacitor for back-up during battery replacement
- Range:**
- » 0.3 m min to 1.2 m max ( 1 to 4 ft)
  - » 0.6 m min to 3 m max (2 to 10 ft)
- Resolution:**
- » 0.2 mm (0.007")
- Accuracy:**
- »  $\pm 1$  mm/m, calculated error less than 0.02%
- Temperature Compensation:**
- » external sensor to compensate over the operating range
- Programming:**
- » via supplied programmer and communication link
- Inputs:**
- » velocity sensor and auxiliary head
    - » range: » 0 to 10 V dc
    - » resolution: » 2.7 mV
- Outputs:**
- » transducer drive: » 44 KHz, 400 Vpp pulses of 0.1 msec typical duration at a 100 msec typical repetition rate.
  - » instrumentation:
    - » range: 0-20 or 4-20 mA
    - » resolution: 5  $\mu\text{A}$
    - » maximum loading: 1  $\text{K}\Omega$

- » isolation: 300 V ac continuous
- » relays:
  - » 3 alarm/control relays
  - » 1 form 'C' SPDT contact per relay, rated at 5 A at 250 V ac non-inductive or 30 V dc
- » dc output:
  - » +24 V dc
  - » 20 mA average to 200 mA at 1/10 duty cycle max
- Communication: » RS-232 or  $\pm 20$  mA bipolar current loop, 300, 600, 1200, 2400, 4800, 9600 or 19200 baud
- Data Logs:
  - » variable rate on 1, 5, 15, 30 or 60 min or 24 hr
  - » 31 days minimum/2 years maximum
- Display: » illuminated liquid crystal 5 x 7 dot matrix display with 2 lines of 40 characters each
- Enclosure:
  - » Type 4X / NEMA 4X / IP65
  - » 209 mm W x 285 mm H x 92 mm D (8.2" W x 11.2" H x 3.6" D)
  - » polycarbonate
- Weight: » 2.3 Kg (5.1 lb)
- Approvals:
  - » CE \*, FM, CSA NRTL/C
  - » MCERTS Class 1 open channel flow device with environment operation limits at 35 °C (95 °F) at 93% relative humidity



SIRA MC 050058/01

## PROGRAMMER

- Enclosure:
  - » general purpose
  - » 67 mm W x 100 mm H x 25 mm D (2.6" W x 4" H x 1" D)
  - » ABS plastic
- Operating Temperature: » -20 to 50 °C (-5 to 122 °F)

**Battery:** » 9 V (ANSI / NEDA 1604, PP3 or equivalent) or  
3V lithium battery

## **TRANSDUCER**

**Model:** » XRS-5\*

Refer to associated Transducer manual.

## **TEMPERATURE SENSOR**

**Model:** » TS-2, LTS-1 or LTS-1C

Refer to associated Temperature Sensor manual.

## **CABLING**

**Transducer:** » RG-62U coaxial  
» maximum separation 183 m (600 ft)  
» must be run in grounded metal conduit

**mA Output:** » Belden 8760 or equivalent

**Synchronisation:** » Belden 8760

**Temperature Sensor:** » Belden 8760, 1 pair shielded/twisted,  
18 AWG or equivalent  
» maximum separation 183 m (600 ft)  
» can be run in conduit with transducer cable

**Communication:** » RS-232: » Belden 8770, 3 wire shielded, 24 AWG  
or equivalent  
» maximum separation 15 m (50 ft)  
» Bipolar Current: » Belden 9552, 2 pair shielded/twisted,  
18 AWG or equivalent  
» maximum separation 1,500 m (5,000 ft)

\*Note: The XRS-5 must be used with the TS-2 external temperature sensor when operating with the OCM-3.

**Velocity Input:** » Belden 8760 or equivalent

**Auxiliary Input:**

» **Belden 8760 or equivalent**

**24 V Output:**

» **Belden 8760**

## **COMMUNICATION SOFTWARE**

**Milltronics Utilities Software on standard PC floppy disk for DOS 3.1 and up.**



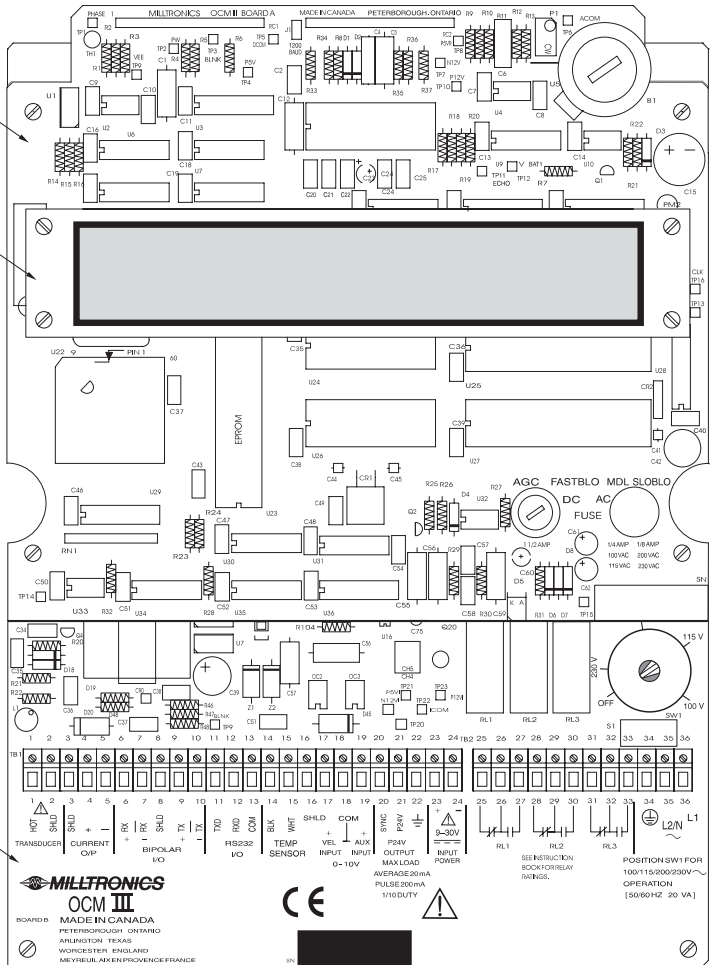


# OCM-3 LAYOUT

board A

display board

board B

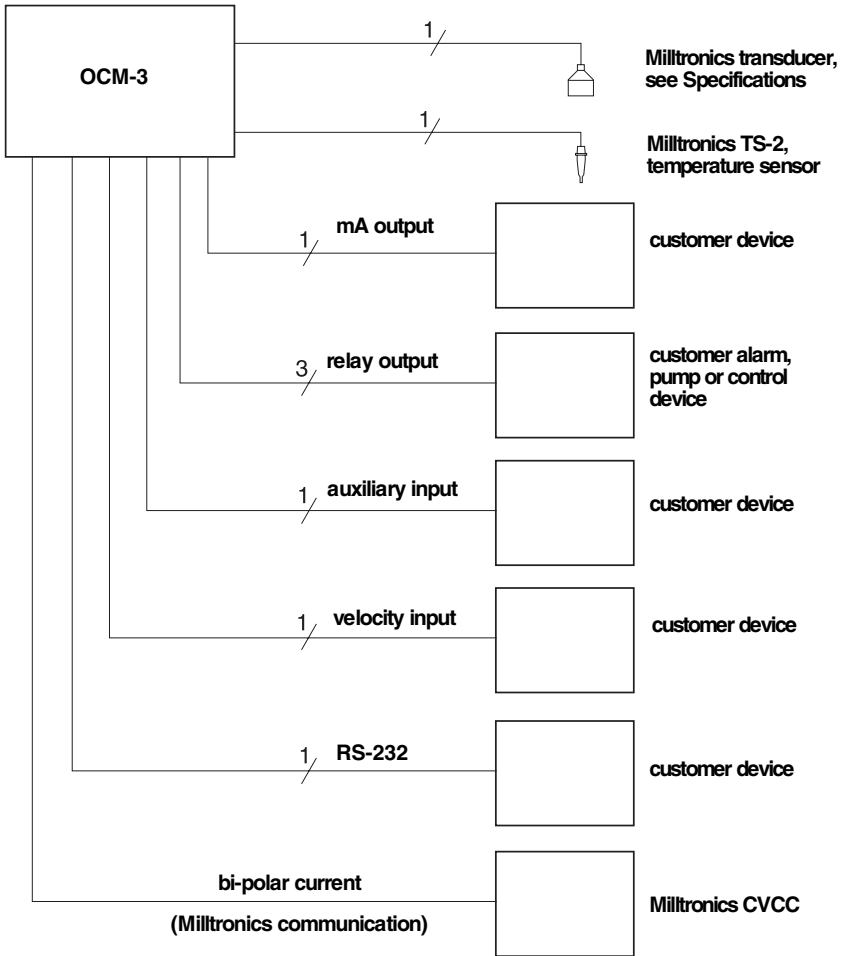


- ⚠ All field wiring must have insulation suitable for at least 250 V.
- ⚠ Hazardous voltage present on transducer terminals during operation.
- ⚠ dc terminals shall be supplied from SELV source in accordance with IEC 1010-1 Annex H.

Relay contact terminals are for use with equipment having no accessible live parts and wiring having insulation suitable for at least 250 V.

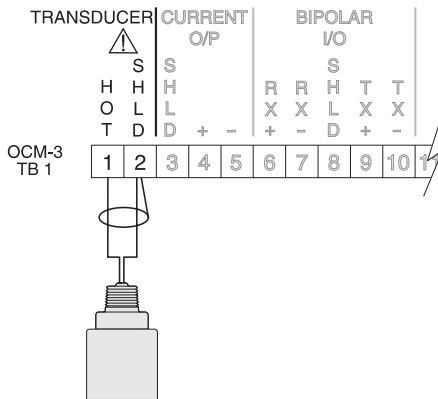
The maximum allowable working voltage between adjacent relay contacts shall be 250 V.

# SYSTEM DIAGRAM



Maximum system capability. Not all components or their maximum quantity may be required.

## INSTALLING THE TRANSDUCER



Max cable run 183 m (600 ft) of RG-62U or equivalent. Cable must be run in a grounded metal conduit with no other cabling (except Temp. Sensor cable).

Ground shield at OCM-3 only.

Insulate shield at junctions to prevent inadvertent grounding.

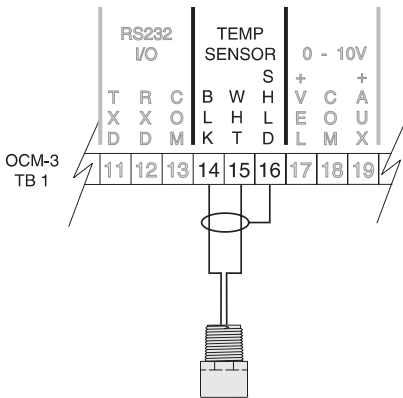
Basic Wiring – Transducer



Hazardous voltage present on transducer terminals during operation.

Note: When using the XRS-5 transducer with the OCM-3, use the TS-2 external temperature sensor. The internal temperature sensor in the XRS-5 cannot be used.

## INSTALLING THE TEMPERATURE SENSOR



In order to compensate for uniform temperature change in the air between the transducer and the flow surface, the temperature sensor must be connected to the OCM-3.

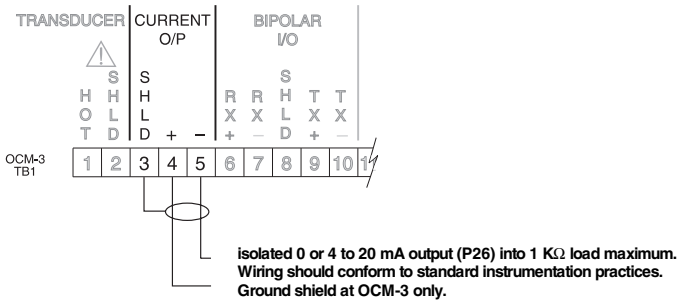
Maximum cable run 183 m (600 ft) of Beldon 8760, 1 pair shielded/twisted, 18 AWG or equivalent.

Temperature sensor cable can be run with the transducer cable in a grounded metal conduit.

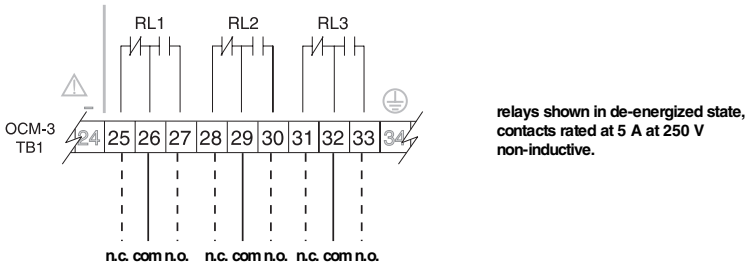
Ground shield at OCM-3 only.

Basic Wiring – Temperature Sensor

## mA OUTPUT



## RELAYS

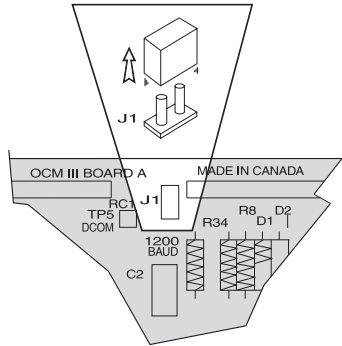


All relays are certified for use in equipment where the short circuit capacity of the circuits in which they are connected is limited by fuses having ratings not exceeding the rating of the relays.

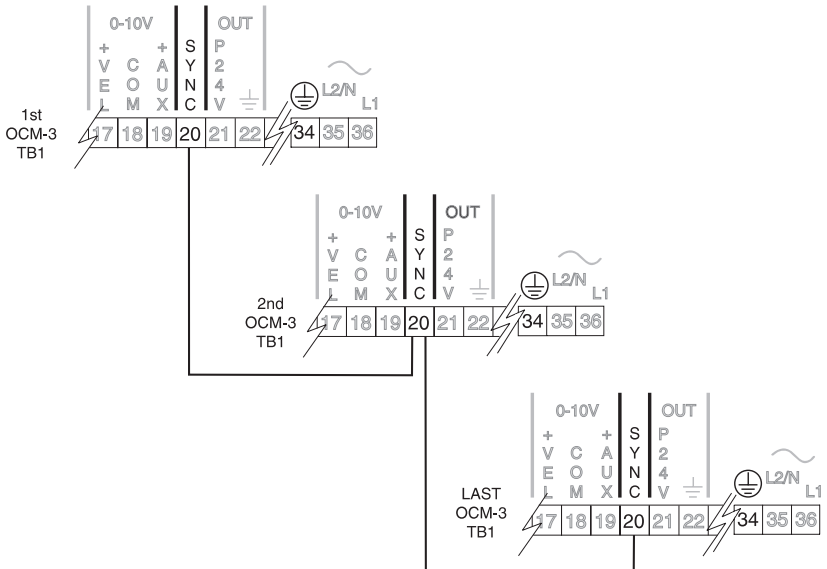
## SYNCHRONIZATION

Where two to a maximum of twelve transducers will be sharing a common conduit the OCM-3s should be synchronized. In order to synchronize OCM-3s:

- » remove jumper J1 on board A on all but one OCM-3



- » interconnect the SYNC terminal (TB1-20) of all OCM-3s. Insure that all OCM-3s share a common ground (TB1-34).

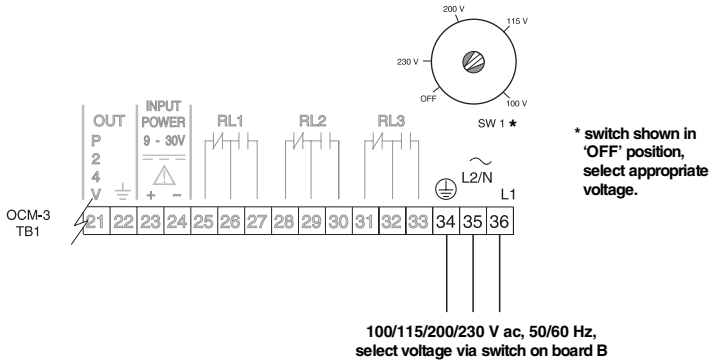


## POWER CONNECTIONS

The OCM-3 power supply accepts 100, 115, 200 or 230 V ac per switch SW1 (board B) selection and 9 to 30 V dc.

The OCM-3 operates either under ac or dc power, or both ac and dc live simultaneously. If both ac and dc power are live, the OCM-3 normally draws power from the ac supply. In the event that the ac supply fails, the OCM-3 then draws power from the dc supply.

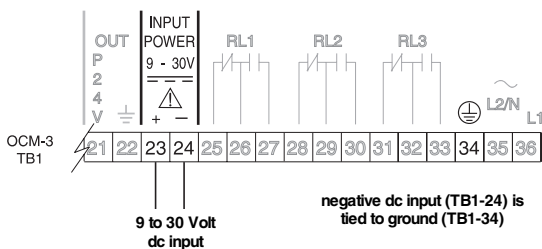
### AC POWER



The equipment must be protected by a 15 A fuse or circuit breaker in the building installation.

A circuit breaker or switch in the building installation, marked as the disconnect switch, shall be in close proximity to the equipment and within easy reach of the operator.

### DC POWER

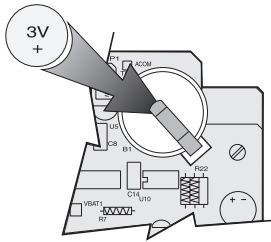


dc terminals shall be supplied from SELV source in accordance with IEC 1010-1 Annex H.

## INSTALLING THE MEMORY BACK-UP BATTERY



Disconnect power before installing or replacing the battery.



Do not install the memory back-up battery until the OCM-3 is to be used.

The unit is supplied with one battery package. Remove the battery from the package and insert it into the battery socket.

Refer to Operation \ Memory.

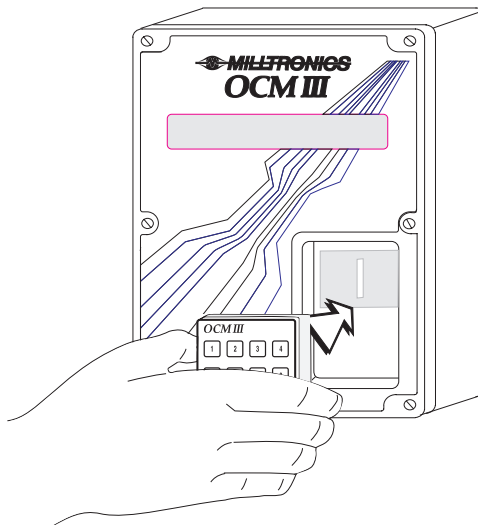
The memory battery, B1 (see Specifications) should be replaced yearly to insure memory back up during lengthy power outages. An on board capacitor provides one hour of memory retention in order to preserve the memory while the battery is being changed.

## COMMUNICATING VIA COMPUTER

Refer to Communication.

## INSTALLING THE PROGRAMMER

To program the OCM-3 via the Programmer, it must be placed into the front cover recess of the OCM-3. The back of the Programmer has a magnetic plate which will hold the programmer in place. It can be removed when programming is completed.



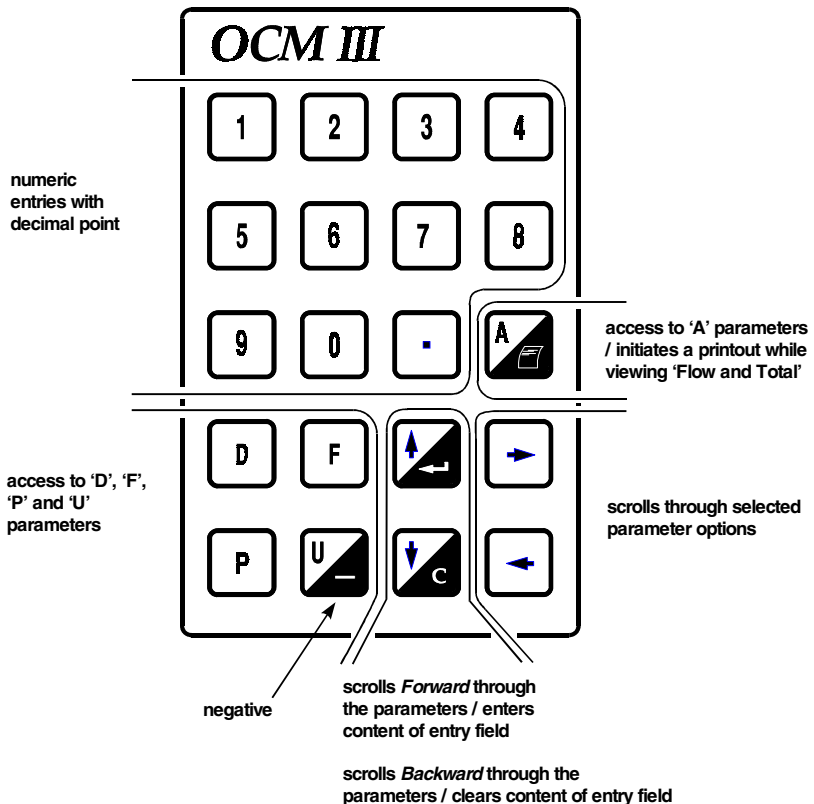
# START UP

## GENERAL

For the initial start up, it is advisable to use the programmer for programming the OCM-3. The programmer transmits a coded infrared signal each time a key is pressed.

The OCM-3 is designed to automatically scroll through the 'A', 'D', 'F', 'P' and 'U' parameters in a structured sequence. The scrolling is interactive in that, depending on the option chosen for a given parameter, subsequent parameters may be skipped or modified. The user is thus prompted to satisfy only the parameters which are available to him for the application he has chosen.

## KEYPAD



## LEGEND

Press the associated programmer key: 

Display shown on OCM-3:

MILLTRONICS OCM III  
Copyright Milltronics, 1992

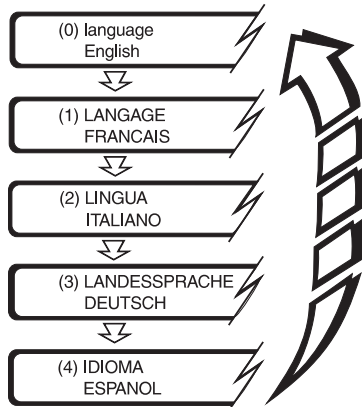
Programmer key: 

## INITIAL START UP

After installation procedures have been completed, the OCM-3 may be powered up. Upon initial powering up, the unit momentarily displays:

Initializing...

and then scrolls through the available languages:



*The OCM-3 is asking which language you prefer to communicate in!*



(0) language  
English

English language  
selected



F0 enter security code  
< - - -

advance to 'F0'



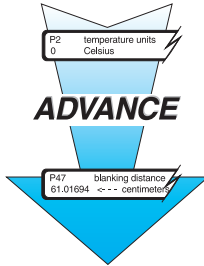
factory set security code  
2.71828 must be entered

P0 language  
0 English

if the wrong language  
was selected, it may  
be changed here



P1 dimensional units  
0 centimeters



continue programming by  
entering the desired options  
and advancing until the  
scroll returns to 'P0'. It is  
then assumed that the  
user has entered all the  
required parameters.

P0 language  
0 English

For optimum calibration accuracy, an 'F13' should be performed prior to accessing 'F2', the normal operating mode.



F13 auto zero calibration

enter the current head. The  
OCM-3 calculates 'P46' and  
automatically enters the value.

e.g. 1 6 0



F13 auto zero calibration  
160



F13 auto zero calibration  
0 completed

If data logging is desired, the time and date must be set.



F4 24-hr. time

e.g. 1141



F4 24-hr. time  
1141

11:41 a.m.,  
seconds are always  
assumed to be 00



F4 24-hr. time  
11:41:00 enter new time

time is displayed in  
hh:mm:ss



F5 (ddmmyyyy) date

e.g. 12101492

October 12, 1492



F5 (ddmmyyyy) date  
12/10/1492 enter new date

The start up procedure is now complete. Enter 'F2' to place the OCM-3 in the normal operating mode.



FLOW	##	units	RELAY	1 2 3
TOTAL	####	units	STATE	???

Note: To save parameter values, return to RUN mode (F2) after programming.

The OCM-3 now displays the flow rate and total. Refer to Operation \ Display

## **FUNDAMENTAL CHECKS**

**For accurate determination of flowrate, accurate head measurement is essential. Check the following and correct if necessary.**

- » check D5 for correct temperature at transducer location.
- » check D9 for correct distance from transducer to head.
- » check D0 for accurate head measurement.



## OPERATION

---

---

Upon power up, the transducer is fired periodically as set by P36. A long interval between measurements may be desirable in order to conserve power\* when operating the OCM-3 from a DC source of limited capacity.

The echo is processed to determine the head (D0). The flow rate (D1) is calculated by the OCM-3 as a mathematical function (P3 and P4) of head or a function of head and velocity (P42). The flow rate is then integrated to yield the totalized flow (D2). The 'Flow' and 'Total' fields which are displayed during the normal running mode (F2) are also continuously updated.

Viewing or changing the content of a parameter (except F1, emulation) is done without disturbing the acquisition, processing or logging of flow data (see \ Security).

\* restricted usage of display lighting (P14), relays (P15, 18 & 21), mA output and communications will also conserve power.

## MEMORY

During a power interruption, the memory back up will hold the programming, the log and the totalizer values, and run the clock. The memory battery (B1) provides up to one year of memory retention (see Appendices \ Maintenance).

Note: To save parameter values, return to RUN mode (F2) after programming.

## SECURITY

The content of all 'A', 'D', 'F', 'P' and 'U' parameters can be viewed without having to satisfy the security parameter, F0. However if it is desired to change the content of any of these parameters, the security parameter must be satisfied (except for resetting the running min/max displays, parameters D3/D4 and D6/D7).

Once security has been satisfied, access continues for 5 minutes after the last key is pressed or until F2 is re-entered.

The security code may be changed from its factory set value, 2.71828, by entering a new value into F10. It is imperative that the new value be recorded, as the code can not be viewed. If the code is lost, consult Milltronics.

## UNITS

Programming of the OCM-3 involves setting the units of measure:

- » P1 linear and velocity
- » P2 temperature
- » P5 flow rate and volume

If the units are changed during the course of operation, the change will be effected through all associated parameters and displays and will rescale flow and total data stored in the logs.

## FLOW CALCULATION

### Absolute vs. ratiometric

The OCM-3 can be programmed to use either of two methods (P4) for calculating flow from the head measurement: absolute or ratiometric. The result is the same regardless of the method used. The principal difference is the information that must be entered in order for the OCM-3 to carry out the calculation. The user's choice of method may ultimately be based upon the information which is at hand. Refer to U parameters for the primary element selected for a listing of the information required.

For the ratiometric method, it is usually sufficient that the user know the flow rate ( $Q_{cal}$ ) which occurs at maximum head ( $h_{cal}$ ).

On the other hand, absolute calculations require that the user enter information such as: the physical dimensions of the primary element and the constant relating to units of measure for both linear dimensions and flow rates.

e.g.

the general formula for flow through a single exponent primary element is:

$$Q = KH^x$$

the specific formula for flow through a 45° V-notch weir is:

$$cfs = 1.03H^{2.5}$$

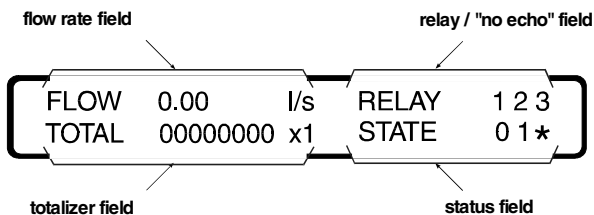
thus:     $Q$  = flow in cubic feet per second  
           $K$  = constant of 1.03  
           $H$  = head in feet

The absolute method is not applicable to the following:

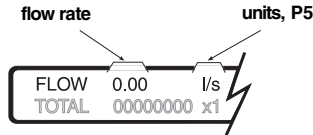
Palmer Bowlus flume  
H flume

## DISPLAY

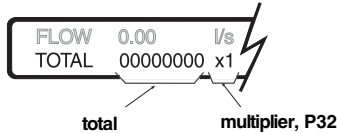
The normal display during operation is the Flow and Total Display (F2).



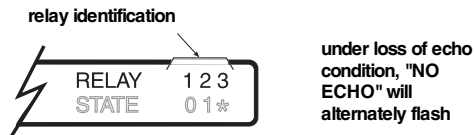
## Flow Rate Field



## Totalizer Field



## Relay / No Echo Field



## Status Field



relay status : 0 = relay de-energized  
1 = relay energized  
\* = alarm state (indicated when flashing)

The OCM-3 provides illumination for the LCD for easier viewing of the display. Illumination can be set (P14) to be normally on or off, or automatic. When automatic is selected, the lighting will automatically go on when keypad activity is sensed and then extinguish after 15 seconds of inactivity.



*For battery operation, set display lighting to off or auto.*

## DAMPING

The OCM-3 provides two separate damping functions: reading and mA output. Zero or no damping allows fastest response while high or 100% provides the slowest response. The damping is usually set to provide a reliable response without sacrificing stability.

The reading damping, P13, dampens only the flow rate reading of the 'Flow and Total' display F2. The damping selections are: off, low, medium and high. Relay functions associated with flow rate respond to the dampened reading values.

mA output damping, P27, dampens the change in the mA output. The parameter entry is in seconds for spanning the 0 to 100% of the mA range selected (P26). Displays and relay functions associated with the mA output respond to its dampened value.

## RELAYS

Three on board multipurpose relays are provided by the OCM-3. P15, 18 and 21 set the respective functions for relays 1, 2 and 3. Depending on the function selected, these parameters determine the need and configuration of the subsequent relay control parameters, P16, 17 (relay 1); P19, 20 (relay 2) and P22, 23 (relay 3).

If the relay is to function as a driver for a remote totalizer or as a flow sampler contact, the totalizer multiplier (P32) will be factored by the setpoint. Note that parameters P16, P19, and P22 will default to zero. When a relay is set to totalizer (P32), you must have the applicable parameter (P16 for relay 1, P19 for relay 2, or P22 for relay 3) set to something other than zero (normally 1).

Example: For relay 1

$$\begin{aligned}\text{Relay totalizer factor} &= \frac{\text{totalizer factor (P32)}}{\text{relay 1 setpoint (P16)}} \\ &= \frac{100 \text{ (P32=5)}}{2 \text{ (P16)}} \\ &= 50 \text{ units/pulse}\end{aligned}$$

The status of each relay is shown in the display. Refer to \ Flow and Total Display.



*For battery operation, have relays energizing on alarm.*

## mA OUTPUT

The OCM-3 provides a mA output (TB1-4/5) which can be assigned (P24) to represent the measurement of flow, head, velocity or temperature. The associated scaling, P25, is factory set to a value of '0'. This provides normal scaling with respect to the assigned measurement.

Normal scaling for representation of flow, head or velocity is:

- » 0 or 4 mA = 0
- » 20 mA = maximum measurement value for:
  - » P6\*: flow rate at maximum head
  - » P7: maximum head
  - » P10: velocity at maximum head

Normal scaling for representation of temperature is:

- » 0 or 4 mA = - 40 °C
- » 20 mA = 60 °C

If custom scaling is required, the 20 mA corresponding value (other than 0) can be entered into P25. The range (0 to 20 or 4 to 20 mA) and damping (see Damping) are set via P26 and P27 respectively.

The mA function can be overridden for test purposes by setting the desired mA value into F3. When the value is entered, the mA output will go to that value. When F3 is exited, the mA output will revert to normal operation. Also, see \ Emulation Mode.

\*In the case of absolute calculations (P4=0),  
P6 is calculated by the OCM-3.

## FAIL-SAFE

In the event of an echo loss, the fail-safe timer will begin counting. If the echo loss duration surpasses that of the time set (P29), a 'No Echo' alert will be displayed in the Status field (see \ Display). The mA output will respond (P30) by either holding the last value or immediately going to a predetermined value (P31). The head and derived flow will hold their last value and totalization and logging will continue, based on that value. Upon resumption of a valid echo, the mA output will return to a value corresponding to the present value of the measurement assigned, at the mA damping rate (P27).

## FLOW RATE AND TOTALIZING

### Flow rate

Calculation of the flow rate is ongoing. It is normally viewed under the Flow and Total display (F2) with the decimal point set per P33. It can also be viewed under D1 as the raw flow calculation. Data on the running minimum and maximum flows that have occurred since the last reset can be viewed in two ways:

- » F7 gives the running min/max flows and their time and date of occurrence since the last reset. F7 is reset by F8 but only after satisfying the security parameter F0.
- » D3/D4 give the respective running min/max flow data, only, that have occurred since they were last reset. D3/D4 are reset simultaneously by entering 0 into either D3 or D4. D3 and D4 will then adopt the current flow rate and track the running min/max values from that point on. The security parameter (F0) does not need to be satisfied in order to reset D3/D4.

Flow data specific to a particular time and date can be viewed under the data log F14 (see \ Logging).

### Totalizing

Totalizing of the calculated flow is ongoing. It is normally viewed under the Flow and Total display (F2).

An auxiliary totalizer (D2) is provided for operator usage and is intended for short term totalizing to a maximum count of 999999. It can be reset or preset independently of the F2 totalizer after satisfying the security parameter (F0).

In order to adjust the rate of filling of the totalizer, the totalizer multiplier (P32) can be set to an appropriate value. The totalizer can be reset via F11. Totalizing that is specific to the time and date can be viewed under the data log F14.

The OCM-3 can be programmed to operate a remote totalizer by assigning any of the relays (P15, 18 or 21) to act as a totalizer contact\*. Under this function, the maximum rate of contact closure is 2/sec with a closure duration of 200 msec\*\*.

\* The totalizer count is set by the relay setpoint parameter (P16, 19 or 22 respectively).

\*\* Typically the totalizer should be set for 300 to 3000 counts per day at maximum flow.

Under low flow conditions, a cut-off head (P45) can be entered to avoid totalizing flows occurring at or below the flow corresponding to the cut-off head.

## LOGGING

The OCM-3 provides an extensive logging feature which can be viewed on the local display or retrieved via the serial communication link. The logging rate (P39) can be fixed or variable. The latter being useful in conserving logging space. The condition for variable logging is determined when selecting the logging rate.

Variable logging rate conditions are categorized as : rate of change of flow, percent of maximum flow or percent of maximum head. Logging occurs at the normal (slower) rate while the condition is less than the setpoint (P40). If the condition exceeds the log rapid setpoint, the rapid rate of logging takes effect until the condition falls below the log normal setpoint (P41).

The associated setpoint units are : % change of maximum flowrate per minute, % of maximum flowrate and % of maximum head, respectively. The setpoints represent the absolute value of the rate of change; that is, for either increasing or decreasing flowrate. The OCM-3 does not recognize negative entries into P-40 and P-41.

Flow data is logged in 1/2 % increments from 0 to 110 % of maximum flow. Flows above 110 % are logged as 110 %. Truncation of flows to 110 % does not apply to daily totalization.

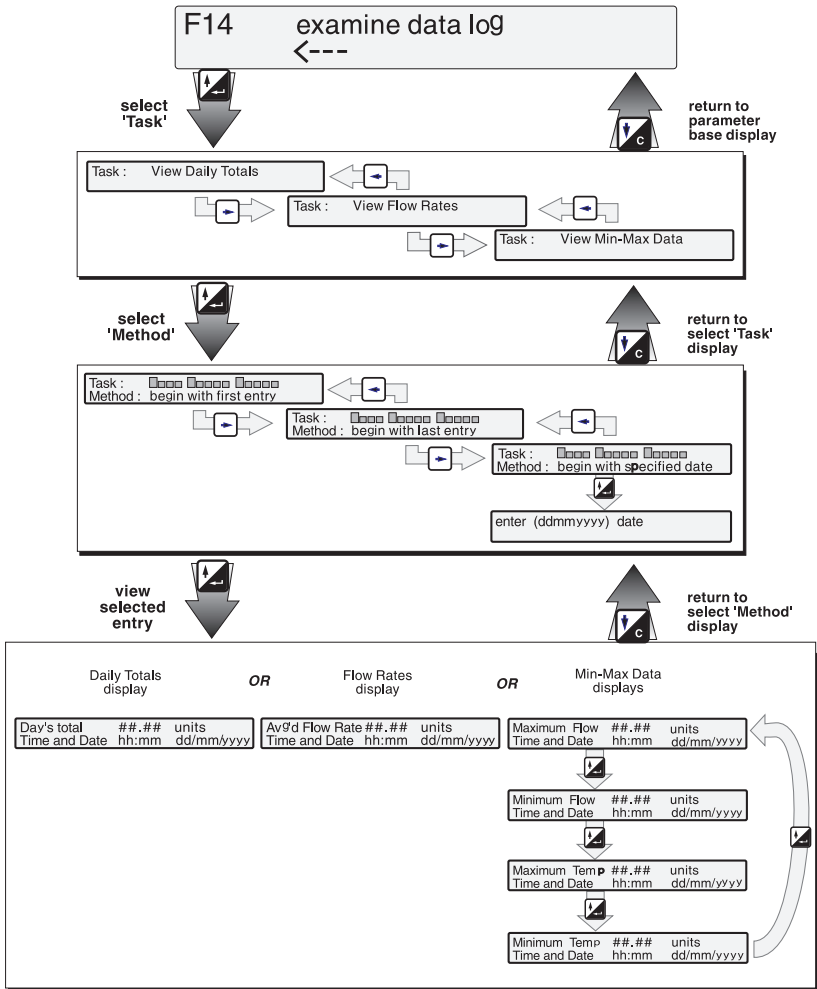
### Log Capacity vs Rates

	<u>rate</u>	<u>capacity</u>
	1 min	31 days
	5	3 months
	15	9 months
	30	1 year
	60	1.5 years
	24 hr	2 years
e.g.	15 / 5	9 months max / 3 months min

Once the log is filled, the old data will be successively written over with the new data being logged.

The log can be examined via F14. Viewing of the log is done by task and by method. The viewing tasks are: daily flow totals, flow rates and min-max flow data for flow or temperature. The viewing methods are: by first entry, by last entry and by specified date. The scrolling keys are used to maneuver through the tasks, methods and time of day.

## Viewing the data log



The day totalizer (F14) does not use the master totalizer multiplier (P32). It is possible that the daily total overflows. In such a case the display will show +++.++.

## BLANKING

Blanking is used to ignore the zone in front of the transducer where ringing or other false echo is at a level that interferes with the processing of the true echo. The minimum blanking is factory set, but can be overridden by entering the desired distance into P47.

Ringing is the inherent nature of the transducer mass to continue vibrating after the transducer has been fired. Ringing decays to acceptable levels in the order of milliseconds. Excessive cold or over tightening of the transducer mounting may increase the ring time such that it appears as an echo during the receive cycle. This is usually indicated by an incorrect high head reading. Excessive ring time may be overcome by increasing the blanking.

## TEMPERATURE

The temperature as currently registered by the temperature sensor is viewed under D5. Data on the running minimum and maximum temperatures that have occurred since the last reset can be viewed in several ways:

F7 gives the running min/max temperatures and their time and date of occurrence since the last reset. F7 is reset by F8 but only after satisfying the security parameter F0.

D6/D7 give the respective running min/max temperature data, only, that have occurred since they were last reset. D6 is reset by entering a value lower than D5, and D7 is reset by entering a value larger than D5. D6 and D7 will then adopt the current temperature value and track the min/max values from that point on. The security parameter F0 does not need to be satisfied in order to reset D6 or D7.

Temperature data specific to the time and date can be viewed under the data log F14 (see \ Logging).

D14 indicates the resistance of the temperature sensor corresponding to the temperature shown in D5.

## TIME AND DATE

If the data logging features of the OCM-3 are to be used, the time (F4) and date (F5) must be set. The day starts at 00:00:00 and ends at 23:59:59.

### Adjusting the Time

If the clock time is advanced beyond the next anticipated logging time, the entry for each missed logging time is filled with a code which indicates that the system was not able to make entries at those times.

The daily total will be reduced proportional to the amount of time the day was shortened.

If the clock time is set back beyond the preceding logging time, the previously logged date will be written over with new data as the logging proceeds.

The daily total will be increased proportional to the amount of time the day was lengthened.

### **Adjusting the Date**

If the calendar is reset, the OCM-3 will adjust the log dates accordingly, taking into account leap years and days per month.

## **EMULATION MODE**

The flow calculation (P3/P4) can be checked for accuracy by using the emulation parameter F1. The head is entered and the corresponding flow is displayed. This function is useful when troubleshooting discrepancies between the OCM-3 calculation and the expected flow.

Relays assigned to functions associated with the emulation parameter respond to the emulated flows.

The mA output does not track the emulated flows when P28 (mA output emulation) = 0. However, if it is required to do so, then the emulator parameter should be set to 1.

## **RESET**

The following resets can only be executed after satisfying the security access, F0.

### **Cold Start**

If it is desired to reset all parameters, logs and totalizers to their factory setting, this is done by forcing a cold start, F12.

### **Master Totalizer**

If it is desired to reset the master totalizer (F2), this is done by parameter F11.

### **Data Log**

If it is desired to reset the data log (F14), this is done by parameter F15.

### **Min/Max Log**

If it is desired to reset the min/max log (F7), this is done by parameter F8.

## FLOW VELOCITY INPUT

In some applications, the flow calculation for the chosen primary element requires a velocity input. In this type of application, the transducer measurement is used to calculate the cross sectional area of the flow. By multiplying the area with the distance per time units of velocity, the volume per time units of flow are calculated. The calculated velocity can be viewed via D8.

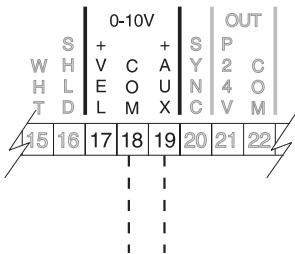
The 0% and 100% limits of the velocity input must be scaled using parameters P8 and P9.

- » select P8
- » enter the voltage corresponding to zero velocity
- » select P9
- » enter the velocity corresponding to 5 V

e.g. If the velocity sensor output is 1 V per m/sec and the output is scaled for 7 V at 100% velocity (7 m/sec), then enter 5 m/sec. If the output is scaled for 4 V at 100% velocity (4 m/sec), enter 5 m/sec.

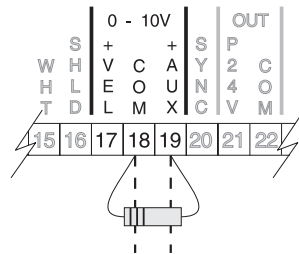
P8 and P9 can only be accessed if P3 has been set for an option that requires the use of a velocity input. The input voltage level can be viewed via D12.

### Voltage Input



typical 1 - 5 V signal from velocity sensor.

### Current Input



typical 4 - 20 mA signal from velocity sensor.  
Add terminating resistor.  
e.g. 250  $\Omega$  for 1 - 5 V over 4 - 20 mA.

*Signal must be positive with respect to ground.*

**Velocity Input (additional to Basic Wiring)**

## AUXILIARY HEAD INPUT

In some applications, the transducer input (TB1-1/2) is not used to provide a signal for head measurement. A typical example of this is an application which is beyond the 3 m (10 ft) range of the OCM-3. In such a case, the head could be derived from another Milltronics level monitor or other compatible device.

The method of head determination is set by P42. The OCM-3 simply substitutes the signal from the auxiliary device for the ultrasonic measurement provided by the transducer. The programming and consequent flow calculation are performed as normal.

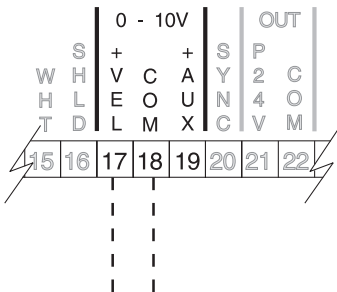
The 0% and 100% limits of the auxiliary input must be scaled using parameters P43 and P44.

- » select P43
- » enter the voltage corresponding to zero head
- » select P44
- » enter the head corresponding to 5 V.

e.g. if the head output is 1 V per m and the output is scaled for 7 V at 100% head (7 m), then enter 5 m. If the output is scaled for 4 V at 100% head (4 m), enter 5 m.

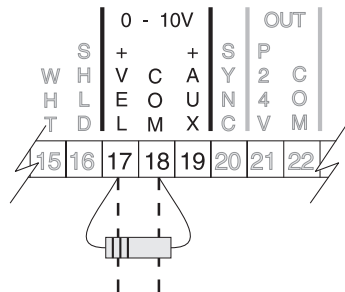
P43 and P44 can only be accessed if P42 has been set for head determination by an auxiliary device. The input voltage level can be viewed via D13.

### Voltage Input



typical 1 - 5 V signal from auxiliary device.

### Current Input



typical 4 - 20 mA signal from auxiliary device. Add terminating resistor. e.g. 250 Ω for 1 - 5 V over 4 - 20 mA.

*Signal must be positive with respect to ground.*

**Auxiliary Input** (additional to Basic Wiring)

## DC OUTPUT

The OCM-3 provides a 24 V DC output that can be used to supply power to a remote customer device. The output is not isolated from the DC rails that supply the OCM-3 electronics and no overload protection is provided. As such, the output must not operate beyond its specified capacity.

## DIAGNOSTIC AIDS

D15 through D18 are diagnostic aids to Milltronics service personnel when troubleshooting system problems.

D18 also serves as a performance indicator by displaying the number of valid echos received as a percentage of the number of pulses being fired by the transducer. A low value indicates that a large proportion of the pulses fired are not producing valid echos. In such instances, the transducer should be checked for proper mounting and aiming or the transducer wiring checked for excessive noise. If the value is zero, shorted or opened transducer wiring may be suspect.

## 'D' PARAMETER LISTING

---

---

Refer to 'Operation' for details.

D0	head
D1	flow rate
D2	short total *
D3	maximum flow rate
D4	minimum flow rate
D5	temperature
D6	maximum temperature
D7	minimum temperature
D8	velocity <sup>◇</sup>
D9	nominal target range
D10	analog milliamps
D11	internal DC volts
D12	velocity volts <sup>◇</sup>
D13	auxiliary input volts
D14	temperature sensor ohms
D15	self-test checksum
D16	restarts
D17	exceptions
D18	valid echos per 100

\* *security access required*

<sup>◇</sup> applicable to flow calculations requiring velocity sensor



## 'F' PARAMETER LISTING

---

---

Refer to 'Operation' for details.

- F0 enter security code
- F1 emulation mode \*
- F2 run mode
- F3 keypad to mA output \*
- F4 show time  
set time \*
- F5 show date  
set date \*
- F6 software identification number
- F7 view min/max data
- F8 reset min/max data \*
- F9 self check \*
- F10 change security code \*
- F11 reset master totalizer \*
- F12 force a cold start \*
- F13 auto zero calibration \*
- F14 examine data log:
  - task: view daily totals
  - view flow rates
  - view min/max data
  - method:
    - first day
    - last day
    - specified day
- F15 clear data log \*

\* security access required



## 'P' PARAMETER LISTING

---

---

Refer to 'Operation' for details.

P0 language

- 0 = english
- 1 = french
- 2 = italian
- 3 = german
- 4 = spanish

P1 dimensional units

*linear*

*velocity*

- |                 |                        |
|-----------------|------------------------|
| 0 = centimetres | centimetres per second |
| 1 = inches      | inches per second      |
| 2 = feet        | feet per second        |
| 3 = metres      | metres per second      |

P2 temperature units

- 0 = Celcius
- 1 = Fahrenheit

P3 primary element

- 0 = exponential device
- 1 = BS-3680 Rectangular Flume
- 2 = BS-3680 Round Nose Horizontal Crest Weir
- 3 = BS-3680 Trapezoidal Flume
- 4 = BS-3680 U-throated Flume
- 5 = BS-3680 Finite Crest Weir
- 6 = BS-3680 Thin Plate Rectangular Weir
- 7 = BS-3680 Thin Plate V-notch Weir
- 8 = Rectangular Weir (contracted)
- 9 = Round Pipe
- 10 = Palmer Bowlus Flume
- 11 = H Flume
- 12 = Universal Head vs. Flow

- 13 = Rectangular Area x Velocity
- 14 = Trapezoidal Area x Velocity
- 15 = Modified Trapezoidal Area x Velocity
- 16 = U-channel Area x Velocity
- 17 = Circular Area x Velocity
- 18 = Gull-wing Area x Velocity
- 19 = Egg-shaped Area x Velocity
- 20 = Universal Area x Velocity

P4 method of calculation

- 0 = absolute
- 1 = ratiometric

P5 flow rate units

<i>flowrate</i>	<i>volume</i>
0 = litres per second	litres
1 = cubic feet per second	cubic feet
2 = imperial gallons per minute	imperial gallons
3 = U.S. gallons per minute	U.S. gallons
4 = imperial million gallons per day	imperial million gallons
5 = U.S. million gallons per day	U.S. million gallons
6 = cubic metres per hour	cubic metres
7 = cubic metres per day	cubic metres

P6 flow at maximum head

P7 height of maximum head

P8 volts in at zero velocity

P9 velocity at 5 volts in

P10 velocity at maximum flow

**P13 display damping**

- 0 = off
- 1 = low
- 2 = med
- 3 = high

**P14 display lighting**

- 0 = on
- 1 = auto off
- 2 = off

**P15 / P18 / P21 relay 1 / 2 / 3 assignment**

- 0 = not in service
- 1 = de-energize on loss of echo
- 2 = energize on loss of echo
- 3 = de-energize on high flow rate
- 4 = energize on high flow rate
- 5 = de-energize on low flow rate
- 6 = energize on low flow rate
- 7 = de-energize on high head
- 8 = energize on high head
- 9 = de-energize on low head
- 10 = energize on low head
- 11 = de-energize on high velocity
- 12 = energize on high velocity
- 13 = de-energize on low velocity
- 14 = energize on low velocity
- 15 = de-energize on high analog
- 16 = energize on high analog
- 17 = de-energize on low analog
- 18 = energize on low analog
- 19 = de-energize on low D11 volts
- 20 = energize on low D11 volts
- 21 = de-energize on high D11 volts
- 22 = energize on high D11 volts
- 23 = de-energize on low Aux. volts

24 = energize on low Aux. volts  
25 = de-energize on high Aux. volts  
26 = energize on high Aux. volts  
27 = de-energize up control on head  
28 = energize up control on head  
29 = de-energize down control on head  
30 = energize down control on head  
31 = de-energize up control on analog  
32 = energize up control on analog  
33 = de-energize down control on analog  
34 = energize down control on analog  
35 = ( pulse ) flow totalizer  
36 = ( pulse ) sampler by volume  
37 = ( pulse ) sampler by time  
38 = ( pulse ) by time of day

P16 / P19 / P22      relay 1 / 2 / 3 high setpoint

P17 / P20 / P23      relay 1 / 2 / 3 low setpoint

P24      mA assignment

0 = flow rate  
1 = head  
2 = velocity  
3 = temperature

P25      If custom mA, 20 mA = ?

0 = normal  
Ø = custom

P26      mA span

0 = 4-20 mA  
1 = 0-20 mA

- P27**      **mA damping (secs)**
- P28**      **mA options (emulator tracking)**  
            **0 = don't track emulator**  
            **1 = track emulator**
- P29**      **fail-safe time (secs)**
- P30**      **fail-safe analog mode**  
            **0 = hold last value**  
            **1 = assume value in P31**
- P31**      **fail-safe analog mA (default value)**
- P32**      **totalizer multiplier**  
            **0 = x 1/1000 (0.001)**  
            **1 = x 1/100 (0.01)**  
            **2 = x 1/ 10 (0.1)**  
            **3 = x 1**  
            **4 = x 10**  
            **5 = x 100**  
            **6 = x 1000**
- P33**      **flow rate display (decimal point)**  
            **0 = no decimal places**  
            **1 = 1**  
            **2 = 2**  
            **3 = 3**  
            **4 = 4**

**P34 printer mode**

- 0 = never print
- 1 = interval to be in minutes
- 2 = interval to be in hours
- 3 = print once each day

**P35 printer timing**

**P36 measurement interval**

- 0 = 1 sec
- 1 = 15 sec
- 2 = 30 sec
- 3 = 1 min
- 4 = 5 min

**P37 serial data rate**

- 0 = 300 baud
- 1 = 600
- 2 = 1200
- 3 = 2400
- 4 = 4800
- 5 = 9600
- 6 = 19200

**P38 site number**

**P39 data logging rate**

*fixed*

0 = 1 min	3 = 30
1 = 5	4 = 60
2 = 15	5 = 24 hr

*variable (condition)*

6 = 15/1 min (% flow / min)	19 = 60 / 1 (flow)
7 = 15 / 5 "	20 = 60 / 5 "
8 = 30 / 1 "	21 = 24 hr / 1 min "
9 = 30 / 5 "	22 = 24 hr / 5 min "
10 = 60 / 1 "	23 = 24 hr / 15 min "
11 = 60 / 5 "	24 = 15 / 1 min (head)
12 = 24 hr / 1 min "	25 = 15 / 5 "
13 = 24 hr / 5 min "	26 = 30 / 1 "
14 = 24 hr / 15 min "	27 = 30 / 5 "
15 = 15 / 1 min (flow)	28 = 60 / 1 "
16 = 15 / 5 "	29 = 60 / 5 "
17 = 30 / 1 "	30 = 24 hr / 1 min "
18 = 30 / 5 "	31 = 24 hr / 5 min "
	32 = 24 hr / 15 min "

**P40 log rapid setpoint**

*P39 variable logging condition*                      *units*

% flow / min	% change of maximum flow per minute
flow	% of maximum flow
head	% of maximum head

**P41 log normal setpoint**

*P39 variable logging condition*                      *units*

% flow / min	% change of maximum flow per minute
flow	% of maximum flow
head	% of maximum head

**P42 head determination**

**0 = by OCM-3**

**1 = by auxiliary device**

**P43 volts in for zero head**

**P44 head at 5 volts in**

**P45 low flow cut-off head**

**P46 range at zero head**

**P47 blanking distance**

## **‘U’ PARAMETERS FOR P3 PRIMARY ELEMENT**

The number of ‘U’ parameters required varies according to the primary element chosen (P3) and the method of calculation (P4). The OCM-3 prompts the user by displaying the next required parameter, insuring the programming is complete.

The following is a list of the specific primary elements to which the OCM-3 can be applied.

Refer to the page covering your particular application; the rest may be disregarded.

<b>P3</b>	<b>primary element</b>
0	exponential device (e.g. proportional, V-notch, Parshall etc)
1	BS-3680 Rectangular Flume (ISO 4359)
2	BS-3680 Round Nose Horizontal Crest Weir (ISO 4374)
3	BS-3680 Trapezoidal Flume (ISO 4359)
4	BS-3680 U-throated Flume (ISO 4359)
5	BS-3680 Finite Crest Weir (ISO 3846)
6	BS-3680 Thin Plate Rectangular Weir (ISO 1438/1)
7	BS-3680 Thin Plate V Notch Weir (ISO 1438/1)
8	Rectangular Weir (contracted)
9	Round Pipe
10	Palmer-Bowlus Flume
11	H Flume
12	Universal Head vs. Flow
13	Rectangular Area x Velocity
14	Trapezoidal Area x Velocity
15	Modified Trapezoidal Area x Velocity
16	U-channel Area x Velocity

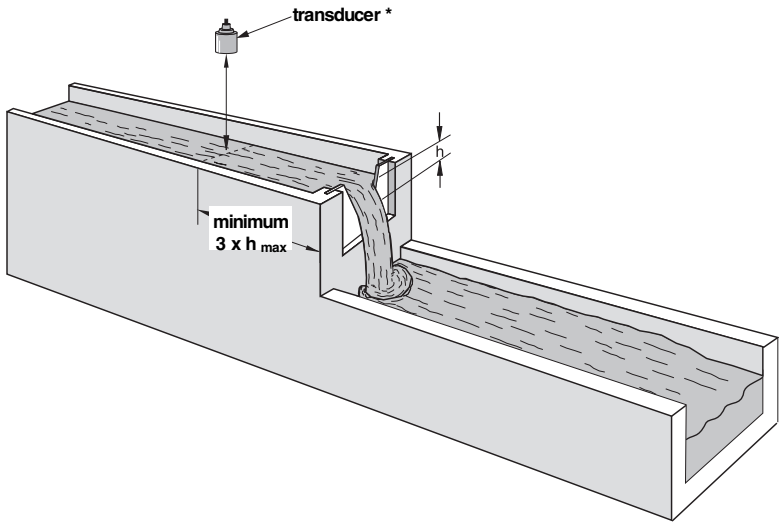
- 17      **Circular Area x Velocity**
- 18      **Gull Wing Area x Velocity**
- 19      **Egg-shaped Area x Velocity**
- 20      **Universal Area x Velocity**

**The primary element must be installed in accordance with the manufacturers recommendations and in accordance with all governing regulations.**

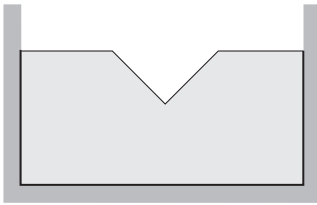


# SIMPLE EXPONENTIAL DEVICES, P3 = 0

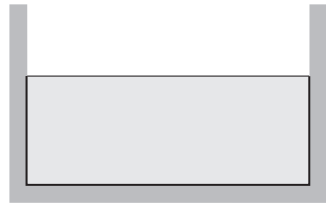
## TYPICAL SHARP-CRESTED WEIRS



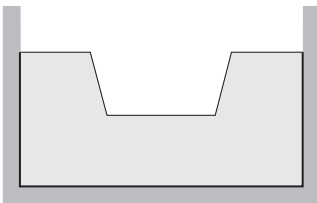
### Typical Weir Profiles



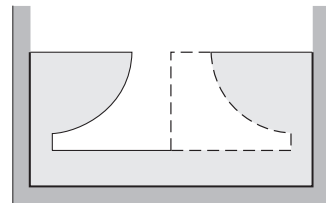
V - notch or Triangular  
 $U_0 = 2.5$



Rectangular - suppressed  
 $U_0 = 1.5$



Trapezoidal (Cipolletti)  
 $U_0 = 1.5$



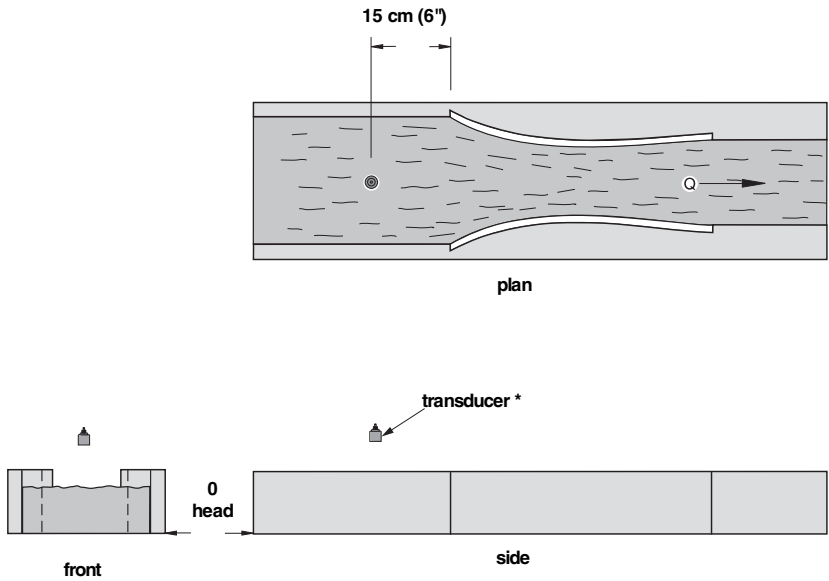
Sutro (Proportional)  
 $U_0 = 1$   
(symmetrical or asymmetrical)

For rated flows under free flow conditions, the head is measured upstream of the weir plate at a minimum distance of 3 times the maximum head (i.e. where the liquid surface is not affected by drawdown).

\* The transducer must be above the maximum head by at least the blanking value, P47.

# SIMPLE EXPONENTIAL DEVICES, P3 = 0

## KHAFAGI VENTURI

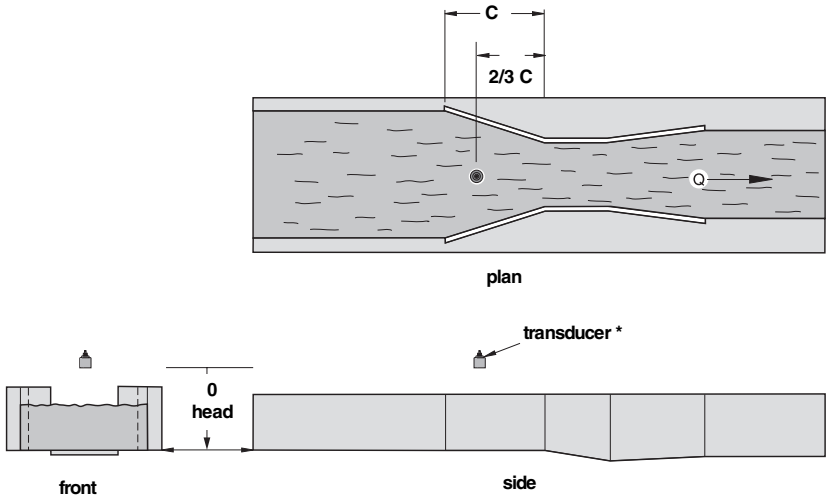


For rated flows under free flow conditions, the head is measured 15 cm (6") upstream from the beginning of the converging section.

\* The transducer must be above the maximum head by at least the blanking value, P47.

# SIMPLE EXPONENTIAL DEVICES, $P_3 = 0$

## TYPICAL PARSHALL FLUME

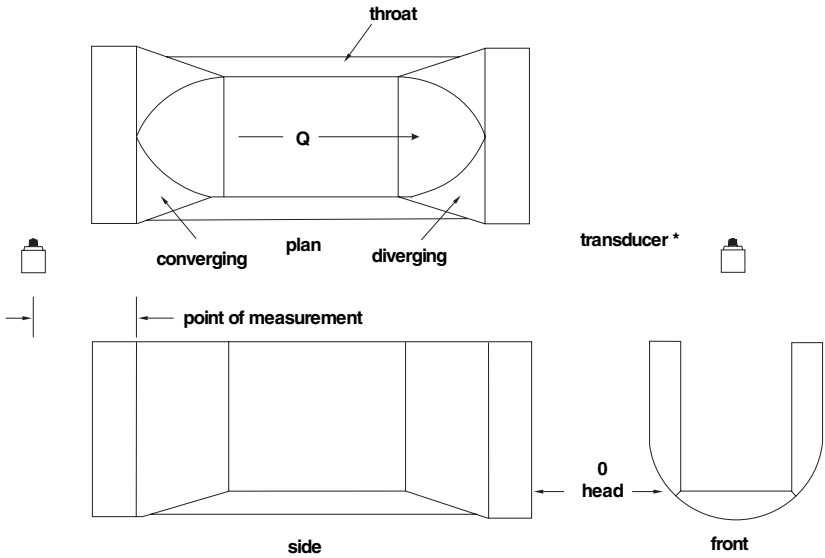


For rated flows under free flow conditions, the head is measured at  $2/3$  the length of the converging section upstream of the beginning of the throat section.

\* The transducer must be above the maximum head by at least the blanking value, P47.

# SIMPLE EXPONENTIAL DEVICES, P3 = 0

## TYPICAL LEOPOLD LAGCO



For rated flows under free flow conditions, the head is measured at a point upstream referenced to the beginning of the converging section. Refer to the following table.

Flume Size (pipe dia. in inches)	Point of Measurement	
	mm	inches
4 - 12	25	1.0
15	32	1.3
18	38	1.5
21	44	1.8
24	51	2.1
30	64	2.5
36	76	3.0
42	89	3.5
48	102	4.0
54	114	4.5
60	127	5.0
66	140	5.5
72	152	6.0

\* The transducer must be above the maximum head by at least the blanking value, P47.

## BS-3680 Rectangular Flume, P3 = 1

### *'U' parameters required \**

U0 = approach width	B
U1 = throat width	b
U2 = hump height	p
U3 = throat length	L

### *'U' parameters calculated \*\**

U4 = Cv
U5 = Cd
U6 = A

\*obtain from manufacturer's specifications.

\*\* calculated by OCM-3. May be viewed by accessing 'U' parameter.

### *Reference*

ABSOLUTE CALCULATION,  $P4 = 0^{\square}$

For flows that can be calculated by the equation:

$$q = (2/3)^{1.5} \times g^{0.5} \times C_v \times C_s \times C_d \times B \times h^{1.5}$$

where : q = flow rate

b = throat width

g = gravitational acceleration

h = head

Cv = velocity coefficient

Cs = shape coefficient

Cd = discharge coefficient

RATIOMETRIC CALCULATION,  $P4 = 1^{\square}$

For flows that can be calculated by the equation:

$$q = q_{cal} \times C_d / C_{d_{cal}} \times C_v / C_{v_{cal}} \times (h / h_{cal})^{1.5}$$

where : q = flow rate

$q_{cal}$  = flow rate at maximum head

h = head

$h_{cal}$  = maximum head

Cv = velocity coefficient

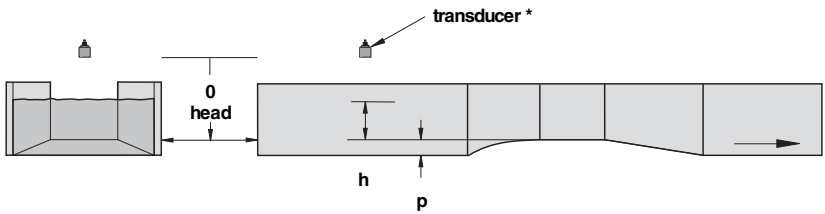
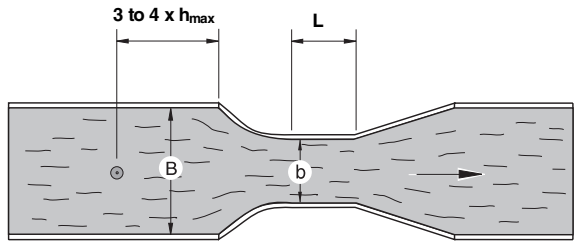
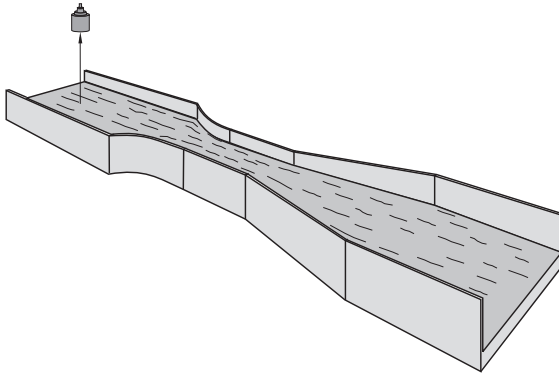
$C_{v_{cal}}$  = velocity coefficient for maximum head

Cd = discharge coefficient for head

$C_{d_{cal}}$  = discharge coefficient for maximum head

$\square$  Refer to Operation \ Flow Calculation.

# BS-3680 RECTANGULAR FLUME



\* The transducer must be above the maximum head by at least the blanking value, P47.

## BS-3680 Round Nose Horizontal Crest Weir, P3 = 2

### *'U' parameters required \**

U0 = crest width	b
U1 = crest height	p
U2 = crest length	L

### *'U' parameters calculated \*\**

U3 = Cv
U4 = Cd
U5 = A

\* obtain from manufacturer's specifications.

\*\* calculated by OCM-3. May be viewed by accessing 'U' parameter.

### *Reference*

ABSOLUTE CALCULATION, P4 = 0<sup>□</sup>

For flows that can be calculated by the equation:

$$q = (2/3)^{1.5} \times g^{0.5} \times Cv \times Cs \times Cd \times b \times h^{1.5}$$

where : q = flow rate

g = gravitational acceleration

b = throat width

h = head

Cv = velocity coefficient

Cs = shape coefficient

Cd = discharge coefficient

RATIOMETRIC CALCULATION, P4 = 1<sup>□</sup>

For flows that can be calculated by the equation:

$$q = q_{cal} \times Cd/Cd_{cal} \times Cv/Cv_{cal} \times (h/h_{cal})^{1.5}$$

where : q = flow rate

q<sub>cal</sub> = flow rate at maximum head

h = head

h<sub>cal</sub> = maximum head

Cv = velocity coefficient

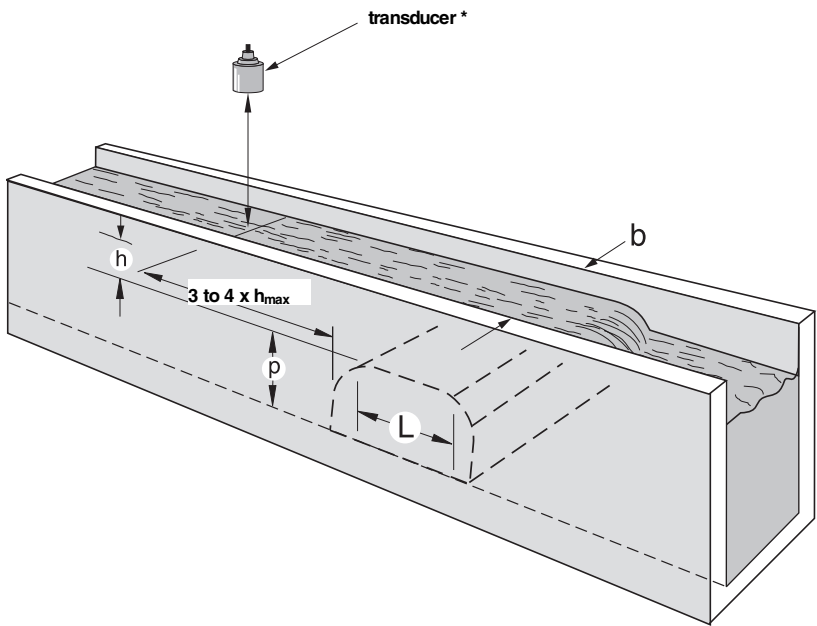
Cv<sub>cal</sub> = velocity coefficient for maximum head

Cd = discharge coefficient for head

Cd<sub>cal</sub> = discharge coefficient for maximum head

<sup>□</sup> Refer to Operation \ Flow Calculation.

## BS-3680 ROUND NOSE HORIZONTAL CREST WEIR



\* The transducer must be above the maximum head by at least the blanking value, P47.

## BS-3680 TRAPEZOIDAL FLUME, P3 = 3

### *'U' parameters required \**

U0 = approach width	B
U1 = throat width	b
U2 = hump height	p
U3 = throat length	L
U4 = slope	m

### *'U' parameters calculated \*\**

U5 = Cv
U6 = Cd
U7 = Cs
U8 = A

\*obtain from manufacturer's specifications.

\*\* calculated by OCM-3. May be viewed by accessing 'U' parameter.

### *Reference*

ABSOLUTE CALCULATION, P4 = 0<sup>□</sup>

For flows that can be calculated by the equation:

$$q = (2/3)^{1.5} \times g^{0.5} \times Cv \times Cs \times Cd \times b \times h^{1.5}$$

where : q = flow rate

g = gravitational acceleration

b = throat width

h = head

Cv = velocity coefficient

Cs = shape coefficient

Cd = discharge coefficient

RATIOMETRIC CALCULATION, P4 = 1<sup>□</sup>

For flows that can be calculated by the equation:

$$q = q_{cal} \times Cs/Cs_{cal} \times Cd/Cd_{cal} \times Cv/Cv_{cal} \times (h/h_{cal})^{1.5}$$

where :

q = flow rate

q<sub>cal</sub> = flow rate at maximum head

h = head

h<sub>cal</sub> = maximum head

Cs = shape coefficient for head

Cs<sub>cal</sub> = shape coefficient for maximum head

Cv = velocity coefficient

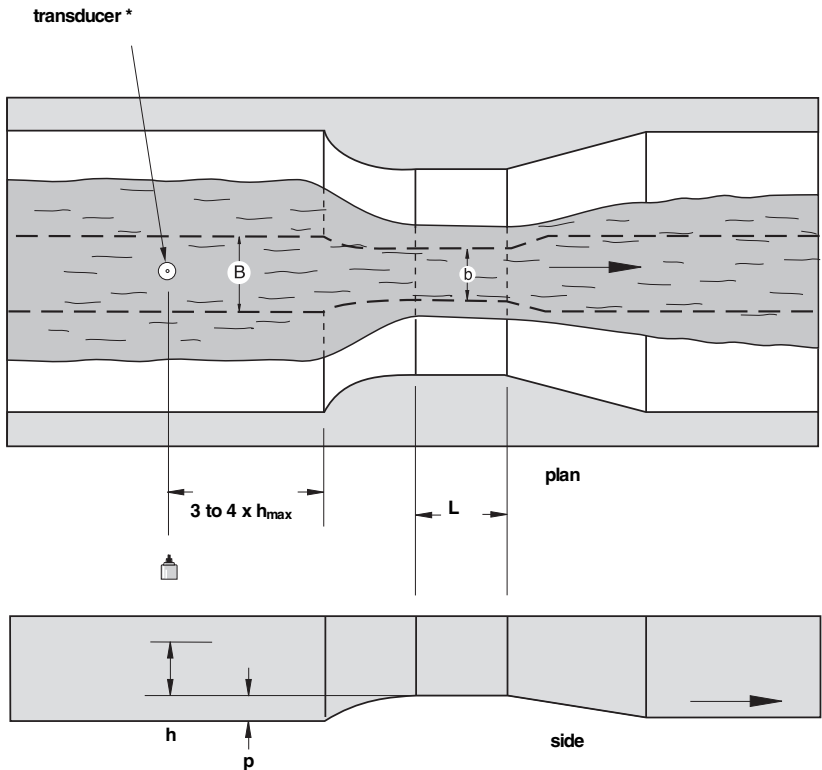
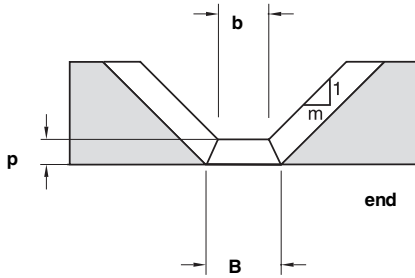
Cv<sub>cal</sub> = velocity coefficient for maximum head

Cd = discharge coefficient for head

Cd<sub>cal</sub> = discharge coefficient for maximum head

<sup>□</sup> Refer to Operation \ Flow Calculation.

**BS-3680 TRAPEZOIDAL FLUME**



\* The transducer must be above the maximum head by at least the blanking value, P47.

## BS-3680 U-Flume, P3 = 4

### *'U' parameters required \**

U0 = approach diameter	Da
U1 = throat diameter	D
U2 = hump height	p
U3 = throat length	L

### *'U' parameters calculated \*\**

U4 = Cv
U5 = Cd
U6 = Cu
U7 = A

\* obtain from manufacturer's specifications.

\*\* calculated by OCM-3. May be viewed by accessing 'U' parameter.

### *Reference*

ABSOLUTE CALCULATION, P4 = 0<sup>□</sup>

For flows that can be calculated by the equation:

$$q = (2/3)^{1.5} \times g^{0.5} \times C_v \times C_u \times C_d \times D \times h^{1.5}$$

where : q = flow rate

g = gravitational acceleration

b = throat width

h = head

Cv = velocity coefficient

Cu = shape coefficient

Cd = discharge coefficient

RATIOMETRIC CALCULATION, P4 = 1<sup>□</sup>

For flows that can be calculated by the equation:

$$q = q_{cal} \times C_u/C_{u_{cal}} \times C_d/C_{d_{cal}} \times C_v/C_{v_{cal}} \times (h/h_{cal})^{1.5}$$

where : q = flow rate

q<sub>cal</sub> = flow rate at maximum head

h = head

h<sub>cal</sub> = maximum head

Cu = shape coefficient for head

C<sub>u<sub>cal</sub></sub> = shape coefficient for maximum head

Cv = velocity coefficient

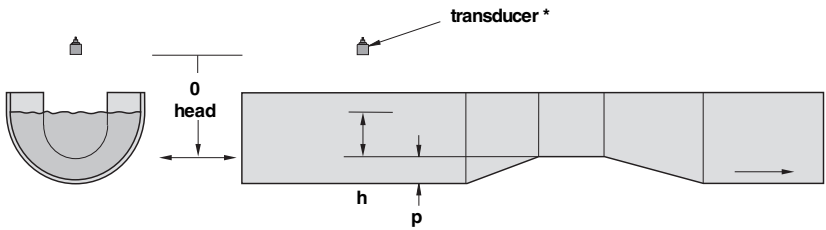
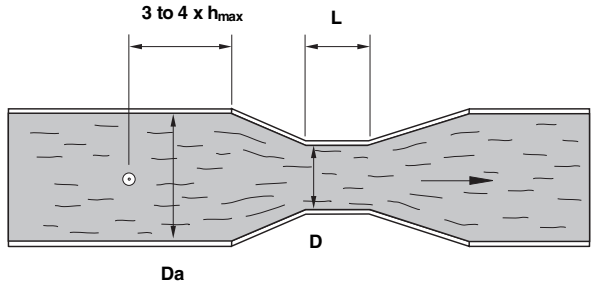
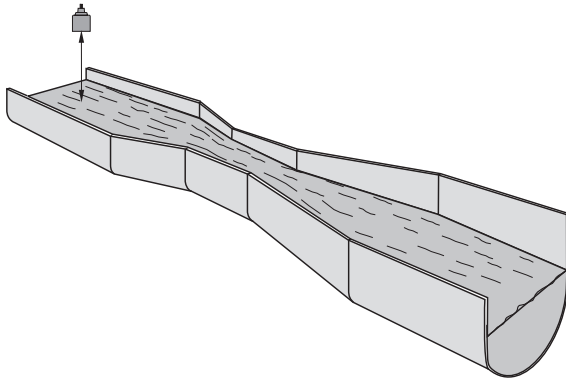
C<sub>v<sub>cal</sub></sub> = velocity coefficient for maximum head

Cd = discharge coefficient for head

C<sub>d<sub>cal</sub></sub> = discharge coefficient for maximum head

□ Refer to Operation \ Flow Calculation.

**BS-3680 U-FLUME**



\* The transducer must be above the maximum head by at least the blanking value, P47.

## BS-3680 FINITE CREST WEIR, P3 = 5

### 'U' parameters required \*

U0 = crest width	b
U1 = crest height	p
U2 = crest length	L

### 'U' parameters calculated \*\*

U3 = C
U4 = Cp

\* obtain from manufacturer's specifications.

\*\* calculated by OCM-3. May be viewed by accessing 'U' parameter.

### Reference

ABSOLUTE CALCULATION,  $P4 = 0^{\square}$

For flows that can be calculated by the equation:

$$q = (2/3)^{1.5} \times g^{0.5} \times C \times Cp \times b \times h^{1.5}$$

where : q = flow rate  
g = gravitational acceleration  
b = crest width  
h = head

C = a function of h and L

Cp = a correction factor as a function of h and p applied to C

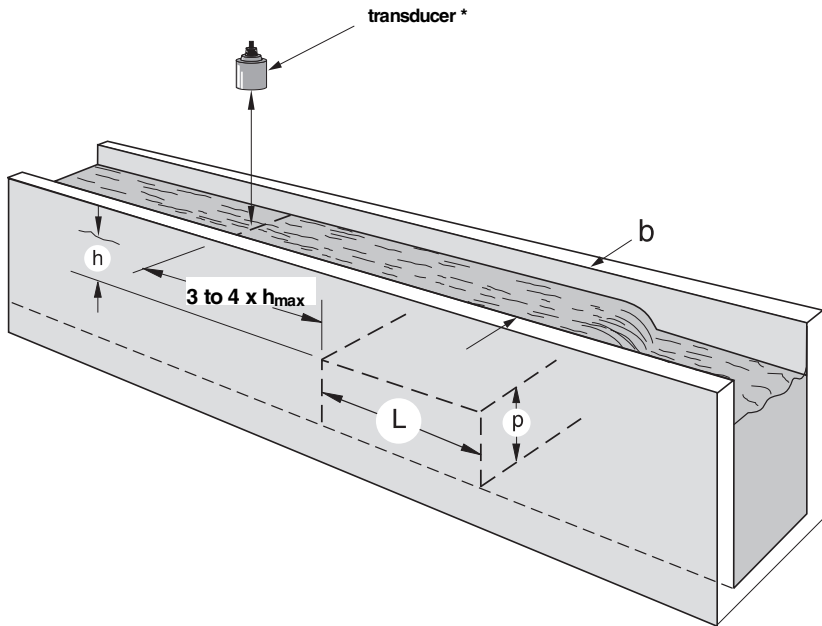
RATIOMETRIC CALCULATION,  $P4 = 1^{\square}$

For flows that can be calculated by the equation:

$$q = q_{cal} \times C/C_{cal} \times Cp/Cp_{cal} \times (h/h_{cal})^{1.5}$$

where : q = flow rate  
q<sub>cal</sub> = flow rate at maximum head  
h = head  
h<sub>cal</sub> = maximum head  
C = discharge coefficient for head  
C<sub>cal</sub> = discharge coefficient for maximum head  
Cp = correction factor for C  
Cp<sub>cal</sub> = correction factor for C<sub>cal</sub>

$\square$  Refer to Operation \ Flow Calculation.



## BS-3680 THIN PLATE RECTANGULAR WEIR, P3 = 6

*'U' parameters required \**

U0 = approach width      B  
U1 = crest width          b  
U2 = crest height          p

*'U' parameters calculated \*\**

U3 = Ce  
U4 = Kb

\*obtain from manufacturer's specifications.

\*\* calculated by OCM-3. May be viewed by accessing 'U' parameter.

### Reference

ABSOLUTE CALCULATION, P4 = 0<sup>□</sup>

For flows that can be calculated by the equation:

$$q = Ce x^{2/3} \sqrt{2g} x be x (h_e)^{1.5}$$

where : q = flow rate

g = gravitational acceleration

b = crest width

h = head

Ce = a function of h, p, b and B

be = effective crest width (b + Kb)

h<sub>e</sub> = effective head (h + K<sub>r</sub>)

K<sub>r</sub> = 1 mm

RATIOMETRIC CALCULATION, P4 = 1<sup>□</sup>

For flows that can be calculated by the equation:

$$q = q_{cal} x Ce/Ce_{cal} x (h/h_{cal})^{1.5}$$

where : q = flow rate

q<sub>cal</sub> = flow rate at maximum head

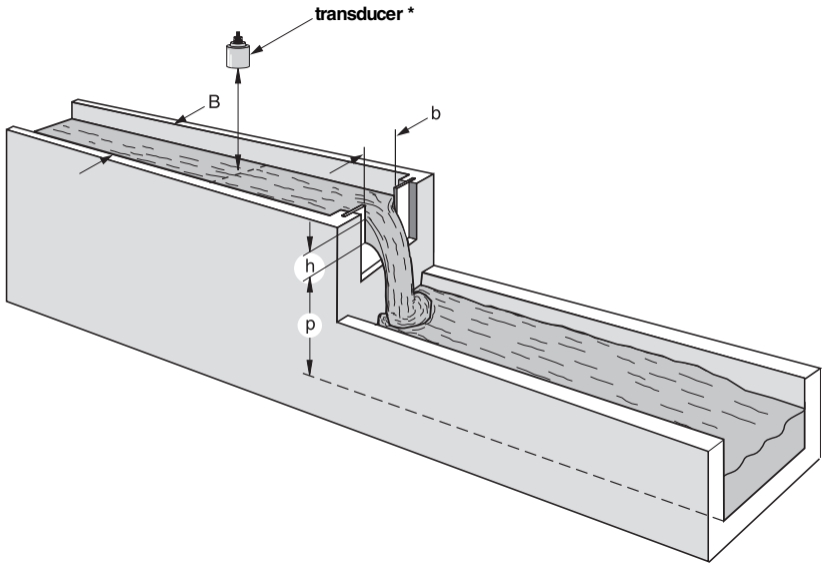
h = head

h<sub>cal</sub> = maximum head

Ce = discharge coefficient for head

Cv<sub>cal</sub> = discharge coefficient for maximum head

<sup>□</sup> Refer to Operation \ Flow Calculation.



## BS-3680 THIN PLATE V-NOTCH WEIR, P3 = 7

*'U' parameters required \**

*'U' parameters calculated \*\**

U0 = notch angle

alpha

U1 = Ce

\* obtain from manufacturer's specifications.

\*\* calculated by OCM-3. May be viewed by accessing 'U' parameter.

### Reference

ABSOLUTE CALCULATION, P4 = 0<sup>□</sup>

For flows that can be calculated by the equation:

$$q = Ce \times 8/15 \times \tan(\alpha/2) \times (2g)^{0.5} \times h^{2.5}$$

where : q = flow rate

h = head

g = gravitational acceleration

Ce = function of h and  $\alpha$

$\alpha$  = notch angle alpha<sup>◇</sup>

◇ angle is restricted to 90°, 53.133° or 28.066°. Otherwise use ratiometric calculation.

RATIOMETRIC CALCULATION, P4 = 1<sup>□</sup>

For flows that can be calculated by the equation:

$$q = q_{cal} \times Ce/Ce_{cal} \times (h/h_{cal})^{2.5}$$

where : q = flow rate

q<sub>cal</sub> = flow rate at maximum head

h = head

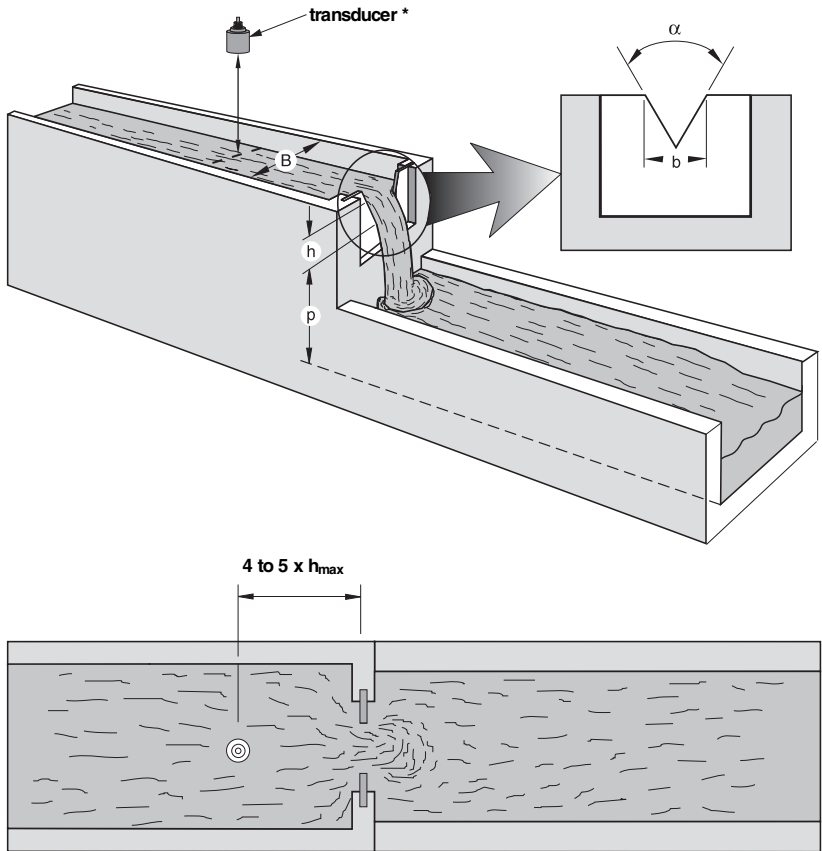
h<sub>cal</sub> = maximum head

Ce = discharge coefficient for head

Ce<sub>cal</sub> = discharge coefficient for maximum head

□ Refer to Operation \ Flow Calculation.

# BS-3680 THIN PLATE V-NOTCH WEIR



\* The transducer must be above the maximum head by at least the blanking value, P47.

## RECTANGULAR WEIR (CONTRACTED), P3 = 8

*'U' parameters required \**

U0 = crest width b

\* obtain from manufacturer's specifications.

\*\* calculated by OCM-3. May be viewed by accessing 'U' parameter.

### *Reference*

ABSOLUTE CALCULATION, P4 = 0<sup>□</sup>

For flows that can be calculated by the equation:

$$q = K \times (b - 0.2h) \times h^{1.5}$$

where : q = flow rate  
h = head  
K = constant

RATIOMETRIC CALCULATION, P4 = 1<sup>□</sup>

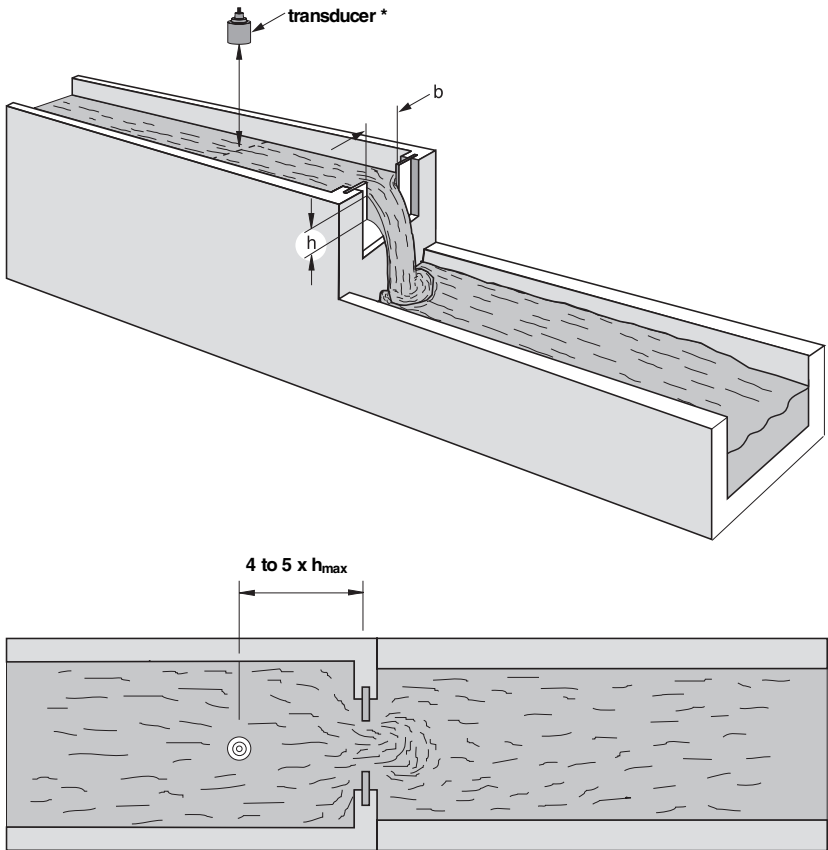
For flows that can be calculated by the equation:

$$q = q_{cal} \times (b - 0.2h)/(b - 0.2h_{cal}) \times (h/h_{cal})^{2.5}$$

where : q = flow rate  
q<sub>cal</sub> = flow rate at maximum head  
h = head  
h<sub>cal</sub> = maximum head

□ Refer to Operation \ Flow Calculation.

## RECTANGULAR WEIR - CONTRACTED



\* The transducer must be above the maximum head by at least the blanking value, P47.

## ROUND PIPE, P3 = 9

(based on the Manning Formula)

*'U' parameters required \**

U0 = pipe inside diameter D

U1 = slope (fall/run) s

U2 = roughness coefficient n

\*obtain from manufacturer's specifications.

### Reference

ABSOLUTE CALCULATION, P4 = 0<sup>2</sup>

For flows that can be calculated by the equation:

$$q = K/n \times f(h) \times s^{0.5}$$

where : q = flow rate

h = head

K = constant

$$f(h) = A \times R^{0.66}$$

A = cross sectional area

R = hydraulic radius

s = slope of hydraulic gradient

n = roughness coefficient

RATIOMETRIC CALCULATION, P4 = 1<sup>2</sup>

For flows that can be calculated by the equation:

$$q = q_{cal} \times f(h)/f(h_{cal})$$

where : q = flow rate

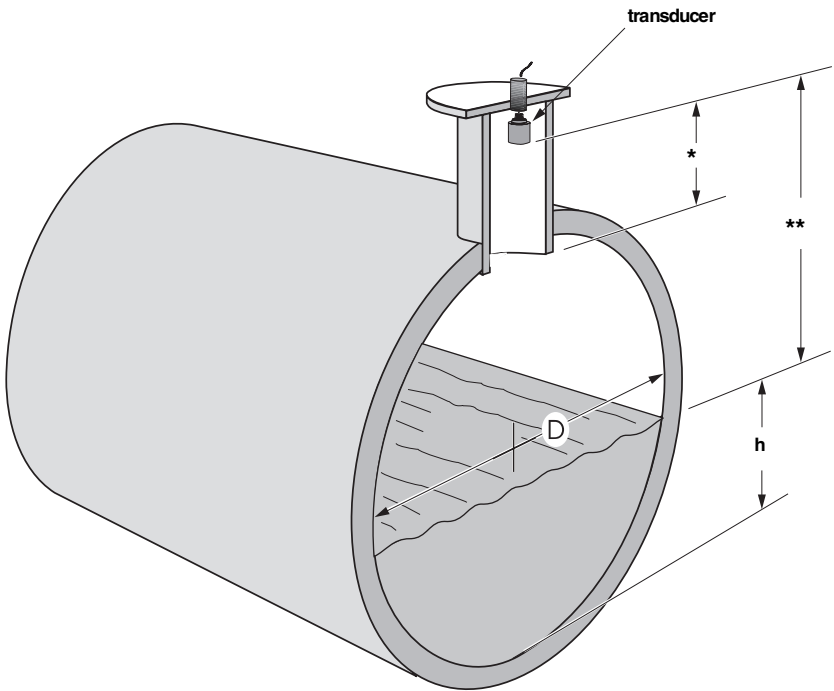
q<sub>cal</sub> = flow rate at maximum head

h = head

h<sub>cal</sub> = maximum head

<sup>2</sup> Refer to Operation \ Flow Calculation.

## ROUND PIPE



\* This dimension should be at least 15 cm (6") shorter than the blanking value, P47.

\*\* The transducer must be above the maximum head by at least the blanking value, P47.

## PALMER-BOWLUS FLUME \*, P3 = 10

*'U' parameters required \*\**

U0 = maximum flume width,  $h_{\max}$

\*typically those manufactured by Warminster or Plasti-Fab.

\*\* obtain from manufacturer's specifications.

### *Reference*

RATIOMETRIC CALCULATION, P4 = 1<sup>□</sup>

For flows that can be calculated by the equation:

$$q = q_{\text{cal}} \times f(h/h_{\max}) / f(h_{\text{cal}}/h_{\max})$$

where :  $q$  = flow rate

$q_{\text{cal}}$  = flow rate at maximum head

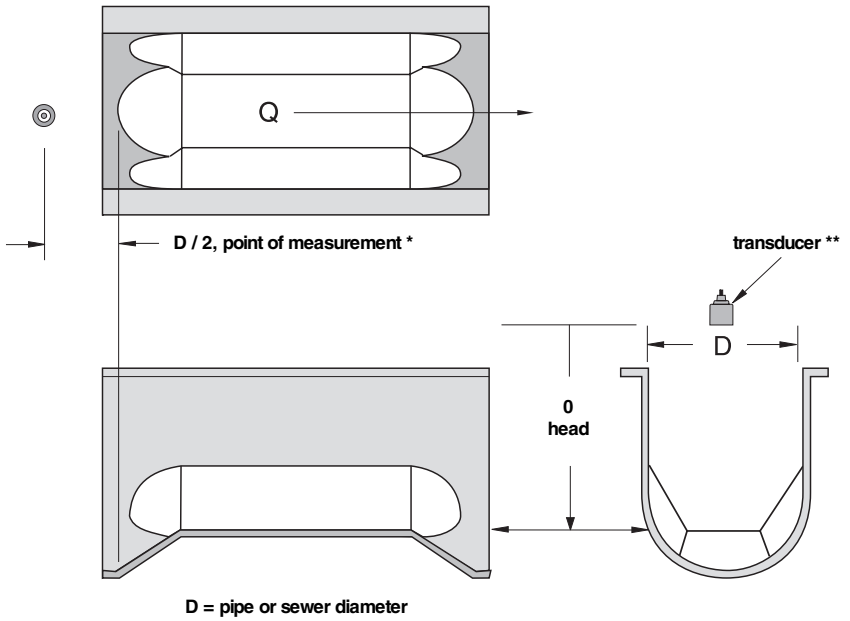
$h$  = head

$h_{\text{cal}}$  = maximum head

$f(h/h_{\max})$  is determined by polynomial synthesis

<sup>□</sup> Refer to Operation \ Flow Calculation.

# PALMER-BOWLUS FLUME



\* for rated flows under free flow conditions

\*\* The transducer must be above the maximum head by at least the blanking value, P47.

## H-FLUME \*, P3 = 11

### *'U' parameters required \**

U0 = maximum listed head, h<sub>max</sub>

\* as developed by the U.S. Department of Agriculture, Soil Conservation Service.

\*\* obtain from manufacturer's specifications.

### *Reference*

RATIOMETRIC CALCULATION, P4 = 1<sup>□</sup>

For flows that can be calculated by the equation:

$$q = q_{cal} \times f(h/h_{max})/f(h_{cal}/h_{max})$$

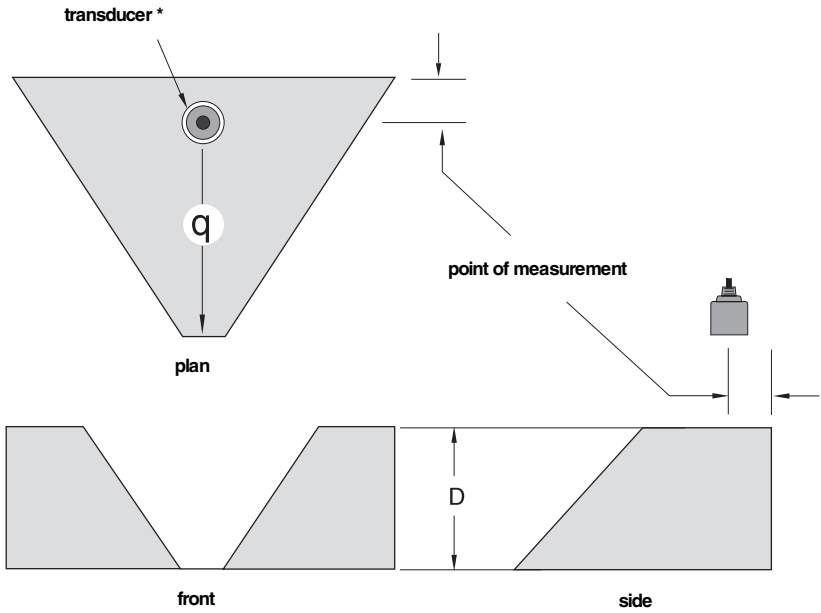
where : q = flow rate

q<sub>cal</sub> = flow rate at maximum head

f(h/h<sub>max</sub>) and f(h<sub>cal</sub>/h<sub>max</sub>) are determined by polynomial synthesis

□ Refer to Operation \ Flow Calculation.

# H-FLUME



For rated flows under free flow conditions, the head is measured at a point downstream from the flume entrance. Refer to the following table.

Flume Size D (feet)	Point of Measurement	
	cm	inches
0.5	4.7	1.88
0.75	6.7	2.69
1.0	9.1	3.63
1.5	13.5	5.38
2.0	17.9	7.19
2.5	22.5	9.00
3.0	27.2	10.88
4.5	40.5	16.19

\* The transducer must be above the maximum head by at least the blanking value, P47.

## UNIVERSAL HEAD vs FLOW, P3 = 12

The flow curve is characterized by entering the head ( $A_{\text{even}}$ ) and flow ( $A_{\text{odd}}$ ) ordinates for the number of data points (n, 4 to 16) over the flow range. The first point ( $A_0, A_1$ ) generally being at 0 head and the last point ( $A_{2n-2}, A_{2n-1}$ ) generally being at maximum head .

### *'U' parameters required \**

$U_0$  = number of data points (n, 4 to 16)

$A_{\text{even}}$  = head

$A_{\text{odd}}$  = flow rate

<sup>\*</sup> obtain from manufacturer's specifications.

### *Reference*

RATIOMETRIC CALCULATION, P4 = 1<sup>□</sup>

For flows that can be calculated by the equation:

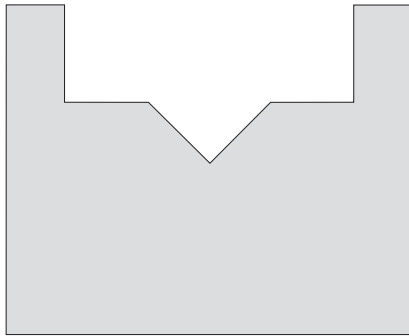
$$q = q_{\text{cal}} \times f(h)/f(h_{\text{cal}})$$

where :  $f(h)$  and  $f(h_{\text{cal}})$  are polynomials based on interpolation of data points

<sup>□</sup> Refer to Operation \ Flow Calculation.

# UNIVERSAL HEAD vs FLOW

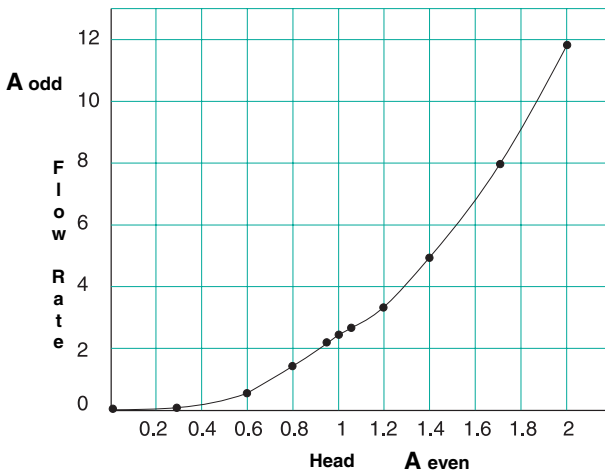
e.g. typical compound weir



## Parameters

$U_0 = 11$

$A_0 = 0$	head, point 1	$A_{12} = 1.05$	head, point 7
$A_1 = 0$	flow, point 1	$A_{13} = 2.65$	flow, point 7
$A_2 = 0.3$	head, point 2	$A_{14} = 1.2$	head, point 8
$A_3 = 0.1$	flow, point 2	$A_{15} = 3.4$	flow, point 8
$A_4 = 0.6$	head, point 3	$A_{16} = 1.4$	head, point 9
$A_5 = 0.7$	flow, point 3	$A_{17} = 5.0$	flow, point 9
$A_6 = 0.8$	head, point 4	$A_{18} = 1.7$	head, point 10
$A_7 = 1.5$	flow, point 4	$A_{19} = 8.0$	flow, point 10
$A_8 = 0.95$	head, point 5	$A_{20} = 2$	head, point 11
$A_9 = 2.25$	flow, point 5	$A_{21} = 11.8$	flow, point 11
$A_{10} = 1$	head, point 6		
$A_{11} = 2.5$	flow, point 6		



For best accuracy concentrate data points where changes in flow rate are the greatest.

## RECTANGULAR AREA X VELOCITY, P3 = 13

***'U' parameters required \****

**U0 = channel width B**

***'U' parameters calculated \*\****

**U1 = area (h)**

\*obtain from manufacturer's specifications.

\*\*calculated by OCM-3. May be viewed by accessing 'U' parameter.

### ***Reference***

ABSOLUTE CALCULATION, P4 = 0<sup>□</sup>

For flows that can be calculated by the equation:

$$q = 1/1000 \times B \times h \times V$$

where :    **q = flow rate in l/sec**  
              **B = channel width in cm**  
              **h = head in cm**  
              **V = velocity in cm/sec**

RATIOMETRIC CALCULATION, P4 = 1<sup>□</sup>

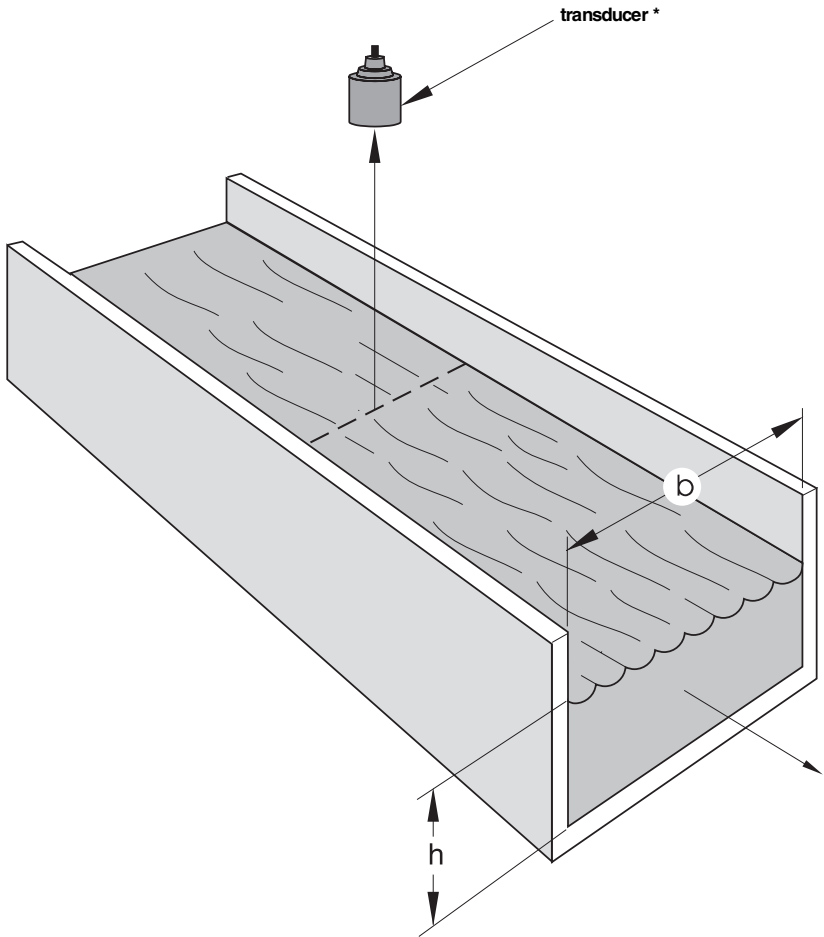
For flows that can be calculated by the equation:

$$q = q_{cal} \times A/A_{cal} \times v/v_{cal}$$

where :    **q = flow rate**  
              **q<sub>cal</sub> = flow rate at maximum head**  
              **h = head**  
              **h<sub>cal</sub> = maximum head**  
              **v = velocity**  
              **v<sub>cal</sub> = velocity at maximum head**

<sup>□</sup> Refer to Operation \ Flow Calculation.

## RECTANGULAR AREA X VELOCITY



\* The transducer must be above the maximum head by at least the blanking value, P47.

## TRAPEZOIDAL AREA X VELOCITY, P3 = 14

*'U' parameters required \**

*'U' parameters calculated \*\**

U0 = channel top width    B

U3 = area (h)

U1 = channel base width    b

U2 = channel depth        ht

\* obtain from manufacturer's specifications.

\*\* calculated by OCM-3. May be viewed by accessing 'U' parameter.

### Reference

ABSOLUTE CALCULATION, P4 = 0<sup>□</sup>

For flows that can be calculated by the equation:

$$q = 1/1000 \times (b + mh) \times v$$

$$m = (B - b)/d$$

where :    q = flow rate, l/sec  
            B = channel top width, cm  
            b = channel bottom width, cm  
            d = depth of channel, cm  
            h = head, cm  
            v = flow velocity, cm/sec

RATIOMETRIC CALCULATION, P4 = 1<sup>□</sup>

For flows that can be calculated by the equation:

$$q = q_{cal} \times A/A_{cal} \times v/v_{cal}$$

$$A = (b + mh) \times h$$

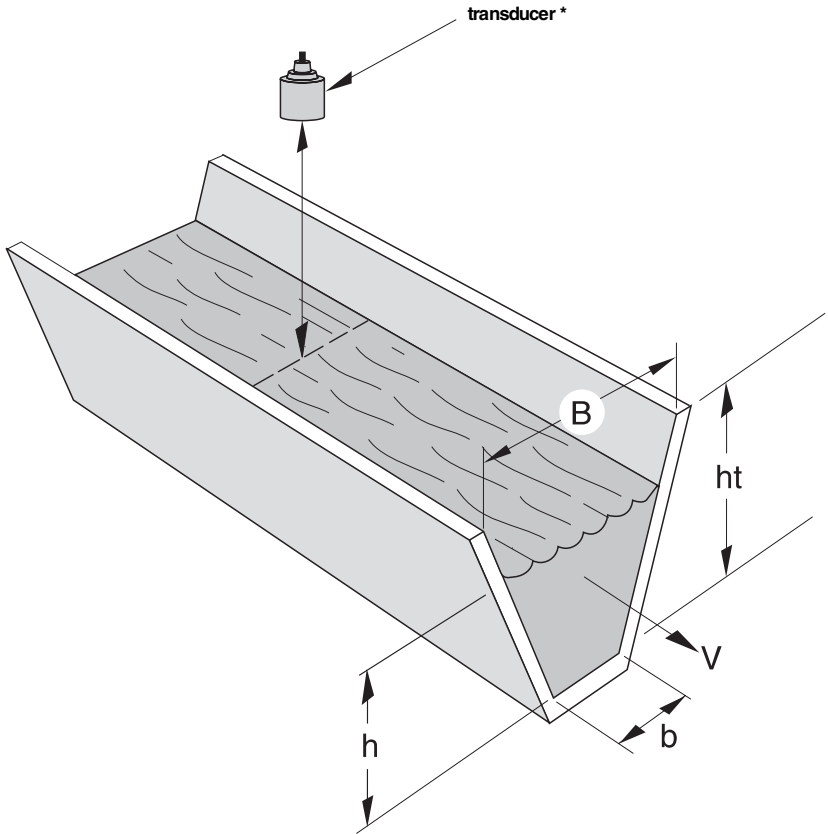
$$A_{cal} = (b + mh_{cal}) \times h_{cal}$$

$$m = (B - b)/d$$

where :    q = flow rate, l/sec  
            B = channel top width, cm  
            b = channel bottom width, cm  
            d = depth of channel, cm  
            h = head, cm  
            v = flow velocity, cm/sec

<sup>□</sup> Refer to Operation \ Flow Calculation.

## TRAPEZOIDAL AREA X VELOCITY



\* The transducer must be above the maximum head by at least the blanking value, P47.

## MODIFIED TRAPEZOIDAL AREA X VELOCITY, P3 = 15

*'U' parameters listed \**

*'U' parameters calculated \*\**

U0 = channel top width    B

U3 = area (h)

U1 = channel base width    b

U2 = transition height    ht

\*obtain from manufacturer's specifications.

\*\* calculated by OCM-3. May be viewed by accessing 'U' parameter.

### Reference

ABSOLUTE CALCULATION, P4 = 0<sup>2</sup>

For flows that can be calculated by the equation:

$$q = 1/1000 \times (b + mh) \times v \quad \text{for } h \leq d$$

$$q = 1/1000 \times ((b + md)d + (B(h - d))) \times v \quad \text{for } h \geq d$$

$$m = (B - b)/d$$

where :    q = flow rate, l/s  
            B = channel top width, cm  
            b = channel base width, cm

d = height of transition, cm  
h = head, cm  
v = flow velocity, cm/sec

RATIOMETRIC CALCULATION, P4 = 1<sup>2</sup>

For flows that can be calculated by the equation:

$$q = q_{cal} \times A/A_{cal} \times v/v_{cal}$$

$$\text{for } h \leq d: \quad A = (b + mh) \times h$$
$$A_{cal} = (b + mh_{cal}) \times h_{cal}$$

$$\text{for } h \geq d: \quad A = (b + md) \times d + B(h - d)$$
$$A_{cal} = (b + md) \times d + B(h_{cal} - d)$$

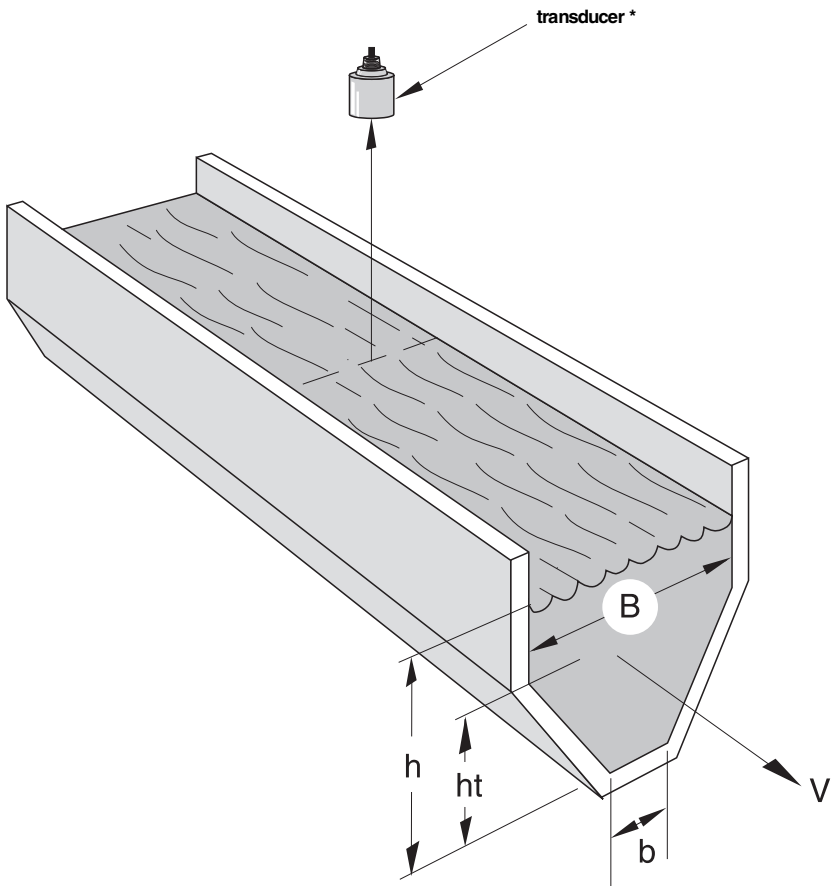
$$m = (B - b)/d$$

where :    q = flow rate  
            q<sub>cal</sub> = flow rate at h<sub>cal</sub>  
            B = channel top width, cm  
            b = channel base width, cm

d = depth of channel  
h = head  
v = flow velocity, cm/sec

<sup>2</sup> Refer to Operation \ Flow Calculation.

## MODIFIED TRAPEZOIDAL AREA X VELOCITY



\* The transducer must be above the maximum head by at least the blanking value, P47.

## U-CHANNEL AREA X VELOCITY, P3 = 16

*'U' parameters required \**

*'U' parameters calculated \*\**

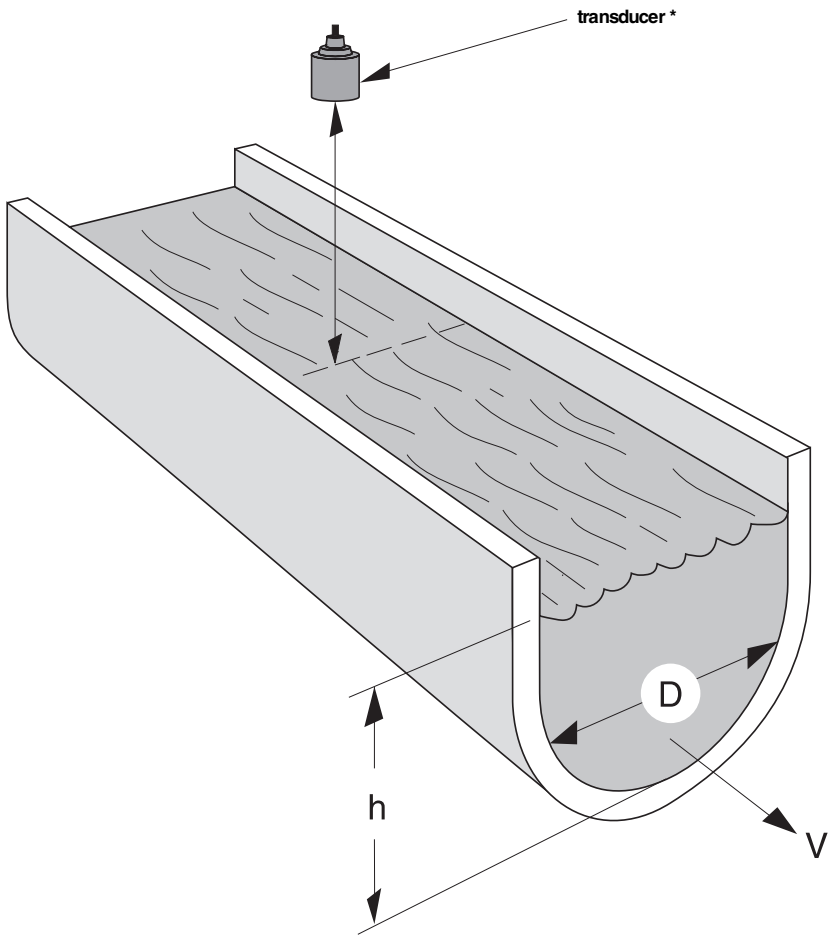
U0 = base diameter D

U1 = area (h)

\* obtain from manufacturer's specifications.

\*\* calculated by OCM-3. May be viewed by accessing 'U' parameter.

## U-CHANNEL AREA x VELOCITY



\* The transducer must be above the maximum head by at least the blanking value, P47.

**CIRCULAR AREA X VELOCITY, P3 = 17**

***'U' parameters listed \****

***'U' parameters calculated \*\****

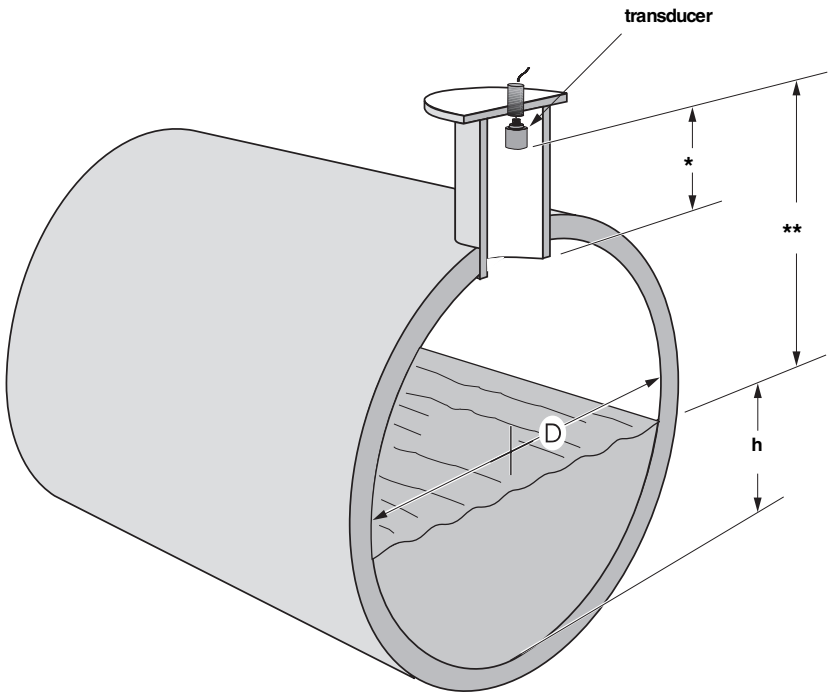
**U0 = conduit diameter      ID**

**U1 = area (h)**

**\* obtain from manufacturer's specifications.**

**\*\* calculated by OCM-3. May be viewed by accessing 'U' parameter.**

## CIRCULAR AREA X VELOCITY



**\* This dimension should be at least 15 cm (6") shorter than the blanking value, P47.**

**\*\* The transducer must be above the maximum head by at least the blanking value, P47.**

## GULL-WING AREA X VELOCITY, P3 = 18

### *'U' parameters required \**

U0 = channel base width    b

U1 = lower angle            alpha ( $\alpha$ )

U2 = upper angle            beta ( $\beta$ )

U3 = transition height      ht

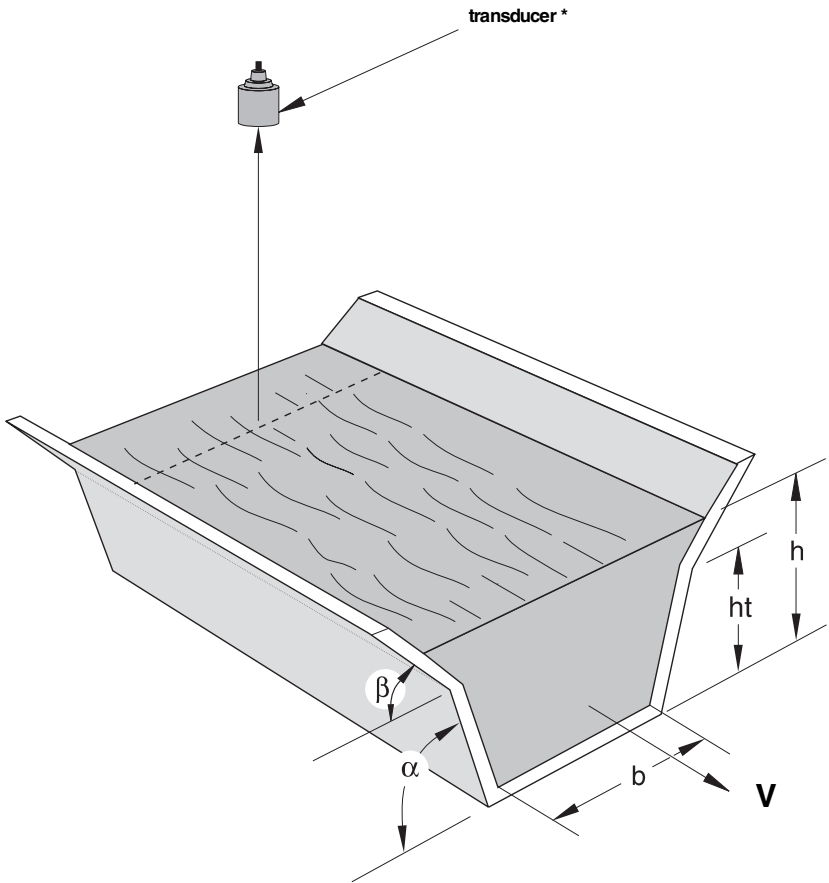
### *'U' parameters calculated \*\**

U4 = area (h)

\* obtain from manufacturer's specifications.

\*\* calculated by OCM-3. May be viewed by accessing 'U' parameter.

# GULL WING AREA X VELOCITY



\* The transducer must be above the maximum head by at least the blanking value, P47.

## EGG-SHAPED AREA X VELOCITY, P3 = 19

*'U' parameters listed \**

*'U' parameters calculated \*\**

U0 = top radius                      R

U3 = area (h)

U1 = bottom radius                  r

U2 = axial displacement          d

\* obtain from manufacturer's specifications.

\*\* calculated by OCM-3. May be viewed by accessing 'U' parameter.

### *Reference*

ABSOLUTE CALCULATION, P4 = 0<sup>□</sup>

For flows that can be calculated by the equation:

$$q = 1/1000 \times A \times v$$

where :    q = flow rate in l/sec

            v = flow velocity in cm/sec

RATIOMETRIC CALCULATION, P4 = 1<sup>□</sup>

For flows that can be calculated by the equation:

$$q = q_{cal} \times A/A_{cal} \times v/v_{cal}$$

where :    q = flow rate

            q<sub>cal</sub> = flow rate at h<sub>cal</sub>

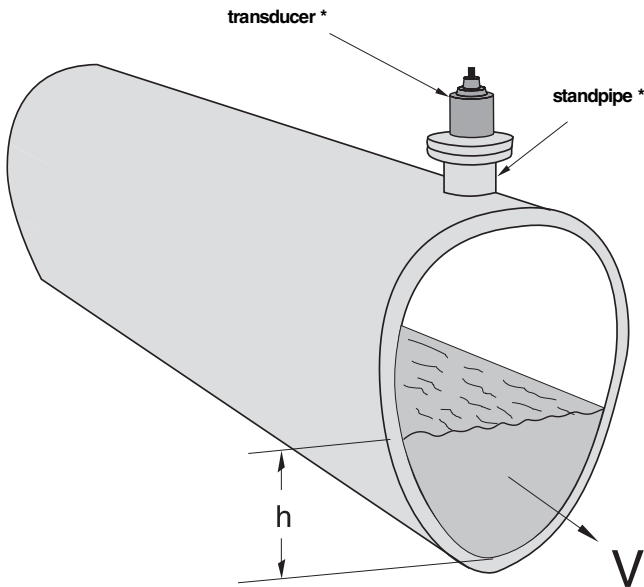
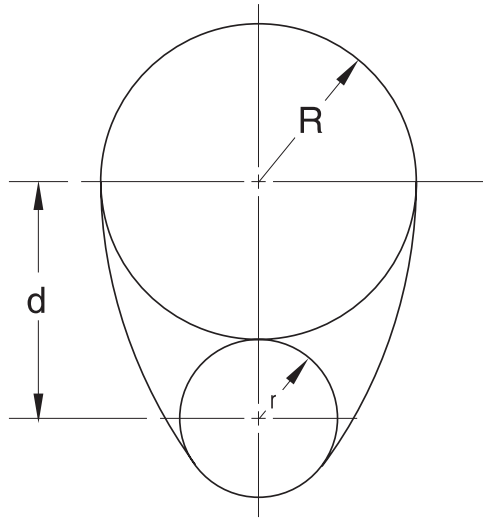
            A = cross sectional area of flow

            A<sub>cal</sub> = cross sectional area of flow at h<sub>cal</sub>

            v = flow velocity

□ Refer to Operation \ Flow Calculation.

## EGG-SHAPED AREA X VELOCITY



\* This dimension should be at least 15 cm (6") shorter than the blanking value, P47.

\*\* The transducer must be above the maximum head by at least the blanking value, P47.

## UNIVERSAL AREA X VELOCITY, P3 = 20

Arbitrary area is typically used when the primary element and/or its flow do not fit any of the primary elements covered by P3. There is no user difference between absolute and ratiometric calculations P4.

The flow curve is characterized by entering the head ( $A_{\text{Even}}$ ) and area ( $A_{\text{Odd}}$ ) ordinates for the number of data points ( $n$ , 4 to 16) over the flow range. The first point ( $A_0, A_1$ ) generally being at 0 head and the last point ( $A_{2n-2}, A_{2n-1}$ ) generally being at maximum head .

**'U' parameters required \***

**U0 = number of data points ( $n$ , 4 to 16)**

**$A_{\text{Even}}$  = head**

**$A_{\text{Odd}}$  = area**

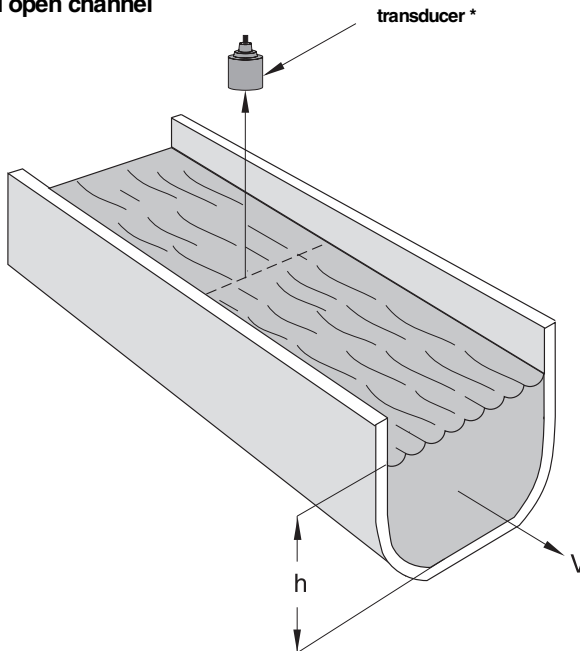
\* obtain from manufacturer's specifications.

\*\* calculated by OCM-3. May be viewed by accessing 'U' parameter.

**'U' parameters calculated \*\***

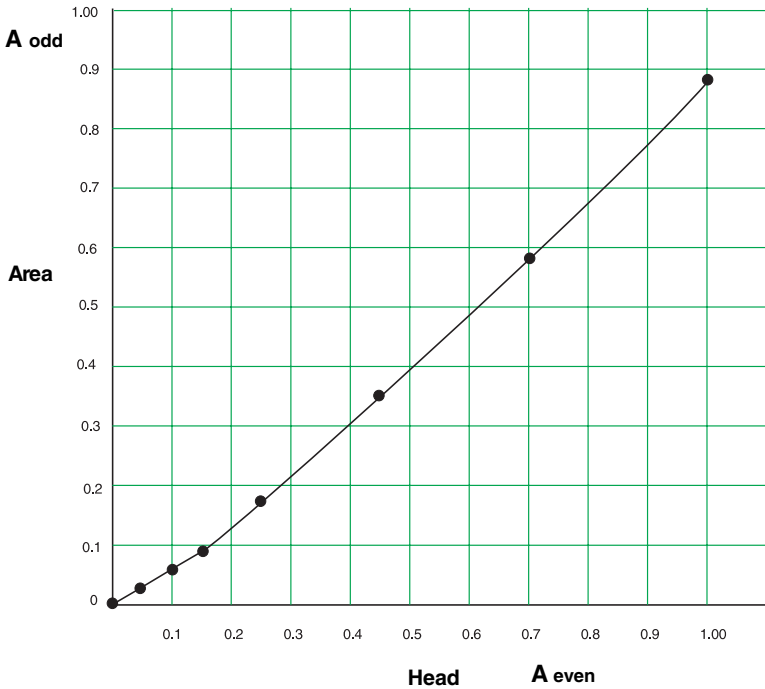
**U1 = area ( $h$ )**

e.g. typical open channel



\* The transducer must be above the maximum head by at least the blanking value, P47.

## UNIVERSAL AREA X VELOCITY



**U0 = 8**

**A0 = 0 head, point 1**

**A1 = 0.0 area, point 1**

**A2 = 0.05 head, point 2**

**A3 = 0.03 area, point 2**

**A4 = 0.1 head, point 3**

**A5 = 0.06 area, point 3**

**A6 = 0.15 head, point 4**

**A7 = 0.09 area, point 4**

**A8 = 0.25 head, point 5**

**A9 = 0.18 area, point 5**

**A10 = 0.45 head, point 6**

**A11 = 0.35 area, point 6**

**A8 = 0.70 head, point 7**

**A9 = 0.59 area, point 7**

**A8 = 1.00 head, point 8**

**A9 = 0.89 area, point 8**

For best accuracy concentrate data points where changes in flow are the greatest.



## **MAINTENANCE**

The OCM-3 requires very little maintenance due to its solid-state circuitry. However, a program of periodic preventative maintenance should be initiated. This should include regular inspection, general cleaning, overall system performance checks and standard good housekeeping practices.

A periodic inspection of the transducer is recommended, at which time any build-up of material on the face should be removed.

The enclosure should be cleaned using a vacuum cleaner and a clean, dry brush.

For battery replacement refer to Installation / Installing the Memory Back-up Battery.

# ERROR CODES

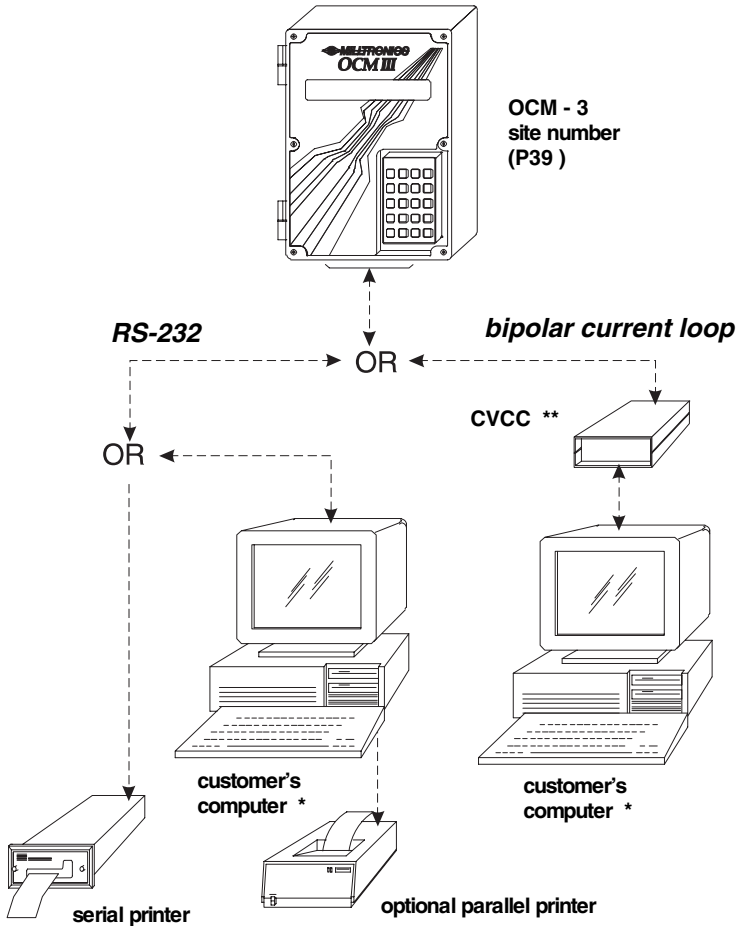
## Error Code Listing

1	number underflow
2	number overflow
3	divide error
4	bad argument
5	invalid parameter
6	system is locked
7	head exceeds BS-3680 spec
8	must use ratiometric
9	invalid angle size
10	invalid selection
11	value is view-only
12	characterizer in use
13	feature not available
14	need whole number
15	invalid date
16	invalid time
20	can't zero auxiliary device
21	b must be greater than R-r

# COMMUNICATIONS

The OCM-3 provides serial communication either through Milltronics proprietary bipolar current loop or industry standard RS-232. Communication can be used to provide a video or paper printout of OCM activity. It can also be used to provide remote programming and retrieval of the data log, from devices such as computers and PLCs.

When using the bipolar current loop, communication runs of up to 1,500 m can be achieved, as opposed to the limited runs of 15 m using RS-232. By terminating the bipolar current loop with a Milltronics CVCC, the communication format is then converted to RS-232.



\* Milltronics OCM -3 Utilities Software available

\*\* provides conversion to RS -232 or 422

Milltronics provides a standard Utilities software package, for convenient communication between an IBM PC compatible computer and the OCM-3. In addition, the user may opt to develop his own custom software program to perform tasks suited to his specific needs.

## Protocol

The protocol for the OCM-3 is as follows:

baud rate:	set via P37
parity:	none
stop bits:	1
word length:	8

The OCM-3 uses a three wire XON/XOFF serial communication link. When the OCM-3's receive buffer is near full, the OCM-3 sends an XOFF signal to tell the sender of the near full condition.

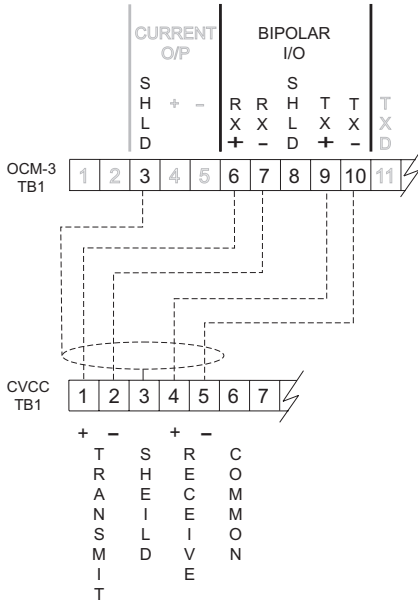
If the sender is also using XON/XOFF, it will respond to the XOFF signal by suspending its transmission.

Similarly, when the OCM-3 receive buffer is near empty, the OCM-3 sends an XON signal to tell the sender that it is safe to resume sending.

The communication baud rate of the OCM-3 and its correspondent must be the same.

# Interconnection

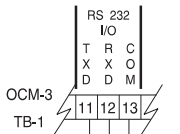
## Bipolar Current



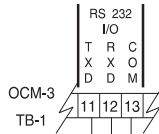
refer to CVCC instruction manual for connection to computer

## RS-232

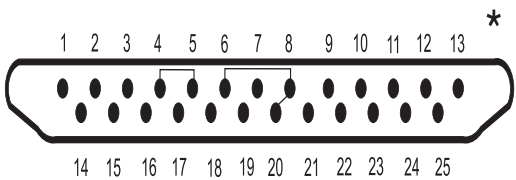
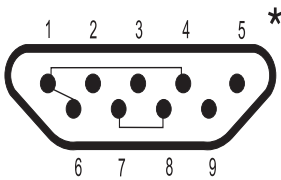
### IBM PC Computer Connection



computer serial port  
DB-9 connector



computer serial port  
DB-25 connector



## Timed Print Out

The OCM-3 can be programmed to periodically print out OCM data (P34/35). A typical print out will have the following format.

Time	hh:mm:ss
Date	dd/mm/yy
Site Number	#
Head	# units
Velocity*	# units
Temperature	# units
Flow Rate	# units
Flow Total	# units

\* only for applications using velocity input

When the output is directed to a serial printer, a delay is inserted between each line to allow the printer time to print each line before another is sent. In that way, the simplest of printers may be used without need of XON/OFF or hardware handshaking; only a three wire connection is required. The printer must be at least 40 columns wide. The OCM-3 sends text in upper and lower case. The printer must support both upper and lower case or else treat lower case as if it had been sent in upper case.

The printing interval must divide evenly into the selected units of time for printing to occur at regular intervals.

e.g. P34 = 1, printer mode set for interval in minutes

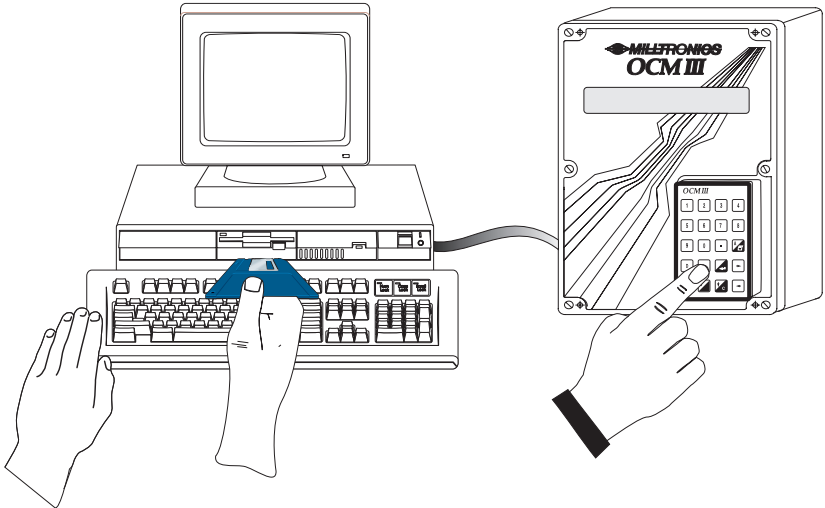
P35 = 7, print interval set for 7 minutes

Printing starts at 7 minutes after the hour and will occur every 7 minutes thereafter until 56 minutes into the hour. The next print out would not occur until 7 minutes into the next hour.

Since the port used for communication is the same as used for normal serial communication, a software switch controls whether or not the display is sent out on the serial port. The switch is controlled by typing 'v' to allow data transmission or 'w' to stop it. The Milltronics printer emulation program does this automatically.

If the OCM-3 is connected to a computer programmed for printer emulation, the computer will receive the print out data and display it on the video terminal (refer to Milltronics Utilities Software).

## Milltronics Utilities Software Disk



The Milltronics Utilities Software expands the human interface capabilities of the OCM-3 as compared to that provided by the simple use of the infra-red programmer.

### *Utilities Software*

- remote OCM-3 programming
- remote OCM-3 display
- saving OCM-3 program parameters
- retrieving log data
- creating spread sheet data log file
- creating ASCII text data log file
- emulating serial printer
- graphic flow rate display

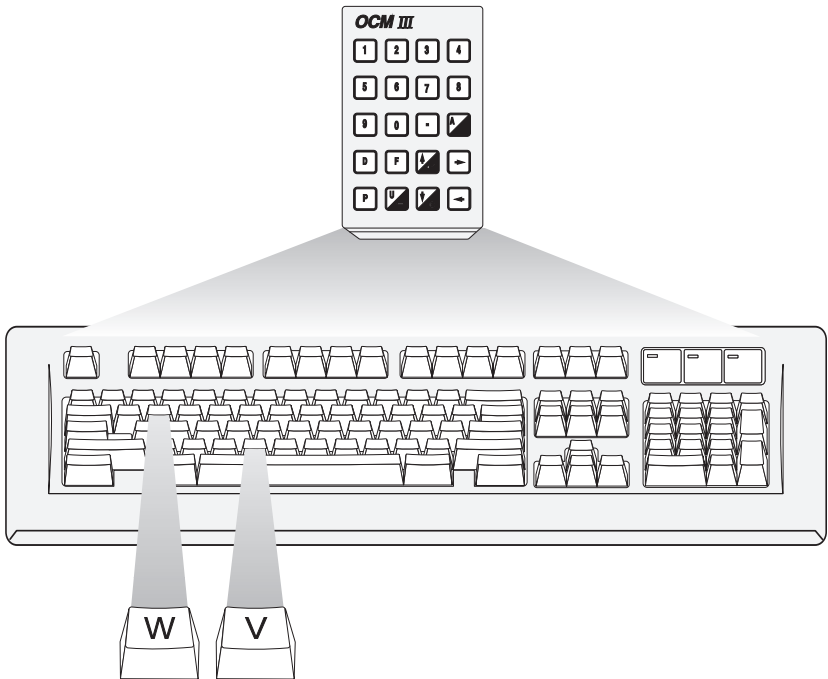
### *Programmer*

- local programming
- local display

The OCM-3 Utilities software provided by Milltronics uses XON/XOFF to ensure communication reliability. The software is written to be executed on an IBM PC compatible computer.

The standard keyboard emulates the OCM-3 programmer. Pressing the keys corresponding to those displayed on the programmer will activate the same function (see Start Up\Keypad). In addition, special functions are provided using the 'w' and 'v' keys found on keyboard.

For additional information, refer to the 'README.DOC' file provided on the disk.



## Custom Programming and Third Party Communication Program

Users who wish to write their own software to communicate with the OCM-3 are urged to implement a fully buffered (interrupt driven) serial link incorporating XON/XOFF.

Some users however, will not have the capacity for such an undertaking. Those users may still communicate with the OCM-3 using the less sophisticated communication capabilities provided by such high level languages as Basic, Pascal or C. The only restriction imposed by using a system that does not use XON/XOFF, is that the user must insure that he does not send long streams of commands to the OCM-3 without pausing periodically to allow the OCM-3 time to process them.

Most users who wish to write their own software to communicate with the OCM-3 will do so for a specific purpose. An example would be to create a customized data log. For this, the user will want that only the numeric values be returned, and none of the descriptive information.

To achieve this, the OCM-3 provides a secondary command parser which is accessed when the OCM-3 receives a command enclosed by '/'. When the leading '/' is detected by the primary parser, the OCM-3 diverts the message to the secondary parser. The secondary parser remains in control until it receives the trailing '/'.

If the trailing '/' is not received within a few seconds, the secondary parser is aborted and control is reverted to the primary parser automatically.

The OCM-3 response message to a command to the secondary parser is a sequence of ASCII characters terminated by an ASCII carriage return (hex 0D) and an ASCII line feed (hex 0A). All system parameters and most other responses are floating point numbers with a maximum of 6 decimal places.

e.g.	typical OCM-3 display value	response message
	0	0.000000
	99.123	99.123000

The following is a list of commands for the secondary parser:

<i>Command</i>	<i>Response</i>
<i>/a#/</i>	the content of a#, where: a = A, D <sup>+</sup> , F, P and U # = 0 through 9 e.g. <i>/P5/</i> the content of P5

- \* D parameters are the only parameters which may be altered through the secondary command parser (which bypasses the security parameter F0). This may be useful, for example, in periodically reading and then resetting the short total, 'D2'. The protocol for altering the value of a D parameter via the secondary parser is:

<i>/dn=#/</i>	where: n is parameter number # is the value stored in the parameter e.g. <i>/d4=50/</i> , this sets the minimum flow rate to 50 for D4
---------------	--

<i>/t0/</i>	totalizer value, similar to that of the 'Flow and Total' (F2) display, except that the multiplier is not displayed
<i>/t1/</i>	totalizer value, returned as a floating point number with a maximum of 6 decimal places, modified to include the effect of the totalizer multiplier. e.g. if the OCM-3 display shows 00005678 x 100, the response would be 567800.000000
<i>/t2/</i>	returns the current 24 hour time: hh:mm:ss
<i>/t3/</i>	returns the current date: dd/mm/yy
<i>/f/</i>	returns the current flow rate

this is similar to the OCM-3 parameter F2 display, however it is not subject to truncation to less than 6 decimal places.

*/j/*

returns a code indicating the relay status

code	relay		
	1	2	3
0	0	0	0
1	1	0	0
2	0	1	0
3	1	1	0
4	0	0	1
5	1	0	1
6	0	1	1
7	1	1	1

*/l/* start data log down load.

*/l1.dd.mm.yyyy/* data log down load - start date

*/l2.dd.mm.yyyy/* data log down load - end date

*/l3/* stop data log down load

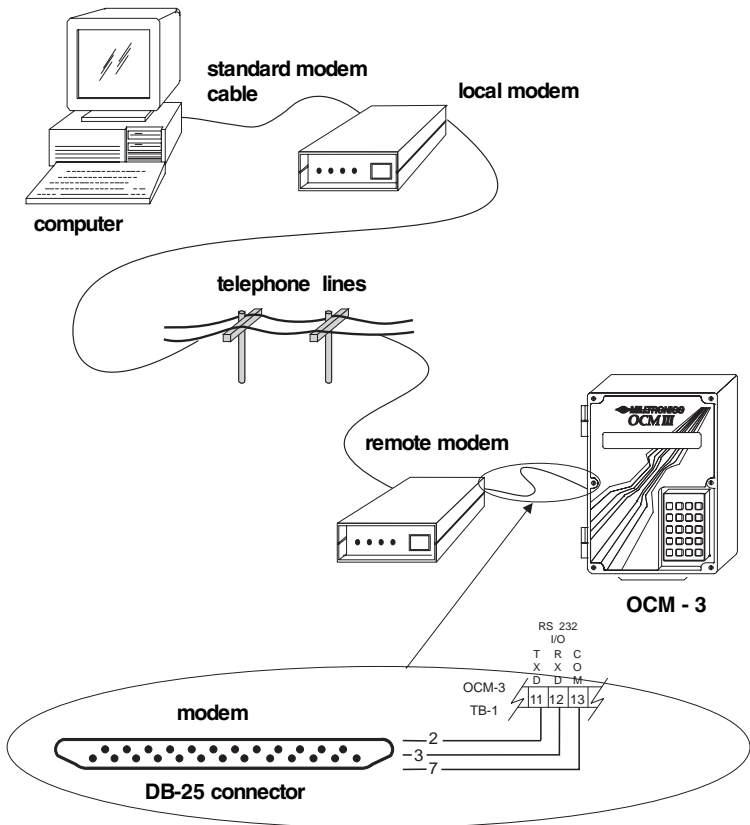
## Modem Communication

Communication with the OCM-3 over an answer back telephone modem is relatively straight forward. For modem communication over conventional telephone lines, a maximum of 1200 or 2400 baud is recommended. Generally, a lower baud rate is more reliable on noisy lines. Modem should be self answering and data checking capability turn on.

The Milltronics Utilities software can be run via modem. In addition the Terminal Emulation program of the Utilities software package can be used to send control sequences directly to the modem.

The remote modem is defined as the modem connected to the OCM-3. The local modem is defined as the modem connected to the computer.

It should be noted that the modem responses listed in the following discussion serve only to typify what is presently common in current field of RS-232 communication.



## Considerations

- set the 'cold start' (F12) default baud to 1200 by removing jumper J1 on board A.
- set both modems and the OCM-3 baud rates to 1200.
- set the remote modem to operate in the 'answer back' mode.  
Refer to modem's user manual.

## Communication

- select serial programming link with OCM-3, from the utilities menu. See Milltronics Utilities Software Disk.

The computer screen will display the letters 'v'. These would normally have gone to the OCM-3 to ask it to send its display, but the modem will have returned it to the screen instead.

### *Establishing Communication*

- type the following:

**ATD** and the telephone number of the remote modem, then press 'ENTER'.

The modem will dial the number you have entered. When the local modem establishes contact with the remote modem, the local modem sends a message to the screen (typical).

**CONNECT**

- press the 'v' and 'ENTER' keys to turn on the OCM-3's display-to-serial channel.

The OCM-3 is now on line and communication can be carried out. The user may escape to the main menu of the Utilities software and select another program if so desired.

To close the communication, return to the Terminal Emulation program.

### *Ending Communication*

- type **W** to break OCM-3 communication with the modem\*. The computer screen will display a flashing message 'OCM-3 muted'.

- type: **+++** (not displayed on the screen) and then press ENTER

This will cause both modems to switch to the 'command' mode. The local modem sends a message to the screen (typical).

OK

- type: **ATH** and press the ENTER key.

Both modems will hang up.

The local modem sends a message to the screen (typical).

OK

\* If the **W** is not sent, the OCM-3 and its modem will still be in communication.

This may result in the OCM-3 modem being unable to answer calls successfully; depending on the type of modem. OCM-3 software, 3.26 or later, averts this problem by automatically breaking communication between the OCM-3 and its modem after 15 minutes.





[www.siemens.com/processautomation](http://www.siemens.com/processautomation)

Siemens Milltronics Process Instruments Inc.  
1954 Technology Drive, P.O. Box 4225  
Peterborough, ON, Canada K9J 7B1  
Tel: (705) 745-2431 Fax: (705) 741-0466  
Email: [techpubs.smpi@siemens.com](mailto:techpubs.smpi@siemens.com)

© Siemens Milltronics Process Instruments Inc. 2005  
Subject to change without prior notice



Printed in Canada

**Rev. 1.0**