

Multiple Path Acoustic Flowmeter for Remote Areas



The Deltaflex is a fourth generation acoustic flowmeter and data recorder designed to measure direct velocity, reflected velocity, stage, discharge, temperature, salinity, speed of sound, receiver gain, and the ratio between the reflected and direct velocities.

The Deltaflex can also log measurements directly to a Telelog™ TL-1 or Filedlog™ FL-2x via RS-232 or SDI-12 to any datalogger.

Basic Deltaflex Features

- Up to 4 Independent paths plus 4 reflected paths.
- One Shot measurement is processed within 17 seconds.
- Velocity resolution and repeatability of 1 mm/s
- Zero velocity offset.
- Extremely low power consumption. ~ (10mA in sleep mode)
- SDI compatible, each path having one SDI subaddress.
- Up to 8 output values per path.
- Relay outputs for pump or gate control.
- Dynamic pathlength can be set from 1m (26ft) to 400m (1320ft)
- Capable of measuring flow in pipes with diameters as small as 0.3m (1.0ft).
- Temperature accuracy to 0.1 degree without calibration

Unique Deltaflex Features

- An attractive Price
- Low cost in the water - The only parts of the Deltaflex submerged in water are the transducers.
- Long transducer cable length allowed - up to 1000m (3000ft).
- Automatic path length detection

Advantages of a Direct and Reflected Velocity

- Two independent velocity measurements for the price of one path.
- Synchronous measurement method provides high accuracy and low standard deviation.
- Unique ability to measure up to the surface capturing the influence of the wind.
- Much better velocity coverage when the stage rises temporarily during short flood events.
- Installation of transducers at low depth level does not sacrifice the precision of velocity measurements at high stage.
- A low path always covered by water is not prone to vandalism.
- The inherent capability to measure the ray bending

Transducers

New plastic transducers are now available in either a streamlined or traditional model. Lightweight and corrosion resistant, these transducers offer the same high quality as a brass transducer but at a substantially lower price. The traditional design will accept a 2-inch nipple for mounting while the streamlined model will attach to the wall of an irrigation channel or to a mounting plate.



Burst – Pulse Transmission

A typical AVM will transmit two acoustic pulses, an upstream pulse and a downstream pulse, one after another. In order to determine velocity, the time difference between the transit times of the two pulses is measured. The DELTAFLEX instead transmits multiple pulses with different spacing in a burst simultaneously in both directions. With some advanced digital data processing this not only enhances the signal to noise ratio, but also eliminates the impact of sudden changes of the velocity of sound. Again, finally the time differences of the direct and the reflected pulse are analyzed and converted into meaningful velocity readings.

One Shot Measurements

Averaging is not necessary with the Deltaflex and it is recommended that the 'one shot' measurement method be used. It takes 17 seconds to process and store the measurement. The fast processing allows for multiple path measurements within reasonable time. The digital post processing uses a "Root of Sum Square Cross Correlation". This method allows the Deltaflex to be virtually foolproof in determining the direct and reflected velocities. Interpolation of zero crossings between sampling points provides an exact timing for determining the water velocity and is accurate to 10 nanoseconds. This relates to a repeatable resolution of 1 mm/s (0.003ft/s) at an 8 m (26ft) path length. The resolution of the measurement increases with path length.

On line Discharge Measurements

The DELTAFLEX has a unique feature: A table is stored in memory containing the relationship between stage S and valid transsection area $A(S)$ along with the appropriate k-factor $k(S)$ to make the proper conversion from measured line velocity to average cross-section velocity, according to the equation $Q = V_{line} \times k(S) \times A(S)$.

To determine the valid numbers of $k(S)$ and $A(S)$ the DELTAFLEX performs automatically a depth measurement accurate to +/- 1 mm over the full temperature and salinity range. The known horizontal acoustic path is used to determine the velocity of sound with a precision of 7 digits, which is then used to measure the depth. (When pressure transducers are used instead they may cause the highest of all errors contributing to discharge calculation, because the density of the water varies with temperature and salinity).

To determine the relationship between stage and transsection area an initial echosounder- or ADCP survey is required. The k-factor can either be determined by calibration or by computer modeling. Computer modeling has the distinct advantage of delivering correct readings right from the day of installation.

There are two options to calculate proper k-factors: The SMT Q-profile software can be used to model rivers that are about 10 times wider than deep assuming normal logarithmic velocity distribution in all verticals. Secondary currents are ignored in this model.

Sophisticated SIMK software based on 'infinite element' modeling can handle any shape of the river transsection, including cases of flooded foreland to achieve 2 % discharge accuracy. This software precisely models secondary currents as well. It takes bottom and weed friction into account.

VELOCITY*For path lengths greater than 7 meters*

- Range: -4 m/s ... 0.0 m/s ... +4 m/s (-13 ft/s ... 0.0 ft/s ... +13 ft/s)
- Resolution: 1 mm/s (0.003 ft/s)
- Repeatability: +/- 1 mm/s at > 8m pathlength (+/- 0.003 ft/s at > 26 ft pathlength)
- Accuracy: +/- 2%

DISCHARGE

- Accuracy: +/- 2% compared with conventional current

STAGE

- Resolution: 1 mm/s (0.003 ft/s)
- Repeatability: +/- 2 mm (+/- 0.006 ft/s)
- Accuracy: +/- 2 mm (+/- 0.006 ft/s)

MECHANICAL DIMENSIONS

- Size: Preliminary ~ 100 x 200 x 200 mm (4in x 8in x 8in)
- Weight: Preliminary ~ 2.6kg

ELECTRICAL SPECIFICATIONS

- Power Consumption: 12V nominal ~ 210mA ~ 2.5W
13.5V ~ 240mA ~ 3.2W
18V ~ 210mA
10mA in sleep mode
- Max Voltage: 32V
- Minimum Voltage to Start: 11.8V
- Cut-off Voltage: 11.0V Auto SRAM protection

LIGHTNING PROTECTION

- Transducer lines: 350V cut-off voltage to ground
- 2 x 20 000 A symmetrical
- Power line: Cut-off at > 32V
- Data line: Zener limit +/- 15 V
- SDI-line: Zener limit + 5.2V/-0.7V

TRANSDUCER SPECIFICATIONS

- Beam width: +/- 10 degrees
- Length: 50mm (2 inches)
- Transducer cable length: 10m (30 ft) longer cables on request
- Max cable length: 1000m (3000ft) including splices
- Recommended cable: Twisted wires, shielded, 100 Ohm impedance.

KERN ELEKTRONIK AG

Messtechnik und Elektronik
Kammstrasse 11
CH - 3800 Interlaken
Tel +41 33 823 74 04
Fax +41 33 823 74 05

<http://www.hydrometrie.ch>
email: info@hydrometrie.ch
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