PCM 4

Portable Flow Measurement for universal use

Undoubtedly the most accurate portable flow measurement

The portable PCM 4 is designed for temporary flow measurement over long-term periods in open channel applications such as wastewater collection systems, storm seewer systems, and combined sewer systems.
The battery powered system provides highly accurate depth and volocity data.

The PCM 4 can be used for many project applications, like

- **infiltration/inflow analysis and reduction**
- **master plan studies**
- **storm sewer monitoring**
- **...**

Some of the most important features for using the PCM 4 even in difficult applications are:

- **measures the real flow velocity profile**
- **spatial allocation of single velocities**
- **no calibration required**
- **absolutely stable zero point and drift-free**
- **triple redundant level measurement**
- **measurement in all part filled and full pipes and channels**
- **measurement in heavily polluted and abrasive media**
- **multilingual parameter setting in dialog mode**
- **also available as PCM Pro, for the use in Ex areas**

Measurement principle

The quantity >>flow "Q"<< cannot be measured directly. The following general equation is the basis for flow calculation:

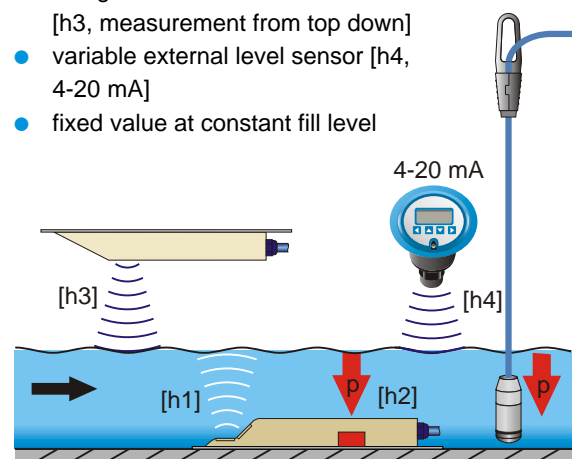$$Q = A \cdot \overline{v}$$

A = wetted cross-sectional area
$\overline{v}$ = average flow velocity

The wetted cross-sectional area A depends on the cross-sectional profile and the flow level.

This flow level will be determined by using integrated and / or external sensors.
The wetted cross-sectional area will be calculated taking the cross-sectional profile into account.

Flow level measurement

You are free to select between 5 different detection principles depending on your application.

- water-ultrasonic integrated in combi sensor [h1, measurement from bottom up]
- pressure measurement cell integrated in combi sensor [h2, measurement from bottom up]
- wedge sensor with air-ultrasonic [h3, measurement from top down]
- variable external level sensor [h4, 4-20 mA]
- fixed value at constant fill level

4-20 mA

[h3] [h4]

[h1] [h2]

2

Ultrasonic

In case of water-ultrasonic as well as in case of air-ultrasonic [h1; h3] the flow level will be detected using the echo sounder principle.
The interface between water and air (water surface) will be detected in both cases and the sound transit time between sensor and water level will be measured.

The flow level is proportional to the measured time which will be determined as a result from that. This measurement method stands out for its accuracy and its long-term stability.
Foam or other substances floating on the water surface do not affect the result of the water-ultrasonic measurement.

Hydrostatic

Level measurement is even possible in strongly absorbing media by using a hydrostatic measurement [h2] which can also be integrated into the sensor.
The high-resistant Hastelloy diaphragm allows the sensor to be used in heavily contaminated or aggressive media.

By detecting atmospheric pressure and the hydrostatic pressure of the measurement medium simultaneously air pressure fluctuations are compensated ideally.

The additional use of a resistant-free air filter reduces measurement inaccuracies to a minimum.

External sensors

External level sensors with 4-20 mA signals can be integrated into the system without any problems.
In case of constant fill levels no additional level sensors are required due to the use of a fixed value.

Flow velocity measurement

An ultrasonic converter (sensor) sends an ultrasonic burst into the medium. The particles or gas bubbles in the medium reflect this impulse. The sensor operates in impulse-echo mode, i.e. the ultrasonic converter will switch to receiving mode immediately after transmitting the burst, receiving the reflected ultrasonic echo as a characteristic echo image pattern.
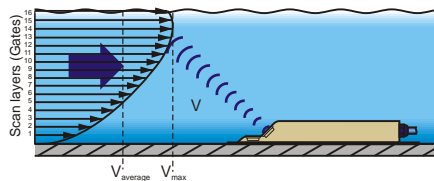
These echo patterns from the first scan will be digitised and saved.
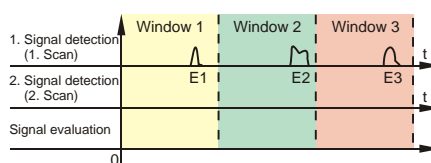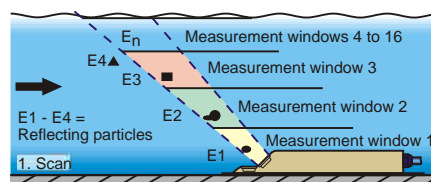
During the second scan, an ultrasonic burst will be sent again and the reflected echo patterns will be saved as well.
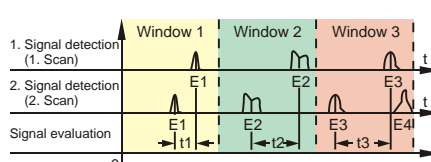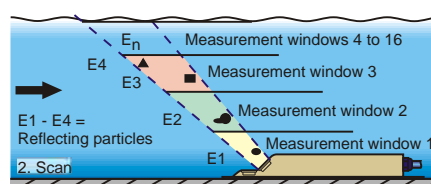
By using the **cross correlation method** the characteristic echo image patterns within the time slots are now checked for compliance. The temporal shift of the echo image pattern of the second scan compared to the first scan can be converted directly into the flow velocity within the individual measurement windows taking the beam angle into account.
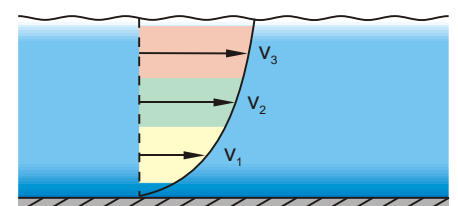
Formula

$$f_g(\tau) = \lim_{t} \frac{1}{T} \int_{-T/2}^{+T/2} f(t)\, g(t+\tau)\, dt$$

This event will be repeated up to 2000 times per second.

The flow profile will be determined directly from the individual velocities in real time by the integrated digital signal processor (DSP). This allows the user to obtain measurement values with the highest accuracy without additional calibration.

Determined flow profile

Transmitter: lightweight

The most important details at a glance:

- large back-lit graphic display

- dialog mode user interface

- graphic indication of hydraulic conditions at the measurement place

- numeric and graphic sensor diagnosis

- protocol function for the most important measurement data

- logging of current flow measurement values (Q, h, v, T) and system parameters

- variable measurement modes for cyclic, event-based and continuous measurement with free selectable storage interval

- removable data memory (flash card) up to 64 MB for data storage and data transfer to PC

- operating time per battery charge 40.000 measurement cycles 3 months / 5 minute cycle

- environmentally acceptable rechargeable battery

- can be used with standard batteries (size D) alternatively

- line powered operation possible

- recording of pump run times, switching events and rain gauge data

- storage of external analog signals (fill levels, flows, analysis values...)

- enclosure rating: IP 67

- analog output of measured values

- sampler driving

- transmission of error messages

- output of limit values

- connection of external counters

- telemetered communication (pending)

Programming

Programming the unit is remarkably simple. The user will be guided through the menu thanks to the windows-like program and the dialog mode on the large graphic display. Programmed settings will be clearly indicated graphically. The program structure is perfectly set for the requirements of a portable measurement system.

This virtually eliminates any possibility of faulty programming. As a standard, access can be restricted in order to prevent the unit from unauthorised modification.

Display

The back-lit display can be clearly read even in dark shafts and manholes. It enables the user to easily program the unit as well as to simply recall sensor data, echo profiles, velocity distributions, historical trend graphs...
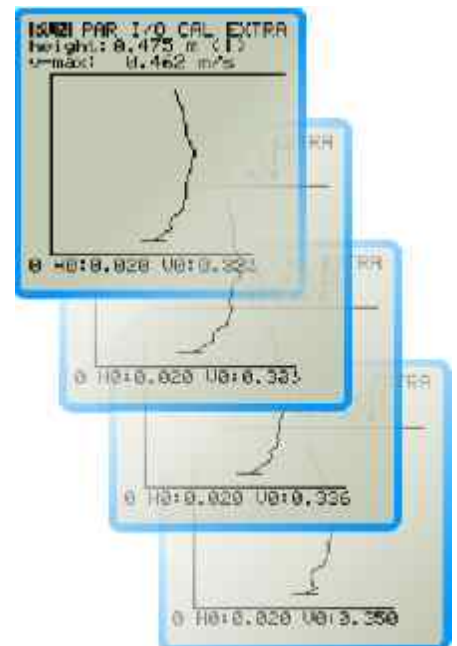
Direct flow profile indication on the display

System diagnostics

Recalling the most important system data on the display

Internal protocol functions to assess the measurement progress without any aid onsite

Diagnostic tools to assess the measurement quality, e.g. flow level
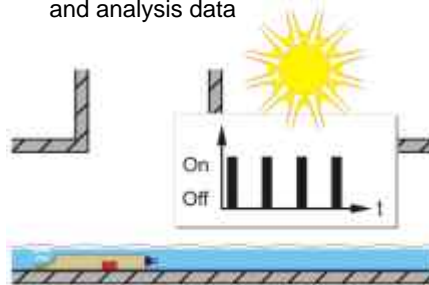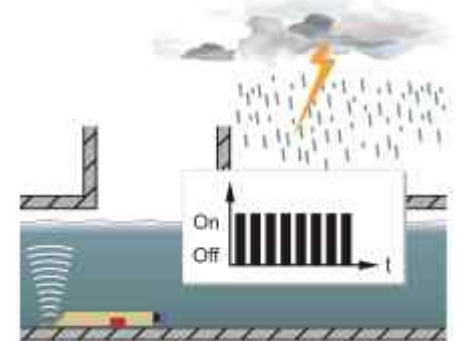
Echo profile analysis

The versatile diagnosis options allow the user to perfectly select a measurement place and trouble-free operation of the measurement system.

Storage

- plug-in industry standard data memory
- redundant data saving
- data files in txt format
- additional storage of parameter and analysis data

Event-based memory changeover

High-level data availability requires unusual solutions. Since standard memory cards do not meet these requirements, NIVUS relies on industry standard. A redundant memory management (parallel data storage on memory card and the internal RAM) virtually eliminates any possibility of data loss. The additional storage of parameter settings and analysis data completes the safety kit. The storage in txt-format ensures compatibility with any standard calculation and spreadsheet applications.
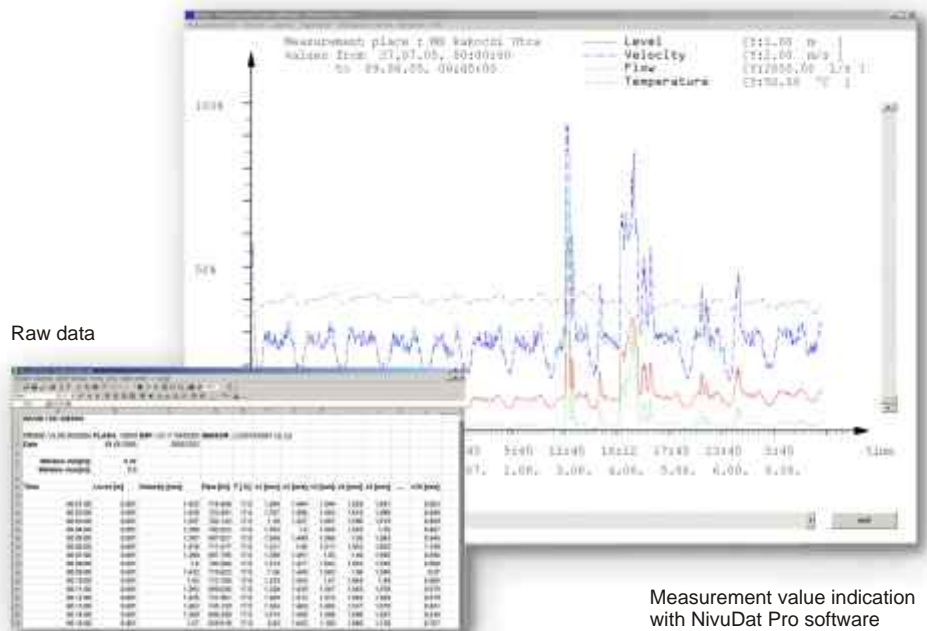
Raw data

Measurement value indication with NivuDat Pro software

NivuDat Pro

Apart from options to evaluate data using common spreadsheet applications, the NivuDat Pro software allows the user to clearly and quickly represent measurement data as tables or graphs under Windows XP / Windows 2000.

Additional editing options such as sequential data export, averaging functions, min. and max. value output, administration of measurement places and more complete the program.

Sensors: unrivalled in versatility
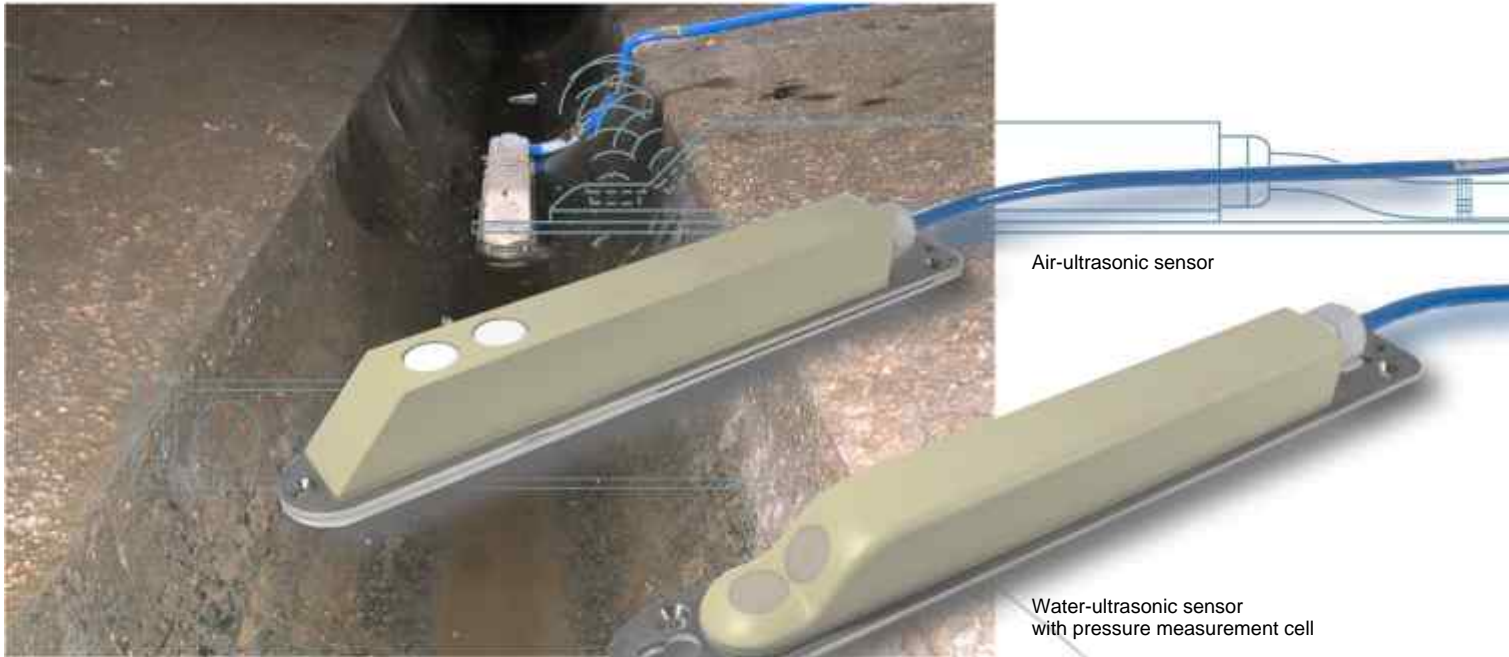
Air-ultrasonic sensor

Water-ultrasonic sensor
with pressure measurement cell

- triple redundant level measurement (air-ultrasonic, water-ultrasonic, hydrostatic)

- high accurate flow velocity measurement

- external level sensors can be connected

- high measurement dynamics from 5mm/s to 6m/s

- measurement in both flow directions

- standard sensors with high medium resistance (PPO, PEEK, 1.4571, Hastelloy)

- sensors resistant to chemical substances for highest demands

- IP 68

- flexible to use

- easy to install using variable fastening system

... remarkably easy to install
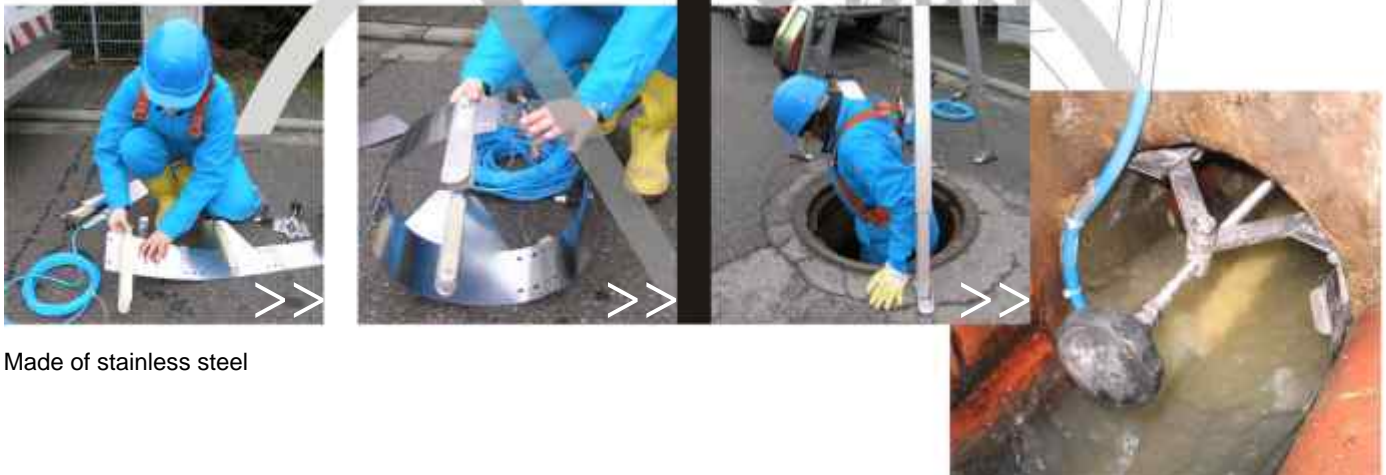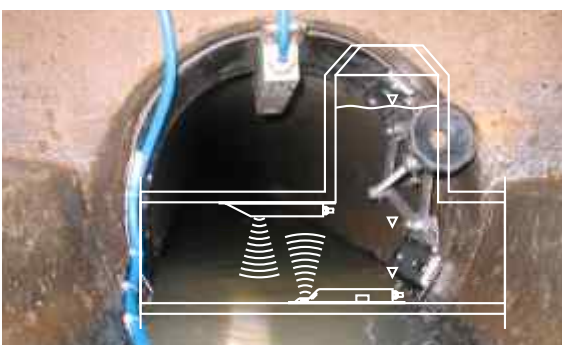

Made of stainless steel
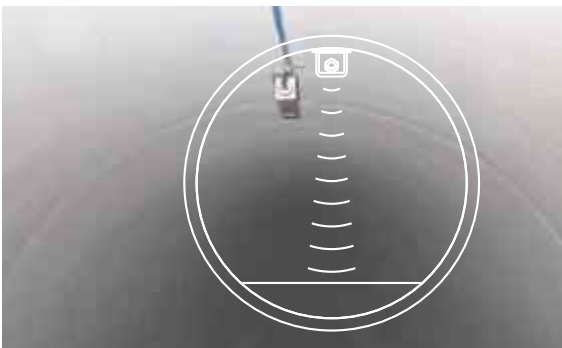
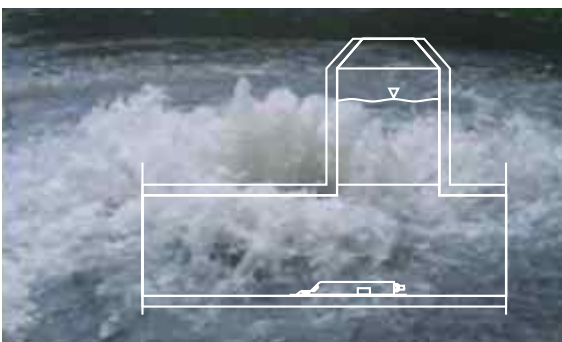Air-ultrasonic - detection of low flow levels, e.g. for investigation of extraneous water

Areas of use

- investigation for infiltration
- data collection for the hydraulic calibration of sewer network models
- billing networks
- collection of basic planning data for storm water detention basins
- recording of rainwater feed
- throttle calibration
- verification of existing sewer systems
- indirect influent monitoring
- temporary verification of process flows
- and much more

No matter if used by local councils, water and environment authorities, engineering consultants and planning agencies, test centres or authorised experts - with its versatile and universal areas of use, its high accuracy and user-friendliness the PCM4 represents a long-life and reliable working tool.

Hydrostatic measurement - flow level detection, e.g. in channels tending to sedimentation

Logging and controlling

More than just a flow measurement

The standard peripheral interfaces of the PCM 4 not only allow accurate and comfortable flow measurement, but also enable to easily embed additional measurement systems into a complete recording concept.

Air-ultrasonic, water-ultrasonic and hydrostatic measurement - investigation of channel efficiency

Hydrostatic measurement - submergence detection

Variable output interfaces enable the integration of the PCM 4 into existing systems without any problems.
This flexibility allows the creation of solutions for various tasks such as:

Sampling
Relay and analog output enable to drive sampling devices either based on volume, time or flow (freely selectable). Presetting a minimum level for sample drawing ensures reliable sampling.

Throttle verification
By measuring throttle volume and tank fill level simultaneously the PCM 4 simply meets any requirements of throttle verifications.

Pump efficiency measurement
Recording pumping rate and pump run times simultaneously enables the control of the current pump efficiency. This point is useful to clarify cost-cutting potentials.

Event monitoring
External switching contacts (float switches, pump relays and similar) or internal limit values either allow to start the flow measurement based on events or to switch over measurement and storage cycles dynamically.
This results in long battery life and high data density during flow-relevant measurement periods.

Signal transfer
Digital and analog output signals allow information transfer to main systems. Freely definable output ranges, impulse lengths and limit values enable connection to devices from various manufacturers.

**Measuring - Controlling - Logging >>PCM 4
One measurement system many possibilities**

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