Instruction Manual for portable Flow Meter PCM 4

(Original Instruction Manual – German)

valid as of Software-Revision No. 1.10

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Translation
If the device is sold to a country in the EEA, this instruction handbook must be translated into the language of the country in which the device is to be used.
Should the translated text be unclear, the original instruction handbook (German) must be consulted or the manufacturer contacted for clarification.

Names
The use of general descriptive names, trade names, trademarks and the like in this handbook does not entitle the reader to assume they may be used freely by everyone. They are often protected registered trademarks even if not marked as such.

1 Contents

1.1 Table of Contents

1.2 Declaration of Conformity

EC Declaration of Conformity

pursuant to

- **the EC Low Voltage Directive 73/23/EEC, Annex III**
- **the EC EMC Directive 89/336/EEC, Annex I and II**

We hereby declare that the design of the

Description: Measuring device PCM 4 with Sensor

as delivered complies with the above regulations and following EC directives and DIN EN standards:

Directive/ Standard	Title

73/23/ EG	EU Low Voltage Directive
EN 61010-1	Safety requirements for electrical equipment for measurement, control and laboratory use – Part 1: General requirements

89/336/EG	EC EMC Directive
EN 61000-6-2	Electromagnetic compatibility – Generic immunity standard – Industrial environment
EN 61000-6-4	Electromagnetic compatibility – Generic immunity standard – Industrial environment

Unauthorised modifications to the device will invalidate this declaration.

Eppingen, January 8th 2007

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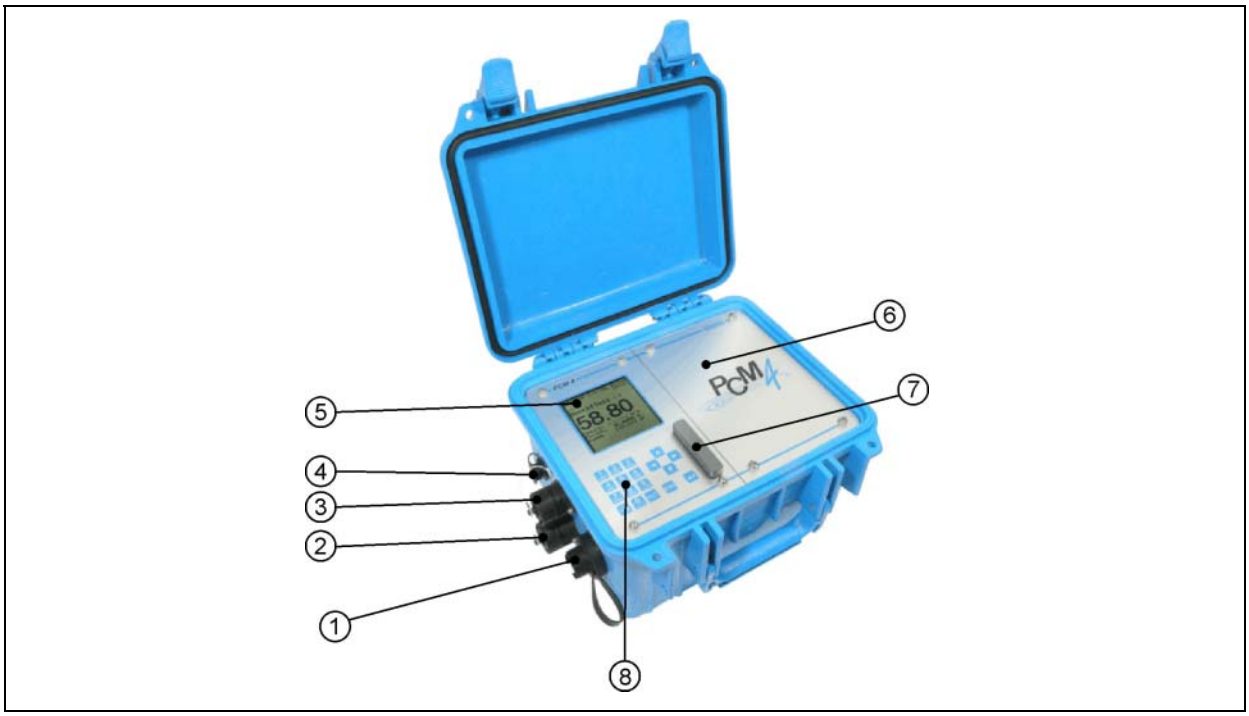
Heinz Ritz
Head of Quality Management

2 Overview and use in accordance with the requirements

2.1 Overview



1 Multifunctional socket to connect either Connector-Box, active digital input (such as rain gauge), 0/4-20mA input signal or 0-10V voltage output and relay output (e.g. sampler)
2 Socket for connection of water-combi sensor
3 Socket for connection of air-ultrasonic sensor Type OCL or external level measurement 4-20mA (such as NivuCompact)
4 Socket for combined mains adapter / battery charger
5 Display
6 (Rechargeable) battery compartment
7 Compact flash card slot with cover
8 Programming keys

Fig. 2-1 Overview PCM 4

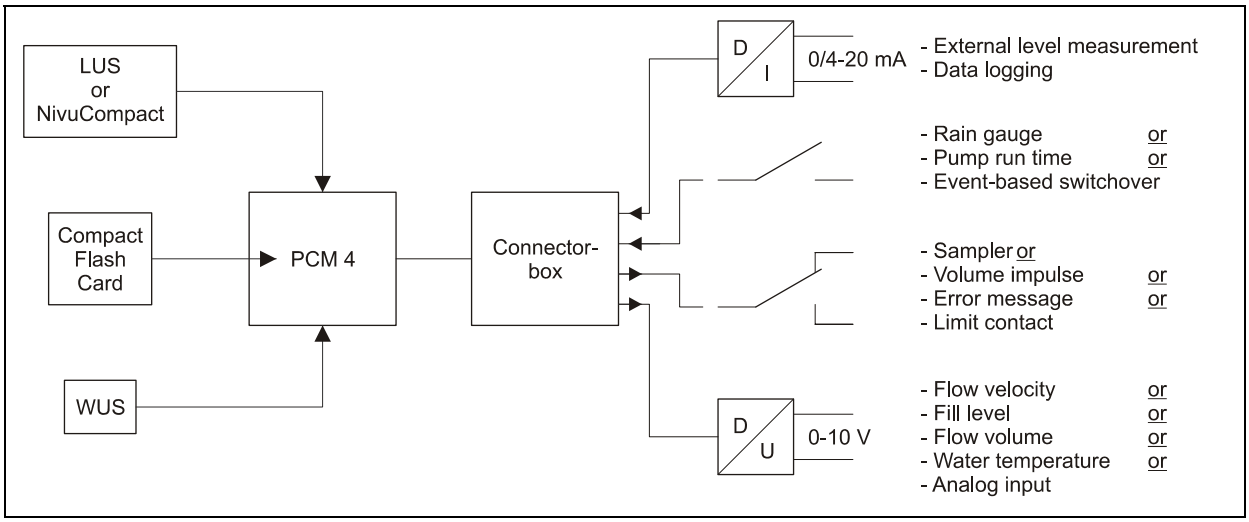
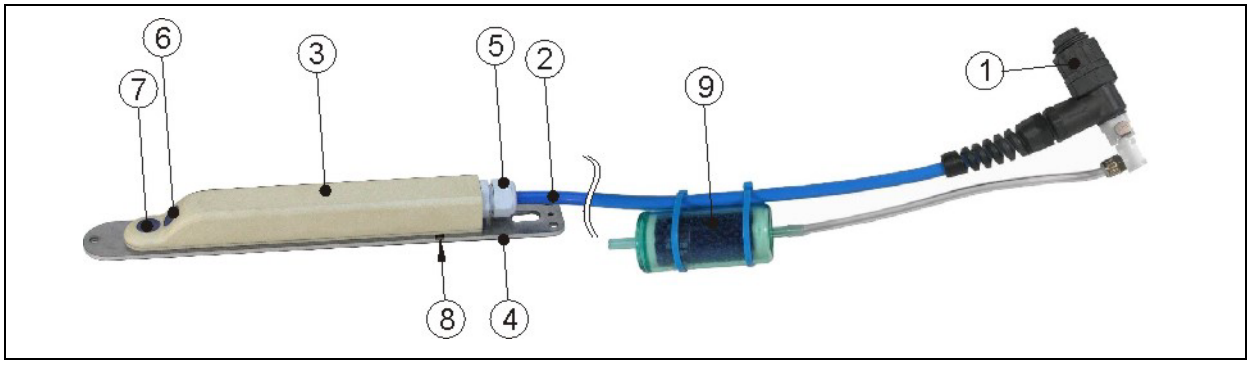


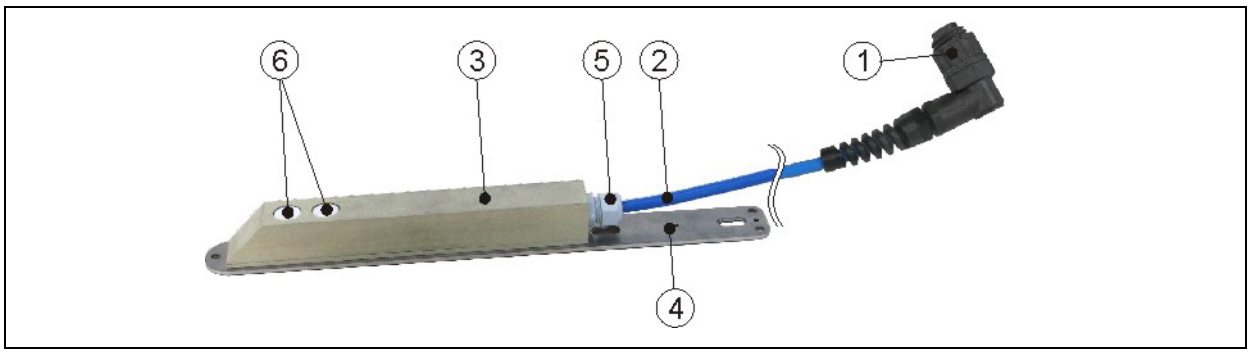
Fig. 2-2 Possible combinations

The Connector-Box shall be used only if more than one input or output has been connected to the multifunctional socket of the PCM 4 simultaneously.



1 Plug with spigot nut, IP68
2 Sensor cable
3 Sensor body
4 Ground plate
5 Cable gland
6 Sensor for flow velocity measurement
7 Sensor for level measurement using water-ultrasonic
8 Sensor for level measurement using pressure
9 Air filter

Fig. 2-3 Overview water-ultrasonic combi sensor



1 Plug with spigot nut, IP68
2 Sensor cable
3 Sensor body
4 Ground plate
5 Cable gland
6 Sensors for level measurement using air-ultrasonic

Fig. 2-4 Overview air-ultrasonic sensor

2.2 Use in accordance with the requirements

The measurement device Type PCM 4 as well as the accompanying sensors are designed to temporarily measure flow of slight to heavy polluted media in part filled and full sewers, pipes and other channels. External data can be detected and recorded as well. Additionally it is possible to drive external peripheral units optionally.
The unit is designed to be powered independent from mains by using either rechargeable batteries or standard batteries. On the other hand the unit can be powered from mains by using the combined power pack / battery charger.
Measured and recorded data is going to be saved on a non-volatile, exchangeable storage medium.
Please necessarily observe the maximum permissible limit values as specified in chapter 2.3. Any cases varying from these conditions without being approved by NIVUS GmbH in writing are entirely at owner's risk.

The device is exclusively intended to be used for purposes as described above.
Modifying or using the devices for other purposes without the written consent of the manufacturer will not be considered as use in accordance with the requirements.
Damages resulting from this are left at user's risk.

2.3 Specifications

2.3.1 Transmitter

Power supply	- rechargeable lead gel battery: 12V/12 Ah - battery compartment for 8 LR20 standard batteries 1.5V - power pack 100 – 240 V AC; 50/60 Hz
Enclosure	- material: Polypropylene, impact resistant - weight: approx. 2.0 kg (4.41 lbs, without sensor and batteries) - protection: IP67 if lid is closed and locked
Operating temperature	-10°C to +40°C (14°F to 104°F)
Storing temperature	0°C to +60°C (32°F to 140°F)
Max. humidity	90 %, non-condensing
Display	back-lit graphic display, 128 x 128 pixel
Operation	18 keys, menus in German, English, French, Italian and Czech
Sockets (IP68)	- 1 x 4 – 20 mA for external level (active 2-wire sensor) or 1 x active air-ultrasonic sensor Type OCL for level measurement - 1 x active combi sensor water-ultrasonic/pressure sensor for flow velocity and level measurement - 1 x multifunctional socket for digital and analog inputs and outputs - 1 x socket for combined power pack and battery charger
Inputs via multifunctional socket	- 1 x active digital input, supply voltage 3.3 V DC - 1 x analog input, 0/4 – 20 mA (passive)
Outputs via multifunctional socket	- 1 x relay (SPDT) switching capacity: 250 V AC/30 V DC, 5A switching frequency: 5 Hz - 1 x voltage output
Memory cycle	- 1 to 60 minutes, cyclical or event-based
Data memory	- externally on plug-in compact flash card up to 128 MB - internal RAM, 8 MB
Data transmission	- via plug-in compact flash card

2.3.2 Water-ultrasonic combi sensor

Measurement principle	- ultrasonic transit time (level) - piezoresistive pressure measurement (level) - correlation with digital pattern detection (flow velocity)
Measurement frequency	1 MHz
Protection	IP 68
Operating temperature	-20°C to +50°C (-4°F to 122°F)
Storing temperature	-30°C to +70°C (-22°F to 158°F)
Operational pressure	max. 4 bar (58 psi) (combi sensor with pressure measurement cell max. 1 bar (14.5 psi))
Cable length	10/15/20/30/50/100 m (33/49.2/66/98.4/164/328 ft) pre-configured, extendable to up to max. 250 m (820 ft); using sensors with integrated pressure measurement cell requires to use a pressure compensation element after a cable length of 30 m (98.4 ft)
Cable type	- combi sensor with pressure measurement: LiYC11Y 2x1.5 + 1x2x0.34 + PA 1,5/2,5 - sensors without pressure measurement: LiYC11Y 2x1.5 + 1x2x0.34
Outer cable diameter	- combi sensor with pressure measurement: 8.7 mm ±0.25 mm (0.34 in ±0.01 in) - sensors without pressure measurement: 7.6 mm ±0.25 mm (0.3 in ±0.01 in)
Sensor types	- flow velocity sensor with v-measurement using cross correlation and temperature measurement to compensate temperature effects on sound velocity - combi sensor with flow velocity sensor using cross correlation; water-ultrasonic level measurement and temperature measurement to compensate temperature effects on sound velocity - combi sensor with flow velocity sensor using cross correlation; level measurement using pressure and temperature measurement to compensate temperature effects on sound velocity (only wedge sensor) - combi sensor with flow velocity sensor using cross correlation; water-ultrasonic level measurement and redundant level measurement using pressure, temperature measurement to compensate temperature effects on sound velocity (only wedge sensor)
Constructions	- wedge-shaped sensor for installation on channel bottoms - pipe sensor for installation in pipes using cutting ring and nozzle
Medium-contacting materials	Polyurethane, stainless steel 1.4571, PPO GF30, PA (only wedge sensor) optionally: chemical-resistant sensor made of PEEK, ground plate made of Hastelloy; ground plate made of titanium; FEP-coated cable
Water-ultrasonic level measurement	
Measurement range	0 to 200 cm (0 to 78.7 in), lowest absolute measurable height 5 cm (2 in)
Zero point drift	absolutely stable zero point
Accuracy	better than ±2 mm (±0.08 in)
Pressure level measurement	
Measurement range	0 to 350 cm (0 to 137.8 in)
Zero point drift	max. 0.75 % of final value (0–50°C / 32-122°F)
Accuracy	≤0.5 % of final value

Flow velocity measurement	
Measurement range	-100 cm/s to +600 cm/s (-3.28 ft/s to +19.7 ft/s)
Number of scan layers	max. 16
Zero point drift	absolutely stable zero point
Error limits (per scan layer)	≤1 % of measurement value (v >1 m/s / 3.28 ft/s) ≤0.5 % of measurement value +5 mm/s / +0.2 in/s (v <1 m/s / 3.28 ft/s)
Number of sensors	1
Sonic beam	±5 degrees
Temperature measurement	
Measurement range	-20°C to +60°C (-4°F to 140°F)
Accuracy	±0.5 K

2.3.3 Air-ultrasonic sensor

Measurement principle	ultrasonic transit time
Measurement frequency	120 kHz
Protection	IP68
Ex approval	II 2 G EEx ib IIB T4
Operating temperature	-20°C to +50°C (-4°F to 122°F)
Storing temperature	-30°C to +70°C (-22°F to 158°F)
Operational pressure	max. 1 bar (14.5 psi)
Cable length	10/15/20/30/50/100 m (33/49.2/66/98.4/164/328 ft) pre-configured
Cable type	LiYC11Y 2x1.5 + 1x2x0.34
Outer cable diameter	7.6 mm ±0,25 mm (0.3 in ±0.01 in)
Constructions	wedge-shaped sensor for installation in channel vertex
Medium-contacting materials	Polyurethane, stainless steel 1.4571, PPO GF30, PA
Level measurement	
Measurement range	0 to 200 cm (0 to 78.7 in)
Dead zone	10 cm (3.9 in)
Accuracy	better than ±5 mm (±0.2 in)
Temperature measurement	
Measurement range	-20°C to +50°C (-4°F to 122°F)
Accuracy	±0.5 K

2.3.4 Accessories (optional)

Memory card	type: compact flash card; capacity: 128 MB
Read-out adapter	adapter for PCMCIA interfaces, mainly for read-out via Laptop / Notebook
Card reader	with USB interface for PC connection
Connector-Box	for simultaneous connection of more than one output or input to the PCM 4 multifunctional socket
Power supply	rechargeable lead gel battery: 12V/12 Ah battery compartment for 8 LR20 standard batteries 1.5V
Pipe mounting system	for temporary, non-permanent clamping installation of wedge sensors (water-ultrasonic combi sensor and air-ultrasonic sensor) in pipes DN 200 – 800 (diameters from 7.9 in to 31.5 in)
Suspension bracket with eyelet	to fasten the PCM 4 on access ladders or similar
Power pack / battery charger	combined battery charger for rechargeable lead gel batteries or for direct mains operation, 100-240V AC/50-60 Hz IP 40
Evaluation software	type: NivuDat for Windows NT/2000 for data read out, data evaluation, generation of hydrographs, average values, hour, day and month totals and more

3 General Notes on Safety and Danger

3.1 Danger Notes

3.1.1 General Danger Signs

Cautions
are framed and labelled with a warning triangle.

Notes
are framed and labelled with a "hand".

Danger by electric voltage
is framed and labelled with the Symbol on the left.

Warnings
are framed and labelled with a "STOP"-sign.

For connection, initial start-up and operation of the PCM 4 the following information and higher legal regulations (e.g. in Germany VDE), such as Ex-regulations as well as safety requirements and regulations in order to avoid accidents, must be adhered to.
All operations, which go beyond steps regarding installation, connection or programming the unit are allowed to be carried out by NIVUS staff only due to reasons of safety and guarantee.

3.1.2 Special Danger Notes

Please note that due to the operation in the waste water field transmitter, sensors and cables may be loaded with hazardous disease germs. Respective precautionary measures must be taken to avoid damage to one's health.

3.2 Device Identification

The instructions in this manual apply only for the type of device indicated on the title page.
The nameplate is fixed on the reverse side of the device and contains the following:

- name and address of manufacturer
- CE label
- type and serial number
- year of manufacture

It is important for queries and replacement part orders to specify type, year of manufacture and serial number (Article no. if necessary). This ensures correct and quick processing.

Fig. 3-1 PCM 4 nameplate

This instruction manual is a part of the device and must be available for users at any time.

The safety instructions contained within must be followed.

It is strictly prohibited to disable the safety devices or to modify the way they work.

3.3 Installation of Spare Parts and Parts subject to Wear and Tear

We herewith particularly emphasize that replacement parts or accessories, which are not supplied by us, are not certified by us, too. Hence, the installation and/or the use of such products may possibly be detrimental to the device's ability to work.
Damages caused by using non-original parts and non-original accessories are left at user's risk.

Using spare parts / parts subject to wear and tear (such as rechargeable batteries, filters or similar) which are not licensed by NIVUS will invalidate any warranty claims.

3.4 Shutdown Procedure

For maintenance, cleaning and repair purposes (authorized staff personnel only) the device has to be disconnected from batteries / mains.

3.5 User's Responsibilities

In the EEA (European Economic Area) national implementation of the framework directive 89/391/EEC and corresponding individual directives, in particular the directive 89/655/EEC concerning the minimum safety and health requirements for the use of work equipment by workers at work, as amended, are to be observed and adhered to.
In Germany the Industrial Safety Ordinance of October 2002 must be observed.

The customer must (where necessary) obtain any local **operating permits** required and observe the provisions contained therein. In addition to this, he must observe local laws and regulations on

- personnel safety (accident prevention regulations)
- safety of work materials and tools (safety equipment and maintenance)
- disposal of products (laws on wastes)
- disposal of materials (laws on wastes)
- cleaning (cleansing agents and disposal)
- environmental protection.

Before operating the device the user has to ensure, that the local regulations (e.g. for operation in channels) on installation and initial start-up are taken into account, if this is both carried out by the user.

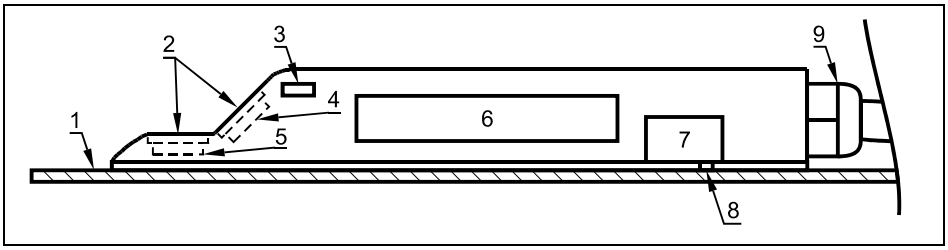
4 Functional Principle

4.1 General

The PCM 4 is a portable measurement system for non-permanent flow measurement and data logging in slight to heavy polluted media of a wide variety of compositions. The system is designed for use in part filled and full channels, sewers and pipes with various shapes and dimensions.

The measurement method is based on the ultrasound reflection principle. Hence, it is indispensable for the system's capability to work that the water contains particles which are able to reflect the ultrasonic signal sent by the sensor (dirt particles, gas bubbles or similar).

The PCM 4 is using a combi sensor which simultaneously detects flow velocity as well as flow level.
Depending on the type of sensor chosen, the fill level can be measured either by using water-ultrasonic, pressure or a combination of both methods.
Two particular piezo crystals which independent from each other operate as transmitter or receiver rare used for ultrasonic measurements (flow level and flow velocity).



1 Ground plate
2 Acoustic coupling layer
3 Temperature sensor
4 Flow velocity sensor
5 Level / height sensor
6 Electronics
7 Pressure sensor
8 Duct to pressure measurement
9 Cable gland

Fig. 4-1 Construction of combi sensor Type „Pro“ for installation on ground

4.2 Water-ultrasonic Level Measurement

Depending on the type of sensor selected (see chapters 4.5) the water-ultrasonic combi sensor may include up to two level measurements: water-ultrasonic and hydrostatic fill level measurement.
If using water-ultrasonic level measurement the horizontal sensor crystal operates according to the ultrasonic transit time method. The time between transmission and reception of a signal being reflected from the water surface is going to be measured.

$$h_l = \frac{c \bullet t_l}{2}$$

h = fill level
c = sonic transit time
t_1 = time between transmitted and received signal

Sound velocity within water at a temperature of 20°C (68°F) is 1480 m/s (4854 ft/s). The temperature-dependent deviation is 0.23 % per Kelvin.
In order to achieve an accuracy of a few millimetres during level measurement the medium temperature is going to be investigated permanently, rectifying the sonic transit time for calculation purposes.
The fixed height predetermined by the sensor crystal installation will be added to the investigated value h_1. This results in the total flow level h.

4.3 Level Measurement using Pressure

The combi sensor may additionally include a hydrostatic level measurement depending on the type of sensor selected.
The piezoresistive pressure sensor operates according to the relative pressure principle, i.e. the pressure of the standing water column above the sensor is direct proportional to the flow level. This sensor enables to determine flow levels even if the combi sensor is installed out of the centre.
During initial start-up procedure, the pressure sensor is going to be adjusted by entering a manually investigated reference value. The level caused by the sensor installation position is going to be added as well.

4.4 Flow Velocity Detection

The piezo crystal which has a slope towards the flow direction operates as a flow velocity sensor. Here an ultrasonic burst with a defined angle is sent into the medium. All particles in the measurement path (air, dirt) reflect a small amount of the ultrasonic signal. Depending on shape and size of the particle a particular signal results. The variety of the reflected signals results in a reflection pattern(see Fig. 4-2). This pattern will be saved in a digital signal processor (DSP).

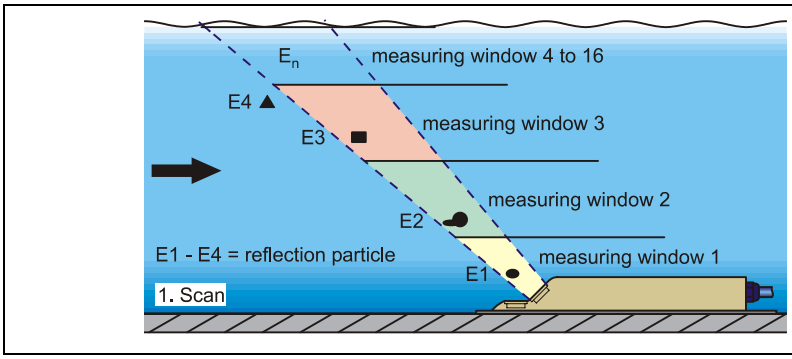


Fig. 4-2 Situation on first signal detection

After a certain period a second ultrasonic burst is sent into the medium. The newly generated reflection signal is saved in the DSP too.
In various flow levels there are different flow velocities (flow velocity profile). Depending on the level, the reflecting particles' movement away from the first measurement point therefore varies. Hence, a distorted reflection pattern results (see Fig. 4-3).
At the same time slightly different reflections occur: some particles have been turning around and thus have another shape of reflection; some particles are no longer within the measurement range and others now have been moving into the measurement range.

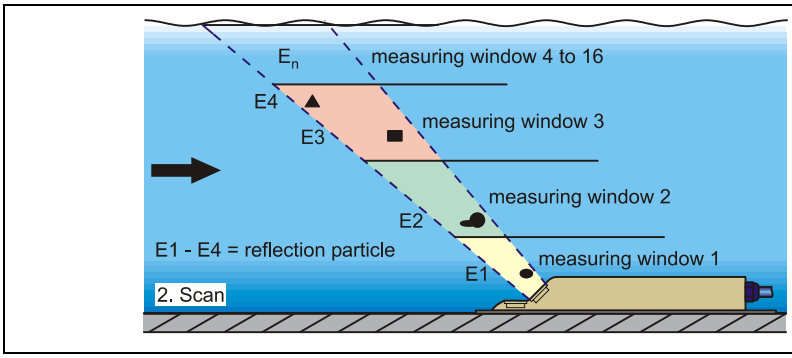


Fig. 4-3 Situation on second signal detection

The DSP checks both the received reflection patterns for similarities using the cross correlation method . All signals which cannot be re-identified clearly are going to be discarded in order to have two distorted and similar signal patterns left over.
These patterns now will be covered with 16 measurement windows according to the previous level measurement. The temporal shift Δt of the pattern in each measurement window is going to be investigated subsequently (see Fig. 4-4).

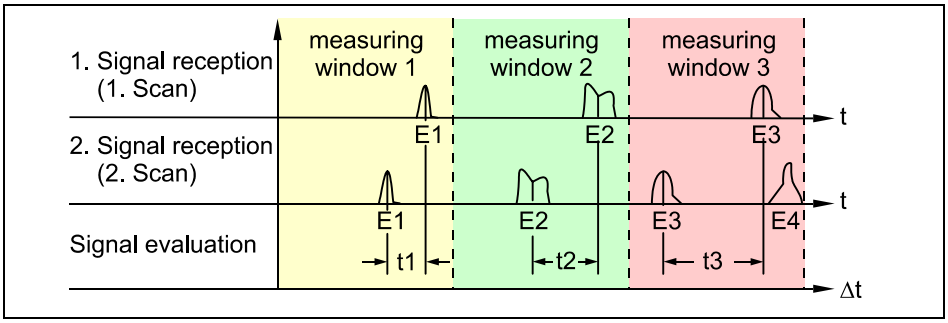


Fig. 4-4 Echo signal images and evaluation

Based on the beam angle, the interval between both transmitted signals and the temporal shift between the signal patterns in each single measurement window the flow velocity can be determined.
Mathematically bringing the single flow velocities in a row results in the flow profile which is indicated on the display of the PCM 4.

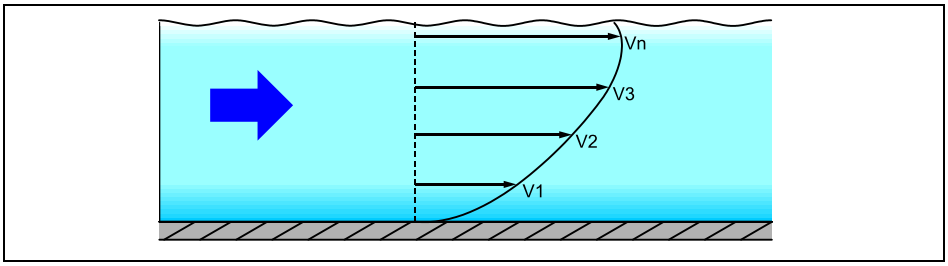


Fig. 4-5 Investigated flow profile

The flow volume is going to be calculated, indicated and saved based on velocity distribution, channel shape, channel dimensions and fill level.

4.5 Unit Versions

Transmitter

The transmitter currently is manufactured in one version.
The unit version at hand can be seen from the article number on a weatherproof label on the reverse side of the enclosure.
The unit type can be exactly specified from the type key.

PCM 4	**Portable flow measurement transmitter for open channels and part filled or full pipes. Spatial allocation of flow velocities by using ultrasonic impulses. Signal evaluation by cross correlation using a digital signal processor. Level measurement depending on sensor type via air- / water-ultrasonic transit time measurement, pressure sensor or mA input for external level measurement. Alphanumeric keypad, full graphic display, communication via compact flash card (not a part of standard delivery). Not for use in Ex areas. Inputs: 1 digital input active U = 3.3 V DC, 1 analog input 0/4 - 20 mA; Outputs: 1 voltage output 0 - 10 V, 1 relay 250 V AC, 30 V DC, 5 A Includes one single-seat licence for NivuDat software for Windows NT / 2000 / XP.**
PC4-PRO	**Portable flow measurement transmitter**

Fig. 4-6 Type key for PCM 4 transmitter

Active sensors for PCM 4

The sensors are available in various constructions (wedge and pipe sensors) and additionally vary in terms of cable lengths as well as various special versions. The article number can be found on both ends of the cables (cable sheath) as well as on the bottom of the ground plate.

POA- Active water-ultrasonic sensor with spatial allocation of flow velocities covering a maximum of 16 scan layers

Level Measurement

V100 **no Level Measurement**

- **KP** Wedge sensor made of high resistant full PEEK, ground plate 1.4571
- **KT** Wedge sensor made of PPO with PEEK sensor face; ground plate 1.4571
- **KX** Wedge sensor, special construction
- **RP** Pipe sensor made of high resistant full PEEK; pipe body 1.4571
- **RT** Pipe sensor made of PPO with PEEK sensor face; pipe body 1.4571
- **RX** Pipe sensor, special construction

V1H1 **with Utrasonic from Bottom up**

- **KP** Wedge sensor made of high resistant full PEEK, ground plate 1.4571
- **KT** Wedge sensor made of PPO with PEEK sensor face; ground plate 1.4571
- **KX** Wedge sensor, special construction
- **RP** Pipe sensor made of high resistant full PEEK; pipe body 1.4571
- **RT** Pipe sensor made of PPO with PEEK sensor face; pipe body 1.4571
- **RX** Pipe sensor, special construction

V1D0 **with Pressure Measurement Cell**

- **KT** Wedge sensor made of PPO with PEEK sensor face; ground plate 1.4571
- **KX** Wedge sensor, special construction

V1U1 **with Pressure Measurement Cell and Ultrasonic from Bottom up**

- **KT** Wedge sensor made of PPO with PEEK sensor face; ground plate 1.4571
- **KX** Wedge sensor, special construction

Approvals

- **0** none
- **E** Ex zone 1 (Attention: no Ex protection on PCM 4)

Cable Length (max. 150 m / with pressure sensor up to 30 m possible)

- **10** 10 m
- **15** 15 m
- **20** 20 m
- **30** 30 m
- **50** 50 m
- **99** 100 m
- **XX** Special length upon request
- **1B** 10 m, FEP coated*
- **2B** 20 m, FEP coated*
- **3B** 30 m, FEP coated*
- **5B** 50 m, FEP coated*
- **9B** 100 m, FEP coated*
- **XB** Special length / special construction*

Sensor Connection

- **F** Connection to PCM Pro and PCM 4 for Types V1D and V1U, portable version incl. plug and exchangeable filter element
- **S** Connection to PCM Pro and PCM 4 for Types V10 and V1H, portable version incl. Plug

Pipe Length

- **0** (only for wedge sensor)
- **2** 20 cm (standard)
- **3** 30 cm (minimum length for stop valve)
- **X** Pipe length in dm, price per dm
- **G** 20 cm + extension thread (absolutely required for NPP)

POA-						

* = Cable not for sensor Types V1D0 and V1U1

Fig. 4-7 Type key for water-ultrasonic combi sensors

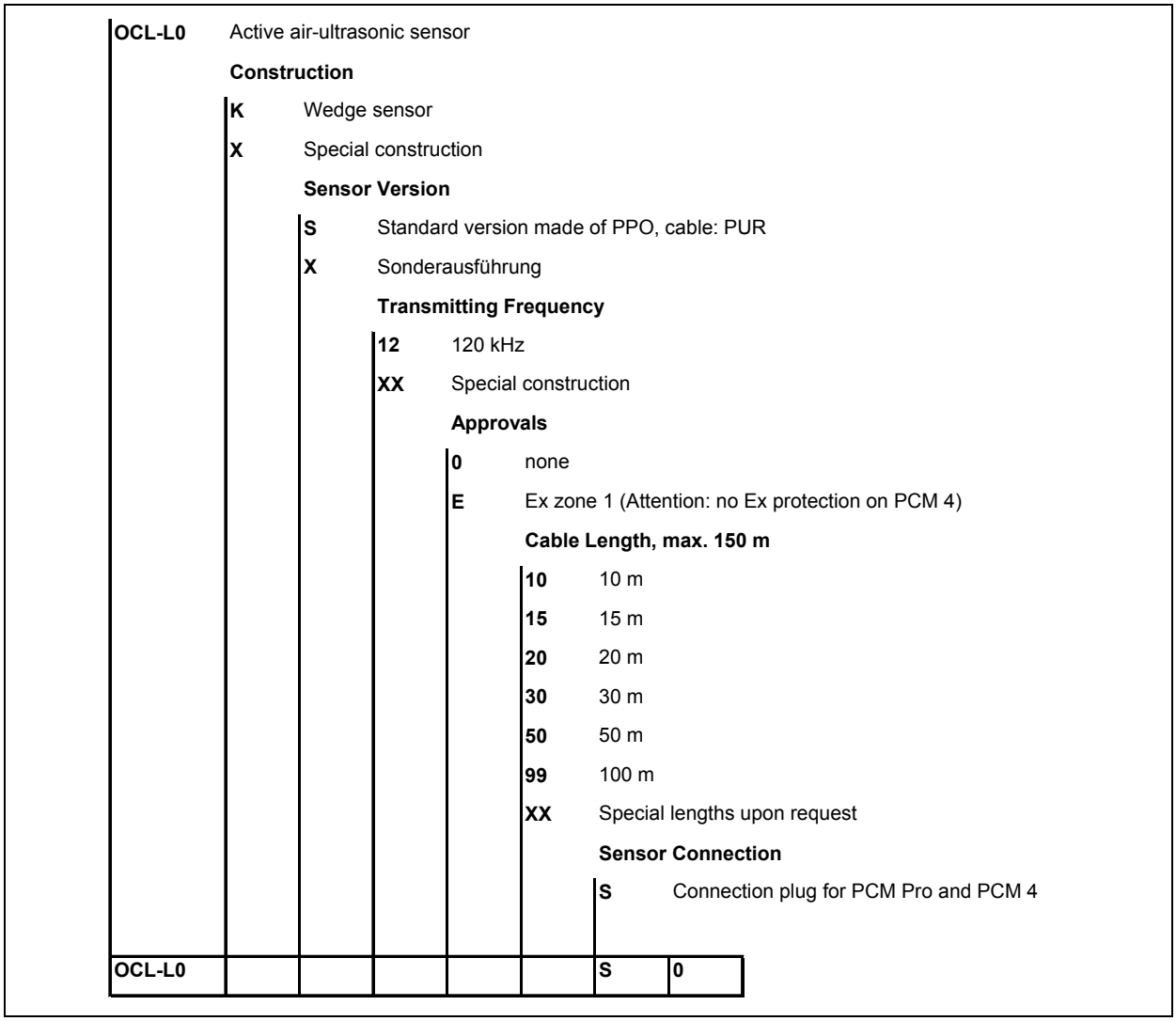


Fig. 4-8 Type key for air-ultrasonic sensors

5 Storing, Delivery and Transport

5.1 Receipt

Please check your delivery if it is complete and in working order according to the delivery note immediately after receipt. Any damage resulting from transport or transit shall be reported to the carrier instantly. An immediate, written report must be sent to NIVUS GmbH Eppingen as well.
Please report any shortcoming due to delivery to your representative or directly to NIVUS Eppingen within two weeks in writing.

Mistakes cannot be rectified later!

5.1.1 Delivery

The standard delivery of the PCM 4 measurement system contains:

- the instruction manual with the certificate of conformity. All required steps to correctly install and to operate the measurement system are listed herein.
- a PCM 4 transmitter
- an active sensor
- a rechargeable battery
- a compact flash card
- a power pack / battery charger
- a copy of evaluation software Type NivuDat for NT / 2000 / XP

Additional accessories depending on order. Please check by using the delivery note.

5.2 Storing

The following storing conditions shall be strictly adhered to:

Transmitter:	max. temperature:	+ 60°C (140°F)
	min. temperature:	0°C (32°F)
	max. humidity:	90 %, non-condensing
Sensors:	max. temperature:	+70°C (158°F)
	min. temperature:	- 30°C (-22°F)
	max. humidity:	100 %
Rechargeable battery:	max. temperature:	+ 25°C (77°F)
	min. temperature:	+ 5°C (41°F)
	max. humidity:	60 %

Remove the batteries from the PCM 4 and keep them in a frost-free place before storing.

The measurement system shall be protected from corrosive or organic solvent vapours, radioactive radiation as well as strong electromagnetic radiation.

5.3 Transport

Sensors and transmitters are designed for harsh industrial conditions.
However do not expose them to heavy shocks or vibrations.
Transportation must be carried out in the original packaging.

Please carry the PCM 4 by using the carrying handle. The unit shall not be carried or suspended using the sensor cable!

5.4 Return

The units must be returned at customer costs to NIVUS Eppingen in the original packaging.
Otherwise the return cannot be accepted!

6 Installation

6.1 General

Before feeding the rated voltage to transmitter and sensor the installation must be completed correctly. The installation should be carried out by qualified personnel only.

For use in accordance with the requirements – flow detection – and the further use of the gained data it is necessary to have comprehensive knowledge about hydraulic conditions. Please note that improper, faulty or unsuitable installation as well as selecting unsuitable or hydraulically problematic measurement places may lead to faulty or incomplete measurement values which may be insufficient for further processing and editing. This is why the installation should be carried out by authorized personnel only.

If required, NIVUS can organise any according training.
Further statutory standards, regulations and technical rulings have to be taken into account.

6.2 Transmitter Installation and Connection

General

The place for transmitter installation shall be selected according to certain criteria. Please strictly avoid:

- direct sunlight
- objects emitting heat (max. ambient temperature: +40°C (104°F))
- objects with strong electromagnetic fields (e.g. frequency converters)
- corrosive chemicals or gas
- mechanical shocks
- installation close to footpaths or travel ways
- vibrations
- radioactive radiation

The PCM 4 shall be suspended into shafts or manholes only by using the carrying handle and sufficient straps, ropes or similar.
It is not allowed to suspend the unit by using the sensor cable as this may lead to cable breaks, leaky plug connections or the transmitter may be torn off and even get lost.

The PCM 4 can be fixed on the carrying handle using an appropriate suspension bracket (Art.-No.: PCM0 ZMSH AK01 000) or another sufficient device e.g. on the access ladder of a manhole.

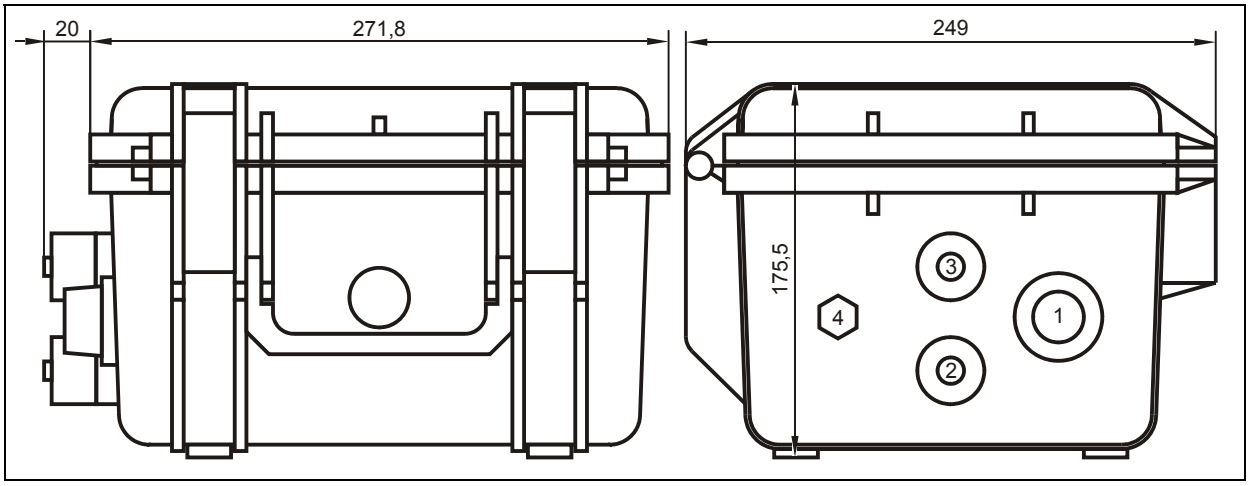
Before locking the enclosure lid please make sure that the sealing is not damaged and clean. Debris and/or dirt shall be removed and the gasket shall be greased again with silicone if required. Damages resulting from leakage or defect sealings are not covered by the manufacturer's liability.

If placed in flood shafts or channels the transmitter must be secured in order to prevent it from being washed away unintentionally (use suspension gear, plastic or steel rope, chain or similar).

Sockets on the PCM Pro which are not required for measurement purposes, sensors or data transmission have to be locked watertight before installation by using the covers fastened on each socket. Otherwise the protection grade of the entire unit is no longer guaranteed. Damages resulting from the non-use of the covers are not covered by the manufacturer's liability..

Covers damaged due to the use of force can be ordered from NIVUS at extra costs.

6.2.1 Enclosure Dimensions



1 Multifunctional socket
2 Socket for water-ultrasonic combi sensor
3 Socket for air-ultrasonic sensor / external level sensor
4 Socket for battery charger

Fig. 6-1 PCM 4 enclosure dimensions and sensor connections

6.3 Sensor Installation

6.3.1 General

Wedge sensor

Take care to reliably and durably install the used water-ultrasonic combi sensors in a way that their bevelled side with the integrated flow velocity sensor is looking exactly towards the flow direction of the medium. Use corrosion-free fastening materials exclusively!
To temporarily fasten the wedge sensor on the channel bottom it is recommended to use the pipe mounting system (Art.-Nr. PCM0 RMS2 0000 000). This system is designed to be used in channels with diameters from 200 to 800 mm (7.9 to 31.5 in) (see chapter 6.3.2).

Fastening the sensor on the channel bottom permanently requires to use 4 stainless steel screws as well as appropriate dowels. The length of the screws should be between 30 and 70 mm (1.18 and 2.76 in) depending on bearing capacity and constitution of the ground. Make sure that the length of the screws ensures safe and durable sensor fastening under all operational conditions.
To reduce the risk of eddy formation or build-up use precisely fitting counter-sunk screws and screw them completely into the ground plate.
NIVUS does not recommend to use stud bolts or similar for installation.
If not agreed otherwise with NIVUS install the sensor exactly in the channel centre with the bevelled side looking towards the flow direction.

If using the combi sensor together with simultaneous fill level detection by water-ultrasound from bottom up please take care to install the sensor absolutely horizontal (±2°).

Otherwise the level measurement might fail in case of higher fill levels and higher flow velocities occurring!

The sensor shape has been flow-optimised in order to reduce the risk of build-up. However there is a certain residual risk of build-up on the sensor ground plate. This is why no gaps shall remain between sensor ground plate and channel bottom!

The channel bottom must be exactly plane for sensor installation! Otherwise the sensor may break and leak whilst tightening the screws!.

To avoid the risk of build-up the sensor cable shall be laid from behind the sensor to the channel wall on the bottom of the channel.

Never lay the cable loosely, unprotected or across the medium! Risk of build-up, sensor or cable tear-off!

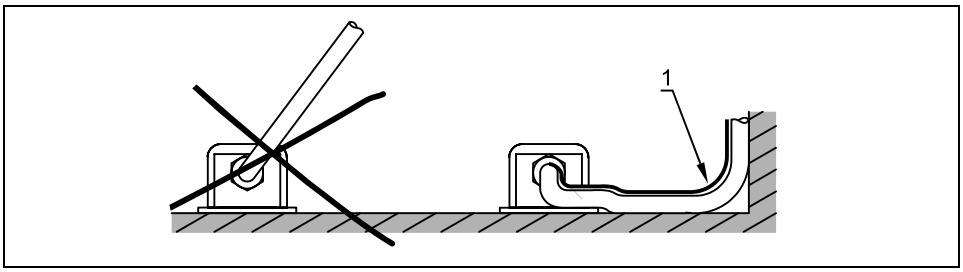


Fig. 6-2 Hints on cable layout

The minimum permissible bending radius of the signal cable is 10cm (3.9 in). A lower radius involves the risk of cable breaks!

Never remove any parts from the sensor since this will invalidate warranty!.

Removing or loosening the senor from ground plate or cable gland lead to leakage resulting in measurement or sensor failure.

To avoid disturbances caused by electric interferences never lay the sensor cable close to engine (motor) lines or main power lines.

Pipe sensor

The pipe sensor is going to be screwed tightly into the 1½ " nozzle by using a cutting ring and spigot nut (additional option: ball valve for removal without pressure or retractable fitting to move the sensor back under operational conditions). It is important that the horizontal part of the sensor is installed flush with the pipe wall (Fig. 6-3, far left).
The cutting ring of the sensor will warp during installation and thus can be used only once. If you should require new cutting rings please contact your NIVUS representative.

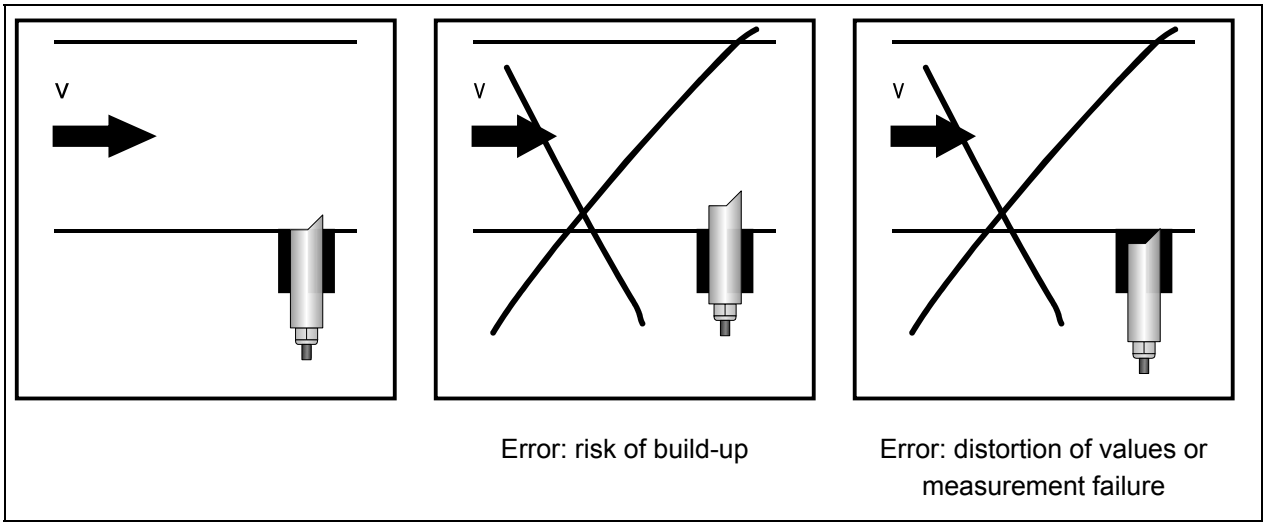
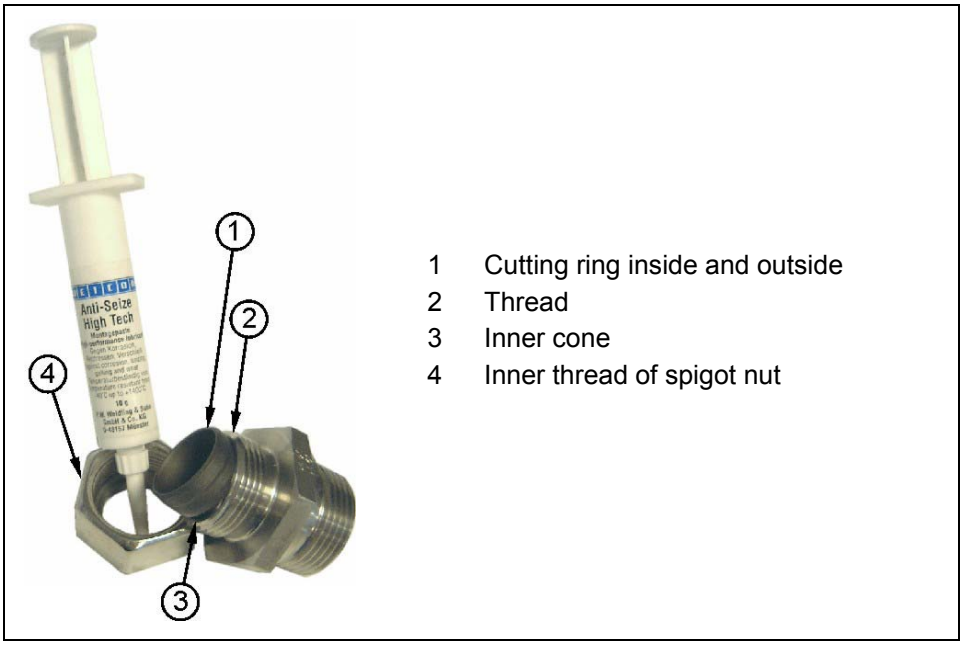


Fig. 6-3 Hints on pipe sensor installation

Place the sensor in a way that the bevelled side is looking exactly towards the flow direction. The “installation help” (see Fig. 6-16) supports positioning. When using a combi sensor with simultaneous ultrasonic level detection from bottom up please observe absolutely horizontal installation (±2 °). Otherwise the level measurement might fail in case of higher filling levels and higher flow velocities!

When assembling the insertion sensor, a special grease paste as specified in DIN 2353 (or equivalent) must be used for stainless steel couplings
The cap nut thread, threads and cone as well as the cutting ring must be slightly greased when pre-assembling the insertion sensor!
The screw joints are greased on delivery. Additional grease can be purchased from NIVUS or local dealers.

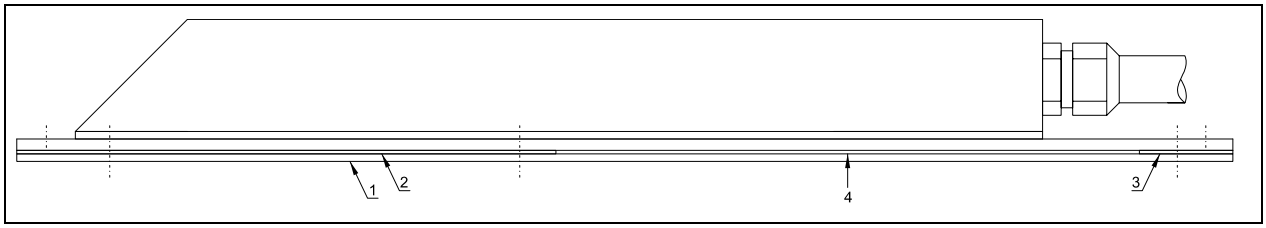


1 Cutting ring inside and outside
2 Thread
3 Inner cone
4 Inner thread of spigot nut

Fig. 6-4 Using the grease

Air-ultrasonic sensors

On delivery the air-ultrasonic sensor Type OCL is designed for clamping installation using a pipe mounting system Type RMS (see chapter 6.3.2).
For installation using the RMS the mounting sheet located in the pipe vertex must be put through cut-out 4 of the air-ultrasonic sensor prior to complete assembly (see Fig. 6-5)



1 Ground plate 1
2 Ground plate 2
3 Ground plate 3
4 Cut-out for pipe mounting plate

Fig. 6-5 Air-ultrasonic sensor for fastening on pipe mounting system

Before clamping the system into the pipe adjust the sensor exactly parallel to the water surface.

If the air-ultrasonic sensor is going to be installed together with the water-ultrasonic combi sensor please observe to install the air-ultrasonic sensor at least 10 cm (3.9 in) downstream of the combi sensor. This helps to avoid hydraulic effects caused by the combi sensor (dam-up) to influence the ultrasonic level measurement.

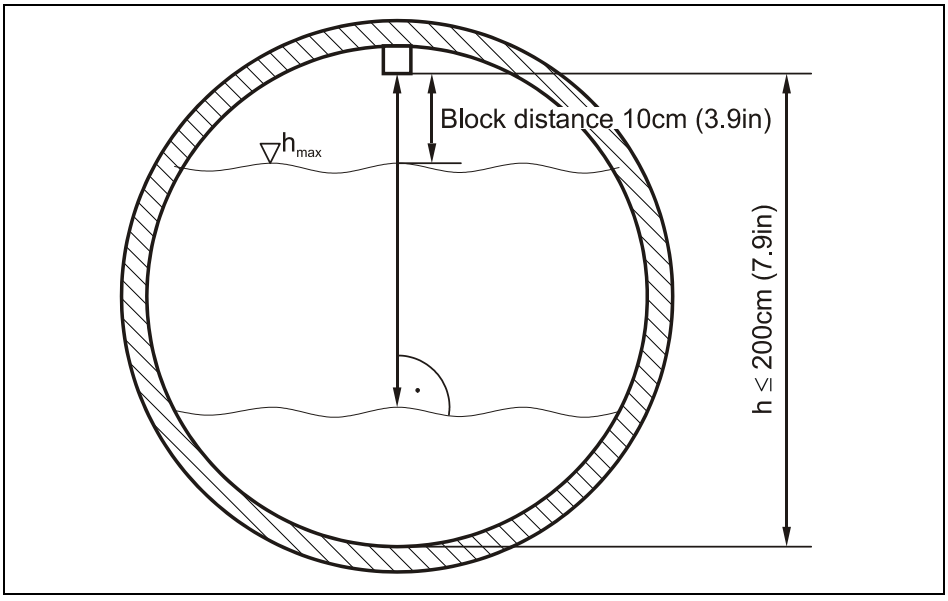


Fig. 6-6 Installation of air-ultrasonic sensor

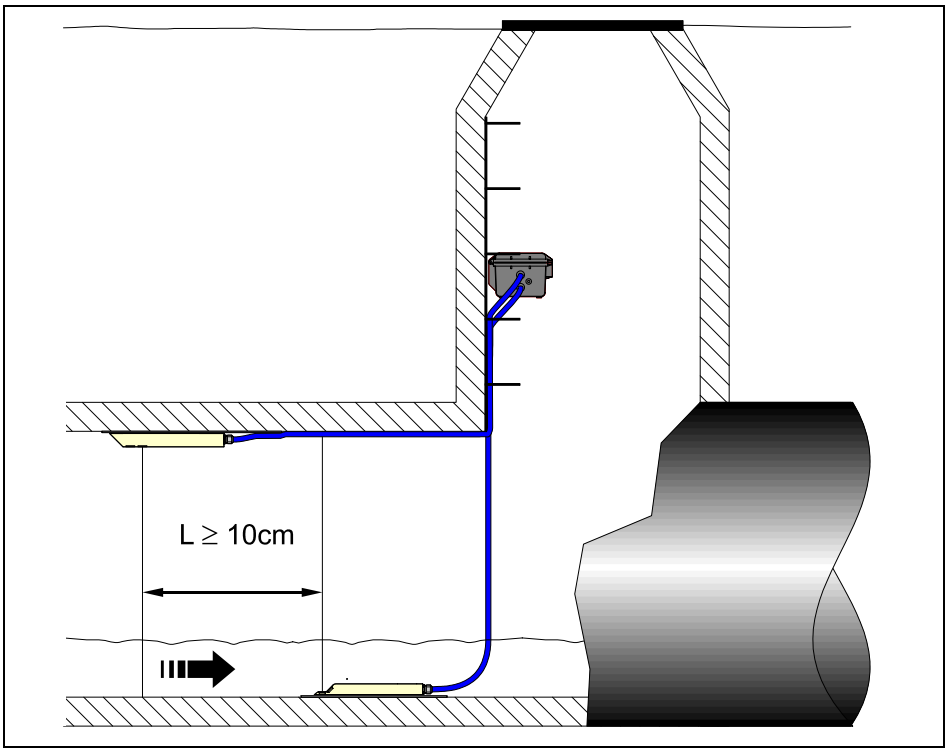


Fig. 6-7 Arranging the sensors

For permanent installation the air-ultrasonic sensor can be fixed on the channel vertex by using 3 appropriate stainless steel screws M5 and appropriate dowels.

The dead zone of the air-ultrasonic sensor Type OCL is 10 cm (3.9 in). Fill levels within this dead zone cannot be measured.

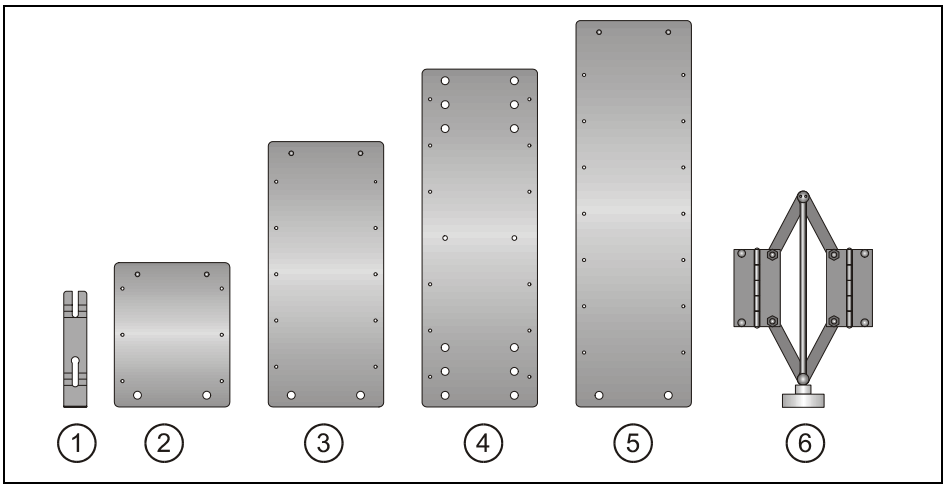
*Flooding the air-ultrasonic sensor will cause the sound to be coupled into the measurement medium. Due to significantly higher sound velocities contrary to air, this will result in the risk of faulty level measurement. This is why the flood area of the air-ultrasonic sensor has to be avoided on programming. The air-ultrasonic sensor must **NOT** be activated within this range!*

6.3.2 Pipe Mounting System

The pipe mounting system consists of the elements below

- scissors jack
- base plate
- fastening clips
- extension sheets (optional)

Select the required elements according to Fig. 6-8 and Fig. 6-13, and the existing pipe diameter.



1 Fastening clip
2 Extension sheet V5
3 Extension sheet V10
4 Base plate
5 Extension sheet V15
6 Scissors jack

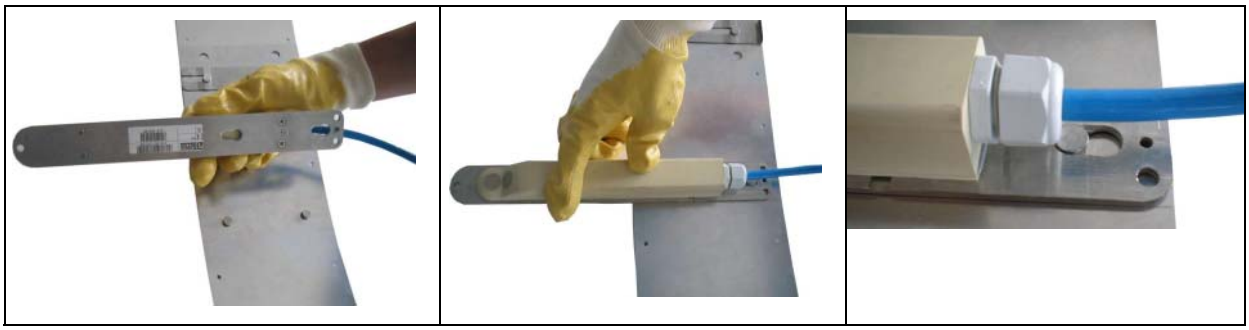
Fig. 6-8 Components of the pipe mounting system

During assembly please observe to always locate the scissors jack at the pipe vertex and the base plate on the channel bottom. Extension sheets which might be required shall be put on the right-hand side as well as on the left-hand side between scissors jack and base plate.
The fastening clips serve for quick installation. They must be put flush onto the mounting plate against the flow direction (see Fig. 6-10 far right)

Assemble base plate and extension sheet	Put the pins into the holes	Lock pins by using fastening clip (must sit flush to mounting plate against flow direction)

Fig. 6-9 Installation with fastening clips

Snap the flow velocity sensor with the both slotted holes on the rear onto the base plate (see Fig. 6-14).
Rotate the clamp handle of the scissors jack counter-clockwise until the scissors are closed. After that put the entire system into the pipe, adjust it and fix it in the pipe by rotating the clamp handle clockwise.



Put the sensor with the cut-outs (slotted holes) onto the plate

Push back...

... until it is locked (flush to the plate)

Fix the scissors jack on both sides of the final plate by using the fastening clip.

Close the scissors by rotating the clamp handle before installing in the channel.

Fig. 6-10 Assembly of Pipe Mounting System

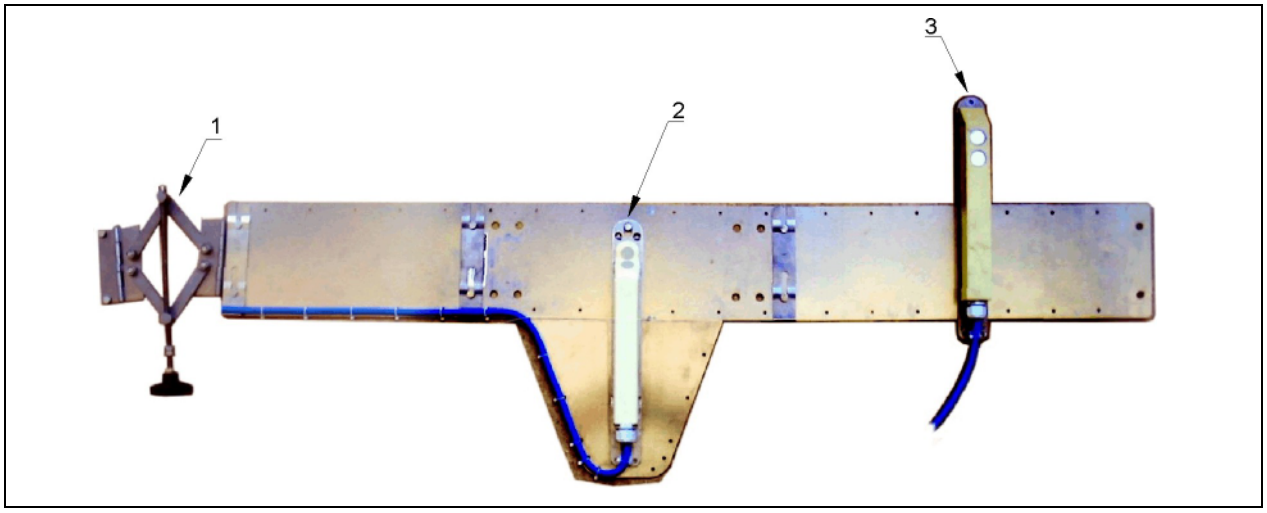
The plates are sharp-edged due to being made of light-gauge metal sheets. Please always wear protective gloves to install or dismantle the pipe mounting system!

Furthermore please observe the following regarding temporary installation by using the pipe mounting system:

- Sufficient contact pressure to the channel wall in order to prevent the pipe mounting system from getting loose. This is important especially in large channel diameters and high flow levels.

  If necessary the system must be secured additionally in order to protect it from being washed away (e.g. by putting additional stainless steel screws into the channel wall)
- Mount parallel to the channel wall to minimize the risk of build-up. No gap between mounting plate and sensor or channel bottom may remain.
- The sensor cable shall be laid to the upside along the mounting system by using cable fasteners.
- Always lay the sensor cable close along the channel wall and fix it with clamps if necessary.
- Please refer to the list of mounting sheets (Fig. 6-13).

- If the active air-ultrasonic sensor and the combination sensor are used simultaneously please use the support plate additionally (Art.-Nr. PCP0 ZRMS 2Z00 000). Here the combination sensor is fastened on the base plate with both the slotted holes on the sensor front (see Fig. 6-14). The support plate serves to ensure proper cable layout as well as to correctly place the combi sensor behind the air-ultrasonic sensor.
- The air-ultrasonic sensor is clamped to the extension plates by using its double mounting plate. It shall be installed exactly plane parallel to the water surface (see also chapter 6.3).



1 Scissors jack
2 Wedge-shaped water-ultrasonic combi sensor
3 Air-ultrasonic sensor

Fig. 6-11 Sensor fastening on pipe mounting system

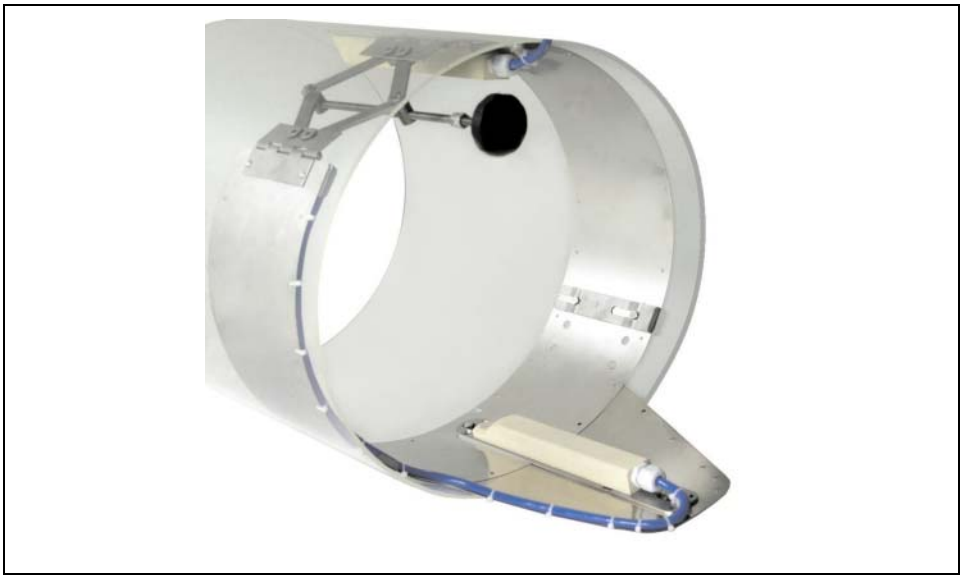
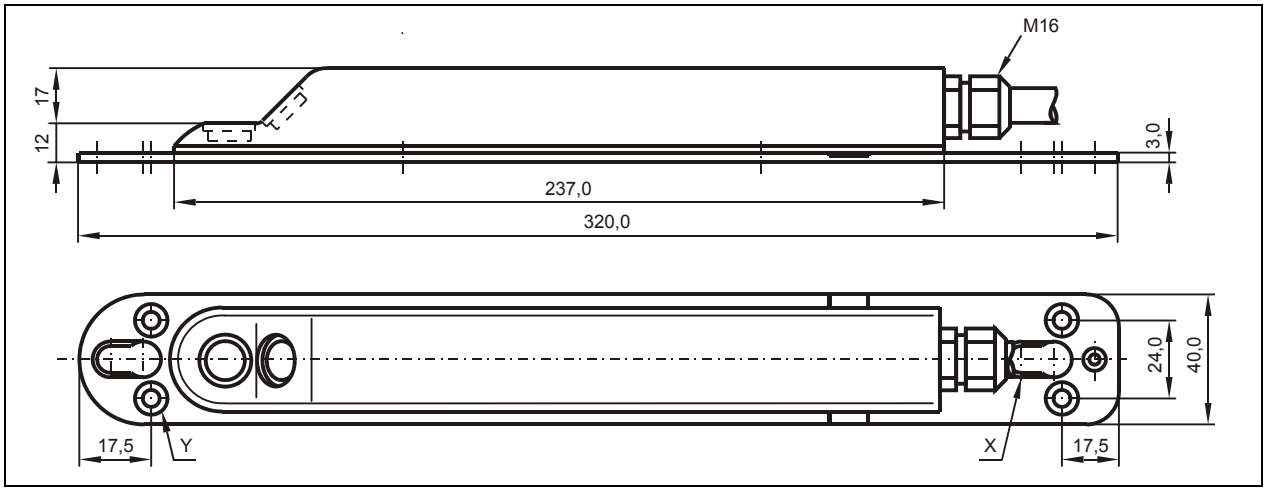


Fig. 6-12 Pipe mounting system with extension sheet for combined installation of combi sensor and air-ultrasonic sensor

I.D. (inside diameter) in mm (")	BST base plate	SPV scissors jack	V5 extension plate	V5 extension plate	V10 extension plate	V10 extension plate	V15 extension plate	V15 extension plate
200 (8")	X inner hole	x						
250 (10")	X inner hole	x	x	x				
300 (12")	X outer hole	x	x	x				
350 (14")	X inner hole	x			x	x		
400 (16")	X outer hole	x			x	x		
450 (18")	X inner hole	x	x	x	x	x		
500 (20")	X outer hole	x	x	x	x	x		
600 (24")	X outer hole	x	x	x			x	x
700 (28")	X outer hole	x			x	x	x	x
800 (32")	X outer hole	x	x	x	x	x	x	x

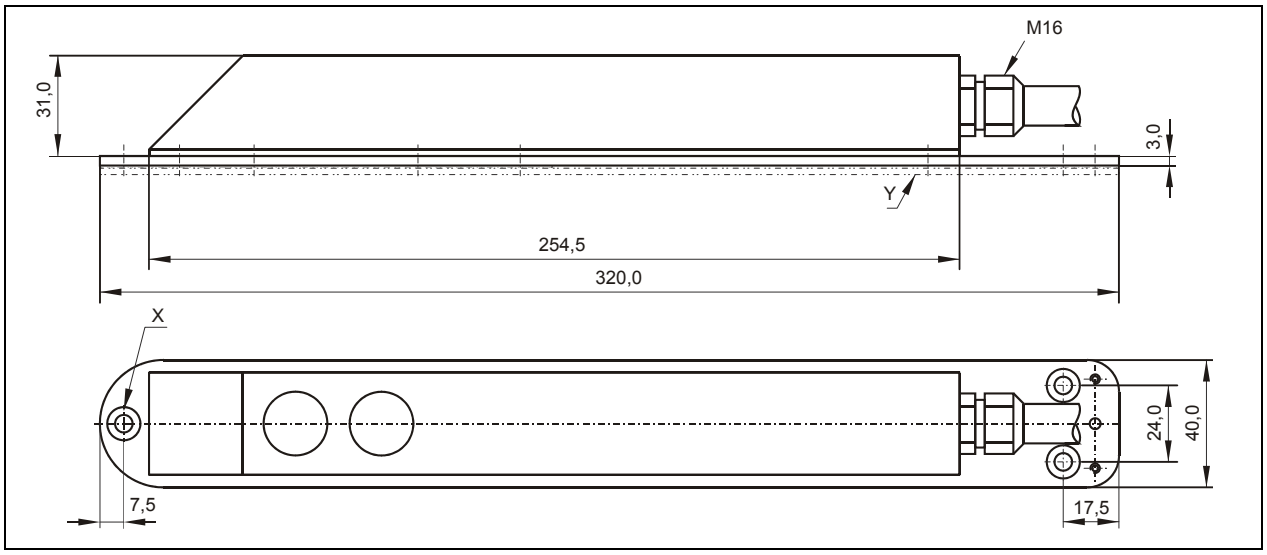
Fig. 6-13 List of mounting sheets

6.3.3 Sensor Dimensions



X Slotted holes for fastening on pipe mounting system
Y 4 x chamfering M6 for direct fastening

Fig. 6-14 Dimensional drawing of wedge-shaped water-ultrasonic combi sensor



X Chamfering according to DIN 74 - A m 5 for direct fastening
Y Three adapter plates are required for fastening on pipe mounting system

Fig. 6-15 Dimensional drawing of air-ultrasonic sensor

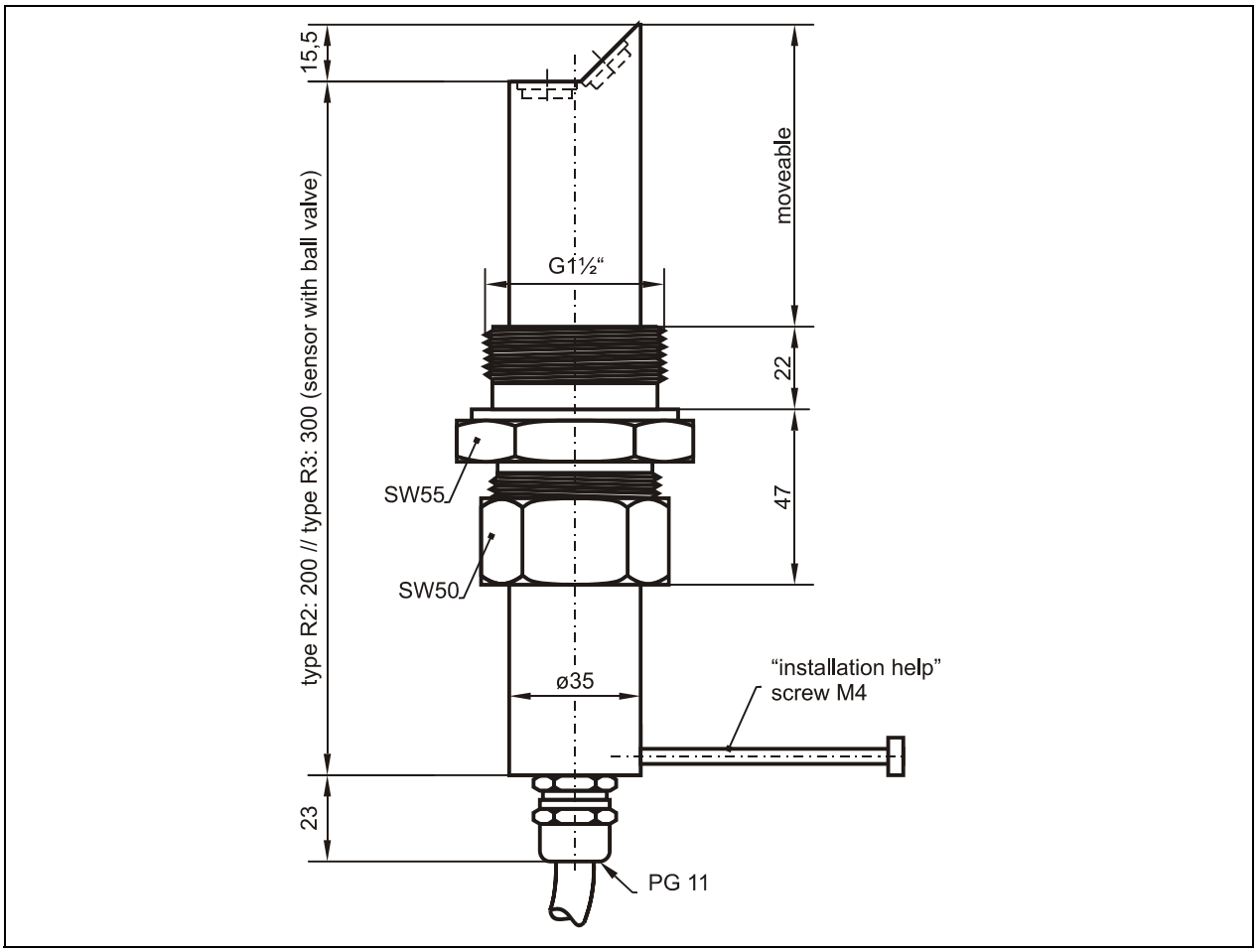


Fig. 6-16 Dimensional drawing of pipe sensor

6.4 Selecting Sensor Positions and Calming Sections

Clearly defined, hydraulic conditions are absolutely necessary for an accurate measurement. Falls, steps or obstructions, fittings, profile change of channels or lateral supplies right in front of or behind the measurement point have to be avoided!

- Measurement sections have to be selected in a way that there is no sedimentation (sand, grit, sludge) arising under standard operating conditions. Sedimentation is caused by low tractive forces within the flow profile indicating too low slopes or structural shortcoming (negative partial slope) within the measurement section (please refer to ATV A 110)
- As from a filling level of approx. 80 % of the nominal diameter closed pipes are tending to sudden short-term impoundage. To avoid pulsation within the measurement section due to that circumstance construct the required diameter in a way that the filling level never exceeds 80 % independent from Q_{min} or Q_{max} in case of standard discharge (2 Q_{TW}).
- Avoid changes of slopes within the measurement section.
- The length of the approach channel shall be min. 5x nominal diameter, the length of the discharge channel shall be min. 2x nominal diameter Longer sections may be required however in case of disturbed hydraulic conditions and distorted flow profiles resulting from these conditions.

The drawings below give an example of appropriate, ill-suited and problematic applications. They serve to give a rough idea on sufficient measurement places as well as on critical hydraulic conditions which might occur.
In case of being uncertain regarding choice or assessment of planned measurement sections please send your drawings/photos and contact your representative or the flow department at NIVUS GmbH in Eppingen.

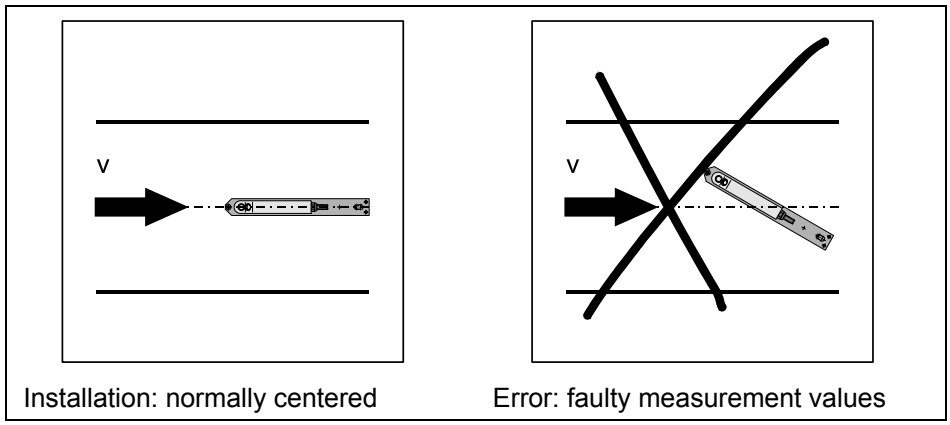
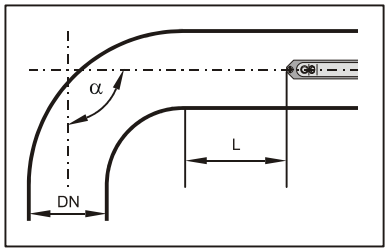
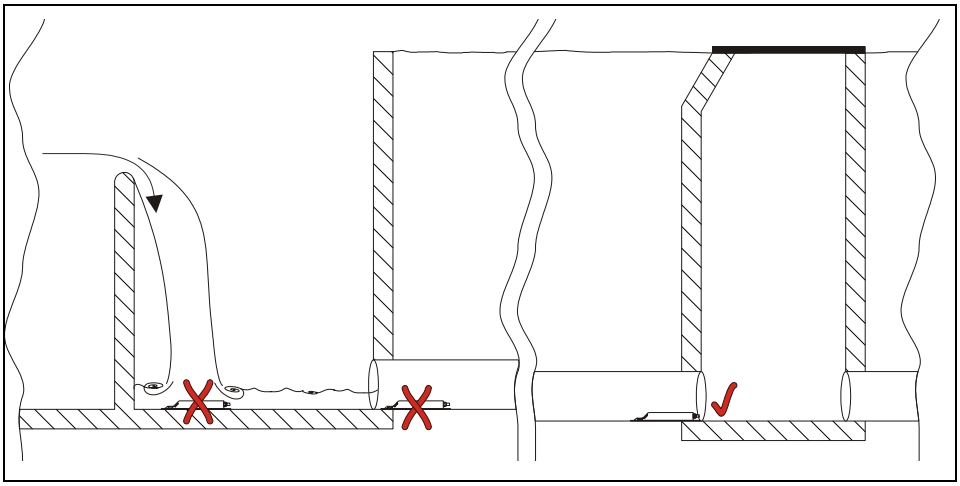


Fig. 6-17 Sensor adjustment



	v ≤ 1m/s (3.28 ft/s)	v > 1m/s (3.28 ft/s)
α ≤15°	L ≥ min. 3x diam.	L ≥ min. 5x diam.
α ≤45°	L ≥ min. 5x diam.	L ≥ min. 10x diam.
α ≤90°	L ≥ min. 10x diam.	L ≥ min. 15-20x diam.

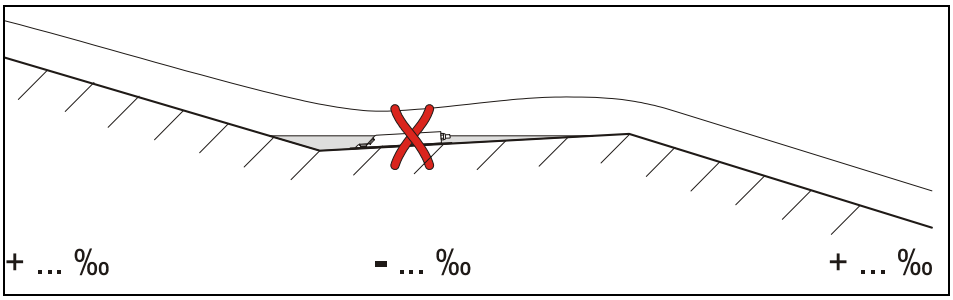
Fig. 6-18 Sensor position behind curves or elbows



× = Error! Indefinable flow conditions

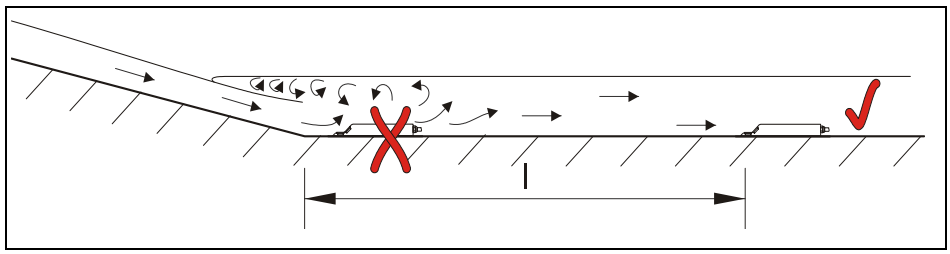
✓ = Sufficient distance to obtain straight flow
(10 ... 50 x diameter depending on application)

Fig. 6-19 Overflow channel or fall error caused by indefinable flow conditions



× = Error!
Risk of silting-up / sludge accumulation caused by negative slope

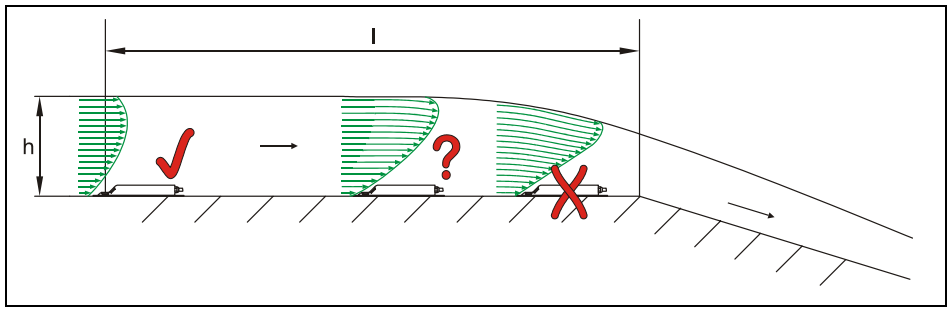
Fig. 6-20 Negative slope – risk of silting-up



× = Error! Alternation of slope = alternation of flow profile

✓ = Distance depending on slope and flow velocity value
l = min. 20 x diameter

Fig. 6-21 Error caused by alternation of slope

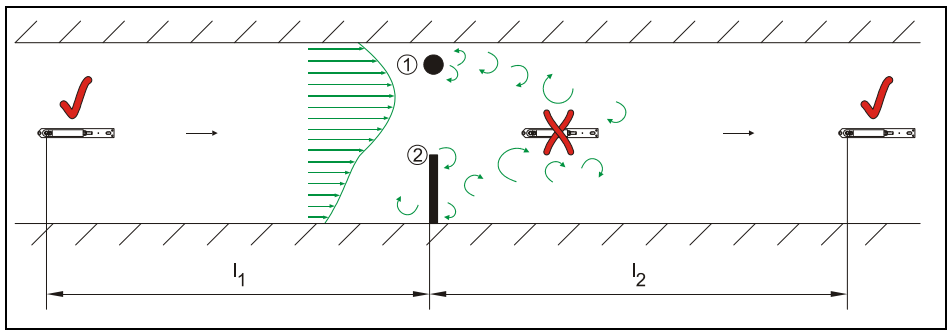


× = Error! Transition from flowing to shooting
Level measurement might fail + velocity and level measurement might be faulty

? = Critical measurement point, not recommended! Begin of sinking flow

✓ = Distance l = min. 5 x h_{max} at place of installation

Fig. 6-22 Error caused by alternation of flow profile in front of slope alternation or fall

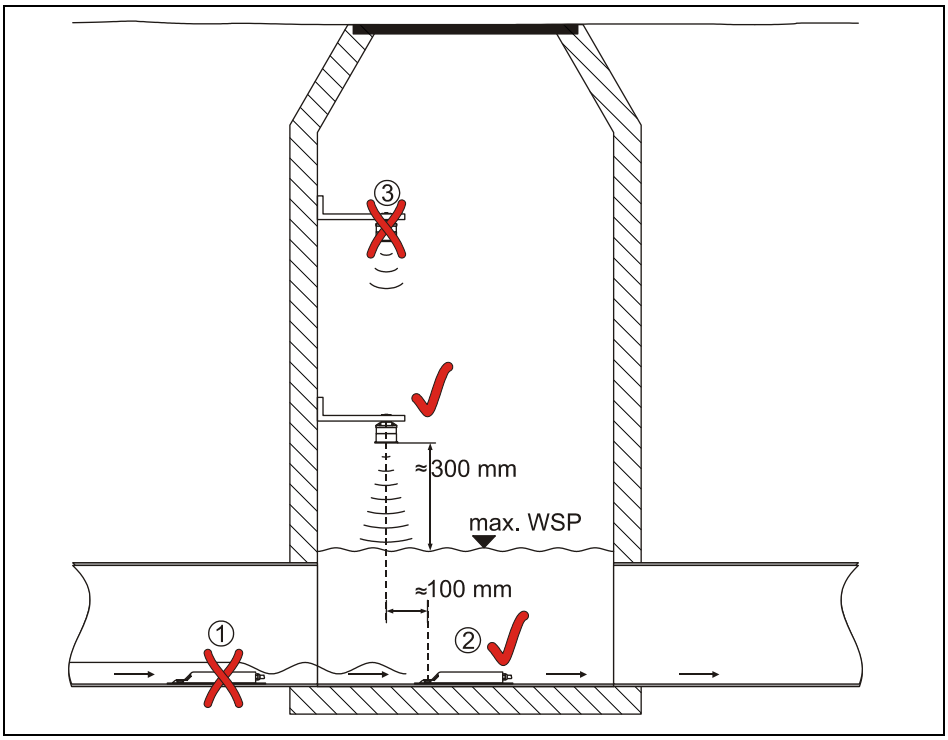


(1) = Fixtures such as samplers or similar
(2) = Diminution

× = Error!
Caused by vorticity, tangential and/or asymmetric flow

✓ = Distance l1 (upstream of diminution) = min. 5 x $h_{water\ level}$
Distance l2 (downstream of diminution) = min. 10 x $h_{water\ level}$

Fig. 6-23 Errors caused by fixtures or obstructions

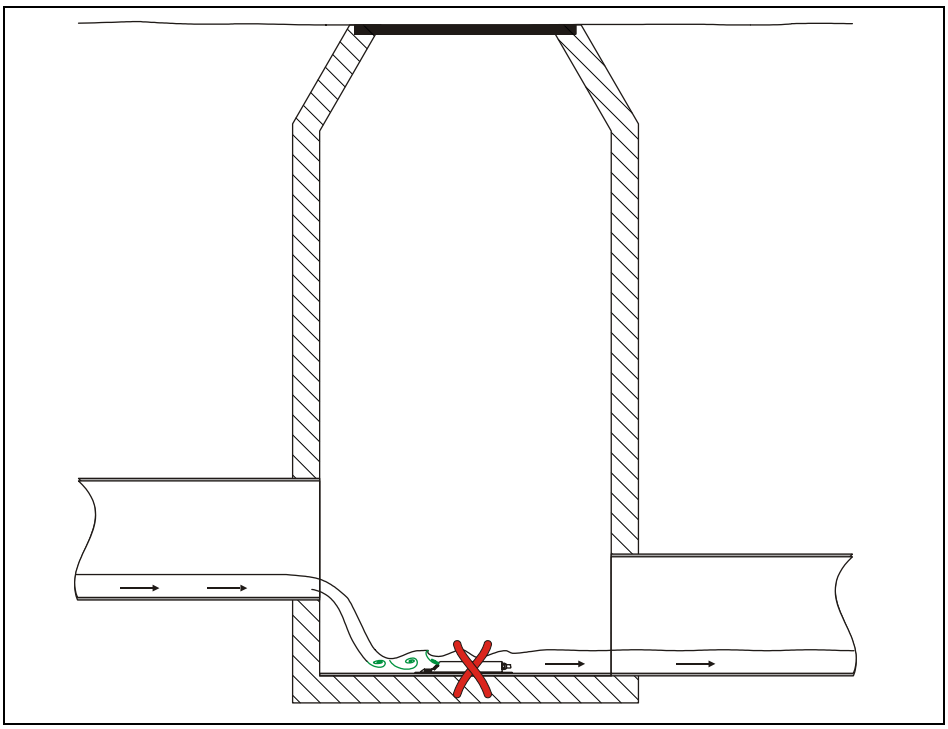


(1) = Wave formation on water surface behind the sensor
→ error message in case of following air-ultrasonic sensor (2)

(2) = O.K.

(3) = Distance too large: edge of sensor bottom to max. water level

Fig. 6-24 Installation with separate echo sounder level measurement in manholes / shafts



× = Error! Caused by vorticity and wave formation behind fall
→ Use other measurement place or renew manhole /shaft

Fig. 6-25 Error caused by fall or alternation of slope

In case of very low flow levels and/or high flow velocities an adjustable so-called dam-up element may create better flow conditions.
Functional principle: the water is going to be dammed up in the area around the sensor by reducing the cross-sectional area. Resulting in a higher fill level and a reduced flow velocity this measure will optimise the flow behaviour.
The dam-up element is going to be installed approximately in the middle of the channel between approach and discharge section. This does not reduce the cross-sectional areas of the pipes. Larger amounts of water are able to flow over the dam-up element.
These elements are available from NIVUS in various diameters. This special backwater systems should preferably be installed by experienced and qualified personnel however.

Fig. 6-26 Dam-up element

When uncertain regarding the choice or assessment of the planned measurement distance, please contact your NIVUS representative or the diversion Flow measurement technology at NIVUS GmbH in Eppingen.

Resulting from the use in accordance with the requirements – flow detection – and the further use of the gained data it is necessary to have comprehensive knowledge about hydraulic conditions. Please note that improper, faulty or unsuitable installation as well as selecting unsuitable or hydraulically problematic measurement places may lead to faulty or incomplete measurement values which may be insufficient for further processing and editing. This is why the installation should be carried out by authorized personnel only.

Please contact NIVUS in order to perform according training measures.

6.5 Connecting Water-Ultrasonic Combi Sensor and Air-Ultrasonic Sensor

Water-ultrasonic combination sensor as well as air-ultrasonic sensor are equipped with the respectively wired plugs. These plugs must be connected to the transmitter according to Fig. 6-1. To do this, unscrew the protective covers from the required sockets, plug in and manually tighten the screw caps on the plugs in order to ensure the grade of protection and secure contact.

Keep threads of plugs and sockets carefully free of dirt, sand or similar and clean the threads with a soft and lint-free cloth prior to connection if required.

Sensors with an integrated pressure cell are equipped with an additional air filter with a dehydration agent on the connection plug. This air filter is necessary to constantly adjust the pressure cell according to the current air pressure.
If the colour indicator contained within the dehydration agent turns from blue to pink the filter must be replaced immediately. Spare filters with plug and connection hose are available from NIVUS under Art.-No. POA0ZUBFIL00000.
If there is a risk of flooding the filter please ensure to correctly install the air hose. This means that the air hose must be installed without sharp bends above the possible maximum water level.

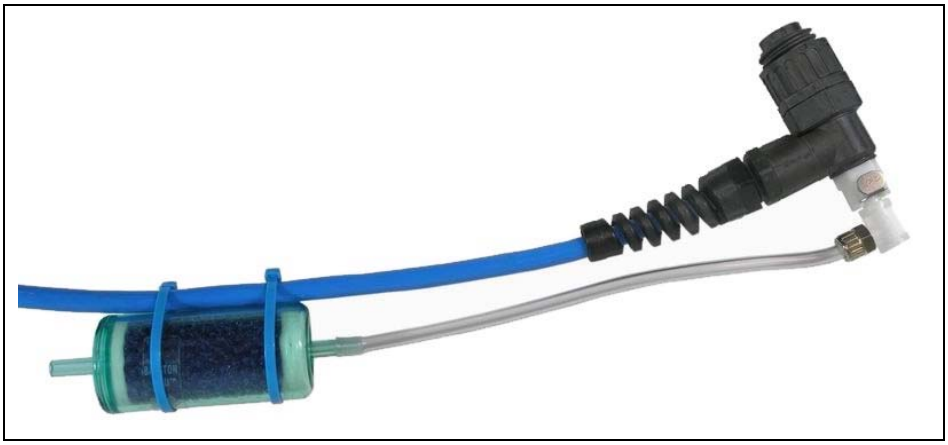


Fig. 6-27 Connection plug with air filter

Sockets on the PCM Pro which are not required for measurements, sensors or data transmission must be locked watertight before installation by using the covers fastened on each socket. Otherwise the protection grade of the entire unit is no longer guaranteed. Damages resulting from missing covers are not covered by the manufacturer's liability.

If covers may get lost caused by the use of force, they can be ordered from NIVUS at extra cost

When using sensors with integrated pressure cell and air filter never operate the transmitter without the filter!

If the filter plug is removed from the sensor plug it will be locked automatically. This prevents water from getting into the sensor, but air balance is impossible too. It is no longer possible to accurately measure the filling level by using the pressure cell then.

The air balance hose must neither be hanging in the water nor be blocked or have sharp bends. Please ensure continuous and unhindered air flow into the filter.

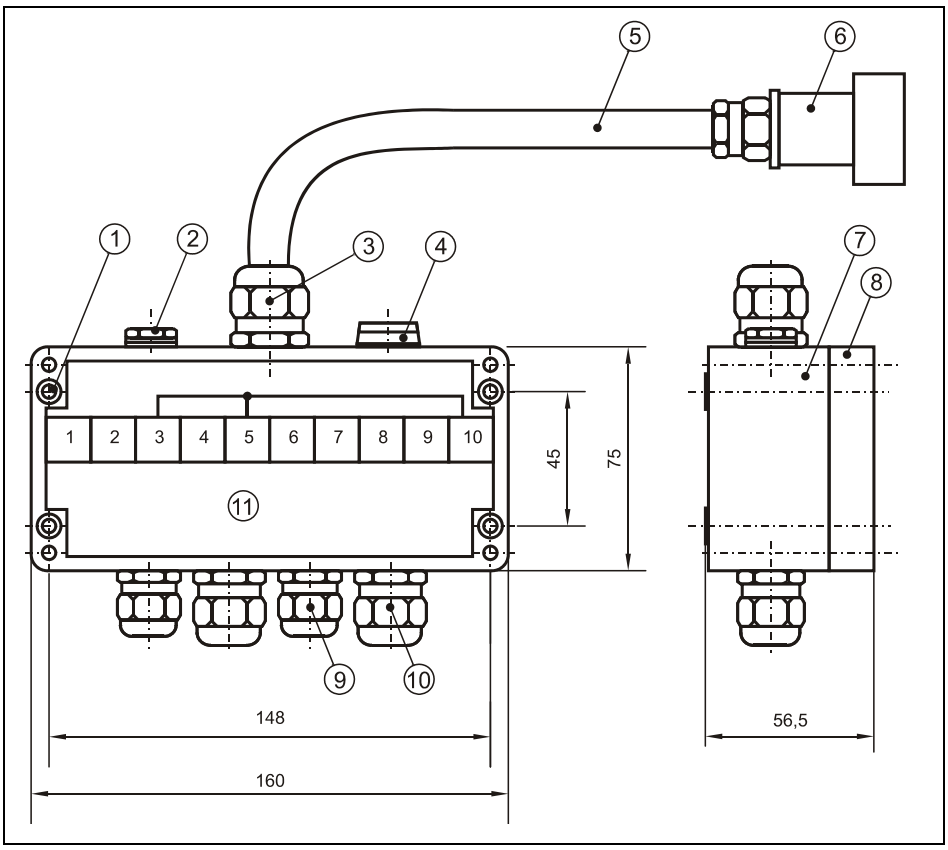
6.6 Connecting peripheral Equipment

The PCM 4 is equipped with various analog and digital inputs and outputs which enable to connect a variety of sensors or actuators. An according overview can be found in Fig. 2-2.
Individual connections can be connected directly to the multifunctional socket (see Fig. 6-1) by using pre-configured cables. The following cable types are available:

Art.-No.	**Description**
PC40 ZVER AE	Connection cable, PCM 4 – analog input (one side with plug for multifunctional socket, other side with open cable end); length of cable 10m (32.8 ft)
PC40 ZVER AA	Connection cable, PCM 4 – analog output (one side with plug for multifunctional socket, other side with open cable end); length of cable 10m (32.8 ft)
PC40 ZVER DE	Connection cable, PCM 4 – digital input (one side with plug for multifunctional socket, other side with open cable end); length of cable 10m (32.8 ft)
PC40 ZVER RA	Connection cable, PCM 4 – relay output (one side with plug for multifunctional socket, other side with open cable end); length of cable 10m (32.8 ft)

6.6.1 Connector-Box

In order to simultaneously connect several signals there is a Connector-Box available. This item can be purchased from NIVUS using order code No. PC40ZVS10000000.



1 Drilled holes for screws M4 for enclosure fastening
2 Pressure compensation element DAE
3 M25x1.5 cable gland
4 Dummy plug M16x1,5
5 Connection cable 1m (3.28 ft)
6 Multifunctional plug with 9 pins for connection to PCM 4
7 Enclosure bottom
8 Enclosure lid
9 2x M16x1.5 cable glands for cable ø4-8 mm / peripheral side
10 2x M20x1.5 (cable glands for cable ø6-12 mm / peripheral side
11 Terminal clamp compartment / wiring

1 Analog input (0 - 20mA)
2 Analog ground (AGND)
3 GND
4 Analog output (0 - 10V)
5 GND
6 Digital input
7 Relay output (NO)
8 Relay output (COM)
9 Relay output (NC)
10 Shield

Fig. 6-28 Overview Connector-Box

6.7 PCM 4 Power Supply

6.7.1 Rechargeable / Batteries

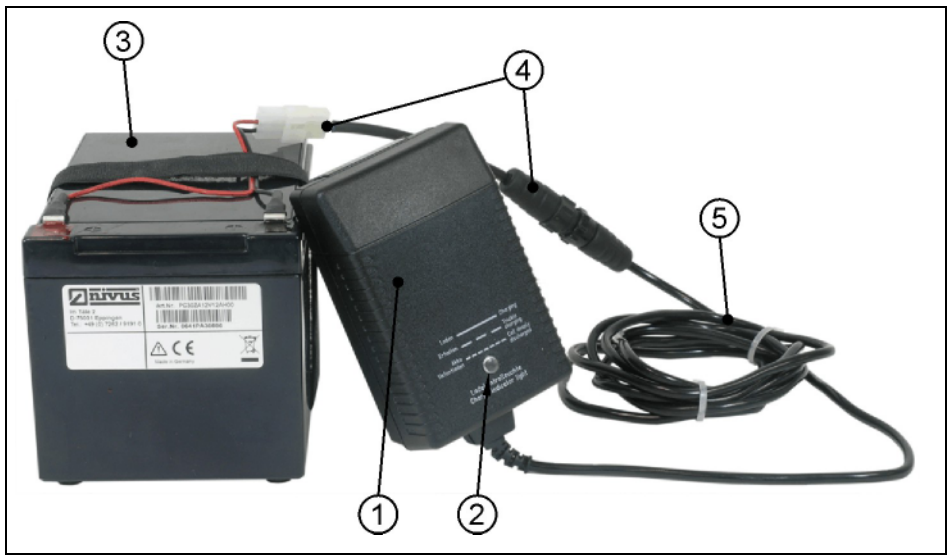
A lead gel battery is part of the PCM 4 standard equipment. This battery pack ensures long measurement periods.
Optionally it is possible to use standard batteries in conjunction with a battery box (Art.-No. PC40ZBBOX000000). The quality of the standard batteries is essential for the duration of the measurement period! Use only batteries from renowned manufacturers therefore.

The rechargeable battery pack is located in a padded battery compartment. This compartment is locked with a lid and 4 knurled screws.

The rechargeable battery will be delivered in charged condition. Due to reasons of operational safety it is required to reload it before the first use.
In order to charge or to replace the battery pack unscrew the 4 screws of the battery compartment lid and remove the cover. Unplug the plug connection and remove the battery pack.
Subsequently tighten the knurled screws (see Fig. 2-1) of the compartment lid manually.

To charge the battery use the NIVUS battery charger exclusively. Please observe the specifications of the battery charger.

Charge the battery under dry conditions only.



1 Battery charger
2 LED indicator
3 Rechargeable lead gel battery
4 Adapter
5 Connection cable

Fig. 6-29 Battery charger with rechargeable battery pack

To charge the battery connect the battery charger to mains. The built-in red LED will report the battery charger to be ready by flashing slowly.

The charging procedure will start automatically after the rechargeable battery has been connected. This will be indicated by the LED changing from flashing to continuous operation.
The end of the charging procedure is going to be indicated by the LED flashing slowly.
An LED flashing quickly indicates a battery defect, total discharge or too low ambient temperatures.

It is possible to charge the battery pack whilst being in the PCM 4 as well. To achieve this disconnect the adapter (4) from the connection cable (5) and plug the battery charger directly into the according socket on the PCM 4.
The charging procedure will start as described above while the PCM 4 is ready for operation.

Fig. 6-30 Battery charger directly connected to PCM 4

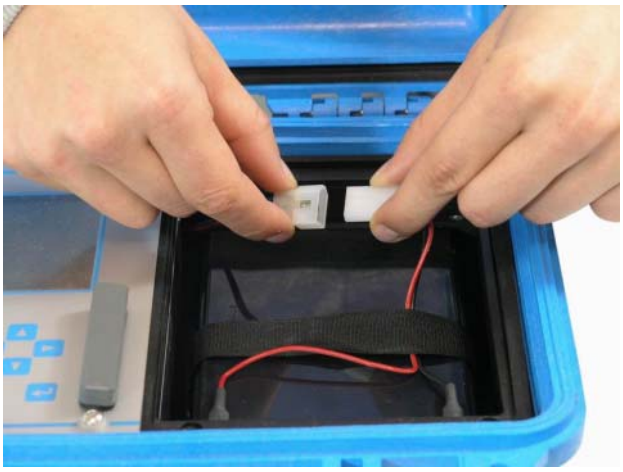


Fig. 6-31 Plug connection to rechargeable battery

The maximum capacity of the rechargeable battery is going to deteriorate in the course of time. This will reduce the lifetime which cannot be considered by the integrated lifetime calculation function of the PCM 4.
High or low ambient temperatures and long periods of use are going to reduce the battery capacity as well.

Rechargeable batteries are subject to wear and tear and shall be replaced after a maximum of two years.

This period may be shorter if being used extensively.

The rechargeable battery should be charged each time before using the PCM 4.
Remove unused batteries after the latest measurement, store them in a dry and frost-free place and recharge them after 2 months in order to maintain capacity as long as possible

The use of spare / replacement parts (such as rechargeable batteries or similar) not authorised by NIVUS will invalidate liability claims.

Always keep the battery compartment firmly locked during operation.

Please make sure to dispose of rechargeable batteries or standard batteries according to laws on environments.
Used batteries can be returned to the manufacturer.

6.7.2 Mains Connection

It is possible to power the PCM 4 directly from mains (100 - 240 V AC) by using the combined mains adapter / battery charger. To do this connect the plug of the mains adapter / battery charger to the according PCM 4 socket (see also Fig. 6-1). The rechargeable lead gel battery shall remain in the PCM 4 during mains operation as it is going to be charged simultaneously. This ensures to have it available as buffer battery in case of mains failures.
Please observe the degree of protection of the mains adapter / battery charger.

7 Initial Start-Up

7.1 General

Notes to the user

Before connecting and operating the PCM 4 please follow the notes below!
This instruction manual contains all necessary information to program and to operate the device, addressing qualified technical staff who have appropriate knowledge about measurement technology, automation technology, information technology and waste water hydraulics.
To ensure a correct function of the PCM 4 please read this instruction manual thoroughly!
If any problems regarding installation, connection or programming should occur please contact our technical division or our service centre.

General principles

It is not allowed to perform an initial start-up before the installation has been finished and inspected. This manual shall be read prior to initial start-up in order to eliminate the possibility of faulty programming.
Please get familiar with the PCM 4 programming via display and keyboard by reading the instruction manual before you begin to program the device.
After transmitter and sensors have been connected (see chapters 6.2 and 6.3) the measurement place parameters must be set. In most cases it is sufficient to set:

- shape or geometry of the measurement place
- the sensor type for level / height measurement
- the memory mode
- the system clock (time and date)

The PCM 4 user surface is designed in a way that even unfamiliar users are able to easily set up basic settings in graphic dialog mode which ensure reliable device operation.

For extensive programming, difficult hydraulic conditions, special channel shapes, in case of absence of expert staff or if a setup and error protocol is required, the programming should be carried out by the manufacturer or an expert company which is authorised by the manufacturer.

7.2 Keypad

To input required data there is a comfortable 18-button keypad available.

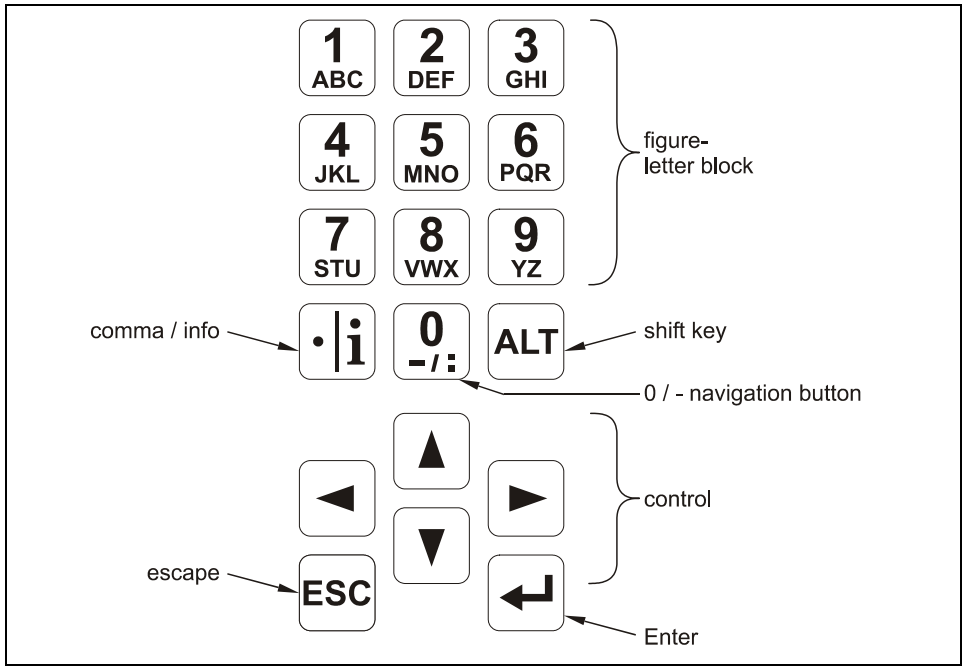
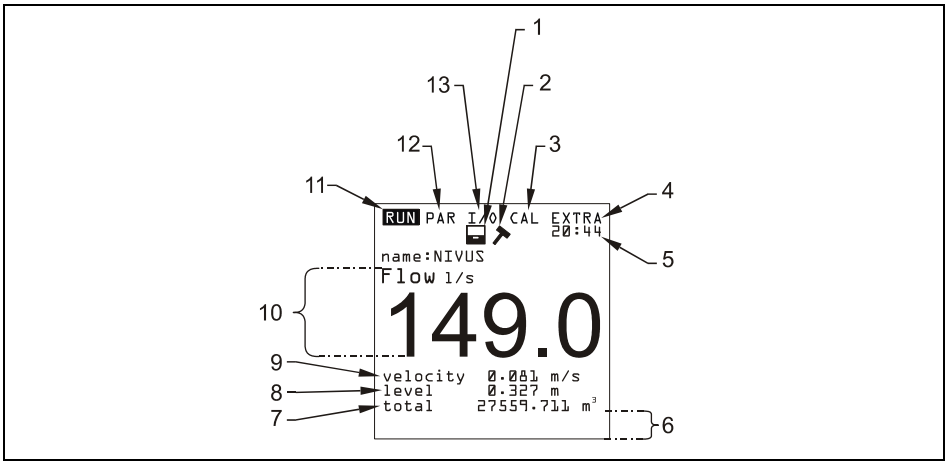


Fig. 7-1 Keypad

7.3 Display

The PCM 4 has a large back-lit graphic display with a resolution of 128 x 128 pixel. This ensures a comfortable communication mode for the user.



1 Memory mode enabled
2 Service mode enabled
3 Calibration menu
4 Display menu
5 current system clock time, alternately appearing medium temperature
6 Field for indication of digital outputs
7 Total
8 Fill level reading (height)
9 Velocity reading
10 Flow reading
11 Operation menu
12 Parameter menu
13 Status menu of inputs, outputs and sensors

Fig. 7-2 Display overview

Five basic menus can be selected, visible in the headline of the display. They can be selected individually. The menus are:

RUN The standard operation mode. Apart from indicating the names of measurement places it allows to display time, flow volume, flow level, average flow velocity as well as to optionally show flow velocity distribution, day totals error messages including a function enabling to record flow volume, flow level and average flow velocity.

PAR This menu is the most extensive of the PCM 4. It is for the complete setting of parameters regarding dimensions of the measurement place, sensors, memory mode and includes other settings such as the capacity of the rechargeable battery and more.

I/O This menu includes information about internal operation of the PCM 4. Current readings can be recalled from here. By using various submenus it furthermore allows to watch echo images from sensors, evaluated individual velocities and more in order to asses hydraulic conditions prevailing on the measurement place or to determine the remaining capacities of memory card and rechargeable battery.

CAL Here it is possible to adjust the level measurements as well as to modify settings regarding the automatic self-calculation of flow volumes.

EXTRA This menu contains basic display settings: contrast, lighting, language, units, system times and totaliser presets.

7.4 Operation Basics

The entire operation is menu driven and supported by explanatory graphics. To navigate within the menu structure use the 4 control keys (see Fig. 7-1)

◄ ► Use these buttons to select the main menus.

▲ ▼ Buttons for scrolling within the menus.

↵ Selected submenus can be entered, inputs can be opened. The “Enter“ key further serves to confirm data entries.

ESC Exit submenus step by step. Will cancel entered data.

1 ABC – 9 YZ These buttons are used for parameter setting and to enter digits. In some sub menus the buttons are to input letters (e.g. name of measuring point). Function compares with mobile phone or cell phone buttons: quickly pressing a button more than once will switch over to the next letter. The cursor will jump to the next digit if no key will be pressed for approx. 2 seconds.

•|i The key “dot/i“ serves to input digits. In RUN-Mode it also recalls internal information on software versions and used electronic components. The key furthermore serves to start communication between transmitter and sensors.

ALT This button is to toggle between uppercase and lowercase letters in text entry mode. In the rest of the parameter setting mode it serves to enable / disable various functions and hence is a toggle key between different programming options. If used in RUN mode the key is going to trigger a forced data dump to CF card.

ESC → ALT Pressing >ESC< and >ALT< in quick succession will cause the unit to fall to sleep mode, disabling measurement as well as data storage! The unit will be re-activated 7 seconds after any key has been pressed.

7.5 Measurement and Display Functions

After the program settings have been finished the PCM 4 will restart performing a complete system reset. The unit subsequently begins to measure using the cycle set. The required measurement duration is going to be determined by the PCM 4 within each cycle depending on flow and hydraulic conditions.
The number of storage events per hour will be calculated from a full hour divided by the periodic interval. The reference to calculate the points in time is a full hour.
Example:

- cycle set: 5 minutes
- programming finished: 12:17 h
- first storage: 12:20 h
- second storage: 12:25 h
- third storage: 12:30 h

and so on.

7.5.1 Display Functions in Memory Mode

Following display options are available:

1. The unit has been turned on for maintenance purposes (indication of data, sensor check, battery replacement or similar) without modifying any parameters → the device shows the current readings for 3 minutes. Data will be saved in the background according to the current cycle if the interval is set shorter than 3 minutes.
   3 minutes after the last key action the unit falls to standby mode and the display goes off. The display subsequently will activate for three times following the cycle set. Due to energy-saving purposes the display now will not re-activate again and the PCM 4 is going to proceed in the background following the interval set.
2. The PCM 4 has been re-programmed or parameters have been modified. After that the modification has been confirmed by entering the PIN code. → the display goes off for a moment, the PCM 4 is going to restart and subsequently will indicate the current readings for 3 minutes. Data will be saved in the background according to the current cycle if the interval is set shorter than 3 minutes.
   3 minutes after the last key action the unit falls to standby mode and the display goes off. The display then will activate for five times following the cycle set. Due to energy-saving purposes the display now will not re-activate again and the PCM 4 is going to proceed in the background following the interval set (see Fig. 7-3).

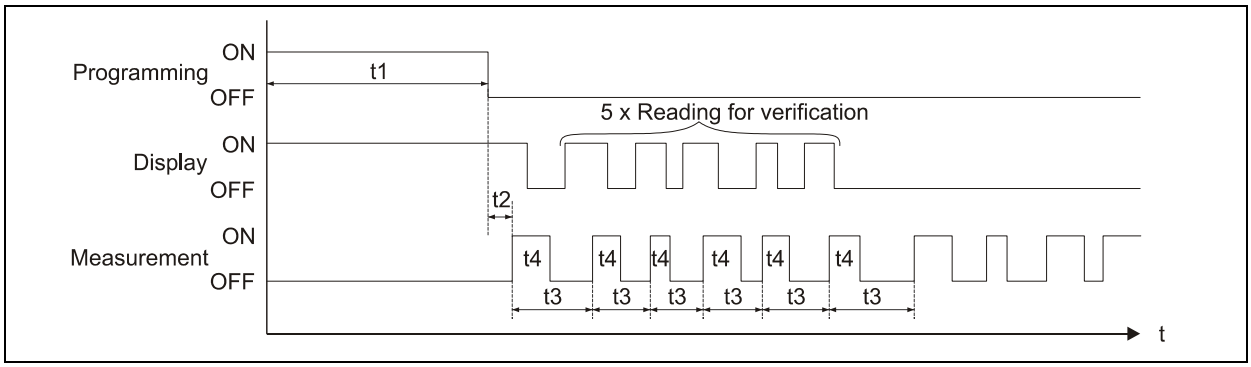


Fig. 7-3 Measurement and display functions after parameter modification

7.5.2 Display Functions without Memory Mode

For initial set-up of the portable flow measurement system in difficult applications, if using the unit for short-term and punctual verification of other metering systems (flumes, weirs, magnetic-inductive systems or similar) or throttles the memory function may be irrelevant. On the other hand it might be important to permanently indicate current readings. The PCM 4 exactly meets the requirements described before since the PCM 4 operates continuously as long as the memory function is disabled.

Current readings are going to be indicated permanently on the display but will not be saved however if the PCM 4 memory mode has not been enabled. At the same time the power consumption will strongly increase.

8 Parameter Setting

8.1 Parameter Setting Quick Guide

In case of standard applications (such as part filled standard channel; level and flow velocity measurement by combi sensor from bottom up, level measurement by water-ultrasonic sensor, no values above or below minimum and maximum detectable fill level of combi sensor, no vertical sensor offset) normally just a few basic settings such as the ones below are required:

1. Install and connect transmitter and sensor as described in chapter 6
2. Connect power supply (charged battery)
3. Menu: PAR – Settings – execute system reset
4. Menu: I/O – System - Batt. full – confirm with >yes<
5. Menu: EXTRA – Units: select units for flow rate (l/s), velocity (m/s), fill level [m] and total [m³] (units in brackets = default settings)
6. Menu: PAR – Measurement place – Channel profile: select profile
7. Menu: PAR – Measurement place – Channel dimensions: enter channel dimensions
8. Menu: PAR – Fill level – Sensor type: select water-ultrasonic
9. Menu: PAR – Memory mode – Operation mode: select periodic, set interval and define the units to be saved (flow [l/s], velocity [m/s], level [m] and total [m³] (units in brackets = default settings))

Additional Settings

10. Menu: EXTRA – System clock: adjust time if required (important for synchronised operation of several PCM 4 units!)
11. Menu: PAR – Measurement place – Name: enter the desired name of the measurement place (default: NIVUS)
12. Exit parameter mode. Save settings by entering >2718<.
13. Calibrate the level sensor if required.

8.2 Parameter Setting Basics

The degree of protection for the unit (see chapter 2.3.1) can be guaranteed only if the enclosure lid is closed and has been safely locked by using both locks. Due to this reason always ensure to safely lock the transmitter before you begin data logging, after settings have been finished and first readings have been checked (see chapter 7.5).

In case of unfavourable situations regarding weather conditions (precipitation) or locations with water leaking from above it is necessary to replace / exchange batteries and / or CF card in a dry place.
If this should not be possible protect the opened unit from ingress of moisture sufficiently.

The unit shall be locked safely by using both snap locks after the parameters have been set. Otherwise the protection degree cannot be guaranteed.

Current readings are going to be indicated permanently on the display but will not be saved however if the PCM 4 memory mode has not been enabled. At the same time the power consumption will strongly increase.

In parameter setting mode the unit will proceed to operate in the background using the settings which have been previously saved. Just after you finish the new entries, the system asks to accepting the new values.
“YES“ requires to enter the PIN code.

2718 Type in this number if prompted.

Never give the code number to any unauthorised persons. Even do not leave the code next to the equipment or write it down on it. The code number protects against unauthorized access

If a faulty code has been entered three times the parameter mode will be aborted. The unit will proceed to operate using the values set earlier. If the correct code has been entered the modified parameters are accepted and the system resets. This reset will take approx. 20-30 seconds.

After mounting and installing sensor and transmitter (see previous chapters) activate the power supply. To do this connect the plug in the battery compartment to the socket of the rechargeable battery.
The PCM 4 initial start-up dialog is the language selection:

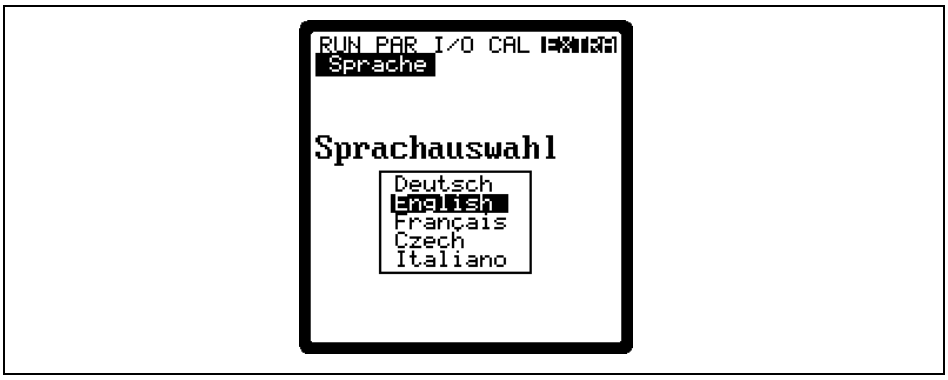


Fig. 8-1 Language selection

A system reset shall be executed prior to each initial start-up in order to reset the unit to default settings. This helps to prevent errors due to faulty settings.

Custom parameters will get lost performing a reset and the unit will reset to factory defaults.

8.3 Operation Mode (RUN)

This menu is a display menu for standard operation mode. Containing the following sub menus, it is not required for parameter setting:

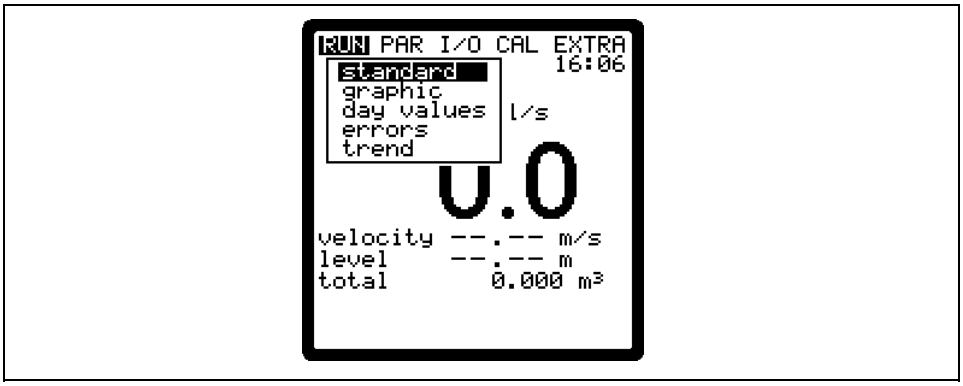
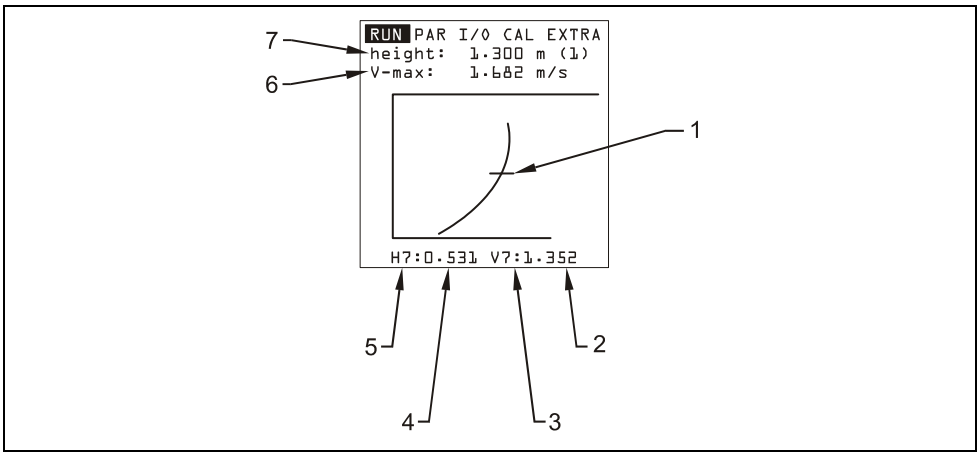


Fig. 8-2 Operation mode selection

Standard Display (basic screen) indicating information on the name of measurement place, time (alternately appearing medium temperature), flow quantity, level and average velocity.

Graphics Indicates the velocity distribution in a vertical measurement path.
Pressing the "arrow up“ or "arrow down“ keys will move the indicator line accordingly. The selected height as well as the current velocity can be read from the bottom line of the display (see Fig. 8-3)
This graphic indication enables to understand the current flow conditions at the chosen measurement place. The velocity profile should be evenly distributed and should not have any errors (see Fig. 8-4)
In case of very unfavourable conditions change the position of the flow velocity sensor.



1 Measurement Window Indication
2 Velocity Value
3 Velocity Measurement Window no.
4 Level Value
5 Level Measurement Window no.
6 Maximum Measured Velocity
7 Maximum Height

Fig. 8-3 Flow velocity distribution

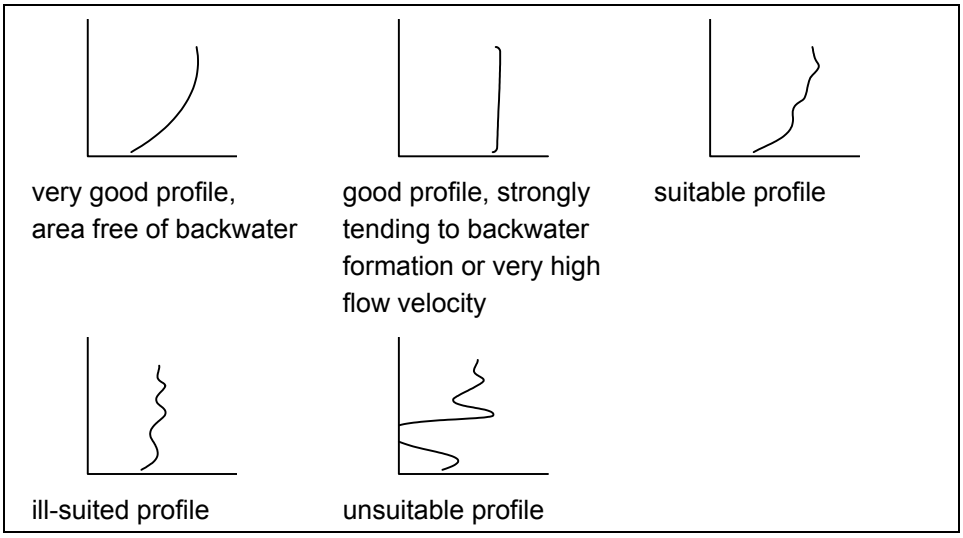


Fig. 8-4 Flow velocity profiles

Day values

Please select the INFO submenu (see Fig. 8-5). This menu contains the total flow values of the past 7 days (see Fig. 8-6, presumed the transmitter was operated without any interruption in the past seven days. Otherwise it shows the total for the uninterrupted days of operation)
Totalisation normally is carried out at 00:00 h (midnight). If desired, this value can be modified under RUN – Day Totals - Interval (see Fig. 8-7)
Additionally, you can get information about partial total value since the last reset (comparable with route mileage counters in cars). Reset to >0< by pressing the >ALT< key. This reset does not influence the totaliser!

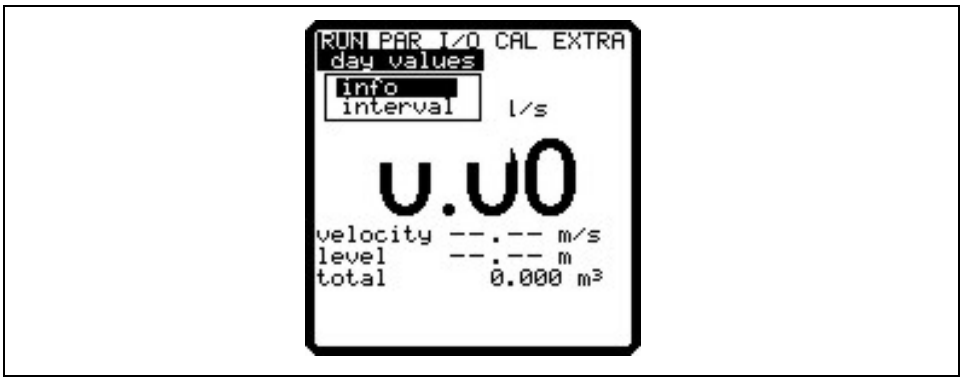


Fig. 8-5 Info menu

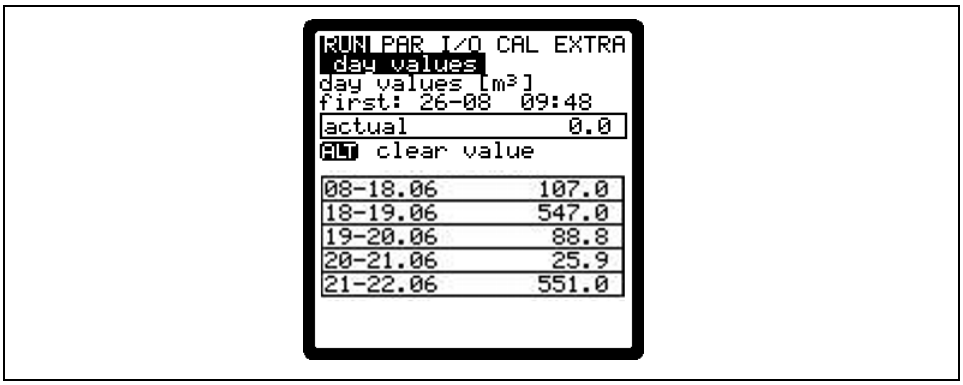


Fig. 8-6 Day totals

Fig. 8-7 Time of day totalising

Errors

This menu is to monitor any interruptions in the unit function. Errors are going to be saved and ordered by type of error, date and time. Pressing the >ALT< key will delete all error messages one by one (from the latest one back to the oldest one). To delete an error message is equivalent to confirming it. If the respective error still is present in the moment of confirmation it is not going to be written into the error memory again.

Trend

This menu operates like an electronic logger, saving cycle values on fill level, average flow velocity and height in an internal memory. The capacity of the PCM 4 memory is capable to save readings for each minute within a period of 14 days.

The submenu allows to select and to watch individual trends. This enables to quickly monitor past situations at measurement places on-site without any additional aid.

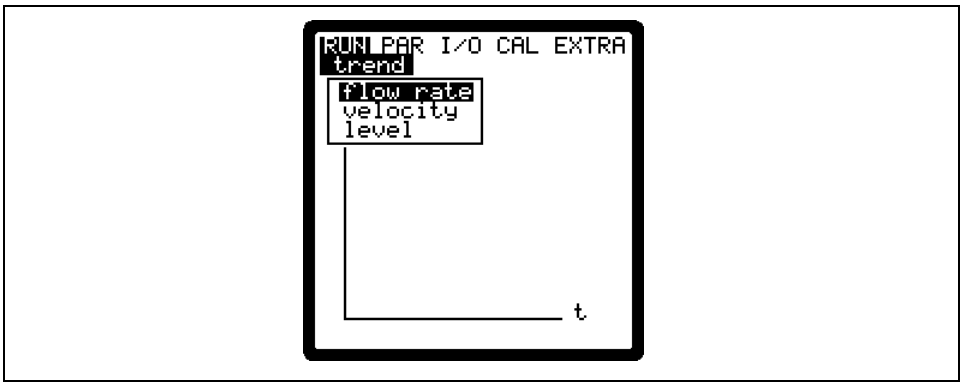
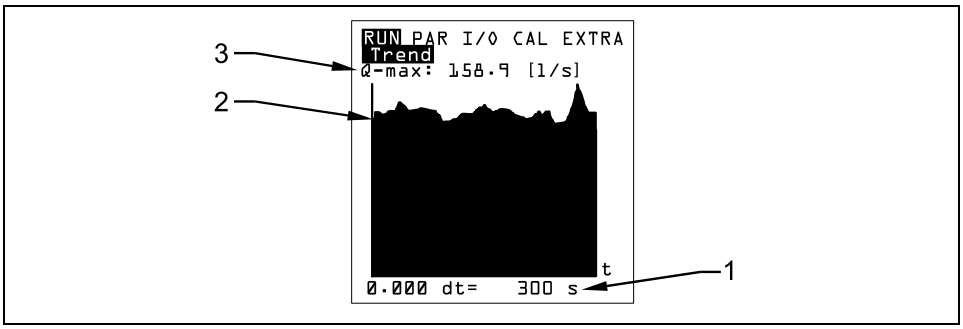


Fig. 8-8 Selection of trend values

The bottom line indicates the period shown including date and time. Browse through the periods (max. 14 days) by using the arrow-left or –right keys.



1 Memory interval
2 Trend graph
3 Maximum value

Fig. 8-9 Trend graph example

The content of the internal memory will get lost on executing a system reset. All trend graphic values saved previously will get lost as well

8.4 Display Menu (EXTRA)

This menu allows to modify settings such as basic screen, units, language as well as the display itself. The following submenus are available:

Fig. 8-10 Extra submenus

Units

Here you can select between the metric system (litre, cubic meters, cm/s etc.), English system (ft, in, gal/s, etc.) and American system (fps, mgd etc.).
The next selection will come up automatically after confirmation.
For each one of the following metered or calculated values you can select a unit appearing on the display:

- Flow rate
- Velocity
- Fill level
- Total

Depending on the unit system selected there are various units available.

Language

Select from German, English, French, Italian and Czech

Display

Allows to adjust display settings regarding contrast and brightness. Use ▼ and ◄ to decrease; ▲ and ► to increase values. ► and ◄ will modify settings in steps of 5%, ▲ and ▼ in steps of 1%.

Set time

In order to perform various control and memory functions, the unit includes an internal system clock saving dates of year, weekdays and week numbers. The clock settings can be modified if required.
First select the menu point “Info”:

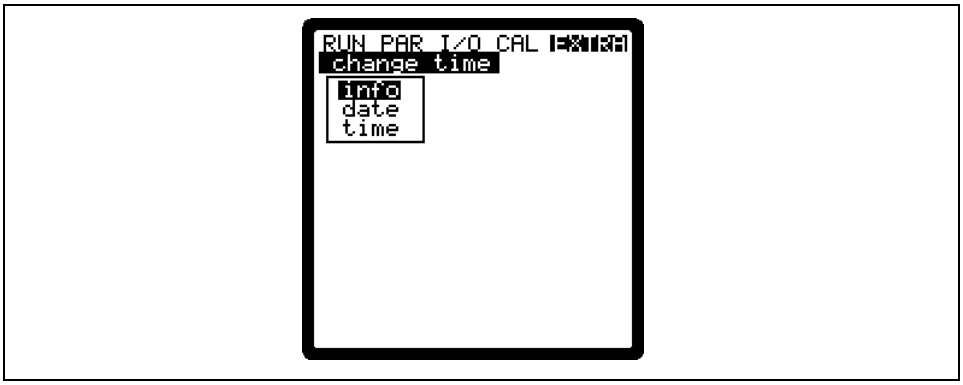


Fig. 8-11 System time submenu

The complete system time is indicated after the settings have been confirmed:

Fig. 8-12 Complete system time

This menu point is for indicating purposes only. Hence the clock cannot be adjusted here. Modifications can be carried out only in the individual menus “Date” and "Time“.

Fig. 8-13 Setting the date

In menu points Set clock / Date and Time it is possible to set the date as well as the time.

Set total-counter Totaliser setting [m³]. Will be set to zero in case of executing a system reset.

Start of Measuring

In memory mode, this setting determines the delay if you do not wish the unit to start measuring immediately after programming has been finished. If this setting has not been modified the PCM 4 is going to start measuring immediately after parameters have been set (if memory mode is active). Only full hours can be selected!

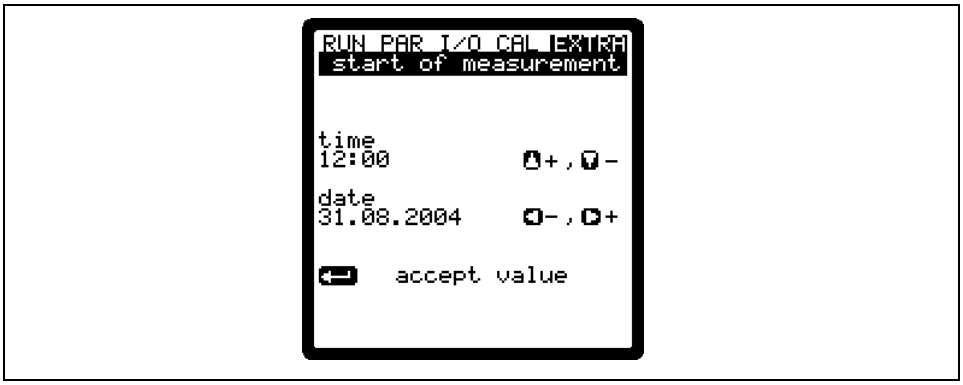


Fig. 8-14 Metering delay

8.5 Parameter Menu (PAR)

Fig. 8-15 Submenu parameter settings

This menu is the most extensive and most important regarding the PCM 4 settings. It nevertheless is sufficient in most cases to set only some essential parameters, which usually are:

- name of measurement place
- channel shape
- channel dimensions
- sensor type
- storage mode

All other functions are additions which are required in special cases only.

8.5.1 Parameter Menu "Measurement Place“

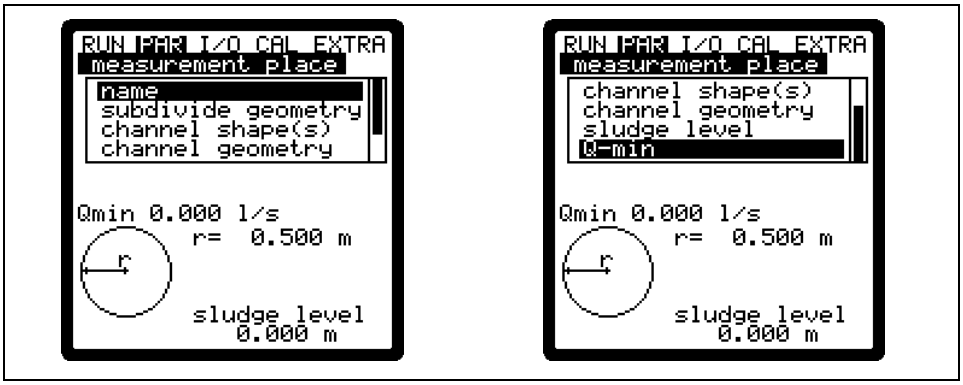


Fig. 8-16 Submenu measurement place

This menu is one of the most important basic menus for parameter setting as the dimensions of the measurement place are going to be defined here.
The menu cannot be indicated completely due to restricted display space. Similar to many well-known PC applications, this is readily identifiable from the black bars on the right-hand side of the screen.

◄ ► Use "Up“ and "Down“ keys to scroll the menu.

Measurement place name

NIVUS recommends to coordinate and to define names according to names stated in the respective documents. Names may contain up to 21 letters. Setting the name is quite similar to operating a mobile phone:
After the submenu >Name of Measurement Place< has been selected the basic setting “nivus“ will come up.

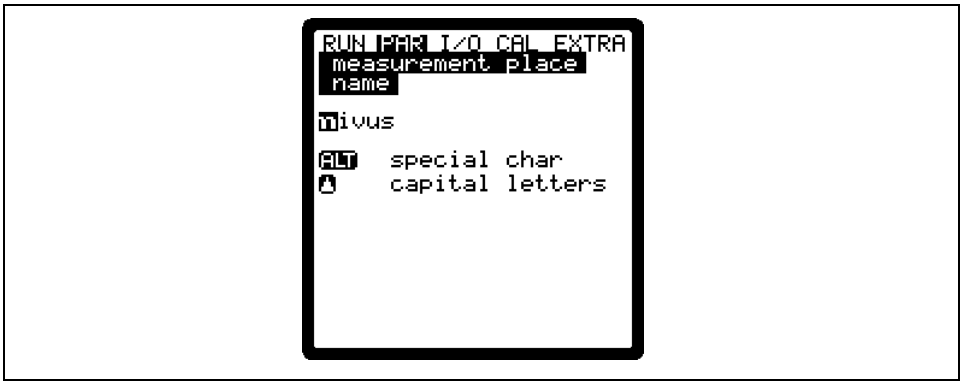


Fig. 8-17 Setting the name of the measurement place

Enter the desired name with the keypad, where each key has assigned three letters and a number. Select between these four characters by briefly pressing a key several times. The cursor will jump to the next character if no key has been pressed for two seconds.

ALT Lets you optionally select special characters which are not available on the keypad (such as >ä<, >ö<, >ü<, >ß<). More special characters will be indicated but however are not allowed to be used as measurement place names. The signs can be used to specify inputs and outputs.

◄ ► These keys move the cursor left or right within the special character menu.

Moving the cursor to the right-hand side with the ► - key creates a space character if in uppercase or lowercase menu.

Pressing the ◄-key will delete the previous character.

▲ Shift to uppercase letters

▼ Shift to lowercase letters

Faulty entries can be corrected by moving the cursor back and overwriting the character accordingly.

↵ Confirm the entered name with “Enter“ and exit the menu.

Subdivide geometry

This is a special parameter which enables to easily set parameters for large special profiles with convex tops. This parameter however will not be required in 98% of all cases!

Pressing the >ALT< key will switch between the 3 options described below:

- NO (no profile subdivision)
- 2 (subdivide in 2 level / height zones)

3 (subdivide in 3 level / height zones)

Zones can be set under Parameter/Measurement Place/Channel Profile(s).

The bottom zone of the profile can be set to Pipe, Egg, Rectangle, U-Profile, Trapezoid, 2r Egg and Q = f(h). Set a height-width or a height-area characteristic in the centre zone and enter a segment of circle in the top profile zone. During setting the profiles please observe that the reference point is always the channel bottom.

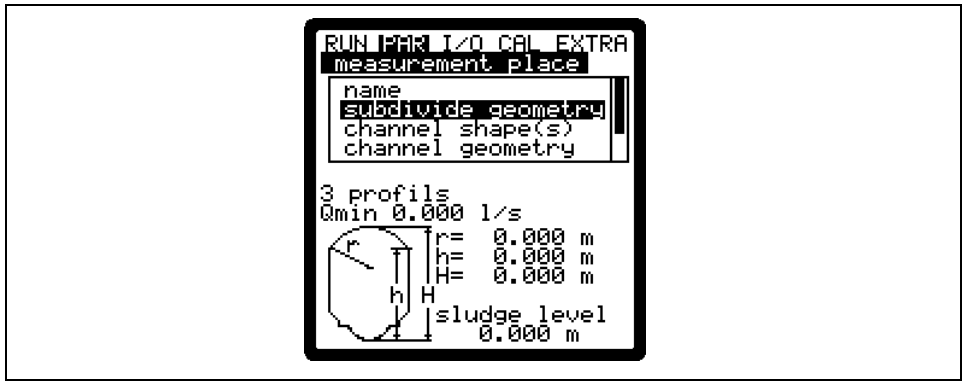


Fig. 8-18 Profile divided into 3 zones

Channel shapes(e)

If the profile has been subdivided, first select the zone (bottom, centre, top) using the ALT key and set the desired profile subsequently. Currently it is possible to select from following standard profiles according to ATV A110:

- Pipe
- Egg (standard; h:w = 1.5:1)
- Rectangle
- U-Profile
- Trapezoid
- 2r Egg (h:w = 1:1) and
  Q= f(h)

Fig. 8-19 Selecting the channel shape

▲ ▼ Select channel shape with "Up“ and "Down“ keys.

↵ Confirm selection with “Enter“.

The selected profile will be indicated in the programming mode screen.

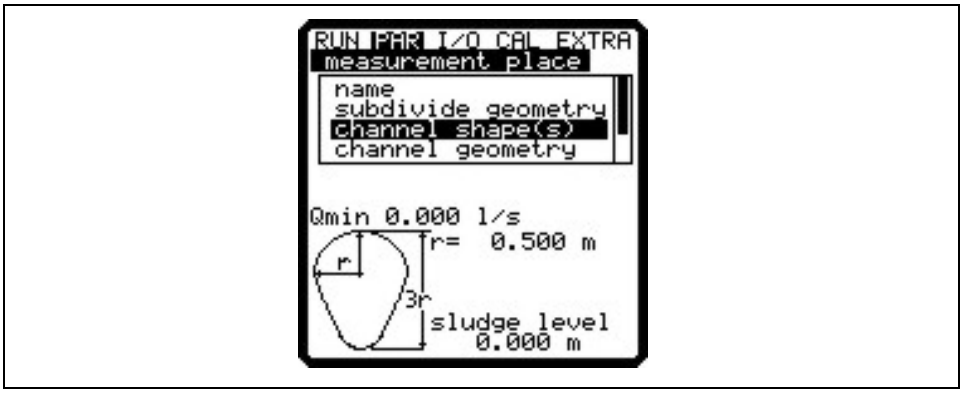


Fig. 8-20 Selected profile

If the existing profile does not comply with the options to select from, choose >Custom shape< in this case.

↵ Confirm with “Enter“.

A request will come up subsequently asking for known relations.

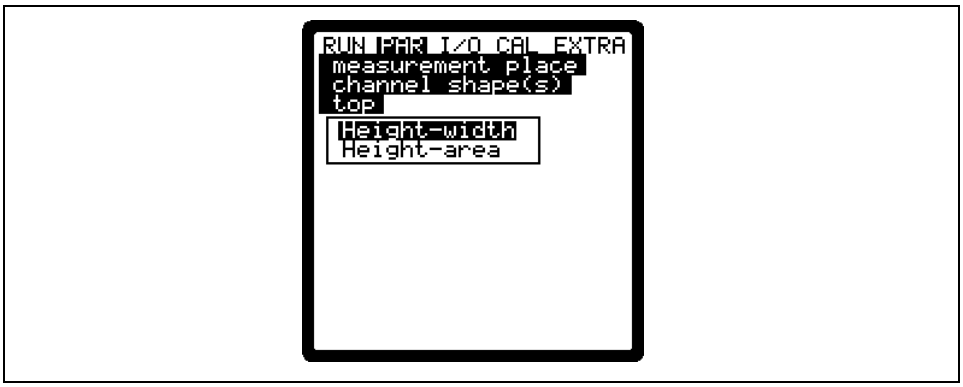


Fig. 8-21 Custom shape menu

Channel geometry

Type in the respective channel dimensions depending on the profile chosen before.

Please observe indicated units!

Choosing >Custom shape< will indicate a table of 32 possible breakpoints on the display. As described above, enter the relations between height-width or height-area and enter the according value pairs.

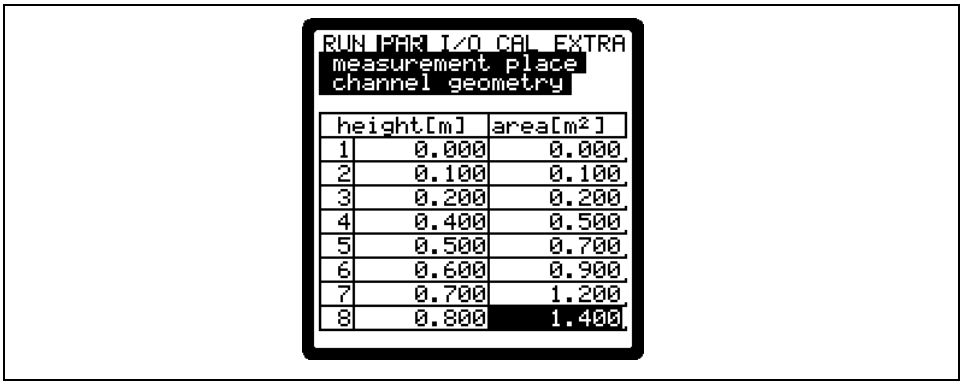


Fig. 8-22 List of custom shape breakpoints

In order to define the zero point of the channel start by entering 0 – 0 in breakpoint 1. All further breakpoint can be set freely regarding height as well as width/area.
There may be different distances between individual level points. Furthermore it is not required to use all of the 32 breakpoints possible. The PCM 4 however is going to use a linearisation function between the breakpoints. Decrease the distance between breakpoints in case of heavy and irregular fluctuation within the area.

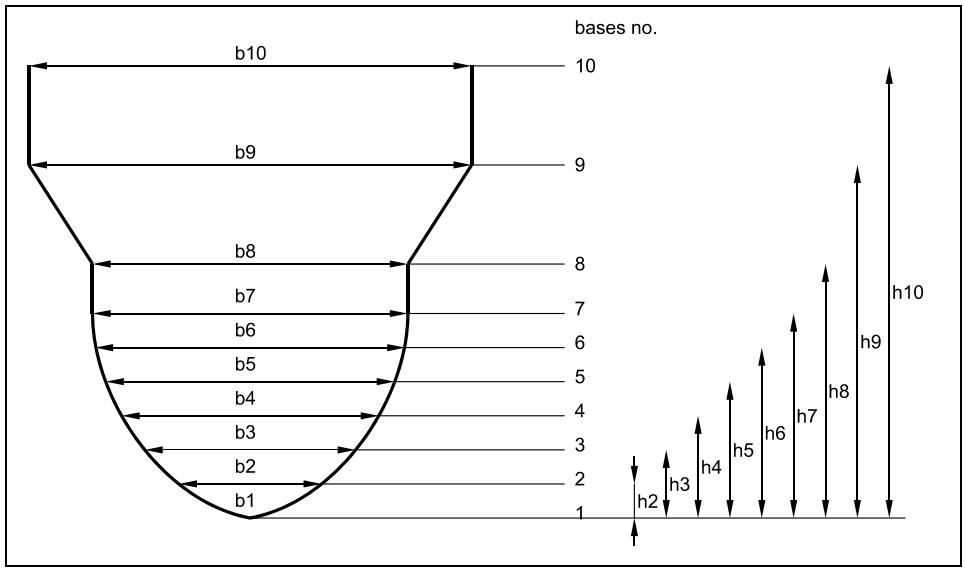


Fig. 8-23 Custom profile breakpoints

If the channel profile has been divided in two zones, the channel profiles below are available to be set:

Bottom area:
- Pipe
- Egg
- Rectangle
- U-Profile
- Trapezoid
- 2r Egg
- Q=f(h)

Top area:
- Custom profile

Dividing in three zones will reveal the following setting options:

Bottom area:
- Pipe
- Egg
- Rectangle
- U-Profile
- Trapezoid
- 2r Egg
- Q=f(h))

Centre area:
- Custom profile

Top area:
- Pipe

If the function Q=f(h) has been selected only one level zone can be defined, i.e. is not possible to divide into centre area or top.

Programming subdivided profiles makes sense only case of exceptional and very unusual profiles with convex tops. The procedure requires comprehensive knowledge and experience in operating the PCM 4. To avoid faulty programming or if in doubt this procedure should be performed by NIVUS service personnel or expert companies authorised by NIVUS.

Sludge Level

The sludge level set is going to be calculated as non-moving channel sub-area and will be subtracted from the wetted hydraulic total area prior to executing flow calculation.

Low-Flow Volume Q_{min}

This parameter serves to suppress lowest movements or apparent volumes arising.

Q_{min}: measurement values lower than this one will be set to >0<. Only positive values are allowed to be set. These values are going to be considered as absolute values and therefore have positive as well as negative effects.

V_{min}: low-flow volumes in applications with large profiles and filling levels can be suppressed by means of this parameter. Lowest velocity fluctuations within longer periods of time may cause apparently large volume fluctuations which cannot be gated by using the value of Q_{min}.

Flow velocities below this value will be set to “0“ which will set the calculated volume to “0“ as well.

Both setting options of low-flow suppression have an OR relation between each other. This means that the low-flow volume suppression is enabled as soon as one or both parameters are not equal to zero. The first parameter whose value goes below the limit will take effect if both parameters have been set.

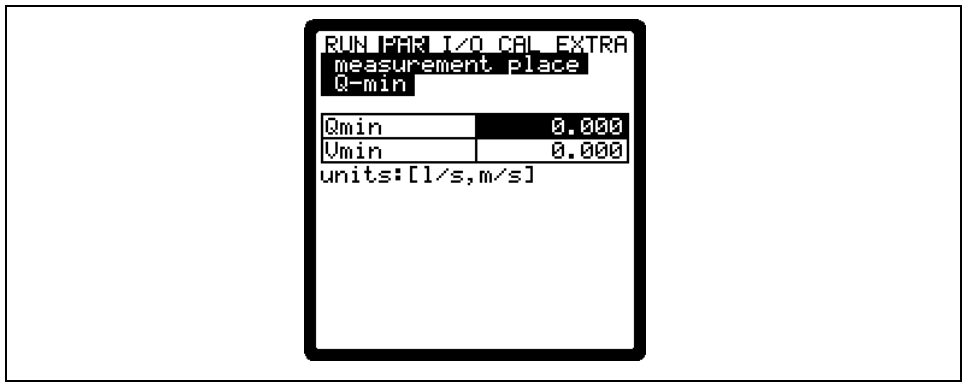


Fig. 8-24 Selection low-flow volumes

*The suppression of low-flow volumes is **no** offset but a limit value.*

8.5.2 Parameter Menu "Level“

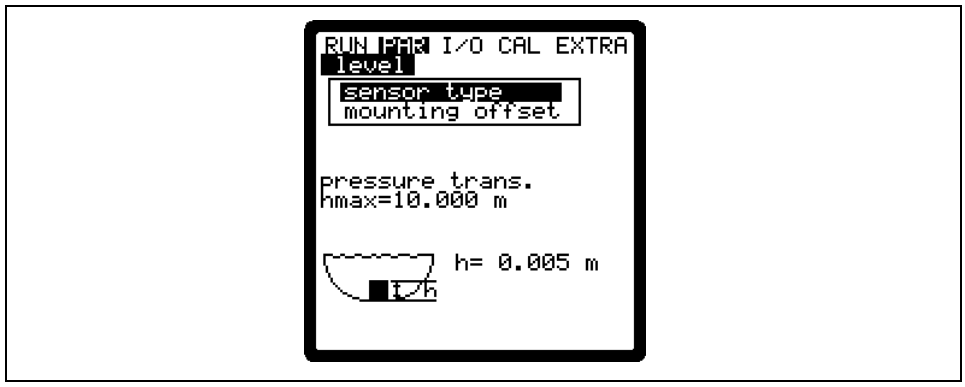


Fig. 8-25 Level measurement – submenu

This menu defines any parameter regarding level measurement. The start screen depicted below as well as the parameters to be set may vary depending on the sensor type selected.

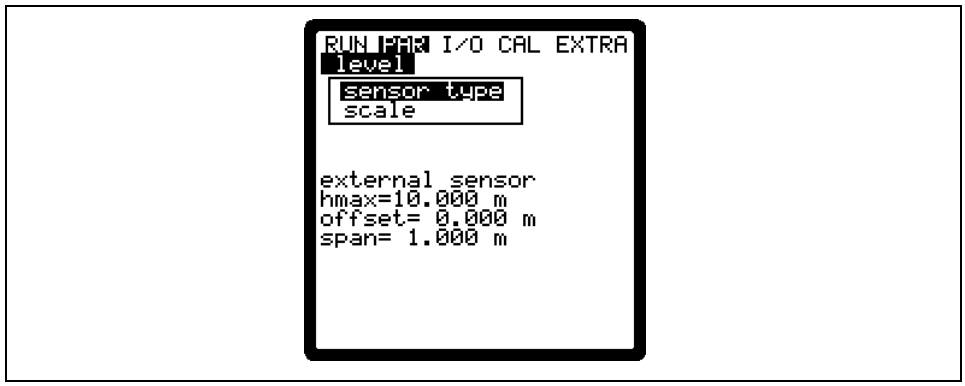


Fig. 8-26 Example: external sensor selected

First of all determine the sensor type. Select from the types below:

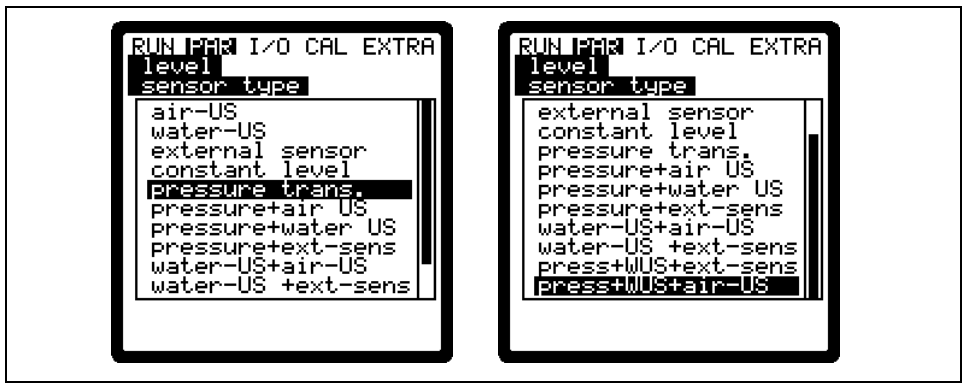


Fig. 8-27 Defining the sensor type

<u>Option 1:</u> Air-Ultrasonic (Air-US)

Air-ultrasonic fill level measurement from top down. Flow rate calculated by exclusively using a Q = f(h) relation without additional flow velocity sensor. The sensor however may be combined with the flow velocity sensor.

<u>Option 2:</u> Water-Ultrasonic (Water-US)

Flow velocity and level measurement by combi sensor from bottom up.

<u>Option 3:</u> External Sensor

Level measurement by external 2-wire sensor supplied by PCM 4 (such as NivuBar Plus or NivuCompact). Flow rate calculated by exclusively using a Q = f(h) relation without additional flow velocity sensor. The sensor however may be combined with the flow velocity sensor.

Option 4: Fixed Value

This option is going to be used for constantly filled pipes and channels (e.g. NPP). Such applications normally do not need level measurements. Set the constant fill level under „Scale/Height".
This parameter is useful in case of testing or initial start-ups if there is no level reading available.

Option 5: Pressure

Flow velocity and level measurement using a combi sensor with integrated pressure measurement from bottom up.

It is possible to combine different options as described below. These combinations may be required if due to constructional conditions a single sensor does not cover the entire measurement range.

Pressure + Air-US	Combination of options 1 and 5. Recommended if an area from flow level 0 mm up to additional impoundment must be measured. The pressure sensor covers the range of additional impoundment and the air-ultrasonic sensor detects the low flow levels. Pressure sensor can be installed out of the channel centre due to heavy sedimentation.
Pressure + Water-US	Combination of options 2 and 5. Recommended if additional impoundment may temporarily occur and the sewer system overload is to be measured. In this case the pressure sensor detects the area of the additional impoundment. The water-ultrasonic sensors can be used only if installed in the centre of the channel bottom. The pressure sensor detects flow levels as from approx. 0.5 cm up, the water-ultrasonic sensor detects flow levels as from approx. 5 cm up.
Pressure + ext. Sensor	Combination of options 3 and 5. Same applications as described under pressure + air-US
Water-US + Air-US (LUS)	Combination of options 1 and 5. To be used in order to detect low flow levels by using the air-ultrasonic sensor. The water-ultrasonic sensor detects flow levels as from approx. 5 cm up. Please observe to install the sensor in the centre of the bottom.
Water-US + external Sensor	Combination of options 2 and 3. To be used in applications as described in water-US + air-US. An external 2-wire sensor instead of an air-ultrasonic sensor is going to be used to detect low flow levels.

Pressure + Water-US (WUS) + ext. Sensor

External sensor detects low flow levels. The flow level up to the channel vertex will be measured by using water-ultrasonic measurement and additional impoundment in the sewer network is going to be detected by using pressure measurement.
Observe to install the active combi sensor with pressure and water-ultrasonic measurement in the centre of the channel bottom.

Pressure + WUS + Air-US

To be used the same way as version pressure + WUS + external sensor. The air-ultrasonic sensor instead of the external sensor is going to be used to detect low flow levels.

After selecting the sensor types the menu will guide the user through the menu point „Split sensors“ automatically (see also Split Sensors, Fig. 8-28)

Mounting offset

In case of selecting the water-ultrasonic sensor this value is set to 10 mm (0.39 in) per default as this is equivalent to the position of the level sensor surface above the channel bottom.
If selecting the pressure sensor the value is set to 5 mm (0.2 in) per default which is equivalent to the sensor installation height.
The according installation level will be adjusted if calibrating the level in CAL - menu.

Scale

Depending on the sensor type set either measurement offset, measurement span and delay or a fixed fill level (which is equivalent to the input signal) is going to be entered.

Delay time

Indicated only if „External sensor“ has been selected.
The sensors will be powered during the delay time after the PCM 4 has been turned on, no measurement is carried out however. This is the time the sensors require to run stable.

Please refer to chapter 6 for sensor connection.

Select layers

This parameter will be indicated only if a sensor combination has been selected.

Fig. 8-28 Split level zones

It is possible to split the fill level in two (top and bottom) or three zones (top, centre, bottom).
This enables to measure e.g. the bottom zone by using an air-ultrasonic or an external sensor, the centre zone by using a water-ultrasonic sensor and the top zone by using pressure in order to obtain current fill level or flow volume.
The threshold for switchover between the zones will be determined in the upper or lower area under >Switchover level<.

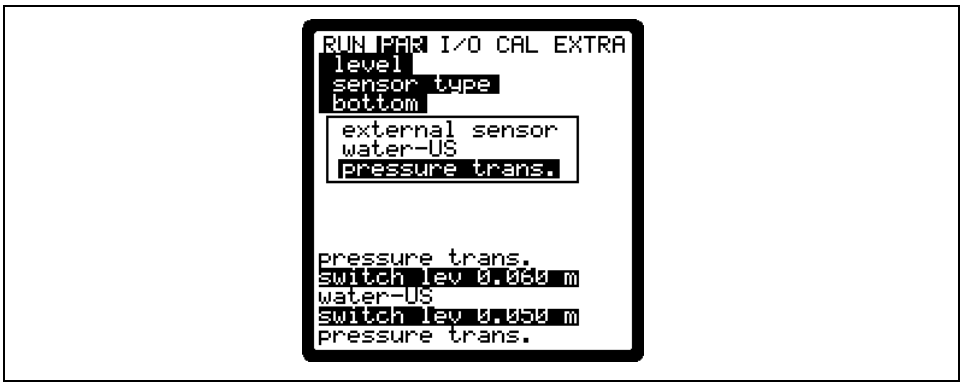


Fig. 8-29 Setting the zones

8.5.3 Parameter Menu “Velocity“

The PCM 4 allows to use a connected flow velocity sensor as combi sensor with integrated level measurement (Type V1H, V1D or V1U) or as flow velocity sensor (Type V10) only.

Fig. 8-30 Sensor settings

The sensor selection will bring up the screen below:

Fig. 8-31 selecting the sensor type

Sensor type
Select between wedge or tube sensor by pressing the >ALT< key.
Installation position is set to “positive“ per default. This parameter should not be modified. It is going to be used only for special applications where the flow velocity sensor is heading upstream (unlike heading downstream towards the flow direction as in standard applications) but is to detect positive velocities however. This is the only case which requires to set “negative“ here

Mounting Place
This menu point is to modify the installation height of the flow velocity sensor. The standard setting is 20 mm (0.788 in) which is equivalent to the position of the sensor centre above the channel bottom. This setting does not need to be modified unless the sensor has been installed higher or lower. If the sensor has been installed higher enter the additional mounting height plus 20mm (0.788in), if installed lower subtract the missing height from 20mm and enter overall height.

If the mounting place of the level sensor has been modified please necessarily increase the value in parameter >Cal/Flow velocity//h_crit< by the same amount.

8.5.4 Parameter Menu "Analog Inputs“

Fig. 8-32 Submenu analog inputs

Channel Number
The PCM 4 has two programmable analog inputs available.
Channel 1: input via socket 3
Channel 4: input via socket 1
Channels 2 and 3 are reserved to measure battery voltage and current power consumption. These channels cannot be programmed.

Name
Does not have to be entered. It is helpful to set a name if the analog input values are to be saved on memory card. This name will be saved on the storage medium.
Set the name as described under PAR/Measurement place/Name of measurement place<.

Function
A function will be assigned to the analog input which has been selected using >Channel Number<. Select from following functions by pressing the >ALT< key:

- analog input disabled
- archive value (analog input will be saved [data logging function of transmitter])

Measurement Span
0/4 – 20 mA

Unit
This parameter is going to be assigned to the saved name and to the breakpoint list explained below.

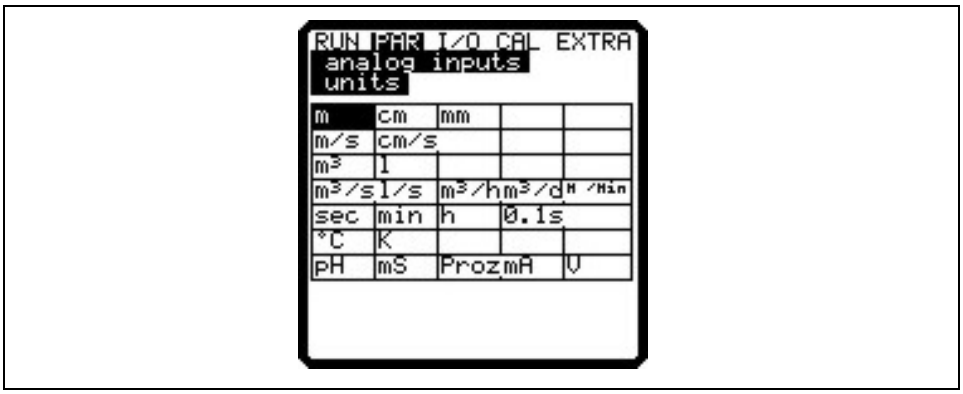


Fig. 8-33 Table of measurement units

Linearisation table

The analog input span can be defined here. Additionally it is possible to modify the weighting of the analog input by means of a 16-digit (max.) breakpoint table. If used properly, this point will open up some helpful special options regarding the setting of PCM 4 parameters. For example it is possible to convert a level/height signal into a volume-proportional signal which can be saved or route this signal to one of the analog outputs for further processing or display purposes.
Just enter the number of breakpoints.
↵ Confirm entry!
↵ A table with the respective units will come up subsequently.

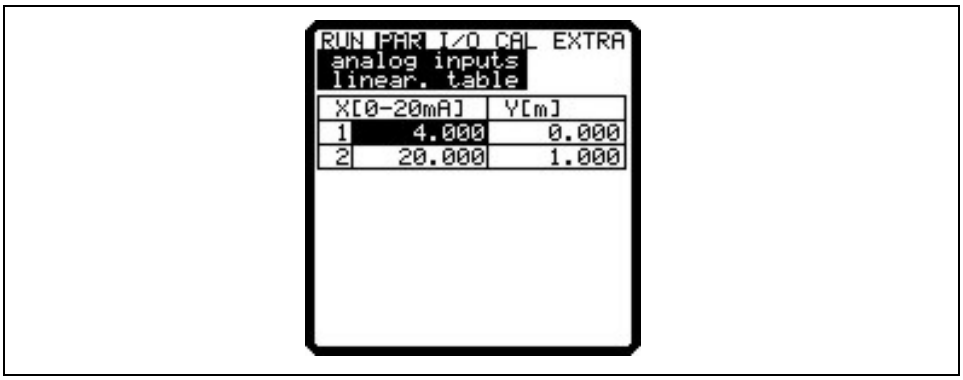


Fig. 8-34 Table of values for analog input span

Enter the mA value in the X-column and the other value in the Y-column (appropriate unit has been selected before under "Units“).
In case of classic applications such as setpoint input or in order to save a measurement value just enter "2“ as breakpoint value. Subsequently define the analog input span, i.e. enter the respective values for 4 mA and 20 mA.

Offset

In addition to the input current, a fixed positive or negative offset using the unit chosen before can be added to the analog value.

8.5.5 Parameter Menu "Digital Inputs“

Fig. 8-35 Submenu digital inputs

Name

It is not necessary however to input a name as it currently is for device-internal use only.
Set the name as described under >PAR/Measurement place/Name of measurement place<.

Function

One of the following functions is going to be assigned to the digital input:

- disabled
- runtime

The transmitter detects switching events via the digital input even in stand-by mode (between measurement cycles) and accurately saves the runtime to the second.

The digital input is enabled and powered with a voltage of 3.3 V DC.

8.5.6 Parameter Menu "Analog Outputs“

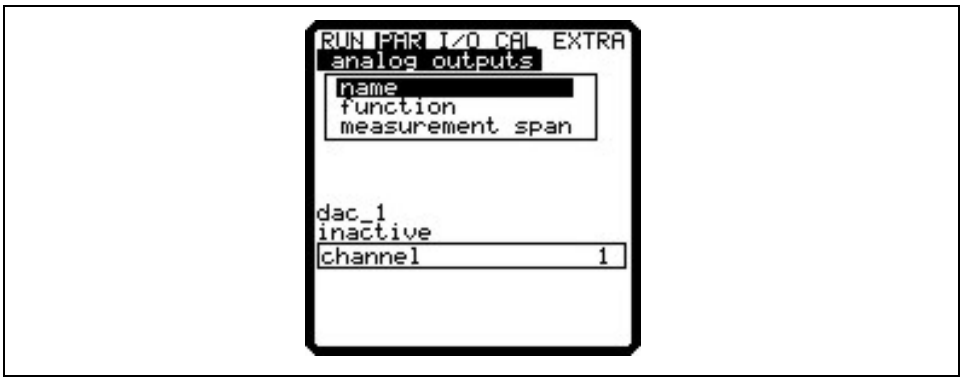


Fig. 8-36 Submenu analog outputs

The analog output is a 0 – 10 V voltage output.
Determine the functions of the analog output in this menu.

Name

Does not have to be entered. It is helpful to set a name if the analog output values are to be saved on memory card. This name will be saved on the storage medium. Set the name as described under PAR/Measurement place/Name of measurement place<.

Function

One of the following functions is going to be assigned to the analog output:

- disabled (no signals from analog output)
- output flow (will output an analog signal which is proportional to the calculated flow volume)
- output level (will output an analog signal which is proportional to the calculated fill level)
- velocity (will output an analog signal which is proportional to the average flow velocity calculated from single velocity readings)
- water temperature (will output the water temperature reading as analog signal)
- analog input 1 (will output the value from analog input 1 which might have been changed by a characteristic)

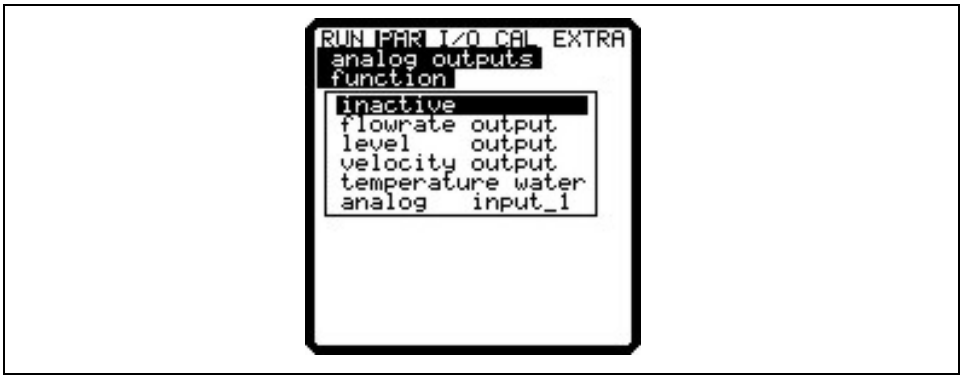


Fig. 8-37 Selecting analog output functions

Measurement Span

Define the values of the output signal here. Input in the units selected under menu "Extra“.
Negative values can be entered as well!

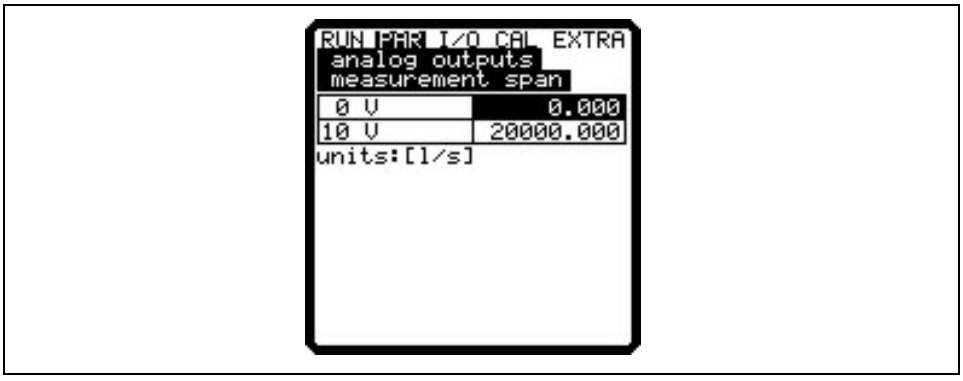


Fig. 8-38 Measurement span

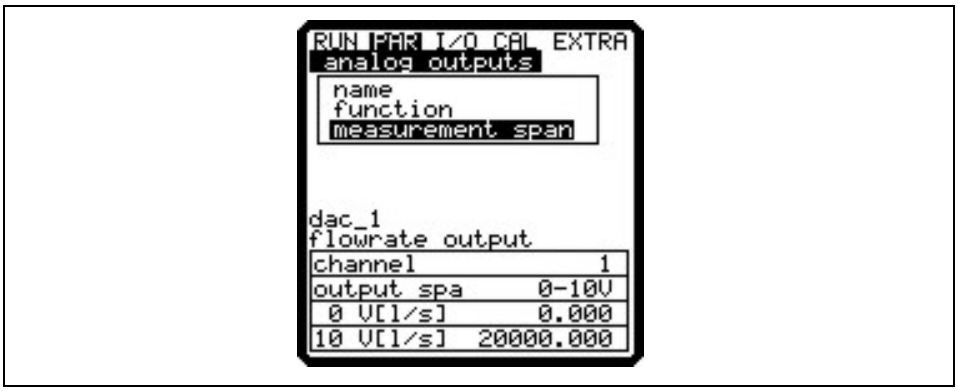


Fig. 8-39 Screen after settings have been made

Example:

A measurement place is partly tending to backwater formation and the negative value is to be detected as well. This case requires the output signal to be set "floating".
This means that flow = 0 will output a V signal in the middle of the measurement span.

Example:
0 V = -100 l/s
10 V = 100 l/s
In this case flow = 0 yields 5 V as output. Backwater will cause the analog signal to decrease, positive flow will cause it to increase.

8.5.7 Parameter Menu “Digital Outputs“

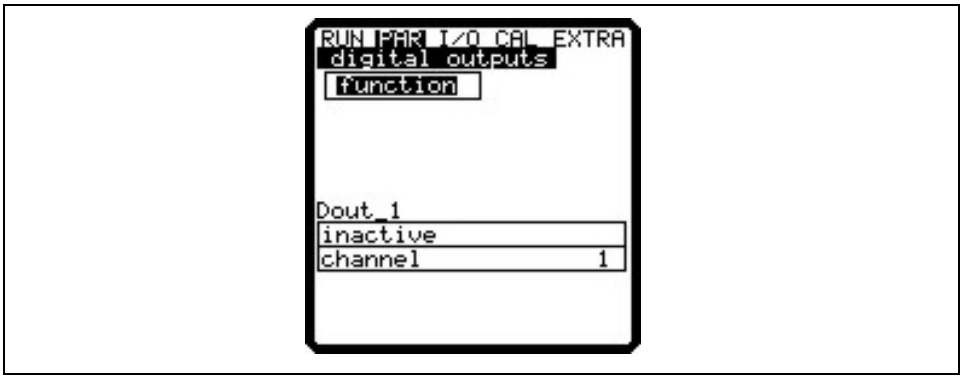


Fig. 8-40 Submenu digital outputs

This menu allows to define functions as well as accompanying parameters such as limit values, impulse duration and more of individual digital outputs.

Function

One of the following functions is going to be assigned to the relay which has been chosen by selecting the channel number:

- disabled
- limit contact flow (relay will energise if the value exceeds a certain flow threshold and will de-energise if the value falls below a second threshold).
- limit contact velocity (relay will energise if the value exceeds a certain velocity threshold and will de-energise if the value falls below a second threshold).
- limit contact level/height (relay will energise if the value exceeds a certain level threshold and will de-energise if the value falls below a second threshold).
- sampler

Name

This menu can be viewed only as soon as a function has been enabled. “Name” means the name of the relay output. It is not necessary however to input a name as it currently is for device-internal use only.
Set the name as described under >PAR/Measurement place/Name of measurement place<.

The PCM 4 operates in continuous operation mode if the function >Sampler< has been selected.

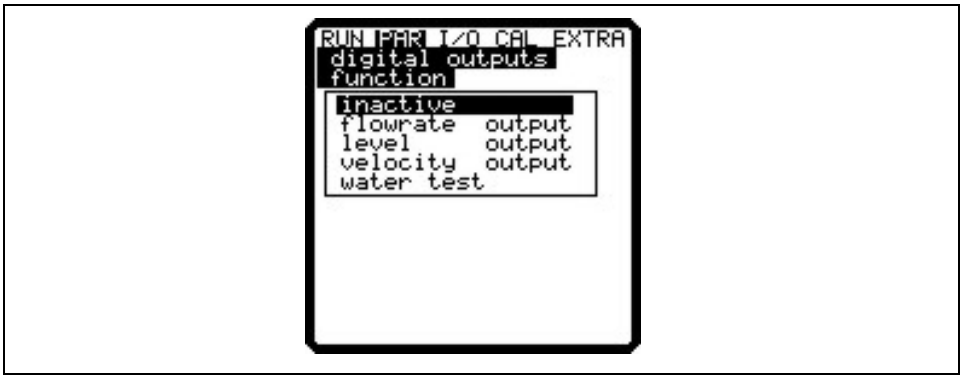


Fig. 8-41 Defining functions

Logic

Select between >normally open< and >normally closed< by using the >ALT< key.
Choosing >normally open< will cause the relay to energise as soon as the threshold set has been reached, choosing >normally closed< will cause the relay to energise immediately after the parameters have been set and to de-energise as soon as the according threshold has bee reached.

Trigger level

This menu can be viewed only as soon as the function >Limit contact< has been enabled.

Fig. 8-42 Threshold settings

The switching behaviour depends if the switch-on point is set higher or lower than the switch-off point: threshold behaviour (ON>OFF) or as in-bounds alarm (ON<OFF).

Water test

This menu can be viewed only as soon as the function >Sampling< has been enabled.

Fig. 8-43 Sampling settings

On time
Set impulse duration here. Adjust the setting depending on the sampler used.

Amount
The contact will close for the duration set as soon as this volume has been reached.

Level
This parameter is for sampler safety. The contact will be closed only if the fill level set has been exceeded. This helps to prevent the sampler from ingesting air.

8.5.8 Parameter Menu “Setup Parameter“

Fig. 8-44 Submenu settings

This menu allows to modify or to restore the basic system settings described below.

Load factory setup Enables to execute a general reset. The following screen appears:

Fig. 8-45 Executing a general reset

Selecting “YES“ will reset the system to the default parameter settings. The default parameters will be loaded and all customer settings will be reset (general reset of system).

In order to avoid faulty programming it is required to execute a general system reset prior to each initial start-up.

Authority check Additional system setting options are going to be revealed as soon as a special code has been entered. It is possible to modify e.g. beam angle or medium sound velocity, transmit voltages or special adjustments regarding the transmitter crystal drive. These settings are reserved to used by the NIVUS initial start-up service as these modifications require comprehensive expert knowledge and do not need to be adjusted during standard use.

Damping This menu enables to adjust the display and analog output damping between 20 and 600 seconds.

Example 1:

damping 30 seconds, jump from 0l/s to 100l/s (=100%) – the unit requires 30 seconds to run from 0l/s to 100l/s.

Example 2:

damping 30 seconds, jump from 80l/s to 100l/s (=20%) – the unit requires 6 seconds to run from 80l/s to 100l/s.

Constancy

This parameter is going to „stabilise“ the readings for the time set in case of measurement dropouts which might be caused by e.g. hydraulic interferences.

Damping and stability will take no longer effect as soon as the unit is going to switch over to active memory mode. Due to the short measurement duration in this mode the unit will use the internally stored damping and stability period of 0 seconds.

8.5.9 Parameter Menu "Storage Mode“

The PCM 4 allows to save recorded data regarding flow velocity, level, temperature, analog and digital inputs and flow volume on compact flash card. You can use NIVUS compact flash cards with capacities from 4 to 128 MB. These cards can be purchased from your NIVUS representative if required.

Use memory cards purchased from NIVUS only. Other manufacturer’s cards may lead to irreversible loss of data or measurement failure (e.g. permanent transmitter reset).

NIVUS is not going to assume any liability due to data loss resulting from the use of third party memory cards.

The enabled memory mode will be indicated by an icon in RUN menu (see also chapter 7.3.).

The PCM 4 will fall to energy-saving standby mode three minutes after the last key action, i.e. the unit is only going to turn on following the intervals set. The PCM 4 display is disabled when in memory mode (see also chapter 7.5.1).

Fig. 8-46 Memory card slot

Due to the card's technically restricted number of storage cycles (approx. 100.000 writing events), the PCM 4 does not constantly save upcoming data on card. First of all the measurement data are saved in an internal memory. Then the readings are going to be transmitted to memory card once per hour. Activating the PCM 4 by pressing any key (or by pressing the >ALT< key if the unit is active) will immediately execute data transmission to memory card which will be indicated on the display by the message „*Memory card busy*“. The interval is pre-set by the internal system time.

Transmit data to compact flash card prior to card replacement as described above to make sure all data being saved on memory card.

Data sets are going to be saved in ASCII format creating a file with the name of the respective measurement place set. The suffix is >.txt<.

The data sets can be read and edited using common software with ASCII interface such as EXCEL.

Never format memory cards on PC but always on PCM 4. The PCM 4 is not capable of using formats created by PC and therefore does not accept cards formatted on PC.

Data will always be saved as current values at the moment of saving.

Fig. 8-47 Selecting memory options

Operation Mode

ALT Use this key to toggle between following modes:

disabled	= no data saving
periodic	= periodic saving of fill level, flow velocity, temperature and volume
Event	= The PCM 4 is able to toggle between two saving cycles. Switchover will be carried out as soon as a level-dependent threshold has been exceeded or by receiving a respective impulse from the digital input.

Source

Level	This setting will force the sensor-integrated electronics to retrieve fill level data every 5 seconds. The PCM 4 will be activated immediately in case of exceeding the threshold, switching over to event mode.
Digital I1	The PCM 4 is permanently monitoring the digital input. The unit will switch over to event mode immediately as soon as the digital input is going to be enabled.

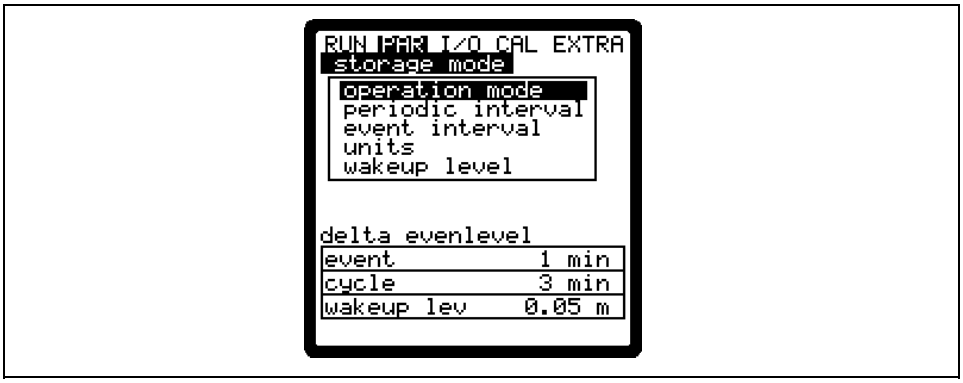


Fig. 8-48 Memory mode screen

Periodic Interval

This parameter is to define the saving interval. Set a value between 1 and 60 minutes.
There are only exact fractional amounts of 1 hour allowed to be set (1 min.; 2 min.; 3 min.; 4 min.; 5 min.; 6 min.; 10 min.; 15 min.; 20 min.; 30 min. or 60 min.).

Event interval

This parameter is active if the event mode has been enabled and is to define the saving cycle in case of events occurring. It is possible to set values between 1 minute and 1 hour. There are only exact fractional amounts of 1 hour allowed to be set (1 min.; 2 min.; 3 min.; 4 min.; 5 min.; 6 min.; 10 min.; 15 min.; 20 min.; 30 min. or 60 min.).

Fig. 8-49 Setting the saving cycle

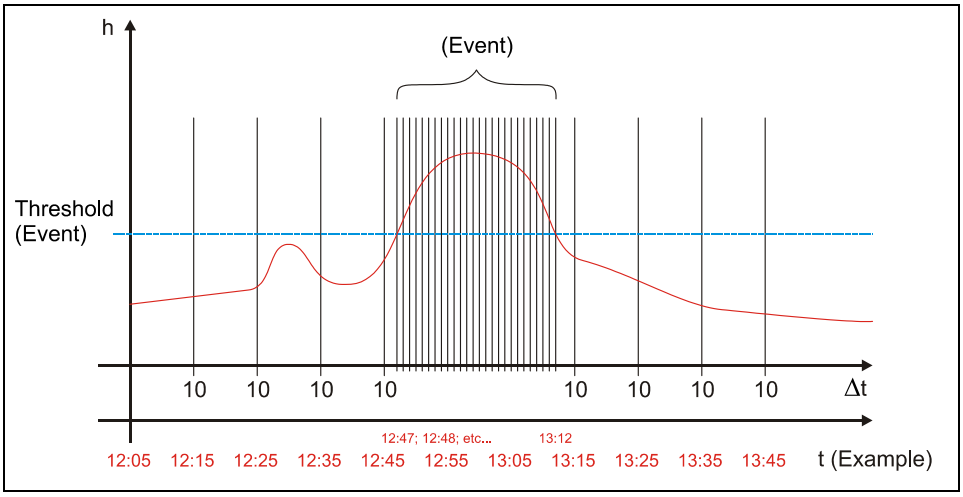


Fig. 8-50 Event parameter setting example

Units

Define which units are to be used to save the 3 main parameters flow, level and velocity. Select from metric (e.g. litres, cubic metres, cm/s and more), english (ft, in, gal/s, and more.) or american system (fps, mgd and more). After your selection has been confirmed the display will jump to the next screen automatically.
When it comes to be saved on memory card, it is possible to define a unit for each of the measured and calculated flow, velocity and fill level readings. These settings do not have an effect on the display. There are various units available depending on the selection made previously.

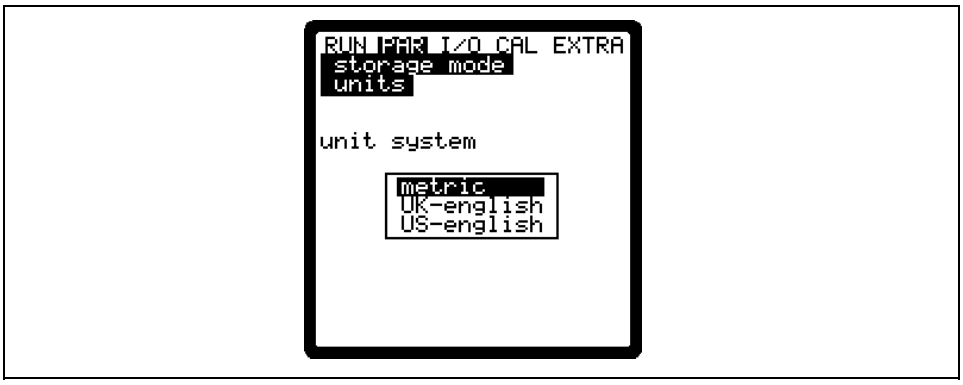


Fig. 8-51 selecting the unit system

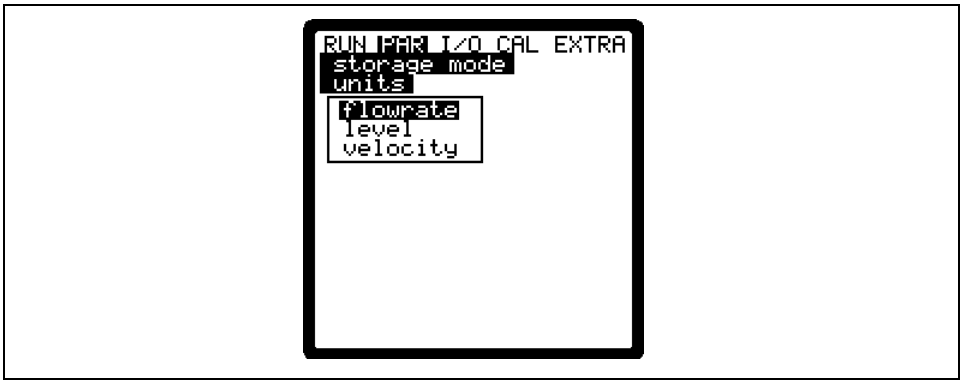


Fig. 8-52 Selecting the measurement value

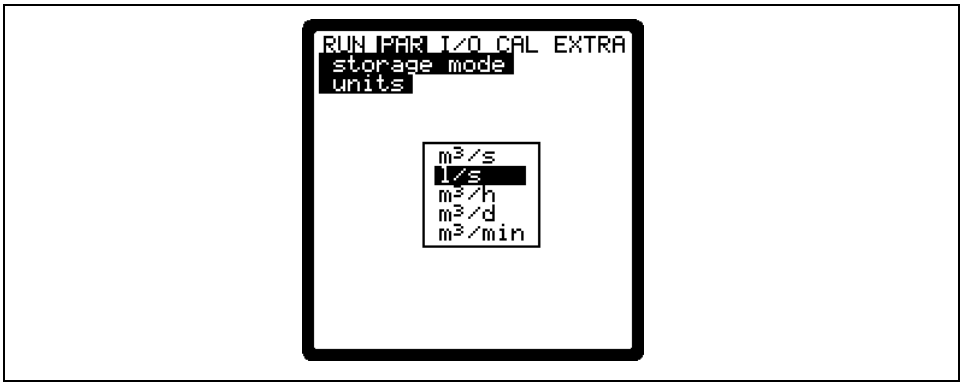


Fig. 8-53 Selecting the units

Wakeup level

This menu is to define the fill level which is used to switch over from periodic interval to event interval.

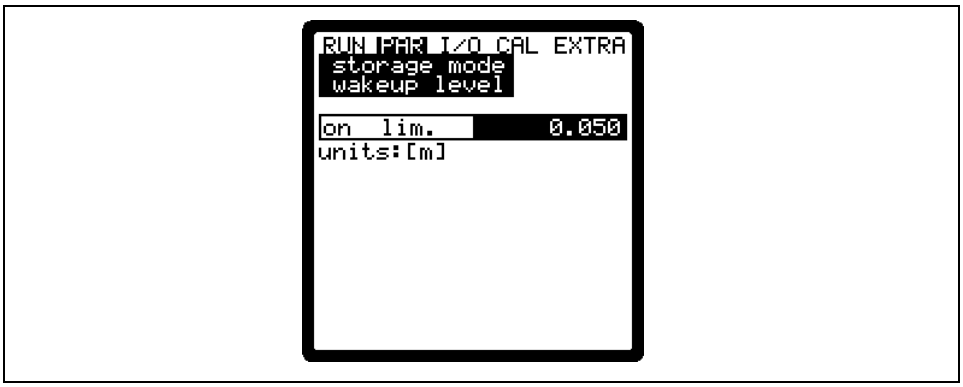


Fig. 8-54 Threshold screen

Format of numbers Choose between commas or dots to be used as decimal points.

8.5.9.1 Data Structure on Memory Card

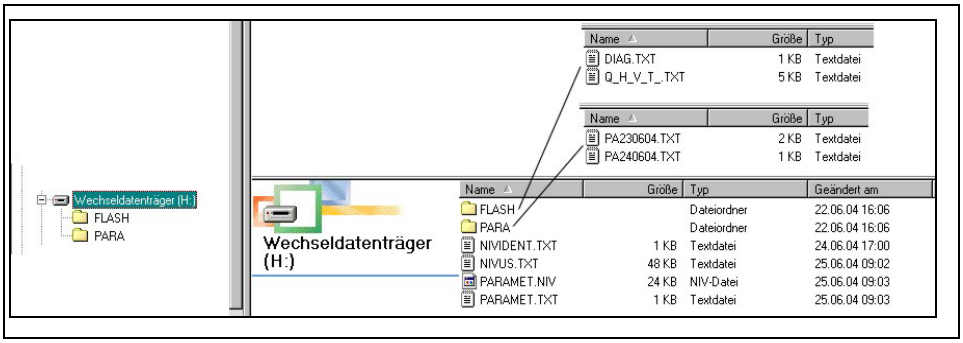


Fig. 8-55 Data structure on memory card

Flash This is the folder where the backup file is being saved (to execute select I/0 – Memory Card – Save backup).
The name of the saved file is always >Q_H_V_T.TXT<. It contains the internal memory values on level, velocity, flow and temperature.
The file >DIAG.TXT< contains all messages including error messages which might have been occurred during measurement operation. These might be start and end of Internet communication, modem restart, CPU restart after system reset or after reprogramming.
The respective message is labelled with date and time:
>: received error/message
<: reason of error/message cleared

PARA This folder includes all parameter files with a date stamp.
The content of this folder allows to retrace transmitter settings regarding the measurement place as well as parameter settings which might have been modified.
The latest modification within the course of a day will be saved.
The file name is: PA TT MM JJ .TXT
(TT = day, MM = month; JJ = year)

NIVIDENT The name of the measurement place.
If the name of the measurement place saved on card does not comply with the name of the measurement place saved in the PCM 4, the unit will prompt to format the card. The PCM 4 will not save any data as long as the card has not been formatted.

Name of Measurement Place.TXT	This is the file where the measurement values are saved. It is going to be saved using the name of the measurement place set.
PARAMET.NIV **PARAMET.TXT**	These files are created as soon as parameters are being saved on the memory card. The file PARAMET.NIV is required in order to upload data to the PCM 4. PARAMET.TXT is the print version of PARAMET.NIV as text file (only parameters modified before are going to be exported).

8.6 Signal Input / Output Menu (I/O)

This menu includes several submenus which both serve to assess and to check sensors as well as to control signal inputs and outputs. It allows to indicate various values (current values of inputs and outputs, relay conditions, echo profiles, individual velocities etc.), however does not enable to influence signals or conditions (offset, adjustment, simulation or similar). The menu therefore primarily serves in order to assess the parameter settings and for error diagnosis.

Fig. 8-56 I/O submenu

8.6.1 I/O Menu "Analog Inputs”

Analog input values routed to the transmitter input clamps can be controlled and checked here.

A 1 [mA]	Input signal from external level sensor via connection socket 1.
A 2 [mA]	Indicates the current power consumption of transmitter and connected sensors.
A 3 [V]	Current battery voltage.
A 4 [mA]	Indicates the input current for the mA input via the multifunctional socket or the Connector-Box.

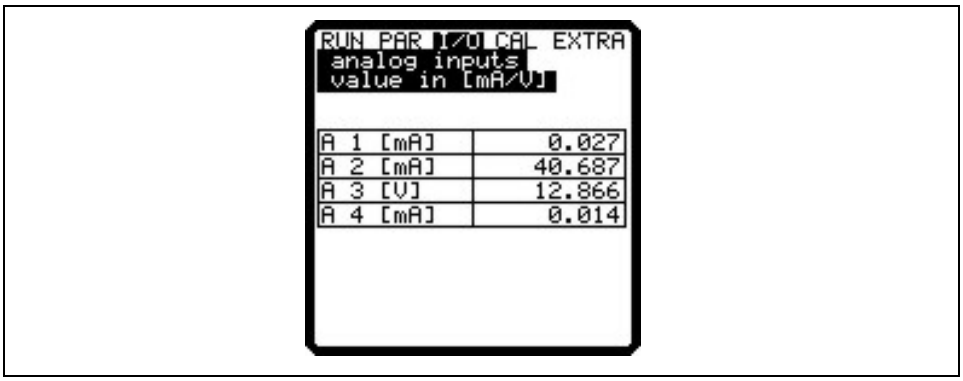


Fig. 8-57 mA Inputs

8.6.2 I/O Menu "Digital Inputs”

Digital input values routed to the transmitter input clamps can be viewed here. Reading is either logically "OFF“ or "ON“.

Fig. 8-58 Screen digital values

8.6.3 I/O Menu "Analog Outputs”

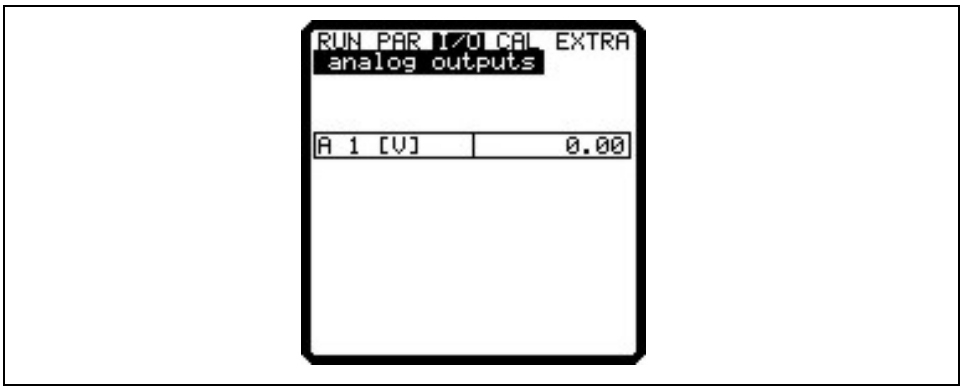


Fig. 8-59 Screen analog values

This menu is to indicate the calculated value which is to be sent to the analog converter.

8.6.4 I/O Menu "Digital Outputs”

Conditions which are calculated by the transmitter and routed to the relay for output purposes subsequently can be viewed here. Reading is either logically "OFF“ or "ON“.

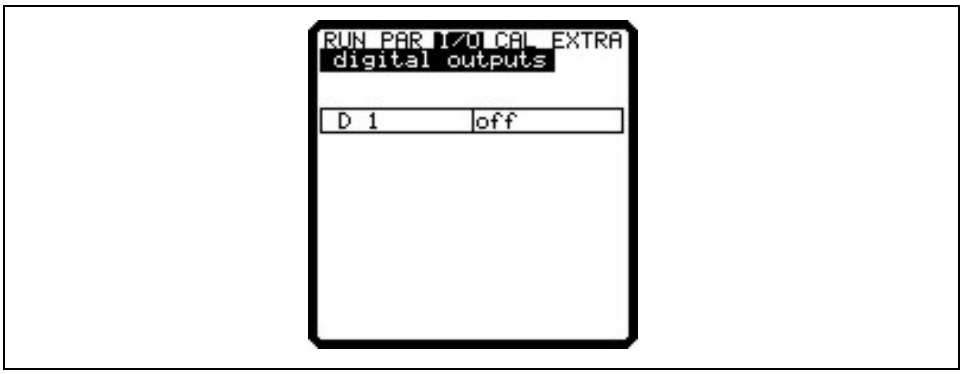


Fig. 8-60 Digital values

8.6.5 I/O Menu "Sensors”

This menu including the respective submenus allow to view and to asses the most important sensor conditions. It hence provides information on the quality of the measurement place, echo signal quality and many more parameters.

Fig. 8-61 I/O submenu, v-sensor

V Sensor

Choosing this point is going to bring up a 2-page table including all individual velocities measured and the heights of the respective measurement windows.

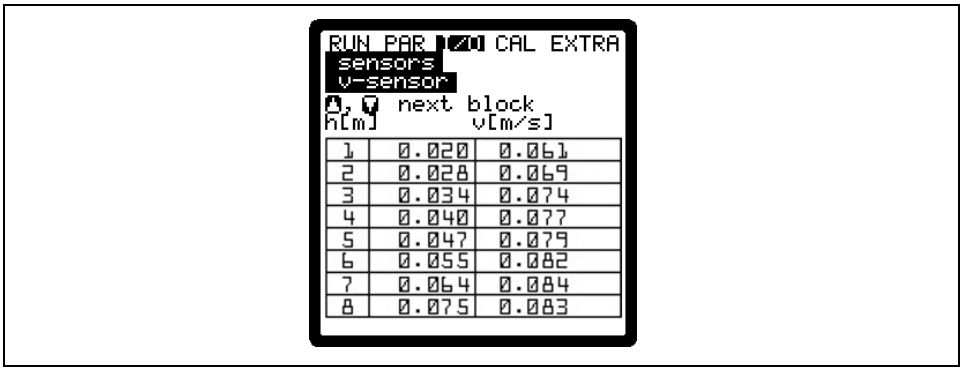


Fig. 8-62 Measured individual velocities

▲ + ▼ Toggle between both pages (measurement windows 1-8 and 9-16) by using the up and down keys

A reading of ------ in a measurement window indicates that there is currently no flow velocity able to be measured in the according window. This might happen due to very clean water or vorticity within this area. This effect might occur as well in case of low flow levels as from approx 35 cm (13.78 in), however is caused due to the PCM 4 automatically reducing the number of measurement windows here. It does not affect the measurement result if single or few windows might fail.

H Sensor(s)

Indicates the measured fill levels.

There are varying menus depending on the sensor version (level measurement using water-ultrasonic, pressure, air-ultrasonic or external sensor) used:

Example 1:

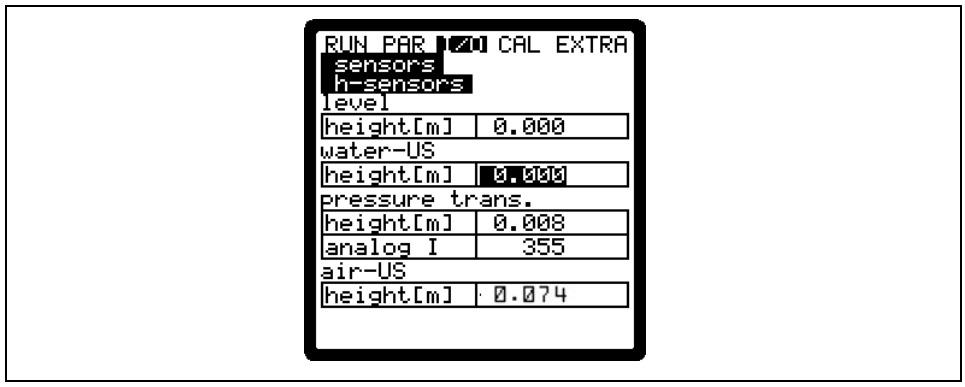


Fig. 8-63 Menu with water-ultrasonic, pressure and air-ultrasonic

Example 2:

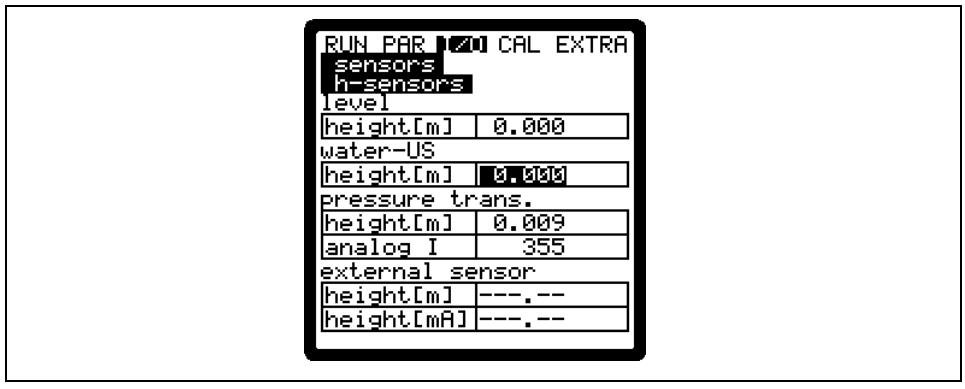


Fig. 8-64 Menu with water-ultrasonic, pressure and external sensor

The sensor types are going to be displayed accordingly if only 1 or 2 types have been selected.

H Echo Profile

Enabled only in case of level water ultrasonic measurement from bottom up and air-ultrasonic measurement from top down.

Fig. 8-65 Selecting level measurement echo profile

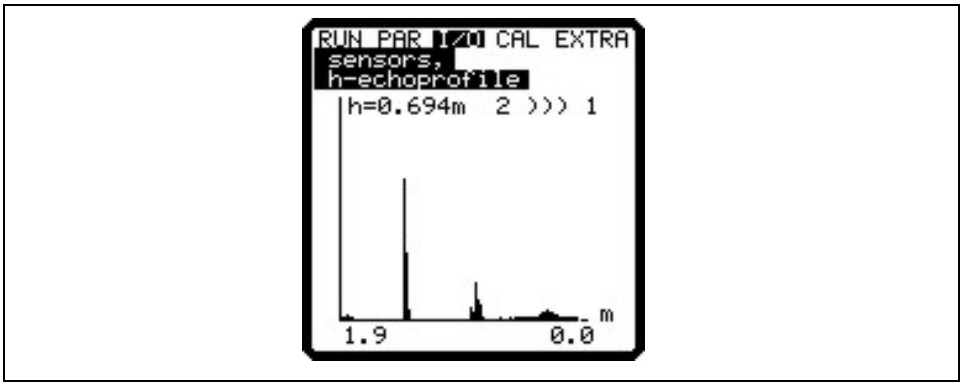


Fig. 8-66 Screen level measurement echo profile

This graph enables the service personnel to assess the echo signal in the measured acoustic path. Ideally the first peak (reflections from the interface between water and air) is very narrow, steep und high, all further peaks (double and multiple reflections caused by the echo signal moving back and forth between the interfaces water/air and water/ground) are lower and wider.

T Sensor

This screen allows to view the measured water and air temperature (only possible in case of using external air-ultrasonic sensor driven by PCM 4). Invalid values indicate cable break, short circuits or incorrectly clamped connections.

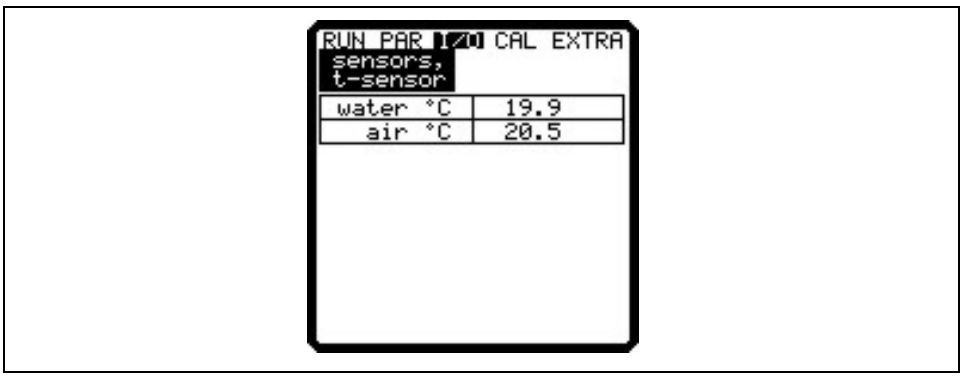


Fig. 8-67 Temperature screen

8.6.6 I/O-Menü „Memory Card”

This menu allows to recall information on the memory card.

Fig. 8-68 Memory card options

Fig. 8-69 Card info menu

Information can be recalled only if the memory card is plugged. To be able to indicate the remaining capacity time the card must be plugged into the PCM 4 one hour at least.
You can use the >Memory Card< menu to execute card formatting as well.

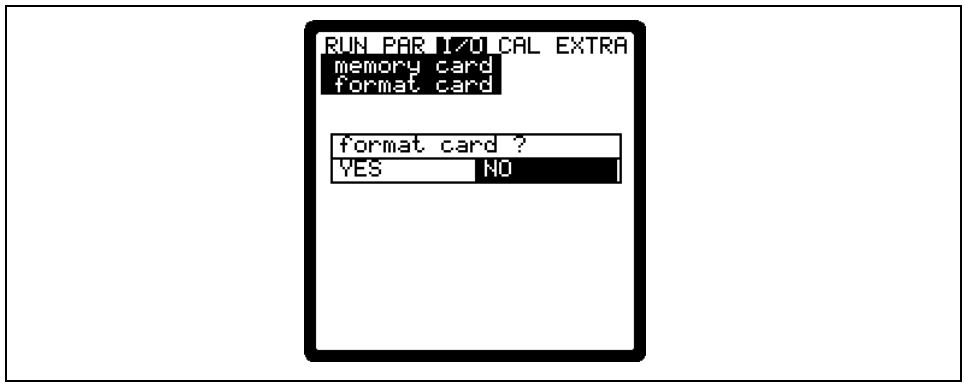


Fig. 8-70 Format card

Use memory cards purchased from NIVUS only. Other manufacturer's cards may lead to irreversible loss of data or measurement failure (e.g. permanent transmitter reset).
Never format memory cards on PC but always on PCM 4. The PCM 4 is not capable of using formats created by PC and therefore does not accept cards formatted on PC.

Formatting the card will erase all data saved on the card.
The card can be replaced at any time by pressing the >ALT< key. This action is going to transmit all data from the internal memory to the memory card. The message >Memory card busy< appears.

Do not replace the card as long as the message >Memory card busy< is indicated on the display.

Furthermore it is possible to read out settings from or to save settings to the PCM 4.
Parameters set will be written to memory card by using the menu point "Save parameters". This will take approximately 30 seconds. The progress is going to be indicated by a progress bar moving from left to right. After transmission has been finished successfully the display will indicate >OK< and jump back to the memory card menu subsequently.

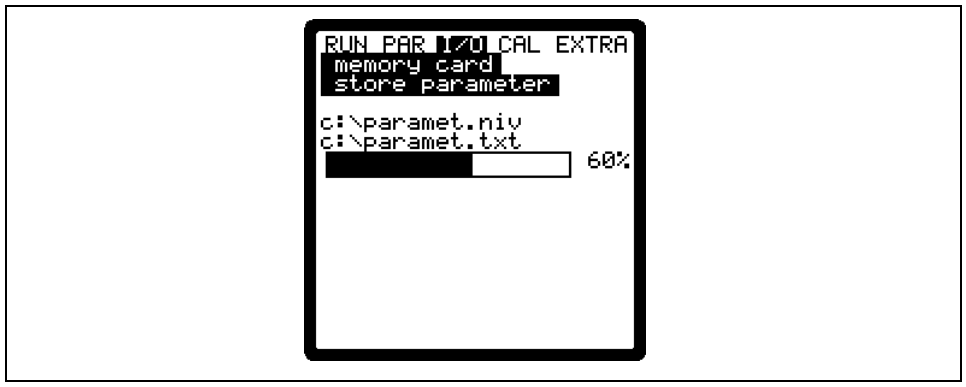


Fig. 8-71 Saving parameters on memory card

The menu point „Load parameters" first of all will show all program files saved on memory card. The file will be transferred to the PCM 4 after choosing.
The name of the file required to program the PCM 4 by memory card is „PARAMET.NIV".

Fig. 8-72 Loading parameters from memory card

The PCM 4 has an additional internal memory which can be saved on memory card as well (save backup). This circular buffer has a capacity of approx. 20.000 measurement values which allows to record the parameters >Level, velocity, flow and temperature< for a period of 14 days.
In order to indicate trends in RUN menu, data from the internal memory is going to be used furthermore.

Executing a system reset will erase all data from the internal memory.

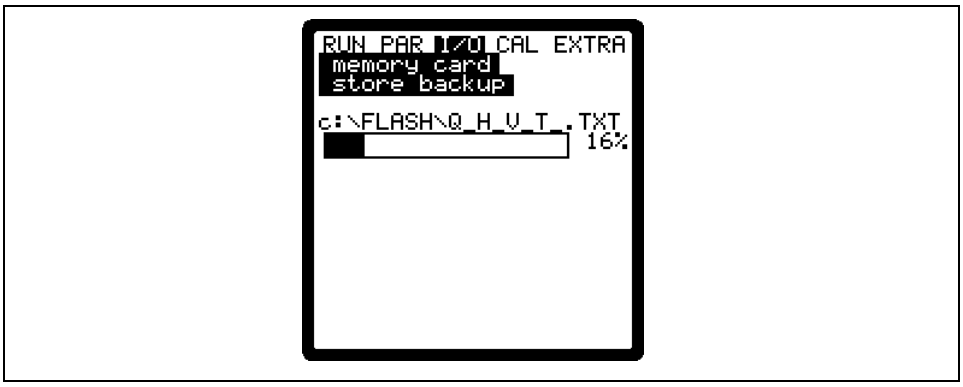


Fig. 8-73 Save backup

8.6.7 /O Menu “System”

This menu allows to recall information on the battery. It also serves to recalculate the capacity of the rechargeable battery after it has been replaced.

Fig. 8-74 System menu

Confirming this message with >YES< will reset the capacity to 100% and the PCM 4 is going to recalculate the battery lifetime.

The indicated lifetime bargraph with % indication is the result of a calculation assuming the maximum capacity and the power consumption. To achieve accurate results please observe to always use a completely charged battery. This reading shall be considered as a typical value due to the system-inherent lifetime of rechargeable batteries.
In order to avoid total discharge and data loss replace the rechargeable battery if the voltage drops below 11 V during standard operation.

Confirmation with >NO< will retain the current values which is useful to recall information on the remaining battery lifetime.

Always confirm with >YES< after replacing the rechargeable battery by a new one.

Fig. 8-75 Battery lifetime screen

Data and Time	current date and time.
Operating Hours	number of PCM 4 operating (measuring) hours. Does not count standby periods.
Consumption [Ah]	power consumption during operating hours in Ah.
Digital I1	condition of digital input.
Power Consumption	current power consumption and current battery voltage. Due to battery protection purposes sensors will be switched off if voltage reaches 11.0 V (error message: error sensor 1).
Capacity	maximum capacity of rechargeable battery. Enter this value under >PAR-Settings-Battery<. Percentage provides insight into remaining battery lifetime.

8.7 Calibration and Calculation Menu (CAL)

Adapt analog outputs to the following system in this menu by emulating relay switching events and analog outputs.
Additionally it is possible to calibrate the fill level sensors by using a reference value.

Fig. 8-76 Selection menu

8.7.1 Cal Menu “Level“

This submenu enables to calibrate the level sensors used e.g. in order to compensate a level offset due to constructional conditions.
Calibration is carried out by entering a reference value. This reference value has been determined by an independent measurement such as by using a precision ruler.

All active sensors are going to be adjusted to this reference value.

The following screen will come up after the calibration prompt has been confirmed:

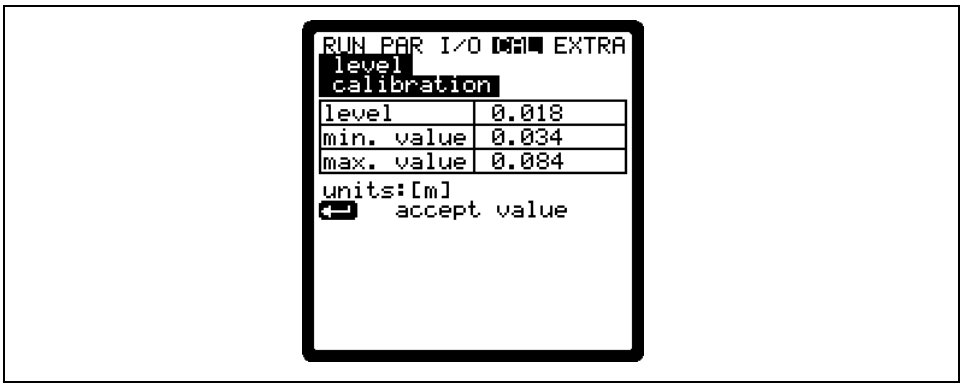


Fig. 8-77 Level screen

The currently enabled fill level sensor as well as its fluctuation range including min. and max. values will be displayed. This allows to draw conclusions on the prevailing flow level conditions (e.g. waviness of surface).
Best results can be achieved at low fluctuation range. Accepting the current level reading by pressing the ↵ key requires to investigate an accompanying reference value. Input this value in the screen below.

Fig. 8-78 Entering the reference value

Confirmation with ↵ is going to bring up an overview screen displaying all active level sensors. This overview is a comparison between the previous (current) and the new (new) offset.
The PCM 4 will output an error message if the deviation between both values is too high. The adjustment will not be accepted.
In this case repeat the adjustment procedure and if required check the conditions of installation.

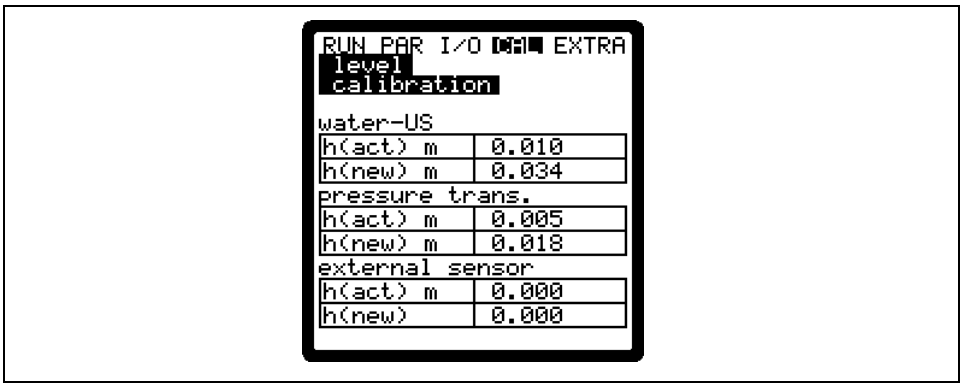


Fig. 8-79 Adjustment screen

Executing an adjustment will adapt the installation height of the single sensors in PAR / Level menu accordingly. Hence it is required to confirm the prompt >Save values?< with >YES< before leaving the menu. This action will cause the adjustment values to be accepted.
Entering >NO< will abort the adjustment procedure.

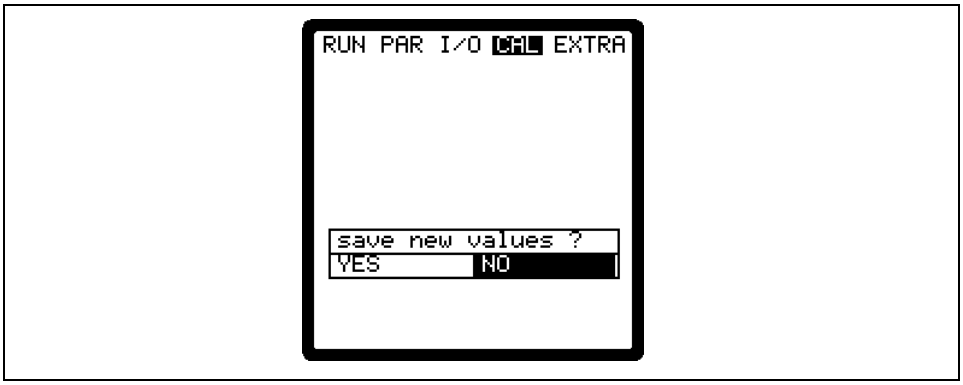


Fig. 8-80 Saving values

8.7.2 Cal Menu "Velocity“

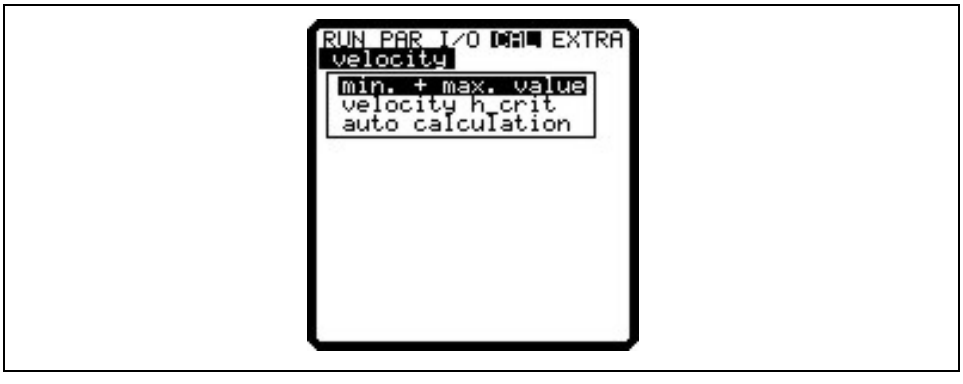


Fig. 8-81 Flow velocity screen

min. + max. Value Defines the flow velocity measurement range.

Velocity h_crit

This parameter includes required data to calculate a Q/h relation below the level h_crit. The level h_crit is pre-determined by the construction of the sensor as well as the measurement method and is set to 0.065 m (2.56 in) per default. This table either indicates the latest associated values which have been determined immediately before h_crit has been reached (measured level and associated velocity) or according values are going to be set here.
At the subsequent measuring event the values set are either going to be verified or corrected if required (automatic YES) or otherwise these values are going to be used permanently (automatic NO) depending on the setting chosen in the following menu.

Fig. 8-82 Table of values for automatic Q/h relation

Auto Calculation

The auto calculation described above can be either enabled or disabled by pressing >ALT<.
If enabled please observe that the system shall be free of backwater at lowest fill levels (risk of backwater formation = no measuring in gravity line required).

Basic Hints on Simulation:

*The simulation of PCM 4 outputs will access any following facility areas **without any safety locking measures**!*

This is the reason why it is required to input the code before accessing these parameters.

*The simulation of analog inputs and outputs is allowed to be carried out by specialist electricians only which have sound knowledge on the control system of the facility. This requires detailed preparation. **It is absolutely necessary to have a safety person available!***

NIVUS herewith refuse in advance to be responsible for any possible damage to persons or objects at any extent due to the extremely high risk of danger and unforeseeable consequences in case of incorrect or faulty simulation!

Analog Outputs

This parameter allows to simulate the PCM 4 output signals.

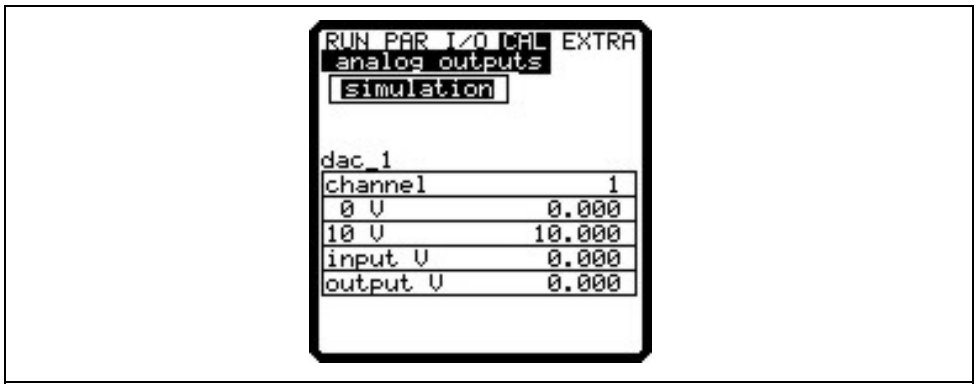


Fig. 8-83 Overview

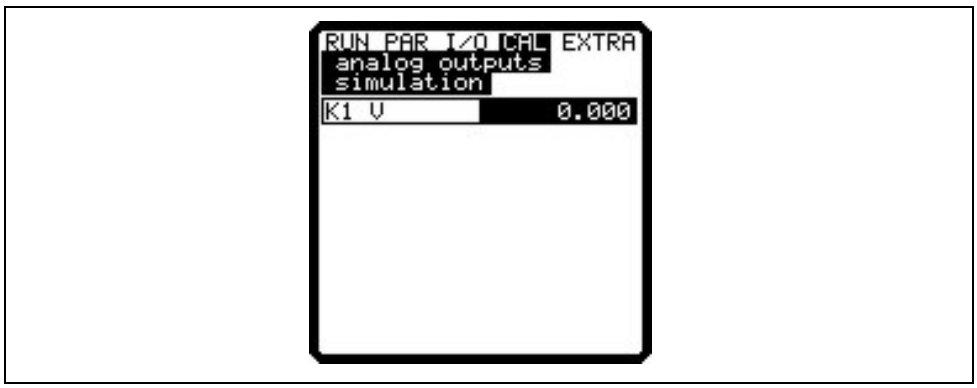


Fig. 8-84 Entering the output value

Simulation

Enter the desired value in Volt and confirm with Enter in order to directly output it on the according clamp.

Digital Outputs

The arrow keys >up< or >down< will either directly enable or disable the relay.

Fig. 8-85 Relay simulation

Simulation

This function allows to simulate a theoretical flow by entering supposed level and velocity values without having these values actually available. The PCM 4 is going to calculate the current flow value by using the simulated values based on the channel dimensions set. The results are going to be sent to the respective outputs (analog + digital)
Simulate the desired flow velocity by pressing the >left< or >right< arrow keys. Using the >up< or >down< keys will simulate the desired flow level.
Both values simulated are going to be indicated in the table. The calculated flow value can be seen above the table.

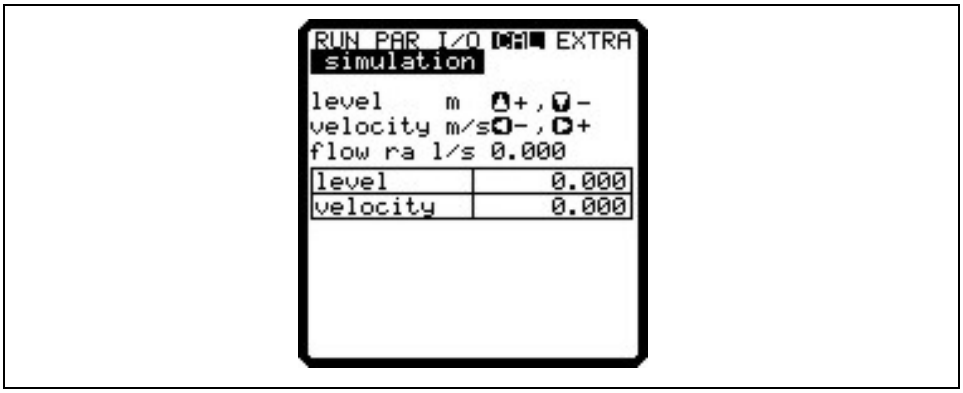
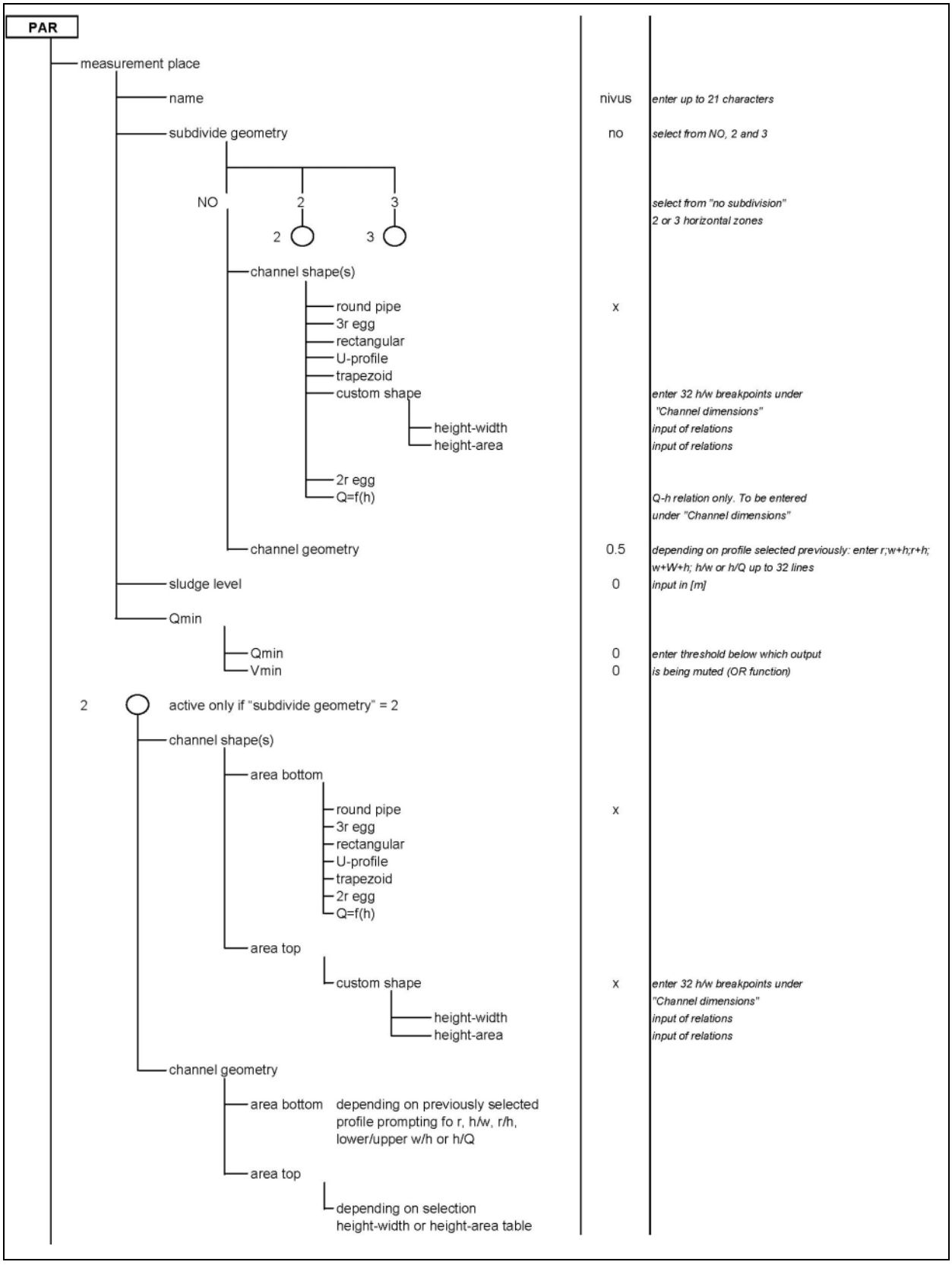


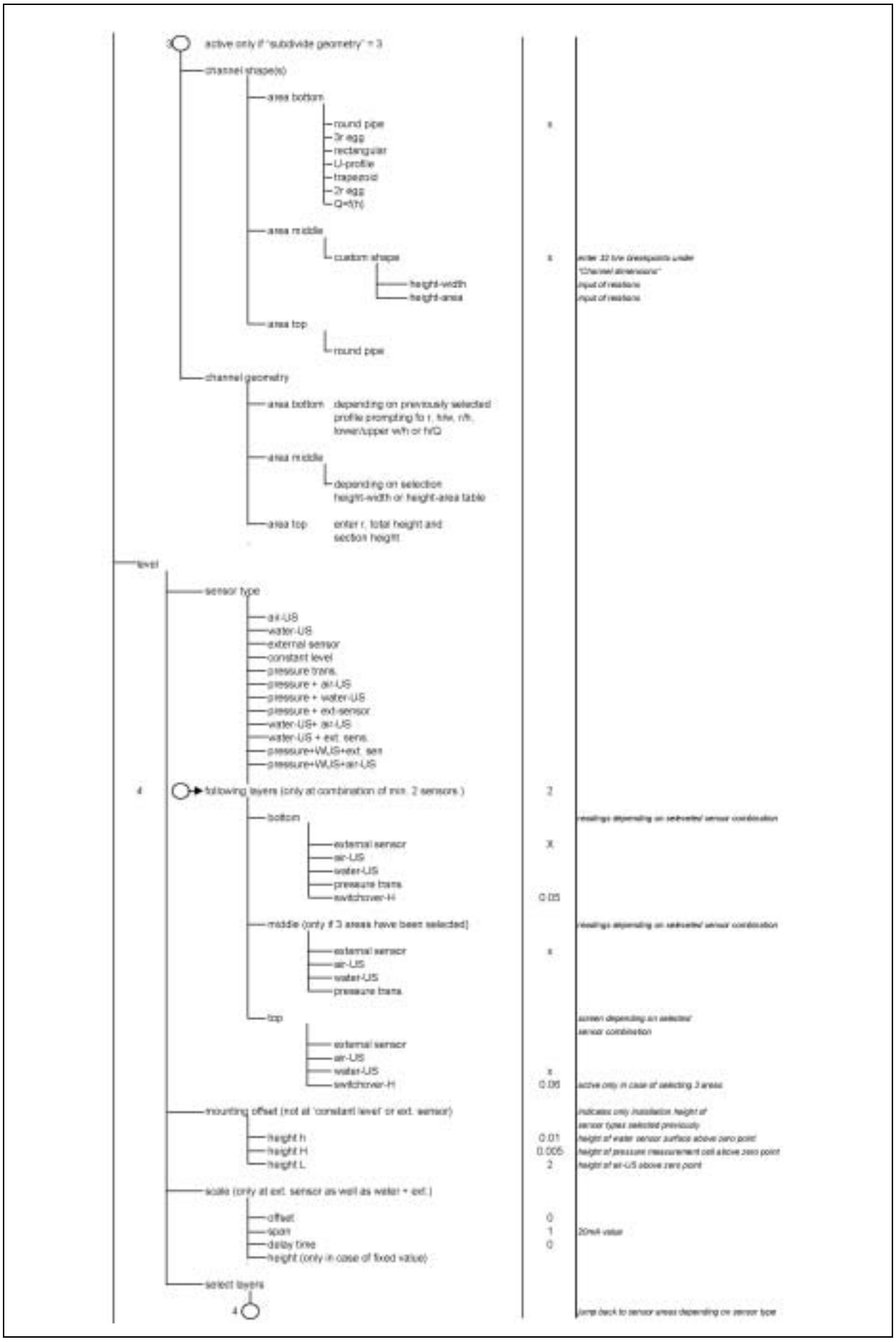
Fig. 8-86 Flow measurement simulation

9 Parameter Tree

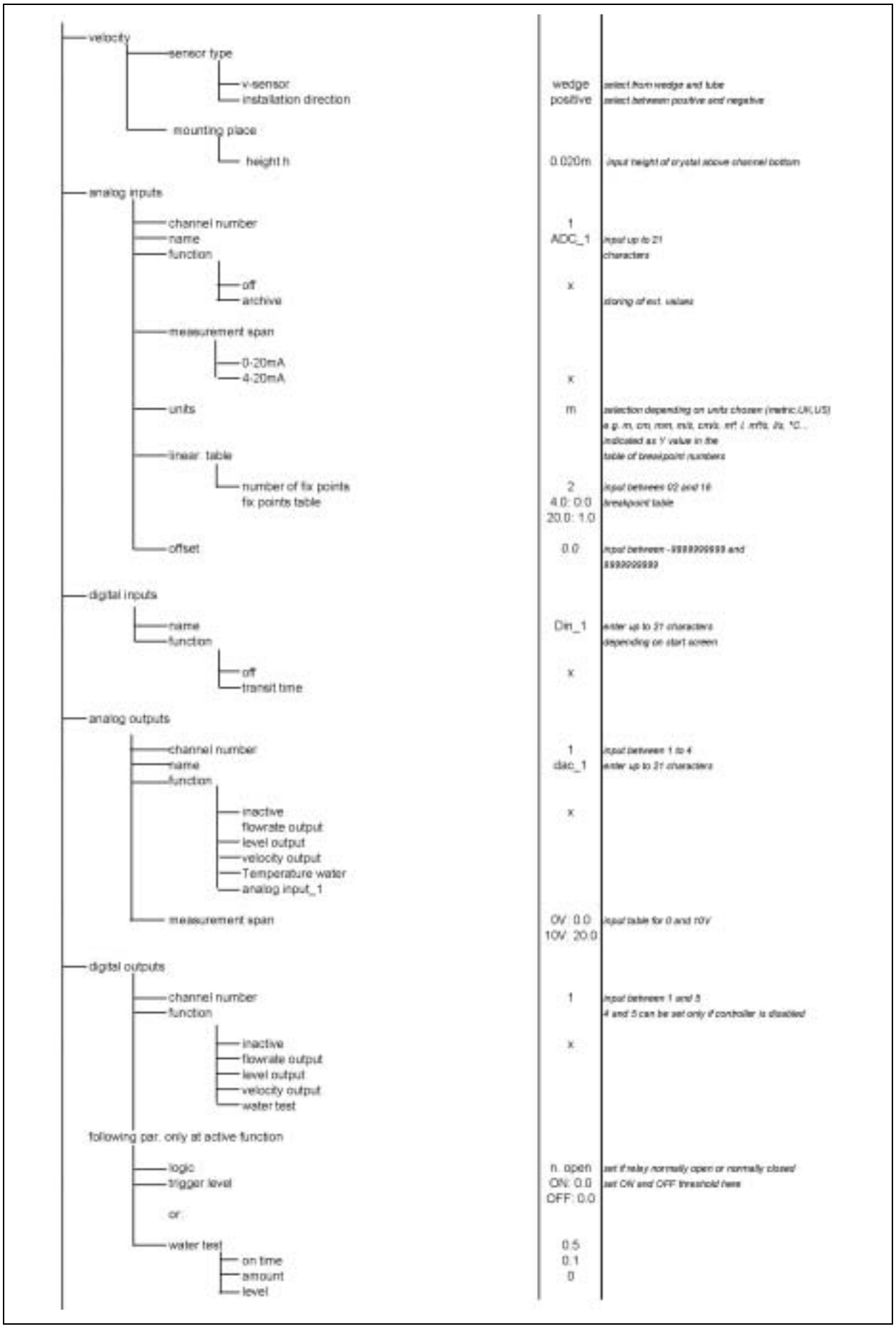
Parameter Menu (PAR) Part 1



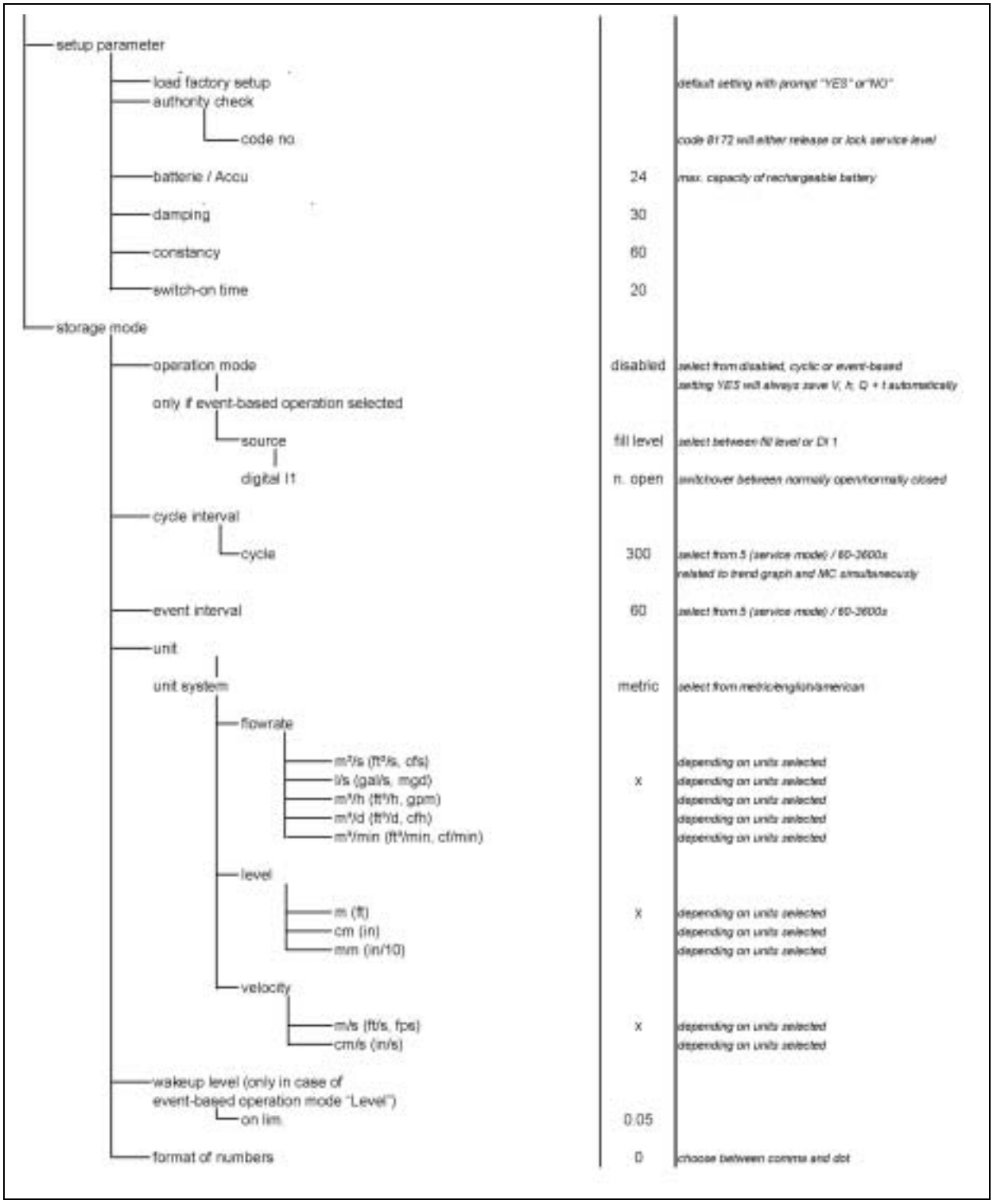
Parameter Menu (PAR) Part 2



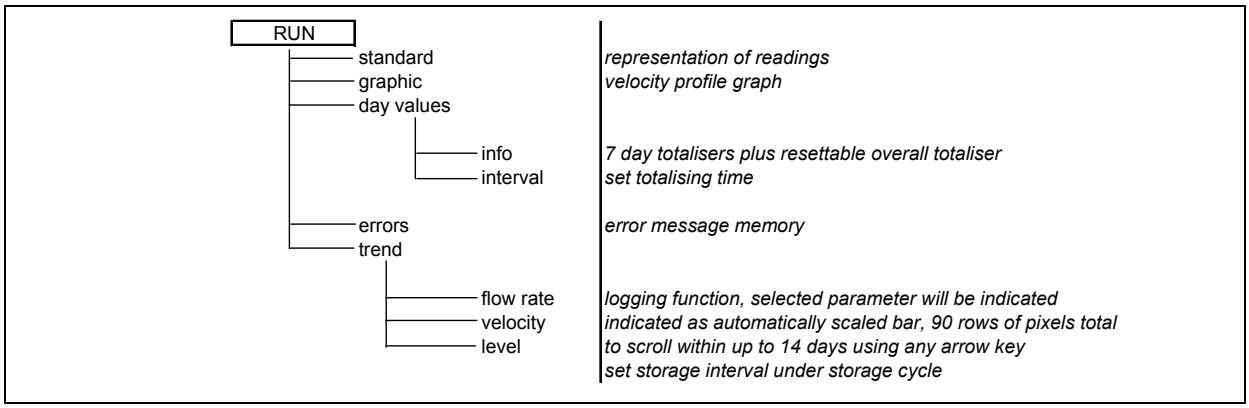
Parameter Menu (PAR) Part 3



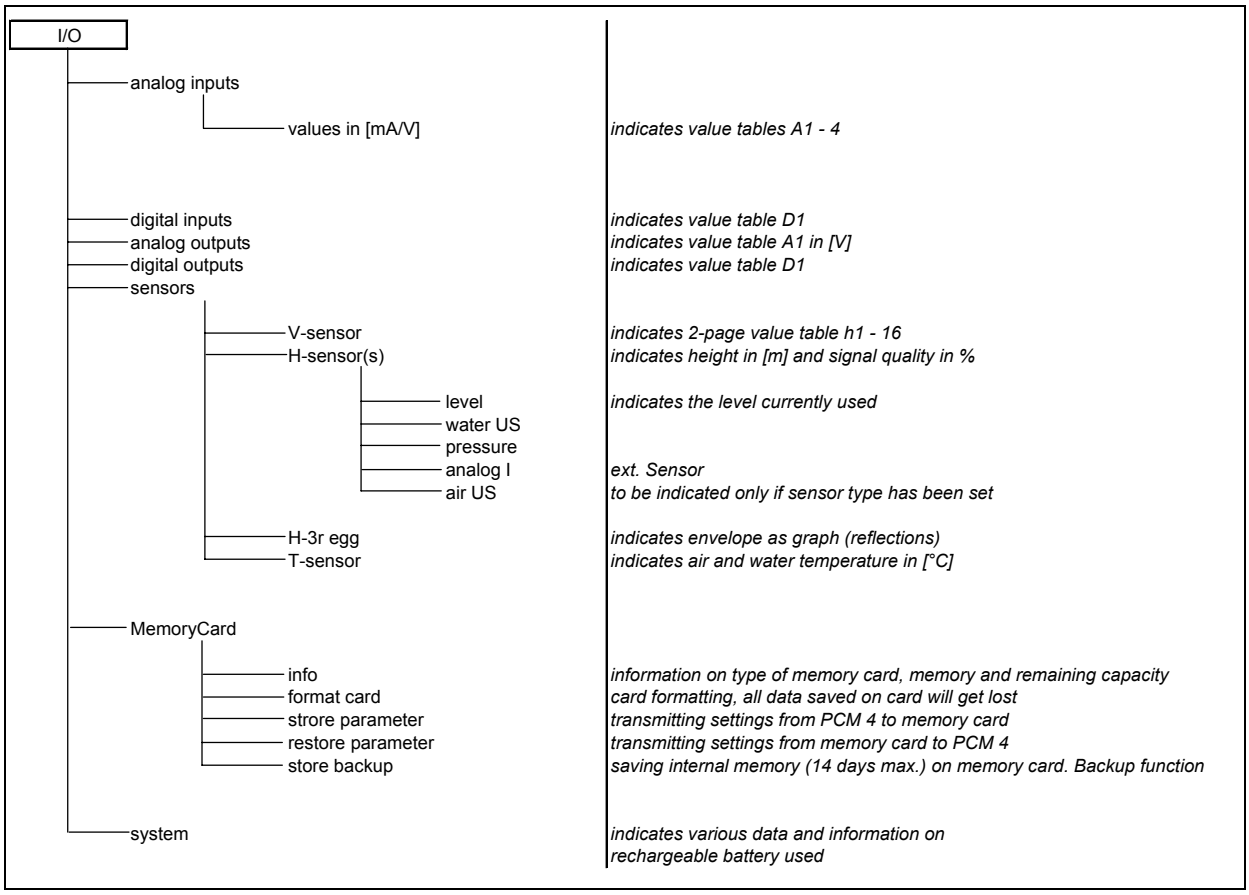
Parameter Menu (PAR) Part 4



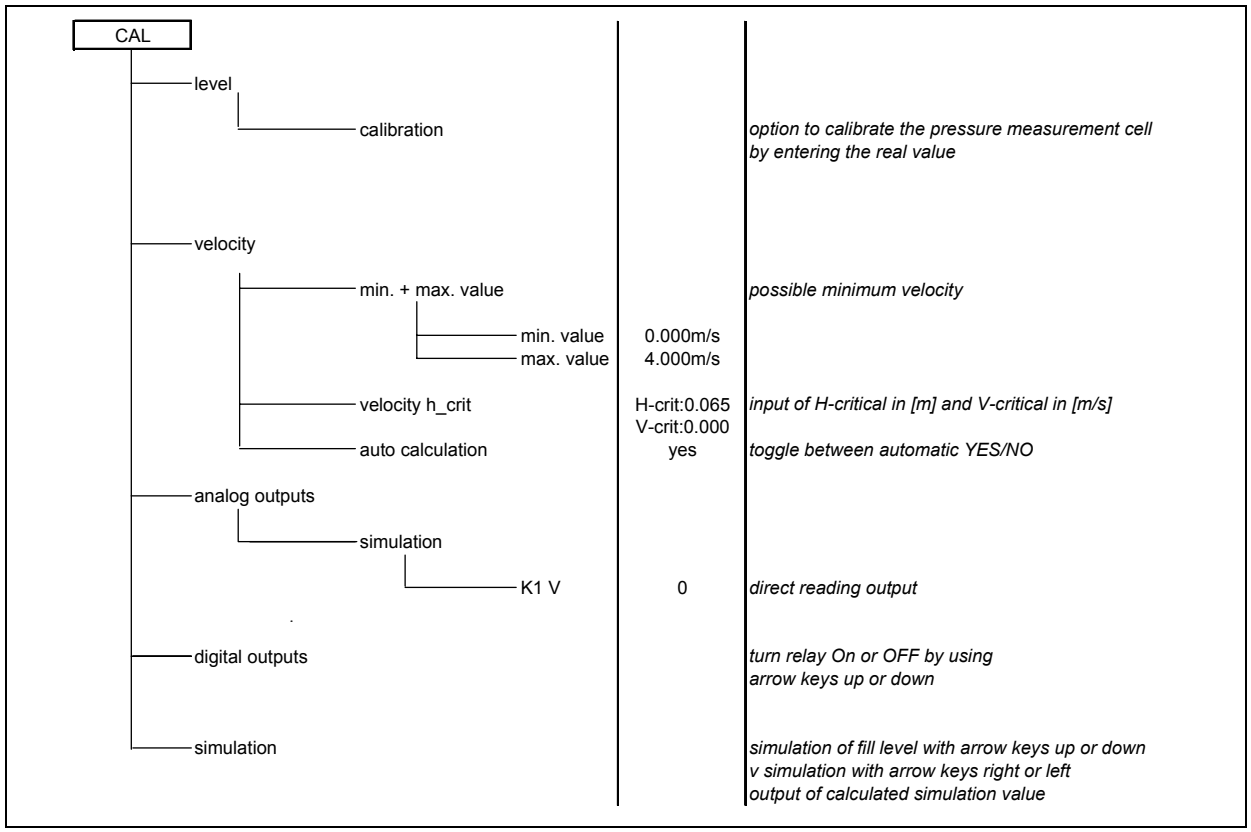
Operation Mode (RUN)



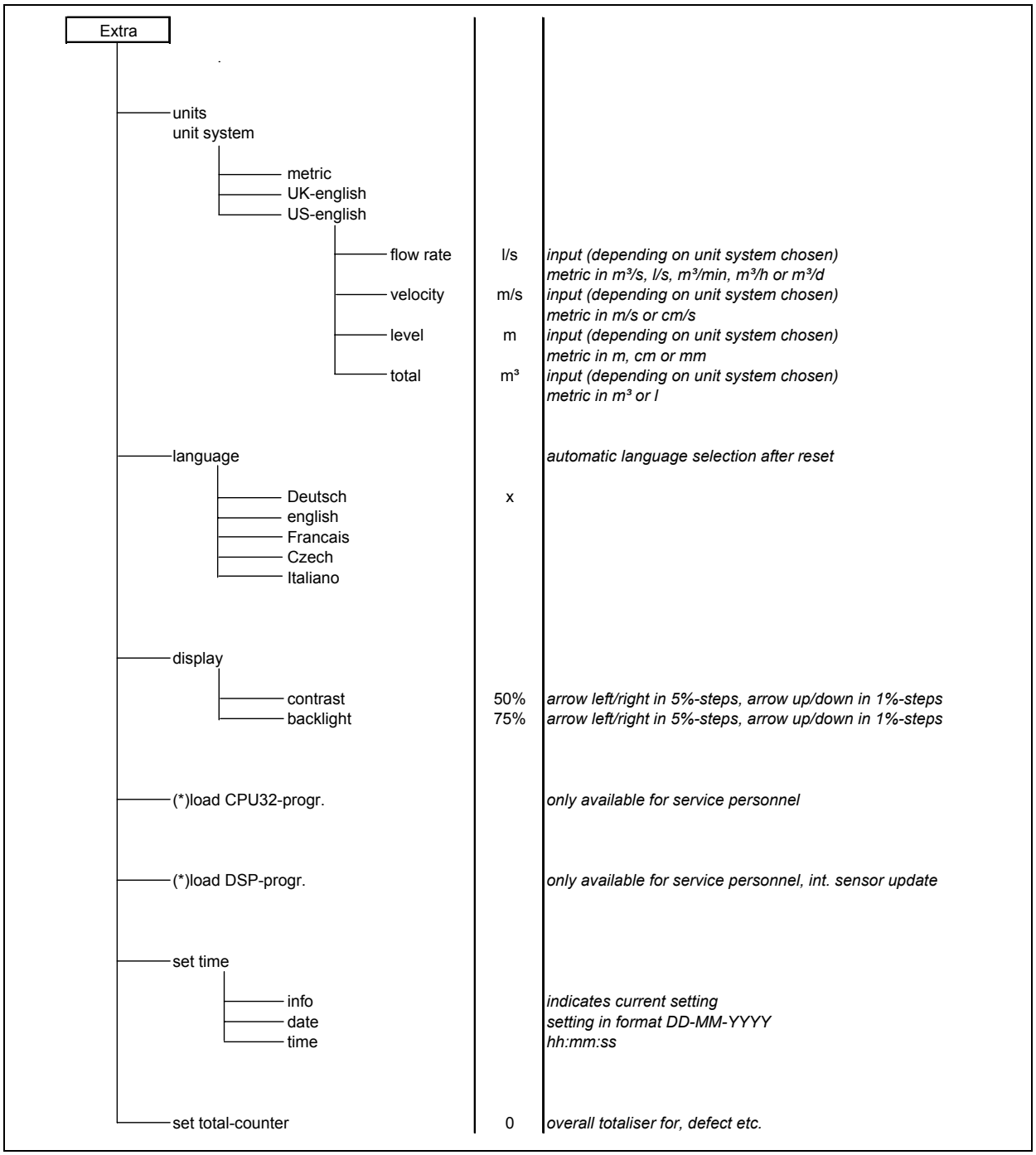
Signal Input / Output Menu (I/O)



Calibration Menu (CAL)



Display Menu (EXTRA)



Extra		
units		
unit system		
metric		
UK-english		
US-english		
flow rate	l/s	*input (depending on unit system chosen) metric in m³/s, l/s, m³/min, m³/h or m³/d*
velocity	m/s	*input (depending on unit system chosen) metric in m/s or cm/s*
level	m	*input (depending on unit system chosen) metric in m, cm or mm*
total	m³	*input (depending on unit system chosen) metric in m³ or l*
language		*automatic language selection after reset*
Deutsch	x	
english		
Francais		
Czech		
Italiano		
display		
contrast	50%	*arrow left/right in 5%-steps, arrow up/down in 1%-steps*
backlight	75%	*arrow left/right in 5%-steps, arrow up/down in 1%-steps*
(*)load CPU32-progr.		*only available for service personnel*
(*)load DSP-progr.		*only available for service personnel, int. sensor update*
set time		
info		*indicates current setting*
date		*setting in format DD-MM-YYYY*
time		*hh:mm:ss*
set total-counter	0	*overall totaliser for, defect etc.*

10 Troubleshooting

Error	Possible Reason	Correction
No indication of flow (0)	Connection	Check sensor connection to PCM 4.
	Sensor	Check if sensor is installed horizontally and towards flow direction.
		Check if sensor is dirty, blocked, covered with sedimentation (to be removed) or damaged (replace sensor).
	Flow level measurement	**No flow level = no flow velocity measurement possible!** Check if water-ultrasonic sensor is installed horizontally; check if pressure sensor is blocked, check functions and signals from air-ultrasonic or external level measurement (cables, clamped connections, short circuits, resistive loads) in menu >I/O-Sensors - H-Sensor - Echo profile<.
		Flow level < 65 mm (2.56 in)? In this case the PCM 4 is in Q/H measurement mode at initial start-up. Manually enter the velocity prevailing at 65 mm (2.56 in) in parameter >CAL – Flow velocity - Velocity h_crit<.
		In full channels without level measurement check value of parameter "fixed level“ in the level measurement.
	Transmitter	Recall error memory. Proceed depending on error message (check cables, check sensor installation) or call NIVUS service personnel (DSP or CPU error).
	Programming	Check complete parameter settings of transmitter.
No screen (black / flickering)	Connection	Check power connection.
	Power supply	Check supply voltage level.
	Memory card	Unauthorised 3rd party manufacture. Use NIVUS memory card.
		Memory card formatted on PC? Send card to NIVUS.
Screen >Sensor Error<	Connection	Check connection cable.
	Battery voltage	Voltage lower than 11.0 V, replace (rechargeable) battery.

DSP error	Communication	Communication with CPU or Sensor disturbed. Can be checked by pressing the >I< key. DSP version should be indicated in the third line of the following screen. Erase error memory (under >>RUN<<) completely. If required disconnect unit from mains for approx. 10 seconds and restart.
	Contacting problems	Can be checked by NIVUS service personnel only.
Unstable measurement values	Insufficient hydraulic conditions on measurement place	Check quality of measurement place by using the flow profile graph. Relocate the sensor to a hydraulically better suitable place (extend calming section).
		Remove soiling, sedimentation or obstructive constructions in front of the sensor.
		Straighten the flow profile by installing appropriate baffle plates and calming elements, flow straighteners or similar upstream of measurement.
		Increase damping.
	Sensor	Check sensor installation (towards flow direction, horizontal installation).
		Check if sensor is dirty or blocked.
Measured value implausible	Insufficient hydraulic conditions on measurement place	See error "Unstable measurement values“.
	External level signals	Check if connection is correct.
		Check if cables are crushed, for short circuits and improper resistive loads or current consumers without galvanic isolation.
		Check measurement range and span.
		Check input signal in I/O menu.
	Sensor	Check if connection is correct.
		Check if cables are crushed, check for extensions/cable types, short circuits, surge arresters or improper resistive loads.
		Check level signal, echo profile, flow velocity signal, cable parameters and temperature in I/O menu.
		Check if sensor is installed on a vibration-free place. Check sensor installation (towards flow direction, horizontal installation), check sensor for soiling.
	Programming	Check if the correct shape of measurement place has been set, check dimensions (observe units), sensor type, sensor installation height etc.

No / incomplete data on memory card	Memory card	Memory card defect. To be checked in menu: I/O – Memory card – Info.
		Unauthorised manufacturer. Use NIVUS memory card.
		Memory card formatted on PC. Send card to NIVUS.
	Transmitter	Memory card not firmly plugged in (not deep enough).
		Memory card not plugged in for a sufficient period of time. Data has not been saved before card has been unplugged (key action)
	Programming	Storage not enabled in Memory Mode – Operation Mode – Mode.

11 Table of Resistiveness

The medium-contacting parts of PCM 4 sensors are made of:

- stainless steel V4A (ground plate or pipe sensor jacket)
- PPO GF30 (sensor body)
- PEEK (sensor crystal cover) and
- Polyurethane (cable sheath and glands)

The sensors are resistant to normal domestic sewages, dirt and rain water as well as mixed water from municipalities and communities. In many industrial plants (such as Huels, BASF etc.) the resistance does not represent any problems. The sensors nevertheless are not resistant to all substances and substance mixtures.
As a basic principle, damage might occur in case of using chloride media as well as various organic solvents!

Please observe that substance mixtures (several substances being present simultaneously) under certain circumstances may cause catalytic effects which might not occur if the individual substances are in use. Due to infinitely possible combinations these catalytic effects cannot be verified entirely.
If in doubt please contact your NIVUS representative and request a free material sample for long time testing purposes.

Chemical resistiveness of Polyurethane at a medium temperature of 21 C (69.8°F).
Storage time: 6 months. The material is resistive against:

- 5 to 36% hydrochloric acid
- 5 to 36% sulphuric acid
- 5 to 20% acetic acid
- 1 to 10% nitric acid
- 5% phosphoric acid
- 5 to 10% ammonia solution
- 1% caustic soda or potash
- 100% methanol

Chemical resistiveness of stainless steel V4A in different temperature ranges:

Substance	Concentration	Temperature	resistant	not resistant
Ammonium chloride	10%	100°C (212°F)	x	
Methanol	100%	20°C (68°F)	x	
Nitric acid	20%	20°C (68°F)	x	
Hydrochloric acid	1%	20°C (68°F)		x
Phosphoric acid	10%	20°C (68°F)	x	
Ammonia	gas	20°C (68°F)	x	
Ammonia	gas	70°C (158°F)		x
Copper chloride	5%	20°C (68°F)		x
Ferric sulphate	5%	100°C (212°F)	x	
Caustic soda	20%	100°C (212°F)	x	
Sulphuric acid	10%	20°C (68°F)	x	

Chemical resistiveness of PPO at 20 C (68°F):

Substance	Concentration	resistant	limited resistance	not resistant
Acetone	100%			x
Ammonia	10%	x		
Petrol, gasoline	100%			x
Benzene	100%			x
Chloroform	100%			x
Diesel fuel	100%		x	
Acetic acid	80%	x		
Hydrofluoric acid	40%	x		
Glycerine	90%	x		
Caustic potash	50%	x		
Sodium base liquor	50%	x		
Methanol	98%	x		
Caustic soda	50%	x		
Petroleum	100%			x
Phosphoric acid	80%	x		
Nitric acid	10%	x		
Tetrachloride	100%	x		
Hydrochloric acid	10%	x		
Sulphuric acid	10%	x		
Soap solution	1%	x		

For more comprehensive tables of resistiveness please contact NIVUS GmbH in Eppingen.

12 Maintenance and Cleaning

Due to using the measurement system mostly in the waste water field which may be contaminated with hazardous germs, please ensure to take respective precautions getting in contact with system, transmitter, cables and sensors

Extent and intervals of maintenance measures depend on the following conditions:

- measurement principle of level sensor
- material wear and tear
- measurement medium und hydraulic conditions of channel
- general regulations for operators of measurement facility
- frequency of use
- environmental conditions

In order to ensure reliable, accurate and trouble-free operation of the measurement system we recommend to have an inspection performed by NIVUS at least once per year.

12.1 Sensors

General

In heavily polluted media tending to sedimentation it may be necessary to clean the sensor regularly. To do this, please use a brush with plastic bristles, a broom or similar.

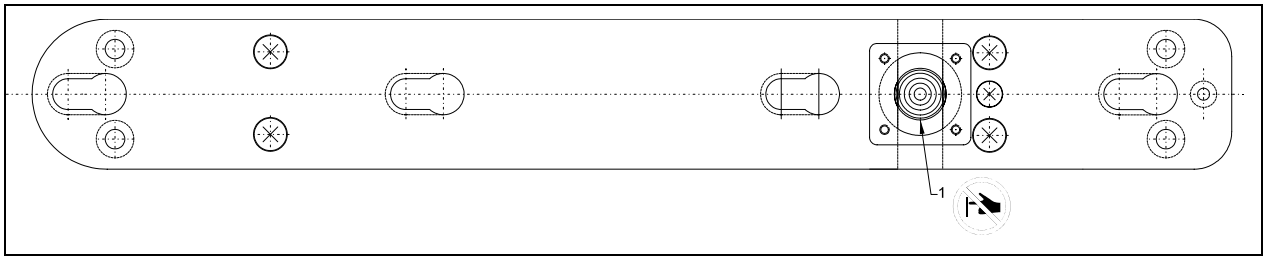
No hard objects such as wire brushes, rods, scrapers or similar shall be used to clean the sensor. Cleaning by using a water jet is allowed up to a max. pressure of 4 bar (see Specifications sensor) (e.g. use water hose). Using a high pressure cleaner may lead to measurement failures and thus is not allowed.

Never use pressure to clean combi sensors with integrated pressure measurement.

High flow velocities and solids (stones, sand or similar) appearing in the measurement medium might lead to abrasion on the combi sensor which may make it necessary to replace the sensor after a certain period of time. This however is normal sensor wear.

12.1.1 Water-Ultrasonic Combi Sensor with Pressure Measurement

Pressure measurement is subject to drift effects due to physical reasons.
Zero point and measurement span adjustments of the pressure sensor can be performed by NIVUS only and should be carried out once per year.
Substances which might settle on the opening of the pressure element (such as grease or lime) have to be removed as this may led to measurement errors otherwise.



1 Pressure sensor

Fig. 12-1 Wedge sensor with pressure, bottom view

Immediately flush the duct between ground plate and pressure measurement element with water each time after uninstalling in order to avoid sedimentation accumulating. Immerse the sensor into water several times to do this. The cover on the pressure measurement can be removed for more extensive cleaning.

Never use pressure (e.g. water jet, screw driver) to clean the pressure element. This will destroy the element!

Removing or loosening the sensor from ground plate or cable gland will result in leakage and lead to measurement / sensor failure.

Except the lowest installation sheet no other parts are allowed to be removed from the air-ultrasonic sensor!!

Please be very careful when cleaning the opened sensor. Clean the pressure sensor only by slightly moving the sensor body in a vessel filled with water. Never touch the pressure element with fingers, brushes, tools, water jets or similar! Otherwise liability claims will expire!

If in doubt let NIVUS clean the pressure element in order to avoid the risk of losing liability claims.

Maintenance must be performed by NIVUS if non-removable sedimentation prevents the level sensor from measuring correctly.

Combi sensors with pressure cell are equipped with an additional air filter containing desiccant. The desiccant is subject to wear and tear depending on measurement duration, measurement intervals, air pressure fluctuation and environmental conditions. Filter wear-out is going to be indicated as the desiccant colour changes from blue to bright pink.
Check the air filter each time before use, battery replacement or data readout. The filter shall be replaced if it begins to change its colour . Replacement air filters can be purchased from NIVUS (Art.-No. POA0ZUBFIL00000).

12.1.2 Air-Ultrasonic Sensor

These sensors operate non-contacting. Hence it is required to check if the sensor face is uncovered and the sonic beam is free to reach the water surface only after being immersed (flooded).
If dirty clean the sensor with water and a cloth or a soft brush.

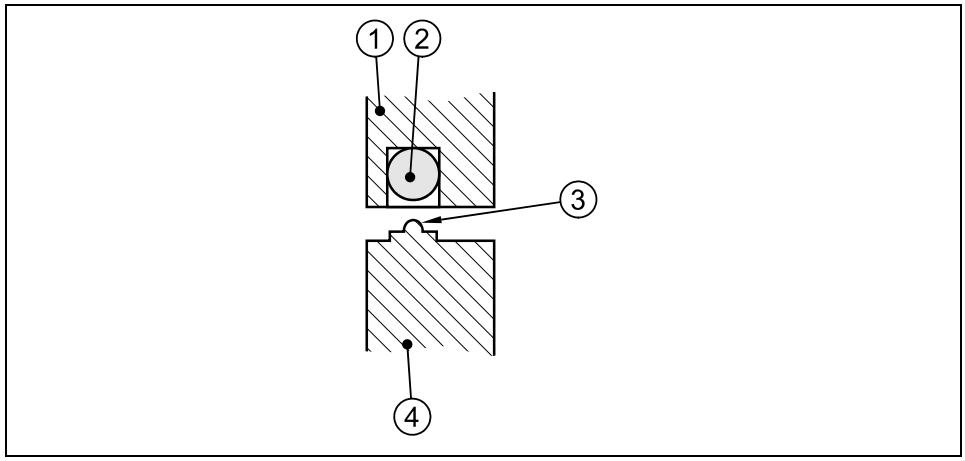
Removing or loosening the sensor from ground plate or cable gland will result in leakage and lead to measurement / sensor failure.

Except the lowest installation sheet no other parts are allowed to be removed from the air-ultrasonic sensor!

12.2 Transmitter

12.2.1 Enclosure

Regularly check the enclosure for leakage (protection IP67). Check the black sealing in the rim of the lid for mechanical damage or dirt. Remove dirt with a wet cloth. Then slightly grease the sealing with silicone grease or similar.



1 Enclosure lid
2 black Sealing
3 Sealing lip
4 Enclosure wall

Fig. 12-2 Enclosure sealing

The sealing of the enclosure lid is subject to wear and tear.
In order to guarantee the degree of protection it is required to return the transmitter to NIVUS once per year to check and if necessary to replace the sealing (not free of charge).

Unused plugs and sockets shall be locked tightly using the supplied caps in order to avoid corrosion of plug contacts and to ensure the degree of protection.

Never unscrew other screws than the ones used to remove the battery compartment cover!

12.2.2 Batteries

Batteries are subject to wear and tear and have to be replaced frequently. While standard batteries are for single use only and have to be disposed according to local regulations after their capacity is used up, rechargeable batteries can be charged again in order to be used many times. But even the lifetime of rechargeable batteries is not unlimited however. Besides frequent maintenance, it also depends on the frequency of use as well as on conditions of use and storage.
Please see chapter 6.7.1. for more information on how to charge batteries.

Rechargeable batteries are subject to wear and tear and hence shall be replaced after a maximum period of 2 years.

This period may be shorter if used extensively.

Do not leave (rechargeable) batteries in the PCM 4 after being discharged. Please ensure to dispose of used batteries according to environmental regulations.

13 Dismantling/Disposal

The device shall be disposed according to the local regulations for electronic products.

14 Table of Pictures

15 Index