Instruction Manual for
PCM3 Measurement Device

(Original Instruction Manual – German)

Software Revision No. 5.6

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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 (as of 2003)**
- **the EC EMC Directive 89/336/EEC, Annex I and II (as of 2003)**
- **the EC Directive 94/9/EC: Equipment and protective systems intended for use in potentially explosive atmospheres (ATEX)**

We hereby declare that the design of the

Description: Measuring device PCM3 with sensor

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

Directive/ Standard	Title	Edition	Remarks
73/23/ EC	**EC Low Voltage Directive**	**1973**	**As of 06. 2003**
EN 61010-1	Safety requirements for electrical equipment for measurement, control and laboratory use – Part 1: General requirements	1993	Harmonised standard
89/336/EC	**EC EMC Directive**	**1989**	**As of 06. 2003**
EN 61000-3-2	Electromagnetic compatibility – Limits for harmonic current emissions	2000	Harmonised standard
EN 61000-3-3	Electromagnetic compatibility – Limits – Limitation of voltage fluctuations and flicker in low voltage supply systems	1995	Harmonised standard
EN 55011	Industrial, scientific and medical (ISM) radio-frequency equipment – Radio disturbance characteristics – Limits and methods of measurement	1998	Harmonised standard
EN 61000-6-2	Electromagnetic compatibility – Generic immunity standard – Industrial environment	1994	Harmonised standard

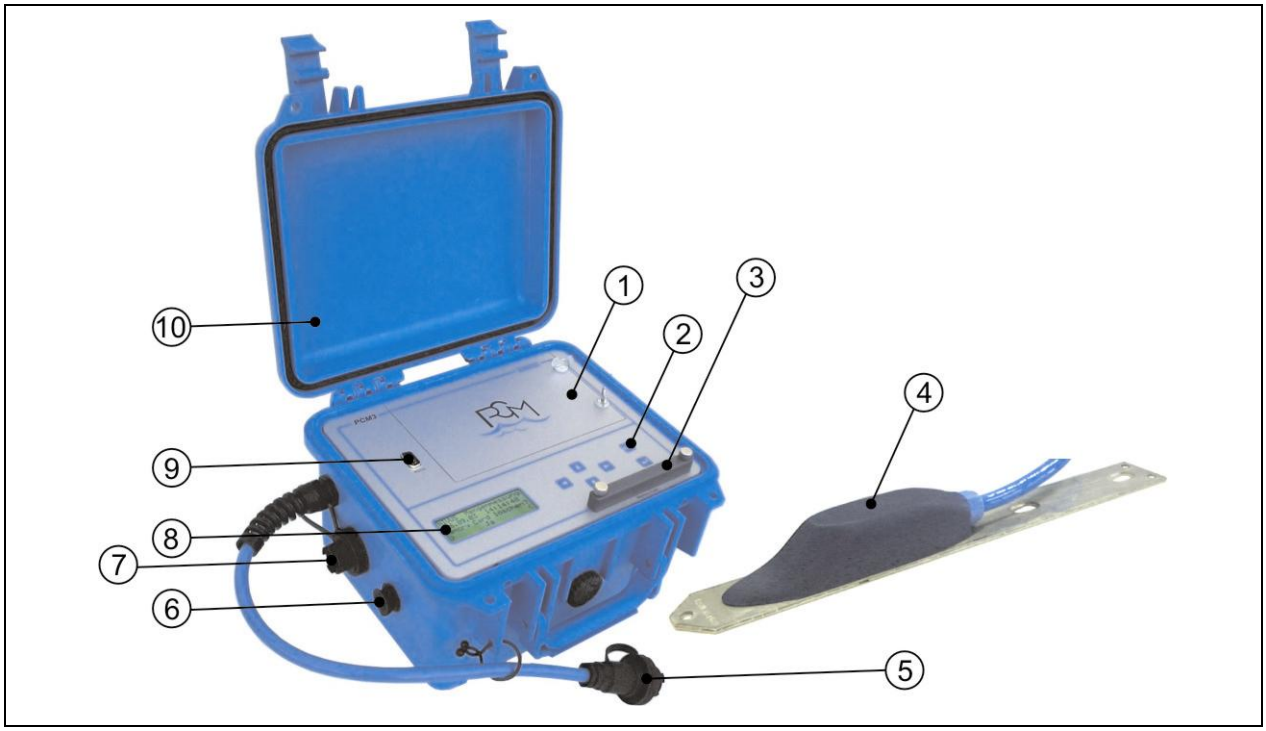
Directive/ Standard	Title	Edition	Remarks
94/9/EC (ATEX 100a)	**EC Directive: Equipment and protective systems intended for use in potentially explosive atmospheres**	**1994**	**As of Feb. 2003**
EN 1127-1	Explosive atmospheres – Explosion prevention and protection – Part 1: Basic concepts and methodology	1997	Harmonised standard
EN 50014	Electrical apparatus for potentially explosive atmospheres – General requirements	1999	Harmonised standard
EN 50020	Electrical apparatus for potentially explosive atmospheres – Intrinsic safety "i"	1994	Harmonised standard

Unauthorized changes to the device invalidate this declaration.

Eppingen, 15. December 2003 .....
Heinz Ritz
Head Quality Management

2 Overview and use in accordance with the requirements

2.1 Overview



1	Battery case
2	Keypad
3	Memory Card Slot with card and cover
4	Wedge sensor
5	Port for combination sensor
6	Socket for battery charger
7	Port for Connector Box or additional sensors
8	Display
9	RS232 interface
10	Enclosure with locking lid

Fig. 2-1 Overview

2.2 Use in accordance with the requirements

The measurement device type PCM3 including the respective sensor technology supplied by NIVUS is intended to be used for discontinuous flow measurement of slight to heavy polluted media in partial and fully filled channels, pipes or similar. Here the allowed maximum values, as specified in chapter ”Specifications“, must be strictly kept. All cases which vary from these conditions and are not passed by NIVUS GmbH in writing are left 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.
The device is designed for a lifetime of approx. 5 years. After that period an inspection in addition with a general overhaul has to be made.

For installation and initial start-up the conformity certificates and test certificates of the respective authorities must be followed..

2.3 Specifications

2.3.1 Transmitter

Power Supply	12 V DC; 12 Ah rechargeable lead battery or 8x mono cells 1,5 V 18 Ah or power supply 100-240 V AC 50/60 Hz
Power Consumption	max. 3 VA
Display	4 x 20 character LC display
Operation	membrane keypad (6 keys) or PC via RS 232 (SUB-D, 9-polar)
Inputs via IP 68 (NEMA 6) Plug Socket	1 x 4 – 20 mA for external level (2-wire probe) or rain gauge or sampler or pH sensor or connector box 1 x combination sensor or level sensor (via atmospheric tube) 1 power supply and battery charger
Program Memory	128 K EPROM; 8 K E²PROM
Clock Module	RTC (Lithium battery buffered)
Memory Cycle	1,3,5,10,15,30,60 min. time cyclical or depending on events
Measurement Time	adjustable
Data Memory	on plug-in memory card up to 256 KB – 2 MB
Enclosure	impact-resistant plastic, IP 67 (NEMA 6) (if lid is closed)
Weight	approx. 2.5 kg (5.5 lbs) (without sensor and battery)
Operating Temperature	-10° C to +60° C (14° F to 140° F)
Storing Temperature	-20° C to +60° C (-4° F to 140° F)

2.3.2 Transmitter Combination Sensor Level / Flow Velocity / Temperature

Measurement Principle	- hydrostatic pressure measurement via atmospheric tube, measurement principle: relative pressure (level measurement) - ultrasonic Doppler (Flow velocity)
Measurement Frequency v	750 kHz
Protection	IP 68 (NEMA 6)
Operating Temperature	-10° C to +50° C (14° F to 122° F)
Storing Temperature	-20° C to +60° C (-4° F to 140° F)
Cable Length	7, 10 and 12 m (23, 32.8 and 39.4 ft)
Cable Type	Li12YC11Y 4x0.25 + 2xcoax + PU hose
Outer Cable Diameter	8 mm (0.32 in)
Sensor Types	combination sensor with level and flow velocity measurement as well as temperature measurement to compensate the temperature influence on the sound velocity
Constructions	wedge sensor for installation on the channel bottom
Medium contacting Materials	Polyurethane, stainless steel 1.4571, PA (wedge sensor only)
Level Measurement	
Measurement Range	0-3 m (0-9.8 ft)
Zero Point Stability	automatic zero point compensation
Long Term Stability	< 0.1 % of final value / year
Accuracy	0.5 % of measurement value or ±3 mm (0.12 in); at 70 - 90 MHz interference irradiation = 0.8 % of measurement range final value

Flow Velocity Measurement	
Measurement Range	-6 m/s to + 6 m/s (-20 fps to +20 fps)
Zero Point Stability	absolutely stable zero point
Long Term Stability	absolutely long-term stable
Accuracy	±1 % of measurement value or ±0.03 m/s (1.2 in/s) (whichever is higher) in water, 16° C (61° F) und H >100 mm (3.9 in)
Minimum Reflecting Particles	Transmit frequency 750 kHz: 100 ppm; > 0.6 mm (0.02 in)
Temperature Measurement	
Measurement Range	0° C to +50° C (32° F to 122° F)
Accuracy	±1 K

2.3.3 Hanging Probe with Atmospheric Reference Tube

Measurement Principle	hydrostatic pressure measurement via atmospheric tube, measurement principle: relative pressure (level measurement)
Measurement Range	0-3 m (0-9.8 ft)
Zero Point Stability	Automatic zero point compensation
Long Term Stability	<0.1% of final value / year
Accuracy	0.5 % of measurement value or +/- 3 mm (0.12 in)
Protection	IP 68 (NEMA 6)
Operating Temperature	-10° C to +50° C (14° F to 122° F)
Storing Temperature	-20° C to +60° C (-4° F to 140° F)
Cable Length	10 m (32.8 ft)
Cable Type	Li12YC11Y 4x0.25 + 2xcoax + PU hose

2.3.4 Accessories (Option)

Memory Card	type: memory card according to Jeida standard; capacity: 256 kB to 2 MB
Read-Out Device	type MCA for memory cards according to Jeida standard
Connector Box	for connecting more than 2 sensors to PCM3, such as pH-measurement, pressure probes and more
pH-Measurement	probe and preamplifier with 7 m (23 ft) cable, for connection to PCM3 or connector box
Power Supply	lead storage battery with cable and connection plug, 12 V / 12 Ah or battery box, 2x6 V / 18 Ah or 8x1,5 V mono cell batteries power supply and battery charger, 100-240 V AC, 50/60 Hz
Cable Connection	cable connection for RS232 PCM3 – PC (SUB –D, 9-polar, 0 modem cable) cable connection PCM3 – sampler
Pipe Mounting System	For temporary, non-permanent clamping installation of wedge sensors in pipes DN200 – 800 (7.9 – 31.5 in diameter)
PC Software	NivuLog 6.XX for Windows 3.xx, 95 or 98

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 PCM3 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 kept.
All operations, which go beyond steps to install, to connect or to program the device, must 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 dangerous disease germs. Respective precautionary measures must be taken to avoid damage to one’s health.

3.2 Device Identification

The instructions in this manual are valid only for the type of device indicated on the title page.
The nameplate is fixed on the bottom of the device and contains the following:

- Name and address of manufacturer
- CE label
- Type and serial number / Type key
- Year of manufacture

It is important for queries and replacement part orders to specify type and order number (or Type key). This ensures correct and quick processing.

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

The safety instructions contained within must be followed.

It is strictly prohibited to disable the safety contrivances or to change 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.

3.4 Turn-off Procedure

For maintenance, cleaning and repairs (authorized staff personnel only) the device has to be disconnected from 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.

Connections:

Before operating the device the user has to ensure, that the local regulations (e.g. for electric supply) 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 PCM3 is a portable measurement system for flow measurement and data storage of slight to heavy polluted media with various compositions. It can be operated in partial and fully filled channels and pipes with various geometries and dimensions.

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

The PCM3 measures level, flow velocity and temperature and calculates the flow on weirs, in channels and pipes. For flow calculation the flow level and the flow velocity are measured with the respective sensors. The flow level can be alternatively measured by using an echo sounder or a pressure sensor. On weirs and flumes hence the flow can be calculated with. Measuring the local flow velocity is made by using an ultrasonic Doppler flow velocity sensor. Using the channel geometry and the measured values the flow as well as the total volume are determined, which are stored on a plug-in memory card and indicated on the display in the selected unit. Via the RS232 interface or a memory card reader, which can be directly connected to a PC, the measurement data can be edited and archived by using the NivuLog software under Windows. The PCM3 is able to be operated either by using the internal keypad and the LC display or an external PC via the RS232 interface.

4.2 Device Variations

The PCM3 transmitter as well as the respective sensors are available in different variations.

4.2.1 Transmitter

The transmitters primarily vary in terms of power supply, Ex-protection and enclosure construction. The current type of device is indicated by the article number, which can be found on a weatherproof label on the bottom of the enclosure.
From this article key the type of device can be specified.

PCM3		**Flowmeter in IP67 submersible, shock-resistant plastic enclosure. Operation via key pad and 4 x 20-digit LCD or via RS232 and PC. Storing on pluggable memory-card. Power-supply via 12V/12Ah lead accumulator or 8 x 1,5V mono-cells-batteries (delivery without power pack, batteries and memory card)**		
PC3/	**Type**			
	PCM3	portable Flowmeter		
		00	Without integrated electronics for flow velocity and level. External sensor(s) will be connected via Sensor Connector Box	
		0P	With integrated level measurement (air bubbling) and automatically zero-point correction.	
		VP	With integrated level measurement (air bubbling) and automatically zero-point correction und temperatur compensated flow velocity measurements.	
			Languages	
			DE	German
			DA	Danish
			FR	French
			EN	English (metrical units)
			US	English (American units)
PC3/	**PCM3**			**000**

Fig. 4-1 Type keys for PCM3 transmitter

4.2.2 Ultrasonic Sensors for PCM3

The sensors are available as wedge sensors with 7, 10 or 12 m (23, 32.8 or 39.4 ft) cable. The article number can be found on the underside of the combination sensor on the mounting plate.

Combination Sensor Level/Flow Velocity/Temperature

PC30 KS07 0000 000	combination sensor in flow optimized shape with 7 m (23 ft) cable and watertight plug
PC30 KS10 0000 000	combination sensor in flow optimized shape with 10 m (32.8 ft) cable and watertight plug
PC30 KS12 0000 000	combination sensor in flow optimized shape with 12 m (39.4 ft) cable and watertight plug

Level Sensors

PC30 HP10 0000 000	hanging probe with atmospheric reference tube for level measurement with 10 m (32.8 ft) cable and watertight plug
PC3/ HU00 0000 000	ultrasonic sensor, 4-20 mA, 2-wire sensor with 10 m (32.8 ft) cable and watertight plug

All level sensors (e.g. NivuBar Plus) can be connected to the PCM3 as 4-20 mA 2-wire probe by using the connector box.

Connector Box

PC30 ZUS1 0000 000	for connecting measurement signals, sensors and additional devices with terminal clamps with 0,5m (1.64ft) cable and watertight plug

5 Storing, Delivery and Transport

5.1 Receipt

Please check your delivery according to the delivery note for completeness immediately after receipt. Any damage in transit must be instantly reported to the carrier. An immediate, written report must be sent to NIVUS GmbH Eppingen as well.
Please report any delivery incompleteness in writing to your representative or directly to NIVUS Eppingen within two weeks.

Mistakes cannot be rectified later!

5.1.1 Delivery

The standard delivery of the PCM3 measurement system contains:

- the instruction manual. Here, all necessary steps to correctly install and to operate the measurement system are listed.
- a PCM3
- a rechargeable battery
- a battery charger
- a memory card
- a combination sensor, construction: wedge sensor

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

5.2 Storing

The following storing conditions must be strictly kept:

Transmitter:	max. temperature:	+60° C (140° F)
	min. temperature:	-20° C (-4° F)
	max. humidity:	90 %
Sensor:	max. temperature:	+60° C (140° F)
	min. temperature:	-20° C (-4° F)
	max. humidity:	100 %
Battery:	max. temperature:	+25° C (77° F)
	min. temperature:	+5° C (41° F)
	max. humidity:	60 %

Before storing the battery must be removed from the PCM3 and must be kept in a frost-free place.

The devices must be protected from corrosive or organic solvent vapors, radioactive radiation as well as strong electromagnetic radiation.

5.3 Transport

Sensor and Transmitter are conceived for harsh industrial conditions. Despite this do not expose them to heavy shocks or vibrations.
Transportation must be carried out in the original packaging.

5.4 Return

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

6 Installation

6.1 General

Before feeding the rated voltage the transmitter and sensor installation must be correctly completed. The installation should be carried out by qualified personnel only. Further statutory standards, regulations and technical rulings have to be taken into account.

6.2 Transmitter Installation and Connection

6.2.1 General

The transmitters mounting place has to be selected according to certain criteria. Please strictly avoid:

- direct sunlight (use weatherproof cover if necessary)
- heat emitting objects (max. ambient temperature: +40° C (104° F))
- objects with strong electromagnetic fields (e.g. frequency converters)
- corrosive chemicals or gas
- mechanical shocks
- vibrations
- radioactive radiation
- installation close to footpaths or travel ways
- permanent flood (protection IP67 (NEMA 6))

The PCM3 can be fixed with its grip using a hanging gear (PCM0 ZMSH AK01 000) e.g. on a rung in the manhole wall.

6.2.2 Dimensions

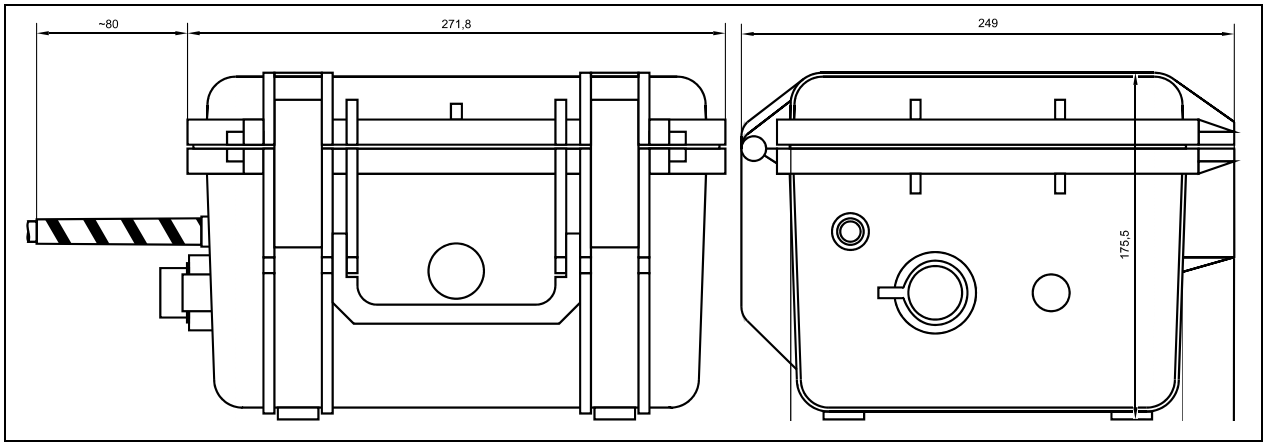


Fig. 6-1 PCM3 enclosure

6.3 Sensor Installation and Connection

6.3.1 General

The sensors have to be fastened hard and tight. The inclined side of the velocity sensor must “look“ (face) against the flow direction of the medium.
Use non-corrosive fastening material only!

To avoid disturbances from electrical interferences, the sensor cable must not be laid close (or parallel) to engine (motor) lines or main power lines..

6.3.2 Combination Sensor

6.3.2.1 Sensor Dimensions

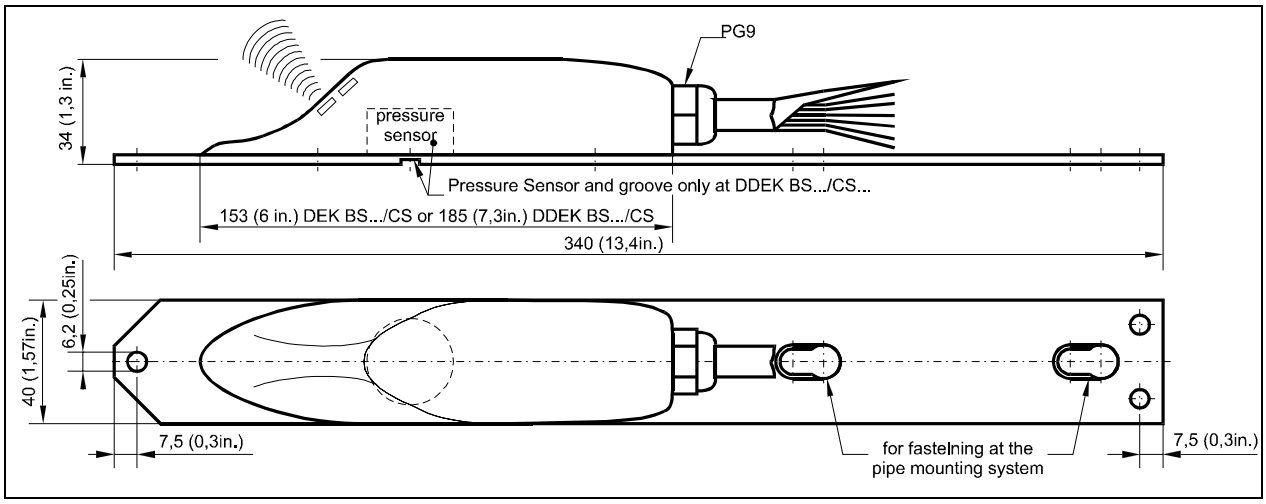


Fig. 6-2 Dimensions wedge sensor

6.3.2.2 Sensor Installation

It is recommended to fix the wedge sensor on the channel bottom by using the pipe mounting system. It can be temporarily applied in channels with pipe diameters from DN200 to DN800 (7.9 to 31.5 in diameter).
If the sensor must be fixed permanently on the channel bottom you need 3 appropriate stainless steel screws with a sufficient length and respective wall plugs. To reduce vortex formation the stainless steel screw on the sensor tip must be a round head screw! If not otherwise agreed with NIVUS, the sensor must be installed exactly in the middle of the channel with the bevelled side (face) “looking“ against the flow direction.

To reduce the risk of build-up the sensor shape was flow optimized. Under certain circumstances the risk of build-up on the sensor mounting sheet exists though. Because of that between sensor mounting sheet or pipe mounting system and the channel ground no gap must be left!

For mounting the sensor on the channel bottom the ground must be flat (plane surface). Otherwise the sensor may break and might become be leaky.

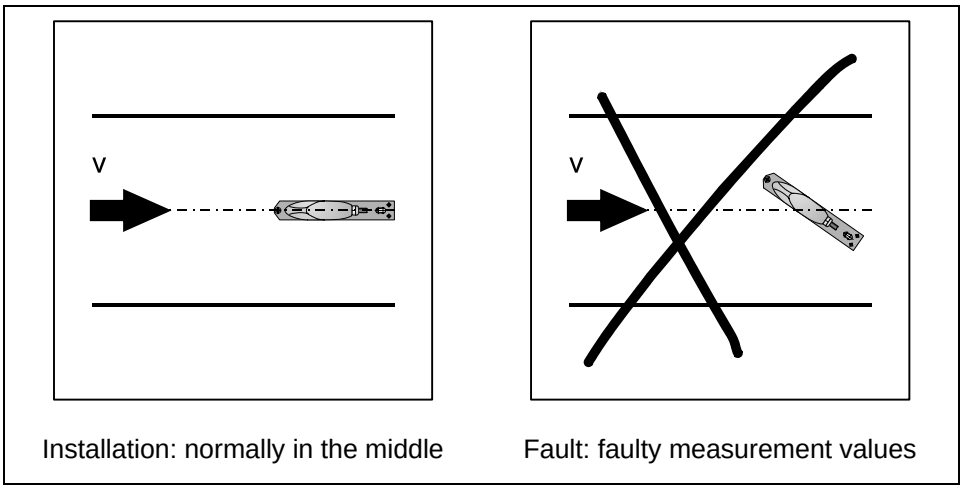


Fig. 6-3 Installation parallel to flow

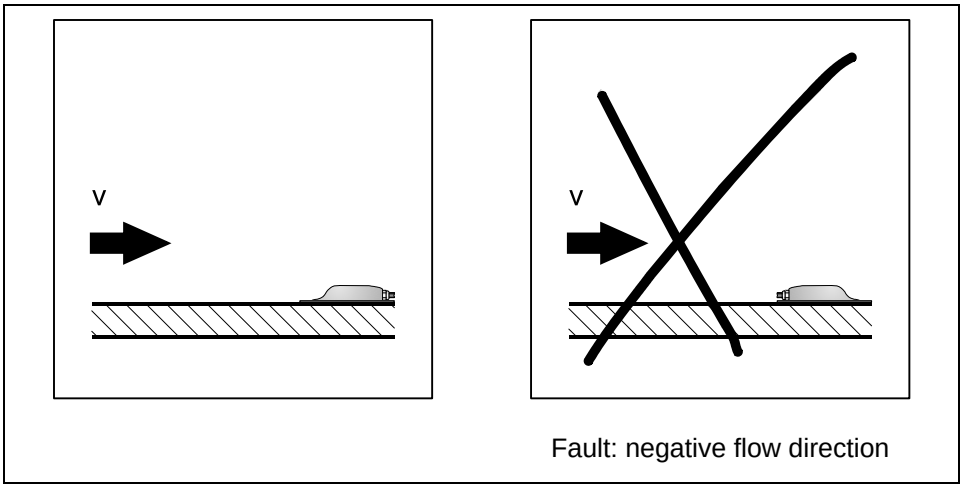


Fig. 6-4 Installation against flow direction

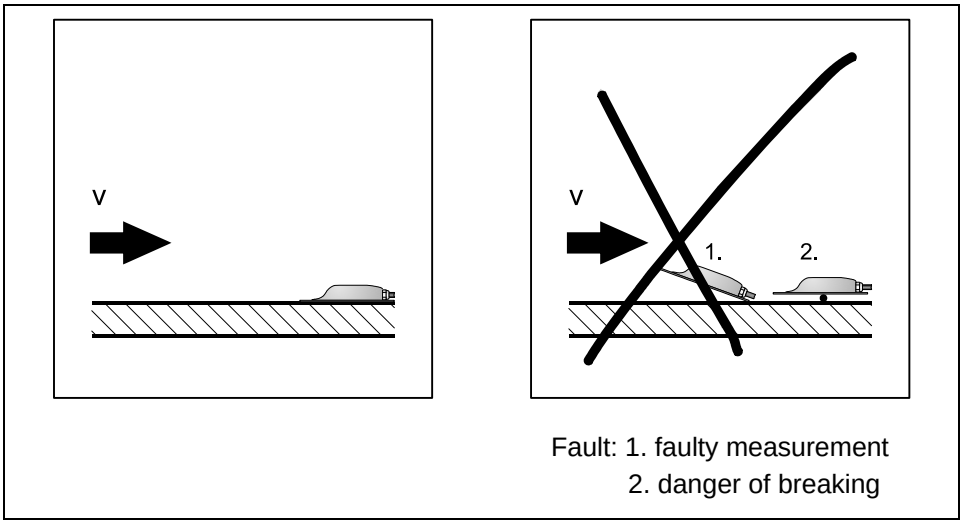
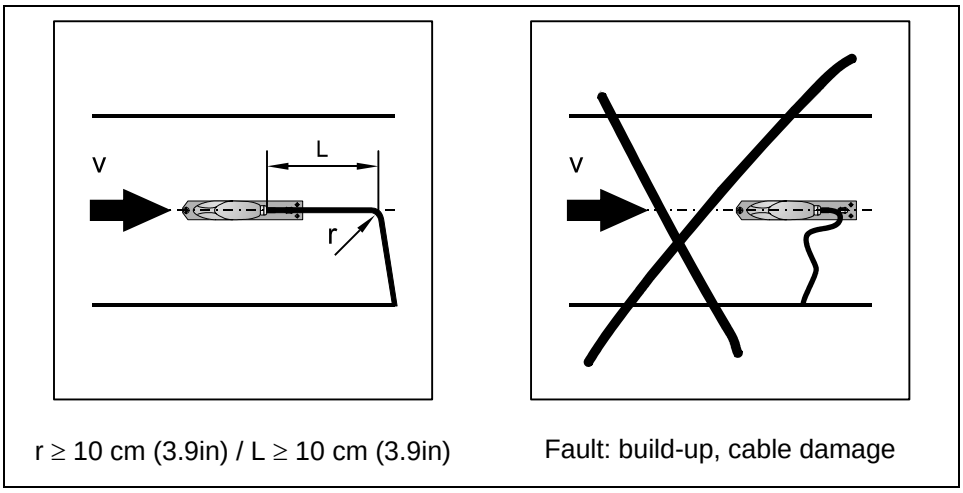


Fig. 6-5 Installation parallel and flush on the channel ground

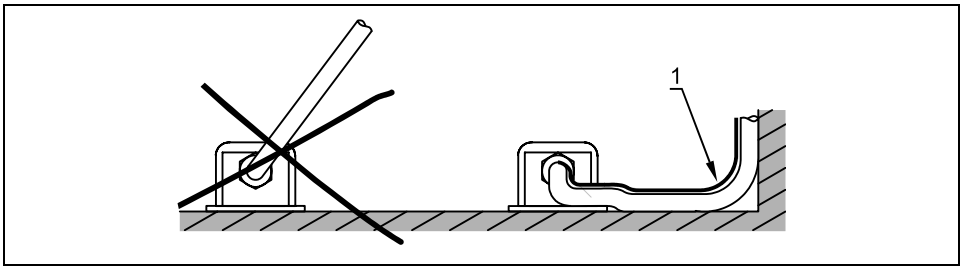


r ≥ 10 cm (3.9in) / L ≥ 10 cm (3.9in) Fault: build-up, cable damage

Fig. 6-6 Cable layout without pipe mounting system

To avoid build-up the sensor cable must be laid on the channel ground from behind the sensor up to the channel wall.

The cable must not be laid loosely, unprotected or exposed to the medium! Risk of build-up, sensor or cable break!



1 Protective cover

Fig. 6-7 Hints for cable layout

The minimum bending radius of the signal cable is 10 cm (3.9 in). Disregarding this may result in cable break!

Pipe Mounting System

When using the pipe mounting system the cable can be fixed to the respective holes with cable straps and therefore laid along the channel wall.

Please additionally observe when fastening the sensor with the pipe mounting system:

- appropriate application pressure to the wall to avoid breaking loose in operation. This particularly applies for large channel diameters and high flow levels.
- installation parallel to the wall to minimize the risk of build-up. No gap must be between mounting sheet and sensor or channel ground.

- use cable straps to lay the sensor cable on the pipe mounting system to above.
- to avoid build-up on the sensor cable the cable should be wrapped into adhesive tape up to above the water surface at low flow velocities.
- the sensor cable must always be laid close along the channel wall and, if necessary, must be fixed with clamps.
- please note the selection chart of the mounting sheets.

Fig. 6-8 Pipe mounting system

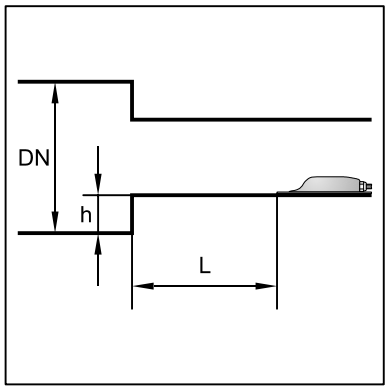
I.D. (inside diameter) in mm (")	BST base plate	SPV scissors jack	V5 extension plate	V5 extension plate	V10 extension plate	V10 extension plate	V15 extension plate	V15 extension plate
200 (8")	x inner hole	x						
250 (10")	x inner hole	x	x	x				
300 (12")	x outer hole	x	x	x				
350 (14")	x inner hole	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
This pipe mounting system is standardized for use with PCM and OCM sensor mounting. Other equipment on request.								

6.3.2.3 Required Distances

Clearly defined, hydraulic conditions are absolutely necessary for an accurate measurement.
For this you need to take into account the information regarding hydraulics and their required distances.

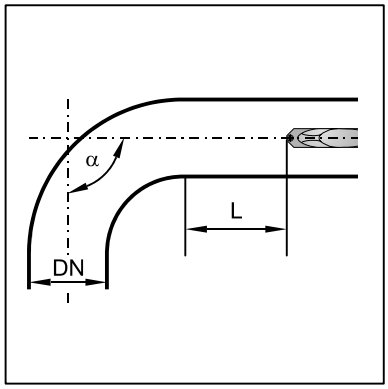
- Falls, steps or obstructions, fittings, profile change of channels or lateral supplies right in front of or behind the measurement point have to be avoided!
- The measurement place must selected under usual operating conditions. No deposits (sand, silt, rubble, sludge). Deposits are possible, when the flow velocity is very slow. Even too low slopes or structural defects may cause deposits to accumulate. If no other measurement place is available, the sensor should be installed at least one sensor width out of the middle of the channel bottom. The level offset must be taken into account during the parameter setting.
- At the measurement point, avoid changes of slopes.
- avoid different material structures in different level areas.
- The upstream measurement distance must be min. 3x diameters, the downstream measurement distance min. 2x diameters. Depending on disturbance of the flow profile, longer distances may be necessary.

Necessary required distances between hydraulic interferences and installation place at:



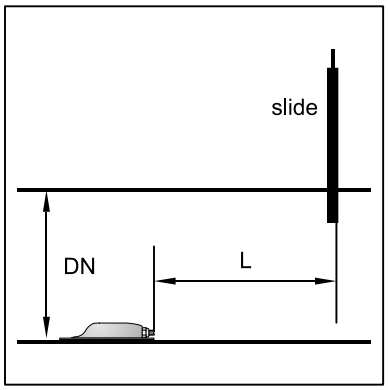
$h \leq 2{,}5$ % of DN — $L \geq$ min. 3 x DN
h > 2,5 % of DN — L = distance to the last standing waves.

Fig. 6-9 Profile changes

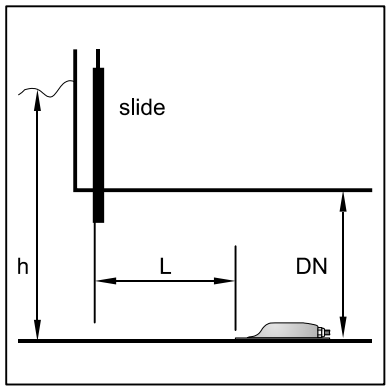


v ≤1m/s	v > 1m/s
α ≤15°, L ≥ min. 3x DN	L ≥ min., 5x DN
α ≤45°, L ≥ min. 5x DN	L ≥ min., 10x DN
α ≤90°, L ≥ min. 10x DN	L ≥ min., 15-20x DN

Fig. 6-10 Bends / curves

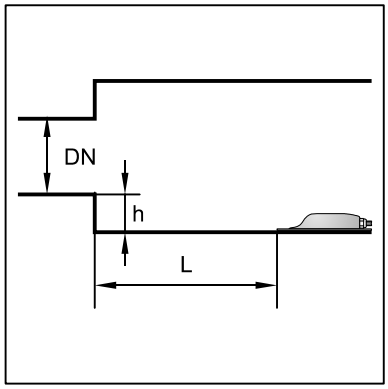


Sensor distance before the slide valve
L = 3 x DN



Sensor distance after the slide valve
L ≥ distance to formation of a flowing discharge plus 2 x DN

Fig. 6-11 Slide valve and valves



h ≤ 2,5% of DN	L ≥ min. 3 x DN
h > 2,5% of DN	L = distance to formation of a flowing discharge plus 2 x DN

Fig. 6-12 Step or obstruction

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

6.3.3 Hanging Probe

6.3.3.1 Sensor Dimensions

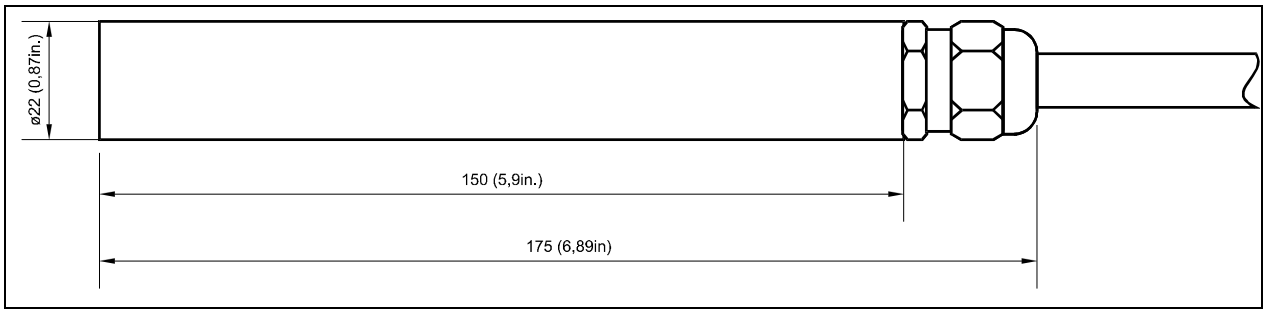
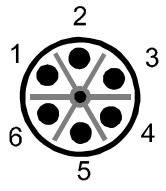


Fig. 6-13 Dimensions hanging probe

6.3.3.2 Hanging Probe Installation

The hanging probe can be fixed directly to the channel wall by using appropriate clamps with 22 mm (0.87 in) inner diameter. The probe must be mounted vertically.
The probe must not float when flooded because otherwise the correct function is not ensured.

6.3.4 Combination Sensor Connection



(rear view plug)

pin 1 transmitter +
pin 2 GND transmitter / receiver
pin 3 receiver +
pin 4 shield
pin 5 thermometer probe +
pin 6 thermometer probe -

Fig. 6-14 Pin wiring of combination sensor plug

When installed the sensor must not be loosened from the PCM3 in order to avoid water leaking into the device via the cable's air hose. This results in faulty level measurement values.

If water has leaked into the air hose it must be flushed free after it is connected to the PCM3 again by using the pump several times.

If the PCM3 is turned on the pump can be manually activated by pressing ▼ and ▲ simultaneously. This must be repeated until the correct level is displayed.

6.3.5 Rain Gauge, Sampler, Level Sensor, Connector Box Connection

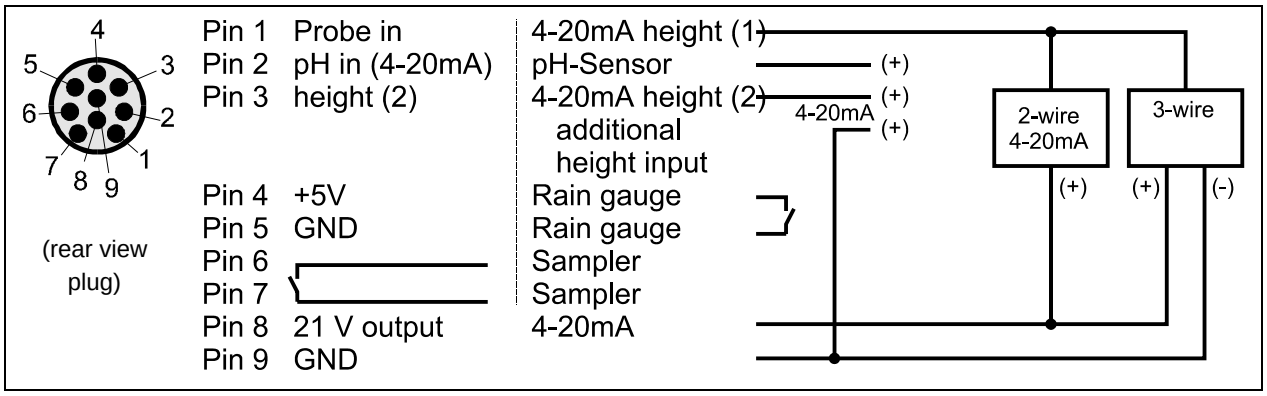


Fig. 6-15 Pin wiring connector box plug

Merely a sampler or a rain gauge or a level sensor or the connector box can be connected via this port. If multiple sensors have to be connected to the PCM3 this must be made by using the connector box.

Connector Box

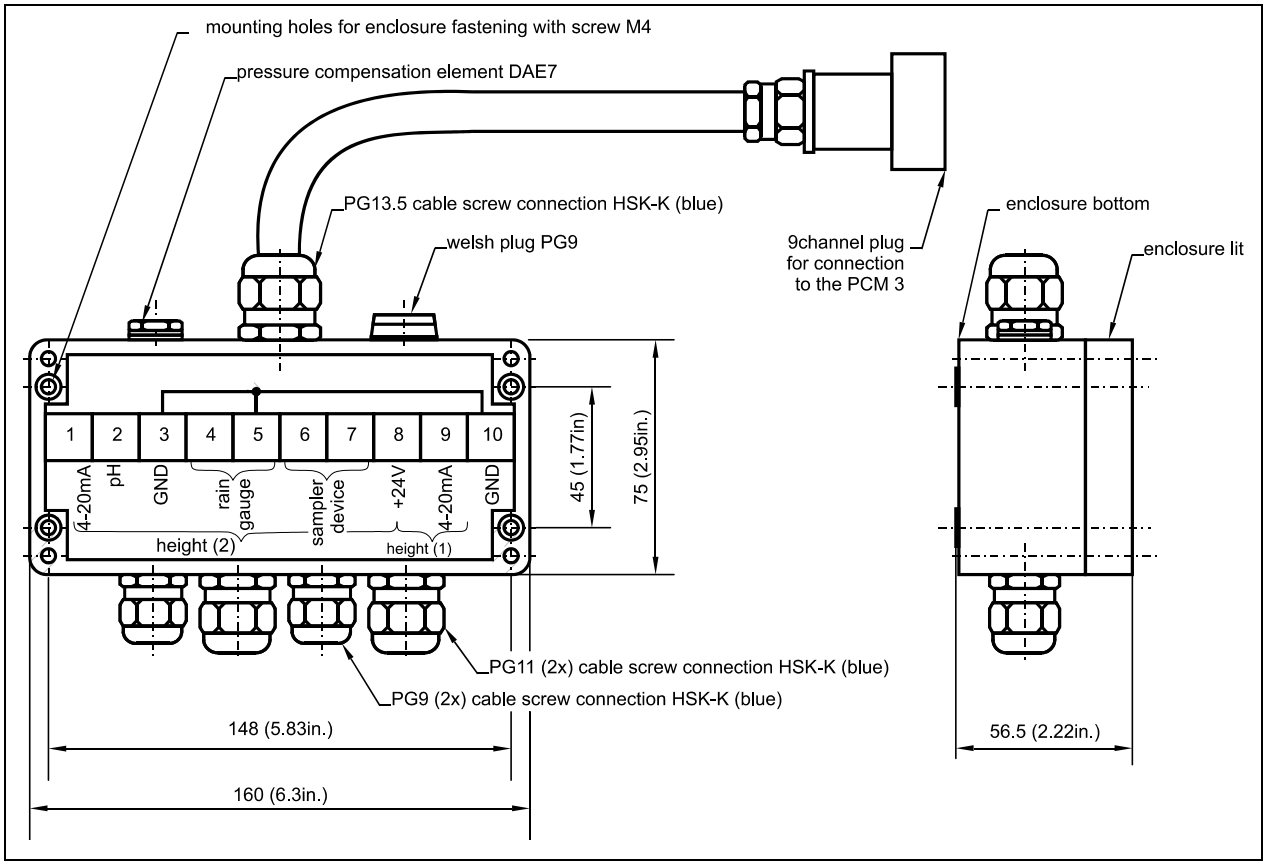
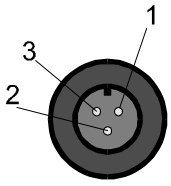


Fig. 6-16 Dimensions and connection connector box

Custom cables with an appropriate section dimension can be used for connecting the connector box. The delivered screw-type conduit fittings must be locked carefully to ensure the IP 67 protection though.

6.4 PCM3 Power Supply

6.4.1 Mains connection to 100-240V AC



pin 1 GND
pin 2 power supply
pin 3 charge

Fig. 6-17 Pin wiring PCM3 power supply plug

If connected to mains via the NIVUS battery charger (PC30ZLGUS000000) on the outer 3-pin socket the internal lead storage battery is charged. On mains failure the PCM3 uses the lead storage battery as a buffer.

7 Initial Start-Up

7.1 General

Notes to the User

Before you connect and operate the PCM3 you should strictly follow the notes below!
This instruction manual contains all necessary information to program and to operate the device.
It is addressed to qualified technical staff who have appropriate knowledge about measurement technology, automation technology, information technology and waste water hydraulics.
If in doubt please contact the NIVUS initial start-up service.
If any problems regarding installation, connection or programming should occur please contact our technical division or our service center.

General Principles

The initial start-up is not allowed until the installation is finished and checked. To exclude faulty programming this instruction manual must be read before the initial start-up.
Please get used to the PCM3 programming via display and keyboard by reading the instruction manual before you begin to program the device.
After transmitter and sensors are connected (see chapters 6.2 and 6.3) the parameters must be set. In the most cases all you need is:

- enter the geometry of the measurement place,
- sensors used
- display and
- storage.

When it comes to extensive programming questions, difficult hydraulic conditions, particular special channel shapes, lack of qualified personnel or if setup and error protocols are required, the programming should be carried out by the manufacturer. Our initial start-up service is available for your convenience whenever you need it.

7.2 Control Panel

For data entries a panel with 6 keys is available.

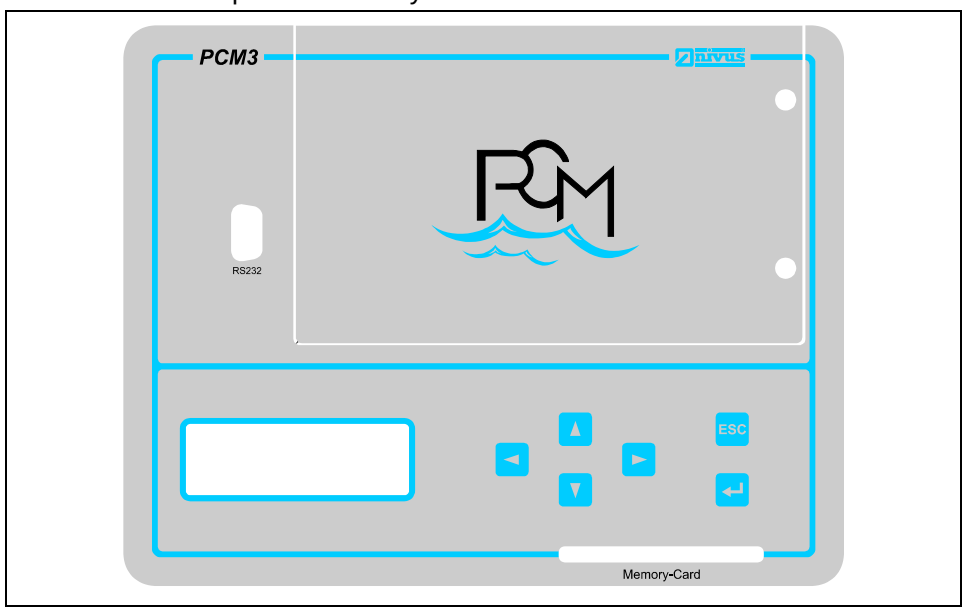


Fig. 7-1 View PCM3 control panel

7.3 Display

The PCM3 has a back-lit 4 x 20 character graphic display.
In the operation mode 4 screens can be called up. Selecting between them is made by using the horizontal arrow keys.

Display velocity, level and flow

```
h:          300.0 cm
v:            0.00 m/s
Q:             0.0 l/s
Σ:             0.0 m3
```

Display T and additional sensors

```
temp.:       23.2 °C
 h(2):        0.0 cm
pH-v.:        0.0
 rain:        0.0 mm
```

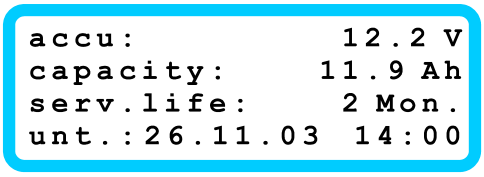
Memory Card status

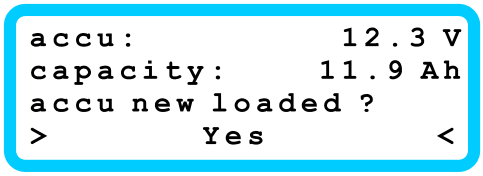
```
NIVUS flow metering
26.09.03  14:05:31
MemoryCard
512 kByte total
```

```
NIVUS flow metering
26.09.03  14:14:48
erase memory card ?
>        Yes       <
```

Display of the remaining memory capacity. Pressing the arrow key up erases the memory card without switching to parameter setting mode.

Rechargeable battery





Display of the remaining battery lifetime.
Pressing the arrow key up in this screen will reset the calculation of the remaining battery lifetime.

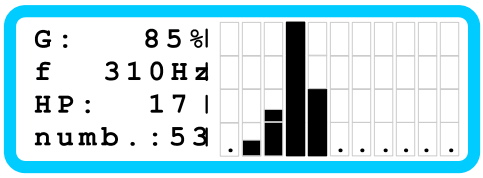
The displayed battery lifetime is calculated from the newly charged battery's capacity, the measurement duration or the measurement delay and the measurement cycle. Hence, it must be observed that always a completely charged battery is used.

Due to the system-based battery lifetime this screen must be considered as a typical value display.

To avoid total discharge, a new battery should be used if the voltage falls below 10 V during full operation.

Frequency Histogram

Display of the velocity signal quality.
This screen can be used to assess the measurement place as well as the hydraulic conditions. The example shows a well measurement situation:



If the quality falls below 30 % or in case of badly fluctuating frequencies another measurement place should be chosen.

7.4 Operation Principles

To switch between the menus and submenus use the 4 control keys (see chapter 7.2).

◄ ► Operation and parameter mode:
Select the main menus with the “arrow left“ or “arrow right“ keys.
Parameter mode:
Select the main menus and move the cursor.

▲ ▼ Operation mode:
Use the “arrow up“ or “arrow down“ keys to call up the physical values in the various menus or to reset the battery or the memory card.
Parameter mode:
Change the numbers, letters or characters
Edit a digit
▼
-. / 012...9 (7 special char.) ABC...ZÄÖÜ (5 special char.)
▲
abc...zäöü (special characters) space

↵ Pressing the “Enter“-key turns on the device, if pressed twice the unit is switching to parameter mode.
This key serves to open and to confirm the parameter contents.
Further it can be used to switch to the next lower menu level.

ESC By using the “ESC“ key the selected submenus can be left step by step. Entries will be cancelled unless confirming them.
In addition, this key turns off the PCM3.

8 Parameter Setting

8.1 Parameter Setting on the PCM3

Turn on the PCM3 by pushing the ↵-key.

Start parameter mode ↵

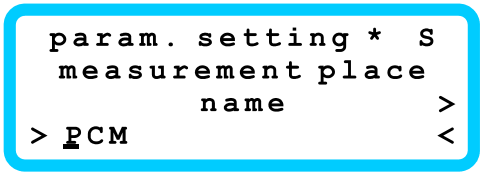


Fig. 8-1 Parameter mode screen

8.1.1 Parameter Mode Screen Structure

Display	Description	Description of characters
1. Line	Program status	Parameter Setting ° the current menu level is the 1. submenu level °° " 2. submenu level °°° " 3. submenu level **S** the service level is active.
2. Line	higher menu level	Main menu
3. Line	current menu level	
4. Line	Parameter entry	**[x x x]** stored numeric value or text **> x x x <** stored value can be edited

The parameter setting is structured as a menu with various levels.
From the main menu level 3 submenu levels can be called up.
The following main menus are available:

- Measurement Place — Enter the name of the measurement place and service level activation
- Measurement Mode — Enter system time and measurement period
- Channel Data — Enter channel geometry and flow calculation method
- Storage — Activate the values to be stored and reset
- Sensors — Adjust the level and velocity sensors to the measurement place
- Sampler — Activate the sampler input
- Rain Gauge — Activate the rain gauge input
- Display — Enter dimension and decimal digits of displayed and stored data

8.2 Parameter Setting via PC

To set the PCM3 parameters via PC or laptop you need the NivuLog software and an interface cable (RS232, SUB-D, 0 modem cable).
Please also note the instruction manual of the parameterization software NivuLog about this.
This Windows software enables to set parameters, to display and to convert data into ASCII-format for further processing in a spreadsheet.
You can read out the parameters from the PCM3, edit them on a PC and transmit them back to the PCM3 again.

There is no online-connection between PC and PCM3.

Connect the PCM3 to the serial interface of your computer with the interface cable (RS 232; SUB-D). The interface as well as the transfer rates for initialization and data transfer can be adjusted in the menu Transmit – Interface of the NivuLog software.

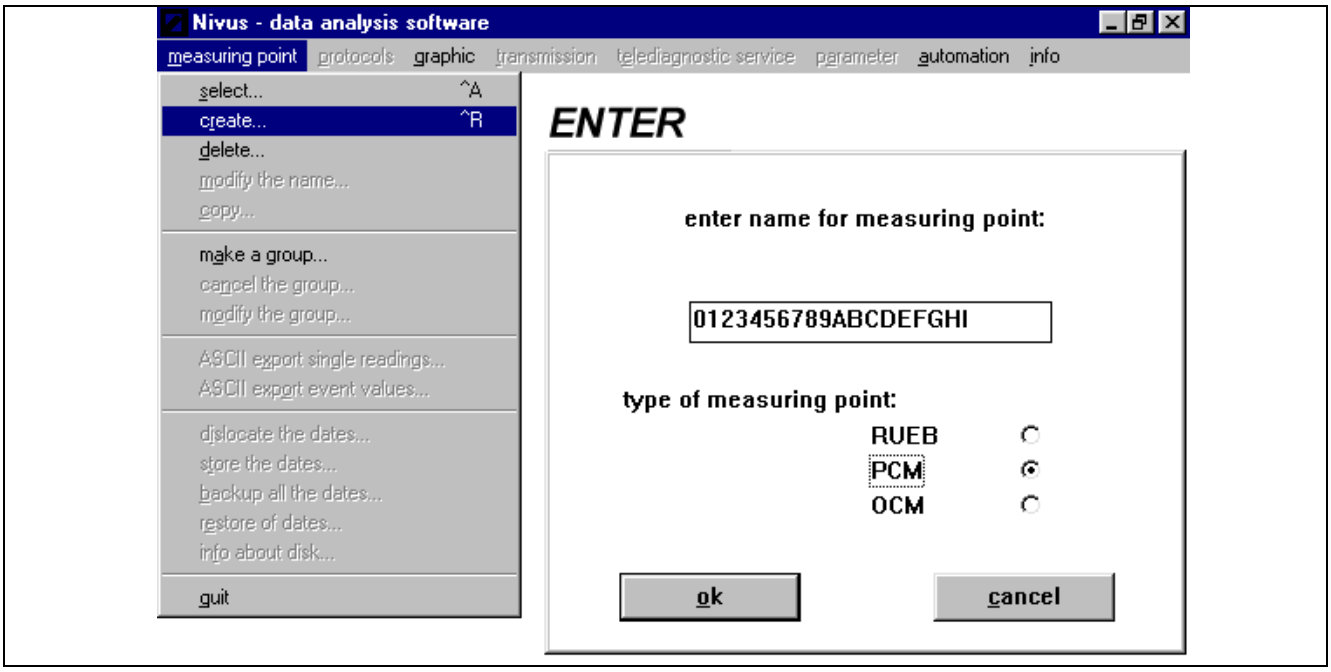
Turn on the PCM3 by pressing ↵ before connecting it to a PC. The connection can be set up only if the device is turned on.

8.2.1 Parameterization Process

1. Start the NivuLog software.
2. Create a measurement place in the NivuLog.

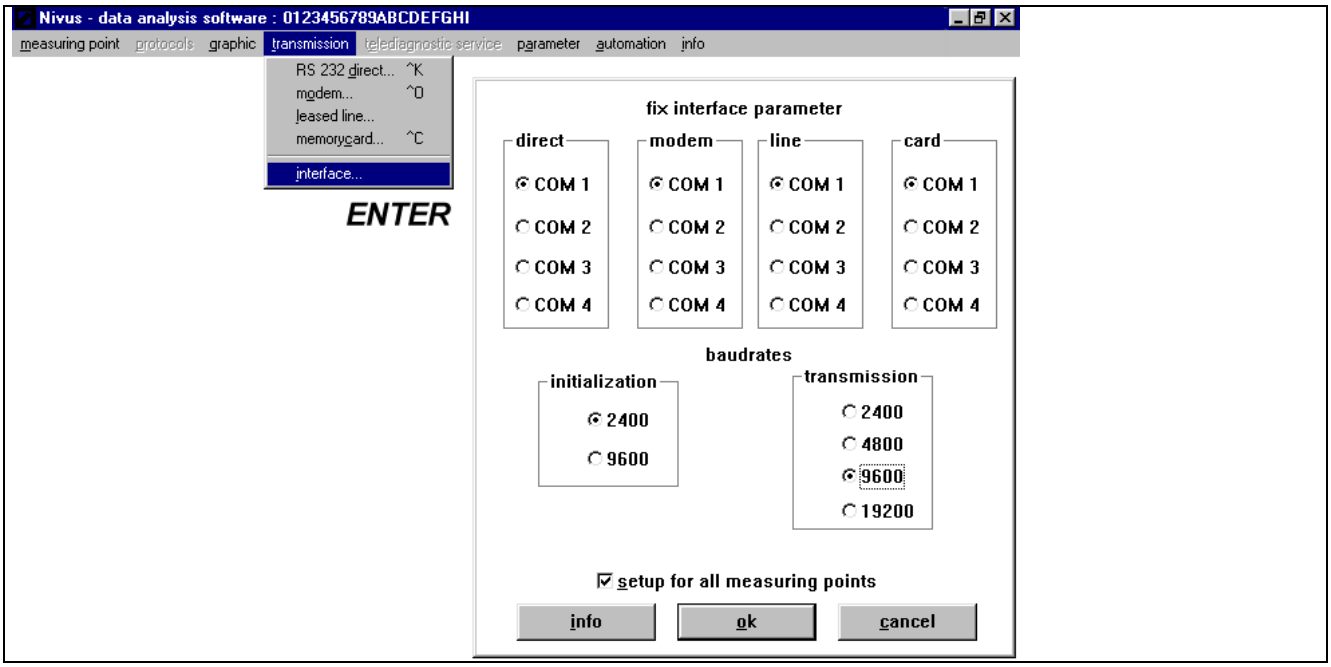
The name of the measurement place must not exceed a maximum of 18 letters. Further no special and blank characters must be used.

Select PCM in the device selection menu to access the respective menu screen.

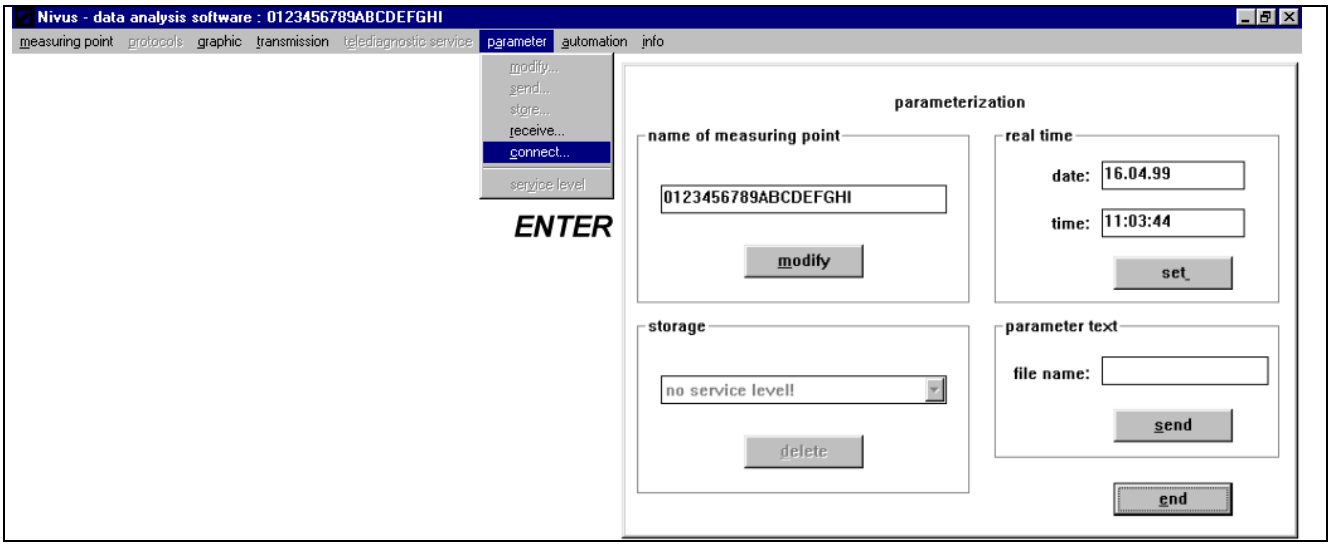


3. Configure interface and data transfer rate.

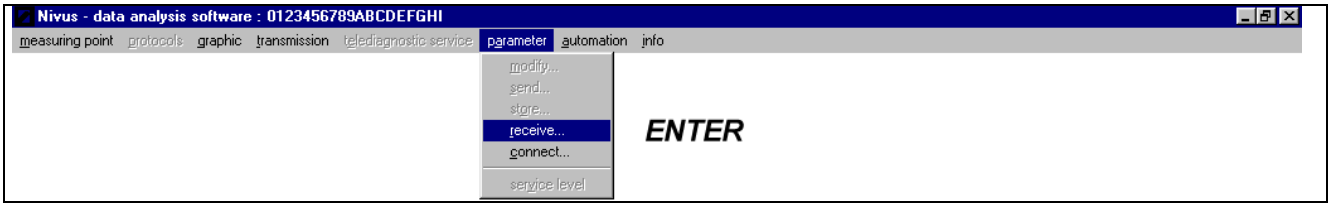
Initialization	2400 Baud
Transmit	19200 Baud



4. Transmit the name of the measurement place to the PCM3.
   Click Parameter - Connect to open the programming mask which enables to set the name of the measurement place and the system time.
   A click on „modify“ will transmit the new name to the PCM3. The default name of the name of the measurement place is „PCM“. This name will be overwritten in the PCM3 parameter list.
   Clicking the „Set“-button will transmit the PC or laptop system time to the PCM3. If multiple and parallel measurement places are to be observed, always use the same PC / laptop to ensure synchronized data evaluation.



5. Transmit parameters from PCM3 to PC/laptop.



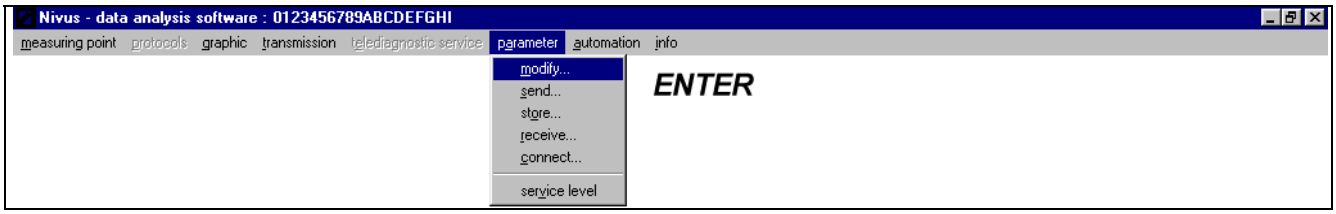
The current PCM3 parameter set now is saved on the PC/laptop under this name.

There is no online-connection between PCM and PC.

Hence, if the parameter set has been changed they have to be changed in the PC or the PCM as well.

After the parameters have been transmitted the connection from PC/Laptop to the PCM3 is offline again.

6. Modify parameters
   Now you can modify the parameters in the NivuLog software. To do this, either a list structure or a tree structure screen are available.
   The parameters are saved on PC / laptop and have to be transferred to the PCM3 after the parameter setting is finished.



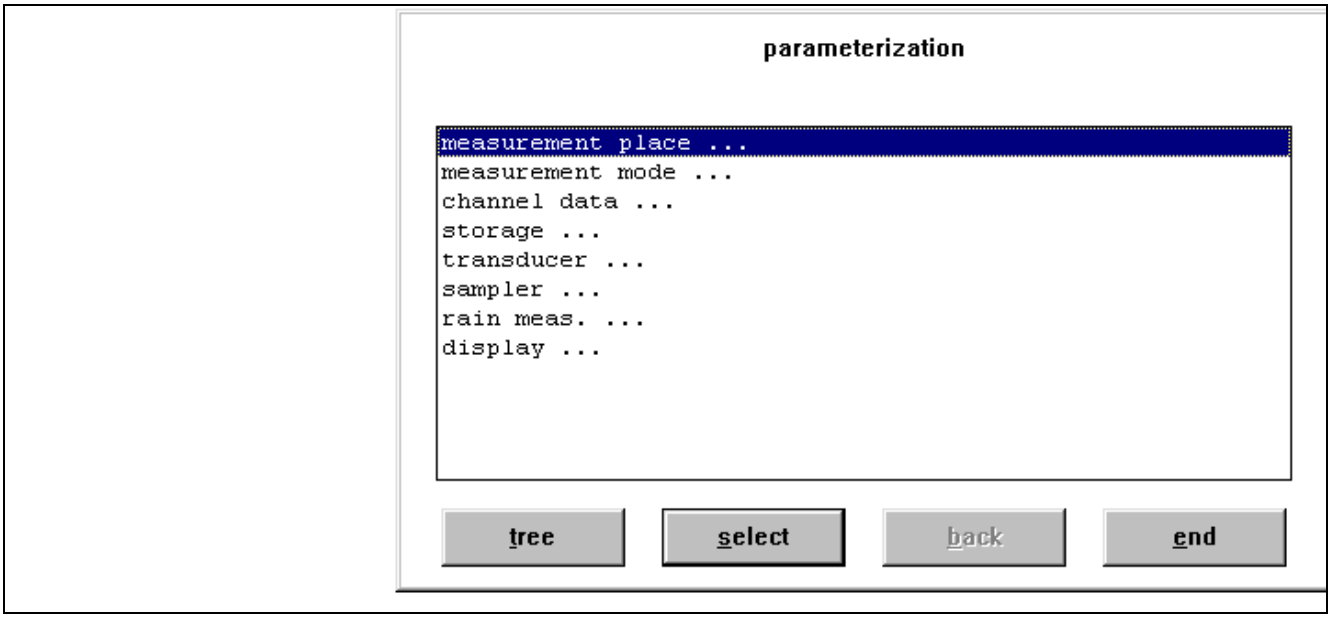


Fig. 8-2 List structure

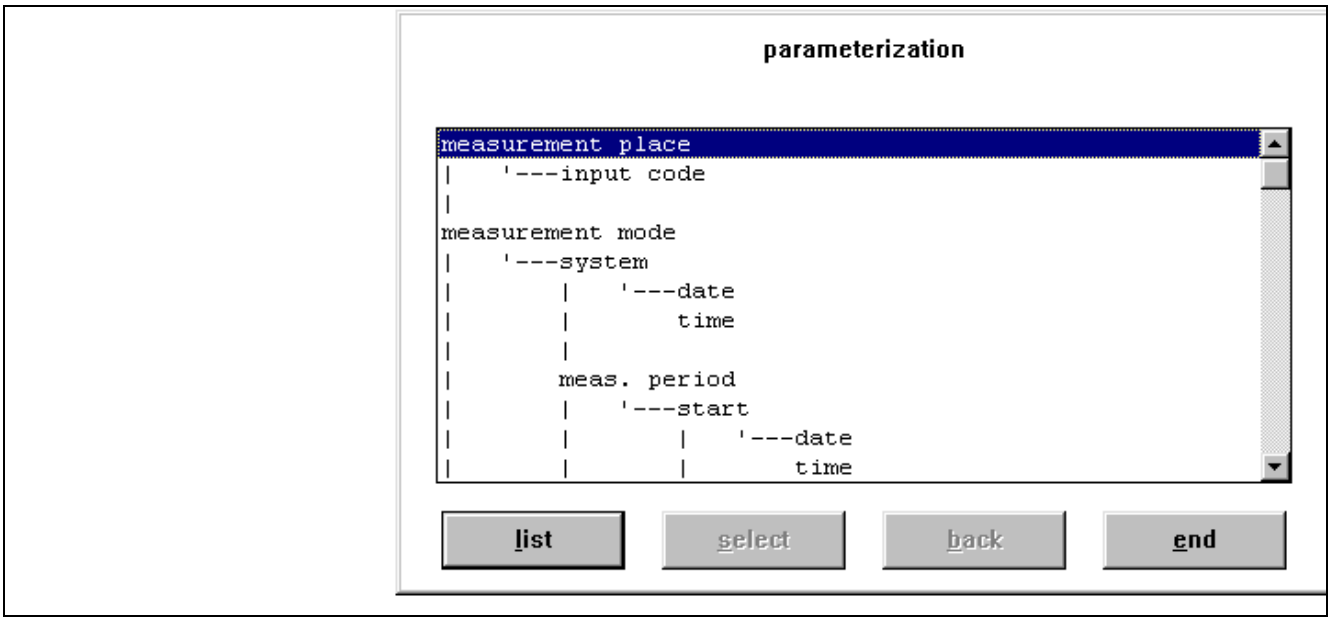


Fig. 8-3 Tree structure

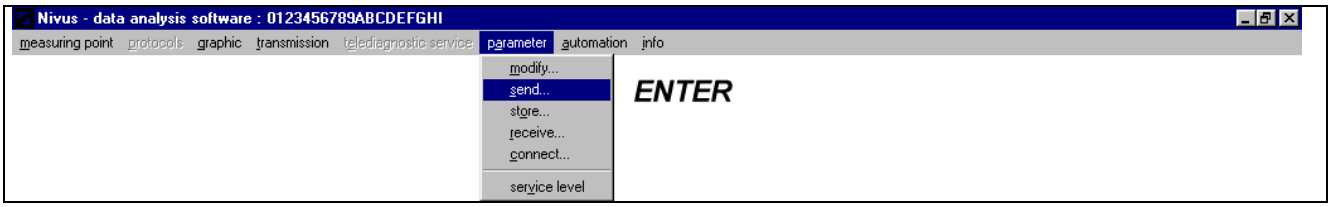


Fig. 8-4 Parameter transfer to PCM3

To be used anew on the same measurement place, it is sufficient to modify the parameters on PC and to transfer them from there.

8.3 Parameter Setting via Memory Card

To set the PCM3 parameters via memory card you need the MCA 2 card reader and a PC. Use the NivuLog software to set the parameters.
The following steps have to be made:

1. Connect the MCA 2 card reader to the PC via the serial port and start NivuLog. Plug the empty memory card into the card reader.
2. Select the respective Com-port in the NivuLog ***Transfer – Interface*** pull-down menu.
3. Select the ***Measurement Place***.

The PCM3 parameter settings can be made only if a measurement place with a respective set of parameters has already been created.

4. Eventually modify parameters under ***Parameter-Modify***.
5. Transfer parameters to memory card with ***Parameter-Save***.
6. Remove the memory card from the MCA 2 card reader and plug into the PCM3.

To do this, the PCM3 must be turned off.

7. Press ↵ and turn on the PCM3. The parameter set will be accepted (default >Yes<). Confirm with ↵. If the parameter set is successfully accepted a respective screen is displayed. The PCM3 now operates with the new parameter set.

To transmit parameters to the PCM3 by using a memory card at least one parameter set must be transmitted from the PCM3 to PC via the serial interface cable. The parameter set can be modified there. We recommend to create a measurement place named „PCM3 Parameters“ or similar without saving measurement data. In this measurement place the parameter set can be generated. Please note before transferring to the memory card to select the measurement name you want to save in the PCM3 in the menu „Measurement Place/Modify Names“. After the parameters are saved the measurement place can be renamed as „PCM3 Parameters“ again.

8.4 Sensor Calibration

8.4.1 Level Calibration

Level measurement combination sensor or hanging probe with atmospheric reference tube:

- Zero point divergences which depend on the sensor will be compensated automatically before each measurement.
- If the sensor is installed above or below the zero point this must be taken into account in the *Sensors/Level Sensor/Measurement Offset* setting.

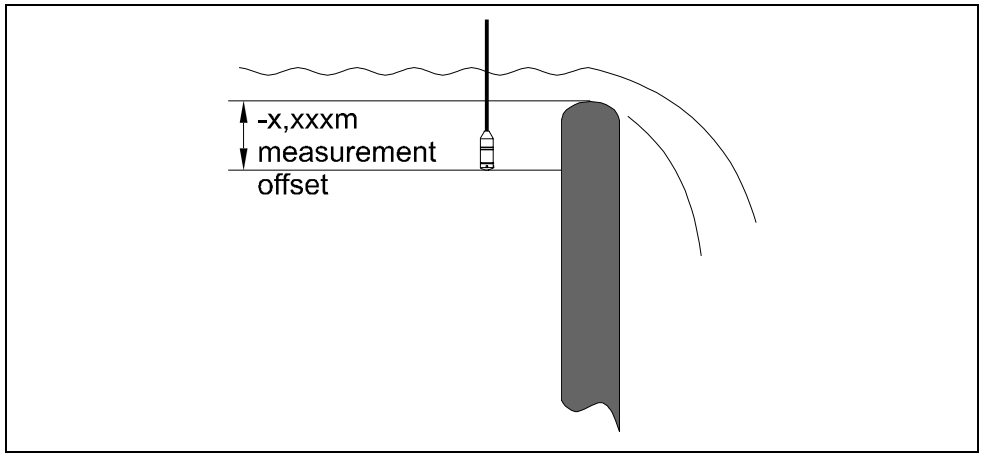


Fig. 8-5 Measurement offset hanging probe

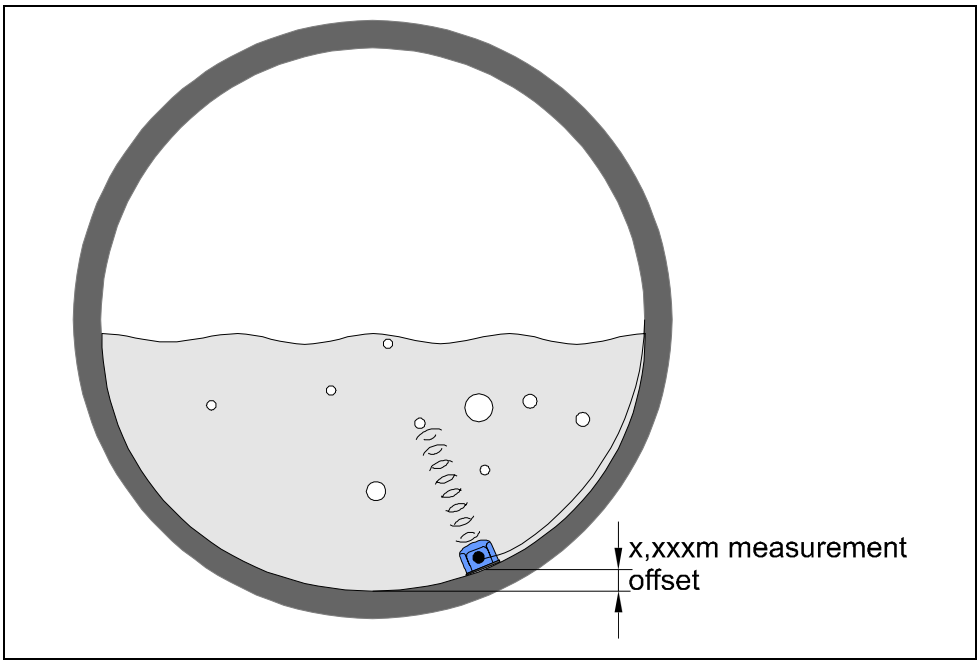


Fig. 8-6 Measurement offset combination sensor

8.4.2 Flow Velocity Calibration

As mentioned before in chapter 6.3.2.3 the hydraulic conditions of the measurement place are essential for an accurate flow velocity measurement. If no appropriate measurement place is available in accordance with the conditions mentioned before, the measurement faults which result from this can be (partially) compensated by carrying out a calibration.

Calibration by using the correction factor:

- Multiplication of measured flow velocities with a fixed calibration factor (menu: *Sensors/Velocity Sensor/Correction Factor*).

With this method measurement interferences, which proportionally affect the entire measurement range (e.g. a different sound velocity, beam angle and detection range of the measured flow velocity) can be compensated.

Example:
v _measured = 1,28 m/s (4.2 ft/s)
v_ Reference Value = 1,35 m/s (4.43 ft/s)
➔ Correction Factor = 1,35/1,28 (4.43/4.2) = 1,055

8.4.2.1 Q/h Characteristics

In certain levels a flow velocity measurement is not feasible.
In low levels (h <0,06 m / 2.4 in) or high flow velocities and low levels a reliable flow velocity measurement is not possible due to the sensor dimensions and the hydraulic conditions of the measurement place.

In this case the flow can be calculated in the lower level area by using the level. This can be carried out by a Q/h-characteristic or in tubes and rectangular channels by a stored calculation function.

To do this, the following steps must be made:

- In menu: Channel Data/divide h-Areas enter „yes“.
  In menu: Channel Data/h-Area1/Limit Level set the level below which Q is calculated by using h.
- For the lower level area (< h-Area 1 limit level) in menu: Channel Data/h-Area 1/ select Geometry (Q-Calculation without v).
- For the higher level area (> h- Area 1 limit level) in menu: Channel Data/h-Area 2/ select Geometry (Q-Calculation with v, e.g. pipe with v).
- In menu: Channel Data/ Geometry Data set the necessary values

8.4.3 Reference Value Investigation

To carry out a calibration reference values must be known. To determine them proceed as follows:

- Measurement of the surface velocity by using an appropriate floating body. The time which a floating body needs to float from point A to point B is measured and regarding the distance between the two points the flow velocity on the surface is determined. This velocity corresponds to the average flow velocity with an uncertainty of ±20 %. This method however is suitable only for carrying out a plausibility test.
- Reference flow velocity measurement by using the maximum flow velocity in the cross-sectional area multiply by 0.86. This factor has an uncertainty of approx. ±5 %.
- Reference flow measurement. Here the temporal correlation of both flows must be taken into account. Then a reference flow velocity must be determined by using the current level.
- Reference measurement of the average flow velocity according to current regulations (in Germany: VDE or DIN). Avoid varying flow values during the measurement period.
- Volumetric reference value of the flow volume over a certain measurement period. If the flow values should vary only an average calibration factor can be determined.

For spot measurement of reference velocities the following devices are sufficient:

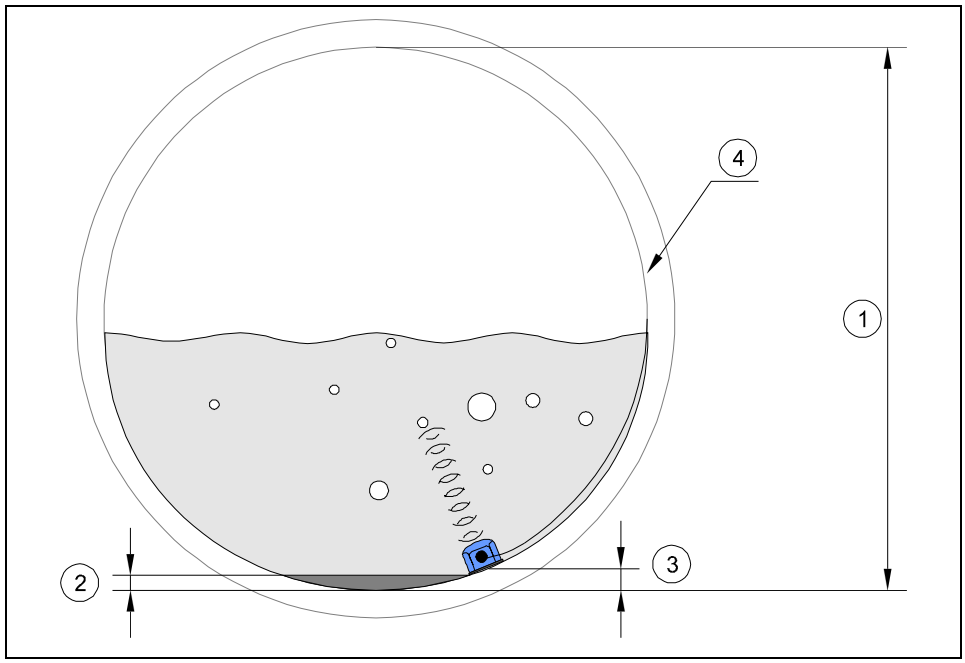
- Mechanical propellers
- Inductive rod probes
- Pulse-ultrasonic probes (e.g. NIVUS PVM-PD)

8.5 Applications / Examples

The following examples are given to guide you through the parameter setting process for your application. Since there is a multitude of possible variations and combinations for the PCM3, only typical applications are listed here.

8.5.1 Example 1 - Pipe

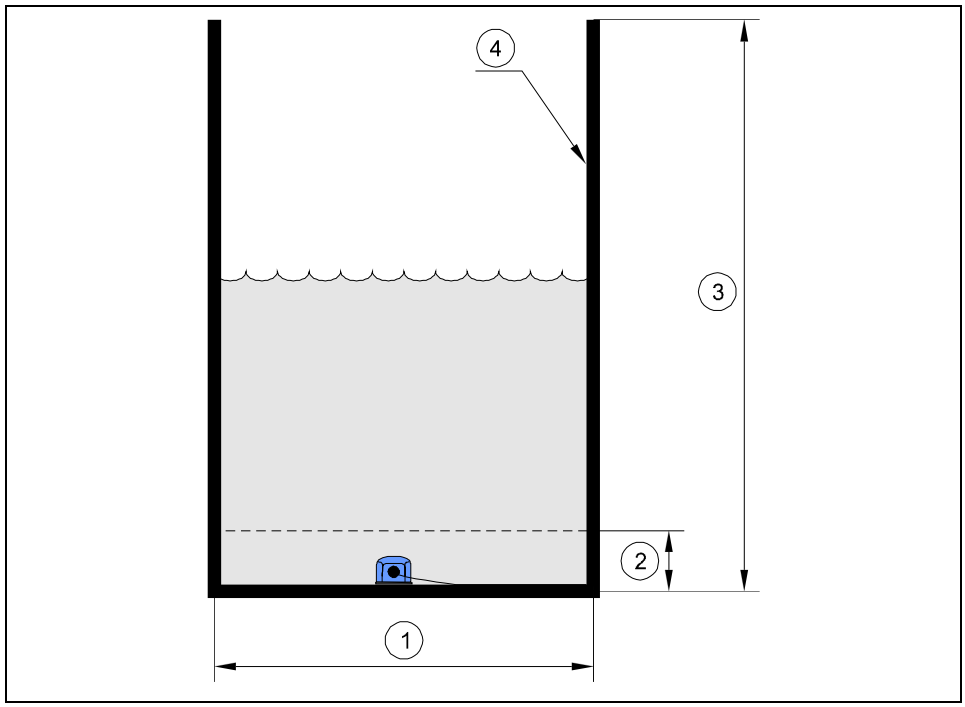
The measurement place is a pipe with 1m (3.28 ft) diameter. There is a permanent 3 cm (1.18 in) sludge/sand sedimentation in the pipe and the minimum water level is 12 cm (4.8 in). The installation place is set off the bottom middle in a height of 6 cm (2.4 in). By means of a velocity calibration the indicated value was found to diverge from the real value (0.37 m/s / 14.6 in) by +0,03 m/s (+1.18 in).



Reference	Main Menu / 1. Submenu / 2. Submenu / 3. Submenu	Entry
	Channel Data / subdivide h-Area	>no<
(1)	Channel Data / Geometry Data / Pipe / Radius	0,5 m (19.7 in)
(2)	Channel Data / Sludge Level	0,03 m (1.18 in)
(3)	Sensors / Level Sensor / Measurement Offset	0,06 m (2.36 in)
(4)	Channel Data / h-Area 1 / Geometry	Pipe with v
Calibration Velocity	Sensors / Velocity Sensor / Correction Factor (0,37:0,4 = 0,925)	0,925

8.5.2 Example 2 – Rectangular Channel

Rectangular Channel (width: 0,6 m (23.6 in), height: 1 m (3.28 ft)); minimum water level 0,0 m; slope 0,2 %; roughness according to table: 1,5 mm (0.06 in)



Reference	Main Menu / 1. Submenu / 2. Submenu / 3. Submenu	Entry
	Channel Data / subdivide h-Area	>yes<
	Switching Hysteresis	0,005
(1)	Channel Data / Geometry Data / Width Roughness Slope	0,6 m (1.97 ft) 1,5 2
(2)	Channel Data / h-Area 1 / Limit Level 1	0,05 m (1.97 in)
(3) Measurement Method between 0 - 0,05 m (0 – 1.97 in)	Channel Data / h-Area 1 / Geometry	Rectangle without v
(2)	Channel Data / h-Area 2 / Limit Level 2	1 m (3.28 ft)
(4) Measurement Method between 0,05 – 1m (1.97 in – 3.28 ft)	Channel Data / h-Area 2 / Geometry	Rectangle with v

8.5.3 Connecting an external 4-20mA Ultrasonic Sensors

Please note the ultrasonic sensor's instruction manual before the initial start-up. The following section is about PCM3 programming only.
It is possible to connect a 4-20 mA sensor to the PCM3. If programmed as level sensor 1 (under Menu / Sensors / Level Sensor) this flow level is used to determine Q.

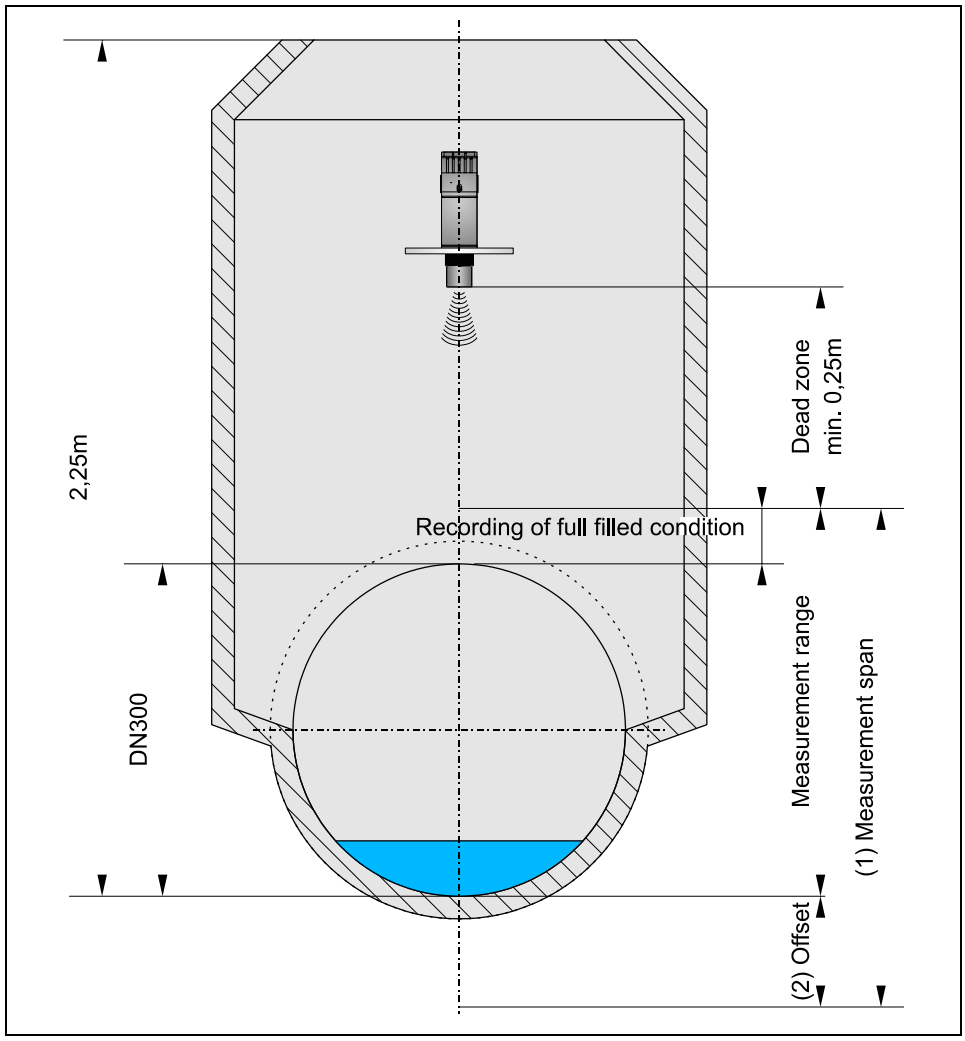
Reference	Main Menu / 1. Submenu / 2. Submenu / 3. Submenu	Entry
	Measurement Place / Service Level	>2718<
	Meas. Mode / Meas. Cycle / Duration of Measurement	15
	Meas. Mode / Meas. Cycle / Measurement Delay	18
	Sensors / Level Sensor / Measurement Mode	4-20 mA
	Sensors / Level Sensor / Area Border (m)	3.0
(1)	Sensors / Level Sensor / Sensor 1 / Measurement Span	see Drawing
(2)	Sensors / Level Sensor / Sensor 1 / Measurement Offset	see Drawing

If a 4-20 mA sensor is connected and programmed as 2. level sensor (under menu Sensors/Level(2)-Sensor) this level can only be additionally logged. No flow determination is carried out.

Reference	Main Menu / 1. Submenu / 2. Submenu / 3. Submenu	Entry
	Measurement Place / Service Level	>2718<
	Meas. Mode / Meas. Cycle / Duration of Measurement	15
	Meas. Mode / Meas. Cycle / Measurement Delay	18
	Sensors / Level(2)Sensor / Base	Value at 4 mA
	Sensors / Level(2)Sensor / Span	Value at 20 mA
(2)	Sensors / Level(2)Sensor / Offset	see drawing

The level sensor (4-20 mA ultrasonic sensor, e.g. type Probe) should be programmed as follows:

4mA Value	Measurement Range + Offset
20mA	Dead Zone
Dead Zone	0,25 m (9.85 in)(Probe)
Damping	0 / instantly
Failsafe	22 mA
Unit	m



8.6 Operation

The operation mode is subdivided in:

- status mode which displays current measurement values and additional info menus without saving the measurement values – continuous operation
- measurement mode which saves the measurement values – storage operation

8.6.1 Status Mode

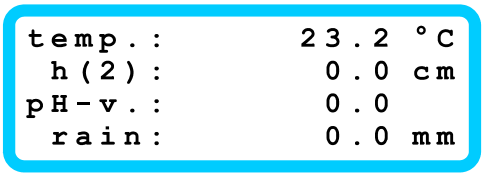
The status can be activated by pressing any key during the measurement break (sleep mode, LC display deactivated) of the PCM3. By Pressing ESC or approx. 3min. after the last key activity the status mode will be left. The measurement mode is activated automatically again.
Alternatively selecting >Continuous Operation<in ***Menu Measurement Mode / Measurement Cycle / Operation Mode*** will continuously activate the status mode. Pressing ↵ will turn on the PCM3 and ESC turns it off.

While the status mode is active and parameters are set no measurement values are saved.

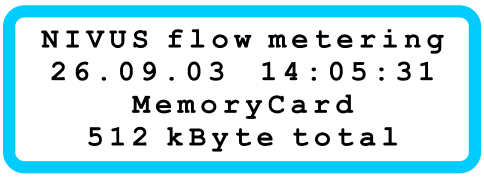
If the PCM3 is in measurement mode this mode will be interrupted. Measurement values for this cycle cannot be saved correctly therefore. Hence, the status mode should be activated during measurement breaks only.

Pressing ◄ ► in the status mode will call up additional information on the display.

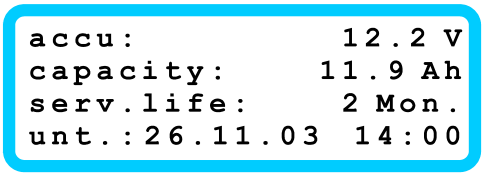
Additional Values:



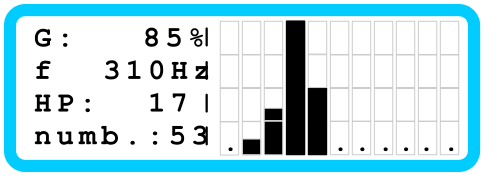
Memory Card Status:



Rechargeable Battery Status:



Frequency Histogram of Flow Velocity:



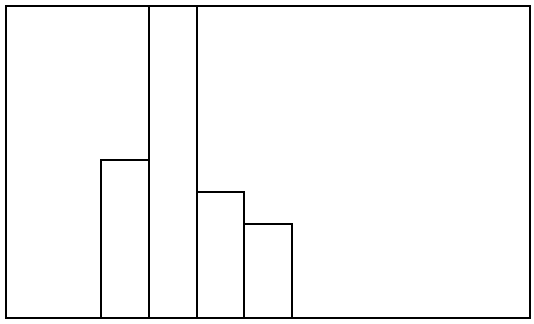
G:	=	% quality
f:	=	Hz, investigated Doppler frequency for flow velocity
HP:	=	Main Peak
Num:	=	Number of frequencies measured in the HP-Group

The frequency histogram shows the distribution of the investigated Doppler frequencies. Each bar (peak) represents a group of frequencies. Eleven frequency groups can be displayed. The bandwidth of the groups is automatically adjusted to the velocity range.
The distribution and the formation of the frequency groups allows to make a statement about the quality of the flow velocity measurement. This is particularly important for assessing and selecting a measurement place as well as selecting the sensor installation place.

Quality (G):
The measurement quality (0-100 %) shows the relation of the evaluated Doppler frequency to the total spectrum of the measured frequencies. Since here complex algorithms are in use a more detailed explanation is not feasible. It basically applies: the higher the quality value the more trustworthy the displayed flow velocity value. A quality below 15 % makes the measurement value to be rejected.
But there are cases in which, despite relatively high quality values, the flow velocity measurement value is not determined correctly. Here, in addition the shape of the frequency distribution must be taken into account.
Following some typical distributions are shown which help to assess histograms in practical use:

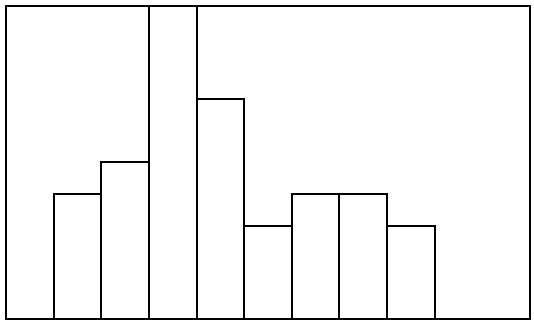
Histogram Types

Measurement perfect:



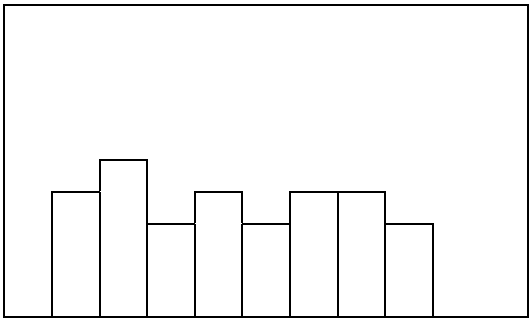
Narrow bandwidth with stable and very high main bar (peak) compared with the secondary bars.
The quality is mostly higher than 80 %.

Measurement normal:



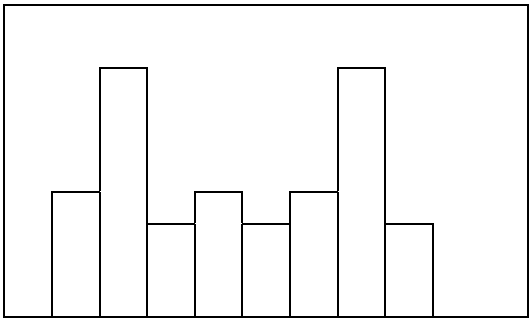
Wide bandwidth with stable (variation about ±1 bar max.) higher main bars.
Quality >40 %

Measurement with low medium reflection quality:



Very wide bandwidth without a stable or higher bar compared with the secondary bars, quality <30 %. Eventually bar formation with a Doppler frequency which is far below the real Doppler frequency of the flow velocity. The quality may be here >30 %. Nevertheless a flow velocity is displayed which is by far too low. If the number or the size of the reflecting particles is too low this may be the reason for a bad measurement quality.

Measurement with interference influences:



Fluctuating main bar around several frequency groups and wide bandwidth. The evaluated Doppler frequency (F) fluctuates very badly.
Despite quality >40 % an incorrect velocity is determined or the velocity is not stable and fluctuates very badly. Vortex formation, standing waves, very wavy water surfaces or unfavourable sensor installation places may cause such histograms (see chapter 6.3.2.3).
Select another installation place for the sensors or another measurement place.

8.7 Transmitting stored Measurement Data to PC

Transmitting the stored measurement data can be carried out in two ways:

- Direct readout of the Memory Card plugged into the PCM3 via RS232 connection to PC
- Readout of the unplugged Memory Card using the MCA 2 card reader

The name entered in the PCM3 under the menu ***Measurement Place/Name*** must be the same as the measurement place selected in NivuLog. This serves as a protection to prevent from unintentional data archiving under a different measurement place.

If you change cycle times and units of a measurement place you should create a new name and a new measurement place. Data records with varying units or measurement cycles lead to incorrect representations and calculations on the PC.

8.7.1 Direct Readout via RS 232 from PCM3 to PC

- Connect the PCM3 to PC via a RS232 cable
- Start NivuLog and select or create the respective name of the measurement place under ***Measurement Place/select***.
  (Attention! The selected measurement place must have the same name like entered in the PCM3 under ***Measurement Place/Name***)
- Start the status mode on the PCM3 by pressing ↵.
- Start data transfer with NivuLog menu ***Data Transfer/RS232***. A successful transfer will be confirmed on the display.
- If the measurement place is not yet created please proceed as described in chapter 8.2.1.

8.7.2 Data Transfer by reading out the Memory Card with Card Reader

Activate PCM3 status mode by pressing ↵. Remove Memory Card and plug into the MCA 2 card reader.

Do not remove the Memory Card while the device is in measurement mode. This may cause loss of data.

Start NivuLog and select the measurement place under ***Measurement Place/select***. Start data transfer with ***Data Transfer/Memory Card***. A successful transfer will be confirmed on the display. If the name of the measurement place which is stored on the Memory varies from the measurement place on the PC the following screen appears:

The stored name of the measurement place on the Memory Card is in the brackets [ ]. Please create a new measurement place with this name.

Memory Card Capacities (Guidelines)

		64k	128k	256k	512k	1024k
1 min.	without external signal	1,8 days	3,7 days	7,5 days	15 days	30,5 days
	with external signal	0,9 days	1,8 days	3,7 days	7,5 days	15 days
3 min.	without external signal	5 days	10,2 days	20,5 days	1,3 months	2,6 months
	with external signal	2,5 days	5 days	10 days	20,5 days	1,3 months
5 min.	without external signal	7,6 days	15,5 days	31 days	2 months	4 months
	with external signal	3,5 days	7,5 days	15 days	1 month	3,3 months
10 min.	without external signal	12,6 days	25,6 days	1,6 months	3,3 months	6,7 months
	with external signal	6 days	12 days	26 days	1,6 months	3,3 months
15 min.	without external signal	16 days	32 days	2,1 months	4,2 months	8,5 months
	with external signal	8 days	15,5 days	1,1 months	2,1 months	4,2 months
30 min.	without external signal	22 days	1,4 months	2,9 months	5,8 months	11,7 months
	with external signal	11 days	21,5 days	1,5 months	2,8 months	5,8 months
60 min.	without external signal	27 days	1,7 months	3,5 months	7,2 months	14,4 months
	with external signal	13,5 days	27 days	1,7 months	3,6 months	7,2 months

Without external signal:
level/velocity/volume/temperature storage only

With external signal:
additional digital or analog input rainfall/analog input 2/conductivity/pH-sensor

8.8 Battery Change

Turn the wing nuts of the battery cover counter clockwise until you hear a crack (approx. ½ turn). Remove the cover and unplug the battery. Remove the battery and put in a completely charged rechargeable battery. Press [↵] and start the PCM3. Select the status menu ***Battery*** by pressing [►].

Select "Battery charged?" with the [▼] / [▲] keys and press [▲] to set the screen to > Yes <. Confirm with [↵].

The PCM3 always assumes a completely charged battery to be in the device. If the battery should not be charged by mistake, this cannot be recognized by the PCM3. Hence, the calculated lifetimes are faulty. A completely charged battery always should indicate a voltage higher than 12.5 V.

Before using the device on a new measurement place it should be equipped with a completely charged battery.

The battery change is made similar to the change of the rechargeable battery. After the batteries have been replaced they are recognized by the PCM3 and the messages in the menu will be adapted respectively.

The PCM3 assumes a battery capacity of 18 Ah. If older or partially discharged batteries are in use the calculated lifetime does not correspond to the real lifetime. This must be taken into account by considering a certain safety factor.

The lifetime display of the PCM3 indicates a value which is calculated from capacity, measurement cycle and measurement duration. Hence, it can be considered as a typical value.

Rechargeable Battery Lifetime (Guidelines)

	PCM 3
	19 000 measurement values with 12 Ah
1 min.	13,2
3 min	39,6
5 min.	66,0
10 min.	131,9
15 min.	197,0
30 min.	395,8
60 min.	791,7

9 Parameter Tree with Description

9.1 Measurement Place

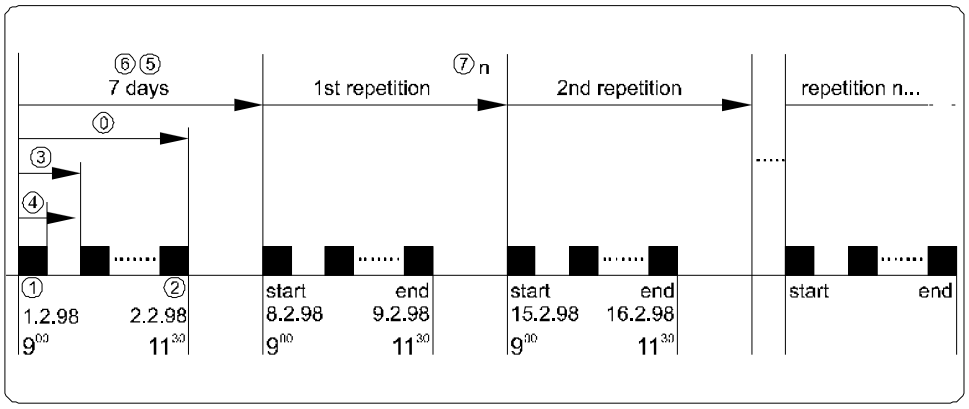
Main Menu	1. Submenu	2. Submenu	3. Submenu	Default	Remarks
Meas. Place					
	Name			PCM	18 characters max., no special characters  Cursor must be under the last character entered. If it is right from there it will be considered as a blank!
	Entry Code			67	
	Service Level				Activate with code number 2718. All menus in *italics* are indicated in the PCM3 display only when the service level is activated.

9.1.1 Measurement Mode

Main Menu	1. Submenu	2. Submenu	3. Submenu	Default	Remarks
Meas. Mode					
	System Time				Enter the current time and date
		Date			DD:MM:YY
		Time			hh:mm:ss
	Meas. Period				
		Begin of Meas.			
			Date		DD:MM:YY
			Time		hh:mm:ss
		End of Meas.			
			Date		DD:MM:YY
			Time		hh:mm:ss
		Meas. Cycle			
			Storage Cycle (min)	10	Cycle for measurement value storage (1,3,5,10,15,30,60)
			Duration of Meas. (s)	20	Value recording time during a storage cycle. with combination sensor: typically 20 s with ext. ultrasonic sensor: typically 15 s
			Meas. Delay (s)	4	Value stabilization time of the sensors. with combination sensor: typically 4 s with ext. ultrasonic sensor: typically 18 s

			Operation Mode	Storage Mode	Storage Mode = periodic measurement value recording and storage according to storage cycle; Continuous Operation = simple measurement value indication without value storage; Event Mode = the periodic value recording will be started in case of an event  When in event mode in the parameters begin of measure-ment and end of measurement dates from the past must be entered.
			Begin of Event depends on	Level	Event start referring to: Level (approx. 3 cm (0.39 in) level fixed default) Rainfall (at first rain impulse) Level *or* rainfall (see above)
			End of Event depends on	Level threshold	An event is considered as finished if: value falls below threshold h value falls below thresholds h and Q value falls below threshold Q value falls below thresholds h and rainfall
			Level Threshold (m)	0,035	
			Flow Threshold (m^3/s)	0	
			Rainfall Threshold (mm/D)	0	
			Number of Meas. Cycles after Event	5	Number of storage cycles in event mode after the cycle mode has been left.
	Repeat of Meas. Period				A measurement period can be repeated periodically. The duration of the measurement period however must be shorter than the selected time unit.
		Time unit		no repeat	hour, day, month
		Period of Time			Number of time units after the begin of the first measurement period, before the start of the second measurement period

		Number of Repeats			Number of measurement periods



1. Begin of Measurement
2. Measurement Mode
3. Storage Interval
4. Duration of Measurement + Measurement Delay
5. Repeat of Measurement Period (Time Unit)
6. Period of Time
7. Number of Repeats

9.1.2 Channel Data

Main Menu	1. Submenu	2. Submenu	3. Submenu	Default	Remarks
Channel Data					
	subdivide h-Area				Normally the level area must not be subdivided. It is not necessary to enter values for h-area 2 and 3. If in the lower filling area the measurement should be carried out by using the level only (Q/h-relation) >yes< must be entered.
	Switching Hysteresis (m)			0	If 2 or 3 h-areas are activated
	Sludge Level (m)			0	 Using the sludge level the not wetted part of the cross section is considered. Cannot be used for Q-determination via level only.
	h-Area 1				
		Limit Level 1 (m)		3	If „subdivide h-areas“ >yes< only. Up to this threshold Q can be determined by using the level.
		Geometry		Pipe with v	Here the channel geometry and the calculation mode for the entire level area (or h-area 1 only) can be selected. Selection: None Egg 1:1,5 with v A f(h) with v U-Profile with v Trapezoid with v Rectangular with v Pipe with v Rectangular without v Q f(h) Pipe without v Flume
		V_check_min (m/s)		0	
		V_check_max (m/s)		0	
	h-Area 2				If subdivide h-areas >yes< only
		Limit Level 2 (m)		0	Normally channel height in closed channels. In open channels expected maximum level

		Geometry		none	
		V_check_min (m/s)		0	
		V_check_max (m/s)		0	
	h-Area 3			0	Select in special cases only in accordance with the manufacturer.
		Limit Level 3 (m)		none	
		Geometry			
		V_check_min (m/s)		0	
		V_check_max (m/s)		0	
	Geometry Data				Here the selected channel geometry is defined more detailed.
		Flume			
			h_max (m)	0	
			Q_max at h_max m3/s)	0	
			Exponent	0	
		Pipe			
			Q_max full (m^3/s)	0	Take from table list. Slope and roughness must be known. If entered Q will be determined using a internally programmed Q/h-curve stored in PCM3. Only the level is measured then. Please select pipe without v under geometry. If under geometry pipe with v is selected this parameter will not be set.
			Radius (m)	0,5	
		Q=f(h)			Freely definable Q/h - relation
			Number of Value Pairs	0	Min. 2; max. 32; X = h [m] / Y = Q[m^3/s]
		Rectangular			
			Width (m)	0	
			Roughness (mm)	0	Take from table list or enter 1,5.
			Slope (0/00)	0	Enter in thousandth
		Trapezoid			
			Lower Width (m)	0	
			Upper Width (m)	0	
			Height (m)	0	

		U-Profile			
			Radius (m)	0	
		A=f(h) with v			Channel profile linearization
			Number of Value Pairs	0	Min. 2; max. 32; X = h [m], Y =A[m²]
		Egg Profile standardized 1:1.5 with v			
			Width (m)	0	

9.1.3 Storage

Main Menu	1. Submenu	2. Submenu	3. Submenu	Default	Remarks
Storage					
	Store Values				
		Level		YES	
		Velocity		YES	
		Flow		YES	
		Temperature		YES	
		Level 2		NO	 Activate, if 2. external level sensor is connected.
		PH		NO	
		Rainfall Vol.		NO	
	Reset				
		Delete Rainfall Volume			Deletes display totalizer
		Delete Overall Volume			Deletes display totalizer
		Delete Memory / Memory Card			
		Delete Parameters (with code only)			Code 2718
		Overall System Reset (with code only)			Use in accordance with the manufacturer only
	Maximum Flow Values				
		Q max (m³/s)		4	If the expected flow is higher than the value set, this value must be changed. The value serves as a scaling for Q. Q is transferred to PC with a 16bit resolution.
		Q min (m³/s)		0	Lower flow volumes than the entered value are set to zero.

9.1.4 Sensors

Main Menu	1. Submenu	2. Submenu	3. Submenu	Default	Remarks
Sensors					
	Level Sensor				
		h_max (m)		3	Value may only be changed if a external 4-20 mA level sensor is in use whose value at 20 mA is higher than the entered value. The value at 20 mA should be entered here. This value serves as a scaling for h. The level value is transferred to PC with a 16 bit resolution.
		h_min (m)		0	
		Meas. Mode		Pressure Board 2	 Change only if a 4-20 mA level sensor is used as level sensor 1.
		Meas. Offset (m)		0	Level measurement adjustment, this value is added to the measurement value (see chapter 8.4.1).
		Area Border (m)		0,65	
		Hysteresis (m)		0,005	
		Pressure Pump			
		Sensor 1(m)			
			Meas. Span (m)	0,7	 Change only if an external 4-20 mA sensor is in use. Value at 20 mA (in pressure mode enter 0,7 m (2.76 ft))
			Meas. Offset (m)	0	
		Sensor 2 (m)			 No adjustment necessary
			Meas. Span (m)	3	
			Meas. Offset (m)	0	

		Flush Function		NO	If the flush function is active the level measurement pump will start periodically. Important for event mode!
	Velocity Sensor				
		Signs allowed		NO	Direction finding can be activated
		Meas. Value / Meas. Cycle		100	Minimum number of impulses per measurement value
		SQ1 Limit Value in %		15	Number of occupied frequency groups divided by 15
		SQ2 Limit Value in %		15	Number of frequencies HP / number of valid frequencies
		Maximum Meas. Time		5	Max. measurement time in sec. per measurement value if the minimum impulse number has not yet been reached
		Damping		5	Damping value
		HP Distance		3	Number of frequency groups adjacent to the main peak frequency group up and down to determine the statistically investigated frequency
		Maximum v-Errors		5	Number of allowed successive measurement errors
		v-horizontal in m		0,988667	Proportionality factor between measured velocity and investigated Doppler frequency at horizontal sensor position.
		Beam Angle in°		44	Beam angle relative to horizontal line
		Correction Factor		1	By changing the factor velocity measurement divergences can be compensated (see chapter 8.4.2).
		v max (m/s)		5	Measurement values > v max will be set to v max
		Temperature Correction		YES	Temperature compensation of the velocity signal
		Reference Temperature in °C		20	
		Temperature Coefficient in %		0,23	Temperature correction for v–measurement

		Linearization			By using value pairs the flow velocity can be corrected depending on h and v.
			Number of Value Pairs F v(h) -	0	Min. 2; max. 32 X= Level value; Y= Correction factor
			Number of Value Pairs F v(v) -		Min. 2; max. 32 X= v_real; Y = v_set point value
		Meas. Value Verification			Definition of how to proceed if the maximum number of measurement errors exceeds
		Diagnosis			
	Temperature Sensor				
		Base (S)		0	
		Span (S)		333,2	
		Offset (S)		-273,2	
	Level (2) - Sensor				If an additional external level sensor is connected.  The level signal will not be taken into account for flow determination. Under save measurement values this value must be activated!
		Base (S)			Value at 4 mA
		Span (S)			Value at 20 mA
		Offset (S)			Value which will be added to / subtracted from the measurement value. Necessary for zero point correction at 4-20mA sensors.
	pH-Sensor				See also quick manual pH-measurement
		Base			
		Span			
		Offset			
		Zero Point			
		Slope			
		Temp. Corr.			
	24V DC			NO	Activates the 24 V supply for external Sensors (e.g. pH) via PCM3

9.1.5 Sampler

Main Menu	1. Submenu	2. Submenu	3. Submenu	Default	Remarks
Sampler					Set only if a sampler is connected.
	active			NO	
	Mode				Depending on time depending on Q
	Min. Level (m)			0	Impulse to the sampler is emitted only if the entered minimum level exceeds. This prevents from drawing in air.
	Time until Sample (min)			0	
	Q until Sample (m^3)			0	

9.1.6 Rainfall Measurement

Main Menu	1. Submenu	2. Submenu	3. Submenu	Default	Remarks
Rainfall Meas.					
	(mm)/Pulse			0	Set the precipitation level which corresponds to a rainfall impulse.

9.1.7 Display

Main Menu	1. Submenu	2. Submenu	3. Submenu	Default	Remarks
Display					
	active			Yes	
	Function			Flow Meas. Values	PCM3 start screen: Flow measurement values Rechargeable battery lifetime Date & Time Other measurement values
	Interval			1	
	Damping			10	
	Dim. Level			cm	m
	Dec. Digits Level			1	
	Dim. Velocity			m/s	cm/s
	Dec. Digits Velocity			2	
	Dim. Flow			l/s	m^3/s , m^3/h
	Dec. Digits Flow			1	
	Dim. Total Volume			m^3	l

	Dec. Digits Total Volume			1	
	Dec. Digits Temperature			1	
	Dec. Digits Level (2)			1	
	Dec. Digits pH-Value			1	
	Dec. Digits Rainfall Volume			1	

9.1.8 Rechargeable Battery / Battery

Main Menu	1. Submenu	2. Submenu	3. Submenu	Default	Remarks
Battery					
	active			YES	
	Capacity (Ah)				Indicates the current capacity of the rechargeable battery
	max. Capacity (Ah)			12	Change only if not the manufacturer's rechargeable battery is in use. Standard batteries (8x mono cells 1,5 V) are recognized automatically and the capacity will be set to 18 Ah.
	Alert Threshold (Ah)			2	From this investigated residual capacity on a message is indicated on the display. Attention! The real residual capacity may diverge.
	Power Consumption				For correct lifetime investigation change only if: **1.**: external 4-20 mA level sensor and PCM3 with flow velocity are in use (Art. No.: PC3/PCM3VP.....) **2.**: external 4-20 mA level sensor and PCM3 (Art. No.: PC3/PCM300.....) are in use **3.**: level sensor with bubbling and PCM3 (Art. No.: PC3/PCM30P.....) are in use
		Internal		40	Do not change value
		External		70	**1.**: increase value by 40 mA **2.**: set value to 40 mA **3.**: set value to zero
		Pump/Valve		255	**1.**: set value to zero **2.**: set value to zero **3.**: do not change value

10 Troubleshooting

Error	Eventual Reason	Remedy
No / faulty flow display	Sensor	No velocity or level measurement (see velocity / flow level measurement).
	Programming	Check geometry – e.g. pipe radius, Q/ h.....
No velocity display	Connection	Check sensor cable connection on PCM3.
	Sensor	Check sensor for flow direction and horizontal installation.
		Check sensor for pollution, false layout, silting-up (remove) or damage (replace sensor).
		Doppler functionality test: rub over the transmitter / receiver area (45° slope) with a wet cloth – indication of flow velocity
		Cable break suspected – sensor must be sent to manufacturer for verification.
	Programming	Check pipe geometry (e.g. pipe with v – measurement) Programming a Q/h-characteristic - > no active V-measurement – limit level reached? Eventually carry out parameter reset (2718) or system reset – Attention! Save parameters in a new measurement place before!!!
	Application	Standing water?
Faulty velocity display	Programming	False correction factor, check calibration, check average flow velocity with an appropriate measurement device(e.g. PVM–PD).
No / faulty flow level display	Sensor	Check sensor cable on PCM3.
		Check pump function – (press vertical arrow keys simultaneously).
		Water inside of air hose - > Was the sensor removed from the transmitter while being installed? Dismantle sensor and eventually force out the water with compressed air.
		Air outlet position changed? – Incrustation causes offset. Unscrew, remove and clean mounting sheet.
	Transmitter	Check pressure compensation membrane.
	Programming	Check transmitter parameterization –> sensor offset: Parameter mode – sensors – measurement offset? Eventually carry out parameter reset (2718) or system reset – Attention, save parameters!
		Correct sensor selected ? Pressure board 2 or 4-20 mA.
No display (black / flickering), device cannot be turned on	Power supply	Charge rechargeable battery and check the voltage / Attention at deep discharging! Rechargeable battery plugged in?
Faulty T-display (-237 °C)	Sensor	Sensor type? T-display with combination sensor only!

Error	Eventual Reason	Remedy
		Cable break or sensor defect
Unstable measurement values	Measurement place hydraulically unfavorable	Check the quality of the measurement place by using the graphic frequency histogram display. Change the sensor position to a place which is hydraulically better (enlarge the stilling distance).
		Remove von pollution, sedimentation or obstructions before the sensor.
		Equalize the flow profile by installing appropriate baffle plates, stilling elements, diffusers or similar before the measurement point.
	Sensor	Check sensor for flow direction and horizontal installation.
		Check sensor for pollution or false layout.
Value implausible	Measurement place hydraulically unfavorable	See „Unstable measurement values“ / check frequency histogram
		Check sensor for vibration freeness, pollution, flow direction and horizontal installation.
	Programming	Check measurement place geometry, dimensions (note units), sensor type, sensor installation height etc. Eventually carry out parameter reset (2718) or system reset – Attention, save parameters!!
		(Plausibility test: save temperature value – temperature progress line should correspond with level progress line.)
No / incomplete Data on Memory Card	Memory Card	Card write-protected? / PCM3 message? – check write protection
		Internal 3 V Li-battery voltage lower than 2,7 V – replace battery
		Send card to manufacturer for verification.
		Card full? Note PCM3 messages.
	Transmitter	Memory Card not plugged correctly (not deep enough)? – Note PCM3 messages.
	Programming	Storage not activated under >Parameter – Storage – Save Values<.
		Check measurement period (check PCM3 status message during automatic shutdown)

11 Resistances

The medium contacting parts of the PCM3 consist of:

- V4A (ground plate or pipe sensor jacket)
- Polyamide (sensor)
- Polyurethane (cable sheath and screwing)

The sensor technology is resistant to normal domestic sewages, dirt- and rain water as well as mixed water from municipalities and communities. It is nevertheless not resistant to all substances and substance mixtures.
Basically, there are dangers in chloride media as well as in various organic solvents!

Please note that in substance mixtures (simultaneous presence of several substances) possibly catalytic effects may occur which may not occur in single substances. These catalytic effects cannot be tested completely due to the infinitely high possibilities of variations.
If in doubt please contact your responsible NIVUS representation and request a free material sample for a long time test.

12 Maintenance and Cleaning

If in contact with measurement system, transmitter, cables and sensors particular precautions must be taken due to frequent use in the waste water field which may be loaded with pathogenic germs.

12.1 General

The maintenance extent and intervals depend on the following factors:

- measurement principle of the level sensor
- material wear
- measurement medium and hydraulic channel conditions
- general regulations for the operation of the measurement devices

To ensure safe, accurate and trouble-free operation we recommend to carry out an inspection by NIVUS once a year.

12.2 Sensors

12.2.1 General

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

12.2.2 Level

12.2.2.1 Air-ultrasonic

If an air-ultrasonic sensor is in use aging effects and progress line changes are not expected. Since these sensors normally operate contact-free just control if the transmitting area is not covered and the sound beam is free to reach the water surface after immerging (flooded condition).

12.2.2.2 Air Bubbling (Combination Sensor)

Since level measurement by air bubbling is drift-free and the zero point is adjusted before each measurement a measurement span and zero point adjustment is not necessary.
If the medium contains substances (e.g. grease, lime) which deposit on the pressure orifice, these substances have to be removed. Otherwise this may cause a faulty measurement. To do this, eventually the sensor mounting plate must be removed. Clean the orifices with a brush, much water and a cleansing agent. Sedimentation on the channel bottom may be another cause of faults for the calculation of the wetted section and must be removed therefore.
High flow velocities and solid substance contents (glass; stones, sand) in the medium may lead to sensor abrasion which makes it necessary to replace the sensor after a certain operation period. This is normal sensor wear. In most applications after many years of operation no significant abrasion could be found though.

12.2.3 Flow Velocity

Aging effects (zero point or progress line fluctuation) do not happen due to the use of the ultrasonic Doppler method.
Sewer, grease and oil films do not influence the measurement value. Heavier sedimentation or if the sensor is completely covered with sludge, fibrous substances or sand damp the signal in such a way that this may lead to a faulty measurement or even to a complete measurement failure. Regular maintenance and cleaning of the measurement place is necessary then.
Abrasion on the transmitting and receiving area of the Doppler sensors leads to a signal attenuation which in extreme cases may cause sensor destruction. Here the same remarks apply as mentioned before.

12.3 PCM3

12.3.1 Enclosure

- The enclosure must be checked for tightness regularly. The black sealing in the lid must be checked for mechanical damage.
- Unused plugs must be sealed tightly with the respective caps. The pressure compensation orifice on the back of the enclosure must be kept clean. If the orifice should be mechanically damaged it must be absolutely replaced to ensure IP 67 protection.
- The desiccating bag with silica gel, which is in the enclosure besides the rechargeable battery, should be dried or replaced regularly.
- After sensor removal absolutely screw the locking caps on the sockets. Dirty threads may cause leakage and thus the IP 68 protection of the plugs is no longer ensured.

12.3.2 Rechargeable Batteries/Batteries

In the course of time the lead storage battery loses its maximum capacity. This reduces the lifetime which cannot be taken into account by the program. All energy calculations are based on assuming that the rechargeable battery has a capacity of 12 Ah. The self-discharge is approx. 3% per month. At low temperatures the available capacity is decreasing. To take this into account it is assumed for lifetime calculation that only 10 of 12 Ah are available. If these 10 Ah are theoretically used up the message “Rechargeable Battery Threshold” is displayed on the screen.

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

The PCM3 rechargeable battery should be charged each time before using. If unused it should be charged after two months at the latest to ensure a long-lasting charging capacity.

Batteries must not remain in the PCM3 for a longer period after discharge.
Please dispose compatible with the environment.
Worn lead storage batteries can be returned to the manufacturer or can be brought to an appropriate dump.

13 Dismantling/Disposal

The device must be disposed according to local regulations and to local environmental restrictions for electronic products.

14 Table of Pictures

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