
Speedy Firmware 4.2x

**NIVUS GmbH**
Im Täle 2
D - 75031 Eppingen
Tel. 0 72 62 / 91 91 - 0
Fax 0 72 62 / 91 91 - 29
E-mail: info@nivus.de
Homepage: www.nivus.de

**NIVUS AG**
Hauptstrasse 49
CH - 8750 Glarus
Tel. +41 (0)55 / 645 20 66
Fax +41 (0)55 / 645 20 14
E-mail: swiss@nivus.de

**NIVUS Sp. z o. o**
Ul. m. Reja 3
PL - 80-404 Gdańsk
Tel. +48 (0)58 / 344 25 25
Fax +48 (0)58 / 344 25 04
E-mail: poland@nivus.de
Homepage: www.nivus.pl

**NIVUS France**
84, route de Strasbourg
F - 67504 Haguenau Cedex
Tel. +33 (0)388 07 16 96
Fax +33 (0)388 07 16 97
E-mail: france@nivus.de

**NIVUS (America) Inc.**
10120 Yonge St., Unit 35B Suite 212
Richmond Hill, Ontario
L4C 3C7 Canada
Tel. +1 (905) 833 - 0885
Fax +1 (905) 833 - 0823
E-mail: america@nivus.de
Homepage: www.nivus.ca

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Speedy User manual
First edition July 2000

2000, NIVUS GmbH
Im Taele 2, 75031 Eppingen

# 1. General

## 1.1 Statements about the operator's manual

For the correct installation and operation of your Speedy with corresponding sensors and accessories, the manual must be throughly read.
Additional documents and operator's manuals for components which are used in connection with the Speedy must be read also and checked for its compatibility with the Speedy.
The operator's manual consists of the following main points:

**General:**
This operator's manual describes the operational principle of the Speedy with it's necessary input and working conditions. The Speedy works only under these conditions and in accordance with the given technical data. A system overview of the equipment configurations shows you all components of the complete system. Check the delivered parts for completeness with your purchase order.

**Technical data:**
The given technical data can be guaranteed only under compliance of the permissible operating conditions and corresponding conditions. Possible external influencing factors which may change the technical data are listed as far as possible.

**Installation:**
Description of all necessary steps for installation of the Speedy, the sensors and accessories.
The installation has to be done completely and checked for correctness before the operating power is supplied. The installation should be carried out only by trained staff. In addition, legal standards, regulations and technical rules have to be complied with.

**Putting into operation:**
This may be carried out first after checking the installation site. Familiarize yourself with the operation of the Speedy, its keyboard/display, before you start with a parameter setting. The Speedy is factory set to show automaticly the velocity in front of the installed sensor.
Refering to shape and geometry of the chanel, the Speedy have to be adjusted to show the middle flow velocity of the stream.
The functions of the used parameters are described and entered in coherence with the respective application. Typical application descriptions serve as a study example, to parameter the Speedy according to your application.

**Maintenance:**
The sensors which are exposed to various operating conditions and corresponding conditions may make periodic maintenance necessary. Logs, notes and empirical values will assist you in determining the maintenance intervals and the extent of the maintenance for you.

## 1.2 Functional principle of the Speedy

The Speedy is measuring the velocity in all open channel shapes, sizes and pipes. In fullfilled pipes it's also possible to calculate flow. For the calculation of the flow, the flow level (depth, height) and the flow velocity measured by the respective sensors are used. The measurement of velocity of flow is carried out by an ultrasonic doppler velocity sensor. With an analog output and relay contacts the flow and the sum can be transferred to other recording systems.

## 1.3 Input and surrounding conditions

The operating conditions for the Speedy are limited by the limit values of the technical data for sensors and measuring transmitter, measurement medium and hydraulic conditions:

Limitations due to performance of the sensors and measurement transmitter (See technical data):

- Temperature limits as in technical data
- Relative atmospheric humidity (only measurement transmitter) of less than 90%.
- In accordance with the CE guidelines these exceed the limits for electromagnetic disturbances.
- Measurement ranges of the single sensors.

Limitations caused by the measurement medium:

- Required number and size of reflection particles in the measuring medium:
  The Doppler method is based on reflection of the transmitted signal. Pure media don't cause any reflections. A velocity measurement with doppler ultrasonic therefore isn't possible in such media.
  The least particle size (for example: air bubbles or dirty substances) and particle total is indicated for the respective sensors in the technical data.
- Material compatibility of the sensors to the measurement medium:
  For the materials used, resistance and compatibility lists are available from NIVUS.
  Abrasive media lead to mechanical wearing of the sensor. The abrasiveness can particularly lead to destruction of the sensor at high media velocities and large particle sizes cause substantive abrasion and in the course of the time destroys the velocity sensors.

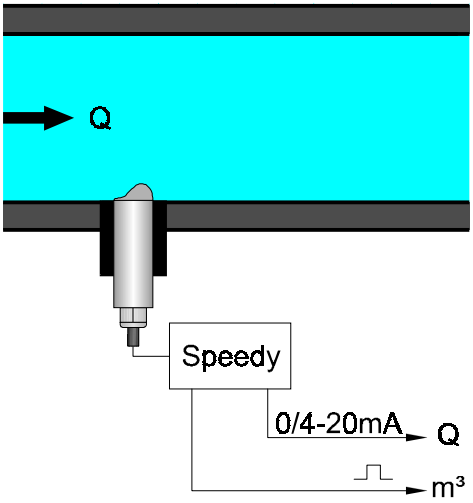
Limitations caused by hydraulics:

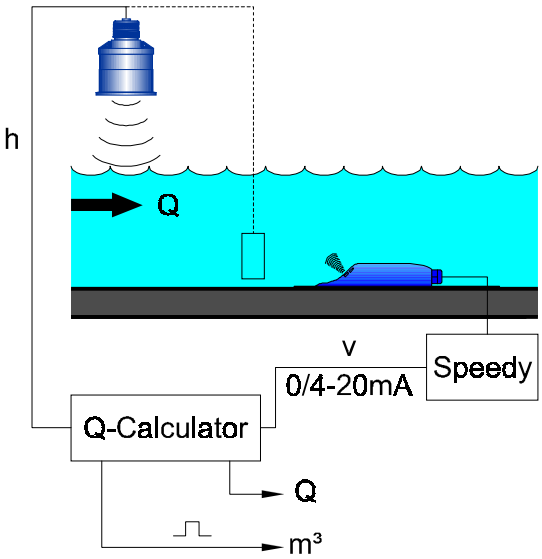
- Bends and slide in front of and at the assembly place of the sensors have to be adhered to in accordance with the assembly notes for the sensors, the reassuring distances at profile changes, hydraulic jumps. If this isn't practical, application conditions may cause additional measurement errors. By calibration on the measurement conditions on the spot, these can be fundamentally compensated.
  Flow changes (streaming or reverse/surcharge) must be avoided at the measurement point. When the flow changes from the sensor, a minimum of 3 x channel breadth distance must be used for sensor placement.

## 1.4 Equipment configurations

The equipment configuration for the operation of a Speedy unit consist of an electronic and a flow velocity sensor.

### 1.4.1 Overview

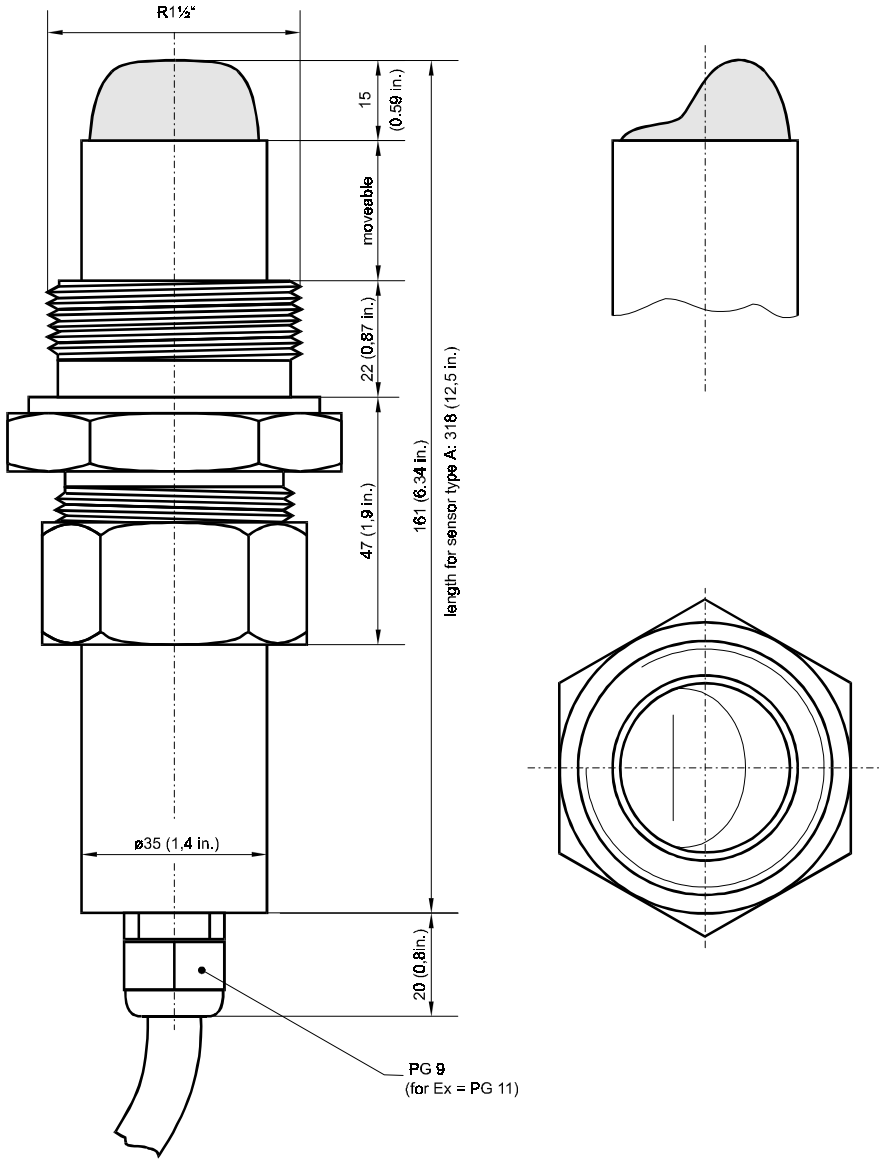


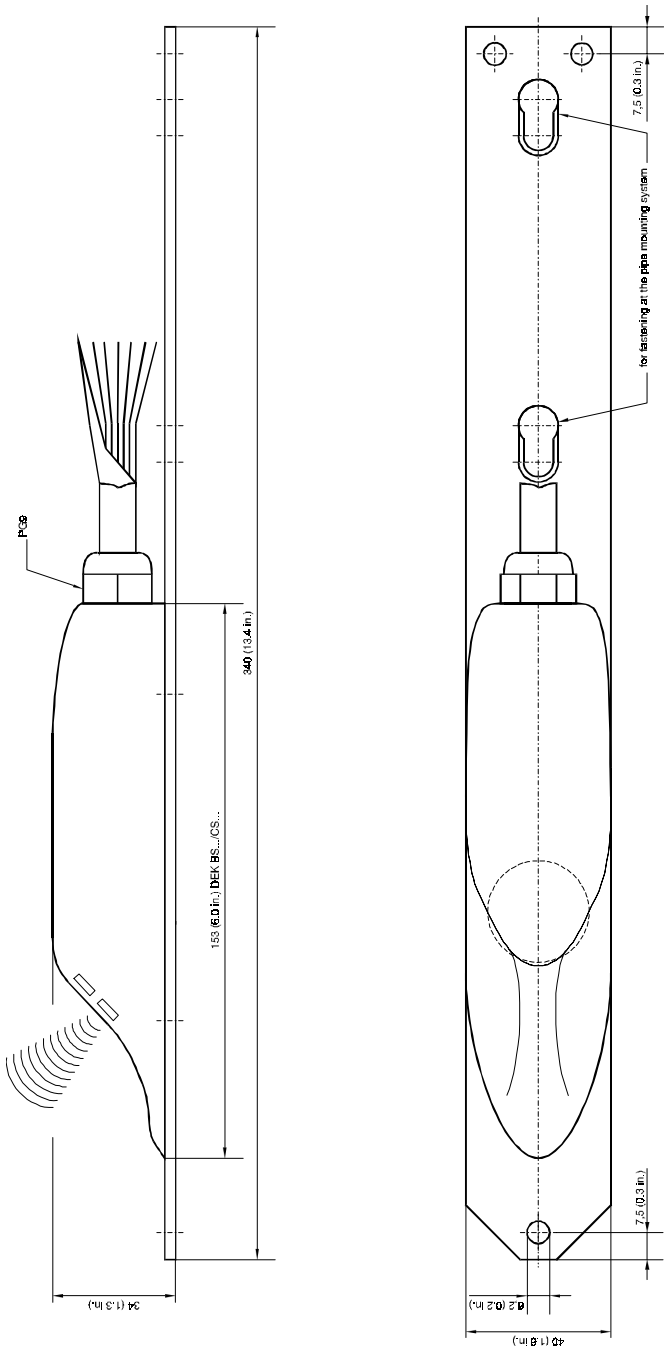
# 2. Technical data

## 2.1 Sensors

Dimensions: OCR/DER... Sensors

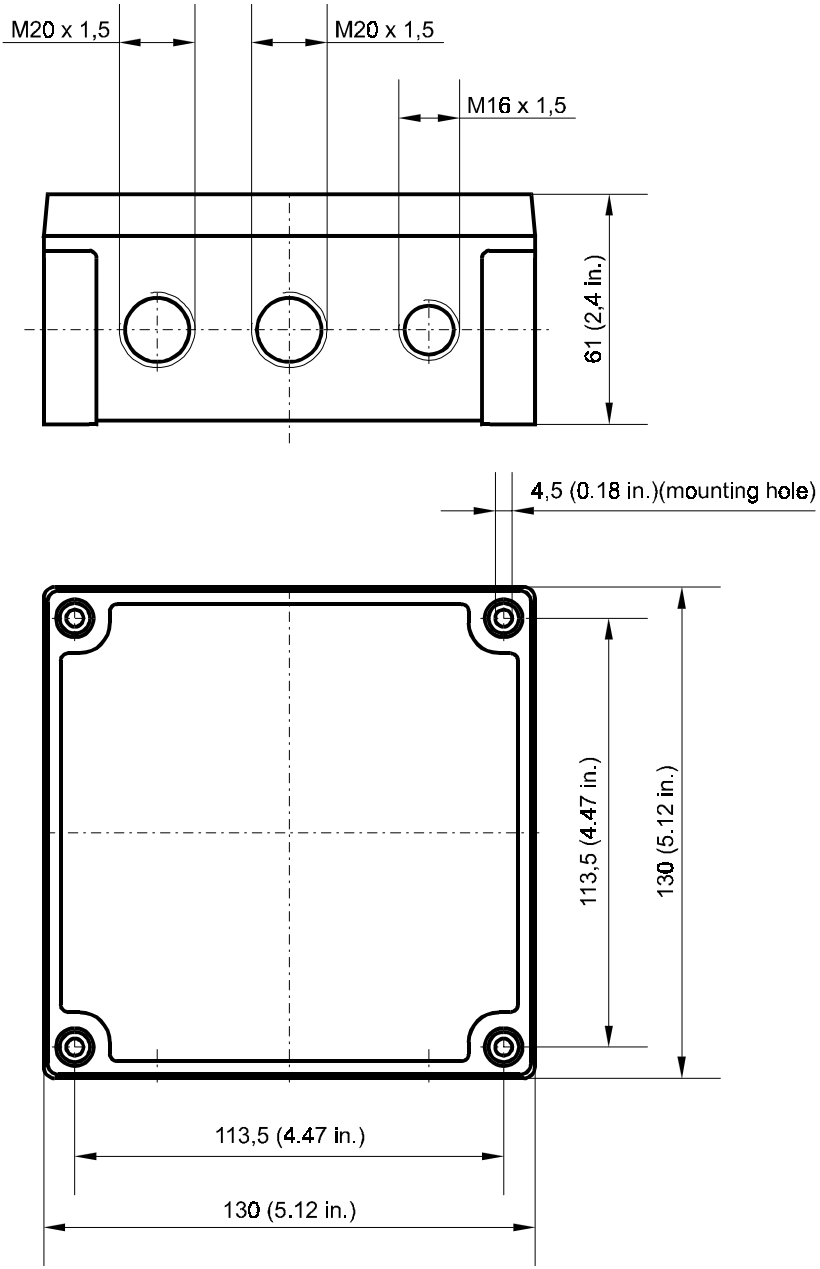


Dimensions OCR/DEK... Sensors



| **Flow velocity sensor: Type: OCR/DE....<br>Technical data:** | |
|---|---|
| Transmission frequency :<br>Types: OCR/D ...B...<br>OCR/D ...C... | <br>750 KHz<br>2 MHz |
| Measurement range: | - 3m/s to 3m/s ( -10ft/s to 10ft/s)<br>option (only for OCR/DExB.. sensors): up to 6m/s (18ft/s), Adjustable via parameter in the Speedy |
| Zero stability: | Zero stable |
| Stability through time: | Stable |
| Measurement accuracy:<br>(measurement medium: Water 16°C, Sound velocity =1475 m/s, flow level >100mm) | 1 % of measurement range or +/-0.03m/s (+/- 0.1ft/s) |
| Minimum reflecting particle size: | Transmission frequency 750 KHz:<br>100 ppm; > 0.6 mm<br>Transmission frequency 2 MHz:<br>>100 ppm; > 0.2 mm |
| Power supply: | 18-24V DC |
| Power consumption: | Max. 60mA (Type: OCR/DE..B...)<br>Max. 100mA (Type: OCR/DE..C...) |
| Output: | Doppler frequency as digital square pulses; Direction and proceed-to-send signal (Enable) |
| | |
| Material: | Stainless steel; Epoxy resin; Polyurethane |
| Enclosure: | IP 68 |
| Connection method / Cable Length: | Safety connected 6-wire cable with shield. Cable length 10m (30 feet) or 30m (90 feet). Extendable up to 150m (450 feet) |
| Operating temperature range: | -10°C up to 50°C |
| Storage temperature: | -20°C up to 60°C |

Dimension measurement transmitter Speedy:



## 2.2 Electromagnetic compatibility (CE)

Electromagnetic compatibility and disturbance radiation to CE (89/336/EWG) standard.

- Following test results only apply for Speedy and the accompanying sensors when using original parts from the manufacturer. If other sensors; cables or additional electrical equipment's are switched between sensors and measurement transmitter the Test result can be deteriorated.
- Sensor cable in parallel not separated by less 100mm to the power cables, use shielded and grounded cable.
- Do not set sensors and measurement transmitter in operating conditions, or in the Norm described, level of accuracy 3 should not be exceeded.

CE

| EMV | Norm | testing process | test result / focus |
|---|---|---|---|
| error emission | EN 55011 | | A / 3 |
| error resistance | EN 50082-2 | IEC 1000-4-2 | A / 3 |
| | | IEC 1000-4-3 | A / 3 |
| | | IEC 1000-4-4 | A / 3 |
| | | IEC 1000-4-5 | A / 3 |
| low voltage directives | EN 61010-1 | | |

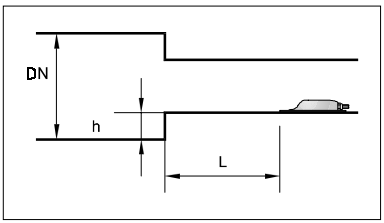
# 3. Assembly and Connection

## 3.1 Sensors

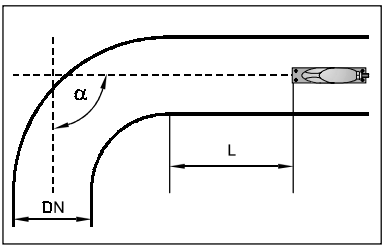
The correct assembly and the placement of the sensors are decisive for measurement accuracy and the reliability of an Speedy velocitiy unit. The measurement errors can increase considerably at non-compliance of the assembly notes.
If the installation specifications cannot be adhered to because of your application conditions a calibration may be necessary.

**Installation of the sensors**
The necessary setting distances between hydraulic disturbance influences and assembly place
by DEK... sensors at:

**Change of profile**
h ≤ 2.5% of Diameter L ≥ min. 3 x Diameter
h > 2.5% of Diameter L = distance to where standing waves do not exist anymore.



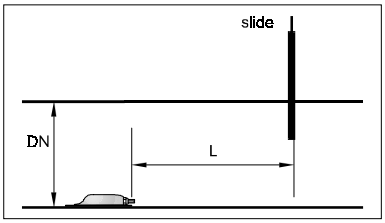

**Curves / Bends**
for v £ 1m/s (3fps):
a ≤ 15° L ³ min. 3 x Diameter
a ≤ 45° L ³ min. 10 x Diameter
a ≤ 90° L ³ min. 20 x DN
for v > 1m/s (3fps):
a > 15° L = distance until the surface of the water reaches laminar position.



**Distance from valves and slide gates**

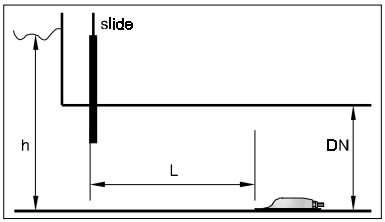
a) Sensors in front of slide gates

L = 3 x Diameter




b) Sensors behind the slide gate

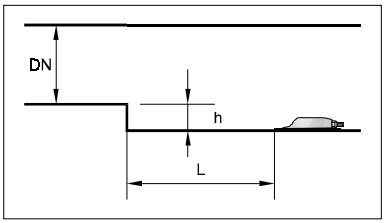
L ≥ distance until a steady flow rises plus 2 x Diameter




**Step or obstruction**

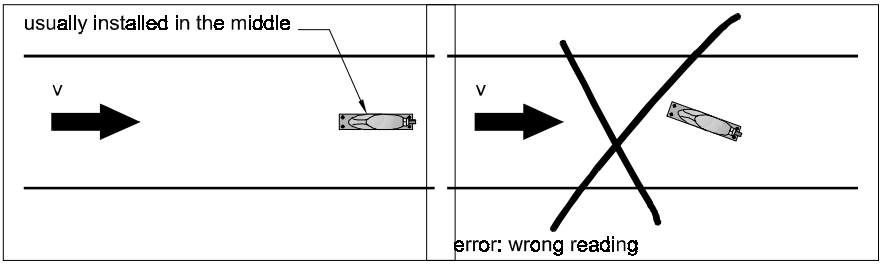
h ≤ 2.5% of Diameter L ³ min. 3 x Diameter

h > 2.5% of Diameter L = distance until a steady flow rises plus 2 x Diameter

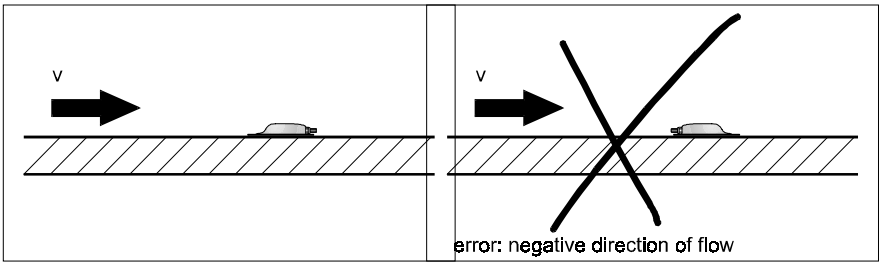


**For installations at the bottom of the flume, please note the following** :

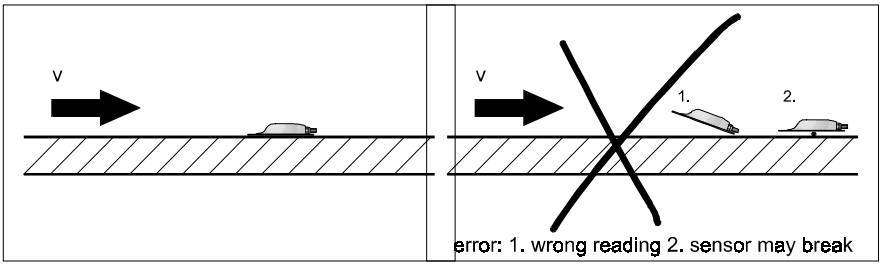
- installation must be parallel to flow direction



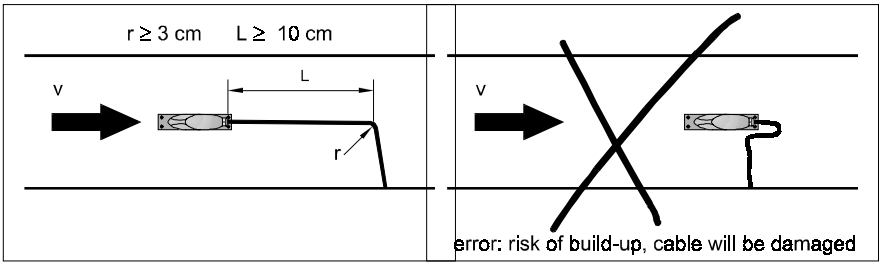

· Installation must be against the flow direction




•· Installation must be parallel to the bottom

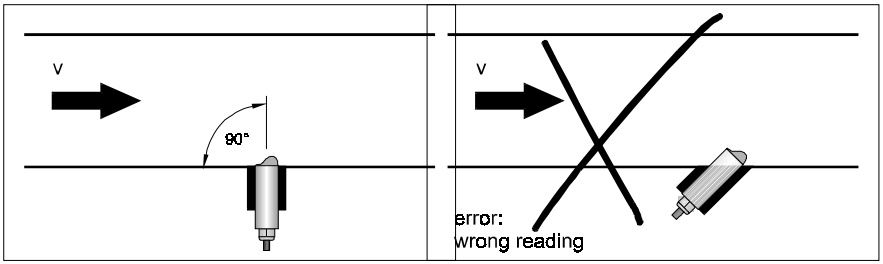



- Cable installation

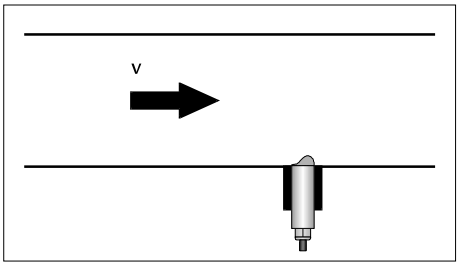


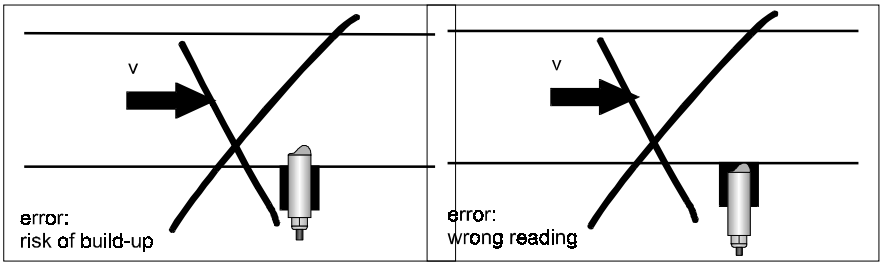
**For the sensor installation inserted into pipe, please note the following:**

- Nozzle 2” in an angle of 90°

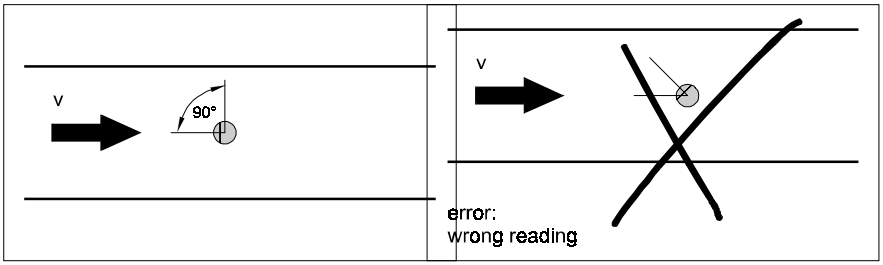



- Step or obstruction mounting



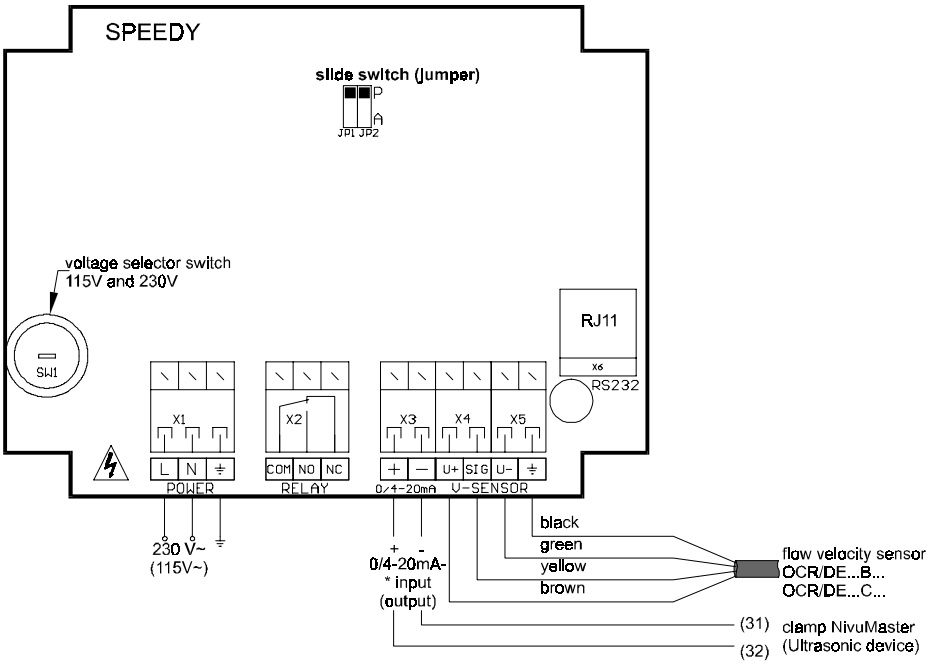




- transmission level 90° to the flow direction



## 3.2 Measurement Transmitter (Connection plans)

Overview connection plan Speedy

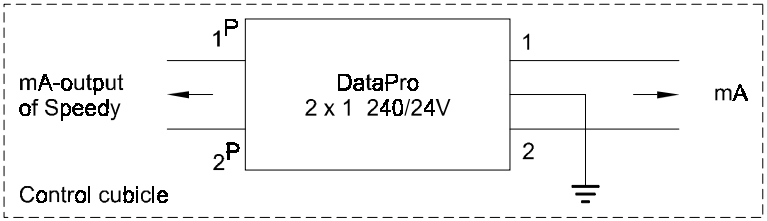



*** slide switch position (jumper) P:**
mA-input passive (Speedy behaves like a 2-wire sensor)
(external power supply: e.g. NivuMaster;
Ultrasonic device Umin. > 10V)

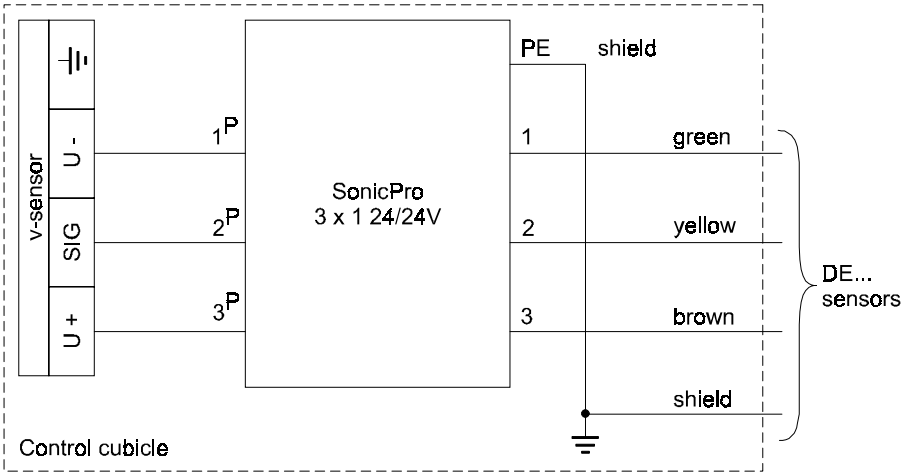
*** slide switch position (jumper) A:**
mA-output aktive; burden max. 600 Ω

### 3.2.3 Protective measures (lightning protection)

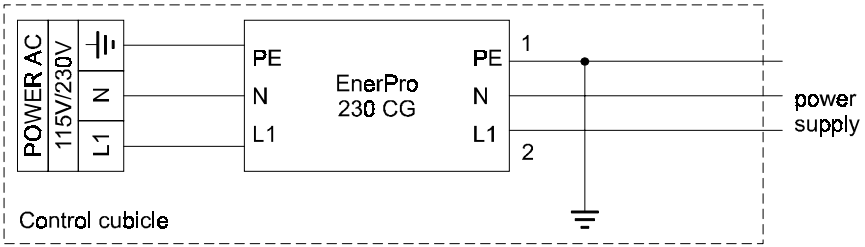
mA - output




flow velocity sensor




power supply

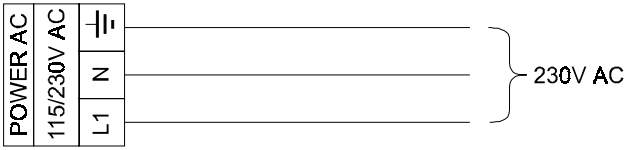


### 3.2.4 Connection of power supply

Connection of the power supply

⚠ Check the power switch (230/115VAC) on the main board of the Speedy...

230V AC




# 4. Putting into operation

Before putting into operation the Speedy electronic and the sensor must be checked and complete installation must be finished. After that you can plug in the power supply. The termination block cover must be closed before switching the power supply on.

## 4.1 Programming with front keys

- P :Program button
- ↑ :Higher
- ↓ :Lower
- ↑↓ :Selectig decimal position


Description of the front keys

There are two, the normal mode and the Parameter setting mode.

## 4.2 Normal mode

The display shows the value selected under P300.

By pressing ↑ you can step to the next value as described in P300.

By pressing ↓ you can step to the previous as described in P300.
After 10 seconds, the display returns to the normal display automatically.

## 4.3 Parameter setting mode

Parameter setting mode is started by presseing the P-button for 5 seconds. The display appears

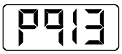
Choose the desired parameter: 

Selection of the decimal position is by pressing both buttons ↑↓ simultaneously.

Add 1 to the digit by pressing the ↑-button

Subtract 1 from the digit by pressing the ↓-button

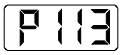
Example**:**

The display shows  , and you like to select 

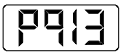
Button sequence:

Press ↑-button 3 x - display appears 

Press ↑↓-buttons 1 x simultaneously

Press ↑-button 1x - display appears 

Press ↑↓buttona 1 x simultaneously

Press ↑-button 8 times - display appears 

***Opening a parameter in display:***
Press P-button, the display shows the parameter content

***Changeing one parameter:***
same thing

***Similar to selecting a parameter and confirming the choice:***
Press P-button, the NivuCont chooses the next parameter automatically.
To not activate the parameter blocks (e.g no characteristic, relays not active or similar) the necessary parameters are simply skipped.

***Leaving Parameter setting mode:***
Press P-button for 5 seconds or wait 3 minutes after last button activity.

# 5. Parameter description

**Parameter list for Speedy Revision 4.25**

The parameters for velocity measurement are identified by their number. The parameter number and the following parameter results must be entered for setting the parameters in the system.
The parameter setting is only possible, when the entry key in parameter P0 is set to **(P0 = 67)**.
Some parameters can be activated by a code number. All actions for deleting are done by this code. These functions are started by the entry of the code number **(Pxxx = 2718)** as parameter value.

Attention: Please do only use the following parameters and values.

P000 Safety parameters F = (67). This parameter can be used to lock the selection in the parameters 100 and higher. It can only be used if the number 67 is changed. The parameters can however be selected and viewed. An attempt to change the parameters will be shown with the indication "EEEE".

P001 Complete reset for all parameters. All selections are reset in the parameters to factory settings of (F) by entering 2718.

**Frequency input**

P200 Mode frequency input
0 = not active
1 = frequency measurement
2 = velocity measurement (m/s) **(F)**
P201 Measurement at 0 Hz **(F = 0)**
P202 Measurement at 9999 Hz **(F = 9999)**
P203 Offset, the value of measurement added or subtracted from the value **(F = 0.0)**
P204 Minimum value supression of all measurements of less than P198 is set with "0" **(F = 0.0)**
P209 Number of the bases for linearization
1 = No linearization, (input is output) **(F)**
2 ... 16 = linearization analog input 2 with 2 ... 16
P210 Actual value 1
P211 Set point 1
.....
P240 Actual value 16
P241 Set point 16

**Display value**

Choice of the display on the LCD of the measured value

P300 4 = display analog output 1 (F=4)

P301 Fractional digits
- 0 = None
- 1 = One
- 2 = Two **(F)**
- 3 = Three
- 4 = Automatic

P302 Units (shown on the ***NivuCont*** display)
- 0 = Absolute **(F)**
- 1 = % (based on the final value at 20mA/5V/10V/9999Hz)

(1...8 = for P300)

**Total quantity calculatin**

P400 Input quantity Q for the total calculation
- 0 = No Q calculation, P401-P405 are locked.
- 6 = for Q from frequency input after linearization **(F)**

P401 Units for the total calculated value of Q as input quantity
- 0 = l/s (litres per second)
- 1 = m³/s **(F)** (cubic metres per second)
- 2 = m³/h (cubic metres per hour)
- 3 = gpm (gallons per minute)
- 4 = Mgd (millions of gallons per day)
- 5 = cfs (cubic feet per second)

P402 Units of the sum value
- 0 = no value
- 1 = m³ **(F)** (cubic metres)
- 2 = Gal (gallons)
- 3 = Mg (millions of gallons)
- 4 = cf (cubic feet)

P403 Integrate units of P402 per total pulses proportional for relays function "lot of contact" **(F = 0.0)**

P404 Presetting of the total quantity for the lowest 4 decimal places (low value) in m³ **(F = 0)**

P405 Presetting of the total quantity for the highest 4 decimal places (high value) in m³ **(F = 0)**

**Relay settings**

P500 Relay mode:
- 0 = No function **(F)**
- 1 = Limit value
- 2 = Total of pulse
- 4 = In bound function
- 5 = Trend (option) relative to analog input 1

P501 Relay function relation at P500 1 = (); ( 3 Od 4 ):
- 4 = Analog output 1

P502 Relay mode:
- 0 = Closed **(F)**
- 1 = Open

P503 Turn on switch point at Fct = 1, 3; Upper value at Fct = 4; 9

P504 Turn off switch point at Fct = 1, 3; Lower value at Fct = 4; 9

P505 Turn-on delay into sec. (0... 300s) at Fct = 1, 3, 4, 9

P506 For switching delay into sec. (0... 300s) at Fct 1, 3, 4, 9

**Anoalog output**

P6000 =
- 0 - 20 mA (0 - 5V)
- 1 = 4 - 20 mA (1 - 5V) (F)
- 2 = Constant current version (value in P607)

P601 Cover on:
- 2 = Frequency input after lnearization

P602 Measurement at 0/4mA (0/1V) **(F = 0m/s)**

P603 Measurement at 20mA **(F = 3.0m/s)**

P604 Offset, the value of measurement added or subtracted **(F = 0.0)**

P605 Minimum value suppression, measurement is set with 0.0 **(F = 0.0)**

P606 Damping. Entered 0 to 10 (10 = highest damping) **(F = 3)**

**Service**

**Velocity calculation**

P900 Activate the service level by selecting the code number 2718

P901 Signal quality 1 **(F=15)**

P902 Signal quality 2 **(F=15)**

P903 P-Factor (please do not change. Only when using special velocitiy transducer ) **(F=0,992)**

P904 Number of invalid measurement values, before velocity is showing 0m/s. **(F=10)**

P905 Gap between two frepency groups **(F=1)**

P906 Number of measurement value per cycle. **(F=100)**

P907 Measurement duration 1-10 Sec. **(F=5)**

**Service**
**Application parameters**

P910 Pipe diameter in m **(F=1)**
P911 Viskosity **(F=18)**
P912 Angle of transmit signal **(F=45)**
P913 Maximum velocity **(F=4m/s**)
P914 Minimum velocity **(F=0m/s)**
P915 Correction factor **(F=1)**
P916 Used velocity
0=v_average **(F=0)**
1=v_max.
P917 Temperature correction **(F=0)**
0=yes
1=no **(F)**
P918 Internal damping for velocity calculation
input 0-19 **(F=5)**
P990 Enter serial number of the Speedy.

# 6. Calibration flow velocity

The hydraulic conditions are mentioned in chapter 1.3 in the measurement place for the precise measurement of the flow velocity.
By using a fixed calibration factor (P915), the flow velocity can be adjusted. Measurement errors (e.g. another sound velocity; one different angle and detection's range of the measured velocity of flow) can be proportionally compensated over the complete measurement range.
Example: v _Measured = 1.28 fps; v_ Reference 1.35 fps
P915 = 1.35/1.28 = 1.055
It's also possible to linearize the flow velocityprogramming breakpoints. (P210 - P241)
So you can use different calibration factors on different flow velocities.

**Carrying out a calibration to be used as reference values. These can be determined by:**

- Measurement of the surface velocity with a suitable unit. A floating unit between point A and B and the time it needs to cover the distance, the surface flow velocity is calculated. This method has an error of accuracy of +/- 20% from the average flow velocity. With this method only one possible check can be carried out
- Reference of flow velocity measurement versus the maximum flow velocity in cross-section x 0.86. This factor is have an accuracy of about ± 5%.
- Reference flow measurement: The temporal correlation of the two flows must be observed.
- Reference measurement of the average flow velocity about a net measurement to the VDE or DIN specifications. Changing flow values must be avoided during the measurement time.
- Volumetric reference value of the flow sum over a measurement time period. At changing flow values only an average calibration factor can be determined.

Units suitable for the measurement of selective reference velocities:

- Mechanical propeller unit
- Inductive magnetic probes
- Pulse ultrasonic probes (e.g. PVM-PD from NIVUS )

# 7. Maintenance

**General:**
The extent of the maintenance and the intervals depend on the following factors:

- Material wear
- Measurement medium and channel hydraulics
- General precautions for running these measurement facilities

## 7.1 Flow velocity

Wear and tear appearances with neutral point, affect the ultrasonic Doppler procedures.
Sluice slime, grease and films of oil don't change the measurement. Stronger coatings or a complete embedding of the sensor into sludge, fibrous substances or sand streams may affect the measurement signal such that a measurement error or a measurement loss can be possible. Then regular maintenance and cleaning of the measurement place is necessary.
Abrasions of the transmitting area and receiving area of the doppler sensors lead to a signal weakening, In extreme cases this can lead to a destruction of the sensor. In this case, the sensor may have to be replaced.

## 7.2 Measurement transmitter

The measurement transmitter needs no regular maintenance. Necessary maintenance's only must be carried out if ordered by predefined maintenance requirements.