



MASS-STREAM™ Instruction Manual

D-6300 Digital Mass Flow Meters / Controllers

Doc. No.: 9.17.104B Date: 27-12-2018



ATTENTION

Before installing and operating the instrument it is strongly recommended that this instruction manual should be read carefully. Not following the guidelines could result in personal injury and/or damage to the equipment.

SCOPE OF THIS INSTRUCTION MANUAL

This instruction manual of M+W Instruments GmbH covers the installation of the digital Bronkhorst® instrument model series D-6300 for mass flow measurement and control of gases and the communication between the instrument and the operator according to the specific (fieldbus) protocol.

Further information can be found in the Bronkhorst® manuals, which are also valid for the Mass-Stream™ model series D-6300.

The Bronkhorst® manuals for multi-bus instruments have a modular set-up and include:

- General instructions digital Mass Flow / Pressure instruments laboratory style / IN-FLOW (document no. 9.17.022)
- Operation instructions digital instruments (document no. 9.17.023)
- Instruction Manual FlowPlot (document no. 9.17.030)
- Fieldbus- / Interface description:
 - FLOW-BUS interface (document no. 9.17.024)
 - PROFIBUS DP interface (document no. 9.17.025)
 - DeviceNet™ interface (document no. 9.17.026)
 - RS232 interface with FLOW-BUS protocol (document no. 9.17.027)
 - Modbus-RTU interface (document no. 9.17.035)
- Multi-Functional Display of the digital D-6300 Mass Flow Meters / Controllers (document no. 9.17.105)

The information in this manual has been reviewed and is believed to be wholly reliable. No responsibility, however, is assumed for inaccuracies. The material in this manual is for information purposes only, and is subject to change without notice.

Warranty

The M+W Instruments GmbH grants a warranty on its products according to the General Terms and Conditions. The warranty is limited to the mass flow meters and controllers and its components. The correct use of the device under the observation of all specified operation conditions is the precondition for the warranty.

ATTENTION!

The warranty is solely limited to the mass flow meters and controllers and its components. No warranty claims are accepted in case of a faulty operation of the instrument, like a wrong electrical hook-up for example.

Any liability is explicitly excluded for any secondary damage, caused by the instrument's failure or the malfunction of any component. All wear parts, like seals for example, are also excluded from the warranty.

All devices are provided with a seal mark upon delivery. In case of a broken seal any warranty claims are void. The opening of the instruments is only permitted by certified service personnel authorized by the Customer Service Department (CSD) of our parent company Bronkhorst High-Tech B.V.

The products of M+W Instruments GmbH are warranted against defects in material and workmanship for a period of three years from the date of shipment, provided they are used in accordance with the ordering specifications and they are not subjected to abuse or physical damage. The products of other manufacturers are warranted for a period of one year.

Products that do not operate properly during this period may be repaired or replaced at no charge. Repairs are normally warranted for one year or the balance of the original warranty, whichever is the longer.

See also paragraph A-V and B-II of the Terms and Conditions of sales of the M+W Instruments GmbH.

The warranty includes all initial and latent defects, random failures, and indeterminable internal causes. It excludes failures and damage caused by the customer, such as contamination, improper electrical hook-up, physical shock etc.

Re-conditioning of products primarily returned for warranty service that is partly or wholly judged non-warranty may be charged for.

M+W Instruments GmbH prepays outgoing freight charges when any party of the service is performed under warranty, unless otherwise agreed upon beforehand. However, if the product has been returned collect to M+W Instruments GmbH, these costs are added to the repair invoice. Import and/or export charges, foreign shipping methods/carriers are paid for by the customer.

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The dimensional drawings and hook-up diagrams of the MASS-STREAM™ Digital Instruments D-6300 are available for download on our website www.bronkhorst.com.

1 SHORT FORM START-UP

All necessary settings for this instrument are already performed at M+W Instruments GmbH. Following the next steps carefully is the quickest way to get the instruments operational in your own system:

Connection

Make sure your PC or PLC is connected to the RS232 interface by means of the correct cable.

The maximum cable length for communication via RS232 must not exceed 10 m!

Power Supply

Make sure that the instrument or interface is connected to the power supply:

+15 Vdc up to +24 Vdc (please check on instrument label)

COM-Port Settings

Use settings [38400,n,8,1] for your COM-Port:

Baud rate = 38400 Baud, no parity, 8 data bits, 1 stop bit.

In case of any trouble during installation or to set up the communication Bronkhorst® programs like FlowDDE or Hyperterminal (available in MS-Windows) could be very useful. Please refer to chapter 4 how to use FlowDDE.

2 DIGITAL INSTRUMENTS

2.1 General

The digital instruments of M+W Instruments GmbH are measurement devices for thermal mass flow and control of gases. They are equipped with a digital electronic multi-bus pc-board and consist of a micro-controller with peripheral circuitry for measuring, controlling and communication. The flow signal is measured directly in the gas flow, digitized and processed by means of the internal software (firmware). The measured and processed values can be output through the analog interface or through the digital communication line (RS232 or optional fieldbus interface). For controllers the setting for the actuator is calculated by the firmware. The setpoint can be given through the analogue interface or through the digital communication line.

Digital instruments have a lot of setting parameters for signal processing, controlling and many extra features and thus a wide range in use. Reading and changing of these settings is only possible via RS232 or a fieldbus, except for measured value, setpoint and valve output, which is also possible through the analogue interface (depending on parameter setting).

Digital instruments can be operated by means of the following options:

1. Analog interface (0...5 Vdc / 0...10 Vdc / 4...20 mA / 0...20 mA)
2. RS232 interface (connected to COM-Port by means of special cable at 38400 Baud)
3. FLOW-BUS interface
4. PROFIBUS DP interface
5. DeviceNet™ interface
6. Modbus-RTU interface

Depending on the pre-settings options 1 and 2 are always present on multi-bus instruments. An interface to any available fieldbus is optional.

The operation via analogue interface, RS232 interface and an optional fieldbus can be performed at the same time. A special parameter called “control mode” indicates which connection is controlling the instrument: analogue or digital (via fieldbus or RS232). The RS232 interface behaves like the Flow-Bus interface. Even when using more interfaces at the same time, the reading can be done simultaneously. When changing a parameter value, the last value send by an interface will become valid.

The micro switches and LED's on top of the instrument can also be used for manual operations of some options (see chapter 5):

- The green LED indicates in which mode the instrument is active.
- The red LED indicates address, baud rate etc. and error/warning in relevant situations.

Scope of Delivery

Immediately upon receipt of the incoming goods the package needs to be checked for any possible damages and the goods have to comply with the scope of delivery listed on the packing note. In case of any damages the supplier and the freight forwarder have to be contacted without delay.

In the event of any discrepancies please get in touch with your local distributor (see www.bronkhorst.com) or contact us directly:

M+W Instruments GmbH
Dorfstr. 1
D-85391 Leonhardsbuch
Tel.: +49 8166 9921 0
Fax: +49 8166 9921 22
Email: sales@mw-instruments.com

When the instrument needs to be returned please include a description of the damage in a closed envelope.

ATTENTION!

All instruments for return must have a fully filled-in “Declaration of Decontamination“.

This declaration has to be attached to the shipping documents, allowing free access on the outside of the package.

The declaration of decontamination is available on our accompanying CD with each instrument shipment or it can be downloaded from our website www.bronkhorst.com.

Please mention the instrument’s model code and the serial number on your order, as well as your VAT number when needed.

2.2 Installation

To avoid personal injury and/or damage to the equipment only trained and qualified personnel shall perform the installation of the instruments:

- Read the instrument’s name plate before installation and check the electrical connection, flow range, media to be measured, inlet and outlet pressure as well as input and output signals.
- The instruments contain electronic components which are sensitive to electronic discharges (ESD). Contact with electronically charged persons or objects could possibly endanger these components or even result in their failure.
- Ensure that all piping is absolutely clean and without any damage. It is recommended to install an inlet filter in front of the instrument.
- While installing the instrument take care of the arrow marking on the instrument’s flow body, determining the flow direction.
- Avoid piping with small diameter at high flow rates. When possible no abrupt angles or other disturbances shall be mounted directly in front of the instrument.

- All devices have Withworth pipe threads – type RP – according to ISO228-1 (cylindrical G-threads in inches according to BSPP). The mounting of NPT-fittings will destroy the inlet threads in the instrument's body.
- Using an inlet pipe with sufficient piping diameter is recommended. The length of the inlet pipe should be at least 10 times the piping diameter.
- Before the first start-up check that the system has absolutely no leakage. If toxic, explosive and/or corrosive gases are to be used, ensure to purge the system long enough with a dry, inert gas. This is also required to remove these kinds of gases from the system.
- The instruments' preferred mounting position is horizontally. Especially when installing bigger mass flow controllers (D-6371 and bigger) in different ways you should get in contact with your distributor or M+W Instruments GmbH beforehand.

ATTENTION!

In the event of power loss or when unplugging the main connector the instrument will be reset into factory settings (=delivery condition).

All instruments described in this manual carry the CE-mark. Therefore they have to comply with the EMC requirements valid for these instruments. However compliance with the EMC requirements is not possible without the use of proper cables and connector/gland assemblies.

In case the instrument is connected to other devices (e.g. power supply) ensure that the operating voltage complies with the supply voltage given on the name plate and that the function of the shielding is not affected. M+W Instruments GmbH recommends using standard cables following the CE-requirements and could supply them when needed.

2.3 Operation and Maintenance

When the power is switched on a warm-up period of at least 30 sec is required allowing the instrument's thermal stabilisation. Afterwards the instrument will work with an accuracy of approximately 4% FS. It takes around 30 minutes until the optimal stability is reached and the instrument will work with an accuracy of < 2% FS. This is supposed to be performed with or without gas flow. To avoid creating gradients it is recommended that gas and ambient temperature are kept at the same level (max ΔT approx. $\pm 2...3$ °C). Otherwise the accuracy of this thermal measurement could be affected in an unpredictable manner.

Be sure that the specified pressures have been applied. Pressure surges, as may occur during the system pressurisation, must be avoided. The control valve cannot be used as a shut-off valve. When starting up, always bring the instrument gradually up to the level of operating conditions.

There are no regular maintenance checks required for the instrument's operation. It has to be ensured that a possible mounted inline filter is checked and cleaned on a regular basis. We recommend having the calibration checked every 24 months by the supplier or an authorized service partner.

2.4 Functional Block Diagram

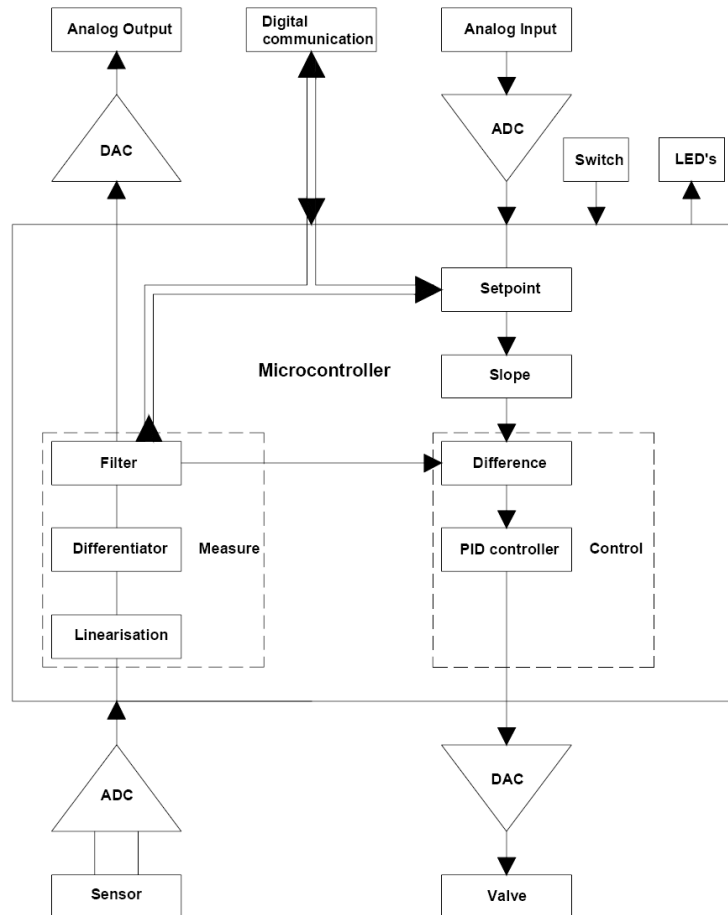
Mass flow meter DMFM

The sensor signal is digitised via ADC and processed internally. Being reconverted from digital to analogue the signal is forwarded as reading on the analogue output by means of current or voltage. The reading is also available as 2-byte integer at parameter 8 and can be readout via RS232.

Mass flow controller DMFC

For mass flow controllers the setpoint is added to the above process. The setpoint is either processed as analogue signal or as 2-byte integer via RS232 (or fieldbus).

The instrument compares setpoint and actual value and controls the valve, until both values match within the tolerances.

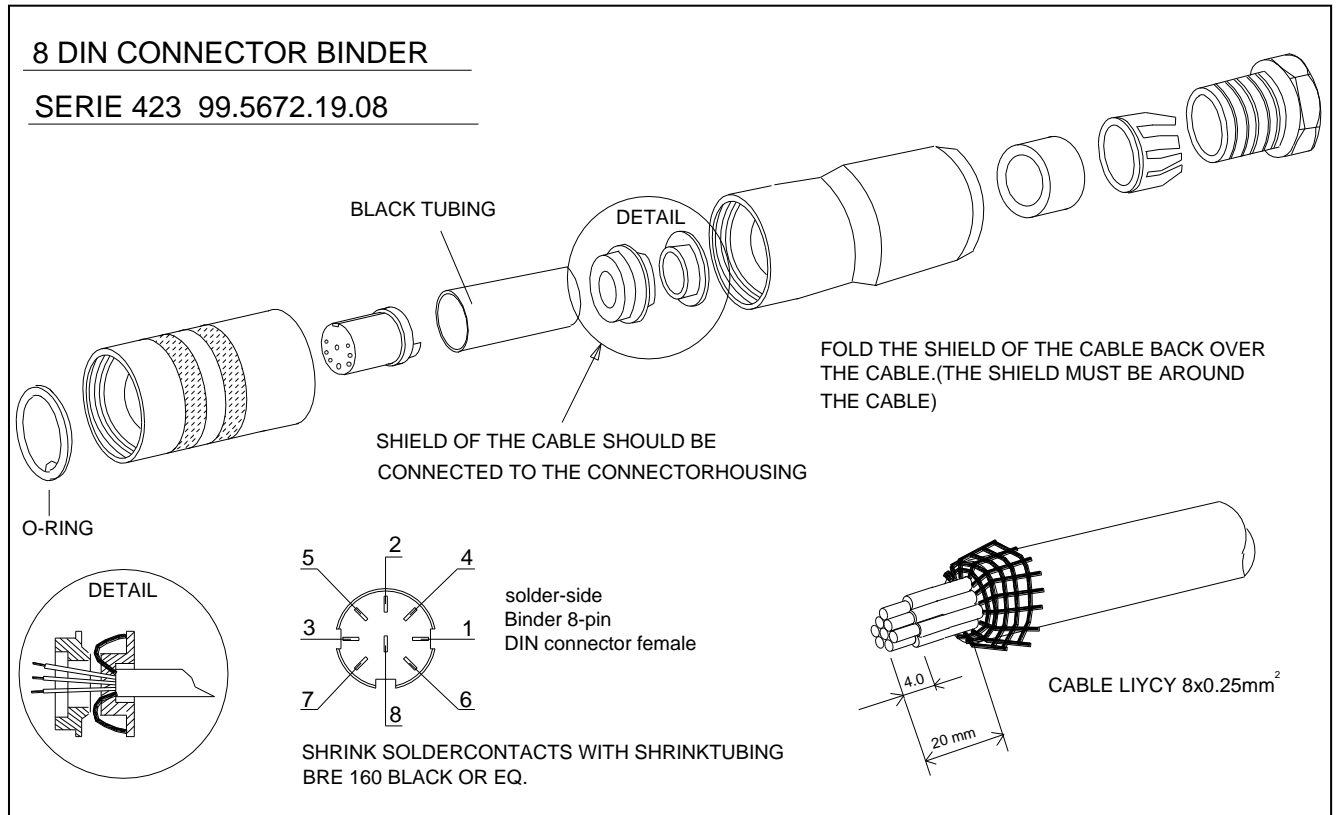


2.5 Specifications of MASS-STREAM™ Digital Instruments D-6300

| Measurement System | |
|---|--|
| Accuracy (based on calibration with Air) | ± 2% FS including non-linearity (± 1% FS or ± 1.5% FS on request) |
| Repeatability | < ± 0.2% FS |
| Pressure sensitivity | ± 0.3% RD / bar typical (Air) |
| Temperature sensitivity | ± 0.2% RD / °C (Air) |
| Response time sensor (τ 63%) | D-631● & D-632●: approx. 0.3 s others: approx. 0.9 s |
| Settling time controller | plus approx. 2 sec (not applicable for BJ valves) |
| Leak integrity (outboard) | < $2 \cdot 10^{-8}$ mbar l/sec He |

| Mechanical Parts | |
|-------------------------------------|--|
| Sensor | Stainless steel 1.4404 (AISI 316L) |
| Instrument body | Aluminium EN AW-6082-T6 anodized OR Stainless steel 1.4404 (AISI 316L) |
| Sieves | Stainless steel |
| Distance parts | Teflon or Stainless steel |
| Protection (with & without display) | IP65 (IP40 with Profibus Sub-D9 connector) |
| Operating Limits | |
| Measuring range | up to 1...100% (1:100) for meters up to 2...100% (1:50) for controllers |
| Temperature | 0...50 °C D-6361/FAS, D-6361/002BI: +10...+50 °C |
| Pressure | 0...10 bar(g) for aluminium body 0...20 bar(g) for stainless steel body The maximum operating pressure of controllers also depends on the selected valve! |
| Warm-up time | 30 min for optimum accuracy within 30 sec for accuracy \pm 4% FS |
| Electrical Properties | |
| Supply voltage | +15 ... 24 Vdc \pm 10% / with BJ-valve: +24 Vdc |
| Current peak values | Meter: approx. 75 mA at 0% flow approx. 125 mA at 100% flow Controller: add 250 mA add 30 mA for display, if applicable add 50 mA for fieldbus, if applicable |
| Output signal | 0...10 Vdc / 0...5 Vdc active 0...20 mA / 4...20 mA active |
| Instrument connector | 8-pin round DIN(male) for analogue and RS232 Optional additional fieldbus connectors: 5-pin M12 (male) for: FLOW-BUS DeviceNet™ Modbus-RTU or 5-pin M12 (female) for: PROFIBUS DP or 9-pin Sub-D (female) for: PROFIBUS DP |

2.5.1 8DIN Connector, 8-pin round (female)



Be sure that the integrity of the shielding is not affected when connecting the system to other devices (e.g. to PLC). Only shielded wire terminals can be used.

3 MEASUREMENT PRINCIPLE AND CALIBRATION

3.1 CTA Through-Flow Measurement

The direct through-flow measurement with CTA (Constant Temperature Anemometry) is also named inline measurement. The working principle is based on King's law of the ratio between the heater energy and the heat degradation by means of gas flow or liquid flows published in 1914.

Two elements, a heater and a temperature probe, are positioned in the gas flow. CTA is aiming to keep the difference in temperature ΔT between both sensor pins at a constant level. The flow rate and the heater energy required to maintain this constant ΔT are proportional and thus indicate the mass flow of the gas. The relation between the heater energy and the mass flow is described by the following formula:

$$P = P_0 + C \cdot \Phi_m^n$$

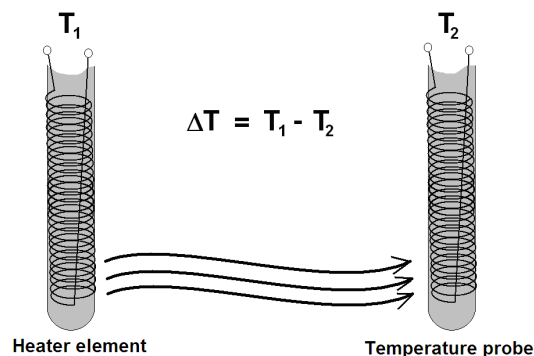
P ... Heater power

P_0 ... Heater power offset at zero flow

C ... Constant (device-dependent)

Φ_m ... Mass flow

n ... dimensionless figure (type 0,5)



3.2 Calibration and Look-up Table

The calibration is processed with a mass flow controller which functions as a reference. The controller and the gas inlet pressure forward a defined gas flow, thus a raw signal of the sensor can be allocated to each specific mass flow. To generate and store the look-up table in the instrument up to 21 measurement points are recorded and equally arranged over the total measurement range. Using the look-up table the instrument's firmware relates the correct gas flow to each raw signal via interpolation. This method allows processing almost any sensor raw signal, given that the signal is monotonically increasing.

Multi-fluid and multi-range instruments can store up to 8 look-up tables for a variety of applications.

Design of a Look-up Table

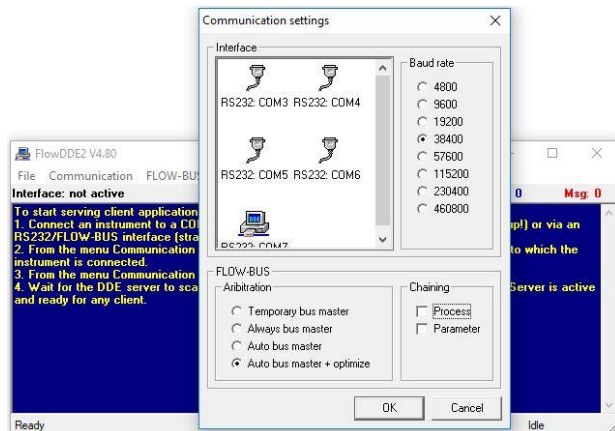
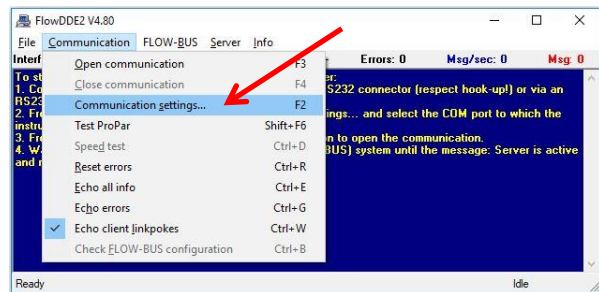
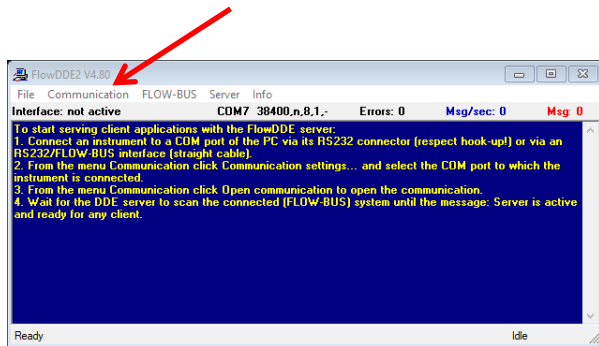
| Index | Raw signal X | Standardized value Y |
|-------|--------------|----------------------|
| 0 | X_0 | Y_0 |
| 1 | X_1 | Y_1 |
| 2 | X_2 | Y_2 |
| 3 | X_3 | Y_3 |
| 4 | X_4 | Y_4 |
| ... | ... | ... |
| 20 | X_{20} | Y_{20} |

4 OPERATION VIA RS232

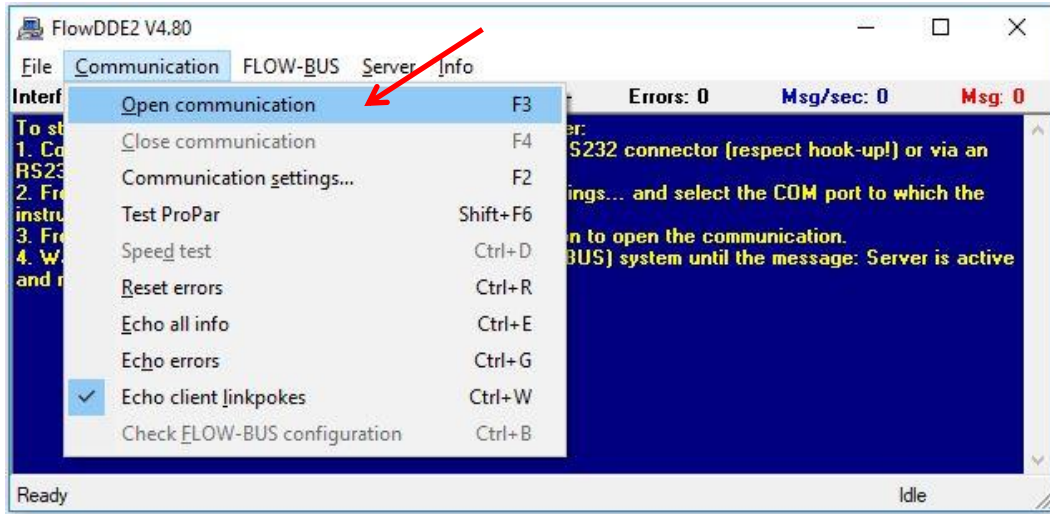
To operate the device from a personal computer via the serial interface it is recommended to install the FlowDDE software. Like other software it can be found on the CD which is accompanying the despatched goods. FlowDDE is required for the following software operations.

Set-up communication between device and computer:

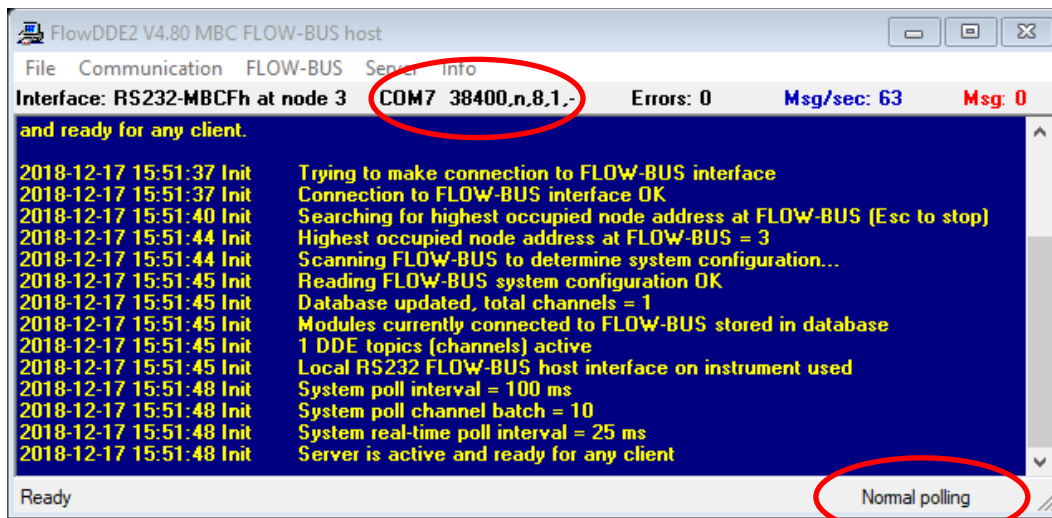
- Hook-up of the instrument following the schematic description in chapter 2.5.
- Start of FlowDDE and select the COM-Port connected to the instrument.
- Set the Arbitration to “Autobusmaster + optimize“, then select “Parameter“ and “Process“ in the menu for chaining.



- Having selected the COM-Port and Baud-Rate you need to start the communication between a personal computer and the instrument via ,F3' or by clicking on the menu "Communication", being followed by a second click on "Open communication".



FlowDDE on your monitor should show the following picture:



4.1 Input Signal via FlowView

The Bronkhorst® FlowView software is ideal for easily used standard operations. FlowView can be found on the CD which is accompanying the despatched goods and can be down-loaded from <http://downloads.bronkhorst.com>.

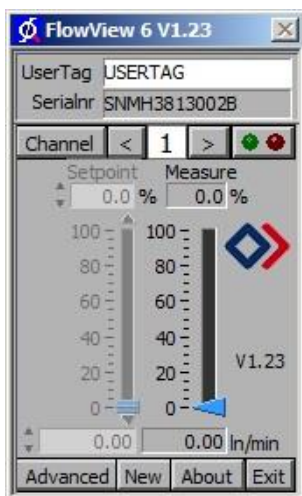
Covered Functions:

- Setpoint adjustment
- Actual reading
- Gas selection for multi-gas instruments
- Alarm functions (configurable)
- Counter functions (configurable)

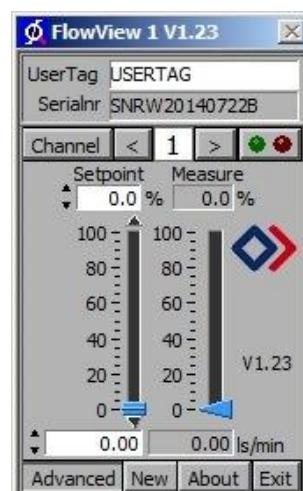
Operations procedure

- Start FlowDDE and open the communication
- Start FlowView
- Following the instrument's pre-settings one of the following pictures should be displayed (Example for a controller)

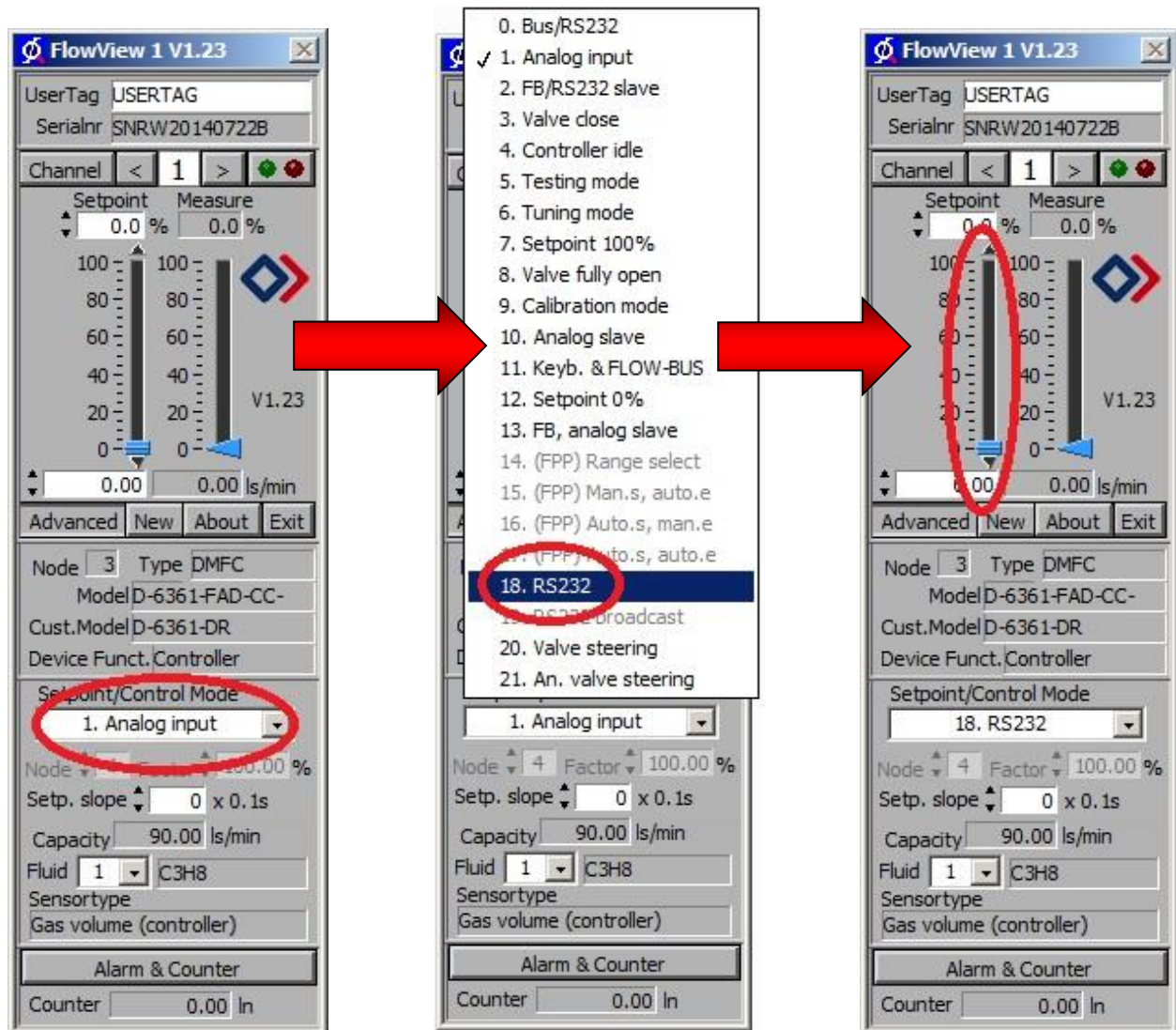
Analogue
pre-settings



Digital
pre-settings

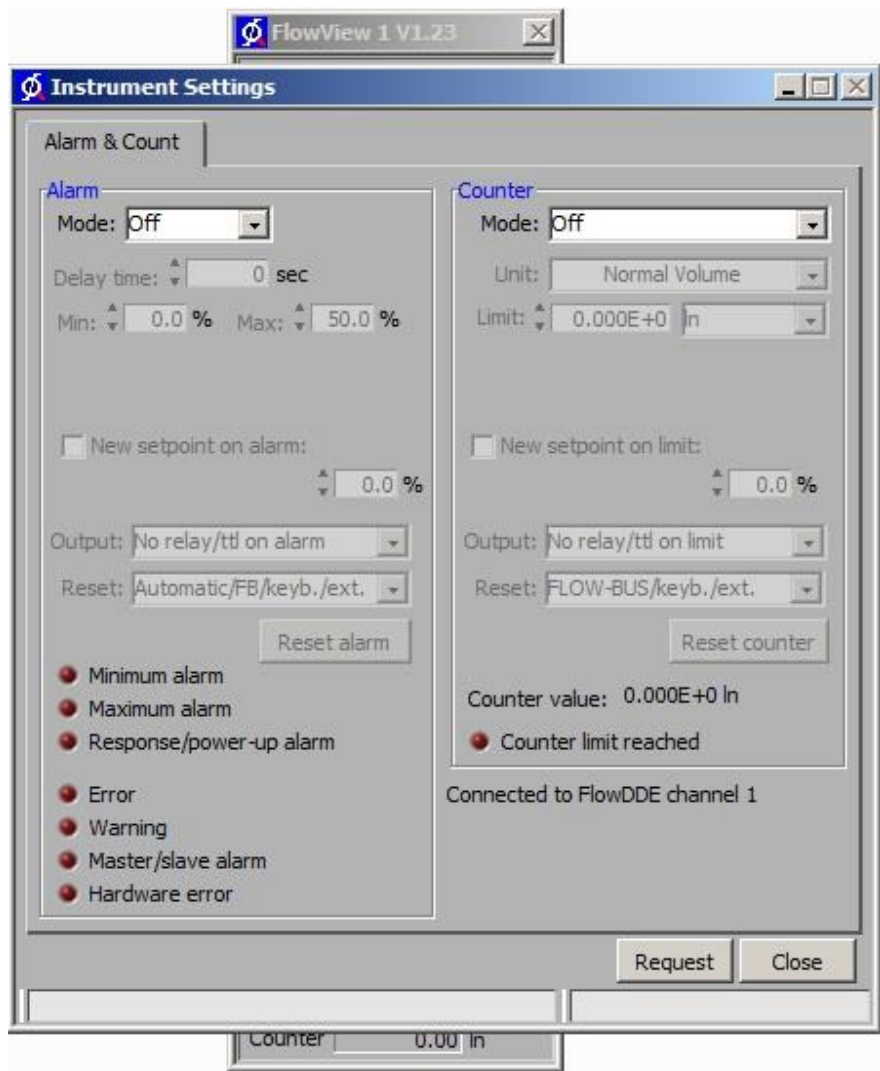
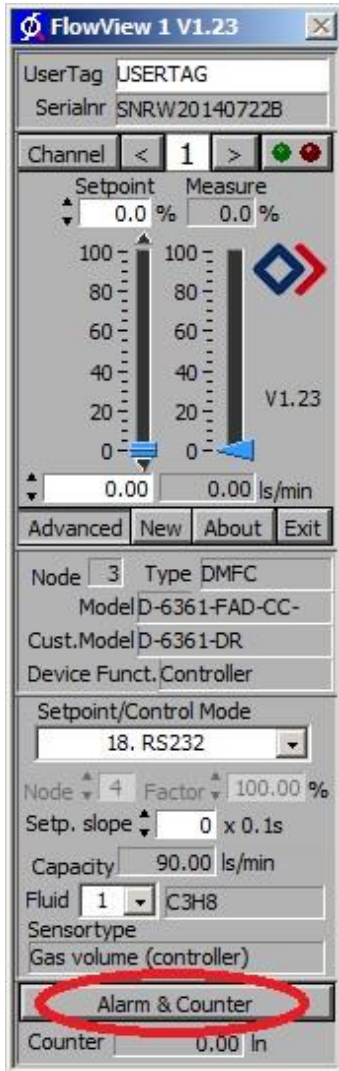


- With analogue pre-settings the setpoint can be set via the designated pin 3 in the DIN8 connector or, following the changeover to the control mode, via RS232.
- To change over in the above named control mode click on “Advanced” to open further options. Click on „Setpoint/Control Mode“ and select „18. RS232“. The requested setpoint can now be adjusted via the task bar or by typing the value in the description field below ‘Setpoint’.

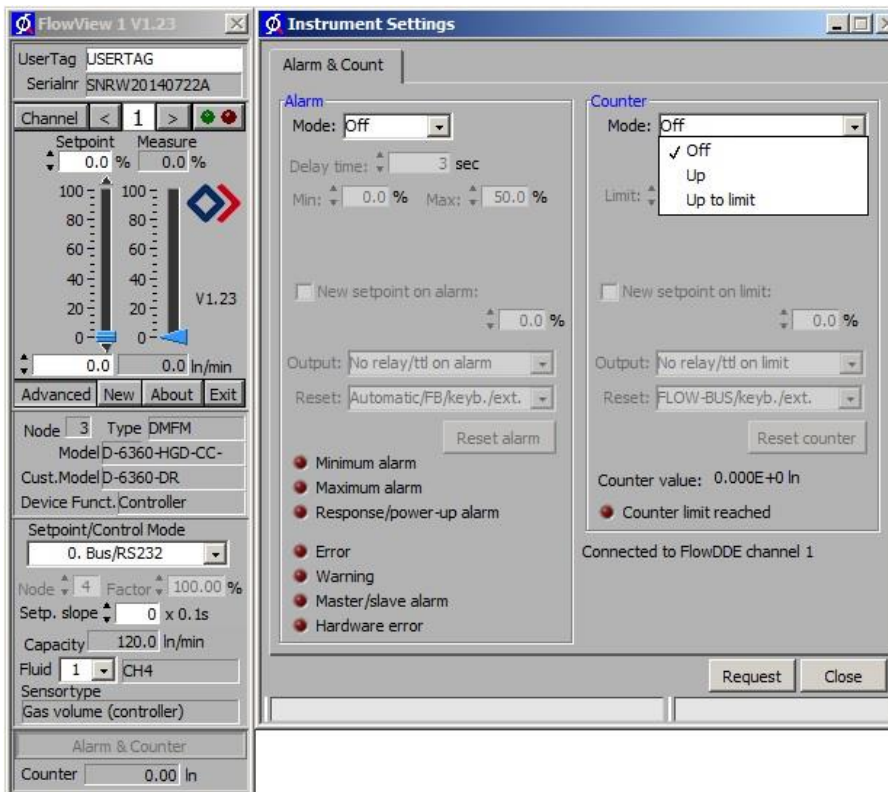
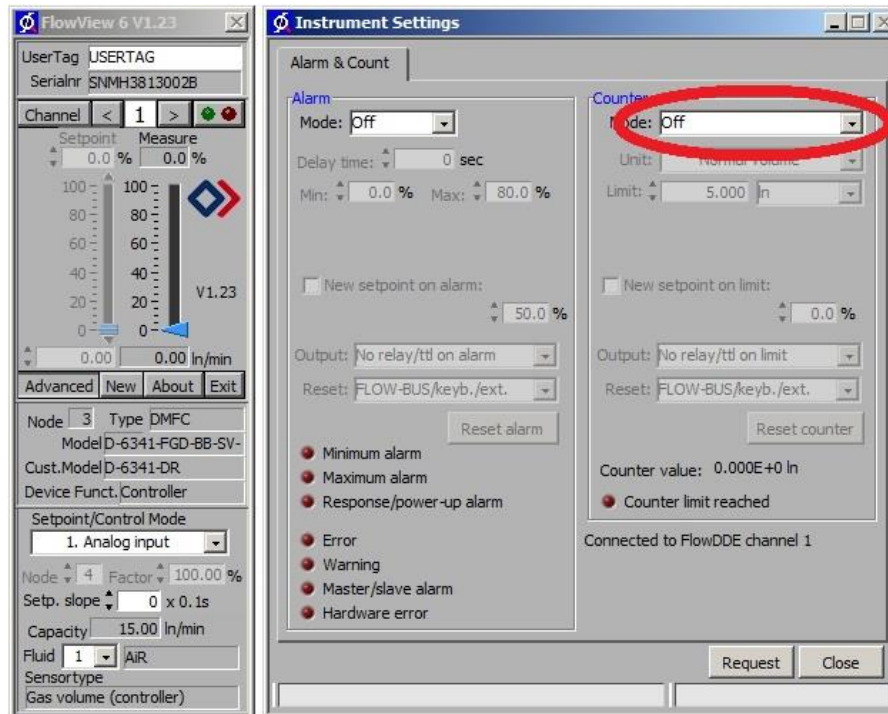


Alarm functions / Counter adjustments

The adjustment of alarm and counter functions is well supported by FlowView. Click on the button “Alarm & Counter“ to open a frame for the adjustment of all settings.



Example of counter adjustments:



5 MANUAL INTERFACE: Micro Switches and LED's

The micro-switch on top of the digital instrument can be used to start a certain function on the instrument. When the switch is pressed down, both LED's will start indicating different patterns in a loop. The switch has to be pressed down until the 2 LED's are indicating the right pattern. Then the switch has to be released and the choice has been made.

Using this micro switch and both LED's the user is offered a variety of possible settings even when the instrument is operated with an analogue interface.

Normally (when the switch is not pressed) the green and red LED are used for mode indication on digital instruments (PROFIBUS DP, DeviceNet™, FLOW-BUS and Modbus-RTU, see *table 1 and 2*).

When the switch is pressed down both LED's will be switched-off for function selection. As long as the switch will be pressed down, there will be a change in indication by both LED's after each 4 seconds. The moment the indication (LED-pattern) for the wanted function is recognised the switch must be released to trigger the instrument.

Table 3 describes the indications for the function to be performed at normal situation (Micro switch will be pressed down during normal operation of the instrument).

Table 4 describes the indications for the functions to be performed at power-up situation of an instrument. This can be realised by pressing the switch first and while pressing, connecting the power. These actions have a more 'initialising' character for the instrument.

**Table 1: Green LED indications on digital instruments
(without using the micro switch)**

| green LED | Time | Indication | | |
|--------------|-----------------------------|---|---|--|
| off | continuously | Power-off or program not running | | |
| on | continuously | normal running/operation mode | | |
| short flash | 0.1 sec on / 2 sec off | Special mode , see specific fieldbus for more details | | |
| | | FLOW-BUS | PROFIBUS DP / Modbus-RTU | DeviceNet™ |
| | | Initialization mode can be changed secured parameters | Initialization mode can be changed secured parameters | Abort state or Initialization mode can be changed secured parameters |
| normal flash | 0.2 sec on / 0.2 sec off | Special mode Instrument is busy performing any special function E.g. auto-zero or self-test | | |
| long flash | 2 sec on / 0.1 sec off | Special mode , see specific fieldbus for more details | | |
| | | FLOW-BUS | PROFIBUS DP / Modbus-RTU | DeviceNet™ |
| | | not used | not used | Idle state |
| slow wink | 0.2 sec on / 0.2 sec off | Wink mode By a command (e.g. send via Flow-Bus) the instrument can “wink” with LED’s to indicate its position in a (large) system | | |
| normal wink | 1 sec on / 1 sec off | Alarm indication: Minimum alarm, limit/maximum alarm, Power-up alarm or limit exceeded or batch reached | | |
| fast wink | 0.1 sec on / 0.1 sec off | Switch released, selected action started | | |

Please note: wink = green-red, green-red in steady turn-by-turn

**Table 2: Red LED indications on digital instruments
(without using the micro switch)**

| Red LED | Time | Indication | | |
|-----------------|-----------------------------|--|---|---|
| off | continuously | No error | | |
| short flash | 0.1 sec on / 2 sec off | Bus communication warning. Instrument functions o.k. See specific fieldbus for more details | | |
| | | FLOW-BUS | PROFIBUS DP / Modbus-RTU | DeviceNet™ |
| | | Node is occupied re-install instrument | No data exchange between master and slave automatic recovery | Minor communication error |
| normal flash | 0.2 sec on / 0.2 sec off | Warning message: An error occurred of minor importance It would be wise to investigate the cause of this You are still able to work with your instrument See specific fieldbus for more details | | |
| | | FLOW-BUS | PROFIBUS DP / Modbus-RTU | DeviceNet™ |
| | | No details | No details | No bus power |
| long flash | 2 sec on / 0.1 sec off | See specific fieldbus for more details | | |
| | | FLOW-BUS | PROFIBUS DP / Modbus-RTU | DeviceNet™ |
| | | Not used | For special service purpose only | Serious communication error; manual intervention needed |
| on | continuously | Critical error message A serious error occurred in the instrument Instrument needs service before further using | | |

Please note for Modbus-RTU: the red LED indicates bus activities and depending on the baud rate can appear to be continuously lit

Table 3: LED indications using micro switch at normal running mode of an instrument

| green LED | red LED | Time | Indication | | |
|-----------|---------|-------------|---|--------------------------|------------|
| off | off | 0 – 1 sec | Pressing a switch shortly by accident will not cause unwanted reactions of instrument Pressing the switch 3 times briefly with intervals of max. 1 sec. will force instrument to indicate its bus-address/MAC-ID and maybe baud rate | | |
| off | off | 1 – 4 sec | In case of min/max alarm or counter batch reached: Reset alarm (only if reset by keyboard has been enabled), see specific fieldbus for more details | | |
| | | | FLOW-BUS | PROFIBUS DP / Modbus-RTU | DeviceNet™ |
| | | | When address is occupied: automatic installation on Flow-Bus | Not used | Not used |
| off | on | 4 – 8 sec | Reset instrument Instrument program will be restarted and all warning and error message will be cleared During (new) start-up instrument will perform a (new) self-test | | |
| on | off | 8 – 12 sec | Auto-zero Instrument will be re-adjusted for measurement of zero-flow (not for pressure meter/controller) NOTE: First ensure there is no flow and instrument is connected to power for at least 30 minutes! | | |
| on | on | 12 – 16 sec | Prepare instrument for FLASH mode At next power-up FLASH mode will be active This mode will be indicated by both LED's off when instrument is normally powered | | |

Please note: “on“ = short flash (0.1 sec on / 2 sec off)

Table 4: LED indications using micro switch at power-up situation of an instrument

| green LED | red LED | Time | Indication | | |
|--------------|-------------|-------------|--|--------------------------|-------------|
| off | off | 0 – 4 sec | No action Pressing a switch shortly by accident will not cause unwanted reactions of the instrument | | |
| off | normal wink | 4 – 8 sec | Restore parameters All parameter settings (except fieldbus settings) will be restored to situation of final test at production | | |
| normal flash | off | 8 – 12 sec | FLOW-BUS | PROFIBUS DP / Modbus-RTU | DeviceNet™ |
| | | | Auto install on bus: Instrument will install itself to a (new) free node address | Not used | Not used |
| normal wink | normal wink | 12 – 16 sec | Remote/manual installation Instrument will get a default address. This can be changed by means of micro-switch and LED's. See description below for description of this procedure. | | |
| | | | Specific fieldbus for default installation address: | | |
| | | | FLOW-BUS | PROFIBUS DP / Modbus-RTU | DeviceNet™ |
| | | | Node address = 0 | Station address = 126 | MAC-ID = 63 |

Please note: normal flash = 0.2 sec on / 0.2 sec off

Set instrument to default installation address/MAC-ID:

At first the instrument needs to be forced into the “remote/manual install mode”. During power-up the micro switch needs to be pressed-down and released when both LED's indicate ‘normal flash’ (pattern: 0.2 sec on / 0.2 sec off). For more details see also *table 4*. When the switch is released, instrument will get the “default installation address”. This will be different for each fieldbus system. The instrument may be switched-off now or it will return into the “normal running/operation mode” automatically after 60 sec. The baud rate setting will not be changed by this action.

Readout of bus-address/MAC-ID and baud rate:

Pressing the micro switch 3 times briefly with intervals of max 1 second in normal running/operation mode will trigger the instrument to “show” its bus address/MAC-ID and baud rate. For the indication of the bus-address/MAC-ID the green LED will flash the amount of tens and the red LED the amount of units in the number. For the indication of the baud rate setting, both LED’s will flash. The flashes are called “count-flashes” and have a pattern of 0.5 sec on / 0.5 sec off.

Table 5: LED indications for bus address/MAC-ID and baud rate

| green LED | red LED | Time | Indication |
|----------------------------------|----------------------------------|--------------------|--|
| amount of count flashes (0...12) | off | 0...12 sec maximum | tens in bus address/MAC-ID for instrument |
| off | amount of count flashes (0...9) | 0...9 sec maximum | units in bus address/MAC-ID for instrument |
| amount of count flashes (0...10) | amount of count flashes (0...10) | 0...10 sec maximum | baud rate setting for instrument |

Please note: The value 'zero' will be indicated by a period of 1 sec off (0.5 sec off / 0.5 sec off)

Examples:

- For bus address /MAC-ID 35
the green LED will flash 3 times and the red LED will flash 5 times
- For bus address /MAC-ID 20
the green LED will flash 2 times and the red LED will flash 0 times
- For bus address /MAC-ID 3
the green LED will flash 0 times and the red LED will flash 3 times
- For bus address /MAC-ID 126
the green LED will flash 12 times and the red LED will flash 6 times

Table 6: Baud rate settings for the various fieldbus systems:

| FLOW-BUS | PROFIBUS DP | DeviceNet™ | Modbus-RTU |
|--|---|---|---|
| 0 = 187500 Baud (only one fixed baud rate) | 0 = not detected 1 = 9600 Baud 2 = 19200 Baud 3 = 45450 Baud 4 = 93750 Baud 5 = 187500 Baud 6 = 500000 Baud 7 = 1500000 Baud 8 = 3000000 Baud 9 = 6000000 Baud 10 = 12000000 Baud | 1 = 125000 Baud 2 = 250000 Baud 3 = 500000 Baud | 1 = 9600 Baud 2 = 19200 Baud 3 = 38400 Baud |

Examples:

- For PROFIBUS DP baud rate readout of 2000000 Baud
both LED's will flash 10 times
- For DeviceNet™ baud rate readout of 250000 Baud
both LED's will flash 2 times

Change bus address/MAC-ID and baud rate:

At first the instrument needs to be forced into the “remote/manual install mode”. Within the time-out period of 60 sec it is possible to start changing the bus address/MAC-ID of the instrument. If the micro switch will not be pressed within this time-out period the instrument returns to the “normal running/operation mode”.

For certain fieldbus systems it is necessary to select the baud rate also. Other fieldbus systems only have one baud rate or the baud rate setting will adapt to the setting of the master automatically. In these cases the baud rate selection is not needed and will be skipped.

Table 7: Procedure for changing bus address/MAC-ID and baud rate

| Step | Action | Signal | Time | Handling |
|------|--|---|--------------------------------|--|
| 1 | force instrument into “remote/manual install mode“ | both LED's flash normal 0.2 sec on / 0.2 sec off | 12–16 sec after power-up | Press micro switch during power-up and release when both LED's indicate normal flash |
| 2 | set tens of bus address/MAC-ID | green LED flashes 0.1 sec on / 0.1 sec off count-flashes start when micro switch is pressed: 0.5 sec on / 0.5 sec off | time out: 60 sec | Press micro switch and count green flashes for tens of bus address/MAC-ID Release when wanted amount has been count. Counts up to max. 12 and then starts at 0 again When counting fails, keep switch pressed and restart counting for next attempt |
| 3 | set units of bus address/MAC-ID | red LED flashes 0.1 sec on / 0.1 sec off count-flashes start when micro switch is pressed: 0.5 sec on / 0.5 sec off | time out: 60 sec | Press micro switch and count green flashes for tens of bus address/MAC-ID Release when wanted amount has been count; Counts up to max. 9 and then starts at 0 again When counting fails, keep switch pressed and restart counting for next attempt |
| 4 | set baud rate of fieldbus communication only for specific types of field-busses: e.g. DeviceNet™. This part will be skipped if no baud rate needs to be selected | both red and green LED's flash 0.1 sec on / 0.1 sec off count-flashes start when micro switch is pressed: 0.5 sec on / 0.5 sec off | time out: 60 sec | Press micro switch and count red and green flashes for baud rate setting of the specific fieldbus Release when wanted amount has been count. Counts up to max. 10 and then starts at 0 again When counting failed, keep switch pressed and restart counting for next attempt Note: selection of 0 means: No change |

The instrument returns to the “normal running/operation mode“. Changes are valid when they are made within the time-out period (60 sec).

The actual setting of the bus address/MAC-ID and baud rate can be checked by pressing the switch 3 times briefly with intervals of max 1 sec. For more details see also *table 5*.

Note 1:

The value zero will be indicated by a period of 1 sec off (0.5 sec off / 0.5 sec. off). When the value zero is wanted press micro switch shortly and release it again within 1 sec.

Note 2:

Before each action of flash counting the LED's will flash in a high frequency (pattern: 0.1 sec on / 0.1 sec off). As soon as the micro switch is pressed-down, this LED or both LED's will be off and the counting sequence will start.

LED indications for readout of setpoint/control mode

For switching between different functions for a digital meter or controller several modes are available. The output signals (sensor signals) on both the analogue and the fieldbus interface are available at the same time.

The instrument will be triggered to “show” its setpoint/control response mode by pressing the switch 2 times briefly in intervals of max 1 sec in the normal running/operation mode.

For the indication of the setpoint/control mode number the green LED will flash the amount of tens and the red LED the amount of units in the number. The flashes are called “count-flashes” and have a pattern of 0.5 sec. on / 0.5 sec. off.

Table 8: Overview of setpoint/control modes

| No | Mode | Instrument action | Setpoint source | Master Source | Slave factor source |
|----|-------------------------------|--|----------------------|----------------|---------------------|
| 0 | Bus/RS232 | controlling | Bus/RS232 | | |
| 1 | external input | controlling | analogue input | | |
| 2 | FLOW-BUS / RS232 slave | controlling as slave from other instrument on bus | Master/Slave process | FLOW-BUS | FLOW-BUS/ RS232 |
| 3 | valve close | closed valve | | | |
| 4 | controller idle | stand-by on bus/RS232 | | | |
| 5 | test mode | testing enabled (M+W only) | | | |
| 6 | tuning mode | tuning enabled (M+W only) | | | |
| 7 | setpoint 100% | controlling flow on 100% | 100% | | |
| 8 | valve purge | purge valve (valve fully opened) | | | |
| 9 | calibration mode | calibration enabled (M+W only) | | | |
| 10 | external input slave | controlling as slave from another instrument on analogue input | Master/Slave process | analogue input | FLOW-BUS/ RS232 |
| 12 | setpoint 0% | controlling flow on 0% | 0% | | |
| 13 | FLOW-BUS slave external input | controlling as slave from another instrument on bus, slave-factor is set with signal on the analogue input | Master/Slave process | FLOW-BUS | Analogue input |
| 18 | RS232 | controlling | RS232 | | |

**Please note: Analogue input = external input = 8 pin round DIN-connector (for details please refer to chapter 2.3.1)
Bus = any available fieldbus**

Change setpoint/control mode

For switching between different control mode functions for a digital meter or controller several modes are available. The output signals (sensor signals) on both the analogue and the fieldbus interface are available at the same time.

Pressing the micro switch 4 times briefly with intervals of max 1 sec in normal running/operation mode will trigger the instrument to “change” its setpoint/control mode.

For the indication of the setpoint/control mode number the green LED will flash the amount of tens and the red LED the amount of units in the number. The flashes are called “count-flashes” and have a pattern of 0.5 sec. on / 0.5 sec. off.

Table 9: LED indication for setpoint/control mode number

| green LED | red LED | Time | Indication |
|------------------------------------|------------------------------------|---------------|---|
| amount of count flashes (0...2) | off | 0...2 sec max | tens in setpoint / control mode number |
| off | amount of count flashes (0...9) | 0...9 sec max | units in setpoint / control mode number |

Please note: The value ‘zero’ will be indicated by a period of 1 sec off (0.5 sec off / 0.5 sec off)

Table 10: Procedure for changing the setpoint/ control mode number

| Step | Action | Indication | Time | Handling |
|------|--|---|--------------------|--|
| 1 | set tens of setpoint/ control mode number | <p>green LED flashes 0.2 sec on / 0.2 sec off</p> <p>count flashes start when micro switch is pressed: 0.5 sec on / 0.5 sec off</p> | time-out 60 sec | <p>Press switch and count green flashes for tens of setpoint/control mode number. Release when wanted amount has been count. Counts up to max. 2 and then starts at 0 again. When counting fails, keep switch pressed and restart counting for next attempt.</p> |
| 2 | Set units of setpoint/ control mode number | <p>red LED flashes 0.2 sec on / 0.2 sec off</p> <p>count flashes start when micro switch is pressed: 0.5 sec on / 0.5 sec off</p> | time-out 60 sec | <p>Press switch and count red flashes for units of setpoint/control mode number. Release when wanted amount has been count. Counts up to max. 9 and then starts at 0 again. When counting failed, keep switch pressed and restart counting for next attempt.</p> |

Note 1:

The value zero will be indicated by a period of 1 sec off (0.5 sec off / 0.5 sec. off). When the value zero is wanted press micro switch shortly and release it again within 1 sec.

Note 2:

Before each action of flash counting the LED's will flash in a high frequency (pattern: 0.1 sec on / 0.1 sec off). As soon as the micro switch is pressed-down, this LED or both LED's will be off and the counting sequence will start.