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Instruction manual

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Digital readout and control system E-7000 for analog and digital instruments

Doc. no.: 9.17.004N Date: 25-07-2011

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ATTENTION
Please read this instruction manual carefully before installing and operating the instrument.
Not following the guidelines could result in personal injury and/or damage to the equipment.

Even though care has been taken in the preparation and publication of the contents of this manual, we do not assume legal or other liability for any inaccuracy, mistake, mis-statement or any other error of whatsoever nature contained herein. The material in this manual is for information purposes only, and is subject to change without notice.

Bronkhorst High-Tech B.V.
July 2011

Warranty

The products of Bronkhorst High-Tech B.V. 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 the instructions in this manual and that they are not subjected to abuse, physical damage or contamination.

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 9 of the Conditions of sales.

The warranty includes all initial and latent defects, random failures, and undeterminable 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.

Bronkhorst High-Tech B.V. 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 Bronkhorst High-Tech B.V., 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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1	System specific sections (if applicable)
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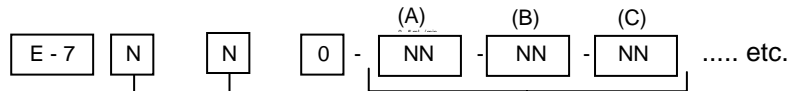
1 INTRODUCTION

1.1 General description

The Bronkhorst High-Tech B.V. serie E-7000 is a modular digital readout and control system for (analog) mass flow/pressure sensors and controllers. Basically a system consists of one or more (14 TE) single channel readout/control modules.

The system can be expanded with additional (14 TE) modules like Ex-proof and heatercontrol for evaporator systems. (For operation of any of these special functions the appropriate additional manuals should be consulted).

1.2 Model configuration



Housing	Code
½ 19" table top (42 TE)	1
19" table top (84 TE)	2
½ 19" rack (42 TE)	3
19" rack (84 TE)	4
Table top cassette (14 TE)	5
Panel mount cassette (14 TE)	6
Other/Specify	9

Supply voltage	Code
100 ... 240 Vac	0
220 ... 240 Vac	1
110 ... 120 Vac	2
24 Vac	3
24 Vdc	4
Other/Specify	9

Modules
to be mounted in the
selected housing;
mounting order from
left to right

A

A B C

A B C D E F

Modules with blind front (14 TE)	Code
Blind front only	01
Blind front + power supply (linked to module with mains entrance)	03
Blind front + power supply + mains entrance + flow bus (incl. cable)	04
Blind front + power supply + RJ45 connector for +15Vdc supply voltage + mains entrance (incl. cable)	05
Blind front + power supply + RJ45 connector for +15Vdc supply voltage (linked to module with mains entrance)	06

Modules with single channel Readout/Control panel (14 TE)	Code
R/C-panel + power supply + mains entrance (incl. cable) analog model	10
R/C-panel + power supply (linked to module with mains entrance) analog model	11
R/C-panel (linked to module with power supply) analog model	12
R/C-panel + power supply + mains entrance (incl. Cable) digital model	13
R/C-panel + power supply (linked to module with main entrance) digital model	14
R/C-panel (linked to module with power supply) digital model	15

Modules with Ex-proof functions (14 TE)	Code
R/C-panel + transmitter supply unit for MFM/EPT (Ex-proof)	20
R/C-panel + supply for MFM/EPT (Ex-proof) + valve with XB-coil	21
R/C-panel + supply for MFM/EPT (Ex-proof) + valve with XC-coil	22
Blind front + transmitter supply unit for MFM/EPT (Ex-proof)	23
Blind front + supply for MFM/EPT (Ex-proof) + valve with XB-coil	24
Blind front + supply for MFM/EPT (Ex-proof) + valve with XC-coil	25

Modules for temperature control for CEM-systems (14 TE)	Code
Temp. R/C-panel + 10 W supply for low capacity CEM-system	33
Temp. R/C-panel + 100 W supply for medium capacity CEM-system	34
Temp. R/C-panel + excl. supply for high capacity CEM-system	35
Temp. R/C-panel + 1000W supply / 230Vac W-303	36
Temp. R/C-panel + 1000W supply / 120Vac operation for W-303	37

Blind front + FLOW-BUS/RS232 interface	40
Blind front + FLOW-BUS/PROFIBUS-DP interface	41

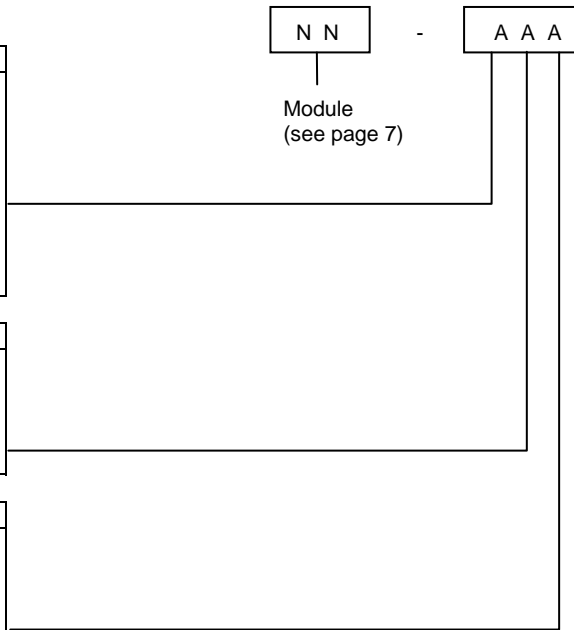
None	00
Other/Specify	99

Code for external output/input signals:

Sensor output signal	Code
0 - 5 Vdc	A
0 - 10 Vdc	B
0 - 20 mA dc (Sinking)	C
4 - 20 mA dc (Sinking)	D
15 - 20 mA dc	E
0 - 20 mA (Sourcing)	F
4 - 20 mA (Sourcing)	G
FLOW-BUS	R
Other/Specify	Z

Module output signal	Code
0 - 5 Vdc	A
0 - 10 Vdc	B
0 - 20 mA (Sourcing)	C
4 - 20 mA (Sourcing)	D
Other/Specify	Z

Ext. setpoint/Module input signal	Code
0 - 5 Vdc	A
0 - 10 Vdc	B
0 - 20 mA (Sinking input)	C
4 - 20 mA (Sinking input)	D
Other/Specify	Z



1.3 Power supply

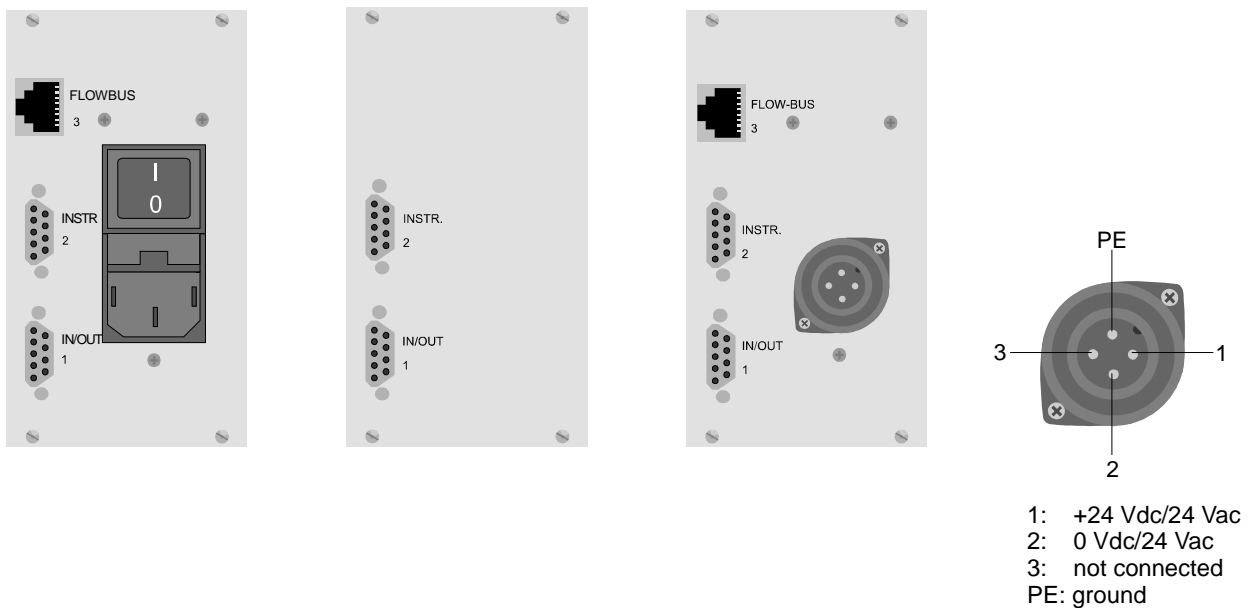
Each E-7000 series housing incorporates one or two power supplies. System setup is such that the instruments that belong to the system can be powered. For other applications or modifications your supplier should be consulted. The power input incorporates an on/off switch and a fuse. For extra protection each power supply has a separate internal fuse.

1.4 In/output signals

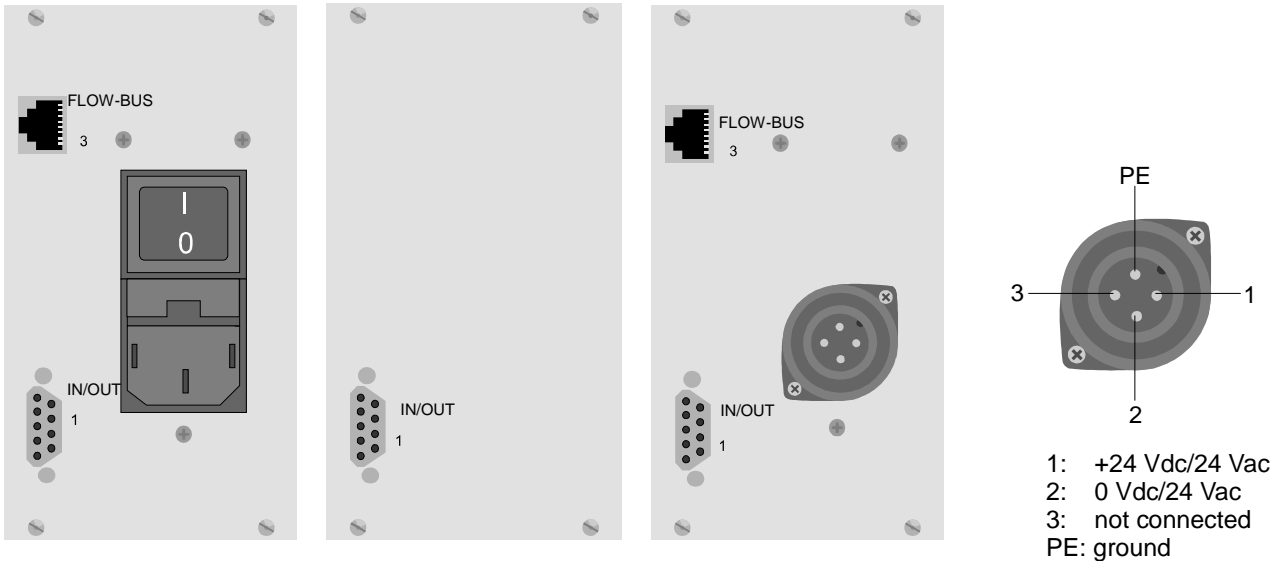
If applicable, connection of cables carrying in- or/and output signals is further explained in the customer system description (see appendices).

1.4.1 Rear panel connectors

for analog instruments:



for digital instruments (FLOW-BUS):



1.4.2 Connection to measuring and controlling devices

The instrument connector (2) is a female sub-miniature 9-pin D-connector. The pin designation is according to the Bronkhorst High-Tech B.V. standard for analog instruments.

pinnumber	description
1	not connected
2	sensor signal
3	setpoint signal
4	0 V valve
5	+ valve
6	- 15 Vdc supply
7	+ 15 Vdc supply
8	0 V/Common
9	ground (shield)

Sensor- and setpointsignals are also according to one of the Bronkhorst High-Tech B.V. standards.

type	signal	
	sensor	setpoint
A	0 - 5 Vdc	0 - 5 Vdc
B	0 - 10 Vdc	0 - 10 Vdc
C	0 - 20 mA (sinking)	0 - 5 Vdc
D	4 - 20 mA (sinking)	1 - 5 Vdc
F	0 - 20 mA (sourcing)	0 - 20 mA
G	4 - 20 mA (sourcing)	4 - 20 mA

1.4.3 Connection to remote equipment

The female in/out (1) (sub-miniature 9-pin) D-connector has the following pin configuration:

pinnumber	description
1	output signal
2	input signal
3	0 V (common)
4	not connected
5	relay contact MC
6	relay contact NO
7	relay contact NC
8	reset input
9	ground (shield)

1.4.3.1 Analog input/output signals

Analog input signals should be connected to pin 2 (+) and 0 V/common.

Analog output signals are available at pin 1 (+) and 0 V/common.

Signals are according to one of the Bronkhorst High-Tech B.V. standards. The model configuration contains a code, describing the input/output signals.

Notes:

- | | |
|-----------------------------------------------|-----------|
| a. Max. load current output (sourcing) | : 375 Ohm |
| b. Min. load voltage output | : 10 kOhm |
| c. Input load resistance (voltage) | : 22K4 |
| d. Input load resistance (current) (sinking) | : 200 Ohm |
| e. Input load resistance (current) (sourcing) | : 250 Ohm |

1.4.3.2 Relay contacts

The (isolated) relay contacts are available at the following pins:

pin 5: common

pin 6: normally open

pin 7: normally closed

Note: contact arrangement during "power on"/"no alarm".

The specifications of the relay contacts are:

Contact arrangement	: SPCO (Single Pole Changeover)
Contact rating	: Switch voltage : 24 Vac/dc max.
	: Switch current : 0,2 A ac/dc max.
	: Switch power : 3 W/3 VA max.

1.4.3.3 Reset input

The reset input signal should be connected to pin 8 (+ V) and pin 3 (0 V/common).

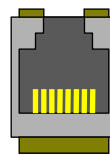
Reset can be achieved by either pulling the + V input (pin 8) to 0 V (pin 3) by means of a contact or a transistor, or by applying an active low logic signal to pin 8 (+ V) and pin 3 (0 V). The logic signal level should be 5 V (high) or 0 V (low).

1.4.4 Connection to FLOW-BUS

1.4.4.1 RJ45 connector

The shielded RJ45 modular jack connector has the following pin configuration:

pinnumber	description
1	+ 15 Vdc supply
2	0 V (ref to +15Vdc)
3	Shield
4	0 V (ref to +15Vdc)
5	+ 15 Vdc supply
6	0 V (RS485)
7	RS485 - B
8	RS485 - A



1.4.5 RS232/FLOW-BUS interface

1.4.5.1 General description

The RS232/FLOW-BUS interface is an interface between the FLOW-BUS and the RS232 V24 serial (computer) port.

It will either be supplied as a separate enclosed unit with a FLOW-BUS connector and a RS232 connector or as an integral 14TE module of your E-7000 readout and control system.

The converter offers communication with a baudrate up to 38,4 kbaud.

Communication software support is available. Consult manual RS232/Flow-Bus interface.

1.4.6 EMC and cables

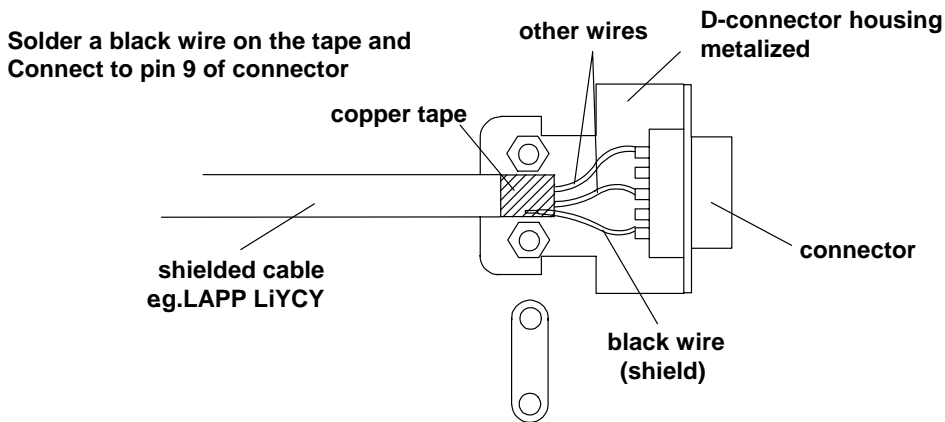
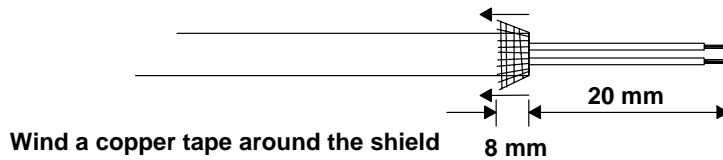
All system setups described in this manual carry the CE-mark.

Therefore they have to comply with the EMC requirements as are valid for this kind of equipment.

However compliance with the EMC requirements is not possible without the use of proper cables and connector assemblies.

For good results Bronkhorst High-Tech B.V. can provide standard cables. Otherwise follow the guidelines as stated below. For cables with 9-pin sub D-connectors:

Fold the shield of the cable back over the cable (the shield must be around the cable).



NOTE:

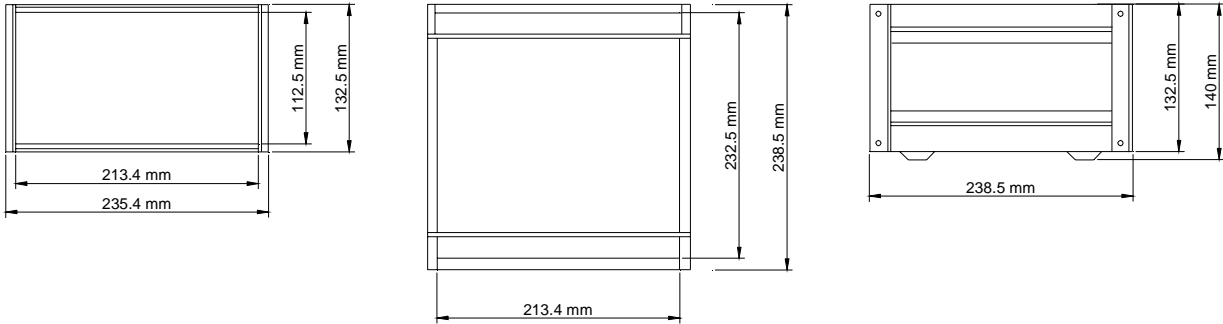
For FLOW-BUS SFTP data (patch)cable connection to RJ45 connectors follow the instructions of the supplier. It is important to use shielded twisted pair cables and shielded RJ45 modular jack connectors. In case the system is electrically connected to another device (e.g. I/O connector to PLC), use shielded cables.

Be sure not to disturb the integrity of the shielding of the cable, never use open wire terminals.

1.5 Specifications

1.5.1 Housings

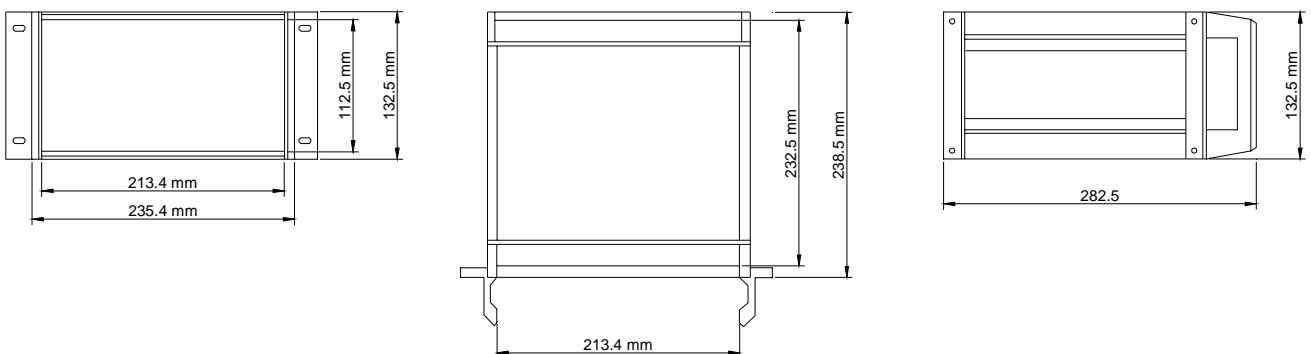
½ 19" table top (42TE)



19" table top (84TE)



½19" rack mount (42TE)



19" rack mount (84TE)

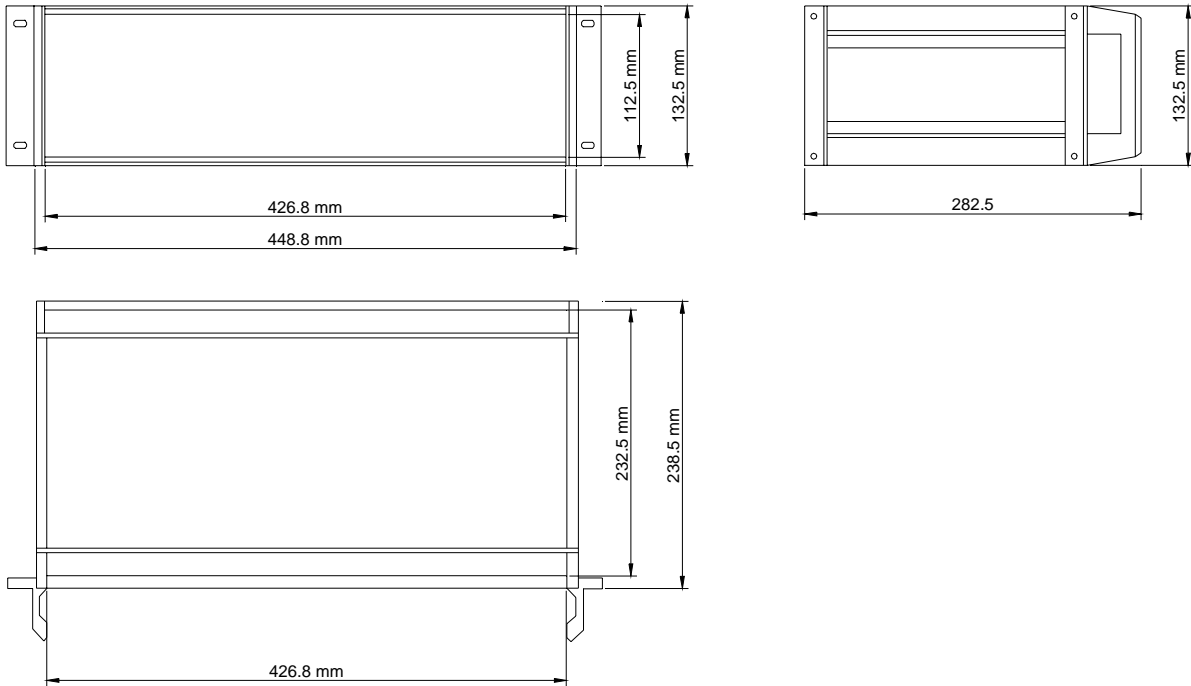
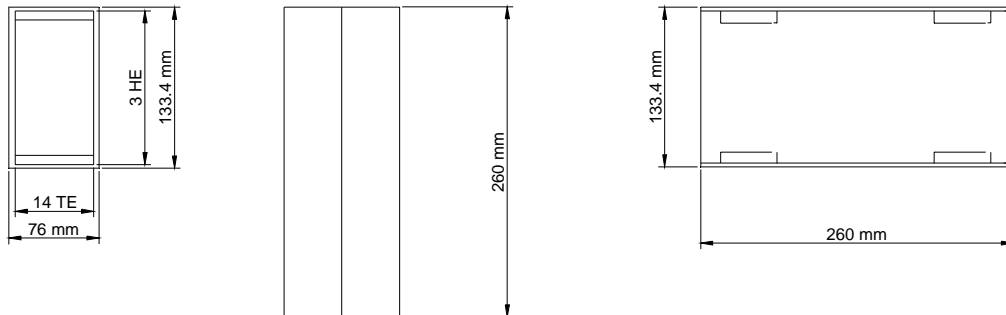
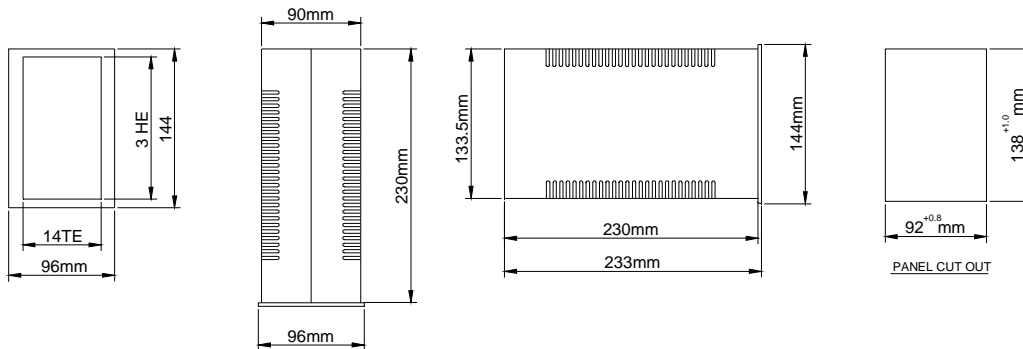


table top cassette (14TE)



panel mount cassette(96x144mm for 14TE module)



1.5.2 EMC and housing

All electronic circuits and modules have been designed to meet the requirements needed to carry the CE-mark.

However compliance with the (EMC) requirements is not possible without the use of properly screened housings.

1.5.3 Electrical specifications

Input: see model configuration for input voltage

Supply voltage: 100 ... 240 Vac	: 50 ... 60 Hz
220 ... 240 Vac	: 50 ... 60 Hz
110 ... 120 Vac	: 50 ... 60 Hz
24 Vac	: $\pm 5 \%$ /50 ... 60 Hz
24 Vdc	: $\pm 5 \%$

Outputs of one power supply:

Mains powered and	:	+ 15 Vdc/2A
24 Vac/dc powered	:	- 15 Vdc/0,5A
	:	+ 5 Vdc/1A nominal 30W

Temperature

Operating range	:	0 ... + 50°C
Storage range	:	- 20 ... + 60°C

Fuse : consult system label

Note :

Never block ventilation holes.

Operation at high ambient temperatures over extended periods may lead to reduction of the operating lifetime of your power supply / readout system

2 INSTALLATION

2.1 General

2.1.1 Receipt of equipment

Check the outside packing for damage incurred during shipment.

Should the packing box be damaged, then the local carrier must be notified at once regarding his liability, if so required.

At the same time a report should be submitted to

BRONKHORST HIGH-TECH B.V.
RUURLO HOLLAND

Remove the envelope containing the packing list; carefully remove the equipment from the packing box. Do not discard spare or replacement parts with the packing material and inspect the contents for damaged or missing parts.

2.1.2 Return shipment

When returning material always describe problem and if possible the work to be done in a covering letter.

Important:

Do clearly note, on top of the package the custom clearance number of Bronkhorst High-Tech B.V., namely:

NL801989978B01

2.1.3 Service

If this equipment is not properly serviced, serious personal injury and/or damage to the equipment could result. It is therefore important that servicing is performed by trained and qualified service personnel. Bronkhorst High-Tech B.V. has a trained staff of servicemen available.

2.1.4 Installation

Before switching on power, please check if all external electrical connections with sensor/controllers and FLOW-BUS (if necessary) are properly connected (consult Customers System Description).

If you receive a readout unit including sensor/controllers, the total system has been tested in full operation under the nearest process-conditions.

For the electrical connection between sensor/controller and readout unit it is recommended to use the standard Bronkhorst HI-TEC cable, which is an eight conductor shielded cable, complete with connectors.

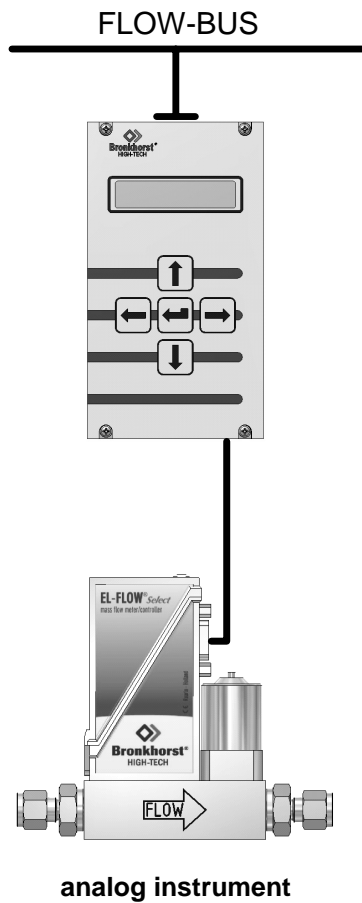
2.1.5 Configuration

All readout and control modules are factory set, for the used Bronkhorst High-Tech sensors/controllers, as described in your customer system description (see appendices).

2.1.6 Equipment storage

The equipment should be stored in its original packing in a cupboard warehouse or similar. Care should be taken not to subject the equipment to excessive temperatures or humidity.

3 Operation of analog instruments



3.1 General information

Before operating your system be sure that it is setup to readout and control analog instruments.

Check: Model configuration; sensor output signal.

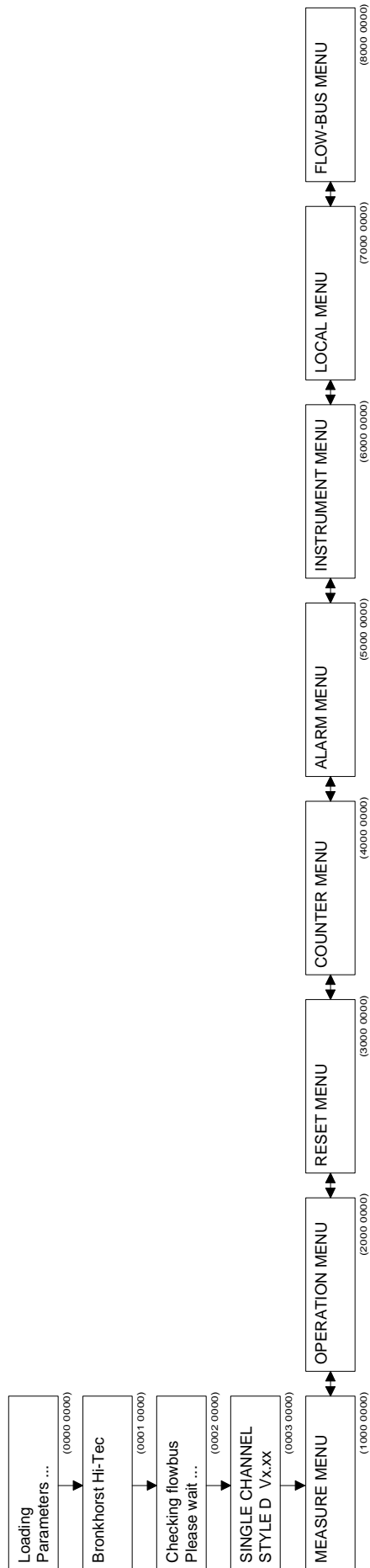
Use 'cursor' keys to scroll through the menu-structure and to select the required menu level.

The 'enter' key is used to acknowledge a selected setting and to enter a edited value and/or text.

Editing can be performed by using the 'cursor' keys to select the character to be edited (← / →) and to scroll through the available character set or units (↑ / ↓).

After power-up the display will show the usual start-up sequence for some seconds.

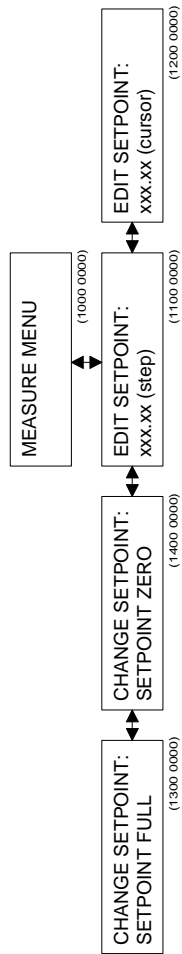
3.2 Startup and menu selection



Menu descriptions

- 0001 0000 Startup screen showing company name
- 0002 0000 Startup screen showing communication check with FLOW-BUS in progress. Takes a short time (few seconds), depending on system size. If the FLOW-BUS address of the module is occupied, you can reinstall the module on a new address.
- 0003 0000 Startup screen showing software revision level
- 1000 0000 Measure menu or 'Readout Display' for reading the amount of flow/pressure, setpoint and/or counter value. When there is an alarm- or counter limit reached it will be shown here. For editing the setpoint/slave factor go down one level.
- 2000 0000 Operation menu for selecting setpoint source (and master/slave), fluidset and setpoint slope for the device to be operated. Also for editing setpoint offset.
- 3000 0000 Reset menu for quick reset of counter and alarm by keyboard. Also password input location to enable advanced use of this module.
- 4000 0000 Counter menu for configuration of all counter options. This menu is secured by means of a password.
- 5000 0000 Alarm menu for configuration of all alarm options. This menu is secured by means of a password.
- 6000 0000 Instrument menu for configuration of the instrument to be operated, such as instrument type, capacity, sensor type, identification and fluid sets with calibration values. This menu is secured by means of a password.
- 7000 0000 Readout menu for configuration of the measure menu. You can select the wanted information for your display.
- 8000 0000 FLOW-BUS menu to install module on the FLOW-BUS or start/stop communication with the bus. This menu is secured by means of a password.

3.3 Measure menu



Menu descriptions

- 1100 0000 Stepsize editor for editing setpoint/slave-factor by a 0.1% step up or down. By holding down UP/DOWN key continuously, the step size will increase. Changes are used by the controller immediately. What is displayed here in this menu depends on the selection of the setpoint source. Analog setpoints can not be edited.
- 1200 0000 Cursor editor for editing setpoint/slave-factor by entering the exact (new) value. After pressing 'enter', the changes will be used by the controller. Could be used for large setpoint steps. What is displayed here in this menu depends on the selection of the setpoint source. Analog setpoints can not be edited.
- 1300 0000 Setpoint full. After pressing 'enter', setpoint for controller will be 100% unconditionally (controller valve will be opened in almost all situations).
- 1400 0000 Setpoint zero. After pressing 'enter', setpoint for controller will be zero unconditionally (controller valve will be closed in almost all situations). You will return to the readout display now. Setpoint will not respond to selected source again until 'enter' has been pressed in menu 1000.

NOTE:

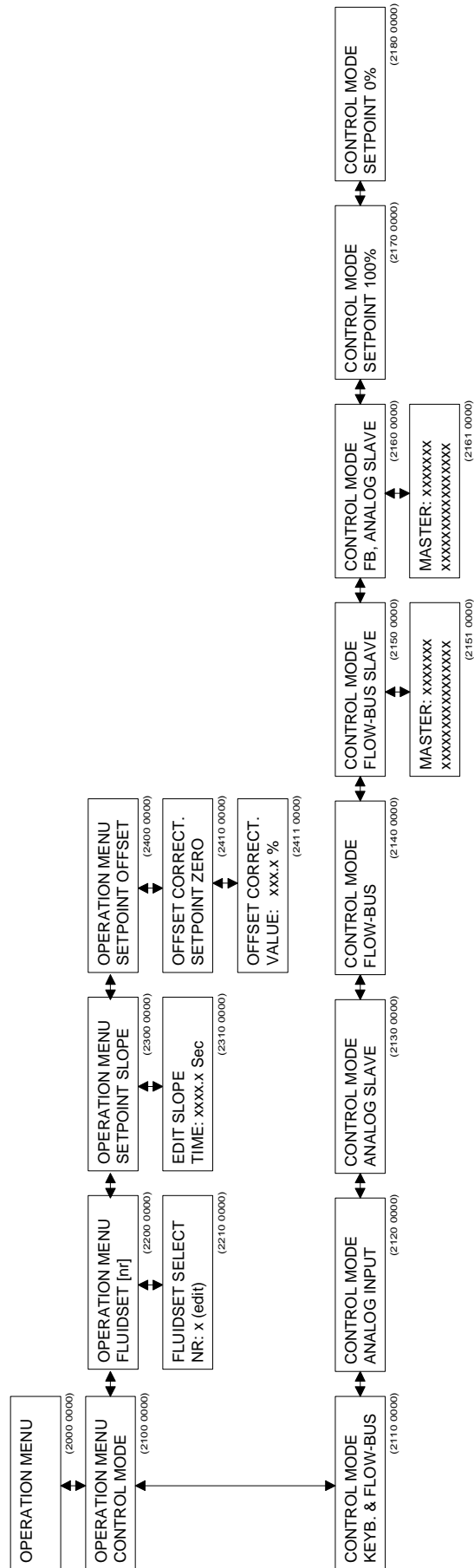
Measured values could be readout up to 110.0%.

Sensor signals > 110.0% will be cut-off.

Setpoint can be entered up to 100.0%. However, setpoint signals can, just like sensor signals, be corrected by means of polynomial calculation.

Also you can use setpoint offset correction to eliminate cable offsets in your system (see operation menu).

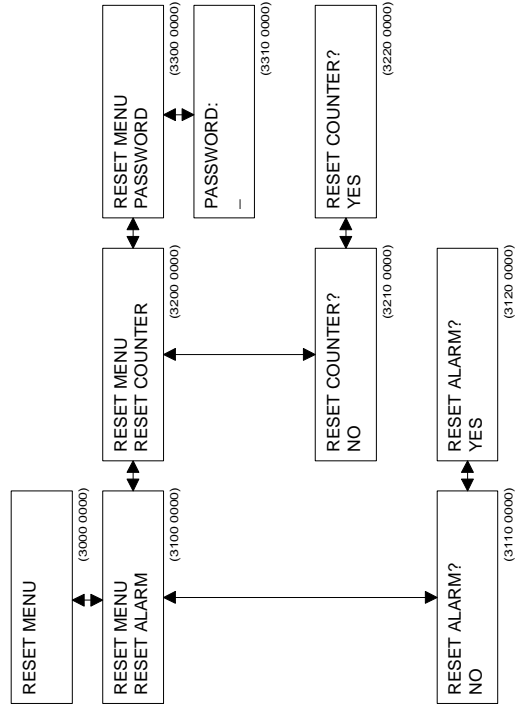
3.4 Operation menu



Menu descriptions

- 2100 0000 Operation mode. Here you can change the source of the setpoint for the operating instrument
- 2110 0000 This option selects a setpoint change with the keyboard or by means of a FLOW-BUS device (operation module or Personal Computer).
- 2120 0000 This option selects a setpoint change coming from an analog input.
- 2130 0000 This option selects a setpoint change coming from an analog input, multiplied by a slave-factor (analog master/slave).
- 2140 0000 This option selects a setpoint change by means of a FLOW-BUS device (operation module or Personal Computer).
- 2150 0000 This option selects a setpoint change coming from an output signal of a master device, via FLOW-BUS, multiplied by a slave-factor (FLOW-BUS master-slave).
- 2151 0000 Choose a master channel. With LEFT/RIGHT you can search for the master device on the FLOW-BUS. Your instrument module will be slave.
Each time a possible master device has been found on the bus, the type and identification number will be displayed. When '----' is displayed, this means that no master could be found. With UP you can stop the search, and with 'enter' you select the currently displayed device. Slave factor must be entered at the position where setpoint is normally entered
- 2160 0000 This option selects a setpoint change coming from an output signal of a master device, via FLOW-BUS, multiplied by a slave-factor (FLOW-BUS master-slave), coming from an analog input.
- 2161 0000 Choose a master channel. With LEFT/RIGHT you can search for the master device on the FLOW-BUS. Your instrument module will be slave.
Each time a possible master device has been found on the bus, the type and identification number will be displayed. When '----' is displayed, this means that no master could be found. With UP you can stop the search, and with 'enter' you select the currently displayed device. Slave factor must be entered at the position where setpoint is normally entered
- 2170 0000 This function sets a setpoint of 100%
- 2180 0000 This function sets a setpoint of 0%
- 2200 0000 Fluidset selection. Here you can change the actual fluidset. Your current settings will be saved and the settings of the selected fluidset will become the new active settings for your instrument. When fluidset changes, the instrument will use the calibration settings in the memory for sensor signal/setpoint adjustments for that fluid.
- 2210 0000 Select the active fluidset by selecting a number from 1 to 8. Settings will be active after pressing 'enter'. This is for selection fluidsets only. For changing fluid calibration settings use Instrument menu.
- 2300 0000 Setpoint Slope. Here you can enter a setpoint slope for this device. When the setpoint has been changed and not overruled by counter limit or an alarm, the setpoint will (smoothly) increase to the set value.
- 2310 0000 Edit the setpoint slope time. This is the time it will take for the setpoint value to increase from 0% to 100% (and vice versa). The value can be entered from 0...3000.0 seconds.
- 2400 0000 Setpoint offset correction. Here you can enter a setpoint offset. This could be used to remove cable offsets.
- 2411 0000 Edit setpoint zero offset. A value can be entered from -2.5%...+2.5%.

3.5 Reset menu



Menu descriptions

3100 0000 Reset Alarm.

Here you can reset an alarm if it is active. This will result in removing the alarm situation defined to take place at the potential free contact and/or at the (temporary) alarm setpoint. If the alarm condition is still present, the alarm will activate again after a few seconds until alarm condition is removed (flow/pressure input signal into save area again) or when alarm mode will be changed.

3200 0000 Reset Counter.

Here you can reset the counter. This will result in setting the counter to value 0 and evt. removing the alarm situation defined to take place at the potential free contact and/or at the (temporary) alarm setpoint. Counter will proceed when counting mode has not been changed.

3300 0000 Password input location.

Here you can enter a password to be allowed to edit the counter, alarm, instrument and FLOW-BUS configurations. The password consists of 5 characters and can not be changed. Cursor can be controlled with LEFT/RIGHT keys. Characters can be selected with UP/DOWN keys. When password has been entered correctly, you have access to all menu's and it is possible to change settings for an instrument. Without password input it is only possible to **operate** an instrument. Password will be erased and access to settings-menu's will be denied when:

- 1) Module has been switched-off and on again (at power-up).
- 2) A wrong password has been entered.
- 3) Automatically after 3 minutes when no key has been pressed.

Password is: **ABABC** and can not be changed.

Menu descriptions

- 4100 0000 Counter Reset Enable.
Here you can enter how the counter may be reset.
- 4110 0000 Keyboard Reset. Here you can enable/disable a counter reset by the keyboard.
- 4120 0000 External Reset. Here you can enable/disable a counter reset by an external signal.
- 4130 0000 FLOW-BUS Reset. Here you can enable/disable a counter reset via the FLOW-BUS by means of f.i. a Personal Computer.
- 4140 0000 When the counter unit is reached, the counter is reset.
- 4200 0000 Counter Mode.
Here you can select how the counter must behave.
- 4210 0000 This option will disable the counter.
- 4220 0000 This option will let the counter count-up*.
- 4230 0000 This option will let the counter count-up, and check if a limit has been reached.
- 4300 0000 Edit Counter Unit.
Here you can change the unit for the counter to display the counter value.
- 4310 0000 Counter Unit Editor.
With UP/DOWN you can change the unit to be counted with.
- 4400 0000 Edit Counter Limit.
Here you can edit at which value the counter will reach its limit.
- 4410 0000 Counter Limit Editor.
With UP/DOWN you can change the number at the cursor, and with LEFT/RIGHT you go to another cursor position.
- 4500 0000 Relay At Limit.
Here you can enter what you want the relay to do when a limit has been reached.
- 4510 0000 This option will disable a relay action at a counter limit.
- 4520 0000 This option will let the relay pulse at a counter limit.
- 4530 0000 This option will let the relay be continuously on at a counter limit.
- 4600 0000 Limit Setpoint.
Here you can configure what to do with the setpoint at a limit. You can make the setpoint go to a predefined value temporarily until reset situation.
- 4610 0000 This option will not change the setpoint.
- 4620 0000 This option will change the setpoint to the entered value.
- 4621 0000 Setpoint At Counter Limit Editor.
Here you can enter the setpoint value to be active until reset.

NOTE:

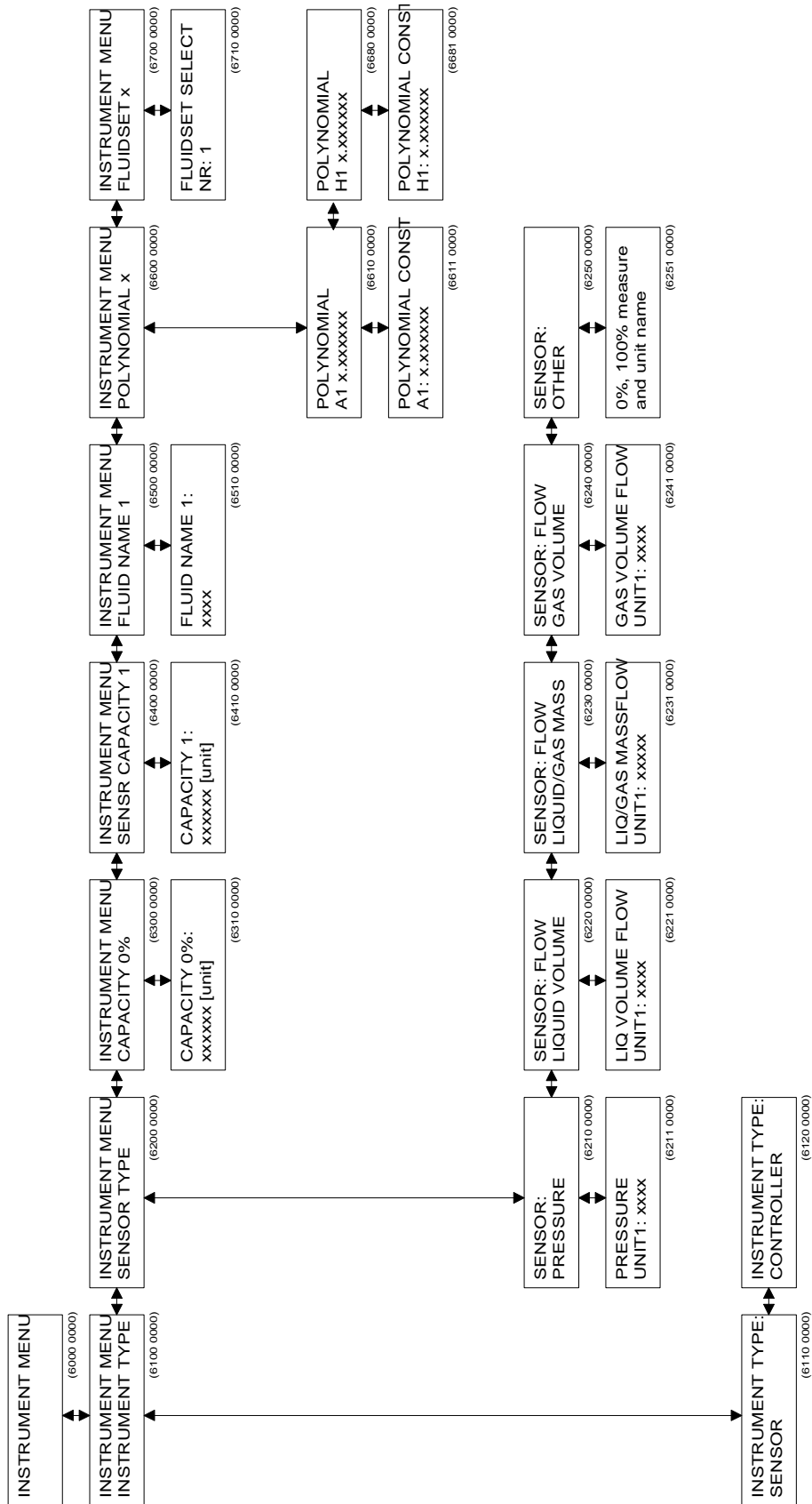
Counter will be disabled when sensor type of instrument is set on either 'Pressure' or 'Other'.

* If in COUNTER MENU RELAY the relay is turned on (pulse or continuous) Every time the limit or its multiple is reached, a pulse is given.

Menu descriptions

- 5100 0000 Alarm Reset Enable.
Here you can enter which way the alarm may be reset.
- 5110 0000 Keyboard Reset.
Here you can enable/disable an alarm reset by the keyboard.
- 5120 0000 External Reset.
Here you can enable/disable an alarm reset by an external signal.
- 5130 0000 FLOW-BUS Reset.
Here you can enable/disable an alarm reset via the FLOW-BUS by means of f.i. a Personal Computer.
- 5140 0000 Auto Reset.
Here you can enable/disable an automatic reset of an alarm. This reset will be activated after a few seconds when the cause of the alarm has been removed.
- 5200 0000 Alarm Mode.
Here you can enter how the alarm-process must react.
- 5210 0000 This option will disable the alarm.
- 5220 0000 This option will enable the alarm.
- 5230 0000 Response Alarm. This option will enable the alarm to detect if the measured value exceeds a minimal or maximal limit related to the setpoint. If the measured value exceeds these limits for a given time, the alarm will be activated. The time can be set with the option Alarm Delay.
- 5240 0000 Power-up Alarm. This alarm will enable the alarm to detect if the instrument had a power failure. At power-up this alarm will be active. The alarm-setpoint can be used to give a setpoint at power-up. The delay time can only be used in combination with auto-reset and the Limit settings have no effect.
- 5300 0000 Edit Alarm Limit.
Here you can edit at which values the alarm will go off.
- 5310 0000 Alarm Minimum Level. Select minimum value for the alarm.
- 5311 0000 Edit Minimum Level.
Here you can change the minimum percentual value for the alarm. Value could be: $2\% \leq \text{minimum limit} \leq \text{maximum limit} - 0.1\%$. Values under 2% are not possible.
- 5320 0000 Alarm Maximum Level. Select the maximum value for the alarm.
- 5321 0000 Edit Maximum Level.
Here you can change the maximum percentual value for the alarm. Value could be: $\text{minimum limit} + 0.1\% \leq \text{maximum limit} \leq 100\%$. Values under 2% are not possible.
- NOTE:** If minimum or maximum limit should not be in use, make limit = 0%. In that case it will be inactive.
- 5400 0000 Relay At Alarm.
Here you can enter what you want the relay to do at an alarm situation.
- 5410 0000 This option will disable a relay action at an alarm.
- 5420 0000 This option will let the relay pulse at an alarm.
- 5430 0000 This option will let the relay be continuously on at an alarm.
- 5500 0000 Limit Setpoint.
Here you can configure what to do with the setpoint at an alarm. You can make the setpoint go to a predefined value temporarily until reset situation.
- 5510 0000 This option will not change the setpoint.
- 5520 0000 This option will change the setpoint to the entered value.
- 5521 0000 Setpoint At Alarm Editor.
Here you can enter the setpoint value to be active until reset.
- 5600 0000 Alarm delay.
Here you can edit the delay in seconds before an alarm message will be given or disappear.

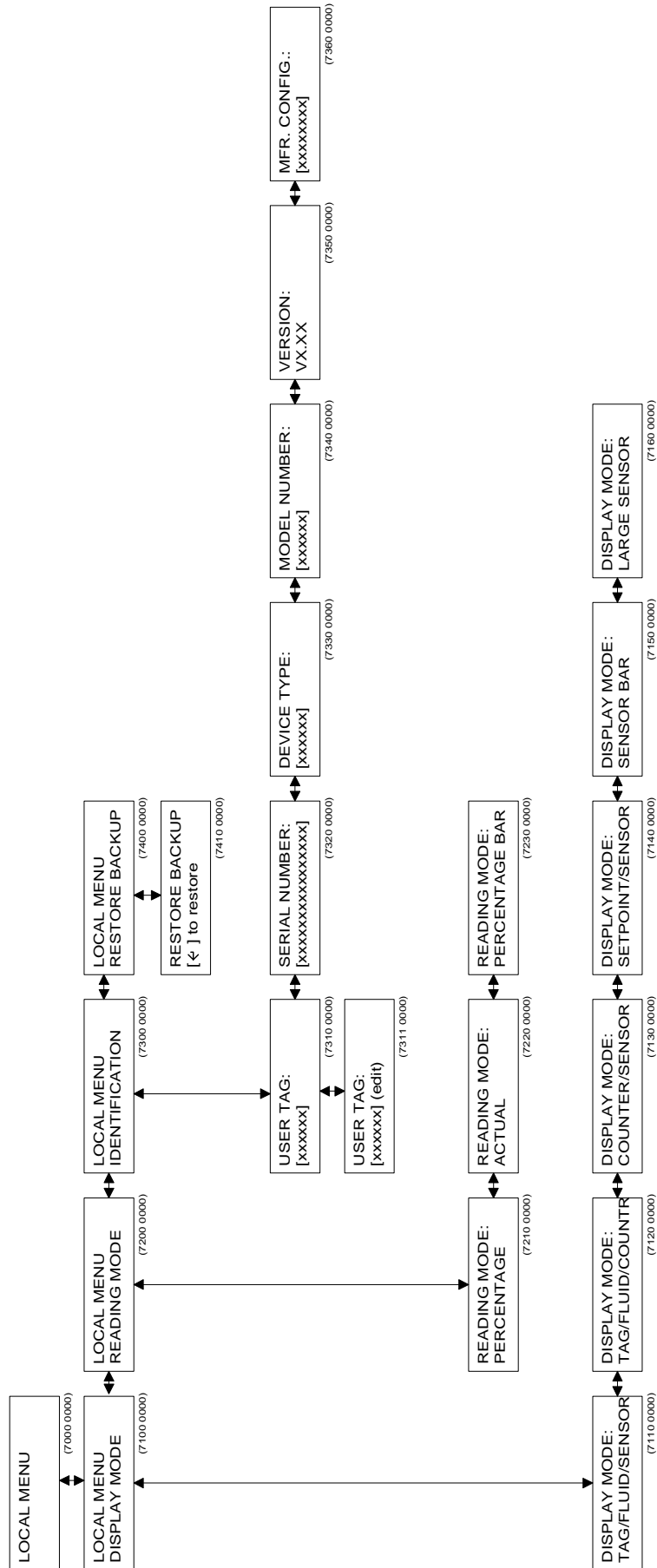
3.8 Instrument menu



Menu descriptions

- 6100 0000 Instrument Type. Here you can change if the instrument will control or only measure mass flow or pressure.
- 6110 0000 This will only let you measure the process. You can't give setpoints.
- 6120 0000 This will let you control the process. You can edit the setpoint.
- 6200 0000 Sensor Type. Here you can select the used sensor type from the device.
This is mainly to obtain correctly direct reading in absolute values. Together with the capacity you can define what 100% signal means. For example: sensortype 'Gas volume' gives readout units like: 'mln/min', 'ln/min', 'm3s/h' etc.
After 'UNIT' the selected fluid number will be shown on the display.
- 6210 0000 Pressure sensor. This prepares module for readout in pressure units. In this mode the counter is not available.
- 6211 0000 Select the pressure sensor readout unit with UP/DOWN key.
After unit selection choose: 'a' (absolute), 'g' (gauge), 'd' (differential) or '.' (no extension)
- 6220 0000 Liquid Volume Sensor. This prepares module for readout in liquid volume units.
- 6221 0000 Select the liquid volume readout unit with UP/DOWN key.
- 6230 0000 Liquid/Gas Mass Sensor. This prepares module for readout in mass flow units.
- 6231 0000 Select the liquid/mass flow sensor unit with UP/DOWN key.
- 6240 0000 Gas Volume Sensor. This prepares module for readout in gas volume (mass) units.
- 6241 0000 Select the gas volume readout unit with UP/DOWN key.
- 6250 0000 Other Sensor Type. This prepares module for readout in customized units. In this mode the counter is not available, and you can not enter a capacity.
- 6251 0000 Here you can define your own sensor type. In order, you must enter the zero scale value (0%), the full scale value (100%) and the unit type.
- 6300 0000 Sensor Capacity 0%. Here you can enter the capacity at 0%. This is the value which goes with 0% signal.
- 6310 0000 Edit the capacity at 0%.
- 6400 0000 Sensor Capacity. Here you can enter the sensor capacity. This is the value which goes with 100% signal at the selected readout unit.
- 6410 0000 Edit the sensor capacity.
- 6500 0000 Fluid Name. Here you can edit the fluid name (max. 10 characters).
- 6510 0000 Edit the fluid name.
- 6600 0000 Polynomial Constants. Here you can change the polynomial correction constants for this instrument Normally these factors are obtained at calibration and represent a 3rd grade polynomial function.
- 6610 0000 Here you can edit the polynomial constant A for selected fluidnr.
- 6611 0000 Edit constant A. (6520 to 6581 likewise for constants B...D or B...H, depending on the instrument to be operate).
- 6700 0000 Fluidset Select. Here you can change the actual fluidset.
Your current settings will be saved and the settings of the selected fluidset will be the active settings.
- 6710 0000 Select the active fluidset with UP/DOWN keys.
The fluidname will be displayed also (when filled-in).

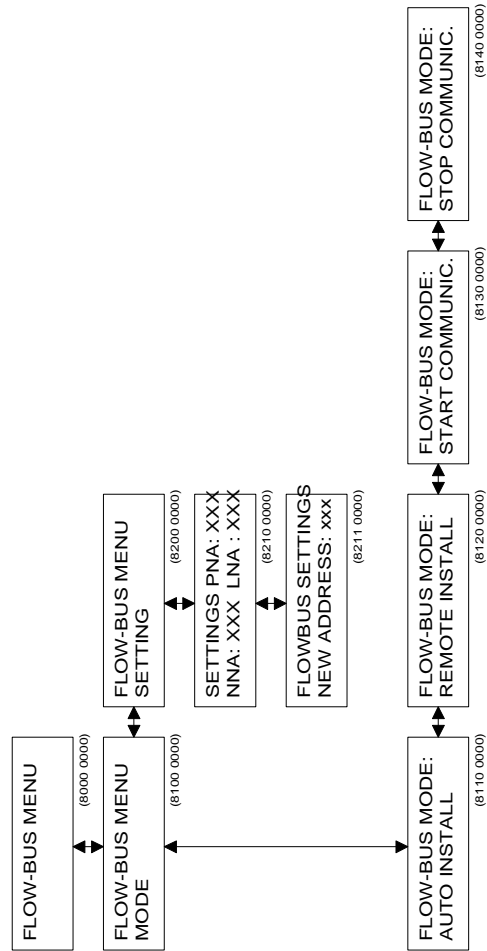
3.9 Local menu



Menu descriptions

- 7100 0000 Display Mode.
Here you can change the values that will be displayed on the Readout Display.
- 7110 0000 This option will display the **usertag**, the **fluidname** and the **measured value** in the measure menu readout screen.
- 7120 0000 This option will display the **usertag**, the **fluidname** and the **counter value**.
- 7130 0000 This option will display the **counter value** and the **measured value**
- 7140 0000 This option will display the **setpoint** and the **measured value**.
- 7150 0000 This option will display the **measured value** in a percentage bar from 0 to 100%.
- 7160 0000 This option will display the **measured value** with large characters.
- 7200 0000 Reading Mode. Here you can switch between direct/percentage reading.
- 7210 0000 Switch to percentage reading.
- 7220 0000 Switch to direct reading in absolute values. Absolute values can be selected at sensor type and capacity of the instrument menu.
- 7230 0000 Switch to percentage bar reading.
- 7300 0000 Local Identification. Here you can change the User Tag and check the hard- and software identification settings of this module.
- 7310 0000 User Tag. Here you can view the user tag of this module.
- 7311 0000 User Tag. Here you can change the user tag.
- 7320 0000 Serial number. Here you can view the serial number of this single channel module. The Bronkhorst High-Tech B.V. serial number is a unique identification for FLOW-BUS modules/instruments.
- 7330 0000 Device Type. Here you can view as which type the device is configured.
- 7340 0000 Model Number. Here you can view the model number of the module.
- 7350 0000 Version. Here you can view the software version.
- 7360 0000 Manufacture Configuration. Here you can view the manufacture configuration
- 7400 0000 Restore Backup. This function restores the backup (the factory settings) which was made after the final test in de factory.
- 7410 0000 Press 'enter' to restore backup.

3.10 FLOW-BUS menu



Menu descriptions

- 8100 0000 FLOW-BUS Mode.
Here you can install this module on the FLOW-BUS or start/stop the communication.
- 8110 0000 Auto install.
Press 'enter' to install this module on the FLOW-BUS. It will search for a free address on the bus by itself and install there.
- 8120 0000 Remote Install.
Press 'enter' to let this module get into INIT mode so it can be installed to the bus by an external device (operation module or PC). You have one minute now to perform the installation procedure.
- 8130 0000 Start Communication.
When you press 'enter' in this menu communication with the bus will be (re)started (use after stopping communication temporarily). When the device is properly installed, it will start communication at power-up and after a reset automatically.
- 8140 0000 Stop Communication.
When you press 'enter' in this menu communication with the bus will be stopped until 'Start communication' will be selected or at a reset of the module.
- 8200 0000 Check Settings. Here you check FLOW-BUS settings of this module.
- 8210 0000 PNA means Primary Node Address of module on the FLOW-BUS.
NNA means Next Node Address. This address points to the next module on the FLOW-BUS and will be changed automatically if a new module is add to the FLOW-BUS behind this module. If the module is the last module on the FLOW-BUS, its NNA points to zero.
- 8211 0000* Here you can change the PNA of the module. If you give a new address, the module will restart the communication. The NNA is default set to PNA+1. During communication NNA values may change automatically because FLOW-BUS optimises it self for optimum communication speed.

NOTE 1:

Normally installation on the FLOW-BUS has to be performed only one time. Mostly this will be done at Bronkhorst High-Tech B.V. when your module has been built and tested. The address on the bus for this module will be stored when the module powers-off. At future power-on situations, it will be part of the FLOW-BUS on the same address each time. However, there can be situations you have to install your module on the bus again. For example:

- 1) When you want to rebuild your FLOW-BUS system.
- 2) When you want to add this module to another FLOW-BUS system.
- 3) When, at the check at start-up, the module finds out that its address to be on the FLOW-BUS is occupied already by another module. You will get a message on your display That you have to re-install the module on the bus.

NOTE 2:

Make sure this module has been switched-off before connecting it to the FLOW-BUS. First make FLOW-BUS connection, then switch-on the power. Only in this order the module is able to perform its communication checkings properly.

How to install the E-7000 modules on the FLOW-BUS network, see manual 9.17.024.

* LNA means last Node Address. This is an indication of the size of the FLOWBUS network. The next module added to the network should have a PNA below this LNA. When a module is automatic installed on the network, this LNA will be changed automatically.

3.11 Calibration with polynomial functions

3.11.1 General information

A normally calibrated device will have linearized transfer functions. This means that real flow/pressure and setpoint are proportional to the output signal (0-5 V, 0-10 V, 0-20 mA or 4-20 mA).

A polynomial function is a method of approximation which mathematically describes a continuous transfer function.

By means of a few samples, a polynomial function can be obtained.

After determining the polynomial function, the original calibration points and an infinite amount of values in between, can be calculated with high accuracy.

In a system where pressure- and/or flow meters and -controllers should be readout and set with high accuracy, these polynomial functions often are used for approximation of their transfer function. For instance the function which describes the relation between output voltage and measured flow.

3.11.2 General form

The general form of a polynomial function of the n-th degree is as follows:

$$Y = a_0 + a_1 \cdot X + a_2 \cdot X^2 + a_3 \cdot X^3 + \dots + a_n \cdot X^n$$

Where 'a₀' to 'a_n' are polynomial parameters, which can be calculated.

When you have 'n + 1' measure-points, they can be approximated by means of a 'n-th' degree polynomial function.

3.11.3 Polynomial functions of sensor signal and setpoint

By means of a calibration at Bronkhorst High-Tech B.V. several measure points will be used to obtain a polynomial function.

The form of this function is:

$$Y = a + b \cdot X + c \cdot X^2 + d \cdot X^3$$

In which 'Y' is the measured value in correct unit (e.g. flow in [ln/min]) and 'X' is the value of output signal in correct unit (e.g. U_{out} in [V]).

Characters 'a - d' are polynomial parameters, which can be obtained by a mathematical program. These parameters can be filled in and the polynomial function is completed.

Now a flow can be calculated out of the sensor output signal of the device.

When a controller is calibrated, also a polynomial function for setpoint is calculated.

This will be the inverse function of the polynomial function of the sensor signal.

The form of this function is:

$$Z = e + f \cdot Y + g \cdot Y^2 + h \cdot Y^3$$

In which 'Y' is the measured value in correct unit again (e.g. flow in [ln / min]) and Z is the value of the setpoint signal in the correct unit (e.g. [V]).

Characters 'e - h' are parameters, which can be filled in.

Now the desired setpoint signal can be calculated out of the amount of flow at which the controller has to operate.

3.11.4 Presentation of parameters

Parameters 'a - d' and 'e - h' are polynomial function parameters, which can be obtained with a mathematical program out of measured calibration points.

All parameters will be printed on the calibration certificate.

They will be presented in scientific notation with 5 significant digits, where the last digit is obtained by rounding-off.

Example (unscaled):

$$\begin{array}{ll} a = -2.7458 \cdot 10^{-3} & e = -2.5396 \cdot 10^{-4} \\ b = +9.5452 \cdot 10^{-1} & f = +1.0892 \\ c = -1.2714 \cdot 10^{-1} & g = +1.7832 \cdot 10^{-2} \\ d = +1.8464 \cdot 10^{-1} & h = -1.1417 \cdot 10^{-1} \end{array}$$

Polynomial function for sensor signal:

$$Y = -2.7458 \cdot 10^{-3} + 9.5452 \cdot 10^{-1} \cdot X - 1.2714 \cdot 10^{-1} \cdot X^2 + 1.8464 \cdot 10^{-1} \cdot X^3$$

Polynomial function for setpoint:

$$Z = -2.5396 \cdot 10^{-4} + 1.0892 \cdot Y + 1.7832 \cdot 10^{-2} \cdot Y^2 - 1.1417 \cdot 10^{-1} \cdot Y^3$$

3.11.5 Using polynomial functions at readout/control unit

The parameters for the polynomial functions are stored at the readout and control-module and can be changed from the keyboard.

Normally both transfer functions of sensor signal and setpoint are linear $Y = X$, the transfer function of the setpoint signals is $Z = Y$.

The connected device will have linearized transfer functions after (normal) calibration.

The accuracy however, will be ≤ 1 % full scale.

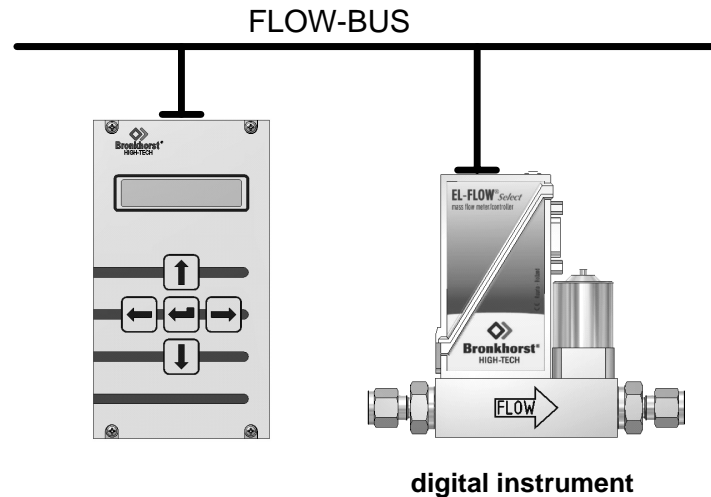
When a special polynomial function calibration is wanted, the parameters 'a-h' will be distilled and printed on the calibration certificate. In the 'INSTRUMENT'-menu you just have to enter these values.

Now you can connect and operate the concerned device.

Note:

Only this device will operate correctly; if you want to connect an other device to this channel, first change the polynomial function parameters.

4 Operation of digital (FLOW-BUS) instruments



4.1 General information

Before operating your system be sure that it is setup to readout and control digital (FLOW-BUS) instruments. Check: model configuration; sensor output signal. The code should be "R"

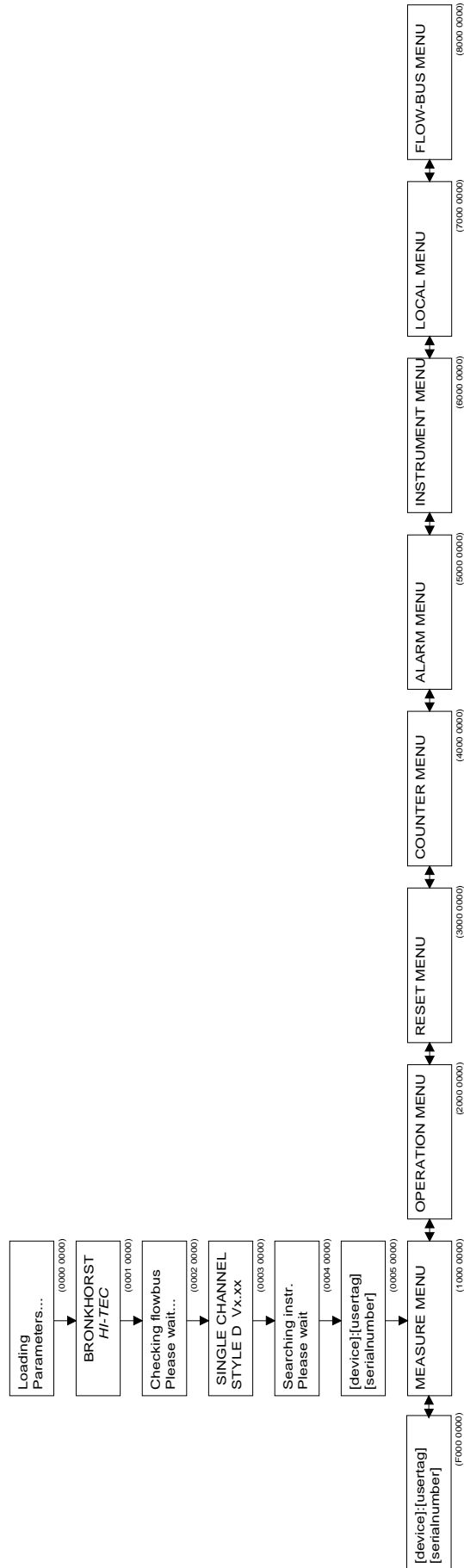
Use 'cursor' keys to scroll through the menu-structure and to select the required menu level.

The 'enter' key is used to acknowledge a selected setting and to enter a edited value and/or text.

Editing can be performed by using the 'cursor' keys to select the character to be edited (← / →) and to scroll through the available character set or units (↑ / ↓).

After power-up the display will show the usual start-up sequence for some seconds.

4.2 Startup and menu selection



Menu descriptions

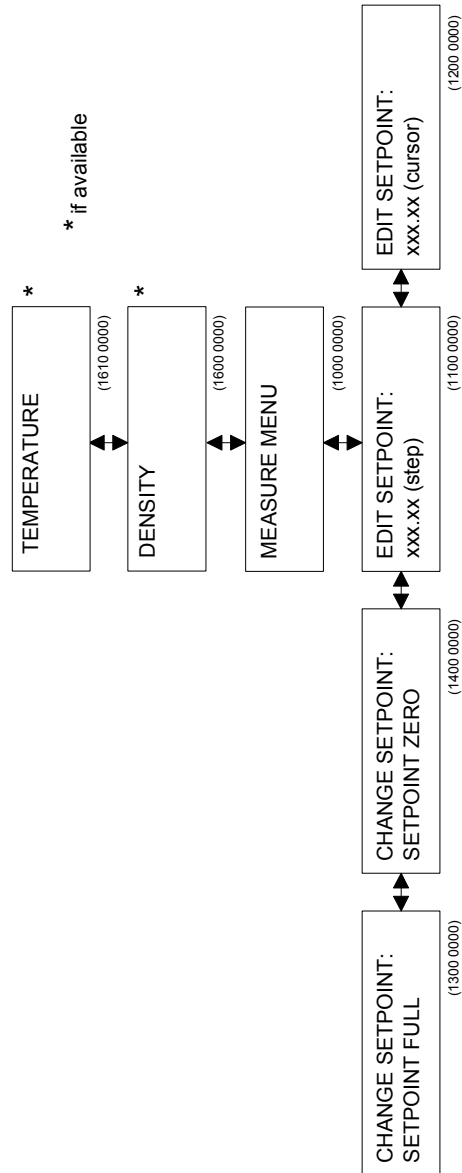
- 0000 0000 Startup screen showing message loading parameters.
- 0001 0000 Startup screen showing company name.
- 0002 0000 Startup screen showing communication check with FLOW-BUS in progress. Takes a short time (few seconds), depending on system size. If the FLOW-BUS address of the module is occupied, you can reinstall the module on a new address.
- 0003 0000 Startup screen showing software revision level
- 0004 0000 Startup screen checking operating instrument. If there is no instrument found on the current instrument node and the MULTI CHANNEL mode is activated, the E7000 module starts searching for an other instrument on the bus.
- 0005 0000 Startup screen showing operating instrument if available.
- 1000 0000 Measure menu or 'Readout Display' for reading the amount of flow/pressure, setpoint and/or counter value. When there is an alarm- or counter limit reached it will be shown here. For editing the setpoint/slave factor go down one level.
- 2000 0000 Operation menu for selecting setpoint source (and master/slave), fluidset and setpoint slope for the device to be operated. Also for editing setpoint offset.
- 3000 0000 Reset menu for quick reset of counter and alarm by keyboard. Also password input location to enable advanced use of this module.
- 4000 0000 Counter menu for configuration of all counter options. This menu is secured by means of a password.
- 5000 0000 Alarm menu for configuration of all alarm options. This menu is secured by means of a password.
- 6000 0000 Instrument menu for configuration of the instrument to be operated, such as instrument type, capacity, sensor type, identification and fluid sets with calibration values. This menu is secured by means of a password.
- 7000 0000 Readout menu for configuration of the measure menu. You can select the wanted information for your display.
- 8000 0000 FLOW-BUS menu to install module on the FLOW-BUS or start/stop communication with the bus. This menu is secured by means of a password.
- F000 0000 Searching instruments. One can search on the bus for instruments with the ↑ and ↓ keys. An instrument can be selected by pressing enter. This option is only available when the MULTI CHANNEL mode is activated.

NOTE:

When you press 'enter' in one of the above menu-options, the module jumps to startup screen '0004 0000' and checks the communication with the operating instrument and shows its serial number.

The MULTI CHANNEL mode can be activated in LOCAL MENU - TERMINAL MODE.

4.3 Measure menu



Menu descriptions

- 1100 0000 Stepsize editor for editing setpoint/slave-factor by a 0.1% step up or down. By holding down UP/DOWN key continuously, the step size will increase. Changes are used by the controller immediately. What is displayed here in this menu depends on the selection of the setpoint source. Analog setpoints can not be edited.
- 1200 0000 Cursor editor for editing setpoint/slave-factor by entering the exact (new) value. After pressing 'enter', the changes will be used by the controller. Could be used for large setpoint steps. What is displayed here in this menu depends on the selection of the setpoint source. Analog setpoints can not be edited.
- 1300 0000 Setpoint full. After pressing 'enter', setpoint for controller will be 100% unconditionally (controller valve will be opened in almost all situations).
- 1400 0000 Setpoint zero. After pressing 'enter', setpoint for controller will be zero unconditionally (controller valve will be closed in almost all situations). You will return to the readout display now. Setpoint will not respond to selected source again until 'enter' has been pressed in menu 1000.

NOTE:

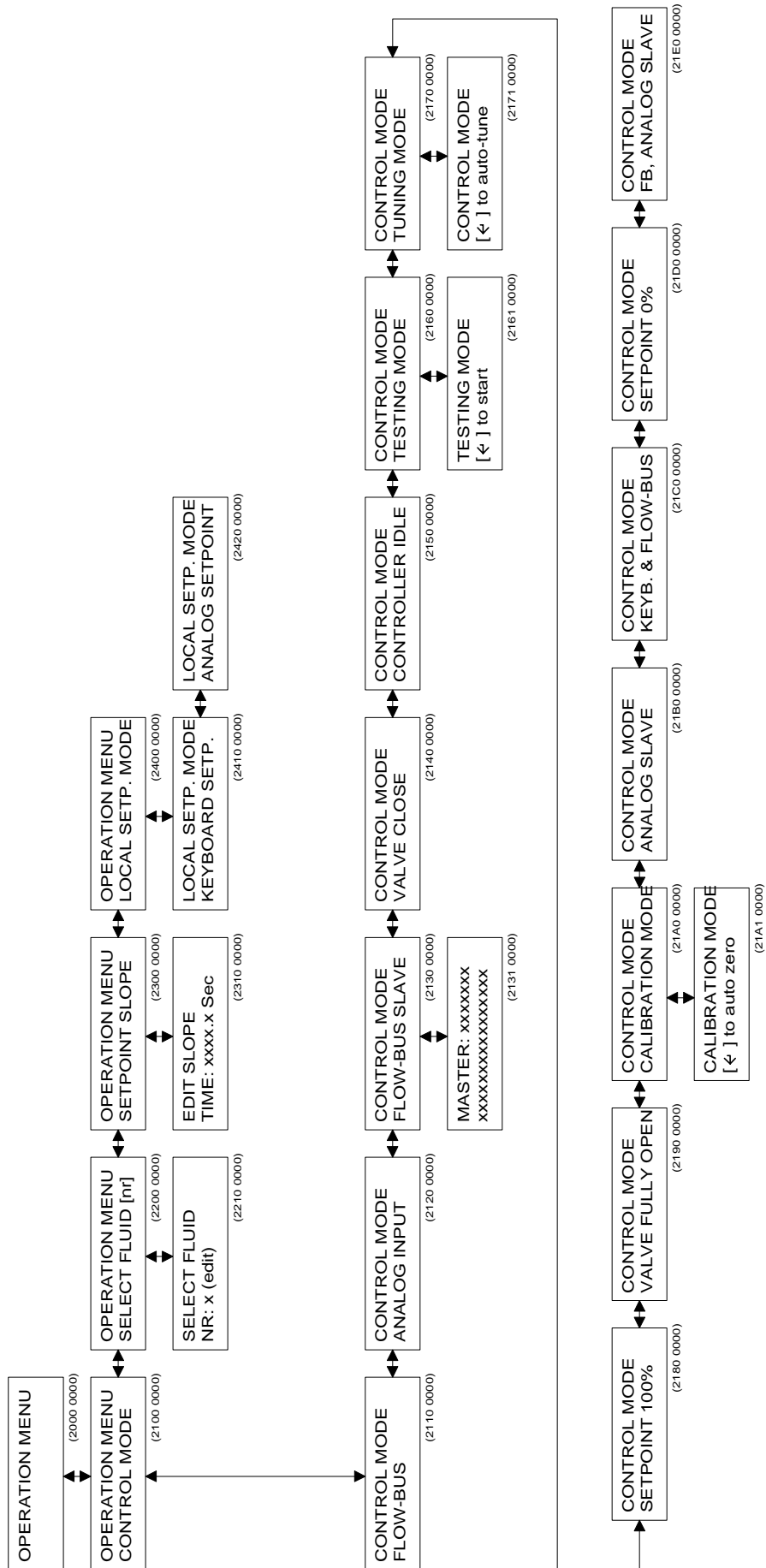
Measured values could be readout up to 110.0%.

Sensor signals > 110.0% will be cut-off.

Setpoint can be entered up to 100.0%. However, setpoint signals can, just like sensor signals, be corrected by means of polynomial calculation.

Also you can use setpoint offset correction to eliminate cable offsets in your system (see operation menu).

4.4 Operation menu



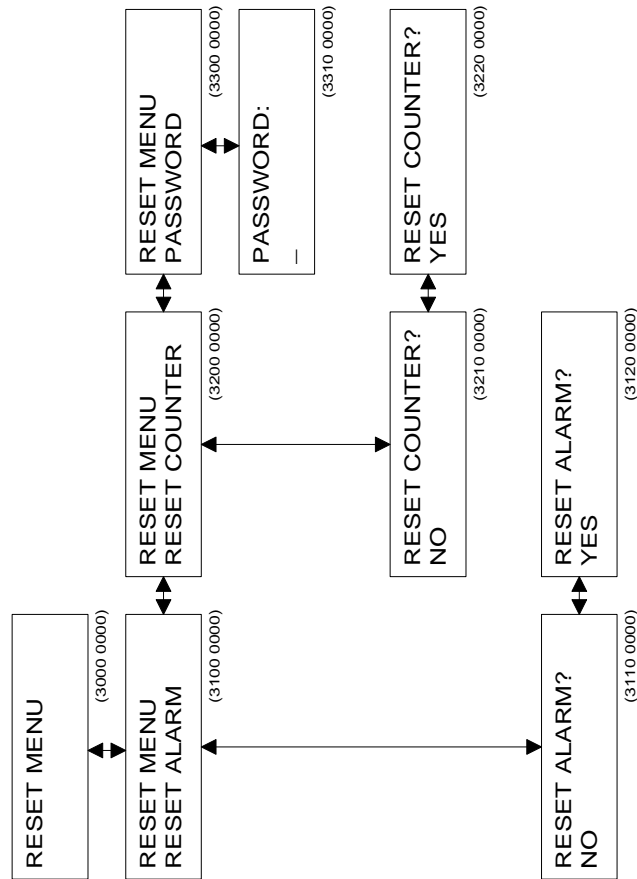
Menu descriptions

- 2100 0000 Operation mode. Here you can change the source of the setpoint for the operating instrument
- 2110 0000 This option selects a setpoint change by means of a FLOW-BUS device (operation module or Personal Computer).
- 2120 0000 This option selects a setpoint change coming from an analog input.
- 2130 0000 This option selects a setpoint change coming from an output signal of a master device, via FLOW-BUS, multiplied by a slave-factor (FLOW-BUS master-slave).
- 2131 0000 Choose a master channel. With LEFT/RIGHT you can search for the master device on the FLOW-BUS. Your instrument module will be slave.
Each time a possible master device has been found on the bus, the type and identification number will be displayed. When '----' is displayed, this means that no master could be found. With UP you can stop the search, and with 'enter' you select the currently displayed device. Slave factor must be entered at the position where setpoint is normally entered
- 2140 0000 This option close the valve of the instrument independent of the setpoint.
- 2150 0000 This function disables all functions of the instrument except the FLOW-BUS communication.
- 2160 0000 This function selects the testing mode of the instrument.
- 2161 0000 Activate the testing mode by pressing 'enter'
- 2170 0000 This function selects the tuning mode of the instrument.
- 2171 0000 Activate the auto-tuning mode by pressing 'enter'
- 2180 0000 This function sets a setpoint of 100%
- 2190 0000 This option opens the valve of the instrument independent of the setpoint.
- 21A0 0000 This function selects the calibration mode of the instrument.
- 21A1 0000 Activate the auto-zero mode by pressing 'enter'.
- 21B0 0000 This option selects a setpoint change coming from an analog input, multiplied by a slave-factor (analog master/slave).
- 21C0 0000 This option selects a setpoint change with the keyboard or by means of a FLOW-BUS device (operation module or Personal Computer).
- 21D0 0000 This function sets a setpoint of 0%
- 21E0 0000 This option selects a setpoint change coming from an output signal of a master device, via FLOW-BUS, multiplied by a slave-factor (FLOW-BUS master-slave), coming from an analog input.
- 21E1 0000 Choose a master channel. With LEFT/RIGHT you can search for the master device on the FLOW-BUS. Your instrument module will be slave.
Each time a possible master device has been found on the bus, the type and identification number will be displayed. When '----' is displayed, this means that no master could be found. With UP you can stop the search, and with 'enter' you select the currently displayed device. Slave factor must be entered at the position where setpoint is normally entered
- 2200 0000 Fluidset selection. Here you can change the actual fluidset. Your current settings will be saved and the settings of the selected fluidset will become the new active settings for your instrument. When fluidset changes, the instrument will use the calibration settings in the memory for sensor signal/setpoint adjustments for that fluid.
- 2210 0000 Select the active fluidset by selecting a number from 1 to 8. Settings will be active after pressing 'enter'. This is for selection fluidsets only. For changing fluid calibration settings use Instrument menu.
- 2300 0000 Setpoint Slope. Here you can enter a setpoint slope for this device. When the setpoint has been changed and not overruled by counter limit or an alarm, the setpoint will (smoothly) increase to the set value.
- 2310 0000 Edit the setpoint slope time. This is the time it will take for the setpoint value to increase from 0% to 100% (and vice versa). The value can be entered from 0...3000.0 seconds.
- 2400 0000 Local Setpoint mode.
- 2410 0000 This option selects the local keyboard for setpoint input.
- 2420 0000 This option selects the local analog input for setpoint input.

NOTE:

Slave factor can be entered up to 500%.

4.5 Reset menu



Menu descriptions

3100 0000 Reset Alarm.

Here you can reset an alarm if it is active. This will result in removing the alarm situation defined to take place at the potential free contact and/or at the (temporary) alarm setpoint. If the alarm condition is still present, the alarm will activate again after a few seconds until alarm condition is removed (flow/pressure input signal into save area again) or when alarm mode will be changed.

3200 0000 Reset Counter.

Here you can reset the counter. This will result in setting the counter to value 0 and evt. removing the alarm situation defined to take place at the potential free contact and/or at the (temporary) alarm setpoint. Counter will proceed when counting mode has not been changed.

3300 0000 Password input location.

Here you can enter a password to be allowed to edit the counter, alarm, instrument and FLOW-BUS configurations. The password consists of 5 characters and can not be changed. Cursor can be controlled with LEFT/RIGHT keys. Characters can be selected with UP/DOWN keys. When password has been entered correctly, you have access to all menu's and it is possible to change settings for an instrument. Without password input it is only possible to **operate** an instrument.

Password will be erased and access to settings-menu's will be denied when:

- 1) Module has been switched-off and on again (at power-up).
- 2) A wrong password has been entered.
- 3) Automatically after 3 minutes when no key has been pressed.

Password is: **ABABC** and can not be changed.

Menu descriptions

- 4100 0000 Counter Reset Enable.
Here you can enter how the counter may be reset.
- 4110 0000 Remote manual reset. Here you can enable/disable a counter reset by the keyboard on the instrument.
- 4120 0000 Remote external reset. Here you can enable/disable a counter reset by an external signal on the instrument.
- 4130 0000 Remote FLOW-BUS reset. Here you can enable/disable a counter reset on the instrument via the FLOW-BUS by means of f.i. a Personal Computer.
- 4140 0000 Remote auto reset. Here you can enable/disable a counter reset on the instrument when the counter has reached its limit.
- 4150 0000 Local manual reset. Here you can enable/disable a counter reset by the keyboard on this module.
- 4160 0000 Local external reset. Here you can enable/disable a counter reset by an external signal on this module.
- 4200 0000 Counter Mode.
Here you can select how the counter must behave.
- 4210 0000 This option will disable the counter.
- 4220 0000 This option will let the counter count-up, but no limit will be checked.
- 4230 0000 This option will let the counter count-up, and check if a limit has been reached.
- 4300 0000 Edit Counter Unit.
Here you can change the unit for the counter to display the counter value.
- 4310 0000 Counter Unit Editor.
With UP/DOWN you can change the unit to be counted with.
- 4400 0000 Edit Counter Limit.
Here you can edit at which value the counter will reach its limit.
- 4410 0000 Counter Limit Editor.
With UP/DOWN you can change the number at the cursor, and with LEFT/RIGHT you go to another cursor position.
- 4500 0000 Remote relay at limit.
Here you can enter what you want the instrument relay to do when a limit has been reached.
- 4510 0000 This option will disable a relay action at a counter limit.
- 4520 0000 This option will let the relay pulse at a counter limit.
- 4530 0000 This option will let the relay be continuously on at a counter limit.
- 4600 0000 Local relay at limit.
Here you can enter what you want the module relay to do when a limit has been reached.
- 4610 0000 This option will disable a relay action at a counter limit.
- 4620 0000 This option will let the relay pulse at a counter limit.
- 4630 0000 This option will let the relay be continuously on at a counter limit.
- 4700 0000 Limit Setpoint.
Here you can configure what to do with the setpoint at a limit. You can make the setpoint go to a predefined value temporarily until reset situation.
- 4710 0000 This option will not change the setpoint.
- 4720 0000 This option will change the setpoint to the entered value.
- 4721 0000 Setpoint At Counter Limit Editor.
Here you can enter the setpoint value to be active until reset.

NOTE:

Counter will be disabled when sensor type of instrument is set on either 'Pressure' or 'Other'.

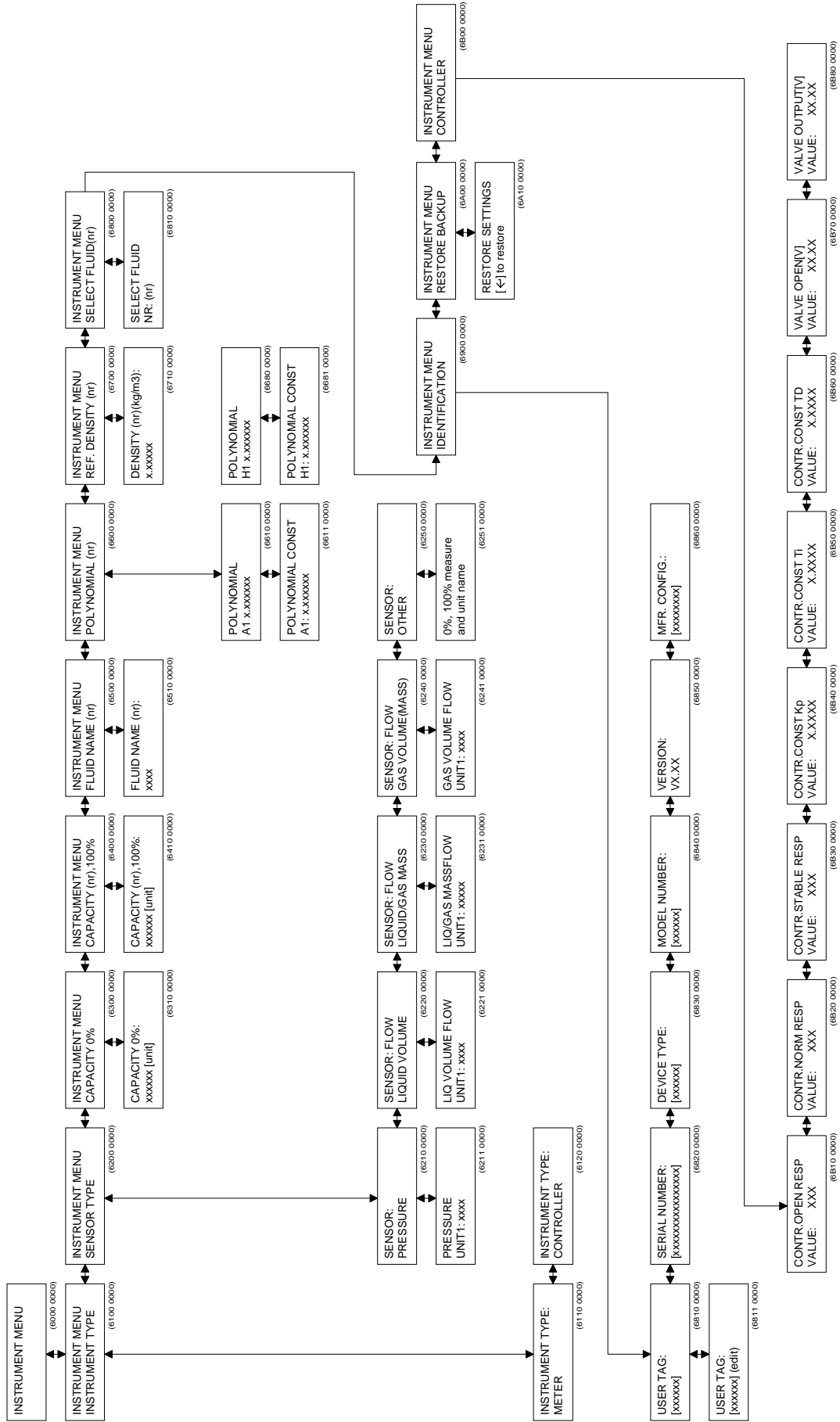
Menu descriptions

- 5100 0000 Alarm Reset Enable.
Here you can enter which way the alarm may be reset.
- 5110 0000 Remote manual reset.
Here you can enable/disable a manual alarm reset on the instrument.
- 5120 0000 Remote external reset.
Here you can enable/disable an alarm reset by an external signal on the instrument.
- 5130 0000 Remote FLOW-BUS reset.
Here you can enable/disable an alarm reset on the instrument via the FLOW-BUS by means of f.i. a Personal Computer
- 5140 0000 Remote auto reset.
Here you can enable/disable an automatic reset of an alarm on the instrument. This reset will be activated after a few seconds when the cause of the alarm has been removed.
- 5150 0000 Local manual reset.
Here you can enable/disable a manual alarm reset on this module.
- 5160 0000 Local external reset.
Here you can enable/disable an alarm reset by an external signal on this module.
- 5200 0000 Alarm Mode.
Here you can enter how the alarm-process must react.
- 5210 0000 This option will disable the alarm.
- 5220 0000 This option will enable the alarm.
- 5230 0000 Response Alarm. This option will enable the alarm to detect if the measured value exceeds a minimal or maximal limit related to the setpoint. If the measured value exceeds these limits for a given time, the alarm will be activated. The time can be set with the option Alarm Delay.
- 5240 0000 Power-up Alarm. This alarm will enable the alarm to detect if the instrument had a power failure. At power-up this alarm will be active. The alarm-setpoint can be used to give a setpoint at power-up. The delay time can only be used in combination with auto-reset and the Limit settings have no effect.
- 5300 0000 Edit Alarm Limit.
Here you can edit at which values the alarm will go off.
- 5310 0000 Alarm Minimum Level. Select minimum value for the alarm.
- 5311 0000 Edit Minimum Level.
Here you can change the minimum percentual value for the alarm. Value could be: $2\% \leq \text{minimum limit} \leq \text{maximum limit} - 0.1\%$. Values under 2% are not possible.
- 5320 0000 Alarm Maximum Level. Select the maximum value for the alarm.
- 5321 0000 Edit Maximum Level.
Here you can change the maximum percentual value for the alarm. Value could be: $\text{minimum limit} + 0.1\% \leq \text{maximum limit} \leq 100\%$. Values under 2% are not possible.
- NOTE:** If minimum or maximum limit should not be in use, make limit = 0%. In that case it will be inactive.
- 5400 0000 Remote relay at alarm.
Here you can enter what you want the instrument relay to do at an alarm situation.
- 5410 0000 This option will disable a relay action at an alarm.
- 5420 0000 This option will let the relay pulse at an alarm.
- 5430 0000 This option will let the relay be continuously on at an alarm.
- 5500 0000 Local relay at alarm.
Here you can enter what you want the module relay to do at an alarm situation.
- 5510 0000 This option will disable a relay action at an alarm.
- 5520 0000 This option will let the relay pulse at an alarm.
- 5530 0000 This option will let the relay be continuously on at an alarm.
- 5600 0000 Limit Setpoint.
Here you can configure what to do with the setpoint at an alarm. You can make the setpoint go to a predefined value temporarily until reset situation.
- 5610 0000 This option will not change the setpoint.
- 5620 0000 This option will change the setpoint to the entered value.
- 5621 0000 Setpoint At Alarm Editor.
Here you can enter the setpoint value to be active until reset.

5700 0000 Alarm delay

5710 0000 Here you can enter the alarm delay in seconds. This delay is used for activating and in case of auto reset also for deactivating the alarm.

4.8 Instrument menu



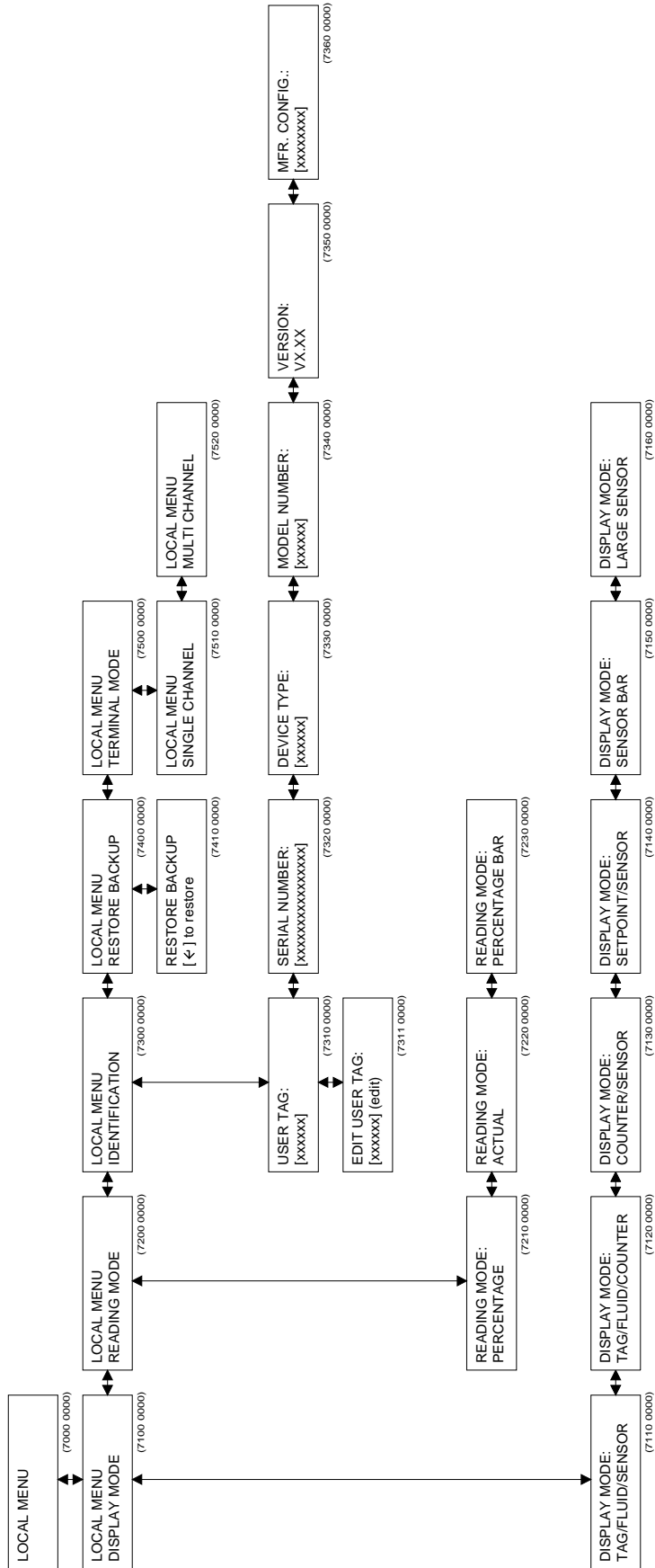
Menu descriptions

- 6100 0000 Instrument Type. Here you can change if the instrument will control or only measure mass flow or pressure.
- 6110 0000 This will only let you measure the process. You can't give setpoints.
- 6120 0000 This will let you control the process. You can edit the setpoint.
- 6200 0000 Sensor Type. Here you can select the used sensor type from the device.
This is mainly to obtain correctly direct reading in absolute values. Together with the capacity you can define what 100% signal means. For example: sensortype 'Gas volume' gives readout units like: 'mln/min', 'ln/min', 'm3s/h' etc.
After 'UNIT' the selected fluid number will be shown on the display.
- 6210 0000 Pressure sensor. This prepares module for readout in pressure units. In this mode the counter is not available.
- 6211 0000 Select the pressure sensor readout unit with UP/DOWN key.
After unit selection choose: 'a' (absolute), 'g' (gauge), 'd' (differential) or '.' (no extension)
- 6220 0000 Liquid Volume Sensor. This prepares module for readout in liquid volume units.
- 6221 0000 Select the liquid volume readout unit with UP/DOWN key.
- 6230 0000 Liquid/Gas Mass Sensor. This prepares module for readout in mass flow units.
- 6231 0000 Select the liquid/mass flow sensor unit with UP/DOWN key.
- 6240 0000 Gas Volume Sensor. This prepares module for readout in gas volume (mass) units.
- 6241 0000 Select the gas volume readout unit with UP/DOWN key.
- 6250 0000 Other Sensor Type. This prepares module for readout in customized units. In this mode the counter is not available, and you can not enter a capacity.
- 6251 0000 Here you can define your own sensor type. In order, you must enter the zero scale value (0%), the full scale value (100%) and the unit type.
- 6300 0000 Sensor Capacity 0%. Here you can enter the capacity at 0%. This is the value which goes with 0% signal.
- 6310 0000 Edit the capacity at 0%.
- 6400 0000 Sensor Capacity. Here you can enter the sensor capacity. This is the value which goes with 100% signal at the selected readout unit.
- 6410 0000 Edit the sensor capacity.
- 6500 0000 Fluid Name. Here you can edit the fluid name (max. 10 characters).
- 6510 0000 Edit the fluid name.
- 6600 0000 Polynomial Constants. Here you can change the polynomial correction constants for this instrument Normally these factors are obtained at calibration and represent a 3rd grade polynomial function.
- 6610 0000 Here you can edit the polynomial constant A for selected fluidnr.
- 6611 0000 Edit constant A. (6520 to 6581 likewise for constants B...D or B...H, depending on the instrument to be operate).
- 6700 0000 Here can you edit the density of the actual fluid.
- 6710 0000 Edit the actual density.
- 6800 0000 Fluidset Select. Here you can change the actual fluidset.
Your current settings will be saved and the settings of the selected fluidset will be the active settings.
- 6810 0000 Select the active fluidset with UP/DOWN keys.
The fluidname will be displayed also (when filled-in).
- 6900 0000 Instrument Identification. Here you can change the User Tag and check the hard- and software identification settings of the operated instrument
- 6910 0000 User Tag. Here you can view the user tag of the operated instrument.
- 6911 0000 User Tag. Here you can change the user tag.
- 6920 0000 Serial number. Here you can view the serial number of the operated instrument. The Bronkhorst HIGH-TECH B.V. serial number is a unique identification for FLOW-BUS modules/ instruments.
- 6930 0000 Device Type. Here you can view as which type the operated instrument is configured.
- 6940 0000 Model Number. Here you can view the model number of the operated instrument.
- 6950 0000 Version. Here you can view the software version of the operated instrument.
- 6960 0000 Manufacturer Configuration. Here you can view the manufacture configuration of the operated instrument.

- 6A00 0000 Restore Backup. This function restores the backup (the factory settings) which was made after the final test in de factory.
- 6A10 0000 Press 'enter' to restore backup on instrument.

- 6B00 0000 Controller menu. This menu option is only available if the operating instrument is a controller.
- 6B10 0000 Here you can change the response factor of the control process when it should open the valve.
- 6B20 0000 Here you can change the response factor of the normal control process of setpoint steps.
- 6B30 0000 Here you can change the response factor of the control process when it is stable, difference between setpoint and measured value <2%.
- 6B40 0000 Here you can change the Kp parameter of the PID controller.
- 6B50 0000 Here you can change the Ti parameter of the PID controller.
- 6B60 0000 Here you can change the Td parameter of the PID controller.
- 6B70 0000 Here you can view the valve open voltage.
- 6B80 0000 Here you can view the actual valve voltage.

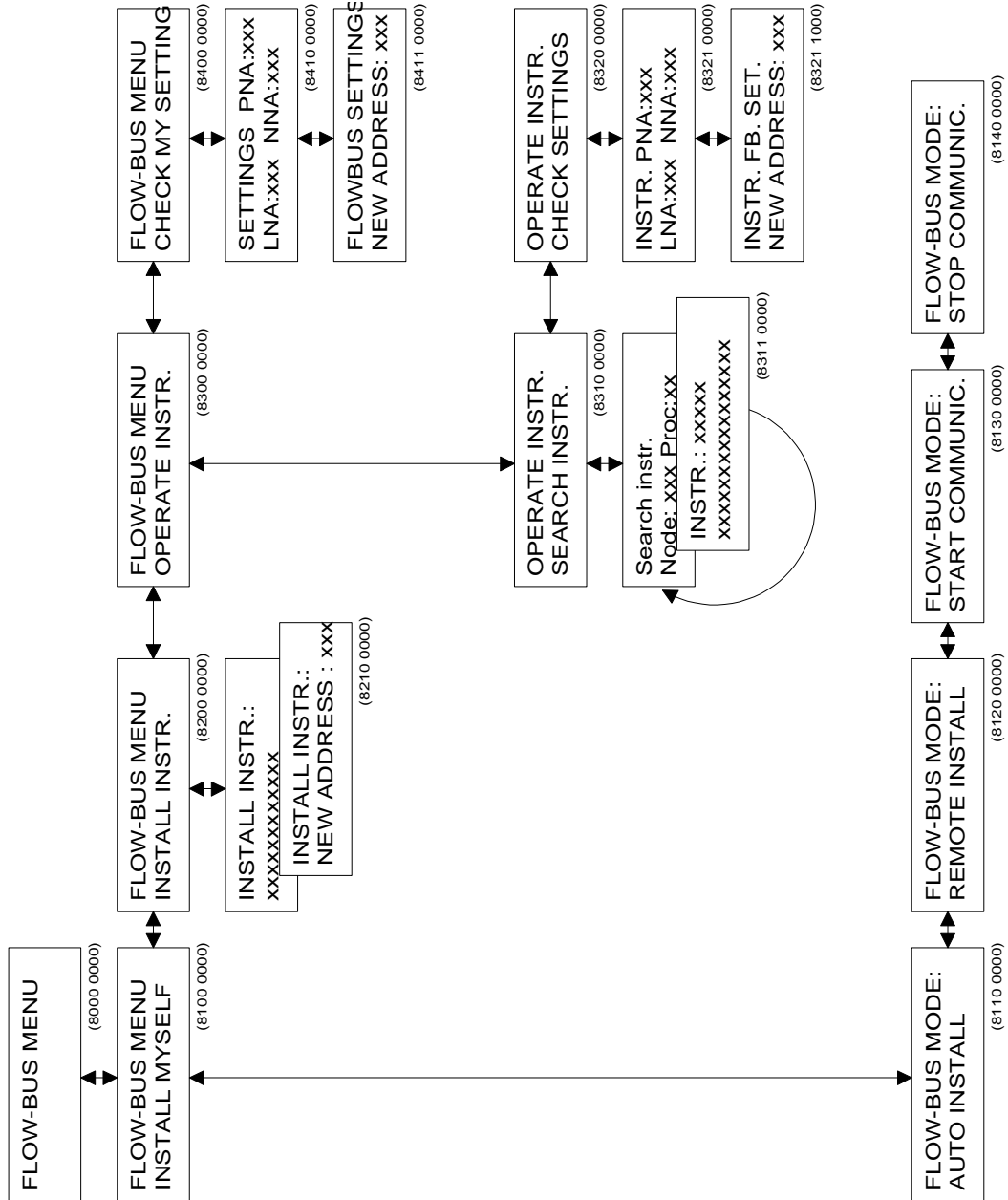
4.9 Local menu



Menu descriptions

- 7100 0000 Display Mode.
Here you can change the values that will be displayed on the Readout Display.
- 7110 0000 This option will display the instrument **user tag**, the **fluid name** and the **measured value** in the measure menu readout screen.
- 7120 0000 This option will display the instrument **user tag**, the **fluid name** and the **counter value**.
- 7130 0000 This option will display the **counter value** and the **measured value**
- 7140 0000 This option will display the **setpoint** and the **measured value**.
- 7150 0000 This option will display the **measured value** in a percentage bar from 0 to 100%.
- 7160 0000 This option will display the **measured value** with large characters.
- 7200 0000 Reading Mode. Here you can switch between direct/percentage reading.
- 7210 0000 Switch to percentage reading.
- 7220 0000 Switch to direct reading in absolute values. Absolute values can be selected at sensor type and capacity of the instrument menu.
- 7230 0000 Switch to percentage bar reading.
- 7300 0000 Local Identification. Here you can change the User Tag and check the hard- and software identification settings of this module.
- 7310 0000 User Tag. Here you can view the user tag of this module.
- 7311 0000 User Tag. Here you can change the user tag.
- 7320 0000 Serial number. Here you can view the serial number of this single channel module. The Bronkhorst HIGH-TECH B.V. serial number is a unique identification for FLOW-BUS modules/ instruments.
- 7330 0000 Device Type. Here you can view as which type the device is configured.
- 7340 0000 Model Number. Here you can view the model number of the module.
- 7350 0000 Version. Here you can view the software version.
- 7360 0000 Manufacture Configuration. Here you can view the manufacture configuration.
- NOTE:** To activate the flowing menu options the password should be entered in RESET MENU PASSWORD.
- 7400 0000 Restore backup. This function restores the backup (the factory settings) which was made after the final test in de factory.
- 7410 0000 Press 'enter' to restore backup.
- 7500 0000 Select terminal mode. Here you can change the terminal mode.
- 7510 0000 Here you can select the single channel mode. This mode is preferred when only one instrument is operated.
- 7520 0000 Here you can select the multi channel mode. This mode is preferred when often switching between different instruments is required.

4.10 FLOW-BUS menu



Menu descriptions

- 8100 0000 Install myself.
Here you can install this module on the FLOW-BUS and start/stop the communication.
- 8110 0000 Auto install.
Press 'enter' to install this module on the FLOW-BUS. It will search for a free address on the bus by itself and install there.
- 8120 0000 Remote Install.
Press 'enter' to let this module get into INIT mode so it can be installed to the bus by an external device (operation module or PC). You have one minute now to perform the installation procedure.
- 8130 0000 Start Communication.
When you press 'enter' in this menu communication with the bus will be (re)started (use after stopping communication temporarily). When the device is properly installed, it will start communication at power-up and after a reset automatically.
- 8140 0000 Stop Communication.
When you press 'enter' in this menu communication with the bus will be stopped until 'Start communication' will be selected or at a reset of the module.
- 8200 0000 Install instrument. Here you can remote install a module which has been set in remote install mode.
- 8210 0000 The module which has been set in remote install mode is shown. After pressing 'enter' you can select an address on which the module should be installed. If an address is selected, press 'enter' again and the module will be installed on this address.

NOTE:

To avoid FLOW-BUS communication problems it is recommended to install new instruments to the advised address.

- 8300 0000 Operate instrument. Here you can search an operating instrument or view and change the FLOW-BUS settings of the operating instrument.
- 8310 0000 Search instrument. Here you can search an instrument to be operated.
- 8311 0000 Use 'left' and 'right' keys to search an instrument on the FLOW-BUS. Confirm with 'enter'.
- 8320 0000 Check settings. Here you view FLOW-BUS settings of the instrument you want to operate.
- 8321 0000 Here you can view the PNA and NNA of the operated instrument.
- 8321 1000 Here you can change the PNA of the operated instrument.
- 8400 0000 Check My Settings. Here you check FLOW-BUS settings of this module.
- 8410 0000 PNA means Primary (own) Node Address of module on the FLOW-BUS.
NNA means Next Node Address. This address points to the next module on the FLOW-BUS and will be changed automatically if a new module is add to the FLOW-BUS behind this module. If the module is the last module on the FLOW-BUS, its NNA points to zero.
LNA means Last Node Address. The next node on the bus should have an address below LNA.
- 8411 0000 Here you can change the PNA of the module. If you give a new address, the module will restart the communication. The NNA is default set to PNA+1. During communication NNA values may change automatically because FLOW-BUS optimises it self for optimum communication speed.

NOTE 1:

Normally installation on the FLOW-BUS has to be performed only one time. Mostly this will be done at Bronkhorst High-Tech B.V. when your module has been built and tested. The address on the bus for this module will be stored when the module powers-off. At future power-on situations, it will be part of the FLOW-BUS on the same address each time. However, there can be situations you have to install your module on the bus again. For example:

- 1) When you want to rebuild your FLOW-BUS system.
- 2) When you want to add this module to another FLOW-BUS system.
- 3) When, at the check at start-up, the module finds out that its address to be on the FLOW-BUS is occupied already by another module. You will get a message on your display That you have to re-install the module on the bus.

NOTE 2:

Make sure this module has been switched-off before connecting it to the FLOW-BUS.

First make FLOW-BUS connection, then switch-on the power. Only in this order the module is able to perform its communication checkings properly.

In case of the hand held version the module is powered by the FLOW-BUS. The module will automatically switch-on when it is connected to the FLOW-BUS.

How to install the E-7000 modules on the FLOW-BUS network, see manual 9.17.024.

4.11 Calibration with polynomial functions

4.11.1 General information

A normally calibrated device will have a linearized transfer function. This means that real flow/pressure and setpoint are proportional to the output signal.

A polynomial function is a method of approximation which mathematically describes a continuous transfer function.

By means of a few samples, a polynomial function can be obtained.

After determining the polynomial function, the original calibration points and an infinite amount of values in between, can be calculated with high accuracy.

In a system where pressure- and/or flow meters and -controllers should be readout and set with high accuracy, these polynomial functions often are used for approximation of their transfer function. For instance the function which describes the relation between output signal and measured flow.

4.11.2 General form

The general form of a polynomial function of the n-th degree is as follows:

$$Y = a_0 + a_1 \cdot X + a_2 \cdot X^2 + a_3 \cdot X^3 + \dots + a_n \cdot X^n$$

Where 'a₀' to 'a_n' are polynomial parameters, which can be calculated.

When you have 'n + 1' measure-points, they can be approximated by means of a 'n-th' degree polynomial function.

4.11.3 Polynomial functions of sensor signal and setpoint

By means of a calibration at Bronkhorst High-Tech B.V. several measure points will be used to obtain a polynomial function.

The form of this function is:

$$Y = a + b \cdot X + c \cdot X^2 + d \cdot X^3$$

In which 'Y' is the measured value and 'X' is the value of output signal.

Characters 'a - d' are polynomial parameters, which can be obtained by a mathematical program. These parameters can be filled in and the polynomial function is completed.

4.11.4 Presentation of parameters

Parameters 'a - d' are polynomial function parameters, which can be obtained with a mathematical program out of measured calibration points.

All parameters will be presented in scientific notation with 5 significant digits, where the last digit is obtained by rounding-off.

Example (unscaled):

a = -2.1899 E-03
 b = +9.7442 E-01
 c = +8.9309 E-02
 d = -5.9906 E-02

Polynomial function for sensor signal:

$$Y = -2.1899 \cdot 10^{-3} + 9.7442 \cdot 10^{-1} \cdot X + 8.9309 \cdot 10^{-2} \cdot X^2 - 5.9906 \cdot 10^{-2} \cdot X^3$$

4.11.5 Using polynomial functions at readout/control unit

The parameters for the polynomial functions are stored in the digital instrument and can be changed from the keyboard.

Normally the transfer function is linear $Y = X$.

The connected device will have linearized transfer functions after (normal) calibration.

The accuracy however, will be $\leq 1\%$ full scale.

When a special polynomial function calibration is wanted, the parameters 'a-d' will be destillated and factory stored in the digital instrument. In the 'INSTRUMENT'-menu you have access to these values.

5 MAINTENANCE

- Be sure you operate under the correct input specifications.
- Be sure the system operates within its temperature range.
- When replacing a defective fuse, first solve the problem.
- Only install a fuse with the correct current rating (see label).
- Only clean the housing (keyboard and display) with a (moist) polishing cloth. Do not use aggressive cleaning fluids.

6 TROUBLESHOOTING

<ul style="list-style-type: none"> LCD is not lit after 'power on' 	<ul style="list-style-type: none"> check power input check fuse
<ul style="list-style-type: none"> Improper reading 	<ul style="list-style-type: none"> check module settings
<ul style="list-style-type: none"> No reading/control 	<ul style="list-style-type: none"> check instrument cabling
<ul style="list-style-type: none"> Improper system operation (alarm, counter) 	<ul style="list-style-type: none"> check module settings
<ul style="list-style-type: none"> Instrument does not respond to setpoint given at keyboard 	<ul style="list-style-type: none"> setpoint source at operation menu should enable setpoint at "keyb. & FLOW-BUS". (other settings means different behaviour) setpoint could have been overruled at an alarm situation or counter limit (first perform reset) setpoint slope has a large value. (setpoint will slowly change in time) Change slope value if necessary. setpoint could be changed by other devices connected to the FLOW-BUS. check polynomial factors for setpoint and measure at instrument menu. check communication with FLOW-BUS. If applicable
<ul style="list-style-type: none"> Setpoint menu cannot be reached 	<ul style="list-style-type: none"> check setting of connected instrument type at instrument menu. For sensor types setpoint facilities will be disabled.
<ul style="list-style-type: none"> Counter/alarm is not responding to reset 	<ul style="list-style-type: none"> check if reset-source has been enabled at reset menu of reset counter/alarm.
<ul style="list-style-type: none"> Instrument seems to give inaccurate values 	<ul style="list-style-type: none"> check if correct fluid set (with calibration factors) has been selected (see fluidname).
<ul style="list-style-type: none"> Display shows '---' 	<ul style="list-style-type: none"> check if the operating instrument is active check if the operating instrument is still at the same address. check instrument and module cabling
<ul style="list-style-type: none"> Other problems 	<ul style="list-style-type: none"> check instrument and operating module parameters.