Interface Description

D184B093U18

Field^IT

Elecgtromagnetic Flowmeter with Pulsed DC Magnetic Field Excitation FXE4000 (COPA-XE/MAG-XE)

FOUNDATION™ Fieldbus

Industrial^IT enabled

Valid on from Gateway Software Edition
D200S022U02 A.11
Flowmeter-Software Edition
D699B180U01 X.33

Fieldbus Foundation

ABB

Product Designation
FXE4000

Interface Description

Part No. D184B093U18

Issue date: 03.03
Revision: 03

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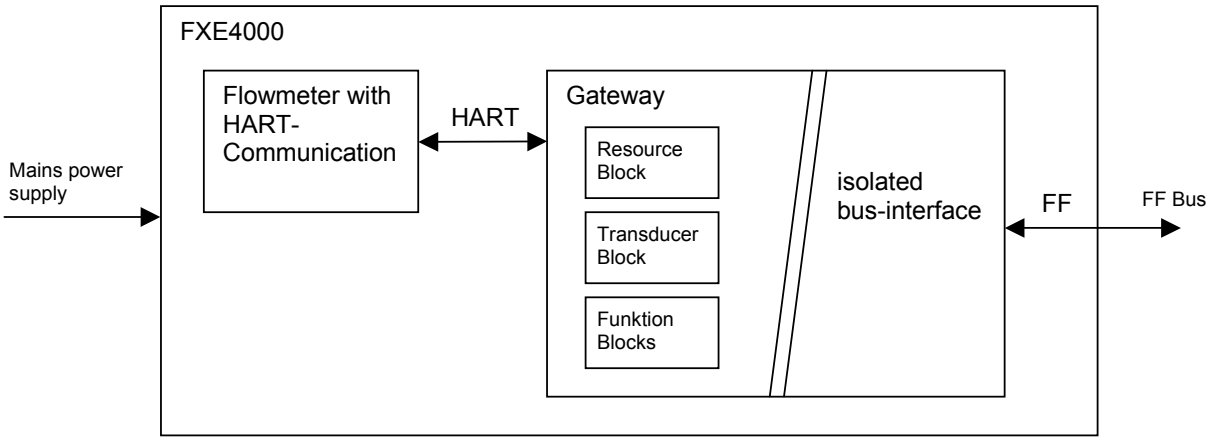
CONTENTS:

1. Hardware

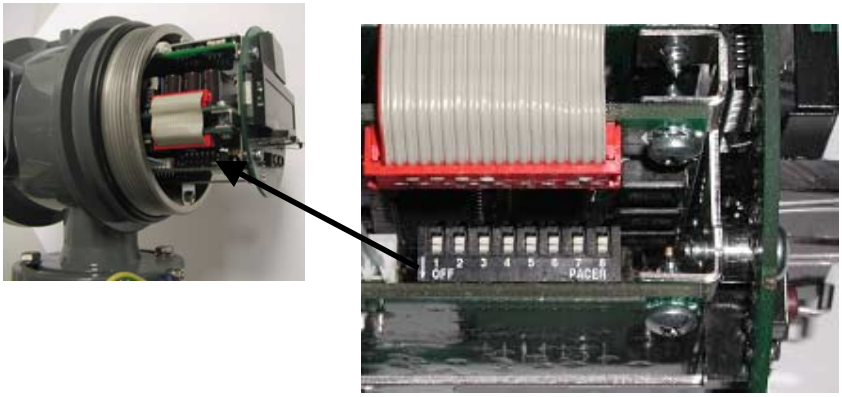
The FF interface is realized as gateway. The FF software with communication stack and function blocks is running inside the gateway. The flowmeter has HART communication. Flowmeter parameters are mapped by HART communication into the transducer block. Because of some special HART commands and an increased HART baudrate there are no disadvantages in speed.

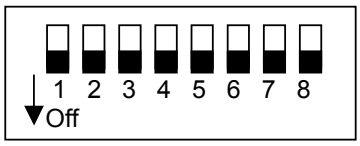


The gateway needs power supply from mains power supply side and additionally from the bus for operation. If the bus is not connected or switched off, then the gateway is not working and FXE4000 displays “Gateway inactive” on its local display.

1.1 Hardware Switch

The switch can be found inside the housing. It has tobe checked, if it is allowed to open the housing (for example take care to explosion proof rules).





Switch 1 = Simulate Enable
off = Simulation Mode disabled
on = Simulation Mode enabled

The switch position is displayed via the resource block within the parameter BLOCK_ERR.

“Simulation Mode enabled” only allows to make a simulation, but don’t activate the simulation.
Simulation is switched on or off using the parameter “Simulate“ (structure on index 9 of the AI-block)

Switch 2 = Write Protect
off = Write Protect disabled
on = Write Protect enabled

The switch position will be displayed via the resource block using the parameter WRITE_LOCK.

Enabling Write Protection prevents writing of block parameters.

2. Version

There is an older version of the FF implementation of the FXE4000:

	Actual Device Rev. 2	Older Device Rev. 1
Function blocks	3 * AI, 1 * PID	1 * AI
Transducer block contains	Most flowmeter parameters	Only a few flowmeter parameters
LAS	Yes	No

Both versions have the same device type code 0x16, but different Device- and DD-Revisions.

2.1 Actual Device Rev. 2

MANUFAC_ID	0x320 = ABB	Manufacturer identification number.
DEV_TYPE	0x16 = FXE4000	Manufacturer model number of device.
DEV_REV	2	Manufacturer revision number of device.
DD_REV	1	Revision of the Device Description of device.

Files:
020101.CFF (02 = Device Revision, 01 = DD-Revision, 01 = CFF-Revision)
0201.FFO (02 = Device Revision, 01 = DD-Revision)
0201.SYM

2.2 Older Device Rev. 1

MANUFAC_ID	0x320 = ABB	Manufacturer identification number.
DEV_TYPE	0x16 = FXE4000	Manufacturer model number of device.
DEV_REV	1	Manufacturer revision number of device.
DD_REV	2	Revision of the Device Description of device.

Files:
010202.CFF (01 = Device Revision, 02 = DD-Revision, 02 = CFF-Revision)
0102.FFO (01 = Device Revision, 02 = DD-Revision)
0102.SYM

3. Block-Overview

The device contains the following FF-Blocks:

1 x Resource Block

1 x Transducer Block

3 x AI Block (Analog Input)

1 x PID Block

The resource and analog input blocks are standard FF blocks. They entirely comply with the FF specification FF-891-1.4.

The transducer block is an enhanced block. The parameters up to the relevant index 29 correspond to the "Standard Flow with Calibration" block of the FF specification FF-903-3.0. The following parameterson from index 30 are instrument specific.

3.1 Block Table Legend

The below table treats the following attributes:

Rel.Index: Relative index of parameter within a block.

Data-Type: Data type of parameter. Some parameters are structures (DS-xx). These structures are specified in chapter 3.8.

Size: Size of the parameter in Bytes.

Storage Type:

- S = Static Parameter are store permanently (non-volatile). When writing a static parameter the Static Revision Counter ST_REV of the respective block (Index 1 in each block) will be incremented by one.
- N = Non-volatile parameters will be stored permanently. When writing non-volatile parameters ST_REV remains unchanged.
- D = Dynamic Parameter will be lost during powering off.

Write: Parameter can partially only be written in certain operating modes (MODE_BLK, Index 5, sub parameter Target)

- OOS: Parameter can be written in Target-Mode „Out of Service".
- Man: Parameter can be written in Target-Mode „Manual".
- Auto: Parameter can be written in Target-Mode „Auto".
- Cas : Parameter can be written in Target-Mode „Cascade".
- RCas: Parameter can be written in Target-Mode „Remote Cascade".
- ROut: Parameter can be written in Target-Mode „Remote Out".

Default Value: Basic settings of the parameters.
The parameter RESTART (Index 16 within Resource Block), selection „Restart with defaults", allows resetting of the parameters to default values.

3.2 Resource Block

The resource block contains general information on the fieldbus instrument, such as manufacturer, instrument type, version no. etc.

3.2.1 Resource Block Parameter, sorted in accordance with index

Relative Index	Parameter Name	Data Type	Size	Storage Type	Write in Target-Mode	Default Values	Description
1	ST_REV	Unsigned 16	2	S	Read only	0	Revision counter for the static parameters. The counter is incremented each time the static parameter is changed.
2	TAG_DESC	Octet String	32	S	OOS, Auto	space	The user description of the intended application of the block.
3	STRATEGY	Unsigned 16	2	S	OOS,Auto	0	This parameter can be used to create a grouping of blocks by relating the same reference number to each block of a group. This parameter is not checked or processed by the block.
4	ALERT_KEY	Unsigned 8	1	S	OOS, Auto	0	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
5	MODE_BLK	DS-69	4	N,D,S,S	OOS,Auto	Target : OOS Actual : OOS Permitted: Auto, OOS Normal : Auto	The actual, target, permitted and normal operation modes of the block.
6	BLOCK_ERR	Bit String	2	D	Read only	0	This parameter contains a summary of the block alarms.
7	RS_STATE	Unsigned 8	1	D	Read only	0	State of the function block state machine.
8	TEST_RW	DS-85	112	D	OOS,Auto	0	Read/write test parameter - used only for conformance testing.
9	DD_RESOURCE	Octet String	32	S	Read only		A description of the device description for the device.
10	MANUFAC_ID	Unsigned 32	4	S	Read only	0x320 = ABB	Manufacturer identification number.
11	DEV_TYPE	Unsigned 16	2	S	Read only	0x16 = FXE4000	Manufacturer's model name of the device.
12	DEV_REV	Unsigned 8	1	S	Read only	2	Device revision.
13	DD_REV	Unsigned 8	1	S	Read only	1	Revision of the DD file of the device.
14	GRANT_DENY	DS-70	2	D	OOS,Auto	0	Options for the access from PLC and DCS systems to device parameters.
15	HARD_TYPES	Bit String	2	S	Read only	0x8000	The types of hardware available for the channels of the device.
16	RESTART	Unsigned 8	1	D	OOS, Auto	1	Several possibilities of restart are possible: 1) Run 2) Restart resource 3) Restart with defaults 4) Restart processor
17	FEATURES	Bit String	2	S	Read only	0x4800	Used to show resource block options. 0x4800 = Reports supported, Hard Write Lock supported
18	FEATURE_SEL	Bit String	2	S	OOS, Auto	0x4800	Used to select resource block options. 0x4800 = Reports supported, Hard Write Lock supported
19	CYCLE_TYPE	Bit String	2	S	Read only	0xC000	Describes the block execution methods. 0xC000 = Scheduled, Completion of block execution
20	CYCLE_SEL	Bit String	2	S	OOS,Auto	0xC000	Select ion of the block execution method. 0xC000 = Scheduled, Completion of block execution

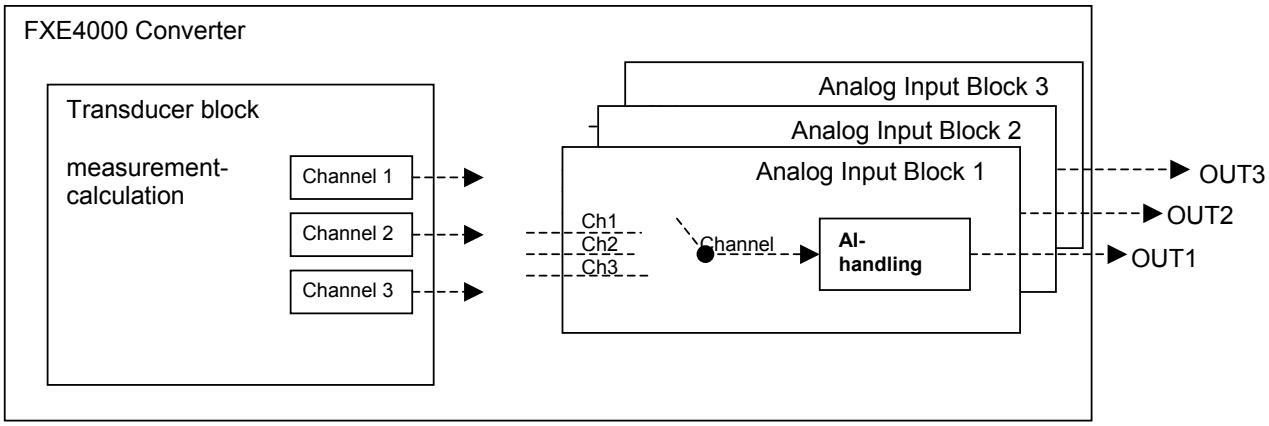
Relative Index	Parameter Name	Data Type	Size	Storage Type	Write in Target-Mode	Default Values	Description
21	MIN_CYCLE_T	Unsigned 32	4	S	-	1600	Time duration of the shortest cycle time of the device in 1/32 ms.
22	MEMORY_SIZE	Unsigned 16	2	S	-	0	Available memory in the device.
23	NV_CYCLE_T	Unsigned 32	4	S	-	0	Interval between writing copies of NV parameters to non-volatile memory. Zero means never.
24	FREE_SPACE	Float	4	D	-	0.0	Percent of memory available for additional configuration.
25	FREE_TIME	Float	4	D	-	0.0	Percent of the block processing time that is free to process additional blocks.
26	SHED_RCAS	Unsigned 32	4	S	OOS,Auto	640000	Timeout time for connections to PLC or DCS in operation mode RCas.
27	SHED_ROUT	Unsigned 32	4	S	OOS,Auto	640000	Timeout time for connections to PLC or DCS in operation mod Rout.
28	FAULT_STATE	Unsigned 8	1	N	-	1	Behaviour of output blocks if communication errors appears.
29	SET_FSTATE	Unsigned 8	1	D	OOS,Auto	1	Allows the Fault State condition to be manually initiated.
30	CLR_FSTATE	Unsigned 8	1	D	OOS,Auto	1	Allows deleting the fault state condition.
31	MAX_NOTIFY	Unsigned 8	1	S	-	8	Maximum number of unconfirmed notify messages possible.
32	LIM_NOTIFY	Unsigned 8	1	S	OOS,Auto	8	Maximum number of unconfirmed notify messages allowed.
33	CONFIRM_TIME	Unsigned 32	4	S	OOS,Auto	640000	The time the device will wait for confirmation of receipt of a report before trying to send again. Retry shall not happen when CONFIRM_TIME = 0.
34	WRITE_LOCK	Unsigned 8	1	S	OOS,Auto	1 = Default switch position = Unlocked	If set, no writing is allowed. Cannot be cleared by software. Note: This parameter is dependent from the hardware switch Write_Lock (see chapter 1.1) 1 = Unlocked 2 = Locked
35	UPDATE_EVT	DS-73	14	D	-	0;0;0;0;0;0;9;0	This message is generated by any change to static data.
36	BLOCK_ALM	DS-72	13	D	OOS,Auto	0;0;0;0;0;0;0;8;0;0	Indicates alarms which are related to the block.
37	ALARM_SUM	DS-74	8	D,D,D,S	OOS,Auto	0;0;0;0	This parameter contains a summary of the block alarms.
38	ACK_OPTION	Bit String	2	S	OOS,Auto	0	Defines if block alarms are automatically acknowledged or not.
39	WRITE_PRI	Unsigned 8	1	S	OOS,Auto	0	Priority of the alarm generated by clearing the WRITE_LOCK.
40	WRITE_ALM	DS-72	13	D	OOS,Auto		This alert is generated if the write lock parameter is cleared.
41	ITK_VER	Unsigned 16	2	S	-	4	Version of the Interoperability Test Kit used to test the device.

3.2.2 Resource Block Parameter, sorted according to names

Parameter Name	Index
ACK_OPTION	38
ALARM_SUM	37
ALERT_KEY	4
BLOCK_ALM	36
BLOCK_ERR	6
CLR_FSTATE	30
CONFIRM_TIME	33
CYCLE_SEL	20
CYCLE_TYPE	19
DD_RESOURCE	9
DD_REV	13
DEV_REV	12
DEV_TYPE	11
FAULT_STATE	28
FEATURE_SEL	18
FEATURES	17
FREE_SPACE	24
FREE_TIME	25
GRANT_DENY	14
HARD_TYPES	15
ITK_VER	41
LIM_NOTIFY	32
MANUFAC_ID	10
MAX_NOTIFY	31
MEMORY_SIZE	22
MIN_CYCLE_T	21
MODE_BLK	5
NV_CYCLE_T	23
RESTART	16
RS_STATE	7
SET_FSTATE	29
SHED_RCAS	26
SHED_ROUT	27
ST_REV	1
STRATEGY	3
TAG_DESC	2
TEST_RW	8
UPDATE_EVT	35
WRITE_ALM	40
WRITE_LOCK	34
WRITE_PRI	39

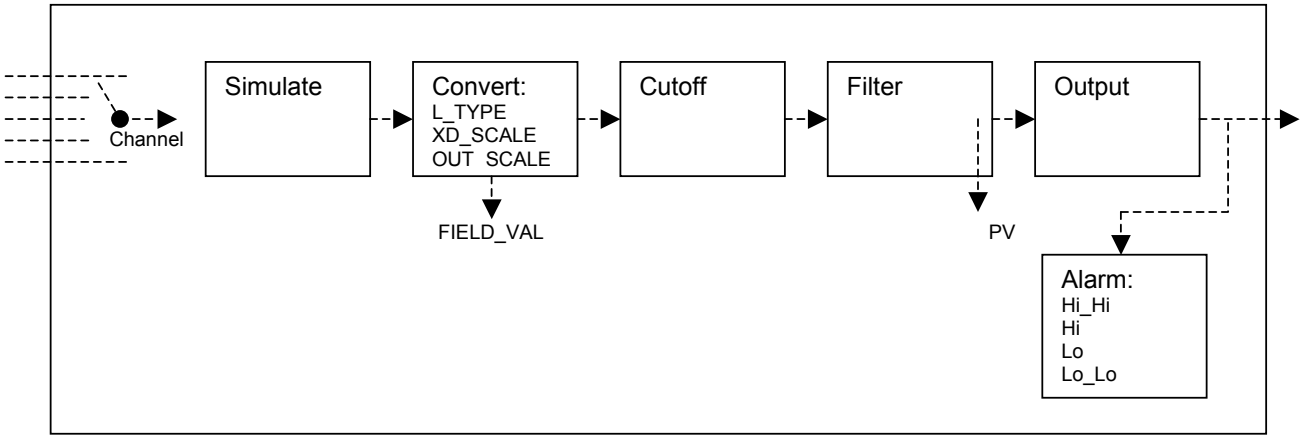
3.3 Analog Input Block

The measurement calculation takes place within the transducer block. The transducer block internally provides the measurement values via “Channels”. The cyclic output of the measurement values takes place via the analog input blocks (AI block). The FXE4000 converter provides three AI blocks.



An AI block executes different tasks, such as change of scaling, alarm handling, simulation etc. - see the following description:

3.3.1 Analog Input Block Diagram



Channel: Using the channel parameter (index 15) you can choose the measured value to be transferred from the transducer block.

Simulate: The simulate parameter is a structure (see 3.8.10). You can activate a simulation by means of the sub-parameter “Simulate En/Disable”. The sub-parameter “Simulate-Value” indicates the simulation value which will be processed instead of the channel value.

Note: The simulation can solely be activated if the hardware switch “Simulation Enable” is set to “on”, see 1.1.

Convert: Converting is determined by the parameters L_TYPE, XD_SCALE and OUT_SCALE.

The scaling structures (see 3.8.3) dispose of the Sub-Parameters EU100%, EU0%, Unit and Decimal Point.

The channel value will be scaled to a percent value (FIELD_VAL) using the XD_SCALE according the following formula :

FIELD_VAL = 100 * (Channel-Value – EU0%) / (EU100%-EU0%)

L_TYPE can be of the following values:

Direct: With direct the entry value will be directly transferred to PV (Primary Analog Value, index 7). There will be no change of scaling:

PV = Channel Value

Structures XD_SCALE and OUT_SCALE have to be adjusted identically.

Indirect: The percent value FIELD_VAL will be scaled to PV (Primary analog Value) using OUT_SCALE:

PV = (FIELD_VAL / 100) * (EU100% - EU0%) + EU0%

Indirect Square Root: Similar to direct. Additionally a roots function will be calculated

PV = sqrt (FIELD_VAL / 100) * (EU100% - EU0%) + EU0%

Cut off: This function is equivalent to a low flow cut-off. It will be activated via a bit in IO_OPTS (index 13). If the PV value calculated undershoot the LOW_CUT value (index 17), PV will be set to 0.

Filter: Using the parameter PV_FTIME (index 18) you may set a damping time expressed in seconds.

Alarm: Four different alarms are available: Hi_Hi, Hi, Lo and Lo_Lo. For each of these alarms, the threshold …_LIM and the priority …_PRI can be set (index 25 to 32).
A detected will be entered into a structure …_ALM (index 33 to 36).

3.3.2 Analog Input Block Parameter, sorted according to index

Relative Index	Parameter Name	Data Type	Size	Storage Type	Write in Target-Mode	Default Values	Description
1	ST_REV	Unsigned 16	2	S	-	0	Revision counter for static variables. Every time a static variable changes the revision counter is incremented by one.
2	TAG_DESC	Octet String	32	S	OOS, Man, Auto	Empty string	The user description of the application of the block.
3	STRATEGY	Unsigned 16	2	S	OOS, Man, Auto	0	This parameter can be used to create groups of blocks by assigning the same reference number to each block of a group. This parameter is not verified and not processed.
4	ALERT_KEY	Unsigned 8	1	S	OOS, Man, Auto	0	This parameter is used as identification number for plant units. It can be used within DCS or PLC systems e.g. to sort alarms.
5	MODE_BLK	DS-69	4	N,D,S,S	OOS, Man, Auto	Target : OOS Actual : OOS Permitted: Auto, Man, OOS Normal : Auto	The actual, target, permitted, and normal operation modes of the block.
6	BLOCK_ERR	Bit String	2	D	-	0	Contains a summary of the block alarms.
7	PV	DS-65	5	D	-	0.0	This parameter is the primary measurement value for use in executing the block.
8	OUT	DS-65	5	D	OOS, Man	0.0	This is out value of the block. OUT will have standard block alarms plus standard HI_HI, HI, LO, and LO_LO alarms applied to it.
9	SIMULATE	DS-82	11	D	OOS, Man, Auto		This is a structure. With the sub parameter Simulate Enable/disable a simulation can be switched on and off. If a simulation is active the sub parameter simulate value is used as input value for the block.
10	XD_SCALE	DS-68	11	S	OOS, Man	EU100%: 100.0 EU0% : 0.0 Unit : 0 DecPoint: 0	Input scaling of the block. Using the100% and 0% values the channel value is scaled to percent (Field_Val). The channel unit must be in accordance with the channel unit. DecPoint indicates the number of digits after the decimal point for the display.
11	OUT_SCALE	DS-68	11	S	OOS, Man	EU100%: 100.0 EU0% : 0.0 Unit : 0 DecPoint: 0	OUTPUT scaling of the block. Using the 100% and the 0% values the percent value (Field_Val) is scaled to the OUT value. The unit is the OUT unit. DecPoint indicates the number of digits after the decimal point for the display.
12	GRANT_DENY	DS-70	2	D	OOS, Man, Auto	0;0	Options for the access of DCS and PLC systems to parameter of the device.
13	IO_OPTS	Bit String	2	S	OOS	0	Options which the user may select to alter input and output block processing. Bit 10: Enable Low_Cutoff
14	STATUS_OPTS	Bit String	2	S	OOS	0	Options which the user may select in the block processing of its status.
15	CHANNEL	Unsigned 16	2	S	OOS	0	The number of the logical channel of the transducer block, which should be processed actually.
16	L_TYPE	Unsigned 8	1	S	OOS, Man	0	Processing the input value: Direct: there is no scaling procedure the OUT identical to the INPUT Indirect: the input value is scaled using XD_SCALE and OUT_SCALE Square root: like indiret, however a mathematical square root is added.
17	LOW_CUT	Float	4	S	OOS, Man, Auto	0.0	Low flow cut off : Values lower than LOW_CUT are set to 0 if the option (see IO_OPTS) is active.
18	PV_FTIME	Float	4	S	OOS, Man, Auto	0.0	Time constant of a damping filter for process variable. Time constant is in seconds.

Relative Index	Parameter Name	Data Type	Size	Storage Type	Write in Target-Mode	Default Values	Description
19	FIELD_VAL	DS-65	5	D	-	0x1C;0.0	Input value in percent scaled by XD_SCALE.
20	UPDATE_EVT	DS-73	14	D	-		This alert is generated by any change to the static data.
21	BLOCK_ALM	DS-72	13	D	OOS, Man, Auto		Indicates the alarms related to the block.
22	ALARM_SUM	DS-74	8	D	OOS, Man, Auto		This parameter contains a summary of the alarms of the bock.
23	ACK_OPTION	Bit String	2	S	OOS, Man, Auto	0	The selection of whether alarms associated with the block will be automatically acknowledged or not.
24	ALARM_HYS	Float	4	S	OOS, Man, Auto	0.5	Alarm Hysteresis, expressed as a percent of the PV span .
25	HI_HI_PRI	Unsigned 8	1	S	OOS, Man, Auto	0	Priority of the high high alarm.
26	HI_HI_LIM	Float	4	S	OOS, Man, Auto	+INF	The value for the high high alarm limit in engineering units.
27	HI_PRI	Unsigned 8	1	S	OOS, Man, Auto	0	Priority of the high alarm.
28	HI_LIM	Float	4	S	OOS, Man, Auto	+INF	The value for the high alarm limit in engineering units.
29	LO_PRI	Unsigned 8	1	S	OOS, Man, Auto	0	Priority of the low alarm.
30	LO_LIM	Float	4	S	OOS, Man, Auto	-INF	The value for the low alarm limit in engineering units.
31	LO_LO_PRI	Unsigned 8	1	S	OOS, Man, Auto	0	Priority of the low low alarm.
32	LO_LO_LIM	Float	4	S	OOS, Man, Auto	-INF	The value for the low low alarm limit in engineering units.
33	HI_HI_ALM	DS-71	16	D	OOS, Man, Auto		The status for high high alarm and its associated time stamp.
34	HI_ALM	DS-71	16	D	OOS, Man, Auto		The status for high alarm and its associated time stamp.
35	LO_ALM	DS-71	16	D	OOS, Man, Auto		The status of the low alarm and its associated time stamp.
36	LO_LO_ALM	DS-71	16	D	OOS, Man, Auto		The status of the low low alarm and its associated time stamp.

Information: INV = Infinite number

3.3.3 Analog Input Block Parameter, sorted according to names

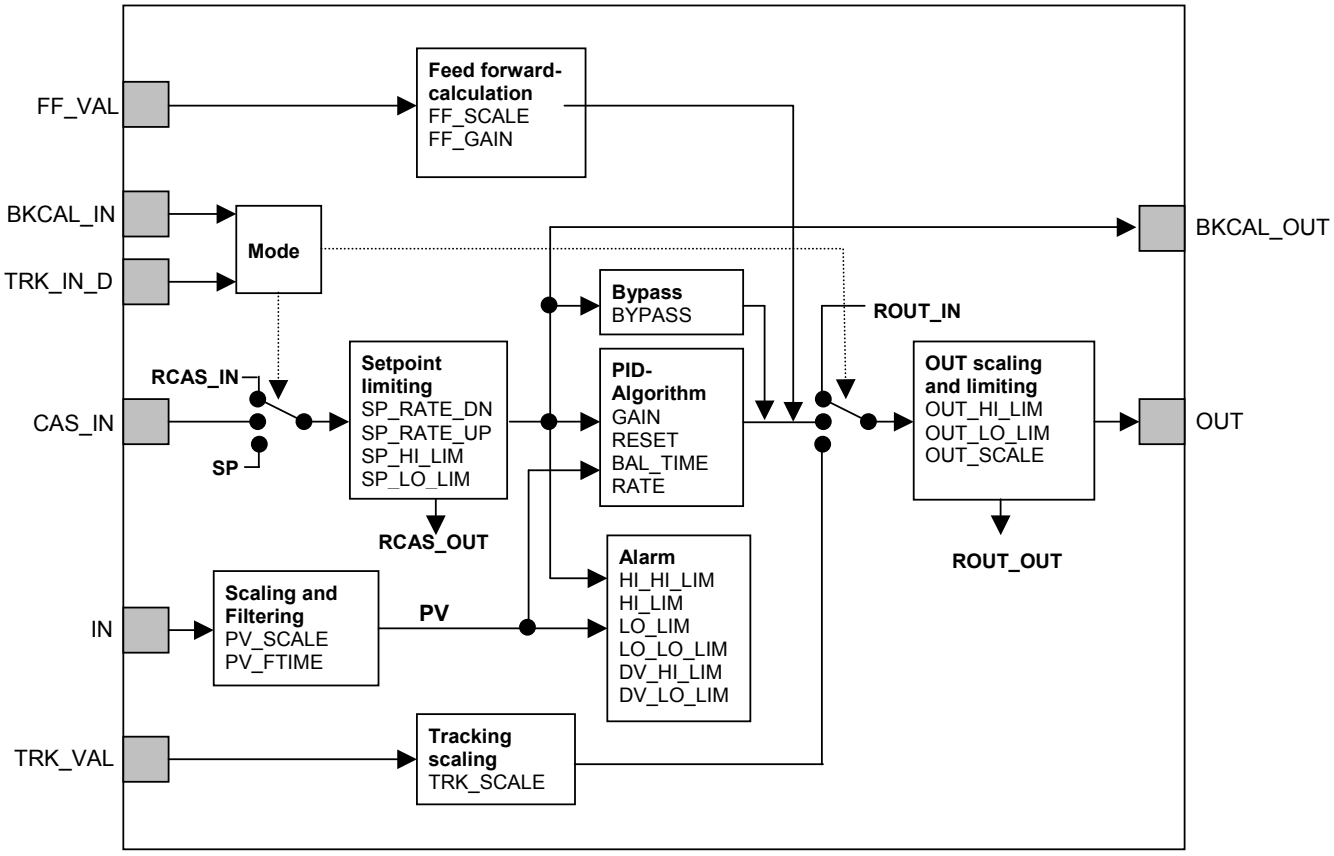
Parameter Name	Relative Index
ACK_OPTION	23
ALARM_HYS	24
ALARM_SUM	22
ALERT_KEY	4
BLOCK_ALM	21
BLOCK_ERR	6
CHANNEL	15
FIELD_VAL	19
GRANT_DENY	12
HI_ALM	34
HI_HI_ALM	33
HI_HI_LIM	26
HI_HI_PRI	25
HI_LIM	28
HI_PRI	27
IO_OPTS	13
L_TYPE	16
LO_ALM	35
LO_LIM	30
LO_LO_ALM	36
LO_LO_LIM	32
LO_LO_PRI	31
LO_PRI	29
LOW_CUT	17
MODE_BLK	5
OUT	8
OUT_SCALE	11
PV	7
PV_FTIME	18
SIMULATE	9
ST_REV	1
STATUS_OPTS	14
STRATEGY	3
TAG_DESC	2
UPDATE_EVT	20
XD_SCALE	10

3.4 PID Block

The PID block offers all functions for a proportional, integral and derivate control algorithm. It also has functions for scaling, limiting, alarm handling, tracking, a feed forward algorithm, etc.

3.4.1 PID Block Diagram

The PID block has following structure:



The process value to be controlled is connected to the **IN** input. The value will be scaled with **PV_SCALE** and filtered by a filter with time constant **PV_FTIME**. The scaled and filtered value is called **PV** (Primary analog Value).

The setpoint source is determined by the mode:

- **AUTO** mode: The **SP** parameter is used as setpoint.
- **CAS** mode: In Cascade mode is **CAS_IN** input used as setpoint. This parameter comes from another function block.
- **RCAS** mode: In Remote Cascade mode is the RCAS_IN-parameter used as setpoint. This parameter is written by a supervisory host computer.

The setpoint value is limited by SP_HI_LIM and SP_LO_LIM. The setpoint ramp rate is limited (only in AUTO mode) by SP_RATE_DN and SP_RATE_UP. The limited setpoint is called **RCAS_OUT**. This value will be used by supervisory host computers in RCAS mode.

The PID algorithm has tree parts:

Proportional control: The OUT value is proportional to the deviation of process value and setpoint. The proportional factor is the GAIN parameter. The disadvantage of a proportional control is, that there is a remaining deviation. This deviation can be removed by an integral control.

Integral control: The integral OUT value is determined by the integration of the deviation. The time constant is the RESET parameter.

Derivate control: The derivate OUT value is determined by the changing rate of the deviation. The time constant is the RATE parameter.

The OUT value of the PID algorithm is the sum of all tree control parts.

Feed forward calculation can be done with the input FF_VAL and the parameters FF_SCALE and FF_GAIN.

Tracking can be done with the input TRK_VAL. This value is scaled by TRK_SCALE. To enable tracking, set in CONTROL_OPTS „Track enable“ or „Track in Manual“. Then switch on tracking in TRK_IN_D. The actual mode will changed to LO (Local Overwrite).

3.4.2 Mode

Priority	Mode		Meaning
7	OOS	Out of Service	Out of Service.
6	IMan	Initialisation Manual	Step on way to Cascade mode, OUT follows BKCAL_IN.
5	LO	Local Override	Tracking-Mode: Output OUT follows input TRK_VAL.
4	Man	Manual	Manual mode
3	Auto	Automatic	PID-Algorithm is working: Setpoint : Parameter SP Process value: Input IN Output : Parameter OUT
2	Cas	Cascade	PID-Algorithm is working: Setpoint : Input CAS_IN Process value: Input IN Output : Parameter OUT
1	RCas	Remote Cascade	PID-Algorithm is working: Setpoint : Parameter RCAS_IN Process value: Input IN Output : Parameter OUT
0	ROut	Remote Output	PID-Algorithm is not working. The PID block gets the setpoint from a supervisory host in ROUT_IN parameter and sends it to ROUT_OUT parameter.

3.4.3 PID Block, sorted in accordance with index

Index	Parameter Name	Data Type	Size	Storage Type	Write in Target-Mode	Default Values	Description
1	ST_REV	Unsigned 16	2	S	read only	0	Revision counter for static variables. Every time a static variable changes the revision counter is incremented by one.
2	TAG_DESC	Octet String	32	S	OOS, Man, Auto	Empty string	The user description of the application of the block.
3	STRATEGY	Unsigned 16	2	S	OOS, Man, Auto	0	This parameter can be used to create groups of blocks by assigning the same reference number to each block of a group. This parameter is not verified and not processed.
4	ALERT_KEY	Unsigned 8	1	S	OOS, Man, Auto	0	This parameter is used as identification number for plant units. It can be used within DCS or PLC systems e.g. to sort alarms.
5	MODE_BLK	DS-69	4	N,D,S,S	OOS, Man, Auto	Target : OOS Actual : OOS Permitted: OOS, Man, Auto, Cas, RCas, ROut Normal : Auto	The actual, target, permitted, and normal operation modes of the block.
6	BLOCK_ERR	Bit String	2	D	read only	0	Contains a summary of the block alarms.
7	PV	DS-65	5	D	read only		This parameter is the primary value for use in executing the block.
8	SP	DS-65	5	N	OOS, Man, Auto		Setpoint.
9	OUT	DS-65	5	N	OOS, Man		The output value of the PID block.
10	PV_SCALE	DS-68	11	S	OOS, Man	EU100%: 100.0 EU0% : 0.0 Unit : 0 DecPoint: 0	Input scaling of the block. Using the 100% and 0% values the IN value is scaled to percent. DecPoint indicates the number of digits after the decimal point for the display.
11	OUT_SCALE	DS-68	11	S	OOS, Man	EU100%: 100.0 EU0% : 0.0 Unit : 0 DecPoint: 0	Output scaling of the block. Using the100% and 0% values the OUT value is scaled. DecPoint indicates the number of digits after the decimal point for the display.
12	GRANT_DENY	DS-70	2	D	OOS, Man, Auto, Cas, RCas, ROut	0; 0	Options for the access of DCS and PLC systems to parameter of the device.
13	CONTROL_OPTS	BitString	2	S	OOS	0	Options for the PID block: Bit 0: Bypass enable Bit 1: SP-PV Track in Man Bit 2: SP-PV Track in Rout Bit 3: SP-PV Track in LO or IMan Bit 4: SP-PV Track retained target Bit 5: Direct acting Bit 7: Track enable Bit 8: Track in Manual Bit 9: Use PV for BKCAL_OUT Bit 12: Obey SP limits if CAS or RCas Bit 13: No OUT Limits in Manual
14	STATUS_OPTS	BitString	2	S	OOS	0	Options for status handling:

Index	Parameter Name	Data Type	Size	Storage Type	Write in Target-Mode	Default Values	Description
							Bit 0: Set IFS (Initial Fault State) if BAD IN Bit 1: Set IFS (Initial Fault State) if BAD CAS_IN Bit 2: Use Uncertain as Good Bit 5: Target to Manual if BAD IN Bit 9: Target to next permitted mode if BAD CAS_IN
15	IN	DS-65	5	N	OOS, Man, Auto, Cas, RCas, Rout		Process value input.
16	PV_FTIME	Float	4	S	OOS, Man, Auto, Cas, RCas, Rout	0	Time constant for filter for IN.
17	BYPASS	Unsigned8	1	S	OOS, Man	0	Bypass for the PID algorithm: 1 = Off, 2 = On
18	CAS_IN	DS-65	5	N	OOS, Man, Auto, Cas, RCas, Rout		In mode CAS an external setpoint coming from another function block is used. This is the input for the external setpoint.
19	SP_RATE_DN	Float	4	S	OOS, Man, Auto, Cas, RCas, Rout	+INF	Changing rate of setpoint SP for changing the value downwards, only for AUTO mode. If the value is 0, then changes will be done immediately.
20	SP_RATE_UP	Float	4	S	OOS, Man, Auto, Cas, RCas, Rout	+INF	Changing rate of setpoint SP for changing the value upwards, only for AUTO mode. If the value is 0, then changes will be done immediately.
21	SP_HI_LIM	Float	4	S	OOS, Man, Auto, Cas, RCas, Rout	100	Upper limit for setpoint SP.
22	SP_LO_LIM	Float	4	S	OOS, Man, Auto, Cas, RCas, Rout	0	Lower limit for setpoint SP.
23	GAIN	Float	4	S	OOS, Man, Auto, Cas, RCas, Rout	0	Proportional gain value for PID algorithm.
24	RESET	Float	4	S	OOS, Man, Auto, Cas, RCas, Rout	+INF	Time constant of integral part of PID algorithm.
25	BAL_TIME	Float	4	S	OOS, Man, Auto, Cas, RCas, ROut	0	Time constant for bias control.
26	RATE	Float	4	S	OOS, Man, Auto, Cas, RCas, Rout	0	Time constant of derivate part of PID algorithm.
27	BKCAL_IN	DS-65	5	N	OOS, Man, Auto, Cas, RCas, Rout		Input for back calculation value from lower function block
28	OUT_HI_LIM	Float	4	S	OOS, Man, Auto, Cas, RCas, Rout	100	Upper limit for OUT value.
29	OUT_LO_LIM	Float	4	S	OOS, Man, Auto, Cas, RCas, Rout	0	Lower limit for OUT value.
30	BKCAL_HYS	Float	4	S	OOS, Man, Auto, Cas, RCas, Rout	0,5%	Hysteresis for limit bits in status of BKCAL_OUT in % of OUT_SCALE.
31	BKCAL_OUT	DS-65	5	D	Read only		Back calculation value, which is send back to an upper function block.
32	RCAS_IN	DS-65	5	N	OOS, Man, Auto, Cas, RCas, Rout		This is the setpoint in mode RCAS (Remote Cascade), which comes from a supervisory host computer.
33	ROUT_IN	DS-65	5	N	OOS, Man, Auto, Cas, RCas, ROut		This is the OUT value in mode ROut (Remote Output), which comes from a supervisory host computer.
34	SHED_OPT	Unsigned8	1	S		0	Determines behaviour, when supervisory host computer has timeout. Look at Resource Block index 26: SHED_RCAS: Timeout for mode Remote Cascade

Index	Parameter Name	Data Type	Size	Storage Type	Write in Target-Mode	Default Values	Description
							Look at Resource-Block Index 27: SHED_ROUT: Timeout for mode Remote Output Possibilities are: • Uninitialized • NormalShed_NormalReturn • NormalShed_NoReturn • ShedToAuto_NormalReturn • ShedToAuto_NoReturn • ShedToManual_NormalReturn • ShedToManual_NoReturn • ShedToRetainedTarget_NormalReturn • ShedToRetainedTarget_NoReturn
35	RCAS_OUT	DS-65	5	D	Read only		This is the setpoint after liming and scaling, which is in mode RCas (Remote Cascade) send back to a supervisory host computer for back calculation.
36	ROUT_OUT	DS-65	5	D	Read only		This is the output value, which is in mode ROut (Remote Output) send back to a supervisory host computer for back calculation.
37	TRK_SCALE	DS-68	11	S	OOS, Man	EU100%: 100.0 EU0% : 0.0 Unit : 0 DecPoint: 0	Scaling for tracking value of the block. Using the100% and 0% values the TRV_VAL is scaled to percent. DecPoint indicates the number of digits after the decimal point for the display.
38	TRK_IN_D	DS-66	2	N	OOS, Man, Auto, Cas, RCas, Rout		This discrete input switches on tracking mode.
39	TRK_VAL	DS-65	5	N	OOS, Man, Auto, Cas, RCas, Rout		This is the input of the tracking value.
40	FF_VAL	DS-65	5	N	OOS, Man, Auto, Cas, RCas, ROut		This is the input of the feed forward value.
41	FF_SCALE	DS-68	11	S	OOS, Man	EU100%: 100.0 EU0% : 0.0 Unit : 0 DecPoint: 0	Scaling for feed forward value of the block. Using the100% and 0% values the FF_VAL is scaled to percent. DecPoint indicates the number of digits after the decimal point for the display.
42	FF_GAIN	Float	4	S	OOS, Man	0	Gain for the feed forward control.
43	UPDATE_EVT	DS-73	14		Read only		This alert is generated by any change to the static data.
44	BLOCK_ALM	DS-72	13	D	OOS, Man, Auto, Cas, RCas, Rout		Indicates the alarms related to the block.
45	ALARM_SUM	DS-74	8	mix	OOS, Man, Auto, Cas, RCas, Rout		This parameter contains a summary of the alarms of the bock.
46	ACK_OPTION	BitString	2	S	OOS, Man, Auto, Cas, RCas, Rout		The selection of whether alarms associated with the block will be automatically acknowledged or not.
47	ALARM_HYS	Float	4	S	OOS, Man, Auto, Cas, RCas, Rout	0,5%	Hysteresis for alarms related to PV.
48	HI_HI_PRI	Unsigned8	1	S	OOS, Man, Auto, Cas, RCas, Rout	0	Priority of the high high alarm.

Index	Parameter Name	Data Type	Size	Storage Type	Write in Target-Mode	Default Values	Description
49	HI_HI_LIM	Float	4	S	OOS, Man, Auto, Cas, RCas, Rout	+Inf	The value for the high high alarm limit in engineering units.
50	HI_PRI	Unsigned8	1	S	OOS, Man, Auto, Cas, RCas, Rout	0	Priority of the high alarm.
51	HI_LIM	Float	4	S	OOS, Man, Auto, Cas, RCas, Rout	+Inf	The value for the high alarm limit in engineering units.
52	LO_PRI	Unsigned8	1	S	OOS, Man, Auto, Cas, RCas, Rout	0	Priority of the low alarm.
53	LO_LIM	Float	4	S	OOS, Man, Auto, Cas, RCas, Rout	-Inf	The value for the low alarm limit in engineering units.
54	LO_LO_PRI	Unsigned8	1	S	OOS, Man, Auto, Cas, RCas, Rout	0	Priority of the low low alarm.
55	LO_LO_LIM	Float	4	S	OOS, Man, Auto, Cas, RCas, Rout	-Inf	The value for the low low alarm limit in engineering units.
56	DV_HI_PRI	Unsigned8	1	S	OOS, Man, Auto, Cas, RCas, Rout	0	Priority of the high deviation alarm.
57	DV_HI_LIM	Float	4	S	OOS, Man, Auto, Cas, RCas, Rout	+Inf	The value for the high deviation alarm limit in engineering units.
58	DV_LO_PRI	Unsigned8	1	S	OOS, Man, Auto, Cas, RCas, Rout	0	Priority of the low deviation alarm.
59	DV_LO_LIM	Float	4	S	OOS, Man, Auto, Cas, RCas, Rout	-Inf	The value for the low deviation alarm limit in engineering units.
60	HI_HI_ALM	DS-71	16	D	OOS, Man, Auto, Cas, RCas, Rout		The status of the high high alarm and its associated time stamp.
61	HI_ALM	DS-71	16	D	OOS, Man, Auto, Cas, RCas, Rout		The status of the high alarm and its associated time stamp.
62	LO_ALM	DS-71	16	D	OOS, Man, Auto, Cas, RCas, Rout		The status of the low alarm and its associated time stamp.
63	LO_LO_ALM	DS-71	16	D	OOS, Man, Auto, Cas, RCas, Rout		The status of the low low alarm and its associated time stamp.
64	DV_HI_ALM	DS-71	16	D	OOS, Man, Auto, Cas, RCas, Rout		Status of deviation high alarm and its associated time stamp.
65	DV_LO_ALM	DS-71	16	D	OOS, Man, Auto, Cas, RCas, ROut		Status of deviation low alarm and its associated time stamp.

Information: INV = Infinite number

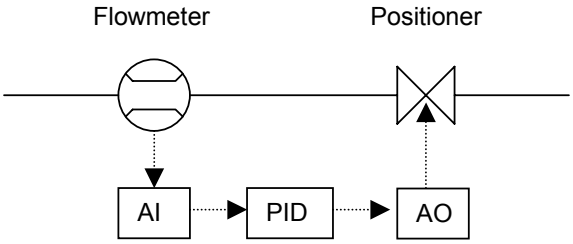
3.4.4 PID-Block, sorted according to names

Parameter Name	Index
ACK_OPTION	46
ALARM_HYS	47
ALARM_SUM	45
ALERT_KEY	4
BAL_TIME	25
BK_CAL_HYS	30
BK_CAL_OUT	31
BKCAL_IN	27
BLOCK_ALM	44
BLOCK_ERR	6
BYPASS	17
CAS_IN	18
CONTROL_OPTS	13
DV_HI_ALM	64
DV_HI_LIM	57
DV_HI_PRI	56
DV_LO_ALM	65
DV_LO_LIM	59
DV_LO_PRI	58
FF_GAIN	42
FF_SCALE	41
FF_VAL	40
GAIN	23
GRANT_DENY	12
HI_ALM	61
HI_HI_ALM	60
HI_HI_LIM	49
HI_HI_PRI	48
HI_LIM	51
HI_PRI	50
IN	15
LO_ALM	62
LO_LIM	53
LO_LO_ALM	63
LO_LO_LIM	55
LO_LO_PRI	54
LO_PRI	52
MODE_BLK	5
OUT	9
OUT_HI_LIM	28
OUT_LO_LIM	29
OUT_SCALE	11
PV	7
PV_FTIME	16
PV_SCALE	10
RATE	26
RCAS_IN	32
RCAS_OUR	35
RESET	24
ROUT_IN	33
ROUT_OUT	36
SHED_OPT	34
SP	8
SP_HI_LIM	21
SP_LO_LIM	22
SP_RATE_DN	19
SP_RATE_UP	20
ST_REV	1
STATUS_OPTS	14
STRATEGY	3
TAG_DESC	2
TRK_IN_D	38
TRK_SCALE	37
TRK_VAL	39
UPDATE_EVT	43

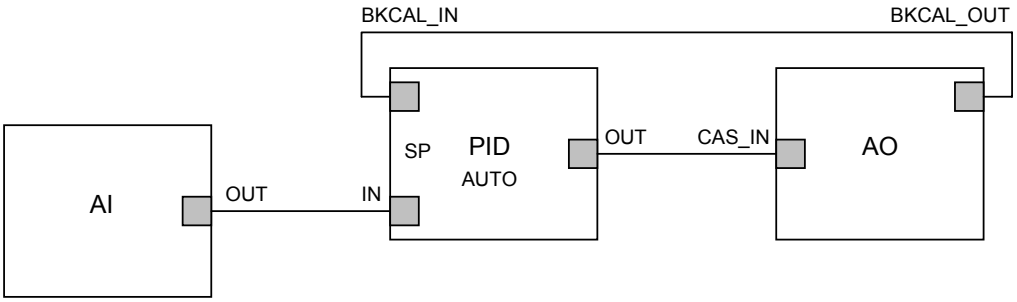
3.4.5 Example for PID control

3.4.5.1 Constant setpoint

The flow in a pipe should be controlled by a positioner. The setpoint is constant.

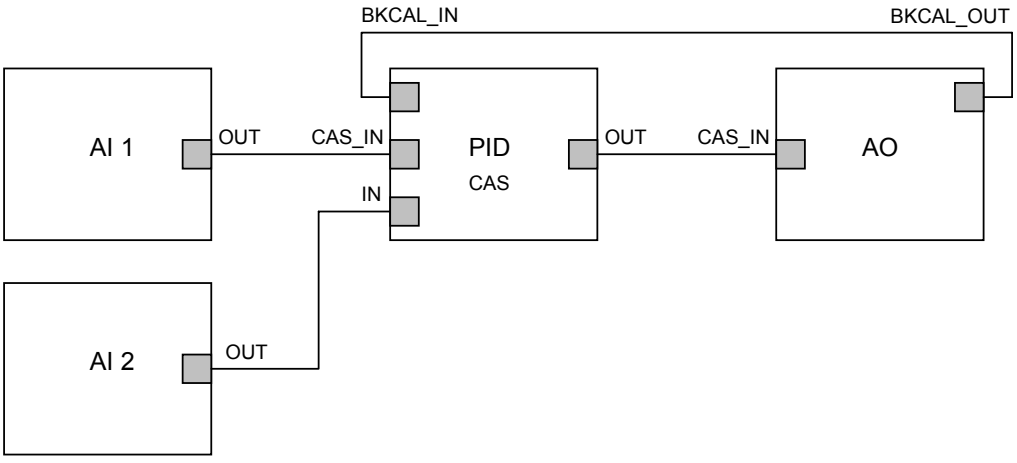


The process value is measured by a flowmeter. The flow value is available as AI block. The constant setpoint is in the SP parameter inside PID block. The OUT value is send to an AO block of a positioner. It is necessary to make a back calculation connection from AO back to PID to get bumbles mode switching. The mode of the PID block is AUTO.



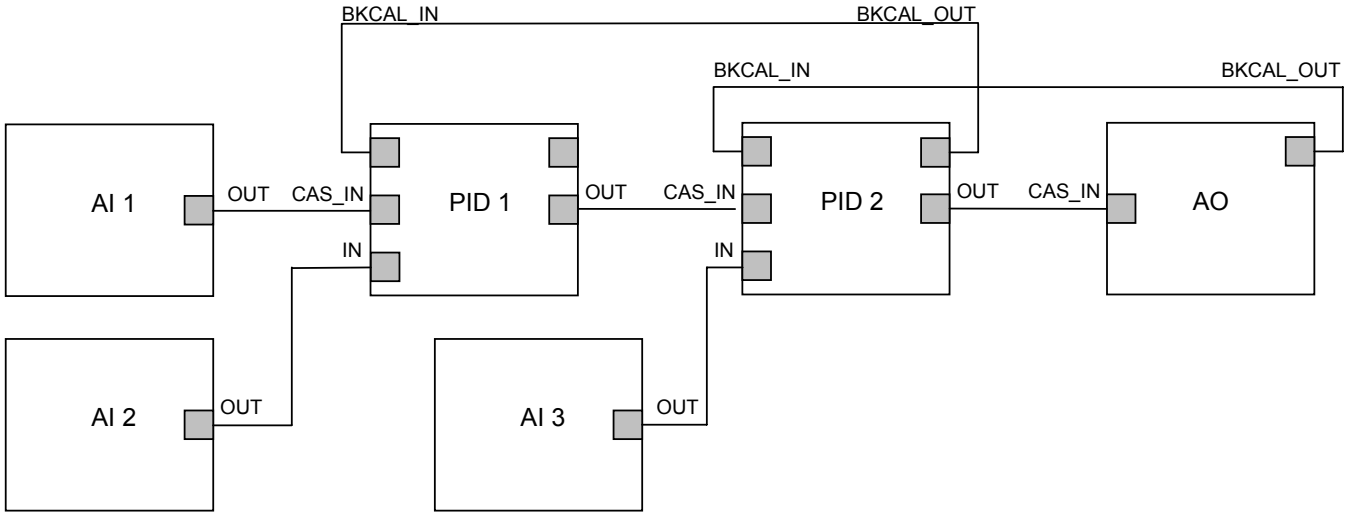
3.4.5.2 External setpoint

An external setpoint from another function block can be connected to the CAS_IN input of the PID block. The mode of the PID block must be CAS (Cascade).



3.4.5.3 Cascade PID blocks

It is possible to cascade PID blocks. This example has an inner control loop with PID2, which gets the process value from AI3 and the setpoint from PID1. The outer control loop with PID1 gets the process Value from AI2 and the setpoint from AI1. Both PID's are in cascade mode. Both PID's need back calculation paths for bumbles mode switching.



3.5 Transducer Block

The Transducer Block contains all instrument specific parameters and functions needed for flow measurement and calculation.

3.5.1 Channels und Units

The transducer block within the FXE4000 provides 3 measurements in so-called channels. Each AI block disposes of one channel parameter (index 15). This channel parameter decides which channel will be transferred from the TB to the AI. Each channel disposes of one physical unit. This unit has to comply with the XD-scale-unit of the AI blocks. Should it fail to do so, the AI block cannot be set to auto-mode.

Channel 1: PRIMARY_VALUE (Index 14) = Flow value

Unit: PRIMARY_VALUE_RANGE (Index 15, equal to TB-Parameter “Range unit”, Index 48).

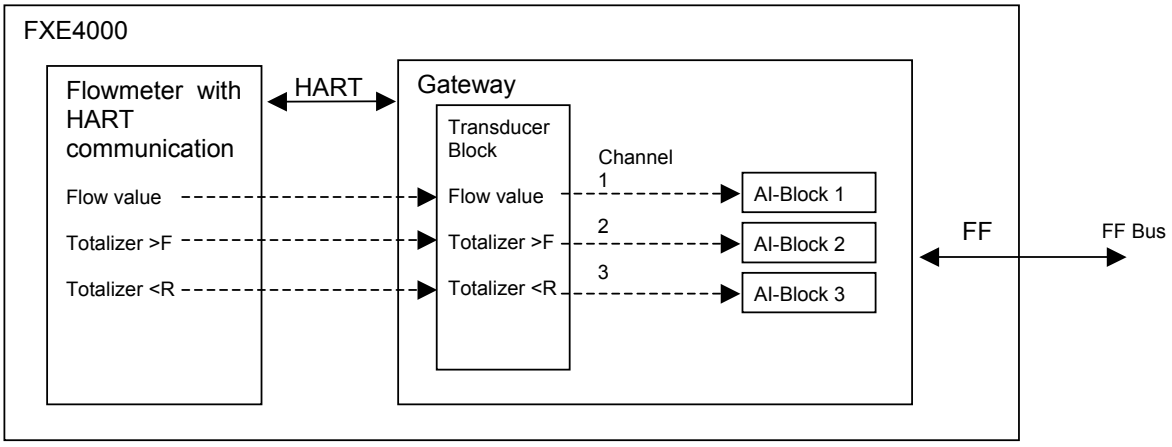
Channel 2: SECONDARY_VALUE (Index 28) = Totalizer >F

Unit: SECONDARY_VALUE_UNIT (Index 29, equal to TB-Parameter “Totalizer unit”, Index 49).

Channel 3: SECONDARY_VALUE_2 (Index 30) = Totalizer <R

Unit: SECONDARY_VALUE_UNIT_2
(Index 31, equal to TB-Parameter “Totalizer unit”,
Index 49).

Noe: The gateway has no integrator function blocks. Instead the flowmeter internal totalizer are mapped into the transducer block and can be selected by the channnel of the AI blocks.



3.5.2 Transducer Block Parameter, sorted in accordance with index

Parameter:
1 to 29 equal a standard flow with calibration block, as described in FF document FF- 903 PS3.
30 to 107 contain further measurement and setting parameters of the converter. These are also accessible via display and keyboard of the converter.
The description of the parameters can be taken from the converter instruction manual. In the following you can find a list of all entry values permitted.

3.5.2.1 Transducer Block part 1: Standard Flow with Calibration

Index	Parameter Name	Data type	Size	Storage Type	Write	Default Values	HART-Cmd read / write	Description
1	ST_REV	Unsigned 16	2	S	read only	1		Revision counter for static variables. Every time a static variable changes the revision counter is incremented by one.
2	TAG_DESC	Octet String	32	S	OOS, Auto	Leerzeichen		The user description of the application of the block.
3	STRATEGY	Unsigned 16	2	S	OOS, Auto	0		This parameter can be used to create groups of blocks by assigning the same reference number to each block of a group. This parameter is not verified and not processed.
4	ALERT_KEY	Unsigned 8	1	S	OOS, Auto	96		This parameter is used as identification number for plant units. It can be used within DCS or PLC systems e.g. to sort alarms.
5	MODE_BLK	DS-69	4	N,D,S, S	OOS, Auto	Target : OOS Actual : OOS Permitted: Auto, OOS Normal : Auto		The actual, target, permitted, and normal operation modes of the block.
6	BLOCK_ERR	Bit String	2	D	read only	0		Contains a summary of block alarms. Following bits are supported: Bit 0 = Other Error Internal HART communication between FXE4000 and gateway has failure. Bit 3 = Simulate Active At following FXE4000 message: XE-status Bit 6: Simulation on Bit 7 = Input Failure/ process variable has BAD status At following FXE4000 message: Error 1: AD-Converter Error 2: Uref to small Error 7: Positive Reference Error 8: Negative Reference Error 9: Excitation Bit 11 = Lost NV Data At following FXE4000 message: Error 5: EEPROM

Index	Parameter Name	Data type	Size	Storage Type	Write	Default Values	HART-Cmd read / write	Description
								Error 6: Totalizer Error C: Primary Error E: Totalizer >F Error F: Totalizer <R Bit 15 = Out-of-Service (MSB) If Transducer block actual-Mode is OOS.
7	UPDATE_EVT	DS-73	14	D	OOS, Auto			This alert is generated by any change to the static data.
8	BLOCK_ALM	DS-72	13	D	OOS, Auto			Indicates the alarms related to the block.
9	TRANSDUCER_DIRECTORY	Array of Unsigned 16	1	C	read only	0		The directory that specifies the number and starting indices of the transducers in the transducer block.
10	TRANSDUCER_TYPE	Unsigned 16	2	C	read only			Identifies the transducer that follows.
11	XD_ERROR	Unsigned 8	1	D	read only			Following messages are supported: 20 = Electronic Failure Internal HART communication between FXE4000 and gateway has failure. 22 = I/O-Error At following FXE4000 message: Error 1: AD-Converter Error 2: Uref to small Error 7: Positive Reference Error 8: Negative Reference Error 9: Excitation 23 = Data integrity error At following FXE4000 message: Error 5: EEPROM Error 6: Totalizer Error C: Primary Error E: Totalizer >F Error F: Totalizer <R
12	COLLECTION_DIRECTORY	Array of Unsigned 32	1	C	read only	0		A directory that specifies the number, starting indices, and DD Item IDs of the data collections in each transducer within a transducer block.
13	PRIMARY_VALUE_TYPE	Unsigned 16	2	S	OOS, Auto	101		The type of measurement represented by the primary value. The table shown below describes this parameter. 101: volumetric flow Information: Only 101 can be written.
14	PRIMARY_VALUE	DS-65	5	D	Read only			The measured primary value and status available to the function blocks. This is the flow value. Unit: look at PRIMARY_VALUE_RANGE.
15	PRIMARY_VALUE_RANGE	DS-68	11	N	read only			The High and Low range limit values, the engineering units code and the number of digits of the right of the decimal point to be used to display the

Index	Parameter Name	Data type	Size	Storage Type	Write	Default Values	HART-Cmd read / write	Description
								Primary Value. High limit value = Range, see index 39 Low Limit Value = -Range, see index 39 Unit = Range unit, see index 48 DecPoint = 2 Information: Because a magnetic inductive flowmeter can measure both flow directions the limits are –Range to +Range.
16	CAL_POINT_HI	Float	4	S	OOS, Auto			The highest calibrated value: Equal to Index 38: Cal factor Writing this index is equal to writing index 38, look for write conditions there.
17	CAL_POINT_LO	Float	4	S	OOS, Auto			The lowest calibrated value: Equal to –Cal factor, index 38. Information: The flowmeter has only one cal factor, valid for both flow directions. This parameter is equal to index 38 with inverted sign, see write conditions there.
18	CAL_MIN_SPAN	Float	4	C	Read only	0		The minimum calibration span value allowed. This parameter is not used and has no function.
19	CAL_UNIT	Unsigned 16	2	S	OOS, Auto	1352		The engineering units code index for the calibration values. Equal to index 48: Range unit. Writing this index is equal to writing index 48.
20	SENSOR_TYPE	Unsigned 16	2	C	OOS, Auto	102		The sensor type defined below: 102: electromagnetic flowmeter Information: Only 102 can be written.
21	SENSOR_RANGE	DS-68	11	C	Read only			The High and Low range limit values, the engineering units code, and the number of digits to the right of the decimal point for the sensor. SENSOR_RANGE.100%: Cal factor, see index 38 SENSOR_RANGE.0% : -Cal factor, see index 38 SENSOR_RANGE.Unit : Range unit, see index 48 SENSOR_RANGE.DecPt: 2
22	SENSOR_SN	Visible String	32	C	Read only			The device has no sensor serial number. Instead of this the device instrument number (index 81) is shown here.
23	SENSOR_CAL_METHOD	Unsigned 8	1	S	OOS, Auto			The method of last sensor calibration.
24	SENSOR_CAL_LOC	Visible String	32	S	OOS, Auto			The location of the last sensor calibration.
25	SENSOR_CAL_DATE	Date	7	S	OOS, Auto			The date of the last sensor calibration.
26	SENSOR_CAL_WHO	Visible String	32	S	OOS, Auto			The name of the person who is responsible for the last sensor calibration.
27	LIN_TYPE	Unsigned 16	2	C	OOS, Auto	1		Contains the linearisation type used to describe the behaviour of the sensor: 1: Linear with Input Information: Only 1 can be written.
28	SECONDARY_VALUE	DS-65	5	D	Read only			Secondary Value: Totalizer >F Unit: look at index 29, SECONDARY_VALUE_UNIT

3.5.2.2 Transducer Block part 2: manufacturer specific parameters

29	SECONDARY_VALUE_UNIT	Unsigned 16	2	S	OOS, Auto			This parameter is equal to index 49, Totalizer unit. Writing this parameter is equal to writing index 49.
30	SECONDARY_VALUE_2	DS-65	5	D	Read only			Secondary Value_2: Totalizer <R Unit: look at Index 29, SECONDARY_VALUE_UNIT_2
31	SECONDARY_VALUE_UNIT_2	Unsigned 16	2	S	OOS, Auto			This parameter is equal to index 49, Totalizer unit. Writing this parameter is equal to writing index 49.
32	FXE4000 Software	Visible String	16	N	Read only	D699B180U01 X.31	231/230 Slot 7	Part and revision number of FXE4000 software.
33	Gateway-Software	Visible String	16	N	Read only	D200S022U02 A.10	-	Part and revision number of gateway software.
34	Language	Unsigned8	1	S	OOS, Auto		128/129 Slot 0	0 German 1 English
35	Meter size	Unsigned8	1	S	OOS, Auto		128/129 Slot 1	0 3 mm 1/10 in 1 4 mm 5/32 in 2 5 mm 3/16 in 3 6 mm 1/4 in 4, 8 mm 5/16 in 5 10 mm 3/8 in 6 15 mm 1/2 in 7 20 mm 3/4 in 8 25 mm 1 in 9 32 mm 1-1/4 in 10 40 mm 1-1/2 in 11 50 mm 2 in 12 65 mm 2-1/2 in 13 80 mm 3 in 14 100 mm 4 in 15 125 mm 5 in 16 150 mm 6 in 17 200 mm 8 in 18 250 mm 10 in 19 300 mm 12 in 20 350 mm 14 in 21 400 mm 16 in 22 450 mm 18 in 23 500 mm 20 in 24 600 mm 24 in 25 700 mm 28 in 26 750 mm 30 in 27 800 mm 32 in 28 900 mm 36 in 29 1000 mm 40 in
36	Short model no.	Visible String	16	S	OOS, Auto		231/230 Slot 1	

37	Order no.	Visible String	16	S	OOS, Auto		231/230 Slot 4	
38	Cal-factor	Float	4	S	OOS, Auto		132/133 Slot 0	If RangeDN (index 75) is fixed, then it is only allowed to write the same Cal factor value, which is already there. If RangeDN is programmable, than any Cal factor value can be written.
39	Range	Float	4	S	OOS, Auto		132/133 Slot 1	Lower Limit: 0.02 or 0.05 * Cal factor (look at index 74: Range<0.05RangeDN) Upper Limit: 150% of cal factor Unit : Range unit, look at index 48
40	Pulse factor	Float	4	S	OOS, Auto	1.0	132/133 Slot 3	Lower Limit: 0.001 Upper Limit: 1000 Unit : 1 / Unit totalizer, look at index 49
41	Pulse width	Float	4	S	OOS, Auto	30	132/133 Slot 4	Lower Limit: 0.1 Upper Limit: 2000 Unit : msec
42	Low flow cut-off	Float	4	S	OOS, Auto	1.0	132/133 Slot 5	Lower Limit: 0.0 Upper Limit: 10.0 Unit : %
43	Damping	Float	4	S	OOS, Auto	5.0	132/133 Slot 6	Lower Limit: 0.2 Upper Limit: 100 Unit : sec
44	Filter	Unsigned8	1	S	OOS, Auto	0	128/129 Slot 2	0 off 1 on
45	Density	Float	4	S	OOS, Auto	1.0	132/133 Slot 7	Lower Limit: 0.01 Upper Limit: 5.0 Unit : g/cm3
46	System zero adjust	Float	4	S	OOS, Auto		132/133 Slot 8	Lower Limit: -50.0 Upper Limit: 50.0 Unit : Hz
47	Start automatic System zero adjust	Unsigned8	1	S	OOS, Auto		147	Read: 0 = no adjust in work 1 = adjust is running Write: 1 = start adjust Writing 1 starts an automatic adjust. This adjust needs 10 to 40 seconds, depending from excitation frequency. As long as adjust is running 1 will be read. If adjust is finished 0 will be read.

48	Range unit	Unsigned8	1	S	OOS, Auto	1352	128/129 Slot 3

1351	l/s	24	(HART-Index)
1352	l/min	17	
1353	l/h	138	
1347	m3/s	28	
1348	m3/min	131	
1349	m3/h	19	
1350	m3/d	29	
1367	igps	137	
1368	igpm	18	
1369	igph	30	
1370	igpd	31	
1366	mgd	23	
1363	gpm	16	
1364	gph	136	
1371	bbl/s	132	
1372	bbl/min	133	
1373	bbl/h	134	
1374	bbl/d	135	
1322	kg/s	73	
1323	kg/min	74	
1324	kg/h	75	
1325	kg/d	76	
1327	t/min	77	
1328	t/h	78	
1329	t/d	79	
1318	g/s	70	
1319	g/min	71	
1320	g/h	72	
1330	lbs/s	80	
1331	lbs/min	81	
1332	lbs/h	82	
1356	ft/s	240	
1357	ft/m	241	
1358	ft/h	242	
1359	ft/d	243	

Information: ft3/... is no standard unit in the range unit list. The flowmeter allows a programmable unit. This programmable unit will be programmed and used for ft3/…, if necessary.

49	Totalizer unit	Unsigned8	1	S	OOS, Auto	1038	128/129 Slot 4	1038 l 41 (HART-Index) 1034 m3 43 1049 igal 42 1048 gal 40 1051 bbl 46 1088 kg 61 1092 t 62 1089 g 60 1094 lbs 63 1043 ft3 244 Information: ft3 is no standard unit in the range unit list. The flowmeter allows a programmable unit. This programmable unit will be programmed and used for ft3, if necessary.
50	Error log	Bitstring	4	N	OOS, Auto			The Error log register shows the actual error and status messages of the FXE4000 flowmeter. Bits appear and disappear similar to appear and disappear of the errors. #0, Bit 0 Error 8: Negative Reference #0, Bit 1 Error 9: Excitation #0, Bit 2 Error A: MAX-Alarm #0, Bit 3 Error B: MIN-Alarm #0, Bit 4 Error C: Primary #0, Bit 5 Error D: - #0, Bit 6 Error E: Totalizer >F #0, Bit 7 Error F: Totalizer <R #1, Bit 0 Error 0: Empty pipe #1, Bit 1 Error 1: A/D-Converter #1, Bit 2 Error 2: Uref to small #1, Bit 3 Error 3: Flow > 130% #1, Bit 4 Error 4: Zero return #1, Bit 5 Error 5: EEPROM #1, Bit 6 Error 6: Totalizer #1, Bit 7 Error 7: Positive Reference #2, Bit 0 Status 0: Automatic adjust running #2, Bit 1 Status 1: Automatic adjust #2, Bit 2 Status 2: Average measurement #2, Bit 3 Status 3: - #2, Bit 4 Status 4: Prot.cust.trans. #2, Bit 5 Status 5: - #2, Bit 6 Status 6: Simulation on #2, Bit 7 Status 7: Function test or test mode on
51	Max alarm	Unsigned16	2	S	OOS, Auto	130	130/131 Slot 0	Lower Limit: 0 Upper Limit: 130 Unit : %

52	Min alarm	Unsigned16	2	S	OOS, Auto	0	130/131 Slot 1	Lower Limit: 0 Upper Limit: 130 Unit : %
53	Detector e.pipe	Unsigned8	1	S	OOS, Auto	0	128/129 Slot 13	0 off 1 on
54	Alarm empty pipe	Unsigned8	1	S	OOS, Auto	0	128/129 Slot 14	0 off 1 on
55	Threshold	Float	4	S	OOS, Auto	2300	132/133 Slot 10	Lower Limit: 0 Upper Limit: 3000 Unit : Hz
56	Frequency detector empty	Float	4	D	Read only		200 Slot 21	Actual measured frequency of detector empty pipe.
57	Adjust detector empty pipe	Unsigned8	1	S	OOS, Auto		200 Slot 20	To adjust detector empty pipe fill pipe. Then read frequency of detector empty pipe. The frequency should be about 2000 Hz. If no, change slightly this adjust value and then read again frequency. Repeat this until frequency is about 2000 Hz. Lower Limit: 0 Upper Limit: 255
58	Totalizer >F	Float	4	S	Read only		132/133 Slot 11	Lower Limit: 0 Upper Limit: 9999999 Unit : look at index 49, Totalizer unit.
59	Overflow >F	Unsigned16	2	S	Read only		130/131 Slot 3	Lower Limit: 0 Upper Limit: 65535 Unit : -
60	Totalizer >F reset	Unsigned8	1	D	OOS, Auto		140 142	Read: Always 0 = no Reset Write: 1= Reset Totalizer and Overflow value 2 = Reset only Overflow value
61	Totalizer <R	Float	4	S	Read only		132/133 Slot 12	Lower Limit: 0 Upper Limit: 9999999 Unit : look at index 49, Totalizer unit.
62	Overflow <R	Unsigned16	2	S	Read only		130/131 Slot 4	Lower Limit: 0 Upper Limit: 65535 Unit : -
63	Totalizer <R reset	Unsigned8	1	D	OOS, Auto		141 143	Read: Always 0 = no Reset Write: 1= Reset Totalizer and Overflow value 2 = Reset only Overflow value
64	totalizer funct.	Unsigned8	1	S	OOS, Auto	0	128/129 Slot 18	0 Standard 1 Differential Totalizer Information to diff. function: The differential Totalizer value can be read in Totalizer >F. The Totalizer <R value then will be 0.

65	Mains interrupt	Unsigned16	2	S	OOS, Auto		130/131 Slot 5	Read: Get mains interrupt value. Write: Writing 0 will reset the main interrupt counter to 0.
66	Display 1st line	Unsigned8	1	S	OOS, Auto	0	128/129 Slot 19	7 Q [Bargraph] 1 Q [unit] 0 Q [%] 9 Detector e.P. 11 Signal p/n 12 Reference p/n 13 Signal, Ref. 8 Blanks 5 Totalizer <R 4 Totalizer >F 3 Totalizer 10 Mains Frequency 15 Channel, Mode, Status 16 Value, Unit
67	Display 2st line	Unsigned8	1	S	OOS, Auto	3	128/129 Slot 20	
68	Display 1st line multipl.	Unsigned8	1	S	OOS, Auto	14	128/129 Slot 21	7 Q [Bargraph] 1 Q [unit] 0 Q [%] 9 Detector e.P. 11 Signal p/n 12 Reference p/n 13 Signal, Ref. 8 Blanks 5 Totalizer <R 4 Totalizer >F 3 Totalizer 10 Mains Frequency 14 Off 15 Channel, Mode, Status 16 Value, Unit
69	Display 2st line multipl.	Unsigned8	1	S	OOS, Auto	14	128/129 Slot 22	
70	Operating mode	Unsigned8	1	S	OOS, Auto	0	128/129 Slot 23	0 Standard 2 Fast
71	Flowdirection	Unsigned8	1	S	OOS, Auto	1	128/129 Slot 24	0 Forward 1 Forward/Reverse
72	Flow indication	Unsigned8	1	S	OOS, Auto	0	128/129 Slot 25	0 standard 1 opposite
73	QmaxDN velocity	Unsigned8	1	S	OOS, Auto	0	128/129 Slot 27	0 10 m/s 1 33.33 ft/s
74	Range<.05RangeDN	Unsigned8	1	S	OOS, Auto	0	128/129 Slot 28	0 off 1 on

75	Range DN (Cal-factor)	Unsigned8	1	S	OOS, Auto	0	128/129 Slot 29	0 fixed 1 programmable
76	Debit Excitation	Unsigned8	1	S	OOS, Auto		128/129 Slot 30	0 6.25 Hz AC/DC 1 7.5 Hz AC/DC 2 12.5 Hz AC/DC 3 15 Hz AC/DC 4 25 Hz AC/DC 5 30 Hz AC/DC 6 6.25 Hz DC 7 7.5 Hz DC 8 12.5 Hz DC 9 15 Hz DC 10 25 Hz DC 11 30 Hz DC 12 negativ 13 positiv
77	Excitation	Unsigned8	1	S	Read only		128/129 Slot 31	
78	Analog range	Unsigned8	1	S	OOS, Auto		128/129 Slot 32	7 V = 8 auto. 6 V = 4 auto. 5 V = 2 auto. 4 V = 1 auto. 3 V = 8 man. 2 V = 4 man. 1 V = 2 man. 0 V = 1 man.
79	Preamplifier	Unsigned8	1	S	OOS, Auto	1	128/129 Slot 33	0 Yes 1 no
80	Service-Code	Unsigned16	2	S	OOS, Auto		130/131 Slot 6	Lower Limit: 0 Upper Limit: 9999 Unit : -
81	Instrument no.	Unsigned16	2	S	OOS, Auto		130/131 Slot 7	Lower Limit: 0 Upper Limit: 65535 Unit : - Information: Instrument no. is pard of the FF identifier, look at 4.3
82	Calibration mode	Unsigned16	2	S	OOS, Auto	0	130/131 Slot 8	Lower Limit: 0 Upper Limit: 65535 Unit : -
83	Calibration	Float	4	S	OOS, Auto		132/133 Slot 18	Lower Limit: -10.0 Upper Limit: 10.0 Unit : %
84	Span adjust >F	Float	4	S	OOS, Auto		132/133 Slot 13	Lower Limit: 250.0 Upper Limit: 300.0 Unit : %

85	Span adjust <R	Float	4	S	OOS, Auto		132/133 Slot 14	Lower Limit: -300.0 Upper Limit: -250.0 Unit : %
86	Zero adjust	Float	4	S	OOS, Auto		132/133 Slot 15	Lower Limit: -5.0 Upper Limit: 5.0 Unit : %
87	Start automatic adjust “Span adjust >F”	Unsigned8	1	S	OOS, Auto		180 Slot 3	Read: 0 = no adjust in work 1 = adjust is running Write: 1 = start adjust Writing 1 starts an automatic adjust. This adjust needs 10 to 40 seconds, depending from excitation frequency. As long as adjust is running 1 will be read. If adjust is finished 0 will be read.
88	Start automatic adjust “Span adjust <R”	Unsigned8	1	S	OOS, Auto		180 Slot 4	
89	Start automatic adjust “Zero adjust”	Unsigned8	1	S	OOS, Auto		180 Slot 5	
90	Span Cs 6.25 Hz	Float	4	S	OOS, Auto		132/133 Slot 19	Lower Limit: 15.0 Upper Limit: 200.0 Or (depends from flow direction) Lower Limit: -200.0 Upper Limit: -15.0 Unit : %
91	Zero Cz 6.25 Hz	Float	4	S	OOS, Auto		132 /133 Slot 20	Lower Limit: -5.0 Upper Limit: 5.0 Unit : %
92	Span Cs 12.5 Hz	Float	4	S	OOS, Auto		132/133 Slot 21	Lower Limit: 15.0 Upper Limit: 200.0 Or (depends from flow direction) Lower Limit: -200.0 Upper Limit: -15.0 Unit : %
93	Zero Cz 12.5 Hz	Float	4	S	OOS, Auto		132/133 Slot 22	Lower Limit: -5.0 Upper Limit: 5.0 Unit : %
94	Span Cs 25 Hz	Float	4	S	OOS, Auto		132 /133 Slot 23	Lower Limit: 15.0 Upper Limit: 200.0 Or (depends from flow direction) Lower Limit: -200.0 Upper Limit: -15.0 Unit : %
95	Zero Cz 25 Hz	Float	4	S	OOS, Auto		132/133 Slot 24	Lower Limit: -5.0 Upper Limit: 5.0 Unit : %
96	Start automatic adjust „Primary span“	Unsigned8	1	S	OOS, Auto		156	Read: 0 = no adjust in work 1 = adjust is running

97	Start automatic adjust „Primary zero point“	Unsigned8	1	S	OOS, Auto		155	Write: 1 = start adjust Writing 1 starts an automatic adjust. This adjust needs 10 to 40 seconds, depending from excitation frequency. As long as adjust is running 1 will be read. If adjust is finished 0 will be read.
98	Initialise external EEPROM	Unsigned16	1	S	OOS, Auto		152	Writing 4000 will initialise the external EEPROM.
99	Load Primary Data	Unsigned8	1	S	OOS, Auto		148	Writing 1 will start loading the primary data.
100	Store Primary Data	Unsigned8	1	S	OOS, Auto		149	Writing 1 will start storing the primary data.
101	Load device data from external EEPROM	Unsigned8	1	S	OOS, Auto		150	Writing 1 will start loading the device data from external EEPROM.
102	Store device data to external EEPROM	Unsigned8	1	S	OOS, Auto		151	Writing 1 will start writing the device data into the external EEPROM.
103	DIP-Switch	Unsigned8	1	N	Read only		-	Actual position of DIP switch, look at 1.1.
104	Calibration date	Visible String	6	S	OOS, Auto		231/230 Slot 0	
105	Message	Visible String	32	S	OOS, Auto		12/17	HART-Message
106	Custom-Tag	Visible String	16	S	OOS, Auto		12/17	HART-Descriptor
107	Communication-Tag	Visible String	8	S	OOS, Auto		12/17	HART-Tag

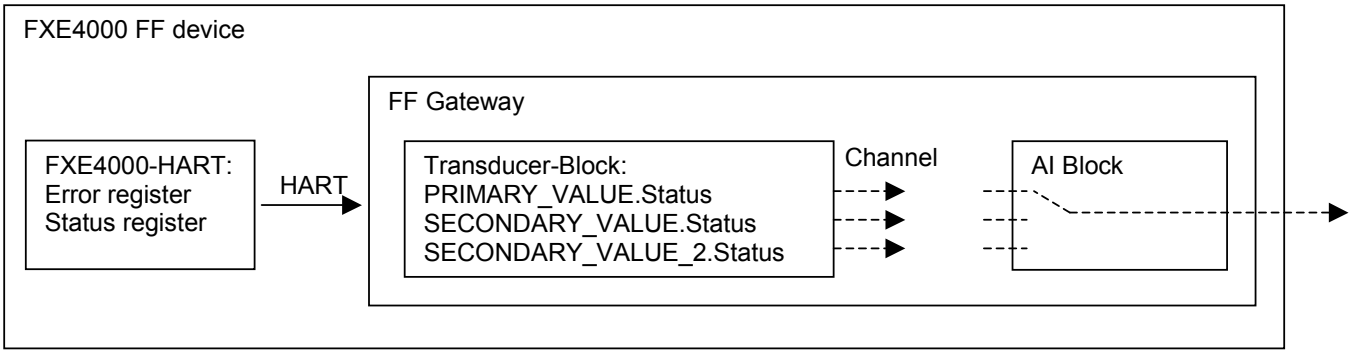
3.5.3 Transducer Block Parameter, sorted according to names

Parameter name	Index
Adjust detector empty pipe	57
Alarm empty pipe	54
ALERT_KEY	4
Analog range	78
BLOCK_ALM	8
BLOCK_ERR	6
CAL_MIN_SPAN	18
CAL_POINT_HI	16
CAL_POINT_LO	17
CAL_UNIT	19
Cal-fact	38
Calibration	83
Calibration date	104
Calibration mode	82
COLLECTION_DIRECTORY	12
Communication-Tag	107
Custom-Tag	106
Damping	43
Debit Excitation	76
Density	45
Detector e.pipe	53
DIP-Switch	103
Display 1st line	66
Display 1st line multipl.	68
Display 2st line	67
Display 2st line multipl.	69
Error log	50
Excitation	77
Filter	44
Flow indication	72
Flowdirection	71
Frequency detector empty	56
Gateway-Software	33
Initialise external EEPROM	98
Instrument no.	81
Language	34
LIN_TYPE	27
Load device data from external EEPROM	101
Load Primary Data	99
Low flow cut-off	42
Mains interrupt	65
Max alarm	51
Message	105
Meter size	35
Min alarm	52
MODE_BLK	5
Operating mode	70
Order no.	37
Overflow <R	62
Overflow >F	59
Preamplifier	79
PRIMARY_VALUE	14
PRIMARY_VALUE_RANGE	15
PRIMARY_VALUE_TYPE	13
Pulse factor	40
Pulse width	41
QmaxDN velocity	73
Range	39
Range DN (Cal-factor)	75
Range unit	48
Range<.05RangeDN	74
SECONDARY_VALUE	28
SECONDARY_VALUE_2	30
SECONDARY_VALUE_UNIT	29
SECONDARY_VALUE_UNIT_2	31
SENSOR_CAL_DATE	25
SENSOR_CAL_LOC	24
SENSOR_CAL_METHOD	23
SENSOR_CAL_WHO	26
SENSOR_RANGE	21
SENSOR_SN	22
SENSOR_TYPE	20
Service-Code	80
Short model no.	36
Span adjust <R	85
Span adjust >F	84
Span Cs 12.5 Hz	92
Span Cs 25 Hz	94
Span Cs 6.25 Hz	90
ST_REV	1
Start automatic adjust "Span adjust <R"	88
Start automatic adjust "Span adjust >F"	87
Start automatic adjust "Zero adjust"	89
Start automatic adjust"Primary span"	96
Start automatic adjust"Primary zero point"	97
Start automatic System zero adjust	47
Store device data to external EEPROM	102
Store Primary Data	100
STRATEGY	3
System zero adjust	46
TAG_DESC	2
Threshold	55
Totalizer <R	61
Totalizer <R reset	63
Totalizer >F	58
Totalizer >F reset	60
totalizer funct.	64
Totalizer unit	49
TRANSDUCER_DIRECTORY	9
TRANSDUCER_TYPE	10
UPDATE_EVT	7
XD_ERROR	11
FXE4000 Software	32
Zero adjust	86
Zero Cz 12.5 Hz	93
Zero Cz 25 Hz	95
Zero Cz 6.25 Hz	91

3.6 Error handling

3.6.1 Mapping flowmeter error and status to Transducer block output parameters

Error and status register of the FXE4000 device are mapped to the Transducer block output parameters:



	Flowmeter error and status	Mapping to PRIMARY_VALUE.Status = Flow value	Mapping to SECONDARY_VALUE.Status and SECONDARY_VALUE_2.Status = Totalizer >F and <R
Error 0	Detector empty pipe	UNCERTAIN, non-specific	UNCERTAIN, non-specific
Error 1	A/D-Converter	BAD, sensor failure	BAD, sensor failure
Error 2	Uref to small	BAD, sensor failure	BAD, sensor failure
Error 3	Flow > 130%	UNCERTAIN, EU range violation	UNCERTAIN, EU range violation
Error 4	Zero return		
Error 5	EEPROM	BAD, device failure	BAD, device failure
Error 6	Totalizer		BAD, device failure
Error 7	Positive Reference	BAD, sensor failure	BAD, sensor failure
Error 8	Negative Reference	BAD, sensor failure	BAD, sensor failure
Error 9	Excitation	BAD, sensor failure	BAD, sensor failure
Error A	MAX-Alarm		
Error B	MIN-Alarm		
Error C	Primary	BAD, device failure	BAD, device failure
Error D	-		
Error E	Totalizer >F		BAD, device failure (only for Totalizer >F)
Error F	Totalizer <R		BAD, device failure (only for Totalizer <R)
Status 0	Automatic adjust running	UNCERTAIN, non specific	UNCERTAIN, non specific
Status 1	Automatic adjust		
Status 2	Average measurement	UNCERTAIN, non specific	UNCERTAIN, non specific
Status 3	-		
Status 4	Prot.cust.trans.		
Status 5	-		
Status 6	Simulation on	UNCERTAIN, non specific	UNCERTAIN, non specific
Status 7	Function test or Test mode on		

3.6.2 Error handling of AI Blocks

Index 5: MODE_BLK

The AI Block goes to Out_of_Service, if

- Rescoure Block goes to Out_of_Service or
- AI Block has configuration error.

Index 6: BLOCK_ERR

Following error messages are supported

OOS	→	If block is Out of Service.
SIMULATE_ACTIVE	→	If Simulation is activated (AI Index 9: Simulate structure).
CONFIG_ERROR	→	If AI Block has Configuration error.
INPUT_FAILURE	→ or	If PV (AI Index 7) has status BAD and the substatus is Device_Failure Sensor_Failure and if Propagate_Fault_Forward is not activated in STATUS_OPTS (AI Index 14).

Index 8: OUT

Status of OUT is:

If block is Out of Service	→ BAD, Substatus Out_Of_Service
If block has configuration error	→ BAD, Substatus Out_Of_Service
If simulation is activated	→ Simulated status
Else	→ Status of PV

An AI configuration error may be:

- Invalid Channel parameter (AI index 15)
- Invalid L_Type parameter (AI index 16)
- XD_SCALE (AI index 10) unit doesn't match Channel unit
- XD_SCALE and OUT_SCALE are not identical for L_Type = direct
- Period_Of_Execution is 0

3.6.3 Error handling chain

Example 1:

Flowmeter has error 3 – flow > 130%

→ Bit 3 in Transducer block error log register is set.

→ Status of Channel 1 (flow value) is UNCERTAIN, Substatus EU range violation.

→ Status of AI-Block PV and OUT is UNCERTAIN, Substatus EU range violation.

Example 2:

Flowmeter has error 1 – A/D-Converter

→ Bit 1 in Transducer block error log register is set.

→ Transducer block BLOCK_ERR shows Input Failure.

→ Transducer block XD_ERROR shows I/O-error.

→ Status of Channel 1 (flow value) is BAD, Substatus Sensor Failure.

→ Status of AI Block PV and OUT is BAD, Substatus Sensor Failure.

→ AI-Block BLOCK_ERR shows INPUT_FAILURE (if Propagate_Fault_Forward is not set in STATUS_OPTS).

Example 3:

Resource-Block is switched to Out of Service:

→ AI-Block also goes to Out of Service.

→ AI-Block BLOCK_ERR shows Out of Service.

→ AI-Block OUT.Status is BAD, Substatus Out_Of_Service.

3.7 Status-Byte

Measurement values are usually transferred as data structure DS-65 – Value & Status. In this structure a value is a float number and a status information a byte. This status byte is splitted to the following parts:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Quality		Quality Substatus				Limits	

Quality
- 0: Bad
- 1: Uncertain
- 2: Good (Not Cascade)
- 3: Good (Cascade)

Substatus BAD
- 0: Non-specific
- 1: Configuration Error
- 2: Not Connected
- 3: Device Failure
- 4: Sensor Failure
- 5: No Communication (last usable value)
- 6: No Communication (no usable value)
- 7: Out of Service

Substatus UNCERTAIN
- 0: Non-specific
- 1: Last Usable Value
- 2: Substitute
- 3: Initial Value
- 4: Sensor Conversion not Accurate
- 5: Engineering Unit Range Violation
- 6: Sub-normal

Substatus GOOD (Non-Cascade)
- 0: Non-specific
- 1: Active Block Alarm
- 2: Active Advisory Alarm (priority < 8)
- 3: Active Critical Alarm (priority > 8)
- 4: Unacknowledged Block Alarm
- 5: Unacknowledged Advisory Alarm
- 6: Unacknowledged Critical Alarm

Substatus GOOD (Cascade)
- 0: Non-specific
- 1: Initialisation Acknowledge
- 2: Initialisation Request
- 3: Not Invited
- 4: Not Selected
- 5: Local Override
- 6: -
- 7: Fault State Active
- 8: Initiate Fault State

Limits:
- 0: Not limited
- 1: Low limited
- 2: High limited
- 3: Constant

3.8 Data structures

3.8.1 DS-64 – Block

E	Element Name	Data Type	Size
1	Block_Tag	Visible String	32
2	DD Member Id	Unsigned32	4
3	DD Item Id	Unsigned32	4
4	DD Revision	Unsigned16	2
5	Profile	Unsigned16	2
6	Profile Revision	Unsigned16	2
7	Execution Time	Unsigned32	4
8	Period of Execution	Unsigned32	4
9	Number of Parameters	Unsigned16	2
10	Next FB to Execute	Unsigned16	2
11	Starting Index of Views	Unsigned16	2
12	Number of View 3	Unsigned8	1
13	Number of View 4	Unsigned8	1

3.8.2 DS-65 – Value & Status – Floating Point Structure

E	Element Name	Data Type	Size
1	Status	Unsigned8	1
2	Value	Float	4

3.8.3 DS-68 – Scaling Structure

E	Element Name	Data Type	Size
1	EU at 100%	Float	4
2	EU at 0%	Float	4
3	Units Index	Unsigned16	2
4	Decimal Point	Integer8	1

3.8.4 DS-69 – Mode Structure

E	Element Name	Data Type	Size
1	Target	Bitstring	1
2	Actual	Bitstring	1
3	Permitted	Bitstring	1
4	Normal	Bitstring	1

3.8.5 DS-70 – Access Permissions

E	Element Name	Data Type	Size
1	Grant	Bitstring	1
2	Deny	Bitstring	1

3.8.6 DS-71 – Alarm Float Structure

E	Element Name	Data Type	Size
1	Unacknowledged	Unsigned8	1
2	Alarm State	Unsigned8	1
3	Time Stamp	Time Value	8
4	Subcode	Unsigned16	2
5	Value	Float	4

3.8.7 DS-72 – Alarm Discrete Structure

E	Element Name	Data Type	Size
1	Unacknowledged	Unsigned8	1
2	Alarm State	Unsigned8	1
3	Time Stamp	Time Value	8
4	Subcode	Unsigned16	2
5	Value	Unsigned8	1

3.8.8 DS-73 – Event Update Structure

E	Element Name	Data Type	Size
1	Unacknowledged	Unsigned8	1
2	Update State	Unsigned8	1
3	Time Stamp	Time Value	8
4	Static Revision	Unsigned16	2
5	Relative Index	Unsigned16	2

3.8.9 DS-74 – Alarm Summary Structure

E	Element Name	Data Type	Size
1	Current	Bitstring	2
2	Unacknowledged	Bitstring	2
3	Unreported	Bitstring	2
4	Disabled	Bitstring	2

3.8.10 DS-82 – Simulate – Floating Point Structure

E	Element Name	Data Type	Size
1	Simulate Status	Unsigned8	1
2	Simulate Value	Float	4
3	Transducer Status	Unsigned8	1
4	Transducer Value	Float	4
5	Simulate En/Disable	Unsigned8	1

3.8.11 DS-85 – Test Structure

E	Element Name	Data Type	Size
1	Value 1	Boolean	1
2	Value 2	Integer8	1
3	Value 3	Integer16	2
4	Value 4	Integer32	4
5	Value 5	Unsigned8	1
6	Value 6	Unsigned16	2
7	Value 7	Unsigned32	4
8	Value 8	Float	4
9	Value 9	Visible String	32
10	Value 10	Octet String	32
11	Value 11	Date	7
12	Value 12	Time of Day	6
13	Value 13	Time Difference	6
14	Value 14	Bitstring	2
15	Value 15	Time Value	8

4. Start-Up

This chapter is set out to provide a description of the device setup using National Instruments Fieldbus Configuration System V2.3.

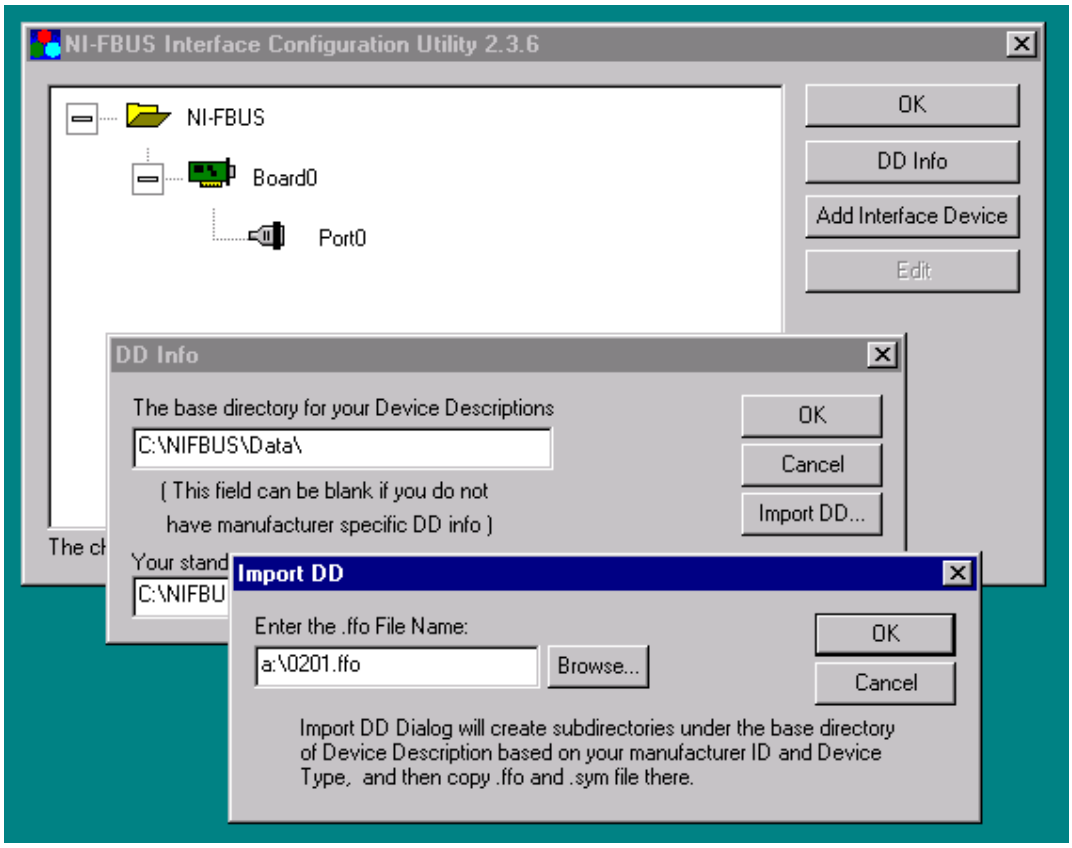
In addition to the instrument, you will require the following instrument-describing files for FXE4000 (000320/0016):

0201.ffo
0201.sym
020101.cff (not required for NI-Configurator)

These files will be delivered along with the instrument. They can likewise be obtained via the Fieldbus Foundation Homepage www.fieldbus.org.

4.1 NI-Interface Configuration Utility

Initially, please, start the National Instruments© Program “Interface Configuration Utility”. Neither the NI-FBUS Configurator nor the NI-FBUS program may be activated. Click on “DD info” and subsequently on “Import DD”. Please enter the path to the ffo- (and sym-) file and press the “OK” button to import the files.

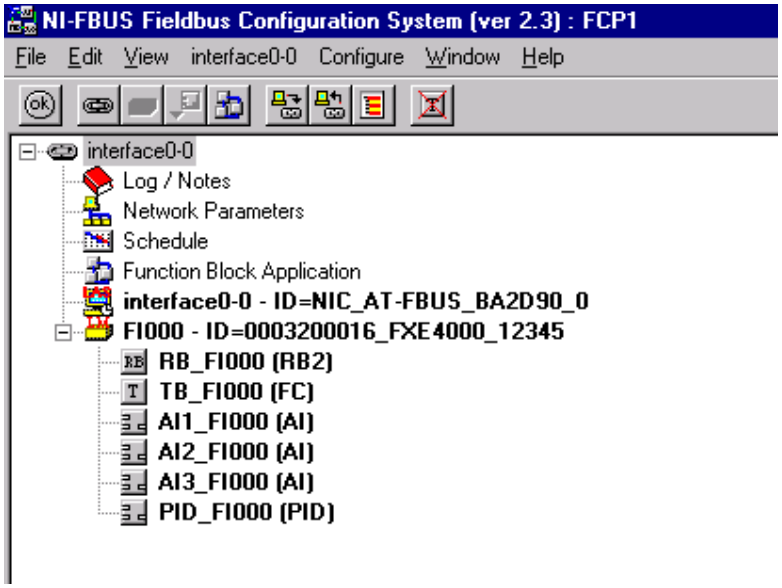


4.2 Verify Hardware switch

Please check on device, whether or not the hardware switches 1 and 2 are set to off. Should this not be the case, please change the setting to off (also feasible during instrument operation).

4.3 Connection Establishment

Please start the National Instruments© NI-FBUS Configurator. Subsequent to the connection establishment, the following message should appear:



This is the identifier (ID) structure:

000320 = manufacturer code ABB, hex

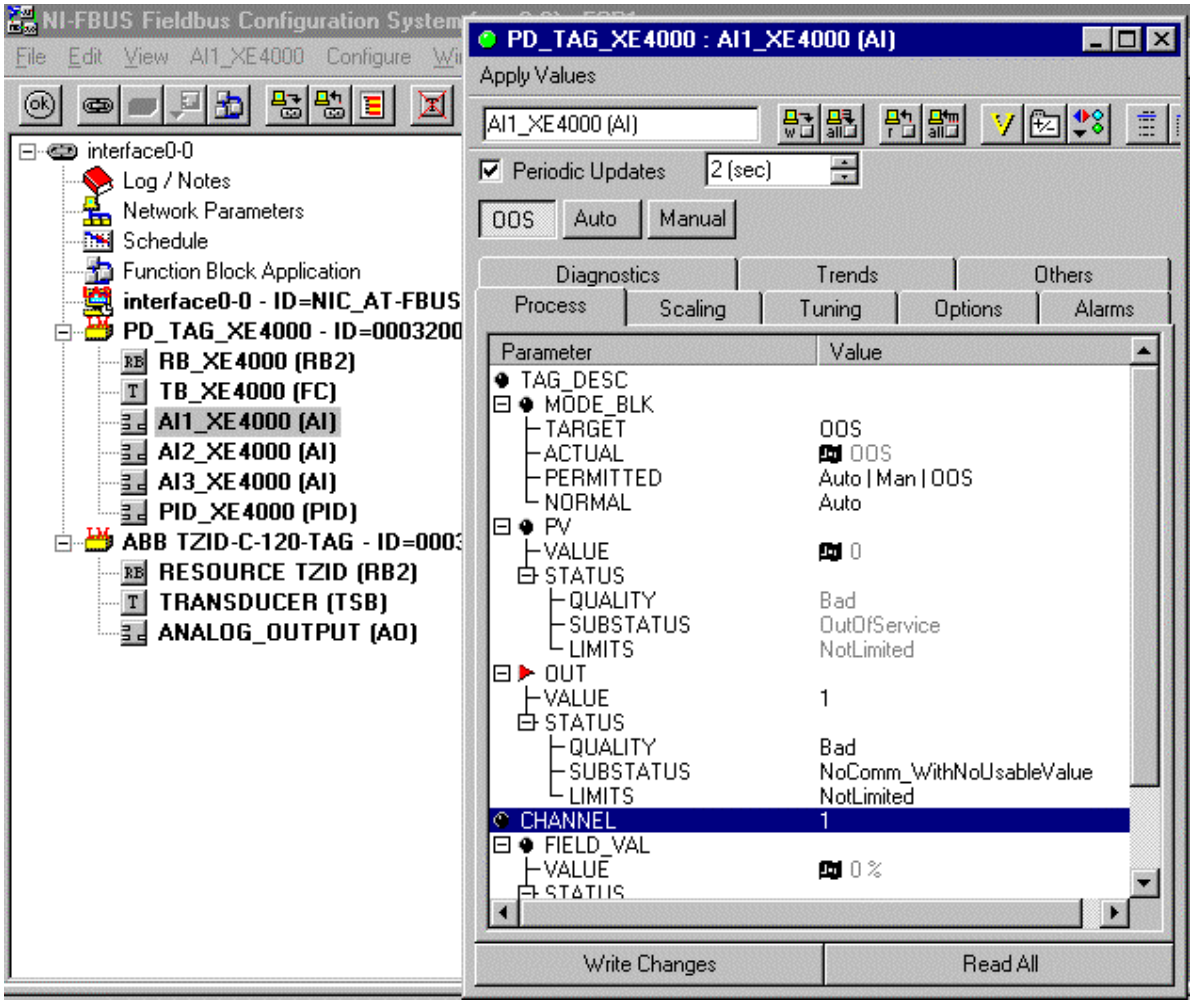
0016 = Device Type Code FXE4000, hex

FXE4000 = Device-name

12345 = serial umber of instrument expressed as 5-digit decimal figure

4.4 Blocks Out of Service

Prior to configuring the instrument, please verify whether all blocks are “out of service” . Verification can be done by opening (double click) the block display for each block:



If necessary, please set blocks to “out of service”.

NOTE: Both Target Mode and Actual mode have to be set to “OOS”.

4.5 Instrument and Block Tags

Please choose an PD-Tag (Physical device tag). To do so, please click on “FI000” using the right mouse button. Using SET TAG, please enter a denomination for the respective instrument. Repeat this procedure to choose tags for the blocks (RB2, FC, AI1, AI2, AI3, PID).

4.6 Resource Block

In general, no settings have to be adjusted within the resource block. Please, set the block to “Auto”.

4.7 Transducer Block

The transducer block contains all instrument specific parameters of the flow converter. If necessary make your parameter settings. Then please set the block to “Auto”.

4.8 Analog Input Block

Next you have to determine the unit handling. The measurements will be calculated within the transducer block and provided by the channels. Each channel disposes of different units (see 3.5.1). Within the AI block this value can merely be transferred (L_TYPE =direct) or the scale can be changed to another unit (L_TYPE =indirect).

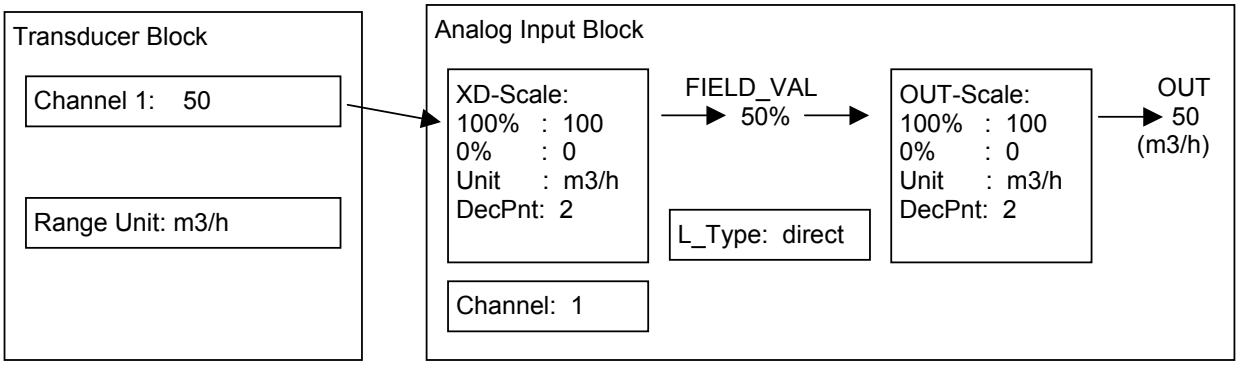
4.8.1 Unit with L_TYPE =Direct

Should within the AI block the L_TYPE (Index 16) be set to “Direct” will the structures XD_SCALE and OUT_SCALE need to be set up identically. The entry value will be directly and with transformation be transferred to OUT. The XD scale unit has to be identical with the channel unit.

Example:

The flow value shall be indicated in m3/h. Thus, please :

- Within the transducer block (Index 48) set “Range unit” to m3/h. Thus this unit displays the channel 1 value.
- Set the L_TYPE within the AI-Block “Direct”
- Set the channel within the AI block to 1 in order to choose flow value (see 3.5.1)
- Within the AI block, please set the units XD_SCALE and OUT_SCALE likewise to m3/h.
- Recommendation (not necessary): set 100%-value in XD-Scale and OUT-Scale to the Range value (Transducer-Block Index 39).
- All values in XD- and OUT_SCALE have to be adjusted identically.
- Set AI block to “Auto”.



Using automatic operation mode the channel 1 value (see above example: “50”) will automatically transferred through the AI block and then be displayed as OUT value “50”.

FIELD_VAL indicates the measurement in input-(XD)-scaling expressed in percent, in this case “50”.

Info: Both the 100% and the 0% values in the XD and OUT scale do not have to be identical with the real measuring ranges of the converter. Both values do in no way represent any limit. Using the AI block you can always enter measuring values differing from the indicated measuring range. E.g.: Taking the above example it would be feasible to enter a measuring value of 200 (m3/h) without having to fear difficulties during processing. FIELD_VAL would than amount to 200%.

Yet, it is recommended to adjust the AI scaling to the real measurement range. Thereto you have to either enter the Cal factor (TB index 38) or Range value (TB index 39). The 0% value is 0. In that case the FIELD_VAL will be indicated as a percentage of the real flow.

NOTE: Should alarms be used, the scaling of XD- and OUT_SCALE has to comply with the real measurement range.

4.8.2 Unit with L_TYPE=Indirect

Should within the AI block the L_TYPE (index 16) be set to „indirect“, a change of scale as to the measured within the AI block will be done. Using the XD_SCALE the channel value will be set to percent (= FIELD_VAL). Using the OUT_SCALE structure, the percent value will be scaled to OUT value. The XD scale unit has to be identical with the channel unit.

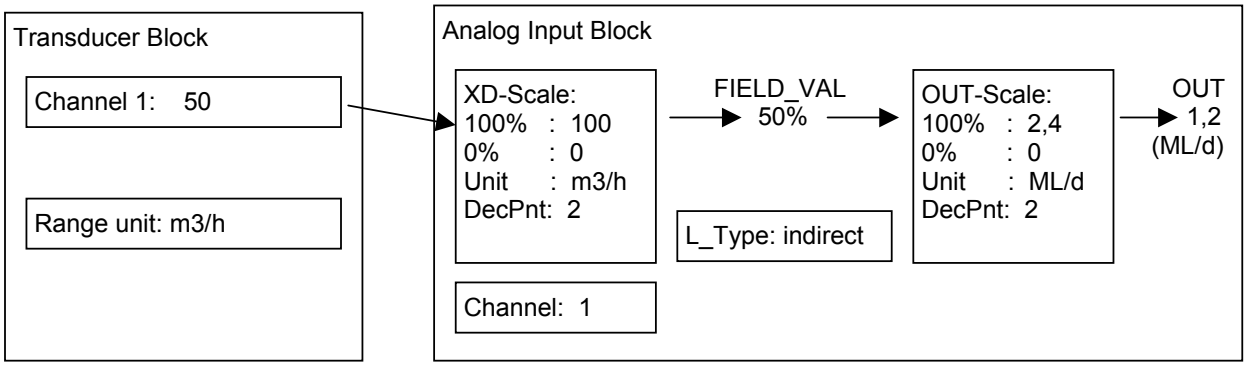
Thus a change of scaling to any suitable unit available with Foundation Fieldbus becomes feasible.

Example:

The flow value shall be displayed in ML/d (MegaLiter/Day. For this purpose, the conversion factor has to be known: 100 m3/h = 2400 m3/d = 2,400,000 L/d = 2.4 ML/d

Settings:

- Set “Range unit” (index 48) within transducer block to m3/h. Thus the channel 1 value will be displayed in this unit.
- Set L_TYPE within AI block to indirect.
- Set Channel within AI block to 1 as to choose flow value (see 3.5.1)
- Set XD-Scale within AI block to 0 to 100 m3/h. The unit has to comply with the channel unit
- Set OUT-scale within AI block to 0 to 2.4 ML/d.
- Set AI block to “auto"



Using the XD scaling, the channel 1 value („50“ in this example) will then be automatically set to 50(%)

Info: As is the case with L_TYPE = „direct“ the range of scaling does not necessarily have to be identical with the measurement range of the instrument. You could also scale the instrument to, say, 0-1000 m3/h to 0-24 ML/d or even 0-1 m3/h to 0-0.024 ML/d. The percent value FIELD_VAL would then differ considerably, depending on the scaling chosen.

Should you want the percent value FIELD_VAL to be displayed as a percent value off the real flow, the scaling range has to correspond to the real measurement range, i.e. to the Cal factor or Range value. Example:

Range = 6 m3/h = 6*0.024 ML/d = 0.144 ML/d

In this case you would have to enter 0-6 m3/h with XD_SCALE and 0-0.144 ML/d with OUT_SCALE. Then FIELD_VAL will show a percentage of Range, i.e. the real flow.

The alarm hysteresis ALARM_HYS (AI index 24) represents a percentage referring to OUT_SCALE.

Note: When using alarms OUT_SCALE has to correspond to the real measurement range.

Warning: **With L_TYPE „indirect“ the converter does not verify scaling and unit of OUT_SCALE**

It is feasible to choose any sensible or insensible units. The above example could for example also be scaled at 0-100 m3/h to 0-100 kg/h, which, under certain circumstances could well be

considered sensible. Yet, the scaling could also be set at 0-100 m3/h to 0-100 Celsius, which, of course, makes no sense at all.

There is always a risk of faulty scaling. You could, e.g., set a scaling of 0-100 ML/d, which would be incorrect.

This behaviour refers to the Foundation Fieldbus AI blocks. The operator takes the responsibility of correctly setting the scale.

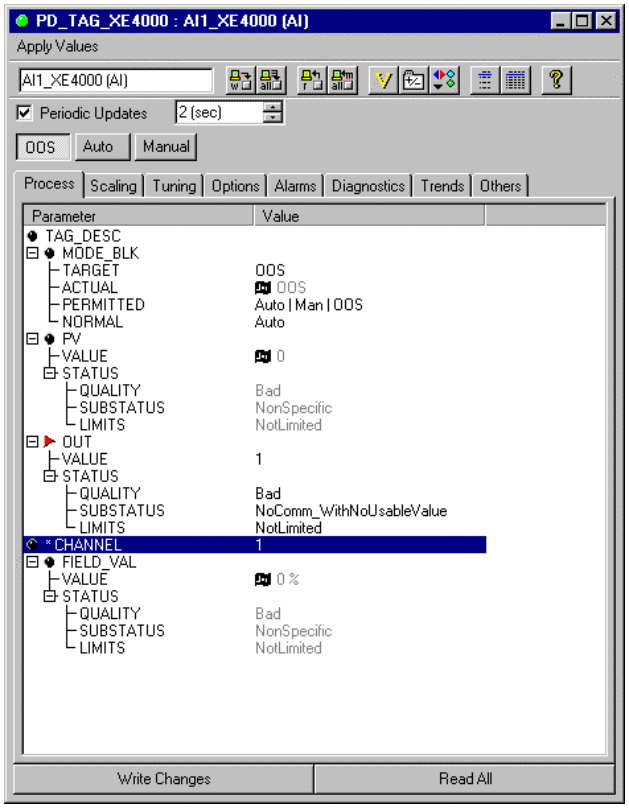
4.8.3 Summary, AI block settings

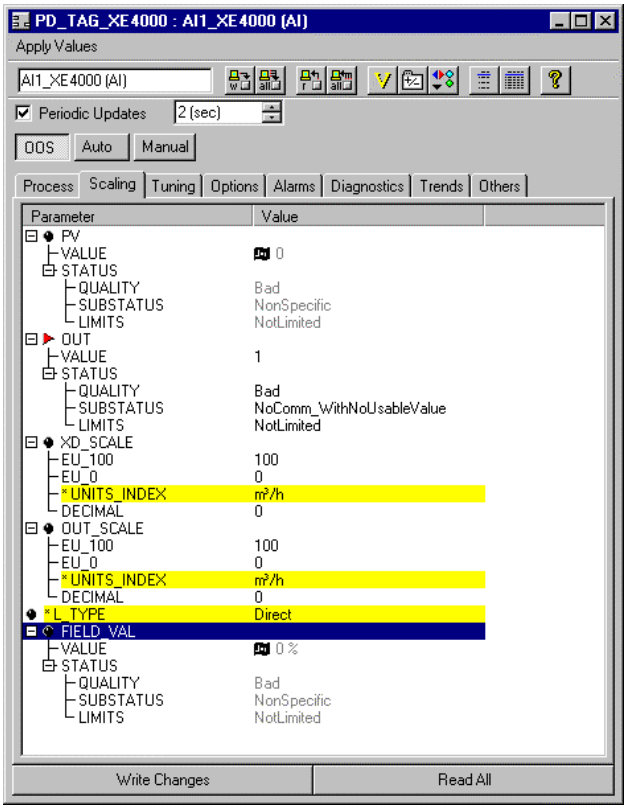
Minimum settings:

- Valid channel
- L_TYPE: direct or indirect
- XD_SCALE
- OUT_SCALE

It is recommended to work with L_TYPE direct in order to avoid errors during change of scaling.

The following pictures show the settings at the National Instruments© NI-FBUS Configurator:





4.9 PID Block

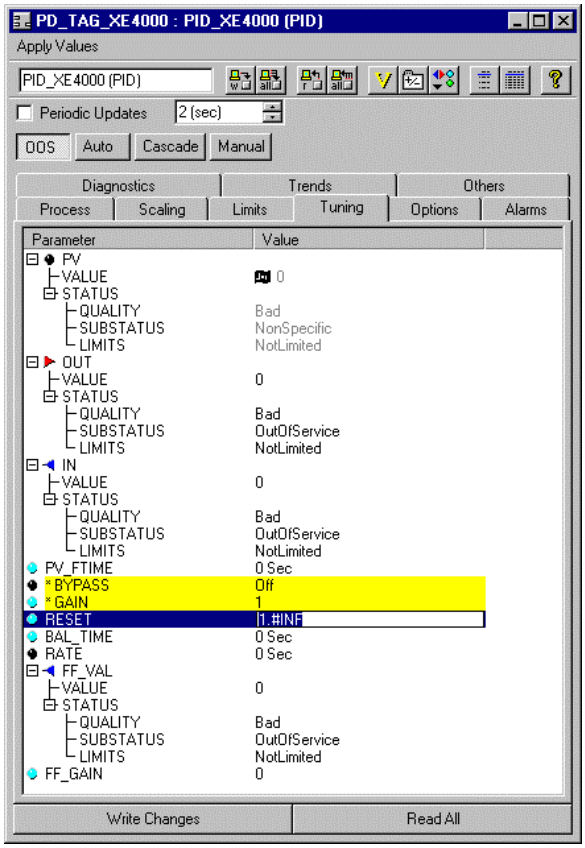
Following parameters have to set to be able to switch the PID block to AUTO mode:

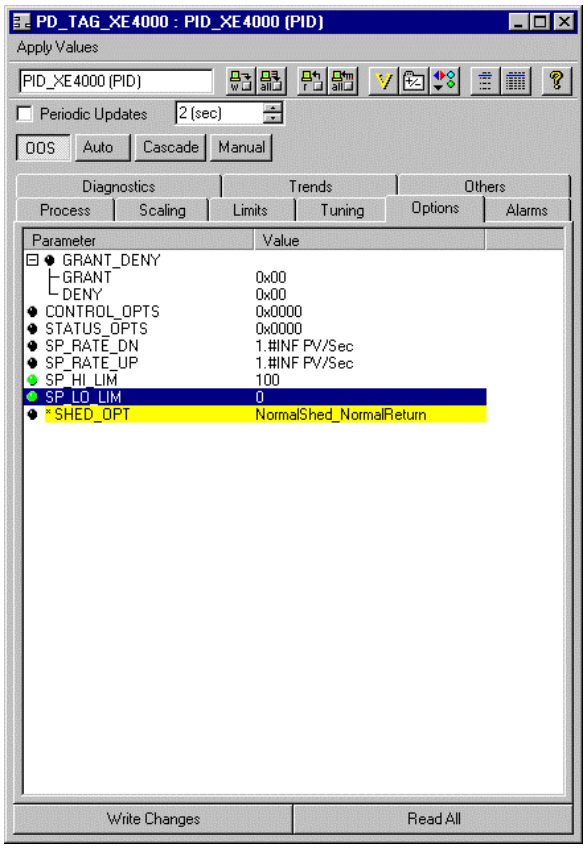
Bypass:	Recommended: Off
Shed_Opt:	Recommended: NormalShed_NormalReturn
Gain:	As required by application
SP:	As required by application

Also recommended to set:

PV_SCALE	Scaling of process variable at input IN
OUT_SCALE	Scaling of output value OUT.
RESET	Time constant for integral control.
RATE	Time constant for derivate control.

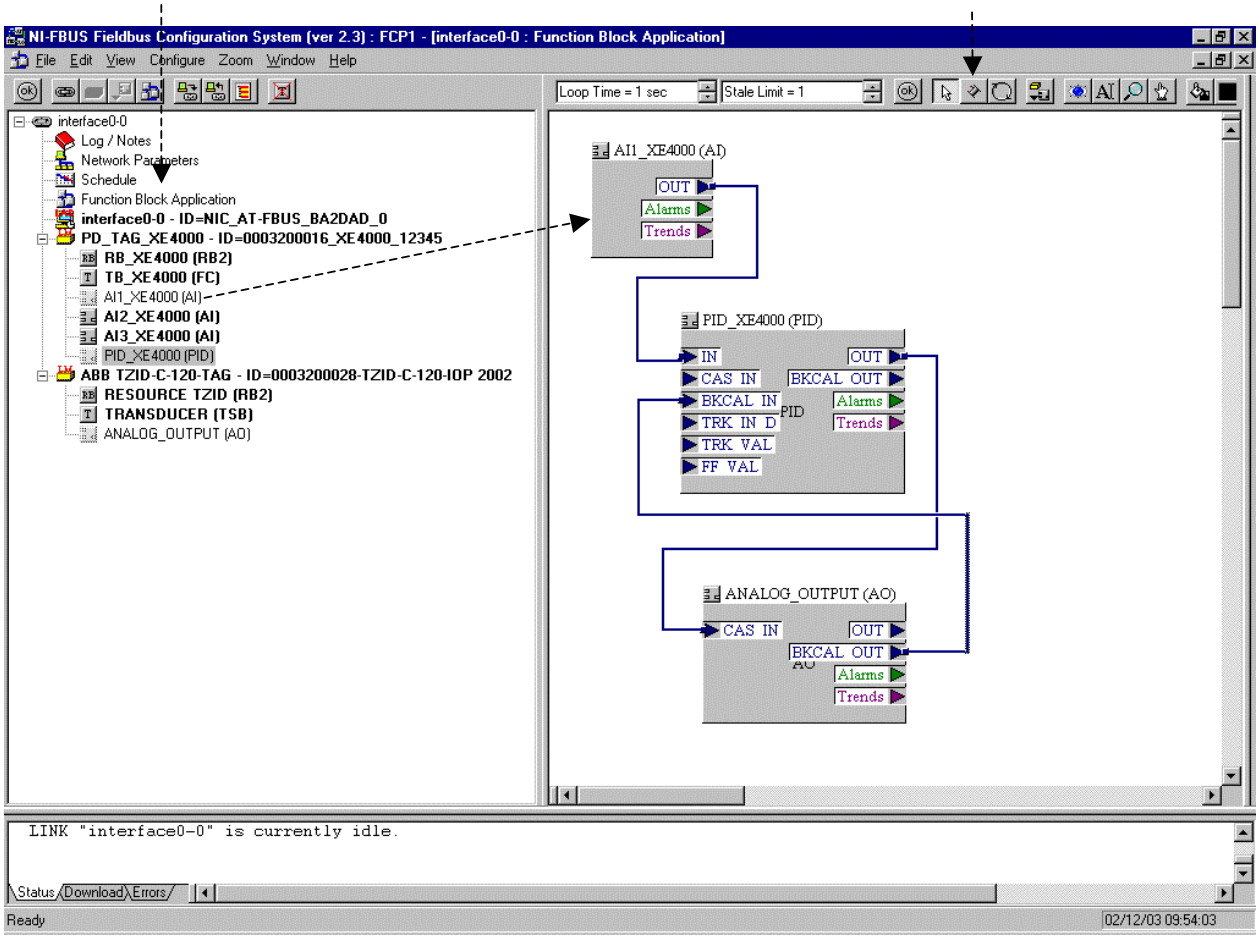
The following pictures show some of the settings at the National Instruments© NI-FBUS Configurator:





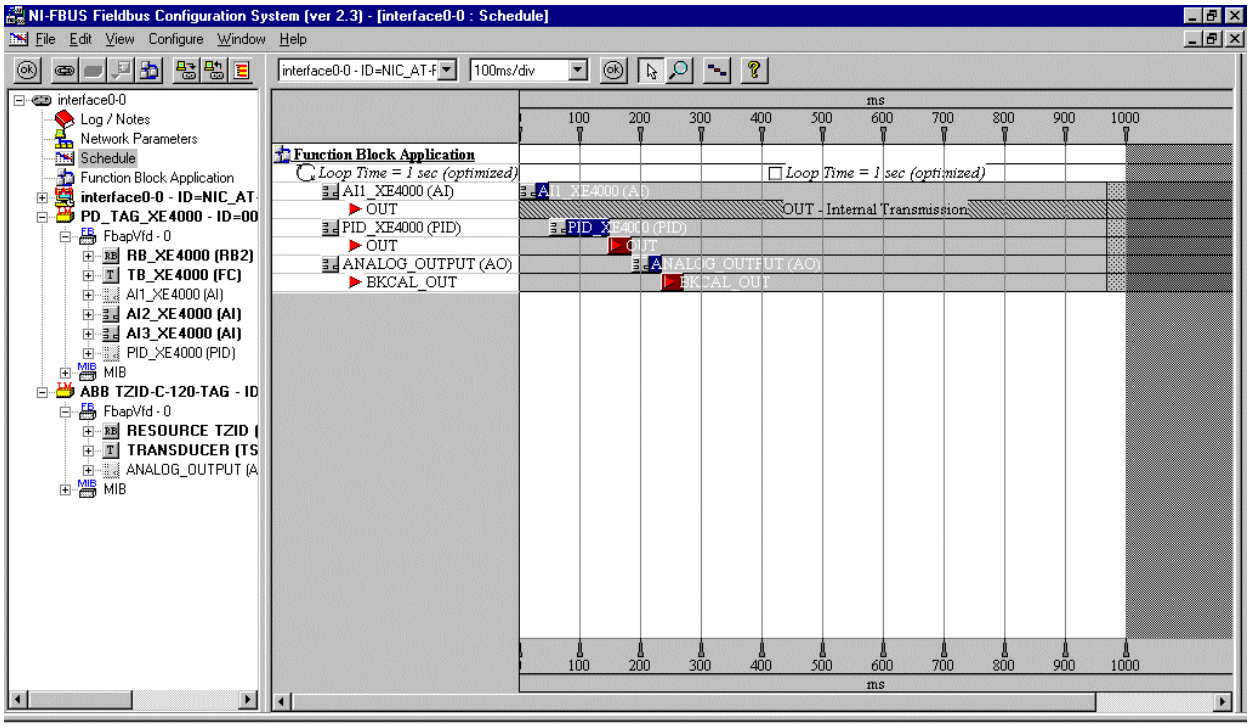
4.10 Function Block Application

A function block application must be created. Therefore open the function application window block by mouse double click. Then pull the required function blocks with the mouse into this window and connect the blocks with the wiring tool.



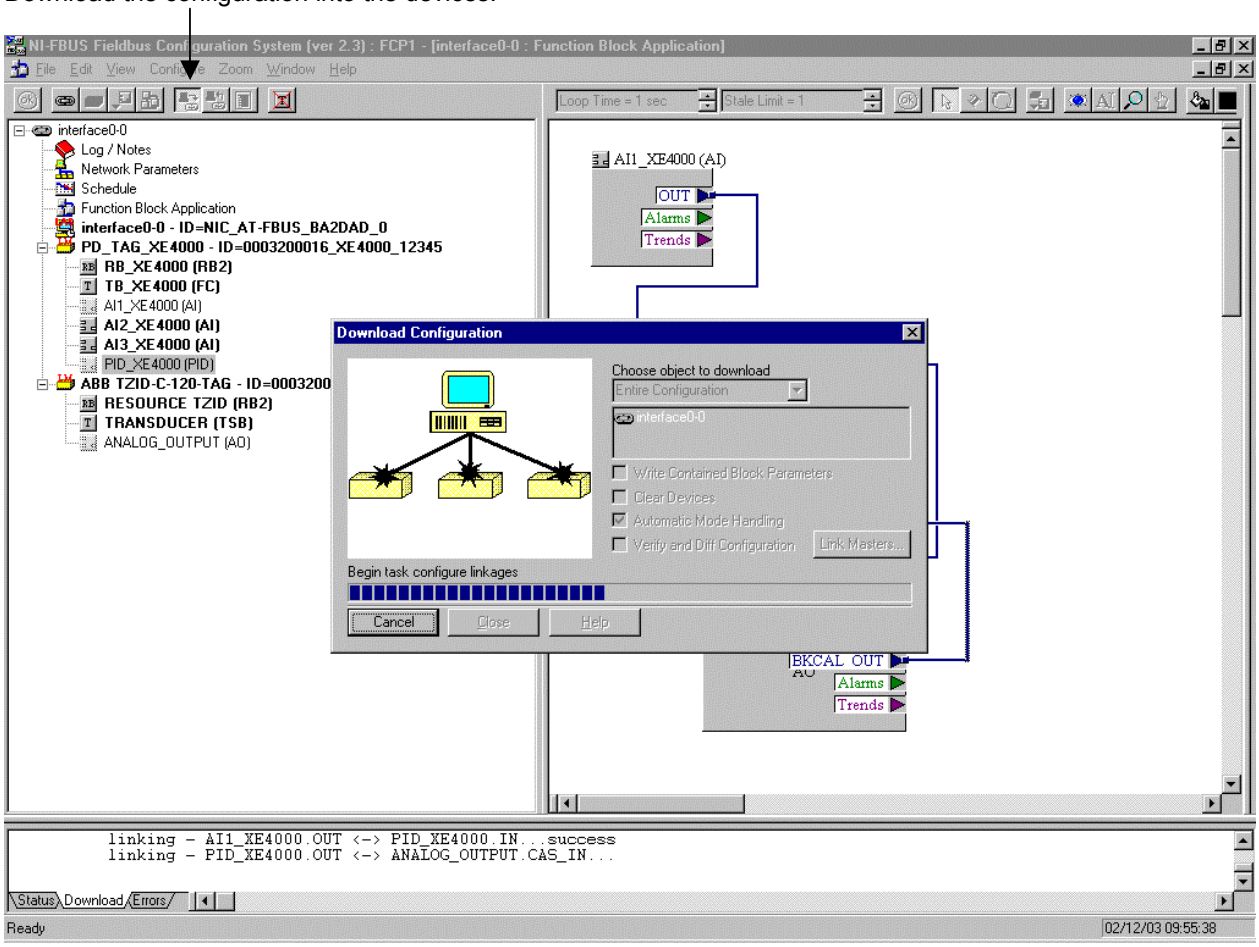
4.11 Schedule

The schedule window shows the timing of the function block application. This will be created automatically by the NI Configurator.



4.12 Downlod Project

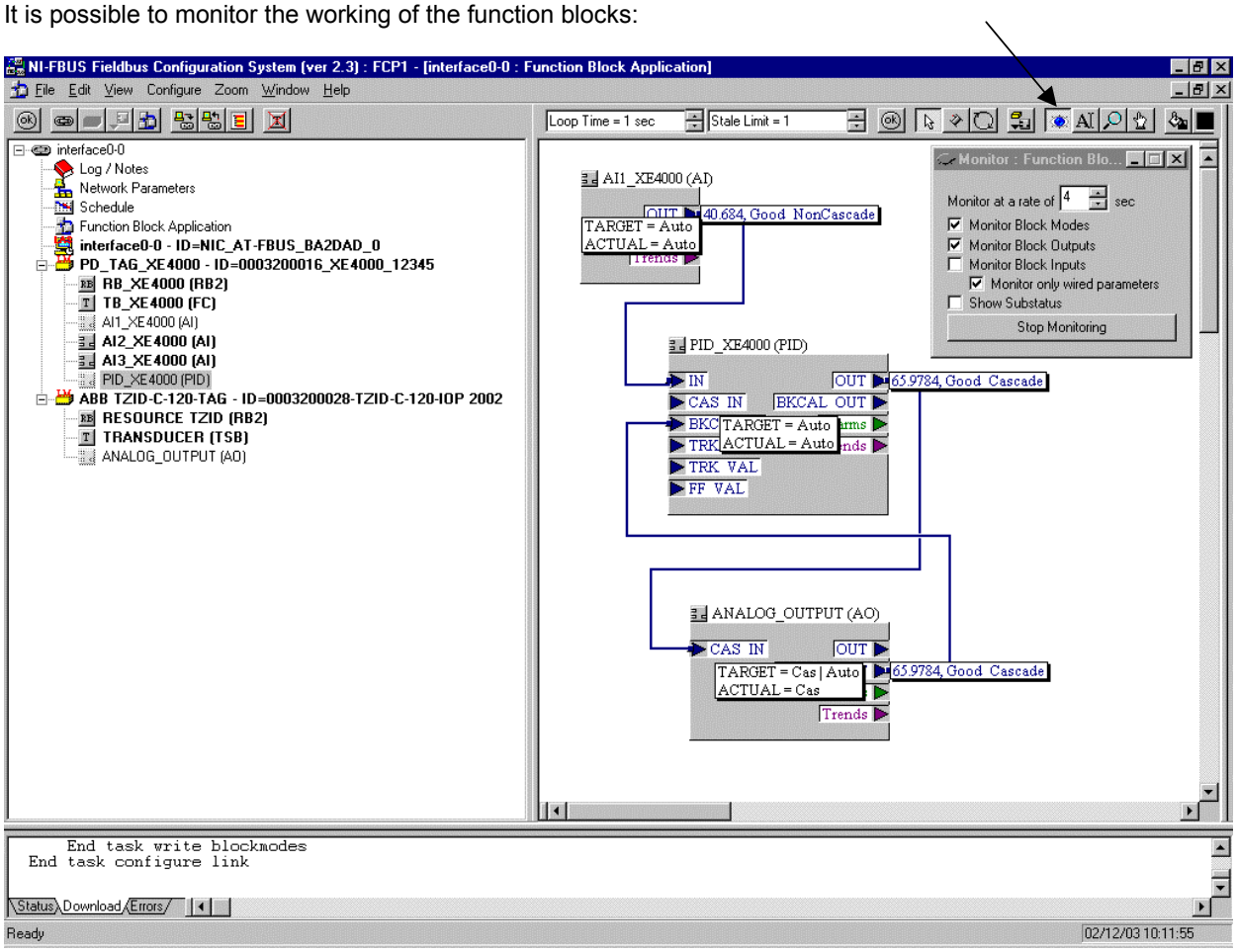
Download the configuration into the devices.



If everything is set and configured correctly, then the function blocks will be in AUTO mode.

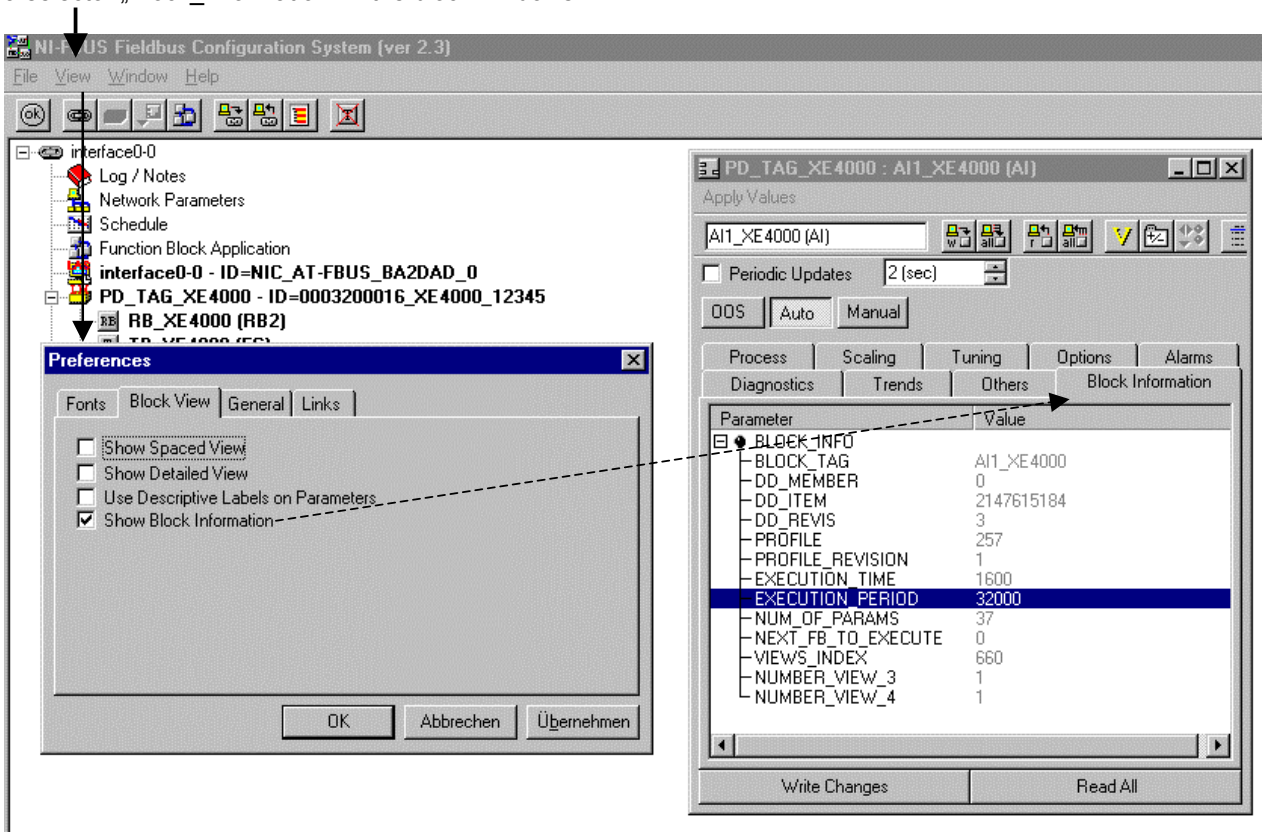
4.13 Monitor Function blocks

It is possible to monitor the working of the function blocks:



4.14 PERIOD_OF_EXECUTION

Go to the NI-Configurator menu „View – Preferences" and activate "Show Block Information". Then you will see a selector „Block_Information" in the block windows:



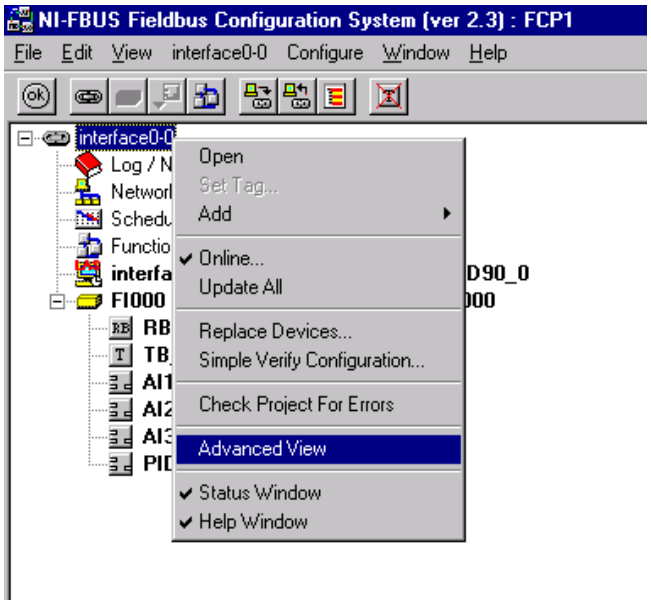
The NI Configurator parameter EXECUTION_PERIOD is called PERIOD_OF_EXECUTION in the FF specifications. This parameter determines the period of function block execution, the time base is 1/32 msec.

The default value is 0. After downloading a configuration the the configured schedule time is displayed, for example 32000 = 32000 / 32 ms = 1000ms (see 4.11, Schedule: Loop Time 1sek).

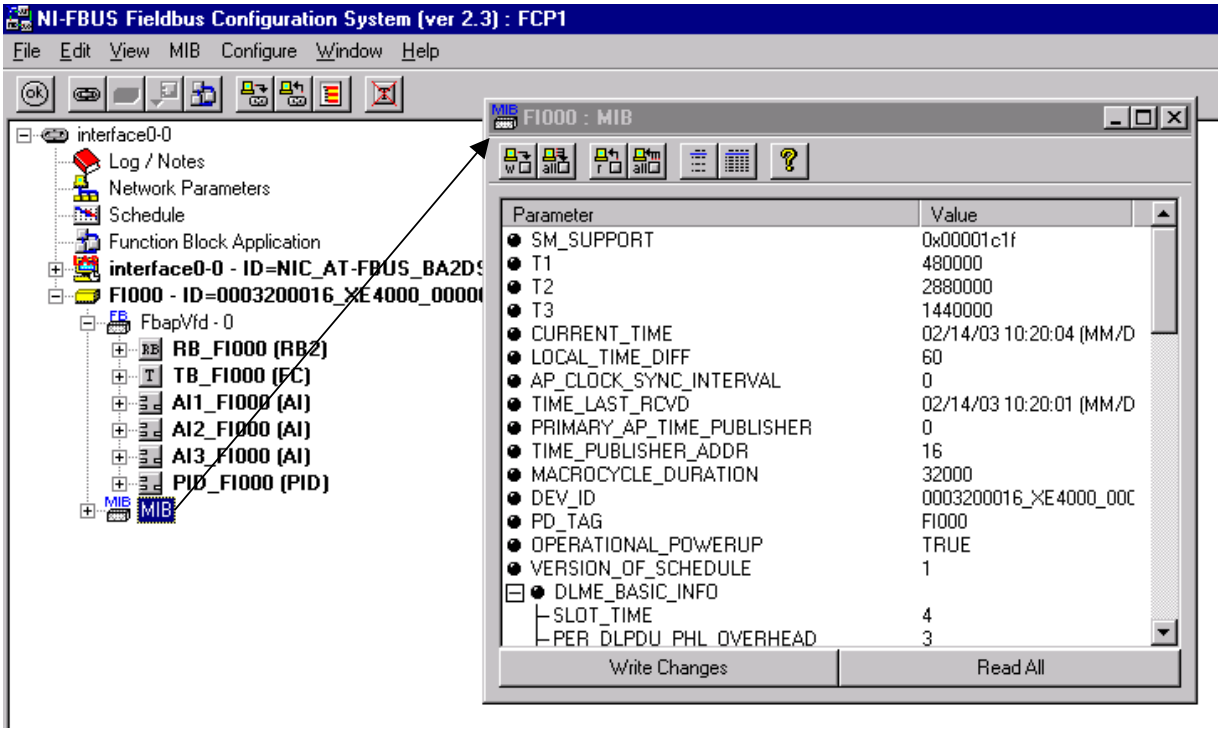
As long as PERIOD_OF_EXECUTION is 0 it is not possible to switch the function block to AUTO mode.

4.15 MIB

The Management Information Base (MIB) contains necessary parameters for the fieldbus system- and network-management. Click with the right mouse button on „interface“ and select “Advanced View“ to make the MIB visible.

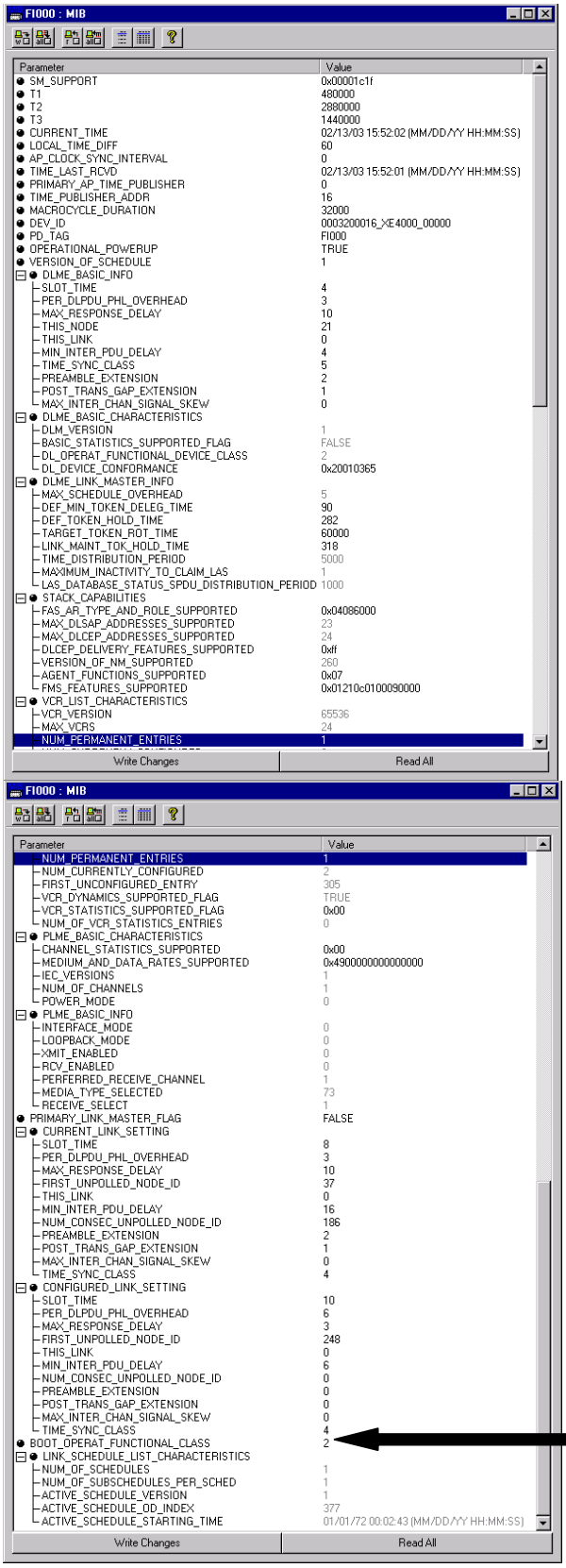


Open the MIB window by a mouse double click on MIB.

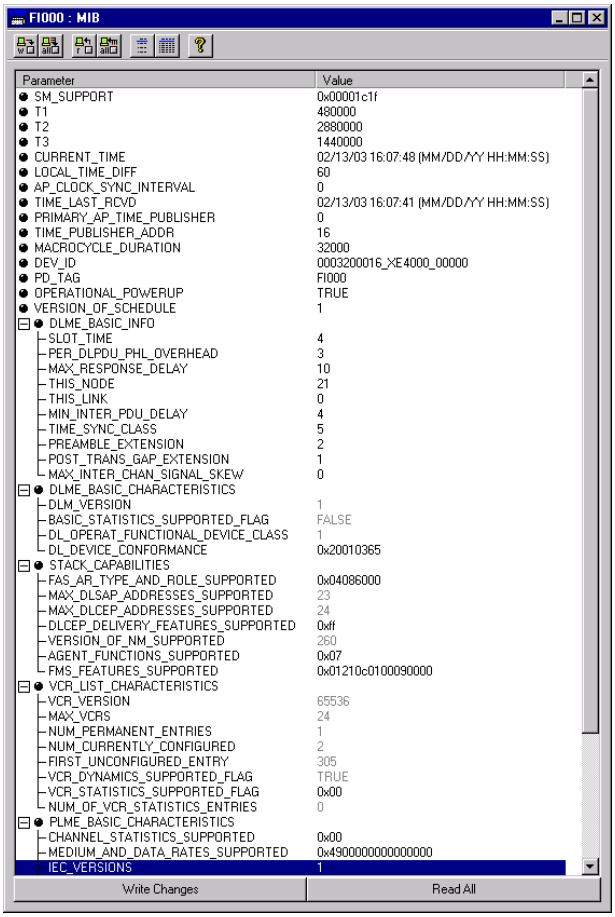


The content of the MIB is dependant from LAS activated or not which means the device is a Link master device (LAS = Link active schedule activated) or Basic field device.

MIB with LAS



MIB without LAS



BOOT_OPERAT_FUNCTIONAL_CLASS:
1 = Basic Field Device (without LAS)
2 = Link Master Device (with LAS)

4.16 Switch off LAS

To deactivate LAS write 1 into the MIB parameter Boot_Operat_Functional_Class. Make a restart of the device. Only after restart the device operates with the new function of Boot_Operat_Functional_Class. Restart can be done by

- Switching power supply off and on
- Writing value „Restart Processor“ into parameter RESTART in Resource Block.

4.17 Switch on LAS

NI Configurator version 2.3.6 has a command to switch LAS on and off. Configurator version 2.3 doesn't have this command. There it is possible to switch on LAS with the program „NI Dialog System“:

- Start NI Dialog System.
- Click with right mouse button on “Open Descriptors“ and select “Expand All“.
- Click with right mouse button on Device of FXE4000 and select “OpenVFD“.
- Type in “MIB” and click on “OpenVFD“.
- Click with right mouse button on “MIB“ and select “Write Object”.
- Choose “Write by Index”, type in 370 (= index of Boot_Operat_Functional_Class) and click on “Edit Data”.
- The actual value from the device will be read and shown.
- Change value to 2 (= Link master device) and click on “Write”.
- After result “Call completed successfully” writing has finished..
- Make a Restart.

4.18 Local display on flowmeter

It is possible to check some AI block parameters on the local display of the device. Therefore select the following parameters to be shown on the display (TB index 66 … 69, or in submenu “Display” on local display).

15: Channel, Mode, Status
16: Value, Unit

4.18.1 Channel, Mode, Status

The actual mode and status of OUT will be shown for all three AI blocks (AI1, AI2, AI3).

```
AI1 OOS Bad 0
```

The number behind the status shows the substatus (coding of substatus see 3.7).
Example: BAD 0 means status is BAD, substatus is 0 = non specific.

4.18.2 Value, Unit

The OUT value and the OUT unit (in OUT_SCALE structure) will be shown for all three AI blocks.

```
AI1  123,45 l/s
```

4.19 Error searching

4.19.1 Writing Parameter

The following error messages may appear while writing a parameter within the NI Configurator:

Write is prohibited (Error code 40)

1. Check whether the write protect switch is deactivated (see 1.1). This can be checked at the device (switch position) or using the WRITE_LOCK parameter (to be found within the NI Configurator in the resource block window below the strap “options”).
2. The respective parameter can (with current configuration) not be written. See description of respective parameter.

Wrong Mode for Request (Error code 39)

Some parameters can merely be written if the target mode is set to „Out of Service“. Other parameters can also be written in “Man” and still others can be written in each of the target modes. For more detailed information, see block description.

Exceed Limit (Error code 38)

It was attempted to write a value exceeding the permitted limits of a parameter. Refer to the parameter description to learn which limits and values respectively are permitted.

4.19.2 AI Block cannot be set to AUTO

The Auto mode of an AI block requires the following :

1. The resource block has to be set to auto. No other pre-conditions.
2. Within the AI block a valid channel has to be entered (1-3).
3. L_Type has to be set to direct or indirect (indirect square root is likewise possible, yet not sensible).
4. XD-SCALE unit has to be idential with channel unit (see also 3.5.1).
5. With L_Type „Direct the XD_SCALE and OUT_SCALE structures have to be identical.
6. The PERIOD_OF_EXECUTION of the AI block has to be of a value other than 0.

Should these conditions be met and the target mode be set to auto, the actual mode and thus the block itself will be set to auto.

Whether these conditions are met or not can be taken from the parameter BLOCK_ERR (within the NI Configurator in the AI window below the strap diagnostics). Should the Block Configuration Error appear, please check which of the above mentioned conditions has not been met.

4.19.3 PID Block cannot be set to AUTO

The Auto mode of a PID block requires the following :

1. The resource block has to be set to auto. No other pre-conditions.
2. Bypass must not be set to default value „uninitialized“.
3. Shed_Opt must not be set to default value „uninitialized“.
4. Gain and SP have to be set.
5. The PERIOD_OF_EXECUTION of the PID block has to be of a value other than 0

PID actual mode remains in mode IMan:

Check the function block behind the PID and check the back calculation path and value.

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