Data Link Description
D184B093U36

Mass Flowmeter
CoriolisMaster FCM2000
FOUNDATION Fieldbus

Valid for Software Levels from A10
D699G001U03 A.10

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FOUNDATION Fieldbus

Data Link Description

D184B093U36

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1. Hardware

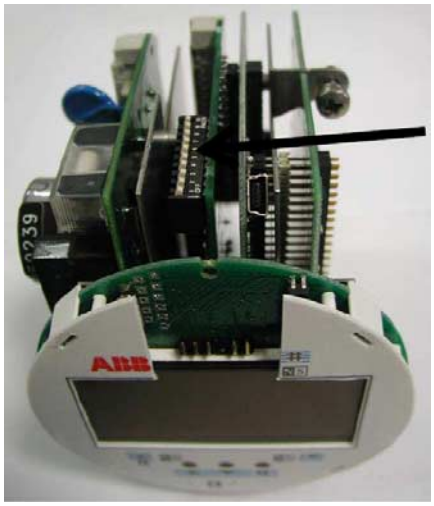
The FF bus interface has the following data:

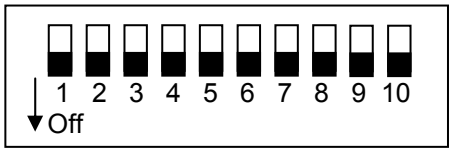
U = 9 – 32 V
I = 14 mA (normal operation)
I_{max} = 26 mA (maximum fault current)

1.1 Hardware switch

Inside of the electronic is a 10 times switch. The switches can be set or reset, when the converter housing is open. Take care to security instructions in the manual when opening the housing!

The switch setting can be checked on the local display of the device in the submenu data link, menu dip switch (refer to 5.2.3). It can also be read over FF communication in the Transducer block (index 90)





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

The switch position will also be 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. An AB-Block-Simulation is switched on or off within the parameter “Simulate“ (structure on index 9 of AI-block)

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

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

Enabling Write Protection prevents writing of block parameters.

The Switches 3 to 10 have no function.

Factory setting: all switches off

2. Block-Overview

The device contains the following FF-Blocks:

1 x Resource Block

6 x AI Block (Analog Input)

2 x Integrator Block

1 x PID Block

1 x Transducer Block

The Resource, AI-, Integrator- and PID-blocks are standard FF blocks.
The transducer block is a custom block. The parameters up to the relevant index 29 correspond to the "Standard Flow with Calibration" block of the FF specification FF-903-PS 3.0. The following parameters are instrument specific.

2.1 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 2.7.

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 para-meters ST_REV remains unchanged.
- D = Dynamic Parameter will be lost during powering off.

Write: Parameter can partially merely 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 setting of the parameters.
The parameter RESTART (Index 16 within Resource Block), selection „Restart with defaults", allows resetting of the parameters to default values.

2.2 Resource Block

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

2.2.1 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	0x18 = FCM2000	Manufacturer's model name of the device.
12	DEV_REV	Unsigned 8	1	S	Read only	1	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
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.

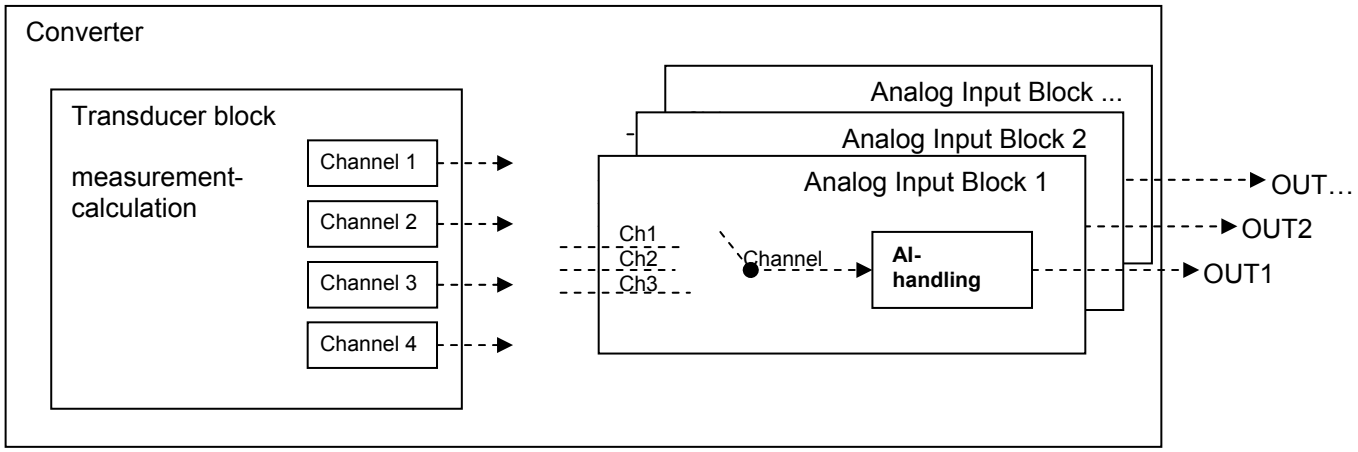
Relative Index	Parameter Name	Data Type	Size	Storage Type	Write in Target-Mode	Default Values	Description
26	SHED_RCAS	Unsigned 32	4	S	OOS,Auto	640000	Timeout time for connections to PLC or DCS in operation mode RCas.
27	SHED_ROUT	Unsigned 32	4	S	OOS,Auto	640000	Timeout time for connections to PLC or 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	-	5	Version of the Interoperability Test Kit used to test the device.

2.2.2 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

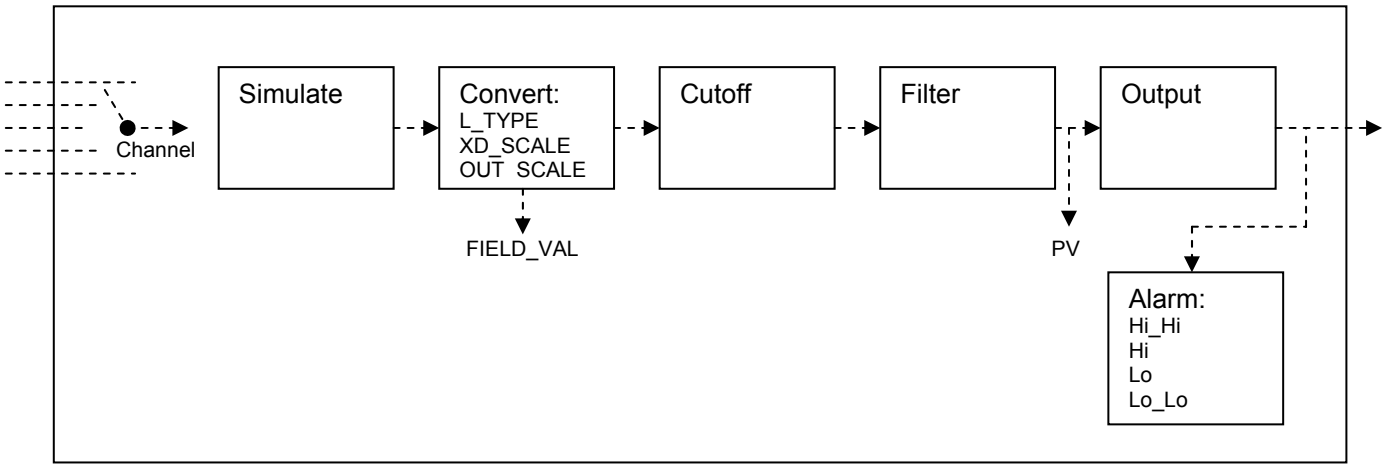
2.3 Analog Input Block

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 converter disposes of six AI blocks.



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

2.3.1 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 2.7.11). 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 only 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 2.7.4) 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 alarm will be entered into a structure …_ALM (index 33 to 36).

2.3.2 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.

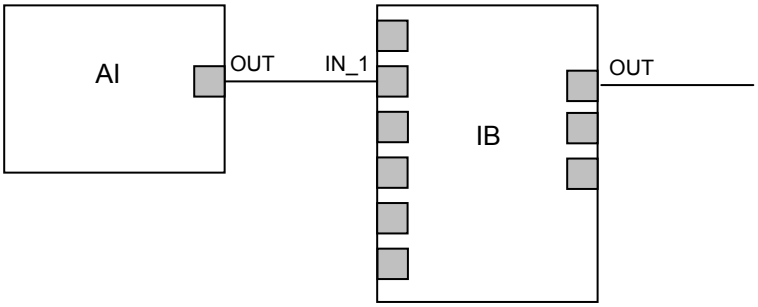
INV = Infinite number

2.3.3 Analog Input Block Parameter, sorted according to names

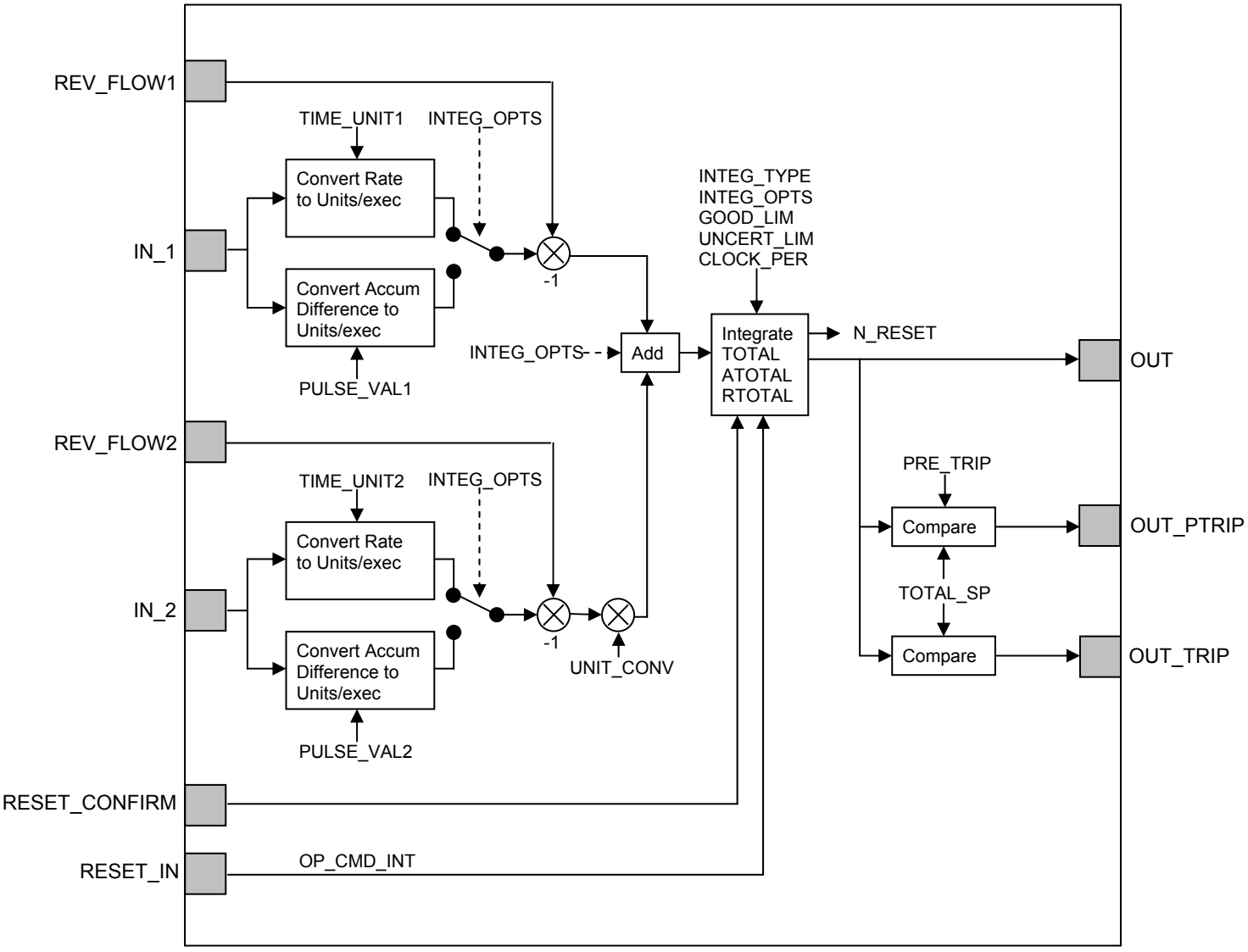
Parameter Name	Relative Index
ACK_OPTION	23
ALARM_HYS	24
ALARM_SUM	22
ALERT_KEY	4
BLOCK_ALM	21
BLOCK_ERR	6
CHANNEL	15
FIELD_VAL	19
GRANT_DENY	12
HI_ALM	34
HI_HI_ALM	33
HI_HI_LIM	26
HI_HI_PRI	25
HI_LIM	28
HI_PRI	27
IO_OPTS	13
L_TYPE	16
LO_ALM	35
LO_LIM	30
LO_LO_ALM	36
LO_LO_LIM	32
LO_LO_PRI	31
LO_PRI	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

2.4 Integrator Block

The integrator block (IB) accumulates the flow values to totalizer values. An analog input block (AI) gets it input from the transducer block block (refer to 2.3). The integrator block can't get values from the transducer block. He can only get input values from other function blocks.



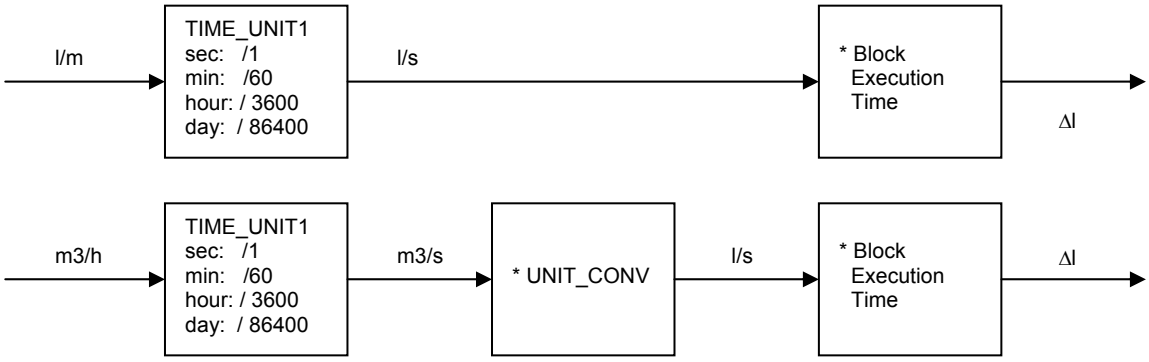
2.4.1 Integrator Block Diagramm



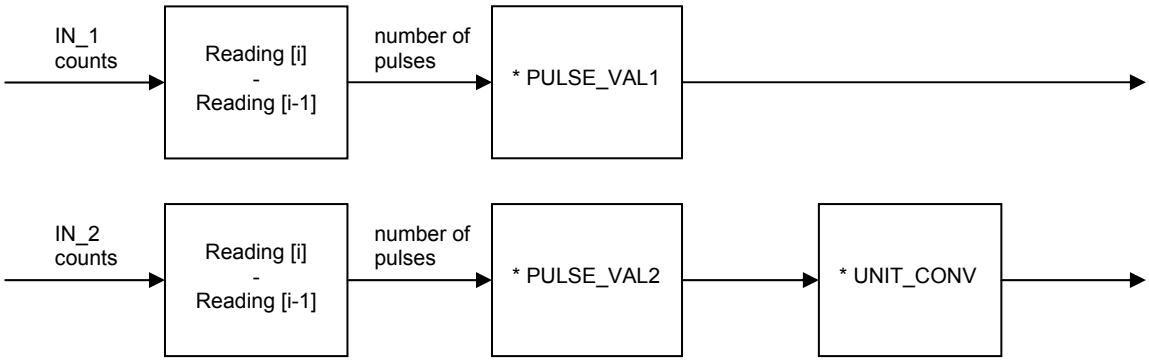
The integrator function block has two inputs IN_1 and IN_2 for flow values. The inputs can work with “Rate” values (for example coming from an analog input block) or with “Accum” values (coming from a pulse input block).

For „Rate“ flow values it is necessary to scale their time base (/s, /m, /h, /d) to the block internal time base /s. This is done with the parameters TIME_UNIT1 and TIME_UNIT2. Input 2 can have a different volume or mass unit than input 1. In this case it is necessary to scale the input 2 unit to the input 1 unit. This is done with the parameter UNIT_CONV. The flow in /s is multiplied with the block execution time to get the delta totalizer value per execution.

Example:



For „Accum“ values the following calculation is done:



The number of pulses per execution is the difference from the actual pulse reading [i] and the pulse reading before [i-1]. A scaling from pulses to units is done by a multiplication with PULSE_VAL1 and PULSE_VAL2. Because both paths can have different units UNIT_CONV can scale the path 2 unit to the path 1 unit.

REV_FLOW1 and REV_FLOW2 (Reverse Flow) can change the sign of the value (+ / -).

The delta-totalizer values of path 1 and path 2 are added. The sum is added to TOTAL, ATOTAL and RTOTAL according to following rules:

- TOTAL = Every value, independent from status, is added with sign.
- ATOTAL = Every value, independent from status, is added as absolute value.
- RTOTAL = Only values with status BAD or UNCERTAIN (depending from INTEG_OPTS settings) are added as absolute value.

TOTAL and ATOTAL are internal values inside the totalizer block. They are not in the list of block parameters. TOTAL is available as OUT parameter (index 8).

N_RESET is counting the number of resets. This value goes up to 999999. Then an overflow happens to 0.

The integrator block has some functions for batch mode. TOTAL_SP is the setpoint for the batch mode. The totalizer can count up or down.

- At up counting the output OUT_TRIP is set, when TOTAL is equal or greater TOTAL_SP.
- At down counting the start point for TOTAL is TOTAL_SP. When TOTAL reaches zero output OUT_TRIP is set.

The batch mode has a second output OUT_PTRIP, which is set depending from the value PRE_TRIP.

- At counting up PRE_TRIP is set, when TOTAL is equal or greater (TOTAL_SP – PRE_TRIP).
- At counting down PRE_TRIP is set, when TOTAL is equal or smaller than PRE_TRIP.

2.4.2 Integrator Block Parameter, sorted according to 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 the static parameters. The counter is incremented each time the static parameter is changed.
2	TAG_DESC	Octet String	32	S	OOS, Man, Auto	Leerzeichen	The user description of the intended application of the block.
3	STRATEGY	Unsigned 16	2	S	OOS, Man, 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, Man, 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, 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	Read only	0	This parameter contains a summary of the block alarms.
7	TOTAL_SP	Float	4	S	OOS, Man, Auto	0	TOTAL_SP is the setpoint for batch mode.
8	OUT	DS-65	5	D	OOS, Man	0.0	This is the output value of the integrator block. It is equal to the TOTAL value.
9	OUT_RANGE	DS-68	11	S	OOS, Man, Auto	0-100%	This structure defines display scaling for the output of the block. It is not used inside the block.
10	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.
11	STATUS_OPTS	Bit String	2	S	OOS	0	Options which the user may select in the block processing of its status.
12	IN_1	DS-65	5	N	OOS, Man, Auto	0.0	Input value 1 of the block.
13	IN_2	DS-65	5	N	OOS, Man, Auto	0.0	Input value 2 of the block.
14	OUT_TRIP	DS-66	2	N	OOS, Man, Auto	0	An output value of the block used in batch mode. At up counting OUT_TRIP is set, when: OUT ≥ TOTAL_SP At down counting OUT_TRIP is set, when: OUT reaches zero. 0: off 1: on
15	OUT_PTRIP	DS-66	2	N	OOS, Man, Auto	0	Another output value of the block used in batch mode. At up counting OUT_PTRIP is set, when: OUT ≥ (TOTAL_SP – PRE_TRIP) At down counting OUT_TRIP is set, when: OUT ≤ PRE_TRIP 0: off 1: on
16	TIME_UNIT1	Unsigned 8	1	S	OOS, Man	0	TIME_UNIT1 converts the time base of IN_1 to seconds. 0: seconds 1: minutes 2: hours 3: days
17	TIME_UNIT2	Unsigned 8	1	S	OOS, Man	0	TIME_UNIT1 converts the time base of IN_2 to seconds. 0: seconds 1: minutes 2: hours 3: days

Index	Parameter Name	Data Type	Size	Storage Type	Write in Target-Mode	Default Values	Description
18	UNIT_CONV	Float	4	S	OOS, Man, Auto	1.0	UNIT_CONV converts the IN_2 unit to IN_1 unit. Valid range: greater zero.
19	PULSE_VAL1	Float	4	S	OOS, Man	0.0	PULSE_VAL1 is the volume or mass of one pulse on input IN_1. Valid range: Zero or greater.
20	PULSE_VAL2	Float	4	S	OOS, Man	0.0	PULSE_VAL2 is the volume or mass of one pulse on input IN_2. Valid range: Zero or greater.
21	REV_FLOW1	DS-66	2	N	OOS, Man, Auto	0	This input variable of the integrator block can change the sign of the flow value in path 1. 0: Forward 1: Reverse
22	REV_FLOW2	DS-66	2	N	OOS, Man, Auto	0	This input variable of the integrator block can change the sign of the flow value in path 2. 0: Forward 1: Reverse
23	RESET_IN	DS-66	2	N	OOS, Man, Auto	0	This input variable of the integrator block makes a reset of the totalizers. 0: Off 1: Reset
24	STOTAL	Float	4	S	read only		STOTAL is a copy of TOTAL just before a reset.
25	RTOTAL	Float	4	S	OOS, Man		RTOTAL counts only values with status BAD or UNCERTAIN (depending from INTEG_OPTS settings) as absolute value.
26	SRTOTAL	Float	4	S	read only		SRTOTAL is a copy of RTOTAL just before a reset.
27	SSP	Float	4	S	read only	0.0	SSP is a copy of TOTAL_SP just before a reset.
28	INTEG_TYPE	Unsigned 8	1	S	OOS, Man, Auto	0	INTEG_TYPE determines the behaviour of the counting: 1: Up Auto Counts up with automatic reset when TOTAL_SP is reached. 2: Up Demand Counts up with demand reset. 3: Dn Auto Counts down with automatic reset when zero is reached. 4: Dn Demand Counts down with demand reset. 5: Periodic Counts up and reset periodicaly according to CLOCK_PER. 6: Demand Counts up and reset on demand. 7: Per & Dem Counts up and reset periodically or on demand.
29	INTEG_OPTS	Bit String	2	S	OOS, Man, Auto	0	INTEG_TYPE determines the behaviour of the integrator block: Bit 0: Input 1 accumulate Bit 1: Input 2 accumulate Bit 2: Flow forward Bit 3: Flow reverse Bit 4: Use uncertain Bit 5: Use Bad Bit 6: Carry Bit 7: Add zero if bad Bit 8: Confirm reset Bit 9: Generate reset event Bit 10–15: Reserved
30	CLOCK_PER	Float	4	S	OOS, Man, Auto	0.0	This is the period for periodically resets. Valid range: Zero or greater. Unit: Seconds.
31	PRE_TRIP	Float	4	S	OOS, Man, Auto	0.0	PRE_TRIP helps to adjust the volume or mass in batch mode (refer to OUT_PTRIP).
32	N_RESET	Float	4	S	read only	0.0	This is the number of resets. It counts up to 999999 and then overflows to 0.

Index	Parameter Name	Data Type	Size	Storage Type	Write in Target-Mode	Default Values	Description
33	PCT_INCL	Float	4	D	read only		This is the percent ratio of input values with GOOD status compared to values with BAD or UNCERTAIN status. The calculation is: 100 * (1- RTOTAL / ATOTAL)
34	GOOD_LIM	Float	4	S	OOS, Man, Auto	0.0	GOOD_LIM is a limit for PCT_INCL. For PCT_INCL values below this limit OUT gets the status GOOD. Valid range: 0 to 100% Unit: %
35	UNCERT_LIM	Float	4	S	OOS, Man, Auto	0.0	UNCERT_LIM is a limit for PCT_INCL. For PCT_INCL values below this limit OUT gets the status UNCERTAIN. Valid range: 0 to 100% Unit: %
36	OP_CMD_INT	Unsigned 8	1	D	OOS, Man, Auto		A reset can be done with the block input parameter RESET_IN or with this parameter OP_CMD_INT. 0: Off 1: Reset
37	OUTAGE_LIM	Float	4	S	OOS, Man, Auto	0.0	Valid range: Zero or greater: Unit: Seconds
38	RESET_CONFIRM	DS-66	2	N	OOS, Man, Auto	0	RESET_CONFIRM is a block input parameter. Refer to Bit 8 in INTEG_OPTS. 0: Off 1: Confirm
39	UPDATE_EVT	DS-73	14	D	Read only		This alert is generated by any change to the static data.
40	BLOCK_ALM	DS-72	13	D	OOS, Man, Auto		Indicates the alarms related to the block.

2.4.3 Intregrator Block Parameter, sorted according to names

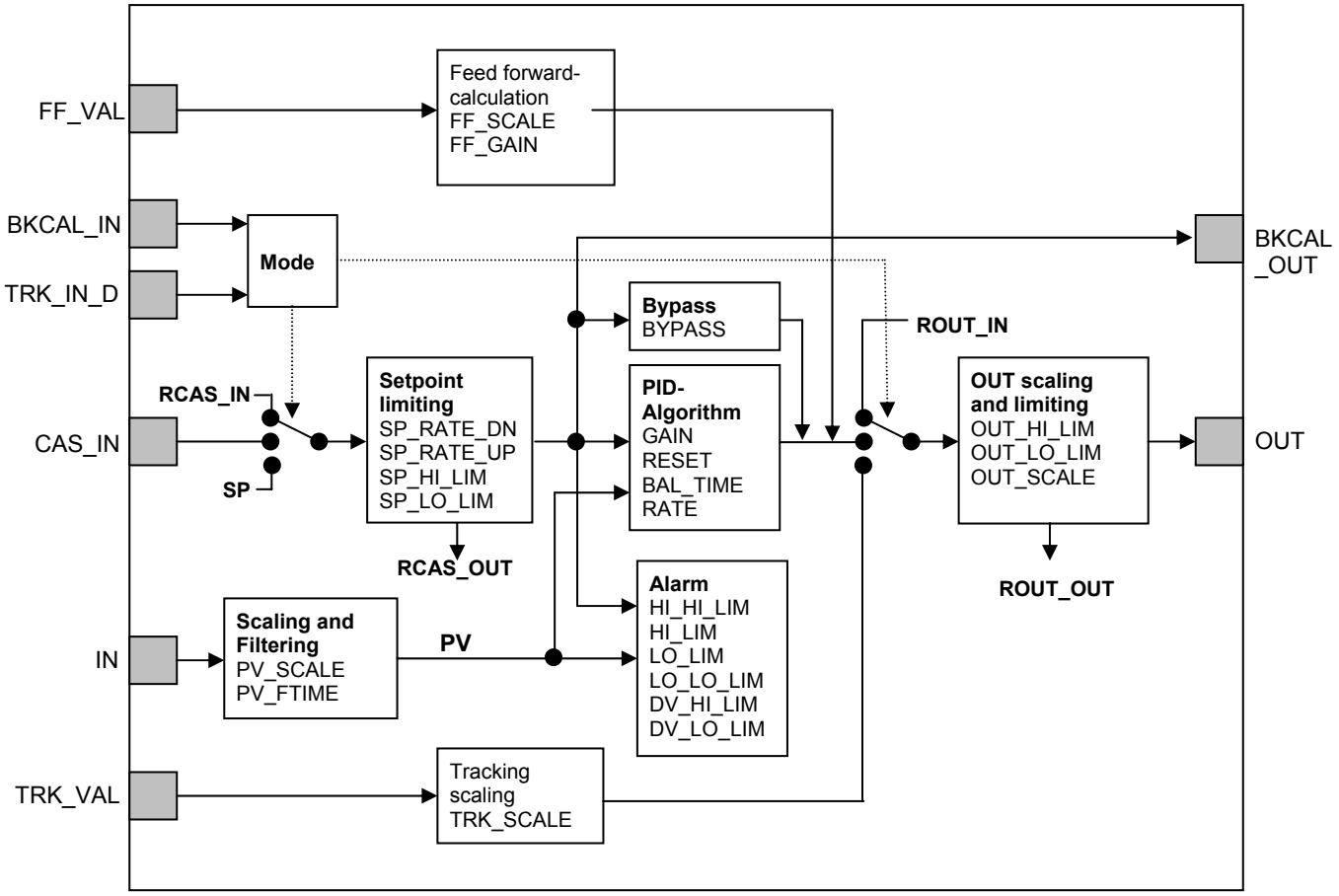
Parameter Name	Index
ALERT_KEY	4
BLOCK_ALM	40
BLOCK_ERR	6
CLOCK_PER	30
GOOD_LIM	34
GRANT_DENY	10
IN_1	12
IN_2	13
INTEG_OPTS	29
INTEG_TYPE	28
MODE_BLK	5
N_RESET	32
OP_CMD_INT	36
OUT	8
OUT_PTRIP	15
OUT_RANGE	9
OUT_TRIP	14
OUTAGE_LIM	37
PCT_INCL	33
PRE_TRIP	31
PULSE_VAL1	19
PULSE_VAL2	20
RESET_CONFIRM	38
RESET_IN	23
REV_FLOW1	21
REV_FLOW2	22
RTOTAL	25
SRTOTAL	26
SSP	27
ST_REV	1
STATUS_OPTS	11
STOTAL	24
STRATEGY	3
TAG_DESC	2
TIME_UNIT1	16
TIME_UNIT2	17
TOTAL_SP	7
UNCERT_LIM	35
UNIT_CONV	18
UPDATE_EVT	39

2.5 PID Block

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

2.5.1 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 change to LO (Local Overwrite).

2.5.2 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.

2.5.3 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 the100% 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:

Index	Parameter Name	Data Type	Size	Storage Type	Write in Target-Mode	Default Values	Description
							SHED_RCAS: Timeout for mode Remote Cascade 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,	0	Priority of the high high alarm.

Index	Parameter Name	Data Type	Size	Storage Type	Write in Target-Mode	Default Values	Description
					Cas, RCas, Rout		
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.

INV = Infinite number

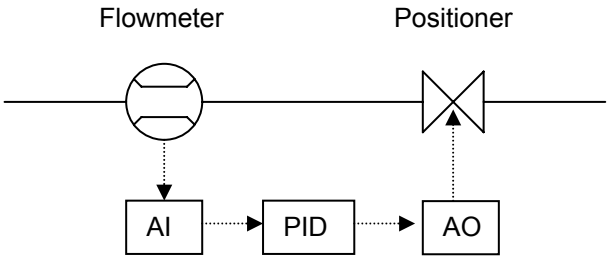
2.5.4 PID-Block, sorted according to names

Parameter Name	Index
ACK_OPTION	46
ALARM_HYS	47
ALARM_SUM	45
ALERT_KEY	4
BAL_TIME	25
BETA	67
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
GAMMA	68
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
T1_RATE	66
TAG_DESC	2
TRK_IN_D	38
TRK_SCALE	37
TRK_VAL	39
UPDATE_EVT	43

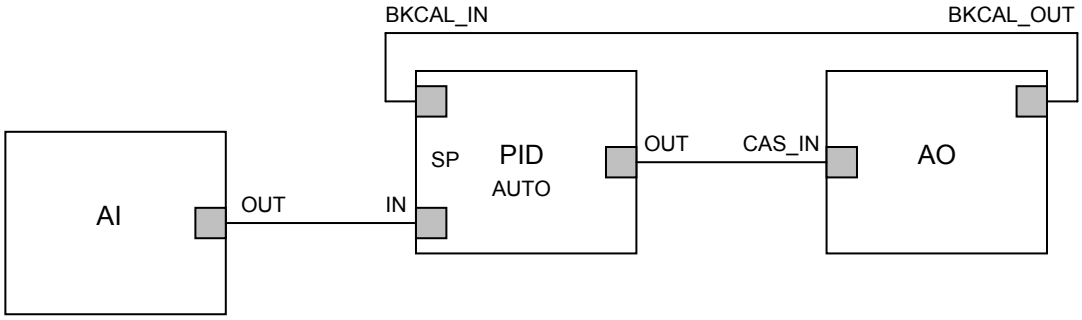
2.5.5 Example for PID control

2.5.5.1 Constant setpoint

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

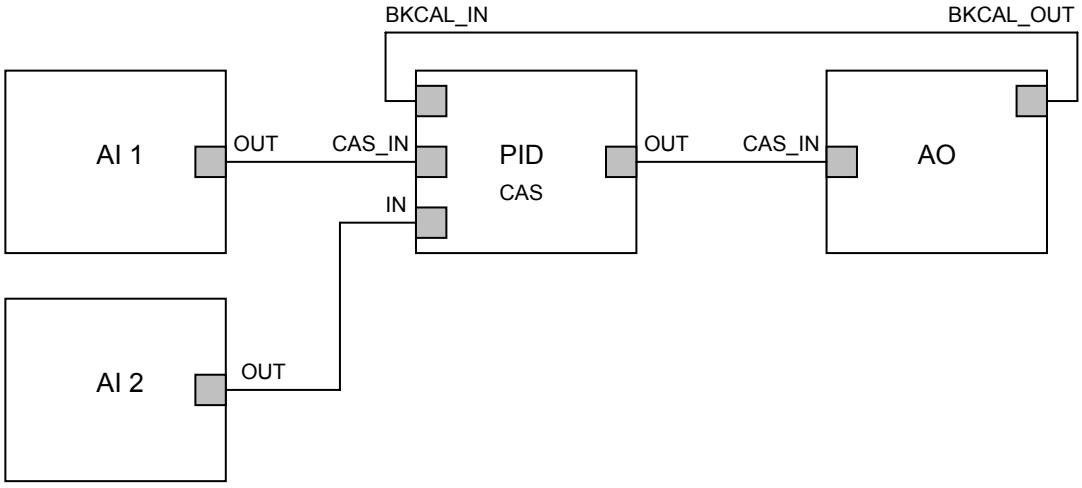


The process value is measured by a flow meter. The flow value is available as AI block. The constant setpoint is in the SP parameter inside PID block. The OUT value is send to an AO block of a positioner. It is necessary to make a back calculation connection from AO back to PID to get bumbles mode switching.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



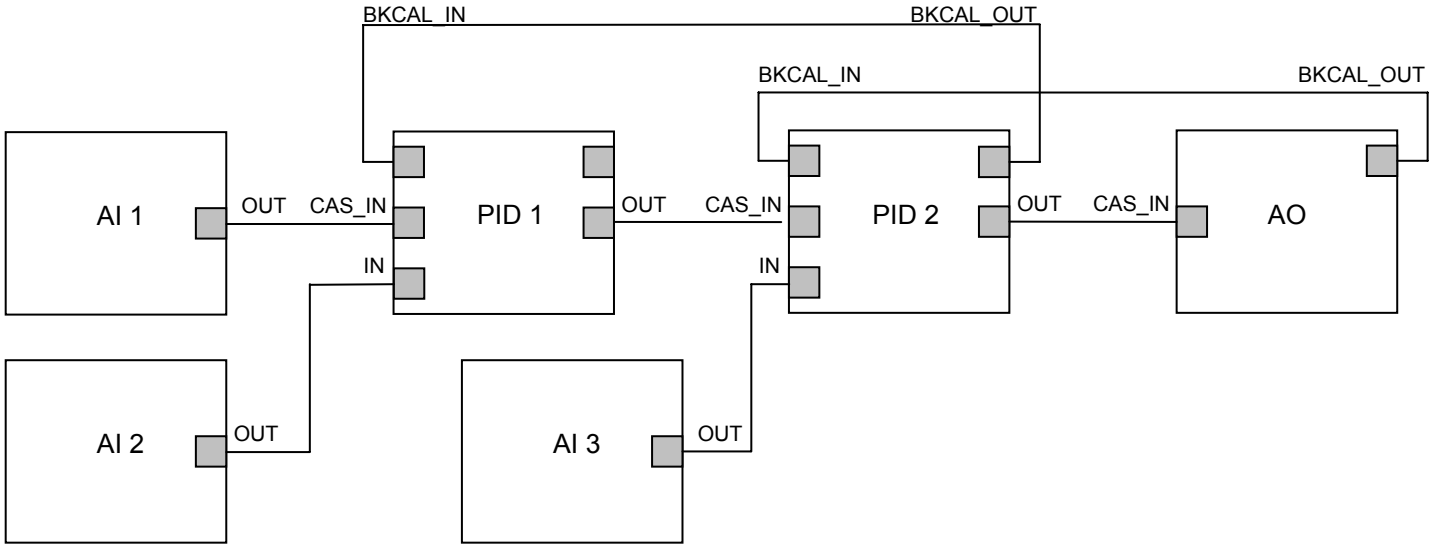
2.5.5.2 Extern setpoint

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).



2.5.5.3 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.



2.6 Transducer Block

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

2.6.1 Channels und Units

The transducer block within the FCM2000 provides eight measurements in so-called channels. Each AI block disposes of one channel parameter (index 15). This so-called channel parameter decides which channel will be transferred from the TB to the AI.

Channel 1: Mass flow (= PRIMARY_VALUE, Index 14)
Unit: refer to PRIMARY_VALUE_RANGE (Index 15) or „Unit Qm“ (Index 36)

Channel 2: Volume flow (= SECONDARY_VALUE, Index 28)
Unit: refer to SECONDARY_VALUE_UNIT (Index 29) or „Unit Qv“ (Index 37)

Channel 3: Density (Index 30)
Unit: refer to „Unit Density“, Index 38

Channel 4: Temperature (Index 31)
Unit: refer to „Unit Temp“, Index 41

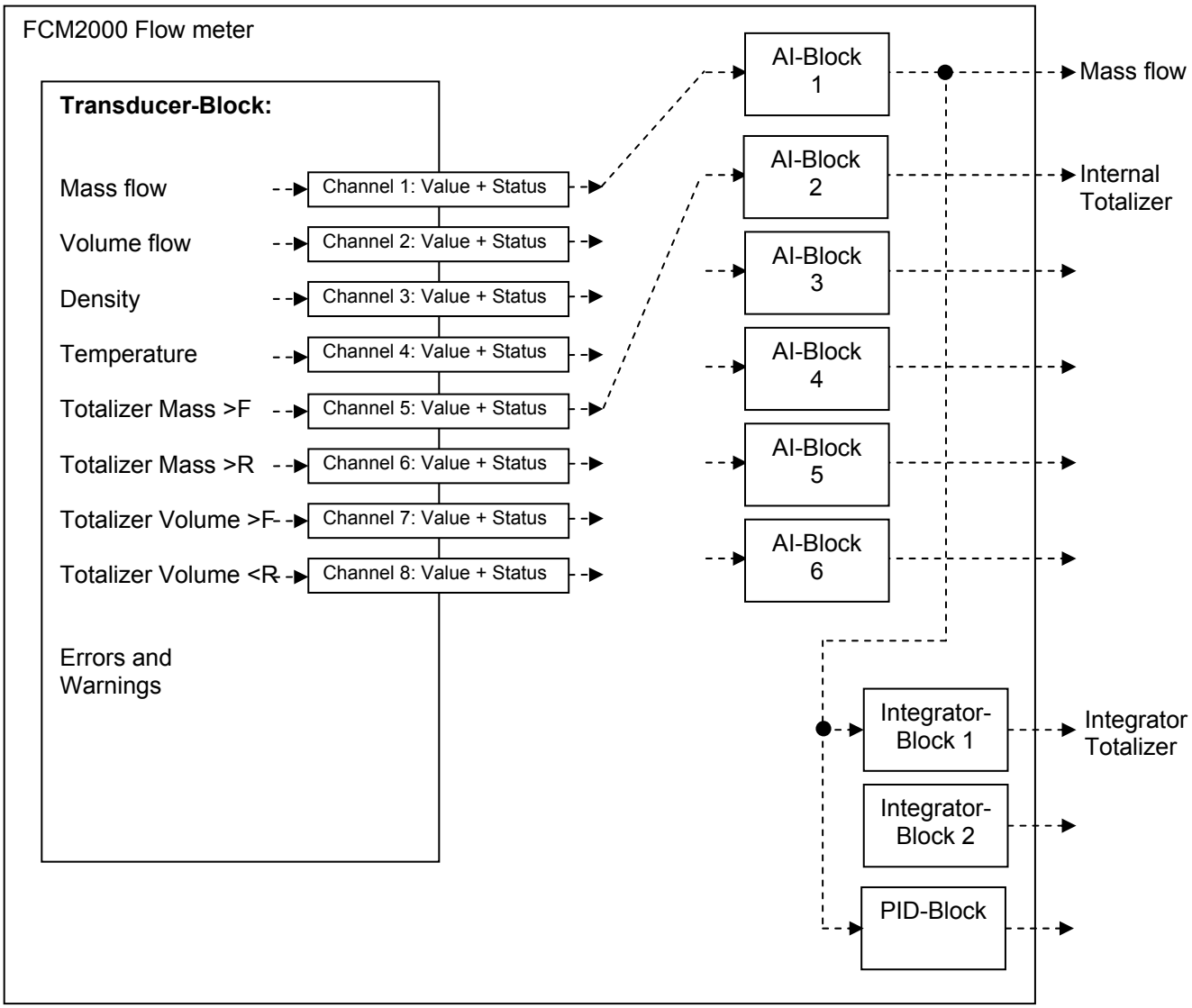
Channel 5: Transducer-Block internal Mass-Totalizer >F (Index 60)
Channel 6: Transducer-Block internal Mass-Totalizer <R (Index 62)
Unit: refer to „Unit Mass-Totalizer“ (Index 39)

Channel 7: Transducer-Block internal Volume-Totalizer >F (Index 64)
Channel 8: Transducer-Block internal Volume-Totalizer <R (Index 66)
Unit: refer to „Unit Volume-Totalizer“ (Index 40)

The internal totalizers (Mass >F and <R, Volume >F and <R) inside the Transducer Block can be read with cyclic communication via the AI-Blocks.

The Integrator Blocks (IB) can also accumulate the flow values to totalizer values. An Integrator Block gets his input value from another function block, for example an AI-Block output value. He can't work with values from the Transducer Block.

The internal totalizers and the Integrator Blocks are independent. Because they can have different units and because they may be reset at different times their numerical values may be different. But also if the units are the same and if they are reset at the same time the numbers may be slightly different in some situations (flow for short time [batch mode] or strong flow fluctuations), because they can work with different sample times.



2.6.2 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 PS3.0.

30 to 107 contain further measurement and setting parameters of the converter. Most of 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.

2.6.2.1 Transducer Block part 1: Standard Flow with Calibration

Index	Parameter Name	Data type	Size	Storage Type	Write	Default Values	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,Man, 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: (Refer also to chapter 3) Bit 3 = Simulate Active At following device messages: Warning 1: Simulation Bit 7 = Input Failure/ process variable has BAD status At following device messages: Error 2b Driver current Error 2a Driver Error 0 Sensor amplitude Error 11d Sensor Error 1 AD-converter Error 10 DSP Communication Fehler 7a T Pipe Measure Error 9b Density to low Error 9a Density Error 11c Sensor C Error 11b Sensor B Error 11a Sensor A Error 7a T House Measure Bit 10 = Lost static Data At following device messages: Error 5a Internal FRAM Error 5b External FRAM

Index	Parameter Name	Data type	Size	Storage Type	Write	Default Values	Description
							Bit 11 = Lost NV Data At following device messages: Error 6a Totalizer Mass >F Error 6b Totalizer Mass <R Error 6c Totalizer Volume >FV Error 6d Totalizer Volume <R Bit 15 = Out-of-Service (MSB) Set, if Transducerblock-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	65535	Identifies the transducer that follows. 65535 = other (no standard Transducer-Block) = FCM2000
11	XD_ERROR	Unsigned 8	1	D	read only		Following messages are supported: (Refer also to chapter 3) 22 = I/O-Error At following device messages: Error 2b Driver current Error 2a Driver Error 0 Sensoramplitude Error 11d Sensor Error 1 AD-converter Error 10 DSP Communication Error 7a T Pipe Measure Error 9b Density to low Error 9a Density Error 11a Sensor A Error 11b Sensor B Error 11c Sensor C Error 7a T House Measure 23 = Data integrity error At following device messages: Error 5a Internal FRAM Error 5b External FRAM Error 6a Totalizer Mass >F Error 6b Totalizer Mass <R Error 6c Totalizer Volume >F Error 6d Totalizer Volume <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	100	The type of measurement represented by the primary value. The table shown below

Index	Parameter Name	Data type	Size	Storage Type	Write	Default Values	Description
							describes this parameter. 100: Mass flow Information: Only 100 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 mass flow value. Unit: refer to index 15 PRIMARY_VALUE_RANGE.Unit or index 36 Unit Qm.
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 Primary Value. High limit value = Range, index 46 Low Limit Value = 0 Unit = Unit Qm, index 36 DecPoint = 2
16	CAL_POINT_HI	Float	4	S	OOS, Auto		The highest calibrated value: Equal to Index 43: QmMax Meter Tube QmMax Meter Tube is read only. FF requires this parameter writable. Therefor here it is only allowed to write the value, which is already in.
17	CAL_POINT_LO	Float	4	S	OOS, Auto		The lowest calibrated value: Equal to -QmMax Meter Tube. QmMax Meter Tube is read only. FF requires this parameter writable. Therefor here it is only allowed to write the value, which is already in.
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	1351	The engineering units code index for the calibration values. Equal to index 36: Unit Qm. Writing this index is equal to writing index 36..
20	SENSOR_TYPE	Unsigned 16	2	C	OOS, Auto	101	The sensor type defined below: 101: Coriolis Only 101 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%: QmMax Meter Tube, index 43 SENSOR_RANGE.0% : -QmMax Meter Tube, index 43 SENSOR_RANGE.Unit : Unit Qm, index 36 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 69) is shown here.
23	SENSOR_CAL_METHOD	Unsigned 8	1	S	OOS, Auto	101	The method of last sensor calibration. 101: static weight Only 101 can be written.
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 Only 1 can be written.

Index	Parameter Name	Data type	Size	Storage Type	Write	Default Values	Description
28	SECONDARY_VALUE	DS-65	5	D	Read only		The measured secondary value and status available to the function blocks. This is the volume flow value. Unit: refer to index 19 SECONDARY_VALUE_UNIT or index 37 Unit Qv.
29	SECONDARY_VALUE_UNIT	Unsigned 16	2	S	OOS, Auto	1352	The engineering units code for SECONDARY_VALUE. Equal to index 37: Unit Qv. Writing this index is equal to writing index 37.

2.6.2.2 Transducer Block part 2: manufacturer specific parameters

This part of the Transducer Block contains specific parameters of the FCM2000 flow meter:

Index	Variable Name	Data Type	Size	Store	Access	Default Value	Description
30	Density	DS-65	5	D	r		The measured density value.
31	Temperature	DS-65	5	D	r		The measured pipe temperature.
32	Prog.prot.code	Unsigned 16	2	S	r,w	0	If a code is entered between 1 and 9999, then menus on the local LCD display are protected and this code number must be put in on local keyboard to get local access. Lower Limit: 0 Upper Limit: 9999 Unit : -
33	Language	Unsigned 8	1	S	r,w	0	Selection of the language for the local LCD display. 0 : German 1 : English
34	Flow direction	Unsigned 8	1	S	r,w	1	Selection, if only forward flow or flow in both flow directions is measured. 0 : forward 1 : forward/reverse
35	Flow indication	Unsigned 8	1	S	r,w	0	If the forward direction is displayed when the flow is in the reverse direction, the direction may be interchanged using this parameter. 0 : standard 1 : opposite
36	Unit Qm	Unsigned 16	2	S	r,w	1323	Selection of the unit for mass flow. This parameter is identical to PRIMARY_VALUE_RANGE.unit (index 15), CAL_UNIT (index 19) and SENSOR_RANGE.unit (index 21). 1318: g/s 1319: g/min 1320: g/h 1322: kg/s 1323: kg/min 1324: kg/h 1325: kg/d 1327: t/min 1328: t/h 1329: t/d 1330: lb/s 1331: lb/min 1332: lb/h 1333: lb/d
37	Unit Qv	Unsigned 16	2	S	r,w	1352	Selection of the unit for volume flow. This parameter is identical to SECONDARY_VALUE_UNIT (index 29). 1351: l/s 1352: l/min 1353: l/h 1347: m3/s 1348: m3/min

Index	Variable Name	Data Type	Size	Store	Access	Default Value	Description
							1349: m3/h 1350: m3/d 1356: ft3/s 1357: ft3/min 1358: ft3/h 1359: ft3/d 1362: usgps 1363: usgpm 1364: usgph 1366: usmgd 1367: igps 1368: igpm 1369: igph 1370: igpd 1371: bbl/s 1372: bbl/m 1373: bbl/h 1374: bbl/d
38	Unit density	Unsigned 16	2	S	r,w	1104	Selection of the unit for density. 1104: g/ml 1105: g/l 1100: g/cm3 1103: kg/l 1097: kg/m3 1107: lb/ft3 1108: lb/ugl
39	Unit mass totalizer	Unsigned 16	2	S	r,w	1088	Selection of the unit for the internal mass totalizer. 1089: g 1088: kg 1092: t 1094: lb
40	Unit volume totalizer	Unsigned 16	2	S	r,w	1038	Selection of the unit for the internal volume totalizer. 1038: l 1034: m3 1043: ft3 1048: ugl 1049: igl 1051: bbl
41	Unit temperature	Unsigned 16	2	S	r,w	1001	Selection of the unit for temperature. 1001: C 1000: K 1002: F
42	Meter Tube	Unsigned 8	1	S	r	-	The flowmeter meter pipe identification is displayed. 4: Trio 1.5S 5: Trio 3T 6: Trio 6B 7: Trio 10C

Index	Variable Name	Data Type	Size	Store	Access	Default Value	Description
							8: Trio 15D 9: Trio 20E 10: Trio 25F 11: Trio 40G 12: Trio 50H 13: Trio 65I 14: Trio 80J 15: Trio 100K 16: Trio 150L
43	QmMax Meter Tube	Float	4	S	r	-	The maximum mass flow range of the meter tube is displayed.
44	Order Number	String	16	S	r	-	Display of the Order Number. It is also listed on the name plate and on the label on the external memory module.
452	EEx Protection	Unsigned 8	1	S	r	-	EEx devices work with a smaller coil driver current. Setting this parameter to “on” reduces the current, depending from the meter size. 0: off 1: on
46	Range	Float	4	S	r,w	-	This range can be programmed by the user. The percent value calculated with range is used for low-flow-cut-off and the Qm alarm values. Lower Limit: 0,01 * QmMax Meter Tube Upper Limit: 1,00 * QmMax Meter Tube Unit : Unit Qm
47	Damping	Float	4	S	r,w	-	Damping represents the response time for a 0 - 99 % step flow rate change. Lower Limit: 1,0 Upper Limit: 100 Unit : sek
48	Low flow cut-off	Float	4	S	r,w	-	Flow values below low flow cut-off are set to zero. Lower Limit: 0 Upper Limit: 10 Unit : %
49	D Correction	Float	4	S	r,w	-	The density accuracy can be optimized here. Lower Limit: equal to -50 g/l in selectet density unit Upper Limit: equal to+50 g/l in selectet density unit Unit : Unit density
50	Qm Correction	Float	4	S	r,w	-	The flow accuracy can be optimized here in percent of the measured value. Lower Limit: -5 Upper Limit: 5 Unit : %
51	System zero adjust	Float	4	S	r,w	-	The system zero point is set here. Lower Limit: -10 Upper Limit: 10 Unit : %
52	Start automatic system zero adjust	Unsigned 8					read: 0 = no adjust running 1 = adjust is running write:

Index	Variable Name	Data Type	Size	Store	Access	Default Value	Description
							2 = abort adjust 3 = start quick adjust (3 seconds) 4 = start slow adjust (20 seconds) Writing 3 or 4 triggers the start of the adjust.
53	Min- and Max-Alarm Qm	Record of Float: Min-Alarm Qm Max-Alarm Qm	8	S	r,w	-	When the mass flow value is outside of the maximum or minimum setting, an alarm is set. Valid Range Min-Alarm Qm: 0% to Max Alarm Qm Valid Range Max-Alarm Qm: MinAlarm Qm to 105% Unit : %
541	Min- and Max-Alarm Density	Record of Float: Min-Alarm D. Max-Alarm D.	8	S	r,w	-	When the density value is outside of the maximum or minimum setting, an alarm is set. Valid Range Min-Alarm Density: 0,5 kg/l toMax Alarm Density Valid Range Max-Alarm Density: Min-Alarm Density to 3,5 kg/l Unit : Unit Density
55	Min- and Max-Alarm Temperature	Record of Float: Min-Alarm T. Max-Alarm T.	8	S	r,w	-	When the temperature value is outside of the maximum or minimum setting, an alarm is set. Valid Range Min-AlarmTemperature -50 C toMax Alarm Temperature Valid Range Max-Alarm Temperature: Min-Alarm Temperatur to 180 C Unit : Unit Temperature
56	Display 1st line	Unsigned 8	1	S	r,w	-	The first and second display lines can be configured to display any of the following values: 14: Driver Current 15: Sensorampl. A, B 18: DSP Flow 21: Temp. Housing 22: Qm Phase + Time 0 : Q [Bargraph] 1 : Qm 2 : Qv 3 : Q [%] 11: Temperature 10: Density 12: TAG Nummer 4 : Totalizer Mass 5 : Totalizer Mass >F 6 : Totalizer Mass <R 7 : Totalizer Volume 8 : Totalizer Volume >F 9 : Totalizer Volume <R 19: Pipe Frequency 13: Blanks 20: off (only for multiplex) 100: Address
57	Display 2nd line	Unsigned 8	1	S	r,w	-	
58	Display 1st line multiplex	Unsigned 8	1	S	r,w	-	
59	Display 2nd line multiplex	Unsigned 8	1	S	r,w	-	
60	Totalizer Mass >F	DS-65	5	S	r,w		This is the mass totalizer value for forward flow. Lower Limit: 0 Upper Limit: 9999999,9 Unit : Unit mass totalizer Info: Only the totalizer value can be written, not the status.
61	Totalizer Mass Overflow >F	Unsigned 16	2	S	r		This is the number of overflows of the mass totalizer for forward flow. The totalizer overflow is at 10000000.

Index	Variable Name	Data Type	Size	Store	Access	Default Value	Description
62	Totalizer Mass <R	DS-65	5	S	r,w		This is the mass totalizer value for reverse flow. Lower Limit: 0 Upper Limit: 9999999,9 Unit : Unit mass totalizer Info: Only the totalizer value can be written, not the status.
63	Totalizer Mass Overflow <R	Unsigned 16	2	S	r		This is the number of overflows of the mass totalizer for reverse flow. The totalizer overflow is at 10000000.
64	Totalizer Volume >F	DS-65	5	S	r,w		This is the volume totalizer value for forward flow. Lower Limit: 0 Upper Limit: 9999999,9 Unit : Unit volume totalizer Info: Only the totalizer value can be written, not the status.
65	Totalizer Volume Overflow >F	Unsigned16	2	S	r		This is the number of overflows of the volume totalizer for forward flow. The totalizer overflow is at 10000000.
66	Totalizer Volume <R	DS-65	5	S	r,w		This is the volume totalizer value for reverse flow. Lower Limit: 0 Upper Limit: 9999999,9 Unit : Unit volume totalizer Info: Only the totalizer value can be written, not the status.
67	Totalizer Volume Overflow <R	Unsigned16	2	S	r		This is the number of overflows of the volume totalizer for reverse flow. The totalizer overflow is at 10000000.
68	Totalizer Reset	Unsigned8	1	D	r,w		Writing 1 will reset all Totalizer and Overflow values. 0 : do nothing 1 : reset all totalizers and overflows Reset is triggered by writing 1 (“edge” triggered, not “level” triggered).
69	Instrument number	Unsigned32	4	S	r		Instrument number of electronic. This number is part of the Fieldbus Identifier.
70	Simulation Mode	Unsigned8	1	D	r,w	0	This is a general enable switch for simulation mode. 0 : Off 1 : On
71	Simulation Qm	Unsigned8	1	D	r,w	0	If simulation mode is on (1 or 2), then the simulation value will be used instead of the real measurement value. 0 : Measure 1 : Enter 2 : Step
72	Simlation Value Qm	Float	4	D	r,w	0	Lower Limit: -115 Upper Limit: 115 Unit : %
73	Simulation Density	Unsigned8	1	D	r,w	0	If simulation mode is on (1 or 2), then the simulation value will be used instead of the real measurement value. 0 : Measure 1 : Enter 2 : Step
74	Simlation Value Density	Float	4	D	r,w	0	Lower Limit: 0,3 kg/l Upper Limit: 3,7 kg/l Unit : Unit Dichte
75	Simulation Pipe Temperature	Unsigned8	1	D	r,w	0	If simulation mode is on (1 or 2), then the simulation value will be used instead of the real

Index	Variable Name	Data Type	Size	Store	Access	Default Value	Description	
							measurement value. 0 : Measure 1 : Enter 2 : Step	
76	Simlation Value Pipe Temperature	Float	4	D	r,w	0	Lower Limit: -60 Upper Limit: 190 Unit : C	
77	Simulation Housing Temperature	Unsigned8	1	D	r,w	0	If simulation mode is on (1 or 2), then the simulation value will be used instead of the real measurement value. 0 : Measure 1 : Enter 2 : Step	
78	Simlation Value Housing Temperature	Float	4	D	r,w	0	Lower Limit: -60 Upper Limit: 190 Unit : C	
79	Funktion Check Memory	Unsigned 8	1	D	r/w	0	A memory test can be started by writing '...run'. The result will be shown by reading '...ok' or '...error'. 0 : No memory test 7 : Test program checksum start/run 8 : Test program checksum ok 9 : Test program checksum error 10: Test bootloader checksum start/run 11: Test bootloader checksum ok 12: Test bootloader checksum error Writing 7 or 10 will start a test. Reading shows, if the test is still running (for example 7) or the result of the test (8 = ok or 9 = error).	
80	Instrument Flow Calibration	Struct	12	N	r		Only for service.	
		Float	4				Zero	Lower Limit: -1000 Upper Limit: 1000 Unit : -
		Float	4				Span Forward	Lower Limit: -1000 Upper Limit: 1000 Unit : -
		Float	4				Span Reverse	Lower Limit: -1000 Upper Limit: 1000 Unit : -
81	Instrument Temp.Pipe	Struct	32	N	r		Only for service.	
		Float	4				Pt100 Adjust Temp.Pipe Min	Lower Limit: -50 C Upper Limit: 180 C Unit : Temperatur Unit
		Float	4				Pt100 Adjust Temp.Pipe Max	Lower Limit: -50 C Upper Limit: 180 C Unit : Temperatur Unit
		Float	4				Pt100 Temp.Pipe Span	Lower Limit: -1000 Upper Limit: 1000 Unit : -

Index	Variable Name	Data Type	Size	Store	Access	Default Value	Description	
		Float	4				Pt100 Temp.Pipe Zero	Lower Limit: -1000 Upper Limit: 1000 Unit : -
		Float	4				Pt1000 Adjust Temp.Pipe Min	Lower Limit: -50 C Upper Limit: 180 C Unit : Temperatur Unit
		Float	4				Pt1000 Adjust Temp.Pipe Max	Lower Limit: -50 C Upper Limit: 180 C Unit : Temperatur Unit
		Float	4				Pt1000 Temp.Pipe Span	Lower Limit: -1000 Upper Limit: 1000 Unit : -
		Float	4				Pt1000 Temp.Pipe Zero	Lower Limit: -1000 Upper Limit: 1000 Unit : -
82	Instrument Temp.Housing	Struct	17	N	r		Only for service.	
		Unsigned8	1				Temp.Housing EEx	0 : Rev.0 1 : Rev.1
		Float	4				Adjust Temp.Housing Min	Lower Limit: -50 C Upper Limit: 180 C Unit : Temperatur Unit
		Float	4				Adjust Temp.Housing Max	Lower Limit: -50 C Upper Limit: 180 C Unit : Temperatur Unit
		Float	4				Temp.Housing Span	Lower Limit: -1000 Upper Limit: 1000 Unit : -
		Float	4				Temp.Housing Zero	Lower Limit: -1000 Upper Limit: 1000 Unit : -
83	Instrument Hardware Front-End-Board	Unsigned8	1	N	r		Only for service. 0 : Revision 0 2 : Revision 2 3 : Revision 4 4 : Revision 5 255 : Revision nicht erkannt (Board nicht vorhanden)	
84	Primary Calibration Driver	Struct	18	N	r		Only for service.	
		Unsigned8	1				Driver	0 : Aus 1 : Ein
		Unsigned8	1				Current Limit	0 : Imax=100mA EEx 2 : Imax=160mA EEx 1 : Imax=350mA
		Float	4				Amplitude [rms]	Lower Limit: 0 Upper Limit: 300 Unit : mV

Index	Variable Name	Data Type	Size	Store	Access	Default Value	Description	
		Float	4				Driver Kp	Lower Limit: 0 Upper Limit: 1000 Unit : -
		Float	4				Driver Ki	Lower Limit: 0 Upper Limit: 1000 Unit : -
		Float	4				Primary Gain	Lower Limit: -1 Upper Limit: 1 Unit : -
85	Primary-Calibration Temperature Pipe	Struct	17	N	r		Only for service.	
		Unsigned8	1				Temp.Pipe Calib.	0 : Rev. 0 1 : Rev. 1
		Float	4				Adjust Temp.Pipe Min	Lower Limit: -50 C Upper Limit: 180 C Unit : Temperatur Unit
		Float	4				Adjust Temp.Pipe Max	Lower Limit: -50 C Upper Limit: 180 C Unit : Temperatur Unit
		Float	4				Temp.Pipe Span	Lower Limit: -1000 Upper Limit: 1000 Unit : -
		Float	4				Temp.Pipe Zero	Lower Limit: -1000 Upper Limit: 1000 Unit : -
86	Primary Calibration Temperature Housing	Struct	19	N	r		Only for service.	
		Unsigned8	1				Temp. Housing	0 : disable 1 : enable
		Unsigned8	1				Temp.Housing EEx	0 : Rev. 0 1 : Rev. 1
		Float	4				Adjust Temp. Housing Min	Lower Limit: -50 C Upper Limit: 180 C Unit : Temperatur Unit
		Float	4				Adjust Temp. Housing Max	Lower Limit: -50 C Upper Limit: 180 C Unit : Temperatur Unit
		Float	4				Temp. Housing Span	Lower Limit: -1000 Upper Limit: 1000 Unit : -
		Float	4				Temp. Housing Zero	Lower Limit: -1000 Upper Limit: 1000 Unit : -
		Unsigned8	1				Temp. Housing Calib.	0 : Rev. 0 1 : Rev. 1
87	Primary Calibration Density	Struct	24	N	r		Only for service.	

Index	Variable Name	Data Type	Size	Store	Access	Default Value	Description	
		Float	4				F1 (20^{0}C empty)	Lower Limit: 0 Upper Limit: 1000 Unit : Hz
		Float	4				D1 (empty)	Lower Limit: -1 Upper Limit: 5 Unit : kg/l
		Float	4				F2 (20^{0}C filled)	Lower Limit: 0 Upper Limit: 1000 Unit : Hz
		Float	4				D2 (filled)	Lower Limit: 0 Upper Limit: 5 Unit : kg/l
		Float	4				KtFreq	Lower Limit: -1000 Upper Limit: 1000 Unit : 1 / 1000K
		Float	4				KtDensity	Lower Limit: -10 Upper Limit: 10 Unit : 1 / 1000K
88	Primary Calibration Flow	Struct	33	N	r		Only for service.	
		Float	4				Zero	Lower Limit: -1000 Upper Limit: 1000 Unit : %
		Float	4				Span Forward	Lower Limit: -1000 Upper Limit: 1000 Unit : %
		Float	4				Zero Offset Forward	Lower Limit: -1000 Upper Limit: 1000 Unit : -
		Float	4				Span Reverse	Lower Limit: -1000 Upper Limit: 1000 Unit : -
		Float	4				Zero Offset Reverse	Lower Limit: -1000 Upper Limit: 1000 Unit : -
		Float	4				Kt Qm	Lower Limit: -1000 Upper Limit: 1000 Unit : 1 / 1000K
		Float	4				Tm Calib. Span	Lower Limit: -50 C Upper Limit: 180 C Unit : Temperatur Unit
		Float	4				Tm Calib. Zero	Lower Limit: -50 C Upper Limit: 180 C Unit : Temperatur Unit
		Unsigned8	1				Flow Calculation	0 : Rev. 0 1 : Rev. 1
89	Service-Connector	Struct	9	N	r		Only for service.	

Index	Variable Name	Data Type	Size	Store	Access	Default Value	Description	
		Unsigned8	1				Service-Connector	6 : aus 7 : automatisch 5 : 2400 baud 4 : 4800 baud 3 : 9600 baud 2 : 19200 baud 1 : 38400 baud 0 : 57600 baud
		Unsigned 32	4				Measurement Value Selection	
		Float	4				Output Cycle	Lower Limit: 0,1 Upper Limit: 3600 Unit : sek
90	DIP-Switch	Bit String	2	S	r		The setting of the switch.	
91	Mains interrupt	Unsigned 16	2	S	r		The number of mains power supply interrupts.	
92	Version	Visible String	16	Cst	r		The version of the device software.	
93	Actual error egister	Bit String	4	D	r		This register shows actual active errors. Some errors can disappear by themselfes, for example error 3: flow > 105%. In this case also the error bit will disappear from this register. Bit-contents refer to 3.2.	
94	Actual warning egister	Bit String	2	D	r		Same as for „actual error register“. **Bit-contents refer to** 3.3.	
95	History of error register	Bit String	4	S	r		This register show all errors, which were set in the past tense or are set in the present. Bit-contents refer to 3.2.	
96	History of warning register	Bit String	2	S	r		Same as for „History of error register“. Bit-contents refer to 3.3.	
97	Mask for error register	Bit String	4	S	r,w	FF,0F,FE,01	This mask determins, which bits of the „actual error register“ should be copied into the „Masked error register“: 0 = no copy 1 = bit will be copied Default setting: All errors will be copied. Bit-contents refer to 3.2.	
98	Mask for warning register	Bit String	2	S	r,w	00,08	Same as for „Mask for error register“. Warning 1 (Simulation) can not be removed from this mask. Default setting: Only warning 1 will be copied, all other warnings not. Bit-contents refer to 3.3.	
99	Masked error register	Bit String	4	D	r		Masked error register = „actual error register“ AND „Mask for error register“. Bit-contents refer to 3.2.	
100	Masked warning register	Bit String	2	D	r		Same as for „Masked error register“. Bit-contents refer to 3.3.	
101	Error and warnings simulation	Unsigned 8	1	D	r,w	0	If this parameter is on, the 'error simulate value' and 'warning simulate value' is used for the error and warning calculation instead of the real error and warning reason. 0 : Off 1 : On Refer to 5.3.1.	
102	Error simulation value	Bit String	4	D	r,w	0,0,0,0	If the ‘Error and warnings simulation’ is on, the 'Error simulate value' is used for the error calculation instead of the real error reason. Refer to 5.3.2	

Index	Variable Name	Data Type	Size	Store	Access	Default Value	Description
103	Warning simulation value	Bit String	2	D	r,w	0,0	If the 'Error and warnings simulation' is on, the 'Warning simulate value' is used for the warning calculation instead of the real warning reason. Refer to 5.3.3
104	Error priority	Array of Unsigned16	32*2 =64	S	r,w	Bit 0 Error 2b Driver current : 936 Bit 1 Error 2a Driver : 944 Bit 2 Error 0 Sensoramplitude : 952 Bit 3 Error 11d Sensor : 960 Bit 4 Error 1 AD-Converter : 968 Bit 5 Error 10 DSP Communication: 976 Bit 6 Error 5b External FRAM : 984 Bit 7 Error 5a Internal FRAM : 992 Bit 8 - : 0 Bit 9 - : 0 Bit 10 - : 0 Bit 11 - : 0 Bit 12 Error 3 Flow > 105% : 896 Bit 13 Error 7a T Pipe Measssure : 912 Bit 14 Error 9b Density <0,5 kg/l : 920 Bit 15 Error 9a Dichtemessung : 928 Bit 16 Error 11c Sensor C : 800 Bit 17 Error 11b Sensor B : 808 Bit 18 Error 11a Sensor A : 816 Bit 19 Error 6d Totalizer Volume <R : 824 Bit 20 Error 6c Totalizer Volume >F : 832 Bit 21 Error 6b Totalizer Mass <R : 840 Bit 22 Error 6a Totalizer Mass >F : 848 Bit 23 - : 0 Bit 24 - : 0 Bit 25 - : 0 Bit 26 - : 0 Bit 27 - : 0 Bit 28 - : 0 Bit 29 - : 0 Bit 30 - : 0 Bit 31 Error 7b T House Measure : 904	The priority shows the importance of an error. These values are not used inside the flow meter.

Index	Variable Name	Data Type	Size	Store	Access	Default Value	Description
105	Warning priority	Array of unsigned 16	32*2 =64	S	r,w	Bit 0 Warning 10 Reverse Q : 236 Bit 1 Warning 5c Min Alarm Temp. : 244 Bit 2 Warning 6c Max Alarm Temp. : 252 Bit 3 Warning 5b Min Alarm Density : 260 Bit 4 Warning 6b Max Alarm Density : 268 Bit 5 Warning 5a Min Alarm Qm : 276 Bit 6 Warning 6a Max Alarm Qm : 284 Bit 7 Warning 2 Totalizer reset : 0 Bit 8 Warning 9d Overflow <R Volume : 180 Bit 9 Warning 9c Overflow >V Volume : 188 Bit 10 Warning 9b Overflow <R Mass : 196 Bit 11 Warning 9a Overflow >V Mass : 204 Bit 12 Warning 1 Simulation : 172 Bit 13 Warning 8b Update extern Data : 212 Bit 14 Warning 8a Update intern Data : 220 Bit 15 Warning 7 Extern Data loaded : 228	The priority shows the importance of a warning. These values are not used inside the flow meter.
106 137 / 153	Error and warning settings	Unsigned8	1	s	r,w	0	Writing a value from 1 to 3 will start the selected action: 0 = do nothing 1 = Clear error and warnig register history 2 = Set mask for error and warnig register to default 3 = Set priority for error and warning to default
107 138 / 154	Housing Temperature	DS-65	5	D	r		The measured housing temperature.

2.6.3 Transducer Block Parameter, sorted according to names

Parameter Name	Index
Actual error egister	93
Actual warning egister	94
ALERT_KEY	4
BLOCK_ALM	8
BLOCK_ERR	6
CAL_MIN_SPAN	18
CAL_POINT_HI	16
CAL_POINT_LO	17
CAL_UNIT	19
COLLECTION_DIRECTORY	12
D Correction	49
Damping	47
Density	30
DIP-Switch	90
Display 1st line	56
Display 1st line multiplex	58
Display 2nd line	57
Display 2nd line multiplex	59
EEx Protection	45
Error and warning settings	106
Error and warnings simulation	101
Error priority	104
Error simulation value	102
Flow direction	34
Flow indication	35
Funktion Check Memory	79
History of error register	95
History of warning register	96
Housing Temperature	107
Instrument Flow Calibration	80
Instrument Hardware Front-End-Board	83
Instrument number	69
Instrument Temp.Pipe	81
Instrument-Temp.Housing	82
Language	33
LIN_TYPE	27
Low flow cutt-off	48
Mains interrupt	91
Mask for error register	97
Mask for warning register	98
Masked error register	99
Masked warning register	100
Meter Tube	42
Min- und Max-Alarm Density	54
Min- und Max-Alarm Qm	53
Min- und Max-Alarm Temperature	55
MODE_BLK	5
Order Number	44
Primary Calibration Density	87
Primary Calibration Driver	84
Primary Calibration Flow	88
Primary Calibration Temperature Housing	86
PRIMARY_VALUE	14
PRIMARY_VALUE_RANGE	15
PRIMARY_VALUE_TYPE	13
Primary-Calibration Temperature Pipe	85
Prog.prot.code	32
Qm Correction	50
QmMax Meter Tube	43
Range	46
SECONDARY_VALUE	28
SECONDARY_VALUE_UNIT	29
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-Connector	89
Simlation Value Density	74
Simlation Value Housing Temperature	78
Simlation Value Pipe Temperatur	76
Simlation Value Qm	72
Simulation Density	73
Simulation Housing Temperature	77
Simulation Mode	70
Simulation Pipe Temperature	75
Simulation Qm	71
ST_REV	1
Start automatic system zero adjust	52
STRATEGY	3
System zero adjust	51
TAG_DESC	2
Temperature	31
Totalizer Mass >F	60
Totalizer Mass <R	62
Totalizer Mass Overflow >F	61
Totalizer Mass Overflow <R	63
Totalizer Reset	68
Totalizer Volume >F	64
Totalizer Volume <R	66
Totalizer Volume Overflow >F	65
Totalizer Volume Overflow <R	67
TRANSDUCER_DIRECTORY	9
TRANSDUCER_TYPE	10
Unit density	38
Unit mass totalizer	39
Unit Qm	36
Unit Qv	37
Unit temperature	41
Unit volume totalizer	40
UPDATE_EVT	7
Version	92
Warning priority	105
Warning simulation value	103
XD_ERROR	11

2.7 Data structures

2.7.1 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

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

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

2.7.3 DS-66 – Value & Status – Discrete Structure

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

2.7.4 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

2.7.5 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

2.7.6 DS-70 – Access Permissions

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

2.7.7 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

2.7.8 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

2.7.9 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

2.7.10 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

2.7.11 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

2.7.12 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

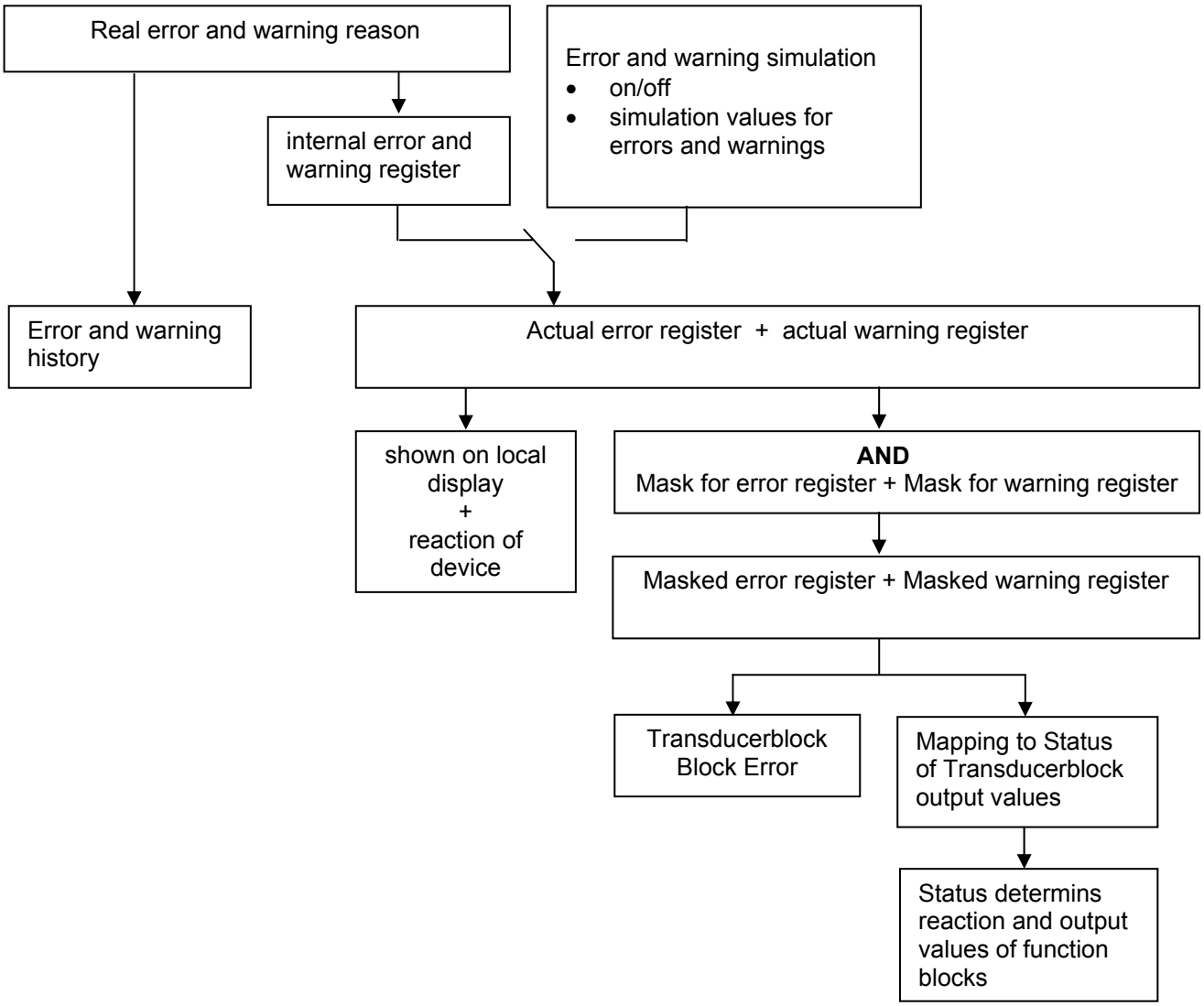
3. Error- and Warnings-Handling

The device has two error registers: The „actual error register“ (Transducer block index 93) shows errors, which are active in this moment. The “History of error register” (index 95) shows errors, which were set in the past tense or present. For warnings there is the same: One register shows actual warnings (index 94), another shows the history of the warnings (index 96). The history-registers can be cleared.

The history is only for information. The actual errors and warnings are important:

- They are show on the local display of the device and they determins the reaction of the device.
- The actual registers are masked with index 97: mask for error register and index 98: mask for warning register. The result is written into index 99: masked error register and index 100: masked warning register. The masks makes it possible to determine, which bits should be be used and which bits should be suppressed.
- These masked registers are important for the fieldbus: They determine the status of the Transducerblock output values (refer to 3.4). This status goes to the function blocks and determins the function block reaction and function block output values.

For testing it is possible to simulate errors and warnings. To do this switch on the simulation (index 101) and write the simulation values (index 102 and 103). Then this simulated errors and warnings will be used for the actual error and warning register instead of the real error and warning reasons. It is also possible do do this simulation on the local display and keyboard (refer to 5.3.1).



3.1 Bit String

"FF-870-1.5 Fieldbus Message Specification" defines in chapter 9.3.1.10 the bit order of Bit Strings:

	Bit 8 (MSB)	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1 (LSB)
Octet 1	0	1	2	3	4	5	6	7
Octet 2	8	9	10	11	12	13	14	15
Octet 3	16	17	18	19	20	21	22	23
Octet 4	24	25	26	27	28	29	30	31

3.2 Error register

The “actual error register” is on index 93 of the Transducer block.
The “history of the error register” is on index 95.

	Bit in Octet	**Bit**	**Error number**	**Error text**
Octet 1	8	0	2b	Driver current
	7	1	2a	Driver
	6	2	0	Sensoramplitude
	5	3	11d	Sensor
	4	4	1	AD-Converter
	3	5	10	DSP Communication
	2	6	5b	External FRAM
	1	7	5a	Internal FRAM
Octet 2	8	8	-	- (HART-Device: Iout 2 to high, unused at PA/FF)
	7	9	-	- (HART-Device: Iout 1 to low , unused at PA/FF)
	6	10	-	- (HART-Device: Iout 1 to high, unused at PA/FF)
	5	11	-	- (HART-Device: Zero return , unused at PA/FF)
	4	12	3	Flow > 105%
	3	13	7a	Pipe temperature measurement
	2	14	9b	Density to low
	1	15	9a	Density
Octet 3	8	16	11c	Sensor C
	7	17	11b	Sensor B
	6	18	11a	Sensor A
	5	19	6d	Totalizer Volume <R
	4	20	6c	Totalizer Volume >F
	3	21	6b	Totalizer Mass <R
	2	22	6a	Totalizer Mass >F
	1	23	-	- (HART-Device: Iout 2 to low, unused at PA/FF)
Octet 4	8	24	-	-
	7	25	-	-
	6	26	-	-
	5	27	-	-
	4	28	-	-
	3	29	-	-
	2	30	-	-
	1	31	7b	Housing temperature measurement

Example: 00 08 00 00 = Error 3, Flow > 105%

3.3 Warning register

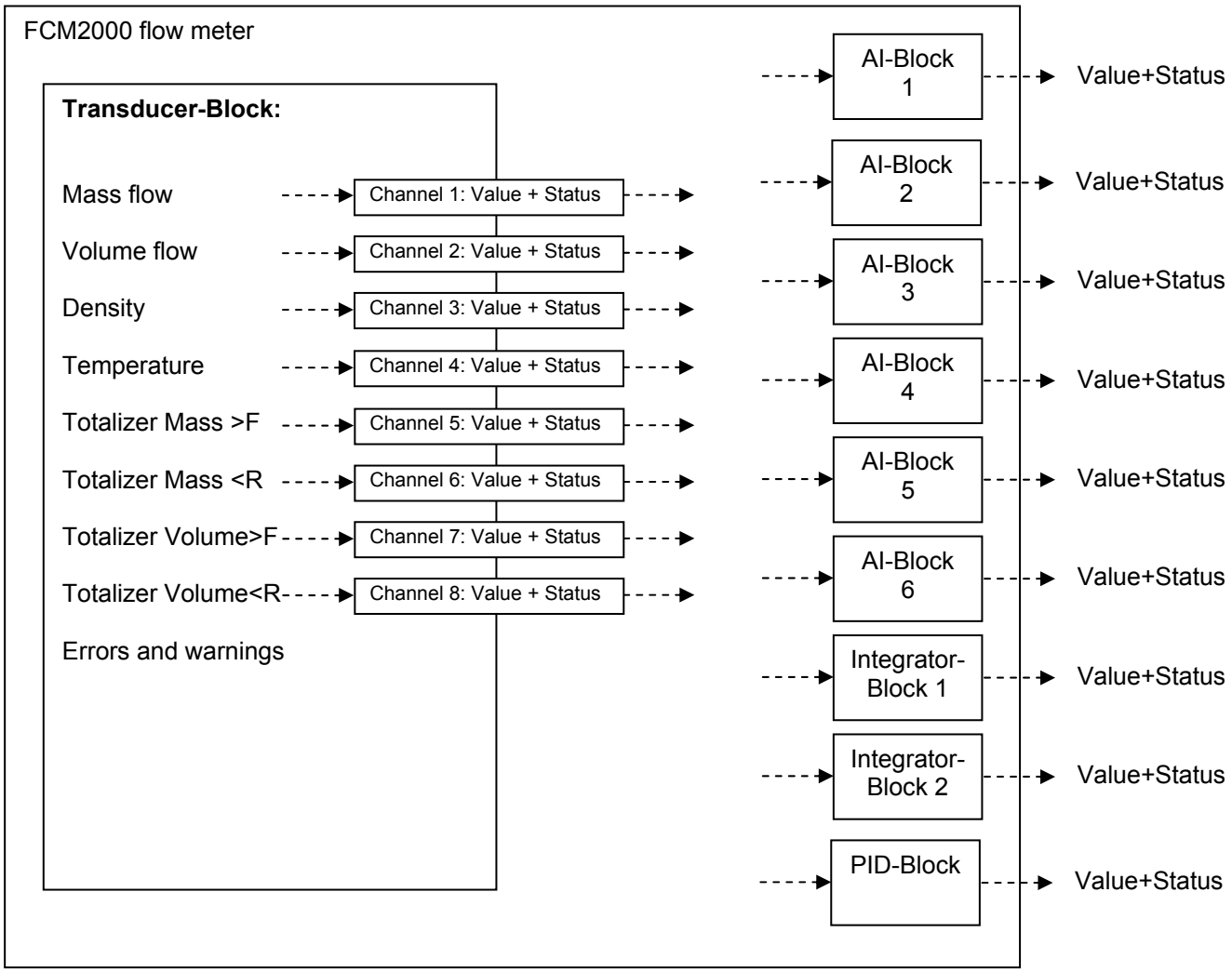
The “actual warning register” is on index 94 of the Transducer block.
The “history of the warning register” is on index 96.

	Bit in Octet	Bit	Warning number	Warning text
Octet 1	8	0	10	Reverse Q
	7	1	5c	Min Alarm Temperature
	6	2	6c	Max Alarm Temperature
	5	3	5b	Min Alarm Density
	4	4	6b	Max Alarm Density
	3	5	5a	Min Alarm Qm
	2	6	6a	Max Alarm Qm
	1	7	-	- (HART-Device: Totalizer Reset , unused at FF)
Octet 2	8	8	9d	Überlauf <R Volumen
	7	9	9c	Überlauf >V Volumen
	6	10	9b	Überlauf <R Masse
	5	11	9a	Überlauf >V Masse
	4	12	1	Simulation
	3	13	8b	Update externe Daten
	2	14	8a	Update interne Daten
	1	15	7	Externe Daten geladen

Example: 80 00 = Warning 10, Reverse Q

3.4 Mapping of errors and warnings to the Transducerblock-Status

The Transducerblock provides the measurement values for the function blocks. These values have the datatype DS-33: value and status. This status determins the reaction and output values of the AI-function blocks.



3.4.1 Mapping-Tabelle

The following errors are mapped to the Transducerblock output values status:

	Bit in Octet	Error nummer	Error text	Mapping to status of Channel 1: MASS_FLOW	Mapping to status of Channel 2: VOLUME_FLOW	Mapping to status of Channel 3: DENSITY	Mapping to status of Channel 4: TEMPERATURE	Mapping to status of Channel 5 - 8: internal totalizers
Octet 1	8	2b	Driver current	BAD, sensor failure	BAD, sensor failure	BAD, sensor failure		
	7	2a	Driver	BAD, sensor failure	BAD, sensor failure	BAD, sensor failure		
	6	0	Sensoramplitude	BAD, sensor failure	BAD, sensor failure	BAD, sensor failure		
	5	11d	Sensor	BAD, sensor failure	BAD, sensor failure	BAD, sensor failure		
	4	1	AD-Converter	BAD, device failure	BAD, device failure	BAD, device failure	BAD, device failure	
	3	10	DSP Cmmuniction	BAD, device failure	BAD, device failure	BAD, device failure	BAD, device failure	
	2	5b	External FRAM	BAD, device failure	BAD, device failure	BAD, device failure	BAD, device failure	
	1	5a	Internal FRAM	BAD, device failure	BAD, device failure	BAD, device failure	BAD, device failure	
Octet 2	8	-						
	7	-						
	6	-						
	5	-						
	4	3	Flow > 105%	UNCERTAIN, engineering unit range violation	UNCERTAIN, engineering unit range violation			
	3	7a	Pipe temp. measurement				BAD, sensor failure	
	2	9b	Density to low		BAD, sensor failure	UNCERTAIN,engineering unit range violation		
	1	9a	Density		BAD, sensor failure	BAD, sensor failure		
Octet 3	8	11c	Sensor C	BAD, sensor failure	BAD, sensor failure	BAD, sensor failure		
	7	11b	Sensor B	BAD, sensor failure	BAD, sensor failure	BAD, sensor failure		
	6	11a	Sensor A	BAD, sensor failure	BAD, sensor failure	BAD, sensor failure		
	5	6d	Totalizer Volume <R					BAD, device failure
	4	6c	Totalizer Volume >F					BAD, device failure
	3	6b	Totalizer Mass <R					BAD, device failure
	2	6a	Totalizer Mass >F					BAD, device failure
	1	-						
Octet 4	8	-						
	7	-						
	6	-						
	5	-						
	4	-						
	3	-						
	2	-						
	1	7b	Housing temp. measurement				BAD, sensor failure	

The following warnings are mapped to the Transducerblock output values status:

	Bit in Octet	Warning number	Warning text	Mapping to status of Channel 1: MASS_FLOW	Mapping to status of Channel 2: VOLUME_FLOW	Mapping to status of Channel 3: DENSITY	Mapping to status of Channel 4: TEMPERATURE	Mapping to status of Channel 5 - 8: internal totalizers
Octet 1	8	10	Reverse Q					
	7	5c	Min Alarm Temperature					
	6	6c	Max Alarm Temperature					
	5	5b	Min Alarm Density					
	4	6b	Max Alarm Density					
	3	5a	Min Alarm Qm					
	2	6a	Max Alarm Qm					
	1	2	Totalizer reset					
Octet 2	8	9d	Totalizer Volume <R Overflow					
	7	9c	Totalizer Volume >F Overflow					
	6	9b	Totalizer Mass <R Overflow					
	5	9a	Totalizer Mass >F Overflow					
	4	1	Simulation	UNCERTAIN, simulated value	UNCERTAIN, simulated value	UNCERTAIN, simulated value	UNCERTAIN, simulated value	
	3	8b	Update external Data					
	2	8a	Update internal Data					
	1	7	External Data loaded					

3.5 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	→	If PV (AI Index 7) has status BAD and the substatus is Device_Failure or 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 (only for channel 5 to 8)
- XD_SCALE and OUT_SCALE are not identical for L_Type = direct

3.6 Error handling chain

Example 1:

Flow meter has error 3 – flow > 105%

→ Error 3 is set in Transducer block error register.
→ Status of Channel 1 (MASS_FLOW) is UNCERTAIN, Substatus EU range violation.
→ Status of AI-Block PV and OUT is UNCERTAIN, Substatus EU range violation.

Example 2:

Flow meter has error 2 - Driver

→ Error 2 is set in Transducer block error register.
→ Transducer block BLOCK_ERR shows Input Failure.
→ Transducer block XD_ERROR shows I/O-error.
→ Status of Channel 1 (MASS_FLOW) 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 is a value as float number and a status information as byte. This status byte has 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

4. Start-Up

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

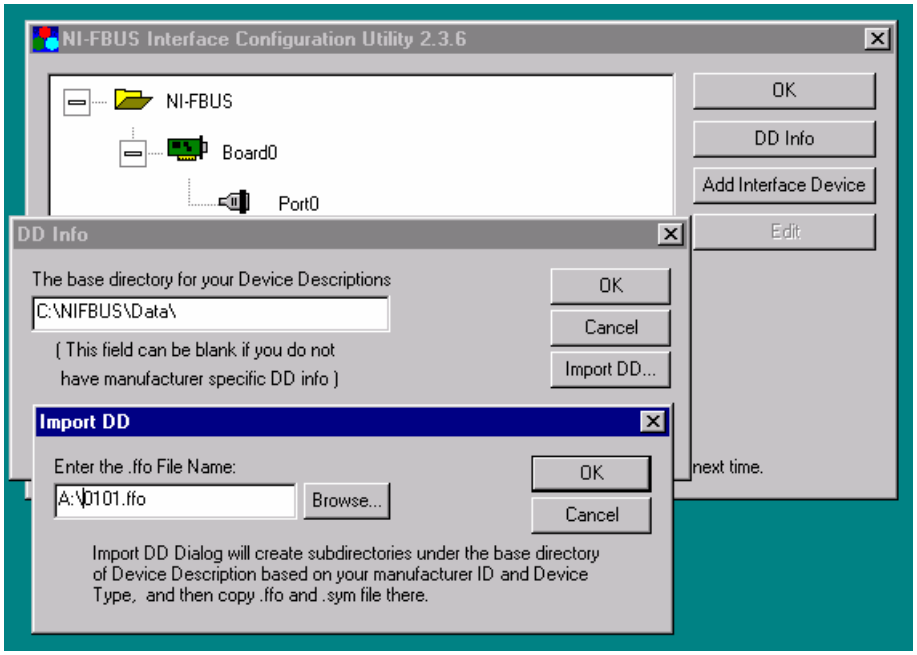
In addition to the instrument, you will require the following instrument-describing files for FSM4000 (000320/0018):

0101.ffo
0101.sym
010101.cff (not required for NI-Configurator)

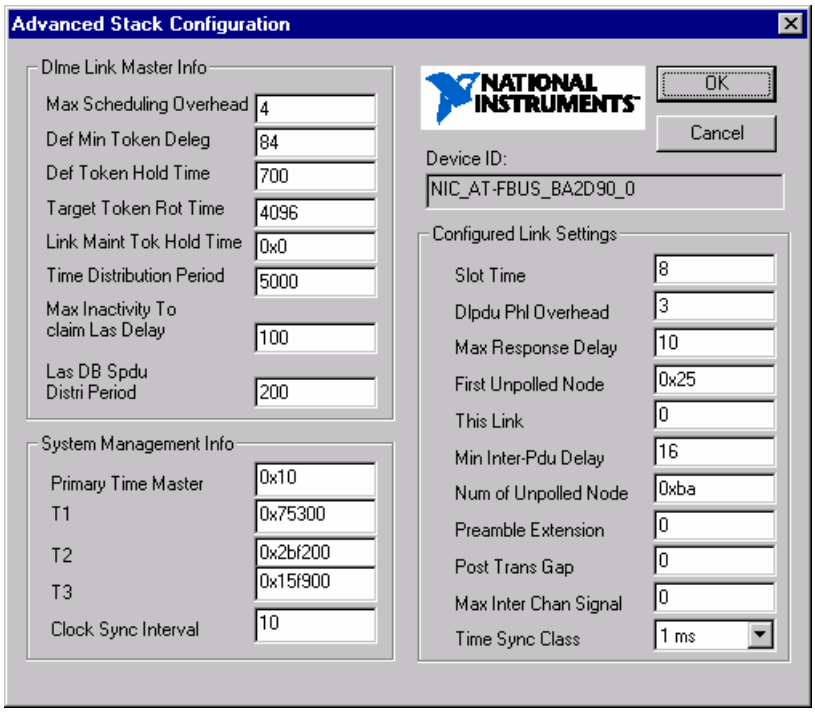
These files will be delivered along with the instrument. They can likewise be obtained via the Fieldbus Foundation Homepage www.fieldbus.org.

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.



At Port0 → Edit → Advanced is the “Advanced Stack Configuration”. These are the recommended settings from the Fieldbus Foundation for the Interop Test:

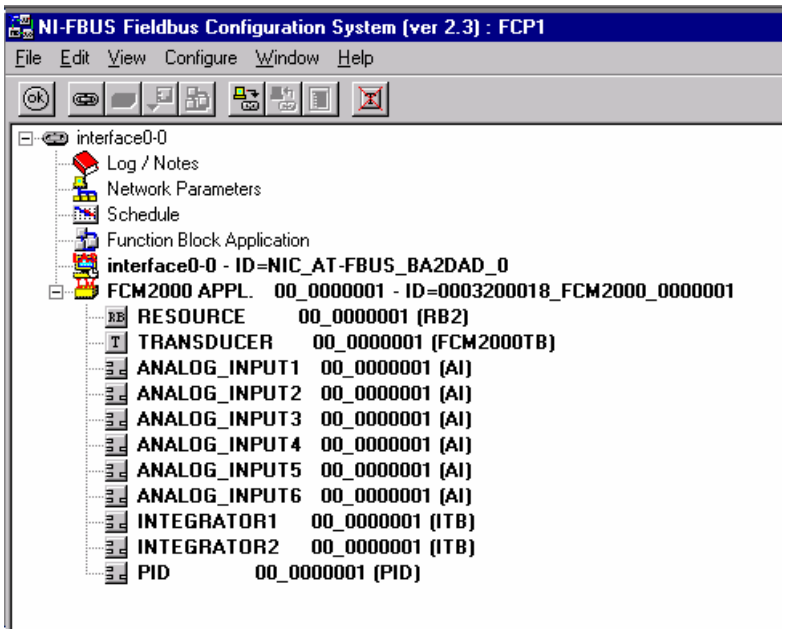


4.2 Verify Hardware switch

Please check on device, whether or not the hardware switch 2 is set to off. Should this not be the case, please change the setting to off (also feasible during instrument operation, refer to 1.1).

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

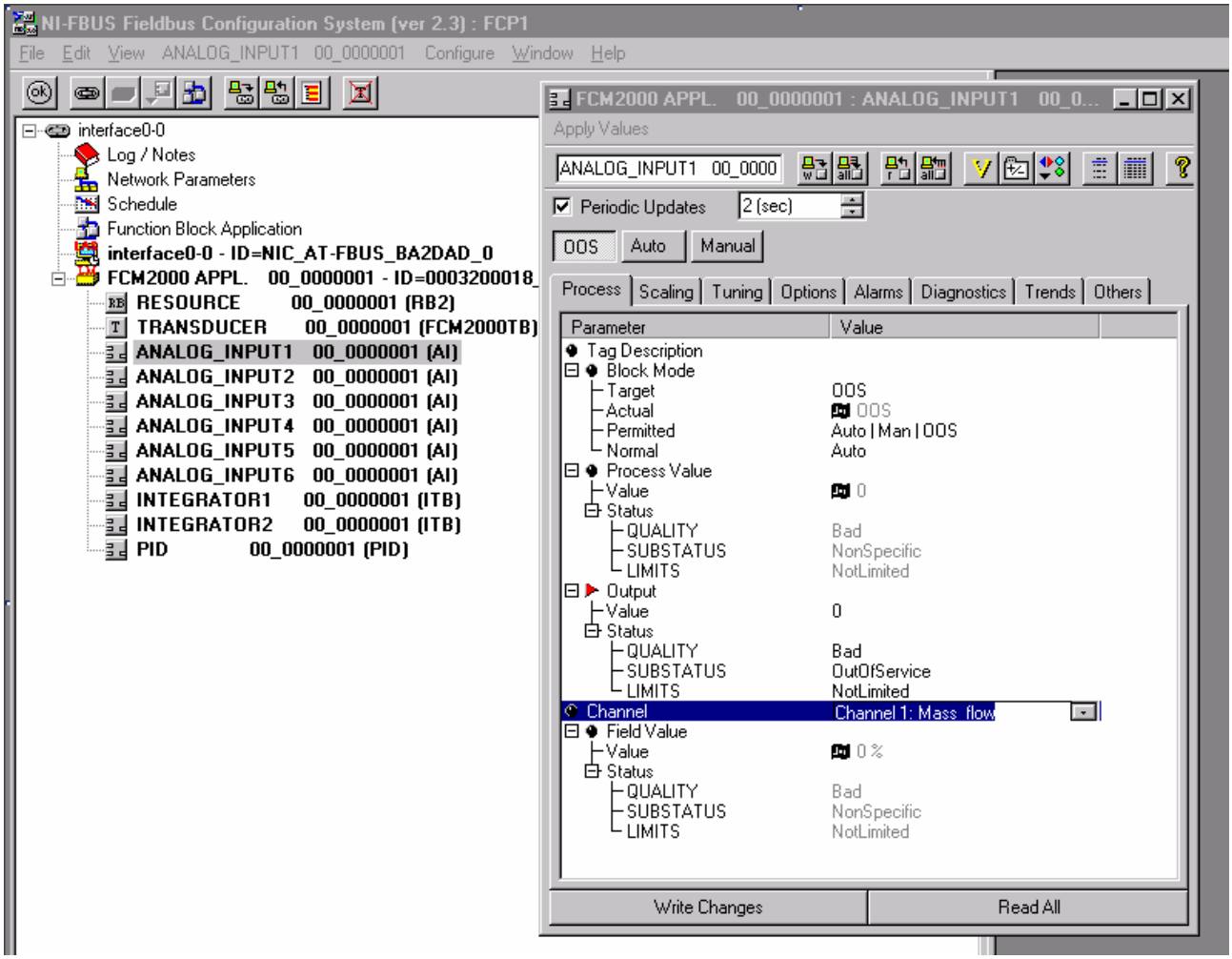
0018 = Device Type Code FCM000, hex

FCM2000 = Device-name

1234567 = serial umber of instrument expressed as 7-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 a PD-Tag (Physical device tag). To do so, please click on “FCM2000 APPL” using the right mouse button. Using SET TAG, please enter a denomination for the respective instrument. Repeat this procedure to choose tags for the other blocks.

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.

- The channel 1 to 4 value (MASS_FLOW, VOLUME_FLOW, DENSITY, TEMPERATURE) is delivered in the unit, which is set in XD_SCALE.Unit inside the AI-Block.

- The channel 5 to 8 values (internal Totalizers) are delivered in the Transducer Block units: “Unit mass totalizer” (Index 39) or “Unit volume totalizer” (Index 40). This is done, because a totalizer value unit conversion without consideration of the totalizer overflows makes no sense.

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).

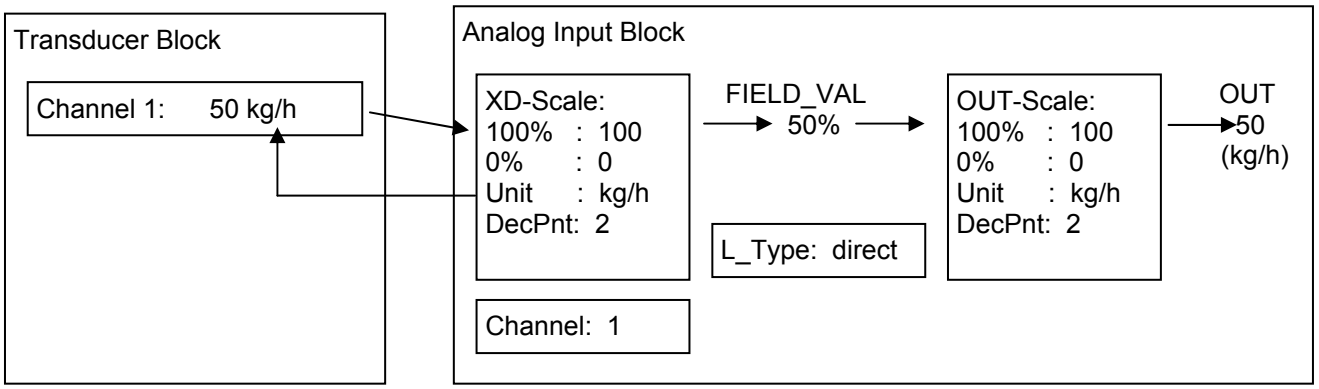
4.8.1 Unit with L_TYPE =Direct

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 be transferred to OUT.

Example:

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

- Set the L_TYPE within the AI-Block “Direct”
- Set the channel within the AI block to 1 in order to choose mass flow value (see 2.6.1)
- Within the AI block, please set the units XD_SCALE and OUT_SCALE likewise to kg/h.
- Recommendation (not necessary): set 100%-values in XD-Scale and OUT-Scale.
- 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 kg/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. 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 measure-ment range.

4.8.2 Unit with L_TYPE=Indirect

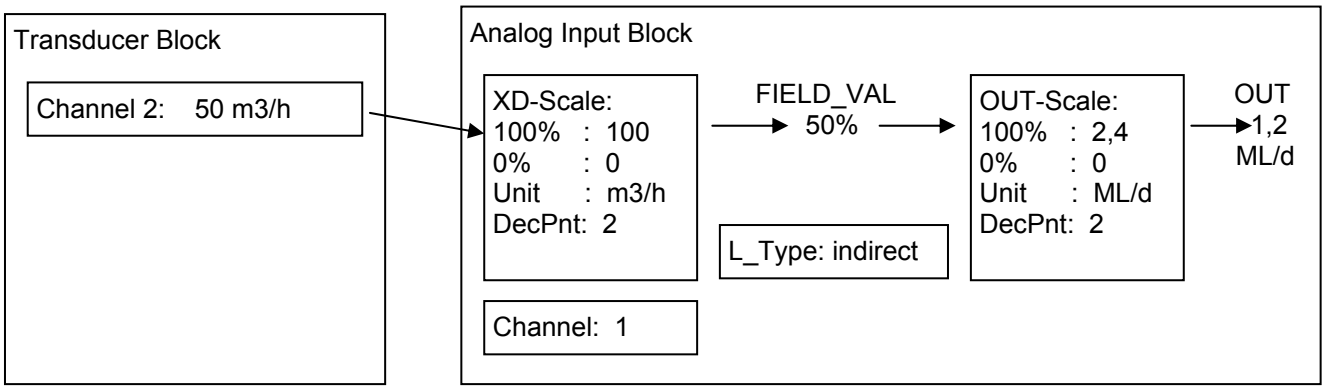
Should within the AI block the L_TYPE (index 16) be set to „indirect“, a change of scale as to the measured within the AI block will be done. Using the XD_SCALE the channel value will be set to percent (= FIELD_VAL). Using the OUT_SCALE structure, the percent value will be scaled to OUT value. Thus a change of scaling to any suitable unit available with Foundation Fieldbus becomes feasible.

Example:

The volume 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 L_TYPE within AI block to indirect.
- Set Channel within AI block to 2 as to choose volume flow value (see 2.6.1)
- Set XD-Scale within AI block to 0 to 100 m3/h.
- Set OUT-scale within AI block to 0 to 2.4 ML/d.
- Set AI block to “auto"



Using the XD scaling, the channel 2 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.

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.

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 scaling could for example be set at 0-100 m3/h to 0-100 Celsius, which, of course, makes no sense at all.

There is, of course, always a risk of faulty scaling. You could set a scaling of 0-100 m3/h to 0-100 ML/d, which would be incorrect.

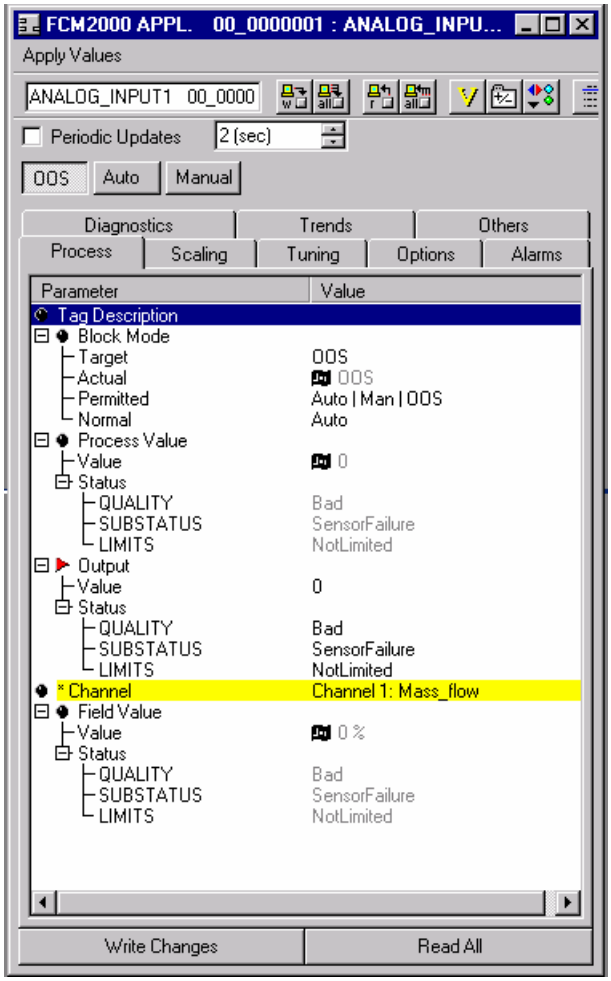
This behaviour refers to the Foundation Fieldbus AI blocks. The operator takes the responsibility of correctly setting the scale.

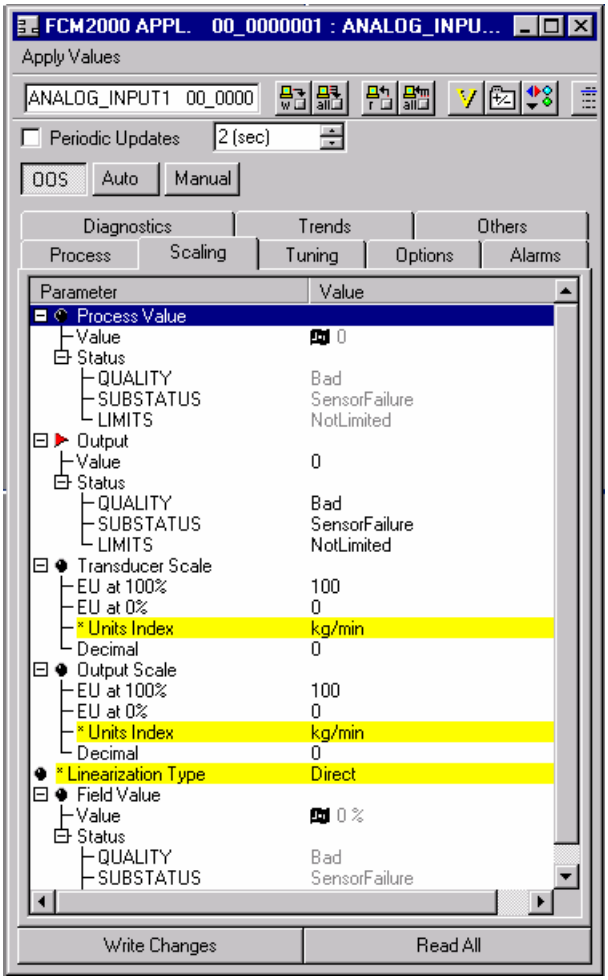
4.8.3 Summary, AI block settings

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:

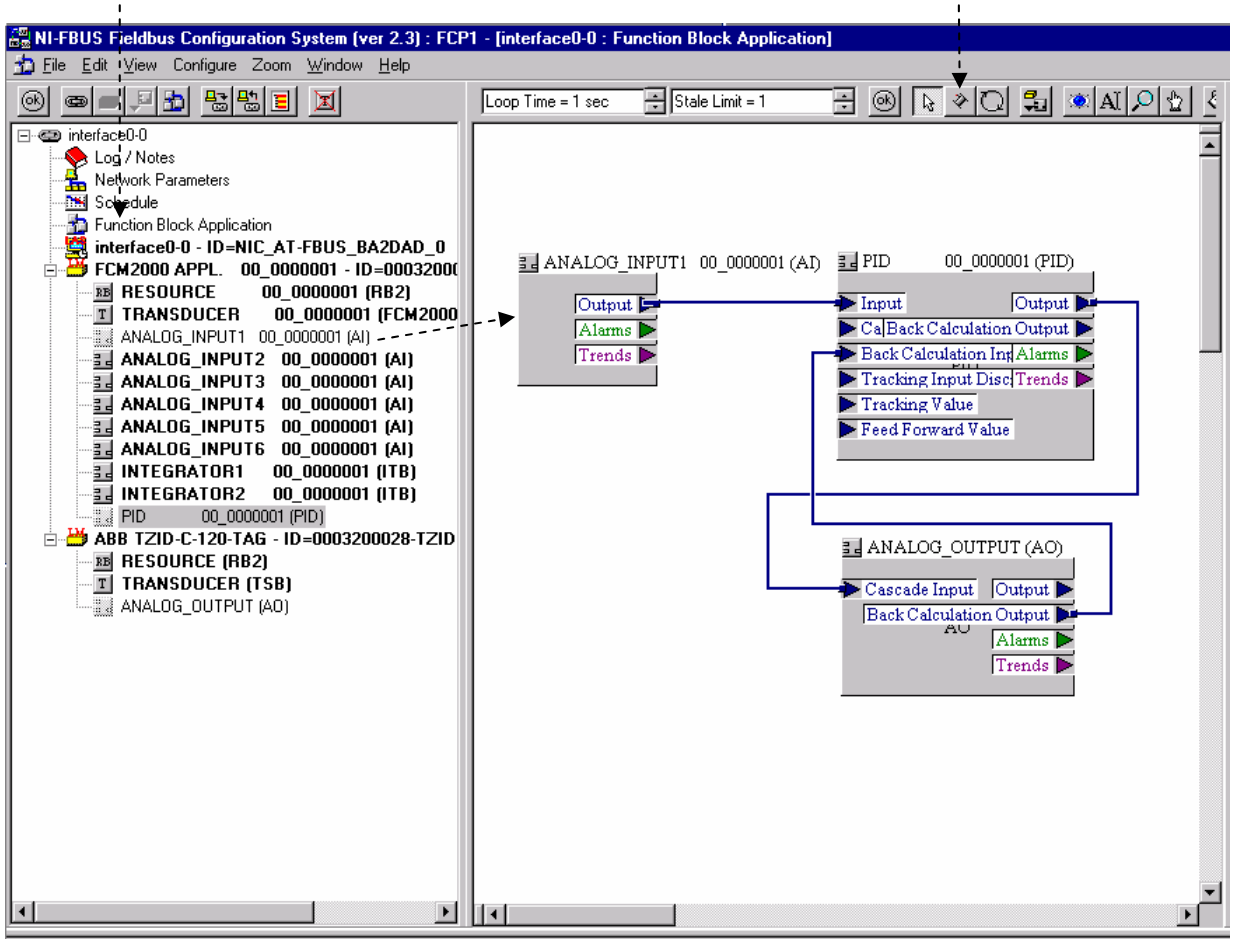
Bypass:	Recommended:Off
Shed_Opt:	Recommended:NormalShed_NormalReturn
Gain:	As required by application
SP:	As required by application

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.

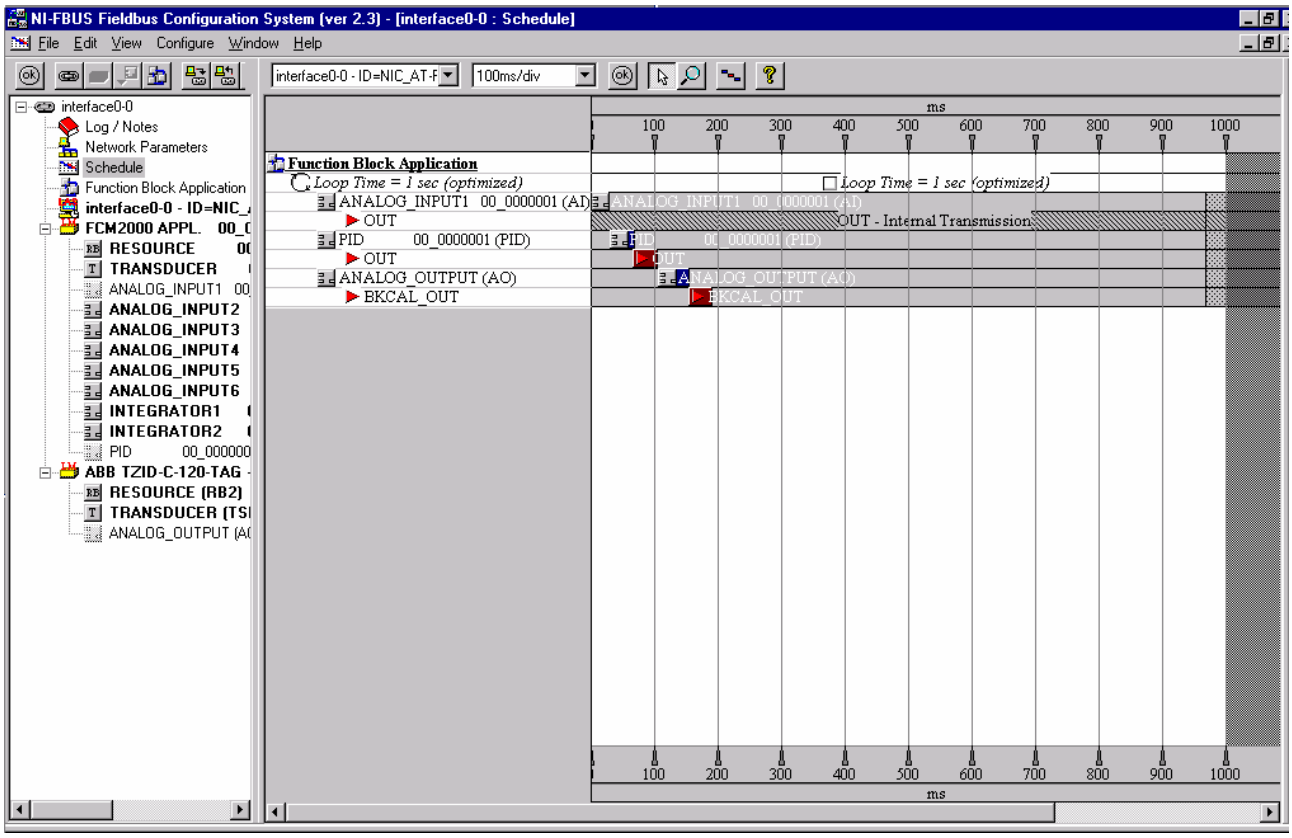
4.10 Function Block Application

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



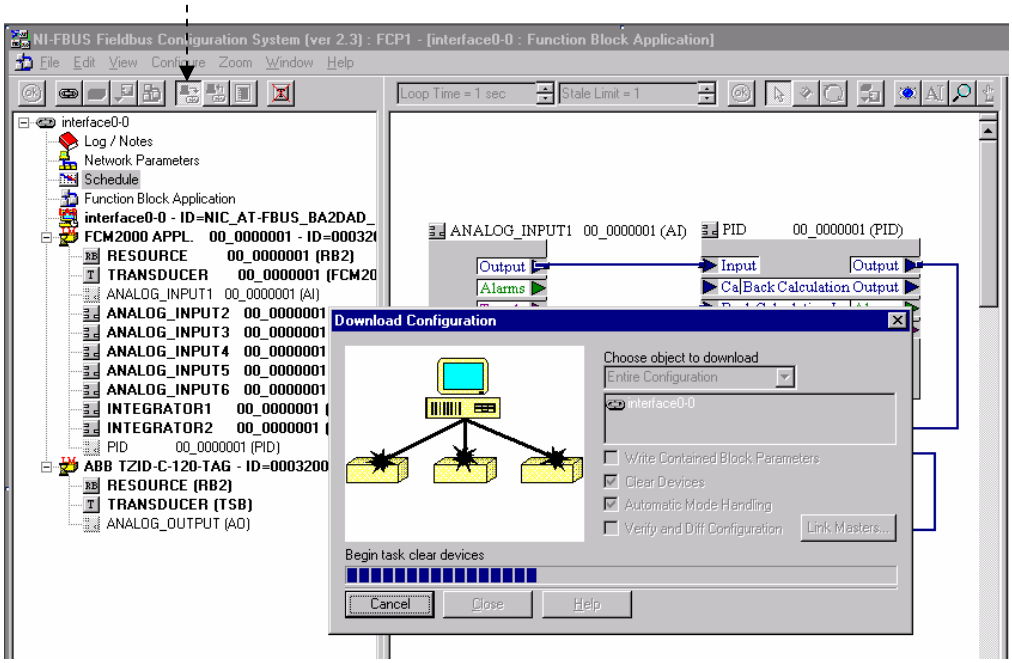
4.11 Schedule

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



4.12 Downlod Project

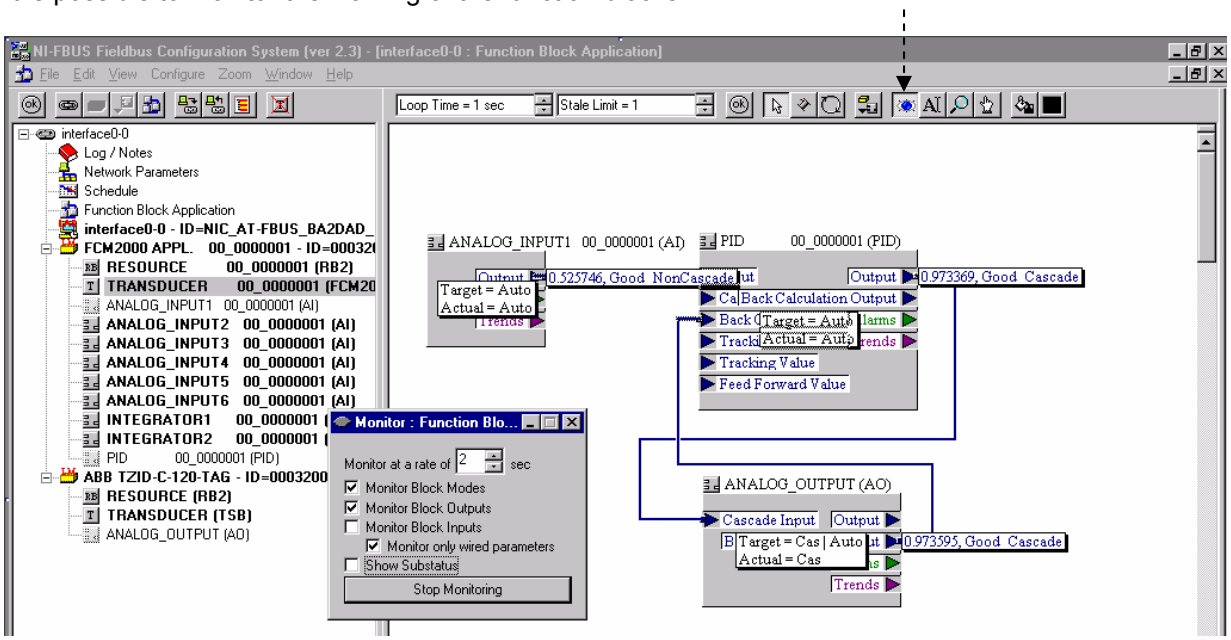
Download the configuration into the devices.



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 Error searching

4.14.1 Writing Parameter

The following error messages can 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.

4.14.2 AI Block cannot be set to AUTO

The Auto mode of an AI block requires the following settings:

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 to 8).
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 for channels 4 to 8 (see also 2.6.1).
5. With L_Type „Direct the XD_SCALE and OUT_SCALE structures have to be identical.

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

4.14.3 PID Block cannot be set to AUTO

The Auto mode of a PID block requires the following settings:

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.

PID actual mode remains in mode IMan:

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

5. Local operation

5.1 Local display

The flow meter has a 2 lines LCD display. In the submenu display can be selected, which parameters should be shown on the measurement value display (refer to Transducer Block index 56 to 59). Only one FF specific parameter is available:

- FF Address
  The address is shown decimal on the measurement value display:

```
FF Adr  21
```

5.2 Submenu data link

5.2.1 FF Address

The address is shown decimal:

```
Address
21
```

5.2.2 Device Identifier

This menu shows the device identifier:

```
Dev. Identifier
```

It is shown after pressing the enter key:

```
0003200017_FCM20
00_1234567
```

5.2.3 Dip Switch

This menu shows the DIP switch setting:

```
Dip Switch
```

Press the enter key to see the setting of the switches one and two (refer to 1.1):

```
1: SimEnable off
2: WriteProt off
```

Press again enter to see the setting of all switches (– open, X closed):

```
123456789A
----------
```

5.2.4 Error Mask

This menu shows the mask for the error register (TB index 97).

```
Error Mask
```

Press Enter. Then this will be shown:

```
Oct 1 Bit 1 OFF
Internal FRAM
```

Line one shows the setting of the bit (on/off). Line two shows the meaning of the bit.

Handling: Keys Data and Step to select a bit, Enter to switch on/off this bit, CE to leave the menu.

5.2.5 Warning Mask

This menu shows the mask for the warning register (TB index 98).
Handling is the same like menu Error Mask.

5.2.6 Revision Communication Software

This menu shows the revision of the communication part of the software.

```
CommSoftwareRev:
2.11.B.02
```

5.3 Submenu Status

The following menus are added to the submenu status.

5.3.1 Error and Warning Simulation On

This menu is only visible, if the service code is entered. With this menu the “error and warning simulation” can be switched on and off (TB index 101).

```
Simualtion
Off
```

Note: 5 minutes after the last simulation handling (via keyboard or Fieldbus) the simulation will be switched off automatically

5.3.2 Error Simulation

This menu is only visible, if the “error and warning simulation” is switched on. It is possible to set or reset every bit of the “error simulation value” (TB index 102).

```
Error Simulation
```

Press Enter. Then this will be shown:

```
Oct 1 Bit 1 OFF
Internal FRAM
```

Line one shows the setting of the bit (on/off). Line two shows the meaning of the bit.

Handling: Keys Data and Step to select a bit, Enter to switch on/off this bit, CE (or 20 sec no key) to leave the menu.

5.3.3 Warning Simulation

This menu is only visible, if the “error and warning simulation” is switched on. It is possible to set or reset every bit of the “warning simulation value” (TB index 103). Handling is the same like menu error simulation.

Note: Warning 1 (Simulation) can not switched of.

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