Interface Description
FOUNDATION Fieldbus
D184B093U32

Electromagnetic Flowmeter FSM4000

Valid for software levels from C.10
Model FSM4000-S4

Electromagnetic Flowmeter
FSM4000-S4

Interface description FOUNDATION Fieldbus

D184B093U32

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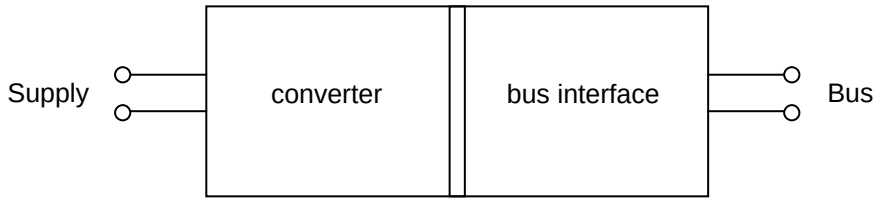
CONTENTS:

1. Hardware

The FF bus interface has the following data:

U = 9 – 32 V
I = 10 mA (normal operation)
I_{max} = 13 mA (maximum fault current)

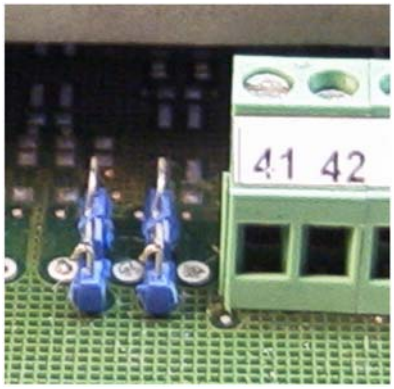
The bus connection is independet from polarity. The bus interface has no explosion proof design. Communication is only possible, if also the converter part has power supply and is working.



1.1 Bus termination

In the connection room of the converter housing are two switches. A termination can be connected to the bus by closing both switches. This should be done only for the last device at the trunk.

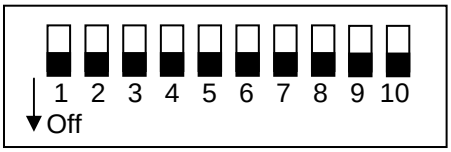
Take care to security instructions in the manual when opening the housing!



1.2 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 5.2.2). It can also be read over FF communication in the Transducer block (index 87)



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. 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.

2. Block-Overview

The device contains the following FF-Blocks:

- 1 x Resource Block
- 2 x Transducer Block
- 3 x AI Block (Analog Input)
- 1 x Enhanced PID Block

The resource and analog input blocks are standard FF blocks.

The PID block has three additional parameters compared to a standard PID and is therefor an enhanced block.

The transducer blocks are manufacturer specific and therefor custom blocks.

2.1 Block Table Legend

The below table treats the following attributes:

Index: Index of parameter within a block.

Data-Type: Data type of parameter. Some parameters are structures (DS-xx). These structures are described 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 resource and function block parameters to default values.

2.2 Resource Block

The resource block contains general information on the fieldbus instrument, such as manufacturer, instrument type, version numbers, etc.

2.2.1 Resource Block Parameter, 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 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	0x17 = FSM4000	Manufacturer's model name of the device.
12	DEV_REV	Unsigned 8	1	S	Read only	2	Device revision.
13	DD_REV	Unsigned 8	1	S	Read only	1	Revision of the DD file of the device.
14	GRANT_DENY	DS-70	2	D	OOS,Auto	0	Options for the access from PLC and DCS systems to device parameters.
15	HARD_TYPES	Bit String	2	S	Read only	0x8000	The types of hardware available for the channels of the device.
16	RESTART	Unsigned 8	1	D	OOS, Auto	1	Several possibilities of restart are possible: 1) Run 2) Restart resource 3) Restart with defaults 4) Restart processor
17	FEATURES	Bit String	2	S	Read only	0x4800	Used to show resource block options. 0x4800 = Reports supported, Hard Write Lock supported
18	FEATURE_SEL	Bit String	2	S	OOS, Auto	0x4800	Used to select resource block options. 0x4800 = Reports supported, Hard Write Lock supported
19	CYCLE_TYPE	Bit String	2	S	Read only	0xC000	Describes the block execution methods. 0xC000 = Scheduled, Completion of block execution
20	CYCLE_SEL	Bit String	2	S	OOS,Auto	0xC000	Select ion of the block execution method. 0xC000 = Scheduled, Completion of block execution

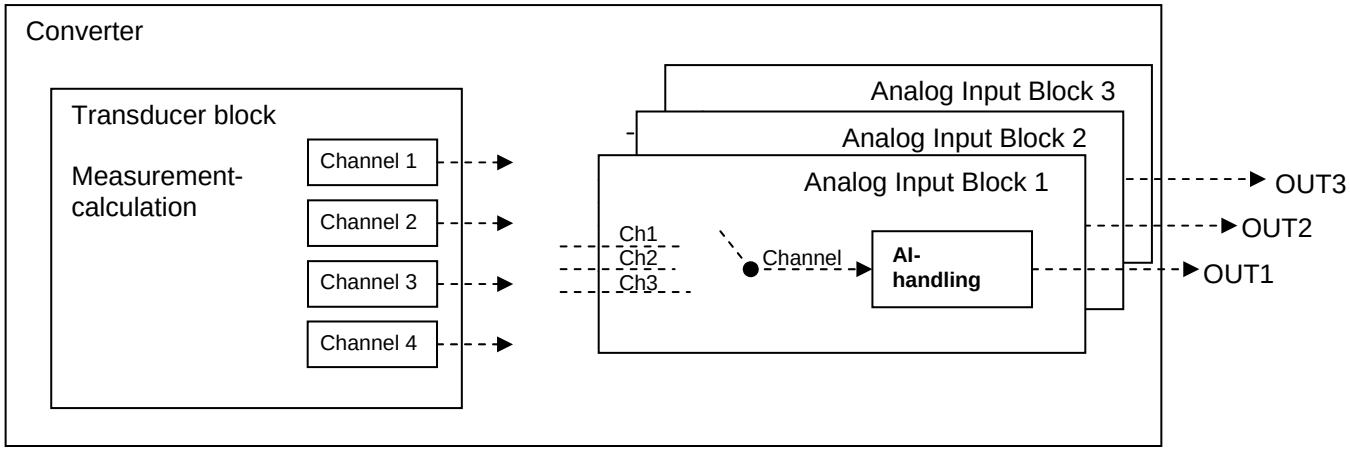
Index	Parameter Name	Data Type	Size	Storage Type	Write in Target-Mode	Default Values	Description
21	MIN_CYCLE_T	Unsigned 32	4	S	-	1600	Time duration of the shortest cycle time of the device in 1/32 ms.
22	MEMORY_SIZE	Unsigned 16	2	S	-	0	Available memory in the device.
23	NV_CYCLE_T	Unsigned 32	4	S	-	0	Interval between writing copies of NV parameters to non-volatile memory. Zero means never.
24	FREE_SPACE	Float	4	D	-	0.0	Percent of memory available for additional configuration.
25	FREE_TIME	Float	4	D	-	0.0	Percent of the block processing time that is free to process additional blocks.
26	SHED_RCAS	Unsigned 32	4	S	OOS,Auto	640000	Timeout time for connections to PLC or DCS in operation mode RCas.
27	SHED_ROUT	Unsigned 32	4	S	OOS,Auto	640000	Timeout time for connections to PLC or DCS in operation mod Rout.
28	FAULT_STATE	Unsigned 8	1	N	-	1	Behaviour of output blocks if communication errors appears.
29	SET_FSTATE	Unsigned 8	1	D	OOS,Auto	1	Allows the Fault State condition to be manually initiated.
30	CLR_FSTATE	Unsigned 8	1	D	OOS,Auto	1	Allows deleting the fault state condition.
31	MAX_NOTIFY	Unsigned 8	1	S	-	8	Maximum number of unconfirmed notify messages possible.
32	LIM_NOTIFY	Unsigned 8	1	S	OOS,Auto	8	Maximum number of unconfirmed notify messages allowed.
33	CONFIRM_TIME	Unsigned 32	4	S	OOS,Auto	640000	The time the device will wait for confirmation of receipt of a report before trying to send again. Retry shall not happen when CONFIRM_TIME = 0.
34	WRITE_LOCK	Unsigned 8	1	S	OOS,Auto	1 = Default switch position = Unlocked	If set, no writing is allowed. Cannot be cleared by software. Note: This parameter is dependent from the hardware switch Write_Lock (see chapter 1.2) 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

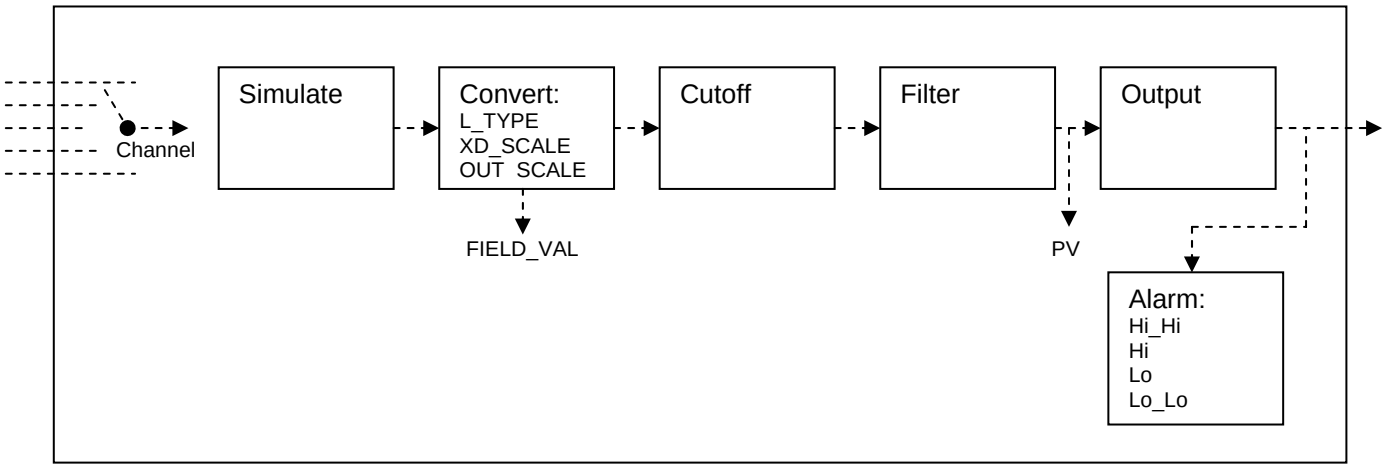
2.3 Analog Input Block

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 (Al block). The converter disposes of tree Al blocks.



An Al 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 2.7.10). You can activate a simulation by means of the sub-parameter “Simulate En/Disable”. The sub-parameter “Simulate-Value” indicates the simulation value, which will be processed instead of the channel value.

Note: The simulation can solely be activated if the hardware switch “Simulation Enable” is set to “on”, see 1.2.

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

The scaling structures (see 2.7.3) dispose of the Sub-Parameters EU100%, EU0%, Unit and Decimal Point.

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

FIELD_VAL = 100 * (Channel-Value – XD_SCALE.EU0%) /
(XD_SCALE.EU100% – XD_SCALE.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) * (OUT_SCALE.EU100% – OUT_SCALE.EU0%) + OUT_SCALE.EU0%

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

PV = sqrt (FIELD_VAL / 100) * (OUT_SCALE.EU100% – OUT_SCALE.EU0%) + OUT_SCALE.EU0%

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

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

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

2.3.2 Analog Input 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	-	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.
19	FIELD_VAL	DS-65	5	D	-	0x1C;0.0	Input value in percent scaled by XD_SCALE.

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

Information: INV = Infinite number

2.3.3 Analog Input Block Parameter, sorted according to names

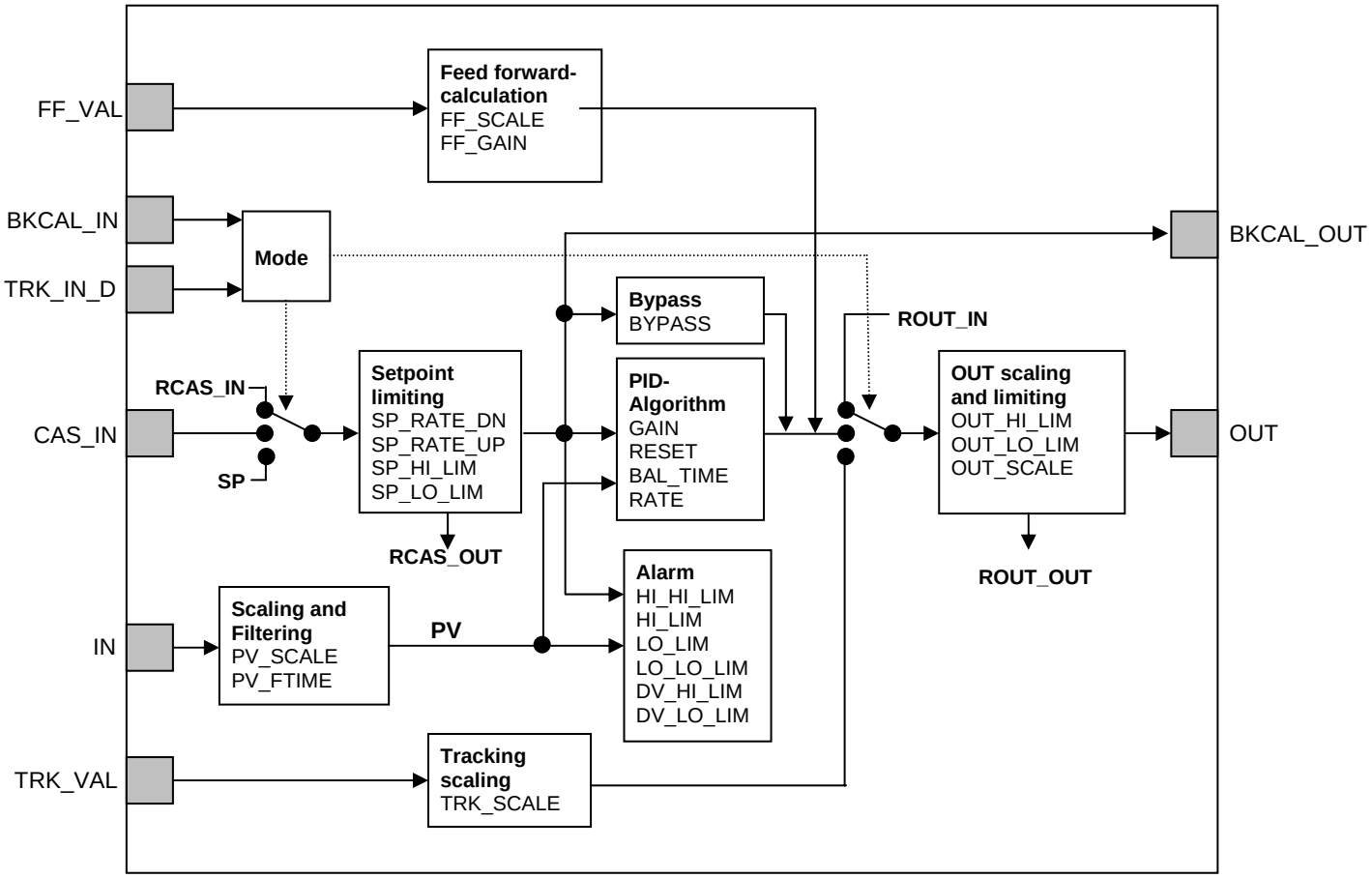
Parameter Name	Index
ACK_OPTION	23
ALARM_HYS	24
ALARM_SUM	22
ALERT_KEY	4
BLOCK_ALM	21
BLOCK_ERR	6
CHANNEL	15
FIELD_VAL	19
GRANT_DENY	12
HI_ALM	34
HI_HI_ALM	33
HI_HI_LIM	26
HI_HI_PRI	25
HI_LIM	28
HI_PRI	27
IO_OPTS	13
L_TYPE	16
LO_ALM	35
LO_LIM	30
LO_LO_ALM	36
LO_LO_LIM	32
LO_LO_PRI	31
LO_PRI	29
LOW_CUT	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 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.

2.4.1 PID Block Diagram

The PID block has following structure:



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

The setpoint source is determined by the mode:

AUTO mode: The **SP** parameter is used as setpoint.

CAS mode: In Cascade mode is **CAS_IN** input used as setpoint. This parameter comes from another function block.

RCAS mode: In Remote Cascade mode is the RCAS_IN-parameter used as setpoint. This parameter is written by a supervisory host computer.

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

The PID algorithm has tree parts:

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

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

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

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

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

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

2.4.2 Mode

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

2.4.3 PID Block, sorted in accordance with index

Index	Parameter Name	Data Type	Size	Storage Type	Write in Target-Mode	Default Values	Description
1	ST_REV	Unsigned 16	2	S	read only	0	Revision counter for static variables. Every time a static variable changes the revision counter is incremented by one.
2	TAG_DESC	Octet String	32	S	OOS, Man, Auto	Empty string	The user description of the application of the block.
3	STRATEGY	Unsigned 16	2	S	OOS, Man, Auto	0	This parameter can be used to create groups of blocks by assigning the same reference number to each block of a group. This parameter is not verified and not processed.
4	ALERT_KEY	Unsigned 8	1	S	OOS, Man, Auto	0	This parameter is used as identification number for plant units. It can be used within DCS or PLC systems e.g. to sort alarms.
5	MODE_BLK	DS-69	4	N,D,S,S	OOS, Man, Auto	Target : OOS Actual : OOS Permitted: OOS, Man, Auto, Cas, RCas, ROut Normal : Auto	The actual, target, permitted, and normal operation modes of the block.
6	BLOCK_ERR	Bit String	2	D	read only	0	Contains a summary of the block alarms.
7	PV	DS-65	5	D	read only		This parameter is the primary value for use in executing the block.
8	SP	DS-65	5	N	OOS, Man, Auto		Setpoint.
9	OUT	DS-65	5	N	OOS, Man		The output value of the PID block.
10	PV_SCALE	DS-68	11	S	OOS, Man	EU100%: 100.0 EU0% : 0.0 Unit : 0 DecPoint: 0	Input scaling of the block. Using 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: 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

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

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

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

Information: INV = Infinite number

2.4.3.1 Enhancement to standard PID block

Index	Parameter Name	Data Type	Size	Storage Type	Write in Target-Mode	Default Values	Description
66	T1_Rate	Float	4	S	OOS, Man, Auto, Cas, RCas, Rout	1	Derivative 1st order filter.
67	BETA	Float	4	S	OOS, Man, Auto, Cas, RCas, Rout	1	Set Setpoint weight proportional part.
68	GAMMA	Float	4	S	OOS, Man, Auto, Cas, RCas, Rout	1	Set-point weight derivative part.

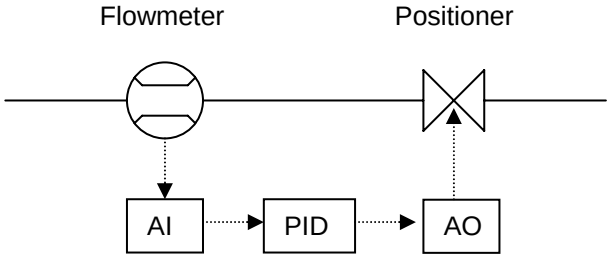
2.4.4 PID-Block, sorted according to names

Parameter Name	Index
ACK_OPTION	46
ALARM_HYS	47
ALARM_SUM	45
ALERT_KEY	4
BAL_TIME	25
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

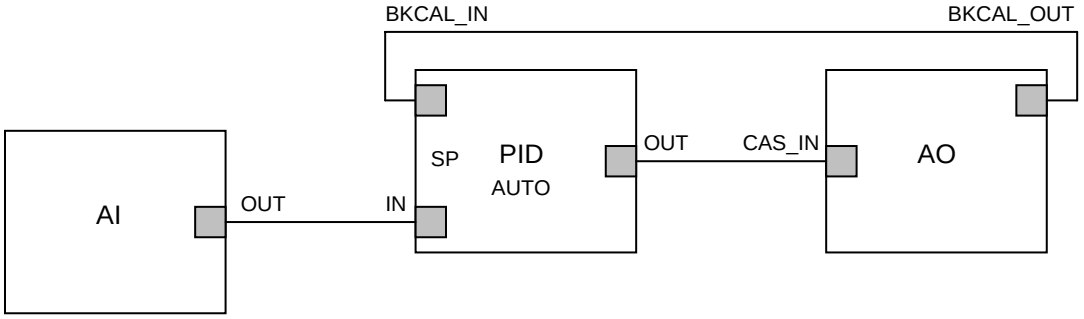
2.4.5 Example for PID control

2.4.5.1 Constant setpoint

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

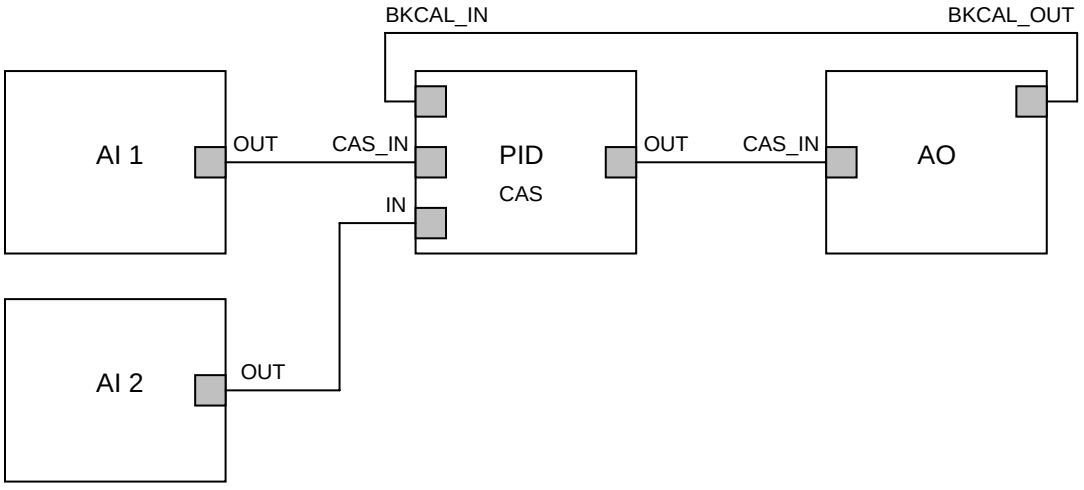


The process value is measured by a flow meter. The flow value is available as AI block. The constant setpoint is in the SP parameter inside PID block. The OUT value is send to an AO block of a positioner. It is necessary to make a back calculation connection from AO back to PID to get bumbles mode switching.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



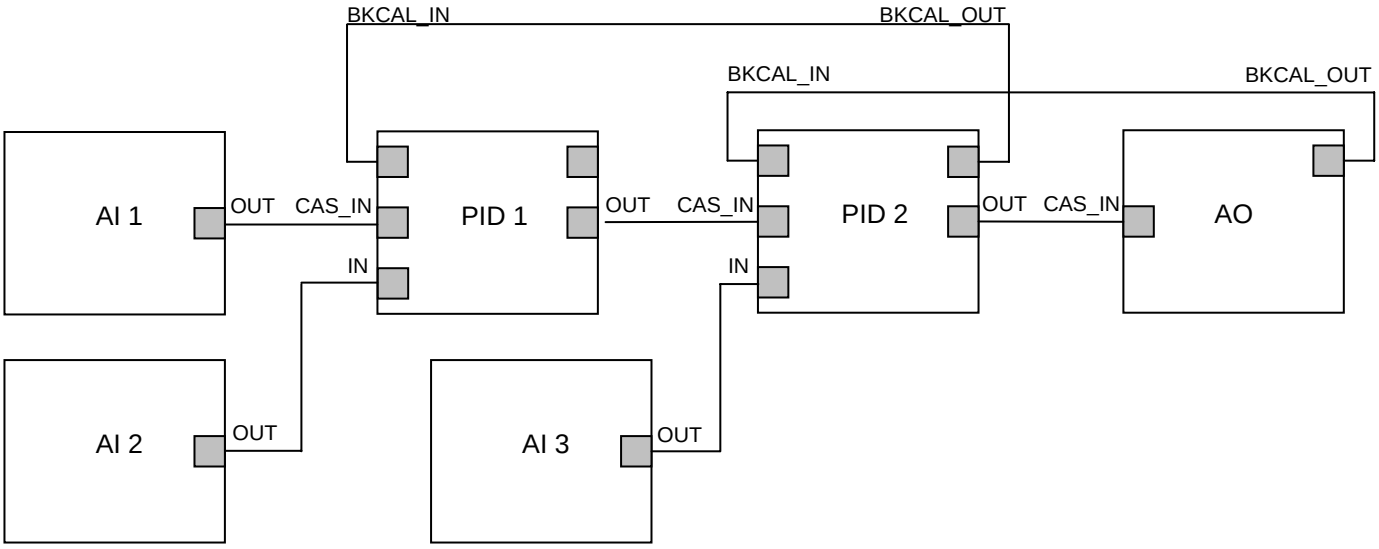
2.4.5.2 Extern setpoint

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).



2.4.5.3 Cascade PID blocks

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



2.5 Transducer Block

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

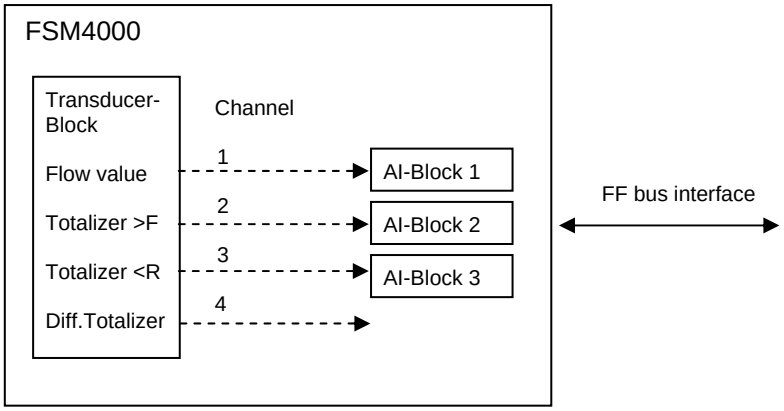
2.5.1 Channels und Units

The transducer block within the FSM4000 provides four 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. Each channel disposes of one physical unit. This unit has to comply with the XD-scale-unit of the AI blocks. Should it fail to do so, the AI block cannot be set to auto-mode.

Channel 1: PRIMARY_VALUE (Index 14) = Flow value
Unit: PRIMARY_VALUE_RANGE (Index 15, equal to index 37: Unit Qmax)

Channel 2 : SECONDARY_VALUE (Index 28) = Totalizer >F
Channel 3: THIRD_VALUE (Index 30) = Totalizer <R
Channel 4: FOURTH_VALUE (Index 31) = Diff. Totalizer
Unit: SECONDARY_VALUE_UNIT (Index 29, equal to index 38: Unit Totalizer)

Information: The FSM4000 has no integrator function blocks. Instead the flow meter internal totalizers are mapped into the transducer block and can be used by the AI blocks.



2.5.2 Transducer Block Parameter, sorted in accordance with index

Parameter:
1 to 29 equal a standard flow with calibration block, as described in FF document FF- 903 PS3.0.
30 to 104 contain further measurement and setting parameters of the converter. These are also accessible via display and keyboard of the converter. The description of the parameters can be taken from the converter instruction manual.

2.5.2.1 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	blank	The user description of the application of the block.
3	STRATEGY	Unsigned 16	2	S	OOS, Auto	0	This parameter can be used to create groups of blocks by assigning the same reference number to each block of a group. This parameter is not verified and not processed.
4	ALERT_KEY	Unsigned 8	1	S	OOS, Auto	96	This parameter is used as identification number for plant units. It can be used within DCS or PLC systems e.g. to sort alarms.
5	MODE_BLK	DS-69	4	N,D,S, S	OOS, Auto	Target : OOS Actual : OOS Permitted: Auto, OOS Normal : Auto	The actual, target, permitted, and normal operation modes of the block.
6	BLOCK_ERR	Bit String	2	D	read only	0	Contains a summary of block alarms. Following bits are supported: Bit 3 = Simulate Active At following device messages: Warning 1: Simulation Warning 15: Error- and Warning-Simulation Bit 7 = Input Failure/ process variable has BAD status At following device messages: Error 1: AD-Converter/DSP Error 2: Driver Error E: NV-Reset Error G: Diagnosis Bit 10 = Lost NV Data At following device messages: Error 5: Int. Datenbase Error C: Ext. Datenbase Bit 11 = Lost NV Data At following device messages: Error 6: Totalizer

Index	Parameter Name	Data type	Size	Storage Type	Write	Default Values	Description
							Bit 15 = Out-of-Service (MSB) If Transducer block actual-Mode is OOS.
7	UPDATE_EVT	DS-73	14	D	OOS, Auto		This alert is generated by any change to the static data.
8	BLOCK_ALM	DS-72	13	D	OOS, Auto		Block Alarm is not supported.
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) = FSM4000
11	XD_ERROR	Unsigned 8	1	D	read only		Following messages are supported: 22 = I/O-Error At following device messages: Error 1: AD-Converter/DSP Error 2: Driver 23 = Data integrity error At following device messages: Error 5: Int. Datenbase Error 6: Totalizer Error C: Ext. Datenbase
12	COLLECTION_DIRECTORY	Array of Unsigned 32	1	C	read only	0	A directory that specifies the number, starting indices, and DD Item IDs of the data collections in each transducer within a transducer block.
13	PRIMARY_VALUE_TYPE	Unsigned 16	2	S	OOS, Auto	101	The type of measurement represented by the primary value. The table shown below describes this parameter. 101: volumetric flow Information: Only 101 can be written.
14	PRIMARY_VALUE	DS-65	5	D	Read only		The measured primary value and status available to the function blocks. This is the flow value. Unit: look at PRIMARY_VALUE_RANGE.
15	PRIMARY_VALUE_RANGE	DS-68	11	N	read only		The High and Low range limit values, the engineering units code and the number of digits of the right of the decimal point to be used to display the Primary Value. High limit value =Qmay, see index 45 Low Limit Value = -Qmax, see index 45 Unit = Unit Qmax, see index 37 DecPoint = 2 Information: Because a magnetic inductive flow meter can measure both flow directions the limits are –Qmaxto +Qmax.
16	CAL_POINT_HI	Float	4	S	OOS, Auto		The highest calibrated value: Equal to Index 44: Cal factor Cal factor 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 –Cal factor, index 44.

Index	Parameter Name	Data type	Size	Storage Type	Write	Default Values	Description
							Information: The flow meter has only one cal factor, valid for both flow directions. This parameter is equal to index 44 with inverted sign. Cal factor 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 37: Range unit. Writing this index is equal to writing index 37.
20	SENSOR_TYPE	Unsigned 16	2	C	OOS, Auto	102	The sensor type defined below: 102: electromagnetic flowmeter Information: Only 102 can be written.
21	SENSOR_RANGE	DS-68	11	C	Read only		The High and Low range limit values, the engineering units code, and the number of digits to the right of the decimal point for the sensor. SENSOR_RANGE.100%: Cal factor, see index 44 SENSOR_RANGE.0% : -Cal factor, see index 44 SENSOR_RANGE.Unit : Range unit, see index 37 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 72) is shown here.
23	SENSOR_CAL_METHOD	Unsigned 8	1	S	OOS, Auto		The method of last sensor calibration.
24	SENSOR_CAL_LOC	Visible String	32	S	OOS, Auto		The location of the last sensor calibration.
25	SENSOR_CAL_DATE	Date	7	S	OOS, Auto		The date of the last sensor calibration.
26	SENSOR_CAL_WHO	Visible String	32	S	OOS, Auto		The name of the person who is responsible for the last sensor calibration.
27	LIN_TYPE	Unsigned 16	2	C	OOS, Auto	1	Contains the linearisation type used to describe the behaviour of the sensor: 1: Linear with Input Information: Only 1 can be written.
28	SECONDARY_VALUE	DS-65	5	D	Read only		This is the Totalizer >F. Unit: look at index 29, SECONDARY_VALUE_UNIT.
29	SECONDARY_VALUE_UNIT	Unsigned 16	2	S	OOS, Auto	1038	This parameter is equal to index 38, Unit totalizer. Writing this parameter is equal to writing index 38.

2.5.2.2 Transducer Block part 2: Manufacturer specific parameters

Index	Variable Name	Data Type	Size	Store	Access	Default Value	Description
30	THIRD_VALUE	DS-65	5	D	r		This is the Totalizer <R. Unit: look at index 29, SECONDARY_VALUE_UNIT.
31	FOURTH_VALUE	DS-65	5	D	r		This is the Difference Totalizer. Unit: look at index 29, SECONDARY_VALUE_UNIT.
32	Prog.Prot.Code	Unsigned 16	2	S	r,w	0	Lower Limit: 0 Upper Limit: 9999 Unit : -
33	Language	Unsigned 8	1	S	r,w	0	0: German 1: English 2: French 3: Finnish 4: Spain 5: Italian 6: Dutch 7: Danish 8: Swedish 9: Turkish
34	Operating mode	Unsigned 8	1	S	r,w	0	0: Standard 1: Piston Pump 2: Fast
35	Flow direction	Unsigned 8	1	S	r,w	0	0: Forward/Reverse 1: Forward
36	Flow indication	Unsigned 8	1	S	r,w	0	0: Normal 1: Invers
37	Unit Qmax	Unsigned 16	2	S	r,w	l/s	1351: l/s 1352: l/min 1353: l/h 1347: m3/s 1348: m3/min 1349: m3/h 1350: m3/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

Index	Variable Name		Data Type	Size	Store	Access	Default Value	Description
								1374: bbl/d 1356: ft3/s 1357: ft3/m 1358: ft3/h 1359: ft3/d 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
38	Unit Totalizer		Unsigned 16	2	S	r,w	l	1040: ml 1038: l 1034: m3 1048: ugl 1049: igl 1051: bbl 1089: g 1088: kg 1092: t 1094: lb
39	Density		Float	4	S	r,w	1	Lower Limit: 0,1 Upper Limit: 5 Unit : g/cm3
40	Data 50Hz		Record	16	N	r		
		Channel	Float	4	N	r		Unit : us
		Zero	Float	4	N	r		Unit : %
		Span >V	Float	4	N	r		Unit : %
		Span <R	Float	4	N	r		Unit : %
41	Data 60Hz		Record	16	N	r		
		Channel	Float	4	N	r		Unit : us
		Zero	Float	4	N	r		Unit : %
		Span >V	Float	4	N	r		Unit : %
		Span <R	Float	4	N	r		Unit : %
42	Data 70Hz		Record	60	N	r		
		Channel	Float	4	N	r		Unit : us
		Zero	Float	4	N	r		Unit : %
		Span >V	Float	4	N	r		Unit : %

Index	Variable Name		Data Type	Size	Store	Access	Default Value	Description
		Span >V	Float	4	N	r		Unit : %
		Zero 2	Float	4	N	r		Unit : % Software C.10
		Span 2 >V	Float	4	N	r		Unit : % Software C.10
		Span 2 >V	Float	4	N	r		Unit : % Software C.10
		Zero 4	Float	4	N	r		Unit : % Software C.10
		Span 4 >V	Float	4	N	r		Unit : % Software C.10
		Span 4 >V	Float	4	N	r		Unit : % Software C.10
		Zero 8	Float	4	N	r		Unit : % Software C.10
		Span 8 >V	Float	4	N	r		Unit : % Software C.10
		Span 8 >V	Float	4	N	r		Unit : % Software C.10
		Zero Pre/FIR2	Float	4	N	r		Unit : % Software C.10
		Zero Pre	Float	4	N	r		Unit : % Software C.10
43	Primary		Record	39	N	r		
		Type of primary	Unsigned 8	1	N	r	0	0 : SE2_,SE4_ 1 : DS2_ 2 : DS4_ 3 : 10DS3111 (A-C) 4 : 10DS3111 (E-) 5 : 10DI1422 6 : 10DI1425 7 : 10DS3111 D 8 : non
		Line frequency	Unsigned 8	1	N	r		0 : 50 Hz 1 : 60 Hz

Index	Variable Name		Data Type	Size	Store	Access	Default Value	Description
		Meter size	Unsigned 8	1	N	r	12	43 : 1 mm 1/25 in 44 : 1,5 mm 1/17 in 45 : 2 mm 1/12 in 0 : 3 mm 1/10 in 1 : 4 mm 5/32 in 2 : 6 mm 1/4 in 3 : 8 mm 5/16 in 4 : 10 mm 3/8 in 5 : 15 mm 1/2 in 6 : 20 mm 3/4 in 7 : 25 mm 1 in 8 : 32 mm 1-1/4 in 9 : 40 mm 1-1/2 in 10 : 50 mm 2 in 11 : 65 mm 2-1/2 in 12 : 80 mm 3 in 13 : 100 mm 4 in 14 : 125 mm 5 in 15 : 150 mm 6 in 16 : 200 mm 8 in 17 : 250 mm 10 in 18 : 300 mm 12 in 19 : 350 mm 14 in 20 : 400 mm 16 in 21 : 450 mm 18 in 22 : 500 mm 20 in 23 : 600 mm 24 in 24 : 700 mm 28 in 25 : 750 mm 30 in 26 : 800 mm 32 in 27 : 900 mm 36 in 28 : 1000 mm 40 in
		Primary Span Cs	Float	4	N	r	100	Unit : %
		Primary Zero Cz	Float	4	N	r	0	Unit : %
		Primary Phase	Float	4	N	r	90	Unit : -
		Reference voltage	Float	4	N	r	70	Unit : mV
		Meter Faktor	Float	4	N	r		Unit : - Software C.10
		Order number	String	16	N	r		
44	Cal-factor 10m/s		Float	4	N	r	50	Unit : Unit Qmax
45	Qmax		Float	4	S	r,w	50	Lower Limit: depends from some other parameters Upper Limit: depends from some other parameters Unit : Unit Qmax
46	Damping [1]		Float	4	S	r,w	5	Lower Limit: depends from operating mode Upper Limit: depends from operating mode Unit : sec
47	Low flow cut off		Float	4	S	r,w	1	Lower Limit: 0

Index	Variable Name	Data Type	Size	Store	Access	Default Value	Description
							Upper Limit: 10 Unit : %
48	Detector empty pipe	Unsigned 8	1	S	r,w	0	0 : Off 1 : On
49	DEP Mode	Unsigned 8	1	S	r,w	0	0 : Standard 1 : New adjust
50	Adjust empty pipe	Float	4	S	r,w	1000	Lower Limit: 100 Upper Limit: 10000000 Unit : -
51	Start automatic adjust empty pipe	Unsigned 8	1	S	r,w	0	read: 0 = no adjust running 1 = adjust is running write: 1 = start adjust Writing 1 triggers the start of the adjust, which needs about 45 seconds.
52	Adjust full pipe	Float	4	S	r,w	500	Lower Limit: 100 Upper Limit: 10000000 Unit : -
53	Start automatic adjust full pipe	Unsigned 8	1	S	r,w	0	read: 0 = no adjust running 1 = adjust is running write: 1 = start adjust Writing 1 triggers the start of the adjust, which needs about 45 seconds.
54	Threshold	Float	4	S	r,w	10000	Lower Limit: 100 Upper Limit: 1000000 Unit : -
55	Alarm empty pipe	Unsigned 8	1	S	r,w	0	0 : Off 1 : On
56	Display mode	Unsigned 8	1	S	r,w	0	0 : 1 big, 1 small 1 : 4 small
57	Display 1st line	Unsigned 8	1	S	r,w	0	0 : Q [Percent] 1 : Q [Unit] 3 : Q [m/s] 100: FF Address 101: TB VolFlowValue 102: TB VolFlow Stat
58	Display 2nd line	Unsigned 8	1	S	r,w	5	
59	Display 3rd line	Unsigned 8	1	S	r,w	11	

Index	Variable Name	Data Type	Size	Store	Access	Default Value	Description	
0	Display 4th line	Unsigned 8	1	S	r,w	11	4 : Q Bargraph 5 : Zähler 6 : Totalizer >F 7 : Totalizer <R 8 : Totalizer Diff. 10 : Empty pipe 11 : Blank 12 : Signal (1) 13 : Reference (1) 14 : Min-/Max-Signal (1) 15 : Min-/Max-Ref. (1) 16 : Min-/Max-SigFilt (1) 17 : Min-/Max-RefFilt (1) 18 : Phase (1) 19 : DEP Puls E1 (1) 20 : DEP Puls E2 (1) 21 : DC-Reset (1) 22 : DAC Amp. (1) 23: Pulse out (2) 24: Fprt1 (2) 25: Fprt2 (2) 26: Fprt3 (2) 27: Fprt4 (2) 28: Hist Max Error (2) 29: Hist Min Error (2) 30: Act Max Error (2) 31: Act Min Error (2) 32: Akt Max Warning (2) 33: Akt Min Warning (2) 34: Connect Warning (2) 35: Connect Error (2)	100: FF Address 101: TB VolFlowValue 102: TB VolFlow Status 103: TB Total >V Value 104: TB Total >V Status 105: TB Total <R Value 106: TB Total <R Status 107: TB TotDiff Value 108: TB TotDiff Status 109: FB AI1 Out.Value 110: FB AI1 Out.Status 111: FB AI2 Out.Value 112: FB AI2 Out.Status 113: FB AI3 Out.Value 114: FB AI3 Out.Status 115: PID In.Value 116: PID In.Status 117: PID Out.Value 118: PID Out.Status 119: PID Cas_In.Value 120: PID Cas_In.Status 121: PID FF_Val.Value 122: PID FF_Val.Status 123: PID Trk_Vaue.Value 124: PID Trk_Value.Status Note (1): Writing of these values is only possible if the service code is put in. Note (2): Writing of this values is only possible if diagnosis is active.
61	Contrast	Unsigned 8	1	S	r,w	137	Lower Limit: 124 Upper Limit: 144 Unit : -	
62	Min. Alarm	Float	4	S	r,w	0	Lower Limit: 0 Upper Limit: Max. Alarm Unit : %	
63	Max. Alarm	Float	4	S	r,w	105	Lower Limit: Min. Alarm Upper Limit: 105 Unit : %	
64	Overflow >F	Unsigned 16	2	N	r			
65	Totalizer >F	DS-33	5	N	r,w		Lower Limit: 0 Upper Limit: 10000000 Unit : Index 38: Unit Totalizer Note: The Totalizer can we written.	

Index	Variable Name	Data Type	Size	Store	Access	Default Value	Description
66	Overflow <R	Unsigned 16	2	N	r		
67	Totalizer <R	DS-33	5	N	r,w		Lower Limit: 0 Upper Limit: 10000000 Unit : Index 38: Unit Totalizer Note: The Totalizer can we written.
68	Overflow Diff.	Signed 16	2	N	r		
69	Totzalizer Diff.	DS-33	5	N	r,w		Lower Limit: 0 Upper Limit: 10000000 Unit : Index 38: Unit Totalizer Note: The Totalizer can we written.
70	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
71	Contact output	Unsigned 8	1	S	r,w	0	0 : No function 1 : F/R-Signal /_ 13: F/R-Signal __ 4 : General Alarm /_ 5 : General Alarm __ 6 : Max/Min Alarm /_ 7 : Max/Min Alarm __ 8 : Min Alarm /_ 9 : Min Alarm __ 10: Max Alarm /_ 11: Max Alarm __ 2 : Empty pipe /_ (1) 3 : Empty pipe __ (1) 14: Extended Diagnosis-Alarm /_ 15: Extended Diagnosis-Alarm __ 16: 5 kHz Output (2) Note (1): Writing is only allowed, when detector empty pipe (Index 48) is switched on. Note (2): Writing is only allowed, when the service code is put in.
72	Instrument number	Unsigned 16	2	S	r	700	
73	Manufacture Code	Visible String	8	S	r	"00000000"	
74	Primary tag	Visible String	32	S	r,w	"----------"	
75	Converter tag	Visible String	32	S	r,w	"----------"	
76	Memory Test	Unsigned8	1	D	r,w	0	0: No Memory Test 1: Memory Test int Fram run 2: Memory Test int Fram ok 3: Memory Test int Fram error 4: Memory Test ext Fram run 5: Memory Test ext Fram ok 6: Memory Test ext Fram error 7: Memory Test Flash run

Index	Variable Name		Data Type	Size	Store	Access	Default Value	Description
								8: Memory Test Flash ok 9: Memory Test Flash error There are three different memory tests: Internal Fram, External Fram and Flash. Writing 1, 4 or 7 will start a test. Reading shows, if the test is still running (for example 1) or the result of the test (2 = int Fram is ok, or 3 = int. Fram has error).
77	Function test contact output							0 : No test 1 : Test active, contact output is off 2 : Test active, contact output is on
78	Simulation Mode		Unsigned8	1	D	r,w	0	0 : Off 1 : On
79	Simlation value		Float	4	D	r,w	0	Lower Limit: -130 Upper Limit: 130 Unit : %
80	System zero		Float	4	S	r,w	0	Lower Limit: -10 Upper Limit: 10 Unit : %
81	Start automatic adjust system zero							read: 0 = no adjust running 1 = adjust is running write: 1 = start adjust Writing 1 triggers the start of the adjust, which needs about 45 seconds.
82	Version		Visible String	16	Cst	r	"D699G004U01 B.10"	
83	Driver		Record	16	N	r		
		Driver	Unsigned 8	1	N	r	0	0 : Controller 1 : Controll system
		Referenve voltage	Float	4	N	r	70	Unit : mV
		Delta Amp.	Float	4	N	r	0,015	Lower Limit: 0 Upper Limit: 1 Unit : -
		DAC Amp.	Unsigned 16	2	N	r	130	Lower Limit: 130 Upper Limit: 1023 Unit : -
		Min DAC Amp.	Unsigned 16	2	N	r	130	Lower Limit: 130 Upper Limit: 1023 Unit : keine
		Max DAC Amp.	Unsigned 16	2	N	r	700	Lower Limit: 130 Upper Limit: 1023 Unit : -
								The parameter “Eigenerregt” is removed in Software C.10.
84	Noise Reduction		Record	9	N	r	0	0 : Off 1 : On

Index	Variable Name		Data Type	Size	Store	Access	Default Value	Description
		Noise Reduction	Unsigned 8	1	N	r	0	0 : Off 1 : On
		Moving Average wide	Unsigned 16	2	N	r	16	Lower Limit: 16 Upper Limit: 400 Unit : -
		Hold time	Unsigned 16	2	N	r	16	Lower Limit: 16 Upper Limit: 400 Unit : -
		Band width	Float	4	N	r	10	Lower Limit: 0,1 Upper Limit: 100 Unit : %
85	Noise voltage reset		Record	8	N	r		
		Threshold On	Unsigned 16	2	N	r	25000	Lower Limit: Threshold Off Upper Limit: 32767 Unit : keine
		Threshold Off	Unsigned 16	2	N	r	15000	Lower Limit: 500 Upper Limit: Threshold On Unit : keine
								Sig. correction: This parameter from B-Software is removed in C-Software. This subindex has an other content in the C-Software.
								MDS Zero: This parameter from B-Software is removed in C-Software. This subindex has an other content in the C-Software
								MDR: This parameter from B-Software is removed in C-Software. This subindex has an other content in the C-Software
								MDS Sum: This parameter from B-Software is removed in C-Software. This subindex has an other content in the C-Software
		DC-Countervalue	Unsigned 8	1	N	r	50	New parameter in Software C10. Lower Limit: 1 Upper Limit: 70 Unit : -
		Prefilter	Unsigned 8	1	N	r	0	New parameter in Software C10. 0 : Off 1 : On
		Filterbandwith	Unsigned 8	1	N	r	5	New parameter in Software C10. 0: 0.15 Hz 1: 0.3 Hz 2: 0.6 Hz 3: 1.1 Hz 4: 2.2 Hz 5: 4.3 Hz 6: 8.7 Hz 7: 17.3 Hz 8: 34 Hz 9: 68 Hz

Index	Variable Name		Data Type	Size	Store	Access	Default Value	Description
		FIR_E/A	Unsigned 8	1	N	r	0	New parameter in Software C10. 0 : Off 1 : On
85	Noise voltage reset		Record	15	N			
		Threshold On	Unsigned 16	2	N	r	25000	Lower Limit: Threshold Off Upper Limit: 32767 Unit : -
		Threshold Off	Unsigned 16	2	N	r	15000	Lower Limit: 500 Upper Limit: Threshold On Unit : -
		Sig. correction	Unsigned 8	1	N	r	0	0 : Off 1 : On
		MDS Zero	Float	4	N	r	500	Lower Limit: 0 Upper Limit: 65535 Unit : -
		MDR	Float	4	N	r	1500	Lower Limit: 0 Upper Limit: 65535 Unit : -
		MDS Sum	Unsigned 16	2	N	r		
86	Primary Adjust		Record	36	N	r		
		Frequncy Primary	Unsigned 8	1	N	r	0	0 : Primary 70Hz 1 : Primary 50Hz 2 : Primary 60Hz Note: Software B10 only supports 70Hz.
		Calib.Date	Visible String	16	N	r		
		Testrig	Unsigned 16	2	N	r	0	Lower Limit: 0 Upper Limit: 9999 Unit : -
		Tester	Visible String	12	N	r	"----------"	
		Cal-factor	Float	4	N	r	0	Lower Limit: -10 Upper Limit: 10 Unit : %
		Gain	Unsigned 8	1	N	r	1	0 : Low 1 : High
		Preamplifier	Unsigned 8	1	N	r	1	New parameter in Software C10. 0 : Off 1 : On
87	DIP Switch		Unsigned 16	2	S	r		Refer to 1.2.
88	Mains interruptl		Unsigned 16	2	S	r		
89	DSP reset		Unsigned 16	2	S	r		
90	Converter status register		Bit String	4	D	r		Refer to 3.4.
91	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.

Index	Variable Name	Data Type	Size	Store	Access	Default Value	Description
92	Actual warning register	Bit String	4	D	r		Same as for „actual error register“. Bit-contents refer to 3.3.
93	History of error register	Bit String	4	N	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..
94	History of warning register	Bit String	4	N	r		Same as for „History of error register“. Bit-contents refer to 3.3.
95	Mask for error register	Bit String	4	S	r,w	EF,3F,00,00	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. Errors 1, 2, 5, 6 and C can not be removed from this mask. Bit-contents refer to 3.2.
96	Mask for warning register	Bit String	4	S	r,w	02,00,03,00	Same as for „Mask for error register“. Default setting: Only warning 1, 15 and 16 will be copied, all other warnings not. Warnings 1 und 15 can not be removed from this mask. Bit-contents refer to 3.3.
97	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.
98	Masked warning register	Bit String	4	D	r		Same as for „Masked error register“. Bit-contents refer to 3.3.
99	Error and warnings simulation	Unsigned 8	1	D	r,w	0	0 : Off 1 : On
100	Error simulation value	Bit String	4	D	r,w	0,0,0,0	If the „error and warning simulation“ is switched on, then this simulated errors will be used for the „actual error register“ instead of the real errors. Bit-contents refer to 3.2.
101	Warning simulation value	Bit String	4	D	r,w	0,0,0,1	Same as for „Error simulation value“. Bit-contents refer to 3.3.

Index	Variable Name	Data Type	Size	Store	Access	Default Value	Description
102	Error priority	Array of Unsigned16	32*2 =64	S	r,w	Bit 0 Error A Max-Alarm : 300 Bit 1 Error 6 Totalizer : 750 Bit 2 Error 5 Int. Datenbase : 750 Bit 3 - : 0 Bit 4 Error 3 Flow > 105% : 400 Bit 5 Error 2 Driver : 750 Bit 6 Error 1 AD-Converter/DS P : 750 Bit 7 Error 0 Empty pipe : 300 Bit 8 - : 0 Bit 9 - : 0 Bit 10 - : 0 Bit 11 - : 0 Bit 12 Error D Old primary : 750 Bit 13 Error F FRAM in primary : 500 Bit 14 Error C Ext. Datenbase : 750 Bit 15 Error B Min-Alarm : 300 Bit 16 - : 0 Bit 17 - : 0 Bit 18 - : 0 Bit 19 - : 0 Bit 20 - : 0 Bit 21 - : 0 Bit 22 - : 0 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 - : 0	The priority shows the importance of an error. These values are not used for internal calculation.

Index	Variable Name	Data Type	Size	Store	Access	Default Value	Description
103	Warning priority	Array of unsigned 16	32*2 =64	S	r,w	Bit 0 Warning 10 Reverse Q : 100 Bit 1 Warning 9c Overflow Diff. : 150 Bit 2 Warning 9b Overflow < R : 150 Bit 3 Warning 9a Overflow > V : 150 Bit 4 Warning 4 Function test : 300 Bit 5 Warning 3 Test mode : 300 Bit 6 Warning 1 Simulation flow : 300 Bit 7 Warning 2 Totalizer reset : 100 Bit 8 Warning 14 hold - MV : 100 Bit 9 Warning 13 Autom. adjust running : 100 Bit 10 - : 0 Bit 11 - : 0 Bit 12 - : 0 Bit 13 Warning 8b Update ext.Database : 100 Bit 14 Warning 8a Update int.Database : 100 Bit 15 Warning 7 Extern Data loaded : 100 Bit 16 - : 0 Bit 17 - : 0 Bit 18 - : 0 Bit 19 - : 0 Bit 20 - : 0 Bit 21 - : 0 Bit 22 - : 0 Bit 23 Warning 15 Simul. error+warning : 300 Bit 24 - : 0 Bit 25 - : 0 Bit 26 - : 0 Bit 27 - : 0 Bit 28 - : 0 Bit 29 - : 0 Bit 30 - : 0 Bit 31 - : 0	The priority shows the importance of an warning. These values are not used for internal calculation.
104	Error and warning settings	Unsigned 8	1	S	r,w	0	Writing a value from 1 to 3 will start the selectet 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
105	Qmin	Unsigned 8	1	S	r	0	New parameter in Software C10. 0: Qmin = 0.05 QDN 1: Qmin = 0.02 QDN

2.5.3 Transducer Block Parameter, sorted according to names

Parameter name	Index
Actual error egister	91
Actual warning register	92
Adjust empty pipe	50
Adjust full pipe	52
Alarm empty pipe	55
ALERT_KEY	4
BLOCK_ALM	8
BLOCK_ERR	6
CAL_MIN_SPAN	18
CAL_POINT_HI	16
CAL_POINT_LO	17
CAL_UNIT	19
Cal-factor 10m/s	44
COLLECTION_DIRECTORY	12
Contact output	71
Contrast	61
Converter status register	90
Converter tag	75
Damping [1t]	46
Data 50Hz	40
Data 60Hz	41
Data 70Hz	42
Density	39
DEP Mode	49
Detector empty pipe	48
DIP Switch	87
Display 1st line	57
Display 2nd line	58
Display 3rd line	59
Display 4th line	60
Display mode	56
Driver	83
DSP reset	89
Error and warning settings	104
Error and warnings simulation	99
Error priority	102
Error simulation value	100
Flow direction	35
Flow indication	36
FOURTH_VALUE	31
Function test contact output	77
History of error register	93
History of warning register	94
Instrument number	72
Language	33
LIN_TYPE	27
Low flow cut off	47
Mains interruptl	88
Manufacture Code	73
Mask for error register	95
Mask for warning register	96
Masked error register	97
Masked warning register	98
Max. Alarm	63
Memory Test	76
Min. Alarm	62
MODE_BLK	5
Noise Reduction	84
Noise voltage reset	85
Operating mode	34
Overflow <R	66
Overflow >F	64
Overflow Diff.	68
Primary	43
Primary Adjust	86
Primary tag	74
PRIMARY_VALUE	14
PRIMARY_VALUE_RANGE	15
PRIMARY_VALUE_TYPE	13
Prog.Prot.Code	32
Qmax	45
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
Simlation value	79
Simulation Mode	78
ST_REV	1
Start automatic adjust empty pipe	51
Start automatic adjust full pipe	53
Start automatic adjust system zero	81
STRATEGY	3
System zero	80
TAG_DESC	2
THIRD_VALUE	30
Threshold	54
Totalizer <R	67
Totalizer >F	65
Totalizer reset	70
Totzalizer Diff.	69
TRANSDUCER_DIRECTORY	9
TRANSDUCER_TYPE	10
Unit Qmax	37
Unit Totalizer	38
UPDATE_EVT	7
Version	82
Warning priority	103
Warning simulation value	101
XD_ERROR	11

2.6 Diagnosis Block

The FSM4000 flowmeter has extended diagnosis functions. These functions are available in an own Fieldbus Diagnosis Block. This interface description only describes the mapping of this parameters to the fieldbus, but not the exact meaning and function of this parameters. For this refer to the diagnosis manual.

2.6.1 Diagnosis Measurement Values

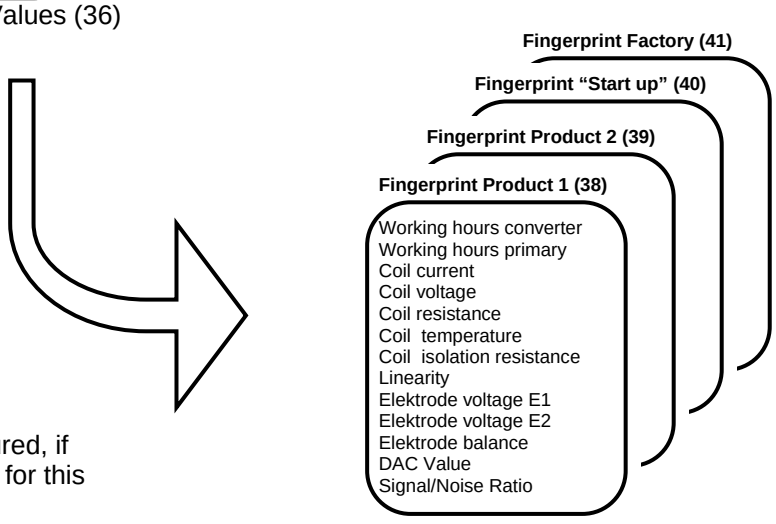
The converter measures periodicallly or on demand (refer to index 9 and 10 of Diagnosis Block) the following parameters. For every parameter are the actual value and the nine values before stored in the converter.

Number behind parameter: Index in Diagnose Block

	Actual Value	Last Value [1]	Value [-2]	Value [-3]	Value [-4]	Value [-5]	Value [-6]	Value [-7]	Value [-8]	Value [-9]
Working Hours Converter (11)	Actual Value	Last Value [1]	Value [-2]	Value [-3]	Value [-4]	Value [-5]	Value [-6]	Value [-7]	Value [-8]	Value [-9]
Working Hours Primary (12)	Actual Value	Last Value [-1]	Value [-2]	Value [-3]	Value [-4]	Value [-5]	Value [-6]	Value [-7]	Value [-8]	Value [-9]
Coil Current (14)	Actual Value	Last Value [-1]	Value [-2]	Value [-3]	Value [-4]	Value [-5]	Value [-6]	Value [-7]	Value [-8]	Value [-9]
Coil Voltage (16)	Actual Value	Last Value [-1]	Value [-2]	Value [-3]	Value [-4]	Value [-5]	Value [-6]	Value [-7]	Value [-8]	Value [-9]
Coil Resistance (18) (*)	Actual Value	Last Value [-1]	Value [-2]	Value [-3]	Value [-4]	Value [-5]	Value [-6]	Value [-7]	Value [-8]	Value [-9]
Coil Temperature (20) (*)	Actual Value	Last Value [-1]	Value [-2]	Value [-3]	Value [-4]	Value [-5]	Value [-6]	Value [-7]	Value [-8]	Value [-9]
Coil Isolation Resistance (22) (*)	Actual Value	Last Value [-1]	Value [-2]	Value [-3]	Value [-4]	Value [-5]	Value [-6]	Value [-7]	Value [-8]	Value [-9]
Linearity (24) (*)	Actual Value	Last Value [-1]	Value [-2]	Value [-3]	Value [-4]	Value [-5]	Value [-6]	Value [-7]	Value [-8]	Value [-9]
Elektrode Voltage E1 (26)	Actual Value	Last Value [-1]	Value [-2]	Value [-3]	Value [-4]	Value [-5]	Value [-6]	Value [-7]	Value [-8]	Value [-9]
Elektrode Voltage E2 (28)	Actual Value	Last Value [-1]	Value [-2]	Value [-3]	Value [-4]	Value [-5]	Value [-6]	Value [-7]	Value [-8]	Value [-9]
Elektrode Balance (30)	Actual Value	Last Value [-1]	Value [-2]	Value [-3]	Value [-4]	Value [-5]	Value [-6]	Value [-7]	Value [-8]	Value [-9]
DAC Value (32)	Actual Value	Last Value [-1]	Value [-2]	Value [-3]	Value [-4]	Value [-5]	Value [-6]	Value [-7]	Value [-8]	Value [-9]
Signal/Noise Ratio (34)	Actual Value	Last Value [-1]	Value [-2]	Value [-3]	Value [-4]	Value [-5]	Value [-6]	Value [-7]	Value [-8]	Value [-9]

Actual Values (36)

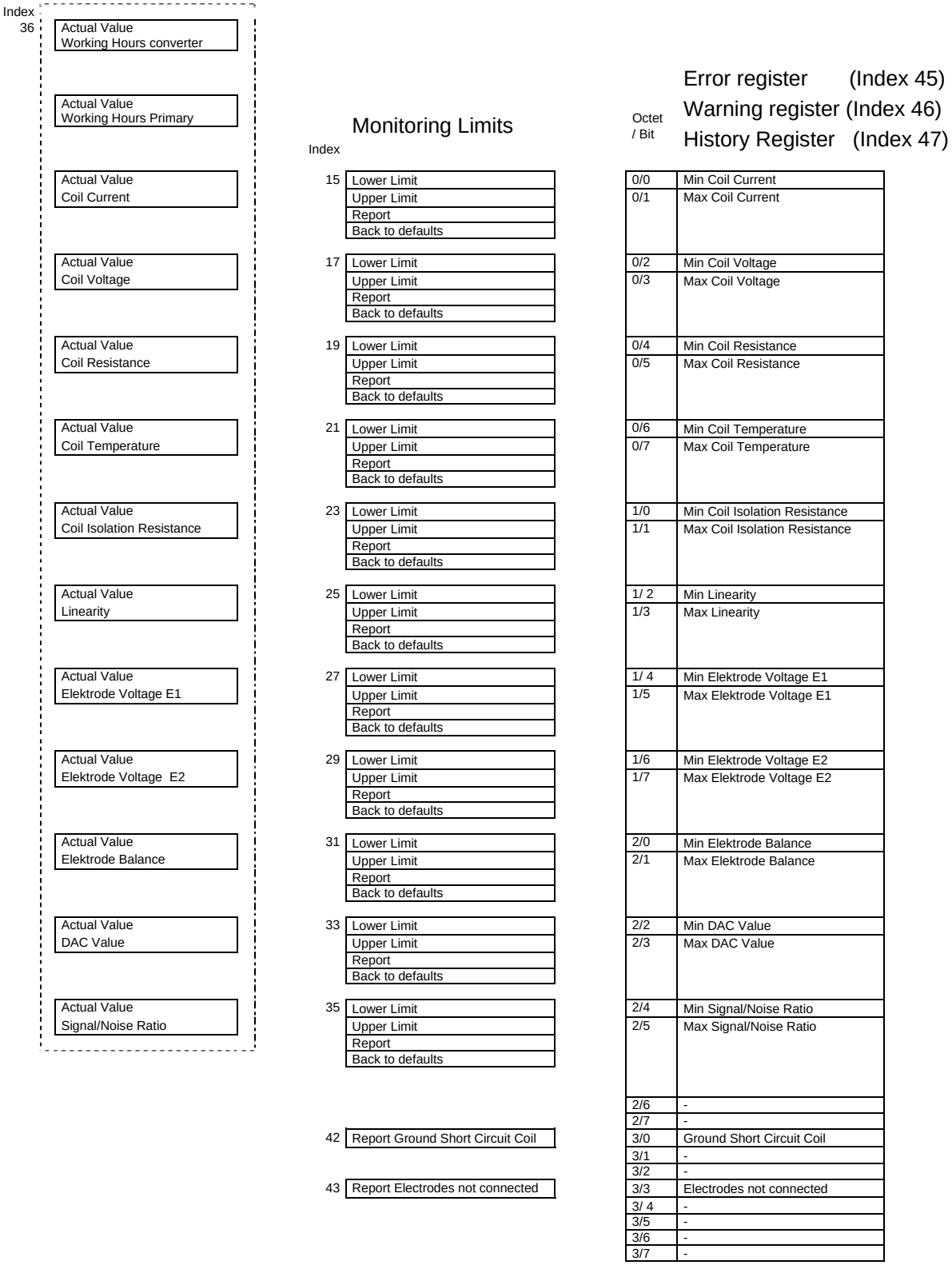
The actual values can be copied (with index 37) into a fingerprint. Customers can only write fingerprints 1, 2 and “start up”.
The fingerprint “factory” can only be written by the manufacturer.



(*) Some values are only measured, if an error or warning checking for this value is switched on, refer to diagnosis manual.

2.6.2 Limits for Diagnosis Measurement Values

For every diagnosis measurement value it is possible to set a lower and upper limit and to set the reporting behaviour, if the value exceeds the limits: No report, a warning or error message. A warning will set the corresponding bit in the warning register, an error sets a bit in the error register. These bits are reset, if the measurment value goes back inside the limits.



2.6.3 Diagnosis Block Error Message Chains

The diagram on the following page shows the way of diagnosis messages from the Diagnosis block to the Fieldbus:

If at least one bit in the Diagnosis Error Register (Diagnosis Block Index 45) is set, this will set the Diagnosis-Bit 10 in the Error Register (Transducer Block Index 91).
The Transducer Block has a Mask for the Error Register (Index 95). This mask enables or disables copying of the “Error Register” Bits to the “Masked Error Register” bits, refer to chapter 3.
If the Diagnosis Bit is set in the “Masked Error Register”, this will be reported as „BAD, Sensor failure“ in the status of the Transducer Block Output Values.
The Transducer Block Output Values are read by the AI Blocks. The AI Block output values can be read with cyclic communication.

A similar chain exists for warning messages. A warning will be reported as “UNCERTAIN, sensor conversion not accurate” in the status of the Transducer Block Output Values.

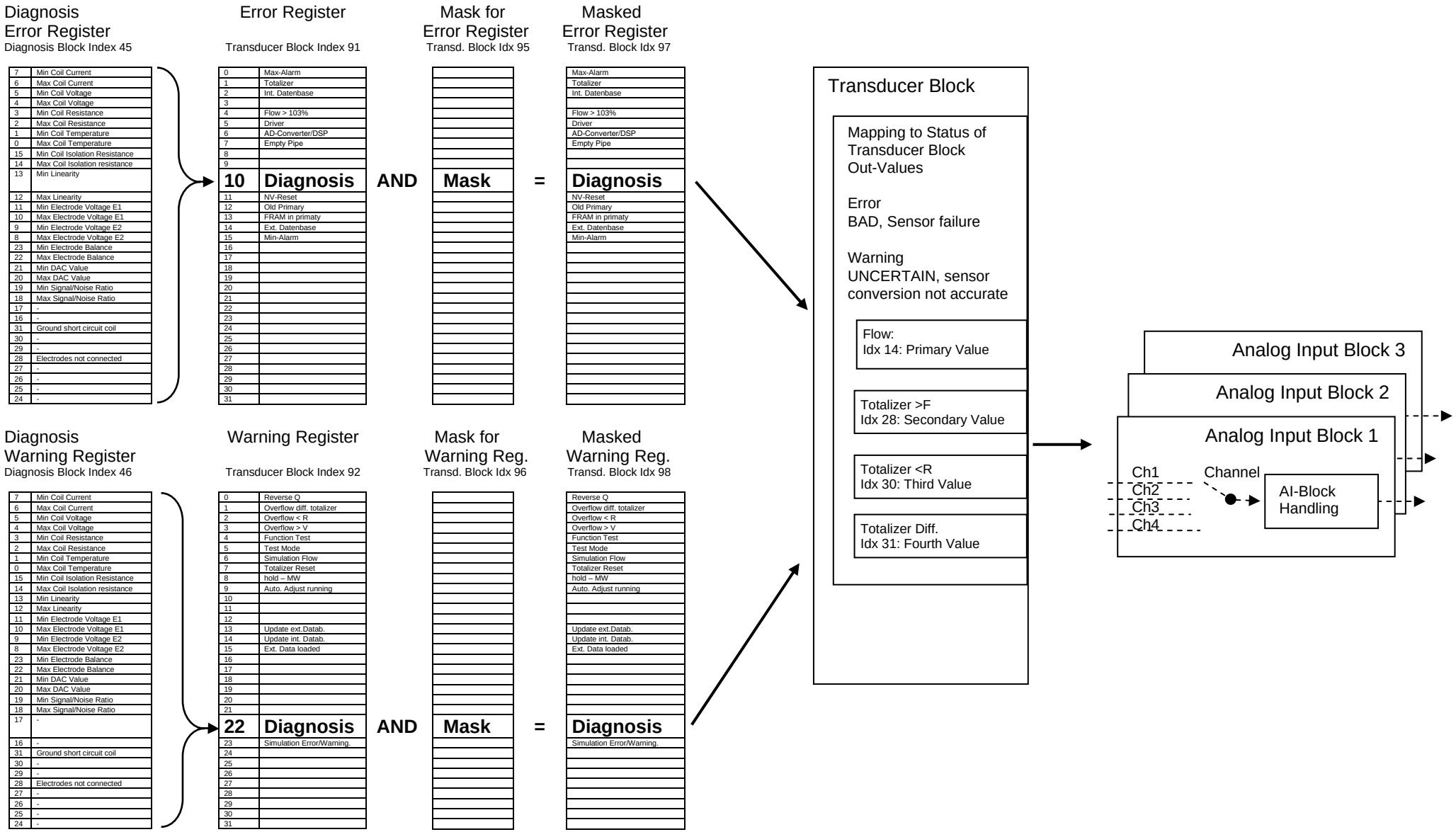
Factory settings are:

All Diagnosis Block monitoring reports (refer to 2.6.2) are switched off.
The “mask for the error register” (Transducer Block Index 95) allows copying of all error bits.
The “mask for the warning register” (Transducer Block Index 96) allows only copying of warnings 1, 15 and 16.

With these factory settings no diagnosis message will be reported to the fieldbus. To get diagnosis messages it is sufficient to enable a message reporting inside the Diagnosis Block.

BLOCK_ERR (Diagnose Block Index 6):

If at least one bit in the Diagnosis Error Register (Diagnosis Block Index 45) is set, this will set Bit 7 = Input Failure in the BLOCK_ERR parameter of the Diagnosis Block.


Diagnosis Error Register
Diagnosis Block Index 45
Error Register
Transducer Block Index 91
Mask for Error Register
Transd. Block Idx 95
Masked Error Register
Transd. Block Idx 97
10 Diagnosis
AND
Mask
=
Diagnosis
Diagnosis Warning Register
Diagnosis Block Index 46
Warning Register
Transducer Block Index 92
Mask for Warning Reg.
Transd. Block Idx 96
Masked Warning Reg.
Transd. Block Idx 98
22 Diagnosis
AND
Mask
=
Diagnosis
Transducer Block
Mapping to Status of Transducer Block Out-Values
Error
BAD, Sensor failure
Warning
UNCERTAIN, sensor conversion not accurate
Flow:
Idx 14: Primary Value
Totalizer >F
Idx 28: Secondary Value
Totalizer <R
Idx 30: Third Value
Totalizer Diff.
Idx 31: Fourth Value
Analog Input Block 3
Analog Input Block 2
Analog Input Block 1
Ch1
Ch2
Ch3
Ch4
Channel
AI-Block Handling

2.6.4 Diagnosis Block Parameter, sorted in accordance with index

2.6.4.1 Diagnosis Block Part 1: Standard Parameters

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,OOS Normal : Auto	The actual, target, permitted, and normal operation modes of the block.
6	BLOCK_ERR	Bit String	2	D	read only	0	Contains a summary of block alarms. Following bits are supported: Bit 7 = Input Failure Set, if at least one bit in the diagnosis error register (Diagnosis Block Index 45) is set Bit 15 = Out of Service Set, if Diagnosis Block Actual-Mode is OOS
7	UPDATE_EVT	DS-73	14	D	OOS, Auto		This alert is generated by any change to the static data.
8	BLOCK_ALM	DS-72	13	D	OOS, Auto		Block Alarm is not supported.

2.6.4.2 Diagnosis Block Part 2: Manufacturer specific parameters

Index	Variable Name	Data Type	Size	Store	Access	Default Value	Description
9	Diagnosis Cycle Time	Unsigned 8	1	S	r,w	0	0 : Manual Diagnosis Start 1 : 10 Seconds 2 : 60 Seconds 3 : 10 Minutes 4 : 60 Minutes 5 : 6 Hours 6 : 12 Hours 7 : 24 Hours 8 : 7 Days
10	Start manual Diagnosis	Unsigned 8	1	S	r,w	0	0: Do nothing 1: Start
11	Working Hours Converter	DS-Value-History	40	N	r		Unit: Hours
12	Working Hours Primary	DS-Value-History	40	N	r		Unit: Hours
13	Set all Limits to Default	Unsigned 8	1	S	r,w	0	0 : Do nothing 1 : All to Default
14	Coil Current	DS-Value-History	40	N	r		Unit: mA
15	Limits Coil Current	DS-Limits	10	S	r,w	2 to 1000mA, no report	Input Range for min: 0 to 500mA Input Range for max: 0 to 1000mA
16	Coil Voltage	DS-Value-History	40	N	r		Unit: V
17	Limits Coil Voltage	DS-Limits	10	S	r,w	1 to 100V, no report	Input Range for min and max: 0 to 150V
18	Coil Resistance	DS-Value-History	40	N	r		Unit: Ohm
19	Limits Coil Resistance	DS-Limits	10	S	r,w	2 to 500 Ohm, no report	Input Range for min and max: 0 to 1500 Ohm
20	Coil Temperature	DS-Value-History	40	N	r		Unit: C
21	Limits Coil Temperature	DS-Limits	10	S	r,w	-50 to 150C, no report	Input Range for min and max: -100 to +200C
22	Coil Isolation Resistance	DS-Value-History	40	N	r		Unit: Mohm
23	Limits Coil Isolation Resistance	DS-Limits	10	S	r,w	0,5 to 50 MOhm, no report	Input Range for min and max: 0 to 500Mohm
24	Linearity	DS-Value-History	40	N	r		Unit: %
25	Limits Linearity	DS-Limits	10	S	r,w	1 to 200%, no report	Input Range for min and max: 0 to 300%
26	Elektrode Voltage E1	DS-Value-History	40	N	r		Unit: uV
27	Limits Elektrode Voltage E1	DS-Limits	10	S	r,w	0 to 3000uV no report	Input Range for min and max: 0 to 30000uV
28	Elektrode Voltage E2	DS-Value-History	40	N	r		Unit: uV
29	Limits Elektrode Voltage E2	DS-Limits	10	S	r,w	0 to 3000uV, no report	Input Range for min and max: 0 to 30000uV
30	Elektrode Balance	DS-Value-History	40	N	r		Unit: %
31	Limits Elektrode Balance	DS-Limits	10	S	r,w	100 to 300%	Input Range for min and max: 0 to 300%

Index	Variable Name	Data Type	Size	Store	Access	Default Value	Description
						no report	
32	DAC Value	DS-Value-History	40	N	r		Unit: Digits
33	Limits DAC Value	DS-Limits	10	S	r,w	16 to 1024 Digits no report	Input Range for min and max: 0 to 1024 Digits
34	Signal/Noise Ratio (SNR)	DS-Value-History	40	N	r		Unit: %
35	Limits Signal/Noise Ratio (SNR)	DS-Limits	10	S	r,w	0,01 to 100% no report	Input Range for min and max: 0 to 100%
36	Actual Diagnosis Values	DS-Fingerprint	52	N	r		Siehe 2.6.1 und 2.6.6.2.
37	Copy actual Values to	Unsigned 8	1	S	r,w	0	0: Do nothing 1: Fingerprint Product 1 2: Fingerprint Product 2 3: Fingerprint Setting-up working
38	Fingerprint Product 1	DS-Fingerprint	52	N	r		Refer to 2.6.1 and 2.6.6.2.
39	Fingerprint Product 2	DS-Fingerprint	52	N	r		Refer to 2.6.1 and 2.6.6.2.
40	Fingerprint Setting-up working	DS-Fingerprint	52	N	r		Refer to 2.6.1 and 2.6.6.2.
41	Fingerprint Factory	DS-Fingerprint	52	N	r		Refer to 2.6.1 and 2.6.6.2.
42	Report Ground Short Circuit Coil	Unsigned 8	1	S	r,w		0: Off 1: Warning 2: Error
43	Report Electrodes not connected	Unsigned 8	1	S	r,w		0: Off 1: Warning 2: Error
44	Clear Diagnosis History Register	Unsigned 8	1	S	r,w	0	0: Do nothing 1: Clear
45	Diagnosis Error Register	Bit String	4	D	r		Bit content refer to chapter 2.6.7
46	Diagnosis Warning Register	Bit String	4	D	r		Bit content refer to chapter 2.6.7
47	Diagnosis History Register	Bit String	4	N	r		Bit content refer to chapter 2.6.7
48	Cable Length	Float	4	S	r,w		Input Range: 0 to 200m
49	Temperature Offset	Float	4	S	r,w		Input Range: -100 to +200C
50	Temperature Definition	Float	4	S	r,w		Input Range: -100 to +200C
51	Reference Resistance at 20C	Float	4	S	r		
52	Elektrode Signals	DS-Elektrode-Signals	32	D	r		Refer to 2.6.6.4.

2.6.5 Diagnosis Block Parameter, sorted according to names

Parameter Name	Index
Actual Diagnosis Values	36
ALERT_KEY	4
BLOCK_ALM	8
BLOCK_ERR	6
Cable Length	48
Clear Diagnosis History Register	44
Coil Current	14
Coil Isolation Resistance	22
Coil Resistance	18
Coil Temperature	20
Coil Voltage	16
Copy actual Values to	37
DAC Value	32
Diagnosis Cycle Time	9
Diagnosis Error Register	45
Diagnosis History Register	47
Diagnosis Warning Register	46
Elektrode Balance	30
Elektrode Signals	52
Elektrode Voltage E1	26
Elektrode Voltage E2	28
Fingerprint Factory	41
Fingerprint Product 1	38
Fingerprint Product 2	39
Fingerprint Setting-up working	40
Limits Coil Current	15
Limits Coil Isolation Resistance	23
Limits Coil Resistance	19
Limits Coil Temperature	21
Limits Coil Voltage	17
Limits DAC Value	33
Limits Elektrode Balance	31
Limits Elektrode Voltage E1	27
Limits Elektrode Voltage E2	29
Limits Linearity	25
Limits Signal/Noise Ratio (SNR)	35
Linearity	24
MODE_BLK	5
Reference Resistance at 20C	51
Report Electrodes not connected	43
Report Ground Short Circuit Coil	42
Set all Limits to Default	13
Signal/Noise Ratio (SNR)	34
ST_REV	1
Start manual Diagnosis	10
STRATEGY	3
TAG_DESC	2
Temperature Definition	50
Temperature Offset	49
UPDATE_EVT	7
Working Hours Converter	11
Working Hours Primary	12

2.6.6 Data structures of Diagnosis Block

2.6.6.1 DS-Value-History

Element Nr.	Element Name	Data Type	Size	Storage	Access	Description
1	Last, Actual Value	Float	4	N	r	
2	Preview Value [-1]	Float	4	N	r	
3	Value [-2]	Float	4	N	r	
4	Value [-3]	Float	4	N	r	
5	Value [-4]	Float	4	N	r	
6	Value [-5]	Float	4	N	r	
7	Value [-6]	Float	4	N	r	
8	Value [-7]	Float	4	N	r	
9	Value [-8]	Float	4	N	r	
10	Value [-9]	Float	4	N	r	

2.6.6.2 DS-Fingerprint

Element Nr.	Element Name	Data Type	Size	Storage	Access	Description
1	Working Hours Converter	Float	4	N	r	Unit: Hours
2	Working Hours Primary	Float	4	N	r	Unit: Hours
3	Coil Current	Float	4	N	r	Unit: mA
4	Coil Voltage	Float	4	N	r	Unit: V
5	Coil Resistance	Float	4	N	r	Unit: Ohm
6	Coil Temperature	Float	4	N	r	Unit: C
7	Coil Isolation Resistance	Float	4	N	r	Unit: MOhm
8	Linearity	Float	4	N	r	Unit: %
9	Elektrode Voltage E1	Float	4	N	r	Unit: uV
10	Elektrode Voltage E2	Float	4	N	r	Unit: uV
11	Elektrode Balance	Float	4	N	r	Unit: %
12	DAC Value	Float	4	N	r	Unit: Digits
13	Signal/Noise Ratio	Float	4	N	r	Unit: %

2.6.6.3 DS-Limits

Element Nr.	Element Name	Data Type	Size	Storage	Access	Description
1	Lower Limit	Float	4	S	r,w	
2	Upper Limit	Float	4	S	r,w	
3	Meldung	Unsigned 8	1	S	r,w	0: Off 1: Warning 2: Error
4	Set Limits back to default	Unsigned 8	1	S	r,w	0: Do nothing 1: Back to default

2.6.6.4 DS-Elektrode Signals

Element Nr.	Element Name	Data Type	Size	Storage	Access	Description
1	Elektrode Voltage E1	Float	4	D	r	Unit: uV
2	Elektrode Voltage E2	Float	4	D	r	Unit: uV
3	Phase Elektrode Voltage E1	Float	4	D	r	Unit: Degree
4	Phase Elektrode Voltage E2	Float	4	D	r	Unit: Degree
5	Elektrode Zeropoint E1	Float	4	D	r	Unit: uV
6	Elektrode Zeropoint E2	Float	4	D	r	Unit: uV
7	Phase Elektrode Zeropoint E1	Float	4	D	r	Unit: Degree
8	Phase Elektrode Zeropoint E2	Float	4	D	r	Unit: Degree

2.6.7 Diagnosis Registers

The registers
Diagnosis Error Register (Index 45)
Diagnosis Warning Register (Index 46)
Diagnosis History Register (Index 47)
are each 4 Byte Bitstrings. The bits have following meanings:

Octet 1	Bit 0 (LSB)	Bitstring 7	Min Coil Current
	Bit 1	Bitstring 6	Max Coil Current
	Bit 2	Bitstring 5	Min Coil Voltage
	Bit 3	Bitstring 4	Max Coil Voltage
	Bit 4	Bitstring 3	Min Coil Resistance
	Bit 5	Bitstring 2	Max Coil Resistance
	Bit 6	Bitstring 1	Min Coil Temperature
	Bit 7 (MSB)	Bitstring 0	Max Coil Temperature
Octet 2	Bit 0 (LSB)	Bitstring 15	Min Coil Isolation Resistance
	Bit 1	Bitstring 14	Max Coil Isolation Resistance
	Bit 2	Bitstring 13	Min Linearity
	Bit 3	Bitstring 12	Max Linearity
	Bit 4	Bitstring 11	Min Elektrode Voltage E1
	Bit 5	Bitstring 10	Max Elektrode Voltage E1
	Bit 6	Bitstring 9	Min Elektrode Voltage E2
	Bit 7 (MSB)	Bitstring 8	Max Elektrode Voltage E2
Octet 3	Bit 0 (LSB)	Bitstring 23	Min Elektrode Balance
	Bit 1	Bitstring 22	Max Elektrode Balance
	Bit 2	Bitstring 21	Min DAC Value
	Bit 3	Bitstring 20	Max DAC Value
	Bit 4	Bitstring 19	Min Signal/Noise Ratio
	Bit 5	Bitstring 18	Max Signal/Noise Ratio
	Bit 6	Bitstring 17	-
	Bit 7 (MSB)	Bitstring 16	-
Octet 4	Bit 0 (LSB)	Bitstring 31	Ground Short Circuit Coil
	Bit 1	Bitstring 30	-
	Bit 2	Bitstring 29	-
	Bit 3	Bitstring 28	Electrodes not connected
	Bit 4	Bitstring 27	-
	Bit 5	Bitstring 26	-
	Bit 6	Bitstring 25	-
	Bit 7 (MSB)	Bitstring 24	-

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-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

2.7.4 DS-69 – Mode Structure

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

2.7.5 DS-70 – Access Permissions

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

2.7.6 DS-71 – Alarm Float Structure

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

2.7.7 DS-72 – Alarm Discrete Structure

E	Element Name	Data Type	Size
1	Unacknowledged	Unsigned8	1
2	Alarm State	Unsigned8	1

3	Time Stamp	Time Value	8
4	Subcode	Unsigned16	2
5	Value	Unsigned8	1

2.7.8 DS-73 – Event Update Structure

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

2.7.9 DS-74 – Alarm Summary Structure

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

2.7.10 DS-82 – Simulate – Floating Point Structure

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

2.7.11 DS-85 – Test Structure

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

3. Error and warning handling

The device has two error registers: The „actual error register“ (Transducer block index 91) shows errors, which are active in this moment. The “History of error register” (index 93) shows errors, which were set in the past tense or present. For warnings there is the same: One register shows actual warnings (index 92), another shows the history of the warnings (index 94). The history registers can be cleared.

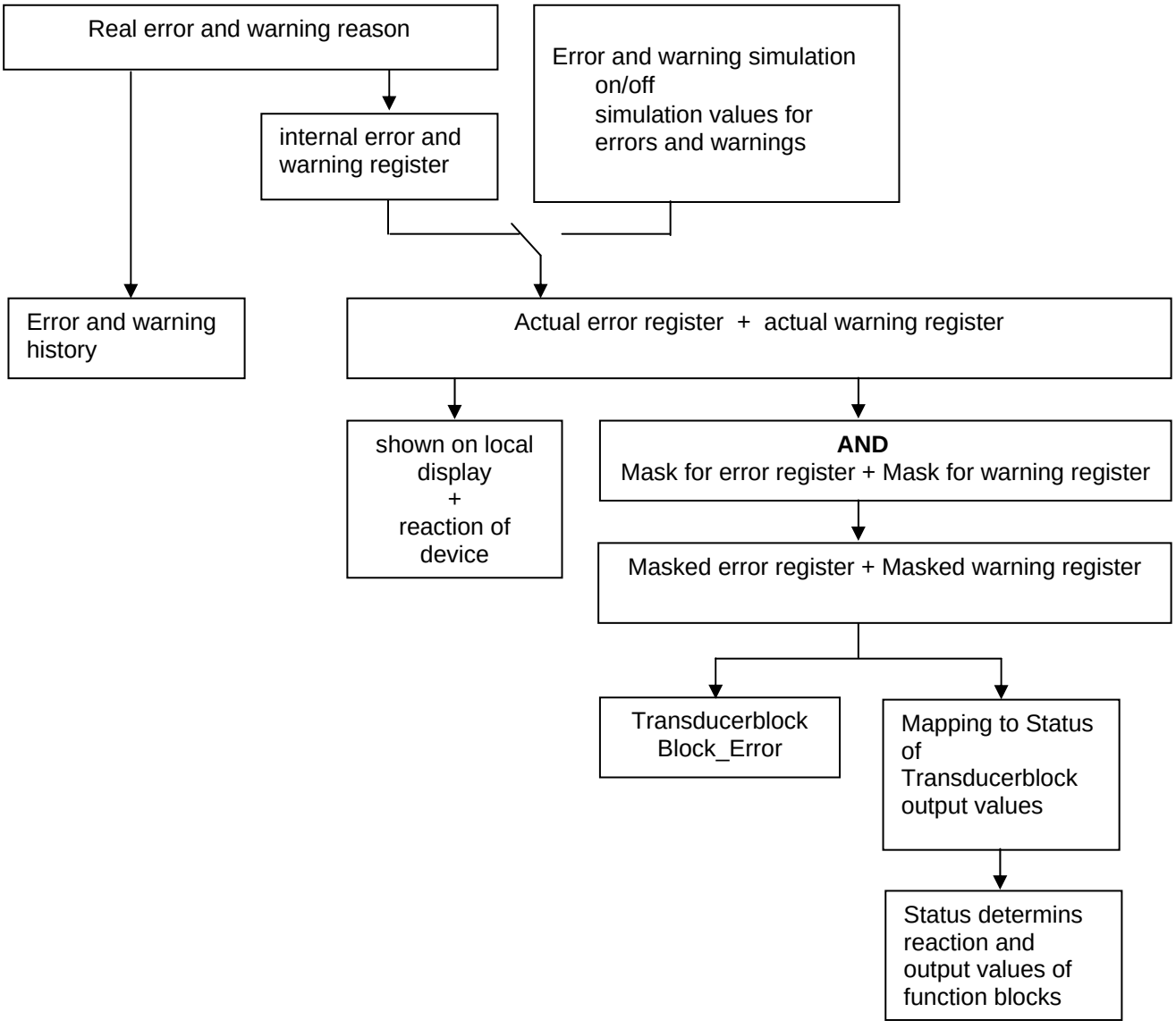
The history is only for information. The actual errors and warnings are important:

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 95: mask for error register and index 96: mask for warning register. The result is written into index 97: masked error register and index 98: 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 3.5). 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 99) and write the simulation values (index 100 and 101). 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 7 (MSB)	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 (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 91 of the Transducer block.
The “history of the error register” is on index 93.

Octet 1	Bit 7 (MSB)	Bitstring 0	Error A	Max-Alarm
	Bit 6	Bitstring 1	Error 6	Totalizer
	Bit 5	Bitstring 2	Error 5	Internal Datenbase
	Bit 4	Bitstring 3	-	- (Error 4, Zero return, only for standard HART device, not for FF device)
	Bit 3	Bitstring 4	Error 3	Flow > 105%
	Bit 2	Bitstring 5	Error 2	Driver
	Bit 1	Bitstring 6	Error 1	AD-Converter/DSP
	Bit 0 (LSB)	Bitstring 7	Error 0	Empty pipe
Octet 2	Bit 7 (MSB)	Bitstring 8	-	
	Bit 6	Bitstring 9	-	
	Bit 5	Bitstring 10	Error G	Diagnosis
	Bit 4	Bitstring 11	Error E	NV-Reset
	Bit 3	Bitstring 12	Error D	Old primary
	Bit 2	Bitstring 13	Error F	FRAM in primary
	Bit 1	Bitstring 14	Error C	External Datenbase
	Bit 0 (LSB)	Bitstring 15	Error B	Min-Alarm
Octet 3	Bit 7 (MSB)	Bitstring 16	-	
	Bit 6	Bitstring 17	-	
	Bit 5	Bitstring 18	-	
	Bit 4	Bitstring 19	-	
	Bit 3	Bitstring 20	-	
	Bit 2	Bitstring 21	-	
	Bit 1	Bitstring 22	-	
	Bit 0 (LSB)	Bitstring 23	-	
Octet 4	Bit 7 (MSB)	Bitstring 24	-	
	Bit 6	Bitstring 25	-	
	Bit 5	Bitstring 26	-	
	Bit 4	Bitstring 27	-	
	Bit 3	Bitstring 28	-	
	Bit 2	Bitstring 29	-	
	Bit 1	Bitstring 30	-	
	Bit 0 (LSB)	Bitstring 31	-	

Example:

01 00 00 00 = Bit 0 (LSB) in Octet 1 = Bitstring 7 = Error 0, Empty pipe

00 08 00 00 = Bit 3 in Octet 2 = Bitstring 12 = Error D, Old primary

3.3 Warning register

The “actual warning register” is on index 92 of the Transducer block.
The “history of the warning register” is on index 94.

Octet 1	Bit 7 (MSB)	Bitstring 0	Warning 10	Reverse Q
	Bit 6	Bitstring 1	Warning 9c	Overflow difference totalizer
	Bit 5	Bitstring 2	Warning 9b	Overflow <R
	Bit 4	Bitstring 3	Warning 9a	Overflow >F
	Bit 3	Bitstring 4	Warning 4	Function test
	Bit 2	Bitstring 5	Warning 3	Test mode
	Bit 1	Bitstring 6	Warning 1	Simulation flow
	Bit 0 (LSB)	Bitstring 7	Warning 2	Totalizer reset
Octet 2	Bit 7 (MSB)	Bitstring 8	Warning 14	hold – MV
	Bit 6	Bitstring 9	Warning 13	Automatic adjust is running
	Bit 5	Bitstring 10	-	- (Warning 12b, Simul. Pulse, only for standard HART device, not for FF)
	Bit 4	Bitstring 11	-	- (Warning 12a, Simul. Iout, only for standard HART device, not for FF)
	Bit 3	Bitstring 12	-	- (Warning 11, Polling Adr.> 0, only for standard HART device, not for FF)
	Bit 2	Bitstring 13	Warning 8b	Update external Datenbase
	Bit 1	Bitstring 14	Warning 8a	Update internal Datenbase
	Bit 0 (LSB)	Bitstring 15	Warning 7	External data loaded
Octet 3	Bit 7 (MSB)	Bitstring 16	-	
	Bit 6	Bitstring 17	-	
	Bit 5	Bitstring 18	-	
	Bit 4	Bitstring 19	-	
	Bit 3	Bitstring 20	-	
	Bit 2	Bitstring 21	-	
	Bit 1	Bitstring 22	Warning 16	Diagnosis
	Bit 0 (LSB)	Bitstring 23	Warning 15	Simulation error and warning
Octet 4	Bit 7 (MSB)	Bitstring 24	-	
	Bit 6	Bitstring 25	-	
	Bit 5	Bitstring 26	-	
	Bit 4	Bitstring 27	-	
	Bit 3	Bitstring 28	-	
	Bit 2	Bitstring 29	-	
	Bit 1	Bitstring 30	-	
	Bit 0 (LSB)	Bitstring 31	-	

Example:

01 00 00 00 = Bit 0 (LSB) in Octet 1 = Bitstring 7 = Warning 2, Totalizer reset

80 00 00 00 = Bit 7 (MSB) in Octet 1 = Bitstring 0 = Warning 10, Reverse Q

3.4 Converter status register

The status register is on index 90 of the Transducer block. It contains informations about test and adjust functions.

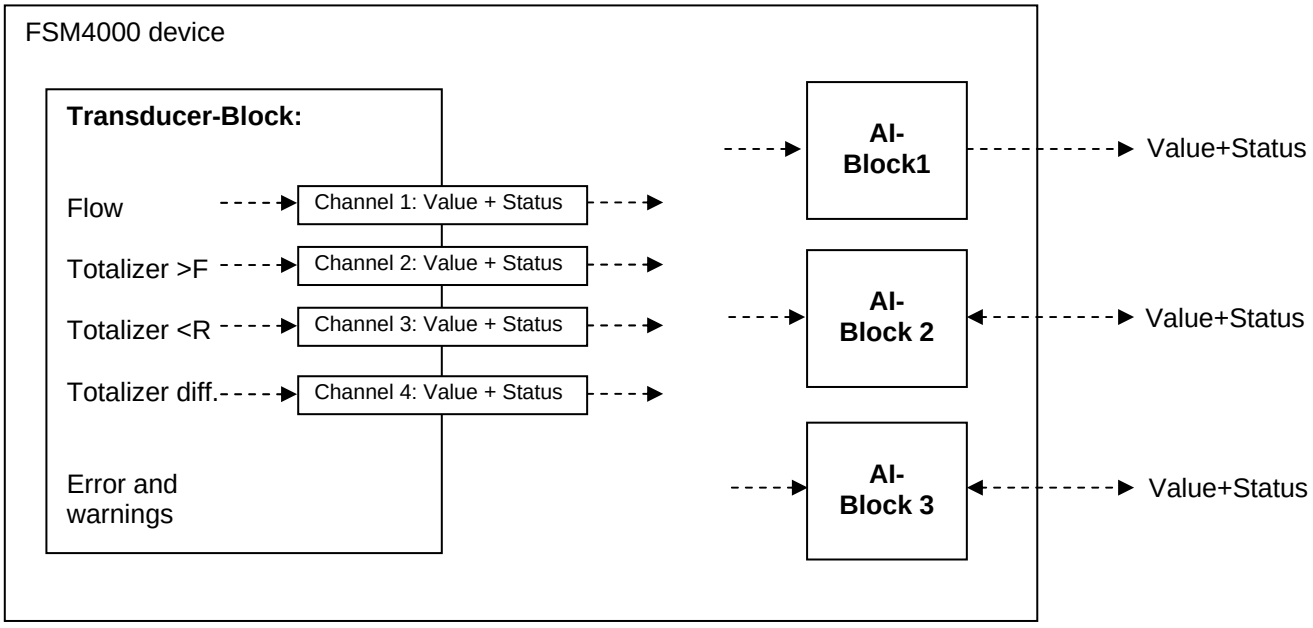
Octet 1	Bit 7 (MSB)	Bitstring 0	-
	Bit 6	Bitstring 1	-
	Bit 5	Bitstring 2	-
	Bit 4	Bitstring 3	-
	Bit 3	Bitstring 4	-
	Bit 2	Bitstring 5	Function test contact output
	Bit 1	Bitstring 6	-
	Bit 0 (LSB)	Bitstring 7	-
Octet 2	Bit 7 (MSB)	Bitstring 8	-
	Bit 6	Bitstring 9	-
	Bit 5	Bitstring 10	Error in function test
	Bit 4	Bitstring 11	Average measurement is running
	Bit 3	Bitstring 12	Error at automatic adjust
	Bit 2	Bitstring 13	Automatic adjust is running
	Bit 1	Bitstring 14	Simulation on
	Bit 0 (LSB)	Bitstring 15	Function test on
Octet 3	Bit 7 (MSB)	Bitstring 16	-
	Bit 6	Bitstring 17	-
	Bit 5	Bitstring 18	-
	Bit 4	Bitstring 19	-
	Bit 3	Bitstring 20	-
	Bit 2	Bitstring 21	-
	Bit 1	Bitstring 22	-
	Bit 0 (LSB)	Bitstring 23	-
Octet 4	Bit 7 (MSB)	Bitstring 24	-
	Bit 6	Bitstring 25	-
	Bit 5	Bitstring 26	-
	Bit 4	Bitstring 27	-
	Bit 3	Bitstring 28	-
	Bit 2	Bitstring 29	-
	Bit 1	Bitstring 30	-
	Bit 0 (LSB)	Bitstring 31	-

Example:

00 01 00 00 = Bit 0 (LSB) in Octet 2 = Bitstring 15 = Function test on

3.5 Mappung of errors and warnings to 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 function blocks.



3.5.1 Mapping-Table

The following FSM4000 errors and warnings are mapped to the Transducerblock output values status:

	FSM4000 error and warning	Mapping to Status of PRIMARY_VALUE (= Index 14 = Flow)	Mapping to Status of SECONDARY_VALUE (= Index 28 = Totalizer >V) THIRD_VALUE (= Index 30 = Totalizer <R) FOURTH_VALUE (= Index 31 = Totalizer diff)
Error 0	Empty pipe	UNCERTAIN, non-specific	UNCERTAIN, non-specific
Error 1	AD-Converter/DSP	BAD, sensor failure	BAD, sensor failure
Error 2	Driver	BAD, sensor failure	BAD, sensor failure
Error 3	Flow > 105%	UNCERTAIN, engineering unit range violation	UNCERTAIN, engineering unit range violation
Error 5	Internal Datenbase	BAD, device failure	BAD, device failure
Error 6	Totalizer	-	BAD, device failure
Error A	Max-Alarm	-	-
Error B	Min-Alarm	-	-
Error C	External Datenbase	BAD, device failure	BAD, device failure
Error D	Old primary	-	-
Error E	NV-Reset	BAD, sensor failure	BAD, sensor failure
Error F	FRAM in primary	-	-
Error G	Diagnosis	BAD, sensor failure	BAD, sensor failure
		-	
Warning 1	Simulation	UNCERTAIN, substitute value	UNCERTAIN, substitute value
Warning 2	Totalizer reset	-	-
Warning 3	Test mode	-	-
Warning 4	Function test	-	-
Warning 7	External Data loaded	-	-
Warning 8a	Update internal Datenbase	-	-
Warning 8b	Update external Datenbase	-	-
Warning 9a	Overflow >F	-	-
Warning 9b	Overflow <R	-	-
Warning 9c	Overflow diff.	-	-
Warning 10	Reverse Q	-	-
Warning 13	Automatic adjust running	UNCERTAIN, non-specific	UNCERTAIN, non-specific
Warning 14	Old primary	-	-
Warning 15	Simulation error and warning	UNCERTAIN, substitute value	UNCERTAIN, substitute value
Warning 16	Diagnosis	UNCERTAIN, sensor conversion not accurate	UNCERTAIN, sensor conversion not accurate

3.6 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
XD_SCALE and OUT_SCALE are not identical for L_Type = direct
Period_Of_Execution is 0

3.7 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 (flow value) 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 1 – A/D-Converter

Error 1 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 (flow value) is BAD, Substatus Sensor Failure.
Status of AI Block PV and OUT is BAD, Substatus Sensor Failure.
AI-Block BLOCK_ERR shows INPUT_FAILURE (if Propagate_Fault_Forward is not set in STATUS_OPTS).

Example 3:

Resource-Block is switched to Out of Service:

AI-Block also goes to Out of Service.
AI-Block BLOCK_ERR shows Out of Service.
AI-Block OUT.Status is BAD, Substatus Out_Of_Service.

3.8 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 Configurator V3.1.

In addition to the instrument, you will require the actual instrument-describing files for FSM4000 (000320/0017). The version for software C.10 are:

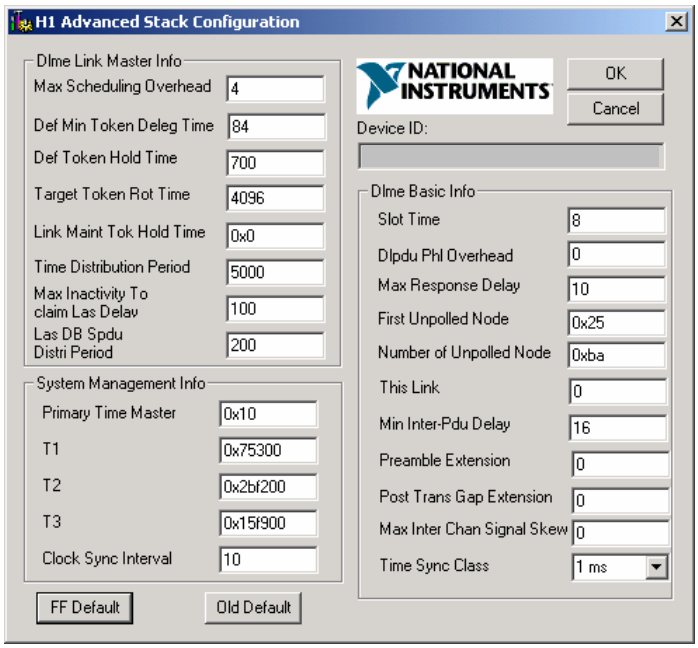
0201.ffo
0201.sym
020101.cff

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 “Import DD/CFF” and install the device description files.

At Port Edit Advanced is the “Advanced Stack Configuration”. With the button „FF Default“ you get the following FF default settings:

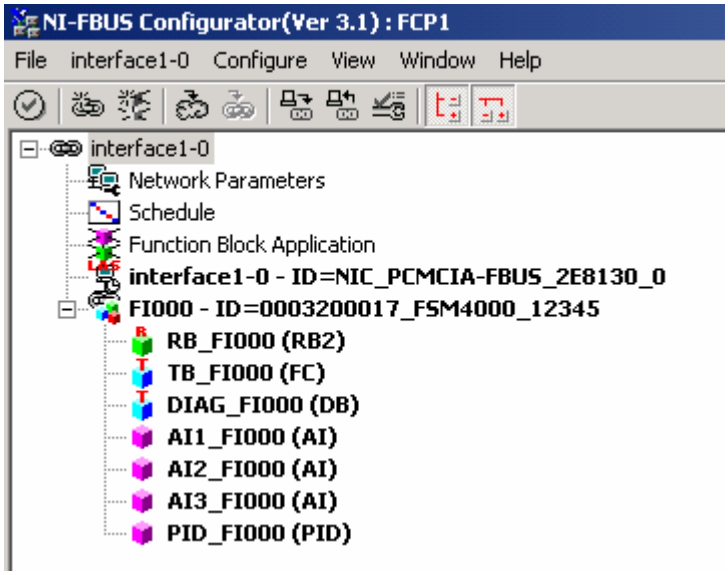


4.2 Verify Hardware switch

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 1.2).

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

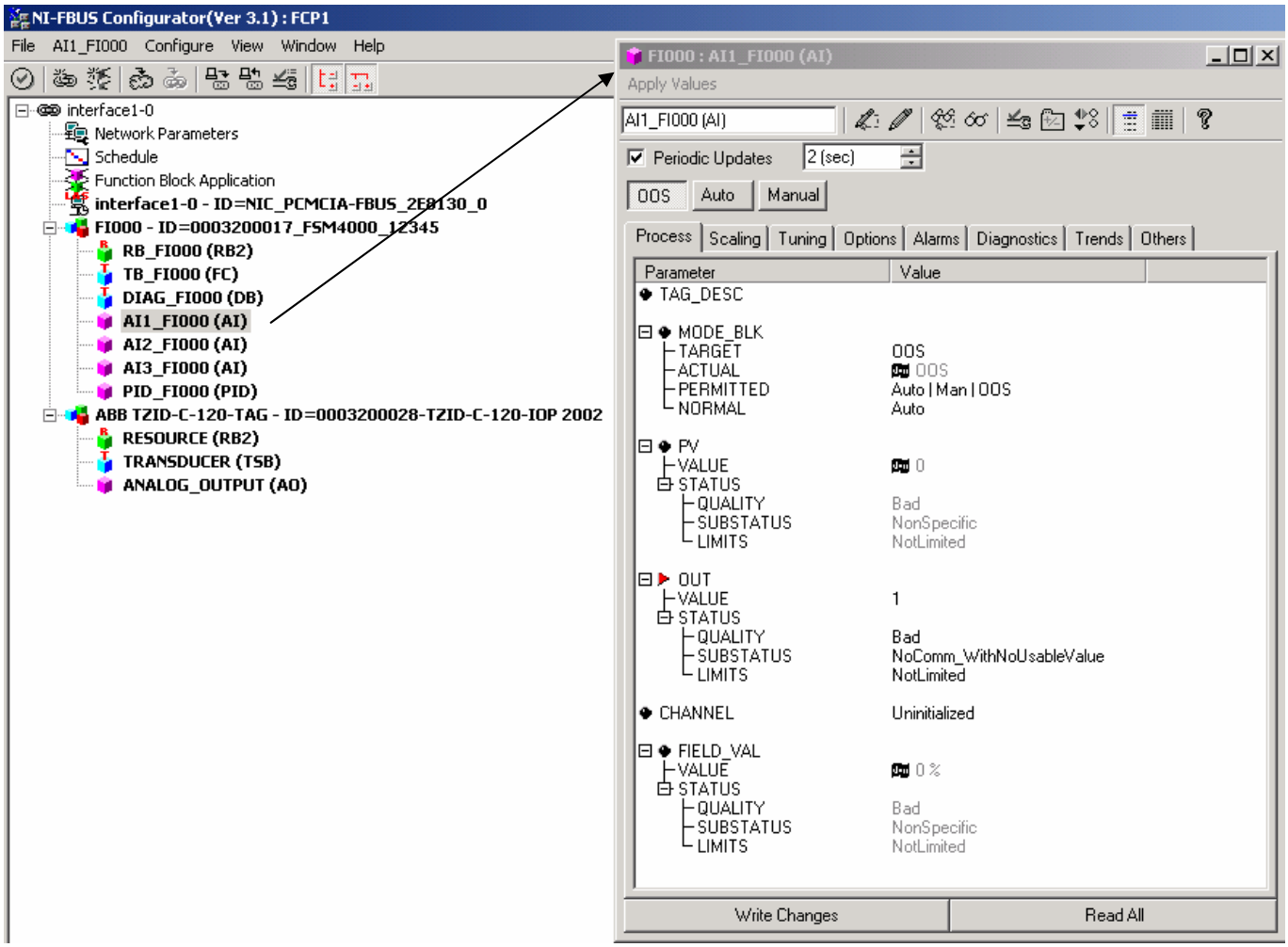
0017 = Device Type Code FSM4000, hex

FSM4000 = Device-name

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

4.4 Blocks Out of Service

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



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

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

4.5 Instrument and Block Tags

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

4.6 Resource Block

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

4.7 Transducer Block

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

4.8 Analog Input Block

Next you have to determine the unit handling. The measurements will be calculated within the transducer block and provided by the channels. Each channel disposes of different units (see 2.5.1). Within the AI block this value can merely be transferred (L_TYPE =direct) or the scale can be changed to another unit (L_TYPE =indirect).

4.8.1 Unit with L_TYPE =Direct

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

Example:

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

Within the transducer block (Index 48) set “Range unit” to m3/h. Thus this unit displays the channel 1 value.

Set the L_TYPE within the AI-Block “Direct”.

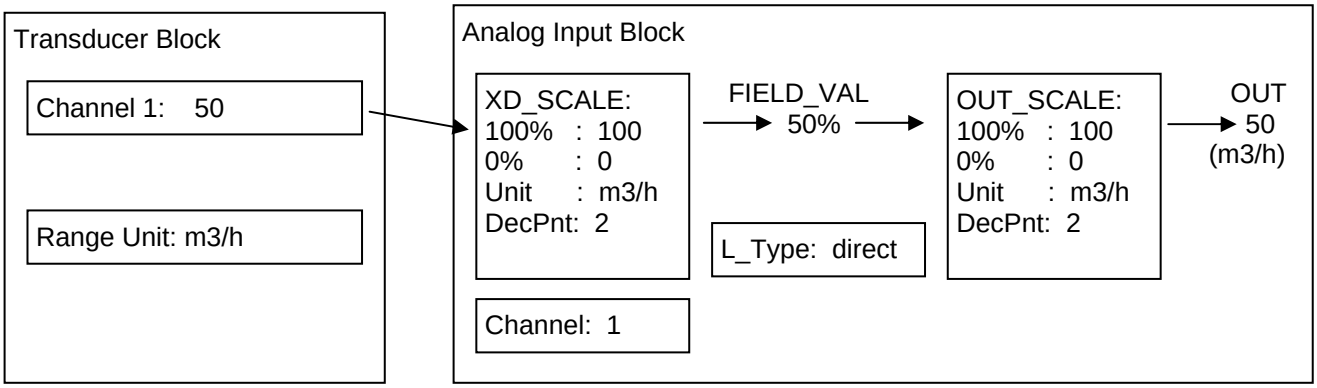
Set the channel within the AI block to 1 in order to choose flow value (see 2.5.1).

Within the AI block, please set the units XD_SCALE and OUT_SCALE likewise to m3/h.

Recommendation (not necessary): set 100%-value in XD_SCALE and OUT_SCALE to the Range value (Transducer-Block Index 39).

All values in XD- and OUT_SCALE have to be adjusted identically.

Set AI block to “Auto”.



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

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

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

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

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

4.8.2 Unit with L_TYPE=Indirect

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

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

Example:

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

Settings:

Set “Range unit” (index 48) within transducer block to m3/h. Thus the channel 1 value will be displayed in this unit.

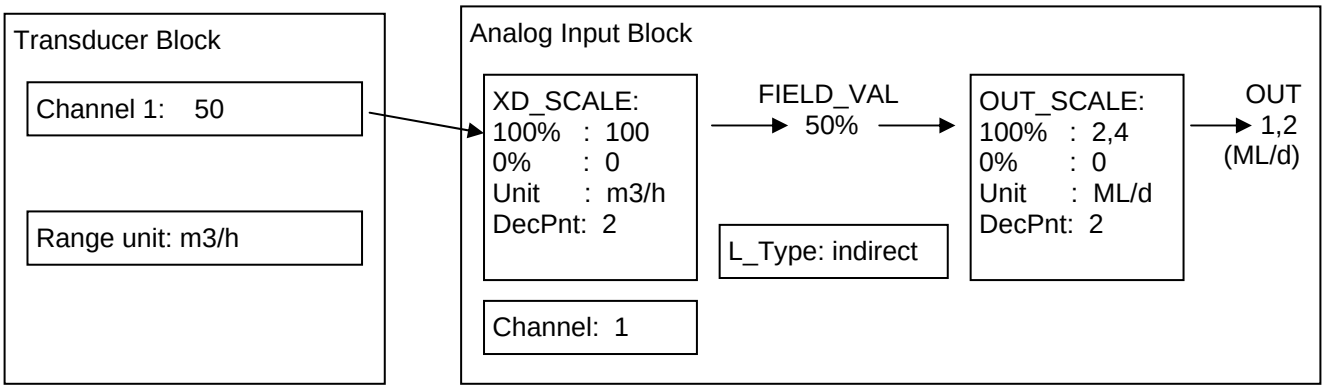
Set L_TYPE within AI block to indirect.

Set Channel within AI block to 1 as to choose flow value (see 2.5.1).

Set XD_SCALE within AI block to 0 to 100 m3/h. The unit has to comply with the channel unit.

Set OUT_SCALE within AI block to 0 to 2.4 ML/d.

Set AI block to “auto".



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

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

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

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

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

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

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

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

It is feasible to choose any sensible or insensible units. The above example could for example also be scaled at 0-100 m3/h to 0-100 kg/h, which, under certain circumstances could well be considered sensible. Yet, the scaling could also be set at 0-100 m3/h to 0-100 Celsius, which, of course, makes no sense at all.

There is, of course, always a risk of faulty scaling. You could, e.g., set a scaling of 0-100m3/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

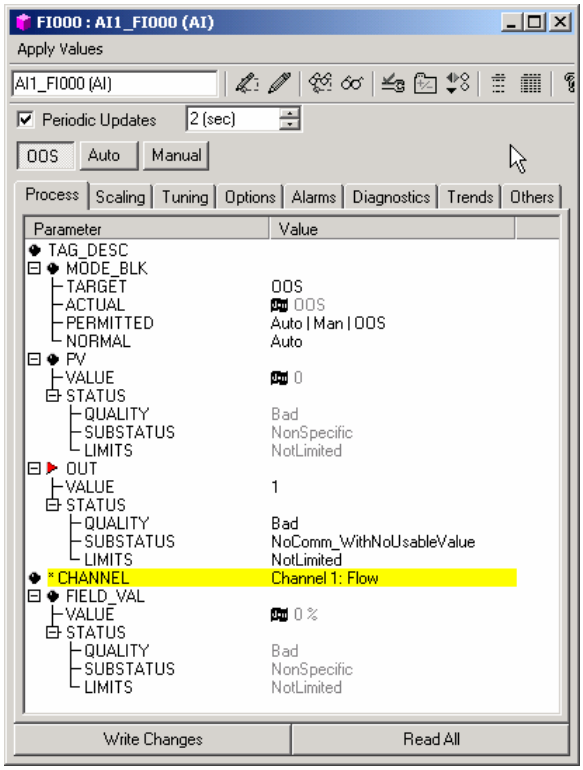
L_TYPE: direct or indirect

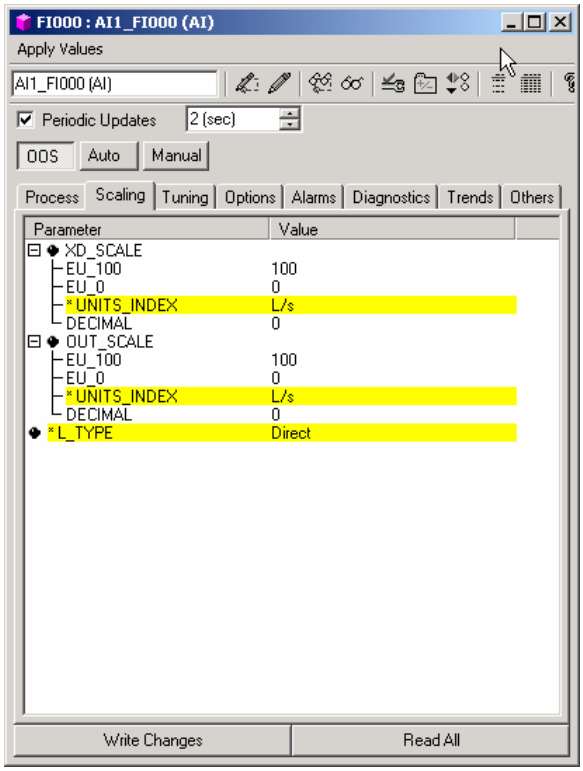
XD_SCALE

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

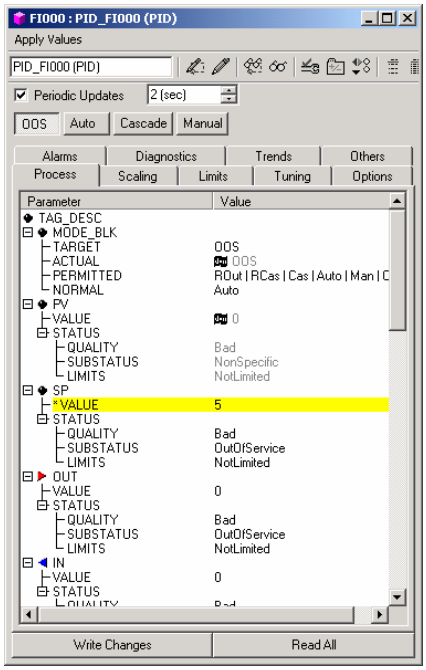
Following parameters have to set to be able to switch the PID block to AUTO mode:

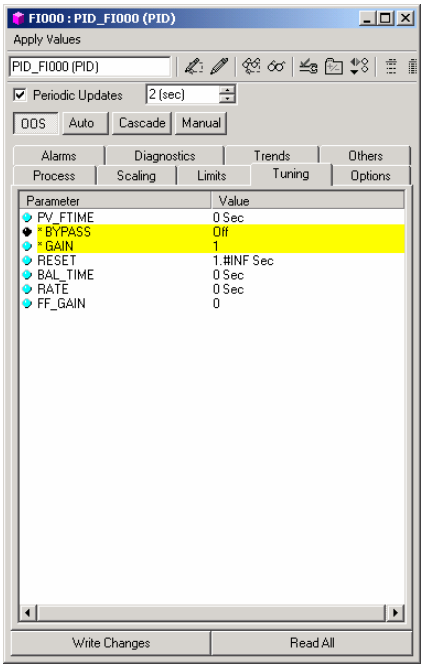
Bypass:	Recommended: Off
Shed_Opt:	Recommended: NormalShed_NormalReturn
Gain:	As required by application
SP:	As required by application

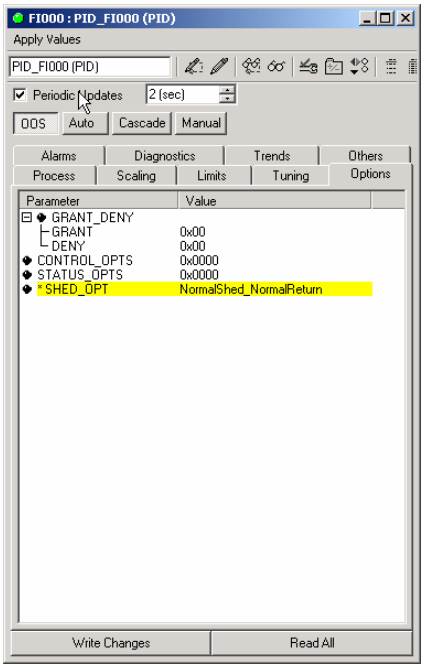
Also recommended to set:

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

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

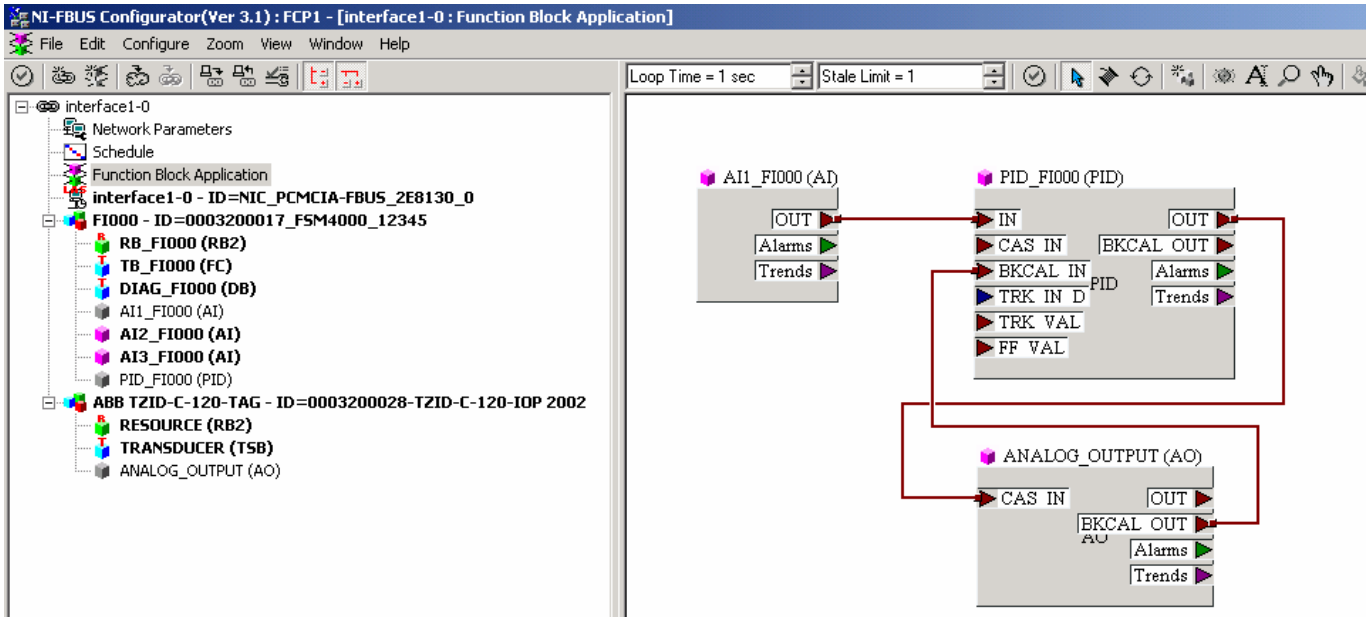






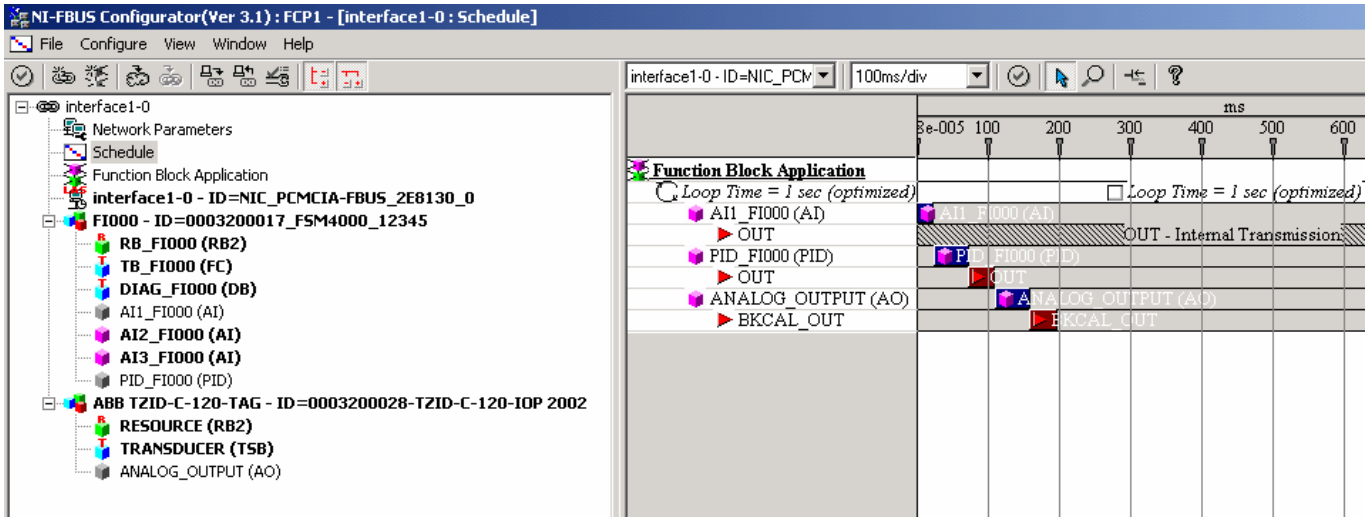
4.10 Function Block Application

A function block application must be created. Therefore open 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.



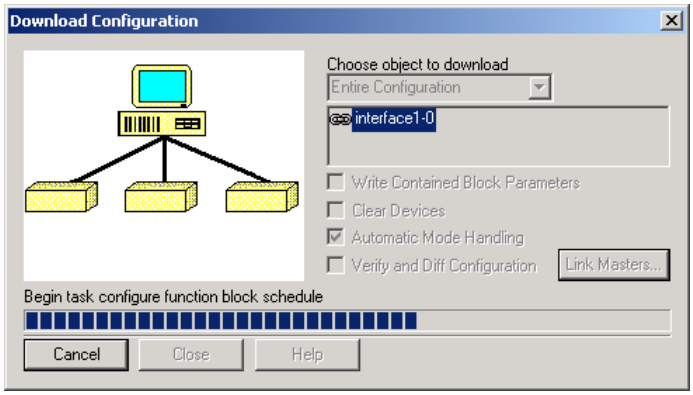
4.11 Schedule

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



4.12 Downlod Project

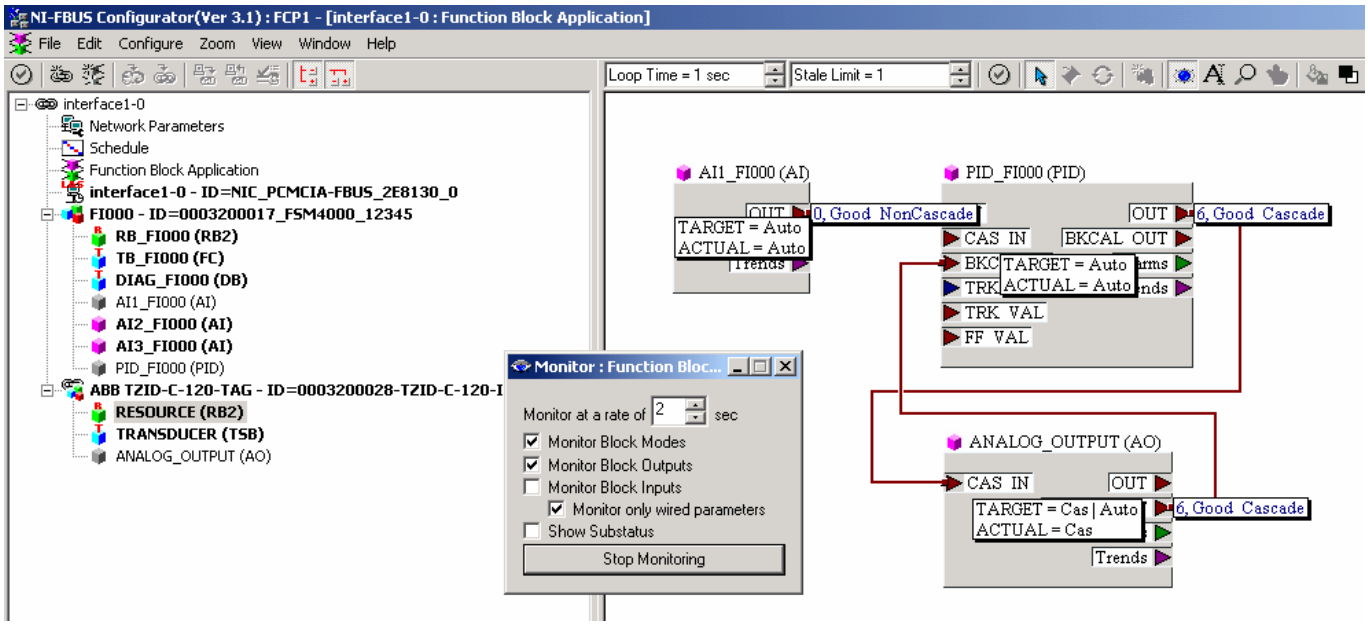
Download the configuration into the devices.



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

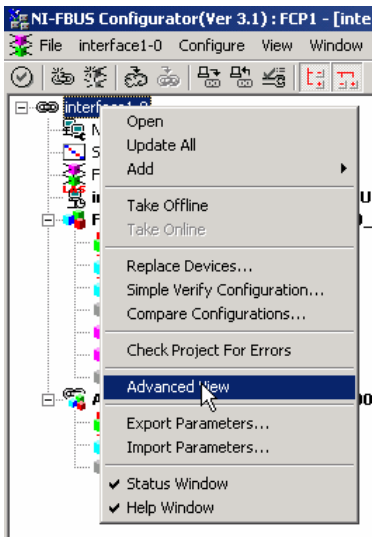
4.13 Monitor Function blocks

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

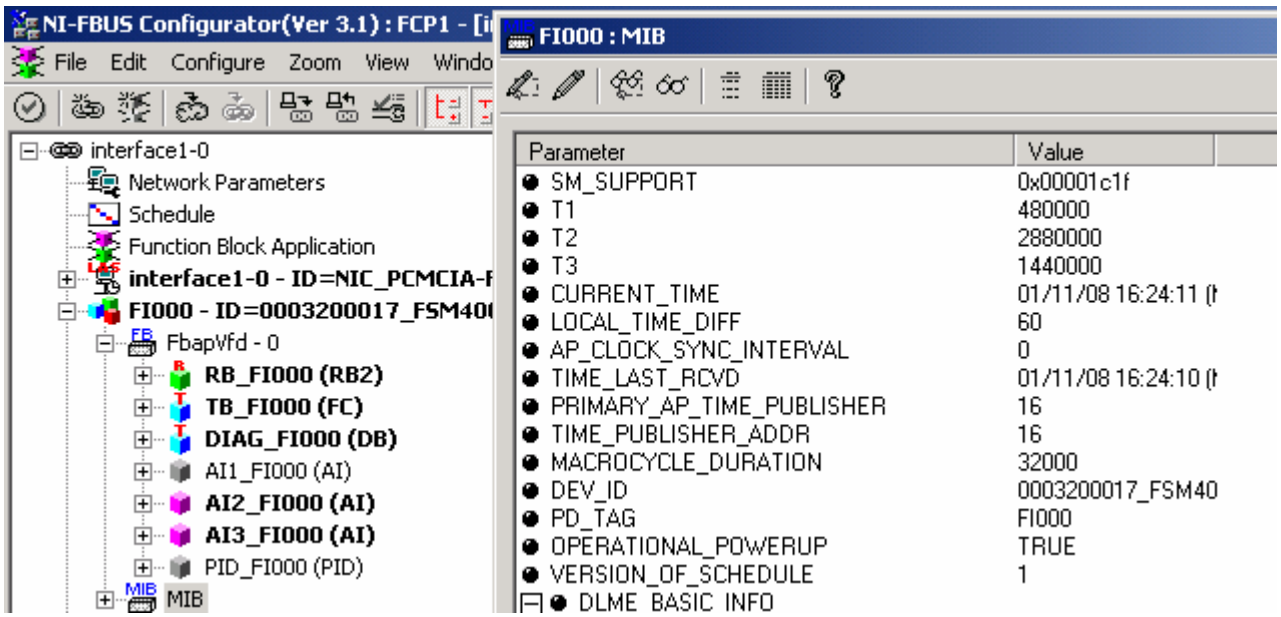


4.14 MIB

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

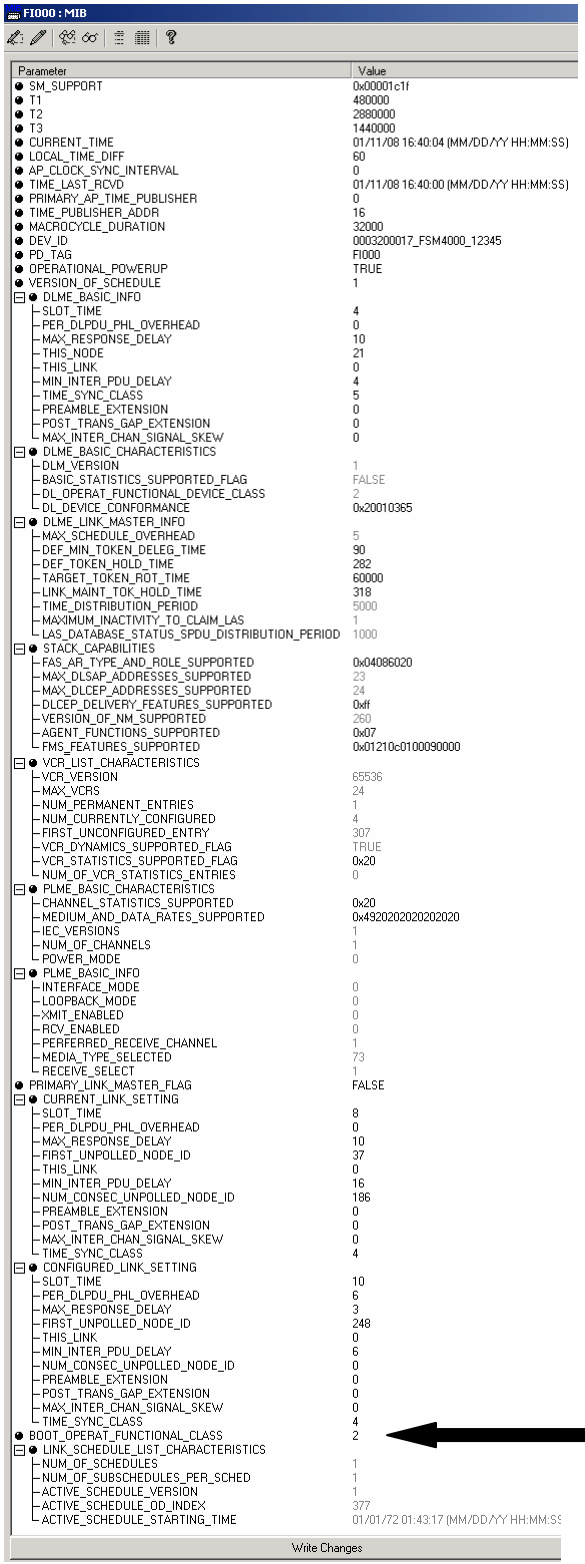


Open the MIB window by a mouse double click on MIB.

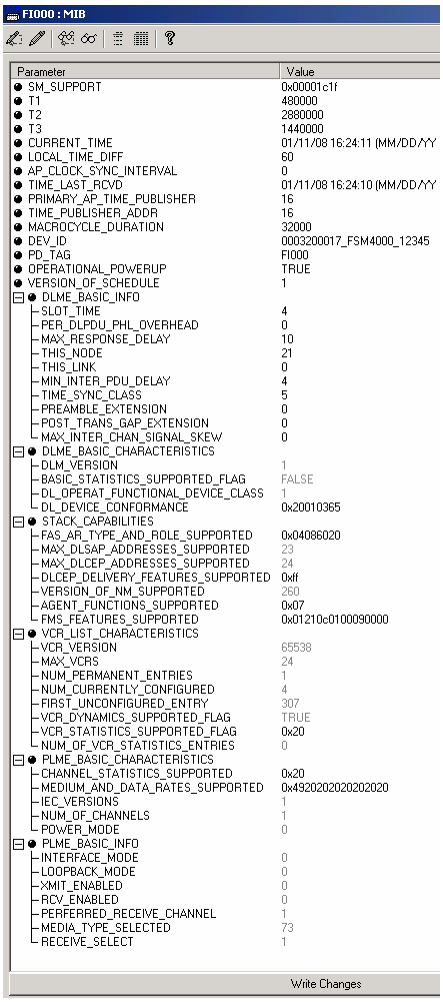


The content of the MIB depends, whether the device is a Link master device (LAS = Link active schedule activated) or Basic field device.

MIB with LAS



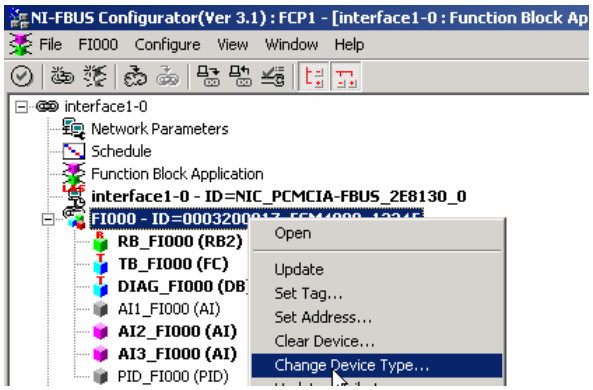
MIB without LAS



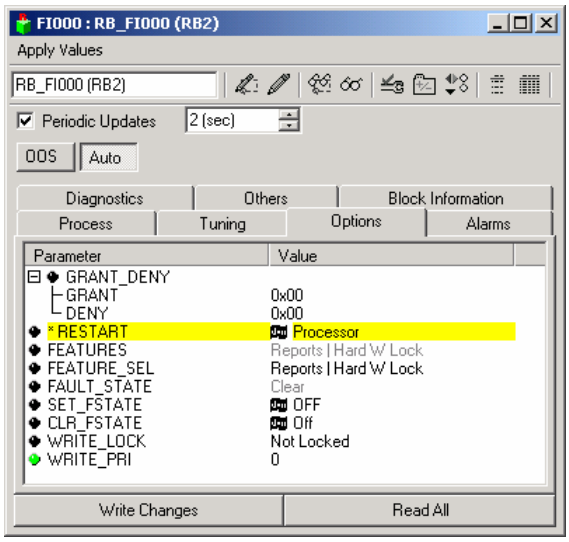
BOOT_OPERAT_FUNCTIONAL_CLASS:
1 = Basic Field Device (without LAS)
2 = Link Master Device (with LAS)

4.15 LAS on/off

To activate LAS (Link Master Device) or to deactivate LAS (Basic Field Device) click with the right mouse button to the device and select „Change Device Type”:



The following necessary restart can be done for example with “Restart processor” in the Resource Block:



4.16 Error searching

4.16.1 Writing Parameter

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

Write is prohibited (Error code 40)

Check whether the write protect switch is deactivated (see 1.2). 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”).

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.

4.16.2 AI Block cannot be set to AUTO

The Auto mode of an AI block requires the following :

1. The resource block has to be set to auto. No other pre-conditions.
2. Within the AI block a valid channel has to be entered.
3. L_Type has to be set to direct or indirect (indirect square root is likewise possible, yet not sensible).
4. XD-SCALE unit has to be idential with channel unit (see also 2.5.1).
5. With L_Type „Direct" the XD_SCALE and OUT_SCALE structures have to be identical.
6. The PERIOD_OF_EXECUTION of the AI block has to be of a value other than 0.

Should these conditions be met and the target mode be set to auto, 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.

It the PD Tag of the device or Block Tags are changed behind a download of a schedule, blocks may also not be able to go to auto mode, altough above conditons are fulfilled. In this case make a new download with the new tags inside.

4.16.3 PID Block cannot be set to AUTO

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

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

PID actual mode remains in mode IMan:

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

5. Local operation

5.1 Local display

The flowmetrer has a 4 lines LCD display. In the submenu display can be selected, which parameters should be shown on the measurement value display (refer to Transducerblock index 57 to 60). The following FF parameters are available:

FF Address	The FF-Address is shown as hex number.
TB VolFlowValue	The value of the flow (TB Primary_Value, Index 14) is shown.
TB VolFlow Stat	The status of the flow (TB Primary_Value, Index 14) is shown.
TB Total >V Value	The value of the totalizer >F (TB Secondary_Value, Index 28) is shown.
TB Total >V Status	The status of the totalizer >F (TB Secondary_Value, Index 28) is shown.
TB Total <R Value	The value of the totalizer <R (TB Third_Value, Index 30) is shown.
TB Total <R Status	The status of the totalizer <R (TB Third_Value, Index 30) is shown.
TB TotDiff Value	The value of the totalizer diff. (TB Fourth_Value, Index 31) is shown.
TB TotDiff Status	The status of the totalizer diff. (TB Fourth_Value, Index 31) is shown.
FB AI1 Out.Value	The value of the Out-parameter from function block AI1 is shown.
FB AI1 Out.Status	The status of the Out-parameter from function block AI1 is shown.
FB AI2 Out.Value	The value of the Out-parameter from function block AI2 is shown.
FB AI2 Out.Status	The status of the Out-parameter from function block AI2 is shown.
FB AI3 Out.Value	The value of the Out-parameter from function block AI3 is shown.
FB AI3 Out.Status	The status of the Out-parameter from function block AI3 is shown.
PID In.Value	The value of the In-parameter from function block PID is shown.
PID In.Status	The status of the In-parameter from function block PID is shown.
PID Out.Value	The value of the Out-parameter from function block PID is shown.
PID Out.Status	The status of the Out-parameter from function block PID is shown.
PID Cas_In.Value	The value of the Cas_In-parameter from function block PID is shown.
PID Cas_In.Status	The status of the Cas_In-parameter from function block PID is shown.
PID FF_Val.Value	The value of the Ff_Val-parameter from function block PID is shown.
PID FF_Val.Status	The status of the Ff_Val-parameter from function block PID is shown.
PID Trk_Vaue.Value	The value of the Trk_Val-parameter from function block PID is shown.
PID Trk_Value.Status	The status of the Trk_Val-parameter from function block PID is shown.

Example:

The status is shown as text, the substatus as number (refer to 3.8).

```
TB VolF  GOOD0
```

For the function blocks the actual mode is shown together with the status:

```
AI1 AUTO GOOD0
```

5.2 Submenu data linke

5.2.1 FF Address

The address and device ID is shown:

```
Address 0x15
Dev_ID
0003200017_FSM40
00_12345
```

5.2.2 Dip Switch

At this menu press Enter:

```
Dip Switch
```

Then this will be shown:

```
123456789A
----------
1: SimEnable off
2: WriteProt off
```

An open switch is shown as -, a closed switch as X. Line 3 and 4 remembers to the function of switch 1 and 2 (refer to 1.2)

5.2.3 Error Mask

This menu shows the mask for the error register (TB index 95).

```
Error Mask
```

Press Enter. Then this will be shown:

```
Bitstring 0  ON
EF0F0000
Error A
Max-Alarm
```

Line one shows the setting of the bit (on/off), which is refered by his bitstring-number. Line two shows the complete mask as hex number. Line three and four show 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.

5.2.4 Warning Mask

This menu shows the mask for the warning register (TB index 96).
Handling same like menu Error Mask.

5.2.5 Revision Communication Software

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

```
Software Rev.
Communication:
2
```

5.3 Submenu status

The following menus are added to the submenu status.

5.3.1 Simulation

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 99)

```
Simulation
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 100).

```
Error Simulation
```

Line one shows the number and setting (on/off) from the bit. Line two shows the whole simulation value as hex number. Line three and four show the meaning of the bit.

```
Bitstring 0 OFF
00000000
Error A
Max-Alarm
```

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 101). Handling is same like menu error simulation.

Note: Warning 15 (means: Error and warning simulation is on) can no be switched off.

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