PROFIBUS

Specification

Profile for Process Control Devices

Version V 3.01

December 2004

Order No: 3.042

PROFIBUS INTERNATIONAL

Document Identification: TC3-04-0006

File name: Profile-PA-Devices_3042_V301_Dec04

Prepared by the PROFIBUS Working Group 3 “PROFIBUS PA Profile” in the Technical Committee 3 “Application Profiles ”.

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1 General Requirements - Introduction

1.1 Scope

Field devices may operate in manufacturing and process control environments that may include intrinsic safety requirements. This creates a need for devices that operate with limited memory and processing power, and for buses that operate using very low bandwidth.

The purpose of this specification is to support the standardisation of application process definitions. The scope of this specification is to define:

(1) a base set of device parameters for operation, commissioning, maintenance, diagnosis,

(2) a mechanism to achieve connectivity of parameters defined by user groups and device vendors.

The fieldbus standard PROFIBUS, standardised in IEC 61158 and IEC 61684 (alias EN 50170 and DIN 19245) covers a large number of potential applications for industrial control, supervision and use in the field as well.

To co-ordinate application functions between transmitter, actuators and controls as well as visualisation and operator terminals the definition of the variable and parameters syntax and semantics have to be defined. This is the main topic of this profile. The mapping to the specific PROFIBUS protocol is defined in the mapping document of the PROFIBUS profile for process control devices. A brief overview how a profile relates to the protocol is shown in Figure 1.

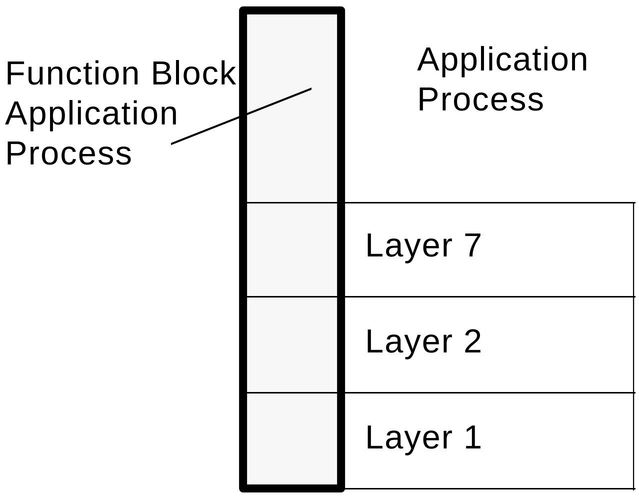

Figure 1. Integration of the Profile (bold) in the Layer Architecture of the ISO OSI Model.

A profile is an instruction set to fulfil the fieldbus standard, or certain defined areas or device functions. A device must conform to both the PROFIBUS protocol specification and this profile to be called a PROFIBUS-PA device. The structure is shown in Figure 2.

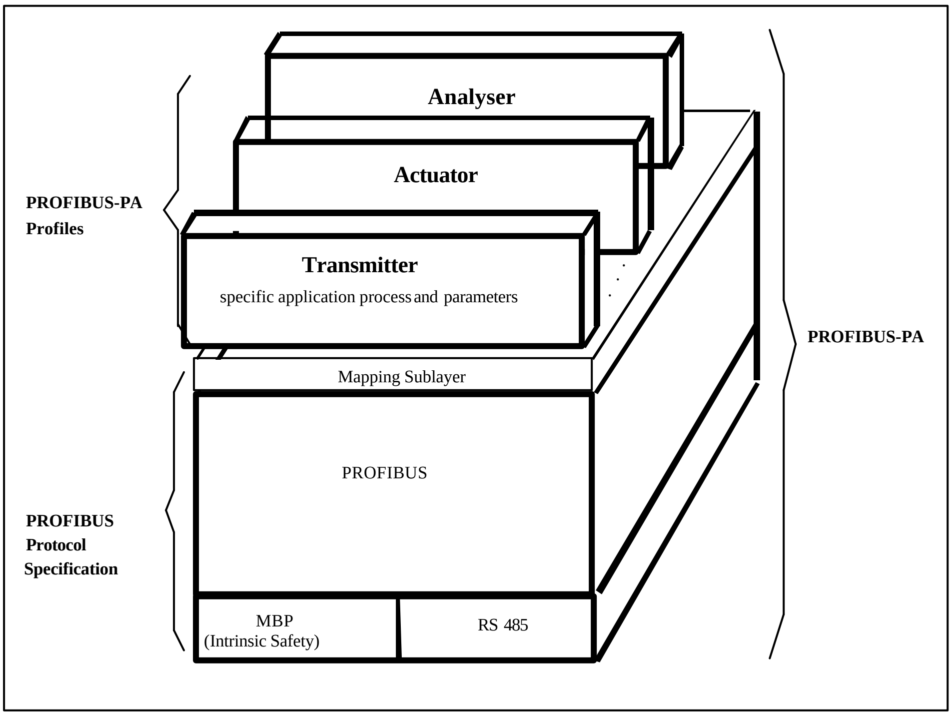

Figure 2. PROFIBUS-PA Structure of the Specification Documents

This document sets out a profile describing transmitters, valves, binary devices and others used in process control e.g. chemical industry, food, water and waste water, power station and basic industries.

The profile provides a standardisation of typical device functions. This offers the possibility to standardise the reactions (behavior) of devices produced by different manufacturers in one system.

The determination of specific application process, parameters and communication functions makes the interaction between the devices and the accompanying control, maintenance and diagnosis devices, much easier.

This profile contains 2 classes, the class A and B. Class A of the profile describes common parameters of simple devices. The scope is limited to the basic functions of the operation phase. The basic set consists of the process variables (e.g. temperature, pressure, level) added by measured value state, the tag name and the engineering unit.

The scope of the class B profile for process control devices is an extension to the class A definition and will cover more complex application functions for identification, commissioning, maintenance and diagnosis. The relationship of the parameters to the classes is visible within the parameter definitions and in the conformance statements (see chapter 6).

1.2 References

1.2.1 Normative References

IEC 61158 (all parts), *Digital data communication for measurement and control – Fieldbus for use in industrial control systems*

IEC 61784:2003, *Digital data communications for measurement and control – Part 1: Profile sets for continuous and discrete manufacturing - Fieldbus relative to use in industrial control systems*

PROFIBUS Profile Amendment 1 to PROFIBUS profile for process conrol devices V 3.0, *PROFIsafe for PA Devices.* V1.0 December 2004.

PROFIBUS Profile Amendment 2 to PROFIBUS profile for process conrol devices V 3.0, *Condensed Status and diagnosis messages.* V1.0 December 2004.

PROFIBUS Profile Amendment 3 to PROFIBUS profile for process conrol devices V 3.0, *Identification and Maintenenace Functions.* V1.0 December 2004.

1.2.2 Bibliography

PROFIBUS: DIN 19245 Beuth Verlag 1994.

EN 50170: General Purpose Field Communication System, CENELEC 1996.

1.3 Definitions

Address :	The address is an absolute numerical reference to a parameter within a device.
Alert Objects:	These are used to communicate notification messages when alarms or events are detected.
Application:	A *software functional unit* consisting of an interconnected aggregation of *Function Blocks, events and objects,* which may be distributed and which may have *interfaces* with other *applications*.
Attribute:	A property or characteristic of an *entity;* for instance, value and status are attributes of an output parameter.
Bus address :	The bus address is the numerical reference of the device at the network.
Block (block instance):	A logical processing unit of software comprising an individual, named copy of the block and associated parameters specified by a block type, which persists from one invocation of the block to the next.
Data structure:	An *aggregate* whose elements need not be of the same *data type*, and each of which may be uniquely referenced by an *identifier.*
Data type:	A set of values together with a set of permitted *operations.*
Device:	A physical entity capable of performing one or more specified functions in a particular context and delimited by its interfaces.
Entity:	A particular thing, such as a person, place, *process*, object, concept, association or *event*.
Function:	(1) A specific purpose of an entity. (2) One of a group of actions performed by an entity in accomplishing its purposes.
Function Block:	A named *block* consisting of one or more input, output and contained parameters. Function Blocks represent the basic automation functions performed by an application which is as independent as possible of the specifics of I/O devices and the network. Each Function Block processes input parameters according to a specified algorithm and an internal set of contained parameters. They produce output parameters that are available for use within the same Function Block application or by other Function Block applications.
Function Block application:	Application of a automation system performed by Physical Blocks, Function Blocks, Transducer Blocks and accompanied objects.
Instance:	A piece of data related to an invocation of a Function Block.
Mode:	Determines the block operating mode and available modes for a block instance.
Object:	An entity having state, behavior and identity.
Parameter:	A *variable* that is an input, output or contained one of a Function Block.
Physical Block:	Hardware specific characteristics of a field device, which are associated with a resource, are made visible through the physical block. Similar to Transducer Blocks, they insulate Function Blocks from the physical hardware by containing a set of implementation independent hardware parameters.
Record:	A set of *data elements* treated as a unit.
Relative Index:	The relative index is a logical offset of a parameter in a block.
Simple variable:	A single variable which is characterised by a defined Data Type.

Transducer Block:	Transducer Blocks insulate Function Blocks from the specifics of I/O devices, such as sensors, actuators, and switches. Transducer Blocks control access to I/O devices through a device independent interface defined for use by Function Blocks. Transducer Blocks also perform functions, such as calibration and linearisation, on I/O data to convert it to a device independent representation. Their interface to Function Blocks is defined as one or more implementation independent I/O channels.
Variable:	A *software* entity that may assume any one of a set of values. The values of a variable are usually restricted to a certain data type.
View Objects:	View objects are provided to support efficient access to parameter data within a Function Block application. View objects allow groups of parameters to be accessed with a single communication request.

1.4 Abbreviations

a	acyclic
AI	Analog Input
AO	Analog Output
AS	Automation System
BM	Binary Messages
cyc	cyclic
DM	Device Management
DS	Data type structures
EUC	Extended Uni Code
FB	Function Block
I/O	Input/Output
LUV	Last Usable Value
NAMUR	Normungsarbeitsgemeinschaft für Meß- und Regelungstechnik in der Chemischen Industrie (Standardisation working group for Measurement and Control in the chemistry in Germany)
PA	Process Automation
PB	Physical Block
PROFIBUS	Process Field Bus
r	read access
TB	Transducer Block
w	write access

1.5 Instruction for Use of this Profile

PROFIBUS-PA compliant devices structure their parameters and functions in Physical, Transducer and Function Block objects. Actual devices consist of instances of these blocks. The collection of block instances in a device follows some rules.

The profile consists of a General Requirement part, covering the overall definition and rules for PROFIBUS-PA devices and a couple of Device Data Sheets including the Transducer, Function and

Physical Block specifications. The mapping to the communication facilities is done in a separate document of this profile.

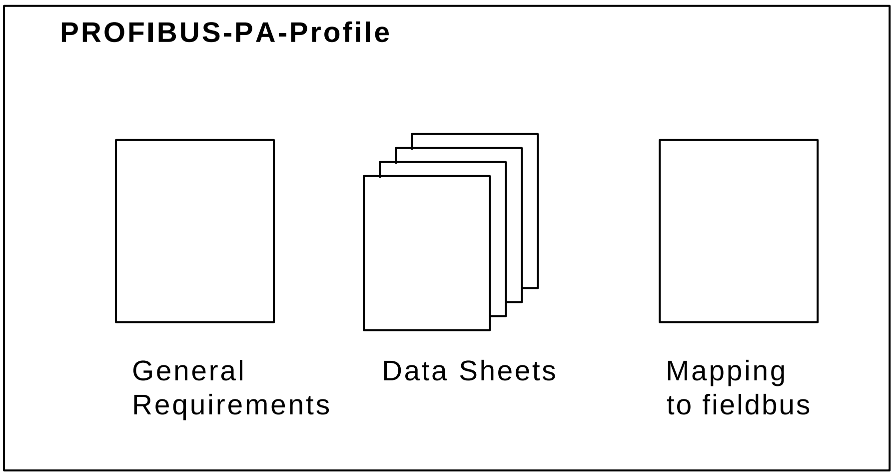

Figure 3. Structure of the Profile

There are devices comprising several applications (e.g. sensor systems, actuators). The profile of these devices is a combination of the definitions of the General Requirements and those of the device data sheets as necessary for the devices. In addition the mapping to the PROFIBUS protocol has to follow the definition of the mapping document of that profile. The structure of the profile, General Definitions as one part and different device data sheets as another part, enables flexible updating of the profile.

2 General Requirements - Technical Overview

2.1 General Overview

Each fieldbus device performs a portion of the total system operation by implementing one or more time-critical applications or portions of an application, such as sensor data acquisition and control algorithm processing. Each application is composed of a set of elementary field device functions modelled by Function Blocks. These applications are referred to as Function Block applications.

PROFIBUS-PA fieldbus systems are composed of digital devices and control/monitoring equipment interconnected by a fieldbus communication network. They are integrated into a plant's or a factory's physical environment where they work together to provide I/O and control for automated processes and operations.

Therefore the field device supports the customer's needs for operation, commissioning, diagnosis and maintenance.

2.2 Device Model

There are two different types of devices performing a PROFIBUS-PA Function Block application. The typical device is a compact one in the area of process control, e.g. transmitter and actuator. A simple device is a special Compact one, which has one sensor attachment only. In addition modular devices such as binary I/O's are often used to execute on/off valves. The compact device is a modular one with exact 1 module (see Figure 4).

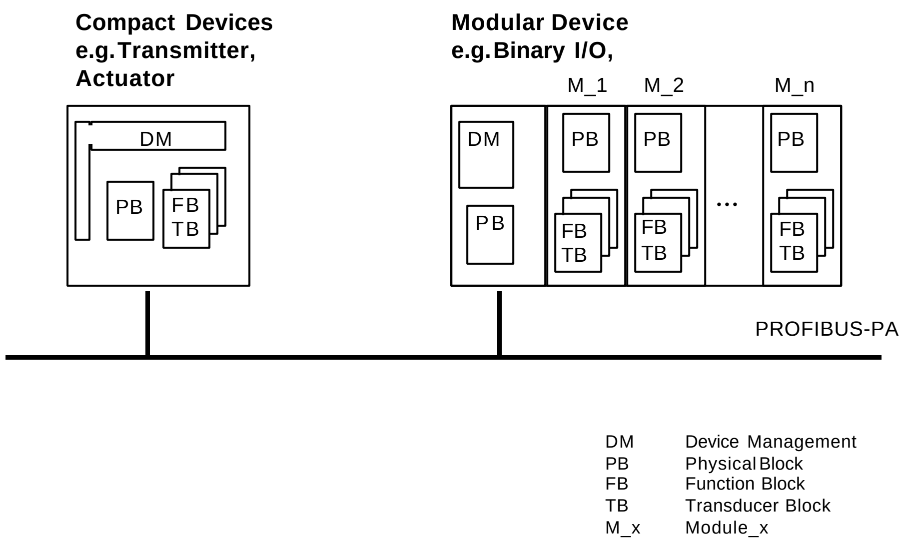

Figure 4. Device Model

Every device is represented by a Physical Block as well as Device Management functions and parameters. The modules of a device contains a Physical Block, Function Blocks and Transducer Blocks (see 2.3). A compact device contains only one Physical Block.

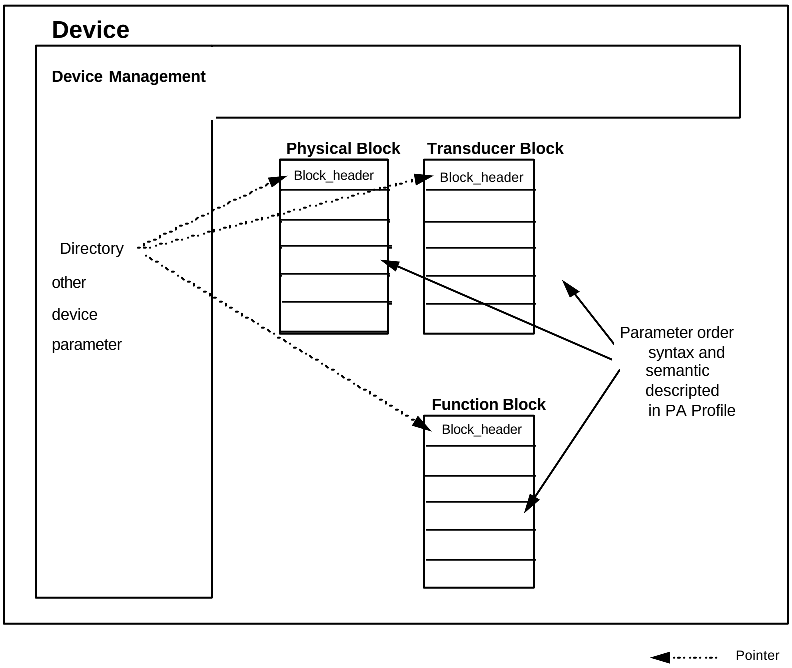

Figure 5. The Relationship between Blocks, Block Parameters and the Directory in the Device Manager

The device management consists of the directory of the block and object structure of the device.

2.3 Block Model

The variables and parameters of a device or module respectively are structured in blocks regarding their assignment to components or parts of functions. (see Figure 6). In the following document a reference is made to parameters because the same parameter could be a variable or constant depending on the context. Components of a device are for example: power supply, memory, electronics of the process attachment unit or preprocessing of the measured value. The components present many views of the devices e.g. commissioning, operation and diagnosis.

Three types of blocks are created from the profile parameters: the Function Block, the Transducer Block and the Physical Block. Function Blocks (FB) describe the functions of the devices executing within the automation system. Examples for FBs are Analog Input (AI) and Analog Output (AO). One device can contain several FBs. The Physical Block (PB) describes the necessary parameters and functions of the device or the operation of the device hardware itself. For the scope of this document one compact device contains one Physical Block.

The Transducer Block (TB) contains the parameters of a device representing the necessary parameters and functions of the connection to the process. Examples are temperature or pressure of the process, the type of sensor, type of reference point or the used linearisation method. Each FB can be connected to one TB at one time. The connection can be fixed or changed during commissioning or maintenance.

The parameters are defined by attributes such as data type or type of transport (cyclic or acyclic). Another attribute of parameters is their assignment to the blocks as Input, Output or Contained parameter. This attribute defines the direction of the information processing and the relationship of the parameters to the algorithm.

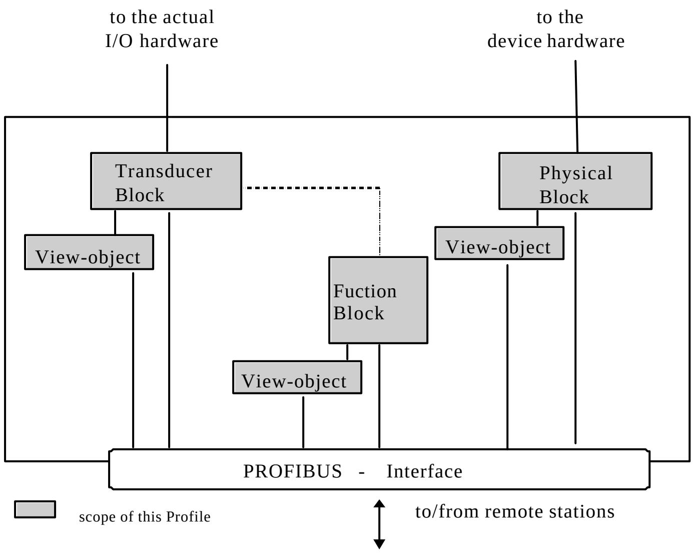

Figure 6. Grouping of the Variables / Parameters in the Device

How the parameters are stored in the device is manufacturer-specific and represented by a so-called Directory object. However, the different view of the life cycle (commissioning, operation, maintenance and diagnosis) needs different structures of the parameters. Transducer Block and Physical Block parameters are usually necessary during commissioning and maintenance, but Function Block parameters are also required during the operation phase. Diagnosis needs parameters from all blocks (see 2.5).

2.4 Status Flow between Blocks

The starting point of the status model is the idea that blocks are connected via their input and output parameters. These parameters are mostly process variables. The process variables are defined as floating point, discrete or bitstring types and structured together with one 'Status Byte'. The 'Status Byte' contains information about the quality of the process variable and is therefore also known as Quality Code. The main process variable types are analog and discrete data structures (e.g. DS_33 and DS_34). The transfer of the status is not limited to process variables but also coupled with manipulated variables or feed back variables. These Status data give information about the current status of the coupled variable and the status of the previous software process instance.

The Status Byte is structured in 3 main groups consisting of 2 bits covering fundamental statements about the transferred value (quality). Additional quality statements are coded in the remaining 4 bits. The meanings of these 4 bits differ in correspondence with the code of the first 2 bits. The third group of the remaining 2 more bits cover the information of limit crossing.

The definition of status coding is described in 3.7.3.

2.5 Parameter

The overall parameter in an actual PROFIBUS-PA field device is constructed from parameters of different specification levels.

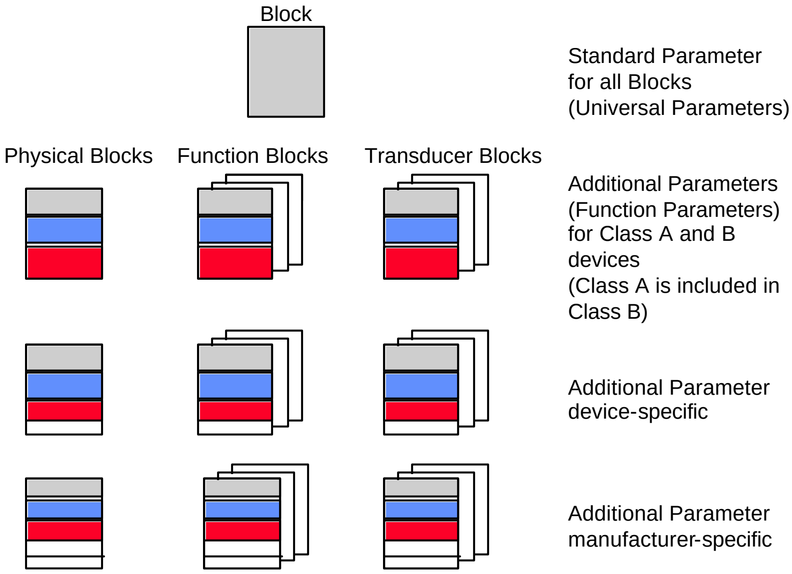

Figure 7. Parameter Conformance Hierarchy in the Blocks

All blocks must provide at least the 7 standard parameters, the Function Block at least 8 (see see chapter 3). That is the top of the hierarchy. Class A blocks must provide the standard parameters plus the device type specific Function Block parameters for class A. Class B devices must provide the standard parameters plus Class A parameters plus the device type specific ones and - if there exist some - the manufacturer specific parameters of Function Block parameters for class B. Device specific and manufacturer specific parameters for each block are possible but not mandatory.

2.5.1 Naming and Addressing of Parameters

All blocks are identified using a tag name. The tags provide a symbolic reference to the blocks. They are unambiguous within the scope of a fieldbus system and assigned by the user of the devices with FBs.

Block parameters are identified by a machine readable name and by a relative index. The relative index is a logical offset of the parameter in the block. Parameter names and the relative index are defined within the scope of a Function Block, Transducer Block and Physical Block. The offset within the block is unique and fixed and may be used to address the parameter at application level. For communication purposes there is an unambiguously mapping between the naming and addressing of the parameters in the FB application and the communication protocol specification. This is defined e.g. in /Map96/.

Parameter Descriptions may be supplemented by additional information, e.g. using the Electronic Device Description Language (EDDL)[1]. Function Block definitions and their associated EDD descriptions are organized into a hierarchy of common parameter sets depending on application area, device function and manufacturer specific capabilities.

[1] The Electronic Device Description Language is neither defined by this specification nor scope of the PROFIBUS Profile class B. EDDL is defined in IEC 61804-2.

2.5.2 Parameter Usage

Parameters are defined for a *block* for a specific purpose. In addition, each is defined for use as an input, an output or a contained parameter.

Contained A *contained parameter* is a *parameter* whose value is configured, set by an operator, higher level device, or calculated. It may not be linked to another Function Block input or output.

Output An *output parameter* is a *parameter* that may be linked to an *input parameter* of one or more *Function Block*(s). *Output parameters* contain both value and status attributes. The output status indicates the quality of the parameter value generated.

Input An *input parameter* obtains its value from a source external to the block. An input parameter may be linked to an output parameter of another Function Block. Its value may be used by the algorithm of the block.

2.6 Standard Parameter Storage in Simple Devices

Simple devices (i.e. devices with one sensor attachment only) are allowed to store ST_REV, TAG_DESC, ALERT_KEY and STRATEGY in one memory place for each parameter. That means that only one TAG is possible (see section 3).

3 General Requirements - Standard Parameters and Objects

3.1 Block Parameters and Objects Introduction

3.1.1 Block Object

This object applies to every block and are placed before the first parameter. It contains the characteristics of the block e.g. block type and profile number.

3.1.2 Static Revision Parameter (ST_REV)

The value of the static revision parameter may be used by a configuration device to determine if a block parameter(s) stored in static memory (as defined as "S" in the parameter attribute table) has changed in value. A change in a static parameter will cause the static revision parameter of the associated block to be incremented. If the value exceeds the data type range it starts with 1. ST_REV shall be reset to zero or incremented at least by one to indicate the change of static parameters in case of a coldstart (i.e. if FACTORY_RESET=1 is set).

3.1.3 Tag Description Parameter (TAG_DESC)

The tag description is a user-supplied description of the block.

3.1.4 Strategy Parameter (STRATEGY)

The strategy parameter has a user-specified value. This assigned value may be used in configuration or diagnostics as a key in sorting block information.

3.1.5 Alert Key Parameter (ALERT_KEY)

The Alert_Key parameter has a user assigned value which may be used in sorting alarms or events generated by a block [1].

3.1.6 Target Mode Parameter (TARGET_MODE)

The target mode attribute indicates what mode of operation is desired for the *block*. It is normally set by a control application or by an operator through a human interface application. The *input parameters* are used by the algorithm in conjunction with the state of the Function Block application containing the *block* to determine if the algorithm can achieve the target mode of operation established for it.

3.1.7 Mode Parameter (MODE_BLK)

The mode parameter is a structured parameter composed of the actual mode, the normal mode and the permitted mode. The actual mode is set (calculated) by the block during its execution to reflect the mode used during execution. The normal mode is the desired operating mode of the block.

The permitted mode shows which changes of the target mode is valid for the specific block to the remote user of the MODE_BLK parameter.

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1 The generation and distribution of alarms and events are neither defined within this specification nor scope of the PROFIBUS Profile class B. Event and alarm handling may be defined on further specification activities (see also analyzer block definitions).

The effect of mode on the operation of the Function Block is summarized as follows:

Out of Service (O/S): The block is not being evaluated. The output shall maintain at the last value or, in the case of output class Function Blocks, the output shall be maintained as defined for power loss. This happens independent of the definition of a fail safe handling.

Local Override (LO): Applies to control and output blocks that support a track input parameter. Also, a local lock-out switch on the device may be provided by a manufacturer to enable LO mode. In the locked out mode, the block output is being set to track the value of the track input parameter. The algorithm (for analog devices) should initialize so that no bump is experienced when the mode switches from LO back to the target mode.

Manual (Man): The block output is not being calculated, although it may be limited. It is directly set by the operator through an interface device. The algorithm should initialize so that no bump is experienced when the mode switches.

Automatic (Auto): The block output is calculated using the input from the TB in case of an input FB and using a setpoint value provide by a host or an operator through an interface device in case of an output FB. For PB and TB this mode indicates, that their block functions are able to work.

Remote Cascade (RCas): The block setpoint is being set by a Control Application through the remote cascade parameter RCAS_IN. Based on this setpoint, the normal block algorithm determines the primary output value.

Execution of a Function Block, physical block or Transducer Block will be controlled by the mode parameter. Mode sub-index values are defined as follows:

1. Target - This is the mode requested by the operator. Only one mode from those allowed by the permitted mode parameter may be requested.

Target and normal are limited to the values allowed by the permitted mode parameter. Modes are assigned within the bitstring in the following manner:

Bit 7: Out of Service (O/S) - MSB

Bit 6: Initialisation Manual (IMan) (not used in Class A and B)

Bit 5: Local Override (LO) (not used in Class A)

Bit 4: Manual (Man)

Bit 3: Automatic (Auto)

Bit 2: Cascade (Cas) (not used in Class A and B)

Bit 1: Remote-Cascade (RCas)

Bit 0: Remote-Output (ROut) - LSB (not used in Class A and B)

The ”automatic” modes used in this profile are Auto and RCas. The ”manual” modes are LO and Man. In O/S mode, the normal algorithm is no longer executed and any outstanding alarms are cleared.

2. Actual - This is the current mode of the block, which may differ from the target based on operating conditions. Its value is calculated as part of block execution.

Under conditions which prevent the Function Block from operating in the target mode, the Function Block actual mode will automatically change. The actual mode will be calculated based on the following:

- Target attribute of the mode parameter and the mode permitted parameter attribute value.
- Status attribute of the cascade, remote-cascade, remote-output, back-calculation and primary input parameters - where these parameters are defined for a block.

- Value attribute of the track input parameter - (only when this parameter is defined for a block).

The concept of priority is used when the block must compute an actual mode that is different from the target mode, and when determining if write access is allowed for a particular actual mode. Mode priority is defined as follows, where zero is the lowest priority.

Mode	Priority
O/S	7 – highest
IMan	6 (not used)
LO	5
Man	4
Auto	3
Cas	2 (not used)
RCas	1
ROut	0 – lowest (not used)

Table 1. Block Mode Priority

The state machine defining the detail of MODE calculation is block class specific (see data sheets).

<u>3. Permitted</u> - Defines the modes which are allowed for an instance of the block. The permitted mode is configured by the block design group, i.e. is defined for every block in the according data sheet. Any mode change request will be checked by the device to insure that the requested target mode is defined as a permitted mode (See Standard parameter MODE_BLK).

<u>4. Normal</u> - This is the mode which the block uses during normal operation conditions. This parameter may be configured and read by an interface device but is not used by the block algorithm. The normal mode is not used in the scope of this profile and for further use.

Blocks of class A devices provide in minimum the MODE "Auto" as mandatory. MODE calculation is mandatory for Function Blocks of class B devices only. Physical and Transducer Blocks don't have to support MODE calculation, its PERMITTED MODE set the AUTO flag only.

3.1.8 Alarm Summary Parameter (ALARM_SUM)

The parameter Alarm Summary summarizes the status of up to 16 block alarms. For each alarm, the current states, unacknowledged states, unreported states and disabled states are maintained. [1]

3.1.9 View Objects

View objects allow groups of Function Block parameter values to be read with one read request. Such capability will be provided to enable group information to be efficiently communicated in a timely fashion. More than one can exist for each physical block, Function Block and Transducer Block instance to show all dynamical information for operation. This profile supports View_1 as mandatory. The parameters to be included in VIEW_1 are defined in the view object table for each block. All elements of the View_1 object are mandatory.

[1] This feature is not fully supported by the actual profile. For this profile the current state part of the alarm is used only (see 3.7.8).

3.1.10 Alarm Objects

Alarm objects are used to communicate notification messages when alarms are detected. An alarm is the detection of a block leaving a particular state and when it returns back to that state. The time at which the alarm state was detected is included as a time stamp[1] in the alert message.

Based on the type of alarm two classes of alarms may be defined in the resource.

Analog Alarms - alarm used to report alarms or events whose associated value is floating point.

Discrete Alarms - alarm used to report alarms or events whose associated value is discrete.

Blocks provide alarm objects, the transfer of the object values is out of the scope of this profile.

3.2 Table Legend

Three tables are used in this section to describe the details of individual block parameters:

Parameter Attribute Table

Parameter Description Table

View Objects Table

The information provided in these tables is explained below.

3.2.1 Parameter Description Table

A description of each block parameter and its intended use is contained in this table. This description contains the semantic of a parameter. For example the coding of enumerated parameters is defined in this table. These are intended to be used as help strings additionally.

If a parameter has an enumeration range it is allowed to support a manufacturer specific subset of the optional codes.

3.2.2 Parameter Attribute Table

Characteristics of the block parameters are specified by the parameter attribute table. This table provides the following information.

Relative Index

Index offset of the parameter relative to the first parameter of the block.

Parameter Name

The Mnemonic name of the parameter.

Object Type

Object type for the parameter value

Simple Simple variable

Record Structure of different simple variables

Array Array of simple variables

Data Type

Data type for the parameter value

Name Basic data type of Simple variable or array

DS-n Data structure (Record) number n

[1] This feature is not supported by the actual profile in general, except in analyser devices. As result of further profile specification activities time stamping may be defined.

Store

Class of memory required

N Non-volatile parameter which must be remembered through a power cycle, but which is not under the static update code.

S Static. Non-volatile and changing the parameter increases the static revision counter ST_REV

D Dynamic. The value is calculated by the block or read by another block.

Cst Constant. The parameter doesn't change in a device.

Size

Data size in number of octets (bytes).

Access

- **r** Indicates that the parameter can be read
- **w** Indicates that the parameter can be written

Parameter usage

- **C** Contained
- **I** Input
- **O** Output

Kind of Transport (minimum requirements as indicated)

- **a** acyclic
- **cyc** cyclic

Reset Class

The FACTORY_RESET (Physical Block parameter) affects a different set of parameters of the blocks in the device. The reset class characteristic of parameters determines if a parameter is involved in the signal chain of the measurement or actuation channel (functional parameter) or the parameter contains additional information (informational parameter).

- **F** Functional
- **I** Informational
- **-** Not applicable

Default Value

The value assigned to parameter in the initialization process. This is required for initialization of an not configured block. Values are of the data type of the parameter. If there is a value in the attribute table of a block, this value has to be used as default value (profile default value). If there is no value for a parameter in the attribute table, the default value is manufacturer specific (manufacturer default value).

Download order

There are data consistency constraints in a device (e.g. several parameters using the same engineering unit). Changing one parameter may lead to some calculation within a device. Therefore a fixed download order of parameters into the device avoid data inconsistencies. A download is a sequence of write accesses to the set of parameters. This attribute defines the order the write access shall be done.

Note: Of course each parameter can be written separately.

Mandatory / Optional

- **M** Indicates the parameter is mandatory for acyclic access.

  Cyclic access may be configured separately.
- **O** Indicates the parameter is optional.

3.2.3 View Object Table

View objects allow groups of parameter values to be read with one read request. Such capability will be provided to enable group information to be efficiently communicated in a timely fashion. More than one object - View_1, View_2, View_3 and View_4 - can exist for each block.

A View object is a concatenation of all parameters (collection) marked in a View table. One communication transaction transports all parameter values. The collection of objects is defined within the view object table in the detailed block specification.

Rel. Index	View	Number_of_Views
0	View object defined to access frequently used dynamic operating parameters of a block and ST_REV	1
1	Reserved	2
2	Reserved	3
3	Reserved	4
4 ...	manufacturer specific	5 ...

Table 2. View Object definition

According to PROFIBUS PA - CLASS B, only View_1 is mandatory for all blocks. The other view objects can be defined, but they are optional. The reserved views have to be counted, if there are manufacturer specific views.

3.3 Standard Parameter Definition

3.3.1 Parameter Description of the Standard Parameters

Parameter	Description
BLOCK_OBJECT	This object contains the characteristics of the blocks.
ST_REV	A block has static block parameters, that are not changed by the process. Values are assigned to this parameter during the configuration or optimisation. The modification of at least one static parameter in a block has to be incremented by the according ST_REV at least by one. This provides a check of the parameter revision. ST_REV shall be reset to zero or incremented at least by one to indicate the change of static parameters in case of a coldstart (i.e. if FACTORY_RESET=1 is set). Additionally the ST_REV shall be increased if a change of a table is accepted.
TAG_DESC	Every block can be assigned a textual TAG description. The TAG_DESC must be unambiguous and unique in the fieldbus system.
STRATEGY	Grouping of Function Block. The STRATEGY field can be used to group blocks.
ALERT_KEY	This parameter contains the identification number of the plant unit. It helps to identify the location (plant unit) of an event.
TARGET_MODE	The TARGET_MODE parameter contains desired mode normally set by a control application or an operator. The modes are valid alternatively only, i.e. only one mode can be set at one time. A write access to this parameter with more then one mode is out of the range of the parameter and have to be refused.
MODE_BLK	This parameter contains the current mode, the permitted and normal mode of the block.
ALARM_SUM	This parameter contains the current states of the block alarms.

Table 3. Parameter Description of the Standard Parameters

3.3.2 Parameter Attributes of the Standard Parameters

Relative Index	Parameter Name	Object Type	Data Type	Store	Size	Access	Parameter Usage / Kind of Transport	Reset Class	Default Value	Mandatory Optional (Class A,B)
0	BLOCK_OBJECT	Record	DS-32	Cst	20	r	C/a	-	-	M
1	ST_REV	Simple	Unsigned16	N	2	r	C/a	-	0	M
2	TAG_DESC	Simple	OctetString [1]	S	32	r,w	C/a	I	‘ ‘	M
3	STRATEGY	Simple	Unsigned16	S	2	r,w	C/a	I	0	M
4	ALERT_KEY	Simple	Unsigned8	S	1	r,w	C/a	I	0	M
5	TARGET_MODE	Simple	Unsigned8	S	1	r,w	C/a	F	-	M
6	MODE_BLK	Record	DS-37	D	3	r	C/a	-	Block spec	M
7	ALARM_SUM [2]	Record	DS-42	D	8	r	C/a	-	0,0,0, 0	M

Table 4. Parameter Attributes of the Standard Parameters

3.3.3 View Object of the Standard Parameters

Relative Index	Parameter Name	View_1	View_2	View_3	View_4
0	BLOCK_OBJECT				
1	ST_REV	2			
2	TAG_DESC				
3	STRATEGY				
4	ALERT_KEY				
5	TARGET_MODE				
6	MODE_BLK	3			
7	ALARM_SUM	8			
-	Overall sum of bytes in View-Object	13			

Table 5. View Object of the Standard Parameters

[1] Prefered data type should be VisibleString.

[2] See remark at 3.1.8

3.4 Block Construction

Chapter 2.5 describes the logical concatenation of parameters to a block. Every block starts with a header the so-called Block Object. The Block Object has a defined structure and is defined in 3.7.2. Figure 8 presents the Block Object (partly) and the parameter structure within one block.

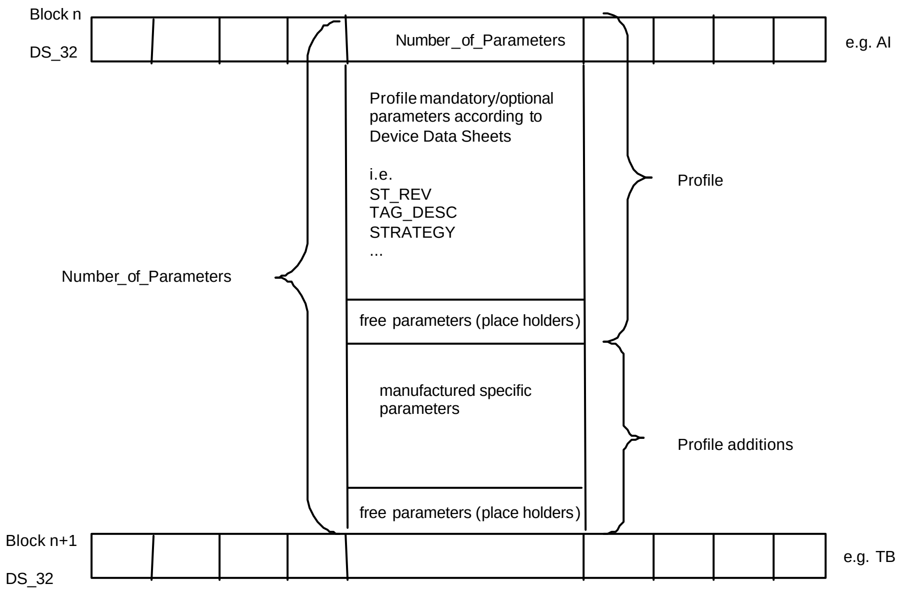


Figure 8. Structure of Parameters in a Block

3.5 Batch Parameter (BATCH) Standard for Function Blocks

The Batch parameter is a structured parameter composed of four elements. This parameter is intended to be used in Batch applications in line with IEC 61512 Part1 (ISA S88). Only Function Blocks carry this parameter. There is no algorithm necessary within a Function Block.

The Batch parameter is necessary in a distributed fieldbus system to identify used and available channels, in addition to identify the current batch in case of alerts.

The Batch parameter is not part of the View_1 object of the Function Blocks.

Parameter	Description
BATCH	This parameter is intended to be used in Batch applications in line with IEC 61512 Part1. Only Function Blocks carry this parameter. There is no algorithm necessary within a Function Block. For more details see 3.7.19.

Table 6. Parameter Description of the BATCH Parameter

Relative Index	Parameter Name	Object Type	Data Type	Store	Size	Access	Parameter Usage / Kind of Transport	Reset Class	Default Value	Mandatory Optional (Class A,B)
1-7	Standard Parameters									M
8	BATCH	Record	DS-67	S	10	r,w	C/a	I	0,0,0, 0	M

Table 7. Parameter Attributes of the BATCH Parameter

3.6 Device Management and Identification Parameters

3.6.1 Device Management Overview

The Device Management provides the table of content of a device by means of a so-called Directory, i.e. the device specific implementation of the PROFIBUS-PA profile definitions. Some parameters are reserved for future definitions. The Device Management is the basis of a Management block, that will be introduced in future versions of the PROFIBUS-PA profile.

3.6.2 Directory Object

3.6.2.1 Overview

The directory object is defined to act as a guide within the Function Block application in a device. It is a list of references to the objects making up this application. This information may be read by an interface device desiring to access objects in the device.

There are different types of objects represented in the directory. One parameter is represented as a single entry in the logical address space of the device. A group of parameters, e.g. a Function Block allocate many single entries is called a Composite object. A Composite object is referenced by a Composite_Directory_Entry in the directory. Composite_Directory_Entries of the same type (i.e. Physical Block, Function Block and Transducer Block, Link objects) are listed in the directory continuously. This results in compact lists of Composite Directory Entries. References to these lists of

Composite Directory Entries are an additional part of the directory, the so called Composite_List_Directory_Entry. The Composite List Directory Entry contains the reference to the list of Physical Block Composite_Directory_Entries, Function Blocks Composite_Directory_Entries, Transducer Blocks Composite_Directory_Entries and Link objects Composite_Directory_Entries if available.

The directory is logically constructed by concatenating the several directory parts. These parts are the header followed by Composite List Directory Entries and the Composite Directory Entries. The Composite_List_Directory_Entries points to the reference of the composite objects types PB, FB, TB and Link objects. The following Composite_Directory_Entries points to the parameter address of the first block parameters and objects (see Figure 9). One Composite Directory Entry is composed of the parameter address of the first element of the according composite object and its number of elements. The directory object is seen as one array. It has to be mapped to the definition of the underlying communication system.

The Directory object consists of the following parts:

Header
Composite List Directory Entries
Composite Directory Entries

with the following definitions:

3.6.2.2 Header

1. Reserved - Directory ID - not used in this profile
2. Directory Revision Number
3. Number of Directory Objects - If more than one object is used for the entire directory, then the elements are treated as continuously defined as though one larger object were used. Multiple directory objects will be contiguously listed in the directory. This object counts the numbers of objects which are necessary for the all over directory. The header object is not counted.
4. Total Number of Directory Entries - Number if Composite List Directory Entries and Composite Directory Entries shall be added
5. Directory Entry number of first Composite List Directory Entry - This number counts the entries within the directory not the address of the parameter which contains the entry. The 1st directory entry is the Physical Block reference in the Composite List Directory Entry. There is no gap between Composite List Directory Entry and Composite Directory Entry in counting the entries.
6. Number of Composite List Directory Entries - Counts the number of different block types (Physical Block, Transducer Blocks and Function Block) and object types (in the scope of this profile Link object only) in the device.

3.6.2.3 Composite List Directory Entries, Composite Directory Entries

1. Directory_Entry_Number for the Physical Block / Number of Physical Blocks
2. Directory_Entry_Number for the first Transducer Block pointer / Number of Transducer Blocks
3. Directory_Entry_Number for the first Function Block pointer / Number of Function Blocks
4. Directory_Entry_Number for the first link object pointer / Number of Link Objects

Note: The Directory_Entry_Number counts both, the address of the parameter which contains the according entry of the Directory (this address is communication system depending, it can be e.g. an index) and the elements in the directory array starting with the first Composite_List_Directory_Entry (this is communication system independent and the counter in the array).

Composite_Directory_Entries

4. Block_ptr_1/Number of Elements
5. Block_ptr_2/Number of Elements
6. …

n. Block_ptr_n/Number of Elements

The Directory is structured in 3 levels as shown in the following figure.

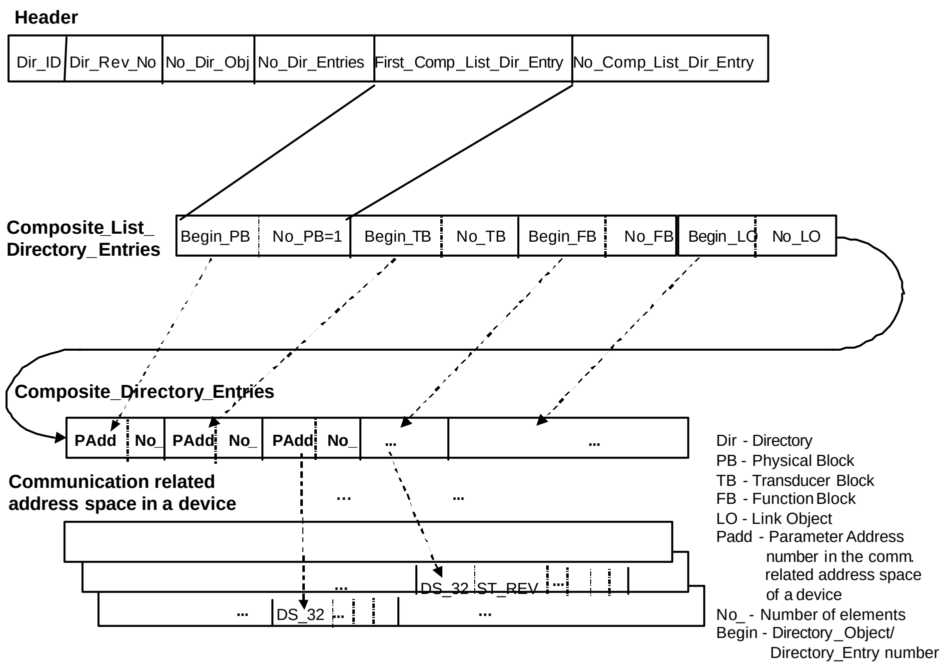


Figure 9. Directory Structure and Reference to the Blocks

The header contains the concrete structure of the directory and objects. The Composite_List_Directory distinguishes between the different block types (FB, TB, PB) and provides the number of each kind of block in the device. The Composite Directory_Entries provides the pointers to the first element of the blocks and the number of elements within the block. The Composite Directory_Entries part of the directory shall follow the Composite_List_Directory_Entry without gap.

The mapping of the Directory object to communication objects is dependent from the communication system and the device capabilities (max. length of communication objects). E.g., if the total number of bytes in the directory is higher than the maximal length of one communication object (respectively parameter), a new parameter has to be added and follows directly with the next index.

3.6.3 Device Management Parameters Attributes

For the Device Management Parameter Description see 9.4.3.

3.6.4 Device Management View Object

The Device Management provides no View Object because there are no dynamic parameters in the read only parameters.

3.7 General Data Types and Structures

3.7.1 Data Types

3.7.1.1 Common Data Types

The data types (1-Boolean to 13-TimeDifference) are used as defined in the underlying PROFIBUS specification.

In the scope of this profile there is no BitString data type. The BitString data type is mapped to the OctetString one as follows:

BitString definition

Byte 1								Byte 2								Byte 3								...
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	...

OctetString definition

Byte 1								Byte 2								Byte 3								...
8	7	6	5	4	3	2	1	16	15	14	13	12	11	10	9	24	23	22	21	20	19	18	17	...
Bit 7							Bit 0	Bit 7							Bit 0	Bit 7							Bit 0	

Table 8. Mapping of BitString to OctetString

3.7.1.2 Time_Value Data Type

This data type is an additional (to Boolean, Unsigned, Integer, ...) data type and is used to represent date and time in the required precision for device time and clock synchronisation. It is a 64-bit unsigned fixed-point number with the integer part in the first 32 bits and the fraction part in the last 32 bits.

DataType Time_Value

Key Attribute Index = 21

In the scope of this profile there is no application time synchronisation and therefore no use of time stamps. Parameter with data type 21 shall have the default value 0 (zero).

3.7.2 Block Structure

This data structure consists of the attributes of the blocks (see also 3.4).

DataType Block

Shortcut DS-32

Attribute Number of Elements = 12

Attribute List of Elements (shown below)

E	Element Name	Data Type	(Index)	Size
1	Reserved	Unsigned8	(5)	1
2	Block_Object	Unsigned8	(5)	1
3	Parent_Class	Unsigned8	(5)	1
4	Class	Unsigned8	(5)	1
5	DD_Reference	Unsigned32	(7)	4
6	DD_Revision	Unsigned16	(6)	2
7	Profile	OctetString	(10)	2
8	Profile_Revision	Unsigned16	(6)	2
9	Execution_Time	Unsigned8	(5)	1
10	Number_of_Parameters	Unsigned16	(6)	2
11	Address_of_View_1	Unsigned16	(6)	2
12	Number_of_Views [1]	Unsigned8	(5)	1

Table 9. List of Elements of the Block Structure

Parameter	Description
Reserved, Block_Object, Parent_Class, Class	These four parameters define the kind of device. Coding: 0 – 127: see Table 11, Table 12 and Table 13 below. 128 – 249: manufacturer specific 250: not used 251: none 252: unknown 253: special 254 and 255: reserved
DD_Reference	For future use.
DD_Revision	For future use.
Profile	Coding see Table 14 below.

[1] If a block has more than one (1) View object, the View objects must follow the first one without gaps.

Parameter	Description
Profile_Revision	Coding: Byte 1 (MSB): Number before the decimal point; range 00 - 99 Byte 2 (LSB): Number after the decimal point; range 0 - 255 The MSB counts the first number and the LSB counts the second and third number of NAMUR NE53: Example for this new profile 3.01: MSB = 0x03, LSB = 0x01.
Execution_Time	For future use.
Number_of_Parameters	Number of used Relative Indices (parameters) of a block including - Gaps within the mandatory part of the block - Optional parameters - Reserved parameters - Manufacturer specific parameters - Gap within the manufacturer specific part of the block The Number_of_Parameters doesn't include the view objects.
Address_of_View_1	Reference to View_1 parameter for access (see 3.1.9). The specific meaning of the value of this parameter is communication specific and defined in the mapping part of this profile. Coding: Byte 1 (MSB): Slot Byte 2 (LSB): Index
Number_of_Views	If there are more than the View_1 view objects in a block, this parameter contains the number of view objects of the block including the View_1 and the reserved ones.

Table 10. Parameter Description of the Block Structure

Block Object of the Physical Block:

Byte 1	Byte 2	Byte 3	Byte 4
Reserved	**Block_Object**	**Parent_Class**	**Class**
0 – 127 reserved Default = 250 (not used)	01 Physical Block	01 Transmitter 02 Actuator 03 Discrete I/O 04 Controller 05 Analyser 06 Lab Device 07 reserved ... 126 reserved 127 Multi-Variable	Default = 250 (not used)

Table 11. Physical Block: Coding of Block_Object, Class and Parent_Class

Block Object of Function Blocks:

Byte 1	Byte 2	Byte 3	Byte 4
Reserved	**Block_Object**	**Parent_Class**	**Class** [1]
	02 Function Block	01 Input 02 Output 03 Control 04 Advanced Control 05 Calculation 06 Auxiliary 07 Alert 08 reserved ... 127 reserved	***Input*** 01 Analog Input 02 Discrete Input 03 reserved ... 127 reserved ***Control*** 01 PID 02 Sample Selector 03 Lab Device Control 04 reserved ... 127 reserved ***Output*** 01 Analog Output 02 Discrete Output 03 reserved ... 127 reserved ***Advanced Control*** 01 Lab instruments 02 reserved ... 127 reserved ***Calculation*** 01 reserved ... 07 reserved 08 Totaliser 09 reserved ... 127 reserved ***Auxiliary*** 01 Ramp 02 BM Logbook 03 Sample 04 reserved ... 127 reserved

[1] More definitions of Class codes are done in the data sheets in arrangement with the PNO.

Byte 1	Byte 2	Byte 3	Byte 4
Reserved	**Block_Object**	**Parent_Class**	**Class** [1]
			Alert 01 reserved ... 127 reserved

Table 12. Function Block: Coding of Block_Object, Class and Parent_Class

Block Object of Transducer Blocks:

Byte 1	Byte 2	Byte 3	Byte 4
Reserved	**Block_Object**	**Parent_Class**	**Class** [1]
	03 Transducer Block	01 Pressure 02 Temperature 03 Flow 04 Level 05 Actuator 06 Discrete I/O 07 Analyzer 08 Auxiliary 09 Alarm 10 reserved ... 127 reserved	***Pressure*** 01 Differential 02 Absolute 03 Gage 04 Pressure + Level + Flow 05 Pressure + Level 06 Pressure + Flow 07 Mixed absolute / diff. Pressure 08 reserved ... 127 reserved ***Temperature*** 01 Thermocouple (TC) 02 Resistance Thermometer (RTD) 03 Pyrometer 04 reserved ... 15 reserved 16 TC + DC U (DC Voltage) 17 RTD + R (R-Resistance) 18 TC+RTD+R+DC U 19 reserved ... 127 reserved ***Flow*** 01 Electromagnetic 02 Vortex 03 Coriolis 04 Thermal Mass 05 Ultrasonic 06 Variable Area 07 Differential Pressure 08 reserved ... 127 reserved ***Level*** 01 Hydrostatic 02 Echo Level

[1] More definitions of Class codes are done in the data sheets in arrangement with the PNO.

Byte 1	Byte 2	Byte 3	Byte 4
Reserved	**Block_Object**	**Parent_Class**	**Class** [1]
			03 Radiometric 04 Capacity 05 reserved ... 127 reserved ***Actuator*** 01 Electric 02 Electro-pneumatic 03 Electro-hydraulic 04 reserved ... 127 reserved ***Discrete I/O*** 01 Sensor Input 02 Actuator 03 reserved ... 127 reserved ***Analyser*** 01 Standard 02 reserved ... 127 reserved ***Auxiliary*** 01 Transfer 02 Control 03 Limit 04 reserved ... 127 reserved ***Alarm*** 01 Binary Message 02 reserved ... 127 reserved

Table 13. Transducer Block: Coding of Block_Object, Class and Parent_Class

Byte 1 (MSB)	Byte 2 (LSB)	Description
Number of the PROFIBUS-PA profiles within the PNO Profile Class	-	The Profile Class is given by the PNO for the profile document on the cover page: "PROFIBUS-PA, Profile for Process Control Devices"
64, i.e. 0x40	0x01 – Compact class A 0x02 – Compact class B	highest bit not set means, all standard parameters have their own memory place
	0x81 – Simple class A 0x82 – Simple class B	highest bit is set means: mapping of the standard parameters ST_REV, TAG_DESC, STRATEGY, ALERT_KEY in one memory place.
	253 – special	manufacturer specific block structures

Table 14. Coding of Profile

3.7.3 Value & Status – Floating Point Structure

This data structure consists of the values and the state of the Floating Point parameters. These parameters can be inputs or outputs.

Data Type Value & Status - Floating Point

Data Type Numeric Identifier = 101

Attribute Number of Elements = 2

Attribute List of Elements (shown below)

E	Element Name	Data Type (Index)	Size
1	Value	Float (8)	4
2	Status	Unsigned8 (5)	1

Table 15. List of Elements of the Value & Status - Floating Point Structure

3.7.3.1 Coding of Status

The definition of the status attribute is the same for all parameters (input, output, and contained). There are four states of quality of the data, an enumerated set of sixteen sub-status values for each quality, and four states of the limits placed on the data. Limit information is generated for all status attributes of all parameters having status.

Meaning of Quality

Quality		Quality Substatus				Limits		
Gr	Gr	QS	QS	QS	QS	Qu	Qu	
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
0	0							BAD
0	1							UNCERTAIN
1	0							GOOD (Non Cascade)
1	1							GOOD (Cascade)

Meaning of Substatus if Quality = BAD

0	0	0	0	0	0			non specific
0	0	0	0	0	1			configuration error
0	0	0	0	1	0			not connected
0	0	0	0	1	1			device failure
0	0	0	1	0	0			sensor failure
0	0	0	1	0	1			no communication (last usable value)
0	0	0	1	1	0			no communication (no usable value)
0	0	0	1	1	1			out of service

Meaning of Substatus if Quality = UNCERTAIN

0	1	0	0	0	0			non specific
0	1	0	0	0	1			last usable value (LUV)
0	1	0	0	1	0			substitute value
0	1	0	0	1	1			initial value
0	1	0	1	0	0			sensor conversion not accurate
0	1	0	1	0	1			engineering unit violation (unit not in the valid set)
0	1	0	1	1	0			sub normal
0	1	0	1	1	1			configuration error
0	1	1	0	0	0			simulated value
0	1	1	0	0	1			sensor calibration

Meaning of Substatus if Quality = GOOD (Non Cascade)

1	0	0	0	0	0			ok
1	0	0	0	0	1			update event
1	0	0	0	1	0			active advisory alarm
1	0	0	0	1	1			active critical alarm
1	0	0	1	0	0			unacknowledged update event
1	0	0	1	0	1			unacknowledged advisory alarm
1	0	0	1	1	0			unacknowledged critical alarm
1	0	1	0	0	0			initiate fail safe
1	0	1	0	0	1			maintenance required

Meaning of Substatus if Quality = GOOD (Cascade)

1	1	0	0	0	0			ok
1	1	0	0	0	1			initialisation acknowlegded
1	1	0	0	1	0			initialisation request
1	1	0	0	1	1			not invited
1	1	0	1	0	0			reserved
1	1	0	1	0	1			do not select
1	1	0	1	1	0			local override
1	1	0	1	1	1			reserved
1	1	1	0	0	0			initiate fail safe

Meaning of the Limit Bits

						0	0	ok
						0	1	low limited
						1	0	high limited
						1	1	constant

Table 16. Coding of the Status Byte

3.7.3.2 Invalid Status Values

Quality		Quality Substatus				Limits		
Gr	Gr	QS	QS	QS	QS	Qu	Qu	
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
1	0	0	0	0	0	1	0	GOOD (Non Cascade)
1	1	0	0	0	0	1	0	GOOD (Cascade)
1	0	0	0	0	0	0	1	GOOD (Non Cascade)
1	1	0	0	0	0	0	1	GOOD (Cascade)

Table 17. Invalid Status Values

3.7.3.3 Reserved Status Values

Quality		Quality Substatus				Limits		
Gr	Gr	QS	QS	QS	QS	Qu	Qu	
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	

Quality = BAD

0	0	1	0	0	0	*	*	reserved
								...
0	0	1	1	1	1	*	*	reserved

Quality = UNCERTAIN

0	1	1	0	1	0	*	*	reserved
								...
0	1	1	1	1	1	*	*	reserved

Quality = GOOD (Non Cascade)

1	0	0	1	1	1	*	*	reserved
1	0	1	0	1	0	*	*	reserved
								…
1	0	1	1	1	1	*	*	reserved

Quality = GOOD (Cascade)

1	1	1	0	0	1	*	*	reserved
								...
1	1	1	1	1	1	*	*	reserved

Table 18. Reserved Status Values

3.7.3.4 Use of the Status Byte for Profile Compliant Devices

0	0	0	1	0	0	0	1

BAD - sensor failure, low limited - lower physical range of the sensor reached

0	0	0	1	0	0	1	0

BAD - sensor failure, high limited - upper physical range of the sensor reached

1	0	0	0	1	0	0	1

GOOD (Non Cascade), active advisory alarm, low limited - e.g. LO_LIM of OUT is exceeded

1	0	0	0	1	0	1	0

GOOD (Non Cascade), active advisory alarm, high limited - e.g. HI_LIM of OUT is exceeded

1	0	0	0	1	1	0	1

GOOD (Non Cascade), active critical alarm, low limited - e.g. LO_LO_LIM of OUT is exceeded

1	0	0	0	1	1	1	0

GOOD (Non Cascade), active critical alarm, high limited - e.g. HI_HI_LIM of OUT is exceeded

1	0	0	0	0	1	*	*

GOOD (Non Cascade), update event - Parameter with S attribute has changed

3.7.3.5 Priority of Status

In the following table, Status is shown in lowest (GOOD - ok) to highest priority (BAD - out of service). When multiple conditions exist which may impact status, the condition having the highest priority will determine the status value. A certain status of an input/output parameter (parameter attribute I and O) is allowed if a “X” is marked in the according column.

The status will be set if the according event occurs and will be reset to the next lower prior status if the event is gone.

Quality	Quality Substatus	Priority
GOOD (NC)	ok	Lowest
GOOD (NC)	maintenance required	…
GOOD (NC)	update event	
GOOD (NC)	active advisory alarm	
GOOD (NC)	active critical alarm	
GOOD (NC)	unacknowledged update event	
GOOD (NC)	unacknowledged advisory alarm	
GOOD (NC)	unacknowledged critical alarm	
GOOD (NC)	initiate fail safe	
UNCERTAIN	non specific	
UNCERTAIN	last usable value (LUV)	
UNCERTAIN	substitute value	
UNCERTAIN	initial value	
UNCERTAIN	sensor conversion not accurate	
UNCERTAIN	engineering unit violation	
UNCERTAIN	sub normal	
UNCERTAIN	configuration error	
UNCERTAIN	sensor calibration	
UNCERTAIN	simulated value	
GOOD (C)	ok	
GOOD (C)	initialization acknowledged	
GOOD (C)	initialization request	
GOOD (C)	not invited	
GOOD (C)	do not select	
GOOD (C)	local override	
GOOD (C)	initiate fail safe	
BAD	non specific	
BAD	configuration error	
BAD	not connected	
BAD	sensor failure	
BAD	device failure	
BAD	no communication (LUV)	
BAD	no communication (no LUV)	…

Quality	Quality Substatus	Priority
BAD	out of service	Highest

Table 19. Priority of the Status Values

3.7.3.6 Definition of Status

The Quality, Quality Substatus, and Limit components of the Status byte are defined as follows:

Meaning of the Quality Bits

Quality		Meaning
0	BAD	The value is not useful.
1	UNCERTAIN	The quality of the value is less than normal, but the value may still be useful.
2	GOOD (Non Cascade)	The quality of the value is good. Possible alarm conditions may be indicated by the sub-status.
3	GOOD (Cascade)	The value may be used in control.

Meaning of Substatus if Quality = BAD

Sub-status	BAD	Meaning
0	non specific	There is no specific reason why the value is BAD. Used for propagation.
1	configuration error	Set if the value is not useful because there is some inconsistency regarding the parameterization or configuration, depending on what a specific manufacturer can detect.
2	not connected	Set if this input is required to be connected and is not connected .
3	device failure	Set if the source of the value is affected by a device failure.
4	sensor failure	Set if the device can determine this condition. If the error depends on an exceeded sensor range the Limits define which direction has been exceeded.
5	no communication (LUV)	Set if this value had been set by communication, which has now failed.
6	no communication (no LUV)	Set if there has never been any communication with this value since it was last Out of Service.
7	out of service	The value is not reliable because the block is not being evaluated, and may be under construction by a configurer. Set if the block mode is O/S.

Meaning of Substatus if Quality = UNCERTAIN

Sub-status	UNCERTAIN	Meaning
0	non specific	There is no specific reason why the value is uncertain. Used for propagation.

Sub-status	UNCERTAIN	Meaning
1	last usable value (LUV)	Whatever was writing this value has stopped doing so. This is used for fail safe handling.
2	substitute value	Predefined value is used instead of the calculated one. This is used for fail safe handling.
3	initial value	Value of volatile parameters during and after reset of the device or of a parameter.
4	sensor conversion not accurate	Set if the value is at one of the sensor limits. The Limits define which direction has been exceeded. Also set if the device can determine that the sensor has reduced accuracy (e.g. degraded analyzer), in which case no limits are set.
5	engineering unit violation	Set if the value lies outside of the set of values defined for this parameter. The Limits define which direction has been exceeded.
6	sub normal	Set if a value derived from multiple values has less than the required number of GOOD sources.
7	configuration error	Set if there is some inconsistency regarding the parameterization or configuration, depending on what a specific manufacturer can detect.
8	simulated value	Set when the process value is written by the operator while the block is in manual mode.
9	sensor calibration	Set during the active calibration procedure together with the current measured value.

Meaning of Substatus if Quality = GOOD (Non Cascade)

Sub-status	GOOD (NC)	Meaning
0	ok	No error or special condition is associated with this value.
1	update event	Set if the value is good and the block has an active Update event.
2	active advisory alarm	Set if the value is good and the block has an active Alarm.
3	active critical alarm	Set if the value is good and the block has an active Alarm.
4	unacknowledged update event	Set if the value is good and the block has an unacknowledged Update event.
5	unacknowledged advisory alarm	Set if the value is good and the block has an unacknowledged Alarm.
6	unacknowledged critical alarm	Set if the value is good and the block has an unacknowledged Alarm.
7	reserved	reserved
8	initiate fail safe	The value is from a block that wants its following output block (e.g. AO) to go to Fail Safe.
9	maintenance required	The device works still without failure but service support will be necessary soon. This may be detected e.g. by a Transducer Block of a value of pH meter.

Meaning of Substatus if Quality = GOOD (Cascade)

Sub-status	GOOD (C)	Meaning
0	ok	No error or special condition is associated with this value.
1	initialisation acknowlegded	The value is an initialized value from a source (cascade input, remote-cascade in, and remote-output in parameters).
2	initialisation request	The value is an initialization value for a source (back calculation input parameter), because the lower loop is broken or the mode is wrong.
3	not invited	The value is from a block which does not have a target mode that would use this input.
4	reserved	reserved
5	do not select	The value is from a block which should not be selected, due to conditions in or above the block.
6	local override	The value is from a block that has been locked out by a local key switch or is a Complex AO/DO with interlock logic active. The failure of normal control must be propagated to a function running in a host system for alarm and display purposes. This also implies Not Invited.
7	reserved	reserved
8	initiate fail safe	The value is from a block that wants its downstream output block (e.g. AO) to go to Fail Safe.

Meaning of the Limit Bits

Limit Bits		Meaning
0	ok	The value is free to move.
1	low limited	The value has acceded its low limits.
2	high limited	The value has acceded its high limits.
3	constant (high and low limited)	'constant' has to be used for parameter in general to indicate that the value of this parameter is set by operator or local means and is not following the value provided by the normal block algorithm. Status may be changed by operator (if writeable).

The four cases are mutually exclusive. A constant cannot also be limited in just one direction.

Table 20. Meaning of the Status Values

3.7.4 Value & Status – Discrete Structure

This data structure consists of the value and state of the discrete value parameters.

Data Type Value & Status - Discrete

Data Type Numeric Identifier = 102

Attribute Number of Elements = 2

Attribute List of Elements (shown below)

E	Element Name	Data Type	(Index)	Size
1	Value	Unsigned8	(5)	1
2	Status	Unsigned8	(5)	1

Table 21. List of Elements of the Value & Status - Discrete Structure

Parameter	Description
Value	Coding: 0 not set (e.g. FALSE) <> 0 set (e.g. TRUE) (values 1 .. 255 can have different semantic)
Status	Coding see 3.7.3.1.

Table 22. Parameter Description of the Value & Status - Discrete Structure

3.7.5 Scaling Structure

This data structure consists of static data used to scale floating point values for display purposes.

DataType Scaling

Shortcut DS-36

Attribute Number of Elements = 4

Attribute List of Elements (shown below)

E	Element Name	Data Type	(Index)	Size
1	EU_at_100%	Float	(8)	4
2	EU_at 0%	Float	(8)	4
3	Units_Index	Unsigned16	(6)	2
4	Decimal_Point	Integer8	(2)	1

Table 23. List of Elements of the Scaling Structure

Codes of Units Index see chapter 5.

Decimal_Point is a memo how many digits after the point are valid. It can be used by the master tool and by the local display.

3.7.6 Mode Structure

This data structure consists of strings for actual, permitted and normal modes.

DataType Mode

Shortcut DS-37

Attribute Number of Elements = 3

Attribute List of Elements (shown below)

E	Element Name	Data Type	(Index)	Size
1	Actual	Unsigned8	(5)	1
2	Permitted	Unsigned8	(5)	1
3	Normal	Unsigned8	(5)	1

Table 24. List of Elements of the Mode Structure

Codes of Mode elements see 3.1.7.

3.7.7 Alarm Float Structure

This data structure consists of data that describe Floating Point Alarms.

DataType Alarm Float

Shortcut DS-39

Attribute Number of Elements = 5

Attribute List of Elements (shown below)

E	Element Name	Data Type (Index)	Size
1	Unacknowledged	Unsigned8 (5)	1
2	Alarm_State	Unsigned8 (5)	1
3	Time_Stamp	TimeValue (21)	8
4	Subcode	Unsigned16 (6)	2
5	Value	Float (8)	4

Table 25. List of Elements of the Alarm Float Structure

Parameter	Description
Alarm_State	Coding: 0 no alarm <> 0 alarm active
Time_Stamp	If the device using this data structure does not provide a clock, the Time_Stamp value is equal to the 1st of January 1984. A time synchronisation of the system time in the device applications is not used in the profile (i.e. System Management functionality is not used).
Subcode	Defines additional information about the reason of the alarm. Coding: 0 not used 1 – 32767 reserved 32768 – 65535 device specific

Table 26. Parameter Description of the Alarm Float Structure

3.7.8 Alarm Summary Structure

This data structure consists of data that summarize 16 alarms.

DataType Alarm Summary

Shortcut DS-42

Attribute Number of Elements = 4

Attribute List of Elements (shown below)

E	Element Name	Data Type (Index)	Size
1	Current	OctetString (10)	2
2	Unacknowledged	OctetString (10)	2
3	Unreported	OctetString (10)	2
4	Disabled	OctetString (10)	2

Table 27. List of Elements of the Alarm Summery Structure

The Bits of the OctetStrings are associated with the following alarms:

Octet	Bit	Element	Description
0	0	Discrete alarm (LSB)	only Function Blocks with discrete limit parameters
0	1	HI_HI_Alarm	only Function Blocks with analog limit parameters
0	2	HI_Alarm	only Function Blocks with analog limit parameters
0	3	LO_LO_Alarm	only Function Blocks with analog limit parameters
0	4	LO_Alarm	only Function Blocks with analog limit parameters
0	5 - 6	reserved	
0	7	Update Event	e.g. increment of ST_REV
1	0 - 7	reserved	

Table 28. Coding of the Bits of the Alarm Summery Structure

Octet 0								Octet 1							
Bit 7							Bit 0	Bit 7							Bit 0

Table 29. Coding of the OctetStrings of the Alarm Summery Structure

Parameter	Description
Current	Limit alarm bits will be set to 1 or 0 if the alarm reason occurs (1) or is gone (0). The update event bit will be set to 1 after ST_REV increment or other problems (see block specification) and will be set to 0 after 10 s. Note: Some alarm reasons are mapped to the cyclic status reporting.
Unreported	for future use
Unacknowledged	for future use
Disabled	for future use

Table 30. Parameter Description of the Alarm Summary Structure

3.7.9 FB Linkage Structure

This data structure consists of Function Block linkage data.

DataType FB Linkage

Shortcut DS-49

Attribute Number of Elements = 5

Attribute List of Elements (shown below)

E	Element Name	Data Type	(Index)	Size
1	Local_Index	Unsigned16	(6)	2
2	Connection_Number	Unsigned16	(6)	2
3	Remote_Index	Unsigned16	(6)	2
4	Service_Operation	Unsigned8	(5)	1
5	Stale_Count_Limit	Unsigned8	(5)	1

Table 31. List of Elements of the FB Linkage Structure

For more details see 3.10.

3.7.10 Simulation - Floating Point Structure

This data structure consists of the Simulation parameters.

DataType Simulation - Floating Point

Shortcut DS-50

Attribute Number of Elements = 3

Attribute List of Elements (shown below)

E	Element Name	Data Type	(Index)	Size
1	Simulate_Status	Unsigned8	(5)	1
2	Simulate_Value	Float	(8)	4
3	Simulate_Enabled	Unsigned8	(5)	1

Table 32. List of elements of the Simulation - Floating Point Structure

Parameter	Description
Simulate_Status	Status written by an operator to simulate the Transducer Block value status.
Simulate_Value	Value written by an operator to simulate the Transducer Block value.
Simulate_Enabled	Switch to enable or disable simulation. Coding: 0 Disabled <> 0 Enabled

Table 33. Parameter Description of the Simulation - Floating Point Structure

3.7.11 Simulation - Discrete Structure

This data structure consists of the Simulation parameters.

DataType Simulation - Discrete

Shortcut DS-51

Attribute Number of Elements = 3

Attribute List of Elements (shown below)

E	Element Name	Data Type	(Index)	Size
1	Simulate_Status	Unsigned8	(5)	1
2	Simulate_Value	Unsigned8	(5)	1
3	Simulate_Enabled	Unsigned8	(5)	1

Table 34. List of Elements of the Simulation - Discrete Structure

Parameter Description see 3.7.10.

3.7.12 Result Structure

This data structure contains the structure of the results.

Data Type Result

Shortcut DS-60

Attribute Number of Elements = 3

Attribute List of Elements (see below)

E	Element Name	Data Type	(Index)	Size
1	PV	Float	(8)	4
2	Measurement_Status	Unsigned8	(5)	1
3	PV_Time	Date	(11)	7

Table 35. List of the Elements of the Result Structure

Parameter	Description
PV	Contains the value of the result of the Transducer Block. The accompanying parameter for the interpretation of this value are contained in the same Transducer Block.
PV_Time	Time the PV was generated.
Measurement_Status	State of the result at the time of the value generation. (Coding see General Requirements).

Table 36. Parameter Description of the Result Structure

3.7.13 Measurement Range Structure

This data structure contains the structure of the measurement range.

Data Type Measurement Range

Shortcut DS-61

Attribute Number of Elements = 2

Attribute List of Elements (see below)

E	Element Name	Data Type (Index)	Size
1	Begin_of_Range	Float (8)	4
2	End_of_Range	Float (8)	4

Table 37. List of Elements of the Measurement Range Structure

3.7.14 Binary Message Structure

This data structure contains the structure of the Binary Messages (BM).

Data Type Binary Message

Shortcut DS-62

Attribute Number of Elements = 5

Attribute List of Elements (see below)

E	Element Name	Data Type (Index)	Size
1	Status_Class	Unsigned16 (6)	2
2	Logbook_Entry	Boolean (1)	1
3	Output_Reference	Unsigned8 (5)	1
4	Supervision	Unsigned8 (5)	1
5	Text	ASCII-String (9)	16

Table 38. List of Elements of the Binary Message Structure

Parameter	Description
Status_Class	There are 16 status classes, the profile defines the first four. Each BM (Binary Message) may be referenced in one or more then one status classes. The number of the bit position (starting with 1) is the reference to the status class. Bit n = 1 and this BM is active means that the sum bit (bit 16) of the status class is set to one, the related bit n in GLOBAL_STATUS is set to 1 and the bit in the related ACTIVE_BM BM is set to 1. (see data sheet Analyzer)
Logbook_Entry	Binary Messages may be stored in the Logbook FB accompanied by its time stamp. This parameter enable or disable the storage of this BM in the Logbook. Coding: False no storage in the Logbook

Parameter	Description
	True storage in the Logbook
Output_Reference	Each BM may relates to exact one Discrete Output (DO). The OUTPUT_REFERENCE value is the number of the connected DO in the device.
Supervision	The BM is immediately active if this parameter is switched to supervision on. Supervision off make it possible to choose between active and inactive BM independent of the occurrence of the BM provision. Coding: 0 Supervision is switched off; Message inactive 1 Supervision is switched off; Message active 2 Supervision is switched on
Text	This parameter contains an ASCII text which may used for the interpretation and more information of the coded message by a terminal or visualisation station. This parameter is optional, because future systems will use the device description technology.

Table 39. Parameter Description of the Binary Message Structure

3.7.15 Sample Selection Structure

This data structure contains the structure of the Sample Selection.

Data Type Sample Selection

Shortcut DS-63

Attribute Number of Elements = 2

Attribute List of Elements (see below)

E	Element Name	Data Type	(Index)	Size
1	Channel	Unsigned16	(6)	2
2	Active_Sample_Time	TimeDifference	(13)	4

Table 40. List of Elements of the Sample Selection Structure

Parameter	Description
Channel	Reference to the active Transducer Block which provides the measurement value to the Block.
Active_Sample_Time	Overall time the sample is active in the device.

Table 41. Parameter Description of the Sample Selection Structure

3.7.16 Logbook Structure

This data structure contains the structure of the Logbook entries.

Data Type Logbook

Shortcut DS-64

Attribute Number of Elements = 4

Attribute List of Elements (see below)

E	Element Name	Data Type	(Index)	Size
1	Type	Unsigned8	(5)	1
2	Value	Unsigned16	(6)	2
3	Active	Boolean	(1)	1
4	Time	Date	(11)	7

Table 42. List of Elements of the Logbook Structure

Parameter	Description
Type	Coding: 0: Global_Status 1 – 16: Status information of class n 255: Binary_Message
Value	The interpretation of Value depends of the content of Type: Type = 0 -> Value = Global_Status Type = 1..16 -> Value = OR sum of the class states of one class Type = 255 -> Value = Number of Binary Message
Active	Coding: True BM becomes active False BM becomes inactive

Table 43. Parameter Description of the Logbook Structure

3.7.17 Precalculation Structure

This data structure contains the structure of the Precalculation parameter.

Data Type Precalculation

Shortcut DS-65

Attribute Number of Elements = 3

Attribute List of Elements (see below)

E	Element Name	Data Type	(Index)	Size
1	Function_Type	Unsigned8	(5)	1
2	Subtype	Unsigned8	(5)	1

3	Choice	Unsigned8	(5)	1

Table 44. List of Elements of the Precalculation Structure

Parameter	Description
Function_Type	This parameter contains the choice of the used function type which will be active in the pre-calculation chain. Coding: 0: no pre-calculation function 1: Filter 2: Average value 3: Integrator 4: Correction 5 – 127: reserved 128 – 255: device specific
Subtype	Contains the specific filter, average, integration or correct pre-calculation function in device specific codes. The default value 1 (one) codes the standard method of the device. The description of the specific algorithms are part of the device manual. Coding: 0: no pre-calculation 1: device specific standard algorithm 2 – 255: device specific
Choice	This parameter selects if the correction is inactive, using a fixed value or using a result of another block. Coding: 0: Function inactive 1: Function uses result of the pre-calculation chain 2: Function uses a fixed value 3: Function uses a Function Block value 4: Function uses a Transducer Block value

Table 45. Parameter Description of the Precalculation Structure

3.7.18 Sequential Control Structure

This data structure contains the structure of the Sequential Control parameter.

Data Type Sequential Control

Shortcut DS-66

Attribute Number of Elements = 4

Attribute List of Elements (see below)

E	Element Name	Data Type	(Index)	Size
1	Time	Date	(11)	7
2	Cycle_Time	TimeDifference	(13)	4
3	Command	Unsigned16	(6)	2
4	Time_Control_Active	Boolean	(1)	1

Table 46. List of Elements of the Sequential Control Structure

Parameter	Description
Time	Determines the time of the first/next execution of the related block. This parameter may determine the start of the cycle for a cyclic execution.
Cycle_Time	Determines the interval for the automatic execution of the related block. The Cycle_Time value 0 (zero) implies a non-cyclic execution.
Command	This parameter contains the code for the command which in influences the related block. The Control Transducer Block contains also a COMMAND parameter. This block command parameter has a higher priority then the one of this structure. Coding: 5: Start 6: Stop 7: Resume 8: Cancel
Time_Control_Active	This parameter determines if the command will be carried out automatically or if the command has no consequences. Coding: False: Execution is disabled True: Execution will be carried out

Table 47. Parameter Description of the Sequential Control Structure

3.7.19 Batch Structure

This data structure contains the structure of the Batch parameter

Data Type Batch

Shortcut DS-67

Attribute Number of Elements = 4

Attribute List of Elements (see below)

E	Element Name	Data Type	(Index)	Size
1	Batch_ID	Unsigned32	(7)	4
2	Rup	Unsigned16	(6)	2
3	Operation	Unsigned16	(6)	2
4	Phase	Unsigned16	(6)	2

Table 48. List of Elements of the Batch Structure

Parameter	Description
Batch_ID	Identifies a certain batch to allow assignment of equipment-related information (e.g. faults, alarms ...) to the batch.
Rup	No. of Recipe Unit Procedure or of Unit: Identifies the active Control Recipe Unit Procedure or the related Unit (e.g. reactor, centrifuge, drier). (Unit is defined in IEC 61512 Part1 / ISA S88, but in a different meaning as parameter UNIT i.e. Engineering Unit)
Operation	No. of Recipe Operation: Identifies the active Control Recipe Operation.
Phase	No. of Recipe Phase: Identifies the active Control Recipe Phase.

Table 49. Parameter Description of the Batch Structure

For more details see 3.5.

3.7.20 Feature Structure

This data structure consists of 2 elements describing the supported and currently enabled features.

Data Type Feature

Shortcut DS-68

Attribute Number of Elements = 2

Attribute List of Elements (shown below)

E	Element Name	Data Type	(Index)	Size
1	Supported	OctetString	(10)	4
2	Enabled	OctetString	(10)	4

Table 50. List of Elements of the Feature Structure

Coding of Supported:

Octet	Bit	Element	Description
1	0	Condensed_Status	Defines the general method how the whole device handles status and diagnostics 0: Condensed status and diagnosis is not supported. 1: Condensed status and diagnosis information according to the Amendment 2 to PROFIBUS profile for process control devices V3.0.
1	1	Expanded Status/Diagnosis	Defines the general method how the whole device handles status and diagnostics 0: Expanded status/diagnosis as defined in this General Requirement part of the profile for process control devices V3.01 is not supported. 1: As defined in this General Requirement part of the profile for process control devices V3.01.
1	2	DxB	0: no support of data exchange broadcast 1: data exchange broadcast supported
1	3	MS1_AR	0: no support of MS1 application relationship 1: MS1 application relationship supported
1	4	PROFIsafe	0: no support of PROFIsafe communication 1: PROFIsafe communication supported
1	5	reserved	
1	6	reserved	
1	7	reserved	
2..4		reserved	

Table 51. Coding of Supported

Coding of Enabled:

Octet	Bit	Element	Description
1	0	Condensed_Status	Defines the general method how the whole device handles status and diagnostics 0: disabled (As defined in this General Requirement part of the profile for process control devices V3.0) 1: enabled (Condensed status and diagnosis information according to Amendment 2 to PROFIBUS profile for process control devices V3.01)
1	1	Expanded Status/Diagnosis	Defines the general method how the whole device handles status and diagnostics 0: disabled 1: enabled (As defined in this General Requirement part of the profile for process control devices V3.01)

Octet	Bit	Element	Description
1	2	DxB	0: disabled (no support of data exchange broadcast) 1: enabled (data exchange broadcast enabled)
1	3	MS1_AR	0: disabled (no support of MS1 application relationship) 1: enabled (MS1 application relationship enabled)
1	4	PROFIsafe	0: disabled (no support of PROFIsafe communication) 1: enabled (PROFIsafe communication enabled)
1	5	reserved	
1	6	reserved	
1	7	reserved	
2..4		reserved	

Table 52. Coding of Enabled

3.8 Table Handling

There is the possibility to load and re-load tables in the devices. This table is used for linearisation mostly. For this procedure the following parameters are necessary:

TAB_ENTRY

TAB_X_Y_VALUE

TAB_MIN_NUMBER

TAB_MAX_NUMBER

TAB_OP_CODE

TAB_STATUS

TAB_ACTUAL_NUMBER

The TAB_X_Y_VALUE parameter contains the value couple of each table entries. The TAB_ENTRY parameter identifies which element of the table is in the X_Y_VALUE parameter currently (see the following figure).

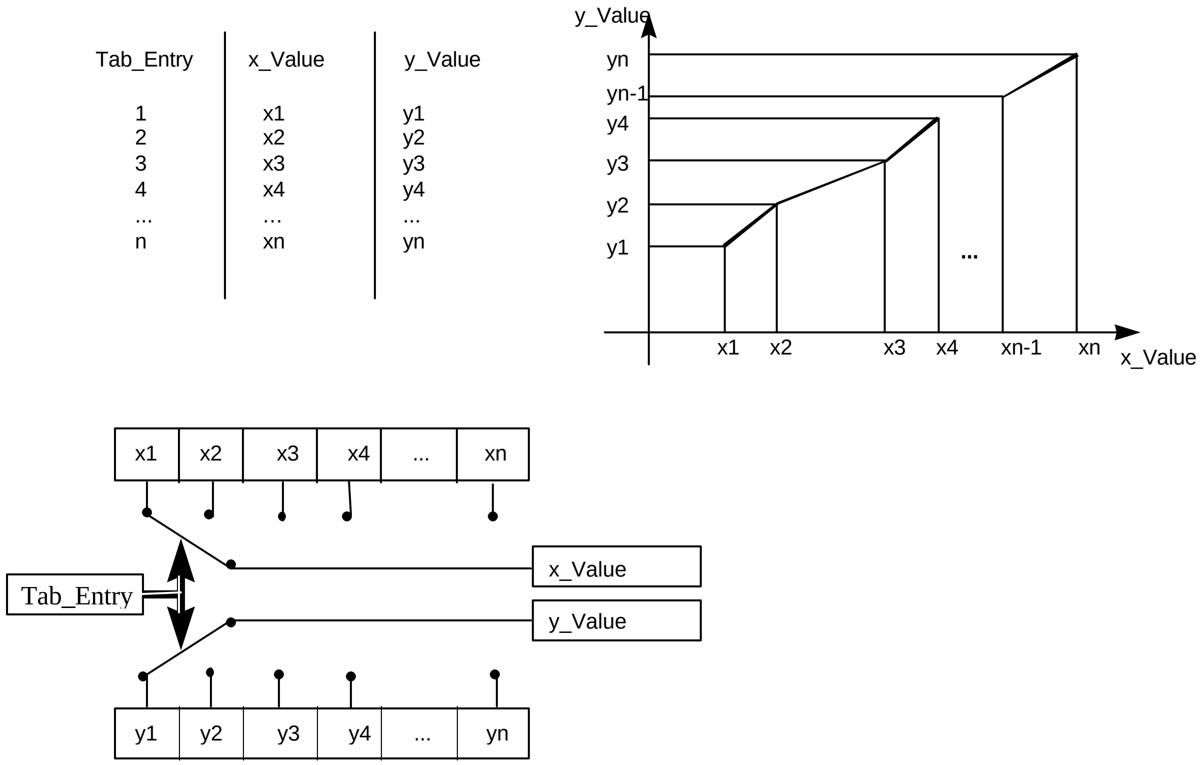


Figure 10. Parameters of a Table

TAB_MAX_NUMBER is the maximum size of the table in the device. For device internal reasons (e.g. for calculation), sometimes it is necessary to use a certain number of table values in minimum. This number is provided in the TAB_MIN_NUMBER parameter.

The modification of a table in a device influences the measurement or actuation algorithms of the device. Therefore an indication of a starting and an endpoint is necessary. The TAB_OP_CODE controls the transaction of the table. It is common to provide a plausibility check in the device. The result of this check is indicated in the TAB_STATUS parameter.

During the load of a new table the device might not be able to provide valid parameters. In this case the status of the process variables (Data Type Numeric Identifier 101) shall be bad-configuration error and for the response code of acknowledged services shall be access-state conflict.

During modification (begin, end see above) up to two tables may be available. The following assignment is assumed for reading/writing:

TAB_ENTRY	new table
TAB_X_Y_VALUE	new table
TAB_MIN_NUMBER	const.
TAB_MAX_NUMBER	const.
TAB_OP_CODE	new table
TAB_STATUS	fixed to 8 if old table is available; fixed to 26 if no valid table is available
TAB_ACTUAL_NUMBER	old table (new calculation after transmission is finished)

The sequence diagram for the load of a table is shown in the following table.

PA-Profile Client	PA Stack	BUS	PA Stack	PA-Profile Server
Write.req	(TAB_OP_CODE)			
->				
				->
				Write.ind
				TAB_OP_CODE =1
				Write.res
				<-
Write.con	(+)			
<-				
Write.req	(TAB_ENTRY)			
->				
				->
				Write.ind
				Index = 1
				Write.res
				<-
Write.con	(+)			
<-				
Write.req	(TAB_X_Y_Value)			
->				
				->
				Write.ind
				TAB_X_Y_Value
				Write.res
				<-
Write.con	(+)			
<-				
				copy of x/y_Value into internal memory is necessary
Write.req	(TAB_ENTRY)			
->				
				->
				Write.ind
				Index = 2
				Write.res

PA-Profile Client	PA Stack	BUS	PA Stack	PA-Profile Server
				<-
Write.con	(+)			
<-				
...				...
Write.con	(+)			Index = n
<-				
				Write.res
				<-
Write.req	(TAB_OP_CODE)			
->				
				->
				Write.ind
				TAB_OP_CODE = 3
				check of the new table
				if TAB_STATUS = GOOD, taking over of the new table and delete the old one"
				Write.res
				<-
Write.con	(+)			
<-				
Read.req	(TAB_STATUS)			
->				
				->
				Read.ind
				TAB_STATUS = xx
				Read.res
				<-
Read.con	(+)			
<-				

Table 53. Sequence Diagram of the Load of a Table

It is visible, that the transaction starts with the write of the TAB_OP_CODE. The order of the write services for one table row shall be Index, TAB_X_Y_VALUE. After this sequence the device copies the X_VALUE and Y_VALUE values to the internal memory.

This TAB_ENTRY parameter should be connected to exact one communication relationship. The TAB_ ENTRY parameter should be connected to a auto-increment function.

3.8.1 Parameter Description of the Table Handling Parameters

Parameter	Description
TAB_ENTRY	The TAB_ENTRY parameter identifies which element of the table is in the X_VALUE and Y_VALUE parameter currently
TAB_X_Y_VALUE	The TAB_X_Y_VALUE parameter contains one value couple of the table
TAB_MIN_NUMBER	For device internal reasons (e.g. for calculation), sometimes it is necessary to use a certain number of table values in minimum. This number is provided in the TAB_MIN_NUMBER parameter.
TAB_MAX_NUMBER	TAB_MAX_NUMBER is the maximum size (number of X_VALUE and Y_VALUE values) of the table in the device.
TAB_OP_CODE	The modification of a table in a device influences the measurement or actuation algorithms of the device. Therefore an indication of a starting and an end point is necessary. The TAP_OP_CODE controls the transaction of the table. 0: not initialized 1: new operation characteristic, first value (TAB_ENTRY=1) 2: reserved 3: last value, end of transmission, check table, swap the old curve with the new curve, update TAB_ACTUAL_NUMBER. 4: delete point of table with actual ENTRY (optional), sort records with increasing Charact-Input-Value, assign new ENTRIES, decrement CHARACT_NUMBER. 5: insert point (Charact-Input-Value relevant) (optional), sort records with increasing Charact-Input-Value, assign new ENTRIES. Increment CHARACT_NUMBER. 6: replace point of table with actual ENTRY (optional). It is possible to read a table or parts of the table without start an stop an interaction (TAB_OB_CODE 1 and 3). The start is indicated by set TAB_ENTRY to 1.
TAB_STATUS	It is common to provide a plausibility check in the device. The result of this check is indicated in the TAB_STATUS parameter. 0: not initialized 1: good (new table is valid) 2: not monotonous increasing (old table is valid) 3: not monotonous decreasing (old table is valid) 4: not enough values transmitted (old table is valid) 5: too many values transmitted (old table is valid)

Parameter	Description
	6: gradient of edge too high (old table is valid) 7: Values not excepted (old values are valid) 8: Table is currently loaded, set after TAB_OP_CODE = 1 and before TAB_OP_CODE = 3 (Additional access to table not valid, old values are valid) 9: sorting and checking of Table (Additional access to table not valid, old values are valid) 10 – 19: reserved 20: not monotonous increasing (table is not initialized) 21: not monotonous decreasing (table is not initialized) 22: not enough values transmitted (table is not initialized) 23: too many values transmitted (table is not initialized) 24: gradient of edge too high (table is not initialized) 25: Values not excepted (table is not initialized) 26: Table is currently loaded, set after TAB_OP_CODE = 1 and before TAB_OP_CODE = 3 (Additional access to table not valid, table is not initialized) 27: sorting and checking of Table (Additional access to table not valid, table is not initialized) 28 – 127: reserved > 128: manufacturer specific
TAB_ACTUAL_NUMBER	Contains the actual numbers of entries in the table. It shall be calculated after the transmission of the table is finished.
LIN_TYPE	Type of linearisation. 0: no linearisation (mandatory) 1: linearisation table (optional) 10: Square root (optional) 20: cylindrical lying container (optional) 21: spherical container (optional) 50: equal percentage 1:33 (optional) 51: equal percentage inverse (quick opening) 1:33 (optional) 52: equal percentage 1:50 (optional) 53: equal percentage inverse (quick opening) 1:50 (optional) 54: equal percentage 1:25 (optional) 55: equal percentage inverse (quick opening) 1:25 (optional) 100: RTD Pt10 a=0.003850 (IEC 751, DIN 43760, JIS C1604-97, BS1904)

Parameter	Description
	101: RTD Pt50 a=0.003850 (IEC 751, DIN 43760, JIS C1604-97, BS1904) 102: RTD Pt100 a=0.003850 (IEC 751, DIN 43760, JIS C1604-97, BS1904) 103: RTD Pt200 a=0.003850 (IEC 751, DIN 43760, JIS C1604-97, BS1904) 104: RTD Pt500 a=0.003850 (IEC 751, DIN 43760, JIS C1604-97, BS1904) 105: RTD Pt1000 a=0.003850 (IEC 751, DIN 43760, JIS C1604-97, BS1904) 106: RTD Pt10 a=0.003916 (JIS C1604-81) 107: RTD Pt50 a=0.003916 (JIS C1604-81) 108: RTD Pt100 a=0.003916 (JIS C1604-81) 109: RTD Pt10 a=0.003920 (MIL-T-24388) 110: RTD Pt50 a=0.003920 (MIL-T-24388) 111: RTD Pt100 a=0.003920 (MIL-T-24388) 112: RTD Pt200 a=0.003920 (MIL-T-24388) 113: RTD Pt500 a=0.003920 (MIL-T-24388) 114: RTD Pt1000 a=0.003920 (MIL-T-24388) 115: RTD Pt100 a=0.003923 (SAMA RC21-4-1966) 116: RTD Pt200 a=0.003923 (SAMA RC21-4-1966) 117: RTD Pt100 a=0.003926 (IPTS-68) 118: RTD Ni50 a=0.006720 (Edison curve #7) 119: RTD Ni100 a=0.006720 (Edison curve #7) 120: RTD Ni120 a=0.006720 (Edison curve #7) 121: RTD Ni1000 a=0.006720 (Edison curve #7) 122: RTD Ni50 a= 0.006180 (DIN 43760) 123: RTD Ni100 a= 0.006180 (DIN 43760) 124: RTD Ni120 a= 0.006180 (DIN 43760) 125: RTD Ni1000 a= 0.006180 (DIN 43760) 126: RTD Cu10 a=0.004270 127: RTD Cu100 a=0.004270 128: TC Type B, Pt30Rh-Pt6Rh (IEC 584, NIST MN 175, DIN 43710, BS 4937, ANSI MC96.1, JIS C1602, NF C42-321)

Parameter	Description
	129: TC Type C (W5), W5-W26Rh (ASTM E 988) 130: TC Type D (W3), W3-W25Rh (ASTM E 988) 131: TC Type E, Ni10Cr-Cu45Ni (IEC584, NIST MN 175, DIN 43710, BS 4937, ANSI MC96.1, JIS C1602, NF C42-321) 132: TC Type G (W), W-W26Rh (ASTM E 988) 133: TC Type J, Fe-Cu45Ni (IEC 584, NIST MN 175, DIN 43710, BS 4937, ANSI MC96.1, JIS C1602, NF C42-321) 134: TC Type K, Ni10Cr-Ni5 (IEC 584, NIST MN 175, DIN 43710, BS 4937, ANSI MC96.1, JIS C1602, NF C42-321) 135: TC Type N, Ni14CrSi-NiSi (IEC 584, NIST MN 175, DIN 43710, BS 4937, ANSI MC96.1, JIS C1602, NF C42-321) 136: TC Type R, Pt13Rh-Pt (IEC 584, NIST MN 175, DIN 43710, BS 4937, ANSI MC96.1, JIS C1602, NF C42-321) 137: TC Type S, Pt10Rh-Pt (IEC 584, NIST MN 175, DIN 43710, BS 4937, ANSI MC96.1, JIS C1602, NF C42-321) 138: TC Type T, Cu-Cu45Ni (IEC 584, NIST MN 175, DIN 43710, BS 4937, ANSI MC96.1, JIS C1602, NF C42-321) 139: TC Type L, Fe-CuNi (DIN 43710) 140: TC Type U, Cu-CuNi (DIN 43710) 141: TC Type Pt20/Pt40, Pt20Rh-Pt40Rh (ASTM E 1751) 142: TC Type Ir/Ir40, Ir-Ir40Rh (ASTM E 1751) 143: TC Platinel II 144: TC Ni/NiMo 145 - 239: reserved 240: Manufacturer specific 249: Manufacturer specific 250: Not used 251: None 252: Unknown 253: Special

Table 54. Parameter Description of the Table Handling Parameters

3.8.2 Parameter Attributes of the Table Handling Parameters

Relative Index	Parameter Name	Object Type	Data Type	Store	Size	Access	Parameter Usage / Kind of Transport	Reset Class	Default Value	Mandatory Optional (Class A,B)
	Parameters of the according Transducer Block									
[1]	TAB_ENTRY	Simple	Unsigned8	D	1	r,w	C/a	F	0	O (B)
	TAB_X_Y_VALUE	Array [2]	Float	D	8	r,w	C/a	F	-	O (B)
	TAB_MIN_NUMBER	Simple	Unsigned8	N	1	R	C/a	F	-	O (B)
	TAB_MAX_NUMBER	Simple	Unsigned8	N	1	R	C/a	F	-	O (B)
	TAB_OP_CODE	Simple	Unsigned8	D	1	r,w	C/a	F	-	O (B)
	TAB_STATUS	Simple	Unsigned8	D	1	R	C/a	F	0	O (B)
	TAB_ACTUAL_NUMBER	Simple	Unsigned8	N	1	R	C/a	F	-	O (B)
	LIN_TYPE	Simple	Unsigned8	S	1	r,w	C/a	F	-	M (B)
	Parameters of the according Transducer Block									O (B)

Table 55. Parameter Attributes of the Table Handling Parameters

3.9 References between Function Blocks and Transducer Blocks

The input and output Function Blocks hide the specific measurement or actuation characteristics for the control application. The Transducer Blocks provide the access to the necessary parameters for configuration or adjustment of the devices. During operation one measurement or actuation channel consists of one transducer and one Function Block which are connected. This connection is configurable using the Channel parameter of the Function Blocks. The connection is a reference, i.e. the FB has a pointer to the related Transducer Block and its parameter.

Typically, a Transducer Block will have one reference. However, in some cases such as multiplexors, other combinations are necessary. The following list defines the allowed configurations:

- A Transducer Block with one reference names the used parameter Primary Value (PV).
- A Transducer Block with more then one reference names the addition used parameter Secondary Value_n (SV_n, with n = 2, ...). That means, that more then one Function Block can be connected to one Transducer Block
- Multiple Transducer Blocks may use the same measurement from the same sensor
- Transducer Block PV and SV parameters may have data type numeric identifier 101, 102 or shortcut DS-60

[1] Relative Index according to the use of the table parameters in concrete blocks

[2] First 4 bytes (Float) X_VALUE, second 4 bytes (Float) Y_VALUE

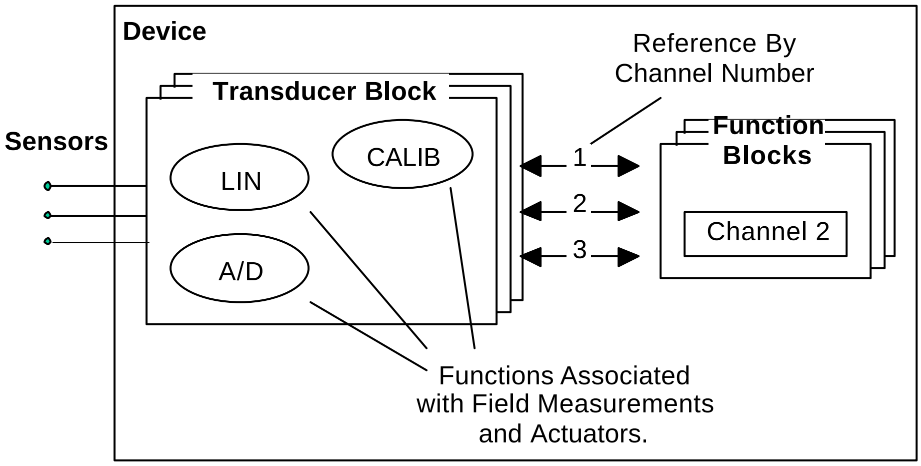


Figure 11. Transducer Blocks are Referenced by Channel Numbers

The reference is an Unsigned16 parameter of the Function Block and is used to logically associated transducer and Function Block information. During block configuration, the value of the channel number may be configured in input and output Function Blocks.

The valid range of this parameter and the information associated with a specific reference are determined as followed:

The Channel parameter consists of 2 elements the TB_ID (1. Byte, see directory definitions) and the Relative Index (2. Byte, see 1. Column of the attribute table of each Transducer Block) of the used TB parameter. If a Transducer Block don't have a PV or SV (Secondary Value) the Relative Index value of the related FB CHANNEL parameter shall be 0 (zero).

This may be visualized in the following manner.

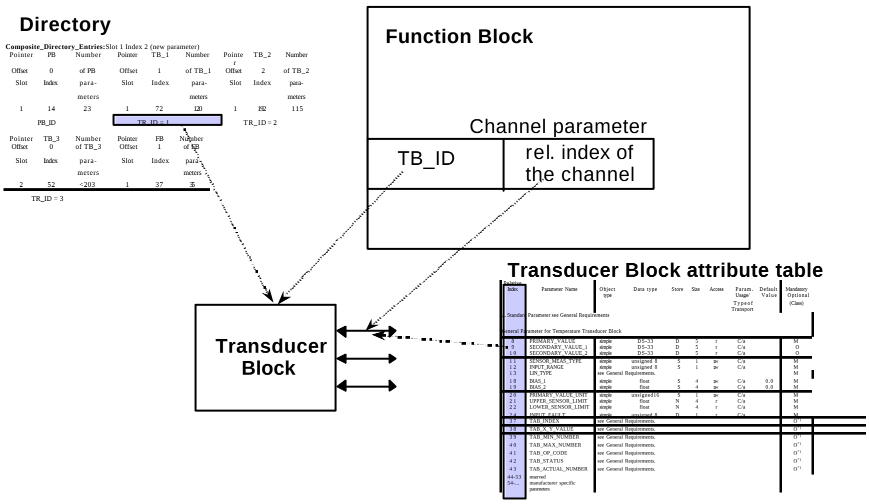


Figure 12. Channel Referencing

3.10 Links between Function Blocks

The data exchange between Function Blocks (FB), i.e. between FB output and input parameters, are described as Link Objects. The Link Object is this structured parameter DS-49 (see section 3.7.9). One connection between two FB parameters is exactly one Link Object. The data types of the source and destination Function Block parameters have to be the same. Configurations with invalid parameters of Function Blocks shall not be accepted. The Link Object parameter structure is readable and writeable across the fieldbus.

The scope of this profile revision is limited to FB links within one device. Within a device a Function Block link is supported from output to one input parameter.

Local Links:

Only one link object is required to define a link within a resource. Such a link may identify an output-input parameter or input-to-input parameter transfer. The parameter identified by the Remote Index will be updated with the value and status of the parameter identified by the Local Index.

3.10.1 Parameter Description of the Link Object

Parameter	Description
Local_Index	This specifies the FB_ID and parameter relative offset number of the output parameter which is to be linked to the input parameter identified by the Remote Index. This is the source of the link.
Connection_Number	Set to zero to identify that this is a link within the device.
Remote_Index	This specifies the FBID and parameter relative offset number of the input parameter linked to the parameter identified by the Local Index (valid for local links only). This is the destination of the link.
Service_Operation	Determines the action of the link. Coding: 0: no service - link is inactive 1: LOCAL - link within a device 2 – 127: reserved 128 – 255: manufacturer specific
Stale_Count_Limit	This is set to zero - stale detection not required.

Table 56. Parameter Description of the Link Object

3.11 Physical Block

3.11.1 Parameter Description of the Physical Block

Parameter	Description
DEVICE_CERTIFICATION	Certifications of the field device, e.g. EX certification.
DESCRIPTOR	User-definable text (a string) to describe the device within the application.
DEVICE_INSTAL_DATE	Date of installation of the device.
DEVICE_MESSAGE	User-definable MESSAGE (a string) to describe the device within the application or in the plant.
DEVICE_ID	Manufacturer specific identification of the device.
DEVICE_MAN_ID	Identification code of the manufacturer of the field device.
DEVICE_SER_NUM	Serial number of the field device.
DIAGNOSIS	Detailed information of the device, bitwize coded. More than one message possible at once. If MSB of byte 4 is set to 1 than more diagnose information is available in the DIAGNOSIS_EXTENSION parameter.
DIAGNOSIS_EXTENSION	Additional manufacturer-specific information of the device, bitwize coded. More than one message possible at once.
DIAGNOSIS_MASK	Definition of supported DIAGNOSIS information-bits. 0: not supported 1: supported
DIAGNOSIS_MASK_ EXTENSION	Definition of supported DIAGNOSIS_EXTENSION information-bits. 0: not supported 1: supported
FACTORY_RESET	Coding: 1: (mandatory) is the command for resetting device for default values. The setting of the bus address is not affected. 2: (optional) is the command for resetting informational device parameters to default values. Parameters with Reset Class characteristic “informational” are defined within the parameter attribute table of each block. The setting of the bus address is not affected. 3: (optional) is the command for resetting device parameters with Reset Class characteristic “functional” to default values. The setting of the bus address is not affected. 3 – 2505: reserved 2506: (optional) is the command for warmstart of the device. All parametrisation remains unchanged. 2507 – 2711: reserved 2712: (optional) The bus address to its default address; other parametrisation remains unchanged. The bus address is changed immediately regardless if the device is in cyclic data transfer state. The reset is not suspended up to a subsequent power cycle/warmstart.

Parameter	Description
	2713 – 32767: reserved 32768 – 65535: manufacturer specific Manufacturing specific commands for other reset results are possible. The Ident_Number_Selector parameter isn’t effected by the Factory_Reset. Note: Address manipulation by local display is not in the scope of this profile.
HARDWARE_REVISION	Revision-number of the hardware of the field device.
IDENT_NUMBER_ SELECTOR	Each PROFIBUS-DP /IEC 61158/ device shall have an Ident_Number provided by the PNO. There are profile specific Ident_Numbers. A device may have profile specific and manufacturer specific ones. The user is able to choose one of these using this parameters. 0: profile specific Ident_Number V3.0 (mandatory) 1: manufacturer specific Ident_Number V3.0 (optional) 2: manufacturer specific Ident_Number of V2.0 (optional) 3: profile specific Ident_Number of Multi-Variable Device V3.0 (optional) 4 – 127: reserved for profile use (not allowed) 128 – 255: manufacturer specific (optional) If a device is switched to the profile Ident_Number, the device shall interact with the profile features of the GSD file. The Ident_Number_Selector parameter isn’t effected by the Factory_Reset. The change of the Ident-Number via the IDENT_NUMBER_SELECTOR change the identity of the cyclic behaviour of the device. The identity of the cyclic behaviour is determined by the according GSD-file. The change is intended to be done if there is no cyclic communication to the device. It is a valid device behaviour additionally that the parameter IDENT_NUMBER_SELECTOR is read only during an active cyclic data transfer to the master class 1. There are master class 1 on the market, which are not able to read the parameter IDENT_NUMBER_SELECTOR via C1 communication. Therefore the master class 1 has no information about the actual Ident_Number of the device. See also NOTE 1, NOTE 2 and NOTE 3
LOCAL_OP_ENA	Local operation enable. 0: disabled (Local operation not allowed, i.e. change of FB MODE from host device only) 1: enabled (Local operation is allowed) The operation of the host has higher priority then the local terminal one. If communication fails for a time greater 30 sec, local operation will be enabled automatically. Communication failure is defined here as absence of cyclic and acyclic communication for the specified time period. If LOCAL_OP_ENA parameter is equal 0 (disabled) and the communication is working again, then the device switch back to remote operation. See 3.11.5.
SOFTWARE_REVISION	Revision-number of the software of the field device.

Parameter	Description
WRITE_LOCKING	Software write protection. 0: acyclic write service of all parameter are refused, except WRITE_LOCKING and the TAB_ENTRY parameter of the Linerarisation table, i.e. access is denied. 1 – 2456: reserved 2457: is the default value and means all writeable parameters of a device are writeable. 2458 – 32767: reserved 32768 – 65535: manufacturer specific
HW_WRITE_ PROTECTION	Indicates the position of a write blocking mechanism (e.g. hardware jumper) which protects acyclic write access to writeable parameters of a device. 0: Unprotected (mandatory) 1: Protected, manual operation permitted (optional) Acyclic write access to all parameter is refused (write access is denied) except the TAB_ENTRY parameter of the Linearisation table and parameters TARGET_MODE and OUT/OUT_D (only valid for AO and DO). 2: Protected, no manual operation (optional) Acyclic write access to all parameter is refused (write access is denied) except the TAB_ENTRY parameter of the Linearisation table. 3 – 127: reserved 128 – 255: manufacturer specific A device may support code 1 and/or 2.
FEATURE	Indicates optional features implemented in the device and the status of these features which indicates if the feature is supported or not supported.

Table 57. Parameter Description of the Physical Block

Note 1 A device may be purchased with manufacturer specific or profile specific Ident-Number. There is no default value for the IDENT_NUMBER_SELECTOR parameter (see Table 58).

The device has to response the Ident_Number during the start-up phase which is intended to be the first use of the device. The parameter IDENT_NUMBER_SELECTOR has to have the according value. For example, a device is purchased as profile device according Profile GSD PA139700.gsd. The device has to respond during the start-up phase with Ident-Number = 9700 and the parameter IDENT_NUMBER_SELECTOR =0.

Note 2 The parameter IDENT_NUMBER_SELECTOR may be changed.

There are the following situations:

- There is no cyclic communication between Master C1 and the device during the change of the IDENT_NUMBER_SELECTOR. After installation of the cyclic data the Ident_Number is used which is selected by the IDENT_NUMBER_SELECTOR. The bit IDENT_NUMBER_VIOLATION of the DIAGNOSIS parameter is not set and remains 0.
- There is a cyclic communication between Master C1 and the device in which the IDENT_NUMBER_SELECTOR value changes. The bit IDENT_NUMBER_VIOLATION of the DIAGNOSIS parameter is set to 1. The cyclic data transfer is not influenced by the parameter

change. The cyclic data transfer and the according Ident_Number of the device remains the same until either the cyclic transfer is aborted and reinstalled or a power down happens. During the new re-establishment of the cyclic data transfer the latest IDENT_NUMBER_SELECTOR value and the related Ident_Number is used.

- It is also a valid behaviour that the parameter IDENT_NUMBER_SELECTOR can not be written during the cyclic data transfer is active.

Note 3 The parameter IDENT_NUMBER_SELECTOR may be changed.

The Profile_Ident_Number attribute of the MS2 Initiate service is not the same as the Ident_Number of the device. It is defined within the profile (see mapping document table 10), that the Profile_Ident_Number of the MS2 Initiate service primitive.req/res attribute is set fix to 0x9700 for all PROFIBUS-PA devices.

3.11.2 Parameter Attributes of the Physical Block

Relative Index	Parameter Name	Object Type	Data Type	Store	Size	Access	Parameter Usage / Kind of Transport	Reset Class	Default Value	Mandatory Optional (Class A,B)
... Standard Parameters see General Requirements										
Additional Physical Block Parameters										
8	SOFTWARE_REVISION	Simple	VisibleString	Cst	16	r	C/a	-	-	M
9	HARDWARE_REVISION	Simple	VisibleString	Cst	16	r	C/a	-	-	M
10	DEVICE_MAN_ID	Simple	Unsigned16	Cst	2	r	C/a	-	-	M
11	DEVICE_ID	Simple	VisibleString	Cst	16	r	C/a	-	-	M
12	DEVICE_SER_NUM	Simple	VisibleString	Cst	16	r	C/a	-	-	M
13	DIAGNOSIS	Simple	OctetString byte4,MSB=1 more diag available	D	4	r	C/a	-	-	M
14	DIAGNOSIS_EXTENSION	Simple	Octetstring	D	6	r	C/a	-	-	O
15	DIAGNOSIS_MASK	Simple	Octetstring	Cst	4	r	C/a	-	-	M
16	DIAGNOSIS_MASK_ EXTENSION	Simple	Octetstring	Cst	6	r	C/a	-	-	O
17	DEVICE_CERTIFICATION	Simple	VisibleString	Cst	32	r	C/a	-	-	O
18	WRITE_LOCKING	Simple	Unsigned16	N	2	r,w	C/a	F	-	O
19	FACTORY_RESET	Simple	Unsigned16	S	2	r,w	C/a	F	-	O
20	DESCRIPTOR	Simple	OctetString	S	32	r,w	C/a	I	-	O
21	DEVICE_MESSAGE	Simple	OctetString	S	32	r,w	C/a	I	-	O
22	DEVICE_INSTAL_DATE	Simple	OctetString	S	16	r,w	C/a	I	-	O
23	LOCAL_OP_ENA	Simple	Unsigned8	N	1	r,w	C/a	F	1	O
24	IDENT_NUMBER_ SELECTOR	Simple	Unsigned8	S	1	r,w	C/a	-	-	M (B)
25	HW_WRITE_ PROTECTION	Simple	Unsigned8	D	1	r	C/a	-	-	O
26	FEATURE	Record	DS-68	N	8	R	C/a	-	-	M (for Revision 3.01)
27-32	Reserved by PNO									

Table 58. Parameter Attributes of the Physical Block

3.11.3 View Object of the Physical Block

Relative Index	Parameter Name	View_1	View_2	View_3	View_4
8	SOFTWARE_REVISION				
9	HARDWARE_REVISION				
10	DEVICE_MAN_ID				
11	DEVICE_ID				
12	DEVICE_SER_NUM				
13	DIAGNOSIS	4			
14	DIAGNOSIS_EXTENSION				
15	DIAGNOSIS_MASK				
16	DIAGNOSIS_MASK_EXTENSION				
17	DEVICE_CERTIFICATION				
18	WRITE_LOCKING				
19	FACTORY_RESET				
20	DESCRIPTOR				
21	DEVICE_MESSAGE				
22	DEVICE_INSTAL_DATE				
23	LOCAL_OP_ENA				
24	IDENT_NUMBER_SELECTOR				
25	HW_WRITE_PROTECTION				
26	FEATURE				
-	Overall sum of bytes in View-Object (+ 13 Standard parameters bytes)	4+13			

Table 59. View Object of the Physical Block

3.11.4 Coding of the Physical Block Parameter DIAGNOSIS

Octet	Bit	DIAGNOSIS Mnemonic	Description	Indication Class
1	0	DIA_HW_ELECTR	Hardware failure of the electronic	R
	1	DIA_HW_MECH	Hardware failure mechanics	R
	2	DIA_TEMP_MOTOR	Motor- temperature too high	R
	3	DIA_TEMP_ELECTR	Electronic temperature too high	R
	4	DIA_MEM_CHKSUM	Memory error	R
	5	DIA_MEASUREMENT	Failure in measurement	R
	6	DIA_NOT_INIT	Device not initialized (No selfcalibration)	R
	7	DIA_INIT_ERR	Selfcalibration failed	R
2	0	DIA_ZERO_ERR	Zero point error (limit position)	R
	1	DIA_SUPPLY	Power supply failed (electrical, pneumatic)	R
	2	DIA_CONF_INVAL	Configuration not valid	R
	3	DIA_WARMSTART	New-start-up (warmstart up) carried out.	A
	4	DIA_COLDSTART	Re-start-up (coldstart up) carried out.	A
	5	DIA_MAINTAINANCE	Maintenance required	R
	6	DIA_CHARACT	Characterization invalid	R
	7	IDENT_NUMBER_VIOLATION	Set to 1 (one), if the Ident_Number of the running cyclic data transfer and the value of Physical Block IDENT_NUMBER_SELECTOR parameter are different.	R
3	0 ... 7	reserved	Reserved	
4	0 ... 6	reserved	Reserved	
4	7	EXTENSION_AVAILABLE	More diagnosis information is available	

Table 60. Coding of the Physical Block Parameter DIAGNOSIS

Coding of the DIAGNOSIS bits:

0: not set
1: set

Indication Class:

R Indication remains active as long as the reason for the message exists.
A The indication has to be set in minimum 10 s and has to be reset not later then 10s after the action is finshed.

Octet 1				Octet 2				Octet 3				Octet 4			
Bit 7			Bit 0	Bit 7			Bit 0	Bit 7			Bit 0	Bit 7			Bit 0

Table 61. Coding of the OctetString of the Parameter DIAGNOSIS

3.11.5 Write Access Protection Control

There are write accesses to block parameters by remote devices via the communication and by a local terminal. This may courses access conflicts which will be controlled by a Protection strategy.

The following Physical Block parameters control the write access to block parameters.

- LOCAL_OP_ENA
- HW_WRITE_PROTECTION
- WRITE_LOCKING

In addition the following issue influences the write access:

- Communication error longer then 30s

These parameters and issue shall control the parameter access as defined in the following table. If there is a emergency input possibility, the access rights may differ from this specification.

LOCAL_OP_ ENA	HW_WRITE_ PROTECTION	Communication Error >30s	Local Access possible	Remote access possible
*	Protected	*	No	No
Enabled	Unprotected	No	Yes (according of write access rigths of WRITE_LOCKING)	Yes (according of write access rigths of WRITE_LOCKING) Remote data will overwrite the local ones
Disabled	Unprotected	No	No	Yes (according of write access rigths of WRITE_LOCKING)
Disabled	Unprotected	Yes	Yes (according of write access rigths of WRITE_LOCKING)	Not possible **
Enabled	Unprotected	Yes	Yes (according of write access rigths of WRITE_LOCKING)	Not possible **

* - don’t care

** - if communication is reconnected the access rights are the same as before the communication loss

Table 62. Access Protection

4 General Requirements - Start-up/break-down

There are two types of start-up that can be selected depending on different situations. The types are called New-start-up and Re-start-up.

Additional subtypes arise from different memory management facilities of the devices. There are devices with non-volatile memory and without non-volatile memory.

During New-start-up and Re-start-up and if the cyclic communication is lost, the status of parameter with attribute I (input) and cyc (cyclic) shall set to BAD – no communication LUV for cyclic communication loss and to BAD – no communication no value for New-start-up and Re-start-up.

Additional descriptions may be described in the specific data sheets.

4.1 New-start-up (cold start-up)

During New-start-up there is usually no specific information about the field device working on the fieldbus in the automation system (existent information is erased because the actual site configurations have been changed). This operation state occurs after the first power-on of the system (purchase configuration of the devices). The devices must deliver the default values* of the parameters (initial state).

The default values* are valid both for the devices with non-volatile and without non-volatile memory.

New start up is executed if FACTORY_RESET = 1 is set.

4.2 Re-start-up (warm start-up)

In using the Re-start-up after a power down, it is assumed that devices working at the fieldbus were in the operation state before the power down.

Devices with non-volatile memory will restart with the state before the power down or with the default values*. Devices without non-volatile memory must restart with the default values*.

New start up is executed if FACTORY_RESET = 2506 is set.

- - Default values are, if defined, the default values of the Parameter Attribute tables or, if not defined in these tables, manufacturer specific.

5 General Requirements - Overview about all parameter codes

The codes of the manufacturer, the engineering units and the materials follow the specifications of the Smart-Transmitter contained in the following tables:

5.1 DEVICE_MAN_ID

The list of DEVICE_MAN_ID is maintained by he cenrral office of the PNO in Karlsruhe. The list is available at www.PROFIBUS.com.

5.2 Units Codes

The definition of several units or the conditions for their measurement might be different for several countries or depends on the sector of industry. If there is no exact conversion/definition within the table the manufacturer has to describe the supported units and their meaning in the device manual. The user has to check for differences if interchangeability is required.

Value	Symbol	Description	Equivalence
0 - 999	reserved		
1000	K	kelvin	SI
1001	°C	degree Celsius	*T*/K = *t*/°C+273.15 ΔT = 1°C is equal to ΔT = 1K
1002	°F	degree Fahrenheit	*T*/K = (*t*/°F+459.67)/1.8
1003	°R	degree Rankine	*T*/K = (*T*/°R)/1.8
1004	rad	radian	= 1 m/m
1005	°	degree	= (π/180) rad
1006	'	minute	= (1/60)°
1007	"	second	= (1/60)'
1008	gon	gon (or grade)	= (π/200) rad
1009	r	revolution	= 2π rad
1010	m	meter	SI
1011	km	kilometer	= 1000.0 m
1012	cm	centimeter	= 0.01 m
1013	mm	millimeter	= 10^{-3} m
1014	µm	micrometer	= 10^{-6} m
1015	nm	nanometer	= 10^{-9} m
1016	pm	picometer	= 10^{-12} m
1017	Å	angstrom	= 10^{-10} m
1018	ft	foot	= 12 in
1019	in	inch (international)	= 0.0254 mm
1020	yd	yard	= 36 in
1021	mile	mile	= 1760 yd
1022	nautical mile	nautical mile	= 1852 m
1023	m^2	square meter	
1024	km^2	square kilometer	
1025	cm^2	square centimeter	
1026	dm^2	square decimeter	
1027	mm^2	square millimeter	
1028	a	are	= 10^2 m^2
1029	ha	hectare	= 10^4 m^2
1030	in^2	square inch	
1031	ft^2	square feet	
1032	yd^2	square yard	
1033	$mile^2$	square mile	
1034	m^3	cubic meter	
1035	dm^3	cubic decimeter	
1036	cm^3	cubic centimeter	
1037	mm^3	cubic millimeter	
1038	L	liter	= 10^{-3} m^3
1039	cl	centiliter	= 0.01 L
1040	ml	milliliter	= 0.001 L
1041	hl	hectoliter	= 100 L
1042	in^3	cubic inch	
1043	ft^3	cubic foot	
1044	yd^3	cubic yard	
1045	$mile^3$	cubic mile	

Value	Symbol	Description	Equivalence
1046	pint	pint (U.S. liquid)	= (1/8) gal
1047	quart	quart (U.S. liquid)	= (1/4) gal
1048	gal	gallon (U.S.)	= 231 in^3
1049	ImpGal	gallon (Imperial)	= 4.54609 L
1050	bushel	bushel (U.S. dry)	= 2150.42 in^3
1051	bbl	barrel (U.S. petroleum)	= 42 gal
1052	bbl (liq)	barrel (U.S. liquid)	= 31.5 gal
1053	ft^3 std.	standard cubic foot	
1054	s	second	SI
1055	ks	kilosecond	= 10^3 s
1056	ms	millisecond	= 10^{-3} s
1057	µs	microsecond	= 10^{-6} m
1058	min	minute	= 60 s
1059	h	hour	= 60 min
1060	d	day	= 24 h
1061	m/s	meter per second	
1062	mm/s	millimeter per second	
1063	m/h	meter per hour	
1064	km/h	kilometer per hour	
1065	knot	nautical mile per hour	= 1.852 km/h
1066	in/s	inch per second	
1067	ft/s	foot per second	
1068	yd/s	yard per second	
1069	in/min	inch per minute	
1070	ft/min	foot per minute	
1071	yd/min	yard per minute	
1072	in/h	inch per hour	
1073	ft/h	foot per hour	
1074	yd/h	yard per hour	
1075	mi/h	mile per hour	= 0.44704 m/s
1076	m/s^2	meter per second squared	
1077	Hz	hertz	= 1 s^{-1}
1078	THz	terahertz	= 10^{12} Hz
1079	GHz	gigahertz	= 10^9 Hz
1080	MHz	megahertz	= 10^6 Hz
1081	kHz	kilohertz	= 10^3 Hz
1082	1/s	per second	= 1 s^{-1}
1083	1/min	per minute	= (1/60) s^{-1}
1084	r/s	revolution per second	
1085	r/min rpm	revolution per minute	
1086	rad/s	radian per second	
1087	$1/s^2$	per second squared	
1088	kg	kilogram	SI
1089	g	gram	= 10^{-3} kg
1090	mg	milligram	= 10^{-6} kg
1091	Mg	megagram	= 10^3 kg
1092	t	metric ton	= 10^3 kg
1093	oz	ounce (Avoirdupois)	= 1/16 lb
1094	lb	pound (Avoirdupois)	= 0.45359237 kg
1095	STon	short ton	= 2000 lb
1096	LTon	long ton	= 2240 lb
1097	kg/m^3	kilogram per cubic meter	
1098	Mg/m^3	megagram per cubic meter	
1099	kg/dm^3	kilogram per cubic decimeter	
1100	g/cm^3	gram per cubic centimeter	

Value	Symbol	Description	Equivalence
1101	g/m^3	gram per cubic meter	
1102	t/m^3	metric ton per cubic meter	
1103	kg/L	kilogram per liter	
1104	g/ml	gram per milliliter	
1105	g/L	gram per liter	
1106	lb/in^3	pound per cubic inch	
1107	lb/ft^3	pound per cubic foot	
1108	lb/gal	pound per gallon (U.S.)	
1109	$STon/yd^3$	short ton per cubic yard	
1110	°Twad	degree Twaddell	
1111	°Baum (hv)	degree Baume heavy	
1112	°Baum (lt)	degree Baume light	
1113	°API	degree API	
1114	SGU	specific gravity units	
1115	kg/m	kilogram per meter	
1116	mg/m	milligram per meter	
1117	tex	tex	$= 10^{-6}$ kg/m
1118	$kg{\cdot}m^2$	kilogram square meter	
1119	kg·m/s	kilogram meter per second	
1120	N	newton	$= 1\ kg{\cdot}m/s^2$
1121	MN	meganewton	$= 10^6$ N
1122	kN	kilonewton	$= 10^3$ N
1123	mN	millinewton	$= 10^{-3}$ N
1124	µN	micronewton	$= 10^{-6}$ N
1125	$kg{\cdot}m^2/s$	kilogram square meter per second	
1126	N·m	newton meter	
1127	MN·m	meganewton meter	
1128	kN·m	kilonewton meter	
1129	mN·m	millinewton meter	
1130	Pa	pascal	$= 1\ N/m^2$
1131	GPa	gigapascal	$= 10^9$ PA
1132	MPa	megapascal	$= 10^6$ PA
1133	kPa	kilopascal	$= 10^3$ PA
1134	mPa	millipascal	$= 10^{-3}$ PA
1135	µPa	micropascal	$= 10^{-6}$ PA
1136	hPa	hectopascal	$= 10^2$ PA
1137	bar	bar	= 100 kPa
1138	mbar	millibar	= 1 hPa
1139	torr	torr	= (1/760) atm
1140	atm	atmosphere	= 101325.0 Pa
1141	lbf/in^2 psi	pound-force per square inch	$= (0.45359237 \cdot 9.80665 / 0.0254^2)$ Pa (unreferenced or differential pressure)
1142	$lbf/in^2{}_a$ psia	pound-force per square inch absolute	$= (0.45359237 \cdot 9.80665 / 0.0254^2)$ Pa (referenced to a vacuum)
1143	$lbf/in^2{}_g$ psig	pound-force per square inch gauge	$= (0.45359237 \cdot 9.80665 / 0.0254^2)$ Pa (referenced to atmosphere)
1144	gf/cm^2	gram-force per square centimeter	= 98.0665 Pa
1145	kgf/cm^2	kilogram-force per square centimeter	= 98066.5 Pa
1146	inH_2O	inch of water	
1147	inH_2O (4°C)	inch of water at 4°C	
1148	inH_2O (68°F)	inch of water at 68°F	
1149	mmH_2O	millimeter of water	
1150	mmH_2O (4°C)	millimeter of water at 4°C	
1151	mmH_2O (68°F)	millimeter of water at 68°F	

Value	Symbol	Description	Equivalence
1152	ftH_2O	foot of water	
1153	ftH_2O (4°C)	foot of water at 4°C	
1154	ftH_2O (68°F)	foot of water at 68°F	
1155	inHg	inch of mercury	
1156	inHg (0°C)	inch of mercury at 0°C	
1157	mmHg	millimeter of mercury	
1158	mmHg (0°C)	millimeter of mercury at 0°C	
1159	Pa·s	pascal second	
1160	m^2/s	square meter per second	
1161	P	poise	= 0.1 Pa·s
1162	cP	centipoise	= 1 mPa·s
1163	St	stokes	$= 10^{-4}\ m^2/s$
1164	cSt	centistokes	$= 1\ mm^2/s$
1165	N/m	Newton per meter	
1166	mN/m	millinewton per meter	
1167	J	joule	= 1 N·m
1168	EJ	exajoules	$= 10^{18}$ J
1169	PJ	petajoules	$= 10^{15}$ J
1170	TJ	terajoules	$= 10^{12}$ J
1171	GJ	gigajoules	$= 10^{9}$ J
1172	MJ	megajoules	$= 10^{6}$ J
1173	kJ	kilojoules	$= 10^{3}$ J
1174	mJ	millijoules	$= 10^{-3}$ J
1175	W·h	watt hour	
1176	TW·h	terawatt hour	
1177	GW·h	gigawatt hour	
1178	MW·h	megawatt hour	
1179	kW·h	kilowatt hour	
1180	cal_{th}	calorie (thermochemical)	= 4.184 J
1181	$kcal_{th}$	kilocalorie (thermochemical)	= 4.184 kJ
1182	$Mcal_{th}$	megacalorie (thermochemical)	= 4.184 MJ
1183	Btu_{th}	British thermal unit (thermochemical)	= (4184 · 0.45359237/1.8) J
1184	datherm	dekatherm	$= 1.05506 \cdot 10^{9}$ J
1185	ft·lbf	foot pound-force	= 1.3558179483314004 J
1186	W	watt	= 1 J/s
1187	TW	terawatt	$= 10^{12}$ W
1188	GW	gigawatt	$= 10^{9}$ W
1189	MW	megawatt	$= 10^{6}$ W
1190	kW	kilowatt	$= 10^{3}$ W
1191	mW	milliwatt	$= 10^{-3}$ W
1192	µW	microwatt	$= 10^{-6}$ W
1193	nW	nanowatt	$= 10^{-9}$ W
1194	pW	picowatt	$= 10^{-12}$ W
1195	$Mcal_{th}/h$	megacalorie per hour	
1196	MJ/h	megajoule per hour	
1197	Btu_{th}/h	British thermal unit per hour	
1198	hp	horsepower (electric)	= 746 W
1199	W/(m·K)	watt per meter kelvin	
1200	$W/(m^2 \cdot K)$	watt per square meter kelvin	
1201	$m^2 \cdot K/W$	square meter kelvin per watt	
1202	J/K	joule per kelvin	
1203	kJ/K	kilojoule per kelvin	
1204	J/(kg·K)	joule per kilogram kelvin	
1205	kJ/(kg·K)	kilojoule per kilogram kelvin	
1206	J/kg	joule per kilogram	

Value	Symbol	Description	Equivalence
1207	MJ/kg	megajoule per kilogram	
1208	kJ/kg	kilojoule per kilogram	
1209	A	ampere	SI
1210	kA	kiloampere	= 10^{3} A
1211	mA	milliampere	= 10^{-3} A
1212	µA	microampere	= 10^{-6} A
1213	nA	nanoampere	= 10^{-9} A
1214	pA	picoampere	= 10^{-12} A
1215	C	coulomb	= 1 A·s
1216	MC	megacoulomb	= 10^{6} C
1217	kC	kilocoulomb	= 10^{3} C
1218	µC	microcoulomb	= 10^{-6} C
1219	nC	nanocoulomb	= 10^{-9} C
1220	pC	picocoulomb	= 10^{-12} C
1221	A·h	ampere hour	
1222	C/m^3	coulomb per cubic meter	
1223	C/mm^3	coulomb per cubic millimeter	
1224	C/cm^3	coulomb per cubic centimeter	
1225	kC/m^3	kilocoulomb per cubic meter	
1226	mC/m^3	millicoulomb per cubic meter	
1227	$\mu C/m^3$	microcoulomb per cubic meter	
1228	C/m^2	coulomb per square meter	
1229	C/mm^2	coulomb per square millimeter	
1230	C/cm^2	coulomb per square centimeter	
1231	kC/m^2	kilocoulomb per square meter	
1232	mC/m^2	millicoulomb per square meter	
1233	$\mu C/m^2$	microcoulomb per square meter	
1234	V/m	volt per meter	
1235	MV/m	megavolt per meter	
1236	kV/m	kilovolt per meter	
1237	V/cm	volt per centimeter	
1238	mV/m	millivolt per meter	
1239	µV/m	microvolt per meter	
1240	V	volt	= 1 W/A
1241	MV	megavolt	= 10^{6} V
1242	kV	kilovolt	= 10^{3} V
1243	mV	millivolt	= 10^{-3} V
1244	µV	microvolt	= 10^{-6} V
1245	F	farad	= 1 C/V
1246	mF	millifarad	= 10^{-3} F
1247	µF	microfarad	= 10^{-6} F
1248	nF	nanofarad	= 10^{-9} F
1249	pF	picofarad	= 10^{-12} F
1250	F/m	farad per meter	
1251	µF/m	microfarad per meter	
1252	nF/m	nanofarad per meter	
1253	pF/m	picofarad per meter	
1254	C·m	coulomb meter	
1255	A/m^2	ampere per square meter	
1256	MA/m^2	megaampere per square meter	
1257	A/cm^2	ampere per square centimeter	
1258	kA/m^2	kiloampere per square meter	
1259	A/m	ampere per meter	
1260	kA/m	kiloampere per meter	
1261	A/cm	ampere per centimeter	
1262	T	tesla	= 1 Wb/m^2

Value	Symbol	Description	Equivalence
1263	mT	millitesla	$= 10^{-3}$ T
1264	µT	microtesla	$= 10^{-6}$ T
1265	nT	nanotesla	$= 10^{-9}$ T
1266	Wb	weber	= 1 V·s
1267	mWb	milliweber	$= 10^{-3}$ W
1268	Wb/m	weber per meter	
1269	kWb/m	kiloweber per meter	
1270	H	henry	= 1 Wb/A
1271	mH	millihenry	$= 10^{-3}$ H
1272	µH	microhenry	$= 10^{-6}$ H
1273	nH	nanohenry	$= 10^{-9}$ H
1274	pH	picohenry	$= 10^{-12}$ H
1275	H/m	henry per meter	
1276	µH/m	microhenry per meter	
1277	nH/m	nanohenry per meter	
1278	$A\cdot m^2$	ampere square meter	
1279	$N\cdot m^2/A$	newton square meter per ampere	
1280	Wb·m	weber meter	
1281	Ω	ohm	= 1 V/A
1282	GΩ	gigaohm	$= 10^{9}$ Ω
1283	MΩ	megohm	$= 10^{6}$ Ω
1284	kΩ	kilohm	$= 10^{3}$ Ω
1285	mΩ	milliohm	$= 10^{-3}$ Ω
1286	µΩ	microohm	$= 10^{-6}$ Ω
1287	S	siemens	$= 1\ \Omega^{-1}$
1288	kS	kilosiemens	$= 10^{3}\ \Omega^{-1}$
1289	mS	millisiemens	$= 10^{-3}\ \Omega^{-1}$
1290	µS	microsiemens	$= 10^{-6}\ \Omega^{-1}$
1291	Ω·m	ohm meter	
1292	GΩ·m	gigaohm meter	
1293	MΩ·m	megohm meter	
1294	kΩ·m	kilohm meter	
1295	Ω·cm	ohm centimeter	
1296	mΩ·m	milliohm meter	
1297	µΩ·m	microohm meter	
1298	nΩ·m	nanoohm meter	
1299	S/m	siemens per meter	
1300	MS/m	megasiemens per meter	
1301	kS/m	kilosiemens per meter	
1302	mS/cm	millisiemens per centimeter	
1303	µS/mm	microsiemens per millimeter	
1304	1/H	per henry	
1305	sr	steradian	$= 1\ m^2/m^2$
1306	W/sr	watt per steradian	
1307	$W/(sr\cdot m^2)$	watt per steradian square meter	
1308	W/m^2	watt per square meter	
1309	lm	lumen	= 1 cd·sr
1310	lm·s	lumen second	
1311	lm·h	lumen hour	
1312	lm/m^2	lumen per square meter	
1313	lm/W	lumen per watt	
1314	lx	lux	$= 1\ lm/m^2$
1315	lx·s	lux second	
1316	cd	candela	SI
1317	cd/m^2	candela per square meter	
1318	g/s	gram per second	

Value	Symbol	Description	Equivalence
1319	g/min	gram per minute	
1320	g/h	gram per hour	
1321	g/d	gram per day	
1322	kg/s	kilogram per second	
1323	kg/min	kilogram per minute	
1324	kg/h	kilogram per hour	
1325	kg/d	kilogram per day	
1326	t/s	metric ton per second	
1327	t/min	metric ton per minute	
1328	t/h	metric ton per hour	
1329	t/d	metric ton per day	
1330	lb/s	pound per second	
1331	lb/min	pound per minute	
1332	lb/h	pound per hour	
1333	lb/d	pound per day	
1334	STon/s	short ton per second	
1335	STon/min	short ton per minute	
1336	STon/h	short ton per hour	
1337	STon/d	short ton per day	
1338	LTon/s	long ton per second	
1339	LTon/min	long ton per minute	
1340	LTon/h	long ton per hour	
1341	LTon/d	long ton per day	
1342	%	percent	= 0.01
1343	% sol/wt	percent solid per weight	
1344	% sol/vol	percent solid per volume	
1345	% stm qual	percent steam quality	
1346	°Plato	degree Plato	
1347	m^3/s	cubic meter per second	
1348	m^3/min	cubic meter per minute	
1349	m^3/h	cubic meter per hour	
1350	m^3/d	cubic meter per day	
1351	L/s	liter per second	
1352	L/min	liter per minute	
1353	L/h	liter per hour	
1354	L/d	liter per day	
1355	ML/d	megaliter per day	
1356	ft^3/s	cubic foot per second	
1357	ft^3/min	cubic foot per minute	
1358	ft^3/h	cubic foot per hour	
1359	ft^3/d	cubic foot per day	
1360	ft^3/min std.	standard cubic foot per minute	
1361	ft^3/h std.	standard cubic foot per hour	
1362	gal/s	gallon (U.S.) per second	
1363	gal/min	gallon (U.S.) per minute	
1364	gal/h	gallon (U.S.) per hour	
1365	gal/d	gallon (U.S.) per day	
1366	Mgal/d	megagallon (U.S.) per day	
1367	ImpGal/s	gallon (Imperial) per second	
1368	ImpGal/min	gallon (Imperial) per minute	
1369	ImpGal/h	gallon (Imperial) per hour	
1370	ImpGal/d	gallon (Imperial) per day	
1371	bbl/s	barrel per second	
1372	bbl/min	barrel per minute	
1373	bbl/h	barrel per hour	
1374	bbl/d	barrel per day	

Value	Symbol	Description	Equivalence
1375	W/m^2	watt per square meter	
1376	mW/m^2	milliwatt per square meter	
1377	$\mu W/m^2$	microwatt per square meter	
1378	pW/m^2	picowatt per square meter	
1379	$Pa \cdot s/m^3$	pascal second per cubic meter	
1380	N·s/m	newton second per meter	
1381	Pa·s/m	pascal second per meter	
1382	B	bel	= lg(ratio)
1383	dB	decibel	$= 10^{-1}$ B
1384	mol	mole	SI
1385	kmol	kilomole	
1386	mmol	mill mole	
1387	µmol	micromole	
1388	kg/mol	kilogram per mole	
1389	g/mol	gram per mole	
1390	m^3/mol	cubic meter per mole	
1391	dm^3/mol	cubic decimeter per mole	
1392	cm^3/mol	cubic centimeter per mole	
1393	L/mol	liter per mole	
1394	J/mol	joule per mole	
1395	kJ/mol	kilojoule per mole	
1396	J/(mol-K)	joule per mole kelvin	
1397	mol/m^3	mole per cubic meter	
1398	mol/dm^3	mole per cubic decimeter	
1399	mol/L	mole per liter	
1400	mol/kg	mole per kilogram	
1401	mmol/kg	millimole per kilogram	
1402	Bq	becquerel	$= 1\ s^{-1}$
1403	MBq	megabecquerel	
1404	kBq	kilobecquerel	
1405	Bq/kg	becquerel per kilogram	
1406	kBq/kg	kilobecquerel per kilogram	
1407	MBq/kg	megabecquerel per kilogram	
1408	Gy	gray	= 1 J/kg
1409	mGy	milligray	
1410	rd	rad	$= 10^{-2}$ Gy
1411	Sv	sievert	= 1 J/kg
1412	mSv	millisievert	
1413	rem	rem	$= 10^{-2}$ Sv
1414	C/kg	coulomb per kilogram	
1415	mC/kg	millicoulomb per kilogram	
1416	R	roentgen	$= 2.58 \cdot 10^{-4}$ C/kg
1417	$1/J \cdot m^3$		
1418	$e/V \cdot m^3$		
1419	m^3/C	cubic meter per coulomb	
1420	V/K	volt per kelvin	
1421	mV/K	millivolt per kelvin	
1422	pH	pH	
1423	ppm	parts per million	$= 10^{-6}$
1424	ppb	parts per billion	$= 10^{-9}$
1425	ppth	parts per thousand	$= 10^{-3}$
1426	°Brix	degree Brix	
1427	°Ball	degree Balling	
1428	proof/vol	proof per volume	
1429	proof/mass	proof per mass	
1430	lb/ImpGal	pound per gallon (Imperial)	

Value	Symbol	Description	Equivalence
1431	$kcal_{th}$/s	kilocalorie per second	
1432	$kcal_{th}$/min	kilocalorie per minute	
1433	$kcal_{th}$/h	kilocalorie per hour	
1434	$kcal_{th}$/d	kilocalorie per day	
1435	$Mcal_{th}$/s	megacalorie per second	
1436	$Mcal_{th}$/min	megacalorie per minute	
1437	$Mcal_{th}$/d	megacalorie per day	
1438	kJ/s	kilojoule per second	
1439	kJ/min	kilojoule per minute	
1440	kJ/h	kilojoule per hour	
1441	kJ/d	kilojoule per day	
1442	MJ/s	megajoule per second	
1443	MJ/min	megajoule per minute	
1444	MJ/d	megajoule per day	
1445	Btu_{th}/s	British thermal unit per second	
1446	Btu_{th}/min	British thermal unit per minute	
1447	Btu_{th}/day	British thermal unit per day	
1448	µgal/s	microgallon (U.S.) per second	
1449	mgal/s	milligallon (U.S.) per second	
1450	kgal/s	kilogallon (U.S.) per second	
1451	Mgal/s	megagallon (U.S.) per second	
1452	µgal/min	microgallon (U.S.) per minute	
1453	mgal/min	milligallon (U.S.) per second	
1454	kgal/min	kilogallon (U.S.) per minute	
1455	Mgal/min	megagallon (U.S.) per minute	
1456	µgal/h	microgallon (U.S.) per hour	
1457	mgal/h	milligallon (U.S.) per hour	
1458	kgal/h	kilogallon (U.S.) per hour	
1459	Mgal/h	megagallon (U.S.) per hour	
1460	µgal/d	microgallon (U.S.) per day	
1461	mgal/d	milligallon (U.S.) per day	
1462	kgal/d	kilogallon (U.S.) per day	
1463	µImpGal/s	microgallon (Imperial) per second	
1464	mImpGal/s	milligallon (Imperial) per second	
1465	kImpGal/s	kilogallon (Imperial) per second	
1466	MImpGal/s	megagallon (Imperial) per second	
1467	µImpGal/min	microgallon (Imperial) per minute	
1468	mImpGal/min	milligallon (Imperial) per minute	
1469	kImpGal/min	kilogallon (Imperial) per minute	
1470	MImpGal/min	megagallon (Imperial) per minute	
1471	µImpGal/h	microgallon (Imperial) per hour	
1472	mImpGal/h	milligallon (Imperial) per hour	
1473	kImpGal/h	kilogallon (Imperial) per hour	
1474	MImpGal/h	megagallon (Imperial) per hour	
1475	µImpGal/d	microgallon (Imperial) per day	
1476	mImpGal/d	milligallon (Imperial) per day	
1477	kImpGal/d	kilogallon (Imperial) per day	
1478	MImpGal/d	megagallon (Imperial) per day	
1479	µbbl/s	microbarrel per second	
1480	mbbl/s	millibarrel per second	
1481	kbbl/s	kilobarrel per second	
1482	Mbbl/s	megabarrel per second	
1483	µbbl/min	microbarrel per minute	
1484	mbbl/min	millibarrel per minute	
1485	kbbl/min	kilobarrel per minute	
1486	Mbbl/min	megabarrel per minute	

Value	Symbol	Description	Equivalence
1487	µbbl/h	microbarrel per hour	
1488	mbbl/h	millibarrel per hour	
1489	kbbl/h	kilobarrel per hour	
1490	Mbbl/h	megabarrel per hour	
1491	µbbl/d	microbarrel per day	
1492	mbbl/d	millibarrel per day	
1493	kbbl/d	kilobarrel per day	
1494	Mbbl/d	megabarrel per day	
1495	$\mu m^3/s$	cubic micrometer per second	
1496	mm^3/s	cubic millimeter per second	
1497	km^3/s	cubic kilometer per second	
1498	Mm^3/s	cubic megameter per second	
1499	$\mu m^3/min$	cubic micrometer per minute	
1500	mm^3/min	cubic millimeter per minute	
1501	km^3/min	cubic kilometer per minute	
1502	Mm^3/min	cubic megameter per minute	
1503	$\mu m^3/h$	cubic micrometer per hour	
1504	mm^3/h	cubic millimeter per hour	
1505	km^3/h	cubic kilometer per hour	
1506	Mm^3/h	cubic megameter per hour	
1507	$\mu m^3/d$	cubic micrometer per day	
1508	mm^3/d	cubic millimeter per day	
1509	km^3/d	cubic kilometer per day	
1510	Mm^3/d	cubic megameter per day	
1511	cm^3/s	cubic centimeter per second	
1512	cm^3/min	cubic centimeter per minute	
1513	cm^3/h	cubic centimeter per hour	
1514	cm^3/d	cubic centimeter per day	
1515	$kcal_{th}/kg$	kilocalorie per kilogram	
1516	Btu_{th}/lb	British thermal unit per pound	
1517	kL	kiloliter	
1518	kL/min	kiloliter per minute	
1519	kL/h	kiloliter per hour	
1520	kL/d	kiloliter per day	
1521	vendor-specific 1521		
1522	vendor-specific 1522		
1523	vendor-specific 1523		
1524	vendor-specific 1524		
1525	vendor-specific 1525		
1526	vendor-specific 1526		
1527	vendor-specific 1527		
1528	vendor-specific 1528		
1529	vendor-specific 1529		
1530	vendor-specific 1530		
1531	vendor-specific 1531		
1532	vendor-specific 1532		
1533	vendor-specific 1533		
1534	vendor-specific 1534		
1535	vendor-specific 1535		
1536	vendor-specific 1536		
1537	vendor-specific 1537		
1538	vendor-specific 1538		
1539	vendor-specific 1539		
1540	vendor-specific 1540		
1541	vendor-specific 1541		
1542	vendor-specific 1542		

Value	Symbol	Description	Equivalence
1543	vendor-specific 1543		
1544	vendor-specific 1544		
1545	vendor-specific 1545		
1546	vendor-specific 1546		
1547	vendor-specific 1547		
1548	vendor-specific 1548		
1549	vendor-specific 1549		
1550	vendor-specific 1550		
1551	S/cm	siemens per centimeter	
1552	µS/cm	microsiemens per centimeter	
1553	mS/m	millisiemens per meter	
1554	µS/m	microsiemens per meter	
1555	MΩ·cm	Megohm centimeter	
1556	kΩ·cm	kilohm centimeter	
1557	Gew%	Gewichtsprozent	
1558	mg/L	milligram per liter	
1559	µg/L	microgram per liter	
1560	%Sät		
1561	vpm		
1562	%vol	Volume percent	
1563	ml/min	milliliter per minute	
1564	mg/dm^3	milligram per cubic decimeter	
1565	mg/L	milligram per liter **(do not use in new projects; use 1558)**	
1566	mg/m^3	milligram per cubic meter	
1567	ct	carat (jewel)	$= 200.0 \cdot 10^{-6}$ kg
1568	lb (tr)	pound (troy or apothecary)	= 0.3732417216 kg
1569	oz (tr)	ounce (troy or apothecary)	= 1/12 lb (tr)
1570	fl oz (U.S.)	ounce (U.S. fluid)	= (1/128) gal
1571	cm^3	cubic centimeter	$= 10^{-6}\ m^3$
1572	af	acre foot	$= 43560\ ft^3$
1573	m^3 normal	Normal cubic meter (0°C, 1atm = 101325Pa)	
1574	L normal	Normal liter (0°C, 1atm = 101325PA)	
1575	m^3 std.	Standard cubic meter (20°C, 1atm = 101325Pa)	
1576	L std.	Standard liter (20°C, 1atm = 101325PA)	
1577	ml/s	milliliter per second	
1578	ml/h	milliliter per hour	
1579	ml/d	milliliter per day	
1580	af/s	acre foot per second	
1581	af/min	acre foot per minute	
1582	af/h	acre foot per hour	
1583	af/d	acre foot per day	
1584	fl oz (U.S.)/s	ounce (U.S. fluid) per second	
1585	fl oz (U.S.) /min	ounce (U.S. fluid) per minute	
1586	fl oz (U.S.)/h	ounce (U.S. fluid) per hour	
1587	fl oz (U.S.)/d	ounce (U.S. fluid) per day	
1588	m^3/s normal	Normal cubic meter per second (0°C, 1atm = 101325Pa)	
1589	m^3/min normal	Normal cubic meter per minute (0°C, 1atm = 101325Pa)	

Value	Symbol	Description	Equivalence
1590	m^3/h normal	Normal cubic meter per hour (0°C, 1atm = 101325Pa)	
1591	m^3/d normal	Normal cubic meter per day (0°C, 1atm = 101325Pa)	
1592	L/s normal	Normal liter per second (0°C, 1atm = 101325PA)	
1593	L/min normal	Normal liter per minute (0°C, 1atm = 101325PA)	
1594	L/h normal	Normal liter per hour (0°C, 1atm = 101325PA)	
1595	L/d normal	Normal liter per day (0°C, 1atm = 101325PA)	
1596	m^3/s std.	Standard cubic meter per second (20°C, 1atm = 101325Pa)	
1597	m^3/min std.	Standard cubic meter per minute (20°C, 1atm = 101325Pa)	
1598	m^3/h std.	Standard cubic meter per hour (20°C, 1atm = 101325Pa)	
1599	m^3/d std.	Standard cubic meter per day (20°C, 1atm = 101325Pa)	
1600	L/s std.	Standard liter per second (20°C, 1atm = 101325PA)	
1601	L/min std.	Standard liter per minute (20°C, 1atm = 101325PA)	
1602	L/h std.	Standard liter per hour (20°C, 1atm = 101325PA)	
1603	L/d std.	Standard liter per day (20°C, 1atm = 101325PA)	
1604	ft^3/s std.	standard cubic foot per second	
1605	ft^3/d std.	standard cubic foot per day	
1606	oz/s	ounce per second	
1607	oz/min	ounce per minute	
1608	oz/h	ounce per hour	
1609	oz/d	ounce per day	
1610	Pa_a	pascal absolute	
1611	Pa_g	pascal gauge	
1612	GPa_a	gigapascal absolute	
1613	GPa_g	gigapascal gauge	
1614	MPa_a	megapascal absolute	
1615	MPa_g	megapascal gauge	
1616	kPa_a	kilopascal absolute	
1617	kPa_g	kilopascal gauge	
1618	mPa_a	millipascal absolute	
1619	mPa_g	millipascal gauge	
1620	μPa_a	micropascal absolute	
1621	μPa_g	micropascal gauge	
1622	hPa_a	hectopascal absolute	
1623	hPa_g	hectopascal gauge	
1624	$gf/cm^2{}_a$	gram-force per square centimeter absolute	
1625	$gf/cm^2{}_g$	gram-force per square centimeter gauge	
1626	$kgf/cm^2{}_a$	kilogram-force per square centimeter absolute	
1627	$kgf/cm^2{}_g$	kilogram-force per square centimeter gauge	
1628	SD4°C	standard density at 4°C	

Value	Symbol	Description	Equivalence
1629	SD15°C	standard density at 15°C	
1630	SD20°C	standard density at 20°C	
1631	PS	metric horsepower (Pferdestärke)	= 735.49875 W
1632	ppt	parts per trillion	= 10^{-12}
1633	hl/s	hectoliter per second	
1634	hl/min	hectoliter per minute	
1635	hl/h	hectoliter per hour	
1636	hl/d	hectoliter per day	
1637	bbl (liq)/s	barrel (U.S. liquid) per second	
1638	bbl (liq)/min	barrel (U.S. liquid) per minute	
1639	bbl (liq)/h	barrel (U.S. liquid) per hour	
1640	bbl (liq)/d	barrel (U.S. liquid) per day	
1641	bbl (fed)	barrel (U.S. federal)	= 31 gal
1642	bbl (fed)/s	barrel (U.S. federal) per second	
1643	bbl (fed)/min	barrel (U.S. federal) per minute	
1644	bbl (fed)/h	barrel (U.S. federal) per hour	
1645	bbl (fed)/d	barrel (U.S. federal) per day	
1646	Reserved		
	...		
1994	Reserved		
1995	Textual unit definition		
1996	Not used		
1997	None		
1998	unknown		
1999	special		
2000-32767	Reserved		
32768-65535	Manufacturer specific		

Table 63. Unit codes

5.3 Material Codes

Value	Display	Abbreviation	Description
0	Carbon Steel		
1	Stainless Steel 304	304 SST	
2	Stainless Steel 316	316 SST	
3	Hastelloy C	Hast C	
4	Monel		
5	Tantalum		
6	Titanium		
7	Pt-Ir		Platinum-Iridium
8	Alloy 20		
9	Co-Cr-Ni		Cobalt-Chromium-Nickel
10	PTFE		PTFE (Teflon)
11	Viton		
12	Buna-N		
13	Ethyl-Prop		
14	Urethane		
15	Gold Monel		Gold Monel Alloy
16	Tefzel		
17	Ryton		Ryton is a registered trademark of Phillips

Value	Display	Abbreviation	Description
			Petroleum Company
18	Ceramic		
19	Stainless Steel 316L	316L SST	
20	PVC		
21	Nitrile Rubber		
22	Kalrez		Teflon and Kalrez are registered trademarks of E. I. DuPont De Nemours Company.
23	Inconel		Inconel is a trademark of International Nickel Company
24	Kynar		Kynar is a trademark of Pennwalt Incorporated. Hastelloy C is a trademark of Cabot Corporation
25	Aluminium	Al	
26	Nickel	Nickel	
27	FEP		Perfluoroethylenpropylene. Typically a sealing material for O-Ring
28	Stainless Steel 316 Ti	316 SST Ti	316 Stainless steel Ti, 16-18% Chromium, 10-14% Nickel, 2-3% Molybdan.
30	Hastelloy C276	Hast C276	
31	Klinger C4401	4401	Material that may be referenced by Klinger compound No. C4401
32	Thermotork		Material trademarked by Armstrong World Industries Inc.
33	Grafoil		Grafoil - Material trademarked by Union Carbide Poly Tetra Fluoro Ethylene coated 316L Stainless steel-Material, PTFE is also known by the trademark name Teflon
34	PTFE coated 316l SST		
35	Gold plated Hastelloy C276	Gold plated Hast C276	
36	PTFE Glass		Poly Tetra Fluoro Ethylene Glass - Material, Glass filled PTFE, PTFE is also known by the trademark name Teflon
37	PTFE Graphite		Poly Tetra Fluoro Ethylene Graphite - Material, Graphite filled PTFE, PTFE is also known by the trademark name Teflon
234	PTFE Hastelloy	PTFE Hast	
235	Stainless Steel CF 8M		
236	Hastelloy SST	Hast SST	
237	Gold plated SST		
239	Monel 400		
250	not used		
251	none		
252	unknown		
253	special		

Table 64. Material codes

6 General Requirements - Conformance Statements

Every device chooses the necessary subset out of the defined structures of this document. Choosing a subset follows certain rules defined in the conformance statements below. The tables show which structure are mandatory (M), selected (S) and which are optional (O).

Item	Conformance Statement
Physical Block	M
Transducer Blocks	O
Function Block	M
Analog_Input_Blocks	S
Analog_Output_Blocks	S
Discrete_Input_Blocks	S
Discrete_Output_Blocks	S
Other Function Blocks	S
...	O

Table 65. Conformance Statements for the Existence of Blocks

Item	Conformance Statement	Subelement
Device Management	M	
Directory Object		M
Block Object		M
Alarm-Objects		O
Link-Objects		O
Trend-Object		O

Table 66. Conformance Statement for Device Management

Item	Conformance Statement	Subelement
Blocks	M	
Standard Parameter from General Requirements		M
functions / blockspecific Parameters		M / O
Manufacturer specific parameters		O
View_1 object		M (Class B), O (Class A)
View_x objects		O

Table 67. Conformance Statement Blocks

7 General Requirements - Document History

Changes from V3.0 to V3.0.1

Chapter/Figure/Table	Change
Entire document	Correction of spelling errors
1.2	Change reference to IEC 61158 and IEC 61784
3.1.10	Delete hint to priority
3.2.1	Integrate Reset_Class characteristic for parameter
3.2.2	Clarify use of parameter range definition which is of type enumeration
3.3.1, Tab.2	Change of description of ST_REV
Table 6	Batch parameter data type “record” instead of structure
3.7	Replace key attribute by Data type numeric identifier or shortcut
All document	Replace DS-33 by 101 and DS-34 by 102
3.7	Harmonisation of the write conventions of sub parameter of GR data structures to “Name_Name”
Tab 15	New table which clarifies the byte order of View reference NOTE all further table numbers a increased by 1
3.7.3.1 and 3.7.3.6	Delete hints to priority < or > 8
Table 14	Description of semantic of Profile Revision
3.7.3.2	Number the table NOTE all further table numbers are increased by additional 1
3.7.3.3 New table 19	Cross bit 2 and 3 within GOOD (cascade) first raw
New table 20	New priority assignment
3.7.3.6	New description substatus “constant”
3.7.19.4	New data type structure “Feature”, i.e. new clause and new tables 55 to 57, NOTE all further table numbers a increased by additional 3
3.7	The following data structures are deleted: DS-35, DS-38, DS-40, DS-41, DS-43 to DS-48, DS-51,
3.8	New text before new table 55
3.8 new Table 55	New text for write.ind and read.ind
3.11.1, new Table 56	New description parameter FATORY_RESET
3.11.2 new Table 58 - 60	New parameter FEATURE
3.11.1, new Table 56	New description parameter IDENT_NUMBER_SELECTOR (with additional notes), WRITE_LOCKING; HW_WRITE_PROTECTION
3.11.4	New description of characteristic of Diagnosis bits
5.1	Replace MAN_ID list by reference to PNO web server
5.2; Table 55	Rename display by symbol within the unit table, add new units
5.2; Table 55	Add codes areas for reserved and manufacturer specific units

Table 68. Changes from V3.0 to V3.01

PROFIBUS - PA

Mapping of the Profile to Profibus-DP

8 Mapping of the Profile to PROFIBUS-DP - Introduction

8.1 Scope

This document defines the mapping of the PROFIBUS FB application profile definition to the PROFIBUS-DP protocol. The description of the device model and the block model is given in /GR04/.

8.2 References

[EN50170]	EN 50170: General Purpose Field Communication System, CENELEC 1996.
[GR99]	PROFIBUS-PA Profile for Process Control Devices, General Requirement, PNO 1999
[DPV1]	PROFIBUS-DP/V1, Version 2.0 Specification, April 1998, PNO Karlsruhe

8.3 Definitions

The definitions is done in /GR99/.

Index:	DP DDLM-Read and DDLM-Write service attribute to address a parameter in a device
Parameter Address:	Reference between the Directory object of a device and the Slot/Index address of the blocks
Slot:	DP DDLM-Read and DDLM-Write service attribute to address a group of parameter in a logical module in a device.

8.4 Abbreviations

AI	Analog Input
AO	Analog Output
DM	Device Management
DS	Data type structure
FB	Function Block
LUV	Last Usable Value
MSAC	Master Slave acyclic
MSCY	Master Slave cyclic
PA	Process Automation
PB	Physical Block
PROFIBUS	Process Field Bus
r	read access
SAP	Service Access Point
TB	Transducer Block
w	write access

9 Mapping of the Profile to PROFIBUS-DP - Technical Overview

The profile which is described in the General Requirement document and the data sheets specifies FB application definitions, without communication characteristics. The profile definition aims to provide access to the application parameters and functions. This access is done by acyclic and cyclic data transfer supported by the Device Mapper, the interface between the FB application and the PROFIBUS-DP protocol. This mapping document describes these two types of access. The alarm handling and the Up/Download mapping to PROFIBUS-DP will be defined in a future version of this document.

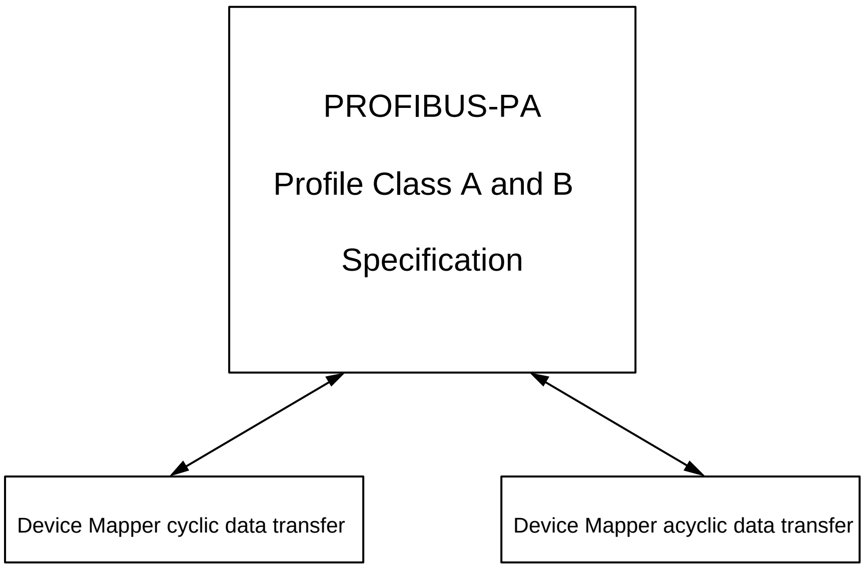


Figure 13. Mapping of the Application Profile Definition to Cyclic and Acyclic Data Transfer

The mapping of the profile is done by means of three examples, a device with one Physical Block, one Function Block and one Transducer Block, a device with more than one Transducer Block and a device with more than one Function Block and Transducer Block.

9.1 General Function Block Mapping

Function Blocks are seen as functional modules similar to the more hardware oriented pluggable modules of PROFIBUS-DP devices. These modules are part of the GSD file which are needed to configure the cyclic data transfer. This profile defines the following rules, to allow the same mapping of PROFIBUS-PA FBs as the PROFIBUS –DP modules (see also section 9.2 and 9.3):

1. 1 Slot contains 1 FB only
2. Slot 1 contains the first FB, Slot 2 contains the 2nd FB, ..., i.e. there is a one to one mapping between Module (in GSD), FB and Slot. Rule number 10 is the only exception.
3. All FBs starts at Index 16 of the according Slot (i.e. Block_Object of FBs are always at Index 16)
4. The Directory of the Device Management starts on Slot 1 Index 0 always
5. Physical Block shall be located in Slot 0 for all Devices. It should begin at Index 16.
6. The order of the FBs in the Slots, the order of the references of the FB start addresses in the Composite_Directory_Entry and the intentional order of the according FB parameters in the cyclic telegram are the same. I.e. the order of the Identifier Byte or Extended Identifier Format in the configuration string and the order of the FBs in the slots should be the same.
7. The allocation of the Transducer Blocks to Slots is manufacturer-specific. It is recommended, that devices with a fixed relation between FB and TB allocate the TB in the same Slot as their FBs. However, one TB may be connected to more then one FB, i.e. a FB may be connected to a TB of another Slot.
8. The allocation of the Physical Blocks for devices with more than one PB to Slots is manufacturer-specific. It is recommended, that devices with a fixed relation between these PB to TR (e.g. plugable hardware modules) allocate the PBs in the same Slot as their TBs.
9. A not used FB of a device is represented by an empty slot Identifier in the configuration string. Only a sequence of Empty Slots at the end of the configuration string is optional
10. FBs which allocate more then 1 slot, are represented by empty slot Identifiers for the additional slots.

The allocation rules are suitable for applications which uses FBs only. Commissioning and other applications which access Physical Block, Transducer Block and Link Object parameters need the information of the directory in the Device Management.

9.2 Mapping for Acyclic Data Transfer

In principle one can distinguishes between the acyclic and cyclic data transfer. PROFIBUS-DP provides protocol functions for both requirements [DP].

Each parameter of a device which has one unique address can be read or written. If a parameter can be written is defined in the according Function Block specification. The parameter address is composed of one Slot number (range: 0 to 254) and one Index number (range: 0 to 254). An address of one parameter is calculated as follows:

Parameter XX address = Slot/Index of Block_Object parameter as defined in the Composite_Directory_Entry + Relative Index as defined in parameter attribute tables of the according block. Is this sum greater then 254 the Slot will be increased by 1 and the Index count beginning by 0 (zero) again.

VIEW_1 address = address (Slot/Index) as defined in Block_Object of the related block

VIEW_n address = VIEW_1 Address + (n-1)

Figure 14 shows a simple device with one PB, FB and TB. The Physical Block's parameter are located in Slot 0. The parameters of the Device Management are assigned to Index 0 to 13 of Slot 1. Function and Transducer Block parameters follow. Usually the blocks have 20 up to 50 parameters and one Slot has 255 Indexes (from 0 to 254, Index 255 of every Slot is reserved).

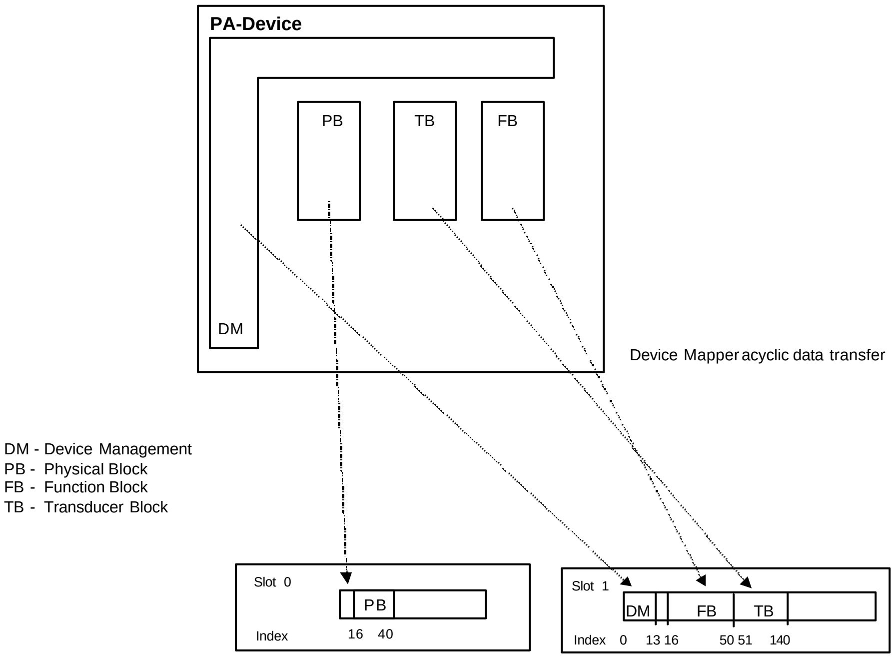


Figure 14. Mapping of one PB, FB and TB to one Common Slot

If not all parameters fit in one Slot the blocks may overlap over the slot boundaries.

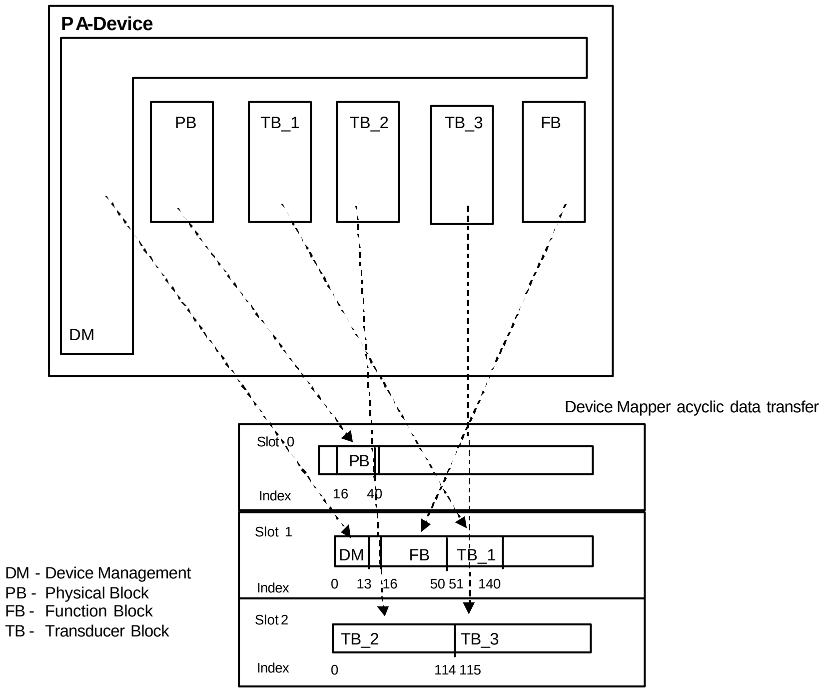


Figure 15. Mapping of one PB, FB and more than one TB to two Slots

A more complex device needs more Slots to locate all parameters. The allocation in the Slots are manufacturer-specific. Gaps between Slot numbers are not allowed, but not all Indices of a Slot have to be used.

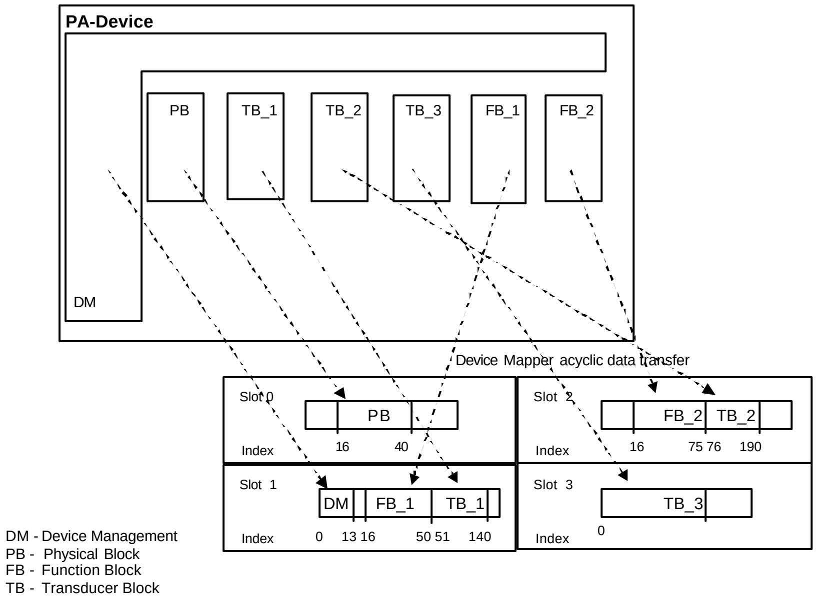


Figure 16. Mapping of one PB and more than one FB and TB to several Slots

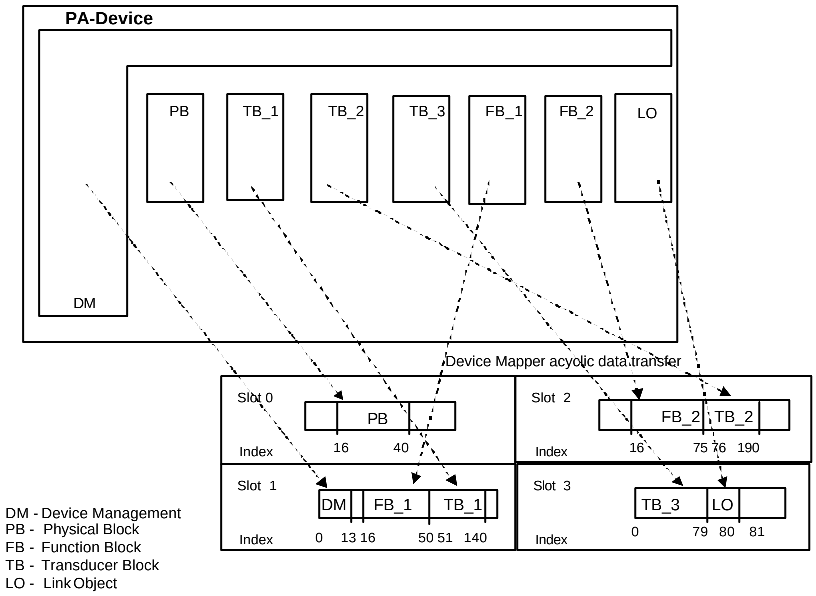


Figure 17. Mapping of one PB, two FBs, three TBs and one Link Object

PROFIBUS-DP maps the block parameter structure to modules which contains the references between the service parameters (Slot and Index) and the FB application block parameters. Each block parameter is mapped to a Slot/Index combination. The starting Slot/Index and the number of block parameters are block specific. The Device Management parameters are fixed bonded to defined modules (i.e. Slot/Index). The block parameters are device specific bonded to the Slots and Index which are referenced in the directory in the Device Management. The Device Mapper is a logical sub-layer and contains the wiring between block parameters and the Slot/Index combination and protects the FB application block structures from the DP communication facilities.

9.3 Mapping for Cyclic Data Transfer

In the FB application profile definition only FBs may have cyclic parameters. Physical and Transducer Blocks don't have cyclic parameters. In the example Figure 18 the FB has one out parameter only which takes place in the cyclic data transfer.

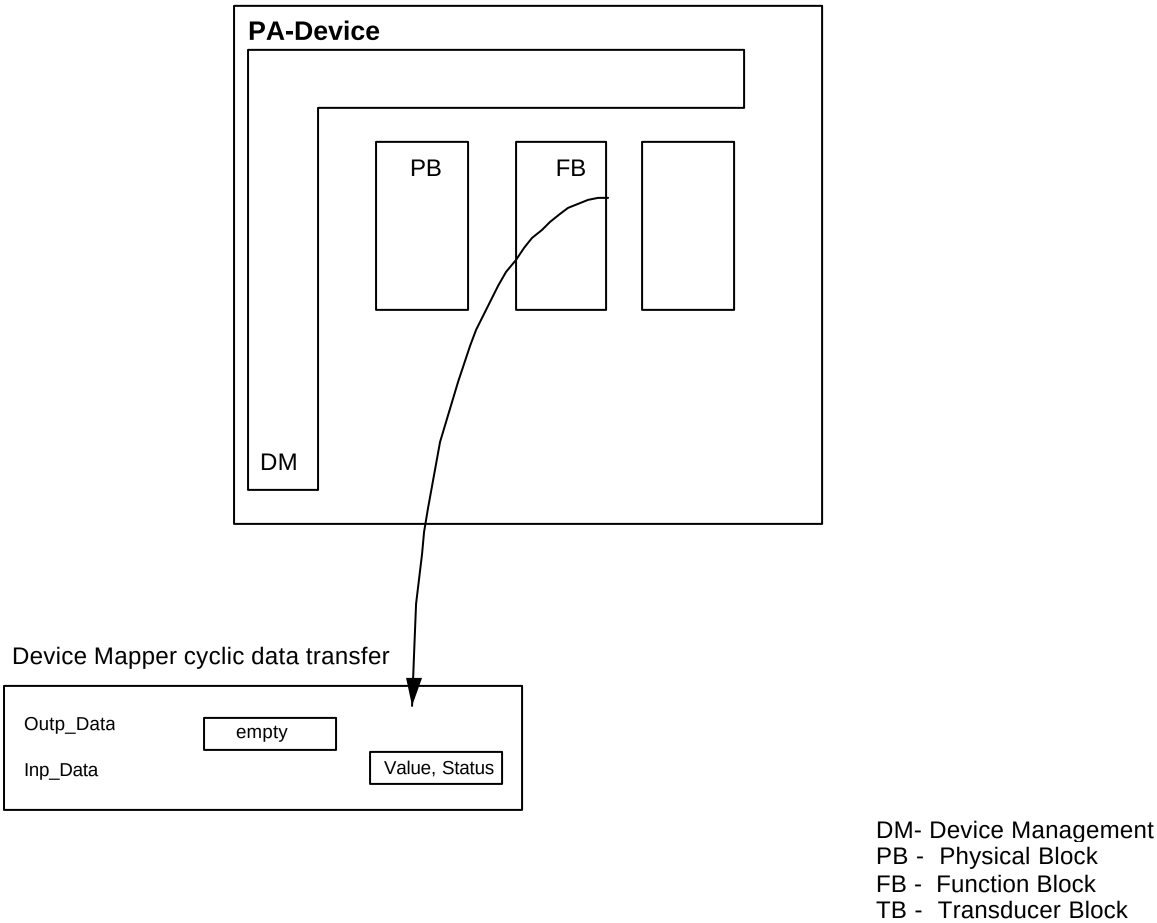


Figure 18. Mapping of one cyclic FB Parameter to the Inp-Data Frame

If there are more than one Transducer Blocks in a device but one Function Block only, there is no difference in cyclic data transfer. If there are more than one Function Blocks with more than one cyclic parameters the data elements are concatenated in the Input and Output data frame (Inp_Data and Outp_Data). The order of the parameters of one Function Block in the input and output data frame is from the lower to the higher Relative Index in the Parameter Attribute table of the Function Blocks. Is there more then one FB with the same type in a device (e.g. 3 AI FBs) the order of the cyclic parameters in the Input and Output data frame is the same as the order of the FB in the directory.

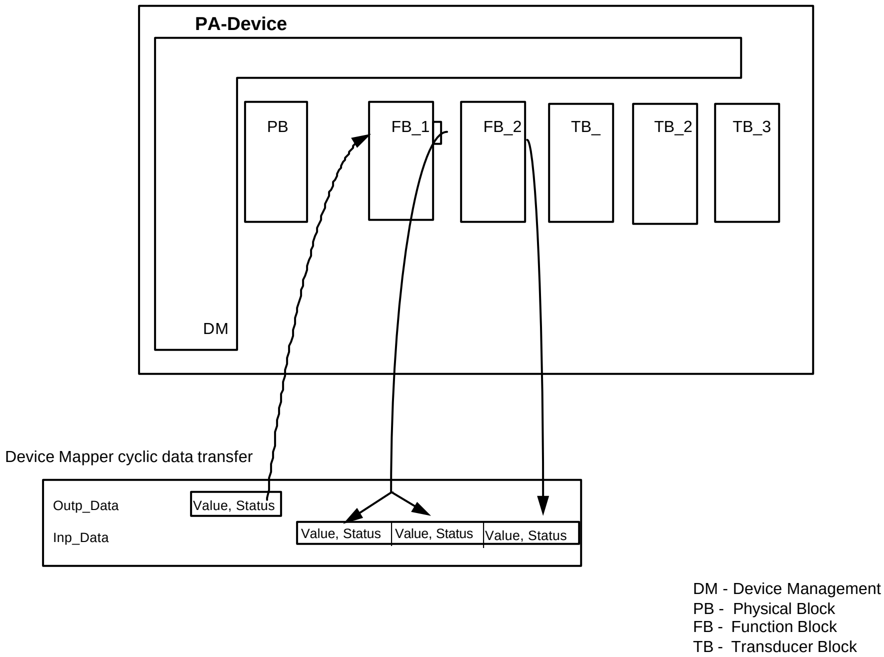


Figure 19. Mapping of more than one Cyclic FB Parameter to the Inp, Outp Data Frame

The DDLM_CHK_CFG contains the CFG_DATA, which describes the members of the Inp_Data and Out_Data of the DDLM_DATA_EXCHANGE service. Each block which provides parameters to the Inp_Data and Outp_Data must be addressed by an Identifier Byte. Only Function Block parameters with the cyclic attribute in the parameter attribute table become members of the cyclic data transfer. For more details about the cyclic data transfer refer to /IEC 61158/ specification.

If an optional parameter for cyclic data transport, which is not implemented but is selected for cyclic data transfer, the configuration which contains this parameter may be accepted by the device.

In this case the status shall be set to "BAD – not connected" and the value shall be set to zero.

9.4 Detailed Definition of the Device Management

9.4.1 Overview

All parameters of a device visible across the PROFIBUS-DP communication protocol are related to a certain block or object (e.g. Link object). The configuration of a device in terms of blocks and objects are device type and manufacturer specific. The concrete configuration of a device is described in a so called Directory object which is located in the Device Management. The Directory object is defined to act as a guide to the information within the Function Block application of a device and described in /GR96/. This information may be read by an interface device desiring to access parameters and used to fulfill the necessary check during the DDLM_CHK_CFG or DDLM_GET_CFG services respectively.

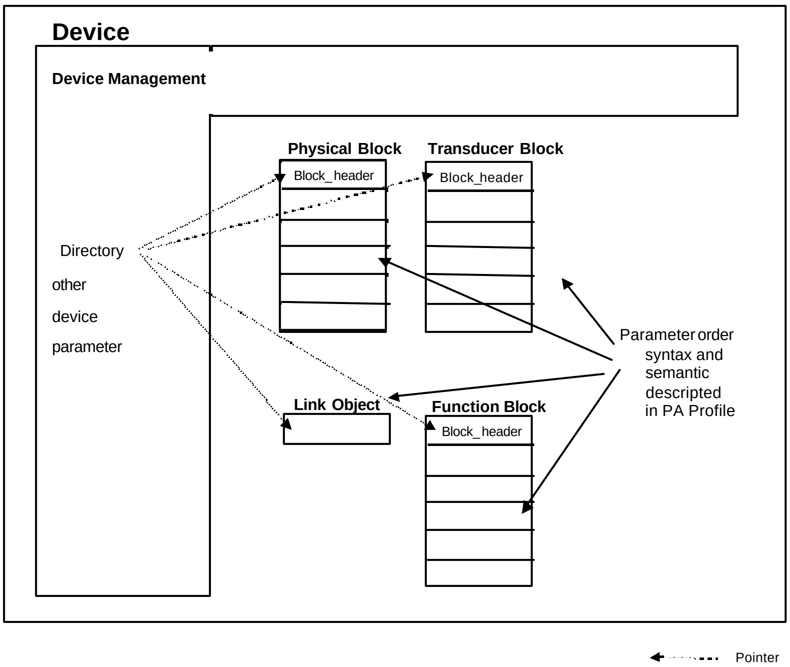


Figure 20. The Relationship between Blocks, Block Parameters and the Directory in the Device Management

The Directory contains in an unambiguously defined syntax the numbers and types of instantiated blocks and objects in its device. The reference table provides the link between the directory syntax defined in this profile and the manufacturer-specific allocation of the block or object beginning in the DP address range. The Directory is part of the Device Management.

9.4.2 Device Management Parameter Description

The device management parameters are described in 3.6.

9.4.3 Device Management Mapping and Parameter Attributes

The Device Management occupies slot 1 Index 0 to 13 and has the following structure:

Relative Index	Parameter Name	Usage	Data Type	Store	Size	Access	Parameter Usage / Kind of Transport	Mandatory Optional (Class A,B)
0	DIRECTORY_OBJECT_ HEADER	Directory Header	Array of Unsigned16	C	spec	R	C/a	M
1	COMPOSITE_LIST_ DIRECTORY_ENTRIES / COMPOSITE_ DIRECTORY _ENTRIES	Begin_PB No_PB Begin_TB_ No_TB Begin_FB_ No_FB Begin_LO_ No_LO[1] Slot/Index_PB No_PB_Param Slot/Index_1.TB No_1.TB_Param ...	Array of Unsigned16	C C C C C C C C	2 2 2 2 2 2 2 2	R R R R R R R R	C/a C/a C/a C/a C/a C/a C/a C/a	M M M M M M O O
2-8	COMPOSITE_ DIRECTORY_ENTRIES continuous	Slot/Index_n.xB No_n.xB_Param ... Slot/Index_n.LO No_n.LO.Param	Array of Unsigned16	C	spec	R	C/a	O
9-13	Reserved by PNO							M
	END of DEVICE MANAGEMENT							
16	Start of 1st Function Block	Block_Object	DS-32		...			
...								
to 254								

Table 69. Parameter Attributes of the Device Management

[1] The Composite_List_Directory_Entry for Link_Object can appear, although no Link_Object is implemented. In this case No_LO shall be set to zero.

The use of the data types are as followed:

Header: Slot 1 Index 0

Dir_ID	Rev-Number	Num_Dir_Obj	Num_Dir_Entry	First_Comp_ List_Dir_ Entry	Num_Comp_ List_Dir_ Entry
Unsigned16	Unsigned16	Unsigned16	Unsigned16	Unsigned16	Unsigned16

Composite_List_Directory_Entries: Slot 1 (is fixed) Index 1 (Directory object number)

Begin_PB Index/Offset	Num_PB	Begin_TB Index/Offset	Num_TB	Begin_FB Index/Offset	Num_FB	Begin_LO Index/Offset	Num_LO
high byte/ low byte	Unsigned16	high byte/ low byte	Unsigned16	high byte/ low byte	Unsigned16	high byte/ low byte	Unsigned16
Directory_Entry number 1		Directory_Entry number 2		Directory_Entry number 3		Directory_Entry number 4	

Directory_Entry - One logical field in the directory composed of a reference and a counter, which occupy 4 bytes.

Composite_List_Directory_Entries (first part of the entry which occupy 2 bytes) reference to Composite_Directory_Entries and count the number of Composite_Directory_Entries of the same type (Physical Blocks, Function Blocks, Transducer Blocks or Link Objects)

Composite_Directory_Entries reference to the first parameter of the Blocks (first part of the entry which occupy 2 bytes) and count the number of parameters within the blocks or object

Index (Directory object number)

- Index is the read and write service attribute Index of this parameter which contains the according Composite Directory Entries parameter. The valid range is 1 to 13.

Offset (Directory Entry number)

- Offset is the logical number of Composite_Directory_Entries, which is counted within the directory starting with the first Composite_List_Directory_Entry by 1.

Composite_Directory_Entries: Slot 1 Index 1 (direct after Composite_List_Directory_Entries in the same array)

Pointer Slot	PB Index	Number para-meters	Pointer Slot	xx Index	Number para-meters	Pointer Slot	… Index	Number para-meters
high byte	Low byte	Unsigned16	high byte	low byte	Unsigned16	high byte	low byte	Unsigned16
PB_ID			TR_ID			FB_ID		
Directory_Entry number 5			Directory_Entry number 6			Directory_Entry number 7		

Pointer Slot	… Index	Number para-meters
high byte	low byte	Unsigned16
LO_ID		
Directory_Entry number n		

Figure 21. Directory Elements Data Types

Slot/Index - Reference to the first parameter of a block (BLOCK_OBJECT) or an object (LINK_OBJECT)

PB_ID, TR_ID, FB_ID and LO_ID are logical numbers for design and configuration purposes. The TR_ID is used

The following ranges are valid for the xx_IDs within one Directory:

- 1 <= PB_ID <= 255
- 1 <= TR_ID <= 255
- 1 <= FB_ID <= 255
- 1 <= LO_ID <= 255

The following sections present examples for the Directory for these devices used in 9.2.

PB_ID, TB_ID and FB_ID are defined as a position of the corresponding block in the Composite_Directory_Entries of the according Block Object type (see 2nd element of the Block structure DS-32) starting with 1.

9.4.4 Device Management Directory Examples

9.4.4.1 Device with 1 PB, 1 FB and 1 TB (see Figure 14)

Header: Slot 1 Index 0

Dir_ID	Rev-Number	Num_Dir_Obj	Num_Dir_Entry	First_Comp_List_Dir_Entry	Num_Comp_List_Dir_Entry
0	1	1	6	1	3

Composite_List_Directory_Entries: Slot 1 Index 1

Begin_PB Index/Offset	Num_PB	Begin_TB Index/Offset	Num_TB	Begin_FB Index/Offset	Num_FB
1 /4	1	1/5	1	1/6	1
Directory_Entry number 1		Directory_Entry number 2		Directory_Entry number 3	

Composite_Directory_Entries: Slot 1 Index 1 (direct after Composite_List_Directory_Entries in the same array)

Pointer Offset Slot	PB 0 Index	Number of PB para-meters	Pointer Offset Slot	TB 1 Index	Number of TB para-meters	Pointer Offset Slot	FB 2 Index	Number of FB para-meters
0	0	25	1	51	90	1	16	35
PB_ID=1			TR_ID = 1			FB_ID=1		
Directory_Entry number 4			Directory_Entry number 5			Directory_Entry number 6		

Figure 22. Directory Example with 1 PB, 1 FB and 1 TB

9.4.4.2 Device with 1 PB, 1 FB and 3 TB (see Figure 15)

Header: Slot 1 Index 0

Dir_ID	Rev-Number	Num_Dir_Obj	Num_Dir_Entry	First_Comp_List_Dir_Entry	Num_Comp_List_Dir_Entry
0	1	2	8	1	3

Composite_List_Directory_Entries: Slot 1 Index 1

Begin_PB Index/Offset	Num_PB	Begin_TB Index/Offset	Num_TB	Begin_FB Index/Offset	Num_FB
2/4	1	2/5	3	2/8	1
Directory_Entry number 1		Directory_Entry number 2		Directory_Entry number 3	

Composite_Directory_Entries: Slot 1 Index 2 (new parameter)

Pointer Offset Slot	PB 0 Index	Number of PB para-meters	Pointer Offset Slot	TB_1 1 Index	Number of TB_1 para-meters	Pointer Offset Slot	TB_2 2 Index	Number of TB_2 para-meters
0	0	25	1	51	90	2	0	115
PB_ID=1			TR_ID = 1			TR_ID = 2		
Directory_Entry number 4			Directory_Entry number 5			Directory_Entry number 6		

Pointer Offset Slot	TB_3 0 Index	Number of TB_3 para-meters	Pointer Offset Slot	FB 1 Index	Number of FB para-meters
2	115	<139	1	16	35
TR_ID = 3			FB_ID = 1		
Directory_Entry number 7			Directory_Entry number 8		

Figure 23. Directory Example with 1 PB, 1 FB and 3 TB

9.4.4.3 Device with 1 PB, 2 FBs and 3 TBs (see Figure 16)

Header: Slot 1 Index 0

Dir_ID	Rev-Number	Num_Dir_Obj	Num_Dir_Entry	First_Comp_List_Dir_Entry	Num_Comp_List_Dir_Entry
0	1	2	9	1	3

Composite_List_Directory: Slot 1 Index 1

Begin_PB Index/Offset	Num_PB	Begin_TB Index/Offset	Num_TB	Begin_FB Index/Offset	Num_FB
2/4	1	2/5	3	2/8	2
Directory_Entry number 1		Directory_Entry number 2		Directory_Entry number 3	

Composite_Directory_Entries: Slot 1 Index 2 (new parameter)

Pointer Offset Slot	PB 0 Index	Number of PB para-meters	Pointer Offset Slot	TB_1 1 Index	Number of TB_1 para-meters	Pointer Offset Slot	TB_2 2 Index	Number of TB_2 para-meters
0	16	25	1	51	90	2	76	115
PB_ID=1			TR_ID = 1			TR_ID = 2		
Directory_Entry number 4			Directory_Entry number 5			Directory_Entry number 6		

Pointer Offset Slot	TB_3 0 Index	Number of TB_3 para-meters	Pointer Offset Slot	FB_1 1 Index	Number of FB_1 para-meters	Pointer Offset Slot	FB_2 2 Index	Number of FB_2 para-meters
3	0	<254	1	16	35	2	16	60
TR_ID = 3			FB_ID=1			FB_ID=2		
Directory_Entry number 7			Directory_Entry number 8			Directory_Entry number 9		

Figure 24. Directory Example with 1 PB, 2 FB and 3 TB

9.4.4.4 Device with 1 PB, 2 FBs and 3 TBs and 1 Link Object (see Figure 17)

Header: Slot 1 Index 0

Dir_ID	Rev-Number	Num_Dir_Obj	Num_Dir_Entry	First_Comp_List_Dir_Entry	Num_Comp_List_Dir_Entry
0	1	2	11	1	4

Composite_List_Directory: Slot 1 Index 1

Begin_PB Index/Offset	Num_PB	Begin_TB Index/Offset	Num_TB	Begin_FB Index/Offset	Num_FB	Begin_Link Index/Offset	Num_Link
2/5	1	2/6	3	2/9	2	2/11	1
Directory_Entry number 1		Directory_Entry number 2		Directory_Entry number 3		Directory_Entry number 4	

Composite_Directory_Entries: Slot 1 Index 2 (new parameter)

Pointer Offset Slot	PB 0 Index	Number of PB Para-Meters	Pointer Offset Slot	TB_1 1 Index	Number of TB_1 para-meters	Pointer Offset Slot	TB_2 2 Index	Number of TB_2 para-meters
0	16	25	1	51	90	2	76	115
PB_ID=1			TR_ID = 1			TR_ID = 2		
Directory_Entry number 5			Directory_Entry number 6			Directory_Entry number 7		

Pointer Offset Slot	TB_3 0 Index	Number of TB_3 para-meters	Pointer Offset Slot	FB_1 1 Index	Number of FB_1 para-meters	Pointer Offset Slot	FB_2 2 Index	Number of FB_2 para-meters
3	0	80	1	16	35	2	16	60
TR_ID = 3			FB_ID=1			FB_ID=2		
Directory_Entry number 8			Directory_Entry number 9			Directory_Entry number 10		

Pointer Offset Slot	Link 0 Index	Number of Link para-meters
3	80	1
LO_ID=1		
Directory_Entry number 11		

Figure 25. Directory Example with 1 PB, 2 FBs, 3 TBs and 1 Link Object

10 Mapping of the Profile to PROFIBUS-DP - Communication Profile

10.1 Subset of Services

The service subset of the communication protocol is defined in /IEC 61158/.

10.2 Return Error Codes

The error codes are defined in /IEC 61158/ and used in the scope of this profile as described in the following table:

Error_Class (Meaning)	Error_Class (decimal)	Error_code (Meaning)	Error_Code (decimal)	Description
application	10	read error	0	Data can not be read from the application (may happen if there is an error in the EEPROM or in local bus)
		write error	1	Data can not be written to the application (may happen if there is an error in the EEPROM or local bus)
		module failure	2	Happens, if a module is not available in a device anymore
		Reserved	3-7	-
		version conflict	8	not used in the scope of this profile
		feature not supported	9	not used in the scope of this profile
		manufacturer specific	10-14	
		Other	15	The reason is unspecific
access	11	invalid index	0	The parameter can not be accessed because it is never used (for optional parameters, which are not implemented). The parameter can not be accessed because of it is invisible at the moment.
		write length error	1	The length in the write request does not match (larger or smaller) to the size of the parameter
		invalid slot	2	Accessed a slot that contains no parameters at all.
		type conflict	3	not used in the scope of this profile
		invalid area	4	not used in the scope of this profile

Error_Class (Meaning)	Error_Class (decimal)	Error_code (Meaning)	Error_Code (decimal)	Description
		state conflict	5	device is busy because it has to work internally. This may happen: after writing the reset parameter time delay during calibration specific parameters are not changeable after the start-up of the device
		access denied	6	The parameter can not be written because the device is write protected.
		invalid range	7	The parameter can not be written because of the value is out of range, e.g.: configurations which are not allowed (e.g. fixed channel between FB and TB) commands which are not supported (e.g. FACTORY_RESET) functions which are not supported (e.g. LIN_TYPE sphere, invalid TARGET_MODE value) a specific order in writing parameters is necessary, for consistency reasons Invalid selection of an enumeration or the value is smaller than the minimum value or the value is greater than the maximum value.
		invalid parameter	8	not used in the scope of this profile
		invalid type	9	not used in the scope of this profile
		read only	10	The parameter can never be written
		temporal invalid	11	The requested service can not be carried out because it is temporally not possible (not valid) in the current state of the device.
		manufacturer specific	12-14	
		other	15	The reason is non-specific
resource	12	Read constraint conflict	0	not used in the scope of this profile
		Write constraint conflict	1	not used in the scope of this profile
		Resource busy	2	because the device: needs some time for EEPROM access get a download
		Resource unavailable	3	Tried to access up-/download parameter objects, but the device does not support up-/downloading.
		Reserved	4-7	

Error_Class (Meaning)	Error_Class (decimal)	Error_code (Meaning)	Error_Code (decimal)	Description
		manufacturer specific	8-14	
		Other	15	The reason is unspecific

Table 70. DPV1 Response Codes

10.3 Use of the DP Services to Provide the Profile Functionality

10.3.1 DDLM_Data_Exchange

This service is used for the cyclic data exchange of the block parameters with the cyclic attribute. The current structure of the Data_Exchange service is specified by the block structure of the device and defined by the CFG_DATA (see 10.3.2).

If more than one cyclic parameter is chosen, the order of the cyclic parameters in DDLM_Data_Exchange is according to the relative index of the parameters in the according attribute parameter table, starting with the lowest one.

10.3.2 DDLM_CHK_CFG

10.3.2.1 General Definition

This service initiates the Function Block application of a PROFIBUS-PA device (i.e. the device management) to check the consistency between the master and slave configuration of cyclic parameter exchange.

/IEC 61158/ describes a structure of the service parameter CFG_DATA and the coding of a number of Identifier Bytes (Identifier Byte is a byte or a string of bytes representing an input and output cyclic data string, which is transferred between a PROFIBUS-DP Master Class 1 and a PROFIBUS-DP slave device.). In terms of this profile each Function Block has its own Identifier Byte, which expresses all of its parameters with the cyclic attribute (see parameter attribute tables of each FB) for PROFIBUS-DP communication configuration.

1. There will be use of Identifier Byte and Extended Identifier Format in the devices. (see Table 72)

The support of Identifier Byte and Extended Identifier Format is mandatory as defined in the table. Before configuration the device answers for analog components with the Identifier Byte version and the smallest parameter combination, for discrete components with the Extended Identifier Format version and the smallest parameter combination (the bold identifier in Table 72 and Table 76).

The structure of the CFG_DATA is directly derived from the block structure of the device, described in the directory of the Device Management. The order of the cyclic parameters in the cyclic data telegram is exactly the same as the order of the Function Blocks in the Slots i.e. the Identifier Bytes are concatenated in the order of their Function Blocks in the Slots. According to the example in Figure 16 the following CFG data strings will be valid for the device (see also Table 72), assuming that the Function Blocks are both Analog Input ones:

- Identifier Byte 0x94, 0x94
- Extended Identifier Format 0x42,0x84,0x08,0x05, 0x42,0x84,0x08,0x05

In case of a device with 4 Discrete Outputs there are the following string valid, assuming the setpoint (SP_D) parameter is in the cyclic data telegram only.

- Identifier Byte 0xA1, 0xA1, 0xA1, 0xA1

For Function Blocks there are different parameter combinations in the cyclic data telegram possible. The differences come from different user needs regarding the necessary scope of information (with feed back of the actual position of the output or without) and the way of integration in the control task (with remote cascade or without). During configuration the operator chooses the parameter combination (see Table 72) and the tools concatenate the according Config string. For Function Blocks the different parameter combinations are marked with one additional number in the Extended Identifier Format as follows:

Bit	Cyclic Parameter for AO	Cyclic Parameter for DO	Cyclic Parameter for TOT	Cyclic Parameter for AI	Cyclic Parameter for DI
0	READBACK	READBACK_D	TOTAL	OUT	OUT_D
1	SP	SP_D	SET_TOT	*	*
2	RCAS_IN	RCAS_IN_D	MODE_TOT	*	*
3	RCAS_OUT	RCAS_OUT_D	*	*	*
4	CHECK_BACK	CHECK_BACK_D	*	*	*
5	POS_D	*	*	*	*
6	not used or vendor specific	*	*	*	*
7	1	1	1	1	1

Table 71. Identification for Cyclic Parameters

The next sections defines the Identifier Bytes for the already existing FBs.

Function Block	Parameter	Identifier Byte	Extended Identifier format
Analog Input (AI)	**OUT**	**0x94**	0x42, 0x84, 0x08, 0x05
Analog Output (AO)	**SP**	**0xA4**	0x82, 0x84, 0x08, 0x05
	SP READBACK POS_D	0x96, 0xA4	0xC6, 0x84, 0x86, 0x08, 0x05, 0x08, 0x05, 0x05, 0x05
	SP CHECK_BACK	0x92, 0xA4	0xC3, 0x84, 0x82, 0x08, 0x05, 0x0A
	SP READBACK POS_D CHECK_BACK	0x99, 0xA4	0xC7, 0x84, 0x89, 0x08, 0x05, 0x08, 0x05, 0x05, 0x05, 0x0A
	RCAS_IN RCAS_OUT	0xB4	0xC4, 0x84, 0x84, 0x08, 0x05, 0x08, 0x05
	RCAS_IN RCAS_OUT CHECK_BACK	0x97, 0xA4	0xC5, 0x84, 0x87, 0x08, 0x05, 0x08, 0x05, 0x0A
	SP READBACK RCAS_IN RCAS_OUT POS_D CHECK_BACK	0x9E, 0xA9	0xCB, 0x89, 0x8E, 0x08, 0x05, 0x08, 0x05, 0x08, 0x05, 0x08, 0x05, 0x05, 0x05, 0x0A
Discrete Input (DI)	**OUT_D**	**0x91**	
Discrete Output (DO)	**SP_D**	**0xA1**	
	SP_D READBACK_D		0xC1, 0x81, 0x81, 0x83

Function Block	Parameter	Identifier Byte	Extended Identifier format
	SP_D CHECK_BACK_D		0xC1, 0x81, 0x82, 0x92
	SP_D READBACK_D CHECK_BACK_D		0xC1, 0x81, 0x84, 0x93
	RCAS_IN_D RCAS_OUT_D		0xC1, 0x81, 0x81, 0x8C
	RCAS_IN_D RCAS_OUT_D CHECK_BACK_D		0xC1, 0x81, 0x84, 0x9C
	SP_D READBACK_D RCAS_IN_D RCAS_OUT_D CHECK_BACK_D		0xC1, 0x83, 0x86, 0x9F
Totalisator	**TOTAL**	**-**	**0x41, 0x84, 0x85**
	TOTAL SET_TOT	-	0xC1, 0x80, 0x84, 0x85
	TOTAL SET_TOT MODE_TOT	-	0xC1, 0x81, 0x84, 0x85
Not used		**0x00**	**0x00**

Table 72. Identifier Bytes for FBs

FBs can be removed from the cyclic data transfer using the PROFIBUS-DP empty module mechanism.

10.3.2.2 Definition of Profile Specific Identification Format for Multi-Variable Devices

Multi-Variable devices are compact or modular devices which are characterised by a variable number and possibly a variable set of FB types. A fixed relation between Function Block combinations and device types as done e.g. for temperature or level devices are not possible. The used Function Block combination of a Multi-Variable device is a result of the configuration process (i.e. dependent on the requirements of the application). It is not possible to specify all useful combinations of Function Blocks of devices within this profile. Technological innovations and manufacturer specific solutions offering a specific added value have to be configurable within the scope of the profile, if the solutions use the behaviour of the specified Function Blocks. This is one of the main advantages using the modular Function Block model.

During the configuration an unambiguously identification of FBs and of their cyclic parameters in the cyclic telegram has to be defined. So it is necessary to identify the type of Function Block (Function Block code) and the chosen cyclic parameter combination of this particular FB within the DDLM_CHK_CFG data string. Therefore the Function Block code and the chosen cyclic parameter combination in the CFG string has to match the order of the Function Blocks in the Slots (remember: one slot contains one Function Block only!). This CFG string is the result of the configuration of the device using the GSD. Therefore there is one specific GSD file for Multi-Variable devices, which gives the opportunity to configure all possible Function Block combinations of all Function Block driven device .

The profile specific Identification Format for Multi-Variable devices are built according to the following rules:

Header	I/O	I/O (if necessary)	Block code	Cyclic parameter combination ID
According to [DP]	According to [DP]	According to [DP]	According to Table 75	According to Table 71

Table 73. Construction of Identification Format for Multi-Variable Devices

The bytes of the Identifier Format represents the structure of the format according to the following definition:

Byte	Bit	Element	Description
1	7 - 6	Header	length of numbers of I/O data
	5 - 4		fixed to 0 (specific identifier format)
	3 - 0		number of profile specific bytes
2	7 - 6	I/O	over all consistency and byte structure
	5 - 0		number of I/O bytes in the Identification Format
3	7 - 6	I/O	over all consistency and byte structure
	5 - 0		number of I/O bytes in the Identification Format (if both I and O)
3/4	7 - 0	Block code	see Table 75
4/5	7 - 0	Cyc P ID	see Table 71

Table 74. Coding of the Identification Format for Multi-Variable Devices

Function Block	Block code
AI	0x81
AO	0x82
DI	0x83
DO	0x84
TOTALIZER	0x85
PID	0x86
Reserved	0x87 to 0xEF
Manufacturer specific	0xF0 to 0xFF

Table 75. Definition of Function Block Codes

The following table defines the Identification Format for Multi-Variable devices as far as defined in the data sheets within version 3.01:

Function Block	Parameter	Identification Format for Multi-Variable devices
Analog Input (AI)	**OUT**	**0x42, 0x84, 0x81, 0x81**
Analog Output (AO)	**SP**	**0x82, 0x84, 0x82, 0x82**
	SP READBACK POS_D	0xC2, 0x84, 0x86, 0x82, 0xA3
	SP CHECK_BACK	0xC2, 0x84, 0x82, 0x82, 0x92
	SP READBACK POS_D CHECK_BACK	0xC2, 0x84, 0x89, 0x82, 0xB3
	RCAS_IN RCAS_OUT	0xC2, 0x84, 0x84, 0x82, 0x8C
	RCAS_IN RCAS_OUT CHECK_BACK	0xC2, 0x84, 0x87, 0x82, 0x9C
	SP READBACK RCAS_IN RCAS_OUT POS_D CHECK_BACK	0xC2, 0x89, 0x8E, 0x82, 0xBF
Discrete Input (DI)	**OUT_D**	**0x42, 0x81, 0x83, 0x81**
Discrete Output (DO)	**SP_D**	**0x82, 0x81, 0x84, 0x82**
	SP_D READBACK_D	0xC2, 0x81, 0x81, 0x84, 0x83
	SP_D CHECK_BACK_D	0xC2, 0x81, 0x82, 0x84, 0x92
	SP_D READBACK_D CHECK_BACK_D	0xC2, 0x81, 0x84, 0x84, 0x93
	RCAS_IN_D RCAS_OUT_D	0xC2, 0x81, 0x81, 0x84, 0x8C
	RCAS_IN_D RCAS_OUT_D CHECK_BACK_D	0xC2, 0x81, 0x84, 0x84, 0x9C
	SP_D READBACK_D RCAS_IN_D RCAS_OUT_D CHECK_BACK_D	0xC2, 0x83, 0x86, 0x84, 0x9F
Totalisator	**TOTAL**	**0x42, 0x84, 0x85, 0x81**

Function Block	Parameter	Identification Format for Multi-Variable devices
	TOTAL SET_TOT	0xC2, 0x80, 0x84, 0x85, 0x83
	TOTAL SET_TOT MODE_TOT	0xC2, 0x81, 0x84, 0x85, 0x87
Not used		0x00

Table 76. Identification Formats for Modules of Multi-Variable Devices

10.3.3 DDLM_GET_CFG

This service delivers the current CFG-DATA (i.e. the order of the cyclic data in the DDLM_DATA-EXCHANGE service) of the device (see 10.3.2). The device shall return the bold marked identifier before first configuration.

10.3.4 DDLM_SET_PRM

This service can be used to initialise parameters with application specific values. The User_Prm_Data of this service are defined in /IEC 61158/ and may have manufacturer specific additions which are described in manufacturer-specific "GSD" files. This profile does not define any User_Prm_Data.

IEC 61158 specifies 3 bytes User_Prm_Data with specific definitions regarding the PROFIBUS-DP. For compatibility reasons devices should accept User_Prm_Data_Len = 0 and User_Prm_Data_Len = 3. The following definitions are valid for devices according to this profile specification:

GSD Revision	GSD key word DPV1-Slave	GSD key word MS1-RW-Support	User_Prm_Data bit DPV1_Enable (valid for MS1 connection only)	Comments
2 *	- (not available)	- (not available)	0 (False)	MS2 connection available
3	0 (False)	0 (False)	0 (False)	Devices without acyclic MS1 and MS2 connections, Devices have not to support DPV1 specific User_Prm_Data
3	1 (True)	0 (False)	0 (False)	Devices without acyclic MS1 connection, Devices have to support DPV1 specific User_Prm_Data
3	0 (False)	1 (True)	Error in GSD	This device configuration isn't valid
3	1 (True)	1 (True)	1 (True)	Devices with acyclic MS1 connection, acyclic MS1 connection will be opened
3	1 (True)	1 (True)	0 (False)	Devices with acyclic MS1 connection, acyclic MS1 connection will not be used

Table 77. DPV1_Enable of User_Prm_Data Definition

Device getting User_Prm_Data which are not in line with the definition of Table 77 shall set a diagnosis Diag_Prm_Fault.

10.3.5 MS2_READ

This service is used to read block parameters with an acyclic or cyclic attribute. The address is defined by Slot and Index number. The values of the Slot and Index number for a parameter in a block can be calculated using the directory object.

10.3.6 MS2_WRITE

This service is used to write block parameters with an acyclic or cyclic attribute. The address is defined by Slot and Index number. The values of the Slot and Index number for a parameter in a block can be calculated using the directory object.

10.3.7 MS1_READ

If MSAC1_READ is supported then the same mapping rules as defined for MSAC2_READ are valid. The support of MSAC1_READ is optional. The GSD definitions have to be considered.

10.3.8 MS1_WRITE

If MSAC1_WRITE is supported then the same mapping rules as defined for MSAC2_ WRITE are valid.

The support of MSAC1_WRITE is optional. The GSD definitions have to be considered.

10.3.9 DDLM_SLAVE_DIAG

The service parameters indicate standardised diagnosis information /IEC 61158/ as well as module specific diagnosis one after the DIAG_STATUS of the DATA_EXCHANGE service has been active. The Physical Block parameter DIAGNOSIS is mapped onto the DDLM_SLAVE_DIAG service parameter. If one bit of the DIAGNOSIS parameter is changed then the DIAG_STATUS is set. The 4 bytes of the DIAGNOSIS parameter is transferred with the DDLM_SLAVE_DIAG service with the following syntax [DPV1]:

Byte	DPV1 name	Bit	Value	Info
1 - 6			DDLM_SLAVE_DIAG	
7	Header	7	0	fixed
		6	0	fixed
		5 - 0	0x08 or optional	block length
8	Status_Type	7	1	Status
		6 - 0	126	Highest manufacturer specific status. Not used in future
9	Slot_Number		Slot Number of PB	The PB contains Diagnosis
10	Specifier	7 - 2	reserved	
		1 - 0	1: Status appears 2: Status disappears	Depends on the content of Diagnosis
11 - 14			Diagnosis	

Table 78. Mapping of DIAGNOSIS into DDLM_SLAVE_DIAG Service Data Structure

10.3.9.1 Status Appears and Status Disappears

The following table shows how to treat the bits "status appears" and "status disappears".

Bit in DIAGNOSIS or DIAGNOSIS_EXTENSION or set synchronously because of the same diagnostic event	Other Bit in DIAGNOSIS or DIAGNOSIS_EXTENSION or set synchronously because of the same diagnostic event	Status disappears	Status appears
0	0	0	0
0 -> 1	*	0	1
1 -> 0	0	1	0
*	0 -> 1	0	1
1 -> 0	1	1	0
0	1 -> 0	1	0

* : does not matter (state 0 or 1 or transition 0->1 or 1->0)

Table 79. Status Appears / Disappears

This means in short terms:

- The default position for the bits status appears and status disappears is 0.
- Every new event is indicated as status appears despite whether there was one before or has gone another. (status appears has higher priority than status disappears)
- If one or more events have gone and no new one has appeared this will be indicated as status disappears.

10.3.10 DDLM_SET_SLAVE_ADD

Slave Devices conforming to this profile revision have to support the DP service DDLM_SET_SLAVE_ADD. If these devices also have a hardware switch to select a bus address the following rules have to be followed:

1. If the hardware switch provides a valid address this address is used by the device. DDLM_SET_SLAVE_ADD is refused by the device.
2. If the hardware switch provides an invalid address it is interpreted as not present. DDLM_SET_SLAVE_ADD is permitted by the device.
3. If the hardware switch is shifted from an invalid address to a valid address the device takes over the hardware selected address.
4. If the hardware switch is shifted from a valid address to an invalid address the device takes over the default address 126. Parameter NO_ADD_CHG will be reseted.
5. Physical Block parameter FACTORY_RESET code 2712 will reset an address set by DDLM_SET_SLAVE_ADD (even if NO_ADD_CHG is set).

An address is valid if the value provided by the switch is within the valid range (<=125).

An address is invalid if the value provided by the switch is outside the valid range (>125).

Additionally the validity of the address can be provided by other means (e.g. additional switch).

10.4 Loss of Cyclic Communication

Loss of cyclic communication is the event, that the DP watchdog timer expires due to missing cyclic Data Exchange to the DP-Master.

During New-start-up and Re-start-up and failure and loss of cyclic communication, the status of parameter with attribute I (input) and cyc (cyclic), which are in DDLM_DATA_EXCHANGE service configured currently, shall set to "BAD – no communication LUV" for cyclic communication loss and to "BAD – no communication no value" for New-start-up and Re-start-up. A prerequisite is, that the DP watch dog is configured.

10.5 Communication Relationship

The connections access points (SAPs) between master class 1 and 2 and DP slaves as well as the allowed services is defined in /IEC 61158/.

A device compliant with this profile shall provide 1 Master/Slave acyclic Class 2 (MS2 relationship) communication relationship in minimum.

/DPV1 figure 2/ specifies the use of different logical applications in one device in terms of the initiate service parameter API (Application Programming Interface). The V 3.01 profile defines, that the PA FB application is reachable under API = 0 and SCL=0 only, i.e. the initiate service parameter API should be API=0 and SCL=0. The API as well as SCL numbers 1 <= API/SCL <= 127 are reserved for future profile use. API/SCL numbers higher than 127 are manufacturer specific.

The Initiate parameters Profile_Ident_Number and Profile_Feature_Supported are defined for devices according to this profile as described in Table 80 additionally. The device has to answer with these values of the Profile_Ident_Number and Profile_Feature_Supported parameters independent what the initiate.req values of these parameters contain, if the initiate.req PDU fulfill the DPV1 definition.

Initiate parameter	Value
Profile_Ident_Number	0x9700
Profile_Feature_Supported	0x0000

Table 80. Initiate Parameter Values

10.6 Default Values for Communication Parameters (Bus Parameters)

10.6.1 RS485

The default communication parameters are a result of a PROFIBUS-Nutzerorganisation e.V. (PNO) working group. These parameters are the basis for a communication between PROFIBUS station without addition configuration (except the station address) at layer 2. Optimisation can be done for specific application purposes. The parameter definition is available in the GSD files.

10.6.2 IEC61158-2 MBP Communication

The default communication parameters are a result of the PROFIBUS-Nutzerorganisation e.V. (PNO) working group DP specification. These parameters are the basis for a communication between a PROFIBUS station without additional configuration (except the station address) at layer 2. Optimisation can be done for specific application purposes. The parameter definition is available in the GSD files.

11 Mapping of the Profile to PROFIBUS-DP - Profile Specific Communication Definition

11.1 Ident Number

The profile provides it's own Ident_Numbers for the devices. The classification are as follows:

Device Classification

• Transmitter	0x9700 to 0x970f
• Actuator	0x9710 to 0x971f
• Discrete_Input	0x9720 to 0x972f
• Discrete_Output	0x9730 to 0x973f
• Transmitter AI + TOT	0x9740
• Transmitter 2 AI + TOT	0x9741
• Transmitter 3 AI + TOT	0x9742
• Analyser	0x9750
• Multi_Variable	0x9760
• reserved	all other numbers until 0x977F

Using the Ident_Numbers from 9700 to 9742 the interchangeability regarding the cyclic data exchange is in principle possible. The prerequisite for interchangeability is that the Function Blocks represent the same measurement and actuation type. The interchangeability covers the following cases (basic set of Function Blocks):

- One input or output Function Block per measurement and actuation point (e.g. temperature)
- Devices with more than one channel with one input or output Function Block per measurement and actuation point (e.g. discrete output)
- Specific and fixed combinations of Function Blocks (e.g. flow)

Devices which provide these basic set of Function Blocks should support the according Ident-Number in minimum for interchangeability reasons. If a device offers more then the basic set of Function Blocks, it can be configured as Multi-Variable device additionally.

Devices which have one and more than one FB of the same type should take the following Ident_Numbers:

- lowest significant digit in the Ident_Number 0: 1 FB of the same type, 1: 2 FBs of the same type, ... f: 16 FBs of the same type

11.2 GSD File Names

The name of the GSD files is combined out of

- PA_x*
- Ident_Number (9700 ... 970f, 9710 ...)
- .gsd

x* - Version number of the GSD language specification, i.e. x = 2 for GSD V2 and x = 3 for GSD V3.
For instance, the GSD file name for Transmitter with one AI FB only is "PA_29700.gsd".
The profile GSD files are available at the PNO server.

12 Mapping of the Profile to PROFIBUS-DP - Conformance Statements

Item	Conformance Statement	Subelemente
Communication Relationships	M	
MSCY		M
MSAC_C1		O
MSAC_C2		M

Table 81. Conformance Requirements for Communication Capabilities

13 Mapping of the Profile to PROFIBUS-DP - GSD-Files

The GSD files according to the definition of this mapping are actual available at the PNO web server.

There are no restrictions for manufacturer specific GSD except those coming from the IEC 61158 definitions.

It is recommended to use only data types which have appropriate definitions in this document.

Profile GSD must cover all devices so sometimes there are features described in the Profile GSD that a device can’t fulfil. E. g. with RS-485 transmission some devices do not support the higher baud rates. Or a device does not support the maximum length of acyclic data written down in the Profile GSD etc.

14 Mapping of the Profile to PROFIBUS-DP - Document History

Changes from V3.0 to V3.0.1

Chapter/Figure/Table	Change
Cover, Header, Footer	Update of date and version
9.1	Physical Block shall be located in Slot 0 for all devices. Old clause 6 deleted.
9.2	Correction of figures concerning allocation and sequence of Blocks, first and last index
9.3	Description of status of an optional not implemented cyclic parameter added.
9.4.3/Table 69	Footnote added concerning Link Object
9.4.3	Sentence added: PB_ID, TB_ID and FB_ID is defined as position of the corresponding block in the Composite_Directory_Entries of the according Block Object type (see 2nd element of the Block structure DS-32) starting with 1.
9.4.4.1/Figure 22 9.4.4.2/Figure 23	PB located in Slot 0
10.2/Table 70	Adaptation of the table header to the terms of IEC 61158,
10.2/Table 70	Access - Invalid range: Additional description if an invalid selection of an enumeration or a value is tried to be written which is out of a range of valid values.
10.2/Table 70	Better definition of Access – temporal invalid: The requested service can not be carried out because it is temporally not possible (not valid) in the current state of the device.
10.3.7 and 10.3.8	MSAC1 services are optional.
10.3.9.1	New chapter to clarify the treating of status disappears and status appears in DDLM_SLAVE_DIAG.
10.3.10	Clarification of the rules if a hardware switch is implemented to select the bus address.
10.3.11	Chapter Alarm handling deleted
10.3.12	Chapter Download deleted
13	Addtitional hints and recommendations concerning manufacturer specific and profile GSDs

Table 82: Changes from V3.0 to V3.0.1

PROFIBUS - PA

Device Data Sheet
Transmitter

15 Device Data Sheet Transmitter

15.1 Additional Parameters for the Physical Block Parameter Description

There are no additional parameters. First manufacturer specific block may start at Relative Index 33.

15.2 Analog Input Function Block

15.2.1 Analog Input Function Block Overview

Analog Input Function Blocks represent transmitters. The parameters are shown in Figure 26.

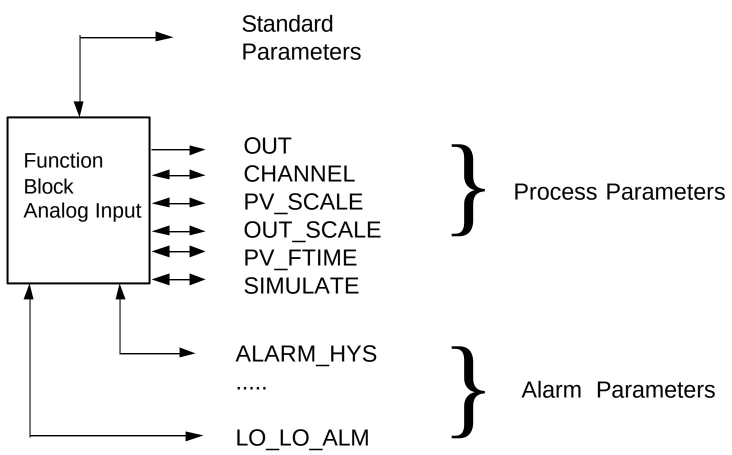


Figure 26. Summary of the Parameters of Analog Input Function Block

The structure of the MODE and the simulation feature of the AI is shown in Figure 27.

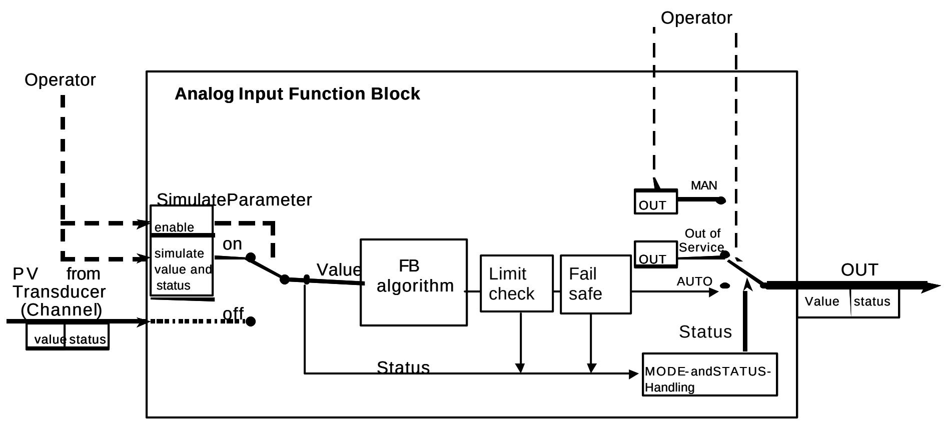


Figure 27. Simulation, Mode and Status Diagram of the Analog Input Function Block

The structure of the AI with Simulation, Mode and Status is shown in Figure 27. More details about the relationships between the AI parameters are visible in Figure 28.

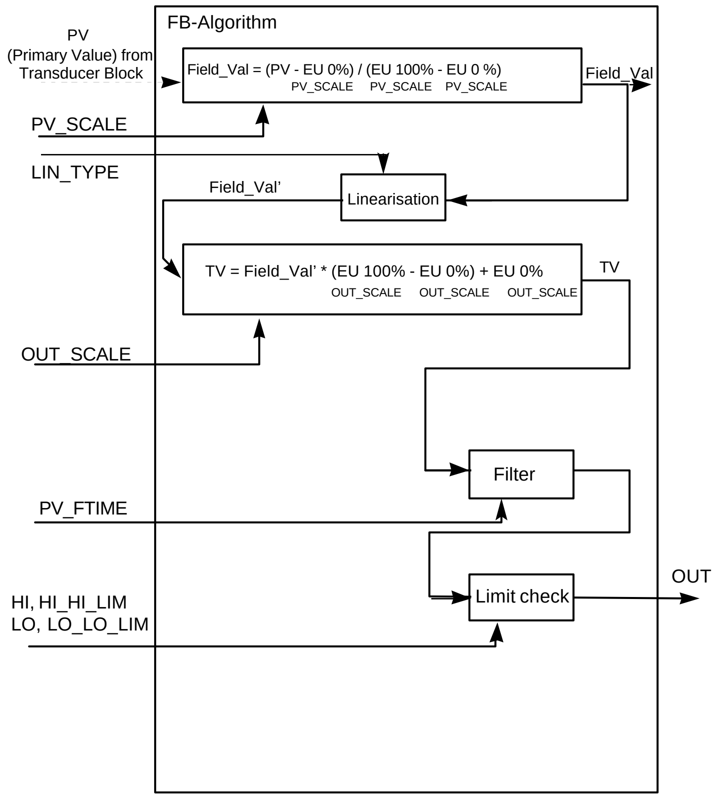


Figure 28. Parameter Relationship of AI FB

The following figure presents a summary of the inputs and outputs of the Mode- and Status-generation.

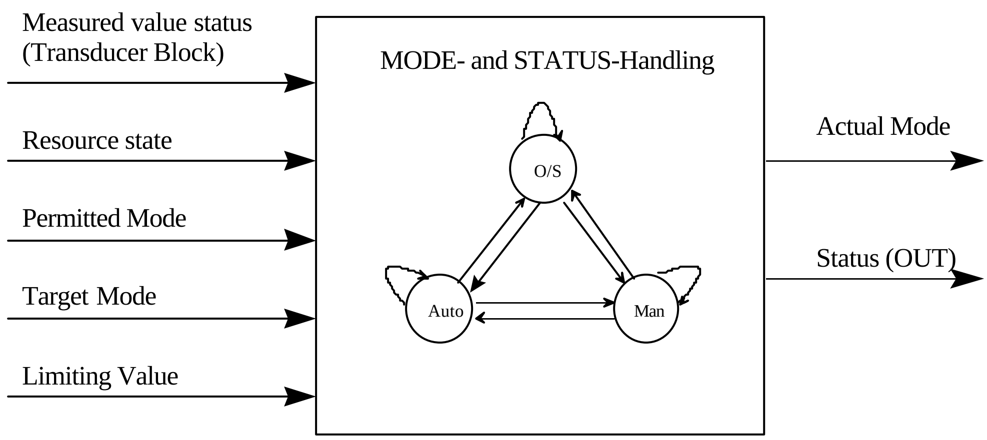


Figure 29. Conditions of Mode and Status Generation

The measurement value status delivered by the Transducer Block to the Function Block across the Channel is one of the input of the MODE calculation. The Resource state describing the health of the device in general is not explicitly defined in the profile i.e. it is device specific and not presented in a parameter, but the Resource state has to distinguish between *ok* and *not o.k.* in minimum. Device state *not ok* means, that there is an failure in the device, which is not covered in the DIAGNOSIS parameter of the Physical Block or in the status byte of the OUT parameter of this AI and the device is not able to able to work properly. Permitted and Target Mode are attributes from the FB-Parameter MODE_BLK. The Target Mode is set by the operator and the permitted Mode according to the block vendor in this specification (Figure 29). Also the high and low limiting value (HI_LIM, HI_HI_LIM, LO_LIM, LO_LO_LIM), regarding the output value, influences the status of the output.

Actual Mode is an attribute of the FB-Parameter MODE_BLK and the result of the mode calculation. The Status (Out) is coupled with the Out parameter (DS 33) of the block.

15.2.1.1 AI State Machine

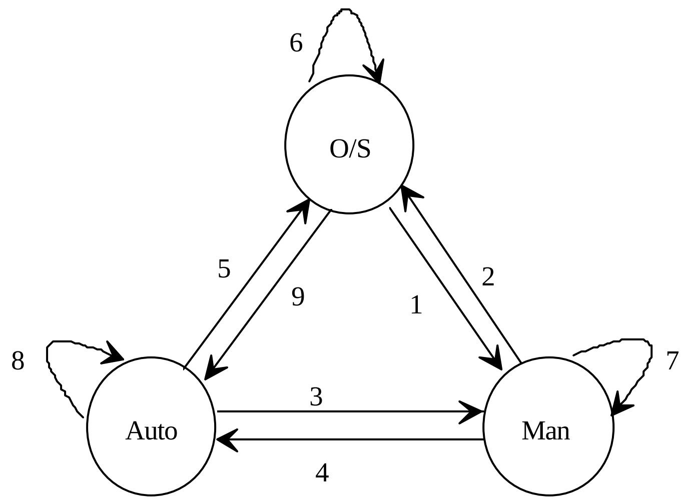


Figure 30. State Machine of the Analog Input Function Block

The possible transitions are illustrated in Figure 30. The MODEs have the following meanings:

O/S	The AI FB is not able to fulfil its functional calculations anymore (e.g. the parameter values in the non-volatile memory are not accessible after a reset).
MAN	The operator writes directly the OUT parameter of the AI FB.
AUTO	The AI FB processes the value from the transmitter (PV) according all algorithms (scaling, filtering, status and mode calculation, limit checks).

The modes O/S (Out of Service), MAN (Manual) and AUTO (Automatic) are mandatory as permitted modes for AI FBs according to conformance class B.

15.2.1.2 Conditions on which the Actual Mode is calculated and the Target Mode is changed

The following table contains on the left side all conditions which demand a mode change from the Actual Mode (last execution) to the new Actual and Target Mode of the AI-Function Block. The results of the calculation are illustrated on the right side.

The first column contains the number of the transition of the state machine in Figure 30.

General condition: permitted modes are O/S (OUT value last usable value or fail safe value), Man (OUT value provided by the operator), Auto (OUT value provided by the device)

Conditions			Results
Transition	Target-Mode (Operator)	Resource State	Actual Mode (calculated)
T2,T5,T6	*	<>o.k.	O/S
T2,T5,T6	O/S	o.k.	O/S
T4,T8,T9	Auto	o.k.	Auto
T1,T3,T7	Man	o.k.	Man

* no influence

Table 83. Conditions and Results of the Actual Mode calculation

15.2.1.3 Conditions on which the Output Status is generated

The following table shows which conditions influence the Status of the output parameter. The conditions are illustrated on the left side and the results of the calculation on the right.

Conditions		result
Actual-Mode	Status (Transducer input)	Status (Out)
O/S	*	BAD-Out of Service high limited = low limited = 1
Man	*	as written by the operator
Auto	BAD	Influenced by the following parameter • FSAFE_TYPE
Auto	<> BAD	Influenced by the following parameter • PV Sub status • Alarms (ST_REV, Limits) • Priority table of status (see General Requirements)

* no influence

Table 84. Conditions and Results of the Status Calculation of the Output Parameter

15.2.2 Parameter Description of the Analog Input Function Block

Parameter	Description
OUT	The Function Block parameter OUT contains the current measurement value in a vendor specific or configuration adjusted engineering unit and the belonging state in AUTO MODE. The Function Block parameter OUT contains the value and status set by an operator in MAN MODE.
PV_SCALE	Conversion of the Process Variable into percent using the high and low scale values. The engineering unit of PV_SCALE high and low scale values are directly related to the PV_UNIT of the configured Transducer Block (configured via Channel parameter). The PV_SCALE high and low scale values follow the changes of the PV_UNIT of the related Transducer Block automatically, i.e. a change of the Transducer Block PV_Unit causes no bump at OUT from AI. There are exceptions possible where the bumb is required such as cleaning of analysers.
OUT_SCALE	Scale of the Process Variable. The Function Block parameter OUT_SCALE contains the values of the lower limit and upper limit effective range, the code number of the engineering unit of Process Variable and the number of digits on the right hand side of the decimal point.
LIN_TYPE	Type of linearisation. For details see 3.8.1, Table Table 54.
CHANNEL	Reference to the active Transducer Block which provides the measurement value to the Function Block. For more details, please see the General Requirement definitions.
PV_FTIME	Filter time of the Process Variable. The Function Block parameter PV_FTIME contains the time constant for the rise time of the FB output up to a value of 63,21 % resulted from a jump on the input (PT1 filter). The engineering unit of the parameter is second.
FSAFE_TYPE	Defines the reaction of device, if a fault is detected. The calculated ACTUAL MODE remains in AUTO. 0: value FSAFE_VALUE is used as OUT Status - UNCERTAIN_Substitute Value, 1: use last stored valid OUT value Status - UNCERTAIN_LastUsableValue if there is no valid value available, then UNCERTAIN-Inital_Value, OUT value is = Initial value 2: OUT has the wrong calculated value and status Status - BAD_* (* as calculated)
FSAFE_VALUE	Default value for the OUT parameter, if a sensor or sensor electronic fault is detected. The unit of this parameter is the same like the OUT one.

Parameter	Description
ALARM_HYS	Hysteresis Within the scope of the PROFIBUS-PA specification for transmitters there are functions for the monitoring of limit violation (off-limit conditions) of adjustable limits. Maybe the value of one process variable is just the same as the value of a limit and the variable fluctuates around the limit it will occur a lot of limit violations. That triggers a lot of messages; so it must be possible to trigger messages only after crossing an adjustable hysteresis. The sensitivity of triggering of the alarm messages is adjustable. The value of the hysteresis is fixed in ALARM_HYS and is the same for the parameters HI_HI_LIM, HI_LIM, LO_LIM and LO_LO_LIM. The hysteresis is expressed as value below high limit and above low limit in the engineering unit of xx_LIM.
HI_HI_LIM	Value for upper limit of alarms Upper limit value for alarms with the same engineering unit of the OUT parameter. If the measured variable is equal or higher than the upper limit value the State Bits in the State Byte of OUT and in the FB parameter ALARM_SUM have to change to 1. The unit of this parameter is the same like the OUT one.
HI_LIM	Value for upper limit of warnings Upper limit value for warnings with the same engineering unit of the OUT parameter. If the measured variable is equal or higher than the upper limit value, the State Bits in the State Byte of OUT and in the FB parameter ALARM_SUM have to change to 1. The unit of this parameter is the same like the OUT one .
LO_LIM	Value for lower limit of warnings Lower limit value for warnings with the same engineering unit of the OUT parameter. If the measured variable is equal to or lower than the lower limit value, the State Bits in the State Byte of OUT and in the FB parameter ALARM_SUM have to change to 1. The unit of this parameter is the same like the OUT one.
LO_LO_LIM	Value for the lower limit of alarms Lower limit value for alarms with the same engineering unit of the OUT parameter. If the measured variable is equal to or lower than the lower limit value, the State Bits in the State Byte of OUT and in the FB parameter ALARM_SUM have to change to 1. The unit of this parameter is the same like the OUT one.
HI_HI_ALM	State of the upper limit of alarms This parameter contains the state of the upper limit of an alarm and the related time stamp. The time stamp expresses the time the measured variable has been equal or higher than the upper limit of the alarm. Devices without clock use the beginning of the PROFIBUS-PA time (1st January 1984) as time stamp. See 3.7.7.
HI_ALM	State of the upper limit of warnings This parameter contains the state of the upper limit of a warning and the related time stamp. The time stamp expresses the time the measured variable has been equal or higher than the upper limit of the warning. Devices without clock use the beginning of the PROFIBUS-PA time (1st January 1984) as time stamp. See 3.7.7.

Parameter	Description
LO_ALM	State of the lower limit of warnings This parameter contains the state of the lower limit of a warning and the related time stamp. The time stamp expresses the time at which the measured variable has been equal to or lower than the lower limit of the warning. Devices without clock use the beginning of the PROFIBUS-PA time (1st January 1984) as time stamp. See 3.7.7.
LO_LO_ALM	State of the lower limit of alarms This parameter contains the state of the lower limit of an alarm and the related time stamp. The time stamp expresses the time at which the measured variable has been equal to or lower than the lower limit of the alarm. Devices without clock use the beginning of the PROFIBUS-PA time (1st January 1984) as time stamp. See 3.7.7.
SIMULATE	For commissioning and test purposes the input value from the Transducer Block in the Analog Input Function Block AI-FB can be modified. That means that the Transducer and AI-FB will be disconnected.
OUT_UNIT_TEXT	If a specific unit of OUT parameter is not in the code list (see General Requirement) the user has the possibility to write the specific text in this parameter. The unit code is then equal to “textual unit definition”.

Table 85. Parameter Description of the Analog Input Function Block

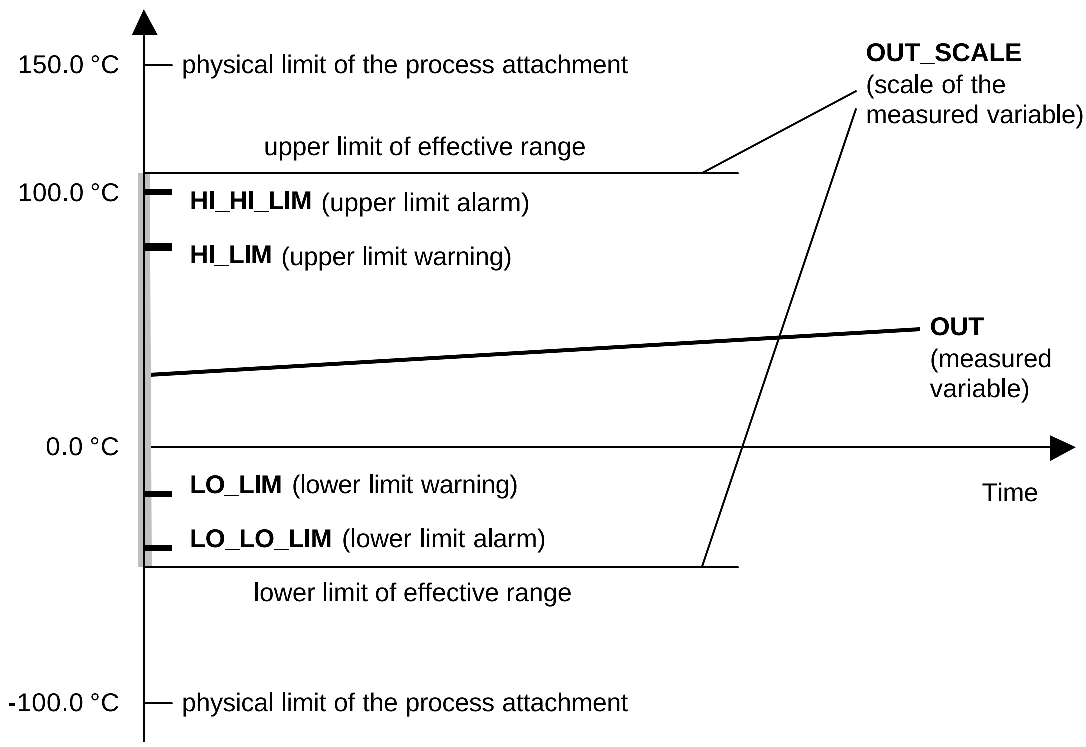


Figure 31. Example for the Use of the Analog Input Function Block Parameters

15.2.3 Parameter Attributes for the Analog Input Function Block

Relative Index	Parameter Name	Object Type	Data Type	Store	Size	Access	Parameter Usage / Kind of Transport	Reset Class	Default Value	Download Order	Mandatory Optional (Class A,B)
... Standard Parameters see General Requirements											
Additional Analog Input Function Block Parameters											
10	OUT	Record	101	D	5	r [1]	O/cyc	-	measured of the variable, state	-	M (A,B)
11	PV_SCALE	Array [2]	Float (*)	S	8	r,w	C/a	F	100,0	1	M (A,B)
12	OUT_SCALE	Record	DS-36	S	11	r,w	C/a	F	100,0,-,-	3	M (B)
13	LIN_TYPE	Simple	Unsigned8	S	1	r,w	C/a	F	0	2 [3]	M (B)
14	CHANNEL	Simple	Unsigned16	S	2	r,w	C/a	F	-	-	M (B)
16	PV_FTIME	Simple	Float	S	4	r,w	C/a	F	0	-	M (A,B)
17	FSAFE_ TYPE [4]	Simple	Unsigned8	S	1	r,w	C/a	F	1	-	O (B)
18	FSAFE_VALUE	Simple	Float	S	4	r,w	C/a	F	-	-	O (B)
19	ALARM_HYS	Simple	Float	S	4	r,w	C/a	F	0.5 % of range	-	M (A,B)
21	HI_HI_LIM	Simple	Float	S	4	r,w	C/a	F	max value	4.1	M (A,B)
23	HI_LIM	Simple	Float	S	4	r,w	C/a	F	max value	4.2	M (A,B)
25	LO_LIM	Simple	Float	S	4	r,w	C/a	F	min value	4.3	M (A,B)
27	LO_LO_LIM	Simple	Float	S	4	r,w	C/a	F	min value	4.4	M (A,B)
30	HI_HI_ALM	Record	DS-39	D	16	r	C/a	-	0	-	O (A,B)
31	HI_ALM	Record	DS-39	D	16	r	C/a	-	0	-	O (A,B)
32	LO_ALM	Record	DS-39	D	16	r	C/a	-	0	-	O (A,B)
33	LO_LO_ALM	Record	DS-39	D	16	r	C/a	-	0	-	O (A,B)
34	SIMULATE	Record	DS-50	S	6	r,w	C/a	F	dis-able	-	M (B)
35	OUT_UNIT_TEXT	Simple	OctetString	S	16	r,w	C/a	-	-	-	O (A,B)
36-44	Reserved by PNO										M (A,B)

[1] The OUT parameter can be written if the AI FB Actual MODE = Man

[2] First Float value: value at EU of 100%, Second Float value: value at EU of 0%

[3] if available

[4] If this parameter is not implemented the AI FB bahaves like FSAFE_TYPE = 1

Relative Index	Parameter Name	Object Type	Data Type	Store	Size	Access	Parameter Usage / Kind of Transport	Reset Class	Default Value	Download Order	Mandatory Optional (Class A,B)
45	First manufacturer specific parameter										O (A,B)

Table 86. Parameter Attributes for the Analog Input Function Block

15.2.4 View Object of the Analog Input Function Block

Relative Index	Parameter Name	View_1	View_2	View_3	View_4
10	OUT	5			
11	PV_SCALE				
12	OUT_SCALE				
13	LIN_TYPE				
14	CHANNEL				
16	PV_FTIME				
17	FSAFE_TYPE				
18	FSAFE_VALUE				
19	ALARM_HYS				
21	HI_HI_LIM				
23	HI_LIM				
25	LO_LIM				
27	LO_LO_LIM				
30	HI_HI_ALM				
31	HI_ALM				
32	LO_ALM				
33	LO_LO_ALM				
34	SIMULATE				
35	OUT_UNIT_TEXT				
	Overall sum of bytes in View-Object (+ 13 Standard parameter bytes)	5 + 13			

Table 87. View Object of the Analog Input Function Block

15.2.5 Additions to the Start-up and Break-down Phase

In addition to the definitions in the General Requirement document the default values defined in Table 86 must be settled at the start-up phase.

15.2.6 Remarks on the Usage of the PV, OUT, and LIMIT Parameters

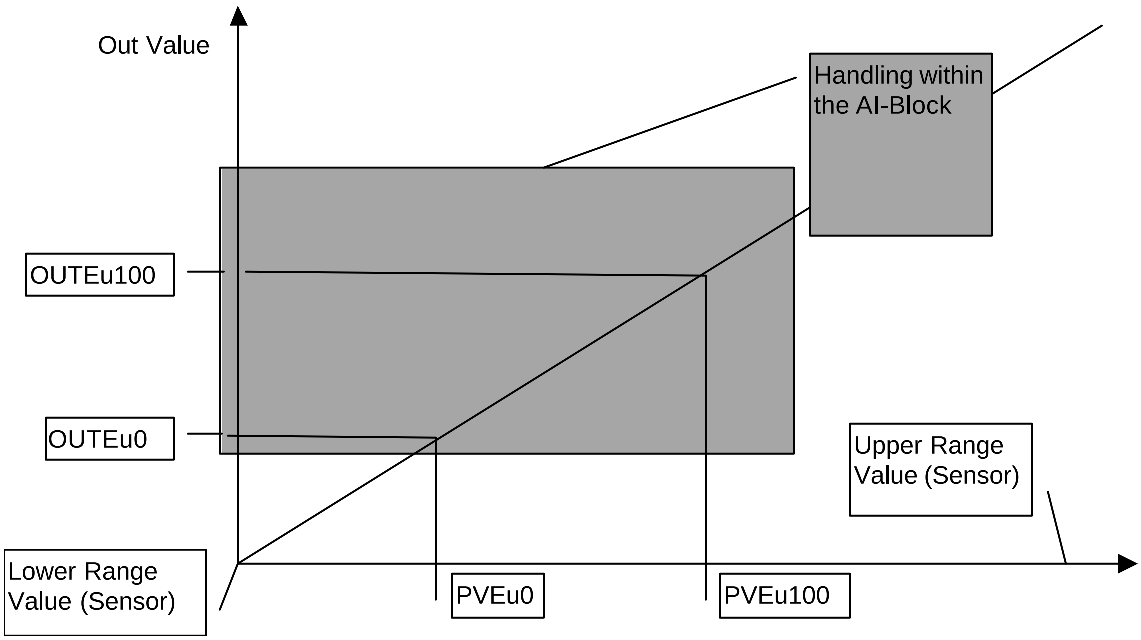


Figure 32. Clarification of scaling parameters

15.3 Totalizer Function Block

15.3.1 Totalizer Function Block Overview

A Totalizer may be used in various applications to integrate („totalize“, accumulate) a rate or another quantity (e.g. flow rate or power) to the corresponding integral (e.g. volume, mass or distance). For instance Totalizers are typically implemented in flow devices to totalize a volume or mass flow to a volume or a mass quantity.

The units for the rate and for the totalized quantity have to match (e.g. if the channel is a mass flow (kg/s), then the totalized quantity has to be a mass kg, g, ton, ...). The unit of the totalized quantity is the integral or compatible (compatible means: g, kg, ton, ... are compatible) to the integral of the channel value unit. All totalized quantity related values (e.g. Hysteresis, Limits) are in the UNIT_TOT.

The Totalizer Function Block can be tailored for different applications using the MODE_TOT parameter. Additionally the FAIL_TOT parameter determines the fail-safe behaviour of this Function Block. The alarm parameters are identical to the parameters of the analog input Function Block and might be also utilised e.g. for a batch functionality. No specific manual, simulation or test modes are defined since with the given control parameters, a defined output of the Function Block may be generated. The default MODE is AUTO, i.e. Permitted Mode is in minimum AUTO and Actual Mode is AUTO too.

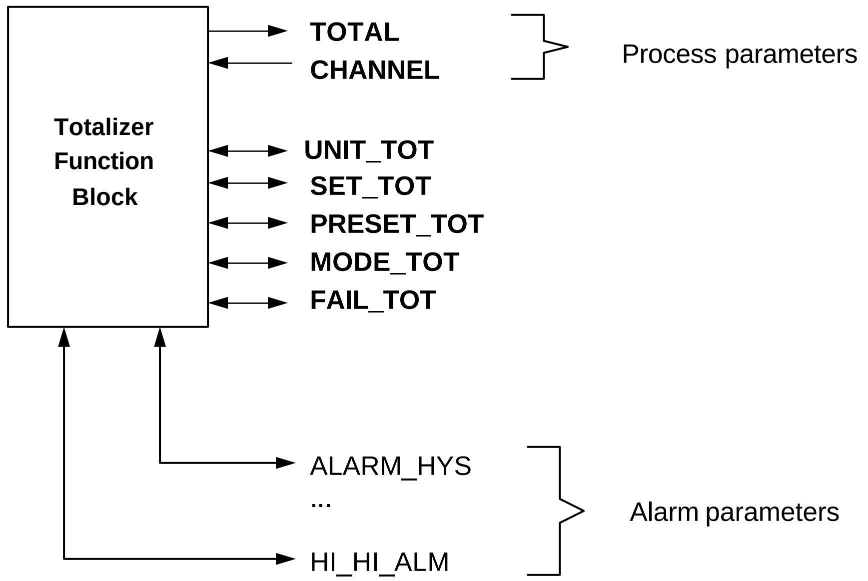


Figure 33. Summary of the Parameters of the Totalizer Function Block

The structure of the Totalizer Function Block and the internal data flow is shown in Figure 34

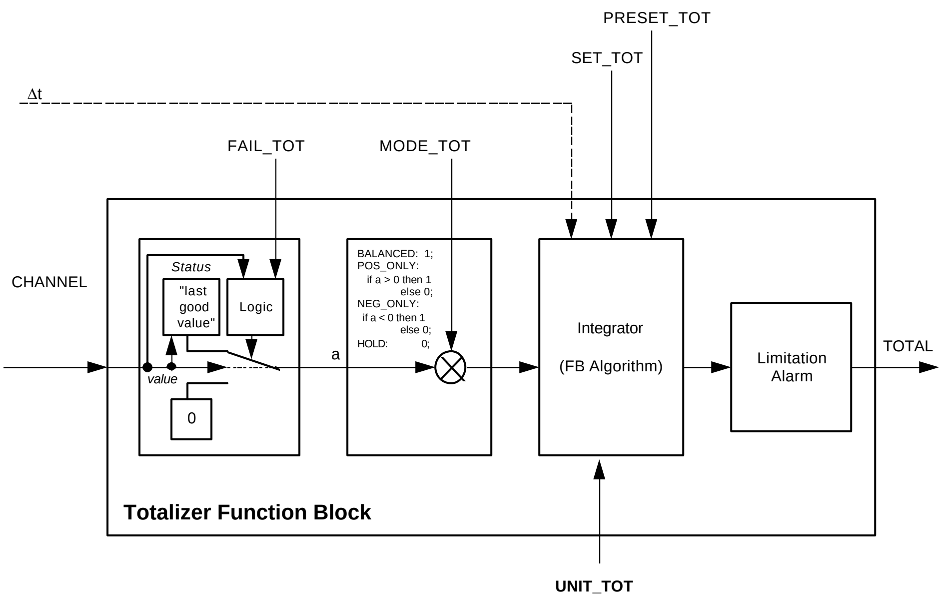


Figure 34. Block Diagram of the Totalizer Function Block

The CHANNEL provides the rate information to the Totalizer, which processes this input in different stages depending on the settings of the control parameters. After passing the first two blocks, which defines the fail-safe behaviour and the operation of the Function Block, the actual Function Block algorithm is entered.

The block „Integrator" accumulates the rate, which represents the measured rate for a specific time interval Δt, to a total quantity. The integration time interval Δt is in general specific to a certain transmitter. Further, it might be constant or it might depend on certain parameters of the transmitter or even the magnitude or the rate. The TOTAL is stored at the event of a power failure by the device in a non-volatile memory and recovered after a following power-up.

The Limitation Alarm affects the status of the output.[1]

15.3.1.1 Totalizer State Machine

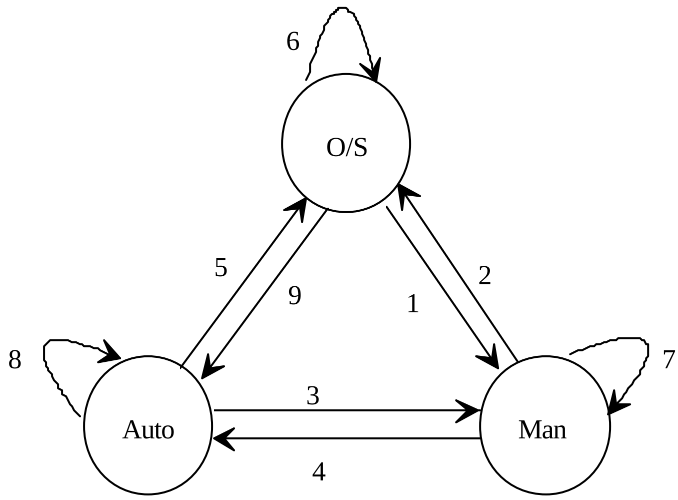


Figure 35. State Machine of the Totalizer Function Block

The possible transitions are illustrated in Figure 35. The MODEs have the following meanings:

- O/S Totalizing is stopped. The Totalizer FB enters this mode without action by the operator if it is not able to fulfil its functional calculations anymore (e.g. the parameter values in the non-volatile memory are not accessible after a reset).
- MAN The TOTAL parameter of the Totalizer FB is disconnected from the Integrator Block. The operator can write direct to the TOTAL parameter. Nevertheless the Integrator Block continues totalizing according to the FB configuration.
- AUTO The Totalizer FB processes the value from the transmitter (PV) according all algorithms (totalizing, status and mode calculation, limit checks).

The modes O/S (Out of Service), MAN (Manual) and AUTO (Automatic) are mandatory as permitted modes for Totalizer FBs according to conformance class B.

[1] Same as the analog input block.

15.3.1.2 Actual Mode Calculation

The Actual Mode of the Totalizer Function Block depends on the parameter TARGET_MODE and internal state of the Function Block. The following table contains on the left side all conditions which demand a mode change of Totalizer Function Block. The results of the calculation are illustrated on the right side.

Conditions			Results
Transition	**Target-Mode (Operator)**	**Resource State**	**Actual Mode (calculated)**
T2,T5,T6	*	<>o.k.	O/S
T2,T5,T6	O/S	o.k.	O/S
T4,T8,T9	AUTO	o.k.	AUTO
T1,T3,T7	MAN	o.k.	MAN

* no influence

Table 88. Conditions and Results of the Actual Mode Calculation

The first column contains the number of the transition of the state machine in Figure 35.

General conditions:

- permitted modes are O/S (TOTAL value is last usable value or fail safe value), MAN (TOTAL value is provided by the operator), AUTO (TOTAL value is provided by the device).
- normal mode is AUTO mode.

15.3.1.3 Status Calculation

The following table shows the conditions which influence the status of the TOTAL parameter. The conditions are illustrated on the left side and the results of the calculation on the right.

Actual Mode	Status (Input) Quality	SET_TOT	MODE_TOT	FAIL_TOT	F-Block State	Result (****) Status (TOTAL) Quality	Sub-Status	Limit
O/S	*	*	*	*	*	BAD	Out of Service	const.
MAN	*	*	*	*	*	as written by the operator		
AUTO	*	*	*	*	hardware defect	BAD	Device Failure	ok.
	*	*	*	*	inconsistent unit	BAD	Configuration Error	ok.
	*	<> TOTALIZE	*	*	ok. (***)	UNCERTAIN	Initial Value	const. (**)
	*	TOTALIZE	HOLD	*	ok. (***)	last status is frozen before MODE_TOT is set to HOLD		const. (**)
	BAD	TOTALIZE	<> HOLD	HOLD	ok. (***)	UNCERTAIN	Last Usable Value	const. (**)
	BAD	TOTALIZE	<> HOLD	MEM	ok. (***)	UNCERTAIN	Non Specific	ok. (**)
	BAD	TOTALIZE	<> HOLD	RUN	ok. (***)	UNCERTAIN	Non Specific	ok. (**)
	UNCERTAIN	TOTALIZE	<> HOLD	*	ok. (***)	Influenced (device specific) by • PV Sub status • Update Event • Limit Check • Priority table of status (see General Requirements)		
	GOOD	TOTALIZE	<> HOLD	*	ok. (***)	Influenced (device specific) by • PV Sub status • Update Event • Limit Check • Priority table of status (see General Requirements)		

Table 89. Conditions and Results of the Status Calculation for TOTAL Parameter

(*) no influence (don't care)

(**) Limit might be changed to „high limited" or „low limited" according to the Totalizer Limit Check

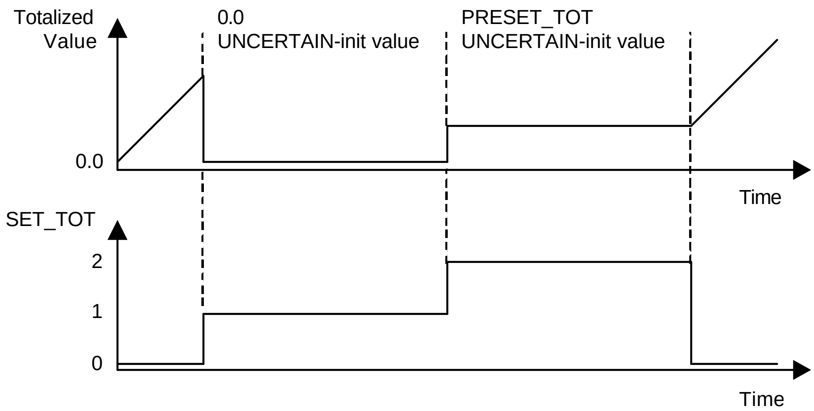
(***) ok. means no hardware defect and no inconsistent unit configured for UNIT_TOT

(****) under the following conditions the status is fixed to UNCERTAIN - Non Specific

- previous status was UNCERTAIN or BAD and
- calculated status according to Table 89 is GOOD

Status is not fixed if it is set to UNCERTAIN because SET_TOT <> TOTALIZE (i.e. no additional actions are required to acknowledge the status if SET_TOT changes to TOTALIZE from RESET or PRESET).

15.3.2 Parameter Description of the Totalizer Function Block

Parameter	Description
TOTAL	The Function Block parameter TOTAL contains the integrated quantity of the rate parameter provided by CHANNEL and the associated status.
UNIT_TOT	Unit of the totalized quantity.
CHANNEL	Reference to the active Transducer Block, which provides the measurement value to the Function Block.
SET_TOT	Reset of the internal value of the FB algorithm to 0 or set this value to PRESET_TOT. The Function Block parameter SET_TOT affects the current totalized value immediately. This function is level sensitive. While SET_TOT is set to RESET or PRESET, the status of the totalized value shall be UNCERTAIN-initial value. The parameter TOTAL is affected if the block is in AUTO mode.  The following selections of this Function Block parameter are possible: 0: TOTALIZE; „normal“ operation of the Totalizer 1: RESET; assign value „0“ to Totalizer 2: PRESET; assign value of PRESET_TOT to Totalizer
MODE_TOT	This Function Block parameter governs the behaviour of the totalization. The following selections are possible: 0: BALANCED; true arithmetic integration of the incoming rate values. 1: POS_ONLY; totalization of positive incoming rate values only. 2: NEG_ONLY; totalisation of negative incoming rate values only. 3: HOLD; totalisation stopped.
FAIL_TOT	Fail-safe mode of the Totalizer Function Block. This parameter governs the behaviour of the Function Block during the occurrence of input values with BAD status. The following selections are possible: 0: RUN ; totalisation is continued using the input values despite the BAD status. The status is ignored. 1: HOLD; totalisation is stopped during occurrence of BAD status of incoming values. 2: MEMORY; totalisation is continued based on the last incoming value with GOOD status before the first occurrence of BAD status.

Parameter	Description
PRESET_TOT	This value is used as a preset for the internal value of the FB algorithm. The value get effective if using the SET_TOT function.
ALARM_HYS	Hysteresis Within the scope of the PROFIBUS-PA specification for transmitters there are functions for the monitoring of limit violation (off-limit conditions) of adjustable limits. Maybe the value of one process variable is just the same as the value of a limit and the variable fluctuates around the limit it will occur a lot of limit violations. That triggers a lot of messages; so it must be possible to trigger messages only after crossing an adjustable hysteresis. The sensitivity of triggering of the alarm messages is adjustable. The value of the hysteresis is fixed in ALARM_HYS and is the same for the parameters HI_HI_LIM, HI_LIM, LO_LIM and LO_LO_LIM. The hysteresis is expressed as value below high limit and above low limit in the engineering unit of xx_LIM.
HI_HI_LIM	Value for upper limit of alarms Upper limit value for alarms with the same engineering unit. If the measured variable is equal or higher than the upper limit value the State Bit in the State Byte of TOTAL and in the FB parameter ALARM_SUM have to change to 1.
HI_LIM	Value for upper limit of warnings Upper limit value for warnings with the same engineering unit. If the measured variable is equal or higher than the upper limit value, the State Bit in the State Byte of TOTAL and in the FB parameter ALARM_SUM have to change to 1.
LO_LIM	Value for lower limit of warnings Lower limit value for warnings with the same engineering unit. If the measured variable is equal to or lower than the lower limit value, the State Bit in the State Byte of TOTAL and in the FB parameter ALARM_SUM have to change to 1.
LO_LO_LIM	Value for the lower limit of alarms Lower limit value for alarms with the same engineering unit. If the measured variable is equal to or lower than the lower limit value, the State Bit in the State Byte of TOTAL and in the FB parameter ALARM_SUM have to change to 1.
HI_HI_ALM	State of the upper limit of alarms This parameter contains the state of the upper limit of an alarm and the related time stamp. The time stamp expresses the time the measured variable has been equal or higher than the upper limit of the alarm. Devices without clock use the beginning of the PROFIBUS-PA time (1st January 1992) as time stamp. See 3.7.7.
HI_ALM	State of the upper limit of warnings This parameter contains the state of the upper limit of a warning and the related time stamp. The time stamp expresses the time the measured variable has been equal or higher than the upper limit of the warning. Devices without clock use the 1st January 1992 as time stamp. See 3.7.7.

Parameter	Description
LO_ALM	State of the lower limit of warnings This parameter contains the state of the lower limit of a warning and the related time stamp. The time stamp expresses the time at which the measured variable has been equal to or lower than the lower limit of the warning. Devices without clock use the 1st January 1992 as time stamp. See 3.7.7.
LO_LO_ALM	State of the lower limit of alarms This parameter contains the state of the lower limit of an alarm and the related time stamp. The time stamp expresses the time at which the measured variable has been equal to or lower than the lower limit of the alarm. Devices without clock use the 1st January 1992 as time stamp. See 3.7.7.

Table 90. Parameter Description of the Totalizer Function Block

15.3.3 Parameter Attributes of the Totalizer Function Block

Relative Index	Parameter Name	Object Type	Data Type	Store	Size	Access	Parameter Usage / Kind of Transport	Reset Class	Default Value	Download Order	Mandatory Optional (Class A,B)
... Standard Parameters see General Requirements											
Additional Totalizer Function Block Parameters											
10	TOTAL	Record	101	N	5	r	O/cyc	-	0	-	M (A,B)
11	UNIT_TOT	Simple	Unsigned16	S	2	r,w	C/a	F	direct integral of the channel value unit	1	M (A,B)
12	CHANNEL	Simple	Unsigned16	S	2	r,w	C/a	F	-	2	M (B)
13	SET_TOT	Simple	Unsigned8 0: TOTALIZE 1: RESET 2: PRESET	N	1	r,w	I/cyc	F	0: TOTALIZE	-	M (B)
14	MODE_TOT	Simple	Unsigned8 0: BALANCED 1: POS_ONLY 2: NEG_ONLY 3: HOLD	N	1	r,w	I/cyc	F	0: BALANCED	3	M (B)
15	FAIL_TOT	Simple	Unsigned8 0: RUN 1: HOLD 2: MEMORY	S	1	r,w	C/a	F	0: RUN	4	M (B)
16	PRESET_TOT	Simple	Float	S	4	r,w	C/a	F	0	8	M (B)
17	ALARM_HYS	Simple	Float	S	4	r,w	C/a	F	0	5	M (A,B)
18	HI_HI_LIM	Simple	Float	S	4	r,w	C/a	F	max value	6	M (A,B)
19	HI_LIM	Simple	Float	S	4	r,w	C/a	F	max value	7	M (A,B)
20	LO_LIM	Simple	Float	S	4	r,w	C/a	F	min value	9	M (A,B)
21	LO_LO_LIM	Simple	Float	S	4	r,w	C/a	F	min value	10	M (A,B)
22	HI_HI_ALM	Record	DS-39	D	16	r	C/a	-	0	-	O (A,B)
23	HI_ALM	Record	DS-39	D	16	r	C/a	-	0	-	O (A,B)
24	LO_ALM	Record	DS-39	D	16	r	C/a	-	0	-	O (A,B)
25	LO_LO_ALM	Record	DS-39	D	16	r	C/a	-	0	-	O (A,B)
26-35	Reserved by PNO										M (A,B)
36	First manufacturer specific parameter										O (A,B)

Table 91. Parameter Attributes of the Totalizer Function Block

15.3.4 View Object of the Totalizer Function Block

Relative Index	Parameter Name	View_1	View_2	View_3	View_4
10	TOTAL	5			
11	UNIT_TOT				
12	CHANNEL				
13	SET_TOT				
14	MODE_TOT				
15	FAIL_TOT				
16	ALARM_HYS				
17	PRESET_TOT				
18	HI_HI_LIM				
19	HI_LIM				
20	LO_LIM				
21	LO_LO_LIM				
22	HI_HI_ALM				
23	HI_ALM				
24	LO_ALM				
25	LO_LO_ALM				
	Overall sum of bytes in View-Object (+ 13 Standard parameter bytes)	5 + 13			

Table 92. View Object of the Totalizer Function Block

15.3.5 Additions to the Start-up and Break-down Phase

In addition to the definitions in the General Requirement document the default values defined in Table 91 must be settled at the start-up phase.

16 Device Data Sheet Transmitter - Transducer Blocks

The Transducer Blocks contain the measurement specific parameters. There is an selection of measurement principles defined in this profile. The selected principles are marked in the following figure. This overview is in line with the German standard DIN V 19259.

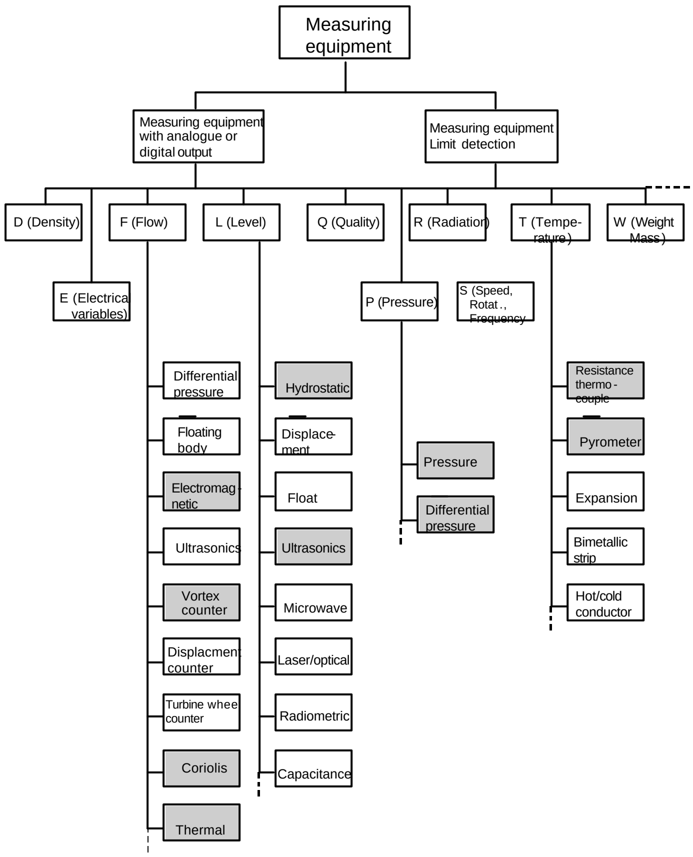


Figure 36. Overview about defined measuring equipment

16.1 Temperature

16.1.1 Temperature Transducer Block Overview

This section describes the specific aspect of temperature measurement used in the process control with three different primary elements, thermocouple, thermoresistance and pyrometer.

16.1.1.1 Thermocouple input

The voltage generated from a thermocouple is compensated with a reference junction value, internal or fixed value EXTERNAL_RJ_VALUE and is a function of the RJ_TYPE parameter .

16.1.1.2 Thermoresistance input

There is the possibility to connect the thermoresistance with 2, 3 and 4 wires. The selection of the internal circuit is chosen by parameter SENSOR_CONNECTION and compensated, if it is a 2 or 3 wires type, by parameter COMP_WIRE1/2.

16.1.1.3 Pyrometer input

The voltage generated from an optical sensor is multiplied by EMISSIVITY factor to relate as a black body. The parameter SPECT_FILT_SET selects the internal optical filters for a specific work-band in the infrared field.

16.1.1.4 Transmitter block

Inputs 1 and 2 the after control of short or open circuit and the range imposed by LOWER_SENSOR_LIMIT and UPPER_SENSOR_LIMIT are linearised in function of parameter LIN_TYPE.

A BIAS_1/2 value is algebraically added to the measuring value.

Input 1 and input 2 are mathematically manipulated in function of parameter SENSOR_MEAS_TYPE to obtain the main measuring value PRIMARY_VALUE.

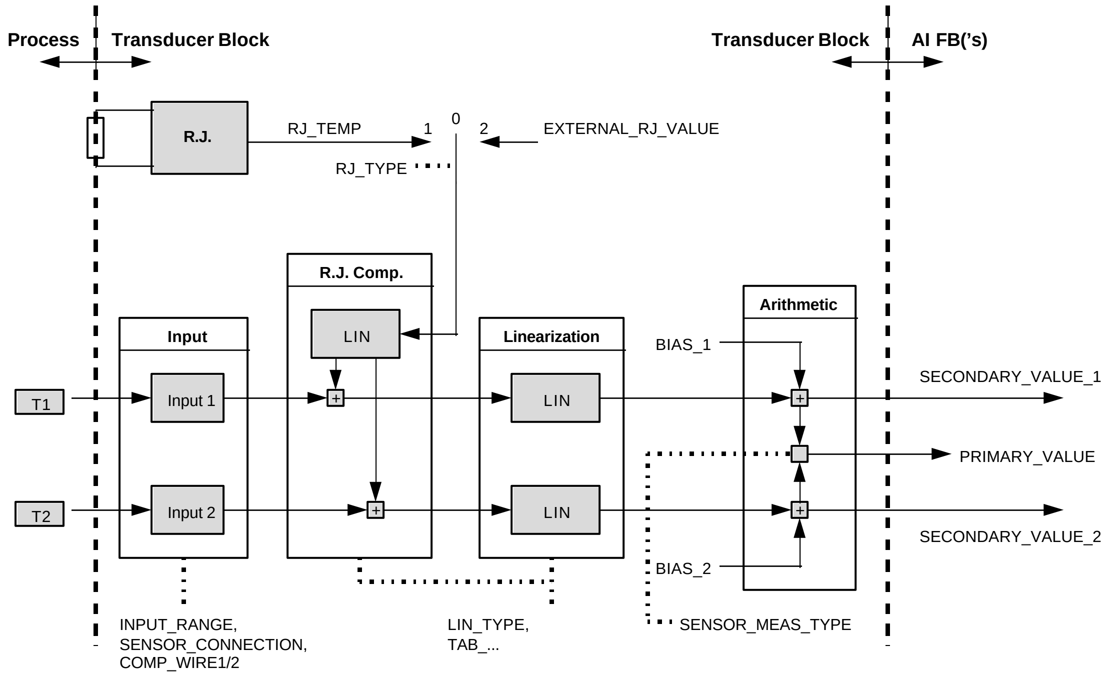


Figure 37. Functional Diagram of the Temperature Transducer Block

In optical pyrometer transducers there is the possibility to have more functions like peak picker detector or track and hold.

16.1.2 Parameter Description of the Temperature Transducer Block

16.1.2.1 Description of the General Parameters of the Temperature Transducer Block

Parameter	Description
BIAS_1	Bias that can be algebraically added to the process value of channel 1. The unit of BIAS_1 is the PRIMARY_VALUE_UNIT.
BIAS_2	Bias that can be algebraically added to the process value of channel 2. The unit of BIAS_2 is the PRIMARY_VALUE_UNIT.
INPUT_FAULT_GEN	Input malfunction: Diagnosis object for errors that concerns all values 0: device OK Bit 0 Rj error Bit 1 Hardware error Bit 2 - 4 reserved Bit 5 - 7 manufacturer specific

Parameter	Description
INPUT_FAULT_1	Input malfunction: Diagnosis object for errors that concern SV_1 0: Input OK Bit 0 underrange Bit 1 overrange Bit 2 lead breakage Bit 3 short circuit Bit 4 - 5 reserved Bit 6 - 7 manufacturer specific
INPUT_FAULT_2	Input malfunction: Diagnosis object for errors that concern SV_2 Bit definition see INPUT_FAULT_1
INPUT_RANGE	Electrical input range and mode. The ranges are manufacturer specific but range n is smaller than range n+1 if more than one range is supported for one input mode (e.g. range1=0...400Ω, range2=0...4kΩ). INPUT_RANGE is equal for channel 1 and 2. Coding (other codes are reserved): 0: mV range 1 1: mV range 2 ... 9: mV range 10 128: Ω range 1 129: Ω range 2 ... 137: Ω range 10 192: mA range 1 193: mA range 2 ... 201: mA range 10 240: manufacturer specific ... 249: manufacturer specific 250: not used 251: none 252: unknown 253: special Remark: When using codes 240..249 (manufacturer specific) interchangeability is not possible.

Parameter	Description
LIN_TYPE	Select the type of sensor (Code) for Thermocouples, Rtd, Pyrometers or linear. For details see 3.8.1, Table Table 54.
LOWER_SENSOR_LIMIT	Physical lower limit function of the sensor (e.g. Pt 100 = -200°C) and input range. In the case of multichannel measurements (e.g. differential measurement) the meaning of LOWER_SENSOR_LIMIT is the limit of one channel and not the calculated limit of both channels. The unit of LOWER_SENSOR_LIMIT is the PRIMARY_VALUE_UNIT.
MAX_SENSOR_VALUE_1	Holds the maximum SECONDARY_VALUE_1. The unit is defined in SECONDARY_VALUE_1.
MIN_SENSOR_VALUE_1	Holds the minimum SECONDARY_VALUE_1. The unit is defined in SECONDARY_VALUE_1.
MAX_SENSOR_VALUE_2	See. MAX_SENSOR_VALUE_1
MIN_SENSOR_VALUE_2	See. MIN_SENSOR_VALUE_1
PRIMARY_VALUE	Process value, function of SECONDARY_VALUE_1/2. The unit of PRIMARY_VALUE is the PRIMARY_VALUE_UNIT.
PRIMARY_VALUE_UNIT	Selects the unit code of the PRIMARY_VALUE and other values. Minimum set of unit codes: 1000: K (Kelvin) 1001: °C (degree Celsius) 1002: °F (degree Fahrenheit) 1003: Rk (Rankine) Electrical units must be supported according to the supported INPUT_RANGE codes (for LIN_TYPE=0).
SECONDARY_VALUE_1 (SV_1)	Process value connected to channel 1 and corrected by BIAS_1. The unit of SECONDARY_VALUE_1 is the PRIMARY_VALUE_UNIT.
SECONDARY_VALUE_2 (SV_2)	Process value connected to channel 2 and corrected by BIAS_2. The unit of SECONDARY_VALUE_2 is the PRIMARY_VALUE_UNIT.

Parameter	Description
SENSOR_MEAS_TYPE	Mathematical function to calculate PRIMARY_VALUE (PV). Coding: 0: PV = SV_1 1: PV = SV_2 128: PV = SV_1 - SV_2 Difference 129: PV = SV_2 - SV_1 Difference 192: PV = ½ * (SV_1 + SV_2) Average 193: PV = ½ * (SV_1 + SV_2) Average but SV_1 or SV_2 if the other is wrong 194: reserved ... 219: reserved 220: manufacturer specific ... 239: manufacturer specific
SENSOR_WIRE_ CHECK_1	Enables lead breakage and short circuit detection for Sensor 1. List of valid values : 0: Lead breakage and short circuit detection enabled 1: Lead breakage detection enable, short circuit detection disabled 2: Lead breakage detection disable, short circuit detection enabled 3: Lead breakage and short circuit detection disabled
SENSOR_WIRE_ CHECK_2	Enables lead breakage and short circuit detection for Sensor 2 Valid values: see SENSOR_WIRE_CHECK_1
TAB_ACTUAL_NUMBER	See 3.8.1, Table Table 54.
TAB_ENTRY	See 3.8.1, Table Table 54.
TAB_MAX_NUMBER	See 3.8.1, Table Table 54.
TAB_MIN_NUMBER	See 3.8.1, Table Table 54.
TAB_OP_CODE	See 3.8.1, Table Table 54.
TAB_STATUS	See 3.8.1, Table Table 54.
TAB_X_Y_VALUE	See 3.8.1, Table Table 54.
UPPER_SENSOR_LIMIT	Physical upper limit function of the sensor (e.g. Pt 100 = 850°C) and input range. In the case of multichannel measurements (e.g. differential measurement) the meaning of UPPER_SENSOR_LIMIT is the limit of one channel and not the calculated limit of both channels. The unit of UPPER_SENSOR_LIMIT is the PRIMARY_VALUE_UNIT.

Table 93. Description of the General Parameters of the Temperature Transducer Block

16.1.2.2 Description of Additional Parameters of Thermocouple Devices

Parameter	Description
EXTERNAL_RJ_VALUE	Fixed temperature value of an external reference junction. The unit of EXTERNAL_RJ_VALUE is the PRIMARY_VALUE_UNIT. If PRIMARY_VALUE_UNIT is no temperature unit (e.g. mV) EXTERNAL_RJ_VALUE is stated in °C.
RJ_TEMP	Reference junction temperature. The unit of RJ_TEMP is the PRIMARY_VALUE_UNIT. If PRIMARY_VALUE_UNIT is no temperature unit (e.g. mV) RJ_TEMP is stated in °C.
RJ_TYPE	Selects reference junction from internal to fixed value. Coding: 0: No reference: Compensation is not used (e.g. for TC Type B). 1: Internal: Reference junction temperature is measured by the device itself via an internal or external mounted sensor. 2: External: The fixed value EXTERNAL_RJ_VALUE is used for compensation. The reference junction must be kept at a constant temperature (e.g. by a reference junction thermostat).

Table 94. Thermocouple Device Temperature Transducer Block Parameter Description

16.1.2.3 Description of Additional Parameters of Thermoresistance Devices

Parameter	Description
COMP_WIRE1	Value in Ω to compensate line resistance when the thermoresistance 1 is connected with 2 or 3 wires.
COMP_WIRE2	Value in Ω to compensate line resistance when the thermoresistance 2 is connected with 2 or 3 wires.
SENSOR_CONNECTION	Connection to the sensor, selected for 2, 3 and 4 wires connection. Coding: 0: 2 wires 1: 3 wires 2: 4 wires

Table 95. Thermoresistance Devices Temperature Transducer Block Parameter Description

16.1.2.4 Description of Additional Parameters of Optical Pyrometer Devices

Parameter	Description
DECAY_RATE	Decay rate in degrees/minutes (used with peak picker).
EMISSIVITY	Emissivity compensation: Value in % (0 to 100) to compensate the process value as a black body.
PEAK_TIME	Time in seconds of peak picking type “C”.

Parameter	Description
PEAK_TRACK	Choice if normal measurement or peak picker (3 types) or track and hold is to be inserted. Coding: 0: No peak and no track 1: Peak „A“ 2: Peak „B“ 3: Peak „C“ Mode 1 4: Peak „C“ Mode 2 5: Track and hold
SPECT_FILT_SET	Selection of filter type. Coding: 0: No selection 1: Filter Nr. 1 2: Filter Nr. 2 3: Filter Nr. 3 ... N: Filter Nr. N
TRACK_HOLD	Logical level to track the measure and hold (used only with track and hold). Coding: 0: Hold 1: Track

Table 96. Optical Pyrometer Devices Temperature Transducer Block Parameter Description

16.1.3 Parameter Attributes of the Temperature Transducer Block

16.1.3.1 Parameter Attributes of the Temperature Transducer Block General Parameters

Relative Index	Parameter Name	Object Type	Data Type	Store	Size	Access	Parameter Usage / Kind of Transport	Reset Class	Default Value	Download Order	Mandatory Optional (Class A,B)
... Standard Parameters see General Requirements											
Additional Temperature Transducer Block Parameters											
8	PRIMARY_VALUE	Record	101	D	5	r	C/a	-			M
9	PRIMARY_VALUE_UNIT	Simple	Unsigned16	S	2	r,w	C/a	F		2	M
10	SECONDARY_VALUE_1	Record	101	D	5	r	C/a	-			M
11	SECONDARY_VALUE_2	Record	101	D	5	r	C/a	-			O
12	SENSOR_MEAS_TYPE	Simple	Unsigned8	S	1	r,w	C/a	F		3	M
13	INPUT_RANGE	Simple	Unsigned8	S	1	r,w	C/a	F		4	M
14	LIN_TYPE	See 3.8.2, Table 55.								1	M
19	BIAS_1	Simple	Float	S	4	r,w	C/a	F	0.0	5	M
20	BIAS_2	Simple	Float	S	4	r,w	C/a	F	0.0		O
21	UPPER_SENSOR_LIMIT	Simple	Float	N	4	r	C/a	-			M
22	LOWER_SENSOR_LIMIT	Simple	Float	N	4	r	C/a	-			M
24	INPUT_FAULT_GEN	Simple	Unsigned8	D	1	r	C/a	-			M
25	INPUT_FAULT_1	Simple	Unsigned8	D	1	r	C/a	-			M
26	INPUT_FAULT_2	Simple	Unsigned8	D	1	r	C/a	-			O
27	SENSOR_WIRE_ CHECK_1	Simple	Unsigned8	S	1	r,w	C/a	F			O
28	SENSOR_WIRE_ CHECK_2	Simple	Unsigned8	S	1	r,w	C/a	F			O
29	MAX_SENSOR_VALUE_1	Simple	Float	N	4	r,w	C/a	I			O
30	MIN_SENSOR_VALUE_1	Simple	Float	N	4	r,w	C/a	I			O
31	MAX_SENSOR_VALUE_2	Simple	Float	N	4	r,w	C/a	I			O
32	MIN_SENSOR_VALUE_2	Simple	Float	N	4	r,w	C/a	I			O
33-44	...	See Table 98, Table 99 and Table 100 below.									
45	TAB_ENTRY	See 3.8.2, Table 55.									O [1]
46	TAB_X_Y_VALUE	See 3.8.2, Table 55.									O [1]
47	TAB_MIN_NUMBER	See 3.8.2, Table 55.									O [1]
48	TAB_MAX_NUMBER	See 3.8.2, Table 55.									O [1]
49	TAB_OP_CODE	See 3.8.2, Table 55.									O [1]
50	TAB_STATUS	See 3.8.2, Table 55.									O [1]
51	TAB_ACTUAL_NUMBER	See 3.8.2, Table 55.									O [1]
52-61	Reserved by PNO										M

[1] These parameters are mandatory if LIN_TYPE=1 (linearisation table) is supported.

Relative Index	Parameter Name	Object Type	Data Type	Store	Size	Access	Parameter Usage / Kind of Transport	Reset Class	Default Value	Download Order	Mandatory Optional (Class A,B)
62	First manufacturer specific parameter										O

Table 97. Parameter Attributes of the Temperature Transducer Block General Parameters

16.1.3.2 Parameter Attributes of the Additional Parameters for Thermocouple Devices

Relative Index	Parameter Name	Object Type	Data Type	Store	Size	Access	Parameter Usage / Kind of Transport	Reset Class	Default Value	Download Order	Mandatory Optional (Class A,B)
... Standard Parameters see General Requirements											
... General Temperature Transducer Block Parameters											
Additional Parameters for Thermocouple Devices											
33	RJ_TEMP	Simple	Float	D	4	r	C/a	-			O
34	RJ_TYPE	Simple	Unsigned8	S	1	r,w	C/a	F		6	M
35	EXTERNAL_RJ_VALUE	Simple	Float	S	4	r,w	C/a	F			O [1]
36-44	Reserved by PNO [2]										

Table 98. Parameter Attributes of the Additional Parameters for Thermocouple Devices

16.1.3.3 Parameter Attributes of the Additional Parameters for Thermoresistance Devices

Relative Index	Parameter Name	Object Type	Data Type	Store	Size	Access	Parameter Usage / Kind of Transport	Reset Class	Default Value	Download Order	Mandatory Optional (Class A,B)
... Standard Parameters see General Requirements											
... General Temperature Transducer Block Parameters											
Additional Parameters for Thermoresistance Devices											
33-35	Reserved by PNO [3]										
36	SENSOR_CONNECTION	Simple	Unsigned8	S	1	r,w	C/a	F		7	M
37	COMP_WIRE1	Simple	Float	S	4	r,w	C/a	F	0.0	8	M
38	COMP_WIRE2	Simple	Float	S	4	r,w	C/a	F	0.0		O [1]

[1] EXTERNAL_RJ_VALUE is mandatory if RJ_TYPE=2 (External) is supported.

[2] The addional parameters for thermoresistance and optical pyrometer devices may optionally be used. Otherwise these indices must not be used.

[3] The additional parameters for thermocouple devices may optionally be used. Otherwise these indices must not be used.

Relative Index	Parameter Name	Object Type	Data Type	Store	Size	Access	Parameter Usage / Kind of Transport	Reset Class	Default Value	Download Order	Mandatory Optional (Class A,B)
39-44	Reserved by PNO [2]										

Table 99. Parameter Attributes of the Additional Parameters for Thermoresistance Devices

[1] COMP_WIRE2 is mandatory if SENSOR_MEAS_TYPE≥128 is supported.

[2] The additional parameters for optical pyrometer devices may optionally be used. Otherwise these indices must not be used.

16.1.3.4 Parameter Attributes of the Additional Parameters for Optical Pyrometer Devices

Relative Index	Parameter Name	Object Type	Data Type	Store	Size	Access	Parameter Usage / Kind of Transport	Reset Class	Default Value	Download Order	Mandatory Optional (Class A,B)
... Standard Parameters see General Requirements											
... General Temperature Transducer Block Parameters											
Additional Parameters for Optical Pyrometer Devices											
33-38	Reserved by PNO [1]										
39	EMISSIVITY	Simple	Float	S	4	r,w	C/a	F	100.0	9	M
40	PEAK_TRACK	Simple	Unsigned8	S	1	r,w	C/a	F	0	10	M
41	DECAY_RATE	Simple	Float	S	4	r,w	C/a	F		11	M
42	PEAK_TIME	Simple	Float	S	4	r,w	C/a	F		12	M
43	TRACK_HOLD	Simple	Unsigned8	S	1	r,w	C/a	F	0	13	M
44	SPECT_FILT_SET	Simple	Unsigned8	S	1	r,w	C/a	F	0	14	M

Table 100. Parameter Attributes of the Additional Parameters for Optical Pyrometer Devices

16.1.4 View Object of the Temperature Transducer Block

Relative Index	Parameter Name	View_1	View_2	View_3	View_4
8	PRIMARY_VALUE	5			
9	PRIMARY_VALUE_UNIT				
10	SECONDARY_VALUE_1				
11	SECONDARY_VALUE_2				
12	SENSOR_MEAS_TYPE				
13	INPUT_RANGE				
14	LIN_TYPE				
19	BIAS_1				
20	BIAS_2				
21	UPPER_SENSOR_LIMIT				
22	LOWER_SENSOR_LIMIT				
24	INPUT_FAULT_GEN	1			
25	INPUT_FAULT_1	1			
26	INPUT_FAULT_2				
27	SENSOR_WIRE_CHECK_1				
28	SENSOR_WIRE_CHECK_2				

[1] The additional parameters for thermocouple and thermoresistance devices are optional. Otherwise these indices must not be used.

Relative Index	Parameter Name	View_1	View_2	View_3	View_4
29	MAX_SENSOR_VALUE_1				
30	MIN_SENSOR_VALUE_1				
31	MAX_SENSOR_VALUE_2				
32	MIN_SENSOR_VALUE_2				
33	RJ_TEMP				
34	RJ_TYPE				
35	EXTERNAL_RJ_VALUE				
36	SENSOR_CONNECTION				
37	COMP_WIRE1				
38	COMP_WIRE2				
39	EMISSIVITY				
40	PEAK_TRACK				
41	DECAY_RATE				
42	PEAK_TIME				
43	TRACK_HOLD				
44	SPECT_FILT_SET				
45	TAB_ENTRY				
46	TAB_X_Y_VALUE				
47	TAB_MIN_NUMBER				
48	TAB_MAX_NUMBER				
49	TAB_OP_CODE				
50	TAB_STATUS				
51	TAB_ACTUAL_NUMBER				
	Overall sum of bytes in View -Object (+ 13 Standard parameter bytes)	20 + 13			

Table 101. View Object of the Temperature Transducer Block

16.2 Pressure

16.2.1 Pressure Transducer Block Overview

This document describes the specific aspects of pressure measurement used in the process control.

The Standard Pressure Profile describes base sets of parameters and characteristics common to pressure measurement. This transducer described is limited in scope to a single type of measurement.

A pressure transducer computes its output using primary sensor data and parameters. The calculation can be modeled using the following steps: The manufacturer-specific Signal Compensation and Linearisation process, Trim, Limit Checking, Primary Value to Eng. Unit Convertion and Alarming processes.

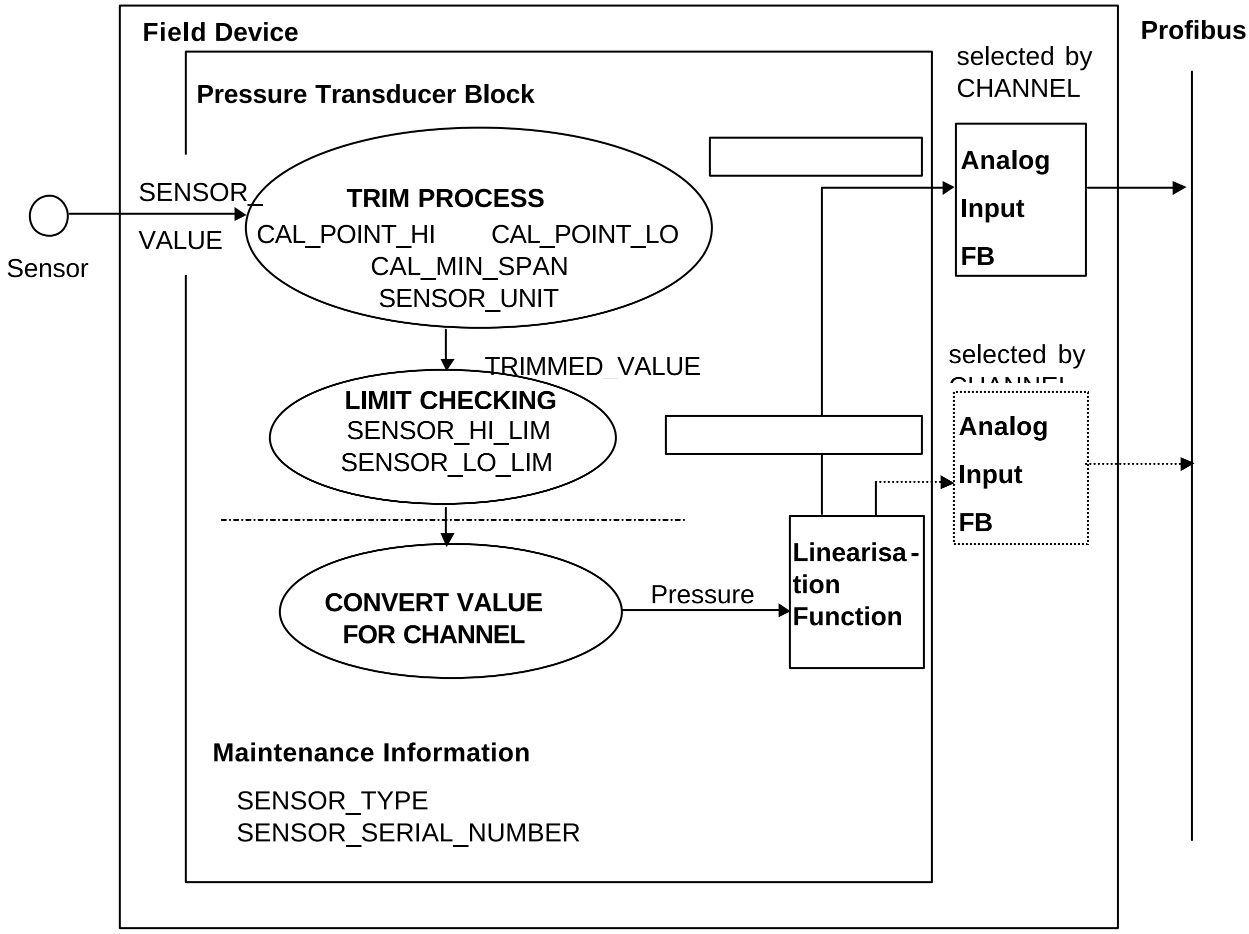


Figure 38. Pressure Transducer Block

Calibration

This information is provided to recommend parameters for a common user calibration method for pressure transmitters.

The calibration process is used to match the channel value reading with the applied input. The calibration of the sensor itself is not changed, because that is a factory procedure. Six parameters are defined to configure this process: CAL_POINT_HI, CAL_POINT_LO, CAL_MIN_SPAN, SENSOR_UNIT, SENSOR_HI_LIM and SENSOR_LO_LIM. The CAL_* parameters define the highest and lowest calibrated values for this sensor, and the minimum allowable span value for calibration (if necessary). SENSOR_UNIT allows the user to select different units for calibration purposes other than the units defined by PRIMARY_VALUE_UNIT.

The SENSOR_HI_LIM and SENSOR_LO_LIM parameter defines the maximum and minimum values the sensor is capable of indicating, according to SENSOR_UNIT used as it can be seen in Figure 39 below.

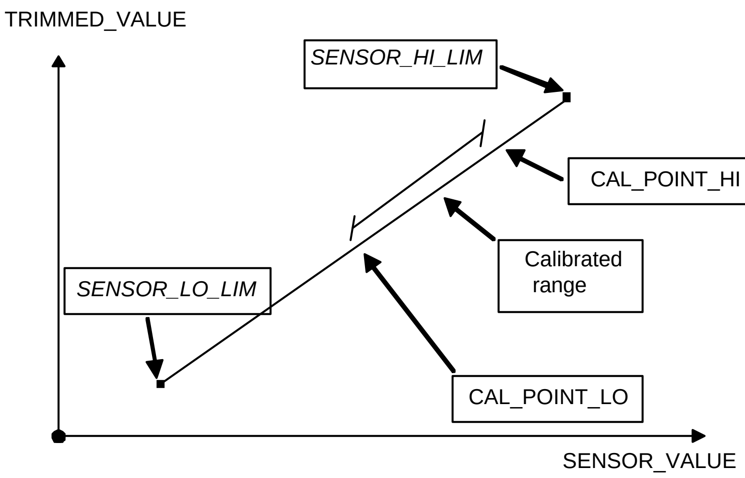


Figure 39. Sensor Calibration

Linearisation Functions

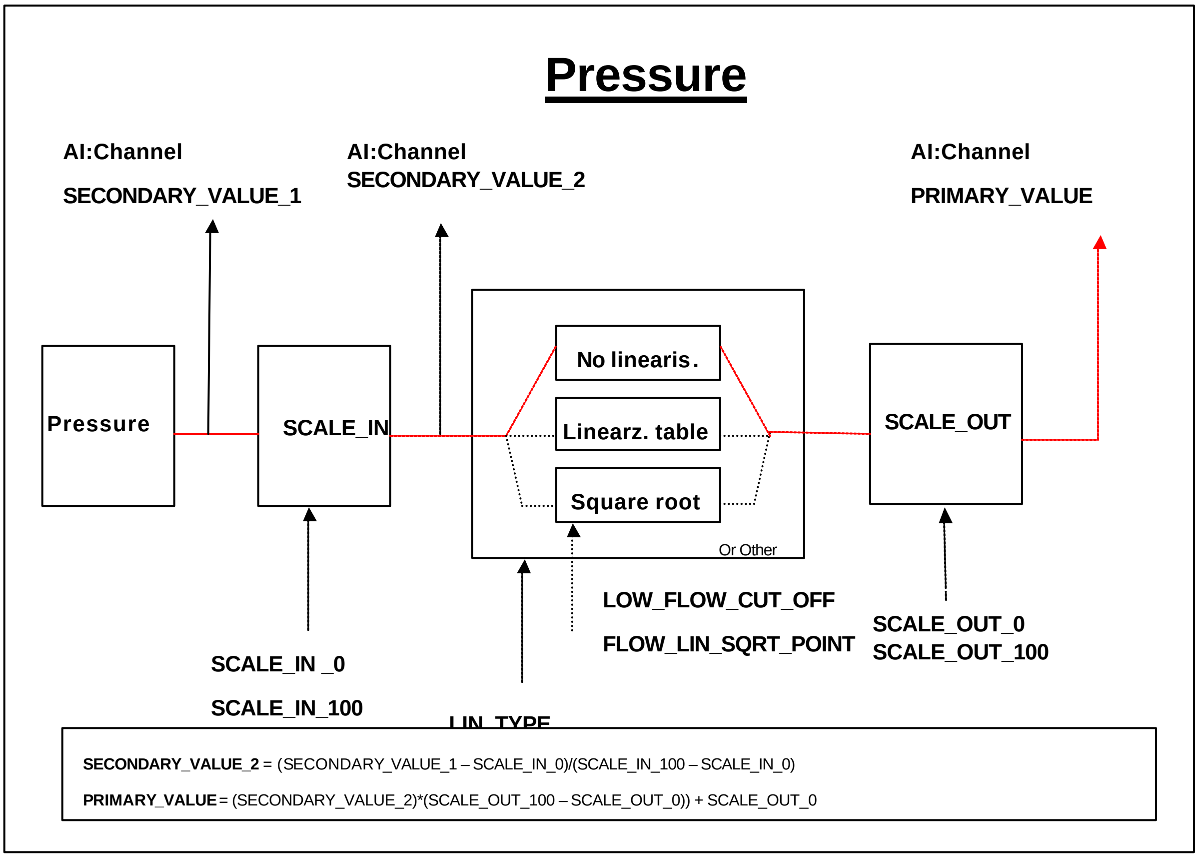


Figure 40. Pressure Transducer Block Function: Pressure

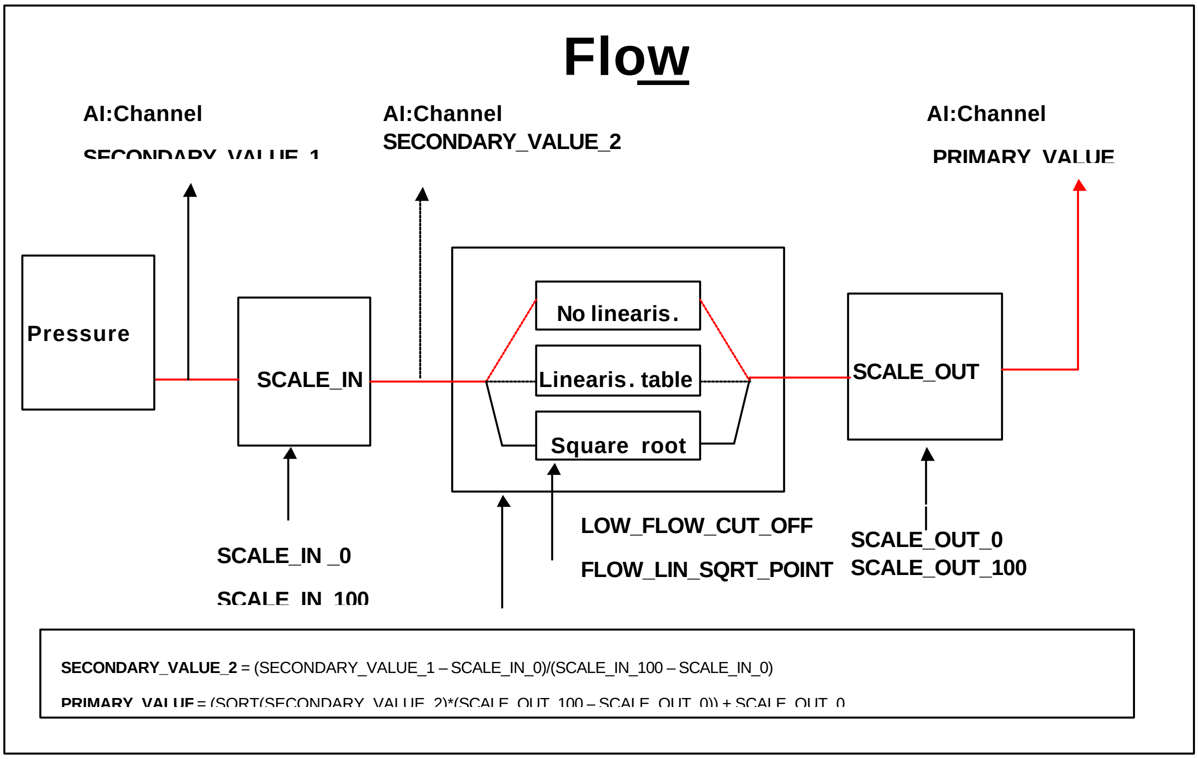


Figure 41. Pressure Transducer Block Function: Flow

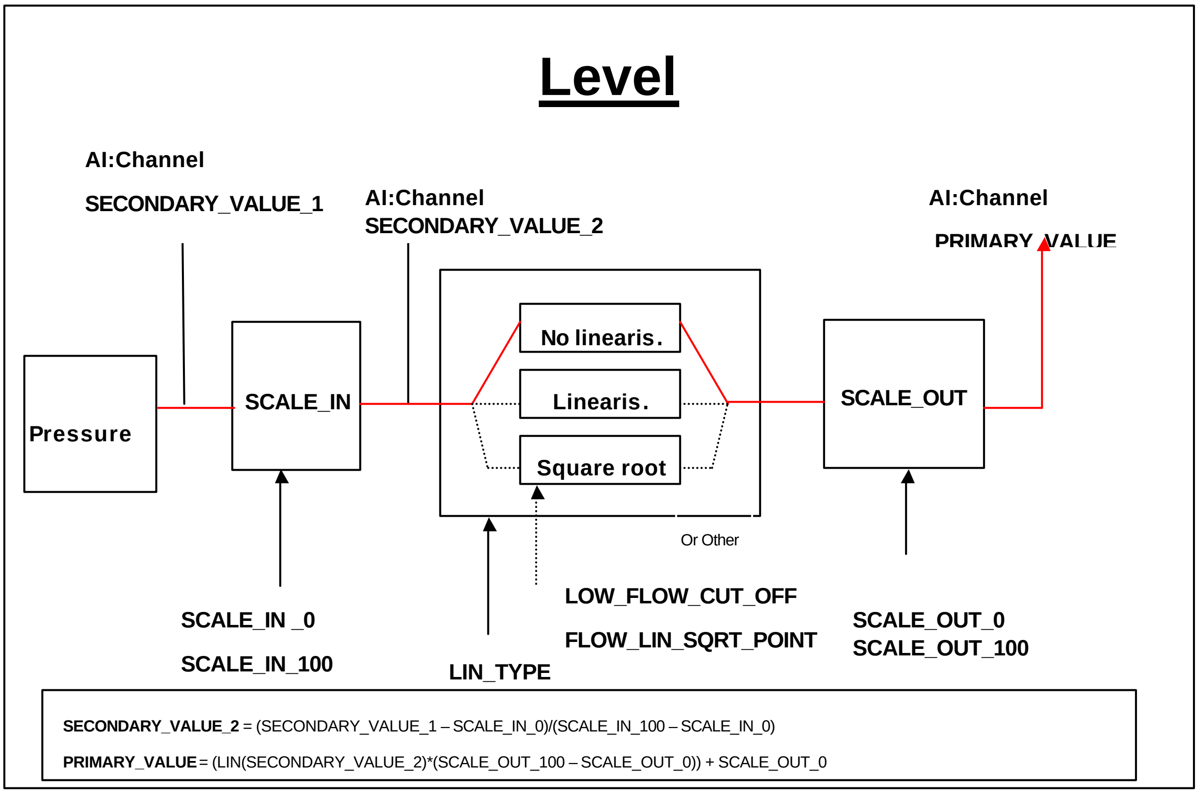


Figure 42. Pressure Transducer Block Function: Level

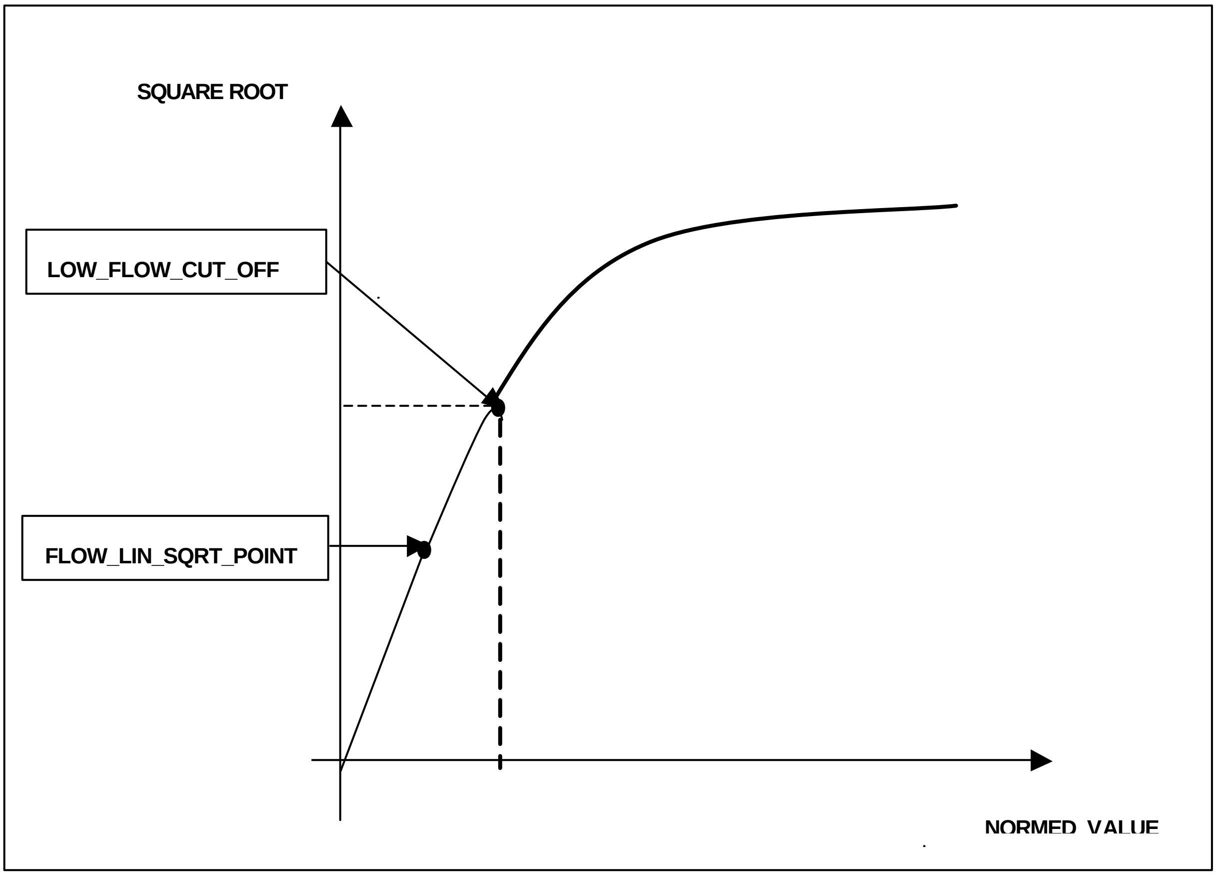


Figure 43. Flow: Square Root Function

16.2.2 Parameter Description of the Pressure Transducer Block

Parameter	Description
CAL_MIN_SPAN	This parameter contains the minimum calibration span value allowed. This minimum span information is necessary to ensure that when calibration is done, the two calibrated points (high and low) are not too close together. Unit is derived from SENSOR_UNIT.
CAL_POINT_HI	This parameter contains the highest calibrated value. For calibration of the high limit point give the high measurement value (pressure) to the sensor and transfer this point as HIGH to the transmitter. Unit is derived from SENSOR_UNIT.
CAL_POINT_LO	This parameter contains the lowest calibrated value. For calibration of the low limit point give the low measurement value (pressure) to the sensor and transfer this point as LOW to the transmitter. Unit is derived from SENSOR_UNIT.
FLOW_LIN_SQRT_POINT	This is the point of the flow function where the curve changes from linear to square root function. The input has to be done in percent of flow.
LIN_TYPE	See General Requirements
LOW_FLOW_CUT_OFF	This is the point in percent of flow until the output of the flow function is set to zero. It is used for suppressing low flow values.

Parameter	Description
MAX_SENSOR_VALUE	Holds the maximum process SENSOR_VALUE. The unit is defined in SENSOR_UNIT.
MIN_SENSOR_VALUE	Holds the minimum process SENSOR_VALUE. The unit is defined in SENSOR_UNIT.
MAX_TEMPERATURE	Holds the maximum temperature.
MIN_TEMPERATURE	Holds the minimum temperature.
PRIMARY_VALUE	This parameter contains the measured value and status available to the Function Block. The unit of PRIMARY_VALUE is the PRIMARY_VALUE_UNIT.
PRIMARY_VALUE_TYPE	This parameter contains the application of the pressure device. Coding: 0: Pressure 1: Flow 2: Level 3: Volume 4-127: reserved > 128: manufacturer specific
PRIMARY_VALUE_UNIT	This parameter contains the engineering unit code for the primary value. The minimum set of unit codes for pressure is: kPa (1133), bar (1137), psi (1141), inHg (1155). If the device supports flow or level measurements the corresponding units have to be supported, too. The minimum set of unit codes for volume flow is: m^3/h (1349), L/s (1351), CFM – cubic feet per minute (1357), GMP - US gallon per minute (1363). The minimum set of unit codes for mass flow is: kg/s (1322), lb/s (1330). The minimum set of unit codes for level is: % (1342), m (1010), ft (1018). The minimum set of unit codes for volume is: m^3 (1034), L (1038),cf^3 - cubic feet (1043),GMP - US gallon (1048). The coding is in accordance to the table of Unit Codes given in the General Requirements. This parameter contains the engineering units code for the primary value according to PRIMARY_VALUE_TYPE. An automatic adjustment of Primary_Value_Unit within the devices is optional.
PROCESS_ CONNECTION_MATERIAL	This parameter contains the index code for the material of the process connection. The coding is in accordance to the table of Material Codes given in the General Requirements.
PROCESS_ CONNECTION_TYPE	This parameter contains the material code for the type of process connection. The index code is manufacturer specific.
SCALE_IN	This is the input conversion of the Pressure into SECONDARY_VALUE_2 using the high and low scale. The related unit is the SECONDARY_VALUE_1_UNIT.
SCALE_OUT	This is the output conversion of the linearisated value using the high and low scale. The related unit is the PRIMARY_VALUE_UNIT. It is in accordance to the table of Units Codes given in the General Requirements.
SECONDARY_VALUE_1	This parameter contains the Pressure value and status available to the Function Block.

Parameter	Description
SECONDARY_VALUE_1_UNIT	This parameter contains the pressure units of the SECONDARY_VALUE_1. The minimum set of unit codes for pressure is: kPa (1133), bar (1137), psi (1141), inHg (1155). It is in accordance to the table of Units Codes given in the General Requirements.
SECONDARY_VALUE_2	This parameter contains the measured value after input scaling and status available to the Function Block. The parameter contains the normalised pressure value without engineering unit.
SECONDARY_VALUE_2_UNIT	This parameter contains the units of the SECONDARY_VALUE_2. It is fixed to None, i.e. the value of this parameter is equal to 1997.
SENSOR_DIAPHRAGM_MATERIAL	This parameter contains the index code for the material of the diaphragm, which comes in contact with the process media.
SENSOR_FILL_FLUID	This parameter contains the index code for the fillfluid inside the sensor. The index code is manufacture specific.
SENSOR_HI_LIM	This parameter contains the sensor upper limit value. Unit is derived from SENSOR_UNIT.
SENSOR_LO_LIM	This parameter contains the sensor lower limit value. Unit is derived from SENSOR_UNIT.
SENSOR_MAX_STATIC_PRESSURE	This parameter contains the maximum static pressure value for the sensor. Unit is derived from SENSOR_UNIT.
SENSOR_O_RING_MATERIAL	This parameter contains the index code for the material of the o-ring between the diaphragm and process connection.
SENSOR_SERIAL_NUMBER	This parameter contains the sensor serial number.
SENSOR_TYPE	This parameter contains the index code for the sensor type described in manufacturer's specific tables.
SENSOR_UNIT	This parameter contains the engineering units index code for the calibration values. SENSOR_UNIT must be a subset of the interchangeable part of the Pressure unit.
SENSOR_VALUE	This parameter contains the raw sensor value. This is the uncalibrated measurement value from the sensor. Unit is derived from SENSOR_UNIT.
TAB_ACTUAL_NUMBER	See 3.8.1, Table Table 54.
TAB_INDEX	See 3.8.1, Table Table 54.
TAB_MAX_NUMBER	See 3.8.1, Table Table 54.
TAB_MIN_NUMBER	See 3.8.1, Table Table 54.
TAB_OP_CODE	See 3.8.1, Table Table 54.
TAB_STATUS	See 3.8.1, Table Table 54.
TAB_X_Y_VALUE	See 3.8.1, Table Table 54.
TEMPERATURE	This parameter contains the temperature (e.g. sensor temperature used for measurement compensation) with the associated status used within the transducer. The unit of TEMPERATURE is the TEMPERATURE_UNIT.

Parameter	Description
TEMPERATURE_UNIT	This parameter contains the units of the temperature. The minimum set of unit codes for volume flow is: K (1000), °C (1001), °F (1002). The coding is in accordance to the table of Units Codes given in the General Requirements.
TRIMMED_VALUE	This parameter contains the sensor value after the trim processing. Unit is derived from SENSOR_UNIT.

Table 102. Parameter Description of the Pressure Transducer Block

16.2.3 Parameter Attributes of the Pressure Transducer Block

Relative Index	Parameter Name	Object Type	Data Type	Store	Size	Access	Parameter Usage / Kind of Transport	Reset Class	Default Value	Download Order	Mandatory Optional (Class A,B)
... Standard Parameters see General Requirements											
Additional Pressure Transducer Block Parameters											
8	SENSOR_VALUE	Simple	Float	D	4	r	C/a	-	-	-	M (B)
9	SENSOR_HI_LIM	Simple	Float	N	4	r	C/a	-	-	-	M (B)
10	SENSOR_LO_LIM	Simple	Float	N	4	r	C/a	-	-	-	M (B)
11	CAL_POINT_HI	Simple	Float	S	4	r,w	C/a	F	-	-	M (B)
12	CAL_POINT_LO	Simple	Float	S	4	r,w	C/a	F	-	-	M (B)
13	CAL_MIN_SPAN	Simple	Float	N	4	r	C/a	-	-	-	M (B)
14	SENSOR_UNIT	Simple	Unsigned16	S	2	r,w	C/a	F	-	2	M (B)
15	TRIMMED_VALUE	Record	101	D	5	r	C/a	-	-	-	M (B)
16	SENSOR_TYPE	Simple	Unsigned16	N	2	r	C/a	-	-	-	M (B)
17	SENSOR_SERIAL_ NUMBER	Simple	Unsigned32	N	4	r	C/a	-	-	-	M (B)
18	PRIMARY_VALUE	Record	101	D	5	r	C/a	-	-	-	M (B)
19	PRIMARY_VALUE_UNIT	Simple	Unsigned16	S	2	r,w	C/a	F	-	3	M (B)
20	PRIMARY_VALUE_TYPE	Simple	Unsigned16	S	2	r,w	C/a	I	-	-	M (B)
21	SENSOR_DIAPHRAGM_ MATERIAL	Simple	Unsigned16	S	2	r,w	C/a	I	-	-	O (B)
22	SENSOR_FILL_FLUID	Simple	Unsigned16	S	2	r,w	C/a	I	-	-	O (B)
23	SENSOR_MAX_ STATIC_PRESSURE	Simple	Float	N	4	r	C/a	-	-	-	O (B)
24	SENSOR_O_RING_ MATERIAL	Simple	Unsigned16	S	2	r,w	C/a	I	-	-	O (B)
25	PROCESS_ CONNECTION_TYPE	Simple	Unsigned16	S	2	r,w	C/a	I	-	-	O (B)
26	PROCESS_ CONNECTION_MATERIAL	Simple	Unsigned16	S	2	r,w	C/a	I	-	-	O (B)
27	TEMPERATURE	Record	101	D	5	r	C/a	-	-	-	O (B)
28	TEMPERATURE_ UNIT	Simple	Unsigned16	S	2	r,w	C/a	F	-	4	O (B)
29	SECONDARY_VALUE_1	Record	101	D	5	r	C/a	-	-	-	O (B)
30	SECONDARY_VALUE_1_ UNIT	Simple	Unsigned16	S	2	r,w	C/a	F	-	5	O (B)
31	SECONDARY_VALUE_2	Record	101	D	5	r	C/a	-	-	-	O (B)
32	SECONDARY_VALUE_2_ UNIT	Simple	Unsigned16	S	2	r,w	C/a	F	-	6	O (B)
33	LIN_TYPE	See 3.8.2, Table 55.								1	M (B)

Relative Index	Parameter Name	Object Type	Data Type	Store	Size	Access	Parameter Usage / Kind of Transport	Reset Class	Default Value	Download Order	Mandatory Optional (Class A,B)
34	SCALE_IN	Array	Float [1]	S	8	r,w	C/a	F	-	7	O (B)
35	SCALE_OUT	Array	Float [1]	S	8	r,w	C/a	F	-	8	O (B)
36	LOW_FLOW_CUT_OFF	Simple	Float	S	4	r,w	C/a	F	-	-	O (B)
37	FLOW_LIN_SQRT_POINT	Simple	Float	S	4	r,w	C/a	F	-	-	O (B)
38	TAB_ACTUAL_NUMBER	See 3.8.2, Table 55.								-	O (B) [2]
39	TAB_ENTRY	See 3.8.2, Table 55.								-	O (B) [2]
40	TAB_MAX_NUMBER	See 3.8.2, Table 55.								-	O (B) [2]
41	TAB_MIN_NUMBER	See 3.8.2, Table 55.								-	O (B) [2]
42	TAB_OP_CODE	See 3.8.2, Table 55.								-	O (B) [2]
43	TAB_STATUS	See 3.8.2, Table 55.								-	O (B) [2]
44	TAB_X_Y_VALUE	See 3.8.2, Table 55.								-	O (B) [2]
45	MAX_SENSOR_VALUE	Simple	Float	N	4	r,w	C/a	I	-	-	O (B)
46	MIN_SENSOR_VALUE	Simple	Float	N	4	r,w	C/a	I	-	-	O (B)
47	MAX_TEMPERATURE	Simple	Float	N	4	r,w	C/a	I	-	-	O (B)
48	MIN_TEMPERATURE	Simple	Float	N	4	r,w	C/a	I	-	-	O (B)
49-58	Reserved by PNO	-	-	-	-	-	-		-	-	-

Table 103. Parameter Attributes of the Pressure Transducer Block

16.2.4 View Object of the Pressure Transducer Block

Relative Index	Parameter Name	View_1	View_2	View_3	View_4
8	SENSOR_VALUE				
9	SENSOR_HI_LIM				
10	SENSOR_LO_LIM				
11	CAL_POINT_HI				
12	CAL_POINT_LO				
13	CAL_MIN_SPAN				
14	SENSOR_UNIT				
15	TRIMMED_VALUE				
16	SENSOR_TYPE				
17	SENSOR_SERIAL_NUMBER				
18	PRIMARY_VALUE	5			
19	PRIMARY_VALUE_UNIT				
20	PRIMARY_VALUE_TYPE				

[1] First Float value: value at EU of 100%, Second Float value: value at EU of 0%

[2] These parameters are mandatory if LIN_TYPE=1 (linearisation table) is supported.

Relative Index	Parameter Name	View_1	View_2	View_3	View_4
21	SENSOR_DIA PHRAGM_MATERIAL				
22	SENSOR_FILL_FLUID				
23	SENSOR_MAX_STATIC_PRESSURE				
24	SENSOR_O_RING_MATERIAL				
25	PROCESS_CONNECTION_TYPE				
26	PROCESS_CONNECTION_MATERIAL				
27	TEMPERATURE				
28	TEMPERATURE_UNIT				
29	SECONDARY_VALUE_1				
30	SECONDARY_VALUE_1_UNIT				
31	SECONDARY_VALUE_2				
32	SECONDARY_VALUE_2_UNIT				
33	LIN_TYPE				
34	SCALE_IN				
35	SCALE_OUT				
36	LOW_FLOW_CUT_OFF				
37	FLOW_LIN_SQRT_POINT				
38	TAB_ACTUAL_NUMBER				
39	TAB_INDEX				
40	TAB_MAX_NUMBER				
41	TAB_MIN_NUMBER				
42	TAB_OP_CODE				
43	TAB_STATUS				
44	TAB_X_Y_VALUE				
45	MAX_SENSOR_VALUE				
46	MIN_SENSOR_VALUE				
47	MAX_TEMPERATURE				
48	MIN_TEMPERATURE				
-	Overall sum of bytes in View-Object (+13 Standard parameter bytes)	5 + 13			

Table 104. View Object of the Pressure Transducer Block

2.2.5 Assignment of Dynamic Variables for Pressure Devices

Application	Transducer Output			
PRIMARY_ VALUE_TYPE	PRIMARY_ VALUE	SECONDARY_ VALUE_1	SECONDARY_ VALUE_2	TEMPERATURE
Pressure	Pressure	—	—	Temperature
Flow	Flow	Pressure	—	Temperature

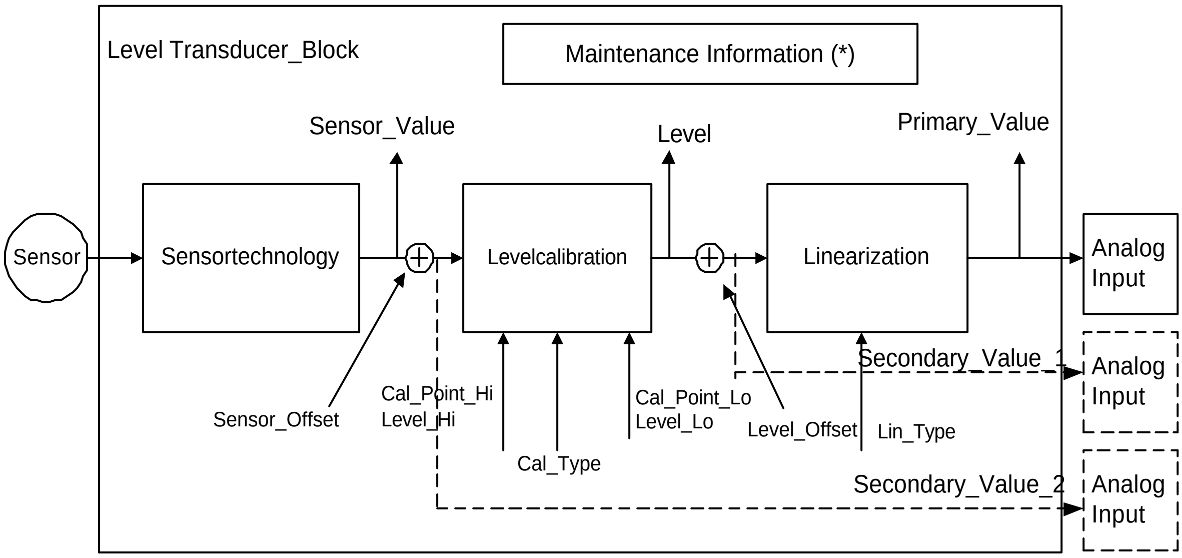
Application	Transducer Output			
PRIMARY_ VALUE_TYPE	PRIMARY_ VALUE	SECONDARY_ VALUE_1	SECONDARY_ VALUE_2	TEMPERATURE
Level	Level	Pressure	—	Temperature
Volume	Volume	Pressure	Normalised Pressure	Temperature

Table 105. Assignment of Dynamic Variables for Pressure Devices

16.3 Level

16.3.1 Level Transducer Block Overview

The Level Transducer Block describes the basic set of parameters for level devices. The following diagrams define the basic functional interrelation of the parameters.



(*) Maintenance Information is additional information which has no influence on the Primary_Value

Figure 44. Functional Diagram of the Level Transducer Block

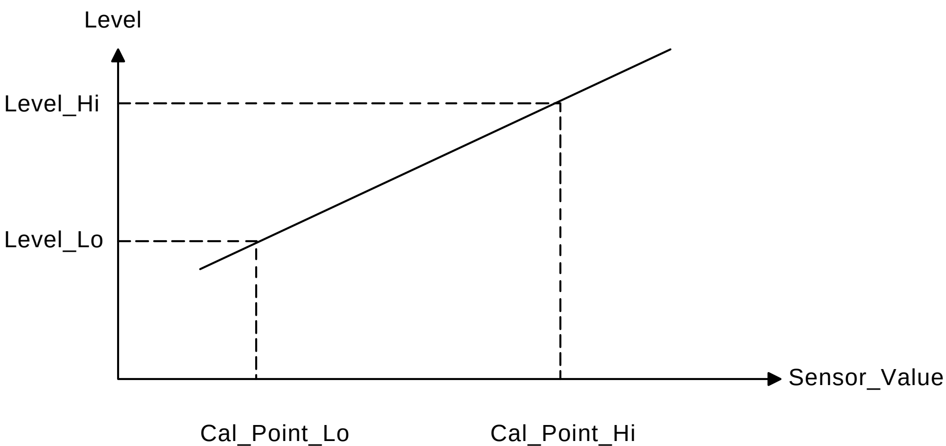


Figure 45. Transfer Function Level Calibration

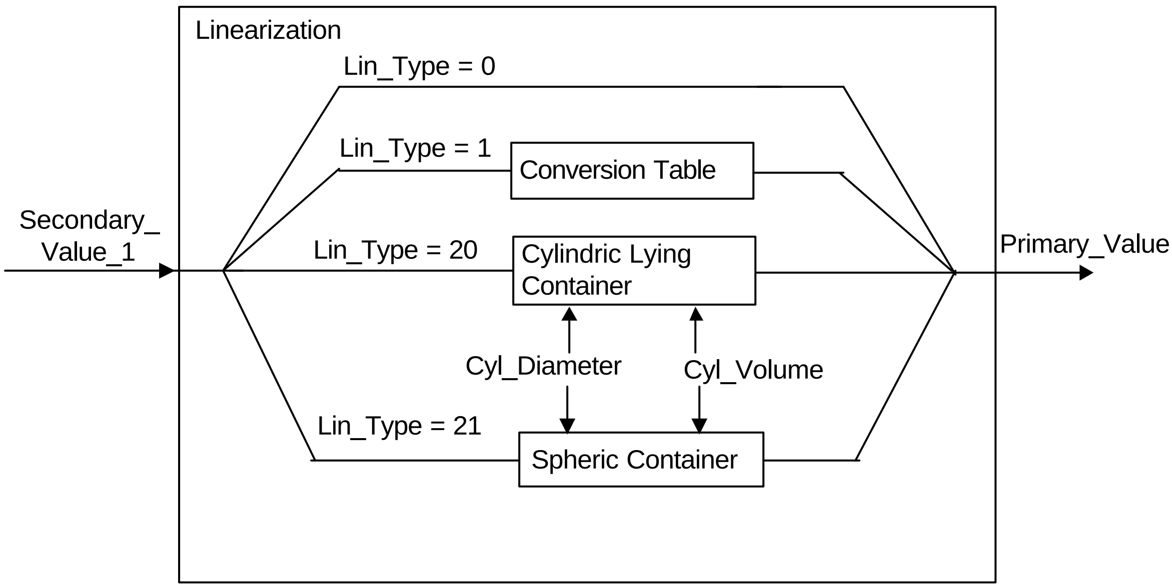


Figure 46. Functional Diagram of Linearisation

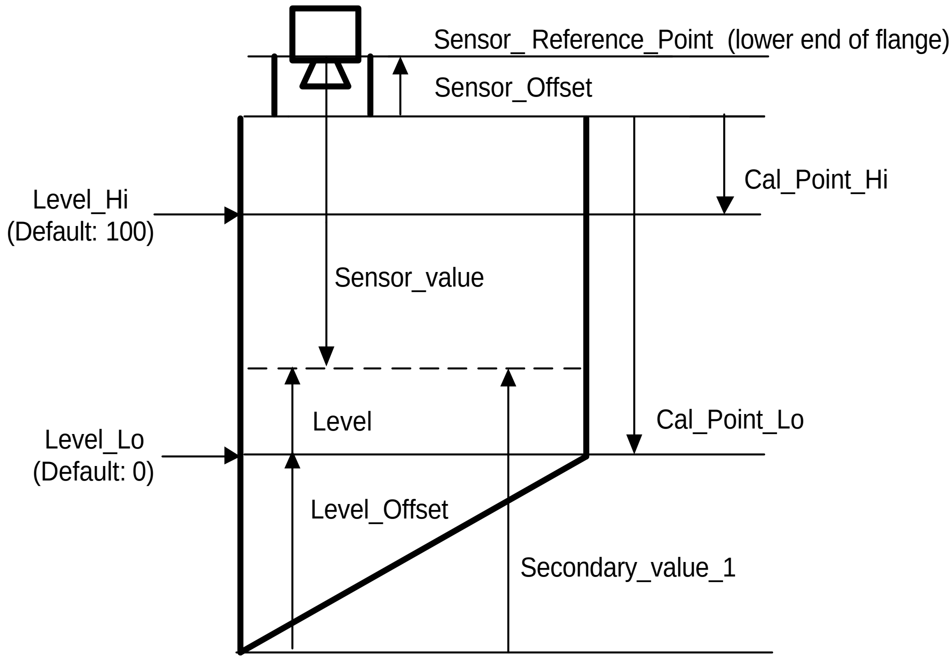
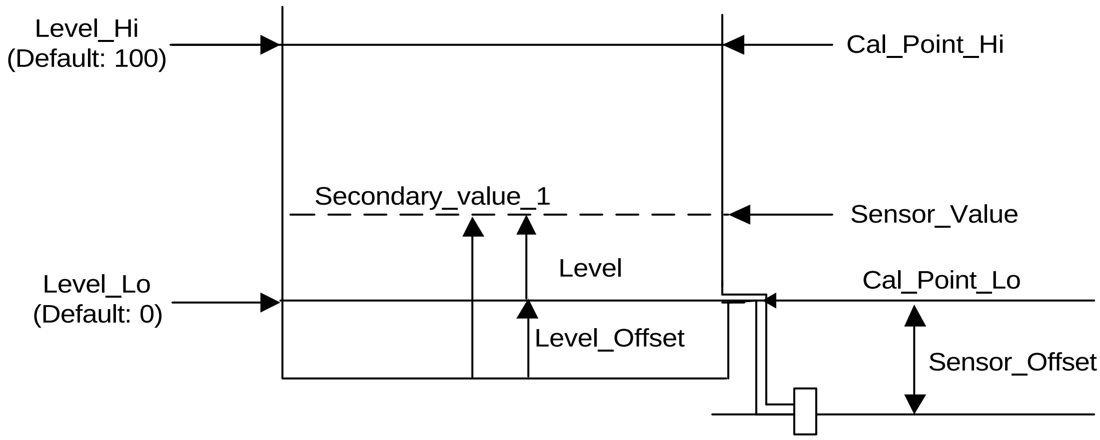
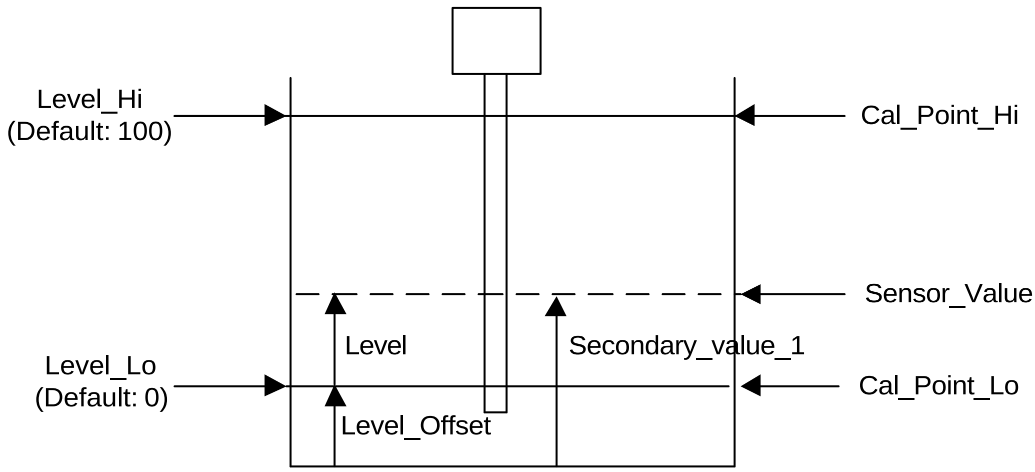


Figure 47. Application Example for Radar Level



Hydrostatic Level Devices can be calibrated online or offline. (SENSOR_VALUE is used for the levelcalibration; CAL_TYPE = 1, Online)

Figure 48. Application Example for Hydrostatic Level



Capacity Level Devices are calibrated online. (SENSOR_VALUE is used for the level calibration; CAL_TYPE = 1, Online)

Figure 49. Application Example for Capacitance Level

16.3.2 Parameter Description of the Level Transducer Block

Parameter	Description
CAL_POINT_HI	Cal_Point_Hi is the upper calibrated point of the Sensor_Value. It refers to Level_Hi. The unit is defined in Sensor_Unit.
CAL_POINT_LO	Cal_Point_Lo is the lower calibrated point of the Sensor_Value. It refers to Level_Lo. The unit is defined in Sensor_Unit.
CAL_TYPE	Defines the type of calibration. Coding: 0: Dry; no influence of the sensor value on level calibration. Mandatory for Radar Devices 1: online; current sensor value determines level calibration.
LEVEL	Level derives directly from Sensor_Value by a linear transformation using Level_hi, Level_Lo, Cal_Point_Hi, Cal_Point_Lo and Sensor_Offset. The unit is defined in Level_Unit.
LEVEL_HI	Level_Hi is the value of Level at Cal_Point_Hi. The unit is defined in Level_Unit. When writing LEVEL_HI and Cal_Type = 1 the Cal_Point_Hi is automatically set to Sensor_Value.
LEVEL_LO	Level_Lo is the value of Level at Cal_Point_Lo. The unit is defined in Level_Unit. When writing LEVEL_LO and Cal_Type = 1 the Cal_Point_Lo is automatically set to Sensor_Value.
LEVEL_OFFSET	Level_Offset is a constant offset that is added after the transfer function of Level_Calibration. The unit is defined in Level_Unit.
LEVEL_UNIT	Selected unit code for Level, Level_Hi, Level_Lo and Cyl_Diameter. Mandatory: %, m, ft
LIN_DIAMETER	Diameter for cylindric lying or spherical container in Level_units It is used when linearisation type = 20 or 21.
LIN_VOLUME	Lin_Volume is the complete volume of the cylindric lying or spherical container. It is used when linearisation type = 20 or 21. The unit is defined in Primary_Value_Unit.
MAX_SENSOR_VALUE	Holds the maximum process Sensor_Value. The unit is defined in Sensor_Unit.
MIN_SENSOR_VALUE	Holds the minimum process Sensor_Value. The unit is defined in Sensor_Unit.
MAX_TEMPERATURE	Holds the maximum process temperature.
MIN_TEMPERATURE	Holds the minimum process temperature.
PRIMARY_VALUE	Primary_Value is the process value and the status of the Transducer Block and is the input for the analog input block. Primary_Value contains the same value as level when linearisation type = 0. The unit is defined in Primary_Value_Unit.
PRIMARY_VALUE_UNIT	Selected unit code for Primary_Value and Cyl_Volume. Mandatory: %, m, ft
SECONDARY_VALUE_1	Secondary_Value_1 is Level + Level_Offset and the status of the Transducer Block. The unit is defined in Secondary_Value_1_Unit. It can be connected to a second Analog Input Block.

Parameter	Description
SECONDARY_VALUE_1_ UNIT	Selected unit code for Secondary_Value_1. It is the same as in Level_Unit. Mandatory: %, m, ft
SECONDARY_VALUE_2	Secondary_Value_2 is Sensor_Value + Sensor_Offset and the status of the Transducer Block. The unit is defined in Secondary_Value_2_Unit. It can be connected to a third Analog Input Block.
SECONDARY_VALUE_2_ UNIT	Selected unit code for Secondary_Value_2. It is the same as in Sensor_Unit. Mandatory for pressure: PA, mbar, psi, Mandatory for distance: m, ft.
SENSOR_HIGH_LIMIT	Upper Process limit of the sensor in Sensor_Units.
SENSOR_LOW_LIMIT	Lower Process limit of the sensor in Sensor_Units.
SENSOR_OFFSET	Sensor_Offset is a constant offset that is added to the Sensor_Value. The unit is defined in Sensor_Unit.
SENSOR_UNIT	Unit for Sensor_Value, Sensor_Low_Limit, Sensor_High_Limit, Cal_Point_Hi, Cal_Point_Lo, Max_Sensor_Value and Min_Sensor_Value Mandatory for pressure: PA, mbar, psi, Mandatory for distance: m, ft.
SENSOR_VALUE	Sensor value is the physical value of the sensor.
TEMPERATURE	Process temperature.
TEMPERATURE_UNIT	Temperature unit. Selects the unit of Temperature, Max_Temperature, Min_Temperature.
TAB_ENTRY	See 3.8.1, Table Table 54.
LIN_TYPE	See 3.8.1, Table Table 54.
TAB_X_Y_VALUE	See 3.8.1, Table Table 54.
TAB_MIN_NUMBER	See 3.8.1, Table Table 54.
TAB_MAX_NUMBER	See 3.8.1, Table Table 54.
TAB_OP_CODE	See 3.8.1, Table Table 54.
TAB_STATUS	See 3.8.1, Table Table 54.
TAB_ACTUAL_NUMBER	See 3.8.1, Table Table 54.

Table 106. Parameter Description of the Level Transducer Block

16.3.3 Parameter Attributes of the Level Transducer Block

Relative Index	Parameter Name	Object Type	Data Type	Store	Size	Access	Parameter Usage / Kind of Transport	Reset Class	Default Value	Download Order	Mandatory Optional (Class A,B)
... Standard Parameters see General Requirements											
Additional Level Transducer Block Parameters											
8	PRIMARY_VALUE	Record	101	D	5	r	C/a	-	-	-	M (B)
9	PRIMARY_VALUE_UNIT	Simple	Unsigned16	S	2	r,w	C/a	F	%	2	M (B)

Relative Index	Parameter Name	Object Type	Data Type	Store	Size	Access	Parameter Usage / Kind of Transport	Reset Class	Default Value	Download Order	Mandatory Optional (Class A,B)
10	LEVEL	Simple	Float	D	4	r	C/a	-	-	-	M (B)
11	LEVEL_UNIT	Simple	Unsigned16	S	2	r,w	C/a	F	%	3	M (B)
12	SENSOR_VALUE	Simple	Float	D	4	r	C/a	-	-	-	M (B)
13	SENSOR_UNIT	Simple	Unsigned16	S	2	r,w	C/a	F	-	4	M (B)
14	SECONDARY_VALUE_1	Record	101	D	5	r	C/a	-	-	-	O (B)
15	SECONDARY_VALUE_1_ UNIT	Simple	Unsigned16	S	2	r,w	C/a	F	-	-	O (B)
16	SECONDARY_VALUE_2	Record	101	D	5	r	C/a	-	-	-	O (B)
17	SECONDARY_VALUE_2_ UNIT	Simple	Unsigned16	S	2	r,w	C/a	F	-	-	O (B)
18	SENSOR_OFFSET	Simple	Float	S	4	r,w	C/a	F	0	5	M (B)
19	CAL_TYPE	Simple	Unsigned8	S	1	r,w	C/a	F	-	7 [1]	M (B)
20	CAL_POINT_LO	Simple	Float	S	4	r,w	C/a	F	-	8 [1]	M (B)
21	CAL_POINT_HI	Simple	Float	S	4	r,w	C/a	F	-	9 [1]	M (B)
22	LEVEL_LO	Simple	Float	S	4	r,w	C/a	F	0	10 [1]	M (B)
23	LEVEL_HI	Simple	Float	S	4	r,w	C/a	F	100	11 [1]	M (B)
24	LEVEL_OFFSET	Simple	Float	S	4	r,w	C/a	F	0	6	M (B)
25	LIN_TYPE	See 3.8.2, Table 55.								1	M (B)
26	LIN_DIAMETER	Simple	Float	S	4	r,w	C/a	F	100	-	O (B)
27	LIN_VOLUME	Simple	Float	S	4	r,w	C/a	F	100	-	O (B)
28	SENSOR_HIGH_LIMIT	Simple	Float	C	4	r	C/a	-	-	-	O (B)
29	SENSOR_LOW_LIMIT	Simple	Float	C	4	r	C/a	-	-	-	O (B)
30	MAX_SENSOR_VALUE	Simple	Float	N	4	r,w	C/a	I	-	-	O (B)
31	MIN_SENSOR_VALUE	Simple	Float	N	4	r,w	C/a	I	-	-	O (B)
32	TEMPERATURE	Simple	Float	D	4	r	C/a	-	-	-	O (B)
33	TEMPERATURE_UNIT	Simple	Unsigned16	S	2	r,w	C/a	F	°C	-	O (B)
34	MAX_TEMPERATURE	Simple	Float	N	4	r,w	C/a	I	-	-	O (B)
35	MIN_TEMPERATURE	Simple	Float	N	4	r,w	C/a	I	-	-	O (B)
36	TAB_ENTRY	See 3.8.2, Table 55.								-	O (B) [2]
37	TAB_X_Y_VALUE	See 3.8.2, Table 55.								-	O (B) [2]
38	TAB_MIN_NUMBER	See 3.8.2, Table 55.								-	O (B) [2]
39	TAB_MAX_NUMBER	See 3.8.2, Table 55.								-	O (B) [2]
40	TAB_OP_CODE	See 3.8.2, Table 55.								-	O (B) [2]
41	TAB_STATUS	See 3.8.2, Table 55.								-	O (B) [2]
42	TAB_ACTUAL_NUMBER	See 3.8.2, Table 55.								-	O (B) [2]
43-52	Reserved by PNO										M (A,B)

[1] Download only allowed if CAL_TYPE = 0.

[2] These parameters are mandatory if LIN_TYPE = 1 (linearisation table) is supported.

Relative Index	Parameter Name	Object Type	Data Type	Store	Size	Access	Parameter Usage / Kind of Transport	Reset Class	Default Value	Download Order	Mandatory Optional (Class A,B)
53	First manufacturer specific parameter										O (A,B)

Table 107. Parameter Attributes of the Level Transducer Block

16.3.4 View Object of the Level Transducer Block

Relative Index	Parameter Name	View_1	View_2	View_3	View_4
8	PRIMARY_VALUE	5			
9	PRIMARY_VALUE_UNIT				
10	LEVEL	4			
11	LEVEL_UNIT				
12	SENSOR_VALUE				
13	SENSOR_UNIT				
14	SECONDARY_VALUE_1				
15	SECONDARY_VALUE_1_UNIT				
16	SECONDARY_VALUE_2				
17	SECONDARY_VALUE_2_UNIT				
18	SENSOR_OFFSET				
19	CAL_TYPE				
20	CAL_POINT_LO				
21	CAL_POINT_HI				
22	LEVEL_LO				
23	LEVEL_HI				
24	LEVEL_OFFSET				
25	LIN_TYPE				
26	LIN_DIAMETER				
27	LIN_VOLUME				
28	SENSOR_HIGH_LIMIT				
29	SENSOR_LOW_LIMIT				
30	MAX_SENSOR_VALUE				
31	MIN_SENSOR_VALUE				
32	TEMPERATURE				
33	TEMPERATURE_UNIT				
34	MAX_TEMPERATURE				
35	MIN_TEMPERATURE				
36	TAB_ENTRY				
37	TAB_X/Y_VALUE				
38	TAB_MIN_NUMBER				
39	TAB_MAX_NUMBER				
40	TAB_OP_CODE				
41	TAB_STATUS				
42	TAB_ACTUAL_NUMBER				
-	Overall sum of bytes in View -Object (+ 13 Standard Parameter bytes)	9 + 13			

Table 108. View Object of the Level Transducer Block

16.4 Flow

16.4.1 Flow Transducer Block Overview

The flow Transducer Block describes the basic set of parameters for flow devices. The mandatory set of parameters for several measuring principles is described in the following chapter. The following diagram shows the functional interrelation of the parameters.

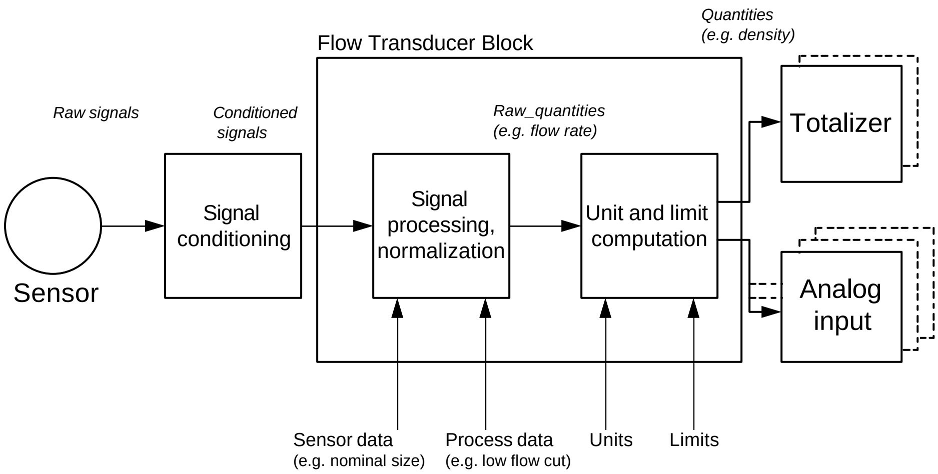


Figure 50. Functional Diagram of the Flow Transducer Block

16.4.2 Flow Transducer Block Parameter Description

The parameters of the flow Transducer Block depend on the type of flow meter. The following table gives an overview of the allocation of parameters. Parameters are defined for electromagnetic, coriolis, vortex, thermal, ultrasonic and variable area flow meters and differential pressure transmitters, in case they are applied for flow measurement (e.g. orifice plate). The following table assigns each parameter for use to one of the flow meter types. For this types all parameters are mandatory.

Parameter	Type of flow Meter					
	Electro-magnetic	Coriolis	Vortex	Thermal Mass	Ultra-sonic	Variable Area
CALIBR_FACTOR	X	X	X	X	X	X
NOMINAL_SIZE	X	X	X	X	X	X
NOMINAL_SIZE_UNITS	X	X	X	X	X	X
LOW_FLOW_CUTOFF	X	X	X	X	X	X
FLOW_DIRECTION	X	X			X	
ZERO_POINT	X	X		X	X	X
ZERO_POINT_ADJUST	X	X		X	X	X
ZERO_POINT_UNIT	X	X		X	X	X
MEASUREMENT_MODE	X	X			X	
SAMPLING_FREQUENCY	X					

Parameter	Type of flow Meter					
	Electro-magnetic	Coriolis	Vortex	Thermal Mass	Ultra-sonic	Variable Area
SAMPLING_FREQ_UNITS	X					
VOLUME_FLOW	X		X		X	X
VOLUME_FLOW_LO_LIMIT	X		X		X	X
VOLUME_FLOW_HI_LIMIT	X		X		X	X
VOLUME_FLOW_UNITS	X		X		X	X
MASS_FLOW		X		X		
MASS_FLOW_LO_LIMIT		X		X		
MASS_FLOW_HI_LIMIT		X		X		
MASS_FLOW_UNITS		X		X		
DENSITY		X				
DENSITY_LO_LIMIT		X				
DENSITY_HI_LIMIT		X				
DENSITY_UNITS		X				
TEMPERATURE		X				
TEMPERATURE_LO_LIMIT		X				
TEMPERATURE_HI_LIMIT		X				
TEMPERATURE_UNITS		X				
VORTEX_FREQUENCY			X			
VORTEX_FREQ_LO_LIMIT			X			
VORTEX_FREQ_HI_LIMIT			X			
VORTEX_FREQ_UNITS			X			
SOUND_VELOCITY					X	
SOUND_VELOCITY_LO_LIMIT					X	
SOUND_VELOCITY_HI_LIMIT					X	
SOUND_VELOCITY_UNITS					X	

Table 109. Overview of Parameters of the Transducer Block of Flow Device

16.4.2.1 Parameter Description of the Transducer Block of an Electromagnetic Flow Device

Parameter	Description
CALIBR_FACTOR	Gain compensation value for the flow sensor, so that flow indication is as accurate as specified by the manufacturer (Sensor specific, must not be downloaded).
FLOW_DIRECTION	Assigns an arbitrary positive or negative sign to the measured PV value.
LOW_FLOW_CUTOFF	Value can have an hysteresis. If the value has an hysteresis, LOW_FLOW_CUTOFF defines the lower switching point. The unit of this value is the unit of the PV.
MEASUREMENT_MODE	Mode of flow measurement, either unidirectional or bidirectional measurement.

Parameter	Description
NOMINAL_SIZE	Ideal size of the measuring pipe, or process pipe size for insertion type flow transmitter.
NOMINAL_SIZE_UNITS	Selects the unit for NOMINAL_SIZE parameter.
SAMPLING_FREQ	Indicates the field frequency of the sensor (Sensor specific, must not be downloaded).
SAMPLING_FREQ_UNITS	Selected unit code for SAMPLING_FREQ parameter.
VOLUME_FLOW	Measuring value, measured volume flow value. Primary Variable (PV) of this device type.
VOLUME_FLOW_HI_LIMIT	Absolute value of the upper range value (volume flow) of the sensor.
VOLUME_FLOW_LO_LIMIT	Absolute value of the lower range value (volume flow) of the sensor.
VOLUME_FLOW_UNITS	Selected unit code for VOLUME_FLOW, VOLUME_FLOW_LO_LIMIT and VOLUME_FLOW_HI_LIMIT parameters.
ZERO_POINT	Offset compensation value for the flow sensor, so that true zero flow value can be indicated during no flow condition (Sensor specific, must not be downloaded).
ZERO_POINT_ADJUST	Initiates a device specific adjustment cycle that determines the true ZERO_POINT value during no-flow process conditions. The result is placed in ZERO_POINT.
ZERO_POINT_UNIT	Selected unit code for ZERO_POINT parameter.

Table 110. Parameter Description of the Transducer Block of an Electromagnetic Flow Device

16.4.2.2 Parameter Description of the Transducer Block of a Coriolis Mass Flow Device

Parameter	Description
CALIBR_FACTOR	Gain compensation value for the flow sensor, so that flow indication is as accurate as specified by the manufacturer (Sensor specific, must not be downloaded).
DENSITY	Measuring value, measured medium density. Secondary Variable (SV) of this device type.
DENSITY_HI_LIMIT	Upper range value (density) of the sensor.
DENSITY_LO_LIMIT	Lower range value (density) of the sensor.
DENSITY_UNITS	Selected unit code for DENSITY, DENSITY_HI_LIMIT and DENSITY_LO_LIMIT parameters.
FLOW_DIRECTION	Assigns an arbitrary positive or negative sign to the measured PV value.
LOW_FLOW_CUTOFF	Value can have an hysteresis. If the value has an hysteresis, LOW_FLOW_CUTOFF defines the lower switching point. The unit of this value is the unit of the PV.
MASS_FLOW	Measuring value, measured mass-flow. Primary Variable (PV) of this device type.
MASS_FLOW_HI_LIMIT	Absolute value of the upper range value (mass flow) of the sensor.
MASS_FLOW_LO_LIMIT	Absolute value of lower range value (mass flow) of the sensor.

Parameter	Description
MASS_FLOW_UNITS	Selected unit code for MASS FLOW, MASS_FLOW_HI_LIMIT and MASS_FLOW_LO_LIMIT parameters.
MEASUREMENT_MODE	Mode of flow measurement, either unidirectional or bidirectional measurement.
NOMINAL_SIZE	Ideal size of the measuring pipe, or process pipe size for insertion type flow transmitter.
NOMINAL_SIZE_UNITS	Selects the unit for NOMINAL_SIZE parameter.
TEMPERATURE	Measured Sensor Temperature. Tertiary Variable (TV) of this device type.
TEMPERATURE UNITS	Selected unit code for TEMPERATURE, TEMPERATURE_HI_LIMIT and TEMPERATURE_LO_LIMIT parameters.
TEMPERATURE_HI_ LIMIT	Upper range value (temperature) of the sensor.
TEMPERATURE_LO_ LIMIT	Lower range value (temperature) of the sensor.
ZERO_POINT	Offset compensation value for the flow sensor, so that true zero flow value can be indicated during no flow condition (Sensor specific, must not be downloaded).
ZERO_POINT_ADJUST	Initiates a device specific adjustment cycle that determines the true ZERO_POINT value during no-flow process conditions. The result is placed in ZERO_POINT.
ZERO_POINT_UNIT	Selected unit code for ZERO_POINT parameter.

Table 111. Parameter Description of the Transducer Block of a Coriolis Mass Flow Device

16.4.2.3 Parameter Description of the Transducer Block of a Vortex Flow Meter

Parameter	Description
CALIBR_FACTOR	Gain compensation value for the flow sensor, so that flow indication is as accurate as specified by the manufacturer (Sensor specific, must not be downloaded).
LOW_FLOW_CUTOFF	Value can have an hysteresis. If the value has an hysteresis, LOW_FLOW_CUTOFF defines the lower switching point. The unit of this value is the unit of the PV.
NOMINAL_SIZE	Ideal size of the measuring pipe, or process pipe size for insertion type flow transmitter.
NOMINAL_SIZE_UNITS	Selects the unit for NOMINAL_SIZE parameter.
VOLUME_FLOW	Measuring value, measured volume flow. Primary Variable PV of this device type.
VOLUME_FLOW_HI_ LIMIT	Absolute value of the upper range value (volume flow) of the sensor.
VOLUME_FLOW_LO_ LIMIT	Absolute value of the lower range value (volume flow) of the sensor.
VOLUME_FLOW_UNITS	Selected unit code for VOLUME_FLOW, VOLUME_FLOW_LO_LIMIT and VOLUME_FLOW_HI_LIMITS parameters.
VORTEX_FREQ	Measured Vortex frequency, proportional to flow velocity. Secondary Variable (SV) of this device type.
VORTEX_FREQ_HI_LIMIT	Upper range value (vortex frequency) of the sensor.

Parameter	Description
VORTEX_FREQ_LO_LIMIT	Lower range value (vortex frequency) of the sensor.
VORTEX_FREQ_UNITS	Selected unit code for VORTEX_FREQ, VORTEX_FREQ_LO_LIMIT and VORTEX_FREQ_HI_LIMIT parameters.

Table 112. Parameter Description of the Transducer Block of a Vortex Flow Meter

16.4.2.4 Parameter Description of the Transducer Block of a Thermal Mass Flow Device

Parameter	Description
CALIBR_FACTOR	Gain compensation value for the flow sensor, so that flow indication is as accurate as specified by the manufacturer (Sensor specific, must not be downloaded).
LOW_FLOW_CUTOFF	Value can have an hysteresis. If the value has an hysteresis, LOW_FLOW_CUTOFF defines the lower switching point. The unit of this value is the unit of the PV.
MASS_FLOW	Measuring value, measured mass flow. Primary Variable (PV) of this device type.
MASS_FLOW_HI_LIMIT	Absolute value of the upper range value (mass flow) of the sensor.
MASS_FLOW_LO_LIMIT	Absolute value of lower range value (mass flow) of the sensor.
MASS_FLOW_UNITS	Selected unit code for MASS_FLOW, MASS_FLOW_LO_LIMIT and MASS_FLOW_HI_LIMIT parameters.
NOMINAL_SIZE	Ideal size of the measuring pipe, or process pipe size for insertion type flow transmitter.
NOMINAL_SIZE_UNITS	Selects the unit for NOMINAL_SIZE parameter.
ZERO_POINT	Offset compensation value for the flow sensor, so that true zero flow value can be indicated during no flow condition (Sensor specific, must not be downloaded).
ZERO_POINT_ADJUST	Initiates a device specific adjustment cycle that determines the true ZERO_POINT value during no-flow process conditions. The result is placed in ZERO_POINT.
ZERO_POINT_UNIT	Selected unit code for ZERO_POINT parameter.

Table 113. Parameter Description of the Transducer Block of a Thermal Mass Flow Device

16.4.2.5 Parameter Description of the Transducer Block of an Ultrasonic Flow Device

Parameter	Description
CALIBR_FACTOR	Gain compensation value for the flow sensor, so that flow indication is as accurate as specified by the manufacturer (Sensor specific, must not be downloaded).
FLOW_DIRECTION	Assigns an arbitrary positive or negative sign to the measured PV value.
LOW_FLOW_CUTOFF	Value can have an hysteresis. If the value has an hysteresis, LOW_FLOW_CUTOFF defines the lower switching point. The unit of this value is the unit of the PV.
NOMINAL_SIZE	Ideal size of the measuring pipe, or process pipe size for insertion type flow transmitter.
NOMINAL_SIZE_UNITS	Selects the unit for NOMINAL_SIZE parameter.

Parameter	Description
MEASUREMENT_MODE	Mode of flow measurement, either unidirectional or bidirectional measurement.
SOUND_VELOCITY	Sound velocity of the medium. Secondary Variable (SV) of this device type.
SOUND_VELOCITY_HI_ LIMIT	Upper range value (sound velocity) of the sensor.
SOUND_VELOCITY_LO_ LIMIT	Lower range value (sound velocity) of the sensor.
SOUND_VELOCITY_UNIT S	Selected unit code for SOUND_VELOCITY, SOUND_VELOCITY_LO_LIMIT and SOUND_VELOCITY_HI_LIMIT parameters.
VOLUME_FLOW	Measuring value, measured volume flow. Primary Variable (PV) of this device type.
VOLUME_FLOW_HI_ LIMIT	Absolute value of the upper range value (volume flow) of the sensor.
VOLUME_FLOW_LO_ LIMIT	Absolute value of the lower range value (volume flow) of the sensor.
VOLUME_FLOW_UNITS	Selected unit code for VOLUME_FLOW, VOLUME_FLOW_LO_LIMIT and VOLUME_FLOW_HI_LIMIT parameters.
ZERO_POINT	Offset compensation value for the flow sensor, so that true zero flow value can be indicated during no flow condition (Sensor specific, must not be downloaded).
ZERO_POINT_ADJUST	Initiates a device specific adjustment cycle that determines the true ZERO_POINT value during no-flow process conditions. The result is placed in ZERO_POINT.
ZERO_POINT_UNIT	Selected unit code for ZERO_POINT parameter.

Table 114. Parameter Description of the Transducer Block of an Ultrasonic Flow Device

16.4.2.6 Parameter Description of the Transducer Block of a Variable Area Flow Device

Parameter	Description
CALIBR_FACTOR	Gain compensation value for the flow sensor, so that flow indication is as accurate as specified by the manufacturer (Sensor specific, must not be downloaded).
LOW_FLOW_CUTOFF	Value can have an hysteresis. If the value has an hysteresis, LOW_FLOW_CUTOFF defines the lower switching point. The unit of this value is the unit of the PV.
NOMINAL_SIZE	Ideal size of the measuring pipe, or process pipe size for insertion type flow transmitter.
NOMINAL_SIZE_UNITS	Selects the unit for nominal size parameter.
VOLUME_FLOW	Measuring value, measured volume flow. Primary Variable (PV) of this device type.
VOLUME_FLOW_HI_ LIMIT	Absolute value of the upper range value (volume flow) of the sensor.
VOLUME_FLOW_LO_ LIMIT	Absolute value of the lower range value (volume flow) of the sensor.
VOLUME_FLOW_UNITS	Selected unit code for VOLUME_FLOW, VOLUME_FLOW_HI_LIMIT and VOLUME_FLOW_LO_LIMIT parameters.

Parameter	Description
ZERO_POINT	Offset compensation value for the flow sensor, so that true zero flow value can be indicated during no flow condition (Sensor specific, must not be downloaded).
ZERO_POINT_ADJUST	Initiates a device specific adjustment cycle that determines the true ZERO_POINT value during no-flow process conditions. The result is placed in ZERO_POINT. During active adjustment, the value of this Parameter is 1 (execute), otherwise 0.
ZERO_POINT_UNIT	Selected unit code for ZERO_POINT parameter.

Table 115. Parameter Description of the Transducer Block of a Variable Area Flow Device

16.4.2.7 Parameters of the Transducer Block of a Differential Pressure Transmitter

Its not possible to define a minimum set of parameters for a flow Transducer Block of a differential pressure transmitter. The output type of the primary variable of the Transducer Block (mass flow or volume flow) depends on the application. The differential pressure transmitter Transducer Block should deliver a sensor lower and upper range value and a corresponding unit.

16.4.3 Parameter Attributes of the Flow Transducer Block

Relative Index	Parameter Name	Object Type	Data Type	Store	Size	Access	Parameter Usage / Kind of Transport	Reset Class	Default Value	Download Order	Mandatory Optional (Class A,B)
... Standard Parameters see General Requirements											
Additional Flow Transducer Block Parameters											
8	CALIBR_FACTOR	Simple	Float	S	4	r,w	C/a	F	Sens or-spec	-	[1]
9	LOW_FLOW_CUTOFF	Simple	Float	S	4	r,w	C/a	F	0	12	[1]
10	MEASUREMENT_MODE	Simple	Unsigned8 0: unidir. 1: bidirect.	S	1	r,w	C/a	F	0	1	[1]
11	FLOW_DIRECTION	Simple	Unsigned8 0: positiv 1: negativ	S	1	r,w	C/a	F	0	2	[1]
12	ZERO_POINT	Simple	Float	S	4	r,w	C/a	F	Sens or-spec	-	[1]
13	ZERO_POINT_ADJUST	Simple	Unsigned8 0: cancel 1: execute	N	1	r,w	C/a	-	0	-	[1]
14	ZERO_POINT_UNIT	Simple	Unsigned16 1062: mm/s	S	2	r,w	C/a	-	1062	3	[1]
15	NOMINAL_SIZE	Simple	Float	S	4	r,w	C/a	F	-	-	[1]
16	NOMINAL_SIZE_UNITS	Simple	Unsigned16 1013: mm 1019: inch	S	2	r,w	C/a	-	1013	4	[1]
17	VOLUME_FLOW	Record	101	D	5	r	C/a	-	-	-	[1]
18	VOLUME_FLOW_UNITS	Simple	Unsigned16 1349: m3/h 1351: L/s 1357: CFM [2] 1363: GMP [3]	S	2	r,w	C/a	F	1349	5	[1]
19	VOLUME_FLOW_ LO_LIMIT	Simple	Float	S	4	r,w	C/a	F	-	-	[1]
20	VOLUME_FLOW_ HI_LIMIT	Simple	Float	S	4	r,w	C/a	F	-	-	[1]
21	MASS_FLOW	Record	101	D	5	r	C/a	-	-	-	[1]

[1] See Table 109.

[2] CFM: cubic feet per minute

[3] GPM: US gallon per minute

Relative Index	Parameter Name	Object Type	Data Type	Store	Size	Access	Parameter Usage / Kind of Transport	Reset Class	Default Value	Download Order	Mandatory Optional (Class A,B)
22	MASS_FLOW_UNITS	Simple	Unsigned16 1322: kg/s 1330: lb/s	S	2	r,w	C/a	F	1322	6	[1]
23	MASS_FLOW_LO_LIMIT	Simple	Float	S	4	r,w	C/a	F	-	-	[1]
24	MASS_FLOW_HI_LIMIT	Simple	Float	S	4	r,w	C/a	F	-	-	[1]
25	DENSITY	Record	101	D	5	r	C/a	-	-	-	[1]
26	DENSITY_UNITS	Simple	Unsigned16 1103: kg/l 1107: lb/ft3	S	2	r,w	C/a	F	1103	7	[1]
27	DENSITY_LO_LIMIT	Simple	Float	S	4	r,w	C/a	F	-	-	[1]
28	DENSITY_HI_LIMIT	Simple	Float	S	4	r,w	C/a	F	-	-	[1]
29	TEMPERATURE	Record	101	D	5	r	C/a	-	-	-	[1]
30	TEMPERATURE_UNITS	Simple	Unsigned16 1000: K 1001: °C 1002: °F	S	2	r,w	C/a	F	1000	8	[1]
31	TEMPERATURE_LO_LIMIT	Simple	Float	S	4	r,w	C/a	F	-	-	[1]
32	TEMPERATURE_HI_LIMIT	Simple	Float	S	4	r,w	C/a	F	-	-	[1]
33	VORTEX_FREQ	Record	101	D	5	r	C/a	-	-	-	[1]
34	VORTEX_FREQ_UNITS	Simple	Unsigned16 1077: Hz	S	2	r,w	C/a	F	1077	9	[1]
35	VORTEX_FREQ_LO_LIMIT	Simple	Float	S	4	r,w	C/a	F	-	-	[1]
36	VORTEX_FREQ_HI_LIMIT	Simple	Float	S	4	r,w	C/a	F	-	-	[1]
37	SOUND_VELOCITY	Record	101	D	5	r	C/a	-	-	-	[1]
38	SOUND_VELOCITY_ UNITS	Simple	Unsigned16 1061: m/s 1067: ft/s	S	2	r,w	C/a	F	1061	10	[1]
39	SOUND_VELOCITY_ LO_LIMIT	Simple	Float	S	4	r,w	C/a	F	-	-	[1]
40	SOUND_VELOCITY_ HI_LIMIT	Simple	Float	S	4	r,w	C/a	F	-	-	[1]
41	SAMPLING_FREQ	Record	101	D	5	r	C/a	-	-	-	[1]
42	SAMPLING_FREQ_UNITS	Simple	Unsigned16 1077: Hz	S	2	r,w	C/a	-	1077	11	[1]
43-52	Reserved by PNO										M (A,B)
53	First manufacturer specific parameter										O (A,B)

Table 116. Parameter Attributes of the Flow Transducer Block

16.4.3.1 View Object of the Flow Transducer Block

Relative Index	Parameter Name	View_1					
		Electro-magnetic	Coriolis	Vortex	Thermal Mass	Ultrasonic	Variable Area
8	CALIBR_FACTOR						
9	LOW_FLOW_CUTOFF						
10	MEASUREMENT_MODE						
11	FLOW_DIRECTION						
12	ZERO_POINT						
13	ZERO_POINT_ADJUST						
14	ZERO_POINT_UNIT						
15	NOMINAL_SIZE						
16	NOMINAL_SIZE_UNITS						
17	VOLUME_FLOW	5		5		5	5
18	VOLUME_FLOW_UNITS						
19	VOLUME_FLOW_LO_LIMIT						
20	VOLUME_FLOW_HI_LIMIT						
21	MASS_FLOW		5		5		
22	MASS_FLOW_UNITS						
23	MASS_FLOW_LO_LIMIT						
24	MASS_FLOW_HI_LIMIT						
25	DENSITY		5				
26	DENSITY_UNITS						
27	DENSITY_LO_LIMIT						
28	DENSITY_HI_LIMIT						
29	TEMPERATURE		5				
30	TEMPERATURE_UNITS						
31	TEMPERATURE_LO_LIMIT						
32	TEMPERATURE_HI_LIMIT						
33	VORTEX_FREQ			5			
34	VORTEX_FREQ_UNITS						
35	VORTEX_FREQ_LO_LIMIT						
36	VORTEX_FREQ_HI_LIMIT						
37	SOUND_VELOCITY					5	
38	SOUND_VELOCITY_UNITS						
39	SOUND_VELOCITY_LO_LIMIT						
40	SOUND_VELOCITY_HI_LIMIT						
41	SAMPLING_FREQ	5					
42	SAMPLING_FREQ_UNITS						
	Overall sum of bytes in View - Object (+ 13 byte Standard Param.)	10 + 13	15	10	5	10	5

Table 117. View Object of the Flow Transducer Block

16.5 Block Order and Assignment

There are three classes of flow devices. A class describes the relation (connection order) of the dynamic variables of the flow Transducer Block to following blocks (Analog Input Blocks and Totaliser Blocks).

Class	Dynamic Transducer Output Variable			
	Block 1	Block 2	Block 3	Block 4
Class 1	PV	TOT		
Class 2	PV	SV	TOT	
Class 3	PV	SV	TV	TOT

PV: Primary Variable, SV: Secondary Variable, TV: Tertiary Variable, TOT: Totaliser Block

Table 118. Flow Transducer Classes

16.5.1 Assignment of Dynamic Variables for Flow Devices

Device type (coded in Transducer class)	Transducer Output		
	PV	SV	TV
Coriolis	Mass flow	Density	Temperature
Electromagnetic	Volume flow	-	-
Thermal Mass	Mass flow	-	-
Ultrasonic	Volume flow	Sound velocity	-
Variable Area	Volume flow	-	-
Vortex	Volume flow	Vortex frequency	-

Table 119. Assignment of Dynamic Variables

17 Device Data Sheet Transmitter - Conformance Statement

Every device chooses the necessary subset out of the defined structures of this document. Choice of a subset follows certain rules defined in the conformance statements below. The tables show which structure is mandatory (M), conditional (C) and which are optional (O).

Parameter	Conformance class A	Conformance class B
Physical Block	M	M
Analog Input Function Block	M	M
Transducer Block	O	M
Temperature Transducer Block	O	C
Pressure Transducer Block	O	C
Level Transducer Block	O	C
Flow Transducer Block	O	C
other Function Blocks	O	O
other Transducer Blocks	O	O

Table 120. Conformance Statement of Transmitter Components

18 Device Data Sheet Transmitter - Document History

Changes from V3.0 to V3.0.1

Chapter/Figure/Table	Change
general	DS-33 replaced with 101
general	Reset class added
15.2.1 / Figure 27	Order of MAN-mode, Limit check and Fail safe.
15.2.1.1	Definition of the supported modes for the Function Blocks AI for Class B.
15.2.2 / Table 85	Handling of PV Scale.
15.3.1.1	Totalizer state machine
15.3.1.2	Totalizer actual Mode Calculation
15.3.1.3	Totalizer status Calculation
15.3.3 / Table 91	The parameter TOTAL is defined as "M(A,B)".
16.2.2 / Table 102	Relation between PRIMARY_VALUE_UNIT and PRIMARY_VALUE_TYPE.
16.2.2 / Table 102	PRIMARY_VALUE_UNIT: The minimum set of unit codes for volume is: m^3 (1034), L (1038),cf^3 - cubic feet (1043),GMP - US gallon (1048).
16.2.3 / Table 103	All default values for the parameters of the pressure transducer are removed.
16.2.3 / Table 103	Access and Storage of SECONDARY_VALUE_1_UNIT changed.
16.2.3 / Table 103	Order of the floats of the parameters SCALE_IN and SCALE_OUT described.
16.3.2 / Table 106 16.3.4 / Table 108	Adapted parameter names in table 25/27 according to table 26: INDEX -> TAB_ENTRY ACTUAL_NUMBER -> TAB_ACTUAL_NUMBER MIN_NUMBER -> TAB_MIN_NUMBER MAX_NUMBER -> TAB_MAX_NUMBER X_VALUE, Y_VALUE -> TAB_X_Y_VALUE
16.3.2 / Table 106	In the description of LIN_DIAMETER and LIN_VOLUME the linearisation types 20 and 21 are referenced.
16.3.3 / Table 107	TEMPERATURE_UNIT size shall be 2 bytes.
16.4.2 / Table 109	The Thermal Mass Transducer Block View Object supports only VOLUME_FLOW. The Ultrasonic Transducer Block View Object supports VOLUME_FLOW and SOUND_VELOCITY.

Table 121. Changes from V3.0 to V3.0.1

PROFIBUS - PA

Device Data Sheet

Discrete Input

19 Device Data Sheet Discrete Inputs

19.1 Additional Parameters for the Physical Block Parameter Description

There are no additional parameters. First manufacturer specific block parameter may be started at relative index 33.

19.2 Discrete Input Function Block

19.2.1 Discrete Input, DI Function Block Overview

Discrete Input Function Blocks represent e.g. inductive-, optical-, capacitive-, ultrasonic-, proximity, … switches.

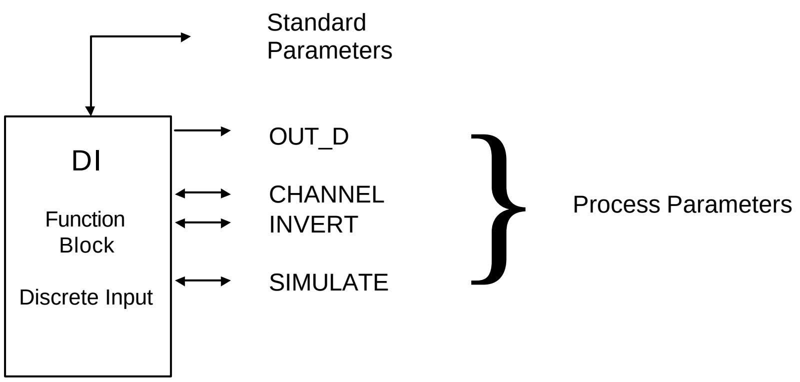


Figure 51. Summary of the Parameters of Discrete Input Function Blocks

The structure of the MODE and the simulation feature of the DI are shown in the following figure.

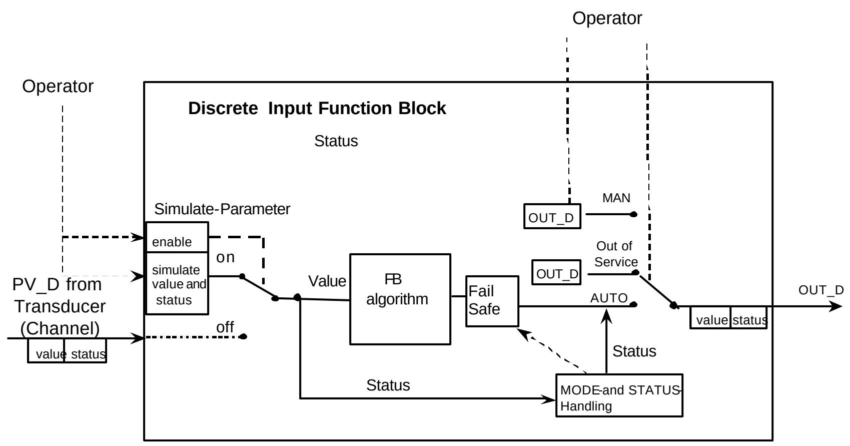


Figure 52. Simulation, Mode and Status Diagram of Discrete Input Function Block

The following figure presents a summary of the inputs and outputs of the Mode- and Status-generation.

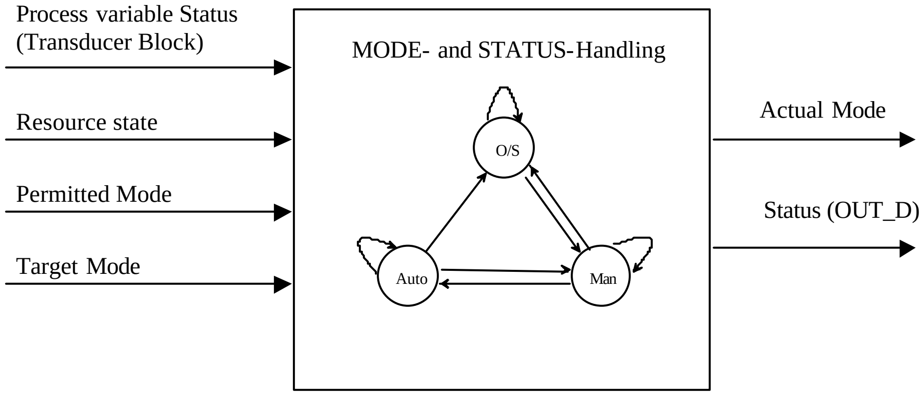


Figure 53. Conditions of Mode and Status Generation

The Transducer Block process variable Status is visible at the Transducer Block. The Resource state is not defined in the profile and device specific. It has to distinguish between *ok* and *not o.k.* in minimum. The Target Mode is set by the operator and the permitted Mode by the block designer. Actual Mode is an attribute of the FB-Parameter MODE_BLK and the result of the mode calculation (see General Requirement document).

The Status (OUT_D) is coupled with the OUT_D value (Data type 102) of the block.

19.2.1.1 DI State Machine

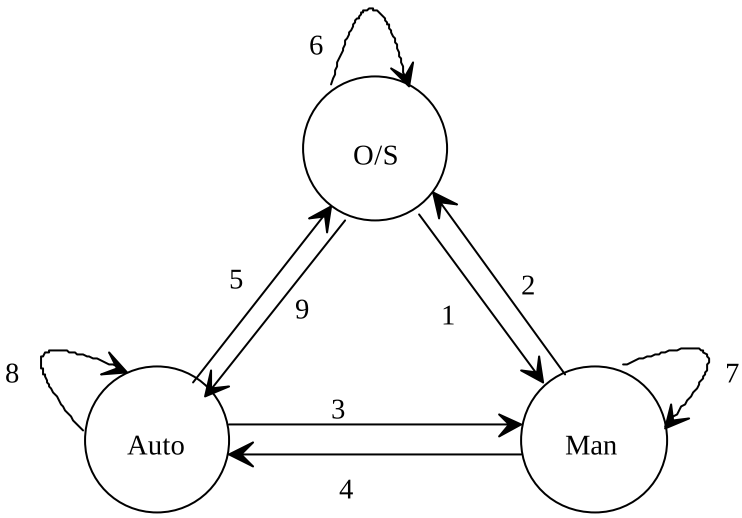


Figure 54. State Machine of the Discrete Input Function Block

The modes O/S (Out of Service), Man (Manual) and Auto (Automatic) are mandatory as permitted modes for DI-FBs according to conformance class B. The possible transitions are illustrated in Figure 54.

19.2.1.2 Actual Mode Calculation

The following table contains on the left side all conditions that demand a mode change from the current Actual Mode (last execution) to the new Actual Mode of the DI-Function Block. On the right side the results of the calculation are illustrated.

The first column contains the number of the transition of the state machine in Figure 54.

General condition: permitted modes are O/S, Man, Auto

Conditions			Result
Transition	Target-Mode (Operator)	Resource State	Actual Mode (calculated)
T2,T5,T6	*	<>o.k.	O/S
T2,T5,T6	O/S	o.k.	O/S
T4,T8,T9	Auto	o.k.	Auto
T1,T3,T7	Man	o.k.	Man

* no influence

Table 122. Conditions and Results of the Actual Mode Calculation

19.2.1.3 Output Status Calculation

The following table shows which conditions influence the Status of the output parameter. On the left side all conditions are illustrated and on the right side the result.

Conditions		Result
Actual-Mode	Status (Transducer output)	Status (OUT_D)
O/S	*	BAD - Out of Service - constant
Man	*	as written by the operator
Auto	BAD	Influenced by the following parameter FSAFE_TYPE
Auto	<> BAD	Influenced by the following parameters PV Sub status Alarms (ST_REV, Limits) Priority table of status (see General Requirements)

* no influence

Table 123. Conditions and Results of the Status Calculation of the Output parameter

19.2.2 Parameter Description of the Discrete Input Function Block

Parameter	Description
CHANNEL	Reference to the active Transducer Block which provides the measurement value to the Function Block. For more details, please see the General Requirement definitions.
INVERT	Indicates whether the input value of the PV_D should be logically inverted before it is stored in the OUT_D. Coding: 0: not inverted 1: inverted
FSAFE_TYPE	Defines reaction of device, if a fault is detected. Coding: 0: value FSAFE_VALUE is used as OUT_D Status = UNCERTAIN-substitute value 1: use of last stored valid OUT_D value Status = UNCERTAIN-last usable value (if no valid value is available UNCERTAIN-Initial Value shall be used) 2: OUT_D has the wrong calculated value and status Status = BAD-* (* as calculated)
FSAFE_VAL_D	Default value for the OUT_D parameter, if a sensor or sensor electronic fault is detected.
OUT_D	OUT_D is the output of the Function Block. The value is specified by the operator in MODE Man.
SIMULATE	For commissioning and test purposes the input value from the Transducer Block in the Discrete Input Function Block DI-FB can be modified. That means that the Transducer and DI-FB will be disconnected.

Table 124. Parameter Description of the Discrete Input Function Block

19.2.3 Parameter Attributes of the Discrete Input Function Block

Relative Index	Parameter Name	Object Type	Data Type	Store	Size	Access	Parameter Usage / Kind of Transport	Reset Class	Default Value	Mandatory Optional (Class A,B)
... Standard Parameters see General Requirements										
Additional Discrete Input Function Block Parameters										
10	OUT_D	Record	102	D	2	r,w	O/cyc	-	-	M
14	CHANNEL	Simple	Unsigned16	S	2	r,w	C/a	F	-	O(A), M(B)
15	INVERT	Simple	Unsigned8	S	1	r,w	C/a	F	0	M
20	FSAFE_TYPE	Simple	Unsigned8	S	1	r,w	C/a	F	-	O(A), M(B)
21	FSAFE_VAL_D	Simple	Unsigned8	S	1	r,w	C/a	F	0	M
24	SIMULATE	Record	DS-51	S	3	r,w	C/a	F	disabled	O(A), M(B)
25-34	Reserved by PNO									M
35	First manufacturer specific parameter									O

Table 125. Parameter Attributes of the Discrete Input Function Block

19.2.4 View Object of the Discrete Input Function Block

Relative Index	Parameter Name	View_1	View_2	View_3	View_4
10	OUT_D	2			
14	CHANNEL				
15	INVERT				
20	FSAFE_TYPE				
21	FSAFE_VAL_D				
24	SIMULATE				
	Overall sum of bytes in View-Object (+ 13 Standard Parameter bytes)	2 + 13			

Table 126. View Object of the Discrete Input Function Block

19.2.5 Additions to the Start-up and Break-down Phase

In addition to the definitions in the General Requirement document the following values must be settled at the start-up phase:

MODE_BLK (actual MODE) = O/S

20 Device Data Sheet Discrete Input - Transducer Blocks

20.1 Parameter Description of the Discrete Input Transducer Block

Parameter	Description
SENSOR_WIRE_CHECK	Enables the lead breakage and short circuit detection. Coding: 0: Lead breakage and short circuit detection enabled 1: Lead breakage detection enabled, short circuit detection disabled 2: Lead breakage detection disabled, short circuit detection enabled 3: Lead breakage and short circuit detection disabled
SENSOR_SER_NUM	Serial number of the sensor.
SENSOR_ID	Identification of the sensor (-type).
SENSOR_MAN	Manufacturer of the sensor.
PV_D	This parameter contains the measured value and status available to the Function Block.

Table 127. Parameter Description of the Discrete Input Transducer Block

20.2 Parameter Attributes of the Discrete Input Transducer Block

Relative Index	Parameter Name	Object Type	Data Type	Store	Size	Access	Parameter Usage / Kind of Transport	Reset Class	Default Value	Mandatory Optional (Class A,B)
... Standard Parameters see General Requirements										
Additional Parameters for Discrete Input Transducer Blocks										
8	SENSOR_WIRE_CHECK	Simple	Unsigned8	S	1	r,w	C/a	F	-	O
9	SENSOR_ID	Simple	OctetString	S	16	r,w	C/a	I	-	O
10	SENSOR_SER_NUM	Simple	OctetString	S	16	r,w	C/a	I	-	O
11	SENSOR_MAN	Simple	OctetString	S	16	r,w	C/a	I	-	O
12	PV_D	Record	102	D	2	r	C/a	-	-	M (B)
13-22	Reserved by PNO									M
23	First manufacturer specific parameter									O

Table 128. Parameter Attributes of the Discrete Input Transducer Block

20.3 View Object of the Discrete Input Transducer Block

Relative Index	Parameter Name	View_1	View_2	View_3	View_4
8	SENSOR_WIRE_CHECK				
9	SENSOR_ID				
10	SENSOR_SER_NUM				
11	SENSOR_MAN				
12	PV_D	2			
	Overall sum of bytes in View-Object (+ 13 Standard Parameter bytes)	2 + 13			

Table 129. View Object of the Discrete Input Transducer Block

21 Device Data Sheet Discrete Input - Conformance Statement

Every device chooses out the necessary subset of the defined structures of this document. To chioce of a subset follows certain rules defined in the conformance statements below. Table 130 show which structure is mandatory (M), selected (S) and which are optional (O).

Parameter	Conformance class A	Conformance class B
Physical Block	M	M
Discrete Input Function Block	M	M
Transducer Block	O	M
Discrete Input Transducer Block	O	S
Other Function Blocks	O	O
Other Transducer Blocks	O	O

Table 130. Conformance Statement of Discrete Input Components

22 Device Data Sheet Discrete Input - Document History

Changes from V3.0 to V3.0.1

Chapter/Figure/Table	Change
19.2.1.1	Sentence added below Figure 54: The modes O/S (Out of Service), MAN (Manual) and AUTO (Automatic) are mandatory as permitted modes for DI FBs according to conformance class B.
19.2.2/Table 124	Editorial: FSAVE_VALUE -> FSAFE_VAL_D
19.2.2/Table 124	Expected status changed in case of - FSAFE_TYPE=0: UNCERTAIN-Initial Value -> UNCERTAIN-Substitute Value - FSAFE_TYPE=2: BAD-Sensor Failure (0x08) -> BAD-* (*=as calculated)
19.2.3/Table 125	Editorial: FSAVE_TYPE -> FSAFE_TYPE FSAVE_VAL_D -> FSAFE_VAL_D
19.2.3/Table 125	Column “Reset Class” added. Default value for FSAFE_TYPE is deleted. Data type DS-34 replaced by Data type 102 according to Profile Guideline.
19.2.4/Table 126	Editorial: FSAVE_TYPE -> FSAFE_TYPE FSAVE_VAL_D -> FSAFE_VAL_D
20.2/Table 128	Column “Reset Class” added. Data type DS-34 replaced by Data type 102 according to Profile Guideline.

Table 131. Changes from V3.0 to V3.0.1

PROFIBUS - PA

Device Data Sheet

Discrete Output

23 Device Data Sheet Discrete Outputs

23.1 Additional Parameters for the Physical Block Parameter Description

There are no additional Parameters. First manufacturer specific block may be started at Relative Index 33.

23.2 Discrete Output, DO Function Block

23.2.1 Overview

This profile is meant to be for every kind of discrete output. So if a valve is mentioned it's just an example.

Discrete Output Function Block represents e.g. discrete valves, relay outputs, transistor outputs etc.

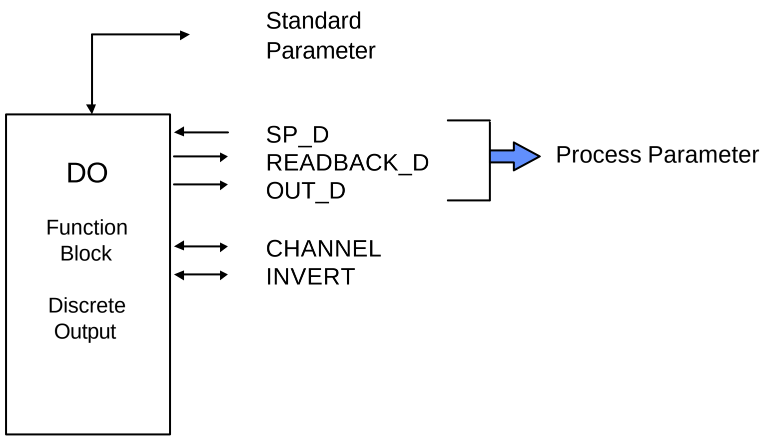


Figure 55. Summary of the Parameters of Discrete Output Function Block

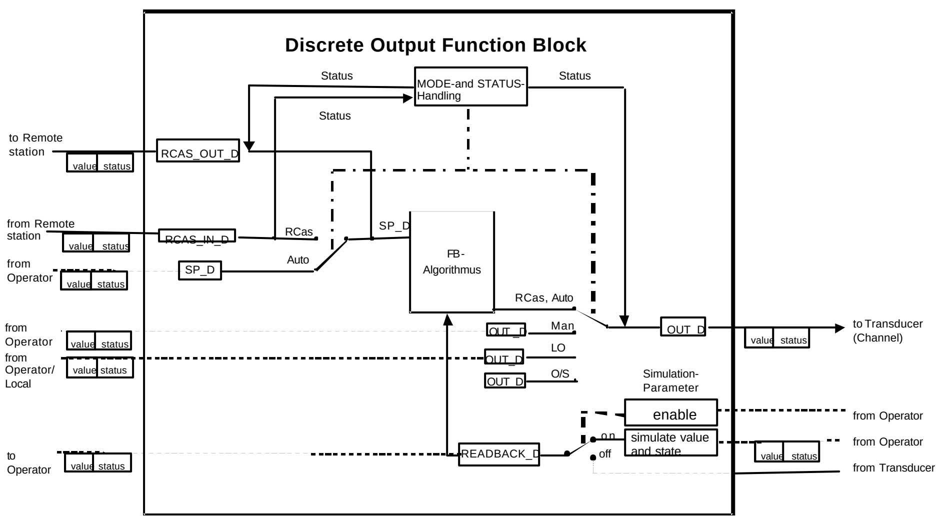


Figure 56. Simulation, Mode and Status Diagram of Discrete Output Function Block

The structure of the DO with Simulation, Mode and Status is shown in Figure 56.

The following figure presents a summary of all considering factors of the Mode and Status generation.

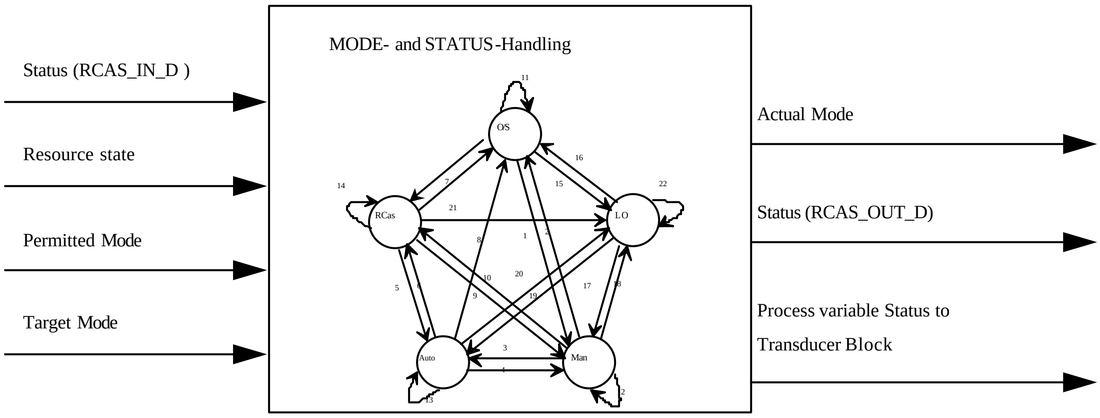


Figure 57. Conditions of Mode and Status Generation

The Status (RCAS_IN_D) is coupled with the value provided by a supervisory host for the target setpoint. The Resource state is not defined in the profile and device specific and has to distinguish between *OK* and *not OK* in minimum. The Target Mode is set by the operator and the permitted Mode by the block designer.

Actual Mode is an attribute of the FB parameter MODE_BLK and the result of the calculation. The Status (RCAS_OUT_D) is coupled with the RCAS_OUT_D value (Data type 102) from the block, provided to a supervisory host. The Process Status to Transducer Block is coupled with the primary Output value (Data type 102) from the Function Block to the Transducer Block.

23.2.1.1 DO State Machine

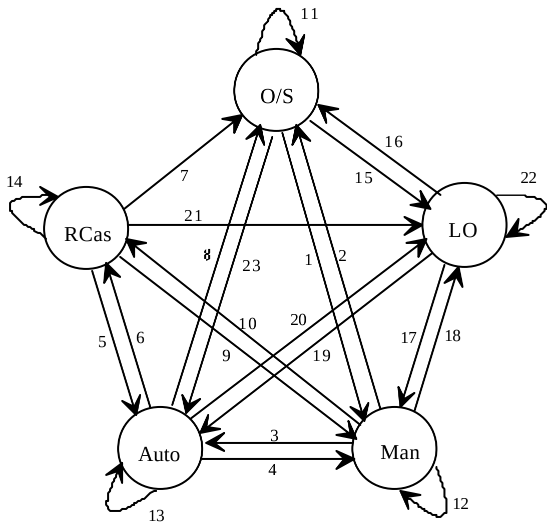


Figure 58. State Machine of the Discrete Output Function Block

The modes O/S (Out of Service), MAN (Manual) and AUTO (Automatic) are mandatory as permitted modes for DO FBs according to conformance class B. The modes LO (Local Override) and RCas (Remote Cascade) are optional. The possible mode changes (transitions) are illustrated in Figure 58.

23.2.1.2 Conditions on which the Actual Mode is calculated and the Target Mode is changed

The following table contains on the left side all conditions that demand a mode change from the Actual Mode (last execution) to the new Actual and Target Mode of the DO-Block. On the right side the results of the calculation are illustrated.

The first column contains the number of the transition of the state machine in section Figure 58.

Conditions						Results
Transi-tion	Target-Mode (Operator)	Actual-Mode (previous execution)	Resource State	Status (RCAS_IN_D)	Status of RCAS_IN_D<> GOOD (C) longer as FSAFE_TIME	Actual-Mode (calculated)
2,7,8,11, 16	*	*	<>o.k.	*	*	O/S
2,7,8,11, 16	O/S	*	o.k.	*	*	O/S
15, 18, 20, 21, 22	LO	*	o.k.			LO
1,4,9,12, 17	Man	*	o.k.	*	*	Man
3,5,13,19, 23	Auto	*	o.k.	*	*	Auto
19	RCas	LO	o.k.	*	*	Auto
23	RCas	O/S	o.k.	*	*	Auto
6	RCas	Auto	o.k.	GOOD (C)-IA	*	RCas
13	RCas	Auto	o.k.	<>GOOD (C)-IA	*	Auto
10	RCas	Man	o.k.	GOOD (C)-IA	*	RCas
12	RCas	Man	o.k.	<>GOOD (C)-IA	*	Man
14	RCas	RCas	o.k.	<>GOOD (C)	no	RCas
5	RCas	RCas	o.k.	<>GOOD (C)	yes	Auto
14	RCas	RCas	o.k.	GOOD (C)	*	RCas
5	RCas	RCas	o.k.	GOOD (C)-IFS	*	Auto

IA Initialization Acknowledge
* no influence

Table 132. Conditions and Results of the Actual Mode Calculation

23.2.1.3 Conditions on which the Output Status is generated

The following tables show which conditions influence the Status of the output parameters.

Conditions			Results
Actual-Mode	Status (SP_D)	Status (RCAS_IN_D)	Status (OUT_D)
O/S	*	*	BAD-Out of Service, constant
LO	*	*	GOOD (NC)- ok, constant
Man	*	*	Last status value and constant or as written by the operator
Auto	<> BAD and <> GOOD (NC)-IFS	*	GOOD (NC)
Auto	BAD (fail safe time still active)	*	GOOD (NC)
Auto	BAD (fail safe time ended) or GOOD (NC)-IFS	*	See FAIL_SAFE_TYPE
Rcas	*	GOOD (C)- *	GOOD (NC)- ok

* no influence

Table 133. Conditions and Results of the Status Calculation of the Output Parameter

Conditions			Results
Actual-Mode	Target-Mode	Status (RCAS_IN_D)	Status (RCAS_OUT_D)
O/S	*	*	BAD-Out of Service, constant
LO	*	*	GOOD (C)-Local Override, constant
Man	<>RCas	*	GOOD (C)-Not Invited,constant
Auto	<>RCas	*	GOOD (C)-Not Invited
Man	RCas	<> Initialization acknowledge	GOOD (C)-Initialization Request, constant
Man	RCas	Initialization acknowledge	GOOD (C)-ok
Auto	RCas	<> Initialization acknowledge	GOOD (C)-Initialization Request
Auto	RCas	Initialization acknowledge	GOOD (C)-ok
Rcas	RCas	GOOD(C) - *	GOOD (C)-ok

* no influence

Table 134. Conditions and Results of the Status Calculation of the Output Parameter

23.2.2 Parameter Description of the Discrete Output Function Block

Parameter	Description
CHANNEL	Reference to the active Transducer Block and its parameter, which provides the actual position of the final control element. For more description see General Requirements (CHANNEL)
CHECKBACK	Detailed information of the device, bitwize coded. More than one message is possible at once.
CHECK_BACK_MASK	Definition of supported CHECK_BACK information bits. Coding of each bit: 0: not supported 1: supported
FSAFE_TIME	Time in seconds from detection of failure of the actual used setpoint (SP_D = BAD or RCAS_IN <> GOOD) to the action of the block if the condition still exists. Note: A communication time out changes the status of the transmitted setpoint to BAD (see 10.4).
FSAFE_TYPE	Defines reaction of the device, if a failure of the actual used setpoint is still detected after FSAFE_TIME or if the status of the actual used setpoint is "Initiate Fail Safe". The calculated ACTUAL MODE is AUTO respectively (see Table 132). Coding: 0: value FSAFE_VALUE _D is used as setpoint status of OUT_D = UNCERTAIN - Substitute Value 1: storing last valid setpoint status of OUT_D = UNCERTAIN - Last usable Value or BAD - No communication, no LUV 2: actuator goes to fail-safe position defined by ACTUATOR_ACTION, status of OUT_D = BAD - non specific
FSAFE_VAL_D	OUT_D used if FSAFE_TYPE = 0 and FSAFE is activated.
INVERT	Indicates whether the SP_D should be logically inverted before writing to OUT_D in mode AUTO or RCAS. Coding: 0: not inverted 1: inverted
OUT_D	This parameter is the process variable of the discrete output block in AUTO, and RCas mode and is the value specified by the operator/engineer in MAN and LO. In case of BAD status the valve goes to the position specified in ACTUATOR_ACTION.
READBACK_D	In case of valve Control this Object indicates the position of the discrete valve and the sensor states. Bit 0 (LSB), 1: 0 = not initialized, 1 = closed, 2 = open, 3 = intermediate Bit 2: State sensor 1 Bit 3: Short circuit sensor 1, 1 = active, 0 = inactive Bit 4: Lead break sensor 1, 1 = active, 0 = inactive

Parameter	Description
	Bit 5: State sensor 2 Bit 6: Short circuit sensor 2, 1 = active, 0 = inactive Bit 7 (MSB): Lead break sensor 2, 1 = active, 0 = inactive
RCAS_IN_D	Target Setpoint and status provided by a supervisory Host to the discrete output block used in MODE RCAS.
RCAS_OUT_D	Function Block Setpoint and status provided to a supervisory Host for monitoring / back calculation and to allow action to be taken under limited conditions or mode change.
SIMULATE	For commissioning and maintenance reasons, it is possible to simulate the READBACK by defining the value and the status. That means that the Transducer Block and the DO-FB will be disconnected.
SP_D	Setpoint of Function Block used in MODE AUTO.

Table 135. Parameter Description of the Discrete Output Function Block

23.2.3 Parameter Attributes of the Discrete Output Function Block

Relative Index	Parameter Name	Object Type	Data Type	Store	Size	Access	Parameter Usage / Kind of Transport	Reset Class	Default Value	Mandatory Optional (Class A,B)
... Standard Parameters see General Requirements										
Additional Discrete Output Function Block Parameters										
9	SP_D	Record	102	D	2	r, w	I/a, cyc	-	-	M
10	OUT_D	Record	102	D	2	r, w	C/a	-	-	O(A), M(B)
12	READBACK_D	Record	102	D	2	r	O/a, cyc	-	-	O
14	RCAS_IN_D	Record	102	D	2	r, w	I/a, cyc	-	-	O
17	CHANNEL	Simple	Unsigned16	S	2	r, w	C/a	F	-	O(A), M(B)
18	INVERT	Simple	Unsigned8	S	1	r, w	C/a	F	0	M
19	FSAVE_TIME	Simple	Float	S	4	r, w	C/a	F	0	O(A), M(B)
20	FSAVE_TYPE	Simple	Unsigned8	S	1	r, w	C/a	F	-	O(A), M(B)
21	FSAVE_VAL_D	Simple	Unsigned8	S	1	r, w	C/a	F	0	O(A), M(B)
22	RCAS_OUT_D	Record	102	D	2	r	O/a, cyc	-	-	O
24	SIMULATE	Record	DS-51	S	3	r, w	C/a	F	disabled	O(A), M(B)
33	CHECK_BACK	Simple	OctetString	D	3	r	C/a, cyc	-	-	M
34	CHECK_BACK_MASK	Simple	OctetString	Cst	3	r	C/a	-	-	M
35-44	Reserved by PNO							-		M

Relative Index	Parameter Name	Object Type	Data Type	Store	Size	Access	Parameter Usage / Kind of Transport	Reset Class	Default Value	Mandatory Optional (Class A,B)
45	First manufacturer specific parameter							-		O

Table 136. Parameter Attributes of the Discrete Output Function Block

23.2.4 View Object of the Discrete Output Function Block

Relative Index	Parameter Name	View_1	View_2	View_3	View_4
9	SP_D	2			
10	OUT_D	2			
12	READBACK_D				
14	RCAS_IN_D	2			
17	CHANNEL				
18	INVERT				
19	FSAVE_TIME				
20	FSAVE_TYPE				
21	FSAVE_VAL_D				
22	RCAS_OUT_D	2			
24	SIMULATE				
33	CHECK_BACK	3			
34	CHECK_BACK_MASK				
	Overall sum of bytes in View-Object (+ 13 Standard Parameter bytes)	13 + 11			

Table 137. View Object of the Discrete Output Function Block

23.2.5 Coding of the Discrete Output FB Parameter CHECK_BACK

For the mapping of BitStrings to OctetStrings see 3.7.1, Table 8.

Bit	CHECKBACK Mnemonic	Description	Ind. Class
0	CB_FAIL_SAFE	Field device in Fail safe active	R
1	CB_REQ_LOC_OP	Request for local operation at device	R
2	CB_LOCAL_OP	Field device under local control	R
3	CB_OVERRIDE	Emergency override active	R
4	CB_DISC_DIR	Actual position feedback different from expected position	R
5	CB_LEAD_BREAK_VALVE	Indicates a lead break of the valve connection.	R
6	CB_SHORT_CIRCUIT_VALVE	Indicates a short circuit of the valve connection.	R
7	Not used		
8	CB_ACT_OPEN	Actuator is moving towards open direction	R
9	CB_ACT_CLOSE	Actuator is moving towards close direction	R
10	CB_UPDATE_EVT	The alert generated by any change to the static data of FB and TB	A
11	CB_SIMULATE	Simulation of process values is enabled	R

Bit	CHECKBACK Mnemonic	Description	Ind. Class
12	Not used		
13	CB_CONTR_ERR	Internal control loop disturbed	R
14	CB_CONTR_INACT	Valve inactive (status OUT_D BAD)	R
15	CB_SELFTEST	Device under self-test.	R
16	CB_TOT_VALVE_TRAV	Indicates that the total valve travel limit is exceeded	R
17	CB_BREAK_TIME_OPEN_TO_CLOSE	Limit for break time of change from OPEN to CLOSE exceeded.	R
18	CB_BREAK_TIME_CLOSE_TO_OPEN	Limit for break time of change from CLOSE to OPEN exceeded.	R
19	CB_CYCLE_TEST	Error occurred in the internal cycle test.	R
20	CB_TRAVEL_TIME_OPEN_TO_CLOSE	Limit for time between change from OPEN to CLOSE exceeded.	R
21	CB_TRAVEL_TIME_CLOSE_TO_OPEN	Limit for time between change CLOSE to OPEN exceeded.	R
22	CB_TRAVEL_BLOCKED	Valve mechanically blocked.	R
23	CB_ZERO_POINT_ERROR	Zero point position cannot be reached.	R

Table 138. Coding of the Discrete Output FB Parameter CHECK_BACK

Values of the CHECK_BACK bits:

0: not set
1: set

Indication Class:

R: Indication remains active as long as the reason for the message exists.
A: Indication will be automatically reset after 10 seconds.

23.3 Additions to Start-up and Break-down Phase

In addition to the definitions in the General Definitions the following values must be settled at the start-up phase: MODE_BLK (actual MODE) = O/S

24 Device Data Sheet Discrete Output - Transducer Blocks

24.1 Parameter Description of the Discrete Valve Control Transducer Block

The output of the Transducer Block is READBACK_D for discrete valve control applications. For each discrete output 2 proximity switches inputs are available. The input signals indicate the ON/OFF state of the valve.

Parameter	Description
ACTUATOR_ACTION	Fail-safe position for power-loss of the actuator resp. the valve: Coding: 0: not initialized 1: opening 2: closing
ACTUATOR_MAN	Name of the actuator Manufacturer
ACTUATOR_ SER_NUM	Serial number of the actuator belonging to the device.
ACTUATOR_ID	Identification of the actuator (-type)
TRAVEL_COUNT	Number of cycles from OPEN to CLOSE and CLOSE to OPEN (Sum of both)
TRAVEL_COUNT_LIM	Limit for TRAVEL_COUNT
BREAK_TIME_OPEN_ CLOSE	Setpoint for the time in 10 millisecond resolution between the change to state CLOSE and the indication that the valve leaves the state OPEN.
BREAK_TIME_CLOSE_ OPEN	Setpoint for the time in 10 millisecond resolution between the change to state OPEN and the indication that the valve leaves the state CLOSE.
BREAK_TIME_OPEN_ CLOSE_ACT	Actual time in 10 millisecond resolution between the change to state CLOSE and the indication that the valve leaves the state OPEN.
BREAK_TIME_CLOSE_ OPEN_ACT	Actual time in 10 millisecond resolution between the change to state OPEN and the indication that the valve leaves the state CLOSE.
BREAK_TIME_OPEN_ CLOSE_TOL	Maximal allowed time difference between BREAK_TIME_OPEN_CLOSE and BREAK_TIME_OPEN_CLOSE_ACT.
BREAK_TIME_CLOSE_ OPEN_TOL	Maximal allowed time difference between BREAK_TIME_CLOSE_OPEN and BREAK_TIME_CLOSE_OPEN_ACT.
CYCLE_TEST_CMD	Enables/disables an internal function test procedure. The function is defined vendor specific. Coding: 0: disabled 1: enabled
CYCLE_TEST_TIME	Time in seconds between two internal test cycles.
SELF_CALIB_CMD	Initiation of a device-specific calibration-procedure, manufacturer specific. 0 – default
SELF_CALIB_STATUS	Result or status of the device-specific calibration-procedure, manufacture specific. 0 – default

Parameter	Description
TRAVEL_TIME_CLOSE_OPEN	Setpoint for the time in 10 millisecond resolution between the changes of the state from CLOSE to OPEN.
TRAVEL_TIME_OPEN_CLOSE	Setpoint for the time in 10 millisecond resolution between the changes of the state from OPEN to CLOSE.
TRAVEL_TIME_CLOSE_OPEN_ACT	The last Travel time from close to open in 10 millisecond resolution.
TRAVEL_TIME_OPEN_CLOSE_ACT	The last Travel time from open to close in 10 millisecond resolution.
TRAVEL_TIME_CLOSE_OPEN_TOL	Maximal allowed time difference between TRAVEL_TIME_CLOSE_OPEN and TRAVEL_TIME_CLOSE_OPEN_ACT.
TRAVEL_TIME_OPEN_CLOSE_TOL	Maximal allowed time difference between TRAVEL_TIME_OPEN_CLOSE and TRAVEL_TIME_OPEN_CLOSE_ACT.
VALVE_MAN	Name of the valve Manufacturer
VALVE_SER_NUM	Serial number of the valve belonging to the device.
VALVE_ID	Identification of the valve (-type)
SENSOR_WIRE_CHECK	Enables the lead breakage and short circuit detection. Coding: 0: Lead breakage and short circuit detection enabled 1: Lead breakage detection enable, short circuit detection disabled 2: Lead breakage detection disable, short circuit detection enabled 3: Lead breakage and short circuit detection disabled

Table 139. Parameter Description of the Discrete Valve Control Transducer Block

24.2 Parameter Attributes of the Discrete Valve Control Transducer Block

Relative Index	Parameter Name	Object Type	Data Type	Store	Size	Access	Parameter Usage / Kind of Transport	Reset Class	Default Value	Mandatory Optional (Class A,B)
... Standard Parameters see General Requirements										
Additional Transducer Block Parameters for Discrete Valve Control Devices										
8	VALVE_MAN	Simple	OctetString	S	16	r,w	C/a	I	-	O (B)
9	ACTUATOR_MAN	Simple	OctetString	S	16	r,w	C/a	I	-	O (B)
10	VALVE_SER_NUM	Simple	OctetString	S	16	r,w	C/a	I	-	O (B)
11	ACTUATOR_SER_NUM	Simple	OctetString	S	16	r,w	C/a	I	-	O (B)
12	VALVE_ID	Simple	OctetString	S	16	r,w	C/a	I	-	O (B)
13	ACTUATOR_ID	Simple	OctetString	S	16	r,w	C/a	I	-	O (B)
14	ACTUATOR_ACTION	Simple	Unsigned8	S	1	r,w	C/a	F	-	M (B)
15	TRAVEL_COUNT	Simple	Unsigned32	N	4	r,w	C/a	[1]	-	O (B)
16	TRAVEL_COUNT_LIM	Simple	Unsigned32	S	4	r,w	C/a	F	-	O (B)
17	BREAK_TIME_OPEN_ CLOSE	Simple	Unsigned16	S	2	r,w	C/a	F	-	O (B)
18	BREAK_TIME_CLOSE_ OPEN	Simple	Unsigned16	S	2	r,w	C/a	F	-	O (B)
19	BREAK_TIME_OPEN_ CLOSE_ACT	Simple	Unsigned16	D	2	r	C/a	-	-	O (B)
20	BREAK_TIME_CLOSE_ OPEN_ACT	Simple	Unsigned16	D	2	r	C/a	-	-	O (B)
21	BREAK_TIME_OPEN_ CLOSE_TOL	Simple	Unsigned16	S	2	r,w	C/a	F	-	O (B)
22	BREAK_TIME_CLOSE_ OPEN_TOL	Simple	Unsigned16	S	2	r,w	C/a	F	-	O (B)
23	CYCLE_TEST_CMD	Simple	Unsigned8	S	1	r,w	C/a	F	-	O (B)
24	CYCLE_TEST_TIME	Simple	Unsigned16	S	2	r,w	C/a	F	-	O (B)
25	TRAVEL_TIME_CLOSE_ OPEN	Simple	Unsigned16	S	2	r,w	C/a	F	-	O (B)
26	TRAVEL_TIME_OPEN_ CLOSE	Simple	Unsigned16	S	2	r,w	C/a	F	-	O (B)
27	TRAVEL_TIME_CLOSE_ OPEN_ACT	Simple	Unsigned16	D	2	r	C/a	-	-	O (B)
28	TRAVEL_TIME_OPEN_ CLOSE_ACT	Simple	Unsigned16	D	2	r	C/a	-	-	O (B)
29	TRAVEL_TIME_CLOSE_ OPEN_TOL	Simple	Unsigned16	S	2	r,w	C/a	F	-	O (B)
30	TRAVEL_TIME_OPEN_ CLOSE_TOL	Simple	Unsigned16	S	2	r,w	C/a	F	-	O (B)
31	SELF_CALIB_CMD	Simple	Unsigned8	N	1	r,w	C/a	-	-	M (B)

[1] Manufacturer specific

Relative Index	Parameter Name	Object Type	Data Type	Store	Size	Access	Parameter Usage / Kind of Transport	Reset Class	Default Value	Mandatory Optional (Class A,B)
32	SELF_CALIB_STATUS	Simple	Unsigned8	N	1	r	C/a	-	-	M (B)
33	SENSOR_WIRE_CHECK	Simple	Unsigned8	S	1	r,w	C/a	F	-	O (B)
34-43	Reserved by PNO									

Table 140. Parameter Attributes of the Discrete Valve Control Transducer Block

24.3 View Object of the Discrete Valve Control Transducer Block

Relative Index	Parameter Name	View_1	View_2	View_3	View_4
8	VALVE_MAN				
9	ACTUATOR_MAN				
10	VALVE_SER_NUM				
11	ACTUATOR_SER_NUM				
12	VALVE_ID				
13	ACTUATOR_ID				
14	ACTUATOR_ACTION				
15	TRAVEL_COUNT				
16	TRAVEL_COUNT_LIM				
17	BREAK_TIME_OPEN_CLOSE				
18	BREAK_TIME_CLOSE_OPEN				
19	BREAK_TIME_OPEN_CLOSE_ACT				
20	BREAK_TIME_CLOSE_OPEN_ACT				
21	BREAK_TIME_OPEN_CLOSE_TOL				
22	BREAK_TIME_CLOSE_OPEN_TOL				
23	CYCLE_TEST_CMD				
24	CYCLE_TEST_TIME				
25	TRAVEL_TIME_CLOSE_OPEN				
26	TRAVEL_TIME_OPEN_CLOSE				
27	TRAVEL_TIME_CLOSE_OPEN _ACT				
28	TRAVEL_TIME_OPEN_CLOSE _ACT				
29	TRAVEL_TIME_CLOSE_OPEN _TOL				
30	TRAVEL_TIME_OPEN_CLOSE _TOL				
31	SELF_CALIB_CMD				
32	SELF_CALIB_STATUS				
33	SENSOR_WIRE_CHECK				
	Overall sum of bytes in View-Object (+ 13 Standard Parameter bytes)	13			

Table 141. View Object of the Discrete Valve Control Transducer Block

25 Device Data Sheet Discrete Output - Conformance Statement

Every device chooses out of the defined structures of this document the necessary subset. To choose a subset follows certain rules defined in the conformance statements below. The tables show which structure is mandatory (M), selected (S) and which are optional (O).

Parameter	Conformance class A	Conformance class B
Physical Block	M	M
Discrete Output Function Block	M	M
Transducer Block	O	M
Discrete valve Transducer Block	O	S
Other Function Blocks	O	O
Other Transducer Blocks	O	O

Table 142. Conformance Statement of Discrete Output Components

26 Device Data Sheet Discrete Output - Document History

Changes from V3.0 to V3.0.1

Chapter/Figure/Table	Change
24.2.1/Figure 56	The value written to by the operator in mode Man is OUT_D instead of SP_D.
24.2.1	DS-34 replaced by data type 102.
24.2.1.1	Sentence changed below Figure 4: The modes O/S (Out of Service), MAN (Manual) and AUTO (Automatic) are mandatory as permitted modes for DO FBs according to conformance class B. The modes LO (Local Override) and Rcas (Remote Cascade) are optional.
24.2.3/Table 136	In column “Mandatory optional Class (A/B)” all “cyc optional” deleted. RCAS_IN_D and RCAS_OUT_D are now O(A/B). Default value for FSAVE_TYPE is deleted. Column “Reset Class” added. Data type DS-34 replaced by data type 102.
24.2.5/Table 138	Description for CB_DISC_DIR changed: Actual position feedback different from expected position Bit 23 CB_ZERO_POINT_ERROR added: Zero point position cannot be reached
25.2/Table 140	Column “Reset Class” added.

Table 143. Changes from V3.0 to V3.0.1

PROFIBUS - PA
Device Data Sheet

Actuator

27 Device Data Sheet Actuator

27.1 Function parameters for the Physical Block

27.1.1 Additional Physical Block Parameter Descriptions

There are no additional parameters.
First manufacturer specific block may be started at Relative Index 33.

27.2 Function parameters for Analog Output Function Block

27.2.1 Analog Output Function Block Overview

Analog Output Function Blocks in this document represent positioners or valves for the actuation of final control. The parameters are shown in the following figure.

Variable speed motor drives (i.e. pumps, ventilators, drives, ...) are not included in the scope of this device data sheet.

The Analog Output Function Block can also be used for other analog outputs than valves. In this case all parameters related to valves have to be used in a way corresponding to the transducer used in this application.

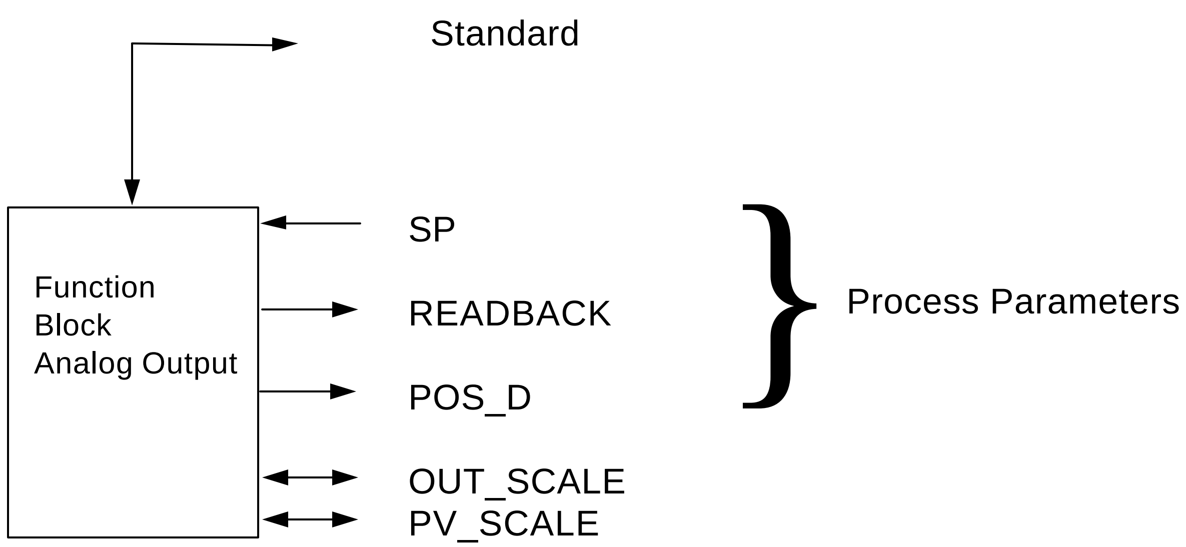


Figure 59. Summary of Parameters of the Analog Output Function Block

27.2.2 Analog Output Function Block Structure

The structure of the AO with Simulation, Mode and Status is shown in Figure 60. More details about the relationships between some AO parameters are visible in Figure 63.

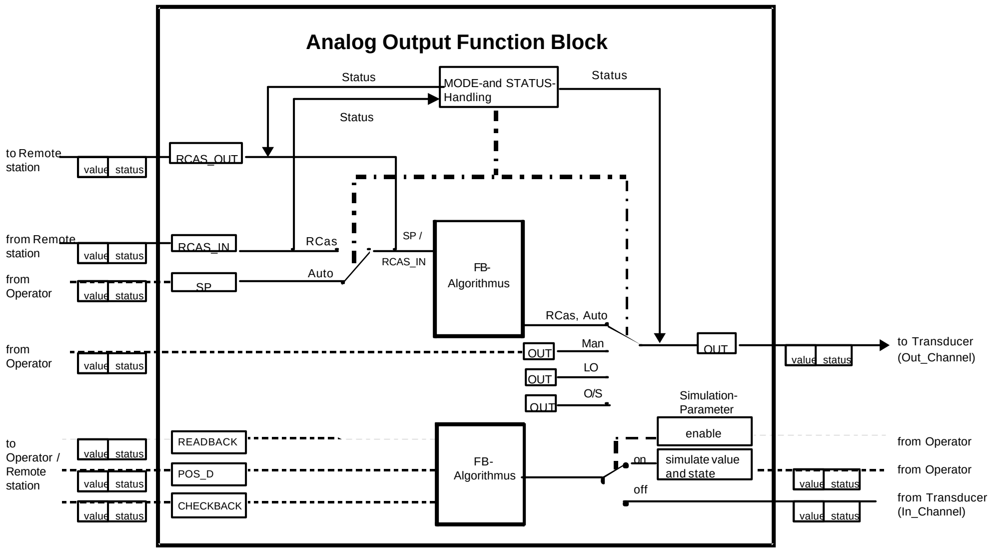


Figure 60. Mode and Simulation Diagram of Analog Output Function Block

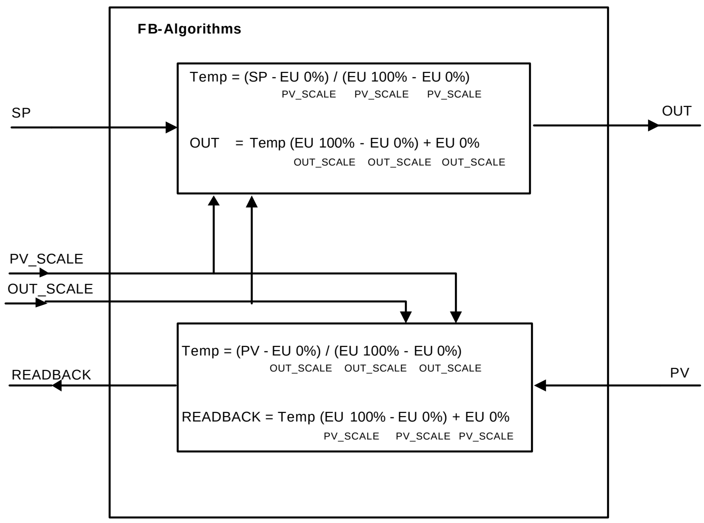


Figure 61. Parameter Relationship of AO FB

27.2.3 Analog Output Function Block State Machine

The following figure presents a summary of all considering factors of the Mode and Status generation.

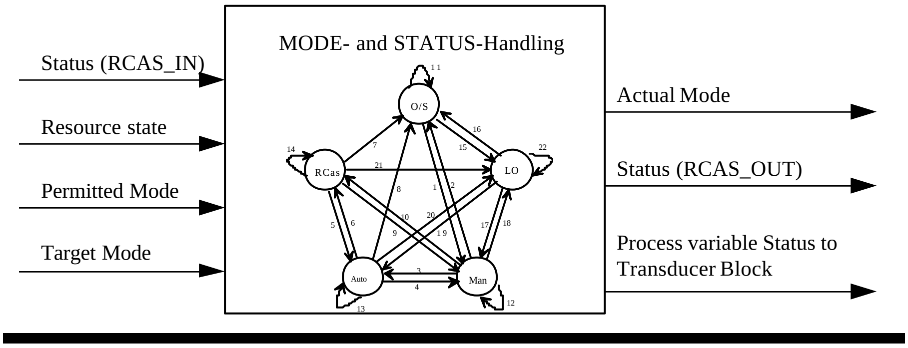


Figure 62. Conditions of Mode and Status generation

The Status (RCAS_IN) is coupled with the value provided by a supervisory host for the target set point. The Resource state is not defined in the profile and device specific and has to distinguish between *OK* and *not OK* in minimum. Permitted and Target Mode are attributes from the FB-Parameter MODE_BLK. The Target Mode is set by the operator and the Permitted Mode by the block designer. Actual Mode is an attribute of the FB parameter MODE_BLK and the result of the calculation. The Status (RCAS_OUT) is coupled with the RCAS_OUT value (Data type 101) from the block, provided to a supervisory host. The Process Status to Transducer Block is coupled with the primary Output value (Data type 101) from the Function Block to the Transducer Block.

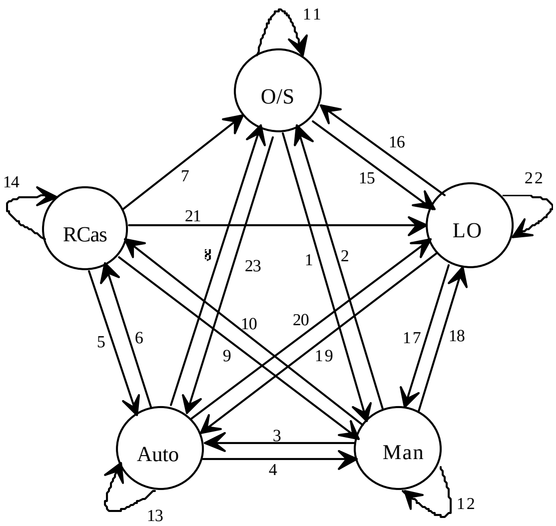


Figure 63. State Machine of the Analog Output Function Block

The modes O/S (Out of Service), MAN (Manual) and AUTO (Automatic) are mandatory as permitted modes for AO Function Blocks according to conformance class B. The modes LO (Local Override) and RCas (Remote Cascade) are optional. The possible mode changes (transitions) are illustrated in Figure 63.

27.2.3.1 Conditions on which the Actual Mode is calculated and the Target Mode is changed

The following table contains on the left side all conditions that demand a mode change from the Actual Mode (last execution) to the new Actual and Target Mode of the AO-Block. On the right side the results of the calculation are illustrated.

The first column contains the number of the transition of the state machine in section Figure 63.

Conditions						Results
Transition	Target-Mode (Operator)	Actual-Mode (previous execution)	Resource State	Status (RCAS_IN)	Status of RCAS_IN <> GOOD (C) longer as FSAFE_TIME	Actual-Mode (calculated)
2,7,8,11	*	*	<>o.k.	*	*	O/S
2,7,8,11, 16	O/S	*	o.k.	*	*	O/S
15, 18, 20, 21, 22	LO	*	o.k.			LO
1,4,9,12, 17	Man	*	o.k.	*	*	Man
3,5,13,19,23	Auto	*	o.k.	*	*	Auto
19	RCas	LO	o.k.	*	*	Auto
23	RCas	O/S	o.k.	*	*	Auto
6	RCas	Auto	o.k.	GOOD (C)-IA	*	RCas
13	RCas	Auto	o.k.	<>GOOD (C)-IA	*	Auto
10	RCas	Man	o.k.	GOOD (C)-IA	*	RCas
12	RCas	Man	o.k.	<>GOOD (C)-IA	*	Man
14	RCas	RCas	o.k.	<>GOOD (C)	no	RCas
5	RCas	RCas	o.k.	<>GOOD (C)	yes	Auto
14	RCas	RCas	o.k.	GOOD (C)	*	RCas
5	RCas	RCas	o.k.	GOOD (C)-IFS	*	Auto

IA Initialization Acknowledge
* no influence

Table 144. Conditions and Results of the Actual Mode Calculation

27.2.3.2 Conditions on which the Output Status is generated

The following table shows the conditions that influence the status of the output parameters. On the left side all conditions and on the right side the results are illustrated.

Conditions			Results
Actual-Mode	Status (SP)	Status (RCAS_IN)	Status (OUT)
O/S	*	*	BAD- Out of Service, constant
LO	*	*	GOOD (NC)- ok, constant
Man	*	*	last status value and constant or as written by the operator
Auto	<> BAD and <> GOOD (NC)-IFS	*	GOOD (NC)
Auto	BAD (fail safe time still active)	*	GOOD (NC)
Auto	BAD (fail safe time ended) or GOOD (NC)-IFS	*	see FAIL_SAFE_TYPE
RCas	*	GOOD (C)- *	GOOD (NC)- ok

* no influence

Table 145. Conditions and Results of the Status Calculation of the Output Parameter

Conditions			Results
Actual-Mode	Target-Mode	Status (RCAS_IN)	Status (RCAS_OUT)
O/S	*	*	BAD-Out of Service, Constant
LO	*	*	GOOD (C)-Local Override, Constant
Man	<>RCas	*	GOOD (C)-Not Invited, Constant
Auto	<>RCas	*	GOOD (C)-Not Invited
Man	RCas	<> Initialization acknowledge	GOOD (C)-Initialization Request, Constant
Man	RCas	Initialization acknowledge	GOOD (C)-ok
Auto	RCas	<> Initialization acknowledge	GOOD (C)-Initialization Request
Auto	RCas	Initialization acknowledge	GOOD (C)-ok
RCas	RCas	GOOD (C)- *	GOOD (C)-ok

* no influence

Table 146. Conditions and Results of the Status Calculation of Cascade Handling

27.2.4 Parameter Description of the Analog Output Function Block

Parameter	Description
CHECK_BACK	Detailed information of the device, bitwise coded. More than one message possible at once.
CHECK_BACK_MASK	Definition of supported CHECK_BACK information bits. Coding: 0: not supported 1: supported
FSAFE_TIME	Time in seconds from detection of failure of the actual used set point (SP = BAD or RCAS_IN <> GOOD) to the action of the block if the condition still exists. Note: A communication time out changes the status of the transmitted set point to BAD (see Mapping).
FSAFE_TYPE	Defines reaction of the device, if a failure of the actual used set point is still detected after FSAFE_TIME or if the status of actual used set point is Initiate Fail Safe. The calculated ACTUAL MODE is AUTO respectively (see Table 1). 0: value FSAFE_VALUE is used as set point status of OUT = UNCERTAIN - Substitute Value 1: use last valid set point status of OUT = UNCERTAIN - Last usable Value or BAD - No communication, no LUV 2: actuator goes to fail-safe position defined by ACTUATOR_ACTION (only useful for actuators with spring return) status of OUT = BAD - non specific
FSAFE_VALUE	Set point used if FSAFE_TYPE = 1 and FSAFE is activated.
INCREASE_CLOSE	Direction of positioner in mode RCas and Auto Coding: 0: rising (increasing of set point input results in OPENING of the valve) 1: falling (increasing of set point input results in CLOSING of the valve)
IN_CHANNEL	Reference to the active Transducer Block and its parameter that provides the actual position of the final control element. For more description see General Requirements (CHANNEL).
OUT	This parameter is the process variable of the analog output block in engineering units in AUTO and RCas mode and is the value specified by the operator/engineer in Man and LO mode.
OUT_CHANNEL	Reference to the active Transducer Block and its parameter that provides the position value for the final control element. For more description see General Requirements (CHANNEL).
OUT_SCALE	Conversion of the OUT of the Function Block in percent to OUT in engineering units as the output value of the Function Block. The high and low scale values, engineering unit code, and the number of digits to the right of the decimal point. The following units should be supported in minimum: mm, ° (Degrees), % (depending on VALVE_TYPE)

Parameter	Description
POS_D	The current position of the valve (discrete). Coding: 0: not initialized 1: closed 2: opened 3: intermediate
PV_SCALE	Conversion of the PV in engineering units to PV in percent as the input value of the Function Block. It consists of the high and low scale values, engineering unit code, and number of digits to the right of the decimal point.
RCAS_IN	Target set point in units of PV_SCALE and status provided by a supervisory host to the analog control or output block in mode RCas.
RCAS_OUT	Function Block set point in units of PV_SCALE and status. Provided to a supervisory Host for monitoring / back calculation and to allow action to be taken under limited conditions or mode change.
READBACK	The actual position of the final control element within the travel span (between OPEN and CLOSE position) in units of PV_SCALE.
SETP_DEVIATION	Difference between set point signal and feedback position in % travel span (between OPEN and CLOSE position).
SIMULATE	For commissioning and maintenance reasons, it is possible to simulate the READBACK by defining the value and the status. That means that the Transducer Block and the DO-FB will be disconnected.
SP	Set point. Defines the position of the final control element within the travel span (between OPEN and CLOSE position) in units of PV_SCALE in mode AUTO.

Table 147. Parameter Description of the Analog Output Function Block

27.2.5 Parameter Attributes of the Analog Output Function Block

Relative Index	Parameter Name	Object Type	Data Type	Store	Size	Access	Parameter Usage / Kind of Transport	Reset Class	Default Value	Mandatory Optional (Class A,B)
... Standard Parameters see General Requirements										
Additional Analog Output Function Block Parameters										
9	SP	Record	101	D	5	r,w	I/cyc	-	-	M
11	PV_SCALE	Record	DS-36	S	11	r,w	C/a	F	100, 0, %	M
12	READBACK	Record	101	D	5	r	O/cyc	-	-	O (A), M (B)
14	RCAS_IN	Record	101	D	5	r,w	I/cyc	-	-	O (B)
21	IN_CHANNEL	Simple	Unsigned16	S	2	r,w	C/a	F	-	O (A), M (B)
22	OUT_CHANNEL	Simple	Unsigned16	S	2	r,w	C/a	F	-	O (A), M (B)
23	FSAFE_TIME	Simple	Float	S	4	r,w	C/a	F	0	O (A), M (B)
24	FSAFE_TYPE	Simple	Unsigned8	S	1	r,w	C/a	F	2	O (A), M (B)
25	FSAFE_VALUE	Simple	Float	S	4	r,w	C/a	F	0	O (A), M (B)
27	RCAS_OUT	Record	101	D	5	r	O/cyc	-	-	O (B)
31	POS_D	Record	102	D	2	r	O/cyc	-	-	M
32	SETP_DEVIATION	Simple	Float	D	4	r	C/a	-	-	O
33	CHECK_BACK	Simple	OctetString	D	3	r	O/cyc	-	-	O (A), M (B)
34	CHECK_BACK_MASK	Simple	OctetString	Cst	3	r	C/a	-	-	O (A), M (B)
35	SIMULATE	Record	DS-50	S	6	r,w	C/a	F	disabled	O (A), M (B)
36	INCREASE_CLOSE	Simple	Unsigned8	S	1	r,w	C/a	F	0	O (A), M (B)
37	OUT	Record	101	D	5	r,w	C/a	-	-	O (A), M (B)
38	OUT_SCALE	Record	DS-36	S	11	r,w	C/a	F	-	M
39-48	Reserved by PNO									M
49	First manufacturer specific parameter									O

Table 148. Parameter Attributes of the Analog Output Function Block

27.2.6 View Object of the Analog Output Function Block

Relative Index	Parameter Name	View_1	View_2	View_3	View_4
9	SP				
11	PV_SCALE				
12	READBACK	5			
14	RCAS_IN				
21	CHANNEL				
23	FSAFE_TIME				
24	FSAFE_TYPE				
25	FSAFE_VALUE				
27	RCAS_OUT				
31	POS_D	2			
32	SETP_DEV				
33	CHECK_BACK	3			
34	CHECK_BACK_MASK				
35	SIMULATE				
36	INCREASE_CLOSE				
37	OUT				
38	OUT_SCALE				
	Overall sum of bytes in View -Object (+ 13 Standard Parameter bytes)	13 + 10			

Table 149. View Object of the Analog Output Function Block

27.2.7 Coding of the Analog Output FB Parameter CHECK_BACK

For the mapping of BitStrings to OctetStrings see 3.7.1, Table 8.

Bit	CHECKBACK Mnemonic	Description	Ind. Class
0	CB_FAIL_SAFE	Field device in Fail safe active	R
1	CB_REQ_LOC_OP	Request for local Operation	R
2	CB_LOCAL_OP	Field device under local control, LOCKED OUT switch is in gear	R
3	CB_OVERRIDE	Emergency override active	R
4	CB_DISC_DIR	Actual position feedback different from expected position	R
5	CB_TORQUE_D_OP	Indicates that the torque limit in OPEN direction is exceeded	R
6	CB_TORQUE_D_CL	Indicates that the torque limit in CLOSE direction is exceeded	R
7	CB_TRAV_TIME	Indicates status of travel monitoring equipment, if YES, travel time for actuator has exceeded	A
8	CB_ACT_OPEN	Actuator is moving towards open direction	R
9	CB_ACT_CLOSE	Actuator is moving towards close direction	R
10	CB_UPDATE_EVT	The alert generated by any change to the static data (Function and Transducer Block).	A
11	CB_SIMULATE	Simulation of process values is enabled	R
12	not used	-	-
13	CB_CONTR_ERR	Internal control loop disturbed	R
14	CB_CONTR_INACT	Positioner inactive (OUT status = BAD)	R
15	CB_SELFTEST	Device under self test	R
16	CB_TOT_VALVE_TRAV	Indicates that total valve travel limit is exceeded	R
17	CB_ADD_INPUT	Indicates that an additional input (i.e. for diagnostics) is activated	R
18-22	not used	-	
23	CB_ZERO_POINT_ERROR	Zero point position cannot be reached	R

Table 150. Coding of the Analog Output FB Parameter CHECK_BACK

Values of the CHECK_BACK bits:

0: not set
1: set

Indication Class:

R: Indication remains active as long as the reason for the message exists.
A: Indication will be automatically reset after 10 seconds.

27.3 Additions to the Start-up and Brake-down Phase

In addition to the definitions in the General Definitions the following values must be settled at the start-up phase:

MODE_BLK (actual MODE) = O/S

28 Device Data Sheet Actuator - Transducer Blocks

28.1 Actuator Transducer Block Overview

The following chapters describe the parameters of the electric and electro-pneumatic Transducer Blocks.

28.2 Parameter Description of the Actuator Transducer Block

Parameter	Description
ACTUATOR_ SER_NUM	Serial number of the actuator belonging to the positioner or the electronic device.
ACTUATOR_ACTION	Fail-Safe position for power-loss of the actuator respectively the valve. Coding: 0: not initialized 1: opening (100%) 2: closing (0%) 3: none / remains in actual position
ACTUATOR_MAN	Name of Actuator-Manufacturer.
ACTUATOR_TYPE	Type of actuator. Coding: 0: electro-pneumatic 1: electric 2: electro-hydraulic 3: others
ACT_ROT_DIR	Actuator rotation in direction OPEN. Coding: 0: clockwise OPEN 1: counterclockwise OPEN
ACT_STROKE_TIME_DEC	Minimum of time to move from OPEN to CLOSE position (in sec.) for total system (positioner, actuator and valve). Measured while commissioning.
ACT_STROKE_TIME_INC	Minimum of time to move from CLOSE to OPEN position (in sec.) for total system (positioner, actuator and valve). Measured while commissioning.
ACT_TRAV_TIME	Travel time limit detection. Measured while commissioning.
ADD_GEAR_ID	Manufacturer specific type identification of the additional component (e.g. a gearbox, booster) mounted between the actuator and valve.
ADD_GEAR_INST_DATE	Installation date of the additional component (e.g. gearbox, booster) mounted between the actuator and valve.
ADD_GEAR_MAN	Manufacturer name of the additional component (e.g. gearbox, booster) mounted between the actuator and valve.
ADD_GEAR_SER_NUM	Serial number of the additional component (e.g. gearbox, booster) mounted between the actuator and valve.

Parameter	Description
ANTI_PUMP_CL	Fast-moving electric actuators with non self-locking gearbox often need the 'Anti-pumping'-feature to avoid pump effects. This may occur if limit-switch releases while actuator moves back a little bit during motor is switched off. This variable defines the distance from limit position CLOSE where the Anti-pumping is enabled.
ANTI_PUMP_OP	Fast-moving electric actuators with non self-locking gearbox often need the 'Anti-pumping'-feature to avoid pump effects. This may occur if limit-switch releases while actuator moves back a little bit during motor is switched off. This variable defines the distance from limit position OPEN where the Anti-pumping is enabled.
BREAK_STRENGTH	Power of actuator brake. Depends on the way, the brake works (time, current,...)
BYPASS_SETP_CL	When starting from limit position CLOSE to direction OPEN, the start bypass allows the max. torque value to exceed for a short time.
BYPASS_SETP_OP	When starting from limit position OPEN to direction CLOSE, the start bypass allows the max. torque value to exceed for a short time.
DEADBAND	Dead band in percent of travel span. Travel span correspondents to OUT_SCALE.
DEVICE_CALIB_DATE	Date of last calibration of the device.
DEVICE_CONFIG_DATE	Date of last configuration of the device.
LIN_TYPE	See General Requirements.
FEEDBACK_VALUE	The actual position of the final control element in units of OUT_SCALE.
MAX_TORQUE	Maximum torque, allowed for the actuator.
MOTOR_ON_TIME	Accumulation of the motor on-time in hours.
NUM_LIMIT_CUT_OFF	Total number of limit switch dependent cut-offs of the actuator.
NUM_MOT_ON_CYC	Total number of Start and Stop cycles of motor.
NUM_MOT_ON_HOUR	Number of cycles that the motor has been switched on/off in the last hour.
NUM_TORQ_CUT_OFF	Total number of torque dependent cut/offs of the actuator.
POSITIONING_VALUE	The actual command variable for the final control element in units of OUT_SCALE. Status BAD will drive the actuator to the fail-safe position defined by ACTUATOR_ACTION.
RATED_TRAVEL	Nominal stroke of the valve in units of OUT_SCALE.
SELF_CALIB_CMD	Initiation of a device-specific (manufacturer specific) calibration-procedure. Coding: 0: default value; no reaction of the field device (mandatory) 1: start zero point adjustment (optional) 2: start self calibration / initialization (optional) 7: reset „total valve travel limit exceeded“ CB_TOT_VALVE_TRAV (optional) and reset „Accumulated valve travel“ TOTAL_VALVE_TRAVEL (optional) 10: reset „internal control loop disturbed“ CB_CONTR_ERR (optional) 255: abort current calibration-procedure (optional)

Parameter	Description
SELF_CALIB_STATUS	Result or status of the device-specific (manufacturer specific) calibration-procedure. Coding: 0: undetermined (mandatory) 2: aborted (optional) 4: error in mechanical system (optional) 11: timeout (optional) 20: aborted by means of „Emergency override active" CB_OVERRIDE (opt.) 30: zero point error (optional) 254: successful (optional) 255: no valid data (optional)
SERVO_GAIN_1 SERVO_GAIN_2	Proportional-action coefficient for both moving directions. Actuators that have only one servo gain use SERVO_GAIN_1.
SERVO_RATE_1 SERVO_RATE_2	Derivative-action coefficient for both moving directions. Actuators that have only one servo rate use SERVO_RATE_1.
SERVO_RESET_1 SERVO_RESET_2	Integral-action coefficient for both moving directions. Actuators that have only one servo reset use SERVO_RESET_1.
SETP_CUTOFF_DEC	When the servo set point goes below the defined percent of span, the position goes to the limit position CLOSE. With electro-pneumatic actuator, this is done by totally ventilate/filling of the actuator (ref. to fail-safe position.) With electric actuator, the actuator goes motor-driven to the limit position CLOSE.
SETP_CUTOFF_INC	When the servo set point goes above the defined percent of span, the position goes to the limit position OPEN. With electro-pneumatic actuator, this is done by totally ventilate/filling of the actuator (ref. to fail-safe position.) With electric actuator, the actuator goes motor-driven to the limit position OPEN.
SETP_CUTOFF_MODE	Select travel- or torque-dependent cut-off (separate for each direction on travel). Coding: 0: torque in dir. OPEN, torque in dir. CLOSE 1: torque in dir. OPEN, travel in dir. CLOSE 2: travel in dir. OPEN, torque in dir. CLOSE 3: travel in dir. OPEN, travel in dir. CLOSE
TAB_ENTRY	See 3.8.1, Table Table 54.
TAB_X_Y_VALUE	See 3.8.1, Table Table 54.
TAB_MIN_NUMBER	See 3.8.1, Table Table 54.
TAB_MAX_NUMBER	See 3.8.1, Table Table 54.
TAB_ACTUAL_NUMBER	See 3.8.1, Table Table 54.
TAB_OP_CODE	See 3.8.1, Table Table 54.

Parameter	Description
TAB_STATUS	See 3.8.1, Table Table 54.
TORQUE_ACTUAL	Indicates actual torque value in engineering unit.
TORQUE_LIM_CL	Set value in engineering units. Determines the limit for the torque dependent switch off in CLOSE direction.
TORQUE_LIM_OP	Set value in engineering units. Determines the limit for the torque dependent switch off in OPEN direction.
TORQUE_UNIT	Engineering unit for torque or force.
TOTAL_VALVE_TRAVEL	Accumulated valve travel in nominal duty cycles.
TOT_VALVE_TRAV_LIM	Limit for the TOTAL_VALVE_TRAVEL in nominal duty cycles.
TRAVEL_LIMIT_LOW	Lower limit of the valve position in percent of travel span. Travel span correspondents to OUT_SCALE.
TRAVEL_LIMIT_UP	Upper limit of the valve position in percent of travel span. Travel span correspondents to OUT_SCALE.
TRAVEL_RATE_DEC	Configurable seconds to full span change (closing time of the valve) in seconds.
TRAVEL_RATE_INC	Configurable seconds to full span change (opening time of the valve) in seconds.
VALVE_MAINT_DATE	Date of last valve maintenance.
VALVE_MAN	Name of Valve Manufacturer.
VALVE_SER_NUM	Serial number of the valve belonging to the positioner or the electronic device.
VALVE_TYPE	Type of valve. Coding: 0: linear moving valve, sliding valve 1: rotary moving valve, part-turn 2: rotary moving valve, multi-turn

Table 151. Parameter Description of the Actuator Transducer Block

28.3 Electric Actuator Transducer Block

28.3.1 Parameter Attributes of the Electric Actuator Transducer Block

Relative Index	Parameter Name	Object Type	Data Type	Store	Size	Access	Parameter Usage / Kind of Transport	Reset Class	Default Value	Mandatory Optional (Class A,B)
... Standard Parameters see General Requirements										
Additional Transducer Block Parameters for electric actuators										
8	ACT_ROT_DIR	Simple	Unsigned8	S	1	r,w	C/a	F	0	O (B)
9	ACT_STROKE_TIME_DEC	Simple	Float	S	4	r	C/a	man spec	-	O (B)
10	ACT_STROKE_TIME_INC	Simple	Float	S	4	r	C/a	man spec	-	O (B)
11	ACT_TRAV_TIME	Simple	Float	S	4	r	C/a	man spec	-	O (B)
12	ANTI_PUMP_CL	Simple	Float	S	4	r,w	C/a	F	-	O (B)
13	ANTI_PUMP_OP	Simple	Float	S	4	r,w	C/a	F	-	O (B)
14	BREAK_STRENGTH	Simple	Float	S	4	r,w	C/a	F	-	O (B)
15	BYPASS_SETP_CL	Simple	Float	S	4	r,w	C/a	F	-	O (B)
16	BYPASS_SETP_OP	Simple	Float	S	4	r,w	C/a	F	-	O (B)
17	TAB_ENTRY	See 3.8.2, Table 55.								O (B)
18	TAB_X_Y_VALUE	See 3.8.2, Table 55.								O (B)
19	TAB_MIN_NUMBER	See 3.8.2, Table 55.								O (B)
20	TAB_MAX_NUMBER	See 3.8.2, Table 55.								O (B)
21	TAB_ACTUAL_NUMBER	See 3.8.2, Table 55.								O (B)
22	DEADBAND	Simple	Float	S	4	r,w	C/a	F	-	O (B)
23	DEVICE_CALIB_DATE	Simple	OctetString	S	16	r,w	C/a	I	-	O (B)
24	DEVICE_CONFIG_DATE	Simple	OctetString	S	16	r,w	C/a	I	-	O (B)
25	LIN_TYPE	See 3.8.2, Table 55.								M (B)
26	MAX_TORQUE	Simple	Float	S	4	r,w	C/a	F	-	O (B)
27	MOTOR_ON_TIME	Simple	Float	D	4	r	C/a	man spec	-	O (B)
28	NUM_LIMIT_CUT_OFF	Simple	Float	D	4	r	C/a	man spec	-	O (B)
29	NUM_MOT_ON_CYCL	Simple	Float	D	4	r	C/a	man spec	-	O (B)
30	NUM_MOT_ON_HOUR	Simple	Unsigned8	D	1	r	C/a	man spec	-	O (B)
31	NUM_TORQ_CUT_OFF	Simple	Float	D	4	r	C/a	man spec	-	O (B)
32	RATED_TRAVEL	Simple	Float	S	4	r,w	C/a	F	-	M (B)
33	SELF_CALIB_CMD	Simple	Unsigned8	N	1	r,w	C/a	-	0	M (B)
34	SELF_CALIB_STATUS	Simple	Unsigned8	N	1	r	C/a	-	0	M (B)
35	SERVO_GAIN_1	Simple	Float	S	4	r,w	C/a	F	-	O (B)

Relative Index	Parameter Name	Object Type	Data Type	Store	Size	Access	Parameter Usage / Kind of Transport	Reset Class	Default Value	Mandatory Optional (Class A,B)
36	SERVO_RATE_1	Simple	Float	S	4	r,w	C/a	F	-	O (B)
37	SERVO_RESET_1	Simple	Float	S	4	r,w	C/a	F	-	O (B)
38	SETP_CUTOFF_DEC	Simple	Float	S	4	r,w	C/a	F	-	M (B)
39	SETP_CUTOFF_INC	Simple	Float	S	4	r,w	C/a	F	-	M (B)
40	SETP_CUTOFF_MODE	Simple	Unsigned8	S	1	r,w	C/a	F	3	O (B)
41	TORQUE_ACTUAL	Record	101	D	5	r	C/a	-	-	O (B)
42	TORQUE_LIM_CL	Simple	Float	S	4	r,w	C/a	F	-	O (B)
43	TORQUE_LIM_OP	Simple	Float	S	4	r,w	C/a	F	-	O (B)
44	TORQUE_UNIT	Simple	Unsigned16	S	2	r,w	C/a	F	-	O (B)
45	TOTAL_VALVE_TRAVEL	Simple	Float	D [1]	4	r,w	C/a	man spec	-	O (B)
46	TOT_VALVE_TRAV_LIM	Simple	Float	S	4	r,w	C/a	F	-	O (B)
47	TRAVEL_LIMIT_LOW	Simple	Float	S	4	r,w	C/a	F	0	M (B)
48	TRAVEL_LIMIT_UP	Simple	Float	S	4	r,w	C/a	F	100	M (B)
49	TRAVEL_RATE_DEC	Simple	Float	S	4	r,w	C/a	F	-	M (B)
50	TRAVEL_RATE_INC	Simple	Float	S	4	r,w	C/a	F	-	M (B)
51	VALVE_MAINT_DATE	Simple	OctetString	S	16	r,w	C/a	I	-	O (B)
55	TAB_OP_CODE	See 3.8.2, Table 55.								O (B)
56	TAB_STATUS	See 3.8.2, Table 55.								O (B)
57	POSITIONING_VALUE	Record	101	D	5	r	C/a	-	-	M (B)
58	FEEDBACK_VALUE	Record	101	D	5	r	C/a	-	-	M (B)
59	VALVE_MAN	Simple	OctetString	S	16	r,w	C/a	I	-	M (B)
60	ACTUATOR_MAN	Simple	OctetString	S	16	r,w	C/a	I	-	O (B)
61	VALVE_TYPE	Simple	Unsigned8	S	1	r,w	C/a	F	-	M (B)
62	ACTUATOR_TYPE	Simple	Unsigned8	Cst	1	r	C/a	-	-	M (B)
63	ACTUATOR_ACTION	Simple	Unsigned8	S	1	r,w	C/a	man spec	-	M (B)
64	VALVE_SER_NUM	Simple	OctetString	S	16	r,w	C/a	I	-	O (B)
65	ACTUATOR_SER_NUM	Simple	OctetString	S	16	r,w	C/a	I	-	O (B)
66	ADD_GEAR_SER_NUM	Simple	OctetString	S	16	r,w	C/a	I	-	O (B)
67	ADD_GEAR_MAN	Simple	OctetString	S	16	r,w	C/a	I	-	O (B)
68	ADD_GEAR_ID	Simple	OctetString	S	16	r,w	C/a	I	-	O (B)
69	ADD_GEAR_INST_DATE	Simple	OctetString	S	16	r,w	C/a	I	-	O (B)
70-79	Reserved by PNO									M (B)
80	First manufacturer specific parameter									O (B)

Table 152. Parameter Attributes of the Electric Actuator Transducer Block

[1] Should be stored non volatile

28.3.2 View Object of the Electric Actuator Transducer Block

Relative Index	Parameter Name	View_1	View_2	View_3	View_4
8	ACT_ROT_DIR				
9	ACT_STROKE_TIME_DEC				
10	ACT_STROKE_TIME_INC				
11	ACT_TRAV_TIME				
12	ANTI_PUMP_CL				
13	ANTI_PUMP_OP				
14	BREAK_STRENGTH				
15	BYPASS_SETP_CL				
16	BYPASS_SETP_OP				
17	TAB_ENTRY				
18	TAB_X_Y_VALUE				
19	TAB_MIN_NUMBER				
20	TAB_MAX_NUMBER				
21	TAB_ACTUAL_NUMBER				
22	DEADBAND				
23	DEVICE_CALIB_DATE				
24	DEVICE_CONFIG_DATE				
25	LIN_TYPE				
26	MAX_TORQUE				
27	MOTOR_ON_TIME				
28	NUM_LIMIT_CUT_OFF				
29	NUM_MOT_ON_CYCL				
30	NUM_MOT_ON_HOUR				
31	NUM_TORQ_CUT_OFF				
32	RATED_TRAVEL				
33	SELF_CALIB_CMD				
34	SELF_CALIB_STATUS				
35	SERVO_GAIN_1				
36	SERVO_RATE_1				
37	SERVO_RESET_1				
38	SETP_CUTOFF_DEC				
39	SETP_CUTOFF_INC				
40	SETP_CUTOFF_MODE				
41	TORQUE_ACTUAL				
42	TORQUE_LIM_CL				
43	TORQUE_LIM_OP				
44	TORQUE_UNIT				
45	TOTAL_VALVE_TRAVEL				
46	TOT_VALVE_TRAV_LIM				

Relative Index	Parameter Name	View_1	View_2	View_3	View_4
47	TRAVEL_LIMIT_LOW				
48	TRAVEL_LIMIT_UP				
49	TRAVEL_RATE_DEC				
50	TRAVEL_RATE_INC				
51	VALVE_MAINT_DATE				
55	TAB_OP_CODE				
56	TAB_STATUS				
57	POSITIONING_VALUE				
58	FEEDBACK_VALUE				
59	VALVE_MAN				
60	ACTUATOR_MAN				
61	VALVE_TYPE				
62	ACTUATOR_TYPE				
63	ACTUATOR_ACTION				
64	VALVE_SER_NUM				
65	ACTUATOR_SER_NUM				
66	ADD_GEAR_SER_NUM				
67	ADD_GEAR_MAN				
68	ADD_GEAR_ID				
69	ADD_GEAR_INST_DATE				
Total	Overall sum of bytes in View-Object (+ 13 Standard Parameter bytes)	13			

Table 153. View Object of the Electric Actuator Transducer Block

28.4 Electro-Pneumatic Actuator Transducer Block

28.4.1 Parameter Attributes of the Electro-Pneumatic Actuator Transducer Block

Relative Index	Parameter Name	Object Type	Data Type	Store	Size	Access	Parameter Usage / Kind of Transport	Reset Class	Default Value	Mandatory Optional (Class A,B)
... Standard Parameters see General Requirements										
Additional Transducer Block Parameters for electro-pneumatic actuators										
9	ACT_STROKE_TIME_DEC	Simple	Float	S	4	r	C/a	man spec	-	O (B)
10	ACT_STROKE_TIME_INC	Simple	Float	S	4	r	C/a	man spec	-	O (B)
17	TAB_ENTRY	See 3.8.2, Table 55.								O (B)
18	TAB_X_Y_VALUE	See 3.8.2, Table 55.								O (B)
19	TAB_MIN_NUMBER	See 3.8.2, Table 55.								O (B)
20	TAB_MAX_NUMBER	See 3.8.2, Table 55.								O (B)
21	TAB_ACTUAL_NUMBER	See 3.8.2, Table 55.								O (B)
22	DEADBAND	Simple	Float	S	4	r,w	C/a	F	-	O (B)
23	DEVICE_CALIB_DATE	Simple	OctetString	S	16	r,w	C/a	I	-	O (B)
24	DEVICE_CONFIG_DATE	Simple	OctetString	S	16	r,w	C/a	I	-	O (B)
25	LIN_TYPE	See 3.8.2, Table 55.								M (B)
32	RATED_TRAVEL	Simple	Float	S	4	r,w	C/a	F	-	M (B)
33	SELF_CALIB_CMD	Simple	Unsigned8	N	1	r,w	C/a	-	0	M (B)
34	SELF_CALIB_STATUS	Simple	Unsigned8	N	1	r	C/a	-	0	M (B)
35	SERVO_GAIN_1	Simple	Float	S	4	r,w	C/a	F	-	O (B)
36	SERVO_RATE_1	Simple	Float	S	4	r,w	C/a	F	-	O (B)
37	SERVO_RESET_1	Simple	Float	S	4	r,w	C/a	F	-	O (B)
38	SETP_CUTOFF_DEC	Simple	Float	S	4	r,w	C/a	F	-	M (B)
39	SETP_CUTOFF_INC	Simple	Float	S	4	r,w	C/a	F	-	M (B)
45	TOTAL_VALVE_TRAVEL	Simple	Float	D [1]	4	r	C/a	man spec	-	O (B)
46	TOT_VALVE_TRAV_LIM	Simple	Float	S	4	r,w	C/a	F	-	O (B)
47	TRAVEL_LIMIT_LOW	Simple	Float	S	4	r,w	C/a	F	0	M (B)
48	TRAVEL_LIMIT_UP	Simple	Float	S	4	r,w	C/a	F	100	M (B)
49	TRAVEL_RATE_DEC	Simple	Float	S	4	r,w	C/a	F	-	M (B)
50	TRAVEL_RATE_INC	Simple	Float	S	4	r,w	C/a	F	-	M (B)
51	VALVE_MAINT_DATE	Simple	OctetString	S	16	r,w	C/a	I	-	O (B)
52	SERVO_GAIN_2	Simple	Float	S	4	r,w	C/a	F	-	O (B)
53	SERVO_RATE_2	Simple	Float	S	4	r,w	C/a	F	-	O (B)

[1] should be stored non volatile

Relative Index	Parameter Name	Object Type	Data Type	Store	Size	Access	Parameter Usage / Kind of Transport	Reset Class	Default Value	Mandatory Optional (Class A,B)
54	SERVO_RESET_2	Simple	Float	S	4	r,w	C/a	F	-	O (B)
55	TAB_OP_CODE	See 3.8.2, Table 55.								O (B)
56	TAB_STATUS	See 3.8.2, Table 55.								O (B)
57	POSITIONING_VALUE	Record	101	D	5	r	C/a	-	-	M (B)
58	FEEDBACK_VALUE	Record	101	D	5	r	C/a	-	-	M (B)
59	VALVE_MAN	Simple	OctetString	S	16	r,w	C/a	I	-	M (B)
60	ACTUATOR_MAN	Simple	OctetString	S	16	r,w	C/a	I	-	M (B)
61	VALVE_TYPE	Simple	Unsigned8	S	1	r,w	C/a	F	-	M (B)
62	ACTUATOR_TYPE	Simple	Unsigned8	Cst	1	r	C/a	-	-	M (B)
63	ACTUATOR_ACTION	Simple	Unsigned8	S	1	r,w	C/a	man spec	-	M (B)
64	VALVE_SER_NUM	Simple	OctetString	S	16	r,w	C/a	I	-	O (B)
65	ACTUATOR_SER_NUM	Simple	OctetString	S	16	r,w	C/a	I	-	O (B)
66	ADD_GEAR_SER_NUM	Simple	OctetString	S	16	r,w	C/a	I	-	O (B)
67	ADD_GEAR_MAN	Simple	OctetString	S	16	r,w	C/a	I	-	O (B)
68	ADD_GEAR_ID	Simple	OctetString	S	16	r,w	C/a	I	-	O (B)
69	ADD_GEAR_INST_DATE	Simple	OctetString	S	16	r,w	C/a	I	-	O (B)
70-79	Reserved by PNO									M (B)
80	First manufacturer specific parameter									O (B)

Table 154. Parameter Attributes of the Electro-Pneumatic Actuator Transducer Block

28.4.2 View Object of the Electro-Pneumatic Actuator Transducer Block

Relative Index	Parameter Name	View_1	View_2	View_3	View_4
9	ACT_STROKE_TIME_DEC				
10	ACT_STROKE_TIME_INC				
17	TAB_ENTRY				
18	TAB_X_Y_VALUE				
19	TAB_MIN_NUMBER				
20	TAB_MAX_NUMBER				
21	TAB_ACTUAL_NUMBER				
22	DEADBAND				
23	DEVICE_CALIB_DATE				
24	DEVICE_CONFIG_DATE				
25	LIN_TYPE				
32	RATED_TRAVEL				

Relative Index	Parameter Name	View_1	View_2	View_3	View_4
33	SELF_CALIB_CMD				
34	SELF_CALIB_STATUS				
35	SERVO_GAIN_1				
36	SERVO_RATE_1				
37	SERVO_RESET_1				
38	SETP_CUTOFF_DEC				
39	SETP_CUTOFF_INC				
45	TOTAL_VALVE_TRAVEL				
46	TOT_VALVE_TRAV_LIM				
47	TRAVEL_LIMIT_LOW				
48	TRAVEL_LIMIT_UP				
49	TRAVEL_RATE_DEC				
50	TRAVEL_RATE_INC				
51	VALVE_MAINT_DATE				
52	SERVO_GAIN_2				
53	SERVO_RATE_2				
54	SERVO_RESET_2				
55	TAB_OP_CODE				
56	TAB_STATUS				
57	POSITIONING_VALUE				
58	FEEDBACK_VALUE				
59	VALVE_MAN				
60	ACTUATOR_MAN				
61	VALVE_TYPE				
62	ACTUATOR_TYPE				
63	ACTUATOR_ACTION				
64	VALVE_SER_NUM				
65	ACTUATOR_SER_NUM				
66	ADD_GEAR_SER_NUM				
67	ADD_GEAR_MAN				
68	ADD_GEAR_ID				
69	ADD_GEAR_INST_DATE				
	Overall sum of bytes in View-Object (+ 13 Standard Parameter bytes)	13			

Table 155. View Object of the Electro-Pneumatic Actuator Transducer Block

28.5 Electro-Hydraulic Actuator Transducer Block

Not specified.

29 Device Data Sheet Actuator - Download Order of Parameters

If a set of parameters have to be written to the device a special order must be obtained. All other parameters must be written after these parameters.

For devices described in this Data Sheet the order is described as follows.

VALVE_TYPE

RATED_TRAVEL

OUT_SCALE

30 Device Data Sheet Actuator - Conformance Statement

Every device chooses out of the defined structures of this document the necessary subset. To choose a subset follows certain rules defined in the conformance statements below. The tables shows which structure is mandatory (M), selected (S) and which are optional (O).

Parameter	Conformance class A	Conformance class B
Physical Block	M	M
Analog Output Function Block	M	M
Transducer Block	O	M
Electro-pneumatic Transducer Block	O	S
Electric Transducer Block	O	S
Electro-hydraulic Transducer Block	O	S
Other Function Blocks	O	O
Other Transducer Blocks	O	O

Table 156. Conformance Statement of Actuator Components

31 Device Data Sheet Actuator - Document History

Changes from V3.0 to V3.0.1

Chapter/Figure/Table	Change
Entire document	Correction of spelling errors
27.2.1	Editorial changes
27.2.3	Clarification of permitted modes
27.2.3	Replaced DS-33 by Data type 101
27.2.3.2 table 145 and 146	Term 'high limit, low limit' replaced by 'Constant'
27.2.5 table 148	Clarification of “Mandatory Optional (Class)”: Replaced “M(A,B)” by “M”; Replaced “M(B)” by O(A), M(B); Replaced “O(B)” by “O”; Changed POS_D to “M”
27.2.5 table 148	Column “Reset Class” added.
27.2.5 table 148	Replaced DS-33 by Data type 101
27.2.5 table 148	Replaced DS-34 by Data type 102
27.2.7 table 150	Bit 23 CB_ZERO_POINT_ERROR added
27.3	Clarification
28.3.1 table 152	Relative Index for first manufacturer specific parameter corrected
28.3.1 table 152	Column “Reset Class” added.
28.3.1.table 152	Replaced DS-33 by Data type 101
28.4.1 table 154	Relative Index for first manufacturer specific parameter corrected
28.4.1 table 154	Column “Reset Class” added.
28.4.1 table 154	Replaced DS-33 by Data type 101

Table 157. Changes from V3.0 to V3.0.1

PROFIBUS - PA

Device Data Sheet

Analyser

32 Device Data Sheet Analyser

32.1 Use of the Function Block model for analyser field devices

The parameter structures of the analyser field devices are in accordance with the block model of the General Requirements document of this guideline. An analyser device consists of one Physical Block as well as of several instances of Transducer Blocks and Function Blocks. The blocks differ in the parameters they contain. The Function Blocks (FB) Analog Input (AI), Analog Output (AO), Discrete Input (DI) and Discrete Output (DO) are used as defined in the other parts of this guideline.

This part defines additional blocks for analyser field devices. The Analyser Transducer Block contains a common set of parameters unique for all analyser devices of this profile. The adaptation of the Analyser Transducer Blocks to particular sensor types is done by the parameter values. The Transfer Transducer Block provides cascadable functions for the precalculation of the process values (e.g. filter, average, integration or correction). The Control Transducer Block starts and stops device functions like "Init", "Measurement" and "Calibration". Additionally a device may have a Multi Point Sampling Function Block and a Logbook Function Block. Alarm Transducer Blocks contain information about device or process specific events (e.g. limit exceedance or short circuit).

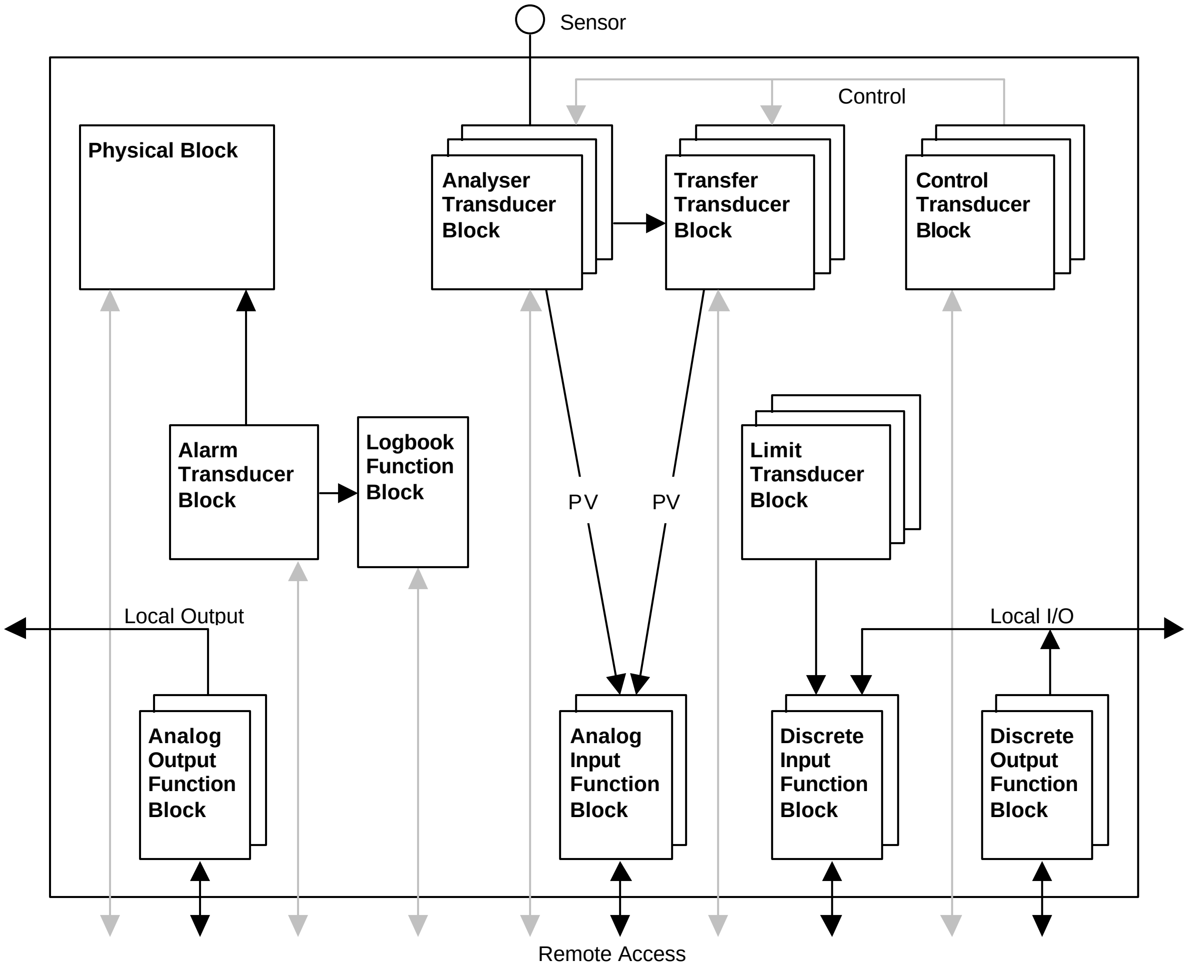


Figure 64. Block Structure of Analyser Devices

Figure 64 shows the block structure of an analyser device. The block model defines that there is exactly one Physical Block and a free number and combination of Transducer and Function Blocks. Most of the block types may be instantiated several times.

The specification of each block starts with a short overview accompanied by figures. All parameters of the blocks are described by text and if necessary by special codes with their meanings. A following table contains all parameters with their specific attributes like data type, access rights and default value.

32.2 Physical Block

32.2.1 Overview

The analyser shall use the Physical Block as defined in the General Requirements part. Additionally the Physical Block comprises the parameters defined in the following subsections.

32.2.2 Parameter Description of the Physical Block

Parameter	Description
DEVICE_ CONFIGURATION	Textual description of its configuration of functional units.
INIT_STATE	The device stops in a parametrised state after a reset and a device specific initialisation phase. This state may be either one of the states of DEVICE_STATE or the state STATUS_BEFORE_RESET. Coding: 1: STATUS_BEFORE_RESET 2: RUN 3: STANDBY 4: POWER_DOWN 5: MAINTENANCE
DEVICE_STATE	There are 4 states, which are disjunct. The operator chooses a new state by writing the code of the desired state to this parameter. Please notice that not all functions of the Control Transducer Block are executable in every device state (see 32.5). Coding: 2: RUN 3: STANDBY 4: POWER_DOWN 5: MAINTENANCE RUN In the RUN state all operation items are active, which are necessary to generate a process value. STANDBY

Parameter	Description
	The device is ready for measurement in the STANDBY state and can be switched to RUN without delay. POWER_DOWN The POWER_DOWN state is a mode with low power consumption i.e. throttled and economy operation. The device is not in operation. Putting into operation can take a longer period of time. MAINTENANCE The behaviour in the state MAINTENANCE is device specific. In addition to the functions of the states RUN, STANDBY and POWER_DOWN other Control Transducer Block functions like test, service or cleaning can be carried out in the state MAINTENANCE.
GLOBAL_STATUS	See 32.7.2, Table 174.

Table 158. Parameter Description of the Physical Block

32.2.3 Parameter Attributes of the Physical Block

Relative Index	Parameter Name	Object Type	Data Type	Store	Size	Access	Parameter Usage / Kind of Transport	Reset Class	Default Value	Mandatory Optional (Class A,B)
... Standard Parameters see General Requirements										
Additional Physical Block Parameters										
33-35	Reserved by PNO									
36	DEVICE_ CONFIGURATION	Simple	VisibleString	N	32	r	C/a	-	-	M
37	INIT_STATE	Simple	Unsigned8	S	1	r,w	C/a	F	-	M
38	DEVICE_STATE	Simple	Unsigned8	D	1	r,w	C/a	F	-	M
39	GLOBAL_STATUS	Simple	Unsigned16	D	2	r	C/a	-	0	M
40-47	Reserved by PNO									M
48	First manufacturer specific parameter									O

Table 159. Parameter Attributes of the Physical Block

32.2.4 View Object of the Physical Block

Relative Index	Parameter Name	View_1	View_2	View_3	View_4
36	DEVICE_CONFIGURATION				
37	INIT_STATE				
38	DEVICE_STATE	1			
39	GLOBAL_STATUS	2			
	Overall sum of bytes in View -Object (+4 of common Physical Block + 13 Standard Parameter bytes)	3 + 4 +13			

Table 160. View Object of the Physical Block

32.3 Analyser Transducer Block

32.3.1 Overview

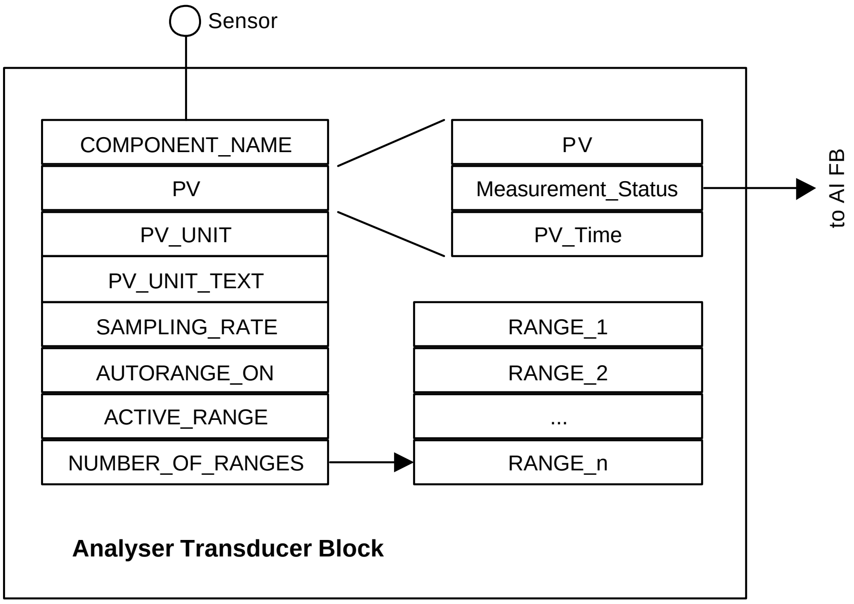


Figure 65. Parameter structure of the Analyser Transducer Block

Every existing measurement value in the analyser device is represented by an Analyser Transducer Block. This block contains a set of parameters which describes the measurement value in a way that can be interpreted by a remote station.

32.3.2 Parameter Description of the Analyser Transducer Block

Parameter	Description
COMPONENT_NAME	Description of the measurement value as readable ASCII text.
PV	The primary value is of primary interest for the device users. All results are available as value which has been scaled and which represents the physical process value. Raw data and internal intermediate results are not visible across the communication system. A measurement value is raw data generated by the sensor. This raw data is a dynamic value. The dynamic values may be calculated further on by using standardised and non-standardised algorithms. These functions are the scope of the Transfer Transducer Block (see 32.4). The PV is read only. The PV is the result of using standardised and non-standardised algorithms and is structured as follows: PV Value of the result. All accompanying information which is necessary to interpret the value is scope of other parameters of the Analyser Transducer Block. Measurement_Status

Parameter	Description
	Status of the result. It is calculated at the sampling time (Coding see General Requirements). PV_Time Sampling time of the measurement value (e.g. for the use in trend objects). Note: Devices without clock use the value 0.
PV_UNIT	Engineering unit of the measurement value (Coding see General Requirements).
PV_UNIT_TEXT	Additional manufacturer specific engineering units.
ACTIVE_RANGE	Number of the active range. The ranges are defined in the according parameter array of this block. Coding: 1: RANGE_1 2: RANGE_2 n: RANGE_n
AUTORANGE_ON	Switches the automatic range choice on and off. There are 2 scaling parameters, one in the Analyser Transducer Block and one in the Analog Input Function Block (AI). For consistency reasons the PV_SCALE parameter of the AI should use the RANGE_n parameter of the Analyser Transducer Block. Two approaches are valid: If the Transducer uses autoranging (AUTORANGE_ON = TRUE) the connected AI should use the Transducer Blocks RANGE_n with the widest measuring range for scaling. If the Transducer uses a fixed measuring range only (AUTORANGE_ON = FALSE) the connected AI should use the Transducer Blocks RANGE_n selected by ACTIVE_RANGE for scaling.
SAMPLING_RATE	The measurement values are sampled device and measurement type specific. This parameter contains the time between two samples.
NUMBER_OF_RANGES	This parameter contains the number of ranges which are supported by the device.
RANGE_n	Every range is a record which contains the values Begin_of_Range and End_of_Range. The engineering unit is the same as the unit of the measurement value of the Analyser Transducer Block.

Table 161. Parameter Description of the Analyser Transducer Block

32.3.3 Parameter Attributes of the Analyser Transducer Block

Relative Index	Parameter Name	Object Type	Data Type	Store	Size	Access	Parameter Usage / Kind of Transport	Reset Class	Default Value	Mandatory Optional (Class A,B)
... Standard Parameters see General Requirements										
Additional Analyser Transducer Block Parameters										
8	COMPONENT_NAME	Simple	OctetString	S	32	r,w	C/a	I	-	M
9	PV	Record	DS-60	D	12	r	C/a	-	-	M
10	PV_UNIT [1]	Simple	Unsigned16	S	2	r,w	C/a	F	-	M
11	PV_UNIT_TEXT	Simple	OctetString	S	8	r,w	C/a	-	-	M
12	ACTIVE_RANGE	Simple	Unsigned8	S	1	r,w	C/a	F	-	M
13	AUTORANGE_ON	Simple	Boolean	S	1	r,w	C/a	F	-	M
14	SAMPLING_RATE	Simple	Time_Difference	S	4	r,w	C/a	F	-	M
15-24	Reserved by PNO									M
25	NUMBER_OF_RANGES	Simple	Unsigned8	N	1	r	C/a	-	-	M
26	RANGE_1	Record	DS-61	N	8	r,w	C/a	F	-	M
...										
25+n	RANGE_n	Record	DS-61	N	8	r,w	C/a	F	-	O
25+n +1	First manufacturer specific parameter									O

Table 162. Parameter Attributes of the Analyser Transducer Block

[1] Engineering units without existing unit code have to use the code 1995. The engineering unit will be placed in the PV_UNIT_TEXT parameter.

32.3.4 View Object of the Analyser Transducer Block

Relative Index	Parameter Name	View_1	View_2	View_3	View_4
8	COMPONENT_NAME				
9	PV	12			
10	PV_UNIT				
11	PV_UNIT_TEXT				
12	ACTIVE_RANGE	1			
13	AUTORANGE_ON				
14	SAMPLING_RATE				
15-24	Reserved by PNO				
25	NUMBER_OF_RANGES				
26	RANGE_1				
...					
25+n	RANGE_n				
	Overall sum of bytes in View -Object (+ 13 Standard Parameter bytes)	13 + 13			

Table 163. View Object of the Analyser Transducer Block

32.4 Transfer Transducer Block

32.4.1 Overview

The result of a Transducer Block may have to be precalculated before being used by an Analog Input FB. This task is carried out by the Transfer Transducer Block which provides average, integration, correction and filter functions. These functions can be concatenated to a cascaded structure. The CHANNEL parameter of the Transfer Transducer Block refers to the Analyser Transducer Block whose PV needs precalculation. The time conditions of the cascaded function structure are device specific and therefore not in the scope of this profile. The Transfer Transducer Block provides the calculated value in the parameter PV.

32.4.2 Parameter Description of the Transfer Transducer Block

Parameter	Description
CHANNEL	The CHANNEL parameter defines the Transducer Block whose PV needs precalculation (Coding see General Requirements).
PV	This parameter contains the calculated value of the Transfer Transducer Block. This value can be used by other blocks.
PV_UNIT	Engineering unit of the measurement value (Coding see General Requirements).
PV_UNIT_TEXT	Additional manufacturer-specific engineering units.
STATIC_VALUE	Fixed value which is used for correction.
CORRECTION_ CHANNEL	This parameter defines the Transducer Block which is used for the correction of the PV (Coding like parameter CHANNEL).

Parameter	Description
FB_VALUE	Output parameter of another block (local or remote) which is used for correction. This parameter is used as FB input parameter, i.e. the connection between the FB output parameter and this parameters is handled by a link object.
NUMBER_OF_ CALCULATION	Number of cascaded precalculations in this block.
CALCULATION_N	This parameter structure contains the code of the functions which will be used for precalculation. The order of execution of the precalculation is the order of the relative index attribute of the precalculation structures in the Transducer Transfer Block.

Table 164. Parameter Description of the Transfer Transducer Block

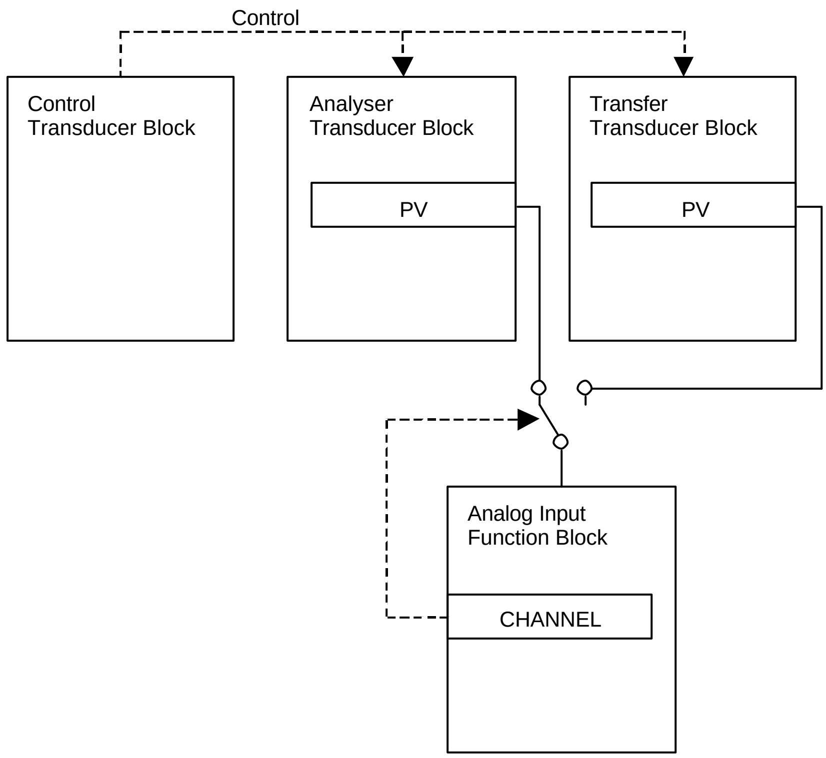


Figure 66. Example of Cooperation between Control Transducer Block, Transfer Transducer Block, Analyser Transducer Block and Analog Input Function Block

32.4.3 Parameter Attributes of the Transfer Transducer Block

Relative Index	Parameter Name	Object Type	Data Type	Store	Size	Access	Parameter Usage / Kind of Transport	Reset Class	Default Value	Mandatory Optional (Class A,B)
... Standard Parameters see General Requirements										
Additional Transfer Transducer Block Parameters										
9	CHANNEL	Simple	Unsigned16	S	2	r,w	C/a	F	-	M
10	PV	Record	DS-60	D	12	r	C/a	-	-	M
11	PV_UNIT [1]	Simple	Unsigned16	S	2	r,w	C/a	F	-	M
12	PV_UNIT_TEXT	Simple	OctetString	S	8	r,w	C/a	-	-	M
13	STATIC_VALUE	Simple	Float	S	4	r,w	C/a	F	-	M
14	CORRECTION_CHANNEL	Simple	Unsigned16	S	2	r,w	C/a	F	-	M
15	FB_VALUE	Record	101	S	5	r,w	C/a	F	0	M
16-25	Reserved by PNO									M
26	NUMBER_OF_ CALCULATION	Simple	Unsigned8	S	1	r,w	C/a	F	-	M
27	CALCULATION_1	Record	DS-65	S	3	r,w	C/a	F	-	M
...										
26+n	CALCULATION_n	Record	DS-65	S	3	r,w	C/a	F	-	M
26+n +1	First manufacturer specific parameter									O

Table 165. Parameter Attributes of the Transfer Transducer Block

[1] Engineering units without existing codes have to use the code 1995. The engineering unit will be placed in the PV_UNIT_TEXT parameter.

32.4.4 View Object of the Transfer Transducer Block

Relative Index	Parameter Name	View_1	View_2	View_3	View_4
9	CHANNEL				
10	PV	12			
11	PV_UNIT				
12	PV_UNIT_TEXT				
13	STATIC_VALUE				
14	CORRECTION_CHANNEL				
15	FB_VALUE				
16-25	Reserved by PNO				
26	NUMBER_OF_CALCULATION				
27	CALCULATION_1				
...					
26+n	CALCULATION_n				
	Overall sum of bytes in View -Object (+ 13 Standard Parameter bytes)	12 + 13			

Table 166. View Object of the Transfer Transducer Block

32.5 Control Transducer Block

32.5.1 Overview

The Control Transducer Block (CTB) is a Transducer Block with contained parameters only, executing general initialisation and control functions of the analyser device. It influences the other Transducer Blocks of the device according to the chosen function (see parameter BLOCK_TYPE). The details of the influence are device specific and are therefore out of the scope of this profile. The functions are represented by codes with a common name. Link objects for the interconnection of parameters between the Control Transducer Block and other Blocks are not possible.

There are function specific parameters in the Control Transducer Block, i.e. not all parameters are used for all functions. An overview is shown in Figure 67.

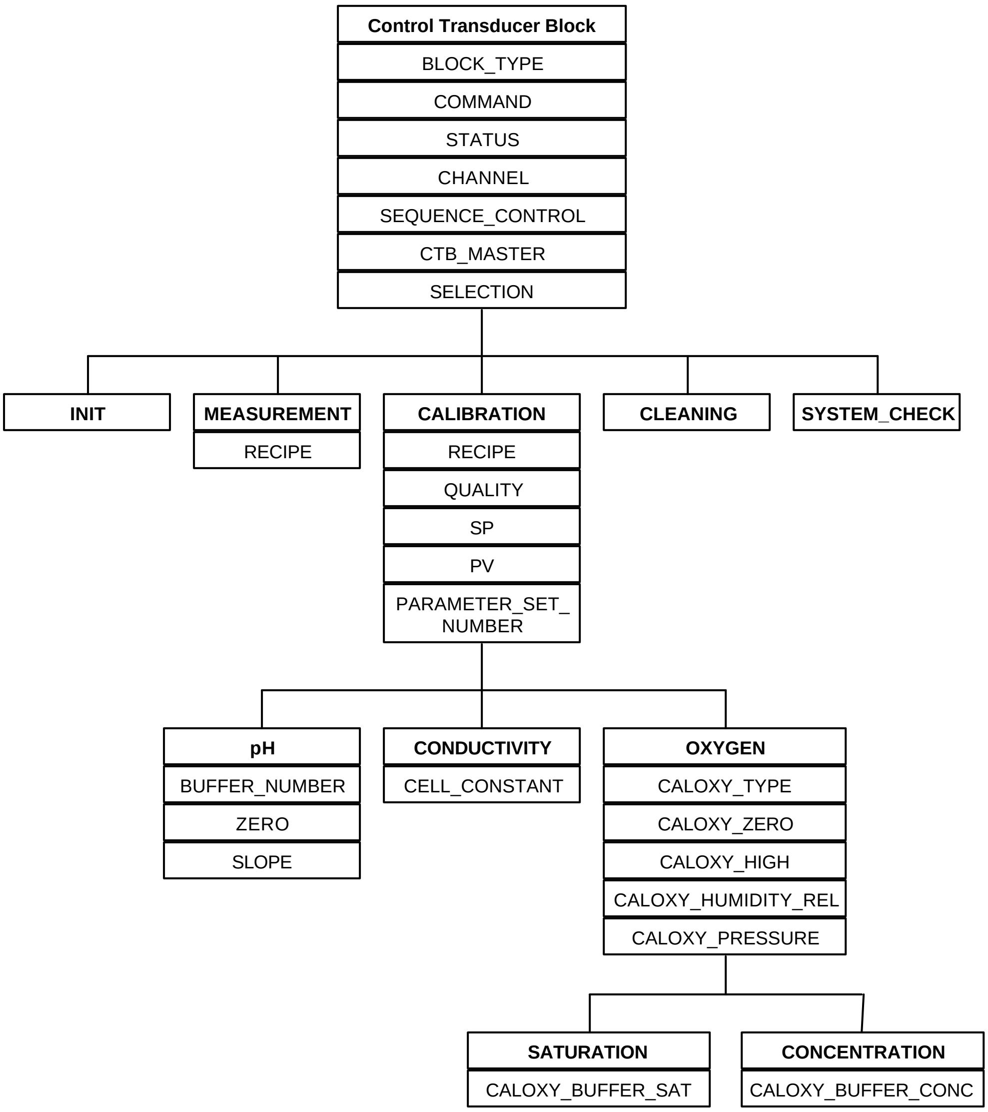


Figure 67. Parameter Hierarchy of the Control Transducer Block

32.5.2 Parameter Description of the Control Transducer Block

Parameter	Description
BLOCK_TYPE	The BLOCK_TYPE determines the function of the Control Transducer Block which has to be executed. The Control Transducer Block carries out exactly one function type at the same time. The switch over to another block type is possible in every operation state. The valid parameters of the Control Transducer Block according to the block types are shown in Figure 67. The choice of device specific Control Transducer Block types is manufacturer specific or can be extended in further versions of the profile. Not all functions are executable in all device states. Table 168 shows the permitted combinations. Coding: 1: INIT 2: MEASUREMENT 3: CALIBRATION 4: CLEANING 5: SYSTEM_CHECK 6 – 32767: reserved 32768 – 65535: manufacturer specific INIT The INIT function carries out a manufacturer specific new initialisation of the related Transducer Block. MEASUREMENT The MEASUREMENT function starts the algorithms for the generation of the process value and the precalculation if any. The related Transducer Block is chosen by the parameter CHANNEL. The parameter RECIPE chooses one of several optional signal calculation functions implemented in the device. CALIBRATION The CALIBRATION calculates correction data from set points and PV. The correction data will be used for the adjustment of the analyser device. With the parameter CHANNEL one single Transducer Block is chosen for calibration. If the calibration calculation is finished successfully, the CTB automatically starts the measurement of the according Transducer Block. CLEANING This is a device specific function. Details are out of the scope of this profile. SYSTEM_CHECK This is a device specific function. Details are out of the scope of this profile.

Parameter	Description
COMMAND	The COMMAND executes the regarding function a single time (e.g. MEASUREMENT, SYSTEM_CHECK, ...). The COMMAND parameter has higher priority than SEQUENCE_CONTROL, i.e. the function of SEQUENCE_CONTROL is active only if COMMAND equals 0 (zero). Coding: 0: RESET COMMAND function is not active 5: START executes a device function 6: STOP interrupts a device function, function remains in current state 7: RESUME function resumes execution from current state 8: CANCEL disables a device function, sets the function into initial state
STATUS	The STATUS presents the current state or the result of the execution of the function. Coding: 0: READY function has successfully been executed 1: NO_INIT function is not initialised 2: IDLE function is inactive 3: RUNNING function is currently active 4: INTERRUPTED function is currently interrupted 5: TIME_OUT function execution time has expired 6 – 127: reserved 128 – 255: manufacturer specific
CHANNEL	The CHANNEL parameter defines the Transducer Block which is controlled by the Control Transducer Block (Coding see General Requirements).
SEQUENCE_CONTROL	The SEQUENCE_CONTROL parameter provides an automated execution of the Control Transducer Block triggered by a cyclic time event or by a defined date and time, e.g. automatic calibration every 8 hours, start Init function at April 3rd 1992, 7.30 am. This parameter is a record containing all necessary information.
RECIPE	The RECIPE parameter provides the possibility to choose between different sub-versions of the Control Transducer Block function selected by BLOCK_TYPE. The coding of RECIPE depends on the BLOCK_TYPE: MEASUREMENT Number of the signal processing method. The default number is zero (0). CALIBRATION 1: Automatic over all calibration

Parameter	Description
	2: Calculate the current value of the active probe and store it at position 1 3: Calculate the current value of the active probe and store it at position 2 4: Calculate the current value of the active probe and store it at position 3 5: Evaluate parallelism with position 1 6: Evaluate slope with position 1 and 2 7: 3-Point-Calibration 8: Check parallelism 9: Check slope 10: Check 3-Point-Calibration 11 – 32767: reserved 32768 – 65535: non standardised recipe (manufacturer specific)
QUALITY	The QUALITY parameter contains the result of the RECIPE check calibration. It is calculated by comparing the SP and the PV of the device.
SP	The calibration of the Transducer Block needs 1 or more SP/PV couples, depending on the calibration method. The parameter SP is therefore an array containing the setpoints. The SP are e.g. filled in ascending order. The engineering unit of the SP is the same as the one of the Transducer Block.
PV	The calibration of the Transducer Block needs 1 or more SP/PV couples, depending on the calibration method. The parameter PV is therefore an array containing the current values. The PV are filled in the same order as the belongig setpoints. The engineering unit of the PV is the same as the one of the Transducer Block.
CTB_MASTER	A master CTB is used to simultaneously control a set of other CTBs. This means that the COMMAND parameter of a master CTB applies to all slave CTBs which are listed in the parameter SELECTION. The STATE and all other parameters are maintained separately in every controlled slave CTB. The master CTB is an additional CTB. There can be more than one master CTB in a device. Coding: TRUE: CTB is a master FALSE: CTB is a slave
SELECTION	The SELECTION parameter is valid for master CTBs only (CTB_MASTER = TRUE). It contains an array of pointers to the slave CTBs which are controlled by this master CTB. The pointers have the same coding as the parameter CHANNEL.
PARAMETER_SET_ NUMBER	Choice of a device or measurement specific set of block parameters. The selected set of block parameters is mapped onto the relative indexes above the index of PARAMETER_SET_NUMBER. This mapping preserves the possibility to integrate other parameter sets in future. Coding: 1: pH 2: CONDUCTIVITY 3: OXYGEN

Parameter	Description
NUMBER_PARAMETERS	Contains the number of parameters belonging to the parameter set selected by PARAMETER_SET_NUMBER.
BUFFER_NUMBER	Choice of the active buffer of the buffer set list which is available in the device. If the buffer number equals 0 (zero), no buffer is used.
ZERO	The ZERO point has the same engineering unit as the associated Analyser or Transfer Transducer Block.
SLOPE	Slope of the sensor characteristics. The engineering unit is mV/pH.
CELL_CONSTANT	Slope of the sensor.
CALOXY_TYPE	Selects the type of calibration. Coding: 1: SATURATION 2: CONCENTRATION
CALOXY_ZERO	Sensor zero point current. Value and status set by calibration. Unit code same as associated Transducer Block.
CALOXY_HIGH	Sensor high point current at normal conditions (Example: 1013.25 hPa, 25 °C, 100 % rH). Value and status set by calibration. Unit code same as related Transducer Block.
CALOXY_HUMIDITY_ REL	Calibration air humidity. Value set by calibration. Unit code 1342 [%].
CALOXY_PRESSURE	Calibration pressure. Value set by calibration. Unit code same as associated Transducer Block.
CALOXY_TEMP	Calibration temperature. Value set by calibration. Unit code same as associated Transducer Block.
CALOXY_BUFFER_SAT	Manual saturation calibration buffer. Value set by calibration. Unit code 1342 [%].
CALOXY_BUFFER_CONC	Manual concentration calibration buffer. Value set by calibration. Unit code same as associated Transducer Block.

Table 167. Parameter Description of the Control Transducer Block

32.5.2.1 COMMAND / STATUS Parameter Description

The COMMAND parameter controls the following state machine. The transitions are fired by the change of the COMMAND value.

The STATUS parameter contains the actual state. Additional states are manufacturer specific.

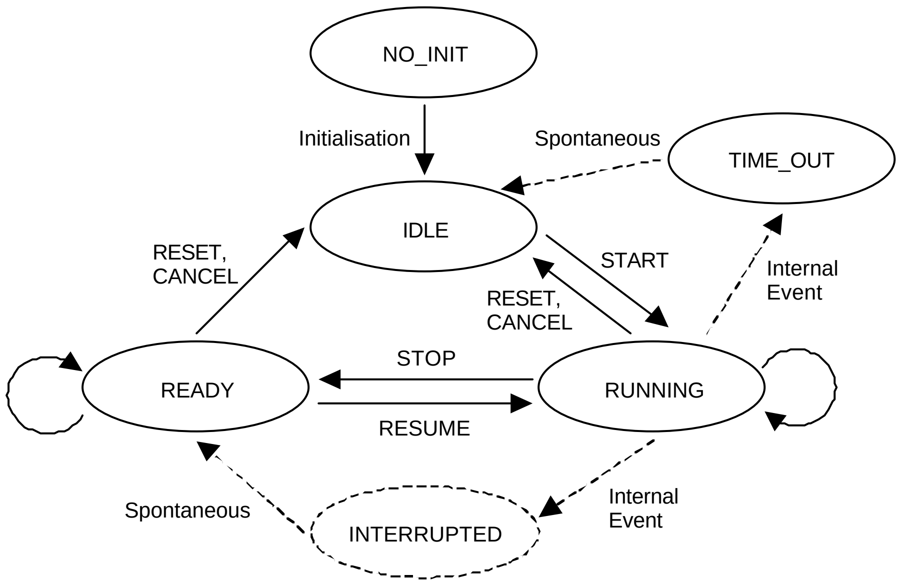


Figure 68. State Diagram of the Control Transducer Block – COMMAND Parameter

32.5.2.2 CTB_MASTER Description

There are two possibilities to control the analysers functions. The COMMAND parameter switches the functions according to the state diagram. The SEQUENCE_CONTROL parameter gives the opportunity for time controlled execution. The Element COMMAND of the SEQUENCE_CONTROL parameter has lower priority than the COMMAND parameter of the Control Transducer Block. The CTB_MASTER mechanism gives the opportunity to control more than one Transducer Block in parallel as result of a COMMAND change in the master CTB. The SELECTION parameter contains a list of slave CTBs which are controlled by the parameter COMMAND of the master CTB.

32.5.2.3 Execution of Analyser Functions

Analyser function	DEVICE STATE RUN	DEVICE_STATE STANDBY	DEVICE_STATE POWER_DOWN	DEVICE_STATE MAINTENANCE
INIT	X	X	X	X
MEASUREMENT	X			X
CALIBRATION	X			X
CLEANING	X			X
SYSTEM_CHECK				X

Legend: X - Function execution permitted

Table 168. Execution of Analyser Functions

32.5.3 Parameter Attributes of the Control Transducer Block

Relative Index	Parameter Name	Object Type	Data Type	Store	Size	Access	Parameter Usage / Kind of Transport	Reset Class	Default Value	Mandatory Optional (Class A,B)
... Standard Parameters see General Requirements										
Additional Control Transducer Block Parameters										
9	BLOCK_TYPE	Simple	Unsigned16	S	2	r,w	C/a	F	-	M
10	COMMAND	Simple	Unsigned16	N	2	r,w	C/a	F	-	M
11	STATUS	Simple	Unsigned8	D	1	r	C/a	-	-	M
12	CHANNEL	Simple	Unsigned16	S	2	r,w	C/a	F	-	M
13	SEQUENCE_CONTROL	Record	DS-66	S	14	r,w	C/a	F	-	M
14	RECIPE	Simple	Unsigned16	S	2	r,w	C/a	F	-	M
15	QUALITY	Array	Float	N	man spec	r	C/a	-	-	O
16	SP	Array	Float	N	man spec	r,w	C/a	F	-	O
17	PV	Array	Float	N	man spec	r	C/a	-	-	O
18	CTB_MASTER	Simple	Unsigned8	N	1	r,w	C/a	F	-	O
19	SELECTION	Array	Unsigned16	N	man spec	r,w	C/a	F	-	O
20-29	Reserved by PNO									M
30	PARAMETER_SET_ NUMBER	Simple	Unsigned8	N	1	r	C/a	-	-	M
31	NUMBER_PARAMETERS	Simple	Unsigned8	N	1	r	C/a	-	-	O
Parameter set for pH										
32	BUFFER_NUMBER	Simple	Unsigned8	N	1	r,w	C/a	F	-	O
33	ZERO	Simple	Float	S	4	r,w	C/a	-	-	O
34	SLOPE	Simple	Float	S	4	r,w	C/a	-	-	O
Parameter set for Conductivity										
32	CELL_CONSTANT	Simple	Float	S	4	r,w	C/a	-	-	O
Parameter set for Oxygen										
32	CALOXY_TYPE	Simple	Unsigned8	S	1	r,w	C/a	F	-	O
33	CALOXY_ZERO	Record	101	S	5	r,w	C/a	-	-	O
34	CALOXY_HIGH	Record	101	S	5	r,w	C/a	-	-	O
36	CALOXY_HUMIDITY_REL	Simple	Float	S	4	r,w	C/a	F	-	O
37	CALOXY_PRESSURE	Simple	Float	S	4	r,w	C/a	F	-	O
38	CALOXY_TEMP	Simple	Float	S	4	r,w	C/a	F	-	O
39	CALOXY_BUFFER_SAT	Simple	Float	S	4	r,w	C/a	F	-	O
40	CALOXY_BUFFER_CONC	Simple	Float	S	4	r,w	C/a	F	-	O
31+n +1	First manufacturer specific parameter									O

Table 169. Parameter Attributes of the Control Transducer Block

32.5.4 View Object of the Control Transducer Block

Relative Index	Parameter Name	View_1	View_2	View_3	View_4
9	BLOCK_TYPE				
10	COMMAND				
11	STATUS	1			
12	CHANNEL				
13	SEQUENCE_CONTROL				
14	RECIPE				
15	QUALITY				
16	SP				
17	PV				
18	CTB_MASTER				
19	SELECTION				
20-29	Reserved by PNO				
30	PARAMETER_SET_NUMBER				
31	NUMBER_PARAMETERS				
Parameter set for pH					
32	BUFFER_NUMBER				
33	ZERO				
34	SLOPE				
Parameter set for Conductivity					
32	CELL_CONSTANT				
Parameter set for Oxygen					
32	CALOXY_TYPE				
33	CALOXY_ZERO				
34	CALOXY_HIGH				
36	CALOXY_HUMIDITY_REL				
37	CALOXY_PRESSURE				
38	CALOXY_TEMP				
39	CALOXY_BUFFER_SAT				
40	CALOXY_BUFFER_CONC				
	Overall sum of bytes in View-Object (+ 13 Standard Parameter bytes)	1 + 13			

Table 170. View Object of the Control Transducer Block

32.6 Limit Transducer Block

32.6.1 Overview

The Limit Transducer Block is used to observe whether a PV of a Transducer Block has exeeded a configurable limit (THRESHOLD). The result of the limit check is stored in LIMIT_STATUS and can be integrated in the cyclic data transfer by a Discrete Input (DI) FB (this is done by setting the CHANNEL parameter of the DI to the LIMIT_STATUS parameter of the Limit Transducer Block). Devices can provide more than one limit check.

32.6.2 Parameter Description of the Limit Transducer Block

Parameter	Description
CHANNEL	The CHANNEL parameter defines the PV of the Transducer Block which is checked against THRESHOLD (Coding see General Requirements).
THRESHOLD	THRESHOLD contains the limit value. The engineering unit is the same as the one of the related Analyser Transducer or Transfer Transducer Block.
HYSTERESIS	Absolute value of the switching hysteresis. The engineering unit is the same as the one of the related Analyser Transducer or Transfer Transducer Block.
DIRECTION	The DIRECTION determines whether the result of the limit check is active in case of a higher or a lower value than the limit. Coding: 0: active if value has fallen below the limit (PV < THRESHOLD) 1: active if value has exceeded the limit (PV > THRESHOLD)
ON_DELAY	ON_DELAY defines the time interval while the PV must permanently exceed the limit before LIMIT_STATUS switches to active.
OFF_DELAY	OFF_DELAY defines the time before LIMIT_STATUS switches back to inactive after the limit exceedance has disappeared.
RESET	With this parameter an active LIMIT_STATUS can be frozen, i.e. LIMIT_STATUS will not return to inactive after the limit exceedance has gone. Coding: 0: update LIMIT_STATE continuously 1: freeze LIMIT_STATE when active
CONFIRMATION	This parameter is used to reset the LIMIT_STATUS parameter. The default value for reset is 0x42. The parameter will be set to 0 (zero) by the Transducer Limit Block after LIMIT_STATUS has been reset to inactive.
LIMIT_STATUS	Result of the limit check. Coding of LIMIT_STATUS.Value: 0: Limit condition is inactive 1: Limit condition is active LIMIT_STATUS.Status is given by the related Transducer Block.

Table 171. Parameter Description of the Limit Transducer Block

32.6.3 Parameter Attributes of the Limit Transducer Block

Relative Index	Parameter Name	Object Type	Data Type	Store	Size	Access	Parameter Usage / Kind of Transport	Reset Class	Default Value	Mandatory Optional (Class A,B)
... Standard Parameters see General Requirements										
Additional Limit Transducer Block Parameters										
9	CHANNEL	Simple	Unsigned16	S	2	r,w	C/a	F	-	M
10	THRESHOLD	Simple	Float	S	4	r,w	C/a	F	-	M
11	HYSTERESIS	Simple	Float	S	4	r,w	C/a	F	-	M
12	DIRECTION	Simple	Unsigned8	S	1	r,w	C/a	F	-	M
13	ON_DELAY	Simple	Time_Difference	S	4	r,w	C/a	F	-	M
14	OFF_DELAY	Simple	Time_Difference	S	4	r,w	C/a	F	-	M
15	RESET	Simple	Unsigned8	S	1	r,w	C/a	F	-	M
16	CONFIRMATION	Simple	Unsigned8	S	1	r,w	C/a	-	-	M
17	LIMIT_STATUS	Simple	102	S	2	r	C/a	-	-	M
18-27	Reserved by PNO									M
from 28	First manufacturer specific parameter									O

Table 172. Parameter Attributes of the Limit Transducer Block

32.6.4 View Object of the Limit Transducer Block

Relative Index	Parameter Name	View_1	View_2	View_3	View_4
9	CHANNEL				
10	THRESHOLD				
11	HYSTERESIS				
12	DIRECTION				
13	ON_DELAY				
14	OFF_DELAY				
15	RESET				
16	CONFIRMATION				
17	LIMIT_STATUS	2			
	Overall sum of bytes in View-Object (+ 13 Standard Parameter bytes)	2 + 13			

Table 173. View Object of the Limit Transducer Block

32.7 Alarm Transducer Block – Binary Alert Status

32.7.1 Parameter Structure of the Alarm Transducer Block

The Alarm Transducer Block is composed of a hierarchy of several objects. The top of this hierarchy is the sum of all class specific states containing the OR information of each class. Stepping into the lower level objects the user can get more detailed information about an alarm, e.g. the alarm source or reason (see Figure 69).

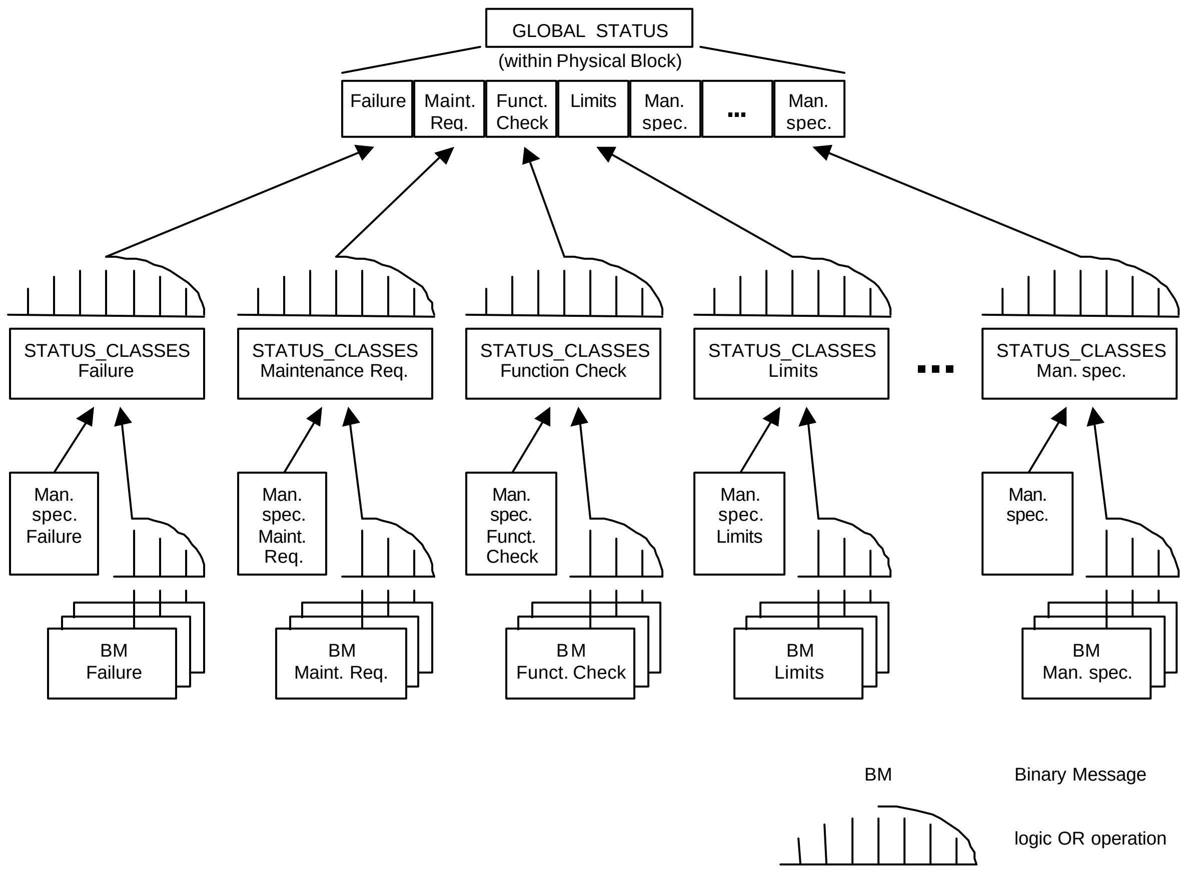


Figure 69. Hierarchy of the Alarm Information

The GLOBAL_STATUS parameter is a summary of all states of the device and is therefore placed in the Physical Block.

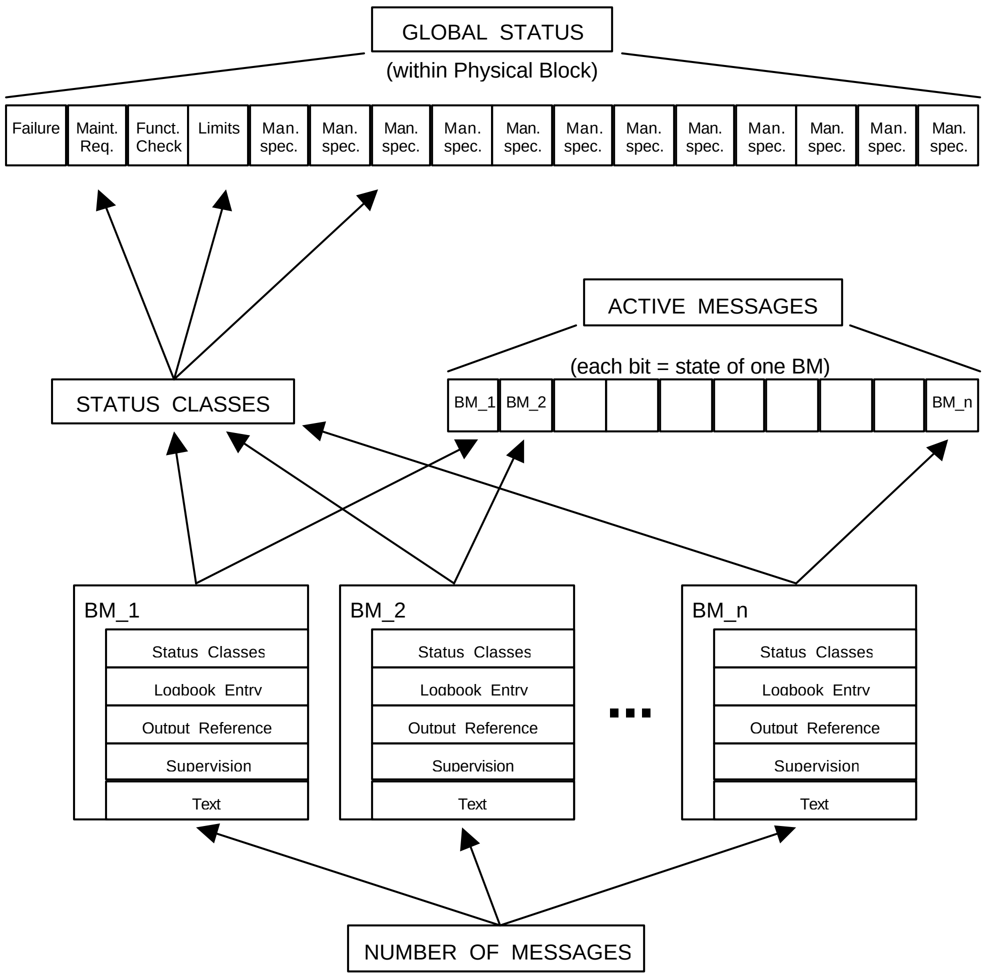


Figure 70. Parameter Structure of the Alarm Transducer Block

Binary Messages are the lowest hierarchy level of the alarm information. They reflect individual device or process states without influence of other signals. All BMs are numbered in ascending order starting with 1. The parameter NUMBER_OF_MESSAGES shows the number of present BMs. The change of BM states can be stored in the Logbook Function Block.

32.7.2 Parameter Description of the Alarm Transducer Block

Parameter	Description
GLOBAL_STATUS	This parameter is the top of the status hierarchy. It shows if any of the status classes has an active message. Each bit of the GLOBAL_STATUS parameter is the OR combination of the related status class. GLOBAL_STATUS is an element of the Physical Block. Bit 1 Failure Bit 2 Maintenance Reqired Bit 3 Function Check Bit 4 Limits (This class is used for the results of the Transducer Blocks and/or the OUT parameter of the Analog Input/Output Blocks) Bit 5 to 16 manufacturer specific
STATUS_CLASSES	This array contains one element (unsigned16) for each status class. The bits 0 to 14 of each element mirror the states of individual Binary Messages or device specific events. Bit 15 (MSB) is the OR combination of all Binary Messages belonging to the status class (see classification of the BM status) and shows if at least one of these Binary Messages is active. Reading the parameter STATUS_CLASSES provides a quick way to find out which BMs are currently active. The assignment of the status classes to the elements of STATUS_CLASSES is shown in Table 175 . Unused STATUS_CLASSES elements are set to 0 (zero). Coding of Bit 16 of each STATUS_CLASSES element: 0: no Binary Message of this status class is active 1: at least one Binary Message of this status class is active Status Class Failure This status class relates to the failure of the device. Bit 1 to15 not standardised Bit 16 reserved for sum of BMs Status Class Maintenance Required This status class relates to the required maintenance of the device. Bit 1 to 15 not standardised Bit 16 reserved for sum of BMs Status Class Function Check The status class Function Check provides information about the current mode and state of the analyser device. If the measurement equipment does not provide the process attributes as required, the message Function Check has to be generated. The status Function Check can be generated

Parameter	Description
	- while the device is in modes which inhibit the measurement of the process attributes. Each device may provide a list of modes which generate the status Function Check. - at least one Binary Message related to status class Function Check is active. Bit 1 Standby Bit 2 Power down Bit 3 Hold Bit 4 Stop measurement Bit 5 Maintenance by hand Bit 6 Maintenance automatically Bit 7 Calibration by hand Bit 8 Calibration automatically Bit 9 to 15 not standardised Bit 16 reserved for sum of BMs Status Class Limits This status class relates to limit exceedance of the measurement values. Bit 1 HI_HI_LIM exceeded in the AI-Block Bit 2 HI_LIM exceeded in the AI-Block Bit 3 LO_LIM exceeded in the AI-Block Bit 4 LO_LO_LIM exceeded in the AI-Block Bit 5 to 15 not standardised Bit 16 reserved for sum of BMs
ACTIVE_MESSAGES	This bitstring contains all configured Binary Messages, i.e. each BM is represented by one bit. All active BMs are marked. The order number of the bits in the bitstring is the same as the order of the BMs in the block parameter list of the Alarm Transducer Block. The number of BMs is device specific. The read access to this parameter provides an overview of all active BMs at a specific time. Coding of each bit: 0 BM_NOT_ACTIVE Binary Message not active 1 BM_ACTIVE Binary Message active
NUMBER_OF_ MESSAGES	Number of configurable Binary Messages in the device.
BM_n	This parameter contains the attributes of the Binary Message (Coding see General Requirements).

Table 174. Parameter Description of the Alarm Transducer Block

STATUS_CLASSES Array element (Bit numbering)	Status class
1	Failure
2	Maintenance Required
3	Function Check
4	Limits
5-16	manufacturer specific

Table 175. Mapping of the Status Classes to the Array Elements of STATUS_CLASSES

32.7.3 Parameter Attributes of the Alarm Transducer Block

Relative Index	Parameter Name	Object Type	Data Type	Store	Size	Access	Parameter Usage / Kind of Transport	Reset Class	Default Value	Mandatory Optional (Class A,B)
... Standard Parameters see General Requirements										
Additional Alarm Transducer Block Parameters										
8	STATUS_CLASSES	Array	Unsigned16	D	32	r	C/a	-	0,...,0	M
9	ACTIVE_MESSAGES	Array	BitString	D	32	r	C/a	-	0,0,0	M
10-14	Reserved by PNO									M
15	NUMBER_OF_MESSAGES	Simple	Unsigned16	N	2	r	C/a	-	-	M
16	BM_1	Record	DS-62	N	21	r,w	C/a	F	-	M
...										
15+n	BM_n	Record	DS-62	N	21	r,w	C/a	F	-	O
15+n +1	First manufacturer specific parameter									O

Table 176. Parameter Attributes of the Alarm Transducer Block

32.7.4 View Object of the Alarm Transducer Block

Relative Index	Parameter Name	View_1	View_2	View_3	View_4
8	STATUS_CLASSES	32			
9	ACTIVE_MESSAGES	32			
10-14	Reserved by PNO				
15	NUMBER_OF_MESSAGES				
16	BM_1				
...					
15+n	BM_n				
	Overall sum of bytes in View-Object (+ 13 Standard Parameter bytes)	64 + 13			

Table 177. View Object of the Alarm Transducer Block

32.7.5 Mapping of the Binary Messages to the Status of the PV

The following table shows the coding of the Status byte of the OUT and OUT_D parameter of the AI and DI Function Blocks as a result of active Binary Messages. For the generation of the Status bytes the device has to make the necessary information available for the FBs.

Namur Binary Message class of BM	Status quality
Failure	BAD – sub-status dependent on failure type
Maintenance required	GOOD – Maintenance required
Function check	UNCERTAIN – Last Usable Value (LUV)
Limit	See General Requirements

Table 178. Mapping of Namur Binary Message Classes to 101/102 Ctatus

32.8 Function Blocks from Other Data Sheets (AI, DI, AO, DO)

This chapter is contained in the data sheets Transmitter, Actuator, Discrete Input and Discrete Output of the PROFIBUS-PA profile.

32.9 Multi Point Sampling Function Block

32.9.1 Overview

An analyser device may offer a Multi Point Sampling Function Block. This block executes all samplings described in the sample list one after another. The execution time of each sample is configured in the according parameter element of the sample structure. A device may contain n samples. Each sample can be used for different applications. There may be one Multi Point Sampling Function Block in an analyser device at the most.

With the commands START and STOP the Multi Point Sampling Function Block will be started and stopped.

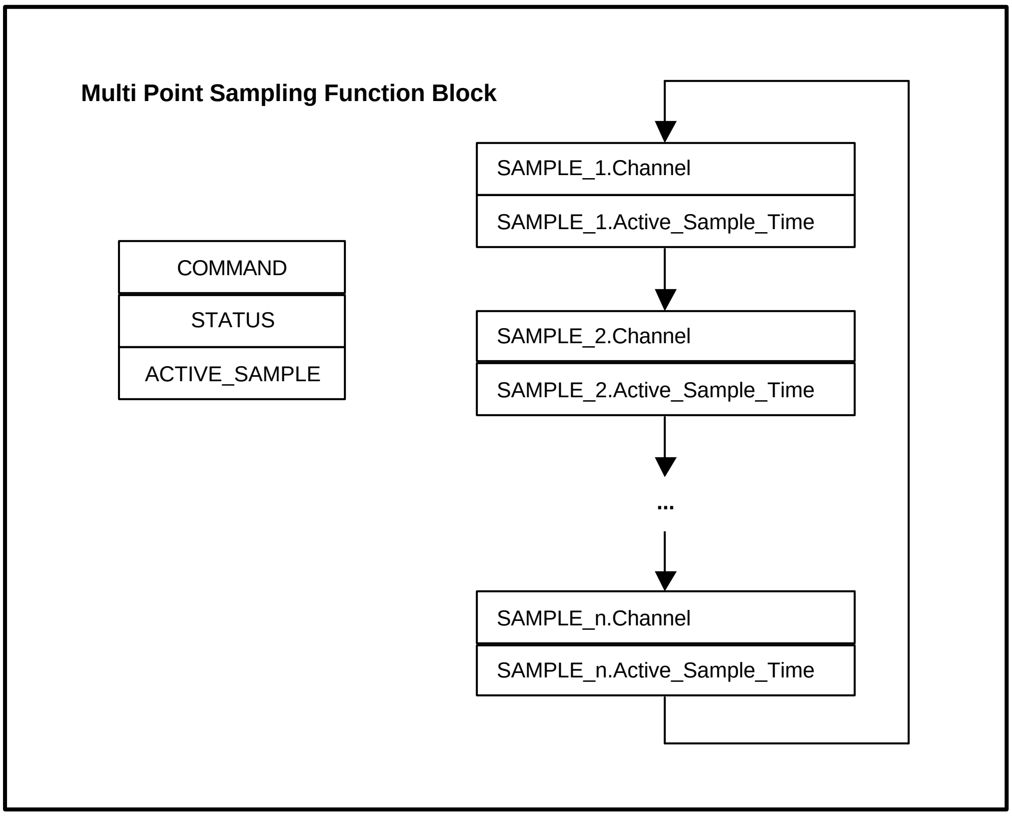


Figure 71. Multi Point Sampling Function Block

32.9.2 Parameter Description of the Multi Point Sampling Function Block

Parameter	Description
COMMAND [1]	The COMMAND parameter controls the sampling activity. Coding: 0: RESET COMMAND function not active 5: START activates this device function 6: STOP interrupts this device function 7: RESUME reactivates an interrupted device function 8: CANCEL stops this device function
STATUS [1]	This STATUS parameter mirrors the state of the function which is currently executed or presents the result of the execution. Coding: 0: READY function execution was stopped successfully 1: NO_INIT function is not initialised 2: IDLE function is inactive 3: RUNNING function is currently active 4: INTERRUPTED functionexecution is currently interrupted 5: TIME_OUT function execution time is over 6 – 127: reserved 128 – 255: manufacturer specific
ACTIVE_SAMPLE	This parameter shows which sample of the sample list is currently taken.
NUMBER_SAMPLES	This parameter shows how many samples are configured in the device.
SAMPLE_n	This parameter structure contains the reference to the samples and the execution time of each sample. The Channel structure element refers to the Transducer Block which is sampled. The order in which the samples are taken equals the order (relative index) of the SAMPLE_n block parameters in the Multi Point Sampling Function Block.

Table 179. Parameter Description of the Multi Point Sampling Function Block

[1] For more details see 32.5.2.1.

32.9.3 Parameter Attributes of the Multi Point Sampling Function Block

Relative Index	Parameter Name	Object Type	Data Type	Store	Size	Access	Parameter Usage / Kind of Transport	Reset Class	Default Value	Mandatory Optional (Class A,B)
... Standard Parameters see General Requirements										
Additional Multi Point Sampling Function Block Parameters										
9	COMMAND	Simple	Unsigned16	N	2	r,w	C/a	F	-	M
10	STATUS	Simple	Unsigned8	D	1	r	C/a	-	-	M
11-20	Reserved by PNO									M
21	ACTIVE_SAMPLE	Simple	Unsigned16	D	2	r	C/a	-	-	M
22	NUMBER_SAMPLES	Simple	Unsigned16	N	2	r	C/a	-	-	M
23	SAMPLE_1	Record	DS-63	N	6	r,w	C/a	F	-	M
...										
22+n	SAMPLE_n	Record	DS-63	N	6	r,w	C/a	F	-	O
22+n +1	First manufacturer specific parameter									O

Table 180. Parameter Attributes of the Multi Point Sampling Function Block

32.9.4 View Object of the Multi Point Sampling Function Block

Relative Index	Parameter Name	View_1	View_2	View_3	View_4
9	COMMAND				
10	STATUS	1			
11-20	reserved by PNO				
21	ACTIVE_SAMPLE	2			
22	NUMBER_SAMPLES				
23	SAMPLE_1				
...					
22+n	SAMPLE_n				
	Overall sum of bytes in View-Object (+ 13 Standard Parameter bytes)	3 + 13			

Table 181. View Object of the Multi Point Sampling Function Block

32.10 Logbook Function Block – Functions for Archiving

32.10.1 Overview

Binary Messages and status information can be stored in a Logbook Function Block. Changes, i.e. the appearance and disappearance of Binary Messages or status information will be coupled with its time stamp and stored in the Logbook. The number of entries in the logbook is limited and configured by the device manufacturer. Read services have access to single entries. The first entry has the number 1. Each new entry gets the next position in the ring memory until the highest position SIZE_OF_ENTRIES is reached. From that moment on each new entry will overwrite the oldest one contained in the logbook. The support of a Logbook in an analyser device is optional. The COMMAND parameter and the parameterisation of the Binary Messages determine whether and in which way events are stored in the Logbook.

Each logbook entry is of data structure DS-64. The first element of this data structure is the type of entry, i.e. a Binary Message or a status information of one of the status classes. The second element is either the number of the Binary Message or the sum of the related status class. The third element shows if the BM became active or inactive. If an entry is a status information this third element has no meaning. The last element contains the time stamp of the state change.

32.10.2 Parameter Description of the Logbook Function Block

Parameter	Description
COMMAND [1]	The COMMAND is used to switch on and off as well as resume or reset the Logbook FB. Coding: 0 RESET 5 START 6 STOP 7 RESUME
STATUS [1]	The STATUS parameter contains the state of the function which is currently executed or presents the result of the execution. Coding: 0 READY function execution was stopped successfully 1 NO_INIT function is not initialised 2 IDLE function is inactive 3 RUNNING function is currently active 4 – 127 reserved 128 – 255 manufacturer specific
SIZE_OF_ENTRIES	This parameter shows the number of different entries which the Logbook can take up at the same time.
NUMBER_OF_ENTRIES	This parameter contains the actual number of entries in the Logbook.
TURN_NUMBER	This parameter counts how many times the logbook has completely been filled.

[1] For more details see 32.5.2.1.

Parameter	Description
NEWEST_ENTRY	This parameter contains the newest entry of the Logbook. As long as no entries have been stored in the Logbook, NEWEST_ENTRY shall point to the following Binary Message (DS-62): Status_Class = 0 Logbook_Entry = TRUE Output_Reference = 0 Supervision = 0 Text = "Empty Logbook" This Binary Message is not listed in the parameters STATUS_CLASSES and ACTIVE_MESSAGES and is overwritten by the first Logbook entry.
OLDEST_ENTRY	This parameter contains the oldest entry of the Logbook.
ACTUAL_POST_READ_ NUMBER	This parameter shows the number of the Logbook entry which will be returned by the next read access to the parameter POST_READ_ENTRY. This parameter provides a flow control of the entry access of the Logbook. It decreases after each POST_READ_ENTRY parameter read access. If the oldest entry was read then this parameter switches to the number of the newest one. If the value 0 (zero) is written to ACTUAL_POST_READ_NUMBER then the parameter POST_READ_ENTRY is set to the newest entry.
POST_READ_ENTRY	A read access to this parameter returns the logbook entry with the number given by ACTUAL_POST_READ_NUMBER. Every read access automatically decreases ACTUAL_POST_READ_NUMBER by one, i.e. the read pointer is shifted to the next older entry. Step by step every entry of the Logbook can be read.

Table 182. Parameter Description of the Logbook Function Block

32.10.2.1 COMMAND / STATUS Parameter Description

The COMMAND parameter controls the following state machine. The transitions are fired by the change of the COMMAND value.

The STATUS parameter contains the actual state. Additional states are manufacturer specific.

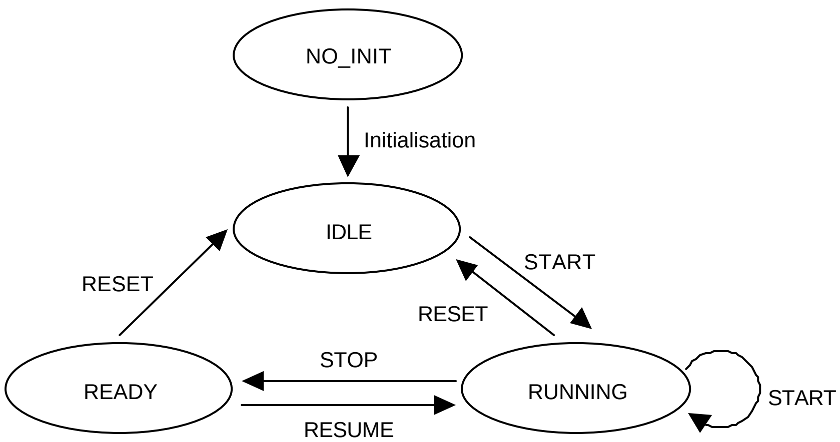


Figure 72. State diagram of Logbook FB – COMMAND parameter

32.10.3 Parameter Attributes of the Logbook Function Block

Relative Index	Parameter Name	Object Type	Data Type	Store	Size	Access	Parameter Usage / Kind of Transport	Reset Class	Default Value	Mandatory Optional (Class A,B)
... Standard Parameters see General Requirements										
Additional Logbook Function Block Parameters										
9	COMMAND	Simple	Unsinged16	S	2	r,w	C/a	F	5	M
10	STATUS	Simple	Unsigned8	D	1	r	C/a	-	-	M
11	SIZE_OF_ENTRIES	Simple	Unsigned16	N	2	r	C/a	-	-	M
12	NUMBER_OF_ENTRIES	Simple	Unsigned16	N	2	r	C/a	-	0	M
13	TURN_NUMBER	Simple	Unsigned16	N	2	r	C/a	-	0	M
14	NEWEST_ENTRY	Record	DS-64	N	11	r	C/a	-	0	M
15	OLDEST_ENTRY	Record	DS-64	N	11	r	C/a	-	0	M
16	ACTUAL_POST_READ_NUMBER	Simple	Unsigned16	D	2	r,w	C/a	F	0	M
17	POST_READ_ENTRY	Record	DS-64	D	11	r	C/a	-	0	M
18-27	Reserved by PNO								-	M
28	First manufacturer specific parameter									O

Table 183. Parameter Attributes of the Logbook Function Block

32.10.4 View Object of the Logbook Function Block

Relative Index	Parameter Name	View_1	View_2	View_3	View_4
9	COMMAND				
10	STATUS	1			
11	SIZE_OF_LOGBOOK				
12	NUMBER_OF_ENTRIES				
13	TURN_NUMBER				
14	NEWEST_ENTRY	11			
15	OLDEST_ENTRY				
16	ACTUAL_POST_READ_NUMBER				
17	POST_READ_ENTRY				
18... 27	Reserved by PNO				
	Overall sum of bytes in View-Object (+ 13 Standard Parameter bytes)	12 + 13			

Table 184. View Object of the Logbook Function Block

33 Device Data Sheet Analyser - Conformance Definition

An analyser device does not have to support all blocks with its parameters and functions defined in section 1 of this document. The definitions mean that if a block with its functions and parameters is accessable in a device then the definitions have to be implemented in the way described. The following tables define which functions and parameters have to be implemented (mandatory – M) and which may be implemented (optional – O) in an analyser device.

Description	Conformity statement
RUN	M
STANDBY	O
POWER_DOWN	O
MAINTENANCE	M

Table 185. Conformance Definition for DEVICE_STATE of the Physical Block

Description	Conformity statement
Physical Block	M
Analyser Transducer Block	M
Transfer Transducer Block	O
Control Transducer Block	O
Limit Transducer Block	O
Alarm Transducer Block	O
Analog Input Function Block	M
Analog Output Function Block	O
Discrete Input Function Block	O
Discrete Output Function Block	O
Multi Point Sampling Function Block	O
Logbook Function Block	O

Table 186. Conformance Definition for Blocks

Function	Conformity statement
INIT	M
MEASUREMENT	M
CALIBRATION	O
CLEANING	O
SYSTEM_CHECK	O

Table 187. Conformance Definition for BLOCK_TYPE of the Control Transducer Block

Command	Conformity statement
RESET	M
START	M
STOP	O
RESUME	O
CANCEL	M

Table 188. Conformance Definition for COMMAND of Control Transducer Block / Multi Point Sampling Function Block / Logbook Function Block

Code for subparameter Choice	Conformity statement
0	M
1 – 4	O

Table 189. Conformance Definition for Subparameter Choice of the Transfer Transducer Block parameter CALCULATION_n

Recipe code	Conformity statement
1	M
2 – 10	O

Table 190. Conformance Definition of the RECIPE Parameter of the Control Transducer Block

34 Device Data Sheet Analyser - Document History

Changes from V3.0 to V3.0.1.

Chapter/Figure/Table	Change
Entire document	Editorial changes.
All parameter tables	Extended by column Reset class.
32.2.2 / Table 158	Reference to inexistent DEVICE_STATE figure deleted.
32.2.2 / Table 158	Description of GLOBAL_STATUS replaced by a reference to the same description within chapter 1.7.2 / Table 17
32.3.2 / Table 161	Description of parameter AUTORANGE_ON clarified.
32.3.4 / Table 163	Size of ACTIVE_RANGE in View_1 changed from 2 to 1. Overall sum of bytes in VIEW_1 changed from 14+13 to 13+13.
32.5.2 / Table 167	Extended by parameters for PARAMETER_SET_NUMBER = 3 (Oxygen).
32.5.2 / Table 167	Description of CTB_MASTER: “parameter Choice” changed to “SELECTION”.
32.5.2 / Table 167	Limitation “which shall be active during an all over calibration” changed to “which are controlled by this master CTB”.
32.5.2.1 / Figure 68	STATUS NO_INIT added; COMMAND CANCEL added.
32.5.2.2	Sentence deleted: One example is shown in the following figure.
32.5.3 / Table 169	Mandatoy Optional attribute of parameter PARAMETER_SET_NUMBER changed from o to m.
32.5.3 / Table 169	Extended by parameters for PARAMETER_SET_NUMBER = 3 (Oxygen).
32.6.2 / Table 171	Coding of parameter DIRECTION changed from TRUE/FALSE to 0/1.
32.6.2 / Table 171	Coding of parameter RESET changed from TRUE/FALSE to 0/1.
32.6.2 / Table 171	Coding of parameter LIMIT_STATE changed from TRUE/FALSE to 0/1. Additional description of new component Status.
32.6.3 / Table 172	Data Type of parameter LIMIT_STATE changed from Unsigned8 to 102. Attribute Size changed from 1 to 2.
32.7.4 / Table 177	Man.-specific deleted from overall sum of bytes in View-Object.
32.7.5 / Table 178	Number of table integrated in the automated table counting. The new number is table 21, all subsequent tabels are shifted one number upwards.
32.8.1	Chapter deleted.
32.8.1.1	Chapter deleted, contents moved to chapter 1.8.
32.8.1.2	Chapter deleted.
32.9	Labels harmonised: “Probe FB” and “Multi Point Sample FB” changed to “Multi Point Sampling FB”.
32.10.1	Change of Logbook description.
32.10.2 / Table 182	Extension to the description of parameter ACTUAL_POST_READ_NUMBER.
32.10.2 / Table 182	Definition of parameter NEWEST_ENTRY enlarged by the definition of a default value.
32.10.2 / Table 182	Value Cancel (8) deleted from the list of valid COMMAND values.
32.10.3 / Table 183	Access attribute of parameter NEWEST_ENTRY changed from r,w to r.

32.10.3 / Table 183	Default value of parameter COMMAND changed from 0 (Reset) to 5 (Start).
32.10.3 / Table 183	Default value of parameter STATUS deleted.
32.10.3 / Table 183	Default value of parameter TURN_NUMBER changed from 1 to 0.
33 / Table 185 – 190	Table captions corrected and redered more precisely.
33 / Table 186	Limit Transducer Block and Alarm Transducer Block added as optionals.
33 / Table 188	Value RESET added as mandatory.

Table 191. Changes from V3.0 to V3.0.1

PROFIBUS-PA

Device Data Sheet

Multi-Variable Device

35 General Function Set for Multi-Variable Devices

There are device types which cover a large variety hardware configuration and functionality. Such device types are a combination of different block types. These device types may be a selection of one or more blocks specified in the range of PROFIBUS-PA Device data sheets. The choice of a subset follows certain rules defined in the conformance statements below. The tables show which block is mandatory (M), conditional (C), selected (S) and which are optional (O).

Parameter	Conformance class B
Physical Block	M
Function Blocks	M (in minimum 1 FB)
Analog Input Function Block	S
Analog Output Function Block	S
Discrete Input Function Block	S
Discrete Output Function Block	S
Totaliser Function Block	S
Logbock Function Block	S
Multipoint Sampling Function Block	S
PID	S
other PROFIBUS-PA Function Blocks	S
Transducer Blocks	O
Temperature Transducer Block	S
Pressure Transducer Block	S
Level Transducer Block	S
Flow Transducer Block	S
Electro-pneumatic Transducer Block	S
Electro Transducer Block	S
Hydraulic Transducer Block	S
Analyser Transducer Block	S
Transfer Transducer Block	S
Control Transducer Block	S
Alarm Transducer Block	S
Limit Transducer Block	S
other PROFIBUS-PA Transducer Blocks	O

Table 192. Conformance Statement of Multi-Variable Devices

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