

INTERNATIONAL STANDARD

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**Function blocks (FB) for process control and electronic device description
language (EDDL) –
Part 2: Specification of FB concept**

**Blocs fonctionnels (FB) pour les procédés industriels et langage de description
electronique de produit (EDDL) –
Partie 2: Spécification du concept de FB**



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**FUNCTION BLOCKS (FB) FOR PROCESS CONTROL AND
ELECTRONIC DEVICE DESCRIPTION LANGUAGE (EDDL) –****Part 2: Specification of FB concept**

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International Standard IEC 61804-2 has been prepared by subcommittee 65E: Devices and integration in enterprise systems, of IEC technical committee 65: Industrial-process measurement, control and automation.

This third edition cancels and replaces the second edition published in 2006 and integrates parts of IEC 61804-1 which was withdrawn in January 2013. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) added command communication mapping in Clause 8;
- b) moved and reword compatibility level definition from IEC 62804-1 to new Annex B and terms and definitions;

c) added proxy concept in new Annex C.

The text of this standard is based on the following documents:

FDIS	Report on voting
65E/567/FDIS	65E/576/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 61804 series, published under the general title *Function blocks (FB) for process control and electronic device description language (EDDL)*, can be found on the IEC website.

Future standards in this series will carry the new general title as cited above. Titles of existing standards in this series will be updated at the time of the next edition.

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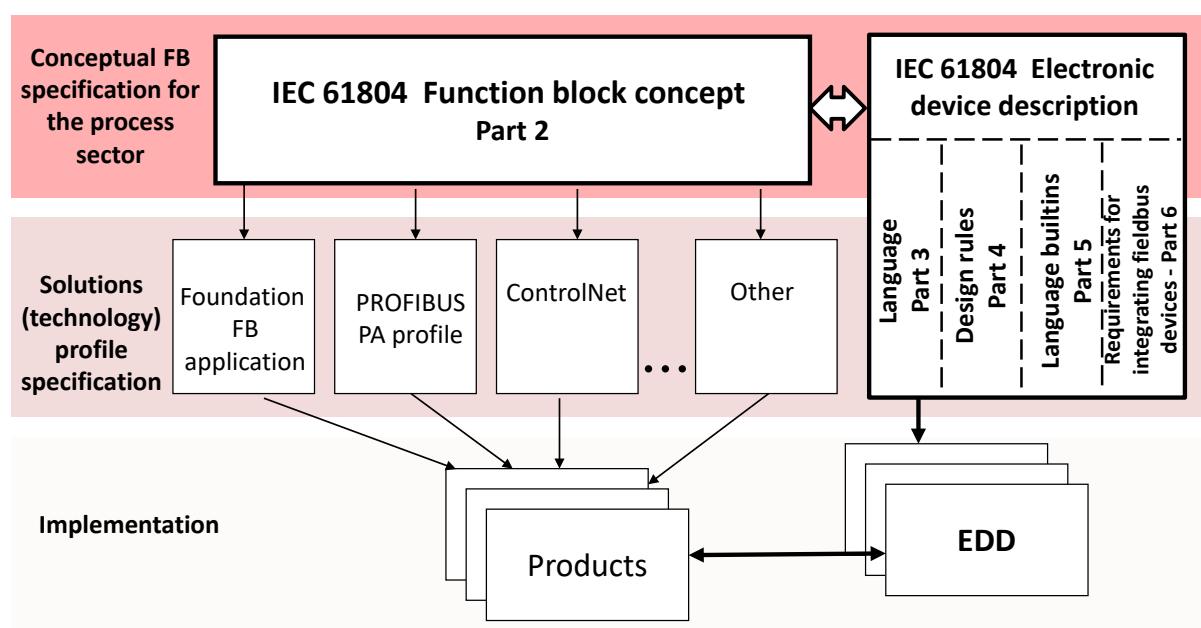
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INTRODUCTION

This part of IEC 61804 provides a conceptual function block (FB) specification, which can be mapped to specific communication systems and their accompanying definitions by industrial groups.

The EDDL fills the gap between the conceptual FB specification of this document and a product implementation. Figure 1 shows these aspects.



IEC

Figure 1 – Position of IEC 61804-2 related to other standards and products

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U.S. Patent No. 5,333,114
 U.S. Patent No. 5,485,400
 U.S. Patent No. 5,825,664
 U.S. Patent No. 5,909,368
 U.S. Patent Pending No. 08/916,178
 Australian Patent No. 638507
 Canadian Patent No. 2,066,743
 European Patent No. 0495001
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 UK – Patent No. 0495001
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The IEC 61804 series has the general title "Function blocks (FB) for process control and electronic device description language (EDDL)" and consists of the following parts:

Part 2: FB concept

Part 3: Electronic device description language (EDDL)

Part 4: EDD design rules

Part 5: EDDL Builtin library

Part 6: Meeting the requirements for integrating fieldbus devices in engineering tools for field devices

FUNCTION BLOCKS (FB) FOR PROCESS CONTROL AND ELECTRONIC DEVICE DESCRIPTION LANGUAGE (EDDL) –

Part 2: Specification of FB concept

1 Scope

This part of IEC 61804 is applicable to function blocks (FB) for process control.

This document specifies FB by using the result of a harmonization work as regards several elements.

- a) The device model which defines the components of an IEC 61804-2 conformant device.
- b) Conceptual specifications of FBs for measurement, actuation and processing. This includes general rules for the essential features to support control, whilst avoiding details which stop innovation as well as specialization for different industrial sectors.
- c) The electronic device description (EDD) technology, which enables the integration of real product details using the tools of the engineering life cycle.

The standardization work for FB was carried out by harmonizing the description of concepts of existing technologies. It results in an abstract level that allowed the definition of the common features in a unique way. This abstract vision is called here the "conceptual FB specification" and is mapped to specific communication systems and their accompanying definitions by the industrial groups.

NOTE This document can be mapped to ISO 15745-1.

There are solutions on the market today, which fulfil the requirements of this document and show how the conceptual specification is implemented in a given technology. New technologies will need to find equivalent solutions (see Figure 4).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61158 (all parts), *Industrial communication networks – Fieldbus specifications*

IEC 61499-1:2012, *Function blocks – Part 1: Architecture*

ISO/IEC 7498-1, *Information technology – Open Systems Interconnection – Basic Reference Model: The Basic Model*

3 Terms, definitions, abbreviated terms and conventions

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1.1

performance

quantitative or qualitative level of a property at any point in time considered

[SOURCE: ISO 15686-1:2011, 3.15, modified – The second term "performance in use" has been deleted. In the definition, the words "quantitative or" have been added and the word "critical" has been deleted.]

3.1.2

semantics

relationships between the symbolic elements and their meanings, interpretation and use

[SOURCE: IEC 61131-3:2013, 3.85, modified – The words "of a programming language" have been deleted.]

3.1.3

algorithm

finite set of well-defined rules for the solution of a problem in a finite number of *operations*

3.1.4

application

software functional unit that is specific to the solution of a problem in industrial-process measurement and control

Note 1 to entry: An application may be distributed among *resources*, and may communicate with other applications.

3.1.5

application function block

application FB

FB which has no input or output to the process

3.1.6

attribute

property or characteristic of an entity, for instance, the version identifier of an FB type specification

Note 1 to entry: The formal description of attributes is part of the solution profiles to get domain specific interoperability. IEC 61804 (all parts) defines the general rules to define the attributes and specifies the EDDL to describe attributes, which may be described in solution profiles.

[SOURCE: IEC 61499-1:2012, 3.6, modified – A note to entry has been added.]

3.1.7

Builtin

predefined subroutine for communication and display executed by the EDD application

3.1.8

coexistence

ability of two or more devices to operate independently of one another in the same network respecting the common rules for sharing the same medium

3.1.9

compatibility

ability of a device to provide the set of functions and data required by an application for a specific role in the physical process

Note 1 to entry: Function comprises application and communication functions including the dynamic behavior.

Note 2 to entry: Data comprises communication frame format and order as well as data type definitions up to semantical description of the functions.

3.1.10

component function block

component FB

FB instance which is used in the specification of an algorithm of a composite FB type

Note 1 to entry: A component FB can be an FB or composite FB type.

3.1.11

composite FB type

FB type whose algorithms are expressed entirely in terms of interconnected component FBs and variables

[SOURCE: IEC 61499-1:2012, 3.16, modified – The words "and the control of their execution" and "event" have been deleted.]

3.1.12

configuration

<of a system or device> selecting functional units, assigning their locations and defining their interconnections

[SOURCE: IEC 61499-1:2012, 3.18]

3.1.13

data

representation of facts, concepts or instructions in a formalized manner suitable for communication, interpretation or processing by human beings or by automatic means

[SOURCE: IEC 61499-1:2012, 3.23, modified – The definition has been rephrased.]

3.1.14

data connection

association established between functional units for conveyance of data

[SOURCE: IEC 61499-1:2012, 3.24, modified – The words "two function blocks" have been replaced by "functional units".]

3.1.15

data input

interface of an FB which receives data from a data connection

[SOURCE: IEC 61499-1:2012, 3.25]

3.1.16

data output

interface of an FB which supplies data to a data connection

[SOURCE: IEC 61499-1:2012, 3.26]

3.1.17

data type

set of values together with a set of permitted operations

[SOURCE: IEC 61499-1:2012, 3.27]

3.1.18

device

independent physical entity capable of performing one or more specified functions in a particular context and delimited by its interfaces

[SOURCE: IEC 61499-1:2012, 3.29, modified – The note to entry has been deleted.]

3.1.19

Device Block

FB, which has no input and no output

3.1.20

device management application

application whose primary function is the management of multiple resources within a device

[SOURCE: IEC 61499-1:2012, 3.30]

3.1.21

EDD application

program using the EDD, or any translated form, which offers functionality such as communication representation, data representation, graphical representation, etc.

3.1.22

EDDL processor

processor or program, which translates the EDD into an executable form that can be processed by an EDD application

3.1.23

EDDL profile

selection of the supported elements of the EDDL lexical structure including the syntax definitions for a number of specific consortia

3.1.24

electronic device description language

EDDL

methodology for describing parameter(s) of a automation system component

3.1.25

electronic device description

EDD

data collection containing the device parameter(s), their dependencies, their graphical representation and a description of the data sets which are transferred.

Note 1 to entry: The electronic device description is created using the electronic device description language (EDDL).

3.1.26

electronic device description source

EDDS

ASCII file containing a specific device description

3.1.27

electronic device description technology

EDDT

technology which includes the EDD development process, the EDD usage and the involved tool chain

3.1.28**electronic device description language compiler**

tool which translates the EDD source in an internal format that is used by the EDD interpreter

3.1.29**electronic device description interpreter****EDDI**

tool which uses the EDD source or an internal format that is given by the EDDL compiler to provide the EDD information to the EDD user

3.1.30**entity**

particular thing, such as a person, place, process, object, concept, association, or event

[SOURCE: IEC 61499-1:2012, 3.31]

3.1.31**event**

instantaneous occurrence that is significant to scheduling the execution of an algorithm

Note 1 to entry: The execution of an algorithm may make use of variables associated with an event.

[SOURCE: IEC 61499-1:2012, 3.32]

3.1.32**exception**

event that causes suspension of normal execution

[SOURCE: IEC 61499-1:2012, 3.36]

3.1.33**function**

intended purpose of an entity or its characteristic action

[SOURCE: IEC 61499-1:2012, 3.44, modified – The word "specific" has been replaced by "intended".]

3.1.34**functional unit**

entity of hardware or software, or both, capable of accomplishing a specified purpose

[SOURCE: IEC 61499-1:2012, 3.48]

3.1.35**function block****function block instance**

software functional unit comprising an individual, named copy of a data structure and associated operations specified by a corresponding FB type

Note 1 to entry: Typical operations of an FB include modification of the values of the data in its associated data structure.

[SOURCE: IEC 61499-1:2012, 3.45, modified – The definition has been rephrased and the second note to entry has been deleted.]

3.1.36

function block diagram

FBD

network in which the nodes are function block instances, variables, literals, and events

Note 1 to entry: This is not the same as the function block diagram defined in IEC 61131-3.

3.1.37

hardware

physical equipment, as opposed to programs, procedures, rules and associated documentation

[SOURCE: IEC 61499-1:2012, 3.49]

3.1.38

implementation

development phase in which the hardware and software of a system become operational

[SOURCE: IEC 61499-1:2012, 3.51]

3.1.39

incompatibility

inability of devices to provide the functions and performance required by their role in a distributed application

3.1.40

input variable

variable whose value is supplied by a data input, and which may be used in one or more operations of an FB

Note 1 to entry: An input parameter of an FB, as defined in IEC 61131-3, is an input variable.

[SOURCE: IEC 61499-1:2012, 3.54]

3.1.41

instance

functional unit comprising an individual, named entity with the attributes of a defined type

[SOURCE: IEC 61499-1:2012, 3.55]

3.1.42

instance name

identifier associated with and designating an instance

[SOURCE: IEC 61499-1:2012, 3.56]

3.1.43

instantiation

creation of an instance of a specified type

[SOURCE: IEC 61499-1:2012, 3.57]

3.1.44

interchangeability

ability of one device to fulfil exactly the same role of another device in the physical process and distributed application as required by the process design

3.1.45**interconnectivity**

ability of two or more devices to operate with one another using the same communications protocols and communication interface

3.1.46**interface**

shared boundary between two functional units, defined by functional characteristics, signal characteristics, or other characteristics as appropriate

[SOURCE: IEC 60050-351:2013, 351-42-25, modified – The word "shared" has been added to the definition, and the notes to entry have been deleted.]

3.1.47**internal variable**

variable whose value is used or modified by one or more operations of a FB but is not supplied by a data input or to a data output

[SOURCE: IEC 61499-1:2012, 3.60]

3.1.48**interoperability**

ability of two or more devices to work together in one or more distributed applications with the shared knowledge of the data types and the semantics of the data transmitted

3.1.49**interworkability**

ability of two or more devices to support the transfer of data between devices with the shared knowledge of the data types of the data transmitted

Note 1 to entry: The content of the data is unknown, e.g. a text string that can be displayed but not interpreted by the receiver device itself, or the content is a value but the unit is unknown.

3.1.50**invocation**

process of initiating the execution of the sequence of operations specified in an algorithm

[SOURCE: IEC 61499-1:2012, 3.61]

3.1.51**management function block**

FB whose primary function is the management of applications within a resource

[SOURCE: IEC 61499-1:2012, 3.64]

3.1.52**management resource**

resource whose primary function is the management of other resources

[SOURCE: IEC 61499-1:2012, 3.65]

3.1.53**mapping**

set of values having defined correspondence with the quantities or values of another set

[SOURCE: IEC 61499-1:2012, 3.66, modified – The words "features or attributes" have been replaced by "values", and "members" by quantities or values".]

3.1.54

model

representation of a real world process, device, or concept

3.1.55

operation

well-defined action that, when applied to any permissible combination of known entities, produces a new entity

[SOURCE: IEC 61499-1:2012, 3.73]

3.1.56

output variable

variable whose value is established by one or more operations of a FB, and is supplied to a data output

Note 1 to entry: An output parameter of an FB, as defined in IEC 1131-3, is an output variable.

[SOURCE: IEC 61499-1:2012, 3.74]

3.1.57

parameter

variable that is given a constant value for a specified application and that may denote the application

[SOURCE: IEC 61499-1:2012, 3.75]

3.1.58

preprocessor

part of the runtime environment that transforms the information given in an EDD

3.1.59

preprocessor directive

description of conditions for filtering the EDD code before compilation or interpretation

Note 1 to entry: For example a preprocessor directive providing the facility to define names for constants or to write macros to make code easier to read.

3.1.60

proxy

computer process that relays a protocol between client and server computer systems, by appearing to the client to be the server and appearing to the server to be the client

[SOURCE: RFC 2828:2000]

3.1.61

resource

functional unit contained within a device which has independent control of its operation, and which provides various services to applications, including the scheduling and execution of algorithms

Note 1 to entry: The RESOURCE defined in IEC 61131-3 is a programming language element corresponding to the resource defined above.

Note 2 to entry: A device contains one or more resources.

[SOURCE: IEC 61499-1:2012, 3.80, modified – The words "contained within a device" have been added.]

3.1.62**resource management application**

application whose primary function is the management of a single resource

[SOURCE: IEC 61499-1:2012, 3.81]

3.1.63**service**

functional capability of a resource which can be modelled by a sequence of service primitives

[SOURCE: IEC 61499-1:2012, 3.87]

3.1.64**software**

intellectual creation comprising the programs, procedures, rules and any associated documentation pertaining to the operation of a system

[SOURCE: IEC 61499-1:2012, 3.92, modified – The word "configuration" has been deleted.]

3.1.65**system**

set of interrelated elements considered in a defined context as a whole and separated from its environment

Note 1 to entry: Such elements may be both material objects and concepts as well as the results thereof (e.g. forms of organization, mathematical methods, and programming languages).

Note 2 to entry: The system is considered to be separated from the environment and other external systems by an imaginary surface, which can cut the links between them and the considered system.

[SOURCE: IEC 60050-351:2013, 351-42-08, modified – The notes to entry 1,2,4 and 5 have been deleted and a new note 1 to entry added.]

3.1.66**Technology Block**

FB, which has at least one input or one output to the process

3.1.67**text dictionary**

collection of multilingual or other texts within the EDD

Note 1 to entry: References within an EDD are used to select an appropriate text dictionary.

3.1.68**type**

software element which specifies the common attributes shared by all instances of the type

[SOURCE: IEC 61499-1:2012, 3.99]

3.1.69**type name**

identifier associated with and designating a type

[SOURCE: IEC 61499-1:2012, 3.100]

3.1.70**variable**

software entity that may take different values, one at a time

Note 1 to entry: The values of a variable are usually restricted to a certain *data type*.

Note 2 to entry: Variables are described as input variables, output variables, and internal variables.

[SOURCE: IEC 61499-1:2012, 3.102, modified – In note 2, the words "internal variables and temporary variables" have been replaced by "and internal variables".]

3.2 Abbreviated terms

ADU	Analog digital unit
AFB	Application function block
ANSI	American National Standard Institute
ANSI C	American National Standard Institute for the programming language C (see ISO 9899-1990)
AP	Application process
ASCII	American Standard Code for Information Interchange (see ISO/IEC 10646)
ASN.1	Abstract Lexical Structure Notation 1
BNF	Backus Naur Format
CFB	Component function block
DAU	Digital analog unit
DD	Device description
DTD	Data type definition
EDD	Electronic Device Description
EDDI	Electronic Device Description Interpreter
EDDL	Electronic Device Description Language
EUC	Extended Unit Code (see ISO/IEC 2022:1994)
FB	Function block
FBD	Function block diagram
FMS	Fieldbus message specification
HMI	Human machine interface
HTML	Hypertext Mark-up Language
I/O	Input/output
IAM	Intelligent actuation and measurement
ID	Identifier
mA	Milliampere
NOAH	Network oriented application harmonisation
OSI	Open Systems Interconnection
P&ID	Piping and instrument diagram
PDU	Protocol data unit
SM	System management
TB	Technology Block
UML	Unified Modelling Language
wao	Write as one
XML	Extended Mark-up Language

3.3 Conventions for lexical structures

The EDDL is generally described using lexical structures in which the elements and the presence of fields are specified. A general form of the lexical structures is shown below.

ABC field1, field2

ABC is a lexical element. This element shall be coded in a concrete syntax. It is not required to code this element with the name "ABC". It is also possible to code this element for example with a tag number.

Field1 and field2 are fields of the lexical element ABC. Each field is mandatory and may have more than one attribute. If a field has attributes, the presence of the attributes is specified in a table. A comma separates field1 and field2. The comma is a lexical element and is not coded explicitly.

If a field has additional attributes, the attributes are defined in a table. The table layout and the possible usage qualifiers are shown in Table 1.

Table 1 – Field attribute descriptions

Usage	Attribute	Description
m	yyy	The presence of this attribute is mandatory
o	xxx	The presence of this attribute is optional
s	z1	The presence of this attribute is selectable with other attributes, which are also marked with "s" in the usage column. Only one of the selectable attributes (z1 or z2) is present
s	z2	The presence of this attribute is selectable with other attributes, which are also marked with "s" in the usage column. Only one of the selectable attributes (z1 or z2) is present
c	uuu	The presence of this attribute is conditional, and it is only present if the condition is true

The characters in the usage column have the following meanings:

- m: this attribute is mandatory and shall be present;
- o: this attribute is optional and need not be present;
- s: this attribute is a selection; one and only one of the fields marked with s (z1 or z2) shall be present;
- c: this attribute is conditional; the condition is described in the Description column.

If more than one attribute in the column Attribute exists, which have the same usage, the attributes are sorted in alphabetical order.

ABC field1+

The plus (+) behind field1 is used to indicate that field1 is used at least once. It may be used more than once.

ABC field2*

The asterisk (*) behind field2 is used to indicate that field2 is optional and need not be used. If it is used it may be used more than once.

ABC [field1, field2]+

The elements field1 and field2 in the square bracket [] are an unsorted list. The plus (+) behind the closing bracket indicates that field1 and field2 are used at least once and may be used more than once as a group.

ABC field1, (field2, field3)<exp>

<exp> indicates that field2 and field3 are used in conjunction with the conditional expression, (conditional constructs are specified in Table 1). The expression <exp> refers only to the fields within the preceding curved brackets (). Usage of conditional expressions is optional.

4 General function block (FB) definition and EDD model

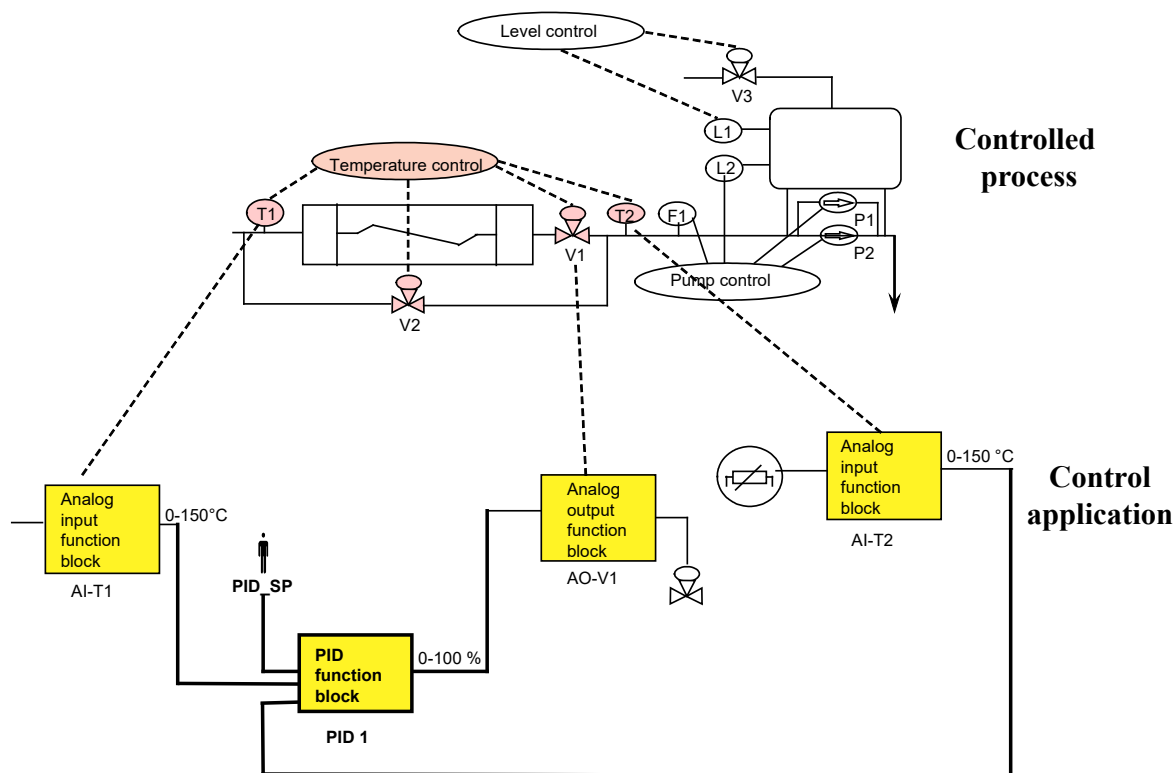
4.1 Device structure (device model)

4.1.1 Device model description

FBs are encapsulations of variables and their processing algorithms. The variables and algorithms are those required by the design of the process and its control system.

NOTE 1 FBs can be derived from the diagram in Figure 2.

FBs perform the application (measurement, actuation, control and monitoring) by connecting their data inputs and data outputs.

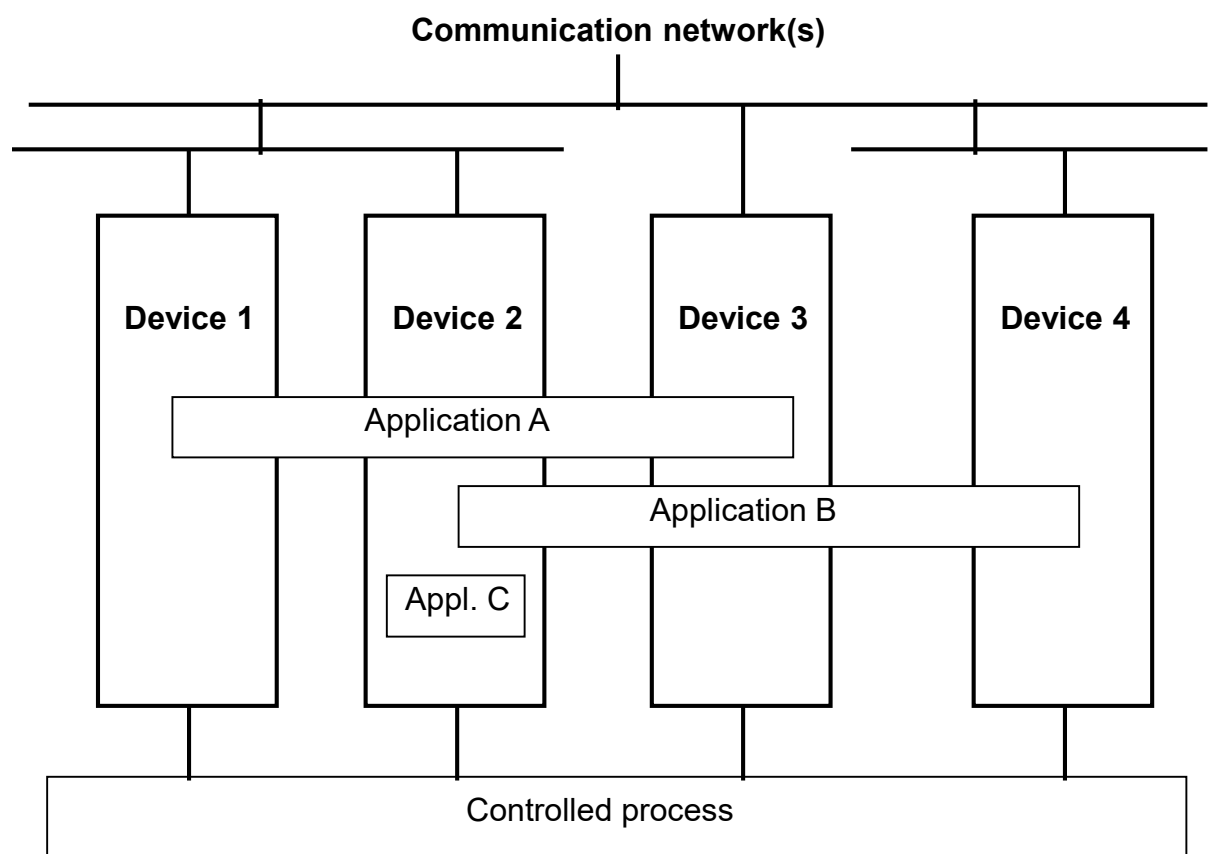


IEC

Figure 2 – FB structure is derived out of the process (P&ID view)

The devices are connected via a communication network or a hierarchy of communication networks.

NOTE 2 The application can be distributed among several devices, see for example Figure 3.



IEC

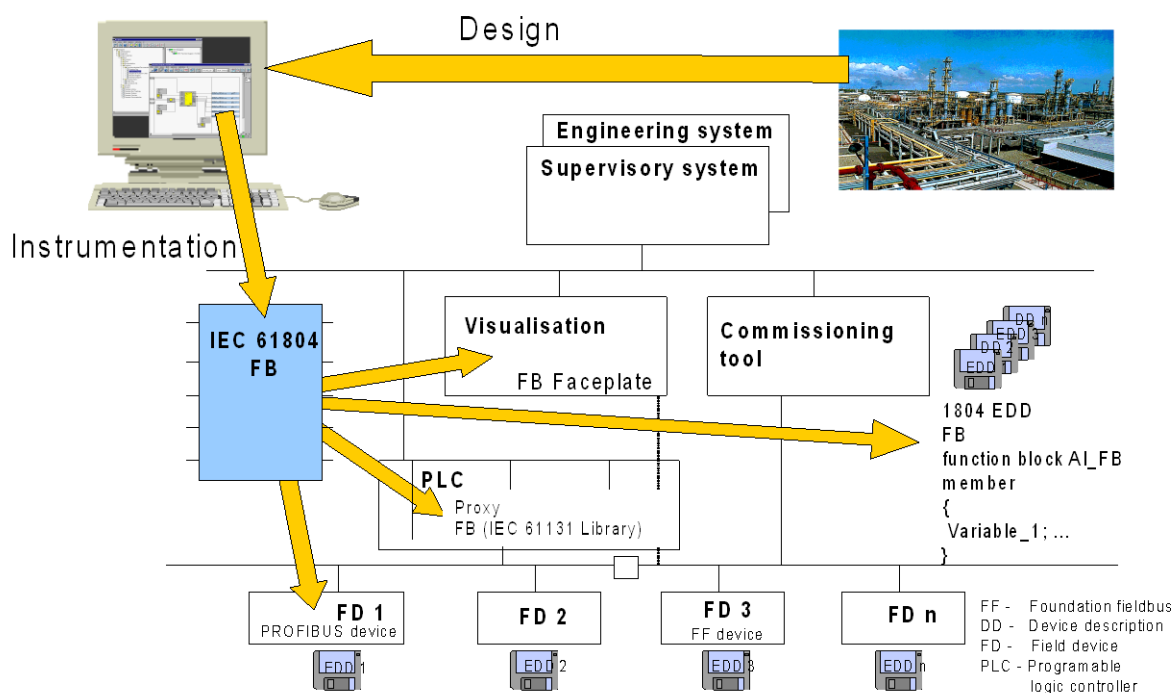
Figure 3 – FB structure may be distributed between devices (according to IEC 61499-1)

The FBs resulting from the design of the control system are abstract representations.

NOTE 3 These can be implemented in different ways in different device types, see Figure 4. FBs can be implemented, for example in field devices, programmable logic controller, visualization stations and device descriptions.

Additionally other applications such as system engineering and supervisory systems have to handle or interact with the FBs.

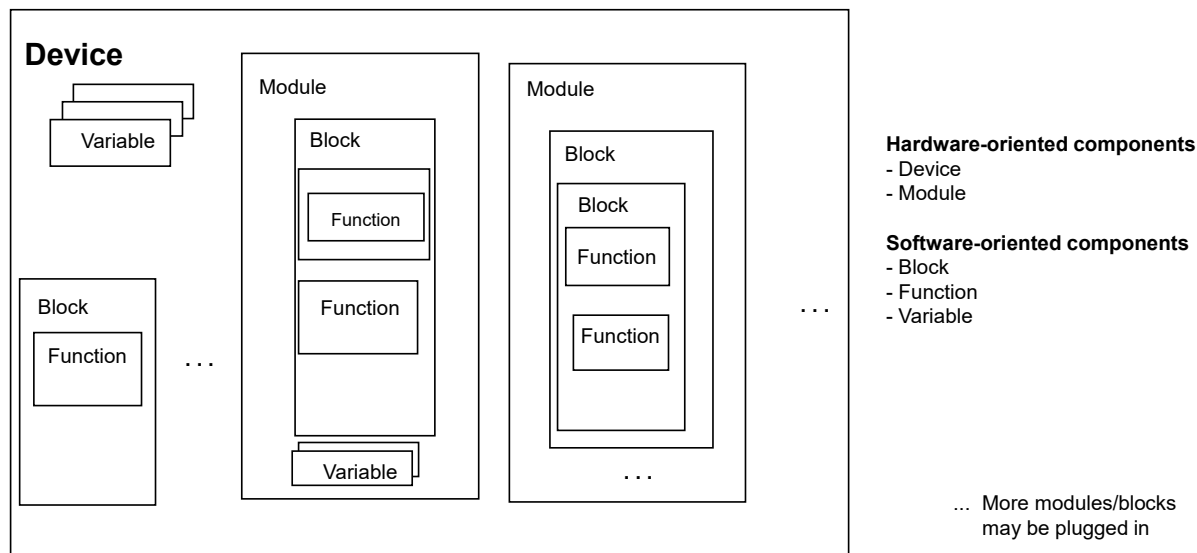
NOTE 4 Algorithms defined for an FB in the conceptual model are not necessarily mapped one-to-one to the device; they can be mapped to the device, a proxy or a supervisory station if the current technology does not solve it in the device.



IEC

Figure 4 – IEC 61804 FBs can be implemented in different devices

For the purposes of this document, devices implement algorithms derived out of the design of the controlled process in terms of FBs. The devices are hardware and software modular, see for example, Figure 5. The components of devices are Modules, Blocks, Variables and Algorithms. There are defined relations between the components that are specified in the UML class diagram below, see Figure 8.



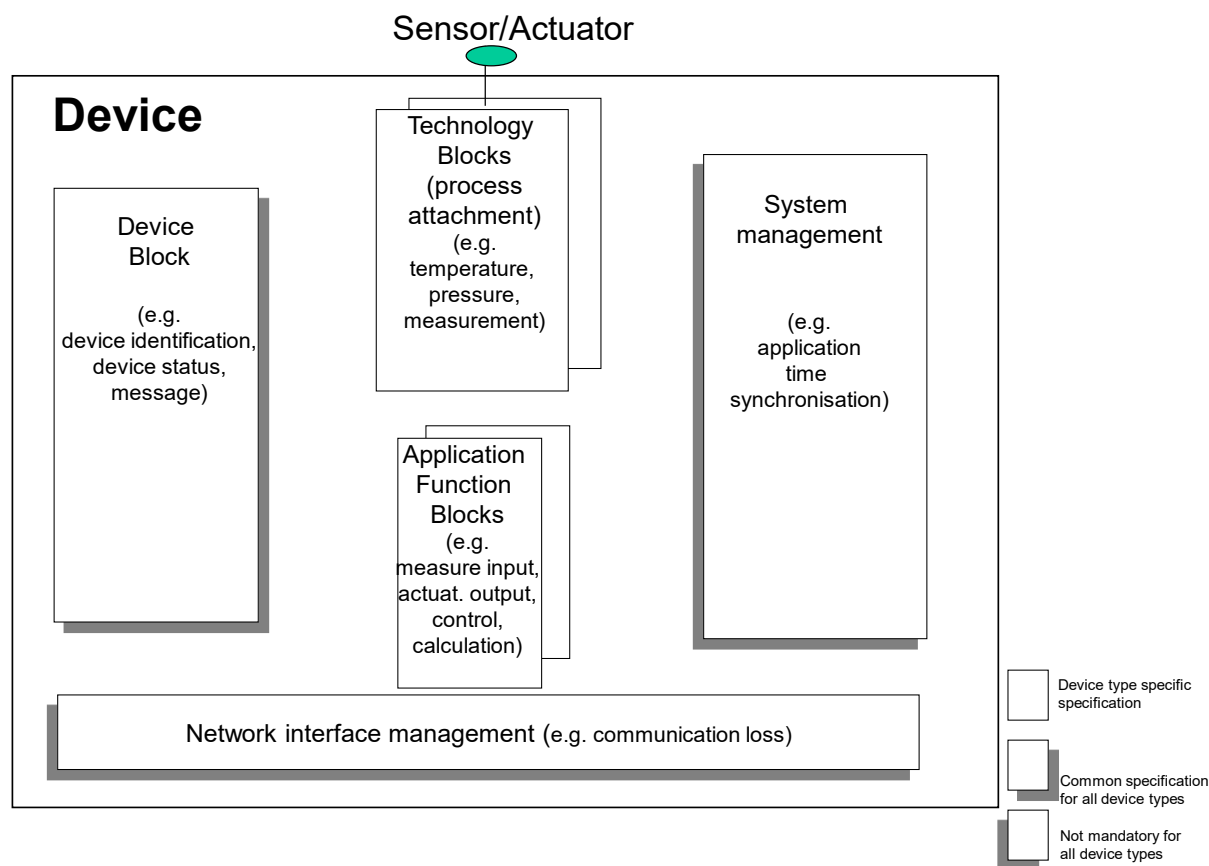
IEC

Figure 5 – General components of devices

For the purposes of this document, there are different block types (see Figure 6), which encapsulate the specific functionality of devices performing an automation application. The Technology Block represents the process attachment of a device. It contains the measurement or actuation principles of a device. The Technology Block is composed of acquisition or output and transformation parts. The application FB (hereafter called FB) contains application related signal processing, such as scaling, alarm detection or control and calculation. Component FBs may perform mathematical and logical processing with specific

additional exception handling procedures such as non-authorized parameter values. They shall be encapsulated within composite FBs.

The Device Block represents the resource of the device that contains information and function about the device itself, the operation system of the device and the device hardware. The device shall have an interface to the communication system and may have system management functionalities.



IEC

Figure 6 – Block types of IEC 61804 (all parts)

All devices within the scope of this document shall have the same logical device structure, see Figure 6. The number and types of blocks, which are instantiated in a device, are device and manufacturer specific. At least, the device shall have one Device Block, one application FB and one network interface management.

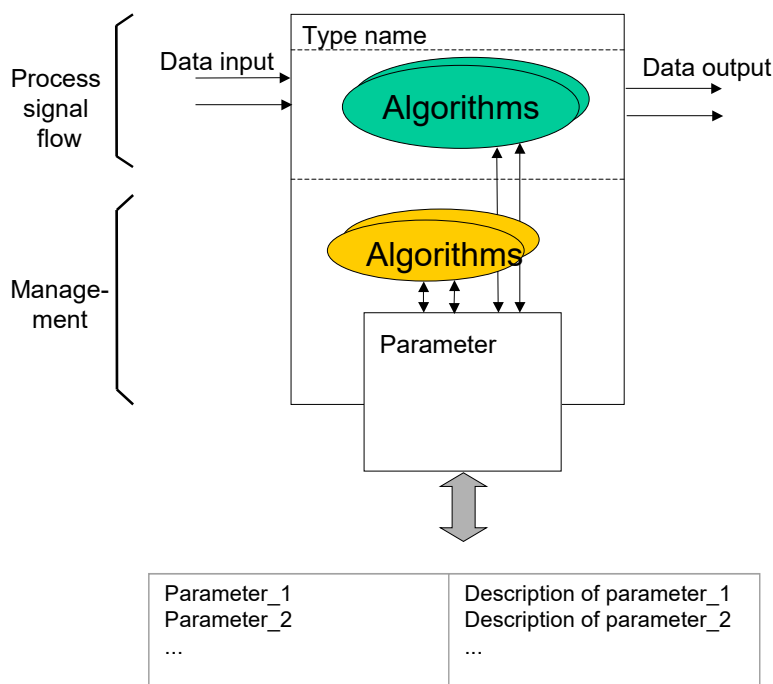
There is a data flow chain from signal detection through the Technology Block and FBs and vice versa. The signals between the parts of the chain are internal within the blocks or visible as linkages between blocks. The logical chain of technology and FB is called a channel. This concept is clarified in 4.2.1 and 4.2.2.

4.1.2 FB type

FBs are functional units in software, which encapsulate variables and algorithms. An FB type is defined by its behaviour. One FB contains one or more than one algorithm. The description of an FB is a list of algorithms, which are encapsulated in the FB together with the related data inputs and data outputs and parameters. There are algorithms, which are related to the process signal flow and those, which are related to other block specific algorithms. These other algorithms are called management. Parameters are related to process signal flow and management.

Graphical representation is not normative, see Figure 7. In other words, the data inputs and data outputs represent the intention of the process signal flow (conceptual definition), not the specific data that carry the corresponding values.

The parameter table specifies all the needed accessible data inputs, data outputs and parameters of the FB.



IEC

Figure 7 – IEC 61804 block overview (graphical representation not normative)

The FB is summarised by the following components:

- a) data inputs¹ which support status² and are related to the process signal flow only;
- b) data outputs¹ which support status² and are related to the process signal flow only;
- c) parameters² which are related to the process signal flow and management;
- d) parameters² to influence functions;
- e) parameters² to notify and make visible internal behaviour;
- f) parameters² to select functions in the signal flow;
- g) internal variables with memory for support of for example initialisation;
- h) mathematical/logical algorithm.

The influence of the FB behaviour is possible by data inputs and parameters only. The data inputs and parameters are used in the following ways:

- i) data, which are used as inputs or outputs of functions (e.g. setpoint for scaling functions);
- j) data, which are used as parameter of functions (e.g. limits for alarms and warnings);
- k) changes of parameter data are interpreted as events which switch transitions of state automata (e.g. start, stop, resumption of operation modus of devices);

¹ The decision which data of an FB is a data input, data output or parameter depends on specific implementations.

² For consistency reasons, data input/data output and status are in one structure, so that both belong to each other.

- l) changes of parameter data are interpreted as events, which start the transactions of sequences of algorithms (e.g. start of calibration procedures).

The data name and their description have to be checked to understand the purpose of the data.

4.1.3 FB execution

There are different execution control methods within devices. Execution control of FB algorithms is a feature of each device. There can be different execution policies within devices and in a distributed system.

NOTE For example, combinations of the following execution control methods are possible and others can be added:

- a) free running;
- b) device internal time schedule (time synchronization);
- c) device internal event triggered;
- d) parameter data changes are interpreted as events (see 4.1.2);
- e) system wide time synchronization (time synchronization across the communication system);
- f) communication service triggered;
- g) system wide event triggered (e.g. IEC 61499-1);
- h) distributed execution control;

The FB execution control within a device is only one aspect of the overall application execution control. The overall execution control is determined for example:

- i) sequence order (sequential or parallel):
 - 1) execution order of blocks along the signal flow;
 - 2) piping of data in parallel execution;
 - 3) handling of loss of communication between devices;
- j) synchronization:
 - 1) time synchronization between device;
 - 2) use of time in scheduling;
- k) time constraints; the following elements are covered:
 - 1) block execution time;
 - 2) communication time delay;
 - 3) scan rate of measurement;
 - 4) actuation time;
 - 5) choice of block algorithms;
 - 6) time delay resulting of communication behaviour;
- l) block execution time:
 - 1) communication time delay;
 - 2) scan rate of measurement;
 - 3) actuation time;
 - 4) choice of block algorithms;
- m) impact of exception handling:
 - 1) clock error;
 - 2) device error;
 - 3) communication error.

The decision of which technology fulfils the requirements has to be based on a detailed check at least of all these aspects. The choice of execution control method also depends on the technology level used to build the devices. So the method of FB execution control is also constrained to those available in the fieldbus used by the system.

4.1.4 Reference between IEC 61499 and IEC 61804 models

The relations to IEC 61499-1 are given in Table 2.

Table 2 – Equivalences between IEC 61804 and IEC 61499 model elements

IEC 61804 model element	IEC 61499 model element
Reference of block types	
Application FB	Application FB
Technology Block	Technology Block
Device (Resource) Block	Device (Resource) Block
Reference of Function Block elements	
Component Block	Component Block
Type Name	Type Name
Data Input ^a	Data Input ^a
Data Output ^a	Data Output ^a
Algorithms	Algorithms
Parameter	Parameter
Internal Variable	Internal Variable
Principle relations between EDDL elements and IEC 61499 transfer syntax elements ^b	
BLOCK_A, BLOCK_B	FUNCTION BLOCK
VARIABLE and CLASS INPUT	VAR_INPUT, END_VAR
VARIABLE and CLASS OUTPUT	VAR_OUTPUT, END_VAR
-	ALGORITHM
VARIABLE and CLASS CONTAINED	-
VARIABLE	VAR, END_VAR
^a The data inputs and data outputs represent the source and sink points for the process signal flow (conceptual definition) not the specific variables, which carry the according data. ^b This is not an exact syntax reference. It is intended to show the general relations.	

An IEC 61804 FB is an IEC 61499-1 FB without execution control and therefore has no event inputs and event outputs. The execution control of the IEC 61804 FBs algorithms are hidden, see 4.1.3.

4.1.5 UML specification of the device model

The device model definitions in 4.1.1, in Figure 5, and Figure 6, are general. To solve the ambiguity, the model is described as a UML class diagram (see ISO/IEC 19501-1). The components are transformed to the UML language elements in Figure 8.

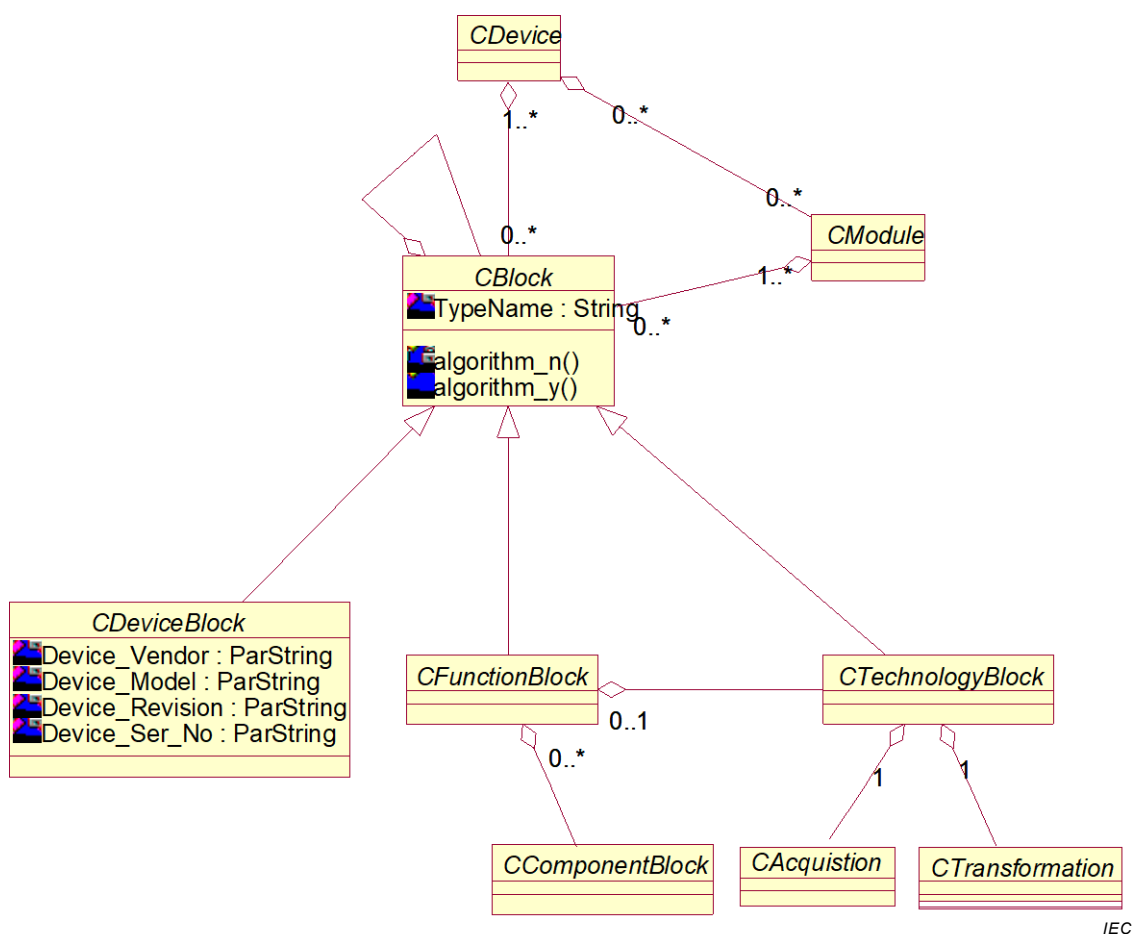


Figure 8 – UML class diagram of the device model

The following major steps are used to convert the device model into a UML class diagram:

- Device becomes the class **CDevice**;
- Module becomes the class **CModule**;
- Device Block, FB, Component FB and Technology Block becomes **CDeviceBlock**, **CFunctionBlock**, **CComponentFunctionBlock** and **CTechnologyBlock**;
- the block types are of the type Block which becomes **CBlock**;
- a Device contains a minimum of one block;
- a Device may contain modules;
- a Module contains a minimum of one block;
- blocks can be composed out of other blocks, i.e. may be of composite FB type;
- a Block contains a minimum of zero or more parameter;
- a Block shall have algorithms which can be internal only or visible from the outside (i.e. private or public);
- a Device Block contains the attribute **Device_Vendor**, **Device_Model**, **Device_Revision** and **Device_Ser_No** which are parameters;
- the FB, Component FB and Technology Block contain the attribute **TypeName**.

NOTE The **CBlock** class can be referenced to the Basic FB Type Declaration of the IEC 61499-1. The IEC 61804 block type has no aggregation to the **ECCDeclaration** class.

4.1.6 Classification of the algorithms

The following list provides common algorithms for use in application FBs, transducer blocks and Device Blocks.

a) Process signal algorithms:

1) measurement acquisition:

- i) sensor connection;
- ii) sensor range/calibration;
- iii) AD conversion;
- iv) status estimation.

2) measurement transformation:

- i) linearization;
- ii) filtering;
- iii) compensation;
- iv) scaling.

3) Measurement application:

- i) limit;
- ii) unit;
- iii) scaling;
- iv) linearization;
- v) simulation.

4) Actuation provision:

- i) amplification;
- ii) conversion;
- iii) status estimation.

5) Actuation acquisition:

See measurement acquisition for readback of actuator output value.

6) Actuation transformation:

- i) scaling;
- ii) compensation;
- iii) transition or activity limits.

7) Actuation application:

- i) limit;
- ii) unit;
- iii) scaling;
- iv) linearization;
- v) simulation.

b) Management:

- 1) estimation of Device status;
- 2) test;
- 3) diagnosis;
- 4) operating mode.

4.1.7 Algorithm description

The algorithm description is done individually for each algorithm in the appropriate language, for example plain English, Harel State Diagram or one of the IEC 61131-3 languages (for example FBD (function block diagram) or IEC 61131 ST (structured text)).

The objective of the profile description is to define a general set of rules allowing identification of a device together with classification and specification of the algorithms supported by the device.

4.1.8 Input and output variables and parameter definition

For the description of the block parameters, Table 3 table shall be used. This table provides a template for describing the interface to a block. It is comparable with a data dictionary or a database.

Table 3 – Variables and parameter description template

Parameter name	Description	Data type	User Access Read/Write	Class m/o/c
Block class				

Parameter name:

Identifier of the variable/parameters that are accessed within the FB. The name is valid within this specification but not normative for products on the market. The decision if a data is an input, output or parameter is application dependent.

Description:

Informative text, describing the purpose of the variable/parameter.

Data type:

The following data types are conceptual ones, i.e. they identify the signal type not the implementable data type. These will be mapped by technology profile to supported data in the following categories:

- a) numeric (e.g. float, real, long real, integer);
- b) enumerated;
- c) Boolean;
- d) string (e.g. visible string, octet string);
- e) array;
- f) structure.

User Access Read/Write

This specifies that the variable/parameter is changeable by a remote device or not.

Class m/o/c

This specifies if the variable/parameter shall be supported within the block or not, the states are: mandatory (m), optional (o), conditional (c).

Additional parameter attributes which shall be specified when mapping of IEC 61804 blocks to other FB specifications are:

g) Class of recovery after power fails shall have the value N or D as follows:

- N indicates a non-volatile parameter which shall be remembered through a power cycle, but which is not under the static update code;
- D indicates a dynamic parameter which is calculated by the process, the block or read from another block.

h) Default value:

indicates the value is assigned to parameter in the initialisation process for an unconfigured block.

4.1.9 Choice of variables and parameters

The block variables, parameters and algorithms included in a block will be those that are significant for the algorithm and device. As a minimum, FBs will include the variables and parameters defined in the P&ID. The names of parameters and variables are not normative.

4.1.10 Mode, Status and Diagnosis

These parameters manage and indicate channel performance. They can be reported, however the report mechanisms are technology dependent. Reported values may also include additional items such as time stamps, priorities, indication of possible reasons.

Mode describes the operation state of a channel or FB and influences the signal flow within the channel. Examples of modes are: Manual, Automatic, Local Override, Out of Service.

Status is a characteristic aspect of a channel which may accompany information transferred within the channel i.e. FB data inputs and data outputs.

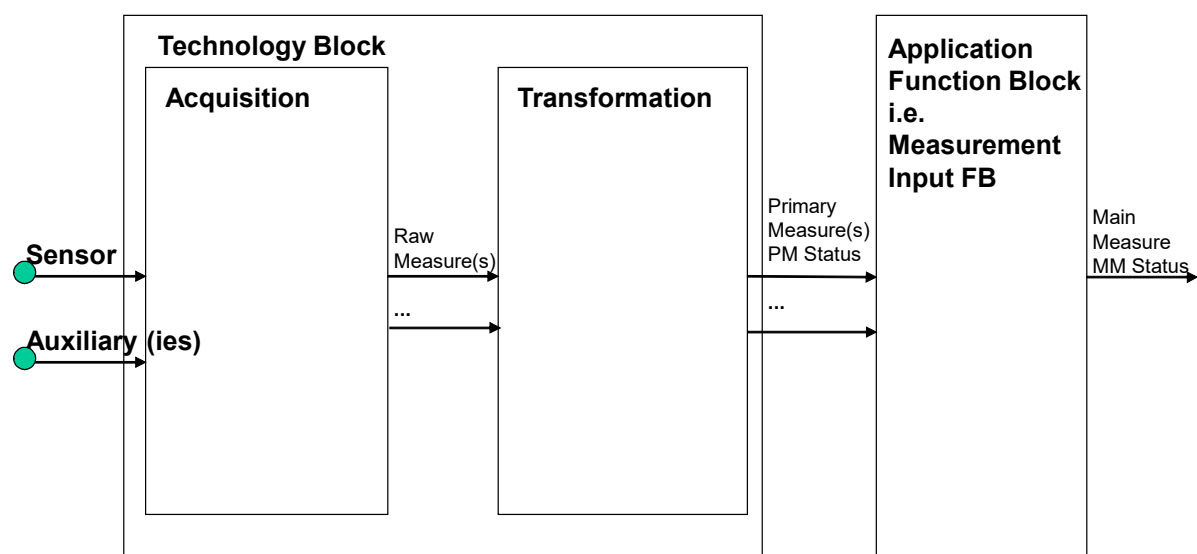
Device State describes the operational state of a device and interacts with the device technology and application blocks, it is maintained within a device by the Device Block.

Diagnosis is a report available from algorithms which assess channel or device internal performance. The results of these internal assessments may be used to construct generic measurement, control and actuation status information.

4.2 Block combinations

4.2.1 Measurement channel

The technology and application FBs provide a functional chain along which the process signals flow. Together they comprise a measurement channel (see Figure 9) or an actuation channel (see Figure 10).



IEC

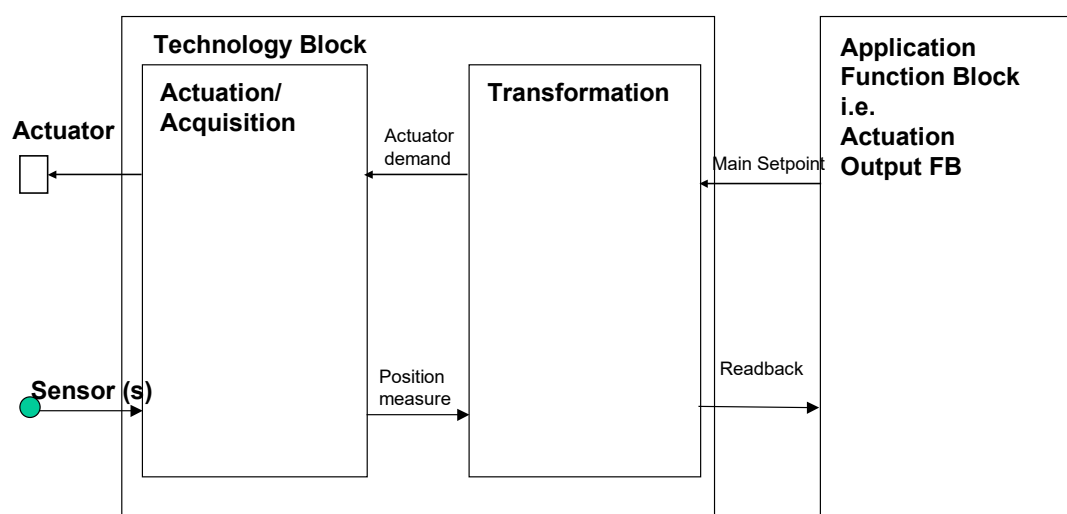
Figure 9 – Measurement process signal flow

A measurement may be accompanied by optional additional auxiliary measurements, for purposes such as compensation. The Technology Block provides a primary measured value and its accompanying status. Additionally, the Technology Block may provide other outputs, for example diagnosis or validation information.

NOTE Additional sensor inputs can also be used and transferred by a Technology Block.

The application FB uses the outputs of the Technology Block and other internal data to generate the main measure and its accompanied status. The status is accomplished by every function in the signal flow starting with the sensor(s) until the last function in the application FB. Information from one Technology Block is offered to more than one application FB. A measurement channel shall consist of at least one application FB. Channels without a Technology Block are possible.

4.2.2 Actuation channel



IEC

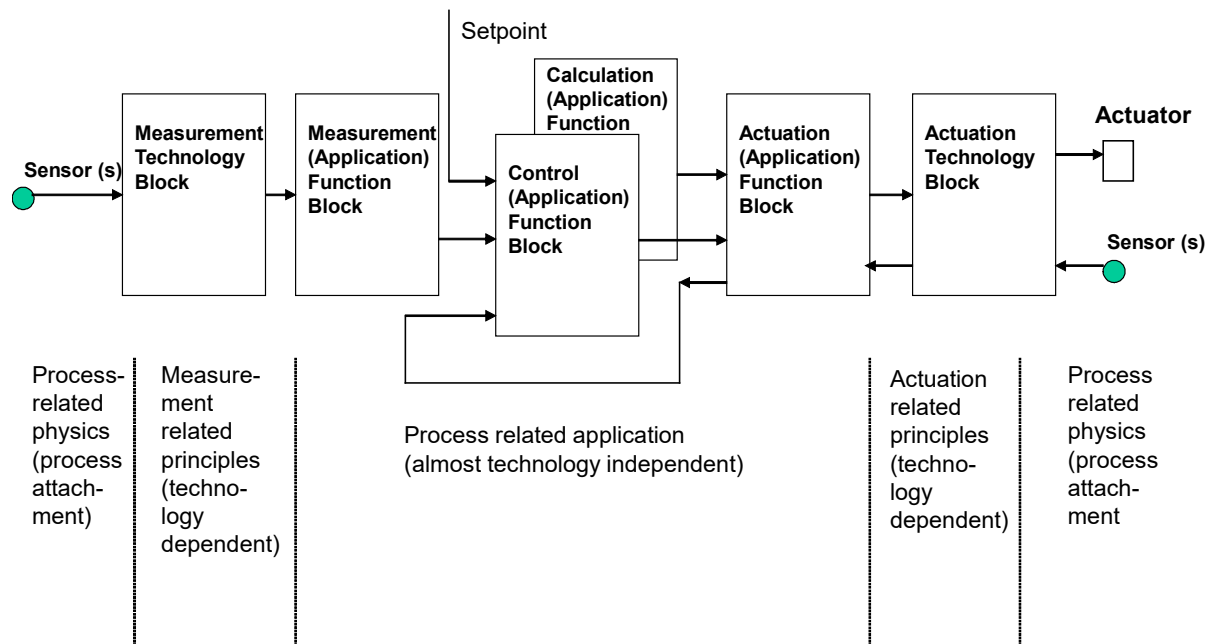
Figure 10 – Actuation process signal flow

The actuation channel is performed out of the function of the actuation signal flow and the additional measurement functions for the measurement of the current position of the actuator. If there is not a sensor for the position measurement, then the actuator demand will be used in the transformation to determine the readback value. Optionally, status values may accompany both signal flow directions and include information about the involved entities. The status accompanying the main setpoint carries information to give the Technology Block the opportunity to go in fail-safe position, if the main setpoint is not good. The status accompanying the readback carries information if the measure value is good or not. An actuation channel shall consist of at least one application FB. Channels without a Technology Block are possible.

4.2.3 Application

A complete application is supported by combinations of measurement and actuation channels together with control and calculation FBs (see Figure 11). The Technology Blocks are technology dependent and the other FBs are technology independent. There may be many different implementations of an application, depending on the technology used within the devices. The application may be performed by implementations using only measurement and actuation devices (i.e. complex devices able to perform measurement, control and actuation) or the application may be built from measurement and actuation devices together with controller devices and other system components.

NOTE A controller can be for instance integrated in the application as one calculation FB or an actuation device can take parts of programmable functions from controller devices in terms of calculation FBs.



IEC

Figure 11 – Application process signal flow

4.3 EDD and EDDL model

4.3.1 Overview of EDD and EDDL

An electronic device description (EDD) contains all the device parameters of an automation system component. The technology used to describe an EDD is called electronic device description language (EDDL). The EDDL provides a set of scalable basic language elements to handle simple, complex or modular devices. The EDDL is a descriptive language based on an ASCII format with clear separation between data and program.

NOTE Data in a text field, which is marked with a country code like Japanese can use multi byte code.

4.3.2 EDD architecture

From the viewpoint of the ISO/OSI model (ISO/IEC 7498-1), an EDD is above Layer 7. However, the EDD application uses the communication system to transfer its information. An EDD contains constructs that support mapping to a supporting communication system.

The device manufacturer defines the objects, which are reflected by the logical representation of the objects within an EDD application. For that reason, EDDL has language elements, which map the EDD data to the data representation of the communication system, so that the user of an EDD does not need to know the physical location (address) of a device object.

EDD describes the management of information to be displayed to the user. The specific representation of such visualisation is not part of EDD or EDDL definitions.

4.3.3 Concepts of EDD

The manufacturer of a device or of an automation system component describes the properties of the device by using the EDDL. The resulting EDD contains information such as:

- description of the device parameters
- description of parameter dependencies
- logical grouping of the device parameters
- selection and execution of supported device functions
- description of the transferred data sets

Depending on the required usage, the EDD may be physically located:

- in a device
- in an external data storage medium such as a compact disk, floppy or a server
- partially distributed in the device and an external storage medium

EDD supports text strings (common terms, phrases etc.) in more than one language (English, German, French, etc.). Text strings may be stored in separate dictionaries. There may be more than one dictionary for one EDD.

An EDD implementation includes sufficient information about the target device, for example manufacturer, device type, revision. This is used to match a specific EDD to a specific device.

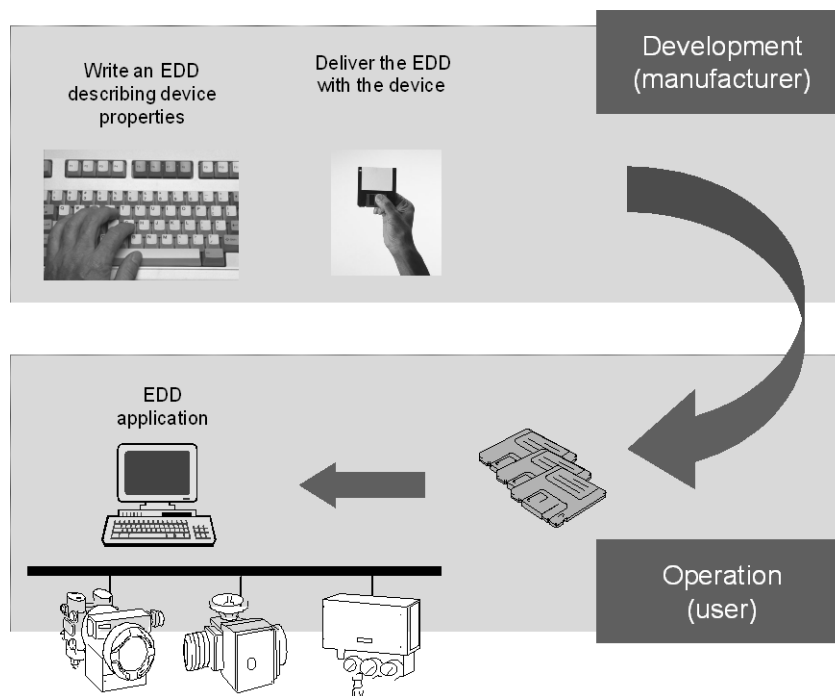
4.3.4 Principles of the EDD development process

4.3.4.1 General

Creation of an EDD is a three-stage process: EDD source generation, EDD pre-processing and EDD compilation.

4.3.4.2 EDD source generation

The EDD generation process is shown in Figure 12.



IEC

Figure 12 – EDD generation process

The device manufacturer writes an appropriate EDD for the device and delivers both (EDD and device). If the automation system supports the EDD method, a system integration can be made by the user.

The EDDs for devices may be embedded in the device memory, or delivered using separate storage media, or downloaded from an appropriate network server. The EDD is "interpreted" or "browsed" by an EDD-application. EDDs are normally stored as source files or preprocessed files.

4.3.4.3 EDD preprocessing

In the preprocessing stage, an EDD preprocessor generates a consistent EDD representation suitable for final compilation.

Preprocessing supports, for example, substitution of definitions and inclusion of external text. The output of the preprocessor is a complete EDD without any preprocessor directive.

4.3.4.4 EDD compilation

The EDD compilation stage produces an EDD application internal representation from a preprocessed EDD to be used in the EDD application.

4.3.5 Interrelations between the lexical structure and formal definitions

The lexical structure of the EDDL and its elements are described in IEC 61804-3 as well as the formal definitions and syntax for each EDDL element. The lexical structure and its formal description use the same name.

NOTE Instead of the specified formal definitions and syntax in IEC 61804-3 another specification can be developed as an additional option.

4.3.6 Builtins

Builtins are predefined subroutines which are executed in the EDD application.

EXAMPLE A hand held terminal is a simple device having a small display and limited cursor functions. For this type of device, a Builtin could be specified to provide display entry using only up/down right/left cursor actions.

The library of Builtins is defined in IEC 61804-5.

4.3.7 Profiles

EDDL is a harmonized specification of existing legacy EDD concepts. Concrete EDD applications use a subset of the EDDL specification. Selection of EDDL elements and Builtins is done in the profiles defined in IEC 61804-3.

In addition to EDD profiles, implementing consortia also publish "Device Profiles", which are used to support interchangeability of compliant devices. These Device Profiles may be described using the EDDL specified in this document.

5 Detailed block definition

5.1 General

This selection of blocks do not intent to be complete. It is a selection of very common measurement and actuation .

5.2 Application FBs

5.2.1 Analog Input FB

5.2.1.1 Analog Input FB overview

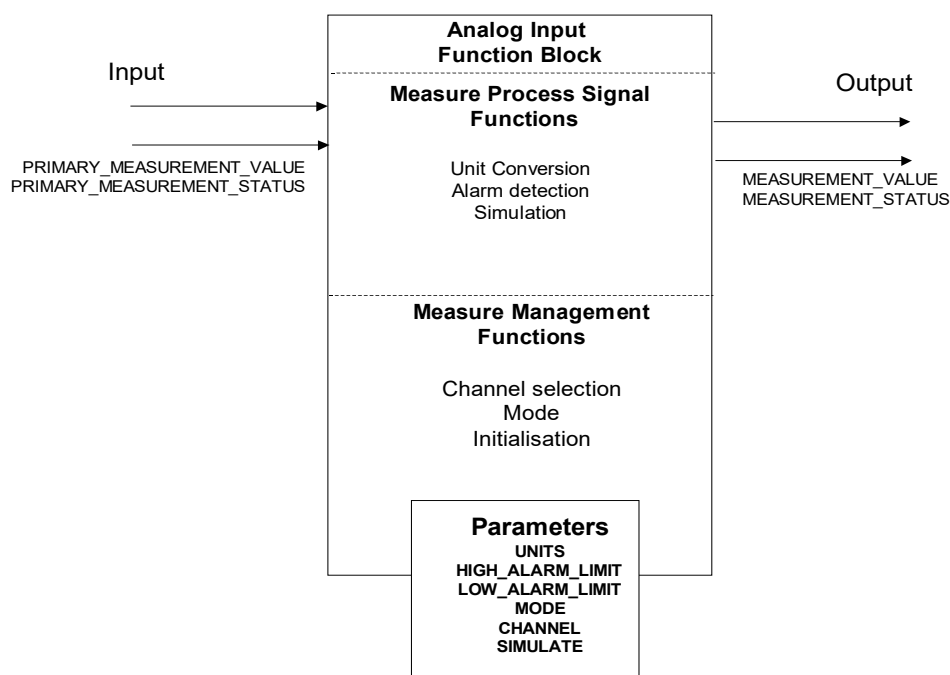
Figure 13 shows the block diagram of Analog Input FB.

The measure process signal function shall be used to convert signal(s) from a Technology Block to units appropriate for the primary measurement required for an application. The result is the MEASUREMENT_VALUE.

NOTE For example, conversion from inches of water to litres per minute. Also, this block can be used to provide operator notification that the primary measurement has detected a high or low alarm. The ability can be provided to simulate the process measurement during system checkout and testing.

Each process signal involves more information than only the value of the signal; the management parameters are generally required. Each measurement has a status, which indicates quality of the measurement value.

The status provided by the Technology Block is propagated to measurement (Input) FB by the PRIMARY_MEASUREMENT_STATUS. The status is a piece of information provided with every measurement to assist the user of measurement data (typically control functions) in assessing its utility. For example it may be a Boolean value (valid/non-valid), a continuous value (measurement uncertainty), a discrete value, or a combination thereof (see 5.6.1).



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NOTE For the parameters description, see Annex A.

Figure 13 – Analog Input FB

5.2.1.2 Unit conversion

This algorithm converts the signal from a Technology Block into an understandable value. That may be used directly by the operator.

The user uses the UNITS to select the engineering units in which the MEASUREMENT_VALUE is to be displayed, for example bar or mbar.

NOTE This algorithm can also provide information on the channel and device operating state to assist in diagnostic of management activities.

5.2.1.3 Alarm detection

The FB shall provide the optional alarm detection inside.

EXAMPLE Low alarm, high alarm, deviation, update.

When implemented, the LOW_ALARM_LIMIT and HIGH_ALARM_LIMIT values shall be compared with the MEASUREMENT_VALUE of the FB. The results are high and low alarm notification, for example for an operator.

NOTE The way of reporting the detected alarms is technology dependent, therefore it is not described in this document and shown in the corresponding figure.

5.2.1.4 Simulation

This algorithm shall be used to simulate the MEASUREMENT_VALUE value to an assigned value using the SIMULATE parameter. This operation is usually carried out during commissioning, adjustment phases, or test purposes, and allows the running application to be temporarily uncoupled from the process.

5.2.1.5 Channel selection

One Technology Block will be used for primary final element data. Channel numbers (CHANNEL) will be defined for the measurement device when using more than one Technology Block.

5.2.1.6 Mode

The mode algorithm determines the source of the output for a measurement input FB based on the MODE parameter value. In Automatic mode, the measurement algorithm determines the output. When mode is set to Manual, the output of the FB is set by another source, for example it may be set by the operator.

5.2.1.7 Initialisation

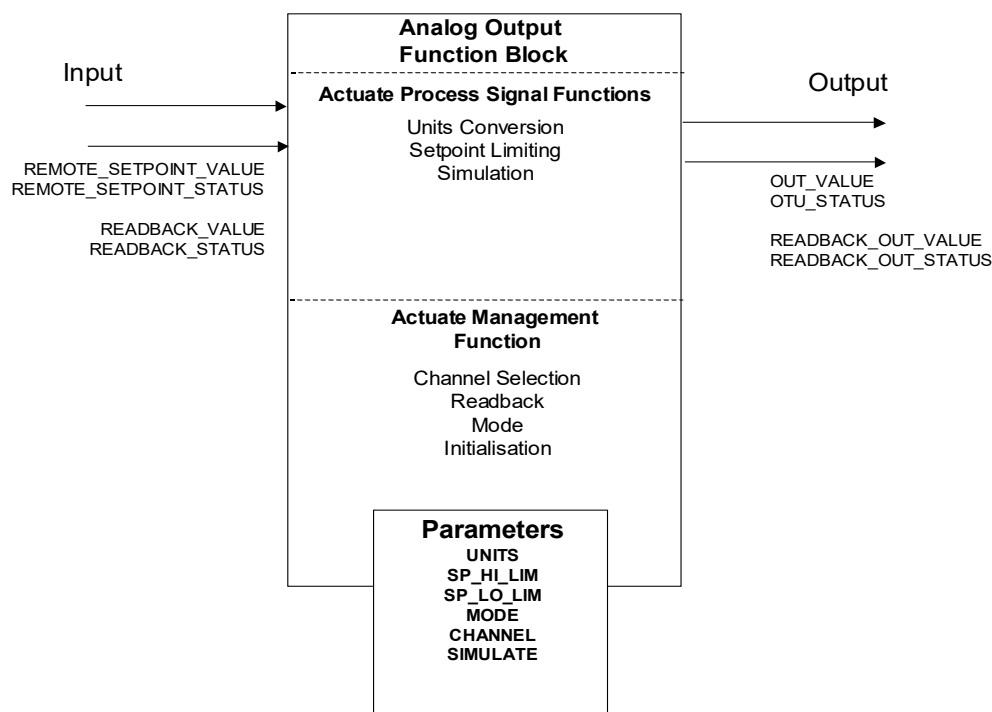
The initialisation algorithm is applied to this block and described in 5.6.3.

5.2.2 Analog Output FB

5.2.2.1 Analog Output FB overview

Figure 14 shows the block diagram of the Analog output FB.

The actuation process signal algorithm converts REMOTE_SETPOINT_VALUE into a useful value (OUT_VALUE) for the hardware specified by the channel selection for the Technology Block. The feedback value (received from the actuator) is provided as the READBACK_VALUE. If the Analog Output FB is part of a cascade chain, then the READBACK_OUT_VALUE provides the actual value to the upstream FB. All these input and output parameters shall be accompanied by their status (see 5.6.1).



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NOTE For the parameters description, see Annex A.

Figure 14 – Analog Output FB

5.2.2.2 Unit conversion

This algorithm converts the REMOTE_SETPOINT_VALUE to a value which can be used by the actuator. UNITS of the REMOTE_SETPOINT_VALUE main setpoint value define the units of the setpoint. The READBACK_VALUE (i.e. the actual delivered value or the final demanded value) is also provided in the units of the setpoint.

5.2.2.3 Setpoint limiting

The REMOTE_SETPOINT_VALUE that is provided to the FB will be limited to the setpoint lower (SP_LO_LIM) and higher (SP_HI_LIM) range limits.

5.2.2.4 Simulation

This algorithm is used to force the READBACK_VALUE and the READBACK_STATUS to the assigned values through the SIMULATE parameter. The simulation can be used for example to simulate Technology Block faults. In simulation mode, the Technology Block ignores the Analog Actuation FB output value(s) and maintains the last value. This operation is usually carried out during commissioning, adjustment phases, or test purpose, and allows the running application to be temporarily uncoupled from the process.

5.2.2.5 Channel selection

One Technology Block will be used for primary final element data. Channel numbers (CHANNEL) will be defined for the Modulation Actuator Device when using more than one Technology Block.

5.2.2.6 Readback

This algorithm gives information about the actual delivered value of the actuator in the process.

The READBACK_STATUS information is provided to reflect the state of the actuating value. This may be a Boolean value (valid/non-valid), a continuous value (measurement uncertainty), a discrete value, or a combination thereof.

5.2.2.7 Fail safe

The fail safe algorithm is described in 5.6.4.

5.2.2.8 Mode

The mode algorithm determines the source of the output for the modulating actuation FB based on the MODE parameter value. In Automatic mode, the output is determined by the modulating actuation algorithm. When the mode is set to Manual, the output of the FB is set by another source, for example it may be set by the operator.

5.2.2.9 Initialisation

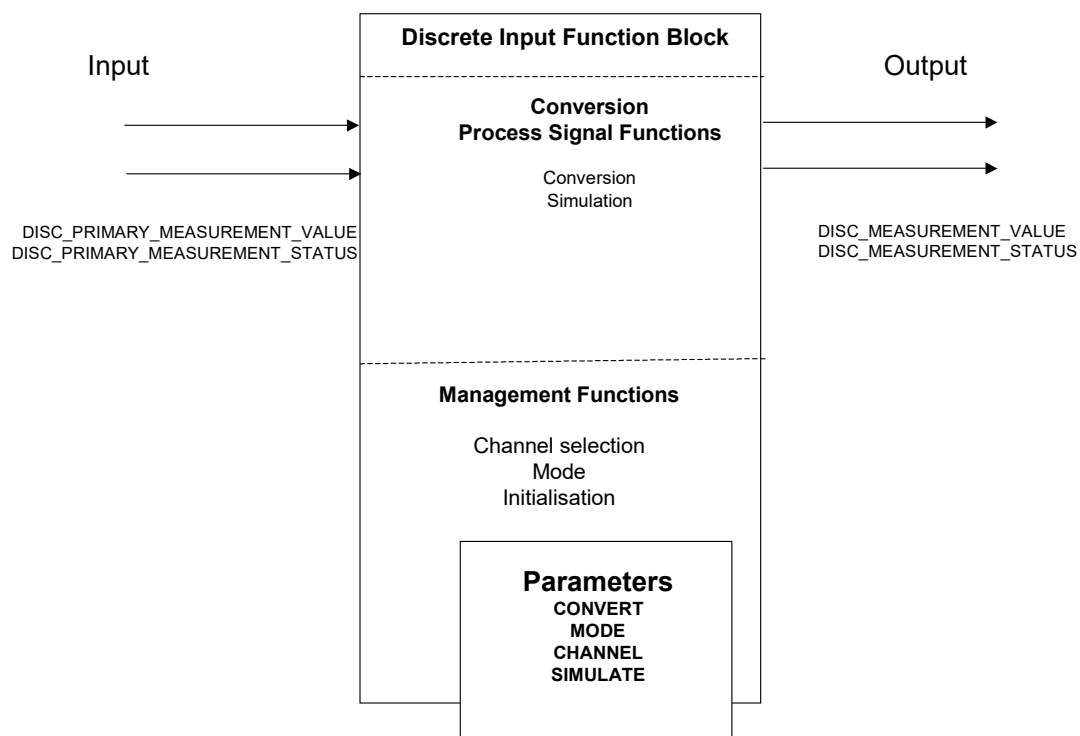
The initialisation algorithm is applied to this block and described 5.6.3.

5.2.3 Discrete Input FB

5.2.3.1 Discrete Input overview

Figure 15 shows the block diagram of the Discrete input FB.

Discrete Inputs represent for example inductive, optical, capacitive, ultrasonic proximity switches. When the digital input changes state the discrete output changes state to



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NOTE For the parameters description, see Annex A.

Figure 15 – Discrete input FB

5.2.3.2 Conversion

This algorithm converts the Boolean or discrete measure in a logical signal.

The result is the DISC_MEASUREMENT_VALUE accompanied by the DISC_MEASUREMENT_STATUS.

5.2.3.3 Channel selection

One Technology Block will be used for primary final element data. Channel numbers (CHANNEL) will be defined for the discrete detection device when using more than one Technology Block.

5.2.3.4 Simulation

This algorithm is used to force the main discrete value to an assigned value using the SIMULATE parameter. This operation is usually carried out during commissioning, adjustment phases, or test purposes, and allows the running application to be temporarily uncoupled from the process.

5.2.3.5 Mode

The mode algorithm determines the source of the measure input FB output (main discrete measure) based on the MODE parameter value. In Automatic mode, the discrete measure algorithm determines the output. When mode is set to Manual, the output of the FB is set by another source, for example it may be set by the operator.

5.2.3.6 Initialisation

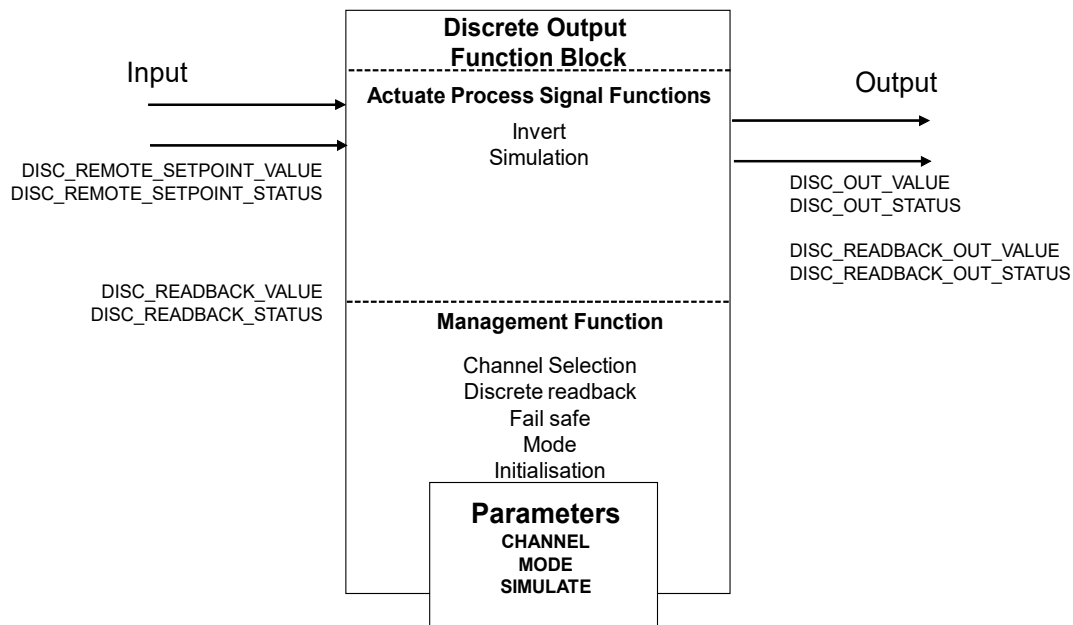
The initialisation algorithm is applied to this block and described in 5.6.3.

5.2.4 On/Off Actuation FB Discrete Output FB

5.2.4.1 On/Off Actuation FB Discrete Output FB overview

Figure 16 shows the block diagram of the Discrete output FB.

The actuation process signal algorithm converts the DISC_REMOTE_SETPOINT_VALUE value to a useful value (DISC_OUT_VALUE) for the hardware at the channel selection to the Technology Block. The DISC_READBACK_VALUE defines the target value of the final element. Is the Discrete Output FB part of a cascade chain the DISC_READBACK_OUT_VALUE provides the actual value to the upstream FB. All these input and output parameters shall be accompanied by their status (see 5.6.1).



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NOTE For the parameters description, see Annex A.

Figure 16 – Discrete Output FB

5.2.4.2 Invert

Sometimes it is necessary to invert logically the DISC_REMOTE_SETPOINT_VALUE before forwarding it to the discrete actuation demand. This is done in this algorithm.

5.2.4.3 Simulation

This algorithm is used to force the DISC_READBACK_VALUE and the DISC_READBACK_STATUS to assigned values using the SIMULATE setting. The simulation can be used for example to simulate Technology Block faults. In simulation mode, the Technology Block ignores the DISC_OUT_VALUE value and maintains the last value. This operation is usually carried out during commissioning, adjustment phases, or test purpose, and allows the running application to be temporarily uncoupled from the process.

5.2.4.4 Channel selection

One Technology Block will be used for the primary final element data. Channel numbers (CHANNEL) will be defined for the Modulation Actuator Device when using more than one Technology Block.

5.2.4.5 Fail safe

The fail safe algorithm is described in 5.6.4.

5.2.4.6 Mode

The mode algorithm determines the source of the on/off actuation FB output based on the MODE parameter value. In Automatic mode, the on/off actuation algorithm determines the output. When the mode is set to Manual, the output of the FB is set by another source, for example it may be set by the operator.

5.2.4.7 Initialisation

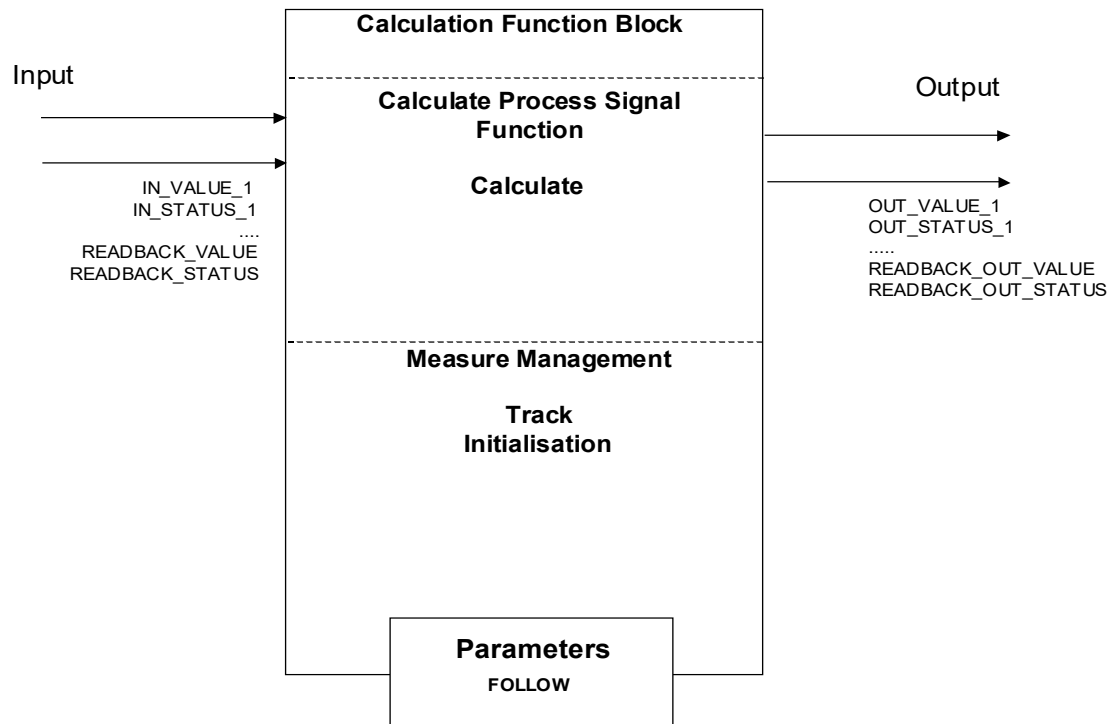
The initialisation algorithm is applied to this block and described in 5.6.3.

5.2.5 Calculation FB

5.2.5.1 Calculation FB overview

Figure 17 shows the block diagram of Calculation FB.

The Calculation FB acts upon the input signal(s) (IN_VALUE_x) from other FBs to provide an application value (OUT_VALUE_x). If the Calculation FB is part of a cascade chain the READBACK_OUT_VALUE provides the actual value to the upstream FB and the READBACK_VALUE is provided by a downstream FB. All these input and output parameters shall accompanied by their status (see 5.6.1).



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NOTE For the parameters description see Annex A.

Figure 17 – Calculation FB

5.2.5.2 Calculate

This algorithm determines the output signal(s) based on a pre-defined algorithm and the input(s) to the FB. Example calculation functions are filtering, delay, input select.

5.2.5.3 Track

The track algorithm allows the FB output to be set to an input value when the FOLLOW parameter is active i.e. non-zero in value. For example this algorithm may be used to initialise a block or to force the calculation results to a specific value.

This does not apply to all blocks.

5.2.5.4 Initialisation

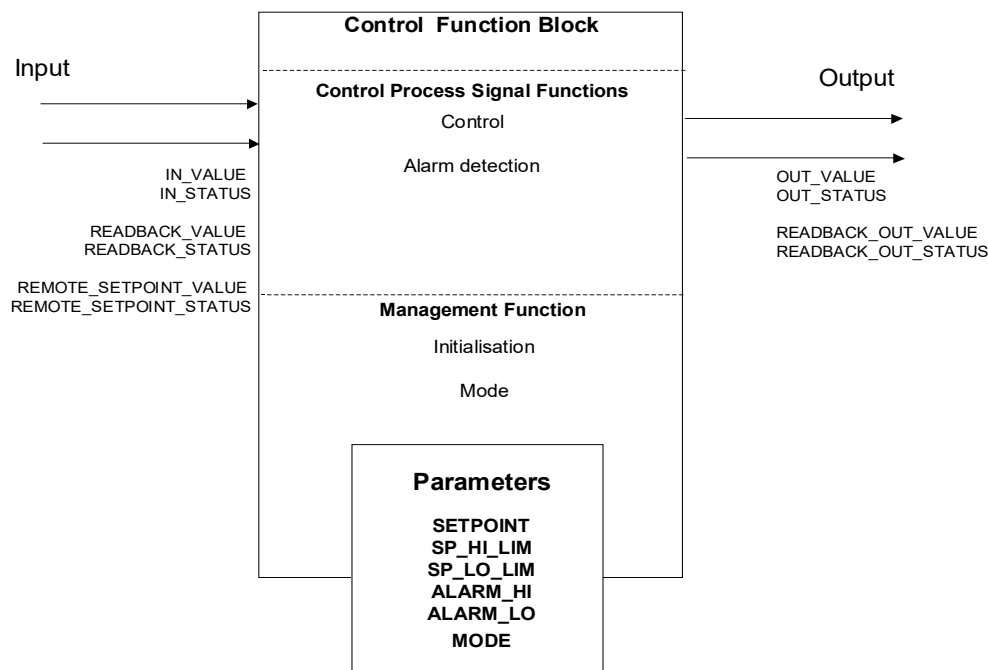
The initialisation algorithm is applied to this block and is described in 5.6.3.

5.2.6 Control FB

5.2.6.1 Control FB overview

Figure 18 shows the block diagram of the Control FB.

The control FB maintains a process input (IN_VALUE) at the setpoint value (SETPOINT) through the regulation of one or more process actuation outputs. The process input measurement is provided by an appropriate FB through the primary input connection. The primary output of the control FB regulates the process through an appropriate actuation FB. The SETPOINT defines the target value of the process measurement in mode "auto". The readback value and status provided by the downstream actuation block may be used in the initialisation and to modify the control action when the output is limited by a downstream condition.



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Figure 18 – Control FB**5.2.6.2 Control**

This algorithm determines the FB output value that is needed to drive the primary input value to the target value specified by the SETPOINT parameter. Changes in the SETPOINT value are limited to the range specified by the SP_HI and SP_LO limits. Actions may be modified when a readback input from the downstream block indicates that a downstream condition limits the adjustment of the block output.

5.2.6.3 Alarm detection

The alarm detection is optional. When implemented, the LOW_ALARM_LIMIT and HIGH_ALARM_LIMIT values shall be compared with the primary control measurement value of the block. The results are high and low alarm notification for example for an operator.

NOTE The way of reporting the detected alarms is technology dependent therefore it is not described in this document and shown in the according figure.

5.2.6.4 MODE

The mode algorithm determines the source of the control block output based on the MODE parameter value. In Automatic mode, the output is determined by the control algorithm and the SETPOINT is specified by the operator. When the mode is set to Manual, the output of the block is set by another source, for example it may be set by the operator.

In remote mode, the output is determined by the control algorithm and the setpoint is determined by the REMOTE_SETPOINT input from another FB.

5.2.6.5 Initialisation

When the feedback status indicates that the path to the process input is blocked, the output of the FB will be set based on the readback value to provide bumpless transfer when the downstream mode is changed to remote.

5.3 Component FBs

A process control application is built out of application FBs as defined above. In addition, the application can include component FBs combined in an application specific way and encapsulated by FBs of composite FB type as described 4.1.1. The exception handling and status handling is technology specific and is part of the component FB definitions.

5.4 Technology Block

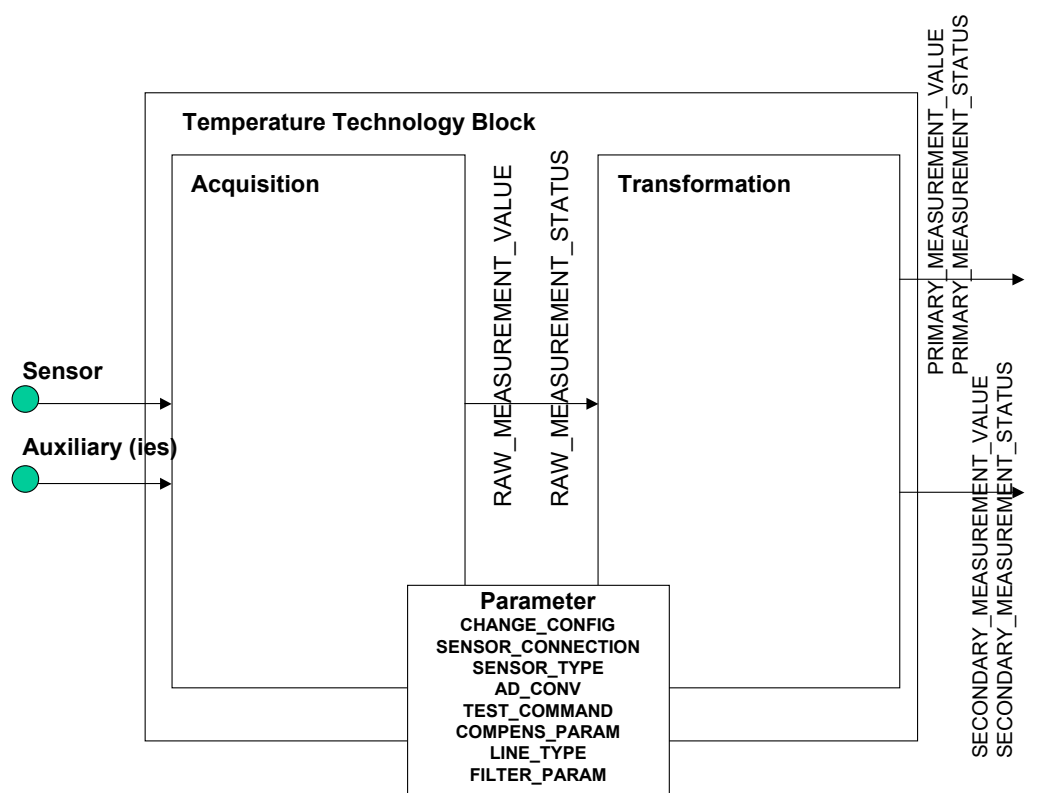
5.4.1 Temperature Technology Block

5.4.1.1 Temperature Technology Block overview

The algorithms of the Temperature Technology Block are summarized below:

- a) sensor connection
- b) channel range/scaling
- c) AD conversion
- d) test
- e) diagnosis
- f) cold junction compensation
- g) linearization
- h) filtering
- i) initialisation

The algorithms are encapsulated in the Acquisition and Transformation part of the Technology Block (see Figure 19).



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Figure 19 – Temperature Technology Block

5.4.1.2 Temperature Acquisition Functions

5.4.1.2.1 Sensor connection

The process signal is connected directly to the interface module.

There is a possibility to connect the thermo resistance with 2, 3 or 4 wires. Compensation is chosen by the parameter `SENSOR_CONNECTION`.

This algorithm checks the sensor link and signals a fault if there is a short-circuit or an open circuit. The wiring check is enabled/disabled via the configuration (`CHAN_CONFIG`).

5.4.1.2.2 Channel range

This algorithm selects the sensor type which is connected to the device. According to the configuration (`SENSOR_TYPE`), it is necessary to differentiate between:

- electrical range (± 10 V, 0 V to 10 V, 0 V to 5 V, 1 V to 5 V, 0 mA to 20 mA or 4 mA to 20 mA),
- thermocouple,
- temperature probes.

Table 4 gives an example of several types of sensor.