TECHNICAL SPECIFICATION

IEC TS 61804-1

First edition
2003-10

Function blocks (FB) for process control –

Part 1: Overview of system aspects

Withdrawn
iTeh Standards
(https://standards.iteh.ai)
Document Preview
IEC TS 61804-1:2003
https://standards.iteh.ai/catalog/standards/iec/918bbf87-e99c-4e71-9eee-7c51ac1l7ca4/iec-ts-61804-1-2003

Reference number
IEC/TS 61804-1:2003(E)

Publication numbering

As from 1 January 1997 all IEC publications are issued with a designation in the 60000 series. For example, IEC 34-1 is now referred to as IEC 60034-1.

Consolidated editions

The IEC is now publishing consolidated versions of its publications. For example, edition numbers 1.0, 1.1 and 1.2 refer, respectively, to the base publication, the base publication incorporating amendment 1 and the base publication incorporating amendments 1 and 2.

Further information on IEC publications

The technical content of IEC publications is kept under constant review by the IEC, thus ensuring that the content reflects current technology. Information relating to this publication, including its validity, is available in the IEC Catalogue of publications (see below) in addition to new editions, amendments and corrigenda. Information on the subjects under consideration and work in progress undertaken by the technical committee which has prepared this publication, as well as the list of publications issued, is also available from the following:

- **IEC Web Site (www.iec.ch)**

- **Catalogue of IEC publications**

  The on-line catalogue on the IEC web site (www.iec.ch/searchpub) enables you to search by a variety of criteria including text searches, technical committees and date of publication. On-line information is also available on recently issued publications, withdrawn and replaced publications, as well as corrigenda.

- **IEC Just Published**

  This summary of recently issued publications (www.iec.ch/online_news/ justpub) is also available by email. Please contact the Customer Service Centre (see below) for further information.

- **Customer Service Centre**

  If you have any questions regarding this publication or need further assistance, please contact the Customer Service Centre:

  Email: custserv@iec.ch
  Tel: +41 22 919 02 11
  Fax: +41 22 919 03 00

Withdrawn
iTeh Standards
(https://standards.iteh.ai)
Document Preview
IEC TS 61804-1:2003
https://standards.iteh.ai/catalog/standards/iec/9f5b6f87-e99c-4e71-9eee-7c51ac117ca4/iec-ts-61804-1-2003

TECHNICAL SPECIFICATION

IEC TS 61804-1

First edition
2003-10

Function blocks (FB) for process control –

Part 1: Overview of system aspects

Withdrawn
iTeh Standards
(https://standards.iteh.ai)
Document Preview
IEC TS 61804-1:2003
https://standards.iteh.ai/catalog/standards/sist/9a8bbf87-e99c-4e71-9eee-7c51ac117ca4/iec-ts-61804-1-2003

© IEC 2003 — Copyright - all rights reserved

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

International Electrotechnical Commission, 3, rue de Varembé, PO Box 131, CH-1211 Geneva 20, Switzerland
Telephone: +41 22 919 02 11 Telefax: +41 22 919 03 00 E-mail: inmail@iec.ch Web: www.iec.ch

Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

PRICE CODE XF

For price, see current catalogue

CONTENTS

FOREWORD 5
INTRODUCTION 7

1 Scope 9
2 Normative references 11
3 Terms, definitions and abbreviated terms 11
3.1 General definitions 11
3.2 Definitions based on IA/IM-channel 17
3.3 Abbreviated terms 18
4 Engineering requirements 18
4.1 General 18
4.2 Requirements for design phase 18
5 Compatibility levels 19
5.1 General 19
5.2 Incompatibility 21
5.3 Coexistence 21
5.4 Interconnectability 21
5.5 Interworkability 21
5.6 Interoperability 21
5.7 Interchangeability 21
6 Functional requirements 22
6.1 General 22
6.2 System (or channel or device) status 22
6.3 Validity index (VI) 24
6.4 Signal processing 24
6.5 Measurement information processing 24
6.6 Device diagnostics and test support 26
6.7 Local interfaces attachment 27
6.8 Device (and system and channel) management 27
7 FB application requirements 31
7.1 System overview 31
7.2 Overview of basic FB types 33
7.3 FB requirements 35
7.4 Initial sets of FBs derived from I&C 37
7.5 FB environment requirements 41
7.6 Communications requirements 43
8 Additional requirements 43
8.1 Cooperation with external applications 43
8.2 Additional characteristic requirements 47
8.3 Conformance requirements 49
9 Device descriptive language 49
9.1 Background 49
9.2 Basic requirements 49
9.3 General requirements 51

Withdrawn
iTeh Standards
(https://standards.iteh.ai)
Document Preview
IEC TS 61804-1:2003
https://standards.iteh.ai/catalog/standards/iec/918bbf87-e99c-4e71-9eee-7c51ac117ca4/iec-ts-61804-1-2003

Annex A (informative) Life cycle of the system 53
Annex B (informative) FB functional requirements: the user's view 77
Annex C (informative) Relation between IEC 61804 series and IEC 61499-1 94
Annex D (informative) Mapping of an analogue input FB to IEC 61499 106
Annex E (informative) FB requirement overview support 119
Annex F (informative) AME requirements 121

Bibliography 127

Figure A.1 – Life cycle from the process circuit to the FRDs 55
Figure A.2 – PFD composed of two process elementary operations 56
Figure A.3 – Control functions explicitly represented on the extended P&ID 57
Figure A.4 – Extraction of control functions from the extended P&ID 58
Figure A.5 – Requirements for control functions and ABs 59
Figure A.6 – Structured documentation for the requirements of the control functions 59
Figure A.7 – The four sections of a folio 60
Figure A.8 – Selection of a folio from the CHD 61
Figure A.9– Folio for detailed requirements of the control function "to control the pumps" 62
Figure A.10 – Example of FRDs 62
Figure A.11 – Functional requirements diagrams independent of I&C system implementation 63
Figure A.12 – The need for a standardized FB language 64
Figure A.13 – Library of standardized EFBs 65
Figure A.14 – From FRDs down to the I&C system and devices 66
Figure A.15 – Design of an actuation and its AB from off-the-shelf actuation devices 67
Figure A.16 – Designing internal behaviour of actuation AB from actuation devices off the shelf 67
Figure A.17 – Networking of the internal blocks inside the AB and with upstream and downstream EFBs and ABs of the control function 68
Figure A.18 – Actuation AB graphic symbol and implicit internal description 69
Figure A.19 – OFF/ON value actuation AB using the IEC 61499-1 system model 69
Figure A.20 – OFF/ON value actuation AB using the IEC 61499-1 system model 70
Figure A.21 – Example of a safe switch over 2/3 AB 70
Figure A.22 – Switchover 2/3 AB using the IEC 61499-1 system model 71
Figure A.23 – From a FRD to a programming scheme using IEC 61499-1 system model 72
Figure A.24 – Distribution of the internal blocks of a pump AB 72
Figure A.25 – Distribution the EFBs and ABs of the control function "to control the pumps" into the I&C architecture 73
Figure A.26 – Implementation of the control function into the I&C devices 74
Figure A.27 – Distribution of the control function "to control the pumps" using the IEC 61499-1 model 74
Figure A.28 – From FRDs to programming schemes 75
Figure B.1– System properties 79
Figure B.2 – IA/IM channel validation 80

Withdrawn
iTeh Standards
(https://standards.iteh.ai)
Document Preview
https://standards.iteh.ai/catalog/standards/sist/...-ts-61804-1-2003

Figure B.3 – Reference functional architecture for distributed automation systems 83
Figure B.4 – User view of the major component functions of each IAM function 84
Figure B.5 – IM channel/CMM interaction: user vision 86
Figure B.6 – Distributed platform using fieldbus: physical composition 86
Figure B.7 – Intelligent transmitter reference model 88
Figure C.1 – Structure of IEC 61499-1 FBs 95
Figure C.2 – Type specific aspects of IEC 61499-1 FBs 95
Figure C.3 – Implementation specific aspects 96
Figure C.4 – Distributed application and distributed operating system 96
Figure C.5 – Basic concepts of process control FBs 98
Figure C.6 – Functional components in process control FBs 99
Figure C.7 – IEC 61499-1 graphical representation of a process control FB (example) 99
Figure C.8 – Full structure of an EFB (example) 100
Figure C.9 – Relationship between IEC 61499-1, IEC 61804 series and other standardization activities 101
Figure D.1 – Summary of the parameter of analogue input blocks 107
Figure D.2 – Simulation, mode and status diagram of analogue input block 107
Figure D.3 – Conditions of mode and status generation 108
Figure D.4 – State machine of the analogue input block 108
Figure D.5 – Example for the analogue input block parameter 112
Figure D.6 – AI FB graphical representation 113
Figure D.7 – AI FB ECC 114
Figure F.1 – Naming and addressing approach 123

Table 1 – Functionality features 20
Table 2 – Example of initial FB set 37
Table 3 – Example of common list of EFBs 38
Table C.1 – Aspects overview of IEC 61499-1 FBs 97
Table C.2 – Reference between IEC 61499-1 and IEC 61804 components 105
Table D.1 – Conditions and results of the actual mode calculation 109
Table D.2 – Conditions and results of the status calculation from the output parameter 109
Table D.3 – Parameter attributes for the analogue input block 110
Table D.4 – Process parameter description 110
Table D.5 – Alarm parameter description 111
Table D.6 – Simulation 112
Table E.1 – Allocation of requirements to architecture components 119
Table E.2 – Overview of related requirements 120

iTeh Standards
(https://standards.iteh.ai)
Document Preview
IEC TS 61804-1:2003
https://standards.iteh.ai/catalog/standards/sist/9c/9438bf87-e99c-4e71-9eee-7c51ac117ca4/iec-ts-61804-1-2003
Withdrawn

INTERNATIONAL ELECTROTECHNICAL COMMISSION

FUNCTION BLOCKS (FB) FOR PROCESS CONTROL –

Part 1: Overview of system aspects

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with an IEC Publication.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

The main task of IEC technical committees is to prepare International Standards. In exceptional circumstances, a technical committee may propose the publication of a technical specification when

- the required support cannot be obtained for the publication of an International Standard, despite repeated efforts, or
- the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards. IEC 61804-1, which is a Technical Specification, has been prepared by subcommittee 65C: Digital communications, of IEC technical committee 65: Industrial-process measurement and control.

This standard cancels and replaces IEC/PAS 61804-1 published in 2002.

Withdrawn
IECNORM.COM : Click to view the full PDF of IEC TS 61804-1:2003
https://standards.iteh.ai/catalog/standards/iec/ts-61804-1-2003

The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
65C/296/DTS	65C/310A/RVC

Full information on the voting for the approval of this technical specification 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.

IEC 61804 consists of the following parts under the general title *Function blocks (FB) for process control*

Part 1: *Overview of system aspects*

Part 2: *Specification of FB concept and electronic device description language (EDDL)*

The committee has decided that the contents of this publication will remain unchanged until 2007. At this date, the publication will be

- transformed into an International standard;
- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

Withdrawn
iTeh Standards
(https://standards.iteh.ai)
Document Preview
IEC TS 61804-1:2003
https://standards.iteh.ai/catalog/standards/iec/918bbf87-e99c-4e71-9eee-7c51ac117ca4/iec-ts-61804-1-2003

INTRODUCTION

This Technical Specification is an end-user driven specification of the requirements of distributed process control systems based on Function Blocks (FB). This Technical Specification and its associated FB standard (IEC 61804-2) originate from the power-plant industrial sector. It is validated by applications in oil and gas, petrochemicals, pharmaceuticals and fine chemicals, pulp and paper, food and beverage, waste water treatment plants, steel milling and others. There will be other general requirement standards and associated specifications for other industrial sectors.

Present and future digital process control systems need to fulfil the following requirements:

- increase security and safety;
- reduce time to market;
- be supportable with available tools;
- reduce costs of development and support;
- minimize training costs;
- support integration of distributed control applications
- support integrated methodology for implementation;
- have increased maintainability, modifiability, agility, upgradeability, flexibility, ability to validate, accessibility, availability, compatibility of support tools, multi-vendor device/ application compatibility, re-usability of knowledge and designs, re-usability of software components;
- be made up of digital devices that are compatible, interworkable, interconnectable interoperable and interchangeable with each other.

Process control systems are required to fulfil these requirements in terms of their architecture and their operation during all the phases of the life cycle. The accepted basic concept for the design process control system is to describe all necessary implementation-specific functions with FB. A FB is an encapsulation of data and algorithms to provide a specific function, which can be self-standing. Process control systems can involve many instances of many different FBs operating in an environment providing common services (for example, communications) and interfaces to other applications. See Figure 1.

Withdrawn
iTeh Standards
(https://standards.iteh.ai)
Document Preview
IEC TS 61804-1:2003

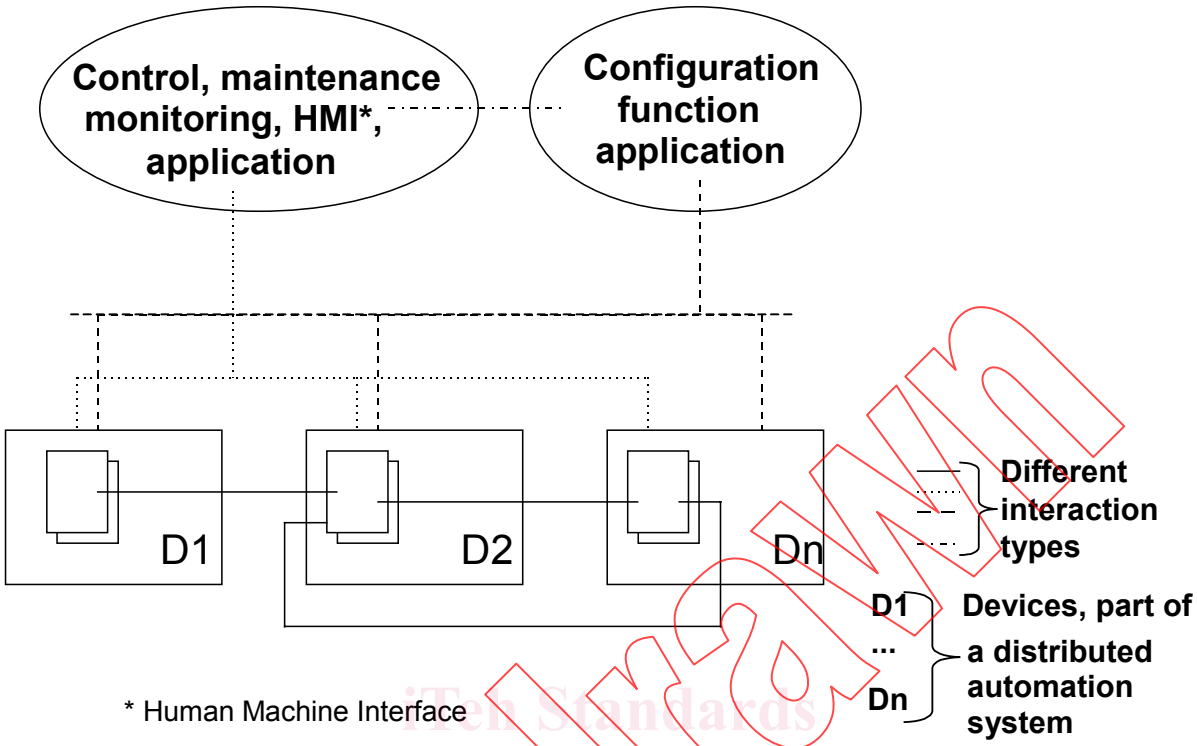

Figure 1 – Interactions of applications

iTeh Standards (https://standards.iteh.ai) Document Preview
IEC TS 61804-1:2003
https://standards.iteh.ai/catalog/standards/iec/918bbf87-e99c-4e71-9eee-7c51ac1l7ca4/iec-ts-61804-1-2003
Withdrawn

FUNCTION BLOCKS (FB) FOR PROCESS CONTROL –

Part 1: Overview of system aspects

1 Scope

This part of IEC 61804 is a Technical Specification which provides *guidelines* for suppliers to meet evolving requirements for digital process control systems through which users can be assured of the compatibility, the interworkability, the interconnectability, the interoperability and the interchangeability of the devices they choose. This part gives the overall requirements. For better understanding, this part gives background information and examples in annexes.

This Technical Specification defines the requirements for FBs to provide control and to facilitate maintenance and technical management as applications which interact with actuators and measurement devices:

- control covers functions necessary to bring and hold the process at the desired behaviour;
- maintenance covers functions to acquire information about the state of the process equipment and the state of automation devices including their adjustments, for example, calibrate a sensor that has drifted;
- technical management deals with information for the optimization of the process.

  It is concerned primarily with the economics of the process and plant equipment. This relates in particular to the evaluation of performance and reliability of specific items of plant or equipment for all the installed period and comparison of performance and reliability of items from different suppliers performing an identical function in the same operating environment. An example of performance is the number of cycles achieved before failure of two valves from different suppliers. This allows for the production of detailed and valid statistical analysis to support management decisions and plant equipment modifications.

A prerequisite for designing, implementing and operating a FB-based process control system is that the tools, the devices and other components follow the same architecture based on a common specification. The architecture is required to define the components of the systems, for example FB, device, data, data connections and more as well as relations between these components. The IEC 61499 series generic FB model on which this Technical Specification is related is able to provide these basic components for FBs for process control. One add-on to the IEC 61499 series is the specification of parameters and functions of FBs that are implementable in devices.

The architecture and the range of FBs that have to be specified are described in 7.4 contains a minimum set of FBs that will be required for the process industries. These are presented in TWO different clauses. One deals with “rich” FBs covering complex but common functions such as control loop (for example proportional, integral, differential – PID) required by the majority of the process industries. Another covers a set of elementary FBs (EFB) such as Boolean functions required to compose very specific and unique functionality.

FBs are used during the complete life cycle of process control systems but viewed from different aspects. This is covered in detail in Annex A. The process design starts with the Piping and Instrumentation Diagram (P&ID) which gives the requirements of the process and instrumentation from a purely functional point of view. From the P&ID, the desired behaviour of the process control system is extracted into a functional requirements diagram (FRD) without considering the detailed behaviour of the underlying devices. The bricks making up the FRD are application blocks (AB), the representation of the data and algorithms in the

Withdrawn
iTeh Standards
(https://standards.iteh.ai)
Document Preview
IEC TS 61804-1:2003
https://standards.iteh.ai/catalog/standards/sist/...-ts-61804-1-2003

design phase. After discussion between the process and automation engineers (end-user and system integrator), the FRDs are turned into detailed designs for the application via several design using devices available on the market together with interconnections and configurations of these devices. In this way a PID loop shown in via bubbles on a P&ID will be transformed into implementable FBs in specific field and/or control-room devices. It should be noted that many parts of the process industries, in particular those with many similar and relatively simple processes (for example, the water industry), do not use the concept or term FRD. They go directly from P&IDs to the implementable FBs and will use a variety of names to describe the process and the resulting design documents. The FRD approach is used here since it represents the most formal view of the design cycle and illustrates the use of FBs at the earliest of phases in the life cycle. Clause 4 summarizes the requirements from this life-cycle point of view.

This Technical Specification specifies a system (an industrial-process measurement and control system based on distributed FB application). A system is described stepwise in terms of architecture, models and the life cycle. The architecture is the "road map" which names the components and presents the structure of the system. The models describe the details of the components, i.e. their functions in the system. The life cycle makes visible how the components work together during their use in different phases of the lifetime, i.e. it makes the operation visible.

Figure 2 shows the different influences, basic specifications and technology support on IEC 61804 from the top-down and bottom-up point of view.

iTeh Standards (https://standards.iteh.ai) Document Preview
IEC TS 61804-1:2003
https://standards.iteh.ai/catalog/standards/sist/...-1-2003
Withdrawn

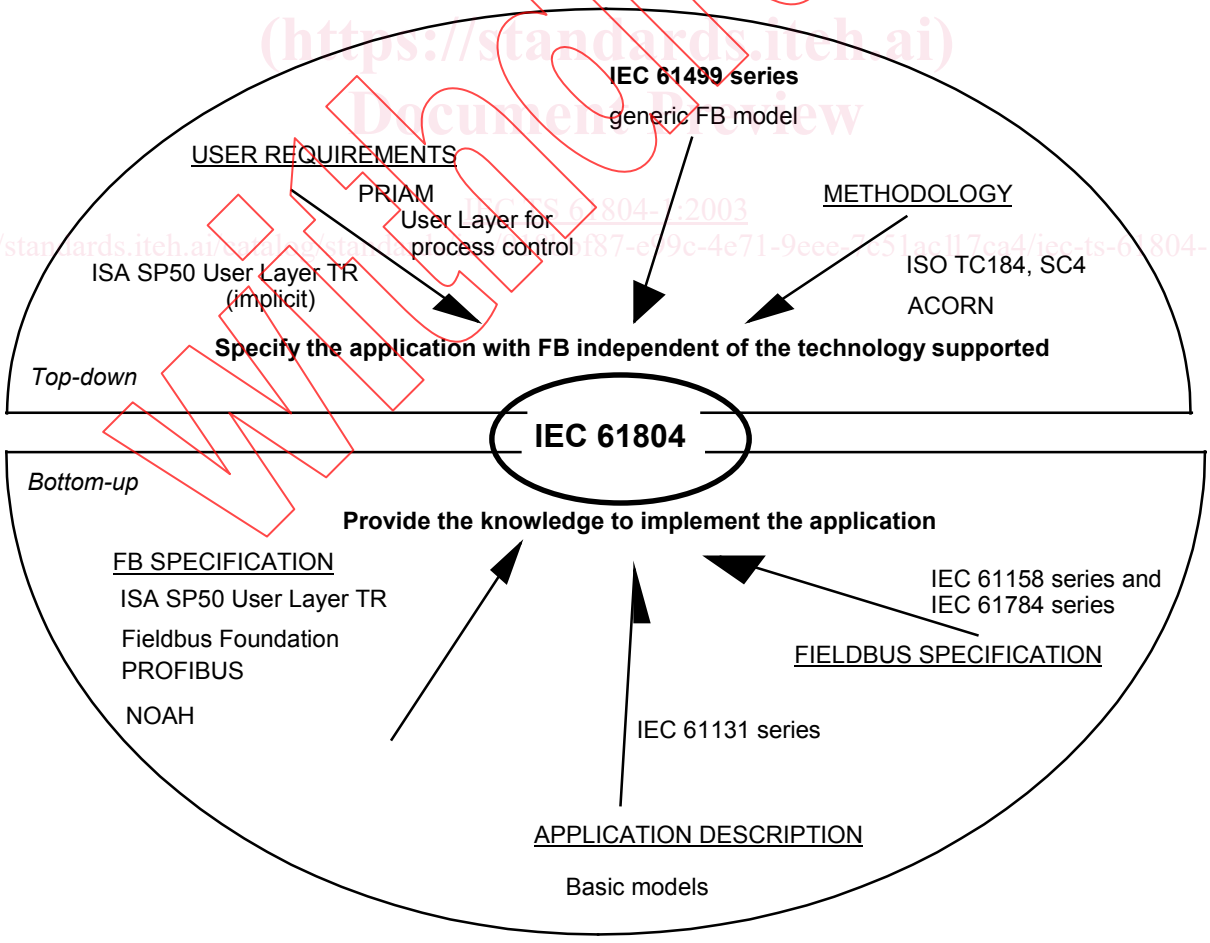

Figure 2 – Influences on IEC 61804

The influences are international standards and projects (PROFIBUS and Fieldbus Foundation[1]), which relate to the same area as IEC 61804. These standards are either technology-independent ones supporting the top-down approach or dedicated to a certain technology, for example, programmable controller or fieldbus. Both together will build the basis of the standard specified by IEC 61804.

The main purpose of this part is the harmonization of different views, models and starting points of end-users, system providers and device manufacturers. It will be the reference document leading the discussions during the specification and the guideline for the readers of IEC 61804-2.

2 Normative references

The following referenced documents are indispensable for the application 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 61131-3:1992, *Programmable controllers – Part 3: Programming languages*

IEC 61499-1:2000, *Function blocks for industrial-process measurement and control systems – Part 1: Architecture*

IEC 61512-1:1997, *Batch control – Part 1:Models and terminology*

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*

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

IEC 61804-2, *Function blocks for process control – Part 2: Specification of FB concept and Electronic Device Description Language (EDDL)* [2]

EN 50170:1996, *General purpose field communication system*

3 Terms, definitions and abbreviated terms

3.1 General definitions

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

3.1.1
interface
shared boundary between two *functional units,* defined by functional characteristics, signal characteristics, or other characteristics as appropriate

[IEC 60050-351:1998, 11-19]

---

[1] PROFIBUS is the registered trade mark of PROFIBUS International (PI). PI is a non-profit trade organization to support the fieldbus PROFIBUS. This information is given for the convenience of users of this Technical Specification and does not constitute an endorsement by CENELEC of the trademark holder or of any of its products. Compliance to this profile does not require use of the trade name PROFIBUS. Use of the trade name PROFIBUS requires permission of the trade-name holder.

Foundation Fieldbus is the trade name of the consortium Fieldbus Foundation. This information is given for the convenience of users of this Technical Specification and does not constitute an endorsement by CENELEC of the product named. Equivalent products may be used if they can be shown to lead to the same results.

[2] To be published.

iTeh Standards (https://standards.iteh.ai) Document Preview
https://standards.iteh.ai/catalog/standards/sist/9438bbf87-e99c-4e71-9eee-7c51ac1f7ca4/iec-ts-61804-1-2003
Withdrawn

3.1.2
system
set of interrelated elements considered in a defined context as a whole and separated from its environment

[IEC 60050-351:1998, 11-01]

NOTE 1 Such element may be material objects and concepts as well as the results thereof (for example forms of organization, mathematical methods, and programming languages).

NOTE 2 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 system considered.

3.1.3
data type
set of values together with a set of permitted *operations*

[ISO 2382 series]

3.1.4
data connection
association between two *function blocks* for the conveyance of *data*

[IEC/PAS 61499-1:2000, 1.3.2.22]

3.1.5
data
representation of facts, concepts or instructions in a formalized manner suitable for communication, interpretation or processing by human beings or by automatic means

[ISO modified[3]]

3.1.6
functional unit
entity of *hardware* or *software*, or both, capable of accomplishing a specified purpose

[ISO 2382 series]

3.1.7
hardware
physical equipment, as opposed to programs, procedures, rules and associated documentation

[ISO modified[3]]

3.1.8
mapping
set of values having defined correspondence with the quantities or values of another set

[ISO 2382 series]

3.1.9
parameter
variable that is given a constant value for a specified *application* and that may denote the application

[ISO 2382 series]

iTeh Standards
(https://standards.iteh.ai)
Document Preview
IEC TS 61804-1:2003
https://standards.iteh.ai/catalog/standards/iec/918bbf87-e99c-4e71-9eee-7c51ac1f7ca4/iec-ts-61804-1-2003
Withdrawn

[3] The notation [ISO modified] following a definition indicates that the definition is taken from the “ISO/AFNOR Dictionary of Computer Science” and has been modified.