INTERNATIONAL STANDARD

IEC 61499-1

First edition
2005-01

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Function blocks –

Part 1: Architecture

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FUNCTION BLOCKS –

Part 1: Architecture

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.
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International Standard IEC 61499-1 has been prepared by IEC technical committee 65: Industrial-process measurement and control.

This standard cancels and replaces IEC/PAS 61499-1 published in 2000. This first edition constitutes a technical revision.

The following major technical changes have occurred between the PAS edition and this edition:

a) Syntax for network segments, links and parameters has been added in Clause B.3 to correspond to the system model of 4.1.
b) Syntax for parameters instead of constant data connections has been included for parameterization of function blocks, devices and resources in Clauses B.2 and B.3 for better consistency with IEC 61131-3.
c) The execution control model of 5.2.2.2 has been simplified and updated for consistency with modern models of state machine control.

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

CDV	Report on voting
65/338/CDV	65/346/RVC

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.

IEC 61499 consists of the following parts, under the general title *Function blocks:*

Part 1: Architecture

Part 2: Software tool requirements

Part 3: Tutorial information

Part 4: Rules for compliance profiles [1]

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

A bilingual version of this standard may be issued at a later date.

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[1] Under consideration.

INTRODUCTION

The IEC 61499 series consists of four Parts:

d) Part 1 (this part of IEC 61499) contains:

- general requirements, including scope, normative references, definitions, and reference models;
- rules for the declaration of *function block types*, and rules for the behavior of *instances* of the types so declared;
- rules for the use of function blocks in the *configuration* of distributed Industrial-Process Measurement and Control *Systems* (IPMCSs);
- rules for the use of function blocks in meeting the communication requirements of distributed IPMCSs;
- rules for the use of function blocks in the management of *applications*, *resources* and *devices* in distributed IPMCSs.

e) Part 2 defines requirements for *software tools* to support the following systems engineering tasks enumerated in Clause 1 of this part of IEC 61499:

- the specification of function block types;
- the functional specification of resource types and device types;
- the specification, analysis, and validation of distributed IPMCSs;
- the *configuration*, *implementation*, operation, and maintenance of distributed IPMCSs;
- the exchange of *information* among *software tools*.

f) Part 3 has the purpose of increasing the understanding, acceptance, and both generic and domain-specific applicability of IPMCS architectures and software tools meeting the requirements of the other Parts, by providing:

- answers to Frequently Asked Questions (FAQs) regarding the IEC 61499 series;
- examples of the use of IEC 61499 constructs to solve frequently encountered problems in control and automation engineering.

g) Part 4 defines rules for the development of *compliance profiles* which specify the features of IEC 61499-1 and IEC 61499-2 to be implemented in order to promote the following attributes of IEC 61499-based systems, devices and software tools:

- interoperability of devices from multiple suppliers;
- portability of software between software tools of multiple suppliers; and
- configurability of devices from multiple vendors by software tools of multiple suppliers.

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FUNCTION BLOCKS –

Part 1: Architecture

1 Scope

This part of IEC 61499 defines a generic architecture and presents guidelines for the use of *function blocks* in distributed Industrial-Process Measurement and Control Systems (IPMCSs). This architecture is presented in terms of implementable reference *models*, textual syntax and graphical representations. These models, representations and syntax can be used for:

- the specification and standardization of *function block types*;
- the functional specification and standardization of system elements;
- the implementation independent specification, analysis, and validation of distributed IPMCSs;
- the *configuration*, *implementation*, operation, and maintenance of distributed IPMCSs;
- the exchange of *information* among *software tools* for the performance of the above *functions*.

NOTE 1 This part of IEC 61499 does not restrict or specify the functional capabilities of IPMCSs or their system elements, except as such capabilities are represented using the elements defined herein. IEC 61499-4 addresses the extent to which the elements defined in this part of IEC 61499 may be restricted by the functional capabilities of compliant systems, subsystems, and devices.

Part of the purpose of this part of IEC 61499 is to provide reference models for the use of function blocks in other standards dealing with the support of the system life cycle, including system planning, design, implementation, validation, operation and maintenance. The models given in this part of IEC 61499 are intended to be generic, domain independent and extensible to the definition and use of function blocks in other standards or for particular applications or application domains. It is intended that specifications written according to the rules given in this part of IEC 61499 be concise, implementable, complete, unambiguous, and consistent.

NOTE 2 The provisions of this part of IEC 61499 alone are not sufficient to ensure interoperability among devices of different vendors. Standards complying with this part of IEC 61499 may specify additional provisions to ensure such interoperability.

NOTE 3 Standards complying with this part of IEC 61499 may specify additional provisions to enable the performance of *system*, *device*, *resource* and *application* management *functions*.

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 60050-351:1998, *International Electrotechnical Vocabulary (IEV) – Part 351: Automatic Control*

IEC 61131-3:2003, *Programmable controllers – Part 3: Programming languages*

ISO/IEC 7498-1:1994, *Information Technology – Open Systems Interconnection – Basic Reference Model: The Basic Model*

ISO/IEC 8824-1, *Information technology - Abstract Syntax Notation One (ASN.1): Specification of basic notation)*

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ISO/IEC 8825-1, *Information technology - ASN.1 encoding rules: Specification of Basic Encoding Rules (BER), Canonical Encoding Rules (CER) and Distinguished Encoding Rules (DER)*

ISO/IEC 10646, *Information technology - Universal Multiple-Octet Coded Character Set (UCS)*

ISO/IEC 10731, *Information technology - Open Systems Interconnection - Basic Reference Model - Conventions for the definition of OSI services*

ISO/AFNOR, *Dictionary of Computer Science*, 1989, ISBN 2-12-4869111-6

3 Terms and definitions

For the purposes of this document, the terms and definitions given in the ISO/AFNOR *Dictionary of computer science*, as well as the following apply.

NOTE Terms defined in this clause are *italicized* where they appear in the bodies of definitions.

3.1
acceptor
function block instance which provides a *socket adapter* of a defined *adapter interface type*

3.2
access path
association of a symbolic name with a *variable* for the purpose of open communication

3.3
adapter connection
connection from a *plug adapter* to a *socket adapter* of the same *adapter interface type*, which carries the flows of *data* and *events* defined by the adapter interface type

3.4
adapter interface type
type which consists of the definition of a set of *event inputs, event outputs, data inputs*, and *data outputs*, and whose *instances* are *plug adapters* and *socket adapters*

3.5
algorithm
finite set of well-defined rules for the solution of a problem in a finite number of *operations*

3.6
application
software functional unit that is specific to the solution of a problem in industrial-process measurement and control

NOTE An application may be distributed among *resources*, and may communicate with other applications.

3.7
attribute
property or characteristic of an *entity*, for instance, the version identifier of a *function block type* specification

3.8
basic function block type
function block type that cannot be decomposed into other function blocks and that utilizes an *execution control chart (ECC)* to control the *execution* of its *algorithms*

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3.9
bidirectional transaction
transaction in which a request and possibly *data* are conveyed from an *requester* to a *responder*, and in which a response and possibly data are conveyed from the responder back to the requester

3.10
character
member of a set of elements that is used for the representation, organization, or control of *data*

[ISO/AFNOR: 1989]

3.11
communication connection
connection that utilizes the "communication mapping function" of one or more *resources* for the conveyance of *information*

3.12
communication function block
service interface function block that represents the *interface* between an *application* and the "communication mapping function" of a *resource*

3.13
communication function block type
function block type whose *instances* are *communication function blocks*

3.14
component function block
function block instance which is used in the specification of an *algorithm* of a *composite function block type*

NOTE A component function block can be of *basic, composite* or *service interface type*.

3.15
component subapplication
subapplication instance that is used in the specification of a *subapplication type*

3.16
composite function block type
function block type whose *algorithms* and the control of their *execution* are expressed entirely in terms of interconnected *component function blocks, events,* and *variables*

3.17
concurrent
pertaining to *algorithms* that are *executed* during a common period of time during which they may have to alternately share common *resources*

3.18
configuration (of a *system* or *device*)
selecting *functional units*, assigning their locations and defining their interconnections

3.19
configuration (of a programmable controller system)
language element corresponding to a *programmable controller system* as defined in IEC 61131-1

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3.20
configuration parameter
parameter related to the *configuration* of a *system, device* or *resource*

3.21
confirm primitive
service primitive which represents an interaction in which a *resource* indicates completion of some *algorithm* previously *invoked* by an interaction represented by a *request primitive*

3.22
connection
association established between *functional units* for conveying *information*

[ISO/AFNOR: 1989]

3.23
critical region
operation or sequence of operations which is *executed* under the exclusive control of a locking object which is associated with the *data* on which the operations are performed

3.24
data
reinterpretable representation of *information* in a formalized manner suitable for communication, interpretation or processing

[ISO 2382-01.01.02]

3.25
data connection
association between two *function blocks* for the conveyance of *data*

3.26
data input
interface of a *function block* which receives *data* from a *data connection*

3.27
data output
interface of a *function block* which supplies *data* to a *data connection*

3.28
data type
set of values together with a set of permitted *operations*

[ISO 2382-15.04.01]

3.29
declaration
mechanism for establishing the definition of an *entity*

NOTE A declaration may involve attaching an *identifier* to the entity, and allocating *attributes* such as *data types* and *algorithms* to it.

3.30
device
independent physical *entity* capable of performing one or more specified *functions* in a particular context and delimited by its *interfaces*

NOTE A *programmable controller system* as defined in IEC 61131-1 is a *device*.

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3.31
device management application
application whose primary function is the management of a multiple *resources* within a *device*

3.32
entity
particular thing, such as a person, place, *process*, object, concept, association, or *event*

3.33
event
instantaneous occurrence that is significant to scheduling the *execution* of an *algorithm*

NOTE The execution of an algorithm may make use of *variables* associated with an event.

3.34
event connection
association among *function blocks* for the conveyance of *events*

3.35
event input
interface of a *function block* which can receive *events* from an *event connection*

3.36
event output
interface of a *function block* which can issue *events* to an *event connection*

3.37
exception
event that causes suspension of normal *execution*

3.38
execution
process of carrying out a sequence of *operations* specified by an *algorithm*

NOTE The sequence of operations to be executed may vary from one *invocation* of a *function block instance* to another, depending on the rules specified by the function block's *algorithm* and the current values of *variables* in the function block's data structure.

3.39
Execution Control action
EC action
element associated with an *execution control state,* which identifies an *algorithm* to be *executed* and an *event* to be issued on completion of execution of the algorithm

3.40
Execution Control Chart
ECC
graphical or textual representation of the causal relationships among *events* at the *event inputs* and *event outputs* of a *function block* and the *execution* of the function block's *algorithms*, using *execution control states, execution control transitions,* and *execution control actions*

3.41
Execution Control initial state
EC initial state
execution control state that is active upon initialization of an *execution control chart*

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