IEC 61499-2

Edition 2.0 2012-11

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Function blocks –
Part 2: Software tool requirements

Blocs fonctionnels –
Partie 2: Exigences pour les outils logiciels

IEC 61499-2:2012

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FUNCTION BLOCKS –

Part 2: Software tool requirements

FOREWORD

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International Standard IEC 61499-2, has been prepared by subcommittee 65B: Measurement and control devices, of IEC technical committee 65: Industrial-process measurement, control and automation.

This second edition cancels and replaces the first edition published in 2005. This edition constitutes a technical revision.

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

- The contents of Annex A have been updated to conform to the technical changes of the second edition of IEC 61499-1.
- CDATA sections are now allowed for the textual contents of algorithms in Tables A.4 and A.5.

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

FDIS	Report on voting
65B/846/FDIS	65B/856/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 of the IEC 61499 series can be found, under the general title *Function blocks*, on the IEC website.

Terms used throughout this International Standard that have been defined in Clause 3 of IEC 61499-1:2012 and in this International Standard appear in *italics*.

The committee has decided that the contents of this publication will remain unchanged until the stability 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- withdrawn,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.

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INTRODUCTION

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- Part 3: Tutorial information (withdrawn)
- Part 4: Rules for compliance profiles

FUNCTION BLOCKS –

Part 2: Software tool requirements

1 Scope

This part of IEC 61499 defines requirements for *software tools* to support the following systems engineering tasks enumerated in IEC 61499-1:

– 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*.

It is assumed that such software tools may be used in the context of an Engineering Support System (ESS) as described in IEC 61499-1.

It is beyond the scope of this standard to specify the entire life cycle of industrial-process measurement and control systems (IPMCSs), or the entire set of tasks and activities required to support an IPCMS over its life cycle. However, other standards which do specify such tasks and activities may extend or modify the requirements specified in this part of IEC 61499.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

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

ISO/IEC 8824 (all parts), *Information technology – Abstract Syntax Notation One (ASN.1)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61499-1, as well as the following apply.

3.1
library element
collection of *declarations* applying to a *data type, function block type, adapter type, subapplication type, resource type, device type, segment type,* or *system configuration*

4 Software tool requirements

4.1 Information to be provided by the software tool supplier

This Clause defines the functional requirements of *software tools* that support the performance of the systems engineering tasks enumerated in Clause 1.

The supplier of a *software tool* shall specify the following information in addition to other information required in this Clause:

- the type or types of *library element* to which the software tool applies;
- the engineering task or tasks supported by the software tool. Task descriptions may be taken from the enumeration of engineering tasks given in Clause 1, or may be defined by the supplier.

4.2 Exchange of library elements

A *software tool* shall be capable of exchanging its *library elements* with other software tools. This exchange shall take the form of *data* in the format defined in Annex A, written on physical media or exchanged over communication links or networks.

4.3 Information to be provided by the supplier of library elements

NOTE The provisions of this subclause are intended to provide the means by which the provider of a library element may achieve protection of intellectual property while still providing sufficient information to permit the effective use of the library element.

The provider of a *library element* may elect to provide an *implementation* of the library element.

EXAMPLE 1 The provider of a *function block type* library element may provide an implementation of the function block type as:

- one or more *instances* of the function block type in a *resource* contained in a *device* of Class 0 or higher as described in IEC 61499-4;
- an instantiable implementation of the function block type in a *resource* contained in a *device* of Class 1 or higher as described in IEC 61499-4;
- a file in an **implementation-dependent** format suitable for installation in a *resource* contained in a *device* of Class 2 as described in IEC 61499-4, for instance using the XML syntax defined in Annex D.

When an implementation of a library element is provided, the provider is not required to provide full details of the implementation. However, the provider shall provide sufficient information to enable the user to fully determine the functionality of the provided library element.

EXAMPLE 2 The requirement of the above paragraph would be met by the provider of an *instance* of a function block *type* in a *resource* through the provision, at a minimum, of the following information:

- a *function block type* library element specifying its *event interfaces, data interfaces* and *services* as defined in IEC 61499-1;
- *resource type* and *device type* library elements showing the occurrence and connections of the function block *instances*.

4.4 Display of declarations

A software tool shall be capable of displaying the *declarations* of its associated *library elements* in a form appropriate to the engineering task. This display may utilize the graphical or textual formats defined in IEC 61499-1, or a format defined by the supplier of the software tool.

NOTE The *declarations* of a library element may define its *interfaces* (event and data inputs and outputs) and internal *variables* as well as its *algorithms* and the control of their *execution*, for example via an *execution control chart* (ECC), etc.

Software tools may provide additional features, beyond those illustrated in IEC 61499-1, in the graphic display of declarations.

EXAMPLE 1 In the display of an Execution Control Chart (ECC), the tool may provide, along with the display of each transition, a cardinal number indicating the order (as defined in IEC 61499-1) in which the transition is evaluated.

EXAMPLE 2 A software tool may provide means of navigating a *mapping* from the display of a function block instance in an *application* to its corresponding display in a *resource*, and vice versa.

4.5 Modification of declarations

A software tool shall enable its user to modify the declarations of its associated library elements as appropriate to the engineering task. Such modifications may include adding, deleting or changing the contents of declarations, and may be performed either graphically or textually or both.

EXAMPLE The software tool may provide convenient means for the user to change the order in which declarations are listed in their textual representation, for instance in a list of transitions in an Execution Control Chart (ECC), without the user having to edit the textual representation by manual means such as "cut and paste".

4.6 Validation of declarations

If required by the associated engineering task, a software tool shall provide facilities for validation of the declarations of its associated library elements. Such facilities may include, but are not limited to:

- Checking the correctness of the syntax of declarations.
- Checking the semantic correctness of declarations, for instance, checking whether all *function block instances* in an *application* and its associated *subapplications* are properly allocated to *resources*, interconnected within resources, and intercommunicating among resources in a *system configuration*.
- Simulation and testing of the operation of an *instance* of a library element *type*, either by itself or in association with other instances of the same or different types.

4.7 Implementation of declarations

If required by the associated engineering task, a software tool shall provide facilities for the *implementation* of the *declarations* of its associated *library elements*. Such facilities may include, but are not limited to:

- the production of an executable code ("firmware") for embedding in instances of resource types and device types;
- the creation and interconnection ("downloading") of function block instances in resources and devices, for instance by using the management facilities defined in subclause 6.3 and Annexes F and G of IEC 61499-1.

4.8 System operation, testing and maintenance

If required by the associated engineering task, a software tool shall provide facilities for the operation, testing and maintenance of an Industrial Process Measurement and Control System (IPMCS) specified by its associated library elements. Such facilities may include, but are not limited to:

- the facilities described in preceding subclauses of this Clause;
- the information exchange facilities defined in IEC 61499-1.

Annex A
(normative)

Document type definitions (DTDs)

A.1 General principles

This Annex presents Document Type Definitions (DTDs) for the exchange of IEC 61499 library elements between *software tools*. These DTDs are defined in the syntax defined in the eXtensible Markup Language (XML) specification at www.w3.org/TR/2000/REC-xml-20001006.

The correspondences between the DTD elements given in this annex, the library elements defined in IEC 61499-1, C.2.1, and the textual syntax given in IEC 61499-1, Annex B are given in Table A.1.

Table A.1 – Document type definition (DTD) elements

DTD element	LibraryElement	Textual syntax
DataType	DataTypeDeclaration	data_type_declaration (IEC 61131-3, B.1.3)
FBType	FBTypeDeclaration	fb_type_declaration
SubapplicationType	SubapplicationTypeDeclaration	subapplication_type_declaration
AdapterType	AdapterTypeDeclaration	adapter_type_declaration
ResourceType	ResourceTypeDeclaration	resource_type_specification
DeviceType	DeviceTypeDeclaration	device_type_specification
System	SystemConfiguration	system_configuration

The first table of each subclause of this Annex contains the DTD for the corresponding library element. The second table of each subclause provides a reference to the textual syntax (if any) plus an explanation for the major elements and attributes in the DTD. Following this, examples are given of the resulting XML files for typical library elements.

NOTE 1 If there is a conflict between the provisions of this Annex and the provisions of Annex B of IEC 61499-1, the provisions of the latter prevail.

NOTE 2 The examples given in this Annex provide a representative, but not exhaustive, sample of the features of the associated DTDs. In particular, these examples are not intended to be used as a test suite for compliance to the provisions of this standard.

A.2 DataType DTD

An XML document complying with the DTD in Table A.2 represents a **DataTypeDeclaration** object as described in C.2.2 of IEC 61499-1.

Table A.2 – DataType DTD (1 of 2)

```
<?xml version="1.0" encoding="UTF-8"?>

<!ELEMENT DataType (Identification?, VersionInfo+, CompilerInfo?,
ASN1Tag?, (DirectlyDerivedType | EnumeratedType | SubrangeType |
ArrayType | StructuredType))>

<!ATTLIST DataType
 Name CDATA #REQUIRED
 Comment CDATA #IMPLIED>
```

```
<!ELEMENT Identification EMPTY>
<!ATTLIST Identification
 Standard CDATA #IMPLIED
 Classification CDATA #IMPLIED
 ApplicationDomain CDATA #IMPLIED
 Function CDATA #IMPLIED
 Type CDATA #IMPLIED
 Description CDATA #IMPLIED>
```

```
<!ELEMENT VersionInfo EMPTY>
<!ATTLIST VersionInfo
 Organization CDATA #REQUIRED
 Version CDATA #REQUIRED
 Author CDATA #REQUIRED
 Date CDATA #REQUIRED
 Remarks CDATA #IMPLIED>
```

```
<!ELEMENT ASN1Tag EMPTY>
<!ATTLIST ASN1Tag
 Class (UNIVERSAL | APPLICATION | CONTEXT | PRIVATE) #IMPLIED
 Number CDATA #REQUIRED>
```



```
<!ELEMENT CompilerInfo (Compiler*)>
<!ATTLIST CompilerInfo
 header CDATA #IMPLIED
 classdef CDATA #IMPLIED>
```



```
<!ELEMENT Compiler EMPTY>
<!ATTLIST Compiler
 Language (Java | Cpp | C | Other) #REQUIRED
 Vendor CDATA #REQUIRED
 Product CDATA #REQUIRED
 Version CDATA #REQUIRED>
```

```
<!ELEMENT DirectlyDerivedType EMPTY>
<!ATTLIST DirectlyDerivedType
 BaseType (BOOL | SINT | INT | DINT | LINT | USINT | UINT | UDINT
| ULINT | REAL | LREAL | TIME | DATE | TIME_OF_DAY | TOD
| DATE_AND_TIME | DT | STRING | BYTE |WORD | DWORD |LWORD |
WSTRING)   #REQUIRED
 InitialValue CDATA #IMPLIED
 Comment CDATA #IMPLIED>
```

```
<!ELEMENT EnumeratedType (EnumeratedValue+)>
<!ATTLIST EnumeratedType
 InitialValue CDATA #IMPLIED
 Comment CDATA #IMPLIED>
```

```
<!ELEMENT EnumeratedValue EMPTY>
<!ATTLIST EnumeratedValue
 Name CDATA #REQUIRED
 Comment CDATA #IMPLIED>
```

Table A.2 (2 of 2)

```
<!ELEMENT SubrangeType (Subrange)>
<!ATTLIST SubrangeType
 BaseType (SINT|INT|DINT|LINT|USINT|UINT|UDINT|ULINT) #REQUIRED
 InitialValue CDATA #IMPLIED
 Comment CDATA #IMPLIED>
```

```
<!ELEMENT Subrange EMPTY>
<!ATTLIST Subrange
 LowerLimit CDATA #REQUIRED
 UpperLimit CDATA #REQUIRED>
```

```
<!ELEMENT ArrayType (Subrange+)>
<!ATTLIST ArrayType
 BaseType CDATA #REQUIRED
 InitialValues CDATA #IMPLIED
 Comment CDATA #IMPLIED>
```

```
<!ELEMENT StructuredType (VarDeclaration|SubrangeVarDeclaration)+>
<!ATTLIST StructuredType
 Comment CDATA #IMPLIED>
```

```
<!ELEMENT VarDeclaration EMPTY >
<!ATTLIST VarDeclaration
 Name CDATA #REQUIRED
 Type CDATA #REQUIRED
 ArraySize CDATA #IMPLIED
 InitialValue CDATA #IMPLIED
 Comment CDATA #IMPLIED>
```



```
<!ELEMENT SubrangeVarDeclaration (Subrange+) >
<!ATTLIST SubrangeVarDeclaration
 Name CDATA #REQUIRED
 Type (SINT|INT|DINT|LINT|USINT|UINT|UDINT|ULINT) #REQUIRED
 InitialValue CDATA #IMPLIED
 Comment CDATA #IMPLIED>
```


Explanations of the elements of the above DTD, and (where applicable) references to the formal syntax for their attributes, are given in Table A.3.

Table A.3 – DataType DTD elements (1 of 2)

Element attributes	Textual syntax (IEC 61131-3, Annex B)	Explanation
DataType		See IEC 61131-3
Name	data_type_name	
Comment	--	A comment per IEC 61131-3 without (* and *) delimiters
Identification		Information for data base retrieval
Standard		Primary reference standard in number-part-subclause format
Classification		Classification code as defined in reference standard
ApplicationDomain		Application domain as defined in reference standard
Function		Function of this element as defined in reference standard
Type		Element type (e.g., device type) as defined in reference standard
Description		Descriptive phrase as defined in reference standard
VersionInfo	--	Possibly one of several entries: First entry – Most recent version Second entry – Immediately preceding released version... Last entry – First released version
Organization	--	The organization supplying this library element
Version	digit [digit] '.' digit [digit] [letter]	The version identification for this library element
Author	--	The author of this library element
Date	date_literal ['-' daytime]	The release date of this version
Remarks	--	Comments relating to this version
ASN1Tag		ASN.1 tag per ISO/IEC 8824
Class		ASN.1 tag class per ISO/IEC 8824
Number		ASN.1 tag number per ISO/IEC 8824
CompilerInfo	--	Information for and about compilers used with this class
header	--	Header information such as package, imports, etc.
classdef	--	The class definition information such as superclass and implemented interfaces. If none is given, a default abstract superclass is used.
Compiler	--	Possibly one of several compilers used with this version
Language	--	The source language of this compiler
Vendor	--	The vendor of this compiler
Product	--	The product name of this compiler
Version	--	The version of this compiler
DirectlyDerivedType		See IEC 61131-3, Tables 12 and 14, item 1
BaseType	elementary_type_name	
InitialValue	constant	
Comment		A comment per IEC 61131-3 without (* and *) delimiters

Table A.3 (2 of 2)

Element Attributes	Textual Syntax (IEC 61131-3, Annex B)	Explanation
EnumeratedType	See IEC 61131-3 Tables 12 and 14, item 2	
InitialValue	enumerated_value	
Comment	A comment per IEC 61131-3 without (* and *) delimiters	
EnumeratedValue	See IEC 61131-3 Table 14, item 2	
Name	enumerated_value	
Comment	A comment per IEC 61131-3 without (* and *) delimiters	
SubrangeType	--	See IEC 61131-3 Tables 12 and 14, item 3
BaseType	integer_type_name	
InitialValue	signed_integer	
Comment	A comment per IEC 61131-3 without (* and *) delimiters	
Subrange	See IEC 61131-3 Tables 12 and 14, item 3	
LowerLimit	signed_integer	
UpperLimit	signed_integer	
ArrayType	See IEC 61131-3 Tables 12 and 14, item 4	
BaseType	non_generic_type_name	
InitialValues	array_initialization	
StructuredType	See IEC 61131-3 Tables 12, item 5 and 14, item 5 and item 6	
VarDeclaration		
Name	structure_element_name	
Type	non_generic_type_name	
ArraySize	[a]	
InitialValue	[b]	
Comment	A comment per IEC 61131-3 without (* and *) delimiters	
SubrangeVarDeclaration	See IEC 61131-3, 2.3.3.	
Name	structure_element_name	
Type	integer_type_name	
InitialValue	signed_integer	
Comment	A comment per IEC 61131-3 without (* and *) delimiters	

[a] The syntax of this attribute when present shall be equivalent to the syntactic expression (subrange {',' subrange}) | integer {',' integer} where the non-terminals subrange and integer are as defined in Annex B of IEC 61131-3. Each term of the second form is equivalent to the subrange 0..n-1, where n is the value of the corresponding integer syntactic element. If this attribute is missing, the structure component is not an anonymously defined array.

[b] The syntax of this attribute is the syntax for initialization of the corresponding variable type as defined in Annex B.1.4.3 of IEC 61131-3.

EXAMPLE The structured data type ANALOG_CHANNEL_CONFIGURATIONI example is expressed in IEC 61131-3, Table 14 as follows: