

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**OPC unified architecture –
Part 10: Programs**

**Architecture unifiée OPC –
Partie 10: Programmes**



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2020 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, 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 either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

67 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Recherche de publications IEC -

webstore.iec.ch/advsearchform

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et une fois par mois par email.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: sales@iec.ch.

Electropedia - www.electropedia.org

Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 000 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 16 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary

67 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**OPC unified architecture –
Part 10: Programs**

**Architecture unifiée OPC –
Partie 10: Programmes**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 25.040.40; 35.100.05

ISBN 978-2-8322-8576-3

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD	4
1 Scope	6
2 Normative references	6
3 Terms, definitions and abbreviated terms	6
3.1 Terms and definitions	6
3.2 Abbreviated terms	7
4 Concepts	7
4.1 General	7
4.2 Programs	8
4.2.1 Overview	8
4.2.2 Security considerations	9
4.2.3 Program Finite State Machine	9
4.2.4 Program states	10
4.2.5 State transitions	11
4.2.6 Program state transition stimuli	11
4.2.7 Program Control Methods	11
4.2.8 Program state transition effects	12
4.2.9 Program result data	12
4.2.10 Program lifetime	13
5 Model	14
5.1 General	14
5.2 ProgramStateMachineType	14
5.2.1 Overview	14
5.2.2 ProgramStateMachineType Properties	15
5.2.3 ProgramStateMachineType components	16
5.2.4 ProgramStateMachineType causes (Methods)	20
5.2.5 ProgramStateMachineType effects (Events)	22
5.2.6 AuditProgramTransitionEventType	24
5.2.7 FinalResultData	25
5.2.8 ProgramDiagnostic2 DataType	25
5.2.9 ProgramDiagnostic2Type VariableType	26
Annex A (informative) Program example	27
A.1 Overview	27
A.2 DomainDownload Program	27
A.2.1 General	27
A.2.2 DomainDownload states	28
A.2.3 DomainDownload transitions	28
A.2.4 DomainDownload Methods	29
A.2.5 DomainDownload Events	30
A.2.6 DomainDownload model	30
Figure 1 – Automation facility control	8
Figure 2 – Program illustration	9
Figure 3 – Program states and transitions	10
Figure 4 – Program Type	14

Figure 5 – Program FSM References	16
Figure 6 – ProgramStateMachineType causes and effects	20
Figure A.1 – Program example.....	27
Figure A.2 – DomainDownload state diagram.....	28
Figure A.3 – DomainDownloadType partial state model	35
Figure A.4 – Ready To Running model	38
Figure A.5 – Opening To Sending To Closing model	40
Figure A.6 – Running To Suspended model	41
Figure A.7 – Suspended To Running model	42
Figure A.8 – Running To Halted – Aborted model	42
Figure A.9 – Suspended To Aborted model.....	43
Figure A.10 – Running To Completed model	44
Figure A.11 – Sequence of operations	45
Table 1 – Program Finite State Machine	10
Table 2 – Program states.....	11
Table 3 – Program state transitions	11
Table 4 – Program Control Methods.....	12
Table 5 – ProgramStateMachineType	15
Table 6 – Program states.....	17
Table 7 – Program transitions	18
Table 8 – ProgramStateMachineType causes	21
Table 9 – ProgramTransitionEventType	22
Table 10 – ProgramTransitionEvents	23
Table 11 – AuditProgramTransitionEventType	24
Table 12 – ProgramDiagnostic2DataType structure	25
Table 13 – ProgramDiagnostic2DataType definition	26
Table 14 – ProgramDiagnostic2Type VariableType	26
Table A.1 – DomainDownload states	29
Table A.2 – DomainDownload Type	31
Table A.3 – Transfer State Machine Type	32
Table A.4 – Transfer State Machine – states.....	33
Table A.5 – Finish State Machine Type	33
Table A.6 – Finish State Machine – states	34
Table A.7 – DomainDownload Type Property Attributes variable values	34
Table A.8 – Additional DomainDownload transition types	36
Table A.9 – Start Method additions	38
Table A.10 – StartArguments	39
Table A.11 – IntermediateResults Object	40
Table A.12 – Intermediate result data Variables	41
Table A.13 – FinalResultData	43

INTERNATIONAL ELECTROTECHNICAL COMMISSION

OPC UNIFIED ARCHITECTURE –

Part 10: Programs

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 itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 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.

IEC 62541-10 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 2015.

This edition includes several clarifications and in addition the following significant technical changes with respect to the previous edition:

- a) Changed ProgramType to ProgramStateMachineType. This is in line with the NodeSet (and thus implementations). In ProgramDiagnosticDataType: changed the definition of lastInputArguments and lastOutputArguments and added two additional fields for the argument values. Also changed StatusResult into StatusCode. Created new version of the type to ProgramDiagnostic2DataType.
- b) Changed Optional modelling rule to OptionalPlaceholder for Program control Methods. Following the clarification in IEC 62541-3, this now allows subtypes (or instances) to add arguments.

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

FDIS	Report on voting
65E/719/FDIS	65E/735/RVD

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

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

Throughout this document and the other parts of the IEC 62541 series, certain document conventions are used:

Italics are used to denote a defined term or definition that appears in Clause 3 in one of the parts of the series.

Italics are also used to denote the name of a service input or output parameter or the name of a structure or element of a structure that are usually defined in tables.

The *italicized terms and names* are also, with a few exceptions, written in camel-case (the practice of writing compound words or phrases in which the elements are joined without spaces, with each element's initial letter capitalized within the compound). For example the defined term is *AddressSpace* instead of *Address Space*. This makes it easier to understand that there is a single definition for *AddressSpace*, not separate definitions for *Address* and *Space*.

A list of all parts of the IEC 62541 series, published under the general title *OPC Unified Architecture*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

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

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

OPC UNIFIED ARCHITECTURE –

Part 10: Programs

1 Scope

This part of IEC 62541 defines the *information model* associated with *Programs* in the OPC Unified Architecture. This includes the description of the *NodeClasses*, standard *Properties*, *Methods* and *Events* and associated behaviour and information for *Programs*.

The complete Address Space model including all *NodeClasses* and *Attributes* is specified in IEC 62541-3. The *Services* such as those used to invoke the *Methods* used to manage *Programs* are specified in IEC 62541-4.

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 TR 62541-1, *OPC Unified Architecture – Part 1: Overview and Concepts*

IEC 62541-3, *OPC Unified Architecture – Part 3: Address Space Model*

IEC 62541-4, *OPC Unified Architecture – Part 4: Services*

IEC 62541-5, *OPC Unified Architecture – Part 5: Information Model*

IEC 62541-7, *OPC Unified Architecture – Part 7: Profiles*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC TR 62541-1, IEC 62541-3 and the following 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

function

programmatic task performed by a *Server* or device, usually accomplished by computer code execution