

INTERNATIONAL STANDARD

**OPC unified architecture -
Part 8: Data access**



THIS PUBLICATION IS COPYRIGHT PROTECTED
Copyright © 2025 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.

IEC Secretariat
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 It also gives information on projects, replaced and withdrawn publications.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.

IEC Products & Services Portal - products.iec.ch

Discover our powerful search engine and read freely all the publications previews, graphical symbols and the glossary. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 500 terminological entries in English and French, with equivalent terms in 25 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD	5
1 Scope	7
2 Normative references	7
3 Terms, definitions and abbreviated terms	7
3.1 Terms and definitions.....	7
3.2 Abbreviated terms.....	8
4 Concepts	9
5 Model	9
5.1 General.....	9
5.2 SemanticsChanged	10
5.3 Variable Types.....	10
5.3.1 DataItemType	10
5.3.2 AnalogItem VariableTypes	12
5.3.3 DiscreteItemType	15
5.3.4 ArrayItemType	18
5.4 Address Space model	25
5.5 Attributes of DataItems	26
5.6 DataTypes	27
5.6.1 Overview	27
5.6.2 Range.....	27
5.6.3 EUInformation	27
5.6.4 ComplexNumberType	30
5.6.5 DoubleComplexNumberType	30
5.6.6 AxisInformation.....	31
5.6.7 AxisScaleEnumeration.....	32
5.6.8 XVType	32
6 Quantities and Units model.....	33
6.1 General.....	33
6.2 Quantities entry point.....	34
6.3 Syntax References.....	34
6.3.1 General	34
6.3.2 Using Dictionary References.....	35
6.3.3 Syntax Reference Identifier	36
6.4 ObjectTypes	37
6.4.1 QuantityType ObjectType definition	37
6.4.2 UnitType and subtypes	39
6.4.3 SyntaxReferenceEntryType ObjectType definition	43
6.5 References	44
6.5.1 HasEngineeringUnitDetails	44
6.5.2 HasQuantity.....	45
6.6 DataTypes	45
6.6.1 AnnotationDataType DataType definition	45
6.6.2 LinearConversionDataType DataType definition	46
6.6.3 ConversionLimitEnum	47
6.6.4 QuantityDimension	48
7 Data Access specific usage of Services.....	50

7.1	General.....	50
7.2	PercentDeadband	50
7.3	Data Access status codes	51
7.3.1	Overview	51
7.3.2	Operation level result codes	51
7.3.3	LimitBits	52
Annex A (normative)	OPC COM DA to UA mapping	53
A.1	Introduction.....	53
A.2	Security Considerations	53
A.3	COM UA wrapper for OPC DA Server	53
A.3.1	Information Model mapping.....	53
A.3.2	Data and error mapping	58
A.3.3	Read data.....	60
A.3.4	Write Data	61
A.3.5	Subscriptions.....	62
A.4	COM UA proxy for DA Client	62
A.4.1	Guidelines	62
A.4.2	Information Model and Address Space mapping	63
A.4.3	Data and error mapping	67
A.4.4	Read data.....	70
A.4.5	Write data.....	71
A.4.6	Subscriptions.....	72
Annex B (normative)	UCUM Symbols.....	73
B.1	Introduction – License.....	73
B.2	Representation	73
B.3	Tables of terminal symbols	74
B.3.1	General	74
B.3.2	Prefixes	74
B.3.3	Base units	75
B.3.4	Derived unit atoms.....	76
B.3.5	Customary unit atoms	79
B.3.6	Other legacy units	83
Annex C (informative)	Outline of syntax references.....	88
C.1	UCUM syntax reference	88
C.2	QUDT syntax reference.....	88
C.3	UNECE syntax reference	89
C.4	IEC CDD Syntax Reference	90
C.5	LATEX_SIUNITX Syntax Reference	91
Bibliography	92
Figure 1	– OPC <i>DataItems</i> are linked to automation data	9
Figure 2	– <i>DataItem VariableType</i> hierarchy	10
Figure 3	– Graphical view of a <i>YArrayItem</i>	20
Figure 4	– Representation of <i>DataItems</i> in the <i>AddressSpace</i>	26
Figure 5	– Enhanced <i>EUIInformation</i> example	28
Figure 6	– Quantity model overview	34
Figure 7	– References to external works	36

Figure 8 – QuantityType	37
Figure 9 – Units model.....	39
Figure 10 – MathML example linear conversion	43
Figure 11 – MathML example inverse linear conversion	43
Figure A.1 – Sample OPC UA Information Model for OPC DA	54
Figure A.2 – OPC COM DA to OPC UA data and error mapping.....	58
Figure A.3 – Status Code mapping	59
Figure A.4 – Sample OPC DA mapping of OPC UA Information Model and Address Space	64
Figure A.5 – OPC UA to OPC DA data & error mapping	68
Figure A.6 – OPC UA Status Code to OPC DA quality mapping	69
Table 1 – DataItemType definition	11
Table 2 – BaseAnalogType definition	12
Table 3 – AnalogItemType definition	14
Table 4 – AnalogUnitType definition.....	14
Table 5 – AnalogUnitRangeType definition	15
Table 6 – DiscreteItemType definition	15
Table 7 – TwoStateDiscreteType definition	16
Table 8 – MultiStateDiscreteType definition	16
Table 9 – MultiStateValueDiscreteType definition	17
Table 10 – ArrayItemType definition.....	18
Table 11 – YArrayItemType definition	19
Table 12 – YArrayItem item description	21
Table 13 – XYArrayItemType definition	22
Table 14 – ImageItemType definition	23
Table 15 – CubelItemType definition.....	24
Table 16 – NDimensionArrayItemType definition.....	25
Table 17 – <i>Range</i> DataType structure.....	27
Table 18 – <i>Range</i> definition	27
Table 19 – <i>EUInformation</i> DataType structure.....	28
Table 20 – <i>EUInformation</i> definition	29
Table 21 – Examples from the UNECE Recommendation.....	29
Table 22 – ComplexNumberType DataType structure	30
Table 23 – ComplexNumberType definition	30
Table 24 – DoubleComplexNumberType DataType structure.....	31
Table 25 – DoubleComplexNumberType definition	31
Table 26 – AxisInformation DataType structure.....	31
Table 27 – AxisInformation definition	32
Table 28 – AxisScaleEnumeration values	32
Table 29 – AxisScaleEnumeration definition	32
Table 30 – XVType DataType structure.....	33
Table 31 – XVType definition	33

Table 32 – Quantities definition	34
Table 33 – List of Syntax References.....	35
Table 34 – Definition of NodeId for instances of the SyntaxReferenceEntryType.....	35
Table 35 – List of Syntax Reference Identifiers	36
Table 36 – QuantityType definition.....	38
Table 37 – QuantityType Additional Subcomponents.....	39
Table 38 – UnitType definition	40
Table 39 – Non-exhaustive list of well-known systems of units.....	40
Table 40 – ServerUnitType definition	41
Table 41 – ServerUnitType Additional Subcomponents	41
Table 42 – AlternativeUnitType definition	42
Table 43 – SyntaxReferenceEntryType Definition	44
Table 44 – HasEngineeringUnitDetails definition.....	44
Table 45 – HasQuantity definition	45
Table 46 – AnnotationDataType Structure.....	45
Table 47 – AnnotationDataType examples	46
Table 48 – AnnotationDataType definition.....	46
Table 49 – LinearConversionDataType Structure	47
Table 50 – LinearConversionDataType Definition.....	47
Table 51 – ConversionLimitEnum Items	47
Table 52 – ConversionLimitEnum Definition	48
Table 53 – QuantityDimension DataType structure.....	48
Table 54 – QuantityDimension definition	49
Table 55 – QuantityDimension examples	49
Table 56 – Operation level result codes for BAD data quality	51
Table 57 – Operation level result codes for UNCERTAIN data quality	52
Table 58 – Operation level result codes for GOOD data quality.....	52
Table A.1 – OPC COM DA to OPC UA Properties mapping.....	57
Table A.2 – DataTypes and mapping	59
Table A.3 – Quality mapping.....	60
Table A.4 – OPC DA Read error mapping	61
Table A.5 – OPC DA Write error code mapping.....	62
Table A.6 – DataTypes and Mapping	69
Table A.7 – Quality mapping.....	70
Table A.8 – OPC UA Read error mapping	71
Table A.9 – OPC UA Write error code mapping.....	71

INTERNATIONAL ELECTROTECHNICAL COMMISSION

OPC unified architecture - Part 8: Data access

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) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at <https://patents.iec.ch>. IEC shall not be held responsible for identifying any or all such patent rights.

IEC 62541-8 has been prepared by subcommittee 65E: Devices and integration in enterprise systems, of IEC technical committee 65: Industrial-process measurement, control and automation. It is an International Standard.

This fourth edition cancels and replaces the third edition published in 2020. This edition constitutes a technical revision.

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

- a) addition of a "Quantity Model" which can be referenced from EngineeringUnit Properties. The model defines quantities and assigned units. In addition it provides alternative units and the conversion to them.

b) addition of rules for ValuePrecision Property:

- can also be used for other subtypes like Duration and Decimal.
- rules have been added when ValuePrecision has negative values.

The text of this International Standard is based on the following documents:

Draft	Report on voting
65E/1055/CDV	65E/1108/RVC

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

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 the "Terms and definitions" clause in one of the parts of the IEC 62541 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, 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 in 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 webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

1 Scope

This part of IEC 62541 is part of the overall OPC Unified Architecture (OPC UA) standard series and defines the information model associated with Data Access (DA). It particularly includes additional *VariableTypes* and complementary descriptions of the *NodeClasses* and *Attributes* needed for Data Access, additional *Properties*, and other information and behaviour.

The complete address space model, including all *NodeClasses* and *Attributes* is specified in IEC 62541-3. The services to detect and access data are specified in IEC 62541-4.

Annex A specifies how the information received from OPC COM Data Access (DA) Servers is mapped to the Data Access model.

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 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 62541-19, *OPC Unified Architecture - Part 19: Dictionary References*

UN/CEFACT: UNECE Recommendation N°20, *Codes for Units of Measure Used in International Trade*

https://www.unece.org/cefact/codesfortrade/codes_index.html

Bibliography

IEC CDD, *IEC Common Data Dictionary*, available at <https://cdd.iec.ch/>

LATEX_SIUNITX: *A comprehensive (si) units package*, available at
<https://ctan.org/pkg/siunitx>
<https://www.texdev.net/>

QUDT, *Quantities, Units, Dimensions and Data Types Ontologies*, available at
<https://QUDT.org>
<https://github.com/qudt/qudt-public-repo>

UCUM, *Unified Code for Units of Measure*, available at <https://ucum.org>

UNECE, Recommendation N° 20, *Codes for Units of Measure Used in International Trade*,
available at <https://www.unece.org/cefact/>
