



**IEEE**

**IEC 61691-8**

Edition 1.0 2021-07

# **INTERNATIONAL IEEE Std 1666.1™ STANDARD**

**Behavioural languages –  
Part 8: Standard SystemC® Analog/Mixed-Signal Extensions Language  
Reference Manual**





**THIS PUBLICATION IS COPYRIGHT PROTECTED**  
**Copyright © 2016 IEEE**

All rights reserved. IEEE is a registered trademark in the U.S. Patent & Trademark Office, owned by the Institute of Electrical and Electronics Engineers, Inc. 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 the IEC Central Office. Any questions about IEEE copyright should be addressed to the IEEE. Enquiries about obtaining additional rights to this publication and other information requests should be addressed to the IEC or your local IEC member National Committee.

IEC Central Office  
3, rue de Varembe  
CH-1211 Geneva 20  
Switzerland  
Tel.: +41 22 919 02 11  
[info@iec.ch](mailto:info@iec.ch)  
[www.iec.ch](http://www.iec.ch)

Institute of Electrical and Electronics Engineers, Inc.  
3 Park Avenue  
New York, NY 10016-5997  
United States of America  
[stds.info@ieee.org](mailto:stds.info@ieee.org)  
[www.ieee.org](http://www.ieee.org)

**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](http://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 It also gives information on projects, replaced and withdrawn publications.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](http://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](http://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](mailto:sales@iec.ch).

**IEC online collection - [oc.iec.ch](http://oc.iec.ch)**

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

**Electropedia - [www.electropedia.org](http://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 18 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

# INTERNATIONAL IEEE Std 1666.1™ STANDARD

---

**Behavioural languages –  
Part 8: Standard SystemC® Analog/Mixed-Signal Extensions Language  
Reference Manual**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

---

ICS 25.040.01; 35.060

ISBN 978-2-8322-9951-7

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

## Contents

1.	Overview.....	1
1.1	Scope.....	1
1.2	Purpose.....	1
1.3	Subsets.....	2
1.4	Relationship with C++.....	2
1.5	Relationship with SystemC.....	2
1.6	Guidance for readers.....	2
2.	Normative references.....	4
3.	Terminology and conventions used in this standard.....	5
3.1	Terminology.....	5
3.1.1	Shall, should, may, can.....	5
3.1.2	Implementation, application.....	5
3.1.3	Call, called from, derived from.....	5
3.1.4	Specific technical terms.....	5
3.2	Syntactical conventions.....	6
3.2.1	Implementation-defined.....	6
3.2.2	Disabled.....	6
3.2.3	Ellipsis (...)......	6
3.2.4	Class names.....	6
3.2.5	Prefixes.....	7
3.3	Typographical conventions.....	7
3.4	Semantic conventions.....	7
3.4.1	Class definitions and the inheritance hierarchy.....	7
3.4.2	Function definitions and side-effects.....	7
3.4.3	Functions whose return type is a reference or a pointer.....	8
3.4.4	Namespaces and internal naming.....	8
3.4.5	Non-compliant applications and errors.....	9
3.5	Notes and examples.....	9
4.	Core language definitions.....	10
4.1	Class header files.....	10
4.1.1	#include “systemc-ams”.....	10
4.1.2	#include “systemc-ams.h”.....	10
4.2	Base class definitions.....	11
4.2.1	sca_core::sca_module.....	11
4.2.2	sca_core::sca_interface.....	13
4.2.3	sca_core::sca_prim_channel.....	14

4.2.4	sca_core::sca_port.....	15
4.2.5	sca_core::sca_time.....	16
4.2.6	sca_core::sca_max_time.....	16
4.2.7	sca_core::sca_parameter_base.....	16
4.2.8	sca_core::sca_parameter.....	18
4.2.9	sca_core::sca_assign_from_proxy <sup>†</sup> .....	20
4.2.10	sca_core::sca_assign_to_proxy <sup>†</sup> .....	21
5.	Timed data flow model of computation.....	22
5.1	Class definitions.....	22
5.1.1	sca_tdf::sca_module.....	22
5.1.2	sca_tdf::sca_signal_if.....	29
5.1.3	sca_tdf::sca_signal.....	30
5.1.4	sca_tdf::sca_default_interpolator.....	31
5.1.5	sca_tdf::sca_in.....	32
5.1.6	sca_tdf::sca_out.....	37
5.1.7	sca_tdf::sca_out<T>.....	39
5.1.8	sca_tdf::sca_out<T, sca_tdf::SCA_CT_CUT, INTERP>.....	44
5.1.9	sca_tdf::sca_out<T, sca_tdf::SCA_DT_CUT>.....	50
5.1.10	sca_tdf::sca_de::sca_in, sca_tdf::sc_in.....	55
5.1.11	sca_tdf::sca_de::sca_in<bool>, sca_tdf::sc_in<bool>.....	62
5.1.12	sca_tdf::sca_de::sca_in<sc_dt::sc_logic>, sca_tdf::sc_in<sc_dt::sc_logic>.....	69
5.1.13	sca_tdf::sca_de::sca_out, sca_tdf::sc_out.....	75
5.1.14	sca_tdf::sca_trace_variable.....	82
5.2	Hierarchical composition and port binding.....	83
5.3	Elaboration and simulation.....	83
5.3.1	Elaboration.....	84
5.3.2	Simulation.....	85
5.4	Embedded linear dynamic equations.....	87
5.4.1	sca_tdf::sca_ct_proxy <sup>†</sup> .....	88
5.4.2	sca_tdf::sca_ct_vector_proxy <sup>†</sup> .....	89
5.4.3	sca_tdf::sca_ltf_nd.....	91
5.4.4	sca_tdf::sca_ltf_zp.....	96
5.4.5	sca_tdf::sca_ss.....	102
6.	Linear signal flow model of computation.....	110
6.1	Class definitions.....	110
6.1.1	sca_lsf::sca_module.....	110
6.1.2	sca_lsf::sca_signal_if.....	110
6.1.3	sca_lsf::sca_signal.....	111
6.1.4	sca_lsf::sca_in.....	111
6.1.5	sca_lsf::sca_out.....	112

6.1.6	sca_lsf::sca_add.....	113
6.1.7	sca_lsf::sca_sub.....	114
6.1.8	sca_lsf::sca_gain.....	115
6.1.9	sca_lsf::sca_dot.....	115
6.1.10	sca_lsf::sca_integ.....	116
6.1.11	sca_lsf::sca_delay.....	117
6.1.12	sca_lsf::sca_source.....	118
6.1.13	sca_lsf::sca_ltf_nd.....	119
6.1.14	sca_lsf::sca_ltf_zp.....	120
6.1.15	sca_lsf::sca_ss.....	121
6.1.16	sca_lsf::sca_tdf::sca_gain, sca_lsf::sca_tdf_gain.....	122
6.1.17	sca_lsf::sca_tdf::sca_source, sca_lsf::sca_tdf_source.....	123
6.1.18	sca_lsf::sca_tdf::sca_sink, sca_lsf::sca_tdf_sink.....	124
6.1.19	sca_lsf::sca_tdf::sca_mux, sca_lsf::sca_tdf_mux.....	125
6.1.20	sca_lsf::sca_tdf::sca_demux, sca_lsf::sca_tdf_demux.....	126
6.1.21	sca_lsf::sca_de::sca_gain, sca_lsf::sca_de_gain.....	127
6.1.22	sca_lsf::sca_de::sca_source, sca_lsf::sca_de_source.....	127
6.1.23	sca_lsf::sca_de::sca_sink, sca_lsf::sca_de_sink.....	128
6.1.24	sca_lsf::sca_de::sca_mux, sca_lsf::sca_de_mux.....	129
6.1.25	sca_lsf::sca_de::sca_demux, sca_lsf::sca_de_demux.....	130
6.2	Hierarchical composition and port binding.....	131
6.3	Elaboration and simulation.....	131
6.3.1	Elaboration.....	131
6.3.2	Simulation.....	132
7.	Electrical linear networks model of computation.....	134
7.1	Class definitions.....	134
7.1.1	sca_eln::sca_module.....	134
7.1.2	sca_eln::sca_node_if.....	135
7.1.3	sca_eln::sca_terminal.....	135
7.1.4	sca_eln::sca_node.....	136
7.1.5	sca_eln::sca_node_ref.....	137
7.1.6	sca_eln::sca_r.....	138
7.1.7	sca_eln::sca_c.....	138
7.1.8	sca_eln::sca_l.....	139
7.1.9	sca_eln::sca_vcvs.....	140
7.1.10	sca_eln::sca_vccs.....	141
7.1.11	sca_eln::sca_ccvs.....	142
7.1.12	sca_eln::sca_cccs.....	142
7.1.13	sca_eln::sca_nullor.....	143
7.1.14	sca_eln::sca_gyrator.....	144
7.1.15	sca_eln::sca_ideal_transformer.....	145

7.1.16	sca_eln::sca_transmission_line.....	146
7.1.17	sca_eln::sca_vsource.....	147
7.1.18	sca_eln::sca_istource.....	148
7.1.19	sca_eln::sca_tdf::sca_r, sca_eln::sca_tdf_r.....	149
7.1.20	sca_eln::sca_tdf::sca_c, sca_eln::sca_tdf_c.....	150
7.1.21	sca_eln::sca_tdf::sca_l, sca_eln::sca_tdf_l.....	151
7.1.22	sca_eln::sca_tdf::sca_rswitch, sca_eln::sca_tdf_rswitch.....	152
7.1.23	sca_eln::sca_tdf::sca_vsource, sca_eln::sca_tdf_vsource.....	153
7.1.24	sca_eln::sca_tdf::sca_istource, sca_eln::sca_tdf_istource.....	154
7.1.25	sca_eln::sca_tdf::sca_vsink, sca_eln::sca_tdf_vsink.....	155
7.1.26	sca_eln::sca_tdf::sca_istink, sca_eln::sca_tdf_istink.....	156
7.1.27	sca_eln::sca_de::sca_r, sca_eln::sca_de_r.....	157
7.1.28	sca_eln::sca_de::sca_c, sca_eln::sca_de_c.....	158
7.1.29	sca_eln::sca_de::sca_l, sca_eln::sca_de_l.....	159
7.1.30	sca_eln::sca_de::sca_rswitch, sca_eln::sca_de_rswitch.....	160
7.1.31	sca_eln::sca_de::sca_vsource, sca_eln::sca_de_vsource.....	161
7.1.32	sca_eln::sca_de::sca_istource, sca_eln::sca_de_istource.....	162
7.1.33	sca_eln::sca_de::sca_vsink, sca_eln::sca_de_vsink.....	162
7.1.34	sca_eln::sca_de::sca_istink, sca_eln::sca_de_istink.....	163
7.2	Hierarchical composition and port binding.....	164
7.3	Elaboration and simulation.....	164
7.3.1	Elaboration.....	165
7.3.2	Simulation.....	165
8.	Predefined analyses.....	167
8.1	Time-domain analysis.....	167
8.1.1	Elaboration and simulation.....	167
8.1.2	Running elaboration and simulation.....	167
8.2	Small-signal frequency-domain analyses.....	167
8.2.1	Elaboration and simulation.....	168
8.2.2	Running elaboration and simulation.....	168
8.2.3	Small-signal frequency-domain analysis of TDF descriptions.....	169
8.2.4	Small-signal frequency-domain analysis of LSF descriptions.....	173
8.2.5	Small-signal frequency-domain analysis of ELN descriptions.....	173
9.	Utility definitions.....	174
9.1	Trace files.....	174
9.1.1	Class definitions.....	174
9.1.2	Function declarations.....	177
9.2	Data types and constants.....	180
9.2.1	Class definition and function declarations.....	180
9.2.2	Definition of constants.....	188

9.3	Reporting information.....	189
9.3.1	Class definition and function declarations.....	189
9.3.2	Mask definitions.....	190
9.4	Version and copyright.....	191
9.4.1	Macro definitions.....	191
9.4.2	Constants.....	193
9.4.3	Function declarations.....	193
Annex A (informative) Introduction to the SystemC Analog/Mixed-Signal extensions.....		195
Annex B (informative) Glossary.....		208
Annex C (informative) Participants .....		210
Index.....		211

## Behavioural languages – Part 8: Standard SystemC® Analog/Mixed-Signal Extensions Language Reference Manual

### 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 document(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.

IEEE Standards documents are developed within IEEE Societies and Standards Coordinating Committees of the IEEE Standards Association (IEEE SA) Standards Board. IEEE develops its standards through a consensus development process, approved by the American National Standards Institute, which brings together volunteers representing varied viewpoints and interests to achieve the final product. Volunteers are not necessarily members of IEEE and serve without compensation. While IEEE administers the process and establishes rules to promote fairness in the consensus development process, IEEE does not independently evaluate, test, or verify the accuracy of any of the information contained in its standards. Use of IEEE Standards documents is wholly voluntary. *IEEE documents are made available for use subject to important notices and legal disclaimers (see <http://standards.ieee.org/ipr/disclaimers.html> for more information).*

IEC collaborates closely with IEEE in accordance with conditions determined by agreement between the two organizations. This Dual Logo International Standard was jointly developed by the IEC and IEEE under the terms of that agreement.

- 2) The formal decisions 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. The formal decisions of IEEE on technical matters, once consensus within IEEE Societies and Standards Coordinating Committees has been reached, is determined by a balanced ballot of materially interested parties who indicate interest in reviewing the proposed standard. Final approval of the IEEE standards document is given by the IEEE Standards Association (IEEE SA) Standards Board.
- 3) IEC/IEEE Publications have the form of recommendations for international use and are accepted by IEC National Committees/IEEE Societies in that sense. While all reasonable efforts are made to ensure that the technical content of IEC/IEEE Publications is accurate, IEC or IEEE 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 (including IEC/IEEE Publications) transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC/IEEE Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC and IEEE do not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC and IEEE are 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 IEEE or their directors, employees, servants or agents including individual experts and members of technical committees and IEC National Committees, or volunteers of IEEE Societies and the Standards Coordinating Committees of the IEEE Standards Association (IEEE SA) Standards Board, 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/IEEE Publication or any other IEC or IEEE 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 implementation of this IEC/IEEE Publication may require use of material covered by patent rights. By publication of this standard, no position is taken with respect to the existence or validity of any patent rights in connection therewith. IEC or IEEE shall not be held responsible for identifying Essential Patent Claims for which a license may be required, for conducting inquiries into the legal validity or scope of Patent Claims or determining whether any licensing terms or conditions provided in connection with submission of a Letter of Assurance, if any, or in any licensing agreements are reasonable or non-discriminatory. Users of this standard are expressly advised that determination of the validity of any patent rights, and the risk of infringement of such rights, is entirely their own responsibility.

IEC 61691-8/IEEE Std 1666.1 was processed through IEC technical committee 91: Electronics assembly technology, under the IEC/IEEE Dual Logo Agreement. It is an International Standard.

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

IEEE Std	FDIS	Report on voting
1666.1 (2016)	91/1712/FDIS	91/1724/RVD

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.

The IEC Technical Committee and IEEE Technical Committee have decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under [webstore.iec.ch](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.

# IEEE Standard for Standard SystemC® Analog/Mixed-Signal Extensions Language Reference Manual

Sponsor

**Design Automation Standards Committee**  
of the  
**IEEE Computer Society**

Approved 29 January 2016

**IEEE-SA Standards Board**

**Abstract:** The SystemC® Analog/Mixed-Signal (AMS) extensions are defined in this standard. SystemC AMS is an ANSI standard C++ class library for electronic system-level design and modeling for use by system architects and engineers who need to address complex heterogeneous systems that are a hybrid between analog, digital and software components. This standard provides a precise and complete definition of the SystemC AMS class library so that a SystemC AMS implementation can be developed with reference to this standard alone. The primary audiences for this standard are the implementors of the SystemC AMS class library, the implementors of tools supporting the class library, and the users of the class library.

**Keywords:** analog mixed signal, behavioral modeling, C++, computer languages, data flow simulation, digital systems, discrete event simulation, electronic design automation, electronic system level, electronic systems, electrical networks, hardware description language, hardware design, hardware verification, IEEE 1666™, IEEE 1666.1™, mixed-signal modeling, SystemC, SystemC AMS, signal flow modeling, system modeling, system-on-chip

**Acknowledgment:** Grateful acknowledgment is made to the Accellera Systems Initiative for the permission to use the following source material: Standard SystemC® AMS extensions 2.0 Language Reference Manual.

## **Important Notices and Disclaimers Concerning IEEE Standards Documents**

IEEE documents are made available for use subject to important notices and legal disclaimers. These notices and disclaimers, or a reference to this page, appear in all standards and may be found under the heading “Important Notice” or “Important Notices and Disclaimers Concerning IEEE Standards Documents.”

### **Notice and Disclaimer of Liability Concerning the Use of IEEE Standards Documents**

IEEE Standards documents (standards, recommended practices, and guides), both full-use and trial-use, are developed within IEEE Societies and the Standards Coordinating Committees of the IEEE Standards Association (“IEEE-SA”) Standards Board. IEEE (“the Institute”) develops its standards through a consensus development process, approved by the American National Standards Institute (“ANSI”), which brings together volunteers representing varied viewpoints and interests to achieve the final product. Volunteers are not necessarily members of the Institute and participate without compensation from IEEE. While IEEE administers the process and establishes rules to promote fairness in the consensus development process, IEEE does not independently evaluate, test, or verify the accuracy of any of the information or the soundness of any judgments contained in its standards.

IEEE does not warrant or represent the accuracy or content of the material contained in its standards, and expressly disclaims all warranties (express, implied and statutory) not included in this or any other document relating to the standard, including, but not limited to, the warranties of: merchantability; fitness for a particular purpose; non-infringement; and quality, accuracy, effectiveness, currency, or completeness of material. In addition, IEEE disclaims any and all conditions relating to: results; and workmanlike effort. IEEE standards documents are supplied “AS IS” and “WITH ALL FAULTS.”

Use of an IEEE standard is wholly voluntary. The existence of an IEEE standard does not imply that there are no other ways to produce, test, measure, purchase, market, or provide other goods and services related to the scope of the IEEE standard. Furthermore, the viewpoint expressed at the time a standard is approved and issued is subject to change brought about through developments in the state of the art and comments received from users of the standard.

In publishing and making its standards available, IEEE is not suggesting or rendering professional or other services for, or on behalf of, any person or entity nor is IEEE undertaking to perform any duty owed by any other person or entity to another. Any person utilizing any IEEE Standards document, should rely upon his or her own independent judgment in the exercise of reasonable care in any given circumstances or, as appropriate, seek the advice of a competent professional in determining the appropriateness of a given IEEE standard.

IN NO EVENT SHALL IEEE BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO: PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE PUBLICATION, USE OF, OR RELIANCE UPON ANY STANDARD, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE AND REGARDLESS OF WHETHER SUCH DAMAGE WAS FORESEEABLE.

## Translations

The IEEE consensus development process involves the review of documents in English only. In the event that an IEEE standard is translated, only the English version published by IEEE should be considered the approved IEEE standard.

## Official statements

A statement, written or oral, that is not processed in accordance with the IEEE-SA Standards Board Operations Manual shall not be considered or inferred to be the official position of IEEE or any of its committees and shall not be considered to be, or be relied upon as, a formal position of IEEE. At lectures, symposia, seminars, or educational courses, an individual presenting information on IEEE standards shall make it clear that his or her views should be considered the personal views of that individual rather than the formal position of IEEE.

## Comments on standards

Comments for revision of IEEE Standards documents are welcome from any interested party, regardless of membership affiliation with IEEE. However, IEEE does not provide consulting information or advice pertaining to IEEE Standards documents. Suggestions for changes in documents should be in the form of a proposed change of text, together with appropriate supporting comments. Since IEEE standards represent a consensus of concerned interests, it is important that any responses to comments and questions also receive the concurrence of a balance of interests. For this reason, IEEE and the members of its societies and Standards Coordinating Committees are not able to provide an instant response to comments or questions except in those cases where the matter has previously been addressed. For the same reason, IEEE does not respond to interpretation requests. Any person who would like to participate in revisions to an IEEE standard is welcome to join the relevant IEEE working group.

Comments on standards should be submitted to the following address:

Secretary, IEEE-SA Standards Board  
445 Hoes Lane  
Piscataway, NJ 08854 USA

## Laws and regulations

Users of IEEE Standards documents should consult all applicable laws and regulations. Compliance with the provisions of any IEEE Standards document does not imply compliance to any applicable regulatory requirements. Implementers of the standard are responsible for observing or referring to the applicable regulatory requirements. IEEE does not, by the publication of its standards, intend to urge action that is not in compliance with applicable laws, and these documents may not be construed as doing so.

## Copyrights

IEEE draft and approved standards are copyrighted by IEEE under U.S. and international copyright laws. They are made available by IEEE and are adopted for a wide variety of both public and private uses. These include both use, by reference, in laws and regulations, and use in private self-regulation, standardization, and the promotion of engineering practices and methods. By making these documents available for use and adoption by public authorities and private users, IEEE does not waive any rights in copyright to the documents.

## Photocopies

Subject to payment of the appropriate fee, IEEE will grant users a limited, non-exclusive license to photocopy portions of any individual standard for company or organizational internal use or individual, noncommercial use only. To arrange for payment of licensing fees, please contact Copyright Clearance Center, Customer Service, 222 Rosewood Drive, Danvers, MA 01923 USA; +1 978 750 8400. Permission to photocopy portions of any individual standard for educational classroom use can also be obtained through the Copyright Clearance Center.

## Updating of IEEE Standards documents

Users of IEEE Standards documents should be aware that these documents may be superseded at any time by the issuance of new editions or may be amended from time to time through the issuance of amendments, corrigenda, or errata. An official IEEE document at any point in time consists of the current edition of the document together with any amendments, corrigenda, or errata then in effect.

Every IEEE standard is subjected to review at least every ten years. When a document is more than ten years old and has not undergone a revision process, it is reasonable to conclude that its contents, although still of some value, do not wholly reflect the present state of the art. Users are cautioned to check to determine that they have the latest edition of any IEEE standard.

In order to determine whether a given document is the current edition and whether it has been amended through the issuance of amendments, corrigenda, or errata, visit the IEEE-SA Website at <http://ieeexplore.ieee.org/expel/standards.jsp> or contact IEEE at the address listed previously. For more information about the IEEE-SA or IOWA's standards development process, visit the IEEE-SA Website at <http://standards.ieee.org>.

## Errata

Errata, if any, for all IEEE standards can be accessed on the IEEE-SA Website at the following URL: <http://standards.ieee.org/findstds/errata/index.html>. Users are encouraged to check this URL for errata periodically.

## Patents

Attention is called to the possibility that implementation of this standard may require use of subject matter covered by patent rights. By publication of this standard, no position is taken by the IEEE with respect to the existence or validity of any patent rights in connection therewith. If a patent holder or patent applicant has filed a statement of assurance via an Accepted Letter of Assurance, then the statement is listed on the IEEE-SA Website at <http://standards.ieee.org/about/sasb/patcom/patents.html>. Letters of Assurance may indicate whether the Submitter is willing or unwilling to grant licenses under patent rights without compensation or under reasonable rates, with reasonable terms and conditions that are demonstrably free of any unfair discrimination to applicants desiring to obtain such licenses.

Essential Patent Claims may exist for which a Letter of Assurance has not been received. The IEEE is not responsible for identifying Essential Patent Claims for which a license may be required, for conducting inquiries into the legal validity or scope of Patents Claims, or determining whether any licensing terms or conditions provided in connection with submission of a Letter of Assurance, if any, or in any licensing agreements are reasonable or non-discriminatory. Users of this standard are expressly advised that determination of the validity of any patent rights, and the risk of infringement of such rights, is entirely their own responsibility. Further information may be obtained from the IEEE Standards Association.

## Introduction

This introduction is not part of IEEE Std 1666.1™-2016, IEEE Standard for Standard SystemC® Analog/Mixed-Signal Extensions Language Reference Manual.
---

This document defines the SystemC Analog/Mixed-Signal (AMS) extensions, which is a C++ class library.

As the electronics industry builds more complex heterogeneous systems involving large numbers of components including analog, digital and software, there is an increasing need for a modeling language that can manage the complexity, heterogeneity, and size of these systems. SystemC AMS provides a mechanism for managing this complexity with its facility for modeling hardware and software together at multiple levels of abstraction. This capability is not available in traditional hardware description languages.

Stakeholders in SystemC AMS include Electronic Design Automation (EDA) companies who implement SystemC AMS class libraries and tools, integrated circuit (IC) suppliers who extend those class libraries and use SystemC AMS to model their intellectual property, and end users who use SystemC AMS to model their systems.

This standard is not intended to serve as a user's guide or to provide an introduction to SystemC AMS. Readers requiring a SystemC AMS tutorial or information on the intended use of SystemC AMS should consult the Accellera Systems Initiative Web site (<http://www.accellera.org>) to locate the supplemental material and training classes available.

# IEEE Standard for Standard SystemC<sup>®</sup> Analog/Mixed-Signal Extensions Language Reference Manual

*IMPORTANT NOTICE: IEEE Standards documents are not intended to ensure safety, health, or environmental protection, or ensure against interference with or from other devices or networks. Implementers of IEEE Standards documents are responsible for determining and complying with all appropriate safety, security, environmental, health, and interference protection practices and all applicable laws and regulations.*

*This IEEE document is made available for use subject to important notices and legal disclaimers. These notices and disclaimers appear in all publications containing this document and may be found under the heading “Important Notice” or “Important Notices and Disclaimers Concerning IEEE Documents.” They can also be obtained on request from IEEE or viewed at <http://standards.ieee.org/IPR/disclaimers.html>.*

## 1. Overview

### 1.1 Scope

This standard defines the Analog/Mixed-Signal extensions for SystemC<sup>®</sup><sup>1</sup>, as an ANSI standard C++ class library based on SystemC for system and hardware design including analog/mixed-signal elements.

### 1.2 Purpose

The general purpose of the SystemC AMS extensions is to provide a C++ standard for designers and architects, who need to address complex heterogeneous systems that are a hybrid between hardware and software. This standard is built on the IEEE Std 1666<sup>™</sup>-2011<sup>2</sup> (SystemC Language Reference Manual) and extends it to create analog/mixed-signal, multi-disciplinary models to simulate continuous-time, discrete-time, and discrete-event behavior simultaneously.

The specific purpose of this standard is to provide a precise and complete definition of the AMS class library, so that a SystemC AMS implementation can be developed with reference to this standard alone. This standard is neither intended to serve as a user’s guide nor to provide an introduction to AMS extensions in SystemC, but does contain useful information for end users.

---

<sup>1</sup>SystemC<sup>®</sup> is a registered trademark of the Accellera Systems Initiative.

<sup>2</sup>Information on references can be found in [Clause 2](#).