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

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

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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

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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.

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1. Overview

1.1 Scope

This standard defines the Analog/Mixed-Signal extensions for SystemC®[1], 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™-2011[2] (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.

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1.3 Subsets

It is anticipated that tool vendors will create implementations that support only a subset of this standard or that impose further constraints on the use of this standard. Such implementations are not fully compliant with this standard but may nevertheless claim partial compliance with this standard and may use the name SystemC AMS extensions.

1.4 Relationship with C++

This standard is closely related to the C++ programming language and adheres to the terminology used in ISO/IEC 14882:2003. This standard does not seek to restrict the usage of the C++ programming language; an application using the SystemC AMS extensions may use any of the facilities provided by C++, which in turn may use any of the facilities provided by C. However, where the facilities provided by this standard are used, they shall be used in accordance with the rules and constraints set out in this standard.

This standard defines the public interface to the SystemC AMS class library and the constraints on how those classes may be used. The SystemC AMS class library may be implemented in any manner whatsoever, provided only that the obligations imposed by this standard are honored.

A C++ class library may be extended using the mechanisms provided by the C++ language. Implementors and users are free to extend SystemC AMS extensions in this way, provided that they do not violate this standard.

NOTE—It is possible to create a well-formed C++ program that is legal according to the C++ programming language standard but that violates this standard. An implementation is not obliged to detect every violation of this standard.[3]

1.5 Relationship with SystemC

This standard is built on IEEE Std 1666-2011 and extends it using the mechanisms provided by the C++ language, to provide an additional layer of analog/mixed-signal constructs. Consequently, an implementation and application may use the SystemC core language and predefined channels defined in the namespace **sc_core** and the SystemC data types defined in the namespace **sc_dt**, unless stated otherwise.

Any SystemC compliant application shall behave the same in the presence of the SystemC AMS extensions.

1.6 Guidance for readers

Readers who are not entirely familiar with the SystemC AMS extensions should start with Annex A, which provides a brief informal summary of the subject intended to aid in the understanding of the normative definitions. Such readers may also find it helpful to scan the examples embedded in the normative definitions and to see Annex B.

Readers should pay close attention to Clause 3. An understanding of the terminology and conventions defined in that clause is necessary for a precise interpretation of this standard.

The semantic definitions given in the subsequent clauses detailing the individual classes are built upon the foundations laid in Clause 4.

Clause 5, Clause 6 and Clause 7 define the public interface to the SystemC AMS class library defining the predefined models of computation.

[3]Notes in text, tables, and figures are given for information only and do not contain requirements needed to implement the standard.

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The following information is listed for each class:

a) A brief class description.

b) A C++ source code listing of the class definition.

c) A statement of any constraints on the use of the class and its members.

d) A statement of the semantics of the class and its members.

e) For certain classes, a description of functions, typedefs, macros, and template parameters associated with the class.

For each predefined model of computation, the execution semantics for elaboration and simulation are defined.

Readers should bear in mind that the primary obligation of a tool vendor is to implement the abstract semantics defined in Clause 5, Clause 6, and Clause 7, using the framework and constraints provided by the class definitions starting in Clause 4.

Annex A is intended to aid the reader in the understanding of the structure and intent of the SystemC AMS class library.

Annex B is giving informal descriptions of the terms used in this standard.

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2. Normative references

The following referenced documents are indispensable for the applications of this document (i.e., they must be understood and used, so each referenced document is cited in text and its relationship to this document is explained) For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments or corrigenda) applies.

This standard shall be used in conjunction with the following publications:

ISO/IEC 14882:2003, Programming Languages—C++[4]

IEEE Std 1666™-2011: IEEE Standard for Standard SystemC Language Reference Manual[5,6]

[4]ISO/IEC publications are available from the ISO Central Secretariat, Case Postale 56, 1 rue de Varembé, CH-1211, Genève 20, Switzerland/Suisse (http://www.iso.ch/). ISO/IEC publications are also available in the United States from Global Engineering Documents, 15 Inverness Way East, Englewood, Colorado 80112, USA (http://global.ihs.com/). Electronic copies are available in the United States from the American National Standards Institute, 25 West 43rd Street, 4th Floor, New York, NY 10036, USA (http://www.ansi.org/).

[5]The IEEE standards or products referred to in this clause are trademarks of The Institute of Electrical and Electronics Engineers, Inc.

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