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Standard for automatic test markup language (ATML) test adapter description

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Standard for Automatic Test Markup Language (ATML) Test Adapter Description

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IEEE Std	FDIS	Report on voting
IEEE Std 1671.5-2015	91/1316/FDIS	91/1340/RVD

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IEEE Standard for Automatic Test Markup Language (ATML) Test Adapter Description

Sponsor

IEEE Standards Coordinating Committee 20 on Test and Diagnosis for Electronic Systems

Approved 26 March 2015

IEEE-SA Standards Board

Abstract: An exchange format using extensible markup language (XML) for identifying all of the hardware, software, and documentation associated with a test adapter is specified in this document. This test adapter may be used as a component of a test program set to test and diagnose a unit under test.

Keywords: ATML instance document, automatic test equipment (ATE), automatic test markup language (ATML), automatic test system (ATS), IEEE 1671.5™, interface device (ID), interface test adapter (ITA), test adapter, test fixture, XML schema

IEEE Introduction

This introduction is not part of IEEE Std 1671.5™-2015, IEEE Standard for Automatic Test Markup Language (ATML) Test Adapter Description.

This child, or dot, standard, also known as an ATML component standard, provides for the definition of the Test Adapter XML schemas, and contains references to examples; both of which accompany this standard.

These XML schemas provide for the identification and definition of a test adapter.

ATML's XML schemas define the basic information required within any test application and provide a vehicle for formally defining the test environment by defining a class hierarchy corresponding to these basic information entities and provide several methods within each to enable basic operations to be performed on these entities. ATML component standards within the ATML framework define the particular requirements within the test environment.

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Standard for Automatic Test Markup Language (ATML) Test Adapter Description

1. Overview

1.1 General

Automatic test markup language (ATML) is a collection of IEEE standards and associated extensible markup language (XML) schemas that allow automatic test system (ATS) and test information to be exchanged in a common format adhering to the XML standard.[1]

The ATML framework and the ATML family of standards have been developed and are maintained under the guidance of the Test Information Integration (TII) Subcommittee of IEEE Standards Coordinating Committee 20 (SCC20) to serve as a comprehensive environment for integrating design data, test strategies, test requirements, test procedures, test results management, and test system implementations, while allowing test program (TP), test asset interoperability, and unit under test (UUT) data to be interchanged between heterogeneous systems.

This standard (as well as the XML schemas and XML instance document examples[2] that accompany this standard) is intended to be used in identifying and documenting test adapters which may be utilized during the testing of a unit under test (UUT). This information includes the mechanical, electrical, and software interfaces of the test adapter.

[1] This information is given for the convenience of users of this standard and does not constitute an endorsement by IEEE of this consortium standard. Equivalent standards or products may be used if they can be shown to lead to the same results.
[2] The XML schemas and examples that accompany this standard are available at the locations defined in Clause 6.

This standard makes use of XML schemas and XML terminology. For readers new to XML, the XML Schema Tutorial [B4] provides a general introduction.

1.2 Application of this document's annexes

This document includes four annexes.

Annex A through Annex D are informative; thus they are provided strictly as information for users, implementers, and maintainers of this document.

1.3 Scope

This standard defines an exchange format, utilizing XML, for both the static description of a test adapter by defining the interface between the UUT and the test station, and the specific description of test adapter instance information.

1.4 Application

This standard provides a clear definition of test adapter information that may be exchanged between conformant cooperating software components and applications. This standard provides a definition that accomplishes the following objectives:

a) Provide a means of describing the aspects of the test adapter, which is the interface between the test station and the UUT

b) Provide a means of describing simple (e.g., cable only), passive, or active test adapters

c) Provide a means of describing multiple or layered test adapters

The information contained in XML documents conforming to this standard will be useful to:

a) Test program set (TPS) developers

b) TPS maintainers

c) ATE system developers

d) ATE system maintainers

e) Developers of ATML-based tools and systems

f) UUT developers and maintainers

1.5 Conventions used within this document

1.5.1 General

In accordance with the *IEEE Standards Style Manual* [B3],[3] any schema examples will be shown in Courier font. In cases where instance document examples are necessary to depict the use of a schema type

[3] The numbers in brackets correspond to those of the bibliography in Annex D.

or element, such examples will also be shown in Courier font. When the characters "..." appear in an example, it indicates that the example component is incomplete.

All simple types, complex types, attribute groups, and elements will be listed; explanatory information will be provided, along with examples, if additional clarification is needed. The explanatory information will include information on the intended use of the elements and/or attributes where the name of the entity does not clearly indicate its intended use. For elements derived from another source type (e.g., an abstract type), only attributes that extend the source type will be listed; details regarding the base type will be listed along with the base type.

When referring to an attribute of an XML element, the convention of [element]@[attribute] will be used. In cases where an attribute name is referred to with no associated element, the attribute name will be enclosed in single quotes. Element and type names will always be set in italics when appearing in text.

This standard uses the vocabulary and definitions of relevant IEEE standards. In case of conflict of definitions, except for those portions quoted from standards, the following precedence shall be observed: 1) Clause 3, and 2) The *IEEE Standards Dictionary Online* [B2].

1.5.2 Precedence

The TestAdapterDescription schema (TestAdapterDescription.xsd) element, child element, and annotation information shall take precedence over the descriptive information contained in Clause 4.

The TestAdapterDescription schema and the material contained in Clause 4 shall take precedence over the example information represented in Annex B.

The TestAdapterInstance schema (TestAdapterInstance.xsd) element, child element, and annotation information shall take precedence over the descriptive information contained in Clause 5.

The TestAdapterInstance schema and the material contained in Clause 5 shall take precedence over the example information represented in Annex B.

1.5.3 Word usage

In accordance with the *IEEE Standards Style Manual* [B3], the word *shall* is used to indicate mandatory requirements strictly to be followed in order to conform to the standard and from which no deviation is permitted (*shall* equals *is required to*). The use of the word *must* is used only to describe unavoidable situations. The use of the word *will* is only used in statements of fact.

The word *should* is used to indicate that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others (*should* equals *is recommended that*).

The word *may* is used to indicate a course of action permissible within the limits of the standard (*may* equals *is permitted to*).

The word *can* is used for statements of possibility and capability (*can* equals *is able to*).

2. Normative references

The following referenced documents are indispensable for the application 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.

IEEE Std 1671™, IEEE Standard for Automatic Test Markup Language (ATML) for Exchanging Automatic Test Equipment and Test Information via XML.[4, 5]

3. Definitions, acronyms, and abbreviations

3.1 Definitions

For the purposes of this document, the following terms and definitions apply. The *IEEE Standards Dictionary Online* should be consulted for terms not defined in this clause.[6] In the event a term is explicitly redefined, or further defined in an ATML component standard, the component standards definition shall take precedence for that ATML component standard.

abstract type: A declared type that can be used to define other types through derivation. Only non-abstract types derived from the declared type can be used in instance documents. When such a type is used, it shall be identified by the xsi:type attribute.

automatic test markup language (ATML) instance document: *See:* **instance document**.

element: A bounded component of the logical structure of an extensible markup language (XML) document that has a type and that may have XML attributes and content. [adapted from *Extensible Markup Language (XML) 1.0* (Fifth Edition)]

entity: Something that has a distinct separate existence.

extensible markup language (XML) attribute: Name-value pair associated with an XML element.

extensible markup language (XML) document: A data object that conforms to the XML requirements for being well-formed. In addition, the data object is valid if it additionally conforms to semantic rules of the XML schema.

extensible markup language (XML) schema: The definition of a class of XML document, typically expressed in terms of constraints on the structure and the content of documents of that class, above and beyond the basic syntax constraints imposed by XML itself.

instance document: An XML document that conforms to a particular XML schema.

object: An object consists of state and behavior. An object stores its states in fields (variables in some programming languages) and exposes its behavior through methods (functions in some programming languages).

well-formed: Conforming to all of XML's syntax rules.

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3.2 Acronyms and abbreviations

ATE	automatic test equipment
ATML	automatic test markup language
ATS	automatic test system
COM	common relay contact
DC	direct current
DCLVA	dc power supply low voltage type A
J	jack
NC	normally closed relay contact
NO	normally open relay contact
P/N	part number
RF	radio frequency
S	switch
TB	terminal block
TII	test information integration
TP	test program
TPS	test program set
UTF-8	8-bit Unicode transformation format
UUT	unit under test
W3C®	World Wide Web consortium
XML	extensible markup language

4. TestAdapterDescription schema

4.1 General

In addition to the conventions specified in 1.5.1, the prefix "*c:*" indicates that the element is defined by/is inherited from the IEEE Std 1671™-2010 associated Common.xsd XML schema. The prefix "*hc:*" indicates that the element is defined by/is inherited from the IEEE Std 1671-2010 associated HardwareCommon.xsd XML schema. The prefix "*te:*" indicates that the element is defined by/is inherited from the IEEE Std 1671-2010 associated TestEquipment.xsd XML schema.

4.2 Elements

4.2.1 TestAdapterDescription root (or document)

Exactly one element exists, called the root, or document element, of which no part appears in the content of any other element. This root element serves as the parent for all other elements of the TestAdapterDescription schema.

The TestAdapterDescription schema's root element is defined as follows:

Name	Set to
Attribute form default	Unqualified (see NOTE)
Element form default	Qualified (see NOTE)
Encoding	UTF-8
Included schema	*None*
Imported schema	urn:IEEE-1671:2010:Common urn:IEEE-1671:2010:HardwareCommon urn:IEEE-1671:2010:TestEquipment
Target namespace	urn:IEEE-1671.5:2015:TestAdapterDescription
Version	2.2
XML schema namespace reference	[a]
NOTE—Qualified and unqualified are described in A.3.7 of IEEE Std 1671.[7]	

[a] The namespace reference URL is: http://www.w3.org/2001/XMLSchema.

4.2.2 TestAdapterDescription

Base type: *ta:TestAdapterDescription*
Properties: content complex

The *TestAdapterDescription* element shall be used to document the aspects of a family of test adapters.

4.2.2.1 Attributes

TestAdapterDescription element inherits the attributes from *TestAdapterDesciption complex type* (see 4.2.3).

4.2.2.2 Child elements

TestAdapterDescription element inherits the child elements from *TestAdapterDescription complex type* (see 4.2.3).

4.2.3 TestAdapterDescription complex type

Base type: *te:TestEquipment*
Properties: content complex

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

The test adapter description type will encompass all information necessary to identify all of the hardware, software, and documentation in a test adapter.

Figure 1 illustrates the XML type inherited that comprises the *TestAdapterDescription*.

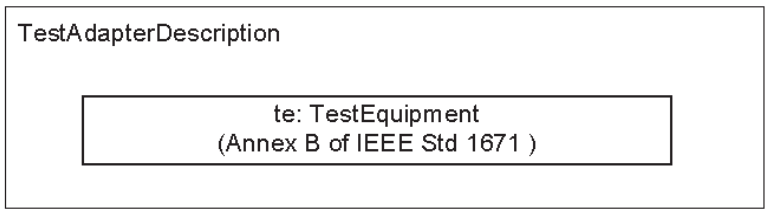

Figure 1—TestAdapterDescription complex type content

4.2.3.1 Attributes

TestAdapterDescription contains the s*ecurityClassification, classified, name, version,* and *uuid* attributes inherited from the hc:HardwareItemDescription complex type and the *DocumentRootAttributes* attribute group defined in Annex B of IEEE Std 1671.

4.2.3.2 Child elements

TestAdapterDescription inherits the child elements of *te:TestEquipment* contained in Annex B of IEEE Std 1671.

4.3 Simple types

None.

5. Schema—TestAdapterInstance.xsd

5.1 General

In addition to the conventions specified in 1.5.1, the prefix "*c:*" represents that the element is defined by/is inherited from the IEEE Std 1671-2010 associated Common.xsd XML schema. The prefix "*hc:*" indicates that the element is defined by/is inherited from the IEEE Std 1671-2010 associated HardwareCommon.xsd XML schema. The prefix "*te:*" indicates that the element is defined by/is inherited from the IEEE Std 1671-2010 associated TestEquipment.xsd XML schema.

5.2 Elements

5.2.1 TestAdapterInstance root (or document)

Exactly one element exists, called the root, or document element, of which no part appears in the content of any other element. This root element serves as the parent for all other elements of the TestAdapterInstance schema.

The TestAdapterInstance schema's root element is defined as follows:

Name	Set to
Attribute form default	Unqualified (see NOTE)
Element form default	Qualified (see NOTE)
Encoding	UTF-8
Included schema	*None*
Imported schema	urn:IEEE-1671:2010:Common urn:IEEE-1671:2010:HardwareCommon urn:IEEE-1671:2010:TestEquipment
Target namespace	urn:IEEE-1671.6:2015:TestAdapterInstance
Version	2.12
XML schema namespace reference	[a]
NOTE—Qualified and unqualified are described in A.3.7 of IEEE Std 1671.	

[a] The namespace reference URL is: http://www.w3.org/2001/XMLSchema.

5.2.2 TestAdapterInstance

Base type: *tai:TestAdapterInstance*
Properties: content complex

The *TestAdapterInstance* element shall be used to document the aspects of a particular instance of a test adapter.

5.2.2.1 Attributes

TestAdapterInstance element inherits the attributes from *TestAdapterInstance complex type* (see 5.2.3).

5.2.2.2 Child elements

TestAdapterInstance element inherits the child elements from *TestAdapterInstance complex type* (see 5.2.3).

5.2.3 TestAdapterInstance complex type

Base type: *te:TestEquipmentInstance*
Properties: content complex

The test adapter instance type will encompass all information necessary to identify all of the hardware, software, and documentation of that particular test adapter serial number.

5.2.3.1 Attributes

TestAdapterInstance inherits the s*ecurityClassification, classified,* and *uuid* attributes inherited from the *DocumentRootAttributes* attribute group defined in Annex B of IEEE Std 1671.

5.2.3.2 Child elements

TestAdapterInstance inherits the child elements of *te:TestEquipmentInstance* contained in Annex B of IEEE Std 1671.

5.3 Simple types

None.

6. ATML TestAdapterDescription XML schema names and locations

IEEE provides a download website for material published in association with published IEEE standards, presented in machine-friendly format. This material is digital rights management restricted use material. The ATML family of standards utilizes this download website to allow easy accessibility to all of the ATML family XML schemas (and in some cases, example XML instance documents). As depicted by Figure 2, the IEEE download website (http://standards.ieee.org/downloads/) contains several folders, each folder labeled by an associated IEEE standard number (e.g., IEEE 1671 series standards are in the 1671 folder). Each folder under this base IEEE standard number contains the material (XML schemas, etc.) for that ATML family component standard. ATML family component standards are identified by their IEEE 1671 series dot standard number and the year in which that standard was published by IEEE.

NOTE 1—Standards that are revised will be contained in a folder for the year in which the standard is reissued. Both folders (for each year the standard was published) will be present on the IEEE download website.

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Figure 2 depicts a portion of the entire IEEE download website as it pertains to the Test Adapter Description ATML family standard.

http://standards.ieee.org/downloads/

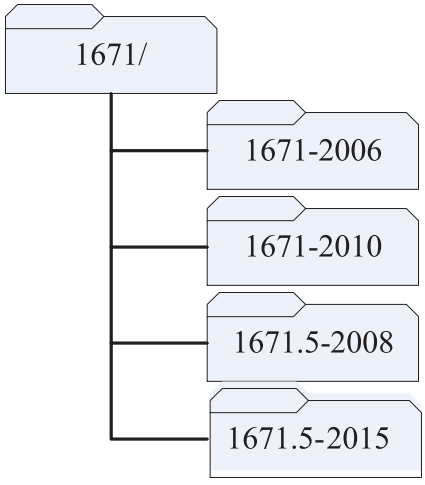

Figure 2—ATML test adapter related IEEE download website structure

The Test Adapter ATML family component standard, where the component is defined, their associated XML schema names, and the IEEE download website folder name (where the XML schemas are located), is as defined in Table 1.

Table 1—ATML family XML schema name and folder location

Component	Defined in clause	XML schema name	IEEE download website folder (See Figure 2)
Test adapter description	4	TestAdapterDescription.xsd	1671.5-2015
Test adapter instance	5	TestAdapterInstance.xsd	1671.5-2015

The XML schema identified in Table 2 includes ATML common elements: the ATML common element (e.g., component), where the component is defined, the associated XML schemas name, and the IEEE download website folder name (where the XML schema are located).

Table 2—ATML common element XML schema name and location

Component	Defined in IEEE Std 1671-2010	XML schema name	IEEE download website folder (See Figure 2)
Common	Annex B.1	Common.xsd	1671-2010
Hardware common	Annex B.2	Hardware Common.xsd	1671-2010
Test equipment	Annex B.3	TestEquipment.xsd	1671-2010

7. ATML XML schema extensibility

The provision of an extension mechanism is necessary to help ensure the viability of the specification and allow producers and consumers of Test Adapter instance documents to interoperate in those cases where there is a requirement to exchange relevant data that is not included in the *Test Adapter* associated XML schema. The use of the extensions shall be done in a way that a conformant consumer can utilize the extended file without error, discard or otherwise sidestep the extended data, and use the non-extended portions of the data as it is intended, without error or loss of functionality.

Extensions shall be additional information added to the content model of the element being extended.

Extensions shall not repackage existing information entities that are already supported by the *Test Adapter* XML schema.

An extended instance document shall be accompanied by the extension XML schema and documentation sufficient to explain the need for the extension as well as the underlying semantics and relationship(s) to the base *Test Adapter* XML schema.

The ATML family of standards associated XML schemas allow for three forms of extension:

a) Wildcard-based extensions allow for the extension of the XML schemas with additional elements

b) Type derivation allows for extending the set of data types by deriving a new type from an existing common element type

c) Lists derived from *c:NamedValues* allowing user defined properties with attached values

8. Conformance

This clause specifies the requirements that must be satisfied to claim conformance to this standard. Conformance is defined for the following items:

a) A TestAdapterDescription instance document

b) A TestAdapterInstance instance document

Extensions are permitted to both the TestAdapterDescription and TestAdapterInstance documents but shall only occur through the facility of the extensibility mechanism described in Clause 7. As defined in the W3C XML schema standard, an extended schema shall conform to the W3C XML schema specification and shall not describe any entities defined in the base schema.

8.1 Conformance of a TestAdapterDescription instance document

A document shall conform as a TestAdapterDescription instance document if it satisfies all of the following conditions:

a) The document satisfies the requirements for a well-formed XML document

b) The root element of the XML document is a TestAdapterDescription element

c) The contents of the XML document are valid with respect to the TestAdapterDescription XML schema, including imported XML schemas

d) The contents of the XML document satisfy the requirements stated in Clause 4

e) The contents of the XML document satisfy the requirements stated in the annotations of the TestAdapterDescription XML schema, including requirements stated in the annotations of imported XML schemas

f) Extensions, if any, satisfy the requirements stated in Clause 7

8.2 Conformance of a TestAdapterInstance instance document

A document shall conform as a TestAdapterInstance instance document if it satisfies all of the following conditions:

a) The document satisfies the requirements for a well-formed XML document

b) The root element of the XML document is a TestAdapterInstance element

c) The contents of the XML document are valid with respect to the TestAdapterInstance XML schema, including imported XML schemas

d) The contents of the XML document satisfy the requirements stated in Clause 5

e) The contents of the XML document satisfy the requirements stated in the annotations of the TestAdapterInstance XML schema, including requirements stated in the annotations of imported XML schemas

f) Extensions, if any, satisfy the requirements stated in Clause 7

Annex A

(informative)

IEEE download website material associated with this document

This document includes supporting material required to maintain and/or develop the ATML framework as well as maintain the ATML family of standards. This material is published by IEEE in association with this document, presented in a machine-friendly format. This is digital rights management restricted use material. The ATML family of standards utilizes this download website to allow easy accessibility to these documents' XML schemas and associated material referenced within this document (e.g., examples or committee drafts). For an explanation and the location of the IEEE download website and its structure (as it pertains to the ATML family of standards), see Clause 6. The material available on the IEEE download website in association with this document is described in Table A.1.

Table A.1—IEEE download website contents

File	Description
TestAdapterDescription.xsd	The ATML Test Adapter Description schema defined in Clause 4
TestAdapterInstance.xsd	The ATML Test Adapter Instance schema defined in Clause 5
1671_5_TestAdapterExample.xml	Example
1671_5_TestAdapterExampleInstance.xml	Example
Readme.txt	This file contains user information pertaining to the files posted, related files, and their usage

Annex B

(informative)

Users information and examples

B.1 Interface test adapter

B.1.1 General

This fictitious example, while not a complete detailed specification of the interface test adapter hardware depicted by Figure B.1, provides example test adapter elements that may be included in either an interface test adapter or a specific instance of an interface test adapter identified by its serial number.

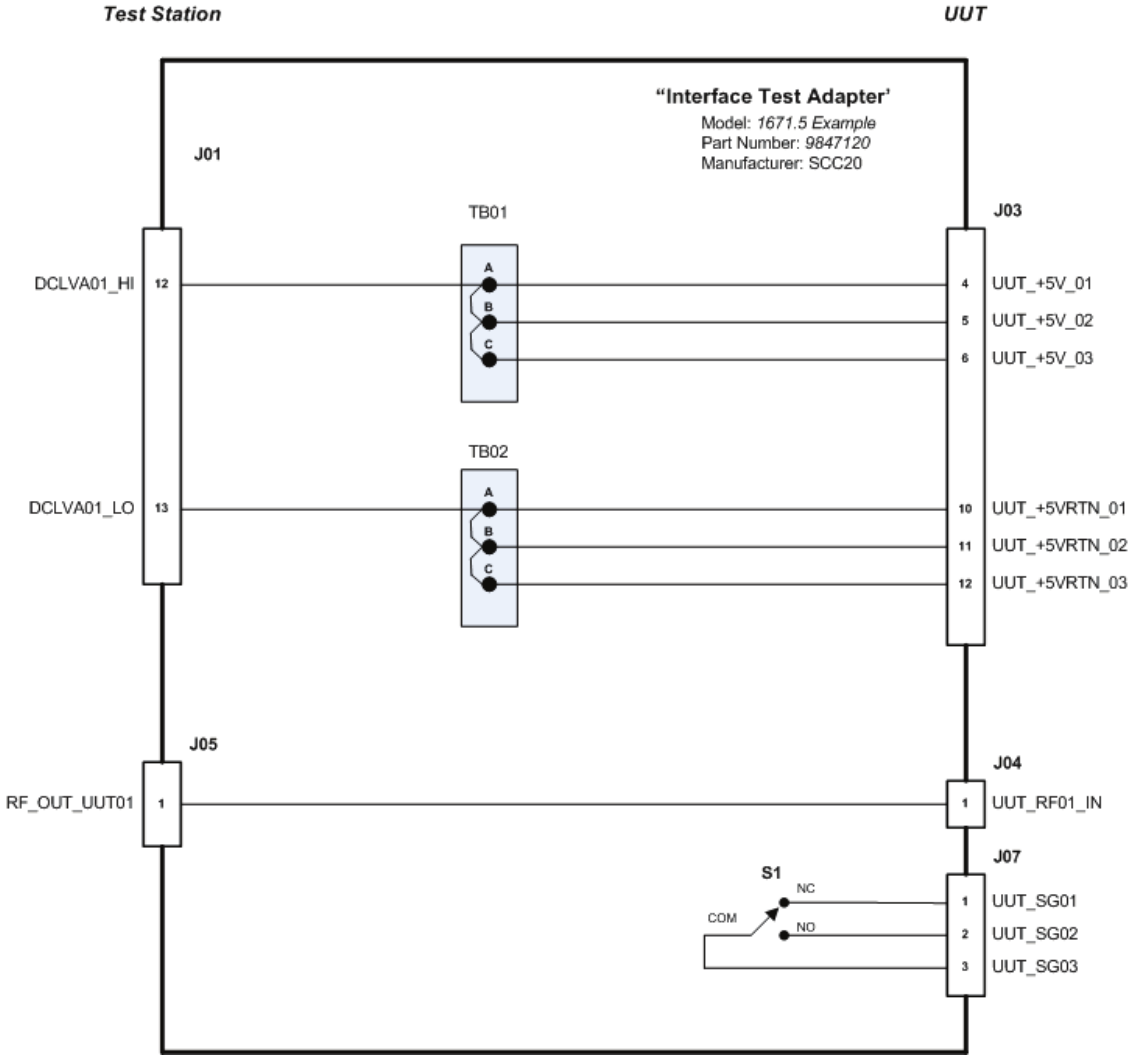

Figure B.1—Interface test adapter

B.1.2 Test adapter description XML instance document

The Test Adapter Description XML instance document *P1671_5_TestAdapterExample.xml* contains the following:

a) Identification definition (manufacturer, part number, contact information)

b) Interface's port definitions (to both the test station and UUT), both connector and pin

c) Interface connector types

d) Documentation (assembly drawings, schematics)

e) Physical characteristics

f) Internal connections (as depicted by Figure B.1)

g) Definition of the switch in the ITA

h) Definition of the terminal blocks in the ITA

The XML instance document *1671_5_TestAdapterExample.xml* shall be available at: http://standards.ieee.org/downloads/1671/1671.5-2015/.

B.1.3 Test adapter instance XML instance document

The Test Adapter Instance XML instance document *P1671_5_TestAdapteInstanceExample.xml*, while not a complete detailed specification of the Interface Test Adapter hardware depicted by Figure B.1, provides example test adapter elements that may be included in a specific instance of an interface test adapter not provided in the Interface Test Adapter XML example:

a) Reference to the description document for the test adapter family for which this instance applies

b) Serial number of this instance

c) Date of manufacture

d) Time of the last calibration

e) Power on information (number of times it has been turned on, and the time it was last turned on)

f) Time that self-test was last run

The XML instance document *1671_5_TestAdapterInstanceExample.xml* shall be available at: http://standards.ieee.org/downloads/1671/1671.5-2015/. As described in Annex A, this XML instance document is also available at the IEEE download website located as defined in Clause 6.

Annex C

(informative)

Glossary

For the purposes of this standard, the following terms and definitions apply. These and other terms within IEEE standards are found in the *IEEE Standards Dictionary Online* [B2].

adapter: A device, or series of devices, designed to provide a compatible connection between the unit under test (UUT) and the test equipment. It may include proper stimuli or loads not included with the automatic test equipment (ATE).

attribute: A documenting characteristic of an entity.

automatic test equipment (ATE): A system providing a test capability for the automatic testing of one or more units under test (UUTs). The ATE system consists of a controller, test resource devices, and peripherals. The controller directs the testing process and interprets the results. The test resource devices provide stimuli, measurements, and physical interconnections. The peripherals, such as displays, keyboards, printers, mass storage, etc., supply the necessary capability for information management.

automatic test system (ATS): Includes the automatic test equipment (ATE) as well as all support equipment, software, test program (TP), and adapters.

framework: A collection of classes created specifically to serve the needs of an application area.

test program (TP): A program specifically intended for the testing of a unit under test (UUT).

test program set (TPS): The complete set of hardware, software, and documentation needed to evaluate a unit under test (UUT) on a given test system.

unit under test (UUT): The entity to be tested. It may range from a simple component to a complete system.

Annex D

(informative)

Bibliography

Bibliographical references are resources that provide additional or helpful material but do not need to be understood or used to implement this standard. Reference to these resources is made for informational use only.

[B1] eXtensible Markup Language (XML) 1.0 (Fifth Edition). World Wide Web Consortium Recommendation 26 November 2008.[8]

[B2] *IEEE Standards Dictionary Online*.[9]

[B3] *IEEE Standards Style Manual*.[10]

[B4] *XML Schema Tutorial*.[11]

[8] Available from the World Wide Web Consortium: http://www.w3.org/TR/2006/REC-xml-20060816.
[9] *IEEE Standards Dictionary Online* subscription is available at: http://www.ieee.org/portal/innovate/products/standard/standards/standards_dictionary.html.
[10] Available from IEEE: http://standards.ieee.org/guides/style/2007_Style_Manual.pdf.
[11] Available from the World Wide Web: http://www.xfront.com/xml-schema.html.

Annex E
(informative)
IEEE list of Participants

At the time this IEEE standard was completed, the P1671.5 Working Group had the following membership:

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Chris Gorringe
Teresa Lopes
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When the IEEE-SA Standards Board approved this standard on 26 March 2015, it had the following membership:

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