

INTERNATIONAL STANDARD



Information technology – Small computer system interface (SCSI) –
Part 251: USB Attached SCSI (UAS)

(standards.iteh.ai)

ISO/IEC 14776-251:2014

<https://standards.iteh.ai/catalog/standards/sist/65556826-5c31-463c-b31f-24b4446bb2cc/iso-iec-14776-251-2014>



THIS PUBLICATION IS COPYRIGHT PROTECTED
Copyright © 2014 ISO/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 ISO/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 Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
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 corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub

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 It also gives information on projects, replaced and withdrawn publications.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 also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 30 000 terms and definitions in English and French, with equivalent terms in 14 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

More than 55 000 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.

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: csc@iec.ch.

ISO/IEC 14776-251:2014
INTERNATIONAL STANDARD PREVIEW
(standards.iteh.ai)
<https://standards.iteh.ai/catalog/standards/sist/24b4446bb2cc/iso-iec-14776-251-2014>



ISO/IEC 14776-251

Edition 1.0 2014-04

INTERNATIONAL STANDARD



Information technology – Small computer system interface (SCSI) –
Part 251: USB Attached SCSI (UAS)

<https://standards.iteh.ai/catalog/standards/sist/65556826-5c31-463c-b31f-24b4446bb2cc/iso-iec-14776-251-2014>

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

PRICE CODE

B

ICS 35.200

ISBN 978-2-8322-1507-4

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

CONTENTS

FOREWORD.....	6
INTRODUCTION	8
SCSI standards family	8
1 Scope	10
2 Normative references	10
3 Terms, definitions, symbols, abbreviations and conventions	10
3.1 Terms and definitions.....	10
3.2 Symbols and abbreviations	13
3.3 Keywords.....	13
3.4 Editorial conventions.....	14
3.5 Numeric and character conventions	15
3.5.1 Numeric conventions.....	15
3.5.2 Byte encoded character strings conventions.....	15
3.6 Sequence figure notation	16
3.7 Notation for procedures and functions.....	16
4 Model	17
4.1 Overview.....	17
4.2 Tag handling.....	18
4.3 Data transfers	18
4.4 UAS domain.....	19
4.5 Addressing.....	20
4.6 World wide name	20
4.7 Resets	20
4.8 I_T Nexus loss	21
4.9 Target power loss expected	21
4.10 USB error handling	21
5 USB.....	22
5.1 Overview.....	22
5.2 USB resource requirements	22
5.2.1 Overview.....	22
5.2.2 USB class specific requests	22
5.2.3 USB descriptors	22
6 Transport.....	27
6.1 Overview.....	27
6.2 IUs.....	27
6.2.1 Overview	27
6.2.2 COMMAND IU.....	28
6.2.3 READ READY IU	29
6.2.4 WRITE READY IU	29
6.2.5 SENSE IU	30
6.2.6 RESPONSE IU.....	30
6.2.7 TASK MANAGEMENT IU	31
6.3 Information unit sequences	33
6.3.1 Overview	33

ITeH STANDARD PREVIEW
(standards.iteh.ai)

ISO/IEC 14776-251:2014

<https://standards.iteh.ai/catalog/standards/sist/65556826-5c31-463c-b31f-24b4446bb2cc/iso-iec-14776-251-2014>

24b4446bb2cc/iso-iec-14776-251-2014

6.3.2 Non-data command/sense sequence.....	34
6.3.3 Non-data command/response sequence	35
6.3.4 Data-out command sequence.....	36
6.3.5 Data-in command sequence.....	37
6.3.6 Task management function sequence	37
6.3.7 Bi-directional command sequence.....	38
6.3.8 Multiple command example	38
6.4 Transport requirements.....	41
7 SCSI Application Layer transport protocol services.....	42
7.1 SCSI transport protocol services overview	42
7.2 Send SCSI Command transport protocol service	43
7.3 SCSI Command Received transport protocol service	44
7.4 Send Command Complete transport protocol service.....	44
7.5 Command Complete Received transport protocol service	45
7.6 Send Data-In transport protocol service	46
7.7 Data-In Delivered transport protocol service	46
7.8 Receive Data-Out transport protocol service.....	46
7.9 Data-Out Received transport protocol service	47
7.10 Terminate Data Transfer transport protocol service.....	47
7.11 Data Transfer Terminated transport protocol service.....	48
7.12 Send Task Management Request transport protocol service.....	48
7.13 Task Management Request Received transport protocol service	49
7.14 Task Management Function Executed transport protocol service	49
7.15 Received Task Management Function Executed transport protocol service	51
7.16 USB Acknowledgement.....	52
8 Device server error handling.....	53

Figure 1 – SCSI document structure	8
Figure 2 – Example Sequence figure	16
Figure 3 – USB Model	17
Figure 4 – Example Simple UAS domain	19
Figure 5 – Example Complex UAS Domain.....	20
Figure 6 – UAS sequence figure notation	34
Figure 7 – Non-data transfer with Sense.....	34
Figure 8 – Non-data Transfer with Response.....	35
Figure 9 – Write Data Transfer	36
Figure 10 – Read Data Transfer	37
Figure 11 – Task management	37
Figure 12 – Bi-directional Data Transfer	38
Figure 13 – Multiple Command example.....	40

iTeh STANDARD PREVIEW (standards.iteh.ai)

ISO/IEC 14776-251:2014

<https://standards.iteh.ai/catalog/standards/sist/65556826-5c31-463c-b31f-24b4446bb2cc/iso-iec-14776-251-2014>

Table 1 – Numbering conventions	15
Table 2 – Device descriptor	22
Table 3 – Configuration descriptor	23
Table 4 – Interface Descriptor	24
Table 5 – Bulk-in endpoint descriptor	24
Table 6 – Bulk-out endpoint descriptor	25
Table 7 – Pipe Usage Descriptor	25
Table 8 – Pipe ID	26
Table 9 – IU ID field summary	27
Table 10 – IU Header	27
Table 11 – COMMAND IU	28
Table 12 – TASK ATTRIBUTE field	28
Table 13 – READ READY IU	29
Table 14 – WRITE READY IU	29
Table 15 – SENSE IU	30
Table 16 – RESPONSE IU	30
Table 17 – RESPONSE CODE field	31
Table 18 – TASK MANAGEMENT IU	31
Table 19 – task management function field	32
Table 20 – Execute Command procedure call transport protocol services	42
Table 21 – Execute Command procedure call transport protocol services	43
Table 22 – Send SCSI Command transport protocol service arguments	43
Table 23 – SCSI Command Received transport protocol service arguments	44
Table 24 – Send Command Complete transport protocol service arguments	45
Table 25 – Command Complete Received transport protocol service arguments	45
Table 26 – Send Data-In transport protocol service arguments	46
Table 27 – Data-In Delivered transport protocol service arguments	46
Table 28 – Receive Data-Out transport protocol service arguments	47
Table 29 – Data-Out Received transport protocol service arguments	47
Table 30 – Terminate Data Transfer transport protocol service arguments	48
Table 31 – Data Transfer Terminated transport protocol service arguments	48
Table 32 – Send Task Management Request transport protocol service arguments	48
Table 33 – Task Management Request Received transport protocol service arguments	49
Table 34 – Task Management Function Executed transport protocol service arguments	50
Table 35 – Received Task Management Function Executed transport protocol service arguments	51
Table 36 – USB Acknowledgement	52
Table 37 – Delivery Result to additional sense code mapping	53

INFORMATION TECHNOLOGY – SMALL COMPUTER SYSTEM INTERFACE (SCSI) –

Part 251: USB Attached SCSI (UAS)

FOREWORD

- 1) ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.
- 2) The formal decisions or agreements of IEC and ISO 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 and ISO member bodies.
- 3) IEC, ISO and ISO/IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees and ISO member bodies in that sense. While all reasonable efforts are made to ensure that the technical content of IEC, ISO and ISO/IEC publications is accurate, IEC or ISO 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 and ISO member bodies undertake to apply IEC, ISO and ISO/IEC publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any ISO, IEC or ISO/IEC publication and the corresponding national or regional publication should be clearly indicated in the latter.
- 5) ISO and IEC do not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. ISO or IEC 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 ISO or its directors, employees, servants or agents including individual experts and members of their technical committees and IEC National Committees or ISO member bodies 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 of, use of, or reliance upon, this ISO/IEC Publication or any other IEC, ISO or ISO/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 ISO/IEC Publication may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

International Standard ISO/IEC 14776-251 was prepared by subcommittee 25: Interconnection of information technology equipment, of ISO/IEC joint technical committee 1: Information technology.

The list of all currently available parts of the ISO/IEC 14776 series, under the general title *Information technology – Small computer system interface (SCSI)*, can be found on the IEC web site.

This International Standard has been approved by vote of the member bodies, and the voting results may be obtained from the address given on the second title page.

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

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 publication using a colour printer.

iTeh STANDARD PREVIEW (standards.iteh.ai)

[ISO/IEC 14776-251:2014](https://standards.iteh.ai/catalog/standards/sist/65556826-5c31-463c-b31f-24b4446bb2cc/iso-iec-14776-251-2014)

<https://standards.iteh.ai/catalog/standards/sist/65556826-5c31-463c-b31f-24b4446bb2cc/iso-iec-14776-251-2014>

INTRODUCTION

This International Standard standard encompasses the following:

- Clause 1 describes the scope.
- Clause 2 provides normative references for the entire standard.
- Clause 3 provides definitions, abbreviations, and conventions used within the entire standard.
- Clause 4 describes the model.
- Clause 5 describes USB requirements.
- Clause 6 describes transport requirements (e.g., IUs).
- Clause 7 describes the SCSI Application Layer Transport Protocol Services.
- Clause 8 describes device server error handling.

SCSI standards family

Figure 1 shows the relationship of this standard to the other standards and related projects in the SCSI family of standards as of the publication of this standard.

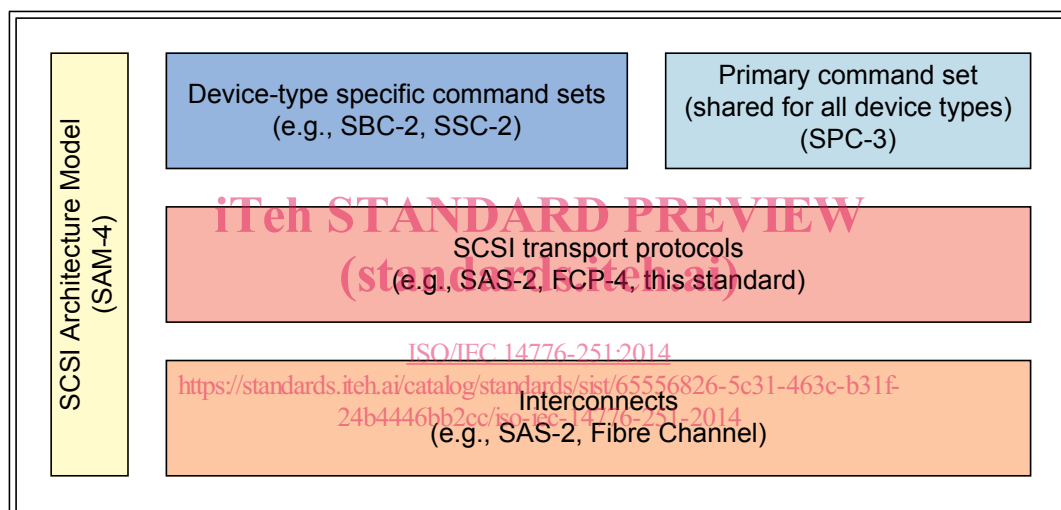


Figure 1 — SCSI document structure

The SCSI document structure in figure 1 is intended to show the general applicability of the documents to one another. Figure 1 is not intended to imply a relationship such as a hierarchy, protocol stack, or system architecture.

SCSI Architecture Model: Defines the SCSI systems model, the functional partitioning of the SCSI standard set and requirements applicable to all SCSI implementations and implementation standards.

Device-Type Specific Command Sets: Implementation standards that define specific device types including a device model for each device type. These standards specify the required commands and behaviors that are specific to a given device type and prescribe the requirements to be followed by a SCSI initiator device when sending commands to a SCSI target device having the specific device type. The commands and behaviors for a specific device type may include by reference commands and behaviors that are shared by all SCSI devices.

Shared Command Set: An implementation standard that defines a model for all SCSI device types. This standard specifies the required commands and behavior that is common to all SCSI devices, regardless of device type, and prescribes the requirements to be followed by a SCSI initiator device when sending commands to any SCSI target device.

SCSI Transport Protocols: Implementation standards that define the requirements for exchanging information so that different SCSI devices are capable of communicating.

Interconnects: Implementation standards that define the communications mechanism employed by the SCSI transport protocols. These standards may describe the electrical and signaling requirements essential for SCSI devices to interoperate over a given interconnect. Interconnect standards may allow the interconnection of devices other than SCSI devices in ways that are outside the scope of this standard.

The term SCSI is used to refer to the family of standards described in this introduction.

iTeh STANDARD PREVIEW (standards.iteh.ai)

[ISO/IEC 14776-251:2014](https://standards.iteh.ai/catalog/standards/sist/65556826-5c31-463c-b31f-24b4446bb2cc/iso-iec-14776-251-2014)

<https://standards.iteh.ai/catalog/standards/sist/65556826-5c31-463c-b31f-24b4446bb2cc/iso-iec-14776-251-2014>

INFORMATION TECHNOLOGY – SMALL COMPUTER SYSTEM INTERFACE (SCSI) –

Part 251: USB Attached SCSI (UAS)

1 Scope

This part of ISO/IEC 14776 describes a SCSI transport protocol (see ISO/IEC 14776-414) for USB-2 and USB-3 with the following properties:

- a) mechanism to send commands associated with any SCSI standard to a USB device;
- b) complies with SCSI Architecture Model - 4 (e.g., autosense and command queuing); and
- c) other capabilities.

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.

ISO/IEC 14776-414, *Information technology, Small Computer System Interface (SCSI) – Part 414: SCSI Architecture Model-4* (herein referred to as SAM-4)¹

IEC 62680-1, *Universal serial bus interfaces for data and power – Part 1: Universal serial bus specification, revision 2.0* (herein referred to as USB-2)

ANSI INCITS 513-2004, *SCSI Primary Commands-4* (herein referred to as SPC-4) [T10/1731-D]²

Universal Serial Bus 3.0 Specification Revision 1.0 (herein referred to as USB-3). November 12, 2008

Universal Serial Bus Mass Storage Class Specification Overview Rev 1.3 (herein referred to as MSC). September 5, 2008³

<https://standards.iteh.ai/catalog/standards/sist/65556826-5c31-463c-b31f-246440662cc9/iso-iec-14776-251-2014>

3 Terms, definitions, symbols, abbreviations and conventions

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1.1

application client

object that is the source of SCSI commands

Note 1 to entry: See ISO/IEC 14776-414.

3.1.2

Bulk-in Endpoint Descriptor

USB Endpoint Descriptor with the BM ATTRIBUTES field set to 02h and bit 7 of the bEndPoint address field set to 1

1. ANSI INCITS 447-2008

2. planned as ISO/IEC 14776-454

For more information on the current status of these documents, contact the INCITS Secretariat at 202-737-8888 (phone), 202-638-4922 (fax) or via E-mail at incits@itc.org. To obtain copies of these documents, contact Global Engineering at 15 Inverness Way, East Englewood, CO 80112-5704 at 303-792-2181 (phone), 800-854-7179 (phone), or 303-792-2192 (fax) or see <http://www.incits.org>.

3. For information on the current status of USB documents, see the USB Implementers Forum at <http://www.usb.org>.

3.1.3

Bulk-in pipe

pipe (see 3.1.9) used to transfer data and status from the UAS target port to the UAS initiator port

3.1.4

Bulk-out Endpoint Descriptor

USB Endpoint Descriptor with the BM ATTRIBUTES field set to 02h and bit 7 of the bEndPoint address field set to 0

3.1.5

Bulk-out pipe

pipe (see 3.1.9) used to transfer data and commands from the UAS initiator port to the UAS target port

3.1.6

default pipe

message pipe (see 3.1.9) created by the USB System Software to pass control and status information between the host and a USB device's endpoint zero (see USB-2)

3.1.7

Information Unit

IU

formatted collection of data that carries command, task management function, sense, response, read ready, or write ready information (see 6.2)

3.1.8

Logical Unit Number

LUN

64-bit identifier for a logical unit

iTeh STANDARD PREVIEW
(standards.iteh.ai)

Note 1 to entry: See ISO/IEC 14776-414:ISO/IEC 14776-251:2014

<https://standards.iteh.ai/catalog/standards/sist/65556826-5c31-463c-b31f-24b4446bb2cc/iso-iec-14776-251-2014>

3.1.9

pipe

logical abstraction using USB endpoints representing an association between a function (see USB-2 and USB-3) of a USB device and an application client

3.1.10

read data

data transferred to the SCSI application client's data-in buffer from the SCSI device server, as requested by the Send Data-In transport protocol service

3.1.11

service deliver subsystem

part of the USB I/O system which transmits information between the UAS initiator port and the UAS target port

EXAMPLE USB hubs, USB cables.

3.1.12

task manager

object that controls the sequencing of commands and processes task management functions

Note 1 to entry: See ISO/IEC 14776-414.

3.1.13

transaction packet

TP

header packet used to communicate information between a UAS target device and a UAS initiator device

Note 1 to entry: See Universal Serial Bus 3.0.

3.1.14

UAS domain

one UAS initiator port and one or more UAS target ports (see 4.4)

3.1.15

UAS initiator device

USB host that contains one or more UAS initiator ports

Note 1 to entry: For USB host, see Universal Serial Bus 2.0 and Universal Serial Bus 3.0.

3.1.16

UAS initiator port

USB host and USB host port components

Note 1 to entry: For USB host, see Universal Serial Bus 2.0.

Note 2 to entry: For USB host port components, see Universal Serial Bus 2.0 and Universal Serial Bus 3.0.

3.1.17

UAS target device

USB device that contains one or more UAS target ports that attach to a UAS initiator device

3.1.18

UAS target port

USB interface that contains two USB Bulk-in endpoints, two USB Bulk-out endpoints and the default USB control endpoint

3.1.19

USB device

one or more USB interfaces and the default control endpoint

[ISO/IEC 14776-251:2014](https://standards.iteh.ai/catalog/standards/sist/65556826-5c31-463c-b31f-24b4446bb2cc/iso-iec-14776-251-2014)

<https://standards.iteh.ai/catalog/standards/sist/65556826-5c31-463c-b31f-24b4446bb2cc/iso-iec-14776-251-2014>

Note 1 to entry: See Universal Serial Bus 2.0 and Universal Serial Bus 3.0.

3.1.20

USB endpoint

collection of characteristics describing the USB device implementation of a pipe

Note 1 to entry: See 3.1.9, and Universal Serial Bus 2.0 and Universal Serial Bus 3.0.

3.1.21

USB interface

description of one or more USB endpoints

Note 1 to entry: See Universal Serial Bus 2.0 and Universal Serial Bus 3.0.

3.1.22

USB Packet

unit of data formatted for transmission over Super Speed USB or High Speed USB

3.1.23

write data

data transferred from the SCSI application client's data-out buffer to the SCSI device server, as requested by the Request Data-Out transport protocol service

3.2 Symbols and abbreviations

Abbreviation	Meaning
x	multiplication
/	division
≠ or NE	not equal
≤ or LE	less than or equal to
±	plus or minus
≈	approximately
+	add
-	subtract
< or LT	less than
= or EQ	equal
> or GT	greater than
≥ or GE	greater than or equal to
IU	Information Unit
LSB	Least significant bit
LUN	Logical unit number
MSB	Most significant bit
MSC	Mass Storage Class
SAM-4	SCSI Architecture Model-4
SCSI	Small Computer System Interface
SPC-4	SCSI Primary Commands-4
UAS	USB Attached SCSI (this standard)
USB	Universal Serial Bus (see USB-2 and USB-3)
USB-2	Universal Serial Bus Revision 2.0
USB-3	Universal Serial Bus 3.0 Revision 1.0

3.3 Keywords

invalid

a keyword used to describe an illegal or unsupported bit, byte, word, field or code value; receipt by a device server of an invalid bit, byte, word, field or code value shall be reported as error

mandatory

a keyword indicating an item that is required to be implemented as defined in this standard

may

a keyword that indicates flexibility of choice with no implied preference

may not

a keyword that indicates flexibility of choice with no implied preference

obsolete

a keyword indicating that an item was defined in prior SCSI standards but has been removed from this standard

option, optional

keywords that describe features that are not required to be implemented by this standard; however, if any optional feature defined by this standard is implemented, then it shall be implemented as defined in this standard