Universal Serial Bus
Mass Storage Class

UASP Testing for High Speed and Super Speed Devices (UASP Test Spec)

Designed using SAM-4, UAS, SPC-4, SBC-3

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Document Status

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1 Introduction

1.1 Purpose

The purpose of this specification is to provide assertions and test descriptions to validate devices which indicate [UASP] support. This specification shall not add requirements to the [UASP], [USB-2], or [USB-3] specifications. This means that [UASP] USB devices shall not add hardware, software, or firmware to test the assertions found in this specification.

1.2 Scope

This specification provides assertions and designs for devices implementing [UASP] to validate proper impementation of [UASP].

If there are conflicts between this specification and [UASP], then [UASP] takes precedence on all issues of conflict.

1.3 Related Documents

[SAM-4] ISO/IEC 14776-414, SCSI Architecture Model-4 (SAM-4) (ANSI INCITS 447:2008)

[SAT-2] SCSI/ATA Translation -2 (SAT-2) (ANSI INCITS 465:2010)

[SPC-4] SCSI Primary Commands - 4 (SPC-4) (T10/1731D). Download from www.t10.org.

[SBC-3] SCSI Block Commands - 3 (SBC-3) (T10/1799D). Download from www.t10.org.

[UAS] USB Attached SCSI (T10/2095D). Download from www.t10.org.

[UAS2] USB Attached SCSI - 2 (T10/2229D). Download from www.t10.org.

[UASP] USB Attached SCSI Protocol Revision 1.0, June 24, 2009. Download from www.usb.org

[USB-2] Universal Serial Bus Specification Revision 2.0, April 27, 2000. Download from www.usb.org.

[USB-3] Universal Serial Bus 3.0 Specification Revision 1.0, November 12, 2008. Download from www.usb.org

For further information regarding ANSI standards, contact ANSI Customer Service Department at 212-642-4900 (phone), 212-302-1286 (fax) or via the World Wide Web at http://www.ansi.org.

2 Management Overview

[UAS] devices require compliance to several standards and specifications. These standards and specifications have a hierarchical relationship as follows:

1) [USB-2] Core Spec -Transport, Link and Phy for High Speed devices
2) [USB-3] Core Spec -Transport, Link and Phy for Super Speed devices
3) [SAM-4] - Device command architecture (Provides base requirements for UAS)
4) [UAS] - Protocol (Implements [SAM-4] requirements using [USB-2] and [USB-3])
5) [SPC-4] - Defines commands and data which are functional regardless of device type
6) [SBC-3] - Defines commands and data specific to block devices such as hard Disk drives and Solid State Drives

The following figure illustrates this relationship.

Command Layer	SPC-4 and SBC-3 define commands and parameters
Protocol Layer	SAM-4 Provide Requirements, UAS Implements SAM-4 Requirements using available transport layer services
Transport Layer	
Link Layer	USB-2 Core Spec and USB-3 Core Spec
Physical Layer	
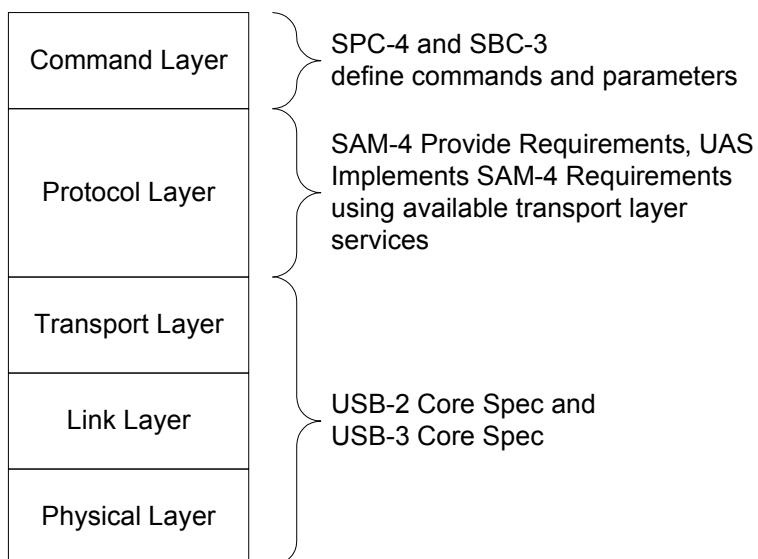
Figure 1 — Standards and Specification Hierarchy

3 Definitions, abbreviations, and conventions

3.1 Acronyms

	Acronym	Decsription
3.1.1	HS	high-speed prefix
3.1.2	VH	high-speed Validation Checks
3.1.3	SS	SuperSpeed prefix
3.1.4	VS	SuperSpeed Validation Checks
3.1.5	SA	Speed Agnostic prefix
3.1.6	VA	Speed Agnostic Validation Checks
3.1.7	HE	high-speed Error case
3.1.8	SE	SuperSpeed Error case
3.1.9	TE	Speed Agnostic Error case
3.1.10	DS	Descriptor Specific
3.1.11	NAA	Naming Address Authority

3.2 Conventions

3.2.1 Lists

3.2.1.1 Lists overview

Lists shall be introduced by a complete grammatical proposition followed by a colon and completed by the items in the list.

Each item in a list shall be preceded by an identification with the style of the identification being determined by whether the list is intended to be an ordered list or an unordered list.

If the item in a list is not a complete sentence, then the first word in the item shall not be capitalized. If the item in a list is a complete sentence, then the first word in the item shall be capitalized,

Each item in a list shall end with a semicolon, except the last item, which shall end in a period. The next to the last entry in the list shall end with a semicolon followed by an "and" or an "or" (i.e., "...; and", or "...; or"). The "and" is used if all the items in the list are required. The "or" is used if only one or more items in the list are required.

3.2.1.2 Unordered lists

An unordered list is one in which the order of the listed items is unimportant (i.e., it does not matter where in the list an item occurs as all items have equal importance). Each list item shall start with a lower case letter followed by a close parenthesis. If it is necessary to subdivide a list item further with an additional unordered list (i.e., have a nested unordered list), then the nested unordered list shall be indented and each item in the nested unordered list shall start with an upper case letter followed by a close parenthesis.

The following is an example of an unordered list with a nested unordered list:

The following are the items for the assembly:

- a) a box containing:
    - A) a bolt;
    - B) a nut; and
    - C) a washer;
- b) a screwdriver; and
- c) a wrench.

3.2.1.3 Ordered lists

An ordered list is one in which the order of the listed items is important (i.e., item n is required before item n+1). Each listed item starts with an Western-Arabic numeral followed by a close parenthesis. If it is necessary to subdivide a list item further with an additional unordered list (i.e., have a nested unordered list), then the nested unordered list shall be indented and each item in the nested unordered list shall start with an upper case letter followed by a close parenthesis.

The following is an example of an ordered list with a nested unordered list:

The following are the instructions for the assembly:

1) remove the contents from the box;
   1) read the instructions; and
   2) check the contents to ensure that all parts are present;
2) assemble the item;
   A) use a screwdriver to tighten the screws; and
   B) use a wrench to tighten the bolts;
   and
3) take a break.

3.2.2 Number range convention

p..q, where p is less than q, represents a range of numbers (e.g., words 100..103 represents words 100, 101, 102, and 103).

3.2.2.1 Field Name convention

Names of fields are in small uppercase (e.g. NAME). Normal case is used when the contents of a field is being discussed. Fields containing only one bit are usually referred to as the NAME bit instead of the NAME field.

4 Test Assertions

Table 1 — [UAS] Descriptor Format Asertions

Label	Assertion	Description	Test	Comments
4.1	[UAS] 5.2.3.2	Configuration Descriptor shall report B NUM INTERFACES > 0	5.3.9	
4.2	[UAS] 5.2.3.3	Interface descriptor shall report class = 08h, subclass = 06h, protocol = 62h.	5.3.10	This precludes reporting subclass 07h and 08h which were designed for use in locking devices when there was only one protocol available.
4.3	[UAS] 5.2.3.3	Interface descriptor may report class = 08h, subclass = 06h, protocol = 62h as an alternate setting.	5.3.11	
4.4	[UAS] 4.1	B NUM ENDPOINTS shall be ≥ 4	5.3.12	
4.5	[UAS] 5.2.3.5	Command Pipe shall be followed by a Pipe Usage Descriptor with the B PIPE ID field set to 01h (Command pipe)	5.3.5	The Pipe Usage descriptor shall be after the affected endpoint descriptor and before the next endpoint descriptor. It is permissable to have other descriptors (e.g., [USB-3] companion or vendor specific) between the endpoint descriptor and the Pipe Usage descriptor
4.6	[UAS] 5.2.3.5	Data-out pipe shall be followed by Pipe Usage Descriptor with the B PIPE ID field set to 04h (data-out pipe)	5.3.6	The Pipe Usage descriptor shall be after the affected endpoint descriptor and before the next endpoint descriptor.
4.7	[UAS] 5.2.3.5	Status pipe shall be followed by Pipe Usage Descriptor with the B PIPE ID field set to 02h (Status pipe)	5.3.7	The Pipe Usage descriptor shall be after the affected endpoint descriptor and before the next endpoint descriptor.
4.8	[UAS] 5.2.3.5	Data-in pipe shall be followed by Pipe Usage Descriptor with the B PIPE ID field set to 03h (data-in pipe)	5.3.8	The Pipe Usage descriptor shall be after the affected endpoint descriptor and before the next endpoint descriptor.
4.9	[UAS] 4.3	Super-Speed: The MAX STREAM field of the SuperSpeed Endpoint Companion Descriptor, for data-in, data-out and Status Pipe, shall be set to a value greater than 1.	5.5.2	Greater than 1 is required to allow for an outstanding command and a task management command (e.g., abort an outstanding command).
4.10	[UAS] 4.1	The interface descriptor bundle shall contain exactly one Pipe Usage descriptor with the B PIPE ID field set to 01h (Command pipe)	5.3.1	
4.11	[UAS] 4.1	The interface descriptor bundle shall contain exactly one Pipe Usage descriptor with the B PIPE ID field set to 02h (Status pipe)	5.3.2	

Table 1 — [UAS] Descriptor Format Asertions

Label	Assertion	Description	Test	Comments
4.12	[UAS] 4.1	The interface descriptor bundle shall contain exactly one Pipe Usage descriptor with the B PIPE ID field set to 03h (data-in pipe)	5.3.3	
4.13	[UAS] 4.1	The interface descriptor bundle shall contain exactly one Pipe Usage descriptor with the B PIPE ID field set to 04h (data-out pipe)	5.3.4	

Table 2 — [UAS] Command Sequencing Assertions (part 1 of 3)

Label	Assertion	Description	Test	Comments
4.14	[UAS] 6.3.2 & 6.3.3	High Speed: the device shall respond to a non-data transfer COMMAND IU on the Command pipe with a SENSE IU or a RESPONSE IU on the Status pipe.	5.4.5.5	
4.15	[UAS] 6.3.2 & 6.3.3	SuperSpeed: the device shall respond to a non-data transfer COMMAND IU on the Command pipe with an ERDY containing the tag from the COMMAND IU followed by a SENSE IU or a RESPONSE IU on the Status pipe.	5.5.6.2	
4.16	[UAS] 6.3.4	High Speed: the device shall respond to a data-out COMMAND IU on the Command pipe with a WRITE READY IU on the Status pipe, accept data on the data-out pipe, followed by a SENSE IU on the Status pipe.	5.4.5.6	
4.17	[UAS] 6.3.4	SuperSpeed: the device shall respond to a data-out COMMAND IU on the Command pipe with an ERDY on the data-out pipe, accept data on the data-out pipe, followed by an ERDY containing the tag from the COMMAND IU followed by a SENSE IU on the Status pipe.	5.5.6.3	
4.18	[UAS] 6.3.5	High Speed: the device shall respond to a data-in COMMAND IU on the Command pipe with a READ READY IU on the Status pipe, send data on the data-in pipe, followed by a SENSE IU on the Status pipe.	5.4.5.7	
4.19	[UAS] 6.3.5	SuperSpeed: the device shall respond to a data-in COMMAND IU on the Command pipe with an ERDY on the data-in pipe, send data on the data-in pipe, followed by an ERDY containing the tag from the COMMAND IU followed by a SENSE IU on the Status pipe.	5.5.6.4	
4.20	[UAS] 6.3.6	High Speed: the device shall respond to a TASK MANAGEMENT IU on the Command pipe with a RESPONSE IU on the Status pipe.	5.4.5.9	

Table 2 — [UAS] Command Sequencing Assertions (part 2 of 3)

Label	Assertion	Description	Test	Comments
4.21	[UAS] 6.3.6	SuperSpeed: the device shall respond to a TASK MANAGEMENT IU on the Command pipe with an ERDY containing the tag from the TASK MANAGEMENT IU followed by a RESPONSE IU on the Status pipe.	5.5.6.6	
4.22	[UAS] 6.3.6	[UAS] device shall support all task management functions listed in the [UAS] task management functions table.	5.6.5.2, 5.6.5.3, 5.6.5.4, 5.6.5.5, 5.6.5.6, 5.6.5.7, 5.6.5.8, 5.6.5.9, 5.6.5.10	
4.23	[UAS] 6.3.7	High Speed: the device shall respond to a bidirectional COMMAND IU on the Command pipe with a READ READY IU or WRITE READY IU on the Status pipe, send data on the data-in pipe, or receive data on the data-out pipe, followed by a SENSE IU on the Status pipe.	5.4.5.8	This assertion is optional for devices which do not implement bi-directional commands. The majority of devices do not need bidirectional transfers. The order of the READ READY IU and WRITE READY IU is determined by the device.
4.24	[UAS] 6.3.7	SuperSpeed: the device shall respond to a bidirectional COMMAND IU on the Command pipe with an ERDY on the data-in pipe, send data on the data-in pipe, or receive data on the data-out pipe, followed by a SENSE IU on the Status pipe.	5.5.6.5	This assertion is optional for devices which do not implement bi-directional commands. The majority of devices do not need bidirectional transfers. The order of the READ READY IU and WRITE READY IU is determined by the device.
4.25	[UAS] 4.3	After the last byte of data is transferred and achieved a USB acknowledgment, the [UAS] target device shall return a SENSE IU on the Status pipe to indicate command completion.	5.6.2.6	This is required to keep completions from being reported before data transfer is done.
4.26	[UAS] 8	A command shall be terminated with CHECK CONDITION status with the sense key set to ABORTED COMMAND and the additional sense code set to TOO MUCH WRITE DATA, INFORMATION UNIT TOO SHORT or INITIATOR RESPONSE TIMEOUT for corresponding data-out delivery failures.		

Table 2 — [UAS] Command Sequencing Assertions (part 3 of 3)

Label	Assertion	Description	Test	Comments
4.27	[UAS] 6.3	For each command sequence that requires USB transfers on the COMMAND, DATA and STATUS pipes, the device shall not require a specific ordering of: a) SuperSpeed: DP on command pipe, ACK (Prime), DP (Stream ID), ACK (Stream ID); or b) HighSpeed: IN Token or OUT Token, on the different pipes.	5.4.5.6, 5.5.6.3, 5.5.6.4, 5.5.6.5, 5.5.7.2, 5.5.7.3, 5.7.2, 5.7.3, 5.7.4, 5.7.5	Need to test both the first command sequencing and second command sequencing. This tests both primed and unprimed operation.
4.28	[UAS] 6.3	For each command sequence that requires USB transfers on the COMMAND and STATUS pipes, a device shall not require a specific ordering of: a) SuperSpeed: ACK (Prime), DP on command pipe, ACK (Stream ID); or b) HighSpeed: IN Token or OUT Token, on the different pipes.	5.5.6.2, 5.5.6.6, 5.6.5.2, 5.6.5.3, 5.6.5.4, 5.6.5.5, 5.6.5.6, 5.6.5.7, 5.6.5.8, 5.6.5.9, 5.6.5.10, 5.7.6, 5.7.7, 5.7.8, 5.7.9, 5.7.10, 5.7.11, 5.7.11	Need to test both the first command sequencing and second command sequencing. This tests both primed and unprimed operation.

Table 3 — [UAS] Protocol Assertions (part 1 of 4)

Label	Assertion	Description	Test	Comments
4.29	[UAS] 4.1	The device shall have sufficient buffering to receive commands after the device has been configured.		
4.30	[UAS] 4.3	The device shall accept multiple commands in its command queue as long as the number of commands is not larger than N, where N is computed as below: N = min(NumberOfStream_DataInPipe, NumberOfStream_DataOutPipe, NumberOfStream_StatusPipe, Host_MaxStreams_Supported)	5.5.4.2	This requirement is by implication. Device queue depth may further limit the number of commands outstanding. This formula is not specified in [UAS], it provides a common mechanism for using a poorly implemented device.
4.31	[UAS] 4.3, 4.10	The device shall not block the Command pipe because its queue is full. Returning NRDY, ACK (NUMP=0), stall or NAK constitute blocking.	5.4.5.5, 5.5.4.3	Stall is from 4.10. This rest is by implication in 4.3. This is the negative statement

Table 3 — [UAS] Protocol Assertions (part 2 of 4)

Label	Assertion	Description	Test	Comments
4.32	[UAS] 4.3	If the task set is full and the [UAS] target port receives a command, then the [UAS] target port shall return a SENSE IU using the Status pipe with a status of TASK SET FULL.	5.4.5.5, 5.5.4.3, 5.7.11	This is a quote This is the positive form of the previous requirement.
4.33	[UAS] 4.2	The device shall support sparse tag assignments	5.4.4.4, 5.5.5.4	Use a tag value that is greater than the number of streams. The number of outstanding tags is less than or equal to the number of streams supported by the device. Tags 0, FFFEh and FFFFh are invalid according to [USB-3]. Tags FFF0h..FFFDh are reserved in the unpublish [UAS-2]. These are tested in the include tests.
4.34	[UAS] 4.2	SuperSpeed: The following tags shall be the same: a) Tag of COMMAND IU = StreamID of Data = StreamID of (SENSE IU or RESPONSE IU); and b) Tag of TASK MANAGEMENT IU = Tag of RESPONSE IU = StreamID of RESPONSE IU.	5.5.5.2, 5.5.5.3	Tag relationships taken as fact in 4.2.
4.35	[UAS] 4.2	High Speed: The following tags shall be the same: a) Tag of COMMAND IU = Tag of SENSE IU = Tag of Read/WRITE READY IU; and b) Tag of TASK MANAGEMENT IU = Tag of RESPONSE IU.	5.4.4.2	
4.36	[UAS] 6.2.2	COMMAND IU shall be contained in a single USB packet and shall not share a USB packet with any other Information Unit		Only one IU is allowed in a packet, If there is more data than expected for that IU, then a RESPONSE IU is returned with INVALID INFORMATION UNIT. You get the packet check the IU type if the data-in the packet is longer than the IU type then you have an invalid IU. Even if the beginning of the packet has what appears to be a valid IU.
4.37	[UAS] 6.2.3	READ READY IU shall be contained in a single USB packet and shall not share a USB packet with any other Information Unit	5.4.3.2	The next 3 assertions could be hard to stimulate.
4.38	[UAS] 6.2.4	WRITE READY IU shall be contained in a single USB packet and shall not share a USB packet with any other Information Unit	5.4.3.3	
4.39	[UAS] 6.2.5	SENSE IU shall be contained in a single USB packet and shall not share a USB packet with any other Information Unit	5.6.4.3	

Table 3 — [UAS] Protocol Assertions (part 3 of 4)

Label	Assertion	Description	Test	Comments
4.40	[UAS] 6.2.6	RESPONSE IU shall be contained in a single USB packet and shall not share a USB packet with any other Information Unit	5.6.4.2	
4.41	[UAS] 6.2.7	TASK MANAGEMENT IU shall be contained in a single USB packet and shall not share a USB packet with any other Information Unit		See COMMAND IU for details (see 4.36)
4.42	[UAS] 4.3	SuperSpeed devices shall use ERDY to supply the tag as a part of returning status.	5.5.3.2	Explicitly stated
4.43	[UAS] 6.2.3	SuperSpeed devices shall use ERDY to supply the tag as a part of returning data to the the host.	5.5.3.3	Explicitly stated
4.44	[UAS] 6.2.4	SuperSpeed devices shall use ERDY to supply the tag as a part of requesting data from the host.	5.5.3.5	Explicitly stated
4.45	[UAS] 6.2.3	Super Speed devices shall not use a READ READY IU as a part of returning data.	5.5.3.4	Implicitly required using "instead of" language
4.46	[UAS] 6.2.4	Super Speed devices shall not use a write ready iu as a part of requesting data.	5.5.3.6	Implicitly required using "instead of" language
4.47	[UAS] 6.2.3	High Speed devices shall use a READ READY IU as a part of returning data.	5.4.5.3	
4.48	[UAS] 6.2.4	High Speed devices shall use A WRITE READY IU as a part of requesting data.	5.4.5.2	
4.49	[UAS] 3.3.7	The device shall set reserved fields in IU's to zero.	5.4.2, 5.6.2.3, 5.6.2.4	[UAS] Definition of reserved.
4.50	[UAS] 3.3.7	The device shall not check reserved fields	5.6.2.2, 5.6.2.5	[UAS] Definition of reserved.
4.51	[UAS] 6.2.1	The device shall return a RESPONSE IU with the RESPONSE CODE field set to INVALID INFORMATION UNIT when it receives an invalid coded value in the IU ID field.	5.7.8	[UAS] definition of reserved
4.52	[UAS] 6.2.7	If the TASK MANAGEMENT FUNCTION field contains a reserved or unsupported value, the task manager shall return a RESPONSE IU with the RESPONSE CODE field set to TASK MANAGEMENT FUNCTION NOT SUPPORTED.	5.7.9	[UAS] Task Management
4.53	[UAS] 6.2.7	If the addressed logical unit does not exist, the task manager shall return a RESPONSE IU with the RESPONSE CODE field set to INCORRECT LOGICAL UNIT NUMBER	5.7.10	[UAS] Task Management

Table 3 — [UAS] Protocol Assertions (part 4 of 4)

Label	Assertion	Description	Test	Comments
4.54	[UAS] 4.2	If a [UAS] target port receives: a) a COMMAND IU with an initiator port transfer tag that is already in use for a task management function; or b) a TASK MANAGEMENT IU with an initiator port transfer tag that is already in use for a command or another task management function, then the [UAS] target device may return a RESPONSE IU with the response code set to OVERLAPPED COMMANDS ATTEMPTED.	5.7.4, 5.7.5	This assertion does not test overlapped commands. There is a may here because devices are not required to police the tags in SCSI. In UAS-2 we might change this requirement.
4.55	[UAS] 4.2	If a UAS target device receives a command with an initiator port transfer tag that is already in use by another command (i.e., an overlapped command) in any logical unit, then the task router and task manager(s) shall: a) abort all task management functions received on that I_T nexus; and b) respond to the overlapped command as defined in SAM-4.	5.7.4, 5.7.5	This assertion only tests overlapped commands
4.56	[UAS] 4.1	If the [UAS] target port is unable to send status to the [UAS] initiator port when said status is available, then the target port may abort all commands in the task set and all commands that the target port receives until the [UAS] target port is able to terminate a command with CHECK CONDITION status with the sense key set to UNIT ATTENTION with the additional sense code set to COMMANDS CLEARED BY DEVICE SERVER.	5.7.2, 5.7.3	This is a quote. The may is present because some devices my be able to hold the status info. There is no provision for the device to lose a status. There is some wording regarding the CREDIT_HP_TIMER that indicates the device has to be able to hold a status for this period of time without aborting everything.
4.57	[UAS] 4.9	If the USB target device detects that it may lose power (e.g., a battery is running low on power), then the USB target port should establish a unit attention condition with additional sense code set to WARNING - POWER LOSS EXPECTED.	5.7.7	UAS
4.58	[SAM-5] 4.7.7	The device shall complete any unsupported command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID COMMAND OPERATION CODE.	5.7.6	SAM-5
4.59	[UAS] 6.4	All the data for a command shall be transmitted before the device requests data transfer for a new command.		This restriction is being removed in UAS-2

Table 4 — [SPC-4] SCSI Command Assertions

Label	Assertion	Description	Test	Comments
4.60	[SPC-4] 6.1	The device shall not return an error when it receives a properly formatted INQUIRY command.	5.6.3.2	[SPC-4] Mandatory command The device can return task set full
4.61		Support: One of SBC (00h) or MMC (05h)		Device types addressed by this spec.
4.62	[UAS] 4.6	The device shall respond to an INQUIRY command with a Device Identification VPD page which contains a DESIGNATOR TYPE field set to 03h	5.4.6.2, 5.5.7.2, 5.6.4.5	This supports the [UAS] requirement that all [UAS] devices support a WWN for each LUN. This specification does not test uniqueness across multiple devices although this is a requirement of WWN. Uniqueness across LUN's is tested.
4.63	[SPC-4] 6.4.1	The device shall support the EVPD bit in the INQUIRY command with page code set to the Device Identification (i.e., 83h) VPD page.	5.4.6.2, 5.5.7.2, 5.6.4.5	The EVPD bit and the page code are mandatory in SPC-4.
4.64	[SPC-4] 6.4.2	INQUIRY data bit CMDQUE shall be set to one	5.4.6.3, 5.5.7.3	
4.65	[SPC-4] 6.4.2	Version descriptors shall match the peripheral device type when they are present.	5.6.4.4	This requires them to match the device, but they are not required to be present. [UAS] calls out [SPC-4] as required, through twisted logic, you could require the VERSION field to have SPC-4
4.66	[SPC-4] 6.1	The device shall not return an error when it receives a properly formatted TEST UNIT READY command	5.6.3.3	[SPC-4] Mandatory command The device can return task set full
4.67	[SPC-4] 6.1	The device shall not return an error when it receives a properly formatted REQUEST SENSE command	5.6.3.4	[SPC-4] Mandatory command The device can return task set full
4.68	[SPC-4] 6.1	The device shall not return an error when it receives a properly formatted REPORT LUNS command	5.6.3.5	[SPC-4] Mandatory command The device can return task set full

5 USB-3 Test Descriptions

5.1 Overview

There are 5 sections of test descriptions: high-speed, SuperSpeed, Speed Agnostic, Descriptor specific test and Error Code check tests for high-speed, SuperSpeed and Speed Agnostic. These tests do not test full-speed devices. The high-speed tests list those tests that only apply when the device is operating at high-speed. The SuperSpeed tests list those tests that only apply when the device is operating at SuperSpeed. The Speed Agnostic tests list those tests that apply when the device is operating at any speed. Descriptor specific tests list those tests that are applied to check the [UAS] specific descriptor fields. The Error code check tests list those tests that apply when the device is responding with the expected error codes.

A compliant device shall pass the Speed Agnostic tests in addition to the speed specific tests at either or both of the speeds at which the device supports operation.

A compliant device shall pass all of the methods described for tests and tests that have multiple methods

Each test describes the assertions tested, an overview of the test steps and the method(s) used to perform the test. There are also tests that are done on specific parts of a command or response. Each test describes the initial conditions required for the test and the verification step(s) required for the test. Each test is identified with a two letter prefix and a number to allow easy reference to each test and test.

In some of the test steps there is an indication that the test should wait at least 1ms but less than 2ms. This is present to ensure the proper ordering of commands to the device. If the host is capable of guaranteeing that the previous step has been seen by the device before the next step is started without the 1-2ms delay, then the proprietary method is an acceptable replacement for this step.

Some tests may leave the device in a condition that has error or unit attention. The test implementor shall ensure that these conditions are cleared before starting a test.

The tests with a VS_ label, a VH_ label and the VA_ label are validation checks. These are test fragments that need to be inserted into the tests where they are referenced (e.g., listed in the Applicable Tests subclause or in the test description of the V?_ test). This is an exercise left to the test designer (e.g., VS_09 validates that the tags are the same for the COMMAND IU, data transfer, and status. This check is performed in every test method that references VS_09).

All field in IUs and commands shall be set to value that allow the data under test to be returned. The status buffers shall be sized to fit the status under test.

5.2 Test Command Sets

5.2.1 Overview

SCSI commands are used to stimulate behavior for the tests defined in this document. Different possible SCSI commands can be used to achieve the desired behavior. The following test command sets are defined and referenced in subsequent tests to allow a test to use one or more of the commands within the test command set to stimulate the desired behavior.

These tests apply to devices that report a PERIPHERAL DEVICE TYPE of 00h (i.e., Direct access block device, see [SPC-4]) or 05h (i.e., CD/DVD device, see [SPC-4]) in the INQUIRY command. All other PERIPHERAL DEVICE TYPEs are only required to support the commands labeled Mandatory SPC-4.

The commands cited here are defined in the standards listed. All of these commands have translations from SCSI into ATA and are found in the [SAT-2] standards document.

For the host to process a command, the following steps are required:

1) Send a COMMAND IU on the command pipe containing a valid command;
2) If the command requires data transfer, then transfer data when the device requests the data; and
3) Receive a SENSE IU or a RESPONSE IU on the status pipe.

5.2.2 TCS-NDT (Test Command Set - Non-data Transfer)

Table 5 — Test Command Set - Non-data Transfer

Command	Mandatory	Reference
TEST UNIT READY	Yes	SPC-4
START STOP UNIT	No	SBC-3
PREVENT ALLOW MEDIUM REMOVAL	No	SBC-3

5.2.3 TCS-TM (Test Command Set - Task Management)

Table 6 — Test Command Set - Task Management

Command	Mandatory	Reference
ABORT TASK		UAS
ABORT TASK SET		UAS
CLEAR ACA		UAS
CLEAR TASK SET		UAS
I_T NEXUS RESET		UAS
LOGICAL UNIT RESET		UAS
QUERY TASK		UAS
QUERY TASK SET		UAS
QUERY ASYNCHRONOUS EVENT		UAS

5.2.4 TCS-DI (Test Command Set - data-in)

Table 7 — Test Command Set - data-in

Command	Mandatory	Reference
INQUIRY	Yes	SPC-4
READ CAPACITY (10)	Yes	SBC-3
READ CAPACITY (16)	No	SBC-3
REQUEST SENSE	Yes	SPC-4
REPORT LUNS	Yes	SPC-4
READ (10)	Yes	SBC-3
READ (12)	No	SBC-3
READ (16)	No	SBC-3

5.2.5 TCS-DO (Test Command Set - data-out)

Table 8 — Test Command Set - data-out

Command	Mandatory	Reference
FORMAT UNIT	Yes	SBC-3
SEND DIAGNOSTIC	Yes	SPC-4
WRITE (10)	Yes	SBC-3
WRITE (12)	No	SBC-3
WRITE (16)	No	SBC-3

5.2.6 TCS-DB (Test Command Set - Data Bi-directional)

Table 9 — Test Command Set - Data Bi-directional

Command	Mandatory	Reference
XDWRITEREAD (10)	No	SBC-3

5.3 Validation of descriptors

5.3.1 DS_01 Verification of Command pipe in Pipe Usage Descriptor

5.3.1.1 Overview

This test verifies that the expected number of the Pipe Usage Descriptors with the Command B PIPE ID are present in the Interface Descriptor.

5.3.1.2 Assertions Used in Test

The Interface Descriptor bundle shall contain exactly one Pipe Usage Descriptor with the B PIPE ID field set to 01h (i.e., Command pipe) (see 4.10).

5.3.1.3 test initialization

Retrieve configuration descriptor bundle (which include interface, endpoint and Pipe Usage Descriptors).

5.3.1.4 test verification

Verify that the only one Command Pipe Usage Descriptor with the B PIPE ID field set to 01h is present.

5.3.2 DS_02 Verification of Status pipe in Pipe Usage Descriptor

5.3.2.1 Overview

This test verifies that the expected number of Pipe Usage Descriptors with the Status B PIPE ID are present in the Interface Descriptor.

5.3.2.2 Assertions Used in Test

The Interface Descriptor bundle shall contain exactly one Pipe Usage Descriptor with the B PIPE ID field set to 02h (i.e., Status pipe) (see 4.11).

5.3.2.3 test initialization

Retrieve configuration descriptor bundle (which include interface, endpoint and Pipe Usage Descriptors).

5.3.2.4 test verification

Verify that only one Status Pipe Usage Descriptor with the B PIPE ID field set to 02h present.

5.3.3 DS_03 Verification of data-in pipe in Pipe Usage Descriptor

5.3.3.1 Overview

This test verifies that the expected number of Pipe Usage Descriptors with the data-in B PIPE ID are present in the Interface Descriptor.

5.3.3.2 Assertions Used in Test

The Interface Descriptor bundle shall contain exactly one Pipe Usage Descriptor with the B PIPE ID field set to 03h (i.e., data-in pipe) (see 4.12).

5.3.3.3 test initialization

Retrieve configuration descriptor bundle (which include interface, endpoint and Pipe Usage Descriptors).

5.3.3.4 test verification

Verify that only one status data-in Pipe Usage Descriptor with the B PIPE ID field set to 03h present.

5.3.4 DS_04 Verification of data-out pipe in Pipe Usage Descriptor

5.3.4.1 Overview

This test verifies that the expected number of Pipe Usage Descriptors with the data-out B PIPE ID are present in Interface Descriptor.

5.3.4.2 Assertions Used in Test

The Interface Descriptor bundle shall contain exactly one Pipe Usage Descriptor with the B PIPE ID field set to 04h (i.e., data-out pipe) (see 4.13).

5.3.4.3 test initialization

Retrieve configuration descriptor bundle (which include interface, endpoint and Pipe Usage Descriptors).

5.3.4.4 test verification

Verify that only one status data-out Pipe Usage Descriptor with the B PIPE ID field set to 04h present.

5.3.5 DS_05 Verification of Command pipe

5.3.5.1 Overview

This test verifies that that the command pipe's usage descriptor contains expected B PIPE ID field.

5.3.5.2 Assertions Used in Test

Command pipe shall be followed by Pipe Usage Descriptor with the B PIPE ID field set to 01h (Command pipe) (see 4.5)

5.3.5.3 test initialization

1) Retrieve configuration descriptor bundle (which include interface, endpoint and Pipe Usage Descriptors); and
2) locate the [UAS] Interface Descriptor.

5.3.5.4 test verification

1) Locate and verify that there is a Command pipe endpoint descriptor before the next Interface Descriptor;
2) verify there is a Pipe Usage Descriptor before the next endpoint descriptor; and
3) verify that B PIPE ID field is 01h.

5.3.6 DS_06 Verification of data-out pipe

5.3.6.1 Overview

This test verifies that the data-out pipe's usage descriptors contain expected B PIPE ID field.

5.3.6.2 Assertions Used in Test

data-out Pipe shall be followed by Pipe Usage Descriptor with the B PIPE ID field set to 04h (data-out pipe) (see 4.6).

5.3.6.3 test initialization

1) Retrieve the configuration descriptor bundle (e.g., interface, endpoint and Pipe Usage Descriptors); and
2) locate the [UAS] Interface Descriptor.

5.3.6.4 test verification

1) Locate and verify that there is a data-out pipe endpoint descriptor before the next Interface Descriptor;
2) verify that there is a Pipe Usage Descriptor before the next endpoint descriptor; and
3) verify that the B PIPE ID field is 04h.

5.3.7 DS_07 Verification of Status pipe

5.3.7.1 Overview

This test verifies that the Status pipe's usage descriptors contain expected B PIPE ID field.

5.3.7.2 Assertions Used in Test

Status pipe shall be followed by Pipe Usage Descriptor with the B PIPE ID field set to 02h (Status pipe) (see 4.7).

5.3.7.3 test initialization

1) Retrieve the configuration descriptor bundle (e.g., interface, endpoint and Pipe Usage Descriptors); and
2) locate the [UAS] Interface Descriptor.

5.3.7.4 test verification

1) Locate and verify there is a Status pipe endpoint descriptor before the next Interface Descriptor;
2) verify there is a Pipe Usage Descriptor before the next endpoint descriptor;
3) verify that the B PIPE ID field is set to 02h.

5.3.8 DS_08 Verification of data-in pipe

5.3.8.1 Overview

This test verifies that the data-in Pipe Usage Descriptors contain the expected B PIPE ID field.

5.3.8.2 Assertions Used in Test

The data-in pipe shall be followed by Pipe Usage Descriptor with the B PIPE ID field set to 03h (data-in pipe) (see 4.8).

5.3.8.3 test initialization

1) Retrieve the configuration descriptor bundle (e.g., interface, endpoint and Pipe Usage Descriptors); and
2) locate the [UAS] Interface Descriptor.

5.3.8.4 test verification

1) Locate and verify that there is a data-in pipe endpoint descriptor before the next Interface Descriptor;
2) verify that there is a Pipe Usage Descriptor before the next endpoint descriptor; and
3) verify that the B PIPE ID field is set to 03h.

5.3.9 DS_09 Verification of Configuration Descriptor's bNumInterfaces

5.3.9.1 Overview

This test verifies that bNumInterfaces is greater than zero in the configuration descriptor.

5.3.9.2 Assertions Used in Test

The Configuration Descriptor shall report B NUM INTERFACES > 0 (see 4.1).

5.3.9.3 test initialization

Fetch the configuration descriptor from the device.

5.3.9.4 test verification

Verify that the bNumInterfaces field is greater than zero.

5.3.10 DS_10 Verification of Interface Descriptor's Class, Subclass & Protocol

5.3.10.1 Overview

This test verifies the [UAS] specific values in Interface Descriptor.

5.3.10.2 Assertions Used in Test

The Interface Descriptor shall report class = 08h, subclass = 06h, protocol = 62h (see 4.2).

5.3.10.3 test initialization

Retrieve configuration descriptor bundle (which include interface, endpoint and Pipe Usage Descriptors).

5.3.10.4 test verification

Verify that at least one Interface Descriptor is received with the following:

a)   class value is set to 08h;
b)   subclass value is set to 06h; and
c)   Protocol value is set to 62h.

5.3.11 DS_11 Verification of Interface Descriptor's Alternate Settings

5.3.11.1 Overview

This test verifies the [UAS] specific values in the Interface Descriptor's alternate settings.

5.3.11.2 Assertions Used in Test

The Interface Descriptor may report class = 08h, subclass = 06h, protocol = 62h as an alternate setting (see 4.3).

5.3.11.3 test initialization

Retrieve the configuration descriptor bundle (e.g., interface, endpoint and Pipe Usage Descriptors).

5.3.11.4 test verification

Verify that there are zero or more alternate settings with:

a)   class value set to 08h
b)   subclass value set to 06h
c)   Protocol value set to 62h

5.3.12 DS_12 Verification of bNumEndPoints

5.3.12.1 Overview

This test verifies that the device supports the expected number of endpoints.

5.3.12.2 Assertions Used in Test

B NUM ENDPOINTS shall be >= 4 (see 4.4)

5.3.12.3 test initialization

Fetch the Interface Descriptor from the device for each [UAS] interface or alternate setting.

5.3.12.4 test verification

Verify that bNumEndPoint value is greater than or equal to 4.

5.4 High-speed Tests

5.4.1 Overview

This section describes the USB [UAS] compliance tests that device shall pass when the device is operating at high-speed. This section describes the tests that need to be performed when the device is in the Configured USB device state. For these tests, the device shall have a configuration selected (e.g., via a SET_CONFIGURATION request) that includes a [UAS] interface.

5.4.2 Reserved Field Validation of IUs

5.4.2.1 Overview

These tests shall be performed on all IUs sent to or received from the device when a [UAS] command is sent to a device or some device response is received.

5.4.2.2 VH_01 Reserved Field Validation of READ READY IUs

This test verifies that the reserved fields in READ READY IUs are set to zero. This test shall be done for every READ READY IU that is sent from a device.

5.4.2.2.1 Assertions Used in Test

The device shall set reserved fields in IUs to zero (see 4.49).

5.4.2.2.2 test initialization

Send TCS-DI to device.

5.4.2.2.3 test verification

Upon reception of READ READY IU, verify that each reserved field is set to zero. The following are the reserved fields in the READ READY IU: Byte 1.

5.4.2.3 VH_02 Reserved Field Validation of WRITE READY IUs

5.4.2.3.1 Overview

This test verifies that the reserved fields in WRITE READY IUs are set to 0. This test shall be done for every WRITE READY IU that is sent from a device.

5.4.2.3.2 Assertions Used in Test

The device shall set reserved fields in IU's to zero (see 4.49).

5.4.2.3.3 test initialization

Send TCS-DO to device.

5.4.2.3.4 test verification

Upon reception of WRITE READY IU, verify that each reserved field is set to zero. The following are the reserved fields in the WRITE READY IU: Byte 1.

5.4.3 Validation of IUs in Single Packet

5.4.3.1 Overview

These tests shall be performed on all IUs sent to or received from the device when a [UAS] command is sent to a device or a device response is received.

5.4.3.2 VH_03 READ READY IUs in Single Packet

5.4.3.2.1 Overview

This test verifies that the READ READY IU is in a single packet.

5.4.3.2.2 Assertions Used in Test

The READ READY IU shall be contained in a single USB packet and shall not share a USB packet with any other Information Unit (see 4.37).

5.4.3.2.3 test initialization

Send TCS-DI to device.

5.4.3.2.4 test verification

Upon reception of READ READY IU, verify that response packet exists within a single USB packet by verifying that the IU length is the same as the received data length from the Status pipe.

5.4.3.3 VH_04 WRITE READY IUs in Single Packet

5.4.3.3.1 Overview

This test verifies that the WRITE READY IU exists in a single packet.

5.4.3.3.2 Assertions Used in Test

The WRITE READY IU shall be contained in a single USB packet and shall not share a USB packet with any other Information Unit (see 4.38).

5.4.3.3.3 test initialization

Send TCS-DO to device.

5.4.3.3.4 test verification

Upon reception of WRITE READY IU, verify that response packet exists within a single USB packet by verifying the IU length is the same as the received data length from the Status pipe.

5.4.4 Validation of Tag Values

5.4.4.1 Overview

These tests shall be performed on all IUs sent/received to/from device.

5.4.4.2 VH_05 Tag Value Verification

This test verifies the tag values during COMMAND operation.

5.4.4.2.1 Assertions Used in Test

The following tags shall be the same:

> Tag of COMMAND IU = Tag of SENSE IU = Tag of READ/WRITE READY IU (see 4.35).

5.4.4.2.2 Method 1
5.4.4.2.2.1 test initialization
1) Send a TCS-DO command to the device with the TAG field set to x; and
2) upon reception of WRITE READY IU, send the data.

5.4.4.2.2.2 test verification

Upon reception of the WRITE READY IU and SENSE IU, verify that the TAG field is set to x.

5.4.4.2.3 Method 2
5.4.4.2.3.1 test initialization
1) Send a TCS-DI to the device with the TAG field set to x; and
2) upon reception of READ READY IU, send the data.

5.4.4.2.3.2 test verification

Upon reception of the READ READY IU and SENSE IU, verify that the tag value is x.

5.4.4.3 VH_06 TASK MANAGEMENT IU Tag Value Verification

5.4.4.3.1 Overview

This test verifies the tag values during COMMAND operation

5.4.4.3.2 Assertions Used in Test

The following tags shall be the same:

> tag of TASK MANAGEMENT IU = tag of RESPONSE IU (see 4.35).

5.4.4.3.3 test initialization

Send a TCS-TM command to the device using a TASK MANAGEMENT IU with tag value x.

5.4.4.3.4 test verification

Upon reception of the RESPONSE IU, verify that the tag value is x.

5.4.4.4 HS_07 Sparse tag assignment verification

5.4.4.4.1 Overview

This test verifies the device accepts any valid tag value in COMMAND and TASK MANAGEMENT IUs. Tag values are arbitrary 16-bit integers chosen by the host.

5.4.4.4.2 Assertions Used in Test

The device shall support sparse tag assignments (see 4.33)

5.4.4.4.3 Applicable Tests

HS_01, HS_02, HS_04 (and by extension, VH_01, VH_02, VH_03, VH_04, VH_05, VH_06, VH_08)

5.4.4.4.4 Method 1

5.4.4.4.4.1 test initialization

1) Send a TCS-DO command to the device with the TAG field set to x, where x is a value chosen from the tag test set is a 16-bit integer:
   A) that is not 0 or FFF0h..FFFFh; and
   B) is greater than the maximum number of streams reported by the device.
2) follow one of the test methods in HS_01 to send data and then receive status from the device; and
3) repeat step 1 and step 2 for the other tags in the tag test set.

5.4.4.4.4.2 test verification

Verify the device completes all the TCS-DO command successfully according to the test methods in HS_01.

5.4.4.4.5 Method 2

5.4.4.4.5.1 test initialization

1) Send a TCS-DI command to the device with the TAG field set to x, where x is a value chosen from the tag test set is a 16-bit integer:
   A) that is not 0 or FFF0h..FFFFh; and
   B) is greater than the maximum number of streams reported by the device.
2) follow one of the test methods in HS_02 to receive the data and then status from the device; and
3) repeat step 1 and step 2 for the other tags in the tag test set.

5.4.4.4.5.2 test verification

Verify the device completes all the TCS-DI command successfully according to the test methods in HS_02.

5.4.4.4.6 Method 3

5.4.4.4.6.1 test initialization

1) Send a TCS-TM command to the device with the TAG field set to x, where x is a value chosen from the tag test set is a 16-bit integer:
   A) that is not 0 or FFF0h..FFFFh; and
   B) is greater than the maximum number of streams reported by the device;
2) follow one of the test methods in HS_04 to receive the response from the device; and
3) repeat step 1 and step 2 for the other tags in the tag test set.

5.4.4.4.6.2 test verification

Verify the device completes all the TCS-TM command according to the test methods in HS_04.

5.4.5 Validation of data-in/data-out Response

5.4.5.1 Overview

These tests shall be performed on all data-in and data-out commands sent to or received from the device when a [UAS] command is sent to a device or a device response is received.

5.4.5.2 VH_07 data-out Command Response Verification

5.4.5.2.1 Overview

This test verifies that the status returned for a valid data-out request is WRITE READY IU.

5.4.5.2.2 Assertions Used in Test

High-speed devices shall use a WRITE READY IU as a part of requesting data (see 4.48).

5.4.5.2.3 test initialization

Send a TCS-DO command to the device.

5.4.5.2.4 test verification

Upon reception of the response, verify that response is a WRITE READY IU.

5.4.5.3 VH_08 data-in Command Response Verification

5.4.5.3.1 Overview

This test verifies that the status returned for a valid data-in request is a READ READY IU.

5.4.5.3.2 Assertions Used in Test

High-speed devices shall use a READ READY IU as a part of returning data (see 4.47).

5.4.5.3.3 test initialization

Send a TCS-DI command to the device.

5.4.5.3.4 test verification

Upon reception of the response, verify that response is a READ READY IU.

5.4.5.4 VH_09 Unused

This test was deleted.

5.4.5.5 VH_10 Verification of Multiple Command Execution

5.4.5.5.1 Overview

This test verifies that multiple commands are executed successfully.

5.4.5.5.2 Assertions Used in Test

The device shall not block the Command pipe because its queue is full. Returning NRDY, stall or NAK constitute blocking (see 4.31 and 4.32).

5.4.5.5.3 test initialization

Send a number of TCS-DO commands until the device's queue is filled.

5.4.5.5.4 test verification

Confirm that received responses are SENSE IU with status TASK SET FULL error code.

5.4.5.6 HS_01 Write Data Transfer Command Response Verification

5.4.5.6.1 Overview

This test verifies the write data transfer command response.

5.4.5.6.2 Assertions Used in Test

The device shall respond to a data-out COMMAND IU with a WRITE READY IU, accept data on the data-out pipe, followed by a SENSE IU (see 4.16).

For each command sequence that requires USB transfers on the COMMAND, DATA and STATUS pipes, the device shall not require a specific ordering of IN Token or OUT Token, on the different pipes (see 4.27).

5.4.5.6.3 Applicable tests

The following tests shall be applied for this test:

VH_07, VH_05, VH_04, VH_02, VA_01, VA_02, VA_05 and VA_11

5.4.5.6.4 Overview of Test Steps

A device shall pass all the methods specified below. These methods are present to test the different ordering defined by UASP for transfers on the Command, Data and Status pipes.

5.4.5.6.5 Method 1

1) Send a TCS-DO command;
2) wait approximately 1ms (but less than 2ms);
3) the host submits a read request for receiving status;
4) the device responds with the WRITE READY IU;
5) perform the following checks on the received response;

       A)   check that the received response contains WRITE READY IU (07h); and
       B)   check that the tag in the WRITE READY IU is the same as the tag in the COMMAND IU;
6)   issue Data to the device on data-out pipe;
7)   wait approximately 1ms (but less than 2ms);
8)   the host submits a read request for receiving status;
9)   the device should respond with the SENSE IU; and
10) perform the following checks on the received response;
       A)   check that the received response contains SENSE IU (03h); and
       B)   check that the tag in the SENSE IU is that same as the tag in the COMMAND IU.

5.4.5.6.6 Method 2

1)   The host submits a read request for receiving status;
2)   wait approximately 1ms (but less than 2ms);
3)   send a TCS-DO command;
4)   the device should respond with a WRITE READY IU;
5)   perform the following checks on the received response;
       A)   check that the received packet contains WRITE READY IU (07h); and
       B)   check that the tag in the WRITE READY IU is that same as the tag in the COMMAND IU;
6)   issue Data to the device on data-out pipe;
7)   wait approximately 1ms (but less than 2ms);
8)   that host submits a read request for receiving status;
9)   the device should respond with a SENSE IU; and
10) perform the following checks on the received response;
       A)   check that the received response contains a SENSE IU (03h); and
       B)   check that the tag in the SENSE IU is the same as the tag in the COMMAND IU.

5.4.5.6.7 Method 3

1)   Send a TCS-DO command;
2)   wait approximately 1ms (but less than 2ms);
3)   the host submits a read request for receiving status;
4)   the device should respond with the WRITE READY IU;
5)   perform the following checks on the received response;
       A)   check that the received response contains WRITE READY IU (07h); and
       B)   check that the tag in the WRITE READY IU is that same as the tag in the COMMAND IU;
6)   the host submits a read request for receiving status;
7)   wait approximately 1ms (but less than 2ms);
8)   issue data to the device on the data-out pipe;
9)   the device should respond with a SENSE IU; and
10) perform the following checks on the received response;
       A)   check that the received response containsa SENSE IU (03h); and
       B)   check that the tag in the SENSE IU is is the same as the tag in the COMMAND IU.

5.4.5.6.8 Method 4

1)   The host submits a read request for receiving status;
2)   wait approximately 1ms (but less than 2ms);
3)   send a TCS-DO command;
4)   the device should respond with the WRITE READY IU;
5)   perform the following checks on the received response;
       A)   check that the received packet contains WRITE READY IU (07h); and
       B)   check that the tag in the WRITE READY IU is the same as the tag in the COMMAND IU;
6)   wait approximately 1ms (but less than 2ms);
7)   the host submits a read request for receiving status;
8)   issue data to the device on data-out pipe;
9)   the device should respond with the SENSE IU; and
10) perform the following checks on the received response;
       A)   check that the received response contains a SENSE IU (03h); and
       B)   check that the tag in the SENSE IU is the same as the tag in the COMMAND IU.

5.4.5.7 HS_02 Read Data Transfer Command Response Verification

5.4.5.7.1 Overview

This test verifies the read data transfer command response.

5.4.5.7.2 Assertions Used in Test

The device shall respond to a data-in COMMAND IU on the Command pipe with a READ READY IU, send data on the data-in pipe, followed by a SENSE IU (see 4.18).

For each command sequence that requires USB transfers on the COMMAND, DATA and STATUS pipes, the device shall not require a specific ordering of IN Token or OUT Token, on the different pipes (see 4.27).

5.4.5.7.3 Applicable tests

Following tests shall be applied for this test:

VH_08, VH_05, VH_03, VH_01, VA_01, VA_02, VA_05 and VA_11

5.4.5.7.4 Overview of Test Steps

A device shall pass all the methods specified below. These methods are present to test the different ordering defined by UASP for transfers on the Command, Data and Status pipes.

5.4.5.7.5 Method 1

1) send a TCS-DI command;
2) wait approximately 1ms (but less than 2ms);
3) the host submits a read request for receiving status;
4) the device should respond with a READ READY IU;
5) perform the following checks on the received response;
    A) check that the received response contains a READ READY IU (06h); and
    B) check that the tag in the READ READY IU is the same as the tag in the COMMAND IU;
6) issue a request to read data from the device on the data-in pipe;
7) wait approximately 1ms (but less than 2ms);
8) the host submits a read request for receiving status;
9) the device should respond with the SENSE IU; and
10) Perform the following checks on the received response;
    A) check that the received response contains a SENSE IU (03h); and
    B) check that the tag in the SENSE IU is the same as the tag in the COMMAND IU.

5.4.5.7.6 Method 2

1) The host submits a read request for receiving status;
2) wait approximately 1ms (but less than 2ms);
3) send a TCS-DI command;
4) the device should respond with a READ READY IU;
5) perform the following checks on the received response;
    A) check that the received response contains a READ READY IU; and
    B) check that the tag in the READ READY IU is the same as the tag in the COMMAND IU;
6) issue a request to read data from the device on the data-in pipe;
7) wait approximately 1ms (but less than 2ms);
8) the host submits a read request for receiving status;
9) the device should respond with a SENSE IU; and
10) perform the following checks on the received response;
    A) check that the received response contains SENSE IU; and
    B) check that the tag in the SENSE IU is the same as the tag in the COMMAND IU.

5.4.5.7.7 Method 3

1) Send a TCS-DI command;
2) wait approximately 1ms (but less than 2ms);
3) the host submits a read request for receiving status;
4) the device should respond with a READ READY IU;

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5) perform the following checks on the received response;
    A) check that the received response contains a READ READY IU; and
    B) check that the tag in the READ READY IU is the same as the tag in the COMMAND IU;
6) the host submits a read request for receiving status;
7) wait approximately 1ms (but less than 2ms);
8) issue a request to read data from the device on the data-in pipe;
9) the device should respond with a SENSE IU; and
10) Perform the following checks on the received response;
    A) check that the received response contains a SENSE IU; and
    B) check that the tag in the SENSE IU is the same as the tag in the COMMAND IU.

5.4.5.7.8 Method 4

1) The host submits a read request for receiving status;
2) wait approximately 1ms (but less than 2ms);
3) send a TCS-DI command;
4) the device should respond with a READ READY IU;
5) perform the following checks on received response;
    A) check that the received response contains a READ READY IU; and
    B) check that the tag in the READ READY IU is the same as the tag in the COMMAND IU;
6) wait approximately 1ms (but less than 2ms);
7) the host submits a read request for receiving status;
8) issue a request to read data from device on the data-in pipe;
9) Device should respond with the SENSE IU; and
10) perform the following checks on the received response;
    A) check that the received response contains a SENSE IU; and
    B) check that the tag in the SENSE IU is the same as the tag in the COMMAND IU.

5.4.5.8 HS_03 Bi-Directional Data Transfer Command's Response Verification

5.4.5.8.1 Overview

This test verifies that the UASP device responds as expected to valid bi-directional data transfer command compliance with the UASP Specification. This test is applicable to a device that supports bi-directional data transfer command.

5.4.5.8.2 Assertions Used in Test

The device shall respond to a bidirectional COMMAND IU on the Command pipe with a READ READY IU or WRITE READY IU, send data on the data-in pipe, or receive data on the data-out pipe, followed by a SENSE IU (see 4.23).

For each command sequence that requires USB transfers on the COMMAND, DATA and STATUS pipes, the device shall not require a specific ordering of IN Token or OUT Token, on the different pipes (see 4.27).

5.4.5.8.3 Applicable tests

Following tests shall be applied for this test:

VH_07, VH_08, VH_05, VH_04, VH_03, VH_02, VH_01, VA_01, VA_02, VA_05 and VA_11

5.4.5.8.4 Overview of Test Steps

A device shall pass all the methods specified below. These methods are present to test the different ordering defined by UASP for transfers on the Command, Data and Status pipes.

5.4.5.8.5 Method 1

1) send a TCS-DB command;
2) wait approximately 1ms (but less than 2ms);
3) the host submits a read request for receiving the response;
4) the device should respond with a READ READY IU followed by a WRITE READY IU or vice versa;
5) perform the following checks on the received response;
    A) check that the received response contains a READ READY IU or a WRITE READY IU; and

B) check that the tag in the READ READY IU or the WRITE READY IU is the same as the tag in the COMMAND IU;
6) when the READ READY IU is received, issue a request to read data from the device on the data-in pipe;
7) when the WRITE READY IU is received, issue a request to write data to the device on the data-out pipe;
8) wait approximately 1ms (but less than 2ms);
9) the host submits a read request for receiving status;
10) the device should respond with a SENSE IU; and
11) perform the following checks on the received response;
    A) check that the received response contains a SENSE IU; and
    B) check that the tag in the SENSE IU is the same as the tag in the COMMAND IU.

5.4.5.8.6 Method 2

1) The host submits a read request for receiving the response;
2) wait approximately 1ms (but less than 2ms);
3) send a TCS-DB command;
4) the device should respond with a READ READY IU followed by a WRITE READY IU or vice versa;
5) Perform the following checks on the received response;
    A) check that the received response contains a READ READY IU or a WRITE READY IU; and
    B) check that the tag in the READ READY IU or the WRITE READY IU is the same as the tag in the COMMAND IU;
6) when the READ READY IU is received, issue a request to read data from the device on the data-in pipe;
7) when the WRITE READY IU is received, issue a request to write data to device on the data-out pipe;
8) wait approximately 1ms (but less than 2ms);
9) the host submits a read request for receiving status;
10) the device should respond with a SENSE IU; and
11) Perform the following checks on the received response;
    A) check that the received response contains SENSE IU; and
    B) check that the tag in the SENSE IU is the same as the tag in the COMMAND IU.

5.4.5.8.7 Method 3

1) Send a TCS-DB command;
2) wait approximately 1ms (but less than 2ms);
3) the host submits a read request for receiving a response;
4) the device should respond with a READ READY IU followed by a WRITE READY IU or vice versa;
5) perform the following checks on the received response;
    A) check that the received response contains a READ READY IU or a WRITE READY IU; and
    B) check that the tag in the READ READY IU or WRITE READY IU is the same as the tag in the COMMAND IU;
6) the host submits a read request for receiving status;
7) wait approximately 1ms (but less than 2ms);
8) when a READ READY IU is received, issue a request to read data from the device on the data-in pipe;
9) when a WRITE READY IU is received, issue request to write data to the device onthe data-out pipe;
10) the device should respond with a SENSE IU; and
11) perform the following checks on the received response;
    A) check that the received response contains a SENSE IU; and
    B) check that the tag in the SENSE IU is the same as the tag in the COMMAND IU.

5.4.5.8.8 Method 4

1) The host submits a read request for receiving a response;
2) wait approximately 1ms (but less than 2ms);
3) send a TCS-DB command;
4) the device should respond with a READ READY IU followed by a WRITE READY IU or vice versa;
5) perform the following checks on the received response;
    A) check that the received response contains a READ READY IU or a WRITE READY IU; and
    B) check that the tag in the READ READY IU or WRITE READY IU is the same as the tag in the COMMAND IU;
6) the host submits a read request for receiving status;

7) wait approximately 1ms (but less than 2ms);
8) when a READ READY IU is received, issue a request to read data from the device on the data-in pipe;
9) when a WRITE READY IU is received, issue a request to write data to the device on the data-out pipe;
10) the device should respond with a SENSE IU; and
11) perform the following checks on the received response;
   A)   check that the received response contains a SENSE IU;
   B)   check that the tag in the SENSE IU is the same as the tag in the COMMAND IU.

5.4.5.9 HS_04 TASK MANAGEMENT IU Command Response Verification

5.4.5.9.1 Overview

This test verifies the TASK MANAGEMENT IU command response.

5.4.5.9.2 Assertions Used in Test

The device shall respond to a TASK MANAGEMENT IU on the Command pipe with a RESPONSE IU (see 4.20).

For each command sequence that requires USB transfers on the COMMAND and STATUS pipes, a device shall not require a specific ordering of IN Token or OUT Token, on the different pipes (see 4.27).

5.4.5.9.3 Applicable tests

The following tests shall be applied for this test:

VH_06, VA_03, VA_04 and VA_10

5.4.5.9.4 Overview of Test Steps

A device shall pass all the methods specified below. These methods are present to test the different ordering defined by UASP for transfers on the Command, Data and Status pipes.

5.4.5.9.5 Method 1

1)   Send a TCS-TM command;
2)   wait approximately 1ms (but less than 2ms);
3)   the host submits a read request for receiving a response;
4)   the device should respond with a RESPONSE IU; and
5)   perform the following checks on the received response;
   A)   check that the received response contains a RESPONSE IU; and
   B)   check that the tag in the RESPONSE IU is the same as the tag in the TASK MANAGEMENT IU.

5.4.5.9.6 Method 2

1)   The host submits a read request for receiving a response;
2)   wait approximately 1ms (but less than 2ms);
3)   send a TCS-TM command;
4)   the device should respond with a RESPONSE IU; and
5)   perform the following checks on the received response;
   A)   check that the received response contains a RESPONSE IU; and
   B)   check that the tag in the RESPONSE IU is the same as the tag in the TASK MANAGEMENT IU.

5.4.6 INQUIRY Command Assertions

5.4.6.1 Overview

This section describes the test cases which are related to the INQUIRY command.

5.4.6.2 HS_05 Verification of Designator Type of VPD Page

5.4.6.2.1 Overview

This test verifies that the INQUIRY command returns VPD information.

5.4.6.2.2 Assertions Used in Test

The device shall respond to an INQUIRY command with a Device Identification VPD page which contains a DESIGNATOR TYPE field set to 03h (see 4.62).

The device shall support the EVPD bit in the INQUIRY command with page code set to the Device Identification (i.e., 83h) VPD page (see 4.63).

For each command sequence that requires USB transfers on the COMMAND, DATA and STATUS pipes, the device shall not require a specific ordering of IN Token or OUT Token, on the different pipes (see 4.27).

5.4.6.2.3 Applicable tests

The following tests shall be applied for this test:

VH_08, VH_05, VH_03, VH_01, VA_01, VA_02, VA_05 and VA_11

5.4.6.2.4 Overview of Test Steps

This test performs the following steps.

5.4.6.2.5 Method 1

1) Send a REPORT LUNS command;
2) wait approximately 1ms (but less than 2ms);
3) the host submits a read request for receiving status;
4) the device should respond with a READ READY IU;
5) perform the following checks on the received response;
    A) check that the received response contains a READ READY IU; and
    B) check that the tag in the READ READY IU is the same as the tag in the COMMAND IU;
6) issue a request to read data from device on the data-in pipe;
7) wait approximately 1ms (but less than 2ms);
8) the host submits a read request for receiving status;
9) the device should respond with a SENSE IU;
10) perform the following check on the received data;
    A) check the received data for the LUN list; and
    B) verify that the STATUS field in SENSE IU contains GOOD;
11) perform the following (step 12 to step 21) on each LUN reported from REPORT LUNS command;
12) send an INQUIRY command with the EVPD field set to 1, the PAGE CODE field set to 83h and the TRANSFER LENGTH field set to at least 10h or to a value large enough in order to obtain the whole Designation descriptor list;
13) wait approximately 1ms (but less than 2ms);
14) the host submits a read request for receiving status;
15) the device should respond with a READ READY IU;
16) perform the following checks on the received response;
    A) check that the received response contains a READ READY IU; and
    B) check that the tag in the READ READY IU is the same as the tag in the COMMAND IU;
17) issue a request to read data from the device on the data-in pipe;
18) wait approximately 1ms (but less than 2ms);
19) the host submits a read request for receiving status;
20) the device should respond with a SENSE IU; and
21) perform the following check on the received data;
    A) check that the received data contains a single designation descriptor with a DESIGNATOR TYPE field set to 03h, an ASSOCIATION field set to 00b for the logical unit addressed by the LOGICAL UNIT NUMBER field in the COMMAND IU;
    B) check that the NAA identifier is unique for each LUN; and
    C) verify that the STATUS field in the SENSE IU contains GOOD.

5.4.6.2.6 Method 2

1) the host submits a read request for receiving status;
2) wait approximately 1ms (but less than 2ms);
3) send a REPORT LUNS command;
4) the device should respond with a READ READY IU;
5) perform the following checks on the received response;
    A) check that the received response contains a READ READY IU;
    B) check that the tag in the READ READY IU is the same as the tag in the COMMAND IU;

6) issue a request to read data from the device on the data-in pipe;
7) wait approximately 1ms (but less than 2ms);
8) the host submits a read request for receiving status;
9) the device should respond with a SENSE IU;
10) perform the following check on the received data;
    A) check that the received data contains the LUN list; and
    B) verify that the STATUS field in SENSE IU contains GOOD;
11) Perform the following (step 12 to step 21) on each LUN indicated by the REPORT LUNS command;
12) the host submits a read request for receiving status;
13) wait approximately 1ms (but less than 2ms);
14) send an INQUIRY command with the EVPD field set to 1, the PAGE CODE field set to 83h and the TRANSFER LENGTH field set to at least 10h or to a value large enough in order to obtain the whole Designation descriptor list;
15) the device should respond with a READ READY IU;
16) perform the following checks on the received response;
    A) check that the received response contains a READ READY IU;
    B) check that the tag in the READ READY IU is the same as the tag in the COMMAND IU;
17) issue a request to read data from device on the data-in pipe;
18) wait approximately 1ms (but less than 2ms);
19) the host submits a read request for receiving status;
20) the device should respond with a SENSE IU; and
21) perform the following check on the received data;
    A) Check that the received data contains a single designation descriptor with a DESIGNATOR TYPE field set to 03h, ASSOCIATION field set to 00b for the logical unit addressed by the LOGICAL UNIT NUMBER field in the COMMAND IU;
    B) check that the NAA identifier is unique for each LUN; and
    C) Verify that the STATUS field in SENSE IU contains GOOD status

5.4.6.2.7 Method 3

1) Send a REPORT LUNS command;
2) wait approximately 1ms (but less than 2ms);
3) the host submits a read request for receiving status;
4) the device should respond with a READ READY IU;
5) perform the following checks on the received response;
    A) check that the received response contains a READ READY IU; and
    B) check that the tag in the READ READY IU is the same as the tag in the COMMAND IU;
6) the host submits a read request for receiving status;
7) wait approximately 1ms (but less than 2ms);
8) issue a request to read data from the device on the data-in pipe;
9) the device should respond with a SENSE IU;
10) perform the following check on the received data;
    A) check that the received data contains a LUN list; and
    B) verify that the STATUS field in SENSE IU contains GOOD status;
11) perform the following (step 12 to step 21) on each LUN indicated by the REPORT LUNS command;
12) send an INQUIRY command with the EVPD field set to 1, the PAGE CODE field set to 83h, and the TRANSFER LENGTH field set to at least 10h or to a value large enough in order to obtain the whole Designation descriptor list;
13) wait approximately 1ms (but less than 2ms);
14) the host submits a read request for receiving status;
15) the device should respond with a READ READY IU;
16) perform the following checks on the received response;
    A) check that the received response contains a READ READY IU;
    B) check that the tag in the READ READY IU is the same as the tag in the COMMAND IU;
17) wait approximately 1ms (but less than 2ms);
18) the host submits a read request for receiving status;
19) issue a request to read data from the device on the data-in pipe;
20) the device should respond with a SENSE IU; and

21) perform the following check on the received data;
   A) check that the received data contains a single designation descriptor with a DESIGNATOR TYPE field set to 03h, an ASSOCIATION field set to 00b for the logical unit addressed by the LOGICAL UNIT NUMBER field in the COMMAND IU;
   B) check that the NAA identifier is unique for each LUN; and
   C) verify that the STATUS field in SENSE IU contains GOOD status.

5.4.6.2.8 Method 4

1) The host submits a read request for receiving status;
2) wait approximately 1ms (but less than 2ms);
3) send a REPORT LUNS command;
4) the device should respond with a READ READY IU;
5) perform the following checks on the received response;
   A) check that the received response contains a READ READY IU; and
   B) check that the tag in the READ READY IU is the same as the tag in the COMMAND IU;
6) wait approximately 1ms (but less than 2ms);
7) the host submits a read request for receiving status;
8) issue a request to read data from the device on the data-in pipe;
9) the device should respond with a SENSE IU;
10) perform the following check on the received data;
   A) check that the received data contains a LUN list; and
   B) verify that the STATUS field in SENSE IU contains GOOD status;
11) Perform the following (step 12 to step 21) on each LUN indicated by the REPORT LUNS command;
12) the host submits read requests for receiving status;
13) wait approximately 1ms (but less than 2ms);
14) send an INQUIRY command with the EVPD field set to 1, the PAGE CODE field set to 83h, and the TRANSFER LENGTH field set to at least 10h or to a value large enough in order to obtain the whole Designation descriptor list;
15) the device should respond with a READ READY IU;
16) perform the following checks on the received response;
   A) check that the received response contains a READ READY IU;
   B) check that the tag in the READ READY IU is the same as the tag in the COMMAND IU;
17) wait approximately 1ms (but less than 2ms);
18) the host submits a read request for receiving status;
19) issue a request to read data from the device on the data-in pipe;
20) the device should respond with a SENSE IU; and
21) perform the following check on the received data;
   A) check that the received data contains a single designation descriptor with the DESIGNATOR TYPE field set to 03h, the ASSOCIATION field set to 00b for the logical unit addressed by the LOGICAL UNIT NUMBER field in the COMMAND IU;
   B) check whether the NAA identifier is unique for each LUN;
   C) verify that the STATUS field in SENSE IU contains GOOD status.

5.4.6.3 HS_06 Verification of INQUIRY Data Bit CMDQUE field

5.4.6.3.1 Overview

This test verifies that INQUIRY data.

5.4.6.3.2 Assertions Used in Test

the INQUIRY data bit CMDQUE shall be set to one (see 4.64).

For each command sequence that requires USB transfers on the COMMAND, DATA and STATUS pipes, the device shall not require a specific ordering of IN Token or OUT Token, on the different pipes (see 4.27).

5.4.6.3.3 Applicable tests

Following tests shall be applied for this test:

VH_08, VH_05, VH_03, VH_01, VA_01, VA_02, VA_05 and VA_11

5.4.6.3.4 Overview of Test Steps

This test performs the following steps.

5.4.6.3.5 Method 1

1) Send an INQUIRY command requesting enough bytes to receive the CMDQUE bit;
2) wait approximately 1ms (but less than 2ms);
3) the host submits a read request for receiving status;
4) the device should respond with a READ READY IU;
5) perform the following checks on the received response;
   A) check that the received response contains a READ READY IU; and
   B) check that the tag in the READ READY IU is the same as the tag in the COMMAND IU;
6) issue a request to read data from the device on the data-in pipe;
7) wait approximately 1ms (but less than 2ms);
8) the host submits a read request for receiving status;
9) the device should respond with a SENSE IU; and
10) perform the following check on the received data;
   A) verify that the received data's CMDQUE bit value is 1;
   B) verify that the STATUS field in SENSE IU contains GOOD status.

5.4.6.3.6 Method 2

1) The host submits a read request for receiving status;
2) wait approximately 1ms (but less than 2ms);
3) send an INQUIRY command;
4) the device should respond with a READ READY IU;
5) perform the following checks on the received response;
   A) check that the received response contains a READ READY IU; and
   B) check that the tag in the READ READY IU is the same as the tag in the COMMAND IU;
6) issue a request to read data from the device on the data-in pipe;
7) wait approximately 1ms (but less than 2ms);
8) the host submits a read request for receiving status;
9) the device should respond with a SENSE IU;
10) perform the following check on the received data;
   A) verify that the received data's CMDQUE bit value is 1; and
   B) verify that the STATUS field in SENSE IU contains GOOD status.

5.4.6.3.7 Method 3

1) Send an INQUIRY command;
2) wait approximately 1ms (but less than 2ms);
3) the host submits a read request for receiving status;
4) the device should respond with a READ READY IU;
5) perform the following checks on the received response;
   A) check that the received response contains a READ READY IU; and
   B) check that the tag in the READ READY IU is the same as the tag in the COMMAND IU;
6) the host submits a read request for receiving status;
7) wait approximately 1ms (but less than 2ms);
8) issue a request to read data from the device on the data-in pipe;
9) the device should respond with a SENSE IU; and
10) perform the following check on the received data;
   A) verify that the received data's CMDQUE bit value is 1; and
   B) verify that the STATUS field in the SENSE IU contains GOOD status.

5.4.6.3.8 Method 4

1) The host submits a read request for receiving status;
2) wait approximately 1ms (but less than 2ms);
3) send an INQUIRY command;
4) the device should respond with a READ READY IU;
5) perform the following checks on the received response;

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    A) check that the received response contains a READ READY IU; and

    B) check that the tag in the READ READY IU is the same as the tag in the COMMAND IU;

6) wait approximately 1ms (but less than 2ms);

7) the host submits a read request for receiving status;

8) issue a request to read data from the device on the data-in pipe;

9) the device should respond with a SENSE IU; and

10) perform the following check on the received data;

    A) verify that the received data's CMDQUE bit value is 1; and

    B) verify that the STATUS field in SENSE IU contains GOOD status.

5.5 SuperSpeed Tests

5.5.1 Overview

This section describes USB [UAS] compliance tests a compliant device shall pass when the device is operating in SuperSpeed mode. This section describes the tests that need to be performed when the device is in the USB Configured device state. For these tests, the device shall have a configuration selected (e.g., via a SET_CONFIGURATION request) that includes a [UAS] interface.

5.5.2 Validation of MaxStream

This tests the MaxStream value from SuperSpeed Endpoint Companion Descriptor.

5.5.2.1 VS_01 MaxStream Field Verification

5.5.2.1.1 Overview

This test verifies that the expected MaxStream value is present in the SuperSpeed endpoint descriptor.

5.5.2.1.2 Assertions Used in Test

The MaxStream field of the SuperSpeed Endpoint Companion Descriptor, for data-in, data-out and Status Pipe, shall be set to a value greater than 1 (see 4.9).

5.5.2.1.3 test initialization

Fetch the SuperSpeed endpoint companion descriptor.

5.5.2.1.4 test verification

Verify that the MaxStream value is greater than 1 in endpoint companion descriptor.

5.5.3 Validation of ERDY

5.5.3.1 Overview

These tests shall be performed on all IUs sent to or received from the SuperSpeed device when a [UAS] command is sent to a device or some device response is received.

5.5.3.2 VS_02 Verification of ERDY as Response

5.5.3.2.1 Overview

This test verifies that the correct tag is used for Status pipe information.

5.5.3.2.2 Assertions Used in Test

SuperSpeed devices shall use ERDY to supply the tag as a part of returning status (see 4.42).

5.5.3.2.3 test initialization

Send an TCS-NDT, TCS-DO, or TCS-DI command to device with tag value x.

5.5.3.2.4 test verification

Verify that the returned Status pipe information is received in the expected stream data buffer for the TAG field supplied in the COMMAND IU.

5.5.3.3 VS_03 Verification of ERDY for data-in Request

5.5.3.3.1 Overview

This test verifies that the correct tag is used for data-in request.

5.5.3.3.2 Assertions Used in Test

SuperSpeed devices shall use ERDY to supply the tag as a part of returning data to the host (see 4.43).

5.5.3.3.3 test initialization

Send a TCS-DI command to the device with tag value x.

5.5.3.3.4 test verification

Verify that the returned data-in pipe information is received in the expected stream data buffer for the Tag that is supplied in the COMMAND IU.

5.5.3.4 VS_04 Verification of No READ READY IU for data-in Request

5.5.3.4.1 Overview

This validation verifies that the status returned for data-in request does not contain READ READY IU.

5.5.3.4.2 Assertions Used in Test

SuperSpeed devices shall not use a READ READY IU as a part of returning data (see 4.45).

5.5.3.4.3 test initialization

Send TCS-DI command using COMMAND IU to device.

5.5.3.4.4 test verification

Verify that the READ READY IU is not received as response.

5.5.3.5 VS_05 Verification of ERDY for data-out Request

5.5.3.5.1 Overview

This test verifies that the correct tag is used for data-out request.

5.5.3.5.2 Assertions Used in Test

SuperSpeed devices shall use ERDY to supply the tag as a part of requesting data from the host (see 4.44).

5.5.3.5.3 test initialization

Send a TCS-DO command to the device with tag value x.

5.5.3.5.4 test verification

Verify that the expected stream data buffer for the TAG field supplied in the COMMAND IU is used to provide data to the device.

5.5.3.6 VS_06 Verification of No WRITE READY IU for data-out Request

5.5.3.6.1 Overview

This test verifies that the WRITE READY IU is not received with a data-out request.

5.5.3.6.2 Assertions Used in Test

SuperSpeed devices shall not use a WRITE READY IU as a part of requesting data (see 4.46).

5.5.3.6.3 test initialization

Send a TCS-DO command to the device.

5.5.3.6.4 test verification

Verify that the WRITE READY IU is not received as response.

5.5.4 Validation of Multiple Commands

5.5.4.1 Overview

This section describes the multiple command execution in SuperSpeed.

5.5.4.2 VS_07 Verification of Multiple Command Execution

5.5.4.2.1 Overview

This test verifies that multiple commands are executed successfully.

5.5.4.2.2 Assertions Used in Test

The device shall accept multiple commands in its command queue (see 4.30) as long as the number of commands is not larger than N, where N is computed as below:

> N = min(Host_MaxStreams_Supported,
> NumberOfStream_DataInPipe,
> NumberOfStream_DataOutPipe,
> NumberOfStream_StatusPipe)

5.5.4.2.3 test initialization

Send N-1 number of TCS-DO commands using COMMAND IU, where N is computed as below:

> N = min(Host_MaxStreams_Supported,
> NumberOfStream_DataInPipe,
> NumberOfStream_DataOutPipe,
> NumberOfStream_StatusPipe)

5.5.4.2.4 test verification

Check that received responses are a SENSE IU with status GOOD or TASK SET FULL.

5.5.4.3 VS_08 Verification of Command pipe Status in case of TASK SET FULL

5.5.4.3.1 Overview

This test verifies that the Command pipe not blocked when queue is full.

5.5.4.3.2 Assertions Used in Test

The device shall not block the Command pipe because its queue is full. Returning NRDY, stall or NAK constitute blocking (see 4.31 and 4.32).

5.5.4.3.3 test initialization

Send greater than N number of TCS-NDT commands using COMMAND IU, where N is computed as below:

> N = min(Host_MaxStreams_Supported,
> NumberOfStream_DataInPipe,
> NumberOfStream_DataOutPipe,
> NumberOfStream_StatusPipe).

> NOTE 1 — the TASK SET FULL condition is created by not placing status requests on the status pipe

5.5.4.3.4 test verification

Verify that a TASK SET FULL response is received and verify that commands are still in pending state.

5.5.5 Validation of Tag Values

5.5.5.1 Overview

This section describes the tag values verification in SuperSpeed transfer.

5.5.5.2 VS_09 Verification of Tag Values in COMMAND IU & SENSE IU

5.5.5.2.1 Overview

This test verifies the tag values during COMMAND operation.

5.5.5.2.2 Assertions Used in Test

The following tags shall be the same:

> Tag of COMMAND IU = StreamID of Data = StreamID of (SENSE IU or RESPONSE IU) (see 4.34).

5.5.5.2.3 test initialization

1) Send a TCS-NDT, TCS-DO, or TCS-DI to the device with the TAG field set to x; and
2) wait approximately 1ms (but less than 2ms), send the data.

5.5.5.2.4 test verification

Verify that the data and status information is received in the expected data buffers also check that the SENSE IU has the expected tag value.

5.5.5.3 VS_10 TASK MANAGEMENT IU Tag Value Verification

5.5.5.3.1 Overview

This test verifies the tag values during TASK MANAGEMENT COMMAND operation.

5.5.5.3.2 Assertions Used in Test

The following tags shall be the same:

> Tag of TASK MANAGEMENT IU = Tag of RESPONSE IU = StreamID of RESPONSE IU (see 4.34).

5.5.5.3.3 test initialization

Send a TCS-TM command to the device with the TAG field set to y.

5.5.5.3.4 test verification

Verify that the status information is received in the expected data buffer and check that the RESPONSE IU has the TAG field set to y.

5.5.5.4 SS_08 Sparse tag assignment verification

5.5.5.4.1 Overview

This test verifies the device accepts any valid tag value in COMMAND and TASK MANAGEMENT IUs. Tag values are arbitrary 16-bit integers chosen by the host and not limited to the number of streams the device supports.

5.5.5.4.2 Assertions Used in Test

The device shall support sparse tag assignments (see 4.33). The device accepts any tag value in the range 1..65520 (FFF0h). (Stream IDs 0, FFF0h..FFFFh are reserved.)

5.5.5.4.3 Applicable Tests

SS_02, SS_03, SS_05 (and by extension, VS_02, VS_03, VS_05, VS_09)

5.5.5.4.4 Method 1

5.5.5.4.4.1 test initialization

1) Send a TCS-DO command to the device with the TAG field set to x, where x is a value chosen from the tag test set is a 16-bit integer:
    A) that is not 0 or FFF0h..FFFFh; and
    B) is greater than the maximum number of streams reported by the device.
2) follow one of the test methods in SS_02 to send data and then receive status from the device; and
3) repeat step 1 and step 2 for the other tags in the tag test set.

5.5.5.4.4.2 test verification

Verify the device completes all the TCS-DO command successfully according to the test methods in SS_02.

5.5.5.4.5 Method 2

5.5.5.4.5.1 test initialization

1) Send a TCS-DI command to the device with the TAG field set to x, where x is a value chosen from the tag test set is a 16-bit integer:
   A) that is not 0 or FFF0h..FFFFh; and
   B) is greater than the maximum number of streams reported by the device.;
2) follow one of the test methods in SS_03 to receive the data and then status from the device; and
3) repeat step 1 and step 2 for the other tags in the tag test set.

5.5.5.4.5.2 test verification

Verify the device completes all the TCS-DI command successfully according to the test methods in SS_03.

5.5.5.4.6 Method 3

5.5.5.4.6.1 test initialization

1) Send a TCS-TM command to the device with the TAG field set to x, where x is a value chosen from the tag test set is a 16-bit integer:
   A) that is not 0 or FFF0h..FFFFh; and
   B) is greater than the maximum number of streams reported by the device.
2) follow one of the test methods in SS_05 to receive the response from the device; and
3) repeat step 1 and step 2 for the other tags in the tag test set.

5.5.5.4.6.2 test verification

Verify the device completes all the TCS-TM command according to the test methods in SS_05.

5.5.6 Validation of SuperSpeed UASP Data Exchange

5.5.6.1 Overview

This section describes the tests of the SuperSpeed sequencing required to support the UASP. This section assumes a familiarity with the [USB-3] Streams protocol.

5.5.6.2 SS_01 Non-Data Transfer Command

5.5.6.2.1 Overview

This test verifies that the UASP device responds as expected to valid non-data transfer command compliance with the UASP Specification.

5.5.6.2.2 Assertions Used in Test

The device shall respond to a non-data transfer COMMAND IU on the Command pipe with an ERDY containing the TAG field from the COMMAND IU followed by a SENSE IU or a RESPONSE IU (see 4.15).

For each command sequence that requires USB transfers on the COMMAND and STATUS pipes, a device shall not require a specific ordering of: ACK (Prime), DP on command pipe, ACK (Stream ID) (see 4.28).

5.5.6.2.3 Applicable tests

The following tests shall be applied for this test:

VS_02, VS_09, VA_01, VA_02, VA_05 and VA_11

5.5.6.2.4 Overview of Tests

This test performs the following steps:

A device shall pass all the methods specified below. These methods are present to test the different ordering defined by UASP for transfers on the Command, Data and Status pipes.

5.5.6.2.5 Method 1

1) Issue a TCS-NDT command;
2) wait approximately 1ms (but less than 2ms);
3) the host submits a read request for receiving status;
4) the device should respond with a SENSE IU; and
5) perform the following checks on the received response;

A) check that the received response contains a SENSE IU; and
B) check that the tag in the SENSE IU is the same as the tag in the COMMAND IU.

5.5.6.2.6 Method 2

1) the host submits a read request for receiving status;
2) wait approximately 1ms (but less than 2ms);
3) issue a TCS-NDT command;
4) the device should respond with a SENSE IU; and
5) perform the following checks on the received response;
A) check that the received response contains SENSE IU (03h); and
B) check that the tag in the SENSE IU is the same as the tag in the COMMAND IU.

5.5.6.2.7 Method 3

1) issue a TCS-NDT command with invalid reserved coded value in the IU IDENTIFIER field (i.e., First byte != 01h);
2) wait approximately 1ms (but less than 2ms);
3) the host submits a read request for receiving status;
4) the device should respond with a RESPONSE IU; and
5) perform the following checks on the received response;
A) check that the received response contains a RESPONSE IU; and
B) check that the tag in the RESPONSE IU is the same as the tag in the invalid IU.

5.5.6.2.8 Method 4

1) the host submits a read request for receiving status;
2) wait approximately 1ms (but less than 2ms);
3) issue a TCS-NDT command with invalid reserved coded value in the IU IDENTIFIER field ((i.e)First byte != 01h);
4) the device should respond with a RESPONSE IU; and
5) perform the following checks on the received response;
A) check that the received response contains RESPONSE IU; and
B) check that the tag in the RESPONSE IU is the same as the tag in the invalid IU.

5.5.6.3 SS_02 Write Data Transfer Command

5.5.6.3.1 Overview

This test verifies that the UASP device responds as expected to validate data-out transfer command compliance with the UASP Specification.

5.5.6.3.2 Assertions Used in Test

The device shall respond to a data-out COMMAND IU on the Command pipe with an ERDY on the data-out pipe, accept data on the data-out pipe, followed by an ERDY containing the tag from the COMMAND IU followed by a SENSE IU (see 4.17).

For each command sequence that requires USB transfers on the COMMAND, DATA and STATUS pipes, the device shall not require a specific ordering of DP on command pipe, ACK (Prime), DP (Stream ID), ACK (Stream ID) (see 4.27).

5.5.6.3.3 Applicable tests

The following tests shall be applied for this test:

VS_02, VS_05, VS_06, VS_09, VA_01, VA_02, VA_05 and VA_11

5.5.6.3.4 Overview of Test Steps

A device shall pass all the methods specified below. These methods are present to test the different ordering defined by UASP for transfers on the Command, Data and Status pipes.

5.5.6.3.5 Method 1

1) Issue a valid TCS-DO command;
2) wait approximately 1ms (but less than 2ms);

3) issue a data transfer request to the device on the data-out pipe;
4) wait approximately 1ms (but less than 2ms);
5) the host submits a read request for receiving status;
6) the device should respond with a SENSE IU; and
7) perform the following checks on the received response;
   A) check that the received response contains a SENSE IU; and
   B) check that the tag in the SENSE IU is the same as the tag in the COMMAND IU.

5.5.6.3.6 Method 2

1) the host submits a read request for receiving status;
2) wait approximately 1ms (but less than 2ms);
3) issue a data transfer request to the device on the data-out pipe;
4) wait approximately 1ms (but less than 2ms);
5) issue a valid TCS-DO command;
6) the device should respond with a SENSE IU; and
7) perform the following checks on the received response;
   A) check that the received response contains a SENSE IU (03h); and
   B) check that the tag in the SENSE IU is the same as the tag in the COMMAND IU.

5.5.6.3.7 Method 3

1) The host submits a read request for receiving status;
2) wait approximately 1ms (but less than 2ms);
3) issue a valid TCS-DO command;
4) wait approximately 1ms (but less than 2ms);
5) issue a data transfer request to the device on the data-out pipe;
6) the device should respond with a SENSE IU; and
7) perform the following checks on the received response;
   A) Check that the received response contains SENSE IU (03h); and
   B) check that the tag in the SENSE IU is the same as the tag in the COMMAND IU.

5.5.6.3.8 Method 4

1) Issue a valid TCS-DO command;
2) wait approximately 1ms (but less than 2ms);
3) the host submits a read request for receiving status;
4) wait approximately 1ms (but less than 2ms);
5) issue a data transfer request to the device on the data-out pipe;
6) the device should respond with a SENSE IU; and
7) perform the following checks on the received response;
   A) check that the received response contains a SENSE IU; and
   B) check that the tag in the SENSE IU is the same as the tag in the COMMAND IU.

5.5.6.3.9 Method 5

1) Issue a data transfer request to the device on the data-out pipe;
2) wait approximately 1ms (but less than 2ms);
3) the host submits a read request for receiving status;
4) wait approximately 1ms (but less than 2ms);
5) issue a valid TCS-DO command;
6) the device should respond with a SENSE IU; and
7) perform the following checks on the received response;
   A) check that the received response contains a SENSE IU; and
   B) check that the tag in the SENSE IU is the same as the tag in the COMMAND IU.

5.5.6.3.10 Method 6

1) Issue a data transfer request to the device on the data-out pipe;
2) wait approximately 1ms (but less than 2ms);
3) issue a valid TCS-DO command;
4) wait approximately 1ms (but less than 2ms);
5) the host submits a read request for receiving status;

6) the Device should respond with a SENSE IU; and
7) perform the following checks on the received response;
    A) check that the received response contains a SENSE IU; and
    B) check that the tag in the SENSE IU is the same as the tag in the COMMAND IU.

5.5.6.4 SS_03 Read Data Transfer Command

5.5.6.4.1 Overview

This test verifies that the UASP device responds as expected to valid data-in transfer command compliance with the UASP Specification.

5.5.6.4.2 Assertions Used in Test

The device shall respond to a data-in COMMAND IU on the Command pipe with an ERDY on the data-in pipe, send data on the data-in pipe, followed by an ERDY containing the tag from the COMMAND IU followed by a SENSE IU (see 4.19).

For each command sequence that requires USB transfers on the COMMAND, DATA and STATUS pipes, the device shall not require a specific ordering of DP on command pipe, ACK (Prime), DP (Stream ID), ACK (Stream ID) (see 4.27).

5.5.6.4.3 Applicable tests

The following tests shall be applied for this test:

VS_02, VS_03, VS_04, VS_09, VA_01, VA_02, VA_05 and VA_11

5.5.6.4.4 Overview of Test Steps

This test performs the following steps:

A device shall pass all the methods specified below. These methods are present to test the different ordering defined by UASP for transfers on the Command, Data and Status pipes.

5.5.6.4.5 Method 1

1) Issue a valid TCS-DI command;
2) wait approximately 1ms (but less than 2ms);
3) issue a data transfer request to the device on the data-in pipe;
4) wait approximately 1ms (but less than 2ms);
5) the host submits a read request for receiving status;
6) the device should respond with a SENSE IU; and
7) perform the following checks on the received response;
    A) check that the received response contains a SENSE IU; and
    B) check that the tag in the SENSE IU is the same as the tag in the COMMAND IU.

5.5.6.4.6 Method 2

1) The host submits a read request for receiving status;
2) wait approximately 1ms (but less than 2ms);
3) issue a data transfer request to the device on the data-in pipe;
4) wait approximately 1ms (but less than 2ms);
5) issue a valid TCS-DI command;
6) the device should respond with a SENSE IU; and
7) perform the following checks on the received response;
    A) check that the received response contains a SENSE IU; and
    B) check that the tag in the SENSE IU is the same as the tag in the COMMAND IU.

5.5.6.4.7 Method 3

1) The host submits a read request for receiving status;
2) wait approximately 1ms (but less than 2ms);
3) issue a valid TCS-DI command;
4) wait approximately 1ms (but less than 2ms);
5) issue a data transfer request to the device on the data-in pipe;

6) the device should respond with a SENSE IU; and
7) perform the following checks on the received response;
    A) check that the received response contains a SENSE IU; and
    B) check that the tag in the SENSE IU is the same as the tag in the COMMAND IU.

5.5.6.4.8 Method 4

1) Issue a valid TCS-DI command;
2) wait approximately 1ms (but less than 2ms);
3) the host submits a read request for receiving status;
4) wait approximately 1ms (but less than 2ms);
5) issue a data transfer request to the device on the data-in pipe;
6) the device should respond with a SENSE IU; and
7) perform the following checks on the received response;
    A) check that the received response contains a SENSE IU; and
    B) check that the tag in the SENSE IU is the same as the tag in the COMMAND IU.

5.5.6.4.9 Method 5

1) Issue a data transfer request to the device on the data-in pipe;
2) wait approximately 1ms (but less than 2ms);
3) the host submits a read request for receiving status;
4) wait approximately 1ms (but less than 2ms);
5) issue a valid TCS-DI command;
6) the device should respond with a SENSE IU; and
7) perform the following checks on the received response;
    A) check that the received response contains a SENSE IU; and
    B) check that the tag in the SENSE IU is the same as the tag in the COMMAND IU.

5.5.6.4.10 Method 6

1) Issue a data transfer request to the device on the data-in pipe;
2) wait approximately 1ms (but less than 2ms);
3) issue a valid TCS-DI command;
4) wait approximately 1ms (but less than 2ms);
5) the host submits a read request for receiving status;
6) the device should respond with a SENSE IU; and
7) perform the following checks on the received response;
    A) check that the received response contains a SENSE IU; and
    B) check that the tag in the SENSE IU is the same as the tag in the COMMAND IU.

5.5.6.5 SS_04 Bi-Directional Data Transfer Command

5.5.6.5.1 Overview

This test validates that the UASP device responds as expected to valid bi-directional data transfer command. This test is only applicable to a device that supports a bi-directional data transfer command.

5.5.6.5.2 Assertions Used in Test

The device shall respond to a bidirectional COMMAND IU on the Command pipe with an ERDY on the data-in pipe, send data on the data-in pipe, or receive data on the data-out pipe, followed by a SENSE IU (see 4.24).

For each command sequence that requires USB transfers on the COMMAND, DATA and STATUS pipes, the device shall not require a specific ordering of DP on command pipe, ACK (Prime), DP (Stream ID), ACK (Stream ID) (see 4.27).

5.5.6.5.3 Applicable tests

The following tests shall be applied for this test:

VS_02, VS_03, VS_04, VS_05, VS_06, VS_09, VA_01, VA_02, VA_05 and VA_11.

5.5.6.5.4 Overview of Test Steps

A device shall pass all the methods specified below. These methods are present to test the different ordering defined by UASP for transfers on the Command, Data and Status pipes.

5.5.6.5.5 Method 1

1) Issue a valid TCS-DB command;
2) wait approximately 1ms (but less than 2ms);
3) issue a request to read data from the device on the data-in pipe and issue a request to write data to the device on the data-out pipe asynchronously;
4) wait approximately 1ms (but less than 2ms);
5) the host submits a read request for receiving the response;
6) the device should respond with the SENSE IU; and
7) check that the received response contains a SENSE IU.

5.5.6.5.6 Method 2

1) The host submits a read request for receiving a response;
2) wait approximately 1ms (but less than 2ms);
3) issue a request to read data from device on the data-in pipe and issue a request to write data to the device on the data-out pipe asynchronously;
4) wait approximately 1ms (but less than 2ms);
5) issue a valid TCS-DB command;
6) the device should respond with a SENSE IU; and
7) check that the received response contains a SENSE IU.

5.5.6.5.7 Method 3

1) The host submits a read request for receiving a response;
2) wait approximately 1ms (but less than 2ms);
3) issue a valid TCS-DB command;
4) wait approximately 1ms (but less than 2ms);
5) issue a request to read data from the device on the data-in pipe and issue a request to write data to the device on the data-out pipe asynchronously;
6) the device should respond with a SENSE IU; and
7) check that the received response contains a SENSE IU.

5.5.6.5.8 Method 4

1) Issue a valid TCS-DB command;
2) wait approximately 1ms (but less than 2ms);
3) the host submits a read request for receiving a response;
4) wait approximately 1ms (but less than 2ms);
5) issue a request to read data from the device on the data-in pipe and issue a request to write data to the device on the data-out pipe asynchronously;
6) the device should respond with a SENSE IU; and
7) check that the received response contains a SENSE IU.

5.5.6.5.9 Method 5

1) Issue a request to read data from the device on the data-in pipe and issue a request to write data to the device on the data-out pipe asynchronously;
2) wait approximately 1ms (but less than 2ms);
3) the host submits a read request for receiving a response;
4) wait approximately 1ms (but less than 2ms);
5) issue a valid TCS-DB command;
6) the device should respond with a SENSE IU; and
7) check that the received response contains a SENSE IU.

5.5.6.5.10 Method 6

1) Issue a request to read data from the device on the data-in pipe and issue a request to write data to the device on the data-out pipe asynchronously;
2) wait approximately 1ms (but less than 2ms);

   3) issue a valid TCS-DB command;
   4) wait approximately 1ms (but less than 2ms);
   5) the host submits a read request for receiving a response;
   6) the device should respond with a SENSE IU;
   7) check that the received response contains SENSE IU.

5.5.6.6 SS_05 TASK MANAGEMENT Command

5.5.6.6.1 Overview

This test verifies that the UASP device responds as expected to valid TASK MANAGEMENT command compliance with the UASP Specification.

5.5.6.6.2 Assertions Used in Test

The device shall respond to a TASK MANAGEMENT IU on the Command pipe with an ERDY containing the tag from the TASK MANAGEMENT IU followed by a RESPONSE IU (see 4.21).

For each command sequence that requires USB transfers on the COMMAND and STATUS pipes, a device shall not require a specific ordering of ACK (Prime), DP on command pipe, ACK (Stream ID) (see 4.28).

5.5.6.6.3 Applicable tests

Following tests shall be applied for this test:

VS_10, VA_03, VA_04 and VA_10

5.5.6.6.4 Overview of Test Steps

A device shall pass all the methods specified below. These methods are present to test the different ordering defined by UASP for transfers on the Command, Data and Status pipes.

5.5.6.6.5 Method 1

   1) Issue a TCS-TM;
   2) wait approximately 1ms (but less than 2ms);
   3) the host submits a read request for receiving a response;
   4) the device should respond with a RESPONSE IU; and
   5) perform the following checks on the received response;
      A) check that the received response contains a RESPONSE IU; and
      B) check that the tag in the RESPONSE IU is the same as the tag in the TASK MANAGEMENT IU.

5.5.6.6.6 Method 2

   1) The host submits a read request for receiving a response;
   2) wait approximately 1ms (but less than 2ms);
   3) issue a TCS-TM command;
   4) the device should respond with a RESPONSE IU; and
   5) perform the following checks on the received response;
      A) check that the received response contains RESPONSE IU; and
      B) check that the tag in the RESPONSE IU is the same as the tag in the TASK MANAGEMENT IU.

5.5.7 INQUIRY Command Assertions

5.5.7.1 Overview

This section describes the test cases which are related with INQUIRY command

5.5.7.2 SS_06 Verification of Designator Type of VPD Page

5.5.7.2.1 Overview

This test verifies that INQUIRY command returns VPD information.

5.5.7.2.2 Assertions Used in Test

The device shall respond to an INQUIRY command with a Device Identification VPD page which contains a DESIGNATOR TYPE field set to 03h (see 4.62).

The device shall support the EVPD bit in the INQUIRY command with page code set to the Device Identification (i.e., 83h) VPD page (see 4.63).

For each command sequence that requires USB transfers on the COMMAND, DATA and STATUS pipes, the device shall not require a specific ordering of DP on command pipe, ACK (Prime), DP (Stream ID), ACK (Stream ID) (see 4.27).

5.5.7.2.3 Applicable tests

The following tests shall be applied for this test:

VS_02, VS_03, VS_04, VS_09, VA_01, VA_02, VA_05 and VA_11

5.5.7.2.4 Overview of Test Steps

This test performs the following steps.

5.5.7.2.5 Method 1

1) Send a REPORT LUNS command;
2) wait approximately 1ms (but less than 2ms);
3) issue request to read data from the device on the data-in pipe;
4) wait approximately 1ms (but less than 2ms);
5) the host submits a read request for receiving status;
6) the device should respond with a SENSE IU;
7) perform the following check on the received data;
   A) check that the received data contains the LUN list; and
   B) verify that the STATUS field in SENSE IU contains GOOD status;
8) perform the following (step 9 to step 15) on each LUN indicated by REPORT LUNS command;
9) send an INQUIRY command with the EVPD field set to 1, the PAGE CODE set to 83h, and the TRANSFER LENGTH field set to at least 10h or to a value large enough in order to obtain the whole Designation descriptor list;
10) wait approximately 1ms (but less than 2ms);
11) issue a request to read data from device on the data-in pipe;
12) wait approximately 1ms (but less than 2ms);
13) the host submits a read request for receiving status;
14) the device should respond with a SENSE IU; and
15) Perform the following check on the received data;
   A) check that the received data contains a single designation descriptor with a DESIGNATOR TYPE field set to 03h, an ASSOCIATION field set to 00b for the logical unit addressed by the LOGICAL UNIT NUMBER field in the COMMAND IU;
   B) check whether the NAA identifier in the WWN is unique for each LUN; and
   C) verify that the STATUS field in SENSE IU contains GOOD status.

5.5.7.2.6 Method 2

1) The host submits a read request for receiving status;
2) wait approximately 1ms (but less than 2ms);
3) issue a request to read data from the device on the data-in pipe;
4) wait approximately 1ms (but less than 2ms);
5) send a REPORT LUNS command;
6) the device should respond with a SENSE IU;
7) perform the following check on the received data;
   A) check that the received data contains a LUN list; and
   B) verify that the STATUS field in SENSE IU contains GOOD status;
8) perform the following (step 9 to step 15) on each LUN indicated by the REPORT LUNS command;
9) the host submits a read request for receiving status;
10) wait approximately 1ms (but less than 2ms);
11) issue a request to read data from the device on the data-in pipe;
12) wait approximately 1ms (but less than 2ms);

13) send an INQUIRY command with the EVPD field set to 1, the PAGE CODE set to 83h, and the TRANSFER LENGTH field set to at least 10h or to a value large enough in order to obtain the whole Designation descriptor list;
14) the device should respond with a SENSE IU; and
15) perform the following check on the received data;
    A) check that the received data contains a single designation descriptor with a DESIGNATOR TYPE field set to 03h, an ASSOCIATION field set to 00b for the logical unit addressed by the LOGICAL UNIT NUMBER field in the COMMAND IU;
    B) check that the NAA identifier in the WWN is unique for each LUN;
    C) verify that the STATUS field in SENSE IU contains GOOD (00h).

5.5.7.2.7 Method 3

1) The host submits a read request for receiving status;
2) wait approximately 1ms (but less than 2ms);
3) send a REPORT LUNS command;
4) wait approximately 1ms (but less than 2ms);
5) issue a request to read data from the device on the data-in pipe;
6) the device should respond with a SENSE IU;
7) perform the following check on the received data;
    A) check that the received data contains the LUN list; and
    B) verify that the STATUS field in SENSE IU contains GOOD (00h);
8) perform the following (step 9 to step 15) on each LUN indicated by the REPORT LUNS command;
9) the host submits a read request for receiving status;
10) wait approximately 1ms (but less than 2ms);
11) send an INQUIRY command with the EVPD field set to 1, the PAGE CODE set to 83h, and the TRANSFER LENGTH field set to at least 10h or to a value large enough in order to obtain the whole Designation descriptor list;
12) wait approximately 1ms (but less than 2ms);
13) issue a request to read data from the device on the data-in pipe;
14) the device should respond with a SENSE IU;
15) perform the following check on the received data;
    A) check that the received data contains a single designation descriptor with a DESIGNATOR TYPE field set to 03h, an ASSOCIATION field set to 00b for the logical unit addressed by the LOGICAL UNIT NUMBER field in the COMMAND IU;
    B) check that the NAA identifier in the WWN is unique for each LUN;
    C) verify that the STATUS field in SENSE IU contains GOOD (00h).

5.5.7.2.8 Method 4

1) Send a REPORT LUNS command;
2) wait approximately 1ms (but less than 2ms);
3) the host submits a read request for receiving status;
4) wait approximately 1ms (but less than 2ms);
5) issue a request to read data from the device on the data-in pipe;
6) the device should respond with a SENSE IU;
7) perform the following check on the received data;
    A) check that the received data contains a LUN list; and
    B) verify that the STATUS field in SENSE IU contains GOOD (00h);
8) perform the following (step 9 to step 15) on each LUN indicated by the REPORT LUNS command;
9) send an INQUIRY command with the EVPD field set to 1, the PAGE CODE set to 83h, and the TRANSFER LENGTH field set to at least 10h or to a value large enough in order to obtain the whole Designation descriptor list;
10) wait approximately 1ms (but less than 2ms);
11) the host submits a read request for receiving status;
12) wait approximately 1ms (but less than 2ms);
13) issue a request to read data from the device on the data-in pipe;
14) the device should respond with a SENSE IU;
15) perform the following check on the received data;

A) check that the received data contains a single designation descriptor with a DESIGNATOR TYPE field set to 03h, an ASSOCIATION field set to 00b for the logical unit addressed by the LOGICAL UNIT NUMBER field in the COMMAND IU;
B) check that the NAA identifier in the WWN is unique for each LUN;
C) verify that the STATUS field in SENSE IU contains GOOD (00h).

5.5.7.2.9 Method 5

1) Issue a request to read data from the device on the data-in pipe;
2) wait approximately 1ms (but less than 2ms);
3) the host submits a read request for receiving status;
4) wait approximately 1ms (but less than 2ms);
5) send a REPORT LUNS command;
6) the device should respond with a SENSE IU;
7) perform the following check on the received data;
   A) check that the received data contains a LUN list; and
   B) verify that the STATUS field in that SENSE IU contains GOOD status;
8) perform the following (step 9 to step 15) on each LUN rindicated by the REPORT LUNS command;
9) issue a request to read data from device on the data-in pipe;
10) wait approximately 1ms (but less than 2ms);
11) the host submits a read request for receiving status;
12) wait approximately 1ms (but less than 2ms);
13) send an INQUIRY command with the EVPD field set to 1, the PAGE CODE set to 83h, and the TRANSFER LENGTH field set to at least 10h or to a value large enough in order to obtain the whole Designation descriptor list;
14) the device should respond with a SENSE IU;
15) perform the following check on the received data;
   A) check that the received data contains a single designation descriptor with a DESIGNATOR TYPE field set to 03h, an ASSOCIATION field set to 00b for the logical unit addressed by the LOGICAL UNIT NUMBER field in the COMMAND IU;
   B) check that the NAA identifier in the WWN is unique for each LUN;
   C) verify that the STATUS field in SENSE IU contains GOOD (00h).

5.5.7.2.10 Method 6

1) Issue a request to read data from the device on the data-in pipe;
2) wait approximately 1ms (but less than 2ms);
3) send a REPORT LUNS command;
4) wait approximately 1ms (but less than 2ms);
5) the host submits a read request for receiving the status;
6) the device should respond with a SENSE IU;
7) perform the following check on the received data;
   A) check that the received data contains a LUN list;
   B) verify that the STATUS field in SENSE IU contains GOOD status;
8) perform the following (step 9 to step 15) on each LUN indicated by the REPORT LUNS command;
9) issue a request to read data from the device on the data-in pipe;
10) wait approximately 1ms (but less than 2ms);
11) send an INQUIRY command with the EVPD field set to 1, the PAGE CODE set to 83h, and the TRANSFER LENGTH field set to at least 10h or to a value large enough in order to obtain the whole Designation descriptor list;
12) wait approximately 1ms (but less than 2ms);
13) the host submits a read request for receiving status;
14) the device should respond with a SENSE IU;
15) perform the following check on the received data;
   A) check that the received data contains a single designation descriptor with a DESIGNATOR TYPE field set to 03h, an ASSOCIATION field set to 00b for the logical unit addressed by the LOGICAL UNIT NUMBER field in the COMMAND IU;
   B) check that the NAA identifier in the WWN is unique for each LUN;
   C) verify that the STATUS field in SENSE IU contains GOOD status.

5.5.7.3 SS_07 Verification of INQUIRY Data Bit CMDQUE

5.5.7.3.1 Overview

This test verifies that INQUIRY data.

5.5.7.3.2 Assertions Used in Test

The INQUIRY data CMDQUE bit shall be set to one (see 4.64).

5.5.7.3.3 Applicable tests

The following tests shall be applied for this test:

VS_02, VS_03, VS_04, VS_09, VA_01, VA_02, VA_05, VA_10 and VA_11.

5.5.7.3.4 Overview of Test Steps

This test performs the following steps.

5.5.7.3.5 Method 1

1) Send an INQUIRY command;
2) wait approximately 1ms (but less than 2ms);
3) issue a request to read data from the device on the data-in pipe;
4) wait approximately 1ms (but less than 2ms);
5) the Host submits read requests for receiving status;
6) the device should respond with a SENSE IU; and
7) perform the following check on the received data;
    A) verify that the received data's CMDQUE field is set to 1; and
    B) verify that the STATUS field in SENSE IU contains GOOD status.

5.6 Speed Agnostic Tests

5.6.1 Overview

This section describes USB [UAS] compliance tests a compliant device shall pass when the device is operating at either SuperSpeed or high-speed. This section describes the tests that need to be performed when the device is in the USB Configured device state. For these tests, the device shall have a configuration selected (e.g., via a SET_CONFIGURATION request) that includes a [UAS] interface.

5.6.2 Validation of Reserved Fields

5.6.2.1 Overview

These tests shall be performed on all IUs sent to or received from the device when a [UAS] command is sent to a device or some device response is received.

5.6.2.2 VA_01 Reserved Field Validation of COMMAND IUs

5.6.2.2.1 Overview

This test verifies that the device ignores reserved fields in COMMAND IUs.

5.6.2.2.2 Assertions Used in Test

The device shall not check reserved fields (see 4.50).

5.6.2.2.3 test initialization

Send a TCS-NDT, TCS-DO, or TCS-DI command to the device with non zero values in the reserved fields. The following are reserved fields in COMMAND IUs: Byte 1, Byte 4 bit 7, Byte 5, Byte 6 bits 0..1, and Byte 7.

5.6.2.2.4 test verification

Upon reception of the response, verify that a SENSE IU was received with GOOD status.

5.6.2.3 VA_02 Reserved Field Validation of SENSE IU

This test verifies that the reserved fields in a SENSE IU are 0.

5.6.2.3.1 Assertions Used in Test

The device shall set reserved fields in IU's to zero (see 4.49).

5.6.2.3.2 test initialization

Send a TCS-NDT, TCS-DO, or TCS-DI command to the device.

5.6.2.3.3 test verification

Upon reception of the response, verify that the received response is a SENSE IU and check that the reserved fields contain the value 0. The following are the reserved fields in a SENSE IU returning good status: Byte 1, Byte 7..13.

5.6.2.4 VA_03 Reserved Field Validation of RESPONSE IU

5.6.2.4.1 Overview

This test verifies that the reserved fields in a RESPONSE IU are 0.

5.6.2.4.2 Assertions Used in Test

The device shall set reserved fields in IU's to zero (see 4.49).

5.6.2.4.3 test initialization

Send a TCS-TM command.

5.6.2.4.4 test verification

Upon reception of the response, verify that the received response is a RESPONSE IU and that the reserved fields contain a value of 0.

The following are the reserved fields in the RESPONSE IU: Byte 1.

5.6.2.5 VA_04 Reserved Field Validation of TASK MANAGEMENT IU

5.6.2.5.1 Overview

This test verifies that the device ignores reserved fields in TASK MANAGEMENT IUs.

5.6.2.5.2 Assertions Used in Test

The device shall not check reserved fields (see 4.50).

5.6.2.5.3 test initialization

Send a TCS-TM command with non-zero values in the reserved fields.

The following are the reserved fields in the TASK MANAGEMENT IU: Byte 1 and Byte 5.

5.6.2.5.4 test verification

Upon reception of response, verify that the RESPONSE IU with a response code of FUNCTION COMPLETE or FUNCTION SUCCEEDED.

5.6.2.6 VA_05 Verification of SENSE IU on Command Completion

5.6.2.6.1 Overview

This test verifies that the command completed successfully.

5.6.2.6.2 Assertions Used in Test

After the last byte of data is transferred and achieved a USB acknowledgment, the [UAS] target device shall return a SENSE IU to indicate command completion (see 4.25).

5.6.2.6.3 test initialization

Send a TCS-NDT/TCS-DI/TCS-DO command.

5.6.2.6.4 test verification

Upon reception of SENSE IU, verify that the status is GOOD.

5.6.3 SCSI Command Assertions

5.6.3.1 Overview

This section describes the test cases which are related with SCSI commands.

5.6.3.2 VA_06 SCSI Inquiry Command

5.6.3.2.1 Overview

This test verifies that the device responds with GOOD status for a properly formed INQUIRY command.

5.6.3.2.2 Assertions Used in Test

The device shall not return an error when it receives a properly formatted INQUIRY command (see 4.60).

5.6.3.2.3 test initialization

Send an INQUIRY command.

5.6.3.2.4 test verification

Verify that the data received is a SENSE IU that contains GOOD (00h) status.

5.6.3.3 VA_07 SCSI TEST UNIT READY Command Assertion

5.6.3.3.1 Overview

This test verifies that the device responds with GOOD status for properly formed TEST UNIT READY command.

5.6.3.3.2 Assertions Used in Test

The device shall not return an error when it receives a properly formatted TEST UNIT READY command (see 4.66).

5.6.3.3.3 test initialization

Send a TEST UNIT READY command.

5.6.3.3.4 test verification

Verify that a SENSE IU with GOOD (00h) status is received.

5.6.3.4 VA_08 SCSI REQUEST SENSE Command Assertion

5.6.3.4.1 Overview

This test verifies that the device responds with a GOOD status for a properly formed REQUEST SENSE command.

5.6.3.4.2 Assertions Used in Test

The device shall not return an error when it receives a properly formatted REQUEST SENSE command (see 4.67).

5.6.3.4.3 test initialization

Send a REQUEST SENSE command.

5.6.3.4.4 test verification

Verify that a SENSE IU containing GOOD (00h) status is received.

5.6.3.5 VA_09 SCSI REPORT LUN Command Assertion

5.6.3.5.1 Overview

This test verifies that the device responds with GOOD status for a properly formatted REPORT LUNS command.

5.6.3.5.2 Assertions Used in Test

The device shall not return an error when it receives a properly formatted REPORT LUNS command (see 4.68).

5.6.3.5.3 test initialization

Send a REPORT LUNS command.

5.6.3.5.4 test verification

Verify that a SENSE IU with GOOD (00h) status is received.

5.6.4 IUs in Single Packet

5.6.4.1 Overview

These tests shall be performed on all IUs sent to or received from the device when a [UAS] command is sent to a device or a device response is received.

5.6.4.2 VA_10 RESPONSE IU in Single Packet

5.6.4.2.1 Overview

This test verifies that the RESPONSE IU is in a single packet.

5.6.4.2.2 Assertions Used in Test

The RESPONSE IU shall be contained in a single USB packet and shall not share a USB packet with any other Information Unit (see 4.40).

5.6.4.2.3 test initialization

Send multiple TCS-TM commands to the device sequentially using TASK MANAGEMENT IUs, followed by a request to read the response.

5.6.4.2.4 test verification

Verify that the received response is multiple RESPONSE IUs and check that each RESPONSE IU is in a single USB packet by verifying the received data length from the Status pipe is equal to the size of a RESPONSE IU.

5.6.4.3 VA_11 SENSE IUs in Single Packet

5.6.4.3.1 Overview

This test verifies that the SENSE IU exists in a single packet.

5.6.4.3.2 Assertions Used in Test

The SENSE IU shall be contained in a single USB packet and shall not share a USB packet with any other Information Unit (see 4.39).

5.6.4.3.3 test initialization

Send multiple TCS-NDT, TCS-DO, or TCS-DI commands to the device sequentially using COMMAND IUs, followed by a request to read the responses.

5.6.4.3.4 test verification

Verify that the received response is multiple SENSE IUs in multiple packets, and check that each SENSE IU is in a single USB packet by verifying the received data length from the Status pipe is equal to the Length field in the IU plus 16.

5.6.4.4 VA_12 Verification of Peripheral Device Type with Version Descriptors

5.6.4.4.1 Overview

This test verifies that the version descriptor value and peripheral device type value match in the INQUIRY data.

5.6.4.4.2 Assertions Used in Test

Version descriptors shall match the peripheral device types when they are present (see 4.65).

5.6.4.4.3 test initialization

Send an INQUIRY command.

5.6.4.4.4 test verification

Check the received inquiry data to confirm that:

    a)   there is a version descriptor value that is appropriate to the peripheral device type value; and

    b)   the STATUS field in the SENSE IU contains GOOD (00h) status.

5.6.4.5 VA_13 Verification of IEEE Company ID

5.6.4.5.1 Overview

This test verifies that the IEEE Company ID in the world wide name information matches the company providing the device.

> NOTE 2 — Implementor should report the WWN breaking out the OUI and Unique identifier within the OUI.

5.6.4.5.2 Assertions Used in Test

All devices shall contain a valid World Wide Name (see 4.62).

The device shall support the EVPD bit in the INQUIRY command with page code set to the Device Identification (i.e., 83h) VPD page (see 4.63).

5.6.4.5.3 test initialization

    1)   Get the IEEE company ID required by UAS from the IEEE;

    2)   fetch IEEE company ID from the VPD page.

5.6.4.5.4 test verification

Check that the IEEE company ID returned in the VPD page is the same as the company provided by the IEEE.

5.6.5 TASK MANAGEMENT Command Validation

5.6.5.1 Overview

These tests shall be performed on all TASK MANAGEMENT commands.

There is no error condition present in the device before issuing these task management commands and the command queue shall be empty in the device.

5.6.5.2 SA_01 ABORT TASK Command Verification

5.6.5.2.1 Overview

This test verifies the ABORT TASK command.

5.6.5.2.2 Assertions Used in Test

[UAS] devices shall support all task management functions listed in the [UAS] task management functions table (see 4.22).

For each command sequence that requires USB transfers on the COMMAND and STATUS pipes (see 4.28), a device shall not require a specific ordering of:

    a)   SuperSpeed: ACK (Prime), DP on command pipe, ACK (Stream ID); or

    b)   HighSpeed: IN Token or OUT Token, on the different pipes.

5.6.5.2.3 Applicable tests

The following tests shall be applied for this test:

VH_06 (high-speed), VS_10 (SuperSpeed), VA_03, VA_04 and VA_10.

5.6.5.2.4 Overview of Test Steps

A device shall pass all the methods specified below. These methods are present to test the different ordering defined by UASP for transfers on the Command, Data and Status pipes.

5.6.5.2.5 Method 1

    1)   Issue a valid TCS-TM command to ABORT TASK;

2) wait approximately 1ms (but less than 2ms);
3) the host submits a read request for receiving the response;
4) the device should respond with a RESPONSE IU; and
5) perform the following checks on the received response;
   A) check that the received response contains a RESPONSE IU; and
   B) check that the received RESPONSE CODE field is set to: TASK MANAGEMENT FUNCTION COMPLETE (i.e., 00h), TASK MANAGEMENT FUNCTION FAILED (i.e., 05h), or TASK MANAGEMENT FUNCTION SUCCEEDED (i.e., 08h).

5.6.5.2.6 Method 2

1) The host submits a read request for receiving a response;
2) wait approximately 1ms (but less than 2ms);
3) issue a valid TCS-TM command to ABORT TASK;
4) the device should respond with a RESPONSE IU; and
5) perform the following checks on the received response;
   A) check that the received response contains a RESPONSE IU; and
   B) check that the received RESPONSE CODE field is set to: TASK MANAGEMENT FUNCTION COMPLETE (i.e., 00h), TASK MANAGEMENT FUNCTION FAILED (i.e., 05h), or TASK MANAGEMENT FUNCTION SUCCEEDED (i.e., 08h).

5.6.5.3 SA_02 ABORT TASK SET Command Verification

5.6.5.3.1 Overview

This test verifies ABORT TASK SET command.

5.6.5.3.2 Assertions Used in Test

A [UAS] device shall support all task management functions listed in the [UAS] task management functions table (see 4.22).

For each command sequence that requires USB transfers on the COMMAND and STATUS pipes (see 4.28), a device shall not require a specific ordering of:

   a) SuperSpeed: ACK (Prime), DP on command pipe, ACK (Stream ID); or
   b) HighSpeed: IN Token or OUT Token, on the different pipes.

5.6.5.3.3 Applicable tests

Following tests shall be applied for this test:

VH_06 (high-speed), VS_10 (SuperSpeed), VA_03, VA_04 and VA_10.

5.6.5.3.4 Overview of Test Steps

A device shall pass all the methods specified below. These methods are present to test the different ordering defined by UASP for transfers on the Command, Data and Status pipes.

5.6.5.3.5 Method 1

1) Issue a valid TCS-TM command to ABORT TASK SET;
2) wait approximately 1ms (but less than 2ms);
3) the host submits a read request for receiving a response;
4) the device should respond with a RESPONSE IU; and
5) perform the following checks on the received response;
   A) check that the received response contains a RESPONSE IU; and
   B) check that the received RESPONSE CODE field is set to: TASK MANAGEMENT FUNCTION COMPLETE (i.e., 00h), TASK MANAGEMENT FUNCTION FAILED (i.e., 05h), or TASK MANAGEMENT FUNCTION SUCCEEDED (i.e., 08h).

5.6.5.3.6 Method 2

1) The host submits a read request for receiving the response;
2) wait approximately 1ms (but less than 2ms);
3) issue a valid TCS-TM command to ABORT TASK SET;

4) the device should respond with a RESPONSE IU; and
5) perform the following checks on the received response;
    A) check that the received response contains a RESPONSE IU; and
    B) check that the received RESPONSE CODE field is set to: TASK MANAGEMENT FUNCTION COMPLETE (i.e., 00h), TASK MANAGEMENT FUNCTION FAILED (i.e., 05h), or TASK MANAGEMENT FUNCTION SUCCEEDED (i.e., 08h).

5.6.5.4 SA_03 CLEAR ACA Command Verification

5.6.5.4.1 Overview

This test verifies the CLEAR ACA command.

5.6.5.4.2 Assertions Used in Test

A [UAS] device shall support all task management functions listed in the [UAS] task management functions table (see 4.22).

For each command sequence that requires USB transfers on the COMMAND and STATUS pipes (see 4.28), a device shall not require a specific ordering of:

    a) SuperSpeed: ACK (Prime), DP on command pipe, ACK (Stream ID); or
    b) HighSpeed: IN Token or OUT Token, on the different pipes.

5.6.5.4.3 Applicable tests

The following tests shall be applied for this test:

VH_06 (high-speed), VS_10 (SuperSpeed), VA_03, VA_04 and VA_10.

5.6.5.4.4 Overview of Test Steps

A device shall pass all the methods specified below. These methods are present to test the different ordering defined by UASP for transfers on the Command, Data and Status pipes.

5.6.5.4.5 Method 1

1) Issue a valid TCS-TM command to CLEAR ACA;
2) wait approximately 1ms (but less than 2ms);
3) the host submits a read request for receiving the response;
4) the device should respond with a RESPONSE IU;
5) perform the following checks on the received response.
    A) check that the received response contains a RESPONSE IU; and
    B) check that the received RESPONSE CODE field is set to: TASK MANAGEMENT FUNCTION COMPLETE (i.e., 00h), TASK MANAGEMENT FUNCTION FAILED (i.e., 05h), or TASK MANAGEMENT FUNCTION SUCCEEDED (i.e., 08h).

5.6.5.4.6 Method 2

1) The host submits a read request for receiving the response;
2) wait approximately 1ms (but less than 2ms);
3) issue a valid TCS-TM command to CLEAR ACA;
4) the device should respond with a RESPONSE IU; and
5) perform the following checks on the received response;
    A) check that the received response contains a RESPONSE IU; and
    B) check that the received RESPONSE CODE field is set to: TASK MANAGEMENT FUNCTION COMPLETE (i.e., 00h), TASK MANAGEMENT FUNCTION FAILED (i.e., 05h), or TASK MANAGEMENT FUNCTION SUCCEEDED (i.e., 08h).

5.6.5.5 SA_04 CLEAR TASK SET Command Verification

5.6.5.5.1 Overview

This test verifies the CLEAR TASK SET command.

5.6.5.5.2 Assertions Used in Test

A [UAS] device shall support all task management functions listed in the [UAS] task management functions table (see 4.22).

For each command sequence that requires USB transfers on the COMMAND and STATUS pipes (see 4.28), a device shall not require a specific ordering of:

- a) SuperSpeed: ACK (Prime), DP on command pipe, ACK (Stream ID); or
- b) HighSpeed: IN Token or OUT Token, on the different pipes.

5.6.5.5.3 Applicable tests

The following tests shall be applied for this test:

VH_06 (high-speed), VS_10 (SuperSpeed), VA_03, VA_04 and VA_10.

5.6.5.5.4 Overview of Test Steps

A device shall pass all the methods specified below. These methods are present to test the different ordering defined by UASP for transfers on the Command, Data and Status pipes.

5.6.5.5.5 Method 1

1) Issue a valid TCS-TM command to CLEAR TASK SET;
2) wait approximately 1ms (but less than 2ms);
3) the Host submits a read request for receiving the response;
4) the device should respond with a RESPONSE IU; and
5) perform the following checks on the received response;
    A) check that the received response contains a RESPONSE IU; and
    B) check that the received RESPONSE CODE field is set to: TASK MANAGEMENT FUNCTION COMPLETE (i.e., 00h), TASK MANAGEMENT FUNCTION FAILED (i.e., 05h), or TASK MANAGEMENT FUNCTION SUCCEEDED (i.e., 08h).

5.6.5.5.6 Method 2

1) The host submits a read request for receiving the response;
2) wait approximately 1ms (but less than 2ms);
3) issue a valid TCS-TM command to CLEAR TASK SET;
4) the device should respond with a RESPONSE IU; and
5) perform the following checks on the received response;
    A) check that the received response contains a RESPONSE IU; and
    B) check that the received RESPONSE CODE field is set to: TASK MANAGEMENT FUNCTION COMPLETE (i.e., 00h), TASK MANAGEMENT FUNCTION FAILED (i.e., 05h), or TASK MANAGEMENT FUNCTION SUCCEEDED (i.e., 08h).

5.6.5.6 SA_05 I_T NEXUS RESET Command Verification

5.6.5.6.1 Overview

This test verifies the I_T NEXUS RESET command.

5.6.5.6.2 Assertions Used in Test

A [UAS] device shall support all task management functions listed in the [UAS] task management functions table (see 4.22).

For each command sequence that requires USB transfers on the COMMAND and STATUS pipes (see 4.28), a device shall not require a specific ordering of:

- a) SuperSpeed: ACK (Prime), DP on command pipe, ACK (Stream ID); or
- b) HighSpeed: IN Token or OUT Token, on the different pipes.

5.6.5.6.3 Applicable tests

The following tests shall be applied for this test:

VH_06 (high-speed), VS_10 (SuperSpeed), VA_04, VA_04 and VA_10.

5.6.5.6.4 Overview of Test Steps

A device shall pass all the methods specified below. These methods are present to test the different ordering defined by UASP for transfers on the Command, Data and Status pipes.

5.6.5.6.5 Method 1

1) Issue a valid TCS-TM command to I_T NEXUS RESET;
2) wait approximately 1ms (but less than 2ms);
3) the host submits a read request for receiving a response;
4) the device should respond with a RESPONSE IU; and
5) perform the following checks on the received response;
   A) check that the received response contains a RESPONSE IU; and
   B) check that the received RESPONSE CODE field is set to: TASK MANAGEMENT FUNCTION COMPLETE (i.e., 00h), TASK MANAGEMENT FUNCTION FAILED (i.e., 05h), or TASK MANAGEMENT FUNCTION SUCCEEDED (i.e., 08h).

5.6.5.6.6 Method 2

1) The host submits a read request for receiving a response;
2) wait approximately 1ms (but less than 2ms);
3) issue a valid TCS-TM command to I_T NEXUS RESET;
4) the device should respond with a RESPONSE IU; and
5) perform the following checks on the received response;
   A) check that the received response contains a RESPONSE IU; and
   B) check that the received RESPONSE CODE field is set to: TASK MANAGEMENT FUNCTION COMPLETE (i.e., 00h), TASK MANAGEMENT FUNCTION FAILED (i.e., 05h), or TASK MANAGEMENT FUNCTION SUCCEEDED (i.e., 08h).

5.6.5.7 SA_06 LOGICAL UNIT RESET Command Verification

5.6.5.7.1 Overview

This test verifies the LOGICAL UNIT RESET command.

5.6.5.7.2 Assertions Used in Test

A [UAS] device shall support all task management functions listed in the [UAS] task management functions table (see 4.22).

For each command sequence that requires USB transfers on the COMMAND and STATUS pipes (see 4.28), a device shall not require a specific ordering of:

a) SuperSpeed: ACK (Prime), DP on command pipe, ACK (Stream ID); or
b) HighSpeed: IN Token or OUT Token, on the different pipes.

5.6.5.7.3 Applicable tests

The following tests shall be applied for this test:

VH_06 (high-speed), VS_10 (SuperSpeed), VA_03, VA_04 and VA_10.

5.6.5.7.4 Overview of Test Steps

A device shall pass all the methods specified below. These methods are present to test the different ordering defined by UASP for transfers on the Command, Data and Status pipes.

5.6.5.7.5 Method 1

1) Issue a valid TCS-TM command to LOGICAL UNIT RESET;
2) wait approximately 1ms (but less than 2ms);
3) the host submits a read request for receiving a response;
4) the device should respond with a RESPONSE IU; and
5) perform the following checks on the received response;
   A) check that the received response contains a RESPONSE IU; and

    B) check that the received RESPONSE CODE field is set to: TASK MANAGEMENT FUNCTION COMPLETE (i.e., 00h), TASK MANAGEMENT FUNCTION FAILED (i.e., 05h), or TASK MANAGEMENT FUNCTION SUCCEEDED (i.e., 08h).

5.6.5.7.6 Method 2

1) The host submits a read request for receiving a response;
2) wait approximately 1ms (but less than 2ms);
3) issue a valid TCS-TM command LOGICAL UNIT RESET;
4) the device should respond with a RESPONSE IU;
5) perform the following checks on the received response;
    A) check that the received response contains a RESPONSE IU; and
    B) check that the received RESPONSE CODE field is set to: TASK MANAGEMENT FUNCTION COMPLETE (i.e., 00h), TASK MANAGEMENT FUNCTION FAILED (i.e., 05h), or TASK MANAGEMENT FUNCTION SUCCEEDED (i.e., 08h).

5.6.5.8 SA_07 QUERY TASK Command Verification

5.6.5.8.1 Overview

This test verifies the QUERY TASK command.

5.6.5.8.2 Assertions Used in Test

A [UAS] device shall support all task management functions listed in the [UAS] task management functions table (see 4.22).

For each command sequence that requires USB transfers on the COMMAND and STATUS pipes (see 4.28), a device shall not require a specific ordering of:

a) SuperSpeed: ACK (Prime), DP on command pipe, ACK (Stream ID); or
b) HighSpeed: IN Token or OUT Token, on the different pipes.

5.6.5.8.3 Applicable tests

The following tests shall be applied for this test:

VH_06 (high-speed), VS_10 (SuperSpeed), VA_03, VA_04 and VA_10.

5.6.5.8.4 Overview of Test Steps

A device shall pass all the methods specified below. These methods are present to test the different ordering defined by UASP for transfers on the Command, Data and Status pipes.

5.6.5.8.5 Method 1

1) Issue a valid TCS-TM command to QUERY TASK;
2) wait approximately 1ms (but less than 2ms);
3) the host submits a read request for receiving a response;
4) the device should respond with a RESPONSE IU; and
5) perform the following checks on the received response;
    A) check that the received response contains a RESPONSE IU; and
    B) check that the received RESPONSE CODE field is set to: TASK MANAGEMENT FUNCTION COMPLETE (i.e., 00h), TASK MANAGEMENT FUNCTION FAILED (i.e., 05h), or TASK MANAGEMENT FUNCTION SUCCEEDED (i.e., 08h).

5.6.5.8.6 Method 2

1) The host submits a read request for receiving a response;
2) wait approximately 1ms (but less than 2ms);
3) issue a valid TCS-TM command to QUERY TASK;
4) the device should respond with a RESPONSE IU; and
5) perform the following checks on the received response;
    A) check that the received response contains a RESPONSE IU; and

    B) check that the received RESPONSE CODE field is set to: TASK MANAGEMENT FUNCTION COMPLETE (i.e., 00h), TASK MANAGEMENT FUNCTION FAILED (i.e., 05h), or TASK MANAGEMENT FUNCTION SUCCEEDED (i.e., 08h).

5.6.5.9 SA_08 QUERY TASK SET Command Verification

5.6.5.9.1 Overview

This test verifies the QUERY TASK SET command.

5.6.5.9.2 Assertions Used in Test

A [UAS] device shall support all task management functions listed in the [UAS] task management functions table (see 4.22).

For each command sequence that requires USB transfers on the COMMAND and STATUS pipes (see 4.28), a device shall not require a specific ordering of:

    a) SuperSpeed: ACK (Prime), DP on command pipe, ACK (Stream ID); or
    b) HighSpeed: IN Token or OUT Token, on the different pipes.

5.6.5.9.3 Applicable tests

The following tests shall be applied for this test:

VH_06 (high-speed), VS_10 (SuperSpeed), VA_03, VA_04 and VA_10.

5.6.5.9.4 Overview of Test Steps

A device shall pass all the methods specified below. These methods are present to test the different ordering defined by UASP for transfers on the Command, Data and Status pipes.

5.6.5.9.5 Method 1

    1) Issue a valid TCS-TM command to QUREY TASK SET;
    2) wait approximately 1ms (but less than 2ms);
    3) the host submits a read request for receiving a response;
    4) the device should respond with a RESPONSE IU; and
    5) perform the following checks on the received response;
        A) check that the received response contains a RESPONSE IU; and
        B) check that the received RESPONSE CODE field is set to: TASK MANAGEMENT FUNCTION COMPLETE (i.e., 00h), TASK MANAGEMENT FUNCTION FAILED (i.e., 05h), or TASK MANAGEMENT FUNCTION SUCCEEDED (i.e., 08h).

5.6.5.9.6 Method 2

    1) The host submits a read request for receiving a response;
    2) wait approximately 1ms (but less than 2ms);
    3) issue a valid TCS-TM command to QUREY TASK SET;
    4) the device should respond with a RESPONSE IU; and
    5) perform the following checks on the received response;
        A) check that the received response contains a RESPONSE IU; and
        B) check that the received RESPONSE CODE field is set to: TASK MANAGEMENT FUNCTION COMPLETE (i.e., 00h), TASK MANAGEMENT FUNCTION FAILED (i.e., 05h), or TASK MANAGEMENT FUNCTION SUCCEEDED (i.e., 08h).

5.6.5.10 SA_09 QUERY ASYNCHRONOUS EVENT Command Verification

5.6.5.10.1 Overview

This test verifies the QUERY ASYNCHRONOUS EVENT command.

5.6.5.10.2 Assertions Used in Test

A [UAS] device shall support all task management functions listed in the [UAS] task management functions table (see 4.22).

For each command sequence that requires USB transfers on the COMMAND and STATUS pipes (see 4.28), a device shall not require a specific ordering of:

    a)   SuperSpeed: ACK (Prime), DP on command pipe, ACK (Stream ID); or
    b)   HighSpeed: IN Token or OUT Token, on the different pipes.

5.6.5.10.3 Applicable tests

The following tests shall be applied for this test:

VH_06 (high-speed), VS_10 (SuperSpeed), VA_03, VA_04 and VA_10.

5.6.5.10.4 Overview of Test Steps

A device shall pass all the methods specified below. These methods are present to test the different ordering defined by UASP for transfers on the Command, Data and Status pipes.

5.6.5.10.5 Method 1

    1)   Issue a valid TCS-TM command to QUERY ASYNCHRONOUS EVENT;
    2)   wait approximately 1ms (but less than 2ms);
    3)   the host submits a read request for receiving a response;
    4)   the device should respond with a RESPONSE IU; and
    5)   perform the following checks on the received response;
        A)   check that the received response contains a RESPONSE IU; and
        B)   check that the received RESPONSE CODE field is set to: TASK MANAGEMENT FUNCTION COMPLETE (i.e., 00h), TASK MANAGEMENT FUNCTION FAILED (i.e., 05h), or TASK MANAGEMENT FUNCTION SUCCEEDED (i.e., 08h).

5.6.5.10.6 Method 2

    1)   The host submits a read request for receiving a response;
    2)   wait approximately 1ms (but less than 2ms);
    3)   issue a valid TCS-TM command to QUREY ASYNCHRONOUS EVENT;
    4)   the device should respond with a RESPONSE IU;
    5)   perform the following checks on the received response;
        A)   check that the received response contains a RESPONSE IU; and
        B)   check that the received RESPONSE CODE field is set to: TASK MANAGEMENT FUNCTION COMPLETE (i.e., 00h), TASK MANAGEMENT FUNCTION FAILED (i.e., 05h), or TASK MANAGEMENT FUNCTION SUCCEEDED (i.e., 08h).

5.7 Device Behavior during Error Scenarios

5.7.1 Overview

This section describes USB [UAS] compliance tests that a compliant device shall pass when the device is operating at both SuperSpeed and high-speed including an expected error code.

5.7.2 HE_01 Verification of COMMANDS CLEARED BY DEVICE SERVER Error Code

5.7.2.1 Overview

This check verifies that the device operating at high-speed returns expected error in case of timeout error.

5.7.2.2 Assertions Used in Test

If the [UAS] target port is unable to send status to the [UAS] initiator port when said status is available, then the target port may abort all commands in the task set and all commands that the target port receives until the [UAS] target port is able to terminate a command with CHECK CONDITION status with the sense key set to UNIT ATTENTION with the additional sense code set to COMMANDS CLEARED BY DEVICE SERVER (see 4.56).

For each command sequence that requires USB transfers on the COMMAND, DATA and STATUS pipes(see 4.27), the device shall not require a specific ordering of:

    a)   SuperSpeed: DP on command pipe, ACK (Prime), DP (Stream ID), ACK (Stream ID); or
    b)   HighSpeed: IN Token or OUT Token, on the different pipes.

5.7.2.3 Overview of Test Steps

A device shall pass all the methods specified below. These methods are present to test the different ordering defined by UASP for transfers on the Command, Data and Status pipes.

5.7.2.4 Method 1

1) Send a TCS-DI to the device using COMMAND IU;
2) wait approximately 1ms (but less than 2ms);
3) the host submits a read request for receiving status;
4) the device should respond with a READ READY IU; and
5) perform the following checks on the received response;
    A) check that the received response contains a READ READY IU; and
    B) check that the tag in the READ READY IU is is the same as the tag in the COMMAND IU;
6) issue requests to read data from device on the data-in pipe;
7) wait approximately for > 10ms;
8) that host submits read requests for receiving status;
9) the device should respond with a SENSE IU; and
10) perform the following checks on the received response;
    A) check that the STATUS field of the SENSE IU is either STATUS GOOD or STATUS CHECK CONDITION; and
    B) if the status is CHECK CONDITION, then check that the SENSE KEY field is set to UNIT ATTENTION and the ADDITIONAL SENSE CODE field set to COMMANDS CLEARED BY DEVICE SERVER.

5.7.2.5 Method 2

1) The Host submits a read request for receiving status;
2) wait approximately 1ms (but less than 2ms);
3) send a TCS-DI command;
4) the device should respond with a READ READY IU;
5) perform the following checks on the received response;
    A) check that the received response contains a READ READY IU; and
    B) check that the tag in the READ READY IU is is the same as the tag in the COMMAND IU;
6) issue requests to read data from the device on data-in pipe;
7) wait approximately for > 10ms;
8) the host submits a read request for receiving status;
9) the device should respond with a SENSE IU; and
10) perform the following checks on the received response;
    A) check that the STATUS field of the SENSE IU is either STATUS GOOD or STATUS CHECK CONDITION; and
    B) if the status is CHECK CONDITION, then check that the SENSE KEY field is set to UNIT ATTENTION and the ADDITIONAL SENSE CODE field set to COMMANDS CLEARED BY DEVICE SERVER.

5.7.2.6 Method 3

1) Send a TCS-DI command;
2) wait approximately 1ms (but less than 2ms);
3) the host submits a read request for receiving status;
4) the device should respond with a READ READY IU;
5) perform the following checks on the received response;
    A) check that the received response contains a READ READY IU; and
    B) check that the tag in the READ READY IU is is the same as the tag in the COMMAND IU;
6) the host submits a read request for receiving status;
7) wait approximately for > 10ms;
8) issue requests to read data from the device on the data-in pipe;
9) the device should respond with a SENSE IU; and
10) perform the following checks on the received response;
    A) check that the STATUS field of the SENSE IU is either STATUS GOOD or STATUS CHECK CONDITION; and

   B) if the status is CHECK CONDITION, then check that the SENSE KEY field is set to UNIT ATTENTION
       and the ADDITIONAL SENSE CODE field set to COMMANDS CLEARED BY DEVICE SERVER.

5.7.2.7 Method 4

1) The host submits a read request for receiving status;
2) wait approximately 1ms (but less than 2ms);
3) send a TCS-DI command;
4) the device should respond with a READ READY IU;
5) perform the following checks on the received response;
    A) check that the received response contains a READ READY IU; and
    B) check that the tag in the READ READY IU is is the same as the tag in the COMMAND IU;
6) wait approximately for > 10ms;
7) the host submits a read request for receiving status;
8) issue requests to read data from the device on the data-in pipe;
9) the device should respond with a SENSE IU; and
10) perform the following checks on the received response;
    A) check that the STATUS field of the SENSE IU is either STATUS GOOD or STATUS CHECK
        CONDITION; and
    B) if the status is CHECK CONDITION, then check that the SENSE KEY field is set to UNIT ATTENTION
        and the ADDITIONAL SENSE CODE field set to COMMANDS CLEARED BY DEVICE SERVER.

5.7.3 SE_01 Verification of COMMANDS CLEARED BY DEVICE SERVER Error Code

5.7.3.1 Overview

This test verifies that a device operating at SuperSpeed returns the expected error in case of timeout.

5.7.3.2 Assertions Used in Test

If the [UAS] target port is unable to send status to the [UAS] initiator port when said status is available, then the
target port may abort all commands in the task set and all commands that the target port receives until the [UAS]
target port is able to terminate a command with CHECK CONDITION status with the sense key set to UNIT
ATTENTION with the additional sense code set to COMMANDS CLEARED BY DEVICE SERVER (see 4.56).

For each command sequence that requires USB transfers on the COMMAND, DATA and STATUS pipes
(see 4.27), the device shall not require a specific ordering of:

   a) SuperSpeed: DP on command pipe, ACK (Prime), DP (Stream ID), ACK (Stream ID); or
   b) HighSpeed: IN Token or OUT Token, on the different pipes.

5.7.3.3 Overview of Test Steps

A device shall pass all the methods specified below. These methods are present to test the different ordering
defined by UASP for transfers on the Command, Data and Status pipes.

5.7.3.4 Method 1

1) Send a TCS-DI command;
2) wait approximately 1ms (but less than 2ms);
3) issue a request to read data from device on data-in pipe;
4) wait approximately for > 10ms;
5) the host submits a read request for receiving status;
6) the device should respond with a SENSE IU; and
7) perform the following checks on the received response;
    A) check that the SENSE KEY field is set to UNIT ATTENTION or GOOD STATUS; and
    B) if the SENSE KEY field is set to UNIT ATTENTION, then check that the ADDITIONAL SENSE CODE field is
        set to COMMANDS CLEARED BY DEVICE SERVER.

5.7.3.5 Method 2

1) The host submits a read request for receiving status;
2) wait approximately 1ms (but less than 2ms);
3) issue requests to read data from the device on the data-in pipe;

4) wait approximately for > 10ms;
5) send a TCS-DI command;
6) the device should respond with a SENSE IU; and
7) perform the following checks on the received response;
   A) check that the SENSE KEY field is set to UNIT ATTENTION or GOOD STATUS; and
   B) if the SENSE KEY field is set to UNIT ATTENTION, then check that the ADDITIONAL SENSE CODE field is set to COMMANDS CLEARED BY DEVICE SERVER.

5.7.3.6 Method 3

1) The host submits a read request for receiving status;
2) wait approximately 1ms (but less than 2ms);
3) send a TCS-DI command;
4) wait approximately for > 10ms;
5) issue requests to read data from the device on the data-in pipe;
6) the device should respond with a SENSE IU;
7) perform the following checks on the received response;
   A) check that the SENSE KEY field is set to UNIT ATTENTION or GOOD STATUS; and
   B) if the SENSE KEY field is set to UNIT ATTENTION, then check that the ADDITIONAL SENSE CODE field is set to COMMANDS CLEARED BY DEVICE SERVER.

5.7.3.7 Method 4

1) Send a TCS-DI command;
2) wait approximately 1ms (but less than 2ms);
3) the host submits a read request for receiving status;
4) wait approximately for > 10ms;
5) issue requests to read data from the device on the data-in pipe;
6) the device should respond with a SENSE IU; and
7) perform the following checks on the received response;
   A) **c**check that the SENSE KEY field is set to UNIT ATTENTION or GOOD STATUS; and
   B) if the SENSE KEY field is set to UNIT ATTENTION, then check that the ADDITIONAL SENSE CODE field is set to COMMANDS CLEARED BY DEVICE SERVER.

5.7.3.8 Method 5

1) Issue requests to read data from the device on data-in pipe;
2) wait approximately 1ms (but less than 2ms);
3) the host submits a read request for receiving status;
4) wait approximately for > 10ms;
5) send a TCS-DI command;
6) the device should respond with a SENSE IU; and
7) perform the following checks on the received response;
   A) check that the SENSE KEY field is set to UNIT ATTENTION or GOOD STATUS; and
   B) if the SENSE KEY field is set to UNIT ATTENTION, then check that the ADDITIONAL SENSE CODE field is set to COMMANDS CLEARED BY DEVICE SERVER.

5.7.3.9 Method 6

1) Issue requests to read data from the device on the data-in pipe;
2) wait approximately 1ms (but less than 2ms);
3) send a TCS-DI command;
4) wait approximately for > 10ms;
5) the host submits a read request for receiving status;
6) the device should respond with a SENSE IU; and
7) perform the following checks on the received response;
   A) check that the SENSE KEY field is set to UNIT ATTENTION; and
   B) check that the ADDITIONAL SENSE CODE field is set to COMMANDS CLEARED BY DEVICE SERVER.

5.7.4 HE_02 Verification of OVERLAPPED COMMANDS ATTEMPTED Error Code

5.7.4.1 Overview

This test verifies that a device operating at high-speed returns the expected error when there is an overlapped tag.

5.7.4.2 Assertions Used in Test

If a [UAS] target port receives:

a) a COMMAND IU with an initiator port transfer tag that is already in use for a task management function; or

b) a TASK MANAGEMENT IU with an initiator port transfer tag that is already in use for a command or another task management function,

then the [UAS] target device shall returna RESPONSE IU with the response code set to OVERLAPPED COMMANDS ATTEMPTED (see 4.54).

If a UAS target device receives a command with an initiator port transfer tag that is already in use by another command (i.e., an overlapped command) in any logical unit (see 4.55), then the task router and task manager(s) shall:

a) abort all task management functions received on that I_T nexus; and

b) respond to the overlapped command as defined in SAM-4.

For each command sequence that requires USB transfers on the COMMAND, DATA and STATUS pipes (see 4.27), the device shall not require a specific ordering of:

a) SuperSpeed: DP on command pipe, ACK (Prime), DP (Stream ID), ACK (Stream ID); or

b) HighSpeed: IN Token or OUT Token, on the different pipes.

5.7.4.3 Overview of Test Steps

A device shall pass all the methods specified below. These methods are present to test the different ordering defined by UASP for transfers on the Command, Data and Status pipes.

5.7.4.4 Method 1

1) Send a TCS-DO command with tag x;
2) wait approximately 1ms (but less than 2ms);
3) the host submits a read request for receiving status;
4) the device should respond with a WRITE READY IU;
5) send a TCS-TM command with tag x (i.e., the same tag used in step 1);
6) wait approximately 1ms (but less than 2ms);
7) the host submits a read request for receiving status;
8) the device should respond with a RESPONSE IU; and
9) check that the RESPONSE CODE field is set to OVERLAPPED COMMANDS ATTEMPTED.

5.7.4.5 Method 2

1) The host submits a read request for receiving status;
2) wait approximately 1ms (but less than 2ms);
3) send a TCS-DO command with tag x;
4) the device should respond with a WRITE READY IU;
5) send a TCS-TM command with tag x (i.e., the same tag used in step 3);
6) wait approximately 1ms (but less than 2ms);
7) the host submits a read request for receiving status;
8) the device should respond with a RESPONSE IU; and
9) check that the RESPONSE CODE field is set to OVERLAPPED COMMANDS ATTEMPTED.

5.7.4.6 Method 3

1) The host submits a read request for receiving status.
2) wait approximately 1ms (but less than 2ms);
3) send a TCS-DO command with tag x;

4) the device should respond with a WRITE READY IU;
5) the host submits a read request for receiving status;
6) wait approximately 1ms (but less than 2ms);
7) send a TCS-TM command with tag x (i.e., the same tag used in step 3);
8) the device should respond with a RESPONSE IU; and
9) check that the RESPONSE CODE field is set to OVERLAPPED COMMANDS ATTEMPTED.

5.7.4.7 Method 4

1) Send a TCS-DO command with tag x;
2) wait approximately 1ms (but less than 2ms);
3) the host submits a read request for receiving status;
4) the device should respond with a WRITE READY IU;
5) the host submits a read request for receiving status;
6) wait approximately 1ms (but less than 2ms);
7) send a TCS-TM command with tag x (i.e., the same tag used in step 1);
8) the device should respond with a RESPONSE IU; and
9) check that the RESPONSE CODE field is set to OVERLAPPED COMMANDS ATTEMPTED.

5.7.4.8 Method 5

1) Send a TCS-TM command with tag x;
2) wait approximately 1ms (but less than 2ms);
3) send another TCS-TM command with tag x (i.e., the same tag used in step 1);
4) wait approximately 1ms (but less than 2ms);
5) the host submits a read request for receiving status;
6) the device should respond with a RESPONSE IU; and
7) check that the RESPONSE CODE field is set to OVERLAPPED COMMANDS ATTEMPTED.

5.7.4.9 Method 6

1) The host submits a read request for receiving status;
2) wait approximately 1ms (but less than 2ms);
3) send a TCS-TM command with tag x;
4) wait approximately 1ms (but less than 2ms);
5) send a TCS-TM to the device using a TASK MANAGEMENT IU with tag x (i.e., the same tag used in step 3);
6) the device should respond with a RESPONSE IU; and
7) check that the RESPONSE CODE field is set to OVERLAPPED COMMANDS ATTEMPTED.

5.7.4.10 Method 7

1) Send a TCS-DO command with tag x;
2) Wait approximately 1ms (but less than 2ms);
3) The host submits a read request for receiving status;
4) The device should respond with a WRITE READY IU;
5) Send another TCS-DO command with tag x (i.e., the same tag used in step 1);
6) Wait approximately 1ms (but less than 2ms);
7) The host submits a read request for receiving status;
8) the device should respond with a RESPONSE IU; and
9) check that the RESPONSE CODE field is set to OVERLAPPED COMMANDS ATTEMPTED.

5.7.4.11 Method 8

1) The host submits a read request for receiving status;
2) wait approximately 1ms (but less than 2ms);
3) send a TCS-DO command with tag x;
4) the device should respond with a WRITE READY IU;
5) send a TCS-DO to the device using a COMMAND IU with tag x (i.e., the same tag used in step 3);
6) wait approximately 1ms (but less than 2ms);
7) the host submits a read request for receiving status;
8) the device should respond with a RESPONSE IU; and

9) check that the RESPONSE CODE field is set to OVERLAPPED COMMANDS ATTEMPTED.

5.7.4.12 Method 9

1) The host submits a read request for receiving status .
2) wait approximately 1ms (but less than 2ms);
3) send a TCS-DO command with tag x;
4) the device should respond with a WRITE READY IU;
5) the host submits a read request for receiving status;
6) wait approximately 1ms (but less than 2ms);
7) send a TCS-DO command with tag x (i.e., the same tag used in step 3);
8) the device should respond with a RESPONSE IU; and
9) check that the RESPONSE CODE field is set to OVERLAPPED COMMANDS ATTEMPTED.

5.7.4.13 Method 10

1) Send a TCS-DO command with tag x;
2) wait approximately 1ms (but less than 2ms);
3) the host submits a read request for receiving status;
4) the device should respond with a WRITE READY IU;
5) the host submits a read request for receiving status;
6) wait approximately 1ms (but less than 2ms);
7) send a TCS-DO command with tag x (i.e., the same tag used in step 1);
8) the device should respond with a RESPONSE IU; and
9) check that the RESPONSE CODE field is set to OVERLAPPED COMMANDS ATTEMPTED.

5.7.4.14 Method 11

1) Send a TCS-TM command with tag x;
2) wait approximately 1ms (but less than 2ms);
3) send a TCS-NDT command with tag x (i.e., the same tag used in step 1);
4) wait approximately 1ms (but less than 2ms);
5) the host submits a read request for receiving status;
6) the device should respond with a SENSE IU; and
7) the device should respond with a RESPONSE IU; and
8) check that the RESPONSE CODE field is set to OVERLAPPED COMMANDS ATTEMPTED.

5.7.5 SE_02 Verification of OVERLAPPED COMMANDS ATTEMPTED Error Code

5.7.5.1 Overview

This test verifies that a device operating at SuperSpeed returns the expected error when there is an overlapped tag.

5.7.5.2 Assertions Used in Test

If a [UAS] target port receives:

a) a COMMAND IU with an initiator port transfer tag that is already in use for a task management function; or
b) a TASK MANAGEMENT IU with an initiator port transfer tag that is already in use for a command or another task management function,

then the [UAS] target device may return a RESPONSE IU with the response code set to OVERLAPPED COMMANDS ATTEMPTED (see 4.54).

If a UAS target device receives a command with an initiator port transfer tag that is already in use by another command (i.e., an overlapped command) in any logical unit (see 4.55), then the task router and task manager(s) shall:
a) abort all task management functions received on that I_T nexus; and
b) respond to the overlapped command as defined in SAM-4.

For each command sequence that requires USB transfers on the COMMAND, DATA and STATUS pipes (see 4.27), the device shall not require a specific ordering of:

a) SuperSpeed: DP on command pipe, ACK (Prime), DP (Stream ID), ACK (Stream ID); or

b) HighSpeed: IN Token or OUT Token, on the different pipes.

5.7.5.3 Overview of Test Steps

A device shall pass all the methods specified below. These methods are present to test the different ordering defined by UASP for transfers on the Command, Data and Status pipes.

5.7.5.4 Method 1

1) Send a TCS-DO command with tag value x;
2) wait approximately 1ms (but less than 2ms);
3) send a TCS-TM command with tag value x (i.e., the same tag used in step 1);
4) wait approximately 1ms (but less than 2ms);
5) the host submits a read request for receiving status;
6) the device should respond with a RESPONSE IU; and
7) check that the RESPONSE CODE field is set to OVERLAPPED COMMANDS ATTEMPTED.

5.7.5.5 Method 2

1) The host submits a read request for receiving status;
2) wait approximately 1ms (but less than 2ms);
3) send a TCS-DO command with tag x;
4) wait approximately 1ms (but less than 2ms);
5) send a TCS-TM command with tag x (i.e., the same tag used in step 3);
6) the device should respond with a RESPONSE IU; and
7) check that the ADDITIONAL SENSE CODE field is set to OVERLAPPED COMMANDS ATTEMPTED.

5.7.5.6 Method 3

1) Send a TCS-DO command with tag x;
2) wait approximately 1ms (but less than 2ms);
3) the host submits a read request for receiving status;
4) wait approximately 1ms (but less than 2ms);
5) send a TCS-TM command with tag value x (i.e., the same tag used in step 1);
6) the device should respond with a RESPONSE IU; and
7) check that the RESPONSE CODE field is set to OVERLAPPED COMMANDS ATTEMPTED.

5.7.5.7 Method 4

1) Send a TCS-TM command with tag x;
2) wait approximately 1ms (but less than 2ms);
3) send another TCS-TM command with tag x (i.e., the same tag used in step 1);
4) wait approximately 1ms (but less than 2ms);
5) the host submits a read request for receiving status;
6) the device should respond with a RESPONSE IU; and
7) check that the RESPONSE CODE field is set to OVERLAPPED COMMANDS ATTEMPTED.

5.7.5.8 Method 5

1) The host submits a read request for receiving status;
2) wait approximately 1ms (but less than 2ms);
3) send a TCS-TM command with tag x;
4) wait approximately 1ms (but less than 2ms);
5) send a TCS-TM to the device using a TASK MANAGEMENT IU with tag x (i.e., the same tag used in step 3);
6) the device should respond with a RESPONSE IU; and
7) check that the RESPONSE CODE field is set to OVERLAPPED COMMANDS ATTEMPTED.

5.7.5.9 Method 6

1) Send a TCS-DO command with tag x;
2) wait approximately 1ms (but less than 2ms);
3) the host submits a read request for receiving status ;
4) send another TCS-DO command with tag x (i.e., the same tag used in step 1);
5) wait approximately 1ms (but less than 2ms);
6) the device should respond with a RESPONSE IU; and
7) check that the RESPONSE CODE field is set to OVERLAPPED COMMANDS ATTEMPTED.

5.7.5.10 Method 7

1) The host submits a read request for receiving status ;
2) wait approximately 1ms (but less than 2ms);
3) send a TCS-DO command with tag x;
4) send a TCS-DO to the device using a COMMAND IU with tag x (i.e., the same tag used in step 3);
5) wait approximately 1ms (but less than 2ms);
6) the device should respond with a RESPONSE IU; and
7) check that the RESPONSE CODE field is set to OVERLAPPED COMMANDS ATTEMPTED.

5.7.5.11 Method 8

1) The host submits a read request for receiving status .
2) wait approximately 1ms (but less than 2ms);
3) send a TCS-DO command with tag x;
4) wait approximately 1ms (but less than 2ms);
5) send a TCS-DO command with tag x (i.e., the same tag used in step 3);
6) the device should respond with a RESPONSE IU; and
7) check that the RESPONSE CODE field is set to OVERLAPPED COMMANDS ATTEMPTED.

5.7.5.12 Method 9

1) Send a TCS-DO command with tag x;
2) wait approximately 1ms (but less than 2ms);
3) the host submits a read request for receiving status ;
4) wait approximately 1ms (but less than 2ms);
5) send a TCS-DO command with tag x (i.e., the same tag used in step 1);
6) the device should respond with a RESPONSE IU; and
7) check that the RESPONSE CODE field is set to OVERLAPPED COMMANDS ATTEMPTED.

5.7.5.13 Method 10

1) Send a TCS-TM command with tag x;
2) wait approximately 1ms (but less than 2ms);
3) send a TCS-NDT command with tag x (i.e., the same tag used in step 1);
4) wait approximately 1ms (but less than 2ms);
5) the host submits a read request for receiving status ;
6) the device should respond with a RESPONSE IU; and
7) check that the RESPONSE CODE field is set to OVERLAPPED COMMANDS ATTEMPTED.

5.7.6 TE_01 Verification of INVALID COMMAND OPERATION CODE Error Code

5.7.6.1 Overview

This test verifies that the device returns expected error in case of unsupported commands.

5.7.6.2 Assertions Used in Test

The device shall complete any unsupported command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID COMMAND OPERATION CODE (see 4.58).

For each command sequence that requires USB transfers on the COMMAND and STATUS pipes (see 4.28), a device shall not require a specific ordering of:

    a)   SuperSpeed: ACK (Prime), DP on command pipe, ACK (Stream ID); or
    b)   HighSpeed: IN Token or OUT Token, on the different pipes.

5.7.6.3 Overview of Test Steps

A device shall pass all the methods specified below. These methods are present to test the different ordering defined by UASP for transfers on the Command, Data and Status pipes.

5.7.6.4 Method 1

    1)   Create a SCSI command which is not supported by the target device and submit it to the device using COMMAND IU;
    2)   wait approximately 1ms (but less than 2ms);
    3)   the host submits a read request for receiving status;
    4)   the device should respond with a SENSE IU; and
    5)   perform the following checks on the received response;
        A)   check that the SENSE KEY field is set to ILLEGAL REQUEST; and
        B)   check that the ADDITIONAL SENSE CODE field is set to INVALID COMMAND OPERATION CODE.

5.7.6.5 Method 2

    1)   The host submits a read request for receiving status;
    2)   wait approximately 1ms (but less than 2ms);
    3)   create a SCSI command which is not supported by target device and submit it to device using COMMAND IU;
    4)   the device should respond with a SENSE IU; and
    5)   perform the following checks on the received response;
        A)   check that the SENSE KEY field is set to ILLEGAL REQUEST; and
        B)   check that the ADDITIONAL SENSE CODE field set to INVALID COMMAND OPERATION CODE.

5.7.7 TE_02 Verification of WARNING - POWER LOSS EXPECTED Error Code

5.7.7.1 Overview

This test verifies that the device returns the expected error when there is low power. This test is optional. Devices are not required to detect low power. If the device is capable of detecting low power, then this test verifies the capability.

5.7.7.2 Assertions Used in Test

If the USB target device detects that it may lose power (e.g., a battery is running low on power), then the USB target port should establish a unit attention condition with additional sense code set to WARNING - POWER LOSS EXPECTED (see 4.57).

For each command sequence that requires USB transfers on the COMMAND and STATUS pipes (see 4.28), a device shall not require a specific ordering of:

    a)   SuperSpeed: ACK (Prime), DP on command pipe, ACK (Stream ID); or
    a)   HighSpeed: IN Token or OUT Token, on the different pipes.

5.7.7.3 Overview of Test Steps

A device shall pass all the methods specified below. These methods are present to test the different ordering defined by UASP for transfers on the Command, Data and Status pipes.

5.7.7.4 Method 1

    1)   Send a TCS-DI command;
    2)   wait approximately 1ms (but less than 2ms);

3) introduce low power at device side;
4) the host submits a read request for receiving status;
5) the device should respond with a SENSE IU; and
6) perform the following checks on the received response;
    A) check that the SENSE KEY field is set to UNIT ATTENTION; and
    B) check that the ADDITIONAL SENSE CODE field is set to WARNING-POWER LOSS EXPECTED;

5.7.7.5 Method 2

1) The host submits a read request for receiving status;
2) wait approximately 1ms (but less than 2ms);
3) introduce low power at device side;
4) send a TCS-DI command;
5) the device should respond with a SENSE IU; and
6) perform the following checks on the received response;
    A) check that the SENSE KEY field set to UNIT ATTENTION; and
    B) check that the ADDITIONAL SENSE CODE field set to WARNING-POWER LOSS EXPECTED.

5.7.8 TE_03 Verification of INVALID FIELD IN COMMAND INFORMATION UNIT Error Code

5.7.8.1 Overview

This test verifies that the expected error is received when and invalid or reserved coded value is present in a COMMAND IU.

5.7.8.2 Assertions Used in Test

The device shall return a RESPONSE IU with the RESPONSE CODE field set to INVALID INFORMATION UNIT when it receives an invalid coded value in the IU IDENTIFIER field. (see 4.51).

For each command sequence that requires USB transfers on the COMMAND and STATUS pipes (see 4.28), a device shall not require a specific ordering of:

a) SuperSpeed: ACK (Prime), DP on command pipe, ACK (Stream ID); or
b) HighSpeed: IN Token or OUT Token, on the different pipes.

5.7.8.3 Overview of Test Steps

A device shall pass all the methods specified below. These methods are present to test the different ordering defined by UASP for transfers on the Command, Data and Status pipes.

5.7.8.4 Method 1

1) Send a TCS-NDT command with an invalid reserved coded value in the IU IDENTIFIER field of the IU;
2) wait approximately 1ms (but less than 2ms);
3) the host submits a read request for receiving status;
4) the device should respond with a RESPONSE IU; and
5) check that the RESPONSE CODE field in the RESPONSE IU is set to INVALID INFORMATION UNIT.

5.7.8.5 Method 2

1) The host submits a read request for receiving status;
2) wait approximately 1ms (but less than 2ms);
3) send a TCS-NDT command with an invalid reserved coded value in the IU IDENTIFIER field of the IU;
4) the device should respond with a RESPONSE IU; and
5) check that the RESPONSE CODE field in the RESPONSE IU is set to INVALID INFORMATION UNIT.

5.7.9 TE_04 Verification of TASK MANAGEMENT FUNCTION NOT SUPPORTED Error Code

5.7.9.1 Overview

This test verifies that the expected error received when reserved or unsupported value present in the TASK MANAGEMENT FUNCTION field of the TASK MANAGEMENT IU.

5.7.9.2 Assertions Used in Test

If the TASK MANAGEMENT FUNCTION field contains a reserved or unsupported value, the task manager shall return a RESPONSE IU with the RESPONSE CODE field set to TASK MANAGEMENT FUNCTION NOT SUPPORTED (see 4.52).

For each command sequence that requires USB transfers on the COMMAND and STATUS pipes (see 4.28), a device shall not require a specific ordering of:

   a) SuperSpeed: ACK (Prime), DP on command pipe, ACK (Stream ID); or
   b) HighSpeed: IN Token or OUT Token, on the different pipes.

5.7.9.3 Overview of Test Steps

A device shall pass all the methods specified below. These methods are present to test the different ordering defined by UASP for transfers on the Command, Data and Status pipes.

5.7.9.4 Method 1

   1) Send a TCS-TM command with a reserved coded value in the TASK MANAGEMENT FUNCTION field of the TASK MANAGEMENT IU;
   2) wait approximately 1ms (but less than 2ms);
   3) the host submits a read request for receiving status;
   4) the device should respond with a RESPONSE IU; and
   5) check that the RESPONSE CODE field is set to TASK MANAGEMENT FUNCTION NOT SUPPORTED.

5.7.9.5 Method 2

   1) The host submits a read request for receiving status;
   2) wait approximately 1ms (but less than 2ms);
   3) send a TCS-TM command with a reserved coded value in the TASK MANAGEMENT FUNCION field of the TASK MANAGEMENT IU;
   4) the device should respond with a RESPONSE IU; and
   5) check that the RESPONSE CODE field is set to TASK MANAGEMENT FUNCTION NOT SUPPORTED.

5.7.10 TE_05 Verification of INCORRECT LOGICAL UNIT NUMBER Error Code

5.7.10.1 Overview

This test verifies that the expected error is received when an invalid LUN is used in a TASK MANAGEMENT IU.

5.7.10.2 Assertions Used in Test

If the addressed logical unit does not exist, the task manager shall return a RESPONSE IU with the RESPONSE CODE field set to INCORRECT LOGICAL UNIT NUMBER (see 4.53).

For each command sequence that requires USB transfers on the COMMAND and STATUS pipes (see 4.28), a device shall not require a specific ordering of:

   a) SuperSpeed: ACK (Prime), DP on command pipe, ACK (Stream ID); or
   b) HighSpeed: IN Token or OUT Token, on the different pipes.

5.7.10.3 Overview of Test Steps

A device shall pass all the methods specified below. These methods are present to test the different ordering defined by UASP for transfers on the Command, Data and Status pipes.

5.7.10.4 Method 1

   1) Send a TCS-TM command with an invalid LUN value in the LOGICAL UNIT NUMBER field of a TASK MANGEMENT IU;
   2) wait approximately 1ms (but less than 2ms);
   3) the host submits a read request for receiving status;
   4) the device should respond with a RESPONSE IU; and
   5) check that the RESPONSE CODE field of the RESPONSE IU is set to INCORRECT LOGICAL UNIT NUMBER.

5.7.10.5 Method 2

1) The host submits a read request for receiving status;
2) wait approximately 1ms (but less than 2ms);
3) send a TCS-TM command with an invalid LUN value in the LOGICAL UNIT NUMBER field of TASK MANGEMENT IU;
4) the device should respond with a RESPONSE IU; and
5) check that the RESPONSE CODE field of the RESPONSE IU is set to INCORRECT LOGICAL UNIT NUMBER.

5.7.11 TE_08 Verification of TASK SET FULL Response

5.7.11.1 Overview

This test verifies that the TASK SET FULL error code is returned by the device.

5.7.11.2 Assertions Used in Test

If the task set is full and the [UAS] target port receives a command, then the [UAS] target port shall return a SENSE IU with a status of TASK SET FULL (see 4.32).

For each command sequence that requires USB transfers on the COMMAND and STATUS pipes (see 4.28), a device shall not require a specific ordering of:

a) SuperSpeed: ACK (Prime), DP on command pipe, ACK (Stream ID); or
b) HighSpeed: IN Token or OUT Token, on the different pipes.

5.7.11.3 Overview of Test Steps

A device shall pass all the methods specified below. These methods are present to test the different ordering defined by UASP for transfers on the Command, Data and Status pipes.

5.7.11.4 Method 1

1) Send N+1 commands to the device, where N is the maximum number of active commands that may be present in a task set;
2) wait approximately 1ms (but less than 2ms);
3) the host submits a read request for receiving status;
4) the device should respond with a SENSE IU; and
5) check that the SENSE IU indicates a TASK SET FULL error.

5.7.11.5 Method 2

1) The host submits a read request for receiving status;
2) wait approximately 1ms (but less than 2ms);
3) send N+1 commands to the device, where N is the maximum number of active commands that may be present in a task set;
4) the device should respond with a SENSE IU; and
5) check that the SENSE IU indicates a TASK SET FULL error.