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USA Set Top Box Test Specification
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1394 Trade Association Board of Directors

Abstract

This specification defines a set of tests to verify the functionality of the 1394 interface as defined in the FCC mandate through both functional and interoperability .

Keywords

expected, ignored, may, reserved, shall, should

1394 Trade Association Specification

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EDITOR'S NOTE –

IEEE Copyright

Portions of this specification are copied from published IEEE standards, by permission.

The source documents are:

IEEE Std 1394-1995, Standard for a High Performance Serial Bus

IEEE Std 1394a-2000, Standard for a High Performance Serial Bus – Amendment 1

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This included the use of tables, graphs, abstracts and scope statements from IEEE Documents

- Intentionally Left Blank -

Foreword (This foreword is not part of 1394 Trade Association Specification 2008003)

This specification defines a set of tests to verify the functionality of the 1394 interface as defined in the FCC mandate through both functional and interoperability .

There is one Annex in this specification. Annex A is informative and are not considered part of this specification.

This specification was accepted by the Board of Directors of the 1394 Trade Association. Board of Directors acceptance of this specification does not necessarily imply that all board members voted for acceptance. At the time it accepted this specification, the 1394 Trade Association. Board of Directors had the following members:

- , Max Bassler, Chair
- , Richard Mourn, Vice-Chair
- , Dave Thompson, Secretary

.....

The AV/Pro Audio Working Group, which developed and reviewed this specification, had the following members:

- Morten Lave, Chair
- Richard Mourn

Revision history

Revision 0.1 (July 13, 2009)

Initial Release

Revision 0.2 (October 25, 2009)

INT302 text changed to be: Tune STB to Copy Never content

Fixed Header/Footer format issues

Revision 1.0 (May 25, 2010)

Final edits and release.

USA Set Top Box Test Specification

1 Scope and purpose

The Federal Communications Commission 47 C.F.R. mandates a functional IEEE-1394 interface. The definition of the requirement is found in section, “76.640 Support for unidirectional digital cable products on digital cable systems” in subsection 4):

(4) Cable operators shall:

(i) Effective April 1, 2004, upon request of a customer, replace any leased high definition set-top box, which does not include a functional IEEE 1394 interface, with one that includes a functional IEEE 1394 interface or upgrade the customer’s set-top box by download or other means to ensure that the IEEE 1394 interface is functional.

(ii) Effective July 1, 2005, include both a DVI or HDMI interface and an IEEE 1394 interface on all high definition set-top boxes acquired by a cable operator for distribution to customers.

(iii) Ensure that these cable operator-provided high definition set-top boxes shall comply with ANSI/SCTE 26 2001 (formerly DVS 194): “Home Digital Network Interface Specification with Copy Protection” (incorporated by reference, *see* § 76.602), with transmission of bit-mapped graphics optional, and shall support the CEA-931-A: “Remote Control Command Pass-through Standard for Home Networking” (incorporated by reference, *see* § 76.602), pass through control commands: tune function, mute function, and restore volume function. In addition these boxes shall support the power control commands (power on, power off, and status inquiry) defined in A/VC Digital Interface Command Set General Specification Version 4.0 (as referenced in ANSI/

SCTE 26 2001 (formerly DVS 194): “Home Digital Network Interface Specification with Copy Protection” (incorporated by reference, *see* § 76.602)).

1.1 Scope

This specification defines a set of tests to verify the “functionality” of the 1394 interface as defined in the FCC mandate through both functional and interoperability .

1.2 Purpose

To define a set of tests that when execute will verify a USA Set Top Box has correctly implemented all the functionality required by the FCC mandate.

2 Normative reference

2.1 Reference scope

The specifications and standards named in this section contain provisions, which, through reference in this text, constitute provisions of this 1394 Trade Association Specification. At the time of publication, the editions indicated were valid. All specifications and standards are subject to revision; parties to agreements based on this 1394 Trade Association Specification are encouraged to investigate the possibility of applying the most recent editions of the specifications and standards indicated below.

2.2 Approved references

The following approved specifications and standards may be obtained from the organizations that control them.

IEEE Std 1394-1995, Standard for a High Performance Serial Bus

IEEE Std 1394a-2000, Standard for a High Performance Serial Bus—Amendment 1

IEEE Std 1394b-2002, Standard for a High Performance Serial Bus—Amendment 2

DTLA, Digital Transmission Content Protection Specification Revision 1.4

IEC 61883-1, Digital Interface for Consumer Audio/Video Equipment – Part 1: General

EIA-775-A/CEA-775-A, DTV 1394 Interface Specification

CEA-931-A, Remote Control Command Pass-through Standard for Home Networking

AV/C Digital Interface Command Set General Specification Version 4.2; 1394TA Document Number 2004006

AV/C Panel Subunit Specification 1.21; 1394TA Document Number 2002009

Throughout this document, the term “IEEE 1394” shall be understood to refer to IEEE Std 1394-1995 as amended by IEEE Std 1394a-2000 and IEEE Std 1394b-2002.

2.3 References under development

At the time of publication, the following referenced specifications and standards were under development.

2.4 Reference acquisition

The references cited may be obtained from the organizations that control them:

1394 Trade Association, 315 Lincoln Ave, Suite E, Mukilteo, WA 98275 USA; (817) 416-2200 / (817) 416-2256 (FAX); <http://www.1394ta.org/>

American National Standards Institute (ANSI), 11 West 42nd Street, New York, NY 10036, USA; (212) 642-4900 / (212) 398-0023 (FAX); <http://www.ansi.org/>

Institute of Electrical and Electronic Engineers (IEEE), 445 Hoes Lane, PO Box 1331, Piscataway, NJ 08855-1331, USA; (732) 981-0060 / (732) 981-1721 (FAX); <http://www.ieee.org/>

In addition, many of the documents controlled by the above organizations may also be ordered through a third party:

Global Engineering Documents, 15 Inverness Way, Englewood, CO 80112-5776; (800) 624-3974 / (303) 792-2192; <http://www.global.ihs.com/>

3 Definitions and notation

3.1 Definitions

3.1.1 Conformance

Several keywords are used to differentiate levels of requirements and optionality, as follows:

3.1.1.1 expected: A keyword used to describe the behavior of the hardware or software in the design models assumed by this specification. Other hardware and software design models may also be implemented.

3.1.1.2 ignored: A keyword that describes bits, bytes, quadlets, octlets or fields whose values are not checked by the recipient.

3.1.1.3 may: A keyword that indicates flexibility of choice with no implied preference.

3.1.1.4 reserved: A keyword used to describe objects (bits, bytes, quadlets, octlets and fields) or the code values assigned to these objects in cases where either the object or the code value is set aside for future standardization. Usage and interpretation may be specified by future extensions to this or other specifications. A reserved object shall be zeroed or, upon development of a future specification, set to a value specified by such a specification. The recipient of a reserved object shall ignore its value. The recipient of an object defined by this specification as other than reserved shall inspect its value and reject reserved code values.

3.1.1.5 shall: A keyword that indicates a mandatory requirement. Designers are required to implement all such mandatory requirements to assure interoperability with other products conforming to this specification.

3.1.1.6 should: A keyword that denotes flexibility of choice with a strongly preferred alternative. Equivalent to the phrase “is recommended.”

3.1.2 Glossary

The following terms are used in this specification:

3.1.2.1 definition: Press ENTER to create a subsequent numbered definition paragraph ...

3.1.3 Abbreviations

The following are abbreviations that are used in this specification:

XXX	The “Normal Indent” paragraph style is used for abbreviations
CSR	Control and status register [B1]

As exemplified by CSR, abbreviations may cite a bibliographic reference.

3.2 Notation

3.2.1 Numeric values

Decimal and hexadecimal are used within this specification. By editorial convention, decimal numbers are most frequently used to represent quantities or counts. Addresses are uniformly represented by hexadecimal numbers. Hexadecimal numbers are also used when the value represented has an underlying structure that is more apparent in a hexadecimal format than in a decimal format.

Decimal numbers are represented by Arabic numerals without subscripts or by their English names. Hexadecimal numbers are represented by digits from the character set 0 – 9 and A – F followed by the subscript 16. When the subscript is unnecessary to disambiguate the base of the number it may be omitted. For the sake of legibility hexadecimal numbers are separated into groups of four digits separated by spaces.

As an example, 42 and 2A₁₆ both represent the same numeric value.

3.2.2 Bit, byte and quadlet ordering

This specification uses the facilities of Serial Bus, IEEE 1394, and therefore uses the ordering conventions of Serial Bus in the representation of data structures. In order to promote interoperability with memory buses that may have different ordering conventions, this specification defines the order and significance of bits within bytes, bytes within quadlets and quadlets within octlets in terms of their relative position and not their physically addressed position.

Within a byte, the most significant bit, *msb*, is that which is transmitted first and the least significant bit, *lsb*, is that which is transmitted last on Serial Bus, as illustrated below. The significance of the interior bits uniformly decreases in progression from *msb* to *lsb*.

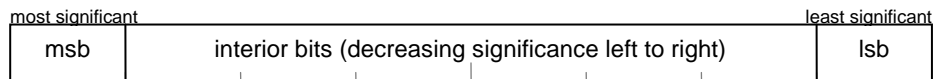


Figure 1 – Bit ordering within a byte

Within a quadlet, the most significant byte is that which is transmitted first and the least significant byte is that which is transmitted last on Serial Bus, as shown below.

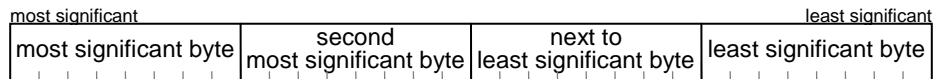


Figure 2 – Byte ordering within a quadlet

Within an octlet, which is frequently used to contain 64-bit Serial Bus addresses, the most significant quadlet is that which is transmitted first and the least significant quadlet is that which is transmitted last on Serial Bus, as the figure below indicates.

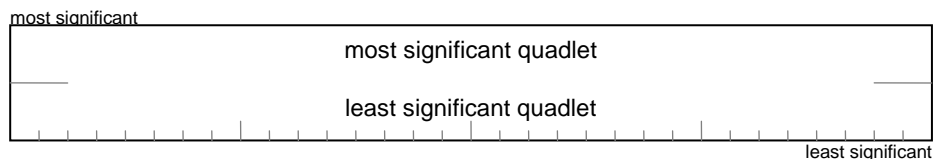


Figure 3 – Quadlet ordering within an octlet

When block transfers take place that are not quadlet aligned or not an integral number of quadlets, no assumptions can be made about the ordering (significance within a quadlet) of bytes at the unaligned beginning or fractional quadlet end of such a block transfer, unless an application has knowledge (outside of the scope of this specification) of the ordering conventions of the other bus.

3.2.3 Register specifications

This specification defines the format and function of control and status registers, CSRs. Some of these registers are read-only, some are both readable and writable and some generate special side effects subsequent to a write.

In order to define CSRs, their bit fields, their initial values and the effects of read, write or other transactions, the format illustrated by Figure 4 is used.

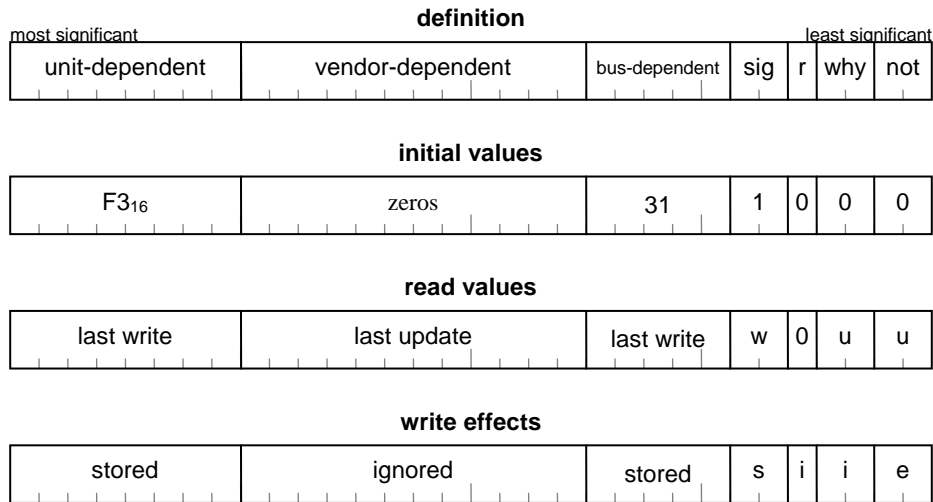


Figure 4 – CSR specification example

The register definition contains the names of register fields. The names are intended to be descriptive, but the fields are defined in the text; their function should not be inferred solely from their names. However, the following field names have defined meanings.

Name	Abbreviation	Definition
bus-dependent		The meaning of the field is defined by the bus standard, in this case IEEE 1394
reserved	r	The field is reserved for future standardization (see 3.1.1)
unit-dependent		The meaning of the field shall be defined by the organization responsible for the unit architecture
vendor-dependent		The meaning of the field shall be defined by the node’s vendor

CSRs shall assume initial values upon the restoration of power (a power reset) or upon a write to the node’s RESET_START register (a command reset). If the power reset values differ from the command reset values, they are separately and explicitly defined. Initial values for register fields may be described as numeric constants or with one of the terms defined for the register definition. Values for register fields subsequent to a reset may be described in the same terms or as defined below.

Name	Abbreviation	Definition
unchanged	x	The field retains whatever value it had just prior to the power reset, bus reset or command reset.

In addition to numeric values for constant fields, the read values returned in response to a quadlet read transaction may be specified by the terms below.

Name	Abbreviation	Definition
last write	w	The value of the field shall be either the initial value or, if a write or lock transaction addressed to the register has successfully completed, the value most recently stored in the field. ¹
last update	u	The value of the field shall be that most recently updated by the node hardware or software. An updated field value may be the result of a write effect to the same register address, a different register address or some other change of condition within the node.

The effects of data written to the register are specified by the terms below.

Name	Abbreviation	Definition
effect	e	The value of the data written to the field may have an effect on the node's state, but the effect might not be immediately visible by a read of the same register. The effect may be visible in another register or might not be visible at all.
ignored	i	The value of the data written to the field shall be ignored; it shall have no effect on the node's state.
stored	s	The value of the data written to the field shall be immediately visible by a read of the same register; it may also have other effects on the node's state.

Reserved fields within a register shall be explicitly described with respect to initial values, read values and write effects. Initial values and read values shall be zero while write effects shall be ignored. CSRs that are not implemented, either because they are optional or they fall within a reserved address space, shall abide by these same conventions if a successful completion response is returned for a read, write or lock request.

¹ For clarity, read values for a field in a register that accepts lock transactions may be described as *last successful lock* rather than *last write*. However, the abbreviation in both cases remains *w*. Similar liberties may be taken with the use of *conditionally stored* in place of *stored* when the action occurs as the result of a lock transaction, but the corresponding one-letter abbreviation, *s*, is also unchanged.

4 USA Set Top Box Test Overview (informative)

4.1 Overview

The USA Set Top Box (STB) Test Specification specifies a set of tests that when executed should determine if an STB meets all the FCC mandate requirements. These tests assume a certain level of IEEE-1394 functionality and rely on the execution of other tests, such as the Base 1394 Test Suite Definition with Extension for 1394b, to verify this functionality. The tests specified in this document focus specifically on the STB functionality defined in the FCC mandate.

4.2 Test Setup and Topologies

Required functionality, content protection and interoperability tests require different test setups and topologies. Both the device under test, Set Top Box (STB), and bus analyzer are required for all tests but the Tester(s) functionality changes for:

Required functionality:

STB ----- Tester ----- Bus Analyzer

Content protection:

STB ----- Golden Sink ----- Bus Analyzer

Interoperability:

STB ----- Golden Sink ----- Recording Device ----- Bus Analyzer

5 US STB Test Definition

Based on the FCC Mandate the following functionality is required of US Set Top boxes with IEEE-1394 ports.

5.1 Required Functionality

IEEE-1394

- Configuration ROM
- Supports Cycle Master functionality
- Supports Isochronous Resource Manager functionality

IEC-61883-1

- Output Plug Master Register
- Output Plug Control Register

CEA-931-A

- Tune function
- Mute function
- Restore volume function

A/VC Digital Interface Command Set General Specification Version 4.0

- Power on
- Power off
- Power status inquiry

Content Protection (in its own section)

- Copy always
- Copy once
- Copy never

5.2 Optional Functionality

Transmission of bit-mapped graphics

The transmission of bit-mapped graphics has been found to be less than optimal therefore few if any implementation of this optional function have been released to the market. Because of this, this document doesn't define tests for this optional function.

5.3 IEEE-1394 Functionality Test

The 1394 Trade Association already defines a test to determine basic (fundamental) 1394 functionality, "Base 1394 Test Suite Definition with Extensions for 1394b". However the "Base 1394 Test Suite Definition with Extensions for 1394b" doesn't test STB specific IEEE-1394 functionality, therefore in addition to the basic test this specification require additional tests that are specific STB implementations.

5.3.1 Configuration ROM

IEEE-1394 Configuration ROM starts at node address 0xFFFF F000 0400. The ROM entries are referenced as offset from this address.

5.3.1.1 Bus Information Block Test

Test ID	Question	Answer	Standard Reference
CR101	Read the Bus_Info_Block of the STB's configuration ROM (offset 0x00 through 0x0C)	-	IEEE-1394-2008 8.3.2.6.4
CR102	Is the Bus_Info_Block.info_length = 0x04?	Yes or No	
Check Point	If you answered "No" to CR102, then the STB's info_length field is incorrect. FAILURE!		
CR103	Is the Bus_Info_Block.crc_length = 0x04 or total length of the Configuration ROM?	Yes or No	IEEE-1394-2008 8.3.2.6.3
Check Point	If you answered "No" to CR103, then the STB's crc_length field is incorrect. FAILURE!		
CR104	Is the Bus_Info_Block.rom_crc_value correct for the number of quadlets covered by the crc.length?	Yes or No	IEEE-1394-2008 8.3.2.6.3
Check Point	If you answered "No" to CR104, then the STB's rom_crc_value field is incorrect. FAILURE!		
CR105	Is the value found at offset 0x04 = 0x31333934?	Yes or No	IEEE-1394-2008 8.3.2.6.4
Check Point	If you answered "No" to CR105, then the STB's bus_name field is incorrect. FAILURE!		
CR106	Is the value found at offset 0x08.capabilities.irmc = 0x1	Yes or No	IEEE-1394-2008 8.3.2.6.4
Check Point	If you answered "No" to CR106, then the STB's irmc field is incorrect. FAILURE!		
CR107	Is the value found at offset 0x08.capabilities.cmc = 0x1	Yes or No	IEEE-1394-2008 8.3.2.6.4
Check Point	If you answered "No" to CR107, then the STB's cmc field is incorrect. FAILURE!		
CR108	Is the value found at offset 0x08.capabilities.isc = 0x1	Yes or No	IEEE-1394-2008 8.3.2.6.4
Check Point	If you answered "No" to CR108, then the STB's isc field is incorrect. FAILURE!		
CR109	Is the value found at offset 0x08.capabilities.bmc = 0x0 or 0x1	Yes or No	IEEE-1394-2008 8.3.2.6.4
Check Point	If you answered "No" to CR109, then the STB's bmc field is incorrect. FAILURE!		
CR110	Is the value found at offset 0x08.capabilities.pmc = 0x0 or 0x1	Yes or No	IEEE-1394-2008 8.3.2.6.4
Check	If you answered "No" to CR110, then the STB's pmc		

Point	field is incorrect. FAILURE!		
CR111	Is the value found at offset 0x08.cyc_clk_acc = 0x0 to 0x64	Yes or No	IEEE-1394-2008 8.3.2.6.4
Check Point	If you answered “No” to CR111, then the STB’s cycle_clk_acc field is incorrect. FAILURE!		
CR112	For offset 0x08.max_rec see Base 1394 Test Suite Definition with Extension for 1394b	-	
CR113	For offset 0x08.max_ROM see Base 1394 Test Suite Definition with Extension for 1394b	-	
CR114	Is the value found at offset 0x08.generation = 0x1 to 0xF	Yes or No	IEEE-1394-2008 8.3.2.6.4
Check Point	If you answered “No” to CR114, then the STB’s generation field is incorrect. FAILURE!		
CR115	Is the value found at offset 0x08.link_spd = p_link_spd	Yes or No	IEEE-1394-2008 8.3.2.6.4
Check Point	If you answered “No” to CR115, then the STB’s generation field is incorrect. FAILURE!		
CR116	For offset 0x0C.node_vendor_ID see Base 1394 Test Suite Definition with Extension for 1394b	-	
CR117	For offset 0x0C.chip_ID_hi see Base 1394 Test Suite Definition with Extension for 1394b	-	
CR118	For offset 0x10.chip_ID_lo see Base 1394 Test Suite Definition with Extension for 1394b	-	

5.3.1.2 Root Directory Tests

Test ID	Question	Answer	Standard Reference
CR201	Read the Root Directory of the STB’s configuration ROM by reading from 0x14 to 0x14 + (crc_length *4)	-	IEEE-1394-2008 8.3.2.6.5
CR202	Is one of the entries the module_vendor_id as indicated by a 0x03 CSR architecture key_type?	Yes or No	IEC61883-1
Check Point	If you answered “No” to CR202, then the STB’s Root Directory is incorrect. FAILURE!		
CR203	Is the module_vendor_id = p_module_vendor_id?	Yes or No	
Check Point	If you answered “No” to CR202, then the STB’s Root Directory is incorrect. FAILURE!		
CR204	Is one of the entries the node_capabilities as indicated by a 0x0C CSR architecture key_type?	Yes or No	IEC61883-1

Check Point	If you answered “No” to CR204, then the STB’s Root Directory is incorrect. FAILURE!		
CR205	Is one of the entries the node_unique_id offset as indicated by a 0x8D CSR architecture key_type?	Yes or No	IEC61883-1
Check Point	If you answered “No” to CR205, then the STB’s Root Directory is incorrect. FAILURE!		
CR206	Are two (one for AVC and one for EIA-775) of the entries the unit_directory offset as indicated by a 0xD1 CSR architecture key_type?	Yes or No	IEC61883-1 and CEA-775
Check Point	If you answered “No” to CR206, then the STB’s Root Directory is incorrect. FAILURE!		
CR207	Is one of the entries the Vendor_Name_textual_descriptor offset as indicated by a 0x81 CSR architecture key_type?	Yes or No	IEC61883-1 and CEA-775
Check Point	If you answered “No” to CR207, then the STB’s Root Directory is incorrect. FAILURE!		

Optionally the Root Directory may contain other entries such as:

0x81 - Type – Leaf offset

*** Textual Descriptor ***

Manufacture Name

0x17 - Type - Immediate

*** Model entry ***

0x81 - Type - Leaf offset

*** Textual Descriptor ***

Model

0xC3 – Type – Vendor directory offset

5.3.1.3 Node_unique_id Leaf Test

Test ID	Question	Answer	Standard Reference
CR301	Read the node_unique_id leaf of the STB’s configuration ROM using the offset found in the root directory with the CSR architecture key_type 0x8D.	-	IEC61883-1 Figure 1
CR302	Is the leaf_length = 2?	Yes or No	
Check	If you answered “No” to CR302, then the STB’s		

Point	node_unique_id leaf length is incorrect. FAILURE!		
CR303	Is the leaf crc correct?	Yes or No	
Check Point	If you answered “No” to CR303, then the STB’s node_unique_id leaf crc is incorrect. FAILURE!		
CR304	Is the node_vendor_id = p_node_vendor_id?	Yes or No	
Check Point	If you answered “No” to CR304, then the STB’s node_vendor_id is incorrect. FAILURE!		
CR305	Is the chip_id_hi = p_chip_id_hi?	Yes or No	
Check Point	If you answered “No” to CR305, then the STB’s chip_id_hi is incorrect. FAILURE!		
CR306	Is the chip_id_lo = p_chip_id_lo?	Yes or No	
Check Point	If you answered “No” to CR306, then the STB’s chip_id_lo is incorrect. FAILURE!		

5.3.1.4 AVC (IEC61883) Unit Directory Test

Test ID	Question	Answer	Standard Reference
CR401	Read the IEC61883 Unit Directory of the STB’s configuration ROM using the offset found in the root directory with the CSR architecture key_type 0xD1.	-	IEC61883-1 Figure 1
CR402	Is the crc correct for the Unit Directory?	Yes or No	
Check Point	If you answered “No” to CR402, then the STB’s AVC Unit Directory crc is incorrect. FAILURE!		
CR403	Is one of the entries the unit_spec_id as indicated by a 0x12 CSR architecture key_type and unit_spec_id (Specifier_ID) = 0x00A02D?	Yes or No	
Check Point	If you answered “No” to CR403, then the STB’s Specifier_ID is incorrect. FAILURE!		
CR404	Is one of the entries the Version as indicated by a 0x13 CSR architecture key_type and unit_sw_version (Version) = 0x010001?	Yes or No	
Check Point	If you answered “No” to CR404, then the STB’s Version is incorrect. FAILURE!		

5.3.1.5 CEA-775 Unit Directory Test

Test ID	Question	Answer	Standard Reference
CR501	Read the CEA-775 Unit Directory of the STB's configuration ROM using the offset found in the root directory with the CSR architecture key_type 0xD1.	-	IEC61883-1 Figure 1
CR502	Is the crc correct for the Unit Directory?	Yes or No	
Check Point	If you answered "No" to CR502, then the STB's CEA-775 Unit Directory crc is incorrect. FAILURE!		
CR503	Is one of the entries the unit_spec_id as indicated by a 0x12 CSR architecture key_type and unit_spec_id (Specifier_ID) = 0x005068?	Yes or No	
Check Point	If you answered "No" to CR503, then the STB's Specifier_ID is incorrect. FAILURE!		
CR504	Is one of the entries the Version as indicated by a 0x13 CSR architecture key_type and unit_sw_version (Version = 0x010101)?	Yes or No	
Check Point	If you answered "No" to CR504, then the STB's Version is incorrect. FAILURE!		

5.3.1.6 Vendor_Name_textual_descriptor Test

Test ID	Question	Answer	Standard Reference
CR601	Read the Vendor_Name_textual_descriptor leaf of the STB's configuration ROM using the offset found in the root directory with the CSR architecture key_type 0x81.	-	CEA-775 12.1.4.1
CR602	Is the leaf crc correct?	Yes or No	
Check Point	If you answered "No" to CR602, then the STB's Vendor_Name_textual_descriptor leaf length is incorrect. FAILURE!		
CR603	Is the Vendor_Name_textual_descriptor = p_Vendor_Name_textual_descriptor?	Yes or No	
Check Point	If you answered "No" to CR603, then the STB's Vendor_Name_textual_descriptor is incorrect. FAILURE!		

5.4 IEC-61883-1 Tests

Defined in IEC61883-1, sections 7.5 and 7.7.

5.4.1 Output Master Plug Register (oMPR)

The Output Master Plug Register is found at CSR address 0xFFFFF0000900.

Field	Initial value	Bus reset and command reset value	Read value	Lock effect
Data rate capability	S100, S200 or S400	unchanged	last update	ignored
Broadcast channel base	vendor specific	unchanged	last successful lock	conditionally written
Non-persistent extension field	ones	ones	last successful lock	conditionally written
Persistent extension field	zeros	unchanged	last successful lock	conditionally written
Reserved	zeros	zeros	zeros	ignored
Number of output plugs	#oPCR	#oPCR	#oPCR	ignored

5.4.2 Output Plug Control Register (oPCR)

The initial Output Plug Control Register is found a CSR address 0xFFFFF0000904.

Field	Initial value	Bus reset and command reset value	Read value	Lock effect
on-line	zeros	unchanged	last update	ignored
broadcast connection counter	zeros	zeros	last successful lock	conditionally written
point-to-point connection counter	zeros	zeros	last successful lock	conditionally written
reserved	zeros	zeros	zeros	ignored
Channel number	zeros	unchanged	last successful lock	conditionally written
data rate	zeros	unchanged	last successful lock	conditionally written
overhead ID	zeros	zeros	last successful lock	conditionally written
Payload	zeros	unchanged	last update	ignored

The following tests shall be conducted:

- The data rate shall be tested for all supported speeds.
- Verify that after a bus reset the STB continues to transmit isochronous data immediately after the bus reset according to the values in the plug control registers immediately before the bus reset (IEC 61883-1 section 7.10).
- The tester shall verify that the channel number used by the set-top box is the same channel number specified in the channel number field.
- The tester shall verify that the payload doesn't exceed that specified in the payload field.

5.4.2.1 Output Plug Register Test

Test ID	Question	Answer	Standard Reference
oPR301	Read the Output Master Plug Register (oMPR) at CSR address 0xFFFFF0000900	-	IEC-61883-1 7.5
oPR302	Is oMPR.data_rate_capability = p_oMPR.data_rate_capability?	Yes or No	
Check Point	If you answered "No" to oPR302, then the data_rate_capability is incorrect. FAILURE!		
oPR303	Is (number of output plugs) oMPR.NoPCR = p_oMPR.NoPCR?	Yes or No	
Check Point	If you answered "No" to oPR303, then the NoPCR is incorrect. FAILURE!		
The following tests assume only one oPCR. The following steps will need to be repeated if multiple oPCRs are present.			
oPR304	Read the first Output Plug Control Register (oPCR1) at CSR address 0xFFFFF0000904	-	IEC-61883-1 7.7
oPR305	Is oPCR.payload = p_oPCR.payload?	Yes or No	
Check Point	If you answered "No" to oPR305, then the p_oPCR.payload is incorrect. FAILURE!		
oPR306	With oPCR unconnected is the oPCR.overhead_ID = p_oPCR.overhead_ID?	Yes or No	
Check Point	If you answered "No" to oPR306, then the p_oPCR.overhead_ID is incorrect. FAILURE!		
oPR307	Initiate CMP_SWAP to make a connection with the STB is S100 data rate and channel 1		
oPR308	Did the STB start transmitting at the correct data rate on the correct channel	Yes or No	
Check	If you answered "No" to oPR308, then the oPCR		

Point	operation is incorrect. FAILURE!		
oPR309	If supported initiate CMP_SWAP to make a connection with the STB is S200 data rate and channel 32		
oPR310	Did the STB start transmitting at the correct data rate on the correct channel	Yes or No	
Check Point	If you answered “No” to oPR310, then the oPCR operation is incorrect. FAILURE!		
oPR311	If supported initiate CMP_SWAP to make a connection with the STB is S400 data rate and channel 63		
oPR312	Did the STB start transmitting at the correct data rate on the correct channel	Yes or No	
Check Point	If you answered “No” to oPR310, then the oPCR operation is incorrect. FAILURE!		
oPR313	Is the maximum bandwidth used equal to or less than that specified by the oPCR.payload?	Yes or No	
Check Point	If you answered “No” to oPR313, then the oPCR operation is incorrect. FAILURE!		
oPR314	Initiate a bus reset.	-	
oPR315	After the bus reset did the STB continues to transmit isochronous data immediately according to the values in the plug control registers immediately before the bus reset?	Yes or No	
Check Point	If you answered “No” to oPR315, then the oPCR operation is incorrect. FAILURE!		

5.5 CEA-931-A Functionality Test

The Set-top box shall support the SUBUNIT INFO status command defined in Section 11.3 of the AV/C Digital Interface Command Set General Specification and shall include in the SUBUNIT INFO command status response a *subunit_type* value 09₁₆ indicating the presence of a Panel Subunit.

The Set-top box shall implement the Panel Subunit, Indirect Mode, defined and described in Sections 4.3 and 4.5 of AV/C Panel Subunit Specification. A target device may return a response of “NOT IMPLEMENTED” to the GUI UPDATE status command. Target devices shall respond with “IMPLEMENTED” to the GENERAL INQUIRY command for PASS-THROUGH command.

Target devices shall implement the PASS-THROUGH control command specified in Section 9 (introduction) and Section 9.4 of AV/C Panel Subunit Specification.

Target devices should respond to PASS-THROUGH control commands with *operation_id* values corresponding to user operations or deterministic functions applicable to that device. If a given *operation_id* value corresponds to an operation or function that is not applicable to the device, that device should respond to the PASS-THROUGH control command with a NOT IMPLEMENTED response.

Target devices shall implement the POWER control command defined in Section 11.1 of AV/C Digital Interface Command Set General Specification, and shall support both the Control and Status forms of that command.

5.5.1 Unit - UNIT INFO Status Command Test

Defined in AV/C Digital Interface Command Set General Specification Version 4.2; 1394 TA Document Number 2004006, section 9.2 GENERAL INQUIRY commands.

Test ID	Question	Answer	Standard Reference
CEA101	Have the tester send a UNIT INFO status command to the STB. (0x01FF30FF 0xFFFFFFFF)	-	See comment above table
CEA102	Did the STB respond with 0x0CFF3107 0x28nnnnnn?	Yes or No	
Check Point	If you answered “No” to CEA102, then response to UNIT INFO status command is incorrect. FAILURE!		

UNIT INFO Status Command Issued

Field	Code	Comments
ctype	0x1	Status
subunit_type	0x1F	Directed at Unit
subunit_ID	0x7	Ignored
opcode	0x30	Report unit info
operand[0]	0xFF	Page data = all – 0xFF
operand[1]	0xFF	Page data = all – 0xFF
operand[2]	0xFF	Page data = all – 0xFF
operand[3]	0xFF	Page data = all – 0xFF
operand[4]	0xFF	Page data = all – 0xFF

Expected UNIT INFO Status Response

Field	Code	Comments
response	0xC	Implemented/Stable
subunit_type	0x1F	Directed at Unit
subunit_ID	0x7	Ignored
opcode	0x31	Plug Info
operand[0]	0x07	Page 000b, extension_code 111b
operand[1]	0x28	Subunit_type 00101b, max_subunit_ID 000b (tuner)
operand[2]	0xnn	Company_ID MSB
operand[3]	0xnn	Company_ID middle byte
operand[4]	0xnn	Company_ID LSB

5.5.2 Panel Subunit - SUBUNIT INFO status command

Defined in AV/C Digital Interface Command Set General Specification Version 4.2; 1394 TA Document Number 2004006, section 9.3 GENERAL INQUIRY commands.

Test ID	Question	Answer	Standard Reference
CEA201	Have the tester send a SUBUNIT INFO status command to the STB. (0x01FF3107 0xFFFFFFFF)	-	See comment above table
CEA202	Did the STB respond with 0x0CFF3107 0x2848FFFF?	Yes or No	
Check Point	If you answered “No” to CEA202, then response to SUBUNIT INFO status command is incorrect. FAILURE!		

SUBUNIT INFO Status Command Issued

Field	Code	Comments
ctype	0x1	Status
subunit_type	0x1F	Directed at Unit
subunit_ID	0x7	Ignored
opcode	0x31	Report subunit info
operand[0]	0x07	Page 000b, extension_code 111b
operand[1]	0xFF	Page data = all – 0xFF
operand[2]	0xFF	Page data = all – 0xFF
operand[3]	0xFF	Page data = all – 0xFF
operand[4]	0xFF	Page data = all – 0xFF

Expected SUBUNIT INFO Response

Field	Code	Comments
response	0xC	Implemented/Stable
subunit_type	0x1F	Directed at Unit
subunit_ID	0x7	Ignored
opcode	0x31	Plug Info
operand[0]	0x07	Page 000b, extension_code 111b
operand[1]	0x28	Subunit_type 00101b, max_subunit_ID 000b (tuner)
operand[2]	0x48	Subunit_type 01001b, max_subunit_ID 000b (panel)
operand[3]	0xFF	Always 0xFF
operand[4]	0xFF	Always 0xFF

5.5.3 Panel Subunit Indirect Mode

AV/C Panel Subunit Specification 1.21; 1394 TA Document Number 2002009, section 4.3 UI data transfer mode and 9. Panel Subunit Commands.

To support the indirect mode the set-top box shall support the following procedure.

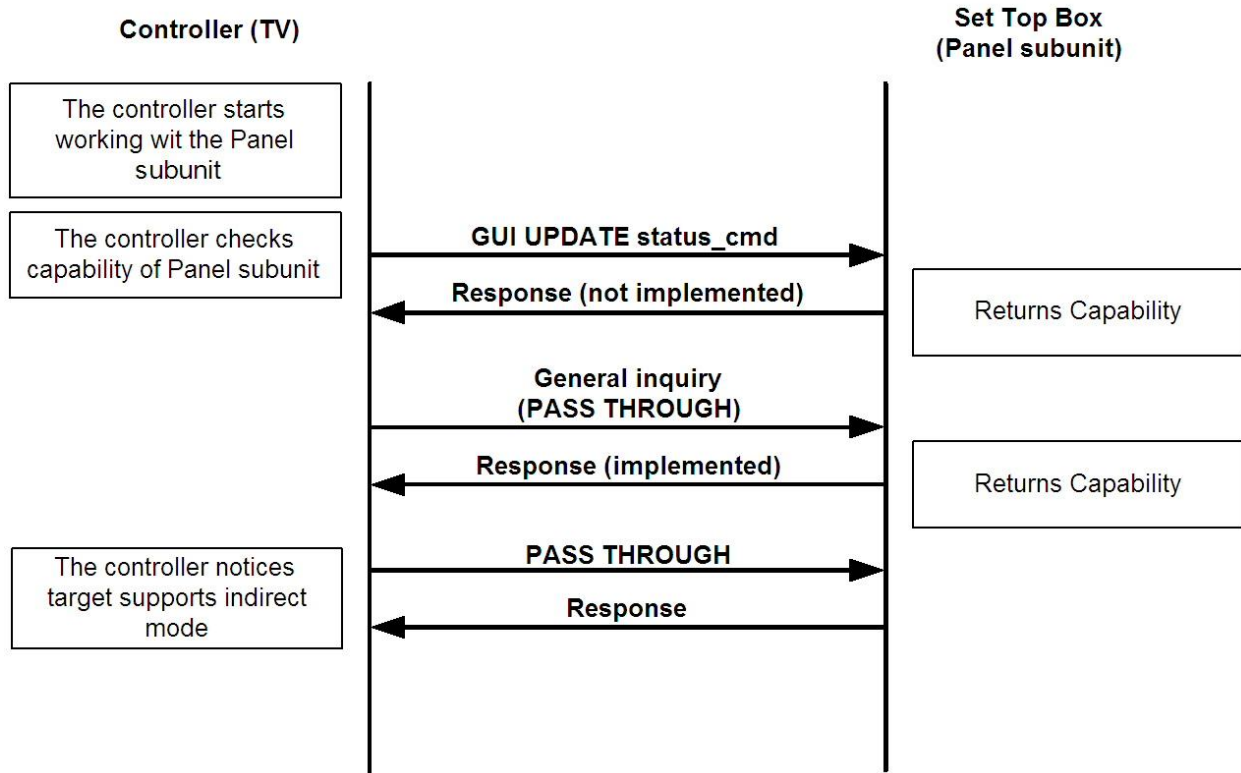


Figure 5 – Start procedure for indirect mode.

5.5.3.1 GUI UPDATE Command Test

Test ID	Question	Answer	Standard Reference
CEA311	Have the tester send a GUI UPDATE command to the STB. (0x01487DFF 0xFFFFFFFF)	-	See comment above table
CEA312	Did the STB respond with 0x08487DFF 0xFFFFFFFF (NOT IMPLEMENTED)?	Yes or No	
Check Point	If you answered “No” to CEA312, then response to GUI UPDATE status command is incorrect. FAILURE!		

GUI UPDATE Command Issued

Field	Code	Comments
ctype	0x1	Status
subunit_type	0x9	Panel
subunit_ID	0x0	Instance 0
opcode	0x7D	GUI UPDATE
operand[0]	0xFF	source_plug
operand[1]	0xFF	generation_ID
operand[2]	0xFF	GUI_resolution
operand[3]	0xFF	subfunction
operand[4]	0xFF	scope

Expected GUI UPDATE Response

Field	Code	Comments
response	0x8	NOT_IMPLEMENTED
subunit_type	0x9	Panel
subunit_ID	0x0	Instance 0
opcode	0x7D	GUI UPDATE
operand[0]	0xFF	Always 0xFF
operand[1]	0xFF	Always 0xFF
operand[2]	0xFF	Always 0xFF
operand[3]	0xFF	Always 0xFF
operand[4]	0xFF	Always 0xFF

5.5.3.2 PASS THROUGH GENERAL INQUIRY Test

Defined in AV/C Digital Interface Command Set General Specification Version 4.2; 1394 TA Document Number 2004006, section 7.5 GENERAL INQUIRY commands.

Test ID	Question	Answer	Standard Reference
CEA321	Have the tester send a PASS THROUGH GENERAL INQUIRY command to the STB. (0x04487CFF 0xFFFFFFFF)	-	See comment above table
CEA322	Did the STB respond with 0x0C487CFF 0xFFFFFFFF (IMPLEMENTED)?	Yes or No	
Check Point	If you answered “No” to CEA322, then response to PASS THROUGH GENERAL INQUIRY status command is incorrect. FAILURE!		

PASS THROUGH GENERAL INQUIRY Command Issued

Field	Code	Comments
ctype	0x4	General Inquiry
subunit_type	0x9	Panel
subunit_ID	0x0	Instance 0
opcode	0x7C	PASS THROUGH
operand[0]	0xFF	Always 0xFF
operand[1]	0xFF	Always 0xFF
operand[2]	0xFF	Always 0xFF
operand[3]	0xFF	Always 0xFF
operand[4]	0xFF	Always 0xFF

Expected PASS THROUGH GENERAL INQUIRY Response

Field	Code	Comments
response	0xC	IMPLEMENTED
subunit_type	0x9	Panel
subunit_ID	0x0	Instance 0
opcode	0x7C	PASS THROUGH

operand[0]	0xFF	Always 0xFF
operand[1]	0xFF	Always 0xFF
operand[2]	0xFF	Always 0xFF
operand[3]	0xFF	Always 0xFF
operand[4]	0xFF	Always 0xFF

5.5.4 PASS THROUGH Control Command Support

AV/C Panel Subunit Specification 1.21; 1394 TA Document Number 2002009, section 9.4 PASS THROUGH control command

and

Remote Control Command Pass-through Standard for Home Networking; CEA-931-A,

ANNEX A, AV/C PASS-THROUGH CONTROL COMMAND

M = Mandatory

R = Recommended

O = Optional

operation_id	user operation	M/R/O	operation_id	user operation	M/R/O
0x00	select	O	0x40	power	O
0x01	Up	O	0x41	volume up	O
0x02	Down	O	0x42	volume down	O
0x03	Left	O	0x43	mute	O
0x04	Right	O	0x44	play	O
0x05	right-up	O	0x45	stop	O
0x06	right-down	O	0x46	pause	O
0x07	left-up	O	0x47	record	O
0x08	left-down	O	0x48	rewind	O
0x09	root menu	O	0x49	fast forward	O
0x0A	setup menu	O	0x4A	eject	O

0x0B	contents menu	O	0x4B	forward	O
0x0C	favorite menu	O	0x4C	backward	O
0x0D	Exit	O	0x4D	reserved	-
0x0E	reserved	-	:	reserved	-
:	reserved	-	0x4F	reserved	-
0x1F	reserved	-	0x50	angle	O
0x20	0	O	0x51	subpicture	O
0x21	1	O	0x52	reserved	-
0x22	2	O	:	reserved	-
0x23	3	O	0x5F	reserved	-
0x24	4	O	0x60	play function	O
0x25	5	O	0x61	pause-play function	O
0x26	6	O	0x62	record function	O
0x27	7	O	0x63	pause-record function	O
0x28	8	O	0x64	stop function	O
0x29	9	O	0x65	mute function	M
0x2A	Dot	O	0x66	restore volume function	M
0x2B	Enter	O	0x67	tune function	M
0x2C	Clear	O	0x68	select disk function	O
0x2D	reserved	-	0x69	select a/v input function	O
:	reserved	-	0x6A	select audio input function	O
0x2F	reserved	-	0x6B	reserved	-
0x30	Channel up	O	:	reserved	-
0x31	channel down	O	0x70	reserved	-
0x32	previous channel	O	0x71	F1	O

0x33	sound select	O	0x72	F2	O
0x34	input select	O	0x73	F3	O
0x35	display information	O	0x74	F4	O
0x36	Help	O	0x75	F5	O
0x37	page up	O	0x76	reserved	-
0x38	page down	O	:	reserved	-
0x39	reserved	-	0x7D	reserved	-
:	reserved	-	0x7E	vendor unique	O
0x3F	reserved	-	0x7F	reserved	-

Table 1 – PASS THROUGH Control Commands

The set-top box shall respond to all not implemented optional PASS THROUGH with NOT IMPLEMENTED.

The set-top box shall respond appropriately to all implemented optional PASS THROUGH commands.

5.5.4.1 Mute Function Control Command Test

Test ID	Question	Answer	Standard Reference
CEA411	Have the tester send a Mute Function command to the STB. (0x00487C65 0x00)	-	See section 5.5.4
CEA412	Did the STB respond with 0x09487C65 0x00 (Accepted)?	Yes or No	
Check Point	If you answered “No” to CEA412, then response to Mute Function command is incorrect. FAILURE!		

Mute Function Control Command Issued

Field	Code	Comments
ctype	0x0	Control
subunit_type	0x9	Panel
subunit_ID	0x0	Instance 0
opcode	0x7C	PASS-THROUGH
operand[0]	0x65	state_flag, operation_id

operand[1]	0x00	operation_data_field_length
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Expected Mute Function Control Command Response

Field	Code	Comments
response	0x9	Accepted
subunit_type	0x9	Panel
subunit_ID	0x0	Instance 0
opcode	0x7C	PASS-THROUGH
operand[0]	0x65	state_flag, operation_id
operand[1]	0x00	operation_data_field_length

5.5.4.2 Restore Volume Function Control Command Test

Test ID	Question	Answer	Standard Reference
CEA421	Have the tester send a Restore Volume Function command to the STB. (0x00487C66 0x00)	-	See section 5.5.4
CEA422	Did the STB respond with 0x09487C66 0x00 (Accepted)?	Yes or No	
Check Point	If you answered “No” to CEA422, then response to Restore Volume command is incorrect. FAILURE!		

Restore Volume Function Control Command Issued

Field	Code	Comments
cstype	0x0	Control
subunit_type	0x9	Panel
subunit_ID	0x0	Instance 0
opcode	0x7C	PASS-THROUGH
operand[0]	0x66	state_flag, operation_id
operand[1]	0x00	operation_data_field_length

Expected Volume Function Control Command Response

Field	Code	Comments
response	0x9	Accepted
subunit_type	0x9	Panel
subunit_ID	0x0	Instance 0
opcode	0x7C	PASS-THROUGH
operand[0]	0x66	state_flag, operation_id
operand[1]	0x00	operation_data_field_length

5.5.4.3 Tune Function Control Command Test

Test ID	Question	Answer	Standard Reference
CEA431	Have the tester send a One Part Tune Function command to the STB. (0x00487C67 0x04nnnnnn 0xnn000000). Channel = 132 (0x84) (0x00487C67 0x04008400 0x00000000)	-	See section 5.5.4
CEA432	Did the STB respond with 0x09487C67 0x04008400 (Accepted)?	Yes or No	
Check Point	If you answered “No” to CEA432, then response to Tune Function command is incorrect. FAILURE!		
CEA433	Have the tester send a One Part Tune Function command to the STB. (0x00487C67 0x04nnnnnn 0xnn000000). Channel = 257 (0x101) (0x00487C67 0x04010100 0x00000000)	-	See section 5.5.4
CEA434	Did the STB respond with 0x09487C67 0x04010100 (Accepted)?	Yes or No	
Check Point	If you answered “No” to CEA434, then response to Tune Function command is incorrect. FAILURE!		

n = channel number entered

Tune Function Control Command Issued

Field	Code	Comments
ctype	0x0	Control

subunit_type	0x9	Panel
subunit_ID	0x0	Instance 0
opcode	0x7C	PASS-THROUGH
operand[0]	0x67	state_flag, operation_id
operand[1]	0x04	operation_data_field_length
operand[2]	0x01	two_port, major_channel_number(MSB)
operand[3]	0x32	major_channel_number (LSB)
operand[4]	0x00	minor_channel_number(MSB)
operand[5]	0x00	minor_channel_number(LSB)

Expected Tune Function Control Command Response

Field	Code	Comments
response	0x9	Accepted
subunit_type	0x9	Panel
subunit_ID	0x0	Instance 0
opcode	0x7C	PASS-THROUGH
operand[0]	0x67	state_flag, operation_id
operand[1]	0x04	operation_data_field_length
operand[2]	nn	two_port, major_channel_number(MSB)
operand[3]	nn	major_channel_number (LSB)
operand[4]	nn	minor_channel_number(MSB)
operand[5]	nn	minor_channel_number(LSB)

5.6 AV/C Digital Interface Command Set General

Defined in AV/C Digital Interface Command Set General Specification Version 4.2; 1394 TA Document Number 2004006, section 9 General commands.

5.6.1 Power Command Test - ON

Test ID	Question	Answer	Standard Reference
CEA611	Have the tester send a Power ON command to the STB. (0x00FFB270)	-	See section 5.6
CEA612	Did the STB respond with 0x09FFB270 (IMPLEMENTED)?	Yes or No	
Check Point	If you answered “No” to CEA612, then response to Power ON command is incorrect. FAILURE!		

Power ON Command Issued

Field	Code	Comments
ctype	0x0	Control
subunit_type	0x1F	Unit
subunit_ID	0x7	Unit
opcode	0xB2	Power Control Command
operand[0]	0x70	0x70 (on) or 0x60(off)

Expected Power ON Response

Field	Code	Comments
response	0x09	Accepted
subunit_type	0x1F	Unit
subunit_ID	0x7	Unit
opcode	0xB2	Power Control Command
operand[0]	0x70	0x70 (on) or 0x60(off)

5.6.2 Power Command Test - OFF

Test ID	Question	Answer	Standard Reference
CEA621	Have the tester send a Power OFF command to the STB. (0x00FFB270)	-	See section 5.6
CEA622	Did the STB respond with 0x09FFB270 (Accepted)?	Yes or No	
Check	If you answered “No” to CEA622, then response to		

Point	Power ON command is incorrect. FAILURE!		
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Power OFF Command Issued

Field	Code	Comments
ctype	0x0	Control
subunit_type	0x1F	Unit
subunit_ID	0x7	Unit
opcode	0xB2	Power Control Command
operand[0]	0x70	0x70 (on) or 0x60(off)

Expected Power OFF Response

Field	Code	Comments
response	0x9	Accepted
subunit_type	0x1F	Unit
subunit_ID	0x7	Unit
opcode	0xB2	Power Control Command
operand[0]	0x70	0x70 (on) or 0x60(off)

5.6.3 Power Status Command Test

Test ID	Question	Answer	Standard Reference
CEA631	Have the tester send a Power OFF command to the STB. (0x00FFB260)	-	See section 5.6
CEA632	Did the STB respond with 0x09FFB260 (Accepted)?	Yes or No	
Check Point	If you answered “No” to CEA632, then response to Power OFF command is incorrect. FAILURE!		
CEA633	Have the tester send a Power Status command to the STB. (0x01FFB260)		
CEA634	Did the STB respond with 0x0CFFB260?	Yes or No	
Check Point	If you answered “No” to CEA634, then response to Power Status command is incorrect. FAILURE!		
CEA635	Have the tester send a Power ON command to the STB. (0x00FFB270)	-	See section 5.6

CEA636	Did the STB respond with 0x0CFFB270 (Accepted)?	Yes or No	
Check Point	If you answered “No” to CEA636, then response to Power ON command is incorrect. FAILURE!		
CEA637	Have the tester send a Power Status command to the STB. (0x01FFB270)		
CEA638	Did the STB respond with 0x0CFFB270?	Yes or No	
Check Point	If you answered “No” to CEA638, then response to Power Status command is incorrect. FAILURE!		

Power Status Command Issued

Field	Code	Comments
ctype	0x1	Status
subunit_type	0x1F	Unit
subunit_ID	0x7	Unit
opcode	0xB2	Power Status Command
operand[0]	0x7F	Power State

Expected Power Status Response

Field	Code	Comments
response	0xC	IMPLEMENTED
subunit_type	0x1F	Unit
subunit_ID	0x7	Unit
opcode	0x60 or 0x70	Returns current state

5.7 Content Protection

Testing Digital Transmission Content Protection (DTCP) in a generic but detail manner is difficult to accomplish without knowledge that would violate DTCP. Therefore the 1394 Trade Association elected to use a “Golden Sink” approach and merely observe the DTCP process to verify the Set Top Box (STB) under test follows the process correctly. This test specification is based on the Digital Transmission Content Protection Specification Revision 1.4 (DTCP) and Chapters 5, 6, and 7 of the Specification for AV/C Digital Interface Command Set (General Specification).

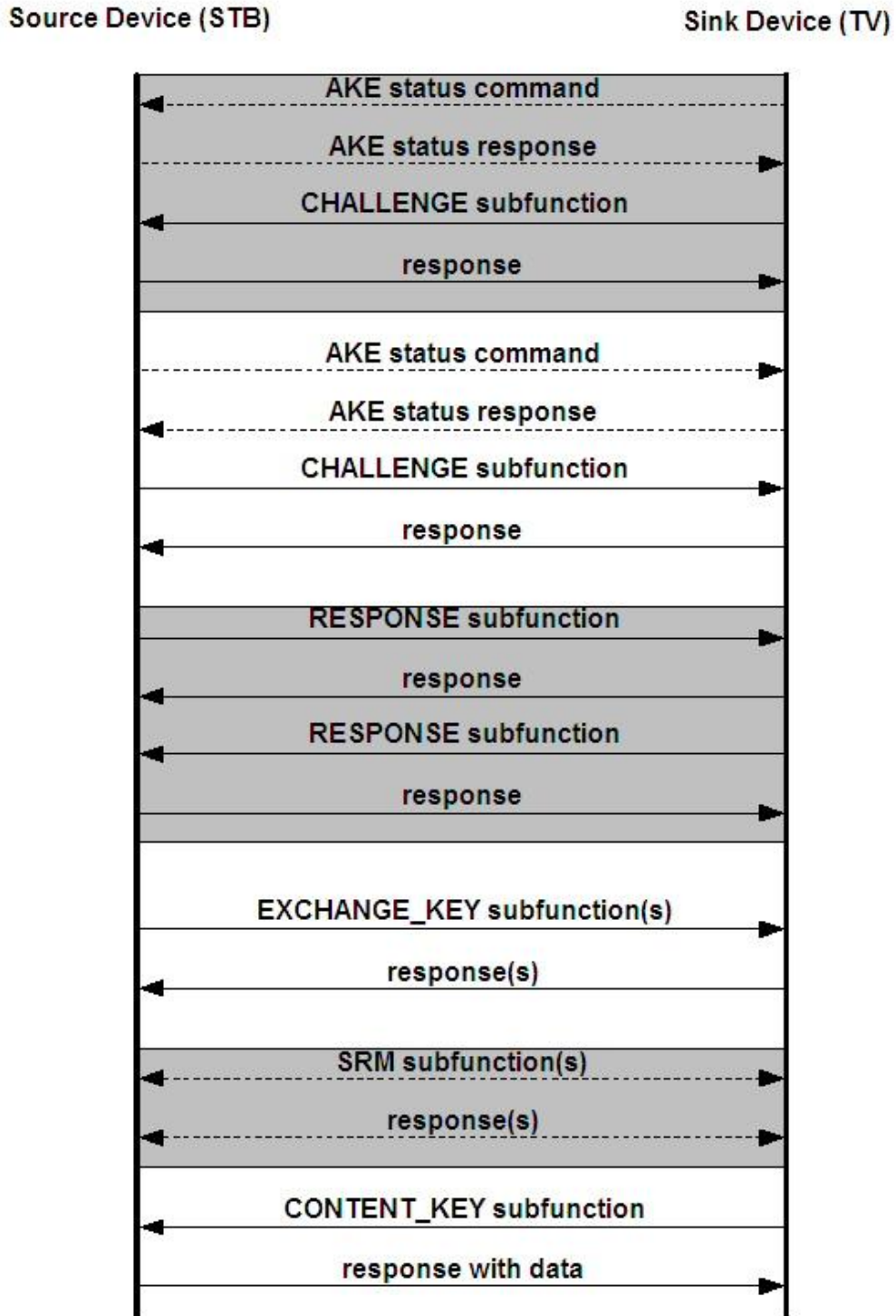


Figure 6 – Full Authentication Protocol Flow

5.7.1 Full Authentication and Key Exchange

Testing of the Full Authentication and Key Exchange is an observation test using a “golden sink” (TV) rather than an tester explicitly testing each case.

5.7.1.1 AKE Status Command from Sink

Before beginning authentication the initiator device must determine if the target device supports DTCP. This is done by issuing an AKE status command. Please refer to DTCP Specification section 8.3.2 for details.

5.7.1.1.1 AKE Status Command from Sink Test

Test ID	Question	Answer	Standard Reference
AKE101	Have the golden sink send AKE Status Command to the STB. (0x01FF0F00 0xFFFFFFFF 0xFFFFFFFF)	-	DTCP Specification section 8.3.2
AKE102	Did the STB respond with 0x0CFF0F00 0xFFnnppFF 0xFFF0Fyzz (IMPLEMENTED)?	Yes or No	
Check Point	If you answered “No” to AKE102, then response to AKE Status command is incorrect. FAILURE!		
AKE103	Did the STB response have operand [2] have bit 0-2 set?	Yes or No	
Check Point	If you answered “No” to AKE102, then response to AKE Status.operand[2] is incorrect. FAILURE!		
AKE104	Did the STB response have operand [3] have bits 0-2 set?	Yes or No	
Check Point	If you answered “No” to AKE102, then response to AKE Status.operand[3] is incorrect. FAILURE!		
AKE105	Did the STB response have operand [6].status = 0?	Yes or No	
Check Point	If you answered “No” to AKE102, then response to AKE Status.operand[6].status is incorrect. FAILURE!		
AKE106	Did the STB response have operand[7][8].data_length > 0x20?	Yes or No	
Check Point	If you answered “No” to AKE102, then response to AKE Status.operand[7][8]. Data_length is incorrect. FAILURE!		

AKE Status Command Issued

Field	Code	Comments
c_type	0x1	Status
subunit_type	0x1F	Unit
subunit_ID	0x7	Unit

opcode	0x0F	Security Command
operand[0]	0x00	AKE_ID
operand[1] – [4]	0xFFFFFFFF	For status shall be 0xFF
operand[5]	0xFF	AKE_label
operand[6]	0xFF	Number (4 bits) and Status (4 bits)
operand[7]	0xFF	Blocks_remaining (7 bits) and most significant bit of data_length
operand[8]	0xFF	Data_length

Expected AKE Status Command Response

Field	Code	Comments
response	0xC	IMPLEMENTED
subunit_type	0x1F	Unit
subunit_ID	0x7	Unit
opcode	0x0F	SECURITY command
operand[0]	0x00	AKE_ID
operand[1]	0xFF	AKE_ID dependent field
operand[2]	0000nnnn ₂	AKE procedure supported. Should have at least bit 0-2 set
operand[3]	0000nnnn ₂	AKE Exchange key values. Should have bits 0-2 set
operand[4]	0xFF	Subfunction_dependant
operand[5]	0xFF	AKE_label
operand[6]	0xF0	Number (4 bits) and Status (No error) (4 bits)
operand[7]	0xFF	Blocks_remaining (7 bits) and most significant bit of data_length
operand[8]	0xF0	Data_length (must be greater than 0x20)

5.7.1.1.2 CHALLENGE subfunction from Sink Test

Test ID	Question	Answer	Standard Reference
AKE201	Have the golden sink send AKE Challenge Command to the source (STB).	-	See section 5.7 above
AKE202	Did the STB respond with 09FF0F00 0104yy01 ppz000nn (ACCEPTED)?	Yes or No	
Check Point	If you answered “No” to AKE202, then response to AKE CHALLENGE command is incorrect. FAILURE!		

CHALLENGE Command Issued

Field	Code	Comments
ctype	0x0	Control
subunit_type	0x1F	Unit
subunit_ID	0x7	Unit
opcode	0x0F	Security Command
operand[0]	0x00	Category 0, AKE_ID
operand[1]	0x01	Subfunction – CHALLENGE
operand[2]	0x04	AKE_procedure – Full Authentication
operand[3]	0x07	Exchange_key for M6 Copy-never, Copy-one-generation, and No-more-copies
operand[4]	0xyy	License required
operand[5]	0xpp	AKE_label – unique to each exchange process
operand[6]	0xzF	Number (4 bits) zero or incrementing and Status (4 bits)
operand[7]	0000000n ₂	Blocks_remaining (7 bits) zero and most significant bit of data_length
operand[8]	0xnn	Data_length

Response to CHALLENGE Command

Field	Code	Comments
ctype	0x9	Accepted

subunit_type	0x1F	Unit
subunit_ID	0x7	Unit
opcode	0x0F	Security Command
operand[0]	0x00	Category 0, AKE_ID
operand[1]	0x01	Subfunction – CHALLENGE
operand[2]	0x04	AKE_procedure – Full Authentication
operand[3]	0x07	Exchange_key for M6 Copy-never, Copy-one-generation, and No-more-copies
operand[4]	0xyy	License required
operand[5]	0xpp	AKE_label – unique to each exchange process
operand[6]	0xz0	Number (4 bits) zero or incrementing and Status (4 bits)
operand[7]	0000000n ₂	Blocks_remaining (7 bits) zero and most significant bit of data_length
operand[8]	0xnn	Data_length

5.7.1.1.3 AKE Status Command from Source Test

Test ID	Question	Answer	Standard Reference
AKE301	Did the STB sends AKE Status Command to the golden sink in response to golden sink status/challenge with the correct format. (0x01FF0F00 0xFFFFFFFF 0xFFFFFFFF)	Yes or No	See 5.7
Check Point	If you answered “No” to AKE301, then response to AKE Status command is incorrect. FAILURE!		

AKE Status Command Issued

Field	Code	Comments
ctype	0x1	Status
subunit_type	0x1F	Unit
subunit_ID	0x7	Unit
opcode	0x0F	Security Command
operand[0]	0x00	AKE_ID
operand[1] – [4]	0xFFFFFFFF	For status shall be 0xFF

operand[5]	0xFF	AKE_label
operand[6]	0xFF	Number (4 bits) and Status (4 bits)
operand[7]	0xFF	Blocks_remaining (7 bits) and most significant bit of data_length
operand[8]	0xFF	Data_length

Expected AKE Status Command Response

Field	Code	Comments
response	0xC	IMPLEMENTED
subunit_type	0x1F	Unit
subunit_ID	0x7	Unit
opcode	0x0F	SECURITY command
operand[0]	0x00	AKE_ID
operand[1]	0xFF	AKE_ID dependent field
operand[2]	0000nnnn ₂	AKE procedure supported. Should have at least bit 0-2 set
operand[3]	0000nnnn ₂	AKE Exchange key values. Should have bits 0-2 set
operand[4]	0xFF	Subfunction_dependant
operand[5]	0xFF	AKE_label
operand[6]	0xF0	Number (4 bits) and Status (No error) (4 bits)
operand[7]	0xFF	Blocks_remaining (7 bits) and most significant bit of data_length
operand[8]	0xF0	Data_length (must be greater than 0x20)

5.7.1.1.4 Source CHALLENGE subfunction Test

Test ID	Question	Answer	Standard Reference
AKE401	Did the source (STB) send a Device Challenge Command with its certificate to the golden sink using the same AKE_label as the sink Challenge Command?	Yes or No	See section 5.7 above
Check Point	If you answered “No” to AKE401, then source AKE CHALLENGE command is incorrect. FAILURE!		

CHALLENGE Command Issued

Field	Code	Comments
c _{type}	0x0	Control
subunit _{type}	0x1F	Unit
subunit _{ID}	0x7	Unit
opcode	0x0F	Security Command
operand[0]	0x00	Category 0, AKE _{ID}
operand[1]	0x01	Subfunction – CHALLENGE
operand[2]	0x04	AKE _{procedure} – Full Authentication
operand[3]	0x07	Exchange _{key} for M6 Copy-never, Copy-one-generation, and No-more-copies
operand[4]	0xyy	License required
operand[5]	0xpp	AKE _{label} – unique to each exchange process
operand[6]	0xzF	Number (4 bits) zero or incrementing and Status (4 bits)
operand[7]	0000000n ₂	Blocks _{remaining} (7 bits) zero and most significant bit of data _{length}
operand[8]	0xnn	Data _{length}

Response to CHALLENGE Command

Field	Code	Comments
c _{type}	0x9	Accepted
subunit _{type}	0x1F	Unit
subunit _{ID}	0x7	Unit
opcode	0x0F	Security Command
operand[0]	0x00	Category 0, AKE _{ID}
operand[1]	0x01	Subfunction – CHALLENGE
operand[2]	0x04	AKE _{procedure} – Full Authentication
operand[3]	0x07	Exchange _{key} for M6 Copy-never, Copy-one-generation, and No-more-copies

operand[4]	0xyy	License required
operand[5]	0xpp	AKE_label – unique to each exchange process
operand[6]	0xz0	Number (4 bits) zero or incrementing and Status (4 bits)
operand[7]	0000000n ₂	Blocks_remaining (7 bits) zero and most significant bit of data_length
operand[8]	0xnn	Data_length

5.7.1.1.5 Source RESPONSE subfunction(s) Test

Test ID	Question	Answer	Standard Reference
AKE501	Did the source (STB) send a RESPONSE Command to the golden sink using the same AKE_label as the sink Challenge Command in the correct format (0x00FF0F00 020407yy ppzF0nnn)?	Yes or No	See section 5.7 above
Check Point	If you answered “No” to AKE501, then source AKE RESPONSE command is incorrect. FAILURE!		

RESPONSE Command Issued

Field	Code	Comments
ctype	0x0	Control
subunit_type	0x1F	Unit
subunit_ID	0x7	Unit
opcode	0x0F	Security Command
operand[0]	0x00	Category 0, AKE_ID
operand[1]	0x02	Subfunction – RESPONSE
operand[2]	0x04	AKE_procedure – Full Authentication
operand[3]	0x07	Exchange_key for M6 Copy-never, Copy-one-generation, and No-more-copies
operand[4]	0xyy	License required
operand[5]	0xpp	AKE_label – unique to each exchange process
operand[6]	0zxF	Number (4 bits) zero or incrementing and Status (4 bits)

operand[7]	0000000n ₂	Blocks_remaining (7 bits) zero and most significant bit of data_length
operand[8]	0xnn	Data_length

Response to RESPONSE Command

Field	Code	Comments
ctype	0x9	Accepted
subunit_type	0x1F	Unit
subunit_ID	0x7	Unit
opcode	0x0F	Security Command
operand[0]	0x00	Category 0, AKE_ID
operand[1]	0x02	Subfunction – RESPONSE
operand[2]	0x04	AKE_procedure – Full Authentication
operand[3]	0x07	Exchange_key for M6 Copy-never, Copy-one-generation, and No-more-copies
operand[4]	0xyy	License required
operand[5]	0xpp	AKE_label – unique to each exchange process
operand[6]	0xz0	Number (4 bits) zero or incrementing and Status (4 bits)
operand[7]	0000000n ₂	Blocks_remaining (7 bits) zero and most significant bit of data_length
operand[8]	0xnn	Data_length

5.7.1.1.6 Sink RESPONSE subfunction(s) Test

Test ID	Question	Answer	Standard Reference
AKE601	Have the golden sink send a RESPONSE Command to the source (STB) in the correct format.	-	
AKE602	Did the STB send the correction response the RESPONSE Command with the correct format Accept (0x09FF0F00 020407yy ppz00nnn)?	Yes or No	See section 5.7 above
Check Point	If you answered “No” to AKE602, then source response to AKE RESPONSE command is incorrect. FAILURE!		

Source RESPONSE Command Issued

Field	Code	Comments
c _{type}	0x0	Control
subunit _{type}	0x1F	Unit
subunit _{ID}	0x7	Unit
opcode	0x0F	Security Command
operand[0]	0x00	Category 0, AKE _{ID}
operand[1]	0x02	Subfunction – RESPONSE
operand[2]	0x04	AKE _{procedure} – Full Authentication
operand[3]	0x07	Exchange _{key} for M6 Copy-never, Copy-one-generation, and No-more-copies
operand[4]	0xyy	License required
operand[5]	0xpp	AKE _{label} – unique to each exchange process
operand[6]	0xzF	Number (4 bits) zero or incrementing and Status (4 bits)
operand[7]	0000000n ₂	Blocks _{remaining} (7 bits) zero and most significant bit of data _{length}
operand[8]	0xnn	Data _{length}

Sink Response to RESPONSE Command

Field	Code	Comments
c _{type}	0x9	Accepted
subunit _{type}	0x1F	Unit
subunit _{ID}	0x7	Unit
opcode	0x0F	Security Command
operand[0]	0x00	Category 0, AKE _{ID}
operand[1]	0x02	Subfunction – RESPONSE
operand[2]	0x04	AKE _{procedure} – Full Authentication
operand[3]	0x07	Exchange _{key} for M6 Copy-never, Copy-one-generation, and No-more-copies

operand[4]	0xyy	License required
operand[5]	0xpp	AKE_label – unique to each exchange process
operand[6]	0xz0	Number (4 bits) zero or incrementing and Status (4 bits)
operand[7]	0000000n ₂	Blocks_remaining (7 bits) zero and most significant bit of data_length
operand[8]	0xnn	Data_length

5.7.1.1.7 Source EXCHANGE_KEY subfunction(s) Test

Test ID	Question	Answer	Standard Reference
AKE701	Did the source (STB) send a EXCHANGE_KEY Command to the golden sink using the same AKE_label as the sink Challenge Command in the correct format (0x00FF0F00 0304ssyy ppzF0nnn)?	Yes or No	See section 5.7 above
Check Point	If you answered “No” to AKE701, then source AKE RESPONSE command is incorrect. FAILURE!		

EXCHANGE_KEY Command Issued

Field	Code	Comments
ctype	0x0	Control
subunit_type	0x1F	Unit
subunit_ID	0x7	Unit
opcode	0x0F	Security Command
operand[0]	0x00	Category 0, AKE_ID
operand[1]	0x03	Subfunction – EXCHANGE_KEY
operand[2]	0x04	AKE_procedure – Full Authentication
operand[3]	0xss	License required
operand[4]	0xyy	License required
operand[5]	0xpp	AKE_label – unique to each exchange process
operand[6]	0xzf	Number (4 bits) zero or incrementing and Status (4 bits)
operand[7]	0000000n ₂	Blocks_remaining (7 bits) zero and most significant bit of

		data_length
operand[8]	0xnn	Data_length

Response to EXCHANGE_KEY Command

Field	Code	Comments
ctype	0x9	Accepted
subunit_type	0x1F	Unit
subunit_ID	0x7	Unit
opcode	0x0F	Security Command
operand[0]	0x00	Category 0, AKE_ID
operand[1]	0x03	Subfunction – EXCHANGE_KEY
operand[2]	0x04	AKE_procedure – Full Authentication
operand[3]	0xss	License required
operand[4]	0xyy	License required
operand[5]	0xpp	AKE_label – unique to each exchange process
operand[6]	0xz0	Number (4 bits) zero or incrementing and Status (4 bits)
operand[7]	0000000n ₂	Blocks_remaining (7 bits) zero and most significant bit of data_length
operand[8]	0xnn	Data_length

5.7.1.1.8 Sink CONTENT_KEY_REQ subfunction(s) Test

Test ID	Question	Answer	Standard Reference
AKE801	Have the golden sink send a CONTENT_KEY_REQ Command to the source (STB) in the correct format.	-	
AKE802	Did the STB send the correction response the CONTENT_KEY_REQ Command with the correct format and Accept (0x09FF0F00 800000yy ppz00nnn)?	Yes or No	See section 5.7 above
Check Point	If you answered “No” to AKE802, then source response to CONTENT_KEY_REQ command is incorrect. FAILURE!		

Source CONTENT_KEY_REQ Command Issued

Field	Code	Comments
ctype	0x0	Control
subunit_type	0x1F	Unit
subunit_ID	0x7	Unit
opcode	0x0F	Security Command
operand[0]	0x00	Category 0, AKE_ID
operand[1]	0x80	Subfunction – CONTENT_KEY_REQ
operand[2]	0x00	AKE_procedure – Full Authentication
operand[3]	0x00	Exchange_key for M6 Copy-never, Copy-one-generation, and No-more-copies
operand[4]	0xyy	License required
operand[5]	0xpp	AKE_label – unique to each exchange process
operand[6]	0xzF	Number (4 bits) zero or incrementing and Status (4 bits)
operand[7]	0000000n ₂	Blocks_remaining (7 bits) zero and most significant bit of data_length
operand[8]	0xnn	Data_length

Sink Response to CONTENT_KEY_REQ Command

Field	Code	Comments
ctype	0x9	Accepted
subunit_type	0x1F	Unit
subunit_ID	0x7	Unit
opcode	0x0F	Security Command
operand[0]	0x00	Category 0, AKE_ID
operand[1]	0x80	Subfunction – CONTENT_KEY_REQ
operand[2]	0x00	AKE_procedure – Full Authentication
operand[3]	0x00	Exchange_key for M6 Copy-never, Copy-one-generation, and No-more-copies

operand[4]	0xyy	License required
operand[5]	0xpp	AKE_label – unique to each exchange process
operand[6]	0xz0	Number (4 bits) zero or incrementing and Status (4 bits)
operand[7]	0000000n ₂	Blocks_remaining (7 bits) zero and most significant bit of data_length
operand[8]	0xnn	Data_length

5.8 Content Protection Interoperability Testing

The following topology is used for the STB Interoperability Testing. The tests defined in section do not attempt to verify all formats (analog, digital, 480i, 720p, 1080i, 1080p, etc.). The purpose of the tests in this section is to verify recording is allowed/disallowed according to the content protection flags.

STB ----- Golden Sink ----- Recording Device ----- Bus Analyzer

5.8.1 Copy Always Test

Test ID	Question	Answer
INT101	Connect the STB as shown in section 5.8.	-
INT102	Tune STB to Copy Always content.	-
INT103	Start Recording Device recording STB content for two minutes.	-
INT104	Stop Recording and verify, was stream successfully recorded (video is smooth with audio and video in sync)?	Yes or No
Check Point	If you answered “No” to INT104, Copy Always content was not successfully recorded. FAILURE!	

5.8.2 Copy Once Test

Test ID	Question	Answer
INT201	Connect the STB as shown in section 5.8.	-
INT202	Tune STB to Copy Once content.	-
INT203	Start Recording Device recording STB content for two minutes.	-
INT204	Stop Recording and verify, was stream successfully recorded (video is smooth with audio and video in sync)?	Yes or No

Check Point	If you answered “No” to INT204, Copy Once content was not successfully recorded. FAILURE!	
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5.8.3 Copy Never Test

Test ID	Question	Answer
INT301	Connect the STB as shown in section 5.8.	-
INT302	Tune STB to Copy Never content.	-
INT303	Start Recording Device recording STB content for two minutes.	-
INT304	Stop Recording and verify, was NO stream was recorded?	Yes or No
Check Point	If you answered “No” to INT304, Copy Never content was recorded. FAILURE!	

Annex A
(informative)

Bibliography

- [B1] IEEE Std 1212-2001, Standard for a Control and Status Registers (CSR) Architecture for microcomputer buses
- [B2] IEEE Std 1394-1995, Standard for a High Performance Serial Bus
- [B3] IEEE Std 1394a-2000, Standard for a High Performance Serial Bus—Amendment 1
- [B4] IEEE Std 1394b-2002, Standard for a High Performance Serial Bus—Amendment 2
- [B5] ISO/IEC 9899:1990, Programming Languages—C