TA Document 2001023

AV/C Disc Subunit - Hard Disk Drive Device Type Specification 1.1

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Abstract:
This specification defines a model and command set for audio/video Hard Disk Drive devices over IEEE Std 1394-1995. The model and command set are compatible with the AV/C Disc Subunit Model and Command Set and rely upon proposed enhancements to that specification currently being developed in the AVWG. The command set makes use of the Function Control Protocol (FCP) defined by IEC 61883, Consumer audio/video equipment - Digital interface, for the transport of audio/video command requests and responses. The audio/video devices are implemented as a common unit architecture within IEEE Std 1394-1995.

Keywords:
Audio, Video, 1394, Digital, Interface, Storage.

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Change history

The following table shows the change history for this specification.

Version 1.0

Original Version

Version 1.1

Version 1.1 of this document differs from version 1.0 in the following ways:

Table 1.1 – Content change for version 1.1

Category	Description
Editorial	Reference documents have been changed.
Technical	OPEN INFO BLOCK has been deleted. See this deleted note below: NOTE —(Informative) This command is mandatory because the Enhancements to the AV/C General Specification 3.0, version 1.0 specifies its requirement when WRITE INFO BLOCK is mandatory. This requirement is expected to change in the next revision of the AV/C General or Enhancements to the AV/C General document. Consequently, it is recommended that OPEN DESCRIPTOR is the preferred method to gain access rights as the OPEN INFO BLOCK command would then become optional.
Technical	The value for *disc_subunit_version* field has been changed in Figure 5.1.
Technical	The definition of the *list_descriptor_length* = 0000 (unknown) has been added to the section 5.3

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1. Overview

1.1 Purpose

This specification is intended to supplement *AV/C Disc Subunit General, version 1.1, AV/C Digital Interface Command Set Specification 4.0, AV/C Descriptor Mechanism 1.1* and *AV/C Information Block Types 1.0*. The features specific to AV-HDD are described. The AV-HDD device type is characterized by different application profiles. One or more Profile ID's define the requirements for an AV-HDD of a particular type and the subset of AV/C commands implemented in an AV-HDD of that type.

1.2 Scope

The scope of this revision of the standard is to define the requirements for the Player/Recorder Profile AV-HDD. The command set and its operational features are defined in this specification. An application model for the Player/Recorder Profile AV-HDD for a typical Play and Record operation is developed.

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2. References

The following standards contain provisions, which through reference in this document constitute provisions of this standard. All the standards listed are normative references. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

[R1] ISO/IEC 13123:1994, Control and Status Register (CSR) Architecture for Microcomputer Buses[1]

[R2] IEEE Std 1394-1995, Standard for a High Performance Serial Bus[2]

[R3] IEC 61883, Digital Interface for Consumer Electronic Audio/Video Equipment[3]

[R4] TA Document 1999026, AV/C Digital Interface Command Set General, version4.0[4], July 23, 2001

[R5] TA Document 1999045, AV/C Information Block Types Specification, version 1.0[4], July 23, 2001

[R6] TA Document 2001021, AV/C Descriptor Mechanism Specification, version 1.1[4] Draft

[R7] TA Document 2001022, AV/C Disc Subunit General, version 1.1[4] Draft

[1] ISO/IEC [ANSI/IEEE] publications are available from the Institute of Electrical and Electronics Engineers, Service Center, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, USA or from International Electrotechnical Commission, 3 rue de Varembé, Case Postale 131, CH 1211, Genève 20, Switzerland/Suisse.

[2] IEEE publications are available from the Institute of Electrical and Electronics Engineers, Service Center, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331 USA.

[3] Document 100C/182/FDIS from: U.S. National Committee of The IEC ANSI, 11 West 42nd Street, 13th Floor, New York, NY 10036 USA. Phone: +1.212.642.4900(Questions) 212.642.4980(Sales). FAX: +1.212.398.0023.

[4] Accepted 1394 Trade Association (AV/C) documents may be ordered through: 1394 Trade Association Regency Plaza Suite 350, 2350 Mission College Blvd., Santa Clara, CA 95054, USA; by contacting taadmin@1394ta.org; by retrieving a PDF-format copy from the 1394 Trade Association web-site at: http://www.1394ta.org/abouttech/specifications/techspec.html.

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3. Definitions

3.1 Conformance levels

3.1.1 expected: A key word 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.

3.1.2 may: A key word that indicates flexibility of choice with *no implied preference*.

3.1.3 shall: A key word indicating a mandatory requirement. Designers are *required* to implement all such mandatory requirements.

3.1.4 should: A key word indicating flexibility of choice with a strongly preferred alternative. Equivalent to the phrase *is recommended*.

3.1.5 reserved fields: A set of bits within a data structure that are defined in this specification as reserved, and are not otherwise used. Implementations of this specification shall zero these fields. Future revisions of this specification, however, may define their usage.

3.1.6 reserved values: A set of values for a field that are defined in this specification as reserved, and are not otherwise used. Implementations of this specification shall not generate these values for the field. Future revisions of this specification, however, may define their usage.

NOTE —The IEEE is investigating whether the "may, shall, should" and possibly "expected" terms will be formally defined by IEEE. If and when this occurs, draft editors should obtain their conformance definitions from the latest IEEE style document.

3.2 Glossary of terms

3.2.1 AV Content Object: An Object Entry that describes an AV Track and its contents. There are AV Content Objects for Digital Video, Audio, and Digital Still Images among others. AV Content Objects have an entry_type value in the range of 80_{16} to $8F_{16}$.

3.2.2 AV Frame: A portion of an AV Track defined by the specific data encoding method applied to that AV Track. For example MPEG encoded AV Tracks have I ,P and B frames as defined by MPEG documentation.

3.2.3 AV Track: A collection of recorded data that is described by an AV Content Object Entry. This definition includes video, audio, textual and other types of data. Although sometimes referred to simply as Tracks, the name AV tracks is intended to differentiate AV content from the tracks normally associated with hard disk drive devices.

3.2.4 AV Segment: A partial AV Track defined as the portion of an AV Track between two adjacent positions. AV segments are useful for performance and editing operations on AV Tracks.

3.2.5 AV subunit: an instantiation of a virtual entity that can be identified uniquely within an AV unit and offers a set of coherent functions.

3.2.6 AV/C: Audio/video control, as in the AV/C Digital Interface Command Set specified by this document.

3.2.7 byte: Eight bits of data.

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3.2.8 CSR: A node or unit Control and Status Register, as defined by IEEE Std 1394–1995.

3.2.9 EUI-64: Extended Unique Identifier, 64-bits, as defined by the IEEE. The EUI-64 is a concatenation of the 24-bit company_ID obtained from the IEEE Registration Authority Committee (RAC) and a 40-bit number (typically a silicon serial number) that the vendor identified by company_ID guarantees to be unique for all of its products. The EUI-64 is also known as the node unique ID and is redundantly present in a node's configuration ROM in both the Bus_Info_Block and the Node_Unique_Id leaf.

3.2.10 FCP: Function Control Protocol, as defined by IEC 61883, Digital Interface for Consumer Electronic Audio/Video Equipment[R3].

3.2.11 IEEE: The Institute of Electrical and Electronics Engineers, Inc.

3.2.12 isochronous: A term that indicates the essential characteristic of a time-scale or signal, such that the time intervals between consecutive instances either have the same duration or durations that are integral multiples of the shortest duration. In the context of Serial Bus, "isochronous" is taken to mean a bounded worst-case latency for the transmission of data; physical and logical constraints that introduce jitter preclude the exact definition of "isochronous."

3.2.13 module: The smallest component of physical management, *i.e.*, a replaceable device.

3.2.14 nibble: Four bits of data. A byte is composed of two nibbles.

3.2.15 node: An addressable device attached to Serial Bus with at least the minimum set of control registers defined by IEEE Std 1394–1995.

3.2.16 node ID: A 16-bit number, unique within the context of an interconnected group of Serial Buses. The node ID is used to identify both the source and destination of Serial Bus asynchronous data packets. It can identify one single device within the addressable group of Serial Buses (unicast), or it can identify all devices (broadcast).

3.2.17 Object Entry: AV/C descriptor structure type that contains descriptive information. It is commonly used to describe AV-content (a track) that is recorded and stored on the HDD device media.

3.2.18 Object List: AV/C descriptor structure type that contains some number of Object Entries.

3.2.19 PCR: Plug Control Register, as defined by IEC 61883, Digital Interface for Consumer Electronic Audio/Video Equipment[R3].

3.2.20 iPCR: Input plug PCR, as defined by IEC 61883.

3.2.21 oPCR: Output plug PCR, as defined by IEC 61883.

3.2.22 plug: A physical or virtual end-point of connection implemented by an AV unit or subunit that may receive or transmit isochronous or other data. Plugs may be Serial Bus plugs, accessible through the PCR's; they may be external, physical plugs on the AV unit; or they may be internal virtual plugs implemented by the AV subunits.

3.2.23 quadlet: Four bytes of data.

3.2.24 Serial Bus: The physical interconnections and higher level protocols for the peer-to-peer transport of serial data, as defined by IEEE Std 1394–1995.

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3.2.25 stream: A time-ordered set of digital data originating from one source and terminating at zero or more sinks. A stream is characterized by bounded bandwidth requirements and by synchronization points, or time stamps, within the stream data.

3.3 Acronyms and abbreviations

AV/C Audio Video Control

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4. The AV-HDD Model

The AV-HDD device has many unique capabilities. The large storage capacity normally associated with an AV-HDD device allows the implementation of many advanced features. A relatively large number of AV tracks (AV content) and associated structures may be stored in the AV-HDD device by the user. These AV tracks can be of several different types including audio, video, digital still image, and text. The AV tracks may be encoded using MPEG, DV, or possibly other encoding methods.

4.1 Device Profiles

The capabilities of AV-HDD devices may range from a basic recorder and player to a complex video and audio editor with features to access AV content by multiple users simultaneously and reliably. The minimum capabilities of an AV-HDD are indicated by a parameter called the Profile ID.

This specification applies to a profile known as a Recorder/Player AV-HDD. Future revisions will address other AV-HDD devices with different profiles.

Different profiles may be supported simultaneously in a multi-profile AV-HDD. It is not necessary that a profile be a subset of any other profiles.

4.1.1 Recorder/Player Profile

The Player/Recorder Profile AV-HDD shall support recording (storage) and playback of multiple AV tracks using 1394 Isochronous transfers. It does not require asynchronous connection support. It supports the descriptor model specified in AV/C Disc Subunit General, version 1.1[R7]. The Player/Recorder Profile AV-HDD may not support all the possible fields of a given descriptor. The limitations are described in this specification.

The Player/Recorder Profile AV-HDD is a digital recorder/player with the following capabilities:

- Play and Record AV tracks. The AV-HDD permits Play and Record operations on a given AV track or tracks.
- Pause AV tracks. The AV-HDD supports Pause for Play and Record operations. If the record and play operations are active upon the same AV track, the play operation can be paused while recording on the AV track continues.
- Position within AV tracks. The AV-HDD supports search operations to position the playback or recording point in a given AV Track.

The basic operations of the Player/Recorder Profile AV-HDD provide real-time control of individual AV tracks, plus random access to individual AV tracks and data files. Stream control includes Stop, Record, Record Pause, Play, Play Pause, Pause Resume, Play Fast Forward, Play Rewind, Search and Simultaneous Record and/or Playback of the same or multiple AV tracks.

4.2 AV Content

The AV content area of the HDD device stores all of the data recorded using the AV/C commands (or content that was placed on the disc during manufacture). Included in this area is the descriptor data (object lists, object entries, etc.). The AV content area is a logically contiguous area, and is not divided into multiple AV content areas. Such content area division is not supported by this model.

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4.3 Simultaneous Playback and Record

In the AV-HDD model it is possible for multiple controllers to access the same AV Track for simultaneous record and playback. At least one playback operation shall be supported and at least one record operation shall be supported.

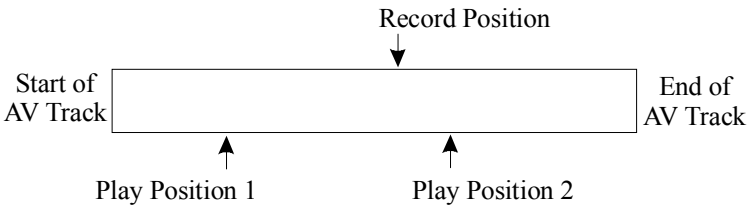

Figure 4.1 – Simultaneous Playback and Record

Unexpected behaviors may occur when the Playback and Record Positions collide during simultaneous access to an AV Track. Unexpected behaviors may also occur when one or more Playback Positions are in advance of the Record Position. The behavior of an AV-HDD device in these situations is implementation dependent.

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5. AV-HDD Features and Capabilities

The descriptor structures supported by Player/Recorder Profile AV-HDD are:

- Subunit Identifier
- Subunit Status Descriptor
- Root Contents List

The structures are developed for Player/Recorder Profile AV-HDD in this revision. Future revisions will address these issues for additional AV-HDD device profiles.

5.1 Subunit Identifier Descriptor

The structure of the Subunit Identifier is as defined in [R7] The *size_of_list_ID*, *size_of_objectID* and *size_of_object_position* fields are defined in the Subunit Identifier structure for each AV-HDD implementation and are independent of profile. Possible values for these fields shall be restricted to 2, 4 or 8. For a multi-profile AV-HDD, these fields shall apply to all profiles listed as supported in the Subunit Identifier. Thus individual profiles within the same multi-profile AV-HDD may not have differing values for the same size field.

The number of *root_object_lists* must be specified as at least 1 for a Player/Recorder Profile AV-HDD. The user is not expected to create the list explicitly. The AV-HDD creates the list on first initialization. The functional characteristics of the subunit are defined in the subunit dependent information field of the Subunit Identifier structure.

5.1.1 Disc Subunit Dependent Information

The *disc_subunit_dependent_information* field of the Subunit Identifier structure contains AV-HDD specific information that describes the capabilities of the subunit. The *disc_subunit_dependent_information* field has the following definition.

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Address	Length, bytes	External Read/Write	Contents
00 00_{16}	2	R	Disc_subunit_dependent_info_fields_length
00 01_{16}			
00 02_{16}	1	R	Subunit_attributes
00 03_{16}	1	R	Disc_subunit_version ($0x12_{16}$)
00 04_{16}	1	R	Number_of_supported_media_types (1)
00 05_{16}	2	R	Supported_media_type
00 06_{16}			
00 07_{16}	1	R	Implementation_Profile_ID
00 08_{16}	1	R	Media_attributes
00 09_{16}	2	R	AV-HDD_type_dependent_length
00 $0A_{16}$			
00 $0B_{16}$			AV-HDD_type_dependent_information
:			
:			
:			

Figure 5.1 – Disc Subunit dependent information

The *disc_subunit_version* field shall contain a value of $0x12_{16}$. A value of $0x12_{16}$ indicates conformance to [R7]

The *number_of_supported_media_types* field shall contain a value of 1. The Player/Recorder Profile AV-HDD supports only the native HDD media type and the *supported_media_type* value shall be 0700_{16} as per [R7]. This is not a published media format.

The Media type specifications is as per [R7]. No media type dependent information is present. The Player/Recorder Profile AV-HDD supports a flat storage model, but may optionally support a hierarchical model. The attribute bit *supports_two_sided_media* has no meaning in this AV-HDD profile.

The *implementation_profile_id* field indicates the Profile ID of the AV-HDD specification to which this subunit conforms. This value shall be 10_{16} for a single profile Player/Recorder AV-HDD. For a multi-profile AV-HDD, this value shall be FF_{16} and the extended implementation profile list in the AV-HDD type dependent information is used to list all profiles the AV-HDD supports.

Table 5.1 – AV-HDD Profile

Implementation_profile_ ID	Meaning
10_{16}	Player/Recorder Profile AV-HDD
FF_{16}	Extended Implementation Profiles Exist
all others	Reserved for future specification

5.1.2 AV-HDD Type Dependent Information

The *AV-HDD_type_dependent_information* field of the Subunit Identifier structure contains AV-HDD specific information that describes its capabilities.

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Address	Length, bytes	External Read/Write	Contents
00 00_{16}	1	R	AV-HDD_version
00 01_{16}	4	R	Maximum_number_of_recordable_objects
00 02_{16}			
00 03_{16}			
00 04_{16}			
00 05_{16}	1	R	Number_of_extended_implementation_profiles
00 06_{16}	1	R	Extended_implementation_profile_ID [0]
00 07_{16}	1	R	Extended_AV-HDD_version[0]
:			
:	1	R	Extended_implementation_profile_ID [n-1]
:	1	R	Extended_AV-HDD_version[n-1]

Figure 5.2 – AV-HDD Type dependent information

If the subunit is not a multiple-profile AV-HDD, then the *AV-HDD_version* field indicates the version number of the AV_HDD profile specification to which the *implementation_profile_id* specified for this subunit conforms.

This field contains an ordinal value, which is increased with each revision of the AV-HDD profile specification. If the *implementation_profile_id* is set to FF_{16}, indicating that extended implementation profiles exist, then the *AV-HDD_version* field may also be set to FF_{16}.

Table 5.2 – AV-HDD Version

AV-HDD_version	Meaning
00_{16}	Version 1.0 of the Player/Recorder AV-HDD specification
all others	Reserved for future specification

The *number_of_extended_implementation_profiles* field indicates how many of the *extended_implementation_profile_id[]* and *extended_AV-HDD_version[]* fields are present if the *implementation_profile_id* field in the subunit dependent information indicates that multiple profiles are supported by the subunit.

Each *extended_implementation_profile_id* field indicates the ID value for a particular AV-HDD profile and each associated *extended_AV-HDD_version* field indicates the *AV-HDD_version* level supported for that particular AV-HDD profile.

5.2 Subunit Status Descriptor

The Subunit Status descriptor structure is as described in [R7]. The supported info blocks are described below.

The Player/Recorder Profile AV-HDD implements the General Disc Subunit Status Info Block, Destination Plug Status Area Info Block (88 01_{16}) and Source Plug Status Area Info Block (88 02_{16}).

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5.2.1 General Disc Subunit Status Area Info Block

This info block is as described in [R7]with the following restrictions. It contains General Disc Subunit Status Area Info Block ($88\ 00_{16}$) with the nested Media and Edit Status Info Block ($88\ 04_{16}$).

The fields in the Media and Edit Status Info Block are restricted as follows.

The *disc_in_drive* field is always $01_{b,}$ the *error_condition* field is either 00_{b} or $10_{b.}$ The undo and difference operations may not be supported by a Player/Recorder Profile AV-HDD. If not supported, the *undo_status* and *difference* fields are FF_{16} and 00_{16} respectively.

5.2.2 Destination Plug Status Area Info Block

The Destination Plug Status Area Info Block structure is as defined in [R7]The supported info blocks for Player/Recorder Profile AV-HDD are:

- Plug Status Info Block ($88\ 05_{16}$)
- Operating Mode Info Block ($88\ 06_{16}$)
- Plug Configuration Info Block ($88\ 07_{16}$) Refer to [R5]for the definition of the structure of this info block. The *AV_object_type* field and *object_and_plug_type* specific information is given in [R7].
- Position Info Block ($00\ 03_{16}$). The structure of the info block is as specified in [R5]. It contains the Position Indicator Info Block ($00\ 02_{16}$). The position of current recording or play point of the AV object will be returned. A Player/Recorder Profile AV-HDD supports the indicator type *relative_HMSF_count*. It is to be noted that the indicated time may not be frame accurate, as accuracy of position is implementation dependent. An AV-HDD may optionally support other additional *indicator_types*.

5.2.3 Source Plug Status Area Info Block

The Source Plug Status Area Info Block structure is as defined in AV/C Disc Subunit General, version 1.0. The supported info blocks for Player/Recorder Profile AV-HDD are:

- Plug Status Info Block ($88\ 05_{16}$)
- Operating Mode Info Block ($88\ 06_{16}$)
- Plug Configuration Info Block ($88\ 07_{16}$) Refer to [R5] for the definition of the structure of this info block. The *AV_object_type* field and *object_and_plug_type* specific information is given in [R7].
- Position Info Block ($00\ 03_{16}$). The structure of the Info Block is as specified in [R5]. It contains Position Indicator Info. Block ($00\ 02_{16}$). The position of current recording or play point of the AV object will be returned. The Player/Recorder Profile AV-HDD supports the indicator type *relative_HMSF_count*. It is to be noted that the indicated time may not be frame accurate, as accuracy of position is implementation dependent. An AV-HDD may optionally support other additional *indicator_types*.

5.3 List descriptor length of Object Lists

In the following object lists, the list_descriptor_length field can be set to the value of 0000_{16}(unknown)

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Table 5.3 – Object lists which`unknown´setting is allowed

List name	List type
Root Contents List	80_{16}
Child Contents Lists	81_{16}
Root Temporary Contents List	82_{16}
Child Temporary Contents Lists	83_{16}
Performance Lists	84_{16}

5.4 Root Contents List

The structure of Root Contents List as described in [R6], Player/Recorder Profile AV-HDD supports only Root Contents List of list type 80_{16}.

The structure of the Root Contents Lists is given below:

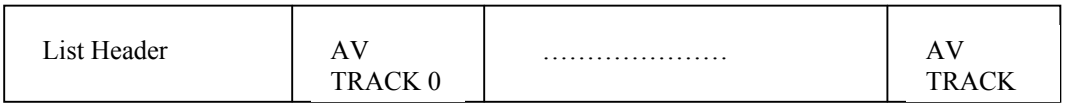

Figure 5.3 – The structure of Root Contents List

The Info Blocks supported for the root lists are:

- Time Stamp Info Block for descriptor modification (00 07_{16})
- Disc Capacity Info Block (80 02_{16})
- Default Playlist Info Block (80 $0B_{16}$)

5.4.1 Object Descriptor

The object descriptor structure within the Root Contents List as described in [R6]. The Player/Recorder Profile AV-HDD is intended to read and write Video Content Objects as described in [R7]. The supported info blocks for the object descriptors are:

- Name Info Block (00 $0B_{16}$). The Name Info block is a nested info block containing additional Character Code Info block (00 08_{16}), Language Code Info Block (00 09_{16}) and Raw Text Info Block (00 $0A_{16}$).
- Size Indicator Info Block (00 01_{16}). The supported type value is 00_{16} (indicating HMSF type).
- Time Stamp Info Block (00 04_{16}). This is the content creation time.
- Video Signal Mode Info Block (88 12_{16}).
- Video Stream Format Subtype Info Block (88 13_{16}).
- Program Attributes Info Block (88 14_{16}).

The Player/Recorder Profile AV-HDD shall be able to reference object entries by position within the list (20_{16}) and by object ID within the list (21_{16}), as described in [R6].

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5.4.2 Player/Recorder Profile Info Blocks

The following table is a list of info blocks that shall be supported by a Player/Recorder Profile AV-HDD.

Table 5.4 – AV-HDD Info Blocks

Info block type	Info block name	The containing Descriptor
00 01_{16}	Size Indicator	Contained in the object descriptor of the Root Contents List
00 02_{16}	Position Indicator	Contained in the Position Info Block
00 03_{16}	Position	Plug Status Area
00 04_{16}	Time Stamp of Content Creation	Contained in the object descriptor of the Root Contents List
00 07_{16}	Time Stamp of Descriptor Modification	Contained in the list specific information of the Root Contents List
00 08_{16}	Character Code	When present, it is contained in the object descriptor and nested in the Name Info Block
00 09_{16}	Language Code	When present, it is contained in the object descriptor and nested in the Name Info Block
00 $0A_{16}$	Raw Text	Contained in the object descriptor and nested in the Name Info Block
00 $0B_{16}$	Name	Contained in the object descriptor of the Root Contents List
80 02_{16}	Disc Capacity	Contained in the list specific information of the Root Contents List
80 $0B_{16}$	Default Playlist	Contained in the list specific information of the Root Contents List
88 00_{16}	General Disc Subunit Status Area	Disc Subunit Status Descriptor
88 04_{16}	Media and Edit Status	Nested in General Disc Subunit Status area
88 02_{16}	Source Plug Status Area	Contained in Disc Subunit Status Descriptor
88 01_{16}	Destination Plug Status Area	Contained in Disc Subunit Status Descriptor
88 05_{16}	Plug Status	Nested Info block within Source Plug Status Area and Destination Plug Status Area
88 06_{16}	Operating Mode Info	Nested info block within Plug Status info block
88 07_{16}	Plug Configuration	Nested info block within Plug Status info block

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Info block type	Info block name	The containing Descriptor
88 12_{16}	Video Signal Mode	Nested info block within Video Content Object
88 13_{16}	Video Stream Format Subtype	Nested info block within Video Content Object
88 14_{16}	Program Attribute	Nested info block within Video Content Object

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6. AV-HDD AV/C Commands

6.1 Player/Recorder Profile AV-HDD Commands

The following table contains commands that a Player/Recorder Profile AV-HDD shall implement. These commands are a subset of category A commands in [R7]. The command and response structure are as described in [R7].

Table 6.1 – AV-HDD Commands

Command	Opcode	Defined ctypes			Comments
		C	S	N	
CONFIGURE	$D1_{16}$	X	-	-	Prepare the HDD for a record or play operation.
ERASE	40_{16}	X	-	-	Erase the single AV track or the entire contents.
PLAY	$C3_{16}$	X	-	-	Begin Playing the selected AV track
RECORD	$C2_{16}$	X	-	-	Records on the selected AV track.
SEARCH (Search type is Position and search indicator is relative.)	50_{16}	X	-	-	Performs a search to the specified position on the selected AV track
SET PLUG ASSOCIATION	$D3_{16}$	X	-	-	Associate a List or Object with a Source or Destination Plug
STOP	$C5_{16}$	X	-	-	Stops the current operation on the selected AV track.

Player/Recorder Profile AV-HDD supports the following additional commands. These commands are a subset of category C commands in [R7] and other commands in [R6].

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Table 6.2 – Additional AV-HDD Commands

Command	Opcode	Defined ctypes			Comments
		C	S	N	
OPEN DESCRIPTOR	08_{16}	X	-	-	Gains the right to access the descriptor.
READ DESCRIPTOR	09_{16}	X	-	-	Read data from the descriptor.
READ INFO BLOCK	06_{16}	X	-	-	Read the specified info block.
WRITE INFO BLOCK	07_{16}	X	-	-	Write data into specified info block.
PLUG INFO	02_{16}	-	X	-	Information about serial bus and external plugs.

6.2 CONFIGURE

In a Player/Recorder Profile AV-HDD the subfunction 00_{16} (Reset to the Default Configuration) and 01_{16} (Set the Configuration) shall be supported.

6.3 ERASE

In a Player/Recorder Profile AV-HDD, erase type 00_{16} (Erase All the Contents) and 01_{16} (Erase the Specified Object) shall be supported. Both the descriptor and AV contents are deleted.

6.4 PLAY

In a Player/Recorder Profile AV-HDD, the subfunctions 75_{16} (Normal Play) and $7D_{16}$ (Forward Pause) shall be supported.

6.5 RECORD

In a Player/Recorder Profile AV-HDD the following subfunctions shall be supported:

Subfunction1: 75_{16} (Record at Normal Speed) and $7D_{16}$ (Forward Pause).

Subfunction2: 00_{16} (Record New).

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6.6 SEARCH - POSITION

In a Player/Recorder Profile AV-HDD the subfunction 00_{16} (Search Type is Position) shall be supported. The search indicator value is 00_{16} i.e. search by *Relative_HMSF_count*. Note the search position may not be frame accurate and only is an estimate of the desired position.

6.7 SET PLUG ASSOCIATION

In a Player/Recorder Profile AV-HDD the subfunction 01_{16} (Set a Specified List/Plug Association) shall be supported. No default association is supported. The associated List ID descriptor identifier supports the descriptor_type 20_{16} (Object Entry Descriptor by Position) and descriptor_type 21_{16} (Object Entry Descriptor by an Object ID).

NOTE —This command was formerly called ASSOCIATE LIST WITH PLUG.

6.8 STOP

The operation of this command is as specified in [R7]. The position where play operation ends shall be maintained by the AV-HDD at least until the AV-HDD enters a power off condition. This behavior emulates VCR operation.

6.9 OPEN DESCRIPTOR

The operation of this command is as specified in [R6].

6.10 READ DESCRIPTOR

The operation of this command is as specified in [R6].

6.11 READ INFO BLOCK

The operation of this command is as specified in [R6].

6.12 WRITE INFO BLOCK

The operation of this command is as specified in [R6] with the following limitations. It is to be noted that AV-HDD creates Info Blocks at the time of object creation on “Record” command execution. It is to be noted that data in some of the info blocks can not be determined by the subunit. In these cases, such data may be initialized with values, which may be implementation dependent.

6.13 PLUG INFO

The Player/Recorder Profile AV-HDD is required to support one source and one destination plug at a minimum. An AV-HDD may support additional source and destination plugs optionally.

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Annexes

Annex A: Optional AV/C Info Blocks and Commands (Informative)

This annex is intended to provide guidance on a subset of useful commands and info blocks for implementers that may choose to do an enhanced Player/Recorder Profile AV-HDD. In general, commands and info blocks not mandated in the normative sections are optional at the discretion of implementers. Thus stating that any particular command or info block is optional provides no further information and creates no more or less burden on implementers. However, the intent of this informative annex is to provide additional guidance on what may be desirable enhancements to the basic Player/Recorder Profile AV-HDD, as a specific combination or subset of additional features.

A.1 OPTIONAL INFO BLOCKS

Table A.1 – Optional AV-HDD Info Blocks

Info block type	Info block name	The containing Descriptor
88 10_{16}	Latest Recording Mode	Nested info block within Video Content Object or Disc Status Descriptor
88 15_{16}	Object Subtype	Nested info block within Video Content Object
88 $0F_{16}$	Playback Position	Nested info block within Video Content Object
88 $0E_{16}$	Recording Position	Nested info block within Video Content Object
88 $0A_{16}$	Monitor Status	Nested info block within Plug Status info block

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A.2 OPTIONAL COMMANDS

Table A.2 – Optional AV-HDD Commands

Command	Opcode	Defined ctypes			Comments
		C	S	N	
CREATE AV TRACK	$D5_{16}$	X	-	-	This command is used to create a track of a given size.
CREATE DESCRIPTOR	OC_{16}	X	-	-	Create new descriptors
DISC STATUS	$D0_{16}$	-	-	X	Request notification when the status of the subunit changes
MONITOR	$C6_{16}$	X	-	-	Monitor the contents of the destination plug
POWER	$B2_{16}$	X	X	X	Control Power Status
RECORD (loop)	$C2_{16}$	X	-	-	Records on the selected AV track in loop mode.
RESERVE	01_{16}	X	X	X	Acquire or release exclusive control of a subunit.
SEARCH (Search type is Relative and search indicator is relative)	50_{16}	X	-	-	Performs a search to the specified position on the selected AV track
UNDO	44_{16}	X	-	-	Undo the most recent editing operation(s)

A.2.1 CREATE AV TRACK

In a Player/Recorder Profile AV-HDD, the CREATE AV TRACK command is optional. When CREATE AV TRACK is supported it will create both a new AV track and a new AV Content Object descriptor. Right after an AV track is created by the CREATE AV TRACK command, the AV track is not recorded. When the controller issues a command to set a play back position in the not recorded part in the AV track, the subunit may return a REJECTED response. When the controller issues a command to set a recording position in the not recorded part except the beginning position of the not recorded part, the subunit also may return a REJECTED response.

A.2.2 CREATE DESCRIPTOR

In a Player/Recorder Profile AV-HDD, the CREATE DESCRIPTOR command is optional. When more than one *root_object_lists* is supported, then the CREATE DESCRIPTOR should be supported as a method to create additional *root_object_lists*. If supported, at least the subfunction of 00_{16} (Create a New Descriptor) is required.

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A.2.3 DISC STATUS

In a Player/Recorder Profile AV-HDD, the DISC STATUS command is optional. When DISC STATUS is supported, at least the subfunction of 00_{16} (Full Status) is required. This will cause a notification to occur whenever the status descriptor changes

A.2.4 MONITOR

In a Player/Recorder Profile AV-HDD, the MONITOR command is optional. When MONITOR is supported, at least subfunction 60_{16} (Monitoring Off)and subfunction 70_{16} (Monitoring On) are required.

A.2.5 POWER

In a Player/Recorder Profile AV-HDD, the POWER command is optional. When POWER is supported, it can be used to control the power state of the AV-HDD. The state 70_{16} is Power On, and the state 60_{16} is Power Off.

A.2.6 RECORD (LOOP)

In a Player/Recorder Profile AV-HDD the loop subfunction is optionally supported.

Subfunction1: 75_{16} (Record at Normal Speed) and $7D_{16}$ (Forward Pause).

Subfunction2: 06_{16} (Record Loop).

A.2.7 RESERVE

In a Player/Recorder Profile AV-HDD, the RESERVE command is optional. When RESERVE is supported, it can be used to reserve or release exclusive use of the AV-HDD.

A.2.8 SEARCH – RELATIVE

In a Player/Recorder Profile AV-HDD, the SEARCH command with subfunction 10_{16} (Search Type is Relative) is optional. The search indicator value is 00_{16} i.e. search by *Relative_HMSF_count*. Note the search position may not be frame accurate and only is an estimate of the desired position.

A.2.9 UNDO

In a Player/Recorder Profile AV-HDD, the UNDO command is optional. When UNDO is supported, the undo_status and difference fields take on appropriate values based on implementation. If supported, UNDO will be implemented for at least the ERASE and WRITE INFO BLOCK commands.

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Annex B: Player/Recorder Profile AV-HDD Use Examples (Informative)

The following methods are examples of control sequences which should be supported by a Player/Recorder Profile AV-HDD. Some examples relate to optional commands and, in this case, the control sequences are also advisory.

B.1 Descriptor Access Examples

B.1.1 Method to read descriptor

In the case of a Player/Recorder Profile AV-HDD, the following method is used for reading Subunit Identifier Descriptor, Status Descriptor and Object Entry Descriptor.

Read procedure is as follows:

(1) The controller issues OPEN DESCRIPTOR command which specifies the object descriptor.

(2) The controller issues READ DESCRIPTOR command with following parameters:

descriptor identifier : indicate object descriptor.

data_length = size that controller can receive.

(example : Async. buffer size of controller - overhead of READ DESCRIPTOR command)

address = 0000_{16}

(3) The Player/Recorder Profile AV-HDD returns the appropriate part of the specified descriptor. There are three cases of an ACCEPTED response.

Case 1 : *read_result_status* = 10_{16}

The READ request can be handled with no problem.

Case 2 : *read_result_status* = 12_{16}

The READ request started in valid data space, but went beyond the end of valid data space.

data_length = The actual number of bytes read.

In the above two cases, “read whole descriptor” sequence is finished, and the controller has received whole descriptor contents.

Case 3 : *read_result_status* = 11_{16}

The READ request was only partially satisfied due to data transfer capacity limitations.

data_length = The actual number of bytes read.

The controller must issue additional READ command(s) to get all of the desired data until

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read_result_status = 12_{16} or 10_{16}

Additional READ DESCRIPTOR command(s) parameter is set to following:

data_length = size that controller can receive.

address = address of preceding READ DESCRIPTOR command

+ data_length value of preceding READ DESCRIPTOR command

B.1.2 Method to read info block

For a Player/Recorder Profile AV-HDD, reading the primary field of an info block is guaranteed.

Reading procedure is as follows:

(1) The controller issues OPEN DESCRIPTOR command to open descriptor which contains object info block.

(2) The controller issues READ INFO BLOCK command with following parameters:

info_block_reference_path : indicate object info block.

data_length = size that controller can receive.

(example : Async. buffer size of controller - overhead of READ INFO BLOCK command)

address = 0000_{16}

(3) The player/reorder AV-HDD returns appropriate part of specified info block.

There are three cases of ACCEPTED responses.

Case 1 : *read_result_status* = 10_{16}

The READ request can be handled with no problem.

Case 2 : *read_result_status* = 12_{16}

The READ request started in valid data space, but went beyond the end of valid data space

data_length = The actual number of bytes read.

In the above two cases, “read whole descriptor” sequence is finished, and the controller has received whole descriptor contents.

Case 3 : *read_result_status* = 11_{16}

The READ request was only partially satisfied due to data transfer capacity limitations.

data_length = The actual number of bytes read.

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The controller must issue additional READ INFO BLOCK command(s) to get all of the desired data until *read_result_status* = 12_{16} or 10_{16}

Additional READ INFO BLOCK command(s) parameter is set to following:

data_length = size that controller can receive.

address = address of preceding READ INFO BLOCK command

+ data_length value of preceding READ INFO BLOCK command.

B.1.3 Method to write info block

All modifiable fields in descriptors of a Player/Recorder Profile AV-HDD are composed of info blocks. The controller shall use WRITE INFO BLOCK command. It is strongly recommended to modify whole primary field at once. The group_tag function may not be supported for Player/Recorder Profile AV-HDD, thus the controller shall write primary field of info block at one WRITE INFO BLOCK transaction.

Write sequence is as follows:

(1) The controller issues OPEN DESCRIPTOR command to open descriptor which contains info block. Parameters of OPEN DESCRIPTOR command are as follows:

descriptor identifier : indicate descriptor that contains objective info block.

Subfunction = 03_{16} ("WRITE OPEN")

(2) If the controller does not know actual size of info block, the controller issues READ INFO BLOCK command.

(3) The controller issues WRITE INFO BLOCK command, which parameters are as follows:

info_block_reference_path : point to objective info block.

group_tag = 00_{16} ("immediate")

replacement_data_length = length of replacement_info_block_data field.(This could be greater than the length of original primary field, other fields of the object descriptor will be affected)

address = 0000_{16} (top of primary field)

original_data_length : length of original primary field.(specifies the number of bytes deleted. Since it is equal to primary length, the entire data is deleted).

replacement_info_block_data : the new data to be written into the info block.

B.1.4 Method to read header part of Root Contents List descriptor

When READ DESCRIPTOR command with descriptor identifier specified Root Contents List, Player/ Recorder AV-HDD returns header part of Root Contents List. If the controller want to read object entry, the controller shall specify each object entry.

Header part of Root Contents List contains following fields:

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list_type

attributes

size_of_list_specific_information

list_specific_information

number_of_entries

Reading sequence for Root Contents List descriptor is:

At first, the controller issues OPEN DESCRIPTOR command, which specifies Root Contents List.

Parameters of OPEN DESCRIPTOR command are following:

descriptor_type =10_{16} (Object list descriptor - specified by list ID)

descriptor_type_specific_reference = $xxxx_{16}$ (list ID of Root Contents List)

Then the controller issues READ DESCRIPTOR command with following parameters:

descriptor_type =10_{16} (Object list descriptor - specified by list ID)

descriptor_type_specific_reference = $xxxx_{16}$ (list ID of Root Contents List)

data_length = size that controller can receive.

address = 0002_{16} (address of list_type field)

A Player/Recorder Profile AV-HDD sends the header part of Root Contents List with RESPONSE frame. RESPONSE procedure is same as “Method to read whole descriptor”, thus controller may need to issue more READ DESCRIPTOR command(s).

Note: In some implementations, it may be very difficult to maintain descriptor_length field of Root Contents List. Thus, above sequence excludes descriptor_length field.

B.1.5 Method to read whole Root Contents List

(1) Read header part of Root Contents List.

(2) Parse header part and look for number of object entry from number_of_entry field.

(3) Read each object entry.

B.2 Player/Recorder Profile AV-HDD Control Examples

B.2.1 Method to find Player/Recorder Profile AV-HDD

Assumption: the controller has already discovered the disc subunit.

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Use the following sequence:

Read Subunit Identifier Descriptor

(1) Scan supported_media_type[i] to find identifier of "AV-HDD" (type =0700_{16}).

(2) Check implementation_profile_ID in supported_media_type_specification[j], which supported_media_type is 0700_{16} ("AV-HDD").

If implementation_profile_ID is 10_{16} (Player/Recorder profile), this subunit is a Player/Recorder Profile AV-HDD.

If implementation_profile_ID is FF_{16} , the AV-HDD is compatible with multi-profile of AV-HDD, then check extended_implementation_profile_ID[k] to discover its capabilities. If extended_implementation_profile_ID[k] is 10_{16} (Player/Recorder profile), this subunit is compatible with Player/Recorder Profile AV-HDD, and may have extended function.

B.2.2 Method to check availability of Player/Recorder Profile AV-HDD

(1) Read general_disc_subunit_status area of the Disc Subunit Status Descriptor and check disc_in_drive field of media_and_edit_status_info_block. If disc_in_drive value is 01b ("installed"), media is available.

(2) Check media_type field in Root Contents List list_specific_information, which value is 0700_{16} ("AV-HDD").

B.2.3 Method to check remaining capacity

Remaining capacity is specified in disc_remaining_recording_capacity field of disc_capacity_info_block, which is located in the Root Contents List optional_info_block_area. In case of Player/Recorder Profile AV-HDD, format of disc_remaining_recording_capacity field is "bytes."

B.2.4 Method to get list of contents

Read each object entry in the Root Contents List

Note 1. There shall be at least one Root Contents List in Player/Recorder Profile AV-HDD.

Note 2. When Root Contents List is updated, time_stamp_info_block in Root Contents List list_specific_information is updated too. The controller should check this info block.

Note 3:

(1) If there are other type object entries than video object, a controller should work without problem. The controller shall check entry_type field of object entry.

(2) If an object has a child list, a controller should work without problem. The controller shall check has_child_ID flag in attribute field of object entry.

These two restrictions and these two checks are to take steps to meet future extension of AV-HDD.

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B.2.5 Method to RECORD specific contents on destination plug #j

(1) Configure destination plug .#j.

Set the video_signal_mode in video object object_and_plug_type_specific_information field of plug_configuration_info_block, which is located in plug_status_info_block in the destination_plug_status_area_info_block of Disc Subunit Status Descriptor.

(2) Issue the SET PLUG ASSOCIATION command to associate Root Contents List with destination plug #j.

(3) Issue the RECORD command to destination plug #j, parameters are as follows:

destination_plug : destination plug #j

subfunction_1 : 75_{16} (“Forward”)

subfunction_2 : 00_{16} (“New”)

Note. As soon as accepting the RECORD command, the Player/Recorder Profile AV-HDD creates new video object.

(4) Write attribute of new video object.

Note 1. ERASE command designate a video object that is currently recording shall be REJECTED.

Note 2. During recording, size information in video object entry may be inaccurate. If the controller wants to know size of a video object during recording, the controller should read the status of destination plug.

B.2.6 Method to “RECORD PAUSE”

(a) To change rec_state from RECORD forward to RECORD pause

Issue the RECORD command to destination plug #j. Parameters are as follows:

destination_plug : destination plug #j

subfunction_1 : $7D_{16}$ (“Forward Pause”)

subfunction_2 : 00_{16} (“New”)

(b) To change rec_state from RECORD Pause to RECORD forward

Issue the RECORD command to destination plug #j. Parameters are as follows:

destination_plug : destination plug #j

subfunction_1 : 75_{16} (“Forward”)

subfunction_2 : 00_{16} (“New”)

Note. Changing rec_state does not cause to create new video object. RECORD operation is on going.

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B.2.7 Method to STOP record operation on destination plug #j

Issue the STOP command specifying destination plug #j.

Note. When the STOP command is ACCEPTED, the value of size_indicator_info_block in video object indicates the size of the video contents recorded.

B.2.8 Method to PLAY specific object on source plug #i at the beginning

Configure source plug #i.

Issue the SET PLUG ASSOCIATION command to associate specific object with source plug #i

Issue the SEARCH command to the beginning point (00:00:00.00)

Note 1. Player/Recorder Profile AV-HDD supports relative HMSF format on SEARCH command.

Issue the PLAY command with forward X1 to source plug #i

Note 2. ERASE command specifying a video object that is currently playing shall be REJECTED.

B.2.9 Method to "PLAY PAUSE"

(a) To change play_state from PLAY Forward to PLAY Pause

Issue the PLAY command to source plug #j. Parameters are as follows:

source_plug : source plug #j

subfunction_1 : $7D_{16}$ ("Forward Pause")

(b) To change play_state from PLAY PAUSE to PLAY FORWARD

Issue the PLAY command to source plug #i. Parameters are as follows:

source_plug : source plug #i

subfunction_1 : 75_{16} ("Forward")

B.2.10 Method to SEARCH specific position

Issue the SEARCH command.

Note 1. Player/Recorder Profile AV-HDD supports relative HMSF format on SEARCH command.

Note 2. After SEARCH operation is ended, operating_mode of plug is resume to the same operating_mode before the SEARCH command was issued.

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B.2.11 Method to STOP Play on source plug #i

Issue the STOP command specifying source plug #i.

Note. The value of current pointer is maintained as it is positioned when the operation stopped.

B.2.12 Method to ERASE specific video object

Issue the ERASE command specifying the video object.

Note. ERASE command specifying a video object that is currently playing or recording shall be REJECTED.

B.2.13 Method to change plug association

Issue the SET PLUG ASSOCIATION command.

Note. SET PLUG ASSOCIATION command shall be REJECTED when operating_mode is not STOP.

B.2.14 Method to CREATE AV TRACK for loop recording (Optional)

(1) Setup destination plug #j

Set *video_signal_mode* in video object *object_and_plug_type_specific_information* field of *plug_configuration_info_block*, which is located in *plug_status_info_block* in the *destination_plug_status_area_info_block* of *Disc Subunit Status Descriptor*.

(2) Issue the SET PLUG ASSOCIATION control command to associate Root Contents List with destination plug #j.

(3) Issue the CREATE AV TRACK control command to destination plug #j, with parameters are as follows:

destination_plug : destination plug #j

subfunction_1 : 21_{16} (“object ID”)

AV_track_size : AV track size to be created
size indicator type : 01_{16} (“raw_byte_count”)

Note: The AV-HDD may round up the value of *AV_track_size*. The controller can check the value of AV track size by reading the size_indicator_info_block in the object entry of the AV track that was created.

B.2.15 Method to “RECORD LOOP” specific AV track from the beginning (Optional)

(1) Issue the RECORD command to destination plug #j, with parameters as follows:

subfunction_1 : 75_{16} (“forward”)

subfunction_2 : 06_{16} (“loop”)

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start_position : beginning position.
indicator_type : 00_{16} ("relative_HMSF_count")
indicator_specific field : 00 00 00 00_{16} (beginning position)

(2) Write attribute of video object by using WRITE INFO BLOCK commands.

Note 1: When the plug configuration that is set up for RECORD loop command is different from the plug configuration for creating this AV track, the AV-HDD can reject the RECORD loop command.

B.2.16 Method to "RECORD LOOP" specific AV track from the current recording position (Optional)

(1) Issue the RECORD command to destination plug #j, with parameters as follows:

subfunction_1 : 75_{16} ("forward")

subfunction_2 : 06_{16} ("loop")

start_positon : unspecified.
indicator_type : 00_{16} ("relative_HMSF_count")
indicator_specific field : FF FF FF FF_{16} (current recording position)

(2) Write attribute of video object by using WRITE INFO BLOCK commands.

Note 1: When the plug configuration that is set up for RECORD loop command is different from the plug configuration for creating this AV track, the AV-HDD can reject the RECORD loop command.

Note 2: ERASE command designate a video object that is currently recording shall be REJECTED.

B.2.17 Method to PLAY specific AV track in loop recording (Optional)

(1) Setup source plug #i.

(2) Issue the SET PLUG ASSOCIATION control command to associate specific AV object with source plug #i.

(3) Issue the SEARCH control command to search the start position in the recorded part of the AV track that is in loop recording

(4) Issue the PLAY control command to source plug #i.

Note 1. When the controller issues the SEARCH control command that specifies the position in the not recorded part of the AV track, the SEARCH control command shall be rejected.

Note 2. When the current play back position catches up the current recording position, the AV-HDD may change play back mode to follow the current recording position.

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