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TECHNICAL REPORT

Professional tape-less camera recorder





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TECHNICAL REPORT

Professional tape-less camera recorder

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

PROFESSIONAL TAPE-LESS CAMERA RECORDER

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IEC 62712, which is a technical report, has been prepared by technical area 6: Storage media, data structures, equipment and systems, of IEC technical committee 100: Audio, video and multimedia systems and equipment.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting	
100/1781/DTR	100/1839/RVC	

Full information on the voting for the approval of this technical report can be found in the report on voting indicated in the above table.

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- replaced by a revised edition, or
- amended.

INTRODUCTION

During the last few years, various types of tape-less camera recorders with different formats have emerged to the broadcast and professional video market. It is desirable to ensure interoperability and to establish its operation. The stage 0 project "Professional tape-less camera recorder" was established to meet these requirements and the purpose of this project was to study the possibility of standardization of this type of products in the current market. The initial step of study was to understand the current status of the products in the market. (Performance comparison is out of the scope of this Technical Report.)

This Technical Report was created as a summary of the project and includes the result of the product survey along with the possibility of standardization. Although the investigation is limited to the products in the market, it does not obstruct or exclude standardization of future products.

PROFESSIONAL TAPE-LESS CAMERA RECORDER

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1 Scope

This Technical Report summarizes the results of the study on products and market status of professional tape-less camera recorders. This report also includes the guideline on the possibilities of standardizations for professional tape-less camera recorders, including the following components:

- codec;
- file format;
- metadata;
- recording media;
- interface.

NOTE 1 Each professional tape-less camera recorder used for the product survey is defined as "PRODUCT".

NOTE 2 Since each PRODUCT is also defined as a "product series" of each manufacturer, PRODUCT may include two or more models with different product specifications.

NOTE 3 Some of the names described in this report represent a trademark or registered trademark of the respective companies. However, symbols such as TM and ® are omitted in this report.

NOTE 4 The interface specifications investigated in this project were limited to a file transfer or compressed bit stream transfer since this report is focusing on a file-based specification.

NOTE 5 The detail specification of each PRODUCT is shown in Annex A.

2 Result of product survey

2.1 General

In this report, eight types of PRODUCTs for investigation are listed, based on the information given by camera recorder manufacturers.

2.2 Codec

2.2.1 Video codec

Each PRODUCT uses efficient video compression formats such as MPEG-2, MPEG-4 AVC/H.264, JPEG2000 and DV. Since these specifications are defined as international standards of ISO/IEC, they can be referred to as a normative reference. The video compression format of PRODUCT-C is defined as SMPTE standard and is also defined as an IEC standard for digital VTR format. It can therefore also be referred to as a normative reference. Since all the compression formats listed in Table 1 are a well-known codec scheme and widely supported in industry, compatibility is ensured with equipment other than camera recorders.

Table 1 – Video codec

	Compression format	Referred standard	
PRODUCT-A			
PRODUCT-B			
PRODUCT-E		ISO/IEC 13818-2	
PRODUCT-F	MPEG-2 HD		
PRODUCT-G			
PRODUCT-H			
PRODUCT-A		ISO/IEC 13818-2	
PRODUCT-E	MPEG-2 SD		
PRODUCT-F			
PRODUCT-C		ISO/IEC 14496-10	
PRODUCT-D	WIFEG-4 AVC / 11.204		
PRODUCT-F	JPEG2000	ISO/IEC 15444-1	
PRODUCT-A		IEC 61834-2	
PRODUCT-B			
PRODUCT-F	DV		
PRODUCT-G			
	DV Recod 100Mbps	SMPTE ST 370	
	Dased Toolwipps	(IEC 62447-2)	
	DV Based 50Mbps	SMPTE ST 314	
	Dv Dased Joimphs	(IEC 62071-2)	

2.2.2 Audio codec

It is characterized that almost all PRODUCTs listed in Table 2 use uncompressed linear PCM audio for audio codec. Altough a linear PCM specification is not defined in any published standard, linear PCM is also widely supported in many products and compatibility is ensured as well as video codec.

Table 2 – Audio codec

	Compression format	Referred standard
PRODUCT-A		
PRODUCT-B		
PRODUCT-C		
PRODUCT-E	Linear PCM	
PRODUCT-F		
PRODUCT-G		
PRODUCT-H		

As listed in Table 3, PRODUCT-D uses AC-3 format defined in the ATSC standard which cannot be referred to as a normative reference.

	Compression format	Referred standard	
PRODUCT-D	AC-3	ATSC A/52B	

Table 3 – Audio codec for PRODUCT-D

2.3 File format

As a file format, MXF (Material eXchange Format) defined as SMPTE standard is adopted in the PRODUCT listed in Table 4. In order to ensure operational compatibility, several kinds of Operational Patterns are defined in the MXF specification. It is characterized that the camera recorders supporting MXF adopt OP-1a (Operational Pattern-1a) or OP-Atom (Operational Pattern-Atom). In case of shooting materials by a camera recorder, since each taken material is wrapped in an individual clip as file, complex operational patterns are not required. OP-1a is used for wrapping video and audio to a single file to facilitate contents exchange. On the other hand, OP-Atom is used for wrapping video and audio in individual files to facilitate contents editing.

NOTE MXF standards are under revision in SMPTE and, in parallel, also under study for standardization in the IEC TC100/TA6 working group. Since it is confirmed that the MXF specification has been adopted for various types of PRODUCTs, it would be significant to standardize MXF as an IEC standard in order to ensure compatibility among different types of equipment. Therefore, it is desirable to start studying standardization in IEC when primary MXF revision projects in SMPTE finish the revision work.

	File format	Referred standard	
PRODUCT-A		SMPTE ST 377-1,	
		SMPTE ST 378,	
PRODUCT-F	MXF OP-1a	SMPTE ST 379-2,	
		SMPTE ST 380,	
PRODUCT-H		SMPTE ST 381, etc	
		SMPTE ST 377-1,	
PRODUCT-C	MXF OP-Atom	SMPTE ST 379-2,	
		SMPTE ST 381,	
		SMPTE ST 382,	
PRODUCT-E		SMPTE ST 383,	
		SMPTE ST 390, etc	
NOTE SMPTE 377-1/379-2 is a revision of 377M-2004/379-1 that supersedes the previous 377M-2004/379-1. Existing equipment in the market may still reference the older version.			

Table 4 – MXF based PRODUCT list

As listed in Table 5, PRODUCT-B and PRODUCT-G adopt the MP4 file format defined as ISO/IEC standard which can be referred to as a normative reference.

Table 5 – File format of	f PRODUCT-B and PRODUCT-G
--------------------------	---------------------------

	File format	Referred standard
PRODUCT-B	MD4	ISO/IEC 14496-12
PRODUCT-G		ISO/IEC 14496-14

The file formats listed in Table 6 are not defined in any standards' bodies. PRODUCT-B and PRODUCT-G adopt AVI Type 2 file format and PRODUCT-G adopts QuickTime file format.

Although both specifications are not standardized, they are generally disclosed and support various types of codec and metadata.

These file formats are widely supported in the IT industry and considered to ensure compatibility with this type of equipment. In addition, it is known that QuickTime file format is the basis for the MP4 file format.

	File format	Referred standard
PRODUCT-B		not standardized
PRODUCT-G	AVITypez	
PRODUCT-G	QuickTime	not standardized

Table 6 – File format of PRODUCT-B and PRODUCT-G

As listed in Table 7, PRODUCT-D adopts MPEG-2 TS (Transport Stream) as a container of contents. Although MPEG-2 TS specification is defined in ISO/IEC 13818-1, actually MPEG-2 TS is not a file wrapper but a stream definition.

Table 7 – File format of PRODUCT-D

	File format	Referred standard
PRODUCT-D	MPEG-2 TS file	ISO/IEC 13818-1

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2.4 Metadata

Metadata is classified as technical metadata and descriptive metadata. The technical metadata is essential data in order to play back video and audio essences. The descriptive metadata provides additional information of the shooting contents. There are two types of encoding of metadata, the determined data specification defined in each supported file format and the proprietary data specification depending on each manufacturer's PRODUCT specification. Table 8 shows metadata specification examples of MXF based camera recorder.

The technical metadata is defined in each file format specification such as MXF or MP4. Since each PRODUCT supports technical information (in case of MXF, defined as the MXF Structural metadata) required to play back video and audio essences, subsequent equipment can determine the essence format and codec type properly and play back each content.

On the other hand, in case of descriptive metadata, PRODUCTS A, F and H implement the descriptive metadata defined in the MXF standard and other PRODUCTs define a proprietary descriptive metadata scheme according to each PRODUCT specification. Each specification on the proprietary descriptive metadata scheme is not disclosed and there is no compatibility.

As for encoding format of metadata, the KLV (Key Length Value) encoding defined as SMPTE ST 336 standard is supported in the MXF specification.

The other feature clarified in this survey is that each PRODUCT adopts a separate metadata file aiming at operational conveniences. These metadata files are XML (eXtensible Markup Language) encoded in common and XML is standardized in W3C (World Wide Web Consortium). As mentioned above, since a metadata specification of each PRODUCT depends on each PRODUCT specification, there is no compatibility in metadata elements.

In order to ensure compatibility of metadata, it is required to define a common metadata scheme, description format and precise meaning of each element. However, currently only

part of technical metadata defined in each file format as essential elements for decoding is ensured compatibility. Implementation and operation of the descriptive metadata, which is specified as optional, is different in each PRODUCT.

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	Technical metadata	Descriptive metadata	
PRODUCT-A	MXF Structural metadata defined in SMPTE ST 377-1	MXF Descriptive metadata scheme-1 (DMS-1) defined in SMPTE ST 380	
	XML clip metadata	XML clip metadata	
PRODUCT-C	MXF Structural metadata defined in SMPTE ST 377-1	XML clip metadata	
	XML clip metadata		
PRODUCT-E	MXF Structural metadata defined in SMPTE ST 377-1	XML clip metadata	
	XML clip metadata		
PRODUCT-F	MXF Structural metadata defined in SMPTE ST 377-1	MXF Descriptive metadata scheme-1 (DMS-1) defined in SMPTE ST 380	
	XML clip metadata	XML clip metadata	
PRODUCT-H	MXF Structural metadata defined in SMPTE ST 377-1	MXF Descriptive metadata scheme-1 (DMS-1) defined in SMPTE ST 380	
	XML clip metadata	SMPTE ST 385	
		XML clip metadata	

 Table 8 – Metadata specification examples of MXF based camera recorder

2.5 Recording media

The recording media used in PRODUCT is classified as proprietary media developed by each camera recorder manufacture as listed in Table 9 and non proprietary media defined by a certain licensing association as listed in Table 10. Since all the specifications are not disclosed, they cannot be referred to as a normative reference.

	Media name	Kind	Detail specification
PRODUCT-A	Professional Disc	Optical Disc	Not disclosed
PRODUCT-B	SxS card	Flash memory card	Not disclosed
PRODUCT-C	P2 card	Flash memory card	Not disclosed
PRODUCT-E	GF Pack	Flash memory card	Not disclosed
PRODUCT-F	REV Pro	Hard Disk Drive	Not disclosed

	Media name	Kind	Detail specification
PRODUCT-D			
PRODUCT-G	SD/SDHC card	Flash memory card	SD Association
PRODUCT-H	CF card	Flash memory card	CF Association

Table 10 – Non proprietary recording media

2.6 Interface

Each interface specification between camera recorder and the other equipment is defined in a certain industry association or cooperation.

As listed in Table 11, some of the PRODUCTs adopt specifications defined as IEEE standard. An IEEE standard can be referred to as a normative reference in a IEC standard.

	Specification	Referred standard	
	RJ-45 10BASE-T	IEEE802.3	IEEE Association
PRODUCT-A	RJ-45 100BASE-TX	IEEE802.3u	IEEE Association
PRODUCT-F	RJ-45 1000BASE-TX	IEEE802.3ab, 802.3z	IEEE Association
PRODUCT-A			IEEE Association
PRODUCT-C	IEEE 1394 SDF2	IEEE 1594	
PRODUCT-A			
PRODUCT-B		IEC 61883	
PRODUCT-C	IEEE1394 bit stream	(define nacket structure of	
PRODUCT-F		synchronous	IEC standard
PRODUCT-G		transmission)	

 Table 11 – Interface specification-1

As listed in Table 12, almost all PRODUCTs adopt Universal Serial Bus (USB) interface and this specification is defined in USB-IF (USB Implementers Forum). Although USB specifications cannot be referred to as a normative reference in an IEC standard at present, a discussion between TC 100 and USB-IF has started in order to standardize Micro USB battery chargers. Since almost all PRODUCTs adopt an USB interface, it is desirable to study the possibility to standardize the USB interface in IEC TC 100.

Table 12 – Interface specification-2

	Specification	Referred st	andard
PRODUCT-B			
PRODUCT-C			
PRODUCT-D			
PRODUCT-E	Universal Serial Bus	USB 2.0	USB-IF
PRODUCT-F			
PRODUCT-G			
PRODUCT-H			

3 Guideline for standardization

3.1 Summary of current issues

Recording media

Since the specifications of recording media used in each PRODUCT are not disclosed, they cannot be referred to as normative reference.

Specification of PRODUCT-D

The format of PRODUCT-D is widely used for camera recorders but the specification is defined in a certain alliance association and not disclosed in general.

– File format of PRODUCT-B and PRODUCT-G

Since both file formats of PRODUCT-B and PRODUCT-G are not defined in any standard bodies, they cannot be referred to as normative reference.

It is clarified that some specifications cannot be referred to in international standards because they are not publicly available or not defined as a standard. Although it is desirable to standardize such specifications, it depends on the decision of each manufacturer or association whether they wish to disclose the specification or not.

3.2 Proposed guideline for standardization

3.2.1 Product based standardization

In order to define the specification of professional tape-less camera recorders on a product basis, recording media is a fundamental element for the document suite such as a video cassette for a video tape recorder (VTR) standard.

As described in 2.1, however, the fundamental issue is that currently not all the specifications on recording media used for professional tape-less camera recorders are disclosed. The possibility of the product-based standardization therefore depends on whether the specifications of recording media will be publicly available as standards or not.

3.2.2 Essence technology based standardization

Another proposal is based on essence technologies adopted in each professional tape-less camera recorder. File format is one essential element to ensure the interoperability of various types of content between other equipment handling content. For example, since it is confirmed that the MXF file format is widely supported for professional tape-less camera recorders, defining specifications by focusing on the MXF file format is recommended. In this case, the following two possibilities should be considered:

- to standardize the MXF specification in IEC for professional tape-less camera recorders; or
- to develop documents on professional tape-less camera recorders supporting the MXF file format.

A PRODUCT list based on the MXF file format is shown in Table 13. As shown below, since all the specifications adopted in each PRODUCT refer to standardized documents, it is possible to create relevant IEC standards or documents by normatively referencing such source documents.

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Table 13 – PRODUCT list based on MXF and other related technologies

PR	R File format		Metadata		Codec	
OD UCT	Specifica- tion	Referred standard	Specification	Referred standard	Specification	Referred standard
			MXF	SMPTE ST 377-1		
		SMPTE ST 377-1	MXF DMS-1	SMPTE ST 380		
		SMPTE ST 378	Metadata	SMPTE ST 335		
	MXF	SMPTE ST 379-2	structure		MPEG-2 HD/SD	ISO/IEC 13818-2
А	OP-1a	SMPTE ST 380	KLV encoding			IEC 61834-2
		SMPTE ST 381	XML	SMPTE ST 336		
		SMPTE ST 382		W3C Recommendation 28 October 2004		
		SMPTE ST 377-1	MXF	SMPTE ST 377-1		
		SMPTE ST 378	MXF DMS-1	SMPTE ST 380		
		SMPTE ST 379-2	Metadata	SMPTE ST 335	JPEG2000	ISO/IEC 15444-1
-	MXF	SMPTE ST 381	structure		MPEG-2 HD/SD	ISO/IEC 13818-2
Г	OP-1a	SMPTE ST 382	KLV encoding		DV	IEC 61834-2
		SMPTE ST 383	XML	SMPTE ST 336	LPCM	
		SMPTE ST 405		W3C Recommendation		
		SMPTE ST 422		28 October 2004		
		SMDTE ST 377 1	MXF	SMPTE ST 377-1		
		SMPTE ST 377-1	Map SDTI-CP	SMPTE ST 385		
		SMPTE ST 379-2	Metadata	SMPTE ST 335		
н	MXF	SMPTE ST 380	structure		MPEG-2 HD/SD	ISO/IEC 13818-2
	OP-1a	SMPTE ST 381	KLV encoding		LPCM	
		SMPTE ST 382	XML	SMPTE ST 336		
		SMPTE ST 385		W3C Recommendation		
				28 October 2004		
		SMPTE ST 377-1	MXF	SMPTE ST 377-1	DV-Based	SMPTE ST 370
		SMPTE ST 379-2	Metadata	SMPTE ST 335	100Mbps	(IEC 62447-2)
		SMPTE ST 381	dictionary structure		DV-Based	SMPTE ST 314
С		SMPTE ST 382	KLV encoding		compe	(IEC 62071-2)
	OF-Alom	SMPTE ST 300	XML	SMPTE ST 336	MPEG-4	ISO/IEC 14496-10
		SMPTE RP 2008		W3C Recommendation	AVC/H.264	
		SMPTE ST 336		28 October 2004	LPCM	
			MXF	SMPTE ST 377-1		
		SMPTE ST 377-1	Metadata	SMPTE ST 335		
		SMPTE ST 379-2	dictionary structure			
Е	MXF	SMPTE ST 381	KLV encoding		MPEG-2 HD/SD	ISO/IEC 13818-2
	OP-Atom	SMPTE ST 382	XML	SMPTE ST 336	LPCM	
		SMPTE ST 390		w3C		
		SMPIE SI 336		Recommendation 28 October 2004		

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4 Conclusion

This Technical Report provides the results of the survey on existing professional tape-less camera recorder products and also includes a guideline on the possibilities of standardizations for professional tape-less camera recorders.

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As a result of investigating the current situation, it is confirmed that developing IEC documents relevant to professional tape-less camera recorders would be possible by specifying the scope of the standardization. For example, it is possible to standardize essential technologies adopted in professional tape-less camera recorders such as file format and related elements such as codec and metadata. It is desirable to specify essential technologies of professional tape-less camera recorders to ensure compatibility with other equipment on a file basis. In addition, in order to standardize on a product basis, it is necessary that the specification of recording media adopted in professional tape-less camera recorders will be publicly available as standard.

Annex A

PRODUCT list

A.1 List-1: PRODUCT-A, -B

		PRODUCT-A	PRODUCT-B
		Optical Disc	Solid Memory
Recording Media		Professional Disc	SxS memory card
		23,3GB / 50GB	8GB/16GB/32GB
		MPEG-2 HD	MPEG-2 HD
	Specification	Long GOP	Long GOP
		422P@HL	MP@HL
	Bit rate	50Mbps	35Mbps
Video			1920 x 1080
Codeo		1920 x 1080	59,94i/50i/29,97p/25p/23,98p
Codec	Resolution	59,94i/50i/29,97p/25p/23,98p	1440 x 1080
	Frame rate	1280 x 720	59,94i/50i/29,97p/25p/23,98p
		59,94p/50p	1280 x 720
			59,94p/50p/29,97p/25p/23,98p
	Standard	ISO/IEC 13818-2	ISO/IEC 13818-2
		LPCM	LPCM
Audio	Specification	48kHz/16bit, 4ch	48kHz/16bit, 2ch
Codec		(Format 8ch)	(Format 4ch)
	Standard		
	Specification	MPEG-2 HD	MPEG-2 HD
		Long GOP	Long GOP
		MP@HL,H14	MP@H14
Video	Bit rate	35Mbps/25Mbps/18Mbps	25Mbps
Codoo		1440 x 1080	
Codec	Resolution	59,94i/50i/29,97p/25p/23,98p	1440 x 1080
	Frame rate	1280 x 720	59,94i/50i/23,98p(pull-down)
		59,94p/50p/23,98p(pull-down)	
	Standard	ISO/IEC 13818-2	ISO/IEC 13818-2
		L PCM	LPCM
Audio	Specification	48kHz/16bit 4cb	48kHz/16bit, 2ch
Codec			(Format 4ch)
	Standard		
	Specification	MPEG-2	
	opecification	422P@ML	
	Bit rate	50Mbps/40Mbps/30Mbps	
Video		720 x 480	
Codec	Resolution	59,94i	
	Frame rate	720 x 576	
		50i	
	Standard	ISO/IEC 13818-2	
مالمير	Specification	LPCM	
Audio	opecification	48kHz/16, 24bit, 4ch	
Codec	Standard		

		PRODUCT-A	PRODUCT-B
	Specification	DV	DV
	Bit rate	25Mbps	25Mbps
Video		720 x 480	720 x 480
Codec	Resolution	59,94i	59,94i
	Frame rate	720 x 576	720 x 576
		50i	50i
	Standard	IEC 61834-2	IEC 61834-2
A	Onesifientien	LPCM	LPCM
Audio	Specification	48kHz/16bit, 4ch	48kHz/16bit, 4ch
Codec	Standard		
	Specification	MXF OP-1a	MP4
		SMPTE ST 377-1,	
		SMPTE ST 378,	
	Standard	SMPTE ST 379-2,	ISO/IEC 14496-12
File Format	Standard	SMPTE ST 380,	ISO/IEC 14496-14
File Format		SMPTE ST 381	
		SMPTE ST 382	
	Specification		AVI Type2
	opeemeation		(for DV recording only)
	Standard		
		Structural metadata	
		Descriptive metadata	Technical matadata
	Specification	(Time/Date, Comments and other	
		proxy data)	XML Clip metadata
		DMS-1	
Metadata		XML Clip metadata	
		MXF metadata:	MD4 motodoto:
		SMPTE ST 377-1,	
	Standard	SMPTE ST 380	XML Schoma:
	otandara	XML Schema:	W3C Recommendation 28 October
		W3C Recommendation 28 October 2004	2004
	Specification	RJ-45 100BASE-TX	Universal Serial Bus
	Standard	IEEE802.3u	USB 2.0
Interface	Specification	RJ-45 10BASE-T	HDV/DV stream
menace	Standard	IEEE802.3	IEEE 1394
	Specification	Serial Bus Protocol 2	
	Standard	IEEE 1394	

A.2 List-2: PRODUCT-C, -D

		PRODUCT-C	PRODUCT-D
		Solid Memory	Solid Memory
Recording Media		P2 memory card	SDHC memory card
		8GB/16GB/32GB/64GB	4GB/8GB/16GB/32GB
		5.40	
	Specification	D-12 DV Rased 100Mbps	AVC (MPEG-4 Part10 H.264)
	Bit rate	100Mbps	21Mbps/17Mbps/13Mbps/6Mbps
		1280 x 1080	
Video		59,94i/29,97p/23,98p	1920 x 1080
Codec	Resolution	1440 x 1080	59,94i/50i/29,97p/25p/23,98p
	Frame rate	50i/25p	1280 x 720
		960 x 720	59,94p/50p/29,97p/25p/23,98p
		59,94p/50p/29,97p/25p/23,98p	
	Standard	SMPTE ST 370	ISO/IEC 14496-10
		IEC 62447-2	
Audio	Specification	LPCM	AC3
Codec	opeemeation	48kHz/16bit, up to 4ch	48kHz/16bit, 2ch
00000	Standard	-	ATSC A/52B
		AVC-Intra	
	Specification	MPEG-4 AVC/H.264	
		High 4:2:2 Intra Profile	
	Bit rate	100Mbps	
		1920 x 1080	
	Resolution Frame rate	59,94i/50i/29,97p/25p/23,98p	
		1280 x 720	
Video		59,94i/50i/29,97p/25p/23,98p	
Codec		AVC-Intra	
Obucc	Specification	MPEG-4 AVC/H.264	
		High 10 Intra profile	
	Bit rate	50Mbps	
		1440 x 1080	
	Resolution	59,94i/50i/29,97p/25p/23,98p	
	Frame rate	960 x 720	
		59,94i/50i/29,97p/25p/23,98p	
	Standard	ISO/IEC 14496-10	
	One office the	LPCM	
Audio	Specification	48kHz/16bit, 24bit, up to 4ch	
Codec	Standard		
	Stanuaru		
	Specification	DV-Based 50Mbps	
	Ditasts	5014	
	Bit rate	50Mbps	
Video Codec		720 x 480	
	Resolution	59,941	
	Frame rate	/20 X 5/6	
-	Standard		
		SMPTE ST 314	
		IEC 62071-2	

		PRODUCT-C	PRODUCT-D
Audio Codec	Specification	LPCM 48kHz/16bit, up to 4ch	
	Standard		
	Specification	MXF OP-Atom	MPEG-2 TS (file)
File Format	Standard	SMPTE ST 377-1, SMPTE ST 379-2, SMPTE ST 381, SMPTE ST 382, SMPTE ST 383, SMPTE ST 390, SMPTE RP 2008, SMPTE ST 336	ISO/IEC 13818-1
	Specification	XML Clip Metadata	XML Clip metadata
Metadata	Standard	XML Schema: W3C Recommendation 28 October 2004	XML Schema: W3C Recommendation 28 October 2004
Interfece	Specification	Universal Serial Bus	Universal Serial Bus
	Standard	USB 2.0	USB 2.0
menace	Specification	Serial Bus Protocol 2	
i T	Standard	IEEE 1394	

A.3 List-3: PRODUCT-E, -F

PRODUCT-E PRODUCT-F Solid Memory Removable HDD Solid Memory Solid Memory	
Solid Memory Removable HDD Solid Memory Solid Memory	
Solid Memory Solid Memory	
Becording Media	
GF PACK memory pack	rd
16GB/32GB/64GB	ra
4GB/8GB/16GB/32GB/64G	iB
MPEG-2 HD	
Specification Intra Frame JPEG2000	
422P@HL	
Bit rate 100Mbps 100Mbps/75Mbps/50Mbp	S
1920 x 1080 1920 x 1080	
Resolution 59,94i/50i/29,97p/25p/23,98p 59,94i/50i/29,97p/25p/23,9	8p
Frame rate 1280 x 720 1280 x 720	
59,94p/50p 59,94p/50p	
MPEG-2 HD	
Specification Long GOP	
422P@HL	
Video Bit rate 50Mbps	
Codec 1920 x 1080	
Resolution 59,94i/50i/29,97p/25p/23,98p	
Frame rate 1280 x 720	
59,94p/50p	
MPEG-2 JPEG2000	
422P@ML	
Bit rate 50Mbps/40Mbps/30Mbps 50Mbps/40Mbps/30Mbps	
720 x 480 720 x 512	
Resolution 59,94i 59,94i	
Frame rate 720 x 576 720 x 608	
50i 50i	
Standard ISO/IEC 13818-2 ISO/IEC 15444-1	
Audio Specification LPCM LPCM	
48kHz/16bit or 24bit, 4ch 48kHz/24bit, 4ch	
Standard — — —	
MPEG-2 HD	
Specification Intra Frame	
MP@HL/MP@H-14L	
Bit rate 80Mbps/60Mbps	
1920 x 1080 / 1440 x 108	0
Resolution 59,94i/50i/29,97p/25p/23,9	8p
Video Frame rate 1280 x 720	
Codec 59,94p/50p	
MPEG-2 HD	
Specification Long GOP	
MP@HL	
Bit rate 50Mbps	
Resolution 1920 x 1080	
Frame rate 59,94i/50i/29,97p/25p/23,9	8p

		PRODUCT-E	PRODUCT-F
			MPEG-2 HD
	Specification		Long GOP
			MP@H14
	Bit rate		35Mbps/25Mbps
	Resolution		1440 x 1080
	Frame rate		59,94i/50i/29,97p/25p/23,98p
			MPEG-2 HD
	Specification		Long GOP
			MP@HL/MP@H-14L
	Bit rate		50Mbps/35Mbps/18Mbps
	Resolution		1280 x 720
	Frame rate		59,94p/50p
			MPEG-2
	Specification		Intra Frame
			422P@ML
	Bit rate		50Mbps/40Mbps/30Mbps
			720 x 480 / 720 x 512
	Resolution		59,94i
	Frame rate		720 x 576 / 720 x 608
			50i
	Standard		ISO/IEC 13818-2
Audio	Specification		LPCM
Codec			48kHz/24bit, 4ch
	Standard		
	Specification		DV
	Bit rate		25Mbps
Video			720 x 480
Codec	Resolution		59,94i
	Frame rate		720 x 576
			50i
	Standard		IEC 61834-2
Audio	Specification		LPCM
Codec			48kHz/16bit, 4ch
	Standard		
	Specification	MXF OP-Atom	MXF OP-1a
			SMPTE ST 377-1,
		SMPTE ST 377-1,	SMPTE ST 378,
		SMPTE ST 379-2,	SMPTE ST 379-2,
File Format	Standard	SMPTE ST 336,	SMPTE ST 381,
	otandara	SMPTE ST 381,	SMPTE ST 382,
		SMPTE ST 382,	SMPTE ST 383,
		SMPTE ST 390	SMPTE ST 405,
			SMPTE ST 422
-	Specification	XML Clip metadata	Subset of SMPTE ST 380
	•		XML Clip metadata
			MXF metadata:
metadata	Otenderd	XML Schema: W3C Recommendation 28 October 2004	SMPTE ST 380
	Standard		XML Schema:
		2004	W3C Recommendation 28 October 2004
Interface	Specification	Universal Serial Bus	Universal Serial Bus

		PRODUCT-E	PRODUCT-F
	Standard	USB 2.0	USB 2.0
	Specification		HDV/DV stream
	Standard		IEEE 1394
	Specification		RJ-45 1000BASE-TX
	Standard		IEEE 802.3ab, IEEE 802.3z

A.4 List-4: PRODUCT-G, -H

		PRODUCT-G	PRODUCT-H
Recording Media		Solid Memory	Solid Memory
		SDHC memory card	Compact Flash card
		4GB/8GB/16GB/32GB	4GB/8GB/16GB/32GB/64GB
		MPEG-2 HD	MPEG-2 HD
	Specification	Long GOP	Long GOP
		MP@HL	422@HL
	Bit rate	35Mbps	50Mbps
		1920 x 1080	
		59,94i/50i/29,97p/25p/23,98p	1920 x 1080
	Resolution	1440 x 1080	59,94i/50i/29,97p/25p/23,98p
	Frame rate	59,94i/50i	1280 x 720
		1280 x 720	59,94p/50p/29,97p/25p/23,98p
		59,94p/50p/29,97p/25p/23,98p	
		MPEG-2 HD	MPEG-2 HD
	Specification	Long GOP	Long GOP
Video		MP@H14	MP@HL
Codec	Bit rate	25Mbps	35Mbps
			1920 x 1080
	Resolution	1440 x 1080	59,94i/50i/29,97p/25p/23,98p
	Frame rate	59,94i/50i	1280 x 720
			59,94p/50p/29,97p/25p/23,98p
		MPEG-2 HD	MPEG-2 HD
	Specification	Long GOP	Long GOP
		MP@HL, MP@H14	MP@H14
	Bit rate	19Mbps	25Mbps
	Resolution	1280 x 720	1440 x 1080
	Frame rate	59,94p/50p/29,97p/25p/23,98p	59,94i/50i/29,97p/25p/23,98p
	Standard	ISO/IEC 13818-2	ISO/IEC 13818-2
	Crestification	LPCM	LPCM
Audio	Specification	48kHz/16bit, 2ch	48kHz/16bit, 2ch
Codec	Standard		
	Specification	DV	
	Bit rate	25Mbps	
Video		720 x 480	
Codec	Resolution	59,94i	
	Frame rate	720 x 576	
		50i	
	Standard	IEC 61834-2	
Audio	Coolfication	LPCM	
Codec	Specification	48kHz/16bit, 4ch	

		PRODUCT-G	PRODUCT-H
	Standard		
File Format	Specification	QuickTime	MXF OP-1a
	Standard	-	SMPTE ST 377-1,
			SMPTE ST 378,
			SMPTE ST 379-2,
			SMPTE ST 380,
			SMPTE ST 381,
			SMPTE ST 382,
			SMPTE ST 385
	Specification	MP4	
	Standard	ISO/IEC 14496-12	
	Standard	ISO/ISC 14496-14	
	Specification	AVI Type2	
		(for DV recording only)	
	Standard		
Metadata	Specification	XML Clip Metadata	Camera Metadata (Stored in SMPTE ST 385 System Item),
			XML Clip Metadata
	Standard	XML Schema: W3C Recommendation 28 October 2004	MXF metadata:
			SMPTE ST 385
			XML Schema:
			W3C Recommendation 28 October 2004
Interface	Specification	Universal Serial Bus	Universal Serial Bus
	Standard	USB 2.0	USB 2.0
	Specification	HDV/DV stream	
	Standard	IEEE 1394	

Bibliography

IEC 61834-2:1998, Recording – Helical-scan digital video cassette recording system using 6,35 mm magnetic tape for consumer use (525-60, 625-50, 1125-60 and 1250-50 systems) – Part 2: SD format for 525-60 and 625-50 systems

IEC 61883 (all parts), Consumer audio/video equipment – Digital interface

IEC 62071-2:2005, Helical-scan compressed digital video cassette system using 6,35 mm magnetic tape – Format D-7 – Part 2: Compression format

IEC 62447-2:2007, Helical-scan compressed digital video cassette system using 6,35 mm magnetic tape – Format D-12 – Part 2: Compression format

ISO/IEC 13818-1:2007, Information technology – Generic coding of moving pictures and associated audio information: Systems

ISO/IEC 13818-2:2000, Information technology – Generic coding of moving pictures and associated audio information: Video

ISO/IEC 14496-10:2010, Information technology – Coding of audio-visual objects – Part 10: Advanced Video Coding

ISO/IEC 14496-12:2008, Information technology – Coding of audio-visual objects – Part 12: ISO base media file format

ISO/IEC 14496-14:2003, Information technology – Coding of audio-visual objects – Part 14: MP4 file format

ISO/IEC 15444-1:2004, Information technology – JPEG 2000 image coding system: Core coding system

ATSC A/52B, Digital Audio Compression (AC-3) (E-AC-3) Standard, Rev. B

SMPTE ST 314:2005, Television – Data Structure for DV-Based Audio, Data and Compressed Video – 25 and 50 Mb/s

SMPTE ST 335:2001, Television – Metadata Dictionary Structure

SMPTE ST 336:2007, Data Encoding Protocol Using Key-Length-Value

SMPTE ST 370:2006, Television – Data Structure for DV-Based Audio, Data and Compressed Video at 100 Mb/s 1080/60i, 1080/50i, 720/60p, 720/50p

SMPTE ST 377-1:2009, Material Exchange Format (MXF) – File Format Specification

SMPTE ST 378:2004, Television – Material Exchange Format (MXF) – Operational Pattern 1a (Single Item, Single Package)

SMPTE ST 379-2:2010, Television – Material Exchange Format (MXF) – MXF Constrained Generic Container

SMPTE ST 380:2004, Television – Material Exchange Format (MXF) – Descriptive Metadata Scheme-1 (Standard, Dynamic)

SMPTE ST 381:2005, Television – Material Exchange Format (MXF) – Mapping MPEG Streams into the MXF Generic Container (Dynamic)

SMPTE ST 382:2007, Material Exchange Format – Mapping AES3 and Broadcast Wave Audio into the MXF Generic Container

SMPTE ST 383:2008, Television – Material Exchange Format (MXF) – Mapping DV-DIF Data to the MXF Generic Container

SMPTE ST 385:2004, Television – Material Exchange Format (MXF) – Mapping SDTI-CP Essence and Metadata into the MXF Generic Container

SMPTE ST 390:2004, Television – Material Exchange Format (MXF) – Specialized Operational Pattern "Atom" (Simplified Representation of a Single Item)

SMPTE ST 405:2006, Television – Material Exchange Format (MXF) – Elements and Individual Data Items for the MXF Generic Container System Scheme 1

SMPTE ST 422:2006, Material Exchange Format – Mapping JPEG 2000 Codestreams into the MXF Generic Container

SMPTE RP 2008:2008, Material Exchange Format – Mapping AVC Streams into the MXF Generic Container

IEEE 802.3-2008, IEEE Standard for Local and Metropolitan Area Networks – Specific requirements – Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications

IEEE 1394-2008, IEEE Standard for a High-Performance Serial Bus

USB 2.0, Universal Serial Bus Specification Revision 2.0

Extensible Markup Language (XML) Schema, W3C Recommendation 28 October 2004

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