



AMWA Specification

AMWA Application Specification

AS-10 MXF for Production

Version 1.1

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Executive summary

AS-10 is a MXF file format for typical end to end production workflows including camera acquisition, server acquisition, editing, play-out, digital distribution and archive. AS-10 is compatible with existing MXF based systems & devices that have been deployed. In addition to this specification a reference implementation (file creator, validator, golden files) are available to AMWA members.

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NOTES – The user's attention is called to the possibility that implementation and compliance with this specification may require use of subject matter covered by patent rights. By publication of this specification, no position is taken with respect to the existence or validity of any claim or of any patent rights in connection therewith. The AMWA, including the AMWA Board of Directors, shall not be responsible for identifying patents for which a license may be required by an AMWA specification or for conducting inquiries into the legal validity or scope of those patents that are brought to its attention.

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1 Scope

This document describes a subset of the MXF format to use for broadcast production workflows from capture and ingest through edit and playout to archive and fulfillment. AS-10 utilizes a single file format originating from Sony XDCAM HD RDD9 that can be used by all production workflow components without the need to transcode or rewrap.

2 Conformance language

Normative text is text that describes elements of the design that are indispensable or contains the conformance language keywords: "shall", "should", or "may". Informative text is text that is potentially helpful to the user, but not indispensable, and can be removed, changed, or added editorially without affecting interoperability. Informative text does not contain any conformance keywords.

All text in this document is, by default, normative, except: the Introduction, any section explicitly labeled as "informative" or individual paragraphs that start with "Note:"

The keywords "shall" and "shall not" indicate requirements strictly to be followed in order to conform to the document and from which no deviation is permitted.

The keywords "should" and "should not" indicate that, among several possibilities, one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required; or that (in the negative form) a certain possibility or course of action is deprecated but not prohibited.

The keywords "may" and "need not" indicate courses of action permissible within the limits of the document.

The keyword "reserved" indicates a provision that is not defined at this time, shall not be used, and may be defined in the future. The keyword "forbidden" indicates "reserved" and in addition indicates that the provision will never be defined in the future.

A conformant implementation according to this document is one that includes all mandatory provisions ("shall") and, if implemented, all recommended provisions ("should") as described. A conformant implementation need not implement optional provisions ("may") and need not implement them as described.

Unless otherwise specified, the order of precedence of the types of normative information in this document shall be as follows: Normative prose shall be the authoritative definition; Tables shall be next; followed by formal languages; then figures; and then any other language forms.

3 Reference documents

The following standards contain provisions that, through reference in this text, constitute provisions of this recommended practice. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this recommended practice are encouraged to investigate the possibility of applying the most recent edition of the standards indicated below.

SMPTE RDD 9:2013, MXF Interoperability Specification of Sony MPEG Long GOP Products
SMPTE ST 298:2009, Universal Labels for Unique Identification of Digital Data
SMPTE ST 326:2000, Television — SDTI Content Package Format (SDTI-CP)
SMPTE ST 331:2011, Element and Metadata Definitions for the SDTI-CP
SMPTE ST 377-1:2011, 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 379-1:2009, Material Exchange Format (MXF) — MXF Generic Container
SMPTE ST 381-1:2005, Television — Material Exchange Format (MXF) — Mapping MPEG Streams into the MXF Generic Container
SMPTE ST 382:2007, Material Exchange Format (MXF) — Mapping AES3 and Broadcast Wave Audio into the MXF Generic Container
SMPTE ST 385:2012, Television — Material Exchange Format (MXF) — Mapping SDTI-CP Essence and Metadata into the MXF Generic Container

4 Acronyms and Abbreviations

AS-10: AMWA AS-10 MXF for Production

UL: SMPTE ST 298:2009 Universal Label

DMS: Descriptive Metadata Scheme

DM: Descriptive Metadata

DM Segment: An MXF structure used to generically contain Descriptive Metadata on a track. See ST 377-1:2011.

KL V Fill: Refers to the well-defined means of inserting empty, "fill", data in an MXF file. See ST 377-1:2011.

DMS Scheme Label: The value stored in an MXF file's Preface::DMSSchemes property. See EG 42:2004.

Shim: An application specification Constraint set that constrains the AS-10 general specification in order to tailor the general specification for a specific purpose.

5 Descriptors

The following descriptors and legal variants shall be supported with AS-10:

Property	Value	Format, Bitrate, System frequency	Comment
Sample Rate	00 00 ea 60 00 00 03 e9	59.94p	
	00 00 00 32 00 00 00 01	50p	
	00 00 75 30 00 00 03 e9	59.94i, 29.97p	
	00 00 00 19 00 00 00 01	50i, 25p	
	00 00 5d c0 00 00 03 e9	23.98p	
Essence Container	06 0e 2b 34 04 01 01 02 0d 01 03 01 02 04 60 01		GC MPEG ES FrameWrap
SignalStandard	04	HD420 1440x1080, 23.98p/25p/29.97p/50i/59.94i HD420 1440x540, 23.98p/25p/29.97p HD422 1920x1080, 23.98p/25p/29.97p/50i/59.94i	04: SMPTE 274M (1125 line)
	05	HD420 1280x720, 50p/59.94p HD422 1280x720, 23.98p/25p/29.97p/50p/59.94p	05: SMPTE 296M (750 line progressive)
FrameLayout	00	23.98p/25p/29.97p/50p/59.94p	00: FULL_FRAME (progressive)
	01	50i/59.94i	01: SEPARATE_FIELDS (interlaced)
StoredWidth	00 00 05 00	HD420 1280x720, 23.98p/50p/59.94p HD422 1280x720, 23.98p/25p/29.97p/50p/59.94p	1280
	00 00 05 a0	HD420 1440x1080, 23.98p/25p/29.97p/50i/59.94i HD420 1440x540, 23.98p/25p/29.97p	1440
	00 00 07 80	HD422 1920x1080, 23.98p/25p/29.97p/50i/59.94i	1920
StoredHeight	00 00 02 20	HD420 1440x1080, 50i/59.94i HD420 1440x540, 23.98p/25p/29.97p HD422 1920x1080, 50i/59.94i	544
	00 00 02 d0	HD420 1280x720, 23.98p/50p/59.94p HD422 1280x720, 23.98p/25p/29.97p/50p/59.94p	720
	00 00 04 40	HD420 1440x1080, 23.98p/25p/29.97p HD422 1920x1080, 23.98p/25p/29.97p/50p/59.94p	1088
StoredF2Offset	00 00 00 00		
SampledWidth	00 00 05 00	HD420 1280x720, 23.98p/50p/59.94p HD422 1280x720, 23.98p/25p/29.97p/50p/59.94p	1280

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	00 00 05 a0	HD420 1440x1080, 23.98p/25p/29.97p/50i/59.94i HD420 1440x540, 23.98p/25p/29.97p	1440
	00 00 07 80	HD422 1920x1080, 23.98p/25p/29.97p/50i/59.94i	1920
SampledHeight	00 00 02 1c	HD420 1440x1080, 50i/59.94i HD420 1440x540, 23.98p/25p/29.97p HD422 1920x1080, 50i/59.94i	540
	00 00 02 d0	HD420 1280x720, 23.98p/50p/59.94p HD422 1280x720, 23.98p/25p/29.97p/50p/59.94p	720
	00 00 04 38	HD420 1440x1080, 23.98p/25p/29.97p HD422 1920x1080, 23.98p/25p/29.97p/50p/59.94p	1080
SampledXOffset	00 00 00 00		
SampledYOffset	00 00 00 00		
DisplayHeight	00 00 02 1c	HD420 1440x1080, 50i/59.94i HD420 1440x540, 23.98p/25p/29.97p HD422 1920x1080, 50i/59.94i	540
	00 00 02 d0	HD420 1280x720, 23.98p/50p/59.94p HD422 1280x720, 23.98p/25p/29.97p/50p/59.94p	720
	00 00 04 38	HD420 1440x1080, 23.98p/25p/29.97p HD422 1920x1080, 23.98p/25p/29.97p/50p/59.94p	1080
DisplayWidth	00 00 05 00	HD420 1280x720, 23.98p/50p/59.94p HD422 1280x720, 23.98p/25p/29.97p/50p/59.94p	1280
	00 00 05 a0	HD420 1440x1080, 23.98p/25p/29.97p/50i/59.94i HD420 1440x540, 23.98p/25p/29.97p	1440
	00 00 07 80	HD422 1920x1080, 23.98p/25p/29.97p/50i/59.94i	1920
DisplayXOffset	00 00 00 00		
DisplayYOffset	00 00 00 00		
DisplayF2Offset	00 00 00 00		
Aspect Ratio	00 00 00 10 00 00 00 09		
VideoLineMap	00 00 00 02 00 00 00 04 00 00 00 15 00 00 02 48	HD420 1440x1080, 50i/59.94i HD422 1920x1080, 50i/59.94i	(21, 584) : Interlace
	00 00 00 02 00 00 00 04 00 00 00 1A 00 00 00 00	HD420 1280x720, 23.98p/50p/59.94p HD422 1280x720, 23.98p/25p/29.97p/50p/59.94p	(26) : Progressive 720p
	00 00 00 02 00 00 00 04 00 00 00 2a 00 00 00 00	HD420 1440x1080, 23.98p/25p/29.97p HD420 1440x540, 23.98p/25p/29.97p HD422 1920x1080, 23.98p/25p/29.97p/50p/59.94p	(42) : Progressive 1080p, 540p
CaptureGamma	06 0e 2b 34 04 01 01 01 04 01 01 01 01 02 00 00		ITU-R BT.709 transfer characteristic
ImageAlignmentOffset	00 00 00 00		
ImageStartOffset	00 00 00 00		
ImageEndOffset	00 00 00 00		
FieldDominance	01		
Picture Essence Coding	06 0e 2b 34 04 01 01 03 04 01 02 02 01 03 03 00	HD420 1440x1080, 17.5M/35M HD420 1280x720, 25M/35M	MP@HL Long GOP
	06 0e 2b 34 04 01 01 08 04 01 02 02 01 05 03 00	HD420 1440x1080, 25M	MP@H-14 Long GOP
	06 0e 2b 34 04 01 01 03 04 01 02 02 01 04 03 00	HD422 1920x1080, 50M HD422 1280x720, 50M	422P@HL Long GOP

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	06 0e 2b 34 04 01 01 03 0e 06 41 02 01 03 03 01	HD420 1440x540, 8.75M/17.5M (Over Crank of HD420 1440x1080, 17.5M/35M)	MP@HL Long GOP Over Crank
	06 0e 2b 34 04 01 01 03 0e 06 41 02 01 05 03 01	HD420 1440x540, 12.5M (Over Crank of HD420 1440x1080, 25M)	MP@H-14 Long GOP Over Crank
	06 0e 2b 34 04 01 01 03 0e 06 41 02 01 04 03 01	HD422 1920x540, 25M (Over Crank of HD422 1920x1080, 50M)	422P@HL Long GOP Over Crank
ComponentDepth	00 00 00 08		8bit
HorizontalSubsampling	00 00 00 02		4:2:0, 4:2:2
VerticalSubsampling	00 00 00 01	HD422	4:2:2
ColorSiting	00	HD422	4:2:2
	06	HD420 (MXF Version 1.3)	
	ff	HD420 (MXF Version 1.2)	
ReversedByteOrder	00		FALSE
PaddingBits	00 00		
BlackRefLevel	00 00 00 10		16
WhiteRefLevel	00 00 00 eb		235
ColorRange	00 00 00 e1		225 (8 bit)
SingleSequence	00		FALSE
	01		TRUE
ConstantBframe	00		FALSE
	01		TRUE
CodedContentType	01	23.98p/25p/29.97p/50p/59.94p	01: Progressive
	02	50i/59.94i	02: Interlaced
LowDelay	00		FALSE
ClosedGOP	00		Open GOP
	01		Closed GOP
IdenticalGOP	00		FALSE
	01		TRUE
MaxGOP	00 0c	23.98p/25p/50i/50p/59.94p	
	00 0f	29.97p/59.94i	
BPictureCount	00 02		
BitRate	01 0b 07 60	HD420 1440x1080, 17.5M	
	01 7d 78 40	HD420 1440x1080, 25M HD420 1280x720, 25M	
	02 16 0e c0	HD420 1440x1080, 35M HD420 1280x720, 35M	
	02 fa f0 80	HD422 1920x1080, 50M HD422 1280x720, 50M	
	00 85 83 b0	HD420 1440x540, 8.75M (Over Crank of HD420 1440x1080, 17.5M)	
	00 be bc 20	HD420 1440x540, 12.5M (Over Crank of HD420 1440x1080, 25M)	

	01 0b 07 60	HD420 1440x540, 17.5M (Over Crank of HD420 1440x1080, 35M)	
ProfileAndLevel	44	HD420 1440x1080, 17.5M/35M HD420 1280x720, 25M/35M HD420 1440x540, 8.75M/17.5M (Over Crank of HD420 1440x1080, 17.5M/35M)	MP@HL
	46	HD420 1440x1080, 25M HD420 1440x540, 12.5M (Over Crank of HD420 1440x1080, 25M)	MP@H-14
	82	HD422 1920x1080, 50M HD422 1280x720, 50M HD422 1920x540, 25M (Over Crank of HD422 1920x1080, 50M)	422P@HL

6 Edit While Ingest (file is growing) and Spanning

Two key functions of MXF media in a production workflow are a Growing File and Spanning Files.

Section 6.1 defines the metadata of a growing file, that enables decoders to access the file while it is growing. Section 6.2 defines the spanning files function, that enables encoders to divide a continuous recording into a series of smaller files, which solves file size limitations.

The methods described are complementary – either or both can be used as needed.

6.1 Growing File

While a file is growing and is still being written, properties of the metadata shall be as follows:

In the Header Partition, the status of the partition shall be Open and Incomplete, the Footer Partition property is set to 0, and the Duration values in the Header Metadata are set to -1.

In the Body Partitions, the status of the partition should be Open and Complete, and the Footer Partition property is set to 0.

Note that while a file is growing, the Footer PartitionPack and the RandomIndexPack (RIP) will not yet have been written.

After a file is finished (no longer growing), and after all final IndexTable Segments are completed, a Footer Partition with a Closed and Complete FooterPartitionPack shall be written, with a FooterPartition property set to the correct value. The Footer Partition shall include a copy of the Header Metadata, with the conclusive Duration of the file.

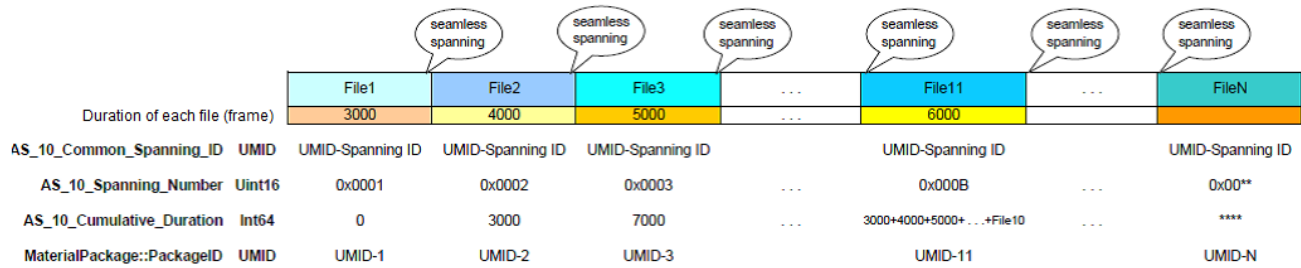
After the Footer PartitionPack is written, a complete RandomIndexPack (RIP) shall be written.

It is not necessary to modify the Header Partition after a file is finished (no longer growing), and after the Footer Partition Pack is written, if desired, the Header may be rewritten as a Closed and Complete Header, with the correct value of the FooterPartition property and with updated Header Metadata including the conclusive Duration.

It is not necessary to modify the BodyPartitionPacks after a file is finished (no longer growing), and after the Footer Partition Pack is written, but if desired, Body PartitionPacks may be rewritten with Closed and Complete status and with the correct value of the FooterPartition property.

6.2 Spanned Files

A single continuous recording may be contained within a set of Spanned Files, as shown in the diagram below:



When Spanning is in use, every file in the set shall include a DMS-AS_10::AS_10_Common_Spanning_ID property, whose value is a basic UMID which shall have the same value for every file in the set (shown as UMID-SpanningID in the above diagram).

When Spanning is in use, every file in the set shall include a DMS-AS_10::AS_10_Cumulative_Duration property, whose value is a 64-bit integer containing the sum of the durations of all preceding files in the set, measured in EditUnits. For example, for File 3 with Spanning Number 3, the Cumulative Duration equals the duration of File 1 plus the duration of File 2.

The files in a set are numbered sequentially using the DMS_AS_10::AS_10_Spanning_Number property. The Spanning Number of the first file in the set shall be set to 1. Spanning Number 0 shall not be used.

When Spanning is not in use, the DMS-AS_10 instance may still be present, and the AS_10_Spanning_Number property shall be set to zero. Decoders shall ignore the AS_10_Common_Spanning_ID and AS_10_Cumulative_Duration properties.

Every file in the set except the last one shall be marked Closed and Complete in the Footer Partition, and the duration of the MaterialPackage shall equal the duration of the FilePackage which shall equal the duration of the essence (excluding any pre-charge).

When Spanning is used in combination with a Growing File, the metadata of the last file (File N) in the set shall be processed as for a Growing File (see 6.1 above). After File N is finished (no longer growing), and after the Footer Partition Pack is written, the Header should be rewritten as a Closed and Complete Header, with the correct value of the FooterPartition property and with updated Header Metadata including the conclusive Duration of File N. If the recording continues thereafter, encoders will start a new file (File N+1).

7 Descriptive Metadata Requirements

AS-10 "MXF for Production" does not require Descriptive Metadata; however, Descriptive Metadata may be useful as part of a production workflow and should be inserted into the file as outlined in this section.

AS-10 metadata shall be encoded using a dedicated Descriptive Metadata track that is added to the MXF Material Package in the MXF file in accordance with SMPTE ST 377-1:2011 and SMPTE EG 42:2004. The descriptive metadata shall contain a DMS_AS_10_Framework object. The presence of the DMS_AS_10_Framework metadata object in the file shall be identified by adding a DMS_AS_10_Scheme label to the file's MXF Preface:DMSchemes property.

7.1 Metadata Scheme Definitions

An AS-10 Metadata Scheme Definition shall fully specify the following: i) the DM Scheme Label that identifies the scheme, ii) the scheme's specialized DM Framework, iii) the individual metadata items that are contained by the scheme's specialized DM Framework.

Shims may be used to include or add Descriptive Metadata to the file in accordance with AS-10 Descriptive Metadata requirements. The AS-10 metadata scheme used in the file shall be identified by the use of a DM Scheme label contained in the MXF Preface::DMSchemes property. Each metadata scheme has an associated specialized DM Framework that shall be contained by a dedicated Descriptive Metadata Track.

All keys used to identify AS-10 DM Scheme labels, this associated specialized DM Framework, and individual metadata items, shall be SMPTE ST 298:2009 Universal Labels and shall be published in the SMPTE metadata registry (<http://www.smp-te-ra.org>).

7.2 Redundant Metadata

Custom metadata included in an AS-10 file should not duplicate metadata elements that are already carried in MXF Structural Metadata. In the event of disagreement between redundant, duplicate, metadata items present in an AS-10 MXF file, decoders should accord the highest priority to MXF Structural Metadata, and lowest priority to the redundant shim-specified metadata.

7.3 KLV Fill

To provide for addition of Descriptive Metadata, applications should include a KLV Fill of at least 8 kilobytes in length following the header partition when initially creating an AS-10 file.

7.4 Static Descriptive Metadata Requirements

AS-10 files shall conform to the descriptive metadata track structure described by SMPTE EG 42:2004. AS-10 descriptive metadata tracks shall use the following subset of the MXF structure described in SMPTE EG 42:2004:

- A Static Track contained by the single Material Package in the AS-10 MXF file.
- A Sequence object contained by the Static Track.
- A single DM Segment object contained by the Sequence.
- A DM Framework instance contained by the DM Segment. The DM Framework instance type shall map to one of the schemes defined in Preface::DMSchemes.

7.5 Detailed Metadata Definitions

The following table specifies a DM scheme and framework that is provided as part of this specification.

DM Scheme	Type	UL	Description
DMS_AS_10_Core	DM_Scheme	060e2b34.04010101.0d010701.0a010000	AS-10 Metadata Scheme
DMS_AS_10_Core_Framework	DM_Framework	060e2b34.02530101.0d010701.0a010100	AS-10 Metadata Framework set key

The following table specifies the AS-10 Framework that is provided as part of this specification.

Name	Type	Length	Req	UL	Description
DMS_AS_10_Core_Framework	DM_Framework	16	Required	060e2b34 02530101 0d010701	AS_10 Metadata Framework Set

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				0a010100	
Length	BER Length	Variable	Required		Value Length
Instance UID	UUID	16	Required		
Generation UID	UUID	16	Optional		
AS_10_Shim_Name	UTF16String	Variable	Required	060e2b34 01010101 0d010701 0a010101	The name of the AS_10 shim
AS_10_Type	UTF16String	Variable	Optional	060e2b34 01010101 0d010701 0a010102	Type that describes the production category of clip
AS_10_Main_Title	UTF16String	Variable	Optional	060e2b34 01010101 0d010701 0a010103	Main title associated with the clip
AS_10_Sub_Title	UTF16String	Variable	Optional	060e2b34 01010101 0d010701 0a010104	Sub title associated with the clip
AS_10_Title_Description	UTF16String	Variable	Optional	060e2b34 01010101 0d010701 0a010105	Title description associated with the clip
AS_10_Organization_Name	UTF16String	Variable	Optional	060e2b34 01010101 0d010701 0a010106	The name of a Organization
AS_10_Person_Name	UTF16String	Variable	Optional	060e2b34 01010101 0d010701 0a010107	The name of a Person
AS_10_Location_Description	UTF16String	Variable	Optional	060e2b34 01010101 0d010701 0a010108	The text description of a location
AS_10_Common_Spanning_ID	UMID	32	Optional	060e2b34 01010101 0d010701 0a010109	UMID for the total spanning clips
AS_10_Spanning_Number	UInt16	2	Optional	060e2b34 01010101 0d010701 0a01010a	Identifier for the spanning number (1 st clip: 00 01)
AS_10_Cumulative_Duration	Position (Int64)	8	Optional	060e2b34 01010101 0d010701 0a01010b	Cumulative Duration of preceding spanning clips in this set (spanning number 0 up to this-1), in Edit Units

8 Shim

8.1 Shim identifier

AS-10 shims shall specify a value, as described, for each of the following shim parameters. Shims describe additional constraints that make sense within the context of the general AS-10 requirements. A shim may describe constraints that tighten the conformance language that appears in the general specification (e.g. change should to shall).

Shim parameter	Description
format	Sony mpg format values can be either "HD" or "HD422"
video_coding	Refers to the MPEG-2 profile and level, values can be "MP@HL" or "422P@HL"
color_sample_ratio	Refers to video sample rate with values of either, "4:2:0" or "4:2:2"
frame_size	Video frame size which can be one of "1440x1080", "1280x720", "1920x1080"
audio_coding	Refers to a value which combines <i>audio channels/bit depth/sample rate</i> and can be one of "PCM 2 ch/16 bit/48kHz", "PCM 4 ch/16 bit/48 kHz", "PCM 8 ch/16 bit/48 kHz", "PCM 4 ch/24 bit/48 kHz"
bit_rate	Video bit rate one of "18_VBR", "25_CBR", "35_VBR", "50_CBR"
Shim Name	The value of the shim name property

8.2 Shims – Parameters and Values

AS-10 CNN Shim Specification

Shim parameter	Shim Value
format	HD
video_coding	MP@HL
color_sample_ratio	4:2:0
frame_size	1440x1080
audio_coding	PCM 4 ch/16 bit/48 kHz
bit_rate	35_VBR
Shim Name	"CNN_HD_2012"

AS-10 NRK Shim Specification

Shim parameter	Shim Value
format	HD422
video_coding	422P@HL
color_sample_ratio	4:2:2
frame_size	1920x1080
audio_coding	PCM 8 ch/16 bit/48 kHz
bit_rate	50_CBR
Shim Name	"NRK_HD_2012"

AS-10 CANAL Shim Specification

Shim parameter	Shim Value
format	HD422
video_coding	422P@HL
color_sample_ratio	4:2:2
frame_size	1920x1080
audio_coding	PCM 8 ch/24 bit/48 kHz
bit_rate	50_CBR
Shim Name	"HIGH_HD_2014"

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AS-10 JVC Shim Specification

Shim parameter	Shim Value
format	HD
video_coding	One of: "MP@H-14"(25_CBR), "MP@HL"(35_VBR)
color_sample_ratio	4:2:0
frame_size	1440x1080
audio_coding	PCM 2 ch/16 bit/48 kHz
bit_rate	One of: "25_CBR", "35_VBR"
Shim Name	One of: "JVC_HD_35_VBR_2012", "JVC_HD_25_CBR_2012"