

**SONY** HANDYCAM®

AVCHD™ Technology Handbook



Full HD  
1080

The world's  
most powerful  
HD experience.

AVCHD

# AVCHD™ format.

Long ago, televisions could only be used to watch broadcasts.

Then Sony helped transform the home entertainment landscape by inventing, co-inventing and spearheading a slew of innovations, including DVD players, videogames and the world's first consumer camcorder.

Today, it's no surprise that the boom in High Definition has inspired Sony to create HD video disc players, HD videogames and HD camcorders.

Now Sony is proud to introduce the world's first consumer camcorder to capture High Definition onto a built-in hard disk drive and the world's first to record HD onto a 3-inch (8-cm) DVD!\* Welcome to the AVCHD format.



**AVCHD™ format.** While the HDV™ format records high definition onto MiniDV cassette tapes, the market was open for a system that recorded HD onto random-access nonlinear media such as 3-inch (8-cm) DVDs, hard disks and flash memory cards. It was for this reason that Matsushita Electric Industrial Co. (Panasonic) and Sony Corporation created the AVCHD format.



# AVCHD™ format benefits.

**Full HD 1080 picture.** While the AVCHD format can support a variety of video standards, Sony has chosen Full HD 1080, with 1440 pixels horizontal x 1080 pixels vertical. The result is a picture with five times as much detail as Standard Definition video.



**Dolby® Digital surround sound.** To enhance the you-are-there realism of your home video sound tracks, the AVCHD system supports Dolby Digital 5.1-channel surround sound. Because this is the same surround sound system used in DVDs and HDTV broadcasting, the sound is compatible with millions of existing home theater systems.



**Instant Access.** While tape is an excellent recording medium, finding a specific clip on a tape means time-consuming fast forward and rewind. Shooting onto tape can also mean accidentally recording over your precious memories. AVCHD media is different. Thumbnail pictures let you access a recorded scene instantly, simply by pointing and clicking. And nonlinear recording means you never need to “cue” a tape to the blank area. The camcorder finds the next unrecorded area automatically.

**Efficient MPEG-4 AVC / H.264 compression.** This is more than twice as efficient as conventional, MPEG-2 compression. So you get a spectacular Full HD 1080 picture, while using similar bitrates and getting similar recording times to a Standard Definition camcorder!

## **Playback on compatible Blu-ray Disc™ players and PLAYSTATION®3 consoles.**

In addition to playing back in the camcorder, DVDs recorded in the AVCHD format will also play back on the new generation of Sony Blu-ray Disc players. The High Definition successor to DVD, Blu-ray Disc is supported by the overwhelming majority of consumer electronics companies, most movie studios and many of the top names in PCs. Blu-ray Disc technology is also built into the PLAYSTATION®3 computer entertainment system, which will also play AVCHD format camcorder DVDs. (Playback on all home Blu-ray Disc players and PLAYSTATION®3 consoles is not guaranteed.)

**PC friendly.** DVD and hard disk are extremely well suited for playback, backup and editing on a compatible PC. For example, you can backup the hard drive camcorder to your PC, connecting via USB 2.0 interface. (Not all products with USB 2.0 connector may communicate with each other due to chipset variations.) PC playback of AVCHD hard drive or DVD content is also possible using the application software supplied with the camcorder. And many third-party editing software companies have already expressed their interest in supporting the AVCHD format in the same way they have supported the HDV format.



# AVCHD™ format specifications.

For maximum flexibility, the AVCHD format supports both 1080- and 720-line High Definition as well as Standard Definition video.

	AVCHD, HD Mode		AVCHD, SD Mode		HDV 1080 (for comparison)
Picture Format	1080/60i	720/60p	480/60i	576/50i	1080/60i
	1080/50i	720/50p			1080/50i
	1080/24p	720/24p			1080/24p (option)
Number of Pixels	1920 x 1080	1280 x 720	720 x 480	720 x 576	1440 x 1080
	1440 x 1080				
Aspect Ratio	16:9		4:3 or 16:9		16:9
Video Compression	MPEG-4 AVC / H.264				MPEG-2
Luminance Sampling Frequency	74.25 MHz		13.5 MHz		55.6875 MHz
Sampling Format	4:2:0				4:2:0
Bits per sample	8 bit (Y, Cb and Cr)				8 bit
Audio Format	Dolby Digital (AC-3)		Linear PCM		MPEG-1 / Audio Layer II
Audio Bit Rate	64 to 640 kbps		1.5 Mbps (2 channel)		384 kbps (fixed)
Audio Mode	1 to 5.1 channel		1 to 7.1 channel		Stereo 2 channel
	MPEG-2 transport stream				
Video Bitrate after Compression	Up to 20 Mbps variable				Max 25 Mbps (fixed)

**Picture format:** The number of scanning lines, followed by the number of interlaced fields or progressive frames per second, followed by the designation “i” for interlaced scanning or “p” for progressive scanning.

**Number of pixels:** Horizontal x vertical.

**Aspect ratio:** Ratio of picture width to picture height.

**Luminance sampling frequency:** The number of digital video samples per second for the black-and-white (luminance or “Y”) channel, measured in megahertz (millions of cycles per second).

**Sampling format:** Refers to the structure of the three video channels: Y (luminance), Cb (blue color difference, Y-B), and Cr (red color difference, Y-R).

**Bits per sample:** The number of bits devoted to each digital video sample.

**Bitrate:** The recorded data rates for audio and video, measured in bits per second. “kbps” stands for kilobits per second. “Mbps” stands for megabits per second.

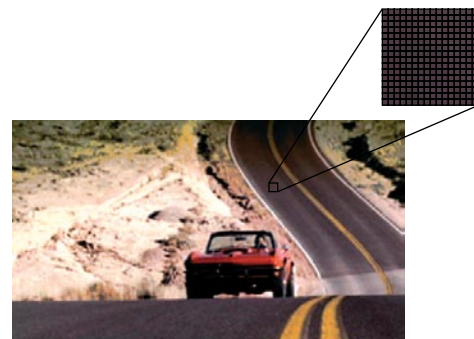


# A new generation of video compression.

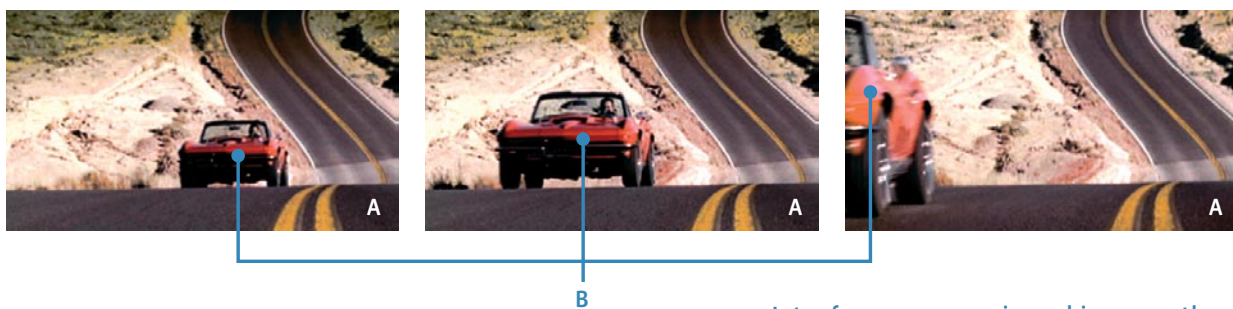
Compression technology is the secret that makes possible much of today's consumer digital entertainment. In the professional studio, uncompressed Standard Definition video requires 168 million bits per second (Mbps) and High Definition requires 1.2 billion bits per second (Gbps). DVDs and HDTV broadcasting would have been unthinkable without MPEG-2 compression technology to bring these massive data rates down to a manageable size. While MPEG-2 technology dates from the 1990s, several recent advances can achieve even higher quality at lower data rates. These advances have been built into a new standard with the somewhat awkward name: "MPEG-4 AVC / H.264."

**DV and intra-frame compression.** Compression works primarily by removing repetition from the video signal. For example, one pixel of blue sky is almost identical to the pixel next to it. Intra-frame compression, as used in the DV (digital videocassette) format, recognizes these patterns and reduces the data accordingly.

**MPEG-2 and inter-frame compression.** MPEG-2 starts with intra-frame technology and adds a second level of compression: inter-frame. Inter-frame compression works because the typical video frame is almost identical to the frames before and after. By encoding only the *differences* between certain frames, MPEG-2 compression can achieve another round of bitrate reduction. The result? Very high quality at far lower bitrates than intra-frame compression alone.



Intra-frame compression works because one pixel of blacktop is almost exactly the same as the pixel next to it.



Inter-frame compression achieves another round of bitrate reduction by taking advantage of the major similarities between one frame and the next. Here the background (A) remains largely the same while the car (B) changes.



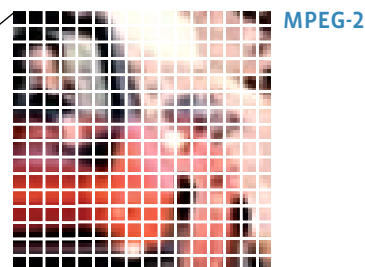
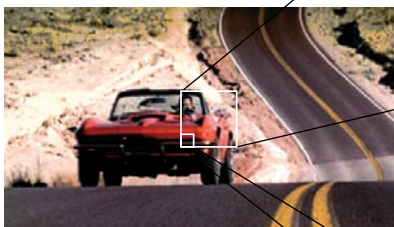
# A new generation of video compression. *continued*

MPEG-2 was the work of the Moving Pictures Experts Group, an international committee with members from many of the world's leading technology companies, including Sony. A broadly supported international standard, MPEG-2 compression has been used in hundreds of millions of devices and computer programs, including digital cable TV boxes, digital satellite TV boxes, consumer camcorders, professional camcorders, DVD players, web video playback software, and HD televisions.

**MPEG-4 AVC / H.264: a generation ahead.** Now the Moving Pictures Experts Group has approved the next-generation compression standard: MPEG-4 AVC / H.264. For simplicity, we'll abbreviate this to "H.264." As you would expect, the new standard takes advantage of modern improvements in digital processing and integrated circuits to boost performance further still.

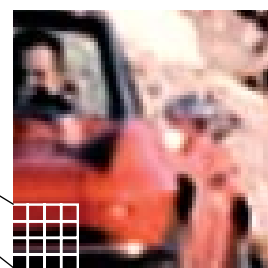
For example, MPEG-2 compression operates on blocks of 16 x 16 pixels. H.264 compression operates on blocks of just 4 x 4 pixels. If you think of the screen as a jigsaw puzzle, MPEG-2 sees about 6,000 pieces, while H.264 sees 100,000 pieces — 16 times as many! In addition, MPEG-2 images sometimes degrade due to "block noise," abrupt transitions at the edges of pixel blocks. H.264 processing enables smoother transitions at the edges of each block, for more natural-looking images.

Compared to MPEG-2 compression (top), H.264 divides the image into smaller pixel blocks for higher picture quality.



MPEG-2

16 x 16 pixel blocks



H.264

4 x 4 pixel blocks



# A new generation of video compression. *continued*



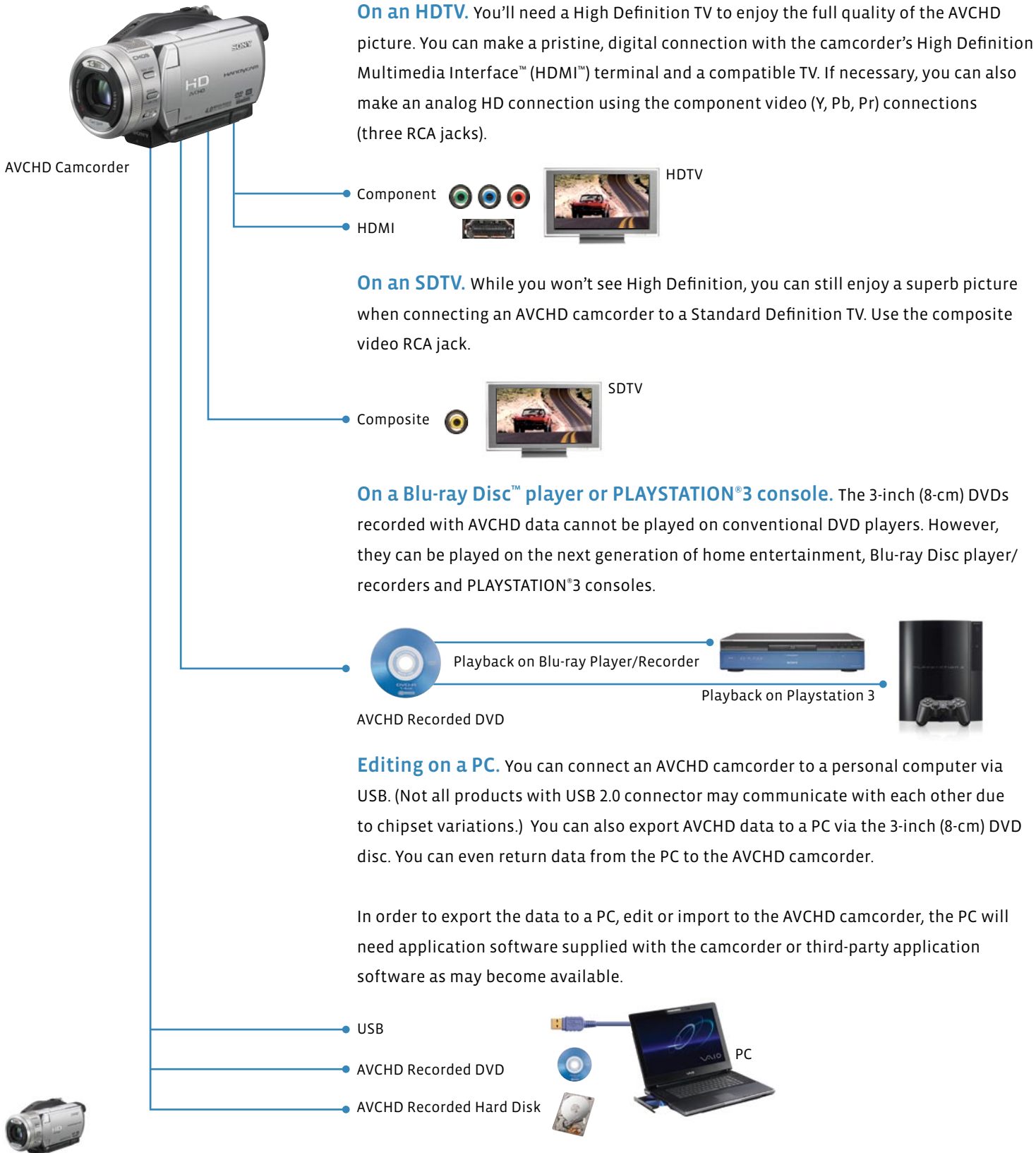
While MPEG-2 (top) can refer only to one frame before and one after, H.264 refers to five frames in total (three before and two after), for greater efficiency.

MPEG-2 encoders work by referring to one frame before the current frame and one frame after. H.264 encoding is far more powerful, referring to 5 frames at a time. This is an effective way to reduce the recorded bitrate without reducing the picture quality.

Just as MPEG-2 saw worldwide acceptance in a dazzling range of applications, we expect similar, widespread adoption of the MPEG-4 AVC / H.264 standard. This has already been standardized by the International Telecommunications Union, Telecommunications Bureau (ITU-T) and the International Organization for Standardization (ISO). H.264 already plays a role in a broad range of applications from the PlayStation Portable (PSP™) system and Digital Mobile Broadcasting in Japan and Korea all the way to high definition coding for the Blu-ray Disc™ format.



# Playing back AVCHD™ recordings.



# The AVCHD™ format and Sony's HD World.

## High Definition TV is now a prominent fact of life in the United States.

- **HDTV programming** now includes movies, episodic dramas and sitcoms, talk shows, sketch comedy shows, plus professional and college football, professional and college basketball, baseball and golf.
- **Over 1500 local television stations** are now broadcasting a digital signal (according to the NAB).
- **Over 10 million HDTVs** have been sold (according to the CEA).
- **Cable channels.** A long and growing list of channels now originates an HD signal.
- **Cable distribution.** Over 97 million TV households are now passed by at least one HDTV cable service (according to the NCTA).
- **Satellite.** Both DIRECTV and the DISH Network services offer subscription HDTV programming.

## Sony has responded not simply with High Definition televisions, but also with a large and growing range of ways to enjoy High Definition.

- **Create HD** on a Sony HDV™ or AVCHD™ camcorder and preserve your precious memories in vivid High Definition.
- **Edit and Burn HD** on a Sony VAIO® computer with a Blu-ray Disc drive.
- **Play HD** on a Sony PLAYSTATION®3 system.
- **Enjoy HD** on a Sony Blu-ray Disc™ player, with six times the resolution of DVD!
- **Hear HD.** Feel the full impact of with a Sony HD Audio surround sound system.
- **Watch HD** on a Sony HDTV, including BRAVIA™ LCD televisions, SXRD™ and 3LCD Grand WEGA™ microdisplay projection televisions and Sony front projectors.



**Q. High Definition signals have up to six times the data of Standard Definition signals. How can an AVCHD™ camcorder deliver recording time similar to a Standard Definition DVD camcorder?**

A. The difference is the compression. The new MPEG-4 AVC / H.264 compression system is far more efficient than the MPEG-2 system of DVD.

**Q. Which interface is best for connecting an AVHD camcorder to a TV?**

A. If your television has one, use the HDMI™ terminal. It delivers a pristine, all-digital HD signal. If your television does not have an HDMI terminal, you can also use the HD component video (Y, Pb, Pr) connection to view your video.

**Q. Can I use ordinary 3-inch (8-cm) DVD media on an AVCHD camcorder?**

A. Yes. AVCHD camcorders that record onto DVD can accept currently available DVD-R/-RW/+RW media as well as the DVD+R Dual Layer (DL) media. For Sony manufactured discs, look for the designation “for VIDEO CAMERA” on the package. NOTE: Do not use AVCHD recorded DVDs in conventional DVD players. A conventional DVD player or recorder may fail to eject an AVCHD recorded disc. A DVD recorder may erase an AVCHD recorded disc without warning.

**Q. What kinds of flash memory will support AVCHD recording?**

A. Recording onto Memory Stick® and SD™ memory cards has been planned as part of the format standards, but has not been implemented at this time.

**Q. What happens when the camcorder’s hard disk drive is full?**

A. Use the application software supplied with the camcorder to copy your video clips to a PC. Then you can record new material onto the camcorder.

**Q. Can I upload AVCHD data to a computer and edit?**

A. Yes, using the application software supplied with the camcorder. Specific editing functions depend on the software manufacturer. Please check with the individual software manufacturer for further details.

**Q. Can I play AVCHD recorded DVDs on a standard DVD player or recorder?**

A. No. Conventional DVD players are not designed to support the new AVCHD format. A DVD player or recorder may fail to eject an AVCHD recorded disc. A DVD recorder may erase an AVCHD recorded disc without warning.

**Q. Can I convert AVCHD High Definition material to Standard Definition, recording onto a Standard Definition DVD?**

A. Yes, if your application software supports the HD-to-SD recording function.

**Q. Can I play AVCHD recorded DVDs on a Blu-ray Disc player or recorder?**

A. Yes. Blu-ray Disc and AVCHD use the same H.264 compression system.

**Q. Can I play AVCHD recorded DVDs on a PLAYSTATION®3 system?**

A. Yes. PLAYSTATION®3 systems support the AVCHD standard.

**Q. What kind of equipment will play AVCHD recorded DVDs?**

A. In addition to camcorders, Blu-ray Disc players from Sony and others depending upon licensing agreements as well as the Sony PLAYSTATION®3 systems.

**Q. Must I “finalize” an AVCHD recorded DVD before playback?**

A. Yes.

**Q. Can an AVCHD camcorder delete and edit video clips?**

A. AVCHD camcorders can delete individual video clips when using DVD-RW or DVD+RW media.

**Q. What is the recording time?**

A. Recording time varies according to the quality setting and audio mode. For conventional, single-layer 3-inch (8-cm) DVDs, approximate recording time is 15 minutes in High Definition and 20 minutes in Standard Definition (at the highest quality setting). The 30GB Hard Disk Drive\*\* can record up to 4 hours in High Definition or 7 hours in Standard Definition (at the highest quality setting).

**Q. Will the AVCHD codec be available for home DVD recorders?**

A. No. The AVCHD system is designed specifically for camcorder shooting.

**Q. Why a new format? Don't HDV™ camcorders already satisfy the need for HD home movies?**

A. HDV camcorders only record to tape. AVCHD camcorders record to instant-access nonlinear media. AVCHD products record to DVD and hard disk drives.

**Q. Can I record clips in both SD and HD on the same media?**

A. It depends on the camcorder. For hard disk drive camcorders, you can mix SD and HD clips. For camcorders that record to DVD, you cannot mix SD and HD.

**Q. Will HDV camcorders disappear?**

A. No. HDV camcorders retain compatibility with the vast collections of consumer Standard Definition DV tapes. People who have recorded these tapes will want to continue enjoying them for years to come.

**Q. How does HDV and AVCHD picture quality compare?**

A. The quality of AVCHD recording in the 9 Mbps (HD-HQ) mode is roughly equal to HDV recording.

**Q. Do you plan to make AVCHD camcorders that record onto 5-inch (12-cm) discs?**

A. We believe that 5-inch (12-cm) discs are not appropriate for consumer camcorders.

# SONY®

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\* DVD media containing AVCHD footage should not be used with DVD based players or recorders, as the DVD player/recorder may fail to eject the media and may erase its contents without warning. DVD media containing AVCHD footage may be played on a compatible Blu-ray Disc™ player/recorder or other compatible device.

\*\* 30GB means 30 billion bytes. Available storage capacity may vary and a portion of the memory is used for data management functions.

All data as of October 1, 2006.

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