TASCAM DV-RA1000

The TASCAM DV-RA1000 is a two channel CD/DVD disc recorder with PCM record/play capability up to a sample rate of 192 kHz. It also can record/play in the DSD mode. Input/Output consists of analog RCA and XLR, digital AES/EBU, S/PDIF coax, and BNC SDIF.

Unlike some of the other recent tape and hard disk recorders that I have measured in my lab and have had somewhat of a difficult time figuring out how to make work, the DV-RA1000 rewarded me with relatively quick and logical functionality.

In the figures where the sampling frequency, Fs, is a parameter of the measurement, Magenta = 44.1 kHz, Red = 96 kHz, Blue = 192 kHz, and Cyan = DSD mode.

In order to keep the amount of data measured reasonable, analog I/O measurements were made for sampling frequencies of 44.1, 96, 192 kHz and in the DSD mode.

Frequency response for the sampling frequencies of 44.1 kHz, 96 kHz, and 192 kHz in PCM modes along with the response in the DSD node are shown plotted in **figure 1**. The frequency range is down to 10 kHz to best illustrate the nature of the high frequency responses. Including frequencies down to 10 Hz reveals a low frequency rolloff of -0.07 dB at 44.1 kHz, -0.19 dB at 96 kHz, and 0.6 dB at 192 kHz. In DSD mode, the rolloff was –0.03 dB. Square wave response in the PCM modes was indicative of the usual FIR digital filtering having symmetrical mirror image ringing at the beginning and end of each half cycle. However, in the DSD mode, the square wave shape was more asymmetrical without ringing – indicative of the DSD path being free of PCM filtering artifacts. Also, notice the frequency response in DSD mode has a much more gradual rolloff – again indicative of what appears to be a true DSD signal path in the DV-RA1000.

Total harmonic distortion plus noise at 0 dBFS in an 80 kHz measuring bandwidth as a function of signal frequency and sampling frequency is shown in **figure 2**. The abrupt rolloff in distortion above about one third the sampling frequency is caused by the fact that the dominant harmonic component is the third and above the one third sampling frequency point, that harmonic is filtered out. Of interest, when the 192 kHz sampling frequency is used, the noise level rises quite a bit dominating the distortion components.

Figure 3 shows how amount of distortion of a 1 kHz signal decreases for signals lower than full scale. The plot is typical for all sampling frequencies in a 22 kHz measurement bandwidth and for the DSD mode when using the sharp AES17 20 kHz low-pass filter.

Noise level vs. frequency is shown as a function of sampling frequency in **figure 4**. Frequency resolution in this plot is 32 Hz. The characteristic rise in out of band noise for the DSD mode is quite obvious. Further, the extra noise in the two higher sampling frequencies, 192 kHz measured here, also show a rise in noise as compared to the lower sampling frequencies of 44.1 kHz and 96 kHz measured.

Deviation from linearity was pretty much constant for all of the PCM sample frequencies and the DSD mode. A composite plot of deviation from linearity for both channels and all measured modes is shown in **figure 5**.

Crosstalk between channels was fairly constant between the various PCM sampling frequencies and the DSD mode a typical result for the two directions of Channels 1 > 2 and 2 > 1 is shown in **figure 6**.

– Bascom H. King

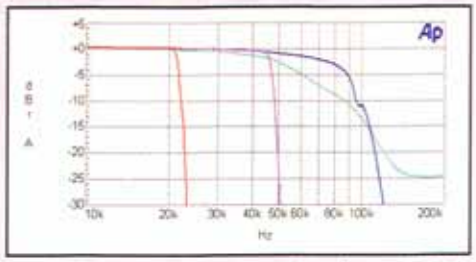

Fig. 1 Frequency response at 44.1 kHz, 96 kHz, 192 kHz Fs, and DSD mode.

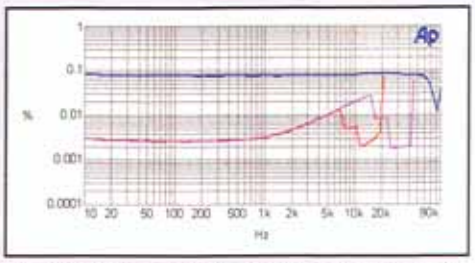

Fig. 2 Typical total harmonic distortion plus noise as a function of frequency at 44.1 kHz, 96 kHz and 192 kHz Fs.

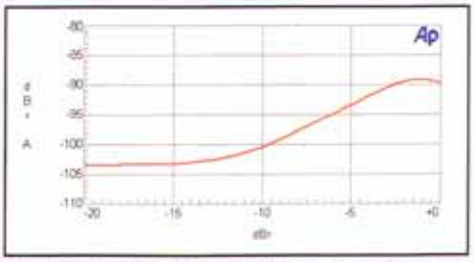

Fig. 3 Typical total harmonic distortion plus noise vs. input level for a 1 kHz tone. All modes.

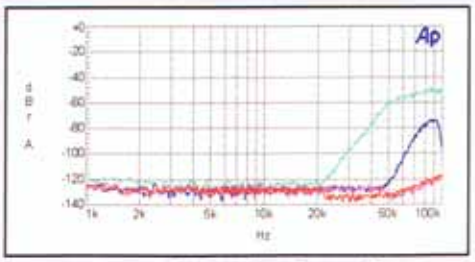

Fig. 4 Spectrum of noise levels as a function of sampling frequency and mode.

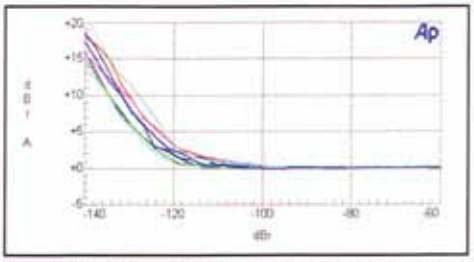

Fig. 5 Deviation from linearity of a 1 kHz test signal as a function of sampling frequency and mode for both channels.

TASCAM, DV-RA1000
High Definition Audio Master Recorder
Bench Measurement Data

[ANALOG/ANALOG I/O]

OUTPUT LEVEL

At digital full scale, just shy of onset of clipping

Balanced I/O

19.8 dBu in, 44.1 - 192 kHz Fs	7.51V, 19.7 dBu
21.6 dBu in DSD Mode	9.12V, 21.4 dBu

Unbalanced I/O

5.8 dBV in, 44.1 - 192 kHz Fs	1.95V, 5.8 dBV
7.4 dBV in DSD Mode	2.32V, 7.3 dBV

INPUT IMPEDANCE

Balanced I/O	45.0 kilohm
Unbalanced I/O	11.3 kilohm

OUTPUT IMPEDANCE

Balanced I/O	440 ohm
Balanced I/O	218 ohm

FREQUENCY RESPONSE

44.1 kHz Fs	+0.0, -0.20 dB 20 Hz - 20 kHz
	-3.0 dB @ 21.4 kHz
96 kHz Fs	+0.0, -0.04 dB 20 Hz – 13.3 kHz
	-3.0 dB @ 46.1 kHz
192 kHz Fs	+0.0, -0.16 dB 20 Hz - 20.5 kHz
	-3.0 dB @ 77.2 kHz
DSD	+0.0, -0.20 dB 20 Hz - 20 kHz
	-3.0 dB @ 57.4 kHz

TOTAL HARMONIC DISTORTION

22 kHz measurement filter

44.1 – 192 kHz Fs	< 0.003% 20 Hz – 300 Hz
	< 0.015% @ 6.0 khz
	< 0.0015% @ 20 khz

AES17 20 kHz measurement filter

DSD	< 0.002% 20 Hz – 500 Hz
	< 0.015% @ 6.0 khz
	< 0.0015% @ 20 khz

LINEARITY ERROR

44.1 - 192 kHz Fs, DSD	+/- 0.3 dB 0 to -100 dBFS
	< +4.0 dB @ -120 dBFS

SIGNAL TO NOISE RATIO

44.1 kHz Fs	
Wideband	67.6 dB
A-weighted	107 dB
96 kHz Fs	
Wideband	70 dB
A-weighted	107.3 dB
192 kHz Fs	
Wideband	55 dB
A-weighted (with AES17 40 kHz LP filter)	105 dB
DSD	
Wideband	26 dB
A-weighted (with AES17 20 kHz LP filter)	105 dB

DYNAMIC RANGE

THD+N of a 1 kHZ -60 dBFS signal in a 22 kHz + A wtd Measurement Bandwidth

44.1 – 192 kHz Fs	107 dB
DSD	102 dB

QUANTIZATION NOISE

THD+N of a 20 Hz tone at 0 dBFS in a 400 Hz to 22 kHz Measurement Bandwidth

44.1 - 192 kHz Fs	-104 dBFS
DSD	–103 dBFS

CHANNEL SEPARATION

Measured channel source Impedance 600 ohm 44.1 - 192 kHz Fs, DSD

Ch1 > Ch2	120 dB 20 Hz - 1.5 kHz
	> 105 dB @ 20 kHz
Ch2 > Ch1	110 dB 20 Hz – 3.0 kHz
	> 95 dB @ 20 kHz

[DIGITAL/DIGITAL I/O]

FREQUENCY RESPONSE

44.1 kHz Fs	< +/- 0.03 dB 10 Hz - 20.7 kHz
96 kHz Fs	< +/- 0.03 dB 10 Hz – 45 kHz
192 kHz Fs	< +/- 0.03 dB 10 Hz - 90 kHz

TOTAL HARMONIC DISTORTION + NOISE

44.1 kHz Fs	< 140 dBFS 10 Hz - 20.7 kHz
96 kHz Fs	< 140 dBFS 10 Hz – 45 kHz
192 kHz Fs	< 137 dBFS 10 Hz - 90 kHz

CHANNEL SEPARATION

44.1 kHz Fs	> 150 dB 10 Hz – 20.7 kHz
96 kHz Fs	> 150 dB 10 Hz – 45 kHz
192 kHz Fs	> 150 dB 10 Hz – 90 kHz

Note: Analog measurements made with balanced I/O unless Otherwise noted. Digital measurements made with AES/EBU I/O. Word length of digital audio test signals was 24-bit. Measurements made on left channel unless otherwise noted.