Colorimetric and Resolution requirements of cameras

Alan Roberts

ADDENDUM 23 : Sony HVR-V1E

This document is a report of the results of tests that are the precursor of those described in the EBU technical document Tech3335. It is not an endorsement of the product.

Data for this addendum is taken from a short examination of one production model of the Sony V1E HDV camcorder, physically very similar to (but smaller and lighter than) the HVR Z1 and FX1 HDV camcorders. It has 3 16:9 1"/4 cmos sensors of 1440x810 pixel dimensions (4.5mm diagonal). It records HDTV using the HDV algorithm onto standard mini DV tapes (1080i and 1080psf), and SDTV using DVCAM format.

The camera is relatively light (about 1.5kg excluding battery) and has an integral lens and viewfinder, with side lcd panel, and seems aimed at the middle to high-end consumer/low-end professional market rather than full broadcast, which would normally demand interchangeable lenses and better control.

It has internal menus for setting the performance, not as complex as in a full broadcast camera, but enough to control some of the important features, albeit only in "on/off" states. It is not suited to multi-camera operation. It has analogue-only video outputs (components and SD-composite via a multi-pin connector and S-video SD) and digits via IEEE1394 Firewire (called i.Link by Sony). This alone puts the camera in the consumer/semi-pro market, rather than broadcast, which would normally expect either HDSDI or BNC connectors for analogue.

The same assessment procedure was used as for other HD cameras, partly attempting to get a good "film-look", and the settings reflect that. However, because of the lack of internal test signals, and as a result of some of the initial measurements, that approach was quickly abandoned and efforts were directed at getting a decent colorimetric performance from the camera. Assuming that a grading operation will be used in post-production, the settings attempt to give the colourist a reasonable exposure range, but this is inevitably well-short of what a film stock could be expected to deliver.

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Addendum 23: Sony-HVR V1E

Data for this is taken from a short examination of a production model of the Sony HDV camcorder, HVR-V1E, with three 1"/4 cmos sensors (4.5mm diagonal, each approximately 1440x810). It records in HDV (1080i/25, 50Hz interlaced) format onto miniDV tapes, and standard definition (576i/25) as DVCAM.

The camera is essentially a pro-sumer model, with some professional features such as having XLR connectors for audio input. It has an integral lens (Zeiss Sonnar, 3.9~78mm, 20:1, F/1.6 maximum aperture ramping to F/2.8) and viewfinder, with side lcd panel, and seems aimed at the consumer and low-end professional market rather than broadcast, which would normally demand interchangeable lenses and higher resolution sensors, together with greater control through the menus. Minimum exposure is claimed to be 4 lux.

The camera has internal menus for setting the performance and a reasonable selection of external controls. There are analogue-only video outputs (components and composite plus S-video at SD, all via multi-pin connectors) and digits via IEEE1394 Firewire (known as "i.Link" by Sony), USB and HDMI.

The normal assessment procedure for cameras could not be used, largely because the V1 does not have a selectable test signal. Therefore, testing had to be done the hard way, via the lens. Recommended settings allowing for a "video-look" have been derived; it was not possible to derive decent "film-look" settings due to shortcomings in the controls of the camera, significant compromises have been made in the camera design. However, if a "film-look" is really needed, then the camera can be switched into 25P mode (CAMERA SET menu>Prog.Scan) and this will give correct jerky motion and a little more vertical resolution than is achieved in interlace, but will not extend the exposure range.

While HDV performance is acceptable in that it is representative of it's market niche, there are significant problems with its performance as an SD camera for professional or broadcast purposes due to the presence of visible aliases that cause a visible "restlessness" in the picture. HD performance with the recommended settings is probably adequate for consumer use, but better SD performance can be expected byt recording in HDV and using a professional hardware down-converter or by using the downconversion facilities available in most good video editing software, or with a genuine SD camera. The reasons for this statement are given in the measurements section of this document.

The controls for these cameras are not as flexible as for full "broadcast" cameras, so more effort was expended in measuring performance than in trying to derive a specific "look" for it. Very small lens apertures (less than F/5.6) soften the picture and produce some visible colour-fringing due to diffraction effects in the iris, the included neutral density filters are the better alternative to small apertures when shooting in very bright light.

Many of the menu items have little or no effect on image quality. Those that have significant effect are highlighted. The full set of menu items is given for completeness. In boxes with a range of numeric settings, the values indicate the range (often no scales are given) and the factory default setting is underlined. My recommendations are in the last column, labelled "BBC", where appropriate. Settings are given only for normal television use, it was not possible to derive good settings for a film look.

In the tables, items that have an important effect on picture appearance are highlighted with grey background. Rather than just making assertions about performance, I have included measurement results that illustrate the reasons for recommending settings. Virtually all picture control is in the **Profile** menus.

Press the "Menu" button to enter the menus, navigate with the "Menu wheel", default values are underlined. Select profiles with the "Profile" button.

This is not intended as a replacement for reading the manual.

1 Switches and Menu settings

SWITCHES, CONNECTORS and BUTTONS			
name	**place**	**feature**	**comment**
Power switch	Right, on tape transport		Right thumb control
Zoom 1	Right, on tape transport	Pressure sensitive	Normal zoom control
Zoom 2	Handle		
Zoom ring	Lens	Manual control	
Photo/Expand Focus	By Zoom 1	Push	Expands image in viewfinder
Exposure	Lens left	Push	Auto control
Exposure dial	Lens left	Wheel	Manual control
ND filter	Lens left	Switch, 1/2/off	2 neutral filters
Auto lock	Back	Switch	Locks exposure
Shutter speed	Back	Push	
Gain	Back	Push	
Focus ring	Lens	Manual control	
Auto focus	Lens left	Push	One-push auto ,focus
Focus	Left mid	Push/push	Auto focus on/off
Expanded focus	Left mid	Push/push	Expands image in viewfinder
White balance	Back	Push	
Record start/stop 1	Power switch		Right thumb control
Record start/stop 2	Handle		
Assign 1,2,3	Lens top	Push	3 assignable buttons
Assign 4,5,6	Under lcd	Push	3 more assignable buttons
Zebra	Under lcd	Switch	Zebras on/off
Menu	Back	Push	
Menu	Back	Wheel	Select from list, after enabling by pressing “Push” button
Sel/Exec	Back	Push	Confirm menu operation
Picture profile	Left back	Push	Select preset “profile” settings
Status check	Left back	Push	Show camera status, sound levels
Tape play controls	Under lcd		All normal controls
Display batt/info	Under lcd	Push	
Volume/memory	Under lcd	Push	Control of stills replay
LANC	By Zoom 1		Remote control
AV connections	Back	Component, AV, 1394	
HDMI out/USB	Below lcd		
Headphones	Left back	3.5mm jack	Mutes speaker
Rec ch select	Sound pod		Channel 1/Channels 1&2
Audio in (XLR x 2)	Sound pod		
Ch 1 auto/man	Sound pod		
Ch 1 +48v	Sound pod		
Ch 2 auto/man	Sound pod		
Ch 2 +48v	Sound pod		
Ch 1 audio level	Sound pod	dial	
Ch 2 audio level	Sound pod	dial	
Reset	Under lcd	Recessed Push	Full system reset

CAMERA SET menu			**Basic camera settings**	
item	**sub**	**range**	**comments**	**BBC**
Exposure/Iris	Dial Assign	Exposure 1, Exposure 2, Iris, AE Shift	What effect the Exposure dial has	
	Dial Sens	High, Middle, Low	Dial sensitivity	
	Dial Rotate	Normal, Opposite		
Smth Slw Rec	Rec Time	3,6,12 seconds	Smooth Slow Recording, at low resolution	
	Rec Timing	Start, End	Record from or to Rec button press	
	Execute		Arms camera to do it, press Menu to cancel	
Cntrst Enhcr		On, Off	Black lift for deep shadows, not when "Back Light" is on	
Prog. Scan		Off, 25P	Progressive, scan, film mode[1]	Off {v}, 25P {f}
Steadyshot		On, Off	Reduces camera shake	
	Type	Hard, Standard, Soft, Wide conv.	Wide Conv lessens the effect, good when using a WA lens adaptor	
Color Bar		On, Off		
	Type	Type 1, Type 2, Type 3	Type 1=SMPTE, Type 3 is full height bars	Type 1
	Tone	On, Off	Add 1kHz at –18dB	
AF Assist		On, Off	If ON, allows brief manual focussing in Auto	
Focus Macro		On, Off	Allow close focussing	
AE Shift		-7~0~+7		
AE Response		Fast, Middle, Slow		
AGC Limit		Off, 12, 6, 0dB	Off=allow 18dB AGC range	
AT Iris Lmt		F11, F5.6, F4	Stop-down limit[2]	F5.6
ATW Sens		Intelligent, High, Middle, Low	Set degree of tolerance for auto white balance	
Flickr Reduce		On, Off	Useful under fluorescent lighting	
Handle Zoom	H	1~6~8	Set zoom speed for Zoom 1 control switch	
	L	1~3~8		
Shot Trans	Trans Time	3.5~4~15 sec	Automatic shot transition settings	
	Trans Curve	Linear, Soft Stop, Soft Trans		
	Start Timer	Off, 5, 10,20 sec	Delay to transition start	
	Rec Link	Off, Shot A, Shot B	Choose which transition to use	
Interval Rec			Record bursts of frames, see manual, P73	
DV Frame Rec		Off, On	Similar in SD, see manual P74	
Back Light		Off, On	Raise auto-exposure when scene is back-lit	
Spot Light		Off, On	Reduce auto-exposure when spot lit	
Hyper Gain		Off, On	36dB gain, not in Spot or Back light	
D.Extender		Off, On	1.5 times magnification	
Fader		Off, White, Black	Fade to/from white or black	

AUDIO SET menu

item	**sub**	**range**	**comments**	**BBC**
DV Au. Mode		FS32k, FS48k	32k is 4-channel, always 48k for HDV	FS48k
Mic NR		Off, On	Mic noise reduction	
XLR Set	Au Man Gain	Separate, Linked	Links gain controls together, for stereo	
	Input 1 Level	Mic, Line		
	Input 1 Trim	0, -8, 016dB		
	Input 1 Wind	Off, On	Selective wind noise reduction	
	Input 2 Level	Mic, Line		
	Input 2 Trim	0, -8, 016dB		
	Input 2 Wind	Off, On	Selective wind noise reduction	
Audio Ch Sel		Ch1&2, Ch1, Ch2	Select which recorded track(s) to play	
DV Audio Mix		Ch1&2, Mix, Ch3&4	In FS32, select which tracks to play	

DISPLAY SET. menu

Viewfinders

[1] Progressive mode is good, it produces the correct jerky film motion, and increases vertical resolution.

[2] Generally, performance of the lens is good, but some colour fringing is visible at F/11 due to diffraction from the edge of the iris. Setting to F/5.6 is a good compromise, but can cause some exposure problems under high light levels (use neutrals and/or shutter to control exposure).

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item	sub	range	comments	BBC
Peaking		Off, On	Edge enhancement, focus aid	
	Color	White, Red, Yellow	Colour of sharp edges	
	Level	High, Middle, Low		
Histogram		Off, On	Exposure histogram	
Marker		Off, On		
	Center	Off, On	Cross hairs	
	Aspect	Off, 4:3, 13:9, 14:9, 15:9	14:9 is useful, works only in "All Scan"	
	Safety Zone	Off, 80%, 90%		
	Guideframe	Off, On		
Exp. Focus Type		Type 1, Type 2	1=enlarge image, 2=enlarge and monochrome	
All Scan Mode		Off, On	Shows whole camera frame, shrunk	
Cam Data Dsp		Off, On	Shows exposure, gain, shutter	
Au.Lvl Disp		Off, On	Audio level meters	
Zoom Display		Bar, Number	Number only shows 0~99, not focal length	
Focus Display		Meter, Feet	Focus distance	
Shutter Disp		Second, Degree	360°=field or frame duration	
LCD Bright			Press Sel/Push Exec dial	
LCD Color			ditto	
LCD Bl Level		Normal, Bright		
VF B.Light		Normal, Bright		
VF Color		On, Off	Off=monochrome	
VF Powermode		Auto, On	Auto switches vf off when lcd's open	
Data Code		Off, Date, Camera Data	Data to show on replay	
Letter Size		Normal, 2x	Big letters for those with rotten eyesight	
Remaining		Auto, On	Auto shows tape left on Play or Power On	
Disp Output		Lcd panel, V.Out/Panel	Control data display	

IN/OUT REC menu

VTR matters

item	sub	Range	comments	BBC
Rec Format		HDV1080i, DV	DV is SD DVCAM	HDV1080i[3]
VCR HDV/DV		Auto, HDV 1080i, DV	Auto senses the tape, otherwise plays only what's selected from tape	
DV Rec Mode		DVCAM, DV SP	DVCAM uses 50% more tape/minute	
DV Wide Rec		On, Off (4:3)		
Ext Rec Ctrl	Rec Ctl Mode	Off, Synchronous, Relay	Allows simultaneous recording on a 1394 connected external recorder	
	Stby Command	Rec Pause, Stop	Control of external recorder, see manual P83	
Component		576i, 1080i/576i	576i for ordinary tv sets	
i.Link Conv		Off, On	Auto up/down-conversion on replay	
Down Convert		Squeeze, Letter Box, Edge Crop	For playing HDV via analogue outputs	

TC/UB SET menu

Timecode etc

item	sub	range	comments	BBC
TC Preset	Preset		See manual P85	
	Reset		Sets TC back to zero	
UB Preset	Preset		See manual P85	
	Reset		Sets User Bits back to zero	
TC Run		Rec Run, Free Run	Rec run times only when tape's rolling	
TC Make		Regenerate, Preset	Makes Rec Run when over-recording	
TC Link			Sync TC on cameras via 1394, see manual P 85	
TC/UB Disp		TC, U-Bit	Which to show on-screen	
UB Time Rec		Off, On	On=record real; time in User Bits	

[3] Recording at DV is not very good, the camera generates significant visible spatial aliasing. Better to record in HDV and down-convert in your favourite software or hardware converter.

MEMORY SET menu

Memory stick matters

item	sub	range	comments	BBC
Quality		Fine, Standard	Record image sizes are1440x810, 1080x810, 640x480,640x360	
All Erase		All Files, Currnt Folder	Deletes files	
Format		Yes	Select to format a card	
File No.		Series, Reset	Reset restarts at 0001 when a new card's used	
New Folder			Make a new folder in the 102-999 series	
Rec Folder			Sel/Push Exec dial, select which to record into	
PB Folder			Same for playback	

OTHERS menu

Basic stuff

item	sub	range	comments	BBC
Camera Prof.			Save/Load/Rename/Delete camera profile, see manual P89	
Assign Button		Last Scn Review, Marker, Hyper Gain, D.Extender, Allscan Mode, Focus Infinity, Rec Review, End Search, Index Mark, Peaking, Steadyshot, Color Bar, Focus Macro, Spotlight, Backlight, Fader, Profile, Shot Trans	Assign any of these to each of the 6 assignable buttons. See manual P49~53 for details	
Photo/Exp. Focus		Photo/Exp. Focus	Assign the Photo/Exp.Focus button	
Clock Set			Set time/date, see manual P28	
World Time			Set offset to local time	
Language			Set on-screen language	
USB Select		Memory Stick, Pict Bridge	Print direct to an enabled printer via USB	
PB Zoom			Allows zooming of play-back stills	
Quick Rec		Off, On	Shorten rec start time, breaks MPEG2 GoP structure, may not be ingestable in some NLEs	Off
Date Rec		Off, On	Superimpose date on stills	
Beep		On, Off	Warbles when recording starts	Off
Rec Lamp		Off, On	Cue lamp	
Remote Ctrl		Off, On	Allows remote control	
Hours Meter			Shows values for: Operation, Drum Run, Tape Run, Threading	

PICTURE PROFILES menus, default settings

Camera control, default settings

item	sub	range	comments	BBC
PP1		Portrait	These are the default settings, not individually investigated. Each can be separately edited, and saved to Memory stick (up to 20 can be stored on one stick).	
PP2		Cinema		
PP3		Sunset		
PP4		Monotone		
PP5				
PP6				
PP7				
PP8				
PP9				

PICTURE PROFILES menus, manual settings

Camera control

item	sub	range	comments	BBC
Color Level		-7~0~+7	Saturation, -8=monochrome	-3
Color Phase		-7~0~+7	Greenish to reddish	0
Sharpness		0~7~15	Detail enhancement	3
Skintone Dtl		Off, Type1, Type2, Type3	Anti-wrinkle cream: 1=narrow, 2=wider, 3-very wide	Off
Skintone Lvl		1~3~6	Boost/restrain skintone detail	
WB Shift		-7~0~+7	- is darker, + lighter	0
Knee Point		Auto, High, Middle, Low	Maximum point is fixed, adjusts intercept with main curve	Middle
Blk Compnstn		Off, Stretch, Compress	Slope near black, need stretch for good colours	Stretch
Cinematone Gamma		Off, Type1, Type2	Film-type gamma curves[4]	Off
Cinematone Color		On, Off	Film-type gamma curve	Off
Profile Name			Set the name, see manual P44	
Copy			Copy these settings to another profile	
Reset			Resets profile to default settings	

[4] The film gamma curves reduce the camera photographic speed by lowering the slope of the curve in mid-tones. This raises saturation a great deal and there was no sufficient control to get colours looking reasonable. Pictures look most like film with the normal gamma, middle knee, and black stretch on. Even so, colouring is a little strange and not particularly nice, it is a great shame that there is no colour matrix to play with, because considerable improvements are to be had.

2 Measurements

Gamma curves and exposure range were not explored in great detail, since there seemed to be little control available over either, this is a "take it or leave it" camera, with little real control over the image quality.

2.1 Colour performance

Assessments were done visually, since there was not sufficient time available with the camera to do a full set of analytical tests. The camera was pointed at a Macbeth chart, and the picture viewed on a large Sony crt HDTV monitor with another Macbeth chart close to it. Both charts were evenly illuminated with studio colour temperature for the camera, D65 for the monitor reference chart.

Figure 1 default settings

Figure 2 saturation=-3, black stretch=on

With the camera set to factory defaults (Fig. 1), the colours were rather muddy, over-contrasty, oversaturated, and tinged with red near black level. With no colour matrix and no black level controls, there was little that could be done about this. Setting *Color Level* (saturation) to *–3*, and *Blk Compnstn* to *Stretch* (Fig. 2), colouring became a little better, but even so some of the colours stayed distinctly of wrong hue and saturation (e.g. the Yellow patch) although skin tones were generally good.

Figure 3 sat=-3, bs=0, cinegamma=2, cinecolor=on

The gamma curve does not appear to be "powerful" enough, resulting in the visible muddy colouring. *Black Stretch* helped a little, but both the *Cinegamma* curves made things worse. The oddly named *Cinematone Color* also made things worse, by increasing both saturation and contrast (Fig. 3).

2.2 Sharpness and resolution

The camera has 3 1"/4 cmos sensors of 1440 by 810 pixels, presumably with green offset from red and blue to enhance horizontal resolution beyond the limit of the sensors, this is normal practice in 3-sensor cameras. The horizontal count in this camera is just adequate for HDV (1440 limit), so it should be adequate for resolution, but the 810-line count is rather low for any attempt at a decent "film look", where resolution up to 1080 is to be expected. It also works in two modes (HD video, SD video) and the requirements for each are quite different.

The test card was a BBC Zone Plate, designed for 1080-line television. This reproduction of it (Fig.4) shows the layout, but also shows considerable aliasing caused by the scaled reproduction here. Each circular zone is a phase-space of spatial frequencies, with zero (dc) in the middle, extending to 1080 lines/picture height (l/ph) vertically, and 1920 lines/picture width (l/pw) horizontally. The scales are linear, so it is relatively easy to make reasonable measurements. In the camera, the image is recorded as 1440 pixels by 1080 lines, i.e. a pixel-based aspect ratio of 4:3, but this illustration is shown with the correct image aspect ratio.

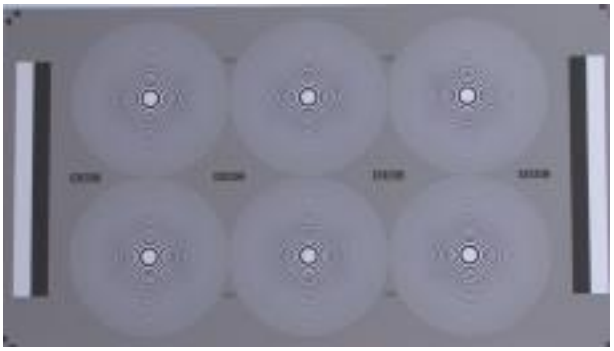

Figure 4 zone plate

2.2.1 Resolution in HDV

Fig.5 shows the chart captured with *Sharpness* set at zero (i.e. this is the native performance of the camera) and the camera set to normal, interlaced, HDV. This time, I have not altered the scale of the HDV file, but have included it here with square pixels rather than the 4:3 pixels that are assumed for HDV.

Along the vertical axis, resolution is visible up to about 75% of the scale (i.e. 1080*0.75=810, which is the resolution limit of the camera's 810-line sensors). The resolution near this limit is easier to see when the camera *Prog.Scan* mode is set to *25P* (progressive) since it causes interlace twitter when set to interlace. Thus the camera appears to be sharper vertically in progressive than in interlace. However, close examination of screen grabs shows no difference in the frame content between interlace and progressive. This is a reasonable compromise in a small camera where the cost of proper filtering would be prohibitive.

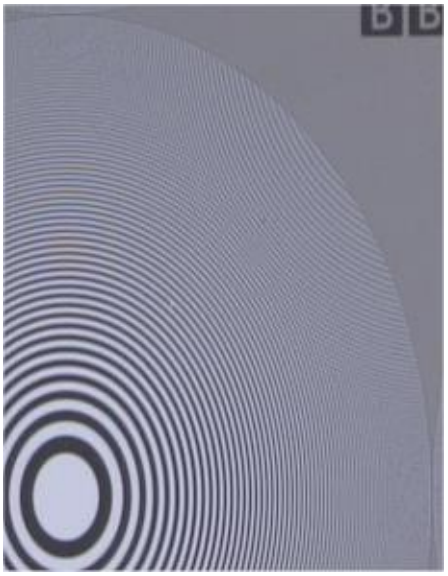

Figure 5 HDV, sharpness=0

Horizontally, there is a null zone (where the image is plane grey, no detail) at 1440. This the horizontal resolution limit of the sensors, however, the green sensor is presumably half-pixel offset from the red and green to raise the effective resolution above 1440, which could explain the lower contrast resolution above 1440. In practice, this results in aliasing in the image (where unwanted detail is "reflected" into the wanted detail), causing problems when the picture moves, so it is rather dangerous to rely on this process for producing high frequency detail.

The camera has only one control for detail (*Sharpness*), thus there is little that can be done to optimise the performance, and it has a large effect with coarse steps. Setting to maximum produce remarkably high aliasing and overshooting on edges, a very unpleasant picture. Fig.6 shows the performance when set to *3*, which is about the maximum value that can be used without causing unduly disturbing effects.

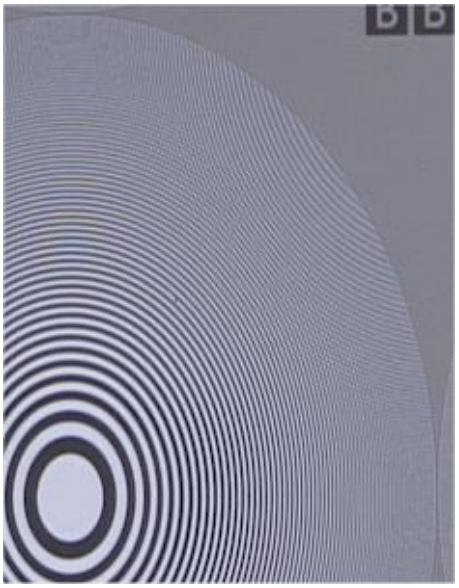

Figure 6 HDV sharpness=3

The effect on vertical resolution is small, this is inevitable since the camera cannot produce resolution above 810, and perhaps the control has no effect on vertical detail anyway. But horizontally it has increased the impression of sharpness by accentuating the aliasing due to detail between 1440 and 1920. This is a mixed blessing, the picture appears to be sharper, but much of this extra "detail" derives from the aliased higher frequencies and not from the wanted detail. When the picture stands still, this is not an issue, but the aliased frequencies move counter to camera motion, so are accentuated when the camera moves. This is why it is not advisable to use higher values of *Sharpness*.

There was no evidence of loss of sharpness when zoomed in tightly, and iris diffraction did not appear to be a problem at normal exposure levels. However, it was not possible to test at substantial over-exposure levels with the lens stopped down; it is advisable not to use smaller iris sizes than about F/5.6 under high-contrast conditions.

2.2.2 Resolution in SD

Recordings were made of the same zone plate chart, with the camera set to SD (625/50, "PAL"). For SD, it was framed such that exactly half the width and height were recorded, thus the circular zones excited frequencies up to 960 pixels/picture width and 540 lines/picture height, adequate for these tests.

Fig.7 shows the result for the same zone quadrant, with the camera set to record interlaced images.

Vertically, there is detail up to 360 line/picture height. A broadcast SD camera can be expected to perform somewhat better, perhaps up to 430. There is no evidence of vertical aliasing due to the presence of the higher frequencies in the zone plate chart. Subjectively, there is some interlace twitter, a restlessness in the image.

Horizontally, there is a null zone at 720 where wanted frequencies and unwanted alias frequencies beat with each other, and there is evidence of detail between 720 and 960. Since the DV format cannot support frequencies above 720 (exactly half the sampling frequency), this can only be aliased frequencies. This is evidence that the down-converter does not use sufficiently good filters, which would normally reject these high frequencies in the camera's HD image. The visible result is a distinct "business" in the signal at high frequencies, a disturbing restlessness (similar to the vertical interlace twitter) that cannot be eliminated with camera settings (other than a diffusing filter on the lens).

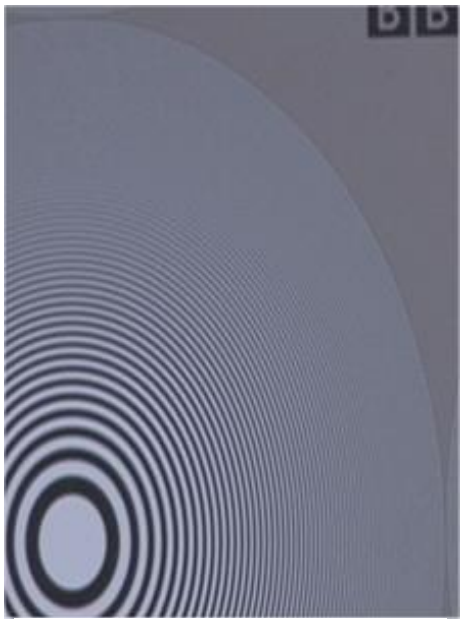

Figure 7 zone plate, 50i SD

Fig.8 shows the result for shooting in 25P. Again, as for HDV recording, the vertical resolution is the same as for interlace, but there is a little more aliasing visible. This indicates that the down-converter takes no account of the camera setting, and deals with each HDTV field separately to make one SDTV field. Viewing this on the same HDTV monitor (which automatically switched to SDTV) there was still significant interlace twitter, because crt-based television monitors rarely show truly progressive images except when supplied with 720p signals.

Horizontally, the result is exactly the same as for interlace.

Overall, down-converted pictures do not look particularly good, neither when the camera is set to HDV and playback is SD, nor when the camera is set to SD. The cause is the presence of high frequencies in the HD image, brought about by the HD lens and sensors. If the camera is to be used for SD work, then the only solution is to use an optical diffusing filter on the lens, possibly a ¼ Black Promist or equivalent, to lower the high frequency content before it reaches the sensors, where the aliases are generated.

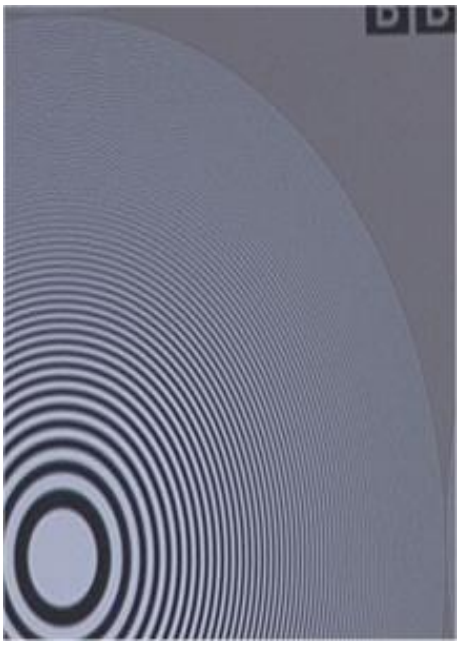

Figure 8 zone plate, 25p SD

2.3 Noise

Noise was measured by exposing the camera to a uniform grey scene, at 4 exposure levels from 15% to 95% video level, with +12dB gain. Allowing for this gain value, the Peak Signal to Noise Ratio (PSNR) at 0dB gain should vary between 54 and 56dB depending on signal level, which is very good for a camera in this price and performance range. Note that the 8-bit DV and HDV recording compressor cannot accurately represent noise at higher than 56dB PSNR anyway, so the camera is a good match to its recording formats.