

Colorimetric and Resolution requirements of cameras

Alan Roberts

ADDENDUM 37 : Sony HDCAM, HDW-650

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 section is taken from the handbook and a brief examination of a Sony HDW-650, serial number 40002. Superficial similarities to the PDW-700 are misleading, this is a different camera. This is a 1080-line HDCAM tape camcorder, physically smaller and lighter than the HDW750. It runs at 50Hz or 59.94Hz interlaced or psf, and the F version of the camcorder will also record at 23.98Hz. It has 3 1920x1080 sensors and records full 1920x1080 images with 3:1:1 sub-sampling down to 1440 luma samples, 480 chroma samples per line using the conventional HDCAM coder. In the expectation that the camera would perform rather better than the recording format would allow (it has 14-bit adcs and 20-bit processing), measurements were taken both directly via HDSDI and from recorded tape.

The camera is housed in a conventional camcorder shell, and consumes about 35 watts. It has many internal menus for setting the performance, such that it can then be used without external controls. It is not ideally suited to multi-camera operation, although it can be controlled remotely. A standard feature is a 8-second picture cache, and it has two conventional filter wheels. There is a live down-converter to SD, so the camera can be used in mixed environments. The SD performance of the camera was not tested, and should be thought of as a monitoring output, not for programme use.

The menu settings result from one measurement session. In the reported measurements, the camera appears to be able to capture up to about 1,000% overexposure (about 3.3 stops, using the full video range 109%) and is able to mimic a film camera and telecine, with “best light” transfer to tape (totalling about 11 stops of tonal range). It is rather noisy, and very sensitive, presumably due to increased head-amplifier gain, and should not be operated at high gain. Noise suppression helps, at the loss of some resolution. Assuming that a grading operation will be used in post-production, the settings give the colourist the same range of options as with film.

Detail enhancement produced some spatial aliasing, but the Aperture compensation produced a much smoother image with complete freedom from aliasing. For use in Sport or Light Entertainment, it would probably be beneficial to switch off the Black Gamma, and to set both Detail Enhancement and Aperture Correction on.

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ADDENDUM 37 : settings for Sony HDW-650

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, e.g. -99~99, the values indicate the range, and zero means no alteration to factory setting, not zero effect, and no scales are given. For each item, the factory setting is given where known, and the range offered. “BBC” recommended settings are in the last column, where appropriate. Factory settings, where known, are underlined. Value ranges shown as -99 ~ 99 may differ in practice, as a result of settings in lower menus.

The data files are used in “layers”, Factory, Service, Preset, User. The effect of a numeric data value in the user menus is the sum of all values for that item in all these layers. Only those in the Factory layer are absolute, thus it is vital to have all layers correctly set when entering new values, if the setup is to be copied from camera to camera. To return to Standard Setup (i.e. factory condition), go to menu FILE02 USER FILE 2 and select CLEAR USR PRESET, or FILE03 ALL FILE and select CLEAR ALL PRESET, and press the rotary encoder. Then values can be entered via menus or Memory Stick to achieve a specific setup. The range of values available in some items may not be those quoted in the camera manual, this is due to settings in the Factory layer which must not be altered.

Settings have been derived and are identified in the “BBC” column, identified as *v* for video, *f* for film.

Measurement results are given in section 2, after the menus.

This listing of the menus and contents is complete, but this should not be used as an excuse for not reading the manuals.

1 Menu items

TOP MENU

USER	Go to daily routine settings, pages that can be customised
USER MENU CUSTOMISE	Customise user menu pages
ALL	Go to all menu pages
OPERATION	Settings for the most common controls
PAINT	Settings that normally need lab facilities to control properly
MAINENANCE	Camera maintenance, usually best avoided
FILE	Load/save reference files etc
DIAGNOSIS	Check status of hardware/software
SERVICE	Keep out of here if at all possible

USER MENUS as set up in CUSTOMISE pages, can contain anything from:-

OUTPUT SEL, FUNCTION1, VF DISP1, VF DISP2, “!” LED, MARKER1, GAIN SW, VF SETTINGS, AUTO IRIS, SHOT ID, SHOT DISP, SET STATUS, USER FILE, LENS FILE
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OPERATION MENUS

OPERATION 01 OUTPUT 1

Setting output signals

item	range	comment	BBC
HD SDI out	Off/ <u>HDSDI</u>		
HD/SD SDI out	Off/ <u>HDSDI</u> /SDSDI		
HD/SD SDI super	<u>Off</u> /On	Adds viewfinder stuff	
Test out select	VBS/ <u>Y</u> / R/G/LCD	Reverts to Y at power up, if R G or B selected. VBS is composite SD.	Y
Test out super	<u>Off</u> /On	Adds viewfinder stuff, complicated	

OPERATION 02 OUTPUT 2

More on setting output signals

item	range	comment	BBC
PB Video	<u>All</u> /HDSDI	Allows tape playback while shooting, for shot matching.	
Down con mode	<u>Crop</u> /Letter/Sqeze	Down-conversion, crop takes central 4x3 portion	Sqeze
Wide ID	<u>Off</u> /On	Changes how Sqeze mode works	

OPERATION 03 SUPER IMPOSE

Yet more on setting output signals

item	range	comment	BBC
Super (VFdisp)	Off/ <u>On</u>	Control output of text and markers to SDI or Test out	
Super (Menu)	Off/ <u>On</u>		
Super (TC)	<u>Off</u> /On		
Super (Marker)	<u>Off</u> /On		
Super (Zebra)	<u>Off</u> /On		

OPERATION 04 LCD

Control of the lcd side panel

item	range	comment	BBC
LCD color	-99 ~ 99	Colour level (saturation), so you can't trust it for picture assessment	
LCD marker & zebra	Off / <u>On</u>	Adds viewfinder stuff to the side lcd	

OPERATION 05 REC FUNCTION

Control of the cache recorder

item	range	comment	BBC
DF/NDF	DF /NDF	Drop Frame TC, only for 59.94Hz	NDF
End Search	<u>Off</u> On	Seeks last recording end	
Cache/Inteval Rec	<u>Off</u> /Cache/A.Int/M/Int		
Cache rec time	0~8sec	Only up to 7 sec at 59.94	
A.Int Total Take Time	5/10/15/20/30/40/50min 1/2/3/4/5/7/10/15/20/30/40/ 50/70/100hour	Auto Interval, set total time and rec time, it does the rest	
A.Int Rec Time	5/10/15/20/30/40/50sec 1~40min		
Prelighting	<u>Off</u> /2/5/10sec		
M.Int Number of Frame	<u>1</u> /2/4/8	Manual Interval recording	
M.Int Trigger Interval	<u>M</u> /1~10/25/20/30/40/50sec /1~10/15/20/30/40/50min /1/2/3/4/6/12/24hour		

OPERATION 06 PB MIX

Control tape playback

item	range	comment	BBC
PB Mix	<u>Off</u> /On	Mixes camera and playback	
Mid Direction	<u>Cam</u> /PB	Which has priority	
Mix Mode	<u>Y-Mix</u> / Wire W/Wire B	How it mixes, Y signals or outlines in white or black	
Mix level	0~80%		
Stop Key Freeze	<u>Off</u> /Frame/Field	Display on tape stop	

OPERATION 07 ASSIGNABLE SW

Custom switches

item	range	BBC
Assign sw <1>	Lots of possibilities	
Assign sw <2>		
Assign sw <3>		
Assign sw <4>		
Assign sw <5>		
Assign sw <RET>		

Zoom speed	0-20-99		
Return video	<u>Off</u> /On		

OPERATION 08 VF DISP 1

Items in the viewfinder

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
VF disp	Off/ <u>On</u>		
VF disp mode	1/2/ <u>3</u>	1=least info, 3=most	
Disp extender	Off/ <u>On</u>		
Disp filter	Off/ <u>On</u>		
Disp CC 5600K	Off/ <u>On</u>		
Disp white	Off/ <u>On</u>		
Disp gain	Off/ <u>On</u>		
Disp shutter	Off/ <u>On</u>		
Disp audio	Off/ <u>On</u>		
Disp tape	Off/ <u>On</u>		

OPERATION 09 VF DISP 2

More items in the viewfinder

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Disp iris	Off/ <u>On</u>		
Disp zoom	Off/ <u>On</u>		
Disp color temp	<u>Off</u> /On		
Disp batt remain	<u>Int</u> /Volt/Auto	For Anton Bauer or BPGL batteries, shows power as % remaining or continuous voltage	
Disp dc in	<u>Off</u> /On		
Disp wr level	<u>Off</u> /On		
Disp timecode	<u>Off</u> /On		
Disp pb mix	Off/ <u>On</u>		

OPERATION 10 VF DISP 3

Items in the viewfinder

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Disp low light	Off/ <u>On</u>		
Disp low light level	-99 ~ 99		
VF batt warning	10% / 20%		
Abdsolute level	<u>Off</u> /On	Shows absolute levels rather than relative	

OPERATION 11 !LED

Warnings in the viewfinder

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Gain	Off/ <u>On</u>		
Shutter	Off/ <u>On</u>		
White balance	Off/ <u>On</u>		
CC 5600K	Off/ <u>On</u>		
ATW run	Off/ <u>On</u>		
Extender	Off/ <u>On</u>		
Filter ND	<u>Off</u> /On		
Filter CC	<u>Off</u> /On		
Override	Off/ <u>On</u>		

OPERATION 12 !LED STD

Standard values for warnings

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Gain	<u>0dB</u> /Low/Mid/High		
Shutter	Off/ECS/ 1/32 1/33 1/48 1/50 1/60 1/96 1/100 1/125 1/250 1/500 1/1000 1/1000		
White balance	P/ <u>A</u> /B/PA/PB/AB		
CC 5600K	<u>Off</u> /On		
ATW run	<u>Off</u> /On		
Extender	<u>Off</u> /On		
Filter ND	<u>1</u> /2/3/4		
Filter CC	A/ <u>B</u> /C/D		
Override	<u>Off</u> /On		

OPERATION 13 MARKER 1

Warnings in the viewfinder

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Marker	Off/ <u>On</u>	All markers	

Center	<u>Off</u> / On	Centre cross	
Center mark	1/2/3/4	Type of centre mark	
Safety zone	<u>Off</u> / On		
Safety area	80% / <u>90%</u> / 92.5% / 95%		
Aspect	<u>Off</u> / On		
Aspect select	15:9/14:9/13:9/ 4:3 / 1.85/2.35		14:9
Aspect mask	<u>Off</u> / <u>On</u>		
Aspect mask lvl	0~ <u>12</u> ~15		
100% marker	<u>Off</u> / On		

OPERATION 14 MARKER2

viewfinder markers, also on side socket monitor output

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
User box	<u>Off</u> / On	User defined marker box	Off
User box width	3~ <u>240</u> ~479	In 4-pixel steps	
User box height	3~ <u>135</u> ~ 69	In 4-line steps	
User box H pos	-477~ <u>0</u> ~476	4-pixel/line steps. Limited by box size, not allowed to go off edge of screen	
User box V pos	-267~ <u>0</u> ~267		
Center H pos	-480~ <u>0</u> ~479		
Center V pos	-270~ <u>0</u> ~269		
Aspect safe zone	<u>Off</u> / On		
Aspect safe area	80% / <u>90%</u> / 92.5% / 95%		

OPERATION 15 GAIN SW

gain switch settings

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Gain low	-6/-3/0/3/6/9/12/18/24/ 30/36/42	Usual gain settings ¹	-6dB
Gain mid			0B
Gain high			+3B
Gain turbo			+9dB
Turbo sw ind	<u>Off</u> / On		
Shockless gain	<u>Off</u> / On	Disables shockless auto gain control	Off

OPERATION 16 VF SETTING

more on the viewfinder

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBCv</i>	<i>BBCf</i>
Zebra	<u>Off</u> / On		On	
Zebra select	<u>1</u> / 2/Both			
Zebra 1 det level	20%~ <u>70%</u> ~107%	Set for skin tone	75	65
Zebra 1 apt level	1%~ <u>10%</u> ~20%			
Zebra 2 det level	52%~ <u>100%</u> ~109%	Set for the camera knee point	85	
VF detail level	-99 ~ 99			

OPERATION 17 AUTO IRIS

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Iris override	<u>Off</u> / On	Allows aim point control, ± 1 stop	Off
Iris speed	-99 ~ 99	-99=slow, 99=fast	
Clip highlight window	<u>Off</u> / On	Ignores signal over 100%	
Iris window	<u>1</u> / 2/3/4/5/6/Var	Detection box shape	
Iris window ind	<u>Off</u> / On	Checks iris window against box cursor	
Iris var width	20~ <u>240</u> ~479	Variable box, set in in 4-pixel/line steps, same as box cursor	
Iris var height	20~ <u>135</u> ~269		
Iris var H pos	-460~ <u>0</u> ~450	4-pixel/line steps. Limited by box size, not allowed to go off edge of screen	
Iris var V pos	-253~ <u>0</u> ~252		

OPERATION 18 SHOT ID

identifying shots for recording

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
ID-1		4 lines, each of 12 characters, alphanumeric, symbols, spaces allowed	
ID-2			
ID-3			
ID-4			

OPERATION 19 SHOT DISP

Stuff recorded over colour bars

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
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¹ Camera noise is very visible at 12dB gain, but is probably acceptable at +9dB. Higher gain settings should be avoided wherever possible unless noise suppression is used, 18dB may be acceptable in extreme cases. Subjectively, noise performance is similar to that of the HDW790 and HDWF900R subject to using these lower gain settings.

Shot data	Off / On		
Shot time	Off / On		
Shot model name	Off / On		
Shot serial no	Off / On		
Shot id sel	Off / ID-1 / ID-2 / ID-3 / ID-4		
Shot 16:9 chara	Off / On		
Shot blink chara	Off / On		

OPERATION 20 SET STATUS

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Status abnormal	Off / <u>On</u>		
Status system	Off / <u>On</u>		
Status function	Off / <u>On</u>		
Status audio	Off / <u>On</u>		

OPERATION 21 WHITE SETTING

White balance controls

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
White switch 	<u>Mem</u> / ATW	White balance switch position B can take preset or auto	
Shockless white	Off / <u>1</u> / 2 / 3	Transition time for change of white balance (1=fast)	
ATW speed	1 / 2 / 3 / <u>4</u> / 5	Transition speed for auto-tracking white (1=fast)	
AWB fixed area	Off / On	Auto white on only centre of screen	
Filter wht mem	Off / On	Store separate white balance for each filter position	

OPERATION 22 OFFSET WHT

White balance stores

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Offset white <A>	Off / On		
Warm-cool <A>	Temp K	Shows current value, coarse adjustment	
Warm-cool bal <A>	-99 ~ 99	Fine adjustment	
Offset white 	Off / On		
Warm-cool 	Temp K	Shows current value, coarse adjustment	
Warm-cool bal 	-99 ~ 99	Fine adjustment	

OPERATION 23 SHT ENABLE

Shutter control

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Shutter ECS	Off / <u>On</u>	Shutter speeds available in the switch list, precise values depend on the system frequency	
Shutter 1/32	Off / <u>On</u>		
Shutter 1/33	Off / <u>On</u>		
Shutter 1/48	Off / <u>On</u>		
Shutter 1/50	Off / <u>On</u>		
Shutter 1/60	Off / <u>On</u>		
Shutter 1/96	Off / <u>On</u>		
Shutter 1/100	Off / <u>On</u>		
Shutter 1/125	Off / <u>On</u>		
Shutter 1/250	Off / <u>On</u>		
Shutter 1/500	Off / <u>On</u>		
Shutter 1/1000	Off / <u>On</u>		
Shutter 1/2000	Off / <u>On</u>		

OPERATION 24 LENS FILE

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Lens file select	<u>1</u> ~ 32	32 lens files allowed	
F.ID	Display only	Name of current file	
S.NO	Display only	Camera serial number	
L.ID	Display only	Lens name	
L.MF	Display only	Lens manufacturer name	

OPERATION 25 FORMAT

System speed

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBCv</i>	<i>BBCf</i>
Current	Display only			
Next	59.94i/50i/25P/23.98P	Factory values and options depend on model, P has 25P, F has 23.98	50i	25p

OPERATION 26 SOURCE SEL

Input mode for front mic

<i>Item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Front mic select	Mono / <u>Stereo</u>		

OPERATION 26 UMID SET

SMPTE330M-2003, Unique Material Identifier

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Ex-ownership Rec	<u>Off</u> / On		
Country code	4 char max	Refer to SMPTE330M for details of the codes permitted. Leave blank or enter 0 if in doubt.	
Organization	4 char max		
User code	4 char max		
Time zone	<u>00</u> ~ 3F		
Machine	Display only		

PAINT**PAINT 01 SW STATUS**

main controls

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBCv</i>	<i>BBCf</i>
Gamma	Off/ <u>On</u>		On	
Black gamma	<u>Off</u> / On		On	
Matrix	<u>Off</u> / On		On	
Knee	Off/ <u>On</u>		On	
White clip	Off/ <u>On</u>		Off	
Detail	Off/ <u>On</u>		On	Off
Aperture	Off/ <u>On</u>		On	Off
Flare	Off <u>On</u>			
Test saw	<u>Off</u> / On	Analogue sawtooth		

PAINT 02 WHITE

colour temperatures stored by the WHITE A/B switch

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Color temp <A>	Display temp K	Shows current white balance in A	
C temp bal <A>	-99 ~ 99	Fine control	
R gain <A>	-99 ~ 99	Tweaking these changes the colour temperature setting	
B gain <A>	-99 ~ 99		
Color temp 	Display temp K	Shows current white balance in B	
C temp bal 	-99 ~ 99	Fine control	
R gain 	-99 ~ 99	Tweaking these changes the colour temperature setting	
B gain 	-99 ~ 99		

PAINT 03 BLACK/FLARE

master black settings

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Master black	-99 ~ 99		
R black	-99 ~ 99		
B black	-99 ~ 99		
Master flare	-99 ~ 99		
R flare	-99 ~ 99		
G flare	-99 ~ 99		
B flare	-99 ~ 99		
Flare	Off/ <u>On</u>		
Test out select	VBS/ <u>Y</u> /R/G/B	Duplicates setting in OPERATION01	

PAINT 04 GAMMA

main gamma controls

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBCv</i>	<i>BBCf</i>
Gamma	Off / <u>On</u>	All curve bending	On	
Step Gamma	0.35~ 0.45 ~0.9		0.45	
Master gamma	-99 ~ 99	These controls have huge range, use with care	0	
R gamma	-99 ~ 99		0	
G gamma	-99 ~ 99		0	
B gamma	-99 ~ 99		0	
Gamma table	<u>STD</u> /HG		STD	HG
Gam Table (STD)	1~ <u>5</u> ~6	4=SMPTE240 (4x), 5=ITU709 (4.5x), 6=BBC (5x)	5	
(HG) Gam Table (HG)	1~ <u>4</u>	1&3=low contrast, 2&4=high contrast, 1&3=clip 100%		4 ²

PAINT 05 BLACK GAMMA

independent slope at black

<i>Item</i>	<i>range</i>	<i>comment</i>	<i>BBCv</i>	<i>BBCf</i>
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² These appear to be the same curves as in the F900R. 1&3 work well in low contrast scenes, 2&4 for high contrast scenes, 1&3 do not exceed 100% and so are safe, 2&4 use the full coding range to 109%

Black gamma	Off / On		On	
Black gam range	Low/L.mid/H.mid/ <u>High</u>		H.mid	
Master blk gamma	-99 ~ 99	Raises slope to about 7.5x	28	
R black gamma	-99 ~ 99		0	
G black gamma	-99 ~ 99		0	
B black gamma	-99 ~ 99		0	
Test out select	VBS/ Y /R/G/B	Duplicates setting in OPERATION01		

PAINT 06 KNEE

highlight compression

item	range	comment	BBCv	BBCf
Knee	Off/ <u>On</u>		On	
Knee point	50% ~ 95% ~ 109%	One soft bend	82.5%	
Knee slope	-99 ~ 99	Affects segment slope, slightly curved	15 ³	
Knee saturation	Off / <u>On</u>		On	
Knee sat level	-99 ~ 99		0	
White clip	Off / <u>On</u>		Off ⁴	
White clip level	90% ~ 109.5%			

PAINT 07 DETAIL1

item	range	comment	BBCv	BBCf
Detail	Off/ <u>On</u>	All DETAIL compensation	On	Off
Aperture	Off/ <u>On</u>	Separate APERTURE correction	On	On ⁵
Detail level	-99 ~ 99	Overall level	16	-19 ⁶
Aperture level	-99 ~ 99	Overall level	87 ⁷	
Detail H/V level	-99 ~ 99	Only changes vertical amount	0 ⁸	
Crsipening	-99 ~ 99	Signal level range that gets crsipened	0	
Level depend	Off / <u>On</u>	Detail level dependency	On	
Level depend lvl	-99 ~ 99	Detail level range affected	0	
Detail frequency	-99 ~ 99	Frequency of detail compensation	maximum ⁹	

PAINT 08 DETAIL2

item	range	comment	BBC
Knee aperture	Off / On	Extra detail above knee point	Off
Knee apt level	-99 ~ 99		
Detail limit	-99 ~ 99		
Detail wht limit	-99 ~ 99	Detail +ve excursion limit	
Detail blk limit	-99 ~ 99	Detail -ve excursion limit	
V dtl creation	NAM/G/ <u>R+G</u> /Y	Source for edge detection	
H/V control mode	HV/ <u>V</u>	HV affects horizontal and vertical, V only vertical	

PAINT 09 SD DETAIL

extra controls for downconverter, if fitted

item	range	comment	BBC
SD detail	Off/ <u>On</u>	All as for HD	Off
SD detail level	-99 ~ 99		
SD crsipening	-99 ~ 99		
SD dtl wht limit	-99 ~ 99		
SD dtl blk limit	-99 ~ 99		
SD level depend	Off/ <u>On</u>		
SD LV depend level	-99 ~ 99		
SD dtl frequency	-99 ~ 99		
SD dtl H/V ratio	-99 ~ 99		
SD cross color	-99 ~ 99	Only relevant in NTSC-land	

PAINT 10 SKIN DETAIL

³ Knee settings are designed to capture 600% overexposure (the limit of the camera performance under test) into 109% coding range, and assumes that a full colour grade will be used, with no clipping during capture. Other settings would be needed for other uses.

⁴ This allows video to go up to 109%, post-production operations must not clip this during ingest, the extra coding range is useful for capturing overexposure and allows grading to do better than otherwise.

⁵ Aperture correction gives a slight boost to medium/high frequencies and is beneficial, but for some film-look applications it might be better switched off.

⁶ This is a reasonable setting for Detail enhancement, but it causes spatial aliasing.

⁷ Aperture correction looks much more smooth and results in sharper pictures with fewer problems.

⁸ Affects either H and V or just V, depending on setting in Detail 2: H/V control mode.

⁹ The control range in the test camera was -47 to +152, clearly the result of settings in lower menu layers.

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Skin detail all	<u>Off</u> / On	All skin detail on/off	Off
Skin detect		Press rotary encoder to detect skin colour	
Skin area ind	<u>Off</u> / On	Zebra display of target area	
Skin dtl select	<u>1</u> / 2 / 3	3 separate banks of skin detail controls	
Skin detail	Off / <u>On</u>	Separate controls for each bank	
Skin detail lvl	-99 ~ 99	Detail level	
Skin detail sat	-99 ~ 99	Saturation change	
Skin detail hue	<u>0</u> ~ 359	Hue change	
Skin detail width	0 ~ <u>40</u> ~ 359	Target hue angle width	

PAINT 11 MTX LINEAR

camera matrix

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Matrix	<u>Off</u> / On	All matrices	On
Matrix (user)	<u>Off</u> / On	Roll your own matrix	Off
Matrix (preset)	Off / <u>On</u>	Standard matrices	On
Matrix (prst) sel	1 ~ <u>2</u> ~ 6	1=SMPTE240, 2=ITU709, 3=SMPTE-WIDE, 4=NTSC, 5=EBU(i.e.PAL), 6=ITU601	2
Matrix (user) R-G	-99 ~ 99		
Matrix (user) R-B	-99 ~ 99		
Matrix (user) G-R	-99 ~ 99		
Matrix (user) G-B	-99 ~ 99		
Matrix (user) B-R	-99 ~ 99		
Matrix (user) B-G	Off / <u>On</u>		

PAINT 12 MTX MULTI

multi-linear matrix, for advanced knob twiddlers only

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Matrix	<u>Off</u> / On	All matrices	On
Matrix (multi)	<u>Off</u> / On	Roll your own multi-segment matrix	Off
Matrix area ind	<u>Off</u> / On	Use zebra to show active region	
Matrix color det	Exec	Press rotary encoder to select current area	
Mtx (multi) axis	<u>B</u> B+/Mg-/Mg/ Mg+/R/R+/ Yl-/Yl/Yl+/G-/G/G+/Cy/Cy+/B-	16 hue angle zones	
Mtx (multi) hue	-99 ~ 99	Adjustment	
Mtx (multi) sat	-99 ~ 99	Adjustment	

PAINT 13 V MODULATION

white V sawtooth lens shading correction

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Vmod	Off / <u>On</u>		
Master vmod	-99 ~ 99	Collective control	
R vmod	-99 ~ 99		
G vmod	-99 ~ 99		
B vmod	-99 ~ 99		
Test out select	<u>VBS</u> / Y / R / G / B	Duplicates setting in OPERATION01	

PAINT 14 SATURATION

extra saturation control for dark bits

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Saturation	<u>Off</u> / On		Off
Saturation level	-99 ~ <u>99</u>		0 ¹⁰
Low key sat	<u>Off</u> / On		Off
L key sat level	-99 ~ 99	Collective control	
L key sat range	Low/L.mid/H.mid/ <u>High</u>		
Y black gamma	<u>Off</u> / On	Keeps saturations right	Off
Y blk gam level	-99 ~ 99	Slope	
Y blk gam range	Low/L.mid/H.mid/ <u>High</u>		

PAINT 15 NOISE SUPPRESSION

Reduces hf noise

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Noise suppress	Off / <u>On</u>		Off ¹¹

PAINT 16 SCENE FILE¹⁰ This is a general saturation control, best left alone, but could be useful for matching cameras together.¹¹ Noise suppression loses some resolution, but makes +18dB gain just about acceptable. Not needed for less than 12dB gain.

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
1		Recall one of the 5 scene files stored in the camera	
2			
3			
4			
5			
Standard		Clear all settings and return to reference values	
Scene recall		Recall file from camera or memory stick	
Scene store		Save to camera or memory stick	
F id		16 character file ID	

MAINTENANCE

MAINTENANCE 01 WHT SHADING

lens corrections

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Wht shad ch sel	<u>R</u> /G/B/Test	Select channel, lower items change	
Test out select	<u>VBS</u> / <u>Y</u> /R/G/B	Duplicates setting in OPERATION01	
R/G/B wht H saw	-99 ~ 99		5
R/G/B wht H para	-99 ~ 99		
R/G/B wht V saw	-99 ~ 99		
R/G/B wht V para	-99 ~ 99		
White saw/para	Off / <u>On</u>	All on/off	On

MAINTENANCE 02 BLK SHADING

lens corrections

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Blk shad ch sel	<u>R</u> /G/B/Test	Select channel, lower items change	
Test out select	VBS/ <u>Y</u> /R/G/B	Duplicates setting in OPERATION01	
R/G/B blk H saw	-99 ~ 99		
R/G/B blk H para	-99 ~ 99		
R/G/B blk V saw	-99 ~ 99		
R/G/B blk V para	-99 ~ 99		
Master black	Off/ <u>On</u>	All on/off	On
Master gain	-6dB to 42dB	Gain changes, only for this operation	12dB

MAINTENANCE 03 LEVEL ADJUST

main output signal levels

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
HD-Y level	-99 ~ 99	Signal level on test out	
VBS video level	-99 ~ 99		
VBS setup level	0%/ <u>7.5</u> %	Only for 59.94Hz	
Test out select	<u>VBS</u> / <u>Y</u> /R/G/B	Duplicates setting in OPERATION01	

MAINTENANCE 04 BATTERY1

voltage parameters, sets warning levels

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Info Before end	<u>5</u> % /10%/15%/ ... /95%/100%	Change these only if you really know what you're doing	
Info End	<u>0</u> % /1%/2%/3%/4%/5%		
Sony Before end	<u>11.5V</u> ~ 17.0V		
Sony End	<u>11.0V</u> ~ 11.5V		
Other Before end	11.5V ~ <u>11.8V</u> ~ 17.0V		
Other End	<u>11.0V</u> ~ 14.0V		
DC in Before end	11.5V ~ <u>11.8V</u> ~ 17.0V		
DC in End	<u>11.0</u> ~ 14.0V		
Detected battery	Display only		

MAINTENANCE 05 BATTERY2

voltage parameters, sets battery indicator scaling

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Type detection	<u>Auto</u> /Other	Auto allows auto detection of battery type	Auto
Segment no.7	11.0V ~ <u>17.0V</u>	These settings are for when "Other" is selected. Each voltage is the value at which the numbered segment turns off	
Segment no.6	11.0V ~ <u>16.0V</u> ~ 17.0V		
Segment no.5	11.0V ~ <u>15.0V</u> ~ 17.0V		
Segment no.4	11.0V ~ <u>14.0V</u> ~ 17.0V		
Segment no.3	11.0V ~ <u>13.0V</u> ~ 17.0V		
Segment no.2	11.0V ~ <u>12.0V</u> ~ 17.0V		
Segment no.1	<u>11.0V</u> ~ 17.0V		

MAINTENANCE 06 AUDIO-1

Boring stuff starts here

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Audio out (f/r)	<u>Cue</u> /EE		
Rec audio out	<u>EE</u> /Save		
Audio ch3/4 mode	Ch1/2/ <u>SW</u>	Which source routes through to ch3 and 4	
Rear XLR auto	<u>Off</u> /On		
Front mic ref	-60dB/ <u>-50dB</u> /-40dB		
Rear mic ref	<u>-60dB</u> /-50dB/-40dB	Ref level for rear xlr when set to mic	
Headphone out	<u>Mono</u> / Stereo		
Rec audio delay	<u>Off</u> /1Fld	Audio delay on recording ¹²	

MAINTENANCE 07 AUDIO-2

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Au rec emphasis	<u>Off</u> /On		
Cue rec	<u>Off</u> / <u>On</u>		
Au ref level	<u>-20dB</u> /-18dB/-16dB	1kHz tone level	
Au ref out	<u>0dB</u> /+4dB/-3dB	Output ref level	
Au ch12 agc mode	<u>Mono</u> /Stereo	Channels 1/2 as monos or stereo	
Au ch34 agc mode	<u>Mono</u> /Stereo		
Au agc spec	<u>-6dB</u> /-9dB/-12dB/-15dB/-17dB	AGC saturation level	
Au limiter mode	<u>Off</u> /-6dB/-9dB/-12dB/-15dB/-17dB	Limiter level for manual control	
Au out limiter	<u>Off</u> / <u>On</u>		

MAINTENANCE 08 AUDIO-3

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Au sg (1kHz)	On/ <u>Off</u> /Auto	On=1kHz on bars, Auto=1kHz when ch1 audio select switch (inside) is on Auto	
Mic ch1 level	Side1/ <u>Front</u> /F+S1		
Mic ch2 level	Side2/ <u>Front</u> /F+S2		
Rear1/WRR level	Side1 /Front/F+S1		
Rear2/WRR level	<u>Side2</u> /Front/F+S2		
Audio select ch3	<u>Auto</u> / Manu/Front	Front=controlled by mic level control on front of camera	
Audio select ch4	<u>Auto</u> / Manu/Front		
Audio ch3 level	0~ <u>70</u> ~100		
Audio ch4 level	0~ <u>70</u> ~100		

MAINTENANCE 09 TIMECODE

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
TC out	<u>Auto</u> /Gene		
DF/NDF	<u>DF</u> /NDF	Drop frame, only in NTSC-land	
Ext-LK UBIT	<u>Int</u> /Ext		
Ltc UBIT	<u>Fix</u> /Time	Fix=you set data, Time=records time	
Vitc UBIT	<u>Fix</u> /Time		
Watch auto adj	<u>Off</u> / <u>On</u>		
UBIT group id	<u>000</u> /101		

MAINTENANCE 10 SHOT MARKER

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
LTC UB-marker	<u>Set</u> /All/Off		
Rec shot mark	<u>Off</u> /On		
Shot mark 1	Off / <u>On</u>	Shot marking , see operations manual or details	
Sot mark 2	Off / <u>On</u>		

MAINTENANCE 11CAM CONFIG 1

General stuff

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Rec tally blink	<u>Off</u> / <u>On</u>	Blinks tally at end of battery or disc	
Rec start beep	<u>Off</u> /On		
Sub lcd mode sel	<u>Timer</u> /Off/Cont	Cont=show TC on lcd even when off	
Sub lcd timer	<u>1h</u> /3h/8h	Shows tc on lcd for this time when in Timer mode	
Video out (f/r)	<u>EE</u> /PB	Set video out during wind/rewind	
STBY off timer	Off/5min/10min/30min/ <u>60min</u>	Time to switch off in Standby	

¹² Lip sync errors occur when a shutter is used, because the shutter delays the video. This is a wonderful feature, but needs to be linked to the shutter switch.

Stop key freeze	<u>Off</u> /Frame/Field	What you get on Stop	
Emergency eject	<u>Off</u> /On	Prohibits tape eject on tape fault	
Tape led bright	Off/Low/ <u>High</u>	Brightness of tape led	

MAINTENANCE 12 CAM CONFIG 2

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Test saw select	<u>Saw</u> /Rec		
Color bar select	<u>Arib</u> /100%/75%/SMPTE		SMPTE ¹³
User & All only	<u>Off</u> /On	Show only User menus in Top menu	
RM common memory	<u>Off</u> /On	Memory sharing for remote control box	
RM rec start	<u>RM</u> / Cam / Para	Recxord enable from remote control box	
HDSDI remote i/f	<u>Off</u> /Chara/G-tly/R-tly	Enables remote control of HDSDI connected recorder	
Sht disp mode	<u>Sec</u> /Deg	Shutter display in degrees or seconds	
Fan control	<u>Auto</u> /Manu/Off	Beware of temperature rises	

MAINTENANCE 13 PRESET WHITE

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Color temp <P>	Display		
C temp bal <P>	-99 ~ 99	Fine control of preset white	
R gain <P>	-99 ~ 99		
B gain <P>	-99 ~ 99		
Awb enable <P>	<u>Off</u> / On	Allows Preset to store an auto white balance	

MAINTENANCE 14 DCC ADJUST

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
DCC function sel	<u>DCC</u> /Fix	DCC is auto knee, Fix uses values below	
DCC D range	400%/450%/500%/550%/ <u>600%</u>	Exposure value the curve reaches in DCC	
DCC point	-99 ~ 99	Minimum knee point	
DCC gain	-99 ~ 99		
DCC delay time	-99 ~ 99	Reaction speed	
DCC peak filter	-99 ~ 99	Sensitivity to peak exposure	

MAINTENANCE 15 AUTO IRIS 2

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Iris window	<u>1</u> /2/3/4/5/6/Var	Size of iris window, Var=variable below	
Iris window ind	<u>Off</u> /On	Frame marker for window	
Iris level	-99 ~ 99	Target value	
Iris apl ratio	-99 ~ 99	Ratio of peak to mean in detection	
Iris var width	20~ <u>240</u> ~479	Frame width in Variable	
Iris var height	20~ <u>135</u> ~269	Frame height in Variable	
Iris var H pos	-460 ~ <u>0</u> ~ 459	Centring	
Iris var V pos	-235 ~ <u>0</u> ~ 252		
Iris speed	-99 ~ 99		
Clip high light	<u>Off</u> /On	Ignores brightest areas	

MAINTENANCE 16 GENLOCK

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Genlock	Off/ <u>On</u>		
GI HD H phase	-99 ~ 99	Horizontal phase, HD	
GI SD H phase	-99 ~ 99	Horizontal phase, SD	
Reference	Internal/ Genlock		

MAINTENANCE 17 ND COMP

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
ND offset adjust	<u>Off</u> /On	Allows separate colour balance for each filter position	
Clear ND adjust	Exec		

MAINTENANCE 18 AUTO SHADING

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Auto blk shading	Exec	Start automatic black shading tweak	
Reset blk shad	Exec	Clear ND filter compensations	
Test out select	VBS/ Y /R/G/B	Duplicates setting in OPERATION01	

¹³ SMPTE colour bars are the accepted standard form HDTV production, but Arib will do just as well.

Master gain (tmp)	-6dB/ ... /42dB	Temporary gain for this adjustment	
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MAINTENANCE 19 APR

Automatic pixel noise reduction

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
APR	Exec	Perform automatic pixel noise reduction	
APR preset	Exec	Delete stored noise measurement	

MAINTENANCE 20 VANC RX

Ethernet connection

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Umid line 1	0~20	Line for umid data, 1 st field. 0=no umid recording	
Umid line 2	0,564~593	2 nd field	

FILE**FILE01 USER FILE**

None of this affects pictures or sound

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
User file load	Exec	load/save USER file from memory stick	
User file save	Exec		
F.ID		16 characters file name	
User preset	Exec	Resets USER menus to standard	

FILE02 USER FILE 2

customising, memory stick operations

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Store user preset	Exec	Save contents of User menus as a preset	
Clear usr preset	Exec	Return USER data to factory settings	
Customize preset	Exec	Reset customised menus to factory	
Load custom data	Off /On	Whether to load customization data on file load	
Load out of user	Off /On	Load user stuff not registered as User	
Before file page	Off /On	Whether to load stuff from beyond User pages	
User load white	Off /On	Whether to load white balances as well	

FILE03 ALL FILE

powerful customising, memory stick operations

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
All file load	Exec	Read all menu items from stick	
All file save	Exec	Save all menu items to stick	
F.ID		16 characters file name	
All preset	Exec	Reset all menu items to standard settings	
Store all preset	Exec	Save all menu items and in the Preset layer	
Clear all preset	Exec	Return all Preset menus to factory settings	
3sec clear preset	Off /On	Allows Preset layer to return to factory settings when Menu Cancel switch pressed for 3 seconds	

FILE04 SCENE FILE

less dangerous memory stick stuff

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
1		Up to 5 files in camera, 100 on a stick. Deals with Paint, shutter and white balance. Goes into sub-menu to do the load/save.	
2			
3			
4			
5			
Standard		Returns to standard setting	
Scene recall	Exec	Brings up secondary menus to save/load scene files	
Scene store	Exec		
F.ID		16 characters file name	

FILE05 REFERENCE

less dangerous memory stick stuff

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Reference store	Exec	Save REF file in from memory stick into camera	
Reference clear	Exec	Reset REF file to factory settings	
Reference load	Exec	Read REF file from memory stick	
Reference save	Exec	Save Ref file to memory stick	
F.ID		16 characters file name	
Scene white data	Off /On	Allow/disallow white data in scene file	

FILE06 LENS FILE 1

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
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Lens file recall	Exec	Brings up secondary menus, load/save up to 5 files to camera or memory stick	
Lens file store	Exec		
F.ID		16 characters file name	
Source		Sows memory number of last loaded lens file	
Lens no offset	Exec	Clear the lens file	
Lens auto recall	Off / On / S.no	Enables auto loading of lens file, if lens can talk to the camera to identify itself	
S.NO	Display only	Camera serial number	
L.ID	Display only	Name of connected lens, if it can talk to the camera	
L.MF	Display only	Lens manufacturer	

FILE07 LENS FILE 2

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Lens M Vmod	-99 ~ 99	Adjust lens file V saw shading	
Lens center H	-480 ~ 0 ~ 479	Compensates horizontal position of lens centre marker	
Lens center V	-270 ~ 0 ~ 269	And vertical	
Test out select	VBS/ Y /R/G/B	Duplicates setting in OPERATION01	
Lens R flare	-99 ~ 99		
Lens G flare	-99 ~ 99		
Lens B flare	-99 ~ 99		
Lens W-R ofst	-99 ~ 99	White balance compensation	
Lens W-B ofst	-99 ~ 99		

FILE08 LENS FILE 3

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Shading ch select	R /G/B/Test	Select channel, Test links to Test Out setting	
Test out select	VBS/ Y /R/G/B	Duplicates setting in OPERATION01	
Lens R/G/B H saw	-99 ~ 99		
Lens R/G/B H para	-99 ~ 99		
Lens R/G/B V saw	-99 ~ 99		
Lens R/G/B B para	-99 ~ 99		

FILE09 MEMORY STICK

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
M.S. format	Exec	Formats the stick, wipes all content	
M S. in > jump to	Off /User/All/Scene/ Lens/Refer/User1	Sets which menu page is automatically loaded when a memory stick is inserted	

DIAGNOSIS**DIAGNOSIS01 HOURS METER**

vtr usage meters

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Reset meter		Reset resettable meters	
Drum running		Drum hours	
Tape running		Tape hours	
Operation		Total powered time	
Threading		Number of tape threadings	
Drum running-2		Drum hours since last reset	
Tape running-2		Tape hours since last reset	
Operation-2		Total hours since last reset	
Threading-2		Threadings since last reset	

DIAGNOSIS02 TIME/DATE

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Adjust	Exec	Opens a sub-menu for setting values	
Hour			
Min			
Sec			
Year			
Month			
Day			

DIAGNOSIS03 ROM VERSION

software versions

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
AT		Firmware versions, not recorded from test camera	

SS			
FP			
AU DSP			
EQ			
DCP			

DIAGNOSIS04 DEV STATUS

reports on hardware status checks

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
I/O : MS,FP,CN,DCP,VF	OK=normal NG=Abnormal ---=state not defined		
D/A : Dcp1,Dcp2			
EEprom : Cn, Dcp, Dr			
Fram : At			
Fan : Cnb			
Lsi : Dcp1, Dcp2, Dcp3, Dcp4, Tg			
Sci : Sy, Rm, Batt			

Further menus exist but are accessible only by setting internal switches. They are best left to qualified service personnel.

2 Measurement results

Measurements were made on camera #40002, fitted with a Canon HJ22 EX7.6 zoom lens. All measurements were made using the HDSDI output, displayed on a Sony 32" grade 1 crt monitor, a waveform monitor, and recorded using proprietary software for analysis.

2.1 Sensitivity

Sensitivity was not measured directly. The specification claims 0.26lux at F/1.4 and +42dB gain. This approximates to about F/15 at 2000lux, equivalent to about 640ASA with 0dB gain, although the specification also claims that the 2000lux sensitivity is F/12 at 50Hz video rates.

2.2 Colour performance, Gamma curves, Exposure range

Using a Macbeth chart, the colour performance was judged to be typical of other Sony cameras, with the standard ITU.709 gamma curve (#5 in the menu). Red, yellow, and magenta were all somewhat oversaturated, the yellow had a greenish tinge. Performance was markedly better when using gamma law #6 (believed to be the BBC 0.4 law), because the gain near black is significantly higher. However, performance using the 709 curve was quite acceptable and produced the highest saturation.

Performance with the Hyper-gamma curves was good, HG1 and 3 matching the BBC 0.4 law quite well.

The HG2 and 4 curves have much lower gain slopes across the mid tonal range. Using a 18% reflectance grey-scale chart, the tabulated exposure apertures produced the same 50% video signal levels. This shows that the film curves are about 0.5 to 1 stop "slower" than the video curve for skin tones, although peak exposure levels stay the same.

ITU.709	F/5.8
HG1	F/4.5
HG2	F/4
HG3	F/5.6
HG4	F/4

The exposure headroom was measured by setting the gamma curve knee to a low point and slope to reach 100% with the greatest range possible. Then the exposure apertures needed to achieve 100% video level from a white card were measured with knee on and off. With knee off, F/1.8 was needed, F/5.6 with knee on. This gives the somewhat surprising range of about 3.3 stops of headroom, 1,000%.

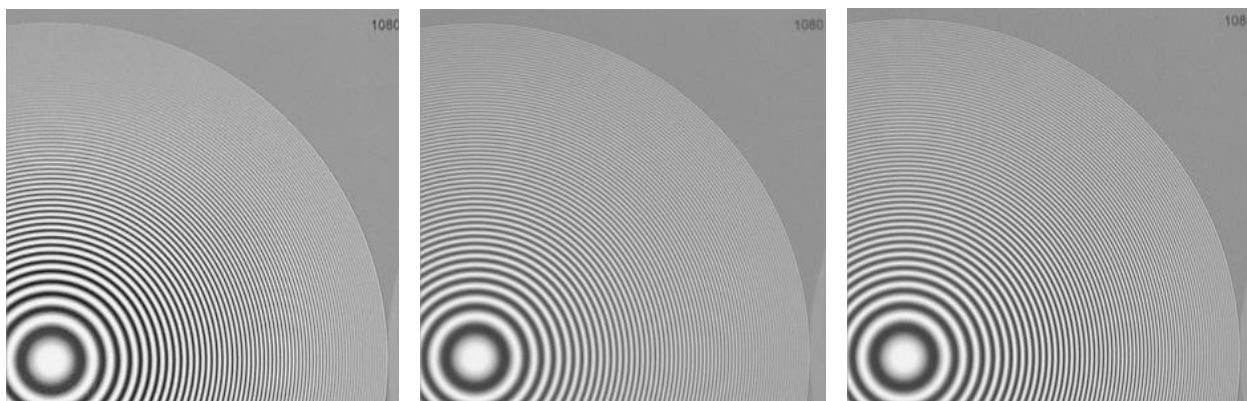
2.3 Resolution and aliasing

All testing was done with a circular zone plate test chart having 6 sinusoidally modulate patterns. The six patterns explore luminance and chroma channels on the top row, RGB channels on the bottom row, the samples shown here are each only one quadrant of the luminance (grey scale) pattern.

In 50i mode (interlaced) the vertical resolution rolls off nicely, and there appears to be a decent match of horizontal and vertical resolution. The vertical roll-off is due to the interlaced sampling, the horizontal roll-off is due to the optical filtering in the camera.

In psf mode (film-look) the vertical resolution is considerably higher, indicating that the optical filtering is only horizontal. When viewed on a crt display, there was excessive interline twitter from the interlaced display, although that should not be a problem for normal HDTV production which is normally viewed on a pixel-based display.

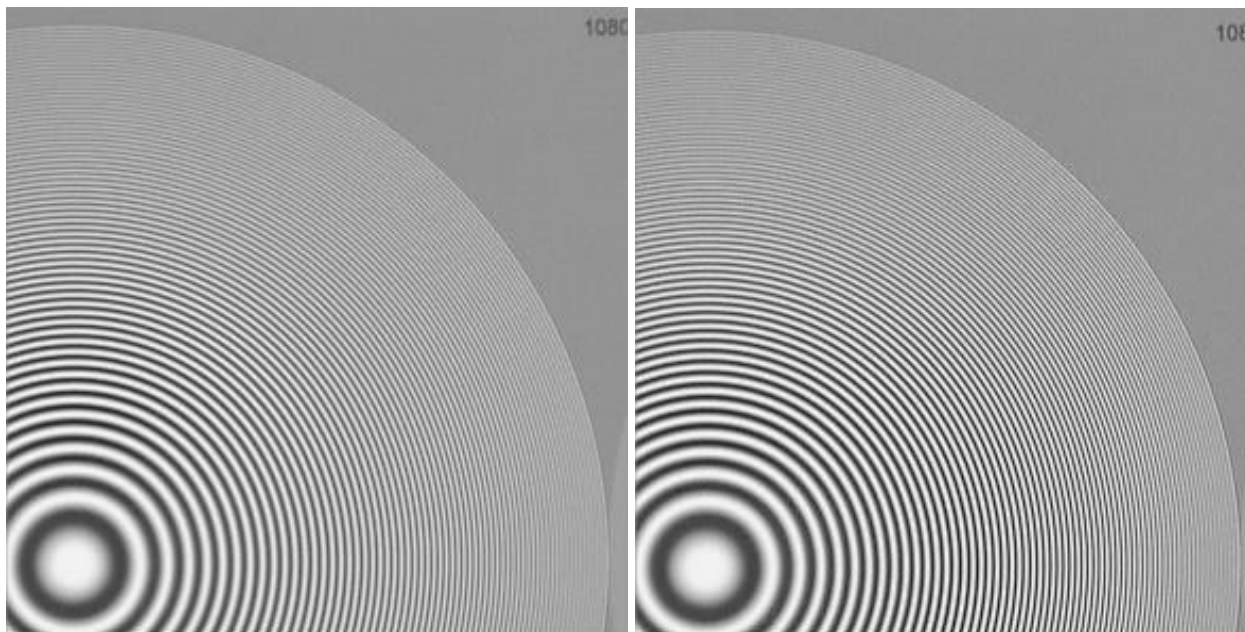
In both cases, the image was completely free from spatial aliasing.



Zone plate: left - interlaced, factory settings; mid - psf with no detail or ak; right - psf with ak=87

The detail enhancement and aperture correction controls appear to do the same as in the PDW700. The detail enhancement again generates some aliasing and so should be used sparingly, but the aperture correction does what it should do. For film work, the recommendation is to use only aperture correction (+87 maximum), which gently raises the higher frequencies. This avoids excessive interlace twitter.

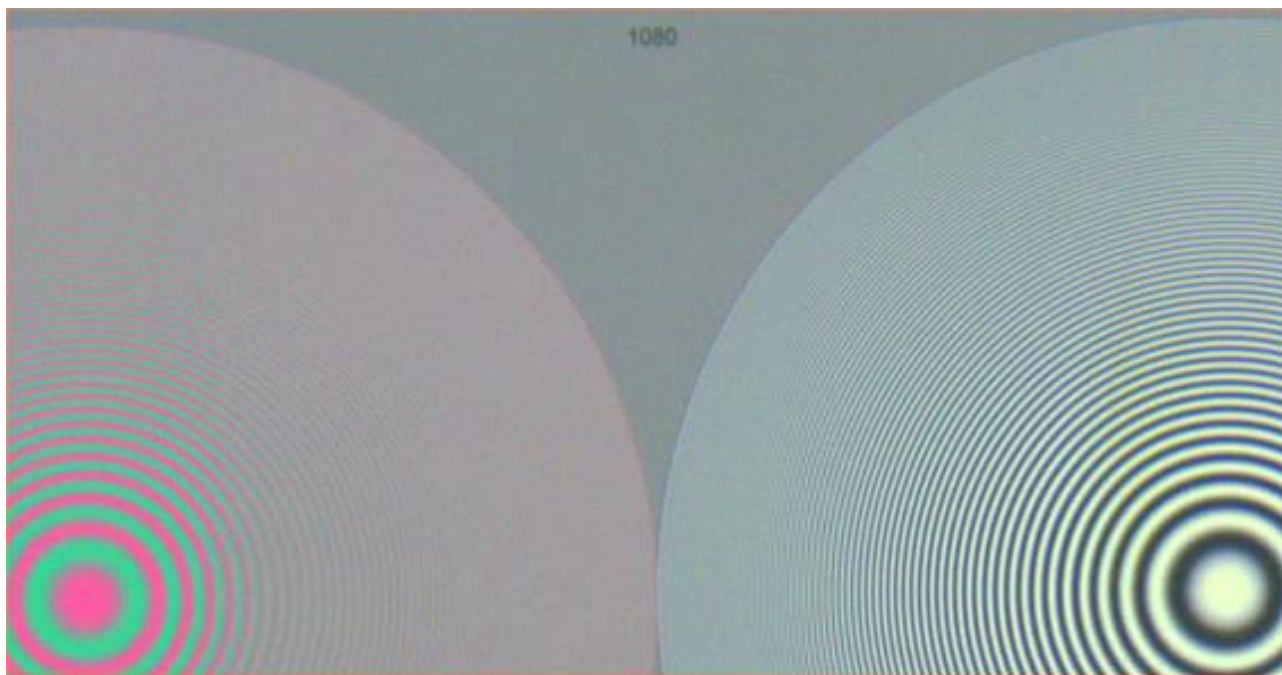
For video work, which would normally require more detail to give the picture more presence, some detail enhancement can be used. Detail at +16 is acceptable, but there is some diagonal aliasing starting to appear, which will give a slightly restless feel to pictures with significant detail content. For a really zingy picture, use both detail and aperture, but don't increase the settings unless there's a very good reason.



Zone plate: left - psf, detail=16; right – psf, detail=16, aperture correction=87

With this combination, there is some horizontal aliasing, but not enough to cause problems.

The down-sampling to HDCAM resolutions from HDSDI (to 1440/480/480 from 1920/960/960 pixels) is good. There is slight aliasing at the edge of the luma pattern, but the chroma pattern (left) is quite clean.



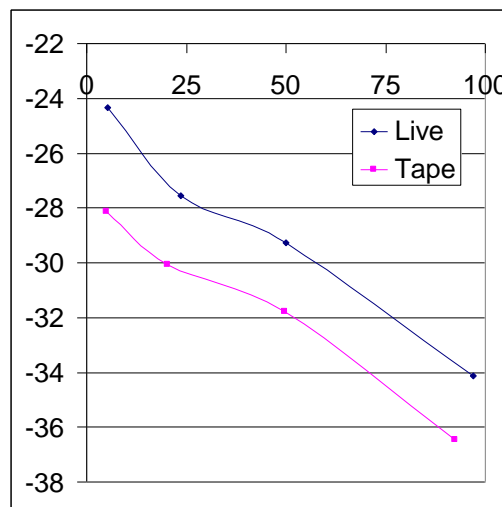
Hypergamma 1 gave resolution very similar to the BBC 0.4 gamma law (#6 in the gamma list) and indicates that the hypergamma's should all be fine for all film-look recording.

2.4 Video Noise

The specification claims that the noise level is -54dB, as with all other HDTV cameras.

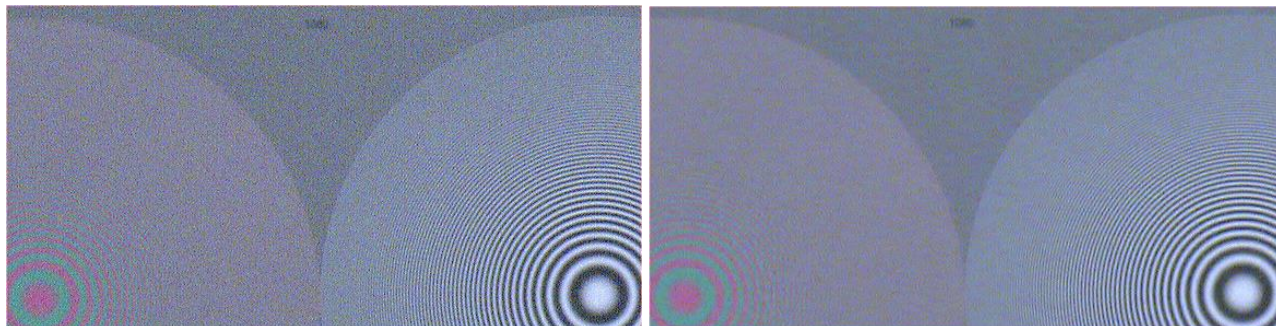
Measurements were taken on an evenly lit white card, exposed at various levels. Image files were captured via HDSDI as data files, then transcoded and decoded in software before performing a software noise analysis. Measurements were taken both live from the camera, and via HDCAM tape recording. The plot shows the noise level in dB versus video signal level in percentage points. The recorded noise is lower than the camera noise, mostly because the recorded bandwidth is significantly lower.

Both curves show the expected slope, which indicates that the noise is genuine camera head noise and not processing noise. Camera processing noise tends to be at a constant level, while camera head noise levels follow the slope of the gamma curve, and should be about 16dB worse near black (0%) than near white (100%).



Noise is worse at higher gain, better at lower gain. Since the camera sensitivity is higher than in previous HDCAM cameras, it seems that the head amplifier gains have been increased, this is born out by the surprising increase in headroom, therefore it makes sense to use half that headroom by setting camera gain to -6dB which would improve the noise levels by 6dB. +9dB is probably the safe limit; +12dB and +18dB did not look good by eye, and should only be used with noise suppression switched on.

The noise suppression was tested at +12dB gain on a zone plate chart, to see how it affects resolution.



Clearly, the noise suppression takes away quite a lot of resolution, possibly more than would be acceptable for normal use. The noise level has dropped by nearly 4dB, not the 5dB claimed in the specification.