Colorimetric and Resolution requirements of cameras

Alan Roberts

ADDENDUM 36 : Menu settings for Panasonic P2 AJ-HPX3700

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.

A brief assessment was made on a production sample of the AJ-HPX3700 (serial number K7TKA0112), a HDTV camcorder with a Canon HA18x7.6 HD lens. It is very similar in form and function to the other cameras in the HPX series, particularly the 3000 and 2700, sharing many features and having a very similar menu set.

The camera has 3 full-resolution ccds, 1920x1080 active sensors (2010x1120 total) and operates only at 1080-line HDTV standards. It can be switched between interlace (50i, 59.94i) and progressive (25psf, 29.97psf, and 23.98psf in both 2:3 and 2:3:3:2 pull-down) modes. It has a variable frame-rate mode in which it can record at frame rates from 1 per second up to the system frame rate. It can generate a "film look" in the camera, and has specific "film-look" gamma curves that incorporate many of the contrast handling features of earlier cameras, making it a great deal easier to set up. It is superficially identical to the HPX3000 and HPX3700.

The recording system is either the conventional DVCProHD format (8-bits, 1440x1080, 6.7:1 compression at 29.97Hz, 6.3:1 at 25Hz) or the newer AVC-Intra at 100Mb/s (10-bits, full resolution, H.264, I-frame only) or at 50Mb/s (¾ horizontal sample count, 4:2:0) onto solid-state P2 cards (5-cage slots in the camera). Sensitivity is specified as F/10 at 2000lux, power consumption 38 watts, weight 4.9kg without lens or viewfinder. Interestingly, it can output full-resolution images in 4:4:4 mode via dual HDSDI, but not record them. This mode was not tested.

It is a little larger than the HDX900, being wider to accommodate the P2 cards instead of the tape mechanism, and has HDSDI output. It has striking similarities to the HPX2100, 2700 and 3000 with which it should be compatible. There is a side-panel lcd display for menu setting and access to recorded files. 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 (being a camcorder) but has enough features to make multi use possible. Monitoring and connectivity have been improved over previous Panasonic models; it will genlock to either analogue HD Y or analogue composite (PAL or NTSC as appropriate); there are two video outputs, one switchable between HDSDI, SDI (appropriate down-conversion), and composite (PAL or NTSC), the other between HDSDI and HD analogue Y for monitoring. It has a LCD side-panel, useful for menu setting etc.

The camera section has 14-bit ADCs that deliver better noise performance than in earlier models. There is also an 8-second cache for pre-recording.

In this setup, the gamma correction and knee are adjusted to capture almost 2 stops of overload, and 1 stop of underexposure, to mimic film performance.

The settings derived here are from a joint test session with the HPX3000 and 2700, where it was found that the same settings could be used across the cameras, giving the same results. This means that the cameras can be freely mixed in productions.

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ADDENDUM 36 : Menu settings for Panasonic P2 AJ-HPX2300

Many menu items have little or no effect on the image. Those that do so are highlighted. The full menus are given for completeness. Where three values are given {f} denotes film use, {v} video and {w} wildlife. The film mode uses the "Filmlike1" gamma curve, which very closely resembles the best that can be done with a conventional gamma curve and knee, but with a nice smooth join; there seems no point in ignoring this curve since Panasonic have clearly put much effort into its design, and it works well. The photographic speed of the camera is unchanged using this curve ("Filmlike2" is a similar curve but copes with about a stop less of overload and reduces the photographic "speed" by about a stop, also the manual knee controls have no effect in this mode so it is not possible to customise it; "Filmlike3" further reduces the exposure range and lowers the photographic "speed" of the camera by about one stop more; both these modes should produce better noise performance and thus may well be the best option for film-like work). The camera also has the "Film-Rec" curve of the Varicam. The video mode uses conventional gamma and knee settings to achieve similar results but with more contrast compression in highlights. Both modes can cope with about 1.7 stops of overexposure (about 350% measured); the video mode (with optimal knee settings) has a slightly more pronounced change of slope in the knee but the difference is marginal. The wildlife mode uses the Film-Rec gamma. The exposure range is about 11 stops.

The shutter can be set to HALF (i.e. 180º), which avoids the problem of having to work out what it should be from the field/frame rate.

Line Mix mode appears to be the equivalent of EVS in other cameras. Switched on in 25p mode, Line Mix reduces the vertical resolution to the same as 50i, thus minimising most interlace twitter artefacts although the effect is not great. There is an 8-second video cache for pre-recording.

When shooting at 59.94 field/29.97 frame rates, drop-frame time code is always used.

Viewfinder and monitoring outputs can both have markers, individually set.

The camera "Gain" switch stores many camera settings, allowing the user to set completely different conditions selectable by that switch. However, most users will want only different gain, the menu contents given here are appropriate for the range of gains quoted, it is for the user to decide which gain settings are appropriate and to set the other conditions accordingly. Beware that the recommended settings were derived during a short laboratory test of the camera; better settings may well be found once the camera goes into general use. The settings given in each switch setting are those recommended for use at the gains given, the user may select what gains to use, but noise precludes the use of higher gains.

DRS (Dynamic Range Stretching) appears to be a fully automatic knee and gamma control, untested here, but could be useful when there's no time to derive best settings.

The camera does not have an SD mode at all.

Factory settings are underlined. Clearly, the digital processing owes much to the design of the other HDX cameras, the menu structure is very similar, and many of the settings for the other HDX cameras have the same effect in this camera. Values are given for Video (v), Film look (f), and Wildlife (w). These settings include rather more detail enhancement than usual, because the camera's basic resolution is clean enough to sustain it.

This should not be used as a substitute for reading the manual.

These settings were derived in a joint test session with the HPX3000 and 2700, where it was found that the same settings could be used in each camera, with the same results. Very possibly, the same is true with the HPX2100, but this has not yet been established.

1 Menus and settings

SYSTEM SETTING

System mode

Main video standard setting

Item	Range	description	BBC v	BBC f	BBC w
System Mode	1080-59.94i, 1080-23.98PsF, 1080-24/PsF, 1080-50i	Any change requires a power-off/on cycle to take effect. Different defaults for E/P models[1]	1080-50i	1080-50i	1080-50i
Rec Format: 1080-59.94i	DVCPROHD/60i, AVC-I 100/60i, AVC-I 100/30PN, AVC-I 100/24PN, AVC-I 50/60i, AVC-I 50/30PN, AVC-I 50/24PN	Codec selection and recording/shooting mode[2]	AVC-I 100/50i	AVC-I 100/25PN	AVC-I 100/24PN[3]
Rec Format: 1080-23.94PsF, 24PsF	AVC-I 100/24PN, AVC-I 50/24PN				
Rec Format: 1080-50i	DVCPROHD/50i, AVC-I 100/50i, AVC-I 100/25PN, AVC-I 50i/50P, AVC-I 50/25PN				
Camera Mode: DVCPROHD/ 1080 60i, 59.94i	60i, 30P, 24P, 24PA	Sets pulldown mode, not needed in AVC-I.[4]			
Camera Mode: DVCPROHD/ 1080 50i	50i, 24P				
Camera Mode: Otherwise	24P, 24P				
VFR	Off, On	Variable Frame rate			
24P VFR Rate	24, 30	Max frame rate in 23.98 or 24fps			
Frame Rate: 59.94i, 23.98PsF, 24PsF	1~24~60	Can also be set with the Synchro Shutter controls			
Frame Rate: 50i	1~25~50				
USR SW F.Rate: 59.94i, 23.98PsF, 24PsF	1~24~60	The frame rate that can be assigned to a User Button		25	24
USR SW F.Rate: 50i	1~25~50				
Scan reverse	On, Off	For lenses that invert the picture			
PC Mode Select	USB host, USB dev	For connection to USB hard-drive[5]: Host=camera control, Dev=PC control			
PC Mode	On, Off	Enables remote (PC) control			

Option mode

General options

Item	Range	description	BBC v	BBC f	BBC w
Access LED	Off, Slot side, LCD side, Both	Enables the P2-card activity LED's			
P.Off GPS Data	Hold, Clear	Holds GPS data while power off			
SDI Metadata	On, Off	Embed UMID data into HDSDI			
Save Switch (Aud out)	Off, On	Disables audio out when in power "Save"			
Save Switch (lcd)	Off, On	Disables LCD when in power "Save"			

Rec function

Specialist recording functions

Item	Range	description	BBC v	BBC f	BBC w
Interval rec mode	On, One shot, Off	Uses internal memory store			
Interval rec hold	On, Off	On keeps the settings through power Off			
Rec time	00s01f~59s29f	Frames to be grabbed, frame count goes up to the frame rate-1			
Pause time	00h00m00s01f~00h04m59s29f	Time between grabs			

[1] Panasonic's nomenclature for formats does not accord with the EBU's: Panasonic's 1080-50i would be known by the EBU as 1920x1080i/25, the number after the slash being the frame rate.

[2] P=Progressive, i=Interlaced, PsF=Progressive with Segmented Frames, i.e. progressive carried via an interlaced signal, PN=Progressive Native i.e. recording only new frames. Both I and PsF will record duplicated frames to fill the time-line at the system frame rate if needed, PN won't.

[3] In theory, this should be the best for wildlife, because it can be set variable for frame rate up to 60fps. However, the time-code and gen-lock inputs will be at 24fps, not a standard video speed. So this mode will be difficult to use with external sound recording. If 60fps is not needed, then set to 1080-50P, which will genlock to 50Hz and time-code will make sense.

[4] 24PA is actually 23.98Hz when the system speed is 59.94. PA is "advance pull-down", 2:3:3:2

[5] The camera can be used as a hard-drive source for the editor, to move clip files, controlled either from the camera or the computer.

	~23h59m59s29f		
Total take time	None~5day	None=continuous	
Total rec time	None, 00m00s01f~99m59s29f, Over100min	Report, not control	
Audio rec	On, Off	Sound capture during interval recording	
Start delay	0sec~10sec	Delay to start interval grabs	
Pre Rec Mode	On, Off	8-second cache pre-recording	
Pre Rec Time	1s~8s	Length of video cache	
Loop Rec Mode	On, Off		
Rec Start	All, Normal	All allows recording to start even during playback except in Interval Rec mode	
P.On Rec Slot Sel	Hold, Slot 1	Which P2 slot to use on power-up	

Output sel Signals on the displays

Item	Range	description	BBC		
			v	f	w
Signal Format	4:2:2, 4:4:4	444 uses both HDSDI outputs.			
P-10Log	On, Off	Selects 10-bit log to replace Film Rec gamma, for 444 output only[6]			
Output Item	Menu Only, TC, Status	Puts metadata onto video outputs			
HD SDI A-B Char	Off, A, B, Both	Superimpose characters on HDSDI feeds			
Monitor Out	VBS, HDSDI	Composite SD or HDSDI on the Monitor BNC			
Monitor Gamma	On, Off	Correct for Film-Rec gamma on video out[7]			ON
VFR/LCD Char	VF-Off, LCD-Off, On	Puts characters on LCD and viewfinder			
VF Mode	Mem, Cam	Mem=EE, Cam always shows the camera			
VF Sel	Mono, Color				
Thumbnail Out	On, Off	Puts thumbnails on monitor video outputs			
Downcon Mode	Lt-Box, Squeeze	Aspect ratio on SD monitor feed			

HDSDI A-B Out Marker What goes on the HDSDI feeds

Item	Range	description	BBC
Marker Sw	Off, A, B, Both	All markers on HDSDI outputs	
Centre Mark	Off, 1, 2, 3, 4	1=big, 2=big hollow, 3-small, 4=small hollow	
Safety Mark	Off, 1, 2	1=box, 2=corners	
Safety Area	80~90~100%	Set outer box in %age	90
Frame Mark	On, Off		
Frame Sig	4:3, 13:9, 14:9, Vista, Snsco	Vistavision=1.85, Scope=2.35	14:9
User Box	On, Off	Settable box	
User Box Width	1~13~100	Size in %age	
User Box height	1~13~100		
User Box H Pos	-50~0~50	Position in %age, from middle	
User Box V Pos	-50~0~50		

Moni Out Marker What goes on the monitoring feed

Item	Range	description	BBC
Centre Mark	Off, 1, 2, 3, 4	1=big, 2=big hollow, 3-small, 4=small hollow	
Safety Mark	Off, 1, 2	1=box, 2=corners	
Safety Area	80~90~100%	Set outer box in %age	
Frame Mark	On, Off		
Frame Sig	4:3, 13:9, 14:9, Vista, Snsco	Vistavision=1.85, Scope=2.35	
User Box	On, Off	Settable box	
User Box Width	1~13~100	Size in %age	
User Box height	1~13~100		
User Box H Pos	-50~0~50	Position in %age, from middle	
User Box V Pos	-50~0~50		

LCD monitor Simple controls

[6] This should be a good way of capturing 444 output, similar to equivalents on other cameras intended to shoot in film-mode.

[7] This is a very welcome addition. Film-Rec gamma is very good, but difficult to use. This correction is an approximation to the curve-bending needed in post, and so should produce representative monitoring.

Item	Range	description	BBC
Brightness	-7~0~+7		
Color Level	-7~0~+7		
Contrast	-7~0~+7		
Backlight	Normal, High		
Self Shoot	Normal, Mirror		

Genlock

Item	Range	description	BBC
Genlock	Int, Ext	Genlock source	
GL.Phase	HDSDI, Composit	Which output is locked[8]	
H.Phase Coarse	-100~0~100	Coarse H timing	
H.Phase Fine	-100~0~100	Fine H timing	

PAINT MENUS

RB Gain Control Colour balancing

Item	Range	description	BBC
R Gain AWB Pre	-200~0~200	Red gain in switch Preset balance	
B Gain AWB Pre	-200~0~200	Blue gain in switch Preset balance	
R Gain AWB A	-200~0~200	Red gain in switch A balance	
B Gain AWB A	-200~0~200	Red gain in switch A balance	
R Gain AWB B	-200~0~200	Red gain in switch B balance	
B Gain AWB B	-200~0~200	Red gain in switch B balance	
AWB A Gain Offset	On, Off	On adds A values above after rebalance in A	
AWB B Gain Offset	On, Off	On adds B values above after rebalance in B	

RGB Black Control More colour balancing

Item	Range	description	BBC
Master Ped	-200~0~200	Master black level	0
R Pedestal	-100~0~100	Red ped, reports value from remote control	
G Pedestal	-100~0~100	Green	
B Pedestal	-100~0~100	Blue	
Pedestal Offset	On, Off	On enables these values	
R Flare	-100~0~100	Red flare correction	
G Flare	-100~0~100	Green	
B Flare	-100~0~100	Blue	

Matrix (User preset) A,B Colour matrix, user settings

Item	Range	description	BBC
Matrix Table	A, B	Two user tweakable matrices	
Matrix R-G	-63~31~63	Settings for matrix A or B[9]	31
Matrix R-B	-63~-4~63		-8
Matrix G-R	-63~-1~63		-1
Matrix G-B	-63~4~63		4
Matrix B-R	-63~1~63		1
Matrix B-G	-63~-1~63		-1
L Matrix Table	Off, A, B	Select matrix in Low	A
M Matrix Table	Off, A, B	Mid	A
H Matrix Table	Off, A, B	High gain setting	A

Color Correction rather dangerous territory

Item	Range	description	BBC
R (Sat/Phase)	-63~0~63	Adjusts colour in 45 degree segments, tweaks saturation and hue.	
R-Mg (Sat/Phase)	-63~0~63		
Mg (Sat/Phase)	-63~0~63		
Mg-B (Sat/Phase)	-63~0~63	This is rather dangerous, but can be very useful	

[8] The monitoring output, when set to SD, has about 90-line delay relative to HD output. This control determines which output is actually locked to the genlock source.

[9] These matrix settings are the same as for the HPX3000 and HPX3700. They make slight improvements to the appearance of a Macbeth test chart. Very possibly, they would improve the HPX2100 as well.

B (Sat/Phase)	-63~0~63	for special effects. Generally, you should avoid this unless you have good test kit, including comprehensive colour test charts.	
B-Cy (Sat/Phase)	-63~0~63		
Cy (Sat/Phase)	-63~0~63		
Cy-G (Sat/Phase)	-63~0~63		
G (Sat/Phase)	-63~0~63		
G-Yl (Sat/Phase)	-63~0~63		
Yl (Sat/Phase)	-63~0~63		
Yl-R (Sat/Phase)	-63~0~63		+63/+60[10]
Color Correct	Off, On		On

Low Setting Low Level Gain switch position

Item	Range	description	BBC		
			v	f	w
Master Gain	-3, 0~30dB	dB settings, 3dB steps	-3	-3	-3
H Dtl Level	0~10~63	[11]	10	8	6
V Dtl Level	0~15~31		15	12	8
Dtl Coring	0~4~60		4		
H Dtl Freq	0~18~31		31		
Level Dep	0~1~5	Low luma zone, no correction	1		
Gamma	0.30~0.45~0.75	0.01 steps	0.45		
Black Gamma	-8~Off~+8	No other controls	Off		
Black Gamma Range	1, 2, 3	1=20%, 2=30%, 3=40%			
Matrix Table	A, B, Off	User preset matrices	A		
Color Corr.	On, Off	12 segment adjust, see above	On		

Mid Setting Mid Level Gain switch position

Item	Range	description	BBC		
			v	f	w
Master Gain	-3~3~30dB	dB settings, 3dB steps	0	0	0
H Dtl Lev	0~8~63		8	6	5
V Dtl Lev	0~12~63		12	8	6
Dtl Coring	0~12~60		8		
H Dtl Freq	0~18~31		31		
Level Dep	0,1~5	Low luma zone, no correction	1		
Gamma	0.30~0.45~0.75	0.01 steps	0.45		
Black Gamma	-8~Off~+8		Off		
Black Gamma Range	1, 2, 3	1=20%, 2=30%, 3=40%			
Matrix Table	A, B, Off	User preset matrices	A		
Color Correct	On, Off	12 segment adjust, see above	On		

High Setting High Level Gain switch position

Item	Range	description	BBC		
			v	f	w
Master Gain	-3~6~30dB	dB settings, 3dB steps	6	6	6
H Dtl Lev	0~6~63		6	5	4
V Dtl Lev	0~10~63		8	7	6
Dtl Coring	0~12~60		12		
H Dtl Freq	0~18~31		31		
Level Dep	0~3~5	Low-luma zone, no correction	1		
Gamma	0.30~0.45~0.75	0.01 steps	0.45		
Black Str	-8~Off~+8		Off		
Black Gamma Range	1, 2, 3	1=20%, 2=30%, 3=40%			
Matrix Table	A, B, Off	User preset matrices	A		
Color Correct	On, Off	12 segment adjust, see above	On		

Additional Dtl Detail, extra controls

Item	Range	description	BBC

[10] Yellow was rather green and de-saturated. This setting makes some improvement but still doesn't get it right. The user should decide whether to use it or not.

[11] The factory settings for detail are a little high, but don't do much damage. I prefer these lower values.

Knee Ape Lvl	Off, 1~5	Correction in knee compressed zone	Off[12]
Dtl Gain +	-31~0~31	correction, +ve going edges	0
Dtl Gain -	-31~0~31	correction, -ve going edges	0
Dtl Clip	0~63	Clip level of detail correction	0
Dtl Source	(R+G)/2,(G+B)/2, (2G+R+B)/4, (3G+R)/4, R, G	Doesn't make much difference except when noise level is high	
Master Dtl	-31~0~31	Copy of master control	0

Skin Tone Dtl

Item	Range	description	BBC
Skin Tone Dtl	Off, A, B, AB	Select skin tone table, reduces wrinkles	Off
Zebra VF	On, Off	Zebra on skin tone detector	
Zebra HD SDI A	On, Off	Adds skin tone zebra to HDSDI	
Zebra HD SDI B	On, Off		
Zebra Moni	On, Off	And on the monitor output	
Detect Table	A, B	Separate tables of target tones	
Skin Tone Get		Looks for skin tone	
Skin Dtl Effect	0~16~31	Sharp/Soft detail	
Y Max	0~190~255	Max luma level for skin	
Y Min	0~10~255	Min luma level for skin	
I Center	0~35~255	Saturation mean level for skin	
I Width	0~55~255	Saturation range for skin	
Q Width	0~10~90	Hue mean level for skin	
Q Phase	-180~0~179	Hue range for skin	

Cam Main Menu 1, Knee Level Don't use Auto knee, manual is better

Item	Range	description	BBC		
			v	f	w
Master Ped	-200~0~200	Duplicate entry for pedestal	0		
Manual Knee	On, Off	Valid only if AUTO is off	On		
Knee Point	70%~93~107%	Manual break point	85		
Knee Slope	0~85~99	Gain in knee zone, about 2.5 stops overload	99	50	50
White Clip	On, Off		On		
White Clip Lvl	90%~109%		109%[13]		
A Knee Point	80%~93~107%	Auto knee point	85%		
A Knee Level	100~107~109		105		
A Knee Response	1~4~8	Auto knee response speed (low=fast)	4		
Chroma level	Off,-99%~0%~40%	Saturation control[14]	0		
DRS effect depth	1, 2, 3	Dynamic Range Stretch, auto-tweaks gamma and knee	1		
Hi-Color Sw	On, Off	Expands colour dynamic range[15]	Off		
Hi-Color Level	1~32	Dynamic colour expansion range			

Gamma Differentials and colour tweaking

Item	Range	description	BBC		
			v	f	w
Master Gamma	0.30~0.45~0.75		0.45		
R Gamma	-15~0~15	Set R away from Master	0		
B Gamma	-15~0~15	Set B away from Master	0		
Gamma Mode Sel	HD, SD, Filmlike1, Filmlike2, Filmlike3, FilmRec, Video Rec	HD=709, SD=BBC0.4, approximately. Film-Rec is Varicam Film Rec[16]	HD	Film like1	Film -Rec

[12] This was not specifically tested, as its relevance depends on the type of scene. Use it if there is needed detail in any part of the scene above the knee point or above 100%.
[13] Video signals will go above 100%. Make sure that the post-production operation knows this and can deal with it.
[14] Use this as a saturation control, rather than tinkering in the Color Correction.
[15] Control over saturation in the upper part of the luma range, around the knee.
[16] For Filmlike 3, Panasonic recommend using manual knee (Point=85%, Slope=50), Filmlike1 and 2 effectively built-in knee . The gamma curves can be ordered by the video level from an 18% reflectance chart, HD, Filmlike1, Filmlike2, Filmlike3, Video-Rec, Film-Rec. When using Film-Rec, the Monitor Gamma function should be used (see Output Sel menu).

F-Rec Dynamic Lvl	200%, 300%, 400%, 500%, 600%	Exposure range in Film-Rec			[17]
F-rec Black Str Lvl	0~30%	Black Stretch specific to Film-Rec			
V-Rec Knee Slope	150~500%		[18]		
V-Rec Knee Point	30%~107%	Knee point specific to Video-Rec			

Camera Settings

Item	Range	description	BBC		
			v	f	w
Detail	On, Off	All detail	On	On	Off
Gamma	On, Off		On		
Test Saw	On, Off				
Flare	On, Off				
H-F Compe	On, Off	Wide-band aperture correction	Off		

VF Display User controls (RC=remote control)

Item	Range	description	BBC		
			v	f	w
Status Mode	Normal, Film-Rec	Film-Rec disables much of what follows			
Disp Condition	Normal, Hold	Show switch status: Normal=On, Hold when ModeCheck pressed	Normal		
Disp Mode	1,2,3	1=off, 2=some, 3=all			
VF Out	Y,NAM,R,G,B	What you see, NAM=non-additive mix	Y		
VF Dtl	0~5~10	10 roughly doubles the HD detail in the v/f			
VF Dtl Coring	0~15	Avoids enhancing noise			
VF H.Dtl Freq	1~4~6				
Zebra 1 detect	0%~70~109%	Set for skin tone (BL-TR)	75	65	65
Zebra 2 detect	0~85~109%	Set for white (TL-BR)	100%		
Zebra 2	Off, Spot, On	SPOT works only if Zebra 2>1	Spot		
Low Light Lvl	Off, 10%~35%	Warns at low light level	35%		
RC menu Disp	On, Off	Shows menus in v/f when RC is connected			
Marker/Char Lvl	50%~100%	Marker/Character brightness			
Synchro scan disp	Sec, Deg	Seconds or degrees, only for synchro shutter			

VF Marker Viewfinder stuff

Item	Range	description	BBC
Table	A, B	Switch between AB, 2 sets of setups set below	
Centre Mark	Off, 1~4	Cross size/type	
Safety Mark	Off, 1, 2	1=box, 2=corners	
Safety Area	80%~90~100%	Size of safety area	
Frame Mark	On, Off	Frame marker	
Frame Sig	4:3, 13:9, 14:9, Vista, Cnsco	Vistavision is 1.85, Cinemascope=2.35	14:9
Frame Lvl	0~15	Picture level outside frame mark, 15=same	

VF User Box More viewfinder stuff

Item	Range	description	BBC
User Box	On, Off	Custom frame	
User Box Width	1~13~100	Width, %	
User Box Height	1~13~100		
User Box H Pos	-50~0~50	0=centred	
User Box V Pos	-50~0~50		

VF Indicator 1 And yet more

Item	Range	description	BBC
Extender	On, Off	Lens extender	
Shutter	On, Off	Shutter speed display	On
Filter	On, Off	Filter position	On
White	On, Off	Show AWB or Preset A/B	
Gain	On, Off		

[17] This controls the exposure range of the camera. Set 600% in very high contrast scenes, 200% for low-contrast scenes.
[18] Use this control when shooting in Video Redc. 150% for low contrast scenes, 500% for high contrast, to taste.

Iris	Off, Iris	Iris (aperture/auto) display	
Camera ID	Off, Bar	Show camera ID over bars	
ID Position	UpperR, UpperL, LowerR, LowerL	Placement	
Date/Time	On, Off	Show time/date with camera ID	
Zoom Lvl	On, Off	Focal length	
Color Temp	On, Off		
System Mode	On, Off	Camera system speed	
Rec Format	On, Off		
Frame Rate	On, Off	Selects Dynamic Range Stretcher display	

VF Indicator 2 And still more

Item	Range	description	BBC
CAC	On, Off	Astigmatism correction[19]	
Gamma Mode	On, Off		
DRS	On, Off		
P-10Log	On, Off	Log law for 44 dual HDSDI output	
VF Gamma	On, Off	Gamma compensation for Film Rec mode	
Monitor Gamma	On, Off		

VF Indicator 3 Even more

Item	Range	description	BBC
P2 Card Remain	Off, One Card, Total	How much is left	
Battery	On, Off	Voltage	On
Audio Level	On, Off	Bar-graph meters	On
TC on color bar	On, Off		
TC	Off, TCG, TCR, TCG/TCR	The usual timecode stuff	
System Info	Off, Always, Normal	Normal=3 second display of problems	
Save LED	Save, P2 Card	Save warns when in Save mode, P2 warns when card nearly full	
Rec Status	On, Off	Rec indicator in VF	
Proxy Rec	On, Off	Proxy recording to P2 and/or SD card	

Mode Check Ind What happens when you press Mode Check

Item	Range	description	BBC
Status	On, Off	Get the status screen	On
!LED	On, Off	Shows why !LED might be lit	On
Function	On, Off	Function screen	On
Audio	On, Off	Audio screen	On
CAC	On, Off	Lens tweaks	
User Sw Status	On, Off		
P.On Ind	On,Off	Get status screen up at power-on	On

! LED VF warnings

Item	Range	description	BBC
Gain (0dB)	On, Off		
Shutter	On, Off		
White Preset	On, Off		
Extender	On, Off		
Black Gamma	On, Off		
Matrix	On, Off		
Color Correct	On, Off		
Filter	On, Off		

OPERATION

Camera ID 3 lines of text

Item	Range	description	BBC
ID1		Max 10 characters	
ID2			
ID3			

[19] Astigmatism correction for lenses that have the software to talk to the camera.

Shutter Speed Select which speeds go onto the switch list

Item	Range	description	BBC
Syncrho Scan	On, Off	Speed set by buttons near filter wheel, longest exposure depends on frame rate	
Synchro Scan 2	On, Off		
Position 1	On, Off	ON adds items to list of settings that can be cycled through using the switch below the lens.	
Position 2	On, Off		
Position 3	On, Off		
Position 4	On, Off		
Position 5	On, Off		
Position 6	On, Off		

Shutter Select

Item	Range	Factory	description	BBC
Position 1	[59.94] 1/60, 1/100, 1/120, 1/250, 1/500, 1/1000, 1/2000, HALF, 180d, 172.8d, 144d, 120d, 90d, 45d [50] 1/50, 1/60, 1/100, 1/120, 1/250, 1/500, 1/100, 1/2000, HALF, 180d, 172.8d, 144d, 120d, 90d, 45d	180d	HALF keeps exposure at 180º irrespective of field or frame rate.	1/60
Position 2		172.8d		1/120
Position 3		144d		1/250
Position 4		120d		1/500
Position 5		90d		1/1000
Position 6		45d		HALF

User SW Assign user switches

Item	Range	Factory	description	BBC		
				v	f	w
User Main Sw	Inh, I.Over, S.Blk, B.Gamma, Yget, DRS, Assist, C.Temp, VFR, FRate, VF Gam, Audio Ch1, AudioCh2, RecSw, RetSW, Pre.Rec, SlotSel, PCmode	VFR[20]				
User 1 Sw		Y Get			Y Get[21]	
User 2 Sw		VF Gam[22]				
Marker Sel (User 3 Sw)	Inh, Y get, Assist, VF Gam, VF Mark, Rec Sw, Ret Sw, Pre Rec, Slot Sel, PC Mode	VF Mark				
Text memo (User 4 Sw)	Inh, Y get, Assist, VF Gam, VF Mark, Rec Sw, Ret Sw, Pre Rec, Slot Sel, PC Mode, Text Memo	Text Memo				

SW Mode More general stuff

Item	Range	description	BBC
Ret Sw	R.Review, Cam Ret	Review last few seconds/check Genlock input	R.Review
S.Blk Lvl	Off, -10, -20, -30	Super black level, not a good idea	
Auto Knee Sw	On, Off, DRS	Disables Auto Knee switch	Off
Shd,Abb Sw Ctl	On, Off	Does black shading with black balance if pressed >8secondfs	On
Color Bars	SMPTE, Full Bars, Split		SMPTE
RC Check Sw	R.Review, Play	What haopopens when you press Record on the remote control	
Side Sw lock	Off, On	On disables Gain/Output/AWB switches	

White Balance Mode Presets

Item	Range	description	BBC
Filter Inh	On, Off	Off allows separate balance data to be stored for each filter wheel position	On
Shockless AWB	Off, Fast, Normal, Slow1, Slow2, Slow3	Response speed to white change, 1~20 seconds	
AWB Area	25%, 50%, 90%	Central screen target area	
Temp Pre Sel Sw	Var, 3.2k/5.6k	Fixes auto white to either 3.2 or 5.6k, good idea	
Color Temp Pre SW	2300K~3200K~9900K	AWB set in Preset	3200K
AWB A Temp	2300K~3200K~9900K	AWB set in A, reports result of rebalance	3200K
AWB B Temp	2300K~3200K~9900K	AWB set in B, reports result of rebalance	3200K

Lens/Iris

[20] This is the easiest way to shoot off speed, so is a must for wildlife shooting.
[21] And this is a wonderfully useful light meter, giving the luma level at the centre marker.
[22] VF Gam is essential when shooting with Film Rec gamma, so is a must for wildlife shooting.

Item	Range	description	BBC
A.Iris Level	0~45~100	Auto iris target level, luma	
A.Iris Peak/Ave	0~30~100	Ratio, 0=average, 100=peak	
A.Iris Window	Norm1, Norm2, Centr	1=full frame, 2=not top, centre=spot	
Iris Gain	Cam, Lens	Where the iris gain control is	
Iris Gain Value	1~10~20	Value used when set to Cam	

MAIN OPERATION

Battery/P2 Card

Item	Range	description	BBC
Battery Select	Propac14, Trimpac14, Hytron50, Hytron140, Dionic90, Dionic160, NP-L7, Endura7, Endura10, EnduraD, PagL95, BP-GL65/95, Nicd14, TypeA, TypeB	Set your power source type and all the warnings and meters will read correctly	
Ext DC in select	Ac adpt, Propac14, Trimpac14, Hytron50, Hytron140, Dionic90, Dionic160, NP-L7, Endura7, Endura10, EnduraD, PagL95, BP-GL65/95, Nicd14, TypeA, TypeB		
Batt near end alarm	On ,Off	Set near end alarm	
Batt near end cancel	On, Off	Mode check button cancels alarm	
Batt end alarm	On, Off		
Batt remain full	70%, 100%	Indicates full at this level	
Card near end alarm	On, Off	Beep near end of card	
Card near end time	2min, 3min	Time for beep	
Card end alarm	On, Off	Beep at card end	
Card Remain	3min, 5min	Segment size in display	

Battery Setting 1

Decide which batteries exist in the list

Item	Range	description	BBC
Propac14	Auto, Manual (11~13.8~15)	Select each battery with * Auto/Manual controls whether you can set the warning level voltage manually. Be sensible with this and you'll never have silly battery warnings	
Trimpac14	Auto, Manual (11~13.6~15)		
Hytron50	Auto, Manual (11~13.2~15)		
Hytron140	Auto, Manual (11~13.0~15)		
Diconic90	Auto, Manual (11~13.6~15)		
Diconic160	Auto, Manual (11~13.1~15)		
NP-L7	Auto, Manual (11~12.9~15)		
Endura7	Auto, Manual (11~13.2~15)		
Endura10	Auto, Manual (11~13.2~15)		
EnduraD	Auto, Manual (11~13.2~15)		
PagL95	Auto, Manual (11~13.5~15)		
BP-GL65/95	Auto, Manual (11~13.6~15)		

Battery Setting 2

Continued

Item	Range	description	BBC
Nicd14			
Near End	11.0~13.8~15.0		
End	11.0~13.4~15.0		
TypeA			
Full	12.0~15.1~17.0		
Near End	11.0~13.6~15.0		
End	11.0~12.9~15.0		
TypeB			
Full	12.0~15.1~17.0		
Near End	11.0~13.6~15.0		
End	11.0~12.9~15.0		

Mic/Audio 1

Item	Range	description	BBC
Front VR Ch1	Off, Front, WL, Rear, All	Where the audio control is, Ch1	
Front VR Ch2	Off, Front, WL, Rear, All	Audio control, Ch2	

Mic Lowcut Ch1	Off, Front, WL, Rear	Bass-cut filters, to 200Hz	
Mic Lowcut Ch2	Off, Front, WL, Rear		
Mic Lowcut Ch3	Off, Front, WL, Rear		
Mic Lowcut Ch4	Off, Front, WL, Rear		
Limiter 1	On, Off		
Limiter 2	On, Off		
Aut Level Ch3	On, Off		
Auto Level Ch4	On, Off		
Test Tone	Off, Normal, Always, ChSel	Which channel(s) get test tone	

Mic/Audio 2

Item	Range	description	BBC
Front Mic Power	On, Off	Phantom power	
Rear Mic Power	On, Off	Phantom power	
Monitor Select	Stereo, Mix	What's monitored	
Front Mic level	-40, -50dB		
Rear Mic Ch1 Level	-50, .-60dB		
Rear Mic Ch2 Level	-50, .-60dB		
Rear Line In Level	-3, 0, +4dB		
Audio Out level	-3, 0, +4dB		
Headroom	18, 20dB	Ref level, Factory=(50) 18dB, (59.94) 20dB	18dB
Wireless Warn	On, Off	Warns when radio mic level is poor	
Wireless Type	Single, Dual	Mono/Stereo wireless	

TC/UB Time code and User Bits

Item	Range	description	BBC
TC Mode	DF, NDF	Always NDF at 50 and 24	NDF
UB Mode	User, Time, Date, Ext, TCG, FrmRate, Regen	User bits data	
VITC UB MODE	User/Ext, Time, Date, TCG, FrmRate, Regen		
TCG Set Hold	On, Off	Store TC when powered down	
First Rec TC	Preset, Regen	How TC is started	
P.Off LCD Display	On, Off	TC display when power OFF	
TC Out	TCG, TCG/TCR		
TC Disp Sel	30F, 24F	Base for 59.94 frame count, always 25 at 50	
TC Video Synchro	0, 1, 2, 3	Correction for TC, refer to the manual	
Rec Recview Regen	On, Off	On uses recorded TC on replay	

UMID Set/Info

Item	Range	description	BBC
Country		Input your data, displays "No-Info" until you do so	
Organization			
User			
Device Node		ID number of the product	

FILE MENUS

SD Card Read/Write

Item	Range	description	BBC
R.Select	1~8	File number to read	
Read		load from file	
W.Select	1~8	File number to write	
Write		write to file	
Card Config		Format SD card	
Title Read		load user data	
Title1-8		Title, max 8 characters	

Cam Card R/W Select Decide what gets saved on the card

Item	Range	description	BBC
System Mode R/W	On, Off	System and Camera Modes	
ID Read/Write	On, Off	On=save cam ID to card	

User Menu Select R/W	On, Off	Load/save Menu items that are/aren't marked	
System Menu R/W	On, Off		
Paint Menu level R/W	On, Off		
Paint Menu Sw R/W	On, Off		
VF Menu R/W	On, Off		
Cam Ope menu R/W	On, Off		
Main Ope Menu R/W	On, Off		
Mainte Menu R/W	On, Off		

CAC File Card Read Lens astigmatism correction

Item	Range	description	BBC
Card read select.	1~32	Select astigmatism data table	
Read		Read it	
Delete		Delete it	
Title read		Read file name	
Title scroll		Scroll CAC files: press rotate Jog wheel	
01-32		File name, 27 characters max	

File Read Screen

Item	Range	description	BBC
Title.		Shows file name	
Yes		Files are recorded in camera	
No (Cancel)		Or not	
Mem store no	Empty, 1~32	Store number to record to, Empty looks for an empty one	
Title scroll	1~25	Scroll CAC files: press rotate Jog wheel	
01-32		File name, 27 characters max	

Lens File

Item	Range	description	BBC
File No.	1~64	Lens file number	
Read		Read it	
Write		Write it	
Reset All		Reset lens file data	
Title1-64		Max 12 characters	

Lens File Card R/W

Item	Range	description	BBC
Card File Select	1~64	64 lens files in pages of 8	
Read			
Write			
Title Read			
Title1-8		Create a title	

Scene

Item	Range	description	BBC
Read Cinematograph			
Read User Data			
Scene Sel	1~16	16 scene files	
Read			
Write			
Reset		Create a title	
Title scroll	1~12	Scroll files: press rotate Jog wheel	
Title1-5		Create a scene file	
1~16		Display up to 16 file names	

Initialise **Reset**

Item	Range	description	BBC
Read Factory Data.		Resets User/Scene data	
Write User Data		Save User data in the camera	

MAINTENANCE

Lens Adj

Item	Range	description	BBC
F2.8 adj	On, Off		
F16 adj	On, Off		

Black Shading

Item	Range	description	BBC
Correct	On, Off		On
Detection (Dig)		This makes it happen	

White Shading

Item	Range	description	BBC
Correct	On,Off		On
Saw/Para	-255~0~255	Values for R/G/B, H/V, Para/Saw	

Lens File Adj

Item	Range	description	BBC
RB Gain Ctrl reset	On, Off		
Lens R Gain Offset	-200~0~200		
Lens B Gain Offset	-200~0~200		
Lens R Flare	0~100		
Lens G Flare	0~100		
Lens B Flare	0~100		

CAC ADJ

Item	Range	description	BBC
CAC Control	On, Off	Chromatic aberration correction	
CAC File Delete		Clear memory and file	
CAC File No.	1~32	32 files	
Title Scroll	1~25	Scroll through the files	
01		Up to 32 file names per page	
02			
03			
04			
05			
06			
07			
08			

Diagnostic 1 Show software versions

Item	Range	description	BBC
Camsoft Main			
Cam Table			
Pulse FPGA			
UCIG FPGA			
FM FPGA			
Char FPGA			
DC FPGA			

Diagnostic 2 **More software versions**

Item	Range	description	BBC
Syscon Soft			
LCD Soft			
P2CS OS			
P2CS AP			
Sh4Ctrl FPGA			
PRCCTRL FPGA			
SYSIF FPGA			
AVC-I Soft			

AVC-I FPGA			

Hours Meter Usage record

Item	Range	description	BBC
Operation		10h	
P.On times			

Option Some more

Item	Range	description	BBC
Eng Security	On, Off	Turns all menus off. DON'T DO THIS unless you're happy to send the camera back to Panasonic to have it turned back on	Off
Frame Rate UB	Frm Rate, Menu	FRM Rate sets frame rate into User Bits	
Audio out delay	Delayed, Through	Speaker/headphone delay to compensate for compression delay	
Fan mode	Off, Auto	Auto recommended unless noise is a problem, remember to turn it to Auto afterwards	
Rate Set At Rec	On, Off	ON allows frame-rate ramping , Off sets the rate at start of recording	

Area Setting Some more

Item	Range	description	BBC
Area Select	NTSC, NTSC J, PAL	SD option	PAL
Area Set		Display of current selection	

2 Measurement results

2.1 Colour performance

Assessments were made visually, using Macbeth charts.. Performance was good, there were no surprises. However, the red, yellow and orange patches were somewhat improved using the matrix and colour correction settings in the tables.

2.2 Resolution

A HDTV zone plate chart was used, containing six circular patterns that fully explore the spatial frequency performance of the camera, up to 1920x1080 pixels per width and height.. Modulation is cosine rather than square wave. Each pattern is a "phase space" map of the possible frequencies that the camera can be expected to deal with, reaching 1920 pixels/picture width (960 cycles) horizontally, and 1080 lines/picture height (540 cycles) vertically.

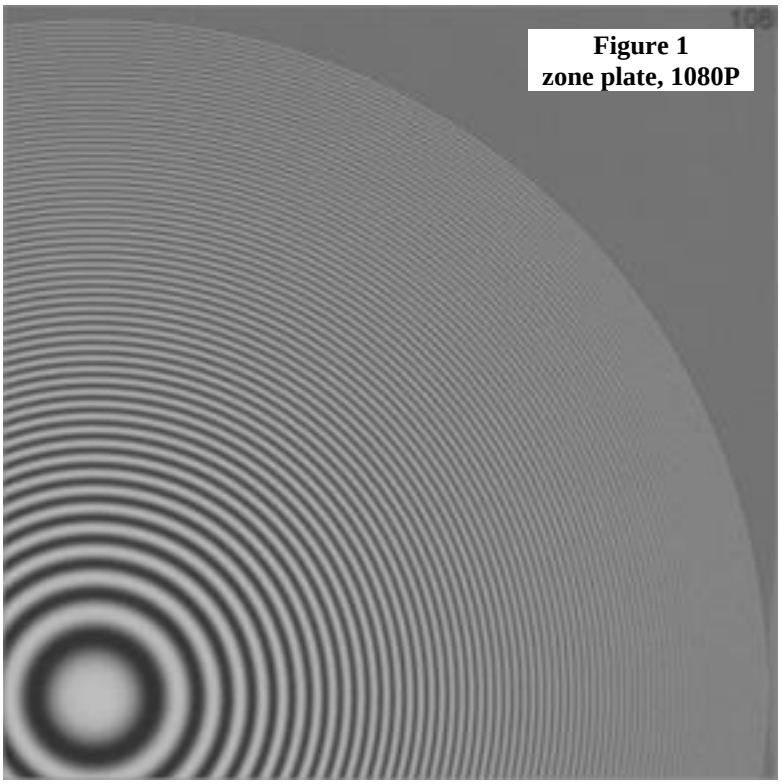

Figure 1
zone plate, 1080P

2.2.1 Resolution, 1080p

Figure 1 shows a single quadrant of one pattern; for this exposure, the camera detail enhancement was turned off, so this is the native performance.

There is no hint of diagonal aliasing, confirming that there is probably no "precision offset" of the green sensor from those of red and blue. Horizontal resolution is clean up to near 1920, limited only by the transmission channel filter. Vertically there is clear resolution all the way to 1080, indicating that there may be no vertical optical filter.

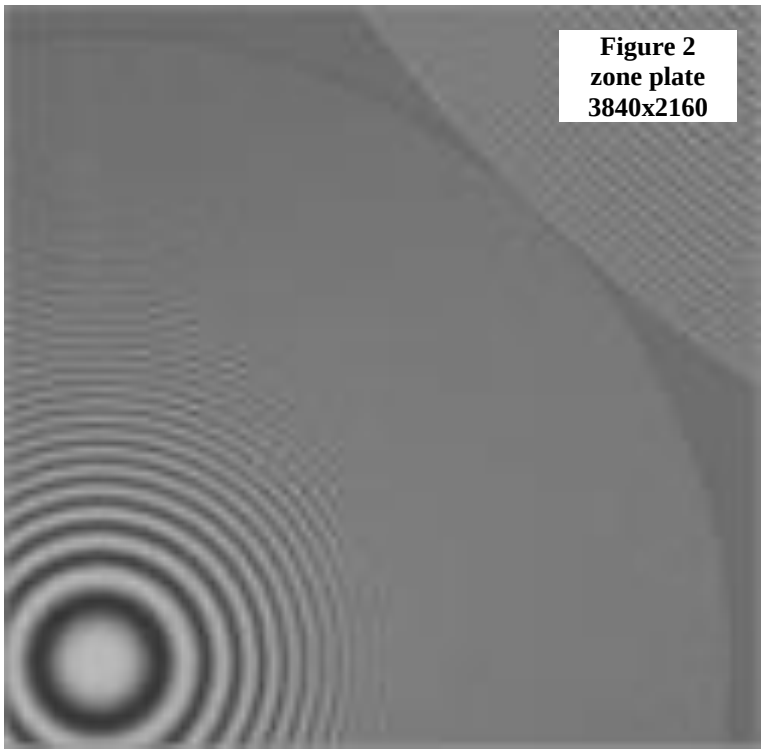

Figure 2
zone plate
3840x2160

Figure 2 confirms this, it is a smaller section of the test chart, designed to explore frequencies double that of the system, 3840x2160. There is no horizontal aliasing beyond just below 1920, but there is clear aliasing above 1080, albeit at a reasonably low level. This aliasing will cause a little interline twittering on interlaced displays.

Despite this, the performance is judged to be rather good.

There is no loss in resolution when recorded as AVC-I.

2.2.2 Detail enhancement

The camera needs little assistance from detail enhancements. The levels have been kept low in the tables. *Figure 3* shows the result of setting the

camera to progressive scanning, and "video" detail enhancement (Horizontal level=10, vertical level=15), and 0dB gain.

Horizontal resolution is improved a little, as is vertical, but some faint aliases have appeared. This aliasing is inevitable when detail is enhanced, because the "extra" detail is asymmetric, negative-going and positive-going edges are each emphasised by the same amount, but the display gamma distorts them differently.

This level of aliasing is perfectly acceptable for video-look pictures, but may be a little problematical for film-look, therefore lower settings are recommended.

Since the camera noise level is rather high, it makes sense to use less detail enhancement at higher gains.

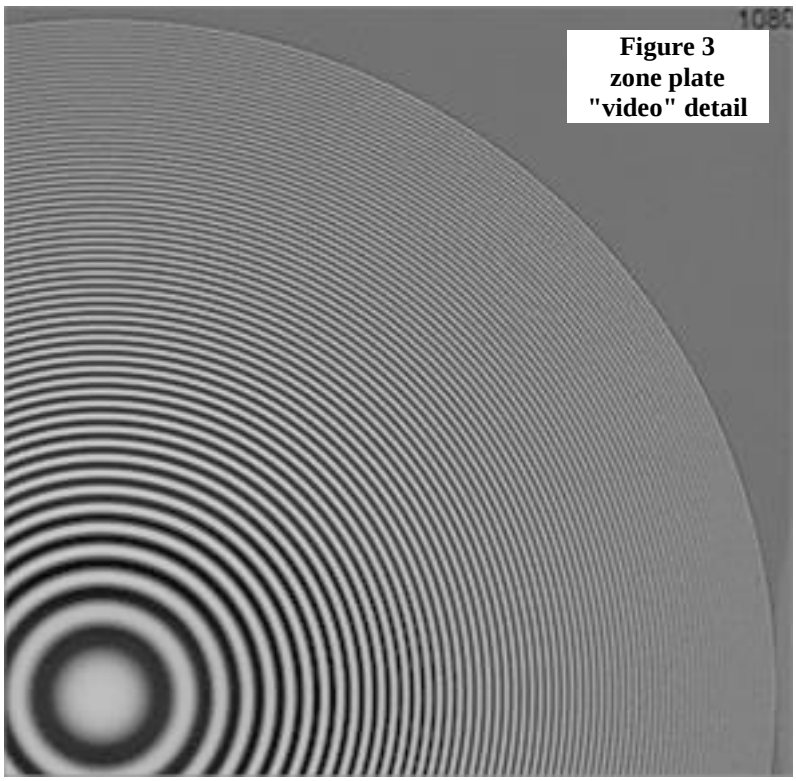

Figure 3 zone plate "video" detail

For a "film-look", even lower levels are advisable, avoiding all risks of video overshooting on sharp edges. For wildlife shooting, it is probably best to turn it off altogether, although a small amount may be acceptable.

2.3 Video Noise Levels

Video noise was measured by recording a white card, uniformly lit, and performing numerical analysis in software. A high-pass filter was used to remove all horizontal frequencies below about 5% of the nominal maximum of half-sampling frequencies, horizontally and vertically. For these measurements, the HDSDI output of the camera was used, but in 8-bit mode to suit the measurement software, so there is a measurement noise floor at about -54dB. To keep clear of this noise floor, measurements were all taken at +6dB gain. Therefore the plotted results are all 6dB pessimistic. +6dB is the highest setting recommended here. Results are shown as noise level, as measured, versus luma signal level.

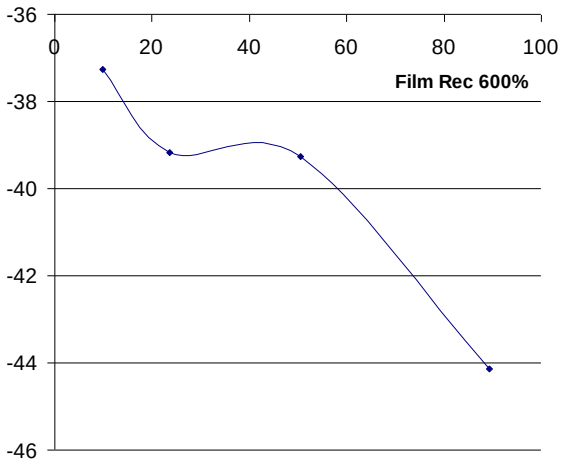

Figure 4 noise distribution

Figure 4 shows "Film" mode, using the Film-Rec gamma curve and 600% dynamic range. There is a decent correlation between the noise level and the slope of the gamma curve, there should be a difference of about 10dB between measurements near white and those near black. This demonstrates that there is no noise processing in the camera, and that the noise is not being affected by the quantising effect of data processing.

Allowing for the 6dB camera gain, the actual noise level (at mid-grey) should be about -46dB at 0dB gain, -49dB at -3dB gain. This is not the claimed -54dB; the pictures did not look particularly noisy, but it would be a good idea not use gain settings of more than +6dB. This is exactly the same as for the HPX3000, to which this camera bears an uncanny resemblance.

Measurements were also made with the Film Rec gamma and dynamic range set to 200%, and in the Video case using the HD gamma curve. The results are very similar, noise is little affected by the choice of gamma curve.

This noise level is significantly higher than the claimed -54dB, but will not be modified by any 8-bit recording. It does, however, restrict the useful dynamic range of the camera to about 10 stops.