Colorimetric and Resolution requirements of cameras

Alan Roberts

ADDENDUM 38 : Assessment of, and settings for, Panasonic AG-HPX301

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 document is taken from a short examination of a production model of the Panasonic AG-HPX301 camcorder (serial number #CTEA0013). This is a HDTV camcorder, similar in size and layout to a digibeta unit in that it has detachable lens, and can be shoulder mounted. It has with 3 ⅓" cmos sensors, each 1920x1080. The manual makes no claims for noise and sensitivity. It records HDTV using the AVC-I or DVCProHD algorithm onto P2 flash cards (1080i, 1080psf, 720p), SDTV using any of the DVCPro50 or DVCPro or DV algorithms onto P2 cards (576i, 576psf, 576psfa). It can also shoot "off-speed" when recording 720p onto P2 cards, but only at spot speeds, it is not continuously variable as is the Varicam AJ-HDC27F. There are 2 P2 card slots.

Perhaps most significantly, the camera has electronic correction for chromatic aberration in the lens. Since cameras with ⅓" sensors suffer iris diffraction starting at about F/4, lens performance appears to deteriorate dramatically at F/5,6 and smaller apertures, this correction facility seems to eliminate much of the chromatic problems, leaving only the gradual softening as the lens is stopped down. Subjectively, this appears to move the onset of diffraction limiting by about 1 stop, and to make further stopping-down less objectionable. However, the lens must be on the list of known lenses in the menus for this to work. The camera is not sensitive to infra-red light.

The camera is light (5kg including lens), has a side lcd panel, and seems potentially aimed at the high-end consumer/professional market and full broadcast, which would normally demand interchangeable lenses. It has the useful Panasonic YGET luma metering facility, waveform monitoring, and a pre-recording facility (3 seconds for HDTV, 7 for SDTV).

It has the same range of external switches and controls as a full broadcast camcorder, plus internal menus for setting the performance, although not as complex as in the 720-line Varicam or the HPX2000/3000 range for example, but enough to control most of the important features. It has genlock and remote control but is no better suited to multi-camera operation than any other professional camcorder. It has two SDI video outputs (at HD or SD), and digits via IEEE1394 Firewire and USB, plus an analogue monitoring output. This puts the camera into the professional or broadcast market, subject to video performance.

The same assessment procedure was used as for other HD cameras, partly attempting to get a good "film-look", and the settings reflect that. It is useful to think of the camera, when used in this way, to be mimicking a film camera and telecine, with "best light" transfer to tape, with about 10 stops of tonal range. Assuming that a grading operation will be used in post-production, the settings attempt to give the colourist the same range of options as with film. The recommended settings allow about 1.3 stops of over-exposure (250%) and one of under-exposure relative to normal operation.

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The assessment of this camcorder was aimed mostly at establishing whether it could perform to broadcast standards, since the sensors are rather small. However, it was possible to derive settings which make sense for both video- and film-type shooting. Measurement results are given in Section 2. The controls are not as flexible as for full "broadcast" cameras, so it was not possible to customise it as much as other cameras, but the performance seemed adequate with the settings available. There is sufficient flexibility to achieve much of what is desirable in "film-look" settings. The sensitivity is not specified in then manual, but has been measured at Panasonic: 2000 lux at F/5.6 with 1/50 exposure (i.e. interlaced or progressive with 180º shutter).

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. -7~7, 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 underlined if it is known, and the range offered by the camera under test. "BBC" settings are in the last column, where appropriate.

BBC-preferred values are given for SD operation, for 1080 interlaced and psf, and for 720 film and sport (where sport covers all uses that are not intended to look like film). Items that have an important effect on picture appearance are highlighted. It is unfortunate that the colour bars that the camera generates are only 100/0/75/0 (i.e. EBU) in 50Hz modes, rather than the much more useful SMPTE or ARIB bars that are ubiquitous in HDTV. However SMPTE bars are available if the camera is set to 59.94Hz modes.

Two preferred settings are given, for video (v) and film-like (f).

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

1 Menus and Settings

MAIN MENU	
SCENE FILE	Camera operational controls, needs lab work to get the best from these
SYSTEM SETUP	Basic camera setup controls
SW MODE	Configuration of switches
RECORDING SETUP	P2 card controls
AUDIO SETUP	Configure audio connections
OUTPUT SEL	
DISPLAY SETUP	
BATTERY SETUP	
CARD FUNCTIONS	P2 flash card controls
LENS SETUP	
OTHER FUNCTIONS	
DIAGNOSTIC	
OPTION MENU	

SCENE FILE 1-6 Main video standard setting, defaults are for Scene-file 1

Item		**Range**	**description**	**BBC**	
				v	f
Load/Save/Init		Exec	Get/save/clear scene file		
VFR		On, <u>Off</u>	Enable variable frame rate (720p only)		
Frame Rate	50Hz	12,15,18,20,21,22,23,24,25,26,27,28, 30,32,34,37,42,48, <u>50</u>	Frame rate at 720p. Not available at SD or 1080, nor when recording to IEEE1394		

	60Hz	12,15,18,20,21,22,24,25,26,27,28,30, 32,34,36,40,44,48,54, 60			
Synchro Scan		Display only	Shows synchro shutter speed		
Detail Level		-7~ 0 ~+7	Collective detail	-2	-4
V Detail Level		-7~ 0 ~+7	Vertical detail	0	
Detail Coring		-7~ 0 ~+7		0	
Chroma Level		-7~ 0 ~+7	Saturation	-2	-4
Chroma Phase		-7~ 0 ~+7	Hue	0	
Color Temp Ach		-7~ 0 ~+7	Fine colour adjustment to A channel balance		
Color Temp Bch		-7~ 0 ~+7	B channel		
Master Ped		-100~ +15 ~+100		+3	
A.Iris Level		-10~ 0 ~+10	Auto iris target level		
DRS Effect		1,2, 3	Soft knee function, compresses highlights	3	
Gamma		HD norm, Low,SD norm,High,B. Press,Cine-like D,Cine-like V	HDnorm-ITU709, Low=eng, SD norm=DVX100, High=BBC0.4, Cine-likeD=film neg, Cine-likeV=finished film	HD norm	Cine-like D
Knee		High, Mid,Low	High starts at 100%, Mid at 90%, Low at 80%	Mid	
Matrix		Norm1, Norm2,Fluo,Cine-like	Norm2 raises saturation	Norm1	Cine-like
Skin Tone Dtl		On, Off	On reduces skin tone detail	Off	
V Detail Freq		Thin, Mid,Thick	Fine to coarse detail	Thin	
Name Edit			Name the file		

SYSTEM SETUP General options

Item		Range	description		BBC	
					v	f
System Mode	50Hz	1080-50i, 720-50p, 576-50i	Turn off power to effect the change. Not available in USB Device mode			
	60Hz	1080-59.94, 720-50.94, 480-59.94i				
Rec Signal		Camera, 1394	Select recording via 1394 input			
Rec Format	1080-50i	AVC-I100/50i, AVC-I100/25pn, AVC-I50/50i, AVC-I50/25pn, DVCPROHD/50i,	i=interlaced, p=progressive, pn=progressive native (i.e. frames not split into fields as psf)		AVC-I100	
	720-50p	AVC-I100/50p, AVC-I100/25pn, AVC-I50/50p, AVC-I50/25pn, DVCPROHD/50p, DVCPROHD/25pn				
	576-50i	DVCPRO50/50i, DVCPRO/50i, DV/50i				
	1080-59.94i	AVC-I100/60i, AVC-I100/30pn,AVC-I100/24pn, AVC-50/60i, AVC-I50/30pn, AVC-I50/24pn, DVCPROHD/60i				
	720-59.94p	AVC-I100/60p, AVC-I100/30pn, AVC-I100/24pn, AVC-I50/60p, AVC-I50/30pn, AVC-I/50/24pn, DVCPROHD/60p, DVCPROHD/30pn, DVCPROHD/24pn				
	480-59.94i	DVCPRO50/60i, DVCPRO/60i, DV/60i				
Camera Mode	50Hz	50i, 25p	pa=2:3:3:2 pulldown		50i	25p
	60Hz	60i, 30p, 24p, 24pa			60i	24pa
Scan Reverse		On, Off	Useful for film lenses and adaptors			
Aspect Conv		Side Crop, Letter Box, Squeeze	Available only when shooting SD (576 or 480)			
Setup		0%, 7.5% A	Relevant only for SD 480			
PC Mode Select		USB Host, USB Device	Camera acts as host or device			
PC Mode		On, Off	Allows direct connection to a computer			

SW MODE Set the external switches

Item	Range	description	BBC	
			v	f
Low Gain	-3, 0, 3,6,9,12dB		-3	
Mid Gain	-3,0,3, 6 ,9,12dB		+3	
High Gain	-3,0,3,6,9, 12dB		+6	
ATW	Bch, Off	Sets Auto Tracking White to B channel		
ATW Type	1, 2	1=normal, 2=limited tracking range		

W.Bal.Preset	3.2K, 5.6K	Set PRST white balance colour	
User Main	Rec Review, Spotlight, Backlight,ATW,ATWlock, Gain:24dB, Yget,DRS,TextMemo,SlotSel, ShotMark,MagA.Lvl,PreRec,PCmode,Wfm	Yget=luma meter	
User 1			
User 2			
Ret Sw	Rec Review, Text Memo, Shot Mark	Lens Ret switch	
WFM	Wave, Vector,Wave/Vect	Waveform or vectorscope display, Wave/Vect toggles them	
Auto Knee Sw	On, Off,DRS		

RECORDING SETUP

Item	Range	description	BBC
Rec Function	Normal, Interval,OneShot,Loop	Clever shooting modes, not always available, see manual page 39	
One Shot Time	1frm, 2frm,4frm,16frm,1s		
Interval Time	2frm, 4frm,8frm,16frm,1s,2s,5s,10,30s,1min,5min,10min		
Start Delay	On, Off	Delays start of Interval/OneShot by 1 sec	
PreRec Mode	On, Off	3 second pre rec in HD, 7 sec in SD	
TC Mode	DF, NDF	Not displayed in 50Hz modes	
UB Mode	User,Time,Date,Ext,TCG, Frm.Rate	Set user bits, Frm.Rate is useful for off-speed shooting	

AUDIO SETUP

Item	Range	description	BBC
Front VR Ch1	Front,W.L.,Rear,All, Off	Enable front audio level control, chan 1	
Front VR Ch2	Front,W.L.,Rear,All, Off	Enable front audio level control, chan 2	
Mic LowCut Ch1	Front,W.L.,Rear, Off	Low-cut filter passes roughly 200Hz~10kHz	
Mic LowCut Ch2	Front,W.L.,Rear, Off		
Mic LowCut Ch3	Front,W.L.,Rear, Off		
Mic LowCut Ch4	Front,W.L.,Rear, Off		
Limiter 1	On, Off	Audio limiters, ignored if Auto is set	
Limiter 2	On, Off		
Auto Level Ch3	On, Off	Off fixes sound level	
Auto Level Ch4	On, Off		
25M Rec Ch Sel	2ch, 4ch	SD sound, 2ch/48k/16b or 4ch/32k/12b	
Test Tone	Normal, Always,Chsel,Off	Normal=tone on bars when Ch1=front	
F.Mic Power	On, Off	Phantom power	
R.Mic Power	On, Off	Phantom power	
Monitor Sel	Stereo, Mix	Sound to audio out and phones/speaker	
F.Mic Level	-40, -50, -60dB		
R.Mic Ch1 Level	-50, -60dB		
R.Mic Ch2 Level	-50, -60dB		
Headroom	18dB, -20dB		
Wireless Warn	On, Off	Warning of poor radio mic signal	
Wireless Type	Single, Dual	Mono/stereo	
1394 Audio Out	Ch1/Ch2, Ch3/Ch4	Only in SD 576 or 480	

OUTPUT SEL Simple controls

Item	Range	description	BBC
SDI Select	Auto, 1080i, 576i(480i)	Auto outputs what's shot, 1080i up-converts 720p, 576(480) always down-converts	
SDI Metadata	On, Off	Adds UMID to SDI	
SDI EDH	On, Off	Adds EDH to SD SDI	
Downcon Mode	SideCrop, LetterBox, Squeeze		
Video Output Char	On, Off	Adds characters	
Video Out Zebra	On, Off		
TC Out	TCG, TCG/TCR	Time code from cam or cam/recording	
TC Video Synchro	TC In, Video Out	Delays TC to match video out	

DISPLAY SETUP

Item	Range	description	BBC	
			v	f
EVF Peak Level	-7~ 0 ~+7	Viewfinder peaking		
EVF Peak Greq	High, Low	Frequency		
EVF Setting		Set brightness and contrast		
EVF B.Light	High, Normal, Low	Backlight level		
EVF Color	On, Off	Off sets monochrome viewfinder		
Zebra1 Detect	50%~ 70% ~109%		75	65
Zebra2 Detect	50%~ 85% ~109%		100	85
Zebra2	On, Spot, Off			
Marker	On, Off	Centre cross marker		
Safety Zone	90%, 4:3,13:9,14:9,Off		14:9	
Focus Bar	On, Off	Bargraph focus display		
LCD Setting		Set saturation, brightness, contrast		
Self Shoot	Normal, Mirror	Lateral inversion of lcd		
LCD Bakclight	High, Normal, Off			
Sync Scan Disp	Sec, Deg			
Date/Time	Time,Date,Time&Date, Off	Set time/date displays		
Level Meter	On, Off	Audio levels		
Zoom	On, Off			
Card/Batt	On, Off	Capacity and charge		
P2card Remain	Total, One-card	Show remaining card capacity		
Other Display	Partial, All,Off			
Menu Back	On, Off	Lowers background transparency		
Rec Counter	Total, Clip	Continuous or clip duration shown		

BATTERT SETUP

Item	Range	description	BBC
EXT DC In Sel	AC Adapter, Battery		
Battery Select	ProPac14,Trimpac14,Hytron50,Hytron140, Dionic90, Dionic160,NP-L7,Endura7,Endura10,Endura-D, PagL95,BP-GL65/95,NiCd14,TypeA,TypeB		
Battery Mode	Auto, Manual		
ProPac14 Near	11.0~ 13.5 ~15.0V	Set Near End voltage	
TrimPac14 Near	11.0~ 13.4 ~15.0V		
Hytron14 Near	11.0~ 13.4 ~15.0V		
Hytron140 Near	11.0~ 13.1 ~15.0V		
Dionic90 Near	11.0~ 13.7 ~15.0V		
Dionic160 Near	11.0~ 13.3 ~15.0V		
NP-L7 Near	11.0~ 13.6 ~15.0V		
Endura7 Near	11.0~ 13.4 ~15.0V		
Endura-D Near	11.0~ 13.4 ~15.0V		
Pag L95 Near	11.0~ 13.8 ~15.0V		
BP-GL65/95 Near	11.0~ 13.4 ~15.0V		
NiCd14 Near	11.0~ 13.5 ~15.0V		
NiCd14 End	11.0~ 13.1 ~15.0V		
Type A Full	11.0~ 15.7 ~17.0V		
Type A Near	11.0~ 13.7 ~15.0V		
Type A End	11.0~ 13.3 ~15.0V		
Type B Full	11.0~ 15.7 ~17.0V		
Type B Near	11.0~ 13.7 ~15.0V		
Type B End	11.0~ 13.3 ~15.0V		
Near End Cancel	On, Off	Press Disp/ModeChk to cancel warning	

CARD FUNCTIONS

Item	Range	description	BBC
Scene File	File Select,Read,Write, Title Reload	Read/Write Scene files to SD card	
User File	File Select,Read,Write, Title Reload	Read/Write User files to SD card	

LENS SETUP

Item	Range	description	BBC
Shading Select	Default, User1,User2,User3,Off		
Shading (User)		Select/Set settings 1~3	
CAC	On, Off	Chromatic aberration correction	On
CAC Property		Show current file number and data	
CAC Card Read	Exec	Loads file from SD card	
CAC File Delete		Show list of files, select to delete	
CAC File Init	Exec	Return to factory settings	
Iris Adjust	F2.8, F16	Forcibly set iris	

OTHER FUNCTIONS

Item	Range	description	BBC
User File	Load,Save,Initial	Move user files around, doesn't affect scene files	
1394 Control	Ext,Both,Chain, Off	Controls external 1394 recorder	
1394 Cmd Sel	Rec_P, Stop	How external recording s stopped	
Access LED	On, Off	P2 card slot access light	
Alarm	High, Low,Off	Alarm volume	
Clock Setting		Set the clock	
Time Zone	-12:00~ 0.00 ~+12:00		
GL Phase	HD SDI, Composite	Set which output is synchronised	
H Phase	-512~ 0 ~+511	Fine tune locking	
Menu Init	Exec	Factory reset all menus and files	

DIAGNOSTIC Reports status and version numbers

Item		Range	description	BBC
Version	Version	9.19-00-0.00	Values found in the camera tested	
	Cam Soft	1.05-00-0.00		
	Syscon Soft	1.04-00-0.00		
	P2CS BL2-1	1.00-00-0.00		
	P2CS BL2-2	1.00-00-0.00		
	P2CS KR	1.00-00-0.00		
	P2CS AP	1.03-00-0.00		
	VUP	1.00-00-0.00		
	VUP FS	1.03-00-0.00		
	DM FPGE	1.04-00-0.00		
Model Name		AG-HPX301E		
Serial No.		C9TEA0013		
Operation				

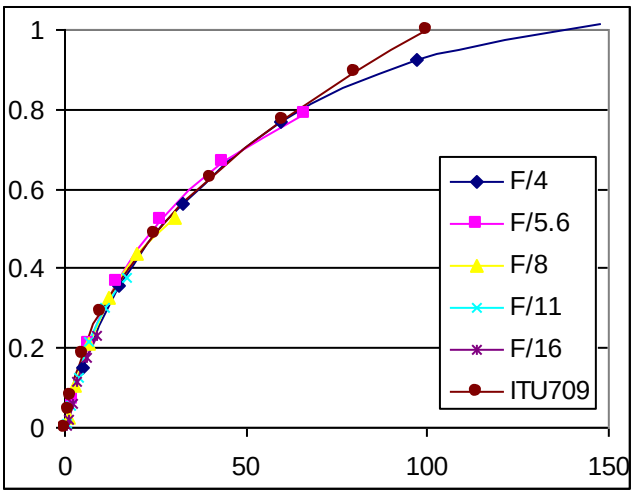
OPTION MENU Check on 1394 status, press Disp/ModeChk then Menu

Item	Range	description	BBC
1394 Status		Shows format, transfer rate, field rate, channels, speed etc	
1394 Config	Defl, 1-255	Opens a configuration menu, use Default normally	

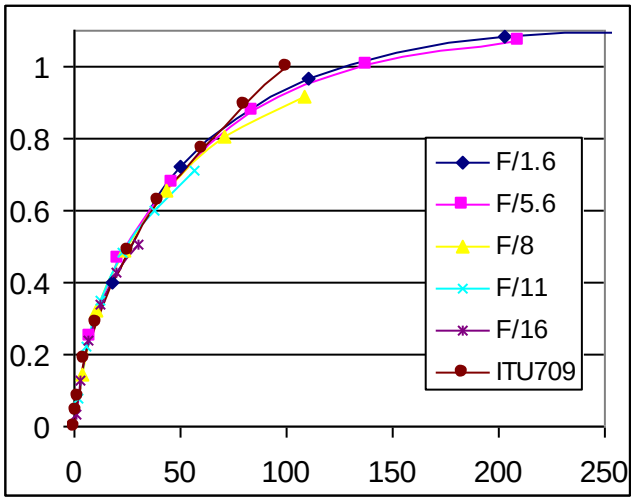
2 Measurements

All measurements were made at BBC R&D, using a Sony 32" crt Grade 1 HDTV monitor and a digital waveform monitor. Frame files were grabbed via HDSDI for software analysis in my own software. Importing recordings into editing software is unreliable because the decoding and transcoding is not fully specified.

2.1 Gamma and Headroom range



Since the HPX301 does not have an in-built test signal (sawtooth), measurements had to be made using a test card. A Macbeth Colorchecker card was to hand, with a known even illuminator, so several exposures were recorded, and the signal levels for the grey scale patches measured in software. The reflectances of the patches are known and tabulated, so it was a simple matter to scale the reflectance values to make the 5 plot lines overlay each other. The graph also shows the ITU709 gamma-correction curve for comparison, and the curves are for the *HDnorm* gamma curve with the knee set to *High* such that there is no contrast compression below 100% signal level. The measurement curve fit the 709 curve reasonably well, except for the white patch (highest value in each curve). The white value is consistently low, suggesting that the chart reflectances are not as they should be; perhaps it is time for a new chart.



Following the same procedure with the *Cine-likeD* curve shows the degree of overexposure that the camera can handle, about 250%, 1.3 stops. The other curves were not investigated in detail, but it seems that the *High* gamma curve is probably the BBC 0.4 curve, providing the most accurate colour reproduction, while B.Press and Cine-likeV both compress low levels rather excessively.

The exposure range is limited by the headroom (250%) and the noise level. The camera specification makes no claim for video signal-to-noise ratio.

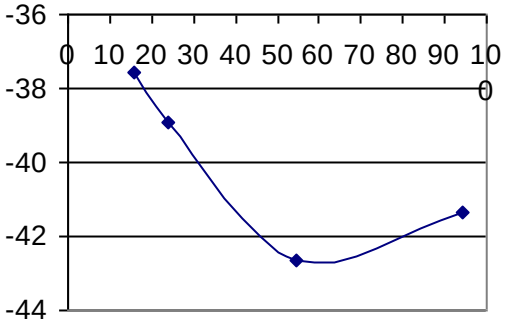
2.2 Colour performance

Having assumed that the HDnorm gamma curve is the IUT709 curve, visual assessments were made of the Macbeth test card. The camera was exposed to a card in an illuminator box lit to P3000, and assessment was made by comparing the displayed picture with another card in a box illuminated to D65. The display contrast was set to match the peak brightness of the real test card. Pictures were judged to be over-saturated, and this was confirmed by software analysis. A more accurate colour reproduction resulted with the camera's Chroma Level control (saturation) set to -3 or -4. This also reduced the video noise a little. The most accurate colour reproduction was with the *High* gamma curve, believed to be the BBC 0.4 law. The recommended values (-2 for video, -4

for film) are only starting points, it is always preferable to use the chroma control than the play with matrix values.

The *Norm2* matrix oversaturates even more, while the Cine-line matrix undersaturates nicely.

2.3 Noise

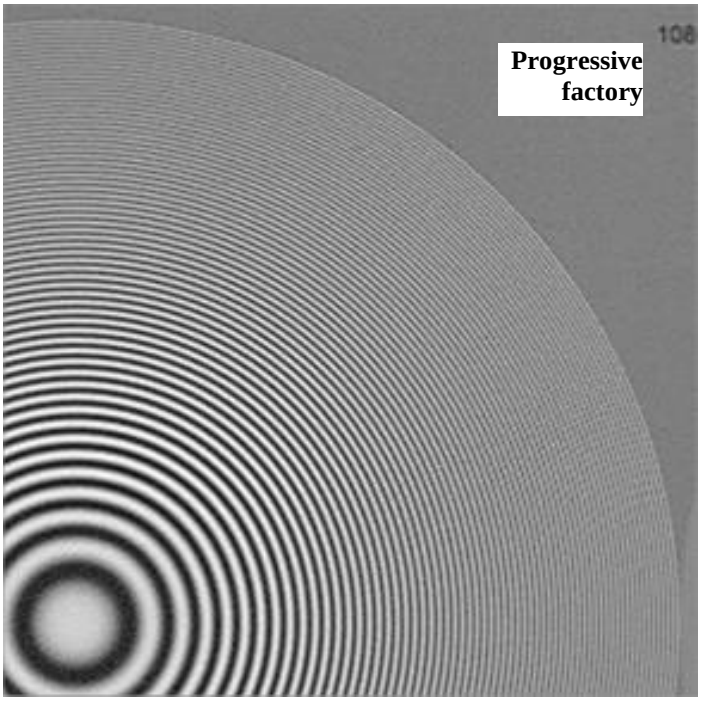


Noise was measured by exposing the camera to an illuminated white card, and exposure adjusted to get 4 luma values between 10% and 100%. The grabbed frames were processed with a high-pass filter to remove shading effects from uneven illumination. Vignetting was avoided by adjusting the lighting level such that the extremes of the aperture range were not used. The plot os of measured noise versus luma signal level (percentage). Noise in the middle range is at about -43dB, which is adequate but a little disappointing. The curve shows the expected rise in noise level as the signal level reduces, due to the increasing gain of the gamma-correction process. Since sensor and head-amplifier noise is amplified differentially by the gamma-correction, the noise level should be proportional to the slope of the gamma curve, and should have a range of about 17dB between 2% and 100% video level. The slight rise in noise near white is probably due to electron-fluctuation (shot noise) and is both unavoidable and non-problematic.

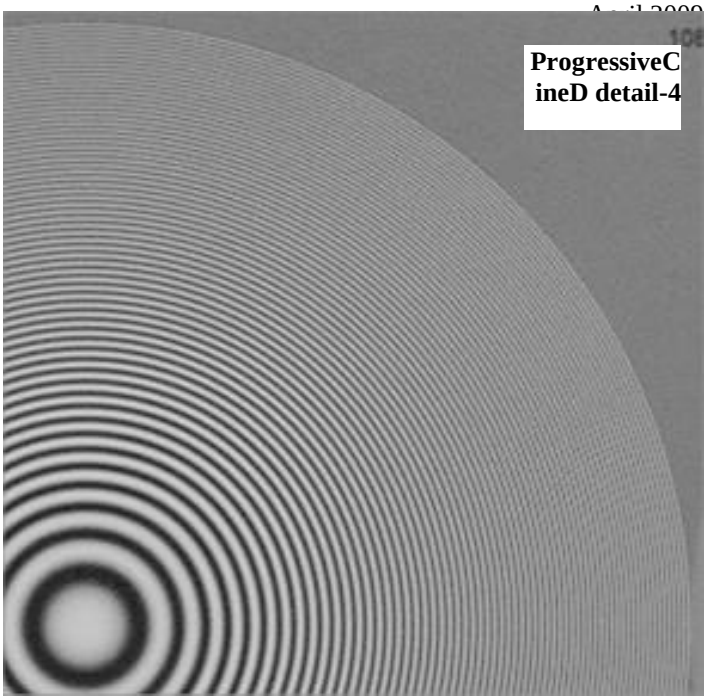
The noise levels are not excessive. It is inevitable that noise should be higher with the small size of the photo-sites in the sensors (place on 2.5µm centres compared with 5µm for a ⅔" camera), shot noise in particular is to be expected. The basic sensitivity of this ⅓" camera should be about 2 stops less than that of a ⅓" camera, or 12dB more noisy, depending on exactly how the signals are converted to digits. The performance of the HPX301 is not surprising, and means that the exposure range is about 10 stops, maybe a little more.

The Noise Coring control appeared to have little effect, typically 1.5dB improvement between setting -7 and +7.

2.4 Resolution



Resolution was tested using a test card of circular zone plates. The zone plate presents a spatial map of all the frequencies the camera should have to deal with, dc and low frequencies in the middle of each pattern, rising to the Nyquist limits horizontally and vertically. The test chart has sinusoidal modulation to avoid sampling problems, and has patterns for luminance, chrominance, R G and B. Only the luminance pattern is presented here, the other patterns revealed no surprises. With factory settings, the result for progressive 1080 is good, there is no aliasing, and resolution nicely reaches the Nyquist limits at a low level, indicating either that there is proper optical filtering in the camera, or that the lens is providing the limit.



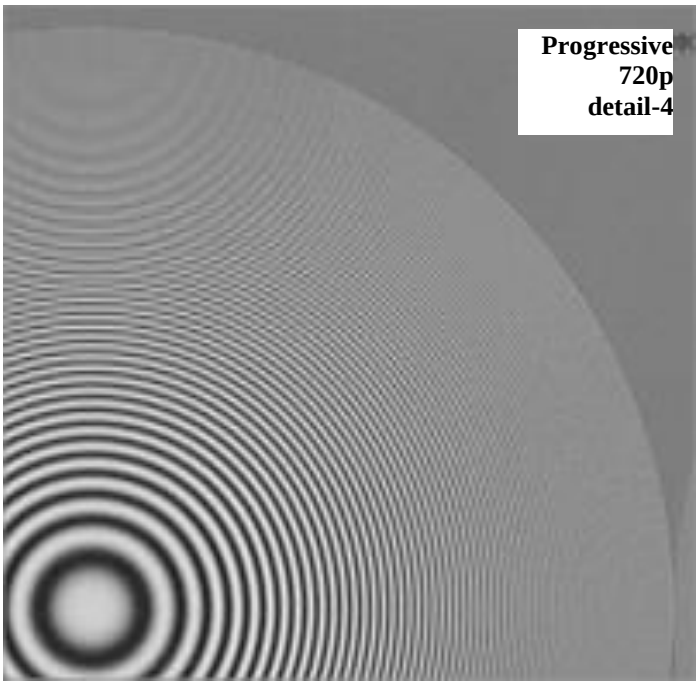
Interlace also provided no surprises, with considerable vertical softening due to the interlaced scanning. Exploring the *detail enhancement*, it became apparent that the range of control is offset, -7 being no enhancement, +7 lots. The central, factory set, level of 0 did not produce the best pictures, values of -2 and -4 were much more acceptable for video- and film-type shooting.

The setting of -4 goes with the use of *Cine-likeD* gamma curve for a film-type look. The pictures are completely clear of aliasing, which should make for efficient video coding.

2.4.1 Resolution at 720p

The camera can be used in 720p mode, which is the only way to get access to "off-speed" shooting.

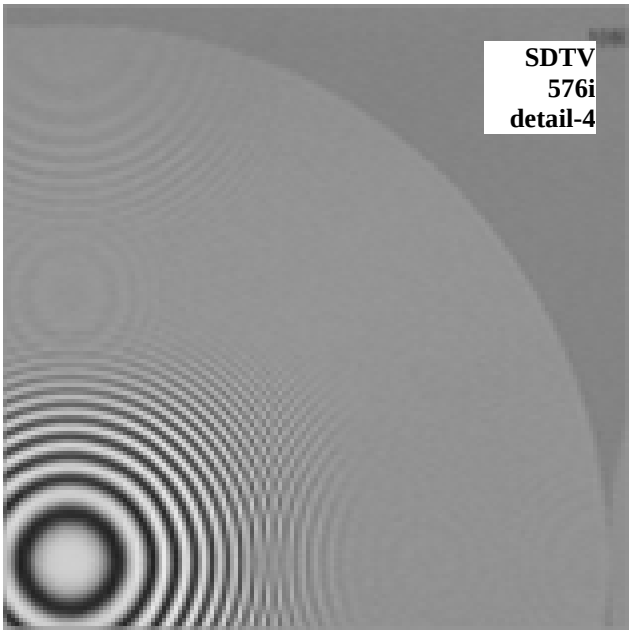
There is clear aliasing in the picture, both horizontally and vertically. This is inevitable in any camera, since the conversion to 720p is a standards-conversion, which cannot be done satisfactorily in any camera at an economic price. Resolution is clean up to about 1280 by 540, with vertical aliasing dominating above 720. The aliasing with a null-centre at 1080 (vertically) and 1920 (horizontally) is evidence that there is probably only horizontal optical filtering in the camera, the strong vertical alias would be suppressed if there were vertical filtering as well.



The performance is not bad, and is probably acceptable if the need is to shoot off-speed, but for shooting on-speed, it would be better to shoot at 1080 and down-convert externally as part of the post-production operation unless the motive for using 720p is to improve motion capture.

2.4.2 Resolution at 576i

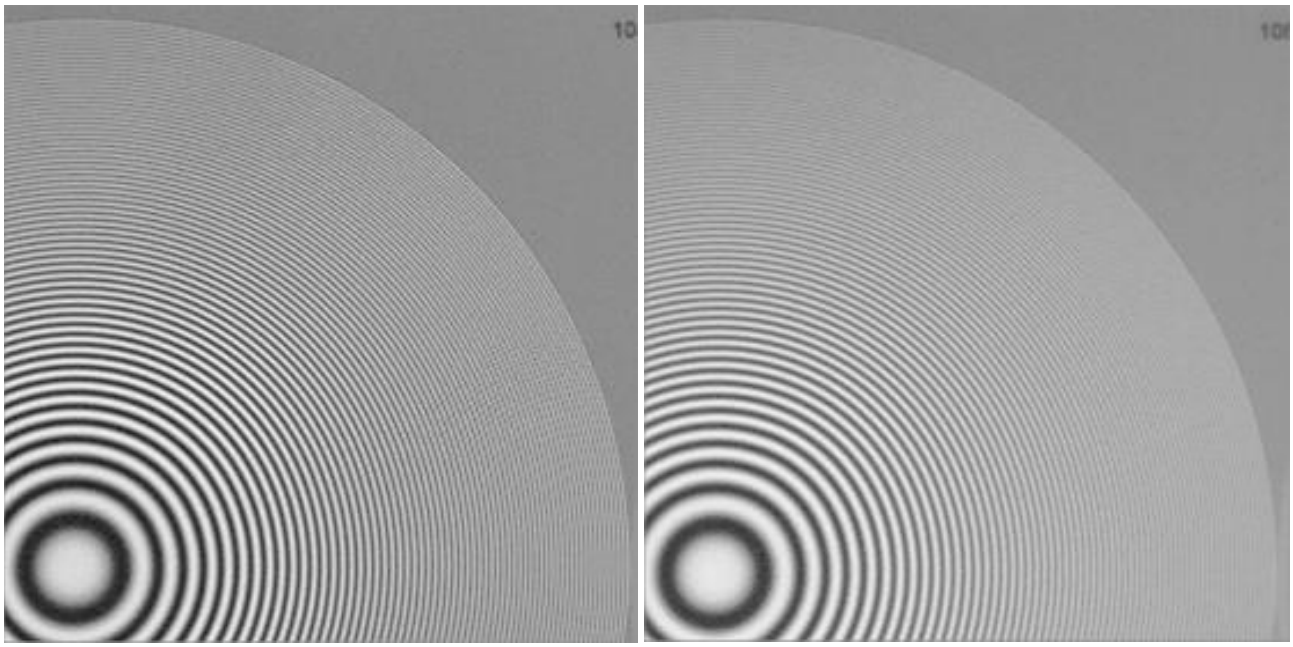
Down-conversion to standard-definition produced more aliasing. The original aliasing with null-centres at 1080 and 9120 are still present (they could hardly be absent since they are generated in the sensors themselves). Vertical filtering is better than horizontal, probably due to the interlacing process. Horizontally there is a triple alias, the outer centred at 1920, the second centred at 1280, and a third centred at 720. It seems possible, but surprising, that the down-conversion to SD is 2-stage, with a first conversion to 1280x720 followed by a conversion down to SDTV. The only reason I can think of for such a process is if the sensors are scanned interlaced and the down-conversion to 720p is then a sensible way to get a progressive image. However, the resolution in



1080p mode is better than would be expected from interlaced sensors, so this remains something of a mystery.

2.5 Iris Diffraction and Chromatic Aberration

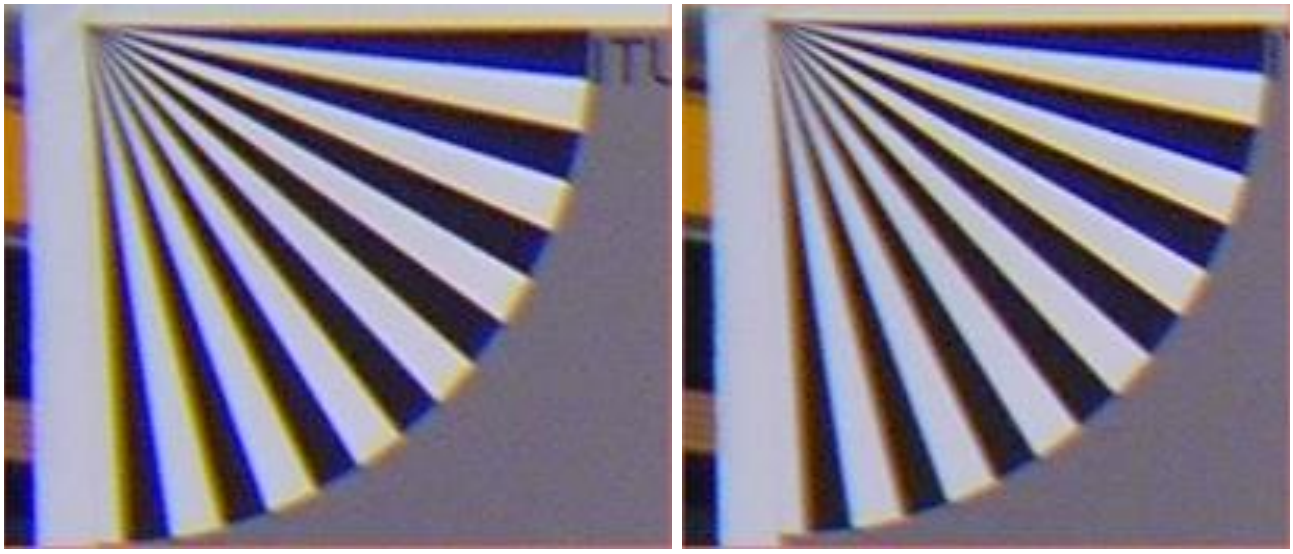
In a 1080-line HDTV camera with ⅓" sensors, the iris diffraction limit is F/4; stopping the lens down beyond that aperture softens the picture and introduces chromatic aberration effects. In a ⅔" camera the limit is F/5.6 and so softening is visible from F/8. Panasonic have introduced a neat trick in this camera (and some others), whereby a video scaler is driven by data from the lens, to correct chromatic aberration. It cannot correct the loss of sharpness, but correcting the coloured fringing should improve matters considerably. The lens supplied with the camera was tested, a Fujinon ⅓" format T17x4.5BRM-K14. Frames were grabbed at the wide and long end of the lens, at two aperture values.



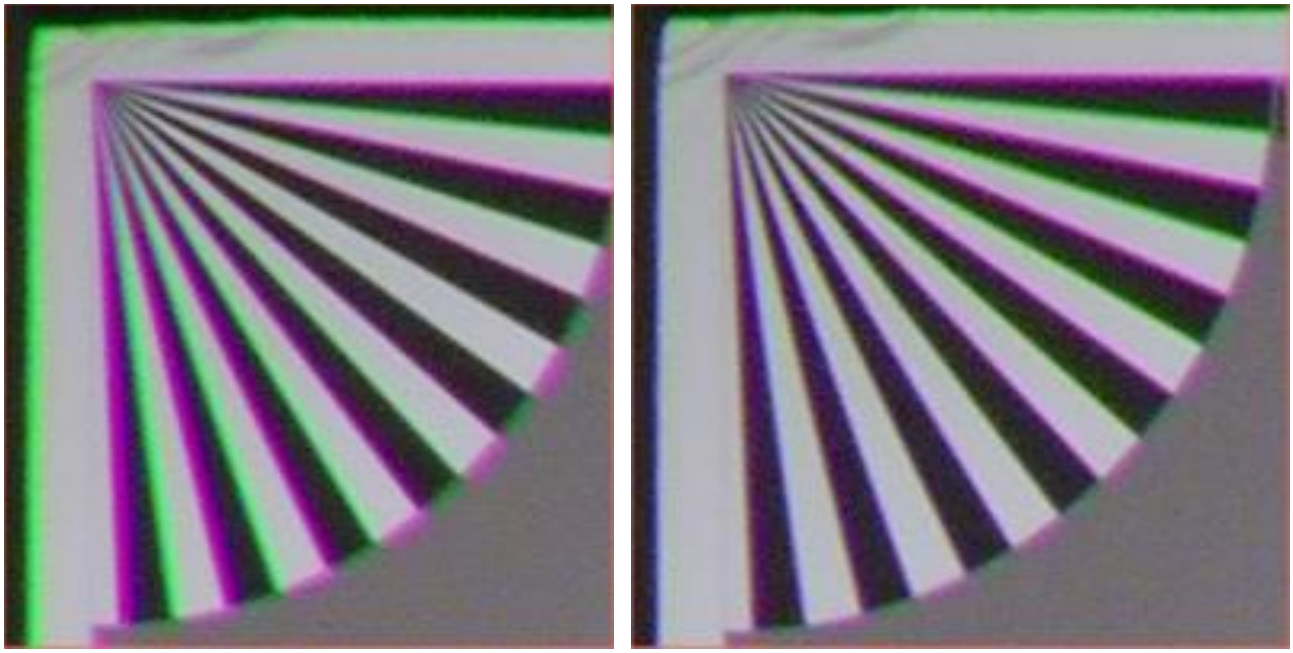
Resolution losses, 25mm F/2.0 (left) and F/8.0 (right)

Clearly considerable resolution has been lost by stopping the lens down; at F/8, the camera barely makes enough resolution for 720p. However, the chromatic aberrations are worst in the corners, in this case top left.

Bear in mind that these are cropped sections of the image, only about 200x180 pixels. The aberrations are not severe, and the correction has not fully worked, but there is a distinct improvement. However, performing the same comparison at the long end of the lens is more revealing.



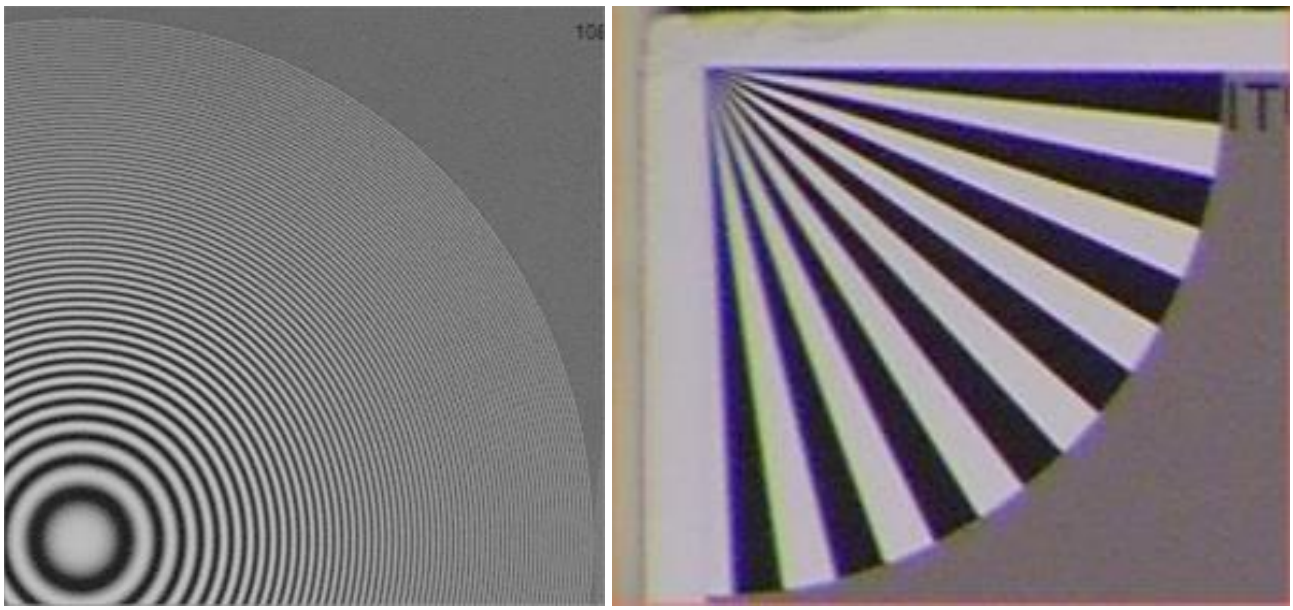
Chromatic aberrations, 25mm F/2.0, uncorrected (left and corrected (right)



Chromatic aberrations, 60mm F/9, uncorrected (left), corrected (right)

It seems that the correction works better horizontally than vertically, or perhaps only horizontally, but the correction is well worth having nevertheless.

An alternative les was available, but there was no data for it in the camera's correction data files. Undaunted, it was tested in the same way, but without attempting correction. Resolution is rather better than the supplied 17x4.5, and chromatic aberration in the corners is dramatically better, even without correction, the uncorrected performance is actually better than the corrected performance with the supplied lens. If Panasonic can characterise this lens and supply data for it, it's performance should be very good.



Fujinon 18x4.2 lens, resolution and chromatic aberration, 60mm F2.8