Colorimetric and Resolution requirements of cameras

Alan Roberts

ADDENDUM 40 : Menu settings for

Thomson/GV DMC1000 "Infinity" camcorder

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 one-day assessment was made on a sample of the DMC1000, Infinity camcorder (serial number 1FRMR), a multi-standard HDTV cam-corder with a Canon HA17x7.6 HD lens. It is a novel camera in many respects, and is the first HD cam-corder made under the Grass Valley name by Thomson. Physically, it resembles many other camcorders, the familiar digibeta size and layout, but it has a large lcd side panel with touch-screen controls for menu control, and records to a Rev-Pro hard drive and/or Compact Flash cards. It has excellent connectivity, including a standard HDMI connector for the viewfinder, and USB client and host connectors for downloading content from the recording media. Remote control is possible through a PDA application. It also has many features which make it suitable for multi-camera use in studio or location shooting. Although production models may well differ slightly from this sample, a full manual was available. Much of the content of this document is taken directly from that manual since there was insufficient time to test many of the innovatory features.

Power consumption is 45 watts, a little high by modern standards, 49 watts when recording to RevPro. However, the power management and cooling system keep the camera cool to the touch, and acceptably quiet acoustically.

The camera has 3 full resolution (1920x1080) cmos sensors and is switchable between HDTV (at both 1080i/25 and 720p/50-line standards) and SDTV (625/50 and 525/59.94). It records to the selected medium in various forms: HD can be JPEG2000 (wavelets) 10-bit full resolution 4:2:2 at 100, 75 or 50Mb/s, or MPEG2 (i-frame only, 8-bit, 4:2:0 but full resolution) at 80 or 60Mb/s; SD can be DV25 (8-bit 4:2:0 for 625/50, 4:1:1 for 525.59.94), or JPEG2000 at 50, 50 or 30Mb/s, or MPEG2 at 50, 40 or 30Mb/s. MPEG2 compression requires an extra card to be fitted, it is not normally part of the camera. For these tests, there was not enough time to test all these formats, but previous tests, informal and unpublished, had already confirmed that the JPEG2000 compression did not limit the resolution or introduce any unwanted spatial aliasing.

The Rev-Pro recording drives are at present only 35MB each, but a larger 70MB version is promised "soon". The Compact Flash sockets will accept Type I and Type II cards.

In this version, it was not possible to switch the camera to a film-look mode with progressive scanning at 25Hz, this is promised for a future revision of the camera. Also, it was not possible to examine the gamma curves in detail because the sawtooth test signal did not work as expected, therefore assessments were done using a Macbeth Colour Checker test chart. As a result, no recommendation can be made for a film-look setup yet. Also, the colour matrix selection is very strange, offering many matrices, none of which is calculated to optimise this camera. Nevertheless, colour performance was good although not exceptional, and when the gamma correction and knee were adjusted to capture about 2 stops of overexposure, the results were quite pleasing. However, noise levels were disturbingly high.

Noise performance was poor. Spatial aliases were visible in the 720 and SD pictures, but not to an excessive degree. Evidence for this is presented at the end of this document.

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Many menu items have little or no effect on the image. Those that do so are highlighted, default values are bracketed where known. The full menus are given for completeness. Where two values are given {f} denotes film use, {v} video. The photographic speed of the camera is about one stop less than an equivalent SD camera, sensitivity is claimed as F/8 at 2000 lux, tests did not contradict this. Using conventional gamma and knee settings, about 2.5 stops of overexposure (about 600%) was achieved. Noise level is claimed as 54dB, and the total exposure range is estimated as about 11 stops. However, the camera noise performance does not appear to be that good, measurements were rather disappointing, details are given in the measurements section at the end of this document.

Simply switching the camera away from it’s native 1080-line mode inevitably introduces some spatial aliasing (a busy-ness in the picture). At 720 lines, there are aliases centred on 540 lines, indicating that the 720-line frames were being generated from the interlaced fields of the 1080 source. This is disappointing, since the cmos sensors should, in theory, be capable of running at 1080p/50, a mode which is missing from the camera, but promised in a future upgrade. However, the SD down-conversions were acceptable, although the limiting SD resolution generated in any HD camcorder is always affected by the complexity (or lack of) of the down-conversion. Evidence for this is given in the final section of this document.

There are two sets of menus, slightly differing, one via the touch screen of the side panel, the other via the viewfinder. Many items are duplicated, I have not duplicated all the settings or comments in the section on the Viewfinder.

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

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1 Menus and settings, touch screen

AUDIO MENU

Inputs Audio levels

Item	Range	description	BBC
Front	+30, +20, +1, 0, -10, -20, -30dB	Pre-gain level for Front 1 mic	
Rear 1 mic	0, +20, +40, +50dB	Pre-gain level for Rear mic 1 input	
Rear 1 line	0, +20, +30dB	Pre-gain level for Rear line 1 input	
Rear 2 mic	0, +20, +40, +50dB	Pre-gain level for Rear mic 2 input	
Rear 2 line	0, +20, +30dB	Pre-gain level for Rear line 2 input	

Channels Audio control

Item	Range	description	BBC
Channel 1			
Ch1 ALC	On, Off	Audio AGC	
Ch1 levl control	Level1, Lev1+Front, Fixed, Front	Which level control is used when AGC off	
Ch1 fixed M	0~99 (50)	Set fixed level	
Channel 2			
Ch2 ALC	On, Off	Audio AGC	
Ch2 levl control	Level2, Lev2+Front, Fixed, Front	Which level control is used when AGC off	
Ch2 fixed M	0~99 (50)	Set fixed level	
Channel 3			
Ch3 ALC	On, Off	Audio AGC	
Ch3 levl control	Level3, Lev3+Front, Fixed, Front	Which level control is used when AGC off	
Ch3 fixed M	0~99 (50)	Set fixed level	
Channel 4			
Ch4 ALC	On, Off	Audio AGC	
Ch4 levl control	Level4, Lev4+Front, Fixed, Front	Which level control is used when AGC off	
Ch4 fixed M	0~99 (50)	Set fixed level	
Source ch1	Rear1, Rear2, Wrx1, Wrx2, Front1, Front2, MicRear, AES1, AES2, Mute	Recording source for channel 1	
Source ch2		Recording source for channel 1	
Source ch3		Recording source for channel 1	
Source ch4		Recording source for channel 1	

Outputs Routing selections

Item	Range	description	BBC
Rear			
Rear	Enabled, Disabled	Disables the rear outputs	
Rear1 mode	Channel, Source		
Rear1 source	Rear1, Rear2, Wrx1, Wrx2, Front1, Front2, MicRear, AES1, AES2		
Rear1 channel	Ch1, Ch2, Ch3, Ch4, Ch1+2, Ch1+3, Ch2+4, Ch3+4		
Rear2 mode	Channel, Source		
Rear2 source	Rear1, Rear2, Wrx1, Wrx2, Front1, Front2, MicRear, AES1, AES2		
Rear2 channel	Ch1, Ch2, Ch3, Ch4, Ch1+2, Ch1+3, Ch2+4, Ch3+4		
AES Audio			
AES mode	Channel, Source		
AES 1 source	Rear1, Rear2, Wrx1, Wrx2, Front1, Front2, MicRear, AES1, AES2		

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AES 1 channel	Ch1, Ch2, Ch3, Ch4, Ch1+2, Ch1+3, Ch2+4, Ch3+4		
AES 2 source	Rear1, Rear2, Wrx1, Wrx2, Front1, Front2, MicRear, AES1, AES2		
AES 2 channel	Ch1, Ch2, Ch3, Ch4, Ch1+2, Ch1+3, Ch2+4, Ch3+4		
SDI out			
SDI channel 1	Ch1, Ch2, VCh3, Ch4, Rear1, Rear2, Wrx1, Wrx2, Front1, Front2, MicRear, AES1, AES2		
SDI channel 2			
SDI channel 3			
SDI channel 4			
SDI channel 5			
SDI channel 6			
SDI channel 7			
SDI channel 8			
Monitoring			
Hdph mode	Channel, Source	Headphone monitoring mode	
Hdph source left	Front1, Front2, MicRear, AES1, AES2, Rear1, Rear2, Wrx1, Wrx2		
Hdph channel left	Ch1, Ch2, Ch3, Ch4, Ch1+2, Ch1+3, Ch2+4, Ch3+4		
Speaker mode	Source, Channel, HdphL, HdphR, HfphL+R		
Hdph source right	Front1, Front2, MicRear, AES1, AES2, Rear1, Rear2, Wrx1, Wrx2		
Hdph channel right	Ch1, Ch2, Ch3, Ch4, Ch1+2, Ch1+3, Ch2+4, Ch3+4		
Speaker mute	On, Off		
Setup			
Test tone	On, Off	Tone with bars	
Headroom	-18dBFS, -20dBFS		

VIDEO MENU

Output sel Signals on the displays

Item	Range	description	BBC
Levels			
Gain			
Gain	<preset ->, 0dB, <preset +>, <preset ++>, <preset +++>	Select gain preset value (presets are set below)	
Gain RGB			
Gain R	0~99 (50)		
Gain G	0~99 (50)		
Gain B	0~99 (50)		
Var. Gain	0.0~42.0dB	Set variable gain, 0.1dB steps	
Gain presets			
Gain-	-6, -3dB	Gains for – preset	
Gain +	+3, +6, +9dB	Gains for + pereset	
Gain ++	+6, +9, +12dB	Gains for ++ preset	
Gain +++	+12, +15dB	Gains for +++ preset	
Painting range	3, 6dB		
Exposure			
Exposure	Norm, Var, 50Hz, 60Hz, 1/200, 1/500, 1/1000	Shutter speed, also on camera front switch	
Lighting	-10~10 (0)	Shutter tweak to synch with 50/60Hz lights	

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Var. exp. time	50Hz~3270Hz (50)	Variable shutter in 1/2Hz steps	
Black			
Black RGBM	0~00 (50)	Black levels, RGB and Master	
Dynamic black	On, Off	This is not explained in the manual	
Flare			
Flare	On, Off		
Flare RGB		Set flare corrections	
Black Stretch			
Black stretch	On, Off		
Black contrast	Stretch, Press	Set to Stretch for neg film look, Press for print film look	
Black str. M	0~99 (50)	0~49 is stretch, 51~99 is press	Adjust to taste
Knee			
Knee	Auto, Var, Off		
Knee source	Y, NAM	NAM=non-additive mix of RGB, use when large parts of picture are highly saturated	Y
Desaturation	On, Off	Desaturation in knee-compressed zone	On
White clipper	On, Off		Off {f}, On {v}
Slope/point			
Slope	0~99 (0)	0=No change, 99=flattest slope	
Point	0~99 (10)	0=70%, 99=100% knee point	50[1]
Desaturation M	0~99 (50)	Knee-desaturation when in variable knee	
White clipper M	0~99 (50)	White clipper level when in variable knee	
Filter wheels			
N/D filter	Clear, ND1/4, ND1/16, ND1/64	Neutral density wheel, motorised for remote operation	
Home filterwheels	On, Off	Send it back to Clear	
Gamma			
Gamma mode	Nom, Low, Lin, Preset	Nom=0.45, Low=0.65	
Gamma curve	BBC0.4, BBC0.5, BBC0.6, ARD, CCIR, 6xARD, RAI	CCIR is actually the ITU709 curve	CCIR
Gamma RGBM	0~00 (76)	Set fine control of gamma, RGB and M, 0=0.35, 99=1.0, 76=0.45	76
Color			
Color temp			
Color temp	3200, 4700, 5600, 7500, FL, AW1, AW2, AWC	Presets: FL=fluorescent, AW=presets, AWC=automatic tracking white	3200[2]
Var. col. temp		Display only, shows current setting	
Matrix			
Matrix	EBU, Skin, B/W, RAI, BBC, 1:1, CoolFL, Var1, Var2	1:1=matrix off.[3]	
Sequence	G/M, M/G	Matrix before or after gamma[4]	M/G
G>R B>R			
G>R	0~99 (50)	Coefficient of G into R in variable matrix	
B>R	0~99 (50)		
R>G B>G			
R>G	0~99 (50)		
B>G	0~99 (50)		
R>B G>B			
R>B	0~99 (50)		
G>B	0~99 (50)		

[1] Setting Knee point to 50 should make it happen at 85%, but this could not be confirmed because the sawtooth test signal did not work properly and so the whole gamma correction process could not be fully investigated.
[2] There is only one filter wheel, with neutrals, colour temperature changes are done with gain changes, and so may well introduce coloured noise.
[3] Matrices are an issue. Although the colour performance with the "BBC" matrix seemed good, there has been no analysis or optimisation of a matrix for this camera, so all the matrices must be suspect. Hopefully, there will be a chance to derive a good matrix for the camera before it is widely distributed.
[4] Matrix-before-gamma is the colorimetrically correct thing to do, but placing the matrix after gamma-correction can be acceptable and can produced lower video noise.

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Shading			
White shading	On,Off	Normal shading correction stuff	
Hor. saw RGB		RGB horizontal sawtooth	
Hor. par RGB		RGB horizontal parabola	
Ver. saw RGB		RGB vertical sawtooth	
Ver. par RGB		RGB vertical parabola	
Color bar	On, Off	Colour bars[5]	
Sawtooth	On, Off	Test sawtooth[6]	
Saturation	0~99 (50)	Colour saturation for CVBS down-converted monitoring output	
Detail			
Detail			
Detail	On, Off	All detail control	On[7]
Source	Y, R, G, RG		Y
Coarse/fine	0~99 (50)	Frequency of main correction	50 {HD}, 33 {SD}
Vertical	0~99 (25 HD, 50 SD)	Vertical control, Level control also affects this	13 {HD}, 24 {SD}
Level	0~99 (25 HD, 50 SD)	Overall level	50 {HD}, 46 {SD}
Noise slicer	0~99 (50)	Noise level below which detail not affected	
Level depend	0~99 (40)	Level dependency of noise slicer[8]	
Soft detail			
Soft detail	On, Off	Prevents very large contrast edges being wrecked, very nice to have	On
Soft level	0~99 (30)	Upper limit of contrast amplitude to enhance	30
Knee detail	Off, 1, 2, 3, 4	Restoration of edges in knee-compression[9]	
Skin detail			
Skin detail	Off, 1, 2, 1+2	2 skin memories to play with	Off
Autoskin	On, Off	Auto skin detection	
Skin width			
Width 1 RB	0~99 (50)	Manual swing of R/B balance, memory 1	
Width 2 RB	0~99 (50)	Manual swing of R/B balance, memory 2	
Location XY		Report only, no control here	
Skin level	0~99	Adjust the detail enhance/depress level	
Skin view	Off, On	Set on to show the affected area	
Skin color			
Color 1 RB			
Color 2 RB			

SETUP MENU

The basics

Item	**Range**	**description**	**BBC**
Formats			
Video standard	1080i/50, 720p/50, 576i/50, 1080i/59, 720p/59, 480i/59	Video standard. There is no progressive standard at 1080[10]	1080i/50

[5] Colour bars are SMPTE only in HD at 59.94Hz. Full height bars at 50Hz. This seems inordinately silly, because SMPTE bars are universally accepted as being "HDTV bars".

[6] In the camera under test, the sawtooth signal was clearly faulty, it did not start at zero/black level. This made it very difficult to assess the gamma curves, knee and black stretch options. Full settings for BBC use cannot be derived until this fault is rectified and the camera retested.

[7] Unusually, I can recommend using detail enhancement, because the camera's native performance is good and clean, and can withstand it, but this must be revisited when the sawtooth problem is resolved and the transfer characteristics properly assessed. The values given provide a good balance between horizontal and vertical detail, the Level value at 50 is about the maximum that should be used, and the noise slicer should be adjusted to prevent excessive magnification of noise at such levels.

[8] Level dependency usually controls the amplitude of detected detail below which it will not be enhanced. In this camera, the control, seems to have more to do with noise slicing than detail level.

[9] Because the knee could not be properly assessed, knee detail could not be assessed either.

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Video source	CAM, SDI, CVBS	Select what to record, so this is a vtr as well as a camcorder	CAM
Compress HD	JP2K50, JP2K75, JP2K100, MP2 60, MP2 80	MPEG coding is requires an option card to be fitted	JP2K100
Compress SD	DV25, JP2K30, JP2K40, JP2K50, MP2 30, MP2 40, MP2 50		
Media selection	REV, CF1, CF2, Extern	Select the recording medium	
Chunk size	10sec, 30sec, 60sec, 3GB, NoLimit	Sets the size of the recording blocks[11]	
VF playback	Conf, Full	Set VF for playback, Conf shows it "as is", Full is "maximised cropping"	
Aspect ratio	16:9, 4:3, LB	Only for SD recording, LB places the 16:9 image in a 4:3 letterbox	
Timecode[12]			
Run mode	Record-run, Free-run	Timecode, standard stuff	
Play mode	Regenerated, From file	Set playback mode for TC display	
User bits			
Userbit mode	Usr value, Real time, Ext input	Source for user bits	
Userbit type	Unspec, 8 bit codes, Date/Time, Page/Line, Reserved		
Userbits 1		Set bytes 1~4, in hexadecimal	
Userbits 2		Set bytes 5~8, in hexadecimal	
Newtimecode	HH|MM|SS|FF (12|00|00|00)	Enter timecode	
ATC			
ATC SD	None, 7~22 (11)	Choose video line for Ancillary TC in SD	
ATC HD	None, 9	Choose video line for Ancillary TC in HD	
SD line double	On, Off		
HD line double	On, Off		
VITC	None, 19, 19+21, 21 (14, 16)	Choose video line number for VITC	
setup			
Input type	DVITC, LTC	Digital Vertical or Linear	
Output type	DVITC, LTC		
F-run sync	Real time, Local value, External	TC sync source	
Clock type	Inaccurate, Accurate	Clock type☺	
Dropframe	NDF, DF	[13]	
Recbuff			
Preferred media	CF-Ext-Rev, Ext-CF-Rev, Ext-Rev-CF, Not active	Choose preference of media for recording, switching is seamless	
Metadata			
Storyfile	<no story>, <list of story file names>	Select the story file, not explained in the manual	
Hardware			
Viewfinder			
VF monitoring	Y, R, G, B, x-G	x-G is inverted green	
Detail			
VF detail	On, Off	VF sharpening	
VF detail lvl	0~99 (50)		
Lens			
Auto iris			
Auto iris	On, Off		

[10] This is surprising, because the cmos sensors are themselves, progressive. The only possible conclusion is that the cmos sensors deliver interlaced 1080, and this has knock-on effects for the lower resolutions, see the measurements section at the end of this document.
[11] At first sight, there's no reason not to choose "NoLimit", but it might make more sense to use smaller chunks if there is any risk of the recording session spanning several storage devices.
[12] Timecode may well be redundant when this camera is used in a full tapeless workflow, since each clip is date/time stamped, and frames counted within the clip.
[13] In theory, DF TC should be relevant only when the frame rate is 29.97, this should not be selectable at 25fps

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Peak average	0~99 (65)	Fade between peak and mean metering	
Set point	0~99 (35)	Sets the aim point	
Extended iris			
Gain speed	1~5 (5)		
Gain max	0~15dB (15dB)		
Iris min	F5.6, F8, F11, F16	Diffraction limiting onset is at about F/8 in HD, stopping way down is not a good idea	
Iris max	F1.4, F2.0, F2.8, F4.0, F5.6		
Autoiris const.			
Iris gain	5~10 (5)	Iris shift speed, 5 is fastest	
Iris threshold	0~99 (63)		
Mom. Iris setpoint	0~99 (8)	Momentary iris aim level	
RE iris comp.	On, Off	Compensation for light loss when using an extender	
Buttons			
User buttons			
Button 1	Disable, Ext iris, Mark out, Mark in, Record, Forward, Rewind, Pause play, Stop play, Start play	User buttons on on left of camera under a slide cover	
Button 2			
Lens			
RET button	Ext signal, Playback		
Handgrip			
Zoom control	Enabled, Disabled	Extra controls on the top handle	
Record switch	Enabled, Disabled		
Ports			
Digital out	Normal, VF	VF stamps "VF" on the picture	
Analog in	CVBS, Timecode, AES audio, Audiosync	What comes through the analogue in BNC	
Analog out		What goes through the analogue out BNC	
IEEE 1394	Off, Exclusive, Both	Exclusive=play only 1394, Both=1394 and SDI etc	
Date/Time			
Date	[Year], [Month], [Day]	Set the date	
Time	[Hours], [Minutes], [Seconds]	And time	
Time zone	UTC+00~UTC+23		
Sidepanel			
Backlight	1~15 (15)	Light level	
Calibration	Exec	Recalibrate the touch screen	
Titlebar	Timecode, Userbits	What's shown on the title bar	
Files			
Std recall mode	Factory, Customer	What happens when you hit recall button	
Recall scene	Factory, Customer, Scene1~4[14]	Recall scene file	
Recall oper		Recall operator file	
Store scene		Store scene file	
Store oper		Store operator file	
Security			
User level	User lvl 0~4	Set the user level for both VF and side panel	

2 Menus and settings, viewfinder

VIEWFINDER MENU

Viewfinder controls

Item	**Range**	**description**	**BBC**
Monitoring	Y, R, G, x-G		
Detail			
Detail	On, Off	VF sharpening	
Level	0~99 (5)		

[14] Only 4 scene files seems a bit mean.

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Focus Assist	On, Off	Adds line-crawling effect to sharp edges (not horizontals)	
Zebra			
Zebra	On, Off	Diagonal pattern	
Mode	Level, Band	Level=zebra for all brighter than level, Band restricts to about 2.5% around level	
Level (%)	0~117 (90)	Video level	90 (v), 75 (f)
Contrast	0~99 (15)	Set zebra contrast level, nice feature	
Indicators			
Zoom	On, Off	0=wide, 99=tele	
Focus	On, Off	0=close up, 99=infinity	
Iris	On, Off	Shows stop	
Filter	On, Off	Neutrals only	
Audio bars	On, Off	Audio level meters, chan 1~4	
Timecode	On, Off		
Selectable	Storage, Batt, Off	Bottom left	
Markers			
Marker	On, Off		
Type	15:9, 14:9, 4:3		
Style	Dot, Shad, Both		
Shading	Shading, Black	Shading makes the outer part transparent, Black blanks it	
Centre cross	On, Off		
Safe Area			
Safe area	On, Off	10% margins	
Type	16:9, 15:9, 14:9, 4:3		
OSD			
White M	0~99 (70)	Character brightness, 0=dark, 99=bright	
Black M	0~99 (30)	Character dark level, 0=black, 99=no shade	
Mode	On, Time	On= always on, Time=goes away	
Time out	0~10 (10)	After this time, not calibrated	

VIDEO MENU

Much duplication here

Item	**Range**	**description**	**BBC**
Gain RGB			
Gain R	0~99 (50)		
Gain G	0~99 (50)		
Gain B	0~99 (50)		
Exposure time			
Var. exp. time	50Hz~3270Hz (50)	Variable shutter in 1/2Hz steps	
Lighting	-10~10 (0)	Shutter tweak to synch with 50/60Hz lights	
Color Temp			
Temp M		Display only, colour temperature	
RE iris comp	On, Off	Exposure compensation for loss with lens extender	
Detail			
Detail	On, Off	All detail control	On[15]
Source	Y, R, G, RG		Y
Level	0~99 (25 HD, 50 SD)	Overall level	50 {HD}, 46 {SD}
Vertical	0~99 (25 HD, 50 SD)	Vertical control, Level control also affects this	13 {HD}, 24 {SD}
Noise slicer	0~99 (50)	Noise level below which detail not affected	
Coarse/fine	0~99 (50)	Frequency of main correction	50 {HD}, 33 {SD}
Soft detail			

[15] Unusually, I can recommend using detail enhancement, because the camera's native performance is good and clean, and can withstand it, but this must be revisited when the sawtooth problem is resolved and the transfer characteristics properly assessed.

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Soft detail	On, Off	Prevents very large contrast edges being wrecked, very nice to have	On
Soft level	0~99 (30)	Upper limit of contrast amplitude to enhance	30
Black lvl			
Dyn. black	On, Off	Looks at the picture and tweaks gamma etc to "optimise" it	Off
Auto black	On, Off	[16]	
Master black	0~99 (50)		
Black M R	0~99 (50)	Manual black levels	
Black M G	0~99 (50)		
Black M B	0~99 (50)		
Black stretch			
Black stretch	On, Off		
Level	0~99 (50)	0=stretch, 99=press	
Contrast	Stretch, Press		
Knee[17]			
Knee	Auto, Var, Off	Auto is not a good idea except when you're in a hurry	
Knee type	Y, NAM	NAM=non-additive mix of RGB, useful in highly coloured scenes	
Point	0~99 (0)	Onset point	
Slope	0~99 (10)	Compression above the knee	
Limit	0~99 (0)	Set knee limit level	
Desat	On, Off	Saturation control in the compressed zone	
Desat M	0~99 (50)	Desaturation in variable knee	
Auto point	0~99 (30)		
Auto ref	0~99 (30)		
Auto limit	0~99 (50)		
Skin			
Skin	Off, 1, 2, 1+2	Two skin memories	
State	Off, On	Indicator only	
View	Off, On	Shows area of each memory	
Level	0~99 (15)	<50 softens, >50 sharpens	
Gate 1			
Red lvl	0~99 (50)	Correction level for gate 1, red	
Green lvl	0~99 (50)		
Blue lvl	0~99 (50)		
Gate 2			
Red lvl	0~99 (50)	Correction level for gate 2, red	
Green lvl	0~99 (50)		
Blue lvl	0~99 (50)		
Auto skin			
Auto skin	On, Off		
State	On, Off	Indicator only	
Gamma			
Gamma mode	Nom, Low, Lin, Preset	Nom=nominal 0.45, Low=0.65	
Curve	BBC0.4, BBC0.5, BBC0.6, ARD, CCIR	CCIR should read ITU709	CCIR
Master gamma	0~99 (76)	Master gamma level, 0=1.0, 99=0.35, 76=0.45	
Gamma R	0~99 (76)	Red gamma fine tweak	
Gamma G	0~99 (76)		
Gamma B	0~99 (76)		
Mat/Gam order	G/M, M/G	Order of operations	M/G
Matrix			
Matrix	EBU, Skin, B/W, RAI, BBC, 1:1, CoolFL, Var1, Var2	This area needs more development, to derive a correct matrix rather than a variety	

[16] There is no black-balance routine on this camera, it is all automatic, and seems to work well enough. There is an automatic routine scanning the picture continuously, mapping out any dead pixels.

[17] Knee could be fully tested in this measurement session because the sawtooth signal did not work properly.

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R/G	0~99 (50)	Variable, red into green	
G>R	0~99 (50)		
R>B	0~99 (50)		
B>R	0~99 (50)		
G>B	0~99 (50)		
B>G	0~99 (50)		
Mat/Gam order	G/M, M/G	Order of operations	M/G
Shading			
Shading	On, Off	White shading compensation	
Hor par R	0~99 (50)	Sawtooth and parabola adjustments	
Hor saw R	0~99 (50)		
Hor par G	0~99 (50)		
Hor saw G	0~99 (50)		
Hor par B	0~99 (50)		
Hor saw B	0~99 (50)		
Ver par R	0~99 (50)		
Ver saw R	0~99 (50)		
Ver par G	0~99 (50)		
Ver saw G	0~99 (50)		
Ver par B	0~99 (50)		
Ver saw B	0~99 (50)		
Flare			
Flare	On, Off		
Red lvl	0~99 (50)		
Green lvl	0~99 (50)		
Blue lvl	0~99 (50)		
White limit			
White limit	On, Off	=Clipper	
Level	0~99 (50)	[18]	
Formats			
Video standard	1080i50, 720p50, 576i50, 1080i59, 7209p59, 480i59	Video standard	
Video source	CAM, SDI, CVBS	Source to record	
Compress HD	JP2K50, JP2K75, JP2K100, MP2 60, MP2 80	HD compression coder, MPEG2 requires an optional card	
Compress SD	DV25, JP2K30, JP2K40, JP2K50, MP2 30, MP2 40, MP2 50	SD compression coder, MPEG2 requires the optional extra card	
Media			
Select primary	REV, CF1, CF2, Extern	Select storage medium	
Preferred	CF-Ext-REV, Ext-CF-Rev, Ext-Rev-CF, Not active	Set the order in which media are used as they become full or unavailable	
Chunk size	10 sec, 30 sec, 60 sec, 2GB, No limit	No Limit not available when using CF recording	
Timecode			
Run mode	Record-run, Free-run	Rec-run=continuous, Free-run=only when recording	
FRun set			
FRun mode			
Output TC type	DVITC, LTC	LTC =linear, DVITC=digits	
Timecode sync			
Dropframe	NDF, DF	Select DF TC when at 59.94Hz	
New timecode			
Hours	0~24	Set the time code	
Minutes	0~59		
Seconds	0~59		
Frames	1~25 (50) 1~60 (59)		
User bit mode	Usr value, Real time, Ext input		
User bits			

[18] This was not tested because of the fault in the sawtooth test signal.

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UB1	0~F	Set user bit 1, hexadecimal	
UB2			
UB3			
UB4			
UB5			
UB6			
UB7			
UB8			
Metadata			
Story name	<list of uploaded story file names>	Pick a story name for recording	

AUDIO MENU

Sound stuff

Item	Range	description	BBC
Inputs (pregain)			
Front	+30, +20, +10, 0, -10, -20, -30dB	Pregain level for Front 1 mic input	
Rear 1 mic	0, +20, +30, +40, +50dB		
Rear 1 line	0, +20, +30dB		
Rear 2 mic	0, +20, +30, +40, +50dB		
Rear 2 line	0, +20, +30dB		
Channels			
Channel 1			
ALC	On, Off	Automatic level control	
Lvl control	Level 1, Lev1+Front, Fixed, Front	Which level control to use	
Fixed lvl	0~99 (50)	Set fixed rec level	
Channel 2			
ALC	On, Off	Automatic level control	
Lvl control	Level 1, Lev1+Front, Fixed, Front	Which level control to use	
Fixed lvl	0~99 (50)	Set fixed rec level	
Channel 3			
ALC	On, Off	Automatic level control	
Lvl control	Level 1, Lev1+Front, Fixed, Front	Which level control to use	
Fixed lvl	0~99 (50)	Set fixed rec level	
Channel 4			
ALC	On, Off	Automatic level control	
Lvl control	Level 1, Lev1+Front, Fixed, Front	Which level control to use	
Fixed lvl	0~99 (50)	Set fixed rec level	
Source channel 1	Rear1, Rear2, Wrx1, Wrx2, Front1, Front2, MicRear, AES1, AES2, Mute		
Source channel 1			
Source channel 1			
Source channel 1			
Outputs			
Rear			
Rear	Enabled, Disabled	Both rear sockets	
Rear 1 mode	Channel, Source		
Rear 1 source	Rear1, Rear2, Wrx1, Wrx2, Front1, Front2, MicRear, AES1, AES2		
Rear 1 channel	Ch1, Ch2, Ch3, Ch4, Ch1+2, Ch1+3, Ch2+4, Ch3+4		
Rear 2 mode	Channel, Source		
Rear 2 source	Rear1, Rear2, Wrx1, Wrx2, Front1, Front2, MicRear, AES1, AES2		
Rear 2 channel	Ch1, Ch2, Ch3, Ch4, Ch1+2, Ch1+3, Ch2+4, Ch3+4		

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AES Audio			
AES mode	Channel, Source		
AES 1 source	Rear1, Rear2, Wrx1, Wrx2, Front1, Front2, MicRear, AES1, AES2		
AES 1 channel	Ch1, Ch2, Ch3, Ch4, Ch1+2, Ch1+3, Ch2+4, Ch3+4		
AES 2 source	Rear1, Rear2, Wrx1, Wrx2, Front1, Front2, MicRear, AES1, AES2		
AES 2 channel	Ch1, Ch2, Ch3, Ch4, Ch1+2, Ch1+3, Ch2+4, Ch3+4		
SDI out			
SDI channel 1	Ch1, Ch2, Ch3, Ch4, Rear1, Rear2, Wrx1, Wrx2, Front1, Front2, MicRear, AES1, AES2		
SDI channel 2			
SDI channel 3			
SDI channel 4			
SDI channel 5			
SDI channel 6			
SDI channel 7			
SDI channel 8			
Monitoring			
Hdph mode	Channel, Source	Headphones	
Hdph left src	Front1, MicRear, AES1, AES2, Rear1, Rear2, Wrx1, Wrx2		
Hdph left chan	Ch1, Ch2, Ch3, Ch4, Ch1+2, Ch1+3, Ch2+4, Ch3+4		
Speaker mode	Source, Channel, Hdph L, Hdph R, Hdph L+R	Louspeacker	
Hdph right src	Front1, MicRear, AES1, AES2, Rear1, Rear2, Wrx1, Wrx2		
Hdph right chan	Ch1, Ch2, Ch3, Ch4, Ch1+2, Ch1+3, Ch2+4, Ch3+4		
Speaker mute	On, Off		
Setup			
Test tone	On, Off	1kHz with bars	
Headroom	-18dBFS, -20dBFS		

SYSTEM

More colour balancing

Item	Range	description	BBC
User lvl	User lvl 3, User lvl 2, User lvl 1, User lvl 0	Set depth of controls available on VF and sidepanel	
Camera #	0~99 (17)	For use in multi-cam operations	
PIN code			
Enter PIN	****	Access to service levels	
Set PIN	****	Change PIN number	
Files			
Scene files			
Store			
Scene file	Scene1, Scene 2, Scene3, Scene4, Customer	File for storing	
Store	Exec	Do it	
Recall			
Scene file	Scene1, Scene 2, Scene3, Scene4, Customer	File for recalling	
Recall	Exec	Do it	
Operator files			
Store			
Operator file	Oper1, Oper2, Oper3, Oper4,	File for storing	

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	Customer		
Store	Exec	Do it	
Recall			
Operator file	Oper1, Oper2, Oper3, Oper4, Customer, Factory	File for recalling	
Recall	Exec	Do it	
Productionr files			
Store			
Production file	Prod1, Prod2, Prod3, Prod4, Customer	File for storing	
Store	Exec	Do it	
Recall			
Production file	Prod1, Prod2, Prod3, Prod4, Customer, Factory	File for recalling	
Recall	Exec	Do it	
Iris			
Iris	0~99 (50)		
Momentary iris			
Momentary iris	On, Off	Quick of auto stab to get close	
Setpoint	0~99 (8)	Aim point for auto	
Auto iris			
Auto iris	On, Off		
Peak/Average	0~99 (78)	0=peak, 99=average	
Setpoint	0~99 (20)	Aim point	
Gain	5~10 (5)	Response speed, 5=slow, 10=fast	
Threshold	0~99 (63)		
Extended iris			
Ext auto iris	On, Off	This is full auto exposure control, iris and gain	
Gain speed	1~5 (5)		
Minimum iris	F5.6, F8, F11, F16	Diffraction limiting starts at about F8 in 2”/3 HDTV cameras	
Maximum iris	F1.4, F2.0, F2.8, F4.0, F5.6		
Max (dB)	0~15dB (9dB)	Gain range allowed in this mode	
Gain presets			
Preset -	6d, -3dB		
Preset +	+6, +9, +12, +18dB		
Preset ++	+9, +12, +18, +24dB		
Preset +++	+30, +36, +42dB		
Tally			
Rear follow	On, Off	On=tally controlled by tally switch on VF	
Service			
LPC	Off, On	Performs leaky pixel correction (dirty window)	
BPC	Off, On	Performs black pixel (dead) calibration	
Sens. calib	Off, On	Calibrates the sensors	
3200 calib	Off, Run	Does 3200K calibration	
Test patterns			
Sawtooth			
Sawtooth	Off, On	This will be very useful when it works	
Mode	PrPr, Asic	PrPr=pre-processor (whole channel), Asic=digital channel only	
Power			
Battery			
Warning lvl (%)	20~30%	Set low level warning	
Fatal (%)	10~20%	Set critical warning level	
Warning lvl (V)	11.1~16.5V	Set low voltage warning	
Fatal (V)	10.7~13.5V	Critical voltage	
Warning lvl (Min)	6~11Min	Time to minimum, minutes	
Fatal (Min)	3~10 Min	Time to critical, minutes	
External			

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Warning lvl (V)	11.0~12/0V	Level for “Power low” message	
Fan control			
Silent mode	RecStdby, Rec, Off	Turns all fans off	
Auto mode	Lin, Profile	Auto mode for can control	
Profile	Max, Normal, Fan	Camera fan profile	
Time/date			
Year	1900~2100		
Month	1~12		
Day	1~31		
Hour	00~23		
Minutes	00~59		
Seconds	00~59		
Store	Exec	Set new time/date	
Buttons			
User buttons			
Button 1	Disable, Ext iris, Mark out, Mark in, Record, Forward, Rewind, Pause play, Stop play, Start play	User buttons, left side of camera under slide cover	
Button 2			
Lens			
Ret button	Ext signal, playback	Function assignment	
Handgrip			
Zoom control	Enabled, Disabled	Controls on the handle	
Record switch	Enabled, Disabled		
IEEE 1394			
IEEE 1394	Off, Exclusive, Both	Exclusive=play on 1394 only, Both=1394 and SDI etc together	
Diagnostics			
Package ID		Software version	
REV			
Drive state	Ok, Error, Warning	Report on state on the RevPro drive	
Disk state	Ok, Error, Warning	Report on state of the actual disk	
Power			
Voltage	<voltage>	Shows current power supply voltage	
Power	<power>	Shows power being used (watts)	
Power mode	External, Battery	Shows where it’s coming from	

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3 Measurement results

3.1 Colour performance

Assessments were made visually, using Macbeth charts as usual.

3.2 Resolution

A HDTV zone plate chart was used (Figure 1, the illustrated version being for 480-line video). This contains six circular patterns that fully explore the spatial frequency performance of the camera, up to 1920x1080 pixels per width and height. Three patterns are grey-scale for testing luma performance, three more are coloured for examining chroma resolution or other colour filtering. 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.

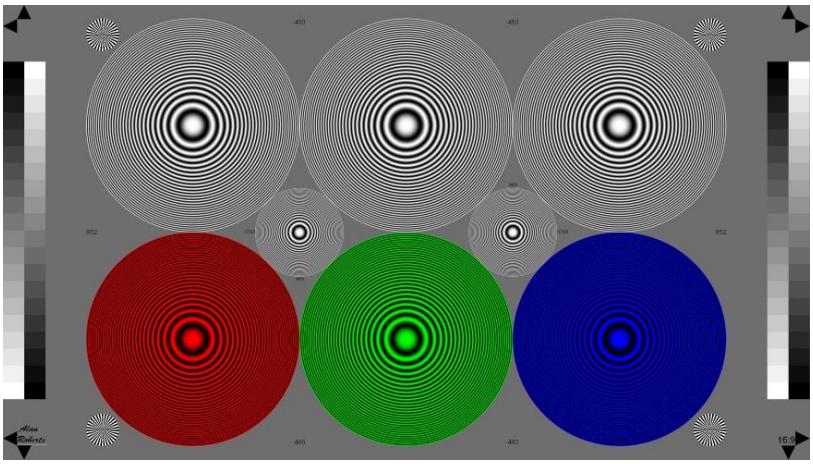

Figure 1, zone plate test chart

3.2.1 Resolution 1080i-line HDTV

Figure 2 shows a single quadrant of one grey-scale pattern; for this exposure, the camera detail enhancement was turned off, so this is the native performance of the camera. There are no visible alias patterns, apart from a feint one centred on 1080 lines (top of the pattern). This confirms that the sensors are 1920x1080. Also, the clean horizontal resolution indicates that there is probably no "precision offset" of the green from red and blue sensors, a common technique to enhance resolution in cameras. The clean way in which the amplitude of the sine-wave patterns falls to the limits confirms that the resolution has been limited with an optical "quarter wave" plate or similar technique. This is very encouraging

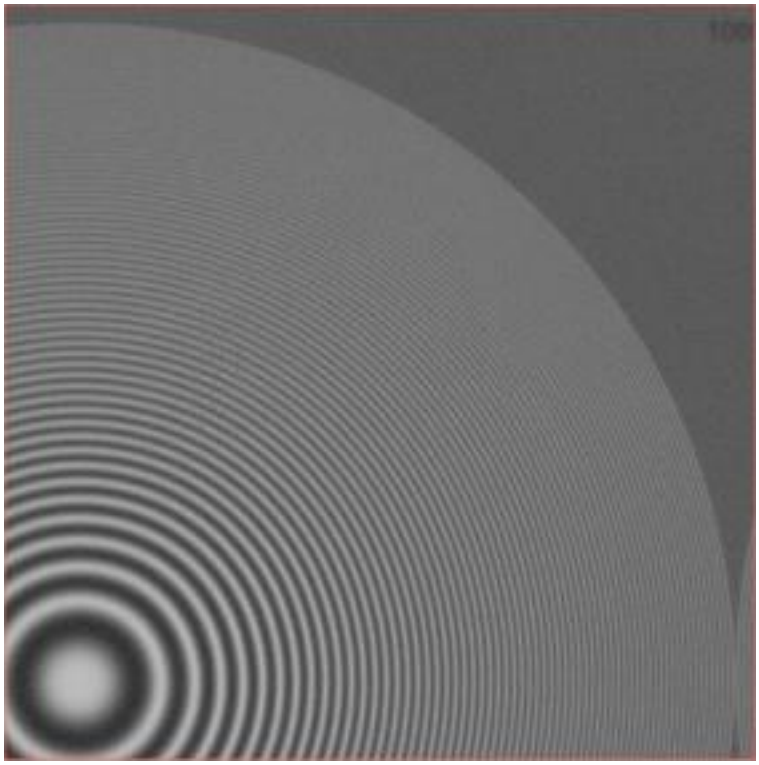

Figure 2, HD 1080-line, no detail

However, it is clear that the horizontal resolution is better than the vertical, not unusual in an interlaced camera, but it hints that the interlacing process is happening very early in the camera.

There were no alias patterns resulting from frequencies beyond the limits of 1920x1080 video.

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3.2.2 Detail enhancement at 1080i HDTV

For a film look (not possible in this camera at 1080-line because it does not, at present, support the normal psf format at 1080i), detail can simply be switched off, and the results will be a good match to super 16 film. However, for a 35mm look, a little enhancement would be a good idea. Clearly, this must be retested when the sawtooth test signal problem is solved and the camera supports progressive scanning at 25Hz (psf).

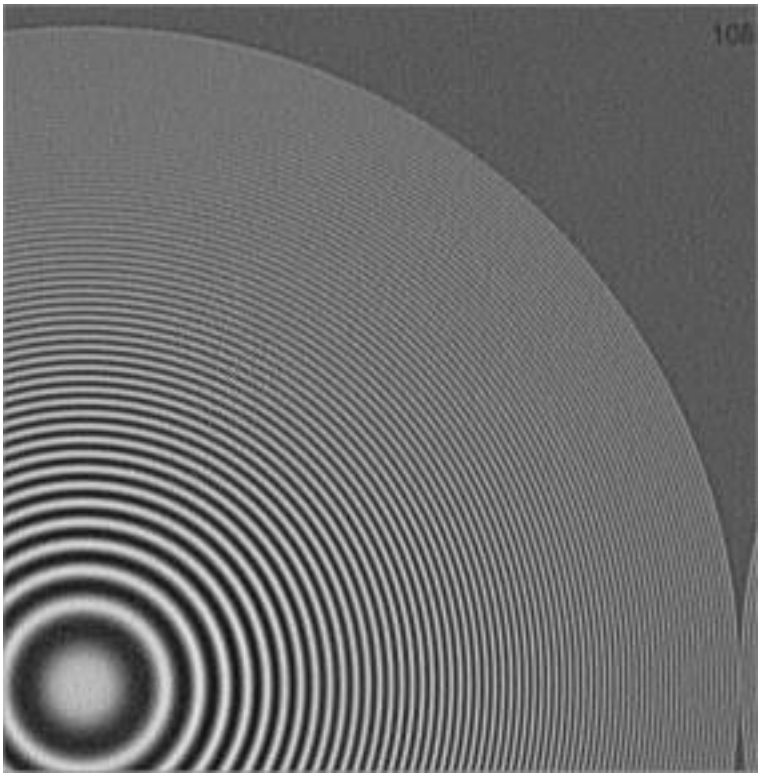

Figure 3, HD 1080-line, maximum detail

Since the native resolution is very clean, it is possible to use rather more detail enhancement than usual. Some initial experiments resulted in a set of control values that resulted in a reasonably well balanced performance, both horizontal and vertical. The results for the same quadrant of the chart are shown in Figure 3. Clearly, the outer edge of the chart is a little too sharpened, but the enhancement has not revealed any aliasing and in theory at least could be used for a "video look". However, such extreme enhancement should be used with care, since it has emphasised the noise somewhat, and so the noise slicer control should be adjusted to prevent that happening. The values used are:

- Level 70
- Source Y
- Coarse/fine 50
- Vertical 13
- Soft On
- Soft level 30

The overall Level setting is a collective control of the detail enhancements; the high setting (default is 50) caused excessive interlace twitter on a high grade HD crt display until the Vertical control was reduced below the default setting (25). Since this was an exercise to explore the camera, noise slicing was not investigated in detail.

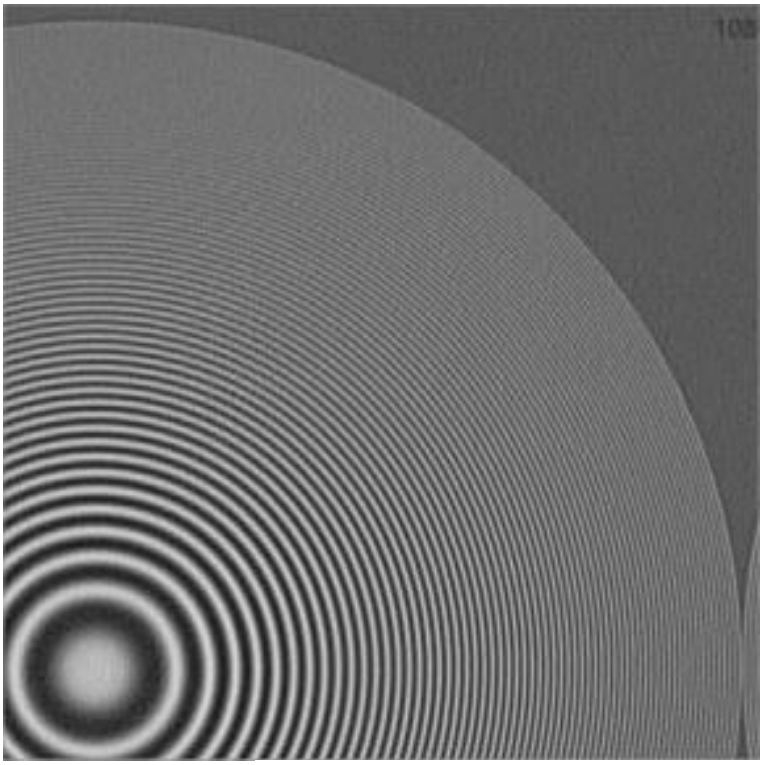

Figure 4, HD 1080-line, detail Level=50

Figure 4 shows the result for the same mixture of settings, but with the overall control (Level) lowered to 50. The annoying dark edge to the pattern has largely gone, and noise is less of a problem, but would probably improve if the noise slicer level were raised a little. The faint vertical alias pattern shows the level of interlace twitter seen on the crt display, on a large flat-screen display (1920x1080 resolution with the internal scaler disabled), this alias was not visible at all.

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This performance would be perfectly suitable for normal video performance, a “television” look, subject to setting the noise slicer. Note that this setting might have to be changed for various settings of the camera gain control. In the short time available for these tests, it was not possible to explore this further.

3.2.3 Resolution 720p HDTV

Figure 5 shows the camera performance at 1280x720, with detail switched off. This is less encouraging than the performance at 180-line.

There is a horizontal null zone (plain grey) centred at 1280 pixels, and aliasing plainly visible above that albeit at levels that are probably low enough to be acceptable. This aliasing would appear as a general “busy”-ness in pictures with fine detail (hair, waving grass, undulating water), but could probably be reduced or even eliminated by fitting a light diffusing filter to the lens. It results from the lens delivering, to the sensor, frequency content above the 1280x720 limits of this format, while the in-built optical spatial filter is properly tailored to the inherent 1920x1080 resolution.

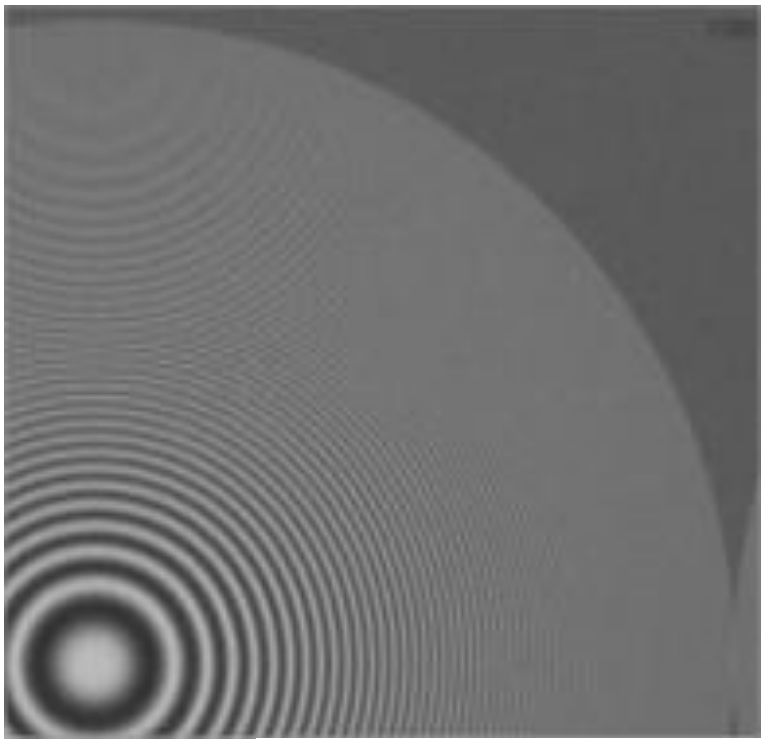

Figure 5, HD720, no detail

Vertically, there is a bigger problem. The null zone is at 540, not 720 as expected. This, and the strong aliasing at higher frequencies, provide evidence that the scaling from 1080 to 720 (the forming of 720-line frames) is being done from the 540-line interlaced fields, and not from the progressive resolution of the sensors themselves. This is disappointing, but may well go away when the promised upgrade to 1080psf/25 appears, since it requires that the sensors are read progressively, and not with interlace.

Nevertheless, the effects of detail enhancement were investigated.

3.2.4 Detail enhancement 720p HDTV

Figure 6 shows the results for the detail enhancement with the same picture as for 1080-line, Level=50. Although the dark ring surrounding the pattern is reduced, the principle effect is to enhance the aliasing in a rather unpleasant manner. It also reveals some aliasing at 720-line, as well as that at 540.

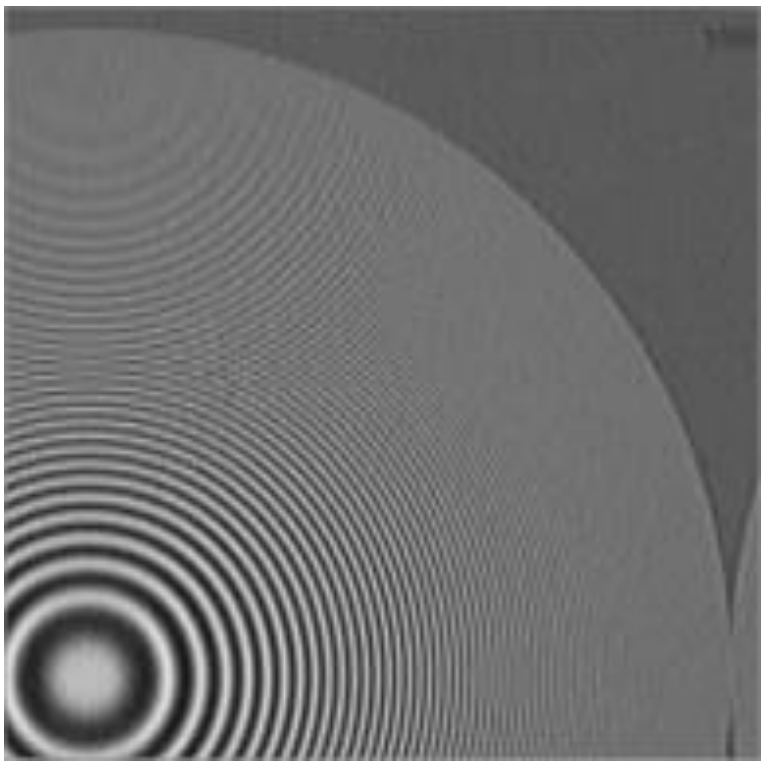

Figure 6, HD 720, detail Level=50

Clearly, the detail settings for 1080-line do not work well at 720-line, and cannot really be expected to work well since the presence of aliasing is rather disturbing.

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3.2.5 Resolution SDTV

Figure 7 shows the 576i-line down-converted picture with detail enhancement off.

Horizontally, the aliased and wanted frequencies are of equal amplitude at about 640 pixels, but the aliases spread out to about 1000 pixels but there is no disturbance above that value. Vertically, there is little wanted frequency content above about 320 lines and aliases are visible, albeit only faintly, between 720 and 1040 lines. Moreover, there is a steep decline in the frequency response between 175 and 320.

The pictures were subjectively soft and the presence of the aliased components shows that the down-sampling filters could be done better.

The performance at 480i appeared to identical, suggesting that the same filtering is used for both formats.

Figure 7, SD 576i, detail off

Figure 8 shows the effect of maximal detail enhancement, with the following settings:

- Level 99
- Source Y
- Coarse/fine 33
- Vertical 24
- Soft On
- Soft level 30

The vertical detail settings was as high as could be tolerated before objectionable edge effects occurred.

Horizontal aliases extend to 995 pixels, vertical aliases are more visible in the range between 540 an 1080. The wanted vertical resolution is now visible up to about 440 lines, and the droop in vertical response is almost corrected. However, this level of enhancement does not look nice at all, dark edges are clearly visible on the pattern boundary.

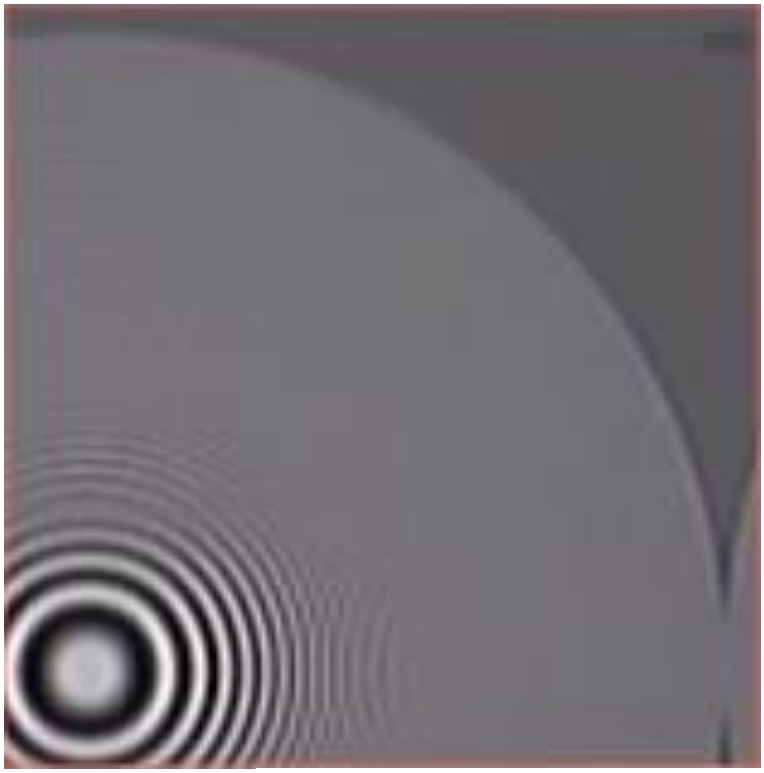

Figure 8, SD 576i, detail maximum

Figure 9 shows the result for the best compromise setting found during the tests, Level=46. The aliases are at lower amplitudes and the overall effect is les distracting. However, the pictures were significantly less sharp and alias-free than should be demanded in a camera making SD pictures for broadcasting purposes.

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Figure 10 shows the effect of the same settings at 480i-line. tThere is very little difference between the 480 and 576 performance in the wanted detail. However, the vertical aliases are rather more visible, and there is a partial null zone (grey with little detail), centred on about 216 lines.

3.3 Noise performance

Measurements were made by exposing the camera to a plain white card, evenly lit, highly defocused. The camera gain was set to 0dB and exposure was set to generate video signals at 4 levels over the signal range. Data files were saved either to a data store via HDSDI or directly in the camera to SD card. Software analysis was then used to convert the files to BMP format, and to measure the rms noise levels in each file, using specialised software. The detail enhancement Level was set to 70, to see the worst scenario.

The noise level at about 50% is representative of the camera performance with gamma-correction switched off, because the ITU.709 curve has a slope of unity at an input level of about 28%, which corresponds to an output level of about 52%.

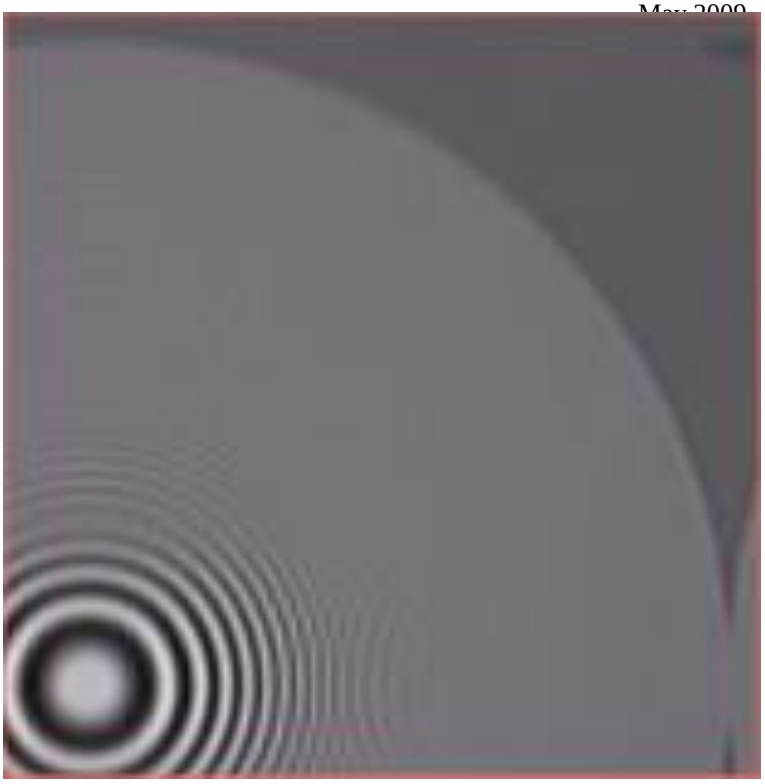

Figure 9, SD 576i, detail=46

Figure 10, SD 480i, detail=46

3.3.1 Noise at 1080i HDTV

The distribution of noise levels over the grey scale conforms well with the slope of the gamma correction curve, and is perfectly normal. However, the numbers do not make good reading.

The camera manual contains a specification figure for noise of 54dB in HDTV mode. That figure is not reached in any of these measurements.

It is clear that operating at 720-lines gives a noise advantage of about 4.5dB, this is to be expected because the down-conversion algorithm involves the weighted averaging of neighbouring pixels, which reduces noise. Also, it is clear that this maximal detail enhancement is adversely affecting the noise by a dB or so, judicious adjustment of the noise slicer should cure that.

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There is one bright prospect though; since the gain control allows setting to -6dB, the noise performance can be improved by 6dB with the loss of one stop of overexposure headroom. Unfortunately, since the sawtooth test signal was not working properly for these tests, it was not possible to measure the headroom reliably, but the informal tests done using a Macbeth chart showed that headroom could be about 2.5 stops (600%), therefore loss of one stop may not be an issue.

Std	Gain	Detail	Level	Noise
1080	0dB	off	8.0%	33dB
			22.1%	37dB
			46.3%	39dB
			84.1%	40dB
		on	44.9%	38dB
	+6dB		44.9%	31dB
	+12dB		46.6%	26dB
720	0dB		9.6%	36dB
			23%	39dB
			45%	41dB
			83%	42dB
	+6dB		43.7%	35dB
	+12dB		46.2%	28dB

3.3.2 Noise at 576i SDTV

Noise levels should be about 6dB better than for HDTV since there is an element of pixel-averaging involved in the down-conversion process. Measurements were again made at 0dB gain, but with the "optimal" detail settings found for SD working.

Level	Noise
10.2%	39.1dB
23.7%	43.2dB
51.8%	48.2dB
88.5%	51.3dB

Even at SDTV, the noise near 50% video level is 6dB worse than the specification for HDTV. This is disappointing.

3.4 Conclusion

Resolution at HDTV 1080 is good. There are significant and visible aliases in the pictures at both 720p and SDTV resolutions, the levels may be acceptable in practice.

Noise performance is poor, the camera does not meet its specification.

Colour performance was acceptable, but could probably be improved by installing a colour matrix calculated for the camera, and eliminating all the preset matrices.

The gamma-correction could not be fully investigated because of a fault in the internal saw-tooth test signal.

The camera should be retested when significant improvements have been made.

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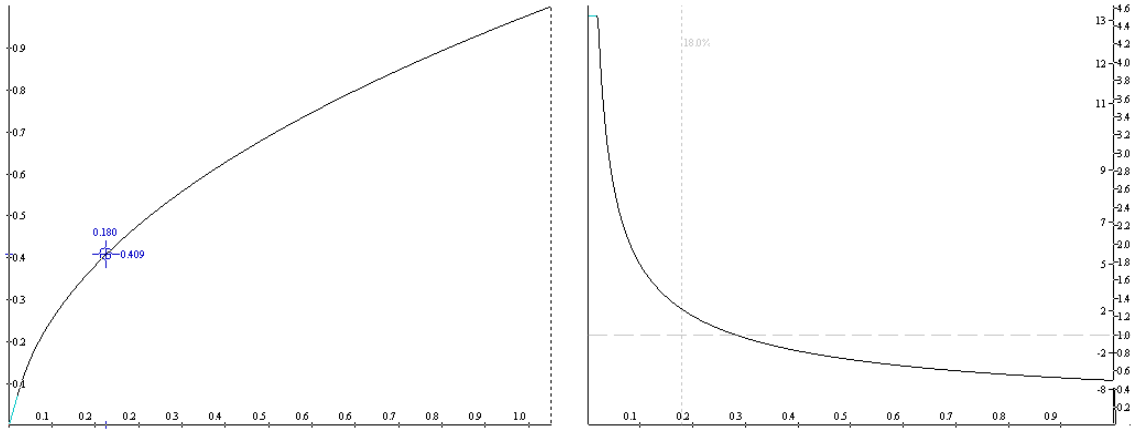
Thomson/GV DMC1000 Infinity

Second tests at Kingswood Warren, April 4 2008

1. Noise levels at 0dB gain.

File	Video level	Noise level
2	0.930	-42.24dB
3	0.464	-45.57dB
4	0.237	-45.97dB
5	0.086	-43.06dB



Noise performance usually follows the slope of the gamma curve, since noise is generated mostly in the analogue front end of the camera. Although the gamma curve selected in the camera was called "CCIR" it is probably intended to be that of ITU.R-BT 709 (left-hand plot).

Thus the noise levels for these four measurement points should be expected to follow the log of the slope, so at 93%, the noise should be about 5.8dB lower than at 27.8%, where the slope of the gamma curve is unity. Also, at 8.6% the noise should be about 5.5dB higher. However, the measurements vary only by about 3.5dB instead of 11dB, implying that some noise is being generated after the gamma corrector. This is unusual, and rather surprising.

The "safety check" is to measure the noise at high gain, to discriminate between front-end and processing noises.

2. Noise levels at 12dB gain

File	Video level	Noise at +12dB	Equivalent noise at 0dB
6	0.900	36.86dB	48.86dB
7	0.461	38.50dB	50.50dB
8	0.246	36.83dB	48.83dB
9	0.117	33.45dB	45.45dB

Noise at +12dB is considerable, and the distribution is a little greater than at 0dB gain. The right-hand column removes the effect of the 12dB gain and predicts the noise at 0dB; the values are significantly different from those measured at 0dB, and this confirms that noise is being added after gamma-corrections.

The camera's noise specification is for -54dB, it misses that figure by at least 8.5dB at 0dB gain.

3. Noise levels in linear mode

One measurement was taken with gamma-correction switched off and 12dB gain.

File	Video level	Noise at +12dB	Noise at 0dB

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10	0.546	36.65dB	48.65dB

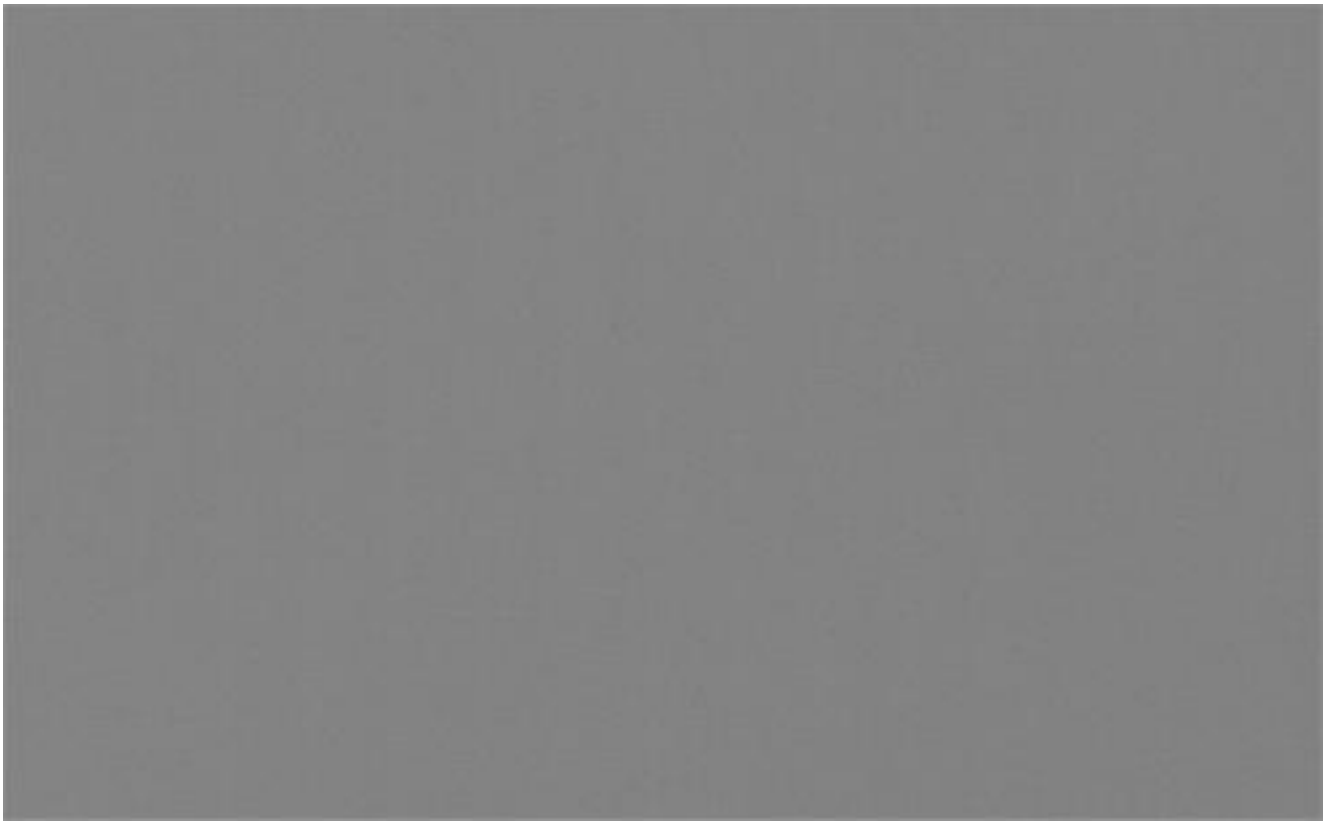
The result is very close to the value derived with gamma-correction, at 25% signal level. This is good confirmation that the gamma curve is not doing anything unexpected.

4. Noise at high temperature

There was a hint of fixed-pattern noise in the video output at high gain, so the camera was allowed to heat up such that the sensors reached 63ºC. A final measurement was then made at +12dB gain. This time, instead of using only the luma (Y) channel, the signal was fully decoded into RGB using ITU-709 a chroma re-sampling filter and decoding equations. This is the same process that I used for decoding the Macbeth Chart image file. For all the other noise measurements, I have used only the luma (Y') channel because the noise was visually fairly neutral when viewed on a Sony 36" HD CRT monitor. However, for investigating such an extreme condition, it is a good idea to see what is happening in the RGB channels as well. The disadvantage is that processing takes a lot longer.

	Levels			Noise		
File	R	G	B	R	G	B
11	0.418	0.452	0.800	-33.98	-35.85	-25.53

There is some visible vertical patterning, but the level is very low. It is most visible in the luma channel, the chroma channels do not seem to have it at all.



It is difficult to see in this sample (495x307 pixels cropped from the centre), but it is rather more visible when the camera is panned across a plain image. Even at this level it might be a problem in some productions. There was no evidence of the pattern at normal temperatures, but it could well be significant on difficult scenes (low video level, plain background, slow pan).

5. Conclusion

Noise levels are lower than was measured in the first tests, by about 7dB. However, the noise is still 9dB short of the specification's claim of 54dB. Based on these tests, this is still the most noisy HDTV camera measured so far. Only the Panasonic HDX400 has similar noise levels, and that camera has been dropped by the BBC. Indeed, it was the visible noise from the HDX900 that started me measuring noise levels in cameras.

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For comparison, the HPX500 noise level is consistently about 3dB lower, and the HPX 3000 is about 2dB less noisy. The Varicam is 1dB more noisy, but that camera is "allowed" because of its unique features.

It seems that noise is generated within the digital part of the camera, after gamma-correction, because noise distribution does not follow the slope of the gamma curve; quite possibly, it is the low-level fixed pattern noise that is polluting the head noise and so returning excessive noise levels.

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