

Colorimetric and Resolution requirements of cameras

Alan Roberts

ADDENDUM 25 : Canon XH G1 (and XH A1)

Data for this addendum is taken from a short examination of one production model of the Canon XH G1 HDV camcorder. It has 3 16:9 1”/3 ccd sensors of 1440x1080 pixel dimensions (4.5mm diagonal). It records interlaced HDTV using the HDV algorithm onto standard mini DV tapes (1080i) and progressive HDTV using a Canon proprietary format onto the same tape and at the same data rate, and SDTV using normal DV format. The A1 (not tested here) is a slightly simplified version of the G1.

The camera is relatively light (about 2.1kg excluding battery) and has an integral lens and viewfinder, with side lcd panel, and seems aimed at the middle to high-end consumer/low-end professional market rather than full broadcast, which would normally demand interchangeable lenses and better control.

It has internal menus for setting the performance, not as complex as in a full broadcast camera, but enough to control some of the important features, albeit only in “on/off” states. It is possibly suited to multi-camera operation because it has an HDSDI connector for video output (not in the A1). This potentially makes it useful in the broadcast and other high-end markets. It has analogue video outputs (3.5mm jacks and BNC on the G1) and digits via IEEE1394 Firewire.

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

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Addendum 25 : Canon XH G1 (and XH A1)

Data for this is taken from a short examination of a production model of the Canon HDV camcorder, HH G1, with three 1”/3 ccd sensors of 1440x1080 pixels. It records in HDV (1080) format onto miniDV tapes, and standard definition (576i/25, or 480i/59.94 in the NTSC model) as DV. The A1 (not tested here) is a slightly simplified version of the G1.

The camera is essentially a prosumer model, with some professional features such as having XLR connectors for audio input. It has an integral lens (4.5~90mm, 20:1, F/1.6 maximum aperture ramping to F/3,5) and viewfinder, with side lcd panel, and seems aimed at the high-end consumer and mid-professional market rather than broadcast, which would normally demand interchangeable lenses and higher resolution sensors, together with greater control through the menus. Minimum exposure is claimed to be 0.3 lux (0.4 lux for the NTSC version).

The camera has internal menus for setting the performance and a reasonable selection of external controls. There are analogue and digital video outputs (SDI/HDSDI but not in the A1, components, and composite SD, all via multi-pin connectors) and digits via IEEE1394 Firewire.

The normal assessment procedure for cameras could not be used, largely because the G1 does not have a selectable test signal. Therefore, testing was all done via the lens. Recommended settings allowing for a “video-look” have been derived; no attempt was made to derive decent “film-look” settings due to limitations in the controls of the camera.

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; some menus are repeated in different camera modes, explanatory notes are given only in the first appearance of each menu. In boxes with a range of numeric settings, the values indicate the range (sometimes no scales are given) and the factory default setting is underlined. My recommendations are in the last column, labelled “BBC”, where appropriate. Settings are given only for normal television use, it was not possible to derive good settings for a film look. Items available only in the NTSC version are marked in italics.

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

Press the “Menu” button to enter the menus, navigate with the “Menu wheel”, default values are underlined. Select profiles with the “Custom” button.

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

1 Controls, Connections

name	place	feature	comment
Power switch	Left, on large control dial		Also mode controls for many other features
Focus Ring	Lens	Rotation	Works even in auto focus
Focus Mode	Left front	Switch	Instant or normal auto focus mode
Push AF	Left front	Push	Push to autofocus when in manual focus
Zoom Ring	Lens	Rotation	Speed-sensitive control
Zoom	Right top	Rocker	Pressure-sensitive control
Zoom Speed	Right top	Dial	2.6~60 sec
Zoom Speed	Right top	Switch	Constant/Variable speed zoom
Iris Ring	Lens	Rotation	Works in AV mode
ND Filter	Left front	Switch	Neutral filter, 1/6 (2.5 stops), 1/32 (5 stops)
Exposure Lock	Left front	Push	Press to hold settings
Shutter Dial	Left front	Rotation	Works in TV mode, about 1/4~1/15000 sec
Gain	Left front	Switch	Auto/3 presets, -3~+36dB
AGC	Left front	Switch	
White Balance Preset	Under lcd	Switch	Auto/Sun/Tungsten/presets
White Balance	Left front	Switch	Preset/A/B
White Balance	Left front	Push	Enter/Exit manual balance mode
AWB	Left front	Switch	On/Off
Lock	Top front	Switch	Disables all controls on the handle
Display	Left front	Push	Cycle through amounts of info to display
Peaking	Left front	Push	Usual emphasis of edges
Magnification	Left front	Push	2x magnification, not while recording
Record Review	Left front	Push	Rewind and show last few seconds of recording
Position Preset	Left front	Switch	Store focus or zoom setting as a preset
Position Preset On/Set	Left front	Switch	
Mic levels	Left back	Rotation	Manual recording level control
Auto Level	Left back	Switch	Auto/Manual audio
Mic Attenuator (1,2)	Sound pod	Switches	Auto/Manual level
Mic Attenuator	Under lcd	Switch	20dB
Line/Mic	Sound pod	Switch	XLR input control
Input Select	Sound pod	Switches	Route XLR channels to recording
+48v power	Sound pod	Switches	Phantom power
Menu	Left back	Thumb wheel	Navigate menus, press to select
Menu	Left back	Push	Press to enter/exit menus
Custom keys (1,2)	Left back	Push	Assignable buttons
Custom Preset	Left back	Push on/off	Custom settings on/off
Custom Preset	Left back	Push select	Push to cycle through custom presets
Card/Tape	Right top	Switch	
Time Code	Right back	Switch	
I/O connectors	Back right		Lanc, 1394, phones, AV 3.5mm, component (G1 only: HDSDI, Genlock, Timecode)
Output	Left front	Switch	Camera/Bars
Video 2	Right back	Connector	Composite
Start/Stop	Tape transport pod	Push	Right thumb position
Start/Stop	Handle	Push	
Standby	Tape transport pod	Rotate	Concentric with Start/Stop
Tape controls	Handle	Push	
End Search	Under lcd	Push	
Photo	Right top	Push	
Photo	Handle	Push	
Reset	Under lcd	Recessed Push	

2 Menus

CAMERA MENU

Signal Setup

Basic camera system settings

Item	sub	range	comments	BBC
Time Code	<i>Frame setting</i>	<u>Drop</u> , <u>NonDrop</u>	<i>Only in NTSC model</i>	
	Count Up	<u>RecRun</u> , <u>RecRunPS</u> , <u>FreeRun</u>	<i>FreeRun not available at 24fps</i>	
	Start Value	<u>Set</u> , <u>Reset</u>		
Genlck Adjust		-1023~1023		
Signal Std		<u>HD</u> , <u>SD16:9</u> , <u>SD4:3</u>		
Frame Rate		<u>50i</u> , <u>25f</u>	<i>(60i,30f,24f)</i>	
Comp.Out		<u>576i</u> , <u>1080i</u> / <u>576i</u>	<i>(480i,1080i/480i)</i>	
SDI Output	(G1 only)	<u>On</u> , <u>Off</u>		
SDI Spec	(G1 only)	<u>Auto</u> , <u>SD locked</u>	Aspect ratio, refer to manual	

Camera Setup

Camera settings

Item	sub	range	comments	BBC
<i>24f Mode Sel</i>		<u>2:3</u> , <u>2:3:3:2</u>	<i>Pulldown for NTSC</i>	
AE Shift		-2,-1.5,-1,25,-1,-0.75,-0.5,-0.25, <u>0</u> ,+.25,+0.5,+0.75,+1,+1.25,+1.5,+2	Stops relative to setting	
Gain Setting	Gain L	-3, <u>0</u> ,3,6,12,18,36dB		
	Gain M	-3,0,3, <u>6</u> ,12,18,36dB		
	Gain H	-3, <u>0</u> ,3,6, <u>12</u> ,18,36dB		
AF Mode		<u>Instant AF</u> , <u>Normal AF</u>	Instant uses external sensor, Normal is TTL	
IMG Stab		<u>On</u> , <u>Off</u>	Image stabiliser	
Skin Detail	Effect Level	<u>Off</u> , <u>Low</u> , <u>Middle</u> , <u>High</u>	Tablets for wrinkly actors	Off
	Hue			
	Chroma			
	Area			
	Y Level			
Sky Detail		<u>Soft</u> , <u>Off</u>	Softens detail in sky	Off
Color Corr.	Correct	<u>Off</u> , <u>A</u> , <u>B</u> , <u>A&B</u>	16-axis colour adjustment	Off
	A Area Sel	ColorPhase,Chroma,Area, Ylevel		
	A Area Rev	R gain,B gain		
	B Area Sel	ColorPhase,Chroma,Area, Ylevel		
	B Area Rev	R gain,B gain		
F Speed Pset		<u>Low</u> , <u>Middle</u> , <u>High</u>	Focus speed control	
Clear Scan			Shutter, 60~200Hz, use shutter dial	

Recording Setup

item	sub	range	comments	BBC
DV Rec Mode		<u>SP</u> , <u>LP</u>	Only in SD mode	
UB Rec		<u>Int</u> , <u>USR-Bit</u> , <u>Ext</u> , <u>User-Bit</u>	User bits	
UB Select		<u>00 00 00 00</u> , <u>Time</u> , <u>Date</u>	00 00 00 00=set UB yourself	
IMG Quality		<u>Superfine</u> , <u>Fine</u> , <u>Normal</u>	Still image quality	
Image Size		<u>LW</u> , <u>SW</u> or <u>L</u> , <u>S</u>	HD or 16:9 - 1920x1080, 848x480, SD4:3 - 1440x1080, 640x480	
File Nos		<u>Reset</u> , <u>Continuous</u>	Reset starts from 0 on each card	

Audio Setup

item	sub	range	comments	BBC
DV Audio		<u>16bit</u> ,12bit	16bit=48kHz 2ch, 12bit=32kHz 4ch	
Aud.M.Set		<u>Normal</u> , <u>Line Out</u>	Line Out adds delay in phones feed	
Mic Mode		<u>Normal</u> , <u>Voice</u> , <u>WS</u>	WS inserts bass cut filter	
Mic Sens		<u>Normal</u> , <u>High</u>		
XLR Input		<u>On-XLR</u> , <u>Off</u>		
XLR Gain Up		<u>Off</u> ,12dB		

Display Setp

item	sub	range	comments	BBC
CVF Setup	Brightness		Viewfinder control	
	Contrast			
	Color			
	Sharpness			
	Backlight	Bright,Normal		
LCD Setup	Brightness		LCD brightness, contrast etc	
	Contrast			
	Color			
	Sharpness			
	Backlight	Bright,Normal		
CVF+LCD BW		On,Off	Monochrome	
CVF+LCD On		On,Off	Off=VF off when lcd's open	
Language		German,English,Spanish, French,Italian,Polish,Russian, Chinese,Japanese	Changes all displays	
Markers		Off,Level mark,Cent mark,Grid		
Aspect Guide		Off,4:3,13:9,14:9,1.66:1,1.75:1, 1.85:1,2.35:1		14:9
Safety Zone		Off,80%,90%		
Zebra		On,Off		
Zebra Level		70,75,80,85,90,95,100		
TV Screen		On,Off	VF indicators on video output	
Audio Level		On,Off	Audio meters on display	
Guide Info		Off,Custom keys,D/T display	Show custom key contents or Date/Time	
UB Display		On,Off	User Bits	

System Setup

item	sub	range	comments	BBC
Custom Key 1		TimeCode,IndexWrite,Zebra, VCRStop,TVScreen,TCHold, AudioLevel,CVF+LCDBW, Magn.B.Lock,ShtrD.Lock, CPBKWDKey,(None)		
Custom Key 2				
D/Time Set	T.Zone/DST		Time zone and Summer time	
	Date/Time		Set date/time with Menu dial	
	Date Format	YMD,MDY,DMY	MDY for NTSC model	
DV Control		On,Off	Control external DV deck	
Magn.Block		Disabled,Active		
Shtr D.Lock		Disabled,Active		
Reset All		No,Yes		

Customize

Custom Preset

Settings that affect the picture

item	Sub	Range	comments	BBC
Edit	Delect CP	Preset-A,B,C,D,E,F,,VideoC, CineV,CineF	9 presets in camera, up to 20 on a card	
	Tune		Change settings in a preset	
	Rename		Name it	
	Protect			
	Reset		Factory settings	
Tune			This is where you change settings	
	Gamma	Normal,Cine1,Cine2	Cine1=TK, Cine2=print to film, both raise contrast and saturation	Normal
	Knee	Auto,Low,Middle,High	Middle is a good compromise	Middle
	Black	Stretch,Middle,Press	Stretch needed to get colours right	Stretch
	Master Ped	-9~+9		0
	Setup Level	-9~+9		0
	Sharpness	-9~+9		3
	H Dtl Freq	Low,Middle,High		High

	Dtl HV Balance	-9~+9	-9=H only, +9=V only	0
	Coring	-9~+9		0
	NR1	<u>Off,Low,Middle,High</u>	Noise reduction, can cause smears	
	NR2	<u>Off,Low,Middle,High</u>	Noise reduction, spatial low-pass	
	Color Mat	<u>Normal,Cine1,Cine2</u>		Normal
	Color Gain	-50~+50		0
	Color Phase	-9~+9		0
	R Gain	-50~+50		0
	G Gain	-50~+50		0
	B Gain	-50~+50		0
	RG Matrix	-50~+50		-6
	RB Matrix	-50~+50		-4
	GR Matrix	-50~+50		0
	GB Matrix	-50~+50		0
	BR Matrix	-50~+50		17
	MG Matrix	-50~+50		2
Camera - Card	Select CP		Select preset to save to card	
	Save Position		Select a filename	
	Execute		And save it, up to 20 on a card	
Card - Camera	Import		Select custom preset file on card	
	Select Position		Select where to put it	
	Execute		And load it	

Custom Function

Settings that affect controls, 3 sets

item	Sub	Range	comments	BBC
Function		C.Fn1,C.Fn2,C.Fn3		
Apply This Set				
Tune			This is where you change things	
Save To Card				
Read From Card				
Reset				
Tune	Shcklss WB/GN	00~03	White Balance and Gain	
	AE Response	00~02	Speed (Mid,High,Low)	
	High-Speed Zoom	00 (Off)~01 (On)		
	Focus Ring Ctrl	00 (Normal)~01 (Slow)		
	Buttons Oper	00~15	OnePush/LongPush: Magnify, WB set, Exp. Lock, Push AF	
	Rings Direction	00~07	Normal/Reverse: Zoom, Focus, Iris	
	Dials Direction	00~03	Normal/Reverse: Cursor, Shutter	
	Focus Priority	00 (Off)~01 (On)	Photo: Off=wait for focus	
	Simult.Img.Rec	00~02	Photo during recording: Off,On	
	Marker Level	00~07	100/40%: Marker, Aspect, Safety	
	F.Ast BW-Mod	00~03	BW during Focus Assist: Magnify, Peaking	
	Obj Dst Unit	00 (m)~01 (ft)		
	Zoom Indicator	00 (Bar)~01 (number)		
	Color Bars	00 (Type1)~01 (Type2)	Type1=SMPTE, 2=Arib	00=SMPTE
	1kHz Tone	00~02	Off, -12, -20dB	02=-20dB
	Wireless Remote	00~02		
	Power Save	00 (Off)~01 (On)	On=shut off at 5min inactive	
	Tally Lamp	00~02	On,Blink,Off	
	Led	00~02		
	Beep	00~02	Volume: Off,Low,High	
	Character Rec	00 (Off)~01 (On)	Burn time/date on video	

Custom Display

Define what appears on-screen

item	Sub	Range	comments	BBC
Save To Card				
Read From Card				
Reset				

Tune	Rec Programs	00 (Off)~01 (On)	Record mode icon
	Camera Data 1	00~03~07	Aperture, Shutter
	Camera Data 2	00~07	Exposure, WB, Gain
	Zoom	00~01~02	Zoom: off/normal/always
	Focus	00~01~02	Focus: off/normal/always
	ND	00 (Off)~1 (On)	
	Image Effects	00~07	Skin, Sky, Colour corr
	F.Assist Func	00~03	Peaking, Magnify
	Customize	00~03	Presets, Function
	Recording Std	00 (Off)~01 (On)	HD icon
	DV Rec Mode	00 (Off)~01 (On)	
	Frame Rate	00 (Off)~01 (On)	
	Tape	00~03~07	TC, Mode icon, DV control
	Tape Remainder	00~02	Off, normal, warning
	Tape/Card	00~03	Ext, Img stab, Stills
	Light Metering	00~03	Spot AE, Mode
	Card	00~03~07	Stills mode, flash
	Card Remainder	00~02	Off, normal, warning
	Audio	00~07	Mic mode, XLR icon, DV audio
	Condensation	00 (Off)~01 (On)	
	Battery	00~02	Off, normal, warning
	Wireless Remote	00~02	Off, normal, warning

VCR/PLAY MENU

Signal Setup

item	sub	Range	comments	BBC
Time Code	<i>Frame Setting</i>	<i>Drop,Non-Drop</i>	<i>NTSC version only</i>	
	Count Up	<u>Rec-Run,Rec-RunPS,Free-Run</u>		
	Start Value	<u>Set,Reset</u>		
	HDV/DV In	<u>Regen,Copy</u>		
Playback Std		<u>Auto,HDV,DV</u>	Down-conversion on replay	
Comp.Out		<i>576i/1080i/576i</i>	<i>(or 480i,1080i/480i)</i>	
SDI Ouitput		<u>On,Off</u>	Only on G1	
SDI Spec		<u>Auto,SD Locked</u>	Only on G1	
HD Down-conv		<u>On,Off</u>		
Letterbox		<u>On,Off</u>		

Recording Setup

item	sub	Range	comments	BBC
DV Rec Mod		<u>SP,LP</u>		
UB Select		<u>00 00 00 00,Time,Date</u>		
Img Quality		<u>SuperFine,Fine,Normal</u>		
HD Img Size		<u>LW 1920x1080,SW 848x480</u>		
File Nos		<u>Reset,Continuous</u>		

Audio Setup

item	sub	Range	comments	BBC
Sel Audio Ch		<u>ch1/3+2/4,1/3+1/3,2/4+2/4</u>	Stereo or 4 ch, L or R to stereo	
Aud.M.Set		<u>Ch1/2,3/4,MixFixed,MixVar</u>	What to play	
Mix Balance		<u>1&2~3&4</u>	Slide fader	
DV Audio		<u>16bit,12bit</u>		

Display Setup

item	sub	Range	comments	BBC
CVF Setup	Brightness			
	Contrast			
	Color			
	Sharpness			
	Backlight	<u>Bright,Normal</u>		
LCD Setup	Brightness			
	Contrast			
	Color			
	Sharpness			
	Backlight	<u>Bright,Normal</u>		
CVF+LCD BW		<u>On,Off</u>		
CVF+LCD On		<u>On,Off</u>		
TV Screen		<u>On,Off</u>		
Audio Level		<u>On,Off</u>		
Language		<u>German,English,Spanish, French,Italian,Ploish,Russian, Chinese,Japanese</u>		
Custom Key		<u>On,Off</u>		
Data Code		<u>Date,Time,Date&Time, CameraData,Cam&D/T</u>		
6 Sec.Date		<u>On,Off</u>	Date shows when play started	
UB Display		<u>On,Off</u>		

System Setup

item	sub	Range	comments	BBC
Custom Key 1		<u>TimeCode,TVScreen,DataCode ,AudioLevel,TCHold, CVF+LCDBW,(None)</u>		

Custom Key 2		TimeCode,TVScreen,DataCode ,AudioLevel,TCHold, CVF+LCDBW,(None)		
D/Time Set	T.Zone/DST			
	Date/Time			
	Date Format	YMD,MDY, <u>DMY</u>	DMY for NTSC model	
Reset All		<u>No</u> ,Yes		

Customize

Custom Function

Settings that affect controls, 3 sets

item	sub	Range	comments	BBC
Function		C.Fn1,C.Fn2,C.Fn3		
Apply This Set				
Tune			This is where you change things	
Save To Card				
Read From Card				
Reset				
Tune	Shcklss WB/GN	<u>00</u> -03	White Balance and Gain	
	AE Response	<u>00</u> -02	Speed (Mid,High,Low)	
	High-Speed Zoom	<u>00 (Off)</u> -01 (On)		
	Focus Ring Ctrl	<u>00 (Normal)</u> -01 (Slow)		
	Buttons Oper	<u>00</u> -15	OnePush/LongPush: Magnify, WB set, Exp. Lock, Push AF	
	Rings Direction	<u>00</u> -07	Normal/Reverse: Zoom, Focus, Iris	
	Dials Direction	<u>00</u> -03	Normal/Reverse: Cursor, Shutter	
	Focus Priority	<u>00 (Off)</u> -01 (On)	Photo: Off=wait for focus	
	Simult.Img.Rec	<u>00</u> -02	Photo during recording: Off,On	
	Marker Level	<u>00</u> -07	100/40%: Marker, Aspect, Safety	
	F.Ast BW-Mod	<u>00</u> -03	BW during Focus Assist: Magnify, Peaking	
	Obj Dst Unit	<u>00 (m)</u> -01 (ft)		
	Zoom Indicator	<u>00 (Bar)</u> -01 (number)		
	Color Bars	<u>00 (Type1)</u> -01 (Type2)	Type1=SMPTE, 2=Arib	00=SMPTE
	1kHz Tone	<u>00</u> -02	Off, -12, -20dB	02=-20dB
	Wireless Remote	<u>00</u> -02		
	Power Save	<u>00 (Off)</u> -01 (On)	On=shut off at 5min inactive	
	Tally Lamp	<u>00</u> -02	On,Blink,Off	
	Led	<u>00</u> -02		
	Beep	<u>00</u> -02	Volume: Off,Low,High	
	Character Rec	<u>00 (Off)</u> -01 (On)	Burn time/date on video	

CARD CAMERA MENU

Signal Setup

item	sub	Range	comments	BBC
Genlck Adjust		-1023~1023		
Comp.Out		576i,1080i/576i	480i,1080i/480i for NTSC model	
SDI Out		On,Off	Only in G1	
SDI Spec		Auto,SD Locked	Only in G1	

Camera Setup

item	sub	Range	comments	BBC
AE Shift		-2,-1.5,-1.25,-1,-0.75,-0.5, -0.25,0,+0.25,+0.5,+0.75,+1,+1.25,+1.5,+2		
Gain Setting	Gain L	-3,0,3,6,12,18dB		
	Gain M	-3,0,3,6,12,18dB		
	Gain H	-3,0,3,6,12,18dB		
AF Mode		Instant Af,Normal AF		
Img.Stab		On,Off		
Skin Detail	Effect Level	Off,Low,Middle,High		
	Hue			
	Chroma			
	Area			
	Y Level			
Sky Detail		Soft,Off		
Color Corr	Correct	Off,A,B,A&B		
	A Area Sel	ColorPhase,Chroma,Area, YLevel		
	A Area Rev	Rgain,Ggain		
	B Area Sel	ColorPhase,Chroma,Area, YLevel		
	B Area Rev	Rgain,Ggain		
F.Speed Pset		Low,Middle,High		
Review		Off,2sec,4,6,8,10sec		

Recording Setup

Item	sub	Range	comments	BBC
Img Quality		Superfine,Fine,Normal		
Image Size		LW1920x1080,SW848x480, L1440x1080,S640x480		
File Nos		Reset,Continuous		

Audio Setup

Item	sub	Range	comments	BBC
Mic Mode		Normal,Voice,WS		
Mic Sens		Normal,High		
XLR Input		On-XLR,Off		
XLR Gain Up		Off,12dB		

Display Setup

Item	sub	Range	comments	BBC
CVF Setup	Brightness			
	Contrast			
	Color			
	Sharpness			
	Backlight	Bright,Normal		
LCD Setup	Brightness			
	Contrast			
	Color			
	Sharpness			
	Backlight	Bright,Normal		
CVF+LCD BW		On,Off		

CVF+LCD On		On,Off		
Language		German,English,Spanish, French,Italian,Polish,Russian, Chinese,Japanese		
Markers		Off,LevelMark,Cent.Mark,Grid		
Zebra		On,Off		
Zebra Level		70,75,80,85,90,95,100%		
TV Screen		On,Off		
Guide Info		Off,CustomKeys,D/Tdisplay		

System Setup

Item	sub	Range	comments	BBC
Custom Key 1		Zebra,Tvscreen,CVF+LCDBW, Magn.B.Lock,ShtrD.Lock,CPB KWDkey,(None)		
Custom Key 2		Zebra,Tvscreen,CVF+LCDBW, Magn.B.Lock,ShtrD.Lock,CPB KWDkey,(None)		
D/Time Set	T.Zone/DST			
	Date/Time			
	Date Format	YMD,MDY, <u>DMY</u>	MDY for NTSC model	
Magn.B.Lock		<u>Disabled</u> ,Active		
Shtr D.Lock		<u>Disabled</u> ,Active		
Reset All		<u>No</u> ,Yes		

Customize

Custom Preset

Item	sub	Range	comments	BBC
Edit	Select CP	<u>Preset-A</u> ,B,C,D,E,F,VideoC, CineV,CineF		
Tune				
Rename				
Protect				
Reset				
Tune	Knee	<u>Auto</u> ,Low,Middle,High		Middle
	Black	Stretch, <u>Middle</u> ,Press		Stretch
	Sharpness	-9~+9		3
	H Dtl Freq	-9~+9		9
	Dtl HV Balance	-9~+9		0
	Coring	-9~+9		0
	Color Gain	-50~50		0
	Color Phase	-9~+9		0
	R Gain	-50~50		0
	G Gain	-50~50		0
	B Gain	-50~50		0
	RG Matrix	-50~50		-6
	RB Matrix	-50~50		-4
	GR Matrix	-50~50		0
	GB Matrix	-50~50		0
	BR Matrix	-50~50		+17
	BG Matrix	-50~50		+2
Camera - Card	Select CP			
	Save Position			
	Execute			
Card - Camera	Import			
	Select Position			
	Execute			

Custom Function

3 separate function settings

Item	sub	Range	comments	BBC
Apply This Set				
Tune				

Save To Card			
Read From Card			
Reset			
Tune	Shckls WB.GN	<u>00</u> -03	
	AE Response	<u>00</u> -02	
	High-Speed Zoom	<u>00 (Off)</u> -01 (On)	
	Focus Ring Ctrl	<u>00 (Normal)</u> -01 (Slow)	
	Buttons Oper	<u>00</u> -15	
	Rings Direction	<u>00</u> -07	
	Dials Direction	<u>00</u> -03	
	Focus Priority	<u>00 (Off)</u> -01 (On)	
	Simult.Img.Rec	<u>00</u> -02	
	Marker Level	<u>00</u> -07	
	F.Ast BW-Mod	<u>00</u> -03	
	Obj Dst Unit	<u>00 (m)</u> -01 (ft)	
	Zoom Indicator	<u>00 (Bar)</u> -01 (Number)	
	Color Bars	00 (Type 1)-01 (Type 2)	
	1kHz Tone	<u>00</u> -02	
	Wireless Remote	<u>00</u> -02	
	Power Save	<u>00 (Off)</u> -01 (On)	
	Tally Lamp	<u>00</u> -02	
	Led	<u>00</u> -02	
	Beep	<u>00</u> -02	
	Character Rec	<u>00 (Off)</u> -01 (On)	

Custom Display

3 separate function settings

Item	sub	Range	comments	BBC
Tune				
Save To Card				
Read From Card				
Reset				
Tune	Rec programs	<u>00 (Off)</u> -01 (On)		
	Camera Data 1	<u>00</u> -03-07		
	Camera Data 2	<u>00</u> -07		
	Zoom	<u>00</u> -01-02		
	Focus	<u>00</u> -01-02		
	ND	<u>00 (Off)</u> -01 (On)		
	Image Effects	<u>00</u> -07		
	F.Assist Func	<u>00</u> -03		
	Customize	<u>00</u> -03		
	Recording Std	<u>00 (Off)</u> -01 (On)		
	DV Rec Mode	<u>00 (Off)</u> -01 (On)		
	Frame Rate	<u>00 (Off)</u> -01 (On)		
	Tape	<u>00</u> -03-07		
	Tape Remainder	<u>00</u> -02		
	Tape/Card	<u>00</u> -03		
	Light Metering	<u>00</u> -03		
	Card	<u>00</u> -03-07		
	Card Remainder	<u>00</u> -02		
	Audio	<u>00</u> -07		
	Condensation	<u>00 (Off)</u> -01 (On)		
	Battery	<u>00</u> -02		
	Wireless Remote	<u>00</u> -02		

CARD VCR/PLAY MENU

Signal Setup

item	sub	Range	comments	BBC
Comp. Out		<u>576i,1080i/576i</u>	<i>480i,1080i/480i for NTSC model</i>	
SDI Out		<u>On,Off</u>	G1 model only	
SDI Spec		<u>Auto,SD Locked</u>	G1 model only	

Card Operations

Item	sub	Range	comments	BBC
Print Ord. All Erase		<u>No, Yes</u>		
Erase All Images		<u>No, Yes</u>		
Initialize		<u>Cancel, Initialize, Compl. Init</u>		

Display Setup

Item	sub	Range	comments	BBC
CVF Setup	Brightness			
	Contrast			
	Color			
	Sharpness			
	Backlight	<u>Bright, Normal</u>		
LCD Setup	Brightness			
	Contrast			
	Color			
	Sharpness			
	Backlight	<u>Bright, Normal</u>		
CVF+LCD BW		<u>On, Off</u>		
CVF+LCD On		<u>On, Off</u>		
TV Screen		<u>On, Off</u>		
Custom Key		<u>On, Off</u>		
Language		German, <u>English</u> , Spanish, French, Italian, Polish, Russian, Chinese, Japanese		

System Setup

Item	sub	Range	comments	BBC
Custom Key 1		<u>Zebra, Tvscreen, CVF+LCDBW, Magn.B.Lock, ShtrD.Lock, CPB KWDkey, (None)</u>		
Custom Key 2		<u>Zebra, Tvscreen, CVF+LCDBW, Magn.B.Lock, ShtrD.Lock, CPB KWDkey, (None)</u>		
D/Time Set	T.Zone/DST			
	Date/Time			
	Date Format	<u>YMD, MDY, DMY</u>	MDY for NTSC model	
Reset All		<u>No, Yes</u>		
Firmware				

Metadata CP

Item	sub	Range	comments	BBC
Card - Camera	Import			
	Select Position			
	Execute			

Customize

Custom Function

3 separate function settings

Item	sub	Range	comments	BBC
Apply This Set				
Tune				
Save To Card				

Read From Card			
Reset			
Tune	Shckls WB.GN	00-03	
	AE Response	00-02	
	High-Speed Zoom	00 (Off)~01 (On)	
	Focus Ring Ctrl	00 (Normal)~01 (Slow)	
	Buttons Oper	00~15	
	Rings Direction	00~07	
	Dials Direction	00~03	
	Focus Priority	00 (Off)~01 (On)	
	Simult.Img.Rec	00~02	
	Marker Level	00~07	
	F.Ast BW-Mod	00~03	
	Obj Dst Unit	00 (m)~01 (ft)	
	Zoom Indicator	00 (Bar)~01 (Number)	
	Color Bars	00 (Type 1)~01 (Type 2)	
	1kHz Tone	00~02	
	Wireless Remote	00~02	
	Power Save	00 (Off)~01 (On)	
	Tally Lamp	00~02	
	Led	00~02	
	Beep	00~02	
	Character Rec	00 (Off)~01 (On)	

3 Measurements

3.1 Colour performance.

Assessment was done using Macbeth charts. There was a distinct red tinge to the picture, although not in the grey scale, this indicates that the problem is not in gamma-balance, but in the basic colorimetry of the camera. All the patches with a significant red component were too “healthy”. After some subjective adjustments to the matrix, the colour performance was improved significantly, although the yellow patch was still too blue, and the light skin tone too red. Fig.1 shows the result with the normal gamma curve, although the reproduction here may not illustrate the effects well. The gamma film curves both increased saturation considerably and exacerbated the colouring problems, and are therefore not recommended.

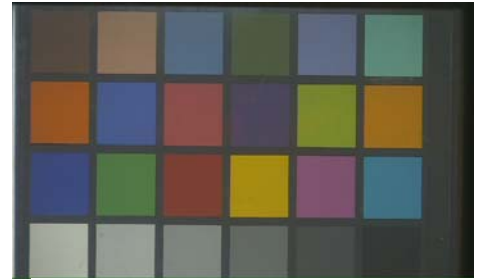


Figure 1 Macbeth chart

3.2 Resolution

A zone plate test chart was used (Fig.2, shown here with inevitable alias patterns due to the scaling for reproduction in this document), designed for 1920x1080 video. Each of the six concentric zones explores the full spatial frequency range that HDTV can resolve, up to 1920 pixels horizontally by 1080 lines vertically.



Figure 2 Zone plate chart

3.2.1 HD resolution

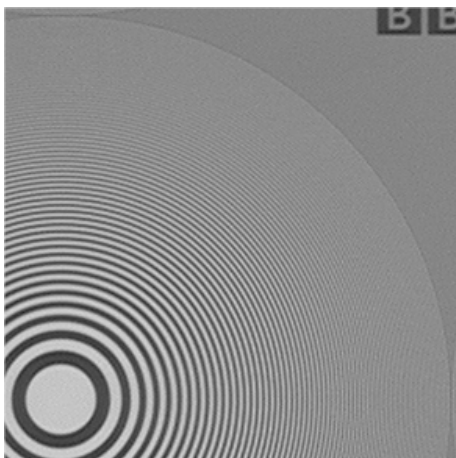


Figure 3 HDSDI, 50i

Measurements were made on the HDSDI output, potentially at full 1920x1080 resolution.

Fig.3 shows a quadrant of one of the zones with the camera set to 50i (interlace). There is vertical resolution up to a vanishing point at about 1015 lines albeit at low amplitude, above which there is a good freedom from aliasing. Horizontally, resolution is strong up to about 1600 pixels. According to the specification, the sensors have approximately 1,560,000 active pixels, which means that for 1080-line there must be $1,560,000/1080=1444$ pixels, probably 1440, the resolution limit of HDV. Clearly, the camera is delivering greater resolution than the pixel count would indicate possible, this is due to the “precision-offset” of the green from red and blue sensors. However, and as expected, this process also generates some horizontal aliasing, and it is at about 1600

pixels that the wanted and aliased frequencies are equal in amplitude.

Subjectively, there was considerable interlace twitter when viewed on a large Sony crt HD monitor, not surprising with so much vertical resolution above 540 lines/picture height.

Fig.4 shows the result for setting the camera to 25p, again captured via the HDSDI output. Very surprisingly, the vertical resolution is a little lower, reaching a vanishing point at about 940 lines/picture height. This is extraordinary, since one of the points of using cameras in “progressive” scan mode is to increase the vertical resolution, but this camera actually reduces it. Also, there is some



Figure 4 HDSDI, 25p

aliasing above this frequency which is not present in the 50Hz interlaced mode. I can think of no reason why this should be. Horizontally, nothing has changed, resolution is still clean up to about 1600, with some aliasing above.

3.2.2 SD resolution

Since HDV cameras are often used in mixed environments, it is important to know how well they work as SD cameras as well as HD. Fig.4 shows the performance. The zone plate chart was still used fully framed, so the pixel limits of the quadrant remain at 1920 horizontally and 1080 vertically; the aspect ratio has changed because SDTV does not use square pixels, and I have presented the result here with square pixels to avoid unnecessary rescaling.

Vertically, resolution is clean up to about 520, which is very good for a camera in this class. There is little evidence of any first alias pattern (which would cause circles or ellipses with a higher-frequency centre), however there is a second alias pattern centred on 540 (weak at low frequencies and stronger at higher frequencies) and a third alias pattern centred on about 990. The second alias is related to the sensor vertical pixel count, while the third is a bit of a mystery.

Horizontally, resolution is fairly clean up to 700, with a first alias pattern centred on 1440, exactly as expected. There is another alias pattern centred on about 920, which is also a bit difficult to explain.

At first sight this does not look too good, and it is caused by the use of a lens that is designed to produce HD pictures combined with down-conversion that uses inadequately simple filtering. The camera sensors, being HD, resolve the unwanted higher frequencies that, for SD use, should be suppressed before the down-conversion process itself. Slightly defocusing the image would remove most of the aliases without losing the wanted resolution, but that works only on single-plane scenes, a more practical approach would be to use an optical diffuser on the lens, perhaps a ¼ Black Promist or equivalent.

3.3 Noise

Uniform exposures to a grey field were made at four luma levels between 85% and 15% and 12dB gain. Allowing for the 12dB gain, the noise levels at 0dB gain should be between -46 and -48dB; while not excessive, this is acceptable for the market niche within which this camera will be used.

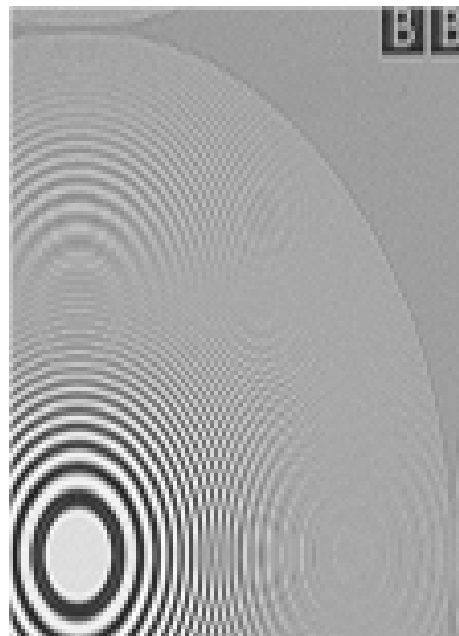


Figure 5 SDSDI, 50i