

## Colorimetric and Resolution requirements of cameras

Alan Roberts

### **ADDENDUM 60 : Tests and Settings on a Sony HCX-100**

**This document is a report of the results of tests that are the precursor of those described in the EBU technical document Tech3335. It is not an endorsement of the product.**

Data for this section is taken from the handbook and examination of a production model (serial number 400428) of the Sony HCX-100. It is a conventional system camera, with separate control unit (Triax cable connected) and viewfinder. It has 3 2/3" CCD sensors of 1920x1080 pixel dimensions, and can operate at 1080 interlaced or 720 progressive, both at 50 and 59.94Hz. The 'E' model defaults to 50Hz, the 'U' model to 59.94Hz, in the menus. Output from the CCU is via HDSDI, and SDI for down-converted for SDTV, however it can be operated from 12volts as a stand-alone camera.

The camera weighs about 4.4kg and has a standard B4 lens mount with F/1.4 optical block, and consumes about 80watts at 12volts. The specification claims sensitivity of F/11, which is normal for this image size and resolution. It appears to be very similar to other full-resolution system cameras in the broadcast range.

It has one filter wheel with neutrals, colour balancing is entirely electronic. Genlock and remote control connectors indicate that it can be integrated into multi-camera production with few problems. There is also automatic correction for chromatic aberration, when used with specific lenses, this was not tested.

There are internal menus for setting the performance, with a structure very similar to that in the HDCAM camcorders. The menus and HDSDI output can be accessed directly from the camera head, such that it can then be used without any external controls, or via a remote control, or via an ethernet connection.

For the test procedures a Canon HJ17ex7.6B lens was used.

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Many of the menu items have little or no effect on image quality. Those that have significant effect are highlighted. The full set of menu items is given for completeness. In boxes with a range of numeric settings, e.g. -99~99, the values indicate the nominal 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, “BBC” settings are in the last column, where appropriate, and the reasons for the values are given in footnotes throughout the tables where necessary.

Where menus are hierarchical (i.e. one menu item opens another menu page), the items are inset.

“BBC” setting values are given for:

Video {v}

Negative film {f}

Where different values are needed for these settings, they are marked e.g. thus: On{v} Off{f}. Note that the film settings are not intended to reproduce precisely the performance of any particular film stock, merely to give a “look” that is representative of a generic film type.

Settings are only starting points, recommendations. They should not be used rigidly, they are starting points for further exploration. However, they do return acceptable image performance.

Menu items which affect the picture quality, and need attention, are highlighted in the menu tables.

The results of tests are given after the menu settings.

## 1 MENU TABLES

### TOP MENU

User	Go to daily routine settings, 5 pages that can be customised
User menu customise	Customise user menu pages
All	Go to all menu pages
Operation	Settings for shot-by-shot control
Paint	Settings that normally need lab facilities to control properly
Maintenance	Camera maintenance, usually best avoided
File	Load/save reference files etc
Diagnosis	Check status of hardware/software
Service	Keep out of here if at all possible

### OPERATION MENUS

#### OPERATION01 VF DISPLAY

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
EX	<u>On</u> , Off		
Zoom	<u>On</u> , <u>Off</u>		
Disp	<u>Left</u> , <u>Right</u>		
Focus	<u>On</u> , <u>Off</u>	Only when a 'serial' lens is fitted	
ND	<u>On</u> , <u>Off</u>		
5600K	<u>On</u> , <u>Off</u>		
Iris	<u>On</u> , <u>Off</u>		
White	<u>On</u> , <u>Off</u>		
Gain	<u>On</u> , <u>Off</u>		
Shutt	<u>On</u> , <u>Off</u>		
Batt	<u>On</u> , <u>Off</u>		
Return	<u>On</u> , <u>Off</u>		
Talk	<u>On</u> , <u>Off</u>		
Messag	<u>All</u> , <u>Wrn</u> , <u>At</u> , <u>Off</u>	Wrn=warnings+, AT=Auto+ higher	

#### OPERATION02 '?' IND

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
ND	<u>On</u> , <u>Off</u>		
	<u>1</u> , <u>2</u> , <u>3</u> , <u>4</u>	The 'normal' setting, combinations allowed	
White	<u>On</u> , <u>Off</u>		
	<u>P</u> , <u>A</u> , <u>B</u>		
5600K	<u>On</u> , <u>Off</u>		
	<u>On</u> , <u>Off</u>		
Gain	<u>On</u> , <u>Off</u>		
	<u>L</u> , <u>M</u> , <u>H</u>		
Shutt	<u>On</u> , <u>Off</u>		
	<u>On</u> , <u>Off</u>		
Fan	<u>On</u> , <u>Off</u>		
	<u>Auto1</u> , <u>Auto2</u> , <u>Min</u> , <u>Max</u>		
Ext	<u>On</u> , <u>Off</u>		
Format	<u>On</u> , <u>Off</u>		
	<u>E</u> , 50Hz	59.94i, 59.94p, 50i, 50p	Scanning format
	<u>U</u> , 59.94	59.94i, 59.94p, 50i, 50p	

#### OPERATION03 VF MARKER

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Marker	<u>On</u> , <u>Off</u>		
	<u>White</u> , <u>Black</u> , <u>Dot</u>		
Center	<u>On</u> , <u>Off</u>	1=full cross, 2=centre hole, 3=centre, 4=centre with hole	
	<u>1</u> , <u>2</u> , <u>3</u> , <u>4</u>		
Safety zone	<u>On</u> , <u>Off</u>		
	80, <u>90</u> , 92.5, 95%		
Effect	<u>On</u> , <u>Off</u> , <u>Focus</u>	Focus available only for Focus Assist	
Aspect	<u>On</u> , <u>Off</u>		
	16:9, 15:9, 14:9, 13:9, <u>4:3</u>		14:9

Mask	On, <u>Off</u>		
	0~ <u>12</u> ~15		
Safety	On, <u>Off</u> Area		
	80, <u>90</u> , 92.5, 95%		

**OPERATION04 VF DETAIL**

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
VF Detail	On, <u>Off</u>		
	0~ <u>25</u> ~100%		
Crisp	-99~ <u>0</u> ~+99		
Frequency	<u>9M</u> , 14M, 18M		
FAT mode	On, <u>Off</u>		
Flicker	On, <u>Off</u>		
Area	<u>100</u> , 70, 60, 50, 40%		
Zoom link	<u>0</u> , 25, 50, 75, 100%		
Color detail	On, <u>Off</u>		
	<u>Blue</u> , Red, Yellow		
Peak color	On, <u>Off</u>		
Chroma level	100, 50, <u>25</u> , 0%		

**OPERATION05 FOCUS ASSIST**

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Indicator	On, <u>Off</u> , Effect	Effect applies to Effect, VF Marker	
Mode	<u>Box</u> , B&W, Col		
	<u>Bottom</u> , Left, Top, Right		
Level	1~ <u>3</u> ~5		
	<u>Quick</u> , Smooth		
Gain	0~ <u>50</u> ~99		
Offset	0~ <u>50</u> ~99		
Area Marker	On, <u>Off</u> , Aspect	Aspect applies to Safety, VF Marker	
Size	Small, <u>Middle</u> , Large		
Position	Left, <u>Center</u> , Right		
Position H	0~ <u>50</u> ~99		
Position V	0~ <u>50</u> ~99		

**OPERATION06 ZEBRA**

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Zebra	On, <u>Off</u>		
	<u>1</u> , 2, 1&2		
Zebra1 level	50~ <u>70</u> ~109%		
Width	0~ <u>10</u> ~30%		
Zebra2	50~ <u>100</u> ~109%		

**OPERATION07 CURSOR**

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Cursor	On, <u>Off</u>		
	<u>White</u> , Black, Dot		
Box/Cross	<u>Box</u> , Cross		
H Position	0~ <u>50</u> ~99		
V Position	0~ <u>50</u> ~99		
Width	0~ <u>50</u> ~99		
Height	0~ <u>50</u> ~99		

**OPERATION08 VF OUT**

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
VF out	<u>Color</u> , Y, R, G, B		
Ret mix vf	On, <u>Off</u>		
Mix direction	Main, <u>Ret</u>		
Mix vf mode	<u>Y-mix</u> , Wire(W), Wire(B)		
Mix vf level	0~80%		
VF scan	<u>16:9</u> , 4:3		

**OPERATION09 SWITCH ASSIGN1**

<i>item</i>		<i>range</i>	<i>comment</i>	<i>BBC</i>
Gain	L	-3, 0, 3, 6, 9, 12dB		-3dB <sup>1</sup>
	M	-3, 0, 3, 6, 9, 12dB		0dB
	H	-3, 0, 3, 6, 9, 12dB		6dB
Assignable 1	E	Off, Return1 sw, Return2 sw, Eng, Prod, Vf detail, Mix vf, 5600k, Fan max		
	U	Off, Return1 sw, Return2 sw, Incom, Vf detail, Mix vf, 5600k, Fan max		
Assignable 2	E	Off, Return1 sw, Return2 sw, Eng, Prod, Vf detail, Mix vf, 5600k, Fan max		
	U	Off, Return1 sw, Return2 sw, Incom, Vf detail, Mix vf, 5600k, Fan max		
Assignable rear	E	Off, Return1 sw, Return2 sw, Incom, Vf detail, Mix vf, 5600k, Fan max, Marker, Cursor, VF scan		
	U	Off, Return1 sw, Return2 sw, Eng, Prod, Vf detail, Mix vf, 5600k, Fan max, Marker, Cursor, VF scan		
Re.rotation		Std, Rvs		

**OPERATION10 SWITCH ASSIGN2**

<i>item</i>		<i>range</i>	<i>comment</i>	<i>BBC</i>
Lens VTR s/s	E	Off, Return1 sw, Return2 sw, Eng, Prod		
	U	Off, Return1 sw, Return2 sw, Incom		
Front ret2	E	Off, Return1 sw, Return2 sw, Eng, Prod		
	U	Off, Return1 sw, Return2 sw, Incom		
Handle sw1	E	Off, Return1 sw, Return2 sw, Eng, Prod, Zoom(T)		
	U	Off, Return1 sw, Return2 sw, Incom, Zoom(T)		
Handle sw2	E	Off, Return1 sw, Return2 sw, Eng, Prod, Zoom(T)		
	U	Off, Return1 sw, Return2 sw, Incom, Zoom(T)		
Zoom speed		0~20~99		

**OPERATION11 HEAD SET**

<i>item</i>		<i>range</i>	<i>comment</i>	<i>BBC</i>
Intercom mic		Dynamic, Carbon, Manual		
Level		-60, -40, -20	Not settable with Carbon or Dynamic mic	
		-6, 0, +6dB	Input gain	
Power		On, Off	Not settable with Carbon or Dynamic mic	
Unbal		On, Off	Not settable with Carbon mic	

**OPERATION12 INTERCOM LEVEL**

<i>item</i>		<i>range</i>	<i>comment</i>	<i>BBC</i>
Sidetone		MU, 1~50~90		

**OPERATION13 RECEIVE SEL1**

<i>item</i>		<i>range</i>	<i>comment</i>	<i>BBC</i>
Intercom receive select		Separate, Mix		
Eng	E	Right, Left, Both		
Prod	E	Right, Left, Both		
Intercom	U	Right, Left, Both		
PGM1		Right, Left, Both		
PGM2		Right, Left, Both		
Tracker		Right, Left, Both		

<sup>1</sup> Camera noise levels are not as low as expected, lower gain settings reduce the noise to acceptable levels.

**OPERATION14 RECEIVE SEL2**

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Tracker receive select	Separate, <u>Mix</u>		
Talk	E Right, <u>Left</u> , Both		
Eng	E Right, <u>Left</u> , Both		
Prod	E Right, <u>Left</u> , Both		
Intercom	U Right, <u>Left</u> , Both		
PGM1	<u>Right</u> , Left, Both		
PGM2	<u>Right</u> , Left, Both		

**OPERATION15 RECEIVE SEL3**

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Earphone receive select	Separate, <u>Mix</u>		
Eng	E Right, <u>Left</u> , Both		
Prod	E Right, <u>Left</u> , Both		
Intercom	U Right, <u>Left</u> , Both		
PGM1	<u>Right</u> , Left, Both		
PGM2	<u>Right</u> , Left, Both		
Tracker	Right, <u>Left</u> , Both		

**OPERATION16 OPERATOR FILE**

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Read (MS-CAM)		Execute, copy from stick to camera	
Write (Cam-MS)		Execute, copy from camera to stick	
Preset		Execute, reset to internal memory file	
File ID		Max 16 characters	
Cam mode		Display only	
Date		Display only	

**OPERATION17 LENS FILE**

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
File	<u>1</u> ~17	16 files normally, 17 with a 'serial' lens Lens file name, non-'serial' lenses Stop value, non-'serial' lens	
Center marker		Set the image centre point	
H.Pos	-20~ <u>0</u> ~+20		
V.Pos	-20~ <u>0</u> ~+20		
Store		Execute	

**PAINT****PAINT01 SW STATUS**

main controls

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Flare	<u>On</u> , Off		On
Gamma	<u>On</u> , Off		On
Blk gamma	On, <u>Off</u>		On{v} Off{f}
Knee	<u>On</u> , Off		On{v} Off{f}
White clip	<u>On</u> , Off		
Detail	<u>On</u> , Off		On{v} Off{f}
Lvl dep	<u>On</u> , Off		
Skin dtl	On, <u>Off</u>		
Matrix	On, <u>Off</u>		On

**PAINT02 VIDEO LEVEL**

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
White	-99~ <u>0</u> ~+99	RGB values	
Black	-99~ <u>0</u> ~+99	RGBM values	
Flare	-99~ <u>0</u> ~+99	RGB values	
Gamma	-99~ <u>0</u> ~+99	RGBM values	
V mod	-99~ <u>0</u> ~+99	RGBM values	
Flare	<u>On</u> , Off		
V.mod	<u>On</u> , Off		
D.shad	On, <u>Off</u>		

Test	<u>Off</u> , Saw, 3step, 10step		
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**PAINT03 COLOR TEMP**

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
White	-99~0~+99	RGB values	
Auto white bal		Execute, press Enter	
Color temp	0~3200~65535K		
Balance	-99~0~+99		
ATW	On, <u>Off</u>		
Speed	1, 2, 3, 4, 5		
Master	-3.0~0.0~+12.0dB		

**PAINT04 GAMMA**

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Level	-99~0~+99	RGBM values	0
Coarse	0.35~0.45~0.90		0.45
Table	<u>Standard</u> , Hyper	Same choices as for other Sonys	Standard {v}, Hyper {f}
Standard	1, 2, 3, 4, 5, 6, 7	1=camcorder, 2+4.5x, 3=3.5x, 4=SMPTE240M, 5-ITU709, 6=BBC0.4, 7=5x 709	6 {v}
Hyper	1, 2, 3, 4	1=325%(100%), 2=460%(100%), 3=325%(109%), 4=460%(109%)	1~4 {f} <sup>2</sup>
Gamma	On, <u>Off</u>		
Test	<u>Off</u> , Saw, 3step, 10step		

**PAINT05 BLACK GAMMA**

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Level	-99~0~+99	RGBM values	
Range	Low, L.mid, H.mid, <u>High</u>		
	On, <u>Off</u>		Off <sup>3</sup>
Test	<u>Off</u> , Saw, 3step, 10step		

**PAINT06 SATURATION**

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Saturation	-99~0~+99		
	On, <u>Off</u>		
Low key sat	-99~0~+99		
	On, <u>Off</u>		
Test	<u>Off</u> , Saw, 3step, 10step		

**PAINT07 KNEE**

highlight compression

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Knee point	-99~0~+99	RGBM values	69
Knee slope	-99~0~+99	RGBM values	-87 <sup>4</sup>
Knee	On, <u>Off</u>		
Knee max	On, <u>Off</u>		
Knee sat	-99~0~+99		
	On, <u>Off</u>		
Auto knee	<u>Off</u> , Auto		
Point limit	-99~0~+99		
Slope	-99~0~+99		
ABS		Toggle between relative and absolute values	

**PAINT08 WHITE CLIP**

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
W clip	-99~+99	RGBM values	
	On, <u>Off</u>		
ABS		Toggle between relative and absolute values	

<sup>2</sup> Hyper gamma curves 1 and 3 handle 1.5 stops, curves 2 and 4 handle 2.3 stops. Curve 1 and 2 are suitable for line/as-line use in that they clip at 100%, curves 3 and 4 use the full video signal range and thus are suitable only when post-production grading can deal with the over-signal range.

<sup>3</sup> Camera noise levels are rather high, use of Black Gamma, while revealing detail near black, will emphasise noise.

<sup>4</sup> Knee copes with about 1.5 stop of headroom.

**PAINT09 DETAIL1**

Sharpening only

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Detail	<u>On</u> , Off		On {v}, Off {f}
Level	-99~ <u>0</u> ~+99		+25 <sup>5</sup>
Limiter M	-99~ <u>0</u> ~+99		+45
Limiter wht	-99~ <u>0</u> ~+99		+46
Limiter blk	-99~ <u>0</u> ~+99		+46
Crisp	-99~ <u>0</u> ~+99		0
Lvl dep	-99~ <u>0</u> ~+99		0
	<u>On</u> , Off		On
ABS		Toggle between relative and absolute values	

**PAINT10 DETAIL2**

Sharpening only

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
H/V ratio	-99~ <u>0</u> ~+99		-20
Freq	-99~ <u>0</u> ~+99		+99
Mix ratio	-99~ <u>0</u> ~+99		0
Knee aperture	-99~ <u>0</u> ~+99		0
ABS		Toggle between relative and absolute values	

**PAINT11 SKIN DETAIL**

Softening

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Skin dtl	<u>On</u> , Off		
Skin gate	On, <u>Off</u> , Mat	Mat appears when Multi-matrix Gate is on	
Auto hue		Execute	
Phase	<u>0</u> ~359	Degrees	
Width	<u>0</u> ~29~90		
Sat	-99~ <u>-89</u> ~+99		
Level	-99~ <u>0</u> ~+99		
ABS		Toggle between relative and absolute values	

**PAINT12 USER MATRIX**

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
R-G	-99~ <u>0</u> ~+99		
R-B	-99~ <u>0</u> ~+99		
G-R	-99~ <u>0</u> ~+99		
G-B	-99~ <u>0</u> ~+99		
B-R	-99~ <u>0</u> ~+99		
B-G	-99~ <u>0</u> ~+99		
Matrix Preset	On, Off		On
	<u>On</u> , Off		On
	SMPTE240M, ITU709, SMPTEwide, NTSC, EBU, ITU601		ITU-709
User	On, <u>Off</u>		
Multi	On, Off		

**PAINT13 MULTI MATRIX**

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Phase	<u>0</u> , 23, 45, 68, 90, 113, 135, 158, 180, 203, 225, 248, 270, 293, 315, 338	Colour axis to operate on	
Hue	-99~ <u>0</u> ~+99		
Sat	-99~ <u>0</u> ~+99		
All clear		Execute	
Gate	On, <u>Off</u> , Skin	Skin shows if Gate of Skin Dtl is on	
Matrix	On, <u>Off</u>		On
Preset	<u>On</u> , Off		On
	SMPTE240M, ITU709, SMPTEwide, NTSC, EBU, ITU601		ITU-709
User	On, <u>Off</u>		
Multi	On, <u>Off</u>		

<sup>5</sup> Setting level zero does not mean no effect, in all cases this only means the factory default value. The values given produce better results, but are a strange combination. They may well be suitable for other cameras of the type (e.g. HDC1500, HSC300, PDW700 etc).



**PAINT14 SHUTTER**

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Shutter	On, <u>Off</u>		
	50	1/60, 1/125, 1/250, 1/500, 1/1000, 1/2000	
	59.94	1/100, 1/125, 1/250, 1/500, 1/1000, 1/2000	
ECS freq	50i	50~4700Hz	
	50p	50.03~4600Hz	
	59.94i	60~4300Hz	
	59.94p	59.96~4600Hz	

**PAINT15 SCENE FILE**

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
1		Select scene file or factory STANDARD. Always load STANDARD first when setting up a camera. Open box indicator to read from camera, filled box indicator to read from stick.	
2			
3			
4			
5			
Standard		Back to standard PAINT data	
Read (MS-cam)		Load 5 scene files from stick	
Write (Cam-MS)		Save 5 scene files to stick	
File ID		16 characters	
Cam code		Display only	
Date		Display only	

**MAINTENANCE****MAINTENANCE01 AUTO SETUP**

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Auto black		Execute	
Auto white		Execute	
Auto level		Execute	
Auto white shading		Execute	
Auto black shading		Execute	
Test	<u>Off</u> , Saw, 3step, 10step		

**MAINTENANCE02 WHITE SHADING**

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
V saw	-99~ <u>0</u> ~+99	RGB values	
V para	-99~ <u>0</u> ~+99	RGB values	
H saw	-99~ <u>0</u> ~+99	RGB values	
H para	-99~ <u>0</u> ~+99	RGB values	
White	-99~ <u>0</u> ~+99	RGB values	
Auto white shading		Execute	
White shad mode	RGB, <u>RB</u>		

**MAINTENANCE03 BLACK SHADING**

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
V saw	-99~ <u>0</u> ~+99	RGB values	
V para	-99~ <u>0</u> ~+99	RGB values	
H saw	-99~ <u>0</u> ~+99	RGB values	
H para	-99~ <u>0</u> ~+99	RGB values	
Blk set	-99~ <u>0</u> ~+99	RGB values	
Black	-99~ <u>0</u> ~+99	RGBM values	
Master gain	-3, <u>0</u> , 3, 6, 9, 12dB		
Auto black shading		Execute	

**MAINTENANCE04 OHB MATRIX**

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Phase	<u>0</u> , 23, 45, 68, 90, 113, 135, 158, 180, 203, 225, 248, 270, 293, 315, 338		
Hue	-99~ <u>0</u> ~+99		
Sat	-99~ <u>0</u> ~+99		
All clear		Execute, reset data	
OHB matrix	On, <u>Off</u>		

Matrix	On, <u>Off</u>	On
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**MAINTENANCE05 AUTO IRIS**

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Auto iris	On, <u>Off</u>		
Window	<u>1</u> , 2, 3, 4, 5, 6	1=low 2/3, 2=mid, 3=mid 2/3, 4=full, 5=low mid, 6=high 2/3	
Override	-99~+99		
Iris level	-99~ <u>0</u> ~+99		
APL ratio	-99~+ <u>65</u> ~+99		
Iris gain	-99~ <u>0</u> ~+99		
Iris close	On, <u>Off</u>		

**MAINTENANCE06 MIC GAIN**

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Mic 1	20, 30, 40, 50, <u>60dB</u>		
Mic 2	20, 30, 40, 50, <u>60dB</u>		
Front mic +48v	On, <u>Off</u>		

**MAINTENANCE07 CALL/TALLY**

Not valid when CCU not connected

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
CCU call	<u>On</u> , Off		
Cam call	On, <u>Off</u>		

**MAINTENANCE08 OUTPUT FORMAT**

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Current		Show current format	
	E 1080 59.94i, <u>1080 50i</u> , 720 59.94p, 720 50p	Change won't happen until power is turned off/on	
	U <u>1080 59.94i</u> , 1080 50i, 720 59.94p, 720 50p		

**MAINTENANCE09 DOWN CONVERTER**

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Output signal	<u>Main</u> , Ret, VF		
Setting	Cam, <u>CCU</u>		
SD matrix	<u>On</u> , Off		
Detail	<u>On</u> , Off		
Dtl level	-99~ <u>0</u> ~+99		
H dtl freq	-99~ <u>0</u> ~+99		
Aspect	<u>SQ</u> , EC	Squeeze, Edge crop	

**MAINTENANCE10 TEST OUT**

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Output	SD sync, HD sync, VF, <u>YBS</u>		
VBS out			
Character	On, <u>Off</u>		
Gain	-127~ <u>0</u> ~+127		
Chroma	-127~ <u>0</u> ~+127		
Setup	<u>On</u> , Off	For NTSC only, 7.5% black lift	
HD sync-out			
V phase	-127~ <u>0</u> ~+127		
H phase	-127~ <u>0</u> ~+127		

**MAINTENANCE11 SDI OUT**

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Output	<u>Main</u> , VF, Ret, SD-SDI		
Character	On, <u>Off</u>		
Emb audio	On, <u>Off</u>		
	1-mic1 2-mic2 3-AES1 4-AES2	Shown when Output=Main	
	1-PGM1 2-PGM2 3-Eng1 4-Prod2	Shown when Output≠Main	

**MAINTENANCE12 POWER SAVE**

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
SDI out	<u>Pwr save</u> , Active		
Down converter	Pwr save, <u>Active</u>		
Prompter	<u>Pwr save</u> , Active		

**MAINTENANCE13 TRUNK**

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Trunk	<u>On</u> , Off		

**MAINTENANCE14 GENLOCK**

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Reference		Displays sync condition, no options here	
Genlock			
Status		Display only	
Format		Display only	
Phase			
V	-1024~ <u>0</u> ~+1023		
HD H	-1700~ <u>0</u> ~+1700		
SD H	-1024~ <u>0</u> ~+1023		

**MAINTENANCE15 DATE**

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Date/time	<u>yyyy/mm/dd</u> hh:mm	2000 to 2099, a bit optimistic ☺	

**MAINTENANCE16 BATTERY ALARM**

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Before end	<u>11.5</u> ~17.0V		
End	<u>11.0</u> ~11.5V		

**MAINTENANCE17 OTHERS 1**

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Fan mode	Off, <u>Auto1</u> , Auto2, Min, Max	Auto1=normal, Auto2=slow	
Cam bars	<u>On</u> , Off		
V dtl creation	NAM, G, R-G, <u>Y</u>		
Dtl H/V mode	<u>H/V</u> , V only		
Test2 mode	<u>3step</u> , 10step		
White setup mode	AWB, <u>A.LVL</u>		
ALAC	<u>Auto</u> , Off	Auto launches automatic chromatic aberration correction. See the manual for details.	

**MAINTENANCE18 OTHERS 2**

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Date type	1 Y/Mn/D, 2 Mn/D, 3 D/M/Y, 4 D/M, 5 <u>M/D/Y</u> , 6 M/D	Pretty obvious layouts	
F no. disp	<u>Control</u> , Return	Where the iris data comes from	

**FILE****FILE01 OPERATOR FILE**

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Read (MS-cam)		The usual stuff, doesn't affect pictures	
Write (Cam-MS)			
Preset			
Store preset file			
File ID		Maximum 16 characters	
Cam code		Display only	
Date		Display only	

**FILE02 SCENE FILE**

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
1		The usual stuff, all picture-related	
2			
3			
4			
5			
Store			
Standard		Recall standard Paint settings	
Read (MS-cam)			
Write (cam-MS)			
File ID		Maximum 16 characters	

picture stuff

Cam code		Display only	
Date		Display only	

**FILE03 REFERENCE FILE**

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Store file		Store current settings as Reference	
Standard		Reset to Standard	
All preset		Back to factory settings	
Read (MS-cam)			
Write (cam-MS)			
File ID		Maximum 16 characters	
Cam code		Display only	
Date		Display only	

**FILE04 LENS FILE**

lens corrections

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Store file			
No.	1~17	Only 16 for non'serial' lenses	
Name		Changeable only for non'serial' lens	
F No	F1.0~F1.7~F3.4	Changeable only for non'serial' lens	
Center marker			
H Pos	-20~0~+20		
V Pos	-20~0~+20		
Store		Execute	

**FILE05 OHB FILE**

sensor file

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Store file		Store offset data for CCDs	

**FILE06 FILE CLEAR**

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
Preset operator			
Reference (all)			
10 sec clear	On, <u>Off</u>		
OHB white shad (all)			
OHB black shad			
OHB ND offset			
OHB matrix			
M.S. format		Format the Memory Stick	

**DIAGNOSIS****DIAGNOSIS01 BOARD STATUS**

Indicators only, no options

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
OHB	Ok, NG		
DPR			
CD			
TX			
SY			
PS			

**DIAGNOSIS02 PLD VERSION**

Indicators only, no options

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
TG	Vx.xx		
AT			
VDAP			
VSOP			
ASSIST			
DEMUX			
DEMAP			

**DIAGNOSIS03 ROM VERSION**

Indicators only, no options

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>
AT	Vx.xx		

**DIAGNOSIS04 SERIAL NO**

Indicators only, no options

<i>item</i>	<i>range</i>	<i>comment</i>	<i>BBC</i>

Model	HCX-100		
No			

## 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. Importing recordings into editing software is unreliable because the decoding and transcoding is not fully specified. The lens was a Canon HJ17ex7.6B.

### 2.1 Gamma and Headroom range

The camera has seven 'standard' gamma curves and four 'hyper' gammas. Colour performance, with the ITU.709 gamma curve, was good, although a little over-saturated.

The Hyper-gamma curves are those of the HDWF900R and several other similar Sony cameras, providing for film-like transfer over either 325% or 460% headroom, delivered into either 100% or 109% video signal range. They are known to perform well, there was no need to examine them in this camera.

The Standard curves, also, are those of other cameras, with a few additions. The most important curves are numbers 6 and 7 in the table, ITU.709 and BBC0.4. Since this is a HDTV camera, the 709 curve should be regarded as the normal option, unless there is a specific need to change it to achieve specific picture performance. However, colouring looks more natural with the BBC0.4 law. Since the Hyper-gammas handle headroom well, there is little need to explore the knee function, using Standard curves. Similar knee curves in other Sony cameras can cope with about 2 stops of over-exposure, but in this camera it was not found possible to set values which could cope with more than 1.5 stops.

### 2.2 Resolution

Resolution was tested using a test card of circular zone plate patterns, calculated for 1920x1080 standard. 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.

#### 2.2.1 Resolution at 1080-line

The camera does not have a progressive mode at 1080-line.

With detail enhancement switched off, the results for 1080-line interlace are as expected. Horizontal resolution droops gracefully towards the edge of the pattern, as it should do, due to the effect of the optical horizontal low-pass filter. Vertical resolution also falls, but this time due to the line-pairing implicit in interlaced scanning. There are no horizontal null zones or alias patterns visible, but there are low-level vertical aliases visible. This is unusual, since the normal interpolation process used to derive interlaced images should suppress such aliasing completely.

As a result, detail enhancement is not quite as good as in other cameras, but is probably adequate. The values developed for the HSC300 work well in this camera, and are here given in the menus for this camera. Although the camera has no progressive scan mode at 1080-line, the less-aggressive detail settings for a film look are quite pleasing in this camera, and still make sense for use in 720p mode.

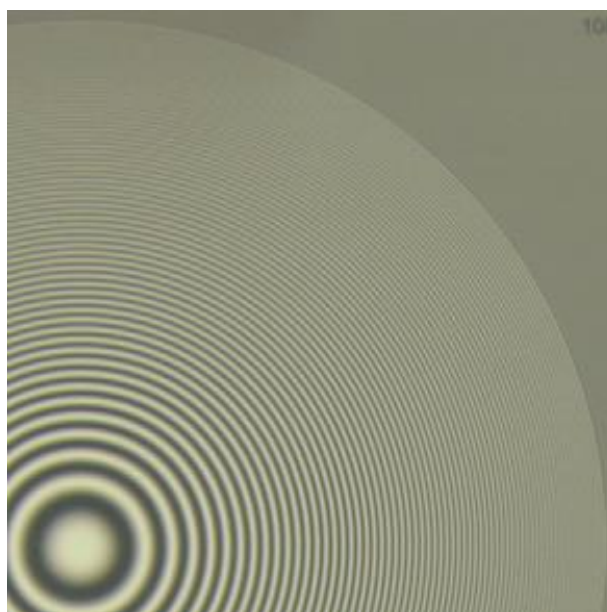


Figure 1 Resolution, 1080i, detail off

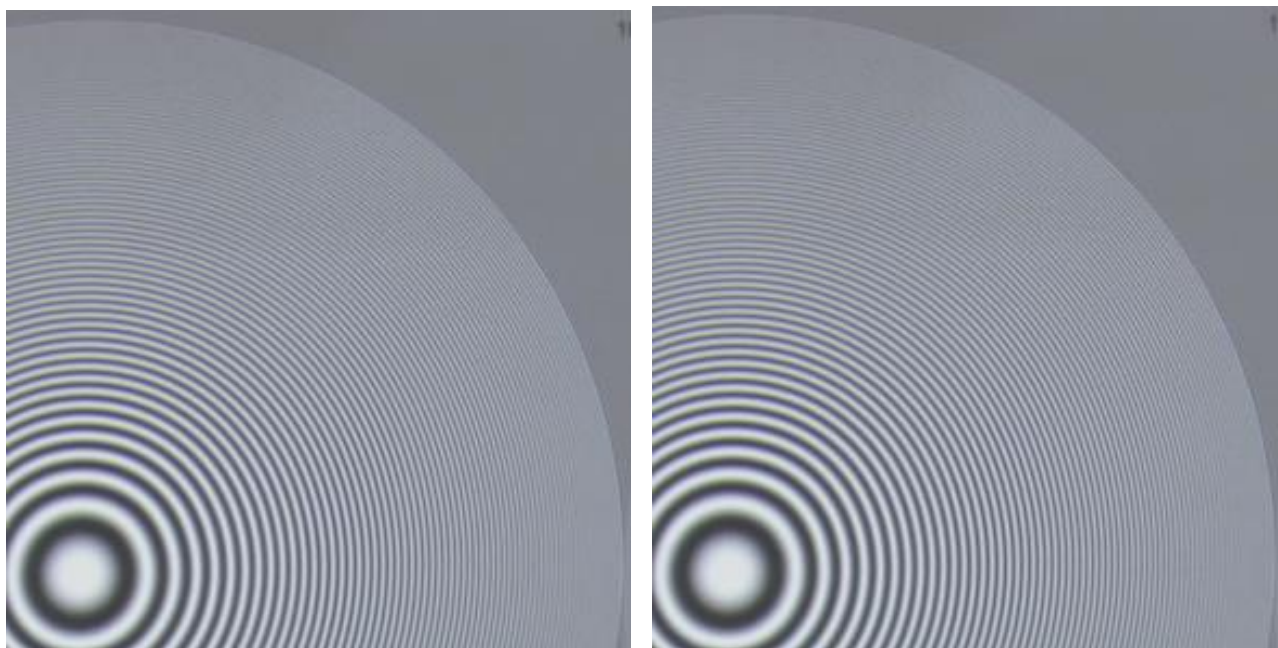


Figure 2 Resolution, 1080i, (a) video detail

(b) film detail

### 2.2.1 Resolution at 720p

The horizontal down-scaling from 1920 to 1280 is clean, with no residual aliasing, the higher frequencies are well suppressed. However, there is significant, and highly visible, coloured vertical aliasing in the picture, where the higher vertical frequencies have been reversed or folded. This is almost inevitable in any camera 1080-line, since the conversion to 720p is a standards-conversion, which cannot be done satisfactorily in any camera at an economic price.

Even though the specification claims that the sensors are scanned progressively, it is evident that progressive images are not properly used in the creation of 720p. If the vertical down-sampling filter were the same as the horizontal down-sampling filter, then there would be no visible aliasing at 720p, but the camera would cost a little more.

The detail enhancement settings for 1080 work equally well at 720p.



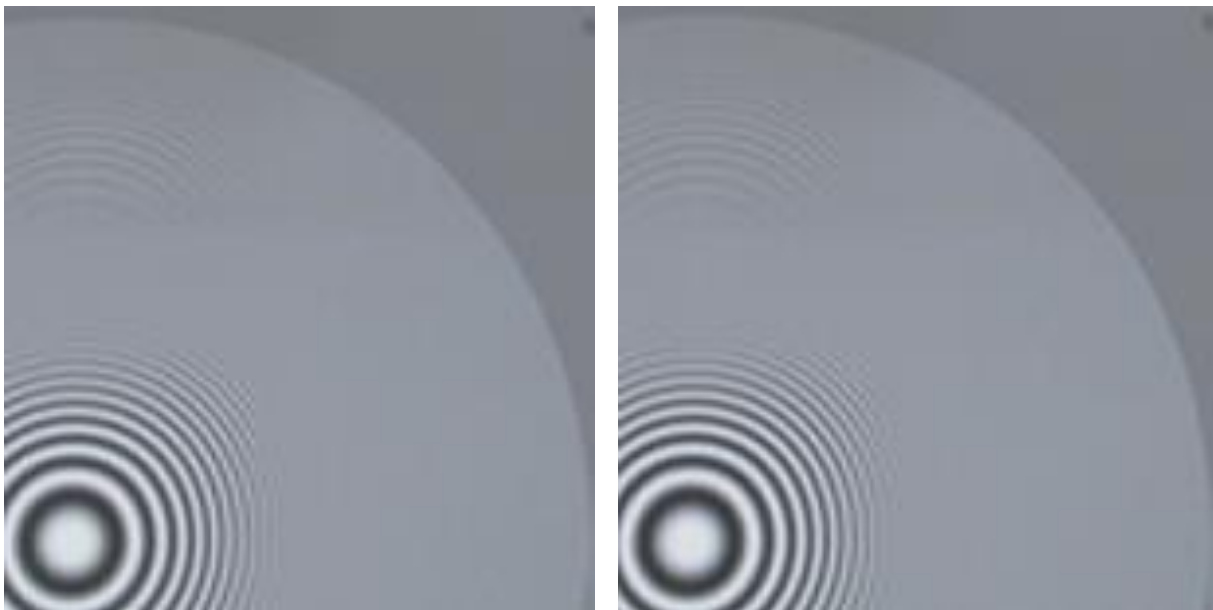
Figure 3 Resolution, 720p, detail off

### 2.2.1 Resolution at SD (576i)

The camera does not have a SDTV mode as such, but there is a continuous feed of SD images from the CCU. For this test, the camera was set to 1920x1080, so there should be only one down-scaling process involved in the production of SD images.

The horizontal resolution is alias-free, which is a good sign, a reassurance that reasonably good filtering has been used in the down-scaling. However, there is significant vertical aliasing, a double folding of the higher frequencies. This hints that the SD output is down-converted via the 720p converter, even when the camera is set to 1080-line operation.

Aliasing at this level is almost inevitable in any camera 1080-line camera when down-converting to SDTV, since the down-conversion filters used are rarely adequate. It was not possible to find any combination of detail control settings which improved the picture, so the search was abandoned.



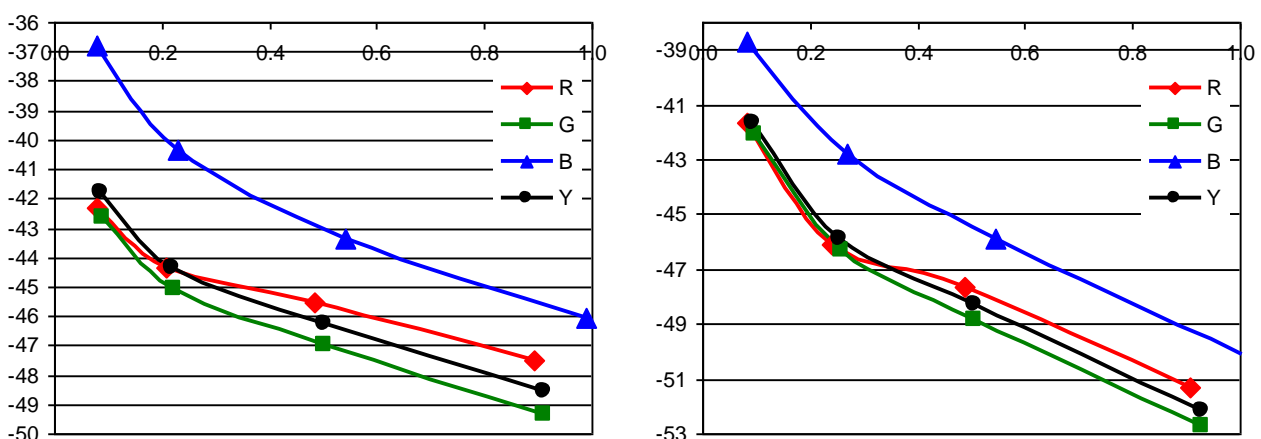
**Figure 4 Resolution, SDTV (a) detail off (b) factory detail settings**

Clearly, the SD output should be used only for monitoring, it is not good enough for use as a programme output.

### 2.3 Noise

Noise was measured by exposing the camera to an evenly illuminated white card, and exposure adjusted to get 4 luma values between 10% and 100%. Noise suppression was switched on for this test, since it is the way the camera is most likely to be used. Gain was set to +0dB. The grabbed frames were processed with a high-pass filter to remove any residual shading effects. Vignetting was avoided by adjusting the lighting level such that the extremes of the aperture range were not used.

The plot of measured noise versus signal level for 1080i shows that noise in the middle range (where the slope of the gamma curve is unity) is at about -46dB, which is adequate but a little disappointing. This was confirmed by direct observation during the tests, both off-screen and on the waveform monitor. The general shapes of the curves are as expected, since the primary source of noise is the analogue circuitry of the sensor and pre-amplifiers, which is non-linearly amplified by the gamma-corrector. Blue noise is a few dB worse than red or green, this is normal.



**Figure 5 Noise levels (a) 1080i (b) 720p**

Noise at 720p is about 2dB lower than for 1080p, primarily due to the reduced video bandwidth.

The noise levels are surprisingly high for a camera with full-resolution 2/3" CCD sensors. Studio cameras should normally be capable of noise levels about 10dB better than this, and these high levels mean that the



maximum exposure range is only about 10 stops, and that high gain settings should be avoided wherever possible.

## **2.5 Conclusion**

The HCX-100 performs quite well, but is rather noisy. The results are very similar to other Sony cameras, particularly those with 14-bit processing. It should work well in any production using, for example, the HDC1500 or HSC300.