Colorimetric and Resolution requirements of cameras

Alan Roberts

ADDENDUM 62 : tests on a Lux Media Plan LMP 1200 mini-camera

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 a very brief examination of a LMP 1200 mini-camera as part of a group test of HDTV mini-cameras. There was neither manual nor specification available at the time of testing.

The camera is small (43x37x47mm), but the controller is relatively large. The single CMOS sensor appears to be ⅔" with a pixel count of 1920x1080. It has a C size lens mount, and servo mechanisms to control a lens. The control unit is fairly compact, 40x205x30mm and has 2 HDSDI output BNC connectors, one SDSDI BNC, plus connections for analogue and genlock. Control is via a separate control panel. There is no menu system as such, all control is via knobs and buttons.

It can operate at 1080i (50 and 59.94Hz), 1080psf (23.98, 24, 25 and 29.97Hz) and 720p (50 and 59.94Hz) but only the 1080i option seemed to be available during the tests. This, together with the lack of specification and manual indicates that the camera was a prototype, and that the final production model may well have significant differences.

There are no controls on the camera itself. Unfortunately, the camera shows significant response to infra-red illumination.

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There are no menus in the camera as such, the following table shows the control available via the control unit. Since there was no manual available, the default values (underlined) are only guesses at this stage.

1 Camera controls

1.1 Menu items

Item	*Range*	*description*	*Pref*
White balance adjust			
M	-100~0~+100		
R	-100~0~+100		
G	-100~0~+100		
B	-100~0~+100		
Black balance adjust			
M	-100~0~+100		
R	-100~0~+100		
G	-100~0~+100		
B	-100~0~+100		
Gamma balance adjust			
M	-100~0~+100		
R	-100~0~+100		
G	-100~0~+100		
B	-100~0~+100		
HD detail adjust			
H	0~+100~+200		+75
M	0~+100~+200		+75
V	0~+100~+200		+75
Chroma adjust	-100~0~+100		
Shutter adjust	1/24, 1/48, 1/120, 1/240		
Auto gain	On, Off		
Auto shutter	On, Off		
Exposure value	0~+32~+100	Possibly auto exposure aim point	
Select HD output B	Cam, HDSDI, Manual	Not sure what this means	
Memory recall	Set	Read from memory, 4 files	
Memory storre	Set	Write to memory, 4 files	
Test signals	Camera, 100% bars, Colour multiburst, BW multiburts, Grid, Inverse grid, Sawtooth, Stress, PEM		
Matrix select	EBU, L, 3200K, User1, User2		EBU
Scan mode	1080/50i, 1080/25psf, 1080/69.94i, 1080/29.97psf, 720/50p, 720/59.94p, 1080/24psf, 1080/23.98psf	Only 1080/50i available on tested camera	
Analogue output select	YUV	No choices here	
Genlock adjust			
R	-100~0~+100		
G	-100~0~+100		
B	-100~0~+100		
Genlock shift	-100~0~+100		
Iris speed adjust			
Slow	+50~+100		

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Fast	+50~+100		
Iris direction	Normal, Reverse		
External Iris/Focus	Enabled, Disabled		
Focus speed adjust			
Slow	+1~+100		
Fast	+1~+100		
Camera address	1~20	the control unit can control up to 20 cameras	
Serial mode	One way, Wireless, Two way, Duplex		
HD1200 RCP 2.157	10-18-2010 13.52.50	Dsplays only	
	CCU V 0.73		
	Head V 0.73		
Calibrate camera head	Start	Not tested	
Protocol select	LMP HD1100, LMP HD1200, +V-Skyline (HD100)		

1.2 CCU controls

Item	*Buttons*	*Range*	*Pref*
Camera number	Up, Down		
Preset	Store, Recall		
Gain	Up, Down	-6, 0, +6, +12dB	
Menu	Up, Down, Set	This gets into the menus	
Bars	On/Off		
White bal	Exec		
Skin	Exec		
Data			
Others	R, G, B, Ped, Iris		

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2 Measurement results

All measurements were made by capturing video on a NanoFlash solid-state recorder using HDSDI output from the control unit. Pictures were extracted for measurement using proprietary software for analysis.

2.1 Sensitivity

Exposing the camera to a 90% reflectance card (the white side of a Kodak Gray Card) at 2700 lux required an aperture of F/10 to get peak white. Correcting to 2000 lux illumination returns a value of about F/11.6, which is normal for a ⅔" sensor.

2.2 Colour performance

Using a Colorchecker chart, the colour performance was judged to be reasonably good. No individual colour stood out as being significantly wrong, but the yellow patch was a little green, read and blue a little desaturated, all of which is quite normal for any camera. This is fortunate, since there are no controls which affect colour performance.

2.3 Resolution and aliasing

All testing was done with a circular zone plate test chart having 6 sinusoidally modulated patterns. The six patterns explore luminance and chroma channels on the top row, RGB channels on the bottom row, the samples shown here are each only one quadrant of the luminance (grey scale) pattern.

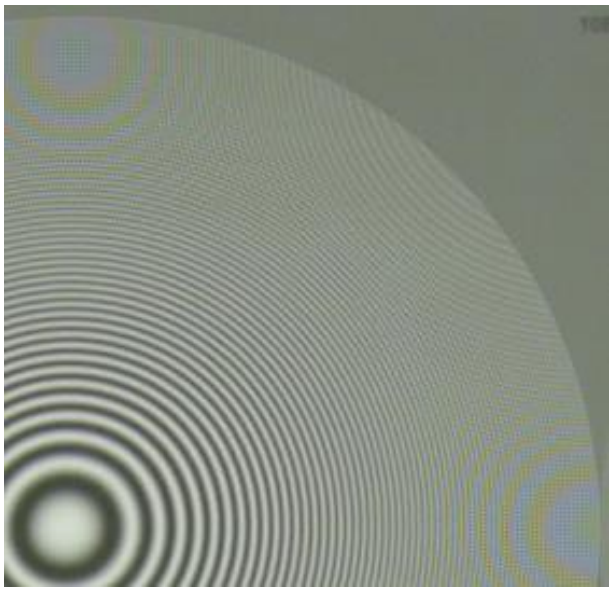

Figure 1 Resolution 1080i

In 1080 interlaced mode, 1920x1080i/25 in EBU parlance, both horizontal and vertical aliasing is present at significant levels.

The aliasing is coloured, which is normal for single sensor, Bayer-patterned, cameras with 1920x1080 sensor. Clean resolution should reach 960x540 (the lower left quadrant of the pattern since that is the resolution of the red and blue Bayer pattern. Resolution up to 1920 and 1080 should be mutually exclusive, i.e. no increase in diagonal resolution beyond 960x540. The diagonal aliases are at a significant level, which confirms that the lens is not a limiting factor.

There was a small but significant improvement to both resolution and the appearance of aliasing by setting the detail correction level to +75. The control has a very large numerical range but does not make dramatic changes to the picture.

It was not possible to switch the camera into 720p or SDTV modes, the reason is unknown, but possibly indicates the prototype nature of the camera under test.

2.4 Video Noise

Measurements were taken on an evenly lit white card, exposed at various levels. Image files were captured then decoded in software before performing a software noise analysis. The plot shows the noise level in dB

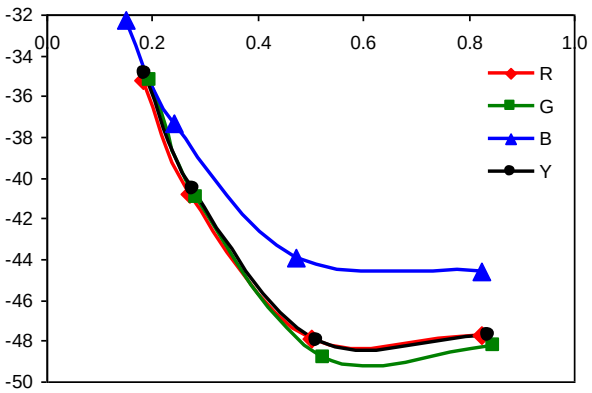

Figure 2 Noise levels

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versus video signal level.

The camera gain was set to 0dB, and the measurement files were high-pass filtered to remove any image shading and tilt, and 6dB gain applied to avoid any effects due to premature data quantising. So, 6dB compensation has been applied to the results, thus the graph is representative of the camera performance at normal 0dB gain setting.

The result is reassuring. The noise levels rise smoothly towards black level, which is the correct result for a camera whose gamma-correction is done in digits rather than analogue, since the primary source of noise is the analogue parts of the camera. The normal distribution of noise follows the slope of the gamma curve, thus noise should be least near white, greatest near black, differing by about 13dB. The noise level at mid-grey is about -48dB, which is adequate but not especially good for a ⅔" camera.

2.5 Rolling shutter effect

Since the sensor is CMOS, there should be effects on the pictures due to the inevitable use of a rolling shutter. To test this, a small 6-bladed fan was used, rotating at a speed designed to cause strobing, and the camera electronic shutter reduced to `1/240 second.

The result clearly shows the effect of a rolling shutter; the blades are differentially distorted depending on whether they are rising (on the left) or falling (on the right), but the effect is hardly disturbing, and is much better than on most CMOS cameras.

Figure 3 Rotating fan, shutter effect

2.6 Infra-red response

The camera showed significant response to infra-red illumination. This is to be expected in low-cost cameras, but can distort colours under some illuminants, and can cause instability in black levels.

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