

Colorimetric and Resolution requirements of cameras

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ADDENDUM 45 : Tests and Settings on a Sony HXR-MC1P mini-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.

Data for this section is taken from the handbook and a very brief examination of Sony HXR-MC1 as part of a group test of HDTV mini-cameras. The camera is permanently connected to its controller/recorder by a multi-core cable, all controls are on the control unit.

The camera is small (37x42.5x86.5mm), the control unit is 82x107x42mm and weighs about 500 grammes. The connecting cable is 2.8m long and cannot be detached from either the camera or controller. The camera has a single CMOS sensor of 1/5" size (3.6mm) and 1.43Mpixels. The pixel array is Bayer patterned, and is rotated 45°, thus rather more complex decoding is required than normal. The lens is integral, F/1.8, 3.2mm to 32mm zoom (10:1).

Recording is either 1080i/25 using AVCHD, or SD using MPEG2. HD recording can use bit-rates from 5 to 16 Mb/s, which is rather low for broadcast purposes. SD recording uses rates from 3 to 9Mb/s, also rather low. Clearly, this is a consumer device.

All camera control is via the controller, with a touch screen for most control purposes. The controls are very similar to those found in small consumer camcorders. Indeed, the whole unit resembles a consumer camcorder with the camera part physically separated from the controls.

Unfortunately, the cameras show significant response to infra-red illumination.

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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 range, and zero means no alteration to factory setting, not zero effect, and no scales are given in the manuals. For each item, the factory setting is underlined where known. “BBC” recommended settings are in the last column, where appropriate. In some instances, it is possible to alter the menus such that they produce more meaningful numbers.

Settings have not been derived, since there is little available control over the camera performance. Therefore, I have omitted the usual complete menu listing in this document.

1 Measurement results

All measurements were made using the HDMI output from the control unit, converted to HDSDI and fed to a Sony 32” grade 1 CRT monitor, a waveform monitor, and recorded using proprietary software for analysis.

1.1 Sensitivity

Sensitivity was not measured. The specification claims minimum illumination of 5 lux with 1/25 second shutter. This is typical of consumer camcorder specifications, and exposure levels.

1.2 Colour performance

Using a Colorchecker chart, the colour performance was judged to be acceptable. The skin tones are good, and the yellow a little green, which is normal. Most other colours are reasonably well reproduced. This is fortunate, since there are no controls to affect colour performance.

The camera shows significant response to infra-red illumination which can seriously pollute some colours under some illuminants.

1.3 Resolution and aliasing

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. Images were captured uncompressed from the control unit as HDSDI.

Both horizontal and vertical aliasing are clearly present, and coloured. There is also some diagonal aliasing. These are very good indicators that the camera has a single sensor, with Bayer filter patterning. There are alias null zones centred on 1170 pixels horizontally and 608 vertically (indicating 680,000 pixels within the



clean area), and there is some resolution preserved above these values, out to about 1440x770. The aliases are coloured, which is normal for a single, Bayer-patterned sensor.

Since the sensor is rotated, there is no simple relationship between resolution and pixel count, but, for a normally-aligned rectilinear array, the achieved resolution is not that of the horizontal or vertical pixel count, but forms a diamond shape which just reaches those dimensions horizontally and vertically, with poor diagonal response. In this case, with the sensor rotated, the maximum achievable resolution really does equal the pixel counts rectilinearly, but with some loss because of the need to filter to decode the Bayer pattern. A factor of $1/\sqrt{2}$ is typical for this resolution loss. Thus, we should expect to have some resolution up to 1594x896 (since $1594*896=1.43$ million), but that there should be aliases above 1127x634 (the pixel count reduced by $1/\sqrt{2}$), which is pretty well what we see in the captured zone plate.

1.4 Video Noise

It was not possible to make meaningful measurements of noise, because the exposure control links iris, gain and shutter, and gives no indication of the values of any. Also, the specification makes no mention of noise. However, subjectively, it would appear to be about -42dB, although it is impossible to quote any figure with certainty.

2 Conclusions

This is a consumer camera, split into head and controller/recorder. It performs like a consumer camera and has the same form of controls. It is responsive to infra-red, which will pollute colours under some illuminants, and has a rolling shutter which will distort moving objects. However, its small size makes it attractive for specialised purposes.