

Monday, October 17, 2016

## TECHNICAL NOTE: Camera/Lens ISO12233 Validation Spatial Frequency Response Measurements

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### 1. Purpose

- 1.1. The Spatial Frequency Response (SFR) of a black/white transition is evaluated in accordance with ISO12233:2014 as a method of characterizing CMOS camera image sharpness of a 2.3 Megapixel auto focus camera compared to a 12 Megapixel fixed focus camera.

### 2. Introduction

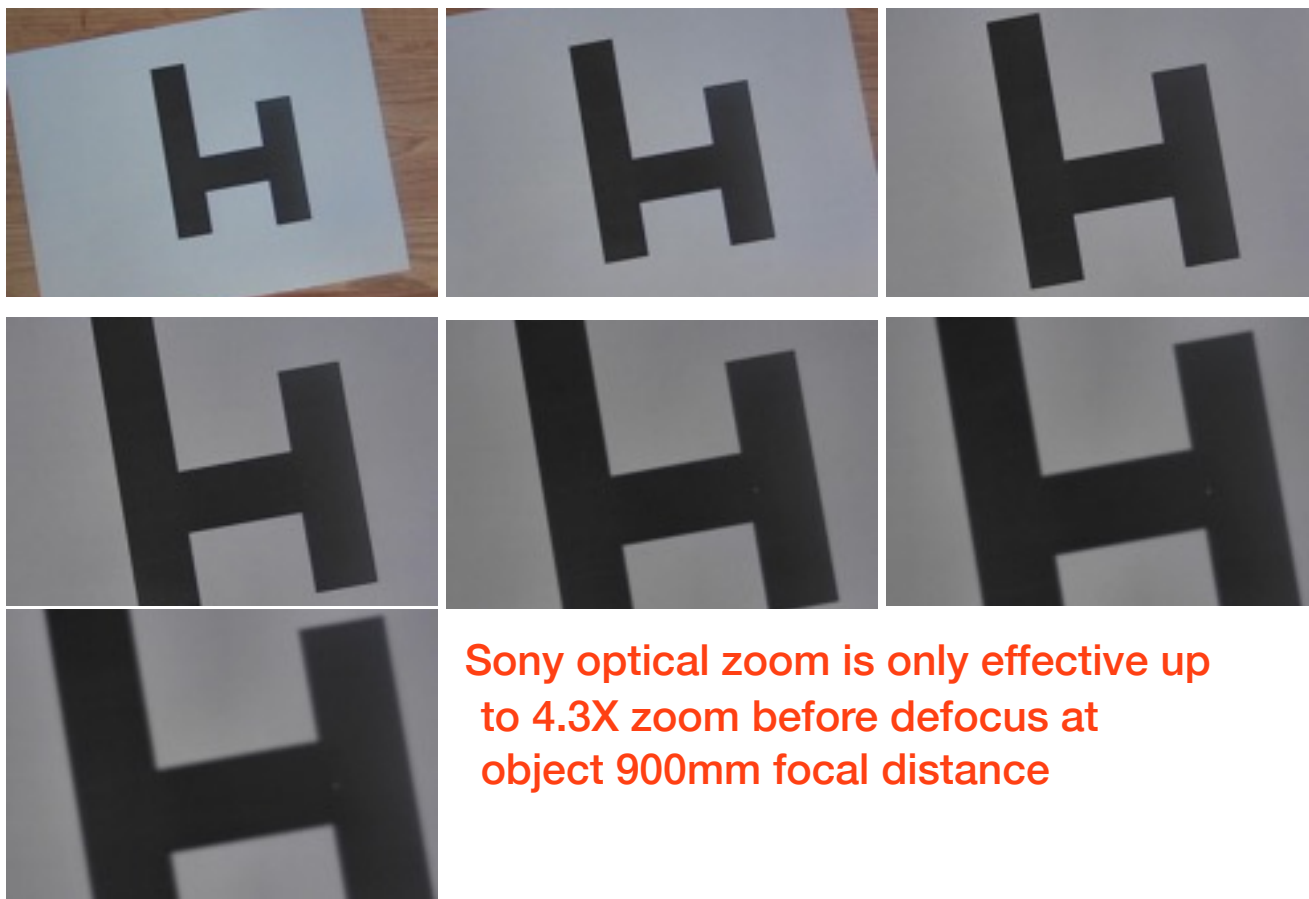
- 2.1. The SFR is a measurement of image contrast as a function of spatial frequency. As such, it is a measure of *device* or *system* sharpness. The SFR is the Fourier transform of the line spread function, which is the derivative of the average slanted black/white edge. The slant makes the measurement insensitive to sampling phase

### 3. Results

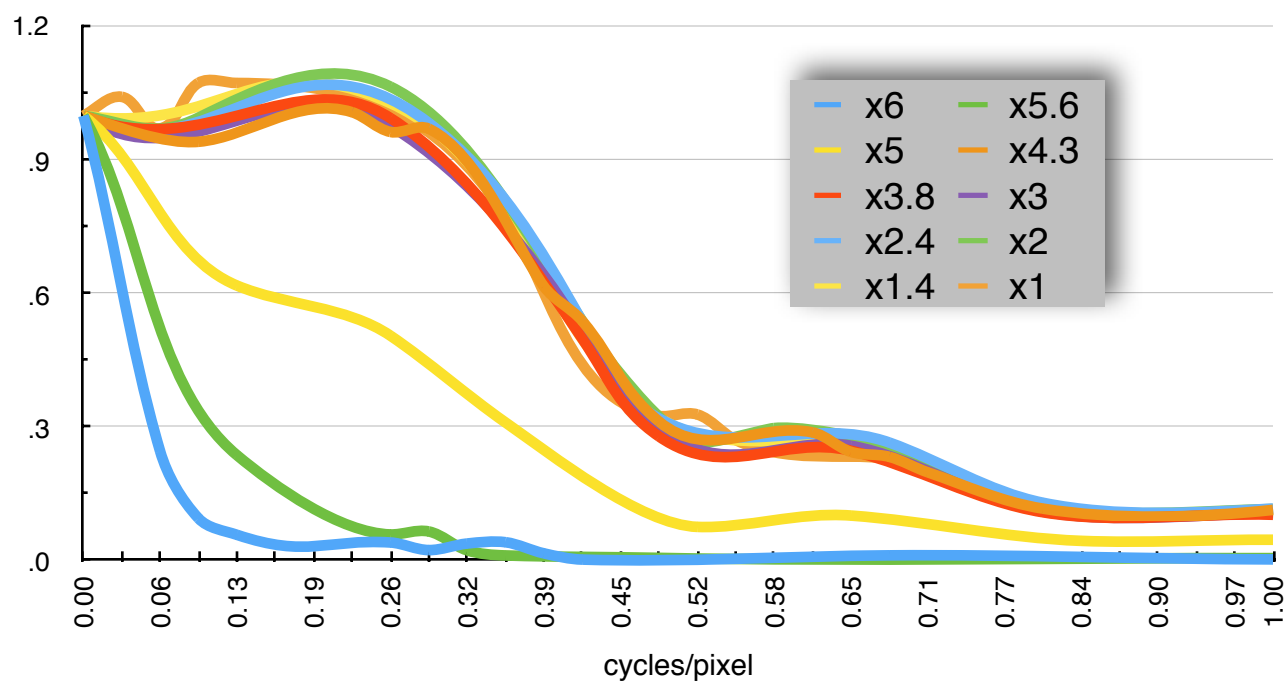
- 3.1. The Sony FCB-EV7520 Block Camera with Full HD and 30x Zoom High Sensitivity Camera is evaluated for sharpness by measuring the SFR at different zoom magnifications of an objet 900mm from lens.
  - 3.1.1. Sony FCB-EV7520 block camera specs
    - 30x zoom
    - 1/2.8" CMOS image sensor (approx. 2.14 million effective pixels)
    - Digital FULL HD (high sensitivity mode the camera can operate effectively in lighting levels as low as 0.35 lx)
    - Advanced Noise Reduction
    - Auto ICR
    - Spherical Privacy Zone Masking
    - Visibility Enhancer
  - 3.1.2. The "H" test pattern is placed 900mm from the camera lens and single frame imaged at 1X, 1.4X, 2X, 2.4X, 3X, 3.8X, 4.3X, 5X, 5.6X and 6X at which point the defocus is clearly a problem. Lighting is room lighting and the test pattern is angled off perpendicular by 4-7 degrees to avoid sampling phase.
  - 3.1.3.



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## Sony Optical Zoom SFR

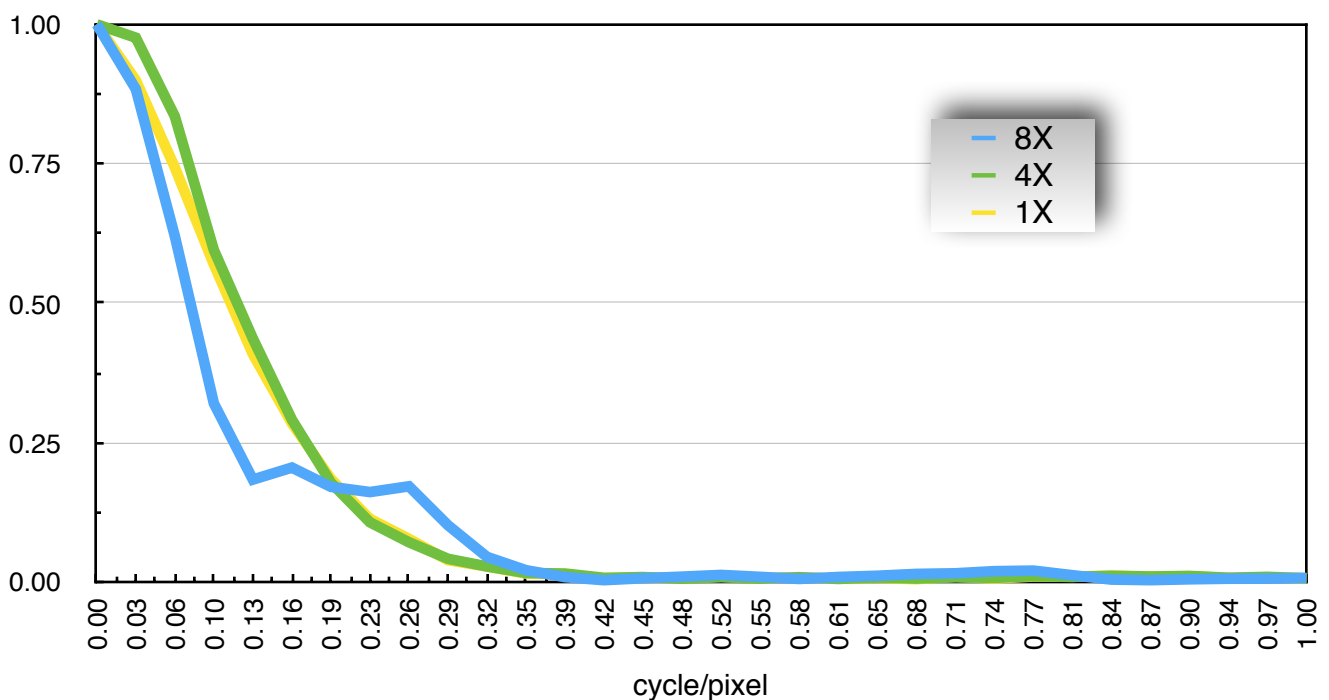


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3.1.4. ON Semiconductor UI-3590CP-C-HQ Rev.2: AB00606

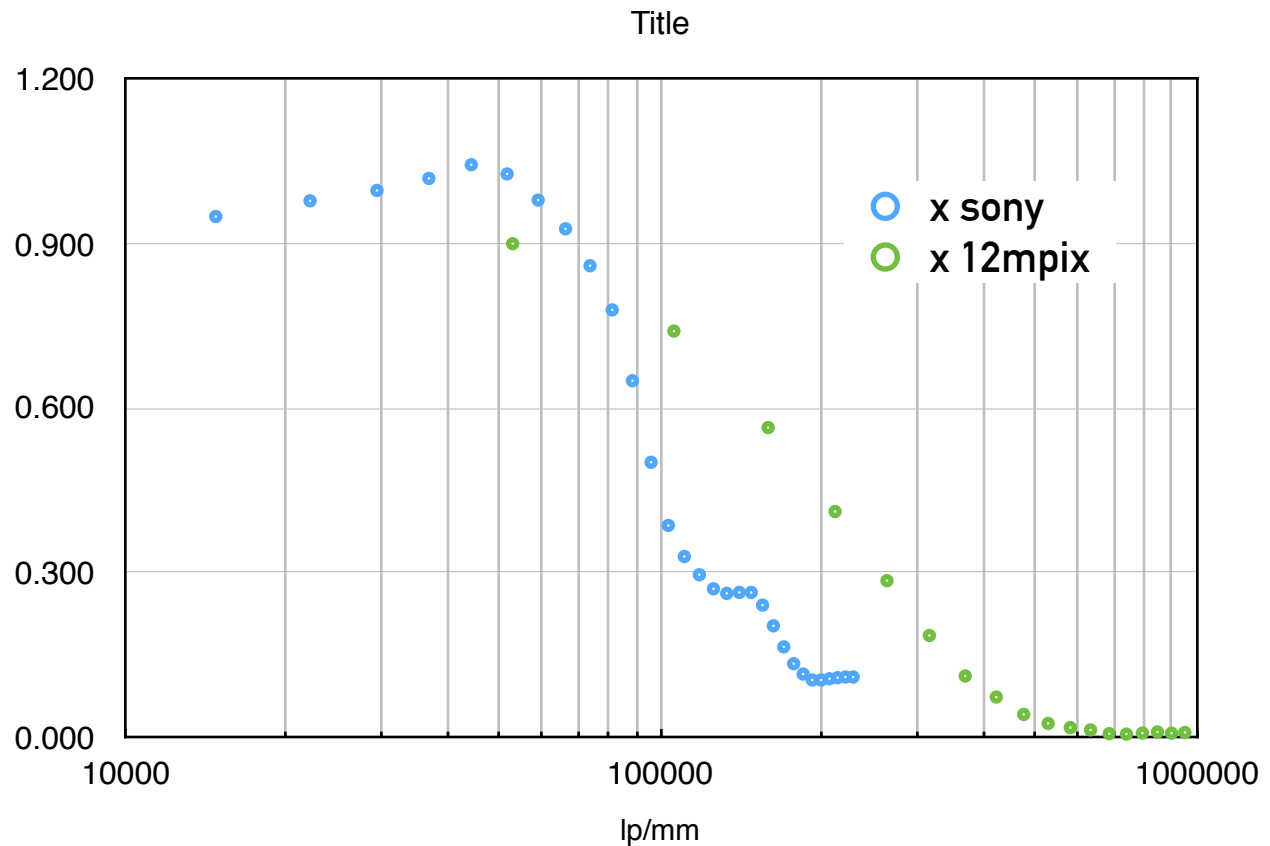
3.1.4.1.	Family	CP
	Interface	USB 3.0
	Sensor type	CMOS
	Manufacturer	ON Semiconductor
	Frame rate	21 fps
	Resolution (h x v)	4912 x 3684
	Shutter	Rolling Shutter
	Optical class	1/2.3"
	Resolution	18.1 MPix
	Pixel size	1.25 $\mu$ m

3.1.4.2. The "H" test pattern is placed 900mm from the camera lens and single frame imaged at 1X,4X and 8X at which point the pixilation is an issue. Lighting is room lighting and the test pattern is angled off perpendicular by 4-7 degrees to avoid sampling phase. The test pattern is larger because it was printed in portrait rather than landscape.



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3.1.4.3. Cycles per pixel is a relative scale for the Fourier Transform and the sensor size and resolution for each camera must be considered to compare absolute spatial dimensions of the 2 camera's SFR curves.



#### 4. Discussion and Conclusion

- 1.1. Comparison of the SFR curves for the two cameras evaluated indicates the 12 megapixel camera retains image sharpness within the zoom range. The spatial frequency FWHM of the 12 Megapixel camera is close to two times as many line pairs/mm
- 4.2. The Sony 30x zoom can only support a 4.3X zoom before the camera can no longer compensate with auto focus and the sharpness drops off dramatically
- 4.3. The 12 Megapixel ON Semiconductor can maintain focused images through the focus range of the Sony camera and has good image quality at 8x digital zoom.
- 4.4. The SFR indicates that there is significant processing of the image internal to the camera by the overshoot and undershoot at the edge profile transition.