Skype video specification support

Skype video specification: instructions and comments

Under development

This document contains instructions for using Imatest with the Skype Hardware Certification Specification — For all Skype Video Devices Version 5.0. It also contains comments and suggestions (some of which we hope might be adopted in a future release of the spec).

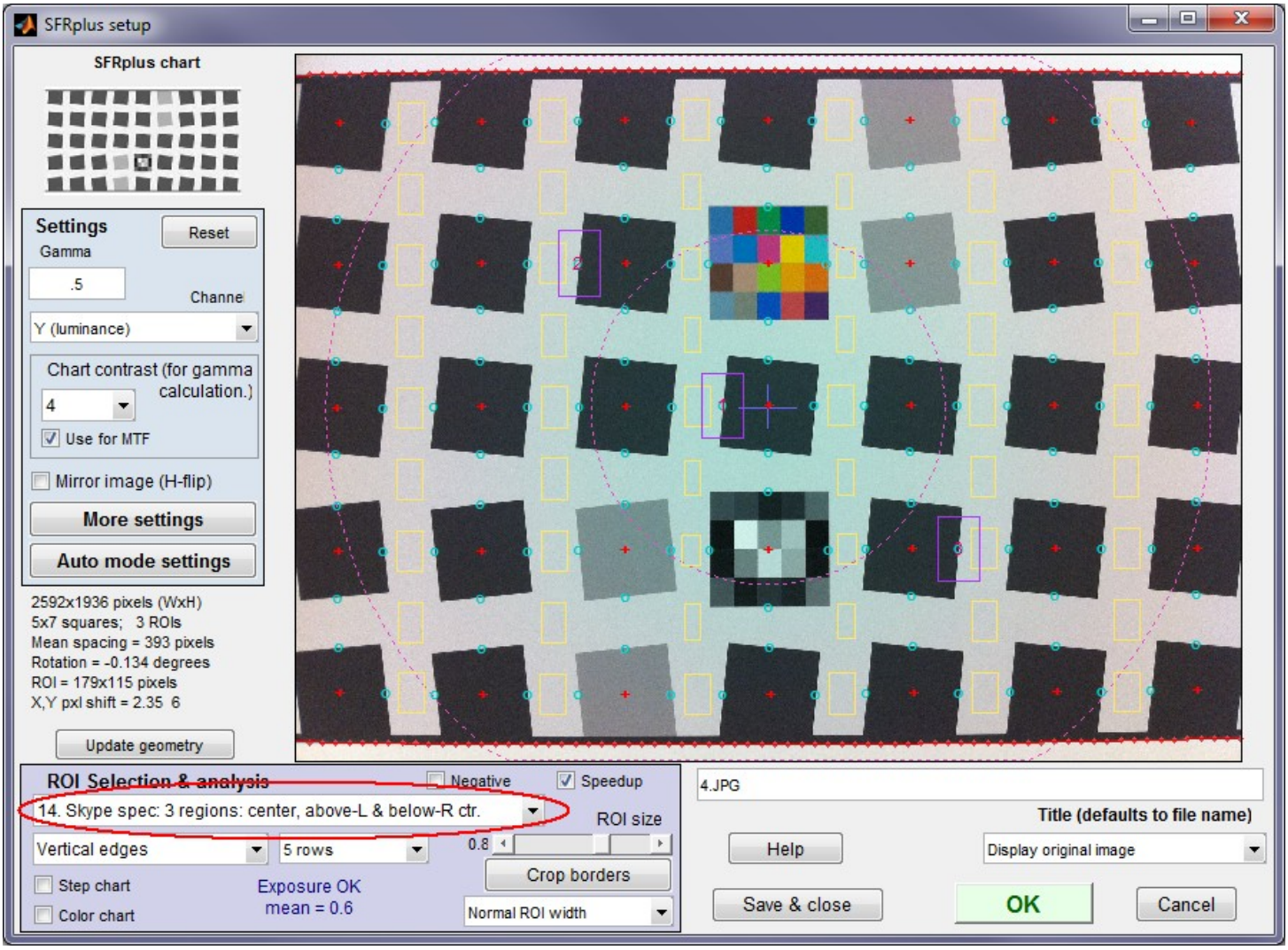
The Skype spec uses only a tiny fraction of Imatest's powerful capabilities. To learn more, see Image Quality Factors and SFRplus (which allows many factors to be measured from a single image). In addition to the GUI-based Master version, non-GUI versions— IT/EXE and IT/DLL— that can interface with manufacturing testing systems are available. Imatest also supports the Microsoft Lync Logo Video Capture Specification and the I3A CPIQ (Camera Phone Image Quality) Phase 2.0 specification.

Results of Skype tests are divided among three sections of the test specs: 2.2 Minimum requirements *(required level*), 2.3 HQV Requirements (*preferred level*; for 640×480 video resolution), and 2.4 HD Requirements (*preferred level*; for 720×1280 video resolution).

We are making a number of enhancements to Imatest 3.9 to make it easier to obtain Skype results. These will be in Imatest 3.9-Beta prior to the official 3.9 release in February or March 2012.

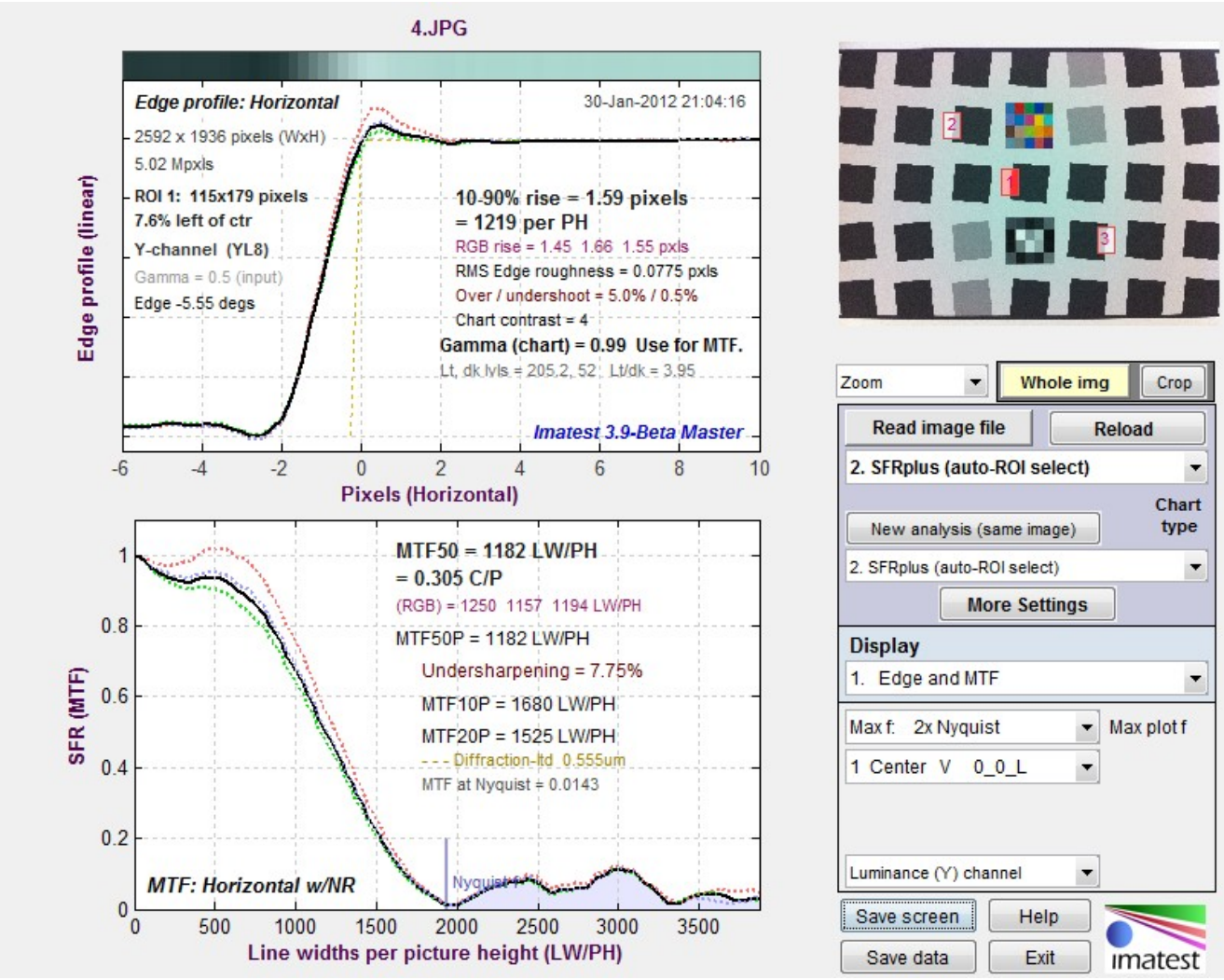
2.1.2 Acuity – MTF50 and Oversharpening, 2.1.14 Depth of field

Starting with Imatest 3.9, SFRplus has a region (ROI) selection setting that conforms to these tests.



SFRplus input settings, with Skype region (ROI) selection

MTF50 and Oversharpening ((–)undersharpening) are displayed in the Edge and MTF plot. In order to display Over/undersharpening, **Display oversharpening only** should be selected in the SFRplus More settings window (in the bottom-left of the **Settings** area).



SFRplus Edge and MTF plot, showing Under/Oversharpening and MTF50

[Modify the Multi-ROI summary to display PW50, Oversharpening, and 1st Secondary readout?]

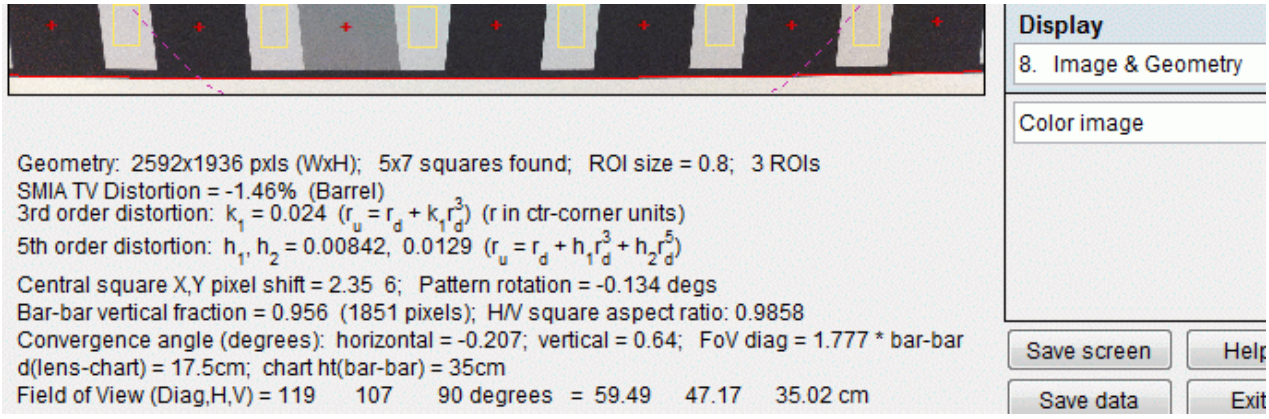
MTF50 (LW/PH) and Oversharpening (%) are written to the multi-region CSV output file, which has a name or the form *filename_extension*_multi.csv (4_JPG_multi.csv for the above example.)

29	Primary results										Secondary readout			
30	N	MTF50 (LW	R1090 (px	CA (pxl)	MTF50 (LW/PH)	R1090 (/PI	Peak MTF	MTF50P (L	MTF50P (LW/PH)	MTF10P	MTF20P	Oversharpening%	Overshoot%
31	1	1262.2932	1.5065	0.2081	1262.3	1285.1	1	1262.2932	1262.3	1960.522	1687.417	-4.85	7.07
32	2	1335.1487	1.5279	0.1756	1335.1	1267.1	1	1335.1487	1335.1	1920.386	1711.353	-6.62	8.82
33	3	1422.2788	1.2702	0.2524	1422.3	1524.2	1	1422.2788	1422.3	2213.908	1855.131	-0.39	4.7

2.2.3 (300lux 5000K) MTF50 ≥ 0.25 cycles/pixel. 2.3.3 (30 lux 3000K) MTF50 ≥ 0.33 cycles/pixel. 2.3.4 (300 lux 5000K) MTF50 ≥ 0.38 cycles/pixel. Fairly strong sharpening is usually required to meet the numbers in 2.3.3 and 2.3.4. 2.3.5 (300 lux 5000K) Oversharpening ≤ 40%. This number is associated with strong sharpening: edge artifacts ("halos") should be highly visible with Oversharpening > 40%.

2.1.3 Lens distortion – SMIA distortion

Imatest uses a different method to measure SMIA distortion, with slightly different (generally larger) results because the measure is extrapolated to represent lines whose separation is 98% of the image height. Distortion can be measured with SFRplus, Distortion, and Dot Pattern.



SFRplus Image & Geometry plot, showing SMIA TV Distortion (-1.46%)

2.3.6 (300 lux 5000K, though lighting does not matter): $|D_{SMIA}| \le 3\%$. This spec should be easy to achieve, especially since distortion can be easily corrected in software (many cameras now do this).

2.1.4 Lens distortion – Stretch distortion

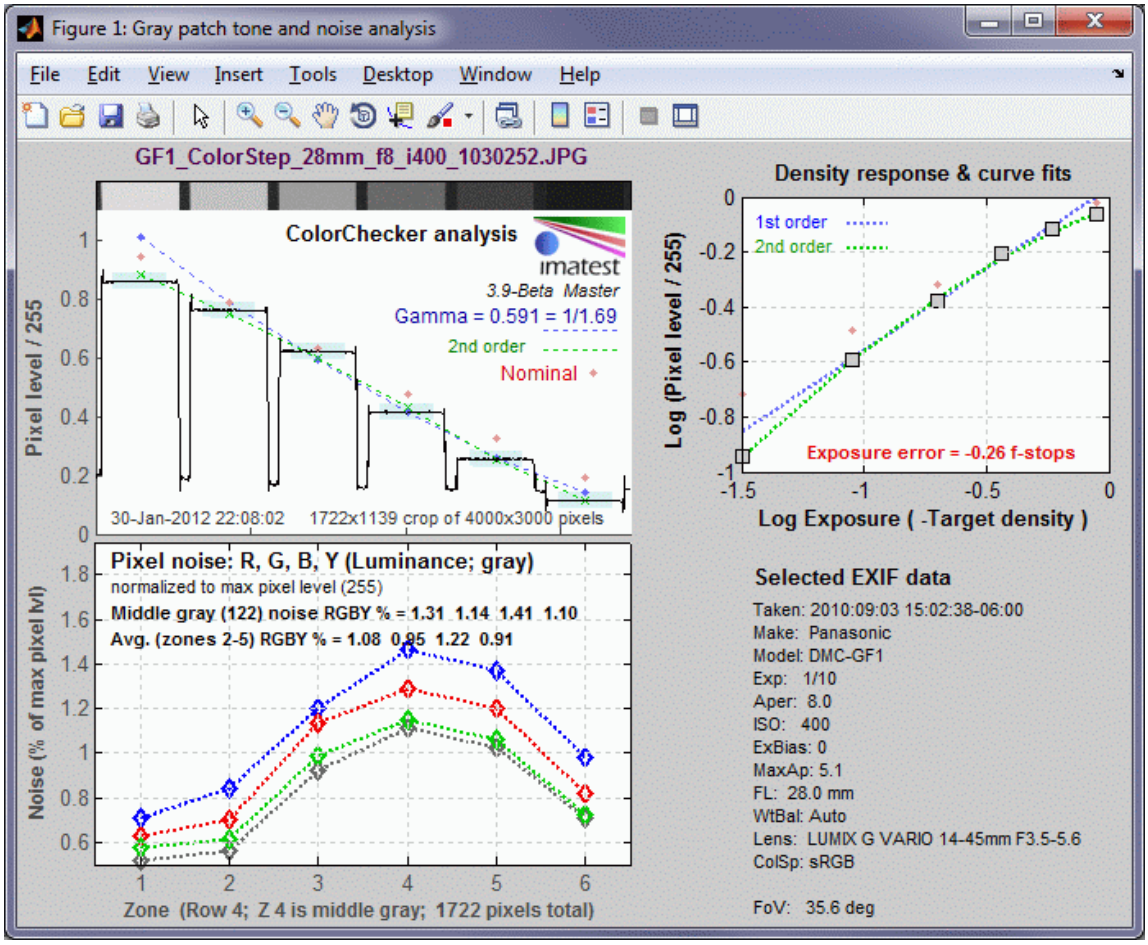
This can be derived from the Horizontal/Vertical aspect ratio, displayed (above) in the SFRplus Image & Geometry plot. Aspect ratio is $A = \Delta w/\Delta h$.

In the Skype spec, $D_{Stretch} = 100\%(w - h)/w = 100\%(1 - h/w) = 100\%(1 - 1/A)$.

2.3.7 (300 lux, 5000K, though lighting does not matter): $|D_{Stretch}| \le 5\%$. This should be easy to achieve.

2.1.5 SNR – Spatial noise deviation

SNR and related measurements can be obtained from a standard Colorcheck run using an image of an X-Rite Colorchecker.



The (normalized) pixel levels are shown in the upper-left plot, and the standard deviations σ, which are the same as noise, (in units of % of the maximum pixel level, 255) are shown on the lower-left. There are other display options: SNR could have been shown instead. All results are summarized in the CSV output file. Here are portions:

SNR 1. This table shows the mean pixel values $\bar{P}$ of the six grayscale patches, corre

Zone	**Gray**	**Pixel**	Pixel/255	Px/255 ideal	Log(exp)	Log(px/255)	WB Err Deg	WB Err Mire
19	**1**	**219.6**	0.8611	0.949	-0.05	-0.065	-399	10
20	**2**	**194.9**	0.7644	0.7882	-0.23	-0.117	-245	
21	**3**	**159**	0.6235	0.6314	-0.44	-0.205	-387	9
22	**4**	**106.1**	0.4162	0.4784	-0.7	-0.381	-358	

23	**5**	**65.3**	0.2562	0.3255	-1.05	-0.591	-453	11
24	**6**	**29.1**	0.1141	0.1922	-1.5	-0.943	-268	6

SNR 2. This table shows luminance (Y) channel noise (σ) expressed as in column M, corresponding to step 5 of the algorithm. *Multiply by* the worst value of Y-noise% multiplied by 2.55 (to get pixel level). Other co

A	B	C	D	E	F	G	H	I	J
Zone	**Gray**								
									(Zones 1-18 (Ro
19	**1**	0.689	0.839	0.773	0.953	0.216	0.262	0.242	0.298
20	**2**	0.754	0.944	0.825	1.126	0.036	0.045	0.039	0.054
21	**3**	1.238	1.522	1.322	1.607	0.051	0.062	0.054	0.066
22	**4**	1.491	1.725	1.54	1.96	0.081	0.094	0.084	0.107
23	**5**	1.37	1.607	1.418	1.833	0.124	0.145	0.128	0.165
24	**6**	0.946	1.097	0.965	1.311	0.113	0.131	0.115	0.156

SNR 3. This table shows the signal to noise ratio (S/N and SNR) ratio expressed grayscale patches. Although SNR is not one of the steps shown in the algorithm, it

S/N (signal/noise) and SNR(dB) (20*log10(signal/noise)) for the 6 gray patches. A is Average

Zone	**Gray**	**Y-S/N**	R-S/N	G-S/N	B-S/N	**Y-SNR(dB)**	R-SNR(dB)
19	**1**	**167.235**	141.119	147.581	118.668	**44.467**	42.992

20	**2**	**135.755**	110.39	123.182	89.868	**42.655**	40.859
21	**3**	**67.422**	56.386	62.43	50.993	**36.576**	35.023
22	**4**	**37.379**	32.996	35.928	27.798	**31.453**	30.369
23	**5**	**25.034**	21.961	23.977	18.135	**27.971**	26.833
24	**6**	**16.143**	14.239	15.699	11.429	**24.16**	23.069

2.3.8, 2.3.9 (30 lux 3000K and 5000K) $\sigma_{MAX} < 2.7$. **2.3.10, 2.3.11** (300 lux 3000K and 5000K): $\sigma_{MAX} < 1.7$. In the above tables, $\sigma_{MAX} = 1.113\% * 2.55 = 2.83$. This spec seems rather stringent.

2.1.6 SNR – Temporal noise

Temporal noise is measured by running Colorcheck, selecting two identical images, and indicating that this is for Temporal noise (not separate or combined analysis). A fifth figure is available for Temporal noise, and all results are written to the CSV output file. The key Skype results in the CSV output— the worst Y (luminance) channel SNR (dB) for gray patches 1-5— are shown below.

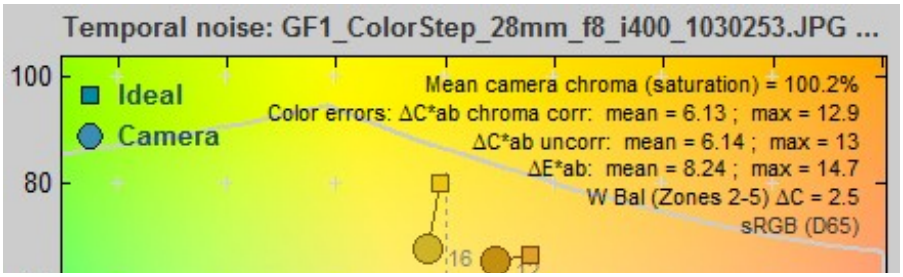
80	Temporal S/N (signal/noise) and SNR(dB) (20*log10(signal/noise)) for the 6 gray patches. A is Average of RBGY channels.											
81	Zone	Gray	Y-S/N	R-S/N	G-S/N	B-S/N	Y-SNR(dB)	R-SNR(dB)	G-SNR(dB)	B-SNR(dB)	A-S/N	A-SNR(dB)
82	19	1	180.938	143.646	160.084	124.809	45.151	43.146	44.087	41.925	152.369	43.577
83	20	2	141.874	110.066	129.061	93.409	43.038	40.833	42.216	39.408	118.602	41.374
84	21	3	69.593	56.256	64.895	52.652	36.851	35.003	36.244	34.428	60.849	35.632
85	22	4	38.337	33.111	36.909	29.511	31.672	30.399	31.343	29.4	34.467	30.704
86	23	5	25.882	21.803	24.904	18.949	28.26	26.77	27.925	25.552	22.884	27.127
87	24	6	17.398	14.75	16.923	11.909	24.81	23.376	24.57	21.518	15.245	23.568

Skype Temporal noise result: worst Y-channel SNR (db) of gray patches 1-5

2.3.12, 2.3.13 (30 lux): $SNR_{Temporal} \geq 30dB$, **2.3.14, 2.3.15** (300 lux): $SNR_{Temporal} \geq 35dB$. This spec is quite stringent.

2.1.7 Color accuracy and Saturation

These are measured with standard Colorcheck runs. In the **Colorcheck settings** window, **Color error display** should be set to **Delta-C, Delta-E (standard)**. (Note: we would have preferred



Delta-C 94 or Delta-C 00, both of which are more recent and accurate as perceptual color difference measurements.)

$\bar{C}$**r** in the Skype spec (with $\bar{}$ *above C*) is **Mean camera chroma (saturation)** in the plot.It is **Mean camera chroma %** in the CSV output file.

$\Delta C^*_{avg\text{-}abcorr}$ is on the second line (right side) of the plot. It is **Mean Delta-C sat corr** in the CSV output file.

ΔC^*_{abcorr} (patch no. 2) (light skin) is the second line below **Delta-C(corr)** in the CSV output file.

78	Zone	Delta-E*ab	Delta-C	Delta-C(corr)	Delta-E*94	Delta-C94	Delta-C94(corr)
79	1	7.35	5.62	5.63	5.67	3.11	3.12
80	2	5.72	5.72	5.72	4.26	4.25	4.25

2.1.8 Exposure accuracy

Exposure accuracy can be obtained from a standard Colorcheck run. The standard Imatest calculation (Exposure error (f-stops) in the CSV output file; displayed in all figures except a*b* color error) is slightly different from the Skype spec. The Imatest measurement uses patches 2-5 from the bottom row of the ColorChecker, while the Skype spec uses all 6 patches. The logic behind the Imatest calculation is that patch 1 is sometimes saturated ($P_1 = 255$) and is often in the highly nonlinear "shoulder" region of the response, while patch 6 is too dark to be visually significant in estimating exposure error (and on rare occasions P_i may be zero so that $\log(P_i) = -\infty$. For patch 6, common tonal response curves with nearly invisible irregularities can have a large effect on the measured results.

Additional details: P_i is the luminance channel = $0.3*R_i + 0.59*G_i + 0.11*B_i$.

2.2.4-2.2.8 (all light intensities, color temps): $-1.5 \le Err_{exp} \le 1.5$

2.1.9 Dynamic range

The Skype Dynamic range, which is quite different from other Imatest dynamic range measurements, can be measured in a standard Stepchart run with an image of the Kodak/Tiffen Q-14 test chart, which consists of 20 patches with a density increment of 0.1 (3 patches per f-stop or EV) for a total tonal range of 1.9 density units = 6.3 f-stops (EV). This is considerably less than the dynamic range of most sensors and cameras. Essentially this spec flags really bad cameras (which may have excessive lens flare, defective sensors, or poorly-designed signal processing).

The Skype Dynamic range is the number of patches where the "brightness" step between the patches is greater than 0.02* the (maximum – minimum) brightness. In Imatest 3.9+ it is written to the CSV

output file as shown below (… linear), and comparable values are written to the JSON output.

Skype Dynamic Range from the CSV output (linear is from the spec)

191	Skype Dynamic Range linear	16	(Skype spec 5.0)
192	Skype Dynamic Range log	20	(better)

We have included a logarithmic measurement because we believe that a linear measurement is far from optimum. The eye has logarithmic response, and gamma (contrast) is defined using a logarithmic curve, which is a better indicator of camera performance.

2.1.10 Capture gamma

The Skype equation (apparently) uses the first two patches in the bottom row of the ColorChecker to calculate gamma. This is not representative of the overall gamma of the image because the first two patches are typically in the "shoulder" region of the contrast curve, where the contrast is often less than the visually-significant middle tones. Imatest uses patches 2-5 to calculate gamma.

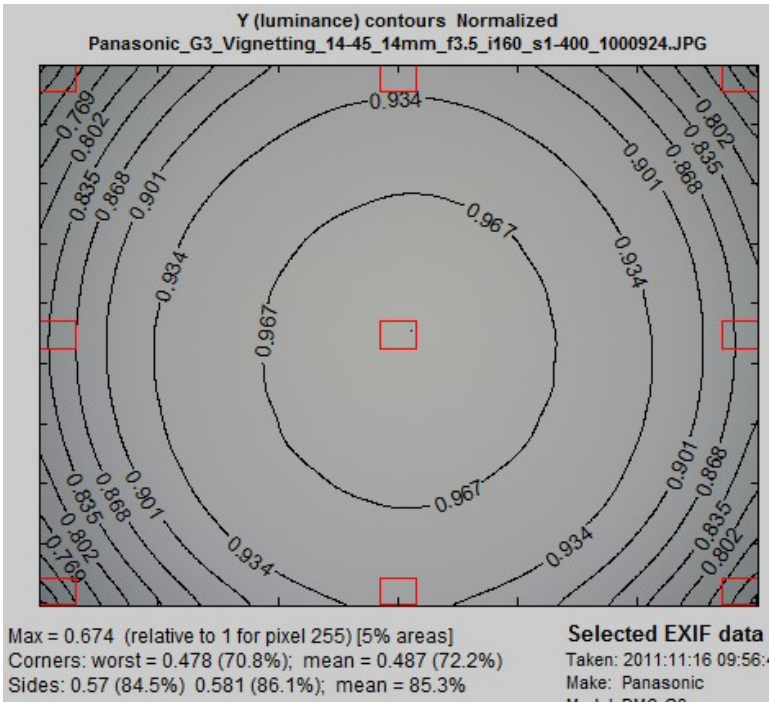
The Imatest equation for gamma, reported in Colorcheck results, is based on a first order fit to patches 2-5 of the bottom row (which should be very close to the Skype equation in the great majority of cases). It is approximately

$\gamma = \log_{10}(P_2/P_5)/(d_5-d_2)$, where P_i is defined identically to the Skype spec.

(We will be discussing this with Skype shortly.)

2.1.11 Light falloff and Color uniformity

This test is performed with Light Falloff. ***A white board (or a uniform light source) should give identical results to a gray board.*** If a reflective target (i.e., any board) is used, extreme care should be taken to obtain uniform lighting.



In the **Light Falloff (Uniformity) settings** window, select **5%** for **Corner and side regions**. **Location** should be **0% (on image border)**, though **1%** could be useful when there are shadows (that may be hard to see) next to the borders.

If you would like to see results in plots (they're also in the CSV output), select **Pixel**

contours only for **Contour plots** and
Red/Green and **Blue/Green** for **Color shading** plots. We recommend checking **Extra smoothing** (on the right of the **Color shading** area) for best plot appearance.

The Y (luminance) contours are shown in the figure on the right. Relative illumination is

$I_{rel} = P_{center}/P_{corner}(worstcase)$ = 100/(worst corner %)

where worst corner % = 70.8; hence I_{rel} = 1.412. In the CSV file (Imatest 3.9+),

The R/G and B/G ratios are shown at the bottom of the Color shading figures and in the CSV output files.

15	Worst corner level (%)	70.8			
16	Mean corner level (%)	72.2			
17	Skype relative illumination	1.412	100/Worst corner level (%)		

2.1.15 Field of view consistency

In Imatest this is measured with SFRplus (not with Colorcheck or the Colorchecker chart).

72	Relative illumination					
73	R/B	R/G	B/G	B/R	G/R	G/B
74	Minimum ratio at corners / ratio at center					
75	0.91	0.945	1.019	1.046	1.027	0.948

Please note that 2.1.12 Frame rate, 2.1.13 Delay, and 2.1.16 Video Encoding tests are not performed by Imatest.