

## Notes on color and luminance measurements on LCD monitor displays

### ***Practical observation:***

If you measure luminance values on LCD monitors on the same specific low light window and on the same specific high light window you most often observe that the absolute luminance and color values obtained with different instruments are different.

Even more astonishing - the ratio between high and low values also differs considerable.

### ***Possible reasons for measuring problems:***

A complex mix of different characteristics of the monitor displays as well as the analyzer instruments gives rise to the above mentioned observations. Important such characteristics are listed below.

1. The light intensity is much more dependent of the viewing angle for an LCD monitor than an ordinary CRT monitor.
2. The color is much more dependent of the viewing angle for an LCD monitor than an ordinary CRT monitor
3. The color and light intensity, as a function of the angle of incidence, may be different at low and high display intensities for LCD monitors.
4. The LCD monitor is normally sensitive to mechanical stress on the display screen from the color sensor. This affects intensity as well as color.
5. Ambient light is to be avoided especially when measuring at low light and especially if the sensor is kept a small distance from the screen to avoid the problem mentioned in 4.
6. LCD displays use a different type of light source than CRTs. The LCD light spectrum may contain high-energy spectral lines, which is quite a challenge for the optical filters in the measuring system. Normally these filters are optimized to handle the expected CRT type of spectrum as well as possible. Operating with a completely different spectrum may give larger errors than usually experienced with standard CRT monitors.
7. Different analyzers can have different sensitivity characteristics as a function of the angle of the incident light. Three main groups exist:
  - a) A light sensitive area is collecting light from almost  $\pm 90^\circ$  space angle in such way that the sensitivity is dependent of the angle of incidence following a cosine relation.
  - b) A light sensitive area is collecting light from a large space-angle by means of a diffuser device, which may give different kind of weighing as a function of the angle of incidence.
  - c) An optical system in front of the light sensor collects light from a narrow space angle, for instance  $1^\circ$ . This means that only light received from one specific direction is measured.

### ***Advices for color and luminance measurements on LCD displays:***

In case one wishes to get a measuring result which is consistent with the perceived color and luminance seen from one specific viewing direction the following is advisable:

- Use an analyzer with a narrow viewing angle.
- The analyzer should not mechanically touch the display.
- Keep ambient light away especially when measuring at low screen intensities.
- Be sure the LCD light spectrum is "compatible" with the filters of the analyzer.