

LightModulation, BenQ Eye-Care Monitors, BL2710 Review

Background

I have long since noticed qualitative differences between LCD computer monitors in various ways, notably problems with contrast, overly reflecting screens, eyestrain/headaches, viewing angle issues, and colour reproduction.

We were contacted at the Computer Laboratory by Adrenalin Solutions who very kindly offered a set of 'review units' of BenQ “*eye-care*” monitors to try-out and were lent a **BenQ BL2710** monitor to try-out. I am assured these review units are the same as units generally on sale.

In ***Summary*** this is an excellent core of a quality flicker-free display, though some of the extra marketed features have been less effective for my particular usage case, with usability glitches.

My detailed views are presented below.

Flicker-Free backlighting

I believe the biggest selling points of this series of monitors is that the display output is steady, free from modulation at frequencies that can cause headaches or eye-tracking difficulties.

Science has long since shown that modulating lighting and display backlight technologies have significant detrimental effects, for example see [1]. In my opinion, this is an area that seems to be a poorly publicised/understood and not well regulated in practice.

Common misunderstandings, for example, are the idea that light source ballasts are simply “low” or “high” frequency, when in fact high frequency light drivers/ballasts vary significantly in quality. For example, ref [2] the HPA identified compact fluorescent lamps as having substantial 100hz low frequency modulation envelope and noted that further research on this may be needed.

Another common misunderstanding is that 'invisible' flicker – above “flicker fusion” is not a problem, but in-fact, this can cause both headaches as per [1] and further detrimental effects on reading especially the interaction with saccades as per [3]. Seemingly keeping all modulation of significant depth significantly above 2kHz is appropriate for good quality lighting/displays.

Measuring Flicker

I have used two types of apparatus, firstly a very simple Audio amplifier with the input biased by a Light Dependent Resistor [this allows to quickly 'hear' light modulation as a sound, in the audible range], although this is not fast responding enough to pick-up particularly high frequencies.

Also, my colleagues produced, in a few variations, a much faster responding circuit, using an Si PIN photodiode, OSRAM SFM213, attached to an MCP6002 trans-impedance amplifier, connected to a portable oscilloscope, which allows a visual representation of flicker waveforms upto a much higher frequency, believed to go to approximately 1Mhz, limited by the amplifier circuit.

Upon making many observations Although neither of these are calibrated equipment, having measured many LCD monitors, I have found that :-

- This particular BenQ BL2710 “*eye-care*” monitor really does have a steady light output, regardless of the brightness/contrast settings, I have not been able to detect modulation on the light using available sensors.
- Some monitors certainly are similarly flicker-free, but finding these is a matter of trial-and-error, taking measurements, not something that can be reliably purchased!.
- Some monitors use pulse width modulating dimming backlights that introduce flicker (often

around 200hz), but only when dimmed from the maximum brightness setting.

- Monitors of apparently the same Make and Model, but of different ages/batches can have different back-light drivers!

I would hope, that BenQ stick to their promises and all monitors branded “eye-care” continue to be produced with flicker-free backlight driving technology across all units sold.

Picture Quality, et. al.

Subjective impressions are that:-

- The picture on this monitor seems to be viewable to well over 45 degrees from center in all directions, which allows plenty of flexibility and no problems when the display is rotated to use in the vertical orientation.
- The colour representation is excellent, and there is an excellent configurable pre-set system to match the colour balance to different lighting environments / user preferences
- I have not tested fast refresh rates for Gaming applications, although I would note this particular monitor is aimed at CAD usage, and other units are available for that purpose.

Eye Protect Sensor

A good idea here, is that the monitor attempts to set its' brightness to match the ambient lighting levels, providing a sensible contrast avoiding

Generally speaking this worked, but I seemed to be experiencing a bug when the monitor came out of 'sleep' states, whereupon the brightness would come back rather too bright, repeatedly. I have generally settled for manual control of the light level. I strongly suspect this is a firmware bug with 'saving and restoring' the brightness when the monitor 'goes to sleep' and this may be fixed in never versions.

I would note, that I tend to use a comparatively low lightlevel and High colour temperature lighting which may confuse a sensor that may be more attuned to 4000K classic office lighting.

Eco Sensor functionality

An idea in this monitor, is that it will “go to sleep” automatically if the user has apparently moved away from the display, in effect an 'internal' screensaver.

The documentation suggests that this is dependent on the users' clothing so may not always work, and indeed this function did not work well in my particular usage case. It may nonetheless work well for some.

Control Panel

The Control panel, involves 6 “magic” buttons, a power button and 5 white LEDs relating to onscreen menus.

The menus themselves are reasonably well organised, although a single-press button to cycle inputs might be more convenient for some users who switch between 2 display inputs regularly.

The “light-touch” buttons SOMETIMES need to be pressed really quite firmly before they will actually register – they are not actually tactile buttons, would I would much preferred to have seen on this unit.

Also, once a menu has been activated, the 5 LEDs are problematically bright, very distracting from the display, and even upon leaving the menus, these typically stay illuminated constantly until the

unit is powered off and on again. This again, ought to be able to be fixed with a firmware update.

Others

The internal speakers/audio works fine, but the bass-response is clearly limited by the small internal speakers. I did not have the need for the USB-hub functionality.

Conclusions

This is most certainly an excellent display, but a few usability glitches frustrate the experience somewhat.

I very much approve that a monitor manufacturer is taking seriously the eye strain issues caused by flickering light sources, and making an explicit statement that these monitors do not have that problem, as well as some of the other intelligent settings that can work for some users.

Certainly LED driving techniques will continue to be an varying quality issue across the light sourcing from monitors and general purpose lighting. See [5] for relevant working group in this area.

Closing

I would particularly like to thank Adrenalin Solutions for the loan and being particularly patient over this while we experimented!

Simon Iremonger
Wolfson College, and Computer Laboratory
University of Cambridge

References

- [1] "Fluorescent Lighting, Headaches and Eye-strain"
<http://www.essex.ac.uk/psychology/overlays/1989-82.pdf>
- [2] Health Protection Agency Research on Compact Fluorescent Lamps
<http://www.hpa.org.uk/NewsCentre/NationalPressReleases/2008PressReleases/081009Emissionsfromcompactfluorescentlights/>
- [3] Article on effects of Flicker over 1000hz
<http://www.essex.ac.uk/psychology/overlays/2013-207.pdf>
- [4] Interesting blog posting relates to the above.
<http://revk.www.me.uk/2009/12/flashing-lights.html>
- [5] IEEE working group on LED driving techniques
<http://grouper.ieee.org/groups/1789/public.html>