

Printing Part 7 – seeing what you’re printing on the Eizo CS2740



The Eizo CS2740 in a kitchen-table workspace, running off my MacBook Pro. The keyboard, mouse, card reader and (unseen) ImagePrint dongle are all running from the monitor USB, leaving a single-cable connection to the computer (the computer is also powered from the monitor).



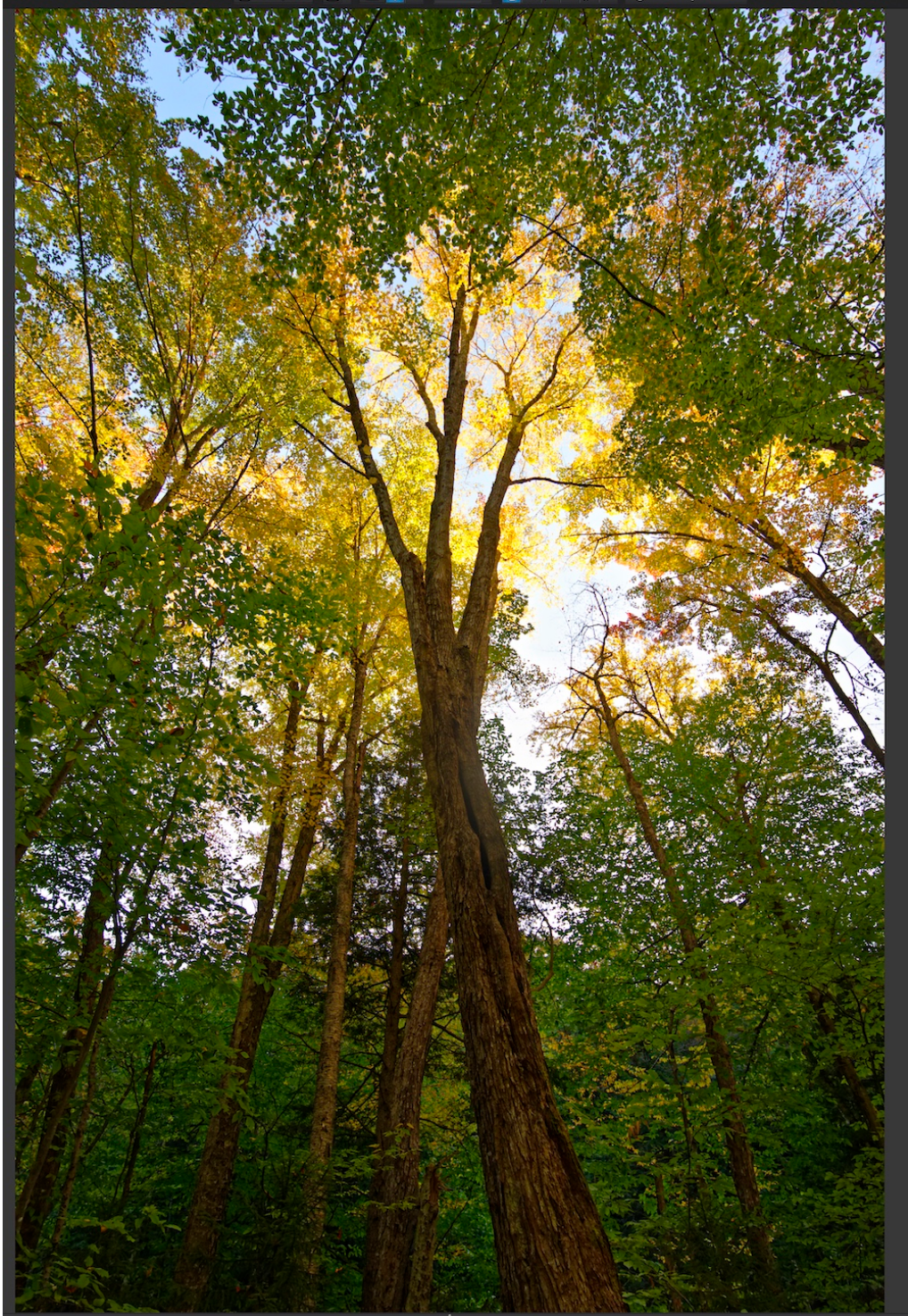
Plug in for a full workstation, pull one cable to grab and go.

One of the most important tools for photographers, especially those who like to print, is an accurate monitor. We use monitors somewhat differently from the average computer user, and the standard specifications that matter to other computer users aren't the most important

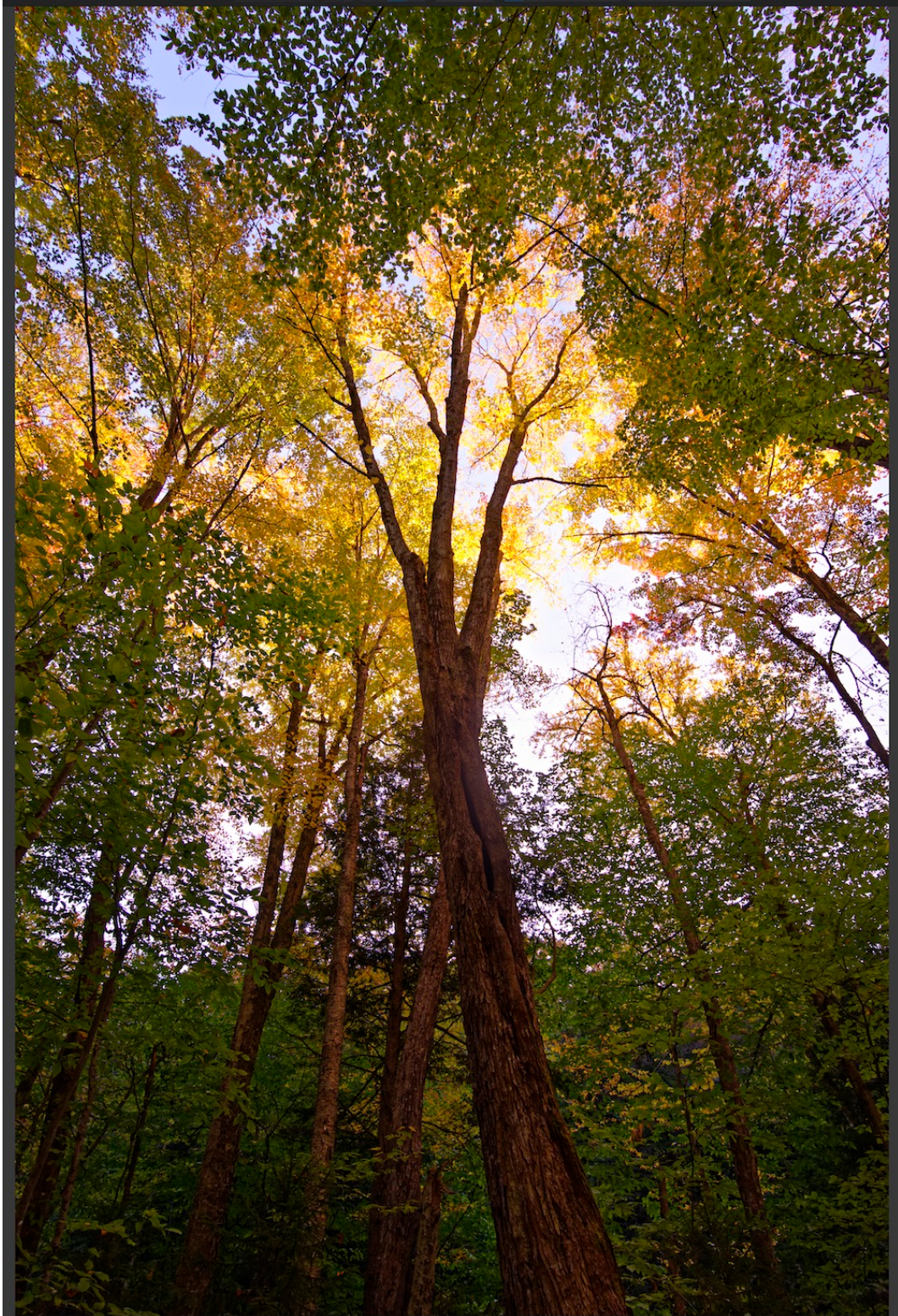
for photographers. Notably, while many monitor companies are promoting refresh rates of 90 Hz, 120 Hz and even as high as 360 Hz, anything above 60 Hz is generally wasted for still photography. Depending on your individual vision, the difference between a 30 Hz display (rare now, and the monitor itself almost certainly supports 60 Hz – a 30 Hz display is probably due to the type of connection to the computer) and a 60 Hz display can be critically important. 30 Hz displays often exhibit flicker, and some people are more sensitive to flicker than others. A really good 60 Hz display with a good backlight and a stable connection will not flicker visibly to almost anyone. Similarly, very fast response times are unnecessary for photography. Both of these highly promoted statistics are useful primarily for gaming – if you want to game and edit photographs on the same monitor, they matter, but if your whole use for a monitor is photography and standard office work, they don't (within the range of variation of modern higher-end monitors).

What DOES matter for photography is color gamut, color accuracy, stability and uniformity. Gamut refers to the range of colors a monitor can display – most standard office and gaming monitors cover the sRGB color gamut that is standard on the Web. Professional photographic monitors tend to cover the much larger Adobe RGB gamut, which is critical because most cameras any LuLa reader might have cover at least Adobe RGB, and most printers one might use for serious photo printing also cover Adobe RGB or more. If you're using an sRGB monitor to edit images you're going to print, you're able to capture and print colors you just can't see on your monitor. Many monitors, especially Apple displays, cover a similar gamut called DCI-P3 instead of Adobe RGB. It's similar to Adobe RGB, but offers more saturated reds and yellows, with less blues and greens. It was developed by Hollywood to be close to the response of cinema projectors and high-end TVs, while Adobe RGB was developed for photographers and graphic artists to match print media. For most photographic workflows, Adobe RGB is the best match – but DCI-P3 is pretty close, and much better than sRGB.

Most Windows laptops and Chromebooks offer only sRGB on their internal display (if you're lucky) – some are ludicrously bad (60-75% of sRGB). Quite a few higher-end laptops offer DCI-P3, at least on some screen options (be careful – many laptops offer both sRGB and DCI-P3 display options, and you definitely want the DCI-P3 version). Adobe RGB laptops have historically existed on the Windows side, but they are less and less common now. On the Mac side, all Apple displays in current production claim a DCI-P3 gamut. MacBook Pros and iMacs have been DCI-P3 for some time, although it's newer on the MacBook Air. Recent iPads, iPhones and even Apple Watches claim DCI-P3.



Accurate color – screenshot off my CS2740 of an edited image



Simulated – same image on a monitor that doesn't calibrate well – the gamut is the same, but there is a strong magenta cast (I artificially added the magenta here, and it's worse than my old Dell monitor).

For an external display, Adobe RGB is easy enough to find that most photographers should be looking for an Adobe RGB display rather than the somewhat more common DCI-P3. Not all Adobe RGB monitors are the same, though – and this is where the other specifications (and even more importantly, looking at the monitor) come in. I have an older Dell monitor that claims full Adobe RGB, but I cannot get it calibrated accurately. The screen never matches the print especially well. It is capable of displaying a LOT of different colors (large gamut), but it still has poor color accuracy. Most Apple displays have pretty good color accuracy, but not superb – I can print from an Apple display, but I will sometimes miss the print color by a bit. A really good professional monitor from EIZO or another top-end brand will have superb color accuracy – what you see on the calibrated display will match what comes off the printer very accurately, and the monitor can proof the effect of different papers very well.

Any high-end display should be extremely stable – you simply shouldn't be seeing flicker on a good display. If you can, look at a display for hours on end before making a buying decision – a monitor without visible flicker can still have enough to generate eyestrain in the longer term. A good display should be uniformly bright from center to corners, while a mediocre one will be much dimmer in the corners, and a lousy one will have one or more “hotspots”. Again, just because a display is Adobe RGB doesn't mean that it is stable or uniform, just like it doesn't mean that it calibrates accurately.

Until 2017, I used a mixture of Apple internal displays and random external monitors, mostly from Apple and Dell. In the winter of 2017-2018, I was printing a show of my images from the Pacific Crest Trail with the Canon Pro-2000, and I was getting very frustrated that I couldn't get the prints to match the screen. I wondered whether a really good monitor would help, and I borrowed an Eizo ColorEdge CS2730. Within a month, I had purchased that CS2730, and it would be my printing reference for the next 2 ½ years. The difference between a “standard” monitor and a professional display for printing can save you a lot of money in paper and ink.

The CS2730 calibrated beautifully, and matched what I was seeing off the printer very well. As soon as you see a monitor like this, the difference from lesser monitors is apparent. The truly professional monitor displays an extremely stable image and it calibrates (generally with its own software, which calibrates the look-up table (LUT) in the monitor itself instead of the output from the video card) quickly and accurately. There were only two problems with the CS2730 as my computer setup evolved – it didn't have USB-C input (requiring an adapter from my newer Mac, and making the monitor's USB ports inconvenient to use). It is also a “standard-resolution” display that turns off Apple's excellent scaling for desktop and text use. Since first using that CS2730, Eizo has been my preferred monitor brand, and I was excited to review the new 4K ColorEdge Cs2740.



ColorEdge CS2740

Eizo press image of the CS 2740

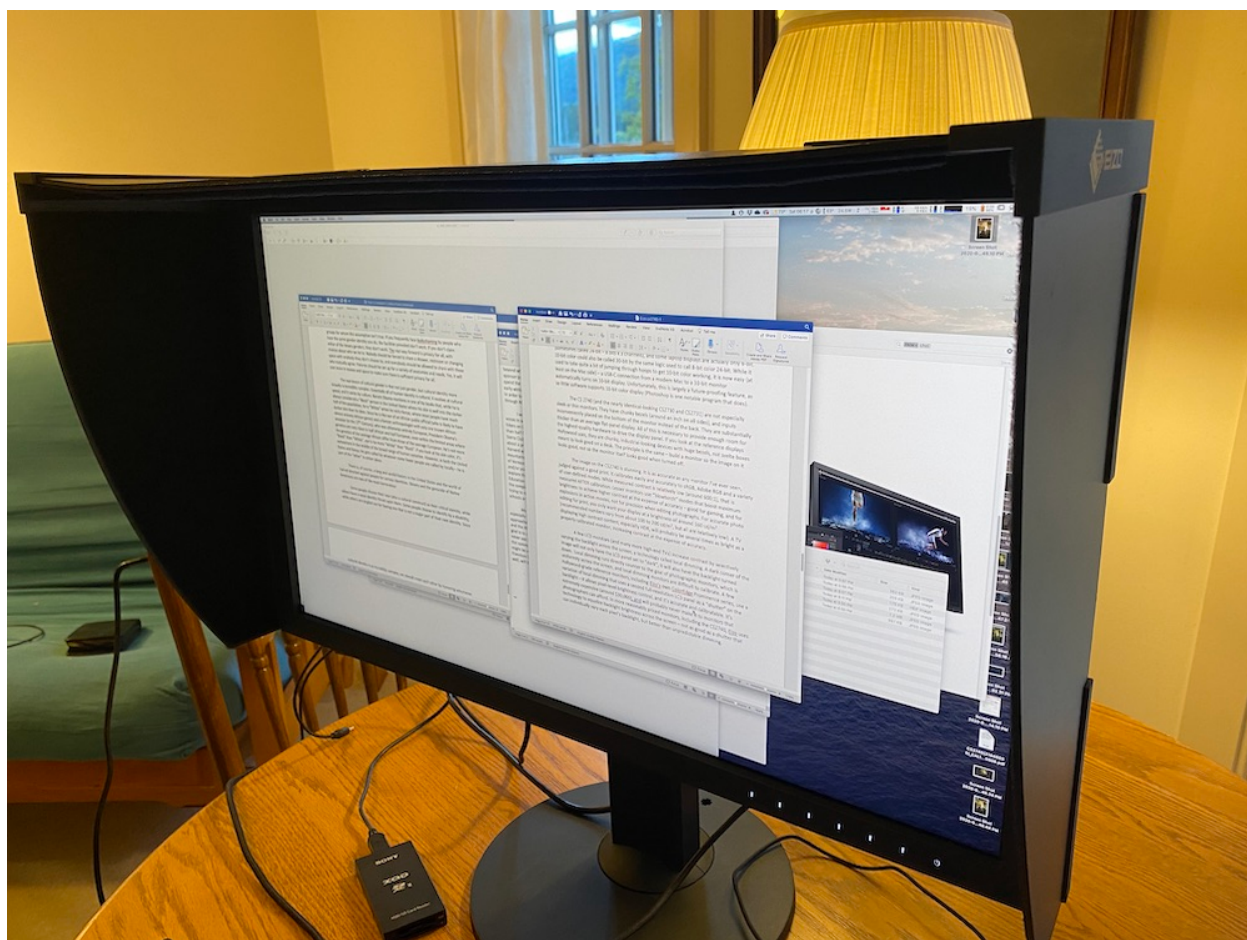
A few months ago, Eizo sent me the CS2740, the 4K successor to my CS2730, for review. While the CS2730 had DisplayPort, HDMI and DVI-D inputs, the CS2740 adds a critical input for the Mac user – USB-C. The two major differences between the CS2730 and the brand-new CS2740 are the 4K resolution and the USB-C input. Eizo also sent the CS2731, a modernized CS2730 that adds USB-C input while keeping the 2560x1440 resolution from the CS2730. Other than resolution, the two monitors are very similar (as is the CS2730).

For most Mac users, the CS2740 is the right choice, because Macs see it as a Retina display and use their best text smoothing and user interface scaling technology. It is also noticeably sharper displaying photographs, although the biggest difference the resolution makes is the very smooth scaled text which radically reduces eyestrain compared to a standard-resolution monitor. If you write (or even use text-based websites) extensively on your photo display, you want the CS2740 for the scaling alone.

Without a Windows PC easily accessible to test, I couldn't test whether the two monitors activate scaling differently on Windows, or whether that is a uniquely Mac feature. One notable use case for the CS2731 (or the CS2730, if you can still find one) is that it has a DVI-D input, which the high-resolution CS2740 lacks. DVI isn't capable of outputting a 4K signal, so it would be a confusing input on the CS2740 – probably why Eizo left it off. If you have some sort of legacy hardware that only outputs DVI, that's probably the best reason to prefer the CS2731. Unless you either absolutely need the DVI input or absolutely never intend to use the monitor for serious reading or writing, the \$400 cost difference between the CS2731 and the CS2740 is well worth it to get the Retina scaling.

Unlike most conventional monitors, when you calibrate a professional photographic display using its included software, the calibration results are stored in the monitor, not the computer. If you move the display from one computer to another, it remains calibrated. If you feed it an uncalibrated source, it remains calibrated. The calibration also takes place with much greater accuracy than conventional computer-based monitor calibration – the calibration lookup tables in a computer are 8-bit, while the Eizo monitor uses 16-bit tables to calibrate the 10-bit panel.

The CS2740 is a true 10-bit per color channel monitor, and it is easy to connect to take advantage of 10-bit color (over a billion colors). Most monitors are 8-bit per channel (sometimes called 24-bit – 8 bits x 3 channels), and some laptop displays are actually only 6-bit. 10-bit color could also be called 30-bit by the same logic used to call 8-bit color 24-bit. While it used to take quite a bit of jumping through hoops to get 10-bit color working, it is now easy (at least on the Mac side) – a USB-C connection from a modern Mac to a 10-bit monitor automatically turns on 10-bit display. Unfortunately, this is largely a future-proofing feature, as so little software supports 10-bit color display (Photoshop is one notable program that does).



With its big ol' glare hood (optional, but recommended) and chunky bezels, the CS2740 definitely has a businesslike look that is less sleek than many 2020 monitors. A bit 1970's NASA? I can almost hear legendary Flight Director Gene Kranz counting down - 10...9...8...7.

The CS 2740 (and the nearly identical-looking CS2730 and CS2731) are not especially sleek or thin monitors. They have chunky bezels (around an inch on all sides), and inputs inconveniently placed on the bottom of the monitor instead of the back. They are substantially thicker than an average flat-panel display. All of this is necessary to provide enough room for the highest-quality hardware to drive the display panel. If you look at the reference displays Hollywood uses, they are chunky, industrial-looking devices with huge bezels, not svelte boxes

meant to look good on a desk. The principle is the same – build a monitor so the image on it looks good, not so the monitor itself looks good when turned off.

The image on the CS2740 is stunning. It is as accurate as any monitor I've ever seen, judged against a good print. It calibrates easily and accurately to sRGB, Adobe RGB and a variety of user-defined modes. While measured contrast is relatively low (around 600:1), that is measured AFTER calibration. Lesser monitors use "blowtorch" modes that boost maximum brightness to achieve higher contrast at the expense of accuracy – good for gaming, and for explosions in action movies, not for precision when editing photographs. For accurate photo editing for print, you only want your display at a brightness of around 160 cd/m² (recommended numbers vary from about 100 to 200 cd/m², but all are relatively low). A TV displaying high contrast content, especially HDR, will probably be several times as bright as a properly calibrated monitor, increasing contrast at the expense of accuracy.

A few LCD monitors (and many more high-end TVs) increase contrast by selectively varying the backlight across the screen, a technology called local dimming. A dark corner of the image will not only have the LCD panel set to "dark", it will also have the backlight turned down. Local dimming runs directly counter to the goal of photographic monitors, which is uniformity across the screen, and local dimming monitors are difficult to calibrate. A few Hollywood-grade reference monitors, including Eizo's own ColorEdge Prominence series, use a variation of local dimming that uses a second full-resolution LCD panel as a "shutter" on the backlight – it allows pixel-level brightness control, and it's accurate and calibratable. It's extremely expensive (around \$30,000), and will probably never make it to monitors that photographers can afford. In more reasonably priced monitors, including the CS2740, Eizo uses technology to equalize backlight brightness across the screen – not as good as a shutter that can individually vary each pixel's backlight, but better than unpredictable dimming.

OLED displays are a different story – they can avoid lighting black pixels at all (the pixel itself generates the light, rather than having a separate backlight). They achieve a much deeper black than any LCD can manage, and they boost contrast at the black end rather than through an extremely bright or manipulated backlight. There are three problems with OLED displays, gorgeous though they are. First is that they are vulnerable to burn-in. If an image sits on an OLED for too long in the same place, it can become temporarily ghosted on the display (visible even when not being displayed). If the image sits for even longer or repeatedly, it can go from ghosting to permanent burn-in. For most TV broadcasts, this isn't a problem, although there are a few elements that can cause ghosting and burn-in – TVs left on sports events that display the score in the same place, or on news channels that always have a scrolling text box or a station logo can have trouble.

On a computer, this is a real issue – menu bars and the like are generally present in constant locations. OLED laptops are showing various levels of burn-in issues, and there are really no desktop OLED monitors available, perhaps because they haven't figured out how to solve burn-in. There are a couple of extremely high-end portable monitors, a \$30,000 reference monitor or two, and a couple of gaming monitors that are really modified 55-inch TVs. The

second issue is that OLEDs are hard to calibrate and have their own color “signature”. Standard calibration tools and software are unprepared for their characteristics, and it will probably be a few years until a usual Spyder or i1 Display unit can handle OLED as well as it does LCD.

The third issue is that an OLED really isn’t a reference for anything except another OLED – largely because there’s no print in the world, and no backlit display, that can match the black levels of a good OLED. If you get an incredibly vivid (but not all that accurate) image with absurdly deep blacks, but you can’t print it on any known combination of printer, paper and ink, what good is it? In addition to being unprintable, an OLED-optimized image can’t be displayed on any LCD monitor. The only reason to edit on OLED is if you’re also displaying on OLED – if your presentation goal for your photographs is on OLED screens. There are certainly cases, especially in commercial photography, where that’s true. I expect OLED to become a more common display medium going forward, especially in commercial and advertising settings. Landscape photography will probably remain largely in the domain of prints for a while to come, but there may be individual situations in which OLED display is a final output medium.

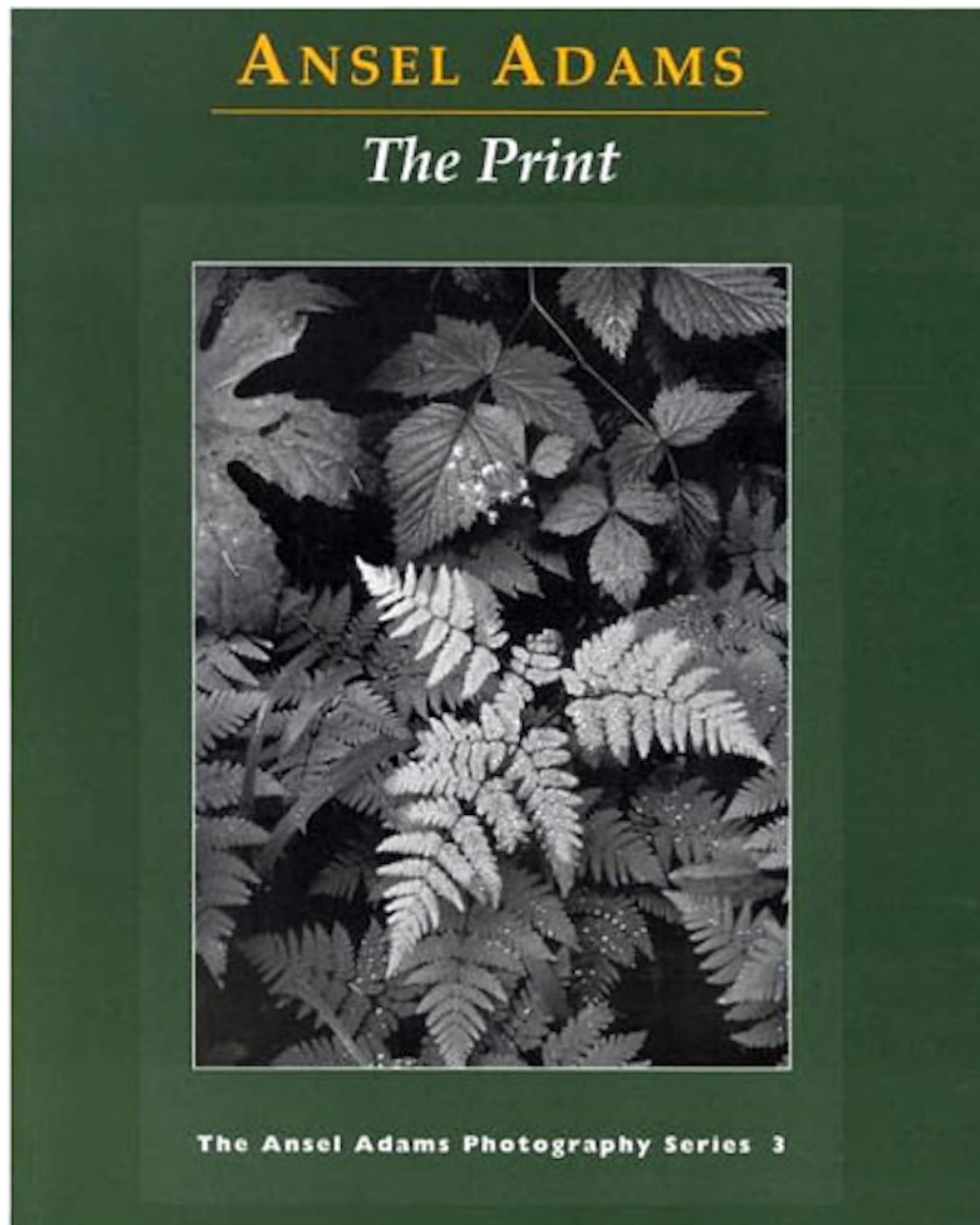
The 600:1 contrast ratio displayed by a fully calibrated CS2740 is essentially the maximum contrast a print can achieve in perfect conditions (a good glossy paper, an excellent file, one of the best current-generation inksets). In photographic terms, 600:1 translates to about 9 ¼ stops. Our cameras capture 13 stops, but our very best printing technology is only around 9 stops – the challenge in making prints is figuring out how to adjust the tones from the camera so they fit into 9 stops in an aesthetically pleasing way. A 9-stop monitor is actually a very good fit for 9-stop printing.

Prints have always been limited in around the same way – no silver-gelatin paper had a range exceeding 9 stops or so, and many of the favorites were much less than that. Color papers have historically had much narrower ranges than black and white. The current state of color inkjet printing, with its relatively wide dynamic range and gorgeous tonality, is the best tool color printmakers have ever had. Dye-transfer came close, and Ilfochrome had beautiful tones, but limited dynamic range.

Somebody is going to point out that platinum and palladium prints have very wide ranges – I looked for a number, but was unable to find one. The whole point of the Zone System and other techniques for adjusting tonal values was, and still is, to fit the range of the scene in front of the photographer, which could be anything from four or five stops (a beach on a heavily overcast day) to 20 stops or more (if the sun is in the image) first onto the range of the film (anywhere from five to eleven stops – good digital sensors have significantly wider dynamic range than any normal film), then into the five to nine stop range of the paper. Our present color technology is good enough, and offers enough control, that Zone System-like techniques now make sense in color, which was very rarely true prior to digital processes.

If you exceed the film or sensor range, there is little artistic choice – either the highlights clip to blown-out white or the shadows descend into mud. By choosing exposure, the photographer can select between those options, and there are a couple of ways to get

additional leeway – HDR merging of multiple exposures can produce a file with more than 13 stops of dynamic range. Another option is to use a graduated neutral density filter to tame the brightest highlights – easier if they're in the sky.



Still as good a reference as there is about getting the range of your scene onto the paper – we use calibrated monitors and ImagePrint instead of N- development and paper grades, but the principles remain. Platine is oddly close to late Oriental Seagull...

Once you have a raw file, potentially with 13 stops of dynamic range, and are trying to print, it's time to make creative choices to squeeze 13 stops into the 9 stop print (or, as the case may be, taking the five stop raw file up to nine stops on the paper). Both global and local adjustments contribute to getting the image onto the paper. So do things like paper choice – a

glossy paper may support nine stops, but a baryta or platine type paper may be slightly less, and any watercolor paper is a lot less. The papers with the narrowest ranges can have as little as five stops, in the case of a dreamy Japanese Washi paper like Moab Moenkopi Kozo. A standard Western watercolor paper might be closer to seven stops.

The most basic global adjustments are brightness/exposure, which moves the whole tonal range of an image, and contrast, which expands and contracts the range. Levels, curves and other controls in that family allow the photographer to control the relationships of tones in a particular part of the scale. Increasingly, we are seeing controls in the clarity/vibrance/microcontrast family, which use sophisticated image analysis to adjust tonal relationships. Most good raw converters have something in this family, which can increase local contrast without losing highlights and shadows.

Every converter also has some form of local adjustment, which creates a mask allowing adjustments of a particular area of the image – some are better than others about smart masking. To make these adjustments, you need a display that can show you accurately what the paper can print. Even if you had a display with three more stops of contrast than the paper was capable of, it wouldn't do you any good – to see the results, you'd need to reduce the display contrast anyway. A good professional display can proof any printer/paper combination, and the CS2740 is very close to that standard.

Eizo ColorEdge series displays are one of two longtime professional favorites (the other is the NEC MultiSync PA series). Eizo ColorEdge monitors have long had an excellent reputation for being stable, uniform, accurate, and Adobe RGB compliant. The first ColorEdge monitors were released as far back as 2003, when they were among the very first LCDs to aspire to top-end calibrated color, competitors to the likes of Sony Artisan and Eizo's own FlexScan CRTs. From that time, the ColorEdge series has continued to improve, although this sort of display rarely gets the headline-grabbing specifications as fast as displays that don't need the same level of consistency. Color-critical displays were the last to switch from CRT to LCD, they were the last to switch from old-style CCFL backlights to LED backlights, and they're still in the process of switching to 4K resolution and beginning to offer USB-C inputs.

As of right now, the Eizo CS2740 is a unique beast – there is no other monitor with its pedigree and performance that offers 4K resolution that a Mac will treat as Retina and USB-C input for convenience with modern Macs, at least until you get into a 32" monitor for twice the price. Its closest competitor is probably the 32" NEC MultiSync PA311D, but that is a \$3249 display, and large enough that you almost want it to be more than 4K. NEC may release a 27" 4K MultiSync PA monitor with USB-C at some point – it would certainly be a logical product.

BenQ offers the SW271, a 27", 4K, USB-C display that aspires to the same class for significantly less money. I've only seen the SW271 at trade shows, and it's an attractive display, but I couldn't tell if it had the stability, accuracy and uniformity of a good Eizo – it looked like it wasn't as stable, but driven by who knows what at PhotoPlus is not the place to judge. Reviews are generally positive, although they tend to say that the mid-priced BenQ is not as uniform in

brightness as the very best monitors from Eizo or NEC. Asus, BenQ and Dell are all trying to enter the professional display space, with varying results. I have used quite a few of Dell's UltraSharp series of supposedly color-accurate monitors, and never had one calibrate truly well. I have not used the newer models, and they have a couple with very promising specifications.

I have no experience at all with Asus' ProArt displays, which include high-end models that use sophisticated local dimming. Without the local dimming (which can be turned off), they claim similar performance to Eizo and NEC monitors. Enabling the local dimming allows true HDR – is there any cost in accuracy? The only review I could find reviewed the \$4000 32" version of the Asus monitor largely for gaming (while admitting that isn't its intended use). The 27" Asus ProArt 27UCX is nearly twice the price of the CS2740, and it is certainly on my review wish list. The HDR capability may not be useful for printing – is it really a video pro's display?

Apple has recently tried to break into the top of this class of monitors with their new Pro Display XDR. They are even positioning the Pro Display XDR in between the Eizo/NEC display market and the rarefied air of Hollywood reference monitors that cost tens of thousands of dollars. It is a 32" monitor with an extremely high 6K resolution and a very sophisticated backlight. Similarly to the Asus ProArt, it uses local dimming to enhance contrast. I have never seen a Pro Display XDR in person, but previous Apple displays have always claimed more than they really offered – the Cinema Displays (and iMac screens) have claimed membership in the Eizo/NEC class of professional displays, but never really got there, occupying a middle ground between standard office-type displays and professional displays.



Really sleek Apple Pro Display XDR - more Star Trek than 1970s NASA, but will it live up to the hype (and the price)? Also note no glare hood – Apple’s really confident in their nano-texture coating.

Is the Pro Display XDR a match for a Hollywood reference display? Is it even a match for a professional photographic display? It might well be, but it has the typical Apple “trust us” attitude. It can’t be calibrated with any standard calibration tool – it undergoes extensive factory calibration, and it has internal calibration tracking, but its backlight design foils standard calibrators. The available nano-texture screen is fragile enough that Apple recommends cleaning it only with their own dedicated cloth – how will it take calibrators rubbing on it (no matter how carefully)? Asus has made provision for typical calibrators (using their own software), despite a similar backlight design. Apple claims that there will be special calibrators “coming soon”, but as of today, the Pro Display XDR can’t be calibrated. It offers only one connection type – Thunderbolt 3 – and the only USB ports it offers to connect your keyboard, ImagePrint dongle or anything else are USB-C. It won’t even turn on if connected to anything other than a Mac (or a specific Blackmagic SDI converter) – even the rare PC with Thunderbolt 3 video won’t turn the monitor on.

Compare that to the Eizo CS2740, which offers a choice of USB-C, HDMI or DisplayPort connections, with switching between them. It is not only capable of calibration with standard tools, it encourages user calibration using the monitor's internal lookup tables for best accuracy. It offers four very convenient USB ports with stable power, as well as powering a laptop connected to the USB-C input. With a single cable, my MacBook Pro is connected to my professional display, ImagePrint dongle, keyboard, trackball, card reader and charger. It's not perfect – it's a 60 watt charger that charges the 16" MacBook Pro slowly, and won't charge at all during especially heavy workloads – but it's very convenient.

The CS2740, while expensive for a 27" monitor at \$1700 or so, is actually in the entry portion of Eizo's ColorEdge line. The next step up is the ColorEdge CG line, which feature built-in calibration sensors and slightly improved contrast. As of August, 2020, there is no 4K ColorEdge CG monitor – the CG279X is a \$2400 27" display with USB-C, but it is 2560x1440. In my view, the wrinkle with lower-resolution monitors disabling Apple's scaling technology makes the CS2740 a better choice for almost all Mac users. Eizo's ColorNavigator 7 software makes using an accessory calibration tool easy, and even the best calibrator costs much less than the price difference.



ColorEdge® **PROMINENCE CG3146**

Eizo press image of the Prominence CG3146 – the absolute top of the line. Using TWO LCD panels (the second is a shutter on the backlight), it gives OLED-like contrast with absolute color accuracy. \$30,000 or so.

If Eizo releases a 4K monitor with a built-in calibrator, it is likely to cost close to \$3000 – will the convenience and a possible modest performance difference be worth nearly twice the price? If they surprise us and release a “CG2740” in the \$2200-\$2400 price range, especially if it offers performance as well as convenience advantages, it could be very compelling. At the very top of the ColorEdge line are the ColorEdge Prominence monitors, \$30,000 Hollywood reference displays. I’ve seen them at a few tradeshow, and they are amazing things, but obviously well out of most photographers’ price range.

While the CS2740 is all about stability, it takes welcome steps into the modern age. Professional-grade displays are updated relatively infrequently, and all too often require contortions with interfaces to connect to your computer – especially if the computer prefers interfaces that are newer than the monitor. They can lack convenience features that are easily found on monitors a fraction of the price. The great thing about the Eizo CS2740 is that it offers full top-end pro-display performance without seriously compromising convenience. Its resolution is high enough that it works as intended with operating system scaling, it offers all common interfaces including USB-C with laptop charging and single-cable hub functionality, and it is a generally easy machine to live with.

If you are printing seriously without using a professional-caliber reference display, you are likely to be wasting paper and ink or getting results that are less than you could be. The Eizo CS2740 is a rock-solid reference display that also offers modern convenience features, and easily earns a **Highly Recommended** rating (the CS2731 is **Recommended**, especially if you need DVI – otherwise, the price jump to the CS2740 is worth it).

As a matter of fact, I am purchasing the loaner CS2740 from Eizo, and it is becoming my new reference for color critical printing (and my daily-use monitor for e-mail, writing and other tasks). It will be the standard against which other monitors that pass through here are judged, and it will be one of the tools I use to evaluate images from cameras and lenses. I have a good relationship with Eizo, and I get review equipment easily – but I pursued that relationship because I believe that their products are the best I’ve seen – and the CS2740 reinforces that view of the company and their products.