NEC PA322UHD 32-Inch Ultra HD Monitor Review

By Christian Eberle , MAY 10, 2015 12:00 AM

1. Introduction

We've been reviewing Ultra HD monitors from every major manufacturer for over a year. The first-gen models, all of which are still for sale, were based on IGZO technology (similar to IPS, but with a potentially more responsive pixel structure). Those screens from Dell, Sharp and Asus originally sold for $3000 and up. They've since dropped to saner prices, though. In fact, the Dell UP3214Q - still a great monitor by today's standards - can be had for well under $2000.

Today we're checking out the latest IGZO-based panel on the market, NEC's PA322UHD. It gets us back up to that $3000 level. But compared to the others, the PA322UHD offers even better performance and build quality. It's a great addition to the pro-oriented PA line of precision monitors. With a self-adjusting mode that doesn't require a computer and a wide-gamut option, professionals shopping for a jumbo Ultra HD screen may have a new top-end model to lust over.

Products	NEC PA322UHD
Pricing	
Panel Type & Backlight	IGZO / W-LED, edge array
Screen Size & Aspect Ratio	32in / 16:9
Max Resolution & Refresh	3840x2160 @ 60Hz
Native Color Depth & Gamut	10-bit w/14-bit LUT / Adobe RGB
Response Time (GTG)	10ms
Brightness	350cd/m2
Speakers	2 x 2w
Video Inputs	2 x DisplayPort, 4 x HDMI, 2 x DVI
Audio	3.5mm headphone output
USB	v3.0 - 2 x up, 3 x down

Panel Dimensions WxHxD w/base	29.3 x 18.4 x 11.9in 745 x 469 x 302mm
Panel Thickness	3.9in / 100mm
Bezel Width	.8in / 21mm
Weight	45.2lbs / 20.5kg
Warranty	Four Years

The PA322UHD is indeed based on a Sharp IGZO panel - in this case the newest wide-gamut version sporting a white LED backlight. Its main feature is a native 10-bit color depth, to which NEC adds a 14-bit 3D look-up table. This means you can use it with a native 10-bit signal and add even more color choices by means of your graphics software to create a larger palette. The gamut doesn't go beyond Adobe RGB; you simply have more shades of each color available. And if sRGB is all you need, that gamut is included too.

NEC's PA line is all about creating professional tools. Given the results from our benchmark suite, we'd take that a step further and call this screen a precision instrument. Calibration isn't necessary thanks to a factory-certified process that renders all color and white point errors below one DeltaE. That's well below the visible threshold of three DeltaE. And yes, our measurements confirm the factory's to within a very tight tolerance.

For those who like to tweak, NEC still provides a huge array of options in the OSD. There is a full color management system capable of adjusting hue, saturation and luminance for each color. Or, you can use the x and y coordinates to dial in color points precisely. Coupled with dead-perfect gamma presets and a high-resolution white balance adjustment, you only need a meter and the appropriate software to achieve fantastic results.

If you don't have the means, NEC offers SpectraView software, which works with a variety of instruments to set the PA322UHD to whatever standard you desire. And for those looking for a quick occasional touch-up, again, the monitor can calibrate itself without the use of a computer.

NEC's price is high, but so is the comprehensiveness of this screen's feature set. Is it a worthy addition to the Ultra HD monitor ranks? Let's take a look.

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2. Packaging, Physical Layout And Accessories

Product 360

The PA322UHD is massively over-built, and it comes in a carton to match. The packaging looks big enough to hold two monitors, in fact. Lots of foam protects the display, which arrives fully assembled. All you have to do is lift it out. Then again, that's easier said than done considering it weighs 45 pounds!

Included in the box are power cords for several different countries, two DisplayPort cables and a USB 3.0 connector. You also get a setup manual and a CD with a complete user's guide.

From the front, this looks like one of NEC's typical industrial-styled screens. The bezel and stand are made from hard plastic with a matte finish that won't pick up reflections. The stand is quite sturdy; it holds the heavy panel in position firmly, yet is easy to adjust. The anti-glare layer doesn't impart any grain or texture to the image. It also rejects light well, making the monitor easy to install in most indoor environments. The stand has a full range of tilt, swivel and height adjustments. Additionally, you can rotate the panel to portrait mode.

Though we've become fans of joystick and S Switch controllers, NEC uses some of the best bezel buttons in the business. When you operate them, small labels appear on the screen telling you their function. The keys click with a feel of quality and the OSD interface is intuitive. The power LED can be blue or green, and it offers adjustable brightness. To the left of the power toggle is a light sensor that can tailor screen brightness to your room's light level.

This is something we've only seen on professional presentation monitors (certain Panasonic plasmas come to mind) – a swappable input board that fits in a cavity on the PA322UHD's right side. By default, it comes with a DisplayPort input but you can also purchase two different SDI (serial-digital interface) modules for use with broadcast systems.

No effort is made to make this panel appear slim. To the contrary, it's nearly four inches thick (mainly due to the massive shielding around the panel's internals). The extra metal also helps shed heat through generous ventilation, resulting in a cool-running monitor.


At the top you can see two small handles, which are much better than grabbing the monitor by its edges. At the bottom of the upright is a small switch that locks the panel into its lowest height. That way, when you lift it off a table, it doesn't suddenly extend on the stand. We love this kind of attention to detail. Unsnapping the upright reveals a 100mm VESA mount. If you use an aftermarket bracket, be sure it's rated for the PA322UHD's 45-pound weight.

I don't think we've ever seen this many inputs on a computer monitor. There are four HDMI inputs, two DVI ports and one DisplayPort connection on the bottom-facing panel. On the left are two upstream and two downstream USB 3.0 jacks. At the extreme right is a headphone output. On the side (not shown) is an additional USB downstream port and the aforementioned option input.

With so many inputs, toggling through them can be a pain. NEC kindly sets them up to auto-sense. When you press the input button on the bezel, only those with active signals appear in the list of choices.

3. OSD Setup And Calibration
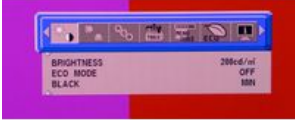
OSD Tour

The PA322UHD's OSD is vast, and some features are repeated in the main and advanced menus. To keep things efficient, we're only showing you commonly-used options and the unique calibration system.

Pressing the menu key on the front bezel brings up a small graphical interface.


The sub-menus are represented by icons along the top. The first one adjusts brightness and sets the Eco Mode, which limits the backlight to different peak levels. The Black adjuster changes the black threshold. You should leave it on Min for the greatest dynamic range.

Note that there is no contrast control. A well-engineered monitor shouldn't need one as long as it doesn't clip the brightest signals. NEC's PA322UHD does not.
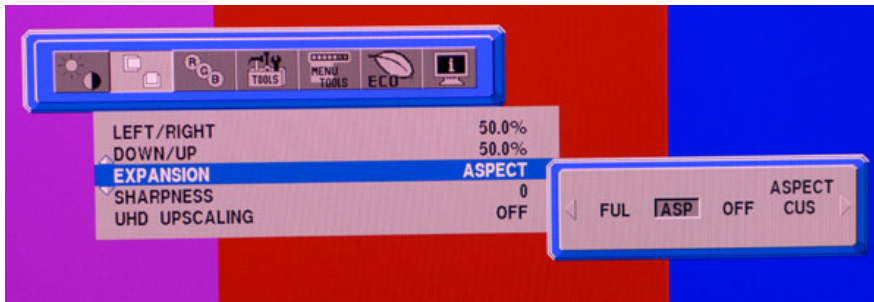
You can position windowed images, adjust the aspect ratio and dial in sharpness from this screen. We saw no evidence of edge enhancement in native-resolution signals, but the 1920x1080 patterns from our AccuPel generator showed some ringing that we couldn't remove.
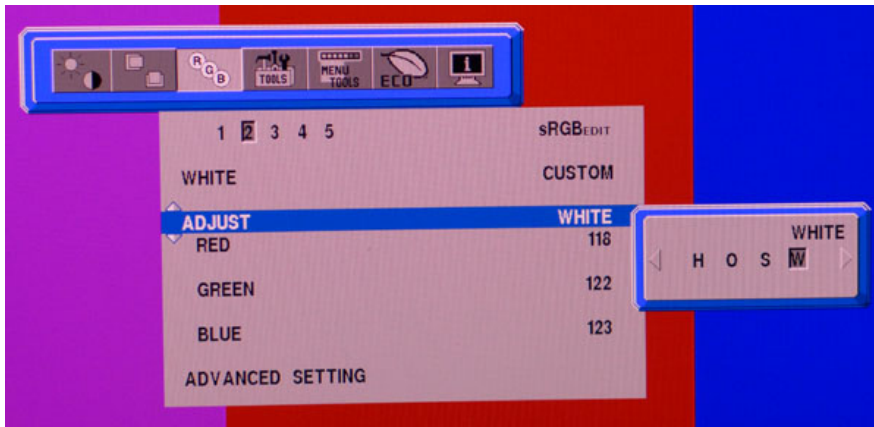
Here is the most important menu of all. At the top are five fully customizable picture modes. We concentrated on the sRGB and Adobe RGB presets, which are calibrated at the factory and include a data sheet to that effect. When you move down to the Adjust field, you can change the white point and calibrate hue, saturation and offset (luminance) for all six colors.
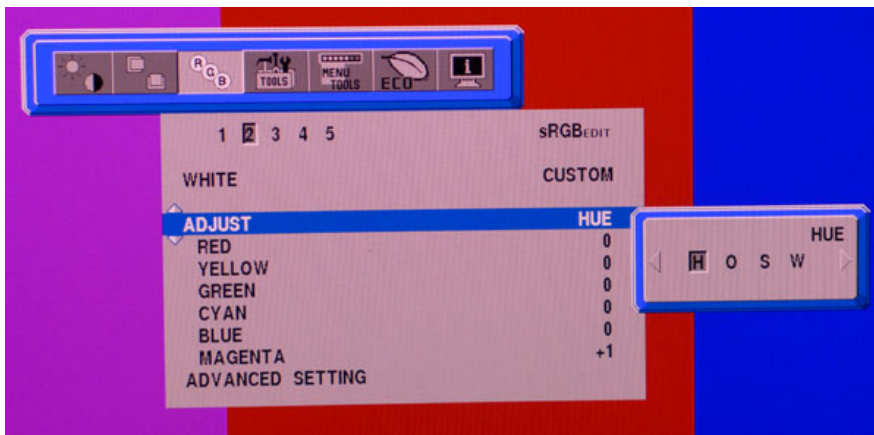
We found the color management system most effective for fixing slight luminance errors and tweaking the positions of secondary colors.

You can see that it says Advanced Setting at the bottom. Choosing this option takes you to an extensive service menu that we'll dig into below.
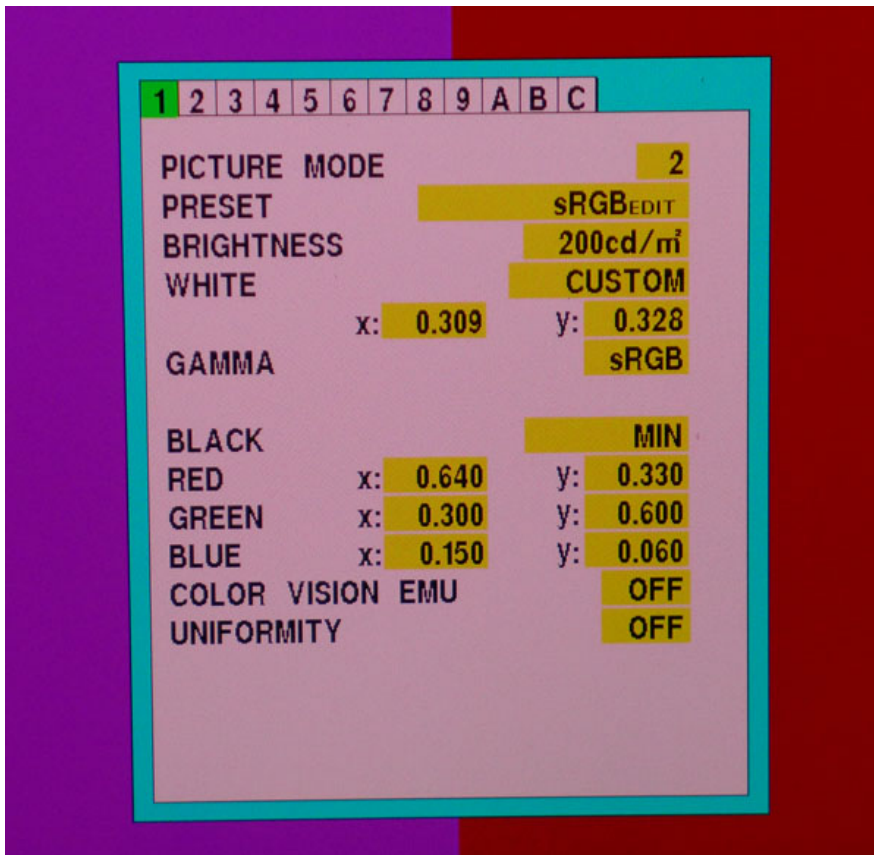
The Advanced menu has all the functions of the main OSD plus many more. As you can see, white and color points can be adjusted by entering x and y coordinates. You can also change the brightness in 1 cd/m^2 increments (that control is very accurate). At the bottom is a screen uniformity compensator. It has five levels, or it can be turned off. When you calibrate the PA322UHD, be sure to turn if off for maximum contrast, since it's on by default.
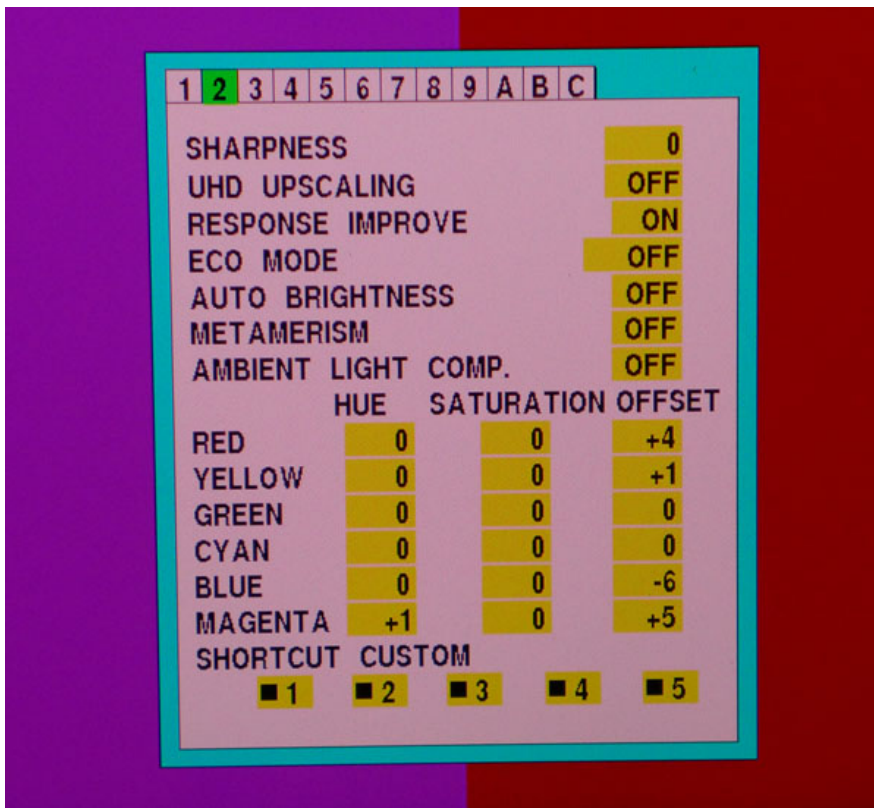
The second screen has several options, plus a repeat of the CMS. The most important one is Metamerism, a compensation for how the human eye perceives white in standard-gamut monitors. In our tests, it reduced the saturation of the blue primary significantly. This is another option that's on by default, but should be switched off for accuracy's sake.
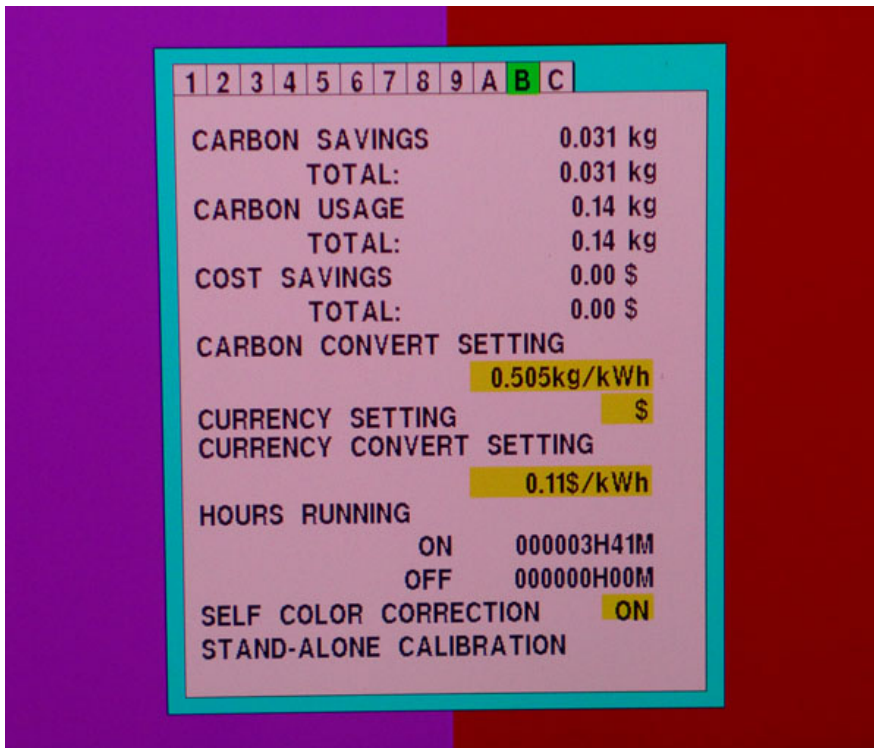
NEC is big on letting users track their power usage. If you enter the cost of your electricity in currency per kilowatt/hour, you'll know exactly what the carbon footprint of your PA322UHD is.

At the bottom of this menu is a Stand-Alone Calibration feature. You can plug in a calibrator sold separately by NEC and adjust the monitor without a computer. It works just like the **HP Z27x** we reviewed last fall. You can also calibrate with SpectraView (available separately). For more on that, check out our review of the **NEC PA272W.**
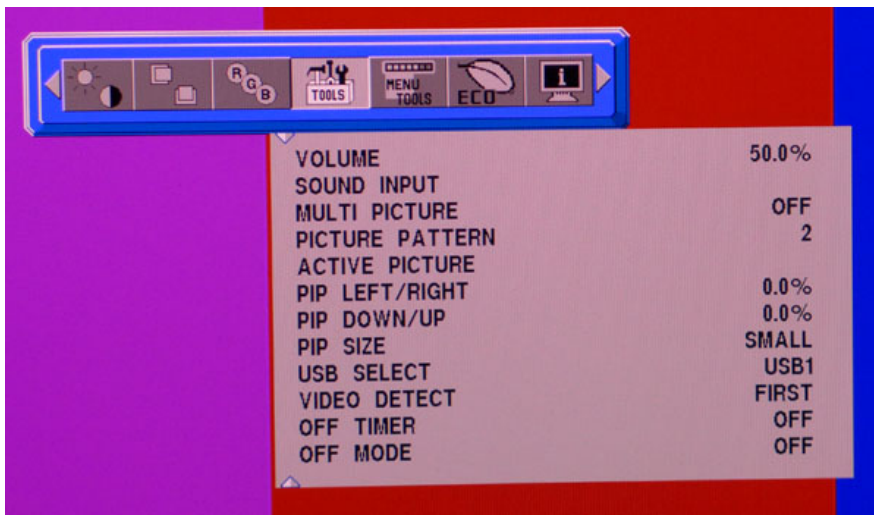
Returning to the main OSD, the above screen adjusts audio options, Multi-Picture, PIP, USB port selection, input signal detection and the off timer. Audio signals can be carried over both HDMI and DisplayPort, and played through the internal speakers or headphone output.

The Multi-Picture function (PIP and PBP) is extremely flexible. You can display up to four signals in both landscape and portrait orientations. In portrait mode, they stack from top to bottom. No other monitor we know of does this.
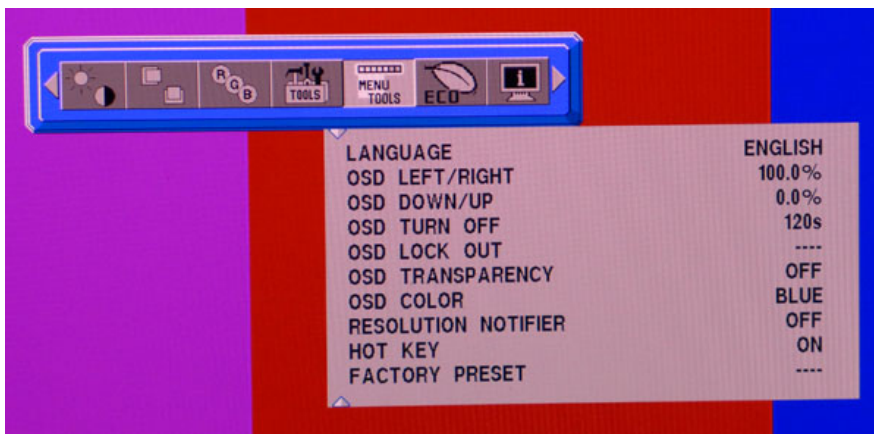
The OSD is available in nine languages and can be moved around the screen or locked out in three different ways. One removes it completely from user intervention. The second mode enables just brightness and volume controls. Finally, you can set custom options in the Advanced OSD. Given the system's complexity, this is a good thing.
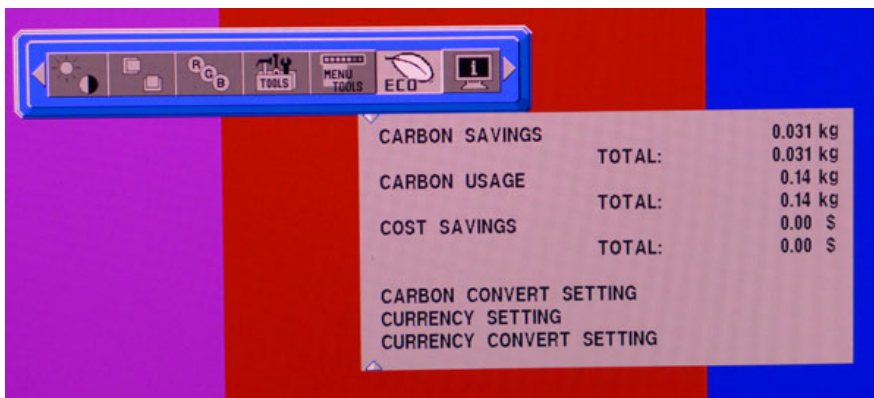
Here's where you can view the carbon footprint and energy cost information after you set parameters in the Advanced menu.
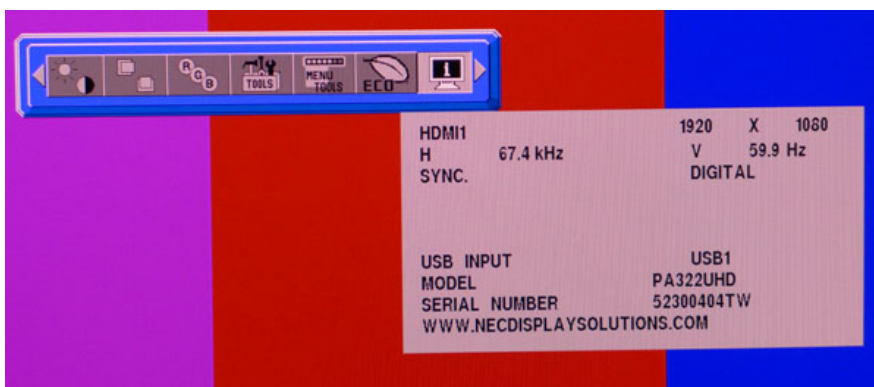
The final sub-menu contains signal information, USB port status and the monitor's serial number.

Calibration

There are three ways to calibrate the PA322UHD: SpectraView software, self-calibration with NEC's i1 Display2-based instrument and traditional OSD adjustments. We chose the latter.

The sRGB and Adobe RGB modes are factory-certified, and we found them to be quite accurate out of the box. Since the ability is there, we used the OSD and Advanced menus to achieve even higher accuracy. The RGB sub-menu has adjustments for white balance plus a full color management system. The controls offer extremely fine resolution and do not interact, making calibration easy and precise. Whether you calibrate or not, it's important to visit the Advanced menu and turn off the Metamerism option. You'll see why on page six. Also, turn off the uniformity compensation for maximum contrast.

Please feel free to try our settings. To make the tables less confusing, we omit the options that were left unchanged.

NEC PA322UHD Calibration Settings - Adobe RGB Mode	
Brightness	200
White Balance	Red 131, Green 135, Blue 136
Offset	Red +3, Yellow +1, Green +1 Cyan +1, Blue -6, Magenta +1
Metamerism	Off
NEC PA322UHD Calibration Settings - sRGB Mode	
Brightness	200
White Balance	Red 118, Green 122, Blue 123
Hue	Magenta +1, All Others 0
Offset	Red +4, Yellow +1, Green 0 Cyan 0, Blue -6, Magenta +5
Metamerism	Off
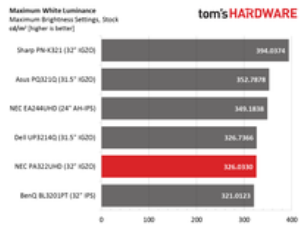
4. Brightness And Contrast

To read about our monitor tests in-depth, please check out Display Testing Explained: How We Test Monitors and TVs. Brightness and Contrast testing is covered on page two.

Asus PQ321Q	**BenQ BL3201PT**	**Dell UP3214Q**	**NEC EA244UHD**	**Sharp PN-K321**

Uncalibrated – Maximum Backlight Level

Today's comparison group includes all previously-reviewed IGZO screens: Asus' PQ321Q, Sharp's PN-K321 and Dell's UP3214Q. We also have NEC's EA244UHD, one of the most accurate screens ever tested on Tom's Hardware. Rounding out the group is a value-oriented entry, BenQ's BL3201PT, the least-expensive 32-inch UHD monitor available.

Maximum White Luminance
Maximum Brightness Settings, Stock
cd/m² [higher is better]

Monitor	Value
Sharp PN-K321 (32" IGZO)	394.0374
Asus PQ321Q (31.5" IGZO)	352.7878
NEC EA244UHD (24" AH-IPS)	349.1838
Dell UP3214Q (31.5" IGZO)	326.7366
NEC PA322UHD (32" IGZO)	326.0330
BenQ BL3201PT (32" IPS)	321.0123

Axis: 0 — 100 — 200 — 300 — 400
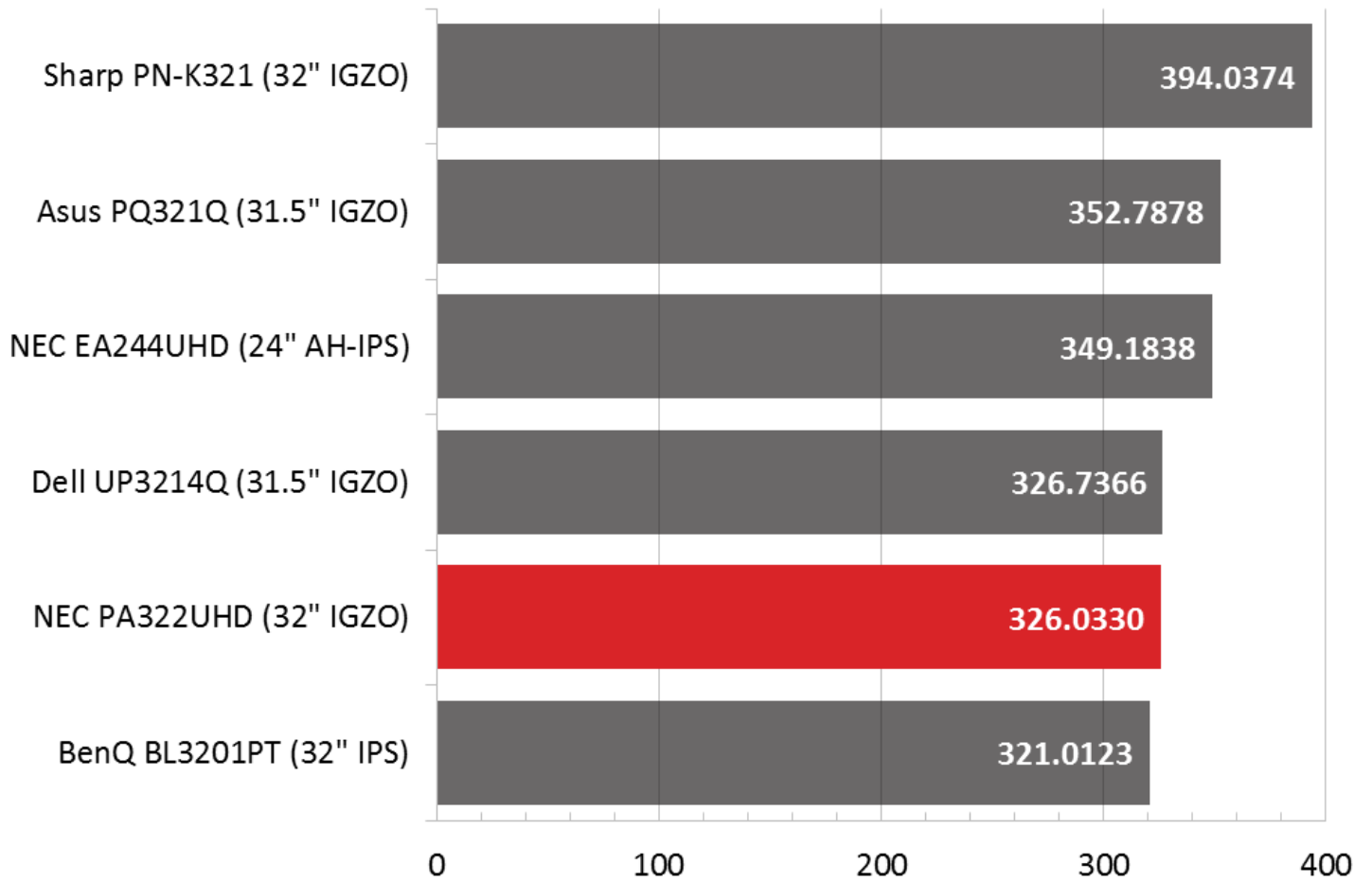
NEC rates the PA322UHD at 350cd/m². It almost gets there in the High Bright mode. If you choose sRGB or Adobe RGB, the monitor tops out around 317cd/m². Though it lands in fifth place, all of these monitors are plenty bright for any application.

Maximum Black Luminance
Maximum Brightness Settings, Stock
cd/m² [lower is better]

tom's **HARDWARE**

Monitor	Value
NEC PA322UHD (32" IGZO)	0.3078
Dell UP3214Q (31.5" IGZO)	0.3253
BenQ BL3201PT (32" IPS)	0.3978
NEC EA244UHD (24" AH-IPS)	0.3990
Sharp PN-K321 (32" IGZO)	0.4874
Asus PQ321Q (31.5" IGZO)	0.5088

0.00   0.10   0.20   0.30   0.40   0.50   0.60
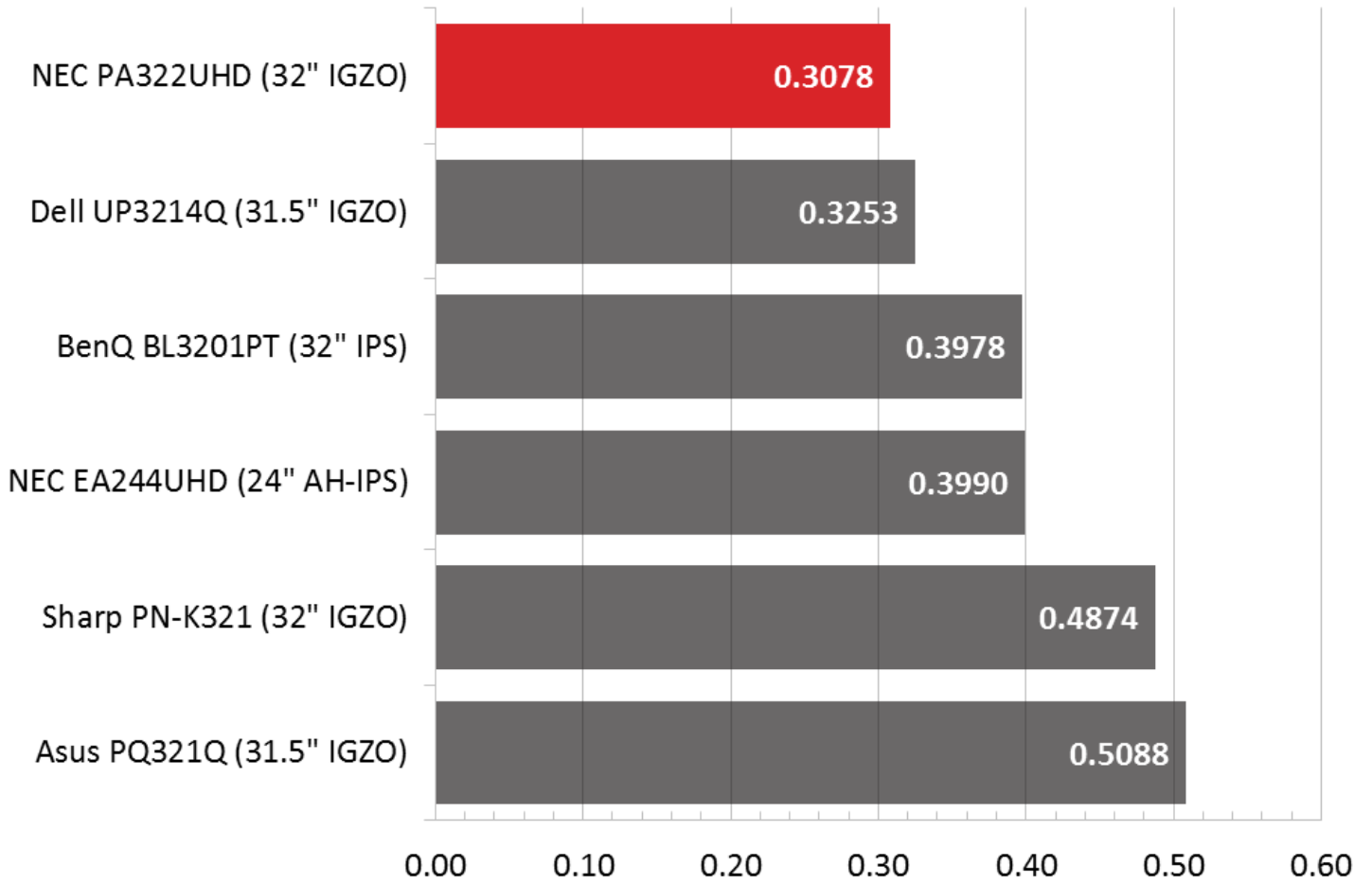
We're happy to see a low black level from an IGZO-based monitor. Previously, only Dell delivered decent contrast. NEC's effort results in a .3078 cd/m² max value.

Maximum Contrast Ratio
Maximum Brightness Settings, Stock
Contrast Ratio [higher is better]

Monitor	Contrast Ratio
NEC PA322UHD (32" IGZO)	1059.2
Dell UP3214Q (31.5" IGZO)	1004.4
NEC EA244UHD (24" AH-IPS)	875.2
Sharp PN-K321 (32" IGZO)	808.5
BenQ BL3201PT (32" IPS)	807.3
Asus PQ321Q (31.5" IGZO)	693.3
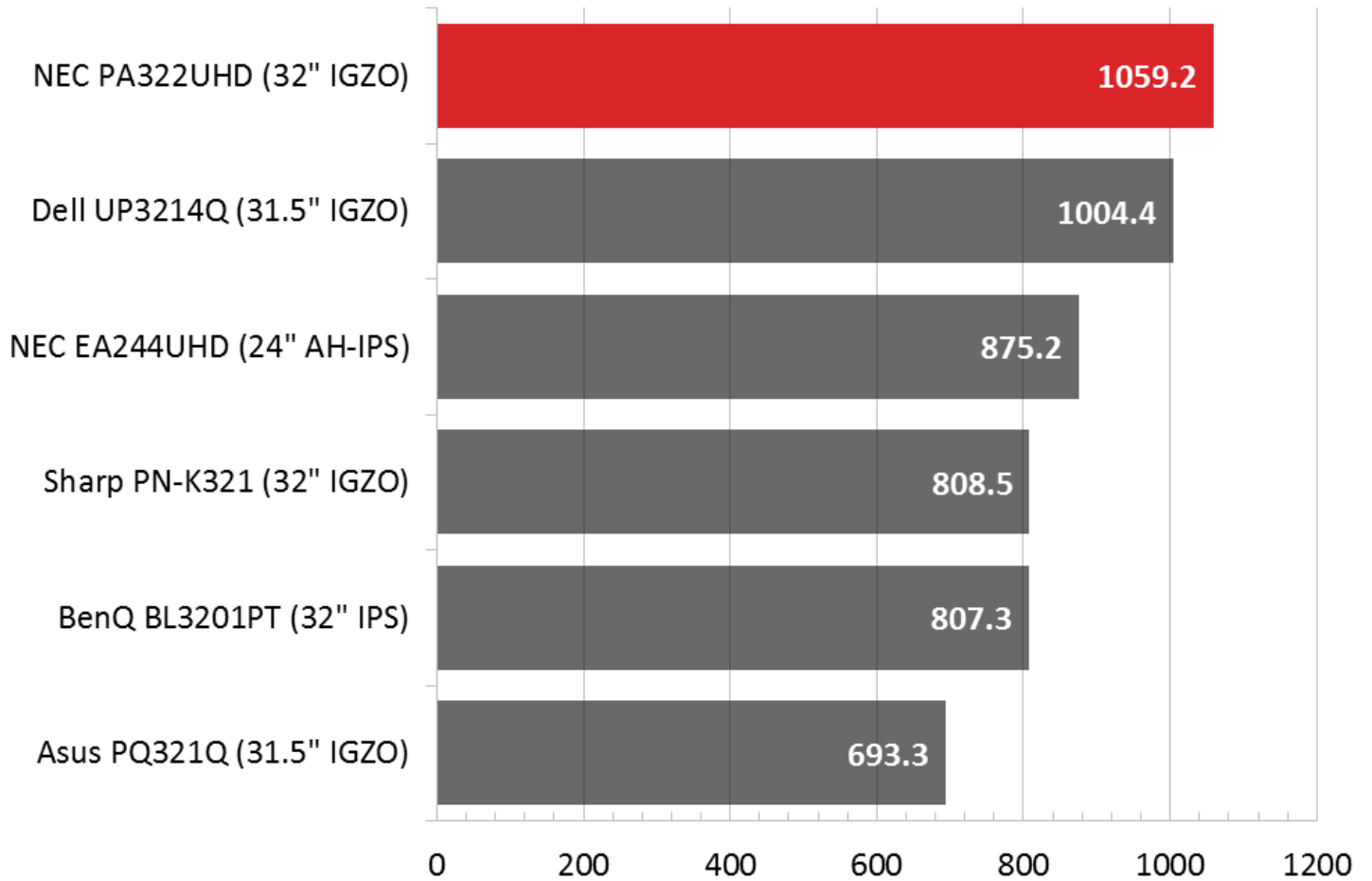
NEC's PA322UHD takes the crown as the highest-contrast Ultra HD screen we've tested. To achieve this, you have to forgo uniformity compensation. We'll have more on that below.

Uncalibrated – Minimum Backlight Level

Minimum White Luminance
Minimum Brightness Settings, Stock
cd/m² [closest to 50 is better]

Monitor	Value
BenQ BL3201PT (32" IPS)	56.5451
Sharp PN-K321 (32" IGZO)	56.1158
Asus PQ321Q (31.5" IGZO)	49.7378
Dell UP3214Q (31.5" IGZO)	33.6211
NEC PA322UHD (32" IGZO)	20.3144
NEC EA244UHD (24" AH-IPS)	20.2799

0　　　　　20　　　　　40　　　　　60
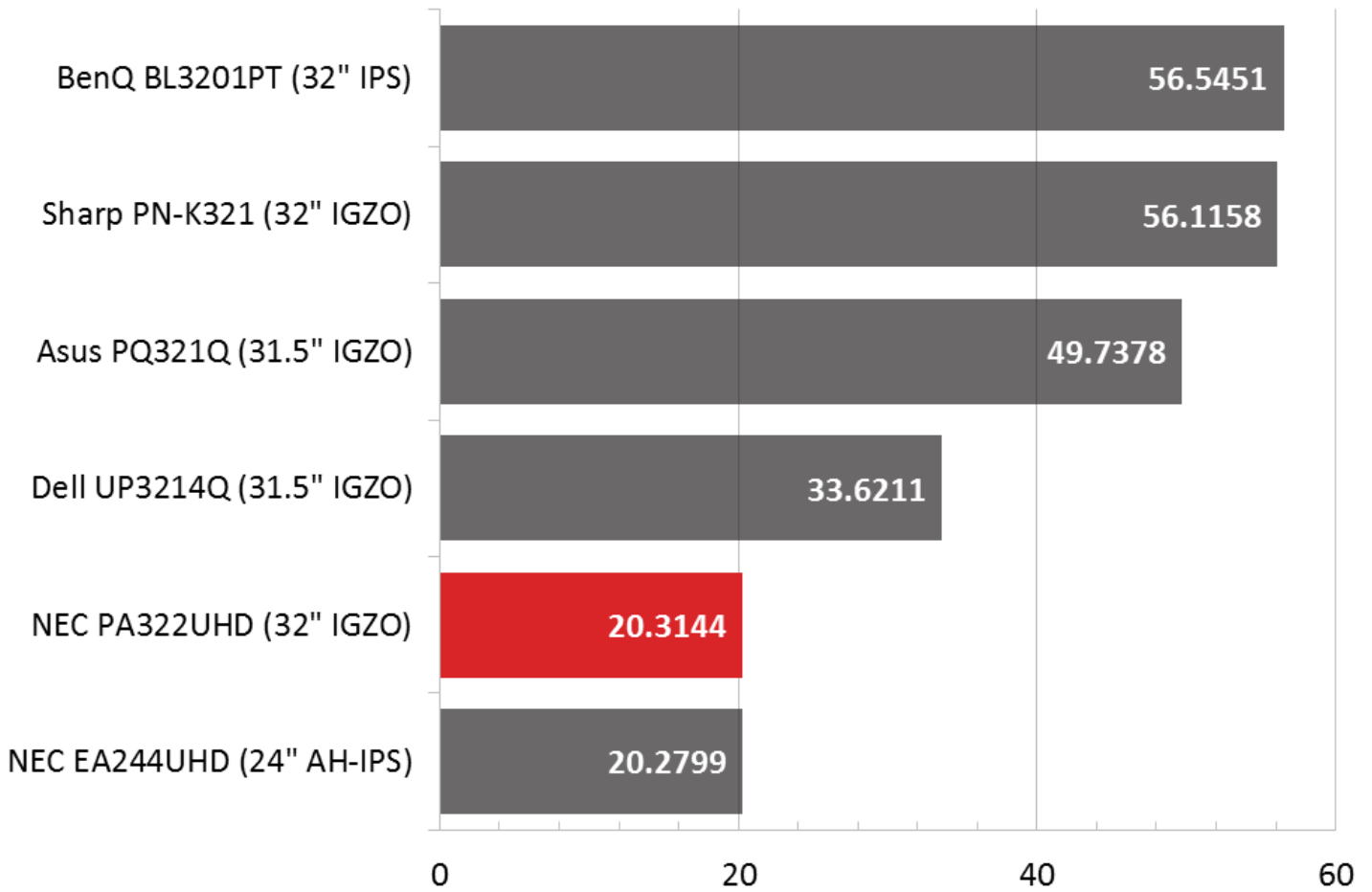
NEC typically specifies its monitors to a low brightness level at the minimum backlight setting. An image that dim is not terribly useful in our opinion. Fortunately, the brightness control is ticked in 1 cd/m² steps, which match our measurements. For example, to set 50 cd/m², move the slider to 50.

Minimum Black Luminance
Minimum Brightness Settings, Stock
cd/m² [lower is better]

Monitor	Value
NEC PA322UHD (32" IGZO)	0.0220
NEC EA244UHD (24" AH-IPS)	0.0241
Dell UP3214Q (31.5" IGZO)	0.0346
Sharp PN-K321 (32" IGZO)	0.0705
BenQ BL3201PT (32" IPS)	0.0708
Asus PQ321Q (31.5" IGZO)	0.0729

0.00   0.02   0.04   0.06   0.08
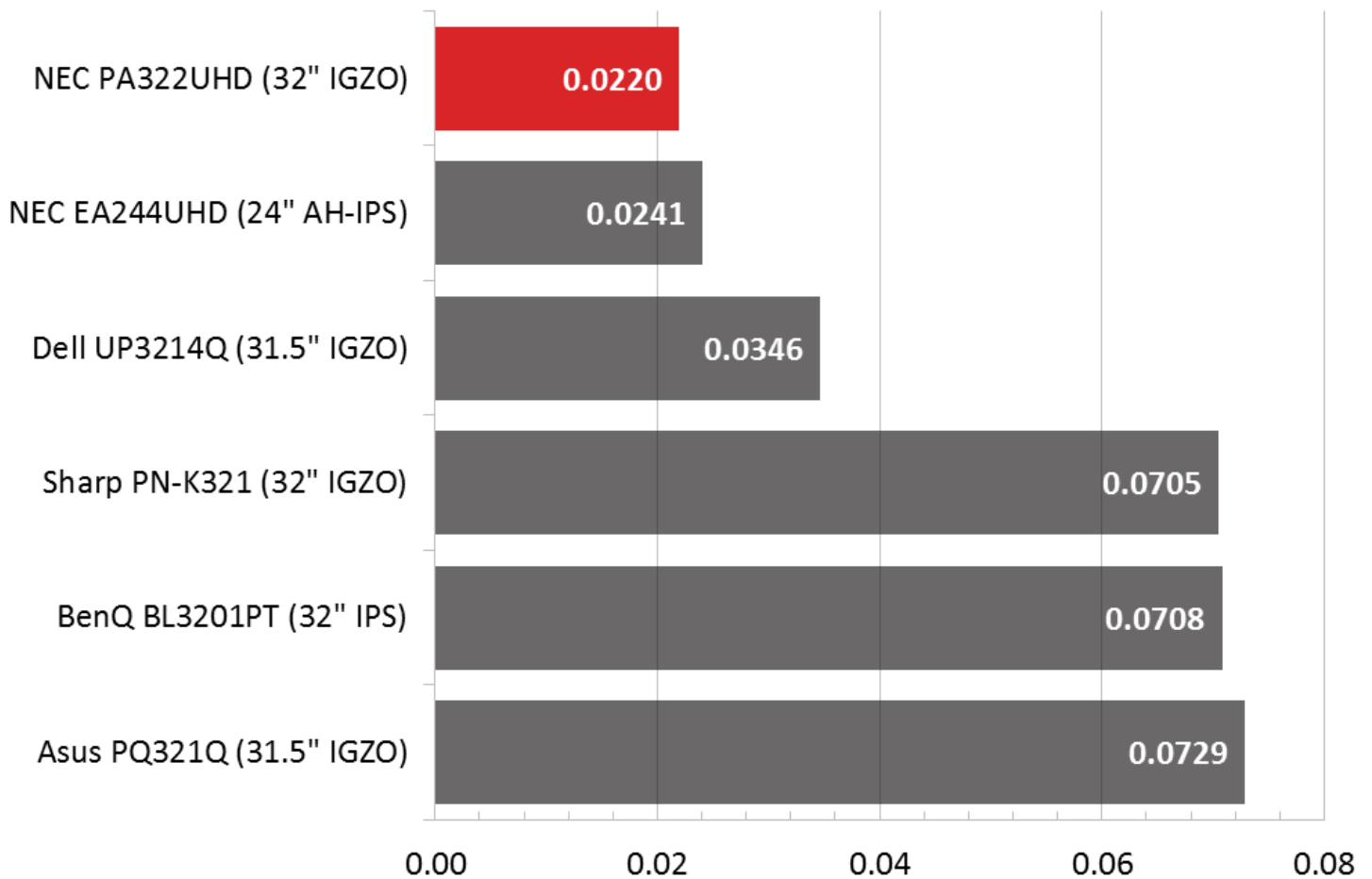
Of course, the minimum black level is extremely low as well. While this test result is impressive, it's not really practical. It's a good thing the PA322UHD has great contrast at all backlight levels.

Minimum Contrast Ratio
Minimum Brightness Settings, Stock
Contrast Ratio [higher is better]

Monitor	Contrast Ratio
Dell UP3214Q (31.5" IGZO)	972.9
NEC PA322UHD (32" IGZO)	924.4
NEC EA244UHD (24" AH-IPS)	841.8
BenQ BL3201PT (32" IPS)	798.8
Sharp PN-K321 (32" IGZO)	796.1
Asus PQ321Q (31.5" IGZO)	682.3
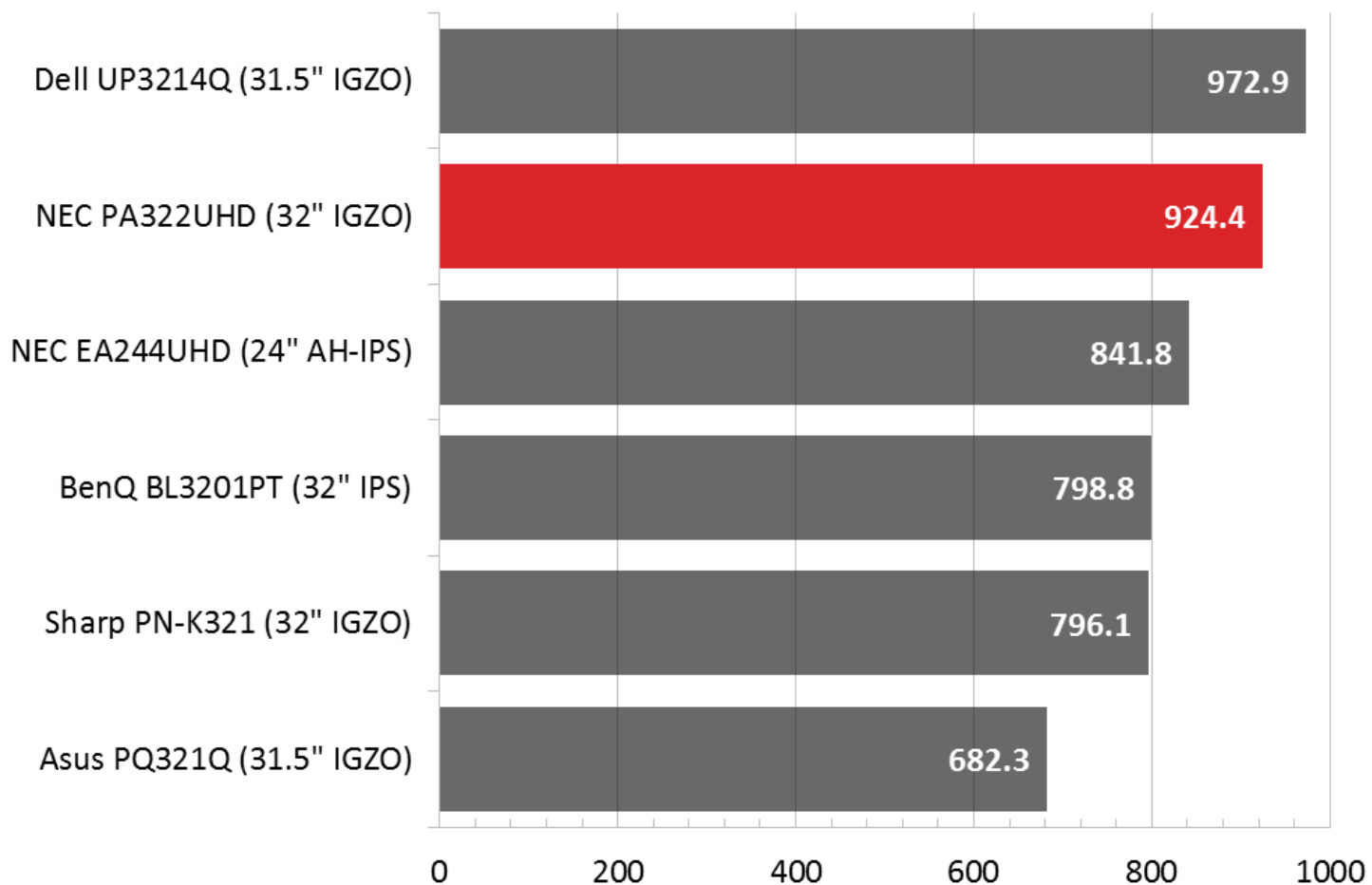
Minimum contrast takes a 12-percent hit when you turn the backlight down all the way. If you set it to our recommended level of 50 cd/m^2, the contrast ratio rises to 1023:1.

After Calibration to 200cd/m^2

Black Luminance
Calibrated to 200 cd/m^2
cd/m^2 [lower is better]

Monitor	Value
Dell UP3214Q (31.5" IGZO)	0.2000
NEC PA322UHD (UC OFF)	0.2001
NEC EA244UHD (24" AH-IPS)	0.2537
BenQ BL3201PT (32" IPS)	0.2538
NEC PA322UHD (UC ON)	0.2663
Asus PQ321Q (31.5" IGZO)	0.2856
Sharp PN-K321 (32" IGZO)	0.2872

0.00   0.05   0.10   0.15   0.20   0.25   0.30
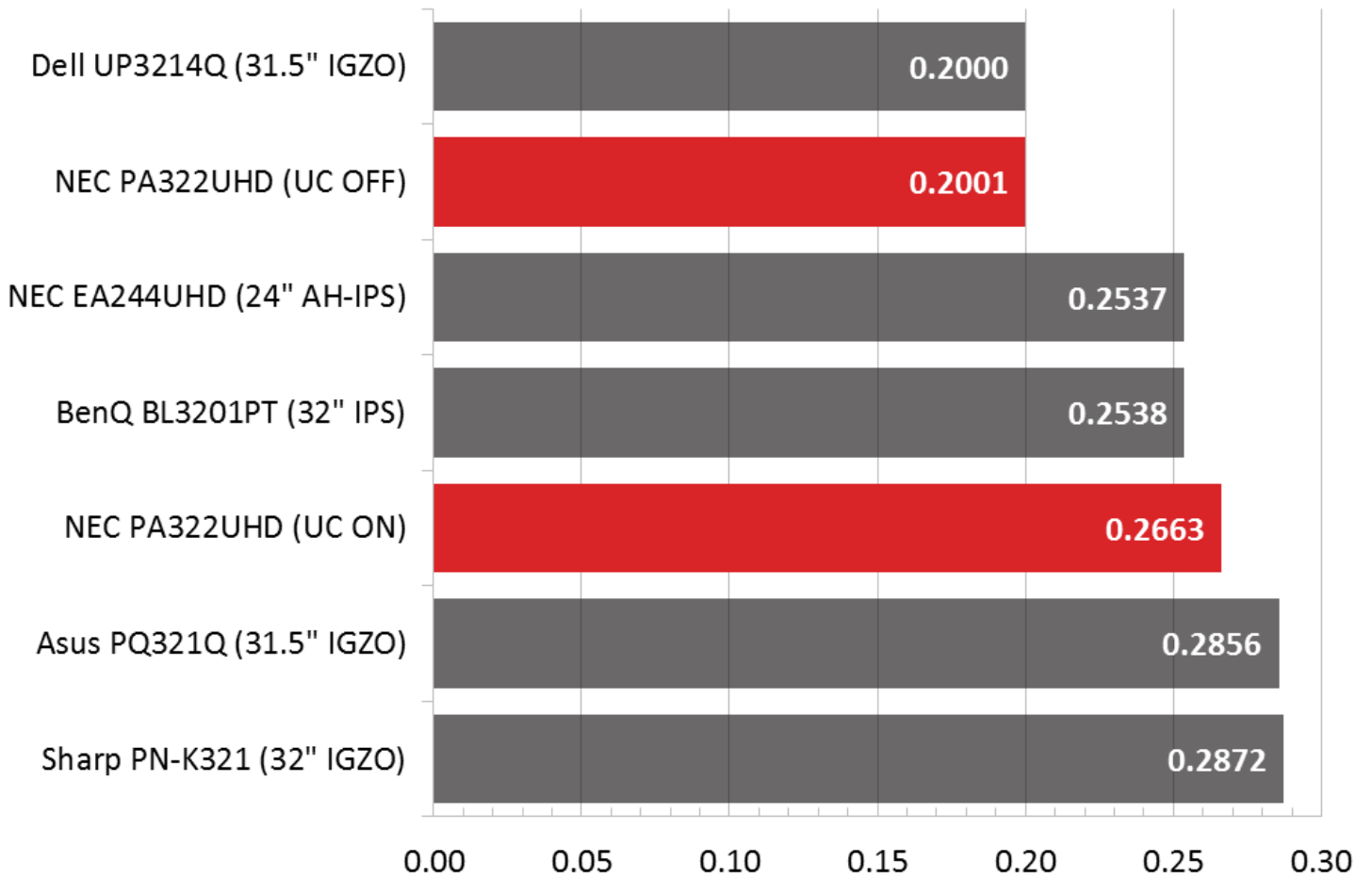
This is where we see the effects of uniformity compensation. Turning it to the highest level raises black luminance by almost 25 percent. NEC still beats the Sharp and Asus screens, though.

Is uniformity compensation worth using? Check out our screen uniformity tests on page eight to find out.

Contrast Ratio
Calibrated to 200 cd/m^2
Contrast Ratio [higher is better]

Monitor	Value
Dell UP3214Q (31.5" IGZO)	1005.5
NEC PA322UHD (UC OFF)	1002.0
NEC EA244UHD (24" AH-IPS)	796.7
BenQ BL3201PT (32" IPS)	784.2
NEC PA322UHD (UC ON)	755.4
Asus PQ321Q (31.5" IGZO)	691.1
Sharp PN-K321 (32" IGZO)	688.3

Axis: 0 200 400 600 800 1000 1200
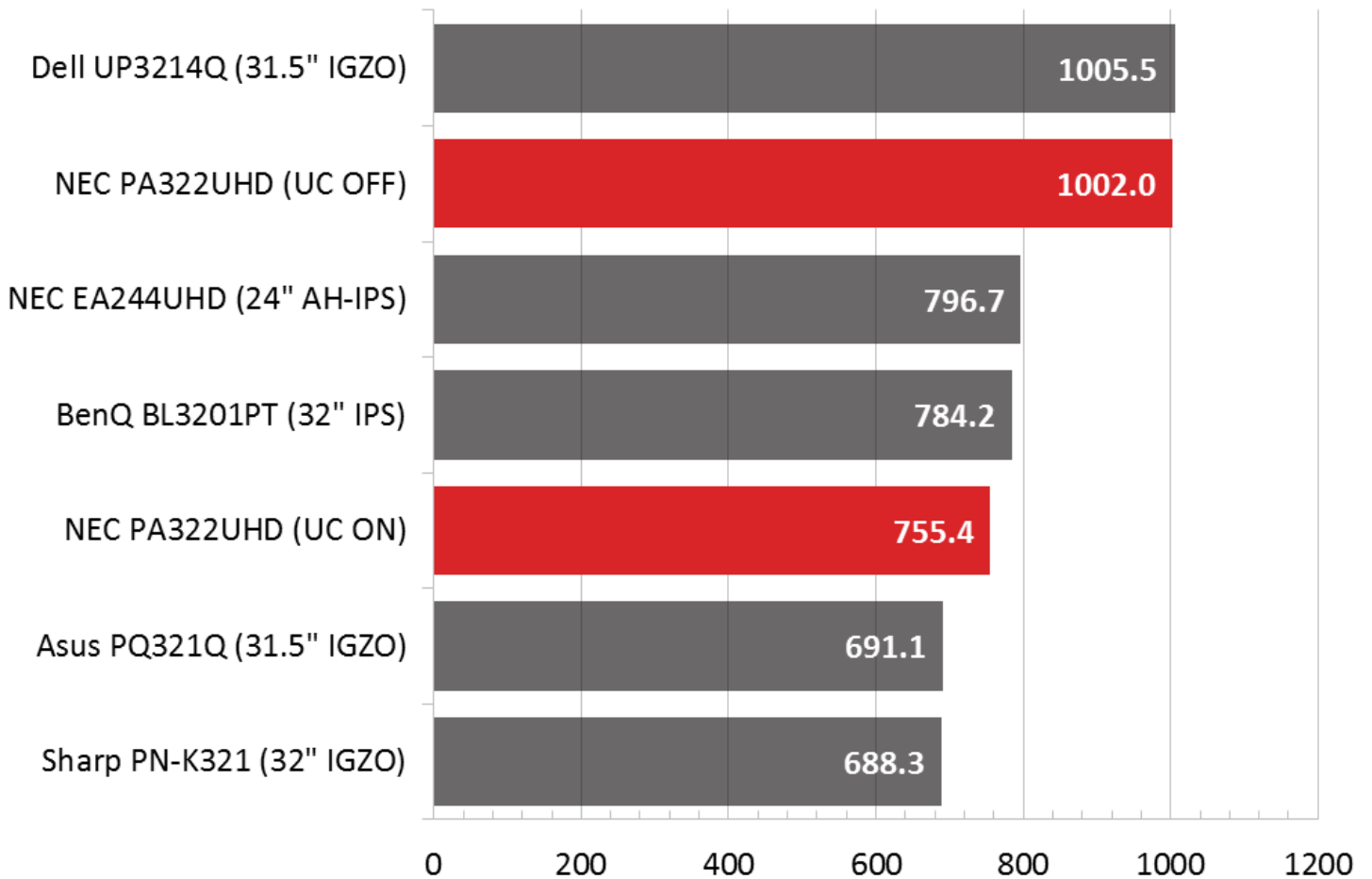
With uniformity compensation turned off, we record an excellent calibrated contrast ratio of 1002:1. NEC's offering is edged out ever so slightly by Dell, though you'll never be able to tell the difference. Both screens offer superb dynamic range, even when they're calibrated.

ANSI Contrast Ratio

16-point ANSI Contrast Ratio
Calibrated to 200 cd/m^2
ANSI Contrast Ratio [higher is better]

Monitor	Value
NEC PA322UHD (UC OFF)	1015.2
Dell UP3214Q (31.5" IGZO)	926.5
NEC PA322UHD (UC ON)	835.1
NEC EA244UHD (24" AH-IPS)	773.2
BenQ BL3201PT (32" IPS)	694.3
Sharp PN-K321 (32" IGZO)	682.9
Asus PQ321Q (31.5" IGZO)	654.2

(Axis: 0, 200, 400, 600, 800, 1000, 1200)
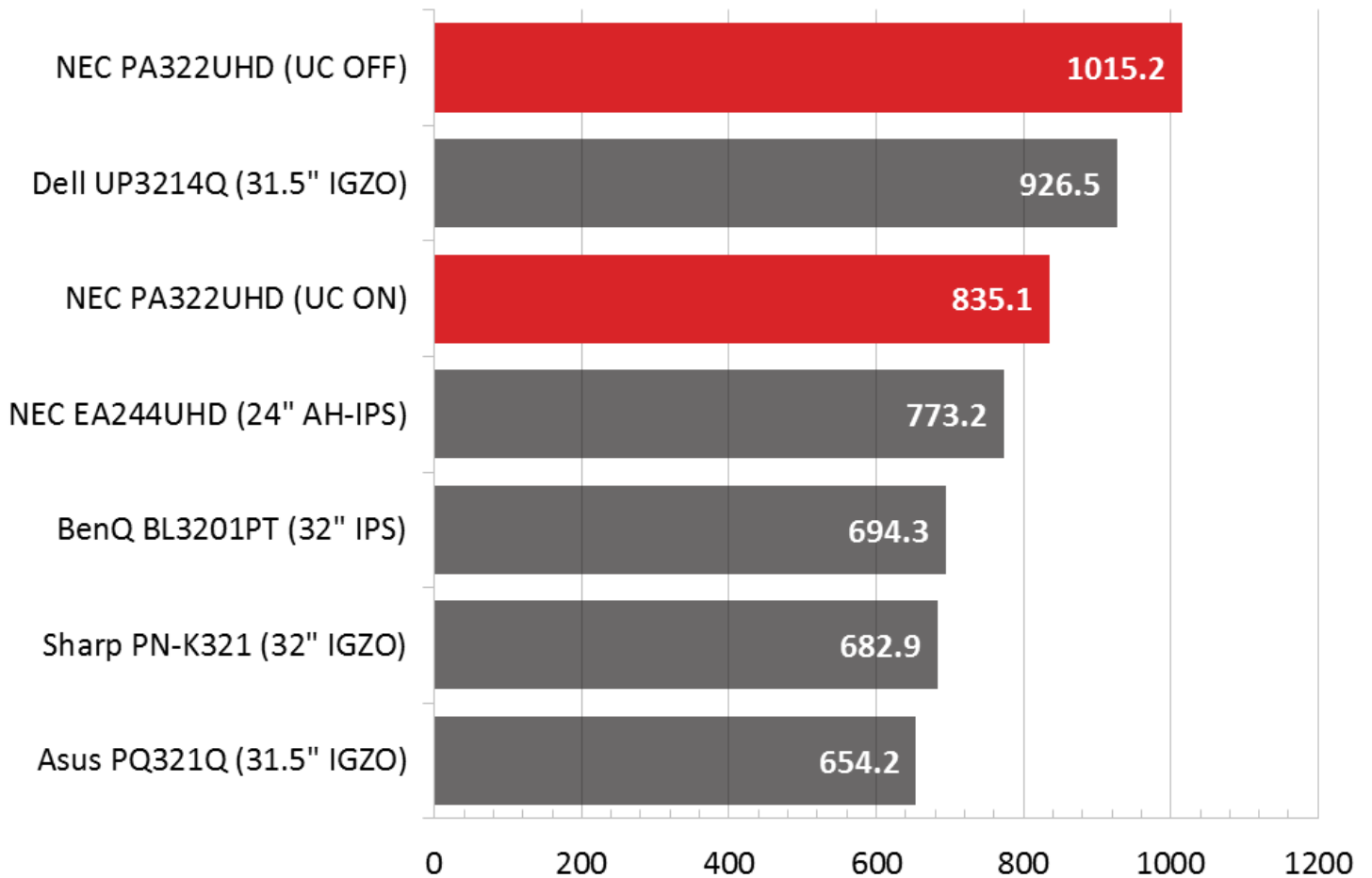
The PA322UHD is a seriously well-built monitor, and for $3000, it should be. We rarely see ANSI contrast ratios over 1000:1. Not surprisingly, then, NEC handily beats the Dell in this test. The only way to get better performance is with a VA-based panel.
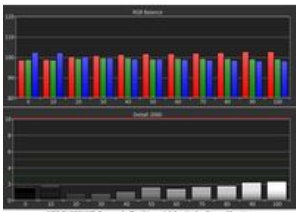
5. Grayscale Tracking And Gamma Response

Our grayscale and gamma tests are described in detail here.

NEC PA322UHD Grayscale Tracking - Adobe Mode, Pre-calibration

At this price point, it's reasonable to expect precise out-of-box performance (at least in the sRGB and Adobe color modes). We're showing you both graphs to demonstrate that the PA322UHD does indeed match its factory-generated tests. The box includes a data sheet for each monitor that shows similar results to what we recorded. There is a slight red push from 30 percent and up, but with all errors under two DeltaE, you won't see it.

NEC PA322UHD Grayscale Tracking - sRGB Mode, Pre-calibration

The sRGB mode shows slightly better performance. Either way, though, you don't have to calibrate.

Then again, if you have the means, why not? Running your own calibration yields the the results below.

NEC PA322UHD Grayscale Tracking - Adobe RGB Mode, Post-calibration
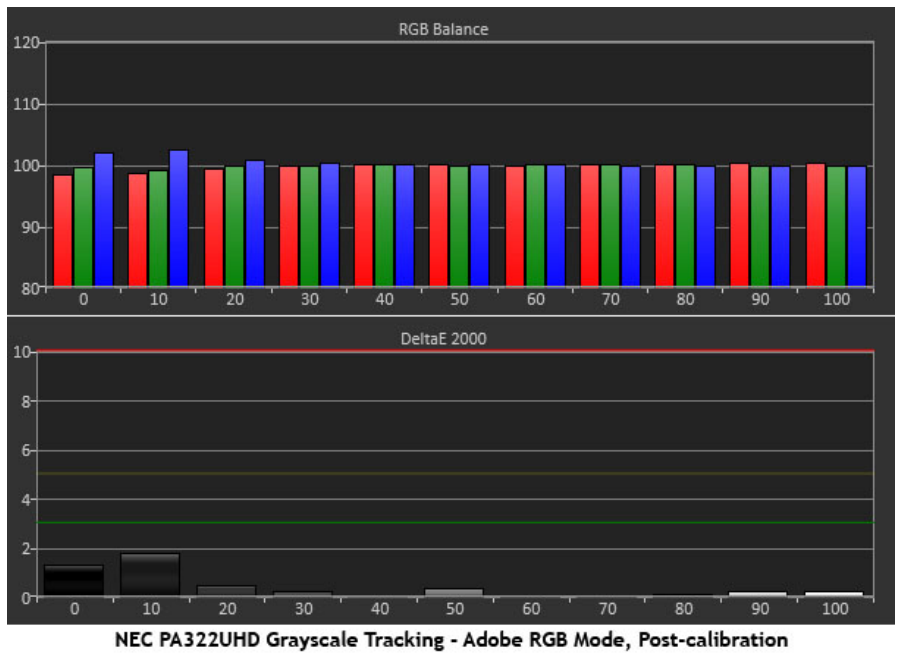
The RGB adjusters are extremely precise. They offer very fine resolution, allowing us to generate one of our best grayscale tracking graphs ever. It doesn't really get much better.

NEC PA322UHD Grayscale Tracking - sRGB Mode, Post-calibration
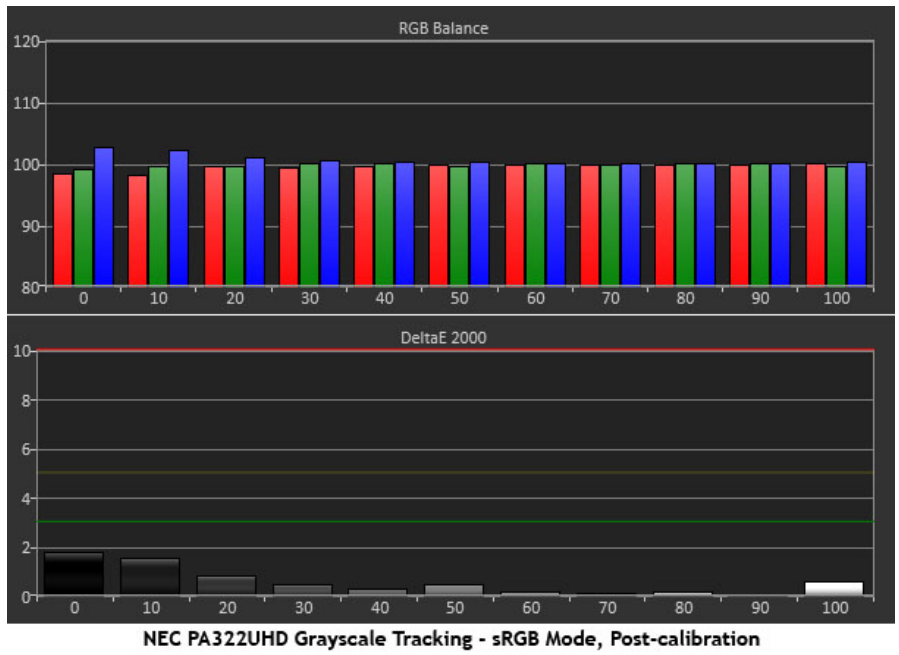
Results from the Adobe RGB mode are pretty much identical.

And here's our comparison group again:

Grayscale Error
Default Settings, Stock
DeltaE 2000 [lower is better]

Monitor	DeltaE 2000
NEC EA244UHD (24" AH-IPS)	0.63
NEC PA322UHD (sRGB)	1.14
Asus PQ321Q (31.5" IGZO)	1.48
NEC PA322UHD (Adobe RGB)	1.60
Dell UP3214Q (31.5" IGZO)	1.87
BenQ BL3201PT (32" IPS)	2.25
Sharp PN-K321 (32" IGZO)	2.88

0.00   0.50   1.00   1.50   2.00   2.50   3.00
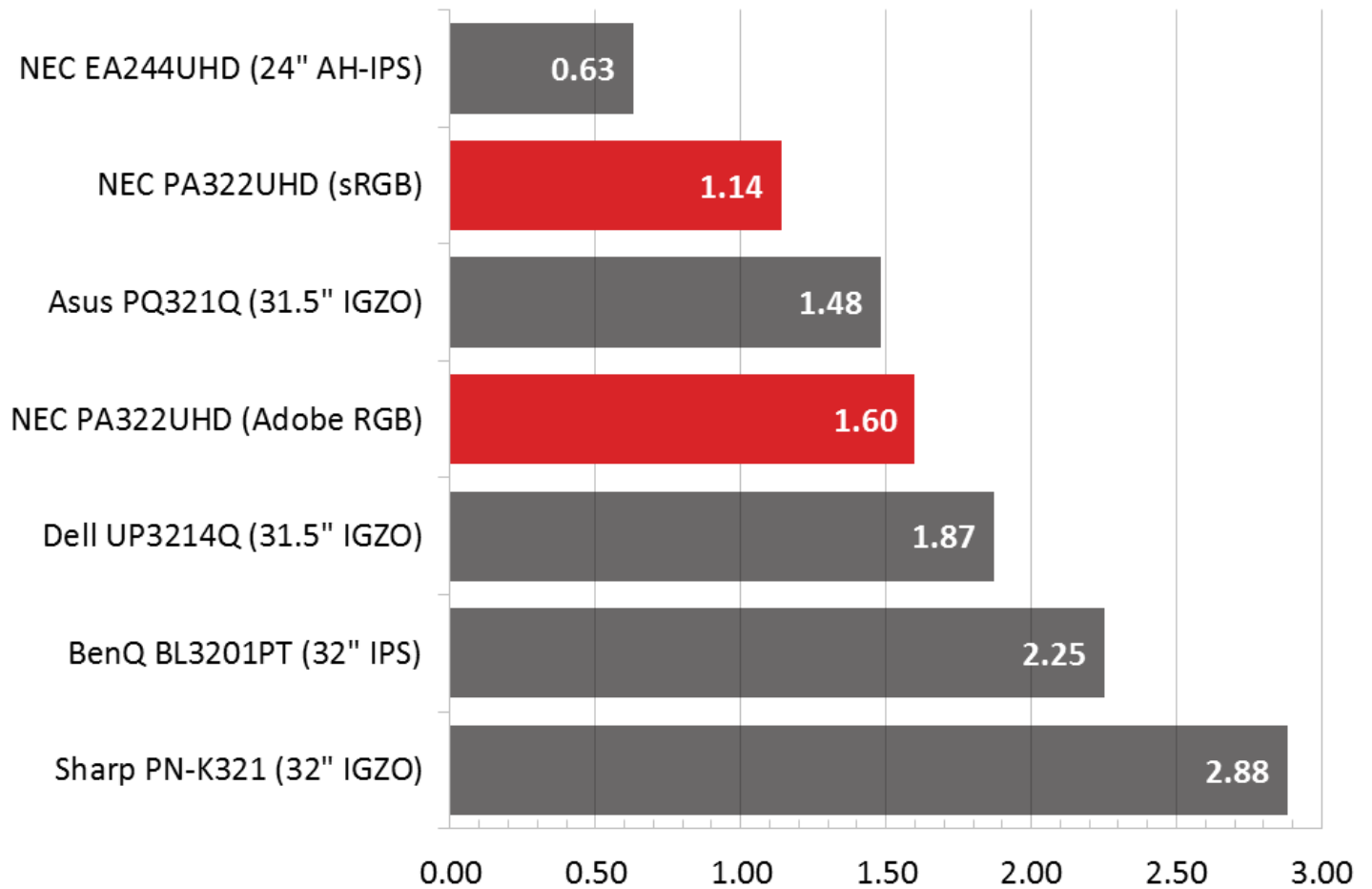
NEC's own EA244UHD still sets the standard for out-of-box grayscale performance, though the PA322UHD is only a tiny bit behind. The sRGB mode is the most accurate, followed closely by the Adobe RGB preset. Like we said earlier, calibration is definitely an option, not a requirement.

Grayscale Error
Calibrated to 200 cd/m^2
DeltaE 2000 [lower is better]

Monitor	DeltaE
NEC PA322UHD (Adobe RGB)	0.46
Asus PQ321Q (31.5" IGZO)	0.53
Sharp PN-K321 (32" IGZO)	0.58
NEC PA322UHD (sRGB)	0.61
NEC EA244UHD (24" AH-IPS)	0.72
Dell UP3214Q (31.5" IGZO)	0.99
BenQ BL3201PT (32" IPS)	1.38

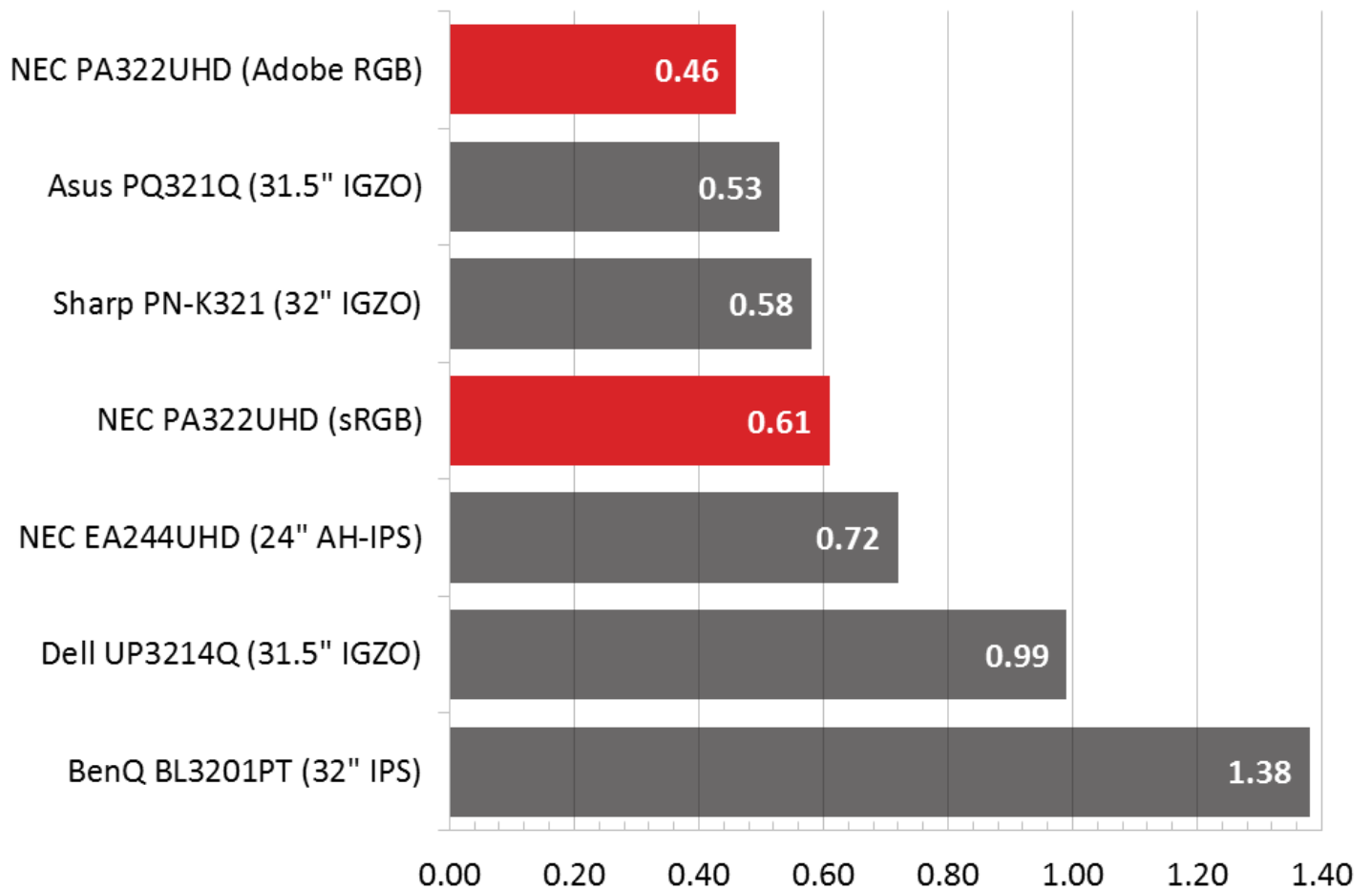The gains we realize from adjusting the PA322UHD are worth it in our opinion. Any professional monitor should score under one DeltaE for grayscale tracking, especially when you're spending $3000.

Really though, none of the screens represented here have flaws worth worrying about. They're all very accurate and perfectly suited for color-critical applications.

Gamma Response

NEC PA322UHD Gamma Tracking - Adobe & sRGB Modes
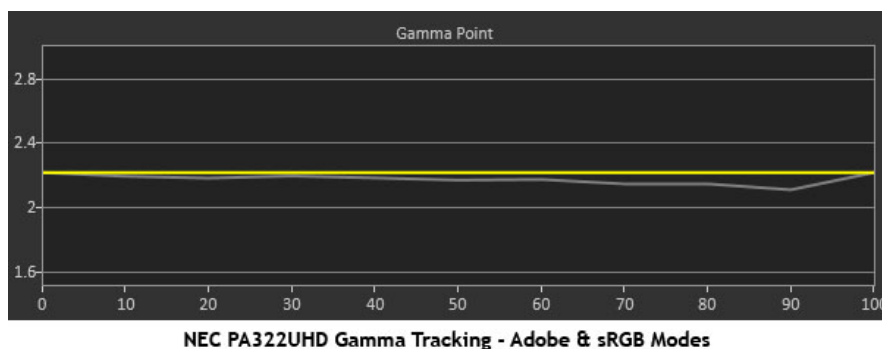
There are gamma presets to be found in the Advanced menu. They all provide solid tracking, as shown above. From 70- to 90-percent brightness, you can see a slight dip, but it only represents an error of 1.81 cd/m^2, which is negligible.

Here is our comparison group again:

Gamma Value Range
Calibrated to 200 cd/m^2
Gamma Range [lower is better]

Monitor	Value
NEC PA322UHD (32" IGZO)	0.08
BenQ BL3201PT (32" IPS)	0.15
Asus PQ321Q (31.5" IGZO)	0.21
NEC EA244UHD (24" AH-IPS)	0.22
Sharp PN-K321 (32" IGZO)	0.22
Dell UP3214Q (31.5" IGZO)	0.25

0.00   0.05   0.10   0.15   0.20   0.25
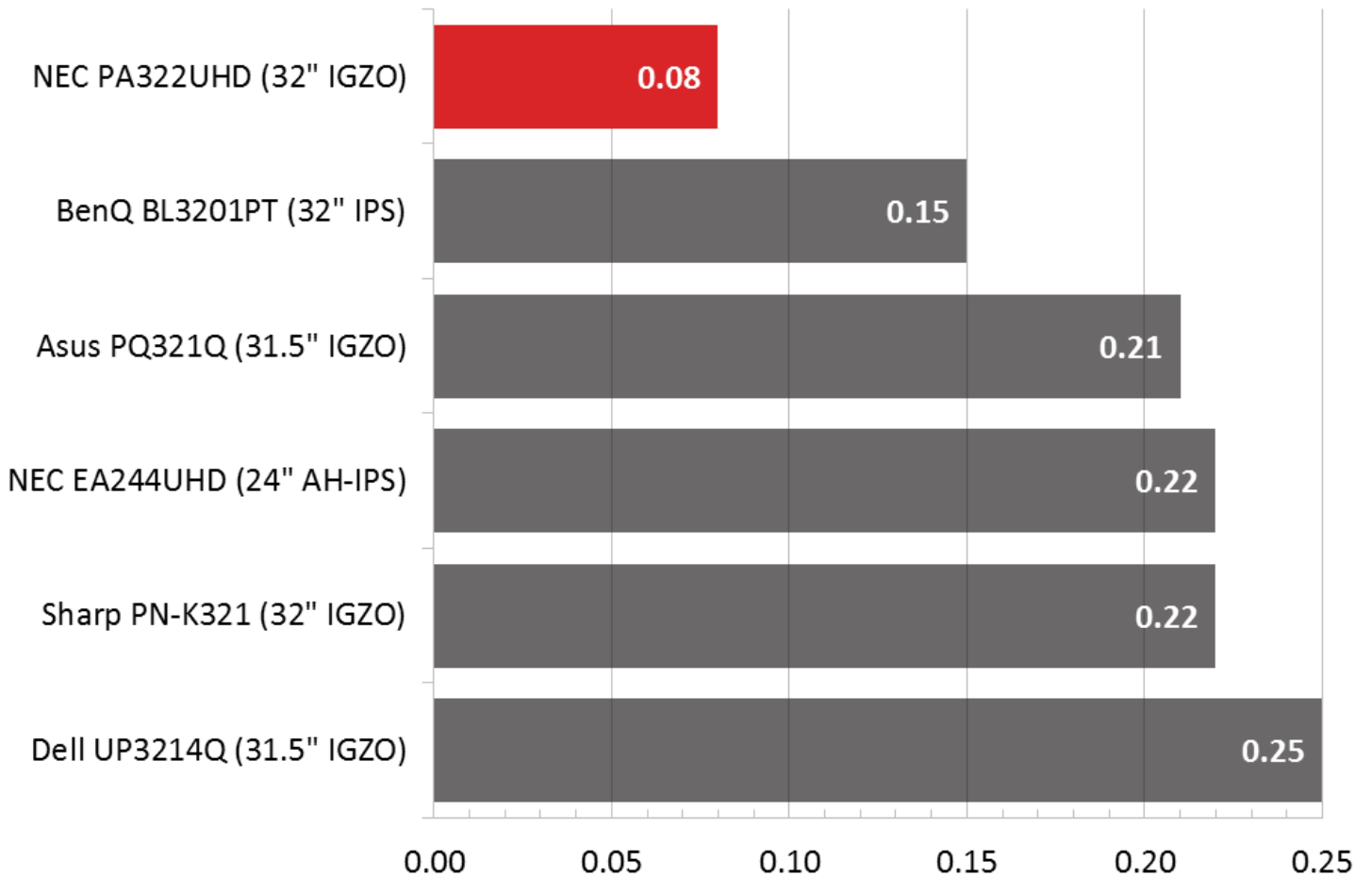
None of the screens have any serious tracking errors, and yet the PA322UHD comes out on top. As with the grayscale result, it matches NEC's factory data sheet perfectly.

We calculate gamma deviation by expressing the difference from 2.2 as a percentage.

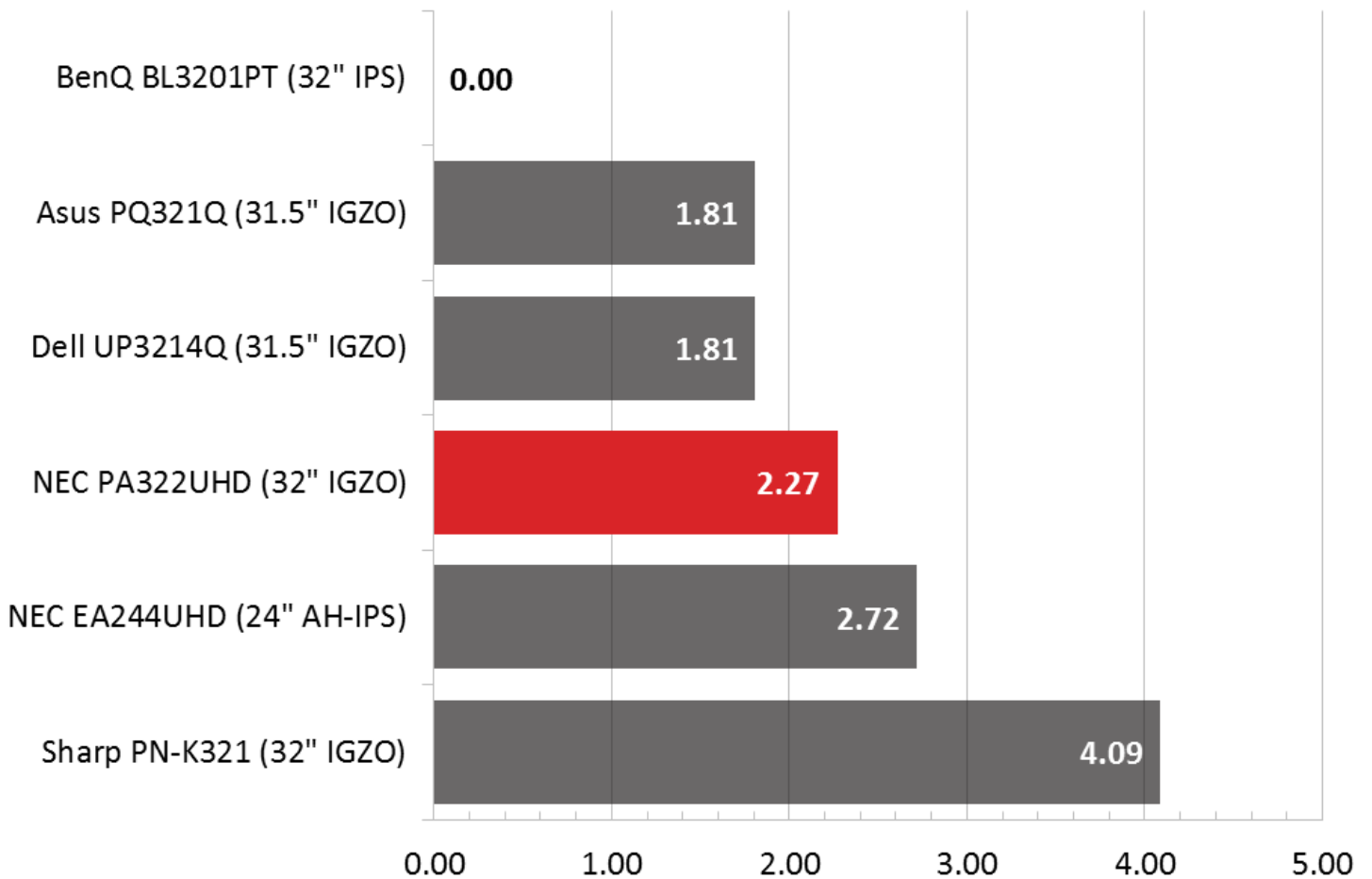**Average Gamma - Deviation From 2.2**
Calibrated to 200 cd/m^2
Deviation In Percent [lower is better]

Monitor	Deviation
BenQ BL3201PT (32" IPS)	0.00
Asus PQ321Q (31.5" IGZO)	1.81
Dell UP3214Q (31.5" IGZO)	1.81
NEC PA322UHD (32" IGZO)	2.27
NEC EA244UHD (24" AH-IPS)	2.72
Sharp PN-K321 (32" IGZO)	4.09

0.00   1.00   2.00   3.00   4.00   5.00

The slight dip from 70 to 90 percent drops the NEC to fourth place. Only Sharp's PN-K321 demonstrates any visible gamma flaws. The rest of the monitors are visually perfect.
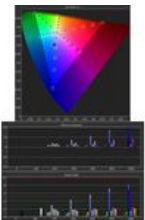
6. Color Gamut And Performance

For details on our color gamut testing and volume calculations, please click here.
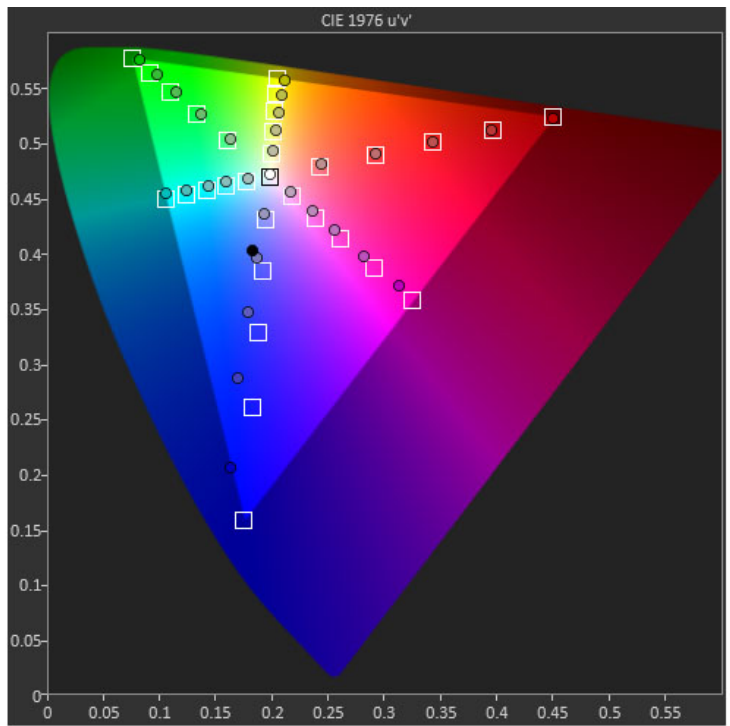
NEC PA322UHD Chromaticity - Adobe RGB Mode, Metamerism On

When we measured the PA322UHD's default state in Adobe RGB mode, we were surprised by the under-saturated and off-hue bl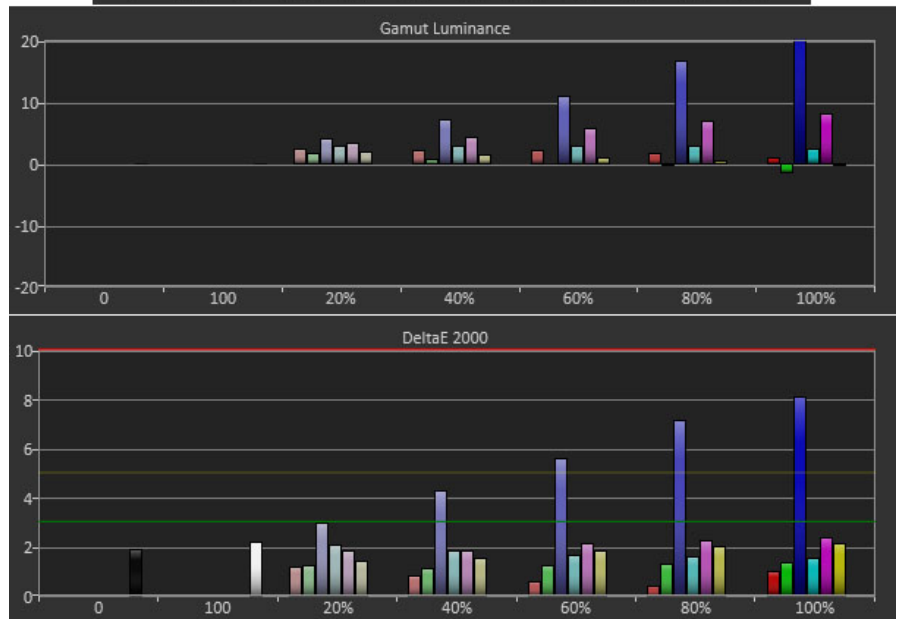ue primary. After exploring the Advanced menu, we discovered Metamerism was turned on. This is a color-compensation feature that really should be left off. If you need to match this monitor to another screen or do anything else outside accepted standards, it's best to simply make the adjustments to white balance and color gamut rather than relying on a preset. You can see the blue issues also affect magenta.
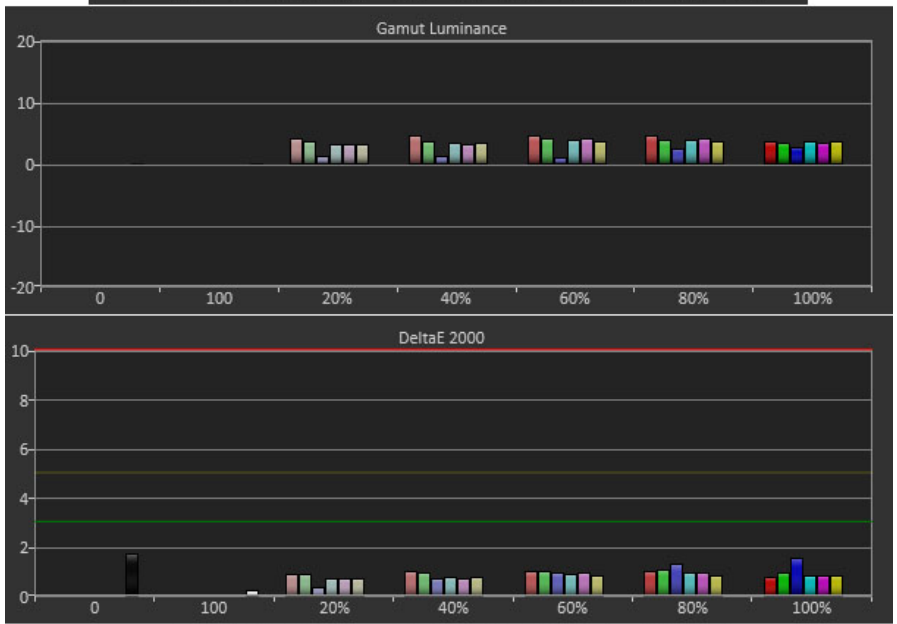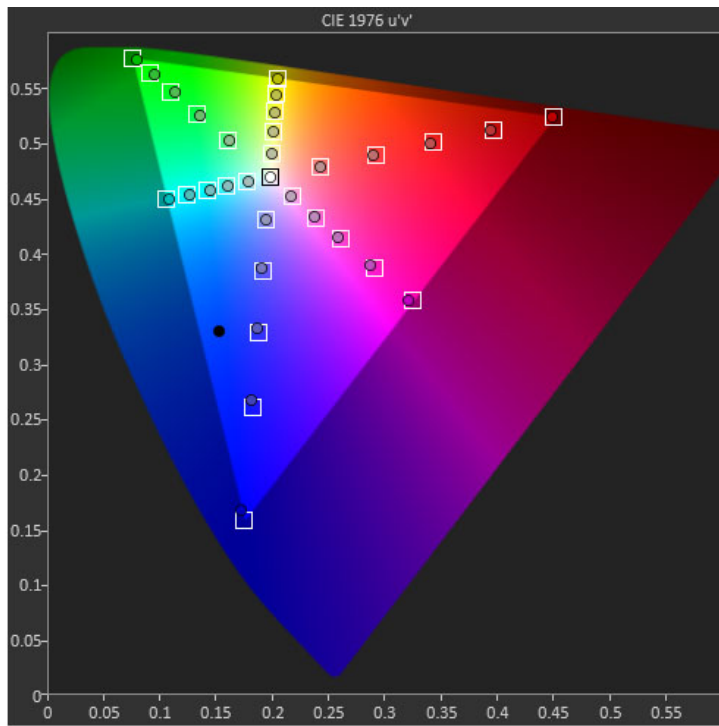
NEC PA322UHD Chromaticity - Adobe RGB Mode Calibrated

After turning Metamerism off and making a few tweaks in the CMS, we recorded the above result for the Adobe RGB mode. With all errors under two DeltaE, you won't see any color issues at all. This is what we expect from a $3000 display.
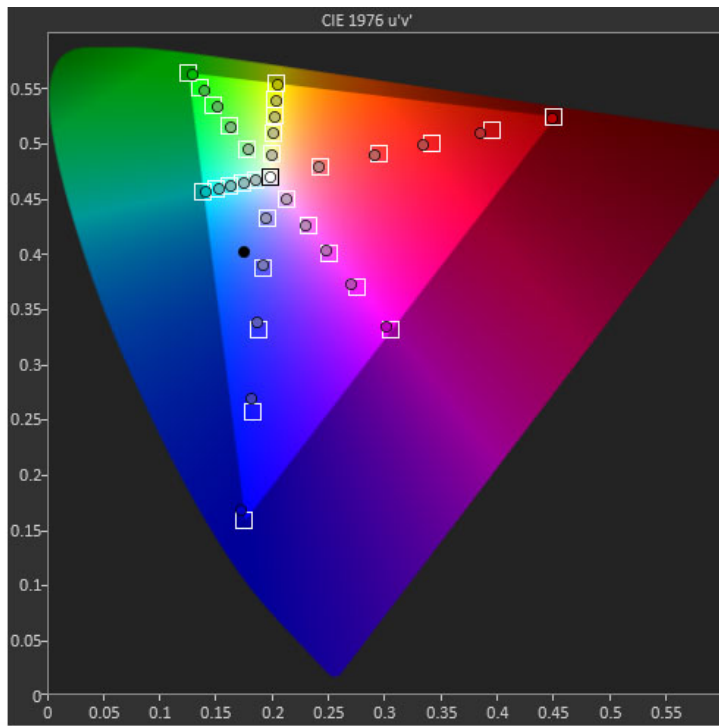
NEC PA322UHD Chromaticity - sRGB Mode Calibrated

The result from sRGB mode is pretty much the same. All color saturations are on or near their targets, and luminance levels are only slightly above the zero-percent line.

Now we return to the comparison group:

Color Gamut Error
Calibrated to 200 cd/m^2
DeltaE 2000 [lower is better]

Monitor	DeltaE 2000
Dell UP3214Q (31.5" IGZO)	0.75
NEC EA244UHD (24" AH-IPS)	0.75
NEC PA322UHD (sRGB)	0.82
NEC PA322UHD (Adobe RGB)	0.91
BenQ BL3201PT (32" IPS)	1.26
Asus PQ321Q (31.5" IGZO)	2.55
Sharp PN-K321 (32" IGZO)	3.06
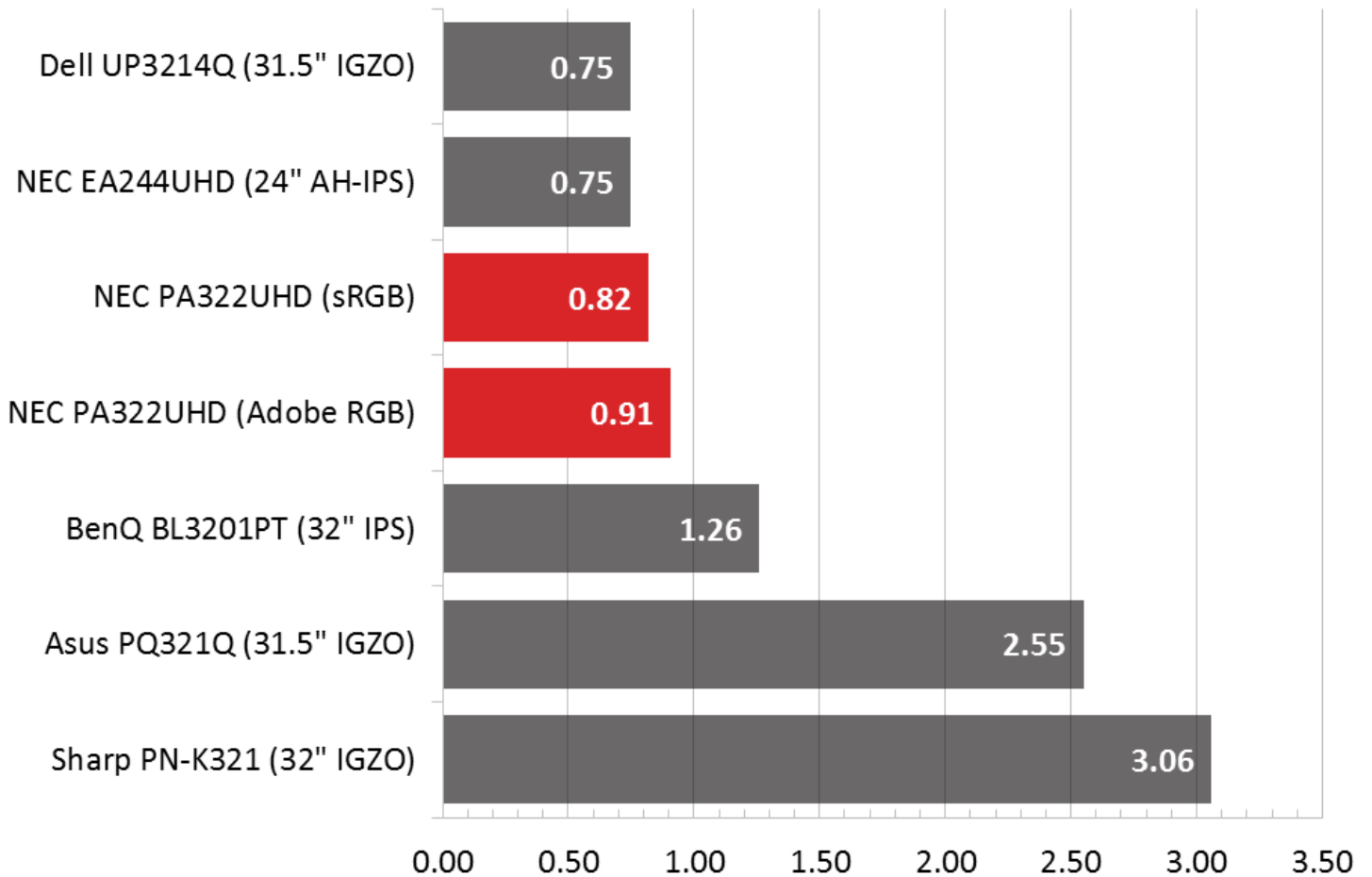
Dell's UP3214Q moves back to the top of the group in color accuracy, but only by a hair. For all intents and purposes, it and the two NEC screens are in the same category. BenQ's BL3201PT appears just behind them; that monitor sells for about one-third the price. Of course, it doesn't enable the wider Adobe RGB gamut though.

Gamut Volume: Adobe RGB 1998 And sRGB

Color Gamut Volume
Rendered Percentage of Adobe RGB 1998
and sRGB, Calibrated to 200 cd/m^2
Percent [higher is better]

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Dell UP3214Q (31.5" IGZO)
- 98.16 (Adobe RGB)
- 98.13 (sRGB)

NEC EA244UHD (24" AH-IPS)
- 95.81 (Adobe RGB)
- 97.78 (sRGB)

NEC PA322UHD (32" IGZO)
- 95.78 (Adobe RGB)
- 95.12 (sRGB)

BenQ BL3201PT (32" IPS)
- 71.84 (Adobe RGB)
- 104.76 (sRGB)

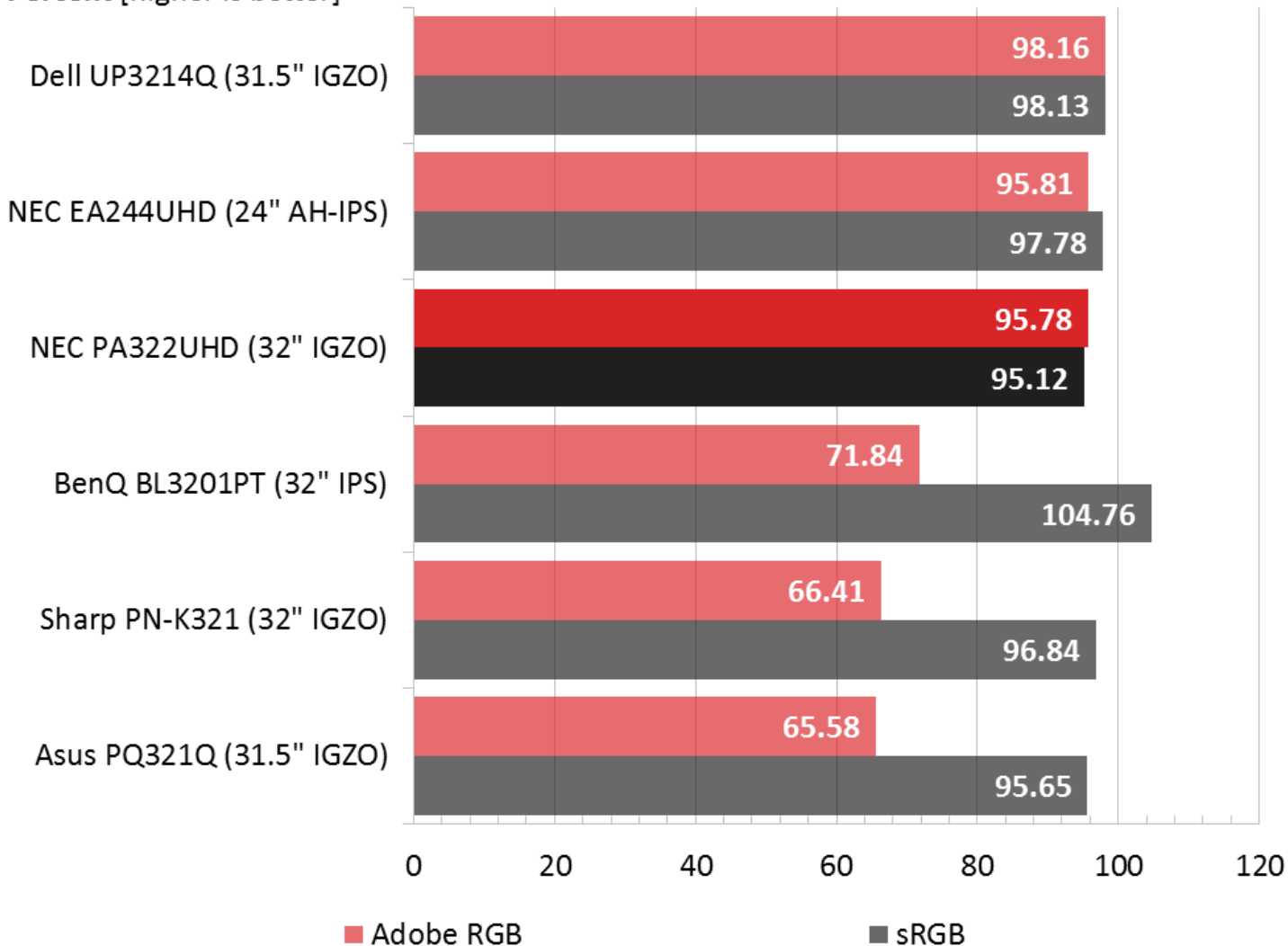**Sharp PN-K321 (32" IGZO)**
- 66.41 (Adobe RGB)
- 96.84 (sRGB)

Asus PQ321Q (31.5" IGZO)
- 65.58 (Adobe RGB)
- 95.65 (sRGB)

Scale: 0   20   40   60   80   100   120

■ Adobe RGB   ■ sRGB

The PA322UHD doesn't quite hit 100 percent in our gamut volume calculations due to colors that are just the tiniest bit under-saturated. With error levels below one DeltaE, though, we don't consider the volume result to be an issue. The top three screens are perfectly suited to professional users with their wide-gamut options. If you don't need Adobe RGB, BenQ's offering is worth serious consideration.
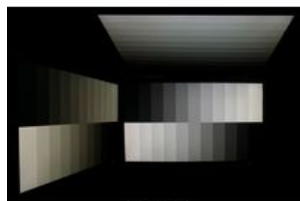
7. Viewing Angles, Uniformity, Response And Lag

To learn how we measure screen uniformity, please click here.
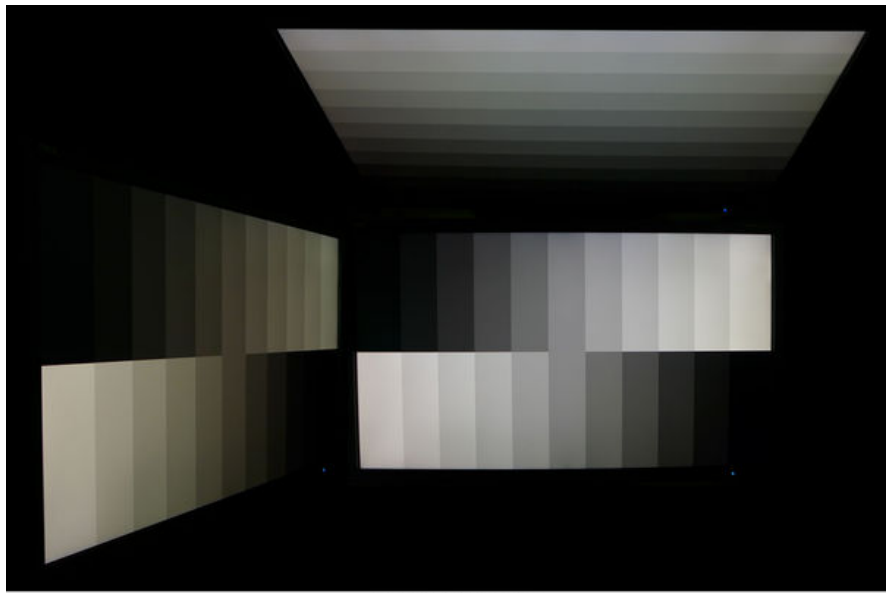
NEC PA322UHD

At sizes over 27 inches, TN-based screens just won't cut it. IGZO is a variant of IPS technology, and all of the examples we've photographed resemble the images above. From the sides you'll see a light falloff and shift towards green. However, detail is retained even in the darkest steps. Brightness is reduced from above, but there's no significant color shift and detail remains solid.

Screen Uniformity: Luminance

Screen Uniformity - Deviation From Center
0% Black Field
Average Deviation In Percent [lower is better]
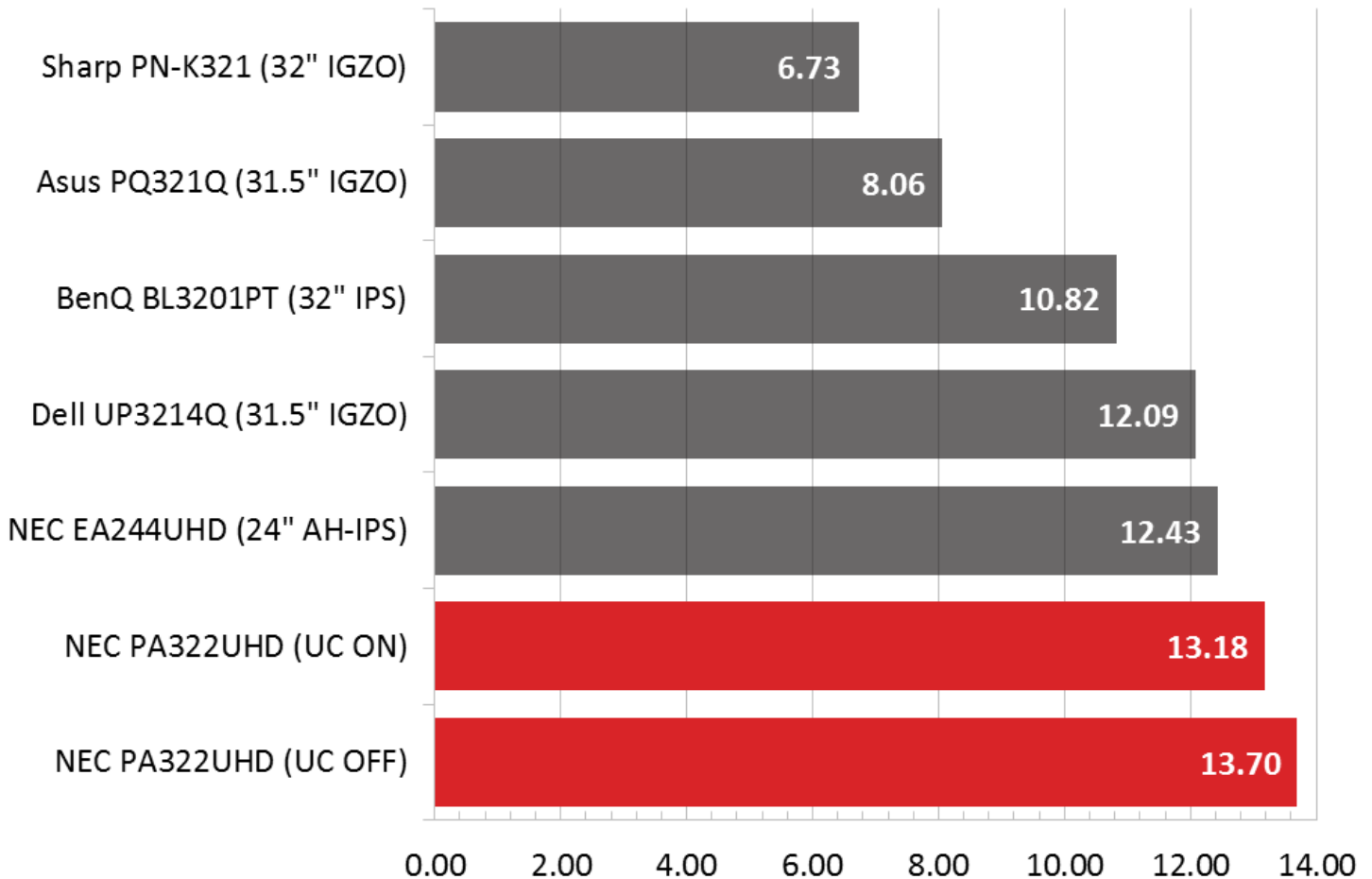
tom's HARDWARE

Monitor	Value
Sharp PN-K321 (32" IGZO)	6.73
Asus PQ321Q (31.5" IGZO)	8.06
BenQ BL3201PT (32" IPS)	10.82
Dell UP3214Q (31.5" IGZO)	12.09
NEC EA244UHD (24" AH-IPS)	12.43
NEC PA322UHD (UC ON)	13.18
NEC PA322UHD (UC OFF)	13.70

0.00 2.00 4.00 6.00 8.00 10.00 12.00 14.00

NEC includes uniformity compensation on all of its professional monitors, including the PA322UHD. Earlier models were more aggressive at the bottom end of the brightness scale, but newer screens do almost nothing (as our test results show). Despite the slight improvement, you ultimately won't see a one-half-percent difference. UC does raise the black level and reduce contrast, however, so you have to decide if it's worth using in your particular application.

Here's the white field measurement:

Screen Uniformity - Deviation From Center
100% White Field
Average Deviation In Percent [lower is better]

tom's HARDWARE

Monitor	Value
NEC PA322UHD (UC ON)	2.92
NEC EA244UHD (24" AH-IPS)	5.77
Sharp PN-K321 (32" IGZO)	5.80
Asus PQ321Q (31.5" IGZO)	7.33
Dell UP3214Q (31.5" IGZO)	9.06
BenQ BL3201PT (32" IPS)	10.34
NEC PA322UHD (UC OFF)	14.37
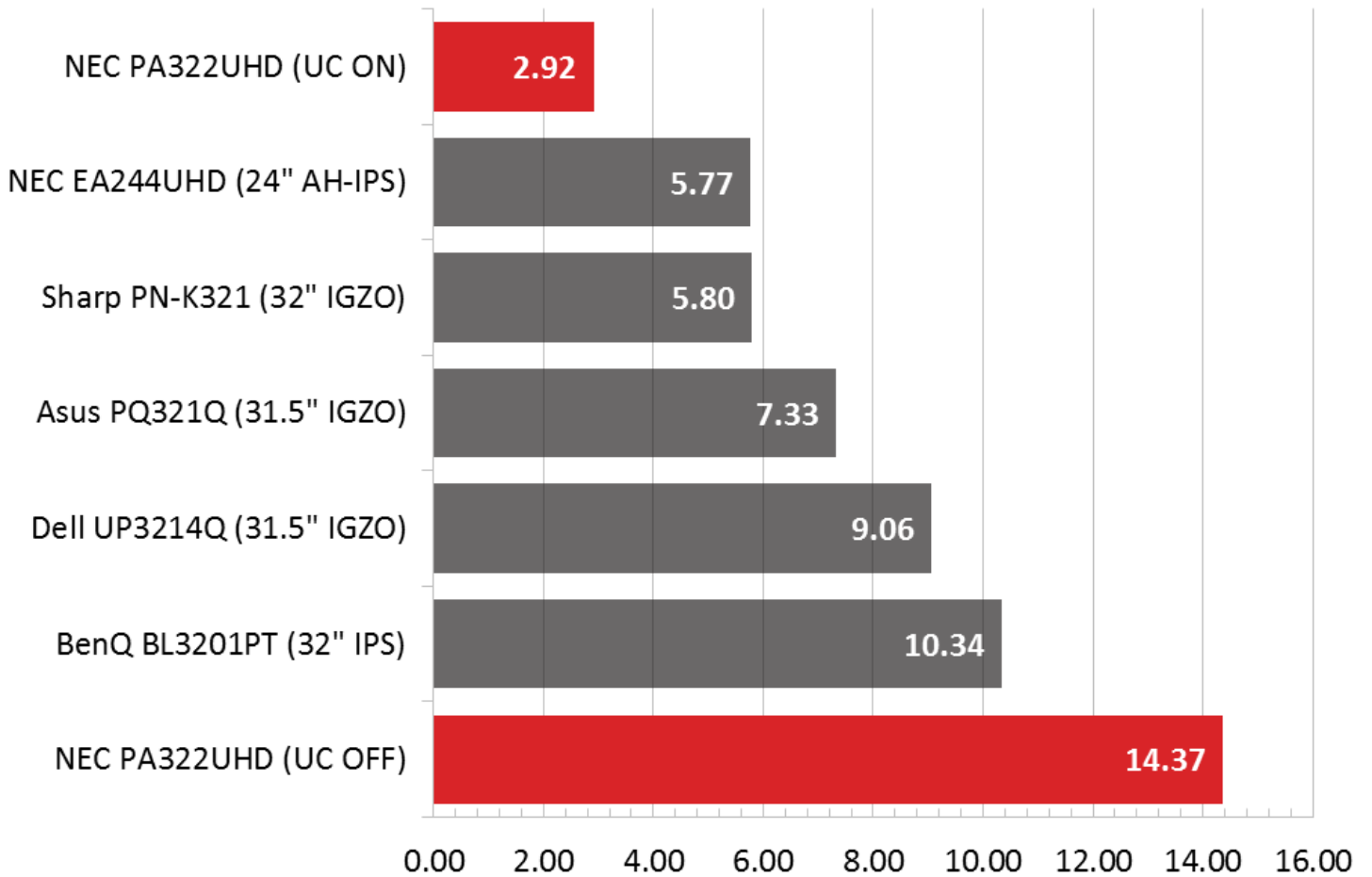
Compensation is far greater at the 100-percent level. The monitor goes from last place to first in our comparison group, and measures better than almost every display we've reviewed to date. Still, after some time using the PA322UHD, we preferred the greater contrast with UC turned off.

Screen Uniformity: Color

Color Uniformity
DeltaE 2000 Variation
Variation High To Low [lower is better]

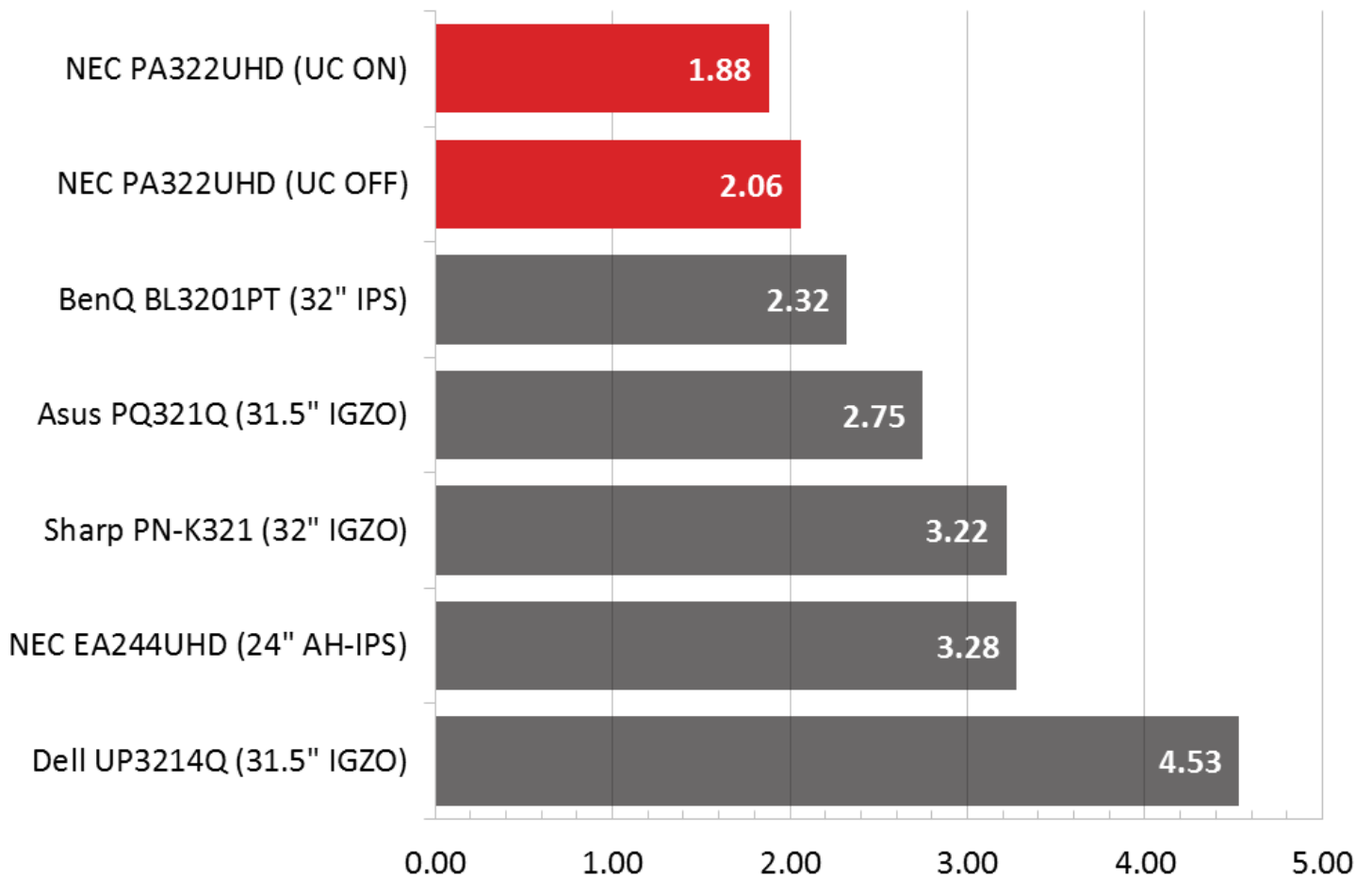| Monitor	DeltaE 2000
NEC PA322UHD (UC ON)	1.88
NEC PA322UHD (UC OFF)	2.06
BenQ BL3201PT (32" IPS)	2.32
Asus PQ321Q (31.5" IGZO)	2.75
Sharp PN-K321 (32" IGZO)	3.22
NEC EA244UHD (24" AH-IPS)	3.28
Dell UP3214Q (31.5" IGZO)	4.53

UC also has a small impact on color uniformity, though you won't see an issue either way given our results. With a factory calibration and top-notch quality control, it's highly unlikely you'll ever buy a PA322UHD with visible problems.
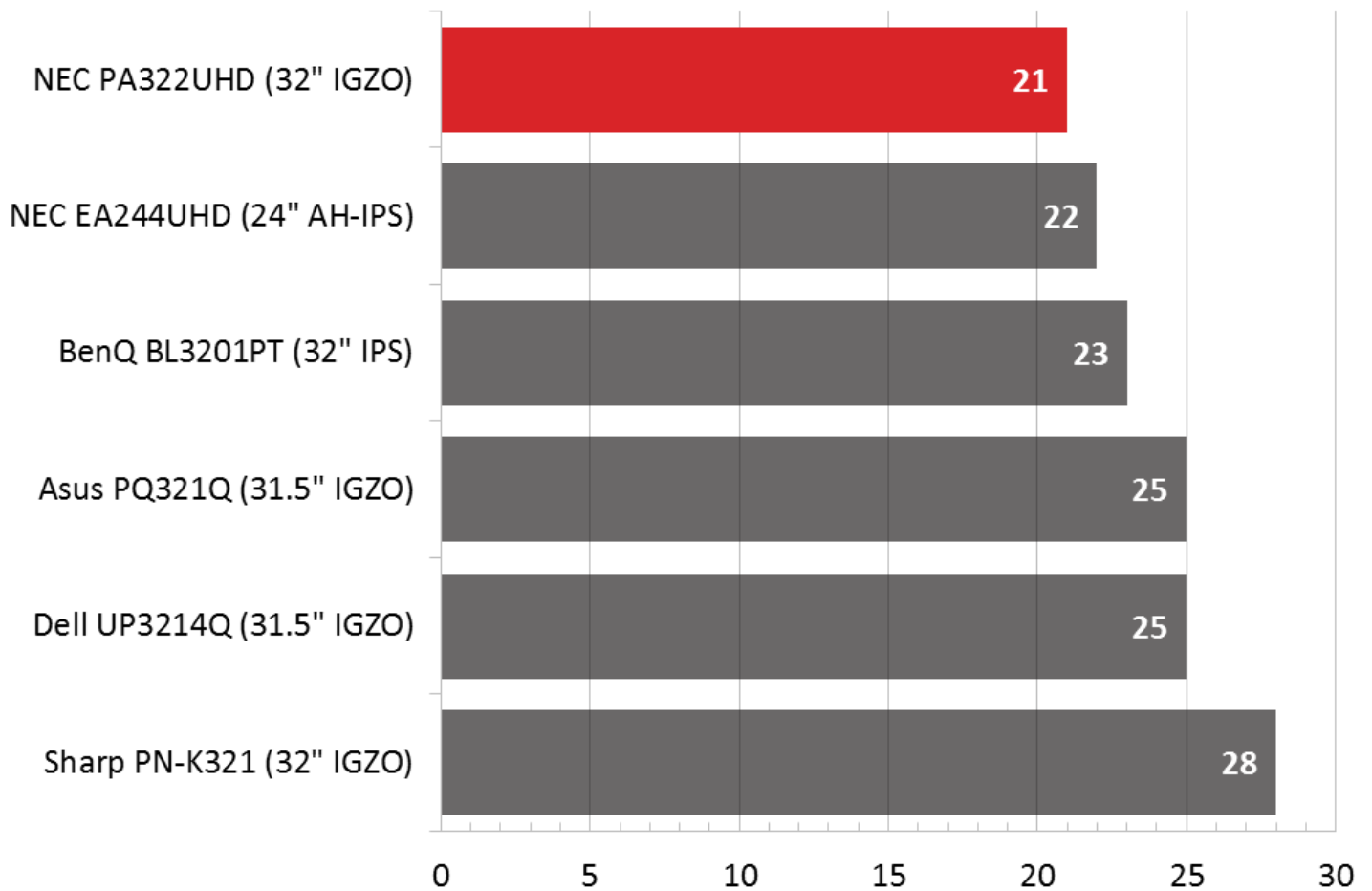
Pixel Response And Input Lag

Please click here to read up on our pixel response and input lag testing procedures.

Response Time
Full Black To White Transition
Milliseconds [lower is better]

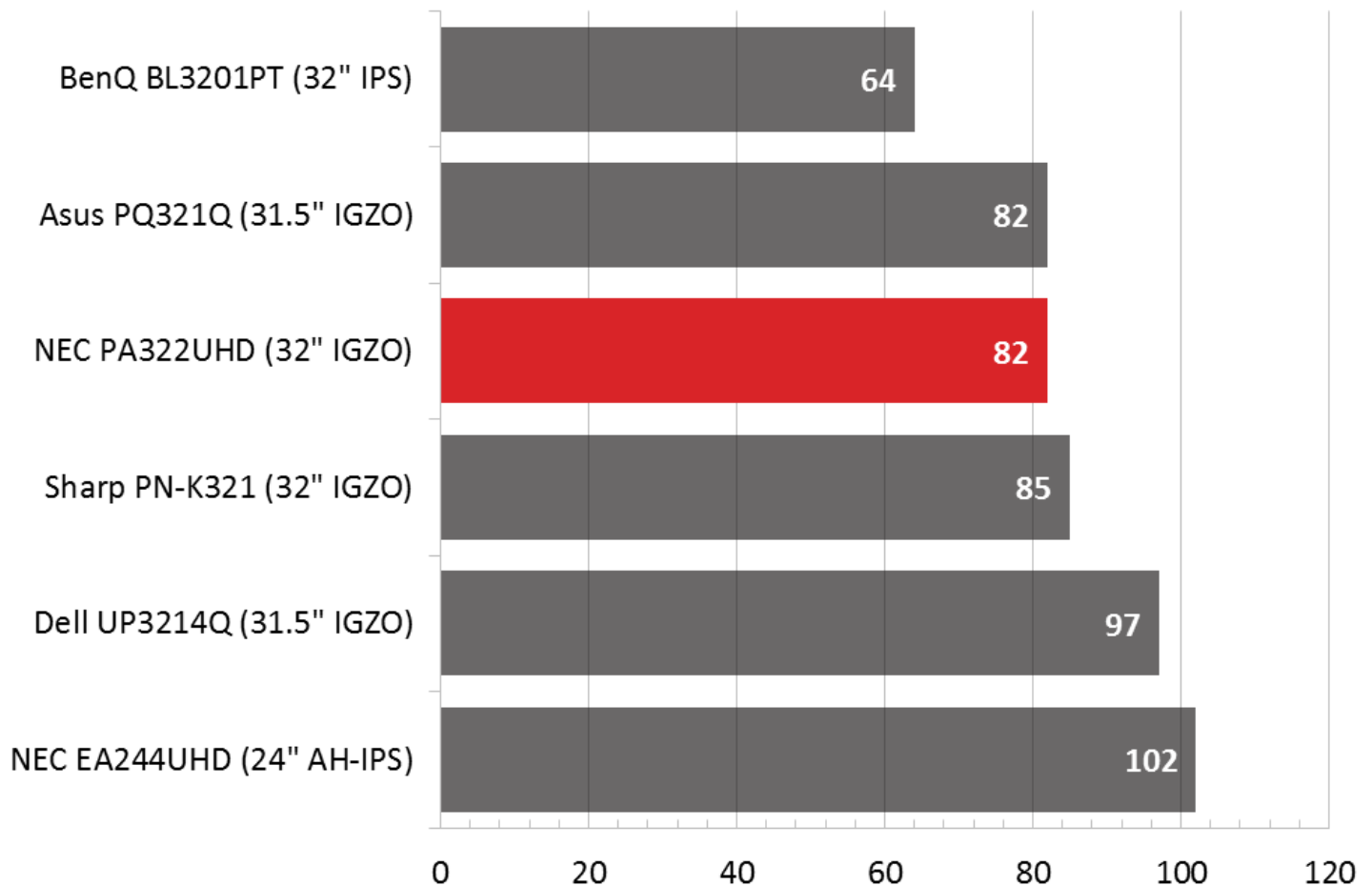| Monitor	Response Time (ms)
NEC PA322UHD (32" IGZO)	21
NEC EA244UHD (24" AH-IPS)	22
BenQ BL3201PT (32" IPS)	23
Asus PQ321Q (31.5" IGZO)	25
Dell UP3214Q (31.5" IGZO)	25
Sharp PN-K321 (32" IGZO)	28

Gamers probably won't find it necessary to spend $3000 on this screen, but at least it posts decent response results. Its motion rendering is nowhere near the quality of a fast-refresh gaming monitor. Among its business-class competition, the PA322UHD has a slight edge.

Here are the lag results:

Absolute Input Lag
Full Black To White Transition
Milliseconds [lower is better]

Monitor	Input Lag (ms)
BenQ BL3201PT (32" IPS)	64
Asus PQ321Q (31.5" IGZO)	82
NEC PA322UHD (32" IGZO)	82
Sharp PN-K321 (32" IGZO)	85
Dell UP3214Q (31.5" IGZO)	97
NEC EA244UHD (24" AH-IPS)	102

In this group, it's the BenQ BL3201PT that shines. Gaming at 3840x2160 is still an expensive proposition fraught with compromise. Enthusiasts looking for the ultimate in monitor performance still have to settle for speedy TN-based panels or one of the rare IPS displays that can run above 60Hz.

8. NEC PA322UHD, Ultra-Performance, Ultra HD

Obviously there aren't legions of computer users willing to spend $3000 on a monitor, regardless of its quality or performance. But if you're familiar with the audiophile's "one-percent rule", then the PA322UHD makes perfect sense.

In a majority of electronics categories, it's possible to purchase 99 percent of the best performance for a reasonable amount of money. You won't get that 99 percent from the value-oriented products, but step up a bit and you'll find it. Our monitor reviews reflect this phenomenon pretty well. If you look at screens in the $500 to $1000 range, you'll find great-performing monitors with excellent accuracy, contrast and features that come fairly close to the top professional models.

The big jump in price happens when you go after the final one percent. There are computer users (and audiophiles, myself included) who are willing to pay just about anything to achieve as much of that last percentage point as possible. It often comes at a premium of two or three times the median cost. In this review, for instance, comparisons between BenQ's BL3201PT and NEC's PA322UHD are inevitable. In terms of accuracy, contrast and build quality, they're really close. The NEC has a slight edge, but for three times the money. What does that extra $2000 get you? Well, a wide gamut for starters, plus a precise calibration engine that is pretty much unrivaled. You also get a four-year warranty and a monitor that's built like Fort Knox.

The closer comparison should be to Dell's UP3214Q. Until now it was the only wide-gamut option available in a 32-inch form factor. And though it's a first-gen product, it still outperforms newer monitors (it even edges out this NEC in a few areas). Overall though, the PA322UHD delivers a tiny bit more contrast, better out-of-box grayscale accuracy and roughly the same level of color quality. It also provides greater flexibility, more precise calibration controls and build quality that's second to none.

So if you're after that last one percent and need the absolute best money can buy (at least for now), the NEC PA322UHD is the clear choice. We've been impressed with every NEC product we've reviewed so far, and this new jumbo Ultra HD screen is no exception. For its exceptional performance, solid engineering, physical quality and feature set, we're giving it the Tom's Hardware Recommended award.

PROS: Grayscale, gamma and color accuracy, high contrast, many calibration options, built like a vault, four-year warranty

CONS: Expensive, default settings that reduce color accuracy

VERDICT : With a host of calibration features that all work with precision; administrative options that make it easy to integrate into an enterprise; fantastic build quality and a four-year warranty, it's hard not to recommend the NEC PA322UHD regardless of its price. The Dell UP3214Q is still a great choice but if you want the absolute best in accuracy and adjustability, look no further.

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Christian Eberle is a Contributing Editor for Tom's Hardware, covering Monitors and TVs.

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