Test EIZO CG2700S: Image processing in perfection

The 27-inch monitor of the ColorEdge series inspires across the board and makes an external colorimeter unnecessary by means of a built-in probe

05.07.2022, Denis Freund

Introduction

EIZO has launched two new graphics monitors for the current year. CG2700S and CG2700X expand the well-known ColorEdge series - and differ mainly in terms of their resolution. While the CG2700X promises true-colour work in full UHD resolution, the CG2700S is limited to WQHD, corresponding to 2560 x 1440 pixels. However, in view of the other performance data and the results achieved in our test, one can hardly speak of an economy model. This much should be anticipated: With the CG2700S, the Japanese monitor specialist shows how good things can be made even better with attention to detail.

A programmable 16-bit 3D LUT forms the heart of the signal processing, embedded in further tables of the scaler pipeline. This ensures extremely precise colour reproduction. It can be further optimised for the specific application via ColorNavigator. The hardware calibration software developed by EIZO has grown into a powerful tool with extensive functionality in version 7. Moreover, due to the measuring device built into the monitor, there is no need for a separate probe.

However, the powerful hardware substructure can only really show off its strengths if the colour gamut is correspondingly high. EIZO is not stinting here and promises almost complete coverage of Adobe RGB and DCI-P3 RGB. This means that all common offset printing conditions can be reliably reproduced. Any colour and brightness differences over the panel surface are to be prevented by a compensation function to improve the surface homogeneity.

The processed signal finally finds its way to the viewing-angle-stable IPS panel, whose contrast stability is improved by a special foil compared to otherwise common panel variants. Contrast range and luminance are comparatively high, but not sufficient for serious colour correction and retouching of HDR material. Nevertheless, the EIZO CG2700S supports variously parameterisable PQ and HLG transfer functions. In fact, together with the powerful colour space emulation, a limited HDR workflow is possible.

Finally, EIZO has given the CG2700S a complete USB-C dock. By means of a single cable, a connected notebook can transmit video signals to the monitor and be supplied with data from the keyboard, mouse and network or with power. A second USB interface enables KVM functionality. Only one set of input devices is needed for two connected systems.

For detailed information on the features and specifications, please refer to the EIZO CG2700S data sheet.

Test environment

Colour measurement devices: X-Rite i1Pro 2, X-Rite i1Display Pro Plus
Graphics card: EVGA GeForce GTX1080 Ti

Software: UDACT 2.4, CCalc 2.4, ColorNavigator 7

Scope of delivery

EIZO delivers the CG2700S with an HDMI cable, two USB cables (type C and type A to type B) and a power cable. We would have liked to see a DisplayPort cable here. Disturbing light influences are reduced by a light shield.

In addition, a report proves the factory calibration. The complete user manual and the ColorNavigator software for hardware calibration can be downloaded from the EIZO homepage.

Optics and mechanics

The EIZO CG2700S fits well into the previous ColorEdge series - and thus into every working environment. Even in the past, one could rather speak of design evolutions than revolutions. Dark plastic dominates, cast in puristic shapes. The EIZO CG2700S goes against the trend towards frameless design by presenting itself with a bezel. This is quite large, especially in the upper area, and increases in size in the middle to form a bead that contains the integrated measuring device. It folds out after activation. However, we miss a flap for dust protection.

The built-in measuring device in the retracted state

The back also presents itself in a tidy manner. Defining design elements are the EIZO logo and a fine metal grid that covers large areas and ensures good heat dissipation.

The EIZO CG2700S with light protection screen

The frame width is about 1.9 cm. In the upper area we measure 3.1 cm. On the desk, the EIZO CG2700S takes up just under 24 cm. Without the stand, there is still about 8 cm.

Height adjustment in detail

Material appearance and build quality are good, but not significantly above the class average. The gaps remain small all around.

Lowest position from the front

Lowest position from behind

Highest position from the front

Highest position from behind

The control range of the height adjustment is 15.5 cm. In the lowest setting, the distance from the lower edge of the frame to the table surface is 3.5 cm. In the highest position, we measure 19 cm. The maximum backward tilt is 35 degrees. A tilt in the opposite direction is possible up to about 5 degrees. Alternative mounting systems are connected to the monitor via the VESA 100 screw connection. The stand allows 180 degrees of rotation in both directions.

Maximum angle of inclination to the rear

Maximum forward tilt angle

Lateral rotation to the left

Lateral rotation to the right

The EIZO CG2700S can also be operated in portrait orientation via a swivel joint.

Upright alignment (pivot) from the front

Upright alignment (pivot) from behind

The waste heat generated during operation is dissipated via the housing with the extended perforated plate and a few additional ventilation slots. Brightness- or contrast-dependent noise is completely absent.

Rear of the EIZO CG2700S with the perforated plate

The light protection screen is not really convincing. It comes in one piece and is quickly mounted thanks to integrated magnets. However, the quality of the workmanship and the feel are not optimal. In addition, there is no option to use the shade in portrait mode.

Light protection screen in detail

Power consumption

With a luminance of 140 cd/m², we determine an efficiency of just under 1.5 candela per watt. This is a very decent value, which is usually significantly undercut by similarly positioned models on the market. Monitors that perform better here always have a much more limited colour gamut.

In energy-saving mode, the power consumption drops sufficiently. Thanks to a real power switch, it can finally be reduced to zero.

	Manufacturer	Measured
Operation maximum	k. A.	36,2 W
140 cd/m²	k. A.	19,1 W
Operation minimum	k. A.	12 W
Energy-saving mode	< 0,5 W	0,4 W
Switched off (mains switch)	0 W	0 W

Connections

The EIZO CG2700S accepts video signals via three connections. The user has a DisplayPort, HDMI and USB-C input with DisplayPort implementation at their disposal. A feed in 10 bits per colour channel is possible for each input in RGB and YCbCr without colour subsampling.

The signal inputs of the EIZO CG2700S

The integrated USB hub provides four downstream connections according to version 3.1 (2 x) and 2.0 (2 x). The interfaces have been recessed on the side, while the connection to the computer is made via the rear port array. Here you will find a USB-C interface and a USB-B upstream connection. These can be assigned to one of the three signal inputs via the OSD. Switching then takes place automatically - and the KVM switch for two computers is ready.

The USB-C interface is not only used to transmit video signals and connect the USB hub to the computer. Rather, data from the Ethernet home network is also available here, which reaches the monitor via the RJ-45 socket. Together with the possibility of providing up to 92 watts of power, the EIZO CG2700S replaces a USB-C dock. A single cable is all that is needed to connect to the notebook. This frees up space on the desk. In our tests, a corresponding connection worked without any problems.

Operation

The controls, which are almost completely unlabelled, have been recessed in the lower frame. To facilitate navigation, their current function assignment is displayed. With the exception of the power switch, these are touch-sensitive buttons. Due to the design, there is no haptic feedback. Various actions - including changing the signal input and picture mode - can be carried out directly.

OSD

Despite the comprehensive hardware calibration, EIZO does not do without a very comprehensive OSD. It is divided into seven clearly structured main menu items.

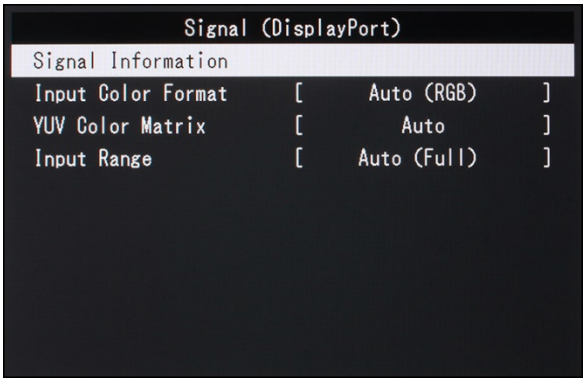
The intensity of the backlight is changed via a brightness control. The desired white point can be adjusted via presets in Kelvin, three RGB gain controls or normative specifications.

A change of the tone value curve is possible via the gamma controller. Apart from fixed values (1.6-2.7), the sRGB characteristic, among others, can also be selected directly. In addition, PQ and HLG transfer functions are available. The gradation characteristic can be adjusted here via further parameters. The colour space emulation is also extensive. In addition to sRGB and Adobe RGB, DCI-P3 RGB and ITU-R BT.2020 are available. An optional gamut clipping ensures the precise reproduction of in-gamut colours and is particularly interesting for the large colour gamut defined in ITU-R BT.2020. The colour space emulation can be controlled individually via ColorNavigator.

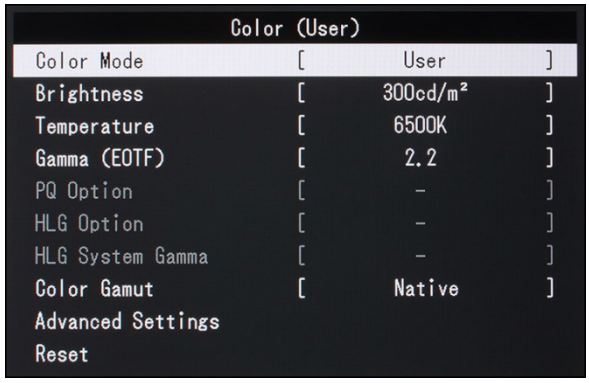
Three scaling settings allow for page-filling, area-filling and unscaled display of incoming signals. Their dynamic range is also taken into account.

The self-calibration is configured via a separate menu item. The necessary target parameters are determined from a previous calibration with ColorNavigator. However, the settings, for example exact scheduling, can also be completely managed by the user in the software.

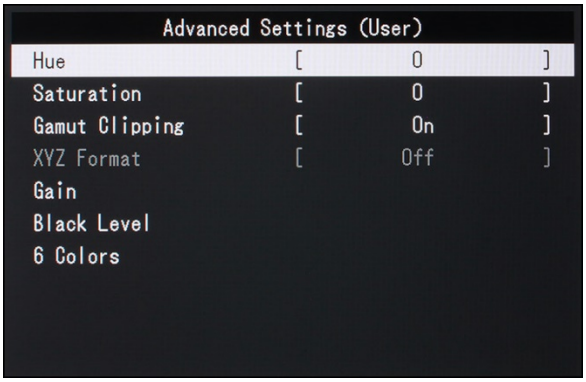
Other functions include selecting the menu language and positioning the OSD.



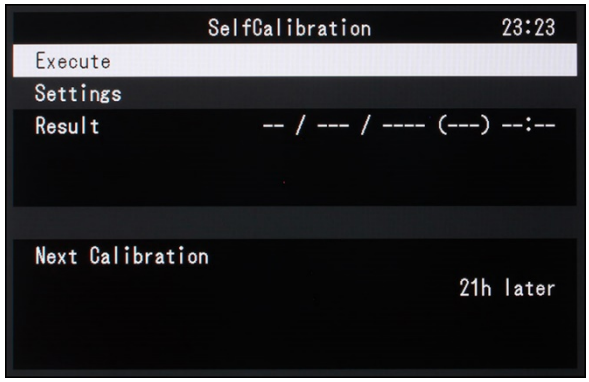
Menu: Signal



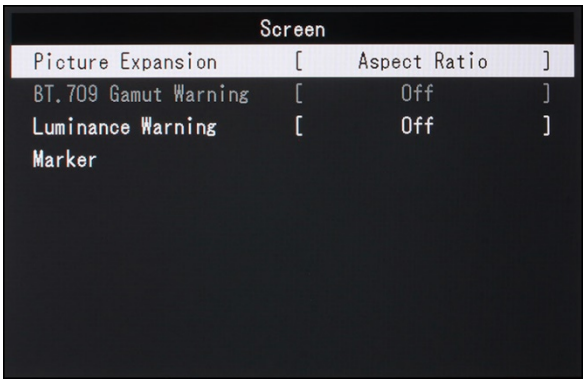
Menu: Colour



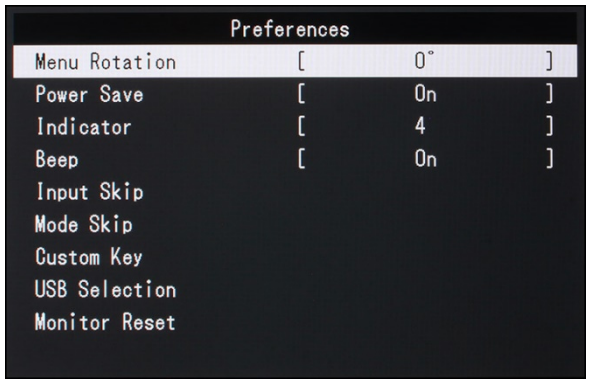
Menu: Color=>Advanced



Menu: SelfCalibration



Menu: Screen

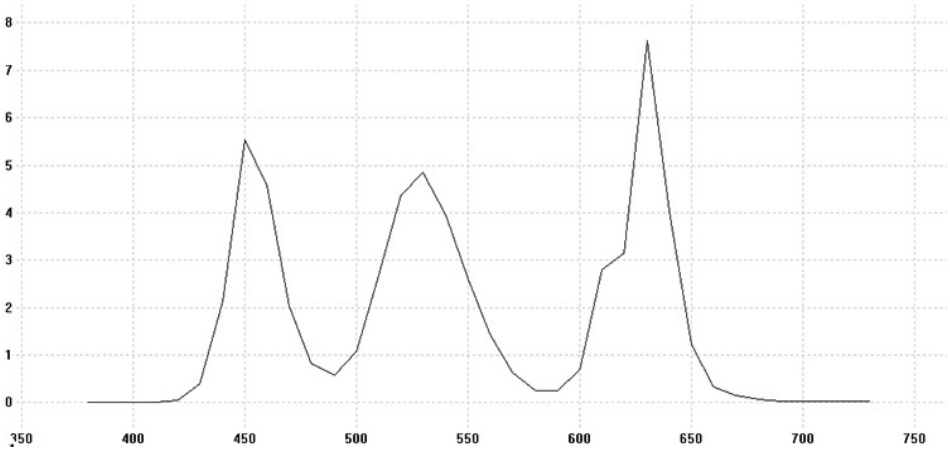


Menu: Preferences

Picture quality/signal processing

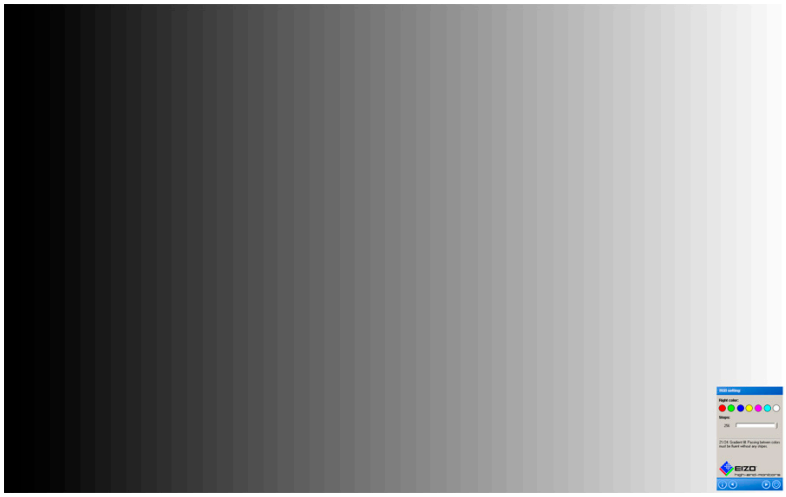
General

EIZO uses a 27-inch IPS panel with LED backlighting for the CG2700S. No further information can be found in the data sheet. So-called quantum dots could be used to optimise their emission spectrum, i.e. to convert or filter them into the desired, relatively narrow-band range.



Spectral radiation distribution white (colour location ~D65) according to colour filters (i1Pro 2; optical bandpass: 10 nm)

Part of the signal processing in the scaler is a programmable 3D LUT. This fulfils an important prerequisite for accurate and loss-free colour reproduction - across all OSD picture modes. Of course, this also applies to the hardware calibration via ColorNavigator. Our tests then also show correspondingly optimal results. Colour breaks are always absent, the representation is visually and metrologically extremely neutral.

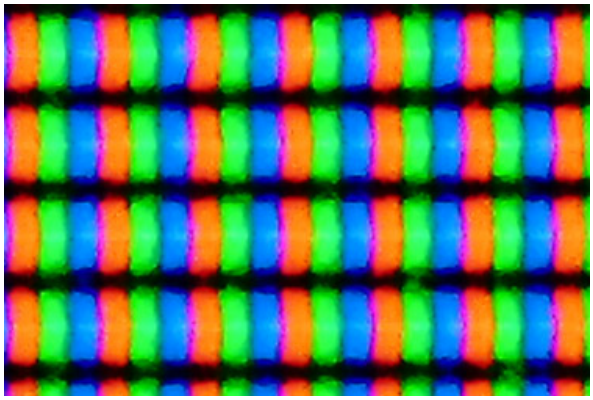


Test image to check grey gradients

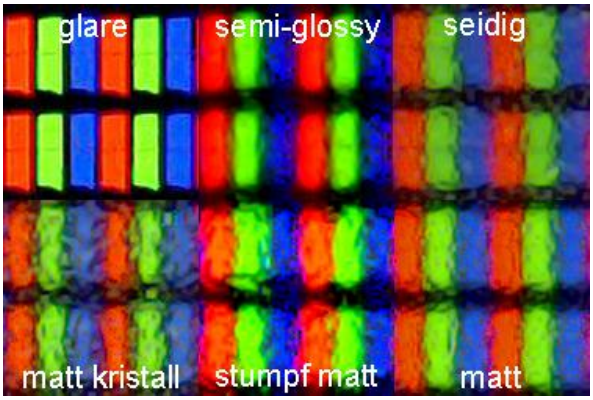
The picture quality is able to meet even the highest demands. In addition to a neutral and homogeneous display, the EIZO CG2700S scores with the very good viewing angle stability of its IPS panel and a comparatively high contrast range. Furthermore, the loss of contrast that is usual for IPS technology, which can lead to annoying brightening even when viewed from the front, has been greatly reduced.

Coating

The surface coating of the panel has a great influence on the visual assessment of image sharpness, contrast and sensitivity to ambient light. We examine the coating with the microscope and show the surface of the panel (foremost film) in extreme magnification.



Coating of the EIZO CG2700S



Reference image for coating

Microscopic view of the subpixels, with focus on the screen surface: The EIZO CG2700S has a dull matt surface with microscopically visible depressions for diffusion. Grain or glitter effects are completely absent.

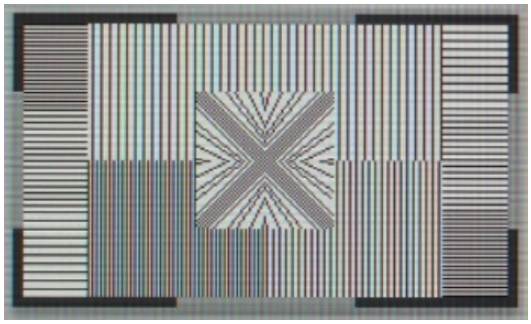
Interpolation

Our test signals are processed well. Scaling by the graphics card does not improve the display. EIZO does without a separate sharpness control, but in most implementations this only achieves questionable improvements anyway.

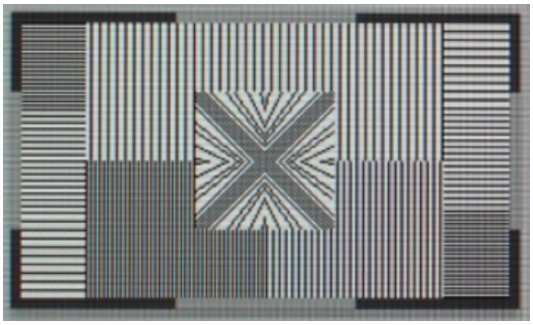
Content with a square pixel aspect ratio can be displayed without distortion. However, the same also applies to SD video signals that deviate from this. In the test, we did not succeed in driving the EIZO CG2700S correctly in 1280 x 1024 and 1280 x 960. However, this should not be a real limitation.

Scaling options

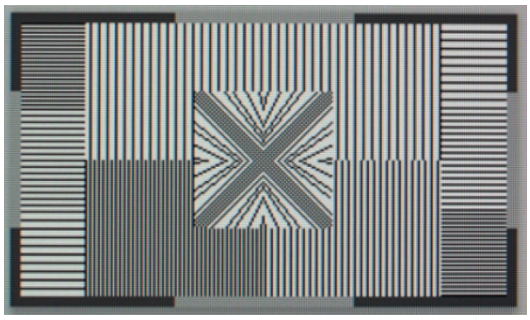
The following pictures give a rough impression of the quality of the scaling. The distance of the camera to the screen is always identical and it is always scaled to full screen according to the page.



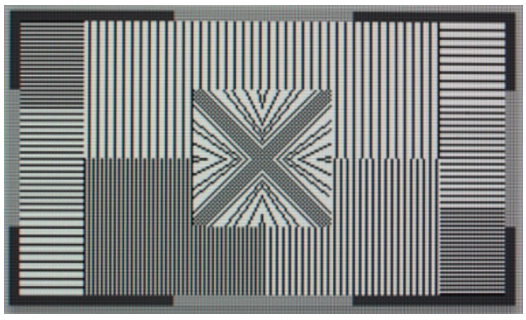
Resolution 2560 x 1440 (native)



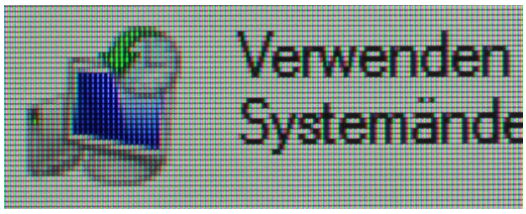
Resolution 1600 x 1200



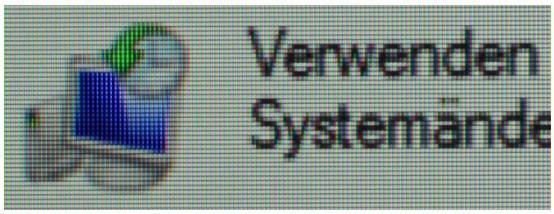
Resolution 1920 x 1080



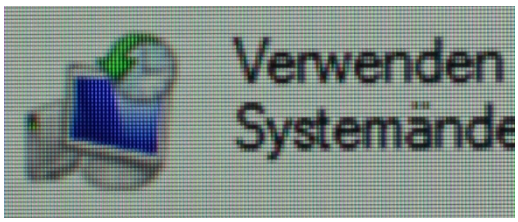
Resolution 1024 x 768



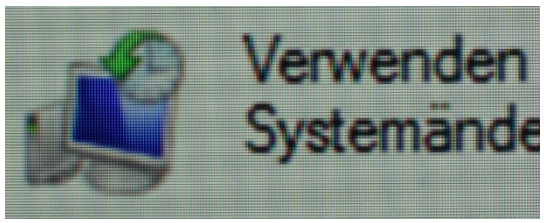
Resolution 1920 x 1080



Resolution 1024 x 768



Resolution 1920 x 1080



Resolution 1024 x 768

Juddertest

To test the frequencies and playback characteristics supported by the EIZO CG2700S, we fed in various signals and evaluated the result.

Our test signals ranging from 24 to 75 Hz are supported throughout. The display is judder-free with all refresh rates (24 Hz, 50 Hz, 60 Hz), which are particularly important for video playback.

Juddertest on the EIZO CG2700S

Deinterlacing

Since an LC display is always full-frame (progressive), a built-in deinterlacer must create a full-frame sequence from incoming fields (interlaced).

We check the deinterlacing with field sequences in 3:2 and 2:2 rhythm and then play in real video material with non-contiguous fields. Optimally, the deinterlacer can reconstruct the original full-frame sequence without loss in the first two cases.

The EIZO CG2700S does not recognise the original full images. Loss of resolution is the result. However, the deinterlacing works quite well overall. Comb artefacts are absent even with poor material with little in-picture movement.

No recognition of 3:2 signals

No recognition of 2:2 signals

Test of the video mode deinterlacing

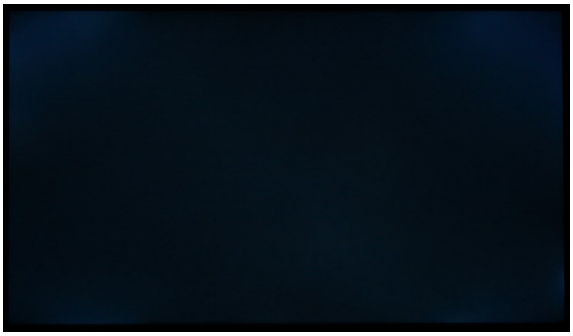
Signal level and colour model

The EIZO CG2700S processes digital RGB and YCbCr signals. The dynamic range can be adjusted via the "Input Range" setting. "*Limited*" assumes a common video signal without BtB and WtW components (tonal value range with 8-bit precision: 16 to 235). "*Limited (109 % White)*", on the other hand, preserves possible information in the highlights (tonal range at 8-bit precision: 16 to 254). "*Full*" is the correct selection for signals that utilise the full dynamic range (tonal range at 8-bit precision: 0 to 255).

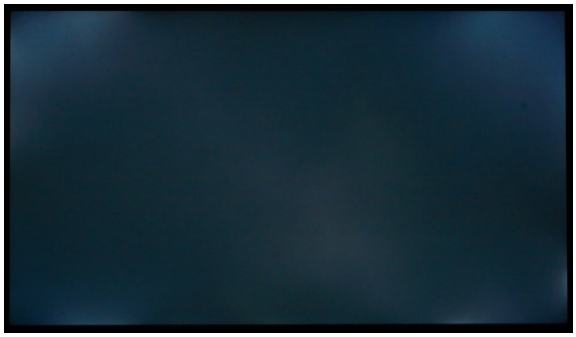
Adjustment of the dynamic range

Illumination

The illumination of our test device is still good. Irregularities can be seen towards the edges - but only at high backlight intensity and in a low-light environment.



Illumination of the monitor with short exposure time



Illumination of the monitor with long exposure time

Image homogeneity

We examine the image homogeneity on the basis of four test images (white, neutral tones with 75 %, 50 %, 25 % brightness), which we measure at 15 points. This results in the averaged brightness deviation in % and the likewise averaged delta C (i.e. the chromaticity difference) in relation to the respective centrally measured value.

-0.04%	-1.11%	-0.08%	+1.12%	+0.8%
+0.26%	-0.17%	0.0%	+0.64%	+0.19%
+2.8%	+1.52%	+1.37%	+2.39%	+1.33%

Brightness distribution [%] (DUE: "Uniformity")

0.3	0.42	0.42	0.63	0.97
0.39	0.63	0.0	0.57	0.63
0.64	0.74	0.23	0.75	0.79

Colour Uniformity [Delta C] (DUE: "Uniformity")

The DUE ("Digital Uniformity Equalizer") has also been implemented excellently in the EIZO CG2700S. The display is extremely uniform across the entire panel surface and all mid-tones. Brightness and colour deviations can neither be detected with the naked eye nor by measurement.

Via the Administrator menu protected with a special key combination (shown in the manual) or ColorNavigator, the interventions of the equalisation function can be reduced (DUE priority: "Brightness"). This increases the contrast range.

-2.71%	-5.6%	-2.37%	-5.54%	-2.45%
-10.93%	-2.78%	0.0%	-4.11%	-10.33%
-9.73%	-0.89%	-2.32%	-1.31%	-10.65%

Brightness distribution [%] (DUE: "Brightness")

0.48	0.54	0.43	0.72	1.26
0.48	0.66	0.0	0.38	0.5
0.27	0.68	0.29	0.67	0.55

Colour purity [Delta C] (DUE: "Brightness")

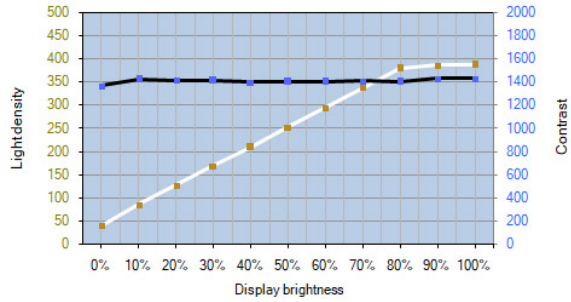
The focus now seems to be on reducing colour drift. While the brightness distribution has clearly deteriorated, the colour deviations still give no cause for criticism.

At this point we would like to point out that the position of our measurements is shifted towards the edges compared to the requirements in ISO 12646.

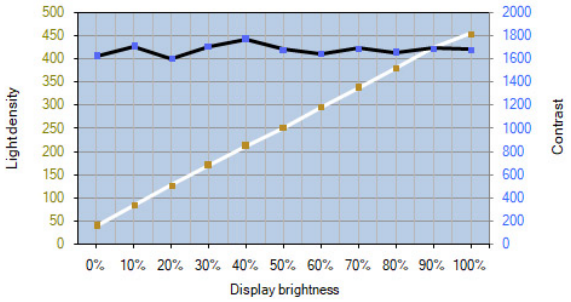
Brightness, black level, contrast

Measurements are taken after calibration to D65 as the white point. If possible, all dynamic controls (including local dimming) are deactivated. Due to the necessary adjustments, the results are lower than when performing the test series with native white point.

The measurement window is not surrounded by a black border. The values can therefore be compared more with ANSI contrast and reflect real-world situations much better than measurements of flat white and black images.



Brightness and contrast curve of the EIZO CG2700S - D65 (DUE: "Uniformity")



Brightness and contrast curve of the EIZO CG2700S - D65 (DUE: "Brightness")

Luminance White (DUE: "Uniformity"):

Brightness	Native	D65	5800 K	D50
100 %	392.9 cd/m²	386.8 cd/m²	379.3 cd/m²	356.0 cd/m²
50 %	-	252.7 cd/m²	-	-
0 %	-	41.0 cd/m²	-	-

Luminance Black (DUE: "Uniformity"):

Brightness	Native	D65	5800 K	D50
100 %	0.27 cd/m²	0.27 cd/m²	0.27 cd/m²	0.27 cd/m²
50 %	-	0.18 cd/m²	-	-
0 %	-	0.03 cd/m²	-	-

Luminance White (DUE: "Brightness"):

Brightness	Native	D65	5800 K	D50
100 %	460.5 cd/m²	454.2 cd/m²	446.7 cd/m²	419.7 cd/m²
50 %	-	252.4 cd/m²	-	-
0 %	-	40.5 cd/m²	-	-

Luminance Black (DUE: "Brightness"):

Brightness	Native	D65	5800 K	D50
100 %	0,27	0.27 cd/m²	0.27 cd/m²	0.27 cd/m²
50 %	-	0.15 cd/m²	-	-
0 %	-	0.03 cd/m²	-	-

With an almost native white point, we achieve a maximum luminance of around 460 cd/m². This is easily sufficient for almost all SDR applications. The only restrictions are for samples according to ISO 3664 P1. The illuminance of 2000 lux required here demands around 640 cd/m² from monitors used in this environment (for example for proof simulation in the pressroom).

A contrast ratio of very good 1600:1 is maintained over the entire range of brightness settings. After switching to DUE mode (Priority: "Uniformity"), the contrast ratio drops only slightly to a still decent 1400:1.

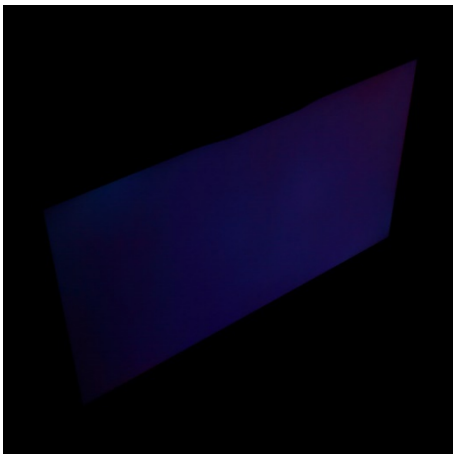
Viewpoint

The factory specification for the maximum viewing angle is 178 degrees horizontally and vertically. The figures are based on a residual contrast of 10:1, which is typical for modern IPS and VA panels. However, further colourimetric changes are not or only insufficiently included in the specification.

Viewing angle of the EIZO CG2700S

The IPS panel of the EIZO CG2700S convinces with its high viewing angle stability. Hue and gradation changes are significantly reduced compared to screens with VA panels. These properties allow large-area display of colour-critical content.

In addition, precautions have been taken to reduce brightening effects caused by the viewing angle. As a result, this improves the subjective black level even when viewed from the front, as the image remains more homogeneous towards the edges even at close viewing distances.



Reduced brightening when viewed from the side

Colorimetric tests

Colour space comparison in CIELAB (D50)

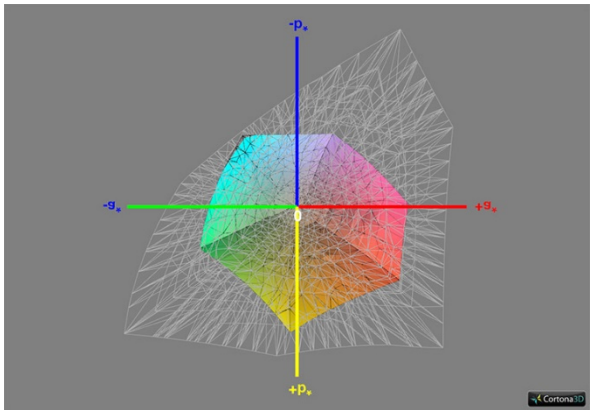
The following illustrations are based on the colourimetric data after a calibration to D65 as white point. The reference white for the preparation in CIELAB is D50 (adapted with Bradford).

White volume: screen colour space
Black volume: reference
colour space Coloured volume: intersection
Comparison targets: sRGB, Adobe RGB, ECI-RGB v2, ISO Coated v2 (ECI), DCI-P3 RGB

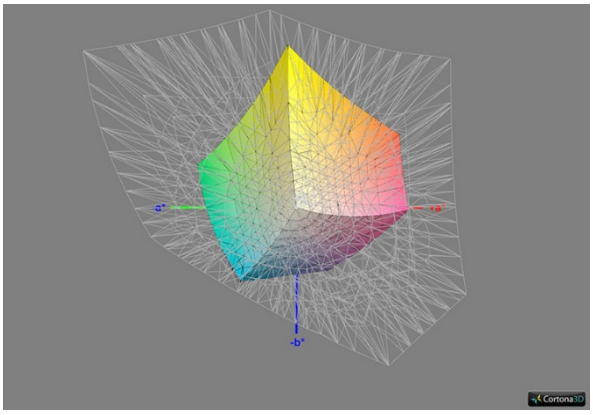
Colour space	Cover
ISO Coated v2	99 %
sRGB	99 %
Adobe RGB	99 %
ECI-RGB v2	92 %
DCI-P3 RGB	97 %

sRGB and Adobe RGB are fully covered. The offset printing condition described by the FOGRA39 characterisation data can also be reproduced precisely. This makes meaningful proof simulations possible. The comparatively high coverage of ECI-RGB v2, which is often used in media-neutral workflows, is also pleasing.

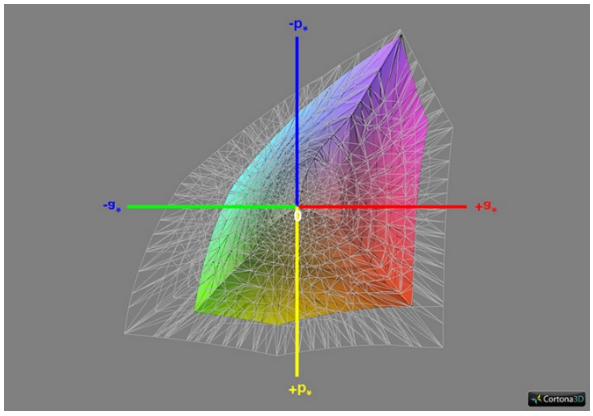
For use in HDR video workflows, the coverage of DCI-P3 RGB plays a major role. Here, the EIZO CG2700S is also convincing.



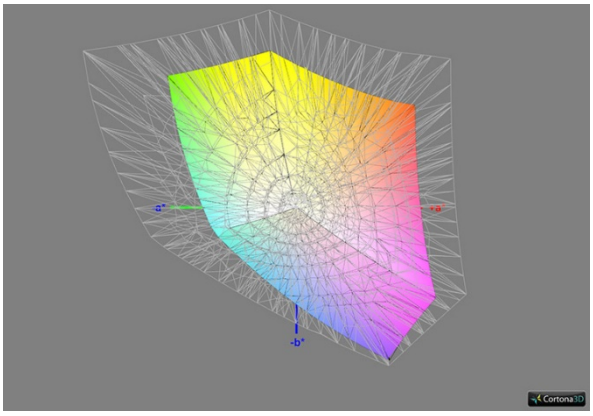
Cover ISO Coated v2, 3D cut 1



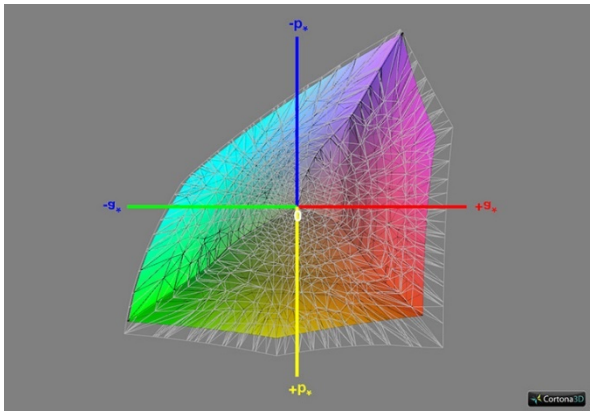
Cover ISO Coated v2, 3D cut 2



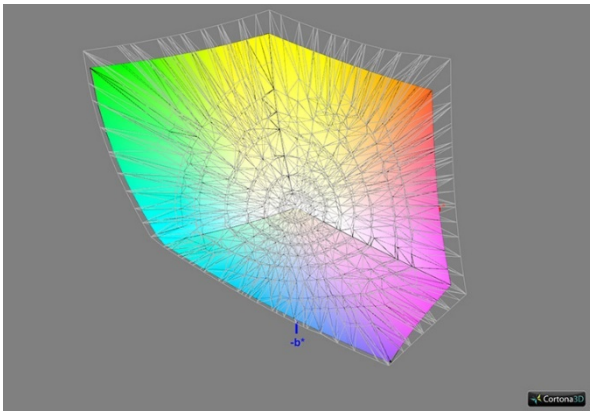
Coverage sRGB, 3D cut 1



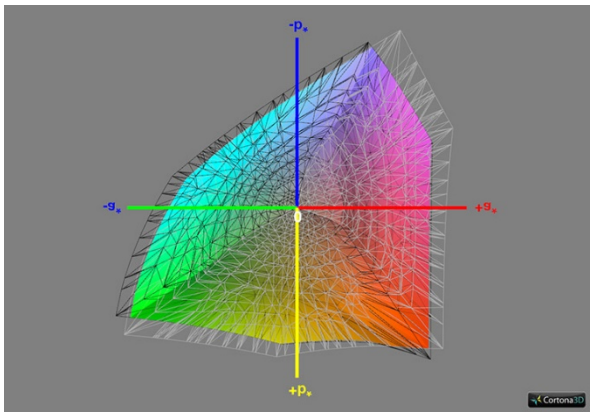
Coverage sRGB, 3D cut 2



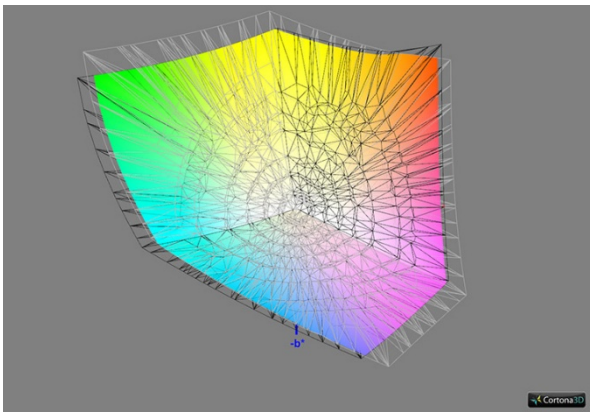
Coverage Adobe RGB, 3D cut 1



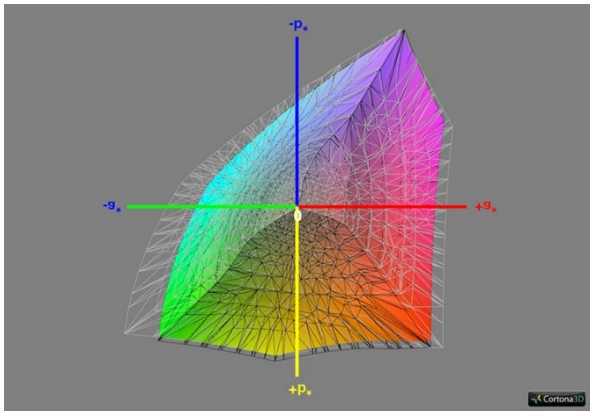
Coverage Adobe RGB, 3D cut 2



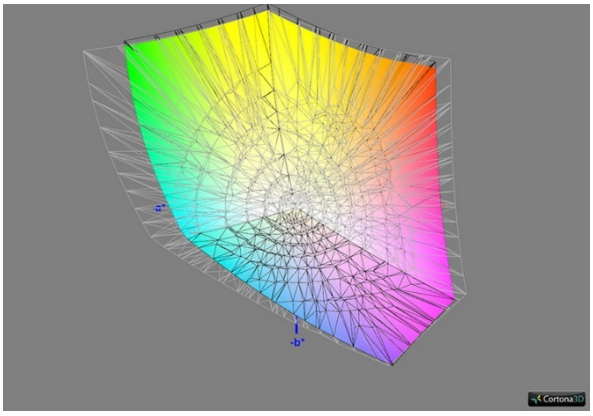
Coverage ECI-RGB v2, 3D cut 1



Coverage ECI-RGB v2, 3D cut 2



Cover DCI-P3 RGB, 3D cut 1



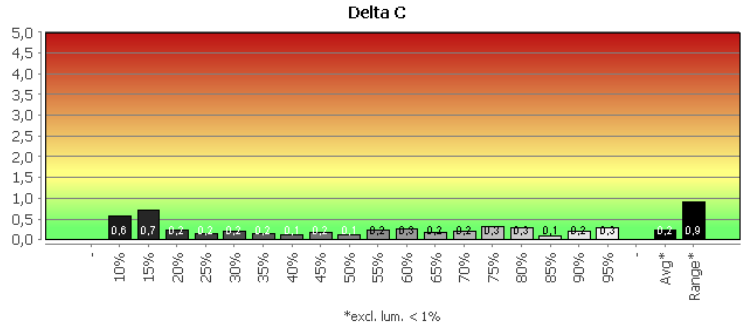
Cover DCI-P3 RGB, 3D cut 2

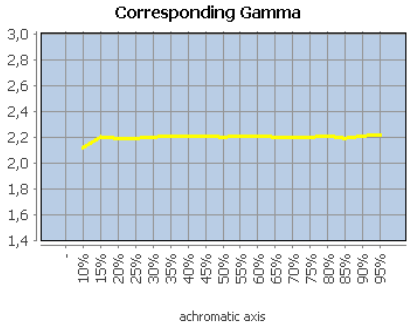
Measurements before calibration and profiling

Dynamic controls are deactivated, if possible, before the subsequent tests.

Factory setting (colour mode: User)

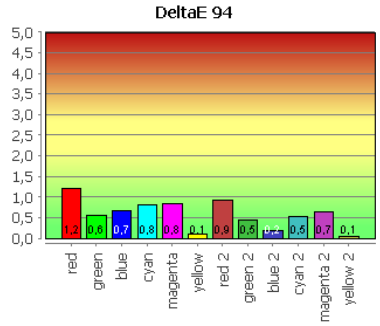
The factory settings of the EIZO CG2700S are convincing. All the parameters we recorded correlate very well with the respective settings in the OSD. The grey balance is excellent.

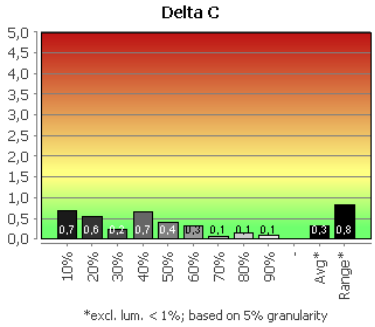


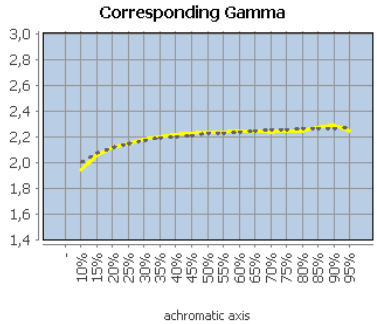


The detailed test results can be downloaded as a PDF file.

Colour mode sRGB compared with sRGB

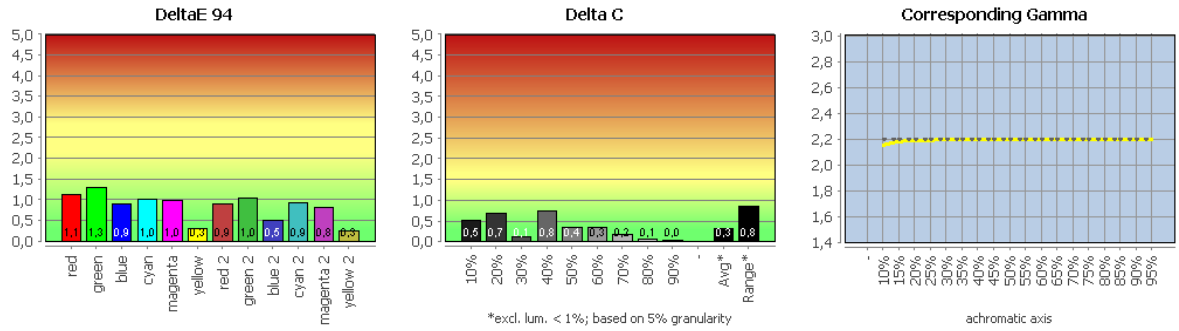






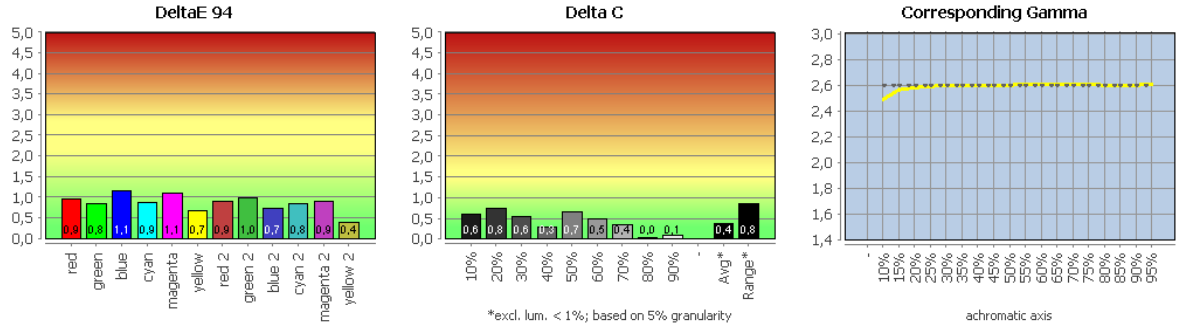
The detailed test results can be downloaded as a PDF file.

Adobe RGB colour mode compared with Adobe RGB



The detailed test results can be downloaded as a PDF file.

Colour mode DCI-P3 RGB compared with DCI-P3 RGB



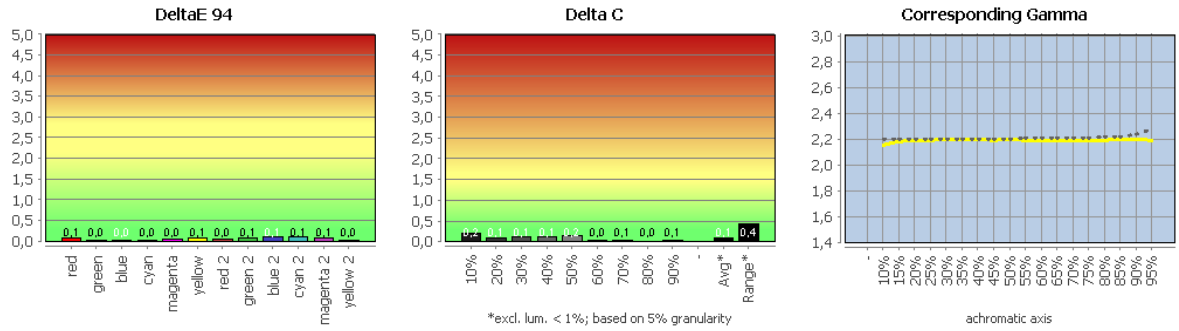
The detailed test results can be downloaded as a PDF file.

Slight deviations in the bright colours are evidence of precise colour space transformations. Corresponding content can thus be reproduced very attractively without further measures, even in applications that are not colour management-capable. The grey balance is still perfect.

Measurements after calibration and profiling

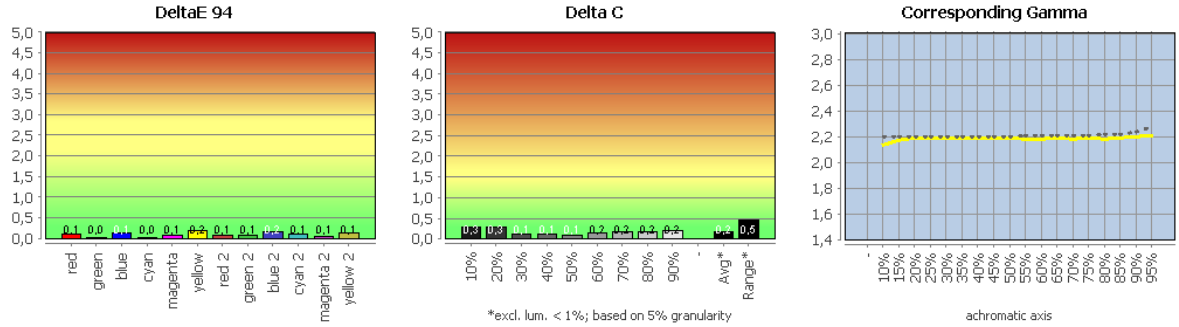
For the following measurements, the EIZO CG2700S was hardware calibrated and profiled from within ColorNavigator with Priority set to "Standard" and Priority set to "Gray balance" (more on this setting in the "ColorNavigator" section). The target brightness was 140 cd/m². D65 was chosen as the white point. Neither of these is a generally valid recommendation. This also applies to the choice of tone curve, especially since the current characteristic is taken into account anyway within the framework of colour management.

Profile validation (Priority: "Standard")



The detailed test results can be downloaded as a PDF file.

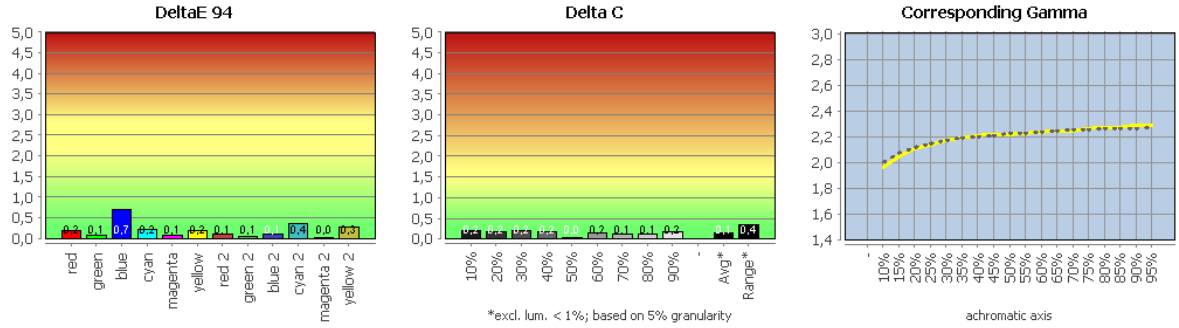
Profile validation (Priority: "Gray balance")



The detailed test results can be downloaded as a PDF file.

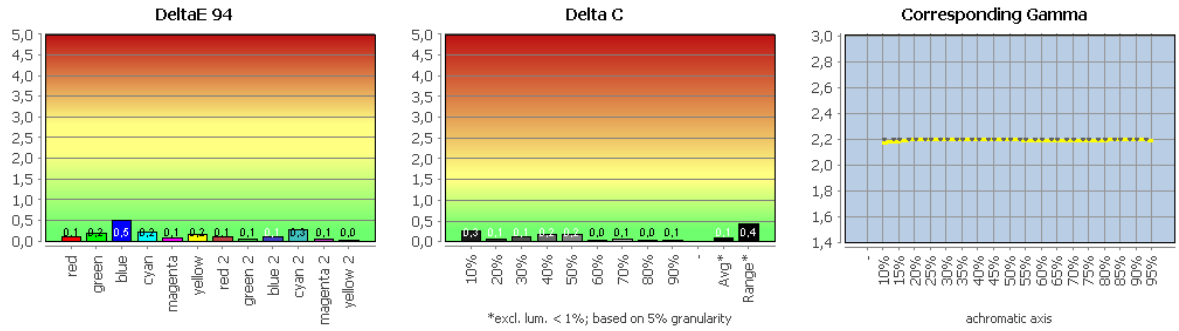
The EIZO CG2700S shows no noticeable drifts or unsightly non-linearities. The shaper/matrix profile describes its condition extremely accurately. A repeat of the profile validation after 24 hours showed no significantly increased deviations. All calibration targets were achieved. The grey balance is virtually perfect.

Comparison with sRGB (colour transformed)



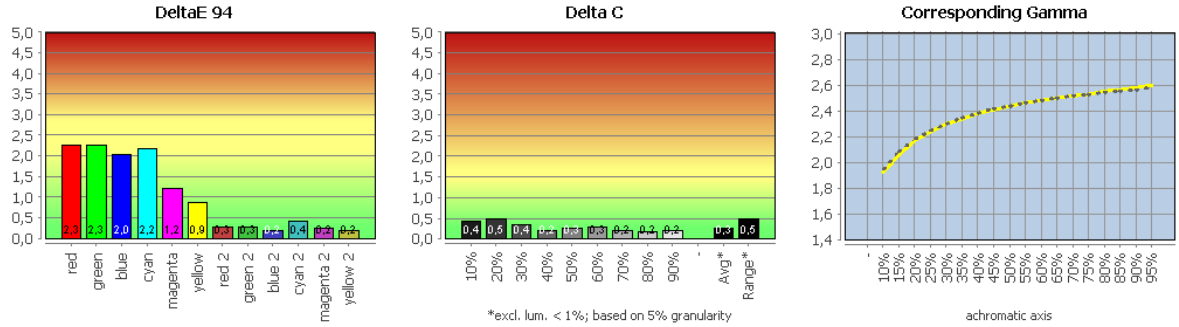
The detailed test results can be downloaded as a PDF file.

Comparison with Adobe RGB (colour transformed)



The detailed test results can be downloaded as a PDF file.

Comparison with ECI-RGB v2 (colour transformed)



The detailed test results can be downloaded as a PDF file.

Our CMM takes into account the working colour space and monitor profile and performs the necessary colour space transformations with colourimetric rendering intent on this basis. This works perfectly for the EIZO CG2700S.

No out-of-gamut colours occur in sRGB and Adobe RGB due to its large colour gamut. Even in ECI-RGB v2 the results are decent. Only a few, strongly saturated tonal values can only be approximately reproduced by mapping to the colour space boundary. Compared to many other monitors with an extended colour space, the risk of tonal value breaks is thus reduced once again.

UDACT ("UGRA test")

Before the test, we calibrated the screen to the following target values, which correspond to UGRA's recommendations for soft proofing tasks (alternatively: L* gradation):

	Brightness	White point (CCT)	White point (XYZ, norm.)	Gradation
Destination	160 cd/m²	5800 K	95.37 100.00 97.39	Gamma 1.8

As part of the certification process, among other things, the UGRA/FOGRA media wedge CMYK is measured on the basis of the selected printing condition. We define here the offset printing condition described by the FOGRA39 characterisation data (glossy or matt coated image printing paper). Certification is not a hurdle for the EIZO CG2700S.

Summary

Calibration (Reference Whitepoint: 5800.00 Kelvin)

White Point	yes
Gray balance	yes
Tone values	yes
Profile quality	yes
Gamut ability	yes

Softproof quality (depends on the calibration verification)

ISO Coated v2 (FOGRA39L)	yes
sRGB	yes
AdobeRGB	yes
ECI-RGB v2.0	yes

Diagram

The monitor has passed the certification according to the UDACT v2.0 specifications.

The detailed test results of the UGRA-UDACT can be downloaded as a PDF file.

ColorNavigator 7

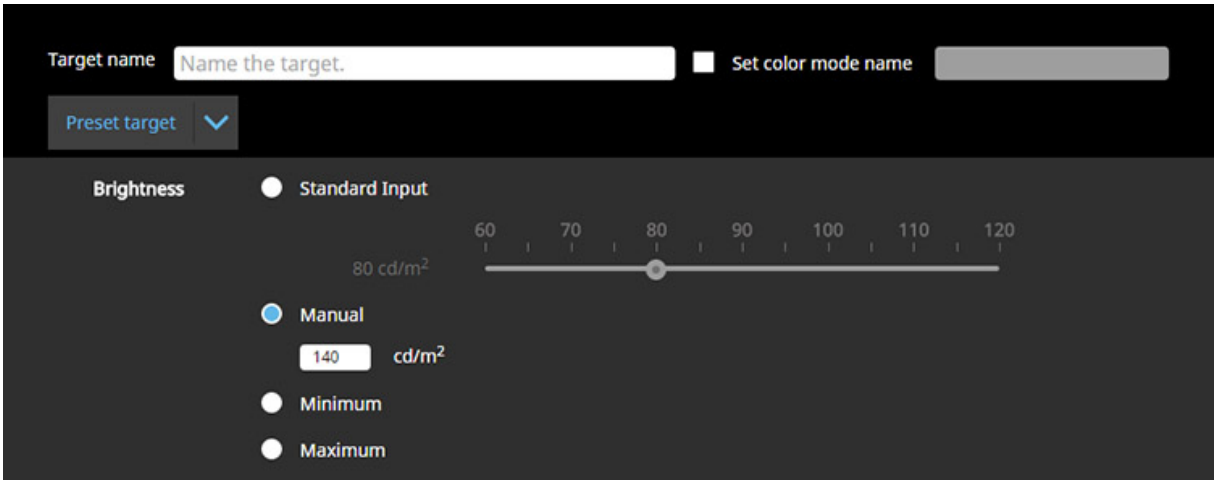
Hardware calibration

The EIZO CG2700S can be calibrated using the supplied ColorNavigator software. Since the scaler or its LUTs are accessed directly, this is a so-called hardware calibration. Numerous measuring devices are supported. The most popular models in the prosumer sector are probably i1Pro (1 to 3), i1Display Pro and Pro Plus from X-Rite as well as Spyder 4, 5 and X from Datacolor. At the other end of the (price) scale is, for example, the Minolta CS-2000, which is also supported.

The user first defines a target and then triggers the calibration. It is possible to switch between already calibrated targets later with a simple mouse click. The flexible colour space emulation is fully integrated into this process.

In the following, we briefly describe the procedure for creating a new destination with manual data entry. Alternatively, various other methods can be used: These include modifying existing targets, reading colourimetric data from ICC profiles, live measurement of another screen and tuning the white point with respect to ambient light or paper white under standard light.

1. "Brightness": The low slider range (60-120 cd/m²) can be overridden by a manual input. This means that the full luminance is also available during hardware calibration.

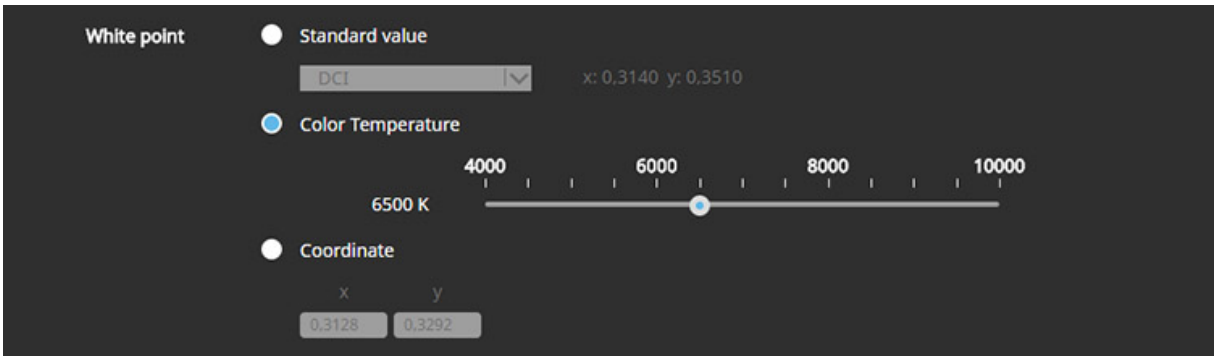


"Brightness"

2. "Black level": The black level can be raised in a defined way if desired.

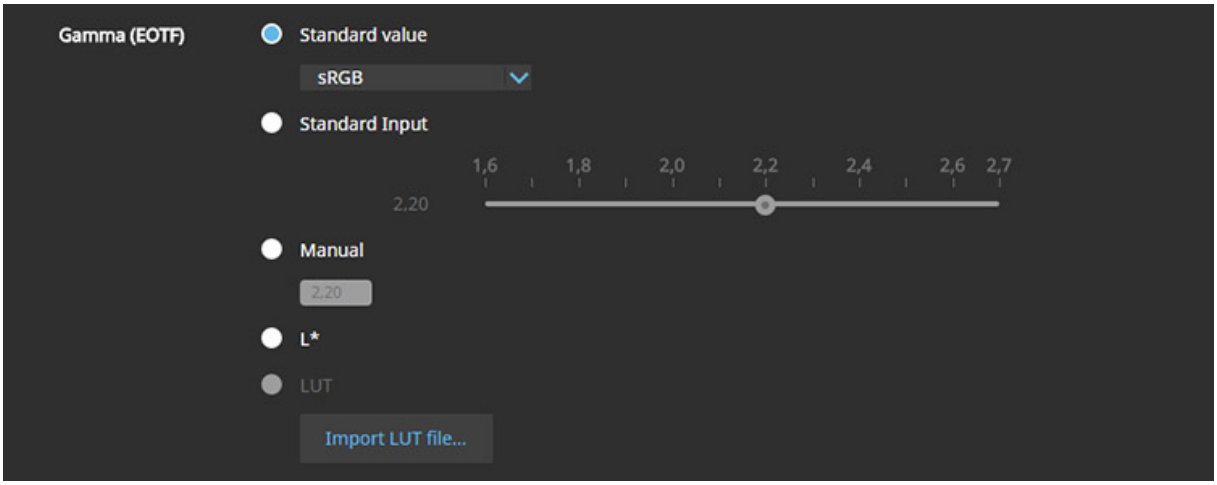
"Black level

3. "White point": The user can choose between different presets in Kelvin (reference: daylight spotlight, illuminant D) and the individual definition in xy standard colour value components.



"White point

4. Gamma (EOTF): Initially, gamma tone value curves (1.0-2.6) and L* as well as sRGB characteristics are available for calibration. However, individual tone value curves can be defined by specifying a suitable colour profile or by loading a text file (CSV) with corresponding assignments. Furthermore, it is possible to select and parameterise PQ and HLG transfer functions. More on this in the section "HDR".

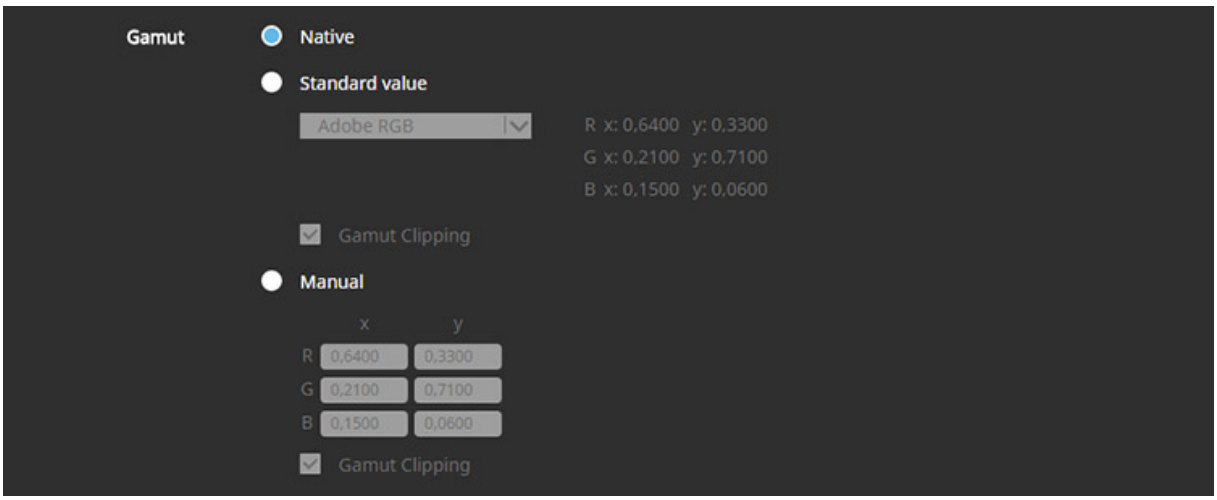


"Gamma (EOTF)"

5. "Priority": The choices under "Priority" control the calibration process. With the "Fixed Gamma" setting, only the white point is adjusted on the basis of concrete measured values. Necessary corrections in the mid-tones are calculated by the scaler. "Standard" optimises the grey balance and tone curve, but does not raise the black level. By choosing "Gray balance", the maximum possible neutrality is achieved. This requires raising the black level to avoid colour casts even in the absolute depths. However, we can no longer see any improvement of the already impeccable result here (see "Profile validation").

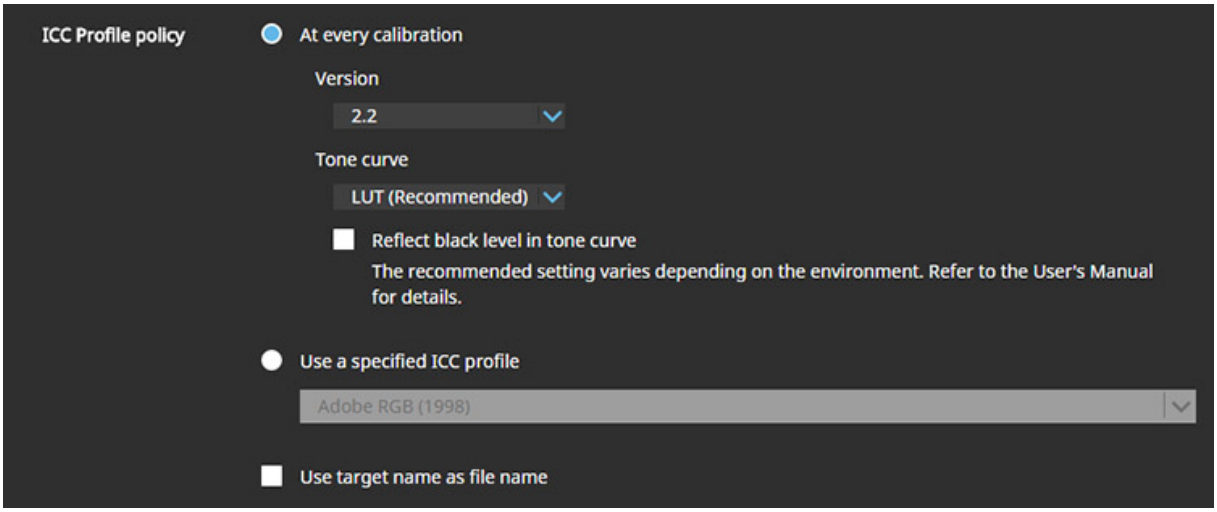
"Priority"

6. "Gamut": In a colour management-enabled workflow, you will mostly want to work on the basis of the native monitor colour space. This maximises flexibility. Alternatively, the colorimetric data of the primary colours can be determined from an ICC profile or by specifying the xy standard chromaticity coordinates. We explain the option "Gamut Clipping" in the section "Colour Space Emulation".



"Gamut"

7. "ICC Profile policy": Finally, the colour profile to be created is specified. It can be saved as v2 or v4 type. CLUT profiles are not generated (only shaper/matrix). In view of the excellent linearity, this is acceptable, especially since the characterisation optionally reflects the actual black level of the monitor.



"ICC Profile policy

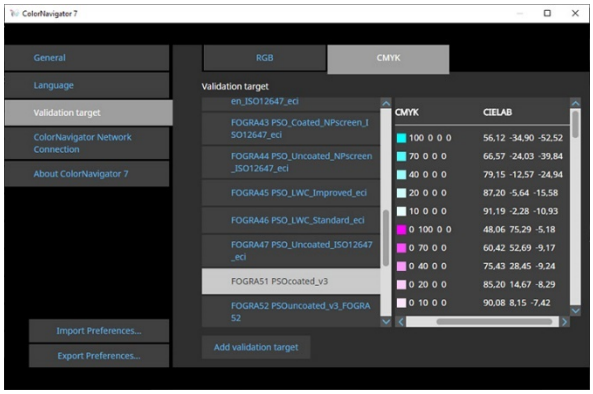
The target is now calibrated with one of the available measuring instruments. This is followed by the profiling. Initially, one memory location is available, but any number of targets can be assigned to it. They must be recalibrated each time. However, each of the predefined image modes (under any new name if required) can also record individual calibration data. Switching is then possible with a mouse click in the task bar. The colour profile in the Windows system folder is also updated.

Testing tools

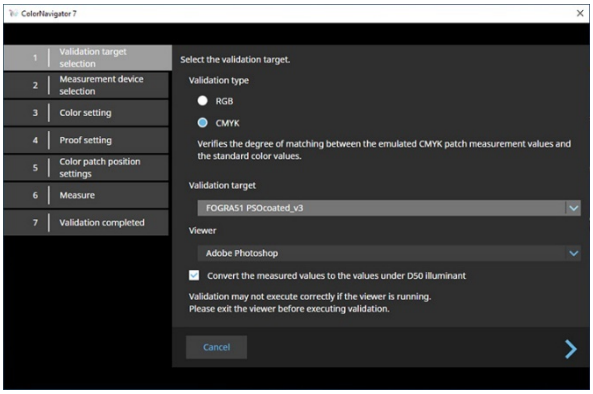
After calibration and profiling have been completed, a quality control can be carried out. In the course of profile validation, any RGB test shapes can be created. EIZO also offers two presets, one of which implements the requirements defined in ISO 12646. The colourimetric data of the displayed colour patches are then compared with the measurement figures resulting from corresponding transformations based on the monitor profile. This target/actual comparison shows how well the calibration target was achieved and how precisely the current characteristic was captured in the profile.

With the EIZO CG2700S, however, CMYK targets can also be measured at this point. External software is used to display the colour patches. Therefore, Adobe Photoshop (from CS1) or Adobe Acrobat (from version 7) must be installed. The actual measurement takes place fully automatically after manual presettings by the user. A softproof display with paper colour simulation is always used. The measured values can thus be compared directly with the target values after a white point adaptation.

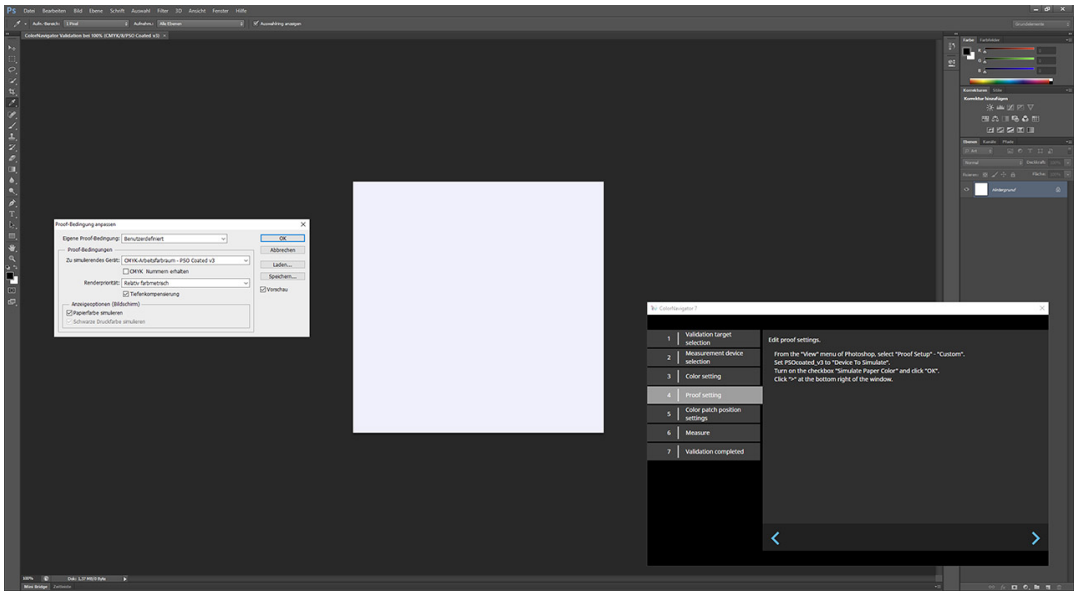
Attention: Unless D50 has been calibrated as the white point, a check box for the corresponding adaptation must now be explicitly activated.



CMYK validation: target definition



CMYK validation: target definition



CMYK validation: Proof simulation and automatic measurement in Adobe Photoshop

Colour space emulation

To configure the colour space emulation, the desired colour gamut is defined via the xy standard colour value components of the primary colours (see section "Hardware calibration", point 6). Alternatively, the data can be read from an ICC profile. In this way, the intended tone value curve is also adopted. Please note that ColorNavigator recalculates the data adapted to D50 in the profile if a "chromatic adaptation tag" is available.

The setting "Gamut Clipping" forces a colourimetric transformation. Out-of-gamut colours are then shifted to the colour space boundary. In-gamut colours are reproduced precisely. Without gamut clipping, the calibration target is internally adjusted to be fully covered by the colour gamut of the monitor. This avoids tonal clipping, but reduces the precision of the reproduction of in-gamut colours - under the premise that a target has been defined that extends beyond the native colour gamut of the monitor.

In order to guarantee the most correct representation possible in colour management-capable applications - here, however, one will usually calibrate without monitor-internal colour space emulation - the ICC profile reflects the emulation target with activated gamut clipping even if the actual monitor colour space is smaller.
However, the colour space transformations can also be precalculated via a CMM and automatically written into the LUT pipeline of the monitor. For this purpose, the user selects

the desired emulation target in the form of an ICC profile and assigns it to a calibration target. As long as its characterisation information is correct, the conversions are performed very accurately and with specified rendering intent (if supported by the profile).

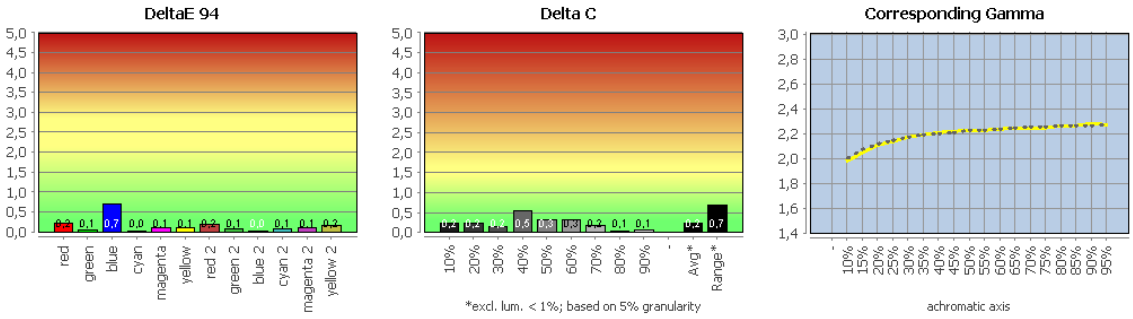
Caution is only required if the monitor profile generated by ColorNavigator reflects the real black value. Since no depth compensation can be used, the selection of RGB working colour spaces as emulation target inevitably leads to tonal value breaks in the depths. In this case, the corresponding setting ("Reflect black level in tone curve") should be omitted in advance of the selected calibration.

Important: The active monitor profile naturally still contains the colourimetric data of the parent target. In colour management-capable applications, this leads to an incorrect display.

A third variant is particularly interesting for professional users in the video sector. Behind the inconspicuous emulation function "LogView LUT Emulation" is a possibility to load ready-made transformations into the 3D LUT of the monitor. If only generic CLUTs are available (for example, according to Rec. 709), they are assigned to a corresponding emulation target.

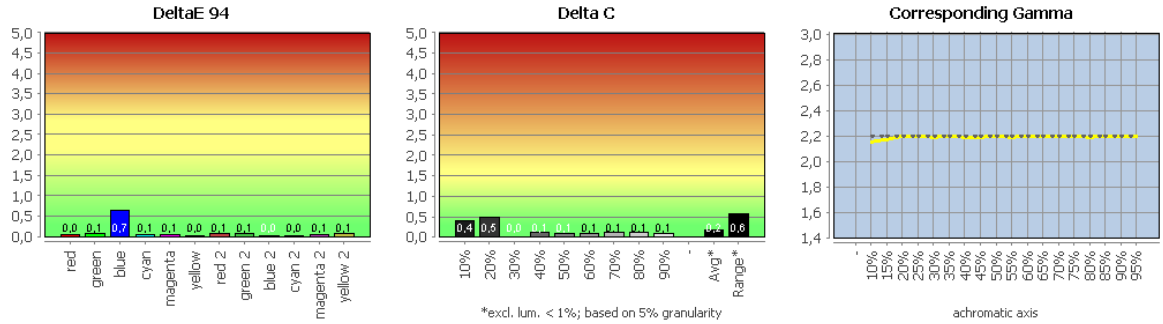
In the following we have used the colour space emulation from within ColorNavigator to simulate sRGB, Adobe RGB and ECI-RGB v2 with gamut clipping enabled. The measurements against the respective working colour space are carried out without colour management. A CMM is therefore not used.

Comparison of sRGB emulation with sRGB



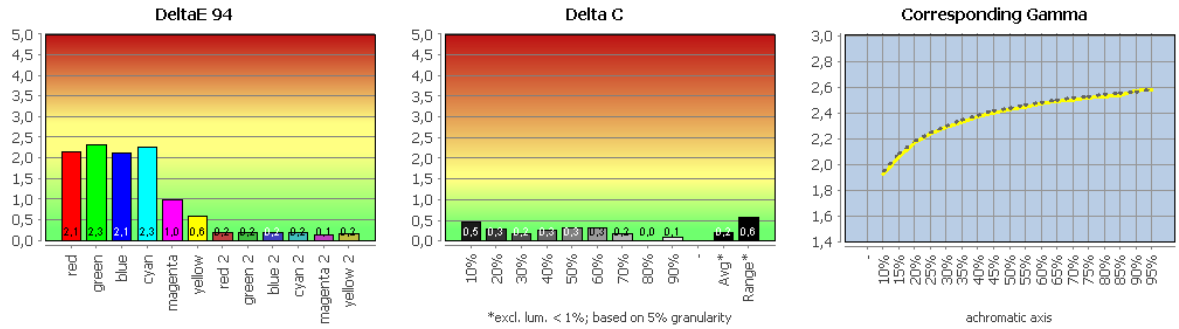
The detailed test results can be downloaded as a PDF file.

Comparison of Adobe RGB emulation with Adobe RGB



The detailed test results can be downloaded as a PDF file.

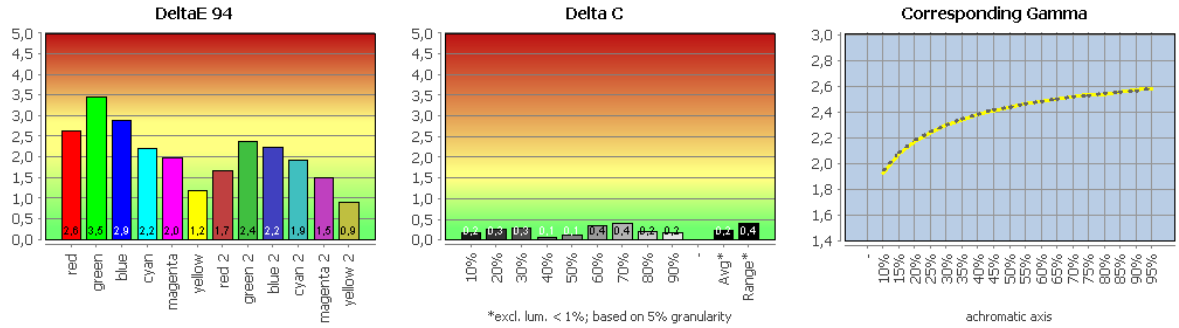
Comparison of ECI-RGB v2 emulation with ECI-RGB v2



The detailed test results can be downloaded as a PDF file.

The colour space transformations are implemented precisely. This enables a defined representation even outside the ICC workflow. The emulation of ECI-RGB v2 shows the relatively colourimetric rendering intent in the result: tonal values within the monitor colour space are ideally converted. All other tonal values end up on the colour space boundary.

For comparison, we have simulated ECI-RGB v2 again with deactivated gamut clipping. This inevitably leads to increased deviations even in areas that lie within the monitor colour space. On the other hand, the full tonal range of the input signal is preserved.

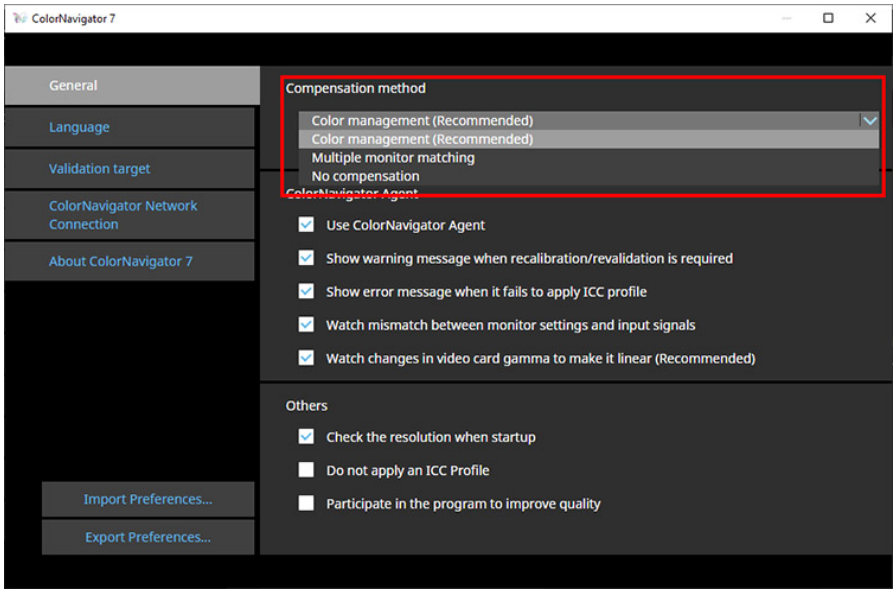


The detailed test results can be downloaded as a PDF file.

Colorimeter correction

The measuring principle on which a colourimeter is based is borrowed from the human eye. Here, the spectral sensitivity of the CIE standard observer is simulated by photoelectric receivers with upstream filters. The design and tuning of the filters (at least three, but often more) are of decisive importance for the achievable measurement accuracy. Due to remaining differences, corrective measures are necessary, which in each case refer to specific reference monitors with characteristic emission spectra.

The correction for the supported colourimeters stored by EIZO in ColorNavigator is hidden in the preferences under the item "Measurement Device".



Correction for colorimeter

The white point deviation - in relation to the i1Pro 2 we used as a reference - is dE = 2.6 for the i1Display Pro Plus after correction. Without further correction, the deviation decreases to dE = 1.4. However, this is obviously not based on X-Rite's generic characterisation. We achieve the best coverage with the characterisation for GB-r LED backlights (RG_Phosphor_Family_25Jul12.edr). For our i1Display Pro, the deviations are dE = 1.7 (with additional correction) or 0.8 (without further correction).

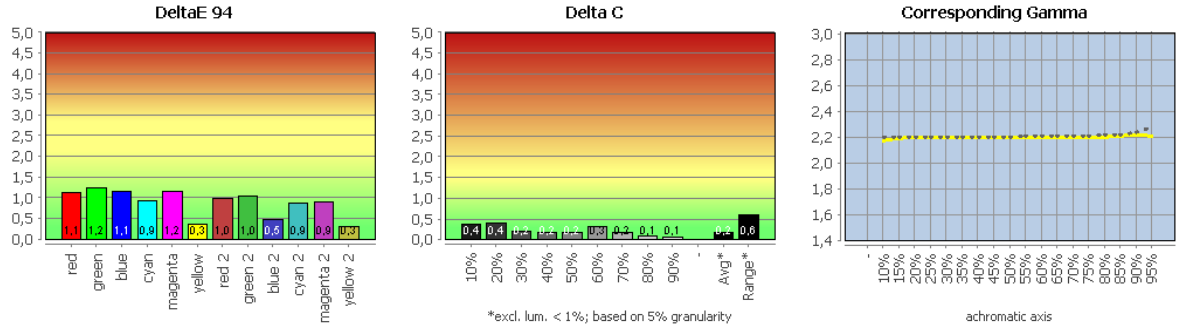
Of course, the i1Pro, no matter in which version, is not an ideal reference. In the past, however, we always achieved slightly better results with the EIZO correction. None of the deviations mentioned are problematic. Other influencing factors and limitations of colour measurement technology and metrics weigh much more heavily.

Built-in measuring device

The built-in measuring device can be selected as a separate probe in ColorNavigator. It allows you to completely dispense with your own measuring equipment and automatically extends in the upper middle range after activation.

The built-in measuring device in action

For testing purposes, we performed calibration and profiling with the built-in meter and then validated the profile with the X-Rite i1Pro 2.
Profile validation (built-in measuring device uncorrelated => i1Pro 2)

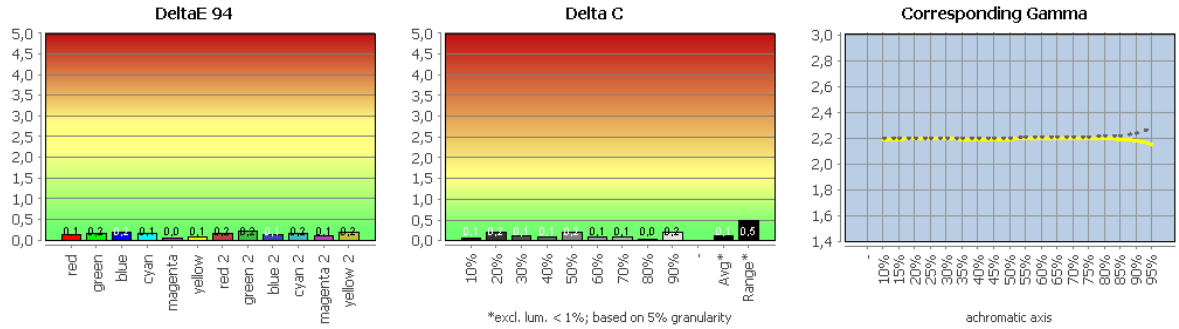


The result is convincing. The slightly increased white point deviation should not be allowed to get the better of you.

If you want to adjust the measurements to an existing probe, this can be done easily via the correlation function. For this purpose, the same measurement series (RGBW) of internal and external probe is run through. The results form the basis for a correction that is automatically applied in the form of a simple 3-x-3 matrix.

The detailed test results can be downloaded as a PDF file.

Profile validation (built-in measuring device correlated => i1Pro 2)



Using the built-in measuring device, the EIZO CG2700S can be recalibrated on a regular basis. This increases the precision between complete calibration and profiling runs via ColorNavigator, which also need to be carried out less frequently.

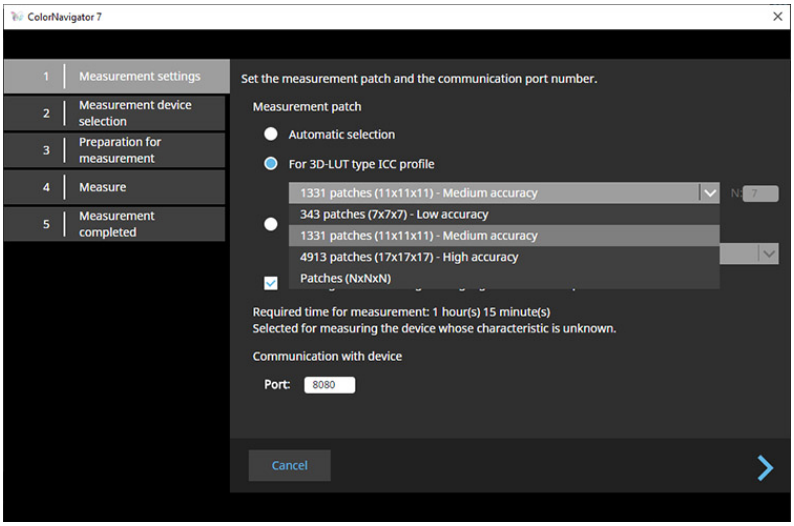
The configuration is simple. If one has already calibrated the screen, the necessary parameters are already noted. The user only has to set the desired time interval.

The detailed test results can be downloaded as a PDF file.

Profiling of other display devices (e.g. tablets and smartphones)

Another interesting function is the profiling of external screen devices such as tablets or smartphones. The test fields are displayed fully automatically on the target device via

internet browser. The necessary network port is specified by the user during configuration. The results can be saved as a matrix or LUT profile and of course also used for colour space emulation.



Profiling of further display units

HDR

Due to its specification, the EIZO CG2700S is not originally designed for the reproduction of HDR material. However, the manufacturer uses the powerful electronic substructure very smartly and helps the newcomer to achieve the best possible properties in this area. Enough for simple sampling. HDR metadata are not processed.

The VESA specifications provide for the HDR10 format as the transmission standard. The signal to be processed has the following properties at its core:

- 10 bit per channel
- Absolute tone value curve according to SMPTE ST 2084
- Colour gamut according to ITU-R BT.2020
- Processing of static metadata defined in SMPTE ST2086

The absolute tone value curve is based on a basic concept that has long been known from the medical field (DICOM). The objective is maximum coding efficiency even under unfavourable conditions (an eye that is always brightness-adapted to assess a minimum difference). There is plenty of room for improvement for the maximum brightness. The same applies to the colour gamut, which could only be achieved with monochromatic primary colours. The VESA takes this into account and defines DCI-P3 RGB as the reference colour space.

The display technology is a good deal behind this transmission standard. However, metadata relating to the specific mastering characterises the material accordingly. The monitor's scaler can then make an adjustment. The basic concept is reminiscent of colour transformations based on ICC profiles, in which a CMM acts on the basis of source and target profile (but here via the diversions of a device-independent colour space that encompasses all perceivable colours).

This is where the difficulties for test magazines begin: HDR10 does not define the adjustment (people like to talk about tone mapping). This is by no means unknown when dealing with ICC profiles: The perceptual rendering intent is transported by the profile manufacturer under various assumptions via corresponding tables. There is no specification

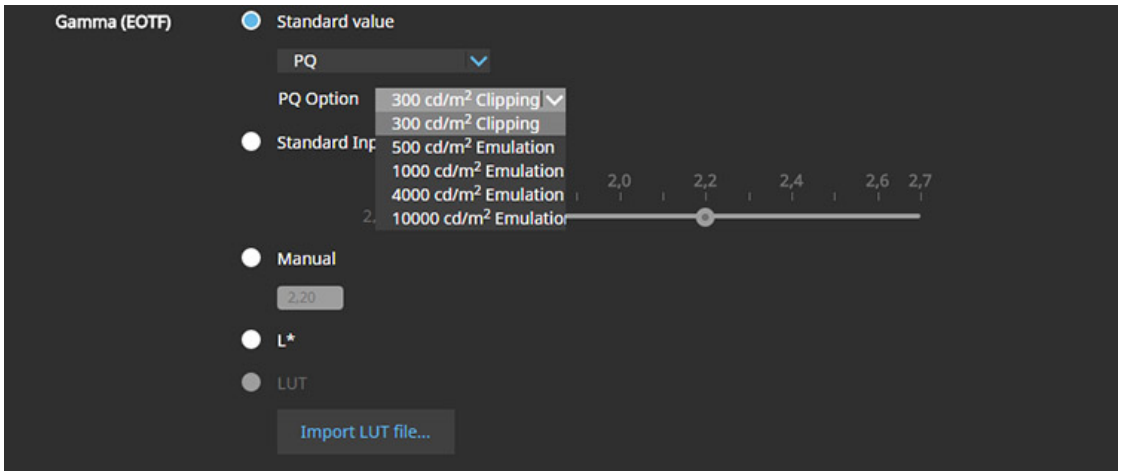
on the part of the ICC, even though the first steps in this direction were taken in version 4.

In the following, we will focus primarily on HDR10 reproduction.

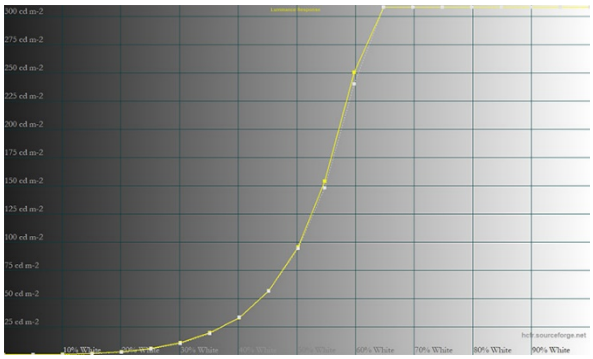
OSD and ColorNavigator make the PQ transfer function available. The settings include:

- 300 cd/m² clipping
- 500 cd/m² emulation
- 1000 cd/m² emulation
- 4000 cd/m² emulation
- 10 000 cd/m² emulation

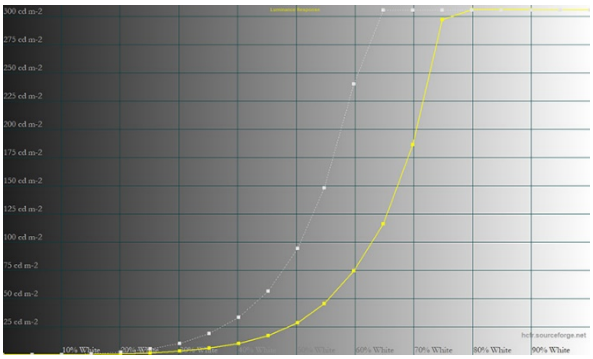
The implementation promises accurate reproduction up to 300 cd/m² for the single clipping setting. Beyond that, of course, differentiation is no longer possible. The emulation settings differentiate up to the eponymous threshold value. Naturally, the precision decreases with increasingly higher values. An interesting feature is the colour highlighting of areas that exceed the threshold values listed above.



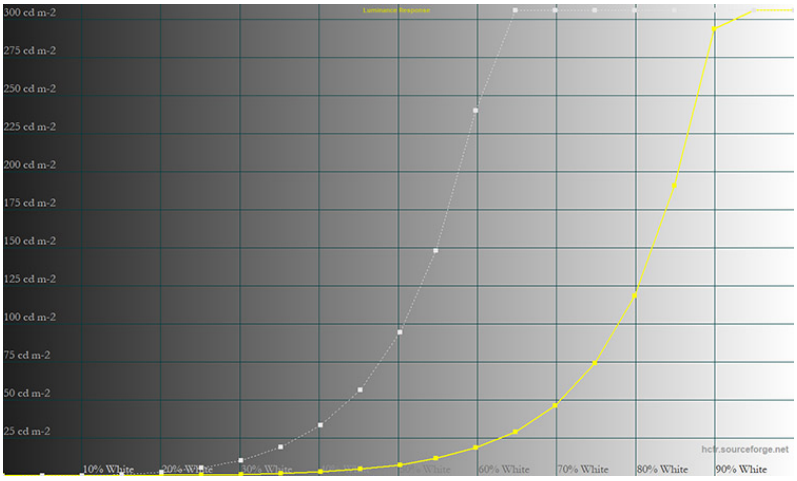
Configuration PQ transfer function in ColorNavigator



PQ 300 cd/m² clipping



PQ 1000 cd/m² emulation

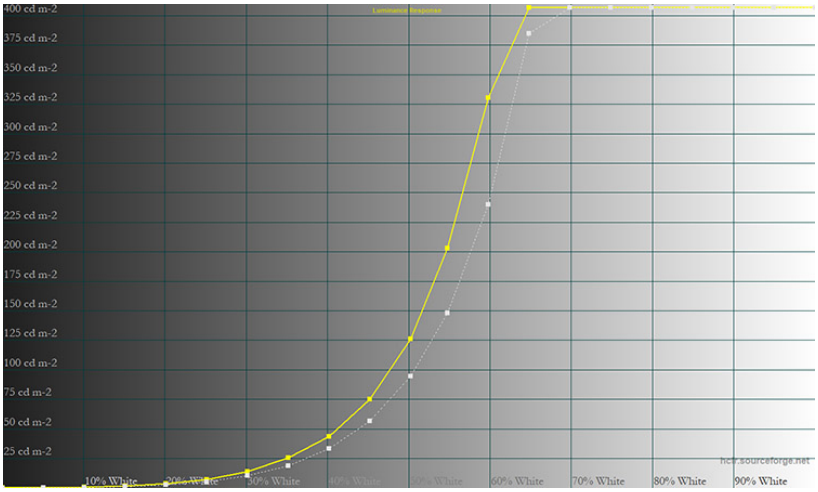


PQ 4000 cd/m² emulation

In the graphics, the target characteristic is deposited as a light grey curve. It is based on the measured maximum brightness and from there follows the PQ transfer function (according to SMPTE ST 2084). This results in a more or less large clipping range for all real monitors, as the maximum 10 000 cd/m² are not reached.

All settings live up to their name. However, with the 4000 cd/m² emulation at the latest, the tone value curve is inevitably lowered to such an extent that even halfway sensible sampling is no longer possible under the given parameters.

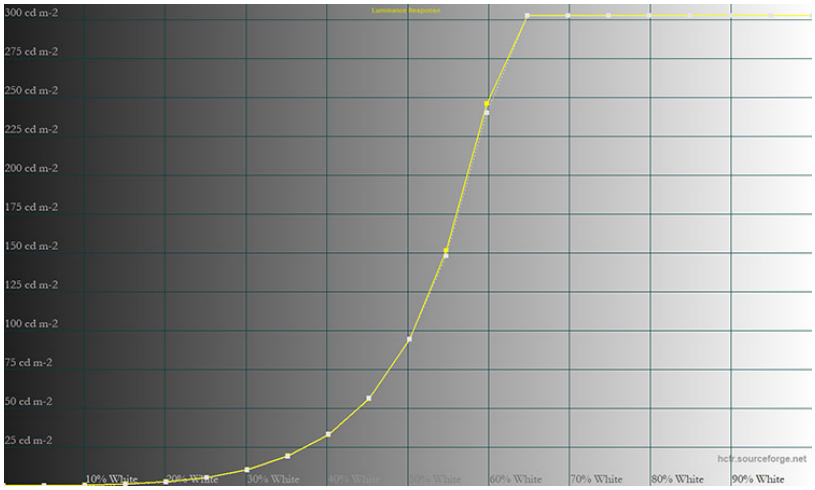
The brightness setting should definitely be 300 cd/m². Deviating values lead to a loss of precision because the calculations are always based on this maximum brightness. Unfortunately, this also applies to hardware calibration.



PQ 300 cd/m² clipping with 400 cd/m² luminance

The tone value curve now no longer follows the target characteristic, but is always slightly above it.

Below we have prepared the results for 300 cd/m² clipping after the hardware calibration:



PQ 300 cd/m² clipping after hardware calibration

Here, too, there is nothing to complain about. The target characteristics are achieved precisely. Moreover, the grey balance was perfect in all test scenarios.

Based on the colour space emulation, we finally carried out a more extensive series of measurements. For this purpose, the PQ transfer function with the setting "300 cd/m² clipping" and a colour gamut according to ITU-R BT.2020 with "gamut clipping" were selected in ColorNavigator (HDR10-compliant). Since the colour gamut of the material generally does not exceed DCI-P3 RGB, no additional tonal value breaks are to be expected despite the extensive gamut clipping. Corresponding out-of-gamut colours are simply not included.

Unfortunately, EIZO does not offer a corresponding predefined picture mode here. The "PQ_DCI-P3" mode offered in the OSD uses a DCI-P3 RGB emulation and implements the PQ transfer function in the 1000 cd/m² clipping setting.

Hardware calibration: PQ 300 cd/m² clipping, ITU-R BT.2020 ("Gamut Clipping")

	Red	Green	Blue	Cyan	Magenta	Yellow
dE94	1,6	1,0	0,7	0,1	0,1	1,0

	Red2	Green2	Blue2	Cyan2	Magenta2	Yellow2
dE94	0,5	0,7	1,0	1,0	0,6	0,8

	Gray35	Gray50	Gray80	White
dE94	0,5	0,8	0,6	0,0

Colour deviations PQ 300 cd/m² clipping and ITU-R-BT.2020 emulation ("gamut clipping") after hardware calibration

In contrast to SDR measurements, the reference point for the evaluation is not the white point at maximum brightness, but an area white with only around 100 cd/m². Here we

assume a complete visual adaptation (adjustments via Bradford). Only colour patches that are within the colour gamut of DCI-P3 RGB but encoded in ITU-R BT.2020 are used.

The colour reproduction of the EIZO CG2700S is once again convincing across the board. The results without prior calibration are hardly worse.

In addition to the PQ transfer function, the EIZO CG2700S also supports the HLG characteristic (Hybrid Log Gamma). This is a relative tone value curve. HDR material encoded accordingly has the advantage of still being reproduced reasonably acceptably on an SDR reproduction device with gamma 2.4/2.2 characteristics (the peak highlights are strongly compressed at the "upper stop"). The metadata-free HLG is therefore mainly used for TV broadcasts. Due to time constraints, we could not make any measurements here.

Reaction behaviour

We tested the EIZO CG2700S in native resolution at 60 Hz on the DisplayPort connection. The monitor was reset to factory settings for the measurement.

Image build-up time and acceleration behaviour

We determine the image build-up time for the black to white change and the best grey to grey change. In addition, we give the average value for our 15 measuring points.

The data sheet specifies a response time of 19 ms (GtG). The EIZO CG2700S does not implement an overdrive function.

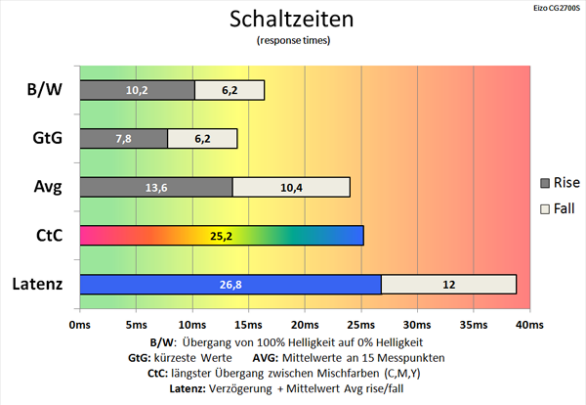
The switching time diagram shows, among other things, how different brightness jumps add up, how fast the monitor reacts in the factory setting in the best case and what average reaction time can be assumed.

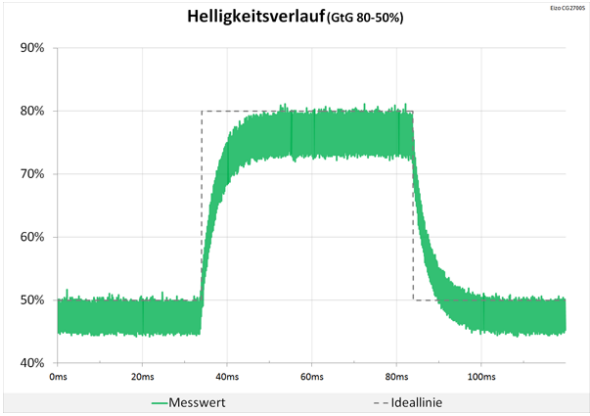
The measurement Color to Color (CtC) goes beyond the conventional measurements of single-colour brightness jumps, after all, one usually sees a coloured image on the screen. This measurement therefore measures the longest period of time that the monitor needs to change from one mixed colour to the other and stabilise its brightness.

The mixed colours cyan, magenta and yellow are used - each with 50 % signal brightness. With the CtC colour change, not all three subpixels of a pixel switch in the same way, but different rise and fall times are combined.

Switching times

We determine the black/white change with 16.4 ms and the fastest grey change with 6.2 ms. The average value for all our 15 measuring points is 7 ms. The CtC value is slow at 25.2 ms, but is still within reason given the deactivated pixel acceleration. The brightness curve (GtG 80-50 %) is of course completely neutral.



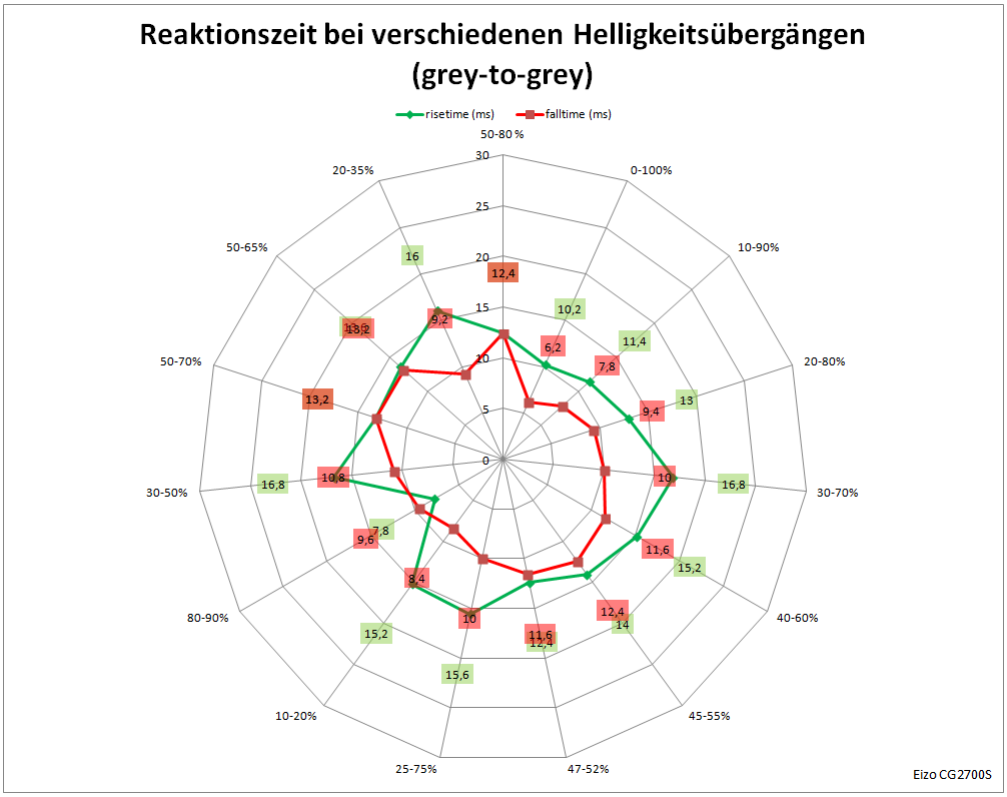


Leisurely switching times

Completely neutral tuning

Network diagram

In the following network diagram you can see an overview of all the measured values for the different brightness jumps of our measurements. Ideally, the green and red lines are close to the centre. Each axis represents a brightness jump of the monitor defined in level and dynamics, measured via light sensor and oscilloscope.



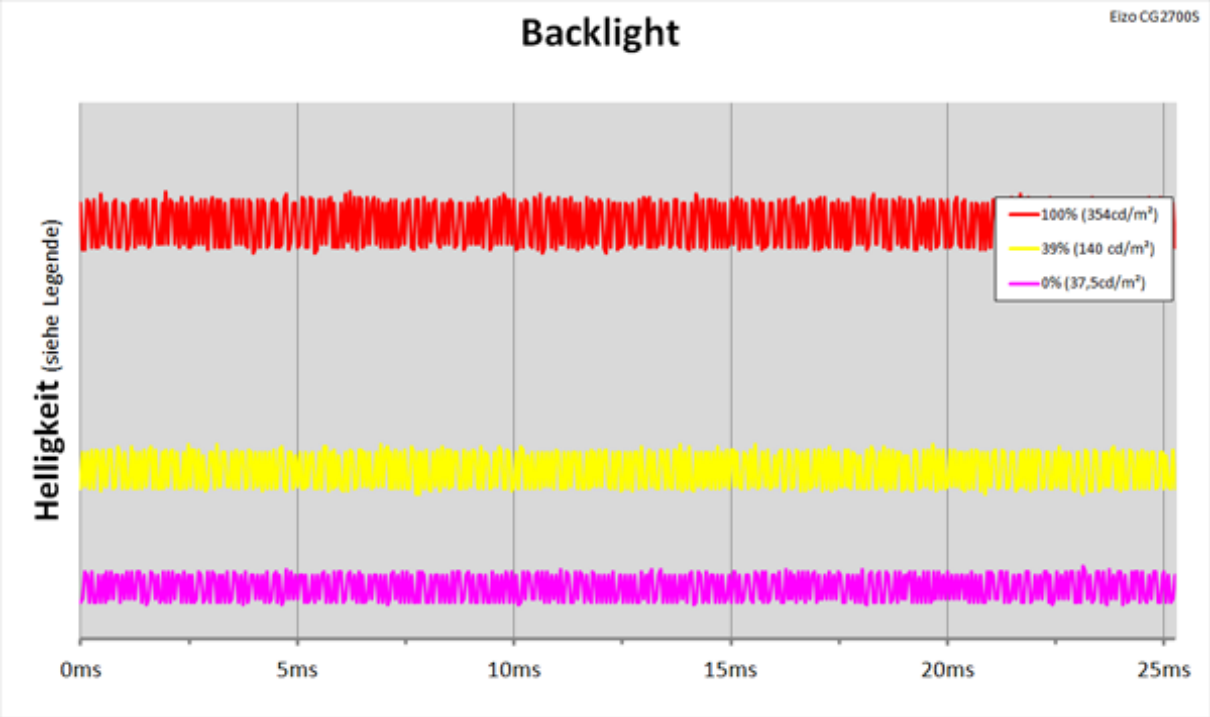
Network diagram

Latency

The latency or signal delay time is an important value for gamers, as low values guarantee direct feedback. At 60 Hz, the latency is relatively high at 26.8 ms.

Backlight

The background light of the monitor is not reduced by pulse width modulation (PWM), therefore there are no interruptions in the luminous flux (flickering). Thus, the monitor is suitable for fatigue-free work even at reduced brightness. The maximum brightness is 354 cd/m² (setting 373 cd/m²).



LED backlight with PWM brightness control

Note: The brightness setting is not in percentages, but is entered directly in cd/m² (minimum 40 to maximum 450 cd/m²). To achieve 140 cd/m², we had to select a somewhat higher setting of 144 cd/m² (around 39 % of max. 373 cd/m²). In the darkest brightness setting (40 cd/m² or 0 % in the chart), we measured 37.5 cd/m².

Subjective evaluation

You can't deny it: gaming is not the domain of the EIZO CG2700S. And it is only here that it shows its first weaknesses. The display quality itself is very good, but there are problems with the moving image and latency. Ambitious gamers might be put off by this. However, the monitor was not designed for this purpose anyway.

Evaluation

Housing processing and mechanics:	5
Ergonomics:	5
Operation/OSD:	5
Energy consumption:	2
Noise generation:	5
Subjective image impression:	5
Viewing angle dependence:	5
Contrast:	5
Illumination (black image):	4
Image homogeneity (brightness distribution Uniformity Comp.: On; Off):	5; 4
Image Homogeneity (Colour Uniformity Comp.: On; Off):	5; 5
Colour space volume (ISO Coated v2; sRGB; Adobe RGB; ECI-RGB v2, DCI-P3 RGB):	5; 5; 5; 4; 5
Before calibration:	5
Before calibration (sRGB; Adobe RGB):	5; 5
After calibration (sRGB; Adobe RGB):	5; 5
After calibration (profile validation):	5
Interpolated image:	4
Suitable for casual players:	2
Suitable for hardcore players:	1
Suitable for DVD/Video (PC):	5
Suitable for DVD/video (external feed):	5
Price-performance ratio:	4
Price [incl. VAT in Euro]:	approx. 2,106 €
Overall ranking:	4.6 (VERY GOOD)

Conclusion

It doesn't really need many words. The EIZO CG2700S is a great monitor and a worthy addition to the ColorEdge product line. The IPS panel can fully convince in terms of picture quality. Contrast range and viewing angle stability are very good, and the DUE helps to achieve impeccable surface homogeneity. Its high colour gamut enables the owner of the CG2700S to perform the most demanding image retouching and colour-safe proof simulations.

Special praise is due to the electronics. The self-developed scaler cast in an ASIC manages tables with a precision of up to 16 bits. ColorNavigator can make full use of them during hardware calibration. The reproduction of even colour-critical content succeeds accordingly precisely and without colour breaks. The colour space emulation is integrated into the calibration process and ensures colour reliability even in applications that are not colour management-capable.

The built-in, well-tuned measuring device makes a separate probe superfluous in most cases. Self-calibration ensures compliance with calibration targets over time and can meanwhile even be started during operation.

The range of functions of the ColorNavigator software is extremely large. Over a long period of development, almost all points of criticism have not only been eliminated, but have been

transformed into strengths. The usability has hardly suffered in the process. Even non-professionals quickly find their way around.

Although the EIZO CG2700S is not aimed at demanding HDR workflows, we like the parameterisable PQ and HLG transfer functions. Simple control tasks are thus quite possible.

Criticism can at best be formulated at an extremely high level. The WQHD resolution is not exactly a technical revolution. However, the CG2700X will fill this gap in the future. Moreover, the colour-safe Japanese is certainly not a gaming pro - which no one would have seriously expected. In all crucial areas, EIZO once again shows what is possible with good R&D and optimised production processes.

After so much praise, one's gaze wanders anxiously to the price tag. And indeed, it is little wonder that so much performance cannot be had on special offer. A street price of just under 2,300 euros is nevertheless reasonable.

Note: PRAD received the CG2700S on loan from EIZO for testing purposes. The manufacturer had no influence on the test report, no obligation to publish it and no confidentiality agreement.

Link to the original test report: https://www.prad.de/testberichte/test-eizo-cg2700s-bildbearbeitung-in-perfektion/