


Monitor calibration tutorial

When editing and reviewing images and visual effects, it's important to work with a calibrated monitor. Calibration ensures you get the truest representation of colors and luminance your monitor can display. Usually, the process consists of either tweaking your monitor's settings, or generating a color profile that your computer applies on the displayed image.

Calibration is often overlooked or considered unnecessary, because players don't play on calibrated monitors or TVs. Even though this is generally true, it's good development practice to create and edit your images in the best conditions you can get. Working on a biased monitor only adds more bias to what the player sees when they play the game on their own screen.

Calibration is also essential when working with a team or artists or developers. It keeps your visual workspace consistent, ensuring that everyone looks at the game in the same conditions and keeps the aesthetic the same across several artists' work.

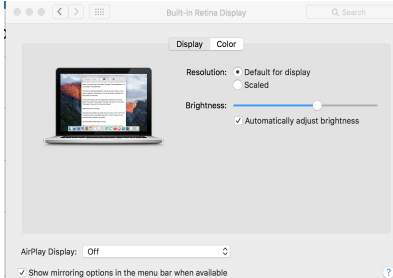
- Step-by-step guide
 - Set-up
 - Calibration
- Advanced calibration
 - Quality check
 - Refining your calibration
 - Calibration frequency
 - TV Calibration
 - Troubleshooting
 - Windows color management issues

	<p>This page takes you through the steps of calibrating your screen using the i1 Display Pro from X-Rite. This device covers a good range of display technologies, and offers a quick and efficient calibration process.</p> <p>It costs around 230 EUR / 250 USD (price quoted October 2016). It runs on macOS and Windows, and is compatible with some apps on Linux (please note Unity has not extensively tested the device on Linux).</p>
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Step-by-step guide

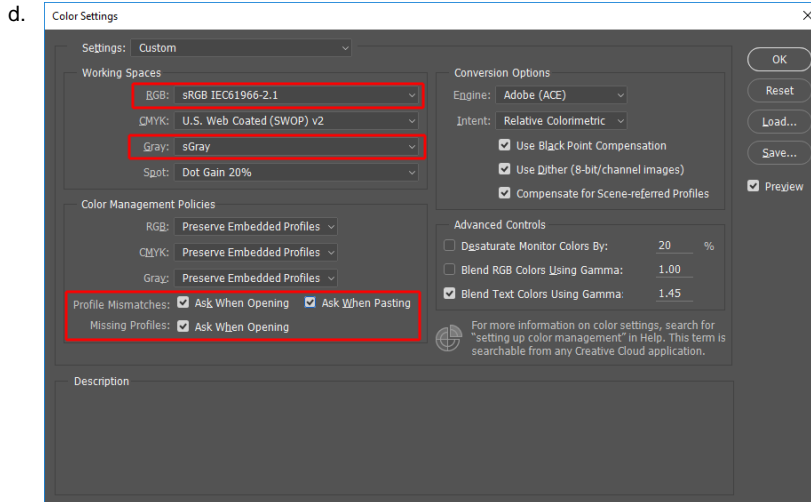
Set-up

1. Make sure that your monitor has been switched on for at least half an hour. This is necessary because the monitor's display colors might change as it warms up.
2. Go to your **Display Settings** and set your monitor to its native resolution. On Windows, this is the **(Recommended)** option; on macOS, it's the **Default for display** option.

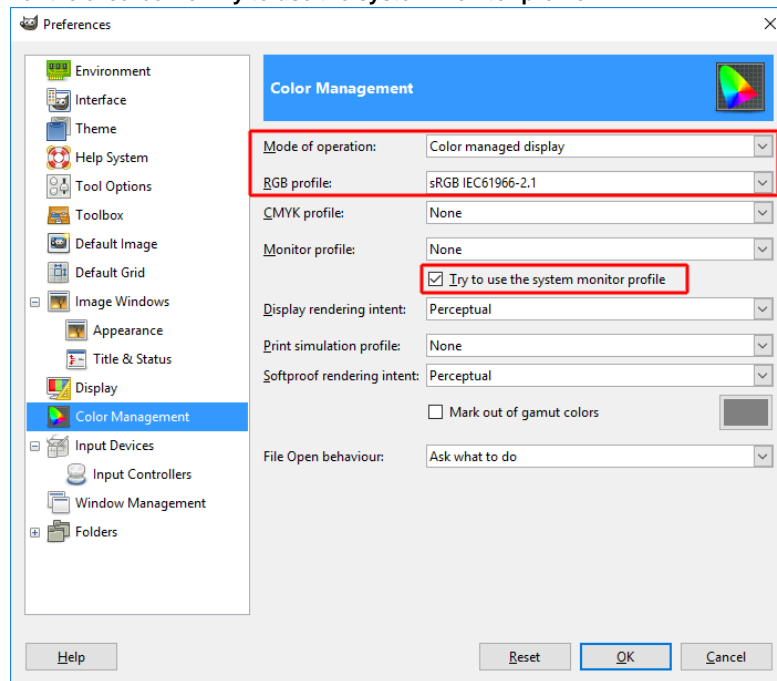
<p>Windows 10 :</p> <p>Resolution</p> <p>2560 × 1440 (Recommended) ▾</p>	<p>OsX 10.11 :</p> 
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3. Reset the monitor to its factory settings.
4. Disable any color-shifting applications (such as f.lux).
5. Make sure that your current ambient light conditions roughly represent your average working day conditions (for example, don't calibrate in total darkness if you always work with the lights on).
6. Make sure your image editing applications are using the right color space:
 - **Adobe Photoshop**
 - a. In Adobe, go to **Edit > Color Settings**
 - b. Under **Working Spaces**, set **RGB** to **sRGB IEC61966-2.1**, and set **Gray** to **sGray**
 - c. Under **Color Management Policies**, tick the checkboxes for **Ask when Opening** and **Ask when Pasting**. This allows you to choose what to do with images which

are not color managed or which are saved in a different color space.



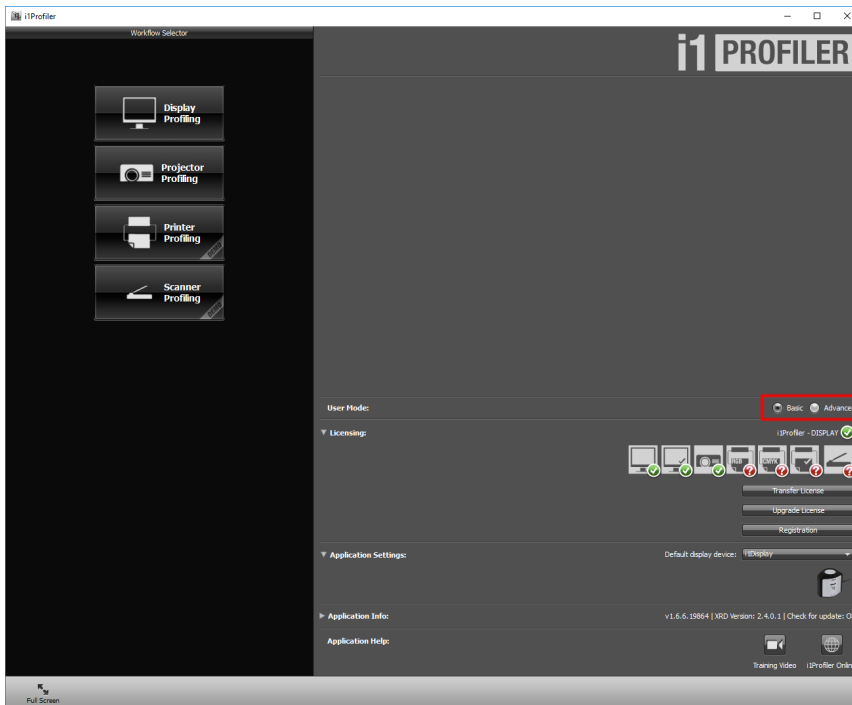
- **GIMP 2.8.18 (Windows)**
 - Go to **Edit > Preferences > Color Management**
 - Set **Mode of operation** to **Color managed display**
 - Set **RGB Profile** to **sRGB IEC1966-2.1** (this can be found in windows\system32\spool\drivers\color)
 - Tick the checkbox for **Try to use the system monitor profile**



Calibration

The i1 Display Pro comes with its own software, **i1Profiler**. You need to set this up before you can start profiling and calibrating your monitor.

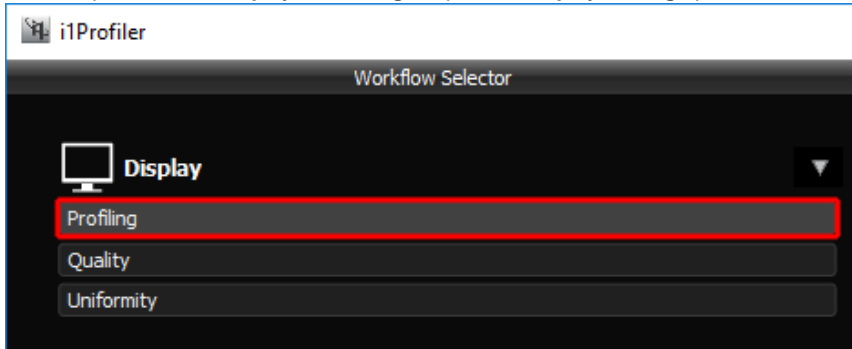
1. Install **i1Profiler** and the sensor's drivers from the disc, or from the X-Rite website
2. Launch **i1Profiler**
3. Under **User Mode**, select **Advanced**



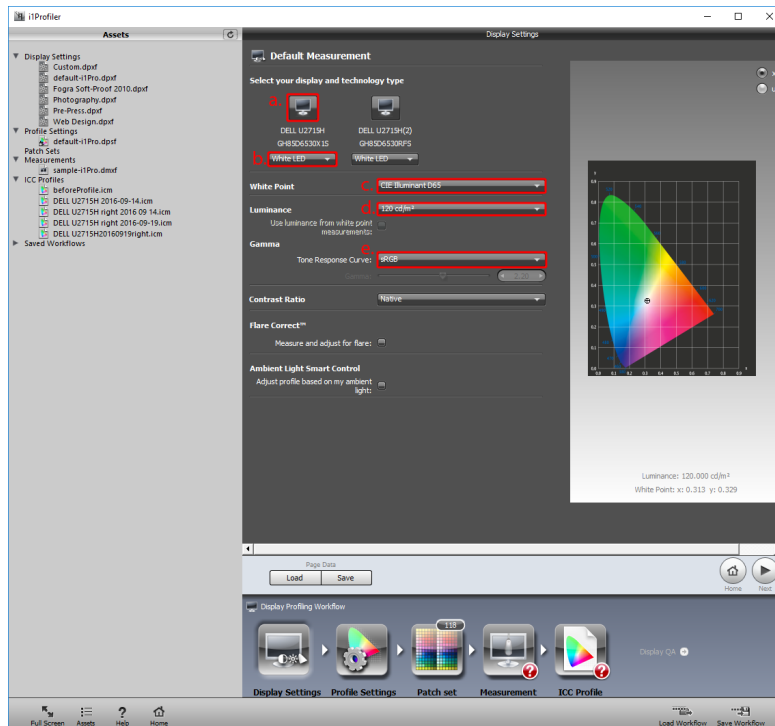
Basic / Advanced mode

Basic mode provides all the most significant settings. However, in this tutorial we want to use two features that are only available in **Advanced** mode. If you only want to know about the most commonly-used settings, feel free to stick to **Basic** mode.

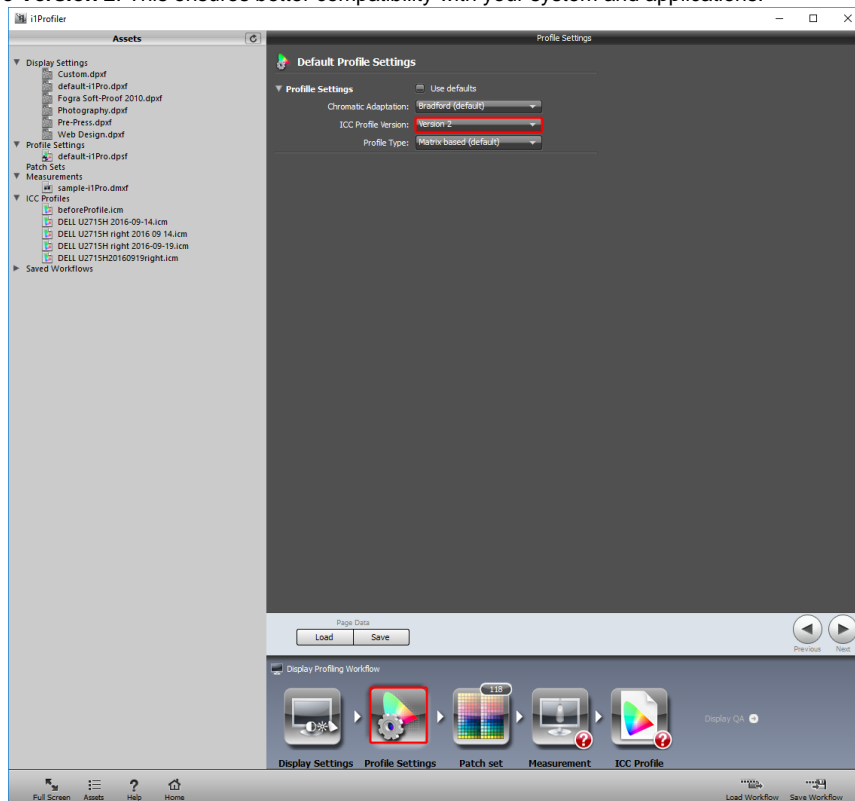
4. In the left panel, select **Display > Profiling** to open the **Display Settings** panel:



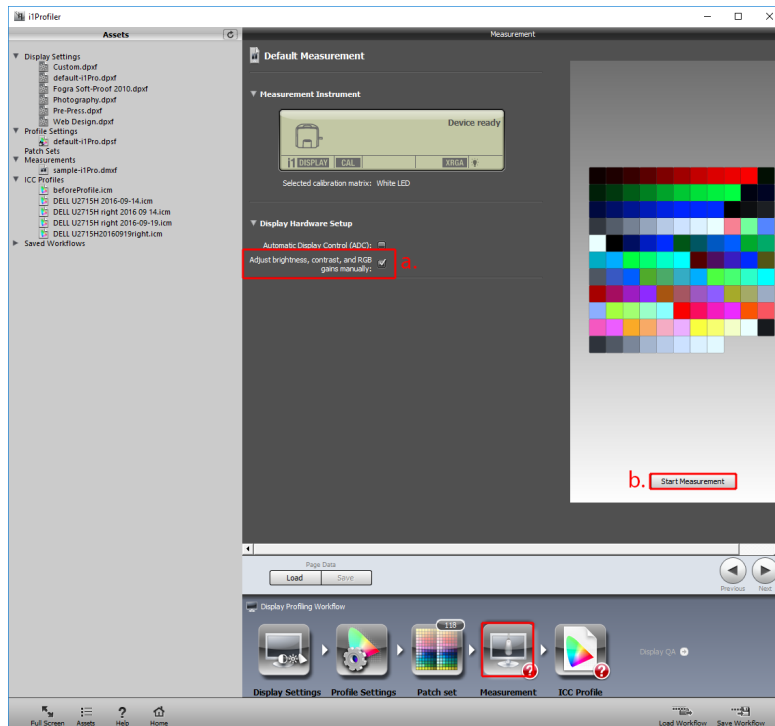
5. In the **Display Settings** panel :
 - a. Click the display icon representing the display you want to calibrate (see box **a** in the image below). If you have multiple monitors, be aware that they are not always shown in the right order - for example, the icon on the left might represent the monitor on your right. To make it clearer for you, **i1Profiler** centers the application window on the display you have selected to be calibrated.
 - b. In the drop-down list under the display icon, select the technology your display is using (see box **b** in the image below). If you don't have the technical specifications of your monitor, you can usually find them on the manufacturer's website, or on specialized review websites. If you cannot find the information, choose "generic".
 - c. Set the **White Point** to **CIE Illuminant D65**. This is a widely used standard that makes your whites match an average daylight color, and makes sense if you work mostly during the daytime.
 - d. Set the **Luminance** to **120 cd/m²**. This represents the brightness of your whites. **120cd/m²** is a common standard when working on images that are to be displayed on a screen (darker whites, between 80-100 cd/m², are recommended when working on images that are to be printed).
 - e. Set the **Tone Response Curve** to **sRGB**. This ensures good compatibility with your color-managed applications (such as Adobe Photoshop).



6. Under **Display Profiling Workflow**, select **Profile Settings**. Set the **ICC Profile Version** to **Version 2**. This ensures better compatibility with your system and applications.



7. Under **Display Profiling Workflow**, select **Measurement** and make the following changes:
 - a. Tick the checkbox for **Adjust brightness, contrast, and RGB gains manually** (see box **a** in the image below)
 - b. Click **Start Measurement** and follow the on-screen instructions (see box **b** in the image below)



8. When you click **Start Measurement**, the calibration process begins. The first window that opens is **Profile My Display**. Here, tick the checkbox for each setting that you are able to manually adjust through your monitor's built-in settings. You should usually be able to adjust **Contrast** and **Brightness**. Make sure you know how to make these adjustments; you will need to be able to do this during calibration. Set the **i1 Display Pro** sensor against the screen as show in its instructions. Make sure the sensor has good contact with the screen, then click **Next**.

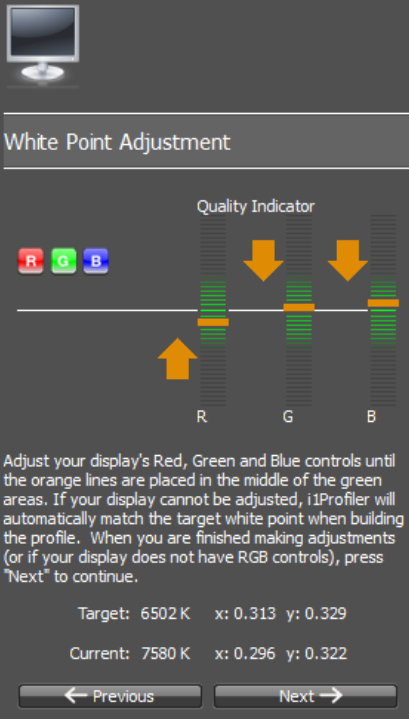


RGB Controls

If you tick the checkbox for **RGB Controls**, an additional window appears to

calibrate this setting. It's good practice to go into your monitor's built-in settings and set each color channel to a lower value than its maximum (for example, 95 if the maximum is 100), so that you have room to adjust them to a higher value if i1Profiler asks you to during the next step.

Profile My Display



White Point Adjustment

Quality Indicator

R G B

R G B

Adjust your display's Red, Green and Blue controls until the orange lines are placed in the middle of the green areas. If your display cannot be adjusted, i1Profiler will automatically match the target white point when building the profile. When you are finished making adjustments (or if your display does not have RGB controls), press "Next" to continue.

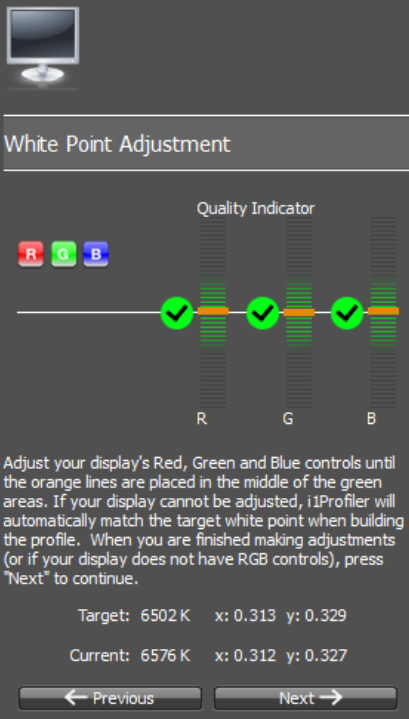
Target: 6502 K x: 0.313 y: 0.329

Current: 7580 K x: 0.296 y: 0.322

← Previous Next →

The screenshot shows the 'White Point Adjustment' screen in i1Profiler. It features a 'Quality Indicator' section with three vertical sliders for Red (R), Green (G), and Blue (B). Each slider has a green area and an orange line. The orange lines are currently positioned to the left of the center of the green areas. Orange arrows point to the right for the R and G sliders, and an orange arrow points to the left for the B slider, indicating the direction of adjustment. Below the sliders, there is a text box with instructions and a table of color temperature and chromaticity coordinates. At the bottom, there are 'Previous' and 'Next' buttons.

Profile My Display



White Point Adjustment

Quality Indicator

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Target: 6502 K x: 0.313 y: 0.329

Current: 6576 K x: 0.312 y: 0.327

← Previous Next →

The screenshot shows the 'White Point Adjustment' screen in i1Profiler, identical in layout to the previous one. However, the orange lines on the R, G, and B sliders are now perfectly centered within their respective green areas. Each slider now has a green checkmark at the top, indicating that the adjustment is complete. The 'Current' color temperature and chromaticity coordinates have updated to reflect the new settings.

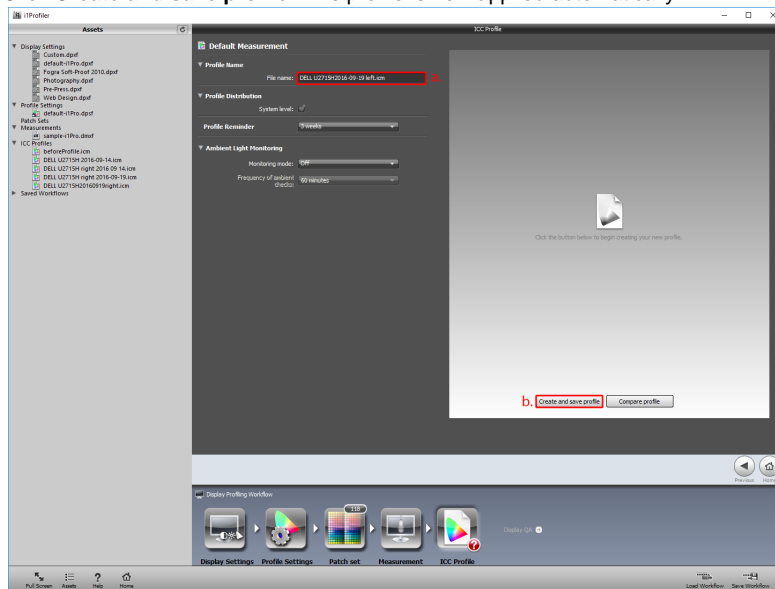
Laptop calibration

It is possible to calibrate a laptop monitor. In **Profile My Display**, tick only the **Br**

ightness checkbox (this is usually the only property you can manually adjust on a laptop monitor). Later, when you need to adjust the brightness, try to get as close as possible to the profiler's suggested **120cd/m²** with the steps your laptop offers you. If you can't get close enough to get the green icon, aim at the brighter value closest to **120cd/m²**. The **i1Profiler** then adjusts the white in the color profile.

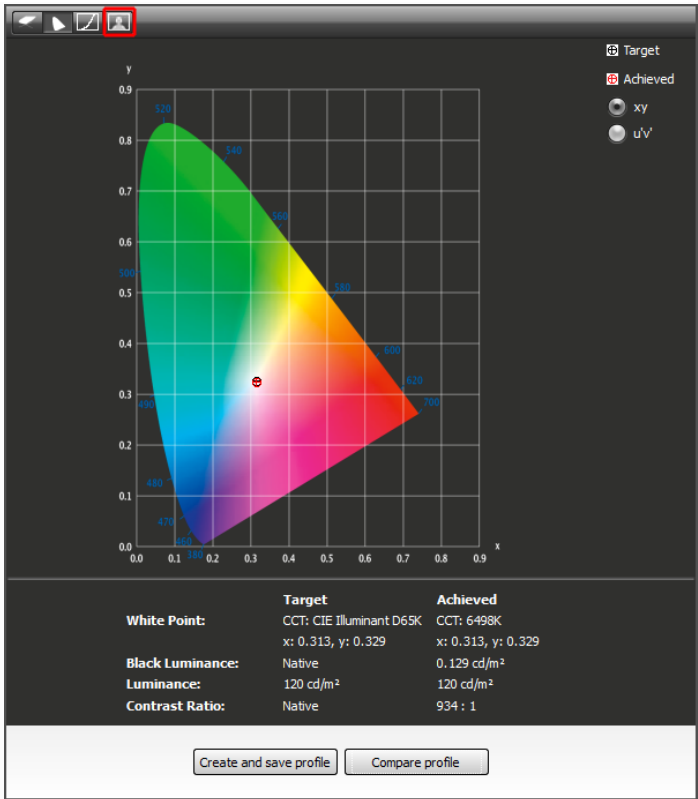
Calibration done this way is only accurate when the laptop is set to the same level of brightness, so it's recommended that you remember how you set up your monitor during the calibration, then use the same settings when working on your game.

9. When you click **Next**, the **i1 Display Pro** device begins taking measurements. During this process, **i1Profiler** asks you to adjust some settings manually on your monitor. Follow the instructions on the screen.
10. When the measurement has finished, go to **ICC Profile**
 - a. Name your profile (it's recommended to give a name which indicated the monitor that has been calibrated, and the date of the calibration).
 - b. Click **Create and save profile**. This profile is now applied automatically.

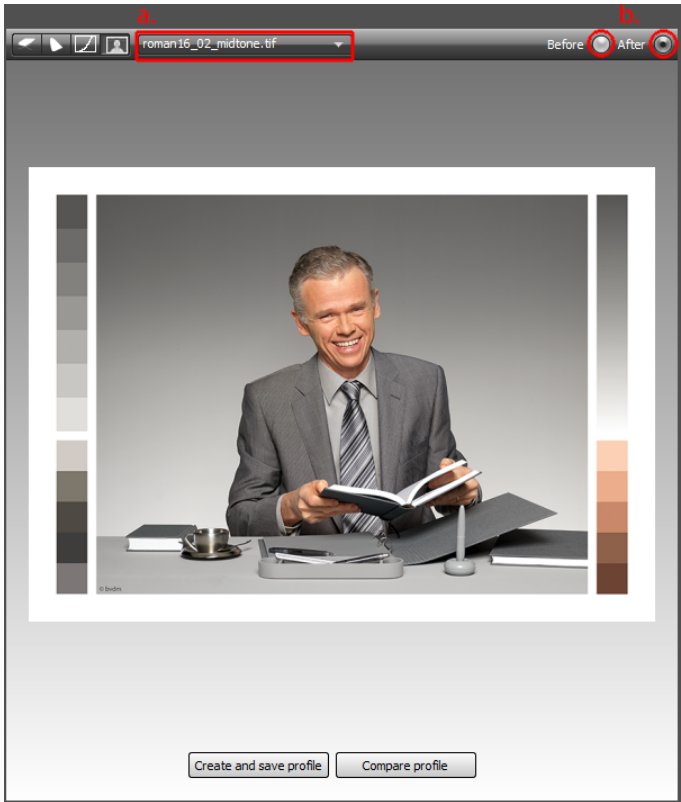


Before and after comparison

When a new profile is created, the right part of the window changes to display the results of the calibration. This visualisation also shows a before and after comparison mode, featuring example photographs. To access this, select the small head-and-shoulders box (highlighted in the below image).



Change the photograph using the dropdown (see box **a** in the image below), and use the two switches on the right (see circles **b** in the image below) to compare before and after effects.

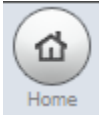


Advanced calibration

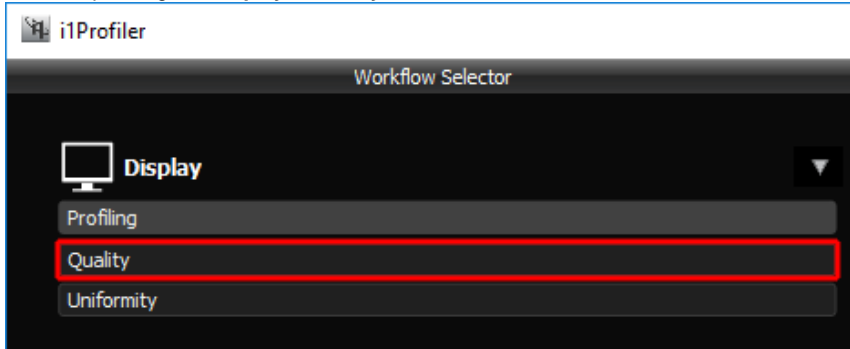
This calibration can be refined and improved using the advanced techniques laid out in this section. These techniques may be useful if you are not satisfied with the results of the calibration, or if you just want to check the quality of your calibration.

Quality check

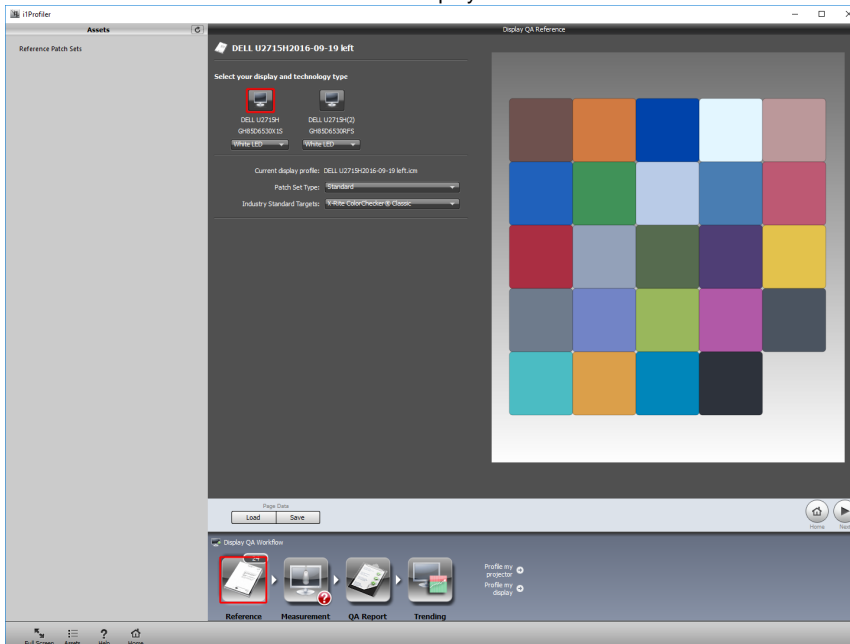
1. In **i1Profiler**, click the **Home** button



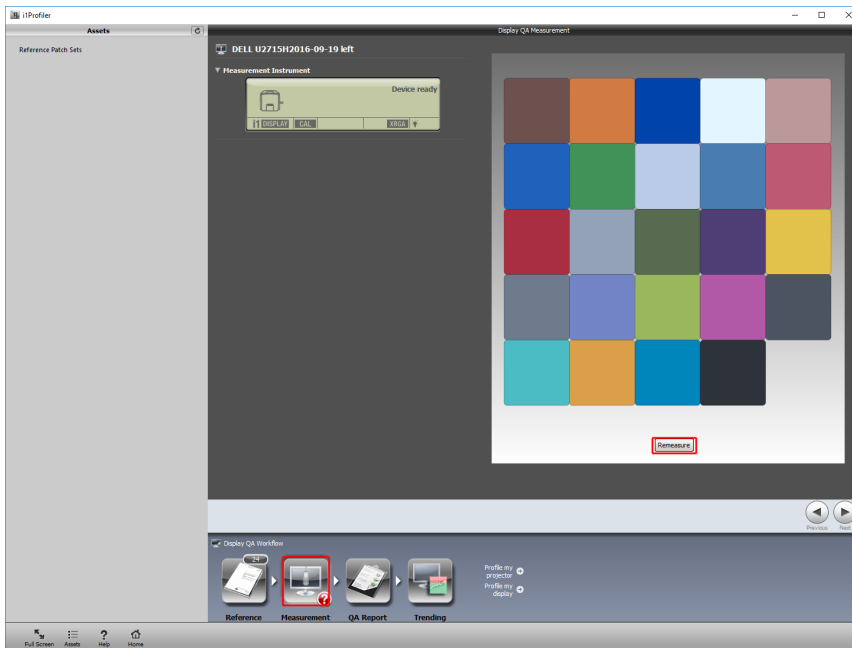
2. In the left panel, go to **Display > Quality**



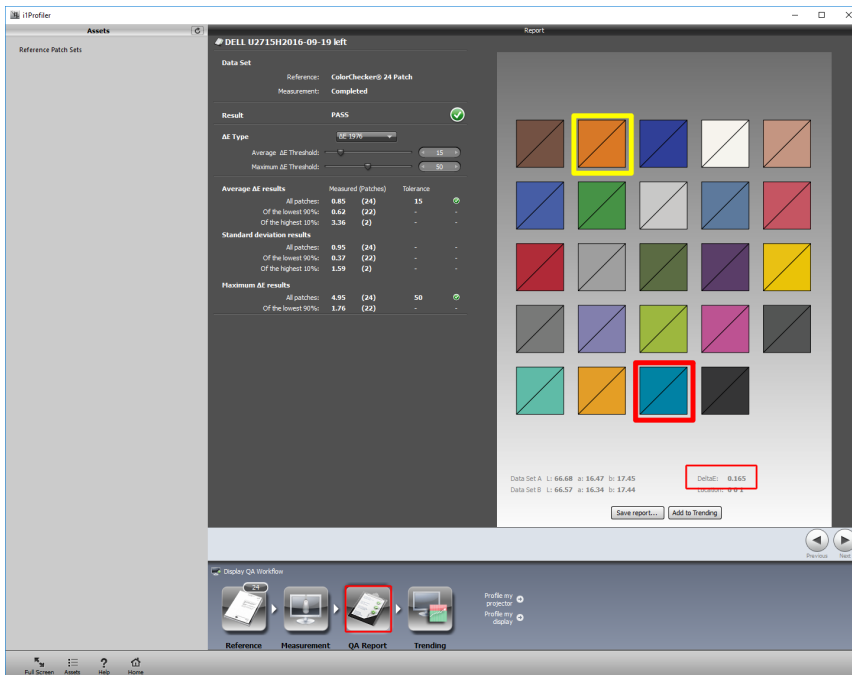
3. Under **Display Profiling Workflow**, select **Reference**, then click on your display's icon to center the **i1Profiler** window on the correct display



4. Under **Display Profiling Workflow**, select **Measurement**, then click **Remeasure** (or **Start Measure**, if this is the first one).



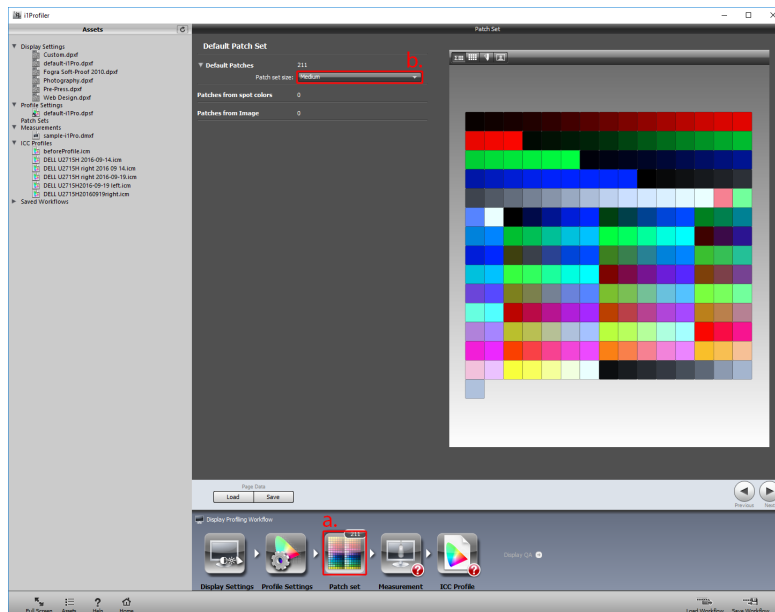
5. Follow the instructions on your screen
6. Under **Display Profiling Workflow**, select **QA Report**. Hover over each colour in the panels to see a **DeltaE** value corresponding to that color displayed in the data below (see lower box in below image). The **DeltaE** value represents how much the color captured on your monitor diverges from the reference color. Ideally, all the colors' **DeltaE** would be below 2. If you have many colors whose **DeltaE** is above 4, you should refine your calibration.



Refining your calibration

If you are not satisfied by your calibration, and all steps of this guide have been carried out, there are two relatively simple ways to do a more in-depth calibration :

1. At **step 8** of the guide, tick the checkbox for **RGB Controls**. This helps to achieve better native colors.
2. After **step 6** of the tutorial:
 - a. Under **Display Profiling Workflow**, go to **Patch Set**
 - b. Set **Patch set size** to **Medium** or **Large**



This makes the measurement process longer by measuring a broader range of colors, which creates a more accurate profile.

Calibration frequency

We recommend that artists calibrate their monitors regularly. Calibration should be done every 3-6 months in order to keep good colour consistency.

- For TN and VA monitors, we recommend re-calibrating every 3 months
- For LED and IPS monitors, we recommend re-calibrating every 6 months

TV Calibration

If you are deploying your game to a video game console, your testing TV should also be calibrated correctly. If you can access the web from your TV (or a device connected to your TV), go to lagom.nl and follow the instructions on the website for a good calibration process.

The best resource of information for calibrating TVs is often a specialized website avforums.com, which reviews TVs and maintains a YouTube channel of videos showing the [best picture settings](#) for many TV models, and [how to calibrate your TV yourself](#).

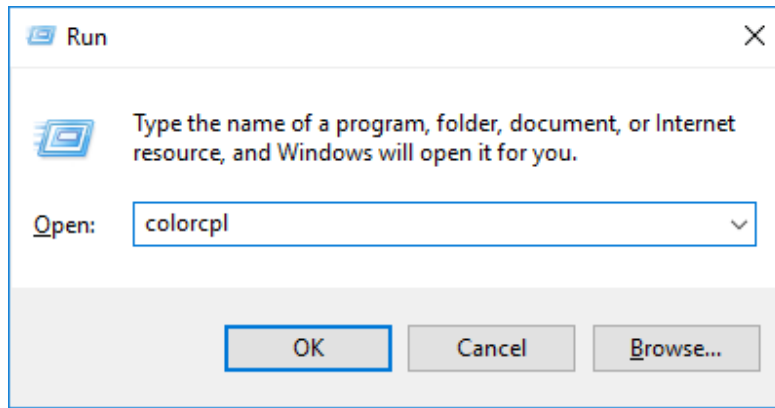
Xbox One has its own integrated calibration tool. See Microsoft's documentation on [How to adjust the display settings on your Xbox One console](#) to learn more.

Troubleshooting

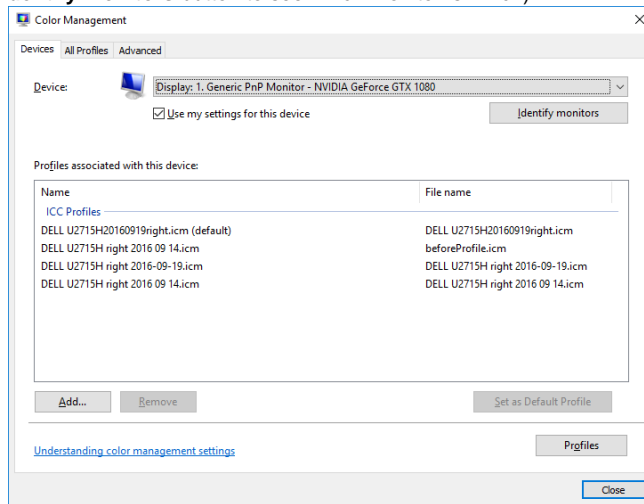
• Windows color management issues

Sometimes, Windows doesn't apply the correct color profile when you restart your computer or when your monitor is disconnected and reconnected. To fix this:

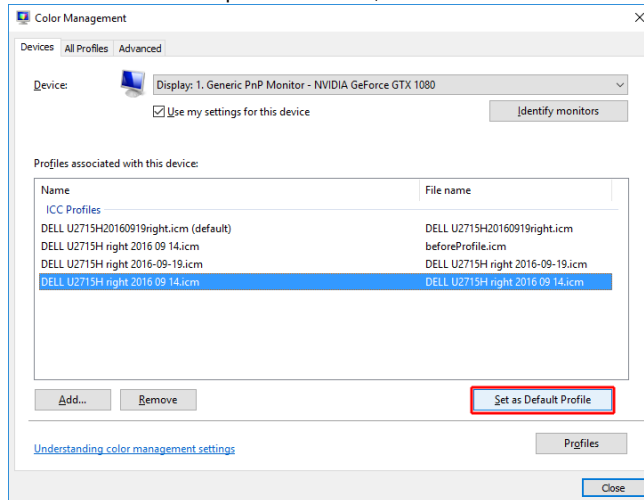
1. Go to **Start menu > Run** and type "colorcpl"



2. Select your monitor in the **Device** dropdown (if you have several displays, use the **Identify monitors** button to see which monitor is which).



3. Select the correct color profile in the list, and click **Set as Default Profile**



4. If you don't see a change immediately, you might need to restart your computer to use the new default color profile.

Content by label

There is no content with the specified labels



