Calibrate MacBook M1 Pro or M1 Max with built-in XDR Display

The new Apple MacBooks Pro 2021 handle color on the built-in XDR display completely differently than before and differently from connected external monitors.
In principle, an XDR display can be "adjusted" for different applications using the built-in tools.
If the screen is to be calibrated individually, further steps are required. In order to achieve optimal results, a good measuring device is required, which is properly calibrated and whose correction matrix - in the case of colorimeters - is correctly selected (RG Phosphor or GBr in the case of XDR displays).

MYIRO-1

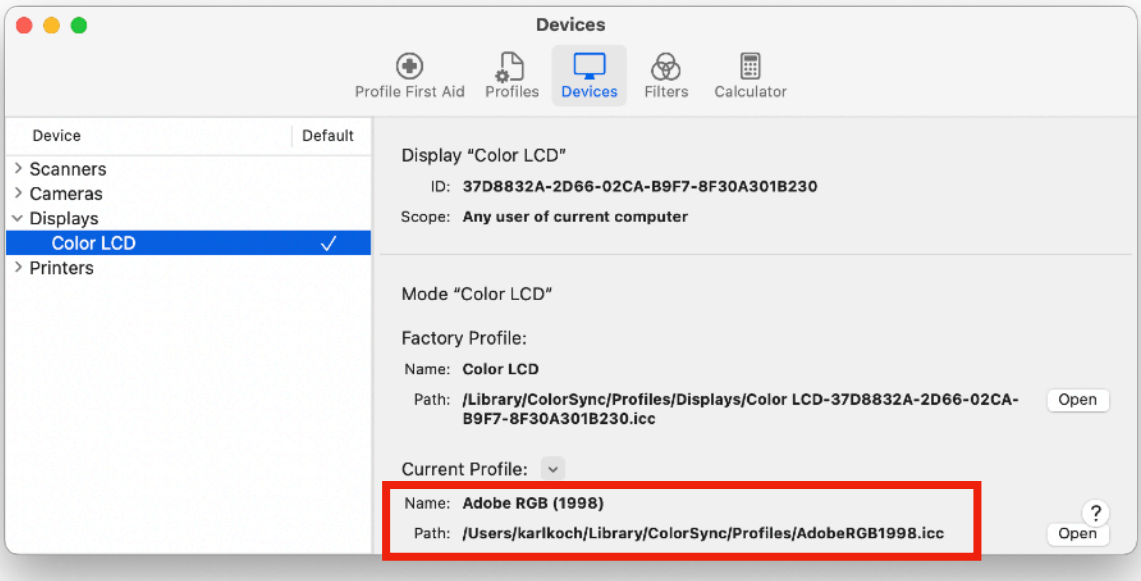
Even if (still) few of you own this instrument, here is a hint for use with the new MacBooks M1:
The MYIRO-1 is often not recognized correctly on these computers when connected to a USB-C adapter (even the original from Apple).
The solution: Use a USB2 hub to connect the meter.

Here are the necessary steps to adjust, calibrate, profile, validate and if necessary optimize the display.

To do this, first leave the computer display screen on for at least 10 minutes to warm up, place the measuring device on the monitor. This allows the monitor and measuring device to reach operating temperature. If the temperature were to change during the measurement, this may falsify the measurement results.

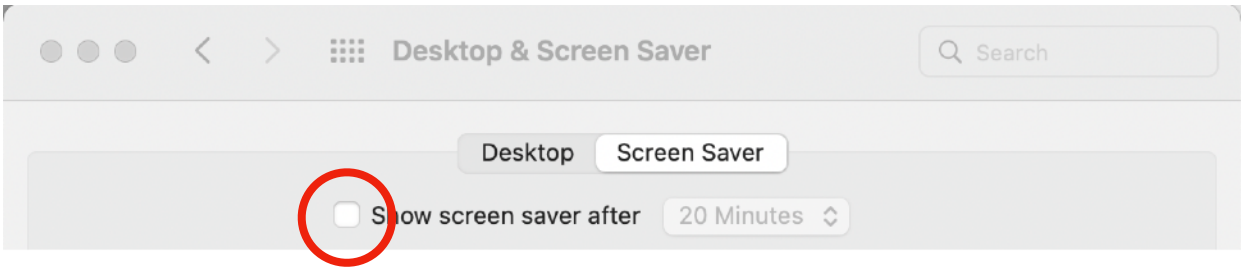
1. Start the "ColorSync Utility" program from Applications¬Utilities

Under "Devices" select any profile as your "Current profile" (e.g. AdobeRGB), but not the factory (LCD-xxx). This cannot be overwritten by basICColor display 6, selecting the factory default option would generate an error message.

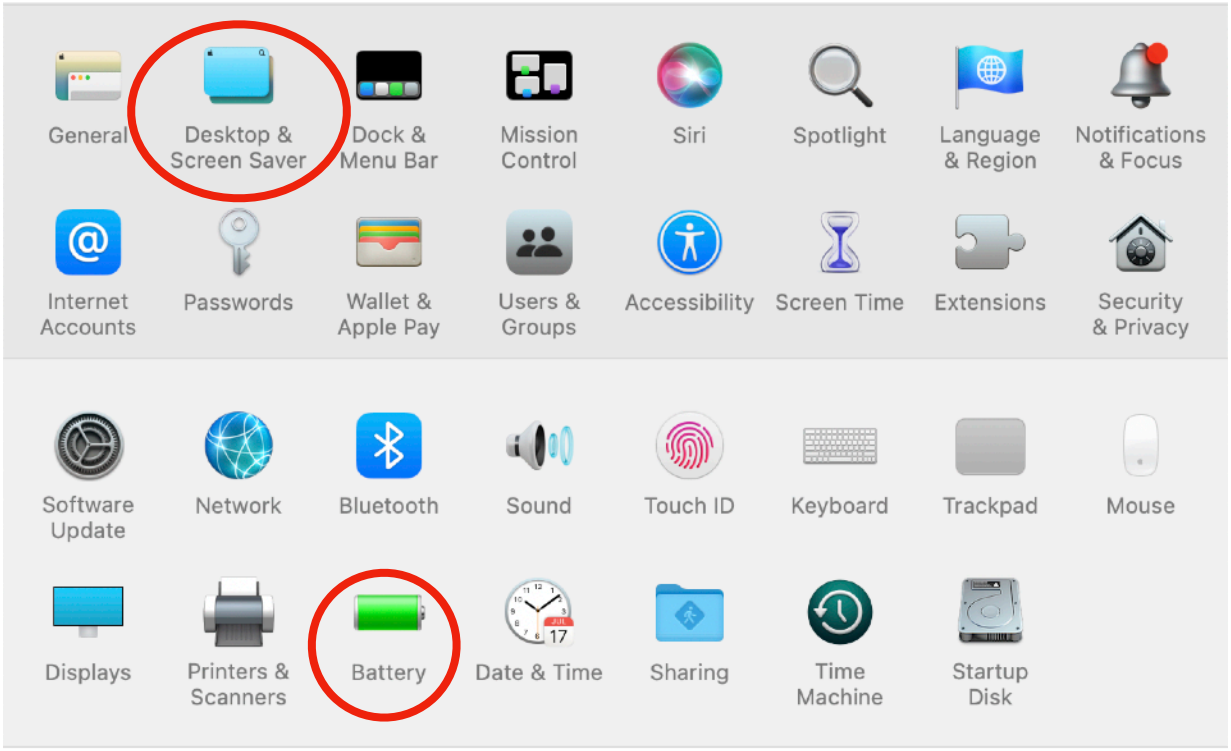


You can leave the ColorSync utility open and see basICColor display 6 replace the selected profile with the newly created one.

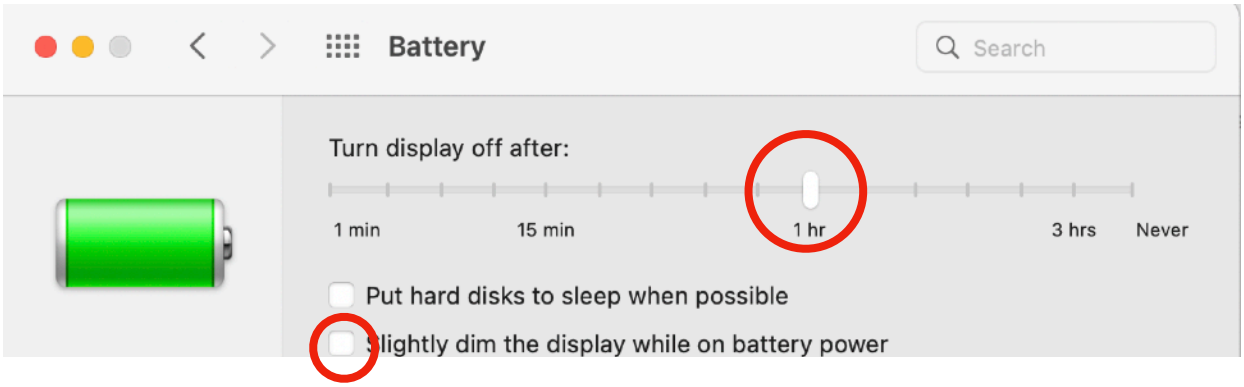
2. **Open System Preferences and select "Desktop & Screensavers“ Remove the checkmark from "Show screensaver after" You can reset this setting later.**



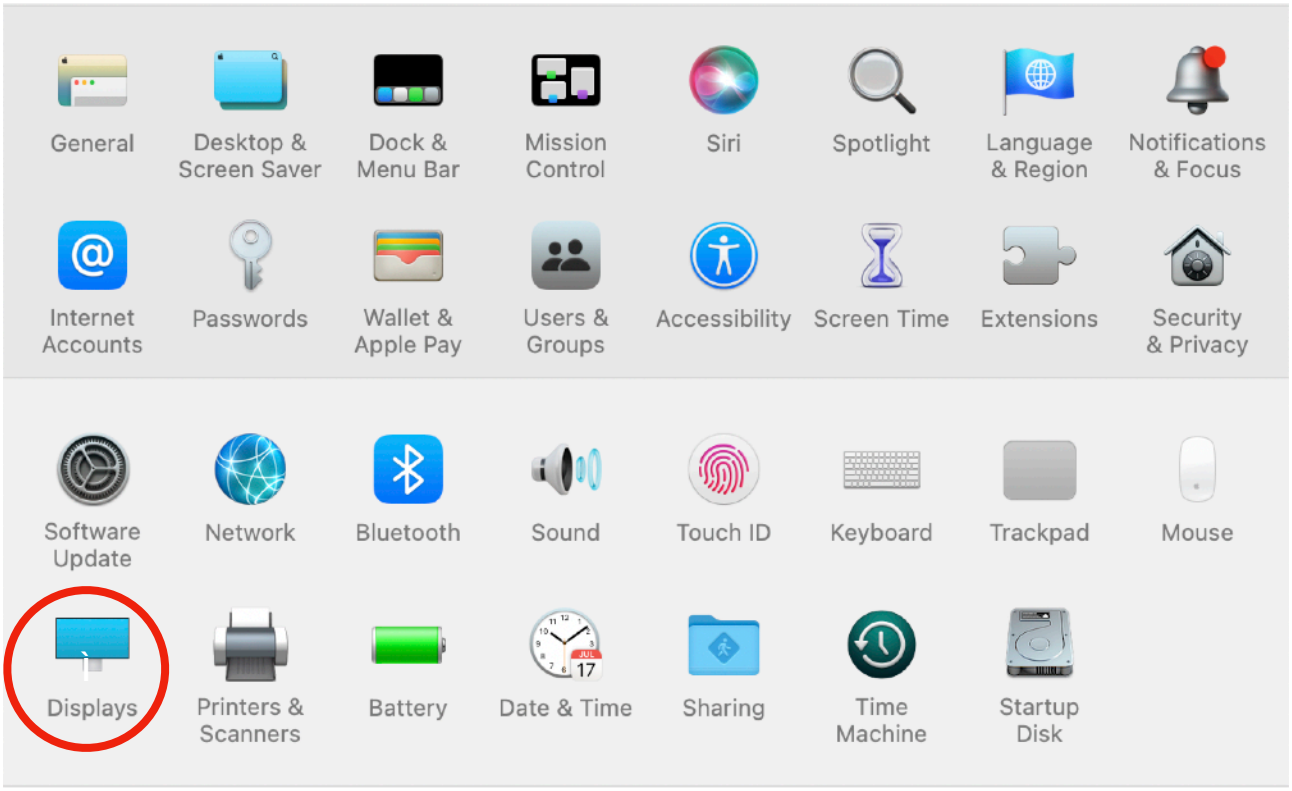
3. **Select "Battery" in System Preferences**



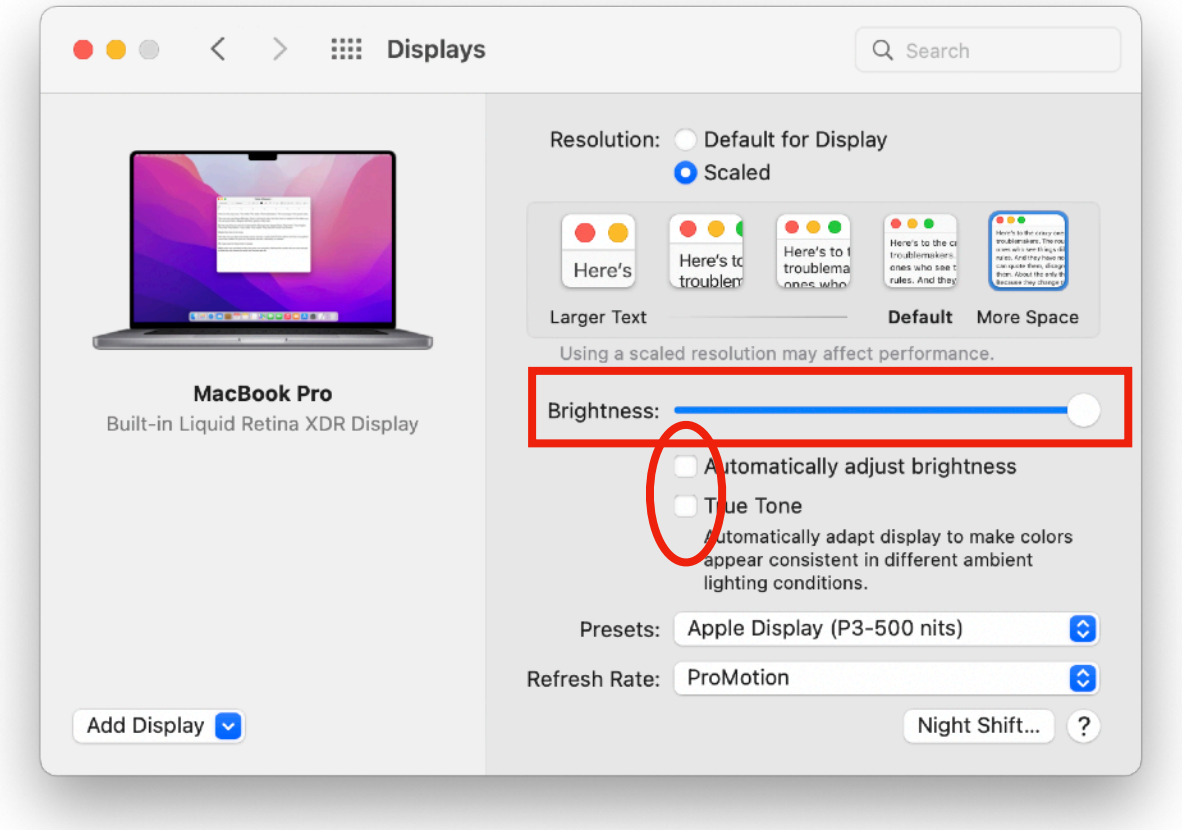
First make sure that
• Both under "Battery and under "Power supply unit" "Switch off monitor after:" is set to "Never" or at least 1 hour (you can also reset these options later)
• „Slightly dim the monitor while on battery power" must not be checked . If you want to work with correct colors when using battery power, you should not change this setting later.



4. Open "Displays" in System Preferences



Switch off
"Automatically adjust brightness" and "True Tone".

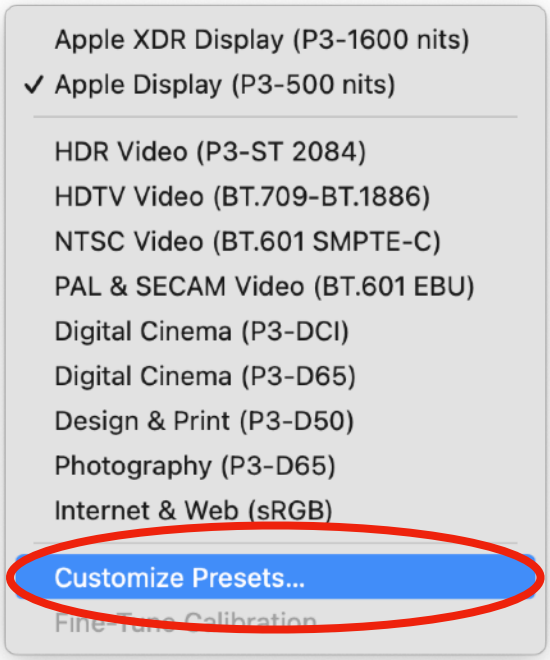


Do not change the Brightness slider!

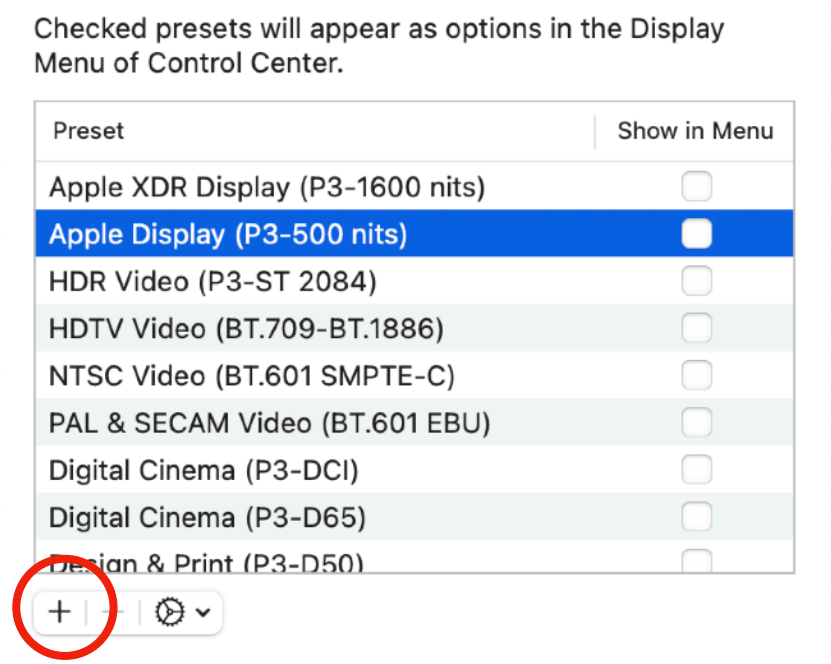
5. Choose a Preset and create a new one

Choose a preset, it doesn't matter which one, as we customize the parameters. This works with any of these presets (also called reference modes in Apple´s documentation).
We use the preset "Apple Display (P3-500 nits)“ here as an example (nits is the American term for cd/m2).

After this is selected, you need to click on this preset again and select „Customize Presets…" from the drop-down menu that opens up.

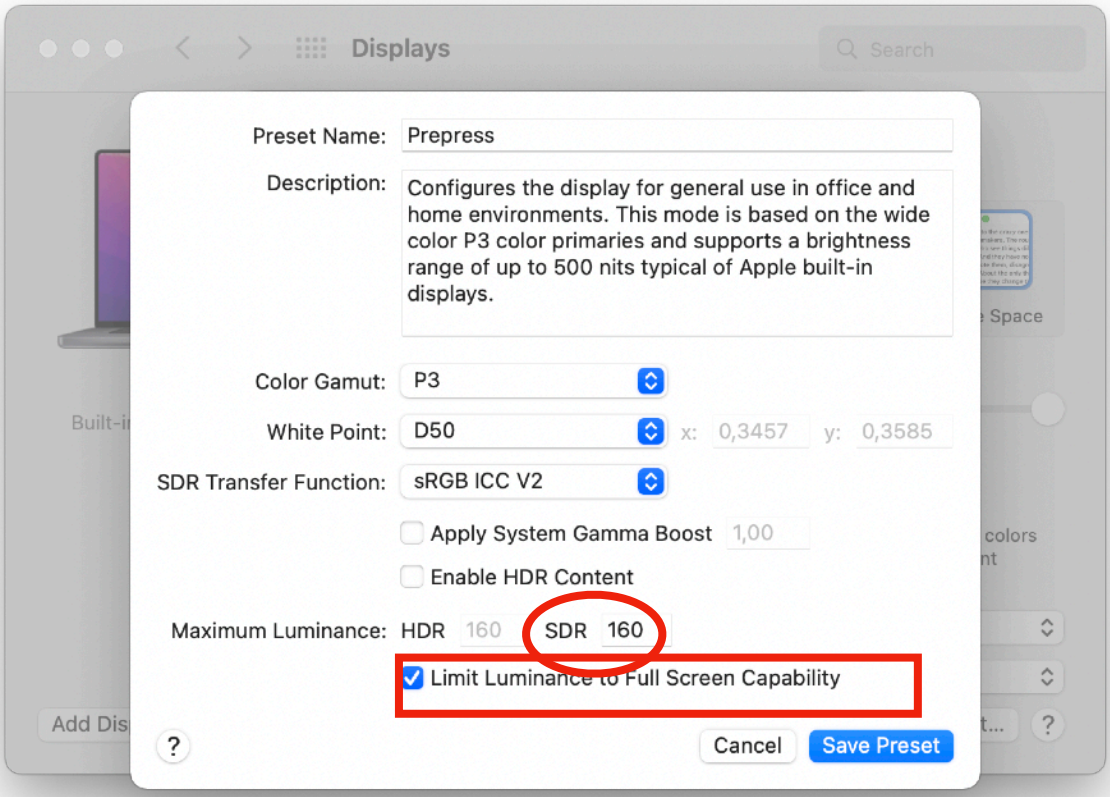


The predefined presets cannot be edited.
Create a copy of the selected setting by clicking on the "+" sign.



Name the new preset as you wish, in our example it is "Prepress".

6. Now it's time to set the desired "calibration parameters“



- Leave the „Color Gamut“ at "P3" for all color managed programs. This is the native color space of the XDR Display.

  You should only chose a different setting here if you are working with programs that require a certain (smaller) color space in order to display colors correctly (e.g. some video editing programs that do not use color management).

- You can set the white point to D50, D65 or DCI (the latter for video), or determine it individually by entering xy values.
  This assumes that you know these values.

- Here are the values for a few common illuminants:

Tabelle 1

Color Temperature	Illuminant	Daylight		Black Body	
or CCT		x	y	x	y
2856	**A**			0,4476	0,4075
4000		0,3823	0,3836	0,3804	0,3767
4500		0,3620	0,3707	0,3607	0,3635
5000		0,3456	0,3585	0,3451	0,3516
5002,70	**D50**	0,3456	0,3584	0,3450	0,3515
5250		0,3387	0,3528	0,3384	0,3461
5500		0,3324	0,3474	0,3324	0,3410
5502,97	**D55**	0,3324	0,3474	0,3323	0,3409
5750		0,3268	0,3424	0,3270	0,3362
6000		0,3216	0,3376	0,3220	0,3317
6250		0,3170	0,3332	0,3176	0,3275
6500		0,3127	0,3290	0,3135	0,3236
6503,51	**D65**	0,3127	0,3290	0,3134	0,3235
6750		0,3088	0,3251	0,3098	0,3199
7000		0,3053	0,3215	0,3063	0,3165
7500		0,2990	0,3148	0,3003	0,3102
7504,05	**D75**	0,2990	0,3148	0,3002	0,3102
8000		0,2937	0,3090	0,2951	0,3047
8500		0,2891	0,3039	0,2907	0,2999
9000		0,2852	0,2994	0,2869	0,2955
9305,02	**D93**	0,2830	0,2969	0,2848	0,2931
9500		0,2817	0,2954	0,2835	0,2917
10000		0,2787	0,2918	0,2806	0,2882

- The SDR transfer function (tone curve) can be selected from any gamma value between 1.6 and 2.6 (referred to here as "Pure Power"), the sRGB curve or BT 1886 (again only suitable for video). Select Gamma 2.2 if you have selected AdobeRGB as your working space or "sRGB ICC V2" if sRGB is your working color space or if you are aiming for an L* calibration, as this best reflects the human perception of tonal gradations. The sRGB curve is closest to L*, which unfortunately is not available for selection here.

- Leave both
"Apply system gamma boost" and
"Enable HDR content" turned off.

- Under "Maximum luminance", you set the desired luminance of your monitor at SDR. Select a value here that is approx. 10% above the desired luminance of the calibrated screen, since the video LUTs may reduce the brightness somewhat in order to achieve the exact color temperature for the white point.

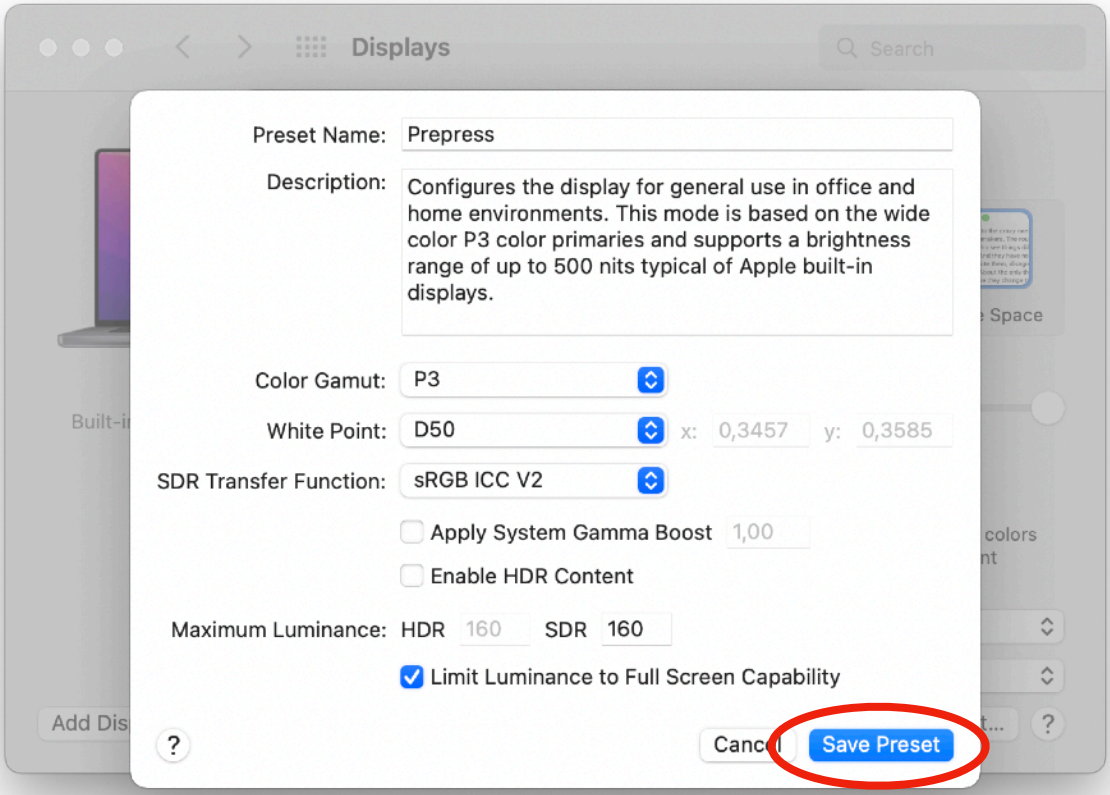
  IMPORTANT!

  Switch „Limit Luminance to Full Screen Capability“ on, otherwise no „Fine-Tune Calibration..." can be done.

7. Save Preset

After completing and saving the settings, the brightness can no longer be changed with the keyboard or the system settings.

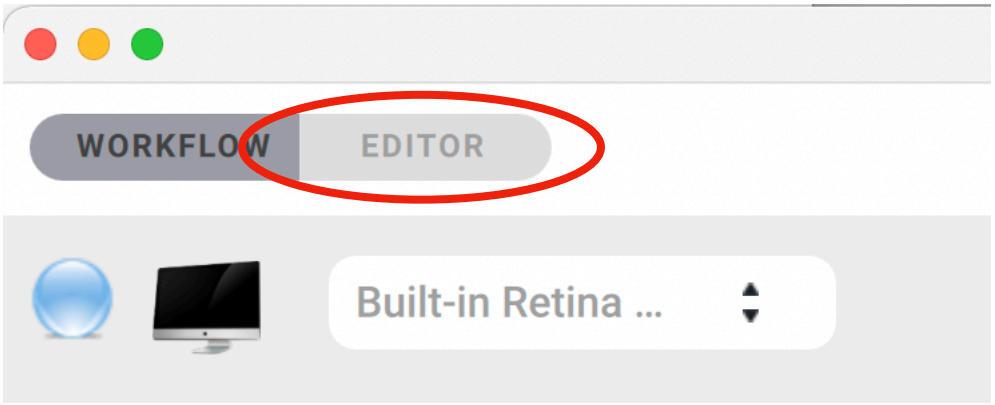
The white point can also only be changed within narrow limits - and rather awkwardly - during „Fine-Tune Calibration...".



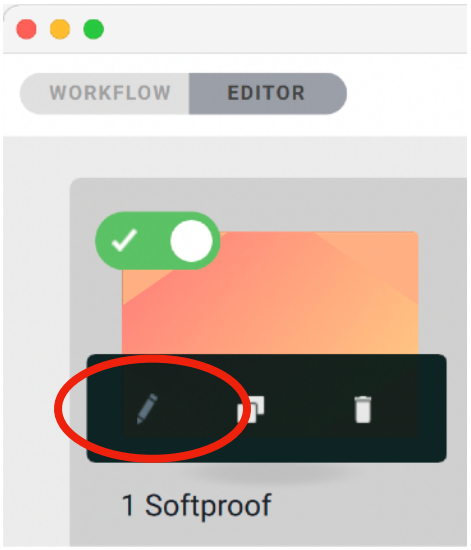
If the desired parameters such as luminance or color temperature cannot be edited in „Fine-Tune Calibration...", you must start the entire process from the beginning and select a lower or higher luminance or other xy values.

8. Now open basICColor display 6

…and switch to EDITOR



Select a WORKFLOW by clicking on the icon. Mouse-over to highlight the edit menu and click the pencil icon.

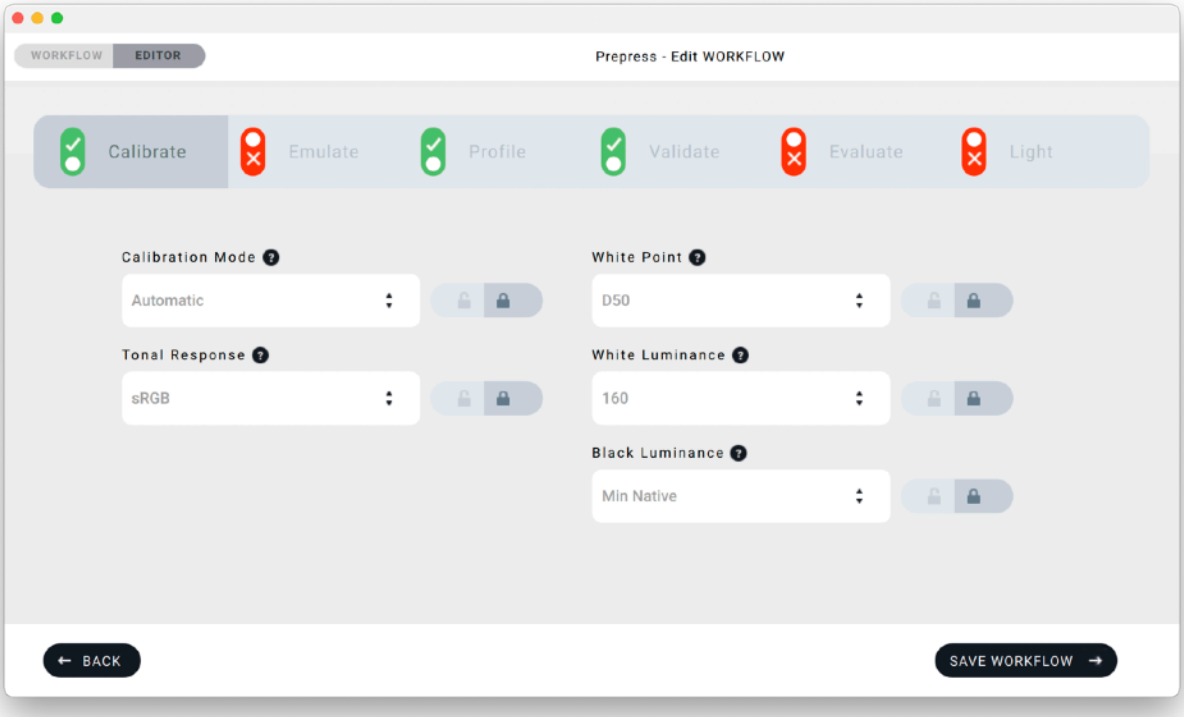


9. EDIT the WORKFLOW

Set the following parameters:

Calibration mode:	"Automatic"
White Point:	Exactly the white point chosen for the active preset (D50 in our example)
Tone curve:	The gamma or sRGB you selected in the preferences under SDR transfer function (sRGB in our example)
White Luminance:	The nits value you set in the preferences under Maximum Luminosity, SDR (160 in our example)
Black Luminance:	Minimum (recommended)

In our example it looks like this:



10. Save the WORKFLOW …

… unter a name of your choice, e.g. Prepress

11. Switch back to WORKFLOW

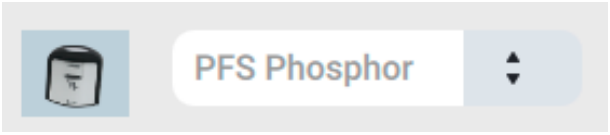
Select the newly created WORKFLOW
Start the calibration and profiling process.

NOTE: We strongly recommend to upgrade to Monterey ≥12.5 before calibration.

Instrument Info

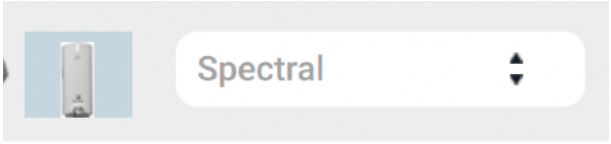
- If you use an i1 Display Pro (color checker Display/Pro/Plus) as your instrument, make sure you select „PFS Phosphor“ as your correction matrix.

  This calibration setting is available in version 6.6.0 build 4230 and up only, please install this version!



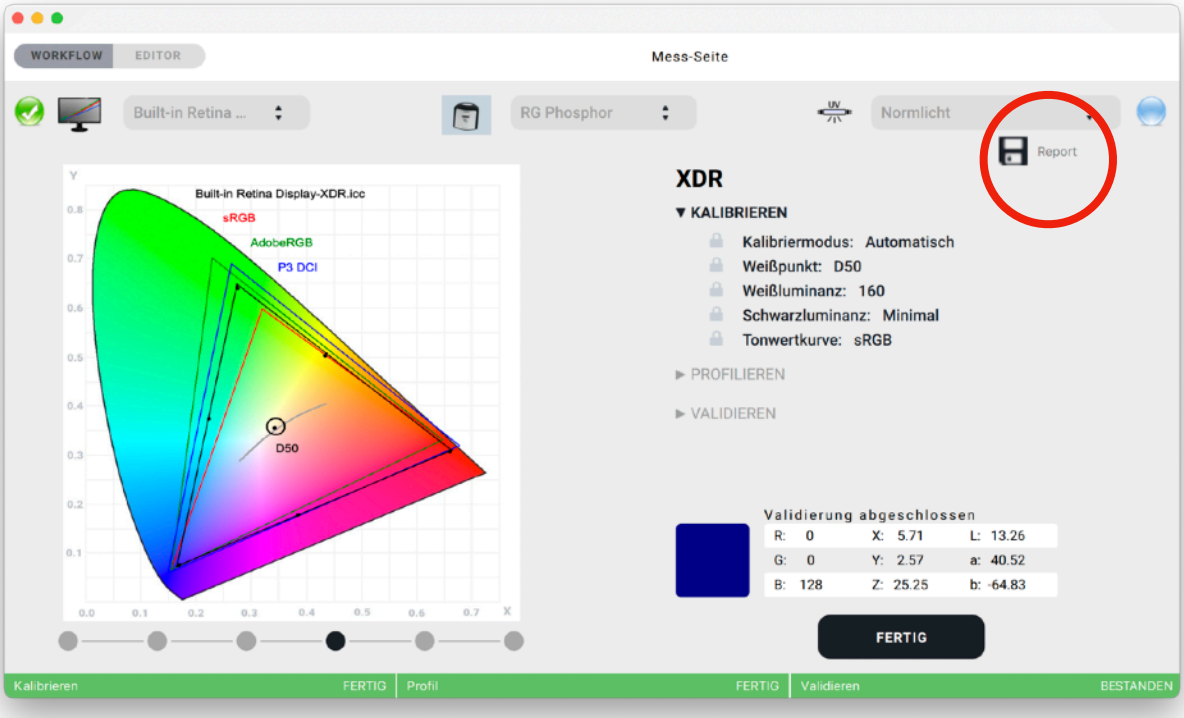
- for Spyder5 it´s RGB LED

- for spectrophotometers (i1 Pro, MYIRO-1) you don´t have to select anything – it´s always „Spectral“.



12. Save the report

After completing Calibrate, Profile and Validate, save the report in order to record the values achieved. You may need this later for „Fine-Tune Calibration...".



If the validation passes, the process is successful and you do not need to do anything else.

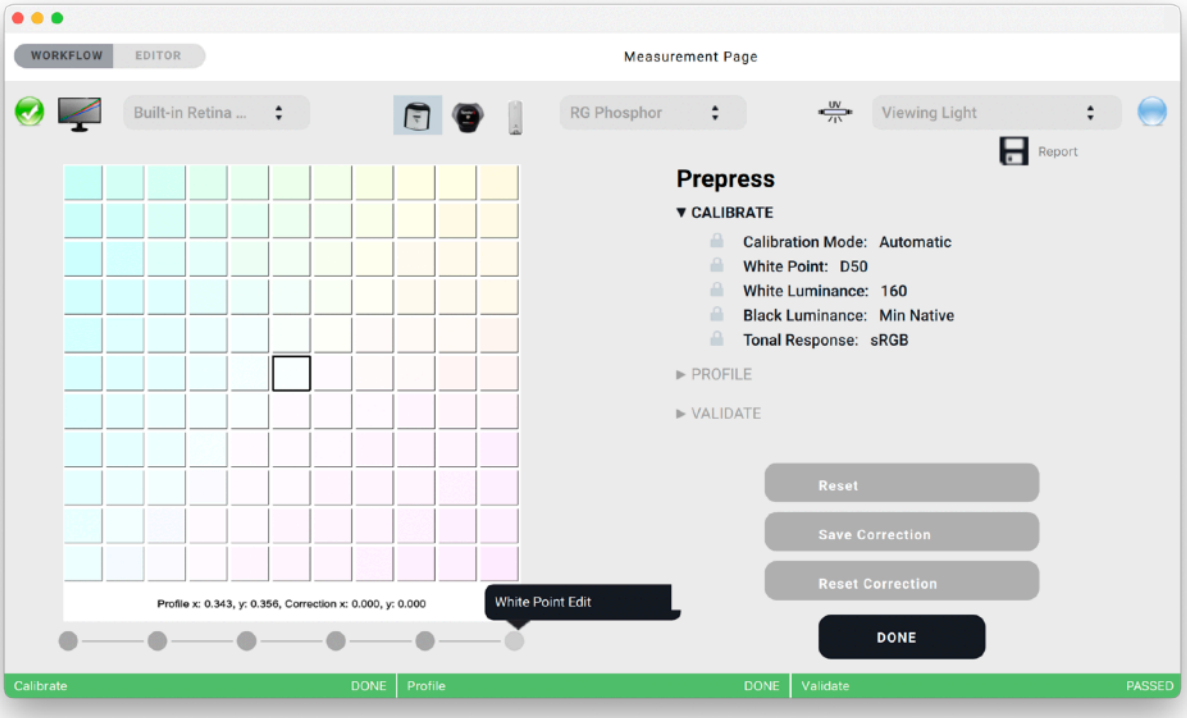
If the validation is unsuccessful, you may be able to correct the values with the calibration fine adjustment in System Settings Displays. However, this is only possible within very narrow limits.

13. White Point Edit (basICColor display 6 Pro)

If you use basICColor display 6 Pro you can edit the white point if it is visually a bit off. Click on the rightmost dot below the graphics window.

Note: This only works correctly from Monterey 12.3, before that the video LUTs are swapped.

This is much easier than Apple's „Fine-Tune Calibration..." or even having to repeat the whole process from the beginning if the tolerances for „Fine-Tune Calibration..." were exceeded.



But you can also use the „Correction“ values for „Fine-Tune Calibration...".