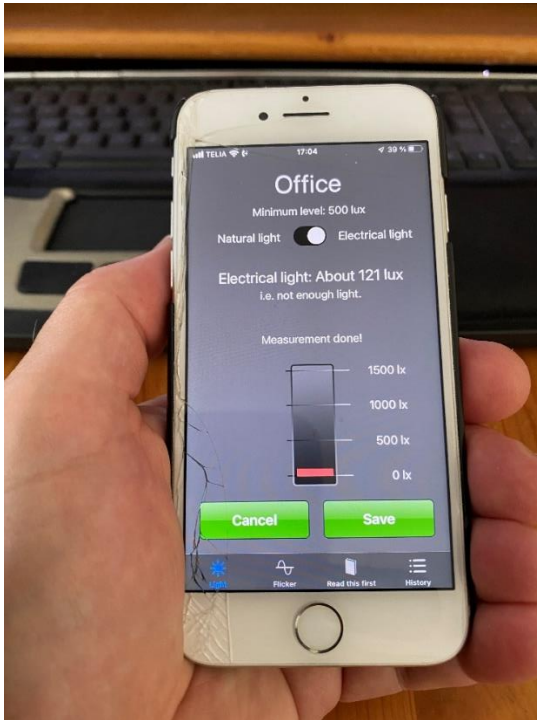


Measure light with your mobile

Measure light with your mobile by using the Swedish Work Environment Authority's app Light. With the app, you can measure daylight and electric light as well as flicker.



The light app is available for both Iphone and Androids. However, Android hardware and software differ between different brands. As the Swedish Work Environment Authority has a limited budget, we have only been able to adapt the app to certain popular models. If a model is not calibrated, this is indicated in red text on the screen.

Here you will find the app on the App Store



Here you will find the app on Google Play



With the Swedish Work Environment Authority's app LIGHT", you can assess the light at your workplace. The app presents recommended lux levels for nine different types of workplaces, such as offices, workshops, and storage. Poor lighting at work such as low lux levels or glare affects well-being and ability to work. It can also lead to work in strained work positions.

The content of the app

A light meter that indicates the lux level. An assessment of whether the light level is according to recommended values in the indoor standard for nine different types of workplaces. An assessment of flicker modulation and frequency up to about 120 Hz.

How to use the app?

Before start, the camera lens must be covered with a piece of ordinary printer paper (80 grams /m², see photos below) otherwise the measured values will be more than 3-4 times false. The paper corresponds to the diffuser on professional photometers. The paper piece can be attached with, for example, a tape at the edges close to the mobile cover. The tape must not shield any part of the lens. The paper can also be placed directly against the lens, but damage to the lens surface can then not be excluded.



Measure lux with the app

Before measuring, make sure that the light source of interest has been switched on for at least five minutes. A light source just turned on sometimes produces significantly less light.

1. Tap "Measure light" at the bottom of the mobile screen.
2. Choose whether you want to measure daylight or electric light. If you want to measure daylight indoors, you must turn off all electric lighting.
3. Under "Choose environment", choose the environment you think is best suited for measuring the light in your workplace. If no one fits, select "Other environment".
4. Touch the "Measure light level" box.
5. Read and follow the instructions, press "OK" and place the phone with the screen downwards on the surface where you want to measure the light. Move yourself backwards to avoid shielding the light. The measurement starts three seconds after you press OK.
6. When the measurement is complete, a beep is heard or the phone vibrates.



How to interpret the result

If "Other environment" is chosen, you must find the recommended lux levels for the current type of work yourself. The Swedish Work Environment Authority is not permitted to publish the entire standard. The values for indoor work can be found in the standards SS-EN 12464-1 (can be purchased via <https://www.sis.se/>) and in the planning guide Ljus & Rum (can be purchased via <https://ljuskultur.se/>). These contain guideline values for lux levels for more than 50 different categories of indoor work with almost 300 different work steps. Guideline values for outdoor work are found in the standard SS EN 12464 2 (<https://www.sis.se/>) which contains 15 categories of outdoor work with approximately 100 different kinds of work.

SIS website opens in a new window (in Swedish)

Ljuskultur's website opens in a new window (in Swedish)

Sources of incorrect measurement values

The measured value are approximate, the mobile camera is not a professional photometer and the app only a tool to get an indicative assessment. The app was calibrated in April 2022 with IOS 15.4.1 (Iphone), Oxygene OS 11.1.10.10 ACOIBA (One Plus Nord), EMUI 10.0.00195 (Huawei), and for those available for the respective Samsung model. Calibration for daylight was done at 100 percent cloudiness and at four different illuminances from artificial lighting (approx. 60, 200, 500, and 1,000 lx; fluorescent tube Philips Master TL 5 HO 49W / 830) with color temperature approx. 2800 K.

When calibrated in April 2022, all errors were less than 20% (mean error <10%) when measuring illuminance in electric light and daylight. However, the spectral sensitivity of mobile phone cameras differs for different types of daylight and for different types of electric light sources. Future general software updates may also affect sensitivity. The occurrence of measured values with deviations greater than 20% from the true value can therefore not be excluded.

What if measured values are below recommended value

If the measured lux value during repeated measurements is below the recommended standard value, you are suggested to inform your immediate manager or safety representative at your workplace. They can then request more accurate measurements, for example from the Occupational Health Service, which normally has access to professional photometers.

Measure flicker with the app

Invisible flicker with frequencies up to about 120 Hz can normally be assessed by the app to get an estimate about frequency and modulation. Some Android models can, however, not measure 100 Hz. This error is then in red text on the screen at attempt to measure. 100-120 Hz is a common flicker frequency since generated by the mains' 50-60 Hz. Flicker can cause problems such as fatigue, headaches, and general discomfort. The degree of discomfort is individual and most people do not notice this flicker while some individuals seem to suffer considerably.



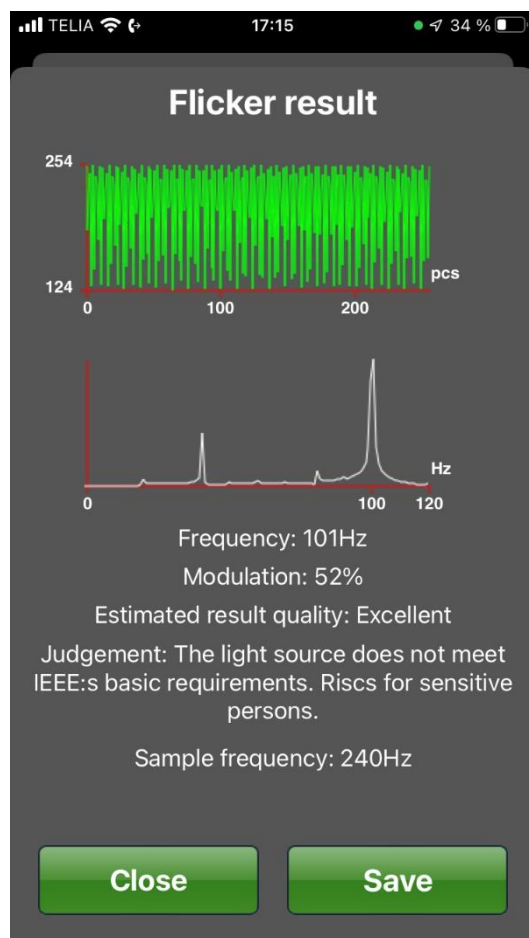
How to measure flicker

The piece of paper used at lux measurement shall be attached in the same way to the lens. First make sure that the light source has been switched on for at least five minutes before you start measuring. A recently turned on light source sometimes emit significantly more flicker.

1. Turn off all other artificial light sources and block daylight completely.
2. Click Flicker at the bottom of the mobile screen.
3. Point the mobile phone so that you can see the light source on the screen; try to get close but not closer than a few decimeters away from the light source.
4. Wait a few seconds. Flickering or moving stripes on the screen do not affect the measurement.
5. Hold the phone as steady as possible, press "Start measuring" and continue to hold the mobile steady when "Measurement in progress" is indicated. The measurement takes less than two seconds.

How to interpret the result

The result is presented as frequency, modulation, a risk assessment, and the sampling frequency (see photo below).





Frequency

This is calculated with Fourier analysis. Note that frequencies higher than 120 Hz cannot be measured reliably due to limitations in the camera's sampling frequency (frames per second, fps). This must be at least twice as high as the frequency to be analyzed (see Nyquist-Shannon's sampling theorem). Modern models of Iphone and most androids use 240 fps. However, there are still mobiles that can only handle 120 fps and these can thus not register 100 Hz flicker.

Nyquist-Shannon's sampling theorem on Wikipedia

Modulation (%)

Calculated as (maximum value minus minimum value) / (maximum value plus minimum value) x 100.

Estimated measurement quality

An assessment of how much interference that is present in the collected signal. If there are too many disturbances, the app indicates that analysis cannot be presented.

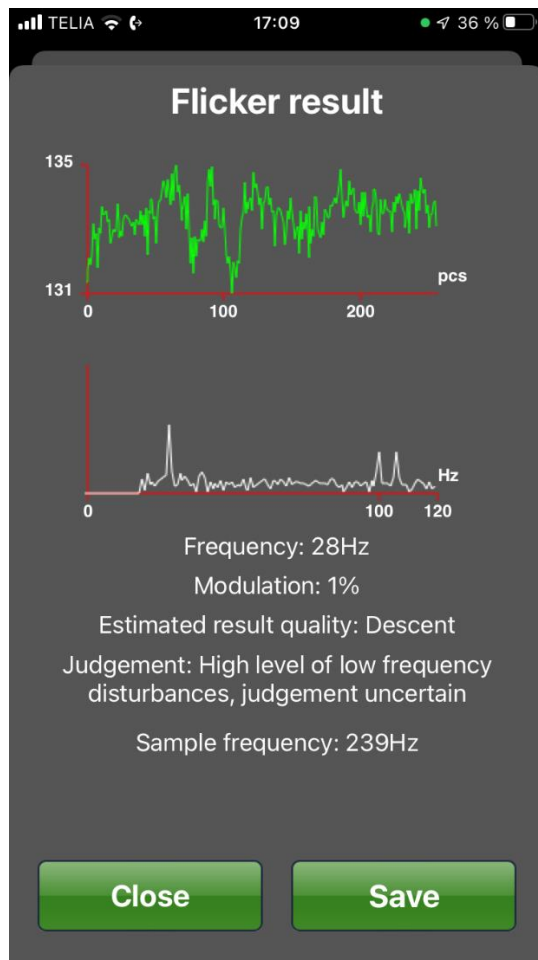
Risk assessment

The app calculates the flicker in relation to the limit for possible symptoms stated in the report IEEE Recommended Practices for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers, see below "Interpretation of the measurement result". The calculation is made by calculating whether the ratio of the flicker frequency and modulation is above or below the curve on page 29 of the report. The quota limits have been set at 12.5 for low-risk inconvenience and to 30 for no risk of inconvenience.

Report, IEEE Recommended Practices for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers, pdf, opens in new window

Sources of incorrect measurement values

The measured value for flicker from light sources with a frequency above 120 Hz and marginal modulation may have an incorrect frequency value. The white curve on the results presentation then has many small peaks and lacks a distinct peak (see photo below).



Movements during the measurement can also give rise to results with too low a frequency even though the measurement quality is stated as good in some form. The frequency specified as a result always applies to the highest peak, which can be generated by involuntary movements. If a distinctly slightly lower peak is also present at, for example, 100 Hz, it is probably generated by the flicker of the light source (see photo above). Then make a new measurement and use a support so that the phone does not move.

Interpretation of the measurement result

A flicker with 100 Hz and 100 percent modulation is considered a considerable risk of uncomfortable symptoms in sensitive individuals, while 100 Hz with less than 8 percent modulation is considered to involve a very low risk. At less than 3 percent, modulation is considered risk-free. For a more detailed assessment, see page 29 of the report IEEE Recommended Practices for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers.

Report, IEEE Recommended Practices for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers, pdf, opens in new window

Measures in case of high modulation and / or significant problems

You are suggested to request more reliable measurements of the flicker if you or a colleague feel obvious and repeated problems in some form when you are exposed to the light from a



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special light source with a frequency between about 95-105 Hz and a high modulation. If you have a safety representative, you can ask them to request more reliable measurements of the flicker with the aim to obtain reasons to switch to a light source with a higher frequency and/or lower modulation.