application note

LED measurement

flicker measurement

admesy
ADVANCED MEASUREMENT SYSTEMS

Contents

1 Introduction

This document is intended to clarify the procedure for flicker measurements of LEDs and SSL (solid state lighting) products. General aspects of flicker measurements and two setups for flicker measurement will be explained. At last a number of general remarks concerning flicker measurements are provided to ensure accurate and repeatable measurements.

These measurements can be carried out using Admesy's Iliad software application. Latest Iliad Version can be downloaded from the Admesy website for free.
www.admesy.nl/download/software/iliad.zip

2 Flicker

Flicker can occur in all sources that emit light and flicker measurements are commonly used in display and lighting industry. In this document the focus of flicker measurements will be on LED and SSL products. These types of lighting typically show flicker more compared to incandescent lighting or fluorescent tubes due to their fast response. Main cause for flicker are fluctuations in mains or power supplies / drivers. Because of rapidly growing applications of LED and SSL products and drivers, quality assessment including measurement of parameters such as flicker which are related to health and wellbeing become more and more important. More detailed information regarding flicker can be found in our technical note. Fluctuations in light output are typically expressed in percentage flicker (Eq. 1) and flicker index (Eq. 2). These values are typically expressed as a value over one cycle of the signal, excluding frequency as component. Figure 1 shows an example of one cycle of a LED output to explain both metrics.

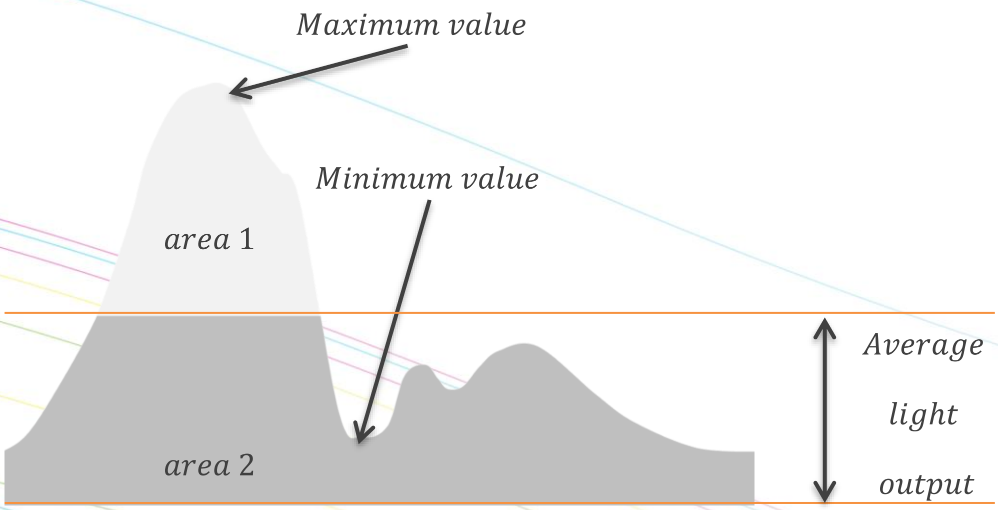


Fig 1 Example of one light fluctuating cycle and relations of flicker.

$$percentage\ flicker = 100 \cdot \frac{\max - min}{\max + min}$$

Equation 1

$$flicker\ index = \frac{area\ 1}{area\ 1 + area\ 2}$$

Equation 2

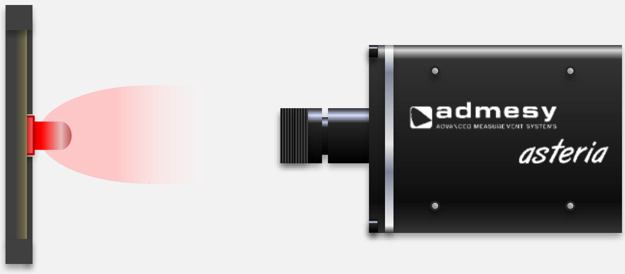
In lighting applications we can differentiate high frequency flicker or stroboscopic effects and low frequency flicker often caused by bad power supplies. Flicker is typically measured by means of human vision corrected sensors (CIE1931 luminance response) typically excluding flicker occurring in wavelengths we cannot see. Depending on the implementation of the measurement devices and samples under test, flicker measurements can be carried out using our Asteria light meter or one of our colorimeters (MSE, Brontes, Cronus). As the procedure of flicker measurement is similar for all these measurement devices, two example setups in this document will show only two device examples.

3 Flicker measurement procedure [detector]

The most basic setup for flicker measurements consists of an Asteria light meter which can measure luminance samples at speeds up to 186567 samples per second. The object under test can be placed in front of the detector and measurements using the Admesy Iliad software can be carried out right away (fig 2). Typically, flicker is rather easy to measure as it is a relative measurement. Do ensure you're only measuring the sample under test and eliminate other (ambient) lighting that should not be taken into account as it may affect the results. It is recommended to point the Asteria towards the light source to obtain a proper signal/noise ratio, depending on the power of the light source.

Procedure overview

Flicker measurement



- Place Asteria light meter in front of object under test and start flicker measurement with Iliad software.

Fig 2 Asteria light meter placed in front of object under test.

4 Flicker measurement procedure [integrating sphere]

For applications that require caption of the total amount of radiant power and flicker at the same time, an integrating sphere is used to spatially distribute the unidirectional radiation emitted by the LED into homogeneous radiation. Depending on properties of the LED, an appropriate sphere size has to be chosen. A Cronus spectro-colorimeter is connected to the sphere by means of a fiber (fig 3) to perform both radiant power and flicker measurements with the same setup.

Procedure overview

Flicker measurement with sphere

- Place object under test into sphere opening and start flicker measurement with Iliad software.

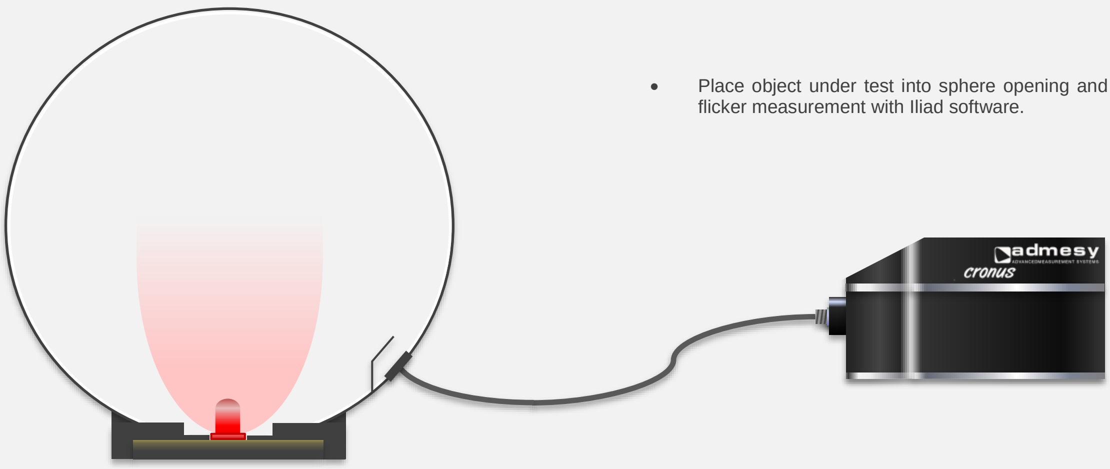


Fig 3 Cronus spectro-colorimeter connected to an integrating sphere.

5 Remarks for measurement procedure

To ensure accuracy and repeatability of measurements, a number of remarks are listed below with a brief explanation.

- Control ambient lighting: other light sources may cause flicker that interfere with object under test and affect the measurement results.
- Control sphere for dust and dirt (in case of sphere setup for combined radiant power).
- Control or consider stabilization time of object under test.
- Control power supplies (current, voltage, AC/ DC, waveform).
- Control measurement parameters: i.e. sample rate.
- Control ambient temperature and humidity of test environment (typical ambient temperature of 25ºC (77F) unless otherwise specified).

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