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Instruction manual for operating the Goniospectrometer in SSL Characterization

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1. Definition

1.1. Scope

This instruction manual describes the principle and the operation of the equipment used for goniospectrometer measurements in SSL characterization. The angular distribution of SSL measured with the setup described in this instruction manual is utilized to calculate the spatial non-uniformity correction factor for the internal source in luminous flux measurements [1, 2].

1.2. Object and field of application

SSL: Light sources for the characterization

Voltage source: Supplies current and/or voltage to the SSL

Konica Minolta CS-2000A: Measures the relative spectral irradiance of the SSL

Newmark RT-3/5 rotary stage: For rotating the SSL

Newmark manual linear stage: For adjusting the center of the SSL on to the intersection of the rotation axes

2. Equipment

2.1. SSL

SSLs (Solid-state lamp/lighting) are LED or OLED-based sources of illumination. Retrofit SSLs are normally based to LEDs and are driven with AC. OLEDs should be driven with DC.

2.2. AC/DC

To power the E27-base retrofit SSLs AC-source Chroma 61601 (500 VA) or Pacific 115ASXT (1500 VA), should be used.

Keithley SourceMeter 2420 should be used for powering OLEDs. SourceMeter should be driven from the LabVIEW-program. The Keithley SourceMeter is connected to the computer with GBIP-cable.

2.3. Spectroradiometer

The spectrum and the intensity of the light are measured with Konica Minolta CS-2000A spectroradiometer which has a diffuser head attached to it.

2.4. Rotators and stray-light box

Newmark RT3 and RT5 rotators are used to rotate the light sources. A Newmark NSC-M motion controller is used to control the rotators and it connects to them and to the

measurement computer through RS-232 interface. The proposed installation is shown in Figure 1.

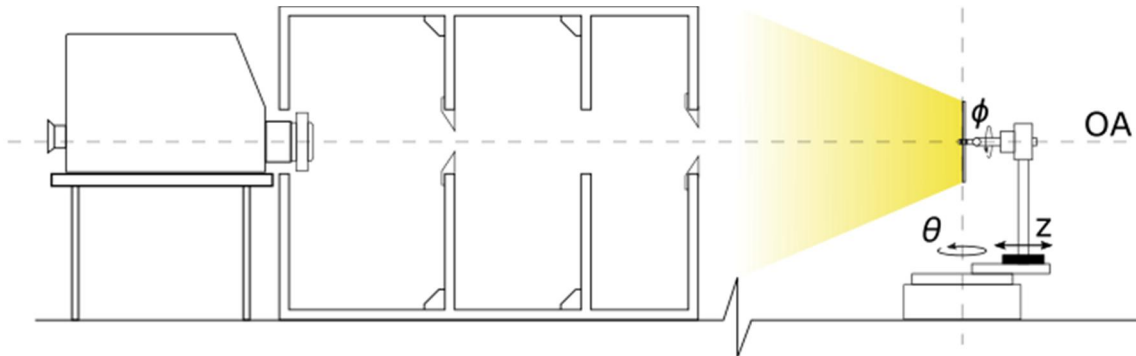


Figure 1. The proposed installation of the goniospectrometer setup.

The metric adapter plate is attached to the rotator RT5 and the linear translator is mounted on an extension piece. The rotator RT3 is attached with an aluminum adapter and an optical post to the linear translator according to Figure 2.



Figure 2. Installation of the rotators and the linear translator

The used apertures on the stray-light box and their location should be chosen in a way that minimizes the reflections reaching the measurement instrument and that the measured light source is seen completely by the instrument.

3. Measurement methods and procedures

Goniospectrometric measurements are used for characterization of the relative angular and spectral distributions of SSLs. Angular and spectral distributions are measured with a calibrated Konica Minolta CS-2000A spectroradiometer.

The measurement program has 6 different sections (Figure 3), which have each different background color. Enabling the measurement devices and rotators (yellow background) should be done before running the program. The Newmark NSC-M ports should be set accordingly to the physical connection. After running the program all other sections are in use. The manual control is to send commands straight to the motion controller, the commands can be found in the manual of the device [3]. The single measurement controls are for aligning the rotary stages, for controlling the CS2000-A, e.g. setting the measurement speed and observer of the instrument, and for controlling the output and compliance level of the Keithley SourceMeter. The measurement sequence section controls is for starting the sequence and for the needed settings. The section with green background is for presenting the measurement results, position of the rotary stages, and the supplied current and voltage by the SourceMeter. Last section is for quitting the program in a controlled way.

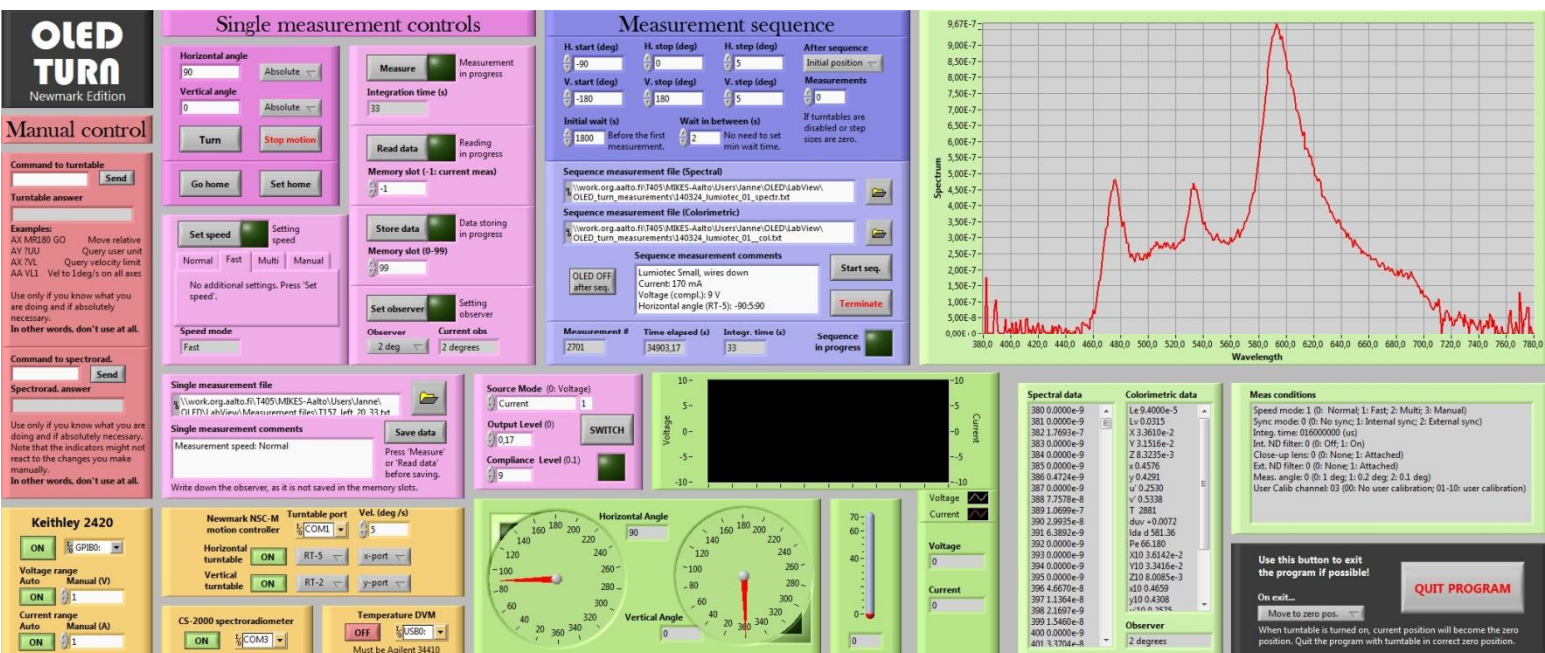


Figure 3. Front panel of the measurement program.

3.1. Alignment procedures

The measurement setup mainly used is shown in Figure 1. Two beam alignment laser is attached to the middle section of the stray-light box with magnetic base. It should be

checked that the centers of the apertures of the box are on the optical axis (OA in Figure 1). The rotation axis of the upper rotary stage is set to optical axis with the alignment laser. The RT-5 rotary stage can be used for correcting the θ -direction.

The spectroradiometer CS2000-A is mounted on top of breadboard lying on optical posts and it is aligned on the optical axis with the alignment laser and a mirror. The diffuser is attached to the instrument and the focus of the lens is set to infinity.

SSL lamp is attached to the upper rotary stage, which is aligned correctly, and the center of the light source is set to the interception of the rotation axes shown in Figure 1 with the linear translator. For OLEDs it should be also checked that the surface is perpendicular to the optical axis with the alignment laser. When connecting the electrical contact the polarity of the light source should be taken into account.

Last, the alignment laser is removed from the stray-light box and the black cardboard floor is put in to its place and the box is closed with the cardboard wall.

3.2. Measurement procedures

For measuring the angular distribution of the SSL spectrally, limits for the angles and the step size should be chosen. If the turntables are not enabled the number of measurements can be defined separately. The wait after the rotation of the SSL should be set to at least 1 second. The speed of the measurement is set to fast, at least for OLEDs. In case of wanting to stabilize the SSL source before beginning the measurement, a time to wait before the first measurement should be set.

4. Safety and handling precautions

4.1. Safety and handling precautions

When removing the spectroradiometer from the setup, it should be checked that the diffuser is not attached to the device! The goniometer setup should only be used to measure SSL-lamps, not traditional incandescent nor any standard lamps.

5. References

- [1] T. Poikonen, T. Pulli, A. Vaskuri, H. Baumgartner, P. Kärhä and E. Ikonen, "Luminous efficacy measurement of solid-state lamps," *Metrologia*, vol. 49, pp. 135-140, 2012.
- [2] *Quality Manual for Luminous Flux Measurements.*
- [3] *User's manual: Intelligent motor controllers - PC78 family.*