



S Swiss Calibration Service
C Schweizerischer Kalibrierdienst
S Service suisse d'étalonnage
S Servizio svizzero di taratura



SCS 0053

Calibration Laboratory accredited by the Swiss Accreditation Service
 Von der Schweizerischen Akkreditierungsstelle akkreditierte Kalibrierstelle
 Laboratoire d'étalonnage accrédité par le service suisse d'accréditation

Accreditation N° **SCS 0053**
 Akkreditierungs-Nr.:
 N° d'accréditation
 accredited according to ISO/IEC 17025

The Swiss Accreditation Service SAS is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates and to the ILAC Mutual Recognition Arrangement (www.sas.ch; www.european-accreditation.org; www.ilac.org)

| | | |
|------------|---|------------|
| SCS | CERTIFICATE of CALIBRATION KALIBRIERZERTIFIKAT CERTIFICAT d'ETALONNAGE | SCS |
|------------|---|------------|

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| Certificate N° Zertifikat Nr. N° de certificat | 19313 -1 | Page of Seite 1 von 5 Page de |
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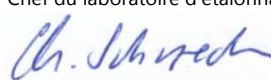
| | | | |
|------------------------------------|---|--|-----------------------|
| Customer Auftraggeber Client | CO.FO.ME.GRA IT-20125 MILANO | Order N°, date Auftrags-Nr, -Datum N° de comm., date | email 24.06.19 |
|------------------------------------|---|--|-----------------------|

| | |
|--|--|
| Device under test (DUT) Gegenstand Objet | <i>UV-Radiometer / Illuminance Meter</i> |
| Model / Serial N° Typ / Serien Nr Type / N° de serie | <i>Multimeter MUM / sn 61</i> |
| Manufacturer Hersteller, Fabricant | <i>CoFoMeGra</i> |
| Accessories Zubehör Accessoires | <i>6 sensors: #UV1111, #UV2068, #UV3199, #UV4017, #UV9001, BST #UV5081</i> |
| Remarks Bemerkungen Remarques | <i>Calibrated for long arc xenon lamp in Solarbox / Suntest CPS</i> |
| Date of calibration Kalibrierdatum Date d'étalonnage | <i>4.- 18.07.2019</i> |

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
 Dieses Kalibrierzertifikat dokumentiert die Rückverfolgbarkeit auf nationale Normale zur Darstellung der physikal. Einheiten (SI).
 Ce certificat d' étalonnage confirme le raccordement aux étalons nationaux qui matérialisent les grandeurs physiques (SI).

The measurements, the uncertainties with confidence probability and the calibration methods are given on the following pages and are part of the certificate
 Messresultate, Messunsicherheiten mit Vertrauensbereich und Messverfahren sind auf den folgenden Seiten aufgeführt und Teil dieses Zertifikates
 Les résultats, les incertitudes avec le niveau de confiance et les méthodes de mesure sont donnés aux pages suivantes et font partie du certificat

Stamp and date
 Stempel und Datum
opto.cal gmbh
 SCS-Kalibrierlabor
 Chemin des Vies 24
 CH-2812 Movelier
 27.07.2019

Head of the Calibration laboratory
 Leiter der Kalibrierstelle
 Chef du laboratoire d'étalonnage

 Christoph Schroeder

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| | | |
|---|---------|------------------------|
| Certificate N° Zertifikat Nr N° de certificat | 19313-1 | Multimeter MUM / sn 61 |
|---|---------|------------------------|

1 CALIBRATION METHOD

The measurements have been executed acc. to SOP 12.04: S(integral)

To establish the calibration of the device under test (DUT), its signal, when irradiated with a test source at the given operating conditions and geometry (→ Chap.4), was recorded. At the same conditions the spectral irradiance $E(\lambda)$ was measured by means of an absolute calibrated reference spectroradiometer in the wavelength range *250-850 nm, the irradiance E was integrated in the spectral bands 295-400 nm and 300-400 nm as well as the illuminance E_v . An integrating sphere was used as light receptor for spectral measurements in order to measure the complete radiation (direct and indirect).

By comparing the reference value in the specified wavelength range or at the specified wavelength and the value of the device under test, the calibration factor(s) were calculated and documented in this certificate.

The device has not been adjusted

2 RESULTS of CALIBRATION

2.1 Measurement of irradiance E and Illuminance E_v

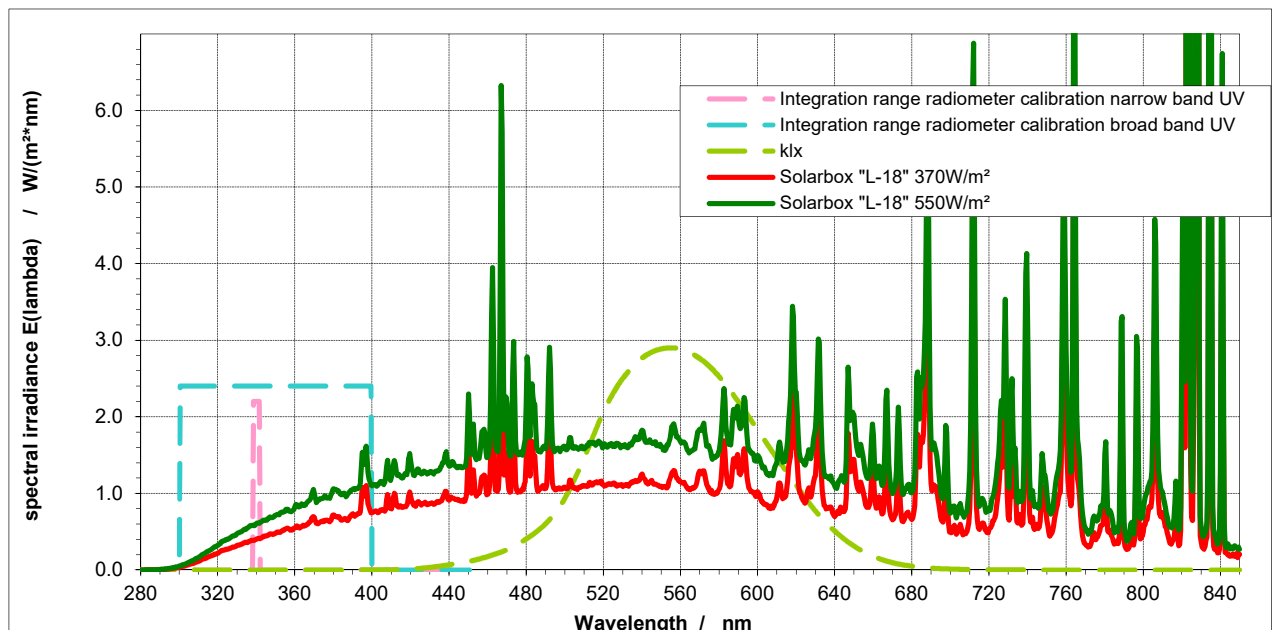
(no adjustment, as found = as left)

For a spectral distribution as it is emitted by a source of the type Solarbox (see graph §2.2) the following calibration factors for the displayed measurement values for spectral irradiance $E(\lambda)$, irradiance E in the following wavelength ranges and for Illuminance E_v have to be reported:

| Radiation source | Wavelength band | Reference Value | Display DUT | Sensor # | Deviation DUT / Réf. | Calibration factor ± Uncertainty | |
|-------------------------------------|-----------------|---------------------|------------------------|------------------------|----------------------|----------------------------------|---|
| Offset | | 0 | 0.0 | | | | |
| Solarbox 1500e, filter outdoor S205 | 340 | 0.537 | 0.499 | UV 1111 | -7% | 1.07 ± 0.08 | |
| | 420 | 1.273 | 1.159 | UV 2068 | -9% | 1.10 ± 0.07 | |
| | nm | | W/(m ² *nm) | W/(m ² *nm) | | | 1 |
| | 295-400 | 61.15 | 54.50 | UV 3199 | -11% | 1.12 ± 0.08 | |
| | 300-400 | 60.99 | 49.94 | UV 9001 | -18% | 1.22 ± 0.07 | |
| nm | | W/(m ²) | W/(m ²) | | | 1 | |
| visible 360-830 | 110.3 | 109.6 | UV 4017 | -1% | 1.01 ± 0.08 | | |
| Unit / Einheit: | | klx | klx | | | 1 | |

! The instrument has not been adjusted, the calibration factors mentioned above shall be applied. !

2.2 Spectral distribution $E(\lambda)$ of test source



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Zertifikat Nr
N° de certificat
Certificate N°

19313-1

Multimeter MUM / sn 61

3 UNCERTAINTY of MEASUREMENT

| | |
|---|--------------|
| relative measurement uncertainty of measurand in wavelength range | |
| ± 7 % | 300 - <400nm |
| ± 4 % | 400 - 800nm |

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k = 2$, which for a normal distribution corresponds to a coverage probability of approximately 95 %.

The uncertainty includes the contributions to uncertainty by the standards, procedures, environmental conditions and unit under test at the moment of calibration. The long term behaviour was not taken into consideration.

± 0.5 nm Uncertainty of wavelength scale

The influence of the directional response (deviation from the cosine of incidence angle, "cosine error") at other measurement geometries and the match of spectral sensitivity for measurement of other sources has not been taken into account.

4 MEASUREMENT CONDITIONS

Measuring geometry Detector at center of Solarbox sample tray
Reference plane = sample tray (bottom of sensor)

Test source: Xe Arc lamp 1500W: Solarbox #L-18

operat. conditions: 370W/m², 550W/m², 750 W/m² Filter outdoor S205

Ambient Temperature: 22.9 °C ± 1.5 °C; Rel. Humidity: 53 %rH ± 15 %rH

5 MEASURING INSTRUMENTS and TRACEABILITY

#B-04: SP320D (Integr.Sphere 4"/Port 1cm², scan.double monochr.250-2150nm+PMT/InGaAs) (Instrument Systems)

spectral resolution (FWHM) / stepsize : 1nm/0.5nm

internally calibrated with Irradiance Standard Lamp FEL1000W #A-35 (sn14905-20) / Metas #11603676 / Cal.due 06.2021

Hg Wavelength standard lamp #A-08hg / (no certificate, natural standard)

Lux-Sekundärnormal #B-17 (VL-3701/sn1124)

Transferrnormal #B-14 (RS-3A / sn HL760) + Detector #D-56

6 RAW DATA

The raw data are archived for 10 years at least.

7 REMARKS

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APPENDIX A1:

A 1 Calibration of temperature probe by Subcontractor (SCS N° 0058)

→ see next 2 pages

Kalibrierzertifikat / Certificate of Calibration

Zertifikat / Certificate **1907182403**

Kunde / Customer **Opto.cal GmbH**
Chemin des Vies 24
2812 Movelier

Auftragsnummer / Order Number **19-3331**
Auftragsdatum / Order Date **17.07.2019**

Prüfobjekt / Test Object

Gerätebezeichnung / Model / Object **Multimeter**
Hersteller / Manufacturer **Cofomegra**
Gerätetyp / Type **MUM**

Prüfmittel Nr. / Inventory No. **313-2**
Serien Nr. / Serial No. **84**

Kalibrierbedingungen / Test-Conditions

Temperatur / Temperature **23.0°C ± 1°C**

Rel. Luftfeuchtigkeit / Relative Humidity **45.0% ± 15%**

Kalibrierergebnisse / Testresults

Resultat / Result **no statement possible**
Nicht bestandene Tests / Failed Tests **-**
Bemerkungen / Remarks **-**

Anlieferung / Incoming **O.K.**

Ort, Kalibrierdatum: / Place, Date of Calibration: **Gümligen, 18.07.2019**

Kalibriert von: / Calibrated by: **Dominic Maurer**



Dieses Kalibrierzertifikat dokumentiert die Rückführbarkeit auf nationale Normale, andere SCS-Kalibrierstellen oder Kalibrierungen beim Hersteller. Dieses Kalibrierzertifikat bestätigt, dass die nicht fett gedruckten Werte innerhalb der angegebenen Spezifikation liegen. Der Inhalt dieses Zertifikats darf nur in vollständiger Form veröffentlicht werden. Die Kalibrierung wurde nach einem Qualitäts-Managementsystem gemäss ISO 9001:2008 durchgeführt.

This calibration certificate documents the traceability to national standards, other SCS calibration laboratory or calibrations by the manufacturer. This certificate of calibration acknowledges that all not bold marked values are situated within the indicated specifications. It may not be published or forwarded other than full. The calibration has been carried out after a quality management system conforming to ISO 9001:2008.

Kalibrierzertifikat / Certificate of Calibration

Certificate No: 1907182403

Range of calibration

The following measuring ranges were tested: Surface temperature.

Measuring procedure

The measurements were carried out according the calibration instructions KA0028.

The measurements were carried out with the customer probe Cofomegra BST (Ser. No.: UV5081).

Calibration Equipment

| Description | Model | Manufacturer | Inventory No. |
|----------------------------------|----------------|--------------|---------------|
| Climatic chamber | MKF 115 / E3.2 | Binder | 80386 |
| Humidity Temperature Sensor | HC2A-S | Rotronic | 80443 |
| Humidity Temperature Data Logger | HL-NT3-D | Rotronic | 80442 |

Results

| No. | Characteristic | Expected | Tolerance | Uncertainty | Measured |
|-----|----------------------------------|----------|---------------|-------------|----------|
| 1. | Maintenance / Preparation | | | | |
| | Probe condition | O.K. | | | ✓ |
| 2. | Temperature | [°C] | ¹⁾ | ±[°C] | [°C] |
| | | 20.96 | | 0.2 | 21.0 |
| | | 60.72 | | 0.2 | 60.5 |

1) No specification available

Measuring uncertainties confidence range

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k = 2$, which for a normal distribution corresponds to a coverage probability of approximately 95%.