

Certificate of Calibration

Spectral Calibration

Customer: Universitat Polytècnica de Catalunya
CD6/UPC, Rambla de Sant Nebridi, 10
08222 Terrassa

Order number: 002638

Spectrometer model: SP320-114


Serial number: 30932004

Calibrated accessories: Optical probe: ISP250-211
Optical fiber guide: OFG-464
Fiber plug adapter: PLG-420

Date of calibration: 18 April 2007

Number of pages: 9

Certified by:



J. Heumos

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1. Calibration steps:

1.1 Wavelength: The wavelength accuracy of the spectroradiometer is checked with a He/Ne laser and/or a Hg/Ar source.

1.2 Spectral calibration: A 1000 W FEL lamp (PTB traceable) is used for the spectral calibration of the spectroradiometer in the range from 800 nm to 1700 nm (InGaAs detector).

The spectral calibration corrects the relative spectral response of the instrument and the optical probe.

2. Calibration setup:

Lamp → ^(optical probe) ISP250-211 → ^(fiber bundle) OFG-464 → ^(fiber plug) PLG-420 → SPECTRO320

3. System and measurement parameters:

Detectors :	InGaAs	Step width :	1 nm
Wavelength range :	800 – 1700 nm	Averaging :	2
Resolution :	5 nm	Density filter :	No
Scan speed :	60 ms / nm	Blocking filters :	Yes
PMT voltage :	--		

4. Results:

4.1. Wavelength:

Standards: Xenon lamp, HeNe laser and DFB laser

expected value [nm]	measured value [nm]	deviation [nm]
881,9	881,89	-0,01
979,97	979,93	-0,04
1152,27	1152,23	-0,04
1265,64	1265,61	-0,03
1531,93	1531,90	-0,03

Specification: +/- 0.2 nm

Certificate of Calibration

Calibration to Radiant Intensity I_{e-B} [W/sr]

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Order number: 002638

Spectrometer model: SP320-114

Serial number: 30932004

Calibrated accessories:

Optical probe:	LED-434
Optical fiber guide:	OFG-464
Fiber plug adapter:	PLG-420

Date of calibration: 18 April 2007

Number of pages: 9

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INSTRUMENT SYSTEMS GmbH Neumarkter Str. 83 D-81673 Munich
<http://www.instrumentsystems.de> e-mail: info@instrumentsystems.de

Phone: ++49/089-454943-0
Fax: ++49/089-454943-11

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1. Calibration steps:

- 1.1 Wavelength: The wavelength accuracy of the spectroradiometer is checked with a He/Ne laser and/or a Xenon source.
- 1.2 Spectral calibration: A 1000 W halogen lamp (PTB traceable) is used for the spectral calibration of the spectroradiometer in the range from 800 nm to 1700 nm. The spectral calibration corrects the relative spectral response of the instrument and the optical probe.
- 1.3 Absolute calibration: The absolute calibration is accomplished by comparison to radiant intensity standards of the PTB.

2. Calibration setup:

Lamp → ^(optical probe) LED-434 → ^(fiber bundle) OFG-464 → ^(fiber plug) PLG-420 → SPECTRO320

3. System and measurement parameters:

Detectors :	InGaAs	Step width :	1 nm
Wavelength range :	800 – 1700 nm	Averaging :	2
Resolution :	5 nm	Density filter :	No
Scan speed :	60 ms / nm	Blocking filters :	Yes

4. Results:

4.1. Wavelength:

Standards: Xenon lamp, HeNe laser and DFB laser

expected value [nm]	measured value [nm]	deviation [nm]
881,90	881,90	0
979,97	979,92	-0,05
1152,27	1152,38	0,11
1265,64	1265,63	-0,01
1531,93	1531,94	0,01

Specification: +/- 0.2 nm

4.2. Absolute intensity:

Standards: LEDs (metal housing with temperature controller); $I_f = 10.00 \text{ mA}$; (Reference: LEDs calibrated to radiant intensity at the PTB Physikalisch-Technischen Bundesanstalt)

LED type / no.	Radiant intensity expected value [$\mu\text{W}/\text{sr}$]	Radiant intensity measured value [$\mu\text{W}/\text{sr}$]	Deviation [%]
78 (950-1)	182,7	180,35	-1,29

Permissible specification: $\pm 5\%$.

5. Calibration files:

- 309320L1.ini Configuration file contains information about the wavelength and absolute calibration and hardware of the spectroradiometer.
309320L1.isc Calibration file contains the information about the spectral calibration.

6. Remarks:

- The calibration is void by any mechanical changes or dismantling of any parts of the system.
- A recalibration is recommended within twelve to eighteen months.
- Instrument Systems guarantees, that during the calibration every system or standard was within its range of validity.

7. Conditions:

Temperature (in Celsius) $23^\circ \pm 2^\circ$
Humidity 36%

Certificate of Calibration

Calibration to Luminous Flux [lm]

Customer: Universitat Polytècnica de Catalunya
CD6/UPC, Rambla de Sant Nebridi, 10
08222 Terrassa

Order number: 002638

Spectrometer model: SP320-114

Serial number: 30932004

Calibrated accessories: Optical probe: ISP-250
Optical fiber guide: OFG-464
Fiber plug adapter: PLG-420

Date of calibration: 18 April 2007

Number of pages: 9

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<http://www.instrumentsystems.de> e-mail: info@instrumentsystems.de

Phone: ++49/089-454943-0
Fax: ++49/089-454943-11

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1. Calibration steps:

- 1.1 Wavelength: The wavelength accuracy of the spectroradiometer is checked with a He/Ne laser and/or a Hg/Ar source.
- 1.2 Spectral calibration: A 1000 W halogen lamp (PTB traceable) is used for the spectral calibration of the spectroradiometer in the range from 350 nm to 930 nm. (A Deuterium lamp is used for the spectral calibration in the wavelength range 240 nm to 350nm). The spectral calibration corrects the relative spectral response of the instrument and the optical probe.
- 1.3 Absolute calibration: The absolute calibration is accomplished by comparison to luminous flux standards of the PTB.

2. Calibration setup:

Lamp → ^(integrating sphere) ISP-250 → ^(fiber bundle) OFG-464 → ^(fiber plug) PLG-420 → SPECTRO320

3. System and measurement parameters:

Detectors :	PMT3	Step width :	1 nm
Wavelength range :	240 – 930 nm	Averaging :	2
Resolution :	2.5 nm	Density filter :	No
Scan speed :	60 ms / nm	Blocking filters :	Yes
PMT voltage :	3		

4. Results:

4.1. Wavelength:

Standards: Hg/Ar lamp and HeNe laser

expected value [nm]	measured value [nm]	deviation [nm]
253,65	253,65	0,00
435,84	435,85	0,01
546,08	546,10	0,02
632,82	632,83	0,01
871,68	871,69	0,01

Specification: +/- 0.2 nm

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4.2. Absolute intensity:

Standards: LEDs (metal housing with temperature controller); $I_f = 20.00 \text{ mA}$; (Reference: LEDs calibrated to Luminous flux at the PTB Physikalisch-Technischen Bundesanstalt)

LED type / no.	Dominant wavelength [nm]	Luminous flux expected value [mlm]	Luminous flux measured value [mlm]	Deviation [%]
S-WS1		26,2	26,7	2,08
S-BL2	468,2	14,8	14,5	-2,11
S-GN3	560,1	14,0	14,2	1,73
S-GE4	589,5	187,9	189,6	0,91
S-OR1	605,8	87,3	86,3	-1,10
S-RT5	631,0	54,9	53,7	-2,19

Permissible specification: +/- 5%.

5. Calibration files:

- 309320I2.ini Configuration file contains information about the wavelength and absolute calibration and hardware of the spectroradiometer.
- 309320I2.isc Calibration file contains the information about the spectral calibration.

6. Remarks:

- The calibration is void by any mechanical changes or dismantling of any parts of the system.
- A recalibration is recommended within twelve to eighteen months.
- Instrument Systems guarantees, that during the calibration every system or standard was within its range of validity.

7. Conditions:

Temperature (in Celsius) $23^\circ \pm 2^\circ$

Humidity 37%

Certificate of Calibration

Calibration to „Averaged LED Intensity“ I_{LED-B} [cd]

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Order number: 002638

Spectrometer model: SP320-114

Serial number: 30932004

Calibrated accessories: Optical probe: LED-434
Optical fiber guide: OFG-464
Fiber plug adapter: PLG-420

Date of calibration: 18 April 2007

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1. Calibration steps:

- 1.1 Wavelength: The wavelength accuracy of the spectroradiometer is checked with a He/Ne laser and/or a Hg/Ar source.
- 1.2 Spectral calibration: A 1000 W halogen lamp (PTB traceable) is used for the spectral calibration of the spectroradiometer in the range from 350 nm to 930 nm. (A Deuterium lamp is used for the spectral calibration in the wavelength range 195 nm to 350nm). The spectral calibration corrects the relative spectral response of the instrument and the optical probe.
- 1.3 Absolute calibration: The absolute calibration is accomplished by comparison to "Averaged LED Intensity" standards of the PTB according CIE condition I_{LED-B} (See CIE Technical Report 127).

2. Calibration setup:



3. System and measurement parameters:

Detectors :	PMT3	Step width :	1 nm
Wavelength range :	195 – 930 nm	Averaging :	2
Resolution :	2.5 nm	Density filter :	No
Scan speed :	60 ms / nm	Blocking filters :	Yes
PMT voltage :	3		

4. Results:

4.1. Wavelength:

Standards: Hg/Ar lamp and HeNe laser

expected value [nm]	measured value [nm]	deviation [nm]
253,65	253,64	-0,01
435,84	435,82	-0,02
546,08	546,09	0,01
632,82	632,84	0,02
871,68	871,69	0,01

Specification: +/- 0.2 nm

4.2. Absolute calibration:

Standards: LEDs (metal housing with temperature controller); $I_f = 20.00 \text{ mA}$; (Reference: LEDs calibrated to „Averaged LED intensity“ at the Physikalisch-Technischen Bundesanstalt PTB)

LED type / no.	Dominant wavelength [nm]	Averaged LED Intensity expected value [mcd]	Averaged LED Intensity measured value [mcd]	Deviation [%]
S-WS1		9,188	9,063	-1,36
S-BL2	467,9	7,881	7,886	0,07
S-GN3	559,5	8,279	8,057	-2,68
S-GE4	589,0	91,30	91,22	-0,08
S-OR1	605,4	46,84	46,08	-1,63
S-RT5	630,9	30,77	30,25	-1,68

Permissible specification: $\pm 5\%$. At checking the calibration standard, measured with above mentioned LEDs (almost lambertian radiation pattern).
The real uncertainty in the measurement depends on the LED type.

5. Calibration files:

- 309320L1.ini Configuration file contains information about the wavelength and absolute calibration and hardware of the spectroradiometer.
309320L1.isc Calibration file contains the information about the spectral calibration.

6. Remarks:

- The calibration is void by any mechanical changes or dismantling of any parts of the system.
- A recalibration is recommended within twelve to eighteen months.
- Instrument Systems guarantees, that during the calibration every system or standard was within its range of validity.

7. Conditions:

Temperature (in Celsius) $23^\circ \pm 2^\circ$

Humidity 37 %