

OL 770VIS/NIR Multi-Channel Spectroradiometer S/N: 09414116

System Information

- ◆ Calibration of Spectral Wavelength and Plot
- ◆ Certificate of Traceability for the Internal Reference Lamp and Plots
- ◆ Certificate of Conformance for the Spectral Response with Maximum CCD Binning and Plot
- ◆ OL 770 Application Software
- ◆ OL 770 Data File(s) Listing
- ◆ OL 770 System Information Sheet Including Wavelength Calibration Coefficients



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**Certificate of Conformance****Calibration of Spectral Wavelength Scale**

for

OL 770VIS/NIR High-speed Test and Measurement System**S/N: 09414116**

Page 1 of 1

Customer: Procter & Gamble Co.
Purchase Order No: GBP-4500810718
Date of Calibration: November 23, 2009
Certification Date: November 24, 2009

Description of Calibration Item

The OL 770VIS/NIR spectroradiometer utilizes a fixed grating spectrograph with a 100 μ m entrance slit, a thermo-electrically cooled CCD detector array with 1024 x 128 pixels and 1-meter glass fiber optic probe (OL 770-7G-1) to couple the spectroradiometer to its optical measurement accessories. A high speed USB bus transmits data between the spectroradiometer controller and the PC.

Description of Wavelength Scale Calibration

The dispersion of light across the array is non-linear and requires a polynomial correction to convert the CCD pixel numbers to a wavelength scale. The mercury argon spectral lamp has emissions line at fixed wavelengths. The spectral lamp is scanned by the OL 770VIS/NIR spectroradiometer and the data is exported to an Excel spreadsheet of data analysis and regression. This produces a 3rd order polynomial converting the CCD pixel number to wavelength. The coefficients of the polynomial, A, B, C & D are saved into the system configuration file.

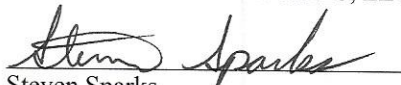
Equipment Used in Wavelength Scale & Coefficient Calibration

Manufacturer	Equipment Description	Serial Number	Traceability	Calibration Performed
OO-HG-1	Hg-Ar Spectral Emission Lamp	n/a	Physical Standard	<input checked="" type="checkbox"/>

Wavelength Scale Test Results

Hg-Ar Emission Line	OL 770 Wavelength Scale	Error	Within Specification Limit ± 1.0 nm	
404.66 nm	404.42 nm	-0.24	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>
435.84 nm	436.22 nm	+0.38	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>
546.07 nm	546.08 nm	+0.01	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>
696.54 nm	696.63 nm	+0.09	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>
763.51 nm	763.41 nm	-0.10	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>
852.14 nm	852.16 nm	+0.02	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>
912.30 nm	912.35 nm	+0.05	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>
1013.98 nm	1013.73 nm	-0.25	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>

Calibration Certified By:
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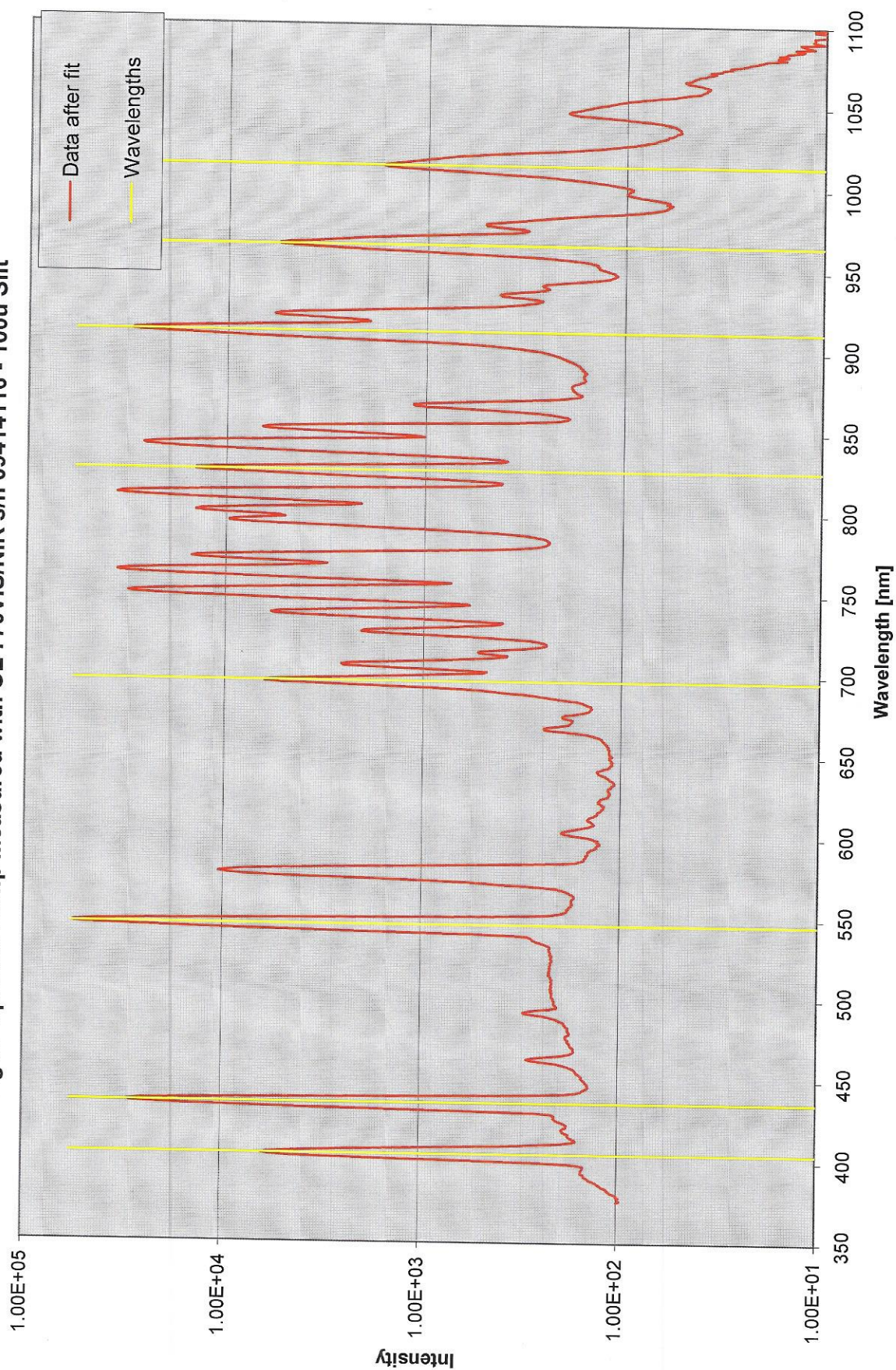

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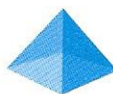
Light Measurement & Instrumentation

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Hg-Ar Spectral Lamp Measured with OL 770VIS/NIR s/n 09414116 - 100u Slit



***Certificate of Traceability***

for the

**OL 700-20-2 Internal Reference Lamp of OL 770VIS/NIR-LED
High-speed LED Test and Measurement System**

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Customer: Procter & Gamble Co.
Purchase Order No: GBP-4500810718
Date of Calibration: November 23, 2009
Certification Date: November 24, 2009

Model No:	OL 770VIS/NIR	OL IS-670-LED
Serial No:	09414116	09100144

Description of Calibration Item

The OL 770VIS/NIR spectroradiometer utilizes a fixed grating spectrograph and a thermo-electrically cooled CCD detector array with 1024 x 128 pixels. An entrance slit and fiber optic probe are used to couple the spectroradiometer to the optical measurement accessories. The spectroradiometer includes a visible internal reference lamp standard ^{1/} and 600 μ m diameter SMA fiber optic probe. The OL 700-20-2 internal reference lamp standard is calibrated using a NIST traceable spectral irradiance standard with each of the optical accessories (and its adapter) and converted into spectral flux or spectral radiant intensity. The calibrated spectral data files associated with each accessory is stored in the ST7 files listed below. The spectral values can be viewed within the OL 770 application software.

Description of Internal Lamp Standard Calibrations

The internal reference lamp is calibrated and saved as:

1. a spectral irradiance standard when used with the OL IS-670-LED
Filename: 770n-116 IRR-IntRefLamp.st7

Validity period of calibration^{2/}

The spectral flux and intensity values for the standard reference lamp should remain stable within $\pm 2\%$ for 50 hours of operation or a period of 1 year, whichever comes first.

^{1/} The internal lamp standard is operated at 960 mA using the OL 770 built in constant current source.

^{2/} ISO 17025 does not recommend issuing validity or recalibration periods.

This is provided as a guide only.

ORIGINAL: O:\product\770\913-166 Procter & Gamble\Internal Cert.913-166.doc
SAVED AS: O:\product\770\913-166 Procter & Gamble\Internal Cert.913-166.doc

OL 700-20-2 Internal Reference Lamp of OL 770VIS/NIR-LED
High-speed LED Test and Measurement System

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Customer: Procter & Gamble Co.
Purchase Order No: GBP-4500810718
Date of Calibration: November 23, 2009
Certification Date: November 24, 2009

Model No:	OL 770VIS/NIR	OL IS-670-LED
Serial No:	09414116	09100144

Calibration Equipment Used


Calibration Equipment			OL 770VIS/NIR System Response	
Manufacturer	Serial Number	Traceability	Calibration Type(s)	Used in Calibration
Description				
Optronic Laboratories OL 752-10 Tungsten Lamp Standard of Spectral Irradiance	770-65D-A	NIST ^{1/}	Total Spectral Flux	<input type="checkbox"/>
Optronic Laboratories OL 245C Standard of Spectral Irradiance	L-865	NIST ^{2/}	Total Spectral Flux	<input type="checkbox"/>
Optronic Laboratories 45W Plug-in Standard	C/N: 616	NIST ^{3/}	Spectral Irradiance	<input checked="" type="checkbox"/>

^{1/} Calibration of Standard 770-65D-A was performed by direct comparison to Optronic Laboratories' NIST traceable OL FEL-C 1000-watt lamp Standard of Spectral Irradiance, S/N: F-919. Calibration of Standard F-919 is traceable to NIST FEL 1000-watt Standard of Spectral Irradiance, S/N: F-578 (NIST Test No. 844/271252) and NIST calibrated Photometers 983 and 993 (NIST Test No. 844/272467).

^{2/} Calibration of Standard L-865 was performed by direct comparison to Optronic Laboratories' NIST traceable OL 245C 45-watt lamp Standard of Spectral Irradiance, S/N: L-854. Calibration of Standard L-854 is traceable to NIST FEL 1000-watt Standard of Spectral Irradiance, S/N: F-525 (NIST Test No. 844/265399) and NIST calibrated Photometers 983 and 993 (NIST Test No. 844/267514).

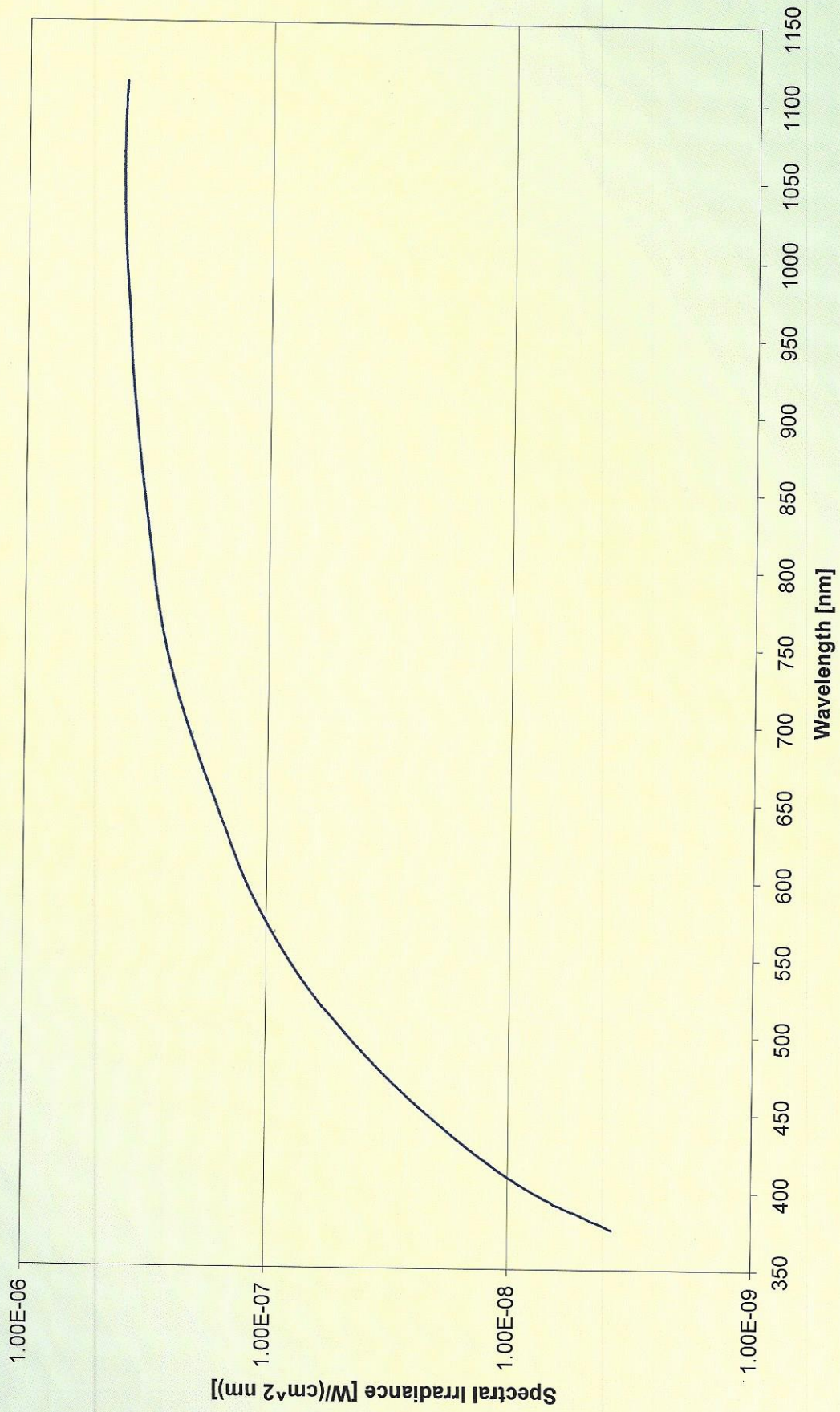
^{3/} Calibration of Standard C/N: 616 was performed by direct comparison to Optronic Laboratories' NIST traceable OL FEL-C-S 1000-watt lamp Standard of Spectral Irradiance, S/N: F-808. Calibration of Standard F-808 is traceable to NIST FEL 1000-watt Standard of Spectral Irradiance, S/N: F-525 (NIST Test No. 844/265399) and NIST calibrated Photometers 983 and 993 (NIST Test No. 844/272467).

Calibration Certified By:
OPTRONIC LABORATORIES, LLC


Steven Sparks
Systems Technician

Internal Lamp Standard for OL IS-670-LED Calibrations (380 - 1100 nm)

File Name: 770n-116 IRR-IntRefLamp.st7





Certificate of Conformance

for the

Spectral Response Calibration (380-1100) of OL 770VIS/NIR-LED High-speed LED Test and Measurement System

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Customer: Procter & Gamble
Purchase Order No: GBP-4500810718
Date of Calibration: November 23, 2009
Certification Date: November 24, 2009

Model No:	OL 770VIS/NIR	OL IS-670-LED
Serial No:	09414116	09100144

Description of Calibration Item

The OL 770VIS/NIR spectroradiometer requires a system response calibration for each of its optical accessories such as the OL IS-670-LED integrating sphere or the OL 15AB Averaged LED Intensity Conditions A/B receptor. Each calibration is performed at the stated CCD binning range with the OL 770 spectroradiometer's own NIST traceable internal calibration lamp standard, model OL 700-20-2.

OL 770 System Configuration

Measurement: Spectral Irradiance
Optical Accessory: OL IS-670-LED
Slit: 100 μ m
Fiber Optic Probe: 1.5-meter Glass FOP
CCD Binning: Max (4 - 125)
Accessories: None S/N: N/A
System Response Calibration File Filename: 770n-116 IRR-IS670-IntRefLamp.cal ^{1/}

Validity period of calibration ^{2/}

The accuracy of the system response calibration files can be verified by measuring the output of the NIST traceable OL 700-20-2 internal reference lamp and comparing the data to the ST7 files. Optronic Laboratories recommend the end-user perform routine system response verifications or calibrations using the NIST traceable internal reference lamp.

Calibration Certified By:

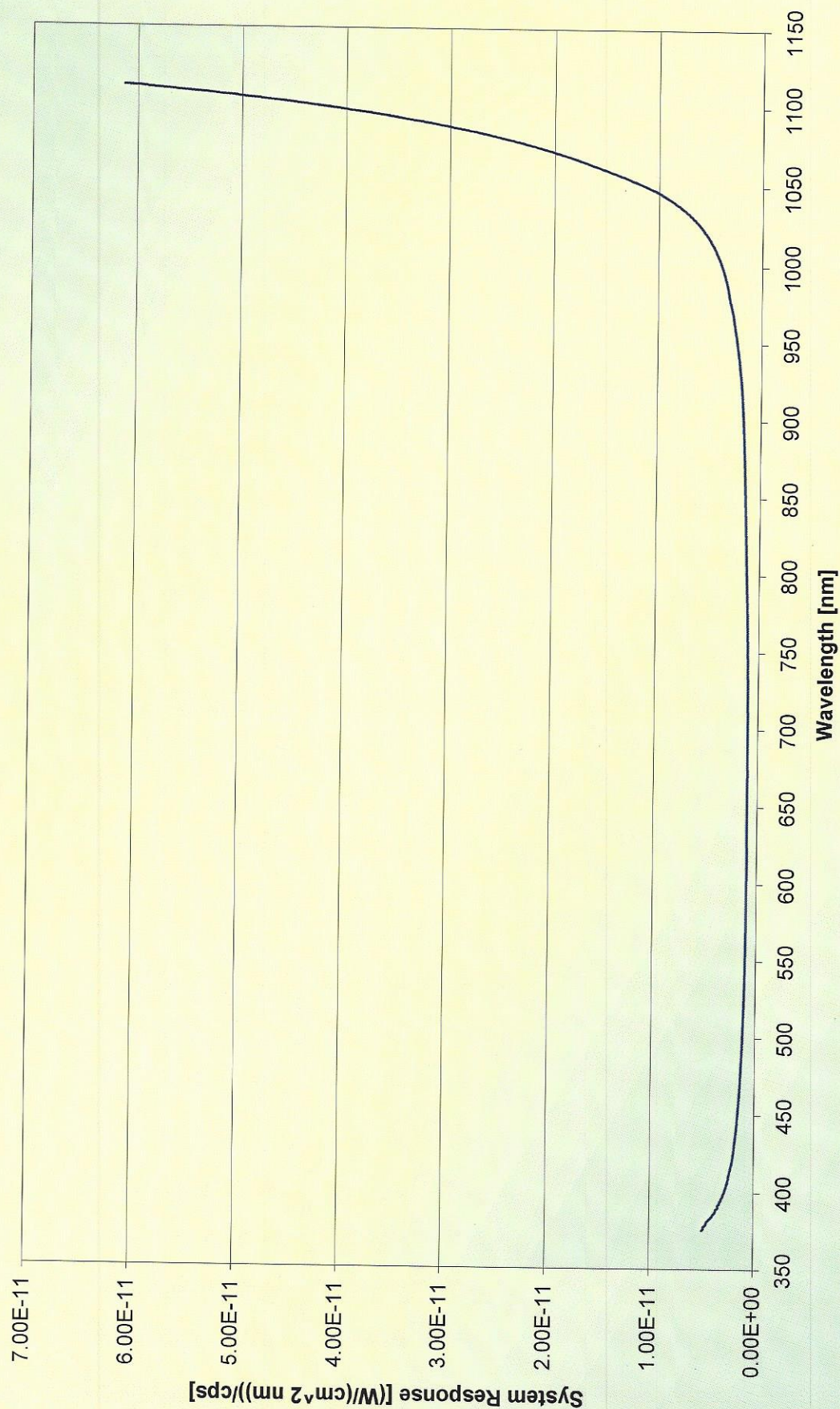
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Systems Technician

^{1/} System response calibrations for total spectral flux measurements are only applicable for similar LED packages – ref Optronic Laboratories Application Note A 16.

^{2/} ISO 17025 does not recommend issuing validity or recalibration periods. This is provided as a guide only.

Typical Irradiance Calibration for OL 770-NIR with OL IS-670-LED
File Name: 770n-116 IRR-IS670-IntRefLamp.cal



OL 770VIS/NIR
Multi-Channel Spectroradiometer
S/N: 09414116
November 24, 2009

Configuration Disk Data File(s) Listing

File Name	Type	Description
auto.cfg	Configuration	System and software settings.
auto cfg for 770-NIR sn09414116.cfg	Configuration	Archive system and software settings.
770n-116 IRR-IntRefLamp.ST7	Standard	Internal reference spectral irradiance [W/(cm ² nm)] with OL IS-670-LED Sphere with 100 µm Entrance Slit.
770n-116 IRR-IS670-IntRefLamp.cal	Calibration	System calibration for spectral irradiance with OL IS-670-LED Integrating Sphere with 100 µm Entrance Slit.

OL 770VIS/NIR
Multi-Channel Spectroradiometer
System Information Sheet

S/N: 09414116
November 24, 2009

After installing the OL 770 Application Software, the Settings File (auto.cfg) **must** be manually imported into it when the program loads for the first time. The Settings File contains system configuration settings such as Wavelength Calibration Coefficients, CCD Binding Lines, Calibration Data File defaults, Template Directories, Graph Parameters, etc.

To Import Settings File (auto.cfg):

- 1) Run the OL 770 Application Software.
- 2) Click on the File Option on the Main Menu.
- 3) Click on the Import Settings File Option.
- 4) Select the "auto.cfg" file in the program's directory and click Open. This imports system configuration settings.

The system configuration settings can be customized and stored for later recall. It is important that the following settings, which are unique to each OL 770, be verified in the System Page of the Modify Settings dialog box (refer to the *Tutorial I / Part 2 – Preparing the Application for Measurements* section of the manual for additional information):

Wavelength Calibration Coefficients:	Enter the following values in the Modify Settings/System Page:			
	50 µm Slit	100 µm Slit	200 µm Slit	350 µm Slit
A		3.975700E-009		
B		9.806900E-006		
C		7.052498E-001		
D		3.754901E+002		

System Settings:	
Min CCD Range	4
Max CCD Range	125
Select CCD Range	Max
Integrating Time Offset (ms)	0.047000
Selected Input Slit Size	100µm

Measurement Type:	Slit Size:	Cal File Path & Name:
Spectral Irradiance	100 µm	C:\Program Files\Optronic Laboratories\OL770\770n-116 IRR-IS670-IntRefLamp.cal