

Application Note (A3)

Spectroradiometric System for Measuring Spectral Response of CCD or Array Type Radiometers

*Revision: A
May 1991*



Optronic Laboratories LLC 4632 36th Street, Orlando, FL 32811
Tel: 1 407 422 3171 Fax: 1 407 648 5412 Email: info@olinet.com

Detector Spectral Response Measurement System Utilizing 4-Inch Collimated Monochromatic Source

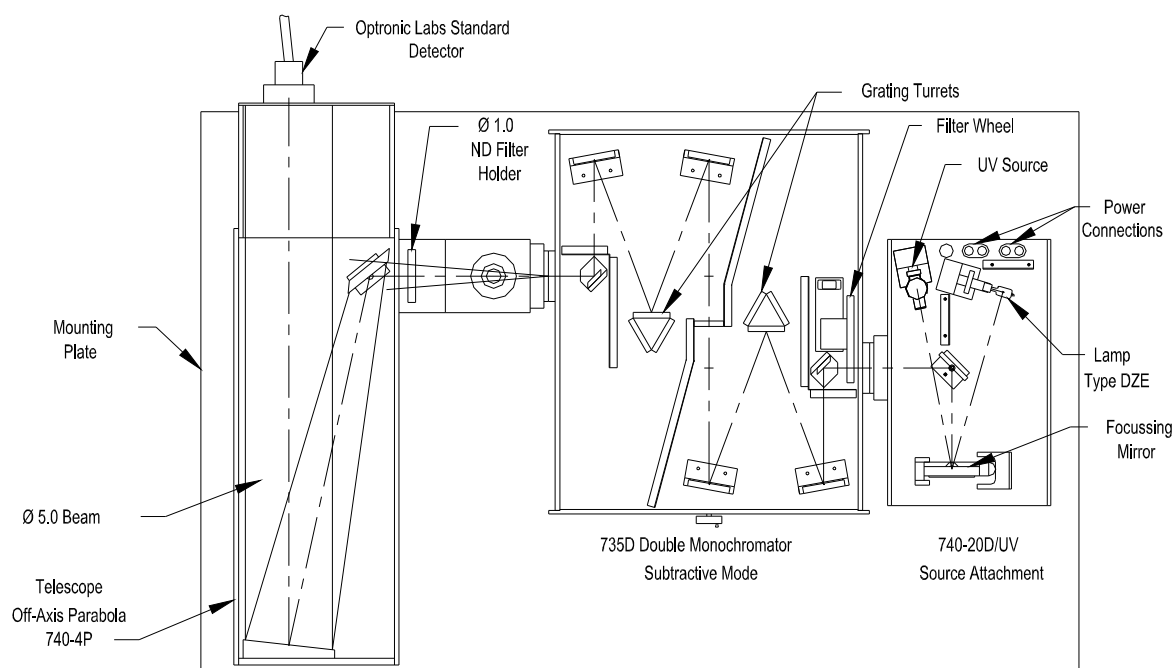
1.0 Overview

This measurement system enables the user to make detector spectral response measurements utilizing a large-area, collimated monochromatic source. The 4-inch diameter beam can be used to uniformly irradiance CCDs and other large area detectors.

This set of instructions serves as a general overview of the measurement system components and operation. Individual system component manuals are available to provide more detailed operational information.

2.0 Set-Up

Figures 1 and 2 give top views of the optical configuration during calibration and measurement phases of operation. Appropriate cabling is provided to allow these components to be interconnected properly. The OL 740-20D/UV Source Attachment mounts to the entrance port of the monochromator and serves as the required stable input source. The OL 740-4P Off-Axis Parabola Telescope is mounted to the exit port of the monochromator. This system configuration yields a collimated monochromatic source unit.



Q000026

Figure 1 - Configuration for Calibrating System's Collimated Beam Monochromatic Irradiance

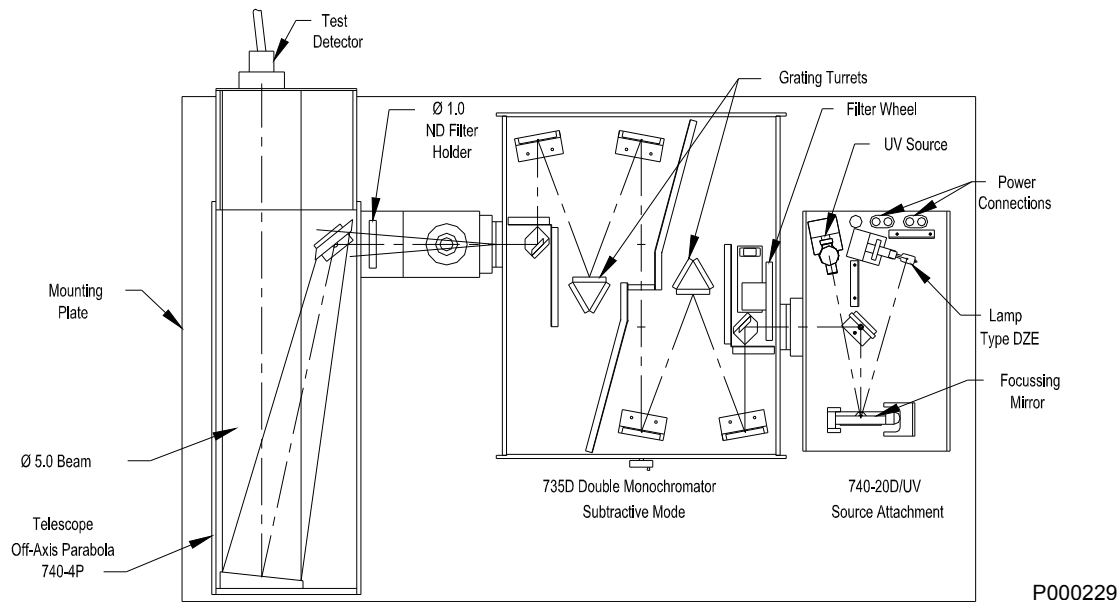


Figure 2 - Configuration for Measuring Spectral Response of Test Detector

The OL 740-20D/UV or OL 740-20D/IR Dual Source Attachment mounts to the entrance port of the monochromator and serves as a stable input source to the monochromator. The OL 740-4P Telescope is mounted to the exit port of the monochromator. Depending on the particular measurement requirements, a system can be configured using either an OL 746/746D based system or an OL 740A/740AD based system. A block diagram of an automated OL 746 Spectroradiometer/ OL 740-20 Source Attachment based system is shown in Figure 3.

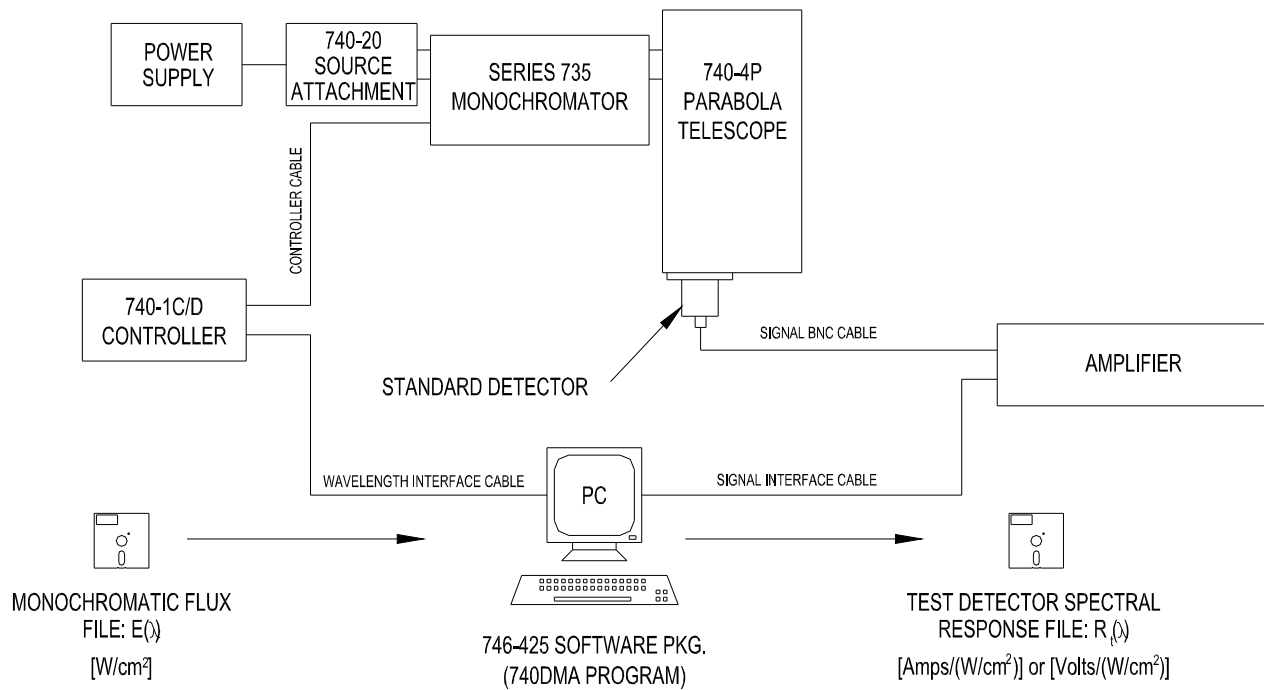


Figure 3 - Measurement System Block Diagram

3.0 Procedure

Detector spectral response measurements involve a two step process:

3.1 Step 1: Calibration of System Monochromatic Irradiance Output

The first step is to calibrate the monochromatic irradiance (W/cm^2) in the beam exiting the OL 740-4P Telescope by using a calibrated standard detector. (See Figures 1 and 3).

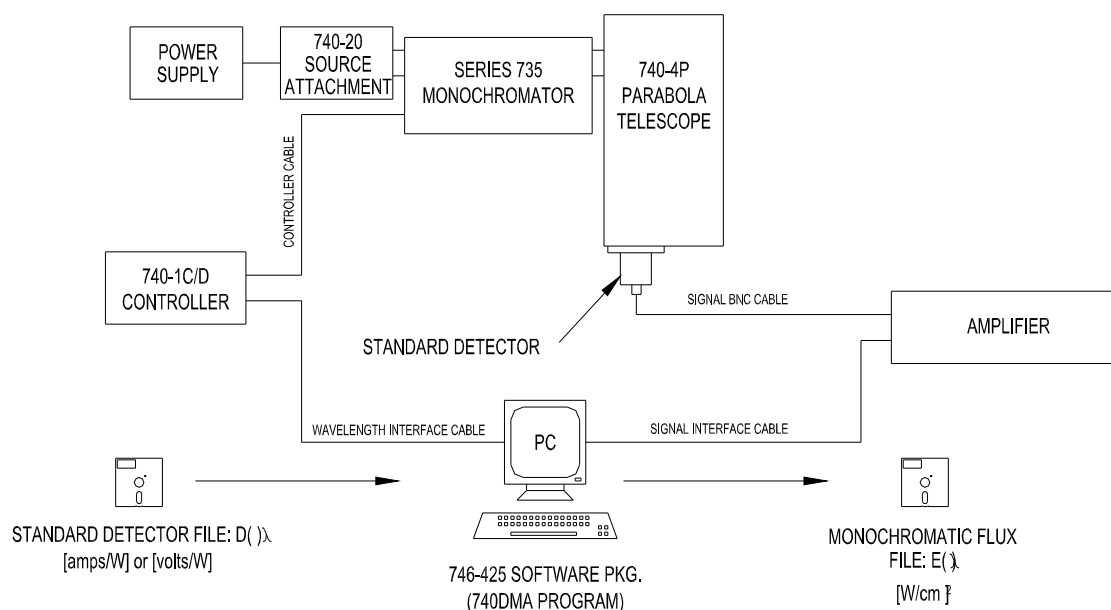


Figure 4 - Calibration of Test Detector Spectral Response (Step 1)

P000227

Select the wavelength region for making measurements and the appropriate detector(s), and source required to cover this range.

The appropriate standard detector for the wavelength region being measured is placed in the monochromatic beam by using the specially designed detector mounting fixture located at the exit aperture of the OL 740-4P Telescope. All of the Optronic Laboratories' supplied standard detectors will fit into this same fixture.

Typical system configurations for use with Optronic Laboratories' standard detectors are as follows:

200 - 400 nm

OL 740-15C Photomultiplier - Use the "Linear Signal Input" on the OL 730A Radiometer. Use the deuterium source in the OL 740-20D/UV Source Attachment in combination with the OL 45D Power Supply with the toggle switches set to the 500 mA and 10V positions.

200 - 1100 nm

OL 730-5C Silicon Detector - Remove the extension tube from the detector. Use the "Linear Signal Input" on the OL 730A Radiometer. Use the tungsten source in the OL 740-20D/UV Source Attachment in combination with the OL 65DS Power Supply. Set the current to 5A (set the 65DS rear panel toggle switch to the 200W position).

After setting up the proper optical configuration to begin a scan, run the "746DMA" measurement program. This program will prompt the user for various information required to correctly execute the measurement.

The monochromatic irradiance output is calculated:

$$E_i = S_s/R_s \quad [\text{watts/cm}^2]$$

where, S_s = signal from the standard detector [amps]
 R_s = responsivity of the standard detector [amps/(watt cm²)].

3.2 Step 2: Test Detector Spectral Response Measurement

Remove the standard detector and the mounting fixture on the OL 740-4P Telescope for holding the Optronic Laboratories' standard detectors. The remaining permanent aperture on the 740-4P Telescope provides the 4" diameter collimated beam.

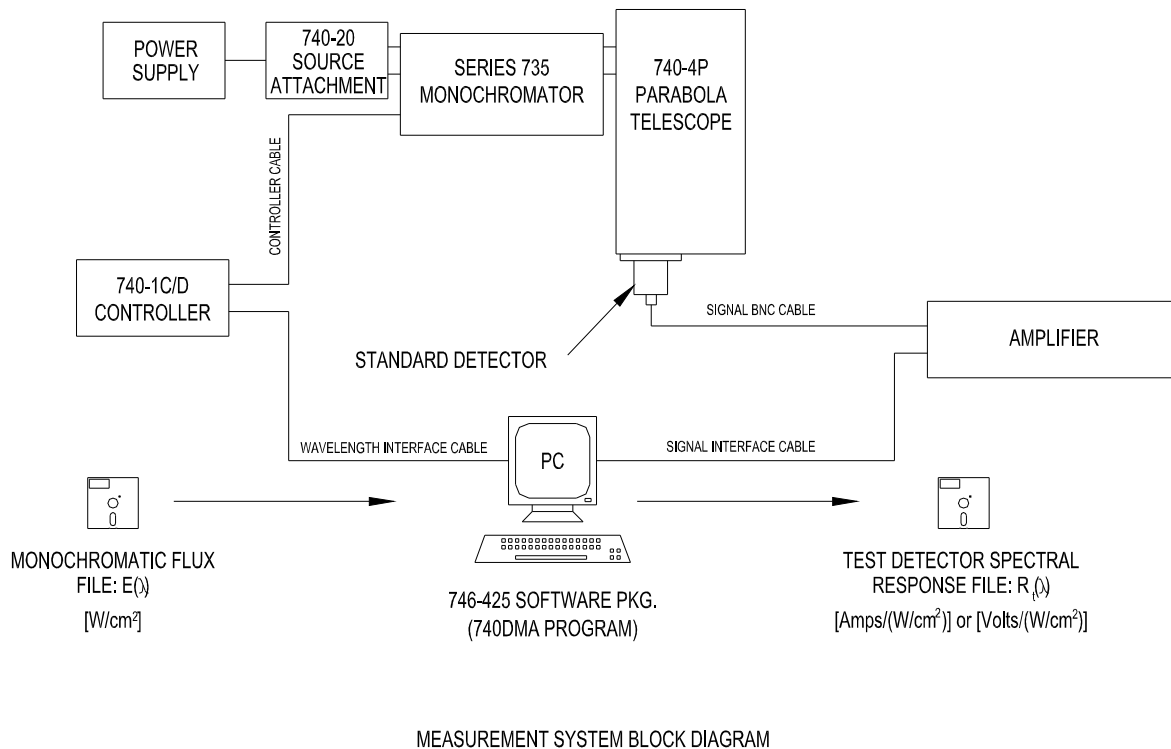


Figure 5 - Measurement of Test Detector Spectral Response (Step 2)

The detector under test is now placed in the beam in the same location as the standard detector(s) used in Step 1. The responsivity of a test or unknown detector at a particular wavelength, R_t , can then be calculated:

$$R_t = S_t/E_i \quad [\text{amps}/(\text{watt cm}^5) \text{ or } \text{volts}/(\text{watt cm}^5)]$$

where, S_t = signal from the test detector [amps or volts].

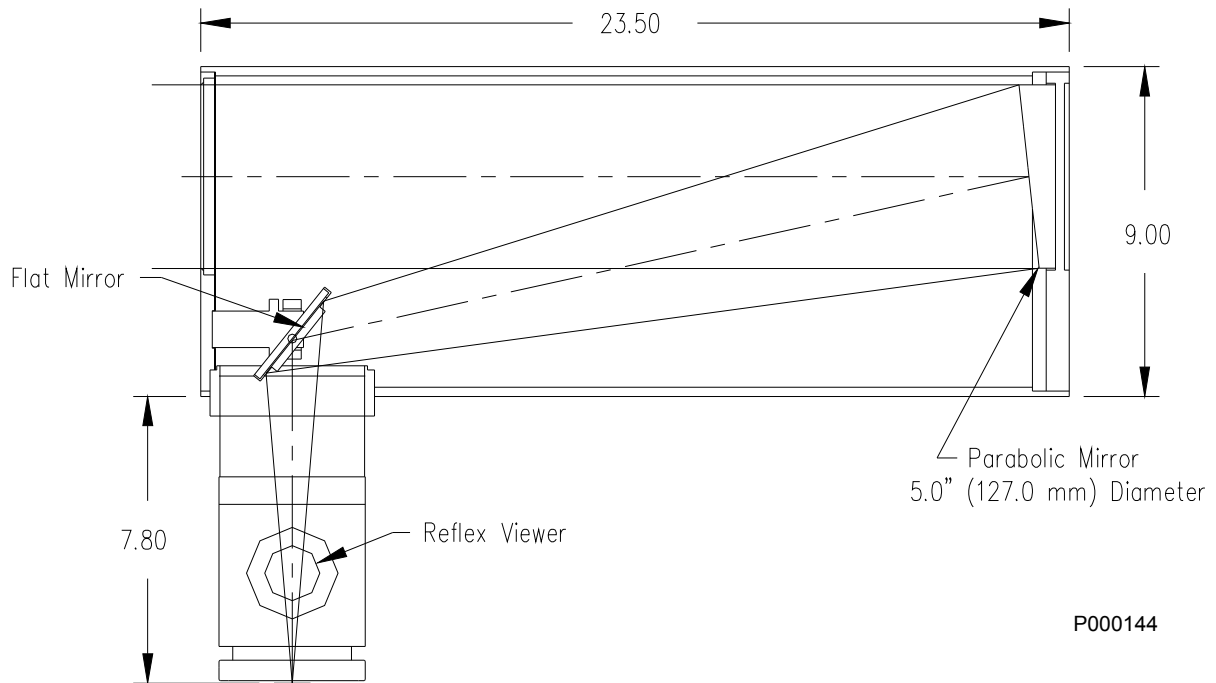


Figure 6 - OL 740-P Optical Layout

Neutral density filters with transmittances of approximately 10% (OL 730-1), 1% (OL 730-2), and .1% (730-3) each covering the wavelength range from 280 to 1100 nm can be supplied. These filters may be used for attenuation during the test detector measurement portion (Step 2) of the scans if the monochromatic irradiance incident on the test detector is too high. The filters are installed in labeled mounts that slide into the OL 740-4P Telescope. Provisions have been made in the software to use the ND filter calibration values during the scans in order to eliminate the need for further processing of the data by the customer.

Table 1

**TYPICAL MONOCHROMATIC IRRADIANCE
of
SPECTRORADIOMETRIC MEASURING SYSTEM**

| Wavelength (nm) | Watts/cm ² |
|-----------------|--------------------------|
| 250 | 1.35 X 10 ⁻⁹ |
| 300 | 5.74 X 10 ⁻¹⁰ |
| 350 | 1.38 X 10 ⁻⁹ |
| 400 | 8.32 X 10 ⁻⁹ |
| 500 | 3.86 X 10 ⁻⁸ |
| 800 | 2.10 X 10 ⁻⁸ |
| 1000 | 7.02 X 10 ⁻⁸ |
| 1500 | 1.26 X 10 ⁻⁷ |
| 1700 | 1.22 X 10 ⁻⁷ |
| 2000 | 1.18 X 10 ⁻⁷ |
| 2500 | 1.77 X 10 ⁻⁷ |
| 3000 | 1.22 X 10 ⁻⁷ |
| 3500 | 4.63 X 10 ⁻⁸ |
| 4000 | 1.45 X 10 ⁻⁸ |
| 4500 | 8.80 X 10 ⁻⁹ |
| 5000 | 6.84 X 10 ⁻⁹ |
| 5500 | 5.42 X 10 ⁻⁹ |

