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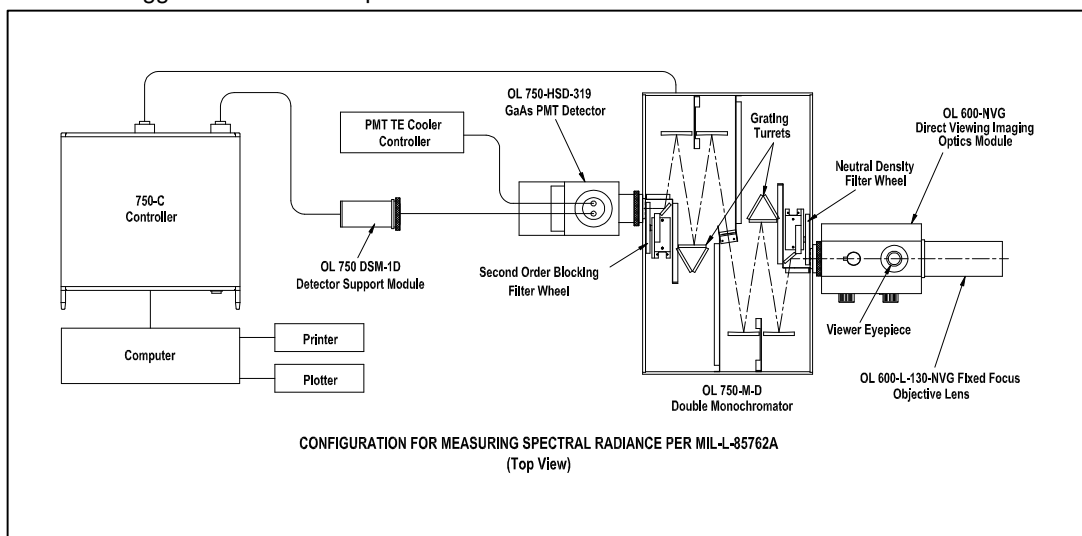


OL Series 750-NVG Automated Spectroradiometric Measurement System

The OL Series 750-NVG is a specially configured version of the OL Series 750 Automated Spectroradiometric Measurement System for spectroradiometric and photometric certification of night vision devices. The OL 750-NVG, which **exceeds** the requirements of MIL-L-85762A, is a complete turnkey system capable of extremely sensitive spectroradiometric and photometric measurements over the wavelength range of 380 to 930 nm. The system incorporates an extremely sensitive GaAs PMT signal detection system with a research grade single (OL 750S-NVG) or double (OL 750D-NVG) grating monochromator and direct viewing imaging optics. The high sensitivity, in combination with the OL 750-423-NVG software, enables the user to certify night vision devices faster and more accurately than previously possible. Depending on the level of the spectral radiance, the time required to scan over the wavelength range 380 to 930 nm at 5 nm intervals varies from 1 to 5 minutes. In order to enhance the portability of the OL 750S-NVG System, the optics head (monochromator/ input optics/ detector housing) is mounted on a rugged aluminum baseplate.

The OL 750-NVG includes:

- **OL 750-M-S Single or OL 750-M-D Double Research- Grade Monochromator:** A single or double grating monochromator with automated, tri-grating turret mounts. Large gratings (68 x 68 mm) are used in order to optimize optical efficiency over the 380 to 930 nm wavelength range. The monochromators have: low stray light, wavelength accuracy of 0.2 nm, wavelength precision of 0.1 nm, automatic wavelength calibration, 4 to 8 nm/mm dispersion factors, an 11-position filter wheel with shutter and appropriate second order blocking filters for the 380 to 930 nm wavelength range and a 5-position neutral density filter wheel that expands the dynamic range to over 10 decades.



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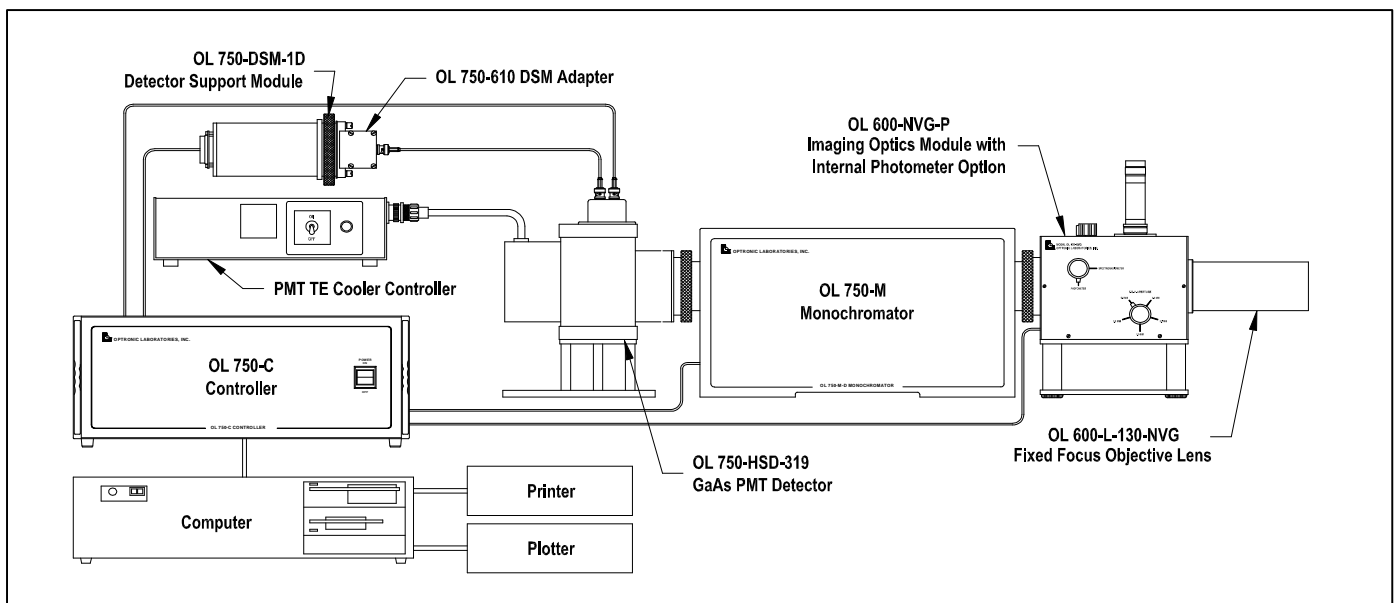
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**OL Series 750-NVG
Automated Spectroradiometric
Measurement System**



- **OL 750-C Controller:** An integral enclosure that houses all data acquisition and control electronics and communicates with the host computer through an RS-232 interface (IEEE-488 optional). The OL 750-C has a 32-bit microprocessor and performs monochromator control, detector selection/interface and signal processing. The OL 750-C is entirely computer operated and does not require manual operation of any controls.
- **OL 750-HSD-319-NVG Cooled GaAs PMT:** An extremely sensitive detector for use over the 380 to 930 nm wavelength range (NEP 10^{-16} watts). A TE/ air-cooled, PMT housing and variable temperature controller, along with a programmable HV power supply, are part of the detector package.
- **OL 750-SDS-210 Signal Detection System:** A signal detection system capable of measuring detector signals from 10^{-3} to 10^{-15} amperes
- **OL 600 Direct Viewing Imaging Optics Module with the OL 600-L-130NVG Fixed Focus Objective Lens:** Direct viewing optics design gives precise positioning or focusing of the source. A 5-position aperture wheel with aperture diameters of 5, 3, 1.5, 0.5 and 0.3 mm in combination with the 1.67:1 magnification enables the system to measure sources as small as 0.007 inches (0.18 mm).
- **OL 750-423-NVG Software:** Windows compatible, NVG optimized software that enables the user to control the OL 750-NVG Measurement System. This software, designated "optOLab," combines data reduction and utility programs with the application programs for a completely integrated operating system. Depending on the user's preference, optOLab can be run from a Windows™ or DOS platform. The software operates on any IBM® 386 or higher PC. Using the Windows "desktop" concept, optOLab permits the user to access multiple screens simultaneously for system setup, utilities support, automated measurements and manual measurements. System calibration and measurement programs are standard. The software computes chromaticity, luminance, and NVIS A and NVIS B radiance and prints out a complete test report.

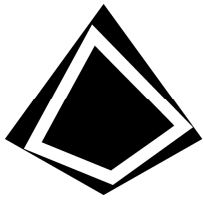


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For display testing, the OL 750-NVG system is the most cost effective equipment available, beating all competitive systems in a price or performance comparison.

The financial restraints of today often result in users settling for a compromise between price and performance. It is rare that the best system is also the lowest price, yet this is true of the OL 750-NVG.

The OL 750-NVG uses state-of-the-art technology, saving on costs while increasing performance. This can be illustrated by considering MIL-L-85762A in relation to:

- *Sensitivity*
- *Speed*
- *Dynamic range*
- *Polarization effects*
- *Actual results*
- *Price*

Sensitivity

The sensitivity of a system reflects its ability to measure low light levels. MIL-L-85762A defines the acceptable values for spectroradiometer sensitivity levels at 10 nm bandpass. However, the specification does not define spot size or integration time to be used in this test - both of which affect the result.

Previous systems have achieved these sensitivity levels only by using long scan times or large spot sizes, placing measurements at smaller spot sizes outside the required specifications. At one-hundredth of a second integration time the OL 750-NVG not only exceeds the sensitivity specification, generally by orders of magnitude, but does so even at the minimum spot size of 0.007 inches (0.178 mm) diameter required for broad band photometers.

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OL 750-NVG Technical Performance and Applications

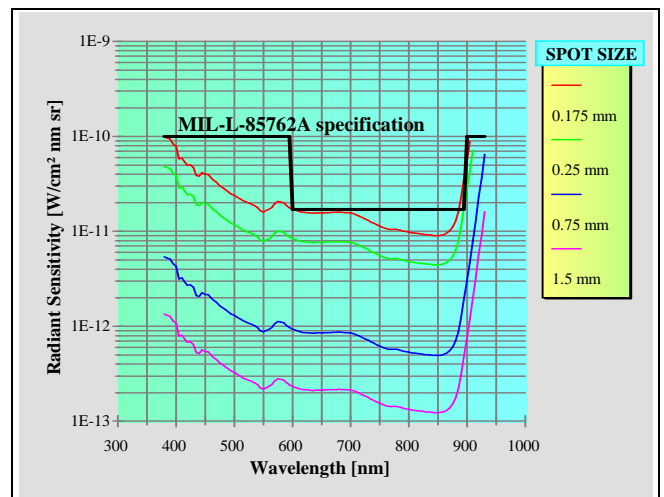


Figure 1. Sensitivities of the OL 750-NVG system at 10:1 signal-to-noise (at 0.01 s integration time) when measuring different spot sizes.

Figure 1 shows the sensitivity of the OL 750-NVG at the 10:1 signal-to-noise level defined in MIL-L-85762A. As can be seen, all spot sizes may be used in measurements. Competitive systems are up to three or four decades less sensitive, placing unacceptable restrictions on the types of measurements that can be made.



Speed

Since older systems can take hours to produce a result, any increases in speed are generally welcomed by users. In fact, speed and sensitivity are often related. MIL-L-85762A states that the minimum acceptable spectroradiometric accuracy of $\pm 5\%$ at each wavelength. Since the signal-to-noise, and hence the accuracy, is limited by the integration time, more sensitive systems can use shorter integration times to achieve the same result. The OL 750-NVG goes beyond the merely "acceptable" by exceeding this accuracy under all conditions and integration times as short as one-hundredth of a second, making it the best - and fastest - system available anywhere.

Signal-to-noise is not the only limit to accuracy: amplifier gain, blocking and ND filter changes are also required to maintain peak performance at all wavelengths. Ignoring these can decrease the accuracy of results to the level where there is no advantage to increased speed. Speed increases are not therefore a simple result of moving the grating faster, but is an optimization of all components while maintaining the specified performance. The OL 750-NVG is fully optimized, allowing top-quality scans to be run in one minute or less.

Dynamic Range

The NVIS class A relative response values vary over 4 decades (1×10^{-4} to 1), and those of NVIS class B vary over 5 decades (1×10^{-5} to 1). In each case, typical sources will have low light levels at those wavelengths that are weighted highest. If a system does not exhibit more than 5 decades of dynamic range it will produce errors in the NVISa and NVISb results, which will fail good sources. The OL 750-NVG uses quality detectors with four fully characterized, signal selectable, ND filters to give 10 decades of dynamic range - enough to give good results on the weakest sources without saturating on the strongest.

Polarization Sensitivity

All monochromators include polarizing optics: slits, gratings, lenses, filters and PMT envelopes. This makes the system more sensitive to some polarizations than to others. Errors are introduced since calibration sources are typically unpolarized, whereas display sources are sometimes highly polarized. Uniquely, the OL 750-NVG incorporates special depolarization optics to reduce this effect to negligible levels - well below the 1% specified in MIL-L-85762A.

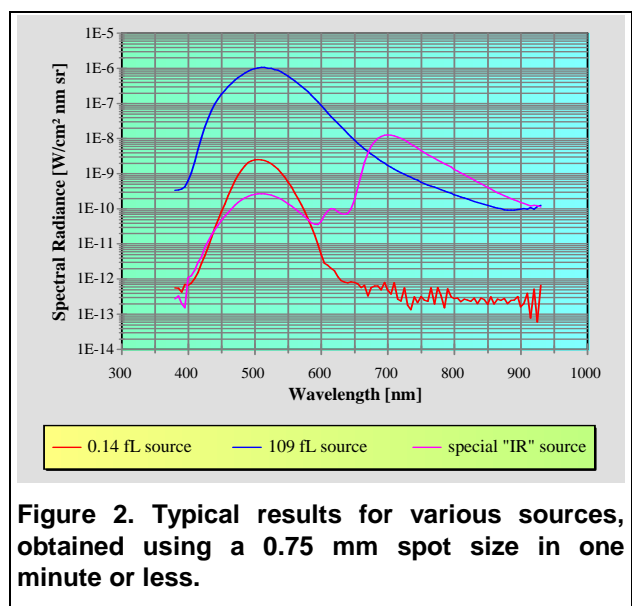
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Results

Ultimately, a system is only as good as the results it generates for the most difficult sources to be measured. As previously explained, this would correspond to small spot sizes, fast integration times and large dynamic ranges. Figure 2 shows some typical results that may be obtained in one minute or less. Although these sources spanned many decades of dynamic range, they could be easily measured without re-optimizing the system, indicating the tremendous versatility of the OL 750-NVG.



Price

Optronic Laboratories offers both single (OL 750S-NVG) and double (OL 750D-NVG) monochromator based systems. Prices for these complete systems are substantially less than those of competitors. In addition to this lower cost, the OL Series 750-NVG systems include many standard features that are optional or not available from competitors. Options available with the OL 750-NVG system include:

- **Stand Alone Photometer operation** for instant luminance values without realignment.
- **Fiber Optic coupling** for enhanced flexibility and restricted spaces
- **Cart-based system integration** for easy movement between sites
- **OL Series 455 Integrating Sphere Calibration Standards** for greatest accuracy.

- **OL 750-NVG-P Internal Photometer (optional):** Enables the OL 750-NVG System to operate as a stand alone, direct photometer. The OL 750-NVG-P Option consists of an accurate photometric sensor, which is mounted in the OL 600-NVG Direct Viewing Imaging Optics Module and the OL 750-422 Stand Alone Photometer Software. A beam deflecting mirror enables the user to direct the beam to either the photometric sensor or, with the mirror positioned out of the optical path, to the entrance slit of the monochromator. The OL-750-C Controller can simultaneously accept the inputs from both the Photometric Sensor and the GaAs PMT. Thus, in order to switch from spectroradiometric to photometric measurements, the user merely switches the beam deflector to the “photometric” position and initiates the photometer software via the computer. The photometric sensor, which can measure signal levels as low as 1×10^{-15} amperes, is sufficiently sensitive to measure 0.1 footlambert sources having diameters of 0.007 inches. In addition, the photometric correction has an f' factor of 1.5%. These features give the user the capability of measuring the luminance of virtually any source quickly and accurately and then performing the spectroradiometric measurements without having to realign the source.

Options for Stand Alone Photometer Operation

- **OL 455-6-1 Integrating Sphere Calibration Standard (optional):** Enables the user to ensure compliance with MIL-L-85762A and MIL-STD-3009 requirements (Appendix B) and easily calibrate the OL 750-NVG System for spectral radiance response and for luminance response (when configured for stand alone photometer operation) in order. The OL 455-6-1 consists of a source module/ optics head with a 6-inch diameter integrating sphere and a separate electronic display console/power supply. Calibration of the OL 750-NVG is easily accomplished as the near normal luminance/radiance of the 1½-inch diameter radiating port is uniform within $\pm 0.5\%$. See Bulletin 108 for more information on the OL Series 455.

The NVG version of the OL 455 is calibrated at 100 fL/ 2856K for spectral radiance whereas the non-NVG version is calibrated at 90% max/ 3000K for spectral radiance. The luminance cal for both is done at 2856 K, but the OL 455-6-1-NVG is done at 100 fL and the non-NVG is done at 90% max.