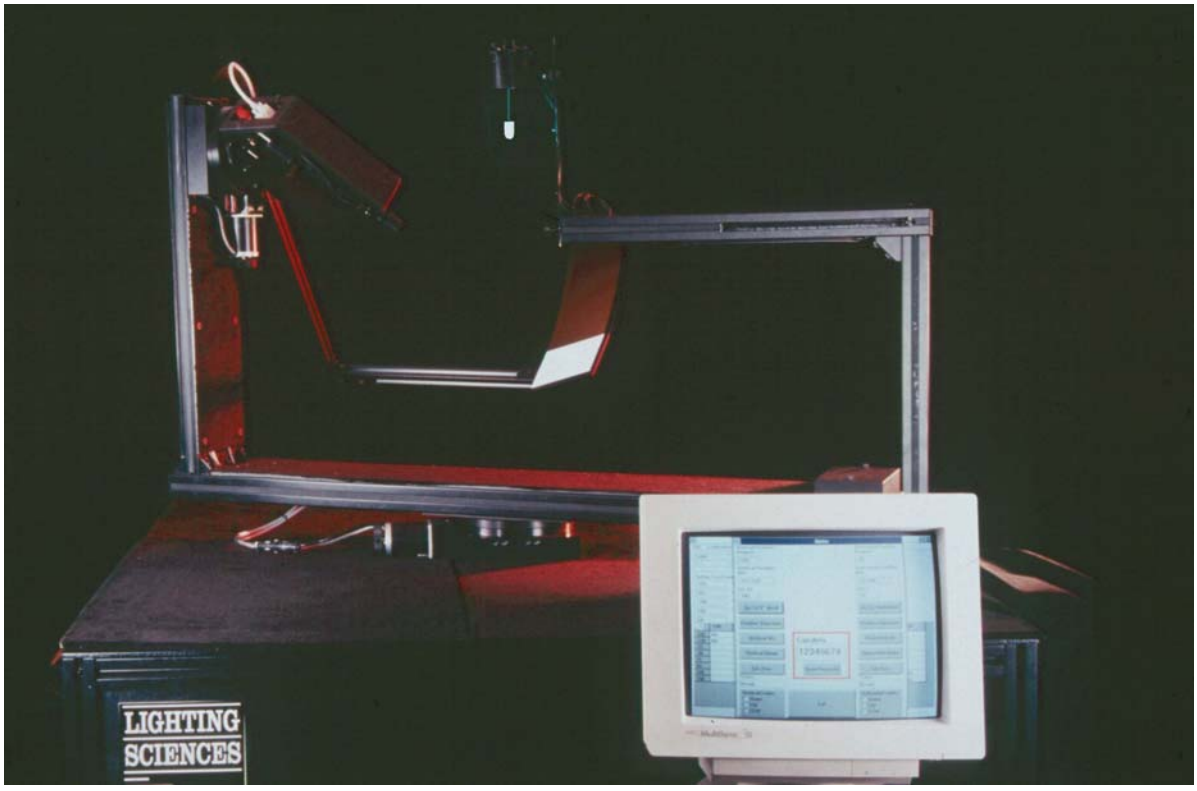
Lamp and LED Photometric System



Lighting Sciences Inc. has been a producer of highest quality special purpose photometers for many years. LSI test systems are installed in laboratories and factories throughout the world. Now, LSI introduces the **Lamp Photometric System** specifically designed for photometric evaluation of lamps and LED's at close distances.

The compact photometric system operates on the same basis as LSI's large mirror goniophotometers, collecting intensity data at all horizontal and vertical angles. As a further option, the system is available with a CCD video camera attachment which allows the production of *luminance* maps of the actual arc streams, filaments and LED chips. This provides complete evaluation of a lamp's photometric characteristics.

State-of-the-art photodetectors and computer hardware, coupled with sophisticated data collection software, provide a fully automated test system for lamp manufacturers and optical system designers.

Description

The Lamp Photometric System consists of three basic systems plus software, and one optional system. Together, these can perform intensity (candlepower) measurement and luminance mapping for all

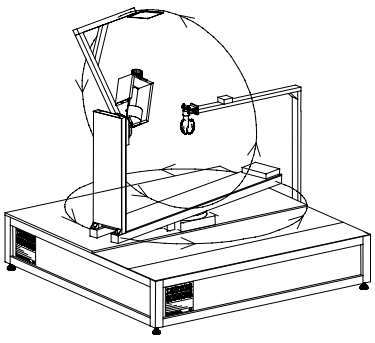


Figure 1 - Principle of System

directions, *without movement of the lamp*. Thus the system is suitable for the photometry of metal halide lamps and other orientation-sensitive types.

Figure 1 illustrates the general principle of the photometer when in use for intensity (candlepower) measurements. A small mirror rotates around the test item, cutting a complete vertical plane. Light collected by the mirror reflects to the photodetector, which is mounted on the mirror arm and thus rotates with the mirror.

The entire mirror and photodetector assembly is mounted on a precision turntable, which provides horizontal rotation. Thus the mirror is able to perform its vertical sweep at any horizontal angle, allowing full data collection.

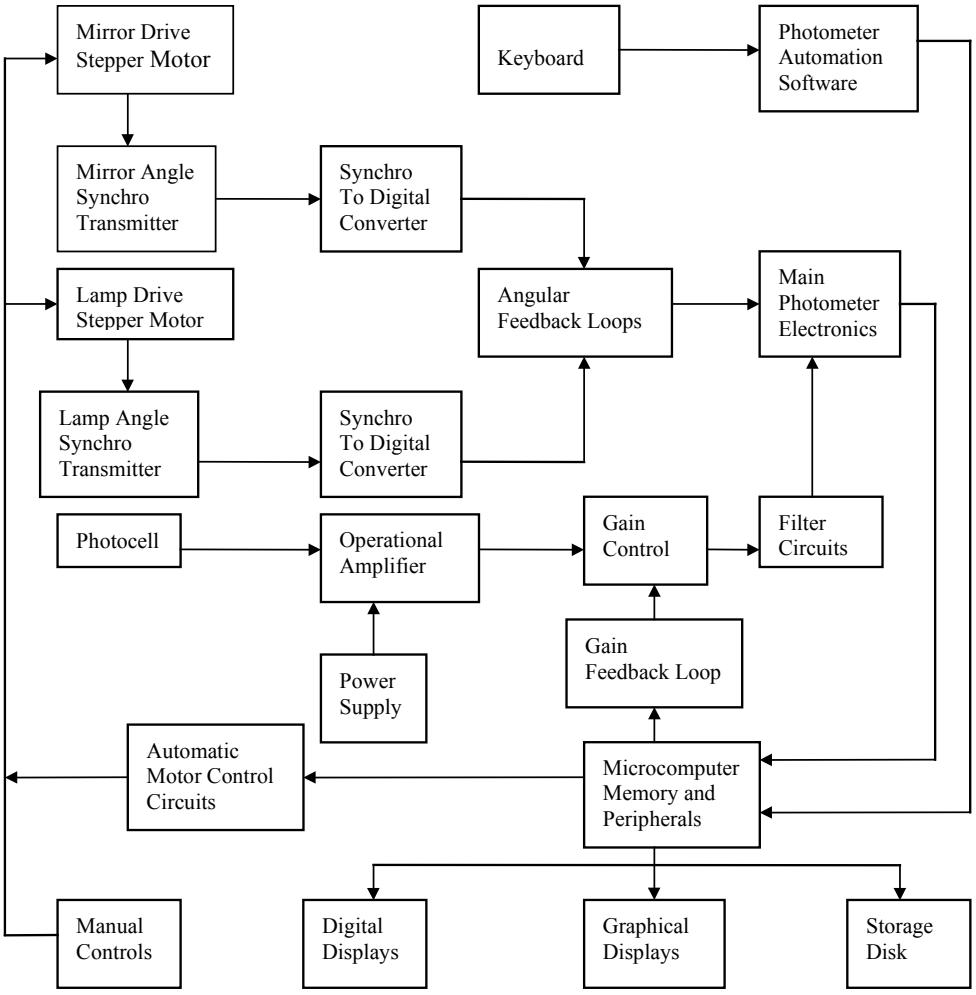


Figure 2 - Schematic Diagram of the Lamp Goniophotometer

Mechanical System

All structural members consist of precision rails and brackets. These are mounted to the vertical and horizontal drive systems, using highest accuracy digital stepping motors. The motors are rated 0.01° resolution, 0.1° accuracy.

The digital motors used in the photometer have no gears or other drive systems, which can introduce backlash in time. LSI uses direct drive motors so that complete reliability is provided for the life of the equipment.

Angle sensing feedback transmitters are contained within the motor drive systems. These provide independent position verification. Thus when a motor rotates under the computer command and reaches its position as instructed, the feedback transmitters confirm to the computer that in fact the correct position has been reached. This provides unparalleled accuracy.

Photodetector and Electronics

The photodetector used for intensity measurements is a high stability, low noise silicon cell. It is equipped with a very high accuracy spectral correction filter (F_1' <2.0%), giving precise measurement even on the most complex discharge sources. Special color calibrations are available for LED testing.

A unique electronic system oversees the photodetector's response activity and automatically adjusts the system sensitivity (i.e., gain) up or down to achieve the highest possible accuracy. Even with the mirror traveling at

its maximum speed, this “Signal Maximizer” circuitry makes decisions “on the fly” so that the optimum amplifier gain is set for each intensity reading being recorded.

The Signal Maximizer circuitry also automatically compensates for what is termed “dark current” - a signal generated by the electronics even when there is no light on the photocell. This signal varies from one gain setting to the next, and if not properly accounted for, can create serious test result errors. Dark current values are automatically measured and applied to each gain stage throughout the test sequence without the need for operator input.

Computer System

LSI provides a Windows-based computer system, supplied as an integral part of the Lamp Photometric System. The system is configured to provide high speed and large capacity. Specifications change rapidly: Please contact Lighting Sciences for information on presently supplied computers

WinScan™ Software

The WinScan software allows extremely simple operation even for unskilled users. The software operates in the Windows environment.

Significant features are:

Automatic Calibration routine. When a standard lamp is placed in the test stand, the photometer provides automatic self-calibration. Calibration factors for the entire test range are determined and placed in computer file storage for use with subsequent tests.

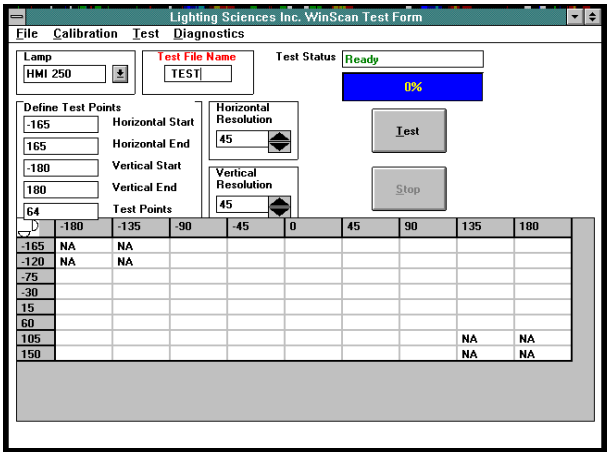


Figure 3 - Data Collection Screen

Automatic Dark Current. Dark current is the signal generated by a photodetector and its electronics for a zero light level. The software automatically performs dark current measurement for each gain stage (or sensitivity) of the amplifier and places the values in computer file storage. These values then are automatically subtracted during subsequent testing to provide dark current compensation and highest accuracy.

Angular Ranges, Increments. By typing required angles into dialog boxes, the user can collect data over any angular range and in any angular increments. For example, to test over a vertical range of 0 to 350° in 10° steps, the operator enters:

Vertical Angle Start	0.00
Stop	350.00
Step	10.00

Then the desired horizontal range is entered. Given this information, testing proceeds and data are collected at every specified vertical and horizontal location.

Sensitivity Control. The photometer constantly verifies highest sensitivity is being applied to the photodetector electronics: part of the LSI Signal Maximizer circuitry.

Positional Feedback. Constant software monitoring for angle verification occurs throughout the testing.

Output. Data output is provided in a computer file which is compatible with spreadsheet operations. Calibrated values of absolute measured candelas are given, tabulated with vertical and horizontal angles. Other formats are available upon request, including IES or CIE format.

Output data provides close-field photometry as is used in many optical design applications. Data are produced also to feed to LSI’s **Raymaster®** illumination optics software.

Luminance Mapping of Sources
LSI's AutoVidi™ system provides an optional high accuracy digital mapping system for luminances. This is based upon a CCD (Charge Coupled Device) video camera system which gives scientific quality pixel-by-pixel luminance measurements for up to 400,000 individual data points. This is the same form of camera used by astronomers for capturing incredibly detailed and accurate light information for deep-space applications.

When mounted on the Lamp Photometric System, the lamp under test is viewed by the AutoVidi camera. Because it is located on the mirror rotation arm in a manner similar to the silicon photodetector, the camera can be set to view the lamp or LED from any vertical or horizontal angle.

Luminance maps provide the exact photometric brightness distribution of the lamp. For example, the point-by-point luminance within a metal halide arc stream can be determined, or the luminance variation across a lamp filament. These data are highly useful in advanced light source modeling for precision illumination system design. Luminance files can be produced which can form input to LSI's **Raymaster®** optical design software. Further details on the AutoVidi system are available upon request.

Dimensions
Test distance (lamp to photodetector) is set as standard at 1m (39 ins). Other test distances, including variable test distance, are available.

Photometer dimensions:

Length	1.27m (50 ins)
Width	1.27m (50 ins)
Height	1.55m (61 ins)

Photometer height includes the 0.36m (14 ins) base, which houses all electrical systems.

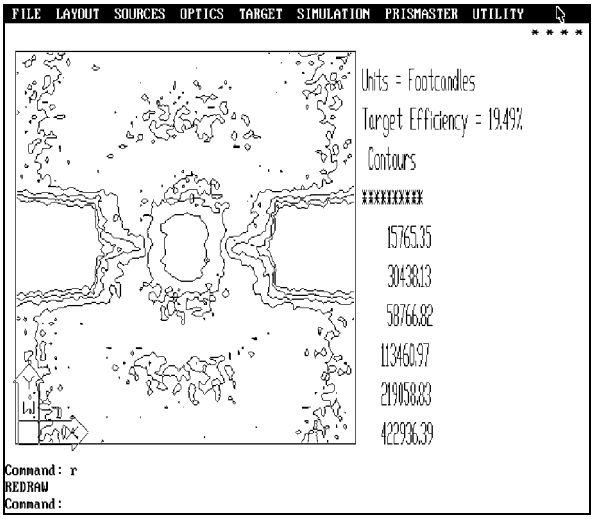


Figure 4 - Arc Stream Luminance Map of Metal Halide Lamp

About Lighting Sciences, Incorporated
Since 1979, Lighting Sciences has offered an ever-broadening variety of consulting and testing services in addition to developing a full range of lighting design and analysis software. Advanced equipment in our laboratories includes a vast array of specialized instrumentation calibrated and maintained to meet stringent industry and government specifications. Also, our development and testing facilities are a perfect solution for small companies without their own Research and Development departments or for supplementing facilities found in overworked larger companies or government agencies. If you require your own quality control equipment, our staff is available to design and manufacture the equipment you need. We also market a full line of computer software used for optical design and photometric processing.

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