

PHOTO RESEARCH[®]

PR-1980A Pritchard[®] Photometer



Glen Spectra
2 Dalston Gardens, Stanmore,
Middlesex HA7 1BQ, UK
Tel: 020 8204 9517 Fax: 020 8204 5189
E-mail: info@glenspectra.co.uk Web: www.glenspectra.co.uk

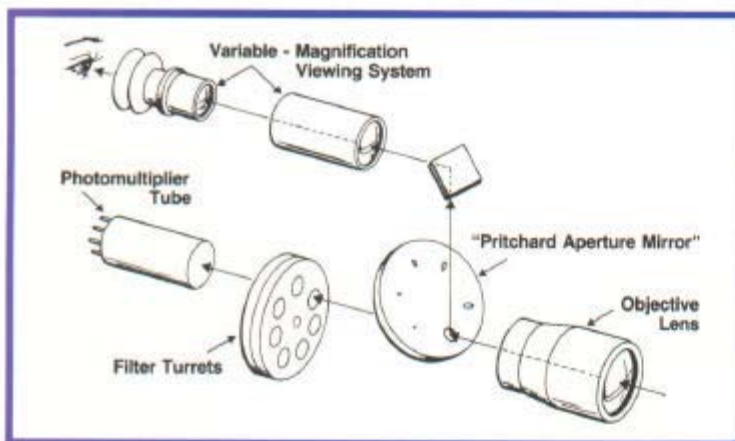


FIGURE 1: PRITCHARD OPTICAL SYSTEM

THE PATENTED PRITCHARD OPTICAL SYSTEM

When measuring small targets or samples in a large field, an accurate and precise optical system is essential to the proper measurement of the basic attributes of light—color and intensity. The Pritchard is such a system—widely accepted as the most accurate and versatile in use today. As shown in Fig. 1, the objective lens forms an image at the Pritchard mirror. The light being measured passes through the selected aperture and the filter turrets to the photomultiplier tube detector. The balance of light at the Pritchard mirror surface is reflected into the viewing system. The operator sees a bright, erect, magnified image in the center of which is a black dot. The dot is created by the hole in the mirror, and since only light passing through that hole is being measured, the dot accurately and unambiguously defines the measuring field within the viewing field.

Another unique feature of the Pritchard Optical System is the patented Magnification Viewing System*. Viewing magnification is adjustable over a range of 6:1 (3.3X, 8.2X and 20.6X). The measuring and viewing system is self-aligning. There are no mirrors, fiber optics or other optical impediments in the measuring path, so no polarization error is introduced.

A metallic mirror, fabricated with as many as 6 apertures, is the heart of this unique system*. Rotating the mirror places a different size aperture on the optical axis, which changes the angular coverage of the measuring field. Five different angular measuring fields from 2 minutes (2') to 3 degrees (3°) are standard, and are available merely by turning a knob.

Note: Special optional apertures such as slits for spatial scanning are also available, as are numerous optical accessories, covering a wide range of light measurement applications. For example, see the patented MicroScanner® Spatial Scanning attachment (Page 5).

*U.S. Patent 3,813,172 and 3,799,680

TYPICAL APPLICATIONS

- Night vision studies
- Image intensifier calibration
- Visual task studies
- Roadway lighting
- Automotive lighting
- Airport lighting
- Material reflectance studies
- CRT luminance and contrast
- MTF and resolution testing
- Display measurements
- LED measurements
- Aircraft panel luminance and color
- Mil-Spec compliance
- Color temperature determination
- Star simulator calibration
- Electroluminescent panel evaluation
- Head-up display measurements
- Flashlamp and beacon analysis
- Human factors testing
- Ground truth studies



PR-1980A SPECTRA® PRITCHARD PHOTOMETER

The Pritchard Tele/Micro Photometer, still the proven leader in precision photometric/colorimetric light measuring instruments after more than three decades, is known for its superior performance, high sensitivity and maximum versatility in the lab or in the field. It features the patented Pritchard Optical System with built-in attenuators, polarizers, colorimetry filters and field apertures interchangeable from 2 arc-minutes to 3 degrees. Many special apertures are also available.

The PR-1980A also combines five dynamic features no other light measuring system does —our patented** AutoComp®, and AutoRange™ and AutoZero™ features, detector overload protection circuit and internal calibration verification. This unique combination virtually eliminates human error and manual computations while maintaining a precise, error-free direct readout.

**U.S. Patent 3,818,198

PR-1980A PHOTOMETER COMPONENTS

The PR-1980A Pritchard Photometer System consists of the PR-1980A-OP Optical Head containing the high-gain photomultiplier tube (PMT) detector and optical system; the PR-1980A-CD Control Console containing the system electronics and readouts; and the required interconnecting cables.

PR-1980A-OP Optical Head

The PR-1980A-OP Optical Head includes the patented Pritchard aperture mirror, a patented variable magnification viewing system, objective lens, two self-contained, seven-position filter turrets, and a specially selected and seasoned low-noise S-20 photomultiplier tube (other detectors are available as factory-installed options). The forward filter turret contains 4 neutral density filters, an open position, and 2 polarization measuring filters. The rear turret contains the individually trimmed photopic (2° Standard Observer) filter, red filter, blue filter, internal calibration source, an open position, and two positions for optional filters. Some of the most popular filter options include high accuracy individually trimmed tristimulus- X_λ , X_λ , and Z colorimetry filters (Opt. 32);



Scotopic (dark adapted eye) Standard Observer (Opt. 31); and special filters optimized for the measurement of light emitting diodes (LEDs). (Opt. 33-0 & 33-1).

Detector Overload Protection is a significant feature of Pritchard systems. To prevent damage to the sensitive detector from excessive light flux, the overload circuit is activated, clamping detector current to a safe level and activating an audible alarm.

Internal Calibration Verification is as simple as one, two, three.

1. Set the Function switch to Zero Amplifier and check/adjust.
2. Set the Function switch to AutoZero Dark Current with the Measure Shutter closed.
3. Place the Function switch to Internal Calibration, rotate the Rear Filter Wheel to CAL, open the Measure Shutter and check/adjust the CAL value.



PR-1980A-CD Control Console

The PR-1980A-CD Control Console contains the readouts, controls and system electronics for the PR-1980A Photometer. Included are the AutoComp, AutoRange, and AutoZero, detector overload protection circuit and other outstanding features which virtually eliminate human error.

The AutoComp Direct Readout System* is a self-contained computer which automatically calculates the correct readout for all possible combinations of filters, apertures, and settings. This readout is supplied in the form of a number from 1.00 to 19.99 on a digital meter. A multiplier readout is also provided, which can be varied from 10^{-6} to 10^7 , depend-

ing on the various combinations of settings. AutoComp also precisely corrects the gain for each filter position to permit accurate system calibration at all times.

*U.S. Patent 3,818,198

AutoRanging automatically changes the electrical sensitivity to provide an optimum reading over any four ranges. Coupled with the 3 1/2-digit readout, AutoRanging provides a usable reading—without operator adjustment—over a light range of 10,000 to 1. The range control may also be locked manually on any single range.

AutoZero provides completely automatic zeroing of phototube dark current.

High Sensitivity Switch increases the system sensitivity by one decade for measurement of extremely low level sources.

Response Speed Switch selects time constants of 20ms, 200ms or 2 seconds.

PR-1980A PRITCHARD PHOTOMETER, SPECIAL AND ENHANCED VERSIONS

Several versions of the basic PR-1980A are available for specialized applications. All include the PR-1980A-CD Control Console with AutoComp, AutoRange, and AutoZero, as described in the preceding paragraphs. Each requires a specialized optical head replacing the PR-1980A-OP, or a special attachment.

PULSED LIGHT CAPABILITY

Two versions of the PR-1980A are available to permit measurement of pulsed light sources such as strobe lights, pulsed LEDs, and phosphor persistence, in addition to steady-state sources.



PR-1980A/WB. The PR-1980A/WB replaces the standard optical head with the PR-1980A-OP-WB Optical Head (Opt. 48-0), which includes a wideband output jack with a minimum rise time of 50 nanoseconds. With the aid of an oscilloscope, this can be used to examine pulse shapes, to measure rise and decay times and be calibrated to measure peak luminance.

PR-1980A/PL. The PR-1980A/PL replaces the standard optical head with the PR-1980A-OP-PL Optical Head (Opt. 48-1), which includes a high speed video amplifier and pulse integration module, permitting the integration of total light energy in a single pulse or a series of pulses. In the Video Mode, pulse rise and decay times can be as short as 60 nanoseconds, and in the Pulse Integration Mode, light output in pulses as short as 1 microsecond can be accurately integrated. A remote/synch output provides precise triggering of flashlamp, and remote control of pulse integration measurements. AutoRanging automatically selects the optimum range for pulse-integration readings on the digital readout. And AutoZero automatically nulls out steady-state ambient light at the push of a button making pulse-integration measurements fast and simple.

LOW LEVEL CAPABILITY

Consult factory for customized super sensitive versions of the PR-1980A System.

COMPUTER CONTROLLED PHOTOMETRIC MEASUREMENTS

PR-1980A/PC IBM®-PC Interface.



The PR-1980A/PC is available for users who wish to operate their PR-1980A under the control of an IBM PC/XT/AT or compatible personal computer. This system includes the PR-1980A, an interface board for the PC, an interface adaptor for the PR-1980A Control Console, an interface cable and PR-1980A/PC basic software. With this system, luminance, illuminance (with appropriate accessory), colorimetry and correlated color temperature measurements are performed from the PC. Results are displayed on screen and can be stored to disk and printed on the system printer. Minimum PC requirements include 512K RAM, two 360K floppy disks and CGA graphics board and monitor.

SPATIAL SCANNING CAPABILITY

Linear MicroScanner Attachment*, SC-80A-OP

The PR-1980A/SP Microphotometer System includes the patented SC-80A-OP MicroScanner Optical Head (Opt. 41-0). It significantly enhances the performance of the PR-1980A Photometer by providing microphotometric/microcolorimetric scanning capability without requiring the optical head or the target to be moved during the scan.

Often used with an optional slit aperture, the MicroScanner permits accurate high resolution linear optical scanning of line width profiles of direct view displays such as monochrome CRTs. The objective lens of the MicroScanner is stepper-motor driven, causing the scanner to transverse up to one inch (25mm) of the target, regardless of lens magnification. The scan speed is continuously variable, and selectable by the operator. The SC-80A-C Manual Control Unit (Opt. 41-1), also included, permits operator control of scan speed, scan length and X-axis offset for an analog X-Y recorder.

*U.S. Patent No. 4,279,507



OPTICAL CONFIGURATION AND SELECTION GUIDE

This section will aid the user in determining field coverage (spot size), working distance and range of sensitivity for common optical accessories and configurations.

Formula 1 and Table A are used to compute the minimum detectable luminance light level with a 10:1 signal-to-noise ratio for any optical configuration.

Formula 2 and Table B are used to compute the maximum full-scale luminance light level for any optical configuration.

Table C (page 11) provides working distance and field coverage for optical accessories with any given aperture. It also includes relative luminance sensitivity attenuation factors for any accessory/aperture combination (numbers in blue).

Minimum (Threshold) Photometer Signal Determination*

To determine the minimum (threshold) signal limit for any accessory/aperture combination, use the following formula.

Formula 1

Threshold Signal = $A \times C \times 10^{ND\#}$ where:

- A = Appropriate value from Table A.
- C = Value from Table C (in blue) corresponding to the desired aperture/accessory combination.
- $10^{ND\#}$ = 10 raised to the power of the neutral density filter that may be necessary. ND-1 equals 10^1 , ND-2 equals 10^2 . Maximum ND value for a standard PR-1980A is 10^4 (ND-4).

For example, to compute the threshold luminance in footLamberts for the standard S-20 PMT with MS-80A lens, using the 20' aperture with no neutral density filter (OPEN position), proceed as follows:

$$\begin{aligned}\text{Threshold Luminance} &= A \times C \times 10^{ND\#} \\ &= 3.0 \times 10^{-6} \times 100 \times 10^0 \\ &= 3.0 \times 10^{-4} \text{ footLamberts}\end{aligned}$$

Maximum (Full-Scale) Signal Determination*

The determination of the maximum (full-scale) sensitivity for any given aperture/accessory combination is very similar to the above procedure for threshold sensitivity. The only difference is the utilization of Table B in place of Table A.

Formula 2

Maximum (Full-Scale) Signal = $B \times C \times 10^{ND\#}$ where:

- B = Value from Table B.
- C = Value from Table C for any given aperture/accessory combination (blue numbers).
- $10^{ND\#}$ = 10 raised to the power of the neutral density filter that may be necessary. ND-1 equals 10^1 , ND-2 equals 10^2 . Maximum ND value for a standard PR-1980A is 10^4 (ND-4).

For example, to compute the maximum luminance in footLamberts for the MS-80A lens, using the 20' aperture with Neutral Density 4 (ND-4), proceed as follows:

$$\begin{aligned}\text{Maximum Luminance} &= B \times C \times 10^{ND\#} \\ &= 1.999 \times 10^{-1} \times 100 \times 10^4 \\ &= 1.999 \times 10^5 \text{ footLamberts}\end{aligned}$$

TABLE A—MINIMUM THRESHOLD SENSITIVITY*

PMT	FootLamberts	cd·m ⁻²
Standard S-20	3.0×10^{-6}	2.0×10^{-5}
Cooled S-20	1.0×10^{-6}	6.7×10^{-6}
Extended multialkali S-25	6.0×10^{-6}	4.0×10^{-5}
Cooled S-25	2.0×10^{-6}	1.3×10^{-5}

TABLE B—MAXIMUM FULL-SCALE SENSITIVITY*

$$\begin{aligned}\text{FootLamberts} &= 1.999 \times 10^{-1} \\ \text{cd·m}^{-2} &= 1.999 \times 10^0\end{aligned}$$

*Notes:

When using the CR-100 or IB-80, use the footLambert values for readings in footcandles. Use the cd·m⁻² values for readings in LUX. When using the LR-80, use the footLambert or cd·m⁻² values for readings in millicandelas. When using the RS-1, footLamberts equals footcandles. For readings in LUX, multiply the cd·m⁻² values by 3.14. (π)

APERTURE SIZE AND RANGE OF FULL-SCALE SENSITIVITY

FIELD APERTURE	SENSITIVITY RANGE (IN FOOTLAMBERTS)	SENSITIVITY RANGE (IN CANDELAS/METER ²)
3°	10^{-5} to 10^3	10^{-4} to 10^4
1°	10^{-4} to 10^4	10^{-3} to 10^5
20'	10^{-3} to 10^5	10^{-2} to 10^6
6'	10^{-2} to 10^6	10^{-1} to 10^7
2'	10^{-1} to 10^7	10^0 to 10^8
0.4' x 40'	10^{-1} to 10^7	10^0 to 10^8

OPTION AND ACCESSORY DESCRIPTIONS

APERTURE OPTIONS*

OPTION 01 – 0.4 Min. x 40 Min. Horizontal Aperture This rectangular slit horizontal aperture is designed for Line Width Measurements when operating in the Spatial Scanning Mode. Other aspect ratio slit apertures are listed below.

OPTION 02 – 2 Min. x 2 Degrees Horizontal Aperture

OPTION 03 – 0.4 Min. x 4 Min. Vertical Aperture

OPTION 04 – 1 Min. Circular Aperture

OPTION 05 – 15 Min. Circular Aperture

OPTION 06 – 30 Min. Circular Aperture

OPTION 07 – 2 Min. x 10 Min. Horizontal Aperture

OPTION 08 – Trapezoidal Aperture (Includes WFL-10 Lens) for right-side roadway luminance measurements

OPTION 09 – 0.4 Min. x 40 Min. Horizontal Aperture and 0.4 Min. x 4 Min. Vertical Aperture (in place of 1° aperture)

OPTION 10 – 0.4 Min. x 10 Min. Horizontal Aperture*

OPTION 11 – 10 Min. x 80 Min. Horizontal Aperture

OPTION 12 – 0.5 Min. x 100 Min. Horizontal Aperture
*Only one can be selected

INTERNAL DETECTOR OPTIONS

OPTION 20 – Thermoelectric PMT Cooler

This option consists of a thermoelectric cooler unit integrally mounted in the photomultiplier tube assembly. It is recommended for those applications where low intensity sources are to be measured and the maximum stability and signal-to-noise (S/N) ratios are desired. It maintains the PMT at approximately 5°C.

OPTION 21-0 – Extended Multialkali Response S-25 PMT (includes Opt. 65)

With this option the standard S-20 PMT (360nm to 830nm) is replaced with an S-25 PMT. The upper operating range is extended out to 860nm. Overall range 360nm to 860nm with a peak sensitivity at around 620nm.

OPTION 23 – Selected Low Noise S-20 PMT

For applications requiring the highest sensitivity the low noise characteristics of this PMT make it the detector of choice. The S/N ratio of these selected PMTs is better than the standard S-20 by a factor of $\geq 2:1$.

FILTER OPTIONS

OPTION 31 – Scotopic Response Filter

The Scotopic Response Filter in the PR-1980A tailors the response of the system to the scotopic (low light level or dark) response of the eye (V'). Thus, the system is capable of duplicating the human eye under these low light conditions.

OPTION 32 – TF-80 Tristimulus Filters (Set of four includes calibration) The four individually trimmed colorimetric response filters make it possible to use the PR-1980A as an accurate 4-filter colorimeter [uses the standard photopic (Y) plus X_r , X_b and Z].

OPTION 33-0* – LED Measuring Filter 630nm to 670nm

OPTION 33-1* – LED Measuring Filter 670nm to 700nm

*The narrow emission range of LEDs requires that the photopic response of the system be matched as closely as possible over a limited range. Two special LED filters are available: LED-630 for orange red LEDs, and LED-670 for far red LEDs.

OPTION 39 – Narrow Band Filters

Narrow band filters are often desired to isolate narrow spectral regions. Any commercially available filter that can be purchased in 0.920" (23.4mm) diameter, and up to 5.0mm thickness, can be installed by Photo Research. Consult factory for price and availability.

SYSTEM OPTIONS

OPTION 41-0 – SC-80A-OP MicroScanner Spatial Scanner Optical Head (See page 5)

This Option includes only the Optical Head itself. To be functional with the PR-1980A, OPTION 41-1 (below) is also required. The SC-80A-OP is furnished with a 1X lens unless otherwise specified. Additional lenses are ordered separately. (See table C.)

OPTION 41-1 – SC-80A-C MicroScanner Manual Control Unit

This Option is specified in addition to OPTION 41 to provide a complete manual SC-80A MicroScanner accessory for the PR-1980A.

OPTION 43 – Military Specifications Calibration

When this option is selected the system is calibrated to MIL SPEC 7788E, 27160 (Polygon) and 25467 (Red Lighting) with a 3215 filter. Certification is supplied for the calibration.

OPTION 44 – Military Specification Calibration

This option covers MIL SPEC 27160 Polygon Calibration ONLY. Certification is supplied for the calibration.

OPTION 45 – Military Specification Calibration

This option covers MIL SPEC 25467 Red Lighting Calibration ONLY with 3215 filter. Certification is supplied with the calibration.

OPTION 48-0 – The WIDEBAND option for the PR-1980A permits user to display the waveform of a pulsed source on an oscilloscope. The characteristics of the pulsed source are thus available for analysis such as peak luminance and rise/decay times. (Not available with the PR-1980A/PL.)

OPTION 48-1 – This option combines OPTION 48-0 with PULSE INTEGRATION such that not only the waveform is available but also the total energy of a single pulse or multiple pulses is determined. (Not available with the PR-1980A/WB.)

OPTION 51-0 – 117V AC $\pm 10\%$ 50/400 Hz

OPTION 51-1 – 230V AC

OPTION 51-2 – 100V AC

It is necessary that one of these options be specified to ensure proper operation from the line power available.

OPTION 52-0 – English

OPTION 52-1 – Metric

Select one. English units are footLamberts, metric units are $\text{cd}\cdot\text{m}^2$. (Consult factory for other units.)

OPTION 56 – IBM®-PC Interface

This option allows current users to turn their PR-1980A into an automatic measurement system controlled from an IBM PC/XT/AT or compatible. It includes a PC interface board, PR-1980A interface adapter, cable and PR-1980A/PC basic software. The system can be easily modified by the user, and requires no special tools or re-calibration. (See PR-1980A/PC System Description for further details)

CALIBRATION AND SOFTWARE OPTIONS

OPTION 65 – RC-80 Radiometric Calibration

Provides absolute radiometric calibration for the PR-1980A Photometer at 576nm. With this calibration the user can obtain absolute radiometric data. A spectral calibration curve is supplied to make the conversion at other wavelengths.

OPTION 66 – Color Temperature Calibration (Open position ONLY)

Determines blue/red ratio for incandescent (tungsten) sources between 1800 and 10,000 Kelvins using supplied curve and tabular data.

OPTION 67 – Color Temperature Calibration (Open position and all 4 Neutral Density Filters) See OPTION 66 above

OPTICAL ACCESSORIES

CO-2000 – Cassegrain Telescope

Increases the magnification of the system by 12 times. The powerful lens system enables the PR-1980A Photometer to accurately measure the brightness of a dime under moonlight conditions at a distance of 1000 feet (350m)

CRF-35 – A set of 20 Chromaticity Reference Filters

These filters provide accurate chromaticity reference points in each of five color categories. Three reds, five greens, five blues, four whites, and an intermediate reference between red and yellow when used with Source A.

FH-80 – Filter Holder for 2 X 2-inch filters

This accessory is thread mounted to the OL-7 Standard, OL-3.5 or MS-80A Objective Lenses and will hold up to two 2" X 2" (50mm X 50mm) filters up to 0.17" (4.3mm) thick. With the filter holder attached the PR-1980A can be adapted to special photometric or radiometric measurements.

FP-80B – Flexible Probe

This accessory is a three foot long flexible probe that is useful in making measurements in cramped or inaccessible places. Luminance/radiance measurements can be made within a fixed circular area 0.12 inches (3mm) in diameter. It is NOT available for calibrated illuminance/irradiance measurements.



GL-1961 – Glare Lens

Used for determining the amount of disability glare contributing to total measurement. Used with the OL-7 Objective Lens and 1° aperture only.

LF-19A – MicroSpectar LF-19A Lens

This accessory lens converts the instrument into a 2X microphotometer with a working distance of 2.7 inches (68.6 mm). It is thread mounted to the standard OL-7 Objective Lens and best suited for close up measurements on very small areas.

MS-80A – MacroSpectar® Close-up Lens

1:1 close-up lens with a working distance 6.6 inches

MS-5X, -7X, -10X, -25X, -50X – Lens Series

The MS lens series of fixed focal length, high-throughput MicroSpectar microscope objective lenses, when used in place of the OL-7 Objective Lens, converts the PR-1980A into a powerful microphotometer/microcolorimeter. Relative sensitivities and working distances are listed in Table C.

MS-610 – MacroSpectar Long Working Distance

A 1:1 fixed focal length lens with a 24-inch working distance designed to be used with the 20 min aperture to measure 1mm spot size. Relative sensitivities are listed in Table C.

NBS-3215 – Filter

Used in conjunction with the MIL-L-25467 calibration for determining the IPL Red Limit panels.

OL-3.5 – 3.5-inch TeleSpectar Objective Lens designed to achieve *twice* the measuring field and accept same accessories as the OL-7 lens. Focusable from 2 feet (0.61m) to infinity.

OL-7 – The Standard 7-inch TeleSpectar Objective Lens

This lens is the standard objective lens supplied with the PR-1980A. It has a working distance of 4 feet (1.22m) to infinity. The front of this lens is threaded to accept mounting of the accessory lenses and attachments

OL-14 – TeleSpectar 14-inch Objective Lens

This accessory infinity-focused lens was developed for the purpose of achieving a measuring area equivalent to a 1/2 the aperture size of the standard OL-7 Objective Lens (for measurement of HUDs, etc).

SC-80A – MicroScanner Objective Lenses

There are five lenses in this family to provide the necessary versatility that line width scanning may require on a variety of displays. They are 1X, 2X, 5X, 10X and 20X. The 5X, 10X and 20X require the SC-80LA Adaptor for mounting the lenses on the MicroScanner Optical Head.

SC-80-LA – Lens Adaptor

Required for mounting microscope objective lenses (except 1X and 2X) on the SC-80A-OP Optical Head. See SC-80A MicroScanner Objective Lens description (above).

SL – High Resolution Supplementary Lens

There are three choices in this family of Supplementary High Resolution Lenses. They are 10A, 20A, and 40A. They are used with the standard OL-7 Objective Lens to reduce the near-focus range to distances of 10 inches or greater. The focus distances for each lens are listed in Table C.

WFL-10 – Wide Field Lens

This lens is interchangeable with the OL-7 Standard Objective Lens and increases the angular coverage by approximately 5 times. The best choice where large areas must be covered when working space is limited.

CR-100 – Cosine Receptor

A Cosine Receptor is designed to collect all illuminance falling on a surface from all sources within a hemisphere above the surface, and apply an attenuating factor listed in Table C. When used with the PR-1980A the system gives correct illuminance readings from all sources regardless of angle of incidence.

IB-80 – Incidence Baffle

A fixed baffle which limits the acceptance angle of the PR-1980A such that the system can be used as an ultrasensitive illuminance photometer. Primarily used to measure small (point) sources, such as stars, miniature lamps, etc. It is thread mounted to the OL-7 Standard Objective Lens (available in English IB-80E or metric IB-80M) and used with the 3° aperture only.

LR-80A – LED Receptor

This accessory is thread mounted to the OL-7, OL-3.5, OL-14 or MS-80A Lenses. It is designed for the measurement of red LEDs and is calibrated at 660nm. (Other calibrations available. Consult factory.) **Calibration is in millicandelas (mcd).**

RS-I – Reflectance Standard, 2 X 2 inches (51 x 51mm)

This reflectance standard is a 2-inch by 2-inch barium sulfate plaque whose diffuse reflectance is nearly 100%. By focusing the PR-1980A on this plaque, placed at 45 degrees to the source, the luminance readings in footLamberts convert directly to illuminance readings in footcandles. (For metric systems, luminance in $\text{cd}\cdot\text{m}^{-2} \times \pi$ = illuminance in LUX.)

MISCELLANEOUS ACCESSORIES

CC-80-C – Carrying Case for PR-1980A Control Console

CC-80-OP – Carrying Case for the PR-1980A Optical Head

CC-80-SC – Carrying Case for the SC-80A MicroScanner

LRS-450 – Luminance/Radiance Calibration Standard

A variable luminance standard from 0.1 to 1000 fL or 0.3 to 1900 $\text{cd}\cdot\text{m}^{-2}$ (also calibrated for spectral radiance). (Consult factory for other sources and standards.)

MM-31-80-10 Manual Positioner

A positioning table upon which to mount the PR-1980A when several measurements are to be made on a small CRT or flat panel display. The optical head remains fixed and the test source is positioned for each sequential measurement.

PR-2301* – Luminance Reference Source for PR-1980A Systems with luminance of 9fL or 30 $\text{cd}\cdot\text{m}^{-2}$

PR-2302* – Luminance Reference Source similar to PR-2301 but with luminance of 100fL or 350 $\text{cd}\cdot\text{m}^{-2}$

*These are not standards, and must be calibrated with each instrument and each accessory.

SCH-80 – Shielded Cable

For use in environments where high ambient inductive EMF is present. Stainless steel braided shielding is fitted over Optical Head Interconnecting Cable.

TR-7 – Tripod, Heavy Duty with Geared Head

This tripod provides the stability to mount the PR-1980A Optical Head for reliable measurements.

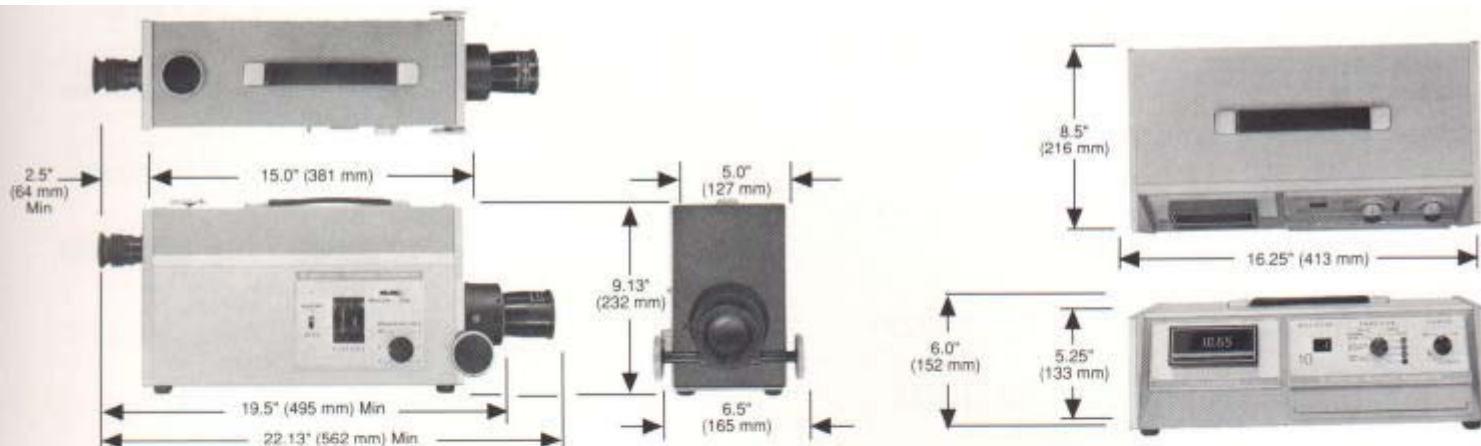
VF-80-PL – Video Filter for PR-1980A-PL Systems

This accessory is a noise attenuator for use when making video (wideband) pulsed-light measurements. Included equipment when PL system is ordered.

VF-80-WB – Video Filter for PR-1980A-WB Systems.

Same as above but for the PR-1980A-WB Systems.





SPECIFICATIONS PR-1980A PHOTOMETER

Measuring Capability: Direct-reading measurement of luminance; standard calibration units are footLamberts (or $\text{cd}\cdot\text{m}^{-2}$ at no added cost). Additional accessories are available (at extra cost) for measuring illuminance, irradiance, luminous and radiant intensity. Special filters are also available for four-filter colorimetry and scotopic response; radiance/irradiance, luminous intensity.

Sensitivity Range: 10^{-6} to 2×10^7 footLamberts (10^{-7} to $2 \times 10^8 \text{ cd}\cdot\text{m}^{-2}$)

Absolute Accuracy: Within $\pm 4\%$ of reading or $\pm 2\%$ of full-scale (whichever is greater), when measuring black-body sources.

Polarization Error: No measurable polarization error.

Objective Lens: Standard objective lens is 7" (178mm) f.1., f/3.5, focusable (rack and pinion) from 4 feet (1.2m) to infinity. Interchangeable and supplementary lenses are available for micro- and telephotometry/colorimetry.

Measuring Field Apertures: This is the heart of the famous Pritchard Optics and provides the most accurate alignment capabilities of any instrument of its type. It contains 5 standard circular apertures providing angular coverage of 2', 6', 20', 1° and 3° (nominal values with standard 7" objective lens). A sixth round, slit-shaped or special-sized aperture is available on special order.

Viewing Field: Adjustable in 3 fixed increments (1.9°, 5.9° and 11° nominal with standard 7" objective lens). Viewing magnification is adjustable over a range of approximately 6:1 (3.3x, 8.2x and 20.6x nominal with standard 7" lens).

Eyepiece: Erect image, adjustable focusing eyepiece with rubber eyecup.

Spectral Response (Unfiltered): 360 to 830nm with standard S-20 Photomultiplier Tube. Optional phototubes provide spectral response out to 860nm in the near infrared; special optics/detectors provide spectral response down to 290nm in the ultraviolet.

Filters: Standard filters include an individually trimmed photopic filter to precisely match the spectral response to the standard CIE $V(\lambda)$ function (380-750nm), 10X, 100X, 1000X, and 10,000X neutral density attenuators. Horizontal- and vertical-plane polarizing filters and red and blue relative-

colorimetry filters are also supplied as a standard feature. (Other filters are available on special order and include scotopic response, special photopic filters for narrow band sources such as LEDs and individually trimmed tristimulus colorimetry filters.)

Operating Temperature Range: 32° to 110°F (0°C to 43°C).

Storage Temperature Range: 0° to 130°F (-18°C to 54°C). Humidity—10-90% non-condensing.

Dimensions: PR-1980A-OP Optical Head: 19½" x 6½" x 9" (495 x 165 x 232mm) with lens removed.

Weight: PR-1980A-OP Optical Head: 20½ pounds (9.3 kg).

CONTROL CONSOLE (PR-1980A-CD)

AutoComp: Built-in computer that provides automatic computation for correct reading for all possible combinations of filters, apertures and sensitivity ranges.

AutoRange: Automatic ranging of electrical sensitivity to provide minimum 3½-digit resolution over 3 full decades (4 ranges) of sensitivity. Manual override provided.

AutoZero: Automatic nulling of phototube dark current whenever "Function" switch is set to the "AutoZero Dark Current" position and the phototube shutter is closed.

Operator Controls: "Power" (on/off, dimmer) and "Function" switches on main control panel. "BCD Hold," "Amplifier Zero Adjust," "Response Speed," "Normal/High Sensitivity," and "Sensitivity Adjust (Calibration)" controls are recessed and protected by a hinged cover.

Digital Readout: 3½-digit, non-blinking, bi-polar digital readout; reads from 0.00 to 19.99 (100% over-range).

Power-of-Ten Indicator: 2-digit, dimmer-controlled, self-luminous display.

AutoRange Indicators: 4 color-coded LEDs indicate which sensitivity range is being utilized.

Analog Output: 0-10 volts analog output signal jack capable of driving any analog device whose impedance is greater than 10,000 ohms.

Digital Output: BCD output jack supplies a means of monitoring both the digital panel meter and the power-of-ten indicator.

Time-Constant: 3-position "Response Speed" switch (on recessed control panel) sets time-constant to approximately 0.02, 0.20 or 2 seconds.

Power Requirements: 110 volts ($\pm 10\%$) AC, 50 to 400 Hz; 220 $\pm 10\%$ volts AC and 100 $\pm 10\%$ volts AC available on special order at no extra charge. Power consumption approximately 20 watts.

Operating Temperature Range: 32°F to 110°F. (0°C to 43°C).

Storage Temperature Range: 0° to 130°F. (-18°C to 54°C).

Dimensions: PR-1980A-CD Control Console: 16 1/4" x 8 1/2" x 6" (413 x 216 x 152mm).

Weight: PR-1980A-CD Control Console: 11 1/4 pounds (5.1 kg).

PR-1980A-WB PULSED LIGHT PHOTOMETER

Minimum rise time for pulse shape evaluation: 50 nanoseconds (at 0.1 fL sensitivity).

Minimum pulse width for accurate pulse shape evaluation: 150 nanoseconds (at 0.1 fL sensitivity).

Minimum pulse amplitude for peak power evaluation (repetitive scan): 10^{-4} footLamberts (10^{-3} cd·m⁻²).

Additional Controls: "Operating Mode" and "Sensitivity" switches.

Additional Outputs: High-speed analog output (0-10 millivolts).

PR-1980A-PL PULSED LIGHT PHOTOMETER

Minimum rise time for pulse shape evaluation: 60 nanoseconds (at 0.01 fL sensitivity).

Minimum pulse width for accurate pulse shape evaluation: 180 nanoseconds (at 0.01 fL sensitivity).

Minimum pulse amplitude for peak power evaluation (repetitive scan): 10^{-5} footLamberts (10^{-4} cd·m⁻²).

Full-scale sensitivity range for pulse integration mode: 10^{-5} to 10^7 footLambert-seconds (10^{-4} to 10^5 cd·m⁻² seconds).

Minimum pulse width for accurate pulse integration readout: 1 microsecond (at 10^{-5} sensitivity).

Additional Controls: "Operating Mode," "Video Sensitivity," "Integrate" and "Automatic Ambient Light Null" switches; "Remote/Synch" external controls.

Additional Outputs: (1) High-speed amplifier analog output (0-2.5 volts), (2) Synchronization signal to trigger external flashlamp.

SC-80A MICROSCANNER SPATIAL SCANNER (with Manual Control Unit)

Total Target Distance Scanned: Up to 1.000 inch (25mm), independent of lens magnification.

Scan Speed: Variable from approximately 0.0036 inches (90 micrometers) to 0.180 inches (4.56 millimeters) per minute.

Luminance Sensitivity (with 1X Lens): 0.001 footLambert

(0.01 cd·m⁻²) with either the 2' aperture or 0.4' x 40' slit aperture.

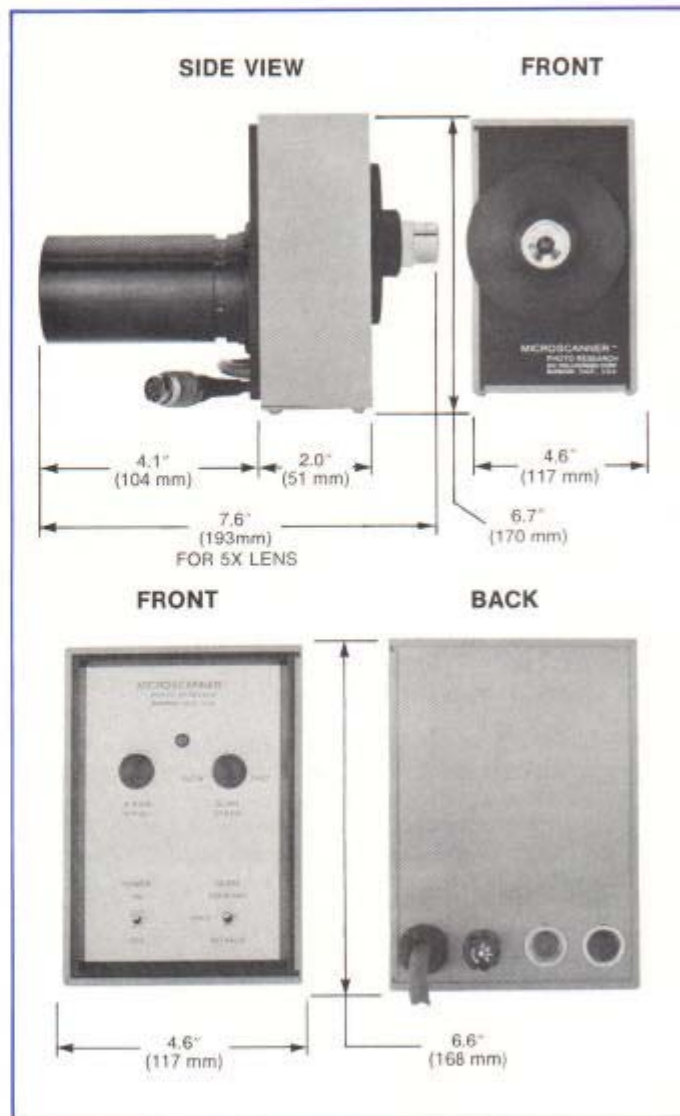
Lens Magnification: 1X, 2X, 5X, 10X and 20X lenses are available; 1X is the standard configuration.

Target Resolution Capability: 0.12 mil (0.003mm) to 20 mils (0.5mm).

Weight: Scanning Head: 3.7 pounds (1.7 kg). Control Unit: 2.6 pounds (1.2 kg).

Size: Scanning Head: 7.6" x 6.7" x 4.6" (193 x 170 x 117 mm) Control Unit: 4.6" x 6.6" (117 x 168mm).

Power: 90-130V 50/60 Hertz, or 180-260V 50/60 Hertz.



All specifications subject to change without notice. All trademarks are property of Kollmorgen.

**PR-1980A TABLE C—FIELD COVERAGE AND
RELATIVE ATTENUATION FOR LENSES AND APERTURES**

LENS OR ACCESSORY		Focusing Range	Lens-To-Subject Distance	FIELD APERTURE					
Category	Model			3"	1"	20'	6'	2'	0.4' x 40' SLIT
FOCUSABLE	7 in. Standard Lens OL-7	4 ft. (1.22 m) to infinity	1000 ft. (1) (305 m)	663 in. (16.85 m) 1.000	209 in. (5.31 m) 10.00	66.2 in. (1.68 m) 100.0	20.9 in. (531 mm) 1000	6.68 in. (169 mm) 10,000	1.34 x 133.6 in. (33.8 mm x 3.38 m) 1000
	OL-3.5 (2)	2 ft. (610 mm) to infinity	1000 ft. (1) (305 m)	1326 in. (33.68 m) 1.000	418 in. (10.62 m) 10.00	132 in. (3.36 m) 100.0	41.8 in. (1.06 m) 1000	13.36 in. (339 mm) 10,000	2.67 x 207 in. (67.8 x 6.78 m) 1000
	Wide Field Lens WFL-10	0 in. (0 mm) to infinity	10 in. (1) (254 mm)	3.17 in. (80.5 mm) 1.000	1.00 in. (25.4 mm) 10.00	0.317 in. (8.05 mm) 100.0	0.100 in. (2.54 mm) 1000	0.032 in. (0.81 mm) 10,000	0.006 x 0.6 in. (0.15 x 15.0 mm) 1000
	CO-2000 Cassegrain Objective	30 ft. (9.14 m) to infinity	1000 ft. (1) (305 m)	56.8 in. (1.44 m) 10.00	17.9 in. (455 mm) 100.0	5.73 in. (145 mm) 1000	1.79 in. (45.5 mm) 10,000	0.572 in. (14.5 mm) 100,000	0.114 x 11.44 in. (2.86 x 290.4 mm) 10,000
	Used With OL-7	Illuminance (3) Baffle IB-80 A	4 ft. (1.22 m) to infinity	663 in. (16.85 m) 0.001	N/A	N/A	N/A	N/A	N/A
		Supplementary Lens SL-40 A	21 in. to 57 in. (533 mm to 1.45 m)	2.22 in. (56.4 mm) 1.000	0.700 in. (17.8 mm) 10.00	0.221 in. (5.61 mm) 100.0	0.070 in. (1.78 mm) 1000	0.022 in. (0.56 mm) 10,000	0.004 x 0.4 in. (0.1 x 10.0 mm) 1000
		Supplementary Lens SL-20 A	14 in. to 24 in. (356 mm to 609 mm)	1.11 in. (28.2 mm) 1.000	0.350 in. (8.89 mm) 10.00	0.111 in. (2.82 mm) 100.0	0.035 in. (0.89 mm) 1000	0.011 in. (0.28 mm) 10,000	0.002 x 0.2 in. (0.05 x 5.0 mm) 1000
		Supplementary Lens SL-10 A	8 in. to 11 in. (203 mm to 279 mm)	0.555 in. (14.1 mm) 1.000	0.175 in. (4.45 mm) 10.00	0.055 in. (1.40 mm) 100.0	0.018 in. (0.46 mm) 1000	0.006 in. (0.15 mm) 10,000	0.001 x 0.1 in. (0.025 x 2.52 mm) 1000
	Used with MS-80A, OL-7 or OL-14	Micro-Spectar LF-19 A	FIXED 2.7 in. (68.6 mm)	0.199 in. (5.07 mm) 1.000	0.063 in. (1.60 mm) 10.00	0.019 in. (0.50 mm) 100.0	0.006 in. (0.16 mm) 1000	0.002 in. (0.05 mm) 10,000	0.0004 x 0.04 in. (0.01 x 1.0 mm) 1000
		Cosine (3) Receptor CR-100	N/A	N/A 0.100	N/A	N/A	N/A	N/A	N/A
		Flexible Probe FP-80B	N/A	0.12 in. (3.0 mm) 10.00	0.12 in. (3.0 mm) 100.0	0.12 in. (3.0 mm) 1000	0.12 in. (3.0 mm) 10,000	0.12 in. (3.0 mm) 100,000	N/A 10,000
		LED (4) Receptor LR-80 A	N/A	2.00 in. (50.8 mm) 10,000	N/A	N/A	N/A	N/A	N/A
FIXED FOCUS	14 in. Lens OL-14	FIXED Infinity Only	1000 ft. (1) (305 m)	332 in. (8.43 m) 1.000	105 in. (2.67 m) 10.00	33.1 in. (841 mm) 100.0	10.5 in. (265 mm) 1000	3.34 in. (85 mm) 10,000	0.67 x 67.2 in. (17 mm x 1.7 m) 1000
	Macro Lenses	Macro-Spectar MS-80 A	FIXED 6.6 in. (168 mm)	0.387 in. (9.83 mm) 1.000	0.122 in. (3.09 mm) 10.00	0.039 in. (0.98 mm) 100.0	0.012 in. (0.31 mm) 1000	0.004 in. (0.10 mm) 10,000	0.0008 x 0.08 in. (0.02 x 2.0 mm) 1000
		Macro-Spectar MS-610	FIXED 24 in. (610 mm)	0.387 in. (9.83 mm) 10.00	0.122 in. (3.09 mm) 100.0	0.039 in. (0.98 mm) 1000	0.012 in. (0.31 mm) 10,000	0.004 in. (0.10 mm) 100,000	0.0008 x 0.08 in. (0.02 x 2.0 mm) 10,000
	Micro Lenses	MS-5X	FIXED 0.7 in. (17.8 mm)	0.078 in. (1.98 mm) 1.000	0.024 in. (0.61 mm) 10.00	0.008 in. (0.20 mm) 100.0	0.002 in. (0.06 mm) 1000	0.0008 in. (0.02 mm) 10,000	0.0002 x 0.02 in. (0.005 x 0.52 mm) 1000
		MS-7X	FIXED 0.7 in. (17.8 mm)	0.055 in. (1.40 mm) 10.00	0.017 in. (0.44 mm) 100.0	0.006 in. (0.14 mm) 1000	0.002 in. (0.04 mm) 10,000	0.0006 in. (0.01 mm) 100,000	0.0001 x 0.012 in. (0.0029 x 0.292 mm) 10,000
		MS-10X	FIXED 0.6 in. (15.2 mm)	0.039 in. (0.99 mm) 10.00	0.012 in. (0.30 mm) 100.0	0.004 in. (0.10 mm) 1000	0.001 in. (0.025 mm) 10,000	0.0004 in. (0.01 mm) 100,000	0.00008 x 0.008 in. (0.002 x 0.20 mm) 10,000
		MS-25X	FIXED 0.6 in. (15.2 mm)	0.015 in. (0.393 mm) 100.0	0.0005 in. (0.124 mm) 1000	0.002 in. (0.04 mm) 10,000	0.0005 in. (0.012 mm) 100,000	0.00003 in. (0.004 mm) 1 x 10 ⁶	0.00003 x 0.0034 in. (0.0009 x 0.087 mm) 100,000
		MS-50X	FIXED 0.3 in. (7.6 mm)	0.008 in. (0.197 mm) 100.0	0.002 in. (0.062 mm) 1000	0.0008 in. (0.0198 mm) 10,000	0.0002 in. (0.0061 mm) 100,000	0.00008 in. (0.0020 mm) 1 x 10 ⁶	0.00002 x 0.0016 in. (0.00051 x 0.05 mm) 100,000
		1X	FIXED 4.5 in. (113 mm)	0.387 in. (9.83 mm) 10.00	0.122 in. (3.09 mm) 100.0	0.039 in. (0.98 mm) 1000	0.012 in. (0.31 mm) 10,000	0.004 in. (0.10 mm) 100,000	0.0008 x 0.08 in. (0.02 x 2.03 mm) 10,000
	MicroScanner SC-80A	2X	FIXED 2.1 in. (53 mm)	0.194 in. (4.92 mm) 10.00	0.061 in. (1.55 mm) 100.0	0.019 in. (0.49 mm) 1000	0.006 in. (0.155 mm) 10,000	0.002 in. (0.05 mm) 100,000	0.0004 x 0.04 in. (0.01 x 1.0 mm) 10,000
		5X	FIXED 0.6 in. (15.3 mm)	0.086 in. (2.18 mm) 10.00	0.027 in. (0.69 mm) 100.0	0.0087 in. (0.22 mm) 1000	0.0027 in. (0.068 mm) 10,000	0.0009 in. (0.023 mm) 100,000	0.0002 x 0.02 in. (0.005 x 0.5 mm) 10,000
		10X	FIXED 0.44 in. (11.2 mm)	0.047 in. (1.19 mm) 10.00	0.015 in. (0.38 mm) 100.0	0.0047 in. (0.12 mm) 1000	0.0015 in. (0.037 mm) 10,000	0.0005 in. (0.012 mm) 100,000	0.0001 x 0.01 in. (0.0025 x 0.252 mm) 10,000
		20X	FIXED 0.44 in. (11.1 mm)	0.025 in. (0.62 mm) 10.00	0.0077 in. (0.20 mm) 100.0	0.0025 in. (0.063 mm) 1000	0.00076 in. (0.019 mm) 10,000	0.00025 in. (0.006 mm) 100,000	0.00005 x 0.0052 in. (0.0012 x 0.12 mm) 10,000

Numbers shown in blue are relative attenuation factors.

Notes:

- (1) Field coverage is proportional to distance. For example, coverage at 100 ft. is 1/10 the coverage at 1000 ft.
- (2) Field coverage is twice (2x) OL-7 coverage, except cannot be used with IB-80 or LR-80.
- (3) Results of calculations using this accessory are in footcandles or LUX.
- (4) Results of calculations using this accessory are in millicandelas (mcd). The dimensions given are the maximum size LED display that can be measured.