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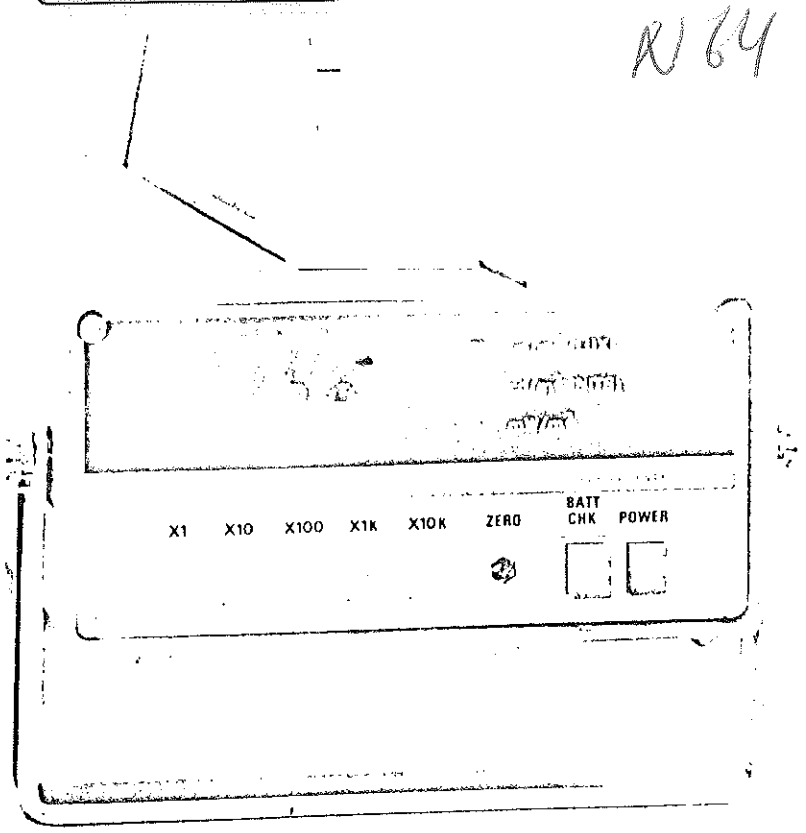

Fig. 1. J16 Digital Photometer/Radiometer

CHARACTERISTICS

The J16 Option 2 Digital Photometer/Radiometer is a compact, battery- or ac-operated instrument primarily intended for calibrated instruments of the intensity of radiation over the 250-to-1200 nanometer (nm) wavelength range. Incorporated are five selectable decade multiplier ranges with measurements displayed on a three-and-a-half digit readout. Interchangeable probes allow measurement of relative levels or absolute level measurements in lux (lm/m^2), nit (cd/m^2), or milliwatts/m^2 units. The probes can be either mounted on the instrument cabinet, a tripod or optical bench, or used with an extension cable available as an optional accessory.

The following instrument specifications apply over an ambient temperature range of 15°C to 40°C (+5°F to +104°F), except as otherwise indicated[1]. Warmup time for given accuracy is one minute. Completion of the calibration procedure (given later in this manual) ensures that this instrument meets the characteristics listed below.

[1]An additional decade of sensitivity is included and is usable if the J16 is carefully zeroed and used at a relatively stable temperature.

ELECTRICAL CHARACTERISTICS

Measurement Range (with Associated Probe)

J6501 or J6511 Illuminance Probes (lux): 0.01[1] to 19,990

J6502 or J6512 Irradiance Probes (mW/m^2) 0.01[1] to 19,990

J6503 or J6523 Luminance Probes (nits): 1.0[1] to 1,999,000

Resolution (with Associated Probe)

Illuminance Probes: 0.001 lux

Irradiance Probes: 0.001 mW/m^2

Luminance Probes: 0.1 nit

System Accuracy

Maximum absolute uncertainty of measurement is less than ±5%, ±1 digit, on any range; uncertainty of linearity is ±2% or less.

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Power Source

The J16 Option 2 uses a built-in rechargeable nickel-cadmium Battery Pack. Typical operating time at +20°C to +30°C (+68°F to +86°F), starting with a fully-charged battery, is two hours.

The J16 Options 2 and 3 have a 115-volt AC Power Supply installed in place of the Battery Pack. J16 Options 2 and 4 are equipped with a 230-volt AC Power Supply.

ENVIRONMENTAL CHARACTERISTICS

Temperature

Operating, −15°C to +40°C (+5°F to +104°F)

Non-Operating, −55°C to +75°C (−67°F to +167°F)

Altitude

Operating, to 15,000 feet

Non-operating, to 50,000 feet

Humidity (operating and non-operating)

5 cycles (120 hours) to 95% relative humidity, referenced to MIL-E-16400F.

Vibration (operating)

Tested for 15 minutes along each of the three major axes at a total displacement of 0.025-inch peak-to-peak (4 g's at 55 Hz) with frequency varied from 10 to 55 to 10 Hz in one minute cycles. All major resonances must be above 55 Hz.

Shock (operating and non-operating)

Tested with two guillotine-type shocks at 150 g's one-half sine, of eleven millisecond duration, in each direction along the three major axes.

MECHANICAL CHARACTERISTICS

Weight (without accessories)

3.25 pounds (1.5 kilograms)

Dimensions (measured at maximum points)

Height: 2.375 inches (6 centimeters)

Width: 4.625 inches (12.3 centimeters)

Depth: 8 inches (20.3 centimeters)

GENERAL INFORMATION

Introduction

The following information is presented to acquaint the user with basic optical terminology in common use and with typical measurement levels encountered when using the J16. Further information may be found by referring to articles listed at the end of this section.

Photometry

Photometry refers to the measurement of visible light, usually with a sensor having a spectral sensitivity curve similar to the average human eye.

The spectral sensitivity curve of the average human eye at typical light levels is called the C.I.E. Photopic Curve, established as a standard by the Commission Internationale de l'Eclairage (C.I.E.). See Figure 2. As can be seen from the curve, the eye responds differently to light of different colors and has maximum sensitivity to yellow and green. For accurate photometric measurements of light of various colors or from differing types of light sources, the spectral sensitivity of a photometer must match the C.I.E. photopic curve very closely.

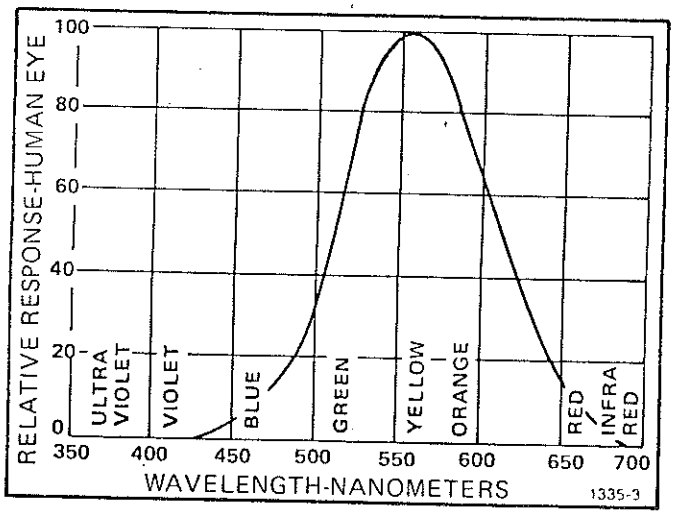

Fig. 2. C.I.E. Photopic Curve.

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The following are commonly used photometric units:

LUMINOUS FLUX

The total light from a source, measured in lumens with a sensor spectrally matched to the average human eye.

LUMINOUS INTENSITY

The luminous flux through a unit of solid angle. Usually measured in candelas (lumens/steradian).

ILLUMINANCE

The amount of luminous flux received by a unit of surface area. Usually measured in lux (lumens/m^2). Illuminance values for normal outdoor light levels are listed in Table 1.

LUMINANCE

The amount of light emitted or scattered by a surface. Usually measured in nits. The nit is 1 candela per square meter. Luminances of several typical light sources are shown in Table 2.

TABLE 1

Approximate Scene Illumination Under Various Outdoor Conditions

Lighting Conditions	Scene Illuminance (lux)
Direct sunlight	100,000
Full daylight*	10,000
Overcast day	1,000
Very dark day	100
Twilight	10
Deep twilight	1
Full moon	0.1
Quarter moon	0.01
Starlight	0.001
Overcast starlight	0.0001

*Not direct sunlight.

TABLE 2

Typical Values of Luminance (Photometric Brightness) For Various Sources

Source	Luminance (nits)
Sun's surface	1.36×10^9
50 watt soft-white bulb	34×10^3
Cool-white fluorescent tube	8500
White paper on a well-lit desk	340
Television screen high-lights	102
Electroluminescent panel	17
White paper, 1 foot from a candle	3.4

Radiometry

Radiometry generally refers to the measurement of radiation in the infrared, visible, and ultraviolet regions of the spectrum.

Instruments used to make radiometric measurements should have equal response to light of all wavelengths to be measured in order to give truly comparative readings. A silicon cell having it's spectral response flattened with glass correction filters, such as the J6502 and J6512 Probes, results in a high sensitivity over the visible and near infrared portion of the spectrum.

The following are commonly used radiometric units:

RADIANT FLUX

The total radiation from a source, measured in watts.

RADIANT INTENSITY

The radiant flux through a unit of solid angle. Usually measured in watts/steradian.

IRRADIANCE

The amount of radiant flux received by a unit of surface area. Usually measured in watts/m^2. (Other units of irradiance, such as $\mu W/cm^2$ and W/cm^2 are also used extensively and are easily converted by shifting decimal places).

RADIANCE

The amount of radiant energy emitted or scattered by a surface. Usually measured in watts/(meter^2·steradian).

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J6502-2 IRRADIANCE PROBE

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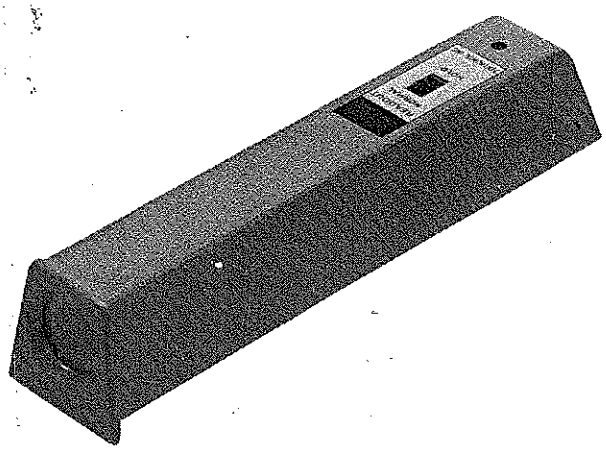


The J6502-2 is designed to measure irradiance in mw/m^2 where light incident upon a surface must be measured. Measurements are made with the J6502-2 pointed at the light source. Narrow angle light sources such as lasers which do not fill the entire active area of the sensor may be measured in which case $1mW/m^2 = 1 \times 10^{-4}mW$.

A silicon photodiode and multilayer glass filter are used to provide a flat spectral response within ±7% from 450 to 950 nanometers. The J6502-2 has useable response between 375 nM and 1100 nM. The effective plane of the sensor is 5 mm behind the glass filter front surface.

The probe has been calibrated in mW/m^2 independently of the J16, thereby permitting interchangeability of probes without the need for re-calibration of either unit. A hold switch is provided to allow the reading to be stored at any time. A standard 0.25-20 mounting socket is located on the bottom for use in mounting on an optical bench or tripod.

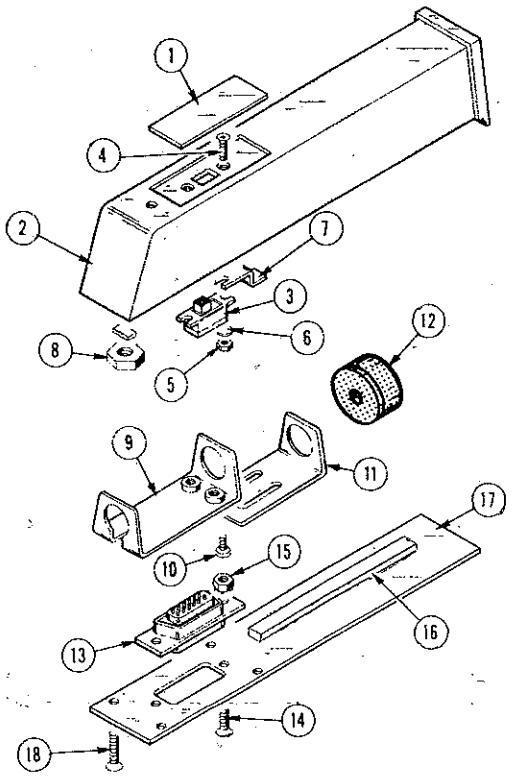
SPECIFICATIONS (When used with a J16)

Measurement ranges: 0.01 to 19.900 mW/m^2
Spectral response: flat within ±7% from 450-950 nanometers
Sensor active area: 1 CM2 ±5%
Accuracy: Within 5% of NBS standards and ±1 digit in the last place. Probes individually calibrated to a tungsten light source traceable to NBS.

DATA SHEET

NO. 062-1553-01
DATE AUG 1973

REPLACEABLE PARTS LIST



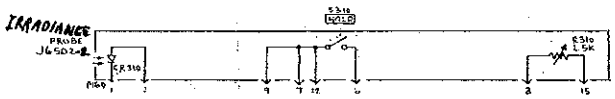


Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description
-1	334-2055-00			1	LABEL, information
-2	380-0298-00			1	HOUSING, probe
-3	260-0960-00			1	SWITCH, slide (S310)
-4	211-0030-00			2	SCREW, 2-56 x 0.25 inch, 100° csk, FHS
-5	210-0405-00			2	NUT, hex., 2-56 x 0.188 inch
-6	210-0001-00			2	WASHER, lock, internal, 0.092 ID
	311-1239-00			1	RESISTOR, variable, 2.5 kΩ, (R310) (not shown)
-7	343-0406-00			1	CLAMP, variable resistor
-8	210-0411-00			1	NUT, hex., 0.25-20 x 0.438 inch
-9	343-0380-00			1	CLAMP, rear
-10	211-0022-00			2	SCREW, 2-56 x 0.188 inch, PHS
-11	343-0379-00			1	CLAMP, front
-12	152-0550-00			1	SEMICONDUCTOR DEVICE, photo w/radiometric filters (CR310)
-13	131-0459-00			1	CONNECTOR, receptacle, electrical, 15 pin, male (J160)
-14	211-0101-00			2	SCREW, 4-40 x 0.25 inch, 100° csk, FHS
-15	210-0586-00			2	NUT, keps, 4-40 x 0.25 inch
-16	252-0603-00			ft	PLASTIC STRIP, 5.50 inch long
-17	200-1409-00			1	COVER, probe
-18	211-0022-00			4	SCREW, 2-56 x 0.188 inch, PHB