User Manual

Tektronix

J17 & J1800 Series LumaColor™ Photometer & Sensor Heads

070-8531-02

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Please check for change information at the rear of this manual.

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Instrument Serial Numbers

Each instrument manufactured by Tektronix has a serial number on a panel insert or tag, or stamped on the chassis. The first letter in the serial number designates the country of manufacture. The last five digits of the serial number are assigned sequentially and are unique to each instrument. Those manufactured in the United States have six unique digits. The country of manufacture is identified as follows:

B010000	Tektronix, Inc., Beaverton, Oregon, USA
E200000	Tektronix United Kingdom, Ltd., London
J300000	Sony/Tektronix, Japan
H700000	Tektronix Holland, NV, Heerenveen, The Netherlands

Instruments manufactured for Tektronix by external vendors outside the United States are assigned a two digit alpha code to identify the country of manufacture (e.g., JP for Japan, HK for Hong Kong, IL for Israel, etc.).

Tektronix, Inc., P.O. Box 500, Beaverton, OR 97077

Printed in U.S.A.

WARRANTY

Tektronix warrants that this product will be free from defects in materials and workmanship for a period of one (1) year from the date of shipment. If any such product proves defective during this warranty period, Tektronix, at its option, either will repair the defective product without charge for parts and labor, or will provide a replacement in exchange for the defective product.

In order to obtain service under this warranty, Customer must notify Tektronix of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. Customer shall be responsible for packaging and shipping the defective product to the service center designated by Tektronix, with shipping charges prepaid. Tektronix shall pay for the return of the product to Customer if the shipment is to a location within the country in which the Tektronix service center is located. Customer shall be responsible for paying all shipping charges, duties, taxes, and any other charges for products returned to any other locations.

This warranty shall not apply to any defect, failure or damage caused by improper use or improper or inadequate maintenance and care. Tektronix shall not be obligated to furnish service under this warranty a) to repair damage resulting from attempts by personnel other than Tektronix representatives to install, repair or service the product; b) to repair damage resulting from improper use or connection to incompatible equipment; or c) to service a product that has been modified or integrated with other products when the effect of such modification or integration increases the time or difficulty of servicing the product.

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Welcome

This is the User Manual for the J17 LumaColor™ Digital Photometer/Radiometer/Colorimeter and the J1800 Series sensor heads. This manual covers all operating instructions for the J17 and the J1800 Series heads.

This manual is divided into several sections:

- *Getting Started* covers installation and minor maintenance of the J17 and sensor heads.
- *At a Glance* provides a quick overview of the controls of the J17.
- *In Detail* provides operating instructions for the J17 and sensor heads. This section covers typical measurement applications.
- The *Appendices* contain reference information, including a performance verification procedure.

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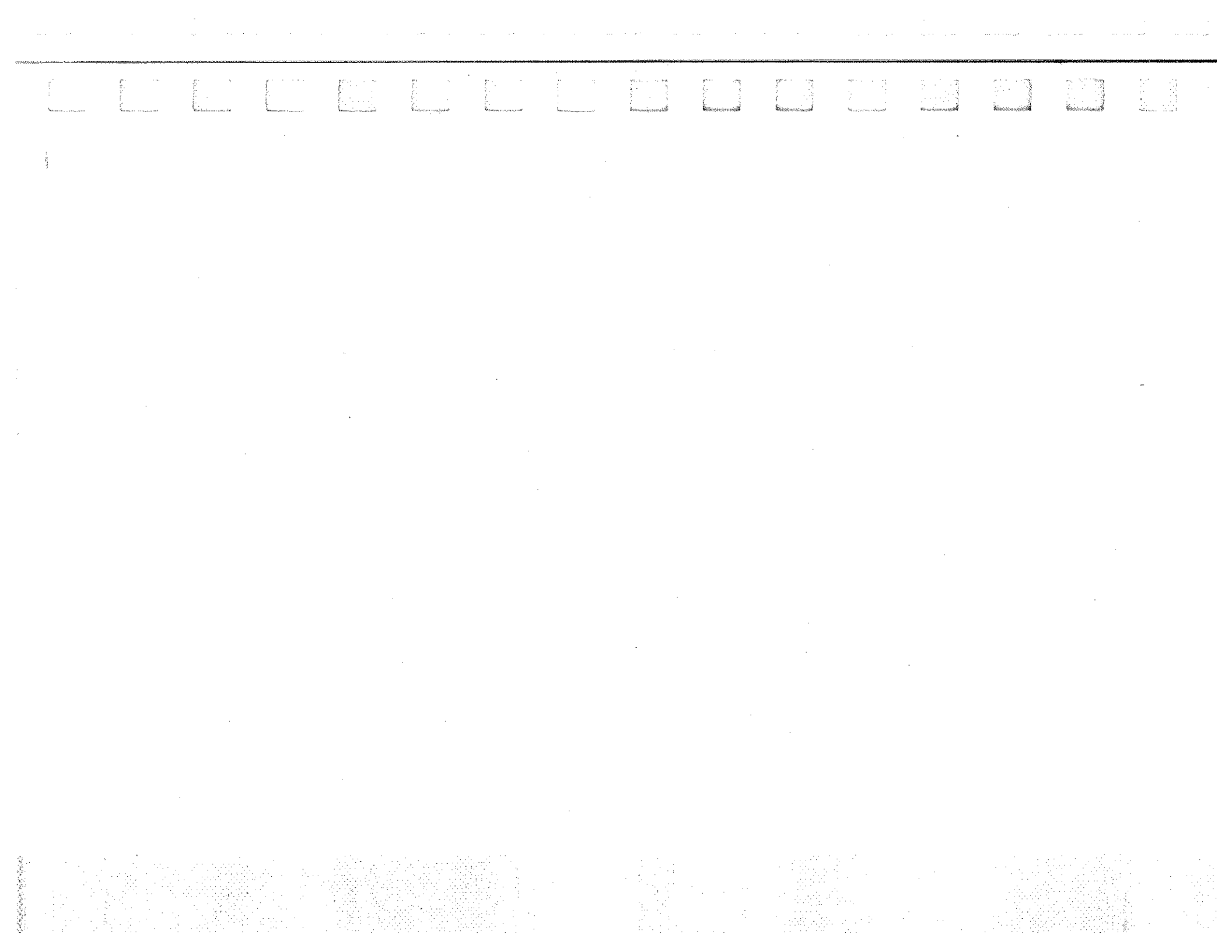


Product Description

The J17 is a handheld digital photometer/radiometer/colorimeter. The fully interchangeable J1800 Series heads, designed for use with the J17 Photometer, provide the ability to make a variety of light measurements.

This section briefly describes the accessories that are shipped with each of the J17 and J1800 Series instruments. If the contents of the shipping container are incomplete, or if shipping resulted in damage, contact your Tektronix representative.

J17 Photometer Features

The J17 provides the following features:

- Autoranging
- Auto zero
- Readings in either English or metric units
- RS-232D interface
- Interchangeable heads for future expansion
- Battery or AC-powered operation (AC adapter available as an optional accessory)
- Backlighted display

Unpacking the J17 Photometer

The J17 Photometer is shipped with the following equipment:

- J17 Photometer
- User Manual (this manual, Tektronix part number 070-8531-02)
- Alkaline battery, IEC type 6LR61, NEDA type 1604 (already installed in J17, Tektronix part number 146-0017-00)

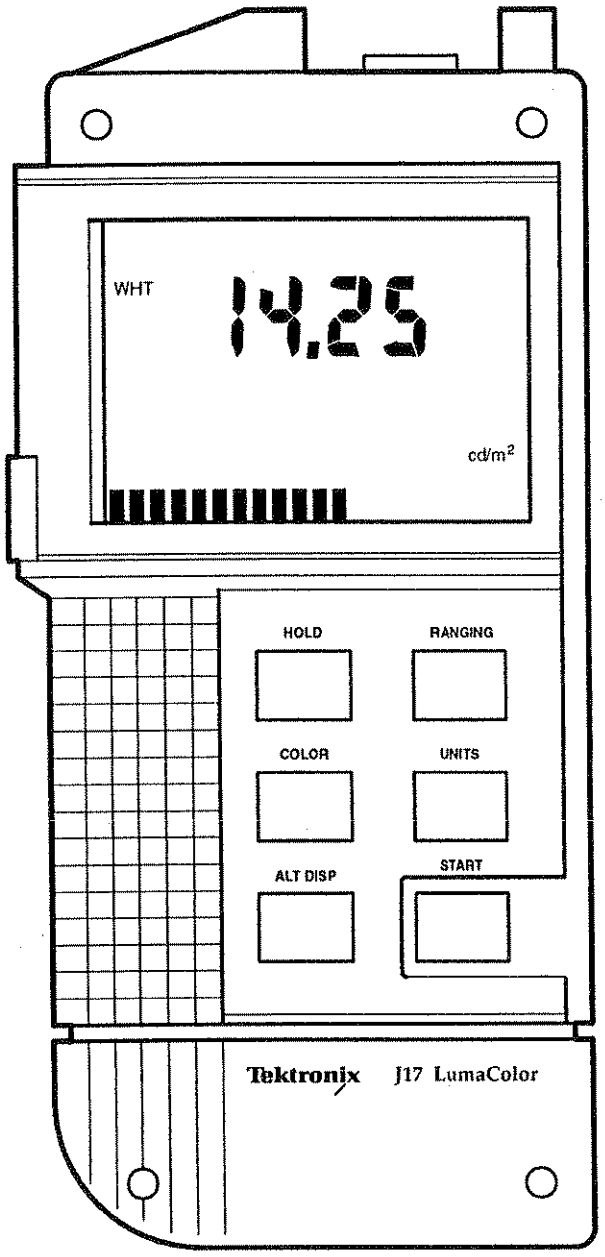


Figure 1-1: The J17 Photometer

J1803 Product Description

The J1803 Luminance Head is designed for use in making display or lighting luminance measurements. It features:

- Eight-degree acceptance angle
- Super-accurate photopic correction (patent pending), allowing measurement of spectrally differing light sources
- Stable multielement laminated glass photopic filters
- Hermetically sealed silicon photodiode
- Wide dynamic range
- Light shield and suction cup for display measurements
- Readings in cd/m^2 (NITS) and foot-lamberts

Unpacking the J1803 Luminance Head

The J1803 is shipped with the following equipment:

- J1803 Luminance Head
- User Manual (this manual, Tektronix part number 070-8531-02)
- Rubber retainer (Tektronix part number 348-1288-00)
- Light shield (Tektronix part number 337-1936-00)
- Suction cup (Tektronix part number 348-1287-00)

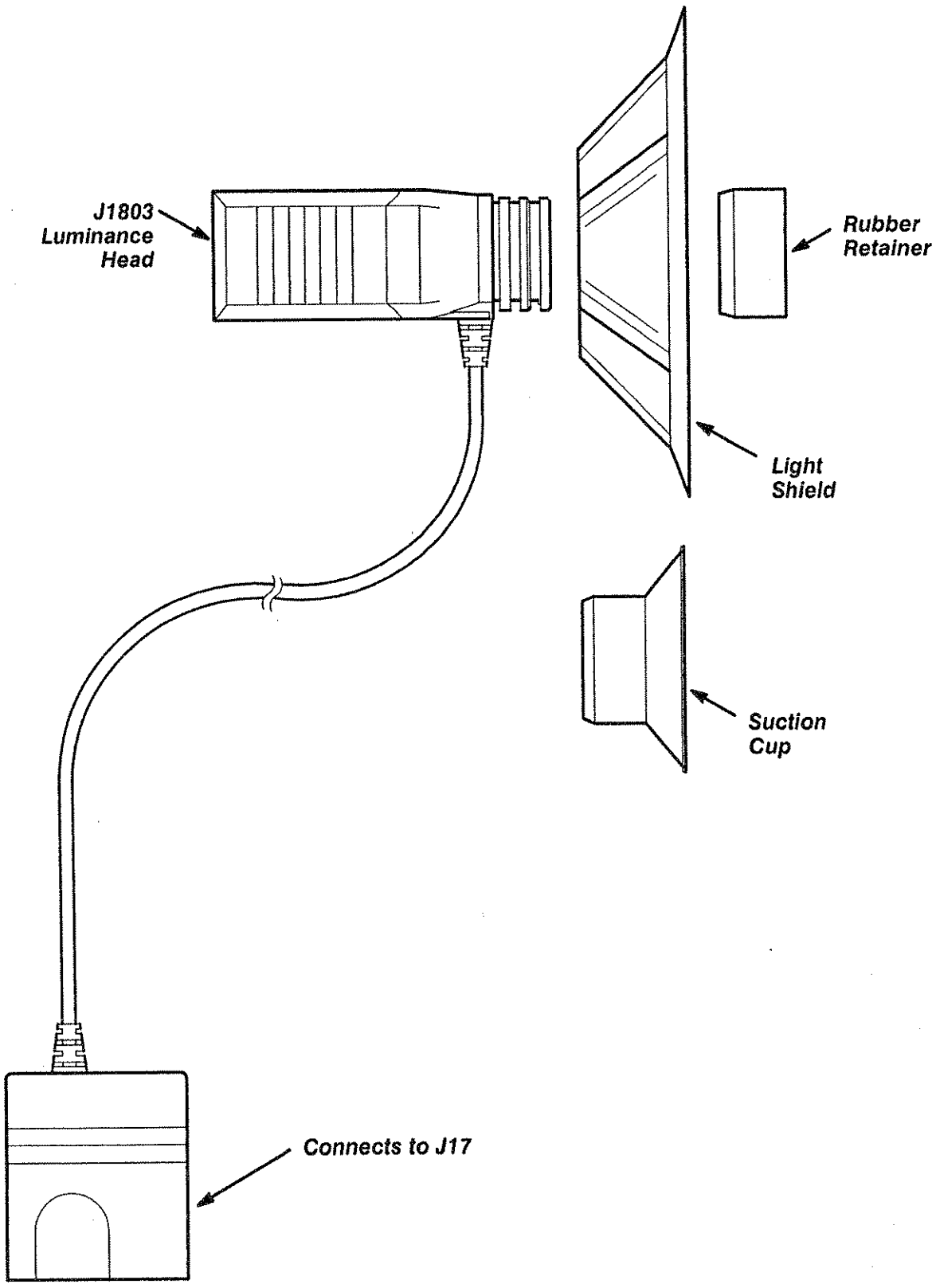


Figure 1-2: The J1803 Luminance Head

J1805 Product Description

The J1805 LED Head is designed for measuring the light output of red, yellow, green, and blue LEDs. It features:

- Super-accurate photopic correction (patent pending), allowing measurement of all visible LED colors with a single sensor head.
- Stable multielement laminated glass photopic filters
- Hermetically sealed silicon photodiode
- Wide dynamic range
- Adapter inserts provide controlled LED-to-sensor spacing
- Readings in candelas, millicandelas, or microcandelas

Unpacking the J1805 LED Head

The J1805 is shipped with the following equipment:

- J1805 LED Head
- User Manual (this manual, Tektronix part number 070-8531-02)
- LED adapter inserts, two 0.120-inch and two 0.200-inch (Tektronix part number 103-0326-00 and 103-0327-00)
- Rubber retainer (Tektronix part number 348-1288-00)

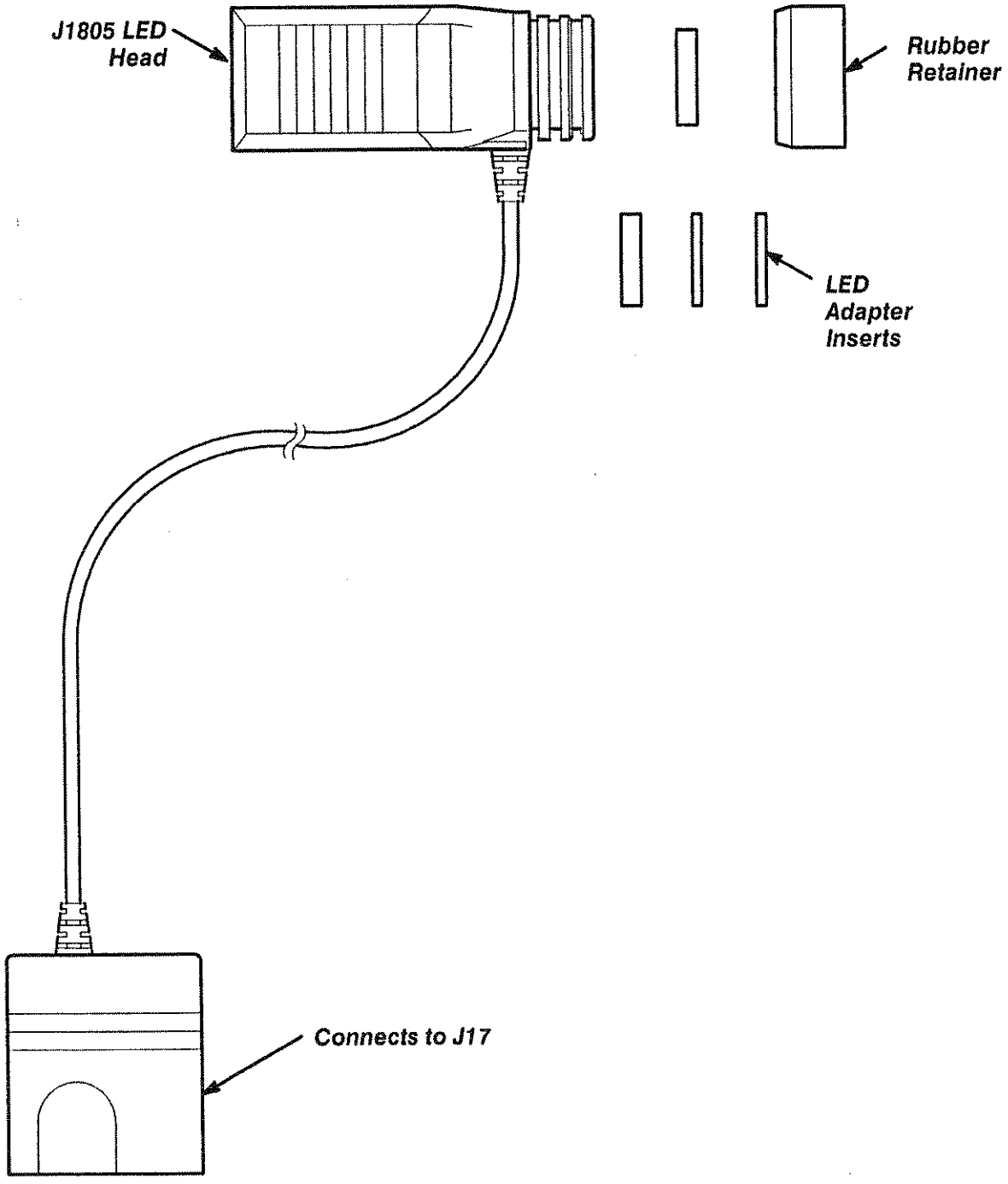


Figure 1-3: The J1805 LED Head

J1806 Product Description

The J1806 Radiance Head is designed for quickly verifying or resetting the color balance of a display that has been color characterized using the J1820 Chromaticity Head. It features:

- Eight-degree acceptance angle
- Flat spectral response ±8% from 450 nm to 750 nm
- Stable multielement laminated glass photopic filters
- Hermetically sealed silicon photodiode
- Wide dynamic range
- Readings in watts/meter^2/steradian

Unpacking the J1806 Radiance Head

The J1806 is shipped with the following equipment:

- J1806 Radiance Head
- User Manual (this manual, Tektronix part number 070-8531-02)
- Suction cup (Tektronix part number 348-1287-00)
- Rubber retainer (Tektronix part number 348-1288-00)

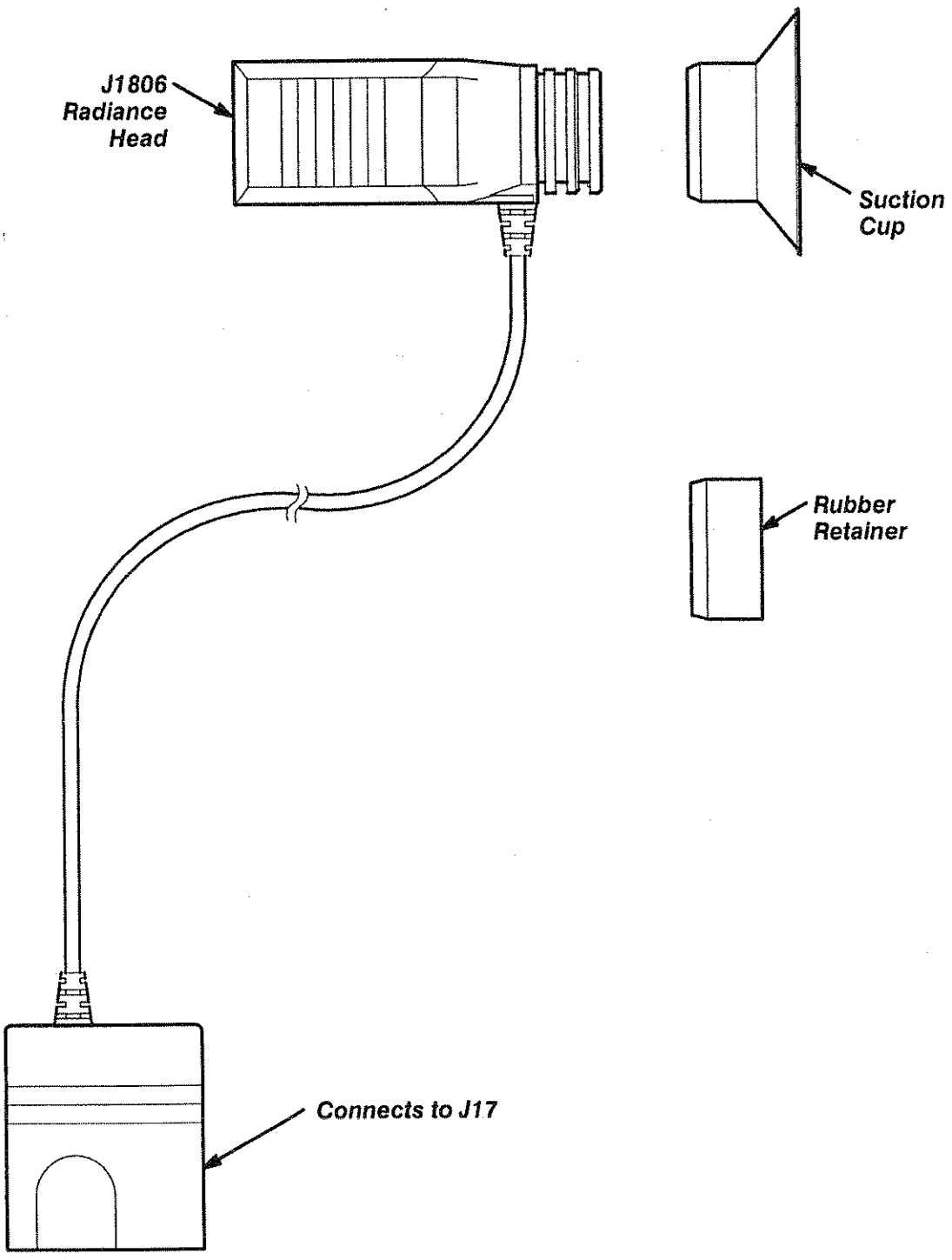


Figure 1-4: The J1806 Radiance Head

J1811 Product Description

The J1811 Illuminance Head can be used for illuminance measurement applications such as highway illumination, office lighting, aircraft lighting, safety and emergency lighting and light trespass. It features:

- Accurately cosine corrected to simulate an ideal 180° field-of-view detector
- Super-accurate photopic correction (patent pending) for use with all visible light sources including incandescent, fluorescent, HID, xenon, trichromatic fluorescent, and sodium
- 72-inch attached cable prevents shadowing of the sensor by the observer
- Leveling indicator
- Wide range of light levels from sunlight to moonlight
- Stable silicon sensor and multielement laminated glass photopic filters
- Readings in lux (lumens/meter^2) or foot candles

Unpacking the J1811 Illuminance Head

The J1811 is shipped with the following equipment:

- J1811 Illuminance Head
- User Manual (this manual, Tektronix part number 070-8531-02)
- Protective cover (Tektronix part number 200-1644-00)

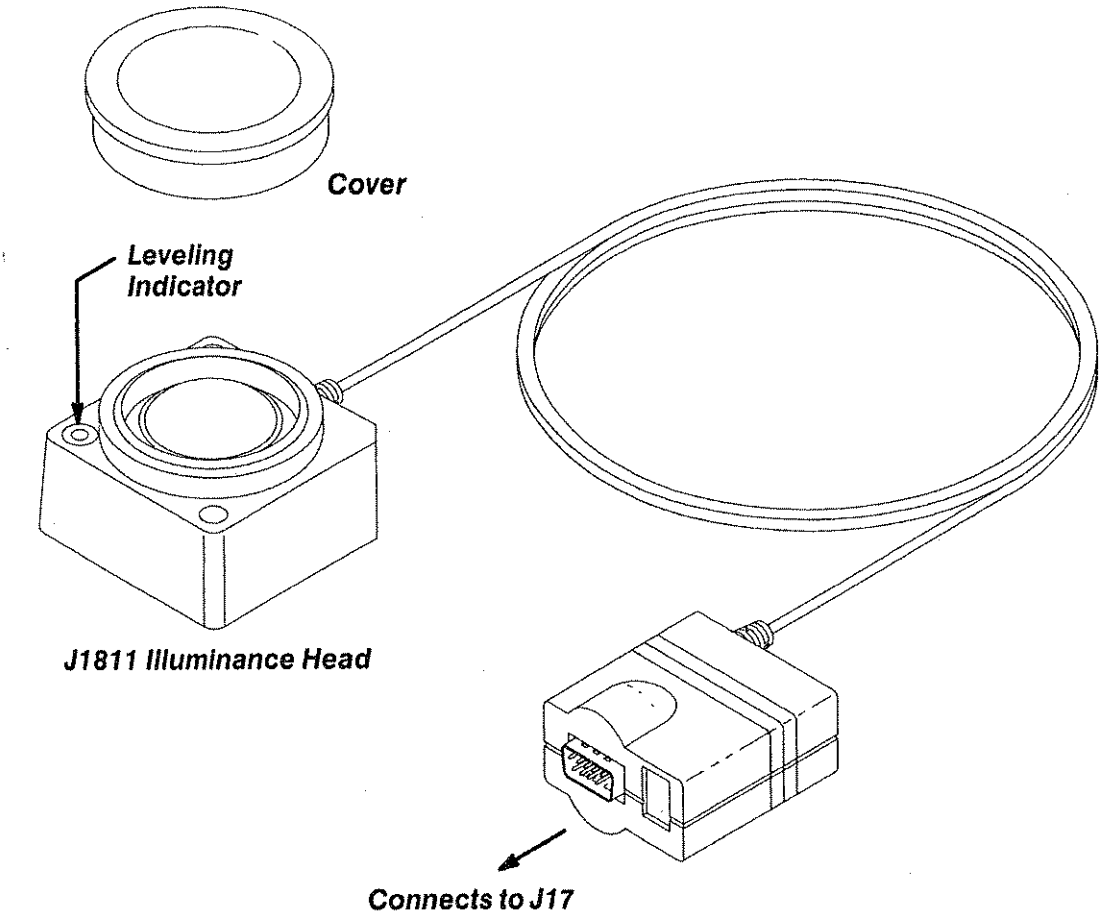


Figure 1-5: The J1811 Illuminance Head

J1812 Product Description

The J1812 Irradiance Head can measure irradiance across the visible and near-infrared light spectrum, and is ideal for infrared LED testing or low-power laser experiments. It features:

- Flat spectral response ±8% from 450 nm to 950 nm
- Stable silicon sensor and multielement laminated glass photopic filters
- Wide dynamic range
- Large 1 cm^2 silicon sensor
- Readings in watts/$meter^2$ or watts

Unpacking the J1812 Irradiance Head

The J1812 is shipped with the following equipment:

- J1812 Irradiance Head
- User Manual (this manual, Tektronix part number 070-8531-02)
- Protective cover (Tektronix part number 200-1644-00)

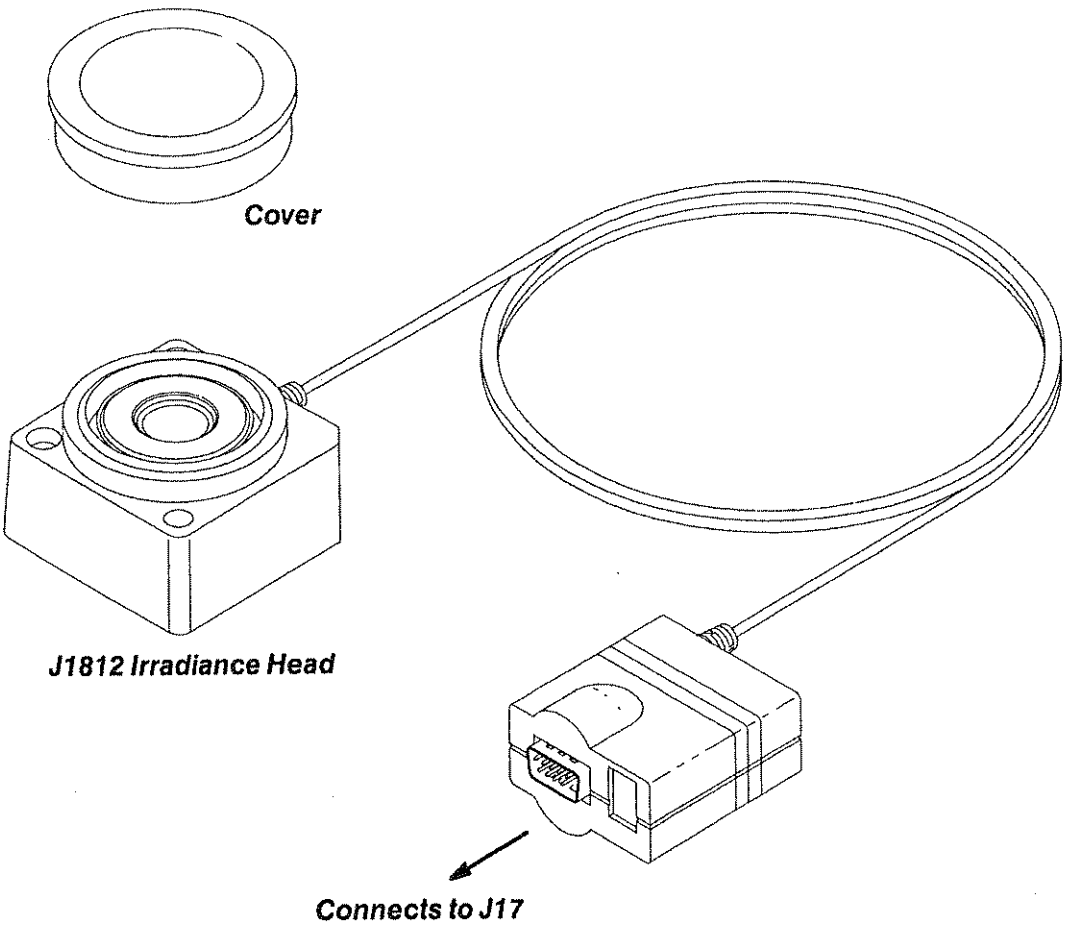


Figure 1-6: The J1812 Irradiance Head

J1820 Product Description

The J1820 Chromaticity Head can be used for chromaticity measurements of displays, ambient lighting measurements, and light source measurements. It features:

- Both chromaticity and luminance measurements
- Chromaticity in both xy and u′v′ coordinate systems
- Luminance in both cd/m^2 (NITS) and foot-lamberts
- Display of raw X, Y, and Z tristimulus data
- Super-accurate photopic correction filter (patent pending)
- Stable multielement laminated glass photopic filters
- Hermetically sealed silicon photodiodes
- 16-degree acceptance angle

Unpacking the J1820 Chromaticity Head

The J1820 is shipped with the following equipment:

- J1820 Luminance Head
- User Manual (this manual, Tektronix part number 070-8531-02)
- Suction cup (Tektronix part number 348-1287-00)

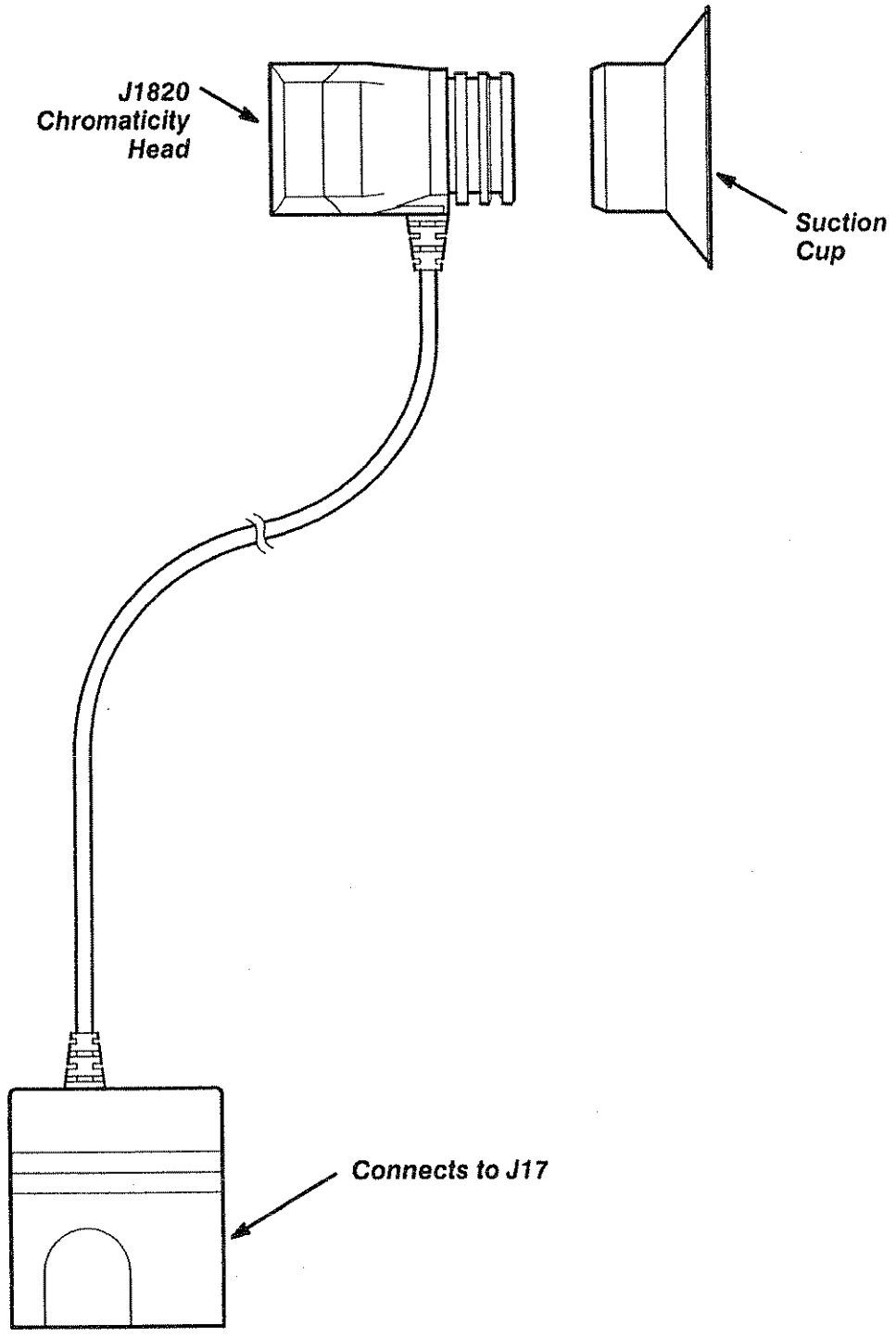


Figure 1-7: The J1820 Chromaticity Head

J1823 Product Description

The J1823 Narrow Angle Head can be used for measurements of displays, ambient lighting measurements, and light source measurements. It features:

- Luminance in both cd/m^2 (NITS) and foot-lamberts
- Super-accurate photopic correction filter (patent pending)
- Stable multielement laminated glass photopic filters
- Hermetically sealed silicon photodiodes
- One-degree acceptance angle (one-third degree with −01 option)

Unpacking the J1823 Narrow Angle Head

The J1823 is shipped with the following equipment:

- J1823 Narrow Angle Head
- Standard accessory lens caps,
  Front (Tektronix part number 200−1835−00)
  Rear (Tektronix part number 200−1836−00)
- User Manual (this manual, Tektronix part number 070-8531-02)

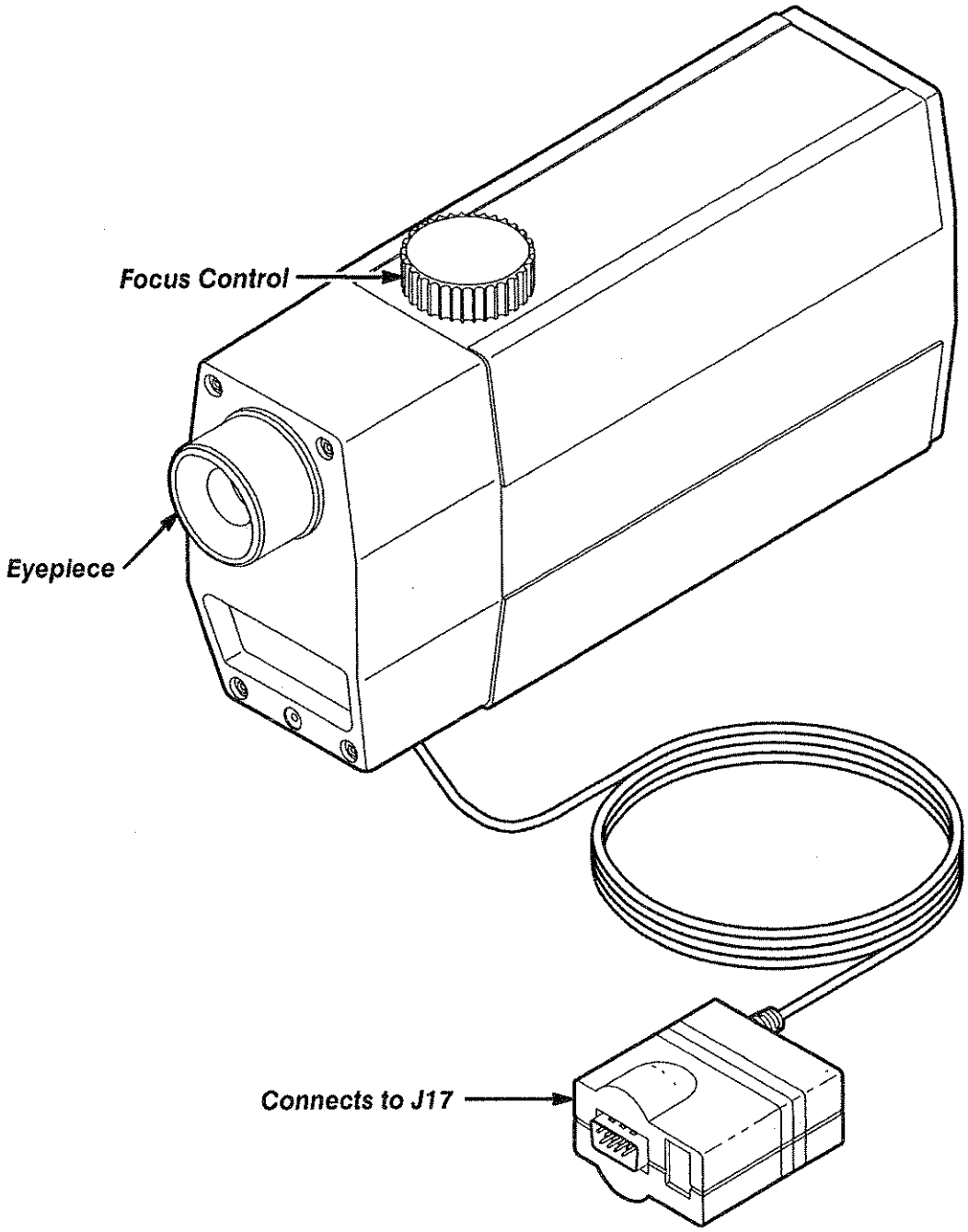


Figure 1-8: The J1823 Narrow Angle Head

Repackaging for Shipment

If you must ship the J17 or one of the J1800 Series heads, package it as follows:

- ☐ **Step 1:** Use the original carton, or an equivalent carton with dimensions at least three inches greater than the instrument to allow for proper cushioning.
- ☐ **Step 2:** Cover the instrument with a polyethylene bag to protect its finish.
- ☐ **Step 3:** Cushion the instrument on all sides with packing material. Seal the carton with shipping tape or with an industrial stapler.
- ☐ **Step 4:** If you are shipping the product to a Tektronix Service Center, be sure to label the carton with the name of your company, a person to contact at your company, and a description of the problem.

Safety

Please take a moment to review these safety precautions. They are provided for your protection and to prevent damage to the J17 Photometer. This safety information applies to all operators and service personnel.

Symbols and Terms

These two terms appear in manuals:

- CAUTION statements identify conditions or practices that could result in damage to the equipment or other property.
- WARNING statements identify conditions or practices that could result in personal injury or loss of life.

These two terms appear on equipment:

- *CAUTION* indicates a personal injury hazard not immediately accessible as one reads the marking, or a hazard to property including the equipment itself.
- *DANGER* indicates a personal injury hazard immediately accessible as one reads the marking.

This symbol appears in manuals:

Static-Sensitive Devices

These symbols appear on equipment:

DANGER
High Voltage

Protective
ground (earth)
terminal

ATTENTION
Refer to
manual

Specific Precautions

Observe all of these precautions to ensure your personal safety and to prevent damage to either the J17 Photometer or equipment connected to it.

Power Source

The J17 Photometer is intended to operate from a power source that will not apply more than 16 volts DC.

Do Not Operate in Explosive Atmospheres

The J17 Photometer provides no explosion protection from static discharges or arcing components. Do not operate the J17 Photometer in an atmosphere of explosive gases.

Electric Overload

Never apply to a connector on the J17 Photometer a voltage that is outside the range specified for that connector.

Proper Use of Batteries

To reduce the risk of fire or injury, read and follow these instructions when recharging, replacing, or otherwise handling the battery for the J17 Photometer.

Use the Correct Battery

Use only a nine-volt alkaline battery, IEC type 6LR61, NEDA type 1604. (A carbon-zinc nine-volt battery may be used safely, but the operating life will be only one-third to one-half that of an alkaline battery.)

WARNING

To reduce the risk of fire or injury, read and follow these instructions.

Dispose of Battery Properly

DO NOT dispose of battery in a fire. The battery may explode. Check with local codes for special disposal instructions.

Use Care When Handling Batteries

DO NOT open or mutilate the battery. Released battery electrolyte is corrosive and may cause damage to the eyes or skin. Released electrolyte may be toxic and can cause poisoning if swallowed.

Exercise care in handling the battery to avoid shorting battery with conducting materials such as rings, bracelets, or keys.

WARNING

To reduce the risk of fire or injury, read and follow these instructions.

Do Not Attempt to Recharge Alkaline Batteries

DO NOT attempt to recharge alkaline batteries. The batteries may leak corrosive electrolyte or explode.

DO NOT attempt to rejuvenate alkaline batteries by heating them. Sudden release of the battery electrolyte may occur, causing burns or irritation to the eyes or skin.

Do Not Store Batteries in the J17 Photometer

Remove the battery from the J17 if it will not be used for a long period of time (several months or more). The battery could leak in the product during long-term storage.

Discard "Dead" Batteries

Remove and discard a dead battery as soon as possible. Dead batteries are more likely to leak in the product.

Battery and Power Information

The J17 Photometer may be powered by either of the following sources:

- a non-rechargeable nine-volt alkaline battery
- an external AC power adapter, available as an optional accessory. (See Appendix A for information about available accessories.)

Using Battery Power

The J17 Photometer provides automatic display shutoff and low battery warning to help prolong battery life and prevent incorrect readings due to low battery power. Refer to *Appendix B: Specifications* for details on expected battery life and environmental concerns.

Automatic Display Shutoff

To conserve battery power, the J17 will automatically shut down the display and minimize internal operations after 15 minutes of front-panel inactivity. Once the display is off, the J17 will check for new data when you press any key, and will return to the low-power state if there is no new data.

The automatic display shutoff does not function when the J17 is powered by the optional AC power supply.

Low Battery Warning

BAT

When battery voltage is below 7.2 volts, the J17 Photometer displays the flashing warning **BAT** in the upper left corner of its display. At this point, you should replace the alkaline battery (see below).

After the **BAT** warning appears, the J17 will operate for several minutes, and then will power off the display automatically to prevent false readings.

If the battery voltage is below 7.2 volts at initial power-on, the J17 will not proceed past the self-test.

Replacing the Alkaline Battery

WARNING

Refer to page 1-21 for the proper handling and use of batteries.

To replace the alkaline battery (refer to Figure 1-9):

- ☐ **Step 1:** Turn off the J17 Photometer.
- ☐ **Step 2:** Open the battery compartment located on the back cover of the J17.
- ☐ **Step 3:** Remove the used battery, and replace it with a fresh one, arranging the wires so that they will not interfere with the battery cover.
- ☐ **Step 4:** Close the battery compartment.
- ☐ **Step 5:** Turn on the J17 and make sure that the low-battery (**BAT**) warning is no longer flashing.

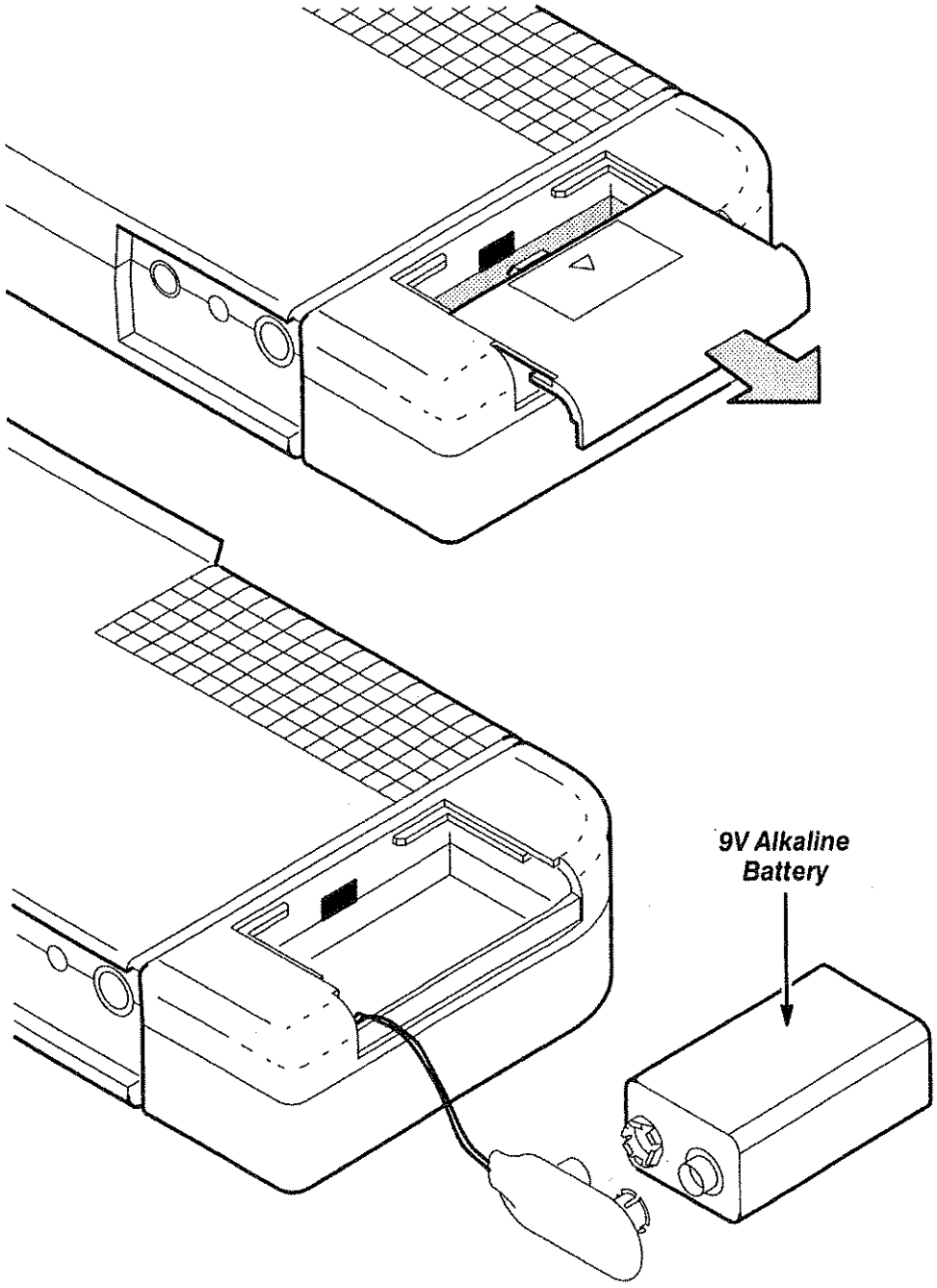


Figure 1-9: Replacing the Alkaline Battery

Using the Optional AC Power Adapter

The J17 Photometer may be powered indefinitely by using the external AC power adapter, available as an optional accessory (Tektronix part number 119-5032-00). The power adapter will override the alkaline battery, if one is installed.

To use this adapter, plug the adapter's pin connector into the **EXT. POWER** connector on the side of the J17 (see Figure 1-10). Plug the power adapter into an external AC power outlet providing 120 VAC at 60 Hz.

The AC power adapter supplies approximately 12 VDC at a minimum of 50 mA. Other similar power supplies in the range of 9 to 16 VDC may be used. Be sure that the center contact polarity is positive.

CAUTION

Be sure that any power supply you use with the J17 provides power within the range of 9 to 16 VDC, and that the center contact polarity of the adapter is positive. A power supply that does not meet these requirements may damage the J17.

The backlight will be illuminated at power-on when the J17 is powered by the AC power adapter. The backlight may be turned off, if desired, by pressing the **BACKLIGHT** button.

The automatic display shutdown feature does not operate when the J17 is powered by the AC adapter, thus allowing the J17 to provide constant monitoring of light sources.

NOTE

Customer-supplied AC power supplies that provide less than 12 volts may not automatically turn on the backlight or override the automatic display shutdown.

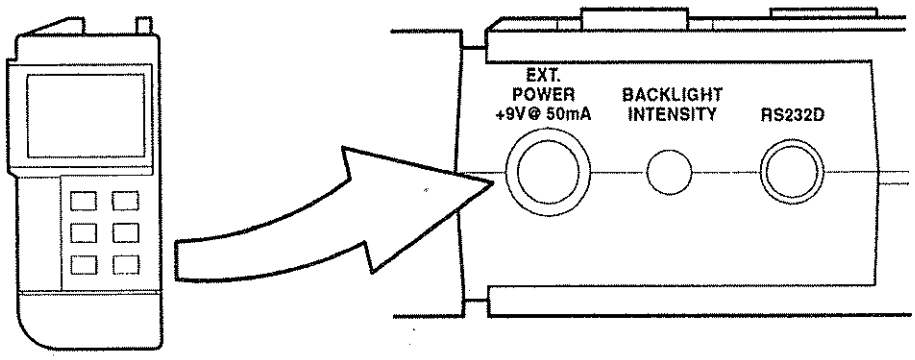


Figure 1-10: Location of J17 Power Adapter Connector

Installation

Follow this sequence when you install the J17 Photometer:

☐ **Step 1:** Verify that a nine-volt alkaline battery is installed in the battery compartment (see page 1-26), or use the optional AC adapter to connect the J17 to an external power source (see page 1-28).

☐ **Step 2:** Connect a J1800 Series sensor head to the J17.

NOTE

Always connect the sensor head to the J17 before turning on the power. The J17 loads data from the sensor head at power-on. If you connect a new sensor head to the J17 while the power is on, any measurements you take may be inaccurate.

☐ **Step 3:** Move the J17 **POWER** switch to the **ON** position.

When you turn the power on, the J17 performs the following actions:

1. The J17 performs a brief self-test. During the self-test,the J17 activates all elements of the display, checks the battery voltage, and performs the auto-zero and auto-range functions.

NOTE

If no sensor head is connected to the J17, the J17 will not proceed past the self-test display.

Low battery voltage is indicated by a flashing **BAT** *indicator. If this icon appears, replace the battery with a fresh one before taking any measurements.*

2. The J17 will display the default measurement units for the type of sensor head attached. If measurements are continuously updated, as with the J1803 Luminance Head, the J17 begins displaying measurement readings automatically. With the J1820 Chromaticity Head, the J17 will complete one measurement cycle and stop. (Pressing the **START** button initiates a new measurement cycle.)

Maintenance

The J17 Photometer and J1800 Series heads do not require periodic maintenance. Clean the instrument cases with a damp cloth as needed.

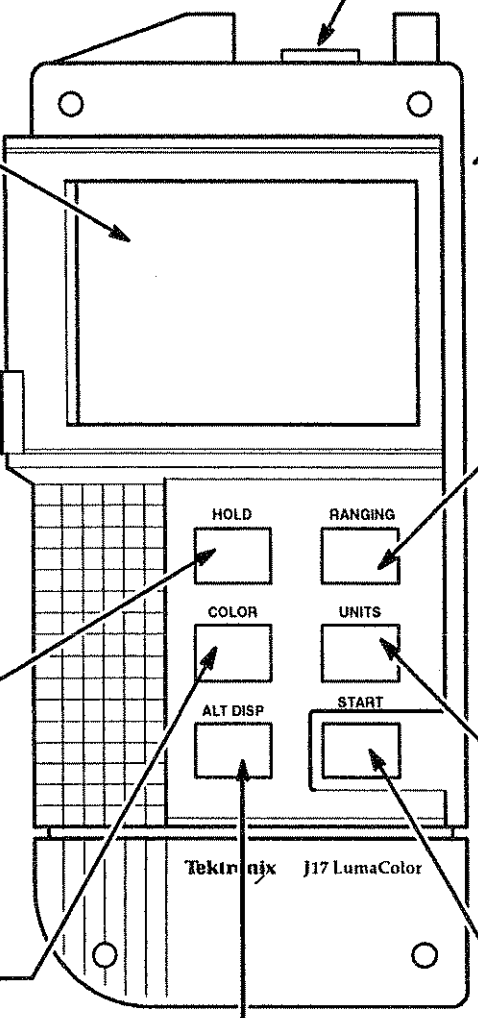
An annual recalibration of the heads will ensure best accuracy. See *Appendix E, Performance Verification*, for a procedure to check calibration.

At a Glance

The J17 at a Glance

This section provides a quick overview of the controls of the J17 Photometer. For many controls, you will find a reference to more detailed operating instructions later in this manual.

The J17 Front Panel



Connect a J1800 Series sensor head here.

All readings appear on the display. See page 2-3.

The POWER switch turns the J17 on or off. The J17 performs a brief self-test at power-on.

Press the BACKLIGHT button to light the display. (Use the BACKLIGHT INTENSITY control, on the right side of the J17, to adjust the backlight.)

Press the RANGING button to switch from autoranging to manual ranging, and to step through the manual ranges.. (This feature cannot be used with the J1820.)

Press HOLD to keep the current measurement reading on the display. This prevents further updating of the measurement until you press HOLD again.

Press UNITS to select the alternate units, if any, for displayed readings.

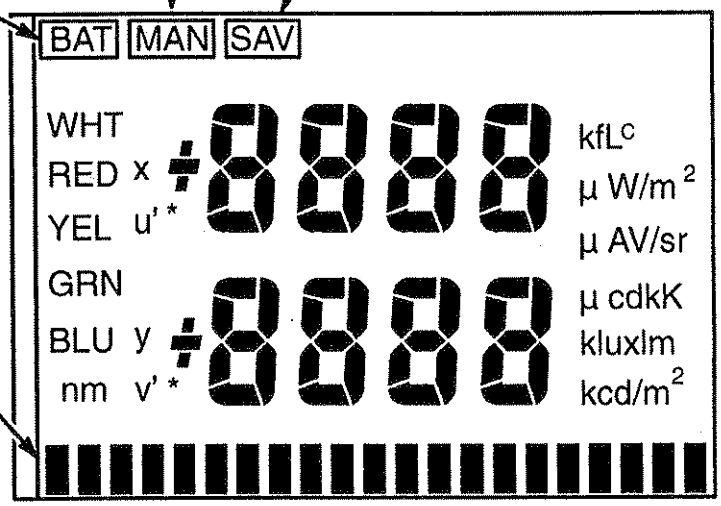
Press COLOR to cycle among white, red, yellow, green, and blue correction factors to maximize accuracy for narrow-band light sources, such as LEDs.

(Rear Panel) Location of battery compartment.

When using the J1820 Chromaticity head, press START to initiate a new reading. See page 3-33.

When using the J1820 Chromaticity head, press ALT DISP to cycle among chromaticity coordinates, luminance, and raw XYZ tristimulus values. See page 3-35.

The J17 Display



The BAT icon flashes when the battery voltage drops below 7.2 V. See page 1-26.

The MAN icon shows that manual ranging is selected.

The SAV icon indicates that the displayed reading is not being updated (the HOLD button has been pressed.)

One of WHT, RED, YEL, GRN, or BLU appears to show the selected correction factor. (White is the default.)

The bar graph indicates the level of the input signal at the A/D converter, which affects the accuracy of the reading. When using manual ranging, choose the range that produces the longest bar graph for best accuracy. The specified accuracy may not be available if the graph is at the low end of the scale.

Measurement readouts are displayed as numerical values in the center of the display, with the appropriate units shown along the left or right side.

Additional items may appear on the display during self-test.

As long as the entire acceptance angle is uniformly filled by the light source, the sensor-to-surface distance is not critical, and the reading will be the same regardless of distance. The area viewed increases proportionally with the square of the distance, thus compensating exactly for the decrease of light that occurs proportionally with the square of the distance.

The extremes to which the distance may be changed without affecting the reading are limited by reflections, shadowing, small area non-uniformity of the surface when the head is close to the surface, and by the acceptance angle's exceeding the size of the emitting area at longer distances. CRT displays usually suffer from a decrease in light output toward the edges and corners of the screen, which also limits the maximum measurement distance.

The minimum viewing diameter of the J1803, using the suction cup in contact with the surface to be measured, is approximately 0.5 inches.

Measurement Units

The J17 Photometer will provide luminance readings in either cd/m^2 (NITS) or foot-lamberts. The default is cd/m^2. To view readings in foot-lamberts, press the **UNITS** button on the J17. Readings revert to their default units at power-on.

Display Luminance Measurements

The J17 Photometer and J1803 head can be used to measure luminance of display monitors (CRT or flat-panel displays).

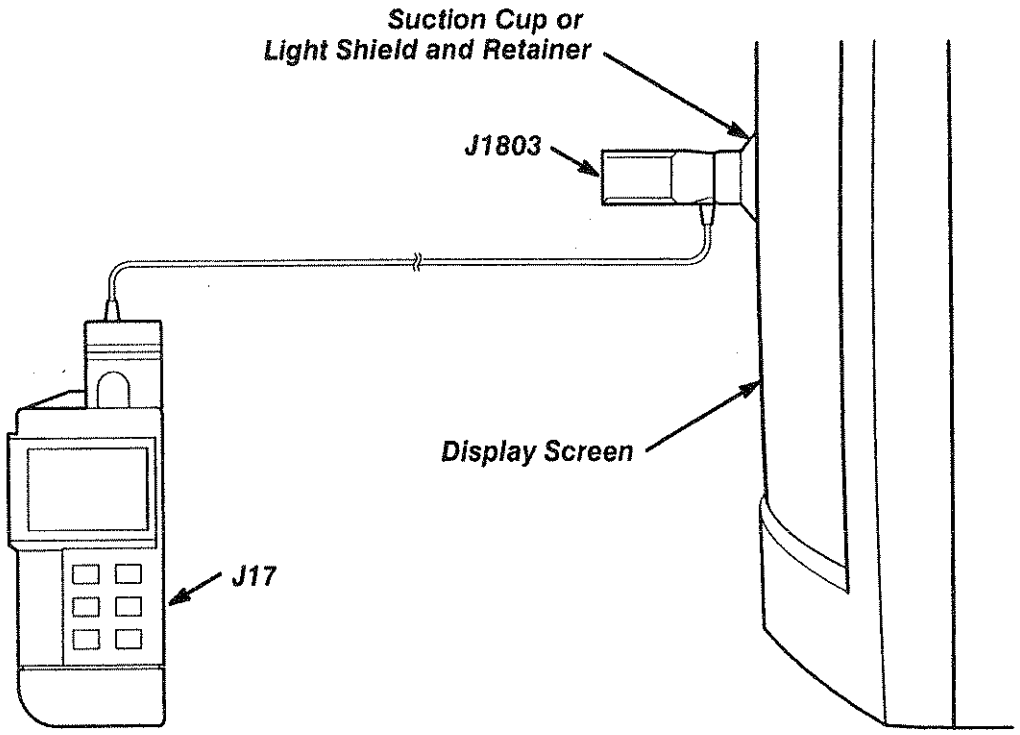


Figure 3-1: Setup for Display Luminance Measurements

To take display luminance measurements using the J17 and the J1803 head:

- ☐ **Step 1:** Turn the monitor on, setting it to its initial brightness and contrast settings.
- ☐ **Step 2:** Position the J1803 head on the monitor.

NOTE

To eliminate ambient light from the measurement reading, attach the light shield (occluder) to the front of the J1803 head and push on the rubber retainer.

If ambient light is not a severe problem, you can attach the rubber suction cup to the J1803 head and use it to position the J1803 on the monitor.

☐ **Step 3:** Read the luminance value from the J17 display. The luminance value is updated continuously.

Luminance readings will be in cd/m^2 by default. For readings in foot lamberts, press the **UNITS** button.

For maximum accuracy when measuring red, green, or blue fields, select the correction factor for that color using the J17 **COLOR** button.

Luminance Measurement of an Illuminated Surface

The J1803 head can be used with the J17 Photometer to measure the reflectance of light from signs, walls, work surfaces, and other surfaces. This method is also useful for measuring light tables and X-ray viewing boxes.

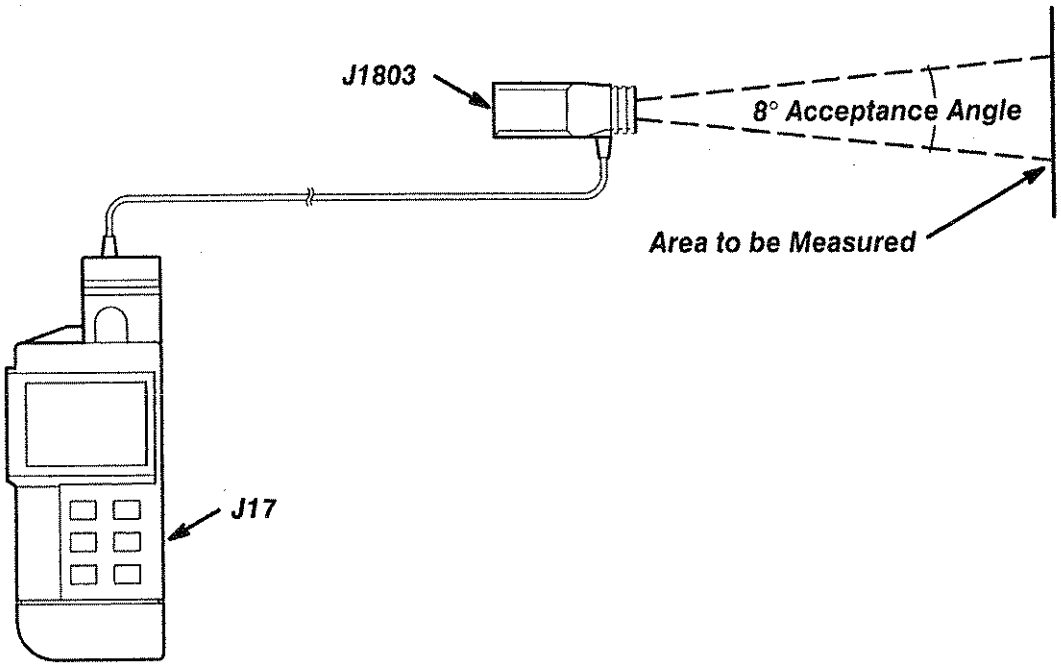


Figure 3-2: Setup for Luminance Measurement of an Illuminated Surface

To take luminance measurements from an illuminated surface using the J17 and the J1803 head:

- ☐ **Step 1:** Point the J1803 head at the surface to be measured, at the desired distance from the surface.
- ☐ **Step 2:** Read the luminance value from the J17 display. The luminance value is updated continuously.

Luminance readings will be in cd/m^2 (NITS) by default. For readings in foot lamberts, press the **UNITS** button.

NOTE

For accurate readings, position the J1803 so that the measurement field is uniformly filled by the surface to be measured. The acceptance angle of the J1803 head is eight degrees. See Operating Characteristics, *on page 3-1.*

Special Considerations

For accurate measurements, observe the following when positioning the J1803 head for measurements of illuminated surfaces:

- Make sure that the area being viewed by the J1803 is uniformly illuminated, and that the entire field of view of the J1803 is filled by the surface you are measuring.
- Position the J1803 so that it does not shadow the surface being measured. Shadowing will occur if the surface is being measured from direction of the illumination.
- Operating the head in direct contact with the surface is not recommended, because reflections may occur between the front surface of the head and the surface to be measured. Placement of the head too close to the surface may also cause shadowing.

  The light shield or suction cup provides adequate spacing between the head and the surface to prevent reflection on backlighted surfaces.

Using the J1805 LED Head

This section describes the operating characteristics of the J1805 LED Head, and provides instructions for measuring the light output of LEDs.

Operating Characteristics

The J1805 provides constantly updated readings.

To prevent the display from updating, press the **HOLD** button on the J17. The display will remain steady until you press **HOLD** again.

Acceptance Angle

When the emitting plane of the LED is located at the front surface of the J1805 head, the J1805 samples an angle of three degrees of the center of the LED beam.

Using the LED Adapter Inserts

Four LED adapters, of two different sizes, are supplied with the J1805. Two have a 0.120-inch opening for T1-size LEDs; the other two have a 0.200-inch opening for T1¾-size LEDs. Other LED sizes may be accommodated by drilling the supplied adapters for a larger size, or by making 1-inch diameter wafers from sheet metal and painting them flat black.

Note that the LED hole in each adapter is recessed on one side. This allows measurement of both diffusing and transparent LEDs. A diffusing LED has an effective emitting plane closer to its tip than a transparent LED. Choose the side of the LED adapter that places the effective emitting plane of the LED closest to the outside flat surface of the J1805 head. (See Figure 3-3.)

Seat the LED flange squarely against the LED adapter to ensure that the sensor is measuring the on-axis portion of the LED beam. This is especially important for LEDs that have very narrow beam widths. The geometry of the J1805 is such that the sensor samples about three degrees from the center of the LED beam, as shown in Figure 3-3.

Use the rubber retainer to secure the adapter to the J1805.

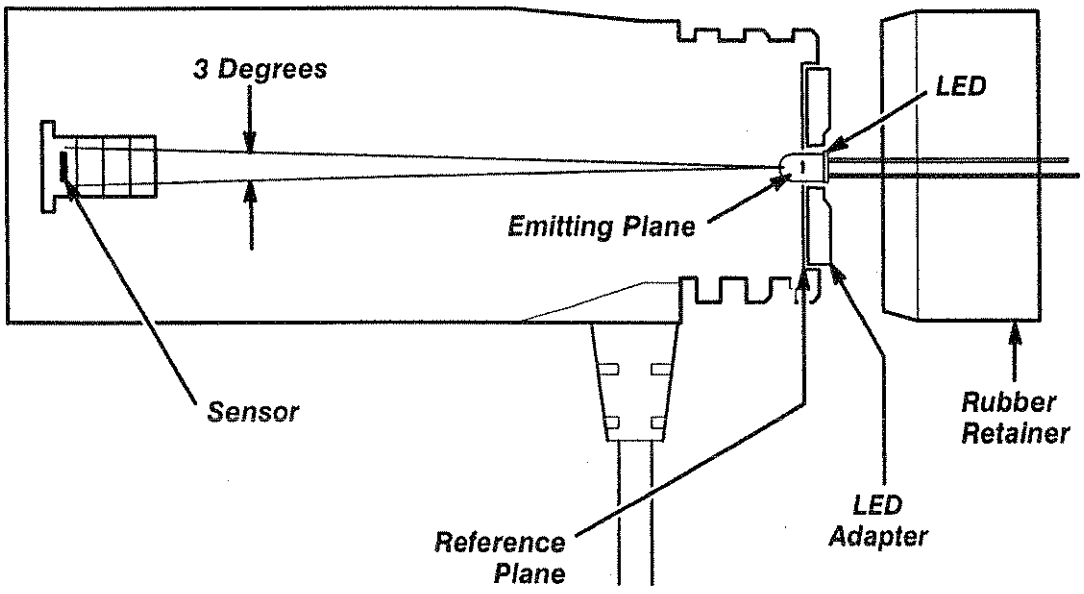


Figure 3-3: LED Measurement Geometry

Measurement Units

The J17 Photometer will provide luminous intensity readings in candelas, millicandelas, or microcandelas.

LED Measurements

The J17 Photometer and J1805 head can be used to measure the luminous intensity of red, yellow, green, and blue LEDs. For maximum accuracy, you should select the color of the LED to be measured (as described in Step 2 of this procedure). The default color at power-on is white.

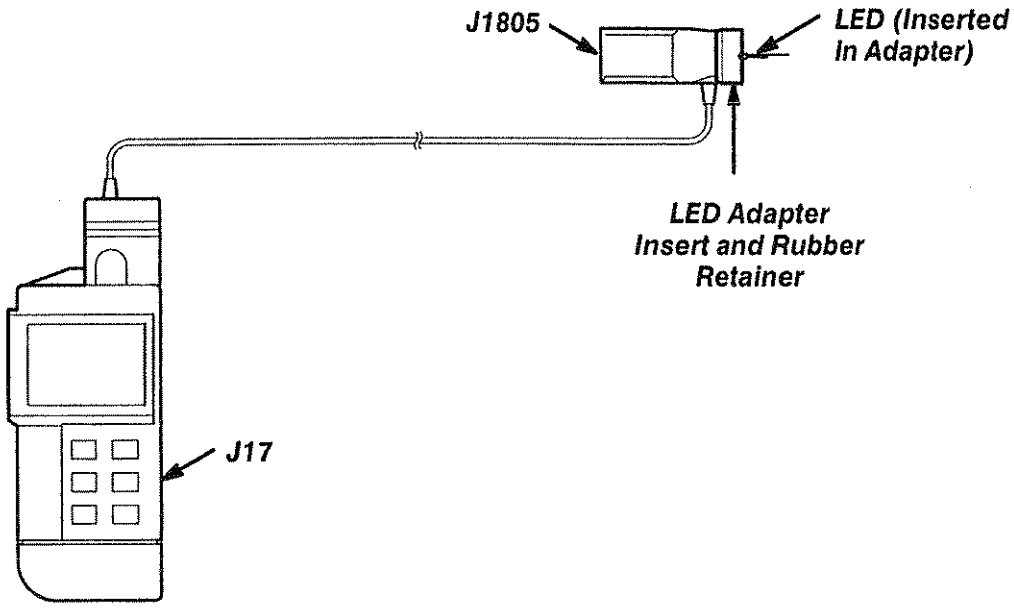


Figure 3-4: Setup for LED Luminous Intensity Measurements

To take LED luminous intensity measurements using the J17 and the J1805 head:

☐ **Step 1:** Select the correct LED insert for the size of your LED, and secure it to the J1805 using the rubber retainer.

Remember that each LED insert has a recessed side. For correct spacing between the LED emitting plane and the J1805 sensor, be sure the correct opening faces out from the J1805. (For details, see *Using the LED Adapter Inserts,* on page 3-7.)

☐ **Step 2:** Press the **COLOR** button on the J17 to select the appropriate color correction factor for the LED you are measuring. The J17 will step through white, red, yellow, green, and blue sequentially each time you press the **COLOR** button.

☐ **Step 3:** Position the J1805 head over the LED.

Selecting a color correction factor maximizes the accuracy of the luminous intensity measurement for a narrow-band light source.

☐ **Step 4:** Read the luminous intensity value from the J17 display. The readout is updated continuously.

Special Considerations

For accurate measurements, observe the following when positioning the J1805 head for LED measurements:

- Use the correct emitting plane-to-sensor distance for the LED under test.
- Seat the LED adapter flat against the LED flange.

- It is best to measure LEDs in subdued light to avoid errors caused by ambient light. To verify that there is no error due to ambient light, turn off the LED and check that the reading is near zero.

  If ambient light is unavoidable, take measurements with the LED off and with the LED on, and subtract the "off" reading from the "on" reading.

- Operate the LED at its recommended current, using a current-regulated power supply if possible.

Using the J1806 Radiance/Radiant Intensity Head

This section describes the operating characteristics of the J1806 Radiance/Radiant Intensity Head, and provides instructions for two typical applications:

- surface radiance measurements
- CRT display color balance

Operating Characteristics

The J1806 and J17 continuously read the light level under test. To hold a reading at any time, press the **HOLD** button on the J17. The last reading displayed prior to pressing the **HOLD** button will be displayed indefinitely. Press the **HOLD** button again to cause the J17 to resume displaying updated readings.

Acceptance Angle

For surface radiance and display measurements, the J1806 field of view must be completely and uniformly filled.

The J1806 head has an acceptance angle (or cone of acceptance) of approximately eight degrees. This corresponds to a 1.7-inch diameter circle at a distance of one foot from the sensor. The diameter measured is proportionally greater as distance increases; for example it is approximately 17 inches at 10 feet from the sensor.

As long as the entire acceptance angle is uniformly filled by the light source, the sensor-to-surface distance is not critical, and the reading will be the same regardless of distance. The area viewed increases proportionally with the square of the distance, thus compensating exactly for the decrease of light that occurs proportionally with the square of the distance.

The extremes to which the distance may be changed without affecting the reading are limited by reflections, shadowing, small area non-uniformity of the surface when the head is close to the surface, and by the acceptance angle's exceeding the size of the emitting area at longer distances. CRT displays usually suffer from a decrease in light output toward the edges and corners of the screen, which also limits the maximum measurement distance.

The minimum viewing diameter of the J1806, using the suction cup in contact with the surface to be measured, is approximately 0.5 inches.

Measurement Units

The J1806 and J17 provide readings in watts/meter^2/steradian for surface radiance measurements in the range of 450 to 750 nm. The steradian (sr) symbol appears below the W/m^2 line on the display.

Surface Radiance Measurements

The J17 Photometer and J1806 head can be used to measure surface radiance.

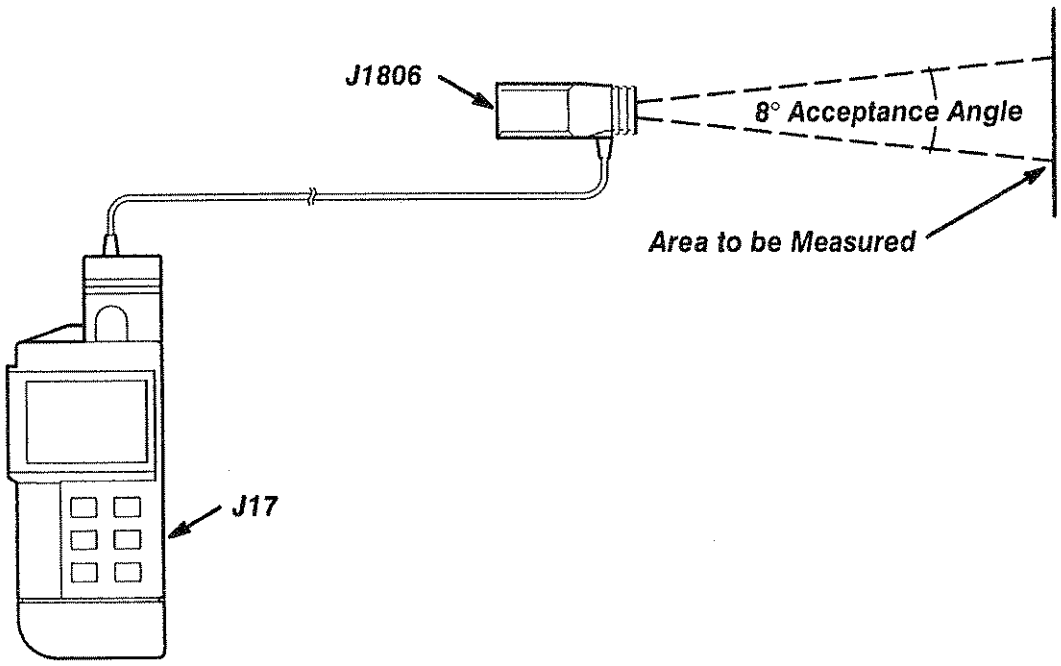


Figure 3-5: Setup for Surface Radiance Measurements

To take surface radiance measurements using the J17 and the J1806 head:

☐ **Step 1:** Position the J1806 so that its acceptance angle is within the surface to be measured. If the surface is illuminated from the same direction that you are taking the measurement from, use care to avoid shadowing the surface.

☐ **Step 2:** Read the radiance value from the J17 display. The units will be watts/meter^2/steradian. Be sure to observe the units prefix, such as milli (m), micro (μ), or nano (n).

Special Considerations

For accurate measurements, observe the following when positioning the J1806 head for measurements of illuminated surfaces:

- Make sure that the area being viewed by the J1806 is uniformly illuminated, and that the entire field of view of the J1806 is filled by the surface you are measuring.
- Position the J1806 so that it does not shadow the surface being measured. Shadowing may occur if the surface is being measured from direction of the illumination.
- Operating the head in contact with the surface is not recommended, because reflections may occur between the front surface of the head and the surface to be measured. Placement of the head too close to the surface may also cause shadowing.

  The suction cup provides adequate spacing between the head and the surface to prevent reflection on backlighted surfaces.

Use the rubber retainer to secure narrow-band or neutral density filters, diffusers, or apertures to the J1806 for special requirements.

CRT Display Color Balance

The J17 Photometer and J1806 head can be used to adjust the color balance of CRT monitors.

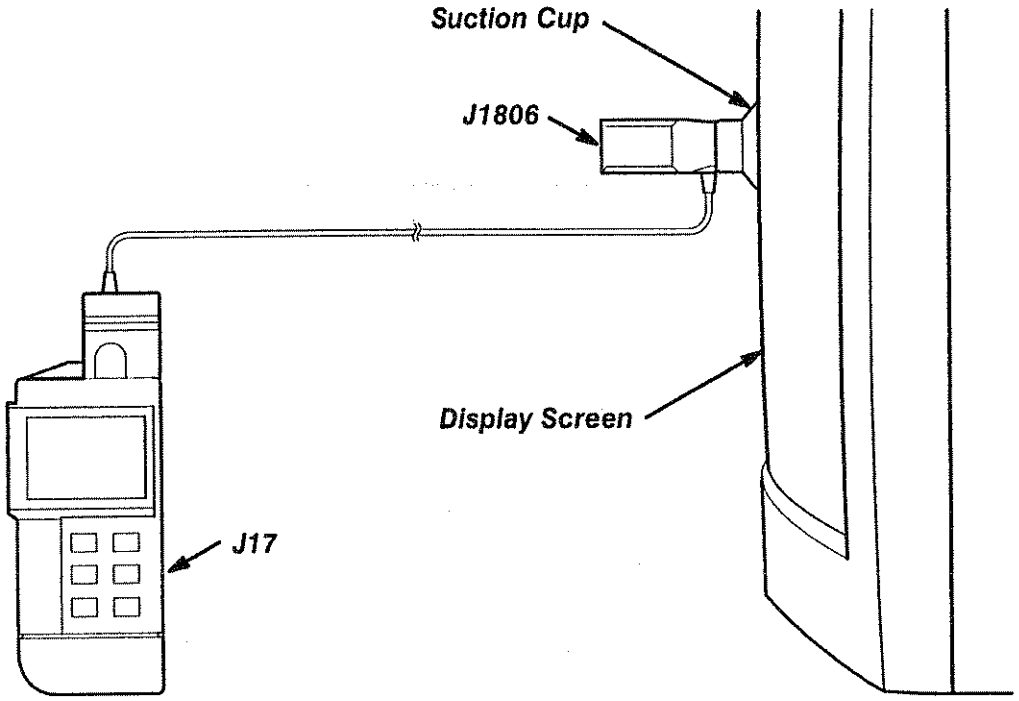


Figure 3-6: Setup for CRT Display Color Balance

To adjust the color balance of a CRT display using the J17 and the J1806 head:

- ☐ **Step 1:** Use a display that has been adjusted to the desired color temperature and color balance (using a J17 and J1820 or other means). This will provide the reference data for future adjustments.
- ☐ **Step 2:** Attach the suction cup to the J1806 and position the J1806 head on the monitor in the center of the pattern.

☐ **Step 3:** Display a white field or window pattern at 100 IRE units using a video signal generator.

A color bar pattern may also be used for less stringent requirements. If color bars are used, ignore the steps of turning the generator drive on and off, and merely position the J1806 over the center of the bar of the specified color.

☐ **Step 4:** Turn off the generator green and blue drive for a red pattern.

☐ **Step 5:** With the J1806 in the center of the red pattern, read and record the radiance value from the J17 display. This value will be used to reestablish exactly the same white field in the future for this or other similar displays.

☐ **Step 6:** Repeat steps 3 through 5 for green and blue patterns.

☐ **Step 7:** Repeat steps 3 through 6 for a drive level of 10 IRE units. This is to ensure correct color tracking at both high and low drive levels.

☐ **Step 8:** Use the data previously obtained at 10 IRE units to set the display SCREEN or BIAS controls for the same value for each color.

☐ **Step 9:** When all three drive signals are applied to the display, the displayed white field should accurately duplicate the original white used for the reference. Note that there may be some interaction between adjustments, especially in lower-cost displays.

Special Considerations

For accurate measurements, observe the following when using the J1806 head to balance CRT display color:

- Different manufacturers may use other names for the controls used to set the high and low drive levels of the display. Consult the operator manual for the controls for a particular display.
- Avoid excessive ambient light. Ambient light may particularly affect the low drive reading. The rubber suction cup for the J1806 will help reduce the light reaching the measurement area, but light scattered by the phosphor may still cause offsets. If in doubt, turn off all video drive and verify that the J17 indicates near zero.
- Allow adequate warmup time for the CRT cathodes to stabilize before making measurements or adjustments.

Using the J1811 Illuminance Head

This section describes the operating characteristics of the J1811 Illuminance Head, and provides instructions for using the J1811 to measure illuminance and luminous intensity.

Operating Characteristics

The J1811 provides constantly updated illuminance readings.

To prevent the display from updating, press the **HOLD** button on the J17. The display will remain steady until you press **HOLD** again.

Measurement Units

The J17 Photometer provides illuminance readings in lux (lm/m^2) or foot candles. The default units at power-on are lux; to convert the readings to foot candles, press the **UNITS** button on the J17. The units will revert to lux when you press the **UNITS** button a second time, or when you turn the J17 off and on again.

Luminous intensity in candelas may be obtained by multiplying the illuminance reading by the square of the distance. Measure the distance in meters for readings in lux; measure distance in feet for readings in footcandles.

Illuminance Measurements

The J17 Photometer and J1811 head can be used to measure illuminance for applications including office, roadway, safety, and transportation lighting.

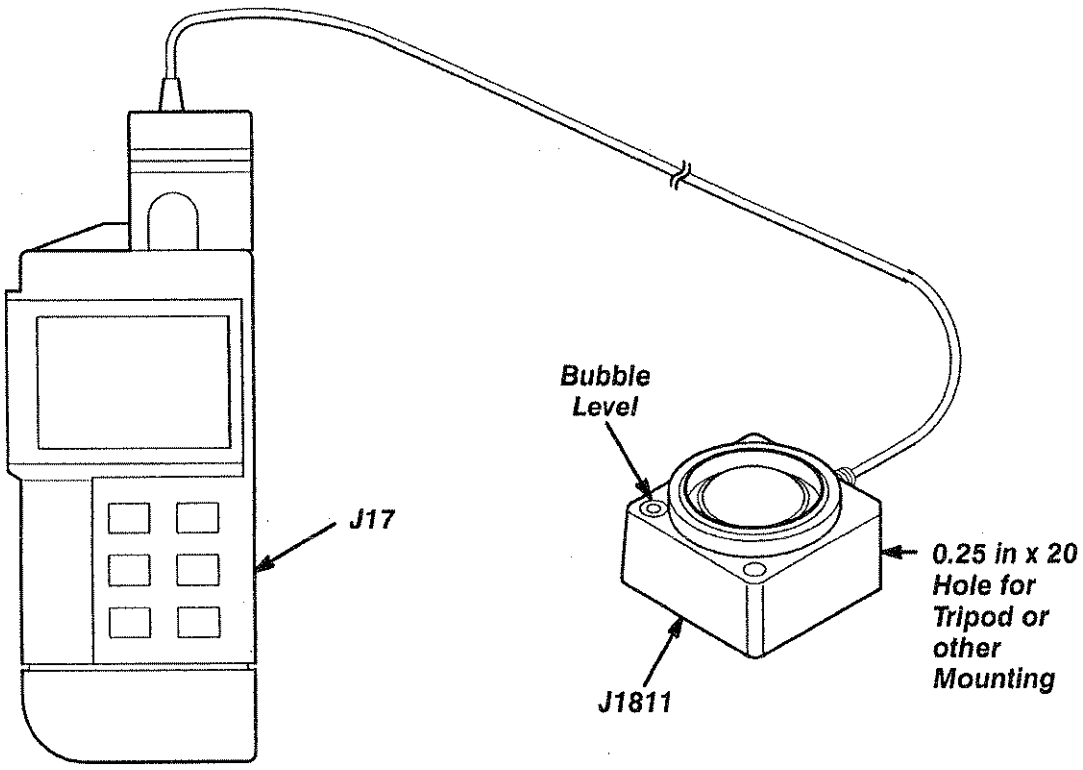


Figure 3-7: Setup for Illuminance Measurements

To take illuminance measurements using the J17 and the J1811 head:

☐ **Step 1:** Position the J1811 on the surface to be measured.

For applications where a significant proportion of the illumination is at extreme angles to the surface, use the small bubble level located on the corner of the J1811 head to determine whether the J1811 is level. Roadway illumination between luminaires is an example of an application where leveling the J1811 is recommended.

NOTE

The self-test that the J17 performs at power-on will proceed more quickly if the sensor head is covered before you turn on the J17.

☐ **Step 2:** Move away from the J1811 head to avoid shadowing it. The J1811 has a 72-inch cable to allow separation between the observer and the measurement location.

☐ **Step 3:** Read the illuminance value from the J17 display. The illuminance value is updated continuously.

The readings will be displayed in lux by default. To obtain readings in foot candles, press the **UNITS** button on the J17. (The units will revert to lux when the J17 is turned off and on again, or when you press the **UNITS** button again.)

Special Considerations

Observe the following guidelines when working with the J1811 Illuminance Head:

- Keep the plastic domed cosine corrector clean and free of scratches. It may be cleaned with a soft cloth and isopropyl alcohol.

- When light is received from many directions simultaneously, take special care to avoid shadowing the sensor with the body.
- Avoid flexing the cable excessively at the strain relief bushings at either end of the cable.

Using the J1812 Irradiance Head

This section describes the operating characteristics of the J1812 Irradiance Head, and provides instructions for using the J1812 to make irradiance, power, and radiant intensity measurements.

Operating Characteristics

The J1812 provides constantly updated irradiance or power readings.

To prevent the display from updating, press the **HOLD** button on the J17. The display will remain steady until you press **HOLD** again.

Measurement Units

The J17 Photometer provides irradiance readings in milliwatts/meter^2 or microwatts/meter^2. It also measures power in milliwatts or microwatts. Radiant intensity in milliwatts/meter^2 or microwatts/meter^2 may be obtained by a simple calculation.

The default units at power-on are for irradiance; to display power readings, press the **UNITS** button on the J17.

Irradiance Measurements

The J17 Photometer and J1812 head can be used to measure irradiance in the visible and near-infrared portion of the spectrum, and output of LEDs and low-average-power lasers.

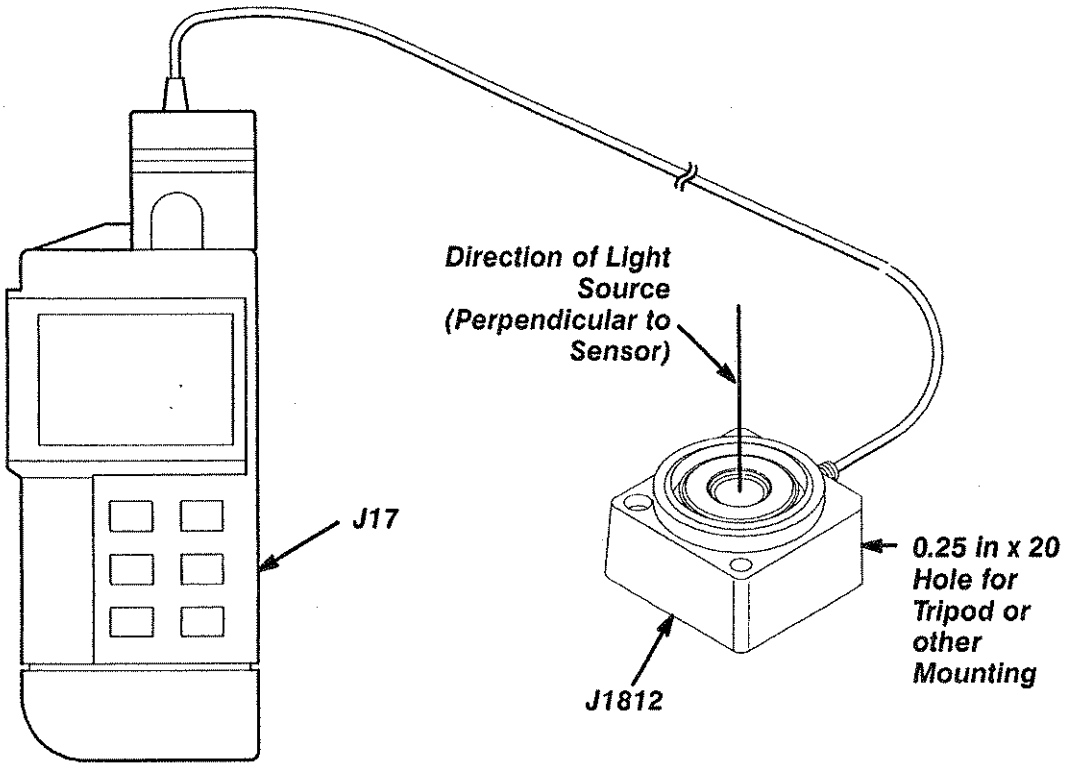


Figure 3-8: Setup for Irradiance Measurements

To take irradiance measurements using the J17 and the J1812 head:

☐ **Step 1:** Position the J1812 perpendicular to the light source.

NOTE

The self-test that the J17 performs at power-on will proceed more quickly if the sensor head is covered before you turn on the J17.

☐ **Step 2:** If light is being received from a wide angle, move away from the J1812 head to avoid shadowing it. The J1812 has a 48-inch cable to allow separation between the observer and the measurement location.

☐ **Step 3:** Read the irradiance value from the J17 display. The irradiance value is updated continuously.

The readings will be displayed in milliwatts/meter^2 or microwatts/meter^2 by default. To obtain readings in milliwatts or microwatts, press the **UNITS** button on the J17. (The units will revert to milliwatts/meter^2 or microwatts/meter^2 when the J17 is turned off and on again, or when you press the **UNITS** button again.)

Laser Measurements

The J17 Photometer and J1812 head can be used to measure low-power laser output by underfilling the sensor with the laser beam.

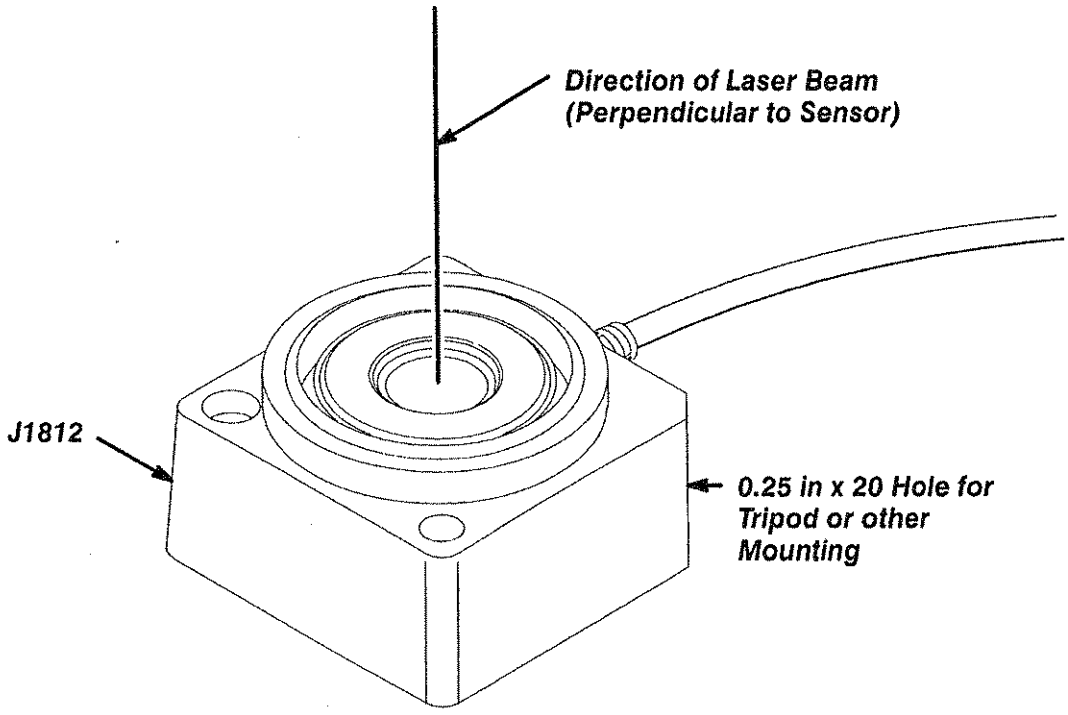


Figure 3-9: Setup for Laser Measurements

To take laser measurements using the J17 and the J1812 head:

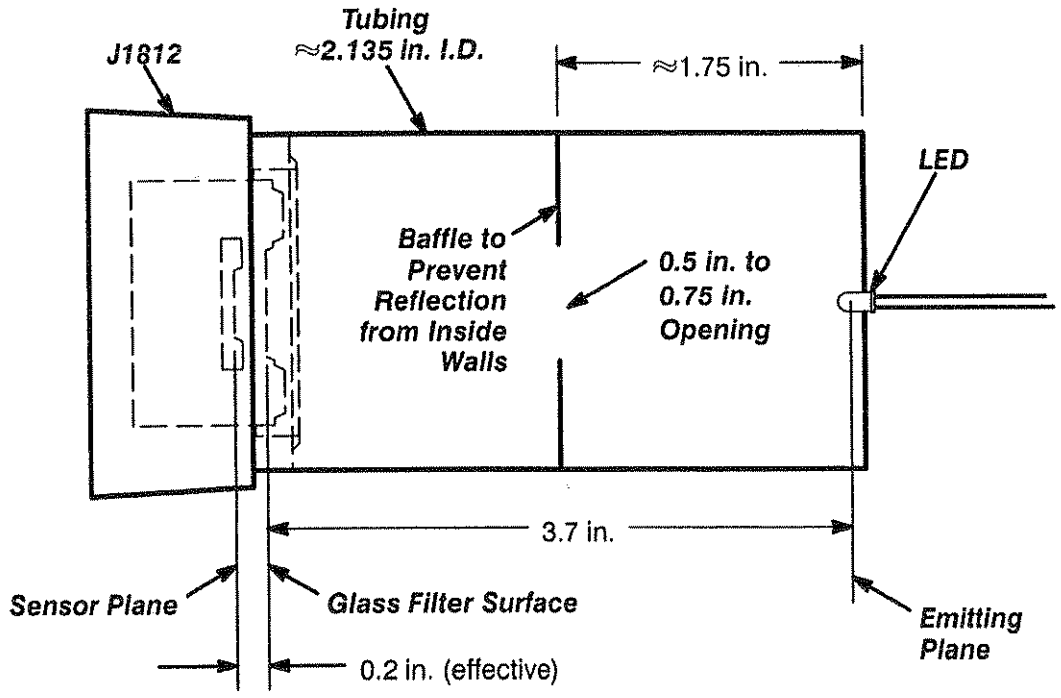
- ☐ **Step 1:** Position the J1812 perpendicular to the laser beam.
- ☐ **Step 2:** Press the **UNITS** button on the J17 to select milliwatts or microwatts.

☐ **Step 3:** Select the correction factor for the device under test using the **COLOR** button on the J17. For example, select red for HeNe lasers. For near-infrared devices, use the white correction factor, which has the best overall accuracy.

☐ **Step 4:** Read the power level from the J17 display. The power reading is updated continuously.

LED Measurements

The J17 Photometer and J1812 head can also be used to measure the output power or radiant intensity of light emitting diodes or other small lamps.



Material: Delrin or aluminum, are preferable. Cardboard may be used. Paint all surfaces ultra-flat black (Krylon 1602)

Figure 3-10: Fixture for LED Measurements

To measure LED output power or radiant intensity using the J17 and the J1812 head:

☐ **Step 1:** Set the distance from the plane of the LED under test to the front glass surface of the J1812 sensor at 3.7 inches. A simple fixture, such as the one shown in Figure 3-10, will help to establish repeatable geometry and exclude ambient light.

☐ **Step 2:** Press the **UNITS** button on the J17 to select units of power (milliwatts or microwatts).

☐ **Step 3:** Select the correction factor for the LED under test using the **COLOR** button on the J17. For example, select red for red LEDs. For infrared LEDs, use the white correction factor for best overall accuracy.

☐ **Step 4:** Read the LED output power from the J17 display. The reading indicates the power within the central 6.5° of the beam.

The radiant intensity, in watts/steradian, of the LED can be computed by multiplying the reading by 100, while being sure to include the units prefix (micro or milli) from the reading.

Special Considerations

Observe the following guidelines when working with the J1812 Irradiance Head:

- Be sure the light to be measured is within the 450 to 950 nanometer region.
- When measuring narrow-band light sources, press the **COLOR** button on the J17 to select the proper correction factor to maximize accuracy.
- When measuring irradiance, the entire sensor (1 cm^2) should be illuminated.

- When measuring power, the sensor should be underfilled, as with a laser beam.
- Minimize stray ambient illumination, which may cause abnormally high readings.

Using the J1820 Chromaticity Head

This section describes the operating characteristics of the J1820 Chromaticity Head, and provides instructions for typical applications:

- display chromaticity measurements
- diffuse light source chromaticity measurements
- chromaticity measurements of illuminated surfaces

Operating Characteristics

The J1820 reads chromaticity in either the 1931 CIE system or the 1976 CIE-UCS system. The XYZ tristimulus values, as read by the J1820's XYZ sensors, are used to compute the chromaticity.

Chromaticity measurements are not updated continuously. To initiate a chromaticity measurement, you press the **START** button on the J17. The measurement cycle may take several seconds to complete, depending on the light level and on the last measurement taken.

NOTE

Hold the J1820 steady relative to the area being measured during the measurement cycle (several seconds). To ensure accuracy, repeat readings to verify that the J17 and light source are properly settled.

Acceptance Angle and Measurement Field

For accurate measurements, you must position the head so that its entire measurement field is uniformly filled by the surface to be measured.

The J1820 chromaticity head has an acceptance angle of 16 degrees. This means that the measurement field of the J1820 is approximately 3.4 inches in diameter at a distance of 1 foot, and is proportionately larger at greater distances (34 inches at 10 feet).

The minimum viewing diameter of the J1820, using the light shield or suction cup in contact with the surface to be measured, is approximately 1.0 inches.

Measurement Units

The J17 Photometer provides chromaticity readings in either the 1931 CIE system or the 1976 CIE-UCS system. The XYZ tristimulus values, as read by the J1820's XYZ sensors, are used to compute the chromaticity.

By default, the J17 displays chromaticity readings in the 1931 CIE system (x, y). To convert the readings to the 1976 CIE-UCS system (u′, v′), press the **UNITS** button on the J17. Readings revert to their default units at power-on, or when you press the **UNITS** button again.

Appendix D, *Chromaticity Reference*, contains diagrams that can be used to interpret chromaticity readings.

Selecting the Luminance and XYZ Values

To display the luminance value, press **ALT DISPLAY** on the J17. The luminance value will initially be displayed in cd/m^2, regardless of the units selected for chromaticity readings. To convert the reading to foot-lamberts, press the J17's **UNITS** button. Readings revert to their default units at power-on, or when you press the **UNITS** button again.

To display the XYZ tristimulus values, press **ALT DISPLAY** a second time. The X and Y tristimulus values will be displayed, with the X value on the first readout line, and the Y value on the second. To view the Z value, press the **UNITS** button.

To return to the chromaticity display, press **ALT DISPLAY** again.

Display Chromaticity Measurements

The J17 Photometer and J1820 head can be used to measure chromaticity and luminance of display monitors.

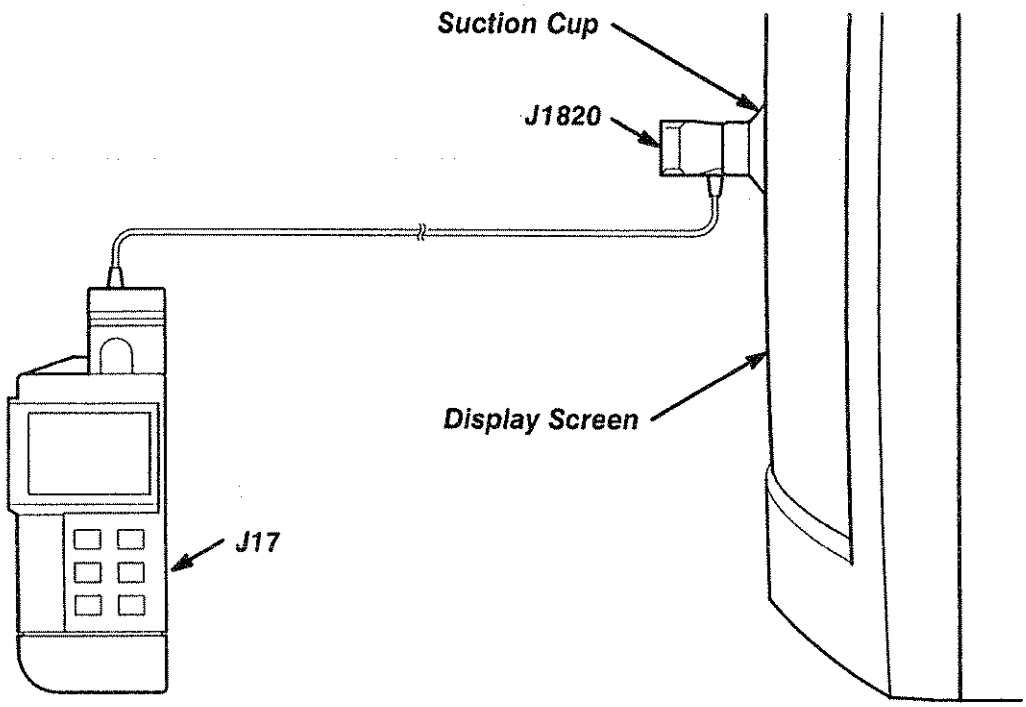


Figure 3-11: Setup for Display Chromaticity Measurements

To take display measurements using the J17 and the J1820 head:

☐ **Step 1:** Connect the J1820 head to the J17, then turn the J17 power on.

NOTE

Always connect the sensor head to the J17 before turning on the power. The J17 loads data from the sensor head at power-on. If you connect a new sensor head to the J17 while the power is on, any measurements you take may be inaccurate.

☐ **Step 2:** Attach the suction cup to the J1820 head, and position the J1820 on the display.

☐ **Step 3:** Press the **START** button on the J17 to initiate a chromaticity reading.

The chromaticity coordinates are displayed as x,y (in the 1931 CIE system) by default. To view the coordinates in u′, v′ (1976 CIE-UCS system), press the J17's **UNITS** button once.

☐ **Step 4:** To read the luminance value, press **ALT DISP** once.

The luminance value is displayed in cd/m^2 (NITS) by default. To view luminance in foot-lamberts, press the J17's **UNITS** button once.

☐ **Step 5:** For best accuracy, repeat the measurement to ensure that the display under test has remained stable.

Light Source Measurements

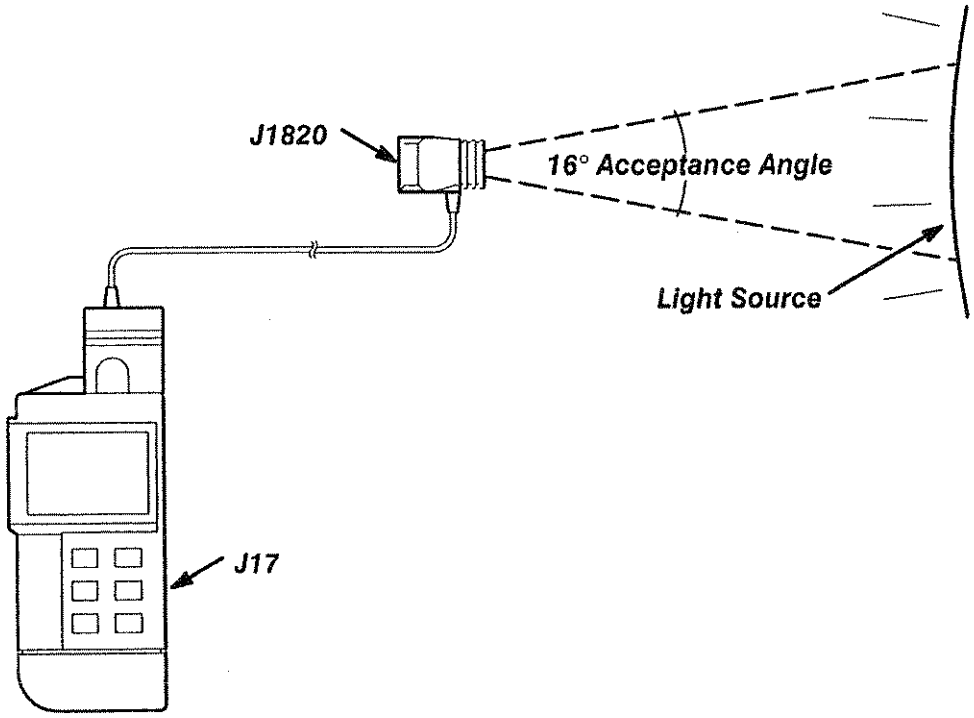


Figure 3-12: Setup for Light Source Measurements

To take light source measurements using the J17 and the J1820 head:

☐ **Step 1:** Connect the J1820 head to the J17, then turn the J17 power on.

NOTE

Always connect the sensor head to the J17 before turning on the power. The J17 loads data from the sensor head at power-on. If you connect a new sensor head to the J17 while the power is on, any measurements you take may be inaccurate.

☐ **Step 2:** Point the J1820 toward the light source, choosing a distance to ensure that the entire field of view is filled by the light source. (The acceptance angle of the J1820 is 16 degrees. See *Operating Characteristics*, on page 3-33.)

☐ **Step 3:** Press the **START** button on the J17 to initiate a chromaticity reading.

NOTE

Hold the J1820 head steady relative to the area being measured during the measurement cycle (several seconds).

The chromaticity coordinates are displayed as x, y (in the 1931 CIE system) by default. To view the coordinates in u′, v′ (1976 CIE-UCS system), press the J17's **UNITS** button once.

☐ **Step 4:** To read the luminance value, press **ALT DISP** once.

The luminance value is displayed in cd/m^2 by default. To view luminance in foot-lamberts, press the J17's **UNITS** button once.

☐ **Step 5:** For best accuracy, repeat the measurement to ensure that the device under test has remained stable.

Chromaticity Measurement of an Illuminated Surface

The J1820 head can be used with the J17 Photometer to measure the chromaticity of light reflected from signs, walls, work surfaces, and other surfaces. This method is also useful for measuring light boxes.

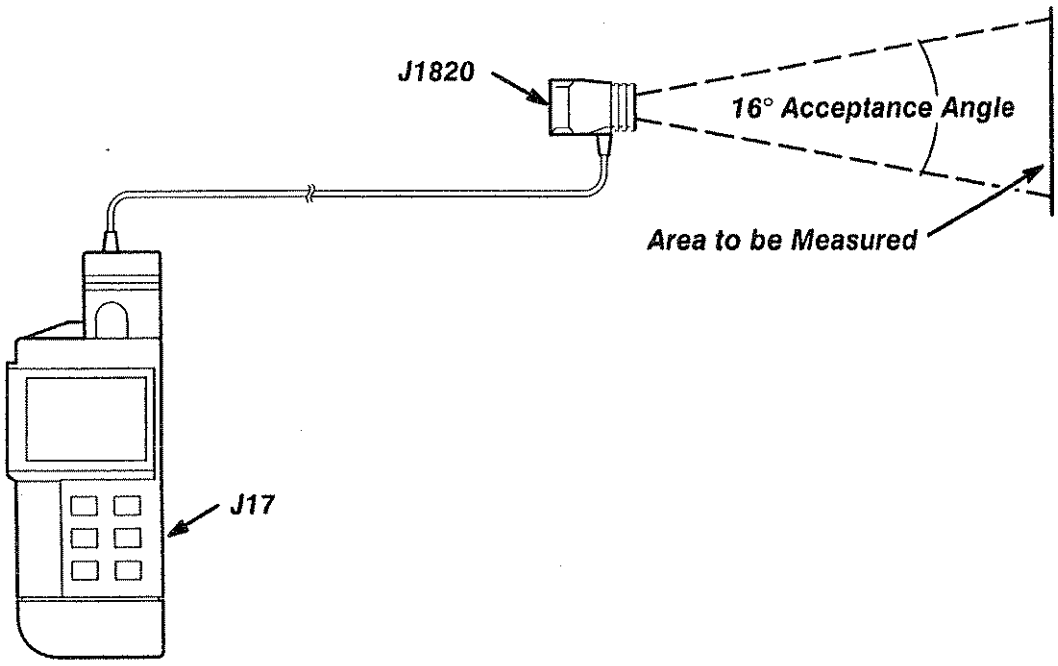


Figure 3-13: Setup for Chromaticity Measurement of an Illuminated Surface

To take chromaticity measurements from an illuminated surface using the J17 and the J1820 head:

☐ **Step 1:** Connect the J1820 head to the J17, then turn the J17 power on.

NOTE

Always connect the sensor head to the J17 before turning on the power. The J17 loads data from the sensor head at power-on. If you connect a new sensor head to the J17 while the power is on, any measurements you take may be inaccurate.

☐ **Step 2:** Point the J1820 head at the surface to be measured, at the desired distance from the surface.

NOTE

For accurate readings, position the J1820 so that the entire measurement field is uniformly filled by the surface to be measured. The acceptance angle of the J1820 head is 16 degrees. See Operating Characteristics, *on page 3-33.*

☐ **Step 3:** Press the **START** button on the J17 to initiate a chromaticity reading.

The chromaticity coordinates are displayed as x, y (in the 1931 CIE system) by default. To view the coordinates in u′, v′ (1976 CIE-UCS system), press the J17's **UNITS** button once.

☐ **Step 4:** To read the luminance value, press **ALT DISP** once.

The luminance value is displayed in cd/m^2 by default. To view luminance in foot-lamberts, press the J17's **UNITS** button once.

☐ **Step 5:** For best accuracy, repeat the measurement to ensure that the light source under test has remained stable.

Special Considerations

For accurate measurements, observe the following when positioning the J1820 head for measurements of illuminated surfaces:

- Make sure that the area being viewed by the J1820 is uniformly illuminated, and that the entire field of view of the J1820 is filled by the surface you are measuring.
- Position the J1820 so that it does not shadow the surface being measured. Shadowing may occur if the surface is being measured from the direction of the illumination.
- Operating the head in contact with the surface is not recommended, because reflections may occur between the front surface of the head and the surface to be measured. Placement of the head too close to the surface may also cause shadowing.

  The suction cup provides adequate spacing between the head and the surface to prevent reflection on backlighted surfaces.

Using the J1823 1° Narrow Angle Luminance Head

This section describes the operating characteristics of the J1823 Luminance Head, and provides instructions for three typical applications:

- display luminance measurements
- luminance measurements of illuminated surfaces
- light source measurements

Operating Characteristics

The J1823 reads luminance in foot-lambert units and candelas per square meter (nits). The probe has a very narrow light-acceptance angle (1° full angle) and can focus over the range from 18 inches (50 cm) to infinity. The addition of a closeup lens (commercially available) to the J1823 allows focusing closer than 18 inches.

The J1823 is also available with a 1/3° measurement angle as a standard option. Combining the narrower measurement angle with closeup lenses enables the J1823 to make precise measurements of very small areas.

The J1823 provides constantly updated luminance readings. To stop the display from updating, press the **HOLD** button on the J17. The display will remain steady until you press **HOLD** again.

Viewing Angle and Measurement Angle

The sighting system of the J1823 permits a viewing angle of 9° with the measurement area marked by a black dot. The approximate size of the view and measurement diameters can be determined by figure 3-14.

This chart shows the relative diameters of 1/3°, 1°, and 9° angles at various ranges in feet.

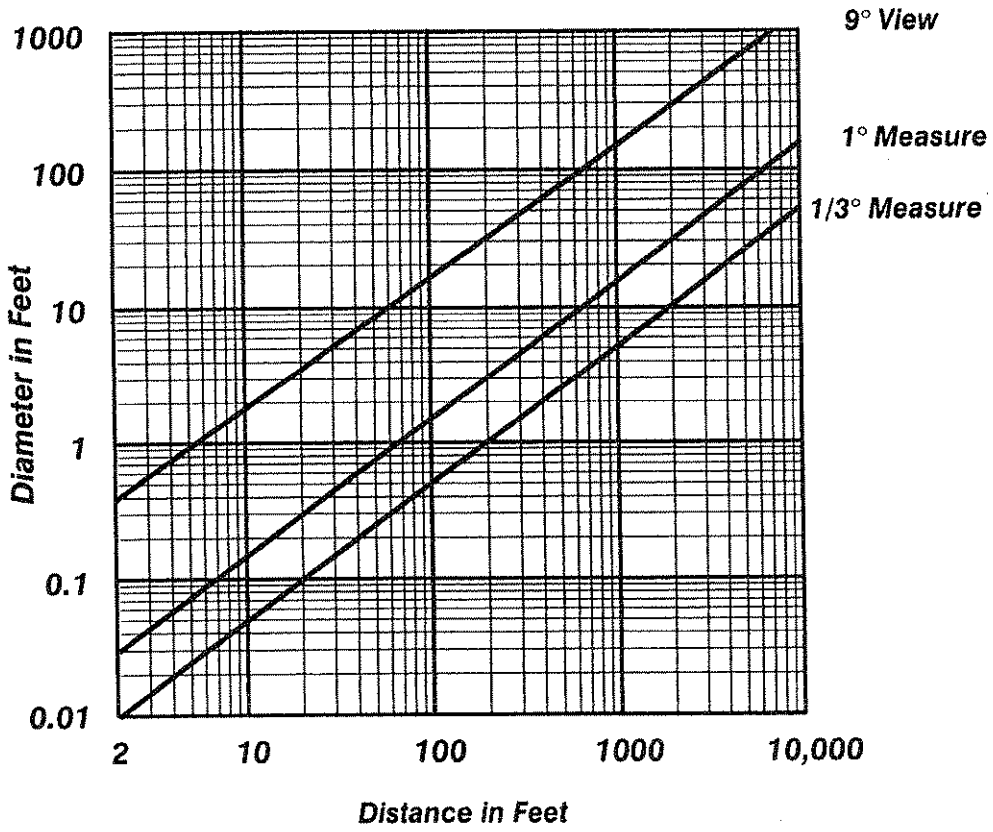


Figure 3-14: View and Measurement Diameters for J1823

The standard J1823 head has a measurement angle (or cone of acceptance) of one degree. This corresponds to a 2.09-inch diameter circle at a distance of

ten feet from the sensor. The diameter measured is proportionally greater as distance increases; for example, it is approximately 20.9 inches at 100 feet from the sensor.

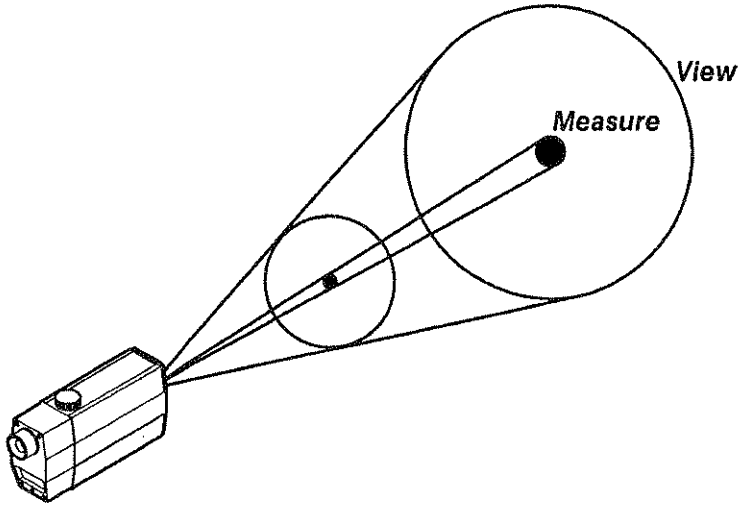


Figure 3-15: Viewing and Measurement Angles

The sensor-to-surface distance is not critical as long as the entire measurement angle is uniformly filled by the light source, and the reading will be the same regardless of distance. The area viewed increases proportionally with the square of the distance, thus compensating exactly for the decrease of light that occurs proportionally with the square of the distance.

For surface luminance and display measurements, the J1823's measurement field must be completely and uniformly filled.

The extremes to which the distance may be changed without affecting the reading are limited by reflections, shadowing, small area non-uniformity of the surface when the head is close to the surface, and by the acceptance angle exceeding the size of the emitting area at longer distances. CRT displays

usually suffer from a decrease in light output toward the edges and corners of the screen, which also limits the maximum measurement distance.

Measurement Units

The J17 Photometer will provide luminance readings in either cd/m^2 (NITS) or foot-lamberts. The default is cd/m^2. To view readings in foot-lamberts, press the **UNITS** button on the J17. Readings revert to their default units at power-on.

Focusing

WARNING

Avoid viewing high-intensity light sources (e.g., arc lamps, lasers, the sun, etc.) through the eyepiece of the J1823. Viewing such light sources can result in damage to the eye.

Prior to making a measurement, the J1823 must be focused. The best visual focus (determined by the eye of the individual user) does not always provide correct focus. The preferred method is to adjust the focus until there is no relative motion between the target and the dark spot visible in the J1823 eyepiece when moving the eye slightly from side to side.

Display Luminance Measurements

The J17 Photometer and J1823 head can be used to measure luminance of display monitors (CRT or flat-panel displays).

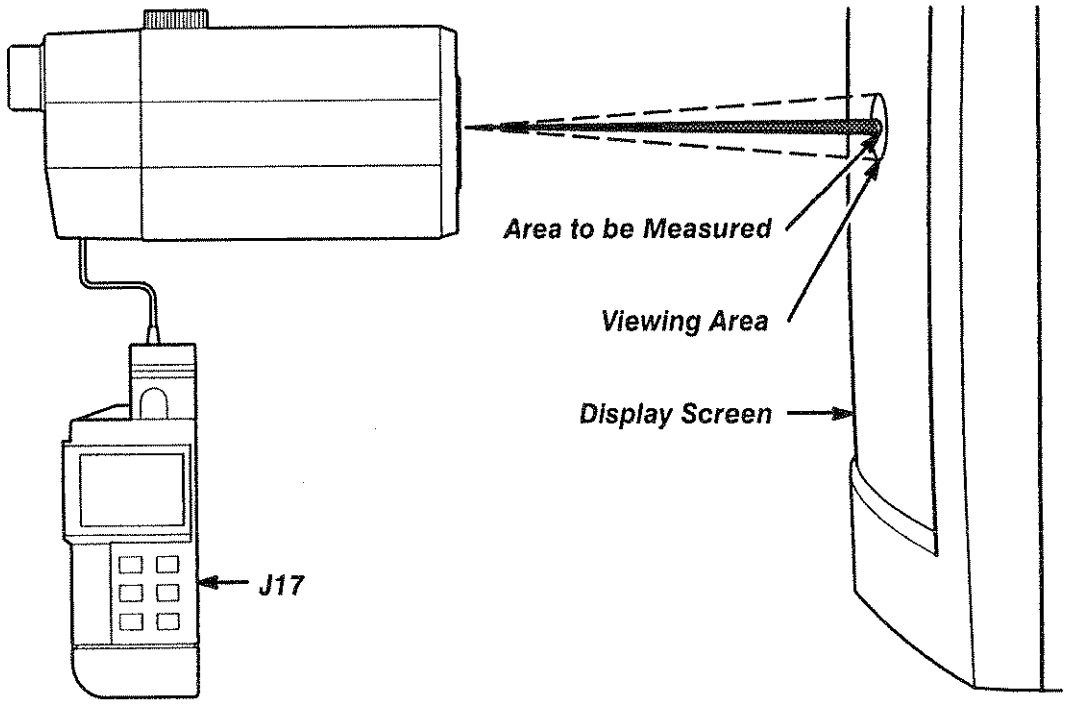


Figure 3-16: Setup for Display Luminance Measurements

NOTE

Always connect the sensor head to the J17 before turning on the power. The J17 loads data from the sensor head at power-on. If you connect a new sensor head to the J17 while the power is on, any measurements you take may be inaccurate.

To take display luminance measurements using the J17 and the J1823 head:

☐ **Step 1:** Turn the monitor on, setting it to its initial brightness and contrast settings.

☐ **Step 2:** Position the J1823 head toward the monitor as shown in Figure 3-16.

NOTE

To eliminate ambient light from the measurement reading, darken the room or shadow the display from the light source.

☐ **Step 3:** Read the luminance value from the J17 display. The luminance value is updated continuously.

Luminance readings will be in cd/m^2 by default. For readings in foot lamberts, press the **UNITS** button.

For maximum accuracy when measuring red, green, or blue fields, select the correction factor for that color using the J17 **COLOR** button.

Luminance Measurement of an Illuminated Surface

The J1823 head can be used with the J17 Photometer to measure the reflectance of light from signs, walls, work surfaces, and other surfaces. This method is also useful for measuring light tables and X-ray viewing boxes.

Special Considerations

For accurate measurements, observe the following when positioning the J1823 head for measurements of illuminated surfaces:

- Make sure that the area being viewed by the J1823 is uniformly illuminated, and that the entire measurement field of the J1823 is filled by the surface you are measuring.
- Position the J1823 so that it does not shadow the surface being measured. Shadowing may occur if the surface is being measured from the direction of the illumination.
- Operating the head in direct contact with the surface is not recommended, because reflections may occur between the front surface of the head and the surface to be measured. Placement of the head too close to the surface may also cause shadowing.

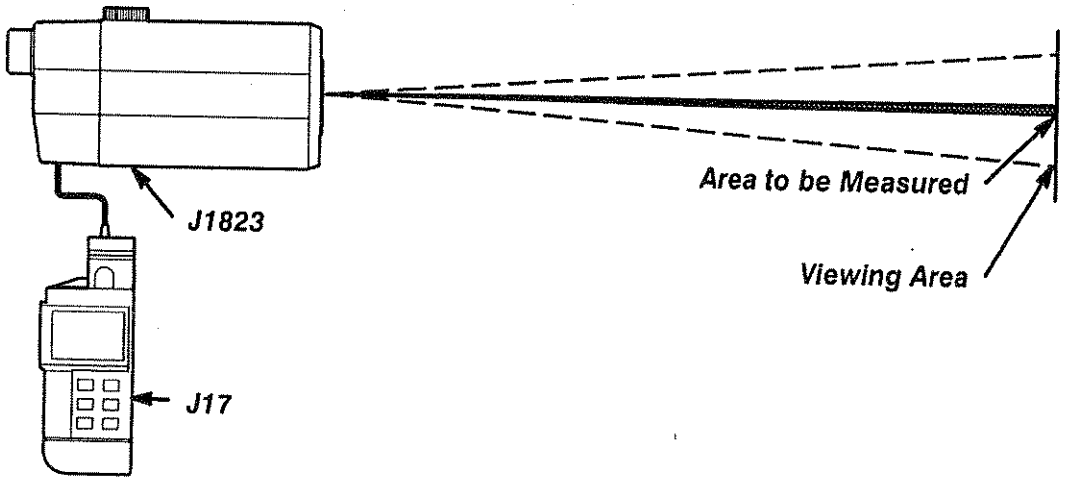


Figure 3-17: Setup for Luminance Measurement of an Illuminated Surface

Figure 3-18 shows the measured spot size versus the lens diopter. The graph was derived using two sets of Hoya close-up lenses containing +1, +2, and +3 diopter lenses each.

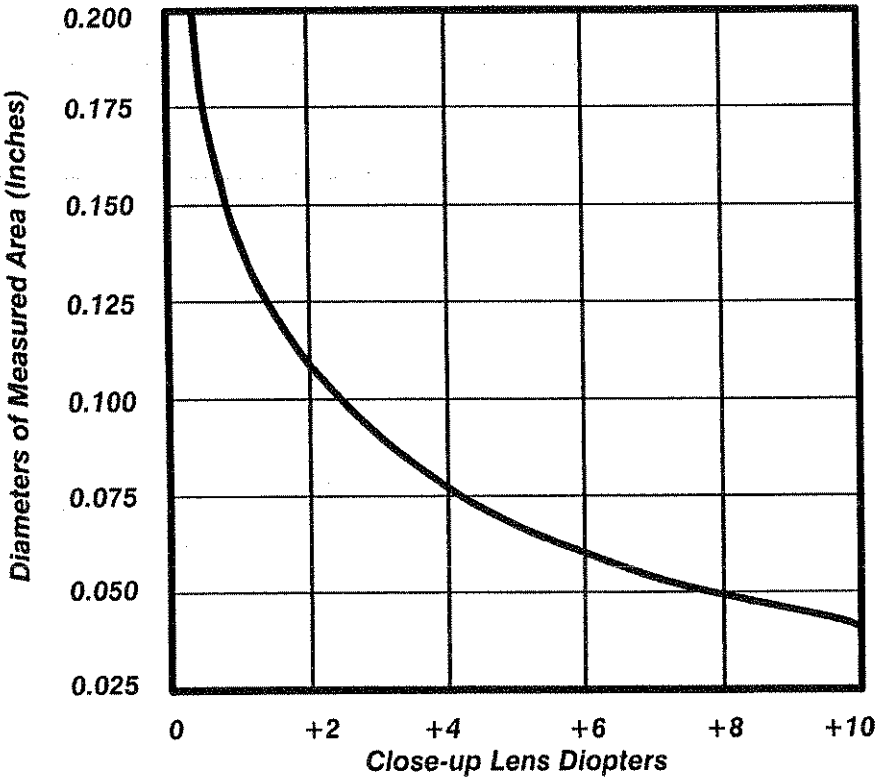


Figure 3-18: Close-Up Lens Diopters Versus Area (1° model)

For maximum magnification, the J1823 focus knob should be fully counterclockwise. The distance from the front of the J1823 to the object being measured is reduced as magnification is increased. With 12 diopters, for example, it would be about three inches. Since the close-up lens affects both the measuring and the viewing system, the eyepiece will still indicate the area being measured.

1/3° Option

The 1/3-degree option provides a narrower measurement angle within the viewing angle. This is useful for precision measurements of small areas such as display pixels or distant areas.

Operation

Operation of the 1/3° model is the same as the 1° model. The dark spot in the viewing area will be smaller to indicate the smaller measurement area.

Because of the smaller measurement area, the sensitivity of the 1/3° model is decreased by a factor of ten. This may require brighter objects or sources for accurate measurement.

Close-Ups

To take maximum advantage of the narrow measurement angle of the 1/3° model, close-up lenses are recommended for measurements of small areas. Although the lenses will slightly reduce the sensitivity of the J1823, they compensate by permitting the user to move much closer to the subject.

The close-up lenses also enlarge the appearance of the subject within the viewing field. This permits measurements of smaller areas to be performed.

Figure 3-19 shows the relationship between the measurement areas and the close-up lenses used. With a high diopter value, very small areas can be accurately measured.

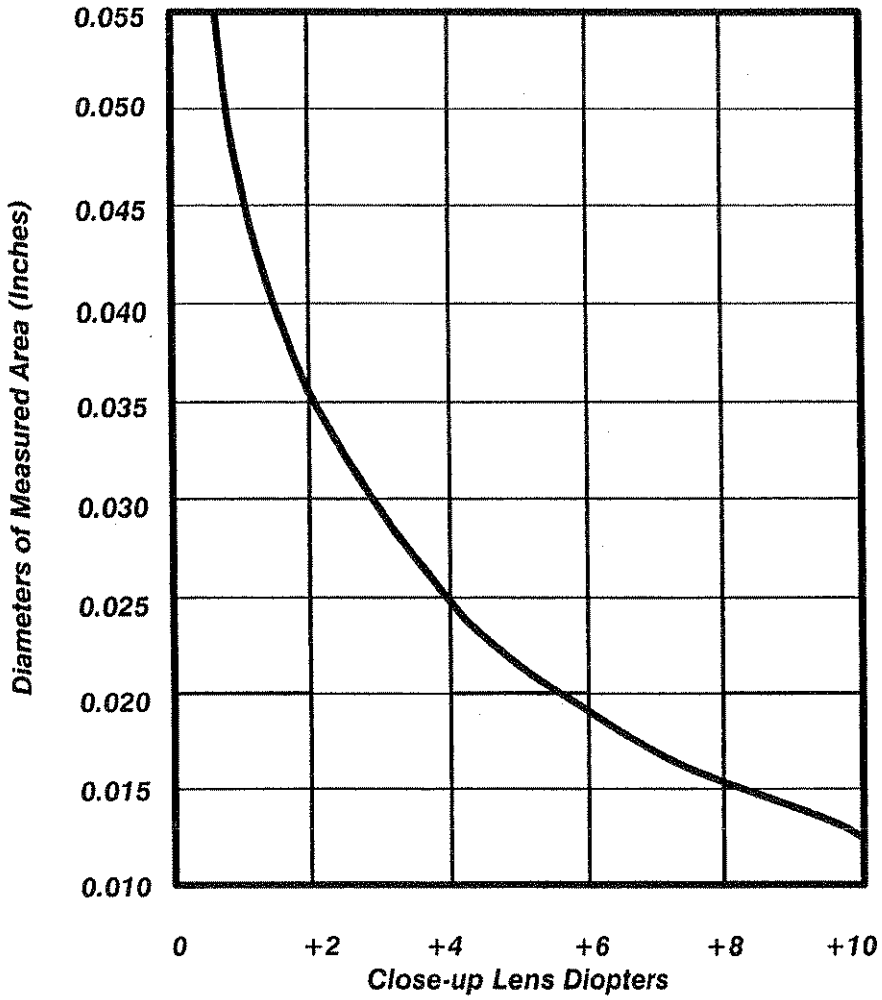


Figure 3-19: Close-Up Lens Diopters Versus Area (1/3° model)

RS-232D Interface

You can use the J17 Photometer's RS-232D port to save measurement readings to a file on a computer, or to perform further computations on the readings. The RS-232D port is a 3.5 mm stereo phone plug.

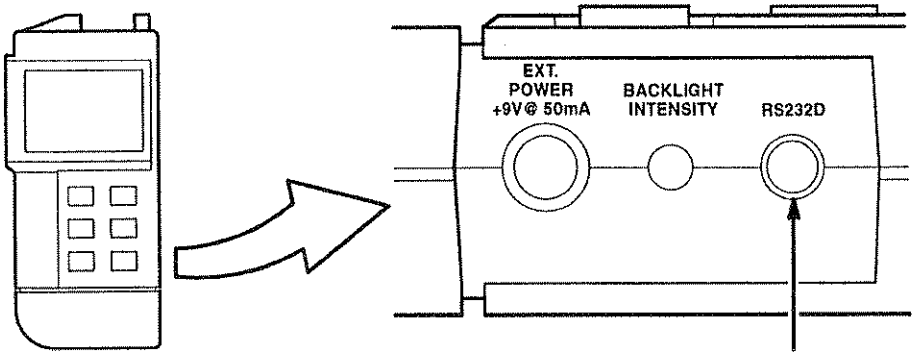


Figure 3-20: Location of the RS-232D Port

An RS-232 cable is available as an optional accessory to the J17 (refer to *Appendix A, Accessories,* for ordering information). This cable has a 3.5 mm connector for the J17, and a DB-9 female connector for connection to the computer. (Another common RS-232 connector on computers is the DB-25 connector. Adapters are commercially available to convert from the DB-9 connector to a DB-25 connector.)

The J17 operates with the RS-232 parameters shown in Table 3-1. The terminal or computer you connect to the J17 must match these parameters in order to communicate by RS-232.

Table 3-1: RS-232 Parameters

Parameter	Value
Baud Rate	2400
Data Bits	8
Stop Bits	1
Data Type	Asynchronous
Operational Mode	Half-duplex (accepts software flow control)

RS-232 Pin Connections

Figure 3-21 shows the pin connections of the J17 RS-232 port and the optional RS-232 cable.

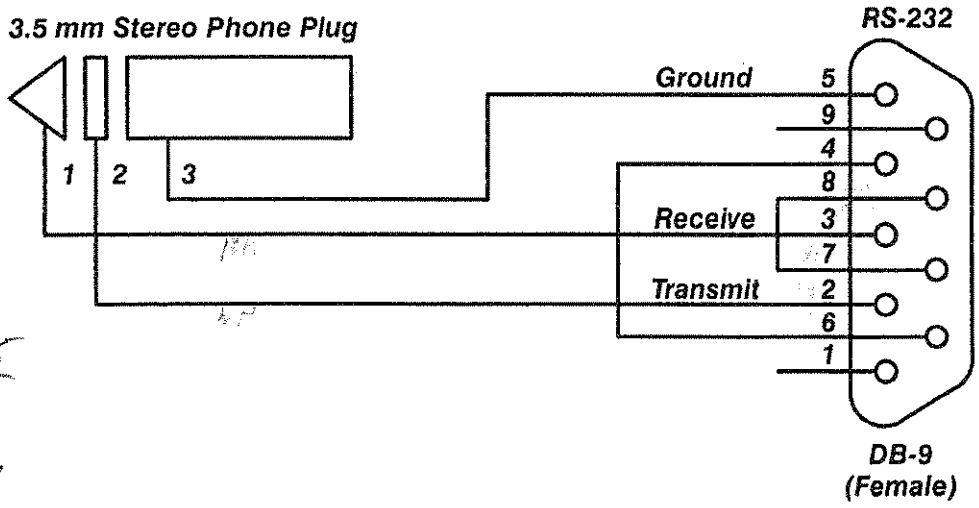


Figure 3-21: RS-232 Pin Connections

Command Set

The J17 Photometer recognizes a single command, NEW, which causes it to report a measurement or a series of measurements.

Table 3-2 summarizes the syntax conventions of the command set.

Table 3-2: Elements of J17 Command Syntax

Symbol	Meaning
!	Begins command. (All commands should be prefaced with an exclamation point.)
{CR}	Carriage return (ASCII 13); recognized as an end-of-command delimiter.
{LF}	Line feed (ASCII 10); also recognized as an end-of-command delimiter.
(white space)	Spaces act as parameter delimiters within commands. The J17 also recognizes commas (,) and tabs as parameter delimiters; any of these three characters may be used interchangeably.
italics	Items in italics are names of parameters. Specify the appropriate value when entering the command.

!NEW — causes the J17 to report a measurement, or a series of measurements:

`!NEW{CR}` causes the J17 to transmit the a single reading (the one currently displayed).

`!NEW` *`size`*`{CR}` causes the J17 to transmit the specified number (sample size) of measurements.

Appendix A: Accessories

This appendix lists the standard and optional accessories available for the J17 and J1800 Series. For detailed information and prices, or to obtain replacements, see a Tektronix products catalog or contact your local Tektronix field representative.

J17 Standard Accessories

The J17 instrument package includes the following standard accessories:

- User manual (this manual), Tektronix part number 070-8531-02
- Alkaline battery, IEC type 6LR61, NEDA type 1604, Tektronix part number 146-0017-00 (shipped installed in J17)

J17 Optional Accessories

In addition to the J1800 Series sensor heads, the following items are available for use with the J17 Photometer:

- External DC power supply, Tektronix part number 119-5032-00
- RS-232D cable, Tektronix part number 012-1411-00

J1803 Standard Accessories

The J1803 instrument package includes the following standard accessories:

- User manual (this manual), Tektronix part number 070-8531-02.
- Light occluder, Tektronix part number 337-1936-00.
- Rubber retainer, Tektronix part number 348-1288-00.
- Rubber suction cup, Tektronix part number 348-1287-00.

J1805 Standard Accessories

The J1805 instrument package includes the following standard accessories:

- User manual (this manual), Tektronix part number 070-8531-02.
- Two 0.120-inch LED adapter inserts, Tektronix part number 103-0326-00
- Two 0.200-inch LED adapter inserts, Tektronix part number 103-0327-00
- Rubber retainer, Tektronix part number 348-1288-00.

J1806 Standard Accessories

The J1806 instrument package includes the following standard accessories:

- User manual (this manual), Tektronix part number 070-8531-02.
- Rubber retainer, Tektronix part number 348-1288-00.
- Rubber suction cup, Tektronix part number 348-1287-00.

J1811 Standard Accessories

The J1811 instrument package includes the following standard accessories:

- User manual (this manual), Tektronix part number 070-8531-02.
- Protective cover, Tektronix part number 200-1644-00.

J1812 Standard Accessories

The J1812 instrument package includes the following standard accessories:

- User manual (this manual), Tektronix part number 070-8531-02.
- Protective cover, Tektronix part number 200-1644-00.

J1820 Standard Accessories

The J1820 instrument package includes the following standard accessories:

- User manual (this manual), Tektronix part number 070-8531-02.
- Rubber suction cup, Tektronix part number 348-1287-00.

J1823 Standard Accessories

The J1823 instrument package includes the following standard accessories:

- User manual (this manual), Tektronix part number 070-8531-02.
- Lens caps,
  Front (Tektronix part number 200–1835–00)
  Rear (Tektronix part number 200–1836–00)

Appendix B: Characteristics

These characteristics are valid under the following conditions:

- The J17 and sensor head must have been calibrated at an ambient temperature between +20°C and +30°C.
- The J17 and sensor head must be used in an environment within the limits described in Table A-1, J17 System Environmental Characteristics.
- The J17 and sensor head must have had a warmup period of at least 10 minutes.

Optical measurements are referred to photometric, radiometric, and colorimetric standards traceable to NIST.

Table A-1: J17 System Environmental Characteristics

Characteristic	Standard
Temperature	
Nonoperating	−55°C to +85°C
Operating	−15°C to +55°C
Humidity, operating and nonoperating	J17 Meets MIL Std 28800E Class 3 Refer to the Environmental Characteristics for each J1800 Series sensor head.
Electrostatic Immunity	Complies with IEC 801−2
Electromagnetic Compatibility	Meets CISPIR 22B, FCC Class A and VDE Class B

J17 Characteristics

Table A-2: J17 Electrical Characteristics

Characteristic	Typical Performance
Power Requirements	
Battery	7 V to 10 V nominal
External Power Supply	9 V to 16 VDC nominal
Battery Life, with IEC 6LR61 9 V battery, backlight off, RS-232 unplugged	30 hours nominal
Battery Low Indication	7.2 V ± 0.2 V typical
Accuracy (Excluding sensor head, including nonlinearity)	1% of reading ± 2 Counts

Table A-3: J17 RS-232 Configuration

Characteristic	Configuration (Nominal)
Interface Standard	EIA RS-232D
Data Bits	8
Stop Bits	1
Operational Mode	Half-duplex
Data Rate	2400 Baud
Data Type	Asynchronous
Control Lines	Receive (tip) used by host computer to initiate read cycle. Transmit (ring) serial data line from J17. Ground (connector shell).

J1803 Characteristics

Table A-4: J1803 Environmental Characteristics

Characteristic	Standard
Temperature	Meets MIL Std 28800E Class 3
Nonoperating	−62°C to +85°C
Operating	−15°C to +55°C
Humidity	48 hours at 97% relative humidity (30°C to 60°C) Modified MIL Std 28800E
Electrostatic Immunity	Complies with IEC 801−2
Electromagnetic Compatibility	Meets CISPIR 22B, FCC Class A and VDE Class B

Table A-5: J1803 Performance Characteristics

Characteristic	Standard
Accuracy (including non-linearity)	5% of reading ± 2 counts (Illuminant A at 150 cd/m^2, 20° C to 30° C, <75% relative humidity)
Spectral Response	See Figure A-1

Table A-6: J1803 Mechanical Characteristics

Characteristic	Standard	
Dimensions (not including suction cup)	Height: 1.4 inches	3.6 cm
	Width: 3.7 inches	9.4 cm
	Length: 7.6 inches	19.3 cm

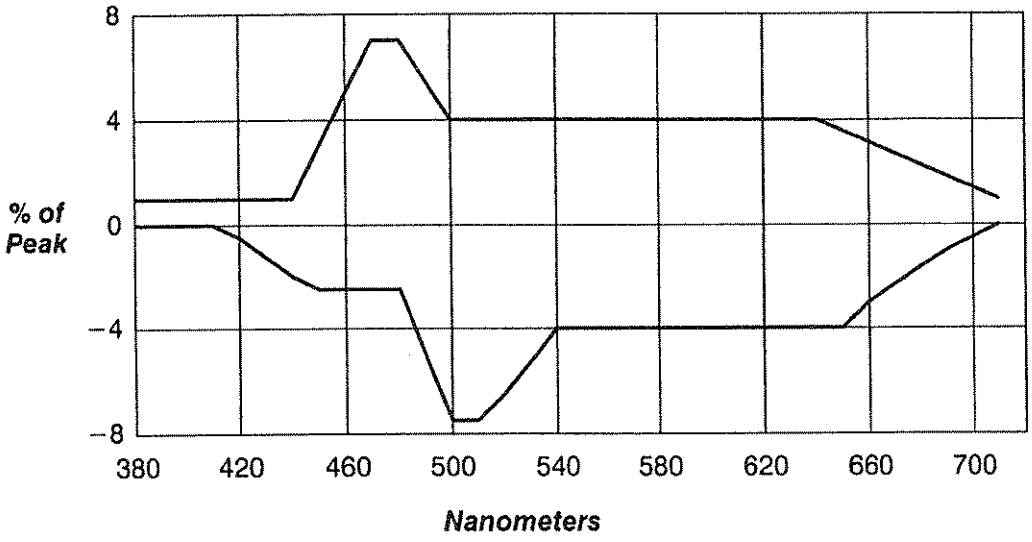


Figure A-1: J1803 Spectral Response, Maximum Deviation Relative to 1931 CIE Photopic Curve

J1805 Characteristics

Table A-7: J1805 Environmental Characteristics

Characteristic	Standard
Temperature	Meets MIL Std 28800E Class 3
Nonoperating	−62°C to +85°C
Operating	−15°C to +55°C
Humidity	48 hours at 97% relative humidity (30°C to 60°C) Modified MIL Std 28800E
Electrostatic Immunity	Complies with IEC 801−2
Electromagnetic Compatibility	Meets CISPIR 22B, FCC Class A and VDE Class B

Table A-8: J1805 Performance Characteristics

Characteristic	Standard
Accuracy (including non-linearity)	5% of reading ± 2 counts (Illuminant A at 1000 cd/m^2, 20° C to 30° C, <75% relative humidity)
Spectral Response	See Figure A-2

Table A-9: J1805 Mechanical Characteristics

Characteristic	Standard	
Dimensions	Height: 1.3 inches	3.3 cm
	Width: 1.4 inches	3.6 cm
	Length: 3.0 inches	7.6 cm

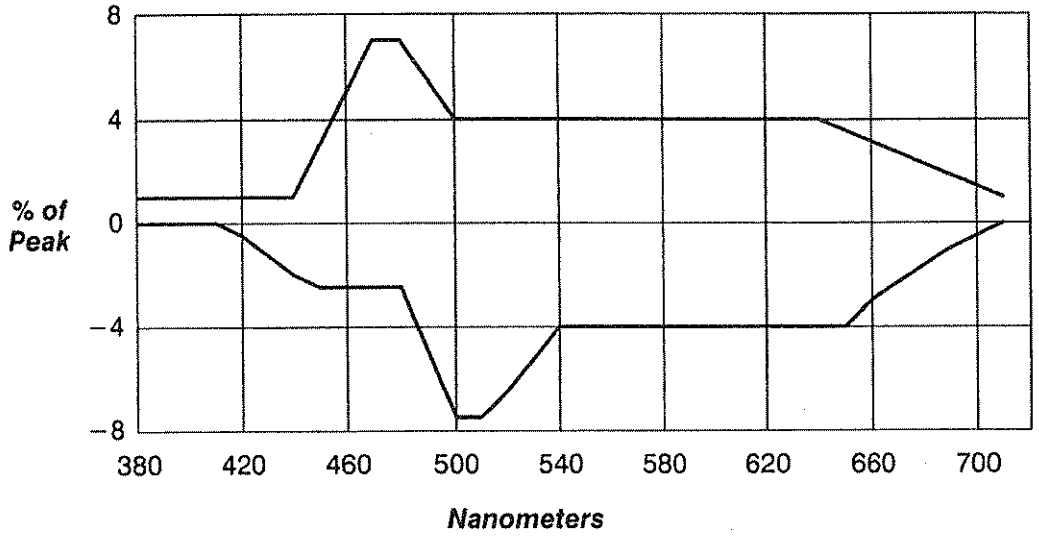


Figure A-2: J1805 Spectral Response, Maximum Deviation Relative to 1931 CIE Photopic Curve

J1806 Characteristics

Table A-10: J1806 Environmental Characteristics

Characteristic	Standard
Temperature	Meets MIL Std 28800E Class 3
Nonoperating	−62°C to +85°C
Operating	−15°C to +55°C
Humidity	48 hours at 97% relative humidity (30°C to 60°C) Modified MIL Std 28800E
Electrostatic Immunity	Complies with IEC 801−2
Electromagnetic Compatibility	Meets CISPIR 22B, FCC Class A and VDE Class B

Table A-11: J1806 Performance Characteristics

Characteristic	Standard
Accuracy (including non-linearity)	5% of reading ± 2 counts (Illuminant A with 656 nm filter 20° C to 30° C, <75% relative humidity)
Spectral Response	±8% from 450 nm to 750 nm

Table A-12: J1806 Mechanical Characteristics

Characteristic	Standard	
Dimensions (not including suction cup)	Height: 1.3 inches	3.3 cm
	Width: 1.4 inches	3.6 cm
	Length: 3.0 inches	7.6 cm

J1811 Characteristics

Table A-13: J1811 Environmental Characteristics

Characteristic	Standard
Temperature Nonoperating Operating	Meets MIL Std 28800E Class 3 −62°C to +85°C −15°C to +55°C
Humidity	48 hours at 97% relative humidity (30°C to 60°C) Modified MIL Std 28800E
Electrostatic Immunity	Complies with IEC 801−2
Electromagnetic Compatibility	Meets CISPIR 22B, FCC Class A and VDE Class B

Table A-14: J1811 Performance Characteristics

Characteristic	Standard
Accuracy (including non-linearity)	5% of reading ± 2 counts (Illuminant A at 1000 cd/m^2 20° C to 30° C, <75% relative humidity)
Spectral Response	See Figure A-3

Table A-15: J1811 Mechanical Characteristics

Characteristic	Standard
Dimensions	Height: Width: Length:

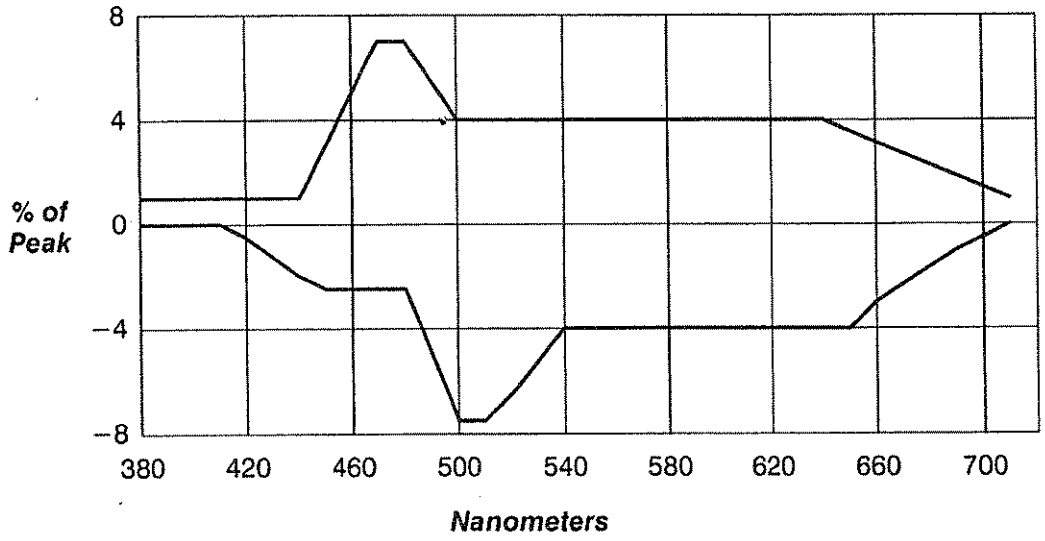


Figure A-3: J1811 Spectral Response, Maximum Deviation Relative to 1931 CIE Photopic Curve

J1812 Characteristics

Table A-16: J1812 Environmental Characteristics

Characteristic	Standard
Temperature	Meets MIL Std 28800E Class 3
Nonoperating	−62°C to +85°C
Operating	−15°C to +55°C
Humidity	48 hours at 97% relative humidity (30°C to 60°C) Modified MIL Std 28800E
Electrostatic Immunity	Complies with IEC 801−2
Electromagnetic Compatibility	Meets CISPIR 22B, FCC Class A and VDE Class B

Table A-17: J1812 Performance Characteristics

Characteristic	Standard
Accuracy (including non-linearity)	5% of reading ± 2 counts (Illuminant A with 762 nm filter, 20° C to 30° C, <75% relative humidity)
Spectral Response	±8% from 450 nm to 950 nm

Table A-18: J1812 Mechanical Characteristics

Characteristic	Standard
Dimensions	Height: Width: Length:

J1820 Characteristics

Table A-19: J1820 Environmental Characteristics

Characteristic	Standard
Temperature	Meets MIL Std 28800E Class 3
Nonoperating	−62°C to +85°C
Operating	−15°C to +55°C
Humidity	48 hours at 97% relative humidity (30°C to 60°C) Modified MIL Std 28800E
Electrostatic Immunity	Complies with IEC 801−2
Electromagnetic Compatibility	Meets CISPIR 22B, FCC Class A and VDE Class B

Table A-20: J1820 Performance Characteristics

Characteristic	Standard
Accuracy (including non-linearity)	Within ±0.018 of x,y value and ±5% of luminance (Illuminant A at 150 cd/m^2, 20° C to 30° C, <75% relative humidity)

Table A-21: J1820 Mechanical Characteristics

Characteristic	Standard	
Dimensions (not including suction cup)	Height: 1.3 inches	3.3 cm
	Width: 1.4 inches	3.6 cm
	Length: 1.7 inches	4.3 cm

J1823 Characteristics

Table A-22: J1823 Environmental Characteristics

Characteristic	Standard
Temperature	Meets MIL Std 28800E Class 3
Nonoperating	−62°C to +85°C
Operating	−15°C to +55°C
Humidity	48 hours at 97% relative humidity (30°C to 60°C) Modified MIL Std 28800E

Table A-23: J1823 Performance Characteristics

Characteristic	Standard
Measurement Angle	1°
Accuracy (including non-linearity)	±5%, ±1 digit to NIST standard light source.
Measurement Range	0.1 fL to 99,990 fL 1 cd/m^2 to 999,900 cd/m^2
Resolution	0.1 fL or 1 cd/m^2
Measurement Repeatability	±2%, ±1 digit

Table A-24: J1823, Option 01 Performance Characteristics

Characteristic	Standard
Measurement Angle	1/3°
Accuracy (including non-linearity)	±5%, ±1 digit to NIST standard light source.
Measurement Range	1.0 fL to 999,900 fL 10 cd/m^2 to 9,999,000 cd/m^2
Resolution	1.0 fL or 10 cd/m^2
Measurement Repeatability	±2%, ±1 digit

Table A-25: J1823 Mechanical Characteristics

Characteristic	Standard	
Dimensions	Height: 4.7 inches	11.94 cm
	Width: 2.6 inches	6.6 cm
	Length: 9.2 inches	23.4 cm
Weight	2.5 pounds	1.13 kg

Appendix C: Photometry and Radiometry Reference

This appendix summarizes convenient relationships and formulas used in photometry and radiometry.

Photometric Relationships

In photometry, the spectral sensitivity of the sensor is matched to the average human eye, with a peak at 555 nm.

- An isotropic light source (a source that emits light uniformly in all directions) of 12.6 lumens is 1 candela (1 candle power).
- A 1 candela source at a distance of 1 meter provides an illuminance of 1 lux on a surface, regardless of the reflectance of the surface.
- A 1 candela source at a distance of 1 foot provides an illuminance of 1 footcandle on a surface, regardless of the reflectance of the surface
- Moving a light source further from a surface reduces the illuminance proportionally with the square of the distance (inverse square law). For example, moving a 1 candela source from 1 foot to 2 feet will reduce the illuminance to ¼ footcandle.
- A perfectly white, diffuse surface illuminated by 1 footcandle has a surface luminance of 1 footlambert.

- A diffuse surface that has a reflectance of less than 100% will have a surface luminance, in footlamberts, equal to the illuminance in foot-candles multiplied by the reflectance factor.
- Measurement of the luminance of a large uniformly illuminated surface is essentially independent of distance, since the area viewed by the sensor increases with the square of the distance, exactly compensating for light falloff due to the inverse square law.

Photometric Formulas

$10.764 \cdot footcandles = lux \quad (lumens/meter^2)$

$3.426 \cdot footlamberts = nits \quad (candela/meter^2)$

$footcandles \cdot distance^2 \ (in\ feet) = candelas$

$lux \cdot distance^2 \ (in\ meters) = candelas$

$footcandles \cdot surface\ reflectance\ factor = footlamberts$

Radiometric Relationships

In radiometry, an ideal sensor has equal sensitivity to all wavelengths of light being measured.

- An isotropic light source (a source that emits light uniformly in all directions) of 12.6 watts produces a radiant flux of 1 watt/steradian.
- 1 watt/steradian at a distance of 1 meter produces an irradiance of 1 watt/meter^2.
- Moving a light source further from a surface reduces the irradiance proportionally with the square of the distance (inverse square law). For example, moving a 1 watt/steradian source from 1 meter to 2 meters will reduce the irradiance to ¼ watt/meter^2.
- A perfectly white, diffuse surface illuminated by an irradiance of 1 watt/meter^2 has a surface radiance of .318 watt/meter^2/steradian (irradiance divided by π).
- A diffuse surface that has a reflectance of less than 100% will have a surface radiance, in watts/meter^2/steradian, equal to the irradiance multiplied by the reflectance factor and divided by π.
- Measurement of the radiance of a large uniformly illuminated surface is essentially independent of distance, since the area viewed by the sensor increases with the square of the distance, exactly compensating for light falloff due to the inverse square law.

Radiometric Formulas

$$watt/cm^2 \cdot 10000 = watt/meter^2$$

$$watt/meter^2 \cdot distance^2 \ \ (in\ meters) = watt/steradian$$

A Note on the Relation of Photometric and Radiometric Data

Note that it is not possible to convert photometric units to radiometric units, or the reverse, except under precisely specified conditions. This is due to the greatly differing spectral sensitivity curves between photometric and radiometric sensors.

For a 555 nanometer, monochromatic source, 1 watt is equal to 683 lumens. Conversion of photometric data to radiometric data for monochromatic sources of other wavelengths may be calculated using the relative sensitivity of the photopic response curve at that wavelength ($y(\lambda)$ in Table A-26). Broader sources must be converted using mathematical integrations of their intensity and the photopic curve at each wavelength.

Appendix D: Chromaticity Reference

The reference material in this appendix can help you categorize and understand chromaticity measurements taken using the J1820 Chromaticity head. This appendix includes:

- the 1931 CIE Chromaticity diagram for x,y readings
- the 1976 CIE-UCS chromaticity diagram for u′, v′ readings
- Spectral tristimulus (X, Y, Z) values for an equal spectral power source, in both graphical and tabular format.

For additional information, we recommend the article "Standardizing CRT Measurements" by Peter Keller, in the April 1984 issue of *Test and Measurement World.*

The 1931 CIE Chromaticity Diagram

The 1931 CIE chromaticity diagram, shown in Figure A-4, can be used to categorize chromaticity measurements expressed as x, y values. The x, y values are determined from the spectral tristimulus values (X, Y, Z), by the following equations:

$$x = \frac{X}{X + Y + Z} \qquad y = \frac{Y}{X + Y + Z}$$

The main features of the 1931 CIE chromaticity diagram include:

- All colors perceptible to the average human eye fall within the bounded area of the chart.
- A straight line drawn through two colors, and passing through the equal energy point (x = 0.333, y = 0.333), indicates complimentary colors.
- Saturated colors, which are located on the periphery of the bounded area, are monochromatic, except on the purple to red boundary. Colors become progressively less saturated toward the white achromatic region in the center. The degree of saturation is a measure of color purity.
- Boundaries between colors are not distinct; one color blends gradually into the next.
- The ratio of distances between two colors to a third color located on a line drawn between them is proportional to the ratio of intensities of a mixture of those two colors required to produce the third color.

The principal disadvantage of the x,y chart is that equal distances on the diagram do not represent equal perceived color distances.

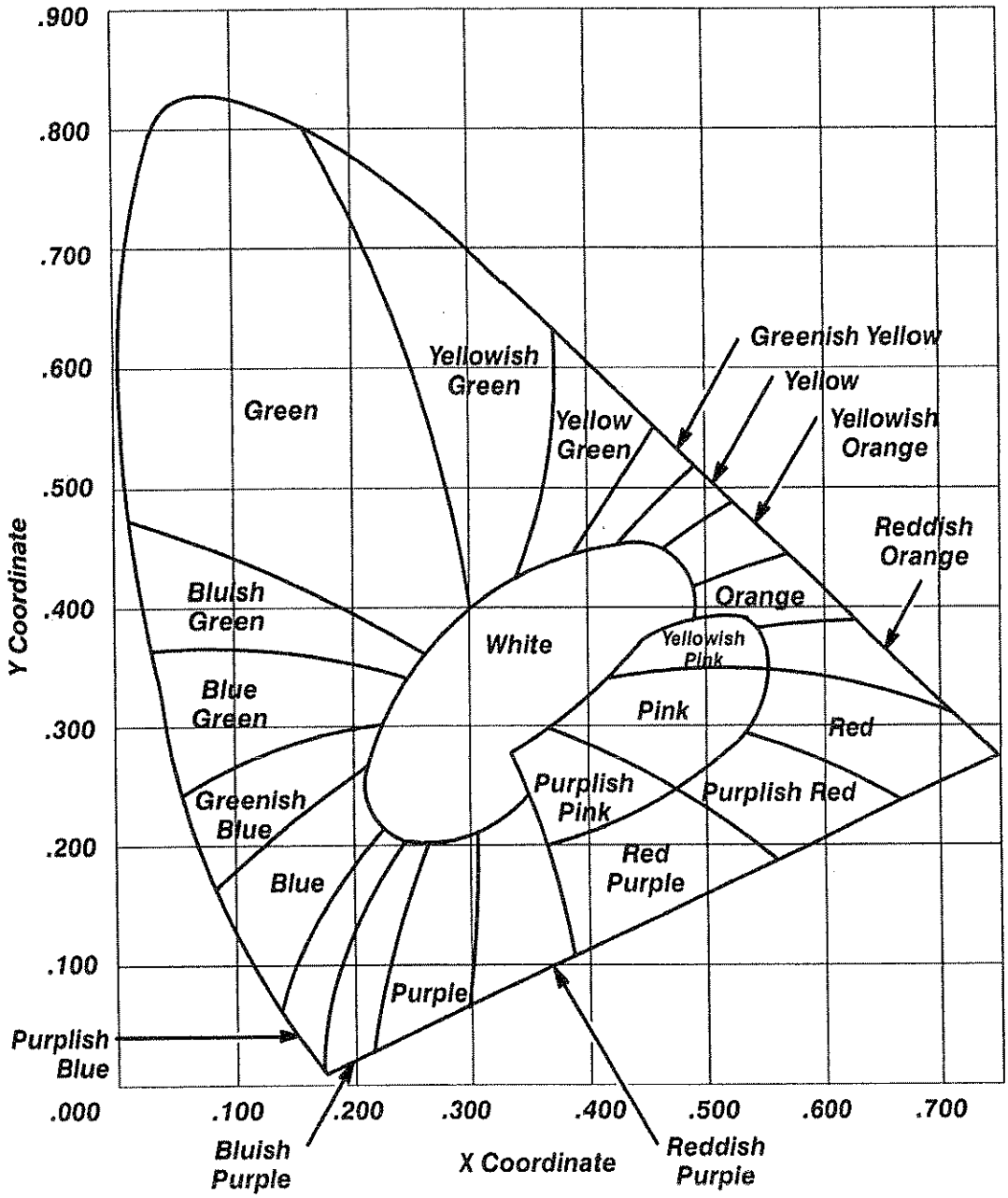


Figure A-4: The 1931 CIE Chromaticity Diagram

Figure A-5 shows the Planckian locus on the 1931 CIE diagram. The numbers along this line indicate the color temperatures (in degrees Kelvin) for black-body light sources.

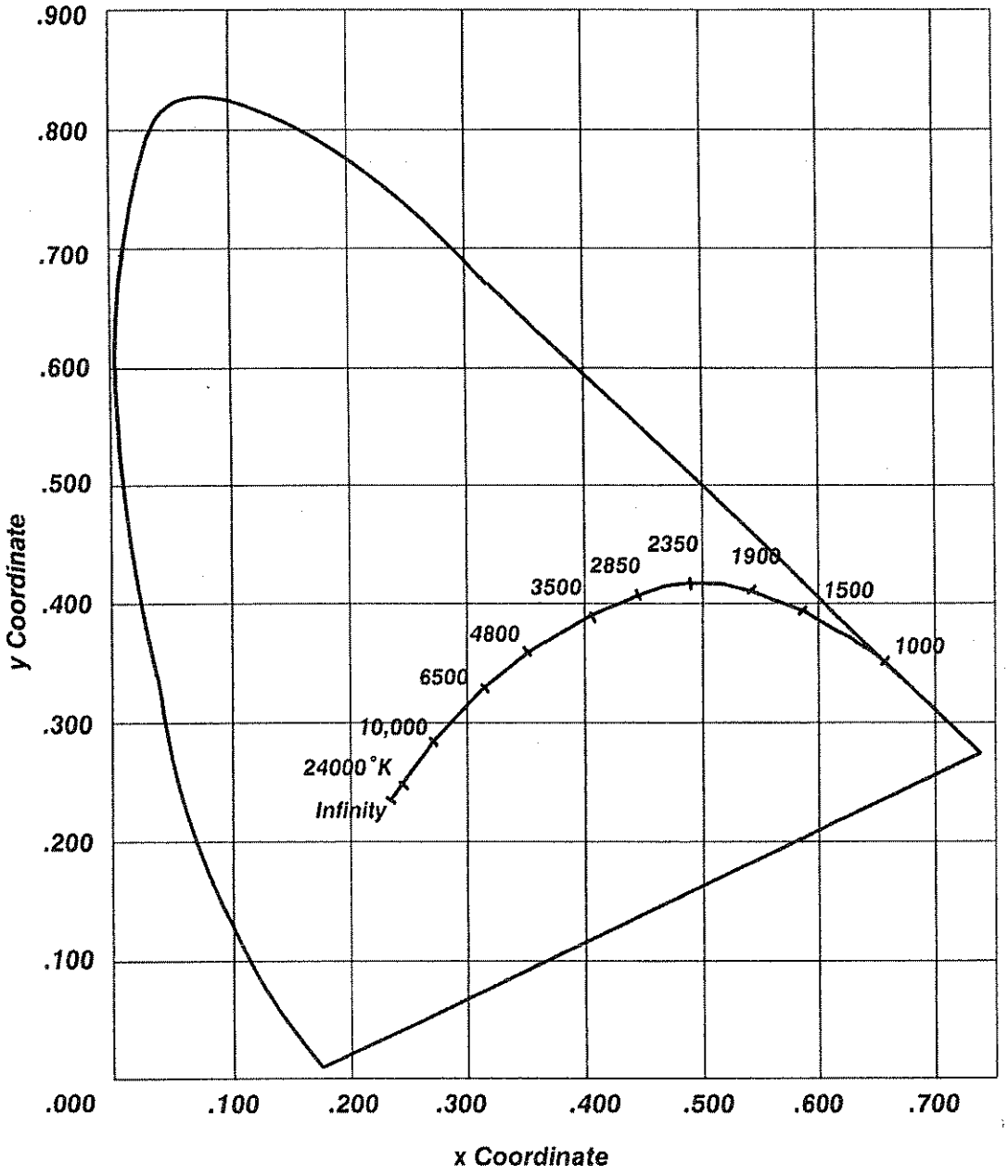


Figure A-5: 1931 CIE Chromaticity Diagram Showing Color Temperature

Figure A-6 shows selected isotemperature lines in the x,y coordinate system. A light source along one of the isotemperature lines will most nearly match the color temperature of a blackbody radiator indicated for that line.

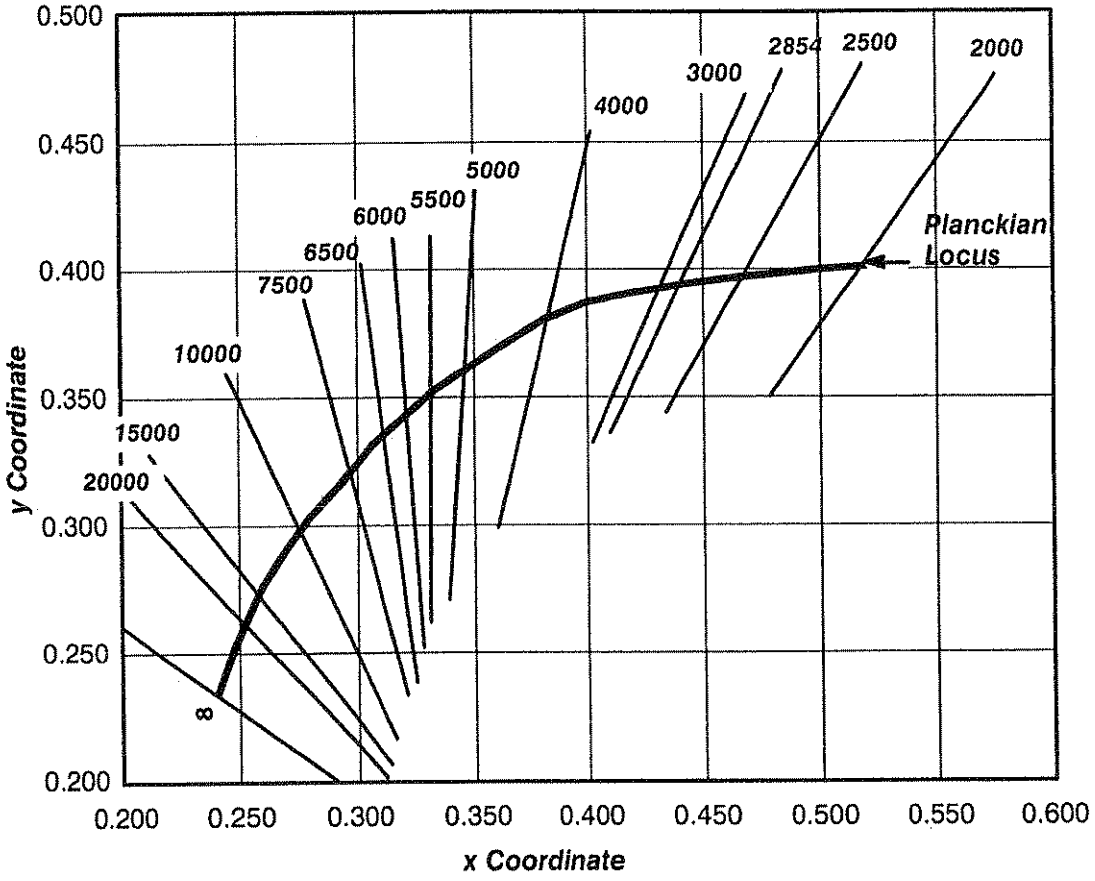


Figure A-6: Correlated Color Temperature Diagram

The 1976 CIE-UCS Chromaticity Diagram

The 1976 CIE-UCS (Uniform Chromaticity Scale) diagram, shown in Figure A-7, can be used to categorize chromaticity measurements expressed as u′, v′ values. u′ and v′ are related to the x and y values of the 1931 CIE chromaticity diagram by the following equations:

$$u' = \frac{4x}{-2x + 12y + 3} \qquad v' = \frac{9y}{-2x + 12y + 3}$$

This diagram is similar to the 1931 CIE chromaticity diagram except for the following:

- Equal distances on the diagram represent approximately equal perceived color differences.
- The equal energy point is u′ = 0.210, v′ = 0.473.

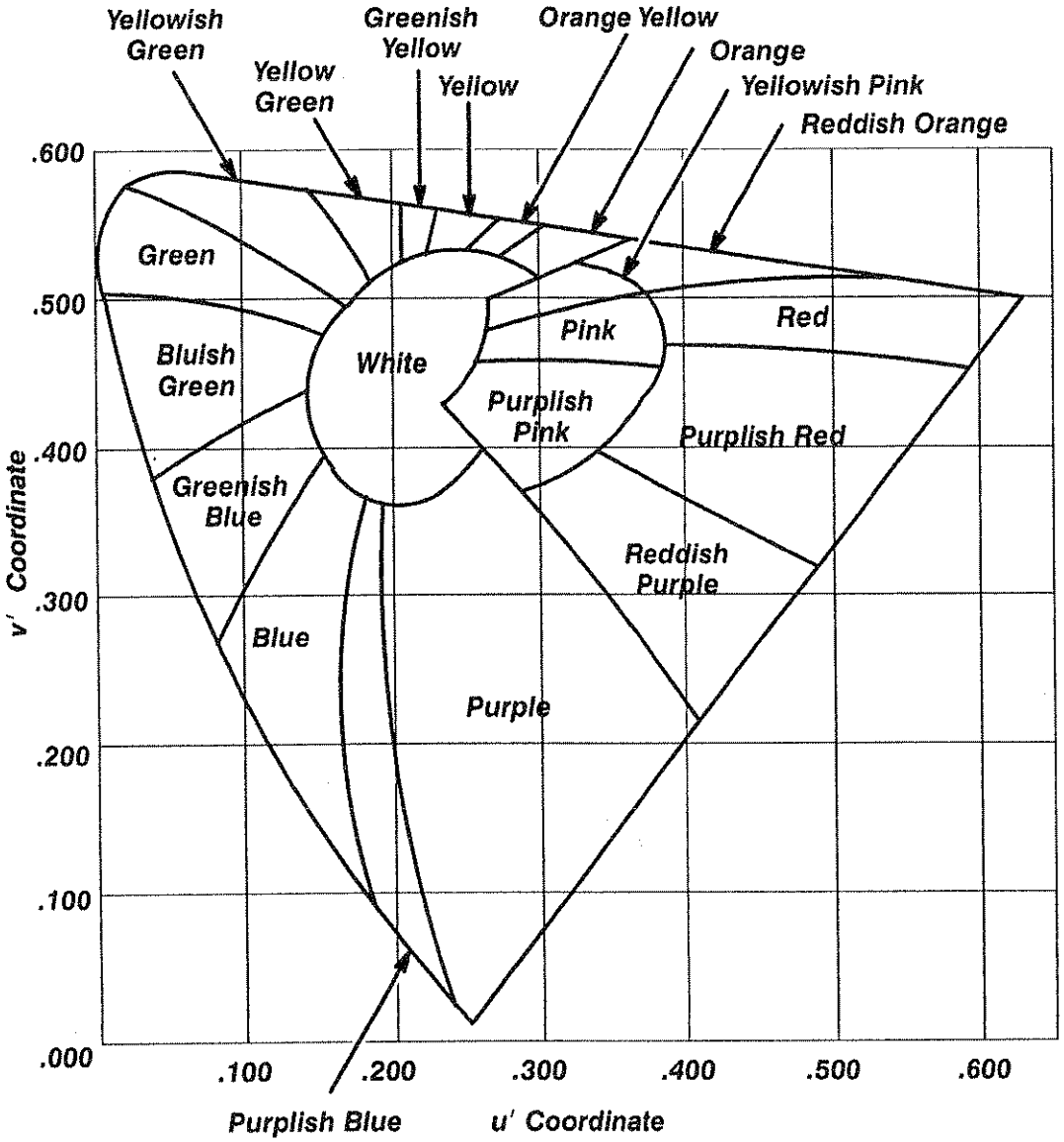


Figure A-7: 1976 CIE-UCS Chromaticity Diagram

Spectral Tristimulus Values

Figure A-8 shows the spectral tristimulus (XYZ) values for a light source of equal spectral power. Table A-26 lists the same data in tabular format.

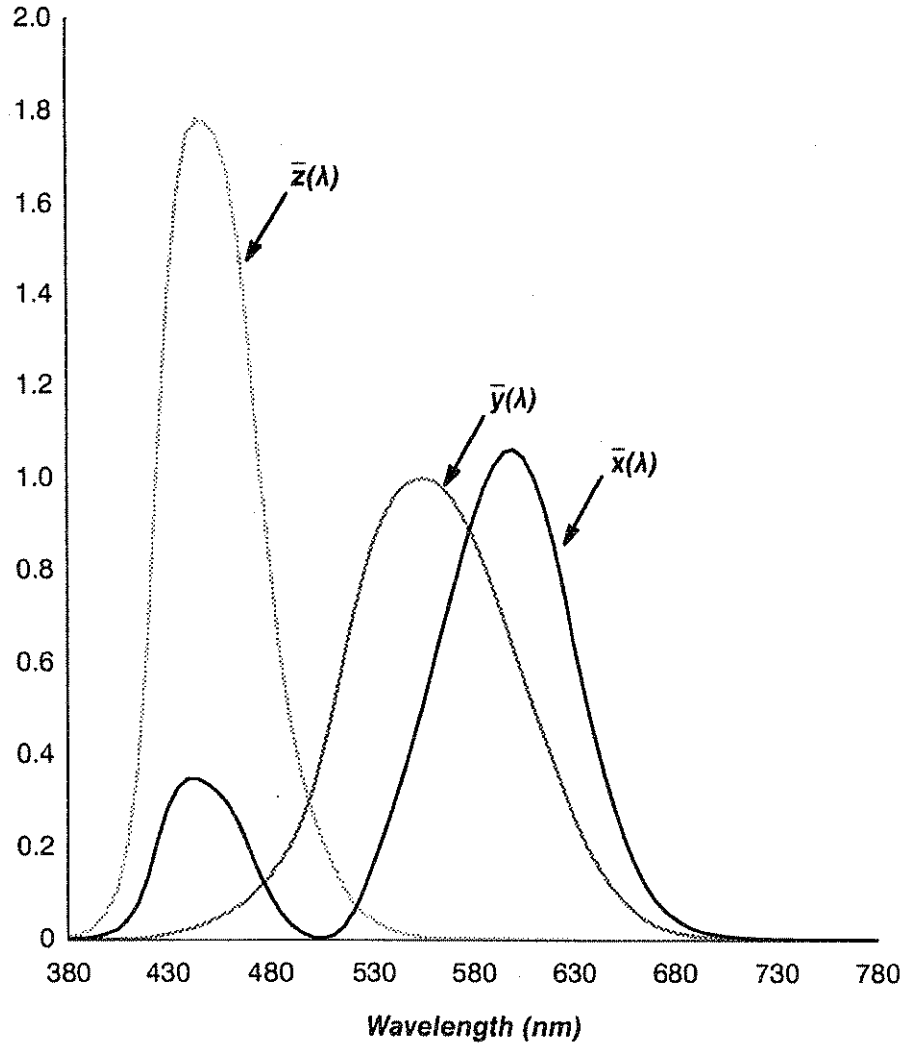


Figure A-8: Spectral Tristimulus Values for Equal Spectral Power Source (CIE 1931 Standard 20 Observer)

Note that $\bar{y}(\lambda)$ is also the photopic curve that represents the relative sensitivity of the average human eye.

Table A-26: Spectral Tristimulus Values for Equal Spectral Power Source (CIE 1931 Standard 20 Observer)

Wavelength (nm)	$\bar{x}(\lambda)$	$\bar{y}(\lambda)$	$\bar{z}(\lambda)$
380	0.0014	0.0000	0.0065
385	0.0022	0.0001	0.0105
390	0.0042	0.0001	0.0201
395	0.0076	0.0002	0.0362
400	0.0143	0.0004	0.0679
405	0.0232	0.0006	0.1102
410	0.0435	0.0012	0.2074
415	0.0776	0.0022	0.3713
420	0.1344	0.0040	0.6456
425	0.2148	0.0073	1.0391
430	0.2839	0.0116	1.3856
435	0.3285	0.0168	1.6230
440	0.3483	0.0230	1.7471
445	0.3481	0.0298	1.7826
450	0.3362	0.0380	1.7721
455	0.3187	0.0480	1.7441
460	0.2908	0.0600	1.6692
465	0.2511	0.0739	1.5281
470	0.1954	0.0910	1.2876
475	0.1421	0.1126	1.0419
480	0.0956	0.1390	0.8130
485	0.0580	0.1693	0.6162
490	0.0320	0.2080	0.4652
495	0.0147	0.2586	0.3533
500	0.0049	0.3230	0.2720
505	0.0024	0.4073	0.2123
510	0.0093	0.5030	0.1582
515	0.0291	0.6082	0.1117
520	0.0633	0.7100	0.0782
525	0.1096	0.7932	0.0573

Table A-26: Spectral Tristimulus Values for Equal Spectral Power Source (CIE 1931 Standard 20 Observer) (Cont.)

Wavelength (nm)	$\bar{x}(\lambda)$	$\bar{y}(\lambda)$	$\bar{z}(\lambda)$
530	0.1655	0.8620	0.0422
535	0.2257	0.9149	0.0298
540	0.2904	0.9540	0.0203
545	0.3597	0.9803	0.0134
550	0.4334	0.9950	0.0087
555	0.5121	1.0000	0.0057
560	0.5945	0.9950	0.0039
565	0.6784	0.9786	0.0027
570	0.7621	0.9520	0.0021
575	0.8425	0.9154	0.0018
580	0.9163	0.8700	0.0017
585	0.9786	0.8163	0.0014
590	1.0263	0.7570	0.0011
595	1.0567	0.6949	0.0010
600	1.0622	0.6310	0.0008
605	1.0456	0.5668	0.0006
610	1.0026	0.5030	0.0003
615	0.9384	0.4412	0.0002
620	0.8544	0.3810	0.0002
625	0.7514	0.3210	0.0001
630	0.6424	0.2650	0.0000
635	0.5419	0.2170	0.0000
640	0.4479	0.1750	0.0000
645	0.3608	0.1382	0.0000
650	0.2835	0.1070	0.0000
655	0.2187	0.0816	0.0000
660	0.1649	0.0610	0.0000
665	0.1212	0.0446	0.0000
670	0.0874	0.0320	0.0000
675	0.0636	0.0232	0.0000

Table A-26: Spectral Tristimulus Values for Equal Spectral Power Source (CIE 1931 Standard 20 Observer) (Cont.)

Wavelength (nm)	$\bar{x}(\lambda)$	$\bar{y}(\lambda)$	$\bar{z}(\lambda)$
680	0.0468	0.0170	0.0000
685	0.0329	0.0119	0.0000
690	0.0227	0.0082	0.0000
695	0.0158	0.0057	0.0000
700	0.0114	0.0041	0.0000
705	0.0081	0.0029	0.0000
710	0.0058	0.0021	0.0000
715	0.0041	0.0015	0.0000
720	0.0029	0.0010	0.0000
725	0.0020	0.0007	0.0000
730	0.0014	0.0005	0.0000
735	0.0010	0.0004	0.0000
740	0.0007	0.0002	0.0000
745	0.0005	0.0002	0.0000
750	0.0003	0.0001	0.0000
755	0.0002	0.0001	0.0000
760	0.0002	0.0001	0.0000
765	0.0001	0.0000	0.0000
770	0.0001	0.0000	0.0000
775	0.0001	0.0000	0.0000
780	0.0000	0.0000	0.0000
Totals:	**21.3714**	**21.3711**	**21.3715**

Appendix D: Chromaticity Reference

Appendix E: Performance Verification

Use the procedures in this section to verify that the J17 Photometer and J1800 Series sensor heads are functioning correctly.

Verifying the J17 and the J1803

To verify the J17 Photometer and the J1803 Luminance Head, you will need the following:

- A diffuse light source, providing light with a known luminance value, approximately illuminant "A." The light source should be traceable to NIST standards, with adequate accuracy to verify the ±5% luminance characteristic.

☐ **Step 1:** Connect the J1803 to the J17.

NOTE

Do not connect the sensor head to the J17 while the J17 power is on. The J17 loads data from the head at power-on. If a sensor head is connected after power-on, any measurements you take may be inaccurate.

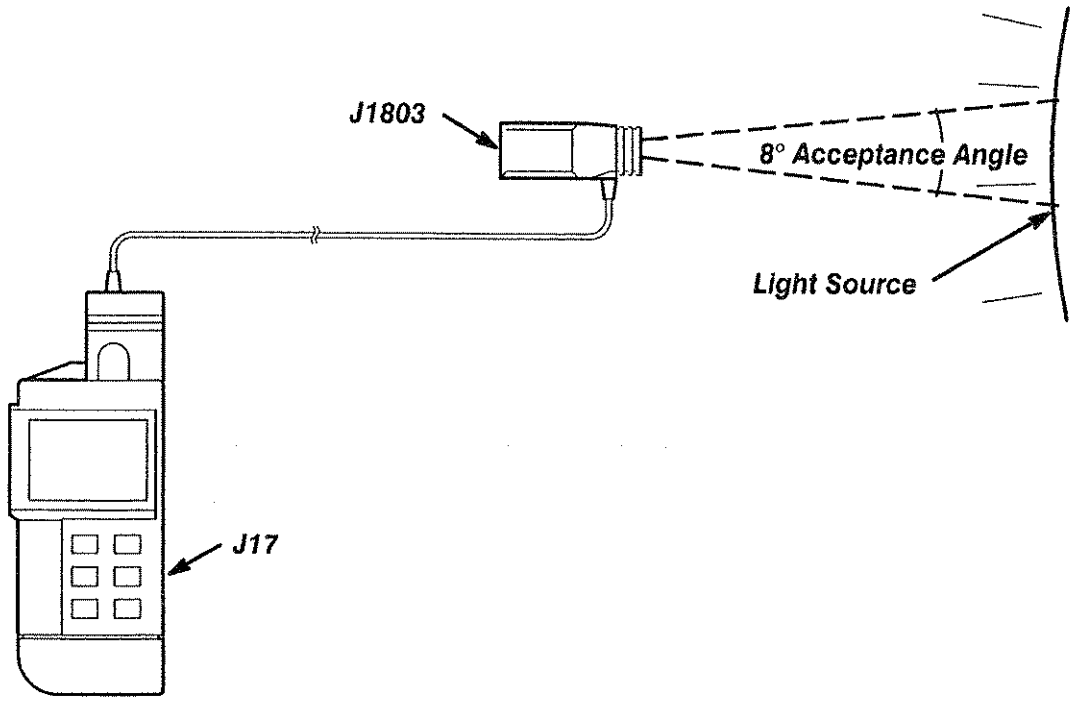


Figure A-9: Setup for Verification of the J17 with the J1803

☐ **Step 2:** Point the J1803 head at the light source. When positioning the J1803, observe the following guidelines:

- For accurate readings, position the J1803 so that the measurement field is entirely filled by the surface to be measured. The acceptance angle of the J1803 head is eight degrees.
- Make sure that the area being viewed by the J1803 is uniformly illuminated, and that the entire field of view of the J1803 is filled by the surface you are measuring.
- The J1803 should be perpendicular to the surface of the light source.

- Operating the head in direct contact with the surface is not recommended, because reflections may occur between the front surface of the head and the surface to be measured. Use of the suction cup or light shield provides adequate spacing to prevent reflections.

The distance from the J1803 to the light source is not critical, provided the above conditions are met. If the reading changes when the distance is changed, verify these conditions.

☐ **Step 3:** Turn on the J17.

The J17 should perform its self-test, briefly displaying all elements on the display, before displaying a measurement of the light source.

NOTE

For this measurement, the J17 color correction factor must be set to **WHITE**. *(This is the default setting at power-on.)*

☐ **Step 4:** Read the luminance value from the J17 display. The luminance value is updated continuously. (If you want to stop the display from updating, press the **HOLD** button.) For accuracy, take several readings and average the results.

Luminance readings will be in cd/m^2 by default. For readings in foot-lamberts, press the **UNITS** button.

☐ **Step 5:** Verify that the reading on the J17 display is within ±5% of the known luminance value of the light source.

If the J17 and J1803 do not provide accurate readings, the J1803 may require calibration. Contact your Tektronix representative. If the J17 does not function properly, refer to *Appendix F, Troubleshooting*, to further isolate the problem.

Verifying the J17 and the J1805

To verify the J17 Photometer and the J1805 LED Head, you will need the following:

- Calibrated LED and power supply. The LED should be traceable to NIST standards, with adequate accuracy to verify the ±5% luminous intensity characteristic.

☐ **Step 1:** Connect the J1805 to the J17.

NOTE

Do not connect the sensor head to the J17 while the J17 power is on. The J17 loads data from the head at power-on. If a sensor head is connected after power-on, any measurements you take may be inaccurate.

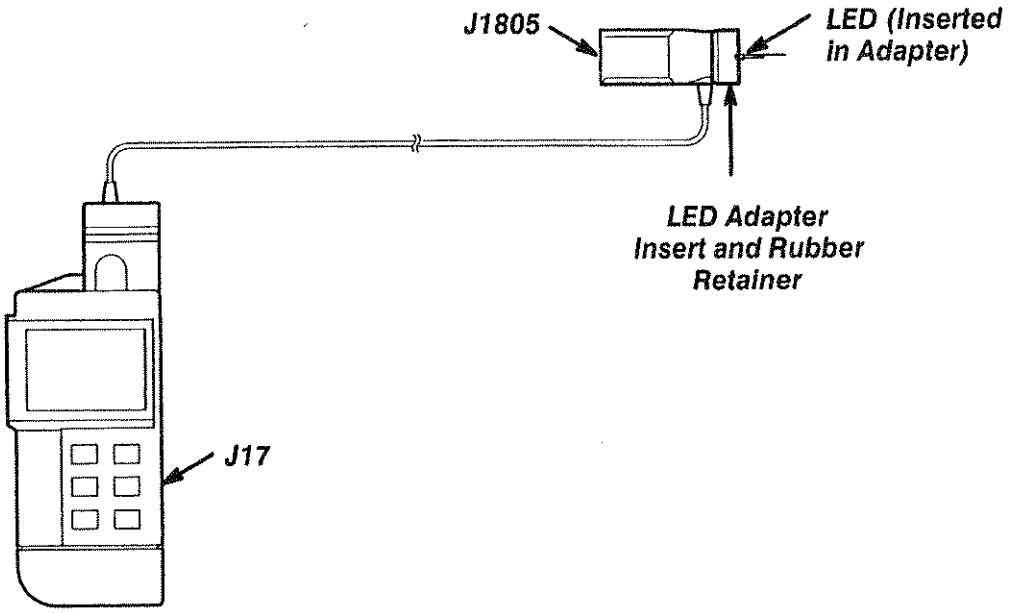


Figure A-10: Setup for Verification of the J17 with the J1805

☐ **Step 2:** Select the correct LED insert for the size of your LED, and secure it to the J1805 using the rubber retainer.

Remember that each LED insert has a recessed side. For correct spacing between the LED emitting plane and the J1805 sensor, be sure the correct opening faces out from the J1805. (For details, see *Using the LED Adapter Inserts*, on page 3-7.)

☐ **Step 3:** Position the J1805 head over the LED.

For accurate measurements, observe the following when positioning the J1805 head for LED measurements:

- Use the correct emitting plane-to-sensor distance for the LED under test.
- Seat the LED adapter flat against the LED flange.

- Situate the LED in an area where ambient light cannot reach the sensor. Ambient light will introduce errors that will invalidate the verification.
- Operate the LED at its recommended current, using a current-regulated power supply.

☐ **Step 4:** Turn on the J17.

The J17 should perform its self-test, briefly displaying all elements on the display, before displaying a measurement of the LED's luminous intensity.

☐ **Step 5:** Press the **COLOR** button on the J17 to select the appropriate color correction factor for the LED you are measuring. The J17 will step through white, red, yellow, green, and blue sequentially each time you press the **COLOR** button.

Selecting a color correction factor maximizes the accuracy of the luminous intensity measurement for a narrow-band light source, such as an LED.

☐ **Step 6:** Read the luminous intensity value from the J17 display. The readout is updated continuously. (If you want to stop the display from updating, press the **HOLD** button.) For accuracy, take several readings and average the results.

☐ **Step 7:** Verify that the reading on the J17 display is within ±5% of the known luminous intensity of the LED.

If the J17 and J1805 do not provide accurate readings, the J1805 may require calibration. Contact your Tektronix representative. If the J17 does not function properly, refer to *Appendix F, Troubleshooting*, to further isolate the problem.

Verifying the J17 and the J1806

To verify the J17 Photometer and the J1806 Radiance/Radiant Intensity Head, you will need the following:

- Diffuse light source. The source spectrum should be centered at 610 ± 5 nm, with a bandpass (full width half maximum) of 20 nm or less. Figure A-11 shows a suitable source configuration.
- Spectroradiometer, traceable to NIST standards, with adequate accuracy to verify the ±5% radiance characteristic.

☐ **Step 1:** Turn on the light source. Allow adequate warm-up time (usually about ten minutes). Read the radiance value of the source using the reference spectroradiometer.

☐ **Step 2:** Connect the J1806 to the J17.

NOTE

Do not connect the sensor head to the J17 while the J17 power is on. The J17 loads data from the head at power-on. If a sensor head is connected after power-on, any measurements you take may be inaccurate.

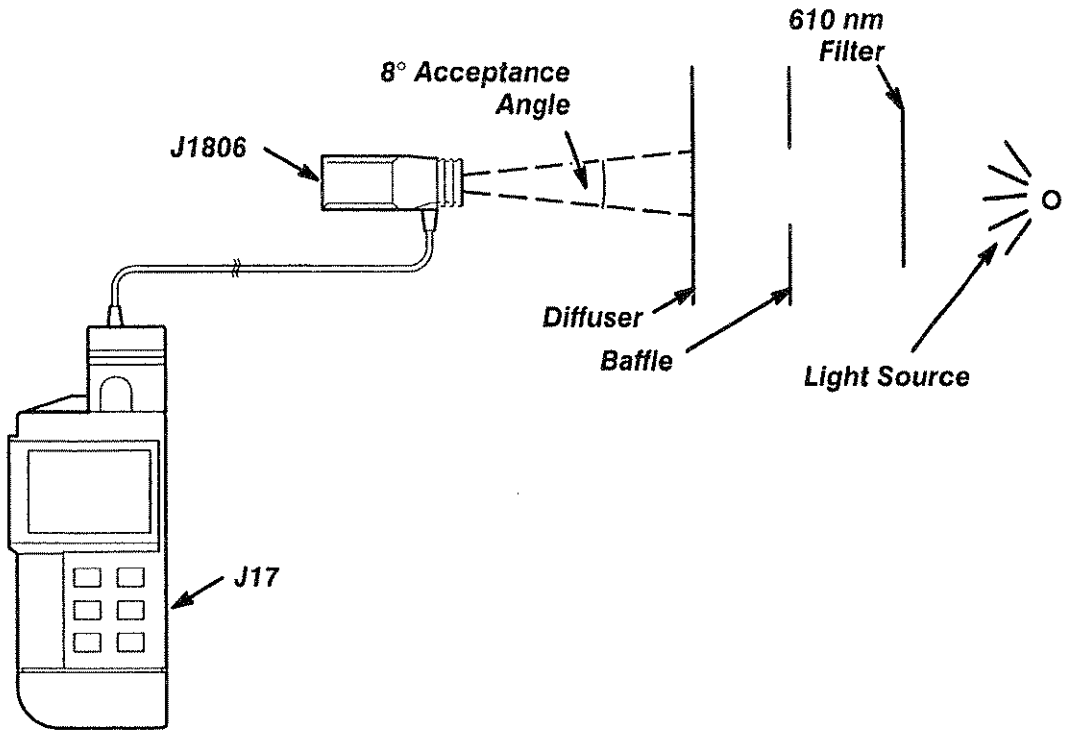


Figure A-11: Setup for Verification of the J17 with the J1806

☐ **Step 3:** Point the J1806 head at the diffuser. When positioning the J1806, observe the following guidelines:

- For accurate readings, position the J1806 so that the measurement field is entirely filled by the surface to be measured. The acceptance angle of the J1806 head is eight degrees.
- Make sure that the area being viewed by the J1806 is uniformly illuminated, and that the entire field of view of the J1806 is filled by the surface you are measuring.
- The J1806 should be perpendicular to the surface of the light source.
- Operating the head in direct contact with the surface is not recommended, because reflections may occur between the front surface of the head and the surface to be measured.

Use of the suction cup or light shield provides adequate spacing to prevent reflections.

The distance from the J1806 to the light source is not critical, provided the above conditions are met. If the reading changes when the distance is changed, verify these conditions.

☐ **Step 4:** Turn on the J17.

The J17 should perform its self-test, briefly displaying all elements on the display, before displaying a measurement of the light source.

NOTE

For this measurement, the J17 color correction factor must be set to either **WHITE** *or* **RED**. *(***WHITE** *is the default setting at power-on.)*

☐ **Step 5:** Read the radiance value from the J17 display. The radiance value is updated continuously. (If you want to stop the display from updating, press the **HOLD** button.) For best accuracy, take several readings and average the results.

☐ **Step 6:** Verify that the reading on the J17 display is within ±5% of the known radiance value of the light source, as measured by the spectroradiometer in Step 1.

If the J17 and J1806 do not provide accurate readings, the J1806 may require calibration. Contact your Tektronix representative. If the J17 does not function properly, refer to *Appendix F, Troubleshooting*, to further isolate the problem.

Verifying the J17 and the J1811

To verify the J17 Photometer and the J1811 Illuminance Head, you will need the following:

- Luminous intensity source providing light of known illuminance at a specified distance, approximately illuminant "A." The light source should be traceable to NIST standards, with adequate accuracy to verify the ±5% illuminance characteristic.

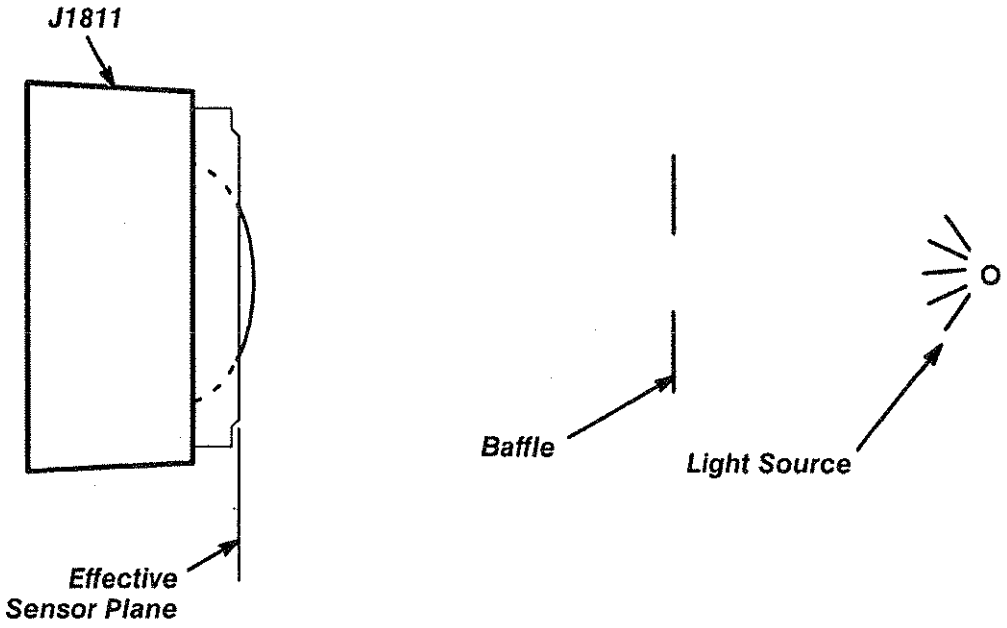


Figure A-12: Setup for Verification of the J17 with the J1811

☐ **Step 1:** Connect the J1811 to the J17.

☐ **Step 2:** Position the J1811 and the light source at the distance for which illuminance of the source is known. Use the metal rim of the J1811 for measuring the distance.

☐ **Step 3:** Turn on the J17.

The J17 should perform its self-test, briefly displaying all elements on the display, before displaying a measurement of the light source.

NOTE

The self-test that the J17 performs at power-on will proceed more quickly if the sensor head is covered before you turn on the J17.

NOTE

For this measurement, the J17 color correction factor must be set to **WHITE**. *(This is the default setting at power-on.)*

☐ **Step 4:** Move away from the J1811 head to avoid reflections or shadowing. The J1811 has a 72-inch cable to allow separation between the observer and the measurement location.

☐ **Step 5:** Read the illuminance value from the J17 display. The illuminance value is updated continuously.

☐ **Step 6:** For best accuracy, repeat the measurement several times to ensure that the light source has remained stable.

☐ **Step 7:** Verify that the reading on the J17 display is within ±5% of the known illuminance value of the light source.

If the J17 and J1811 do not provide accurate readings, the J1811 may require calibration. Contact your Tektronix representative. If the J17 does not function properly, refer to *Appendix F, Troubleshooting*, to further isolate the problem.

Verifying the J17 and the J1812

To verify the J17 Photometer and the J1812 Irradiance Head, you will need the following:

- Light source with suitable dimensions to be considered a point source. The source spectrum should be centered at 762 ± 10 nm, with a bandpass (full width half maximum) of 20 nm or less. Figure A-13 shows a suitable source configuration.
- Photodetector with known absolute spectral response and area, traceable to NIST standards, and with adequate accuracy to verify the ±5% irradiance characteristic.

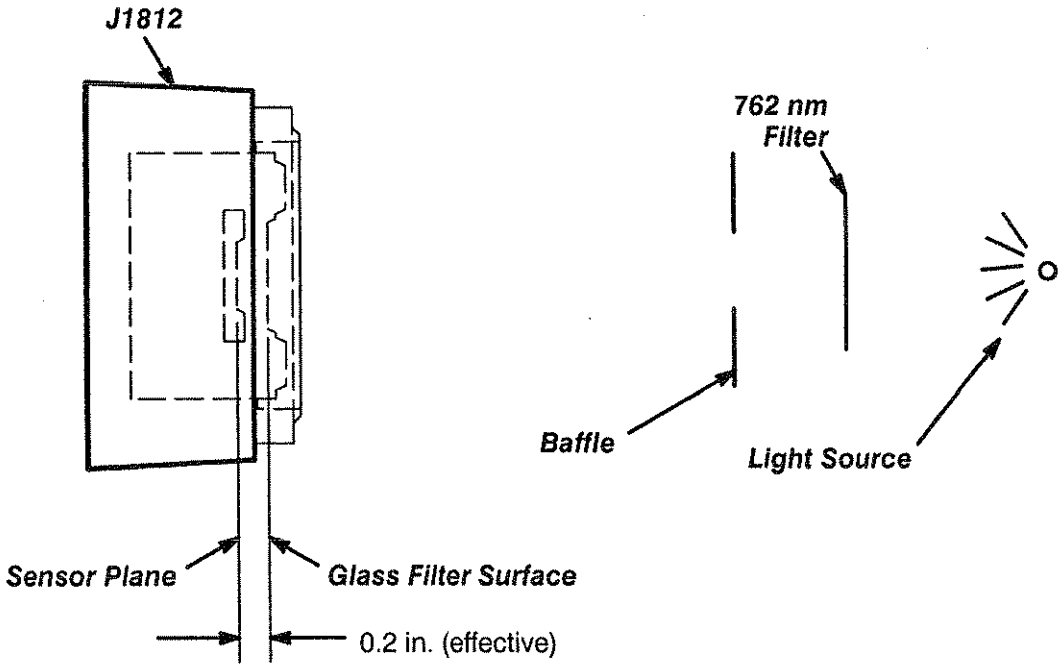


Figure A-13: Setup for Verification of the J17 with the J1812

☐ **Step 1:** Turn on the light source. Allow adequate warm-up time (usually about ten minutes). Read the irradiance value of the source using the reference photodetector, and note the distance from the source to the reference plane of the photodetector.

☐ **Step 2:** Connect the J1812 to the J17.

☐ **Step 3:** Position the J1812 so that the effective sensor plane (0.2 inches behind the front glass filter surface) is at the same point as was used for the reference sensor.

☐ **Step 4:** Turn on the J17.

The J17 should perform its self-test, briefly displaying all elements on the display, before displaying a measurement of the light source.

NOTE

The self-test that the J17 performs at power-on will proceed more quickly if the sensor head is covered before you turn on the J17.

NOTE

For this measurement, the J17 color correction factor must be set to **WHITE**. *(This is the default setting at power-on.)*

☐ **Step 5:** Move away from the J1812 head to avoid reflections or shadowing. The J1812 has a 72-inch cable to allow separation between the observer and the measurement location.

☐ **Step 6:** Read the irradiance value from the J17 display. The irradiance value is updated continuously.

☐ **Step 7:** For best accuracy, repeat the measurement several times and average the readings.

☐ **Step 8:** Verify that the reading on the J17 display is within ±5% of the known irradiance value of the light source.

If the J17 and J1812 do not provide accurate readings, the J1812 may require calibration. Contact your Tektronix representative. If the J17 does not function properly, refer to *Appendix F, Troubleshooting*, to further isolate the problem.

Verifying the J17 and the J1820

To verify the J17 Photometer and the J1820 Chromaticity Head, you will need the following:

- Diffuse light source, providing light with known chromaticity and luminance values, approximately illuminant "A." The light source should be traceable to NIST standards, with adequate accuracy to verify the ±5% luminance characteristic and the ±0.018 x,y chromaticity characteristic.

☐ **Step 1:** Connect the J1820 to the J17.

NOTE

Do not connect the sensor head to the J17 while the J17 power is on. The J17 loads data from the head at power-on. If a sensor head is connected after power-on, any measurements you take may be inaccurate.

The Display Shows Err

The word **Err** (error) appears on the display when you press a button that is not appropriate with the sensor head attached to the J17, or not appropriate in the chosen operating mode.

The Display Goes Blank

It is normal for the J17 to blank the display after about 15 minutes of inactivity when battery power is used. The display should refresh when you press a key, but will return to its blanked state if there is no new data to display.

Measurements are Inaccurate

If measurements taken with the J17 are inaccurate or inconsistent, check the operating setup:

- Did you connect the sensor head to the J17 *before* power-on? If not, turn the J17 off, then turn it back on. The J17 will load data from a sensor head at power-on.
- For luminance, radiance, and chromaticity measurements, make sure that the sensor head is positioned so that the measurement field is entirely filled by the surface to be measured.

  The acceptance angle of the J1803 and J1806 is eight degrees.

  The acceptance angle of the J1820 is 16 degrees.
- For luminance, radiance, and chromaticity measurements, make sure that the area being viewed by the sensor head is uniformly illuminated.

- Shadowing will occur if the surface is being measured from direction of the illumination. Position the sensor head so that it does not shadow the surface being measured.
- Operating the head in contact with the surface is not recommended, because reflections may occur between the front surface of the head and the surface to be measured. Placement of the head too close to the surface may also cause shadowing.

  The light shield or suction cup provides adequate spacing between the head and the surface to prevent reflection on backlighted surfaces.

If measurements are still incorrect, the sensor head may require calibration. Contact your Tektronix representative.

Board-level Troubleshooting

The two circuit boards in the J17 may be replaced. If the J17 does not function, you can use these procedures to isolate the problem to one of the boards. Refer to *Appendix G, Replaceable Parts,* for ordering information.

CAUTION

The following servicing instructions are for use by qualified service personnel only. Once the covers of the J17 are removed, the instrument could be damaged.

Most functions of the J17 are located on the A1 board. The A2 Display board controls the display, backlight, and keyboard. The general troubleshooting sequence for the J17 is:

1. Verify that the problem is not covered in *Basic Troubleshooting.*
2. Check for a display, backlight, or keyboard problem (indicating the A2 board). If there appears to be a display problem, also check the power supply on the A1 board, which could be at fault.
3. Other problems are due to the A1 board. If a power supply problem is suspected, perform the procedure in *Checking the Power Supply* to verify that the power supply, and not the battery, is at fault.

The A1 Board

Most functions of the J17 are located on the A1 board. *Checking the Power Supply*, later in this section, will allow you to determine whether there is a power supply problem.

The A2 Display Board

The A2 Display board is probably at fault if:

- segments of the display are missing
- the backlight does not operate

To check the display, power on the J17 without a sensor head attached, and note whether all segments of the display are activated.

If the entire display is inactive, or if the backlight does not operate, proceed to *Checking the Power Supply* to rule out a problem with the power supply.

Checking the Power Supply

To check the power supply, you will need:

- $^{3}/_{32}$ inch hex wrench
- Posidriv® screwdriver
- a voltmeter (for voltages in the range 0 to 15 V)
- Nine-volt, IEC 6LR61-type alkaline battery

☐ **Step 1:** Remove the battery from the battery compartment.

CAUTION

Do not apply power to the J17 while disassembling it. Damage to the A2 board could result.

Static electricity can damage the circuit boards of the J17. Observe static precautions when the covers of the J17 are removed.

☐ **Step 2:** Using the hex wrench, remove the four screws from the J17 front panel.

☐ **Step 3:** Remove the back cover of the J17.

☐ **Step 4:** Remove the five screws that attach the A1 board to the A2 board.

☐ **Step 5:** Gently pull the two boards apart, taking care not to bend the pins on the A1 board.

☐ **Step 6:** Connect the battery to the A1 board and turn on the power switch.

☐ **Step 7:** Connect the voltmeter to test point 90 and test point 32 (ground). Check test point 90 for a voltage of +7.2 V or higher. Refer to Figure A-16 for test point locations.

If the voltage at test point 90 is less than +7.2 V, the problem is the battery, not the power supply. If the voltage is +7.2 V or greater, proceed to Step 8.

☐ **Step 8:** Retaining the connection to test point 32 (ground), check for a voltage of +5.75 V ± 0.05 V at test point 30.

☐ **Step 9:** While still connected to test point 32 (ground), check test point 31 for a voltage of +5.000 V ± 0.025 V.

If the voltages at test points 30 and 31 are correct, the problem is not the power supply. If these voltages are not correct, the A1 board must be replaced.

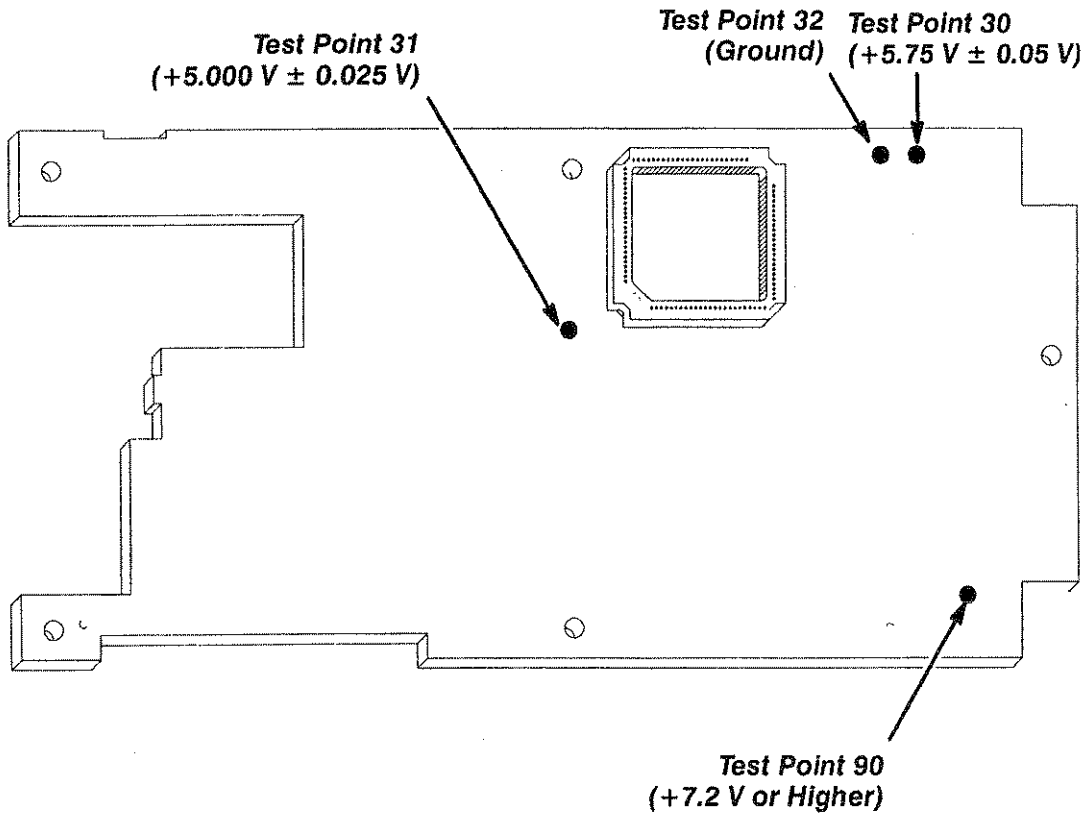


Figure A-16: Test Point Locations on the A1 Board

Appendix G: Replaceable Parts

This section contains a list of the modules that are replaceable for the J17 Photometer and the J1800 Series sensor heads. Use this list to identify and order replacement parts.

Parts Ordering Information

Replacement parts are available from or through your local Tektronix, Inc. service center or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available and to give you the benefit of the latest circuit improvements. Therefore, when ordering parts, it is important to include the following information in your order:

- Part number
- Instrument type or model number
- Instrument serial number
- Instrument modification number, if applicable

If a part you order has been replaced with a different or improved part, your local Tektronix service center or representative will contact you concerning any change in the part number.

Change information, if any, is located at the rear of this manual.

Using the Replaceable Parts List

The tabular information in the Replaceable Parts List is arranged for quick retrieval. Understanding the structure and features of the list will help you find the all the information you need for ordering replacement parts.

Item Names

In the Replaceable Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, U.S. Federal Cataloging Handbook H6-1 can be used where possible.

Indentation System

This parts list is indented to show the relationship between items. The following example is of the indentation system used in the Description column:

1 2 3 4 5 Name & Description

Assembly and/or Component
Attaching parts for Assembly and/or Component
(END ATTACHING PARTS)
Detail Part of Assembly and/or Component
Attaching parts for Detail Part
(END ATTACHING PARTS)
Parts of Detail Part
Attaching parts for Parts of Detail Part
(END ATTACHING PARTS)

Attaching parts always appear at the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation. Attaching parts must be purchased separately, unless otherwise specified.

Abbreviations

Abbreviations conform to American National Standards Institute (ANSI) standard Y1.1

CROSS INDEX – MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip Code
TK0392	NORTHWEST FASTENER SALES INC	7923 SW CIRRUS DRIVE	BEAVERTON OR 97005–6448
TK0435	LEWIS SCREW CO	4300 S RACINE AVE	CHICAGO IL 60609–3320
TK0503	AIMSCO INC	5707 AIRPORT WAY SO.	SEATTLE WA 98108
TK0588	UNIVERSAL PRECISION PRODUCTS	1775 NW 216TH	HILLSBORO OR 97123
TK1060	DURACELL INTERNATIONAL INC BATTERY TECHNOLOGY CO	S BROADWAY	TARRYTOWN NY 10591
TK1325	LZR ELECTRONICS	8174 BEACHCRAFT AVENUE	GAITHERSBURG MD 20879
TK1666	ACRAVAC PRODUCTS	2660 SE PARK AVE	MILWAUKIE OR 97222
0AHE5	SEALS UNLIMITED	17300 SW BASELINE ROAD	BEAVERTON OR 97006
0DWW6	MICRO POWER ELECTRONICS	7973 SW CIRRUS DRIVE BLDG. #22	BEAVERTON OR 97005
0KB01	STAUFFER SUPPLY	810 SE SHERMAN	PORTLAND OR 97214
5Y400	TRIAX METAL PRODUCTS INC DIV OF BEAVERTON PARTS MFG CO	1800 216TH AVE NW	HILLSBORO OR 97124–6629
7X318	KASO PLASTICS INC	11015 A NE 39th	VANCOUVER WA 98662
73743	FISCHER SPECIAL MFG CO	111 INDUSTRIAL RD	COLD SPRING KY 41076–9749
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON OR 97077–0001

Fig. & Index No.	Tektronix Part No.	Serial No. Effective Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
A-17-	--------		1	J17,PHOTOMETER:		
-1	211-0789-00		4	SCREW,CAP:4-40,0.625 L,HEX SKT,STL,BLK OXIDE	0KB01	211-0789-00
-2	380-1032-00		1	HOUSING,TOP AS:W/KEYCAPS & GASKET	80009	380103200
-3	210-0405-00		1	NUT,PLAIN,HEX:2-56 X 0.188,BRS CD PL	73743	12157-50
-4	210-0053-00		1	WASHER,LOCK:#2 SPLIT,0.02 THK STL	TK0392	ORDER BY DESC
-5	671-2439-00		1	CIRCUIT BD ASSY:DISPLAY	80009	671243900
-6	211-0180-00		1	SCR,ASSEM WSHR:2-56 X 0.25, PNH,BRS,NP,POZ	TK0435	ORDER BY DESC
-7	129-1361-00		3	SPACER,POST:0.460 L,W/4-40 THD ONE END,#2-5.6 OTHER END,AL,0.188 HEX	TK0588	PER TEK DOCUMEN
-8	671-2061-00		1	CIRCUIT BD ASSY:PROCESSOR	80009	671206100
-9	211-0007-00		3	SCREW,MACHINE:4-40 X 0.188,PNH,STL	TK0435	ORDER BY DESC
-10	386-0045-00		1	PLATE,MTG:CONNECTOR,BLACK ANODIZE	5Y400	386-0045-00
-11	380-1039-00		1	HOUSING,HALF:BOTTOM,ABS	7X318	380-1039-00
-12	200-3896-00		1	DOOR,ACCESS:BATTERY LID	80009	200-3896-00
-13	146-0017-00		1	BATTERY,DRY:9V,0.4AH @ 8MA	TK1060	MN1604BK
-14	131-1160-00		1	CLIP,ELECTRICAL:BATTERY	0DWW6	ORDER BY DESC
-15	211-0007-00		2	SCREW,MACHINE:4-40 X 0.188,PNH,STL	TK0435	ORDER BY DESC

Fig. & Index No.	Tektronix Part No.	Serial No. Effective Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
-16	129-1361-00		2	SPACER,POST:0.460 L,W/4-40 THD ONE END,#2-5.6 OTHER END,AL,0.188 HEX	TK0588	PER TEK DOCUMEN
-17	160-8856-00		1	IC,DIGITAL:6208 X 8 MICROPROCESSOR,PRGM,MC68HC705B6F.N	80009	160885600
				STANDARD ACCESSORIES		
	070-8531-02		1	MANUAL,TECH:USER,J17/J1800 SERIES	80009	070853102
				OPTIONAL ACCESSORIES		
-18	119-5032-00		1	ADAPTER,ELEC:12V,100MA;120 VAC/60HZ,POWER SUPPLY,OPT-05 PLUGS	TK1325	AD-1210
-19	012-1411-00		1	CABLE,INTCON:RS232 CABLE,72.0 L	80009	012141100

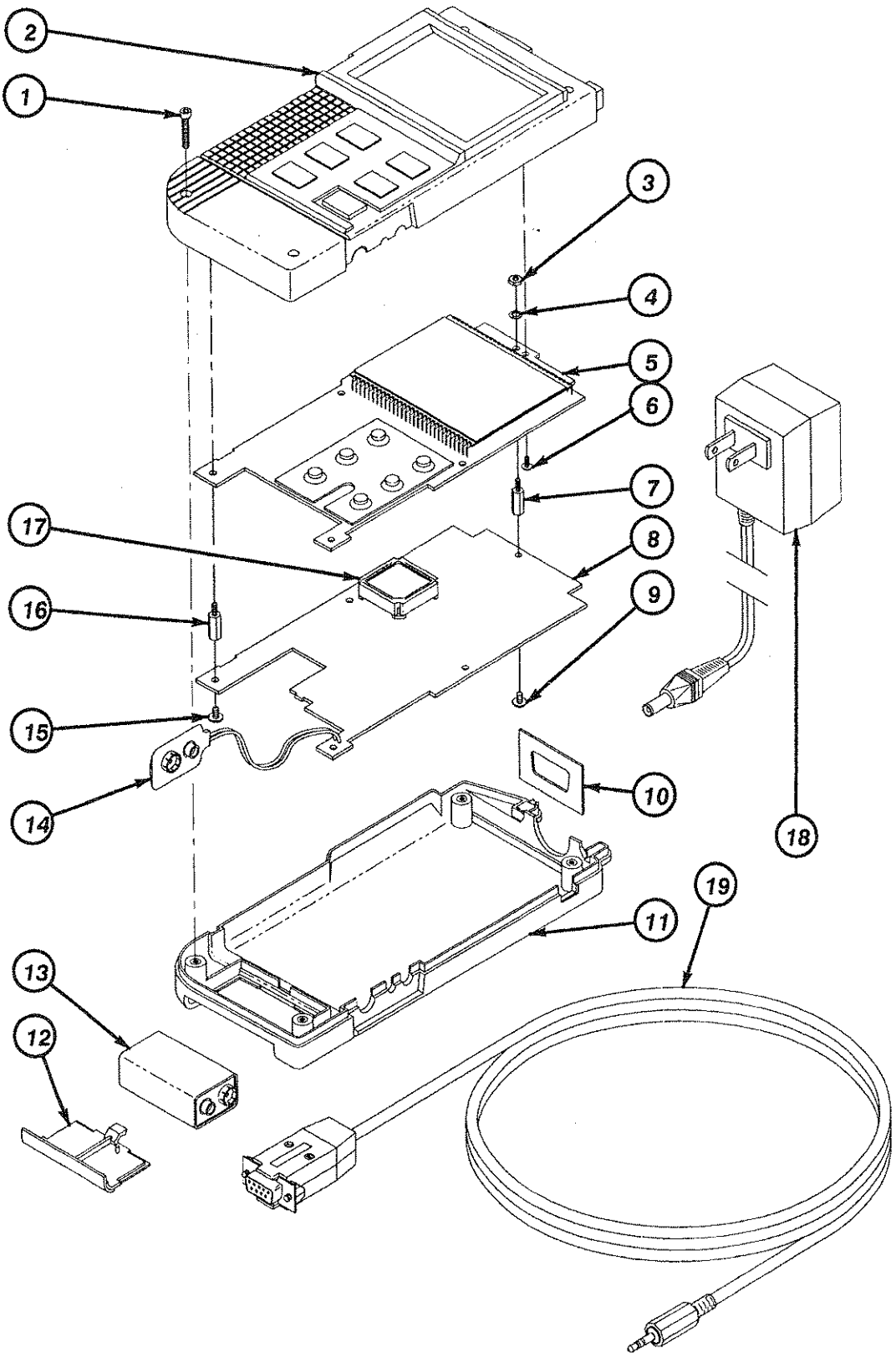


Figure A-17: J17 Replaceable Parts

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
A-18-1	---------			1	J1803,LUMINANCE HEAD:8 DEG ACCEPTANCE ANGLE		
					STANDARD ACCESSORIES		
-2	337-1936-00			1	SHIELD,LIGHT:OCCLUDER	TK1666	ORDER BY DESC
-3	348-1287-00			1	SUCTION CUP:NEOPRENE,ETDM,SHORE 50	0AHE5	348-1287-00
-4	348-1288-00			1	RETAINER,RUBBER:BLACK,NEOPRENE	0AHE5	348-1288-00
	070-8531-02			1	MANUAL,TECH:USER,J17/J1800 SERIES	80009	070853102
-5	---------			1	J1820,CHROMATICITY HD:COLOR COORDINATE		
					STANDARD ACCESSORIES		
-6	348-1287-00			1	SUCTION CUP:NEOPRENE,ETDM,SHORE 50	0AHE5	348-1287-00
	070-8531-02			1	MANUAL,TECH:USER,J17/J1800 SERIES	80009	070853102

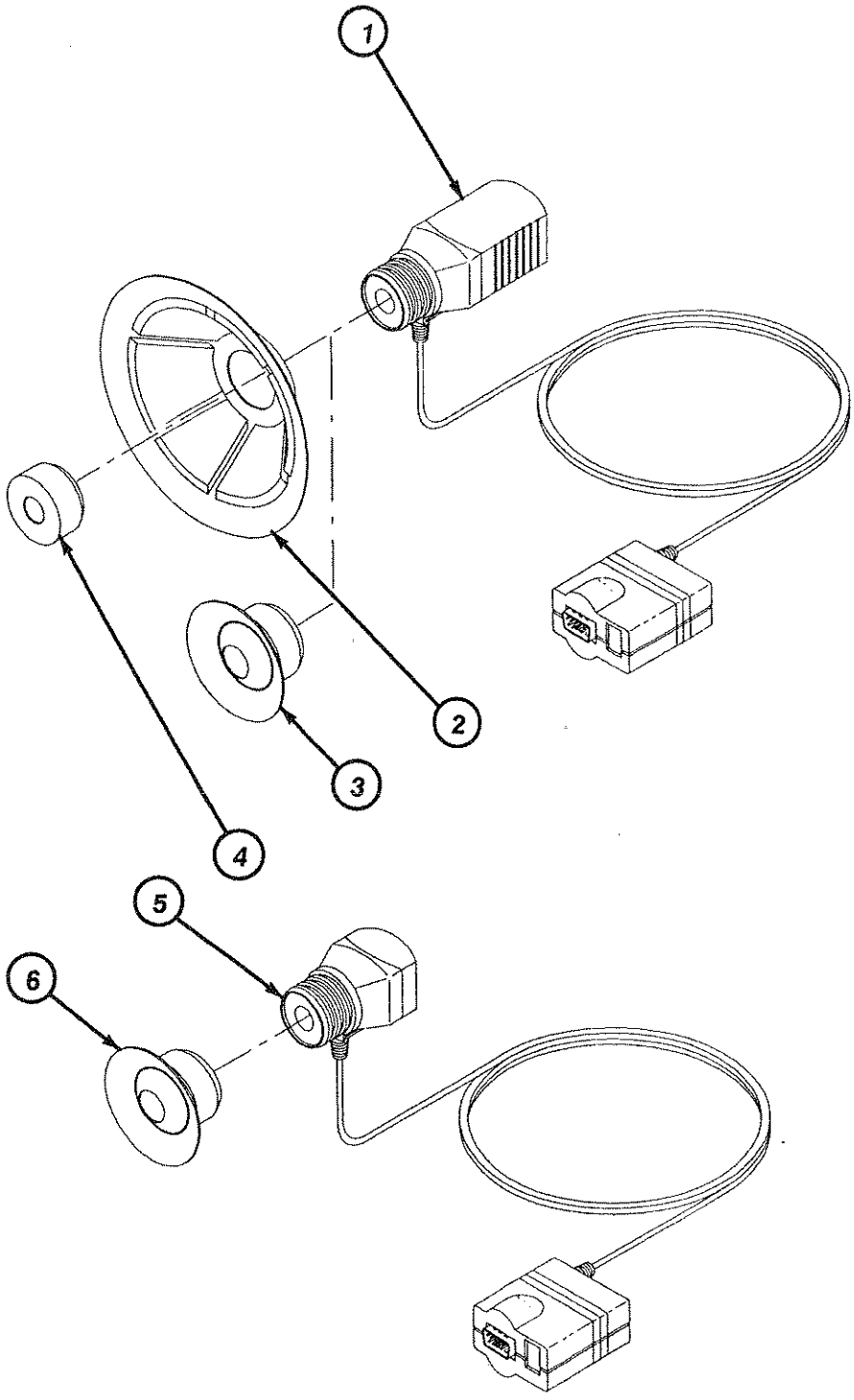


Figure A-18: J1803 and J1820 Replaceable Parts

Fig. & Index No.	Tektronix Part No.	Serial No. Effective Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
A-19-1	--------		1	J1805,LED HEAD:LUMINOUS INTENSITY		
				STANDARD ACCESSORIES		
-2	103-0326-00		2	ADAPTER,LED:DELRIN ,0.12ID	80009	103032600
-3	348-1288-00		1	RETAINER,RUBBER:BLACK,NEOPRENE	0AHE5	348-1288-00
-4	103-0327-00		2	ADAPTER,LED:DELRIN, 0.20ID	80009	103032700
	070-8531-02		1	MANUAL,TECH:USER,J17/J1800 SERIES	80009	070853102
-5	--------		1	J1806,RADIANCE HEAD:8 DEG ACCEPTANCE ANGLE		
				STANDARD ACCESSORIES		
-6	348-1287-00		1	SUCTION CUP:NEOPRENE,ETDM,SHORE 50	0AHE5	348-1287-00
-7	348-1288-00		1	RETAINER,RUBBER:BLACK,NEOPRENE	0AHE5	348-1288-00
	070-8531-02		1	MANUAL,TECH:USER,J17/J1800 SERIES	80009	070853102

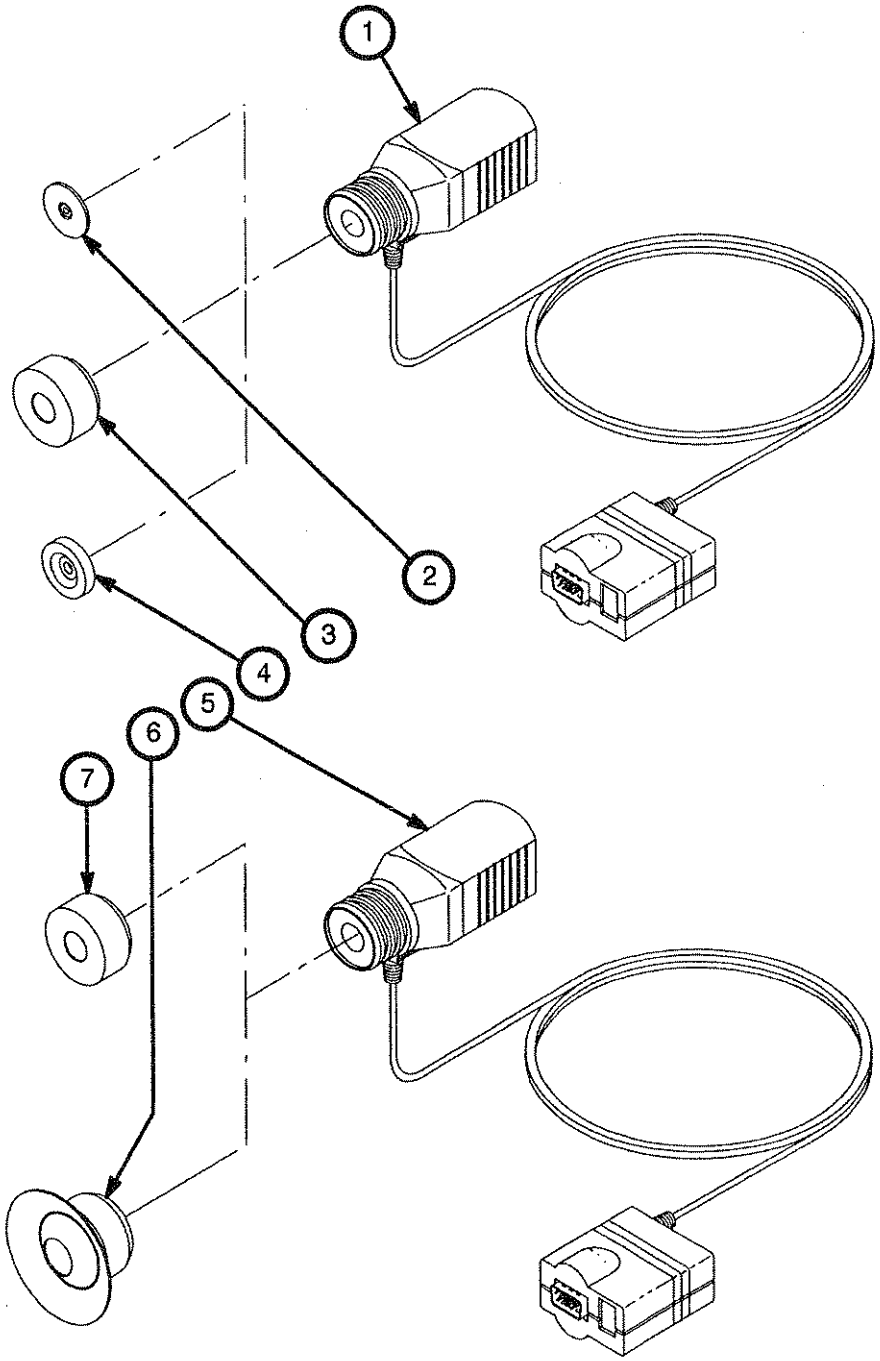


Figure A-19: J1805 and J1806 Replaceable Parts

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
A-20–1	––––––––			1	J1811,ILLUMINANCE HD:COSINE CORRECTED HEAD		
					STANDARD ACCESSORIES		
–2	200–1644–00			1	COVER,PROBE:PLASTIC,BLACK	80009	200164400
	070–8531–02			1	MANUAL,TECH:USER,J17/J1800 SERIES	80009	070853102
–3	––––––––			1	J1812,IRRADIANCE HEAD:REMOTE		
					STANDARD ACCESSORIES		
–4	200–1644–00			1	COVER,PROBE:PLASTIC,BLACK	80009	200164400
	070–8531–02			1	MANUAL,TECH:USER,J17/J1800 SERIES	80009	070853102

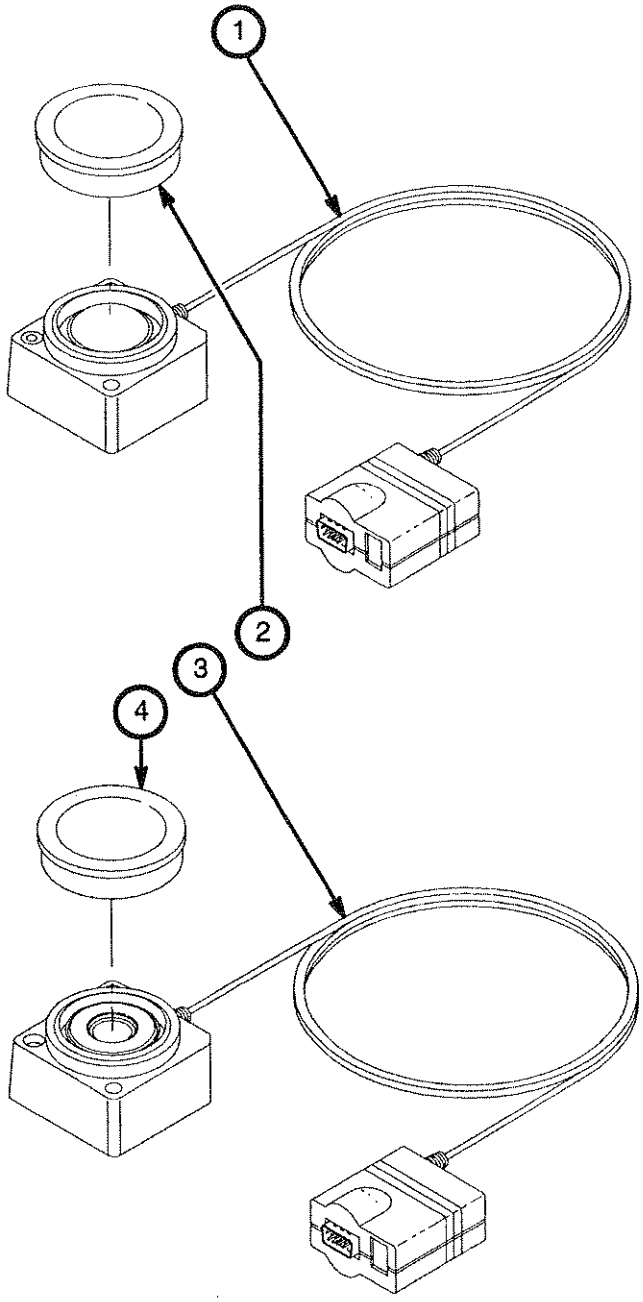


Figure A-20: J1811 and J1812 Replaceable Parts

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
A-21-1	---------			1	J1823,LUMINANCE HEAD:1 DEG ACCEPTANCE ANGLE		
	---------			1	J1823;01,LUMINANCE HEAD:I/3 DEG ACCEPTANCE ANGLE		
-2	366-1150-02			1	KNOB:SIL GY,.5M TO INF,0.252 IDX 1.452 OD	80009	366115002
					STANDARD ACCESSORIES		
-3	200-1835-00			1	COVER,LENS:FRONT	80009	200183500
-4	200-1836-00			1	COVER,LENS:REAR	TK0503	ORDER BY DESC
	070-8531-02			1	MANUAL,TECH:USER,J17/J1800 SERIES	80009	070853102

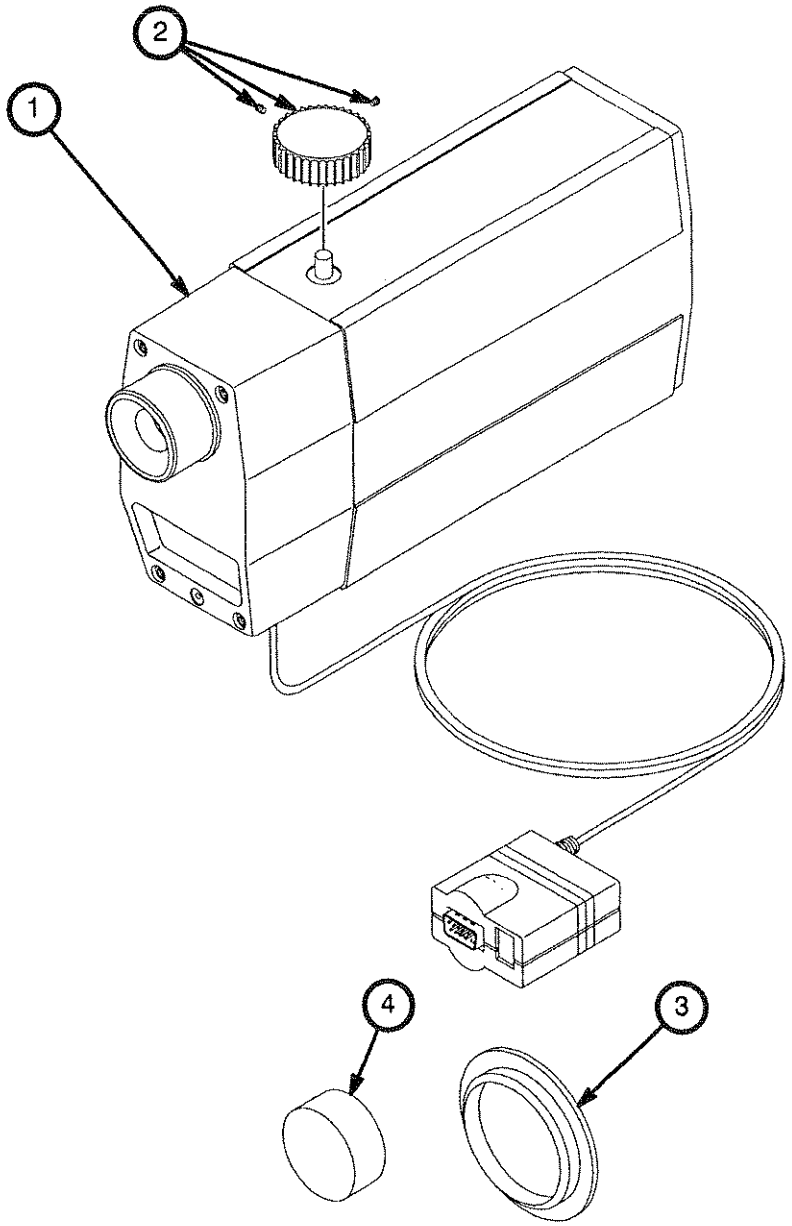


Figure A-21: J1823 Replaceable Parts

Glossary and Index

Glossary

Area Source
A light source of large angular size.

Blackbody (Planckian Radiator)
A thermal light source having light produced by heating. The intensity and color of a blackbody are primarily dependent on operating temperature.

Chromaticity
The quality of color. Based on wavelength and purity.

Color Temperature
The absolute temperature, in kelvin, of a blackbody required to produce an equivalent chromaticity from a light source.

Correlated Color Temperature
The absolute temperature of a blackbody required to most closely match the chromaticity of a light source.

Illuminance
The amount of luminous flux received by a unit of surface area. Usually measured in lux (lumens/meter^2) or foot-candles with a sensor spectrally matched to the average human eye.

Inverse Square Law
The falloff of light with distance; light varies inversely with the square of the distance from the source.

Irradiance

The amount of radiant flux received by a unit of surface area. Usually measured in watts/meter^2 or watts/cm^2 with a sensor having equal spectral sensitivity to the wavelengths being measured.

Isotropic Source

A light source that emits light uniformly in all directions.

Luminance

The amount of light emitted or scattered by a surface. Usually measured in candelas/meter^2 (nits)or foot-lamberts with a sensor spectrally matched to the average human eye.

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) with a sensor spectrally matched to the average human eye.

Photometry

Measurement of light as seen by the human eye.

Photopic Correction

The correction of a sensor to match the CIE sensitivity function of the average human eye.

Point Source

A light source of small angular size, such that light appears to come from a point.

Radiance

The amount of radiant energy emitted or scattered by a surface. Usually measured in watts/meter^2/steradian with a sensor having equal spectral sensitivity to all wavelengths being measured.

Radiant Flux

The total radiation from a source, measured in watts with a sensor having equal spectral sensitivity to the wavelengths being measured.

Radiant Intensity

The radiant flux through a unit of solid angle. Usually measured in watts/steradian with a sensor having equal spectral sensitivity to the wavelengths being measured.

Radiometry

The measurement of radiant power. A radiometric sensor is equally sensitive to all wavelengths present in the light being measured.

Reflectance Factor

The ratio of reflected light to received light on a surface.

Tristimulus Values (X,Y,Z)

The amounts of each of three color primaries required to match the color of a light.

R

S

T

U

V

W

X

Glossary

Area Source
A light source of large angular size.

Blackbody (Planckian Radiator)
A thermal light source having light produced by heating. The intensity and color of a blackbody are primarily dependent on operating temperature.

Chromaticity
The quality of color. Based on wavelength and purity.

Color Temperature
The absolute temperature, in kelvin, of a blackbody required to produce an equivalent chromaticity from a light source.

Correlated Color Temperature
The absolute temperature of a blackbody required to most closely match the chromaticity of a light source.

Illuminance
The amount of luminous flux received by a unit of surface area. Usually measured in lux (lumens/meter^2) or foot-candles with a sensor spectrally matched to the average human eye.

Inverse Square Law
The falloff of light with distance; light varies inversely with the square of the distance from the source.

Irradiance

The amount of radiant flux received by a unit of surface area. Usually measured in watts/meter^2 or watts/cm^2 with a sensor having equal spectral sensitivity to the wavelengths being measured.

Isotropic Source

A light source that emits light uniformly in all directions.

Luminance

The amount of light emitted or scattered by a surface. Usually measured in candelas/meter^2 (nits)or foot-lamberts with a sensor spectrally matched to the average human eye.

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) with a sensor spectrally matched to the average human eye.

Photometry

Measurement of light as seen by the human eye.

Photopic Correction

The correction of a sensor to match the CIE sensitivity function of the average human eye.

Point Source

A light source of small angular size, such that light appears to come from a point.

Radiance

The amount of radiant energy emitted or scattered by a surface. Usually measured in watts/meter^2/steradian with a sensor having equal spectral sensitivity to all wavelengths being measured.

Radiant Flux

The total radiation from a source, measured in watts with a sensor having equal spectral sensitivity to the wavelengths being measured.

Radiant Intensity

The radiant flux through a unit of solid angle. Usually measured in watts/steradian with a sensor having equal spectral sensitivity to the wavelengths being measured.

Radiometry

The measurement of radiant power. A radiometric sensor is equally sensitive to all wavelengths present in the light being measured.

Reflectance Factor

The ratio of reflected light to received light on a surface.

Tristimulus Values (X,Y,Z)

The amounts of each of three color primaries required to match the color of a light.

Index

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