



**J1800 Series
LumaColor™ Photometer
Sensor Heads
Technical Reference**

070-9017-03



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General Safety Summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it.

Only qualified personnel should perform service procedures.

While using this product, you may need to access other parts of the system. Read the *General Safety Summary* in other system manuals for warnings and cautions related to operating the system.

Injury Precautions

Do Not Operate in Wet/Damp Conditions

To avoid electric shock, do not operate this product in wet or damp conditions.

Do Not Operate in Explosive Atmosphere

To avoid injury or fire hazard, do not operate this product in an explosive atmosphere.

Wear Eye Protection

To avoid eye injury, wear eye protection if there is a possibility of exposure to high-intensity rays.

Product Damage Precautions

Use Proper Power Source

Do not operate this product from a power source that applies more than the voltage specified.

Do Not Operate With Suspected Failures

If you suspect there is damage to this product, have it inspected by qualified service personnel.

Do Not Immerse in Liquids

Clean the probe using only a damp cloth. Refer to cleaning instructions.

Safety Terms and Symbols

Terms in This Manual

These terms may appear in this manual:



WARNING. *Warning statements identify conditions or practices that could result in injury or loss of life.*



CAUTION. *Caution statements identify conditions or practices that could result in damage to this product or other property.*

Terms on the Product

These terms may appear on the product:

DANGER indicates an injury hazard immediately accessible as you read the marking.

WARNING indicates an injury hazard not immediately accessible as you read the marking.

CAUTION indicates a hazard to property including the product.

Symbols on the Product

The following symbols may appear on the product:



DANGER
High Voltage



Protective Ground
(Earth) Terminal



ATTENTION
Refer to
Manual



Double
Insulated



Preface

This is the Technical Reference manual for the J1800-series sensor-heads for the J17 and J18 photometers. This manual contains the installation, operation, specification, verification, and replaceable parts information for all of the J1800-series sensor-heads.

Information concerning the operation of the J17 or J18 photometers is located in the photometer Instruction Manuals.

This manual is organized in the following sequence:

- Safety Information
- Sensor Technical Information
- Maintenance
- Replaceable Parts Lists
- Appendices

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



Sensor Technical Information

J1803 Luminance Head

The J1803 Luminance Head is designed for use in making display or lighting luminance measurements in cd/m^2 (NITS) and footlamberts.

The J1803 features super-accurate correction (patent pending), allowing measurement of spectrally differing light sources.

The J1803 and standard accessories are shown in Figure 1-1.

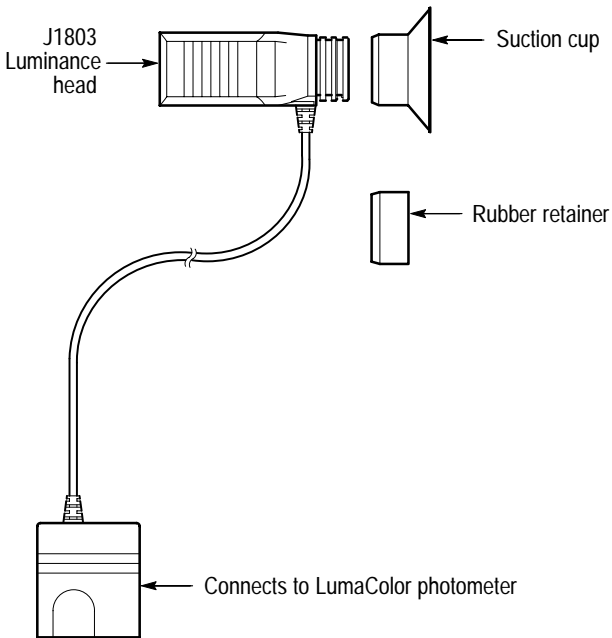


Figure 1-1: The J1803 Luminance head

Unpacking the J1803

The J1803 is shipped with the following items:

- J1803 luminance head
- Technical Reference (this manual)
- Rubber retainer
- Suction cup

Refer to the *Replaceable Parts* section for ordering and part number information.

Operating Characteristics

For surface luminance and display measurements, the J1803 field of view must be completely and uniformly filled.

The J1803 has an acceptance angle of approximately eight degrees. This corresponds to a 1.7-inch (43 mm) diameter circle at a distance of one foot from the sensor. The diameter measured is proportionally greater as distance increases.

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 minimum viewing diameter of the J1803, using the suction cup in contact with the surface to be measured, is approximately 0.5 inches (12.7 mm).

Operating Examples

This section provides examples for taking measurements with the J1803.

Display Luminance Measurements

To take a display luminance measurement, follow these steps:

1. Cover the sensor head and connect it to the photometer.
2. Power on the photometer. Do not uncover the sensor head or move its cable until the photometer self-test is complete.
3. Turn the monitor on and set the brightness and contrast settings.
4. Attach the rubber suction cup or retainer ring to the J1803 and position the J1803 on the monitor. Refer to Figure 1–2.

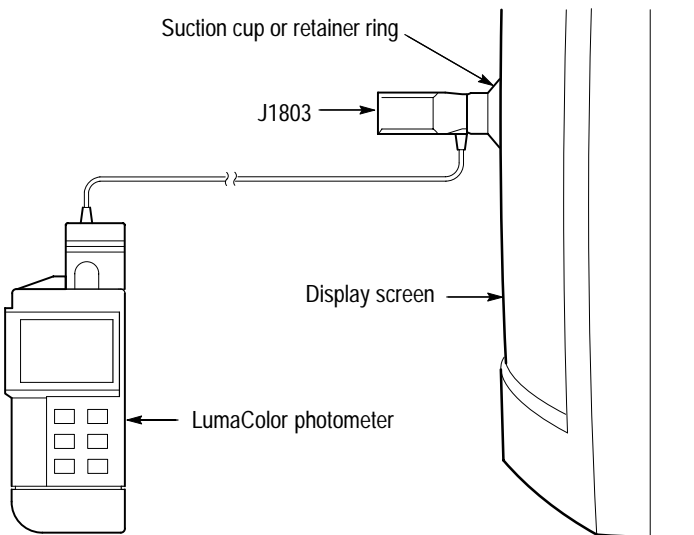


Figure 1–2: J1803 setup for display luminance measurements

5. Read the luminance value from the photometer display.
The luminance value is updated continuously.

Luminance Measurement of an Illuminated Surface

To take a luminance measurement from an illuminated surface, follow these steps:

1. Cover the sensor head and connect it to the photometer.
2. Power on the photometer. Do not uncover the sensor head or move its cable until the self-test is complete.
3. Point the J1803 at the surface to be measured, at the desired distance from the surface. Refer to Figure 1–3.

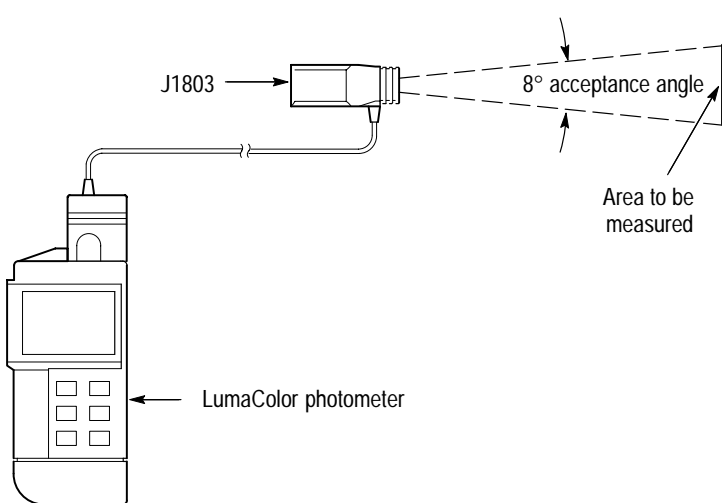


Figure 1–3: J1803 setup for luminance measurement of an illuminated surface

4. Read the luminance value from the photometer display.
The luminance value is updated continuously.

NOTE. For accurate readings, position the J1803 so that the surface to be measured uniformly fills the measurement field. The acceptance angle of the J1803 head is 8°. See Operating Characteristics on page 1–2.

Special Considerations

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

- 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 the direction of the illumination.
- Do not operate the head in direct contact with the surface. Reflections may occur between the front surface of the sensor-head and the surface to be measured. Placing the head too close to the surface may also cause shadowing.

The suction cup or rubber retainer provides adequate space between the sensor-head and the surface to prevent reflection on backlighted surfaces.

Specifications

Tables 1–1 to 1–3 list the specifications of the J1803.

Table 1–1: J1803 performance characteristics

Characteristic	Standard
Accuracy (including non-linearity)	5% of reading \pm 2 counts (Illuminant A at 150 cd/m ² , 20° C to 30° C, <75% relative humidity)
Spectral Response	See Figure A–1 on page A–4.
Spectral Accuracy	$f_1' = <3\%$ (DIN class A)
Acceptance Angle	8° (1.7 inch diameter at 1 foot; minimum area of 0.5 inches) (43 mm diameter at 0.3 m; minimum area of 12.7 mm)

Table 1–2: J1803 typical physical 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)
Cable Length	3.5 feet (1.1 m)

Table 1–3: J1803 environmental characteristics

Characteristic	Standard
Temperature	Meets MIL Std 28800E Class 3 Nonoperating: -62°C to $+85^{\circ}\text{C}$ Operating: -15°C to $+55^{\circ}\text{C}$
Humidity	48 hours at 97% relative humidity (30°C to 60°C) Modified MIL Std 28800E
EMC Compliance	Meets the intent of Directive 89/336/EEC for Electromagnetic Compatibility when it is used with the product(s) stated in the specifications table. Refer to the EMC specification published for the stated products. May not meet the intent of the Directive if used with other products.
FCC Compliance	Emissions comply with FCC Code of Federal Regulations 47, Part 15, Subpart B, Class A Limits.

Performance Verification

Use this procedure to verify that the photometer and J1803 are functioning correctly.

For best results, follow these guidelines:

- Hold the sensor steady while taking measurements.
- Make certain that the light source fills the sensor field of view.

To verify the photometer and the J1803 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 $\pm 5\%$ luminance characteristic.
1. Cover the sensor head and connect it to the photometer.
 2. Power on the photometer. The photometer will perform its self-test, briefly displaying all elements on the display. Do not uncover the sensor head or move its cable until the self-test is complete.
 3. Point the J1803 at the light source. Refer to Figure 1–4. Use the following guidelines when positioning the J1803:
 - 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 is eight degrees.
 - Make sure that the area being viewed by the J1803 is uniformly illuminated, and that the J1803 entire field of view is filled by the surface you are measuring.
 - The J1803 should be perpendicular to the surface of the light source.
 - Operating the sensor-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 the suction cup or the retainer ring to provide adequate spacing to prevent reflections.

The distance from the J1803 to the light source is not critical, provided the above guidelines are met. If the reading changes when the distance is changed, verify that you are meeting the position guidelines.

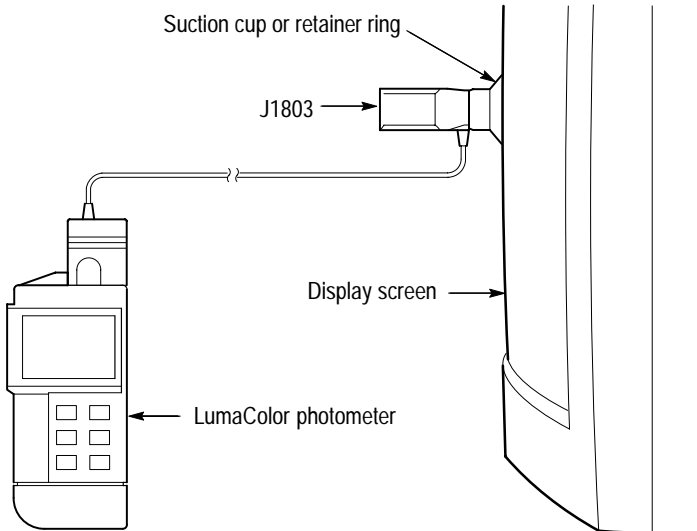


Figure 1-4: Setup for verification of the photometer with the J1803

4. Press the sensor-head onto the display and read the luminance value. 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 footlamberts, press the **UNITS** button.

5. Verify that the reading on the photometer display is within $\pm 5\%$ of the known luminance value of the light source.

J1805 LED Head

The J1805 LED Head is designed for measuring the light output of red, yellow, green, and blue LEDs in candelas, millicandelas, or microcandelas.

The J1805 features super-accurate correction for measurement of all visible LED colors.

The J1805 and standard accessories are shown in Figure 1–5.

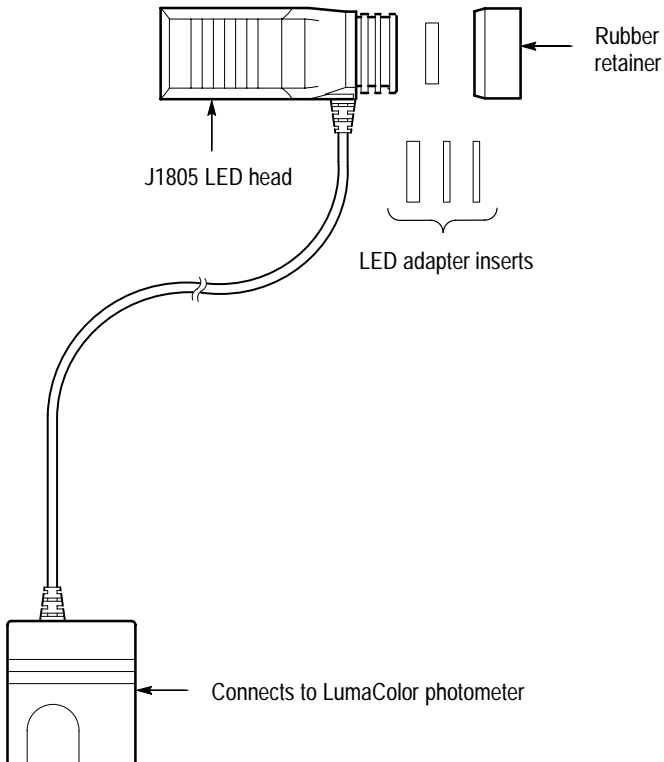


Figure 1–5: The J1805 LED head

Unpacking the J1805

The J1805 is shipped with the following items:

- J1805 LED head
- Technical Reference (this manual)
- LED adapter inserts (0.120 inch and 0.200 inch)
(3 mm and 5.1 mm)
- Rubber retainer

Refer to the *Replaceable Parts* section for ordering and part number information.

Operating Characteristics

Intercept Angle

When the emitting plane of the LED is located at the front surface of the J1805, the J1805 samples an angle of 3° at 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 T1^{3/4}-size LEDs. Other LED sizes may be accommodated by drilling the supplied adapters for a larger size, or by making 1-inch (2.54 cm) 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. (See Figure 1–6.)

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 designed so the sensor samples about 3° at the center of the LED beam, as shown in Figure 1–6.

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

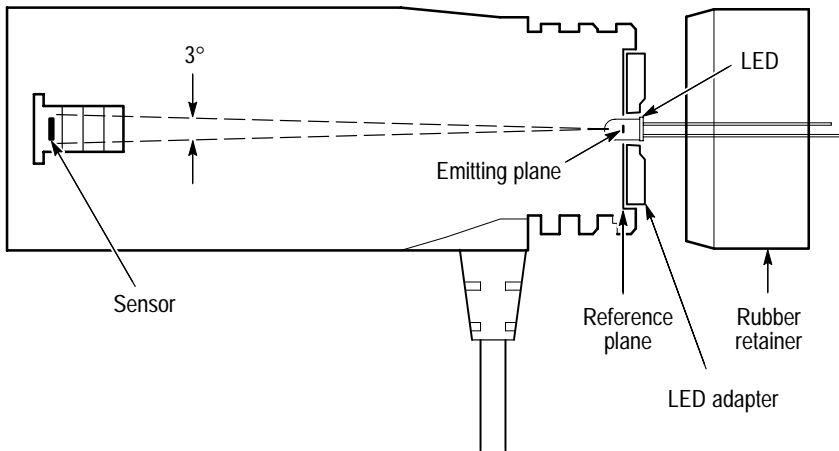


Figure 1–6: LED measurement geometry

LED Measurements

Use the LumaColor photometer and J1805 to measure the luminous intensity of red, yellow, green, and blue LEDs.

To take LED luminous intensity measurements, follow these steps:

1. Cover the sensor head and connect it to the photometer.
2. Power on the photometer. Do not uncover the sensor head or move its cable until the self-test is complete.
3. 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, be sure the correct opening faces out from the J1805.

4. Position the J1805 head over the LED. Refer to Figure 1–7.

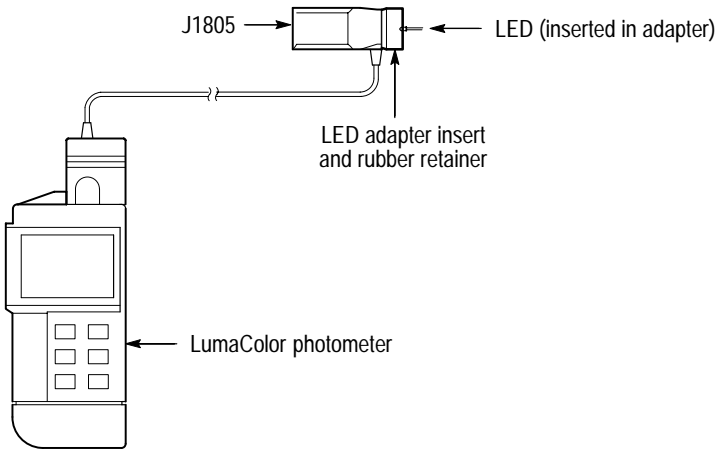


Figure 1–7: J1805 setup for LED luminous intensity measurements

5. Press the **COLOR** button if you are using a J17 to select the appropriate color correction factor. The photometer will step through white, red, yellow, green, and blue sequentially each time you press the **COLOR** button.

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

6. Read the luminous intensity value from the photometer display. The readout is updated continuously.

Special Considerations

For accurate measurements, observe the following when positioning the J1805 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.

Specifications

Tables 1–4 to 1–6 list the specifications of the J1803.

Table 1–4: J1805 performance characteristics

Characteristic	Standard
Accuracy (including non-linearity)	5% of reading \pm 2 counts (Illuminant A at 1000 cd/m ² , 20° C to 30° C, <75% relative humidity)
Spectral Response	CIE photopic (See Figure A-1 on page A-4)
Spectral Accuracy	$f_1' = <3\%$ (DIN class A)
Acceptance Angle	Intercepts 3° of LED beam

Table 1–5: J1805 typical physical 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)
Cable Length	3.5 feet (1.1 m)

Table 1–6: J1805 environmental characteristics

Characteristic	Standard
Temperature	Meets MIL Std 28800E Class 3 Nonoperating: -62°C to $+85^{\circ}\text{C}$ Operating: -15°C to $+55^{\circ}\text{C}$
Humidity	48 hours at 97% relative humidity (30°C to 60°C) Modified MIL Std 28800E
EMC Compliance	Meets the intent of Directive 89/336/EEC for Electromagnetic Compatibility when it is used with the product(s) stated in the specifications table. Refer to the EMC specification published for the stated products. May not meet the intent of the Directive if used with other products.
FCC Compliance	Emissions comply with FCC Code of Federal Regulations 47, Part 15, Subpart B, Class A Limits.

Performance Verification

Use the procedures in this section to verify that the photometer and J1805 sensor-head are functioning correctly.

For best results, follow these guidelines:

- Cover and connect the sensor-head to the photometer before turning the power on.

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

- Hold the sensor-head steady while taking measurements.
- Make certain that the light source fills the sensor field of view.

To verify the photometer and the J1805, you will need the following:

- Calibrated LED and power supply. The LED should be traceable to NIST standards, with adequate accuracy to verify the $\pm 5\%$ luminous intensity characteristic.
1. Cover the sensor head and connect it to the photometer.
 2. Power on the photometer. Do not uncover the sensor head or move its cable until the self-test is complete.
 3. Select the correct LED insert for the size of your LED, and secure it to the J1805 using the rubber retainer. Refer to Figure 1–8.

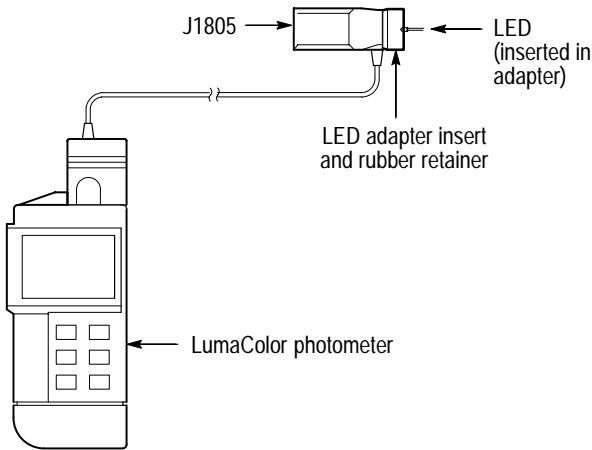


Figure 1-8: Setup for verification of the photometer with the J1805

Remember that each LED insert has a recessed side. For correct spacing between the LED emitting plane and the J1805, be sure the correct opening faces out from the J1805.

4. Position the J1805 over the LED.

For accurate measurements, observe the following when positioning the J1805 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.

5. Read the luminous intensity value from the photometer 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.
6. Verify that the reading on the photometer display is within $\pm 5\%$ of the known luminous intensity of the LED.



CAUTION. *Do not operate the reference LED above the calibrated operating current. Damage to the LED may result.*

The output of the LED will change depending on temperature, current, and time. The reference LED must be operated at the calibrated conditions for accurate results. Operate the reference LED for as short a period as possible to minimize any aging effects.

J1806 Radiance Head

The J1806 Radiance Head is designed for quickly verifying or resetting the color balance of a display. The display should first be color characterized using either a J17 with a J1820 chromaticity head, or using a J18 with a J1810 chromaticity head.

The J1806 has a flat spectral response $\pm 8\%$ from 450 nm to 750 nm due to its stable multi-element laminated glass photopic filters. Readings taken are measured in watts/meter²/steradian.

The J1806 features are shown in Figure 1-9.

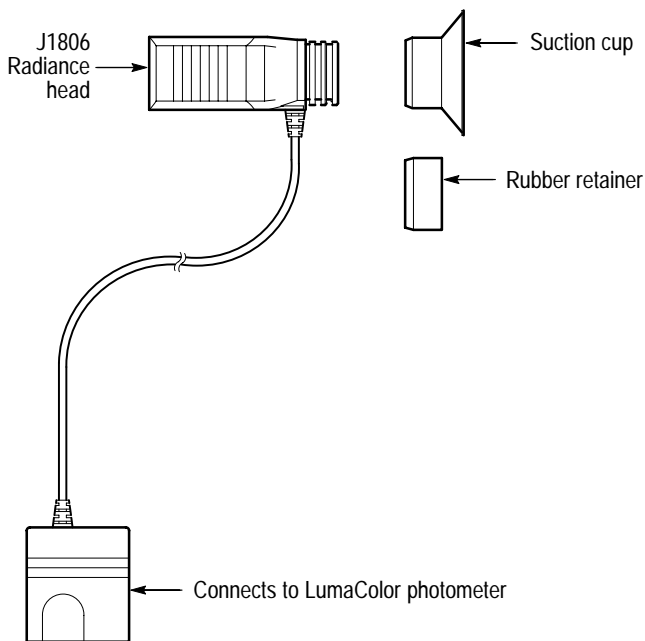


Figure 1-9: The J1806 Radiance head

Unpacking the J1806

The J1806 is shipped with the following items:

- J1806 Radiance Head
- Technical Reference (this manual)
- Rubber retainer
- Suction cup

Refer to the *Replaceable Parts* section for ordering and part number information.

Operating Characteristics

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

The J1806 has an acceptance angle (or cone of acceptance) of approximately eight degrees. This corresponds to a 1.7-inch (4.3 cm) 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 (43 cm at 3 m) 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 minimum viewing diameter of the J1806, using the suction cup in contact with the surface to be measured, is approximately 0.5 inches (1.27 cm).

Operating Examples

This section provides instructions for performing measurements using the J1806.

Surface Radiance Measurements

To measure surface radiance, follow these instructions:

1. Cover the sensor head and connect it to the photometer.
2. Power on the photometer. Do not uncover the sensor head or move its cable until the self-test is complete.
3. 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. Refer to Figure 1–10.

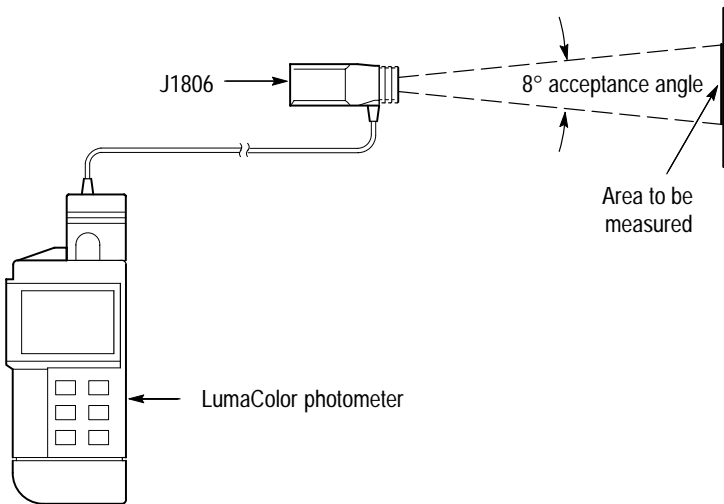


Figure 1–10: J1806 setup for surface radiance measurements

4. Read the radiance value from the photometer display. The units will be watts/meter²/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 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 sensor-head in contact with the surface is not recommended, because reflections may occur between the front surface of the sensor-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 sensor-head and the surface to prevent reflection on backlit surfaces.

Use the rubber retainer to secure 1-inch diameter (2.54 cm) narrow-band or neutral density filters, diffusers, or apertures to the J1806 for special requirements.

CRT Display Color Balance

To adjust the color balance of a CRT display, follow these instructions:

1. Cover the sensor head and connect it to the photometer.
2. Power on the photometer. Do not uncover the sensor head or move its cable until the self-test is complete.
3. Use a display that has been adjusted to the desired color temperature and color balance. This will provide the reference data for future adjustments.

4. Attach the suction cup to the J1806 and position the J1806 on the monitor in the center of the pattern. Refer to Figure 1–11.

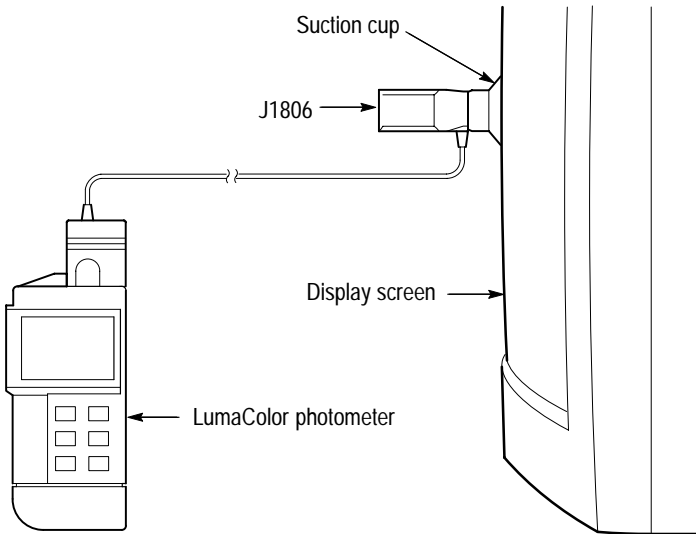


Figure 1–11: J1806 setup for CRT display color balance

5. 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.

6. Turn off the generator green and blue drive for a red pattern.
7. With the J1806 in the center of the red pattern, read and record the radiance value from the photometer display. This value will be used to reestablish exactly the same white field in the future for this or other similar displays.
8. Repeat steps 5 through 7 for green and blue patterns.

9. Repeat steps 5 through 8 for a drive level of 10 IRE units. This is to ensure correct color tracking at both high and low drive levels.
10. Use the data previously obtained to reset the display color-balance in the future..
11. 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 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 photometer display indicates near zero.
- Allow adequate warmup time for the CRT cathodes to stabilize before making measurements or adjustments.

Specifications

Tables 1–7 to 1–9 list the J1806 specifications.

Table 1–7: J1806 performance characteristics

Characteristic	Standard
Accuracy (including non-linearity)	5% of reading \pm 2 counts (Illuminant A with 656 nm filter 20° C to 30° C, <75% relative humidity)
Spectral Response	Flat \pm 8% from 450 nm to 750 nm
Acceptance Angle	8° (1.7 inch diameter/foot; minimum area of 0.5 inches)

Table 1–8: J1806 typical physical 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)
Cable Length	3.5 feet (1.1 m)

Table 1–9: J1806 environmental characteristics

Characteristic	Standard
Temperature	Meets MIL Std 28800E Class 3 Nonoperating: -62°C to $+85^{\circ}\text{C}$ Operating: -15°C to $+55^{\circ}\text{C}$
Humidity	48 hours at 97% relative humidity (30°C to 60°C) Modified MIL Std 28800E

Table 1–9: J1806 environmental characteristics (Cont.)

Characteristic	Standard
EMC Compliance	Meets the intent of Directive 89/336/EEC for Electromagnetic Compatibility when it is used with the product(s) stated in the specifications table. Refer to the EMC specification published for the stated products. May not meet the intent of the Directive if used with other products.
FCC Compliance	Emissions comply with FCC Code of Federal Regulations 47, Part 15, Subpart B, Class A Limits.

Performance Verification

Use the procedures in this section to verify that the photometer and J1806 are functioning correctly.

For best results, follow these guidelines:

- Cover and connect the sensor-head to the photometer before turning the power on.

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

- Hold the sensor steady while taking measurements.
- Make certain that the light source fills the sensor field of view.

To verify the photometer and the J1806, 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 1–12 shows a suitable source configuration.
 - Spectroradiometer, traceable to NIST standards, with adequate accuracy to verify the $\pm 5\%$ radiance characteristic.
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.

2. Cover the sensor head and connect it to the photometer.
3. Power on the photometer. Do not uncover the sensor head or move its cable until the self-test is complete.
4. Point the J1806 at the diffuser. Refer to Figure 1–12. 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 8°.
 - 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 sensor-head in direct contact with the surface is not recommended, because reflections may occur between the front surface of the sensor-head and the surface to be measured. Use of the suction cup or light shield provides adequate spacing to prevent reflections.

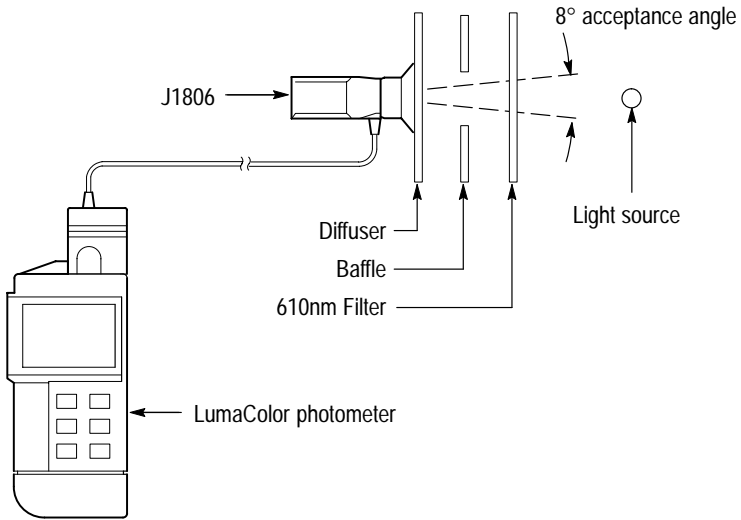


Figure 1-12: Setup for verification of the photometer with the J1806

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.

5. Read the radiance value from the photometer 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.
6. Verify that the reading on the photometer display is within $\pm 5\%$ of the known radiance value of the light source, as measured by the spectroradiometer in step 1.

J1810 Chromaticity Head

The J1810 reads chromaticity in either the 1931 CIE system or the 1976 CIE-UCS system.

NOTE. The J1810 Chromaticity Head will work only with the J18.

The J1810 features are shown in Figure 1–13.

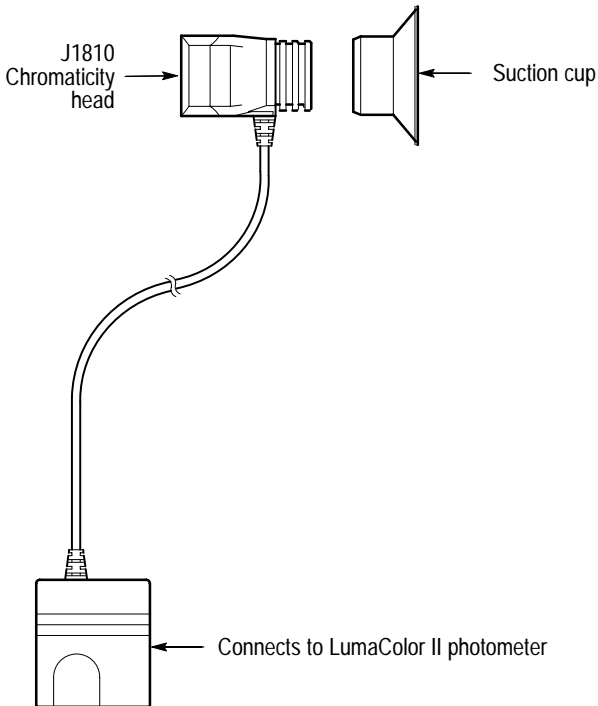


Figure 1–13: The J1810 Chromaticity head

Unpacking the J1810

The J1810 is shipped with the following items:

- J1810 Chromaticity head
- Technical Reference (this manual)
- Suction cup

Refer to Figure 1–13.

Operating Characteristics

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

Acceptance Angle and Measurement Field

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

The J1810 has an acceptance angle of 16° . This means that the measurement field of the J1810 is approximately 3.4 inches (8.6 cm) in diameter at a distance of 1 foot (0.30 m), and is proportionately larger at greater distances (34 inches at 10 feet or 0.86 m at 3.0 m).

The minimum viewing diameter of the J1810, using the light shield or suction cup in contact with the surface to be measured, is approximately 1.0 inches (2.54 cm).

Measurement Units

The J18 photometer provides chromaticity readings in either the 1931 CIE system or the 1976 CIE-UCS system. The XYZ tristimulus values, as read by the J1810's XYZ sensors, are used to calculate the chromaticity.

The J18 will display either xy , $u'v'$, or XYZ values. Press the **ALT DISPLAY** button to step through the three coordinate systems.

The *Chromaticity Reference* section starting on page B-1 contains diagrams that can be used to interpret chromaticity readings.

Selecting the Luminance and Color Temperature

To display the luminance value, press the **UNITS** button on the photometer. The luminance value will be displayed in cd/m^2 , fL, or it can be displayed as a color temperature in Kelvin units. Press the **UNITS** button to step through the available units.

Correlated color temperature can be displayed from 2000 K to 9900 K. Using correlated color temperature as the only reference for calibrating a display may result in incorrect display calibration.

Light levels below ~ 1 fL ($3.4 \text{ cd}/\text{m}^2$) are displayed as zeros in the xy and $u'v'$ coordinate systems. Zeros are displayed to prevent errors when measuring light levels below the accurate range of the photometer.

Operating Examples

This section provides instructions for performing measurements using the J1810.

Display Chromaticity Measurements

You can use the J18 photometer and the J1810 to measure chromaticity and luminance of display monitors.

To take display measurements, follow these instructions:

1. Cover the sensor head and connect it to the photometer.

2. Power on the photometer. Do not uncover the sensor head or move its cable until the self-test is complete.
3. Attach the suction cup to the J1810 and position the J1810 on the display. Refer to Figure 1-14.

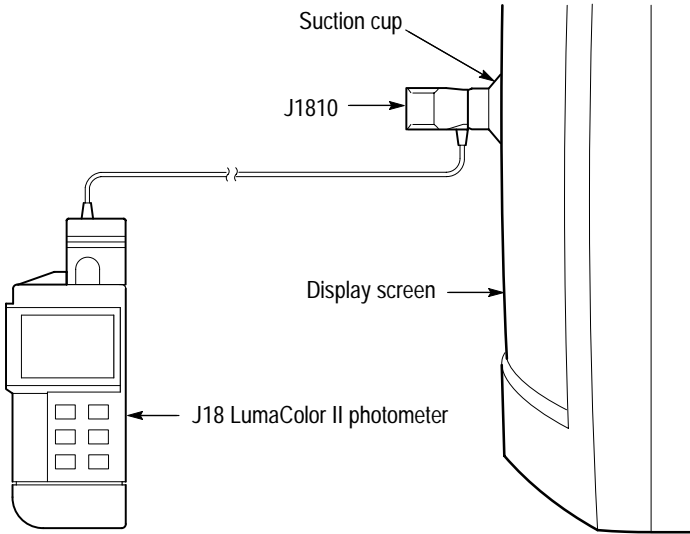


Figure 1-14: J1810 setup for display chromaticity measurements

4. Press the **ALT DISP** button to select the coordinate system.
5. Press the **UNITS** button to select the measurement units.
6. For best accuracy, repeat the measurement to ensure that the display under test has remained stable.

NOTE. At power on, the J18 photometer returns to the mode used prior to being powered off. If the photometer powers on in the differential mode, press the **HOLD/RUN** button to return to the direct measurement mode.

Refer to the *J18 Photometer Instruction Manual* for more information on using the J1810 sensor head with the J18 photometer.

Light Source Measurements

To take light source measurements using the J18 and the J1810:

1. Cover the sensor head and connect it to the photometer.
2. Power on the photometer. Do not uncover the sensor head or move its cable until the self-test is complete.
3. Point the J1810 toward the light source, choosing a distance to ensure that the entire field of view is filled by the light source. Refer to Figure 1–15. (The acceptance angle of the J1810 is 16° . See *Operating Characteristics*, on page 1–32.)

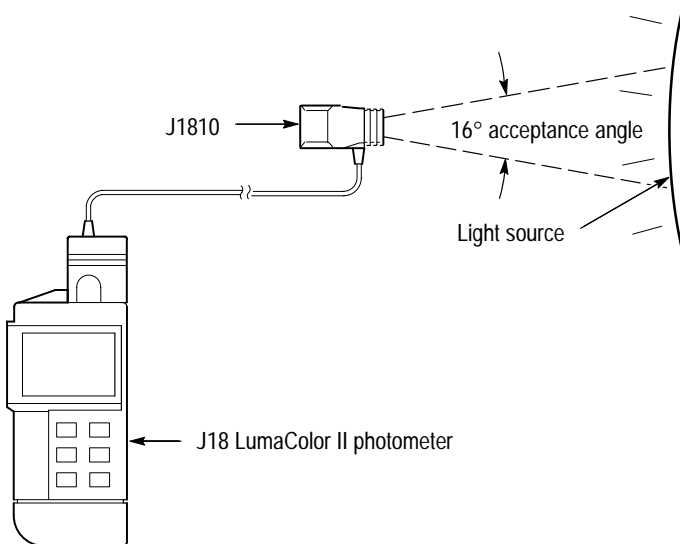


Figure 1–15: J1810 setup for light source measurements

4. Press the **ALT DISP** button to select the coordinate system.

5. Press the **UNITS** button to select the measurement units.
6. For best accuracy, repeat the measurement to ensure that the light source under test has remained stable.

Chromaticity Measurement of an Illuminated Surface

The J1810 can be used to measure the chromaticity of light reflected from signs, walls, work surfaces, and other surfaces.

To take chromaticity measurements from an illuminated surface, follow these instructions:

1. Cover the sensor head and connect it to the photometer.
2. Power on the photometer. Do not uncover the sensor head or move its cable until the self-test is complete.
3. Point the J1810 head at the surface to be measured, at the desired distance from the surface. Refer to Figure 1–16.

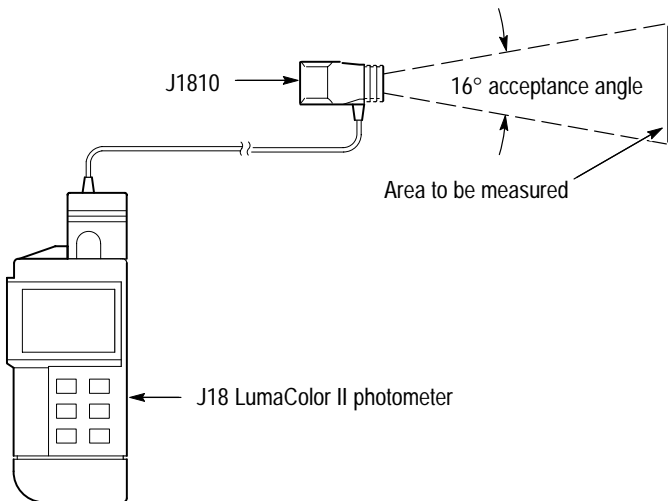


Figure 1–16: J1810 setup for chromaticity measurement of an illuminated surface

NOTE. For accurate readings, position the J1810 so that the entire measurement field is uniformly filled by the surface to be measured. The acceptance angle of the J1810 is 16°. See Operating Characteristics, on page 1–32.

4. Press the **ALT DISP** button to select the coordinate system.
5. Press the **UNITS** button to select the measurement units.
6. For best accuracy, repeat the measurement to ensure that the display under test has remained stable.

Specifications

Tables 1–10 to 1–12 list the J1810 specifications.

Table 1–10: J1810 performance characteristics

Characteristic	Standard
Accuracy (including non-linearity)	Within ± 0.009 of x,y value and $\pm 5\%$ of luminance (D6500, 20° C to 30° C, <75% relative humidity)
Spectral Response	CIE Tristimulus
Spectral Accuracy	$f_1' = <3\%$ (DIN class A)
Acceptance Angle	16°

Table 1–11: J1810 typical physical 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)
Cable length	3.5 feet (1.1 m)

Table 1–12: J1810 environmental characteristics

Characteristic	Standard
Temperature	Operating: -15°C to $+55^{\circ}\text{C}$ Nonoperating: -62°C to $+85^{\circ}\text{C}$ Per Tektronix Standard 062-2847-00
Humidity	48 hours at 97% relative humidity (30°C to 60°C) Per Tektronix Standard 062-2847-00
EMC Compliance	Meets the intent of Directive 89/336/EEC for Electromagnetic Compatibility when it is used with the product(s) stated in the specifications table. Refer to the EMC specification published for the stated products. May not meet the intent of the Directive if used with other products.
FCC Compliance	Emissions comply with FCC Code of Federal Regulations 47, Part 15, Subpart B, Class A Limits.

Performance Verification

Use the procedures in this section to verify that the photometer and J1810 sensor head are functioning correctly.

To verify the J18 and the J1810, you will need a diffuse phosphor light source, providing light with known chromaticity and luminance values, approximately 6500 K. The light source should be traceable to NIST standards, with adequate accuracy to verify the $\pm 5\%$ luminance accuracy and the ± 0.009 xy chromaticity accuracy.

1. Cover the sensor head and connect it to the photometer.
2. Power on the photometer. Do not uncover the sensor head or move its cable until the self-test is complete.

3. Point the J1810 at the light source. When positioning the J1810, observe the following guidelines (refer to Figure 1–17):
 - Make sure that the area being viewed by the J1810 is uniformly illuminated, and that the entire field of view of the J1810 is filled by the surface you are measuring. The acceptance angle of the J1810 is 16°.
 - The J1810 should be perpendicular to the surface being measured.
 - Operating the sensor head in direct contact with the surface is not recommended, because reflections may occur between the front surface of the sensor head and the surface to be measured. Use of the suction cup provides adequate spacing to prevent reflections.

The distance from the J1810 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.

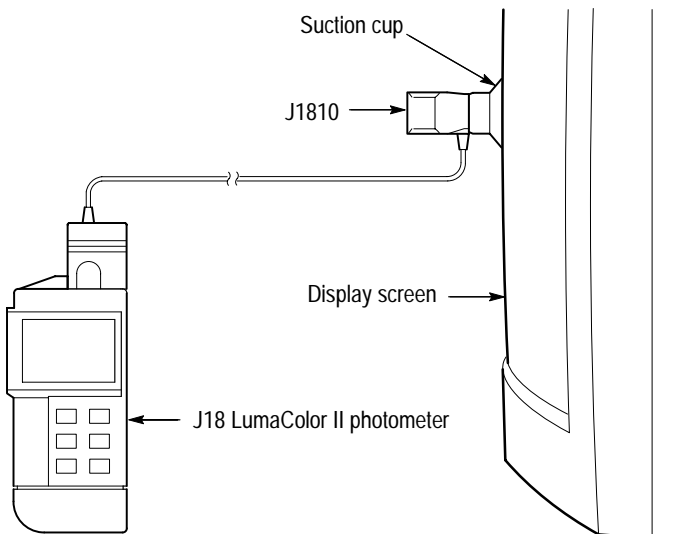


Figure 1–17: Setup for verification of the J18 with the J1810

4. Display the chromaticity coordinates as xy (in the 1931 CIE system). (To view the $u'v'$ coordinates, press the **ALT DISP** button once.)
5. Display the luminance value in cd/m^2 .
6. For best accuracy, repeat the measurement several times and average the readings.
7. Verify that the chromaticity coordinates are within ± 0.009 of the known values, and that the luminance value is within $\pm 5\%$ of the known luminance value of the light source.

J1811 Illuminance Head

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.

The J1811 features super accurate photopic correction for use with all visible light sources including incandescent, florescent, HID, xenon, trichromatic florescent, and sodium.

The J1811 is also accurately cosine corrected to simulate an ideal 180° field-of-view detector, and includes a built in leveling indicator.

The J1811 features are shown in Figure 1–18.

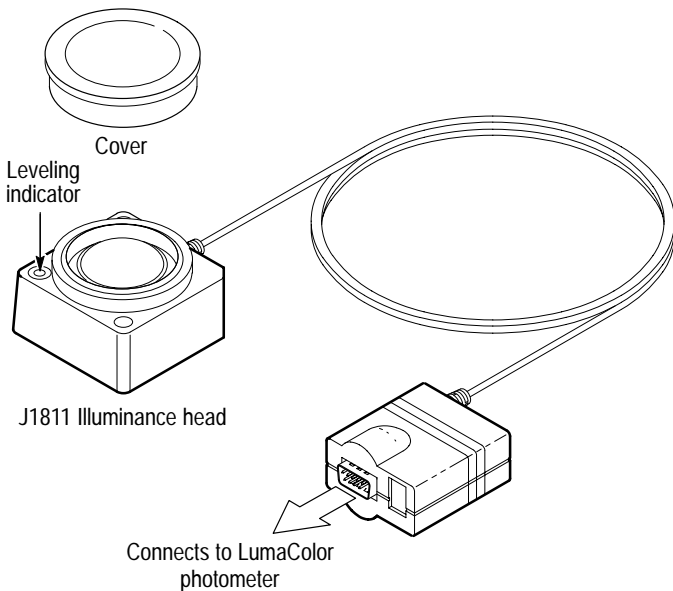


Figure 1–18: The J1811 Illuminance head

Unpacking the J1811

The J1811 is shipped with the following items:

- J1811 Illuminance Head
- Technical Reference (this manual)
- Protective cover

Refer to the *Replaceable Parts* section for ordering and part number information.

Operating Characteristics

The photometer provides illuminance readings in lux (lm/m^2) or foot candles. Press the **UNITS** button on the photometer to toggle between the two measurement units.

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 photometer and J1811 measure illuminance for applications including office, roadway, safety, and transportation lighting.

To take illuminance measurements, follow these instructions:

1. Cover the sensor head and connect it to the photometer.
2. Power on the photometer. Do not uncover the sensor head or move its cable until the self-test is complete.
3. Position the J1811 on the surface to be measured. Refer to Figure 1–19.

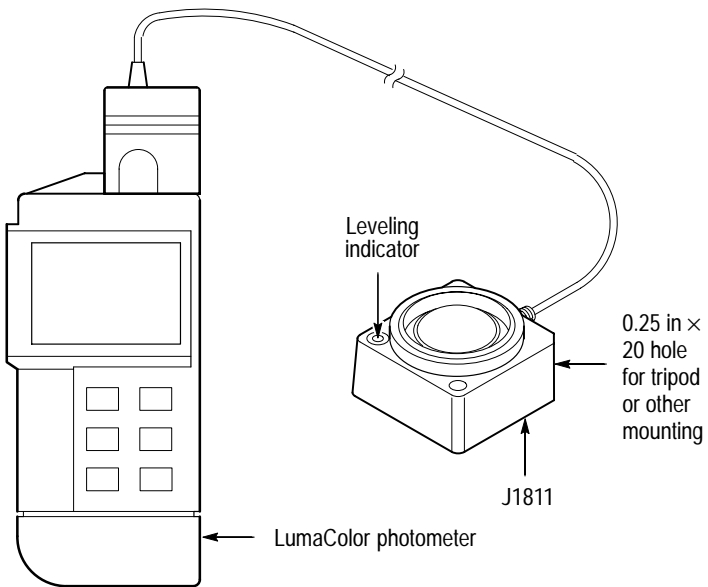


Figure 1–19: J1811 setup for illuminance measurements

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 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 photometer performs at power-on will proceed more quickly if the sensor-head is covered before you turn on the photometer.*

4. Move away from the J1811 to avoid shadowing it. The J1811 has a 6-foot cable to allow separation between the observer and the measurement location.
5. Press the **UNITS** button on the photometer to select the measurement units.
6. Read the illuminance value from the photometer display.

Special Considerations

Observe the following guidelines when working with the J1811:

- 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 your body.
- Avoid flexing the cable excessively at the strain relief bushings at either end of the cable.

Specifications

Tables 1–13 to 1–15 list the J1811 specifications.

Table 1–13: J1811 performance characteristics

Characteristic	Standard
Accuracy (including non-linearity)	5% of reading \pm 2 counts (Illuminant A at 1000 cd/m ² 20° C to 30° C, <75% relative humidity)
Spectral Response	CIE photopic (See Figure A–1 on page A–4)
Spectral Accuracy	$f_1' = <3\%$ (DIN class A)
Acceptance Angle	Cosine corrected (180°)

Table 1–14: J1811 typical physical characteristics

Characteristic	Standard
Dimensions (not including lens cap)	Height: 1.4 inches (35 mm)
	Width: 2.5 inches (63 mm)
	Length: 2.5 inches (63 mm)
Cable length	6 feet (1.8 m)

Table 1-15: J1811 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
EMC Compliance	Meets the intent of Directive 89/336/EEC for Electromagnetic Compatibility when it is used with the product(s) stated in the specifications table. Refer to the EMC specification published for the stated products. May not meet the intent of the Directive if used with other products.
FCC Compliance	Emissions comply with FCC Code of Federal Regulations 47, Part 15, Subpart B, Class A Limits.

Performance Verification

Use the procedures in this section to verify that the photometer and J1811 are functioning correctly.

For best results, follow these guidelines:

- Cover and connect the sensor-head to the photometer before turning the power on.

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

- Hold the sensor-head steady while taking measurements.
- Make certain that the light source completely fills the cosine-correction dome.

To verify the photometer and the J1811, 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 $\pm 5\%$ illuminance characteristic.
1. Cover the sensor head and connect it to the photometer.
 2. Power on the photometer. Do not uncover the sensor head or move its cable until the self-test is complete.
 3. 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. Refer to Figure 1–20.

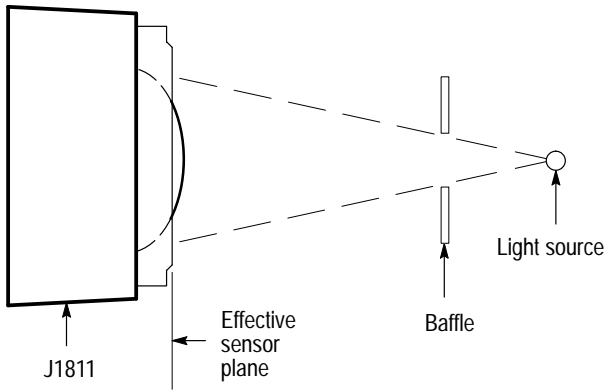


Figure 1-20: Setup for verification of the photometer with the J1811

4. Move away from the J1811 head to avoid reflections or shadowing. The J1811 has a 6-foot cable to allow separation between the observer and the measurement location.
5. Read the illuminance value from the photometer display.
6. For best accuracy, repeat the measurement several times to ensure that the light source has remained stable.
7. Verify that the reading on the photometer display is within $\pm 5\%$ of the known illuminance value of the light source.

J1812 Irradiance Head

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

The J1812 features are shown in Figure 1–21.

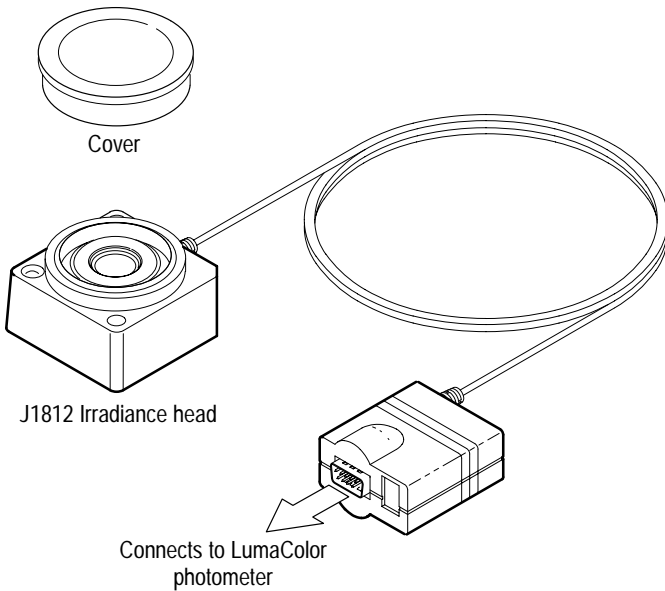


Figure 1–21: The J1812 Irradiance head

Unpacking the J1812

The J1812 is shipped with the following items:

- J1812 Irradiance head
- Technical Reference (this manual)
- Protective cover

Refer to the *Replaceable Parts* section for ordering and part number information.

Operating Characteristics

Irradiance readings are displayed in milliwatts/meter² or microwatts/meter². The LumaColor photometer can also measure power in milliwatts or microwatts.

Press the **UNITS** button on the photometer to select the measurement units. Radiant intensity in milliwatts/meter² or microwatts/meter² can be determined with a simple calculation.

Compute the radiant intensity, in watts/steradian, by multiplying the reading by 100. Be sure to include the units prefix (micro or milli) from the reading.

Operating Examples

This section provides instructions for performing measurements using the J1812.

Irradiance Measurements

You can use the photometer and J1812 to measure irradiance in the visible and near-infrared portion of the spectrum, and output of LEDs and low-average-power lasers.

To take irradiance measurements, follow these instructions:

1. Cover the sensor head and connect it to the photometer.
2. Power on the photometer. Do not uncover the sensor head or move its cable until the self-test is complete.

3. Position the J1812 perpendicular to the light source. Refer to Figure 1–22.

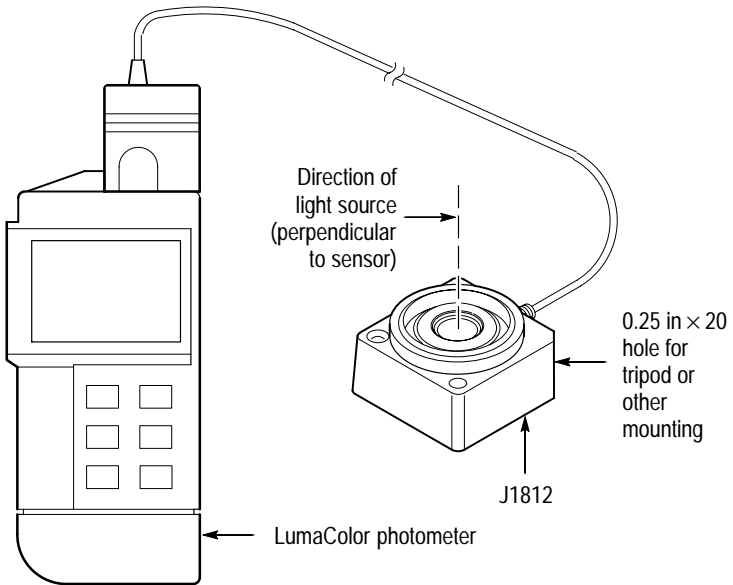


Figure 1–22: J1812 setup for irradiance measurements

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

4. If light is being received from a wide angle, move away from the J1812 to avoid shadowing it. The J1812 has a 6-foot (1.8 m) cable to allow separation between the observer and the measurement location.
5. Read the irradiance value from the photometer display. The irradiance value is updated continuously.
6. Press the **UNITS** button on the photometer to select the measurement units.

Laser Measurements

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



WARNING. Avoid directly viewing high-intensity light sources (e.g., arc lamps, lasers, the sun, etc.) when using the J1812. Viewing such light sources can result in damage to the eye. Make sure that proper eye protections standards are followed.

To take laser measurements, follow these instructions:

1. Cover the sensor head and connect it to the photometer.
2. Power on the photometer. Do not uncover the sensor head or move its cable until the self-test is complete.
3. Position the J1812 perpendicular to the laser beam. Refer to Figure 1–23.

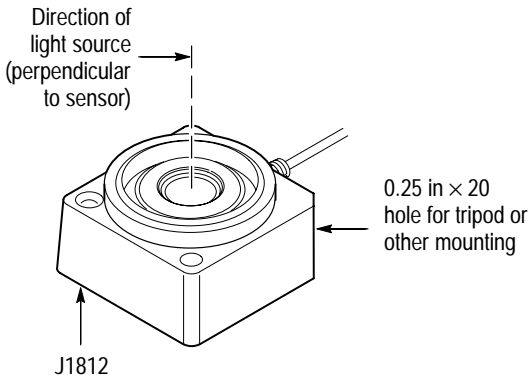


Figure 1–23: J1812 setup for laser measurements

4. Press the **UNITS** button on the photometer to select milliwatts.

***NOTE.** When using a J17, select the correction factor for the device under test using the **COLOR** button. For example, select red for HeNe lasers. For near-infrared devices, use the white correction factor, which has the best overall accuracy.*

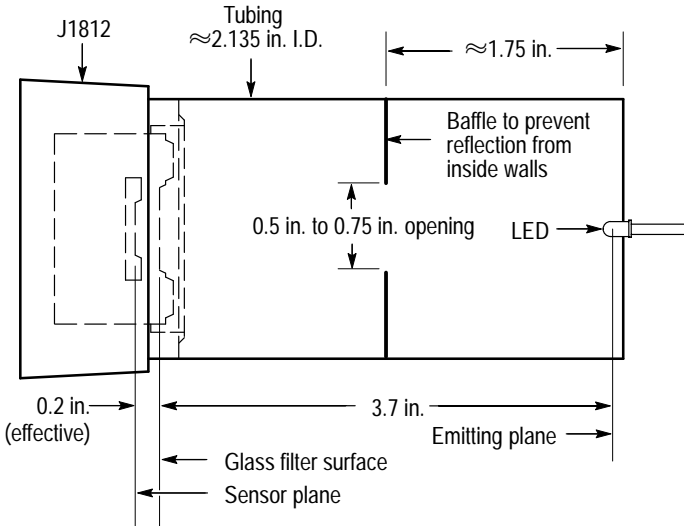
5. Read the power level from the photometer display.

LED Measurements

You can use the photometer and J1812 to measure the output power or radiant intensity of light emitting diodes or other small lamps.

To measure LED output power or radiant intensity, follow these instructions:

1. Cover the sensor head and connect it to the photometer.
2. Power on the photometer. Do not uncover the sensor head or move its cable until the self-test is complete.
3. Set the distance from the plane of the LED under test to the front glass surface of the J1812 at 3.7 inches (9.4 cm). A simple fixture, such as the one shown in Figure 1–24, will help to establish repeatable geometry and exclude ambient light.



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

Figure 1-24: J1812 fixture for LED measurements

4. Press the **UNITS** button on the photometer to select the measurement units.

NOTE. When using the J17, select the correction factor for the LED under test using the **COLOR** button. For example, select red for red LEDs. For infrared LEDs, use the white correction factor for best overall accuracy.

5. Read the LED output power from the photometer 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 used with the J17 to measure narrow-band light sources, press the **COLOR** button to select the proper correction factor to maximize accuracy.
- When measuring irradiance, the entire sensor (1 cm²) should be illuminated.
- When measuring power, the sensor should be underfilled.
- Minimize stray ambient illumination, which may cause abnormally high readings.

Specifications

Tables 1–16 to 1–18 list the J1812 specifications.

Table 1–16: J1812 performance characteristics

Characteristic	Standard
Acceptance Angle	Approximately 96°
Accuracy (including non-linearity)	5% of reading \pm 2 counts (Illuminant A with 762 nm filter, 20° C to 30° C, <75% relative humidity)
Spectral Response	Flat \pm 8% from 450 nm to 950 nm

Table 1–17: J1812 typical physical characteristics

Characteristic	Standard
Dimensions (not including lens cap)	Height: 1.4 inches (35 mm) Width: 2.5 inches (63 mm) Length: 2.5 inches (63 mm)
Cable Length	6 feet (1.8 m)

Table 1–18: 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

Table 1–18: J1812 environmental characteristics (Cont.)

Characteristic	Standard
EMC Compliance	Meets the intent of Directive 89/336/EEC for Electromagnetic Compatibility when it is used with the product(s) stated in the specifications table. Refer to the EMC specification published for the stated products. May not meet the intent of the Directive if used with other products.
FCC Compliance	Emissions comply with FCC Code of Federal Regulations 47, Part 15, Subpart B, Class A Limits.

Performance Verification

Use the procedures in this section to verify that the photometer and J1812 are functioning correctly.

For best results, follow these guidelines:

- Cover and connect the sensor head to the photometer before turning the power on.

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

- Hold the sensor steady while taking measurements.
- Make certain that the light source fills the sensor field of view when measuring irradiance.

To verify the photometer and the J1812, 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 1–25 shows a suitable source configuration.
- Photodetector with known absolute spectral response and area, traceable to NIST standards, and with adequate accuracy to verify the $\pm 5\%$ irradiance characteristic.

1. Cover the sensor head and connect it to the photometer.
2. Power on the photometer. Do not uncover the sensor head or move its cable until the self-test is complete.
3. 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.
4. Position the J1812 so that the effective sensor plane (0.2 inches or 0.5 cm) behind the front glass filter surface) is at the same point as was used for the reference sensor. Refer to Figure 1–25.

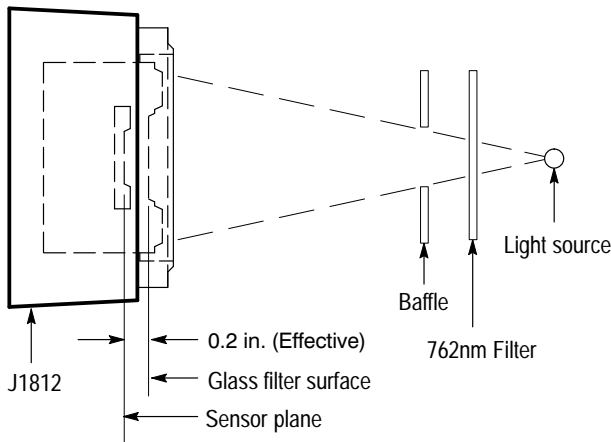


Figure 1–25: Setup for verification of the photometer with the J1812

5. Move away from the J1812 head to avoid reflections or shadowing. The J1812 has a 6-foot (1.8 m) cable to allow separation between the observer and the measurement location.
6. Read the irradiance value from the photometer display. The irradiance value is updated continuously.
7. Repeat the measurement several times and average the readings.
8. Verify that the reading on the photometer display is within $\pm 5\%$ of the known irradiance value of the light source.

J1820 Chromaticity Head

The J1820 reads chromaticity in either the 1931 CIE system or the 1976 CIE-UCS system.

The J1820 features are shown in Figure 1–26.

NOTE. *The J1820 Chromaticity Head will work only with the J17.*

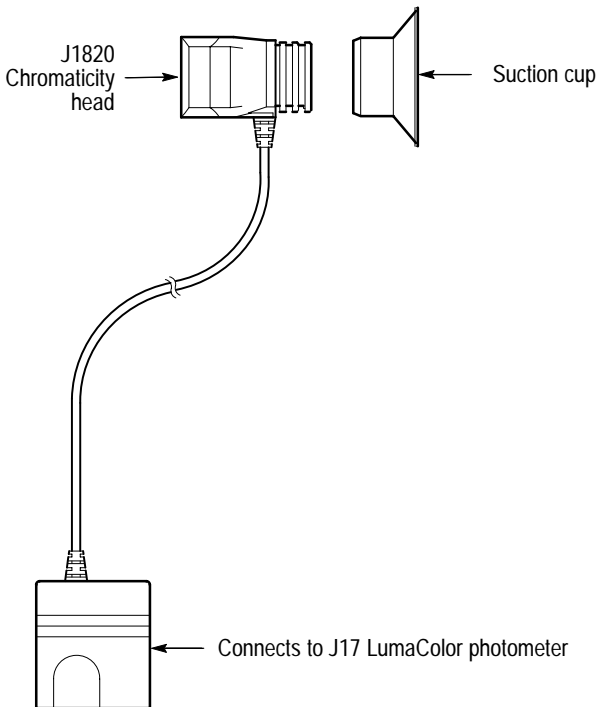


Figure 1–26: The J1820 Chromaticity head

Unpacking the J1820

The J1820 is shipped with the following items:

- J1820 Chromaticity head
- Technical Reference (this manual)
- Suction Cup

Refer to the *Replaceable Parts* section for ordering and part number information.

Operating Characteristics

Acceptance Angle and Measurement Field

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

The J1820 has an acceptance angle of 16° . This means that the measurement field of the J1820 is approximately 3.4 inches (8.6 cm) in diameter at a distance of 1 foot, and is proportionately larger at greater distances (34 inches at 10 feet, or 0.86 m at 3 m).

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 (2.54 cm).

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.

The *Chromaticity Reference* section contains diagrams that can be used to interpret chromaticity readings.

Selecting the Luminance and XYZ Values

Display the luminance value by pressing **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 footlamberts, press the **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.

Operating Examples

This section provides instructions for performing measurements using the J1820.

Display Chromaticity Measurements

To measure chromaticity and luminance of display monitors, follow these instructions:

1. Cover the sensor head and connect it to the photometer.
2. Power on the photometer. Do not uncover the sensor head or move its cable until the self-test is complete.
3. Attach the suction cup to the J1820, and position the J1820 on the display. See Figure 1–27.

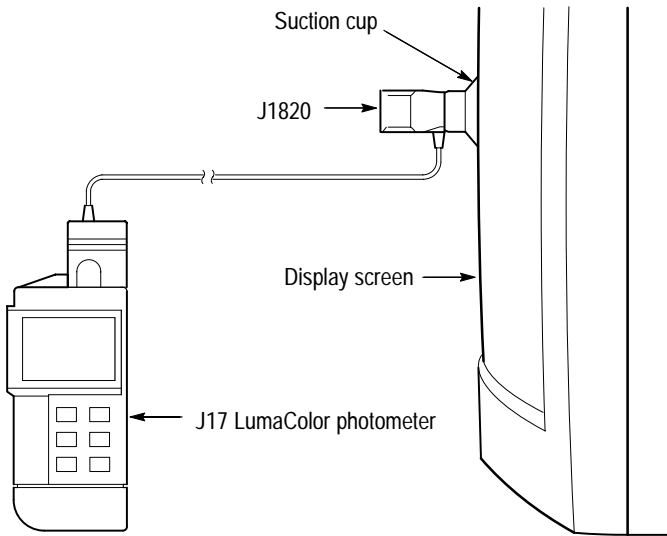


Figure 1–27: J1820 setup for display chromaticity measurements

4. Press the **START** button on the J17 to initiate a chromaticity reading.

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

5. 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 footlamberts, press the **UNITS** button once.

6. For best accuracy, repeat the measurement to ensure that the display under test has remained stable.

Light Source Measurements

1. Cover the sensor head and connect it to the photometer.
2. Power on the photometer. Do not uncover the sensor head or move its cable until the self-test is complete.
3. Point the J1820 toward the light source, choosing a distance to ensure that the entire field of view is filled by the light source. See Figure 1–28. (The acceptance angle of the J1820 is 16° . See *Operating Characteristics*, on page 1–62.)

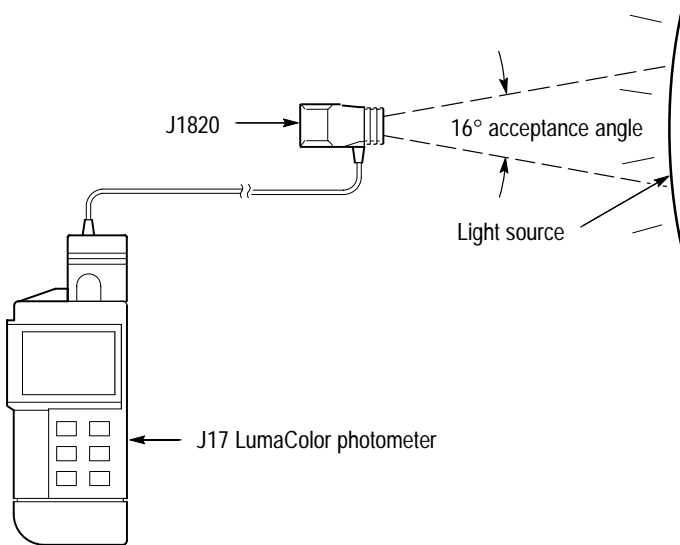


Figure 1–28: J1820 setup for light source measurements

To take light source measurements, follow these instructions:

4. 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 xy (in the 1931 CIE system) by default. To view the coordinates in $u'v'$ (1976 CIE-UCS system), press the **UNITS** button once.

5. To read the luminance value, press **ALT DISP** once.

The luminance value is displayed in cd/m^2 by default. To view luminance in footlamberts, press the **UNITS** button once.

6. For best accuracy, repeat the measurement to ensure that the device under test has remained stable.

Chromaticity Measurement of an Illuminated Surface

You can use the J1820 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.

To take chromaticity measurements from an illuminated surface, follow these instructions:

1. Cover the sensor head and connect it to the photometer.
2. Power on the photometer. Do not uncover the sensor head or move its cable until the self-test is complete.
3. Point the J1820 head at the surface to be measured, at the desired distance from the surface. See Figure 1–29.

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 is 16° . See Operating Characteristics, on page 1–32.

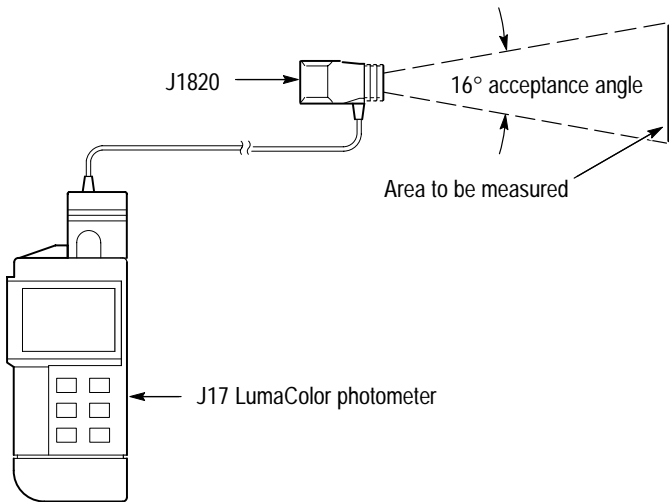


Figure 1-29: J1820 setup for chromaticity measurement of an illuminated surface

4. Press the **START** button on the J17 to initiate a chromaticity reading.

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

5. To read the luminance value, press **ALT DISP** once.

The luminance value is displayed in cd/m^2 by default. To view luminance in footlamberts, press the **UNITS** button once.

6. For best accuracy, repeat the measurement to ensure that the light source under test has remained stable.

Specifications

Tables 1–19 to 1–21 list the J1820 specifications.

Table 1–19: J1820 performance characteristics

Characteristic	Standard
Accuracy (including non-linearity)	Within ± 0.018 of x,y value and $\pm 5\%$ of luminance (Illuminant A at 150 cd/m ² , 20° C to 30° C, <75% relative humidity)
Spectral Response	CIE Tristimulus
Spectral Accuracy	$f_1' = 3\%$ (DIN class A)
Acceptance Angle	16°

Table 1–20: J1820 typical physical 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)
Cable Length	3.5 feet (1.1 m)

Table 1–21: 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
EMC Compliance	Meets the intent of Directive 89/336/EEC for Electromagnetic Compatibility when it is used with the product(s) stated in the specifications table. Refer to the EMC specification published for the stated products. May not meet the intent of the Directive if used with other products.
FCC Compliance	Emissions comply with FCC Code of Federal Regulations 47, Part 15, Subpart B, Class A Limits.

Performance Verification

Use the procedures in this section to verify that the J17 and J1820 are functioning correctly.

For best results, follow these guidelines:

- Cover and connect the sensor head to the photometer before turning the power on.

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

- Hold the sensor steady while taking measurements.
- Make certain that the light source fills the sensor field of view.

To verify the J17 and the J1820, 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 $\pm 5\%$ luminance characteristic and the ± 0.018 xy chromaticity characteristic.
1. Cover the sensor head and connect it to the photometer.
 2. Power on the photometer. Do not uncover the sensor head or move its cable until the self-test is complete.
 3. Point the J1820 head at the light source. Refer to Figure 1–30. When positioning the J1820, observe the following guidelines:
 - 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. The acceptance angle of the J1820 is 16 degrees.
 - The J1820 should be perpendicular to the surface being measured.
 - 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 provides adequate spacing to prevent reflections.

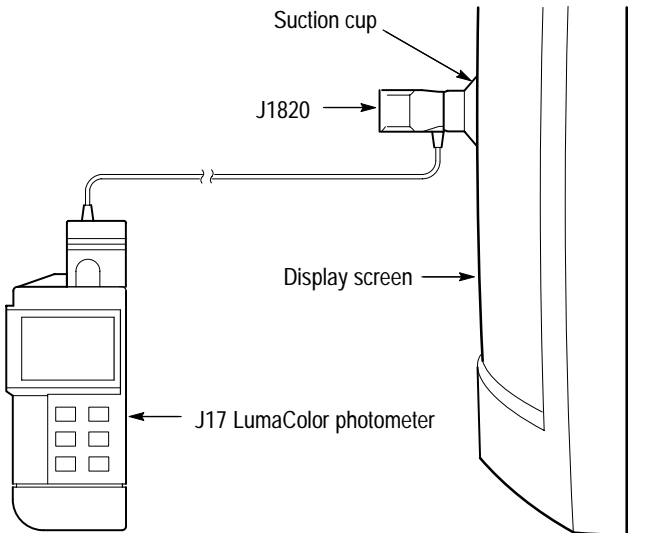


Figure 1-30: Setup for verification of the J17 with the J1820

The distance from the J1820 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.

4. Press the **START** button on the J17 to initiate a chromaticity reading.

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

The chromaticity coordinates are displayed as xy (in the 1931 CIE system) by default. (To view the $u'v'$ coordinates, press the **UNITS** button once.)

5. To read the luminance value, press **ALT DISP** once.
The luminance value is displayed in cd/m^2 by default. (To view luminance in footlamberts, press the **UNITS** button once.)
6. For best accuracy, repeat the measurement several times and average the readings.
7. Verify that the chromaticity coordinates are within ± 0.018 of the known values, and that the luminance value is within $\pm 5\%$ of the known luminance value of the light source.



Maintenance

Maintenance

There are no servicable parts inside of the J1800 series sensor heads. Servicing is limited to cleaning the head body, and replacement of the attachment pieces listed in the replaceable parts list.

Cleaning

To clean the head body, use a soft cloth dampened in a solution of mild detergent and water.

Do not use chemicals containing benzine, benzene, toluene, xylene, acetone, or similar solvents.

Do not immerse the head in liquids or use abrasive cleaners.

Preparation for Shipment

If the original packaging is unfit for use or not available, use the following packaging guidelines:

1. Use a corrugated cardboard shipping carton having inside dimensions at least one inch greater than the probe dimensions. The box should have a carton test strength of at least 200 pounds (91 kg).
2. Put the head into a plastic bag or wrap to protect it from dampness.
3. Place the head into the box and stabilize it with light packing material.
4. Seal the carton with shipping tape.



Replaceable Parts



Replaceable Parts

This section contains a list of the J1800 series heads replaceable parts. 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.

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	<i>Name & Description</i>
					<i>Assembly and/or Component</i>
					<i>Attaching parts for Assembly and/or Component</i>
					<i>(END ATTACHING PARTS)</i>
					<i>Detail Part of Assembly and/or Component</i>
					<i>Attaching parts for Detail Part</i>
					<i>(END ATTACHING PARTS)</i>
					<i>Parts of Detail Part</i>
					<i>Attaching parts for Parts of Detail Part</i>
					<i>(END ATTACHING PARTS)</i>

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
0AHE5	SEALS UNLIMITED	17300 SW BASELINE ROAD	BEAVERTON OR 97006
TK0503	AIMSCO INC	5707 AIRPORT WAY SO.	SEATTLE WA 98108
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON OR 97077-0001

J1803 Replaceable Parts

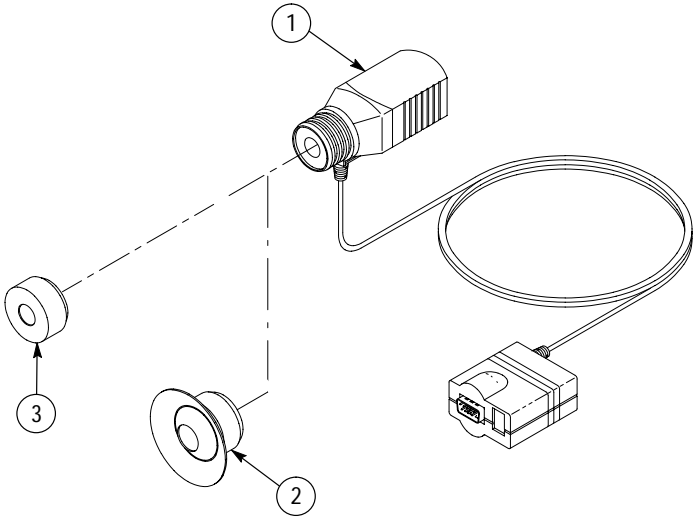


Figure 3-1: J1803 replaceable parts

Fig. & Index No.	Tektronix Part No.	Serial No. Effective Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
3-1-1	-----		1	J1803,LUMINANCE HEAD:8 DEG ACCEPTANCE ANGLE		
				STANDARD ACCESSORIES		
-2	348-1287-00		1	SUCTION CUP;NEOPRENE,ETDM,SHORE 50	0AHE5	348-1287-00
-3	348-1288-00		1	RETAINER,RUBBER,BLACK,NEOPRENE	0AHE5	348-1288-00
	070-9017-03		1	MANUAL,TECH:TECH REF,J1800 HEADS	80009	070901703

J1805 Replaceable Parts

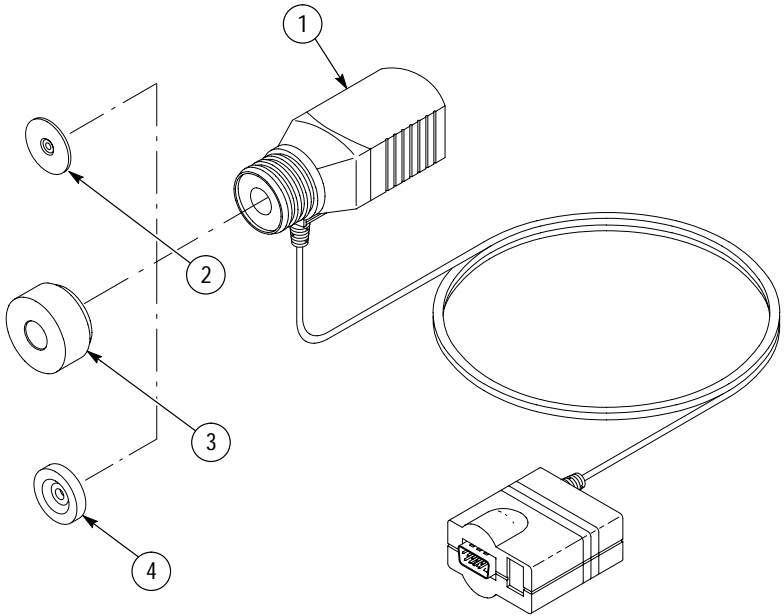


Figure 3-2: J1805 replaceable parts

Fig. & Index No.	Tektronix Part No.	Serial No. Effective Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
3-2-1	-----		1	J1805,LED HEAD,LUMINOUS INTENSITY		
				STANDARD ACCESSORIES		
-2	103-0326-00		2	ADAPTER,LED;DELFIN, 0.12ID	80009	103032600
-3	348-1288-00		1	RETAINER,RUBBER;BLACK,NEOPRENE	0AHE5	348-1288-00
-4	103-0327-00		2	ADAPTER,LED;DELFIN, 0.20ID	80009	103032700
	070-9017-03		1	MANUAL,TECH;TECH REF.,J1800 HEADS	80009	070901703

J1806 Replaceable Parts

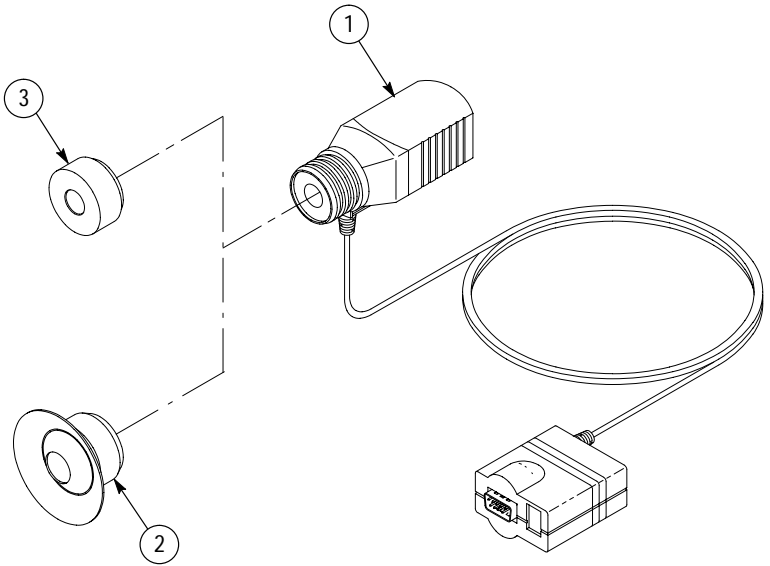


Figure 3-3: J1806 replaceable parts

Replaceable Parts

Fig. & Index No.	Tektronix Part No.	Serial No. Effective Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
3-3-1	-----		1	J1806,RADIANCE HEAD:8 DEG ACCEPTANCE ANGLE		
				STANDARD ACCESSORIES		
-2	348-1287-00		1	SUCTION CUP:NEOPRENE,ETDM,SHORE 50	0AHE5	348-1287-00
-3	348-1288-00		1	RETAINER,RUBBER:BLACK,NEOPRENE	0AHE5	348-1288-00
	070-9017-03		1	MANUAL,TECH:TECH REF,J1800 HEADS	80009	070901703

J1810 Replaceable Parts

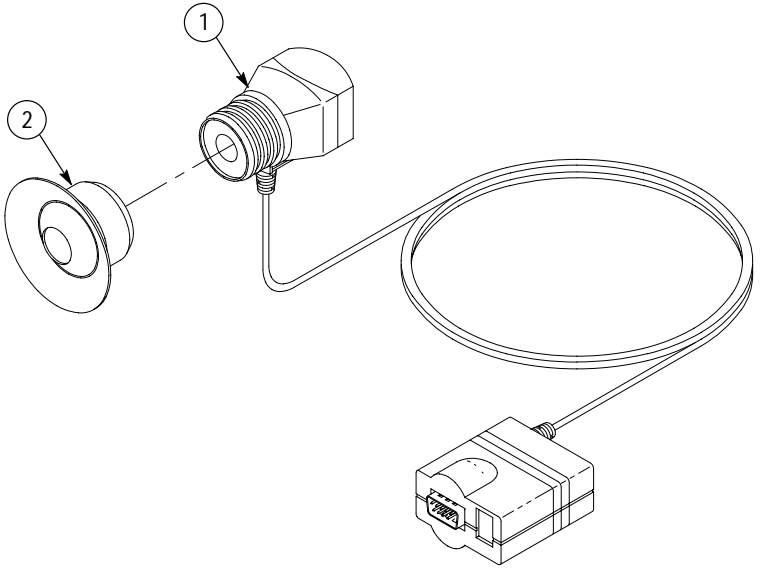


Figure 3-4: J1810 replaceable parts

Replaceable Parts

Fig. & Index No.	Tektronix Part No.	Serial No. Effective Dscont	Qty	Name & Description	12345	Mfr. Code	Mfr. Part No.
3-4-1	-----		1	J1810,COLOR HEAD:			
				STANDARD ACCESSORIES			
-2	348-1287-00		1	SUCTION CUP:NEOPRENE,ETDM,SHORE 50		0AHE5	348-1287-00
	070-9017-03		1	MANUAL,TECH:TECH REF,J1800 HEADS		80009	070901703

J1811 Replaceable Parts

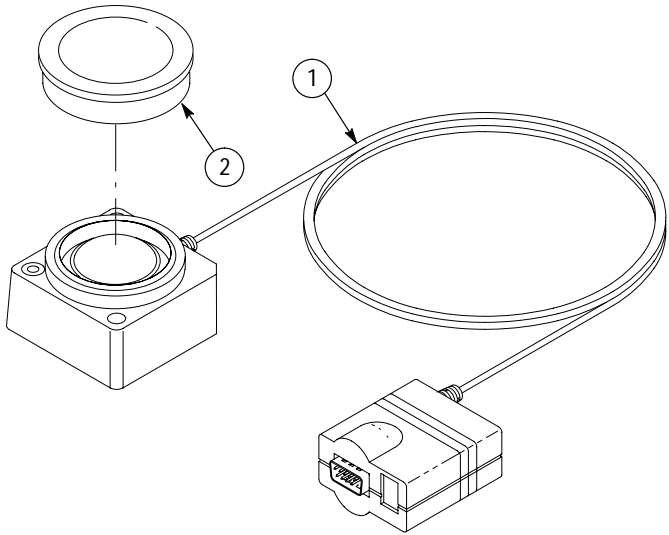


Figure 3-5: J1811 replaceable parts

Fig. & Index No.	Tektronix Part No.	Serial No. Effective Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
3-5-1	-----		1	J1811, ILLUMINANCE HD; COSINE CORRECTED HEAD		
				STANDARD ACCESSORIES		
-2	200-1644-00		1	COVER, PROBE: PLASTIC, BLACK	80009	200164400
	070-9017-03		1	MANUAL, TECH: TECH REF, J1800 HEADS	80009	070901703

J1812 Replaceable Parts

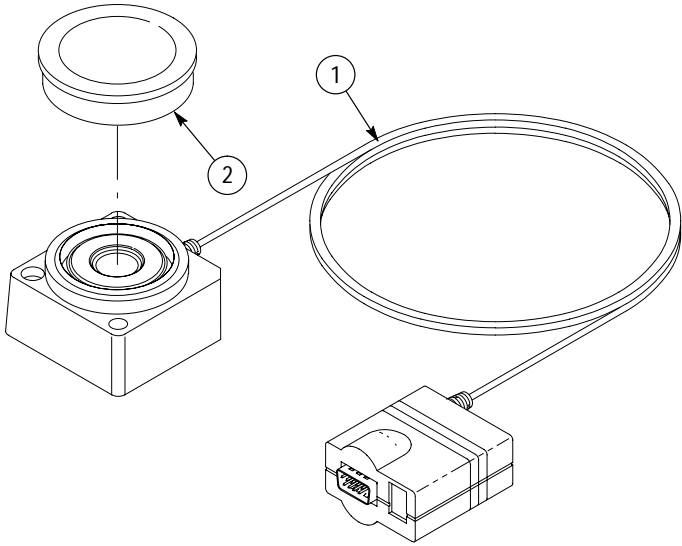


Figure 3-6: J1812 replaceable parts

Replaceable Parts

Fig. & Index No.	Tektronix Part No.	Serial No. Effective Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
3-6-1	-----		1	J1812.IRRADIANCE HEAD:REMOTE		
				STANDARD ACCESSORIES		
-2	200-1644-00		1	COVER,PROBE:PLASTIC,BLACK	80009	200164400
	070-9017-03		1	MANUAL,TECH:TECH REF,J1800 HEADS	80009	070901703

J1820 Replaceable Parts

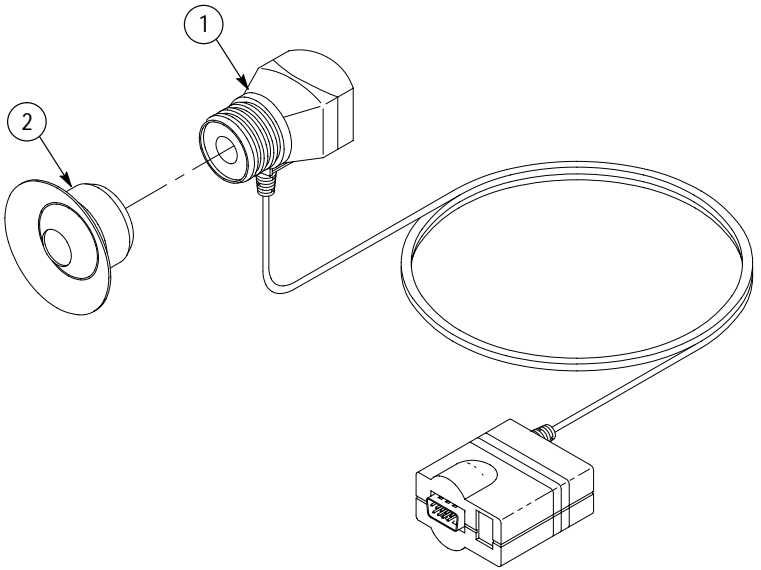


Figure 3-7: J1820 replaceable parts

Fig. & Index No.	Tektronix Part No.	Serial No. Effective Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
3-7-1	-----		1	J1820,CHROMATICITY HD:COLOR COORDINATE		
				STANDARD ACCESSORIES		
-2	348-1287-00		1	SUCTION CUP:NEOPRENE,ETDM,SHORE 50	0AHE5	348-1287-00
	070-9017-03		1	MANUAL,TECH:TECH REF,J1800 HEADS	80009	070901703



Appendices

Appendix A: Photometry and Radiometry

This appendix summarizes convenient relationships and formulas used in photometry and radiometry. This appendix also explains the CIE photopic curve and its relationship to sensor sensitivity.

***NOTE.** 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.*

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 $1/4$ 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 footcandles 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

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

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

$$\text{footcandles} \cdot \text{distance}^2 \quad (\text{in feet}) = \text{candelas}$$

$$\text{lux} \cdot \text{distance}^2 \quad (\text{in meters}) = \text{candelas}$$

$$\text{footcandles} \cdot \text{surface reflectance factor} = \text{footlamberts}$$

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/meter².
- 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 $1/4$ watt/meter².
- A perfectly white, diffuse surface illuminated by an irradiance of 1 watt/meter² has a surface radiance of .318 watt/meter²/steradian (irradiance divided by π).

- A diffuse surface that has a reflectance of less than 100% will have a surface radiance, in watts/meter²/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

$$\text{watt/cm}^2 \cdot 10000 = \text{watt/meter}^2$$

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

CIE Photopic Curve

The CIE photopic curve is an international standard for the color response of the average human eye. By definition, footcandles, footlamberts, lux, and nits are based on a detector having a color response identical to the CIE photopic curve. Tektronix photopic sensors have response curves that match the CIE photopic curve. Refer to Figure A-1.

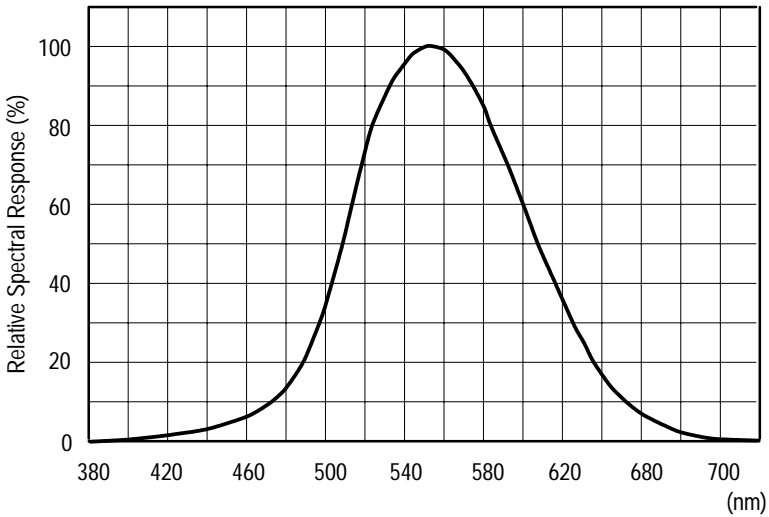


Figure A-1: CIE photopic curve



Appendix B: Chromaticity Reference

The reference material in this appendix can help you categorize and understand chromaticity measurements taken using the J1810 or J1820 Chromaticity sensor-heads. This appendix includes:

- the 1931 CIE chromaticity diagram for xy 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 B-1, can be used to categorize chromaticity measurements expressed as xy 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 complementary 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 xy chart is that equal distances on the diagram do not represent equal perceived color distances.

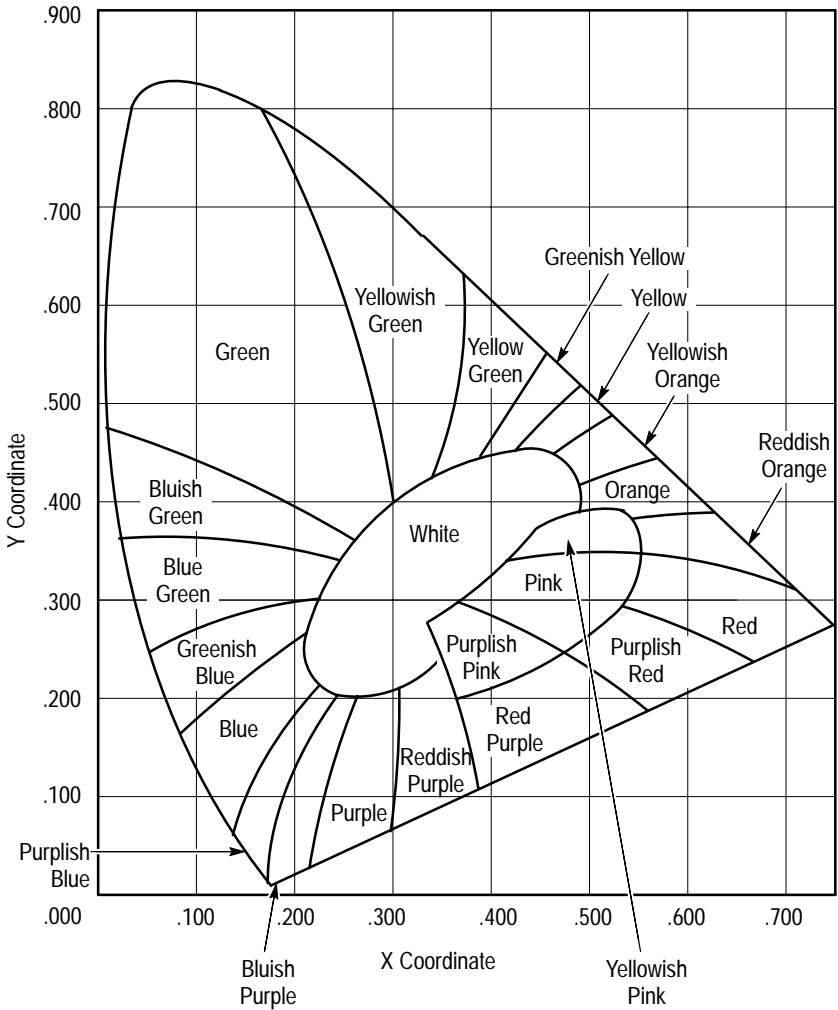


Figure B-1: The 1931 CIE chromaticity diagram

Figure B-2 shows the Planckian locus on the 1931 CIE diagram. The numbers along this line indicate the color temperatures (in degrees Kelvin) for blackbody light sources.

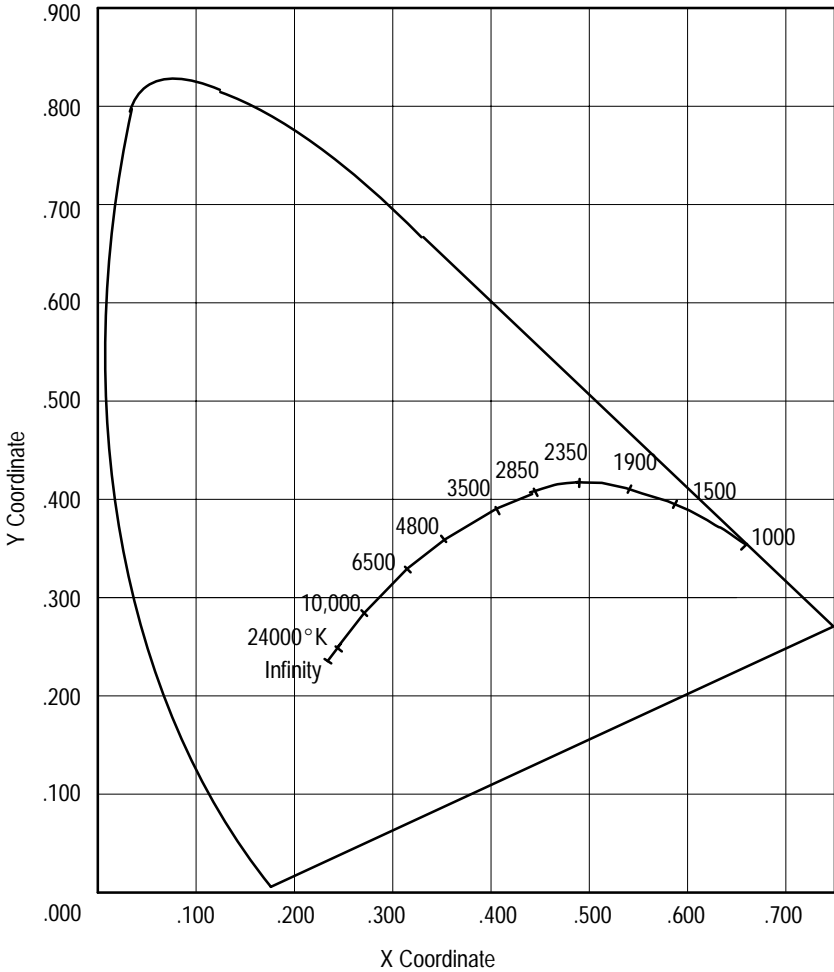


Figure B-2: 1931 CIE chromaticity diagram showing color temperature

Figure B-3 shows selected isothermperature lines in the x,y coordinate system. A light source along one of the isothermperature lines will most nearly match the color temperature of a blackbody radiator indicated for that line.

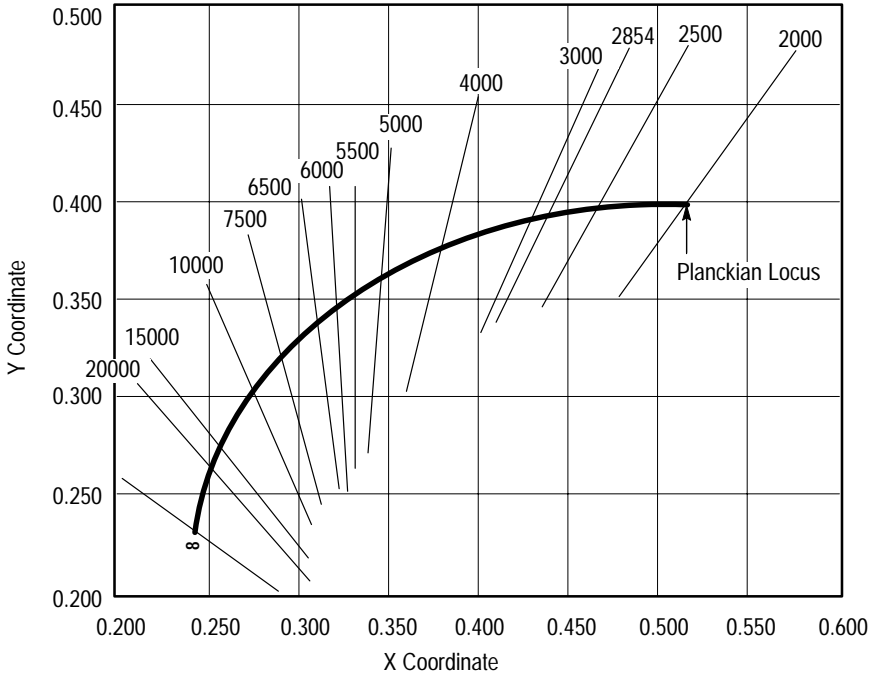


Figure B-3: Correlated color temperature diagram

The 1976 CIE-UCS Chromaticity Diagram

The 1976 CIE-UCS (Uniform Chromaticity Scale) diagram, shown in Figure B-4, 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 $u' = 0.210$, $v' = 0.473$.

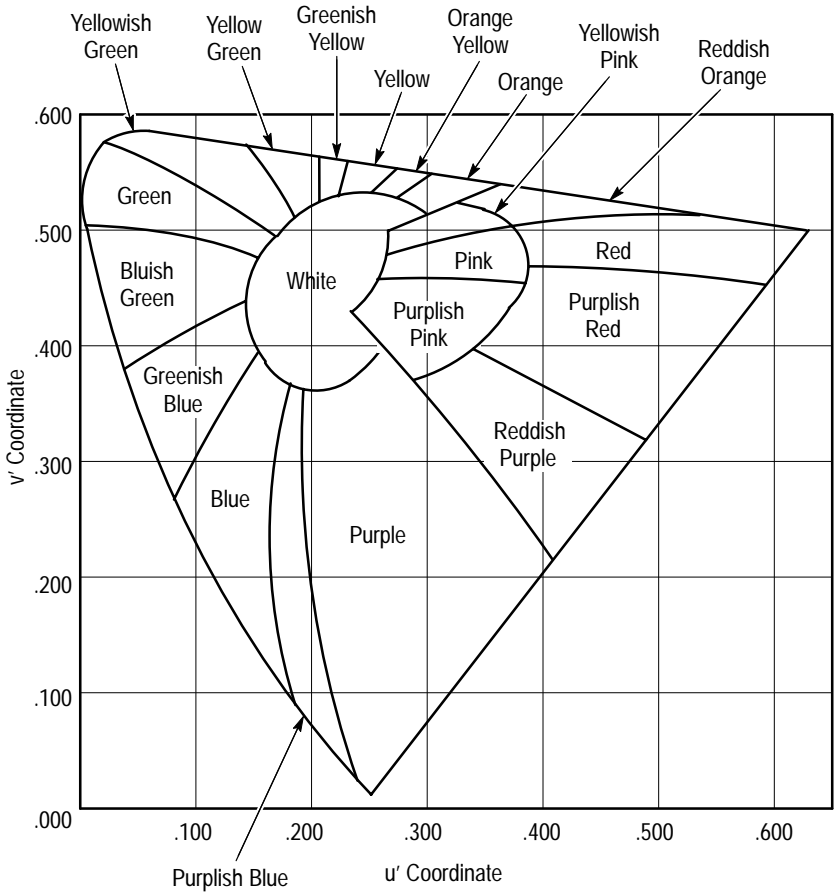


Figure B-4: 1976 CIE-UCS chromaticity diagram

Spectral Tristimulus Values

Figure B-5 shows the spectral tristimulus (XYZ) values for a light source of equal spectral power. Table B-1 lists the same data in tabular format.

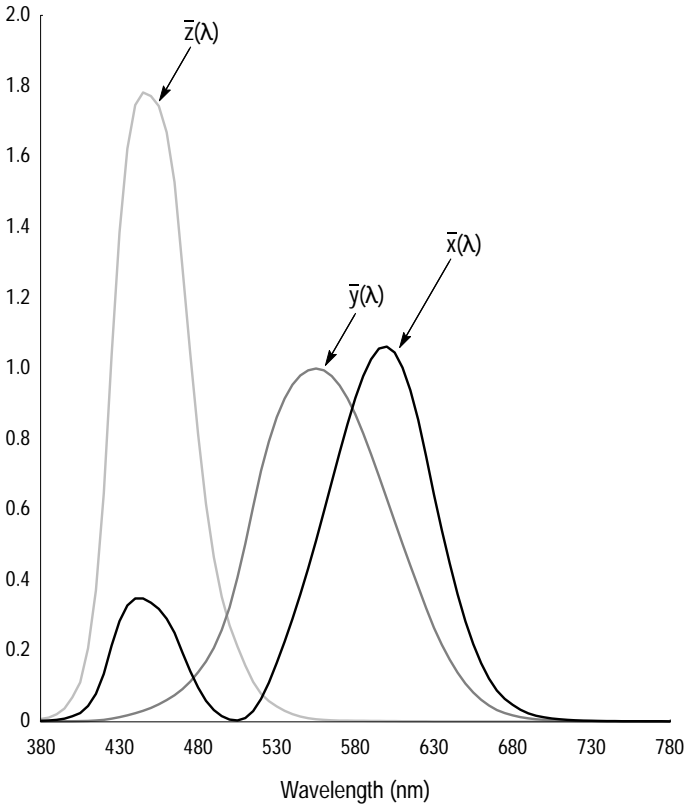


Figure B-5: Spectral tristimulus values for equal spectral power source (CIE 1931 standard 2° observer)

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

**Table B-1: spectral tristimulus values for equal spectral power source
(CIE 1931 standard 2° 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

Table B-1: spectral tristimulus values for equal spectral power source (CIE 1931 standard 2° observer) (Cont.)

Wavelength (nm)	$\bar{x}(\lambda)$	$\bar{y}(\lambda)$	$\bar{z}(\lambda)$
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
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

Table B-1: spectral tristimulus values for equal spectral power source (CIE 1931 standard 2° observer) (Cont.)

Wavelength (nm)	$\bar{x}(\lambda)$	$\bar{y}(\lambda)$	$\bar{z}(\lambda)$
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
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

Table B-1: spectral tristimulus values for equal spectral power source (CIE 1931 standard 2° observer) (Cont.)

Wavelength (nm)	$\bar{x}(\lambda)$	$\bar{y}(\lambda)$	$\bar{z}(\lambda)$
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



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 distribution 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/meter²) 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/meter² or watts/cm² 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/meter² (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/meter²/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.

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