



# Advanced Test Equipment Rentals

www.atecorp.com 800-404-ATEC (2832)

### FEATURES

- Digital LED Readout
- Eight Silicon Sensor Probes Quickly Interchange Without Recalibration
- Accurate Spectral and Cosine Corrections
- Metric and US Versions Available
- AC or Internal Rechargeable Battery Versions
- Application Notes Available

### BENEFITS

- Easy to Read in Dark Areas
- Rugged but Accurate
- Adaptable to Many Light Measurement Needs
- Use Anywhere

### J16 PHOTOMETER/RADIOMETER

The Tektronix J16 is a portable digital photometer/radiometer capable of making a wide variety of light measurements—in the laboratory, in the field, or on the production floor. A J16 System consists of a J16 mainframe, and one of eight detachable probes which can be either mounted on the J16 or on the end of an extension cable. All probes have a Hold switch which allows the displayed reading to be held.

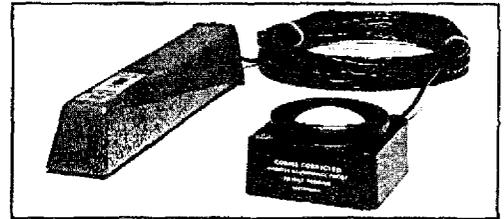
Eight quickly interchangeable probes are available for measuring illuminance, irradiance, luminance, light-emitting diode output, and relative intensity. Recalibration is not necessary when probes are interchanged. Connection of a probe to the J16 automatically selects the correct front panel units indicator. The 3 1/2 digit LED display can be easily read under low ambient conditions.

All probes use silicon photodiodes individually corrected with multi-element glass filters for maximum stability and accuracy.

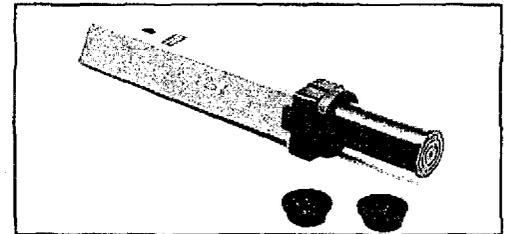
The optional BCD/analog output feature (Option 07) allows the user either a BCD output of the displayed reading or an analog signal (level) proportional to the light falling upon the sensor. The J16 can be also used with Tek MI 5010/50M30 system for interface with a GPIB system.

Under normal usage, the internal rechargeable nickel cadmium batteries will operate the J16 for four hours. An ac power supply is recommended for continuous operation.

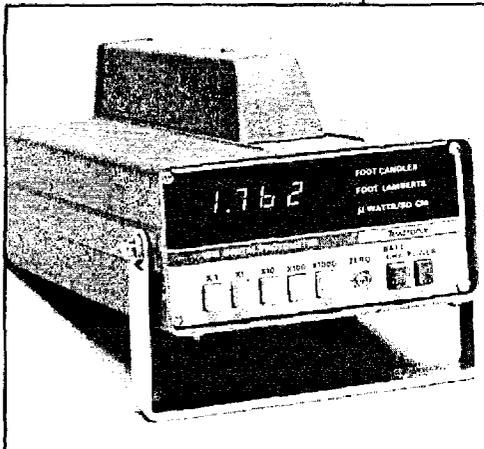
Power supplies or battery packs can be changed quickly by removing four screws on the J16's rear panel. The cabinet and probes have an internal threaded socket (1/4" x 20") for convenient mounting on a tripod or optical bench.



J6511 (shown) J6512-A



LED Adapter with extra LED Holders (included with J6505) 014-0047-00



J16 with optional probe.

### CHARACTERISTICS

#### J16 MAINFRAME

**Display** – 3 1/2 digit LED readout and three LEDs automatically indicating correct units for probe in use. Metric version readout is also available (Option 02).

**Stability** –  $\leq 2\%$  per year.

**Linearity** –  $\leq 2\%$  over entire range (enables single point calibration).

**Integration Time** –  $\approx 100$  ms.

**Calibration** – Electrical calibration of the J16 mainframe is performed with a calibrated voltage source or DVM traceable to NBS. Calibrated probes can be used with any J16 without additional calibration.

#### POWER REQUIREMENTS

**Standard and Opt. 01** – Has internal rechargeable NiCad batteries that require 16 hours for a full charge. The J16 will operate nominally four hours continuously on a charge. For continuous-operation an ac power supply is recommended.

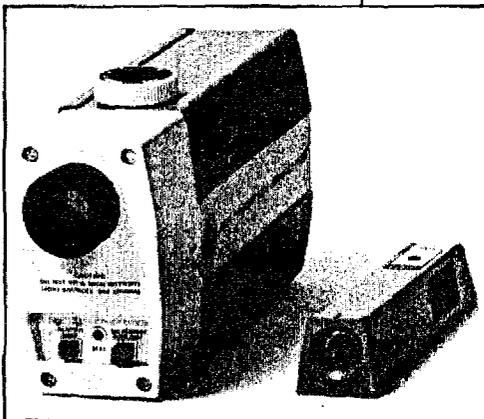
**Opt. 03 and Opt. 04** – AC only operation, no internal batteries.

### J16-TV PACKAGE

The J16-TV package is an excellent transfer mechanism which provides a simple, accurate method for adjustment of monitor screen color temperature. The primary colors are measured and adjusted to produce white color temperature balance.

The J16-TV with optional J6503 or J6523 measures monitor screen brightness on both color and black and white monitors. Other applications include measurement of studio lighting, camera lighting, and illumination of work areas.

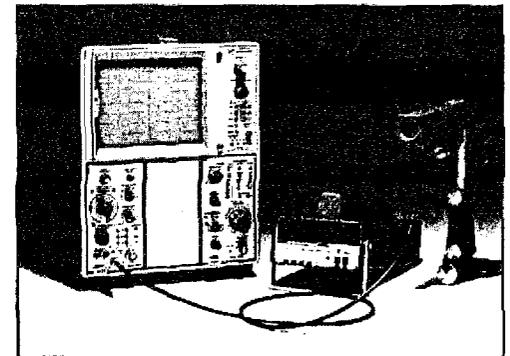
The 16-TV package includes: J16 Battery-Operated Photometer, J6502-A Irradiance Probe, light occluder, probe extension cable, and battery charger. See Application Note 58A-2926-1 for additional information.



J6523

J6501  
J6502-A  
J6503

J6504  
J6505



J16 used to measure pulsed light source. Refer to Application Note 58A-2702-1.

## PROBE CHARACTERISTICS

Application	Illuminance	Irradiance	Luminance		Uncorrected	Red LED	Green/Yellow LED
Probe	J6511	J6502-A/J6512-A**	J6503	J6523	J6504	J6505	J6501
Range	US <sup>†</sup> 0.001 to 1999 footcandles* <sup>†</sup>	0.001 to 1999 microwatts/cm <sup>2</sup> * <sup>†</sup>	0.1 to 199,900 footlamberts* <sup>†</sup>	0.1 to 19,990 footlamberts* <sup>†</sup>	Relative response only	0.001 to 1999 footcandles* <sup>†</sup>	0.001 to 1999 footcandles* <sup>†</sup>
Metric (Opt. 02)	0.01 to 19,990 lumens/m <sup>2</sup> (lux)* <sup>†</sup>	0.01 to 19,990 milliwatts/m <sup>2</sup> * <sup>†</sup>	1 to 1,999,000 candelas/m <sup>2</sup> (nits)* <sup>†</sup>	1 to 199,900 candelas/m <sup>2</sup> (nits)* <sup>†</sup>	Relative response only	0.01 to 19,990 lumens/m <sup>2</sup> (lux)* <sup>†</sup>	0.01 to 19,990 lumens/m <sup>2</sup> (lux)* <sup>†</sup>
Accuracy (including J16)	Within 5% of NBS standards and ±1 digit in last place. Calibrated with a 3100° tungsten light source.	Same as J6511, except calibrated with a 762 nm filter	Within 5% of NBS standard and ±1 digit in last place. Calibrated with a 3100°K tungsten light source		Probe-to-probe accuracy ±5% with tungsten light source	Same as J6501, except calibrated with a 656 nm filter	Within 5% of NBS standards and ±1 digit in last place. Calibrated with a 3100° tungsten light source.
Spectral Response	CIE photopic curve	Flat within ±7%* <sup>†</sup> from 600 to 950 nm 450-600 is ±8%	CIE Photopic curve		UV enhanced silicon spectral curve (250 to 1200 nm)	CIE photopic curve from 600 to 710 nm	CIE photopic curve
Acceptance Angle	Cosine corrected (180°)	50% sensitivity at 48° off axis	8°	1°	50% sensitivity at 48° off axis		50% sensitivity at 48° off axis
Stability and Repeatability	Within 2% per year						
Linearity	Within 2% over entire range enabling single point calibration						

\*<sup>†</sup> An additional decade of sensitivity is included and is usable if the J16 is carefully zeroed and used at a relatively stable temperature.

† 0.000001 to 199.9 candelas when used with 014-0047-00 LED adapter or at 3.8 inches source-to-sensor spacing. Luminous intensity readings of higher intensity light sources may be easily made at correspondingly greater distances using the formula: Footcandles x d<sup>2</sup> = candelas where d is the distance from the source to the sensor in feet. (For metric readings, use lux x d<sup>2</sup> = candelas where d is distance from the source to the sensor in meters.) Request J16 Application Note 58A-2704-1 for further information.

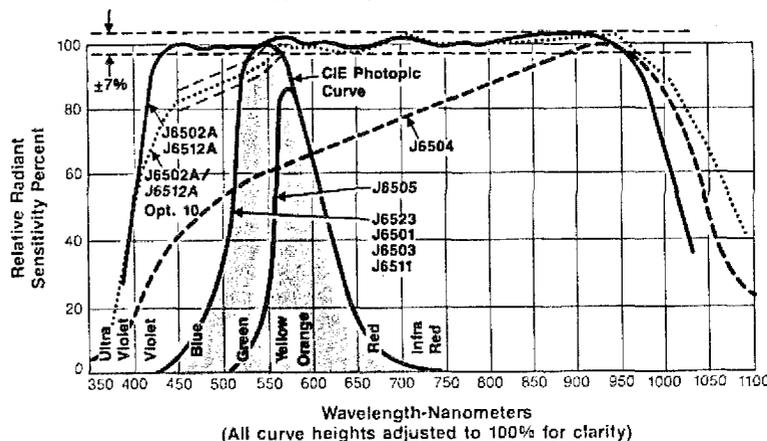
US/Metric Conversions	US to Metric	Metric to US
Illuminance	fc x 10.764 = lux	lux x 0.0929 = fc
Luminance	fl x 3.426 = nits	nits x 0.2919 = fl

NOTE: CIE stands for International Commission on Illumination

<sup>†</sup> Measurements in the 450 to 950 nm range can now be made to within a ±1% uncertainty traceable to NIST, formerly NBS. Using the new standard the J6502 and J6712 were no longer flat across the range, see the Spectral Characteristics Chart. The "A" version of those probes were developed to provide a flat response when measured with the new standard.

For those who need new probes that match the characteristics of the original J6502/J6512 probes, order J6502A or J6512A with Option 10. IT IS NOT POSSIBLE TO UPGRADE AN ORIGINAL J6502 OR J6512 TO AN "A" MODEL BECAUSE THEY USE A DIFFERENT DETECTOR AND GLASS.

### TYPICAL PROBE SPECTRAL CHARACTERISTICS



NOTES: C.I.E. stands for the International Commission on Illumination. Dashed lines around a curve indicate the approximate range of the curve.

## APPLICATION NOTES

Title	Literature #
Photometry/Radiometry primer, and standardizing CRT measurements	60-W-5750
Luminous intensity and visible LED measurements w/Tektronix J16 Photometer	58-A-2635
Measuring pulsed light sources with the J16 and an oscilloscope	58-A-2702-1
Radiant intensity and infrared emitting diode measurements	58-A-2704-1
Television station applications for the J16 Photometer	58-AX-2764-1
Practical lighting measurements with the Tektronix J16	58-A-2912
TV picture monitor color temperature adjustment using the Tektronix J16	58-A-2926-1
Photographic exposure measurements with the Tektronix J16	58-AX-3060-1
Measuring the luminance of small areas of light with the J16 and J6523	58-AX-3252
Optical communications measurements	58-AX-3602

## PHYSICAL CHARACTERISTICS (With Probe and Battery Pack Installed)

Dimensions	mm	in.
Width	123	4.6
Height	60	2.4
Depth	203	8.0
Weight =	kg	lb
Net	1.5	3.3
Domestic Shipping	2.3	5.0
Export-packed	4.5	10.0

**J6511****Illuminance Probe**

- Highway Illumination
- Luminaries and Lamps
- Workstation Illumination
- Studio Lighting
- Office Lighting
- Lighting Equipment

**J6502-A/J6512-A  
Irradiance Probes**

- Laser Research
- Display Color Balancing
- Radiant Efficiency
- Infrared LED Testing

**J6503****8° Luminance Probe**

- TV and Computer Display Screens
- Work Surface Illumination
- Signal Illumination
- Projection Screens

**J6523****1° Luminance Probe**

- Roadway Lighting
- TV and Computer Display Screens
- Photographic Equipment Testing
- Glare and Contrast Measurement

**J6505****Red LED Probe**

- Output of Red LEDs (600-710 nm)

**J6501****Illuminance Probe**

- For Yellow and Green LEDs

**J6511 ILLUMINANCE PROBE**

The J6511 is an illuminance probe with readout in footcandles [lumens/m<sup>2</sup> (lux) for the J6511 Option 02]. A multi-element glass filter and silicon photo-diode ensure a close match to the CIE photopic curve (color corrected). The silicon-sensor recovery time is virtually instantaneous; low-light levels can be measured immediately after exposure to bright sunlight.

The angular response is accurately cosine corrected, simulating an ideal 180° field-of-view detector. The low-profile probe has a leveling indicator to ensure accurate measurements where a significant proportion of the illumination comes from sources at low angles to the horizon.

A 25-foot cable between the probe (J6511) and J16 allows the user to be out of the field of view while making measurements.

**J6502-A/J6512-A IRRADIANCE PROBE**

The J6502-A/J6512-A measure irradiance in micro-watts/cm<sup>2</sup> (milliwatts/m<sup>2</sup>) with Option 02). The spectral response is flat from 450 to 950 nanometers. The response is typically down 50% at 400 and 1030 nm.

An optional filter holder is available for the J6502-A to mount standard 1 inch diameter customer supplied filters of up to 3/8 inch thickness. Where high intensity sources are used (over 1990  $\mu$  watts/cm<sup>2</sup>), neutral density filters can be used to extend the range of the J16. (An ND 1 filter has 10% transmission, and ND 2 has 1%, etc). These filters may be held with an optional filter holder.

Where the 1 sq cm sensor is not completely filled by the source, for example with a laser beam, the reading obtained represents microwatts instead of  $\mu$  watts/cm<sup>2</sup> or milliwatts x 10<sup>-4</sup> instead of milliwatts/m<sup>2</sup> (Option 02). Small variations in sensor uniformity may add  $\pm$ 5% uncertainty to this measurement.

The J6512-A has a low-profile detector head and six-foot cable.

Note: The J6502-A/J6512-A are calibrated for a flat response using the latest NBS standards. If you require probes that are compatible with the original J6502/J6512, then order Option 10 on J6502-A or J6512-A.

**J6503 8° LUMINANCE PROBE**

The J6503 measures luminance in foot-lamberts (candelas/m<sup>2</sup> (nit) with Option 02) where light scattered or emitted by a surface must be measured. The probe is pointed at the emitting surface.

The probe's response is closely matched to the CIE photopic curve, ensuring accurate results even when measuring spectrally different light sources.

The acceptance angle is approximately 8 degrees, which is determined by internal field stop apertures. Providing that the 8 degrees field is uniformly filled, the probe can be held at any distance from the source. At 21 inches from the front of the probe, the field of view is approximately three inches in diameter. The footlambert or candelas/m<sup>2</sup> (nit) (Option 02) indicator automatically lights when the J6503 is connected.

**J6523 1° LUMINANCE PROBE**

The J6523 will measure the luminance in footlamberts (candelas/m<sup>2</sup> with Option 02) of a spot as small as 0.32 inch in diameter. By using commercially available 55-mm stackable close-up lenses, areas as small as 0.035 inch (+10 diopters) can be measured. These 55-mm lenses are physically similar to threaded 55 mm photography stores. (See Application Note 58-AX-3252.)

The 1 degree angle represents 0.21 inch per foot of distance from the probe to the source. Thus at 10 feet, the J6523 measures a 2.1 inch diameter spot.

The probe includes an optical sighting system with a 9 degree viewing field. The focusing range is 18 inches to infinity, closer with 55-mm close-up lenses. The spectral response is closely matched to the CIE photopic curve (color-corrected) for accurately measuring all commonly used light sources. The J6523 may be attached to the J16 or used with an optional probe extension cable. A standard 1/4 inch x 20 threaded socket allows it to be used on a tripod or an optical bench.

**J6505 PROBE FOR RED LEDs**

Note: For yellow or green LEDs use the J6501 probe, for infrared LEDs use the J6502-A probe.

The J6505 measures illuminance in foot candles (lumens/m<sup>2</sup> (lux) with Option 02), which can easily be converted into luminous intensity in candelas. (See Application Notes 58-A-2635 and 58-A-2704-1.)

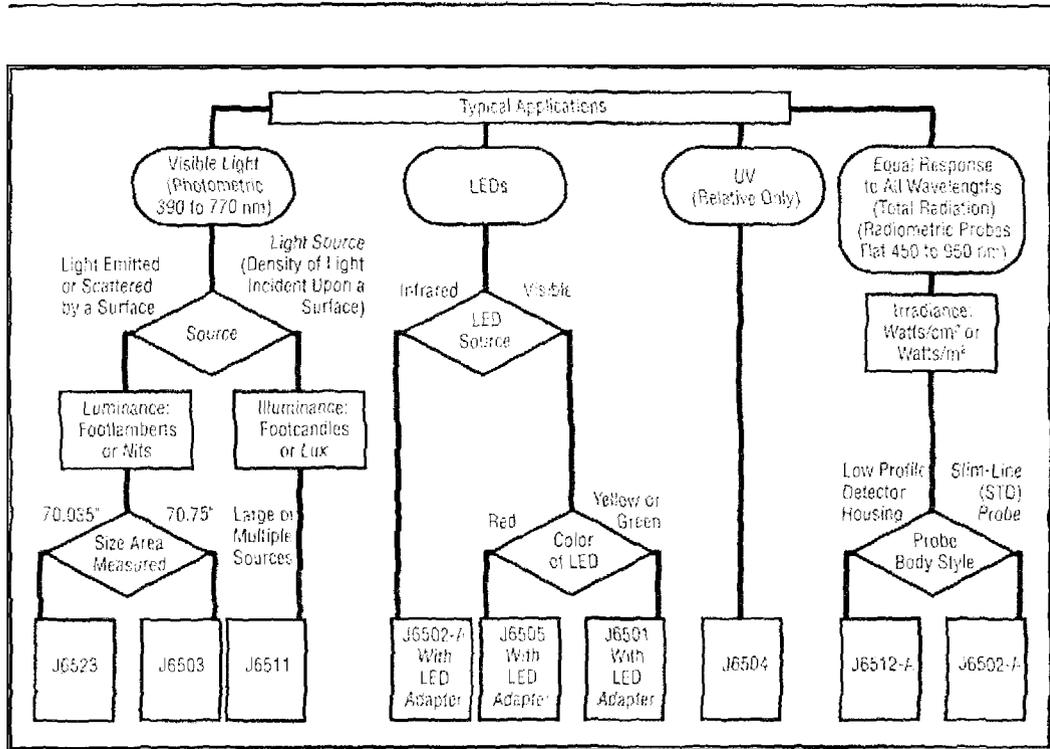
An adapter supplied with the probe provides a controlled spacing between the sensor and the LED under test. The adapter excludes ambient light, and has internal baffles to prevent stray reflections during the measurement. Three inserts are supplied with the adapter to fit common sizes of LEDs (0.080 inch, 0.125 inch, and 0.200 inch diameter). These inserts are made of soft plastic that can be easily modified by the user.

With the adapter in place, a reading of 1 footcandle of the J16 represents 100 millicandelas of luminous intensity. With a metric version of the J16/J6505 (Option 02), 1 lumen/m<sup>2</sup> represents 10 millicandelas.

In the J6505, the silicon photodiode-filter combination provides an excellent match to the photopic curve in the region 600 nm to 710 nm. This close match requires compromising in the 380 to 600 nm region, making this probe unsuitable for general illuminance measurements. For LED measurements in the yellow or green regions, the LED adapter must be used with the J6501, and the same conversion factor for luminous intensity applies.

**J6501 ILLUMINANCE PROBE**

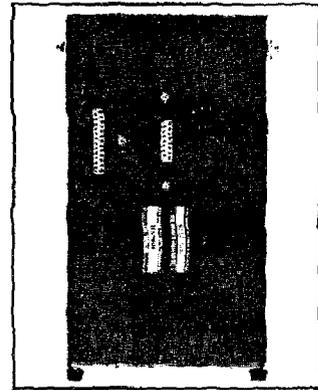
Where cosine correction is unnecessary, the standard J6701 probe is available with the same photopic correction and units as the J6511. The J6501 can be used to measure green and yellow LEDs.



## J6504 Uncorrected Probe

- Photoresist/Photo-Processing Light Sources
- Comparison of UV Light Sources

## Option 07 BCD/Analog Output



J16 with Analog BCD Output (Option 07)

### J6504 UV UNCORRECTED PROBE

This probe is designed for applications where only relative measurements need be made. The J6504 has the widest spectral range, and is the most sensitive probe. Use is made of a UV-enhanced silicon sensor and a UV-transmitting window rather than spectral-correction filters.

No units are indicated on the three front panel indicators when using the J6504, since it provides relative readings only. Because of this, the standard J6504 will work with either standard or metric (Option 2) J16s. No Option is required for the J6504.

An optional filter holder may be used to mount standard 1 inch diameter filters on standard-configuration probes. Ultra violet, visible, or near infrared filters can be used to select the wavelength of the interest and exclude ambient light.

### OPTION 07

Option 07 adds a 25-pin connector on the J16's top. This connector provides parallel TTL logic and BCD outputs, a "hold" input line (TTL), and a linear analog signal output 0 to -2 V or 0 to -6 V (depending upon the probe used), for a full-scale readout. The analog bandwidth is approximately 0.8 Hz. A cable-end connector and cover have been added to the accessories complement.

## ORDERING INFORMATION

<b>J16 Photometer/Radiometer Battery Version, with 115 Vac, 50 to 400 Hz</b> Includes: Battery charger (119-0375-02); shoulder strap (348-0104-00); battery pack (016-0539-01); instruction manual (070-1679-00); or with Opt. 02 instruction manual (070-1880-00).	<b>\$1,380</b>
<b>J16-TV Photometer/Radiometer Package for TV Color Monitor Set-Up</b> Includes: Same as J16 plus J6502A irradiance probe; light occluder (016-0305-00); 42 inch probe extension cable (012-0414-02).	<b>\$2,120</b>
<b>J16 OPTIONS</b>	
<b>Opt. 01</b> - Battery version with 230 Vac, 50 to 400 Hz charger (119-0375-03).	<b>NC</b>
<b>Opt. 02**</b> - Metric readout	<b>NC</b>
<b>Opt. 03</b> - 115 Vac only operation, 50 to 400 Hz	<b>NC</b>
<b>Opt. 04</b> - 230 Vac only operation, 50 to 400 Hz	<b>NC</b>
<b>Opt. 07</b> - BCD/Analog output	<b>+\$100</b>
<b>*1 Opt. 02 must also be ordered for probes.</b>	

<b>PROBES</b>	
Actual plotted spectral curve is included with each probe.	
<b>J6501</b> Illuminance Probe	<b>\$630</b>
<b>J6502-A</b> Irradiance Probe	<b>"</b>
<b>J6503</b> 8" Luminous Probe	<b>\$630</b>
<b>J6504</b> Uncorrected Probe	<b>\$540</b>
<b>J6505</b> LED Probe, Includes Red LED Adapter and 3 LED holders	<b>\$650</b>
<b>J6511</b> Illuminance Probe, Cosine corrected (with 25-ft cable)	<b>\$650</b>
<b>J6512-A</b> Irradiance Probe (with 6-ft cable)	<b>"</b>
<b>J6523</b> 1" Luminance Probe	<b>\$1,790</b>

<b>PROBE OPTIONS</b>	
<b>Opt. 02</b> - Metric probes required for metric readout J16s (Opt. 02) except J6504.	<b>NC</b>
<b>Opt. 10</b> - (Only for the J6502A and J6512A Probes) calibrated to match the original curves for the J6502 and J6512. (See page 379.)	<b>"</b>
<b>OPTIONAL ACCESSORIES</b>	
<b>42-inch** Probe Extender Cable</b> - Connects J16 to probe. Order 012-0414-02	<b>\$120</b>
<b>Light Occluder</b> - For TV color CRT balancing. Order 016-0305-00	<b>\$32</b>
<b>Filter Holder**</b> - Mounts 1 in. diameter filters, of up to 3/8 in. thickness, to probes (except J6511, J6512, J6523). Order 016-0527-00	<b>\$31</b>
<b>LED Adapter</b> - With 3 LED holders (included with J6505). Order 014-0047-00	<b>\$95</b>
<b>Tripod</b> - Order 016-0253-00	<b>\$160</b>
<b>** Longer length extender cables are available as a modified product by contacting your local Tektronix Sales Office.</b>	
<b>**3 Filters available from vendors such as: ORIEL (203) 377-7877 or CORION CORP. (508) 429-5065 and others.</b>	

<b>POWER SUPPLIES</b>	
Power supplies can be quickly changed by removing four corner screws on the rear panel and sliding the power supply or battery pack out.	
<b>AC Power Supply</b> - Allows J16 to be used without batteries. 115 Vac, 50 to 400 Hz (Included with Opt. 03) Order 119-0404-00	<b>\$275</b>
230 Vac, 50 to 400 Hz (included with Opt. 04) Order 119-0404-01	<b>\$255</b>
<b>Spare Battery Pack</b> - Order 016-0539-01	<b>\$200</b>
<b>**4 Contact your local sales representative.</b>	