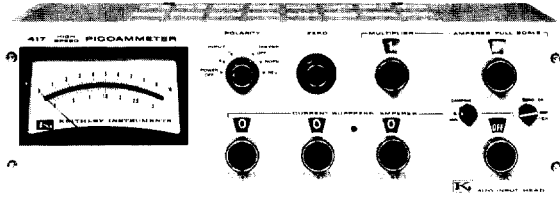


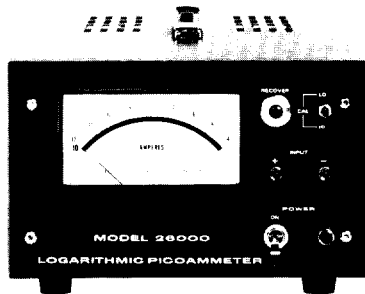
# MODELS 417, 26000

## PICOAMMETERS



### MODEL 417 HIGH SPEED PICOAMMETER

- $10^{-13}$  to  $3 \times 10^{-5}$  ampere full scale ranges
- rise time of 30 milliseconds at  $10^{-12}$  ampere
- offset current less than  $2 \times 10^{-14}$  ampere
- drift less than 1% per 8 hours
- input voltage drop less than 1 millivolt
- calibrated current suppression



### MODEL 26000 LOGARITHMIC PICOAMMETER

- range up to eight decades
- sensitivity to  $10^{-3}$  amperes
- low drift with temperature
- all solid-state circuitry
- optional dual polarity
- optional high voltage source

The Model 417 High Speed Picoammeter is a fast, sensitive dc current-measuring instrument designed for high resistance sources.

Its removable input head is furnished as a plug-in amplifier that allows the input of the 417 Picoammeter to be located 25 feet or more from the instrument chassis. This feature permits short connections between the signal source and the input which minimizes external capacitance and noise usually introduced by long cable runs to the input. A full complement of optional accessories is available for externally mounting the 4170 Input Head away from the main chassis. The Model 417 also provides calibrated current suppression from  $10^{-13}$  to  $10^{-4}$  ampere. By suppressing background current, such as dark current in photocells,  $10^{-13}$  ampere variations in a  $10^{-10}$  ampere steady-state signal can be displayed full scale.

A variable front panel damping control can be adjusted to increase the rise time of the Model 417 up to 3 seconds. It is ideal for measurements which require minimum noise but do not need the extremely fast rise time of the 417. The damping control helps achieve an optimum balance of response speed and noise, thus minimizing the effect of 60 Hz and other external noise pickup as well as noise from the source. The recorder output of the Model 417 provides three volts at full-scale deflection on all ranges at up to one milliamperes so that chart recorders may be driven directly. This feature facilitates long-term monitoring in applications such as nuclear reactor operation.

Another feature of the 417 is the high zero stability, better than 1% of full scale per eight hours, which enables meaningful, long-duration measurements to be made.

The Model 26000 Series includes three basic log picoammeters which provide a logarithmic scale covering a wide range of currents without switching. Current measurements are easily performed since the picoammeter can be directly connected to phototubes, photomultipliers, ion vacuum gauges, ion chambers and automated semiconductor testing equipment.

The 26000 Series provides operational features such as a RECOVER switch that allows quick recovery from large overloads and a calibration check switch that allows a quick verification of high and low scales. Since chassis ground and input low are connected via a shorting link, the system designer may select the point of grounding anywhere in his system and thereby eliminate troublesome ground loops. This feature provides control of system grounding for maximum rejection of line interference.

A wide variety of standard options enables the user to select the instrument most ideally suited to the particular application. These options include either negative or dual polarity input and internally installed high voltage source.

The linear versus logarithmic transfer characteristic can be illustrated as shown in the figure on page 37. The transfer function is a means of evaluating the input-current to output-voltage characteristic. The measure of the quality of the picoammeter in determining the value of an unknown input current can be stated by the overall accuracy. Since an actual production unit may deviate from the nominal design due to production tolerances and ambient temperature variations, a specified band of  $\pm 10$  mV identifies the possible inaccuracy in the measurement. The actual uncertainty in knowing the current can be minimized by determining the actual transfer function. The transfer function shown in the figure can be given by  $E_o = M \log I + C$  which takes on specific values for each basic instrument.

# SPECIFICATIONS MODEL 417

**RANGE:**  $10^{-13}$  ampere full scale to  $3 \times 10^{-5}$  ampere in eighteen 1x and 3x ranges, positive or negative currents.

**ACCURACY:**  $\pm 2\%$  of full scale on  $3 \times 10^{-5}$  to  $10^{-8}$  ampere ranges;  $\pm 3\%$  of full scale on  $3 \times 10^{-9}$  to  $10^{-13}$  ampere ranges.

**ZERO DRIFT:** Less than 1% of full scale per 8 hours on any range with multiplier set at 1 after a 30-minute warm-up and with source voltages greater than 1 volt. With multiplier settings of 0.3 and 0.1, the drift is increased in proportion to the increase in sensitivity.

**ZERO CHECK:** Allows zeroing without disturbing the circuit.

**GRID CURRENT:** Less than  $2 \times 10^{-14}$  ampere.

**INPUT VOLTAGE DROP:** Less than 1 millivolt for full-scale meter deflection on all ranges when properly zeroed.

**EFFECTIVE INPUT RESISTANCE:** 100 ohms on  $10^{-5}$  ampere range, increasing to 10,000 megohms on  $10^{-13}$  ampere range in decade steps.

**RISE TIME, MAXIMUM:** Seconds, from 10% to 90%.

Range, amperes	No External Capacitance	With 50 pF Across Input	With 500 pF Across Input	With 5000 pF Across Input
$10^{-13}$	0.5	1.0	3.5	18.0
$10^{-12}$	0.03	0.06	0.4	4.0
$10^{-11}$	0.005	0.01	0.035	0.4
$10^{-10}$	0.004	0.004	0.006	0.04
$10^{-9}$	0.004	0.004	0.004	0.006
$10^{-8}$	0.004	0.004	0.004	0.004
$10^{-7}$ and above	less than 0.001	less than 0.001	less than 0.001	less than 0.001

Note: Rise time may be lengthened by approximately 3 seconds with variable damping control on  $3 \times 10^{-8}$  to  $10^{-13}$  ampere ranges.

**CALIBRATED CURRENT SUPPRESSION:** Up to 1000x full scale; maximum suppression,  $10^{-4}$  ampere. Suppression current is read directly from 4 in-line dials. Accuracy is  $\pm 5\%$  of reading or  $\pm 5\%$  of decade setting, whichever is greater, except for the  $10^{-12}$  decade where it degrades to  $\pm 10\%$  with multiplier settings between 50 and 100.

**CONNECTORS:** Input: Teflon-insulated UHF type. Output: Amphenol 80-PC2F. Remote: Cannon DA15S.

### RECORDER OUTPUT:

Output:  $\pm 3$  volts at up to 1 milliamperes for full-scale meter deflection.

Output polarity is opposite input polarity.

Resistance: Less than 5 ohms.

Noise: Less than 4% rms of full scale on  $10^{-13}$  ampere range at minimum damping, decreasing to 0.4% rms with maximum damping.

**POWER:** 105-125 or 210-250 volts (switch selected), 50-1000 Hz, 20 watts.  
**DIMENSIONS, WEIGHT:** Standard 133 mm x 482 mm rack mounting (5 1/4 in. x 19 in.) 390 mm (15 1/2 in.) depth behind front panel. Net weight, 10.0 kg (22 lbs.).

**ACCESSORIES AVAILABLE:** (See ACCESSORIES, pages 60 through 63.)

Model 3000 Bench Mounting Kit	\$35
Model 4171 Remote Zero Switch permits zero checking of Model 417 when input head is remotely located	\$112
Model 4172 Remote Housing provides a firm mounting base when the Model 417 input head is used remotely	\$112
Model 4173-10 Remote Connecting Cable (3.1 m)	\$112
Model 4713-25 Remote Connecting Cable (7.6 m)	\$125
Model 6106 Electrometer Connection Kit	\$175

**PRICE:** (For export pricing see inside front cover.)

Model 417 High Speed Picoammeter (rack) ..... \$1395

# SPECIFICATIONS MODEL 2600

### BASIC MODELS

Model No.	Range Span Amperes	Decade Span	Calibration Points Amperes	Price
26100	$10^{-3}$ to $10^{-11}$	8	$10^{-4}$ / $10^{-10}$	\$1225
26200	$10^{-4}$ to $10^{-12}$	8	$10^{-5}$ / $10^{-11}$	\$1295
26300	$10^{-7}$ to $10^{-13}$	6	$10^{-8}$ / $10^{-11}$	\$1495

Input polarity is positive negative or dual polarity at added cost.

### OVERALL OPERATING CHARACTERISTICS:

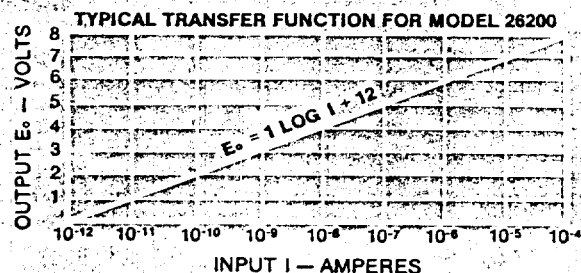
**TEMPERATURE COEFFICIENT:** Less than 2%/°C referred to input current from +10 to +30°C.

**RISE TIME:** Seconds to 90% of final current value (DAMPING control at minimum setting):

Current Change Amperes	Capacitance Across Input Terminals	
	None	5000 pF
$10^{-12}$ to $10^{-7}$	1 second	2 seconds
$10^{-13}$ to $10^{-12}$	3 seconds	6 seconds

### LINEAR-LOG RELATIONSHIP:

Ideal  $E_0 = M \log I + C$ , where M = slope and C = offset of transfer function  
Actual:  $E_0$  actual will deviate from the best straight line by less than:  
10 mV from  $10^{-9}$  to  $10^{-11}$  A; 40 mV at  $10^{-12}$  A; 300 mV at  $10^{-13}$  A



**RECORDER OUTPUT:** 1 volt per decade from minimum current to maximum current. Positive input polarity is standard.

**GROUNDING:** Provision is made on rear panel for grounding instrument via a link between low and chassis.

**CONNECTORS:** Input: BNC type. Output: Microphone receptacle, XLR-3-32 (connectors located on rear panel).

**POWER:** 90-125 volts or 180-250 volts, 50-60 Hz.

**ACCESSORIES SUPPLIED:** Set of mating connectors.

**DIMENSIONS, WEIGHT:** 140 x 222 x 330 mm (5 1/2 in. high x 8 3/4 in. wide x 13 in. deep); net weight, 3.6 kg (8 pounds).

### OPTIONS AVAILABLE: (at added cost)

Model	Description	Price
26X1X	Negative polarity only. (Recorder Output is Positive.)	\$52
26X2X	Dual polarity. (Recorder output is positive. Polarity indicated on front panel and output flag signal.)	\$230
26XX1	Power source installed, +300 volts	\$200
26XX2	Power source installed, -300 volts	\$200
26XXXR	Rack Mounting kit. Specify single or dual mounting	\$50

(For export pricing see inside front cover.)

### ORDERING EXAMPLE:

To order a Log Picoammeter with options, add the cost of option to basic price.

Model	Description	Total
26221R	Model 26200 Log Picoammeter ( $10^{-4}$ to $10^{-12}$ A)	\$1225
	Dual polarity option	\$230
	Power source option, +300 volts	\$200
	Rack mounting kit, single	\$50
<b>TOTAL</b>		<b>\$1705</b>