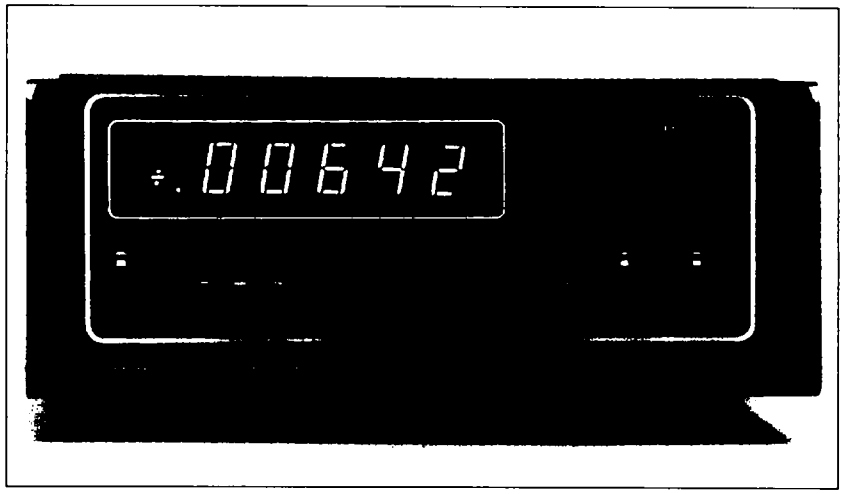
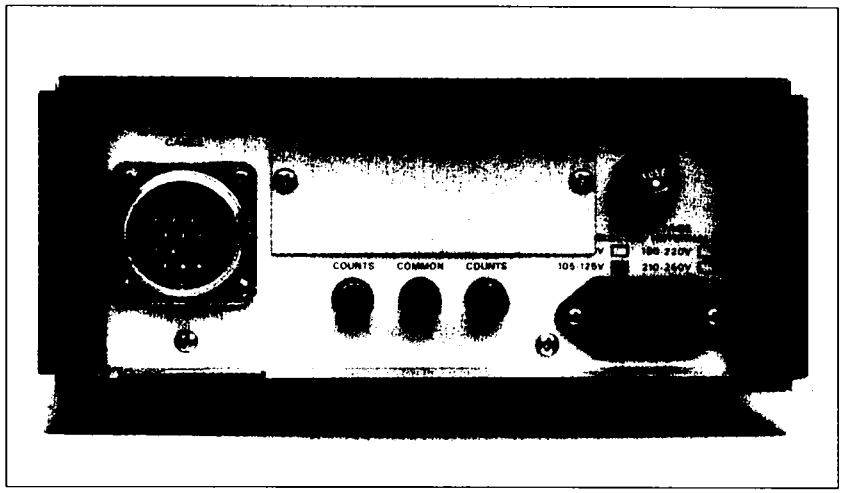
642, 642 LNFPA • ELECTROMETER

IEEE-488 INTERFACEABLE

- **10^{-17}A (10aA) sensitivity**
- **Over 100:000:1 linear dynamic range at analog output**
- **Fast response: 22msec. time constant on 10^{-10}A range**





The Keithley 642 is a direct-reading MOSFET-based electrometer for sensitive measurement of current, voltage, or charge. Its current measurement range is 10aA to 200nA with typically less than 1mV voltage burden. Voltage reading capabilities are 10μV to 10V with 10,000TΩ input resistance. Charge can be measured from 800aC to 100pC. Maximum sensitivity is obtained when using the CHARGE mode to integrate current applied to the input.

High Resolution. The digital format permits observation of small changes in large signals with resolution to 1 part in 20,000 at the digital display. The FEEDBACK output has low noise and non-linearity of only about 5ppm. This wide dynamic range (from noise level to maximum output) provides constant gain over the full span, and eliminates the need for range changing.

State-of-the-Art Design. The 642 uses a specially packaged dual monolithic MOSFET with compensated temperature coefficient in a guarded package. Variations in ambient temperature do not cause significant errors because compensation circuitry is individually adjusted for each FET to give a voltage coefficient of only 30μV/°C.

In the design of the remote head, the active input volume has been minimized. Less than 15 ionization current pulses per hour are observed.

The preamplifier is a direct-coupled circuit with a single, well-controlled time constant. It is a first-order system which produces an exponential response to step inputs. Response time can be varied over a 100:1 span on the 10^{-12}A range.

The remote head is sealed and contains desiccant paper to maintain low internal humidity. Internal humidity can be observed on an indicator on the bottom of the remote head.

The ZERO CHECK switching mechanism has been designed for minimum charge transfer, typically less than 10fC. Internal adjustments may be used to further compensate the average charge transfer.

Analog Outputs. Three analog outputs are provided: The FEEDBACK output on the remote head has the most precision and widest dynamic range (over 10^5), lowest noise, and fastest speed. The 1V/10,000 COUNTS output on the rear of the mainframe normalizes the output to 1V per 10,000 counts regardless of range. The 1V/100 COUNTS output (also on the rear panel) is useful in sensitive measurements to amplify the signal so that 1V corresponds to 100 counts.

Accessories. Input connections are described on the Input Connection Chart. In addition, an isolated BCD output option (Model 6422), IEEE-488 output (Model 6423), 12V battery adapter (Model 6428), and individually sealed desiccant paper refills (Model 6421) are available.

ORDERING INFORMATION

642	Electrometer
642 LNFPA	Electrometer, <50μV p-p noise, fast 10^{-11}A range
642 LNFPA/6423	Electrometer, <50μV p-p noise, fast 10^{-11}A range with IEEE-488 Output

See page 241 for complete Ordering Information.

ELECTROMETER • 642, 642 LNFPA

IEEE-488 INTERFACEABLE

AS A DC AMMETER

CURRENT SETTING	MAXIMUM READING ON 0.1 RANGE	MAXIMUM READING ON 10 RANGE
10^{-8} A	0.19999×10^{-8} A	10.9999×10^{-8} A
10^{-10} A	0.19999×10^{-10} A	10.9999×10^{-10} A
10^{-11} A	0.19999×10^{-11} A	10.9999×10^{-11} A
10^{-12} A	0.19999×10^{-12} A	10.9999×10^{-12} A

CURRENT SETTING	ACCURACY (6 Mo.) 23°C ±1°C ±(% rdg + counts)	1% SETTLING TIME ON 10 RANGE AT 1V/10k COUNTS ANALOG OUTPUT, AT MINIMUM DAMPING
10^{-8} A	1 + 3	≤ 40 msec.
10^{-10} A	1 + 3	≤100 msec.
10^{-11} A	1.3 + 3	≤400 msec.
10^{-12} A	1.5 + 6	≤ 5 msec.

NOISE: 4×10^{-17}A rms (2×10^{-16}A p-p); <15 self-generated alpha pulses per hour.

AS A DC VOLTMETER

RANGE	READING	ACCURACY (6 Mo.) 18°–28°C (Exclusive of Noise) ±(% rdg + counts)	1% SETTLING TIME AT 1V/10k COUNTS ANALOG OUTPUT
0.1 V	.19999	0.5 + 3	3 sec.
1 V	1.9999	0.05 + 1	0.3 sec.
10 V	10.999	0.05 + 1	0.03 sec.

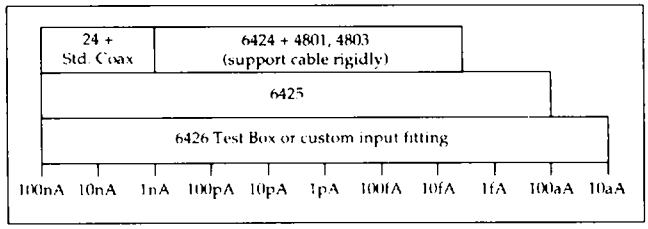
NOISE: <20µV rms (100µV p-p).
ZERO STABILITY: 24 hours, ±3°C: ±180µV.
TEMPERATURE COEFFICIENT OUTSIDE OF ±3°C SPAN: ±(30µV + 0.5 count)/°C.
INPUT RESISTANCE: $10^{16}\Omega$.

AS A COULOMBMETER

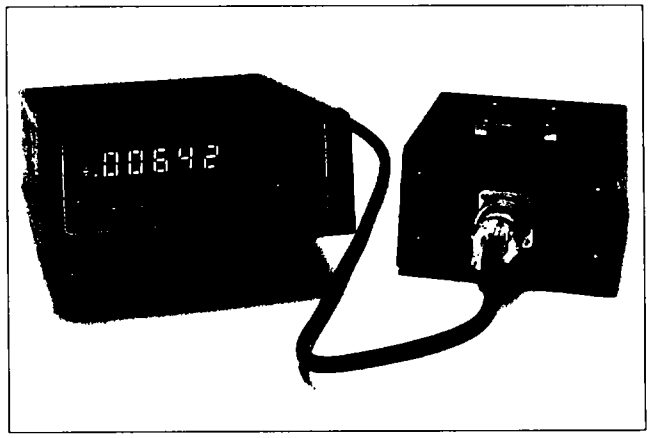
RANGES: 10^{-11} coulombs, 0.1, 1, or 10 ranges.
INPUT CURRENT (23°C ±1°C): $<5 \times 10^{-17}$A.
ACCURACY (23°C ±1°C for 6 months, exclusive of noise): ±(0.3% + 5 counts).
NOISE: 8×10^{-16} coulombs rms (4×10^{-15} coulombs p-p), 0.1 range; <15 self-generated alpha pulses per hour.
CHARGE ERROR DUE TO ACTUATION OF ZERO CHECK: Typically $<10^{-14}$ coulombs.

GENERAL

MAXIMUM INPUTS: Normal or Common Mode: 30V rms, DC to 60Hz.
DISPLAY: Five 0.5 in. LED digits with decimal point and polarity indication.
CONVERSION PERIOD FOR DIGITAL DISPLAY: 400msec..
ANALOG OUTPUTS: Two analog outputs are provided on mainframe rear panel: 1V/10,000 counts and 1V/100 counts of the digital display.
POWER REQUIREMENTS: 90–110V, 105–125V, 120–220V, or 210–250V; 50Hz to 60Hz, 30VA maximum.
DIMENSIONS, WEIGHTS: Mainframe: 3.5 in. half rack, 100mm high × 217mm wide × 308mm deep (4 in. × 8.5 in. × 12.125 in.). Net weight 2.9kg (6 lbs., 6 oz.).
Remote Head: 102mm high × 162mm wide × 165mm deep (4 in. × 6.375 in. × 6.5 in.), exclusive of connectors. Net weight 4.1kg (9 lbs., 2 oz.).
INTERCONNECT CABLE: 4 ft. long. Net weight 0.6kg (1 lb., 3 oz.).
ACCESSORY SUPPLIED: Four-foot remote head to mainframe interconnect cable.
ACCESSORIES AVAILABLE: See Selector Guide on page 61.



***Input Connection Chart**, showing recommended input connections for various current sensitivities.*



***642 Remote Head** is sealed and contains desiccant paper to maintain low internal humidity.*

642 LNFPA

In precision ratio isotope mass spectrometry, the sensitivity and linearity of the 642 are essential. However, the standard unit may not be fast enough to settle to within 0.01% of final value in the short time the beam remains stable. Also, precision requirements often demand lower noise per unit bandwidth to obtain sufficiently repeatable results.

The 642 LNFPA was developed for these demanding situations. Typically, it will settle to within 0.01% of final value in 2 seconds or less on the 10^{-11}A range, allowing most of the time the beam is stable for integration of the signal from the precision FEEDBACK output. It also has a selected lower noise input FET. Noise is documented and <50µV (vs. the standard 100µV) in the VOLTAGE mode, reducing the effective noise current on the 10^{-11}A range.

See page 241 for complete Ordering Information.