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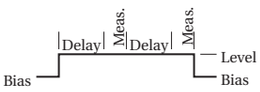
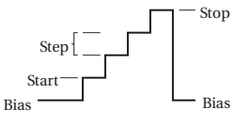
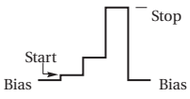
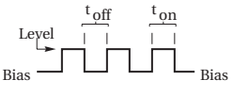
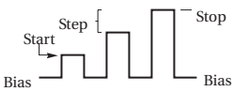
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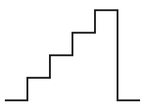
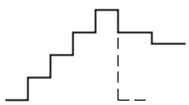
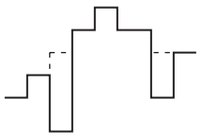
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# 236 Source-Measure Unit

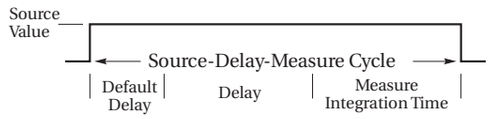
| SWEEP WAVEFORMS | DESCRIPTION |
|---|---|
|  Fixed Level | LEVEL, COUNT (number of DELAY-MEASURE cycles), DELAY, BIAS |
|  Linear Stair | START, STOP, STEP, DELAY, BIAS |
|  Logarithmic Stair | START, STOP, POINTS/DECADE (5, 10, 25, or 50), DELAY, BIAS |
|  Pulse | LEVEL, COUNT, $T_{ON}$, $T_{OFF}$, BIAS |
|  Linear Stair Pulse | START, STOP, STEP, $T_{ON}$, $T_{OFF}$, BIAS |
|  Logarithmic Stair Pulse | START, STOP, POINTS/DECADE (5, 10, 25, or 50), $T_{ON}$, $T_{OFF}$, BIAS |

| WAVEFORM OPERATORS | DESCRIPTION |
|---|---|
|  Create | Allows selection of waveform parameters. Generates all source values. |
|  Append | Combines multiple waveforms and adds new points to those already in memory. |
|  Modify | Select and change any points in a previously created (or appended) waveform. |

**SOURCE-MEASURE UNIT:** Sources voltage while measuring current, or sources current while measuring voltage.

**FUNCTION:** Can be used as DC source or meter, sweep source, or full source-measure unit.

**SOURCE-DELAY-MEASURE CYCLE:**




**Default Delay:** Fixed delay for instrument settling.

**User Delay:** Additional delay for device under test or system capacitance.

**MEASURE**:

| Integration Time | | | |
|---|---|---|---|
| Fast | 416 | µs | 4-digit resolution |
| Medium | 4 | ms | 5-digit resolution |
| Line Cycle | 16.67 | ms (60 Hz) | 5-digit resolution |
| | 20.00 | ms (50 Hz) | |

**Elapsed Time:** Measures and stores time from sweep trigger to measurement complete for each step of sweep.

**RANGING:**

**Source:** Auto-ranging through keypad entry; fixed range selection using rotary dial and SELECT keys (DC function). Fully programmable in SWEEP function.

**Measure:** Auto or fixed range. Fixed range selection made by choice of COMPLIANCE value.

**FILTER:** Takes n measurements, calculates and outputs average (n = 2, 4, 8, 16, or 32, selectable).

**SUPPRESS:** Subtracts displayed measurement from subsequent readings.

**MENU**: DC Measurement Delay, Default Delay On/Off, Local/Remote Sense, 50/60Hz, IEEE Address, Self Tests.

**DATA ENTRY:** Numeric keypad or detented rotary dial.

**TRIGGER:**

**Input and Output:** Set for any phase of SOURCE-DELAY-MEASURE sequence or trigger output at end of sweep.

**Origin:** Internal, External (including front panel MANUAL TRIGGER button), IEEE-488 bus (TALK, GET, "X").

**MEMORY:** Stores one full sweep (up to 1000 points) of source, delay, and measure values, elapsed times, and sweep parameters. Lithium battery backup.

**INTERLOCK:** Use with test fixture or external switch. Normally closed; open puts instrument in standby.

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KEITHLEY Keithley Instruments, Inc.
Cleveland, Ohio 44139

**SPECIFICATIONS**

**PART NUMBER**
SPEC-236

BRUNING 40-21 62198-SBG

FORM 28777A-SBG

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PURCHASED ITEM

# 236 Source-Measure Unit

## EXECUTION SPEED

**MINIMUM SOURCE-DELAY-MEASURE CYCLE TIME:** 1ms.

**RESPONSE TO IEEE-488 COMMAND (as a source):** 25ms.

**MEASUREMENT RATE:** 1ms per point into internal buffer.

**CONTINUOUS MEASUREMENT SPEED (source DC value over IEEE-488 bus):** 110 readings per second.

**TRIGGER LATENCY TIME:** <2ms.

## IEEE-488 BUS IMPLEMENTATION

**MULTILINE COMMANDS:** DCL, LLO, SDC, GET, GTL, UNT, UNL, SPE, SPD.

**UNILINE COMMANDS:** IFC, REN, EOI, SRQ, ATN.

**INTERFACE FUNCTIONS:** SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT1, C0, E1.

All front panel functions and setups are available over the IEEE-488 bus, in addition to Status, Service Request, Output Format, EOI, Trigger, and Terminator.

IEEE-488 address is set from the front panel menu.

## GENERAL

**LOAD CAPACITANCE:** Stable into 20,000pF typical.

**REMOTE SENSE:** Corrects for up to 2V drop in each output lead. Maximum 1kΩ per sense lead for rated accuracy. Residual output resistance (as a voltage source) is 0.5Ω.

**GUARD: Output Resistance:** ≤12kΩ.

**Maximum Output Current:** ±2mA.

**Offset Relative to Output HI:** ±2mV max.

**ISOLATION (Output LO to chassis):** Typically >$10^{10}$Ω in parallel with 500pF.

**MAXIMUM COMMON MODE VOLTAGE:** 200V.

**CONNECTORS: Outputs:** 3-lug triax.

**Trigger Input/Output:** BNC.

**Interlock:** 3-pin miniature DIN.

**TEMPERATURE COEFFICIENT (0°–18°C & 28°–50°C):** ±(0.1 × applicable accuracy specification)/°C.

**ENVIRONMENT:**

**Operating:** 0°–50°C, 70% relative humidity up to 35°C. Linearly derate 3% RH/°C, 35°–50°C.

**Storage:** –25° to 65°C.

**EMC:** Conforms to European Union Directive 89/336/EEC.

**SAFETY:** Conforms to European Union Directive 73/23/EEC (meets EN61010-1/IEC 1010).

**WARM-UP:** One hour to rated accuracy.

**COOLING:** Internal fan forced air cooling.

**POWER:** 105–125 or 210–250V AC (external switch selectable), 90–110V and 180–220V version available. 100VA max.

**DIMENSIONS, WEIGHT:** 89mm high × 435mm wide × 448mm deep (3½ in × 17⅛ in × 17⅝ in). Net weight 9kg (19.75 lb).

**ACCESSORIES SUPPLIED:**
Model 7078-TRX-3: Triax to Triax Cable, 0.9m (3 ft.)
Model 236-ILC-3: Interlock Cable

**ACCESSORIES AVAILABLE:**
Model 8000-10: Equipment Rack for 3 SMUs (10 in.)
Model 8000-14: Equipment Rack for 4 SMUs (14 in.)

## VOLTAGE

| SOURCE V | | | MEASURE V | | |
|---|---|---|---|---|---|
| RANGE (Max. Value) | STEP SIZE | ACCURACY (1 Year, 18°–28°C) | RESOLUTION 4-Digit | RESOLUTION 5-Digit | ACCURACY[1] (1 Year, 18°–28°C) |
| ±1.1000 V[2] | 100 µV | ±(0.033%+650 µV + [$I_O$/$I_{FS}$] × 450µV) | 100 µV | 10 µV | ±(0.028% + 300µV + [$I_O$/$I_{FS}$] × 450µV) |
| ±11.000 V | 1 mV | ±(0.033% + 2.4mV) | 1 mV | 100 µV | ±(0.025%+ 1mV) |
| ±110.00 V | 10 mV | ±(0.033% + 24mV) | 10 mV | 1 mV | ±(0.025%+ 10mV) |

$I_O$ = Output current; $I_{FS}$ = Full scale on selected current range

[1] Specifications apply for 5-digit resolution. For 4-digit resolution add 100ppm of range.

[2] Assumes remote sense for I > 100µA.

**COMPLIANCE:** Bipolar current limit set with single value.

**Maximum:** ±100mA.

**Minimum:** ±0.1% of range, except 0.5% of 1.1V range.

**Accuracy, Step Size:** Same as current source.

**NOISE (p-p):**

| RANGE | 0.1–10Hz |
|---|---|
| 110 V – 1100 V | < 3ppm of range |
| 11 V | < 3ppm of range |
| 1.1 V | <10ppm of range |

**WIDEBAND NOISE:** 0.1 to 20MHz, 8mV p-p typical.

**OVERSHOOT:** <0.01% (110V step, 10mA range).

**SETTLING TIME:** <500µs to 0.01% (110V step, 10mA range).

**NMRR:** >60dB at 50 or 60Hz (LINE CYCLE integration time selected).

**CMRR:** >120dB at DC, 50 or 60Hz (LINE CYCLE integration time selected).

**INPUT IMPEDANCE (as a voltmeter):** >$10^{14}$Ω paralleled by <20pF.

## CURRENT

| SOURCE I | | | MEASURE I | | |
|---|---|---|---|---|---|
| RANGE (Max. Value) | STEP SIZE | ACCURACY (1 Year, 18°–28°C) | RESOLUTION 4-Digit | RESOLUTION 5-Digit | ACCURACY[1] (1 Year, 18°–28°C) |
| ±1.0000 nA | 100 fA | ±(0.3 %+ 450 fA) | 100 fA | 10 fA | ±(0.3 % + 100 fA)[2] |
| ±10.000 nA | 1 pA | ±(0.3 %+ 2 pA) | 1 pA | 100 fA | ±(0.3 % + 1 pA) |
| ±100.00 nA | 10 pA | ±(0.21%+ 20 pA) | 10 pA | 1 pA | ±(0.21 % + 6 pA) |
| ±1.0000 µA | 100 pA | ±(0.05%+ 200 pA) | 100 pA | 10 pA | ±(0.04 % + 60 pA) |
| ±10.000 µA | 1 nA | ±(0.05%+ 2 nA) | 1 nA | 100 pA | ±(0.035% + 700 pA) |
| ±100.00 µA | 10 nA | ±(0.05%+ 20 nA) | 10 nA | 1 nA | ±(0.035% + 6 nA) |
| ±1.0000 mA | 100 nA | ±(0.05%+ 200 nA) | 100 nA | 10 nA | ±(0.035% + 60 nA) |
| ±10.000 mA | 1 µA | ±(0.05%+ 2 µA) | 1 µA | 100 nA | ±(0.038% + 600 nA) |
| ±100.00 mA | 10 µA | ±(0.1 %+ 20 µA) | 10 µA | 1 µA | ±(0.1 % + 6 µA) |

[1] Specifications apply for 5-digit resolution. For 4-digit resolution, all offset terms are 200ppm of range.

[2] Offset specification applies for 23°C ± 1°C with suppression. Temperature coefficient 50fA/°C.

**COMPLIANCE:** Bipolar voltage limit set with single value.

**Maximum:** ±1100V.

**Minimum:** ±0.1% of selected current range.

**Accuracy, Step Size:** Same as voltage source.

**NOISE (p-p of range):** 0.1–10Hz: <3ppm (<20ppm on 1nA and 10nA ranges).

**OVERSHOOT:** <0.01% typical (10mA step, $R_L$ = 10kΩ).

**SETTLING TIME:** <500µs to 0.01% (10mA step, $R_L$ = 10kΩ).

**OUTPUT R, C:** >$10^{14}$Ω paralleled by <20pF (on 1nA range).

**VOLTAGE BURDEN (as an ammeter):** <1mV.

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