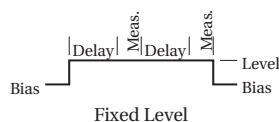


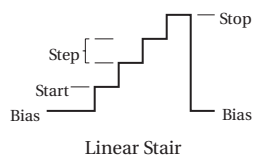
236 Source-Measure Unit

SWEEP WAVEFORMS

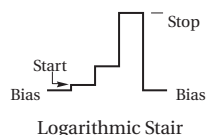
DESCRIPTION



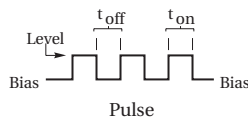
LEVEL, COUNT (number of DELAY-MEASURE cycles), DELAY, BIAS



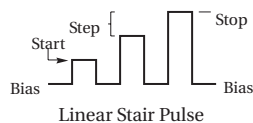
START, STOP, STEP, DELAY, BIAS



START, STOP, POINTS/DECADE (5, 10, 25, or 50), DELAY, BIAS



LEVEL, COUNT, T_{ON} , T_{OFF} , BIAS



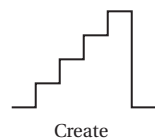
START, STOP, STEP, T_{ON} , T_{OFF} , BIAS



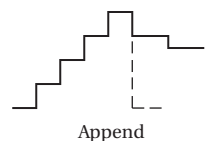
START, STOP, POINTS/DECADE (5, 10, 25, or 50), T_{ON} , T_{OFF} , BIAS

WAVEFORM OPERATORS

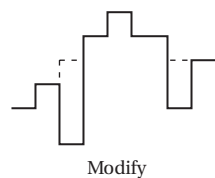
DESCRIPTION



Allows selection of waveform parameters. Generates all source values.



Combines multiple waveforms and adds new points to those already in memory.



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 μ s	4-digit resolution
Medium	4 ms	5-digit resolution
Line Cycle	16.67 ms (60 Hz) 20.00 ms (50 Hz)	5-digit resolution

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.

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, PPO, 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 1k Ω per sense lead for rated accuracy. Residual output resistance (as a voltage source) is 0.5 Ω .

GUARD: Output Resistance: $\leq 12\text{k}\Omega$.

Maximum Output Current: $\pm 2\text{mA}$.

Offset Relative to Output HI: $\pm 2\text{mV}$ max.

ISOLATION (Output LO to chassis): Typically $>10^{10}\Omega$ 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): $\pm(0.1 \times \text{applicable accuracy specification})/^\circ\text{C}$.

ENVIRONMENT:

Operating: 0°–50°C, 70% relative humidity up to 35°C. Linearly derate 3% RH/ $^\circ\text{C}$, 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 \times 435mm wide \times 448mm deep (3½ in \times 17½ in \times 17½ 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) + [I _O /I _{FS}] \times 450 μV	RESOLUTION 4-Digit	5-Digit	ACCURACY ¹ (1 Year, 18°–28°C) + [I _O /I _{FS}] \times 450 μV
	$\pm 1.1000\text{ V}^2$	100 μV	$\pm(0.033\% + 650\text{ }\mu\text{V}$ + [I _O /I _{FS}] \times 450 μV)	100 μV	10 μV	$\pm(0.028\% + 300\text{ }\mu\text{V}$ + [I _O /I _{FS}] \times 450 μV)
	$\pm 11.000\text{ V}$	1 mV	$\pm(0.033\% + 2.4\text{ mV})$	1 mV	100 μV	$\pm(0.025\% + 1\text{ mV})$
	$\pm 110.00\text{ V}$	10 mV	$\pm(0.033\% + 24\text{ mV})$	10 mV	1 mV	$\pm(0.025\% + 10\text{ mV})$

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 > 100 μA .

COMPLIANCE: Bipolar current limit set with single value.

Maximum: $\pm 100\text{ mA}$.

Minimum: $\pm 0.1\%$ 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: <500 μs 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): $>10^{14}\Omega$ paralleled by <20pF.

CURRENT	SOURCE I		MEASURE I			
	RANGE (Max. Value)	STEP SIZE	ACCURACY (1 Year, 18°–28°C) + [I _O /I _{FS}] \times 450 fA	RESOLUTION 4-Digit	5-Digit	ACCURACY ¹ (1 Year, 18°–28°C) + [I _O /I _{FS}] \times 450 fA ²
	$\pm 1.0000\text{ nA}$	100 fA	$\pm(0.3\% + 450\text{ fA})$	100 fA	10 fA	$\pm(0.3\% + 100\text{ fA})^2$
	$\pm 10.000\text{ nA}$	1 pA	$\pm(0.3\% + 2\text{ pA})$	1 pA	100 fA	$\pm(0.3\% + 1\text{ pA})$
	$\pm 100.00\text{ nA}$	10 pA	$\pm(0.21\% + 20\text{ pA})$	10 pA	1 pA	$\pm(0.21\% + 6\text{ pA})$
	$\pm 1.0000\text{ }\mu\text{A}$	100 pA	$\pm(0.05\% + 200\text{ pA})$	100 pA	10 pA	$\pm(0.04\% + 60\text{ pA})$
	$\pm 10.000\text{ }\mu\text{A}$	1 nA	$\pm(0.05\% + 2\text{ nA})$	1 nA	100 pA	$\pm(0.035\% + 700\text{ pA})$
	$\pm 100.00\text{ }\mu\text{A}$	10 nA	$\pm(0.05\% + 20\text{ nA})$	10 nA	1 nA	$\pm(0.035\% + 6\text{ nA})$
	$\pm 1.0000\text{ mA}$	100 nA	$\pm(0.05\% + 200\text{ nA})$	100 nA	10 nA	$\pm(0.035\% + 60\text{ nA})$
	$\pm 10.000\text{ mA}$	1 μA	$\pm(0.05\% + 2\text{ }\mu\text{A})$	1 μA	100 nA	$\pm(0.038\% + 600\text{ nA})$
	$\pm 100.00\text{ mA}$	10 μA	$\pm(0.1\% + 20\text{ }\mu\text{A})$	10 μA	1 μA	$\pm(0.1\% + 6\text{ }\mu\text{A})$

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 \pm 1°C with suppression. Temperature coefficient 50fA/ $^\circ\text{C}$.

COMPLIANCE: Bipolar voltage limit set with single value.

Maximum: $\pm 1100\text{ V}$.

Minimum: $\pm 0.1\%$ 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 = 10k Ω).

SETTLING TIME: <500 μs to 0.01% (10mA step, R_L = 10k Ω).

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

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