

236
237
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Source-Measure Unit High Voltage Source-Measure Unit High Current Source-Measure Unit



- **Four instruments in one (voltage source, voltage measure, current source, current measure)**
- **10fA, 10pV measurement sensitivity**
- **1100V source and measure (237 only)**
- **1A source and measure (238 only)**
- **Standard and custom sweep capability including pulse**
- **1000 source/measurements per second**
- **Four quadrant source operation**
- **Internal 1000-reading memory**

ACCESSORIES AVAILABLE

CABLES AND CONNECTORS

237-TRX-NG	3-Slot Triax to 3-Lug Female Triax Connector
7078-TRX-3	3-Slot, Low Noise Triax Cable, 0.9m (3 ft)
7078-TRX-20	3-Slot, Low Noise Triax Cable, 6m (20 ft)

RACKS & RACK MOUNT KITS

1938	Fixed Rack Mount Kit
1939	Slide Rack Mount Kit

SOFTWARE

METRICS-ICS-35	IV, CV Curve Tracer Software
TestPoint™	Test Development Software

The 236, 237, and 238 Source-Measure Units (SMU) are fully programmable instruments, capable of sourcing and measuring voltage or current simultaneously. These systems are really four instruments in one: voltage source, current source, voltage measure, and current measure.

Applications

These instruments address a wide variety of applications, including the characterization of semiconductor devices and the measurement of leakage currents or insulation resistance. They are particularly useful as source and measuring instruments in automated test equipment (ATE).

Wide Dynamic Range

The Model 236 will source voltage from 100μV to 110V, and current from 100fA to 100mA. It can also measure voltage from 10μV to 110V and current from 10fA to 100mA. The Model 237 offers the same capabilities with a decade enhancement in voltage source and measure (1100V). In this higher voltage range, current source and measure is 10mA maximum. The Model 238 offers a decade enhancement in current source and measure (1A). In this higher current range, voltage source and measure is 15V maximum.

Selectable Sweeps of Voltage and Current

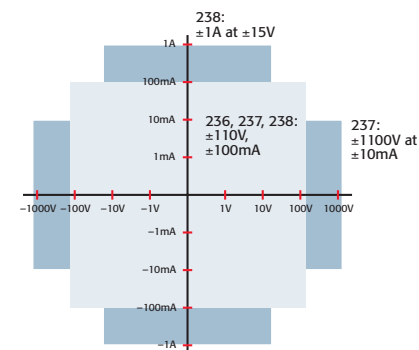
The 236, 237, and 238 can be programmed to perform source-measurements as a function of a stepped voltage or current. Voltage and current can be swept linearly, logarithmically, or pulsed. The START, STOP, STEP method of setting sweep parameters allows operators to become proficient at using the instrument very quickly. Sweep parameters may be appended (APPEND key) to obtain more complex test sequences.

Creating custom sweeps of voltage or current is facilitated by the use of three waveform operations: CREATE, APPEND, and MODIFY. These allow the user to select waveform parameters, combine multiple waveforms, and select and change any points in a waveform previously created or appended.

Fully-Guarded Four-Terminal Measurements

The Model 236, 237, and 238 outputs and inputs are fully guarded, and the units are configured to allow four-terminal measurements. Two-terminal measurements are also available for more standard test procedures. These outputs can be floated up to ±200V from ground.

SMU Source Capability



Ordering Information

236	Source-Measure Unit
237	High Voltage Source-Measure Unit
238	High Current Source-Measure Unit

These products are available with an Extended Warranty.

Accessories Supplied

- 7078-TRX-10 3-Slot Low Noise Triax Cables, 3m (10 ft) (2)**
- 236-ILC-3 Interlock Cable, 3m (10 ft)**
- 237-ALG-2 Low Noise Triax Cable, 2m (6.6 ft)**

Source and measure voltage and current simultaneously

SOURCE AND MEASURE

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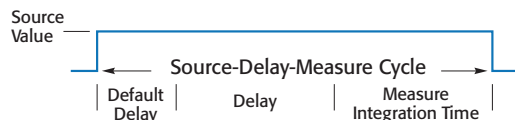
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Source-Measure Unit

High Voltage Source-Measure Unit

High Current Source-Measure Unit

SOURCE-DELAY-MEASURE CYCLE:



Default Delay: Fixed delay for instrument setting.

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)	

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.

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 >10¹⁰Ω in parallel with 500pF (650pF on Model 238).

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. (120VA max. on Model 238).

DIMENSIONS, WEIGHT: 89mm high × 435mm wide × 448mm deep (3½ in × 17¼ in × 17½ in). Net weight 9kg (19.75 lb).

VOLTAGE

	SOURCE V			MEASURE V		
	RANGE (Max. Value)	STEP SIZE	ACCURACY (1 Year, 18°–28°C)	RESOLUTION (1 Year, 4-Digit)	5-Digit	ACCURACY (1 Year, 18°–28°C)
236, 237	±1.1000 V	100 μV	±(0.033% + 650 μV)	100 μV	10 μV	±(0.028% + 300 μV)
	±11.000 V	1 mV	±(0.033% + 2.4 mV)	1 mV	100 μV	±(0.025% + 1 mV)
	±110.00 V	10 mV	±(0.033% + 24mV)	10 mV	1 mV	±(0.025% + 10 mV)
237 Only	±1100.0 V	100 mV	±(0.04 % + 240 mV)	100 mV	10 mV	±(0.035%+100 mV)
238 Only	±1.5000 V	100 μV	±(0.033% + 800 μV)	100 μV	10 μV	±(0.028% + 450 μV)
	±15.000 V	1 mV	±(0.033% + 2.7 mV)	1 mV	100 μV	±(0.025%+ 1 mV)
	±110.00 V	10 mV	±(0.033%+ 24 mV)	10 mV	1 mV	±(0.025%+ 10 mV)

COMPLIANCE: Bipolar current limit set with single value.

Maximum: ±100mA (except ±10mA on 1100V range in Model 237 and ±1A on 15V range in Model 238).

Minimum: ±1% of range, except 0.5% of 1.1V range.

Accuracy, Step Size: Same as current source.

NOISE (p-p):

RANGE	0.1–10Hz	DC–20MHz
110 V – 1100 V	< 3ppm of range	40 mV
11 V (15 V on 238)	< 3ppm of range	15 mV
1.1 V (1.5 V on 238)	<10ppm of range	15 mV

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): >10¹⁴Ω paralleled by <20pF.

CURRENT

	SOURCE I			MEASURE I		
	RANGE (Max. Value)	STEP SIZE	ACCURACY (1 Year, 18°–28°C)	RESOLUTION (4-Digit)	5-Digit	ACCURACY (1 Year, 18°–28°C)
All	±1.0000 nA	100 fA	±(0.3 % + 450 fA)	100 fA	10 fA	±(0.3 % + 100 fA) ¹
	±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)
	238 Only ±1.0000 A	100 μA	±(0.12% + 700 nA)	100 μA	10 μA	±(0.12 % + 300 μA)

COMPLIANCE: Bipolar voltage limit set with single value.

Maximum: ±1100V (except ±110V in Model 238 and on 100mA range in Model 237).

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 and on 1A range in Model 238).

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

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

OUTPUT R, C: >10¹⁴Ω paralleled by <20pF (on 1nA range).

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

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238 High Current Source-Measure Unit

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.

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

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

238 High Current Source-Measure Unit

VOLTAGE	SOURCE V			MEASURE V		
	RANGE	STEP	ACCURACY (1 Year, 18°–28°C)	RESOLUTION		ACCURACY ¹ (1 Year, 18°–28°C)
	(Max. Value)			4-Digit	5-Digit	
	±1.5000 V	100 µV	±(0.033% + 800 µV + [I _O /I _{FS}] × 600µV) ²	100 µV	10 µV	±(0.028% + 450µV + [I _O /I _{FS}] × 600µV) ²
	±15.000 V	1 mV	±(0.033% + 2.7mV)	1 mV	100 µV	±(0.025%+ 1.3mV) ²
	±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. Assumes remote sense for I > 100µA.

² On the 1A range use [I_O/I_{FS}] × 250µV.

COMPLIANCE: Bipolar current limit set with single value.

Maximum: ±1A (±100mA on 110V range).

Minimum: ±1% of selected voltage range.

Accuracy, Step Size: Same as current source.

NOISE (p-p typical):	
RANGE	0.1–10Hz
110 V	< 3ppm of range
15 V	< 3ppm of range
1.5V	<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): >10¹⁴Ω paralleled by <20pF.

CURRENT	SOURCE I			MEASURE I		
	RANGE	STEP	ACCURACY (1 Year, 18°–28°C)	RESOLUTION		ACCURACY ^{1,2} (1 Year, 18°–28°C)
	(Max. Value)			4-Digit	5-Digit	
	±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 %+ 6 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)
	±1.0000 A	100 µA	±(0.12%+ 700 µA)	100 µA	10 µA	±(0.12 %+ 300 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: ±110V (±15V on the 1A range).

Minimum: ±1% of selected current range.

Accuracy, Step Size: Same as voltage source.

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

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

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

OUTPUT R, C: >10¹⁴Ω paralleled by <20pF (on 1nA range).

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.

Open Circuit Offset Relative to Output HI: ±2mV max.

ISOLATION (Output LO to chassis): Typically >10¹⁰Ω in parallel with 650pF.

MAXIMUM COMMON MODE VOLTAGE: 200V peak.

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.

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. 120VA max.

DIMENSIONS, WEIGHT: 89mm high × 435mm wide × 448mm deep (3½ in × 17½ in × 17½ in). Net weight 9kg (19.75 lb).

ACCESSORIES SUPPLIED:

Model 7078-TRX-10: Triax to Triax Cable, 3m (10 ft.) (2 supplied)

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.)