The 2460-EC Electrochemistry Lab System is Keithley’s low cost alternative to traditional electrochemistry potentiostats. The 2460-EC brings speed, flexibility, and simplicity right to your fingertips. Its innovative graphical user interface (GUI) and advanced, capacitive touchscreen technology allow intuitive usage and minimize the learning curve to enable researchers, scientists, and students to learn faster, work smarter, and invent easier. The 2460-EC is a versatile instrument, particularly well-suited for research and development in fundamental electrochemical lab research, characterizing the next generation of materials and electrolytes, new energy storage devices, and faster, smaller sensors.

The Keithley 2460-EC Electrochemistry Lab System: A Low Cost Alternative to the Potentiostat

While potentiostats are excellent instruments for electrochemistry applications, they typically lack any front panel display and control knobs, often are 2-quadrant systems only, and must be completely controlled by a computer with software that is not always open for users to customize tests beyond what the software can do.

Keithley’s 2460-EC is a smart alternative as a DC/low frequency potentiostat. The 2460-EC has features that, in many cases, can perform as well as a potentiostat at lower cost including a wide range of voltages and currents for sourcing or measuring, nV / fA sensitivities, and high impedance sense leads with a typical input resistance of 50G ohms and only 1pA of input bias current, typically acceptable with a wide variety of reference electrodes. The 2460-EC can run internal application test scripts so electrochemistry measurements can be run without the use of an external computer. Results (graphs) are immediately displayed right on the instrument front panel touchscreen. Connecting the 2460-EC to a 2-, 3-, or 4-electrode cell to perform the same tests as a potentiostat is simple with the included translation cable.

The 2460-EC can be easily connected to a 3-electrode cell.

Electrochemical Cell

Working Electrode

Reference Electrode

Counter Electrode
2460-EC

Electrochemistry Lab System

Ordering Information
2460-EC Electrochemistry Lab System, 105V, 7A, 100W SourceMeter Instrument

Accessories Supplied
Electrochemistry Translation Cable Accessory Kit
2460-KIT Rear Panel Mating Mass Terminated Screw Connector
8608 High Performance Test Leads
USB-B-1 USB Cable, Type A to Type B, 1m (3.3 ft)
CS-161-3 Safety Interlock Mating Connector
CA-180-3A TSP-Link/Ethernet Cable
Documentation CD
Application Test Scripts and Documentation
Test Script Builder Software (available at www.tektronix.com)
KickStart Startup Software (available at www.tektronix.com)
LabVIEW and IVI Drivers (available at www.tektronix.com)

Learn Faster; Work Smarter; Invent Easier
Unlike traditional potentiostats that lack a user-interface front panel to interact with, the 2460-EC features a five-inch, full-color, high resolution touchscreen that facilitates ease of use, and optimizes overall speed and productivity. Built-in, context-sensitive help enables intuitive operation and minimizes the need to review a separate manual. These capabilities combined with its application versatility make the 2460-EC inherently easy to use for basic and advanced measurement applications, regardless of your experience level with electrochemistry instruments.

Convert Raw Data into Information
A full graphical plotting window converts raw data and displays it immediately as useful information, such as cyclic voltammograms. The touch screen interface makes it easy to observe, interact with, and explore measurements with “zoom and pinch” simplicity. By using the built-in graphing cursors, you can immediately analyze your data without a computer. All graphic screens can be saved to a USB thumb drive for incorporation into reports and journals. Using the graphical sheet view, test data can also be displayed in tabular form. The instrument supports exporting data to a spreadsheet for further analysis, dramatically improving productivity for research and development. This combination of high performance and high ease of use offers unparalleled insight into your test results.

Built-in real-time graphing, charting, scope-like cursors, and data display spreadsheet for export simplifies converting test results into useful information.
Test Applications
The 2460-EC’s built-in open source scripting enables electrochemists, chemists, and materials scientists to create libraries of reusable, customizable experimental software for running tests including cyclic voltammetry, chronopotentiometry, and more. The following electrochemistry test scripts are loaded in the internal memory of the 2460-EC.

- **Cyclic Voltammetry**: Potential is swept at a user programmable scan rate between two to four defined vertices while current is measured. Current is measured using an analog integration method.
- **Linear Sweep Voltammetry**: Potential is swept at a user programmable scan rate between two defined points while current is measured.
- **Open Circuit Potential**: Measures the cell potential difference between two electrodes with high input impedance as a function of time.
- **Potential Pulse and Square Wave with Current Measure**: The 2460-EC sources potential at programmable peak and base levels while current is recorded at a user-defined position on the pulse peak level.
- **Current Pulse and Square Wave with Voltage Measure**: The 2460-EC sources current at programmable peak and base levels while potential is recorded at a user-defined position on the pulse peak level.
- **Chronoamperometry**: The potential is stepped to a programmed value while the resulting current is measured as a function of time.
- **Chronopotentiometry**: The current is stepped to a programmed value while the resulting potential is measured as a function of time.

In addition to preloaded test scripts, the built-in open source scripting language enables the user to create their own library of electrochemistry test scripts that can be modified as the test and measurements evolve.

All-in-One Instrument
The 2460-EC offers a highly flexible, four-quadrant voltage and current source/load coupled with precision voltage and current meters. When not used in potentiostat type applications, this all-in one instrument can be re-purposed as a general lab instrument, including use as a:

- Precision power supply with V and I readback
- True current source
- Digital multimeter (DCV, DCL, ohms, and power with 6½-digit resolution)
- Precision electronic load
- Trigger controller

**TYPICAL APPLICATIONS**
Ideal for electrochemical research and development in a wide variety of applications studies, including:

- **Basic Analytical Research**
  - Electrochemical cells
  - Electrode studies
  - Solid electrolytes
- **Materials Research**
  - Electrode compositions
  - Electrolyte solutions
  - Ceramics, polymers, ferro/piezoelectrics
  - Organic semiconductors
  - Low-k dielectrics
  - Biomaterials
  - Nanomaterials
  - Electrodeposition
- **Energy Systems and Storage**
  - Dye-sensitized solar cells
  - Batteries
  - Fuel cells, flow batteries
  - Supercapacitors
- **Sensors**
  - Environmental monitoring
  - Industrial process control
  - Healthcare/medical
2460-EC Electrochemistry Lab System

Ease of Use Beyond the Touchscreen
In addition to its five-inch, color touchscreen, the 2460-EC front panel has many features that supplement its speed, user-friendliness, and learnability, including a USB 2.0 memory I/O port, a HELP key, a rotary navigation/control knob, a front/rear input selector button, and banana jacks for basic bench applications. The USB 2.0 memory port supports easy data storing, saving instrument configurations, loading test scripts, and system upgrades. Plus, all front panel buttons are backlit to enhance visibility in low-light environments.

Comprehensive Built-in Connectivity
Rear panel access to rear-input triax connectors, remote control interfaces (GPIB, USB 2.0, and LXI/Ethernet), D-sub 9-pin digital I/O port (for internal/external trigger signals and handler control), instrument interlock control, and TSP-Link® jacks enables easy configuration of multiple instrument test solutions and eliminates the need to invest in additional adapter accessories.

Free Instrument Control Start-up Software
The 2460-EC can be repurposed for applications beyond electrochemistry as a general purpose lab tool, e.g. I-V testing, leakage testing, battery charge/discharge profiling, etc. KickStart, Keithley’s instrument control non-programming start-up software, lets users start taking measurements in minutes for typical current versus voltage applications. In most cases, users merely need to make quick measurements, graph the data, and store the data to disk to perform analysis in software environments such as Excel.

KickStart offers the following functionality:
• Instrument configuration control to perform I-V characterization
• Native X-Y graphing, panning, and zooming
• Spreadsheet/tabular viewing of data
• Saving and exporting data for further analysis
• Saving of test setups
• Screenshot capturing of graph
• Annotation of tests
• Command line dialog for sending and receiving data
• HTML help
• GPIB, USB 2.0, Ethernet compliant

With KickStart start-up software, users are ready to take measurements in minutes.
2460-EC
Electrochemistry Lab System

Simplified Programming with Ready-to-Use Instrument Drivers
For those who prefer to create their own customized application software, native National Instruments LabVIEW® drivers, as well as IVI-C and IVI-COM drivers are available at www.tektronix.com.

Test Script Specifications

CYCLIC VOLTAMMETRY
Potential Range: ±5V.
Voltage Step Size During Ramping:
100µV (1mV/s) scan rate < 350mV/s
1mV (35mV/s) scan rate < 350mV/s
10mV (350mV/s) ≤ scan rate ≤ 3500mV/s.
Scan Rate: 0.1mV/s to 3500mV/s.
Current Measurement Range (full scale): 100µA, 1mA, 10mA, 100mA, 1A.
Number of Cycles: 1 to 100.
User Selectable Sampling Interval Units: Points/Test, Points/Cycle, Seconds/Point, Points/Second.
Maximum Number of Points: Up to 100,000 readings.

OPEN CIRCUIT POTENTIAL
Vrange: 0.2V, 2V, 7V, 10V, 20V.
Number of Samples: 1 ≤ n ≤ 100,000.
Measure Interval: 0.75s ≤ measurement interval ≤ 100s.

POTENTIAL PULSE AND SQUARE WAVE
Peak Potential: Vpeak ≤ ±20V.
Base Potential: Vbase ≤ ±20V.
Current Ranges: 1µA, 10µA, 100µA, 1mA, 10mA, 100mA, 1A, 4A, 5A, 7A.
Pulse Width and Period:
IRange = 1µA, 10µA, 100µA.
80ms ≤ period ≤ 3600s.
40ms ≤ pulse width ≤ (0.99 × period).
IRange = 1mA, 10mA, 100mA, 1A, 4A, 5A, 7A.
10ms ≤ period ≤ 3600s.
5ms ≤ pulse width ≤ (0.99 × period).
Number of Cycles: 1 ≤ n ≤ 100,000.
Program Time:
10ms ≤ program time ≤ (100,000 × period).
Sample Time: 0.01 PLC ≤ sample time ≤ 10 PLC & sample time ≤ (pulse width – 0.001)s.

CURRENT PULSE AND SQUARE WAVE
Peak and Base Current: Ipeak ≤ ±7A, Ibase ≤ ±7A.
Potential Ranges: 0.2V, 2V, 7V, 10V, 20V.
Pulse Period and Width:
Ipeak ≤ 1.05µA
80ms ≤ period ≤ 3600s
40ms ≤ pulse width ≤ (0.99 × period).
1.05µA < Ipeak ≤ 7A
10ms ≤ period ≤ 3600s
5ms ≤ pulse width ≤ (0.99 × period).
Number of Cycles: 1 ≤ n ≤ 100,000.
Program Time:
10 ms ≤ program time ≤ (100,000 × period).
Sample Time: 0.01 PLC ≤ sample time ≤ 10 PLC & sample time ≤ (pulse width – 0.001)s.

CHRONOAMPEROMETRY
Step Potential: Vstep ≤ ±20V
Current Ranges: 1µA, 10µA, 100µA, 1mA, 10mA, 100mA, 1A, 4A, 5A, 7A.
Step Duration: 10ms ≤ t ≤ 99,999s
Measurement Interval:
10ms ≤ measurement interval ≤ 100s
Sample Period: 0.01 PLC ≤ sample period ≤ 10 PLC & sample period ≤ (measurement interval – 0.005)s & sample period ≤ (t – 0.005)s.

CHRONOPOTENTIOMETRY
Step Current: Istep ≤ ±7.35A.
Potential Ranges: 0.2V, 2V, 7V, 10V, 20V.
Step Duration: 10ms ≤ t ≤ 99,999s.
Measurement Interval:
10ms ≤ measurement interval ≤ 100s.
Sample Period: 0.01 PLC ≤ sample period ≤ 10 PLC & sample period ≤ (measurement interval – 0.005)s & sample period ≤ (t – 0.005)s.

ACCESSORIES AVAILABLE

TEST LEADS AND PROBES
1754 2-wire Universal 10-Piece Test Lead Kit
5805 Kelvin (4-Wire) Spring-Loaded Probes
5808 Low Cost Single-pin Kelvin Probe Set
5809 Low Cost Kelvin Clip Lead Set
8605 High Performance Modular Test Leads
8606 High Performance Modular Probe Kit
8608 High Performance Clip Lead Set

CABLES, CONNECTORS, ADAPTERS
2460-BAN Screw Terminal Connector to Banana Cable
2460-KIT Mating Mass Termination Connector
8607 2-Wire, 1000V Banana Cables, 1m (3.3 ft.)
CS-1616-3 Safety Interlock Mating Connector

COMMUNICATION INTERFACES & CABLES
7007-1 Shielded GPIB Cable, 1m (3.3 ft)
7007-2 Shielded GPIB Cable, 1m (6.6 ft)
CA-180-3A CATS Crossover Cable for TSP-Link/Ethernet
KPCI-488PA IEEE-488 Interface for PCI Bus
KUSB-488B IEEE-488 USB-to-GPIB Interface Adapter
USB-B-1 USB Cable, Type A to Type B, 1m (3.3 ft)

TRIGGERING AND CONTROL
2450-TLINK DB-9 to Trigger Link Connector Adapter.
8501-1 Trigger Link Cable, DIN-to-DIN, 1m (3.3 ft)
8501-2 Trigger Link Cable, DIN-to-DIN, 2m (6.6 ft)

RACK MOUNT KITS
4299-8 Single Fixed Rack Mount Kit
4299-9 Dual Fixed Rack Mount Kit
4299-10 Dual Fixed Rack Mount Kit. Mount one 2460 and one Series 26xxB
4299-11 Dual Fixed Rack Mount Kit. Mount one 2460 and one Series 2400, Series 2000, etc.
4250-Benchkit Ears and Handle for 2460-NFP-RACK and 2460-RACK models

SERVICES AVAILABLE
2460-3Y-EW 1 Year Factory Warranty extended to 3 years from date of shipment
2460-5Y-EW 1 Year Factory Warranty extended to 5 years from date of shipment
C/2460-3Y-STD KeithleyCare® 3 Year ISO 17025 Calibration Plan
C/2460-5Y-DATA KeithleyCare® 3 Year Calibration w/Data Plan
C/2460-3Y-STD KeithleyCare® 3 Year Std. Calibration Plan
C/2460-5Y-STD KeithleyCare® 5 Year Std. Calibration Plan
C/NEW DATA KeithleyCare® 5 Year Std. Calibration Plan
C/NEW DATA ISO ISO-17025 Calibration Data for New Units
### Voltage Specifications

<table>
<thead>
<tr>
<th>Range</th>
<th>Max. Current</th>
<th>Resolution</th>
<th>Accuracy (23°C ±5°C), 1 Year (±(% setting + volts))</th>
<th>Noise (RMS) (&lt;10Hz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20.00000 mV</td>
<td>7.35 A</td>
<td>5 µV</td>
<td>0.015 % + 200 µV</td>
<td>1 µV</td>
</tr>
<tr>
<td>2.000000 V</td>
<td>7.35 A</td>
<td>50 µV</td>
<td>0.015 % + 300 µV</td>
<td>10 µV</td>
</tr>
<tr>
<td>7.00000 V</td>
<td>7.35 A</td>
<td>250 µV</td>
<td>0.015 % + 2.4 mV</td>
<td>100 µV</td>
</tr>
<tr>
<td>10.00000 V</td>
<td>5.25 A</td>
<td>500 µV</td>
<td>0.015 % + 2.4 mV</td>
<td>100 µV</td>
</tr>
<tr>
<td>20.00000 V</td>
<td>4.20 A</td>
<td>500 µV</td>
<td>0.015 % + 2.4 mV</td>
<td>100 µV</td>
</tr>
<tr>
<td>100.0000 V</td>
<td>1.05 A</td>
<td>2.5 µV</td>
<td>0.015 % + 15 mV</td>
<td>1 mV</td>
</tr>
</tbody>
</table>

### Current Specifications

<table>
<thead>
<tr>
<th>Range</th>
<th>Max. Voltage</th>
<th>Resolution</th>
<th>Accuracy (23°C ±5°C), 1 Year (±(% setting + amps))</th>
<th>Noise (RMS) (&lt;10Hz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00000 µA</td>
<td>105 V</td>
<td>50 µA</td>
<td>0.025 % + 1 nA</td>
<td>40 nA</td>
</tr>
<tr>
<td>10.00000 µA</td>
<td>105 V</td>
<td>500 µA</td>
<td>0.025 % + 1.5 nA</td>
<td>40 nA</td>
</tr>
<tr>
<td>100.0000 µA</td>
<td>105 V</td>
<td>5 mA</td>
<td>0.020 % + 15 nA</td>
<td>100 nA</td>
</tr>
<tr>
<td>1.00000 mA</td>
<td>105 V</td>
<td>50 nA</td>
<td>0.020 % + 150 nA</td>
<td>1 nA</td>
</tr>
<tr>
<td>10.00000 mA</td>
<td>105 V</td>
<td>500 nA</td>
<td>0.020 % + 1.5 µA</td>
<td>10 nA</td>
</tr>
<tr>
<td>100.0000 mA</td>
<td>105 V</td>
<td>5 nA</td>
<td>0.020 % + 15 µA</td>
<td>100 nA</td>
</tr>
<tr>
<td>1.00000 A</td>
<td>105 V</td>
<td>50 µA</td>
<td>0.050 % + 750 µA</td>
<td>5 µA</td>
</tr>
<tr>
<td>4.000000 A</td>
<td>21 V</td>
<td>250 µA</td>
<td>0.100 % + 3 mA</td>
<td>25 µA</td>
</tr>
<tr>
<td>5.00000 A</td>
<td>10.5 V</td>
<td>250 µA</td>
<td>0.100 % + 3 mA</td>
<td>25 µA</td>
</tr>
<tr>
<td>7.00000 A</td>
<td>7.35 V</td>
<td>150 µA</td>
<td>0.150 % + 6 mA</td>
<td>125 µA</td>
</tr>
</tbody>
</table>

### Resistance Measurement Accuracy (Local or Remote Sense)

<table>
<thead>
<tr>
<th>Range</th>
<th>Default Resolution</th>
<th>Default</th>
<th>Test Current</th>
<th>Normal Accuracy (23°C ±5°C), 1 Year (±(% rdg. + ohms))</th>
<th>Enhanced Accuracy (23°C ±5°C), 1 Year (±(% rdg. + ohms))</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;2.0000000 Ω</td>
<td>1 µΩ</td>
<td>100 mΩ</td>
<td>0.05 % + 0.005 Ω</td>
<td>0.04 % + 0.001 Ω</td>
<td></td>
</tr>
<tr>
<td>20.00000 Ω</td>
<td>10 µΩ</td>
<td>100 mΩ</td>
<td>0.05 % + 3 Ω</td>
<td>0.04 % + 0.1 Ω</td>
<td></td>
</tr>
<tr>
<td>2.000000 Ω</td>
<td>1 mΩ</td>
<td>1 mΩ</td>
<td>0.05 % + 0.3 Ω</td>
<td>0.04 % + 0.1 Ω</td>
<td></td>
</tr>
<tr>
<td>20.00000 Ω</td>
<td>10 µΩ</td>
<td>100 µΩ</td>
<td>0.05 % + 30 Ω</td>
<td>0.05 % + 10 Ω</td>
<td></td>
</tr>
<tr>
<td>20000000 Ω</td>
<td>100 µΩ</td>
<td>10 µΩ</td>
<td>0.05 % + 100 Ω</td>
<td>0.05 % + 100 Ω</td>
<td></td>
</tr>
<tr>
<td>20000000 Ω</td>
<td>10 µΩ</td>
<td>1 µΩ</td>
<td>0.14 % + 1000 Ω</td>
<td>0.12 % + 500 Ω</td>
<td></td>
</tr>
<tr>
<td>&gt;20000000 Ω</td>
<td>— User defined</td>
<td>Source Ins + Meas. V&lt;sub&gt;r&lt;/sub&gt;</td>
<td>Meas. I&lt;sub&gt;r&lt;/sub&gt; + Meas. V&lt;sub&gt;r&lt;/sub&gt;</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### SUPPLEMENTAL CHARACTERISTICS

- **MAX. OUTPUT POWER**: 100W, four-quadrant source or sink operation.
- **SOURCE LIMITS**: 
  - Vsource: ±7.35V (±7A range), ±10.5V (±5A range), ±21V (±4A range), ±105V (±4A range).
  - Isource: ±7.35A (±7V range), ±5.25mA (±10V range), ±4.2A (±20V range), ±1.05mA (±100V range).
- **OVERRANGE**: 105% of range, source and measure.
- **REGULATION**: 
  - Voltage: ±0.1% of range + Load: ±0.1% of range + 100µA.
  - Current: ±0.1% of range + Load: ±0.1% of range + 100µA.
- **SOURCE LIMITS**: 
  - Voltage Current Limit: Bipolar current limit set with single value. Min. 10% of range.
  - Current Source Voltage Limit: Bipolar voltage limit set with single value. Min. 10% of range.
- **V-LIMIT / I-LIMIT ACCURACY**: Add 0.3% of setting and ±0.02% of reading to base specification.
- **OVERSHOOT**: 
  - Voltage Source: ±0.1% typical (full scale step, resistive load, 20V range, 10mA I-Limit).
  - Current Source: ±0.1% typical (1mA step, RLoad = 10kΩ, 20V range)
- **NOISE REJECTION (typical)**: 
  - Common Mode Isolation: >1G
  - Normal Mode: 60 dB
  - Normal Mode: 100 dB
- **LOAD IMPEDANCE**: 
  - Normal Mode: 20mΩ typical.
  - High Capacitance Mode: Stable into 500µF typical. High-C mode valid for ±10A ranges.
- **MAX. VOLTAGE DROP BETWEEN FORCE AND SENSE TERMINALS**: 5V
- **MAX. SENSE LEAD RESISTANCE**: 1MΩ for rated accuracy.
- **SENSE INPUT IMPEDANCE**: >10GΩ.
## System Measurement Speeds

Reading rates (readings per second) typical for 60Hz (50Hz), script (TSP®) programmed.

<table>
<thead>
<tr>
<th>NPLC</th>
<th>Trigger Origin</th>
<th>Measure to Memory</th>
<th>Measure to GPIB/USB/LAN</th>
<th>Source Measure to Memory</th>
<th>Source Measure to GPIB/USB/LAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.01 NPLC</td>
<td>Internal</td>
<td>3050 (2800)</td>
<td>2800 (2500)</td>
<td>1700 (1600)</td>
<td>1650 (1550)</td>
</tr>
<tr>
<td>0.01 NPLC</td>
<td>External</td>
<td>2300 (2100)</td>
<td>2150 (2000)</td>
<td>1650 (1550)</td>
<td>1600 (1450)</td>
</tr>
<tr>
<td>0.1 NPLC</td>
<td>Internal</td>
<td>540 (460)</td>
<td>530 (450)</td>
<td>470 (410)</td>
<td>470 (400)</td>
</tr>
<tr>
<td>0.1 NPLC</td>
<td>External</td>
<td>500 (420)</td>
<td>500 (420)</td>
<td>460 (390)</td>
<td>450 (350)</td>
</tr>
<tr>
<td>1 NPLC</td>
<td>Internal</td>
<td>59 (48)</td>
<td>59 (48)</td>
<td>58 (48)</td>
<td>58 (48)</td>
</tr>
<tr>
<td>1 NPLC</td>
<td>External</td>
<td>58 (48)</td>
<td>58 (48)</td>
<td>57 (48)</td>
<td>57 (48)</td>
</tr>
</tbody>
</table>

Reading rates (readings per second) typical for 60Hz (50Hz), SCPI programmed.

<table>
<thead>
<tr>
<th>NPLC</th>
<th>Trigger Origin</th>
<th>Measure to Memory</th>
<th>Measure to GPIB/USB/LAN</th>
<th>Source Measure to Memory</th>
<th>Source Measure to GPIB/USB/LAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.01 NPLC</td>
<td>Internal</td>
<td>3000 (2800)</td>
<td>3000 (2790)</td>
<td>1700 (1600)</td>
<td>1550 (1500)</td>
</tr>
<tr>
<td>0.01 NPLC</td>
<td>External</td>
<td>2330 (2150)</td>
<td>2330 (2150)</td>
<td>1650 (1550)</td>
<td>1500 (1450)</td>
</tr>
<tr>
<td>0.1 NPLC</td>
<td>Internal</td>
<td>540 (460)</td>
<td>540 (460)</td>
<td>470 (410)</td>
<td>460 (400)</td>
</tr>
<tr>
<td>0.1 NPLC</td>
<td>External</td>
<td>510 (430)</td>
<td>510 (430)</td>
<td>460 (390)</td>
<td>460 (390)</td>
</tr>
<tr>
<td>1 NPLC</td>
<td>Internal</td>
<td>59 (48)</td>
<td>59 (48)</td>
<td>58 (48)</td>
<td>58 (48)</td>
</tr>
<tr>
<td>1 NPLC</td>
<td>External</td>
<td>58 (48)</td>
<td>58 (48)</td>
<td>57 (48)</td>
<td>57 (48)</td>
</tr>
</tbody>
</table>

13. Reading rates applicable for voltage or current measurements, autozero off, autorange off, filter off, binary reading format, and source readback off.

## General Characteristics (default mode unless specified)

- **Factory Default Standard Power-Up:** SCPI Mode.
- **Source Output Modes:** Fixed DC Level, Memory/Configuration List (mixed function), Sweep (linear and logarithmic), Sweep (dual linear and dual logarithmic).
- **Memory Buffer:** >250,000 readings. Includes selected measured value(s) and time stamp.
- **Real-Time Clock:** Lithium battery backup (3 yr. + battery life).
- **Remote Interfaces:**
  - **GPIB:** IEEE-488.1 compliant. Supports IEEE-488.2 common commands and status model topology.
  - **USB Device (rear panel, type B):** 2.0 Full Speed USBTMC.
  - **USB Host (front panel, type A):** USB 2.0, support for flash drives, FAT32.
  - **Ethernet:** RJ-45 (10/100BT).
- **Digital I/O Interface:**
  - **Lines:** 6 Input/Output user defined for digital I/O or triggering
  - **Connector:** 9-pin female D
  - **Input Signal Levels:** 0.7V (maximum logic low), 3.7V (minimum logic high)
  - **Input Voltage Limits:** –0.25V (Abs. minimum), +5.25V (Abs. maximum)
  - **Maximum Source Current:** +2.0mA @ >2.7V (per pin)
  - **Maximum Sink Current:** –50mA @ 0.7V (per pin, solid-state fuse protected)
  - **5V Power Supply Pin:** Limited to 50mA @ >4V (solid-state fuse protected)
  - **Handler:** User definable Start of Test, End of Test, 4 category bits
- **Programmability:** SCPI or TSP command sets.
- **TSP Mode:** Embedded Test Script Processor (TSP) accessible from any host interface.
- **IP Configuration:** Static or DHCP.
- **Expansion Interface:** The TSP-Link expansion interface allows TSP enabled instruments to trigger and communicate with each other.
- **LXI Compliance:** 1.4 LXI Core 2011.
- **Display:** 5 inch capacitive touch, color TFT WVGA (800×480) with LED backlight.
- **Input Signal Connections:** Front: Banana. Rear: Mass termination screw terminal.
- **Interlock:** Active High Input.
- **Cooling:** Forced air, variable speed.
- **Over Temperature Protection:** Internally sensed temperature overload puts unit in standby mode.
- **Power Supply:** 100V to 240V RMS, 50–60Hz (automatically detected at power up).
- **VA Rating:** 350 volt-amps max.
- **Altitude:** Maximum 2000 meters above sea level.
- **EMC:** Conforms to European Union EMC Directive.
- **Environment:**
  - **Operating:** 0°–50°C, 70% R.H. up to 35°C. Derate 3% R.H./°C, 35°–50°C, non-condensing.
  - **Storage:** –25°C to 65°C.
Contact Information:

ASEAN / Australia (65) 6356 3900
Austria 00800 2255 4835
Balkans, Israel, South Africa and other ISE Countries +41 52 675 3777
Belgium 00800 2255 4835
Brazil +55 (11) 3759 7627
Canada 1 800 833 9200
Central East Europe and the Baltics +41 52 675 3777
Central Europe & Greece +41 52 675 3777
Central Europe and the Baltics +41 52 675 3777
Danmark +45 80 88 1401
Finland +41 52 675 3777
France 00800 2255 4835
Germany 00800 2255 4835
Hong Kong 400 820 5835
India 000 800 650 1835
Italy 00800 2255 4835
Japan 81 (3) 6714 3010
Luxembourg +41 52 675 3777
Mexico, Central/South America & Caribbean 52 (55) 56 04 50 90
Middle East, Asia, and North Africa +41 52 675 3777
The Netherlands 00800 2255 4835
Norway 800 16098
People’s Republic of China 400 820 5835
Poland +41 52 675 3777
Portugal 80 08 12370
Republic of Korea 001 800 8255 2835
Russia & CIS +7 (495) 6647564
South Africa +41 52 675 3777
Spain 00800 2255 4835
Sweden 00800 2255 4835
Switzerland 00800 2255 4835
Taiwan 886 (2) 2656 6688
United Kingdom & Ireland 00800 2255 4835
USA 1 800 833 9200

For Further Information
Tektronix maintains a comprehensive, constantly expanding collection of application notes, technical briefs and other resources to help engineers working on the cutting edge of technology. Visit www.tektronix.com or www.keithley.com.

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