

**2110**

# 5½-Digit Dual-Display Digital Multimeter



- High accuracy, high speed for general purpose measurements
- 15 measurement functions, including capacitance and thermocouple measurements
- Dual-line display allows concurrent measurements
- TMC-compliant USB 2.0 interface for use with SCPI test commands
- GPIB option for use in system applications
- Includes PC software utilities for graphing and data sharing in both Microsoft® Word and Excel
- Rugged construction for durability in bench/portable applications
- Includes all accessories, such as start-up software, USB cable, power cable, and safety test leads
- CE compliant and cUL<sup>US</sup> listed
- Three year warranty

## APPLICATIONS

### Built for Production Testing

The Model 2110 Digital Multimeter is ideal for applications in manual, semi-automatic, and automatic testing of low-cost electronic devices, circuits, modules, electrical components, and semiconductor components. Key features include:

- **Speed: up to 50,000 readings per second**
- **Control: GPIB (optional) and USB interfaces, accepting SCPI (IEEE-488.2) commands**
- **External BNC trigger lines**
- **NIST traceability (with included calibration certificate)**

### Built for General Purpose Uses

The Model 2110 Digital Multimeter is also ideal for bench uses such as research, development, service, calibration, and teaching. Bench-oriented features include:

- **Accuracy: 0.012% basic DCV accuracy**
- **Easy-to-operate panel**
- **Easy waveform plotting and data collection with KI-Tool and KI-Link**
- **Store up to 2000 readings**

The Model 2110 5½-Digit Dual-Display Digital Multimeter combines a compelling price with a comprehensive set of capabilities, superior measurement accuracy, and high speed for a broad range of applications. It features 15 measurement functions and 7 math functions and has dual-line display capability, which allows it to display two different measurements concurrently. The Model 2110 is an unbeatable value for production, R&D, and test engineers, scientists, and students making a wide variety of measurements in portable, bench, and system applications.

## High Accuracy, Abundant Capabilities, Low Cost

The Model 2110 provides precision and a rich set of capabilities at a value price. It has 0.012% one-year basic DC voltage accuracy and 0.020% one-year basic resistance accuracy up to the 100kΩ range.

The Model 2110 provides a wide number of measurement ranges and functions:

- DC voltage: 0.1V, 1V, 10V, 100V, and 1000V
- AC voltage: 0.1V, 1V, 10V, 100V, and 750V
- DC current: 10mA, 100mA, 1A, 3A, and 10A
- AC current: 1A, 3A, and 10A
- Two- and four-wire resistance: 100Ω, 1kΩ, 10kΩ, 100kΩ, 1MΩ, 10MΩ, and 100MΩ
- Frequency: From 10Hz to 300kHz
- Capacitance measurement: 1nF, 10nF, 100nF, 1μF, 10μF, 100μF
- Thermocouple measurement: J-, R-, S-, T-, E-, N-, B-, C-, and K-type thermocouples
- Temperature (RTD and NTC Thermistor) measurements
- Diode measurement
- Continuity test
- Programmable A-D converter and filter settings for signal to noise optimization. Additionally, seven mathematical operations can be performed on measurement readings: percentage, average, min/max, NULL, limits, mX+b, dB, and dBm testing.

## Speed

At 5½ digits, the Model 2110 delivers up to 200 readings/s via the USB remote interface. At the fast 4½-digit setting, it reads up to 50,000 readings/s and up to 30,000 readings/s into the buffer, making it ideal for production and monitoring applications in which speed is critical.

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# 2110

## 5½-Digit Dual-Display Digital Multimeter

### Ordering Information

2110-100: 5½-digit USB Digital Multimeter (100V)

2110-120: 5½-digit USB Digital Multimeter (120V)

2110-220: 5½-digit USB Digital Multimeter (220V)

2110-240: 5½-digit USB Digital Multimeter (240V)

2110-100-GPIB: 5½-digit USB and GPIB Digital Multimeter (100V)

2110-120-GPIB: 5½-digit USB and GPIB Digital Multimeter (120V)

2110-220-GPIB: 5½-digit USB and GPIB Digital Multimeter (220V)

2110-240-GPIB: 5½-digit USB and GPIB Digital Multimeter (240V)

### Accessories Supplied

Reference Manual on CD, Specifications, LabVIEW® Driver, Keithley I/O Layer, USB Cable, Power Cable, Safety Test Leads, KI-Tool, and KI-Link Add-in (both Microsoft Word and Excel versions), Calibration Certificate



All accessories, such as start-up software, USB cable, power cable, and safety test leads, are included with the Model 2110.

### Simplicity

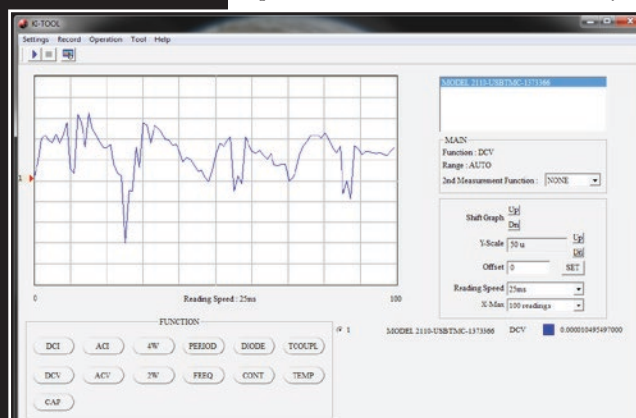
The Model 2110 is operational and intuitive to use right out of the box. The functions on the front panel are user friendly and easy to read. Its KI-Tool and KI-Link software allow users to quickly control the instrument over GPIB (if equipped) or USB, record measurements, and display time-series plots of the data. Its LabView® and IVI drivers give more-advanced customers even more control over the instrument. Both the TMC-compliant USB remote interface and the GPIB interface allow easy re-use of existing SCPI programs.

### Startup Software, PC Utilities Included

The KI-Tool application provides charting and graphing capabilities without programming to simplify setup, checkout, and basic measurement applications requiring graphical data representation. Scale, offset, and level can be adjusted to fine-tune images for visual evaluation of signal and noise elements over time. It also includes tabular data and SCPI command prompt windows for maximum flexibility. Data sets can also be saved to disk files.

The Microsoft Excel Add-In utility is also included and provides quick data import into a standard Microsoft Excel spreadsheet, including selectable graphing, instrument settings, and number of data points collected. Data can then be analyzed through standard or optional Microsoft Excel functions, including graphical, statistical, and trend charting. A version supporting Microsoft Word is also included for direct data import into reports.

LabView, IVI-C, and IVI-COM drivers are also supplied to allow for increased flexibility in integrating the Model 2110 into new and existing systems and test routines.



KI-Tool simplifies basic measurement applications through every setup and graphical data representation.

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Low-cost 5½-digit DMM for system, bench, or portable applications

DIGITAL MULTIMETERS & SYSTEMS

## Specifications

## DC CHARACTERISTICS

| DC VOLTAGE |            |                  | Accuracy <sup>1</sup>        | Temperature Coefficient |
|------------|------------|------------------|------------------------------|-------------------------|
| Range      | Resolution | Input Resistance | ±(% of reading + % of range) | 0°–18°C & 28°–40°C      |
| 100.000 mV | 1 μV       | 10 MΩ            | 0.012 + 0.004                | 0.001 + 0.0005          |
| 1.00000 V  | 10 μV      |                  | 0.012 + 0.001                | 0.0009 + 0.0005         |
| 10.0000 V  | 0.1 mV     |                  | 0.012 + 0.002                | 0.0012 + 0.0005         |
| 100.000 V  | 1 mV       |                  | 0.012 + 0.002                | 0.0012 + 0.0005         |
| 1000.00 V  | 10 mV      |                  | 0.02 + 0.003                 | 0.002 + 0.0015          |

| DCI (DC CURRENT) |            |                  | Accuracy <sup>1</sup>        | Temperature Coefficient |
|------------------|------------|------------------|------------------------------|-------------------------|
| Range            | Resolution | Shunt Resistance | ±(% of reading + % of range) | 0°–18°C & 28°–40°C      |
| 10.0000 mA       | 0.1 μA     | 5.1 Ω            | 0.05 + 0.020                 | 0.005 + 0.002           |
| 100.000 mA       | 1 μA       | 5.1 Ω            | 0.05 + 0.010                 | 0.005 + 0.001           |
| 1.00000 A        | 10 μA      | 0.1 Ω            | 0.150 + 0.020                | 0.008 + 0.001           |
| 3.0000 A         | 100 μA     | 0.1 Ω            | 0.200 + 0.030                | 0.008 + 0.001           |
| 10.0000 A        | 100 μA     | 5 mΩ             | 0.250 + 0.050                | 0.008 + 0.001           |

| RESISTANCE <sup>2</sup> |            |              | Accuracy <sup>1</sup>        | Temperature Coefficient |
|-------------------------|------------|--------------|------------------------------|-------------------------|
| Range                   | Resolution | Test Current | ±(% of reading + % of range) | 0°–18°C & 28°–40°C      |
| 100.000 Ω               | 1 mΩ       | 1 mA         | 0.020 + 0.020                | 0.003 + 0.0005          |
| 1.00000 kΩ              | 10 mΩ      | 1 mA         | 0.020 + 0.003                | 0.003 + 0.0005          |
| 10.0000 kΩ              | 100 mΩ     | 100 μA       | 0.020 + 0.002                | 0.003 + 0.0005          |
| 100.000 kΩ              | 1 Ω        | 10 μA        | 0.020 + 0.002                | 0.003 + 0.0005          |
| 1.00000 MΩ              | 10 Ω       | 1 μA         | 0.030 + 0.004                | 0.005 + 0.0005          |
| 10.0000 MΩ              | 100 Ω      | 0.1 μA       | 0.200 + 0.004                | 0.05 + 0.0005           |
| 100.000 MΩ              | 1 kΩ       | 0.1 μA       | 2.000 + 0.005                | 0.5 + 0.0005            |

| DIODE TEST |            |              | Accuracy <sup>1</sup>        | Temperature Coefficient |
|------------|------------|--------------|------------------------------|-------------------------|
| Range      | Resolution | Test Current | ±(% of reading + % of range) | 0°–18°C & 28°–40°C      |
| 1.0000V    | 10 μV      | 1 mA         | 0.020 + 0.030                | 0.002 + 0.0005          |

| CONTINUITY |            |              | Accuracy <sup>1</sup>        | Temperature Coefficient |
|------------|------------|--------------|------------------------------|-------------------------|
| Range      | Resolution | Test Current | ±(% of reading + % of range) | 0°–18°C & 28°–40°C      |
| 1000Ω      | 10 mΩ      | 1 mA         | 0.020 + 0.020                | 0.002 + 0.0005          |

- Specifications valid after two hour warm-up.
  - ADC set for continuous trigger operation.
  - Input bias current <30pA at 25°C.
  - Measurement rate set to 10 PLC.
- Specifications for 4W ohms mode. For 2W ohms, use zero null or subtract lead resistance from displayed reading.
  - Maximum lead resistance 10% of range per lead for 100Ω and 1kΩ ranges; add 1kΩ per lead for all other ranges.

## MEASUREMENT NOISE REJECTION DC (60Hz/50Hz) at 5.5 DIGITS

CMRR: 120dB for 1kΩ unbalance in LO lead.

NMRR: 60dB for line frequency ±0.1%.

## TEMPERATURE (THERMOCOUPLE) CHARACTERISTICS

| Thermocouple Type                  | Range          | Accuracy <sup>1</sup> ±°C |
|------------------------------------|----------------|---------------------------|
| 1 Year, exclusive of lead accuracy |                |                           |
| B                                  | 600 to 1800°C  | 1.5                       |
| C                                  | 0 to 2300°C    | 1.5                       |
| E                                  | –250 to 1000°C | 1.5                       |
| J                                  | –200 to 1200°C | 1.0                       |
| K                                  | –200 to 1350°C | 1.0                       |
| N                                  | –200 to 1300°C | 1.0                       |
| R                                  | 0 to 1750°C    | 1.5                       |
| S                                  | 0 to 1750°C    | 1.5                       |
| T                                  | –250 to 400°C  | 1.5                       |

- Specifications valid after two hour warm-up;
  - ADC set for continuous trigger operation.

RTD and NTC Thermistor Measurements: Accuracy ±0.8°C, 1 year, exclusive of lead accuracy. PT100, D100, F100, PT385, PT3916, SPRTD (R-Zero, A4, B4, Ax, Bx, Cx, and Dx), NTCT (A, B, and C), and user-definable RTD.

## CAPACITANCE CHARACTERISTICS

| Range                        | Test Current | Accuracy <sup>1</sup> |
|------------------------------|--------------|-----------------------|
| ±(% of reading + % of range) |              |                       |
| 1 Year, 23° ±5°C             |              |                       |
| 1.000 nF                     | 10 μA        | 2.0 + 0.80            |
| 10.00 nF                     | 10 μA        | 1.0 + 0.50            |
| 100.0 nF                     | 100 μA       | 1.0 + 0.50            |
| 1.000 μF                     | 100 μA       | 1.0 + 0.50            |
| 10.00 μF                     | 100 μA       | 1.0 + 0.50            |
| 100.0 μF                     | 1 mA         | 1.0 + 0.50            |

- Specifications valid after two hour warm-up.
  - ADC set for continuous trigger operation.
  - Null enabled.

## ACCESSORIES AVAILABLE

|         |                                     |
|---------|-------------------------------------|
| 4299-3  | Single Rack Mount Kit               |
| 4299-4  | Dual Rack Mount Kit                 |
| 4299-7  | Fixed Rack Mount Kit                |
| 5805    | Kelvin Probes, 0.9m (3ft)           |
| 5805-12 | Kelvin Probes, 3.6m (12ft)          |
| 5808    | Low Cost, Single Pin, Kelvin Probes |
| 5809    | Low Cost, Kelvin Clip Lead Set      |
| 6517-TP | Thermocouple Bead Probe (K-Type)    |
| 7007-1  | Shielded GPIB Cable, 1m (3.3 ft)    |
| 7007-2  | Shielded GPIB Cable, 2m (6.6 ft)    |
| 8605    | High Performance Modular Test Leads |
| 8606    | High Performance Modular Probe Kit  |
| 8680    | RTD Probe Adapter                   |
| 8681    | Low Cost RTD                        |

## SERVICES AVAILABLE

|                |   |
|----------------|---|
| C/2110-3Y-DATA | 3 (Z-540-1 compliant) calibrations within 3 years of purchase for Model 2110    |
| C/2110-5Y-DATA | 5 (Z-540-1 compliant) calibrations within 5 years of purchase for Model 2110    |
| C/2110-3Y-ISO  | 3 (ISO-17025 accredited) calibrations within 3 years of purchase for Model 2110 |
| C/2110-5Y-ISO  | 5 (ISO-17025 accredited) calibrations within 5 years of purchase for Model 2110 |

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## AC CHARACTERISTICS

| FREQUENCY AND PERIOD                 |                  | Accuracy <sup>1</sup>                            | Temperature Coefficient |
|--------------------------------------|------------------|--|-------------------------|
| Range                                | Frequency (Hz)   | ±(% of reading + % of range)<br>1 Year, 23° ±5°C | 0°–18°C & 28°–40°C      |
| 100.000 mV to 750.000 V <sup>2</sup> | 10–40<br>40–300k | 0.03<br>0.02                                     | 0.002<br>0.002          |

| ACV (AC TRMS VOLTAGE)                |               |  | Accuracy <sup>1</sup>                                    | Temperature Coefficient                                 |
|--------------------------------------|---------------|--|--|---|
| Range                                | Resolution    | Frequency  | ±(% of reading + % of range)<br>1 Year, 23° ±5°C         | 0°–18°C & 28°–40°C                                      |
| 100.000 mV to 750.000 V <sup>2</sup> | 1 μV to 10 mV | 10 Hz–20 kHz<br>20 kHz–50 kHz<br>50 kHz–100 kHz<br>100 kHz–300 kHz | 0.12 + 0.05<br>0.25 + 0.05<br>0.65 + 0.08<br>5.00 + 0.50 | 0.01 + 0.01<br>0.02 + 0.02<br>0.04 + 0.02<br>0.2 + 0.02 |

| ACI (AC TRMS CURRENT) |                 |                              | Accuracy <sup>1</sup>                            | Temperature Coefficient    |
|-----------------------|-----------------|------------------------------|--|----------------------------|
| Range                 | Resolution      | Frequency                    | ±(% of reading + % of range)<br>1 Year, 23° ±5°C | 0°–18°C & 28°–40°C         |
| 1.0000 A to 3.00000 A | 10 μA to 100 μA | 10 Hz–900 Hz<br>900 Hz–5 kHz | 0.30 + 0.06<br>1.50 + 0.15                       | 0.02 + 0.01<br>0.02 + 0.01 |
| 10.0000 A             | 100 μA          | 10 Hz–900 Hz<br>900 Hz–5 kHz | 0.50 + 0.12<br>2.50 + 0.20                       | 0.02 + 0.01<br>0.02 + 0.01 |

- Specifications valid after two hour warm-up.
  - Slow AC filter (3Hz bandwidth).
  - Pure sine wave input greater than 5% of range.
- 750VAC range is limited to 100kHz.

## GENERAL

Input bias current: <30pA at 25°C.  
 Input protection: 1000V all ranges (2W input).  
 AC CMRR: 70dB (for 1kΩ unbalance LO lead).  
 Power Supply: 100V/120V/220V/240V.  
 Power Line Frequency: 50/60Hz auto detected.  
 Power Consumption: 25VA max.  
 Digital I/O interface: USB-compatible Type B connection, GPIB (option).  
 Environment: For indoor use only.  
 Operating Temperature: 0° to 40°C.  
 Operating Humidity: Maximum relative humidity 80% for temperature up to 31°C.  
 Storage Temperature: –40° to 70°C.  
 Operating Altitude Up to 2000 m above sea level.  
 Bench Dimensions (with handles and bumpers): 107 mm high × 252.8 mm wide × 305 mm deep (3.49 in. × 9.95 in. × 12.00 in.).  
 Weight: 2.23 kg ( 4.92 lbs.).  
 Safety: Conforms to European Union Low Voltage Directive, EN61010-1. Measurement Cat 1 1000V and CAT II 600V.  
 EMC: Conforms to European Union Directive 89/336/EEC, EN61326-1.  
 Warranty: Three years.



Model 2110 rear panel.