# SMX2040, SM2040 Series

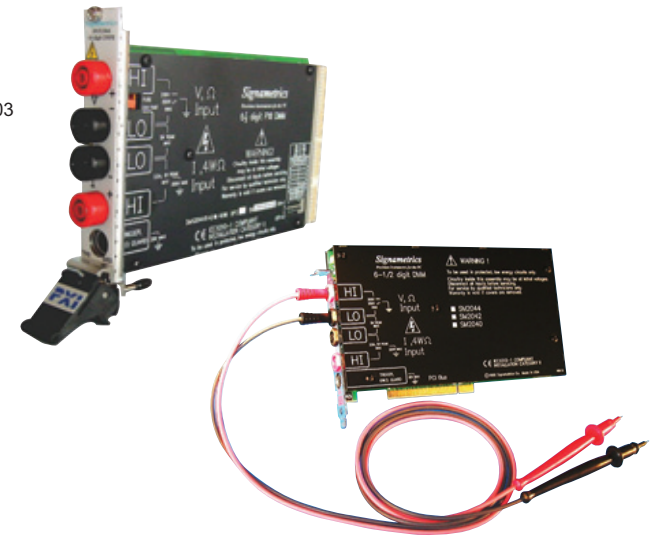
## 6-½ Digit Digital Multimeter

### Features

- Flexible, full-featured auto-ranging DMM
- 6-½ digit resolution
- Up to 1,000 readings/second
- DC & AC Volts & Current, 2-Wire, 4-Wire Ohms
- True AC RMS measurements, 10 Hz to 100 kHz
- Measure 1 µV to 330 V
- Frequency Counter 1 Hz to 300 kHz
- Capacitance, Inductance, Leakage, 6-Wire Guarded Resistance, Temperature measurements (SMX2042/2044, SM2042/2044)
- 330 V Isolation Barrier
- Self-Calibrating
- Plug-and-Play, Windows® 95/98/Me/NT/2000/XP/2003
- Language support - Visual Basic, MSVisual C++, Delphi
- Package support - LabVIEW™, LabWindows/CVI, TestPoint, ATEasy, Matlab, VBA & more.

**Operating Systems**
- Windows 98/NT/2000/XP/2003

**Recommended Software**
- VB/VC++/BCB/Delphi
- DAQBench



### Introduction

The SMX2040 and SM2040 series are 6-½ digit Digital Multimeter which provide a combination of resolution, accuracy, and speed that surpasses rivals. A 6-½ digit display, 0.0045% basic DCV accuracy and 1,000 readings per second assure accurate, fast, and repeatable measurements. The SMX2040 and SM2040 series designed as a universal, multi-function DMM. Measurements commonly associated with "high-end" system DMMs are standard features with the SMX2040 and SM2040 family, such as 2-wire, 4-wire and 6-wire guarded resistance measurements, inductance and capacitance, leakage and temperature, RMS and peak-to-peak, frequency and timing, sourcing of voltage and current, and much more. The SMX2044 and SM2044 are best suited for applications demanding precision sources with simultaneous measurements such as in Parametric testing, while the SMX2040 and SM2040 fit the bill where basic DMM functions are required, such as telecommunication, aerospace, automotive and education fields.

### Specifications

Specifications subject to change without notice.
For the most current and complete specifications, please refer to the user manual.

#### DC Functions

**DC Voltage**

Accuracy ± (% of reading + Volts) [1]

| Range | Full scale 6-½ Digits | Resolution | Input Resistance | 24 hours 23˚C±1˚C | 90 Days 23˚C±5˚C | One Year 23˚C±5˚C |
|---|---|---|---|---|---|---|
| 330 mV | 330.0000 mV | 100 nV | >10 GΩ | 0.003 + 4.5 µV | 0.004 + 5.5 µV | 0.007 + 8 µV |
| 3.3 V | 3.300000 V | 1 µV | >10 GΩ | 0.002 + 10 µV | 0.0025 + 12 µV | 0.0045 + 17 µV |
| 33 V | 33.00000 V | 10 µV | 10 MΩ | 0.003 + 250 µV | 0.004 + 280 µV | 0.007 + 330 µV |
| 330 V | 330.0000 V | 100 µV | 10 MΩ | 0.004 + 1 mV | 0.005 + 1.2 mV | 0.008 + 1.5 mV |

[1] With reading rate set to 10 readings per second (rps) or slower, and within one hour of DCV zero, using Relative control.

**DC Current**

Accuracy ± (% of reading + Amps) [1]

| Range | Full scale 5-½ Digits | Resolution | Max Burden Voltage | 24 hours 23˚C±1˚C | 90 Days 23˚C±5˚C | One Year 23˚C±5˚C |
|---|---|---|---|---|---|---|
| 3.3 mA | 3.30000 mA | 10 nA | 350 mV | 0.052 + 200 nA | 0.07 + 350 nA | 0.1 + 400 nA |
| 33 mA | 33.0000 mA | 100 nA | 350 mV | 0.04 + 1 µA | 0.06 + 2 µA | 0.1 + 3 µA |
| 330 mA | 330.000 mA | 1 µA | 350 mV | 0.05 + 30 µA | 0.055 + 40 µA | 0.075 + 60 µA |
| 2.5 A | 2.50000 A | 10 µA | 350 mV | 0.55 + 50 µA | 0.6 + 200 µA | 0.65 + 350 µA |

[1] With reading rate set to 10 rps or slower, and within one hour of DCI zero, using Relative control.

**2-Wire and 4-wire Resistance**

Accuracy ± (% of reading + Ω) [1]

| Range [3] | Full scale 6-½ Digits | Resolution | Source Current | 24 hours 23˚C±1˚C | 90 Days 23˚C±5˚C | One Year 23˚C±5˚C |
|---|---|---|---|---|---|---|
| 33 Ω[2] | 33.00000 Ω | 10 µΩ | 10 mA | 0.0038 + 1 mΩ | 0.005 + 1.5 mΩ | 0.008+ 2 mΩ |
| 330 Ω | 330.0000 Ω | 100 µΩ | 1 mA | 0.0037 + 4.5 mΩ | 0.0046 + 5 mΩ | 0.007 + 6 mΩ |
| 3.3 kΩ | 3.300000 kΩ | 1 mΩ | 1 mA | 0.0023 + 28 mΩ | 0.004 + 32 mΩ | 0.005 + 33 mΩ |
| 33 kΩ | 33.00000 kΩ | 10 mΩ | 100 µA | 0.0025 + 300 mΩ | 0.0033 + 330 mΩ | 0.006 + 350 mΩ |
| 330 kΩ | 330.0000 kΩ | 100 mΩ | 10 µA | 0.0055 + 3.2 Ω | 0.007 + 4 Ω | 0.009 + 5 Ω |
| 3.3 MΩ | 3.300000 MΩ | 1 Ω | 1 µA | 0.018 + 40 Ω | 0.03 + 50 Ω | 0.04 + 70 Ω |
| 33 MΩ | 33.0000 MΩ | 100 Ω | 100 nA | 0.12 + 400 Ω | 0.13 + 500 Ω | 0.2 + 600 Ω |
| 330 MΩ[2] | 330.00 MΩ | 1 kΩ | 10 nA | 1 + 50 kΩ | 1.4 + 60 kΩ | 2.0 + 80 kΩ |

[1] With reading rate set to 2 rps or slower, and within one hour of Ohms zero, using relative control.
[2] 33 Ω and 330 MΩ ranges are only available with the SMX2042, SMX2044, SM2042 and SM2044.
[3] 4-wire ohms is available up to the 330 kΩ range.

**Diode Characterization**

| Maximum Diode Voltage Compliance | Available DC current Uncertainty | Typical Current Value | Typical Voltage Value Uncertainty |
|---|---|---|---|
| 4 V | 100 nA, 1 µA, 10 µA, 100 µA and 1 mA (SMX2044 and SM2044: 10 mA constant current plus variable current from 10 nA to 12.5 mA) | 1 % | 0.02 % |

#### AC Functions

**AC Voltage (true RMS)**

One Year Accuracy ± (% of reading + Volts), 23˚C±5˚C

| Range | Full scale 6-½ Digits | Resolution | 10 Hz - 20 Hz | 20 Hz - 47 Hz | 47 Hz - 10 kHz | 10 kHz - 50 kHz | 50 kHz-100 kHz |
|---|---|---|---|---|---|---|---|
| 330 mV | 330.0000 mV | 100 nV | 3.2 + 430 µV | 0.95 + 200 µV | 0.15 + 120 µV | 0.63 + 230 µV | 5.6 + 400 µV |
| 3.3 V | 3.300000 V | 1 µV | 3.2 + 2.5 mV | 1.0 + 1.7 mV | 0.065 + 1.2 mV | 0.70 + 1.5 mV | 5.3 + 2 mV |
| 33 V | 33.00000 V | 10 µV | 3.3 + 20 mV | 1.0 + 16 mV | 0.073 + 13 mV | 0.35 + 25 mV | 2.4 + 40 mV |
| 250 V | 250.0000 V | 100 µV | 3.3 + 200 mV | 1.0 + 150 mV | 0.06 + 130 mV | 0.45 + 200 mV | 3.2 + 300 mV |

**AC Current (true RMS)**

One Year Accuracy ± (% of reading + Volts), 23˚C±5˚C

| Range | Full scale 6-½ Digits | Resolution | Max Burden Voltage (RMS) | 10Hz - 20Hz[1] | 20Hz - 47Hz[1] | 47Hz - 1kHz[1] | 1kHz - 10kHz[1] |
|---|---|---|---|---|---|---|---|
| 3.3 mA | 3.300000 mA | 1 nA | 350 mV | 2.9 + 4 µA | 1.0 + 4 µA | 0.12 + 4 µA | 0.22 + 4 µA |
| 33 mA | 33.00000 mA | 10 nA | 350 mV | 2.8 + 30 µA | 1.0 + 30 µA | 0.16 + 30 µA | 0.4 + 40 µA |
| 330 mA | 330.0000 mA | 100 nA | 350 mV | 2.8 + 400 µA | 1.0 + 400 µA | 0.22 + 220 µA | 0.6 + 400 µA |
| 2.5 A | 2.500000 A | 1 µA | 350 mV | 2.7 + 5 mA | 0.9 + 6 mA | 0.65 + 4 mA | 0.7 + 5 mA |

[1] All AC Current ranges have typical measurement capability to 20 kHz.

## Time Functions (SMX2042, SMX2044, SM2042, SM2044)

### Frequency and Period

***ACV Mode***

| Input RMS Voltage range | Input Impedance | Frequency Range | Period Range | Resolution | Uncertainty |
|---|---|---|---|---|---|
| 33 mV - 250 V | 1 MΩ with < 300 pF | 1 Hz - 300 kHz | 1 s - 3.33 µs | 5 1/2digits | ±0.002% of reading |

***ACI Mode***

| Input RMS Voltage range | Input Impedance | Frequency Range | Period Range | Resolution | Uncertainty |
|---|---|---|---|---|---|
| 0.33 mA - 2.5 A | 10 Ω (3 mA & 30 mA)<br>0.1 Ω (330 mA & 2.5 A) | 1 Hz - 500 kHz | 1 s - 2.0 µs | 5 1/2 digits | ± 0.01% of reading |

### Pulse Width

| Polarity | Frequency Range | Resolution | Width Range | Typical Uncertainty |
|---|---|---|---|---|
| Positive or negative pulse widths | 1 Hz to 100 kHz | 2 µs | 2 µs to 1 s | 0.01 % of reading ±4 µs |

### Threshold DAC

| Selected VAC Range | Threshold range (DC level) | Threshold DAC resolution | Highest allowed input Vp-p | Typical one year setting uncertainty |
|---|---|---|---|---|
| 330 mV | -1.0 V to +1.0 V | 0.5 mV | 1.900 V | 0.2% + 4 mV |
| 3.3 V | -10.0 V to +10.0 V | 5.0 mV | 19.00 V | 0.2% + 40 mV |
| 33 V | -100.0 V to +100.0 V | 50 mV | 190.0 V | 0.2% + 0.4 V |
| 250 V | -500 V to +500 V | 500 mV | 850.0 V | 0.2% + 4 V |

### Totalizer

| Active edge polarity | Maximum Count | Allowed rate | Condition |
|---|---|---|---|
| Positive or negative transition | 10^9 | 1 to 30,000 events per second | Uses Threshold DAC |

## Capacitance and Inductance Specifications (SMX2042, SMX2044, SM2042 and SM2044)

### Capacitance

Accuracy ± (% of reading + farads) [1]

| Range | Full scale Reading | Resolution | One Year 23˚C±5˚C |
|---|---|---|---|
| 10 nF | 11.999 nF | 1 pF | 2.1 ± 5 pF |
| 100 nF | 119.99 nF | 10 pF | 1.0 |
| 1 µF | 1.1999 µF | 100 pF | 1.0 |
| 10 µF | 11.999 µF | 1 nF | 1.0 |
| 100 µF | 119.99 µF | 10 nF | 1.0 |
| 1 mF | 1.1999 mF | 100 nF | 1.2 |
| 10 mF | 11.999 mF | 1 µF | 2 |

[1] Within one hour of zero, using Relative control. Accuracy is specified for values higher than 5% of the selected range with the exception of the 10 nF range, which measures down to 0 pF.

### Inductance (SM2044 and SMX2044 only)

Accuracy ±(% of reading + henrys)

| Range | Test Frequency | Full Scale 4 1/2 Digits | Resolution | One Year Accuracy 23˚C±5˚C [1] |
|---|---|---|---|---|
| 33 µH | 75 kHz | 33.000 µH | 1 nH | 3.0% + 500 nH |
| 330 µH | 50 kHz | 330.00 µH | 10 nH | 2.0% + 3 µH |
| 3.3 mH | 4 kHz | 3.3000 mH | 100 nH | 1.5% + 25 µH |
| 33 mH | 1.5 kHz | 33.000 mH | 1 µH | 1.5% + 200 µH |
| 330 mH | 1 kHz | 330.00 mH | 10 µH | 2.5 + 3 mH |
| 3.3 H | 100 Hz | 3.3000 H | 100 µH | 3.0 + 35 mH |

[1] Within one hour of zero, and Open Terminal Calibration. Accuracy is specified for values greater than 5% of the selected range.

Other measurement functions of the SMX2044 and SM2044: 6-wire guarded resistance, AC peak-to-peak voltage, AC crest factor, AC median value, leakage current, RTD temperature, in circuit AC-based capacitance

## Source Functions (SMX2044 and SM2044 only)

- DC Voltage Source
  - Output range: -10.000 V to +10.000 V
  - DAC resolution: 18 bits (closed loop), 12 bits (open loop)
- AC Voltage Source
  - Output range: 50 mV to 7.1 VRMS
  - DAC resolution: 16 bits (closed loop), 12 bits (open loop)
  - Frequency range/resolution: 2 Hz to 75 kHz/ 2 Hz
- DC Current Source
  - Output range: 1.25 µA to 12.5 mA

## Trigger Functions

- External Hardware Trigger (at DIN-7 connector)
  - Trigger input voltage level range: High: +3 V to +15 V, Low: -15 V to +0.8 V
  - Trigger high current drive: Min. 1 mA, Max 10 mA (TTL or CMOS logic level)
- PXI Bus Hardware Trigger Inputs (at PXI J2)
  - Trigger Input: TTL or CMOS positive pulse
  - Trigger Pulse Width: Minimum 250 µs
- PXI Bus Hardware Trigger Outputs (to PXI J2)
  - Trigger Output: TTL or CMOS negative pulse. Positive edge = ready
  - Trigger Pulse Width: Approximately 140 µs
- Analog Threshold Trigger
  - Captures up to 64 post-trigger readings
  - Reading rate: 10 rps or higher

## General Specifications

- Reading Rate (user selectable):
  - 0.5 to 1,000 readings per second (rps)
  - Up to 10 rps, 6 1/2 digits
  - Up to 30 rps, 5 1/2 digits
- Overload Protection (voltage inputs): 330 VDC, 250 VAC
- Isolation: 330 VDC, 250 VAC from Earth Ground
- Maximum Input (Volt x Hertz):
  - $8x10^6$ Volt x Hz normal mode input
  - $1x10^6$ Volt x Hz common mode input
- Calibration: Calibrations are performed by Signametrics in a computer at a 3˚C internal temperature rise. All calibration constants are stored in a text file.
- Operating Temperature: -10 to 70˚C
- Storage Temperature: -65 to 85˚C
- Power requirements: +5 volts, 300 mA maximum
- Dimensions (not including connectors):
  - SMX2040 series: 160 mm x 100 mm
  - SM2040 series: 208 mm x 112 mm
- Safety: Designed to IEC 1010-1, Installation Category II

## Ordering Information

- **SMX2044**
  6-1/2 digits PXI LCR Sourcing Digital Multimeter
- **SMX2042**
  6-1/2 digits PXI Multi-Function Digital Multimeter
- **SMX2040**
  6-1/2 digits PXI Digital Multimeter
- **SM2044**
  6-1/2 digits PCI LCR Sourcing Digital Multimeter
- **SM2042**
  6-1/2 digits PCI Multi-Function Digital Multimeter
- **SM2040**
  6-1/2 digits PCI Digital Multimeter