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Agilent Technologies

Signametrics
Precision Instruments for the PC

SMX2060, SMU2060, SM2060 7-1/2 digit PXI, USB & PCI Digital Multimeters

7-1/2 Digit Multimeters

Features

- **7-1/2 Digit Resolution**
- **+ 24,000,000 count A/D**
  +2.399,999,9V
- **Zero Latency from 0.5rps to 4,500rps**
- **Select Aperture**
  - **130us to 5s**
- **Select Read-Interval**
  - **0 to 1s**
- **Set function&range in 20ms**
- **DC & AC Volts 10nV to 330V**
  - **240mV, 2.4V, 24V, 240V, 330V**
- **DC Current 1nA to 2.4A**
  - **2.4mA, 24mA, 240mA, 2.4A**
- **AC Current 20uA to 2.4A**
  - **2.4mA, 24mA, 240mA, 2.4A**
- **True RMS ACV & ACI**
  - **Fast/Slow RMS Filter**
- **Resistance: 10mΩ to 24MΩ**
  - **2-Wire: 240, 2.4k, 24k, 240k, 2.4M, 24M**
  - **4-Wire: 240, 2.4k, 24k, 240k**
  - **5 test currents to 1mA**
- **Capacitance: 1pF-12mF**
  - **1.2n, 12n, 120n, 1.2u, 12u, 120u, 1.2m, 12m**
- **Temperature:**
  - **RTDs: pt385, pt3911, pt3916, pt3926, Cu, Ro:2Ω to 24kΩ**
  - **Thermocouples: B, E, J, K, N, R, S, T**
- **Diode V/I Characteristics**
- **Frequency: 2Hz – 300kHz**
- **Extensive triggering**
- **Sync Output**
- **Component Handler interface**
- **Universal Software driver**
  - **Linux & Windows**
  - **Fast to install - tiny footprint**
  - **Compatible with most S/W**
  - **Stand alone – no dependencies**
  - **Excel, Word, MatLab, Lab View, C, C++, C#, Lab Windows, VB…**

To preserve the accuracy of these DMMs make sure you use Instrumentation type Switching.

Hundreds of users consider these to be the best plug-in DMMs.

The Signametrics 2060 models are high precision, high resolution 7-½ digit Multimeters (DMMs), designed for PXI, PCI and USB environments. They raise the bar on system Digital Multimeters (DMM's), setting new performance levels, at a very reasonable price. Their remarkable throughput and accuracy are attributable to recent advances in conversion technology, manifested in a very gradual degradation in resolution with increased measurement rates, making these DMM's suitable for automated test systems and production test. Expect them to perform much faster, and be a lot simpler to control than any bench top DMMs.

These units replace the older generation IEEE488 and/or RS232 DMM's, which are very slow, unreliable, and require a lot more in hardware and software interface.

In addition to the standard DMM measurements, these full featured DMMs include a fast frequency counter as well as a highly sensitive capacitance meter. Considering the small size, ease of use and low cost of these DMM's, it is hard to imagine going back to the slower box DMM. These units will run circles around any DMM in an automated test setting. For an additional peace of mind, these DMMs carry a 30 day no-risk trial period.

The software package that comes with these DMM's is complete, and does not require any additional drivers or packages. It is not in *Signametrics* interest to constrain users to a handful of S/W packages. This is the reason the type of driver provided is universal. It allows these DMM's to be accessible by a very large number of software environments, including MS Word, Excel, Mat Lab, Visual Basic, C, C++, C#, Lab Windows, Lab View, ATEasy, Delphi and may other graphical and text based software packages. An added benefit of this approach is a fast, easy and small installation, and super fast driver. In less than five minutes you will be making measurements.

If low cost is the priority, the 2055 models should be considered. For more versatile LCR/Source Measure DMM, the 2064 models will baffle you. When using DMMs, make sure you use an Instrumentation quality switching system. It will prevent signal degradation. It is best to use the SMX4032 switch with the 2060 and 2064 models, and the SMX4042 with the 2055 DMM models.

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SMX2060, SMU2060, SM2060 7-1/2 digit PXI, USB & PCI Digital Multimeters

DC Voltage Measurement

- **Input Resistance 240 mV, 2.4 V Ranges:** >10 GΩ
- **Input Resistance 24 V, 240 V, 330V Ranges:** 10.00 MΩ

Accuracy ± (% of reading + Volts) [1]

Range	Full Scale 7-½ Digits	Resolution	24 hours 23°C ± 1°C	One Year 23°C ± 5°C
240 mV	240.00000 mV	10 ηV	0.003 + 1 µV	0.005 + 2 µV
2.4 V	2.4000000 V	100 ηV	0.002 + 3 µV	0.003 + 5 µV
24 V	24.000000 V	1 µV	0.004 + 120 µV	0.006 + 150 µV
240 V	240.00000 V	10 µV	0.003 + 250 µV	0.005 + 0.5 mV
330 V	330.00000 V	10 µV	0.0075 + 0.5 mV	0.015 + 0.8 mV

[1] With Aperture set to ≥ 0.5 Sec, within one hour from Self Cal.

Resolution vs. Aperture and measurement rate

Measurement Aperture	Reading Rate	Resolution	
0.5 s ≤ Aperture	2 / second	7-1/2 digits	25 bits
10 ms ≤ Aperture	100 / second	6-1/2 digits	22 bits
130µs ≤ Aperture	4,500 / second	5 digits	17 bits

DCV Noise Rejection Normal Mode Rejection, at 50, 60, or 400 Hz ± 0.5%; better than 95 dB (apertures ≥ 0.160s. CMRR, with 1 kΩ lead imbalance; ≥ 120 dB.

DC Current Measurement

- **Number of shunts** Five
- **Burden Voltage** 240mV max.
- **Protected** with 2.5A Fast blow fuse

Accuracy ± (% of reading + Amps) [1]

Range	Full Scale Reading	Res.	24 hours 23°C ± 5°C	One Year 23°C ± 5°C
2.4 mA	2.40000 mA	10 ηA	0.05 + 300 ηA	0.07 + 550 ηA
24 mA	24.0000 mA	100 ηA	0.05 + 350 ηA	0.08 + 550 ηA
240 mA	240.000 mA	1 µA	0.05 + 50 µA	0.065 + 80 µA
2.4 A	2.40000 A	10 µA	0.3 + 60 µA	0.45 + 90 µA

Resistance Measurements

- **Number of Current Sources** five

Range	Full Scale Reading	Resolution	Test current	Max. Test Voltage
240 Ω	240.00000 Ω	10 µΩ	1 mA	240mV
2.4 kΩ	2.4000000 kΩ	100 µΩ	1 mA	2.4V
24 kΩ	24.000000 kΩ	1 mΩ	100 µA	2.4V
240 kΩ	240.00000 kΩ	10 mΩ	10 µA	2.4V
2.4 MΩ	2.4000000 MΩ	100 mΩ	1 µA	2.4V
24 MΩ	24.0000 MΩ	100 Ω	100 nA	2.4V

2-Wire and 4-Wire resistance

Accuracy ± (% of reading + Ω) [1]

Range	24 hours 23°C ± 1°C	One Year 23°C ± 5°C
240 Ω	0.0037 + 3 mΩ [2]	0.007 + 5 mΩ [2]
2.4 kΩ	0.0023 + 28 mΩ	0.006 + 33 mΩ
24 kΩ	0.0025 + 300 mΩ	0.006 + 350 mΩ
240 kΩ	0.0055 + 3.2 Ω	0.007 + 5 Ω
2.4 MΩ	0.018 + 40 Ω	0.04 + 70 Ω
24 MΩ	0.12 + 400 Ω	0.2 + 600 Ω

[1] With Aperture set to ≥ 0.5 Sec, within one hour from Self Calibration (S-Cal).

AC Voltage Measurements, True RMS

- **Input Resistance** 1 MΩ, shunted by < 300 pF
- **Max. Crest Factor** 4 at Full Scale, 7 at 10% of range
- **AC coupled** 10 Hz to 100 kHz
- **Typical Settling time** < 0.5s to within 0.1% of final value
- **Fast RMS Settling** < 0.05s to within 0.1% of final value

Range [1]	Full Scale 7-½ Digits [2]	Lowest specified Voltage	Resolution
240 mV	240.0000 mV	5 mV [1]	100 ηV
2.4 V	2.400000 V	20 mV	1 µV
24 V	24.00000 V	200 mV	10 µV
240 V	240.0000 V	2 V	100 µV
330 V	330.0000 V	2.5 V	100 µV

[1] Between 5 mV and 10 mV, add 100 µV additional errors.

[2] Signal is limited to $8x10^6$ Volt Hz Product. For instance, at 32 kHz the highest input is 250 V.

Accuracy ± (% of reading + Volts) [1]

Range	Frequency	24 hours 23°C ± 1°C	One Year 23°C ± 5°C
240 mV	10 Hz - 20 Hz	3.0 + 350 µV	3.2 + 430 µV
	20 Hz - 47 Hz	0.37 + 150 µV	0.4 + 200 µV
	47 Hz - 10 kHz	0.13 + 100 µV	0.15 + 120 µV
	10 kHz - 50 kHz	0.25 + 160 µV	0.27 + 230 µV
	50 kHz - 100 kHz	1.9 + 350 µV	2.0 + 400 µV
2.4 V	10 Hz - 20 Hz	3.0 + 2 mV	3.2 + 2.5 mV
	20 Hz - 47 Hz	0.37 + 1.3 mV	0.4 + 1.7 mV
	47 Hz - 10 kHz	0.05 + 1 mV	0.065 + 1.2 mV
	10 kHz - 50 kHz	0.32 + 1.2 mV	0.35 + 1.5 mV
	50 kHz - 100 kHz	1.9 + 1.5 mV	2.1 + 2 mV
24 V	10 Hz - 20 Hz	3.0 + 14 mV	3.3 + 20 mV
	20 Hz - 47 Hz	0.37 + 12 mV	0.4 + 16 mV
	47 Hz - 10 kHz	0.06 + 10 mV	0.073 + 13 mV
	10 kHz - 50 kHz	0.18 + 18 mV	0.22 + 25 mV
	50 kHz - 100 kHz	1.3 + 30 mV	1.5 + 40 mV
240 V	10 Hz - 20 Hz	3.0 + 140 mV	3.3 + 200 mV
	20 Hz - 47 Hz	0.37 + 120 mV	0.4 + 150 mV
	47 Hz - 10 kHz	0.04 + 100 mV	0.06 + 130 mV
	10 kHz - 50 kHz	0.28 + 150 mV	0.30 + 200 mV
	50 kHz - 100 kHz	1.4 + 200 mV	1.6 + 300 mV
330 V	10 Hz - 20 Hz	3.0 + 200 mV	3.3 + 200 mV
	20 Hz - 47 Hz	0.43 + 180 mV	0.45 + 250 mV
	47 Hz - 10 kHz	0.07 + 150 mV	0.09 + 230 mV
	10 kHz - 50 kHz	0.28 + 200 mV	0.32 + 300 mV
	50 kHz - 100 kHz	1.3 + 270 mV	1.6 + 400 mV

RTD Temperature Measurement

- **Ro:** Adjustable 2 Ω to 24 kΩ
- **Measurement Method:** 4-Wire

RTD Type	Resolution	range	Accuracy 23°C ± 5°C [1] One Year
pt385, pt3911, pt3916, pt3926	0.01°C	-150 to 650°C	±0.06°C
pt385, pt3911, pt3916, pt3926	0.01°C	-150 to 650°C	±0.03°C
Cu (Copper)	0.01°C	-100 to 200°C	±0.18°C at ≤ 20°C, ±0.05°C otherwise
Cu (Copper)	0.01°C	-100 to 200°C	±0.10°Cat ≤ 20°C, ±0.05°C otherwise

[1] With Aperture of 0.5s and higher.

6073 50th Avenue N.E., Seattle, WA 98115
Phone (206) 524-4074, Fax (206) 525-8578
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AC Current Measurement, True RMS

- **Crest Factor** 4 at Full Scale, 10 at Lowest Specified Current
- **Burden Voltage** 240mV max.
- **Protected** with 2.5 A Fast Blow fuse

Range	Full Scale 6 1/2 Digits	Lowest Specified	Max Burden	Resolution
2.4 mA	2.400000 mA	60 µA	25mV	1 nA
24 mA	24.00000 mA	300 µA	250mV	10 nA
240 mA	240.0000 mA	3 mA	55mV	100 nA
2.4 A	2.400000 A	30 mA	520mV	1 uA

Accuracy ± (% of reading + Amps)

Range	Frequency [1]	24 hours 23°C ± 1°C	One Year 23°C ± 10°C
2.4 mA	10 Hz - 20 Hz	3.8 + 4 µA	2.9 + 4 µA
	20 Hz - 47 Hz	0.9 + 4 µA	1.0 + 4 µA
	47 Hz - 1 kHz	0.04 + 1.5 µA	0.12 + 4 µA
	1 kHz - 10 kHz	0.12 + 4 µA	0.22 + 4 µA
24 mA	10 Hz - 20 Hz	1.8 + 30 µA	2.8 + 30 µA
	20 Hz - 47 Hz	0.6 + 30 µA	1.0 + 30 µA
	47 Hz - 1 kHz	0.07 + 10 µA	0.16 + 30 µA
	1 kHz - 10 kHz	0.21 + 30 µA	0.4 + 40 µA
240 mA	10 Hz - 20 Hz	1.8 + 400 µA	2.8 + 400 µA
	20 Hz - 47 Hz	0.6 + 400 µA	1.0 + 400 µA
	47 Hz - 1 kHz	0.1 + 100 µA	0.2 + 220 µA
	1 kHz - 10 kHz	0.3 + 300 µA	0.4 + 400 µA
2.4 A	10 Hz - 20 Hz	1.8 + 4 mA	2.7 + 5 mA
	20 Hz - 47 Hz	0.66 + 4 mA	0.9 + 6 mA
	47 Hz - 1 kHz	0.3 + 3.8mA	0.35 + 4 mA
	1 kHz - 10 kHz	0.4 + 4mA	0.5 + 5 mA

[1] All have typical measurement capability of at least 20 kHz.

Diode Characterization

- **Preset test currents** 100 ηA, 1 µA, 10 µA, 100 µA and 1 mA
- **1yr Current Source Uncertainty** 2.5% + 2η
- **1yr Voltage Measurement Uncertainty** 0.01% + 50uV
- **Voltage measurement range** 0V to 2.4V
-

Thermocouple Temperature Measurement

- **Cold Junction Compensation:** By Sensor or soft entry.
- **Cold Junction range:** 0 °C to 50 °C
- **Isothermal Blocks:** SM40T, SMX40T

C Type	Resolution	Maximum Temperature	Temperature Accuracy 23°C ± 5°C One Year
B	0.01°C	2200°C	±0.38 °C
E	0.01°C	1200°C	±0.035 °C
J	0.01°C	T2000°C	±0.06 °C
K	0.01°C	3000°C	±0.07 °C
N	0.01°C	3000°C	±0.10 °C
R	0.01°C	2700°C	±0.25 °C
S	0.01°C	3500°C	±0.35 °C
T	0.01°C	550°C	±0.06 °C

Capacitance Measurements

- **Measurement time** as low as 200ms (depending on value)

Accuracy ± (% of reading + Farads)

Range	Full Scale Reading	Resolution	One Year 23°C ± 5°C
1,200 pF	1,199.9 pF	0.1 pF	1 ± 1 pF
12 ηF	11.999 ηF	1 pF	1.2 ± 5 pF
120 ηF	119.99 ηF	10 pF	1.0 [1]
1.2 µF	1.1999 µF	100 pF	1.0 [1]
12 µF	11.999 µF	1 ηF	1.0 [1]
120 µF	119.99 µF	10 ηF	1.0 [1]
1.2 mF	1.1999 mF	100 ηF	1.2 [1]
12 mF	50.000 mF	1 µF	2 [1]

[1] Specified for values higher than 5% of the selected range.

Time Measurements

Frequency and Period Measurements

- **Input Impedance** 1 MΩ with < 300 pF
- **Ranging** Auto-Ranging (default) or Range-Lock
- **Maximum acquisition time while in Auto-Ranging mode** 7s
- **Acquisition Time in Range Locked mode** 35ms to 2s

Frequency (Hz)	One Year accuracy (% of reading + Hz)	Resolution (Hz)	Minimum amplitued (RMS)
1 – 130	0.025% + 0.0015	0.001	30mV or 5% of range, (whichever is greater)
130 – 640	0.025% + 0.02	0.0065	
640 – 2.5k	0.03% + 0.075	0.025	
2.5k – 40k	0.03% + 1.2	0.4	
40k – 200k	0.05% + 7	2.5	25% of range
200k – 300k	0.07% + 5	1.5	

Trigger Functions

External Hardware Trigger

Trigger Input voltage level range (at DIN-7 connector)	+3 V to +15 V activates the trigger.
Minimum Trigger Pulse Width	Aperture + 50µS when using:
Trigger input impedance	3 kΩ
Internal Reading Buffer	Circular; 80 or 120 readings depending on resolution.
Edge	Positive or negative.

PXI Bus Trigger inputs (SMX2060)

Trigger Input voltage level range	CMOS level (see PXI standard)
Minimum Trigger Pulse Width	1/Aperture + 50µS
Internal Reading Buffer	Circular; 80 or 120 readings depending on resolution.
Edge	Selectable positive or negative edge.

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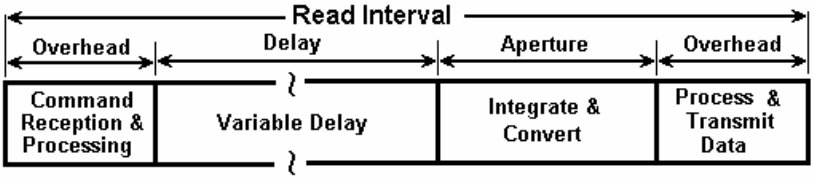
Analog Threshold Trigger

- **Trigger point:** Selectable threshold and transition
- **Buffer type:** Circular
- **Captures:** up to 120 post-trigger readings
- **Aperture range:** 160ms to 130µS
- **Read Interval range:** 1/Aperture to 65ms
- **Post-Trigger readings:** Selectable from 0 to buffer size
- **Pre-trigger readings:** Selectable from 0 to buffer size.

Delayed Trigger

- **Delay:** 50µs to 1s following Trigger event.
- **Delay Resolution:** 1µs
- **Trigger Edge:** Positive or Negative
- **Measurements:** 1 to 120 stored in DMM's buffer.

Relations of Aperture and Time Interval parameters.



- **Apertures values:** (30) 5s, 2s, 1s, 0.5s, 266ms, 160ms,133ms, 80ms, 66ms, 40ms, 33ms, 20ms, 16.6ms, 10ms, 8.3ms, 5ms, 4.2ms, 2.5ms, 2ms, 1.25ms, 1ms, 625us, 520us, 312us, 260us, 130us.
- **Read-Interval range: :** 250µs to 65s; 1µs resolution, 65ms to 1s; 20µs resolution.

Accessories

Several accessories are available for the SMX2055 DMM. These can be purchased directly from Signametrics, or one of its approved distributors or representatives. These are some of the accessories available:

- DMM probes SM-PRB
- DMM probe kit SM-PRK
- Deluxe probe kit SM-PRD ($95.00).
- Shielded SMT Tweezers Probes SM-PRSMT
- Multi Stacking Double Banana shielded cable 36" SM-CBL36.
- Multi Stacking Double Banana shielded cable 48" SM-CBL48.
- Mini DIN Trigger, 6-Wire Ohms connector SM2060-CON7
- Extended 3 Year warrantee (does not include calibration).

Signametrics reserves the rights to change any or all of the above without notice, and at any time.

See manual for more detailed specifications.

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