

# 2700 Multimeter/Data Acquisition System

## DC CHARACTERISTICS<sup>1</sup>

CONDITIONS: MED (1 PLC)<sup>2</sup> or 10 PLC or MED (1 PLC) with Digital Filter of 10

FUNCTION	RANGE	RESOLUTION	TEST CURRENT ±5% OR BURDEN VOLTAGE	INPUT RESISTANCE OR OPEN CKT. VOLTAGE <sup>3</sup>	ACCURACY: ±(ppm of reading + ppm of range) (ppm = parts per million) e.g., 10ppm = 0.001%			TEMPERATURE COEFFICIENT 0°-18°C & 28°-50°C
					24 Hour <sup>4</sup> 23°C±1°	90 Day 23°C±5°	1 Year 23°C±5°	
Voltage <sup>11</sup>	100.0000 mV	0.1 µV		>10 GΩ	15 + 30	25 + 35	30 + 35	(1 + 5)/°C
	1.000000 V	1.0 µV		>10 GΩ	15 + 6	25 + 7	30 + 7	(1 + 1)/°C
	10.0000 V	10 µV		>10 GΩ	10 + 4	20 + 5	30 + 5	(1 + 1)/°C
	100.0000 V	100 µV		>10 MΩ ± 1%	15 + 6	35 + 9	45 + 9	(5 + 1)/°C
	1000.000 V <sup>5</sup>	1 mV		>10 MΩ ± 1%	20 + 6	35 + 9	50 + 9	(5 + 1)/°C
Resistance <sup>6,8</sup>	100.0000 Ω	100 µΩ	1 mA	6.6 V	20 + 20	80 + 20	100 + 20	(8 + 1)/°C
	1.000000 kΩ	1 mΩ	1 mA	6.6 V	20 + 6	80 + 6	100 + 6	(8 + 1)/°C
	10.00000 kΩ	10 mΩ	100 µA	6.6 V	20 + 6	80 + 6	100 + 6	(8 + 1)/°C
	100.0000 kΩ	100 mΩ	10 µA	12.8 V	20 + 6	80 + 10	100 + 10	(8 + 1)/°C
	1.000000 MΩ	1.0 Ω	10 µA	12.8 V	20 + 6	80 + 10	100 + 10	(8 + 1)/°C
	10.00000 MΩ <sup>7</sup>	10 Ω	0.7 µA // 10MΩ	7.0 V	150 + 6	200 + 10	400 + 10	(70 + 1)/°C
	100.0000 MΩ <sup>7</sup>	100 Ω	0.7 µA // 10MΩ	7.0 V	800 + 30	2000 + 30	2000 + 30	(385 + 1)/°C
	Continuity (2W) <sup>21</sup>	1.000 kΩ	100 mΩ	1 mA	6.6 V	40 + 100	100 + 100	100 + 100
Current	20.00000 mA	10 nA	<0.2 V		60 + 30	300 + 80	500 + 80	(50 + 5)/°C
	100.0000 mA	100 nA	<0.05 V		100 + 300	300 + 800	500 + 800	(50 + 50)/°C
	1.000000 A	1.0 µA	<0.3 V <sup>9</sup>		200 + 30	500 + 80	800 + 80	(50 + 5)/°C
	3.000000 A	10 µA	<1.0 V <sup>9</sup>		1000 + 15	1200 + 40	1200 + 40	(50 + 5)/°C

Channel (Ratio)<sup>10</sup> Ratio Accuracy = Accuracy of selected Channel Range + Accuracy of Paired Channel Range

Channel (Average)<sup>10</sup> Average Accuracy = Accuracy of selected Channel Range + Accuracy of Paired Channel Range

## TEMPERATURE<sup>19</sup>

(Display in °C, °F, or K. Exclusive of probe errors.)

Thermocouples (Accuracy based on ITS-90.)

Type	Range	Resolution	90 Day/1 Year (23°C ±5°C)			Temperature Coefficient 0°-18°C & 28°-50°C
			Relative to Simulated Reference Junction	Using 77XX Module		
J	-200 to +760°C	0.001°C	0.2°C	1.0°C		0.03°C/°C
K	-200 to +1372°C	0.001°C	0.2°C	1.0°C		0.03°C/°C
N	-200 to +1300°C	0.001°C	0.2°C	1.0°C		0.03°C/°C
T	-200 to +400°C	0.001°C	0.2°C	1.0°C		0.03°C/°C
E	-200 to +1000°C	0.001°C	0.2°C	1.0°C		0.03°C/°C
R	0 to +1768°C	0.1°C	0.6°C	1.8°C		0.03°C/°C
S	0 to +1768°C	0.1°C	0.6°C	1.8°C		0.03°C/°C
B	+350 to +1820°C	0.1°C	0.6°C	1.8°C		0.03°C/°C

### 4-Wire RTD:

(100Ω platinum [PT100], D100, F100, PT385, PT3916, or user type, Offset compensation On)

-200° to 630°C	0.01°C	0.06°C	0.003°C/°C
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### Thermistor: (2.2kΩ, 5kΩ, and 10kΩ)<sup>20</sup>

-80° to 150°C	0.01°C	0.08°C	0.002°C/°C
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## DC SYSTEM SPEEDS<sup>15,18</sup>

RANGE CHANGES<sup>16</sup>: 50/s (42/s).

FUNCTION CHANGES<sup>16</sup>: 50/s (42/s).

AUTORANGE TIME<sup>16</sup>: <30ms.

ASCII READINGS TO RS-232 (19k BAUD): 55/s.

MAX. INTERNAL TRIGGER RATE: 2000/s.

MAX. EXTERNAL TRIGGER RATE: 375/s.

## DC MEASUREMENT SPEEDS<sup>15</sup>

Single Channel, 60Hz (50Hz) Operation

FUNCTION	DIGITS	READINGS/s	PLCs
DCV, DCI, Ohms (<10M), Thermocouple, Thermistor	6.5 <sup>12,16</sup>	5 (4)	10
	6.5 <sup>16</sup>	30 (24)	1
	6.5 <sup>12,16</sup>	50 (40)	1
	5.5 <sup>12,16</sup>	100 (80)	0.1
	5.5 <sup>16,17</sup>	250 (200)	0.1
4W Ohms (<10M)	5.5 <sup>17</sup>	480 (400)	0.1
	4.5 <sup>17</sup>	2000 (1800)	0.01
	6.5 <sup>16</sup>	1.4 (1.1)	10
	6.5 <sup>16</sup>	15 (12)	1
RTD	5.5 <sup>17</sup>	33 (25)	0.1
	6.5 <sup>16</sup>	0.9 (0.7)	10
	6.5 <sup>16</sup>	8 (6.4)	1
Channel (Ratio), Channel (AVG)	5.5 <sup>16,17</sup>	18 (14.4)	0.1
	6.5 <sup>16</sup>	2.5 (2)	10
	6.5 <sup>16</sup>	15 (12)	1
	5.5 <sup>17</sup>	25 (20)	0.1

## Multiple Channels Into Memory<sup>15,18</sup>

7703 and 7710 Scanning DCV	175/s
7703 and 7710 Scanning with Limits or Time Stamp On	170/s
7703 and 7710 Scanning DCV alternating 2WΩ	40/s
7710 Scanning Temperature (T/C)	80/s
7700 and 7708 Scanning Temperature (T/C)	50/s

## Multiple Channels Into and Out of Memory<sup>15,16,17,18</sup>

7703 and 7710 Scanning DCV	150/s
7703 and 7710 Scanning with Limits or Time Stamp On	150/s
7703 and 7710 Scanning DCV alternating 2WΩ	40/s
7710 Scanning Temperature (T/C)	70/s
7702 Scanning DCV	65/s
7700 and 7708 Scanning Temperature (T/C)	50/s

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## DC SPEED vs. NOISE REJECTION

Rate	Filter	Readings/s <sup>12</sup>	RMS Noise			
			Digits	10V Range	NMR	CMRR <sup>14</sup>
10	50	0.1 (0.08)	6.5	<1.2 $\mu$ V	110 dB <sup>13</sup>	140 dB
1	Off	15 (12)	6.5	<4 $\mu$ V	90 dB <sup>13</sup>	140 dB
0.1	Off	500 (400)	5.5	<22 $\mu$ V	-	80 dB
0.01	Off	2000 (1800)	4.5	<150 $\mu$ V	-	80 dB

## DC MEASUREMENT CHARACTERISTICS

### DC Volts

A-D LINEARITY: 2.0 ppm of reading + 1.0 ppm of range.

### INPUT IMPEDANCE:

**100mV-10V Ranges:** Selectable >10G $\Omega$ / with <400pF or 10M $\Omega$   $\pm$ 1%.

**100V, 1000V Ranges:** 10M $\Omega$   $\pm$ 1%.

**INPUT BIAS CURRENT:** <75pA at 23°C.

**COMMON MODE CURRENT:** <500nA at 50Hz or 60Hz.

**AUTOZERO ERROR:** Add  $\pm$ (2ppm of range error +5 $\mu$ V) for <10 minutes and  $\pm$ 1°C.

**INPUT PROTECTION:** 1000V, all ranges, 300V with plug-in modules.

### Resistance

**MAX 4W $\Omega$  LEAD RESISTANCE:** 10% of range per lead for 100 $\Omega$  and 1k $\Omega$  ranges; 1k $\Omega$  per lead for all other ranges.

**OFFSET COMPENSATION:** Selectable on 4W $\Omega$  100 $\Omega$ , 1k $\Omega$ , and 10k $\Omega$  ranges.

**CONTINUITY THRESHOLD:** Adjustable 1 to 1000 $\Omega$ .

**INPUT PROTECTION:** 1000V, all Source Inputs, 350V Sense Inputs, 300V with plug-in modules.

### DC Current

**SHUNT RESISTORS:** 100mA-3A, 0.1 $\Omega$ , 20mA, 5 $\Omega$ .

**INPUT PROTECTION:** 3A, 250V fuse.

### Thermocouples

**CONVERSION:** ITS-90.

**REFERENCE JUNCTION:** Internal, External, or Simulated (Fixed).

**OPEN CIRCUIT CHECK:** Selectable per channel. Open >11.4k  $\pm$ 200 $\Omega$ .

**EARTH ISOLATION:** 500V peak, >10G $\Omega$  and <150pF any terminal to chassis.

## DC Notes

- 20% overrange except on 1000V and 3A.
- Add the following to "ppm of range" uncertainty; 100mV 15ppm, 1V and 100V 2ppm, 100 $\Omega$  30ppm, <1M $\Omega$  2ppm, 10mA and 1A 10ppm, 100mA 40ppm.
- $\pm$ 2% (measured with 10M $\Omega$  input resistance DMM, >10G $\Omega$  DMM on 10M $\Omega$  and 100M $\Omega$  ranges).
- Relative to calibration accuracy.
- For signal levels >500V, add 0.02ppm/V uncertainty for portion exceeding 500V.
- Specifications are for 4-wire  $\Omega$ , 100 $\Omega$  with offset compensation on, 77xx plug-in module with LSYNC and offset compensation on. With offset compensation on OPEN CKT. VOLTAGE is 12.8V. For 2-wire  $\Omega$  add 1 $\Omega$  additional uncertainty.
- Must have 10% matching of lead resistance in Input HI and LO.
- Add the following to "ppm of reading" uncertainty when using plug in modules:

All Modules:	10 k $\Omega$	100 k $\Omega$	1 M $\Omega$	10 M $\Omega$	100 M $\Omega$
		220 ppm	2200 ppm		
<b>7701, 7703, 7707, and 7709 Modules:</b>	10 ppm	100 ppm	1000 ppm	1%	10%
<b>7706, 7708 Modules:</b>	5 ppm	50 ppm	500 ppm	5000 ppm	5%
<b>7710 Model 23°C <math>\pm</math>5°C:</b>	11 ppm	110 ppm	1100 ppm	1.1%	11%
<b>7710 Model Temp Coeff. &gt;28<math>\rightarrow</math>50°C</b>	0.3 ppm/ $^{\circ}$ C	3 ppm/ $^{\circ}$ C	30 ppm/ $^{\circ}$ C	0.03%/ $^{\circ}$ C	0.3%/ $^{\circ}$ C

- Add 1V when used with plug-in modules.
- For RATIO, DCV only. For AVERAGE, DCV, and Thermocouples only. Available with plug-in modules only.
- Add 6 $\mu$ V to "of range" uncertainty when using Models 7701, 7703, and 7707, 3 $\mu$ V for Models 7706, 7709, and 7710.
- Auto zero off.
- For LSYNC On, line frequency  $\pm$ 0.1%. For LSYNC Off, use 60dB for  $\geq$  1PLC.
- For 1k $\Omega$  unbalance in LO lead. AC CMRR is 70dB.
- Speeds are for 60Hz (50Hz) operation using factory defaults operating conditions (\*RST).  
Autorange off, Display off, Limits off, Trigger delay = 0.
- Speeds include measurements and binary data transfer out the GPIB.
- Sample count = 1000 (into memory buffer), auto zero off.
- Auto zero off, NPLC = 0.01.
- Additional Uncertainty

Type	Range	7710 Module Using CJC
J	0 to +760°C	1.5°C
K	0 to +1372°C	—
N	0 to +1300°C	0.5°C
T	0 to +400°C	0.5°C
E	0 to +1000°C	0.5°C
R	+400 to +1768°C	0.9°C
S	+400 to +1768°C	0.9°C
B	+1100 to +1820°C	0.9°C

Type	Range	Plug-In Modules					
		Front Terminals Sim. Ref. Junction	7709 Sim. Ref. Junction	7701, 7703, 7707 Sim. Ref. Junction	7700 and 7708 Using CJC	7706 Using CJC	7710 Using CJC
J	-200 to 0°C	0.1	0.1	0.3	0.8	1.6	4.5
K	-200 to 0°C	0.2	0.2	0.4	0.8	1.6	1
N	-200 to 0°C	0.3	0.3	0.6	0.8	1.6	2.5
T	-200 to 0°C	0.2	0.1	0.4	0.8	1.6	2.5
E	-200 to 0°C	-	0.1	0.3	0.8	1.6	2.5
R	0 to +400°C	0.4	0.6	1.2	0.5	1.0	2.2
S	0 to +400°C	0.4	0.6	1.2	0.5	1.0	2.2
B	+350 to +1100°C	0.8	0.3	1.7	0.5	1.0	2.2

- For lead resistance >0 $\Omega$ , add the following uncertainty/ $\Omega$  for measurement temperatures of:

	70 $^{\circ}$ -100 $^{\circ}$ C	100 $^{\circ}$ -150 $^{\circ}$ C
<b>2.2 k<math>\Omega</math></b> (44004)	0.22 $^{\circ}$ C	1.11 $^{\circ}$ C
<b>5.0 k<math>\Omega</math></b> (44007)	0.10 $^{\circ}$ C	0.46 $^{\circ}$ C
<b>10 k<math>\Omega</math></b> (44006)	0.04 $^{\circ}$ C	0.19 $^{\circ}$ C

- Front panel resolution limited to 0.1 $\Omega$ .

# 2700 Multimeter/Data Acquisition System

## AC SPECIFICATIONS<sup>1</sup>

Function	Range	Resolution	Calibration Cycle	Accuracy: $\pm$ (% of reading + % of range), 23°C $\pm$ 5°C				
				3 Hz-10 Hz	10 Hz-20 kHz	20 kHz-50 kHz	50 kHz-100 kHz	100 kHz-300 kHz
Voltage <sup>2</sup>	100.0000 mV	0.1 $\mu$ V	90 Days	0.35 + 0.03	0.05 + 0.03	0.11 + 0.05	0.6 + 0.08	4.0 + 0.5
	1.000000 V	1.0 $\mu$ V	(all ranges)					
	10.00000 V	10 $\mu$ V	1 Year	0.35 + 0.03	0.06 + 0.03	0.12 + 0.05	0.6 + 0.08	4.0 + 0.5
	100.0000 V	100 $\mu$ V	(all ranges)					
	750.000 V	1.0 mV						
			(Temp. Coeff.) <sup>3</sup>	0.035 + 0.003	0.005 + 0.003	0.006 + 0.005	0.01 + 0.006	0.03 + 0.01
Current <sup>2</sup>	1.000000 A	1.0 $\mu$ A	90 Day/1 Yr.	3 Hz-10 Hz	10 Hz-3 kHz	3 kHz-5kHz		
	3.00000 A	10 $\mu$ A		0.30 + 0.04	0.10 + 0.04	0.14 + 0.04		
				0.35 + 0.06	0.15 + 0.06	0.18 + 0.06		
				(Temp. Coeff.) <sup>3</sup>	0.035 + 0.006	0.015 + 0.006		
Frequency <sup>4</sup> and Period	100 mV	0.333 ppm	90 Day/1 Yr.	Accuracy $\pm$ (ppm of reading + offset ppm) (3 Hz-500 kHz) (333 ms-2 $\mu$ s)				
	to	3.33 ppm		100 ppm + 0.333 ppm (SLOW, 1s gate)				
	750 V	33.3 ppm		100 ppm + 3.33 ppm (MED, 100ms gate)				
				100 ppm + 33.3 ppm (FAST, 10ms gate)				

## Additional Uncertainty $\pm$ (% of reading)

Low Frequency Uncertainty	MED	FAST
20Hz - 30Hz	0.3	—
30Hz - 50Hz	0	—
50Hz - 100Hz	0	1.0
100Hz - 200Hz	0	0.18
200Hz - 300Hz	0	0.10
> 300Hz	0	0

**CREST FACTOR<sup>5</sup>:** 1-2    2-3    3-4  
**Additional Uncertainty:** 0.05    0.15    0.30  
**Maximum Crest Factor:** 5 at full-scale.

## AC MEASUREMENT CHARACTERISTICS

### AC Volts

**MEASUREMENT METHOD:** AC-coupled, True RMS.  
**INPUT IMPEDANCE:** 1M $\Omega$   $\pm$ 2% // by <100pF.  
**INPUT PROTECTION:** 1000Vp or 400VDC, 300Vrms with plug-in modules.

### AC Current

**MEASUREMENT METHOD:** AC-coupled, True RMS.  
**SHUNT RESISTANCE:** 0.1 $\Omega$ .  
**BURDEN VOLTAGE:** 1A <0.3Vrms, 3A <1Vrms. Add 1Vrms when used with plug-in modules.  
**INPUT PROTECTION:** 3A, 250V fuse.

### Frequency and Period

**MEASUREMENT METHOD:** Reciprocal Counting technique.  
**GATE TIME:** SLOW 1s, MED 100ms, and FAST 10ms.

### AC General

**AC CMRR<sup>6</sup>:** 70dB.  
**VOLT HERTZ PRODUCT:**  $\leq 8 \times 10^7$ .

## AC MEASUREMENT SPEEDS<sup>7,8</sup>

Single Channel, 60Hz (50Hz) Operation

Function	Digits	Readings/s	Rate	Bandwidth
ACV, ACI	6.5	2s/Reading	SLOW	3 Hz-300kHz
	6.5	4.8 (4)	MED	30 Hz-300kHz
	6.5 <sup>9</sup>	35 (28)	FAST	300 Hz-300kHz
Frequency, Period	6.5	1 (1)	SLOW	3 Hz-300kHz
	5.5	9 (9)	MED	30 Hz-300kHz
	4.5	35 (35)	FAST	300 Hz-300kHz
	4.5 <sup>10</sup>	65 (65)	FAST	300 Hz-300kHz

## Multiple Channel Into Memory<sup>10,11</sup>

7710 SCANNING ACV: 120/s.  
 7710 Scanning ACV with Auto Delay on: 2s/reading.

## AC System Speeds<sup>7,9,11</sup>

**RANGE CHANGES<sup>12</sup>:** 4/s (3/s).  
**FUNCTION CHANGES<sup>12</sup>:** 4/s (3/s).  
**AUTORANGE TIME:** < 3s.

**ASCII READINGS TO RS-232 (19.2k baud):** 50/s.  
**MAX. INTERNAL TRIGGER RATE:** 300/s.  
**MAX. EXTERNAL TRIGGER RATE:** 250/s.

## AC Notes

- 20% overrange except on 750V and 3A.
- Specifications are for SLOW mode and sine wave inputs >5% of range. SLOW and MED are multi-sample A/D conversions. FAST is DEtector: BANDwidth 300 with nPLC = 1.0.
- Applies to 0°-18°C and 28°-50°C.
- For square wave inputs >10% of ACV range, except 100mV range. 100mV range frequency must be >10Hz if input is <20mV.
- Applies to non-sine waves >5Hz and <500Hz. (Guaranteed by design for Crest Factors >4.3)
- For 1k $\Omega$  unbalance in LO lead.
- Speeds are for 60Hz (50Hz) operation using factory defaults operating conditions (\*RST). Autorange off, Display off, Limits off, Trigger delay=0.
- Includes measurement and binary data transfer out GPIB.
- Auto Zero off.
- Sample count = 1000 (into memory buffer).
- DEtector: BANDwidth 300 with nPLC = 0.01.
- Maximum useful limit with trigger delay = 175ms.

# 2700 Multimeter/Data Acquisition System

## GENERAL SPECIFICATIONS

### EXPANSION SLOTS: 2

**POWER SUPPLY:** 100V / 120V / 220V / 240V +10%.

**LINE FREQUENCY:** 45Hz to 66Hz and 360Hz to 440Hz, automatically sensed at power-up.

**POWER CONSUMPTION:** 28VA.

**OPERATING ENVIRONMENT:** Specified for 0°C to 50°C. Specified to 80% RH at 35°C.

**STORAGE ENVIRONMENT:** -40°C to 70°C.

**BATTERY:** Lithium battery-backed memory, 3 years @ 23°C.

**WARRANTY:** 3 years.

**EMC:** Conforms to European Union Directive 89/336/EEC EN61326-1.

**SAFETY:** Conforms to European Union Directive 73/23/EEC EN61010-1, CAT I.

**VIBRATION:** MIL-PRF-28800F Class 3, Random.

**WARM-UP:** 2 hours to rated accuracy.

### DIMENSIONS:

**Rack Mounting:** 89mm high × 213mm wide × 370mm deep (3.5 in. × 8.375 in. × 14.563 in.).

**Bench Configuration (with handle and feet):** 104mm high × 238mm wide × 370mm deep (4.125 in. × 9.375 in. × 14.563 in.).

**SHIPPING WEIGHT:** 6.5kg (14 lbs).

**DIGITAL I/O:** 2 inputs, 1 for triggering and 1 for hardware interlock. 5 outputs, 4 for Reading Limits and 1 for Master Limit. Outputs are TTL compatible or can sink 250mA, diode clamped to 33V.

### TRIGGERING AND MEMORY:

**Window Filter Sensitivity:** 0.01%, 0.1%, 1%, 10%, or Full-scale of range (none).

**Reading Hold Sensitivity:** 0.01%, 0.1%, 1%, or 10% of reading.

**Trigger Delay:** 0 to 99 hrs (1ms step size).

**External Trigger Delay:** <2ms.

**External Trigger Jitter:** <1ms.

**Memory Size:** 55,000 readings.

**MATH FUNCTIONS:** Rel, Min/Max/Average/Std Dev/Peak-to-Peak (of stored reading), Limit Test, %, 1/x and  $mX + b$  and with user defined units displayed.

### REMOTE INTERFACE:

GPIB (IEEE-488.2) and RS-232C.

SCPI (Standard Commands for Programmable Instruments)

**ACCESSORIES SUPPLIED:** Model 1751 Safety Test Leads, Product Information CD-ROM, Software CD-ROM with IVI/VISA drivers for VB, VC/C++, LabVIEW, TestPoint, and LabWindows/CVI, and free runtime startup software.

### ACCESSORIES AVAILABLE:

77xx Modules

Extended Warranty

ExceLINUX-1A (Excel add-in datalogger software)

TestPoint™ Software Development Package

**SOFTWARE:** Windows 98, NT, 2000, ME, and XP compatible.