

2701 Ethernet Multimeter/Data Acquisition System

DC CHARACTERISTICS¹

CONDITIONS: MED (1 PLC)² 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 ³	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 ⁴ 23°C±1°	90 Day 23°C±5°	1 Year 23°C±5°	
Voltage ¹¹	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 ⁵	1 mV		10 MΩ ± 1%	20 + 6	35 + 9	50 + 9	(5 + 1)/°C
Resistance ^{6,8}	100.0000 Ω	100 µΩ	1 mA	6.9 V	20 + 20	80 + 20	100 + 20	(8 + 1)/°C
	1.000000 kΩ	1 mΩ	1 mA	6.9 V	20 + 6	80 + 6	100 + 6	(8 + 1)/°C
	10.00000 kΩ	10 mΩ	100 µA	6.9 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 ⁷	10 Ω	0.7 µA // 10MΩ	7.0 V	150 + 6	200 + 10	400 + 10	(70 + 1)/°C
	100.0000 MΩ ⁷	100 Ω	0.7 µA // 10MΩ	7.0 V	800 + 30	2000 + 30	2000 + 30	(385 + 1)/°C
Continuity (2W) ²¹	1.000 kΩ	100 mΩ	1 mA	6.9 V	40 + 100	100 + 100	100 + 100	(8 + 1)/°C
Current	20.00000 mA	10 nA	<0.2 V		60 + 30	300 + 80	500 + 80	(50 + 5)/°C
	100.0000 mA	100 nA	<0.1 V		100 + 300	300 + 800	500 + 800	(50 + 50)/°C
	1.000000 A	1.0 µA	<0.5 V ⁹		200 + 30	500 + 80	800 + 80	(50 + 5)/°C
	3.000000 A	10 µA	<1.5 V ⁹		1000 + 15	1200 + 40	1200 + 40	(50 + 5)/°C

Channel (Ratio)¹⁰ Ratio Accuracy = Accuracy of selected Channel Range + Accuracy of Paired Channel Range

Channel (Average)¹⁰ Average Accuracy = Accuracy of selected Channel Range + Accuracy of Paired Channel Range

TEMPERATURE¹⁹

(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)²⁰

-80° to 150°C	0.01°C	0.08°C	0.002°C/°C
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DC SYSTEM SPEEDS^{15,18}

RANGE CHANGES¹⁶: 50/s (42/s) (excludes 4 Wire Ohms).

FUNCTION CHANGES¹⁶: 50/s (42/s).

AUTORANGE TIME¹⁶: <30ms.

ASCII READINGS TO RS-232 (115.2k BAUD): 300/s.

MAX. INTERNAL TRIGGER RATE: 2800/s.

MAX. EXTERNAL TRIGGER RATE: 2000/s.

DC MEASUREMENT SPEEDS¹⁵

Single Channel, 60Hz (50Hz) Operation

FUNCTION	DIGITS	READINGS/s	PLCs
DCV, DCI, Ω (<10M), Thermocouple, Thermistor	6.5 ^{12,16}	5 (4)	10
	6.5 ¹⁶	35 (24)	1
	6.5 ^{12,16}	50 (48)	1
	5.5 ^{12,16}	150 (120)	0.1
	5.5 ^{16,17}	300 (240)	0.1
4WΩ (<10M)	5.5 ¹⁷	500 (400)	0.1
	4.5 ¹⁷	3000 (3000)	0.006
	3.5 ¹⁷	3500 (3500)	0.002
4WΩ 0Comp, RTD	6.5 ¹⁶	1.4 (1.1)	10
	6.5 ¹⁶	15 (12)	1
	5.5 ^{16,17}	33 (25)	0.1
Channel (Ratio), Channel (AVG)	6.5 ^{16,17}	0.9 (0.7)	10
	6.5 ^{16,17}	8 (6.4)	1
	5.5 ^{16,17}	18 (14.4)	0.1
Channel (Ratio), Channel (AVG)	6.5 ^{16,17}	2.5 (2)	10
	6.5 ^{16,17}	15 (12)	1
	5.5 ^{16,17}	25 (20)	0.1

Multiple Channels Into Memory^{15,18}

7710 Scanning DCV	500/s
7710 Scanning with Limits or Time Stamp On	500/s
7710 Scanning DCV alternating 2WΩ	115/s
7710 Scanning Temperature (T/C)	500/s
7700 and 7708 Scanning Temperature (T/C)	80/s

Multiple Channels Into and Out of Memory^{15,16,17,18}

7710 Scanning DCV	440/s
7710 Scanning with Limits or Time Stamp On	440/s
7710 Scanning DCV alternating 2WΩ	110/s
7710 Scanning Temperature (T/C)	440/s
7700 and 7708 Scanning Temperature (T/C)	80/s
7702 Scanning DCV	75/s

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DC SPEED vs. NOISE REJECTION

Rate	Filter	Readings/s ¹²	Digits	RMS Noise		
				10V Range	NMRR	CMRR ¹⁴
10	50	0.1 (0.08)	6.5	<2.5 μ V	110 dB ¹³	140 dB
1	Off	15 (12)	6.5	<6 μ V	90 dB ¹³	140 dB
0.1	Off	500 (400)	5.5	<40 μ V	-	80 dB
0.006	Off	3000 (3000)	4.5	<300 μ V	-	80 dB
0.002	Off	3500 (3500)	3.5	<1 mV	-	60 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 Ω // with <400pF or 10M Ω \pm 1%.

100V, 1000V Ranges: 10M Ω \pm 1%.

EARTH ISOLATION: 500V peak, >10G Ω and <300pF any terminal to chassis.

INPUT BIAS CURRENT: <75pA at 23°C.

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

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

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

Resistance

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

OFFSET COMPENSATION: Selectable on 4W Ω 100 Ω , 1k Ω , and 10k Ω ranges.

CONTINUITY THRESHOLD: Adjustable 1 to 1000 Ω .

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

DC Current

SHUNT RESISTORS: 100mA-3A, 0.1 Ω , 20mA, 5 Ω .

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 Ω .

DC Notes

- 20% overrange except on 1000V and 3A.
- Add the following to "ppm of range" uncertainty; 100mV 15ppm, 1V and 100V 2ppm, 100 Ω 30ppm, 1k \rightarrow <1M Ω 2ppm, 10mA and 1A 10ppm, 100mA 40ppm.
- \pm 2% (measured with 10M Ω input resistance DMM, >10G Ω DMM on 10M Ω and 100M Ω ranges).
- Relative to calibration accuracy.
- For signal levels >500V, add 0.02ppm/V uncertainty for portion exceeding 500V.
- Specifications are for 4-wire Ω , 100 Ω 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 Ω add 1.0 Ω to "ppm of range" 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:

	10 k Ω	100 k Ω	1 M Ω	10 M Ω	100 M Ω
All Modules:				220 ppm	2200 ppm
7701, 7703, 7707, and 7709 Modules:	10 ppm	100 ppm	1000 ppm	1%	10%
7706, 7708 Modules:	5 ppm	50 ppm	500 ppm	5000 ppm	5%
7710 Model 23°C \pm5°C:	11 ppm	110 ppm	1100 ppm	1.1%	11%
7710 Model Temp Coeff. >28°C \rightarrow 50°C:	0.3 ppm/ $^{\circ}$ C	3 ppm/ $^{\circ}$ C	30 ppm/ $^{\circ}$ C	0.03%/ $^{\circ}$ C	0.3%/ $^{\circ}$ C

- Add 1.0V when used with plug-in modules.
- For RATIO, DCV only. For AVERAGE, DCV and Thermocouples only. Available with plug-in modules only.
- Add 6 μ V to "of range" uncertainty when using Models 7701, 7703, and 7707, 3 μ 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 Ω 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.
- Speeds include measurements and data transfer out the ethernet (reading elements only). (100BaseT Ethernet, 3 meter RJ-45 crossover cable, PIII-800, Windows version 98 SE, VB version 6.0, direct Winsocket interface).
- Sample count = 1000 (into memory buffer), auto zero off.
- Auto zero off, NPLC = 0.002.
- 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. 7701, 7703, Ref. Junction	7700 and 7707 Sim. 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 Ω , add the following uncertainty/ Ω for measurement temperatures of:

	70°-100°C	100°-150°C
2.2 kΩ (44004)	0.22°C	1.11°C
5.0 kΩ (44007)	0.10°C	0.46°C
10 kΩ (44006)	0.04°C	0.19°C

- Front Panel resolution is limited to 0.1 Ω .

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AC SPECIFICATIONS¹

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

Additional Uncertainty $\pm(\% \text{ of reading})$

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 ⁵ :	1-2	2-3	3-4	4-5
Additional Uncertainty:	0.05	0.15	0.30	0.40
Maximum Crest Factor:	5 at full-scale.			

AC MEASUREMENT CHARACTERISTICS

AC Volts

MEASUREMENT METHOD: AC-coupled, True RMS.

INPUT IMPEDANCE: $1\text{M}\Omega \pm 2\%$ // by $<100\text{pF}$.

INPUT PROTECTION: 1000Vp or 400VDC, 300Vrms with plug-in modules.

AC Current

MEASUREMENT METHOD: AC-coupled, True RMS.

SHUNT RESISTANCE: 0.1 Ω .

BURDEN VOLTAGE: 1A $<0.5\text{Vrms}$, 3A $<1.5\text{Vrms}$. Add 1.5Vrms when used with plug-in modules.

INPUT PROTECTION: 3A, 250V fuse.

Frequency and Period⁴

MEASUREMENT METHOD: Reciprocal Counting technique.

GATE TIME: SLOW 1s, MED 100ms, and FAST 10ms.

AC General

AC CMRR⁶: 70dB.

VOLT HERTZ PRODUCT: $\leq 8 \times 10^7$.

AC MEASUREMENT SPEEDS^{7,13}

Single Channel, 60Hz (50Hz) Operation

Function	Digits	Readings/s	Rate	Bandwidth
ACV, ACI	6.5	2s/Reading	SLOW	3 Hz-300 kHz
	6.5	4.8 (4)	MED	30 Hz-300 kHz
	6.5 ⁹	40 (32)	FAST	300 Hz-300 kHz
Frequency, Period	6.5	1 (1)	SLOW	3 Hz-300 kHz
	5.5	9 (9)	MED	30 Hz-300 kHz
	4.5	35 (35)	FAST	300 Hz-300 kHz
	4.5 ¹⁰	65 (65)	FAST	300 Hz-300 kHz

Multiple Channel Into Memory^{10,11}

7710 SCANNING ACV: 440/s.

7710 Scanning ACV with Auto Delay On: 2s/reading.

AC SYSTEM SPEEDS^{7,9,11}

RANGE CHANGES¹²: 4/s (3/s).

FUNCTION CHANGES¹²: 4/s (3/s).

AUTORANGE TIME: $< 3\text{s}$.

ASCII READINGS TO RS-232 (115.2k baud): 300/s.

MAX. INTERNAL TRIGGER RATE: 2800/s.

MAX. EXTERNAL TRIGGER RATE: 2000/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 $>10\text{Hz}$ if input is $<20\text{mV}$.
- Applies to non-sine waves $>5\text{Hz}$ and $<500\text{Hz}$. Crest factor greater than 4.3 is guaranteed by design only.
- For 1k Ω 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.
- For ACV inputs at frequencies of 50 or 60Hz ($\pm 10\%$) add the following to "% of Range" uncertainty: 100mv 0.25%, 1V 0.05%, 10V 0.13%, 100V 0.03%, 750V 0.01%.
- Auto Zero off.
- Sample count = 1000.
- DETector: BANDwidth 300 with nPLC = 0.006.
- Maximum useful limit with trigger delay = 175ms.
- Includes measurement and data transfer out Ethernet (Reading Element only). (100bTx Ethernet, 3 meter RJ-45 crossover cable, PIII-800, Windows version 98 SE, VB version 6.0, direct WinSocket interface).

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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: 80VA.

OPERATING ENVIRONMENT: Specified for 0°C to 50°C. Altitude <2000m above Sea Level. Specified to 80% RH at 35°C.

STORAGE ENVIRONMENT: -40°C to 70°C.

BATTERY: Lithium Ion battery-backed memory, 30 days of buffer storage @ 23°C and >4 hours charge time. Battery lifetime: 3 years @ 23°C, 1.5 years @ 50°C.

WARRANTY: 3 years, excludes battery.

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: 4.75kg (10 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 40V.

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: <1ms.

Memory Size: 450,000 readings.

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

REMOTE INTERFACE:

Ethernet: RJ-45 connector, TCP/IP (Auto sensed 10bT or 100bTx) and RS-232C.

SCPI (Standard Commands for Programmable Instruments)

ACCESSORIES SUPPLIED: Model 1751 Safety Test Leads, Product Information CD-ROM, Model 2701 Networking Manual, Model 2701 Getting Started Foldout, 3m crossover Ethernet cable. 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

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

TestPoint™ Software Development Package

IP CONFIGURATION: Static or DHCP

PASSWORD PROTECTION: 11 characters

SOFTWARE: Windows 98, NT, 2000, ME and XP compatible, Internet Explorer 5.0 or higher required. Web pages served by 2701.