Integra Series – Model 2701
Ethernet-based Multimeter/Data Acquisition System

KEITHLEY

A GREATER MEASURE OF CONFIDENCE

Instrument-quality,
networked measurement and

The Model 2701 is the latest addition to Keithley's popular Integra Series instruments line. All Integra Series products combine precision measurement, switching, and control in a single tightly integrated enclosure. Each one is based on a state-of-the-art 6½-digit, 22-bit integrating A/D converter to ensure superior measurement precision and noise rejection. With the addition of Ethernet communications capability, the Model 2701 opens the door to making precision measurements easily and economically just about anywhere.

control system

The Model 2701 Ethernet-based Multimeter/Data Acquisition System brings superior measurement integrity together with remote measurement capabilities in one highly integrated system. It's ideal for distributed data acquisition applications because it provides stable, 6½-digit measurements, while taking advantage of a facility's existing network architecture and a PC's built-in Ethernet interface. The Model 2701 is designed to connect directly to an Ethernet port—there's no need for additional interface cards, proprietary cables, or software—so it's quick and economical to create virtually any required system configuration.

Each Model 2701 can be configured with up to 80 differential channels, depending on the plug-in switching/control modules used. Each channel provides built-in signal conditioning and can be configured independently for any of 14 measurement/control functions:

- Temperature with thermocouples, RTDs, or thermistors
- DC, AC volts
- DC, AC current
- 2-wire or 4-wire Ω
- Frequency
- Period
- Continuity
- Event counter/totalizer
- Digital I/O

The Model 2701 addresses the testing needs of a wide range of test, measurement, control, and data acquisition applications:

Burn-in/stress testing applications
- Increases test productivity and reduces costs by allowing centralized control of multiple test stands.
- Stores up 450,000 time-stamped readings in battery-backed memory in case of power interruptions during long test cycles.
- Eliminates yield losses due to false failures.

Corporate Network
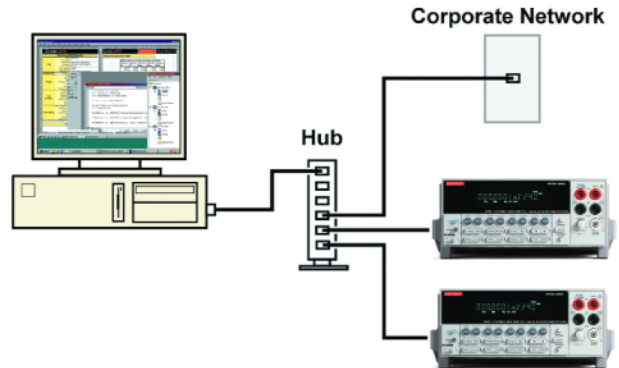
Industrial monitoring and control applications
- Supports continuous monitoring of industrial equipment on multiple channels for extended periods.
- Offers stable, high precision measurements, even in noisy industrial environments.
- Simplifies configuring systems for long distance or distributed applications.
- Allows pre-programming limits for automatic alarm notification.

Research and development applications
- Increases research productivity and decreases costs by combining remote communications with precise measurements.
- Provides a modular, easily scalable solution.
- Supports remote equipment diagnostics and monitoring of lab environments (temperature, humidity, presence of gases) economically.
- Makes high precision affordable with a low cost per channel.

Fast, long distance communication
meets high measurement accuracy

If there's a power failure, valuable data is protected with the battery-backed non-volatile memory and scans can automatically be resumed right where they stopped when power returns.

Open lead detection protects against false readings due to lead disconnections.

Front panel input jacks simplify manual probing, troubleshooting, and calibration. Includes 1000V protection in case of accidental overload.

Built-in signal conditioning and statistical analysis is configurable per channel for maximum flexibility.

Its familiar DMM-like front panel scheme makes the Model 2701 easy to use on the bench or in the rack. Select or change functions with the press of a button.

Large memory buffer (450,000 readings) for storing data without tying up the network.

Fast and convenient 10/100BaseTX Ethernet with TCP/IP protocol.

Screw terminals use oversize connectors for easier, mistake-free wiring.

Immediate alarm notification independent of the PC provided by built-in open-collector digital I/O lines for control, external triggering, and HI/LO alarm/limit ouputs.

A variety of measurement and control modules makes it simple to mix, match, and change input signals or control lines as needed. Get up to 80 differential channels and up to 500 channels per second scanning rate.

Rugged 50-pin D-sub connectors ensure dependability and quick setup/teardown in production test racks.

Built-in relay cycle counters on each module for ease of maintenance.

Versatile Integra Series plug-in modules
for any application
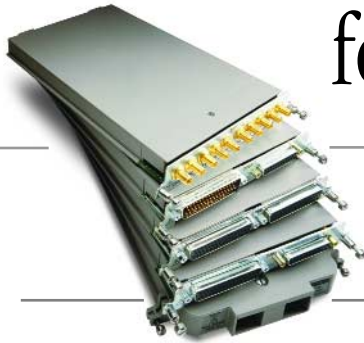
Any of these modules can be plugged into either of the two slots in the Model 2701's back panel. No special connection or software configuration is needed— just insert the modules and they are detected automatically and ready to run.

Module	# Differential Analog Inputs	Configuration	2- or 4- Pole	Type of Connector	Max. Voltage	Max. Switched Current	Switch Speed	Other
7700	20	Multiplexer w/CJC	1 × 20 or two 1 × 10	Screw terminals	300V	1A	< 3 ms	Automatic CJC
7701	32	Multiplexer	1 × 32 or two 1 × 16	D-sub (IDC)	150V	1A	< 3 ms	32 channels of common-side 4-wire Ω
7702	40	Multiplexer	1 × 40 or two 1 × 20	Screw terminals	300V	1A	< 3 ms	Maximum 125 VA. 2 current channels @ 3A.
7703	32	Reed Relay Multiplexer	1 × 32 or two 1 × 16	D-sub (solder or crimp)	300V	500mA	< 1 ms	Reed relays
7705	NA	40 channel independent SPST	N/A	D-sub (solder or crimp)	300V	2A	< 3 ms	Programmable for Form C
7706	20	Multiplexer w/CJC + Analog Output + Digital Outputs + Counter/Totalizer	1 × 20 or two 1 × 10	Screw terminals	300V	1A	< 3 ms	Two ±12V analog outputs, 100 kHz counter, & 16 digital outputs
7707	10	Digital I/O + Multiplexer	1 × 10 or two 1 × 5	D-sub (IDC)	300V	1A	< 3 ms	32 digital I/O (33V, 100mA)
7708	40	Multiplexer w/CJC	1 × 40 or two 1 × 20	Screw terminals	300V	1A	< 3 ms	Automatic CJC
7709	48	6 × 8 Matrix	2- or 4-pole	D-sub (IDC)	300V	1A	< 3 ms	Daisy chain for larger matrix
NEW! **7710**	20	Solid-state Multiplexer w/CJC	1 × 20 or two 1 × 10	Removable Screw terminals	60V	0.1A	< 0.5 ms	Long relay life, higher speed 500 channels/s

			Insertion Loss	VSWR	Crosstalk				
NEW! **7711**		2GHz Dual 1×4 Multiplexer	<1.0dB	<1.2	<-55dB	SMA	60V	0.5A	< 10 ms
NEW! **7712**		3.5GHz Dual 1×4 Multiplexer	<1.1dB	<1.45	<-50dB	SMA	42V	0.5A	< 10 ms

Call Keithley or visit **www.keithley.com** to receive your free Model 2701 technical data book, which offers more technical details about these modules, applications, and available accessories.

A VARIETY OF MEASUREMENT AND CONTROL MODULES

Model 2701 Applications

The Model 2701's versatility makes it ideal for use on the factory floor, in quality control labs, and in R&D settings. Here are some typical applications:
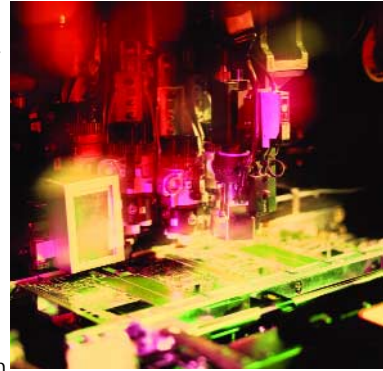
Electronic manufacturing burn-in/ stress testing

Electronic manufacturing facilities rely on burn-in/stress testing (often referred to as HALT/HASS testing) to ensure long-term product reliability. Performing these tests efficiently demands the ability to make remote measurements in widely distributed burn-in chambers from a central location. Multiple Model 2701s can be placed nearby each burn-in chamber and can be networked to a central PC. In addition, The Model 2701 combines 14 measurement/control functions and built-in signal conditioning with high measurement stability and repeatability to eliminate yield losses due to false failure. It offers up to 80 channels of differential measurements with a far lower cost per channel than competitive solutions. A battery-backed memory provides secure data storage in case of power interruptions.

Call or visit **www.keithley.com** to receive a free white paper: "Making AST/Burn-in Testing More Productive with Ethernet-based Instruments."

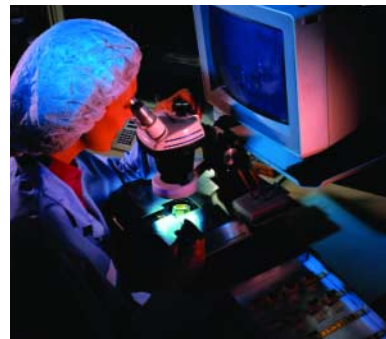## Industrial monitoring and control applications

To increase the efficiency and profitability of industrial equipment such as generators, engines, pumps, and motors, multiple channels must be monitored continuously for extended periods, often in noisy or hard-to-reach environments where PCs and operators are impractical. The Model 2701 can be placed near the machine and its data can be shared over the company's Intranet. It also provides 6½-digit (22-bit) integrated measurements for superior noise immunity and a solid-state switching option for long life and extended reliability. Built-in alarm limits and analog triggers can be pre-programmed per channel for automatic notification, without PC intervention, when critical events occur.

Research and development

To validate and characterize a system design or to monitor lab environments remotely (i.e., for humidity, temperature, or the presence of CO or other volatile gases), researchers and lab users need long distance remote measurement of multiple channels in a modular, easily scalable form factor. The Model 2701 connects to the lab's network drop and combines high measurement accuracy with a choice of twelve plug-in modules for greater measurement flexibility. Its low cost per channel makes the Model 2701 an affordable solution for labs with limited equipment budgets.
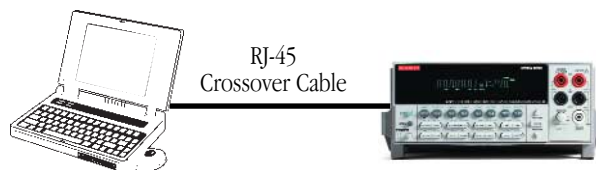
Ideal for single- or multi-unit
distributed applications

The Model 2701 is an Ethernet-based instrument, so it can be used in a variety of network applications. It can be configured on its own dedicated network or as part of a corporate network. In either case, just configure the network parameters from the front panel or the built-in Web page (IP address, subnet mask, gateway) to get it up and running on the network.
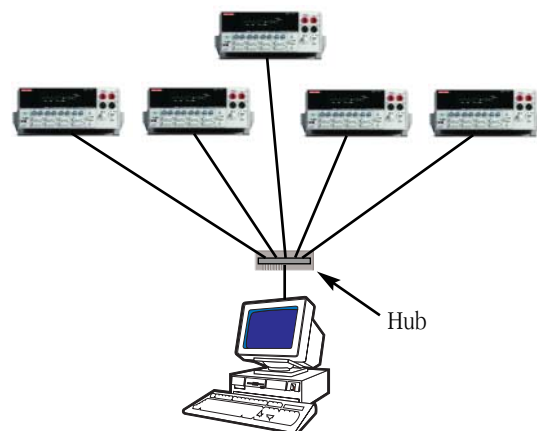
Convenient straight-through connection

With a Model 2701, there is no need to open a PC or install separate communication interfaces such as GPIB boards. Just connect the Model 2701 directly to the PC's Ethernet port via a crossover RJ-45 cable, which is included with the Model 2701.

RJ-45
Crossover Cable

Wider distribution using the corporate network

Use the corporate network infrastructure to connect Model 2701s to any network drop in a building. The Model 2701s will then be able to acquire data and send it to any PC in the building. To prevent other users from interfering with its data, a Model 2701 can be password protected so that only permitted users can connect to the unit. For additional security, only one PC at a time can control the 2701.
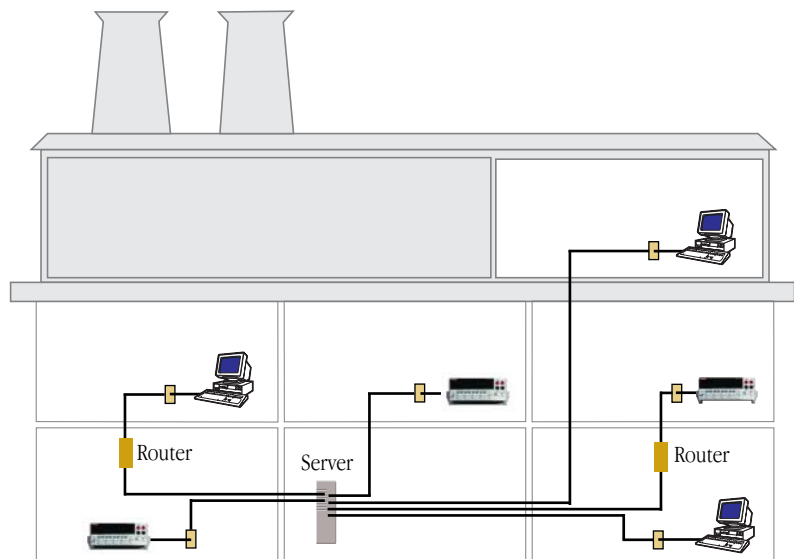
Multiple units distributed with a hub and a central computer

Take advantage of the long distance and speed capabilities of Ethernet to distribute multiple Model 2701s using a standard hub. There's no need to dedicate one PC for each test station—one central PC can control many Model 2701s, increasing equipment productivity and decreasing cost.

Hub

Router   Server   Router

Call Keithley or visit **www.keithley.com** to order a free Model 2701 application note on networking principles.

Powerful, easy-to-use software tools

The Model 2701 offers a wide range of software tools, including free start-up software and drivers and more advanced optional packages. All these software tools are designed to communicate with the instrument through the industry-standard Windows TCP/IP socket interface.

## Free built-In Web diagnostic tool
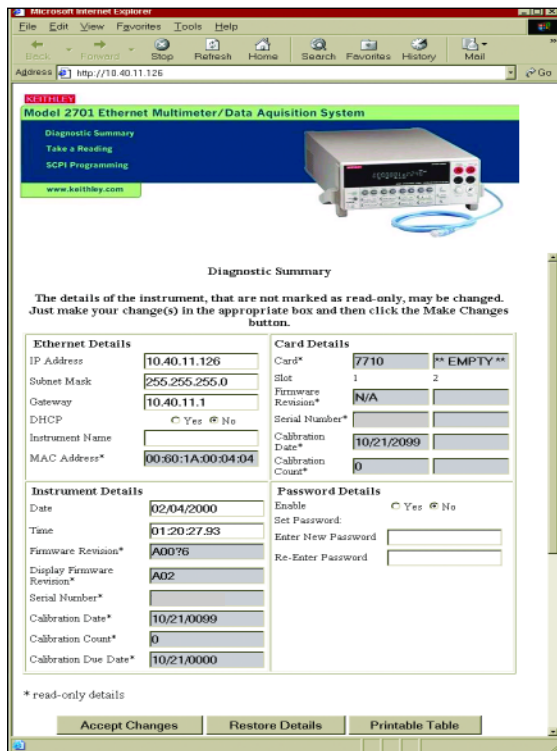
To start communicating with the Model 2701, simply start Microsoft® Internet Explorer® on a PC and type the instrument's IP address into the URL line. The built-in web diagnostic interface allows for easy communication and debugging, without the need to install external software. This interface makes it easy to read and set network parameters such as IP address, subnet mask, gateway, MAC address, calibration dates, and other data stored in the Model 2701. It also takes readings from the instrument and allows the user to send command strings and receive data.

## Free customizable start-up software
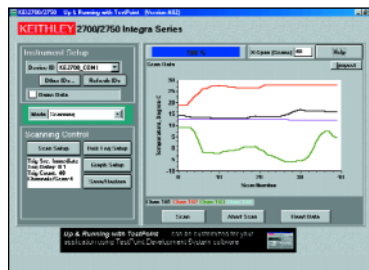
This free TestPoint runtime offers basic datalogging capabilities that can get a system "up & running" almost immediately. With just a few clicks of the mouse, this software can confirm the system's hardware, wiring, communications, and software drivers are installed and operating correctly. It can also configure instrument functions and perform simple data acquisition tasks. Data from multiple channels can be saved to disk and up to eight channels of data can be graphed automatically. If the application demands greater functionality, this runtime can be modified with the TestPoint application development package.

ExceLINX-1A
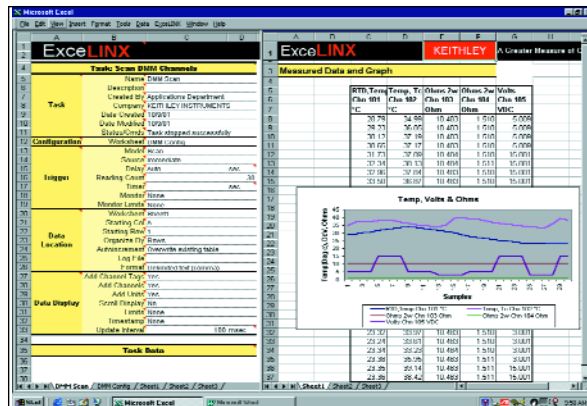
For advanced datalogging tasks, this powerful and economical add-in utility for Microsoft® Excel makes it simple to acquire data from the Model 2701 directly into Excel, then employ Excel's graphic, charting, and analysis capabilities to turn that data into useful information. No programming is required—a few mouse clicks are all it takes to configure channels, set parameters, configure triggers, and scan lists. ExceLINX-1A can control up to three Model 2701s and is sold separately.
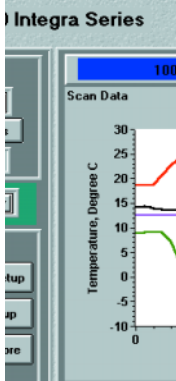
TestPoint application development package

If the free start-up software doesn't provide a feature the job demands, there's no problem—just use the economical TestPoint application development package to modify it. TestPoint's object-oriented, drag-and-drop technology offers the flexibility needed to build basic systems quickly, without in-depth programming. Expanding TestPoint applications is easy too, with database and statistical process control toolkits. TestPoint and additional toolkits are sold separately.

Free IVI (VISA-Based) instrument driver

For larger or customized systems, programmers can take advantage of this IVI instrument driver, designed for use with application development environments such as Visual Basic®, Visual C/C++®, LabVIEW™, LabWindows™/CVI, and TestPoint™. This IVI-style driver (VISA based) supports all of the instrument's functionality and comes with numerous programming examples to help programmers get started quickly. The standard Windows socket interface can also be used to program the Model 2701 directly with standard command strings (SCPI).
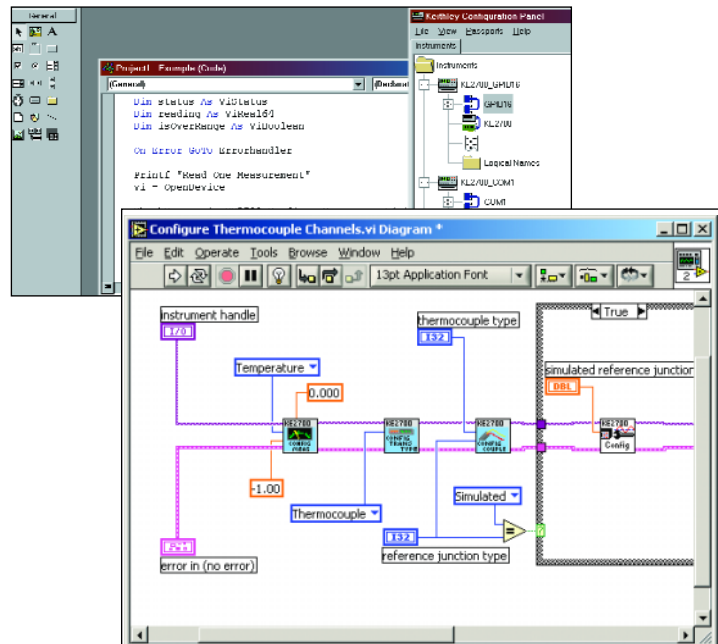
Call Keithley or visit **www.keithley.com** to order a free Model 2701 application note that discusses programming multiple 2701s using the IVI/VISA driver, as well as the direct Windows socket interface.

Other Integra Series Systems
The Models 2700 and 2750—GPIB/RS-232 systems

Model 2700 Multimeter/Data Acquisition System

The Model 2700 is a lower cost, two-slot GPIB/RS-232 system that can accommodate up to 80 channels or 96 matrix crosspoints. It has the same footprint as the Model 2701 and packs the accuracy, convenience, and traceability of a true 6-½ digit (22-bit) DMM in a half-rack-sized unit at a price that's comparable to a high performance data acquisition plug-in board.

Model 2750 Multimeter/Switch System

The Model 2750 is a high channel count measurement and control system for larger ATE, switching, and data acquisition applications. The Model 2750 offers five slots for up to 200 channels of differential measurement and 240 matrix crosspoints. It also features low ohms capabilities ($1\mu\Omega$ sensitivity) for measurements of connectors, harnesses, squibs, semiconductors, and other low ohms devices.

Built on the same basic platform as the Model 2701, the Model 2700 and 2750 share many of its measurement capabilities and programming commands. They also share the same plug-in modules. Although the Model 2700 and 2750 do not support Ethernet, they do support other communication protocols, including GPIB/IEEE-488 and RS-232.

Integra Systems Overview

Model	Communication Bus	No. of Slots	Max. No. of Channels or Crosspoints*	Battery-Backed Memory Buffer	Measurement Speed (single channel)	Scanning Rate** (Multiple channels)	Other
Model 2701	Ethernet, RS-232	2	80 channels or 96 crosspoints	450,000 readings	3500 rdgs/s	500 chan/s	Built-in Web tool
Model 2700	GPIB, RS-232	2	80 channels or 96 crosspoints	55,000 readings	2000 rdgs/s	180 chan/s	
Model 2750	GPIB, RS-232	5	200 channels or 240 crosspoints	110,000 readings	2500 rdgs/s	200 chan/s	Low ohms capabilties, 1μohm sensitivity

*Crosspoints possible using the Model 7709, a 6×8 matrix switch module.
** Scanning rates vary per plug-in module, mainframe and measurement function.

Call Keithley or visit **www.keithley.com** for more technical information on the Model 2700 and Model 2750.

Model 2701 Condensed Specifications*

DC VOLTAGE
1000V protection all ranges; A/D Linearity of 2ppm rdg + 1ppm rng; 1200000 max counts

Range	Reso-lution	Accuracy (90 day rdg + rng)	Accuracy (1 year rdg + rng)	Input Resistance
100.0000mV	100nV	0.0025% + 0.0035%	0.0030% + 0.0035%	10MΩ or >10GΩ
1.000000V	1.0μV	0.0025% + 0.0007%	0.0030% + 0.0007%	10MΩ or >10GΩ
10.00000V	10μV	0.0020% + 0.0005%	0.0030% + 0.0005%	10MΩ or >10GΩ
100.0000V	100μV	0.0035% + 0.0009%	0.0045% + 0.0009%	10MΩ
1000.000V	1.0mV	0.0035% + 0.0009%	0.0050% + 0.0009%	10MΩ

THERMOCOUPLE
Conversion to ITS-90; Automatic, External, or Simulated CJC; Open T/C check.

Type	Range	Accuracy (1 year) Simulated CJC	Accuracy (1 year) Using plug-in module
J	-200 to +760°C	±0.2°C	±1.0°C
K	-200 to +1372°C	±0.2°C	±1.0°C
N	-200 to +1300°C	±0.2°C	±1.0°C
T	-200 to +400°C	±0.2°C	±1.0°C
E	-200 to +1000°C	±0.2°C	±1.0°C
R	0 to +1768°C	±0.6°C	±1.8°C
S	0 to +1768°C	±0.6°C	±1.8°C
B	+350 to +1820°C	±0.6°C	±1.8°C

RESISTANCE
2- or 4-wire; Offset Compensation selectable; 1000V / 350V protection on source / sense inputs

Range	Reso-lution	Accuracy (90 day rdg + rng)	Accuracy (1 year rdg + rng)	Test Current
100.0000Ω	100μΩ	0.0080% + 0.0020%	0.0100% + 0.0020%	1mA
1.000000kΩ	1.0mΩ	0.0080% + 0.0006%	0.0100% + 0.0006%	1mA
10.00000kΩ	10mΩ	0.0080% + 0.0006%	0.0100% + 0.0006%	100μA
100.0000kΩ	100mΩ	0.0080% + 0.0010%	0.0100% + 0.0010%	10μA
1.000000MΩ	1.0Ω	0.0080% + 0.0010%	0.0100% + 0.0010%	10μA
10.00000MΩ	10Ω	0.0200% + 0.0010%	0.0400% + 0.0010%	0.7μA
100.0000MΩ	100Ω	0.2000% + 0.0030%	0.2000% + 0.0030%	0.7μA

RTD
100Ω platinum [PT100], D100, F100, PT385, PT3916, or user type; plus probe error

Range	Resolution	Accuracy (1 year)
-200 to +630°C	0.010°C	±0.06°C

THERMISTOR
2.2kΩ, 5kΩ, and 10kΩ; plus sensor error

Range	Resolution	Accuracy (1 year)
-80 to +150°C	0.010°C	±0.08°C

DC CURRENT
250V, 3A fused inputs; Built-in shunt resistors

Range	Reso-lution	Accuracy (90 day rdg + rng)	Accuracy (1 year rdg + rng)	Burden Voltage
20.00000mA	10nA	0.03% + 0.008%	0.05% + 0.008%	<0.2V
100.0000mA	100nA	0.03% + 0.080%	0.05% + 0.080%	<0.1V
1.000000A	1μA	0.05% + 0.008%	0.06% + 0.008%	<0.5V
3.000000A	10μA	0.11% + 0.008%	0.12% + 0.008%	<1.5V

AC VOLTAGE
True RMS; 5:1 max Crest Factor

Range	Resolution	Frequency Range	Accuracy (1 year rdg + rng)
100mV to 750V	0.1μV to 1mV	3Hz – 10Hz	0.35% + 0.03%
		10Hz – 20kHz	0.06% + 0.03%
		20kHz – 50kHz	0.12% + 0.05%
		50kHz – 100kHz	0.6% + 0.08%
		100kHz – 300kHz	4.0% + 0.5%

FREQUENCY and PERIOD
Selectable Gate Times of 10msec, 100msec, 1sec

Range	Frequency Range	Period Range	Accuracy (1 year rdg + rng)
100mV to 750V	3Hz to 500kHz	333msec to 2μsec	0.01% + 0.333ppm (1.0 sec)
			0.01% + 3.33ppm (0.1 sec)
			0.01% + **33.3ppm** (0.01 sec)

AC CURRENT
True RMS; 5:1 Crest Factor

Range	Resolution	Frequency Range	Accuracy (1 year rdg + rng)
1A	1μA	10Hz – 5kHz	0.3% + 0.04%
3A	10μA	10Hz – 5kHz	0.16% + 0.06%

DC SINGLE CHANNEL READING RATES

Function	Digits	Readings/sec	NPLC
DCV, DCI,	6.5	5	10
2W Ohms,	6.5	50	1
Thermocouple,	5.5	500	0.1
Thermistor	4.5	3000	0.01
	3.5	3500	0.002
4W Ocomp, RTD	6.5	1	10
	6.5	8	1
	5.5	18	0.1

MULTICHANNEL RATE, INTO AND OUT OF MEMORY TO ETHERNET

	Channels/s
7710 scanning DCV, temperature (T/C) with limits and timestamp on	500/s
7702 scanning DCV	75/s
7700 and 7708 scanning temperature (T/C)	80/s

DC READING SPEED VS. NOISE REJECTION

NPLC	Digits	Filter	NMRR	CMRR	RMS Noise (10V range)
10	6.5	50	110dB	140dB	<2μV
1	6.5	Off	90dB	140dB	<6μV
0.1	5.5	Off	–	80dB	<40μV
0.01	4.5	Off	–	80dB	<300μV
0.002	3.5	Off	–	60dB	<1mV

SYSTEM FEATURES

Expansion slots	2
Scanning Channels	Up to 80 differential
Trigger Source	External digital input, front panel keypad, channel monitor, interval timer, Ethernet/RS-232, Trigger Link, immediate
Scan Count	1 to 450,000 or continuous
Scan Interval	0 to 99 hours; 1msec step size
Channel Delay	0 to 9999999sec per channel; 1msec step size
Configuration	Per channel for measurement setups, math, and limits
Power Fail Recovery	Resume scanning sequence; configuration and stored data are preserved
Power up Memory	4 user configurations with labels
Real Time Clock	Included; use to timestamp readings
Data Storage	Non-volatile 450,000 reading buffer with timestamp; continuous fill; query while filling; min/max/avg/std dev
Alarm Limits	2 HI and 2 LO limits per channel; selectable polarity
Digital Inputs	2 TTL level – external trigger plus interlock
Digital Outputs	4 TTL level – selectable polarity; HI/LO limit configurable
Master Alarm	1 TTL level output toggles when any HI/LO limit is exceeded
Front Panel Lock	Software enabled
Communication	Ethernet TCP/IP (10/100 BaseTX autosense), RS-232, RJ-45 3-meter crossover cable included
IP Configuration	Static or DHCP
Password protection	Up to 11 characters
Per-channel Math	mX+b, %
Multi-channel Math	Ratio, Average
Resolution	6½-digit with 20% overrange; 28-bit readings available over Ethernet or RS-232
Software	Built-in web page in HTML and VBscript requires Microsoft IE 5.0 or higher TestPoint-based start-up applications; LabVIEW, TestPoint, LabWindows/CVI, Visual Basic, C/C++ driver. Requires Pentium 233 MHz or higher, Win 98, NT or higher

GENERAL INFORMATION

Power Supply	100V / 120V / 220V / 240V / ±10%
Line Frequency	45Hz to 66Hz; 360Hz to 400Hz
Operating Environment	0°C to 50°C
Size	89mm H x 213mm W x 370mm D
Warranty	3 years on mainframe, 1 year on 77xx Expansion Measurement & Control Modules
Safety	EN61010-1 CAT I
EMC	EN 61326-1

ACCURACY, CONVENIENCE, AND TRACEABILITY

Specifications subject to change without notice.

All the support you need

Register for a free online interactive demo

Keithley's engineering experts offer free online demonstrations of the Model 2701 hardware and software. All it takes to participate is an Internet connection and a telephone to watch the demonstration and communicate with the moderator. Call us at **1-888-KEITHLEY (534-8453)** or contact us via our website, www.keithley.com, to register for a session.

Request more technical information

Detailed information about the Model 2701 is free for the asking, including a technical data book, which supplies full specifications for mainframes and modules, application examples, and other information that can help you choose the most appropriate modules and accessories. White papers, application notes, and articles are also available. Request them by calling **1-888-KEITHLEY (534-8453)** or by visiting www.keithley.com

Informative reference materials

Visit **www.keithley.com** to access our library, which offers many valuable reference works:

- Application notes and white papers that provide practical, real-world answers to many application questions
- Data Acquisition and Control Handbook
- Low Level Measurements
- Switching Handbook

A greater measure of confidence

With more than a half-century of expertise in making demanding measurements, Keithley offers its customers a greater measure of testing confidence on production floors, in quality control labs, and in R&D labs. For more information on how Keithley test solutions can help you keep pace with changing technologies, call your local Keithley sales engineer or visit our website.

Service you can depend on

When you need help, contact us at www.keithley.com or call us at **1-888-KEITHLEY (534-8453)**. Whatever the application, Keithley's application engineers are ready to help you meet its challenges, before and after the sale. We can suggest the most effective system configurations and provide prompt, reliable applications support once your system is set up. The next time you're faced with a challenging application, give us a call. We'll offer you a cost-effective solution that will help you improve your product quality, throughput, and yield.

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