# Series 3700A

## System Switch/Multimeter and Plug-In Cards



- **Six-slot system switch mainframe with optional high performance multimeter**
- **Multi-processor architecture optimized for high throughput scanning and pattern switching applications**
- **Remote PC control via Ethernet, USB, and GPIB interfaces**
- **Up to 576 two-wire or 720 one-wire multiplexer channels in one mainframe**
- **Up to 2,688 one-pole matrix crosspoints in one mainframe**
- **Embedded Test Script Processor (TSP®) offering unparalleled system automation, throughput, and flexibility**
- **master/slave connection provides easy system expansion and seamless connection to Series 2600 and 2600B**
- **Capable of over 14,000 readings per second to memory with optional high performance multimeter**
- **LXI interface with embedded Web browser interface for test setup, maintenance, and basic application control**

The Series 3700A offers scalable, instrument grade switching and multi-channel measurement solutions that are optimized for automated testing of electronic products and components. The Series 3700A includes four versions of the Model 3706A system switch mainframe along with a growing family of plug-in switch and control cards. When the Model 3706A mainframe is ordered with the high performance multimeter, you receive a tightly integrated switch and measurement system that can meet the demanding application requirements in a functional test system or provide the flexibility needed in stand-alone data acquisition and measurement applications.

### Maximizes System Control and Flexibility

To provide users with greater versatility when designing test systems, the Series 3700A mainframes are equipped with many standard features. For example, easy connectivity is supported with three remote interfaces: LXI/Ethernet, General Purpose Interface Bus (GPIB), and Universal Serial Bus (USB). Fourteen digital I/O lines are also included, which are programmable and can be used to control external devices such as component handlers or other instruments. Additionally, system control can be greatly enhanced by using our Test Script Processor (TSP) technology. This technology provides "smart" instruments with the ability to perform distributed processing and control at the instrument level versus a central PC.

### High Quality Switching at a Value Price

The Series 3700A builds upon Keithley's tradition of producing innovative, high quality, precise signal switching. This series offers a growing family of high density and general purpose plug-in cards that accommodates a broad range of signals at very competitive pricing. The Series 3700A supports applications as diverse as design validation, accelerated stress testing, data acquisition, and functional testing.

### Model 3706A Mainframe

The Series 3700A includes the base Model 3706A system switch/multimeter mainframe with three options for added flexibility. This mainframe contains six slots for plug-in cards in a compact 2U high (3.5 inches/89mm) enclosure that easily accommodates the needs of medium to high channel count applications. When fully loaded, a mainframe can support up to 576 two-wire multiplexer channels or 2,688 one-pole matrix crosspoints for unrivaled density and economical per channel costs.

### High Performance, 7½-digit Multimeter (DMM)

The high performance multimeter option provides up to 7½-digit measurements, offering 26-bit resolution to support your ever-increasing test accuracy requirements. This flexible resolution supplies a DC reading rate from >14,000 readings/second at 3½ digits to 60 readings/second at 7½ digits to accommodate a greater span of applications. The multimeter does not use a card slot, so you maintain all six slots in your mainframe. In addition, the multimeter is wired to the mainframe's analog backplane, ensuring a high quality signal path from each card channel to the multimeter.

**Single Channel Reading Rates**

| NPLC | DCV/ 2 Wire Ohms | 4 Wire Ohms |
|---|---|---|
| 1.0 | 60 | 29 |
| 0.2 | 295 | 120 |
| 0.06 | 935 | 285 |
| 0.006 | 6,200 | 580 |
| 0.0005 | 14,100 | 650 |

The multimeter supports 13 built-in measurement functions, including: DCV, ACV, DCI, ACI, frequency, period, two-wire ohms, four-wire ohms, three-wire RTD temperature, four-wire RTD temperature, thermocouple temperature, thermistor temperature, and continuity. In addition, the multimeter offers extended low ohms (1Ω) and low current (10µA) ranges. In-rack calibration is supported, which reduces both maintenance and calibration time.

# Series 3700A

# System Switch/Multimeter and Plug-In Cards

## Ordering Information

### Mainframes

**3706A**    Six-slot system switch with high performance DMM

**3706A-NFP**    Six-slot system switch with high performance DMM, without front panel display and keypad

**3706A-S**    Six-slot system switch

**3706A-SNFP**    Six-slot system switch, without front panel display and keypad

### Plug-in Cards

**3720**    Dual 1×30 multiplexer card (auto CJC when used with 3720-ST)

**3721**    Dual 1×20 multiplexer card (auto CJC when used with 3721-ST)

**3722**    Dual 1×48, high density, multiplexer card

**3723**    Dual 1×30, high speed, reed relay multiplexer card

**3724**    Dual 1×30 FET multiplexer card

**3730**    6×16, high density, matrix card

**3731**    6×16 high speed, reed relay matrix card

**3732**    Quad 4×28, ultra-high density, reed relay matrix card

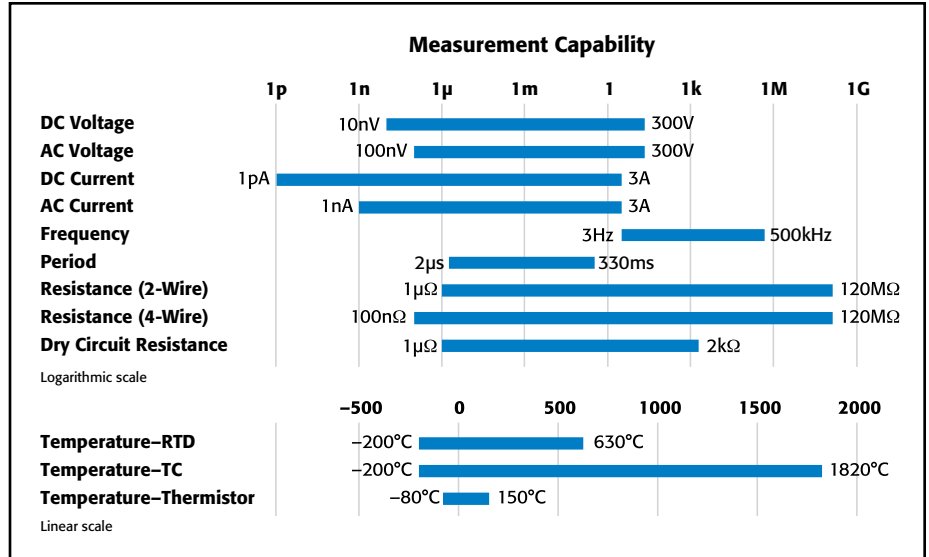**3740**    32 channel isolated switch card

**3750**    Multifunction control card

### Accessories Supplied

**Test Script Builder Software Suite CD**

**Ethernet Crossover Cable (CA-180-3A)**

**Series 3700A Product CD (includes LabVIEW®, IVI C, and IVI.COM drivers)**

### Measurement Capability

| | 1p | 1n | 1µ | 1m | 1 | 1k | 1M | 1G |
|---|---|---|---|---|---|---|---|---|
| DC Voltage | | | 10nV | | | 300V | | |
| AC Voltage | | | 100nV | | | 300V | | |
| DC Current | 1pA | | | | | 3A | | |
| AC Current | | 1nA | | | | 3A | | |
| Frequency | | | | | 3Hz | | 500kHz | |
| Period | | | 2µs | | 330ms | | | |
| Resistance (2-Wire) | | | 1µΩ | | | | 120MΩ | |
| Resistance (4-Wire) | | 100nΩ | | | | | 120MΩ | |
| Dry Circuit Resistance | | | 1µΩ | | | 2kΩ | | |

Logarithmic scale

| | −500 | 0 | 500 | 1000 | 1500 | 2000 |
|---|---|---|---|---|---|---|
| Temperature–RTD | −200°C | | 630°C | | | |
| Temperature–TC | −200°C | | | | | 1820°C |
| Temperature–Thermistor | −80°C | 150°C | | | | |

Linear scale

**Measurement capabilities of the high performance multimeter**

## ACCESSORIES AVAILABLE

### GPIB INTERFACES AND CABLES

| | |
|---|---|
| 7007-1 | Shielded GPIB Cable, 1m (3.5ft) |
| 7007-2 | Shielded GPIB Cable, 2m (6.6ft) |
| KPCI-488LPA | IEEE-488 Interface/Controller for the PCI Bus |
| KUSB-488B | IEEE-488 USB-to-GPIB Interface Adapter |

### DIGITAL I/O, TRIGGER LINK, AND TSP-LINK

| | |
|---|---|
| 2600-TLINK | Trigger I/O to Trigger Link Interface Cable, 1m (3.3 ft) |
| CA-126-1 | Digital I/O and Trigger Cable, 1.5m (4.9 ft) |
| CA-180-3A | CAT5 Crossover Cable for TSP-Link |

### MULTIMETER CONNECTORS

| | |
|---|---|
| 3706-BAN | DMM Adapter Cable, 15-pin D-sub to banana jacks, 1.4m (4.6 ft) |
| 3706-BKPL | Analog Backplane Extender Board, 15-pin D-sub to terminal block |
| 3706-TLK | Test Lead Kit, includes 3706-BAN and plug-in test lead accessories |
| 8620 | Shorting Plug |

### RACK MOUNT KIT

| | |
|---|---|
| 4288-10 | Fixed Rear Rack Mount Kit |

### SERVICES AVAILABLE

**Mainframe Models 3706A and 3706A-NFP**

| | |
|---|---|
| 3706A-3Y-EW | 1 Year Factory Warranty Extended to 3 Years |
| 3706A-5Y-EW | 1 Year Factory Warranty Extended to 5 Years |
| C/3706A-3Y-STD | Calibration Contract, 3 Years, Standard Calibration* |
| C/3706A-3Y-DATA | Calibration Contract, 3 Years, Z540 Compliant Calibration with Data* |
| C/3706A-3Y-ISO | Calibration Contract, 3 Years, ISO 17025 Accredited Calibration* |
| C/3706A-5Y-STD | Calibration Contract, 5 Years, Standard Calibration* |
| C/3706A-5Y-DATA | Calibration Contract, 5 Years, Z540 Compliant Calibration with Data* |
| C/3706A-5Y-ISO | Calibration Contract, 5 Years, ISO 17025 Accredited Calibration* |

**Mainframe Models 3706A-S and 3706A-SNFP**

| | |
|---|---|
| 3706A-S-3Y-EW | 1 Year Factory Warranty Extended to 3 Years |
| 3706A-S-5Y-EW | 1 Year Factory Warranty Extended to 5 Years |

### SOFTWARE SERVICES
### SYSTEM DEVELOPMENT OR IMPLEMENTATION

Other service contracts are available; please contact us for details.

*Not available in all countries.

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TEL:03-5970828  FAX:03-5972622  新竹湖口工業區工業四路3號2F

**KEITHLEY**
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# Series 3700A

# System Switch/Multimeter and Plug-In Cards

## TSP Distributed Control Increases Test Speed and Lowers Test Cost

TSP technology enhances instrument control by allowing users the choice of using standard PC control or of creating embedded test scripts that are executed on microprocessors within the instrument. By using TSP test scripts instead of a PC for instrument control, you avoid communication delays between the PC controller and instrument, which results in improved test throughput. Test scripts can contain math and decision-making rules that further reduce the interaction between a host PC and the instrument.

This form of distributed control supports the autonomous operation of individual instruments or groups of instruments and can possibly remove the need for a high level PC controller, which lowers test and ownership costs. This is the same proven TSP technology found in our innovative Series 2600B System SourceMeter® SMU instruments.
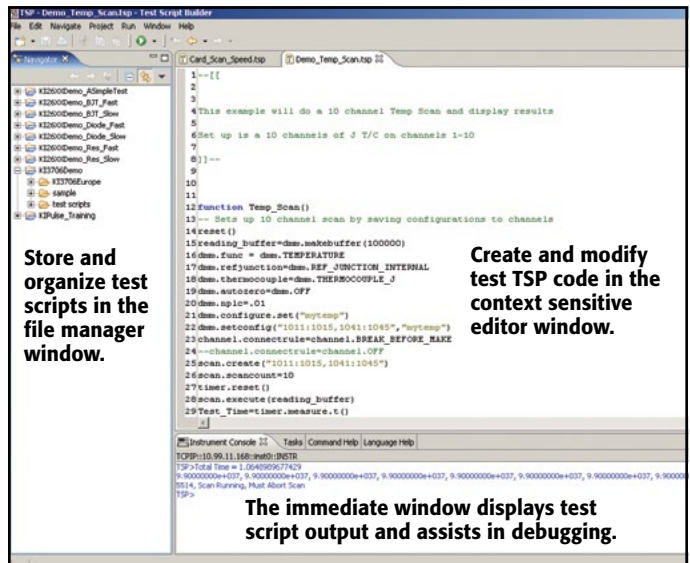
## TSP-Link Technology for Easy and Seamless System Coordination and Expansion

If your channel density requirements grow or if you need to process more signal types, use TSP-Link Technology to expand your system. The TSP-Link master/slave connection offers easy system expansion between Series 3700A mainframes. You can also use TSP-Link Technology to connect to other TSP-Link enabled instruments such as Series 2600B SourceMeter SMU instruments. Everything connected with TSP-Link can be controlled by the master unit, just as if they were all housed in the same chassis.

This high speed system expansion interface lets users avoid the complex and time consuming task of expanding their remote interfaces to another mainframe. There is no need to add external triggers and remote communication cables to individual instruments, since all TSP-Link connected devices can be controlled from a single master unit.

## Test Script Builder Software Suite

Test Script Builder is a software tool that is provided with all Series 3700A instruments to help users easily create, modify, debug, and store TSP test scripts. It supplies a project/file manager window to store and organize test scripts, a text-sensitive program editor to create and modify test TSP code, and an immediate instrument control window to send Ethernet, GPIB, and USB commands and to receive data from the instrument. The immediate window also allows users to see the output of a given test script and simplifies debugging.



Store and organize test scripts in the file manager window.

Create and modify test TSP code in the context sensitive editor window.

The immediate window displays test script output and assists in debugging.

**Test Script Builder Software Suite**

**LXI** Version 1.4

LXI Core 2011 with LXI Clock Synchronization, LXI Timestamped Data, LXI Event Messaging, LXI Event Log.

## Transportable Memory, USB 2.0 Device Port

All Model 3706A mainframes contain a USB device port for easy transfer of readings, configurations, and test scripts to memory sticks. This port, which is located on the front panel, provides you with easy access to and portability of measurement results. Simply plug in a memory stick and, with a few simple keystrokes, gain access to virtually unlimited memory storage. Additional capabilities include: saving and recalling system configurations and storage for TSP scripts.
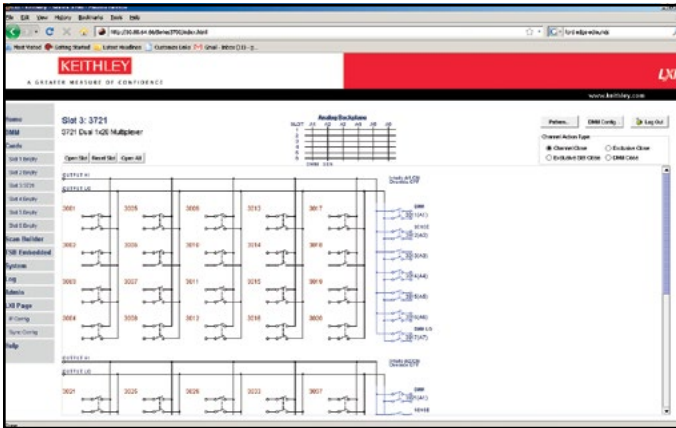
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# Series 3700A

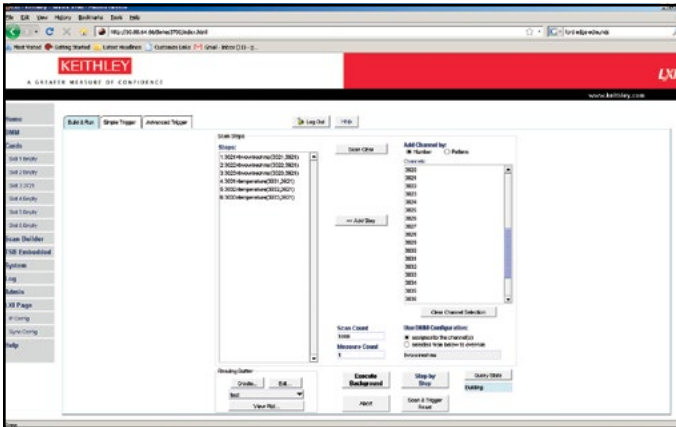## System Switch/Multimeter and Plug-In Cards

### Embedded Web Server

The built-in Web interface offers a quick and easy method to control and analyze measurement results. Interactive schematics of each card in the mainframe support point-and-click control for opening and closing switches. A scan list builder is provided to guide users through the requirements of a scan list (such as trigger and looping definitions) for more advanced applications. When the mainframe is ordered with the multimeter, additional Web pages are included for measurement configuration and viewing, including a graphing toolkit.

### Built-in Web Server Interface



**1. Configure your switch channels and measurement functions.** Configure the DMM to make your measurements at the desired speed, resolution, etc. and assign them to the desired channels.



**2. Build and run your automated scan list.** The toolkit makes it easy to build and execute an automated sequence of channel-open and channel-close commands and triggered multimeter measurements.



**3. Analyze your data.** View your results in real-time or historical mode with point-and-click simplicity. Data can be exported directly to your PC in either numerical or graphical formats for presentation or other applications.



**Model 3706A front panel**



**Model 3706A-S front panel**



**Model 3706A-NFP and Model 3706A-SNFP front panel**



**Model 3706A rear panel**

**Series 3700A specifications**

**SWITCHING AND CONTROL**

## High Performance Multimeter Specifications (Rev. A)

## DC Specifications

**CONDITIONS:** 1 PLC or 5 PLC.

For <1PLC, add appropriate "ppm of range" adder from "RMS Noise" table.

Includes rear panel Analog Backplane connector and transducer conversion. Refer to DC Notes for additional card uncertainties.

| Function | Range[1] | Resolution | Test Current or Burden Voltage | Input Resistance or Open Circuit Voltage[2] | Accuracy: ±(ppm of reading + ppm of range) (ppm = parts per million) (e.g., 10ppm = 0.001%) 24 Hour[3] 23°C ± 1°C | 90 Day 23°C ± 5°C | 1 Year 23°C ± 5°C | Temperature Coefficient 0°–18°C and 28°–50°C |
|---|---|---|---|---|---|---|---|---|
| **Voltage[4]** | 100.00000 mV [19] | 0.01 μV | | >10 GΩ or 10 MΩ ±1% | 10 + 9 | 25 + 9 | 30 + 9 | (1 + 5)/°C |
| | 1.0000000 V [19] | 0.1 μV | | >10 GΩ or 10 MΩ ±1% | 7 + 2 | 25 + 2 | 30 + 2 | (1 + 1)/°C |
| | 10.000000 V | 1 μV | | >10 GΩ or 10 MΩ ±1% | 7 + 2 | 20 + 2 | 25 + 2 | (1 + 1)/°C |
| | 100.00000 V | 10 μV | | 10 MΩ ±1% | 15 + 6 | 35 + 6 | 40 + 6 | (5 + 1)/°C |
| | 300.00000 V | 100 μV | | 10 MΩ ±1% | 20 + 6 | 35 + 6 | 40 + 6 | (5 + 1)/°C |
| **Resistance[4, 5, 6, 7]** | 1.0000000 Ω | 0.1 μΩ | 10 mA | 8.2 V | 15 + 80 | 40 + 80 | 60 + 80 | (8 + 1)/°C |
| | 10.000000 Ω | 1 μΩ | 10 mA | 8.2 V | 15 + 9 | 40 + 9 | 60 + 9 | (8 + 1)/°C |
| | 100.00000 Ω | 10 μΩ | 1 mA | 13.9 V | 15 + 9 | 45 + 9 | 65 + 9 | (8 + 1)/°C |
| | 1.0000000 kΩ | 100 μΩ | 1 mA | 13.9 V | 20 + 4 | 45 + 4 | 65 + 4 | (8 + 1)/°C |
| | 10.000000 kΩ | 1 mΩ | 100 μA | 9.1 V | 15 + 4 | 40 + 4 | 60 + 4 | (8 + 1)/°C |
| | 100.00000 kΩ | 10 mΩ | 10 μA | 14.7 V | 20 + 4 | 45 + 5 | 65 + 5 | (8 + 1)/°C |
| | 1.0000000 MΩ | 100 mΩ | 10 μA | 14.7 V | 25 + 4 | 50 + 5 | 70 + 5 | (8 + 1)/°C |
| | 10.000000 MΩ | 1 Ω | 0.64 μA/10 MΩ | 6.4 V | 150 + 6 | 200 + 10 | 400 + 10 | (70 + 1)/°C |
| | 100.00000 MΩ | 10 Ω | 0.64 μA//10 MΩ | 6.4 V | 800 + 30 | 2000 + 30 | 2000 + 30 | (385 + 1)/°C |
| **Dry Circuit Resistance[6, 8]** | 1.0000000 Ω | 1 μΩ | 10 mA | 27 mV | 25 + 80 | 50 + 80 | 70 + 80 | (8 + 1)/°C |
| | 10.000000 Ω | 10 μΩ | 1 mA | 20 mV | 25 + 80 | 50 + 80 | 70 + 80 | (8 + 1)/°C |
| | 100.00000 Ω | 100 μΩ | 100 μA | 20 mV | 25 + 80 | 90 + 80 | 140 + 80 | (8 + 1)/°C |
| | 1.0000000 kΩ | 1 mΩ | 10 μA | 20 mV | 25 + 80 | 180 + 80 | 400 + 80 | (8 + 1)/°C |
| | 2.0000000 kΩ | 10 mΩ | 5 μA | 20 mV | 25 + 80 | 320 + 80 | 800 + 80 | (8 + 1)/°C |
| **Continuity (2W)** | 1.000 kΩ | 100 mΩ | 1 mA | 13.9 V | 40 + 100 | 100 + 100 | 100 + 100 | (8 + 1)/°C |
| **Current[9]** | 10.000000 μA | 1 pA | <61 mV | | 40 + 50 | 300 + 50 | 500 + 50 | (35 + 9)/°C |
| | 100.00000 μA | 10 pA | <105 mV | | 50 + 9 | 300 + 30 | 500 + 30 | (50 + 5)/°C |
| | 1.0000000 mA | 100 pA | <130 mV | | 50 + 9 | 300 + 30 | 500 + 30 | (50 + 5)/°C |
| | 10.000000 mA | 1 nA | <150 mV | | 50 + 9 | 300 + 30 | 500 + 30 | (50 + 5)/°C |
| | 100.00000 mA | 10 nA | <0.4 V | | 50 + 9 | 300 + 30 | 500 + 30 | (50 + 5)/°C |
| | 1.0000000 A | 100 nA | <0.6 V | | 200 + 60 | 500 + 60 | 800 + 60 | (50 + 10)/°C |
| | 3.0000000 A | 1 μA | <1.8 V | | 1000 + 75 | 1200 + 75 | 1200 + 75 | (50 + 10)/°C |

## TEMPERATURE

(Displayed in °C, °F, or K. Exclusive of probes errors.)

**THERMOCOUPLES (Accuracy based on ITS-90):**

| Type | Range | Resolution | 90 Day/1 Year, 23°C ± 5°C Simulated reference junction | 90 Day/1 Year, 23°C ± 5°C Using 3720, 3721, or 3724 Cards | Range | 90 Day/1 Year, 23°C ± 5°C Using 3720, 3721, or 3724 Cards | Temperature Coefficient 0°–18°C and 28°–50°C |
|---|---|---|---|---|---|---|---|
| J | −150 to + 760°C | 0.001°C | 0.2°C | 1.0°C | −200 to −150°C | 1.5°C | 0.03°C/°C |
| K | −150 to +1372°C | 0.001°C | 0.2°C | 1.0°C | −200 to −150°C | 1.5°C | 0.03°C/°C |
| N | −100 to +1300°C | 0.001°C | 0.2°C | 1.0°C | −200 to −100°C | 1.5°C | 0.03°C/°C |
| T | −100 to +400°C | 0.001°C | 0.2°C | 1.0°C | −200 to −100°C | 1.5°C | 0.03°C/°C |
| E | −150 to +1000°C | 0.001°C | 0.2°C | 1.0°C | −200 to −150°C | 1.5°C | 0.03°C/°C |
| R | +400 to +1768°C | 0.1°C | 0.6°C | 1.8°C | 0 to +400°C | 2.3°C | 0.03°C/°C |
| S | +400 to +1768°C | 0.1°C | 0.6°C | 1.8°C | 0 to +400°C | 2.3°C | 0.03°C/°C |
| B | +1100 to +1820°C | 0.1°C | 0.6°C | 1.8°C | +350 to +1100°C | 2.8°C | 0.03°C/°C |

**4-WIRE RTD OR 3-WIRE RTD (100Ω platinum [PT100], D100, F100, PT385, PT3916, or user 0Ω to 10kΩ) (Selectable Offset compensation On or Off):**
For 3-wire RTD, dmm.connect=dmm.CONNECT_FOUR_WIRE, ≤0.1Ω lead resistance mismatching in Input HI and LO. Add 0.25°C/0.1Ω of lead resistance mismatch.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 4-Wire RTD | −200 to +630°C | 0.01°C | 0.06°C | | | | 0.003°C/°C |
| 3-Wire RTD | −200 to +630°C | 0.01°C | 0.75°C | | | | 0.003°C/°C |

**THERMISTOR:** 2.2kΩ, 5kΩ, and 10kΩ. Not recommended with Model 3724 card. See Model 3724 manual for "Measurement Considerations."

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | −80 to +150°C | 0.01°C | 0.08°C | | | | 0.002°C/°C |

# Series 3700A

## System Switch/Multimeter and Plug-In Cards

## DC SPEEDS vs. RMS NOISE

Single Channel, 60Hz (50Hz) Operation.
1PLC and 5PLC RMS noise are included in DC specifications.

**RMS Noise[16], PPM of Range**
RMS Noise Calculator:
Add 2.5 × "RMS Noise" to "ppm of range" (e.g., 10V @ 0.006 PLC)
"ppm of range" = 2.5 × 7.0 ppm + 2 ppm

| Function | NPLC | Aperture (ms) | Digits | 100mV | 1V | 10V | 100V | 300V | Measurements into Buffer (rdgs/s)[13] Azero On | Azero Off | Measurement to PC (ms/rdg) Azero Off[13] Ethernet | GPIB | USB |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5[14] | 83.3 (100) | 7½ | 1.0 | 0.07 | 0.05 | 0.7 | 0.2 | 9.5 (8) | 12 (10) | 86.3 (104) | 86.1 (102.8) | 86.3 (103.1) |
| | 1[14] | 16.7 (20) | 7½ | 0.9 | 0.12 | 0.1 | 0.8 | 0.35 | 42 (33) | 59.8 (49.5) | 19.4 (22.7) | 19.5 (22.8) | 19.9 (23.2) |
| | 0.2[12, 14] | 3.33 (4.0) | 6½ | 2.5 | 0.32 | 0.3 | 2.5 | 1.0 | 50 (40) | 60 (50) | 19.4 (22.7) | 19.5 (22.8) | 19.9 (23.2) |
| DCV | 0.2[14] | 3.33 (4.0) | 6½ | 3.5 | 1.7 | 0.7 | 3.5 | 1.5 | 120 (100) | 295 (235) | 7.6 (8.3) | 6.2 (6.8) | 6.4 (7.0) |
| | 0.06[15] | 1.0 (1.2) | 5½ | 12 | 3.0 | 1.5 | 8.0 | 3.5 | 205 (165) | 935 (750) | 1.40 (1.80) | 1.50 (1.80) | 1.60 (2.30) |
| | 0.006[15] | 0.100 (0.120) | 4½ | 55 | 15 | 7.0 | 70 | 35 | 218 (215) | 6,200 (5,500) | 0.55 (0.57) | 0.65 (0.67) | 0.75 (0.77) |
| | 0.0005[15] | 0.0083 (0.001) | 3½ | 325 | 95 | 95 | 900 | 410 | 270 (270) | 14,600 (14,250) | 0.50 (0.5) | 0.60 (0.60) | 0.70 (0.70) |

| Function | NPLC | Aperture (ms) | Digits | 10–100Ω | 1kΩ | 10kΩ | | | Azero On | Azero Off | Ethernet | GPIB | USB |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5[14] | 83.3 (100) | 7½ | 2.0 | 0.5 | 0.4 | — | — | 9.5 (8) | 12 (10) | 87.0 (105) | 86.1 (103) | 86.5 (104) |
| | 1[14] | 16.7 (20) | 7½ | 3.5 | 0.8 | 0.6 | — | — | 42 (33) | 59.8 (49.5) | 21.0 (24.3) | 19.5 (22.8) | 19.9 (23.2) |
| 2WΩ | 0.2[12, 14] | 3.33 (4.0) | 6½ | 6.5 | 1.7 | 1.5 | — | — | 50 (40) | 60 (50) | 21.0 (24.3) | 19.5 (22.8) | 19.9 (23.2) |
| (≤10kΩ) | 0.2[14] | 3.33 (4.0) | 6½ | 8.0 | 4.5 | 5.5 | — | — | 120 (100) | 295 (235) | 7.6 (8.3) | 6.2 (6.8) | 6.4 (7.0) |
| | 0.06[15] | 1.0 (1.2) | 5½ | 15 | 6 | 6.5 | — | — | 205 (165) | 935 (750) | 1.40 (1.80) | 1.50 (1.80) | 1.60 (2.30) |
| | 0.006[15] | 0.100 (0.120) | 4½ | 60 | 15 | 15 | — | — | 218 (215) | 6,200 (5,500) | 0.55 (0.57) | 0.65 (0.67) | 0.75 (0.77) |
| | 0.0005[15] | 0.0083 (0.001) | 3½ | 190 | 190 | 190 | — | — | 270 (270) | 14,100 (13,700) | 0.50 (0.5) | 0.60 (0.60) | 0.70 (0.70) |

| Function | NPLC | Aperture (ms) | Digits | 10µA | 100µA | 1mA–100mA | 1A | 3A | Azero On | Azero Off | Ethernet | GPIB | USB |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5[14] | 83.3 (100) | 7½ | 3.5 | 1.6 | 1.6 | 2.9 | 2.0 | 9.5 (8) | 12 (10) | 88 (103) | 86.1 (102.8) | 86.3 (103.1) |
| | 1[14] | 16.7 (20) | 6½ | 3.5 | 1.1 | 1.1 | 2.2 | 1.8 | 42 (33) | 59.8 (49.5) | 21.0 (22.7) | 19.5 (22.8) | 19.8 (23.1) |
| DCI | 0.2[12, 14] | 3.33 (4.0) | 5½ | 50 | 5.0 | 3.0 | 4.0 | 8.0 | 50 (40) | 60 (50) | 19.4 (22.7) | 19.5 (22.8) | 19.8 (23.1) |
| | 0.2[14] | 3.33 (4.0) | 4½ | 100 | 35 | 12 | 4.0 | 8.0 | 120 (100) | 295 (235) | 7.6 (8.3) | 6.2 (6.8) | 6.4 (7.0) |
| | 0.06[15] | 1.0 (1.2) | 4½ | 350 | 35 | 20 | 8.0 | 20 | 205 (165) | 935 (750) | 1.40 (1.80) | 1.50 (1.80) | 1.60 (2.30) |
| | 0.006[15] | 0.100 (0.120) | 4½ | 400 | 200 | 40 | 50 | 100 | 218 (215) | 6,200 (5,500) | 0.55 (0.57) | 0.65 (0.67) | 0.75 (0.77) |
| | 0.0005[15] | 0.0083 (0.001) | 3½ | 2500 | 450 | 250 | 325 | 750 | 270 (270) | 14,100 (13,700) | 0.50 (0.5) | 0.60 (0.60) | 0.70 (0.70) |

| Function | NPLC | Aperture (ms) | Digits | 1Ω | 10–100Ω | 1kΩ | 10kΩ | | Azero On | Azero Off | Ethernet | GPIB | USB |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5[14] | 83.3 (100) | 7½ | 5.5 | 0.8 | 0.5 | 0.5 | — | 5 (4) | 5.9 (4.7) | 173 (206) | 173 (206) | 173 (206) |
| | 1[14] | 16.7 (20) | 7½ | 15 | 1.4 | 0.5 | 0.7 | — | 23.5 (18.5) | 29 (23) | 39 (46) | 39 (46) | 39 (46) |
| 4WΩ | 0.2[12, 14] | 3.33 (4.0) | 5½ | 100 | 30 | 10 | 50 | — | 26.5 (21) | 30 (24) | 39 (46) | 39 (46) | 39 (46) |
| | 0.2[14] | 3.33 (4.0) | 5½ | 300 | 50 | 10 | 63 | — | 80 (60) | 120 (95) | 12.3 (14.5) | 11.3 (13.3) | 11.7 (13.7) |
| | 0.06[15] | 1.0 (1.2) | 4½ | 500 | 50 | 15 | 70 | — | 140 (110) | 285 (225) | 6.2 (7.2) | 6.3 (7.3) | 6.5 (7.6) |
| | 0.006[15] | 0.100 (0.120) | 4½ | 750 | 75 | 30 | 100 | — | 200 (195) | 580 (565) | 4.2 (4.4) | 4.3 (4.5) | 4.6 (4.8) |
| | 0.0005[15] | 0.0083 (0.001) | 3½ | 3500 | 450 | 250 | 250 | — | 210 (205) | 650 (645) | 4.2 (4.4) | 4.3 (4.5) | 4.6 (4.8) |

| Function | NPLC | Aperture (ms) | Digits | 1Ω | 10–100Ω | 1kΩ | 10kΩ | | Azero On | Azero Off | Ethernet | GPIB | USB |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5[14] | 83.3 (100) | 7½ | 5.5 | 0.8 | 0.5 | 0.5 | — | 2.5 (2.0) | 2.9 (2.3) | 343 (427) | 341 (425) | 342 (426) |
| 4WΩ | 1[14] | 16.7 (20) | 7½ | 16 | 1.5 | 0.7 | 1.5 | — | 12.7 (10) | 14 (11.2) | 77 (95) | 74 (92) | 75 (93) |
| OCOMP | 0.2[12, 14] | 3.33 (4.0) | 6½ | 45 | 4.5 | 2.1 | 3.5 | — | 14 (11.2) | 15 (12) | 70 (86.5) | 70 (86.5) | 70 (86.5) |
| | 0.2[14] | 3.33 (4.0) | 5½ | 500 | 50 | 13 | 30 | — | 46.5 (37) | 56 (44) | 22.7 (25) | 20.5 (23) | 21.1 (24) |
| | 0.0005[15] | 0.0083 (0.001) | 3½ | 4500 | 650 | 400 | 400 | — | 129 (125) | 215 (210) | 6.7 (6.7) | 6.8 (6.8) | 7 (7) |

| Function | NPLC | Aperture (ms) | Digits | 1–10Ω | 100Ω | 1kΩ | 2kΩ | | Azero On | Azero Off | Ethernet | GPIB | USB |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5[14] | 83.3 (100) | 6½ | 8.0 | 10 | 10 | 8.0 | — | 2.5 (2.0) | 2.9 (2.3) | 347 (430) | 345 (428) | 346 (429) |
| Dry-CktΩ | 1[14] | 16.7 (20) | 5½ | 17 | 22 | 25 | 28 | — | 12 (9.5) | 13 (10) | 80 (99) | 77 (95) | 78 (97) |
| OCOMP | 0.2[12, 14] | 3.33 (4.0) | 4½ | 50 | 50 | 50 | 50 | — | 14 (11.2) | 15 (12) | 70 (86.5) | 70 (86.5) | 70 (86.5) |
| | 0.2[14] | 3.33 (4.0) | 3½ | 500 | 1000 | 1000 | 1500 | — | 35 (30) | 45 (36) | 27 (33) | 25 (31) | 26 (32) |
| | 0.0005[15] | 0.0083 (0.001) | 2½ | 8500 | 8500 | 8500 | 8500 | — | 84 (84) | 115 (110) | 10.7 (10.7) | 10.7 (10.7) | 11 (11) |

## RTD SPEEDS vs. NOISE

1 PLC and 5 PLC Noise are included in RTD Specifications.

| | | | | Add °C to Reading[16] | | Measurements into Buffer[13] (rdg/s) | | Measurement to PC[13] (ms/rdg) Azero Off | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Function** | **NPLC** | **Aperture (ms)** | **Digits** | **4-Wire** | **3-Wire** | **Azero On** | **Azero Off** | **Ethernet** | **GPIB** | **USB** |
| | 5[14] | 83.3 (100) | 7½ | 0 | 0 | 5 (4) | 5.9 (4.7) | 173 (206) | 173 (206) | 173 (206) |
| | 1[14] | 16.7 (20) | 7½ | 0 | 0 | 23.5 (18.5) | 29 (23) | 39 (46) | 39 (46) | 39 (46) |
| | 0.2[12, 14] | 3.33 (4.0) | 5½ | 0.01 | 0.01 | 26.5 (21) | 30 (24) | 39 (46) | 39 (46) | 39 (46) |
| OCOMP OFF | 0.2[14] | 3.33 (4.0) | 5½ | 0.18 | 0.18 | 80 (60) | 120 (95) | 12.3 (14.5) | 11.3 (13.3) | 11.7 (13.7) |
| | 0.06[15] | 1.0 (1.2) | 4½ | 0.24 | 0.24 | 140 (110) | 285 (225) | 6.2 (7.2) | 6.3 (7.3) | 6.5 (7.6) |
| | 0.006[15] | 0.100 (0.120) | 4½ | 0.37 | 0.37 | 200 (195) | 580 (565) | 4.2 (4.4) | 4.3 (4.5) | 4.6 (4.8) |
| | 0.0005[15] | 0.0083 (0.001) | 3½ | 3.10 | 3.10 | 209 (205) | 650 (645) | 4.2 (4.4) | 4.3 (4.5) | 4.6 (4.8) |
| | 5[14] | 83.3 (100) | 7½ | 0 | 0 | 2.5 (2.0) | 2.9 (2.3) | 343 (427) | 341 (425) | 342 (426) |
| | 1[14] | 16.7 (20) | 7½ | 0 | 0 | 12.7 (10) | 14 (11.2) | 77 (95) | 74 (92) | 75 (93) |
| OCOMP ON | 0.2[12, 14] | 3.33 (4.0) | 6½ | 0.02 | 0.02 | 14 (11.2) | 15 (12) | 70 (86.5) | 70 (86.5) | 70 (86.5) |
| | 0.2[14] | 3.33 (4.0) | 5½ | 0.38 | 0.38 | 46.0 (37) | 56 (44) | 22.7 (25) | 20.5 (23) | 21.1 (24) |
| | 0.0005[15] | 0.0083 (0.001) | 3½ | 4.67 | 4.67 | 128 (125) | 215 (210) | 6.7 (6.7) | 6.8 (6.8) | 7 (7) |

## SYSTEM PERFORMANCE [13], [14]

3½-Digit Mode, Azero off, nPLC = 0.0005. Time includes function change from either DCV or 2WΩ to listed function.

| Function | Function Change (ms) | Range Change (ms) | Auto-range (ms) |
|---|---|---|---|
| DCV or 2WΩ (<10kΩ) | 10 | 10 | 10 |
| 4WΩ (<10kΩ) | 20 | 20 | 20 |
| DCI | 10 | 10 | 10 |
| Frequency or Period [17] | 110 | 10 | — |
| ACV or ACI [17] | 20 | 85 | 300 |

| Buffer Transfer Speed | Ethernet | GPIB | USB |
|---|---|---|---|
| Average for 1000 readings | 2450/s | 2000/s | 1800/s |
| Average for 1000 readings with timestamp | 2300/s | 1800/s | 1600/s |

| Card | Command | Single Command Execution Time (ms) | | |
|---|---|---|---|---|
| | | Ethernet | GPIB | USB |
| 3720, 3721, 3722, 3730 | channel.close (ch_list) or channel.open (ch_list) | 5.7 | 5.8 | 6.1 |
| 3723, 3724 3731, 3732 [18] | channel.close (ch_list) or channel.open (ch_list) | 2.3 | 2.4 | 2.7 |
| 3740 | channel.close (ch_list 1-28) or channel.open (ch_list 1-28) | 10.7 | 10.8 | 11.1 |
| | channel.close (ch_list 29-32) or channel.open (ch_list 29-32) | 22.7 | 22.8 | 23.1 |

## DC MEASUREMENT CHARACTERISTICS

### DC VOLTS

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

**INPUT IMPEDANCE: 100mV–10V Ranges:** Selectable >10GΩ // <400pF or 10MΩ ±1%. **100V–300V Ranges:** 10MΩ ±1%.

**INPUT BIAS CURRENT:** <50pA at 23°C with dmm.autozero=dmm.OFF or dmm.inputdivider=dmm.ON.

**COMMON MODE CURRENT:** <500nA p-p for ≤1MHz.

**AUTOZERO OFF ERROR:** For DCV ±1°C and ≤10 minutes, add ±(8ppm of reading + 5μV).

**INPUT PROTECTION:** 300V all ranges.

**COMMON MODE VOLTAGE:** 300V DC or 300Vrms (425V peak for AC waveforms) between any terminal and chassis.

### RESISTANCE

**MAX. 4WΩ LEAD RESISTANCE:** 5Ω per lead for 1Ω range; 10% of range per lead for 10Ω–1kΩ ranges; 1kΩ per lead for all other ranges.

**MAX. 4WΩ LEAD RESISTANCE (DRY CKT):** 0.5Ω per lead for 1Ω range; 10% of range per lead for 10Ω–100Ω ranges; 50Ω per lead for 1kΩ–2kΩ ranges.

**INPUT IMPEDANCE: 1Ω–10Ω Ranges:** 99kΩ ±1% // <1μF. **100Ω–2kΩ Ranges:** 10MΩ ±1% // <0.015μF.

**OFFSET COMPENSATION:** Selectable on 4WΩ 1Ω–10kΩ ranges.

**OPEN LEAD DETECTOR:** Selectable per channel. 1.5μA, ±20% sink current per DMM SHI and SLO lead. Default on.

**CONTINUITY THRESHOLD:** Adjustable 1 to 1000Ω.

**AUTOZERO OFF ERROR:** For 2WΩ ±1°C and ≤10 minutes, add ±(8ppm of reading + 0.5mΩ) for 10Ω and 5mΩ for all other ranges.

**INPUT PROTECTION:** 300V all ranges.

## DC MEASUREMENT CHARACTERISTICS (continued)

### DC CURRENT

**AUTOZERO OFF ERROR:** For ±1°C and ≤10 minutes, add ±(8ppm of reading + range error). Refer to table below.

| Range | 3 A | 1 A | 100 mA | 10 mA | 1 mA | 100 μA | 10 μA |
|---|---|---|---|---|---|---|---|
| Shunt Resistance guaranteed by design | 0.05 Ω | 0.05 Ω | 1 Ω | 10 Ω | 100 Ω | 1 kΩ | 6 kΩ |
| Burden Voltage | <1.75 V | <0.55 V | <0.4 V | <150 mV | <130 mV | <105 mV | <61 mV |
| Burden Voltage with 3721 card | <2.35 V | <1.15 V | <0.4 V | <150 mV | <130 mV | <105 mV | <61 mV |
| Autozero OFF "of range" Error | 100 μA | 100 μA | 5 μA | 0.5 μA | 50 nA | 5 nA | 0.85 nA |
| For each additional amp after ±1.5A input, add the following to ppm of range: | — | 120 | 60 | 60 | 60 | 60 | 95 |

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

### THERMOCOUPLES

**CONVERSION:** ITS-90.

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

**OPEN LEAD DETECTOR:** Selectable per channel. Open >1.15kΩ ±50Ω. Default on.

**COMMON MODE ISOLATION:** 300V DC or 300Vrms (425V peak for AC waveforms), >10GΩ and <350pF any terminal to chassis.

### DC NOTES

1. 20% overrange on DC functions except 1% on 300V range and 3.33% on 3A range.
2. ±5% (measured with 10MΩ input resistance DMM, >10GΩ DMM on 10MΩ and 100MΩ ranges). Refer to table for other 2W/4W configurations. For Dry Circuit, +20%, <1mV with dmm.offsetcompensation=ON for 100Ω–2kΩ ranges.

| Range | 2W | 4W | 4W–Kelvin | Ocomp 4W | Ocomp 4W–Kelvin |
|---|---|---|---|---|---|
| 1, 10Ω | 8.2 V | 8.2 V | 8.2 V | 12.1 V | 12.1 V |
| 100, 1kΩ | 13.9 V | 14.1 V | 13.9 V | 15.0 V | 12.7 V |
| 10kΩ | 9.1 V | 9.1 V | 9.1 V | 0.0 V | 0.0 V |
| 100k, 1MΩ | 12.7 V | 14.7 V | 12.7 V | — | — |
| 10M, 100MΩ | 6.4 V | 6.4 V | 6.4 V | — | — |

3. Relative to calibration accuracy.
4. Add the following additional uncertainty with -ST accessory:

| Card | ±(ppm of range) | | | ±(ppm of reading + ppm of range) | | | |
|---|---|---|---|---|---|---|---|
| | 100 mV | 1 V | 10 V | 100 kΩ | 1 MΩ | 10 MΩ | 100 MΩ |
| 3720, 3721, 3722, and 3730 | 45 | 4.5 | – | 8 + 5 | 8 + 0.5 | — | — |
| 3723 | 60 | 6.0 | – | 8 + 6 | 8 + 0.5 | — | — |
| 3724 | 45 | 4.5 | – | 8 + 5 | 80 + 0.5 | 250 + 1 | 5000 + 1 |
| 3731 | 800 | 80 | 8 | 8 + 80 | 40 + 8 | 0 + 25 | 0 + 15 |
| 3732 (Quad 4×28) | 200 | 20 | 2 | 8 + 20 | 40 + 2 | 0 + 7 | 0 + 4 |

5. Specifications are for 4-wire Ω, 1Ω–1kΩ with offset compensation on. For Series 3700A plug-in cards, $L_{SYNC}$ and offset compensation on. 1Ω range is 4-wire only. Model 3724 card: 1kΩ–100MΩ ranges only. Model 3731 card: 100Ω–100MΩ ranges only.

For 2-wire Ω specifications, add the following to "ppm of range" uncertainty:

| DMM Connect Relays | Rel Enable | Rear Panel Connector or 3700 Card | 3724 Card | 3731 Card |
|---|---|---|---|---|
| CONNECT_ALL | ON | 100 mΩ | 500 mΩ | 900 mΩ |
| CONNECT_ALL | OFF | 1.5 Ω | 64 Ω | 2.3 Ω |
| CONNECT_TWO_WIRE | ON | 700 mΩ | 1.2 Ω | 1.5 Ω |
| CONNECT_TWO_WIRE | OFF | 1.5 Ω | 64 Ω | 2.3 Ω |

6. Test current with dmm.offsetcompensation=OFF, ±5%.
7. Add the following to "ppm of reading" uncertainty when using Series 3700A Plug-in Cards in Operating Environment ≥50%RH.

| Card | 10kΩ | 100kΩ | 1MΩ | 10MΩ | 100MΩ |
|---|---|---|---|---|---|
| 3720, 3721, 3724, 3730, 3731, 3732 (Quad 4×28) with MTC D-Shell connector | 1 ppm | 10 ppm | 0.01% | 0.1% | 1% |
| 3720, 3721, 3724, 3730, 3731, 3732 (Quad 4×28) with -ST screw terminal module | 10 ppm | 100 ppm | 0.1% | 1% | 10% |
| 3722 and 3723 | 10 ppm | 100 ppm | 0.1% | 1% | 10% |

**Series 3700A Plug-in Cards Operating Environment:** Specified for 0° to 50°C, ≤70%RH at 35°C.

8. Dry-Ckt Ω is 4-wire only. Specifications with offset compensation and $L_{SYNC}$ on.

| Card | Ranges |
|---|---|
| 3720, 3721, and 3730 | 1 Ω – 2 kΩ |
| 3722, 3723, and 3732 | 10 Ω – 2 kΩ |
| 3724 | 1 kΩ – 2 kΩ |
| 3731 | 100 Ω – 2 kΩ |

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## DC NOTES (continued)

9. Includes Analog Backplane 15-pin rear panel connector. For 3721, refer to DC Current table for additional uncertainties.
10. For $L_{SYNC}$ On, line frequency ±0.1%.

| | nPLC | 5 | 1 | <0.2 | <0.01 |
|---|---|---|---|---|---|
| $L_{SYNC}$ On | NMRR | 110 dB | 90 dB | 45 dB | — |
| $L_{SYNC}$ Off | NMRR | 60 dB, ±2 dB | 60 dB, ±2 dB | — | — |

11. For 1kΩ unbalance in LO lead. AC CMRR is 70dB.

| nPLC | 5 | 1 | 0.2 [12] | ≤0.2 |
|---|---|---|---|---|
| CMRR | 140 dB | 140 dB | 120 dB | 80 dB |

12. For $L_{SYNC}$ On.
13. Reading rates are for 60Hz (50Hz) operation using factory defaults operating conditions dmm.reset("all"), Autorange off, dmm.autodelay=dmm.OFF, dmm.opendetector=dmm.OFF, format.data.=format.SREAL. Ranges as follows: DCV = 10V, 2WΩ/4WΩ = 1kΩ, DCI = 1mA, Dry-Ckt Ω = 10Ω, ACI = 1mA, and ACV = 1V.

For Dry-Ckt Ω with Offset Comp OFF 2kΩ, 60 rdg/s max. Dry-Ckt Ω with Offset Comp ON 2kΩ, 29.5 rdg/s max. For temperature reading rates use DCV for T/C and 2WΩ for Thermistor. Speeds are typical and include measurements and data transfer out the Ethernet, GPIB, or USB.

14. DMM configured for single reading, dmm.measurecount=1, and print(dmm.measure()). May require additional settling delays for full accuracy, depending on measurement configuration.
15. DMM configured for multisample readings and single buffer transfer, dmm.measurecount=1000, buf=dmm.makebuffer(1000), dmm.measure(buf), and printbuffer(1,1000,buf).
16. dmm.autozero=dmm.ON. RMS noise using low thermal short for DCV, 2WΩ, 4WΩ, and Dry-Ckt Ω. For DCI, dmm.connect=dmm.CONNECT_NONE or 0. For RTD, noise using low thermal 190Ω precision resistor. Includes Model 3721 card accuracies. RMS noise values are typical.
17. For DCV or 2WΩ to Frequency or Period, dmm.nplc=0.2 and dmm.aperture=0.01 sec. For ACI or ACV, dmm.detectorbandwidth=300. For ACI or ACV with dmm.autodelay=dmm.ON, best speed is 65ms.
18. Speeds are within same multiplexer bank. Add an additional 8ms when changing banks or slots.
19. When properly zeroed using REL function.

## AC Specifications

| Function | Range[1] | Resolution | Calibration Cycle | Accuracy: ±(% of reading + % of range) 23°C ± 5°C | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 Hz–5 Hz | 5 Hz–10 Hz | 10 Hz –20 kHz | 20 kHz–50 kHz | 50 kHz–100 kHz | 100 kHz–300 kHz |
| Voltage[2] | 100.0000 mV | 0.1 µV | 90 Day (100mV–100V) | 1.0 + 0.03 | 0.30 + 0.03 | 0.05 + 0.03 | 0.11 + 0.05 | 0.6 + 0.08 | 4.0 + 0.5 |
| | 1.000000 V | 1 µV | | | | | | | |
| | 10.00000 V | 10 µV | 1 Year (100mV–100V) | 1.0 + 0.03 | 0.30 + 0.03 | 0.06 + 0.03 | 0.12 + 0.05 | 0.6 + 0.08 | 4.0 + 0.5 |
| | 100.0000 V | 100 µV | | | | | | | |
| | 300.0000 V | 1 mV | 90 Day | 1.0 + 0.05 | 0.30 + 0.05 | 0.05 + 0.05 | 0.11 + 0.08 | 0.6 + 0.11 | 4.0 + 0.8 |
| | 300.0000 V | 1 mV | 1 Year | 1.0 + 0.05 | 0.30 + 0.05 | 0.06 + 0.05 | 0.12 + 0.08 | 0.6 + 0.11 | 4.0 + 0.8 |
| | | | Temp. Coeff. /°C[3] (all ranges) | 0.010 + 0.003 | 0.030 + 0.003 | 0.005 + 0.003 | 0.006 + 0.005 | 0.01 + 0.006 | 0.03 + 0.01 |

| Function | Range[1] | Resolution | Calibration Cycle | 3 Hz–5 Hz | 5 Hz–10 Hz | 10Hz –2 kHz | 2 kHz –5 kHz | 5 kHz –10 kHz |
|---|---|---|---|---|---|---|---|---|
| Current[2] | 1.000000 mA[7] | 1 nA | | 1.0 + 0.04 | 0.30 + 0.04 | 0.08 + 0.03 | 0.09 + 0.03 | 0.09 + 0.03 |
| | 10.00000 mA | 10 nA | | 1.0 + 0.04 | 0.30 + 0.04 | 0.08 + 0.03 | 0.09 + 0.03 | 0.09 + 0.03 |
| | 100.0000 mA | 100 nA | 90 Day/1 Year | 1.0 + 0.04 | 0.30 + 0.04 | 0.08 + 0.03 | 0.09 + 0.03 | 0.09 + 0.03 |
| | 1.000000 A | 1 µA | | 1.0 + 0.04 | 0.30 + 0.04 | 0.20 + 0.04 | 0.88 + 0.04 | 2.0 + 0.04 |
| | 3.000000 A | 10 µA | | 1.0 + 0.05 | 0.30 + 0.05 | 0.20 + 0.05 | 0.88 + 0.05 | 2.0 + 0.05 |
| | | | Temp. Coeff. /°C[3] (all ranges) | 0.10 + 0.004 | 0.030 + 0.004 | 0.005 + 0.003 | 0.006 + 0.005 | 0.006 + 0.005 |

| Function | Range[1] | Resolution | Calibration Cycle | Accuracy: ±(ppm of reading + offset ppm) | | |
|---|---|---|---|---|---|---|
| | | | | 3 Hz–500 kHz | 3 Hz–500 kHz | 333 ms–2 µs |
| Frequency[4] and Period | 100.0000 mV to 300.0000 V | 0.333 ppm | 90 Day/1 Year (all ranges) | 80 + 0.333 | 80 + 0.333 | (0.25 s gate) |
| | | 3.33 ppm | | 80 + 3.33 | 80 + 3.33 | (100 ms gate) |
| | | 33.3 ppm | | 80 + 33.3 | 80 + 33.3 | (10 ms gate) |

## ADDITIONAL UNCERTAINTY ±(% of reading)

| Low Frequency Uncertainty | Detector Bandwidth | | |
|---|---|---|---|
| | 3 (3 Hz–300 kHz) | 30 (30 Hz–300 kHz) | 300 (300 Hz–300 kHz) |
| 20 Hz–30 Hz | 0 | 0.3 | — |
| 30 Hz–50 Hz | 0 | 0 | — |
| 50 Hz–100 Hz | 0 | 0 | 4.0 |
| 100 Hz–200 Hz | 0 | 0 | 0.72 |
| 200 Hz–300 Hz | 0 | 0 | 0.18 |
| 300 Hz–500 Hz | 0 | 0 | 0.07 |
| >500 Hz | 0 | 0 | 0 |

| Additional Uncertainty ±(% of reading) | Detector Bandwidth | Crest Factor[5] Maximum Crest Factor: 5 at full-scale | | | |
|---|---|---|---|---|---|
| | | 1–2 | 2–3 | 3–4 | 4–5 |
| 5 Hz–10 Hz | 3 | 0.50 | 1.20 | 1.30 | 1.40 |
| 10 Hz–30 Hz | 3 | 0.20 | 0.30 | 0.60 | 0.90 |
| 30 Hz–500 Hz | 3 or 30 | 0.20 | 0.30 | 0.60 | 0.90 |
| >100 Hz | 3 or 30 | 0.05 | 0.15 | 0.30 | 0.40 |
| 300 Hz–500 Hz | 300 only | 0.50 | 1.20 | 1.30 | 1.40 |
| ≥500 Hz | 300 only | 0.05 | 0.15 | 0.30 | 0.40 |

Series 3700A specifications

SWITCHING AND CONTROL

## AC SPEEDS  Single Channel, 60Hz (50Hz) Operation

| Function | Detector Bandwidth | NPLC | Aperture (ms) | Measurements into Buffer [9] (rdg/s) | | | Measurement to PC [9] (ms/rdg) | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Digits | Azero On | Azero Off | Ethernet | GPIB | USB |
| | 3 | N/A | N/A | 6½ | 0.45 (0.45) | N/A | 2150 (2150) | 2150 (2150) | 2150 (2150) |
| | 30 | N/A | N/A | 6½ | 2.5 (2.5) | N/A | 400 (400) | 400 (400) | 400 (400) |
| | 300 | 1.0 [10] | 16.67 (20) | 6½ | 42 (33) | 59.5 (50) | 19.4 (22.7) | 19.5 (22.8) | 19.8 (23.1) |
| ACI / ACV | 300 | 0.2 [10] | 3.33 (4.0) | 6½ | 120 (100) | 295 (235) | 7.6 (8.3) | 6.2 (6.8) | 6.4 (7.0) |
| | 300 | 0.06 [11] | 1.0 (1.2) | 5½ | 170 (165) | 935 (750) | 1.40 (1.80) | 1.50 (1.80) | 1.60 (2.30) |
| | 300 | 0.006 [11] | 0.100 (0.120) | 4½ | 218 (215) | 6,200 (5,500) | 0.55 (0.57) | 0.65 (0.67) | 0.75 (0.77) |
| | 300 | 0.0005 [11] | 0.0083 (0.001) | 3½ | 218 (215) | 14,600 (14,250) | 0.50 (0.5) | 0.60 (0.60) | 0.70 (0.70) |
| Frequency/Period | N/A | N/A | 10–273 | N/A | 2× input period + gate time | N/A | 2× input period + gate time + 2.7ms | 2× input period + gate time + 2.8ms | 2× input period + gate time + 3.1ms |

## AC MEASUREMENT CHARACTERISTICS

### AC VOLTS
**MEASUREMENT METHOD:** AC-coupled, True RMS.

**INPUT IMPEDANCE:** 1MΩ ±2% // by <150pF.

**INPUT PROTECTION:** 300VDC or 300Vrms rear inputs or 37xx cards.

### AC CURRENT
**MEASUREMENT METHOD:** AC-coupled, True RMS.

| Range | 3 A | 1 A | 100 mA | 10 mA | 1 mA |
|---|---|---|---|---|---|
| Shunt Resistance guaranteed by design | 0.05 Ω | 0.05 Ω | 1.0 Ω | 10 Ω | 100 Ω |
| Burden Voltage Rear Panel | <1.75 V rms | <0.55 V rms | <0.4 V rms | <150 mV rms | <125 mV rms |
| Burden Voltage 3721 Card | <2.4 V rms | <1.0 V rms | <0.6 V rms | <200 mV rms | <130 mV rms |

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

### FREQUENCY AND PERIOD
**MEASUREMENT METHOD:** Reciprocal Counting technique.

**GATE TIME:** dmm.aperture=0.273→0.01. Default 0.01s.

### AC GENERAL
**AC CMRR[6]:** 70dB.

**VOLT·HERTZ PRODUCT:** ≤8×10⁷ Volt·Hz (guaranteed by design), ≤2.1×10⁷ Volt·Hz verified. Input frequency verified for ≤3×10⁵ Hz.

## AC NOTES

1. 20% overrange on AC functions except 1% on 300V and 3.33% on 3A. Default resolution is 5½ digits, maximum useable resolution is 6½ with 7½ digits programmable.
2. Specification are for Detector Bandwidth 3 and sinewave inputs >5% of range. Detector Bandwidth 3 and 30 are multi-sample A/D conversions. Detector bandwidth 300 is a single A/D conversion, programmable from 0.0005PLC to 15PLC. Default condition set to 1PLC.
3. Applies to 0°–18°C and 28°–50°C.
4. Specified for square wave inputs. Input signal must be >10% of ACV range. If input is <20mV on the 100mV range then the frequency must be >10Hz. For sinewave inputs, frequency must be >100Hz.
5. Applies to non-sinewave inputs 5Hz–>10kHz, and DC content ≤3% of range.
6. For 1kΩ unbalance in LO lead.
7. For Model 3721, 1mA ACI, add 0.05% to "of reading" uncertainty from 250Hz → 10kHz.
8. Shunt resistance guaranteed by design.
9. Reading rates are for 60Hz (50Hz) operation using factory defaults operating conditions dmm.reset("all"), Autorange off, dmm.autodelay=dmm.OFF, dmm.opendetector=dmm.OFF, format.data.=format.SREAL. Ranges as follows: DCV = 10V, 2WΩ/4WΩ = 1kΩ, DCI = 1mA, Dry-Ckt Ω = 10Ω, ACI = 1mA, and ACV = 1V. For Dry-Ckt Ω with Offset Comp OFF 2kΩ, 60 rdg/s max. Dry-Ckt Ω with Offset Comp ON 2kΩ, 29.5 rdg/s max. For temperature reading rates use DCV for T/C and 2WΩ for Thermistor. Speeds are typical and include measurements and data transfer out the Ethernet, GPIB, or USB.
10. DMM configured for single reading, dmm.measurecount=1, and print(dmm.measure()). May require additional settling delays for full accuracy, depending on measurement configuration.
11. DMM configured for multisample readings and single buffer transfer, dmm.measurecount=1000, buf=dmm.makebuffer(1000), dmm.measure(buf), and printbuffer(1,1000,buf).

# Series 3700A

## System Switch/Multimeter and Plug-In Cards

## GENERAL

**EXPANSION SLOTS:** 6.

**POWER LINE:** Universal, 100V to 240V.

**LINE FREQUENCY:** 50Hz and 60Hz, automatically sensed at power-up.

**POWER CONSUMPTION:** 28VA with DMM and display, up to 140VA with six 37xx cards.

**REAL TIME CLOCK:** Battery backed, 10 years typical life.

**EMC:** Conforms to European Union EMC Directive.

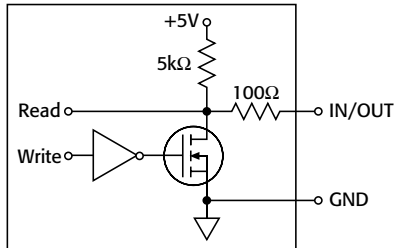**SAFETY:** Conforms to European Union Low Voltage Directive.

**VIBRATION:** MIL-PRF-28800F Class 3, Random.
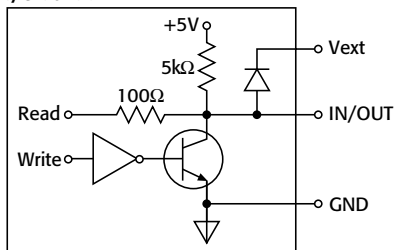
**WARM-UP:** 2 hours to rated accuracy.

**DIGITAL I/O:** 25-pin female D-shell.

| | I/O 1–9 | I/O 10–14 | Vext |
|---|---|---|---|
| $I_{SINK}$, max. | 5 mA | 250 mA | — |
| Absolute $V_{IN}$ | 5.25 V to −0.25 V | 5.25 V to −0.25 V | 5 V to 33 V |
| $V_{IH}$ min | 2.2 V | 2.2 V | — |
| $V_{IL}$ max | 0.7 V | 0.7 V | — |
| $V_{OL}$ max at 5mA $I_{sink}$ | 0.7 V | 0.7 V | — |
| $V_{OL}$ max at $I_{sink}$ max | — | 2.3 V | — |
| $V_{OH}$ min, 0.4mA source | 2.7 V | 2.4 V | — |
| Min $V_{IN}$ pulse | 2 $\mu$s | 10 $\mu$s | — |
| Min $V_O$ pulse | 1 $\mu$s | 50 $\mu$s | — |

### I/O 1–9



### I/O 10–14



**TRIGGERING AND MEMORY:**

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

**Trigger Delay:** 0 to 99 hrs. (10$\mu$s step size).

**External Trigger Delay:** <10$\mu$s.

**Memory:** Up to 650,000 time-stamped readings with Web page disabled. Additional memory available with external "thumb drive."

**Non-volatile Memory:** Single user save setup, with up to 75 DMM configurations and ≥600 channel patterns (dependent on name length, DMM function and configuration, and pattern image size). Additional memory available with external "thumb drive."

**MATH FUNCTIONS:** Rel, dB, Limit Test, %, 1/x, and mX+b with user defined displayed.

**REMOTE INTERFACE:**

**Ethernet:** RJ-45 connector, LXI Class B Version 2, 10/100BT, no auto MDIX.

**GPIB:** IEEE-488.1 compliant. Supports IEEE-488.2 common commands and status model topology.

**USB Device (rear panel, type B):** Full speed, USBTMC compliant.

**USB Host (front panel, type A):** USB 2.0, support for thumb drives.

**LXI COMPLIANCE:** LXI Class B Version 2 with IEEE 1588 precision time protocol.

**LXI TIMING (applies to scanning) and SPECIFICATION:**

**Receive LAN[0–7] Event Delay:** n/s (not specified) min., 800$\mu$s typ., n/s max.

**Alarm to Trigger Delay:** 25$\mu$s min., 50$\mu$s typ., n/s max.

**Generate LAN[0–7] Event:** n/s min., 800$\mu$s typ., n/s max. (minimums are probabilistic and represent a 95% confidence factor).

**Clock Accuracy:** 25ppm.

**Synchronization Accuracy:** <150ns (probabilistic and represents a 95% confidence factor).

**Timestamp Accuracy:** 100$\mu$s.

**Timestamp Resolution:** 20ns.

**LANGUAGE:** Embedded Test Script Processor (TSP) accessible from any host interface. Responds to individual Instrument Control Library (ICL) commands. Responds to high-speed test scripts comprised of ICL commands and Test Script Language (TSL) statements (e.g., branching, looping, math, etc.). Able to execute high-speed test scripts stored in memory without host intervention.

**IP CONFIGURATION:** Static or DHCP.

**PASSWORD PROTECTION:** 11 characters

**MINIMUM PC HARDWARE:** Intel Pentium 3, 800MHz, 512Mbyte RAM, 210Mbyte disk space or better.

**OPERATING SYSTEMS/SOFTWARE:** Windows® 2000 and XP compatible, supports Web browsers with Java plug-in (requires Java plug-in 1.6 or higher). Web pages served by 3706A.

**OPERATING ENVIRONMENT:** Specified for 0° to 50°C, ≤80%RH at 35°C, altitude up to 2000 meters.

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

**DIMENSIONS:**

**Rack Mounted:** 89mm high × 483mm wide × 457mm deep (3.5 in. × 19 in. × 18 in.).

**Bench Configuration (includes handle and feet):** 104mm high × 483mm wide × 457mm deep (4.125 in. × 19 in. × 18 in.)

**SHIPPING WEIGHT:** 13kg (28 lbs).

**KEITHLEY**
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