Series 3700A System Switch/Multimeter

User's Manual

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3700AS-900-01C

KEITHLEY
A Tektronix Company

Series 3700A

System Switch/Multimeter

User's Manual

The following safety precautions should be observed before using this product and any associated instrumentation. Although some instruments and accessories would normally be used with nonhazardous voltages, there are situations where hazardous conditions may be present.

This product is intended for use by personnel who recognize shock hazards and are familiar with the safety precautions required to avoid possible injury. Read and follow all installation, operation, and maintenance information carefully before using the product. Refer to the user documentation for complete product specifications.

If the product is used in a manner not specified, the protection provided by the product warranty may be impaired.

The types of product users are:

Responsible body is the individual or group responsible for the use and maintenance of equipment, for ensuring that the equipment is operated within its specifications and operating limits, and for ensuring that operators are adequately trained.

Operators use the product for its intended function. They must be trained in electrical safety procedures and proper use of the instrument. They must be protected from electric shock and contact with hazardous live circuits.

Maintenance personnel perform routine procedures on the product to keep it operating properly, for example, setting the line voltage or replacing consumable materials. Maintenance procedures are described in the user documentation. The procedures explicitly state if the operator may perform them. Otherwise, they should be performed only by service personnel.

Service personnel are trained to work on live circuits, perform safe installations, and repair products. Only properly trained service personnel may perform installation and service procedures.

Keithley products are designed for use with electrical signals that are measurement, control, and data I/O connections, with low transient overvoltages, and must not be directly connected to mains voltage or to voltage sources with high transient overvoltages. Measurement Category II (as referenced in IEC 60664) connections require protection for high transient overvoltages often associated with local AC mains connections. Certain Keithley measuring instruments may be connected to mains. These instruments will be marked as category II or higher.

Unless explicitly allowed in the specifications, operating manual, and instrument labels, do not connect any instrument to mains.

Exercise extreme caution when a shock hazard is present. Lethal voltage may be present on cable connector jacks or test fixtures. The American National Standards Institute (ANSI) states that a shock hazard exists when voltage levels greater than 30 V RMS, 42.4 V peak, or 60 VDC are present. A good safety practice is to expect that hazardous voltage is present in any unknown circuit before measuring.

Operators of this product must be protected from electric shock at all times. The responsible body must ensure that operators are prevented access and/or insulated from every connection point. In some cases, connections must be exposed to potential human contact. Product operators in these circumstances must be trained to protect themselves from the risk of electric shock. If the circuit is capable of operating at or above 1000 V, no conductive part of the circuit may be exposed.

Do not connect switching cards directly to unlimited power circuits. They are intended to be used with impedance-limited sources. NEVER connect switching cards directly to AC mains. When connecting sources to switching cards, install protective devices to limit fault current and voltage to the card.

Before operating an instrument, ensure that the line cord is connected to a properly-grounded power receptacle. Inspect the connecting cables, test leads, and jumpers for possible wear, cracks, or breaks before each use.

When installing equipment where access to the main power cord is restricted, such as rack mounting, a separate main input power disconnect device must be provided in close proximity to the equipment and within easy reach of the operator.

For maximum safety, do not touch the product, test cables, or any other instruments while power is applied to the circuit under test. ALWAYS remove power from the entire test system and discharge any capacitors before: connecting or disconnecting cables or jumpers, installing or removing switching cards, or making internal changes, such as installing or removing jumpers.

Do not touch any object that could provide a current path to the common side of the circuit under test or power line (earth) ground. Always make measurements with dry hands while standing on a dry, insulated surface capable of withstanding the voltage being measured.

For safety, instruments and accessories must be used in accordance with the operating instructions. If the instruments or accessories are used in a manner not specified in the operating instructions, the protection provided by the equipment may be impaired.

Do not exceed the maximum signal levels of the instruments and accessories. Maximum signal levels are defined in the specifications and operating information and shown on the instrument panels, test fixture panels, and switching cards.

When fuses are used in a product, replace with the same type and rating for continued protection against fire hazard.

Chassis connections must only be used as shield connections for measuring circuits, NOT as protective earth (safety ground) connections.

If you are using a test fixture, keep the lid closed while power is applied to the device under test. Safe operation requires the use of a lid interlock.

If a ⏚ screw is present, connect it to protective earth (safety ground) using the wire recommended in the user documentation.

The ⚠ symbol on an instrument means caution, risk of hazard. The user must refer to the operating instructions located in the user documentation in all cases where the symbol is marked on the instrument.

The ⚡ symbol on an instrument means warning, risk of electric shock. Use standard safety precautions to avoid personal contact with these voltages.

The symbol on an instrument shows that the surface may be hot. Avoid personal contact to prevent burns.

The symbol indicates a connection terminal to the equipment frame.

If this (Hg) symbol is on a product, it indicates that mercury is present in the display lamp. Please note that the lamp must be properly disposed of according to federal, state, and local laws.

The **WARNING** heading in the user documentation explains hazards that might result in personal injury or death. Always read the associated information very carefully before performing the indicated procedure.

The **CAUTION** heading in the user documentation explains hazards that could damage the instrument. Such damage may invalidate the warranty.

The **CAUTION** heading with the ⚠ symbol in the user documentation explains hazards that could result in moderate or minor injury or damage the instrument. Always read the associated information very carefully before performing the indicated procedure. Damage to the instrument may invalidate the warranty.

Instrumentation and accessories shall not be connected to humans.

Before performing any maintenance, disconnect the line cord and all test cables.

To maintain protection from electric shock and fire, replacement components in mains circuits — including the power transformer, test leads, and input jacks — must be purchased from Keithley. Standard fuses with applicable national safety approvals may be used if the rating and type are the same. The detachable mains power cord provided with the instrument may only be replaced with a similarly rated power cord. Other components that are not safety-related may be purchased from other suppliers as long as they are equivalent to the original component (note that selected parts should be purchased only through Keithley to maintain accuracy and functionality of the product). If you are unsure about the applicability of a replacement component, call a Keithley office for information.

Unless otherwise noted in product-specific literature, Keithley instruments are designed to operate indoors only, in the following environment: Altitude at or below 2,000 m (6,562 ft); temperature 0 °C to 50 °C (32 °F to 122 °F); and pollution degree 1 or 2.

To clean an instrument, use a cloth dampened with deionized water or mild, water-based cleaner. Clean the exterior of the instrument only. Do not apply cleaner directly to the instrument or allow liquids to enter or spill on the instrument. Products that consist of a circuit board with no case or chassis (e.g., a data acquisition board for installation into a computer) should never require cleaning if handled according to instructions. If the board becomes contaminated and operation is affected, the board should be returned to the factory for proper cleaning/servicing.

Safety precaution revision as of June 2017.

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Introduction

In this section:

Welcome

Thank you for choosing a Keithley Instruments product. The Series 3700A System Switch/Multimeter features 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.

Introduction to this manual

This manual provides information to familiarize you with the Keithley Instruments Series 3700A System Switch/Multimeter. It provides the basics of two of the Series 3700A interfaces, the front panel and the web interface, to familiarize you with the instrument.

For application examples that demonstrate how to use the instrument in specific situations, refer to the *Series 3700A Application Manual*.

For detailed information about the Series 3700A, refer to the *Series 3700A Reference Manual*.

Contact information

If you have any questions after you review the information in this documentation, please contact your local Keithley Instruments office, sales partner, or distributor. You can also call the Tektronix corporate headquarters (toll-free inside the U.S. and Canada only) at 1-800-833-9200. For worldwide contact numbers, visit tek.com/contact-us.

Extended warranty

Additional years of warranty coverage are available on many products. These valuable contracts protect you from unbudgeted service expenses and provide additional years of protection at a fraction of the price of a repair. Extended warranties are available on new and existing products. Contact your local Keithley Instruments office, sales partner, or distributor for details.

Product documentation, drivers, and software

The Series 3700A documentation is available for download in PDF format on the Product Support web page (tek.com/product-support). Documentation includes:

- **Quick Start Guide:** Provides unpacking instructions, describes basic connections, and reviews basic operation information. If you are new to Keithley Instruments equipment, refer to the Quick Start Guide to take the steps needed to unpack, set up, and verify operation.

- **User's Manual:** Provides an overview of the instrument, information on how to set up remote communications, and basic operating information.

- **Application Manual:** Provides application examples. If you need a starting point to begin creation of applications, refer to the Application Manual for a variety of specific examples.

- **Reference Manual:** Includes advanced operation topics and maintenance information. Programmers looking for a command reference, and users looking for an in-depth description of the way the instrument works (including troubleshooting and optimization), should refer to the Reference Manual.

- **Switching and Control Cards Reference Manual:** Contains information specific to the switch cards that can be used with the Series 3700A.

- **Additional product information:** Product data sheets, product specifications, and accessories information.

Additional drivers and software are available for download from the Product Support web page (tek.com/product-support), including:

- **Keithley Instruments Test Script Builder (TSB):** A software tool that simplifies building and creating test scripts. It includes built-in color coding, debugging tools, and error handling.

- **Keithley I/O Layer:** Software that manages the communications between Keithley instrument drivers and software applications and the instrument.

- J2SE™ Runtime Environment: Web browser plug-in required to run the web applications that

- are available through the instrument web interface.

- Drivers for National Instruments LabView™.

- Firmware updates.

To identify IP addresses of instruments connected to the local area network (LAN) that support VXI-11 discovery protocol, including the Series 3700A, you can also use the LXI Discovery Tool, available from the Resources tab of the LXI Consortium website (lxistandard.org).

Measuring capabilities

The basic measurement capabilities of Series 3700A systems are summarized in the following figure.

Figure 1: Multimeter measurement capability
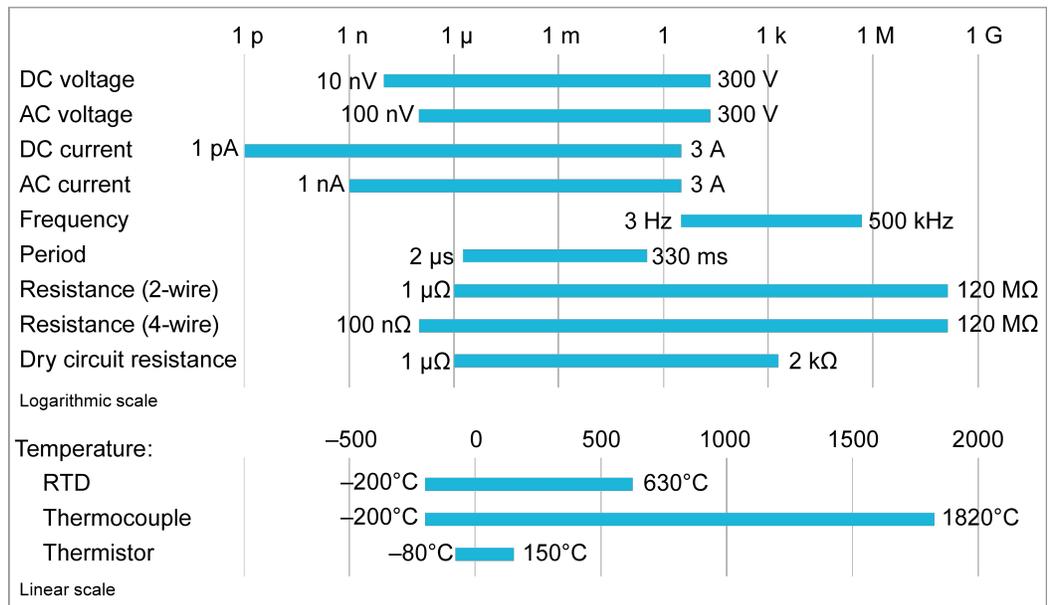
Safety precautions for connections

⚠ WARNING

Connection information for switching cards is intended for qualified service personnel. Do not attempt to connect DUT or external circuitry to a switching card unless qualified to do so.

To prevent electric shock that could result in serious injury or death, comply with these safety precautions:

Before making or breaking any connections to the switching card, make sure the Series 3700A is turned off and power is removed from all external circuitry.

Do not connect signals that will exceed the maximum specifications of any installed switching card.

If both the rear analog backplane connector of the Series 3700A and the switching card terminals are connected at the same time, the test lead insulation must be rated to the highest voltage that is connected. For example, if 300 V is connected to the analog backplane connector, the test lead insulation for the switching card must also be rated for 300 V.

Dangerous arcs of an explosive nature in a high-energy circuit can cause severe personal injury or death if contacted. If the multimeter is connected to a high-energy circuit when set to a current range, low resistance range, or any other low-impedance range, the circuit is virtually shorted.

Dangerous arcing can result (even when the multimeter is set to a voltage range) if the minimum voltage spacing is reduced in the external connections. For details about how to safely make high energy measurements, see High-energy circuit safety precautions in the *Series 3700A Reference Manual*.

As described in the International Electrotechnical Commission (IEC) Standard IEC 664, the Series 3700A is Installation Category I and must not be connected to mains.

Using the front-panel interface

In this section:

Introduction

Before starting this section, complete the tasks outlined in the Series 3700A Quick Start Guide. Once you have completed those tasks, read this section, which provides enough basic information about the Model 3706A front-panel interface to begin working with the Series 3700A.

The Keithley Instruments Models 3706A and 3706A-S front panels contain the following items:

- (1) The USB port (on page 2-3)

- (2) The display (on page 2-3)

- (3) The navigation wheel (on page 2-5)

- (4) The POWER key (on page 2-5)

- (5) The status lights (on page 2-5)

- (6) The setup and control keys (on page 2-5)

For these models, you can use the keys, display, and the navigation wheel ☉ to access, view, and edit the menu items and set values.

NOTE

The Model 3706A-SNFP front panel does not have a display, navigation wheel, and setup and control keys. These models are configured and controlled through a remote interface. For more information, see Using the web interface (on page 3-1) in this manual, and refer to the *Series 3700A Reference Manual* for detailed information about instrument programming and remote commands.

Series 3700A front panel overview

The Series 3700A includes several models that support different features. The following figures show the front panels of each of the models; a brief description of the features follows the figures.

For more detailed information about the Model 3706A front panel, see the "General operation" section in the *Series 3700A Reference Manual*.

Figure 2: Model 3706A with DMM front panel

Figure 3: Model 3706A-S front panel (no DMM)

Figure 4: Model 3706A-SNFP (no DMM) front panel

(1) The USB port

(USB port)

Use the front-panel USB port to connect a USB flash drive. The USB flash drive can be used to store reading buffer data, scripts, and user setup options.

(2) The display

During setup, the display shows menu choices that you can use to configure the instrument. See "Menu overview" in the *Series 3700A Reference Manual* for more information about Series 3700A menus.

During operation, the display provides information about the selected channel, channel pattern, channel state, and errors. It also shows the control status (local or remote). If `REM` is displayed, the instrument is presently controlled through a remote interface (GPIB, LAN, or USB). If `REM` is not displayed, control is through the front panel. The following figure shows an example of the Series 3700A during operation.

Figure 5: Series 3700A display during operation

Series 3700A display during operation	
1	Active channel (slot 1, channel 004)
2	Channel state (open, 2-pole operation)
3	Present state of the DMM attributes for displayed channel: ▪ The 4-WΩ and autorange are enabled ▪ Dry-circuit ohms is disabled (DRY−) ▪ Offset compensation is off (OC−) For detailed descriptions of the DMM attribute symbols, see the table labeled "DMM attribute symbols" in the "Front-panel operation" topic in the *Series 3700A Reference Manual*
4	Arrow indicating that more menu items exist; turn the navigation wheel ☉ to the left or right to see the additional items
5	The 4-WΩ and autorange is enabled
6	Indicates the instrument is in remote operation rather than local operation

The table below lists the display indicators and what they mean.

Indicator	Meaning
AUTO	Measure autorange is selected
EDIT	Instrument is in the editing mode
ERR	Questionable reading or invalid calibration step
FILT	Digital filter is enabled
LSTN	Instrument is addressed to listen
MATH	Enabled for mX+b, percent, or reciprocal (1/X) calculation
REL	Relative mode is enabled
REM	Instrument is in remote mode
SRQ	Service request is asserted
TALK	Instrument is addressed to talk
TRIG	Instrument is processing a front-panel reading request
4W	Four-wire resistance or RTD temperature reading
* (asterisk)	Readings are being stored in the buffer

The bottom left line of the display contains the DMM attribute symbols. The symbols that appear are dependent on whether the attribute exists for the selected function. The following table indicates the DMM attribute symbols that may appear on the front panel. If the symbol has a value associated with it, the third column in the table indicates the value definition.

DMM attribute symbols

Front-panel DMM attribute	Symbol	Values
range	R=	AUTO or n, where n equals the range
nplc	N=	n, where n equals the NPLC
autodelay	AD	+ for ON, 1 for ONCE, or 0 for OFF
autozero	AZ	+ for ON or – for OFF
line sync	LS	+ for ON or – for OFF
limit	LIM	+ for a limit enabled or – for limits disabled
detector bandwidth	DBW	3, 30, or 300
threshold	THR=	n, where n indicates the threshold
aperture	A=	n, where n indicates the aperture setting
dry circuit	DRY	+ for ON or – for OFF
offset compensation	OC	+ for ON or – for OFF
thermocouple sensor K	K_T/C	N/A
thermocouple sensor T	T_T/C	N/A
thermocouple sensor E	E_T/C	N/A
thermocouple sensor R	R_T/C	N/A
thermocouple sensor S	S_T/C	N/A
thermocouple sensor B	B_T/C	N/A
thermocouple sensor N	N_T/C	N/A
thermistor	THRM	N/A
three-wire RTD	3RTD	N/A
4-wire RTD	4RTD	N/A
simulated reference junction	RJ_SIM	N/A
internal reference junction	RJ_INT	N/A
external reference junction	RJ_EXT	N/A

(3) The navigation wheel

Turn the navigation wheel to scroll to a menu option or to change the value of the selected numeric parameter. Pressing the navigation wheel has the same functionality as pressing the **ENTER** key.

When changing a multiple character value, such as an IP address or channel pattern name, press the navigation wheel to enter edit mode, rotate the navigation wheel to change the characters value as needed, but do not leave edit mode. Use the **CURSOR** keys to scroll to the other characters and use the navigation wheel to change their value as needed. Press the **ENTER** key when finished changing all the characters.

(4) The POWER key

POWER

Power switch. The in position turns the Series 3700A on (I); the out position turns it off (O).

(5) The status lights

The Series 3700A has three status lights on the front panel.

The 1588 status light indicates 1588 operation. If this light is off, the 1588 feature is disabled or improperly configured. If the light blinks at a one-second rate, the instrument is the 1588 master. If the instrument is a slave, the light will not blink.

The LAN status light is lit when the instrument is connected through the local area network (LAN) with no errors. If this is not lit, the instrument is not connected through the LAN or there is a connection problem.

If you are using the web interface, the LAN Status light blinks when you click **ID**.

The POWER light is lit when power is applied to the instrument.

(6) The setup and control keys

The setup and control keys provide front panel control and configuration. The following figure illustrates each key's location. The table following the figure contains a definition of each key. For detailed information about front-panel keys, refer to the "Menu overview" topic in the *Series 3700A Reference Manual*.

Figure 6: Model 3706A with DMM setup and control keys

Key descriptions

Key	Description
DISPLAY	Toggles between the channel measure display, closed channels list, and the user message mode
CONFIG	Configures a function or operation
RESET	Restores factory default LAN settings
OPEN ALL	Opens all closed channels
STEP	Steps through each step in a predefined scan list
OPEN	Opens the selected channel or channel pattern
CLOSE	Closes the selected channel or channel pattern
STORE	Selects, clears, and saves reading buffer data and creates and deletes reading buffers
REC	Displays stored readings for selected reading buffer
RATE	Sets measurement speed (fast, medium, or slow) for the active or selected function
FUNC	Changes to the next function in a factory-defined list of available DMM functions
CHAN	If a channel is displayed, opens and closes channels; if a pattern is displayed, switches to channel view
PATT	If a pattern is displayed, manages, opens and closes, and resets patterns; if a channel is displayed, changes to display a pattern
SLOT	Displays information about the installed cards and the instrument, including firmware revision, model name, and model number
SCAN	Allows you to run, manage, view, and reset scan lists
DMM	Opens the DMM ACTION menu
LIMIT	Puts cursor in the compliance limit field for editing and selects the limit value to edit
REL	Controls relative measurements; allows baseline value to be subtracted from reading
FILTER	Enables or disables the digital filter; you can use this filter to reduce reading noise
LOAD	Loads test for execution
RUN	Runs the last selected user-defined test code
INSERT	Appends the present channels to the scan list
DELETE	Deletes channels or channel patterns from the scan list
TRIG	Triggers readings
MENU	Accesses the main menu, which can be used to configure instrument operation
EXIT (LOCAL)	Cancels selection and backs out of the menu structure; also used as a **LOCAL** key to take the instrument out of remote operation
ENTER	Accepts the current selection or brings up the next menu option; pressing this key is often the same as pressing the navigation wheel
AUTO	Enables or disables autorange for the selected function
RANGE (up and down arrows)	Selects the next higher or lower measurement range on the measurement display for the selected function
CURSOR	Moves the cursor left or right for editing and scrolls through menu options

Channel identification

The specifiers for the channels depend on the type of channels, as defined in the following topics.

Matrix card channel specifiers

The channels on the matrix cards are referred to by their slot, bank, row, and column numbers:

- **Slot number**: The number of the slot in which the card is installed.

- **Bank number**: The bank number, if used by your card. See your card documentation.

- **Row number**: The row number is either 1 to 8 or A to Z. See your card documentation.

- **Column number**: Always two digits. For columns greater than 99, use A, B, C and so on to represent 10, 11, 12, …; the resulting sequence is: 98, 99, A0, A1, …, A8, A9, B0, B1, …

Matrix card channel examples

Specifier	Slot number	Bank number	Row number	Column number
1104	1	N/A	1	04
11104	1	1	1	04
1203	1	N/A	2	03
213A4	2	1	3	104
3112	3	N/A	1	12
62101	6	2	1	01

Analog backplane relay channel specifiers

The channels for slots with analog backplane relays are referred to by their slot, backplane, bank, and relay numbers:

- **Slot number:** The number of the slot.

- **Backplane number:** Always 9.

- **Bank number:** The bank number, if used by your card. See your card documentation for detail.

- **Analog backplane relay number:** The number of the backplane relay. Typically 1 to 6. See your card documentation for detail.

Backplane relay examples

Specifier	Slot number	Backplane number	Bank number	Backplane relay number
1914	1	9	1	4
1922	1	9	2	2
2924	2	9	2	4
3916	3	9	1	6

Multiplexer, digital I/O, totalizer, and DAC channel specifiers

The channels for multiplexer (MUX), digital I/O, totalizer, and digital to analog converter channels are referred to by their slot and channel numbers:

- **Slot number:** The number of the slot in which the card is installed.

- **Channel number:** The number of the channel (always three digits).

Specifier	Slot number	Channel number
1004	1	004
2050	2	050
3012	3	012
3003	3	003
2007	2	007
1020	1	020

Operating a channel from the front panel

CAUTION

Hot switching can dry-weld reed relays, causing them to always be on. Hot switching is recommended only when external protection is provided.

You can perform operations on a single channel from the front panel.

To select a channel:

1. If the instrument is being controlled remotely, press **EXIT** to allow control from the front panel.

2. Press the navigation wheel ☉ to select the first digit of the channel specifier, which is the slot number indicated by 1 in the following figure. The digit flashes, which indicates that it can be edited.

Figure 7: Select a channel from the Model 3706A front panel

3. To change to a different slot number, turn the navigation wheel ☉ until the slot number you want is displayed.

4. Press navigation wheel ☉.

5. If your card supports banks, the next number you can select is the bank number. Set this as needed using the navigation wheel ☉.

6. Set the channel number (or rows and columns for installed matrix cards), identified as 2 in the following figure, as needed using the navigation wheel ⊙.

7. The display shows the current state of the selected channel in the bottom row, as shown by 3 in the following figure. In this example, the channel is open and 2-pole.

Figure 8: Series 3700A selected channel state

NOTE

If you see **:** followed by a channel specifier, you selected a range; press **EXIT** to return to the main display and reselect your channel.

8. To:
   - Close a channel without affecting any other channels: Select **CLOSE**.
   - Open the channel: Press **OPEN**.
   - Close a channel and open any other closed channels on the instrument: Select **CHAN** and select **EXCLOSE**. Press **ENTER** to close the selected channels.
   - Close a channel and open any other closed channels on the slot that contains the selected channel: Select **CHAN**, and then select **EXSLOTCLOSE**. Press **ENTER** to close the selected channels.

NOTE

Once a channel is selected, it is the selected channel for any subsequent front-panel operations.

Viewing the close or open status of a channel

Closed channels are shown separated by commas after the `CLS:` characters on the display of the instrument. If no channels are closed, `<none>` is displayed here. If the list of closed channels extends past one screen, `...` is displayed at the end of the line. Press **DISPLAY** to display the full list of closed channels. Use the navigation wheel ☉ to scroll through the list. After viewing the list, press **DISPLAY** twice to return to the main display.

Figure 9: Multiple closed channels
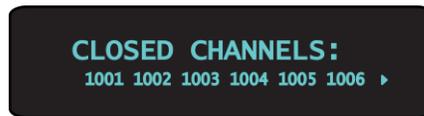
Emulate a Model 3706

If you replace a Model 3706 with a Model 3706A in a system where computer drivers may be querying the model, you may need to emulate a 3706. This can occur if you replace a 3706 with a 3706A in an existing system, or if you duplicate a system but use a 3706A instead of a 3706.

When this is set to emulate a 3706, the model number is reported as a 3706 when you send a request with a command such as `localnode.model` or `*idn?`. This allows drivers that query the model number to continue to operate normally.

This setting is maintained through an instrument reset and through power cycles.

To emulate a Model 3706 using the front panel menus:

1. If the instrument is being controlled remotely, press **EXIT** to allow control from the front panel.
2. Press **MENU**.
3. Use navigation wheel ☉ to display and select **EMULATION**.
4. Select **3706**.
5. Press **ENTER**.

You can also use the remote command `localnode.emulation` to set emulation.

NOTE

All other Model 3706A behavior is the same. Emulation mode does not affect the changes to the IEEE-1588 features or the response times that occurred with the update from the Model 3706 to the Model 3706A.

Channel patterns

You can use channel patterns as a convenient way to refer to a group of switching channels and backplane relays with a single alphanumeric name. When you perform close or open operations on a channel pattern, only the channels and analog backplane relays that are in the channel pattern are affected.

There is no speed difference when performing close and open operations on channel patterns compared to performing the same operations on individual channels or a list of channels.

Create a channel pattern

When you create a channel pattern, make sure to:

- Include all the channels and backplane relays that are needed for that channel pattern.
- Check that channels in the pattern are correct.
- Check that channels in the pattern create the correct path connection.
- Make sure that channels that you want to include in the pattern are not set to forbidden to close.

When naming the channel pattern, be aware:

- The first character of the name must be alphabetic (upper or lower case)
- Names are case sensitive
- Pattern names must be different than channel labels

To create channel pattern "TEST01" from channels that are presently closed:

1. Close the channels you want to include in the channel pattern. For this example, close channels **1001**, **1015**, and **1031**. Refer to for instructions on how to close individual channels.
2. Press the **PATT** key.
3. From this menu, select the **CREATE** menu item.
4. From this menu, select the **SNAPSHOT** menu item.
5. At the prompt, enter a pattern name using the navigation wheel ☉. For this example, enter the name **TEST01**. Use the navigation wheel ☉ to select each character of the name.
6. Press the **ENTER** key to apply the selection.
7. Press the **EXIT** key to leave the menu.

NOTE

Refer to "Channel patterns" in the *Series 3700A Reference Manual* for more details.

Performing close and open operations on channel patterns

⚠ WARNING

Careless channel pattern operation could create an electric shock hazard that could result in severe injury or death. Improper operation can also cause damage to the switching cards and external circuitry. The control of multiple channels using channel patterns should be restricted to experienced test engineers who recognize the dangers associated with multiple channel closures.

You can close and open channel patterns the same way you do for individual channels.

When you request a close or open operation, the Series 3700A verifies that the channels exist for a pattern but does not verify that the switch path connection is correct. You must ensure the requested operation is safe for a channel pattern and that a good connection will result for your application with the channel pattern.

To close channel pattern "TEST01" from the front panel:

1. Press the **PATT** key to display a channel pattern.
2. Use the navigation wheel ☉ to select **TEST01**, the channel pattern you want to close.
3. Perform any of the following actions:
   - Open the channels in the channel pattern: Press **OPEN**.
   - Close the channels in the channel pattern without affecting any other channels: Press **CLOSE**.
   - Close the channels in the channel pattern and open any other closed channels on the instrument: Select **PATT** and select **EXCLOSE**. Press **ENTER** to open or close the channels.
   - Close the channels in the channel pattern and open any other closed channels on the slot: Press **PATT** and select **EXSLOTCLOSE**. Press **ENTER** to open or close the channels.

Set up row, column, and channel labels

You can define labels for channels. Using labels is a more descriptive way to refer to switching paths than the default channel identifiers.

Labels must be unique; they cannot have the same as the name of another channel or channel pattern. Labels cannot contain spaces, and they do not persist through a power cycle.

Channel labels can be up to 19 characters. You can set labels only for channels that are in the instrument.

To create a channel label using the front panel:

1. Press the **CONFIG** key, and then press the **CHAN** key. The CHANNEL ATTR MENU opens.

2. Select **LABEL**, and the press the navigation wheel ☉.

3. Press the navigation wheel ☉ again to enter EDIT mode.

4. At the blinking cursor, turn the navigation wheel ☉ to the right to select an alphanumeric character, or turn it to the left to select a numeral.

NOTE

The cursor blinks for several seconds when you enter the EDIT mode; if the cursor stops blinking before you are done, press the navigation wheel again to resume EDIT mode.

5. Press the right cursor key to move to the next character to set.

6. Repeat steps 4 and 5 until you have added all the characters for the label.

7. Press the navigation wheel ☉ to save the label, and then press the **EXIT** key to return to the default display.

Front-panel scanning

A scan is a series of steps that opens and closes switches sequentially for a selected group of channels. During each step, actions occur, such as waiting for a trigger, taking a measurement, and completing a step count. Scans automate actions that you want to perform consistently and repeatedly on a set of channels.

Exercise: Perform a scan and save to a USB flash drive

This exercise creates a ten-channel scan operation to measure voltage on ten sequential channels. A buffer is created to store the scan data to save to a standard USB flash drive. For this exercise, assume a known voltage (or short) is connected across channels 1-5 and 17-21 on a multiplexing switch card installed in slot 1.

To perform a scan operation and save data to a USB flash drive:

1. Create a scan list.

    a. Use the navigation wheel ☉ to select and modify the start channel to **001**.

    b. Use the navigation wheel ☉ to select and modify the end channel to **005**.

    c. Press the **INSERT** key to add more channels to the scan list.

2. Assign the default voltage DC DMM configuration to the scan list:

    a. Use the navigation wheel ☉ to select **dcvolts** as the measurement configuration.

    b. Use the navigation wheel ☉ to select and modify the start channel to **1017**.

    c. Use the navigation wheel ☉ to select and modify the end channel to **1021**.

NOTE

In addition to the default DMM configurations, the scan list will also show the names of any user-created DMM configurations. For more information about user-created DMM configurations, see "Save DMM configurations" in the *Series 3700A Reference Manual*.

3. Create a buffer (required to save readings on the USB flash drive):

   a. Press the **STORE** key on the front panel.

   b. Use the navigation wheel ☉ to select **CREATE > fpbuf**.

NOTE

The default buffer name is `fpbuf`, but can be modified using the navigation wheel ☉ in edit mode. This example assumes the buffer name is `fpbuf`.

   c. Press **Enter** until `CAPACITY 000010` is displayed.

   d. Press **Enter**. The fpbuf MENU is displayed.

   e. Use the navigation wheel ☉ to choose **SELECT > fpbuf**, and then press **Enter**.

   f. Press the **EXIT** key to return to the active channel display.

4. Run the scan:

   a. Press the **SCAN** key.

   b. Use the navigation wheel ☉ to select **BACKGROUND**.

   c. Press **Enter**.

5. Store the buffer data on a USB flash drive:

   a. Insert the USB flash drive (not included) into the front-panel USB connector.

   b. Press the **STORE** key to access the buffer menu.

   c. Use the navigation wheel ☉ to select **SAVE > USB**.

   d. Use the navigation wheel ☉ to select the default buffer name **fpbuf** and change it to a more meaningful name for storage on the USB flash drive.

   e. Push the navigation wheel ☉ until the Buffer menu is displayed. The data file is now stored in the root directory on the USB flash drive.

Taking measurements without a switch card

Pseudocards

You can perform most open, close, and scan operations and configure your system without having an actual plug-in card installed in your instrument. Using the remote interface, you can assign a pseudocard, allowing the instrument to operate as if a plug-in card were installed.

NOTE

While most operations can be simulated with a pseudocard, some operations, such as channel delays, cannot be simulated.

A pseudocard cannot be configured from the front panel. However, once the remote configuration is complete, you can use the front panel to use the pseudocard. Press the **EXIT** key to take the instrument out of remote mode.

When the instrument is turned off, the pseudocard is no longer assigned to the slot.

NOTE

A saved setup or created configuration script retains the model number of the card installed in each slot. The model number of a pseudocard is the same as the model number of an actual card (except for Model 3732 cards; see the "Pseudocard support for the Model 3732" topic in the *Series 3700 Switch and Control Cards Reference Manual* for details). This allows a saved setup or created configuration script to be recalled if the installed card (or pseudocard) matches the model number for the slot in the saved setup or created configuration script.

# Using the analog backplane connector to make measurements

You can perform measurements without an installed switch card by using the rear-panel analog backplane connection, which is always connected to the digital multimeter (DMM) input. To connect to the analog backplane as shown below, use a standard DB-15 mating connector (not supplied).

CAUTION

The switch card and analog backplane connector cannot be used at the same time because they are connected in parallel.
There is no relay that connects to the DB-15 connector.

Figure 10: Analog backplane measurement connections
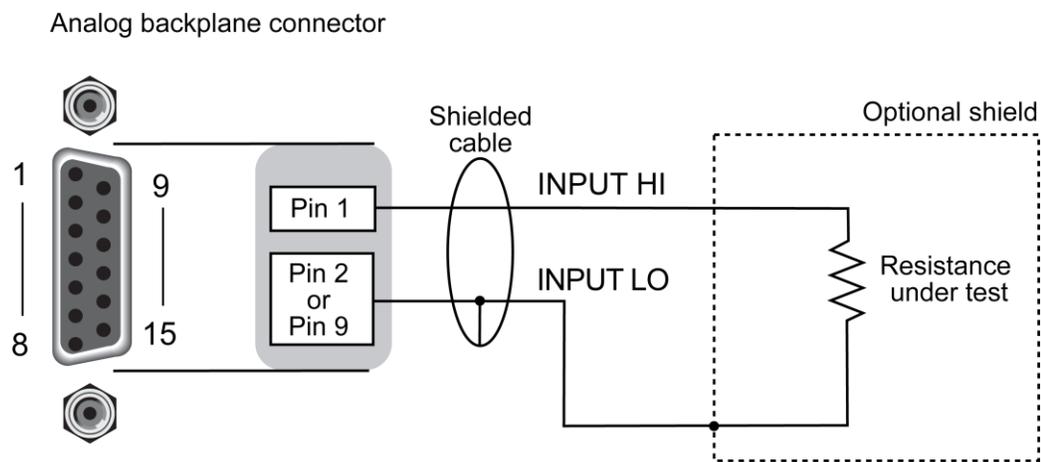
NOTE

Source current flows from the connector HI to the connector LO pins.

To make a measurement using the analog backplane connector:

1. Connect the resistor to the input terminals.

2. Configure the measurement by pressing the **FUNC** key until 2WΩ is displayed.

3. Press the **AUTO** key to enable the autorange feature. AUTO is displayed in upper right corner.

4. Press the **TRIG** key to trigger a reading.

Using the web interface

In this section:

Introduction

The Series 3700A web interface allows you to review instrument status, control the instrument, and upgrade the instrument over a LAN connection.

The instrument web page resides in the firmware of the instrument. Changes you make through the web interface are immediately made in the instrument.

Many examples in this manual and in the *Series 3700A Reference Manual* can be run through the TSB Embedded page of the instrument web interface.

Connecting to the instrument web interface

NOTE

The instrument web interface requires the web browser plug-in Java™ SE Runtime Environment Version 6 or later. The latest version of the plug-in is available from the Java download site (java.com/en/download/manual.jsp).

The instrument web interface uses Java applets and, depending on your browser security settings, may require your permission to download and install them.

To connect to the instrument web interface, you must have a LAN connection from the computer to the instrument. See "LAN concepts and settings" in the *Series 3700A Reference Manual* for more information about configuring the Series 3700A for a LAN connection, connecting the Series 3700A to the LAN, and establishing a LAN connection to the instrument.

To find the IP address of the Model 3706A from a computer, use the LXI Discovery Tool, a utility that is available from the Resources tab of the LXI Consortium website (lxistandard.org).

To manually set up the IP address to connect to the instrument web interface:

1. Connect the Series 3700A to the LAN and confirm that the LAN Status light on the instrument is illuminated.

2. Press the **MENU** key on the instrument front panel and then select
    LAN > STATUS > IP-ADDRESS.

3. Open an Internet browser, such as Microsoft® Windows® Internet Explorer® (version 6.0 or later only).

4. In the Address box of the Internet browser, enter the IP address of the instrument and press **Enter**.

The home page of the instrument web interface is displayed.

Web interface home page

The home page of the web interface gives you basic information about the instrument, including:

*   The instrument model, serial number, firmware revision, and LXI information

*   A list of slots and the switch cards that are installed in each slot

*   An **ID** button to help you locate the instrument

*   Links to the instrument web options, including TSB Embedded

Log in to the instrument

The web interface has both interactive and read-only pages. These pages are always listed in the navigation panel on the left side of the web interface. You can review information on any of the pages without logging in, but to change information, you must log in.

Pages that contain information you can change include a **Login** button. Once you have logged in to one page of the web interface, you do not need to log in again unless you reload the page.

To log in to the instrument:

1. Open a page that contains a Login button, such as one of the Cards pages, Scan Builder, or TSB Embedded.

Figure 11: Web interface login

2. Click **Login**. The login dialog box is displayed.

3. Enter the password (the default is **admin**).

Figure 12: Enter web interface password
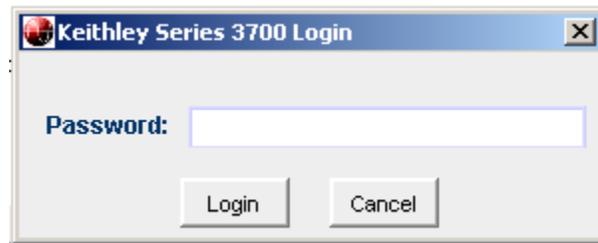
4. Click **Login**.

NOTE

The default password is `admin`. If the password has been changed, it is available from the front panel of the instrument. Press **MENU** > **LAN** > **STATUS** > **PASSWORD**.

Card pages

The card pages are interactive pages where you can work with channels in each slot.

To open a card page, on the left navigation, click the slot number.

There is a specific page for each card installed in the mainframe. The page displays a grid that shows the relay configuration of the switch card.

Figure 13: Series 3700A web interface cards page

Open and close channels from the card pages

You can open and close channels from the card pages in several ways.

The simplest method is to click a connection. The channel changes state to open or closed. When the channel is open, the connection will look similar to one of the following graphics (the actual item on the web interface depends on the installed card):

Figure 14: Web interface open channel


Figure 15: Web interface relay open
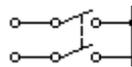
When the channel is closed, the connection will look similar to one of the following:

Figure 16: Web interface closed channel

Figure 17: Web interface relay closed
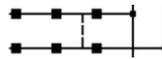
To specify the type of close, select a Channel Action Type from the box in the upper right before closing a channel. The options are:

- **Channel Close**: Close the selected channel without affecting the state of any other channels.
- **Exclusive Slot Close**: Close the selected channel and open any closed channels in the same slot.
- **Exclusive Close**: Close the selected channel and open any closed channels in the instrument (the only closed channel is the selected channel).

You can open all channels in a slot by clicking **Open Slot**.

You can open all channels in the instrument by clicking **Open All**.

For more information on opening and closing channels, see "Working with channels" in the *Series 3700A Reference Manual*.

Exercise: Close multiple channels using the web interface

This exercise describes how to close channels and channel patterns using the web interface.

To close multiple channels using the web interface:

1. The instrument home page is displayed. From the navigation on the left, select the slot that contains the channels you want to close.

Figure 18: Series 3700A web interface select slot
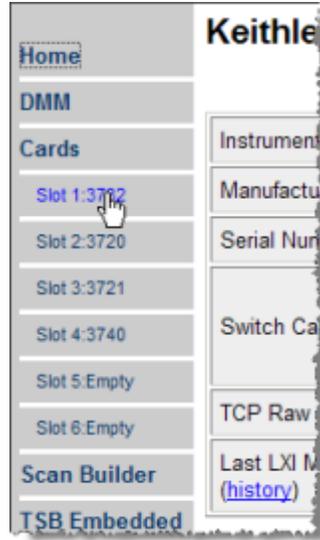
2. You must log into the instrument to work with the channels. See <u>Log in to the instrument</u> (on page 3-2). After logging in, you can access the channel controls.

3. To close channel "11101", click the channel.

Figure 19: Series 3700A web interface close channel
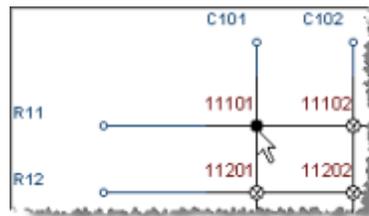
4. To perform an exclusive close on channel "11102", select **Exclusive Slot Close** in the Channel Action Type box.

Figure 20: Select exclusive slot close
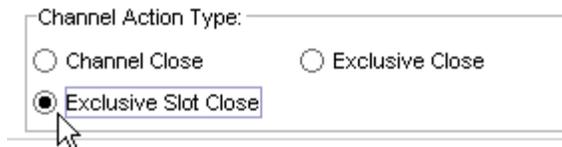
5. Click "11102" to close that channel and open all other channels.

Figure 21: Series 3700A web interface exclusive close
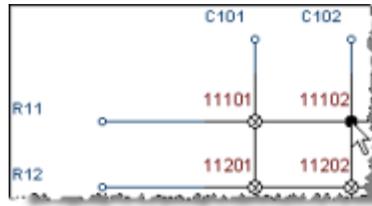
Set up channel patterns from the web interface

You can use channel patterns as a convenient way to refer to a group of switching channels with a single alphanumeric name. When you perform close or open operations on a channel pattern, only the channels that are in the channel pattern are affected.

There is no speed advantage in performing close and open operations on channel patterns compared to performing the same operations on individual channels or a list of channels.

Exercise: Create channel pattern "Test1Pattern" using the Snapshot feature

To create a channel pattern "Test1Pattern" from the web interface using the Snapshot feature:

1. From the left navigation, click **Slot 2**.

2. Close the channels that you want to include in the pattern. For this example, close channels **2001**, **2008**, **2014**, **2021**, and **2028**.

3. Click **Pattern** (above the Channel Action Type box). The Channel Pattern Configuration dialog box is displayed.

4. Type **Test1Pattern** for the pattern name in the box at the top of the dialog box.

5. Click **Snapshot**. A new pattern is created that contains the closed channels.

Figure 22: Series 3700A channel pattern configuration dialog box
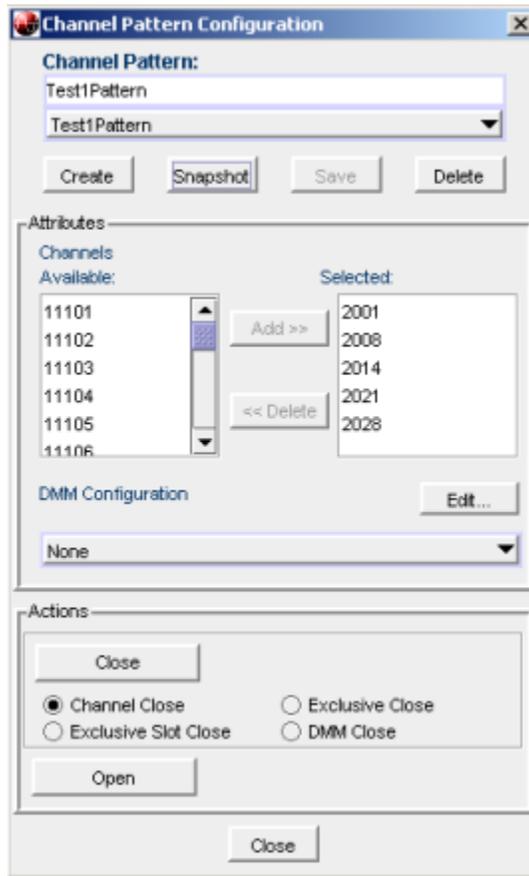
Exercise: Close channels in "Test1Pattern" from the web interface

To close channels in channel pattern "Test1Pattern" from the web interface:

1. Click **Pattern** (above the Channel Action Type box). The Channel Pattern Configuration dialog box is displayed.
2. Select **Test1Pattern** from the list at the top of the dialog box.
3. In the Actions area, select the type of close you want to perform.

Figure 23: Close channels in a pattern

4. Click **Close** to close the channels.

5. When you are done acting on this channel pattern, click **Close** at the bottom of the dialog box to exit.

To delete a channel pattern from the web interface:

1. Select the name of the pattern that you want to delete in the Channel Pattern Configuration dialog box.

2. Click **Delete**.

3. For more information about patterns, including opening and closing the channels that are in patterns, see <u>Channel patterns</u> (on page 2-11).

Scan Builder page

The Scan Builder page allows you to set up and run scans and triggers.

A scan is a series of steps that opens and closes switches sequentially for a selected group of channels. During each step, actions occur, such as waiting for a trigger, taking a measurement on an external instrument, and completing a step count. Scans automate actions that you want to perform consistently and repeatedly on a set of channels.

Triggers are events that prompt the instrument to move from one step to another in a scan. Triggers can come from a variety of sources, such as a key press, digital input, or expiration of a timer. The sequence of actions and events that occur during the scan is called the trigger model.

Scanning and triggering allow you to synchronize actions across channels. You can set up a scan using the trigger model to precisely time and synchronize the Series 3700A between channels and multiple instruments. You can also use triggers without the triggering model to set up a scan to meet the needs of a specific application that does not fit the triggering model.

NOTE

If you use Scan Builder to create a scan, use the options in the Scan Builder page to run the scan. Using the TSB Embedded page may not give you the expected results.

NOTE

If you create a reading buffer through the Scan Builder page, the name of the buffer must be different than the name of any scripts in the system.

Create a scan list

Before you can run a scan, you must create a scan list. A scan list is a set of steps that runs in order during a scan. Each step contains a channel, channels, or channel patterns that you want to measure in that step. Each step is acted on separately during the scan.

You can mix channel patterns and individual channels in a scan list. Note that the steps are executed in the order in which they are added to the scan.

NOTE

Before setting up a scan list, make sure your channels and channel patterns are configured. See "Working with channels" in the *Series 3700A Reference Manual* for detail.

If you change the channel configurations or channel patterns after the scan list has been set up, you may not see expected results. If the change prevents the scan from functioning properly (such as deleting something referenced by the scan), an error message is logged.

Exercise: Create a scan list from the web interface

In the following exercise, create a scan list containing channels **2001**, **2008**, **2014**, **2021**, **2028** and the pattern **Test1Pattern**.

To create the scan list from the web interface:

1. From the left navigation of the web interface home page, select **Scan Builder**.
2. In the Add Channel By list on the right, select **Number** to add the channels. Select the channel numbers from the list. You can use **Ctrl+click** to select multiple channels and **Shift+click** to select a range of channels. To remove your selections from the Add Channel By list, click **Clear Channel Selection**.
3. Click **Add Step**. The channels are added to the Steps list.
4. In the Add Channel By list on the right, select **Pattern**.
5. Select **Test1Pattern** from the Channel Pattern list.
6. Click **Add Step**. The pattern is added to the Steps list.
7. In the Scan Count box, enter the number of times you want to repeat the steps in the scan. For example, enter **5**.

Run the scan

You can run a scan in one of several ways:

- **Background:** Runs the scan in the background so that you can perform other tasks while the scan is running. You can use the Query State to check scan status.
- **Step by Step:** Steps through the scan.

To run the scan from the web interface:

Click **Execute Background** or **Step by Step**.

Stop the scan

To stop the scan from the web interface:

On the Build & Run tab, select **Abort**.

Clear the scan list from the web interface

Clearing the scan list deletes all channels and channel patterns from the scan list.

To clear the scan list from the web interface:

1. From the left navigation area of the web interface home page, select **Scan Builder**.
2. Click **Scan Clear**.

Set up simple triggers

You can set up triggers to control your scan using the options on the Simple Trigger tab. You can set:

- The event that starts the scan
- The time interval event that controls the channel action for each step of the scan
- The time interval event that controls how measurements are taken during the scan

To see these options, click the **Simple Trigger** tab from the top of the Scan Builder page.

Selecting scan triggers

You can choose the triggers that will be used to start the scan. The options to start the scan are:

- **Immediate**: When Immediate is selected, the scan starts as soon as you click **Execute Background** on the Build & Run tab. Select Immediate when you do not have trigger requirements that must be met before the scan starts. This is the default selection.
- **Digital Input**: When selected, you select the digital line (1 to 14) that is used to start a scan. You can select falling or rising for the digital input. Falling selects the falling edge trigger. Rising selects the rising edge of the trigger.

NOTE

If Other is displayed in the mode list, a different mode (other than falling or rising) is already selected. Other is not a mode and cannot be selected. It is only an indicator that the digital triggering is already set up for a different mode. See the *Series 3700A Reference Manual*, "Using the web interface" section, and the "Advanced triggering" topic for other options.

- **Time:** When selected, you can select options that define when the scan starts and at what rate triggers will occur. You can set the time of the first trigger in seconds from the scan start or on a specific date and time (year, month, day, hour, minute, and second). You can also select the time interval (in seconds) for subsequent triggers.

Selecting channel action triggers

You can select the trigger to use to continue channel action for each scan. The options to continue channel action are:

- **Immediate**: When immediate is selected, the scan immediately steps to the next channel in the scan list. This is the default setting.
- **Digital Input**: When selected, you select a digital line (1 to 14) that is used to trigger the instrument to step to the next channel. You can select falling or rising for the digital input. Falling selects the falling edge trigger. Rising selects the rising edge of the trigger.
- **Every** *N* **seconds**: This parameter adds a fixed delay between each channel. The delay occurs before the next channel in the scan list is closed.

Selecting measurement triggers

You can also select the trigger to use to take a measurement for each scan step.

- **Immediate**: When immediate is selected, the measurement is taken as soon as the channel is closed. This is the default setting.

- **Digital Input**: When selected, you select a digital line (1 to 14) that triggers the instrument to take a measurement. You can select falling or rising for the digital input. Falling selects the falling edge trigger. Rising selects the rising edge of the trigger.

- **Every** *N* **seconds**: This parameter adds a fixed delay after the channel is closed and before the measurement is made.

TSB Embedded

TSB Embedded is a web application that includes a command-line interface that you can use to issue commands and interact with the instrument. TSB Embedded also provides a convenient way to create and manage user scripts. TSB Embedded resides in the instrument.

You can use TSB Embedded to run the application examples in the *Series 3700A Application Manual*.

If you can access the web interface home page, but cannot use TSB Embedded (or TSP Express), make sure you have the Java™ SE Runtime Environment (JRE) Version 6 or later installed on your computer.

Create a script using TSB Embedded

NOTE

If you are using TSB Embedded to create scripts, you do not need to use the commands `loadscript` or `loadandrunscript` and `endscript`. For information about using TSB Embedded, see the help on the instrument's web page.

Exercise: Create and run a script with TSB Embedded

This exercise script checks each slot to see what channels are available.

To create and run a script with TSB Embedded:

1. From the navigation area on the left side of the web interface, select **TSB Embedded**. The TSB Embedded page is displayed.

Figure 24: Web interface: Select TSB embedded
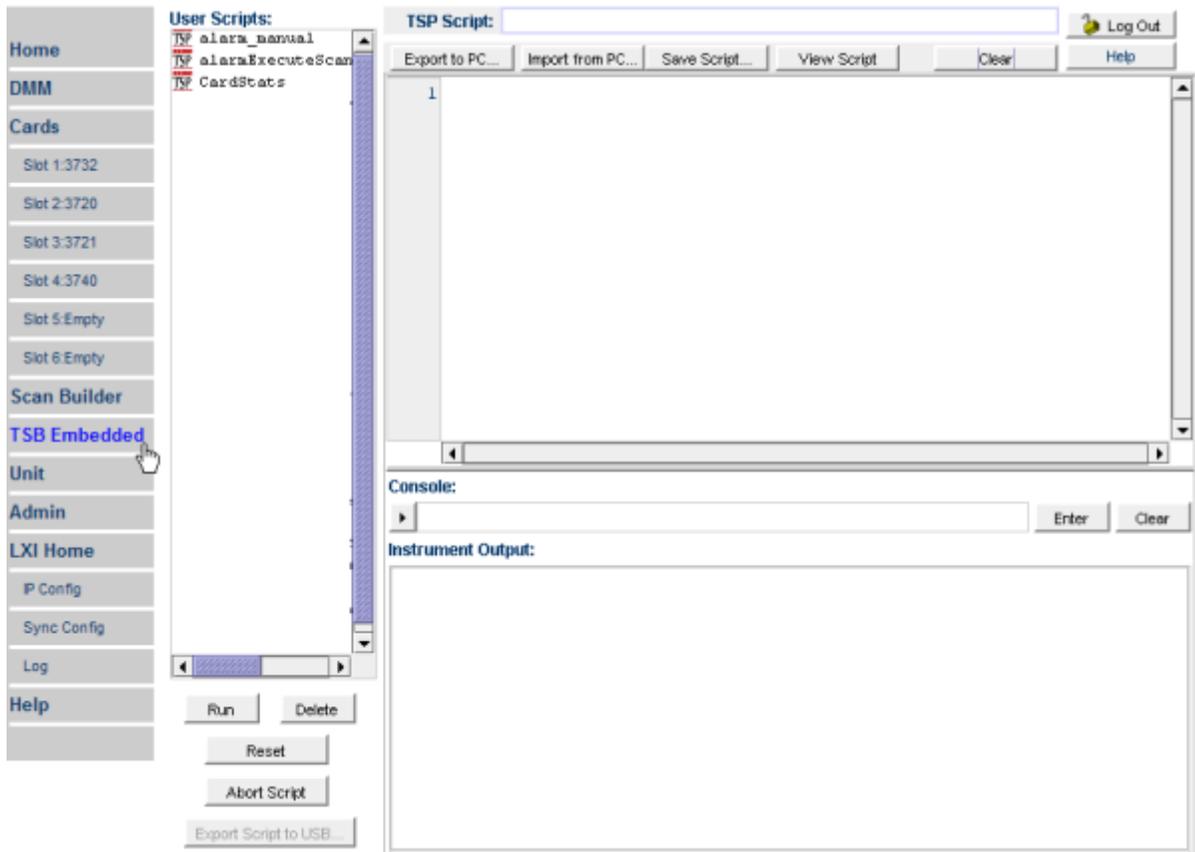
2. You must log in to the instrument to use TSB Embedded. After logging in, you can access the options on the TSB Embedded page.

3. To create the example script, enter the name, **CardStats**, in the TSP Script box.

Figure 25: Enter script name
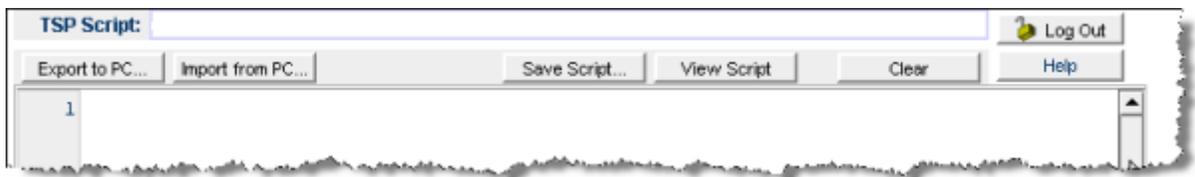
4. Enter the following code in the TSB box below the buttons.

```
CardChannels = function(SlotNumber)
   if slot[SlotNumber].idn == "Empty Slot" then
      print("   Slot is Empty")
   else
      if (slot[SlotNumber].startchannel.voltage == nil) and
          (slot[SlotNumber].endchannel.voltage == nil) then
         print("   no voltage channels")
   else
         print("   Start voltage channel is " ..
            slot[SlotNumber].startchannel.voltage)
         print("   End voltage channel is " ..
            slot[SlotNumber].endchannel.voltage)
      end
      if (slot[SlotNumber].startchannel.amps == nil) and
            (slot[SlotNumber].endchannel.amps == nil) then
         print("   no amp channels")
      else
         print("   Start amp channel is " ..
            slot[SlotNumber].startchannel.amps)
         print("   End amp channel is " ..
            slot[SlotNumber].endchannel.amps)
      end
      if (slot[SlotNumber].digio == 1) then
         print("   Start digital i/o channel is " ..
            slot[SlotNumber].startchannel.digitalio)
         print("   End digital i/o channel is " ..
            slot[SlotNumber].endchannel.digitalio)
      else
         print("   no digio channels")
      end
if (slot[SlotNumber].totalizer == 1) then
         print("   Start totalizer channel is " ..
            slot[SlotNumber].startchannel.totalizer)
         print("   End totalizer channel is " ..
            slot[SlotNumber].endchannel.totalizer)
      else
         print("   no totalizer channels")
      end
      if (slot[SlotNumber].startchannel.analogoutput == nil) and
            (slot[SlotNumber].endchannel.analogoutput == nil) then
         print("   no analog output channels")
      else
         print("   Start analog output channel is " ..
            slot[SlotNumber].startchannel.analogoutput)
         print("   End analog output channel is " ..
            slot[SlotNumber].endchannel.analogoutput)
      end
      if (slot[SlotNumber].matrix == 1) then
         print("   Channels on card are matrix type")
      end
   end
end
for x = 1,6 do
   print("Checking card channels in slot " .. x)
   CardChannels(x)
end
```

NOTE

Commands and parameters for Series 3700A are case-sensitive. It is important to type in the commands exactly as shown to avoid any syntax or execution errors.

---

5. Click **Save Script**. The script is added to the User Scripts list.

6. To run the script, select the script in the User Scripts list and click **Run**.

7. The Instrument Output box displays the output from the script and error messages.

Script management options

Existing scripts are listed in the User Scripts box on the left side of TSB Embedded.

To run a script, click the name of the script and then click **Run**.

To delete a script, click the name of the script and click **Delete**. The script is deleted from the User Scripts list and from the nonvolatile memory of the instrument.

To stop operation of a script, click **Abort Script**.

To export the selected script to a flash drive, click **Export Script to USB**. Place a flash drive in the USB port on the front panel of the instrument. In TSP, enter the name as appropriate and click **OK**. Scripts are saved to a file with the extension `tsp`. TSP files are native to Test Script Builder or TSB Embedded, but they can be opened and edited in any text editor.

To import scripts from the computer, click **Import from PC**. Select the directory that contains the file. You can only import files with the extension `tsp`.

To clear the name box and the box that contains the script, click **Clear**.

To view the contents of a script, type the name of a script in the TSP Script box and click **View Script**.

Exercise: Use the command line to close and open channels

Use the command line interface to perform close and open operations on channels:

1. To send a single command to the instrument, you can enter it in the Console box.

2. To close channel 1002, enter `channel.close("1002")` in the Console box.

3. Click **Enter** to send the command.

4. To open all channels, enter `channel.open("allslots")` in the Console box.

5. Click **Enter** to send the command.

Figure 26: Enter command in Console box

To resend a command, click the arrow on the left side of the Console box.

Figure 27: Web interface console
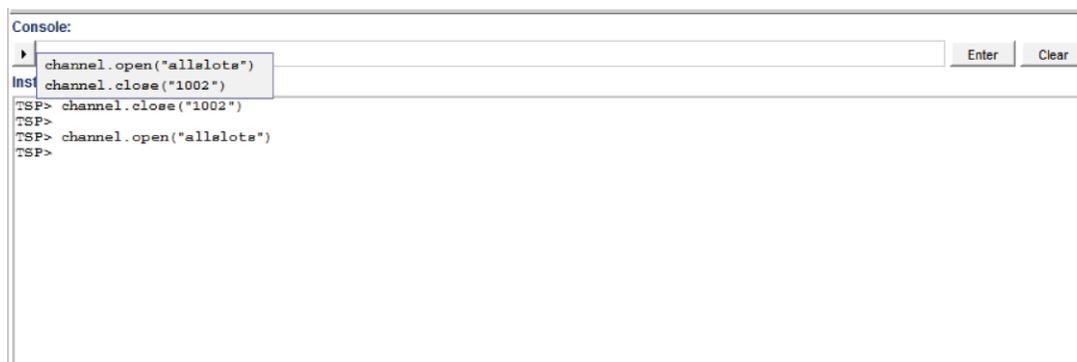
More information about commands that can be used to control the instrument can be found in the *Series 3700A Reference Manual.*

Maintenance

In this section:

Introduction

This section provides maintenance information and procedures that can be done by the operator.

⚠ WARNING

Disconnect all external power from the equipment and the line cord before performing any maintenance on the Model 3706A.
Failure to disconnect all power may expose you to hazardous voltages, that if contacted, could cause personal injury or death. Use appropriate safety precautions when working with hazardous voltages.

Fuse replacement

The Model 3706A has two replaceable fuses, the analog backplane AMPS fuse and the instrument fuse. Both fuses are accessible from the rear panel, as shown in the following figure.

Figure 28: Series 3700A fuse locations
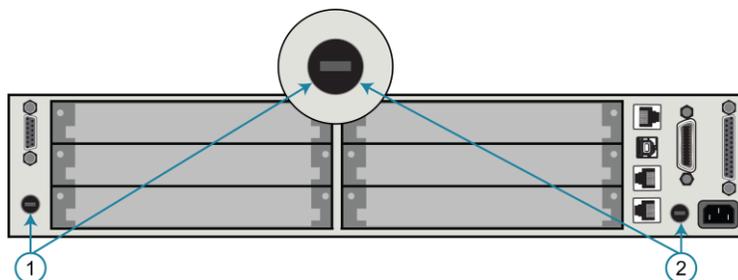
The replacement part numbers are provided in the following table.

Fuse location	Rating	Keithley Instruments part number
1. Analog backplane fuse	250 V, 3 A fast blow 5 × 20 mm	FU-99-1
2. Instrument fuse	250 V / 1.25 A slow blow 5 × 20 mm	FU-106-1.25

CAUTION

To prevent instrument damage, do not use a fuse with a higher current rating than specified. If the instrument repeatedly blows fuses, locate and correct the cause of the trouble before replacing the fuse.

Instrument fuse replacement

To replace the instrument line fuse:

1. Power off the instrument.
2. Disconnect the power line and connections.
3. Use a flat-blade screwdriver to disengage the fuse holder by rotating it counterclockwise.
4. Pull out the fuse holder.
5. Replace the fuse with the correct type.
6. Install the new fuse by reversing the procedure above.

If a fuse continues to become damaged, a circuit malfunction exists and must be corrected. Return the instrument to Keithley Instruments for repair.

AMPS analog backplane fuse replacement

NOTE

The Model 3721 card also has replaceable fuses. For replacement information, refer to the "Model 3721: AMPS channels fuse replacement" section in the *Series 3700A Switching and Control Cards Reference Manual*.

To replace the analog backplane fuse:

1. Power off the instrument.
2. Disconnect the power line and connections.
3. From the rear panel, gently push in the AMPS fuse holder with a flat-blade screwdriver and rotate the fuse holder one-quarter turn counterclockwise.
4. Pull out the fuse holder.
5. Replace the fuse with the correct type.
6. Install the new fuse by reversing the procedure above.

Front-panel tests

You can test the functionality of the front-panel keys and the display.

Keys test

This test checks the functionality of each front-panel key.

Perform the following steps to run the KEYS test:

1. If the instrument is in remote mode, press the **EXIT (LOCAL)** key once to place the instrument in local mode.
2. Press the **MENU** key.
3. Navigate through the menus by turning the navigation wheel ⊙. Press the **ENTER** key to select the menu items as follows: **DISPLAY > TEST > DISPLAY-TESTS**.
4. Turn the navigation wheel ⊙ until the **KEYS** menu item is highlighted.
5. To start the test, press the **ENTER** key. When you press a key while the test is active, the label name for that key is displayed to indicate that it is functioning properly. When you release the key, the message `No keys pressed` is displayed.
6. To test the EXIT (LOCAL) key, press the **EXIT (LOCAL)** key once.
7. To exit the test, press the **EXIT (LOCAL)** key twice consecutively. You exit the test and the instrument returns to the FRONT PANEL TESTS menu.
8. Press the **EXIT (LOCAL)** key multiple times to exit out of the menu structure.

Display patterns test

This test lets you verify that each pixel and indicator in the vacuum fluorescent display is working properly.

Perform the following steps to run the display test:

1. If the instrument is in remote mode, press the **EXIT (LOCAL)** key once to place the instrument in local mode.
2. Press the **MENU** key.
3. Navigate through the menus by turning the navigation wheel ⊙, and then pressing the **ENTER** key to select the items as follows: **DISPLAY > TEST > DISPLAY-TESTS**.
4. Turn the navigation wheel ⊙ until the **DISPLAY-PATTERNS** menu item is highlighted.

5. To start the display test, press the **ENTER** key. There are three parts to the display test. Each time the **ENTER** key or the navigation wheel ☉ is pressed, the next part of the test sequence is selected. The test sequence is as follows:

   ▪ Checkerboard pattern and the indicators that are on during normal operation

   ▪ Checkerboard pattern (alternate pixels on) and all the numeric indicators (which are not used) are illuminated

   ▪ Each digit and adjacent indicators are sequenced; all the pixels of the selected digit are on

6. When finished, abort the display test by pressing the **EXIT (LOCAL)** key. The instrument returns to the FRONT PANEL TESTS menu. Continue pressing the **EXIT (LOCAL)** key to exit out of the menu structure.

Displaying the serial number

The instrument serial number is on a label on the rear panel of the instrument. You can also access the serial number from the front panel using the front-panel keys and menus.

To display the serial number on the front panel:

1. If the Series 3700A is in remote operation, press the **EXIT (LOCAL)** key once to place the instrument in local operation.

2. Press the **MENU** key.

3. Use the navigation wheel ☉ to scroll to the **UNIT-INFO** menu item.

4. Press the **ENTER** key. The UNIT INFORMATION menu is displayed.

5. Scroll to the **SERIAL#** menu item.

6. Press the **ENTER** key. The Series 3700A serial number is displayed.

Upgrading the firmware

Use this procedure to upgrade the Model 3706A firmware from a USB flash drive. The process should take approximately five minutes, depending on the cards in the system and if a digital multimeter (DMM) is installed.

You can choose to upgrade to a higher-level firmware version or a previous version. If you upgrade to a higher level, if any part of the system is already at a higher firmware revision, that part of the system is skipped during the upgrade. If you select Previous, the firmware for all components is updated to the version you are loading.

The upgrade process changes the firmware for the mainframe, the DMM, and any cards in the system. Make sure all available cards are populated in the mainframe before beginning the procedure.

NOTE

You can upgrade a single card to a higher level by installing the card in the instrument and re-running the procedure.

Be sure to use a USB flash drive that is empty except for the upgrade file.

The file has a name such as `main_p37xx_vvvvv.zip`, where *vvvvv* is the firmware version.

Upgrade files are available for download from the <u>Product Support web page</u> (<u>tek.com/product-support</u>).

CAUTION

Disconnect the input terminals before you upgrade.

Do not remove power from the Series 3700A or remove the USB flash drive while an upgrade is in progress. Wait until the instrument completes the procedure and shows the opening display. If you are upgrading a Model 3706A-NFP instrument, the LAN and 1588 LEDs on the front panel blink in unison during the upgrade and stop when the upgrade is complete.

Do not initialize or reset TSP-Link before starting the upgrade.

Before starting the upgrade, turn the instrument power off, wait a few seconds, then turn the instrument power on.

To upgrade or downgrade the firmware using the front panel:

1.   Copy the file to a blank USB flash drive.
2.   Turn the instrument power off. Wait a few seconds.
3.   Turn the instrument power on.
4.   Install the USB flash drive in the front-panel connector.
5.   On the front panel, press the **MENU** key
6.   Turn the navigation wheel to scroll to **UPGRADE** and press the navigation wheel. **UPGRADE UNIT?** is displayed.
7.   Select **Previous** to install a previous version or select **Yes** to upgrade to a newer version.
8.   Press the navigation wheel.

As the upgrade progresses, the status is displayed on the front panel, including the percentage complete. The upgrade status is displayed.

The instrument reboots automatically when the upgrade is complete.

Troubleshooting FAQs

In this section:

About this section

This section helps you find answers to the most common questions encountered with the Series 3700A. For additional FAQs, see "Frequently Asked Questions (FAQs)" in the *Model Series 3700A Reference Manual*.

How do I change the power line frequency or voltage?

The Series 3700A only supports a line frequency of 50 or 60 Hz. The line frequency is automatically sensed and no user action is needed.

Why doesn't the Series 3700A recognize my switch card?

Card is not correctly seated in the slot

Make sure the card is seated correctly:

1. Remove power from the instrument.
2. Pull the card out of the slot.
3. Carefully guide the card inside the rails while reinstalling.
4. Make sure the outer shield is not inserted into the card rails.
5. Make sure that no other portions of the card catch on any part of the instrument frame while installing.
6. Make sure the card is seated correctly before restarting the instrument.

Edge connector is dirty

If the card was stored outside of the instrument, it is possible that the edge connector is dirty.

1. Check the edge connector. The gold edge connector fingers should have a bright surface when properly cleaned.
2. If necessary, clean the edge connector.
3. Reinstall the card.

Confirm that the card is supported in the Series 3700A

See the Series 3700A specifications.

Why is there an error when I try to close a channel?

If the instrument generates `"Error 1115: Parameter error no forbidden channels accepted,"` make sure that the channel specifier is valid. For more information on channel specifiers, see "Specifying a channel" in the *Series 3700A Reference Manual*.

If the specifier is correct, the forbidden attribute of the channel may be set to true. To close the specified channel, the forbidden attribute must be set to false.

To set the forbidden attribute to false using the front panel:

1. Press the **CONFIG** key, and then select **CHAN**.
2. Select **FORBID**.
3. Select **NO**.

To set the forbidden attribute to false using the web interface:

1. On the Cards page, right-click the channel.
2. Clear the Forbidden box.
3. Click **OK**.

To set the forbidden attribute to false using remote commands:

Use the command:

```
channel.clearforbidden()
```

Why are the switch relays not closing?

Verify that the system power is sufficient to close the switch relays.

Check the front panel or script output for an error that might have been returned from the operation.

How do I save the present state of the instrument?

Use the Create Config Script option (or the command `createconfigscript`). See the *Series 3700A Reference Manual*, "Save the present configuration."

Where can I get the LabVIEW driver?

The latest NI™ LabVIEW™ driver is available on tek.com/keithley.

Why can't the Series 3700A read my USB flash drive?

Verify that the flash drive is formatted with the FAT32 file system. The Series 3700A only supports FAT and FAT32 drives using Master Boot Record (MBR).

In Microsoft® Windows®, you can check the file system by checking the properties of the USB flash drive.

NOTE

Higher capacity USB drives take longer to be read and loaded by the instrument.

Next steps

In this section:

Next steps

This manual has prepared you to start using your new Series 3700A for your real-world applications. For sample applications, refer to the *Series 3700A Application Manual*, 3700AS-904-01.

For more detailed information about the Series 3700A, refer to the Keithley Instruments *Series 3700A Reference Manual*, part number 3700AS-901-01.

For information on Series 3700A cards, refer to the Keithley Instrument *Series 3700A Switching and Control Cards Reference Manual*.

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