



Switch Matrix
Printable Application Help





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Printable Application Help

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- In North America, call 1-800-833-9200.
- Worldwide, visit www.tek.com to find contacts in your area.

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Welcome

Switch Matrix is a software solution which simplifies the user experience to configure and setup automated multi-lane testing using RF switch. The solution allows you to map each of the several transmitter signals and forward the selected input either to another relay or to the oscilloscope channel.



Key Features:

- Auto Detects Keithley and Gigatronics switches on the GPIB/LAN interfaces.
- De-embed using filter files with multiple de-embed options.
- Apply single filter file for all relays, for each relay type separately, for each relay separately, and for each connection separately.
- Ability to cascade multiple relays within a switch.
- Operates with TekExpress and DPOJET (Debug Mode)
- Use standard built-in configurations or create custom configurations
- Save/recall configurations
- Graphical view with print option to support hardware wiring
- Built in error handling to support easy and error-free configuration.
- Programmatic interface to support scripting and easy integration into the user's automation environment.

Debug Mode:

- Debug mode to manually close each relay channel.
- Ability to close multiple contacts on a relay
- Built-in Self-Test with report in .csv file

Status Indicators:

- Status indicators for each relay signal being de-embedded
- Status indicator for input displaying open or close relay contacts
- Live status for Self-Test

Getting help and support

Conventions used in help

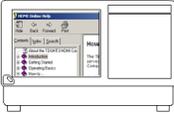
This help uses the following conventions:

- The terms "Application" and "Software" refer to the Switch Matrix application.
- The term “select” is a generic term that applies to the two methods of choosing a screen item (button, control, list item): using a mouse or using the touch screen.
- The term "close" refers to normally close the relay signal (select the signal).
- The term "open" refers to normally open the relay signal (unselect the signal).
- The term "channel" refers to the relay signal or oscilloscope channel.

Related documentation

The following documentation is available as part of the Switch Matrix[®] application.

Table 1: Product documentation

Item	Purpose	Location
Help	Application operation and User Interface help	
PDF of the help	Printable version of the compiled help	
PDF of the TekScope Application User Manual	Activate the license	 www.tek.com

Technical support

Tektronix values feedback on our products. To help us serve you better, please send us your suggestions, ideas, or comments on your application or oscilloscope. Contact Tektronix through mail, telephone, or the Web site.

When you contact Tektronix Technical Support, please include the following information (be as specific as possible):

- Software version number
- Description of the problem so that technical support can duplicate the problem
- If possible, save the setup files for all the instruments used and the application.

Getting started

Minimum system requirements

The following table shows the minimum system requirements for the Switch Matrix application.

Table 2: Minimum system requirements

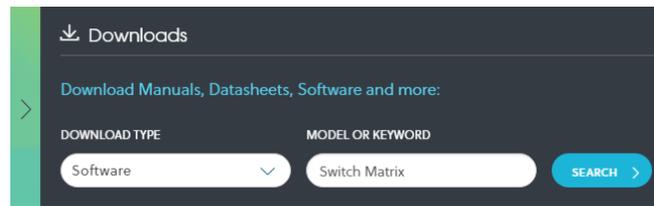
Component	Requirement
Oscilloscope	
Firmware	<ul style="list-style-type: none">■ TekScope 10.7.0 or greater (for Windows 7)■ TekScope 10.8.0 or greater (for Windows 10)
Software	<ul style="list-style-type: none">■ IronPython 2.7.3 installed■ PyVisa 1.0.0.25 installed■ Microsoft .NET 4.0 Framework■ Microsoft Internet Explorer 11.0 SP1 or greater, or other Web browser for viewing reports■ Adobe Reader software 7.0 or greater for viewing portable document format (PDF) files
Operating system	Windows 7
Processor	Same as the oscilloscope
Memory	Same as the oscilloscope
Hard Disk	Same as the oscilloscope
Display	Super VGA resolution or higher video adapter (800 x 600 minimum video resolution for small fonts or 1024 x 768 minimum video resolution for large fonts). The application is best viewed at 96 dpi display settings ¹
Other devices	Microsoft compatible mouse or compatible pointing device

¹ If TekExpress is running on an instrument that has a video resolution less than 800x600, connect and configure a second monitor to the instrument.

Downloading and installing the application

Complete the following steps to download and install the latest Switch Matrix application. See [Minimum system requirements](#) for compatibility.

1. Go to www.tek.com.
2. Click **Downloads**. In the Downloads menu, select DOWNLOAD TYPE as Software and enter Switch Matrix in the MODEL OR KEYWORD field and click **SEARCH**.



3. Select the latest version of software and follow the instructions to download. Copy the executable file into the oscilloscope.
4. Double-click the executable and follow the on-screen instructions. The software is installed at *C:\Program Files\Tektronix\TekExpress\Switch Matrix*.
5. Select **Analyze > Switch Matrix** from the TekScope menu to [launch the application](#).

Purchase the license

Contact Tektronix to purchase the license key (Option). Visit www.tek.com to find the contacts in your area.

Activate the license

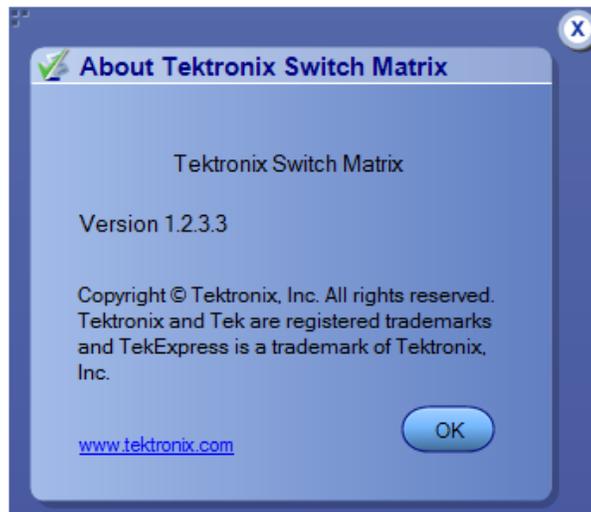
Refer to *Install an option* in the *TekScope Application User Manual* to activate the license. This manual is downloadable from the Tektronix Web.

View the software version

Use the following instructions to view version information for the application and for the application modules, such as the programmatic interface and the programmatic interface client.

To view the version information, click **Options** ▾ > **About Switch Matrix** in *Switch Matrix configuration panel*.

A dialog box similar to the following figure appears.



Status indicators

Status indicators	Description
	Success indicator
	Failure indicator
 NC	Closed channel indicator (NC = Normally Closed)
 NO	Opened channel indicator (NO = Normally Opened)

File name extensions

This application uses the following file name extensions:

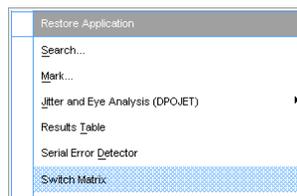
File name extension	Description
.html	Saved configuration and Graphical view file formats
.xml	Switch Matrix configuration files

Operating basics

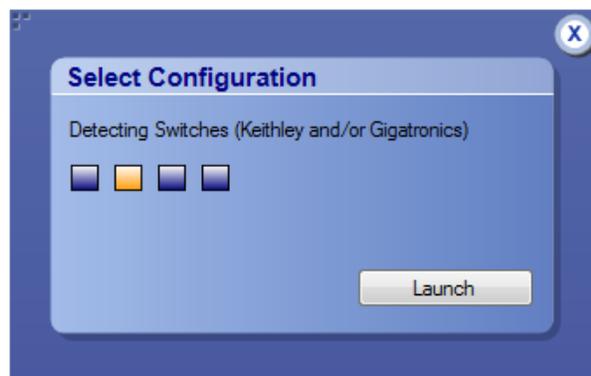
Launch the application

Complete the following steps to launch the Switch Matrix application:

1. Click **Analyze > Switch Matrix** from the TekScope menu.



The application automatically detects for connected switch(es) on GPIB, and then prompts to search on other networks (LAN, Serial, VXI, USB, and TekLink) ¹.



NOTE. Autodetect works only for Keithley and Gigatronics switches.

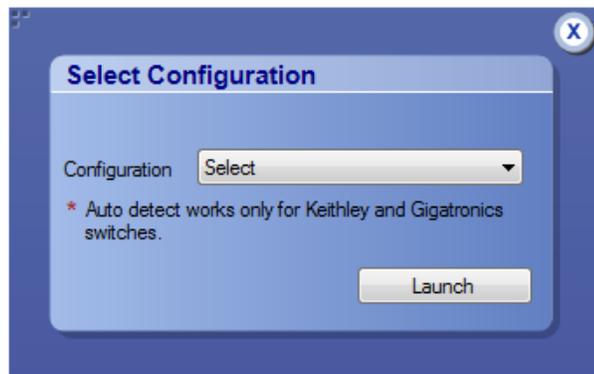
If only one switch is detected, the application launches with the configuration for the detected switch.

¹ Searching on LAN and other networks (LAN, Serial, VXI, USB, and TekLink) might take few minutes.

2. If multiple switches are detected, the Select Relevant Switch window displays where you can select the appropriate switch.



3. If no switch is detected, the Select Configuration window displays; Select the configuration from the drop-down list and click **Launch**.

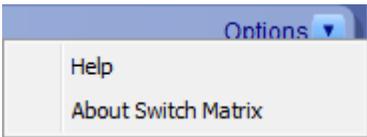


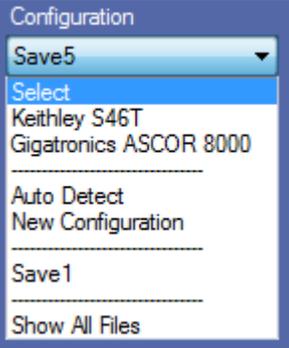
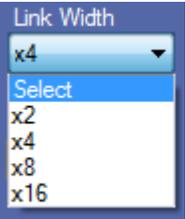
Application overview

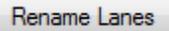
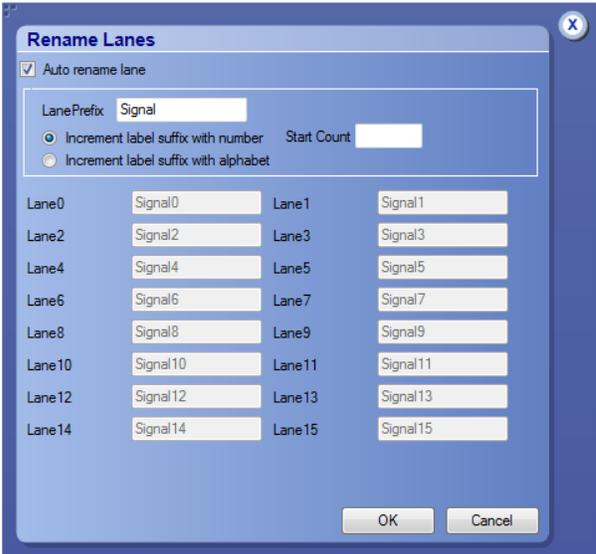
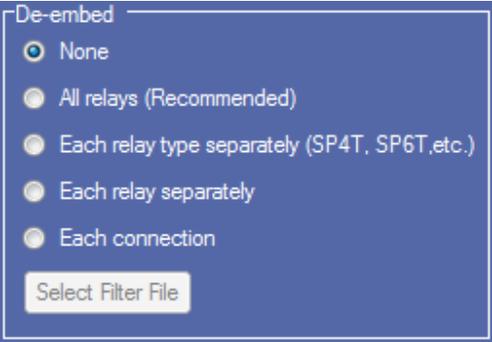
This section describes the Switch Matrix application settings.



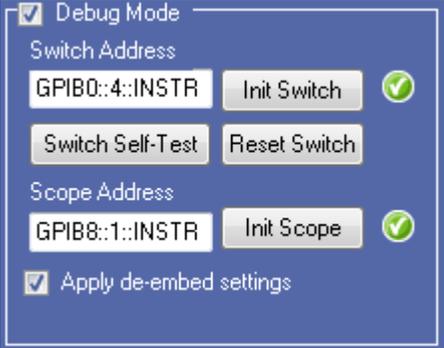
Table 3: Switch Matrix configuration settings

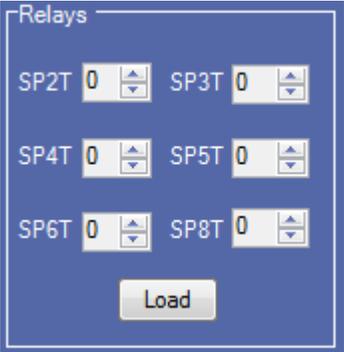
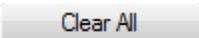
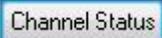
Item	Description
	Click to expand/collapse the switch matrix configuration.
Options 	Click Help to view the software help document and About Switch Matrix for software version.
Switch Matrix configuration	

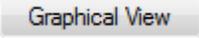
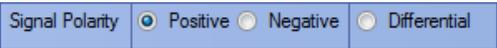
Item	Description
<p>Configuration</p> 	<p>Select the configuration option:</p> <ul style="list-style-type: none"> ■ Keithley S46T: 6-input-to-1-output switch configuration ■ Gigatronics ASCOR 8000: 8-input-to-1-output switch configuration ■ Auto Detect: Select to autodetect the switch. ■ New Configuration: Select to manually configure the switch. ■ Saved file names: Saved configuration file name(s) are displayed in the drop-down list. Select to recall the configuration. ■ Show All Files: Select to view the list of all saved files.
<p>Vendor</p> 	<p>Select the vendor from the drop-down list. This field is displayed:</p> <ul style="list-style-type: none"> ■ When you select Configuration > New Configuration to create afresh configuration. ■ When you open a saved configuration. The displayed vendor name is not editable. ■ When Auto Detect is selected. The displayed vendor name is not editable.
<p><i>Link Width</i></p> 	<p>Select the Link Width from the drop-down list. This determines the maximum number of lanes supported by the DUT.</p>
<p>Add <X> more lane(s)</p> 	<p>Select to add extra lanes (Additional1, Additional2,...) to the lanes list. The extra lanes added are displayed in the relay signals. You can add a maximum of 10 lanes.</p>

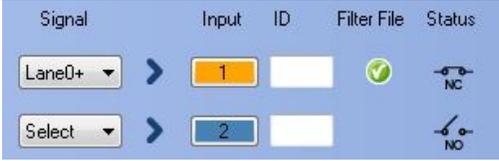
Item	Description
<p>Rename Lanes</p> <p></p>	<p>Click to rename the lanes. Enter the LanePrefix and select the increment label type to suffix by either number or alphabet. The number of lanes depends on the Link Width selected. Clear the Auto rename lane check box to set unique names for the lanes.</p> 
<p>De-embed</p> <p>De-embed ²</p> 	<p>Select the De-embed option:</p> <ul style="list-style-type: none"> ■ None ■ <i>All relays (Recommended)</i> ■ <i>Each relay type separately (SP4T, SP6T, etc.)</i> ■ <i>Each relay separately</i> ■ <i>Each connection</i> <p>Select the de-embed option and click Select Filter File to browse and select the filter file(s).</p>
<p>Debug Mode</p>	

² Configure at least one relay before configuring the de-embed settings.

Item	Description
<p><i>Debug Mode</i></p> 	<p>Select Debug Mode to manually configure the switch.</p> <p>Switch Address Enter the Switch Address in the GPIB or TCPIP format. GPIB format: GPIB0:X:INSTR TCPIP format: TCPIP::IPADDR::INSTR</p> <p>Init Switch This will synchronize the configuration of relay(s) in the application with the relay(s) in the switch. Synchronization will be successful only for the relays whose configuration matches with the physical switch. Pass/Fail status is displayed next to the button.</p> <hr/> <p>NOTE. Relay configurations (number of relays, number of relay inputs, and name of relays) in the application should match the physical switch, for successful synchronization.</p> <hr/> <p>Switch Self-Test This will close and open all switch channels one-by-one and displays the pass/fail status of the channel next to the ID. A self-test report (CSV) is generated at the end of the process. You cannot abort this process.</p> <hr/> <p>NOTE. Initialize the switch before performing the self-test.</p> <hr/> <p>Reset Switch Click Reset Switch to reset the switch. This will open all channels.</p> <p>Scope Address Enter the oscilloscope address in the GPIB or TCPIP format. GPIB format: GPIB0:X:INSTR TCPIP format: TCPIP::IPADDR::INSTR</p> <p>Init Scope Enter the oscilloscope address in the Scope Address field and click Init Scope to initialize the oscilloscope. This will establish the connection with the oscilloscope. The pass/fail status is displayed next to the button.</p> <p>Apply De-embed settings Select to apply de-embed settings to the channels. When the oscilloscope is initialized and de-embed settings are configured, closing a connection will apply the de-embed settings and then close the connection.</p>
<p>Relays</p>	

Item	Description
<p>Relays</p> 	<p>Select the relay(s). In SPnT, <i>n</i> represents the number of connection signals for the relay. For example, SP4T is a four signal connection relay.</p> <p>This field displays only for a new configuration. By default, zero relays are selected.</p> <p>Enter the total number of relays to be loaded in their respective input box and click Load.</p> <p>You can also click  or  to increase or decrease the number.</p>
<p>Save</p> 	<p>Click to save the configuration at <i>C:\ProgramData\Tektronix\Switch Matrix Configurations*.xml</i>.</p> <p>This operation checks whether all the required configurations are done. If any of the required configurations are not selected, then error popup is displayed, which prompts you to complete the configuration(s).</p>
<p>Clear All</p> 	<p>Click to clear all configurations. The application will be loaded with Configuration drop-down (default).</p>
<p>Channel Status</p> 	<p>Click to view the relays and status of channels of Keithley or Gigatronics switch. This updates the channel status dynamically.</p> <p>In Switch Channel Status Viewer, select the Vendor type, enter the Switch Address and click Init to initialize the switch. This will establish the connection with the switch.</p> <p>Click Query Status to get the details of the relays of the switch and the status of the channels.</p> <p>Click Reset to reset the status viewer.</p> 

Item	Description
<p>Graphical View</p> 	<p>Click to view the graphical representation of the configured relays. If the relays are cascaded, then they are also displayed in the graphical representation.</p>
Relay configuration	
<p>Signal Polarity</p> 	<p>Select the signal polarity of DUT:</p> <ul style="list-style-type: none"> ■ Positive: populates Lane0+, Lane1+, connection signals. ■ Negative: populates Lane0-, Lane1-, connection signals. ■ Differential: populates Lane0, Lane1, connection signals.
<p>Relay Name</p> 	<p>Enter the relay name. This name should match the relay name of the connected switch.</p>
<p>Delete</p> 	<p>Click to delete the relay. This configuration is only available for the configured (loaded) relays, when Configuration > New Configuration is selected.</p>
<p>Cascade</p> 	<p>Select to cascade the relay by connecting the common channel as the input signal for another relay. Select the Relay and the Input of the relay. Check that the selected relay signal displays the appropriate relay name. The cascade settings is also displayed in the graphical view. Click here to get details about Cascade.</p> <p>NOTE. Select the cascade settings before you save the configuration.</p>

Item	Description
<p>Common</p> 	<p>Select the oscilloscope channel for Common. If cascaded, it displays the name of the relay. Click Reset Inputs to clear all connection signal settings.</p> <p>NOTE. Select the common settings for all the relays, before you save the configuration.</p>
	<p>Signal Select the DUT connection signal. This drop-down list shows the lanes based on Link Width and Signal Polarity settings. If the link width is x8 and signal polarity is Positive, then the Signal drop-down list will have Lane0+ to Lane7+ options.</p> <p>Input This button is enabled only in debug mode and if a valid signal is configured for the channel. Click to close or open the channel.</p> <p>ID Enter the three character alias name for the channel. This is shown in the graphical view of switch matrix configuration.</p> <p>Filter File This column shows  or  indicating the status of the filter file configuration for the channel. If no de-embed option is selected, then this column remains blank.</p> <p>Status This column displays the status of the channel.</p> <p>Channel closed (normally closed) : </p> <p>Channel opened (normally opened) : </p>

Saved configurations

Click **Configuration > Show All Files** to view the list of all saved files.

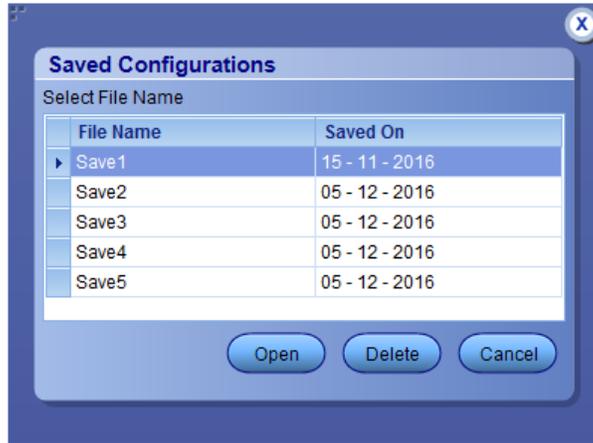


Table 4: Saved configurations

Item	Description
Open	Opens the selected file.
Delete	Deletes the selected file.
Cancel	Closes the Saved Configurations window.

De-embed settings

De-embed allows you to apply filter file(s) for relay(s). Select the De-embed option and click **Select Filter File** to browse and select the filter file(s).

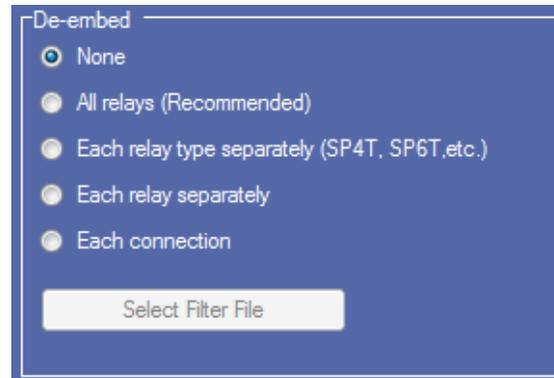
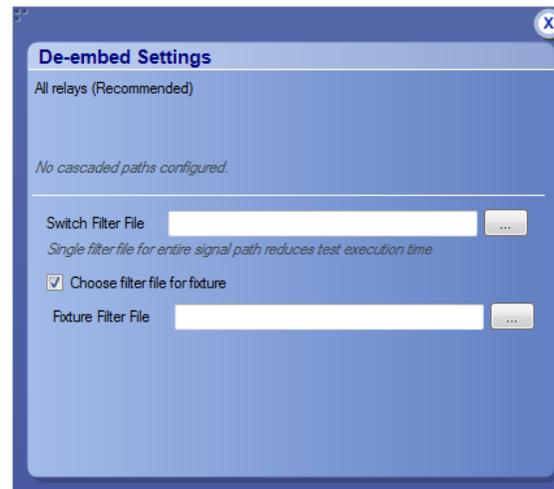


Figure 1: De-embed options

Apply a filter file for all relays

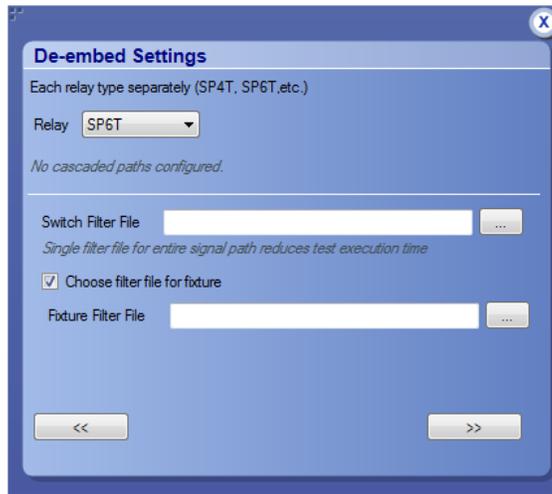
Select to apply a single filter file for all relays.



Click **...** to browse and select the filter file for the switch. To apply the filter file for the fixture, select **Choose filter file for fixture** and browse the filter file.

Apply a filter file for each relay type separately

Select to separately apply a single filter file for each relay type.



Select the Relay type from the drop-down list; click **...** to browse and select the filter file for the switch. To apply the filter file for the fixture, select **Choose filter file for fixture** and browse the filter file.



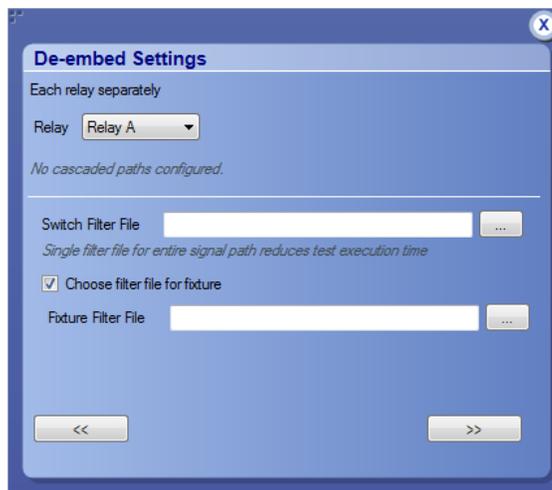
TIP. Click **<<** or **>>** to select the previous or next relay type.



TIP. The selected relay types are highlighted in dark blue in the application.

Apply a filter file for each relay separately

Select to separately apply a filter file for each relay.



Select the Relay from the drop-down list; click  to browse and select the filter file for the switch. To apply the filter file for the fixture, select **Choose filter file for fixture** and browse the filter file.



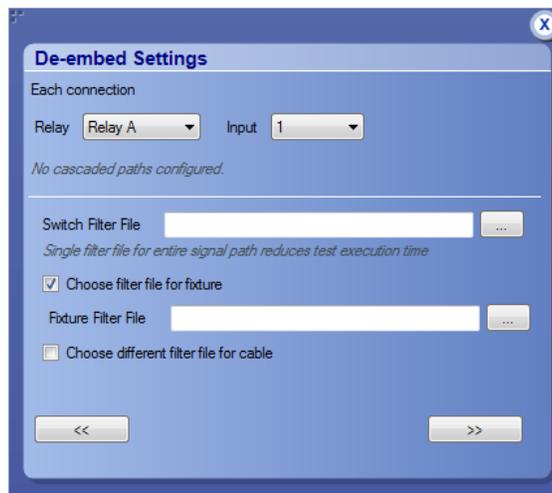
TIP. Click  or  to select the previous or next relay.



TIP. The selected relay is highlighted in dark blue in the application.

Apply a filter file for each connection separately

Select to apply a filter file for each connection.



Select the Relay and the Input from the drop-down list; click  to browse and select the filter file for the switch. To apply the filter file for the fixture, select **Choose filter file for fixture** and browse the filter file. Select **Choose different filter file for cable** to browse and select the filter file for cable.



TIP. Click  or  to select the previous or next channel.



TIP. The selected relay signal is highlighted in dark blue in the application.

NOTE. Clicking  on the last input of a relay selects the first input of the next relay; clicking  on the first input of a relay selects the last input of the previous relay.

Graphical view of switch matrix configuration

The Graphical view displays the pictorial representation of the switch configuration.

The following figure displays the graphical view of a Keithley switch configuration.



Saving the configuration

Click **Save** in the configuration panel; in the Configuration Save dialog box, enter the file name and click **Save**. The default save path is `C:\ProgramData\Tektronix\Switch Matrix Configurations\`.



NOTE. Save configuration checks whether all the required configurations are done. If any of the required configurations are not selected, then error message is displayed, which prompts you to complete the configuration(s).

Feature description

Configure new switch

Switch Matrix allows you to manually configure any third party switch. Select **Configuration > New Configuration** and then select **Vendor > Configure New Switch** and complete the following steps to configure an third party switch:

1. Basic Information: Enter Vendor Name, Model Name, and the Serial Number; click **Next**.



Configure New Switch

Switch Information

Basic Information

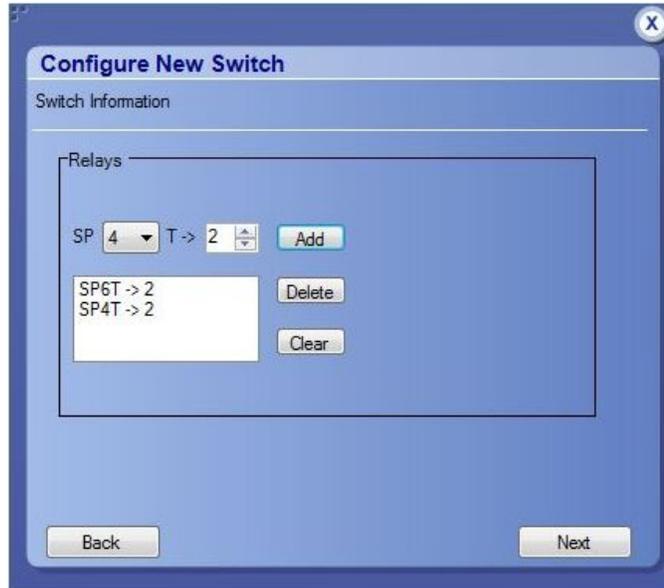
* Vendor Name ABC

* Model Name XYZ

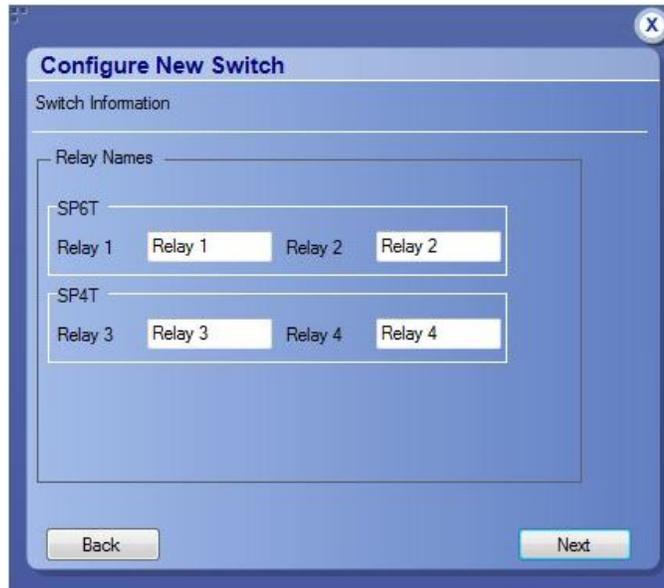
* Serial Number 123456789

Next

2. Relays: Select the relay type (SP), enter the number of relays (T), and click **Add**; after adding all the relays, click **Next**.



3. Relay Names: The relays are grouped by their type. Enter the relay names as per the hardware specification and click **Next**.



4. Switch Level Commands: Configure the switch level commands; click **Test** to execute the command. The command execution status is indicated by the success/failure indicator displayed next to the Test button.
 - a. Default Address: Enter the switch address.
 - b. Reset Switch: Enter the switch reset command.
 - c. Open All: Enter the command to open all the channels.
 - d. Clear Error: Enter the command to clear the switch error.
 - e. Query Error: Enter the command to query the error.
 - f. Validate the Query Error response:
 - a. Query Error Criteria: This allows you to validate the command response of the Query Error. Enter the Search Keyword and select the validation method.
 - a. Contains: Checks for the keyword in the response.
 - b. Equals: Checks whether the response is equal to the keyword.
 - c. Starts with: Checks whether the response starts with the keyword.
 - d. Ends with: Checks whether the response ends with the keyword.
 - b. Search Keyword: Enter the string that needs to be validated in the Query Error command response.
 - c. Add: Click to add the string in the search keyword to the list.
 - d. Delete: Select the keyword in the list and click delete to delete from the list.
 - g. Click **Next** after configuring the switch level commands.

Configure New Switch

Switch Information

Switch Level Commands

Default Address

Reset Switch

Open All

Clear Error

Query Error

Query Error Criteria

Search Keyword

5. Relay Level Commands: Configure the commands for the selected relay; click **Test** to execute the command. The command execution status is indicated by the success/failure indicator displayed next to the Test button.
 - a. Relay: Select the relay.
 - b. Open All: Enter the command to open all the channels of the selected relay.
 - c. Configure the relay level commands and click **Next**.



6. Connection Level Commands: Configure the commands for relay connections; click **Test** to execute the command.
 - a. Relay: Select the relay.
 - b. Input: Select the input of the relay.
 - c. Retain values from previous connection: Select to use the values from the previous connection.
 - d. Open: Enter the command to open the channel.
 - e. Close: Enter the command to close the channel.
 - f. Status Check: Enter the command to check the status of the channel.
 - g. Validate the Status Check response:
 - a. Status Check Criteria: This allows you to validate the command response of Status Check. Enter the Search Keyword and select the validation method.
 - a. Contains: Checks for the keyword in the response.
 - b. Equals: Checks whether the response is equal to the keyword.
 - c. Starts with: Checks whether the response starts with the keyword.
 - d. Ends with: Checks whether the response ends with the keyword.
 - b. Search Keyword: Enter the string that needs to be validated in the String Check command response.
 - c. Add: Click to add the string in the search keyword to the list.
 - d. Delete: Select the search keyword in the list and click delete to delete from the list.

Configure New Switch

Switch Information

Connection Level Commands

Relay Input

Retain values from previous connection for fresh configuration

* Open

* Close

* Status Check

* Status Check Criteria Search Keyword

7. Configure all the mandatory commands and click **Finish** to load the switch configurations.

NOTE.

- To save the switch configurations, click **Save** from the Switch Matrix menu.
 - To edit the switch settings, select **Options > Edit/Configure New Switch**.
-

Link width

Link width determines the number of DUT signals. For example, x8 represents an eight lane DUT.

This works in conjunction with the signal polarity selected for each relay. For example, if the link width is x8, and:

- If the signal polarity is **Positive**, then the signal drop-down list will have selections from Lane0+ to Lane7+.
- If the signal polarity is **Negative**, then the signal drop-down list will have selections from Lane0- to Lane7-.
- If the signal polarity is **Differential**, then the signal drop-down list will have selections from Lane0 to Lane7.

Debug mode

Init Switch. Enter the Switch Address and click **Init Switch** to initialize the switch. This will synchronize the configuration of relay(s) in the application with the relay(s) in the switch. Synchronization will only be successful for those relays that match the physical switch. Pass/Fail status is displayed next to the button.

The factory default GPIB address for Keithley (GPIB0::7::INSTR) and Gigatronics (GPIB0::4::INSTR) is populated in the switch address based on the configured vendor. You can enter the address in GPIB (GPIB0:X:INSTR) or TCPIP (TCPIP::IPADDR::INSTR) format.

NOTE. Relay configurations (number of relays, number of relay inputs, and name of relays) in the application should match the physical switch, for successful synchronization.

Switch Self-Test. This will close and open all switch channels one-by-one. A selftest report (CSV) is generated at the end of the process. You cannot abort this process.

NOTE. Initialize the switch before performing the Switch Self-Test.

Reset Switch. Click **Reset Switch** to reset the switch. This will open all channels.

Init Scope. Enter the oscilloscope address in the Scope Address field and click **Init Scope** to initialize the oscilloscope. This will establish the connection with the oscilloscope. The pass/fail status is displayed next to the button.

You can enter the address in GPIB (GPIB0:X:INSTR) or TCPIP (TCPIP::IPADDR::INSTR) format.

When the oscilloscope is initialized and de-embed settings are configured, closing a connection will apply the de-embed settings and then close the connection.

NOTE. *The virtual GPIB address of the oscilloscope is GPIB8::1::INSTR.*

NOTE. *If oscilloscope fails to respond to the *IDN? query during initialization, then the connection attempt is considered a failure.*

Cascade (Relay cascade)

This feature allows you to cascade the relay by connecting the common channel as an input signal for another relay.

To cascade, select **Cascade** in the relay and select the Relay and Input of the relay. Check that the selected relay signal displays the relay name, specifying that the lane input signal is the output from that relay.

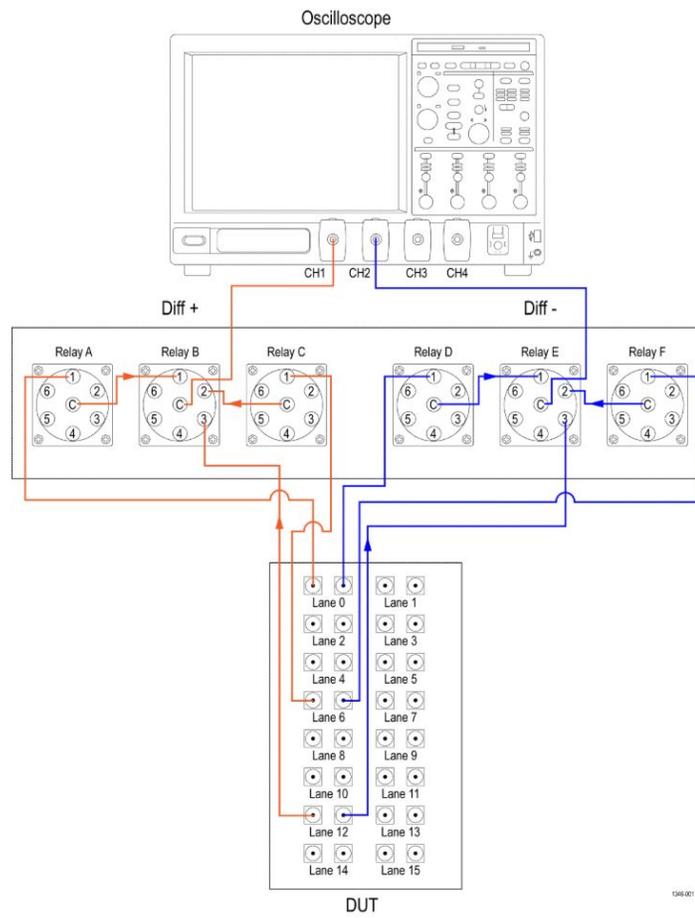


Figure 2: Graphical view of relay cascade configuration



TIP. *Switch Matrix application supports only single-level cascading of the relays. For example, if the Relay A output is cascaded to Relay B, then the Relay B output cannot be cascaded.*

Tutorial

Gigatronics switch configuration with cascade settings

1. Click **Analyze > Switch Matrix** from the TekScope menu.
2. Select **Configuration > Gigatronics ASCOR 8000**.
3. The following default configuration will be loaded:
 - Link Width - 16
 - De-embed as None
 - Four SP8T relays (S1 - Positive, S3 - Negative, S4 - Positive, S6 - Negative) and two SP2T relays (S2 - Positive and S5 - Negative)
4. Configure the relay settings:
 - a. Select Signal connection for S1:
 - a. Lane0+; Lane1+; Lane2+; Lane3+; Lane4+; Lane5+; Lane6+; Lane7+
 - b. Select Signal connection for S3:
 - a. Lane0-; Lane1-; Lane2-; Lane3-; Lane4-; Lane5-; Lane6-; Lane7-
 - c. Select Signal connection for S4:
 - a. Lane8+; Lane9+; Lane10+; Lane11+; Lane12+; Lane13+; Lane14+; Lane15+
 - d. Select Signal connection for S6:
 - a. Lane8-; Lane9-; Lane10-; Lane11-; Lane12-; Lane13-; Lane14-; Lane15-
5. Configure cascade settings:

Select the Cascade checkbox in all SP8T relays and select the following Relay and Input settings:

 - Cascade S1 to Relay S2, Input NO
 - Cascade S3 to Relay S5, Input NO
 - Cascade S4 to Relay S2, Input NC
 - Cascade S6 to Relay S5, Input NC
6. Select S2 Common to Ch1 and S5 Common to Ch2.
7. Click **Save**; enter the file name in the Configuration Save dialog box, and click **Save**.



Figure 3: Gigatronics switch configuration with cascade settings

Create a new configuration (four lane, two SP4T relays)

1. Click **Analyze > Switch Matrix** from the TekScope menu.
2. Select **Configuration > New Configuration** (Select Auto Detect to autodetect the switch).
3. Select **Link Width > x8**.
4. Select De-embed as None.
5. Select four SP6T and two SP2T relays and click **Load**. Check that the relays are loaded.
6. Relay configuration:
 - a. Select the Signal Polarity as **Positive** for Relay A, Relay C, Relay 1 and **Negative** for Relay B, Relay D, Relay2.
 - b. Select Signal connection for Relay A:
 - a. Lane0+; Lane1+; Lane2+; Lane3+; Lane4+; Lane5+; Lane6+; Lane7+
 - c. Select Signal connection for Relay B:
 - a. Lane0-; Lane1-; Lane2-; Lane3-; Lane4-; Lane5-; Lane6-; Lane7-
 - d. Select Signal connection for Relay C:
 - a. Lane8+; Lane9+; Lane10+; Lane11+; Lane12+; Lane13+; Lane14+; Lane15+
 - e. Select Signal connection for Relay D:
 - a. Lane8-; Lane9-; Lane10-; Lane11-; Lane12-; Lane13-; Lane14-; Lane15-

7. Configure cascade settings:

Select the Cascade checkbox in all SP6T relays and select the following Relay and Input settings:

- Cascade Relay A to Relay 1, Input NO
 - Cascade Relay B to Relay 2, Input NO
 - Cascade Relay C to Relay 1, Input NC
 - Cascade Relay D to Relay 2, Input NC
8. Select Relay 1 Common to Ch1 and Relay 2 Common to Ch2.
9. Click **Save**; enter the file name in the Configuration Save dialog box, and click **Save**.

Configure the filter file for each relay separately

1. Click **Analyze > Switch Matrix** from the TekScope menu.
2. Select **Configuration > Keithley S46T**.
3. Select the De-embed option as **Each relay separately** and do the following:
 - a. Click **Select Filter File**.
 - b. Select **Relay** as Relay A in the De-embed Settings dialog box; browse for the Switch Filter File.
 - c. Repeat Step 3.b for all the relays.

For improved performance during execution, the single filter file (.flt) for the entire signal path is recommended. If a separate filter file has to be applied for a fixture, then select **Choose filter file for fixture**, and browse for the Fixture Filter File.

4. Close the filter file window. Observe that the relays with selected filter files show ✓ against all connections in the Filter File column.
5. Click **Save**; enter the file name in the Configuration Save dialog box and click **Save**.

Debug the Keithley S46T switch

1. Click **Analyze > Switch Matrix** from the TekScope menu.
2. Select **Configuration > Keithley S46T**.
3. Select De-embed as None.
4. Select **Debug Mode** and do the following:
 - a. Enter the Switch Address and click **Init Switch**. The switch initialization status should be Pass.
 - b. Click **Switch Self-Test**.
 - c. Enter the oscilloscope address in the Scope Address field and click **Init Scope**. The switch initialization status should be Pass.
 - d. Click the input toggle button of the channel to close or open the channel manually (this is enabled only in debug mode and only if a valid signal is configured for the channel).
5. Click **Save**; enter the file name in the Configuration Save dialog box, and click **Save**.

SCPI commands

About SCPI commands

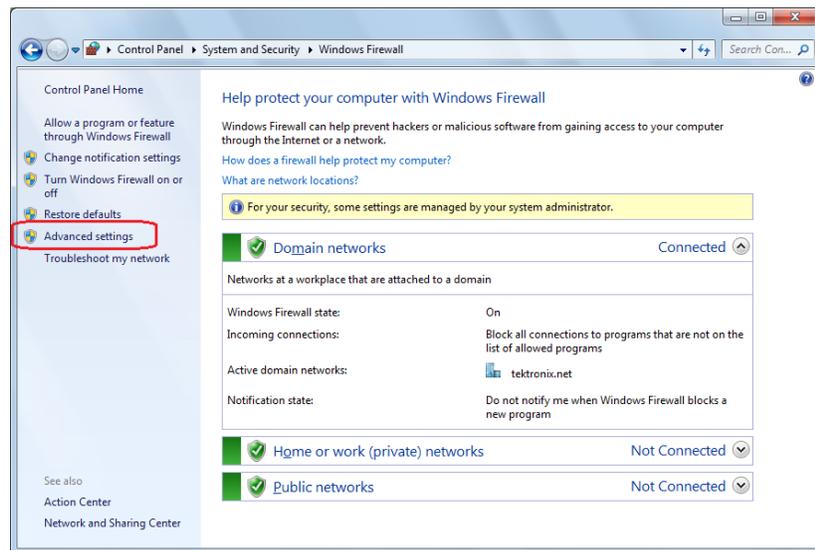
You can use Standard Commands for Programmable Instruments (SCPI) to communicate with the TekExpress application.

Socket configuration for SCPI commands

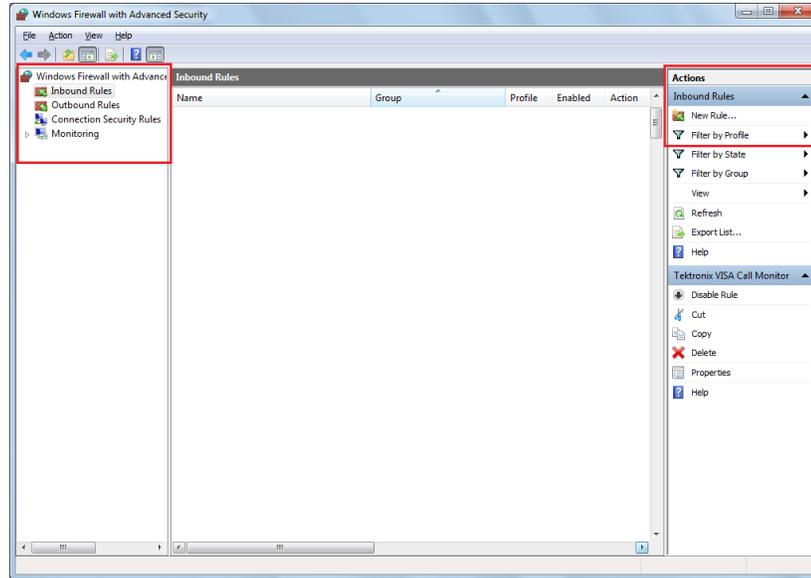
This section describes the steps for TCP/IP socket configuration and TekVISA configuration to execute the SCPI commands.

TCP/IP socket configuration

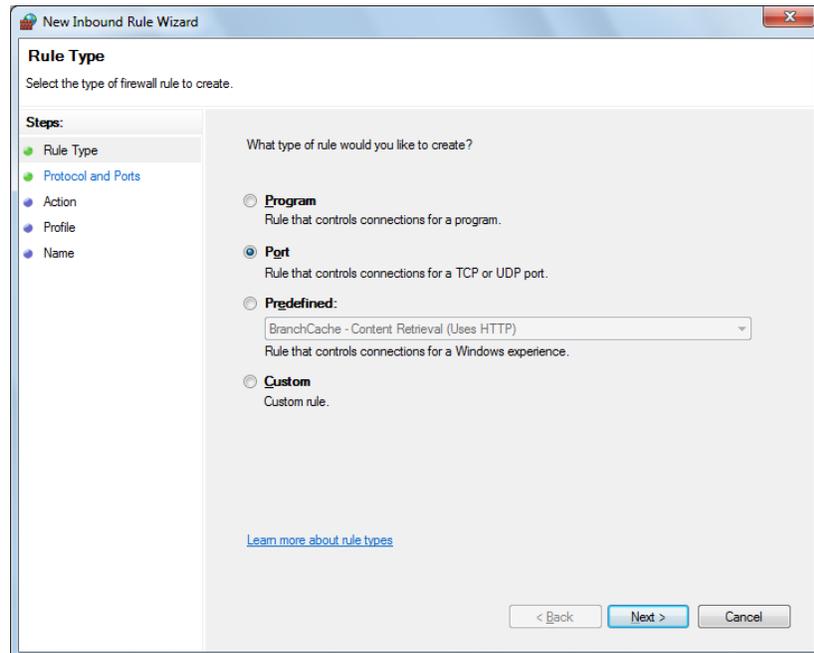
1. Click **Start > Control Panel > System and Security > Windows Firewall > Advanced settings**.



2. In Windows Firewall with Advanced Security menu, select **Windows Firewall with Advanced Security on Local Computer > Inbound Rules** and click **New Rule...**



3. In New Inbound Rule Wizard menu:
 - a. Select **Port** and click **Next**.



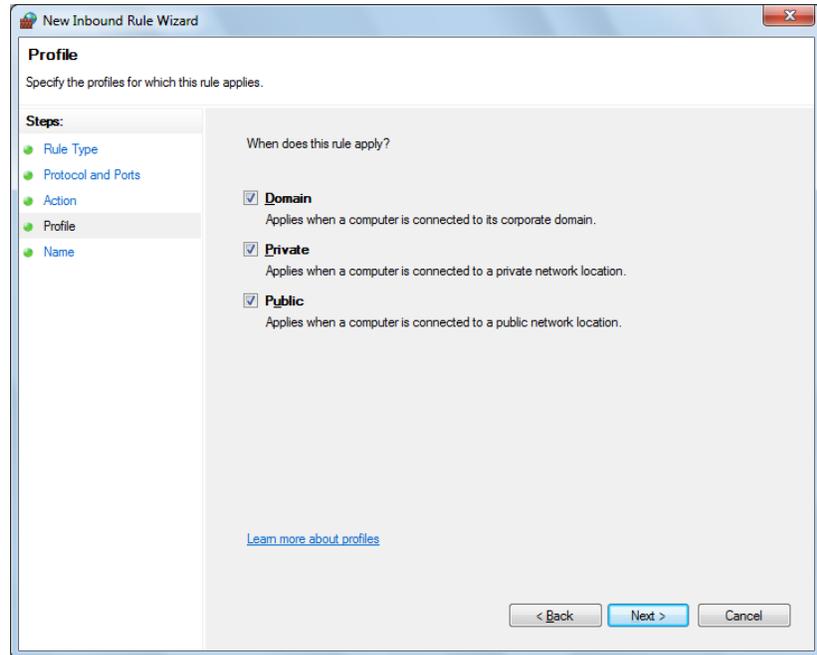
- b. Select **TCP** and enter 5000 for **Specific local ports** and click **Next**.

The screenshot shows the 'New Inbound Rule Wizard' dialog box, specifically the 'Protocol and Ports' step. The title bar reads 'New Inbound Rule Wizard'. The main heading is 'Protocol and Ports' with the instruction 'Specify the protocols and ports to which this rule applies.' On the left, a 'Steps:' list shows 'Rule Type', 'Protocol and Ports', 'Action', 'Profile', and 'Name', with 'Protocol and Ports' selected. The main area contains two questions: 'Does this rule apply to TCP or UDP?' with radio buttons for 'TCP' (selected) and 'UDP'; and 'Does this rule apply to all local ports or specific local ports?' with radio buttons for 'All local ports' and 'Specific local ports:' (selected). The 'Specific local ports:' field contains the text '5000' and an example 'Example: 80, 443, 5000-5010'. At the bottom right are buttons for '< Back', 'Next >', and 'Cancel'. A link 'Learn more about protocol and ports' is at the bottom left.

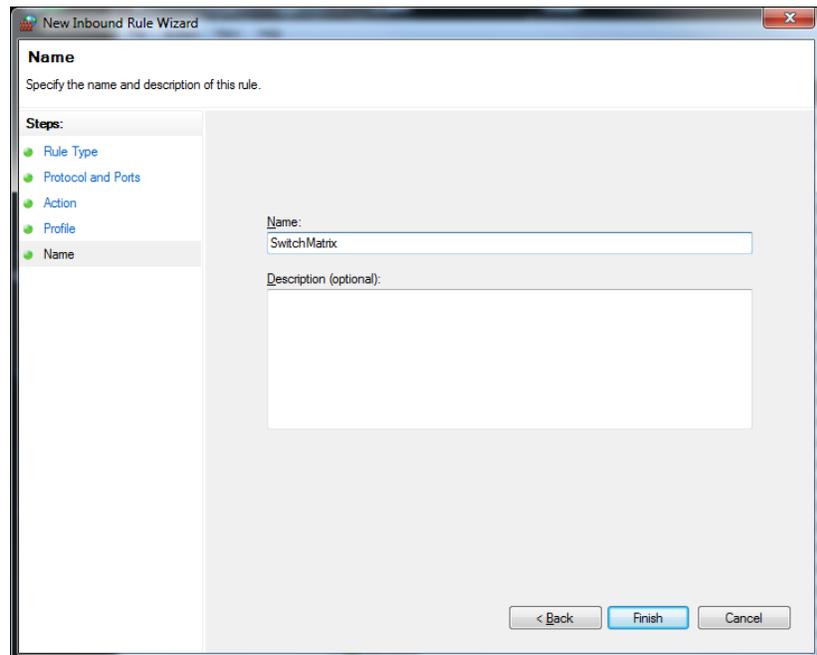
- c. Select **Allow the connection** and click **Next**.

The screenshot shows the 'New Inbound Rule Wizard' dialog box, specifically the 'Action' step. The title bar reads 'New Inbound Rule Wizard'. The main heading is 'Action' with the instruction 'Specify the action to be taken when a connection matches the conditions specified in the rule.' On the left, a 'Steps:' list shows 'Rule Type', 'Protocol and Ports', 'Action', 'Profile', and 'Name', with 'Action' selected. The main area contains the question 'What action should be taken when a connection matches the specified conditions?' with three radio button options: 'Allow the connection' (selected), 'Allow the connection if it is secure', and 'Block the connection'. The 'Allow the connection' option has a sub-description: 'This includes connections that are protected with IPsec as well as those are not.' The 'Allow the connection if it is secure' option has a sub-description: 'This includes only connections that have been authenticated by using IPsec. Connections will be secured using the settings in IPsec properties and rules in the Connection Security Rule node.' and a 'Customize...' button. At the bottom right are buttons for '< Back', 'Next >', and 'Cancel'. A link 'Learn more about actions' is at the bottom left.

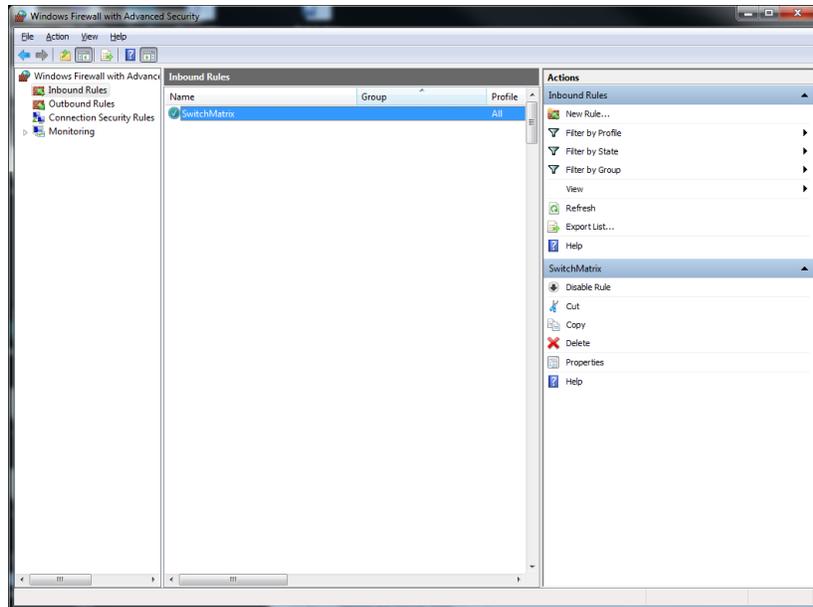
- d. Select **Domain,Private,Public**, and click **Next**.



- e. Enter **Name, Description (optional)**, and click **Finish**.

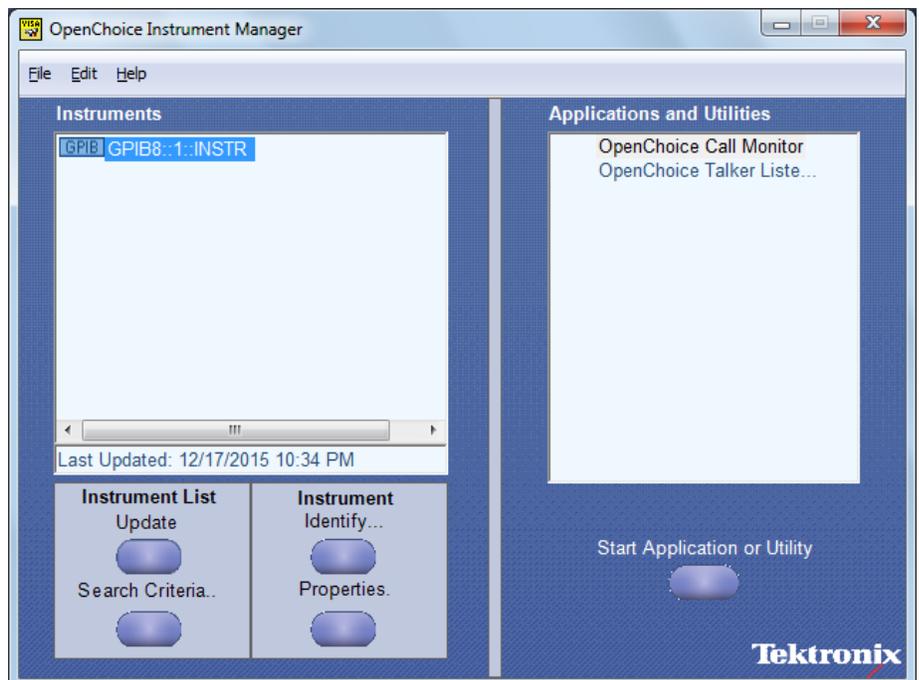


4. Verify the Rule name is displayed in **Windows Firewall with Advanced Security** menu > **Inbound Rules**.



TekVISA configuration

1. Click **Start > All Programs > TekVISA > OpenChoice Instrument Manager**.

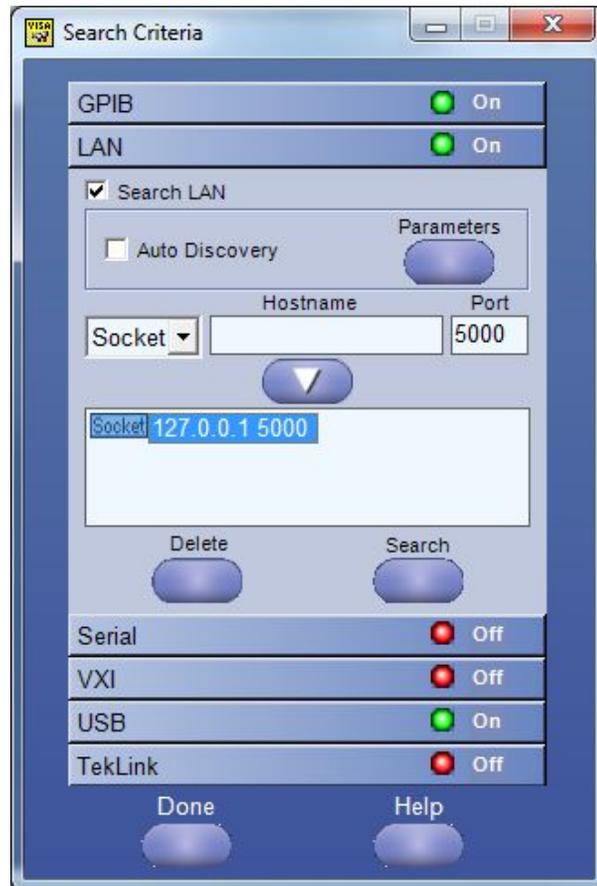


2. Click **Search Criteria**. In the Search Criteria menu, click **LAN** to Turn-on. Select **Socket** from the drop-down list, enter the IP address of the TekExpress device in **Hostname** field and set the **Port** to 5000. Click

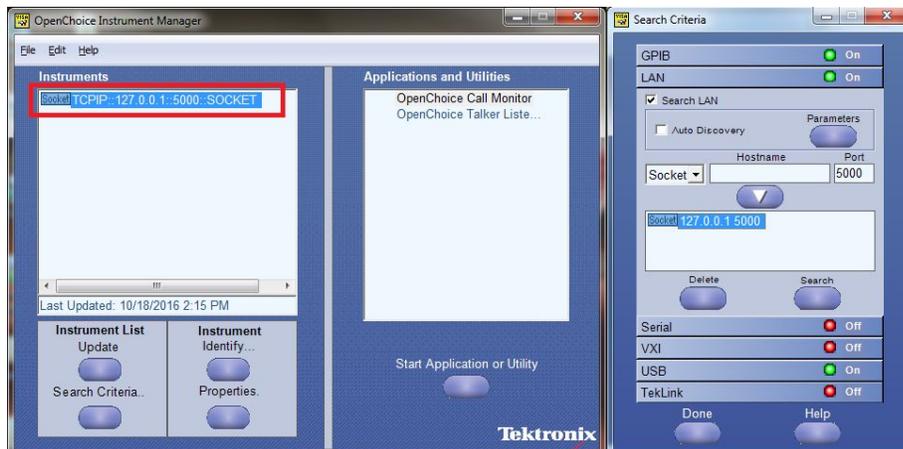


to configure the IP address with Port.

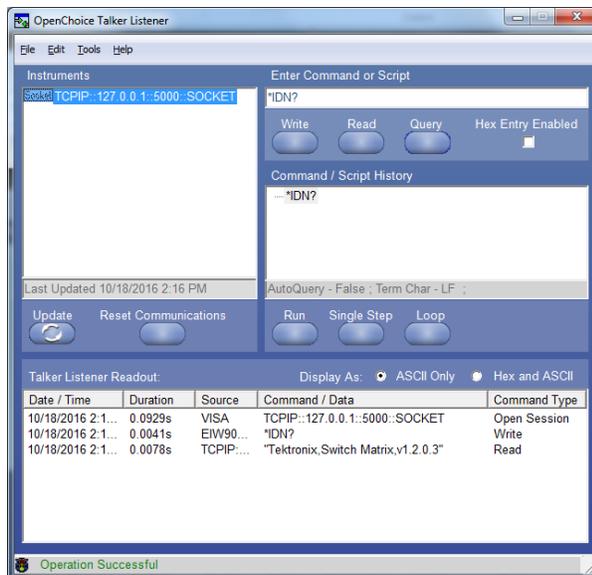
Enter the Hostname as 127.0.0.1 if the TekVISA and TekExpress application are in the same system, otherwise enter the IP address of the TekExpress application system.



- Click **Search** to set up the TCPIP connection with the host. Check whether the TCPIP host name is displayed under **OpenChoice Instrument Manager > Instruments**.



- Double-click **OpenChoice Talker Listener**, enter ***IDN?** in command entry field and click **Query**. Check that the Operation is successful and Talker Listener Readout displays the Command and Data.



SWITCH:*IDN

This command queries the switch matrix version information.

Syntax SWITCH:*IDN?\n

Inputs NA

Outputs Returns the switch martrix version information.

Example SWITCH:*IDN?\n returns "Tektronix,Switch Matrix,v1.0.0.0", where v1.0.0.0 is the Switch Matrix version.

SWITCH:*OPC

This command queries the previously executed commands execution status.

Syntax SWITCH:*OPC?\n

Inputs NA

Outputs Returns 0 if the previously executed command execution is in progress.
Returns 1 if the previously executed command execution is done.

Example SWITCH:*OPC?\n returns 1, when the previously executed command execution is done.

SWITCH:CONFIG

This command sets or queries the config file.

- Syntax** SWITCH:CONFIG {"<ConfigName>" | "<UserConfigFilePath>"}\n
SWITCH:CONFIG?\n
- Inputs** <ConfigName> specifies the config file.
<UserConfigFilePath> specifies the config file from the given path.
- Outputs** Returns the loaded config file name with path.
- Examples** SWITCH:CONFIG "Keithley S46T"\n sets the config file of Keithley.
SWITCH:CONFIG "E:\myconfig.xml"\n sets the config file from the given path.
SWITCH:CONFIG?\n returns "E:\myconfig.xml".

SWITCH:DE-EMBED:ALL:FILTER_FILE

This command sets the filter file for all connections.

- Syntax** SWITCH:DE-EMBED:ALL:FILTER_FILE
"<SwitchFilterFilePath>","<FixtureFilterFilePath>"\n
- Inputs** <SwitchFilterFilePath> specifies the switch filter file path.
<FixtureFilterFilePath> specifies the fixture filter file path.

Outputs NA

Example SWITCH:DE-EMBED:ALL:FILTER_FILE "C:\FilterFiles\SWTCH1.flr", "C:\FilterFiles\CABLE_1.flr"\n sets the switch filter file for all connections and the fixture filter file for all cables connected.

SWITCH:DE-EMBED:CONN:FILTER_FILE

This command sets the filter file for the switch, fixture, and cable for the specified connection.

Syntax SWITCH:DE-EMBED:CONN:FILTER_FILE
 "<RelayName>","<InputName>","<SwitchFilterFilePath>","<FixtureFilterFilePath>","<CableFilterFilePath>"\n

Inputs <RelayName> specifies the relay name.
 <InputName> specifies the input name.
 <SwitchFilterFilePath> specifies the switch filter file path.
 <FixtureFilterFilePath> specifies the fixture filter file path.
 <CableFilterFilePath> specifies the cable filter file path.

Example SWITCH:DE-EMBED:CONN:FILTER_FILE "Relay A","1","C:\FilterFiles\RA_1.flr","C:\FilterFiles\Fxtre_1.flr","C:\FilterFiles\cbl_1.flr"\n sets filter files to Relay A's input 1 and to the connected cable.

SWITCH:DE-EMBED:FILTER_FILE

This command queries the filter file based on the mode selected in the application.

Syntax SWITCH:DE-EMBED:FILTER_FILE?\n

Inputs NA

Outputs Returns the filter file in any of the the below specified format, based on the mode selected.

None
ALL;"<SwitchFilterFilePath>" "<FixtureFilterFilePath>"
RELAY_TYPE;"<RelayType1>" "<SwitchFilterFilePath1>" "<FixtureFilterFilePath1>" "<RelayType2>" "<SwitchFilterFilePath2>" "<FixtureFilterFilePath2>"
RELAY;"<RelayName1>" "<SwitchFilterFilePath1>" "<FixtureFilterFilePath1>" "<RelayName2>" "<SwitchFilterFilePath2>" "<FixtureFilterFilePath2>"
CONN;"<RelayName1>" "<InputName1>" "<SwitchFilterFilePath1>" "<FixtureFilterFilePath1>" "<CableFilterFilePath1>" "<RelayName1>" "<InputName2>" "<SwitchFilterFilePath2>" "<FixtureFilterFilePath2>" "<CableFilterFilePath2>"

Example SWITCH:DE-EMBED:FILTER_FILE?\n returns ALL;"C:\FilterFiles\SWTCH1.flr" "C:\FilterFiles\Fxtre_1.flr".

SWITCH:DE-EMBED:MODE

This command sets or queries the De-Embed mode.

Syntax SWITCH:DE-EMBED:MODE {NONE | ALL | RELAY_TYPE | RELAY |
CONN}\n
SWITCH:DE-EMBED:MODE?\n

Inputs {NONE | ALL | RELAY_TYPE | RELAY | CONN}

Outputs Returns the De-Embed mode.

Examples SWITCH:DE-EMBED:MODE ALL\n sets the De-Embed mode as ALL.
SWITCH:DE-EMBED:MODE?\n returns ALL.

SWITCH:DE-EMBED:RELAY:FILTER_FILE

This command sets the filter file and fixture file for the specified relay.

Syntax SWITCH:DE-EMBED:RELAY:FILTER_FILE
"<RelaName>","<SwitchFilterFilePath>","<FixtureFilterFilePath>"\n

Inputs <RelaName> specifies the relay name.
<SwitchFilterFilePath> specifies the switch filter file path.
<FixtureFilterFilePath> specifies the fixture filter file path.

Outputs SWITCH:DE-EMBED:RELAY:FILTER_FILE "Relay A","C:\FilterFiles\RA.flr","C:\FilterFiles\Fxtre_1.flr"\n sets filter files for all connections in Relay A.

SWITCH:DE-EMBED:RELAY_TYPE:FILTER_FILE

This command sets the filter file for specified relay type.

Syntax SWITCH:DE-EMBED:RELAY_TYPE:FILTER_FILE "<RelayType>",<SwitchFilterFilePath>",<FixtureFilterFilePath>"\n

Inputs <RelayType> specifies the relay type.
<SwitchFilterFilePath> specifies the switch filter file path.
<FixtureFilterFilePath> specifies the fixture filter file path.

Example SWITCH:DE-EMBED:RELAY_TYPE:FILTER_FILE "SP2T","C:\FilterFiles\SP2T.flr","C:\FilterFiles\Fxtre_1.flr"\n sets filter file for SP2T relay type.

SWITCH:LASTERROR

This command queries the error occurred while executing last command.

Syntax SWITCH:LASTERROR?\n

Inputs NA

Outputs Returns the error occurred while executing last command.

Error message	Description
NO_ERROR	No error occurred executing last command.
INVALID_COMMAND	The last command sent is either invalid or syntax is not correct.
"No config file loaded."	The last command to load the config file is failed.
"Invalid configuration."	The last command has invalid configuration.
"Invalid linkwidth."	The last command has invalid linkwidth.
"Invalid de-embed mode."	The last command has invalid de-embed mode.
"Invalid signal polarity."	The last command has invalid signal polarity.
"Invalid relay name."	The last command has invalid relay name.
"Invalid relay type."	The last command has invalid relay type.
"Invalid signal name."	The last command has invalid signal name.
"Invalid common value."	The last command has invalid value for common.
"Invalid input ID."	The last command has invalid input ID.

Example SWITCH:LASTERROR?\n returns the last error occurred.

SWITCH:LINKWIDTH

This command sets or queries the link width.

Syntax SWITCH:LINKWIDTH {X2 | X4 | X8 | X16}\n
 SWITCH:LINKWIDTH?\n

Inputs	{X2 X4 X8 X16}
Outputs	Returns the link width value.
Examples	SWITCH:LINKWIDTH X8\n sets the linkWidth to 8. SWITCH:LINKWIDTH?\n returns 8.

SWITCH:RELAY:CASCADE

This command sets or queries the cascade of the relay.

Syntax	SWITCH:RELAY:CASCADE "<FromRelayName>","<ToRelayName>","<InputName>"\n SWITCH:RELAY:CASCADE? "<RelayName>"\n
Inputs	<FromRelayName> specifies the relay name from which to cascade. <ToRelayName> specifies the relay name to cascade. <InputName> specifies the input name of the relay to cascade. <RelayName> specifies the relay name.
Outputs	Returns the cascading info of the relay if cascaded else returns NOT_CASCADED.
Example	SWITCH:RELAY:CASCADE "Relay A","Relay B","2"\n sets Relay A's output cascade to Relay B's input 2. SWITCH:RELAY:CASCADE? "Relay A"\n returns "Relay B","2". SWITCH:RELAY:CASCADE? "Relay B"\n returns NOT_CASCADED.

SWITCH:RELAY:CASCADED

This command sets or queries cascaded state of the relay.

Syntax SWITCH:RELAY:CASCADED "<RelayName>",{TRUE | FALSE}\n
SWITCH:RELAY:CASCADED? "<RelayName>"\n

Inputs <RelayName> specifies the relay name.
TRUE or FALSE to cascade the relay or not.

Outputs Returns whether the relay is cascaded or not.

Examples SWITCH:RELAY:CASCADED "Relay A",TRUE\n sets the cascaded state of Relay A to TRUE.
SWITCH:RELAY:CASCADED? "Relay A"\n returns TRUE.

SWITCH:RELAY:COMMON

This command sets or queries the relays common connection connected to scope channels.

Syntax SWITCH:RELAY:COMMON "<RelayName>",{CH1 | CH2 | CH3 | CH4}\n
SWITCH:RELAY:COMMON? "<RelayName>"\n

Inputs <RelayName> specifies the relay name.
{CH1 | CH2 | CH3 | CH4} specifies the channel number.

Outputs Returns the channel connected to the common connection of relay.

Example SWITCH:RELAY:COMMON "Relay A",CH1\n sets the common connection of Relay A to CH1.

SWITCH:RELAY:COMMON? "Relay A"\n returns CH1.

SWITCH:RELAY:POLARITY

This command sets or queries the signal polarity of the specified relay.

Syntax SWITCH:RELAY:POLARITY "<RelayName>",{POS | NEG | DIFF}\n
SWITCH:RELAY:POLARITY? "<RelayName>"\n

Inputs <RelayName> specifies the relay name.
{POS | NEG | DIFF} specifies the signal polarity as Positive, Negative or Differential respectively.

Outputs Returns the signal polarity of the relay.

Examples SWITCH:RELAY:POLARITY "Relay A",POS\n sets the Relay A's signal polarity to POS.

SWITCH:RELAY:POLARITY? "Relay A"\n returns POS.

SWITCH:RELAY:SIGNAL

This command sets or queries the signal name connected to input port.

Syntax SWITCH:RELAY:SIGNAL
"<RelayName>","<InputName>","<SignalName>"\n
SWITCH:RELAY:SIGNAL? "<RelayName>","<InputName>"\n

Inputs <RelayName> specifies the relay name.
<InputName> specifies the input name of the relay.
<SignalName> specifies the signal name to connect to the relays input.

Outputs Returns the signal name connected to the input port.

Example SWITCH:RELAY:SIGNAL "Relay A","1","Lane0+"\n sets the signal name Lane0+ to Relay A's input 1.
SWITCH:RELAY:SIGNAL? "Relay A","1"\n returns "Lane0+".

Reference

Error messages

Error message	Possible solution
"A filename cannot be empty and it cannot contain any of the following characters:\n\t. \ \ / : ? \ " < > * ! @ # \$ % ^ & * () - + . , / \ \ ' < > Also, the file name cannot be \"Keithley S46T\", \"Gigatronics ASCOR 8000\", \"Select\", \"New Configuration\", \"Custom\", \"Auto Detect\" or \"Show All Files\""	
Configure appropriate signals before the de-embed settings.	Select at least one signal for a relay before configuring the de-embed settings.
Either the instrument address is invalid or instrument is not connected.	Check the GPIB connection from oscilloscope to switch and verify the instrument address.
Error occurred while trying to recall the configuration settings. Try re-creating configuration or recalling a different configuration file.	Re-create the configuration file or recall a different configuration file.
Error occurred while trying to access the connection for open/close operation.	
Filter file <FilterFileName> not found.	Reselect the de-embed filter file and try again.
Graphical view is not generated or does not exist.	
Initialize the switch	Initialize the switch and then perform the switch operations.
Instrument address doesn't belong to any supported switch.	Verify the switch address.
Instrument address is empty.	Instrument address cannot be empty. Enter a valid instrument address in the GPIB (<i>GPIB0:X:INSTR</i>) or TCPIP (<i>TCPIP::IPADDR::INSTR</i>) format.
No switch detected. Connect a Keithley or Gigatronics switch and try auto detection by selecting Configuration > Auto Detect.	Check the GPIB connection from the oscilloscope to switch and whether the instrument is detected in TekVISA.
Number of relays cannot be more than 26	
Please ensure that the name(s) of the configured relay(s) match the ones present on the physical switch.	
Relay name cannot be empty	

Error message	Possible solution
Scope initialization failed. Check if the address is valid and ensure that the instrument is switched on and try again.	Validate the oscilloscope address try again.
Switch communication failed...	Ensure that the switch is on. Reset the switch and try again.
Switch initialization failed. Check if the address is valid and ensure that the instrument is switched on and try again.	Validate the switch address and ensure that the instrument is switched on. Try again.
The start count cannot be more than 74	
Timeout Error. Either the command is invalid or instrument is not active.	Check the command syntax and the connection of the instrument by <code>SWITCH:*IDN</code> command.
Two or more lanes have same name. The lane names should be unique.	
Two or more relays have same name.	

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