

Keysight U1816A/C USB Coaxial Switch

DC to 26.5 GHz SP6T USB-controlled
switch matrix



Operating and
Service Manual

Notices

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 <p>This symbol indicates the time period during which no hazardous or toxic substance elements are expected to leak or deteriorate during normal use. Forty years is the expected useful life of the product.</p>	<p>This equipment is Class A suitable for professional use and is for use in electromagnetic environments outside of the home.</p> <p>A급 기기 (업무용 방송통신기자재)</p> <p>이 기기는 업무용(A급) 전자파적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적으로 합니다.</p>  <p>MSIP-REM-ATI-WNU1816BS20</p>

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Product category:

With reference to the equipment types in the WEEE directive Annex 1, this instrument is classified as a “Monitoring and Control Instrument” product.

The affixed product label is as shown below.



Do not dispose in domestic household waste.

To return this unwanted instrument, contact your nearest Keysight Service Center, or visit www.keysight.com/environment/product for more information.

Declaration of Conformity (DoC)

A copy of the Manufacturer's European Declaration of Conformity for this USB Switch can be obtained by contacting your local Keysight Technologies sales representative, or copies can be downloaded from the Keysight Technologies Web site at:

<http://www.keysight.com/go/conformity>

NOTE

If you are unable to search for the respective DoC, contact your local Keysight representative.

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1 Introduction

Product Overview **14**

This chapter provides an overview of the Keysight U1816A/C USB Coaxial Switch.

Product Overview

The Keysight U1816A/C is a USB-controlled switch matrix that consists of two single-pole-six-throw (SP6T) switches. It enables the switching of multiple signal paths without physically changing the connections. This allows multiple tests to be performed with the same setup, eliminating the need for frequent connects and disconnects. An entire testing process can be automated, increasing the throughput in high-volume production environments.



Figure 1-1 U1816A/C USB-Controlled Switch Matrix

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This chapter provides you important information on how to check and prepare your instrument for operation.

Initial Inspection

- 1 Unpack and inspect the shipping container and its contents thoroughly to ensure that nothing was damaged during shipment. If the shipping container or cushioning material is damaged, the contents should be checked both mechanically and electrically.
 - Check for mechanical damage such as scratches or dents.
 - Procedures for checking electrical performance are given under “**Operator’s check**” on page 28.
- 2 If the contents are damaged or defective, contact your nearest Keysight Technologies Service and Support Office. Keysight Technologies will arrange for repair or replacement of the damaged or defective equipment. Keep the shipping materials for the carrier’s inspection.
- 3 If you are returning the instrument under warranty or for service, repackaging the instrument requires original shipping containers and material or their equivalents. Keysight Technologies can provide packaging materials identical to the original materials. Attach a tag indicating the type of service required, return address, model number, and serial number. Mark the container **FRAGILE** to insure careful handling. In any correspondence, refer to the instrument by model number and serial number.

Service and Recalibration

If your U1816A/C requires service or repair, contact the nearest Keysight office for information on where to send it. The performance of the U1816A/C can only be verified by specially-manufactured equipment and calibration standard from Keysight. The recommended interval for recalibration is 12 months.

Verify the U1816A/C Shipment Contents

The following table lists the items that are shipped with the U1816A/C.

Table 2-1 U1816A/C contents

Quantity	Description	Part number
1	Keysight U1816A/C Product Software and Information CD	U1816-10001
1	U1816A/C Operating and Service Manual	U1816-90001
1	Certificate of Calibration	5962-0476
1	USB cable 1.8 m	8121-0506
1	Power supply	0950-5014
1	China RoHS Addendum for Test Accessories - RF and Microwave	9320-6695

Related Documentation

This Operating and Service Manual and the Keysight U1816A/C USB Switch Soft Front Panel can be located on the product CD that is shipped with the product. They are also available at <http://www.keysight.com/find/USBswitch>.

Operating and Safety Precautions

Observe the following guidelines before connecting or operating the U1816A/C USB-controlled switch matrix.

ESD damage

Protection against electrostatic discharge (ESD) is important while handling and operating the U1816A/C.

Static electricity can build up on your body and can easily damage sensitive components when discharged.

Static discharges too small to be felt can cause permanent damage to the unit.

To prevent damage from ESD:

- **Use** a grounded antistatic mat in front of your test equipment and wear a grounded wrist strap attached to it when handling or operating the U1816A/C.
- **Wear** a heel strap when working in an area with a conductive floor.
- **Ground** yourself before you clean, inspect, or make a connection to the U1816A/C. You can, for example, grasp the grounded outer shell of the analyzer test port or cable connector briefly.
- **Avoid** touching the exposed connector pins.

Connector care

Because connectors can become defective due to wear during normal use, all connectors should be inspected and maintained to maximize their service life.

- Inspect the mating surface each time a connection is made. Metal particles from connector threads often find their way onto the mating surface when a connection is made or disconnected.
- Clean dirt and contamination from the connector mating surface and threads. This simple step can extend the service life of the connector and improve the quality of your calibration and measurements.
- Gage connectors periodically. This not only provides assurance of proper mechanical tolerances and thus connector performance, but can also indicate situations where the potential for damage to another connector may exist.

CAUTION

The U1816A/C can be damaged if excessive torque is applied to the connectors.

The recommended torque value is 8 lb-in torque for SMA.

System Requirements

Prior to any installation or configuration, ensure that the following system requirements are met.

Operating system	Windows® XP SP3 or later (32-bit)	Windows Vista® SP1 and SP2 (32-bit and 64-bit), Business, Ultimate, Enterprise, Home Basic, and Home Premium	Windows® 7 (32-bit and 64-bit) Starter, Home Basic, Home Premium, Professional, Ultimate, Enterprise
Processor speed	600 MHz or higher required, 800 MHz recommended	1 GHz 32-bit (x86), 1 GHz 64-bit (x64), no support for Itanium® 64	1 GHz 32-bit (x86), 1 GHz 64-bit (x64), no support for Itanium® 64
Available memory	256 MB minimum (1 GB or higher recommended)	1 GB minimum	1 GB minimum
Available hard-disk space^[a]	1 GB for Microsoft® .NET Framework 3.5	1 GB for Microsoft® .NET Framework 3.5	1 GB for Microsoft® .NET Framework 3.5
Video	Super VGA (800×600) 256 colors or more	Support for DirectX® 9 graphics with 128 MB graphics memory recommended (Super VGA graphics supported)	Support for DirectX® 9 graphics with 128 MB graphics memory recommended (Super VGA graphics supported)
Browser	Microsoft® Internet Explorer 6.0 or higher	Microsoft® Internet Explorer 7 or higher	Microsoft® Internet Explorer 7 or higher

[a] Because of the installation procedure, less memory may be required for operation than is required for installation.

Software Installation

The U1816A/C software is located on the U1816A/C Product Software and Information CD (U1816-10001). The software installation includes the Soft Front Panel (SFP) software and the Examples file. The Examples file covers the Visual Basic, Visual C#, Visual C++, and Keysight VEE examples. The SFP software and the Examples file are also available for download at www.keysight.com/find/USBswitch.

Use the following procedure to install the software:

- 1 Power up the host PC to install the U1816A/C software.
- 2 From the U1816A/C Product Software and Information CD browser, launch the installer.
- 3 Follow the installer prompts to install all software and documentation for the U1816A/C.
- 4 After installation has completed, power down the host PC.

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This chapter provides the specifications of the U1816A/C USB Switch.

General Specifications

Specifications

Specifications refer to the performance standards or limits against which the U1816A/C is tested.

Typical characteristics are included for additional information only and they are not specifications. These are denoted as “typical”, “nominal”, or “approximate”, and are printed in italic.

Table 3-1 U1816A/C specifications

Specifications	U1816A	U1816C
Frequency range	DC to 8 GHz	DC to 26.5 GHz
Insertion loss (max)	0.3 dB + 0.015 × frequency (GHz)	
Isolation (min)	100 dB	DC to 12 GHz: 100 dB 12 to 15 GHz: 80 dB 15 to 20 GHz: 70 dB 20 to 26.5 GHz: 65 dB
VSWR (max)	DC to 4 GHz: 1.20 4 to 8 GHz: 1.35	DC to 4 GHz: 1.20 4 to 12.4 GHz: 1.35 12.4 to 18 GHz: 1.45 18 to 26.5 GHz: 1.70
Insertion loss repeatability (up to 5 million cycles measured at 25 °C)	0.03 dB maximum	
Connectors	SMA (f)	
Drive method	USB	
Switching time ^[a]	<15 ms	
DC supply voltage (power adapter provided)	15 – 19 V	
Physical dimensions:		
Height	103.8 mm (4.09 in)	
Width	232.6 mm (9.16 in)	
Depth	245.0 mm (9.65 in)	
Weight	1.5 kg (3.31 lb)	

[a] The switching time of <15 ms is guaranteed at the switch level only. Typically, the total effective switching time varies around 15 to 25 ms; the extra time may be attributed to the overall test system performance (e.g., CPU).

NOTE

For detailed information of the switches used in the U1816A/C, refer to the Keysight 87106x Multiport Coaxial Switch documentation at <http://literature.cdn.keysight.com/litweb/pdf/5091-3366E.pdf>

Mechanical Dimensions

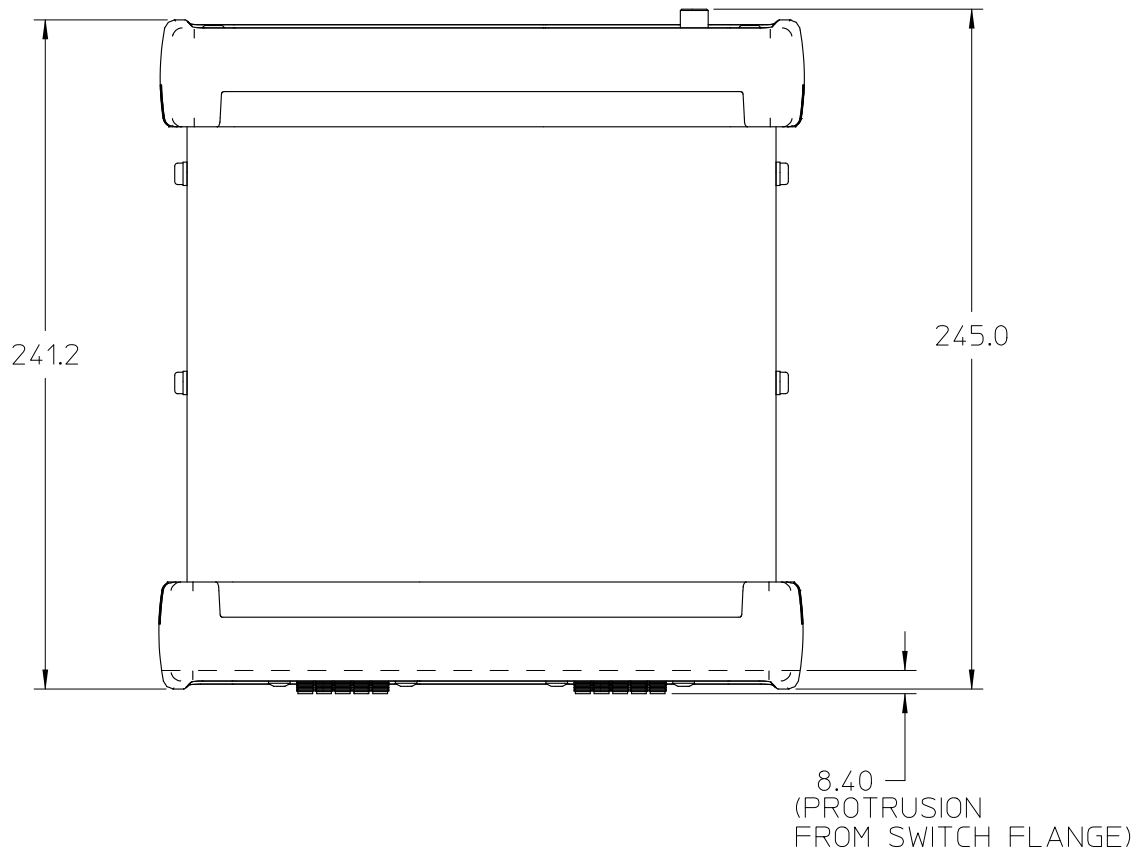


Figure 3-1 Top view of the U1816A/C

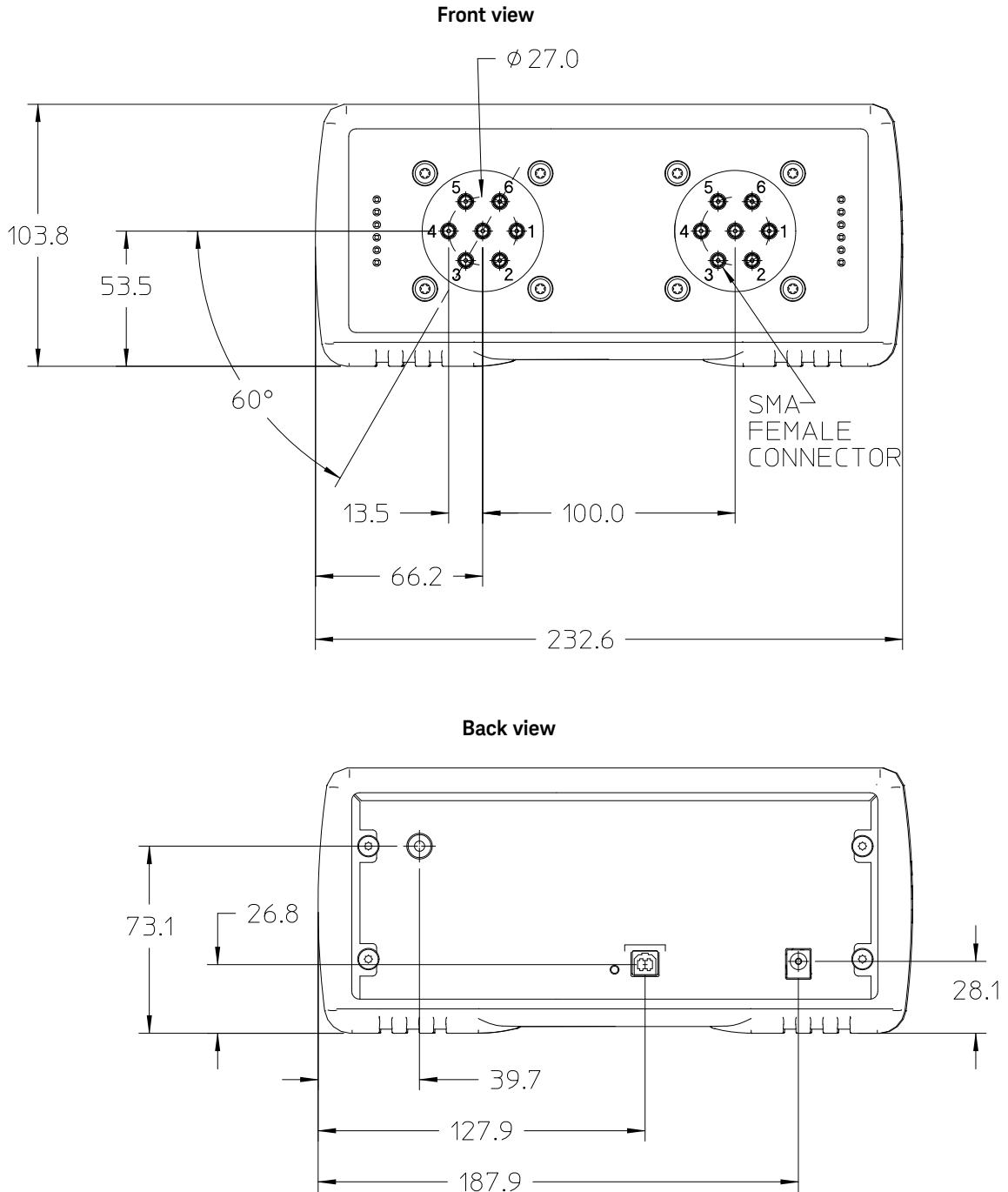


Figure 3-2 Front and back views of the U1816A/C

Environmental Specifications

The U1816A/C is designed to fully comply with Keysight Technologies's product operating environmental specifications.

The following table shows the summarized environmental specifications for this product.

Table 3-2 U1816A/C environmental specifications

Temperature	
- Operating	0 °C to 55 °C
- Storage	-40 °C to 70 °C
Vibration	
- Operating random	5 to 500 Hz, 0.3 g RMS
- Survival random	5 to 500 Hz, 3.41 g RMS
Shock	
- End use handling shock	Half sine waveform, 120 in/s, duration <3 ms
- Transportation shock	Trapezoidal, 50 g
Humidity	
- Operating/Storage	15 to 95% Relative Humidity (RH)
Altitude	
- Operating/Storage	15000 ft/4600 m
ESD immunity	
- Direct discharge	8.0 kV
- Air discharge	15 kV

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This chapter provides simple quick-check instructions to verify the U1816A/C USB-controlled switch matrix's functionality prior to usage. It also provides information to get you started on the Soft Front Panel (SFP) of the U1816A/C.

Operating Instructions

Operator's check

The operator's check is supplied to allow the operator to make a quick check of the U1816A/C prior to usage or if a failure is suspected.

CAUTION

ESD exceeding the level specified in **Table 3-2** or the RF power applied is greater than the maximum specified as in **Table 3-1** may cause permanent damage to the device.

Operator's check for the S-parameter test

The coaxial multiport switch is connected to a network analyzer configured for the S-parameter measurement. The network analyzer can be set to sweep over the whole or selected frequency range of the switch to be verified. The S-parameter measurement is the best way to determine if the switch is working properly.

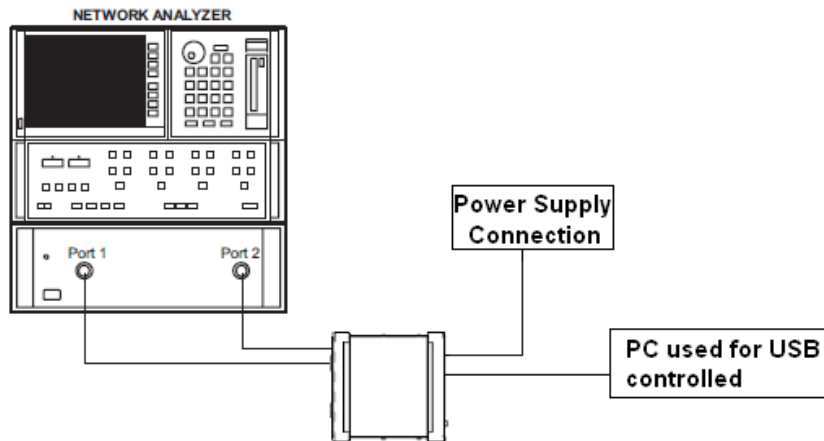


Figure 4-1 Connection to perform a quick check

Quick-check procedure

- 1 Connect the common port of the switch to Port 1 of the network analyzer and one of the outer RF ports to Port 2 of the network analyzer as illustrated in **Figure 4-1**.
- 2 Refer to **"Getting Started with the Soft Front Panel (SFP)"** on page 29 to use the SFP for controlling the U1816A/C to close the selected path.
- 3 Perform the S-parameter measurement and verify against the specifications in **Table 3-1**.
- 4 Repeat from step 1 until all paths are measured and verified.

Getting Started with the Soft Front Panel (SFP)

This section guides you through the SFP that provides an easy-to-use interface for controlling the U1816A/C.

- 1 Refer to **Chapter 2**, "Software Installation" to install the SFP.
- 2 Launch the SFP software from the desktop by double-clicking the SFP icon, or from **Start > All Programs > Keysight > U1816x > U1816x SFP**.
- 3 The SFP window will appear as shown below.

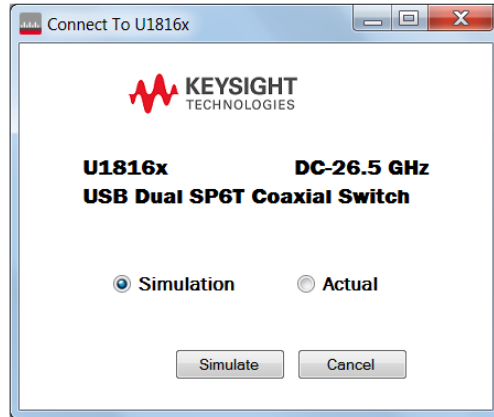


Figure 4-2 U1816A/C SFP window

- 4 The main SFP interface is shown in **Figure 4-3** and described in **Table 4-1**.

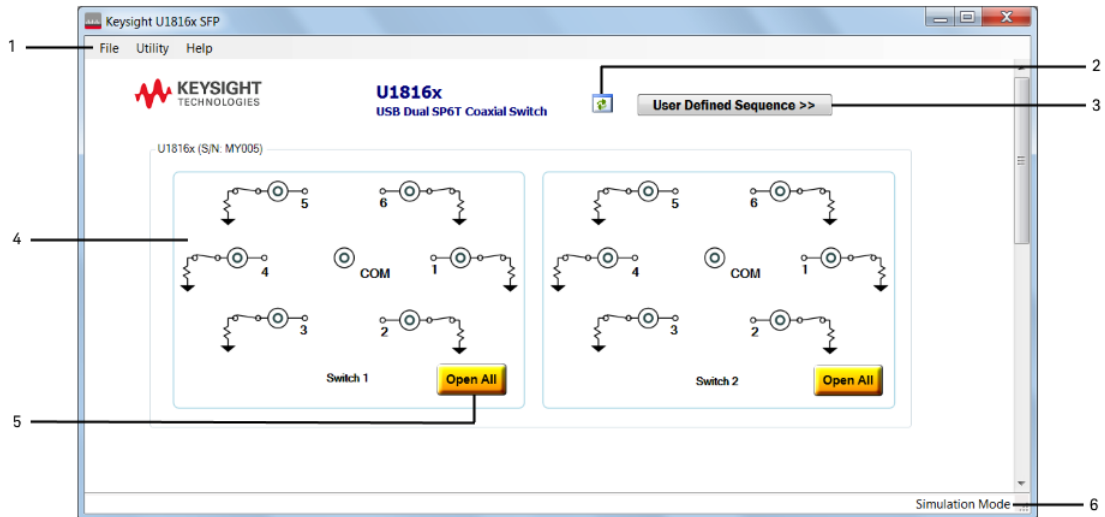


Figure 4-3 U1816A/C main SFP interface

Table 4-1 Overview of the main SFP interface

No.	Item	Description
1	Menu bar	<ul style="list-style-type: none"> - The File menu consists of the following functions: <ul style="list-style-type: none"> - Close: Closes this window and returns to the Connect To U1816x window. - Exit: Exits the SFP. - The Utility menu consists of the following functions: <ul style="list-style-type: none"> - Cycle Count: Opens the Cycle Count window. - Reset: Resets the U1816x. - Driver Call Log: Opens the Driver Call Log window. - The Help menu consists of the following functions: <ul style="list-style-type: none"> - Help: Opens this help file. - Online Support: Opens the USB switch Web interface. - Firmware Revision: Displays the current firmware revision of the U1816x. - About: Opens the SFP information window.
2	Refresh button	Refreshes the SFP. During the refresh operation, a message will appear to inform you not to connect or disconnect any USB devices.
3	User Defined Sequence button	Opens the U1816x User Defined Sequence window which allows you to configure the switching sequence.
4	Switch relays	Performs switching of the U1816x when a port is clicked.
5	Open All button	Disconnects all switch ports.
6	Status indicator	Displays the operating status.

NOTE

Do not connect or disconnect any USB devices when the SFP initializing and refresh operations are in progress.

5 The U1816A/C SFP is a graphical interface that helps you with the following tasks:

a To connect to the U1816A/C

-- Upon launching the SFP, the U1816A/C SFP window will appear as shown in **Figure 4-2**.

-- Click the **Actual** radio button. Then, click **Connect** to access the main interface which will display the connected U1816A/C switch diagram.

-- In the situation when the U1816A/C is not connected, the simulation mode can be used. On the U1816A/C SFP window (**Figure 4-2**), click the **Simulation** radio button. Then, click **Simulate** to access the main interface of the U1816A/C.

b To operate the U1816A/C

-- On the U1816A/C main SFP interface as shown in **Figure 4-4**, click any port of 1 to 6 to make a connection with the common (COM) port. To disconnect all ports, click **Open All**.

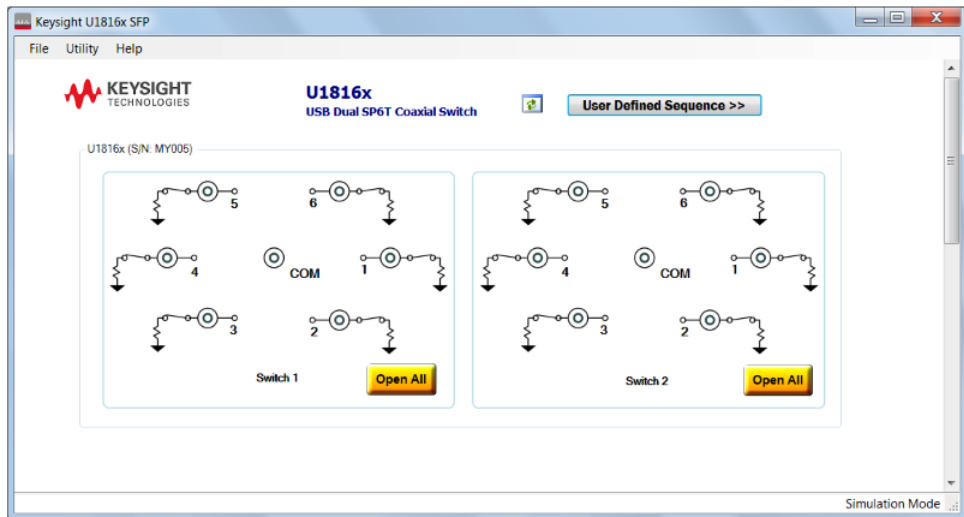


Figure 4-4 U1816A/C main SFP interface

c To configure the User Defined Sequence

- You can set the sequence to perform switching in the U1816x User Defined Sequence window as shown in **Figure 4-5**. The Sequence table allows you to select among Ports 1 to 6 or Open All for the connected switches. You can also double-click to edit the **Sequence** field or to specify the time delay for each sequence at the **Wait (mSec)** field.

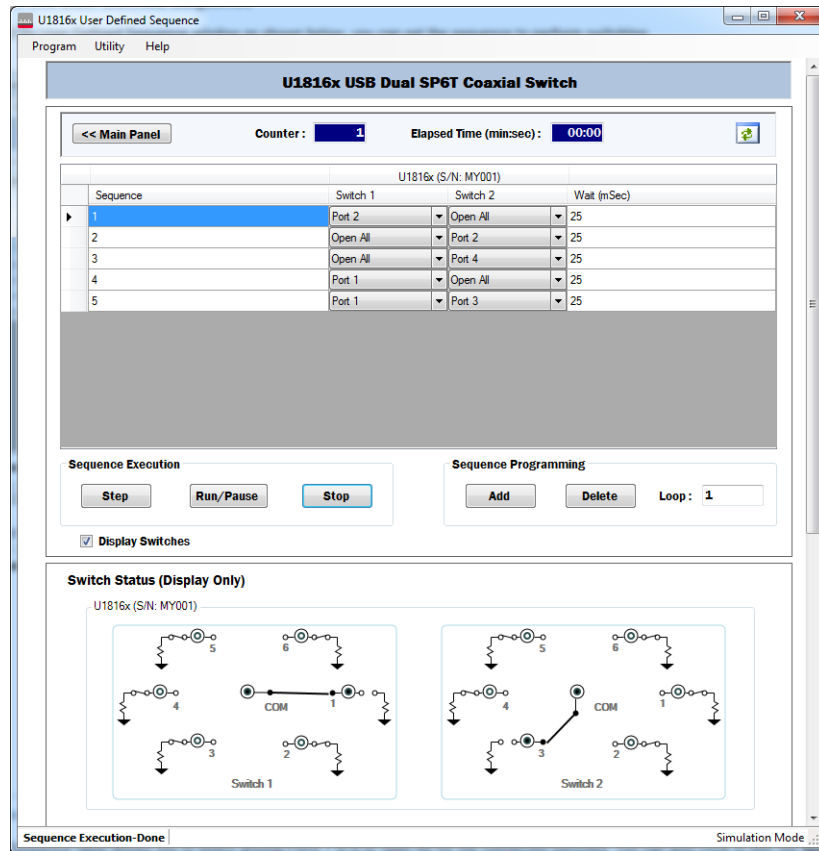



Figure 4-5 User Defined Sequence window

- The **Sequence Programming** area allows you to add or delete a sequence by selecting the entire row and clicking the respective buttons. You can also specify the number of times to repeat the entire sequence at the **Loop** field.
- The **Sequence Execution** area allows you to run, pause, step across, or stop the sequence by clicking the respective buttons. If you disconnect a switch and then you click **Run/Pause**, a warning message will prompt you to delete the data entry for that switch. If you choose not to delete, the data entry field will be highlighted in blue.
- For each switching operation, the cycle **Counter** will increment one switch cycle.
- The Refresh button () when clicked allows you to update the table if there are any switches being connected or disconnected. If you disconnect a switch and then you click the Refresh button, a warning message will prompt you to delete the data entry for that switch. If you choose not to delete, the data entry field will be highlighted in blue.

- You can view the switch status by clicking the **Display Switches** check box. To close the display, clear the check box.
- The status indicator at the bottom of the window displays the switch operating status.
- The << **Main Panel** button when clicked allows you to return to the main interface. A message will prompt you to save the current data before exiting.
- The menu bar provides additional functions as described in **Table 4-2**.

Table 4-2 User Defined Sequence menu bar

Item	Function description
Program	<ul style="list-style-type: none"> - New: Opens a new table. This new table will replace the existing table. - Save: Saves the existing table data to a file at "<user's personal folder>\Keysight U1816x\Sequence". If you click Open Path, you will be directed to all the saved table data files at "<user's personal folder>\Keysight U1816x\Sequence". - Recall: Recalls a saved table data file to use. The table data will be displayed in the existing table. If you disconnect a switch, a message will prompt you to swap with another available switch. Select the switch and click Swap. If you choose not to swap, the data field of the disconnected switch will be displayed in blue. If you click Delete, the data field of the disconnected switch will be deleted from the table. - Delete: Deletes a saved table data file. - Export: Exports the commands of the User Defined Sequence functions to a text file. - Close: Closes the User Defined Sequence window and returns to the main interface.
Utility	Cycle Count: Displays the cycle count for all connected U1816x switches.
Help	<ul style="list-style-type: none"> - Help: Opens this help file. - Online Support: Opens the USB switch Web interface. - About: Opens the SFP information window.

NOTE

No auto-refresh operation is allowed when switches are being connected or disconnected.

d To clear the cycle count

- On the main SFP interface as shown in **Figure 4-4**, click **Utility > Cycle Count** from the menu bar to open the Cycle Count window as shown in **Figure 4-6**.

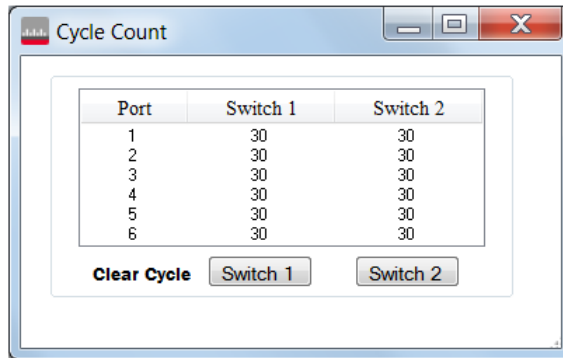


Figure 4-6 Cycle Count window

- Click **Switch 1** or **Switch 2** to permanently clear the cycle count for the respective switch.

e To reset the U1816A/C

- On the main SFP interface as shown in **Figure 4-4**, click **Utility > Reset** from the menu bar to reset all U1816A/C switch ports to the open state.

f To monitor driver calls

- The Driver Call Log allows you to identify the commands required to operate the U1816A/C switch. Each log entry corresponds to an operation triggered via the SFP.
- On the main SFP interface as shown in **Figure 4-4**, click **Utility > Driver Call Log** from the menu bar to open the Driver Call Log window as shown in **Figure 4-7**.

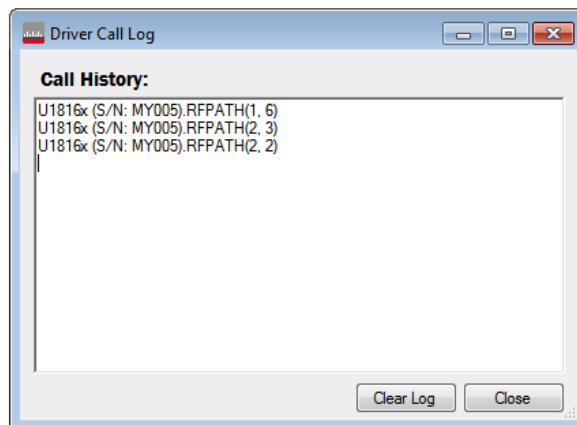


Figure 4-7 Driver Call Log window

- To erase all driver calls from the log, click **Clear Log**.
- 6** To get help using the SFP, refer to the Help file from the main SFP interface.

Software Programming Guide

The following table lists the methods used to control the U1816A/C.

The DLL file is located in the program file folder.

- For 32-bit Windows:

C:\Program Files\Keysight\U1816x\Dll

- For 64-bit Windows:

C:\Program Files (x86)\Keysight\U1816x\Dll

Table 4-3 List of methods

Method	Description
1. string InstrumentModel():	Return the model information
2. string SerialNumber():	Return the device serial number
3. string InstrumentFirmwareRevision():	Return the firmware revision
4. StatusEnum RFPATH(int SwitchNo, int PathNo):	Set the RF path according to the switch and path selection - Switch selection: 1 or 2 - RF path selection: 0 to 6 where 0 = all open
5. StatusEnum GetRFPATH(int SwitchNo,Byref int PathNo):	Get the RF path according to the switch selection - Switch selection: 1 or 2
6. StatusEnum RFPATH2(int SW1PathNo, int SW2PathNo):	Set the RF path for both banks - Switch 1 RF path selection: 0 to 6 where 0 = all open - Switch 2 RF path selection: 0 to 6 where 0 = all open
7. StatusEnum GetRFPATH2(ByRef int SW1Path,ByRef int SW2Path):	Get the path for both switches
8. StatusEnum GetRelayCount(int SwitchNo,int PathNo,ByRef CycleCount):	Get the switching cycle according to the switch and path selection - Switch selection: 1 or 2 - RF path selection: 1 to 6
9. StatusEnum ClearRelayCount(int SwitchNo):	Clear the cycle count for the selected switch - Switch selection: 1 or 2
10. StatusEnum CyclingControlState(Boolean state):	Set the switch auto cycling control - false = disabled, true = enabled
11. boolean GetCyclingControlState():	Get the switch auto cycling control state
12. StatusEnum AutoCycling():	Switch auto cycling
13. List(Of String) InstrumentList():	Return list of connected switch

The following table lists the members of StatusEnum.

Table 4-4 List of StatusEnum members

Member name	Value	Description
STAT_SUCCESS	0	Execution completed
HARDWARE_ERROR	-1	Hardware error
SYNTAX_ERROR	-2	Syntax error
INVALID_SWITCH_NO	-3	Invalid switch number
INVALID_SWITCH_PATH	-4	Invalid RF path number

Software programming

Apart from using the SFP, you also have the option to control the U1816A/C via other commonly-used software programming platforms such as Visual Basic, C#, C++, LabVIEW™, and VEE.

Control via Visual Basic

The Visual Basic example file is located on the U1816A/C product software and information CD (U1816-10001). After installation has completed, you can launch it from **Start > All Programs > Keysight > U1816x > Examples > VS.NET > VB** with the file name of **DLL_VB_Example1**.

Control via C#

The C# example file is located on the U1816A/C product software and information CD (U1816-10001). After installation has completed, you can launch it from **Start > All Programs > Keysight > U1816x > Examples > VS.NET > CSharp** with the file name of **DLL_CS_Example1**.

Control via C++

The C++ example file is located on the U1816A/C product software and information CD (U1816-10001). After installation has completed, you can launch it from **Start > All Programs > Keysight > U1816x > Examples > VS.NET > Cpp** with the file name of **DLL_Cpp_Example1**.

Control via Keysight VEE

The Keysight VEE example file is located on the U1816A/C product software and information CD (U1816-10001). After installation has completed, you can launch it from **Start > All Programs > Keysight > U1816x > Examples > Keysight VEE Pro** with the file name of **U1816x_DLL_Examples1.vee**.

Control via NI LabVIEW

The NI LabVIEW example file is located on the U1816A/C product software and information CD (U1816-10001). After installation has completed, you can launch it from **Start > All Programs > Keysight > U1816x > Examples > LabVIEW** with the file name of **DLL_LabVIEW_Example1.vi**.

Service and Maintenance

Service

The U1816A/C does not have internal adjustments and should not be opened; it should only be repaired by service-trained personnel. Should it become necessary to return the U1816A/C for repair or service, contact your nearest Keysight Sales and Service Center.

Maintenance

The connectors of the U1816A/C, particularly the connector faces, must be kept clean. Keysight recommends that the connectors be periodically inspected and cleaned if necessary. For instructions on the connection and maintenance of your connectors, refer to the Connector Care Quick Reference Card (08510-90360).

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This information is subject to change without notice. Always refer to the English version at the Keysight Web site for the latest revision.

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