Keysight U1816A/C/E/F USB Coaxial Switch

DC to 67 GHz SP6T USB-controlled switch matrix

Operating and Service Manual

Notices

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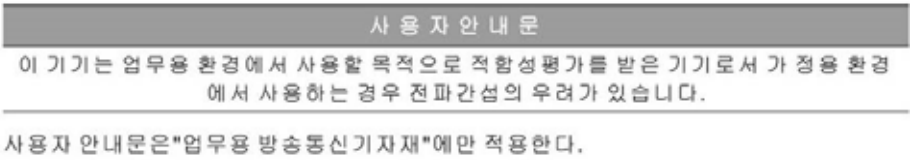

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To contact Keysight for sales and technical support, refer to the support links on the following Keysight websites:

- www.keysight.com/find/USBswitch
  (product-specific information and support, software and documentation updates)
- www.keysight.com/find/assist
  (worldwide contact information for repair and service)

Table of Contents

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List of Tables

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1 Introduction

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

Product Overview

The Keysight U1816A/C/E/F 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 U1816x USB-Controlled Switch Matrix

2 Installation

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 throughly 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 (refer to "Sales and Technical Support"on page 4). 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. Refer to "Sales and Technical Support"on page 4 for the Keysight office nearest to you. 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/E/F requires service or repair, contact the nearest Keysight office for information on where to send it. The performance of the U1816A/C/E/F 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/E/F Shipment Contents

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

Table 2-1 U1816A/C/E/F contents

Quantity	Description
1	U1816A/C/E/F Quick Start Poster
1	Certificate of Calibration
1	Recalibration Due Date Form
1	USB cable 1.8 m
1	Power supply
1	China RoHS Addendum for Test Accessories - RF and Microwave

Related Documentation

This Operating and Service Manual and the Keysight U1816A/C/E/F USB Switch software are available at www.keysight.com/find/USBswitch.

Operating and Safety Precautions

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

ESD Damage

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

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 anti-static mat in front of your test equipment and wear a grounded wrist strap attached to it when handling or operating the U1816A/C/E/F.
- ***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/E/F. 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

Since connectors can become defective due to wear and tear 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/E/F can be damaged if excessive torque is applied to the connectors.

The recommended torque value is 8 in–lb torque for 1.85 mm and 2.4 mm connectors, and 5 in–lb torque for SMA connectors.

Supported Operating Systems

Prior to any installation or configuration, ensure that one of the following operating systems is installed on your PC.

- Windows 7 32-bit
- Windows 10 32-bit, 64-bit

Software Installation

The U1816A/C/E/F software and the Examples file are available for download at www.keysight.com/find/USBswitch. 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.

Use the following procedure to install the software:

1. Power up the host PC to install the U1816A/C/E/F software.
2. Launch the installer.
3. Follow the installer prompts to install the necessary software and documentation for the U1816A/C/E/F.
4. Once the installation is complete, power down the host PC.

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3 Specifications

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

General Specifications

Specifications

Specifications refer to the performance standards or limits against which the U1816A/C/E/F 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/E/F specifications

Specifications	U1816A	U1816C	U1816E	U1816F
Frequency range	DC to 8 GHz	DC to 26.5 GHz	DC to 50 GHz	DC to 67 GHz
Connectors	SMA (f)		2.4 mm (f)	1.85 mm (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	2.43 kg (5.35 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).

Mechanical Dimensions

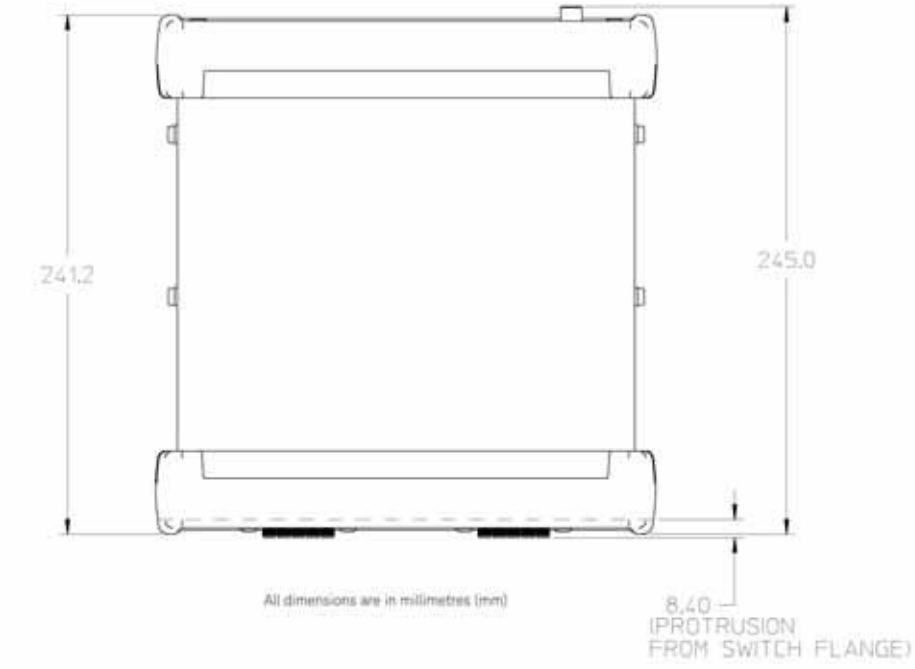
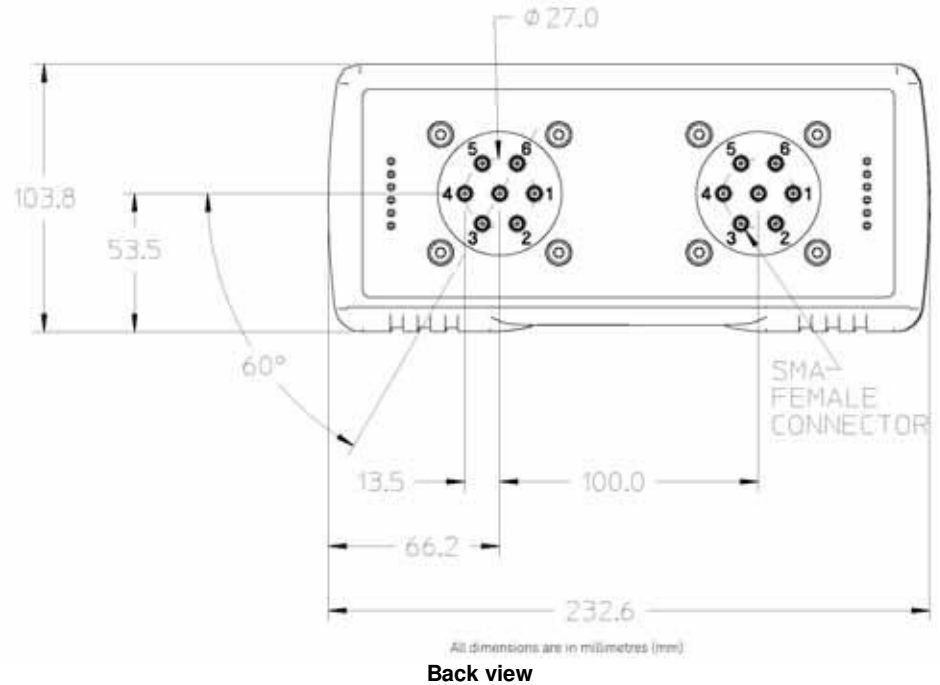


Figure 3-1 Top view of the U1816A/C

Front view



Back view

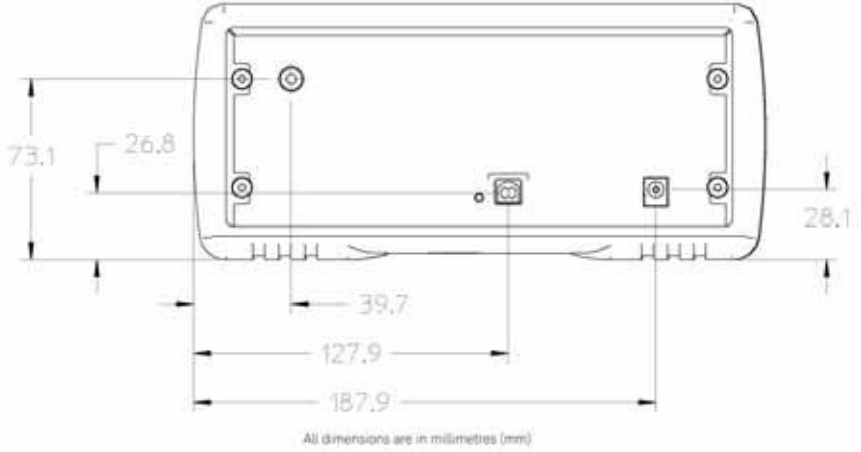


Figure 3-2 Front and back views of the U1816A/C

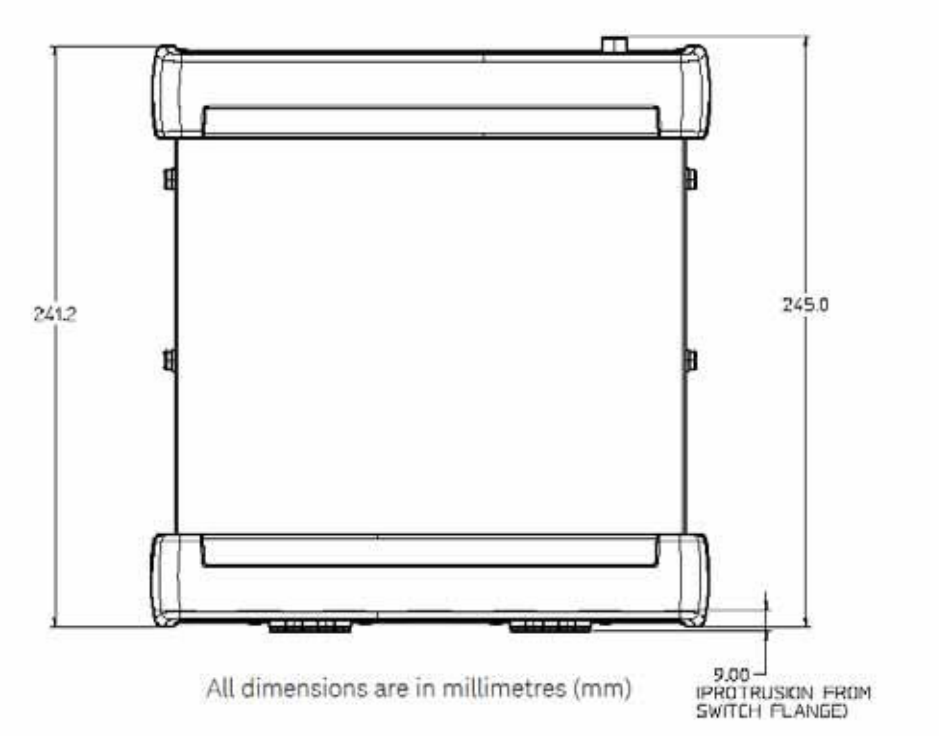
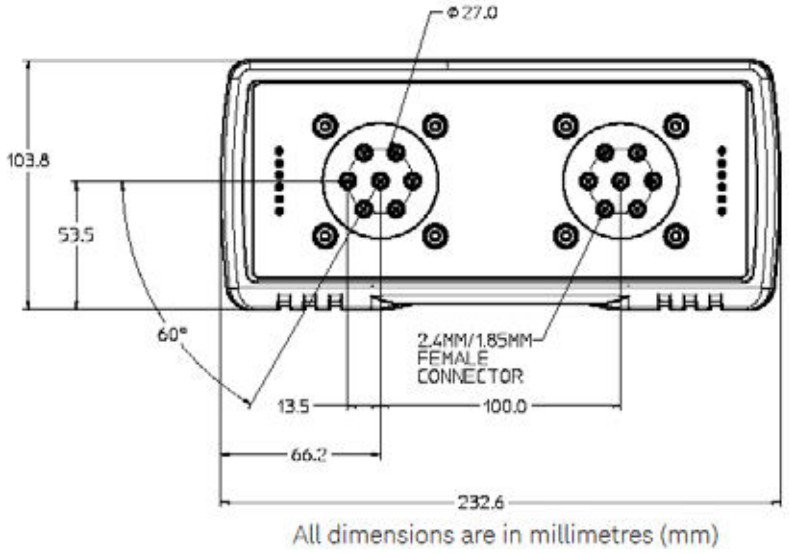


Figure 3-3 Top View of the U1816E/F

Front view



Back view

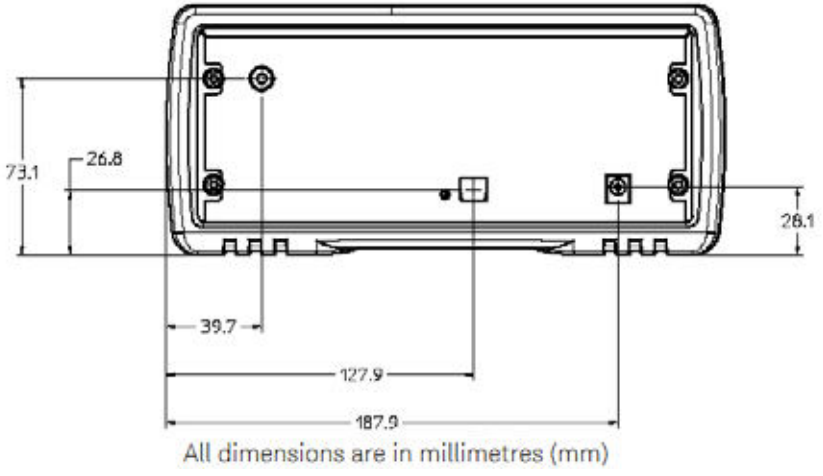


Figure 3-4 Front and back views of the U1816E/F

Environmental Specifications

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

The following tables show 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 Grms
– Survival random	5 to 500 Hz, 3.41 Grms
Shock	
– End use handling shock	Half sine waveform, 120 in/s, duration <3 ms
– Transportation shock	Trapezoidal, 50 g, delta-V: 8m/s
Humidity	
– Operating/Storage	15 to 95% Relative Humidity (RH)
Altitude	
– Operating/Storage	4600 m/4600 m
ESD immunity	
– Contact discharge	4 kV
– Air discharge	8 kV

Table 3-3 U1816E/F environmental specifications

Temperature	
– Operating	0°C to 55°C
– Storage	–40°C to 70°C
Vibration	
– Operating random	5 to 500 Hz, 0.21 Grms
– Survival random	5 to 500 Hz, 2.09 Grms
Shock	
– End use handling shock	Half sine waveform, 1.6m/s, duration <3 ms
– Transportation shock	Trapezoidal, 50 g, delta-V: 8m/s
Humidity	
– Operating	95% RH at 40°C, 24 hours cycling, 5 cycles
– Condensing	50% RH to 95% RH at 23°C to 40°C, Method 1
Altitude	
– Operating/Storage	4600 m/4600 m
ESD immunity	
– Contact discharge	4 kV
– Air discharge	8 kV

NOTE

For detailed information of the switches used in the U1816A/C/E/F, refer to the Keysight 87106x and U7104x/U7106x Multiport Coaxial Switch Technical Overview documents at www.keysight.com/us/en/assets/7018-06804/technical-overviews/5091-3366.pdf

www.keysight.com/us/en/assets/3120-1534/technical-overviews/U7104-6E-N-F-Multiport-Electromechanical-Coaxial-Switches.pdf

4 Operating Guide

This chapter provides simple quick-check instructions to verify the U1816A/C/E/F 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/E/F.

Operating Instructions

Operator's Check

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

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

The coaxial multi-port 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.

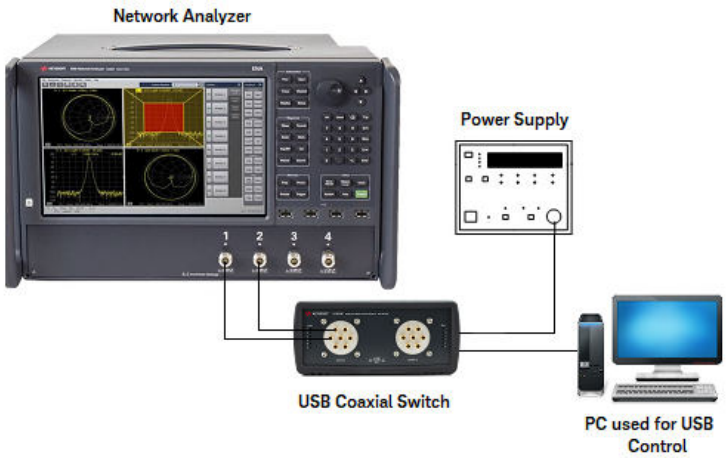


Figure 4-1 Connection to perform a quick check

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) to use the SFP for controlling the U1816A/C/E/F 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/E/F.

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/E/F SFP window

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

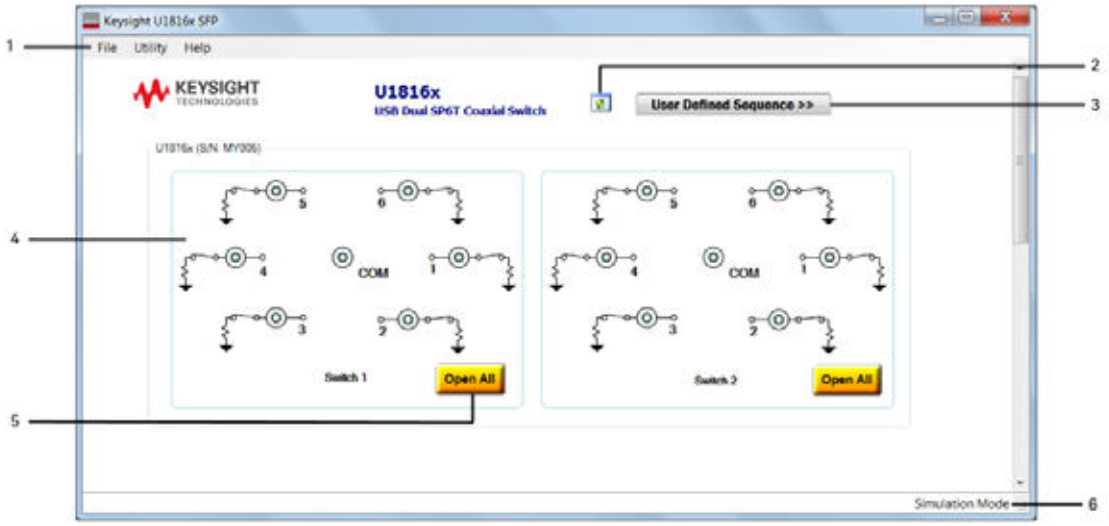


Figure 4-3 U1816A/C/E/F main SFP interface

Table 4-1 Overview of the main SFP interface

No.	Item	Description
1	Menu bar	– The File menu consists of the following functions: – Close: Closes this window and returns to the Connect To U1816x window. – Exit: Exits the SFP. – The Utility menu consists of the following functions: – 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: – Help: Opens the SFP 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.

Table 4-1 Overview of the main SFP interface

No.	Item	Description
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/E/F SFP is a graphical interface that helps you with the following tasks:

a To connect to the U1816A/C/E/F

-- Upon launching the SFP, the U1816A/C/E/F SFP window appears as shown in Figure 4-2.

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

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

b To operate the U1816A/C/E/F

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

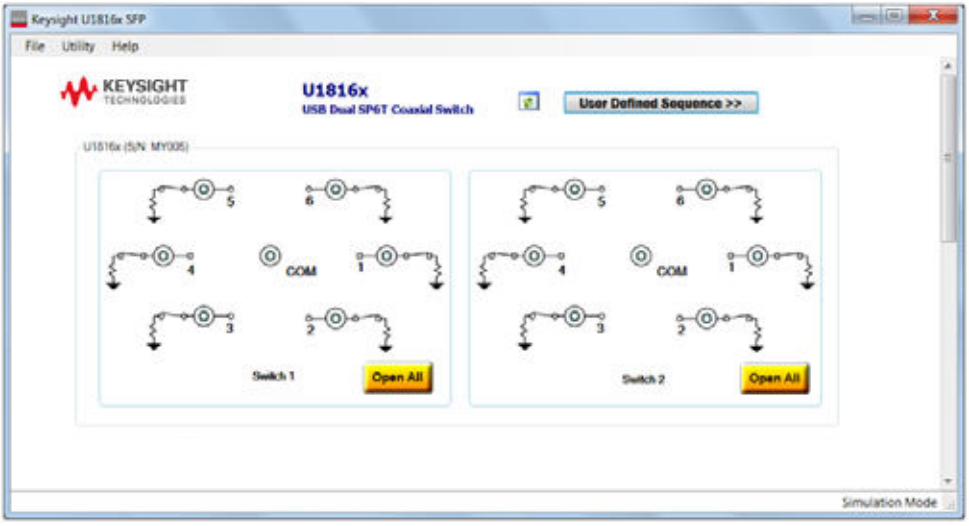


Figure 4-4 U1816A/C/E/F main SFP interface

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 specify the time delay for each sequence at the **Wait (mSec)** field.

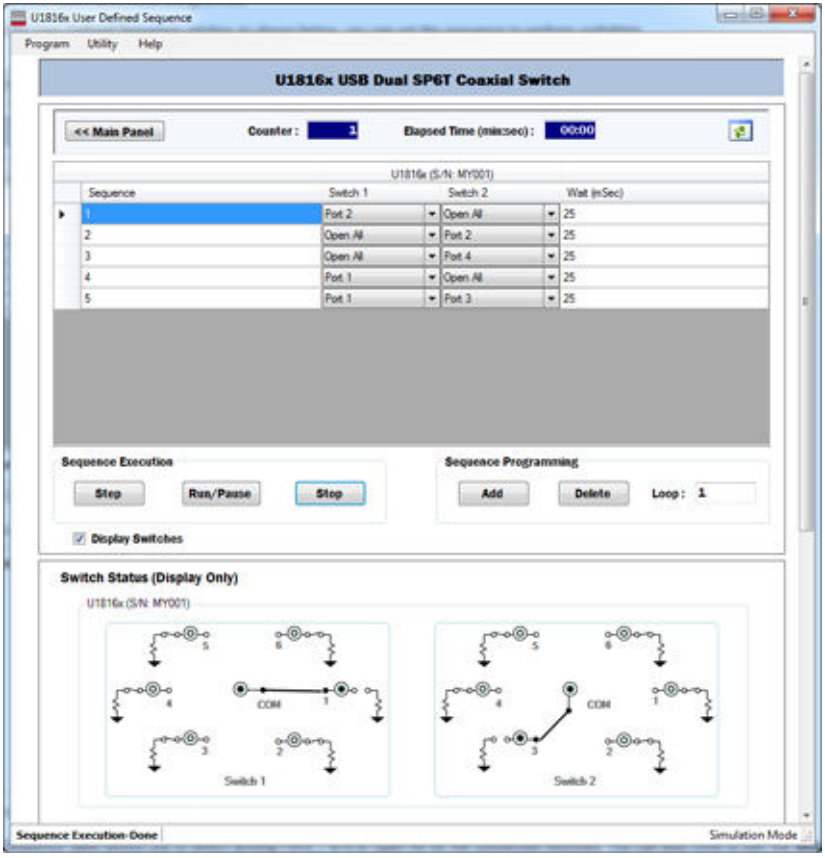


Figure 4-5 User Defined Sequence window

- 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 prompts you to delete the data entry for that switch. If you choose not to delete, the data entry field is highlighted in blue.
- For each switching operation, the cycle **Counter** increments 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 click Refresh, a warning message prompts you to delete the data entry for that switch. If you choose not to delete, the data entry field is 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 prompts 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	– 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 are 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 is displayed in the existing table. If you disconnect a switch, a message prompts 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 is displayed in blue. If you click **Delete**, the data field of the disconnected switch is 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	– Help: Opens the SFP 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.

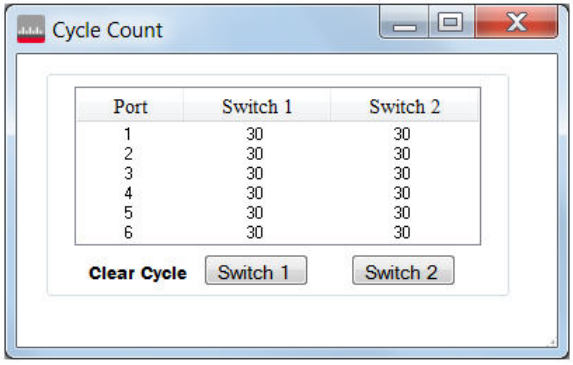


Figure 4-6 Cycle Count window

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

e To reset the U1816A/C/E/F

-- On the main SFP interface shown in Figure 4-4, click **Utility > Reset** from the menu bar to reset all U1816A/C/E/F 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/E/F switch. Each log entry corresponds to an operation triggered via the SFP.

-- On the main SFP interface 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.

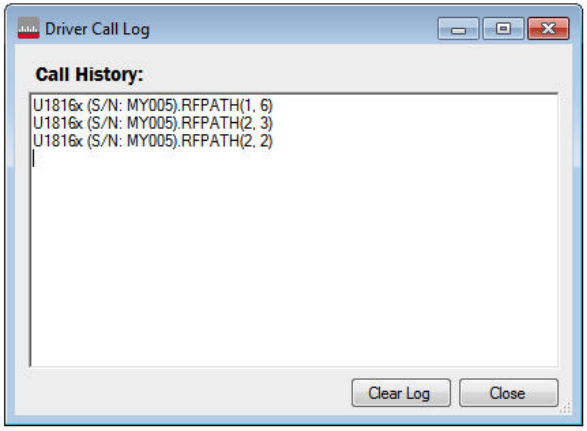


Figure 4-7 Driver Call Log window

-- To erase all driver calls from the log, click **Clear Log**.

6 For help on how to use the SFP, refer to the Help file accessible from the main SFP Help menu.

Software Programming Guide

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

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

Table 4-3 List of methods

Method	Description
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/E/F 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 installed with the U1816A/C/E/F product software. Once the software installation is complete, 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 installed with the U1816A/C/E/F product software. Once the software installation is complete, 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 installed with the U1816A/C/E/F product software. Once the software installation is complete, 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 is installed with the U1816A/C/E/F product software. Once the software installation is complete, 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 LabVIEW

The LabVIEW example file is installed with the U1816A/C/E/F product software. Once the software installation is complete, 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/E/F 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/E/F for repair or service, contact your nearest Keysight Sales and Service Center.

Maintenance

The connectors of the U1816A/C/E/F, 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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