

# USB 2.0 Electrical Compliance Test User Manual



User Manual

EN01A



深圳市鼎阳科技股份有限公司  
SIGLENT TECHNOLOGIES CO.,LTD



# CONTENT

|       |  |    |
|-------|--|----|
| 1     | Introduction.....                        | 2  |
| 2     | Test Items .....                         | 3  |
| 3     | Test Equipment.....                      | 5  |
| 3.1   | SIGLENT Provision .....                  | 5  |
| 3.2   | Additional Equipment.....                | 5  |
| 4     | Fixture .....                            | 6  |
| 4.1   | Delivery Checklist .....                 | 6  |
| 4.2   | Introduction to Functional Modules ..... | 7  |
| 4.2.1 | Signal board .....                       | 7  |
| 4.2.2 | Load Board .....                         | 8  |
| 4.2.3 | Test Point.....                          | 8  |
| 5     | Compliance Test Software.....            | 10 |
| 5.1   | Tests Config.....                        | 10 |
| 5.2   | Results.....                             | 14 |
| 5.3   | Report Setting.....                      | 15 |
| 6     | USB IF Official Application.....         | 16 |

## 1 Introduction

FX-USB2 is a test fixture launched with the USB 2.0 compliance test function of SDS7000A digital oscilloscope, and the two together can easily and quickly complete the USB-IF test on all electrical items of hosts, devices and hubs. This manual contains introductions to the FX-USB2 and USB 2.0 compliance test.

## 2 Test Items

FX-USB2 and SDS7000A's USB 2.0 compliance test function combine to support the following USB 2.0 electrical compliance measurements:

### ► Host Tests

- High-Speed DS Signal Quality (EL\_2, EL\_3, EL\_6, EL\_7)
- High-Speed DS Packet Parameters (EL\_21, EL\_22, EL\_23, EL\_25, EL\_55)
- High-Speed DS Chirp Timing (EL\_33, EL\_34, EL\_35)
- High-Speed DS Suspend Resume (EL\_38 EL\_39, EL\_41)
- High-Speed DS Not Driven Voltage Levels (EL\_8, EL\_9)
- Full-Speed DS Signal Quality
- Low-Speed DS Signal Quality
- Drop
- Droop

### ► Device Tests

- High-Speed US Signal Quality (EL\_2, EL\_4/EL\_5, EL\_6, EL\_7)
  - Far-end for tethered hubs (EL\_5)
  - Near-end for un-tethered hubs (EL\_4)
- High-Speed US Packet Parameters (EL\_21, EL\_22, EL\_25)
- High-Speed US Chirp Timing (EL\_28, EL\_29, EL\_31)
- High-Speed US Suspend Resume (EL\_38 EL\_39, EL\_40 EL\_41)
- High-Speed to Reset (EL\_27, EL\_29, EL\_31)
- Suspend to Reset (EL\_28, EL\_29, EL\_31)
- High-Speed US Not Driven Voltage Levels (EL\_8, EL\_9)
- High-Speed US Receiver Sensitivity (EL16, EL17, EL18)
- Full-Speed US Signal Quality
- Low-Speed US Signal Quality
- Back Voltage
- Inrush

### ► Hub Tests

- High-Speed Signal Quality
  - Downstream: EL\_2, EL\_6, EL\_7, EL\_47
  - Upstream: EL\_2, EL\_6, EL\_7, EL\_46
- High-Speed Packet Parameters
  - Downstream: EL\_21, EL\_22, EL\_23, EL\_25, EL\_55
  - Upstream: EL\_21, EL\_22, EL\_25

High-Speed Chirp Timing

Downstream: EL\_33, EL\_34, EL\_35

Upstream: EL\_28 EL\_29, EL\_31

High-Speed Suspend Resume

Downstream: EL\_38 EL\_39, EL\_41

Upstream: EL\_38 EL\_39, EL\_40 EL\_41

Upstream High-Speed to Reset (EL\_27, EL\_29, EL\_31)

Upstream Suspend to Reset (EL\_28, EL\_29, EL\_31)

High-Speed Not Driven Voltage Levels

Upstream / Downstream: EL\_8, EL\_9

High-Speed US Repeater (EL\_42, EL\_43, EL\_44, EL\_45, EL\_48)

High-Speed DS Repeater (EL\_42, EL\_43, EL\_44, EL\_45, EL\_48)

High-Speed US Receiver Sensitivity

Full-Speed Signal Quality (Upstream / Downstream)

Low-Speed Signal Quality (Upstream / Downstream)

Drop

Droop

Inrush

Back Voltage

## 3 Test Equipment

The following equipment is required for complete USB 2.0 compliance test.

### 3.1 SIGLENT Provision

- ▶ Oscilloscope (SDS7000A): >2GHz BW, with USB 2.0 compliance software (SDS7000A-CT-USB2) activated as the USB 2.0 electrical compliance analysis tool.
- ▶ Fixture (FX-USB2): USB 2.0 electrical compliance test fixture that guides devices and hubs to the relevant test state and provides test points.
- ▶ Differential Probe (SAP2500D or SAP5000D): 2GHz or higher bandwidth for HS tests.
- ▶ Single-ended probe (SAP2500): 2GHz or higher bandwidth for HS/FS/LS tests.
- ▶ Low Bandwidth Probe: 500MHz bandwidth for HS (except Packet Parameters)/FS/LS tests.
- ▶ Current Probe: for upstream inrush test only.
- ▶ Arbitrary Waveform Generator (SDG7000A): for HS trigger sensitivity test only.

### 3.2 Additional Equipment

- ▶ Certified High-Speed USB self-powered hub (4 ea.): for FS/LS tests.
- ▶ Certified Full-Speed USB self-powered hub: for FS/LS tests.
- ▶ 5 meter USB cables Type-A to Type-B male (6 ea.): for FS/LS tests.
- ▶ 1 meter USB cables Type-A to Type-B male (quantity depending on test items): for HS/FS/LS tests.
- ▶ Certified Low-Speed trigger device (e.g. USB mouse): for LS tests.
- ▶ Certified Full-Speed trigger device: for FS tests.
- ▶ Certified High-Speed trigger device (e.g. USB flash drive): for HS tests.
- ▶ Computer (USBHSET installed): for HS host tests.

## 4 Fixture

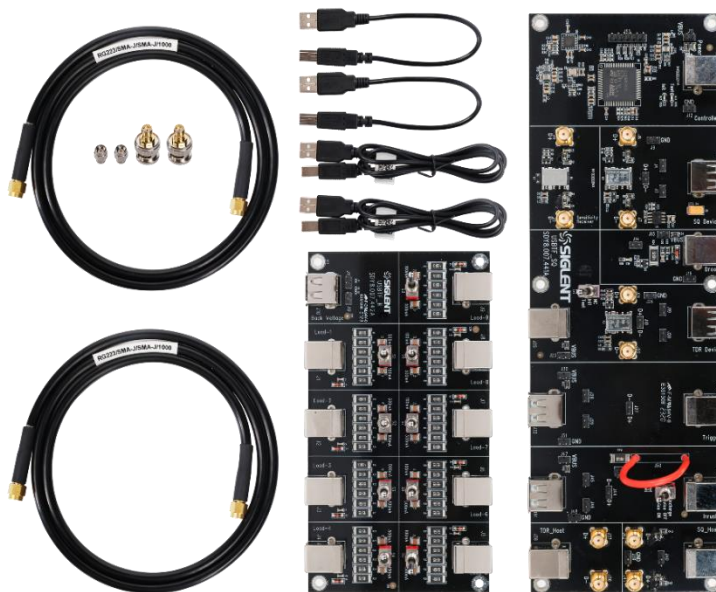
The FX-USB2 is a test fixture launched to match the USB 2.0 compliance test function of the SDS7000A. The processor on the board can control the devices and hubs to enter the test mode, reset, suspend, etc. according to the user's test requirements, simplifying the test process.

Host tests require the host under test to be placed into test mode autonomously. For related software, please refer to the section "USB IF Official Application".

### 4.1 Delivery Checklist

The FX-USB2 is placed inside a black suitcase. Please verify that all items listed on the packing list have been delivered. If you note any omissions or damage, please contact SIGLENT customer service center or distributor as soon as possible. If you fail to contact us immediately in case of omission or damage, we will not be responsible for replacement.

| Item                           | Quantity |
|--------------------------------|----------|
| User manual                    | 1        |
| Signal board (USBTF_SQ)        | 1        |
| Load board (USBTF_R)           | 1        |
| SMA cable                      | 2        |
| BNC-SMA adapter                | 2        |
| Short type-A to type-B cable   | 2        |
| 1 meter type-A to type-B cable | 2        |
| 50Ω terminal (SMA)             | 2        |



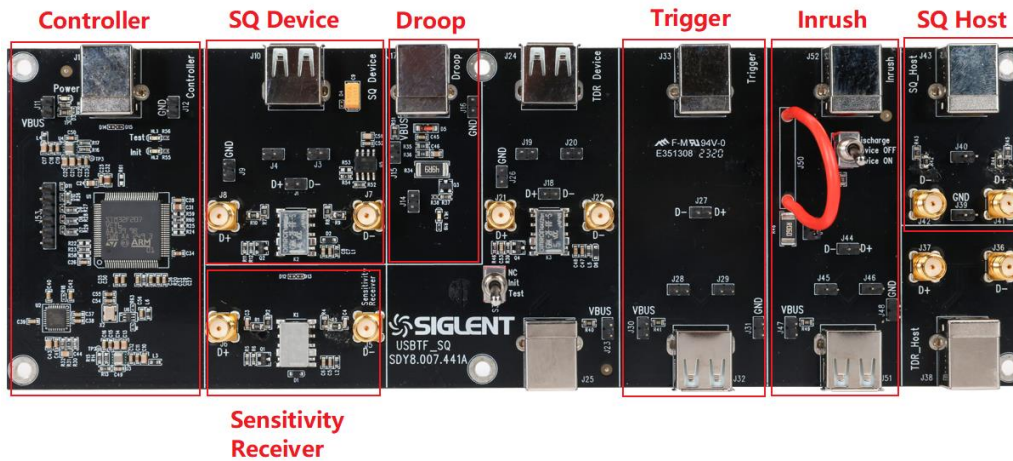


## 4.2 Introduction to Functional Modules

FX-USB2 includes 2 boards, the signal board (USBTF\_SQ) and the load board (USBTF\_SR).

### 4.2.1 Signal board

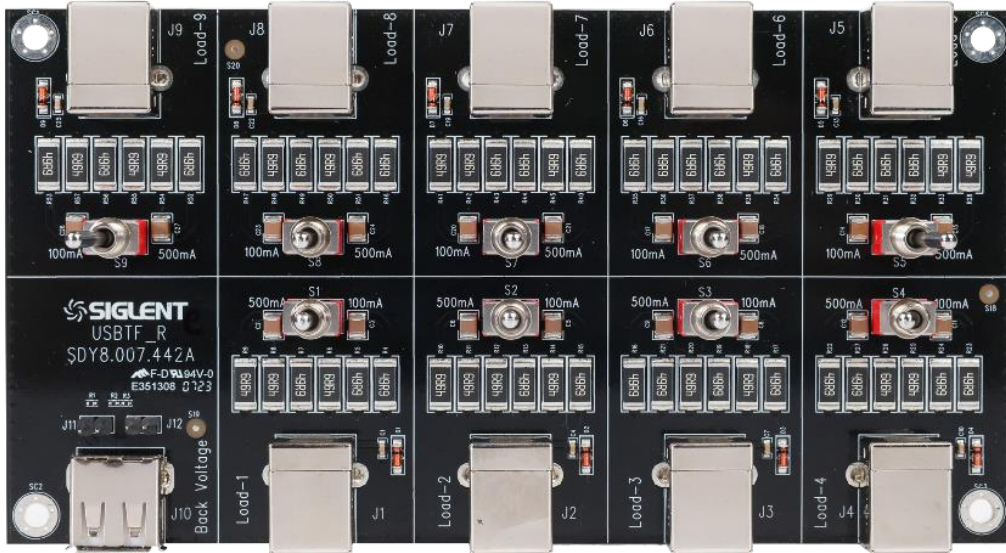
The following figure shows the various modules of the signal board, followed by a general description of the role played by each module in the compliance test.



- ▶ Controller: In device tests and hub tests, it controls DUT or hub into test mode, reset, suspend, etc. Also it is the power supply port for the entire fixture.
- ▶ SQ Device: HS signal quality, packet parameters, suspend, reset, and not-driven J/K voltage test modules for upstream facing ports.
- ▶ Sensitivity Receiver: External signal input point in upstream facing port trigger sensitivity test.
- ▶ Droop: Provides 100mA dynamic load for downstream facing port droop.
- ▶ Trigger: Provides test point for downstream facing port packet parameters, suspend, repeat, FS, LS, drop.
- ▶ Inrush: The upstream facing port inrush test module, and assists the Trigger module to complete the FS and LS tests.
- ▶ SQ Host: Downstream facing port HS signal quality test module.

### 4.2.2 Load Board

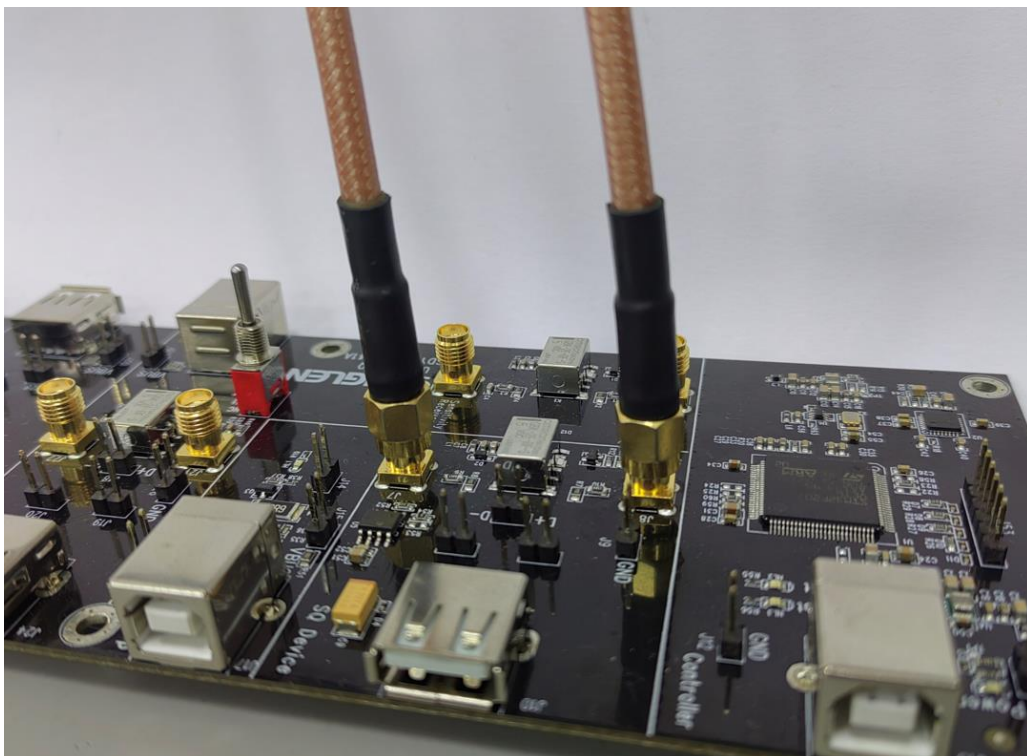
The load board consists of two sections, nine 100mA/500mA loads controlled by twist switches for drop and droop test and Back Voltage for back voltage test of upstream facing port.



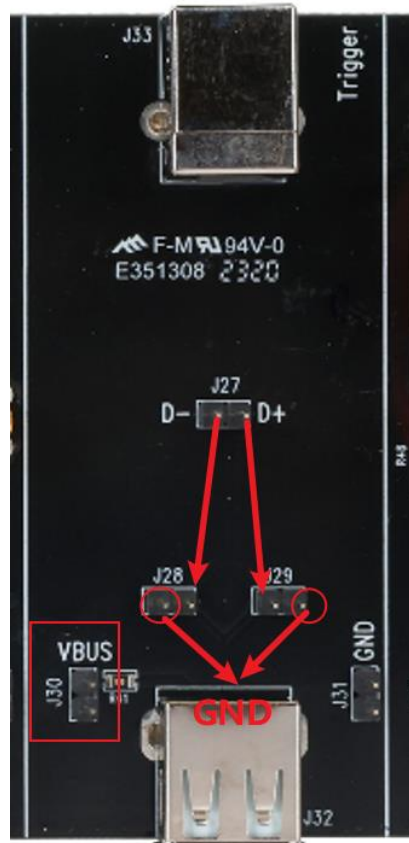
### 4.2.3 Test Point

In each module of the fixture, corresponding test points are provided, and the function of each test point is briefly introduced next.

- ▶ SMA interface: The SMA interface on the signal board, which is connected to D+ and D-, is connected to the oscilloscope through the SMA cable to complete the signal quality test.



- ▶ Test probes: Placed in D+, D-, and VBus respectively, as shown below:  
 J27 connects D+ and D- to provide test points for differential probes, while J29 connects D+ and J28 connects D-, a GND ground point is also reserved to facilitate the connection of single-ended probes; J30 connects VBus to facilitate the measurement of its voltage.



## 5 Compliance Test Software

SDS7000A provides USB 2.0 compliance test function, according to **Analysis** > **Compliance Test** > **Protocol Type Select USB2.0** > **Click ON** , you can open the compliance test function which is divided into three major parts: Tests Config, Results and Report Setting.

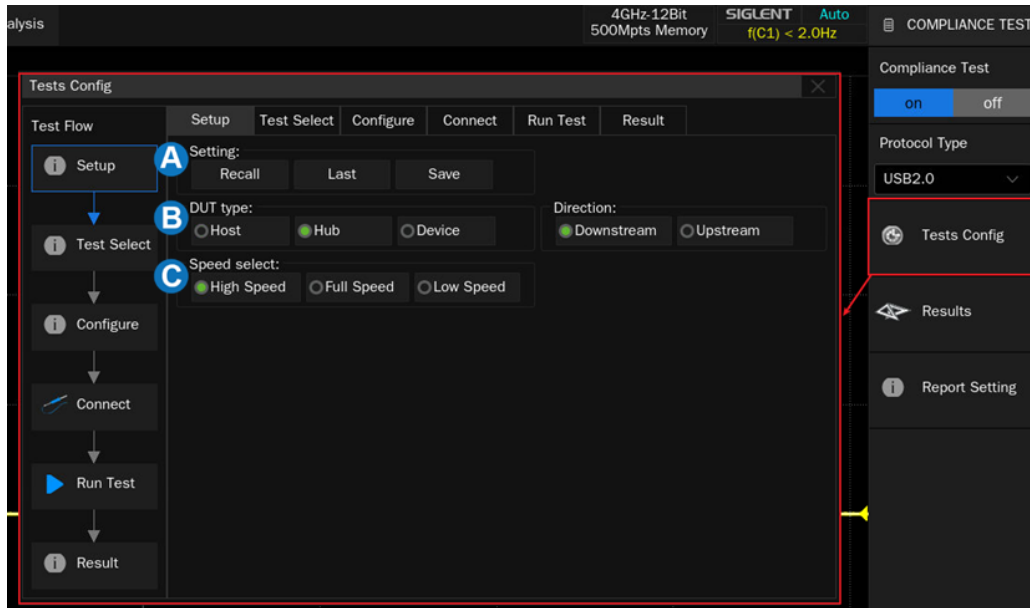


### 5.1 Tests Config

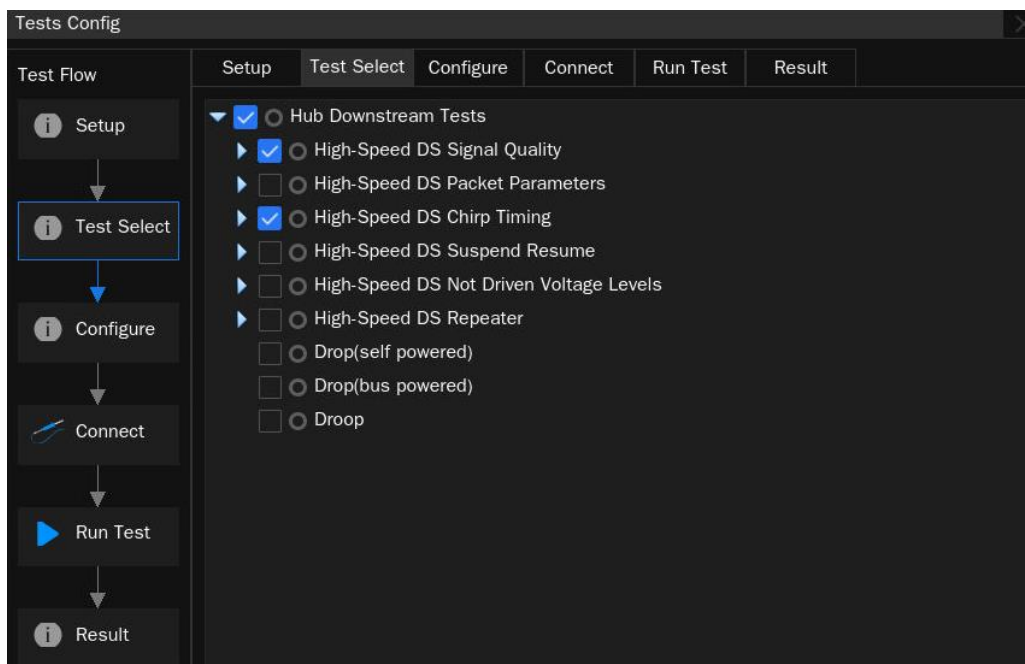
Clicking on Tests Config will pop up the specific test window, as shown in the figure below, which is divided into six steps according to the test flow: Setup, Test Select, Configure, Connect, Run Test, and Result.

#### ► Setup

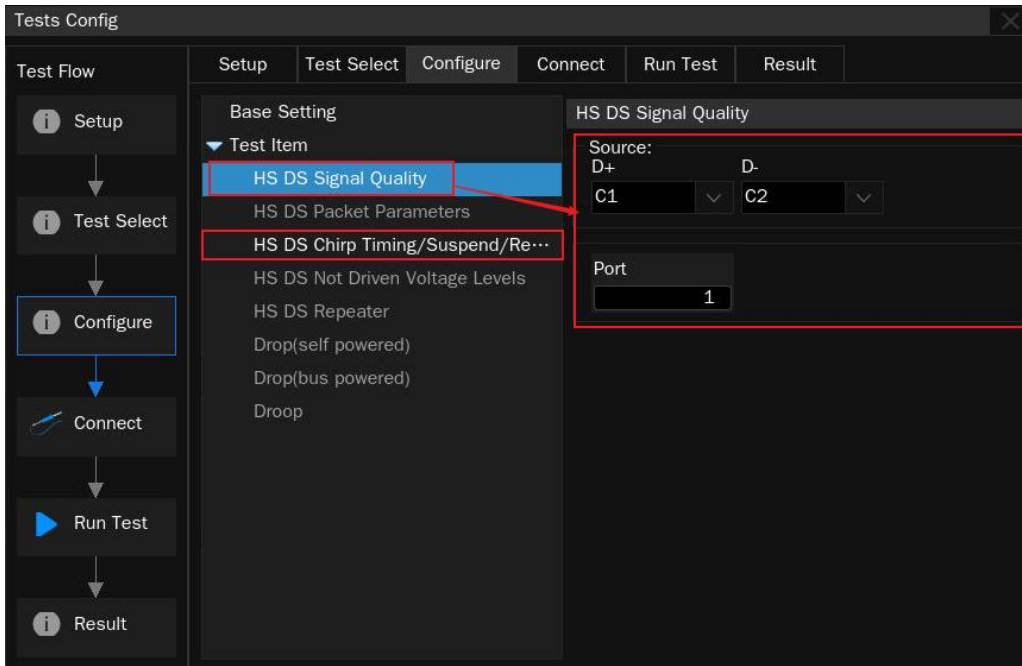
- A. Provide three functions of "Recall", "Last" and "Save" for the "Setting".
- B. In the "DUT type", select the type of device under test, in which the hub needs to be distinguished between "Downstream" and "Upstream".
- C. Select the rate of the device under test in "Speed select".



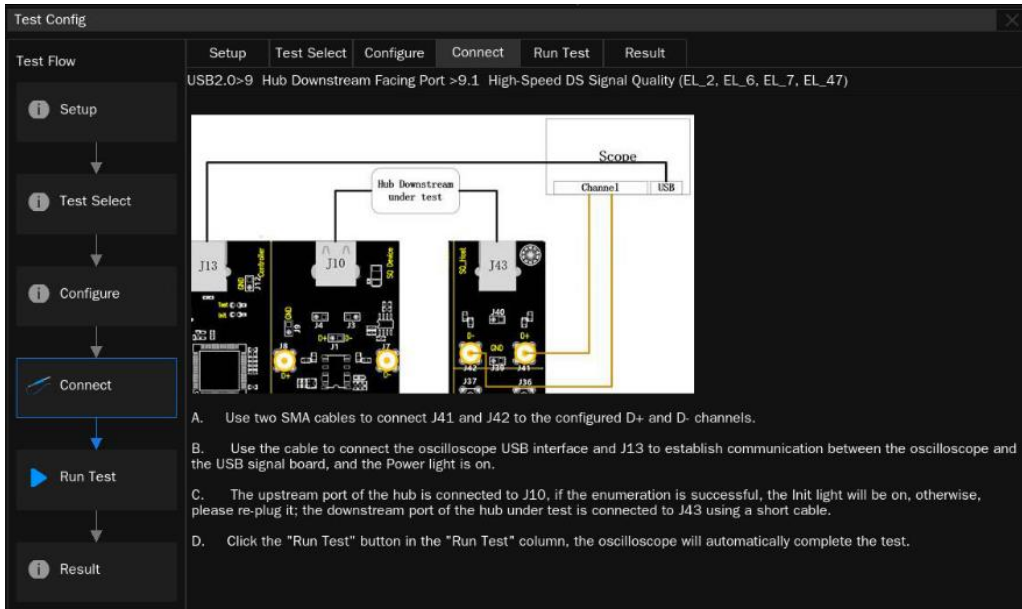
- ▶ Test Select: Select the items to be tested in this section.



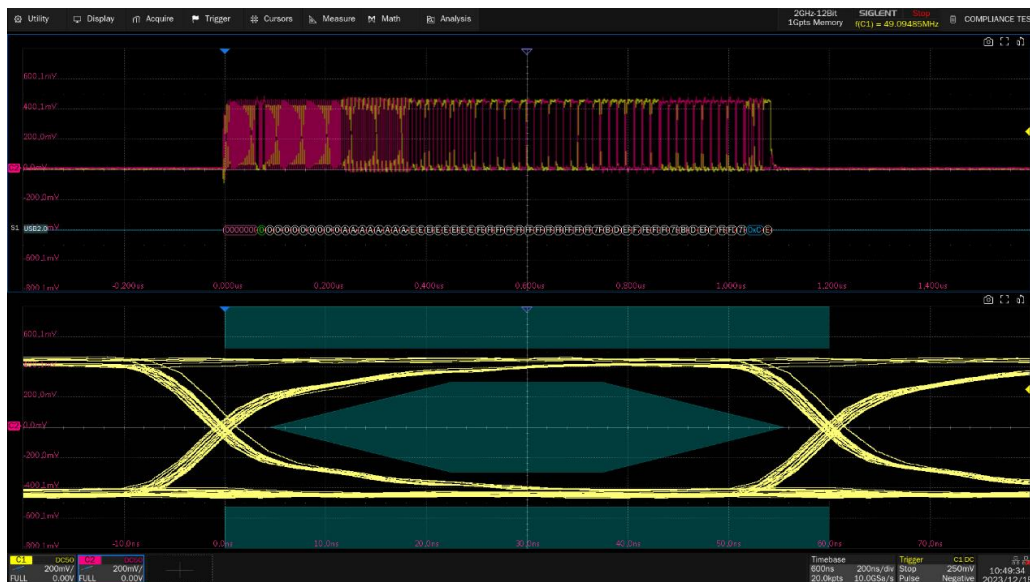
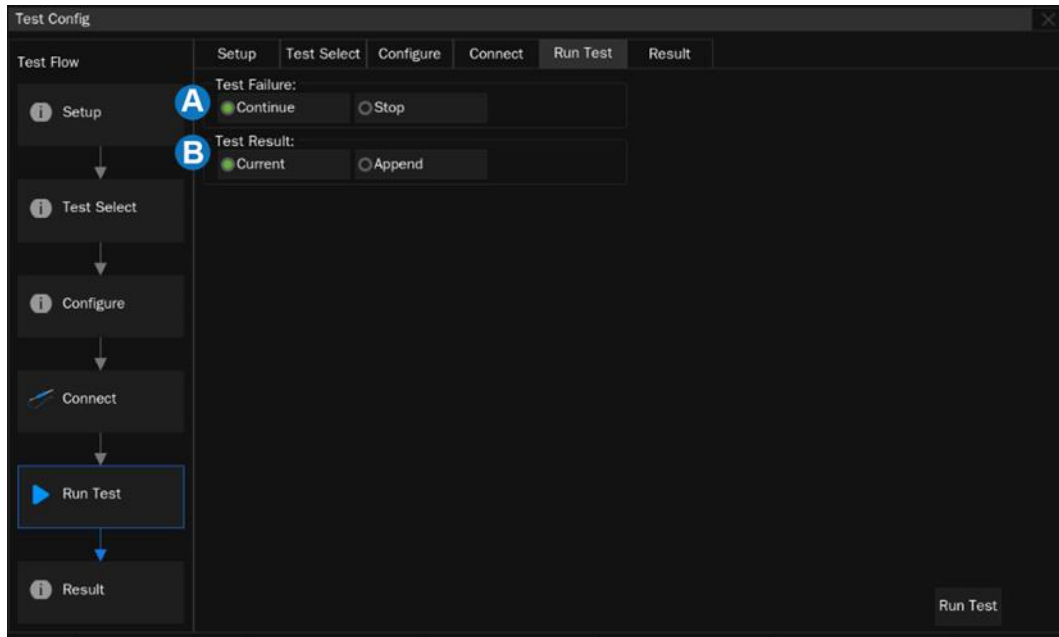
- ▶ Configure: The test item selected before will be highlighted in this column, click to configure the corresponding test item and set the channel for oscilloscope measurement.



- ▶ **Connect:** This column displays the test wiring diagram and test steps, if you select more than one test item at the same time, it will only display the information of the first item to be tested, and the wiring diagram of other test items will have a separate page pop-up prompt after the end of the last test item.



- ▶ **Run Test**
    - A. Supports "Continue" and "Stop" options in "Test Failure".
    - B. Supports "Current" and "Append" options for "Test result".
- Click "Run Test" in the lower right corner to start the round.



In the next test flow, follow the pop-up window to complete the test, and the test results will pop up after all the test items are completed.

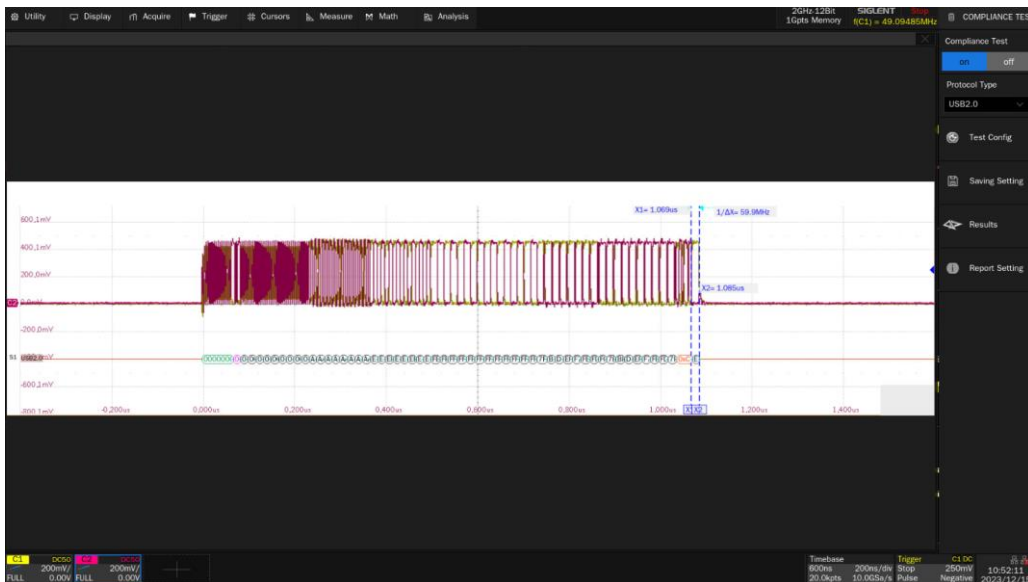
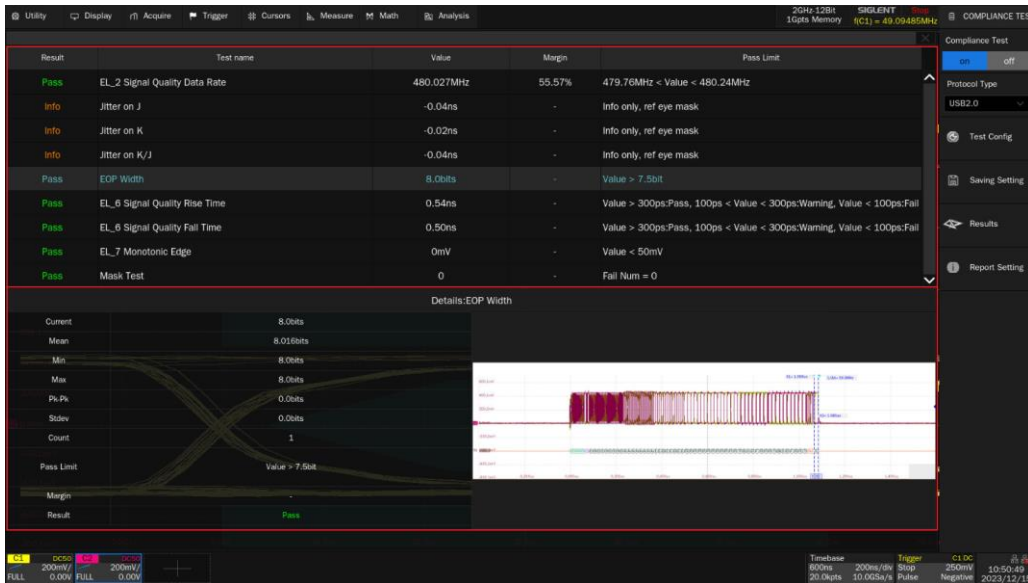
If you select multiple test items in one round of test, there will be a pop-up window prompting the wiring mode of the item when you proceed to the next item, and you can go back to the "Configure" column to modify the source of the test item in the middle of the test, and then click "Run Test" in the pop-up window to continue the test.

## 5.2 Results

Click "Results" to view the corresponding test results.

The upper half of the section shows the test items, providing the test results for each item as well as the officially required reference threshold values.

The lower part is the corresponding detail figure, click on the item of interest in the upper part, the lower part can show the corresponding details, click on the figure to view the details.

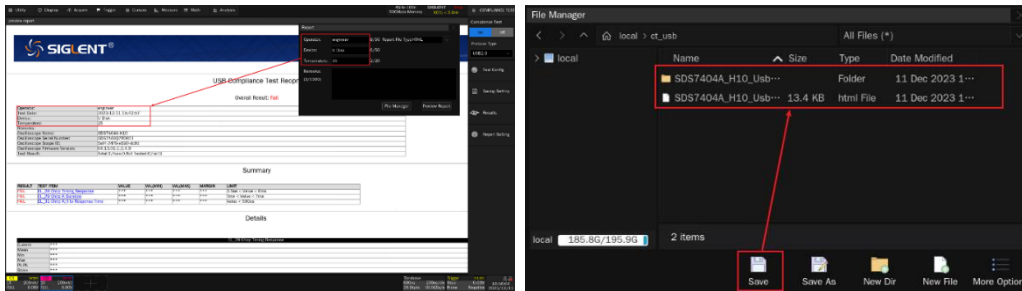




### 5.3 Report Setting

Click "Report Setting", fill in the relevant test information, select the report type. Click "Preview Report" to view the effect of the generated report in advance. Click "File Manager" to select the path to save and click "Save" to save the test results.

**Note:** When saved in HTML format, a folder will be generated with the HTML file, if you need to copy, copy both away and keep both under the same path.



The test report includes a summary table of all test results with hyperlinks to the details page, which includes a screenshot of the associated test.

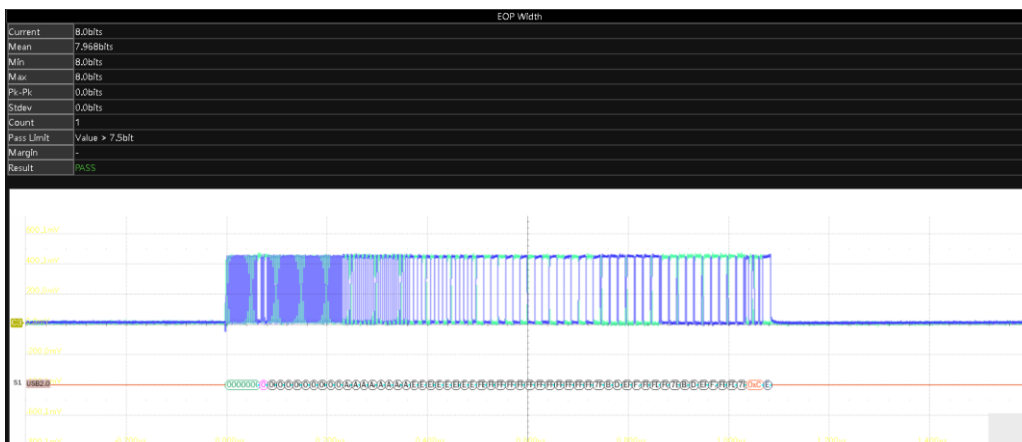
#### USB Compliance Test Report

Overall Result: Pass

|                                |                                    |
|--------------------------------|------------------------------------|
| Operator:                      |                                    |
| Test Date:                     | 2023-07-07 17:20:31                |
| Device:                        |                                    |
| Temperature:                   |                                    |
| Remarks:                       |                                    |
| Oscilloscope Name:             | SDS7404A H12                       |
| Oscilloscope Serial Number:    | SDS70020230514                     |
| Oscilloscope Scope ID:         | c392-f947-58da-f342                |
| Oscilloscope Firmware Version: | 03.10.1.0.5.0                      |
| Test Result:                   | Total:9,Pass:8,Not_Tested:5,Fail:0 |

| RESULT  | TEST ITEM                    | VALUE      | VAL(MIN)   | VAL(MAX)   | MARGIN | LIMIT  |
|---------|------------------------------|------------|------------|------------|--------|--|
| PASS    | EL2_Signal_Quality_Data_Rate | 480.039MHz | 480.039MHz | 480.039MHz | 58.05% | 479.76MHz < Value < 480.24MHz  |
| INFO    | Jitter_on_I                  | -43ps      | -43ps      | 29ps       | -      | Info only, ref eye mask  |
| INFO    | Jitter_on_K                  | -24ps      | -50ps      | 36ps       | -      | Info only, ref eye mask  |
| INFO    | Jitter_on_KJ                 | -44ps      | -69ps      | 49ps       | -      | Info only, ref eye mask  |
| PASS    | EOP_Width                    | 8.0bits    | 8.0bits    | 8.0bits    | -      | Value > 7.5bit   |
| WARNING | EL6_Signal_Quality_Rise_Time | 162ps      | 149ps      | 197ps      | -      | Value > 300ps;Pass,100ps < Value < 300ps;Warning, Value < 100ps;Fail |
| WARNING | EL6_Signal_Quality_Fall_Time | 234ps      | 212ps      | 377ps      | -      | Value > 300ps;Pass,100ps < Value < 300ps;Warning, Value < 100ps;Fail |
| PASS    | EL7_Monoprotic_Edge          | 0mV        | 0mV        | 0mV        | -      | Value < 50mV   |
| PASS    | Mask_Test                    | 0          | 0          | 0          | -      | Fail Num = 0   |



## 6 USB IF Official Application

USB IF provides software to assist with USB 2.0 electrical compliance test.

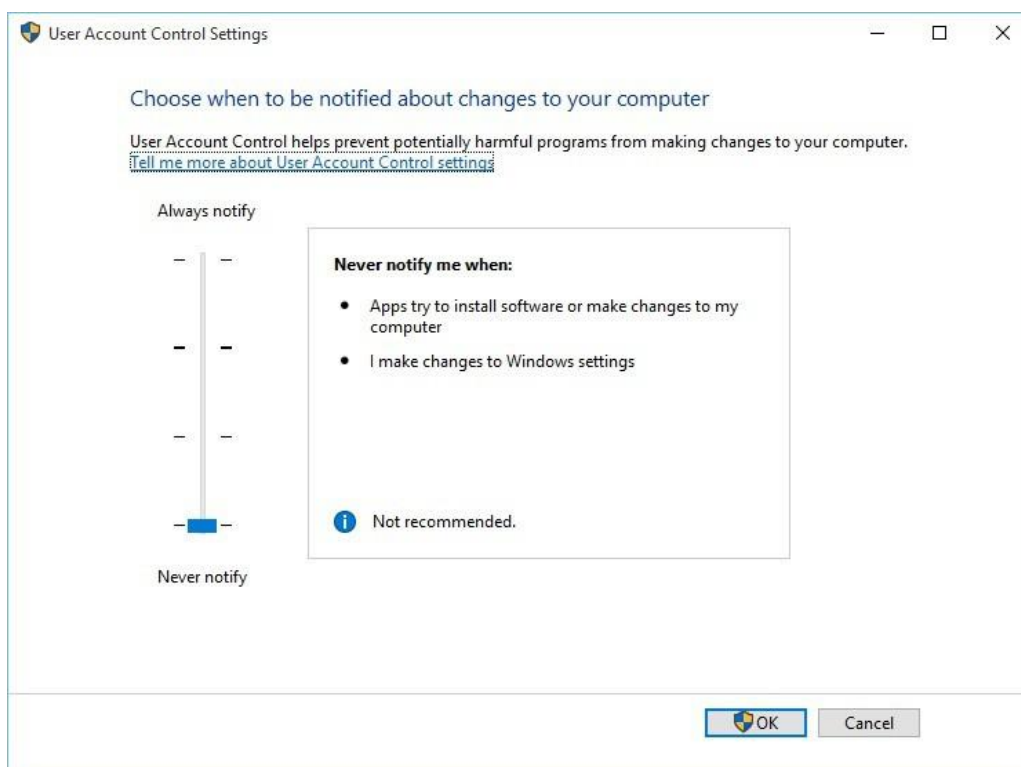
- ▶ USBET20: USB IF official electrical analysis tool that to analyze the signal data captured by the oscilloscope, including signal quality and inrush analysis.

Download address: <https://www.usb.org/document-library/usbet20>

- ▶ USBHSET: stand for USB High-speed Electrical Test Tool, configuration software provided by the USB IF that controls the device under test to enter test mode, send packets, suspend, and reset.

Download address: <https://www.usb.org/document-library/usbhset-ehci-64-bit>

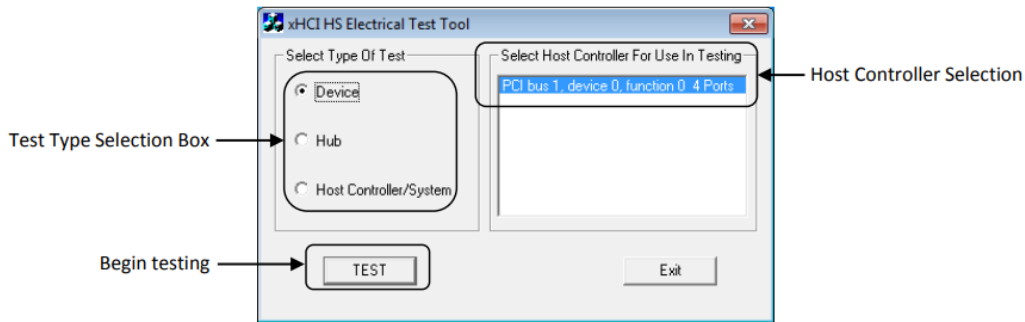
USBHSET is applicable to Windows 7 and Windows 7 Professional. Before installing, User Account Control (UAC) should be disabled in Windows. Choose Start > Control Panel > User Accounts and Family Safety > User Accounts > Change User Account Control Settings . Set the Settings Bar to "Never notify", click "OK", and then restart the computer.



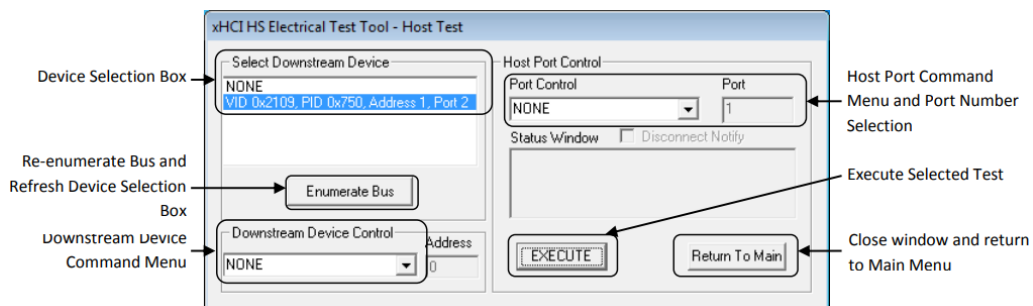
**Note:** When using the USBHSET software, the corresponding USB hub will be occupied and its external devices will not work properly.

The main interface of USBHSET is shown as below, the left side provides three choices of device, hub and host, this manual will only introduce the host related content, if you want to know more about it, please go to the following URL to view.

[https://www.usb.org/sites/default/files/HSETT\\_Instruction\\_0\\_4\\_1.pdf](https://www.usb.org/sites/default/files/HSETT_Instruction_0_4_1.pdf)



Choose "Host Controller/System", click the "Test" button to enter the host test menu.



The Host Control menu provides options for placing the host controller or a device connected to that controller into the electrical test mode. Select the appropriate command from the Port Control or Downstream Device Control Menu. For the root port test, the user must also select the port number of the port under test.

If the test item is related to the device, observe the PID/VID, select the connected device from the Device Selection Box, and then click "EXECUTE", if the device cannot be found, please disconnect the device, insert it and click "Enumerate Bus" again.

- ▶ USB 2.0 developer documentation is available on the USB Implementers Forum website at <https://www.usb.org/documents>



## About SIGLENT

SIGLENT is an international high-tech company, concentrating on R&D, sales, production and services of electronic test & measurement instruments.

SIGLENT first began developing digital oscilloscopes independently in 2002. After more than a decade of continuous development, SIGLENT has extended its product line to include digital oscilloscopes, isolated handheld oscilloscopes, function/arbitrary waveform generators, RF/MW signal generators, spectrum analyzers, vector network analyzers, digital multimeters, DC power supplies, electronic loads and other general purpose test instrumentation. Since its first oscilloscope was launched in 2005, SIGLENT has become the fastest growing manufacturer of digital oscilloscopes. We firmly believe that today SIGLENT is the best value in electronic test & measurement.

### Headquarters:

SIGLENT Technologies Co., Ltd  
Add: Bldg No.4 & No.5, Antongda Industrial  
Zone, 3rd Liuxian Road, Bao'an District,  
Shenzhen, 518101, China  
Tel: + 86 755 3688 7876  
Fax: + 86 755 3359 1582  
Email: sales@siglent.com  
Website: int.siglent.com

### North America:

SIGLENT Technologies America, Inc  
6557 Cochran Rd Solon, Ohio 44139  
Tel: 440-398-5800  
Toll Free: 877-515-5551  
Fax: 440-399-1211  
Email: info@siglentna.com  
Website: www.siglentna.com

### Europe:

SIGLENT Technologies Germany GmbH  
Add: Staetzlinger Str. 70  
86165 Augsburg, Germany  
Tel: +49(0)-821-666 0 111 0  
Fax: +49(0)-821-666 0 111 22  
Email: info-eu@siglent.com  
Website: www.siglenteu.com

Follow us on  
Facebook: SiglentTech

