

USB2.0 Signal Quality Test Fixture Kit USB20-SQ-HD



User Manual USB20-SQ-HD.1.0 October 2024

Foreword

Thank you for choosing this UNI-T instrument. For safe and proper use this instrument, please read this manual carefully, especially the safety instructions section.

After reading this manual, it is recommended to keep the manual in a convenient location, preferably near the device, for future reference.

Document Overview

This document introduces the designs and applications of two types of test fixtures used for USB 2.0 signal quality testing.

Fixtures

- High-Speed Device Signal Quality Test Fixture
- High-Speed Host Signal Quality Test Fixture

Fixture Application Scenarios

- High-Speed Device Signal Quality Testing
- High-Speed Host Signal Quality Testing
- Hub Upstream High-Speed Signal Quality Testing
- Hub Downstream High-Speed Signal Quality Testing

Fixture Layout



High-Speed Device Signal Quality Test Fixture

No.	Connector	Description
1	DUT CONN (J2)	DUT connector: USB-A female socket
2	EXT POW (J5)	Fixture power supply port: USB-B female socket
3	SW1	Test switch: Switches between Init mode and Test mode
4	HOST CONN (J4)	Host connector: Connects to a device with USB test software
		via a USB-B female socket
5	J7	USB2.0 remote test point
6	J1	USB signal differential negative voltage output terminal:
		Connects to an oscilloscope using an SMA cable
7	J3	USB signal differential positive voltage output terminal:
		Connects to an oscilloscope using an SMA cable
8	J6	USB2.0 near-end test point

High-Speed Host Signal Quality Test Fixture



No.	Connector	Description								
1	J1	A device with USB test software (host): USB-A male socket								
2	J4	VBUS voltage test point: Connects using a single-ended port								
3	J3	USB signal differential negative voltage output terminal:								
		Connects to an oscilloscope using an SMA cable								
4	J2	USB signal differential positive voltage output terminal: Connects								
		to an oscilloscope using an SMA cable								

High-Speed Device Signal Quality Test Item

Test Item	HOST	Device	HUB	HUB			
			Upstream	Downstream			
Eye Diagram	\checkmark	\checkmark	\checkmark	\checkmark			
EOP Bit Width	\checkmark	\checkmark	\checkmark	\checkmark			
Signal Rate	\checkmark	\checkmark	\checkmark	\checkmark			
Edge	\checkmark	\checkmark	\checkmark	\checkmark			
monotonicity							
Cross-over point	\checkmark	×	×	×			
voltage							
Consecutive Jitter	\checkmark	\checkmark	\checkmark	\checkmark			
Paired JK Jitter	\checkmark	\checkmark	\checkmark	\checkmark			
Paired KJ Jitter	\checkmark	\checkmark	\checkmark	\checkmark			
Rising Rate	\checkmark	\checkmark	\checkmark	\checkmark			
Falling Rate	\checkmark	\checkmark	\checkmark	\checkmark			
Rising Time	\checkmark	\checkmark	\checkmark	\checkmark			
Falling Time	\checkmark	\checkmark	\checkmark	\checkmark			
VBUS Voltage	\checkmark	×	×	\checkmark			
Decay							
VBUS Voltage Sag	\checkmark	×	×	\checkmark			

Note: High-speed signal quality testing is an important part of compliance analysis testing.

" \checkmark " indicates that testing is required, and " \times " indicates that testing is not required.

Test Preparation

Before conducting the test, ensure the following preparations are made:

- Oscilloscope: Supports the USB 2.0 analysis function.
- Computer: With a USB 2.0 port. Install the "High-Speed Electrical Test Software" (XHCI -HSETT) on the computer, which can download from the website <u>https://www.usb.org/document-library/xhsett-x64</u>

The software installation package is named XHSETT 1.3.6.8 Installer - x64 Release.exe.

- DUT (Device Under Test): The DUT will be tested.
- Additional test tools: Fixtures, probes, and SMA cables.

Oscilloscope

According to the requirements of USB Implementers Forum (USB-IF), the digital oscilloscope is

required to have a minimum bandwidth of 2.0 GHz and a sample rate of 5 GSa/s or higher.

It is recommended to use the UNI-T MSO7000X and MSO8000HD oscilloscopes for this purpose.

For the digital oscilloscope used in testing, please ensure the following operations have been

performed:

- The oscilloscope should be warmed up for at least 30 min.
- When the ambient temperature variation fluctuates by 5°C or more, perform the selfcalibration operation.
- Perform the "Function Inspection" and "Probe Compensation" operation on the oscilloscope.

Note: The oscilloscope used for test connections and steps in this manual is taken as an example of the MSO7000X series oscilloscope. For instructions on executing the self-calibration

program, performing the function check, and conducting the probe calibration operation, please refer to the following manuals:

- MSO7000X Series Mixed Signal Oscilloscopes User Manual
- UT-PA2000 Active Single-Ended Probe User Manual
- UT-PD2500 Active Differential Probe User Manual

Probe

The differential probe and single-ended probe are used for high-speed signal quality test.

Differential probe: The bandwidth should be at least 2.0 GHz. It is recommended to use the UT-

PD2500 active differential probe for this purpose.

Single-ended probe: The bandwidth should be at least 2.0 GHz. It is recommended to use the UT-PA2000 active single-ended probe (with at least two cables) for this purpose.

Driver Installation

 After installing the "High-Speed Electrical Test Tool" (XHCI-HSETT) software, if the driver is not automatically updated, the user must manually update the driver for the "xHCI Compliance Test Host Controller" via the device manager on the PC. The steps are as follows.

Open the device manager on the PC, navigate to "Universal Serial Bus Controller", and rightclick on "USB Extensible Host Controller" to select "Update Driver" from the context menu, as shown in the following figure.

🕂 Device Manager

File(F) operate(A) View(V)

⊨ ⇒ 📰 🖾 🖬 🚑 🖳 💺 头 🖲	
> 📔 Firmware	
> 💻 Computer	
> 🛄 monitor	
> 🔜 keyboard	
8 Bluetooth	
Other equipment	
Anthropological input devices	
Software Devices	
Software Components	
Biometric devices	
Sound, video, and game controllers	
Mice and other pointing devices	
 <tr< td=""><td></td></tr<>	
Inter(R)USB3.10 Scalable host control- 1.20 (Mic	rocoft)
Inter(R)USB3.20 Scalable host control 1.20 (Mic	Update the drivers(P)
USB Composite Device	Disable the device(D)
USB mass storage device	Uninstall the device(U)
USB Root Hub(USB3.0)	
USB Root Hub(USB3.0)	Scans hardware changes(A)
Interview Configurator	Attribute(P)
System equipment	AUDULE(K)

2. From the driver program context menu, click "Browse My Computer for Driver software". Next,

select "Let me pick from a list of available drivers on my computer." Finally, click"xHCI

Compliance Test Host Controller" to complete the driver update process.

Display compatible hardware(C)



3. If "xHCI Compliance Test Host Controller" is not listed under "Show Compatible Hardware", the

driver must be installed manually.

Click "Install from Disk, the default path is"C:\Program Files\USB-IF Test Suite \Drivers and Firmware\xHCI Host Drivers". If the path has been modified, the path is located in the directory "\USB-IF Test Suite\Drivers and Firmware\xHCI Host Drivers".

USBxHCI compliant host controller

This driver is digitally signed

Install from disk(H)...

Note: After switching the driver program of the serial port, all USB interfaces on the host may become disabled (e.g., USB devices such as keyboards and mice may no longer function). In such cases, the host can only be operated remotely from another computer, or by using a touchpad or a PS/2 mouse. Do not restart the computer during the test.

Fixture Application Scenarios

Single-ended Probe Connection Diagram



Single-ended Probe Connection Diagram for High-Speed Device Signal Quality Test



Single-ended Probe Connection Diagram for VBUS Voltage Sag

Differential Probe Connection Diagram



Differential Probe Connection Diagram for High-Speed Device Signal Quality Test

SMA Cable Connection Diagram



SMA Cable Connection Diagram for High-Speed Host Signal Quality Test



SMA Cable Connection Diagram for High-Speed Device Signal Quality Test

Test Example

USB2.0 DEVICE High-Speed Signal Eye Diagram Test

Test Steps

- Connect the test instrument and devices following the instructions in the high-speed device signal quality test connection diagram. You may use differential probes, single-ended probes, or SMA cables for testing. This example demonstrates the use of SMA cables for connections.
- Ensure the driver program is switched or installed according to the steps mentioned in the Driver Installation section.
- 3. Once the driver installation is complete, launch the "XHCI HSETT" software. After selecting the appropriate controller, click Continue to proceed with the test. When the following prompt

appears, click Continue again, as shown in the following figure.

Note: During this process, external USB devices such as a mouse or keyboard may not function.

It is recommended to use a computer with a touch screen for convenience.

Stack Switcher								
Select host controller to load Compliance Driver Stack on.								
PCI - Intel(R) USB 3.10 ************************************								
Continue Exit								
Stack Switcher								
Do you want to continue with the host controller you have selected?								
Click 'Continue' if so. Click 'Abort' if you would like to exit CV or choose a different host.								
If you don't click anything, CV will unload the compliance driver from this host controller in 15 seconds and return to the host selection window.								
Continue Abort								

4. Select "Device" as the high-speed test item and click "TEST" to start the test.

xHCI Electrical Test Tool	×
Hi-Speed © Device C Hub C Host Controller/System	- Select Host Controller For Use In Testing PCI:?0 ? 13 媍 0 5 Ports
SuperSpeed C Host/Hub DSF Ports	
TEST	Exit

5. Set the fixture mode to "Init mode" and click the "Enumerate Bus" button to refresh the device port. If the device port is not refreshed, disconnect the fixture from PC, reconnect it, and repeat the steps to enable the "XHCI HSETT" software for enumeration.

Note: It is common for multiple device ports to be enumerated on a computer. A useful tip is to unplug the device under test and refresh the enumeration to identify which port becomes disconnected. The disconnected port corresponds to the device under test.

6. After selecting the port of the device under test, choose "TEST_PACKET" in the "Device Command". Once selected, click EXECUTE. If the Status Window displays "Operation Successful", indicating that the selected signal has been output successfully.

xHCI HS Electrical Test Tool - Device Test	
Select Device NONE VID/PID 0x48d/1234. Address 1. Port 1 VID/PID 0x46d/c077. Address 2. Port 5 VID/PID 0x174t/244c. Address 3. Port 7 VID/PID 0x27c6/55a4. Address 4. Port 9 VID/PID 0x8087/26. Address 5. Port 10	Device Control Device Command Device Address TEST_PACKET Status Window Operation Successful
Enumerate Bus	EXECUTE Return To Main

- 7. Switch the test fixture mode to "Test mode" to send the signal to the fixture. At this point, adjust the oscilloscope's basic parameters to capture the signal packet.
- 8. Open the oscilloscope's jitter analysis software and enable it. Configure the required settings for the eye diagram. After setting the jitter analysis parameters, select "Eye Diagram" in the graph selection menu and enable the graph.



The eye diagram provides an intuitive representation of the signal quality of a USB 2.0 device during transmission. In addition to the eye diagram, the jitter analysis software offers various graphs to support USB 2.0 signal jitter measurement. By selecting "All" in the graph selection menu, users can access TIE trend graphs, histograms, spectrograms, bathtub curves, and more for comprehensive jitter measurement and analysis.

USB20-SQ-HD

UNI-T	Triged	Single	Autoset	н	200	ns/div 0 s	A J	∩ Normal, 1	100MPts, 1	10.00GSa/s		т	Edge C1	<u>م</u> ر ا	401.192 mV		\sim	₩ <u>ï</u>	Acq	Q	ä	<u>)</u>	≞ {€	}	83
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