Tektronix

TDSUSB2
Universal Serial Bus Measurements Package

This document supports software version 1.2.0 and above.

Warning
The servicing instructions are for use by qualified personnel only. To avoid personal injury, do not perform any servicing unless you are qualified to do so. Refer to all safety summaries prior to performing service.

Table of Contents

General Safety Summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. To avoid potential hazards, use this product only as specified.

Only qualified personnel should perform service procedures.

While using this product, you may need to access other parts of the system. Read the *General Safety Summary* in other system manuals for warnings and cautions related to operating the system.

To avoid Fire and Personal Injury

Use Proper Power Cord. Use only the power cord specified for this product and certified for the country of use.

Use Proper Power Cord. Use only the power cord specified for this product and certified for the country of use.

Connect and Disconnect Properly. Connect the probe output to the measurement instrument before connecting the probe to the circuit under test. Disconnect the probe input and the probe ground from the circuit under test before disconnecting the probe from the measurement instrument.

Ground the Product. This product is indirectly grounded through the grounding conductor of the mainframe power cord. To avoid electric shock, the grounding conductor must be connected to earth ground. Before making connections to the input or output terminals of the product, ensure that the product is properly grounded.

Observe All Terminal Ratings. To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product.

Use Proper AC Adapter. Use only the AC adapter specified for this product.

Use Proper Fuse. Use only the fuse type and rating specified for this product.

Do Not Operate With Suspected Failures. If you suspect there is damage to this product, have it inspected by qualified service personnel.

Do Not Operate in Wet/Damp Conditions.

Do Not Operate in an Explosive Atmosphere.

Keep Product Surfaces Clean and Dry.

Terms in this Manual   These terms may appear in this manual:

WARNING. Warning statements identify conditions or practices that could result in injury or loss of life.

CAUTION. Caution statements identify conditions or practices that could result in damage to this product or other property.

Terms on the Product

These terms may appear on the product:

DANGER indicates an injury hazard immediately accessible as you read the marking.

WARNING indicates an injury hazard not immediately accessible as you read the marking.

CAUTION indicates a hazard to property including the product.

Symbols on the Product   The following symbols may appear on the product:

Introduction

Welcome to the TDSUSB2 Universal Serial Bus Measurements Package

The TDSUSB2 Universal Serial Bus Measurements Package is a Sun Java™ -based application that runs on the TDS5000, TDS6000, TDS7000, CSA7000 series and TDS694C instruments connected to a PC. You can use the application software with the compliance test fixture to take the following measurements:

- Signal Quality

- Inrush

- Droop

- Drop (supported by the test fixture only)

- Receiver Sensitivity

- Impedance Measurement using Time Domain Reflectometry (TDR), supported only by the test fixture

- Chirp measurements

On the TDS5000, TDS6000, TDS7000 series of instrument, the application runs on the instrument and displays on the lower half of the screen. The instrument application runs on the upper half of the screen.

On a TDS694C instrument, the instrument is connected to a PC using an external GPIB. The application runs on the PC and the signals are acquired and displayed on the TDS694C instrument.

NOTE: TDS5052 instrument does not support the application.

What would you like to do?

Read the product description on Page 17

Go to Installing the Application Procedures on page 23

🖑**Tip** To return to the Table of Contents, select Help Topics from the Help Topic Menu.

Online Help and Related Documentation

You can access information on how to operate the application and the instrument through the following related documents and online help.

What do you want to do?

Read the conventions followed in this manual on page 14

Read the Related Documentation on page 14

Read about how to contact Tektronix on page 14

Provide feedback on this Tektronix product on page 15

Using Online Help

Online help has many advantages over a printed manual because of advanced search capabilities. Select Help on the right side of the application menu bar to bring up the help file.

The main (opening) Help screen shows a series of book icons and three tabs along the top menu, each of which offers a unique mode of assistance:

- **Tables of Contents (TOC) tab** — organizes the Help into book-like sections. Select a book icon to open a section; select any of the topics listed under the book.

- **Index tab** — enables you to scroll a list of alphabetical keywords. Select the topic of interest to bring up the appropriate help page.

- **Find tab** — allows a text-based search. Follow these steps:

  1. Type the word or phrase you want to find in the search box.

  2. Select some matching words in the next box to narrow your search.

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3. Choose a topic in the lower box, and then click the Display button.

▪ To print a topic, select the Print button from the Help Topics menu bar.

▪ Select Options from the menu bar for other commands, such as to annotate a topic, keep the help window on top, or to use system colors.

▪ Select the Back button to return to the previous help window. Use the Hyperlink to jump from one topic to another. If the Back button is grayed out or a jump is not available, choose the Help Topics button to return to the originating help folder.

▪ Browse buttons (Next >> and Previous <<) allow you to move forward and backward through topics in the order of the Table of Contents (TOC).

▪ Sometimes you will see the bolded word, **Note,** in topic text. This indicates important information.

NOTE: Certain aspects of the online help are unique to applications that run on the instrument.

Green text (with no underlines) indicates a Popup. Select the green text to display a brief help message. Click on the help message to return to the topic.

Green-underlined text indicates a jump (hyperlink) to another topic. Select the green text to jump to the related topic. For example, click the green text to jump to the topic on Online Help and Related Documentation on page 12.

💡**Tip** You can tell when the cursor is over an active hyperlink (button, jump, or popup), because the cursor arrow changes to a small hand. Note the light bulb and word Tip in the graphic above. This graphic indicates additional information to help you function faster or more efficiently.

Printing from the Online Help

Some online help topics have color in the examples of the displayed application. If you want to print this type of topic on a monochrome printer, some information may not print because of certain colors. Instead, you should print the topic from PDF (portable document format) file that corresponds to the Online Help. You can find the file in the Documents directory on the *Optional Applications Software on Windows-Based Oscilloscopes CD–ROM*. The figures of application menus in the PDF file are gray scale and all of the information prints.

Conventions

Online help uses the following conventions:

- Refers to the software part of the TDSUSB2 Universal Serial Bus Measurements Package as the TDSUSB2 application or as the application.

- When steps require a sequence of selections using the application interface, the ">" delimiter marks each transition between a menu and an option. For example, one of the steps to recall a setup file would appear as File> Recall.

- Unit under test (UUT): Refer to the USB2.0 device under test, hub under test, host under test, and port under test.

Contacting Tektronix

Phone	1–800–833–9200*****
Address	Tektronix, Inc. Department or name (if known) 14200 SW Karl Braun Drive P.O. Box 500 Beaverton, OR 97077 USA
Web site	www.tektronix.com
Sales support	1–800–833–9200, select option 1*****
Service support	1–800–833–9200, select option 2*****
Technical support	Email: techsupport@tektronix.com 1–800–833–9200, select option 3***** 6:00 a.m. - 5:00 p.m. Pacific time

* This Telephone number is toll free in North America. After office hours, please leave a voice mail message. Outside North America, contact a Tektronix sales office or distributor; See the Tektronix web site for a list of offices.

Related Documentation

In addition to the Online Help, you can access other information on how to operate the instrument through the following related documents:

- Instrument Information: The user manual for your instrument provides general information on how to operate the instrument.

- Programmer Information: The online help for your instrument provides details on how to use GPIB commands to control the instrument.

🔆**Tip** You can also download the file with programmer information and examples from the Tektronix web site.

- *Optional Applications Software on Windows-Based Oscilloscopes Installation Manual*

- *TDSUSB2 Universal Serial Bus Measurements Package Reference*

- *TDSUSBF USB2.0 Compliance Test Fixture Instructions*

For more information on USB2.0 specifications, visit www.usb.org.

- Refer to the *Optional Applications Software on Windows-Based Oscilloscopes Installation Manual* for the following information:

- Software warranty

- Software license agreement

- List of all available applications, compatible instruments, and relevant software and firmware version numbers

- How to apply a new label

- Installation procedures

- How to enable an application

- How to download updates from the Tektronix web site

You can find a PDF (portable document format) file for this document in the Documents directory on the *Optional Applications Software on Windows-Based Oscilloscopes CD –ROM*. The CD booklet only contains information on installing the application from the CD and on how to apply a new label.

Feedback

Tektronix values your feedback on our products. To help us serve you better, please send us your suggestions, ideas, or comments on your instrument.

Direct your feedback via email to

techsupport@tektronix.com or FAX at (503) 627-5695

and include the following information. Please be as specific as possible.

General information:

- Instrument model number and hardware options, if any

- Probes used

- Your name, company, mailing address, phone number, FAX number

- Please indicate if you would like to be contacted by Tektronix about your suggestion or comments

Application specific information:

- Software version number

- Description of the problem such that technical support can duplicate the problem

- If possible, save the instrument and application setup files as .set files

- If possible, save the waveform on which you are performing the measurement as a .wfm file

Once you have gathered this information, you can contact technical support by phone or through e-mail. If using e-mail, be sure to enter in the subject line "TDSUSB2 Problem," and attach the .set and .wfm files.

Tip To include screen shots from the instrument menu bar, select File> Export Setup> Image tab. Select Export and save the screen shot in C:\TDS7000\Images\screenshots.jpeg. That saves the file in the C:\TDS7000\Images directory. You can define the destination directory of the screen shots. If you want the screen shots in color, select Edit> Copy setup> Images tab. Select the Color, Full Screen and the Normal radio buttons. Select Copy. Copy the picture to any Paint editor software.

You can then attach the file to your email (depending on the capabilities of your email editor).

Getting Started

Introduction and Product Description

The TDSUSB2 Universal Serial Bus Measurements is a package that runs on the TDS5000, TDS6000, TDS7000 series and TDS694C instruments. The solution consists of a Java™-based application and a comprehensive test fixture. You can use the application software with the compliance test fixture to take the following measurements:

- Signal Quality

- Inrush

- Droop

- Drop (supported by the test fixture only)

- Receiver Sensitivity

- Impedance Measurement using Time Domain Reflectometry (TDR), supported by the test fixture only

- Chirp measurements

The application performs tests that measure the test signals for USB2.0 compliance, display Eye Diagrams and Plots, display the results as a summary or as details, and generate reports in different formats.

What would you like to do?

Check Accessories on page 18

Look Over Requirements and Restrictions on page 18

Install the Application on page 23

Compatibility

The TDSUSB2 Universal Serial Bus Measurements application is compatible with the TDS5000, TDS6000, TDS7000 series, the CSA7000 series and the TDS694C instruments. The table below lists the instruments and the firmware version. The dynamic range of the probes used for Low Speed and Full Speed testing should be at least ± 8 volts. For High Speed testing, the dynamic range should be ± 2 volts.

Table 1-1 gives a list of instruments and the firmware versions that the application is compatible with.

Table 1-1: Firmware versions

Model Number* Options	Firmware
TDS694C	V6.0 or higher
TDS7054, TDS7104 TDS7254, TDS7404	V1.4.1
TDS7154	V2.0.0
CSA7154, CSA7404	V2.0.0
TDS5054, TDS5104	V1.0.5
TDS5034	V1.1.5 or higher
TDS6604	V2.0.0

*For a current list of compatible instruments, see the Software and Drivers category in the Tektronix web site.

Requirements and Restrictions

You must install Java Run-Time Environment V1.2.2 on the TDS5000, TDS6000, TDS7000 instruments or on your PC connected to the TDS694C instrument. The TDSUSB2 application running on the PC requires full access to the TDS694C GPIB port.

The application uses the Math1 channel for low speed and full speed mode of operation. You will lose any information that you have stored in the Math1 channel.

You cannot restore the instrument settings if you select File> Exit from the application.

Accessories

The application includes the following standard accessories:

- *Optional Application Software on Windows-Based Oscilloscopes CD–ROM*

- *Optional Application Software on Windows-Based Oscilloscopes Installation Manual*

- *TDSUSB2 Universal Serial Bus Measurements Package Reference*

- *TDSUSBF USB2.0 Compliance Test Fixture Instructions*

- TDSUSBF USB2.0 Compliance Test Fixture

Optional Accessories:

- DG2040 Data Generator (for receiver sensitivity)

- AWG610 Arbitrary Waveform Generator

- P6248 Differential probes

- P6245, P6243 Single-ended active probes

- TCP202 Current probes

- TDS8000 Instrument with 80E04 Time Domain Reflectometry sampling module

- Deskew Fixture: Probe Calibration and Deskew Fixture (067-0405-xx) used for TDS5000, TDS6000, TDS7000 series of instruments.
  Probe Deskew Fixture (679-4809-xx) used with the TDS694C instrument.

Installation

Setting up the Instrument to Take Measurements

To set up the instrument, follow these steps:

1. You must power on the instrument for twenty minutes before you can start to take measurements.

2. You must run the compensation signal path on the instrument.

3. You must make sure that the default factory setups is recalled before you start using the application in the instrument. To do so, push the Recall Default setup button on the front-panel of the instrument to recall the default factory settings.

4. You should always use calibrated probes and degauss the current probes.

5. Table 1-2 lists the recommended instruments and probes.

Table 1-2: Compatible instruments and probes

USB2.0 Signal Speed	Instrument required	USB-IF Recommended probes
High Speed	TDS7404 TDS7254 CSA7404 TDS694C TDS6000 series	P6248
Low Speed and Full Speed	TDS7054 TDS7104 TDS7404 TDS7254 TDS7154 CSA7404 CSA7154 TDS694C TDS5054 TDS5104 TDS6000 series	P6245, P6243
Inrush	All TDS7000 series TDS694C TDS5054, TDS5104 CSA7404, CSA7154 TDS6000 series	TCP202
Droop	All TDS7000 series TDS694C TDS5054, TDS5104 CSA7404, CSA7154,TDS6000 series	P6245, P6243

Tip *Use the Select button on the instrument to toggle between the cursors when you use the cursors on a TDS694C instrument.*

Installing the Application

Refer to the *Optional Applications Software on Windows-Based Oscilloscopes Installation Manual* for the following information:

- Installation procedures

- How to apply a new label

- How to enable an application

- How to download updates from the Tektronix web site

You can find a PDF (portable document format) file for this document in the Documents directory on the *Optional Applications Software on Windows-Based Oscilloscopes CD–ROM*. The CD booklet only contains information on installing the application from the CD and on how to apply a new label.

Deskewing the Probes and Channels

To ensure accurate measurements, you must deskew the probes before you take measurements from your unit under test. The deskew process is where the instrument adjusts the relative delay between the signals to accurately time correlate the displayed waveforms.

The application includes an automated deskew utility that you can use to deskew any pair of instrument channels.

NOTE: It is recommend that you use the Deskew Fixture specified in the Accessories section to perform deskew. The deskew source can be a built-in probe compensation signal in the instrument or an external signal source. The instrument has a deskew range of 50 ns

Deskewing Probes and Channels on the TDS5000, TDS6000 and TDS7000 Instruments

You can use the probe compensation signal from the TDS5000, TDS6000 and TDS7000 instrument as the source for the deskew fixture. To do so, follow these steps:

1. Connect the probes to Ch1 and Ch2 on the instrument.

2. Connect the probe compensation signal to the deskew fixture.

3. Follow the on-screen prompts for the deskew operation with an external source.

Figure 1-1 shows signals before performing the deskew procedure with a single edge.
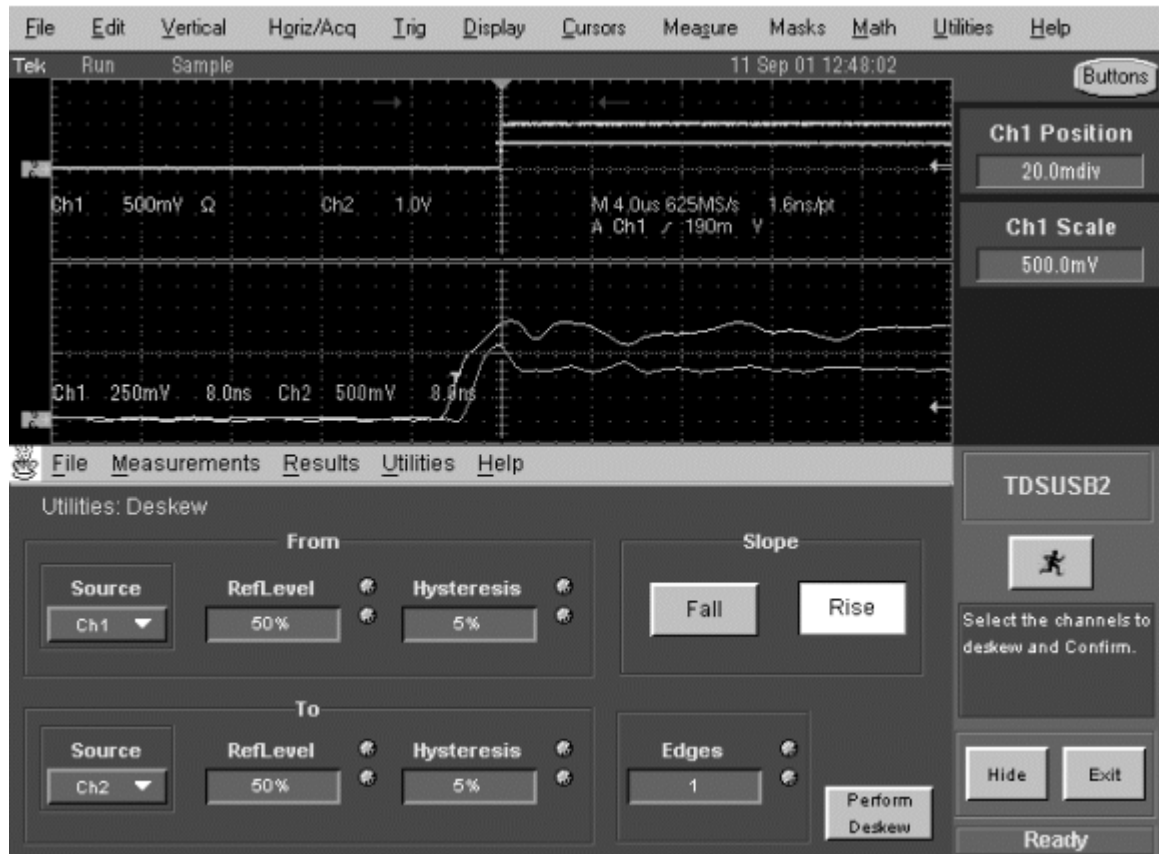
Figure 1-1: Signals before the single edge deskew

4. To start the application from a TDS5000, TDS6000 and TDS7000 series instrument, select File> Run Application> USB2.0TestPackage from the menu bar of the instrument.

5. Select Utilities> Deskew.

6. Set the channel Source in the From area to Ch1. The Source waveform is the reference point to which the remaining channels are deskewed.

7. Set the channel Source in the To area to Ch2, the channel to be deskewed.

8. Select the Reference Level for Ch1 and set the reference value. The reference level is the percentage level of the waveform from which to take the edges to deskew.

9. Select the Reference Level in the To area for Ch2 and set the reference value.

10. Select the Hysteresis in the From area for Ch1. Hysteresis helps to ignore the noise level in the waveform.

11. Select the Hysteresis in the To area for Ch2 and set the hysteresis value.

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12. Select the Slope, Rise or Fall, on which to perform the deskew operation.

13. Select the number of edges used for deskew.

14. To start the deskew utility, select Utilities> Perform Deskew and confirm the operation.

15. Without changing the From: Ch1 channel, deskew the remaining channels.

    The next figure shows the results after performing the deskew operation with a single edge. The reference level is set to 50% for Ch1 and Ch2, the hysteresis is set to 5%, the number of edges is set to 1, and the slope is set to the rising edge.

NOTE: If you are using TDS5000, TDS6000 and TDS7000 series of instrument, the probe compensation signal varies from 0.8 volts to 1 volt with an offset of 0.8 volts rather than swinging from 0 to 1 volt in a traditional instrument. In this situation, set the Reference level and the Hysteresis level appropriately so that the Ref level should be at the middle level of the swing on the signal.

Figure 1-2: Signals after the single edge deskew

To perform the deskew operation with an external source, follow these steps:

1. Connect the probes to Ch1 and Ch2 on the instrument.

2. Connect an external source to the deskew fixture.

3. Follow the instructions of the Deskew fixture (Tektronix part number: 067-0405-xx) to make the connections.

4. Set up the instrument as follows:

   ▪ Use the Horizontal Scale knob to set the instrument to an acquisition rate so that there are two or more samples on the deskew edge.

   ▪ Use the Vertical Scale and Position knobs to adjust the signals to fill the display without missing any part of the signals.

   ▪ Set the Record Length so that there are more samples for the edges in the acquisition. It is recommended that you set the record length to 25000 points.

5. To start the application from a TDS5000, TDS6000 and TDS7000 series instrument, select File> Run Application> USB2.0TestPackage from the menu bar of the instrument. Select Utilities> Deskew.

6. Set the channel Source in the From area to Ch1. The remaining channels are deskewed to the Source waveform, which is the reference point.

7. Set the channel Source in the To area to Ch2, the channel to be deskewed.

8. Select the Reference Level for Ch1. The reference level is the percentage level of the waveform from which to take the edges to deskew.

9. Select the Reference Level in the To area for Ch2 and set the reference value.

10. Select the Hysteresis in the From area for Ch1. Hysteresis helps to ignore the noise level in the waveform.

11. Select the Hysteresis in the To area for Ch2 and set the hysteresis value.

12. Select the Slope, Rise or Fall, on which to perform the deskew operation.

13. Select the number of edges used for deskew.

14. To start the deskew utility, select Utilities> Perform Deskew and confirm the operation.

15. Without changing the From: Ch1 channel, deskew the remaining channels.

The next figure shows an example of a deskew setup. The setup is an acquisition of a square signal at100 KHz, with the Record length set to 25000 points to achieve the sample resolution of 1.6 ns.
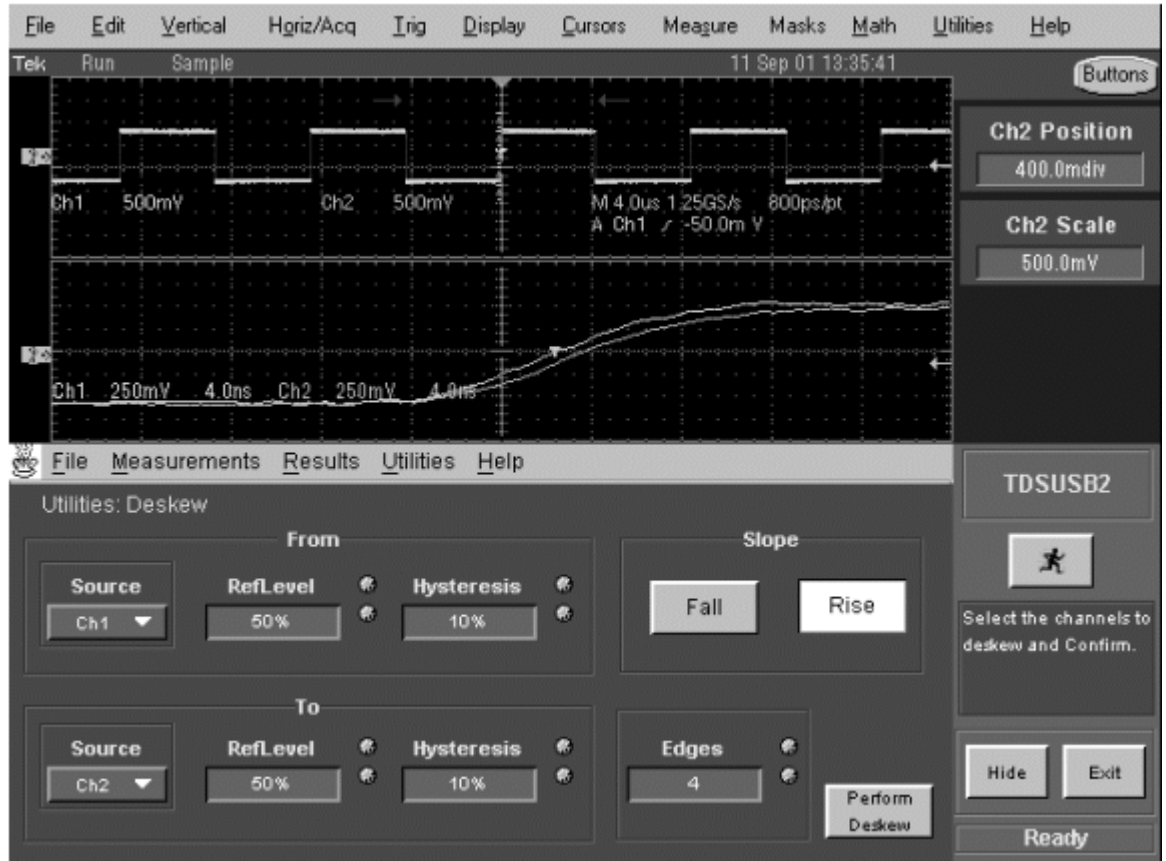
Figure 1-3: Signals before the multiple edge deskew

16. Set the Reference levels for Ch1 and Ch2 in the application to 50%, the hysteresis to 10%, the number of edges to 4, and the type to rising edge. The next figure shows the display after performing the deskew for the multiple edges.
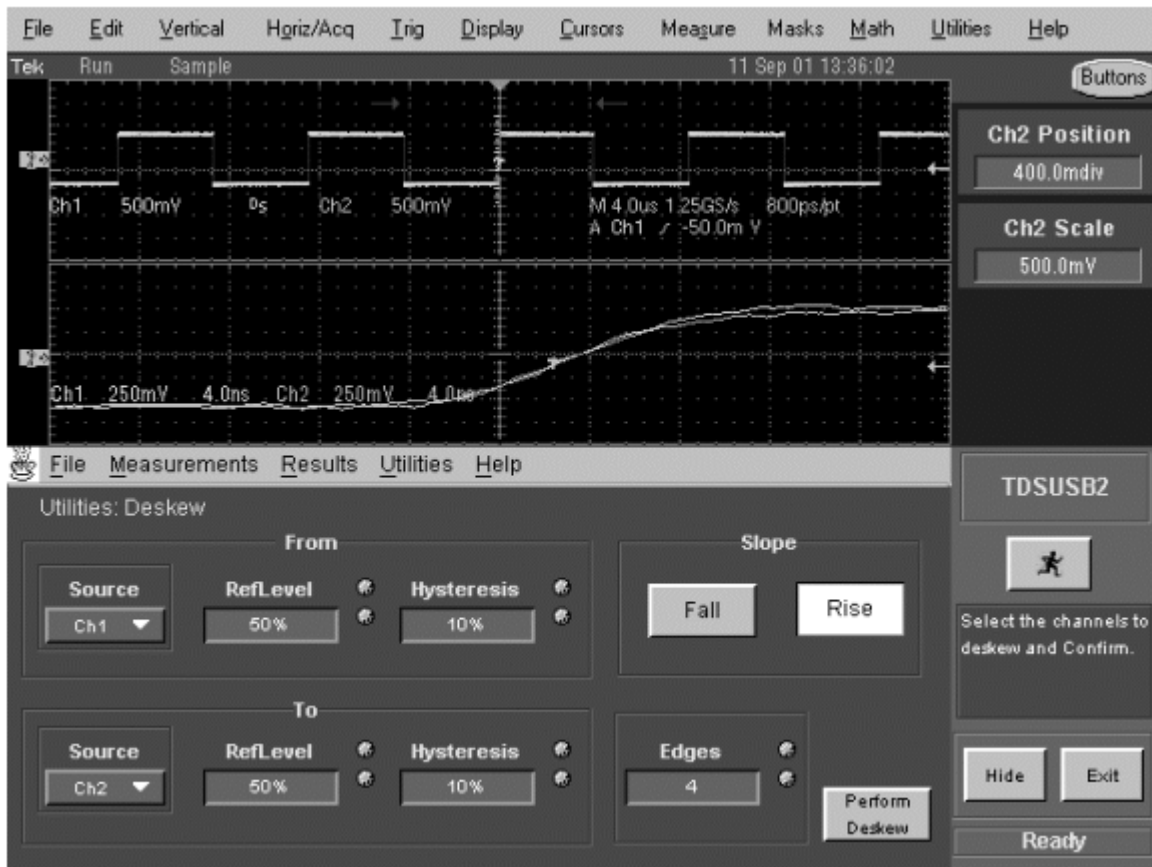
Figure 1-4: Signals after the multiple edge deskew

17. The zoomed section of the waveform available on the lower part of the screen shows the results of the deskew operation clearly. You will see that after performing the deskew operation, the skew is automatically removed.

Deskewing Probes and Channels on the TDS694C Instrument

To deskew probes and channels on the TDS694C instrument, follow these steps. You can use the probe compensation signal from the instrument as the source for the deskew fixture.

1. Connect the Probe compensation signal from the instrument to the CAL/DESKEW FIXTURE (Tektronix part number: 679-4809-XX).

2. Follow the instructions provided with the deskew fixture to make the connections.

3. Connect the probes to the instrument channels.

4. To start the application on a PC connected to a TDS694C instrument, select the USB2.0 shortcut icon on the desktop.

5. Select Utilites> Deskew.

6. Select the channel Source in the From area, for instance Ch1. The remaining channels are deskewed to the Source waveform, which is the reference point.

7. Select the channel Source in the To area as the channel to be deskewed. You can select this from Ch1 to Ch4. The available selections exclude the channel selected in step 7.

8. Select the Reference Level in the From area for Ch1. The reference level is the percentage of the waveform level from which to select edges for deskew. An appropriate value is 50%.

9. Select the Reference Level in the To area as Ch2.

10. Select the Hysteresis in the From area for Ch1. Hysteresis helps in ignoring the noise level in the waveform. An appropriate hysteresis value is 10%.

11. Select the Hysteresis in the To area for Ch2.

12. Select the Slope, Rise or Fall, on which to perform deskew.

13. Select the number of edges for deskew.

14. To start the deskew operation, select Utilities> Perform Deskew.

15. Without changing the Ch1 from the From area channel, deskew the remaining channels.

To perform the deskew operation with an external source and deskew fixture for the TDS694C instrument, follow these steps:

NOTE: Follow this procedure if you are using the deskew fixture (Tektronix part number: 067-0405-XX) that is used for the TDS5000, TDS6000, TDS7000 series of instruments.

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1. Connect the probes to Ch1 and Ch2 on the instrument.

2. Connect an external source to the deskew fixture.

3. Follow the instructions provided with the Deskew fixture to make the connections.

4. Set up the instrument as follows:

   ▪ Use the Horizontal Scale knob to set the instrument to an acquisition rate so that there are two or more samples on the deskew edge.

   ▪ Use the Vertical Scale and Position knobs to adjust the signals to fill the display without missing any part of the signals.

   ▪ Set the Record Length, preferably to 25 K, so that there are more samples for the edges in the acquisition.

5. To start the application on a PC connected to a TDS694C instrument, select the USB2.0 shortcut icon on the desktop.

6. Select Utilites> Deskew.

7. Select the channel Source in the From area, for instance Ch1. The Source waveform is the reference point to which the remaining channels are deskewed.

8. Select the channel Source in the To area. You can select this from Ch1 to Ch4. The available selections exclude the channel selected in step 7.

9. Select the Reference level in the From area for Ch1. The reference level is the percentage of the waveform level from which to select edges for deskew. An appropriate value is 50%.

10. Select the Reference level in the To area for Ch2.

11. Select the Hysteresis in the From area for Ch1. Hysteresis helps to ignore the noise level in the waveform. An appropriate hysteresis value is 10%.

12. Select the Hysteresis in the To area for Ch2.

13. Select the Slope, Rise or Fall, on which to perform deskew operation.

14. Select the number of edges used for deskew.

15. To start the deskew utility, select Utilities> Perform Deskew.

16. Without changing the channel in the From area, deskew the remaining channels.

Operating Basics

About Basic Operations

This section contains information on the following topics and tasks:

- Application interface
- Using basic instrument functions
- Setting up the software
- Selecting a measurement
- How to Save and Recall setups
- Exiting the application

Application Interface

The application uses a Windows interface. You should refer to the user manual of your instrument for the operating details of other controls, such as the front-panel buttons.

NOTE: The instrument screen shrinks to half size and appears in the top half of the display when the application is running on the TDS5000, TDS6000, TDS7000 series of instruments.

If you are taking measurements with aTDS694C instrument, the application runs on the PC.

Application Interface Menu Controls

Table 2–1 lists the interface items with a brief description of each.

Table2-1: Application interface items

Item	Description
Menu bar	Located at the top of the application display and contains application menus
Tab	Labeled group of options containing similar items
Area	Visual frame that encloses a set of related options
Option button	Button that defines a particular command or task
List box	Box that contains a list of items from which you can select one item
Box	Box that you can use to type in text, or to enter a value with the Keypad or a Multipurpose knob

Check Boxes	Square box that you can use to select or clear preferences
Scroll bar	Vertical or horizontal bar at the side or bottom of a display area that can be used for moving around in that area
Browse	Displays a window where you can look through a list of directories and files
Command button	Button that initiates an immediate action
Keypad	Keypad appears when you select the box; select and use it to enter a value
MP/GP knob	When you select the multipurpose (MP or GP) knob, a line appears between the knob and the box; turn the knob on the instrument to select a value

Basic Instrument Functions

You can use the Help menu to access information about the instrument. You can also use other instrument functions and easily return to the application.

Using Online Help   The TDSUSB2 application includes Online Help about the application menus and controls.

To display the Online Help, follow these steps:

1. Choose Help from the TDSUSB2 menu bar on a the TDS5000, TDS6000, TDS7000 instrument. For the TDS694C instrument, choose the Help from the application running on the PC.

2. Use the Contents, Table of contents, or Index tabs to navigate through the help.

3. In the the TDS5000, TDS6000, TDS7000 series of instruments, the touch screen mode of operation is enabled by default. You can disable this by using the Touch Screen OFF button in the front panel of the instrument.

Minimizing and Maximizing the Application   To minimize the application, select File> Minimize. When you minimize the instrument, the application is continually displayed.

To maximize the application, select the TDSUSB2 icon in the Windows taskbar

Returning to the Application   When you access instrument functions, the instrument fills the display. You can access instrument functions in the following ways.

1. Select the Hide button in the application display.

2. Choose the Menu bar or the Toolbar mode on the instrument and access the menus.

3. To return to the application, click the App button on the menu bar of the instrument.

NOTE: This does not apply if the application is running on theTDS694C instrument.

Application Directories and File Names

The application uses the directories for a variety of functions, such as save and recall setup files for the TDS5000, TDS6000, TDS7000 instrument, and uses the extensions appended to file names to identify the file type.

The following table lists default directory names for the TDS5000, TDS6000, TDS7000 instrument:

Table 2-2: Default directory names

Directory	Used for
C:\TekApplications\tdsusb2	Home location
C:\TekApplications\tdsusb2\report	Report files
C:\TekApplications\tdsusb2\setup	Setup files
C:\TekApplications\tdsusb2\tsvfilegenerator	Default directory for the tsv file generated by the file generator and for other csv files.
C:\TekApplications\tdsusb2\datagen	DG2040 pattern files for use in Receiver Sensitivity Test
C:\TekApplications\tdsusb2\images	Images of the eye diagram and waveform plots
C:\TekApplications\tdsusb2\temp	Temporary files used in the application
C:\TekApplications\tdsusb2\tsvfiles	Stores the TSV files

File Name Extensions: Table 2–3 lists the file name extensions used or generated by the application.

Table 2-3: File name extensions

Extensions	Descriptions
.csv	Input file is in the .csv format and is used to generate a .tsv file (comma separated variable format)
	An exported waveform that may be used as a source to generate a tsv format file
.ini	Application setup file
.set	Instrument setup file with the same name, saved and recalled with .ini and .set file name extension
.tsv	Input file in a Tab Separated Variable format

See Also

CSV File Format on page 33

TSV File Generator on page 66

Setting up the Software to take Measurements

Description of the Test Fixture

The TDSUSBF USB2.0 Compliance Test Fixture is a break-out board that enables you to test live USB2.0 signals, exchanged between the device and the host. For more information on the compliance test fixture, refer to the *TDSUSBF USB2.0 Compliance Test Fixture Instructions* shipped with the test fixture.

The compliance test fixture consists of the following sections:

- SQ Test Section

- Receiver Sensitivity Test

- Impedance Measurement Test (TDR Test)

- Disconnect Detect Test

- Adjacent Trigger and Droop Test

- Host SQ

- Inrush Test
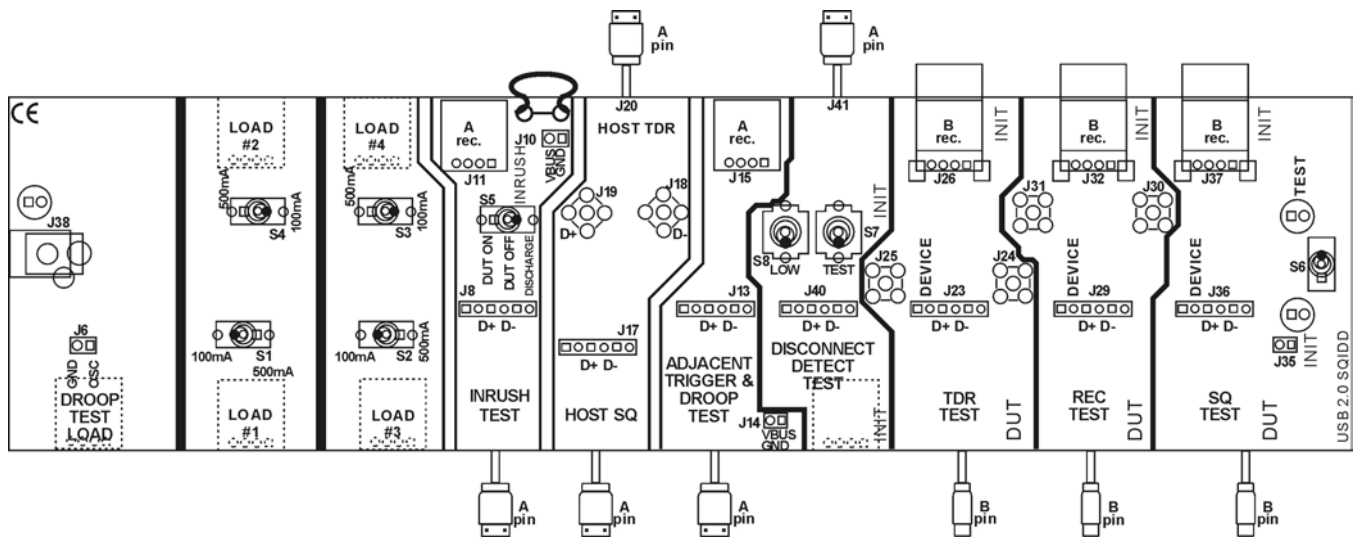
Figure 2-1: Compliance test fixture

Setting Up the Device Details

You can enter a unique identifier (ID) and description for the unit under test (device). The identifier and the description appear in reports generated for the tests performed on the unit under test. You can either type in the text directly in the boxes for these fields, or use the keypad or a keyboard. You can also choose to generate automatic IDs for the unit or enter a prefix using the keypad.
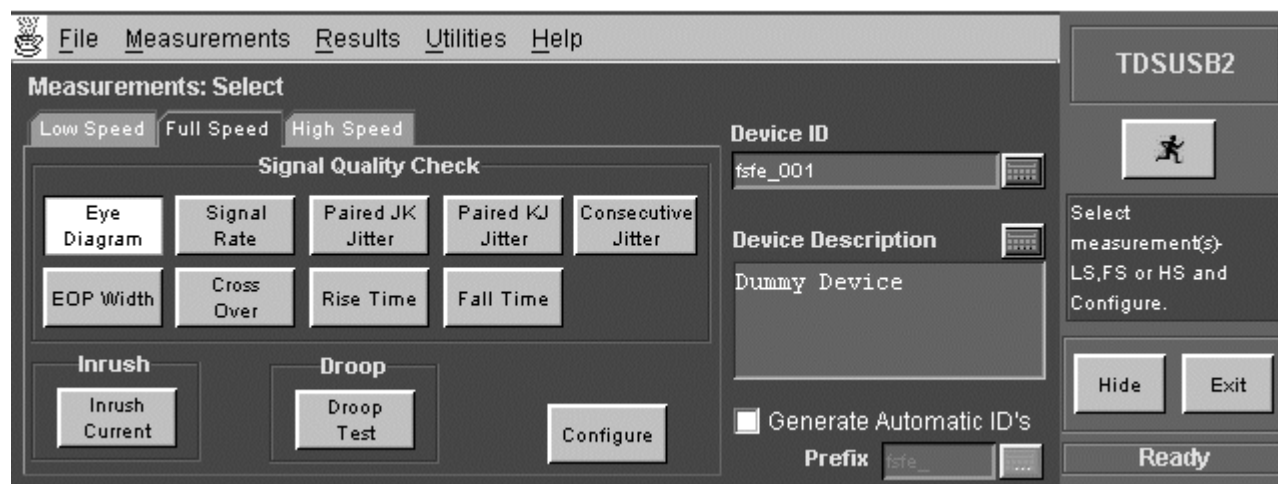
Figure 2-2: Default opening screen and entering device details

NOTE: The Device ID field box is disabled if you select the Generate Automatic ID checkbox.

The Prefix field box is enabled if you check the Generate Automatic ID checkbox.

The report for Inrush Measurement displays details of the Signal Setup with the device description.

Setting Up the Software   You can set up the application to take one or more measurements at the same time. In addition, you can view the results as a summary, details, an eye diagram, and a waveform plot for Signal Quality checks. You can also generate reports in one of the three formats: Tektronix Specific, Plug-Fest and CSV.

In the TDS5000, TDS6000, TDS7000 series of instruments, the application runs on the instrument. In case of TDS694C instrument, the application runs on a PC and is connected to the instrument through external GPIB. It is recommended that you connect the keyboard and the mouse for TDS5000, TDS6000, TDS7000 series to use the application effectively.

See Also

Selecting a Measurement on page 37

Configuring a Measurement on page 45

Setting Preferences   The Preferences menu consists of two tabs: General and Advanced. To access the Preferences menu, select File> Preferences.

In the General tab, you can select the following options:

▪   Set a warning to indicate that the configuration options were not changed since the last time you ran the application. If you set this option, the application prompts you to configure the measurements before acquiring data.

▪   Automatically display the Eye Diagram without having to select the option.

- Automatically display the Waveform Plot without having to select the option.

- Automatically generate reports without having to select the option, if the selected report format is one of the two: Tektronix Specific or Plug-Fest specific. If you select the user configurable limits in the Advanced tab, the Plug-Fest option is disabled.

- Always display the waiver mask in the eye diagram Figure 2-3 shows the Preferences: General tab.
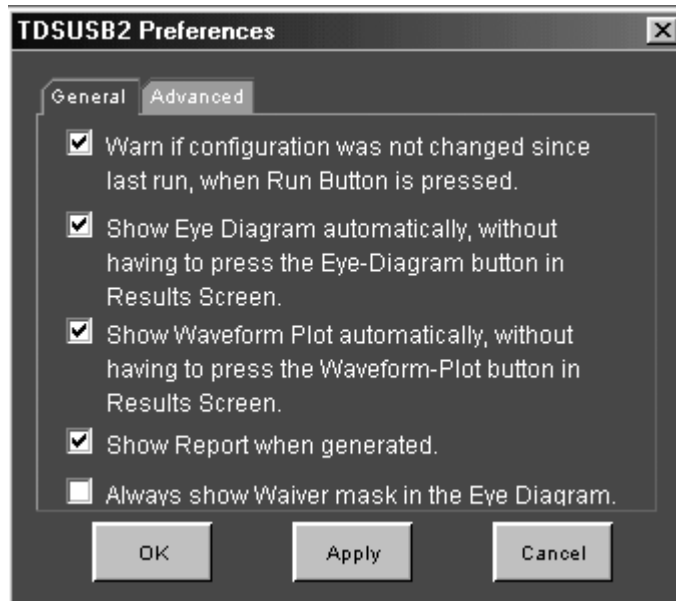
Figure 2-3 : Preferences:general tab

In the Advanced tab, you can select the following options:

- Test a Low or Full Speed device with USB2.0 silicon.

- Prompt during report generation for the Drop test readout. When you enable this option, the application disables report generation in the Automatic mode.

- Configure the test limits. The result: PASS or FAIL is determined by the limits you have defined.

- Place the vertical cursors between the start and end of the single USB2.0 packet. This is used when there is more than one USB2.0 packet displayed on the instrument for Signal Quality measurements.

Figure 2-4 shows the Preferences: General tab.
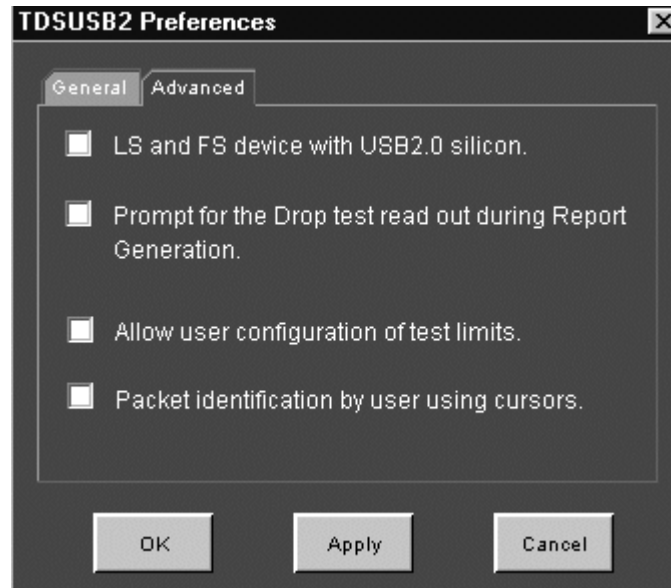
Figure 2-4: Preferences: advanced tab

NOTE: If you enable the Configure Test Limits option, the Results Summary and Report Generation in Plug-Fest format is disabled.

Selecting a Measurement

To take a measurement, select Measurement> Measurements menu, which is also the default opening screen in the application. To access the Select option in the Measurement menu, choose Measurements> Select.

There are three categories of measurements: Full Speed, High Speed and Low Speed measurements. The measurements for Low, Full and High Speed signals are Signal Quality Checks, Inrush Current Check, and Droop Test. The additional measurements for High Speed tests are Receiver Sensitivity, Monotonic Property, and Chirp Test.
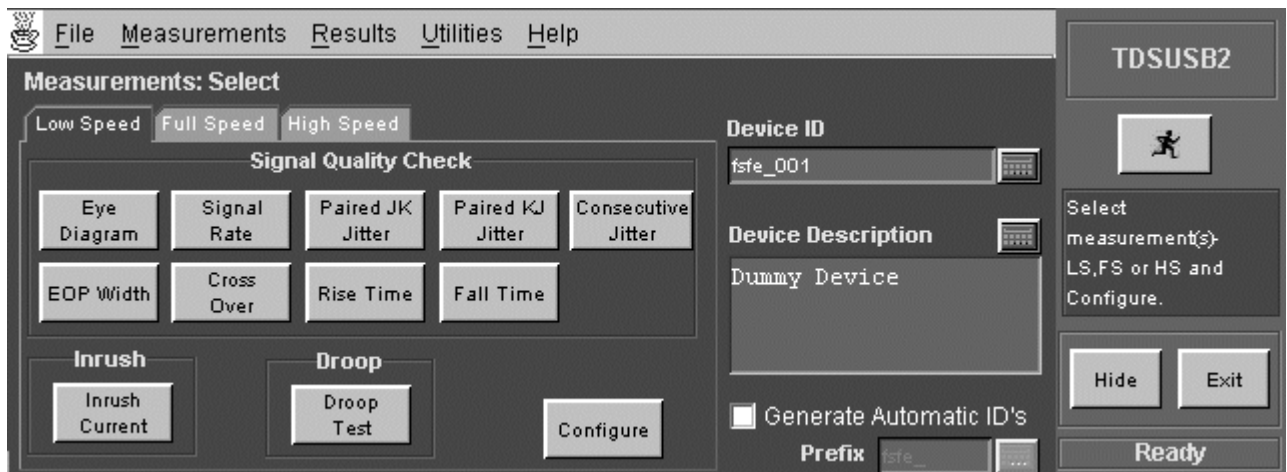
Figure 2-5: Selecting a low speed signal quality measurement

TDSUSB2 Universal Serial Bus Measurements Package User Manual   37
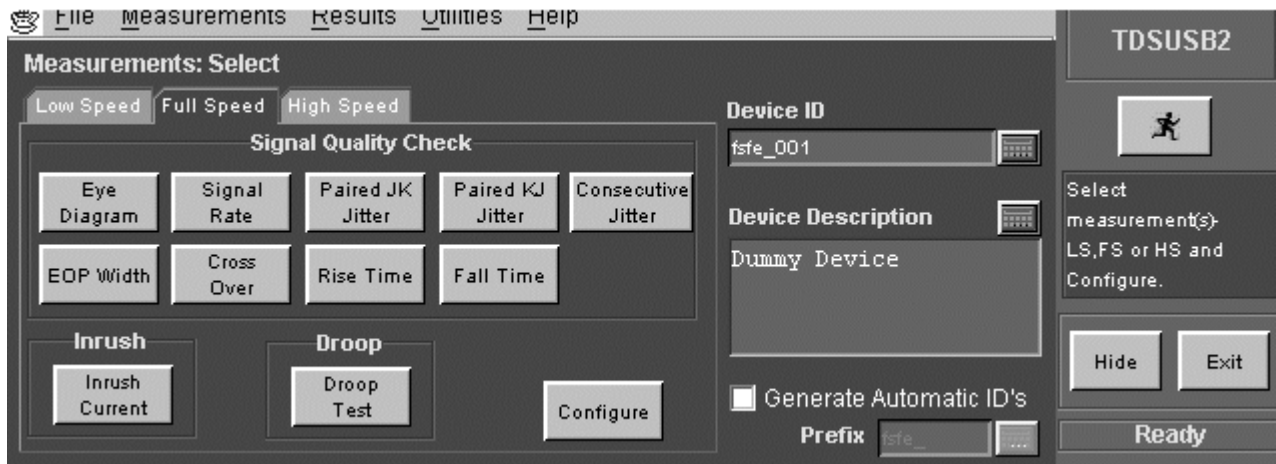
Figure 2-6: Selecting a full speed signal quality measurement

You need to select the measurements for a particular signal speed of the unit under test. After selecting the tests, you must configure the application based on Signal Source, Tier, Test Point, and Signal Direction. You can test the units for the following:

- Devices for Upstream Signal Quality Check

- Hubs and Hosts for Downstream Signal Quality Check

- Ports of a Hub for Droop Test

- Devices for Inrush Current

See Also

Signal Quality Check on page 41

Inrush Current Check on page 41

Droop Test on page 42

Receiver Sensitivity on page 43

Chirp Test on page 44

What do you want to do?

Go to a table listing the measurements areas and options that can be selected on page 39.

Go to configuring a measurement on page 45

Find out how to save or recall measurement setups on page 68

Table of Measurements and Options

Tables 2–4 and 2–5 lists the measurements with a brief description of each.

Table 2-4: Select Low Speed and Full Speed Measurements

Area	Option	Description
Signal Quality Check	Eye Diagram	Checks whether the USB signal is aligned with its corresponding eye diagram
Signal Quality Check	Signal Rate	Measures the inverse of the average bit-time that gives the transmission rate of the USB signal
Signal Quality Check	Paired JK Jitter	Measures the jitter time for paired (JK next to KJ) differential data transition
Signal Quality Check	Paired KJ Jitter	Measures the jitter time for paired (KJ next to JK) differential data transition
Signal Quality Check	Consecutive Jitter	Measures the jitter at every consecutive data bit calculated using the signal rate
Signal Quality Check	EOP Width	Measures the width of the end-of-packet of a USB signal
Signal Quality Check	Cross over voltage	Measures the voltage at which the D+ voltage crosses the D– voltage
Signal Quality Check	Rise Time	Measures the elapsed time from when a rising edge crosses the low reference voltage level and then the high reference voltage level
Signal Quality Check	Fall Time	Measures the elapsed time from when a falling edge crosses the high reference voltage level and then the low reference voltage level
Inrush Current Check	Inrush Current	Measures the amount of electrical charge drawn by a device as soon as it is connected to a USB network
Droop Test	Droop Test	Measures the difference in the V_{BUS} voltage when the load switch is open to the lowest value of the voltage and the load switch

Table 2-5: Select High Speed Measurements

Area	Option	Description
Signal Quality Check	Eye Diagram	Checks whether the USB signal is aligned with its corresponding eye diagram
Signal Quality Check	Signal Rate	Measures the inverse of the average bit-time that gives the transmission rate of the Test_Packet.
Signal Quality Check	Monotonic Property	Detects when the Signal is Monotonic if and only if data [i+1] >= data [i] in case of consistently increasing (rising slope), never decreasing data [i+1] <= data [i] when consistently decreasing (falling slope) and never increasing in value where i ranges from 0 to n.
Signal Quality Check	EOP Width	Measures the width of the end-of-packet pattern of a Test_Packet

Signal Quality Check	Rise Time	Measures the elapsed time from when a rising edge crosses the low reference voltage level and then the high reference voltage level
Signal Quality Check	Fall Time	Measures the elapsed time from when a falling edge crosses the high reference voltage level and then the low reference voltage level
Inrush Current Check	Inrush Current	Measures the amount of electrical charge drawn by a device is connected to a USB network
Droop Test	Droop Test	Measures the difference in the V_{BUS} voltage when the load switch is open to the lowest value of the voltage and the load switch
Receiver Sensitivity Test	Receiver Sensitivity	Is an indicator of Receiver Sensitivity. A High Speed capable device must indicate 'packet(Data) not received' (squelch) when the input of the receiver falls below 100 mV differential amplitude. Similarly the device must not indicate squelch if the differential amplitude is greater than 150 mV
Chirp Test	Chirp	Checks a part of handshake that occurs during Reset Protocol for high speed capable hubs and devices. In this handshake, the hub/host and the device are required to detect chirp J and K of a specified minimum duration and amplitude

Signal Quality Check   Table 2-6 lists the Signal Quality checks.

Table 2-6: Signal quality checks

Area	Option	Description
Signal Quality Check	Eye Diagram	Checks whether the USB signal is aligned with its corresponding eye diagram
Signal Quality Check	Signal Rate	Measures the inverse of the average bit-time that gives the transmission rate of the USB signal
Signal Quality Check	Paired JK Jitter	Measures the jitter time for paired (JK next to KJ) differential data transition
Signal Quality Check	Paired KJ Jitter	Measures the jitter time for paired (KJ next to JK) differential data transition
Signal Quality Check	Consecutive Jitter	Measures the jitter at every consecutive data bit calculated using the signal rate
Signal Quality Check	EOP Width	Measures the width of the end-of-packet of a USB signal
Signal Quality Check	Cross over voltage	Measures the voltage at which the D+ voltage crosses the D– voltage
Signal Quality Check	Rise Time	Measures the elapsed time from when a rising edge crosses the low reference voltage level and then the high reference voltage level
Signal Quality Check	Fall Time	Measures the elapsed time from when a falling edge crosses the high reference voltage level and then the low reference voltage level
Signal Quality Check	Monotonic Property (For High Speed only)	Measures the Monotonic Signal if the data [i+1] >= data [i] where data [I] is the record point in the acquired waveform.This is in the case of consistently increasing(rising Slope) only. If the data [i+1]>= data [i] in case of consistently decreasing(falling slope) and never increasing in value where i ranges from 0 to n, the signal I is said to be monotonic.

NOTE: The USB2.0 specifications recommend that you should test the signal quality for upstream and downstream traffic. In upstream testing, the application captures the signals transmitted from the device to the host. In downstream testing, the application captures the signals transmitted from the host to the device.

Downstream testing is performed on ports of a hub. When testing a hub, you need to connect the USB2.0 unit to Tier 6 to ensure the worst case. Each hub level is referred to as a Tier. The hub under test is connected into Tier 5, so that you can test the hub on the Tier 6.

Inrush Current Check   The application can perform an Inrush current check to verify that the unit under test does not draw current higher than USB2.0 specifications when connected to a USB2.0 system. If the measured current drawn is higher than a specified value, the other USB2.0 devices connected to the bus may not be able to function properly.

When a unit is connected, there is a sharp intake of current followed by a comparatively less steep decay. Small humps or perturbations are noticed in the current trace, depending on when the unit reset.

The TDSUSB2 application automatically sets up the instrument. The application gives a direct readout of Charge (µC) and Capacitance (µF) values. The application displays the details of the results after comparing the test results with the USB2.0 specifications.
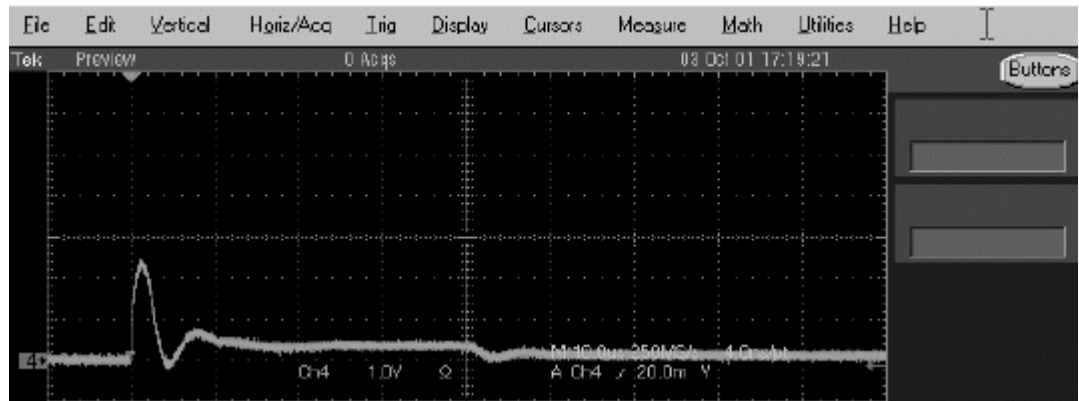

Figure 2-7: Output of the inrush current check

Droop Measurement

The Droop voltage is the difference in the V_{BUS} voltage when you apply a no load condition and a 100 mA load to the port under test (all other ports are fully loaded).

The Droop test evaluates the worst case droop by alternately applying a droop load and no load to the port under test while all other ports are supplying the maximum load possible. All the V_{BUS} measurements are relative to local ground.

The TDSUSB2 application automatically sets up the instrument for the specified test configuration. When you start the application, it acquires the signal, and provides the V$_{DROOP}$ measurement, and displays PASS or FAIL.
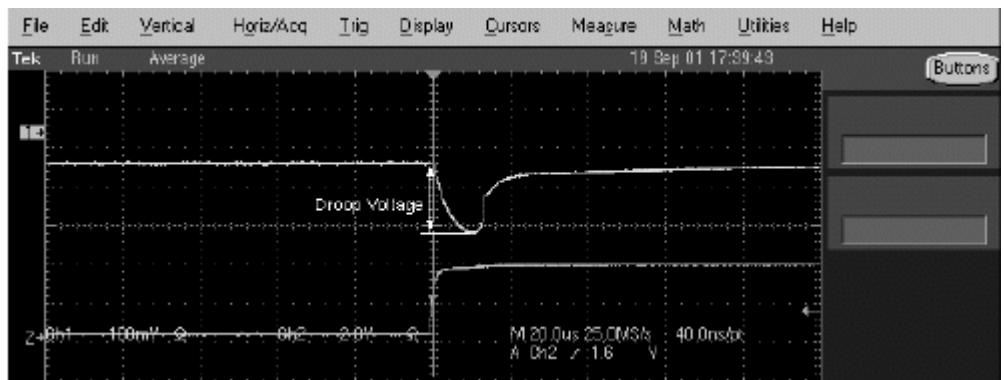

Figure 2-8: Output of the droop measurement

NOTE: The TDSUSB2 application helps to report the Drop test. You can do this by enabling an option in the File> Preferences> Advanced menu. You can enter the multimeter reading for the Drop test in the TDSUSB2 application during report generation for a consolidated report.

Receiver Sensitivity Measurement

To improve the performance of the application in a noisy environment, the USB2.0 high speed device should respond to IN tokens with NAKs when the signaling level is at or above the specified level.

The Receiver Sensitivity test requires a high-speed data simulator, such as the Tektronix DG2040 USB Data Generator, to transmit IN tokens of varying amplitude. The test requires the unit under test to be placed in the Test_SE0_NAK mode. The host is then replaced by the DG2040 Data Simulator to continue to transmit IN tokens. The signaling amplitude is presented to the device under test at a level at or above 150 mV. At these levels, the unit under test must not be in the squelched mode, responding to IN packets with NAKs. The amplitude of the signals from DG2040 Data Generator is then varied less than 100 mV. The unit under test must be squelched and not respond to IN tokens with NAKs.

This tests the receiver capability of high speed units (device) to respond to a particular data pattern generated by the USB2.0 Data Generator (DG2040). The unit under test responds to the data pattern level above the squelch level (>150 mV) and should not respond when the data pattern level is below the squelch level (<100 mV).

The TDSUSB2 application provides the procedural steps to perform this measurement. It also provides DG2040 Data Generator pattern files.
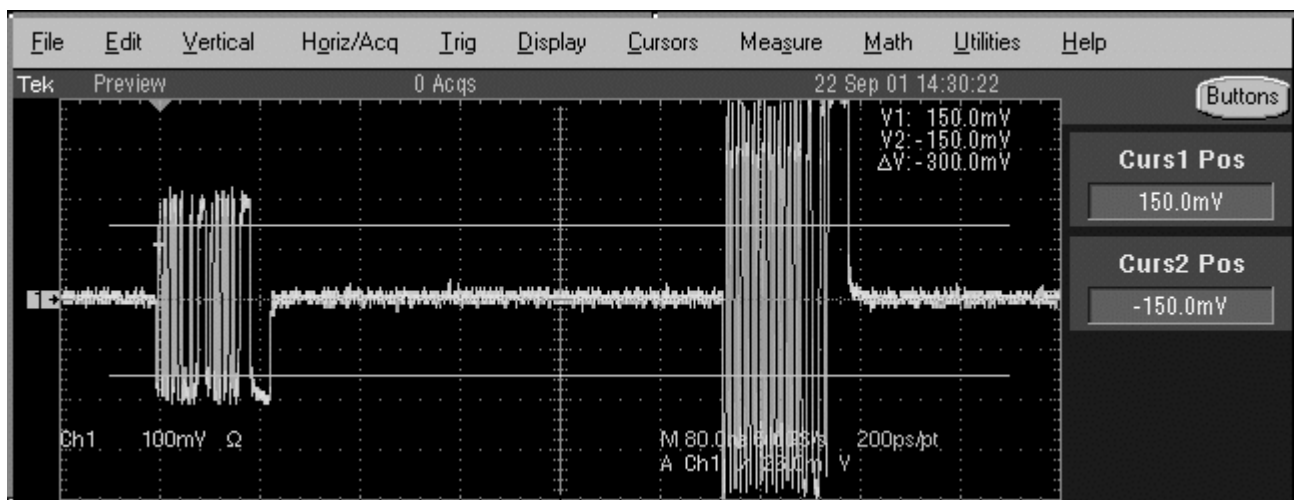

Figure 2-9: Output of the receiver sensitivity measurement

Chirp Measurement   To perform a Chirp test, connect the unit under test and the single-ended probes to acquire data. You can measure the Data for Chirp K amplitude, Chirp K duration, and Reset duration. You need to manually verify that there should be three K–J pairs less than 500 µs.
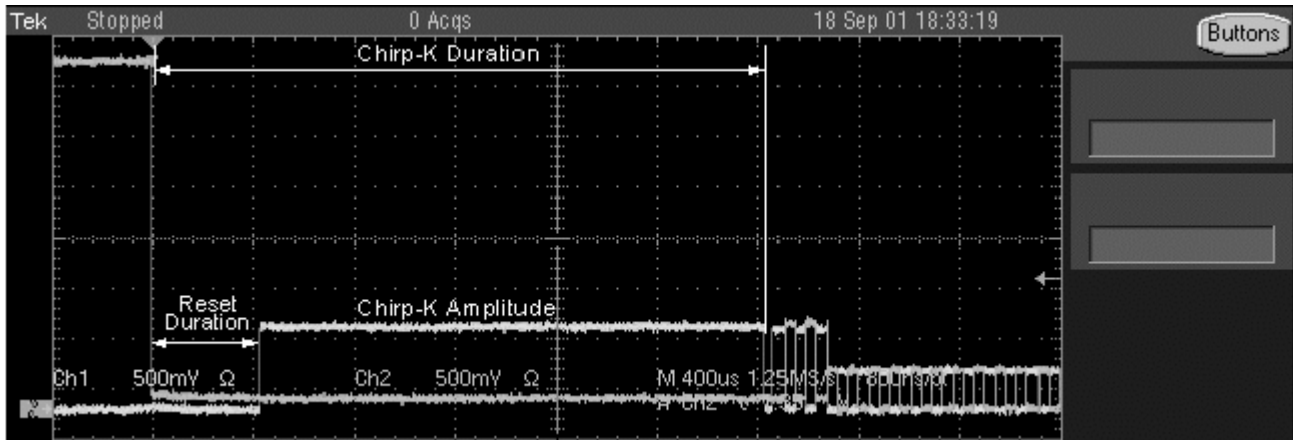

Figure 2-10: Output of the chirp test

The TDSUSB2 application automates this process and automatically reports the results for Chirp-K duration, Chirp-K amplitude, and Reset duration.

Monotonic Property   While performing a USB2.0 High Speed compliance test, you need to verify that the signal to be tested is monotonic.

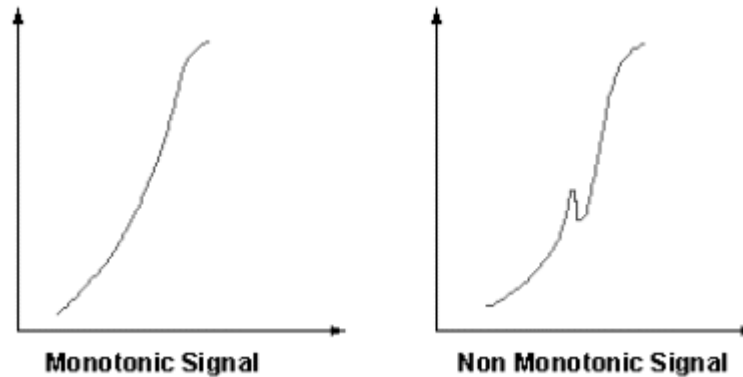The following graph shows the monotonic behavior of a USB2.0 High speed signal with a rise time of 500 ps.

Figure 2-11: Monotonic behavior of a monotonic signal

To verify the monotonic behavior of a signal, the instrument must have a sample rate high enough to capture as many sample points as possible on a rising or falling edge. In addition, the instrument should have enough bandwidth to ensure that the high frequency nonmonotonic transition is not attenuated. The instrument with a sample rate of 10 GS/s and a bandwidth of 3 or 4 GHz, such as the TDS694C instrument and TDS7404 Digital Phosphor Instrument, respectively, is the ideal tool for monotonicity testing.

The application coupled with a high performance instrument automates the process and ensures repeatability of test results.

Configuring a Measurement

To access the Configure: Measurement, go to Measurements> Configure. The application also provides a Configure option with each measurement area to allow you to configure the selected measurements.

NOTE: If you select the Run button before configuring a measurement, the application displays the message 'The selected measurements have not been configured. Do you want to continue?' In this case, the application runs with the default settings.

If you select the Run button before configuring the measurement and have enabled the File> Preferences> General option, the application displays the warning message 'Warn if configuration was not changed since last run, when the run button is pressed.'

Configuring Signal Quality Measurements

Be sure to select the relevant measurements before configuring them. To access the Measurement: Configure, go to Measurements> Configure. There are two tabs for the Signal Quality Measurements: Configure and Source.

The Configure tab allows you to set the voltage value on Vbus and the unit under test. The Vbus can be entered manually or probed from a channel that is captured from the test fixture. Select this option from the Source tab of Inrush Configuration menu.

For Low Speed and High Speed signals, you can set Test Point to Near End or Far End. For Full Speed signals, you can set the Test Point to Far End only.

For Rise Time, Fall Time, and Monotonic Property, you can configure the measurement levels.

The Source tab allows you to select the Source of the signal: a live signal or the signal from a file. For a live signal there are two options: Differential and Single-Ended. For Low Speed and Full Speed devices, you can test only single-ended signals (D+ and D–). For High Speed devices, it is recommended that you use a differential probe.

Figure 2-12 shows the Configure tab for configuring a low speed signal quality measurement.
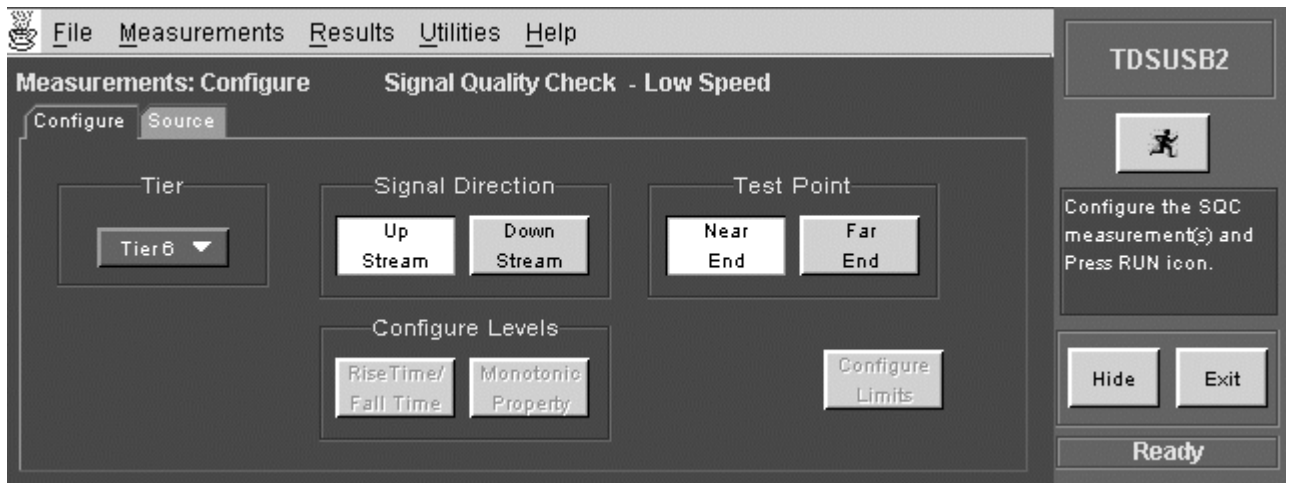

Figure 2- 12: Configure tab for a low speed signal quality measurement

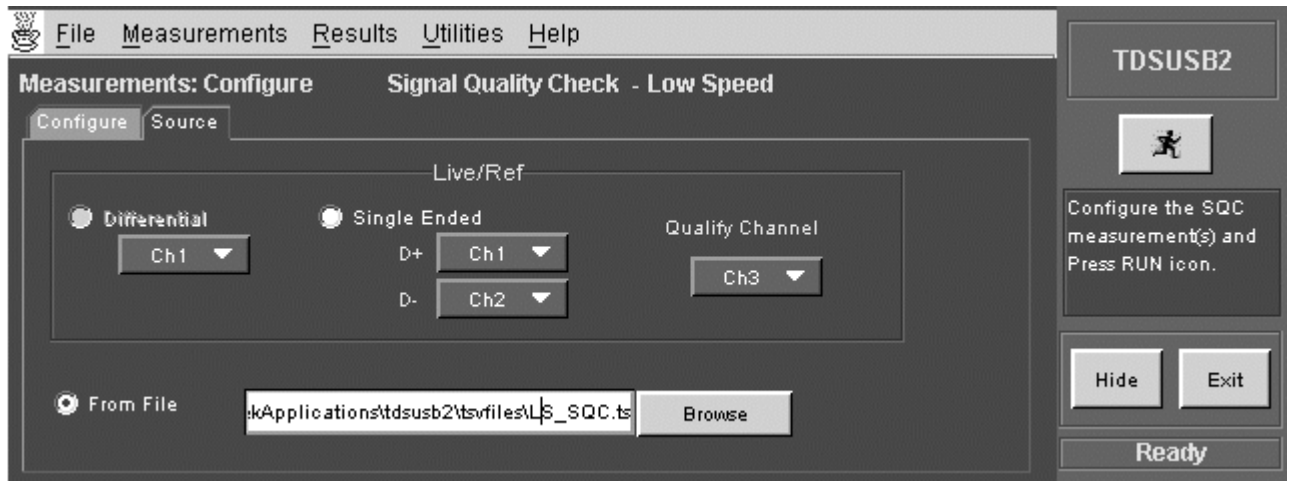Figure 2-13 shows the Source tab for configuring a low speed signal quality measurement.

Figure 2-13: Source tab for a low speed signal quality measurement

Signal Quality Configuration Options: Table 2-7 lists the configuration options for the signal quality checks with a brief description of each.

Table 2-7: Signal quality configuration options

Option	Description
Tier	From where the signal is acquired, Tier 1 to Tier 6
Signal Direction	Direction of the signal, Upstream or Downstream
Test Point	Position at which the signal is acquired, Near or Far End

Configure Levels
  Rise/Fall Time
  Monotonic Property (For High Speed devices only)
	Configures the range of measurement levels for Rise Time, Fall Time, and Monotonic Property tests by changing the measurement levels for each.

Configure Limits	Configure the measurement limits by changing the maximum and minimum extents within valid values

Source	Live:
	  Differential
	  Single Ended- D+, D –
	  Qualifier
	Ref:
	  Differential
	File:
	  From a .tsv file

NOTE: The USB2.0 specifications recommend that you test the signal quality for upstream and downstream traffic. In upstream testing, the application captures the signals transmitted from the device to the host. In downstream testing, the application captures the signals transmitted from the host to the device.

Downstream testing is performed on ports of a hub. When testing a hub, you need to connect the USB2.0 unit to Tier 6 to ensure the worst case. Each hub level is referred to as a Tier. The hub under test is plugged into Tier 5, so that you can test the hub on the Tier 6.

See Also

Signal Quality Check on page 41

Configuring Inrush Current Measurements

To access the Measurements: Configure menu, go to the Measurements> Configure.

The Configure tab allows you to set the voltage value on V$_{BUS}$ and unit under test. Tier1 is always used for testing. The unit under test can be any one of the following types:

- Hot Plug Attach

- Low Powered Configure

- Low Powered Resume

- High Powered Configure

- High Powered Unconfigure

- High Powered Resume

The Hot Plug Attach is the most common unit under test. The Source tab allows you to select the Source of the signal: a live signal or the signal taken from a tsv file. If you choose to manually enter the V$_{BUS}$ voltage, you cannot select the V$_{BUS}$ voltage source.

Figure 2-14 shows the Configure tab for configuring an inrush current measurement.
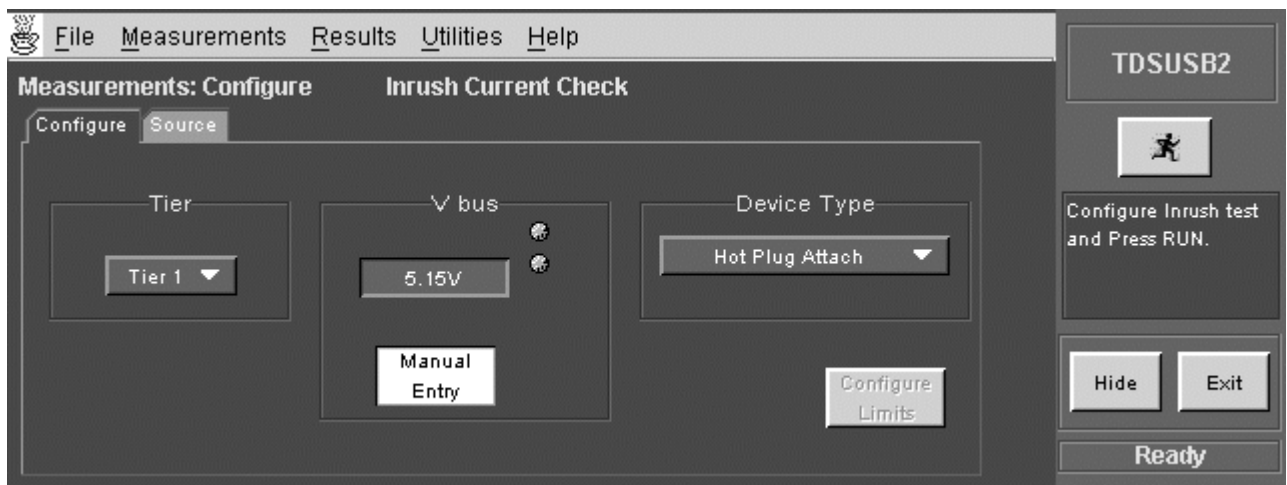

Figure 2-14: Configure tab for an inrush current measurement

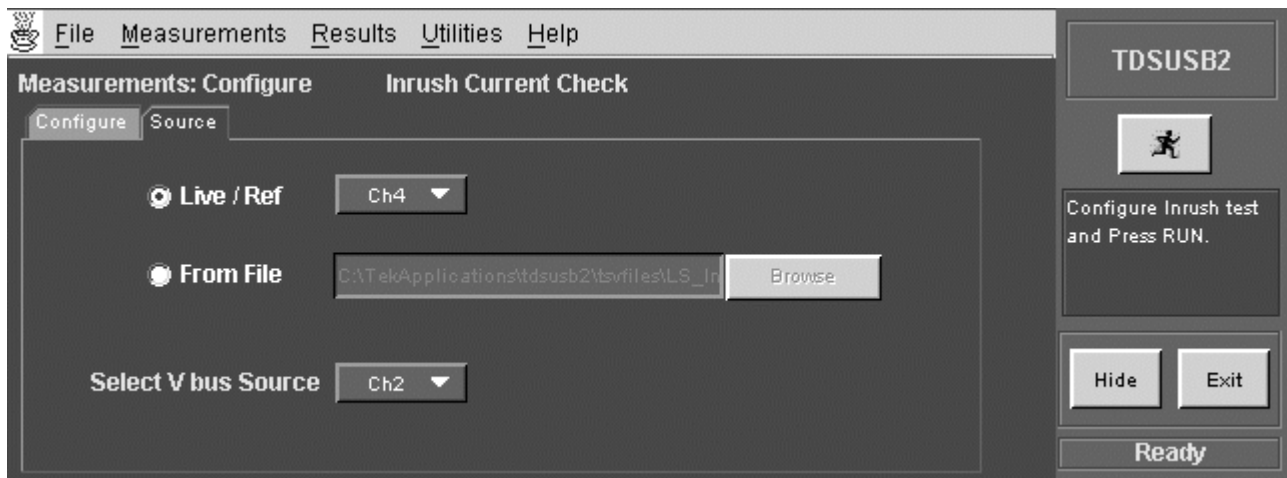Figure 2-15 shows the Source tab for configuring an inrush current measurement.

Figure 2-15: Source tab for an inrush current measurement

Inrush Configuration Options: Table 2–8 lists the configuration options for the inrush current measurement with a brief description of each.

Table 2-8: Inrush current configuration options

Option	Description
Tier	Tier from where the signal is acquired, Tier 1
V$_{BUS}$ (Manual)	Supply Voltage that is, the V$_{BUS}$ can be entered manually or probed from a channel which is captured from the test fixture. You can select from the Source tab of Inrush Configuration menu.
Device Type	Select the type of unit under test from the following: Hot Plug Attach, Low Power Configure, Low Power Resume, High Power Configure, High Power Unconfigure, High Power Resume

Source	Live:
	    Differential
	    Single Ended- D+, D-
	    Qualifier
	Ref:
	    Differential
	File:
	    From a .tsv file

Configure limits	Configure the measurement limits by changing the maximum and minimum limits within valid values, if you select this option in the Preferences menu
V$_{BUS}$ (Source)	Source of the V$_{BUS}$ voltage. This is applicable only if the value is not entered manually

See Also

Inrush Current Check on page 41

Configure Inrush Current Measurement Menu Parameters on page 140

Configuring Droop Measurements

Select the Droop measurement and configure it. To access the Configure: Measurements menu, go to Measurements> Configure.

The Configure tab allows you to select the Port (Port 1 through 7), Hub and Source of the signal. The source of the signal can be live or from a .tsv file. The hubs can either be Self powered or Bus powered.

Figure 2-16 shows the configuration menu for configuring an inrush current measurement.
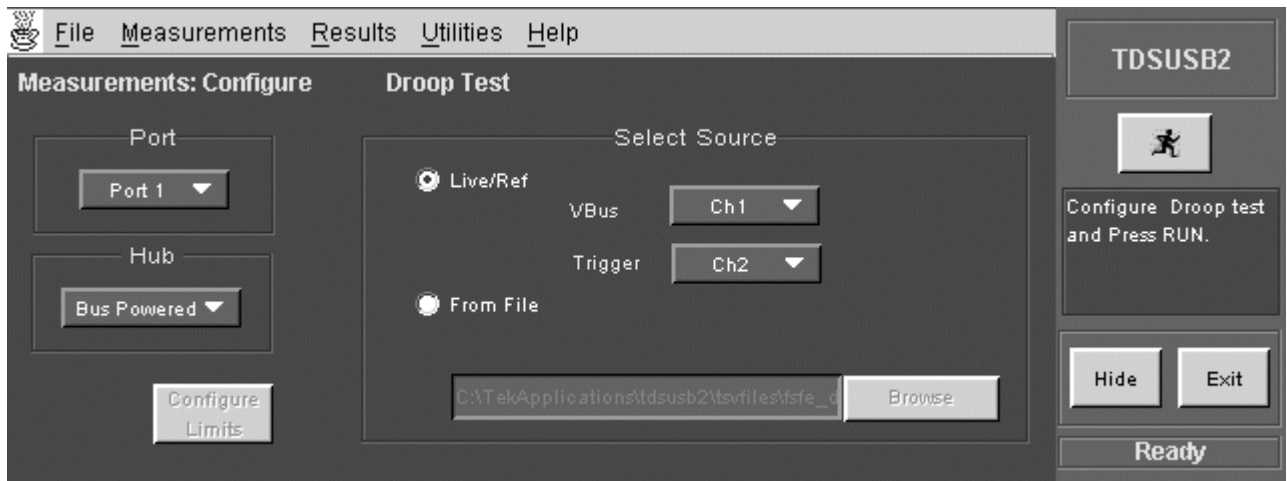

Figure 2-16: Configuration screen for the droop test

Droop Configuration Options: Table 2–8 lists the configuration options for the Droop measurement with a brief description of each.

Table 2-8: Droop configuration options

Option	Description
Port	Port of the unit under test (hub) from where the signal is acquired, Port 1 to Port 7
Hub	Selects the hub from the following: Self Powered or Bus Powered
Source	Source of signal, whether Live/Reference or stored signal is used. Stored signal is taken from a file
Configure Limits	Configures the measurement limits by changing the maximum and minimum limits within valid values if you have selected this option in the Preferences menu

See Also

Droop Test on page 42

Configuring Receiver Sensitivity Measurements

To configure receiver sensitivity measurements, follow these steps:

1. To access the Configure Measurements menu, go to Measurements> Configure.

2. Select the Receiver Sensitivity measurement.

3. Select the Source from Ch1 to Ch4.

4. Select OK and follow the on-screen prompts to perform the tests.

5. To generate reports, select Utilities>Report Generator.

Figures 2-17 through 2-21 show the steps in performing a receiver sensitivity measurement.
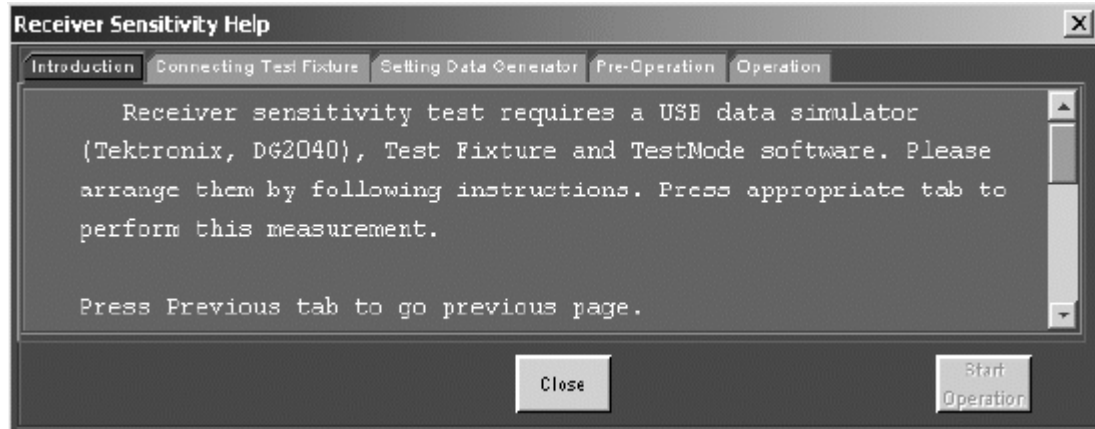

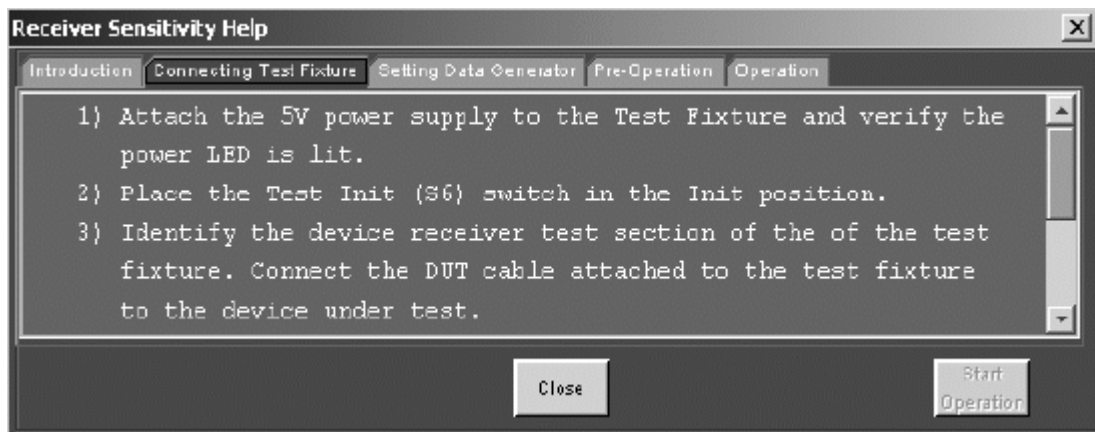**Figure 2-17: Steps in performing the receiver sensitivity measurement**

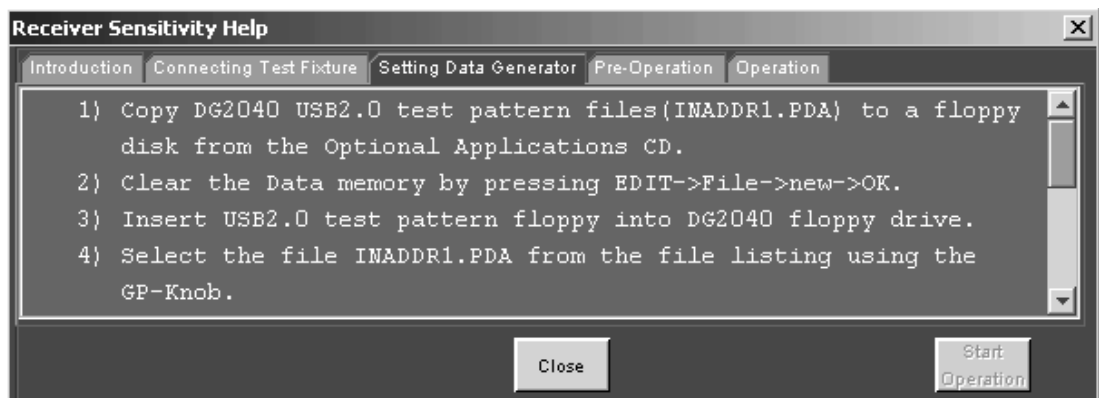**Figure 2-18: Steps in performing the receiver sensitivity measurement**

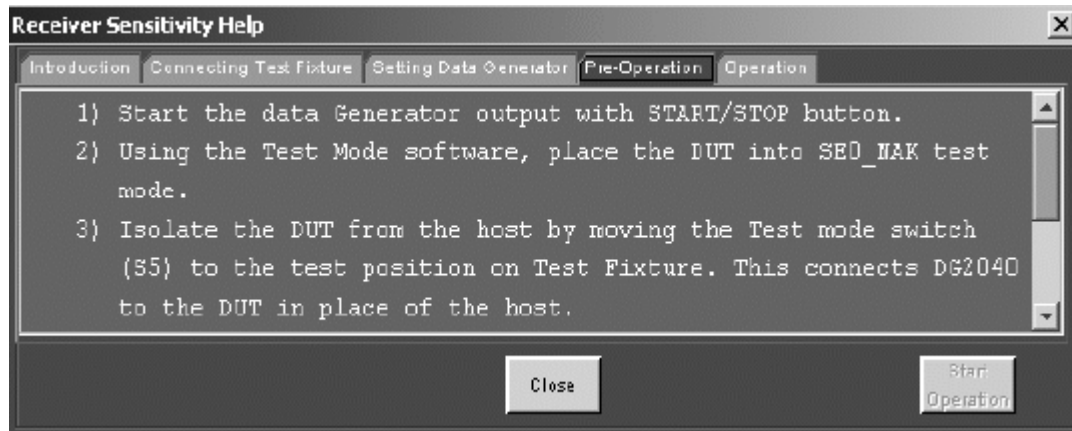**Figure 2-19: Steps in performing the receiver sensitivity measurement**

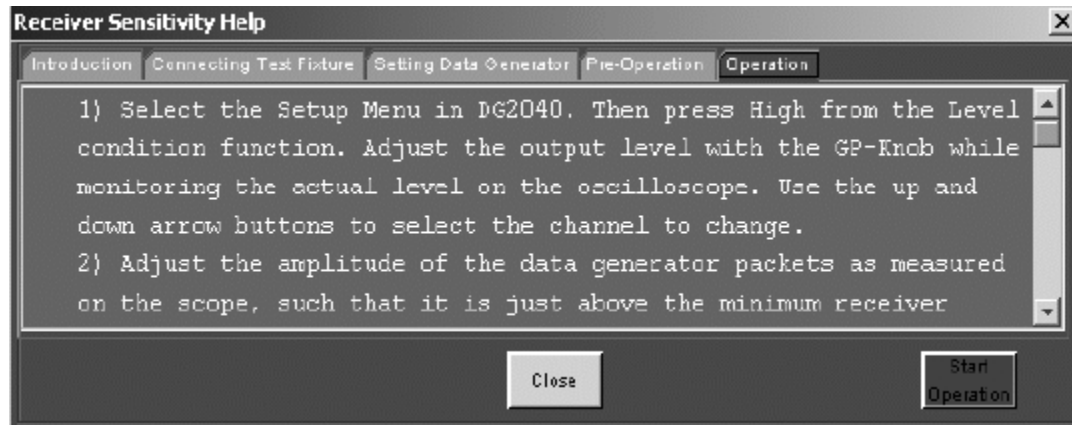**Figure 2-20: Steps in performing the receiver sensitivity measurement**

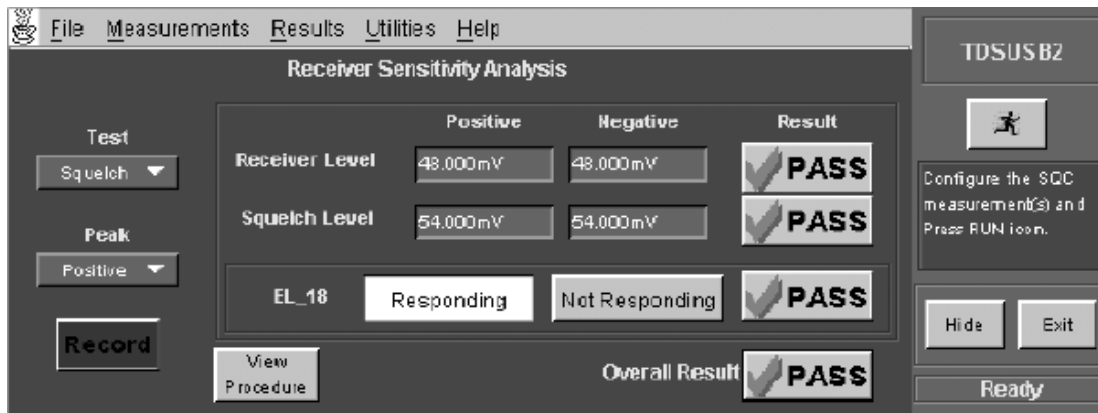**Figure 2-21: Steps in performing the receiver sensitivity measurement**

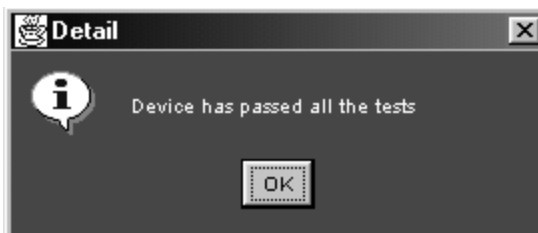**Figure 2-22: Configuration screen for the receiver sensitivity measurement**

Figure 2-23 Receiver Sensitivity Details

See Also

Receiver Sensitivity Test on page 43

Configuring Chirp Measurement

To configure receiver sensitivity measurements, follow these steps:

1. To access the Configure Measurements menu, go to Measurements> Configure. Select the chirp measurement.

2. Select the channel source for D+ and D– from Ch1 to Ch4.

3. Select OK.

Figure 2-24 shows the configure menu for the chirp test.
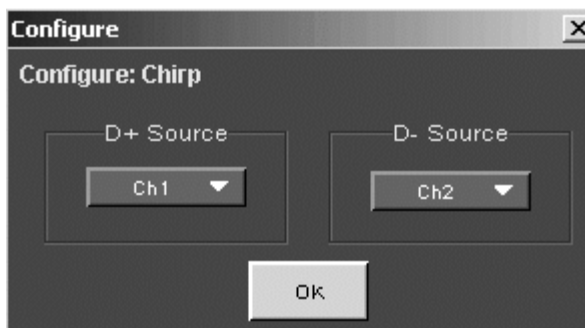
Figure 2-24: Configuration screen for the chirp test

See Also

Chirp Test on page 44

Taking Measurements

Acquiring Data

The application automatically sets the instrument settings for the selected measurements. To acquire data from the instrument, follow these steps:

1. Select the 🏃 command button to run the application.

2. The application displays the message 'Please press OK when correct waveform is acquired' for live signals**.**

Figure 2-25 shows the how to the confirmation screen to acquire data.

Figure 2-25: Confirming a waveform

3. If you select the Cursor Mode, the application displays the message 'Place the Cursors at the start and end position of the USB packet. Press OK when done.'

Figure 2-26 shows the how to the place the cursors at the start and end positions of a USB packet.

Figure 2-26: Placing cursors

4. If you select the Inrush measurement, the application displays the message in the next figure.

Figure 2-27 shows the how to confirm a waveform while acquiring data for an inrush test.

Figure 2-27: Confirming a waveform while acquiring data for inrush test

5. If you select the Droop measurement, the application displays the message in the next figure.

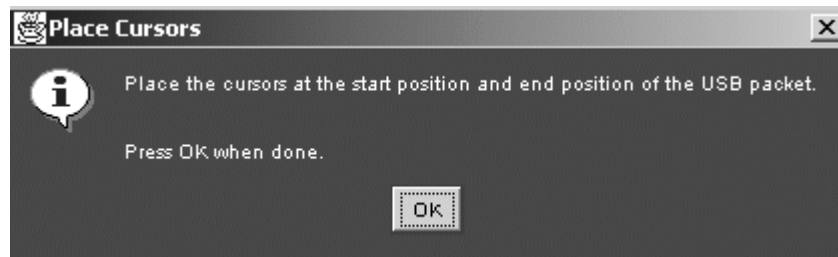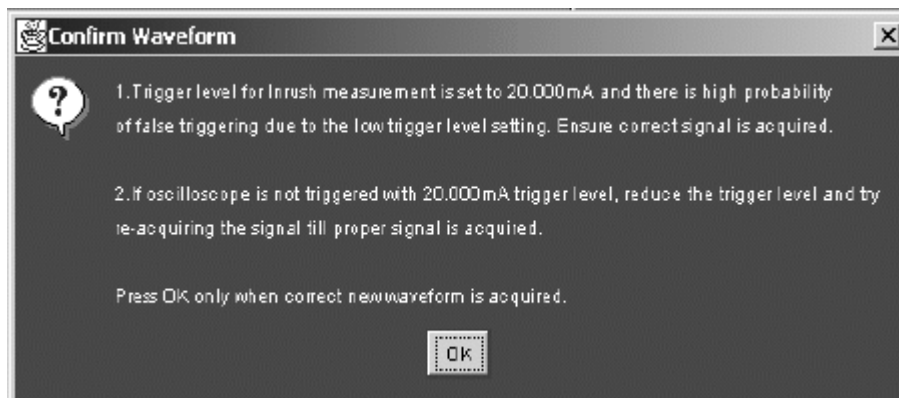Figure 2-28 shows the how to confirm a waveform while acquiring data for a droop test.
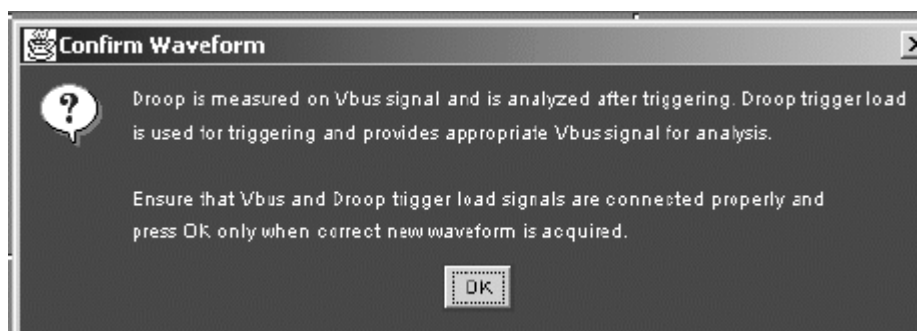
Figure 2-28: Confirming a waveform while acquiring data for droop test

6. The application automatically displays the result after acquiring the data.

7. The application automatically displays the eye diagram and the waveform plot for the acquired signals if you enable this option in the Preferences> General.

NOTE: You can modify the automatic instrument settings if there is no valid waveform on the TDS7000, TDS6000, TDS5000 series and TDS694C instrument screen. To do so, select the ⚡ command button to run the application. and select OK to complete the process. Since the TDS5052 instrument does not support the application, the above process is invalid.

Tip You may need to adjust the inrush setups, as inrush currents have a wide variety of durations and peak currents. Use the vertical division settings between 100 mA/division to 5 A/division and timebases between 500 ns/div and 20 µs/division. If you set a timebase higher than 20 µs/division, adjust the instrument's record length to have minimum acquisition duration of 20 µs.

Control Menu   Figure 2-29 shows the Control menu for the application.
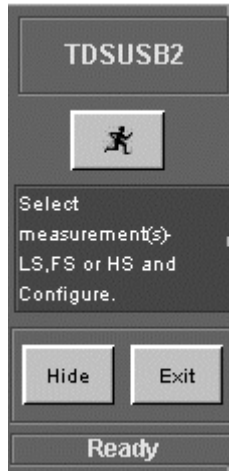
Figure 2-29 : Control menu

Table 2–9 lists the control menu options with a brief description of each.

Table 2-9: Control menu options

Option/button	Description
Run icon	Runs the application
Hide button	Hides the application and displays the instrument application on the entire screen
Exit button	Exits the application

See Also

Control Menu Parameters on page 143

Viewing Results

You can view the results in a summary form or in a detailed form. To access Results: Summary, select Results> Summary. The application displays one of the following results.

PASS A PASS indicates that the results of the measurements comply with the USB2.0 specifications.

FAIL A FAIL indicates that the measured values of the measurements are beyond the waiver limits and do not comply with the USB2.0 specifications.

⚠PASS A Conditional PASS indicates that the limits of the tests are within the USB2.0 waiver limits.

NOTE: The application displays PASS or FAIL, based on the limits you set.

To access Details: select Results> Details. Use the scroll bar to view the results that are not visible within the display window. The report contains statistical values for the following:

- Standard deviation (StdDev)

- Peak-to-peak (Pk–Pk)

- Root mean square (RMS)

- Maximum (Max) and minimum (Min) values

- Population (the number of cycles used to calculate the statistics). The population used for signal rates is number of bits.

- Status (PASS/FAIL/Conditional PASS) for the selected tests

You can also view the eye diagram and the waveform plot for signal quality check.

Eye Diagram

You can select the Eye Diagram option to view the Eye Diagram for the unit under test. The eye diagram has the Zoom and Cursor features that you can use to view the results. You can also use the Reset button to reset the default eye pattern.

The Eye Diagram menu contains the following options:

Zoom: You can select Zoom from the menu. Select the icon ⊕ to zoom into the area of interest. Define the area of interest using the mouse and selecting the zoom in area. The selected area is displayed in the entire upper half of the instrument. Select the ⊖ icon to zoom out. You can use the Zoom In and Zoom Out icons until the application reaches the maximum and the minimum zoom limits.

Figure 2-30 shows the eye diagram that is generated.

Figure 2-30: Eye diagram

Figure 2-31 shows a zoomed in section of the eye diagram.
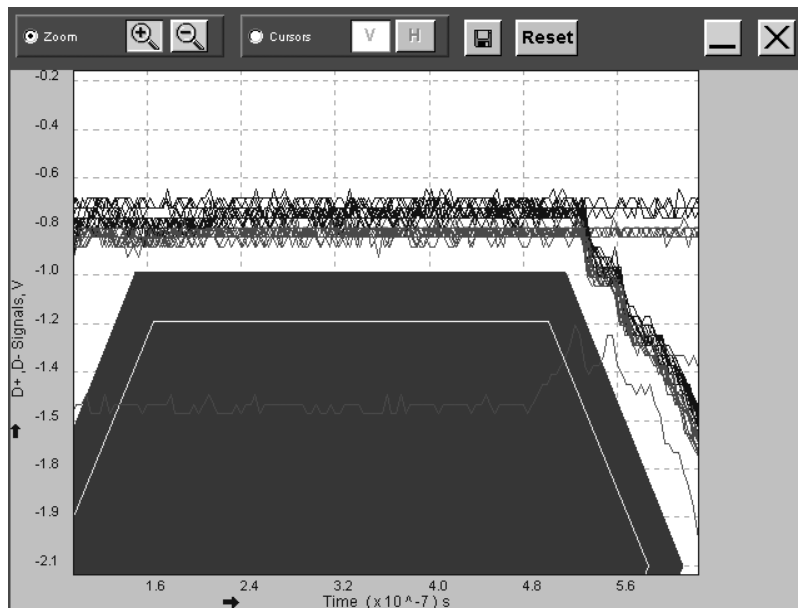
Figure 2-31: Zoomed in section of the eye diagram

Cursors: You can select Cursors and the vertical cursors [Cursors V H] appear. You can drag the cursors to change the positions, and read time values on the X-axis.

Use the mouse to select the Horizontal cursor [Cursors V H]. You can drag the cursors to change the positions, and read voltage values on the Y-axis.

Waveform Plot

You can select the Waveform Plot option to view the Waveform Plot for the unit under test. The Waveform Plot has a Zoom/Cursor feature that you can use to view the results.

The Waveform Plot has features that enable you to zoom in and out on the waveform, use Vertical and Horizontal Cursors, Save the Plot, Reset the original plot, and select to display the signals. To display any or all the signals for the waveform plots menu, use the following options:

Zoom: You can select Zoom from the menu. Select the [⊕] icon to zoom into the area of interest. Define the area of interest using the mouse and selecting the zoom in area. The entire upper half of the instrument displays the selected area. Select the [⊖] icon to zoom out. You can use the Zoom In and Zoom Out icons until the application reaches the maximum and the minimum zoom limit.

Figure 2-32 shows the corresponding waveform plot for the eye diagram that is generated.
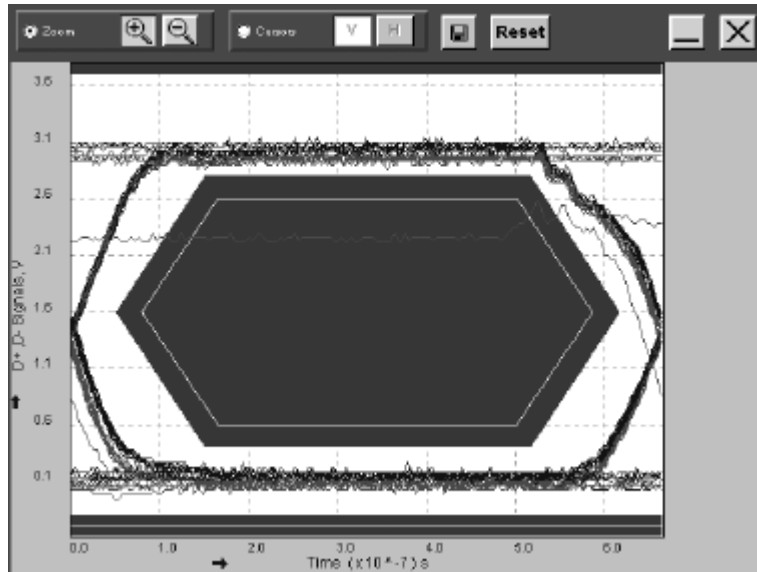

Figure 2-32: Waveform plot

Cursor: You can select Cursors and the vertical cursors [🔘 Cursors | V | H] appear. You can drag the cursors to change the positions of the cursors, and read time values on the X-axis.

Figure 2-33 shows the waveform plot with the vertical cursors.

Figure 2-33: Waveform plot with the vertical cursors

You can select the Horizontal cursors [🔘 Cursors | V | H]. You can drag the horizontal cursors to change the positions, and read voltage values on the Y-axis.

NOTE: The Zoom and Cursor options are mutually exclusive.

Save: You can use the save button to save the zoomed in or zoomed out diagram as a .jpg file.

Reset: You can use Reset button to restore the waveform plot to its original display.

For waveform plots, any or all the signals can be displayed using the following buttons:

- D+ [D+] : Use this button to turn on or off the display of the D+ signal.

- D– [D-] : Use this button to turn on or off the display of the D– signal.

- CMD [CMD] : Use this button to turn on or off the display of the Common Mode voltage.

- Diff **Diff** : Use this button to turn on or off the display of the Differential signal.

You can use any combination of the Zoom or Cursors, D+, D–, CMD (Common Mode Voltage) and Diff buttons to view and save the waveform plot.

The annotations at the lower edge of the Waveform Plot classify the signal pulse into different bus states: J, K , E (EOP), I (IDLE) and Sync (C).

There are two Results menu options.

Summary: The application summarizes the results of the measurements. The results are classified as PASS, FAIL and Conditional PASS. Click on PASS, FAIL, and Conditional PASS. The dialog box shows the Measured Mean, USB2.0 Specifications and the Waiver Limits.

Figure 2-34 shows the details of the test when you click on one of the result buttons.
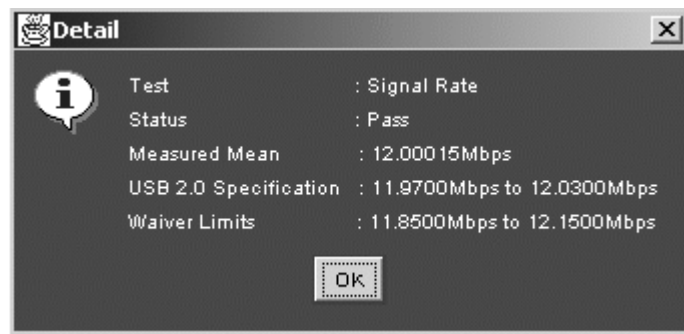
Figure 2-34: Individual details of the test result

Details: The application displays results of the completed tests in a tabular form. Figure 2-35 shows the result details of the selected tests.
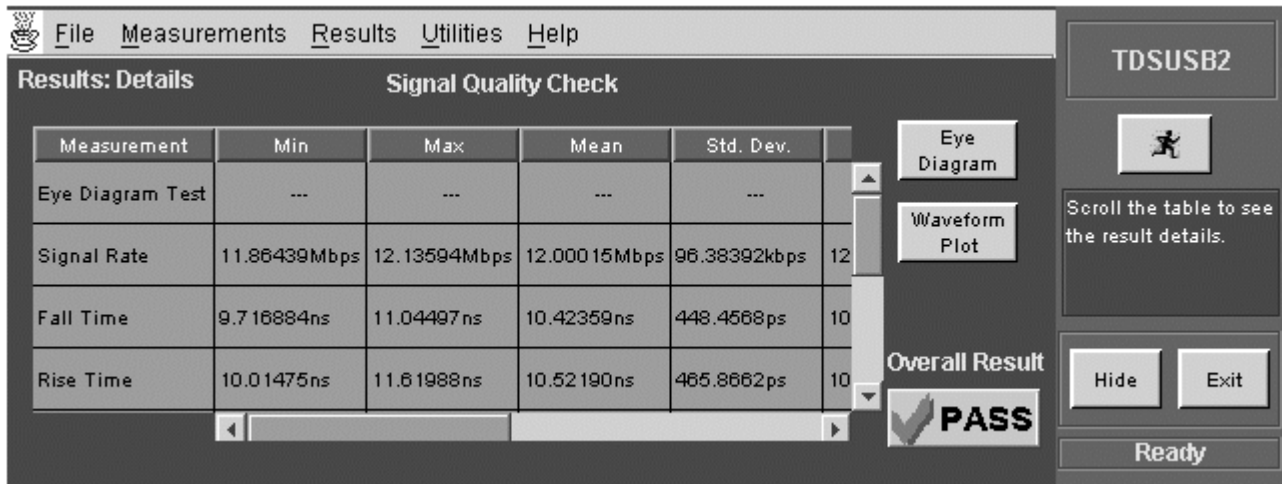
Figure 2-35: Result details of the selected tests

NOTE: The application displays the user column in Results Details only if the User Configurable Limits are selected in File> Preferences> Advanced tab.

The application disables the Results> Summary and Report generation in Plug-Fest Specific format when you enable Configure Test Limits.

Configure Limits

The application displays the maximum and minimum values for the selected tests. You can use the '>' sign on the keypad to configure limits for these options.

Figure 2-36 shows the Configure Limits menu.
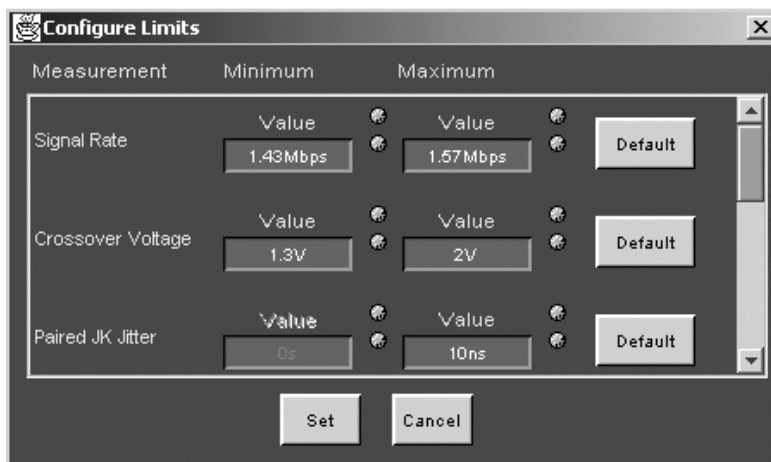
Figure 2-36: Configure limits menu

Table 2–10 lists the Configure Limits menu options with a brief description of each.

Table 2-10: Configure limits menu options

Option	Description
Set	Sets the values you enter
Default	Restore the default values
Cancel	Cancels all the changes you enter

NOTE: The application enables the Configure Limits values when you select the option File> Preferences> Advanced menu.

Report Generation

Generating Reports   To access the Report Generator menu, select Utilities> Report Generator. You can generate reports in any one of the three formats:

- Tektronix Specific is the format that is used by the TDSUSB2 application. This is the default format.

- Plug-Fest format is the format used by the USB-IF.

- CSV format report is a user defined report generated in a comma separated variable format.

Figure 2-37 shows the Report Generator menu.

Figure 2-37: Report generator menu

You can generate reports in one of the following modes:

Manual: Select the report format, the directory name, and the file to which the report is saved. Select the Generate option to generate the report. You have to specify the file name for the report.

Automatic: The application generates reports automatically without user intervention as soon as the results are calculated. Select Generate Automatic Ids to enable this option while selecting measurements. The application uses the prefix that you enter to generate the file. The reports are generated in the following path:

C:\TekApplications\tdsusb2\report. The file name is prefix_reportformat_001.csv or prefix_reportformat_001.htm.

The report contains the device ID, device description, date and result of the test. The report also contains following statistical values:

- Maximum (Max) and minimum (Min) values

- Mean

- Peak-to-peak (Pk–Pk)

- Standard deviation (StdDev)

- Root mean square (RMS)

- Population

- Status (PASS/FAIL/Conditional PASS) for the selected tests

- User- The application displays this value if you select the "Allow user configuration of test limits" in the Preferences menu and set the test limits before running the measurement

The report includes the eye diagram and waveform plots for Signal Quality Check. If you are running the application using the TDS5000, TDS6000, TDS7000 series of instruments, the display on the instrument screen is embedded in the Inrush/Droop report. If you are running the application on a PC connected to the TDS694C instrument, there will be no images in the report.

NOTE: Automatic Report generation is not available if you select the Drop Test read out option in File> Preferences> Advanced tab.

Table 2–11 lists the report generator configuration options with a brief description of each.

Table 2-11: Report generator configuration options

Option	Description
Report Format	Select any one of the report formats
Generation Mode	Select a report generation mode: Automatic or Manual
File	Enter/browse the name of the report file
Generate	Used to generate the report in the manual mode

Viewing Reports

You can use an HTML viewer or a browser to view the Tektronix specific and Plug-Fest format reports. You can view the .csv (Comma Separated Variable) report in a text editor, spreadsheet, database, or data analysis program for further analysis. You can edit the .csv file to suit your needs.

NOTE: All reports contain the Eye Diagram and Waveform Plot except for the reports generated in the .csv file format.

View Reports

To view the report file in a text editing application, such as Wordpad, follow these steps:

1. From the Windows tool bar, select Start> Programs> Accessories> Wordpad.

2. Select File> Open.

3. Locate the C:\TekApplications\tdsusb2\reports directory.

4. Select All Documents (*.*) for the Files of Type.

5. Select the results .csv file and open.

You can also import the .csv file to a DOS–based personal computer and then view the file with a spreadsheet, database, or a data analysis program.

TSV File Generator

You can use the TSV File Generator Utility to convert a .csv (Comma Separated Variable) file to a .tsv (Tab Separated Variable) file. To access the TSV File Generator, go to the main menu and select Utilities> TSV File Generator.

Figure 2-38 shows the TSV File Generator menu.
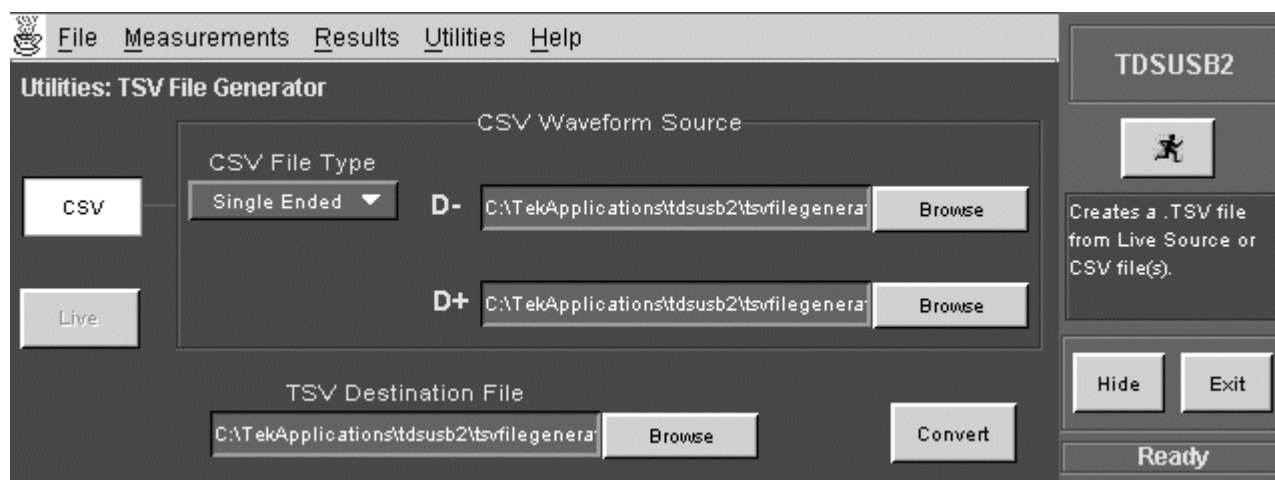
Figure 2-38: TSV file generator menu

If the Input is a .csv file, then the application enables the CSV Waveform Source area. You can select the sources based on the Signal type. For a single-ended signal, you have to specify the D+ and D– inputs.

You can specify the directory C:\TekApplications\tdsusb2\tsvfilegenerator for the differential signal from where the .csv file is taken.

If the Input is a Live signal, you cannot access the CSV Waveform Source area. Select the Live or Ref as the source file to enable the Live Input option. You can enable the Convert option only if you take the measurements and display the results. For the TDS5000, TDS6000, TDS7000 series of instruments, the default directory for the .tsv files is C:\TekApplications\tdsusb2\tsvfiles. You can also specify the location where the tsv file is to be generated.

TSV file format description

For Low Speed and Full Speed Signal Quality Check, the input TSV file is an m x 3 matrix with m rows and three columns. The file has Time values and Voltage values for D+ and D– in the first, second and third columns respectively.

The input TSV file for High Speed Signal Quality Check is a m x 2 matrix with m rows and two columns. The file has Time and Voltage values for Differential signals in the first and second columns.

The input TSV files for Inrush and Droop tests are an m x 2 matrix with m rows and 2 columns. For Inrush tests, the file has Time and Current values in the first and second columns. For Droop test, the file has Time and Voltage values in the first and second columns.

CSV file format description

Low Speed and Full Speed single-ended signals for Signal Quality Check require two .csv files to generate the corresponding TSV file. The .csv files have two columns. One .csv file has time and voltage values for D+ signals, while the second column has the time and the current values for D– signals. Both files must have the same time values.

Differential signals require one .csv file with two columns, one for time and another for voltage values.

If you select Differential for Inrush and Droop signals, the .csv file has two columns: one for time values, and another for current and voltage values. You require only one .csv file for Inrush and Droop tests. This .csv file has two columns: one for the Time Values and the other for Current (Inrush) and Voltage (Droop) values. You must use the Differential option for conversion.

Table 2-12 lists the TSV file generator configuration options with a brief description of each.

Table 2-12: TSV file generator configuration options

Option	Description
Input	Select the Input from the CSV file or a Live file
CSV Waveform Source	A file that is a waveform exported from the instrument in the .csv format. There are two separate .csv files corresponding to D+ and D- signals. You need only one .csv file for the Differential signals
Live	The waveform from the scope is directly taken and converted to a .tsv file
Signal Type	Select Signal Type: Single Ended or Differential
Diff	It is the path for Differential .csv file applicable when you select the Differential option
D+	It is the path for the Dplus.csv file applicable when you select the Single Ended option
D-	It is the path for the Dminus.csv file applicable when you select the Single Ended option
TSV Destination File	Name of the TSV file generated
Convert	Used to initiate the conversion process

Saving and Recalling Setups

How to Save and Recall a Setup

You can use the Save and Recall menus to save and recall various configuration setups. To access the Save and Recall menus, go to the File menu in the menu bar and choose Save or Recall.

NOTE: Do not edit the .ini or the .set files, or recall setup files generated by the application, since this can cause the application to become unstable. If you try to edit the.ini of the .set files, you get an error message 'The saved file has been corrupted and cannot be recalled'.

Saving a Setup

You can save various configuration setups and recall them when needed. To save the application settings to a setup file, follow these steps:

1. Select File> Save.

2. Select the Save button.

3. Browse or enter a file name. The application appends a .ini extension to the name of setup files.

4. Choose Save to save the setup or Cancel to cancel the action.

NOTE: In TDS5000, TDS6000, TDS7000 series of instruments, the application saves the instrument setup to a .set file. The application .ini files and instrument .set files have the same file name.

Recalling the Default Setup

To recall the application settings from the Default setup file, select File> Recall Default. The application recalls the default setup and displays the message 'Default setup recalled successfully.'

Figure 2-39 shows the message that is displayed when a default setup is recalled.

Figure 2-39 : Recalling a default setup

Recalling a Saved Setup

To recall the application settings from a saved setup file, follow these steps:

1. Select File> Recall.

2. Browse the directory C:\TekApplications\tdsusb2\setup to recall the .ini files or select the directory where you have saved the setup file.

3. Select or enter a .ini file name.

4. Choose Open to recall the setup or Cancel to cancel the operation.

NOTE: In TDS5000, TDS6000, TDS7000 series of instrument, the application recalls the instrument setup from a .set file.

Recently Saved Setup The application stores the last four saved setups. If you need to modify any of them, follow these steps:

1. Select File> Recently Saved.

2. Choose the setup from the list of recently saved setups that are displayed.

NOTE: When you select a file from the list of recently saved files menu, the file becomes the first element in the list of selections.

Recently Recalled Setup The application stores the last four recalled setups. If you need to recall any of them, follow these steps:

1. Select File> Recently Recalled.

2. Choose the setup from the list of setups displayed.

NOTE: When you select a file from the list of recently saved files popup menu, the file becomes the first element in the list of selections.

Exiting the Application

To exit the application, select the Exit button or File> Exit or select the Exit button from the control panel. Figure 2-40 shows the message that appears when you exit the application.
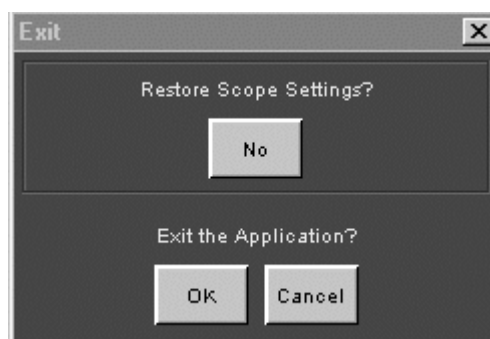
Figure 2-40: Exiting the application

In the TDS5000, TDS6000, TDS7000 of instruments, when you exit the application, you can select to keep the instrument setup currently in use with the application or to restore the instrument setup that was present before you started the application.

Tutorial

Introduction to the Tutorial

The tutorial teaches you how to set up the application by recalling a .tsv file, take measurements, and view the results. More operating information is available in the Operating Basics section. Before you begin the tutorial, you must do the following tasks:

- Start the application

- Recall a .tsv file

Starting the Application

To start the application from a TDS5000, TDS6000, TDS7000 instrument, File> Run Application> USB2.0 TestPackage. The application starts up and displays.

When taking measurements on a TDS694C instrument, connect the instrument to the PC on which the application runs. To start the application from the PC, select the USB2.0 Test Package desktop shortcut icon or through Start> Programs\TekApplications\USB2.0 TestPackage.

Recalling a .tsv File

The application distribution includes the tsv files used with this tutorial.

Table 3-1 shows the types of signals that represent these tsv files.

Table 3-1: TSV files and signal types

Tsv File name	Signal type
C:\TekApplications\tdsusb2\tsvfiles\FS_SQC.tsv	Full Speed
C:\TekApplications\tdsusb2\tsvfiles\HS_sqc.tsv	High speed
C:\TekApplications\tdsusb2\tsvfiles\LS_inrush.tsv	Low Speed

Taking a Full Speed Signal Quality Measurement

This section discusses how to take a Full Speed Signal Quality measurement, view the results, and generate a report. To perform these tasks, the application must be installed and enabled on the TDS5000, TDS6000 and TDS7000 instruments. View Installing the application on page 23 to install the application.

To take a Full Speed Signal Quality measurement, follow these steps:

1. To set the application to default values, select File> Recall Default. The application displays the 'Default setup recalled successfully.'

2. Select all the Signal Quality measurements in the Signal Quality Check area.
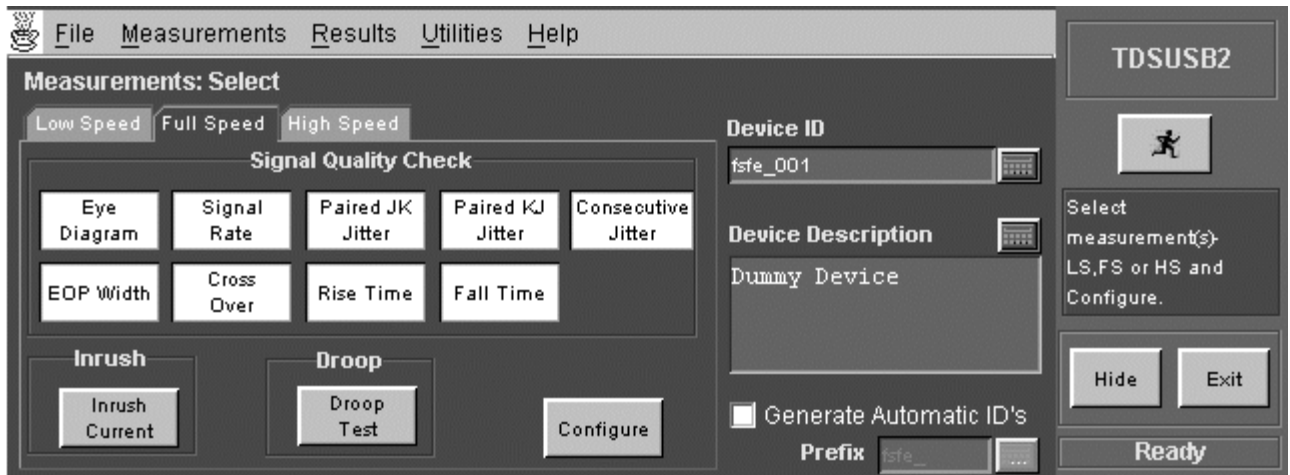
Figure 3-41: Selecting measurements: full speed signal quality

3. Select the Configure tab or select Measurements> Configure. The Measurements: Configure default settings display.
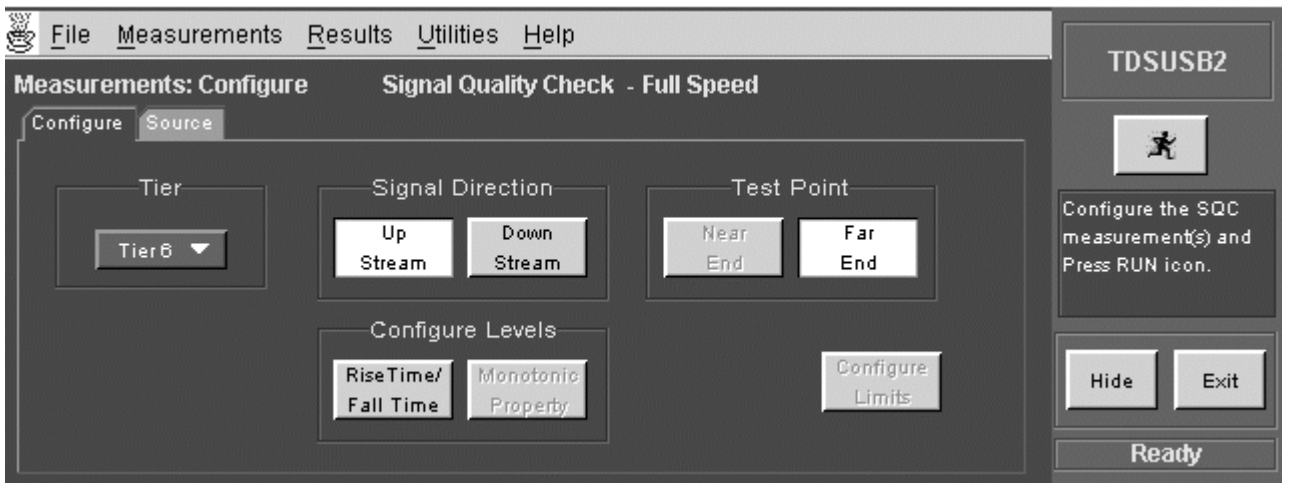
Figure 3-42: Configuring measurements: Configure tab

4. Select the Measurements: Source. If the source is Live or Ref, configure the appropriate channels for D+, D– and Qualifier. If the source is from the file, use the browse button to find the file. You have to always select D+ first. If you select any one of the Live channels CH1-CH4 for D+ source, the remaining Live channels are selected from the D– and the Qualifier channel source. If you select any one of the Ref channels Ref1-Ref4 for D+ source, the remaining Ref channels are selected from the D– .There is no Qualifier channel source for the Ref signals.
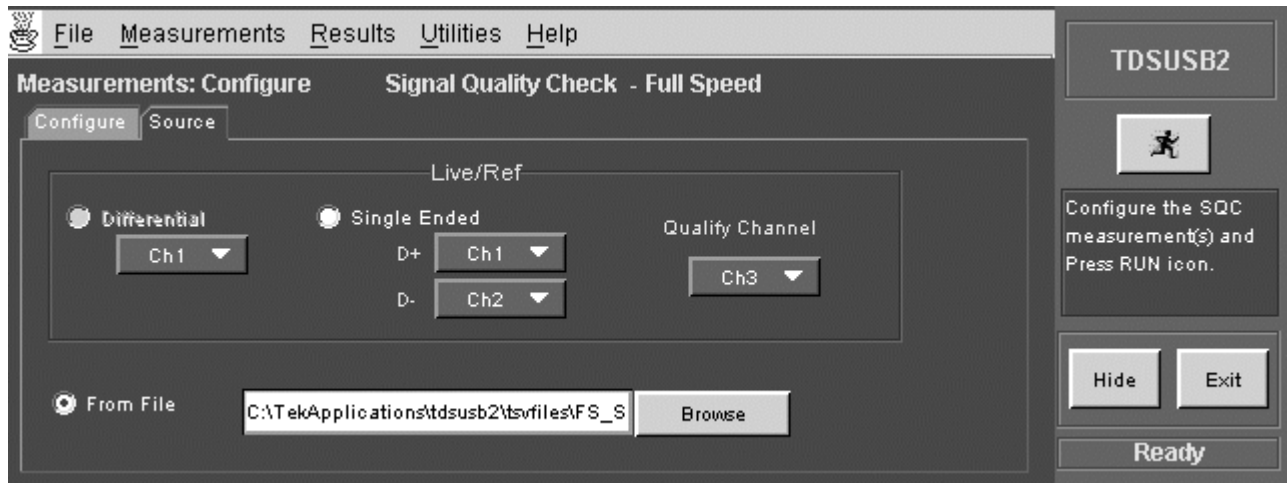
Figure 2-43: Configuring measurements: Source tab

5. Select the file C:\TekApplications\tdsusb2\tsvfiles\FS_SQC.tsv.

6. Select the ⚘ command button to run the application. The application displays the Eye Diagram and the Waveform Plot.
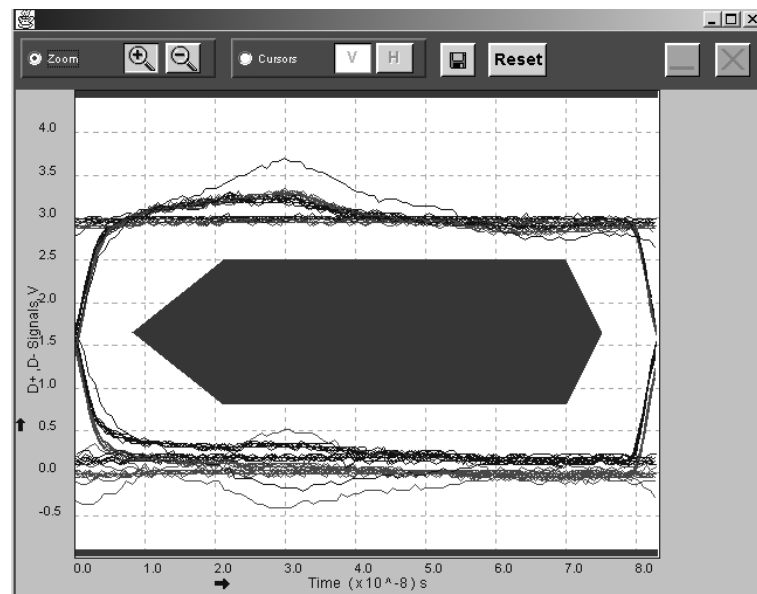
Figure 2-44: Eye diagram
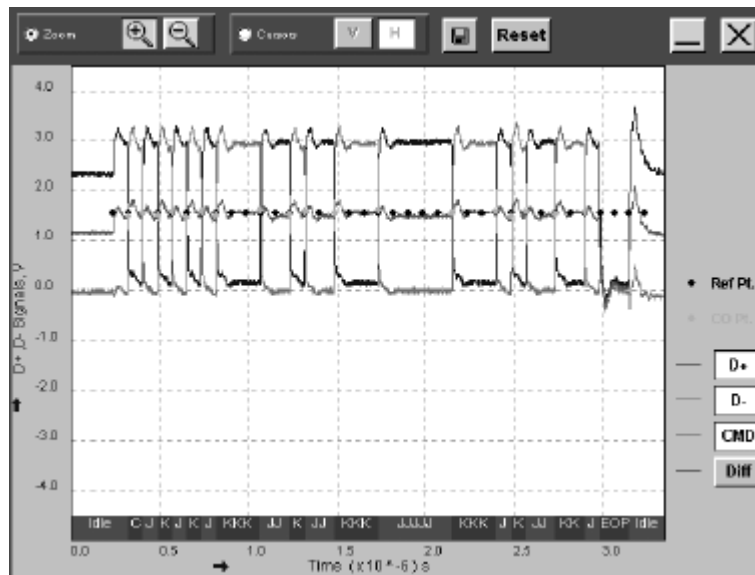
Figure 2-45: Waveform plot

7. Minimize the eye diagram and the waveform plot to view the summary results.

8. The application displays the Results Summary as PASS ✔**PASS**. You can also click on the result to view the details of the selected test.

9. To view the Results Details, select Results> Details in the application menu bar or PASS command button in the Overall Result area to view the details of each measurements.
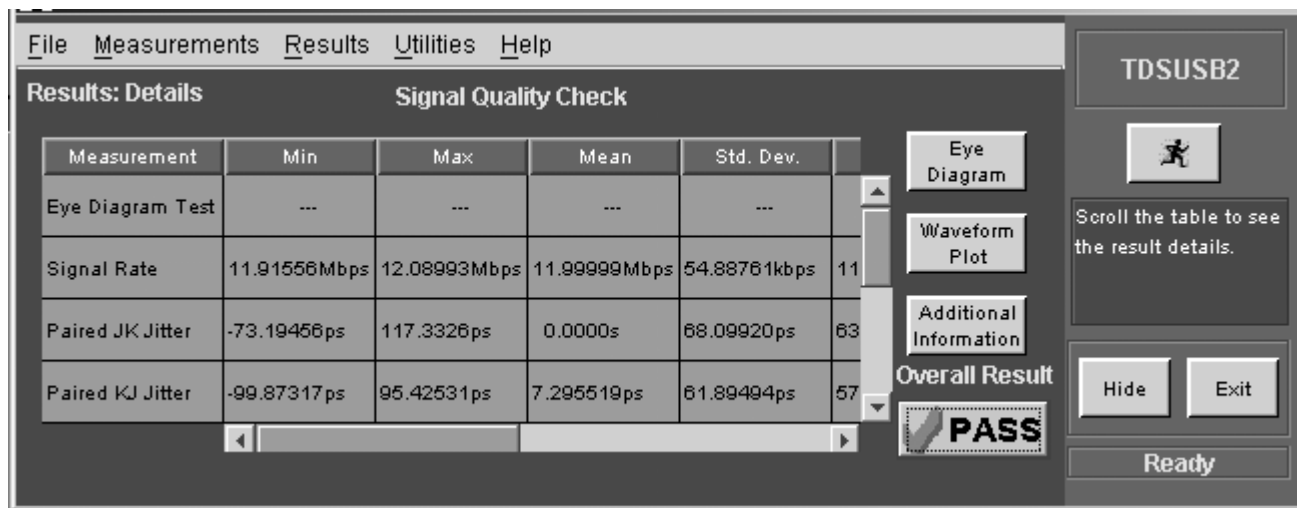
Figure 2-46: Results: Details

10. Select Utilities> Report Generator in the application menu bar to generate the Report.

11. You can view the default screen with the Tektronix Specific Format enabled. The report directory appears with a default file name. You can change the file name if you want. Click on the Generate button.
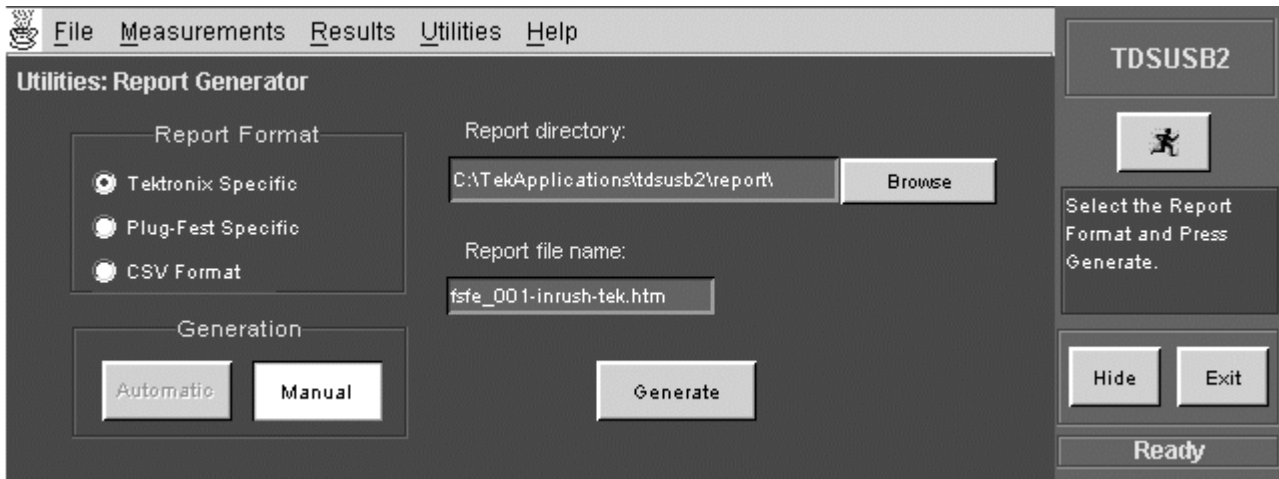
Figure 2-47: Utilities: Report Generator

12. The application generates an HTML file in C:\TekApplications\tdsusb2\report. To view this report, open it in an HTML viewer or a browser.
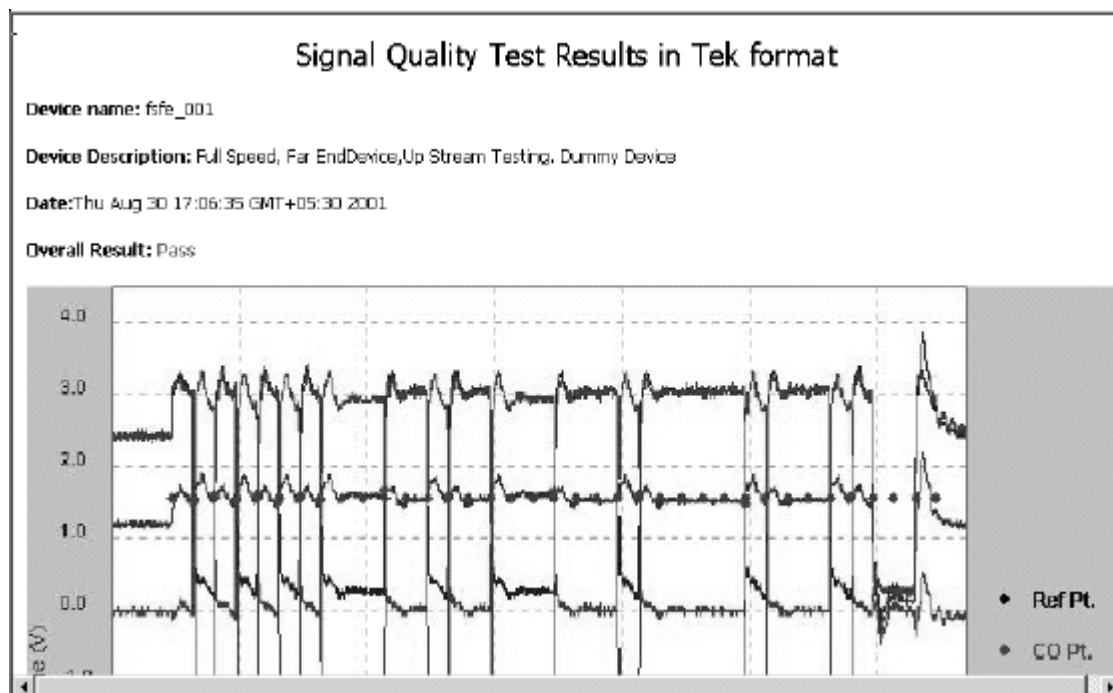
Figure 2-48: View report

Note:If you select Rise Time and Fall Time option in the default panel, the application displays these values as additional information in Full Speed Signal Quality reports. Rise Time and Fall Time options are not an input for the pass/fail criteria.

Taking an Inrush Measurement

This section discusses how to take a Low Speed Inrush Current Measurement, view the results, and generate a report. To perform these tasks, the application must be installed and enabled on the TDS5000, TDS6000, TDS7000 instruments.

1. To set the application to default values, select File> Recall default. The application displays the message 'Default setup recalled successfully.'

2. Select Measurements> Low Speed tab.

3. Select Inrush Current measurement.
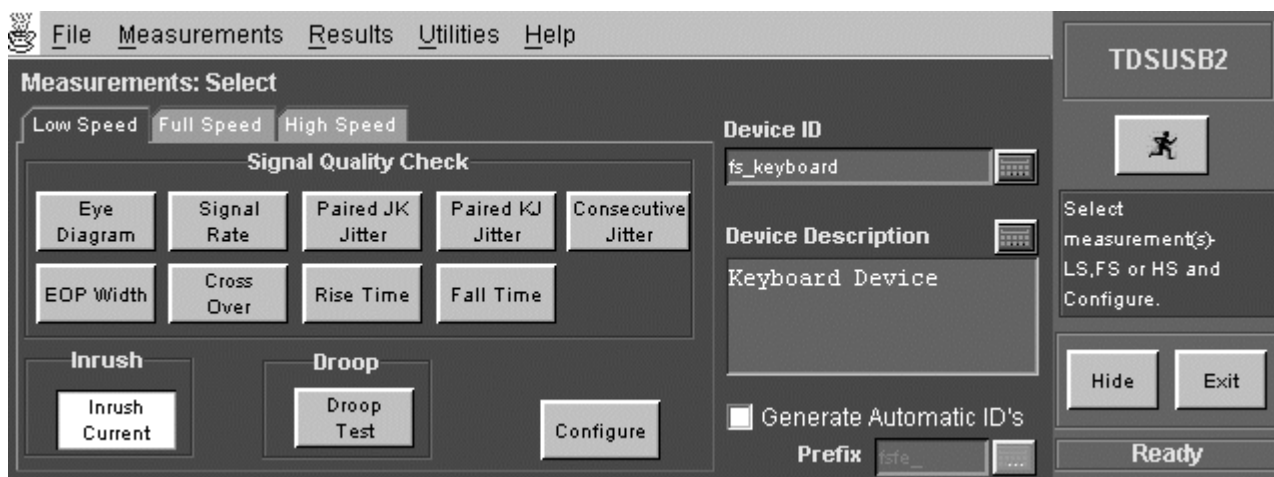
Figure 2-49: Selecting measurement: Low speed inrush current

4. Select Measurements> Configure tab and use the default settings set by the application.
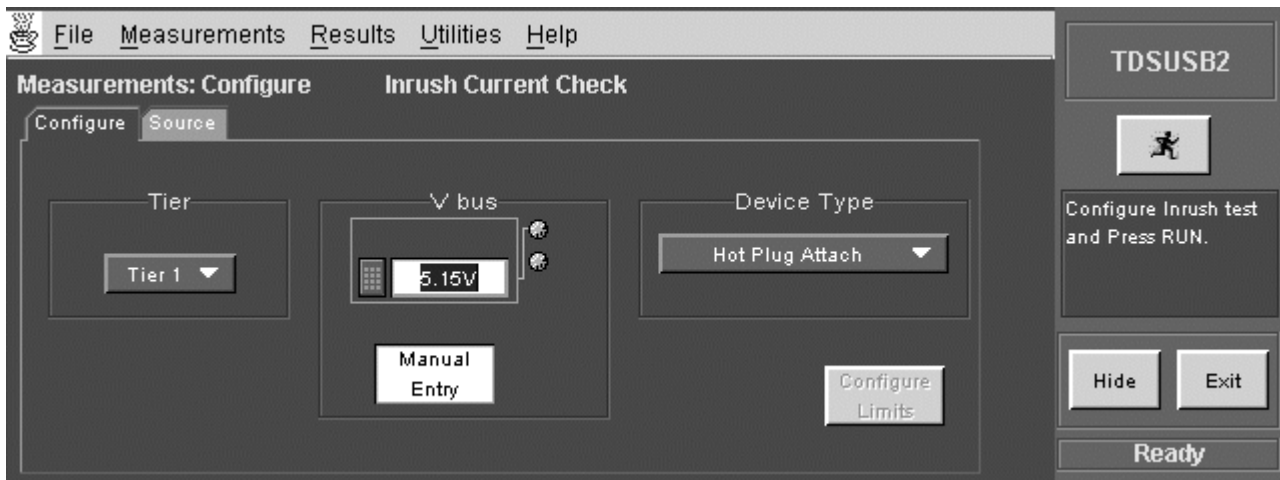
Figure 2-50: Inrush current: Configure tab

5. Select the Source tab. Select From File.
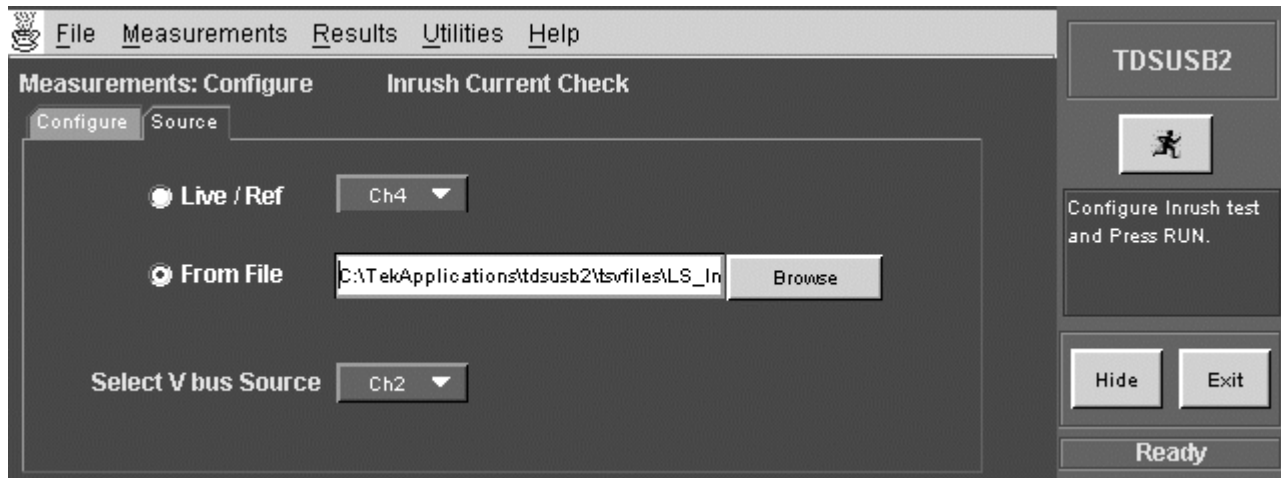
Figure 2-50: Inrush current: Source tab

6. Select file C:\TekApplications\tdsusb2\tsvfiles\LS_inrush.tsv

7. Select the [run] command button to run the application.

8. The application displays the Results Summary as Conditional PASS.
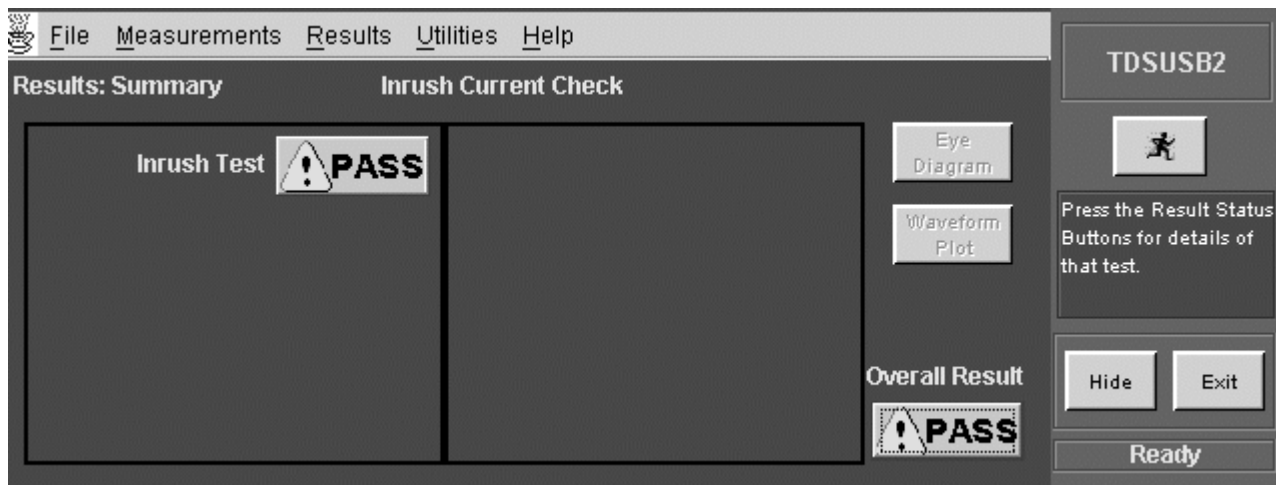
Figure 2-51: Inrush current: Results summary

9. You can also click on the result to view the details of the selected tests.
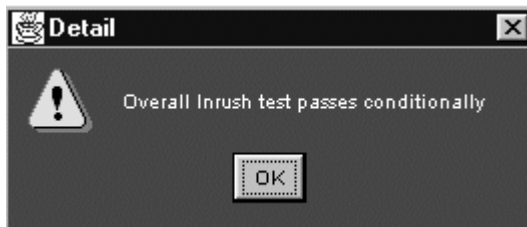
Figure 2-52: Inrush current: Results summary

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10. Select Results> Details from the application menu bar to view Results Details.
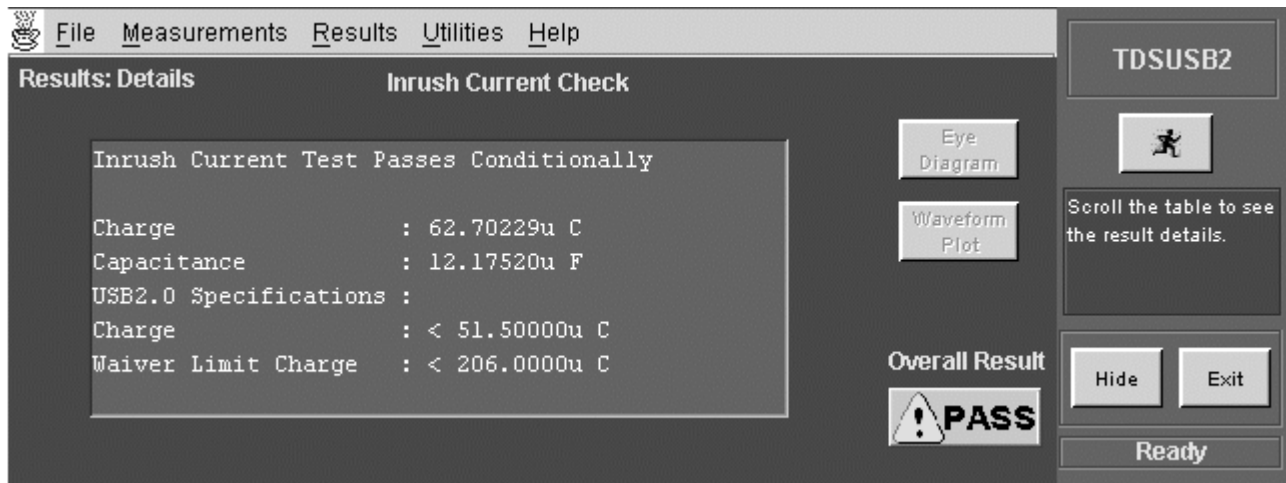
Figure 2-53: Inrush current: Results details

11. Select Utilities> Report Generator in the application menu bar to generate a report.

12. Select the CSV Specific Report and use the default file name. Select the Generate button.

13. The application displays the sample report file in a browser.

Figure 2-54: View report

NOTE: There is no image of the waveform plot in if you take this measurement using the TDS694C instrument since the application runs on a PC.

Taking a High Speed Measurement

This section discusses how to take a High Speed Signal Quality measurement, view the results, and generate the report. To perform these tasks, the application must be installed and enabled on the TDS6000 and TDS7000 series of instruments.

To take a High Speed Signal Quality measurement, follow these steps:

1. To set the application to default values, select File> Recall Default. The application displays the message 'Default setup recalled successfully.'

2. Select Measurements> High Speed and select all the Signal Quality measurements in the Signal Quality Check area.
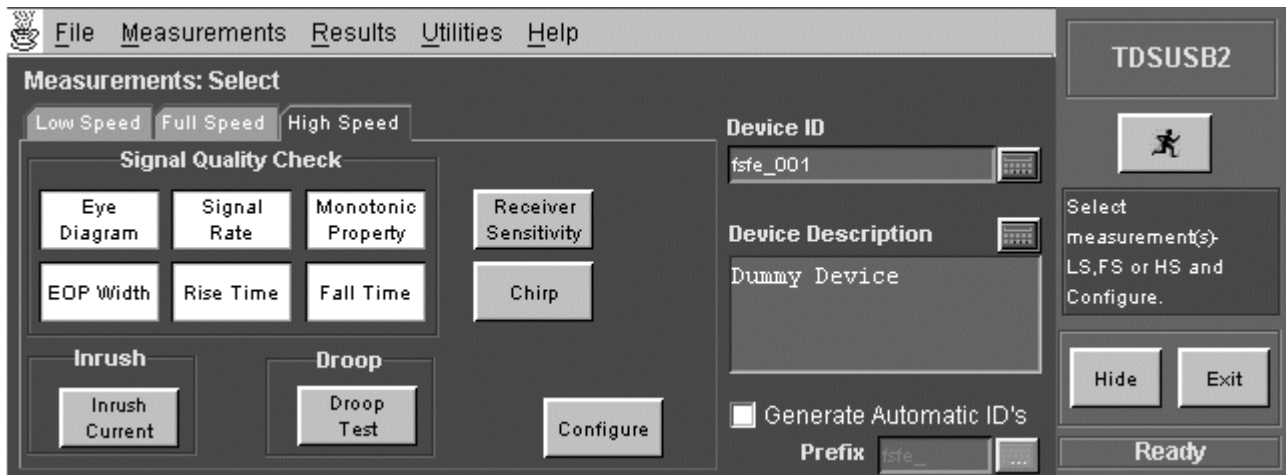
Figure 2-55: Selecting measurements: High speed signal quality

3. Select the Configure option or go to Measurements> Configure.

4. Select the Source tab> From File>Browse and locate the file.
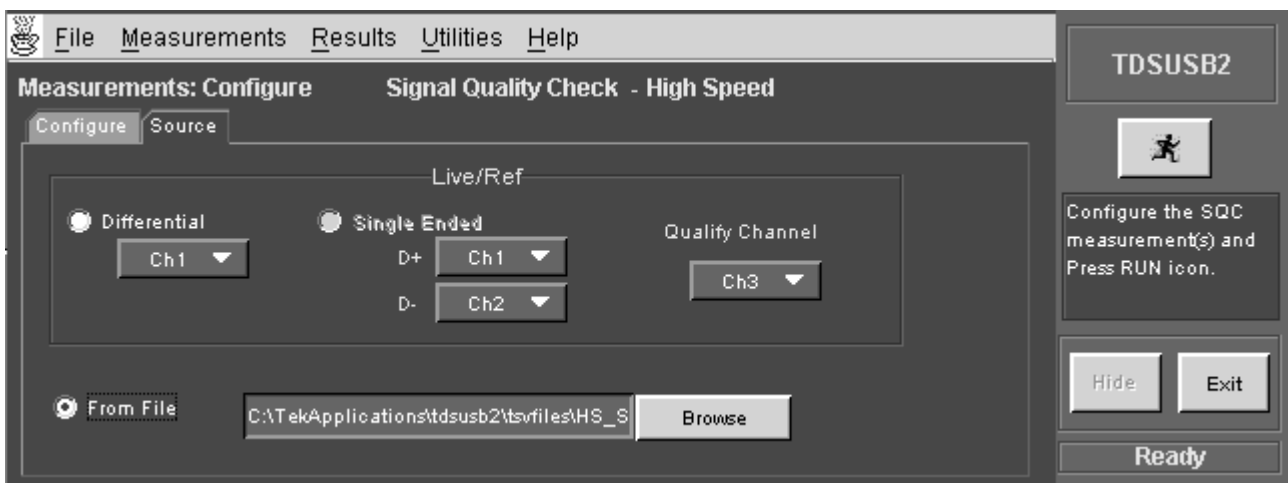
Figure 2-56:Configuring measurements: High speed signal quality

5. Select the file C:\TekApplications\tdsusb2\tsvfiles\HS_sqc.tsv.

6. Select the [icon] command button to run the application. The application automatically displays the Eye Diagram and the Waveform Plot.
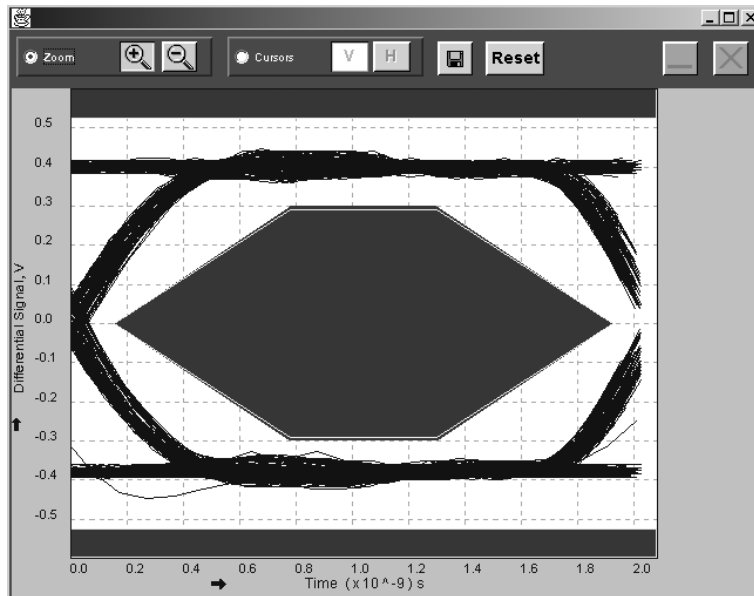
Figure 2-57: High Speed: Eye diagrams
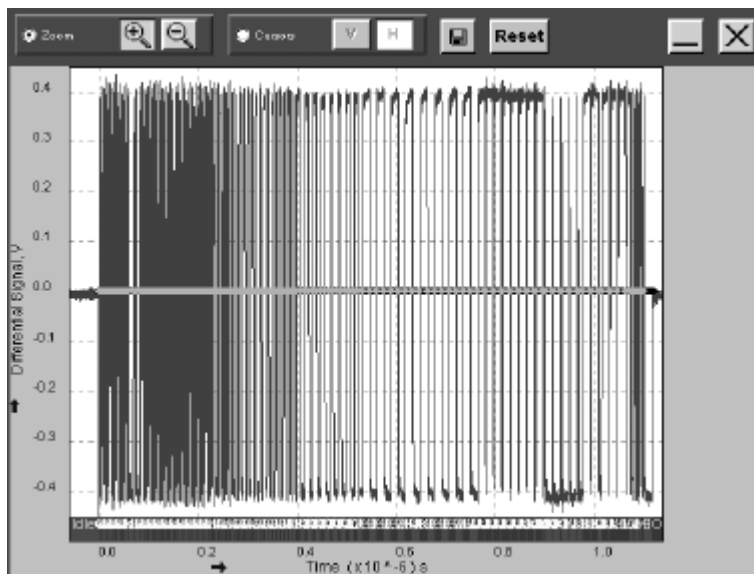
Figure 2-58: High Speed: Waveform plot

7. Minimize the eye diagram and the waveform plot to view the Summary Results.

8. Select the Results> Details in the application menu bar to view the Results Details.
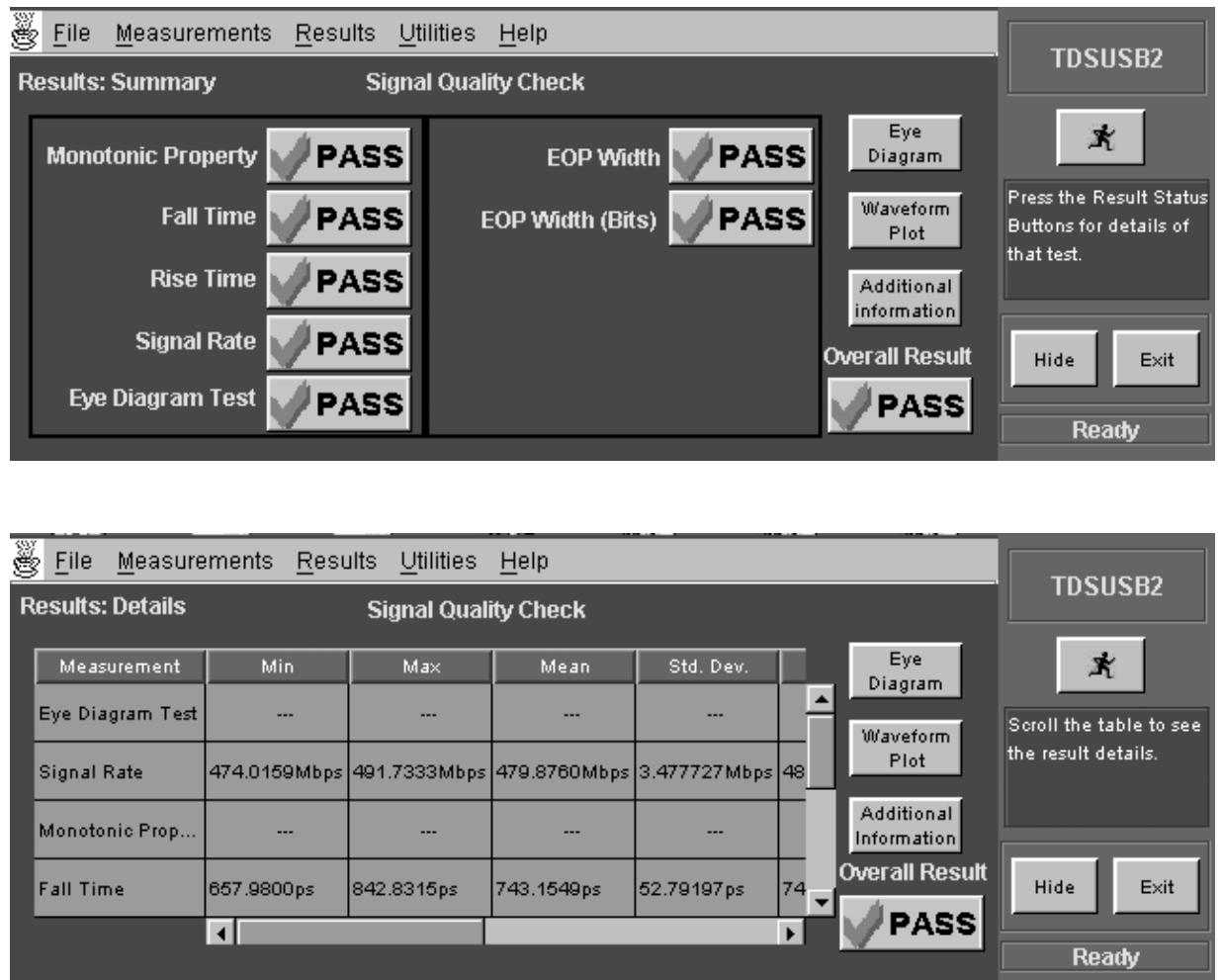
Figure 2-59: Results details

9. Select Utilities> Generate Report to generate the report.

10. Select the Report format as Plug-Fest Specific and use the default file name. Select Generate.
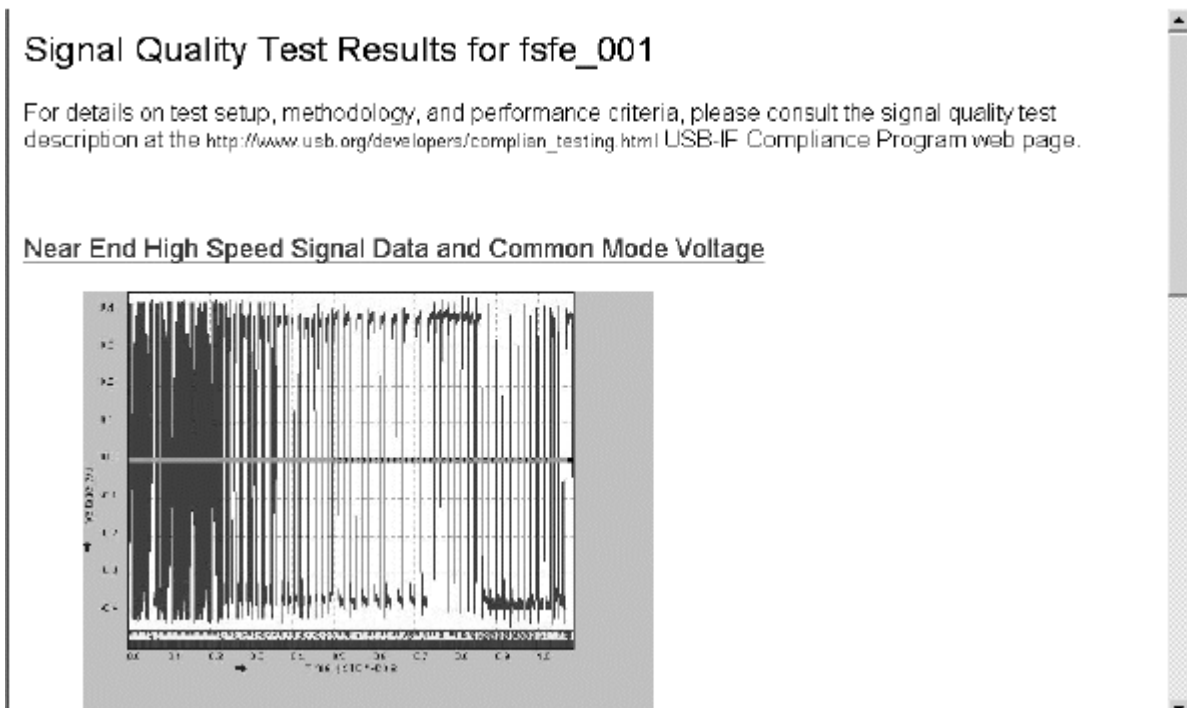
Figure 2-60: View report

11. The application displays the sample report file in a browser.

Stopping the Tutorial

If you need more than one session to complete the tutorial, you can stop the tutorial and return later.

To save the application and instrument setup, stop your session, refer to page 68 and to Exiting the Application on page 69.

Returning to the Tutorial

To return to the tutorial setup, you can start the application and then recall the saved setup. To recall the application setup, refer to Recalling a Saved Setup on page 68.

Application Examples

About Application Examples

This section presents the application examples. The simplified examples highlight the application measurements and show how to use the application to solve your test problems.

To use these examples, you must have the TDSUSB2 application installed and enabled on the instrument. Connect the probes to your unit under test (UUT), and perform the configuration tasks. For information, see Installing the application on page 23 and Starting the Application on page 71.

See Also

Signal Quality tests on Full Speed device for Downstream Testing on page 87

Signal Quality tests on Full Speed device for Upstream Testing on page 97

Inrush Current Test for Full Speed device on page 102

Droop Test for Ports of Hub on page 93

Signal Quality for High Speed devices on page 106

Full Speed Signal Quality Tests for Downstream Testing

Specifying the Equipment   The following equipment is needed for downstream signal quality check on a Full Speed device testing:

- Tektronix digital instrument

- TDSUSB2 application

- TDSUSBF compliance test fixture

- Two P6245 single-ended voltage probes

Typical Equipment Setup   To set up the equipment for Full Speed Signal Quality Downstream test, follow these steps:

1. Set the S6 switch to the Init position.

2. Use the adapters to connect the dongle from Device SQ test section (marked DUT) of the test fixture to the USB2.0 Low Speed device.

3. Connect Ch1 of the D+ probe to the D+ pins on the Device SQ section of the test fixture.

4. Connect Ch2 of the D– probe to the D– pins on the Device SQ section of the test fixture.

5. Connect the Init port of the Device SQ section of the test fixture to any port of the unit under test (hub) using the USB cable.

6. Select and configure the measurements.

7. Run the application by pressing the [runner icon] icon.

8. Select OK after acquiring a waveform. Verify that it is a correct waveform.

NOTE: Make sure the acquired signal is a valid waveform.

Full Speed Downstream Hub Equipment Setup
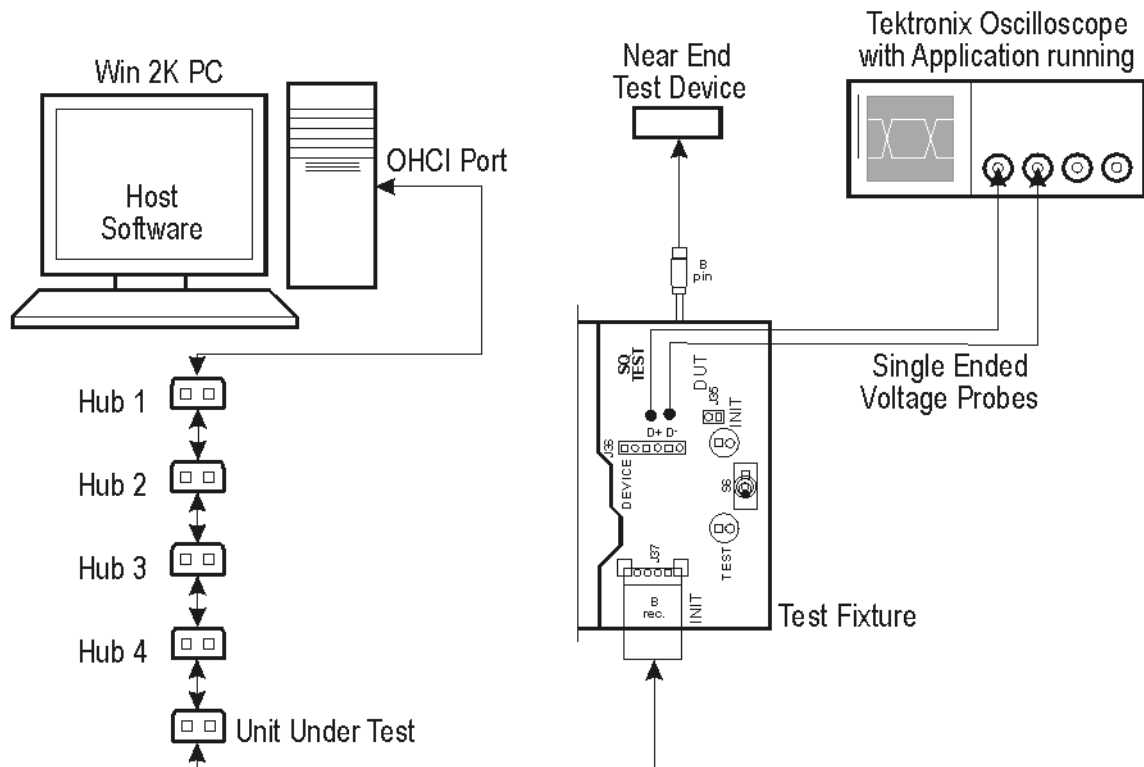
Figure 2-61 Setup for full speed signal quality for downstream testing

Selecting and Configuring Measurements

Follow the steps to select measurements for Full Speed Signal Quality check:

1. From the application menu, select Measurement> Select> Full Speed tab.

2. Select the following signal quality checks:

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- Eye Diagram Test

- Signal Rate

- Paired JK Jitter

- Paired KJ Jitter

- Consecutive Jitter

- EOP Width

- Cross over Voltage

- Rise Time

- Fall Time

Note :If you select Rise Time and Fall Time option in the default panel, the application displays these values as additional information in Full Speed Signal Quality reports. Rise Time and Fall Time options are not an input for the pass/fail criteria.

Configuring the Measurement: Follow the steps to configure the selected measurements:

1. From the application menu, select Measurement> Configure> Configure.

2. Configure the following options.

Option	Set to
Tier	Tier6
Direction	Downstream
Test Point	Set the test point to Far End

3. Select the Source tab.

4. Configure the following options.

Option	Set to
Live/Ref	Single-ended

5. If you select Single-ended, you must select two channels for D+ and D–.

6. Select Run to acquire the data.

7. The application automatically displays the eye diagram and waveform plot of the signal acquired from the unit under test.

Viewing Results   To view the results of the tests, follow these steps:

1. From the application menu, select Results> Summary. Figure 2-62 shows the summary results.
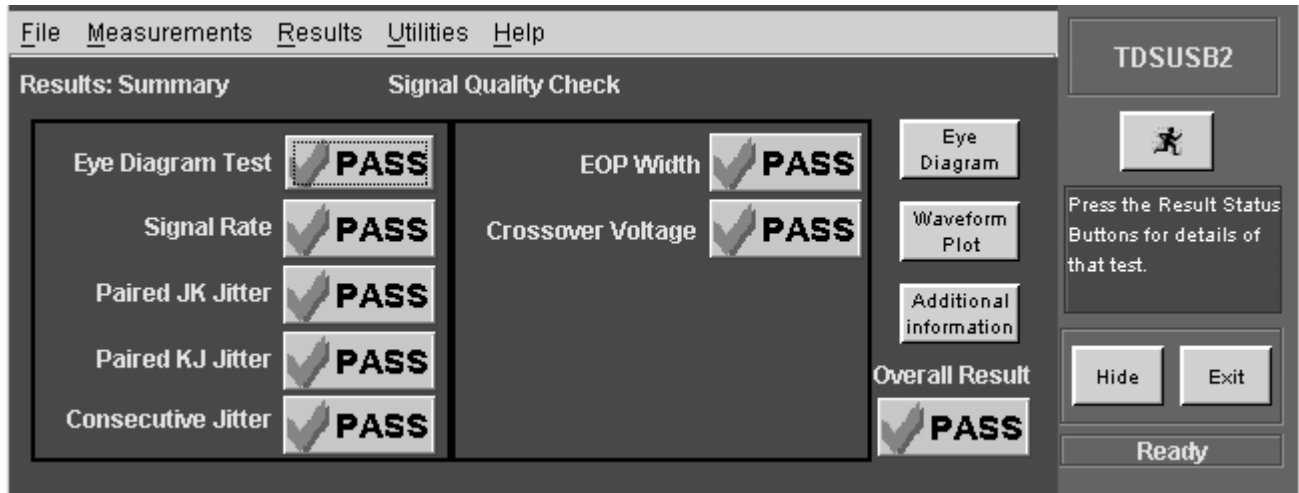
Figure 2-62: Summary results for full speed signal quality for downstream testing

2. Click on any of the test result buttons to get the details of that test.

3. From the application menu, select Results> Details. Figure 2-63 shows the detailed results.
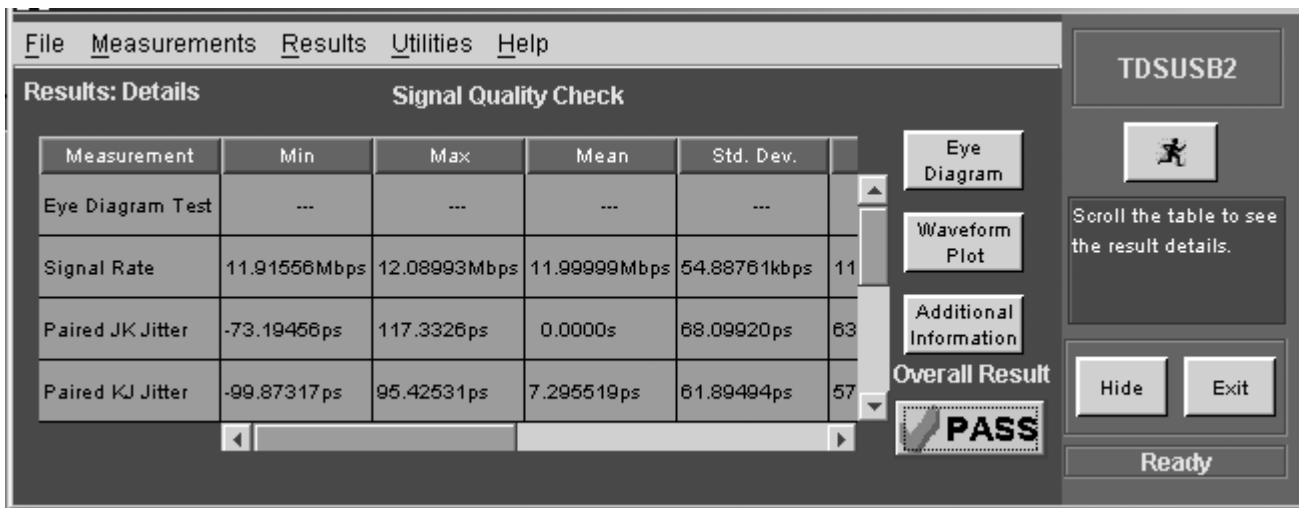
Figure 2-63: Detailed results for full speed signal quality for downstream testing

4. Click on the Eye Diagram option in Results Summary or the Details to view the Eye Diagram. Figure 2-64 shows the eye diagram.
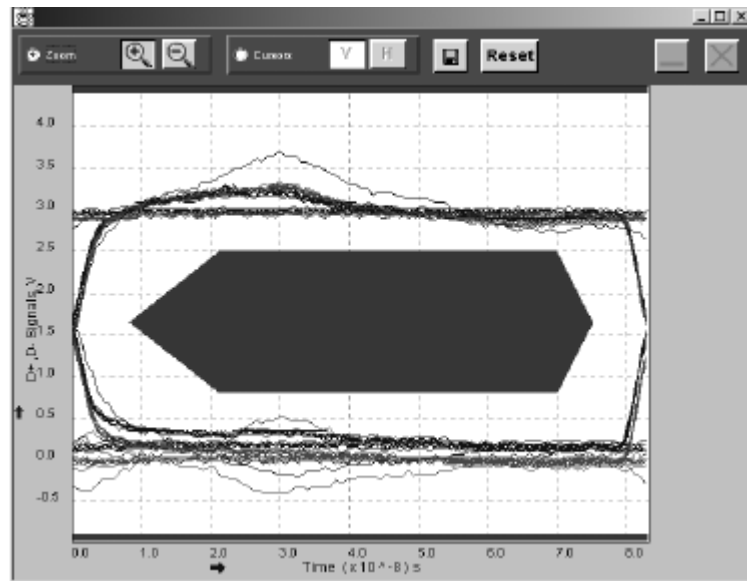
Figure 2-64: Eye diagram for full speed signal quality for downstream testing

5. Click on the Waveform Plot option to view the annotated waveform plot. Figure 2-65 shows the corresponding waveform plot.
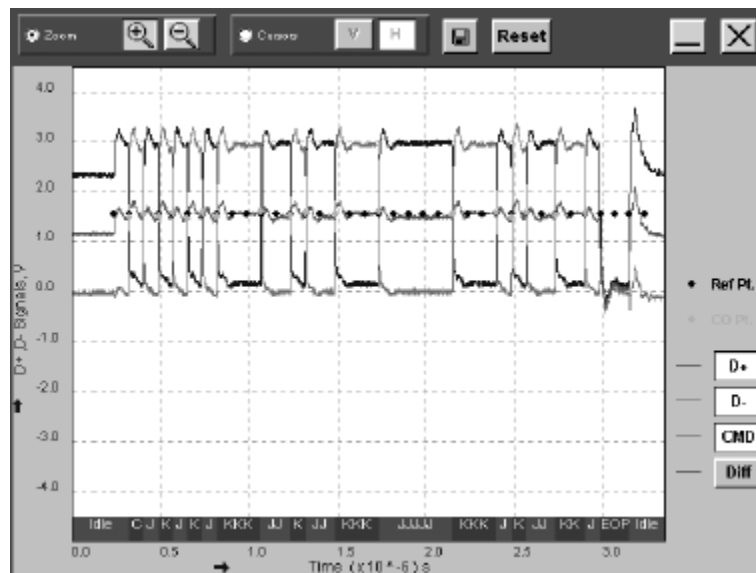
Figure 2-65: Waveform plot for full speed signal quality for downstream testing

Generating Reports   To generate reports of the test results, follow these steps:

1. From the application menu, select Utilities> Report Generator.

2. Select any one of the Report Formats: Tektronix Specific, Plug-Fest Specific or CSV format.

3. Select the Manual option to generate the report.

4. Select Generate.

5. View the Tektronix Specific or Plug-Fest Specific report format as HTML pages or the CSV format in Microsoft Excel. Figure 2-66 shows the report in Plug-Fest format.
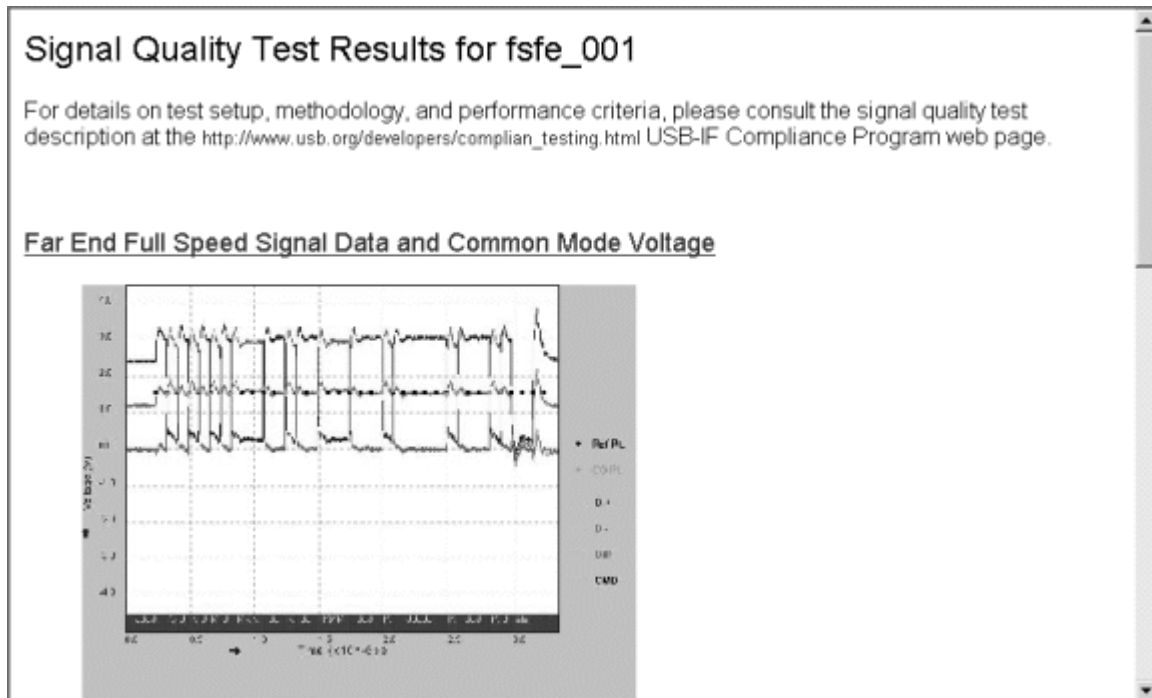
Figure 2-66: Report in Plug-Fest format

Droop Test for Ports of Hub

Specifying the Equipment   The following equipment is needed to perform a Droop Test for Low Speed device:

- Tektronix digital instrument
- TDSUSB2 application
- TDSUSBF compliance test fixture
- Two P6245 single-ended probes

Typical Equipment Setup   To set up the equipment for Droop test, follow these steps:

1. Use the Droop and Adjacent Trigger section for the Droop test. Use standard 3-ft (one meter) length of USB cable to connect the loads on the test fixture to the ports of the unit under test as shown in the next figure.

2. The setup requires two channels of the instrument: one for the Droop Load Trigger Timer that is on the Droop test load section, and the other for V_{BUS} that is on the Adjacent Trigger and Droop Test section of the test fixture. Use the load switch to select appropriate loads for Droop Test.

3. In the Droop and Adjacent Trigger section on the test fixture, probe Ch1 from the V_{BUS} and ground the pins.

4. In the Droop Test Load section on the test fixture, probe Ch2 from the oscillator (marked OSC) and ground the pins.

5. Connect the Droop Trigger Test Load to the Port1 of the unit under test (hub).

6. Connect the Load1 to Port2 of the hub under test.

7. Connect the Load2 to the A receptacle of the Droop and Adjacent Trigger section on the test fixture. Connect the A pin dongle from the Droop and Adjacent Trigger section to the Port4 of the unit under test (hub). Port4 is the port under test of the hub.

8. Connect the Load3 to Port3 of the unit under test (hub). Now all the ports of the unit under test are connected (hub).

9. Run the application by pressing the ![run icon] icon for the instrument settings that are automatically set.

10. Select OK when the valid waveform is acquired.

11. Observe the droop in the V_{BUS} when Droop test load is applied.

> *NOTE: The application does automatic instrument setup for acquiring Droop signal. If you do not get a valid signal, set up the instrument accordingly.*
>
> *Use the Load Switch to select 500 mA test loads for Droop testing of a self powered hub and system.*
>
> *Use the Load Switch to select 100 mA test loads for Droop testing of bus powered hub and system.*
>
> *Use the Load Switch to select 500 mA test loads for Droop testing of self powered hub and system.*

Figure 2-67 shows the equipment setup for droop test for ports of hub.

Droop Test Equipment Setup
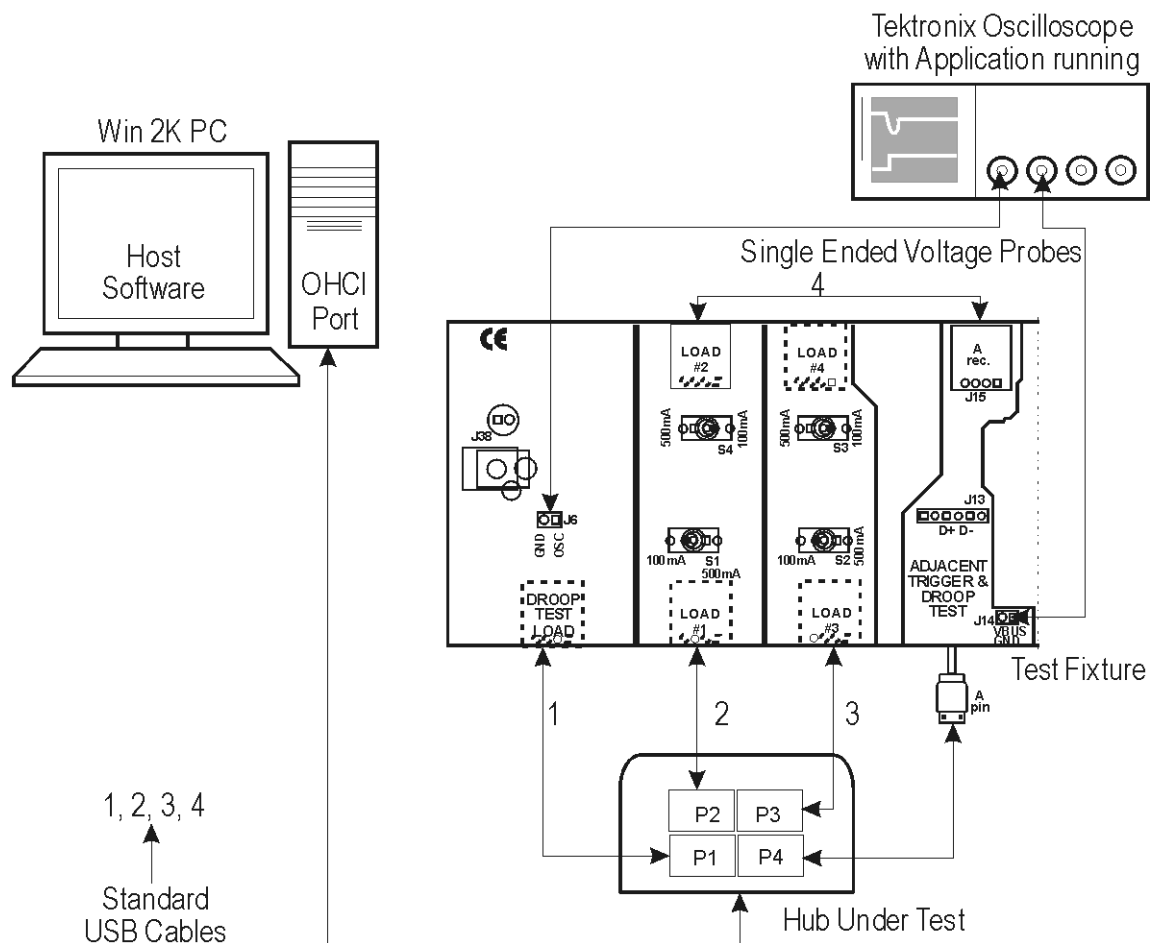
Figure 2-67: Setup for droop test for ports of hub

Selecting and Configuring Measurements

From the application menu, select Measurement> Select> Low Speed> Droop Test.

Configuring the measurement: Follow the steps to configure the selected measurement:

1. From the application menu, select Measurement> Configure.

2. Configure the following options.

Option	Set to
Port	Port under test
Source	Downstream
V$_{BUS}$	Ch1
Trigger	Ch2
Device type	Self-powered

3. Select ![running figure icon] to acquire the data.

4. After acquiring the data, the application displays the eye diagram and the waveform plot automatically.

Viewing Results   To view the results of the tests, follow these steps:

1. Run the application and from the application menu, select Results> Summary. Figure 2-68 shows the summary results for the droop test.
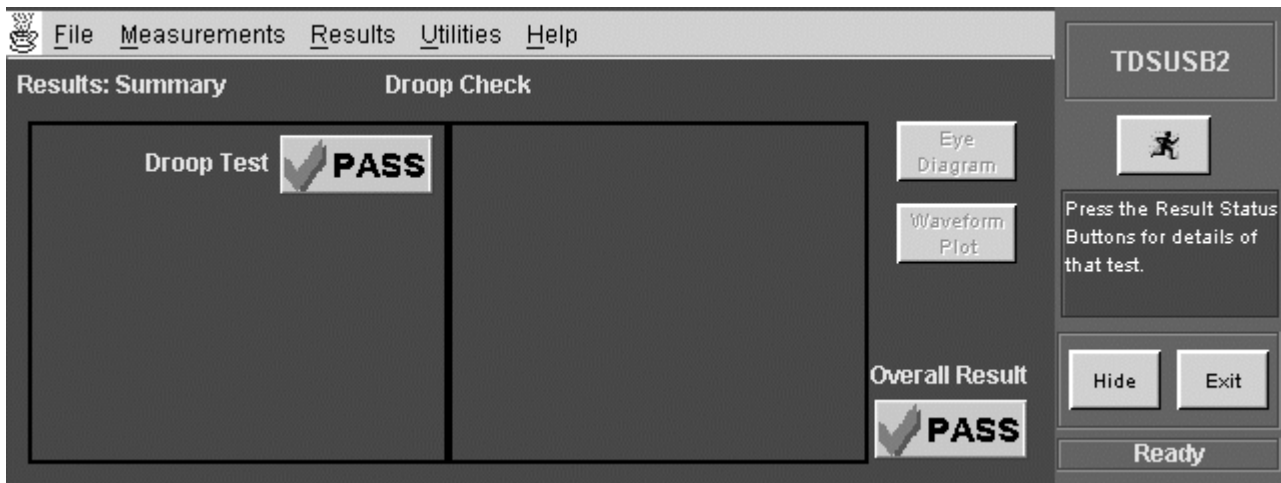
Figure 2- 68: Summary results for the droop test

2. Click on any of the test result buttons to get the details of that test.

3. From the application menu, select Results> Details. Figure 2-69 shows the detailed results for the droop test.
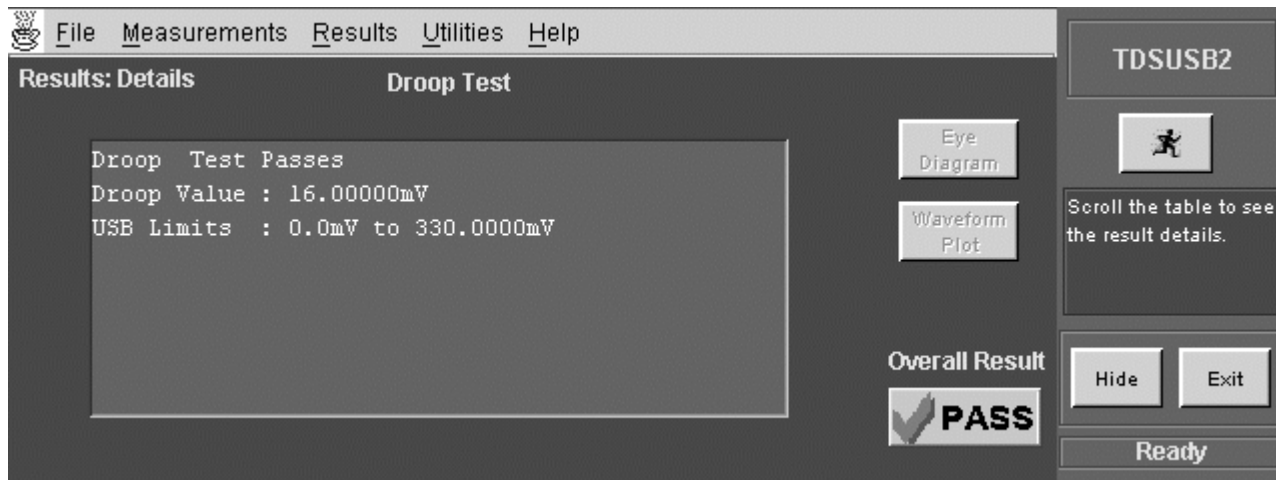
Figure 2- 69: Detailed results for the droop test

4. You can also view the instrument output for the corresponding results.

Generating Reports   To generate reports of the test results, follow these steps:

1. From the application menu, select Utilities> Report Generator.

2. Select any one of the Report Formats: Tektronix Specific, Plug-Fest Specific or CSV format.

3. Select Manual option to generate the report.

4. Select Generate.

5. View Tektronix Specific or Plug-Fest Specific report format as HTML pages or the CSV format in Microsoft Excel. Figure 2-70 shows the droop test report in Tektronix Specific format.
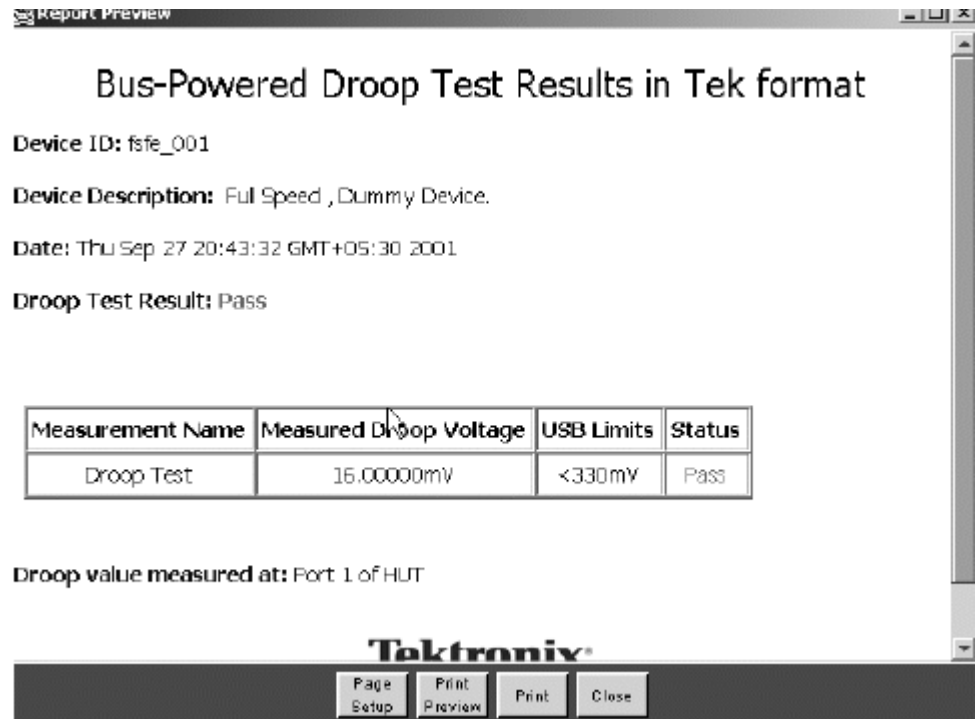
Figure 2-70: Droop test report in Tektronix format

Full Speed Signal Quality Tests for Upstream Testing

Specifying the Equipment   The following equipment is needed for upstream signal quality check on a low or full speed device:

- Tektronix digital instrument

- TDSUSB2 application

- TDSUSBF compliance test fixture

- Three P6245 single-ended voltage probes

Typical Equipment Setup   To set up the equipment for Full Speed Upstream test, follow these steps:

1. Use the A receptacle to connect the USB unit under test (device) to the Inrush Droop section of the test fixture.

2. Connect the Qualifier device to the Adjacent Trigger and Droop section of the test fixture as shown in the next figure.

3. Connect Ch1 of the D+ probe to the D+ pins on the Inrush Droop section of the test fixture.

4. Connect Ch2 of the D– probe to the D– pins on the Inrush Droop section of the test fixture.

5. Connect the D+ (D– for Low speed) pin of the Adjacent Trigger and Droop Section of the test fixture to Ch3 as shown in the next figure.

6. Use the connectors to connect the A pin dongle from the Adjacent Trigger and Droop section of the test fixture to one port of the Hub 5. Use the A pin dongle from the Inrush Droop section of the test fixture to another port of the Hub 5.

7. Select and configure the measurements.

8. Run the application by pressing the icon.

9. Select OK after acquiring a waveform. Verify that it is a correct waveform.

NOTE: Use the standard 16-ft (five meter) length of USB cables to connect between the hubs. Keep the Discharge switch in the Inrush Droop section in the ON position.

Figure 2-71 shows the equipment setup for setup for full speed signal quality for upstream testing.
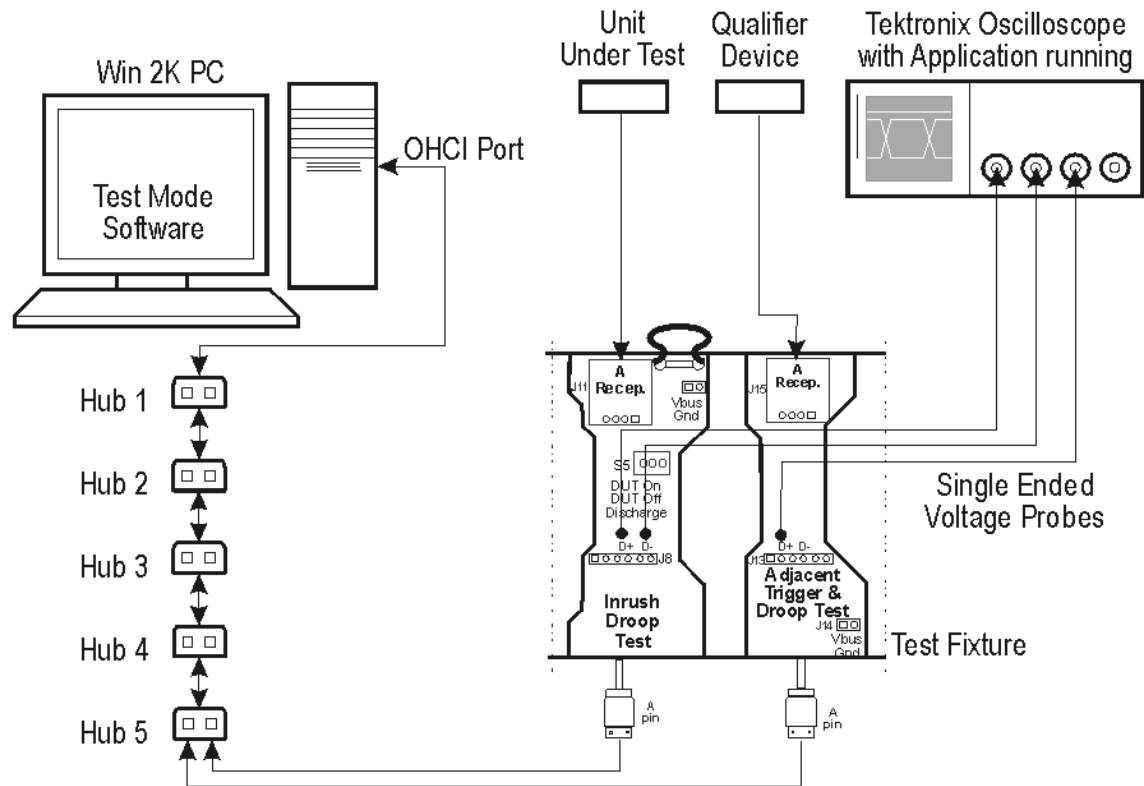
Figure 2-71: Setup for full speed signal quality for upstream testing

Selecting and Configuring Measurements

Follow the steps to select measurements for Full Speed Signal Quality check:

1. Select Measurements> Select > Full Speed tab.

2. Select Signal Quality tests:

   - Eye Diagram Test

   - Signal Rate

   - Paired JK Jitter

   - Paired KJ Jitter

   - Consecutive Jitter

   - EOP Width

   - Cross over Voltage

- ▪ Rise Time

- ▪ Fall Time

Note: If you select Rise Time and Fall Time option in the default panel, the application displays these values as additional information in Full Speed Signal Quality reports. Rise Time and Fall Time options are not an input for the pass/fail criteria.

Configuring the Measurement: Follow the steps to configure the selected measurement:

1. From the application menu, select Measurement> Configure> Configure tab.

2. Configure the following options.

Option	Set to
Tier	Tier6
Direction	Upstream
Test Point	Far End

3. Select the Source tab.

4. Configure the following options.

Option	Set to
Live/Ref	Single-ended Ch1, Ch2
Qualify Channel	Ch3

5. Run the application by pressing the ⚡ icon.

6. The application automatically displays the Eye Diagram and the Waveform Plot of the signal acquired from the unit under test. Figure 2-72 shows the eye diagram for full speed upstream signal quality testing.
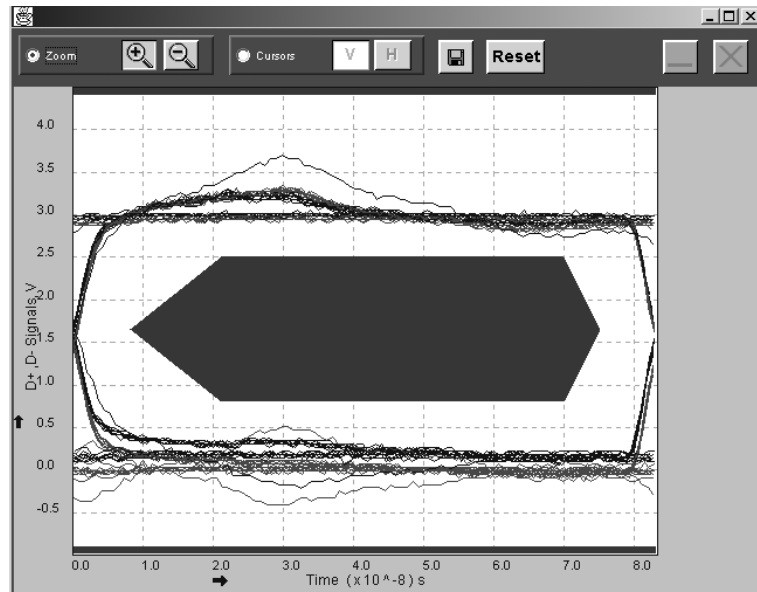
Figure 2-72: Eye diagram for full speed upstream signal quality testing

Viewing Results To view the results of the tests, follow these steps:

1. Run the application and from the application menu, select Results> Summary.

2. Click on any of the test result buttons to get the details of that test.

3. From the application menu, select Results> Details.

4. Click on the Eye Diagram option in Results Summary or Results Details to view the Eye Diagram.

5. Click on the Waveform Plot to view the annotated waveform plot.

Generating Reports To generate reports of the test results, follow these steps:

1. From the application menu, select Utilities> Report Generator.

2. Select any one of the Report Formats: Tektronix, Plug-Fest Specific or CSV format.

3. Select the Manual option to generate the report.

4. Select Generate.

5. View the Tektronix Specific or Plug-Fest Specific report format as HTML pages or the CSV format in Microsoft Excel. Figure 2-73 shows a sample report in the Plug-Fest Specific format.
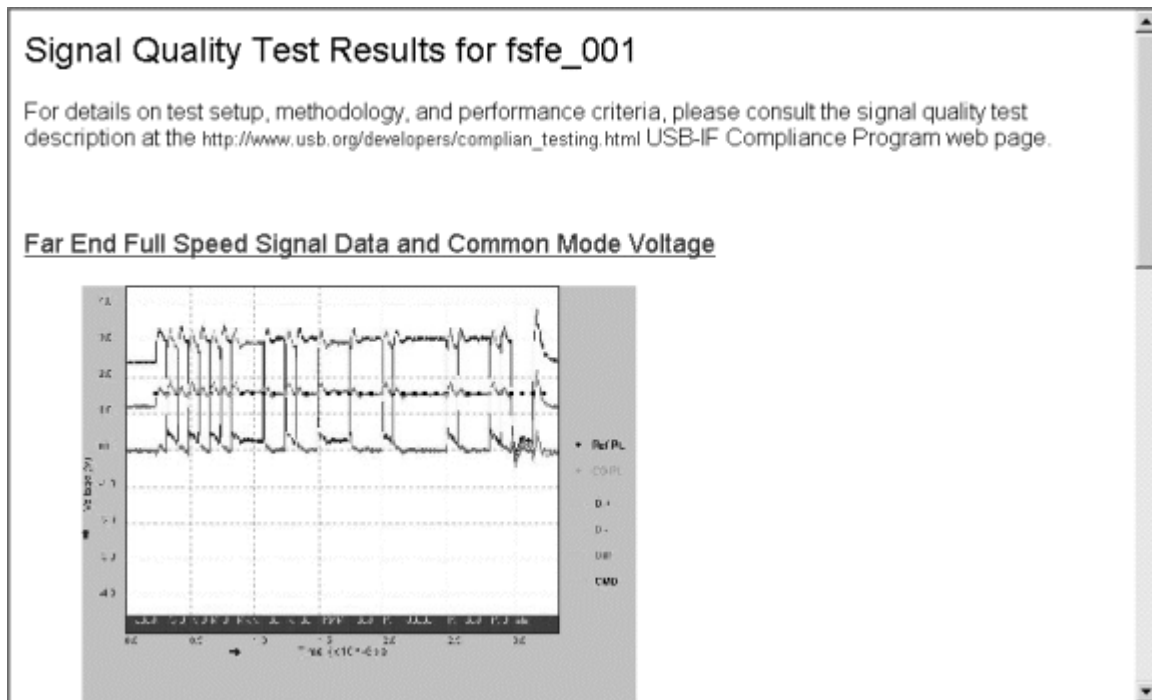
Figure 2-73: Report in the Plug-Fest format

Inrush Current Test for a device

Specifying the Equipment   The following equipment is needed for Inrush Current Check on a Full Speed Device:

- Tektronix digital instrument

- TDSUSB2 application

- TDSUSBF compliance test fixture

- One TCP202 current probe

Typical Equipment Setup   To set up the equipment for Inrush test, follow these steps:

1. Use the dongles on the Inrush section of the test fixture to connect it to the host system.

2. Connect the current probe between the V_{BUS} loop wire on the Inrush section on the Test fixture and Ch1 of the instrument.

3. Configure the measurement and run the application by pressing the 🏃 icon.

4. Connect the unit under test to the A Receptacle of the Inrush section of the test fixture and observe the Inrush current signal.

5. Select OK after acquiring a waveform. Verify that it is a correct waveform.

NOTE: To avoid the triggering of Inrush signals and false inrush current by the discharge switch, place the inrush discharge switch in the ON position and hot-plug the unit under test (device).

In case a valid Inrush signal is not acquired, use the cursor mode in File> Preferences or set up the instrument to get a valid waveform.

Figure 2-74 shows the setup for inrush current check for full speed device.

Inrush Equipment Setup
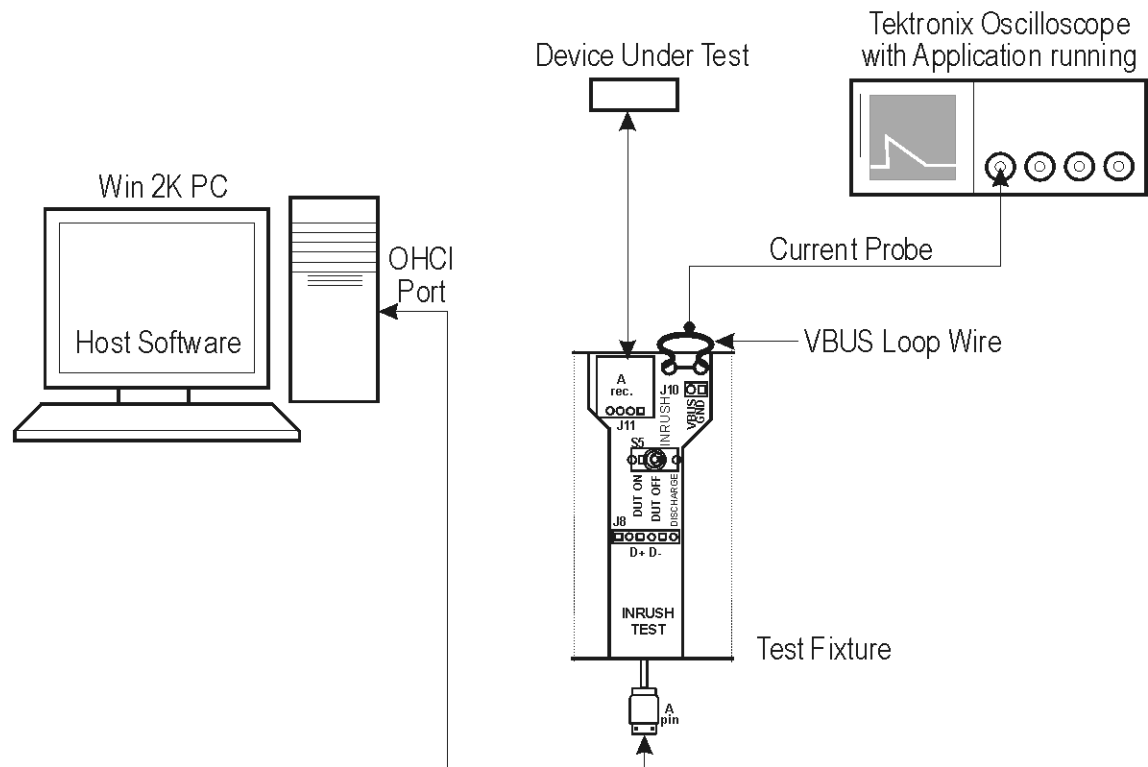
Figure 2-74: Setup for inrush current check for full speed device

Selecting and Configuring Measurements

From the application menu, select Measurement> Select> Inrush Current.

Configuring the Measurement: Follow the steps to configure the selected measurement:

1. From the application menu, select Measurement> Configure> Configure tab.

2. Configure the following options.

Option	Set to
Tier	Tier is always set to 1
V_{BUS}	Enter voltage measured across V_{BUS} manually
Device Type	Hot Plug Attach

3. Select the Source tab.

4. Configure the following options.

Option	Set to
Live/Ref	Channel acquiring the signal

5. Run the application by pressing the icon.

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Viewing Results   To view the results of the tests, follow these steps:

1. Run the application and from the application menu, and select Results> Summary.

2. Click on any of the test result buttons to get the details of that test.

3. From the application menu, select Results> Details.

4. You can also view the instrument output for the corresponding results.

Generating Reports   To generate reports of the test results, follow these steps:

1. From the application menu, select Utilities> Report Generator.

2. Select any one of the Report formats: Tektronix Specific, Plug-Fest Specific or CSV format.

3. Select the manual report generation mode.

4. Select Generate.

5. View the Tektronix Specific or Plug-Fest Specific report format as HTML pages or the CSV format in Microsoft Excel.

Figure 2-75 shows the report for inrush current check in CSV format.

Figure 2-75: View report for inrush current check in CSV format

Signal Quality for High speed devices

Specifying the Equipment   The following equipment is needed for signal quality tests on a Full Speed device for upstream testing:

- Tektronix digital instrument

- TDSUSB2 application

- TDSUSBF compliance test fixture

- One P6248 differential probe

Typical Equipment Setup   To set up the equipment for the High Speed Signal Quality test, follow these steps:

1. Set the S6 switch to the Init position.

2. Connect the standard 16-ft (5 meter) length of USB cable between the Device SQ Init port and the host port.

3. Connect the dongle (marked DUT) from the Device SQ test port of the test fixture to the unit under test (device).

4. Configure the measurements and run the application by pressing the [icon] icon.

5. Place the device in the test mode Test_Packet from the host controller.

6. Set the test Init switch to the test position to isolate the unit under test while maintaining the bus power.

7. Select OK after acquiring a waveform. Verify that it is a correct waveform.

High Speed Signal Quality
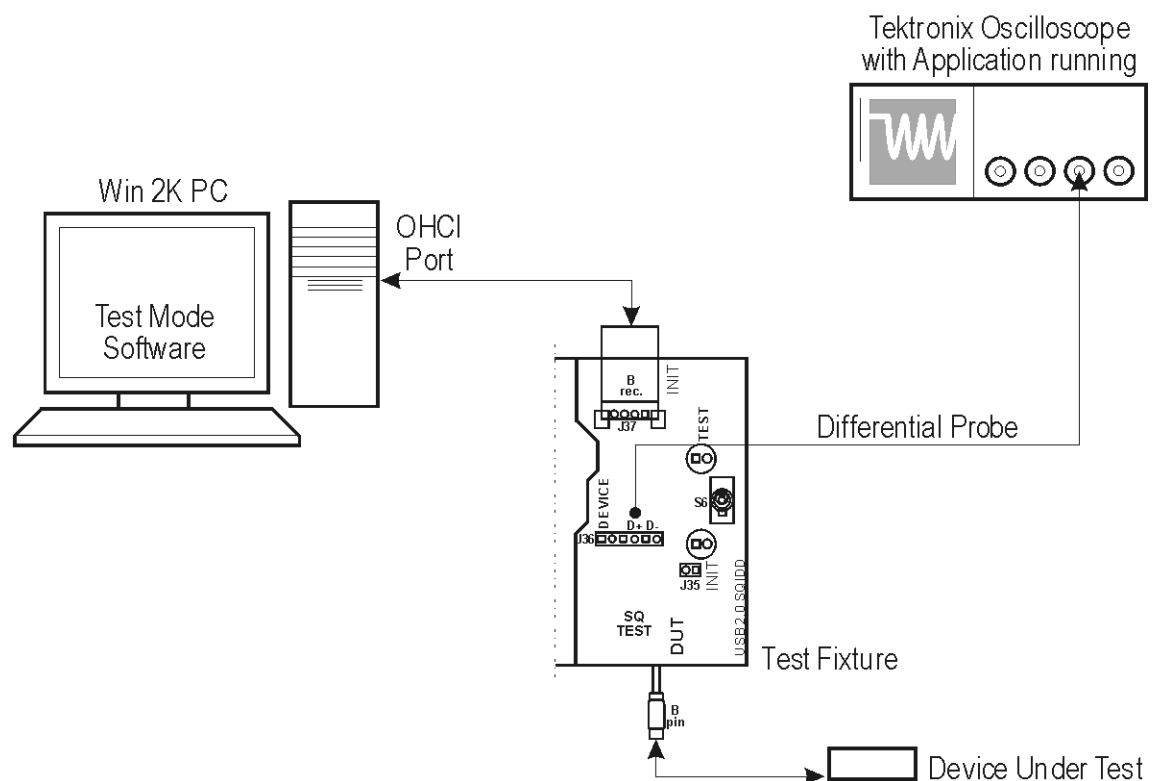
Figure 2-76: Setup for high speed signal quality tests

Selecting and Configuring Measurements

Follow the steps to select measurements for High Speed Signal Quality check:

1. From the application menu, select Measurement> Select> High speed (tab).

2. Select the tests.

   ▪ Eye Diagram Test

   ▪ Signal Rate

- EOP Width

- Rise/Fall Time

- Monotonic Property

Configuring the Measurement: Follow the steps to configure the selected measurements:

1. From the application menu, select Measurement> Configure> Configure tab.

2. Configure the following options.

Option	Set to
Tier	Tier1
Direction	Upstream
Test Point	Set the test point to Near End

3. Select the Source tab.

4. Configure the following options.

Option	Set to
Live/Ref	Differential

5. Run the application by pressing the ![icon] icon.

6. The application automatically displays the Eye Diagram and Waveform Plot of the signal acquired from the unit under test. This is possible if you enable the automatic display of the eye diagram and the waveform plot in the Preferences menu.

Viewing Results   To view the results of the tests, follow these steps:

1. Run the application and from the application menu, select Results> Summary.

Figure 2-77 shows the summary results for high speed signal quality tests.
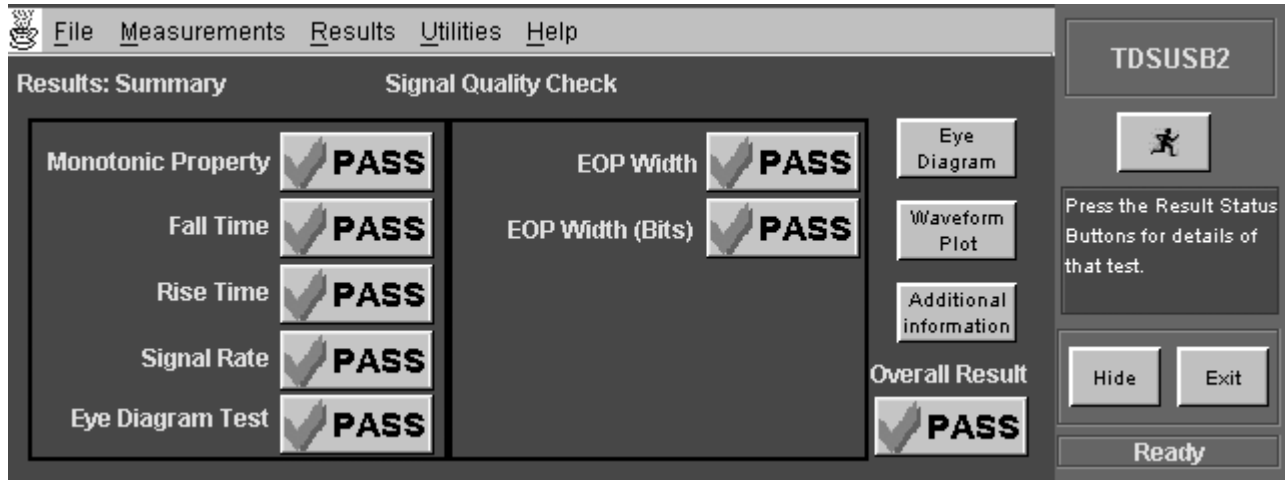
Figure 2-77: Summary results for high speed signal quality tests

2. Click on any one of the test result buttons to get the details of that test. Click on the Additional Information button to display any additional information.

3. From the application menu, select Results> Details. Figure 2-78 shows the detailed results for high speed signal quality tests.
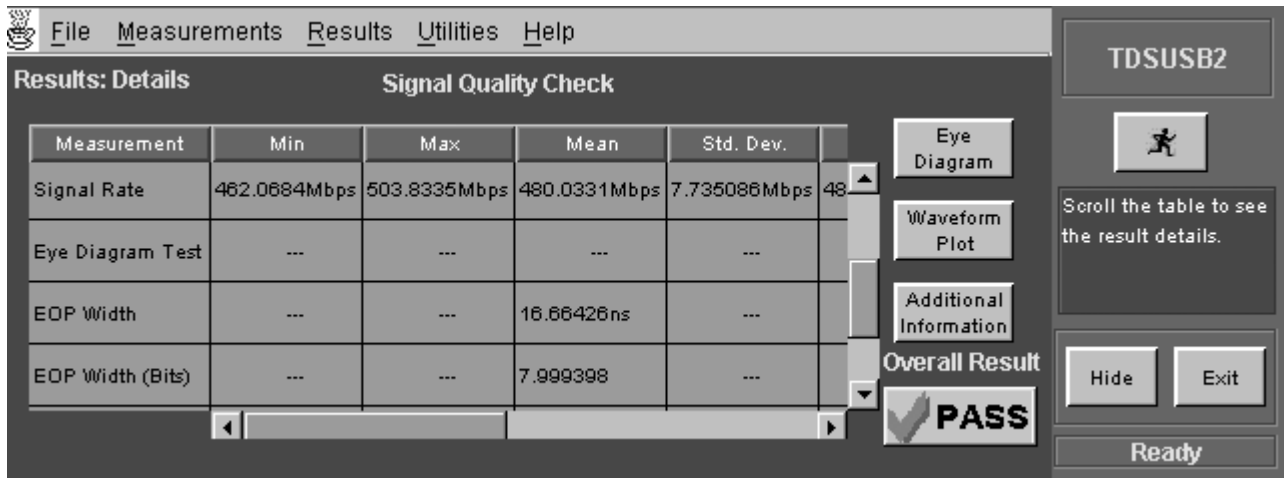
Figure 2-78: Detailed results for high speed signal quality tests

4. Click on the Eye Diagram in Results Summary or the Results Details to view the eye diagram. Figure 2-79 shows the eye diagram for high speed signal quality tests.
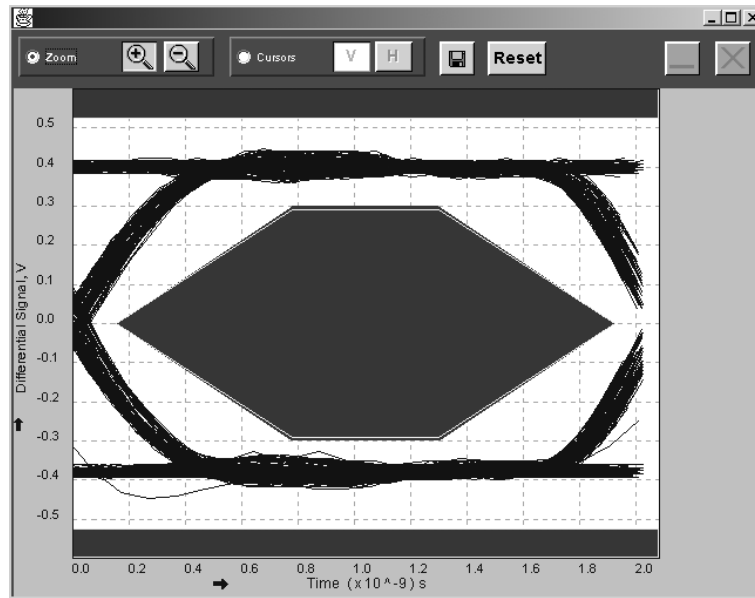
Figure 2-79: Eye diagram for high speed signal quality tests

5. Click on the Waveform Plot to view the waveform plot. . Figure 2-80 shows the waveform plot for high speed signal quality tests.
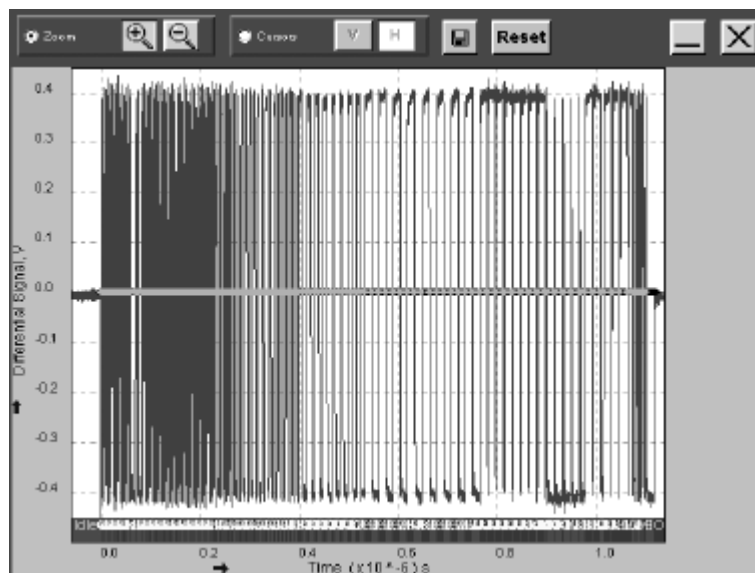
Figure 2-80: Eye diagram for high speed signal quality tests

Generating Reports   To generate reports of the test results, follow these steps:

1. From the application menu, select Utilities> Report Generator.

2. Select any one of the Report formats: Tektronix Specific, Plug-Fest Specific or CSV format.

3. Select the manual generation mode.

4. Select Generate.

5. View the Tektronix Specific or Plug-Fest Specific report format as HTML pages or the CSV format in Microsoft Excel. Figure 2-81 shows the report for high speed tests in CSV format.

	A	B	C	D	E	F	G	H	I	J
1					Signal Quality Report					
2	USB2.0 Test PackageVersion 1.3.3									
3	Device ID	fsfe_001								
4	Device Des	High Spee	Dummy Device							
5	Time Stam	Thu Apr 25 11:44:06 GMT+05:30 2002								
6										
7	Measurem	Unit	Min	Max	Pk-Pk	Mean	Rms	Std Dev	Population	Status
8	Consecutiv	-	-	-	-	-	-	-	-	-
9	Fall Time	s	6.58E-10	8.43E-10	1.85E-10	7.43E-10	7.45E-10	5.28E-11	107	Pass
10	Rise Time	s	6.70E-10	8.59E-10	1.89E-10	7.46E-10	7.47E-10	4.05E-11	106	Pass
11	Signal Rat	bps	4.74E+08	4.92E+08	0	4.80E+08	4.81E+08	3477727	512	Pass
12	Crossover	-	-	-	-	-	-	-	-	-
13	EOP Widtl	s	0	0	0	1.66E-08	0	0	1	Pass
14	EOP Widtl	-	0	0	0	7.955375	0	0	1	Pass
15	Paired JK .	-	-	-	-	-	-	-	-	-
16	Paired KJ .	-	-	-	-	-	-	-	-	-
17	Monotonic		0	0	0	0	0	0	0	Pass
18										
19	Monotonicity test is performed on the test limits of 15.0% and 85.0%.									
20										
21	Additional Information :									
22	Consecutive Jitter range : -70.65ps to 80.88ps RMS Jitter 28.56ps									
23	KJ Paired Jitter range : -41.12ps to 54.72ps RMS Jitter 19.99ps									
24	JK Paired Jitter range : -54.63ps to 64.89ps RMS Jitter 20.73ps									
25										
26										

HS_001-sqc

Ready   NUM

Figure 2-81: View report for high speed tests in CSV format

Reference

Shortcut Keys

Table 3-1 gives the shortcut keys that you can use for all the tasks.

Table 3-1: Shortcut keys for tasks

Action	Shortcut Keys
File Menu	
Recall Default	AltF+D
Recall	AltF+R
Save	AltF+S
Preferences	AltF+P
Recently Recalled	AltF+C
Recently Saved	AltF+A
Minimize	AltF+N
Exit	AltF+X
Measurements Menu	
Select	AltM+S
Configure	AltM+C
Results Menu	
Summary	AltR+S
Details	AltR+D
Utilities Menu	
Deskew	AltU+K
Report Generator	AltU+R
TSV File Generator	AltU+T
Help Menu	
Help Topics	AltH+T
About TDSUSB2	AltH+A

NOTE: Use the Alt key with the first keystroke only. Release the Alt key before you press the final key. For example, to use the shortcut key AltF+D, press the Alt and F keys together. Release the keys and then press D.

USB2.0 Specifications

This section gives the USB2.0 values for measurements for Low, Full and High speed signals.

Tables 3-2 through 3-4 give the USB2.0 limits for the low, full and high speed signals for signal quality checks.

Table 3-2: USB2.0 limits for low speed signals

| Measure-ments | USB Limits | | Waiver Limits | | User Configure Limits | | References* |
	Max	Min	Max	Min	Max. range	Min. range	
Cross Over Voltage	2.0 V	1.3 V	0.8 V	2.5 V	1.6-2.4 V	1.04-1.56 V	Chapter 7, Table 7-7, Section 7.1.2.1
Signal Rate	1.5225 Mbps	1.4775 Mbps	1.5675 Mbps	1.4325 Mbps	1.5675-1.881 Mbps	1.146-1.4325 Mbps	Chapter 7, 7.1.11
Conse-cutive Jitter	<25 ns	N/A	<333 ns	N/A	20-30 ns	N/A	Chapter 7, 7.1.13.1
Paired Jitter	<10 ns	N/A	<200 ns	N/A	8-12 ns	N/A	Chapter 7, 7.1.13.1
Rise Time	300 ns	75 ns	N/A	N/A	240-360 ns	60-90 ns	Chapter 7, 7.1.2.1
Fall Time	300 ns	75 ns	N/A	N/A	1240-360 ns	60-90 ns	Chapter 7, 7.1.2.1
EOP Width	1.5e-6 s	1.25e-6 s	3 bit times	1 bit time	1.2-1.8	1-1.5 ns	Chapter 7, 7.1.13.2.1

*The References Section refers to the chapter numbers in the 'Universal Serial Bus Specifications Revision 2.0-2000'.

> *NOTE: Results within the USB limit lead to a PASS condition.*
>
> *Results within the waiver limits, but outside USB limits lead to a Conditional PASS.*
>
> *Results within the user configured limits lead to PASS. When user configure limits is selected, you can view only the result details.*
>
> *Testing at Tier 6 leads to a PASS.*
>
> *Testing at Tier 5 and 4 leads to a Conditional PASS that is a Pass within the waiver limits.*
>
> *Testing at Tier 1 to 3 leads to a FAIL.*

Table 3-3: USB2.0 limits for full speed signals

Measure-ments	USB Limits		Waiver Limits		User Configure Limits		References*
	Max	Min	Max	Min	Max range	Min range	
Cross Over Voltage	2.0 V	1.3 V	0.8 V	2.5 V	1.6-2.4 V	1.04-1.56 V	Chapter 7, Table 7-7, Section 7.1.2.1
Signal Rate	12.03 Mbps	11.97 Mbps	12.15 Mbps	11.85 Mbps	12.15 to 14.8 Mbps	9.48-11.85 Mbps	Chapter 7,7.1.13.1
Consecutive Jitter	<2 ns	N/A	<40 ns	N/A	1.6-2.4 ns	N/A	Chapter 7, 7.1.13.1
Paired Jitter	<1 ns	N/A	<20 ns	N/A	.8-1.2 ns	N/A	Chapter 7, 7.1.13.1
Rise Time	20 ns	4 ns	N/A	N/A	16-24 ns	3.2-4.8 ns	Chapter 7, 7.1.2.1
Fall Time	20 ns	4 ns	N/A	N/A	16-24 ns	3.2-4.8 ns	Chapter 7, 7.1. 2.1
EOP Width	175 ns	160 ns	3 bit times	1 bit time	140-210 ns	128-192 ns	Chapter 7, 7.1.13.2.1

*References Section refers to the chapter numbers in the 'Universal Serial Bus Specifications Revision 2.0-2000'.

NOTE: Results within the USB limits lead to a PASS.

Results within the waiver limits, but outside USB limits lead to a Conditional PASS.

Results within the user configured limits lead to a PASS result. If you select configured limits, you can view only the result details.

Testing at Tier 6 leads to a PASS.

Testing at Tier 5 and 4 leads to a Conditional PASS that is a Pass within the waiver limits.

Testing at Tier 1 to 3 leads to a FAIL.

The application uses the USB signal rate limits of Low Speed or Full Speed devices that are not capable of High Speed. The same limits for Low Speed or Full Speed that are High Speed capable to decide the result - PASS or FAIL.

Table 3-4: USB2.0 limits for high speed signals

Measure-ments	USB Limits		Waiver Limits		User Configure Limits		80% to 120%	*References
	Max	Min	Max	Min	Max range	Min range	USB Pass/Fail	
Signal Rate	480.24 Mbps	479.76 Mbps	480.264 Mbps	479.736 Mbps	480.264-576.316 8Mbps	383.7888-479.736 Mbps	YES	Chapter 7,7.1.11
Rise Time	N/A	500ps	N/A	N/A	N/A	400-600 ps	YES	Chapter 7, 7.1.22
Fall Time	N/A	500ps	N/A	N/A	N/A	400-600 ps	YES	Chapter 7, 7.1. 22
Monotonicity	0	0	N/A	N/A	N/A	N/A	N/A	N/A
EOP Width	8.5 bit times	7.5 bit times	N/A	N/A	8.5-10.2 bit times	6-7.5 bit times	YES	Chapter 7, 7.1.13.2.2

*The References Section refers to the chapter numbers in the 'Universal Serial Bus Specifications Revision 2.0-2000'.

NOTE: Results within the USB limits lead to a PASS.

Results within the waiver limits, but outside USB limits lead to a Conditional PASS.

Results within the user configured limits lead to PASS. If you select your configured limits, you can view only the result details.

Whenever a high speed device is used in the low speed and full speed mode, the USB limits of the low speed and full speed devices are used to decide PASS or FAIL.

USB2.0 specifications have not specified the maximum rise time and fall time. If rise or fall times are greater than 0.5 bit times than a wrong, (long) rise or fall time will be captured as an eye diagram failure.

Tables 3-5 and 3-6 give the USB2.0 limits for Inrush Current Check and Droop Test.

Table 3-5: USB2.0 limits for inrush current check

	USB Limits		Waiver Limits		User Configure Limits		80% to 120%	*References
Measurements Hot Plug Attach	Max	Min	Max	Min	Max range	Min range	USB Pass/Fail	
V$_{BUS}$ Default Volts 5.15	5.25 V	4.4 V	N/A	N/A	N/A	N/A	YES	Chapter 7, 7.22
Inrush Level	100 mA	N/A	N/A	N/A	80-120 mA	N/A	YES	Current Draw.pdf

Table 3-6: USB2.0 limits for droop test

	USB Limits		Waiver Limits		User Configure Limits		80% to 120%	*References
Measure-ments	Max	Min	Max	Min	Max range	Min range	USB Pass/Fail	
Droop Compliance Voltage	<330 mV	70.0 m	N/A	N/A	264-396 mV	N/A	YES	Chapter 7, 7.2.4.1

*References Section refers to the chapter numbers in 'Universal Serial Bus Specifications Revision 2.0-2000'.

Error Codes and Warnings

This section gives a list of error codes that the application displays and their descriptions.

Table 3-7: Table of errors codes and descriptions

Error Codes	Error Message	Description	Possible Solutions
Sequencer Errors			
E101	Error importing waveform from the instrument	The application is trying to import the waveform(s) from the selected source(s), but is not able to import waveform to the application.	Make sure that the application settings are same as the selected instrument channels. Check the probe connections and the compliance test fixture connections for the live signal(s).
E102	Error in accessing .tsv file	This error occurs whenever .tsv file is selected as the source file and this file is not a valid .tsv file.	Check whether the file name extension is .tsv. The selected .tsv source file may be corrupted. Try running the application with a different tsv file.
E103	Mismatch in the .tsv file format	The .tsv file should match with the file structure mentioned in Reference section of this Help. For Low and Full Speed signal, each data record should have three values (Timestamp, D+, D–). For a High Speed .tsv file, the file should have two columns (Time, Diff). Use a valid file.	Try generating the .tsv file using .tsv File Generator utility that is available in the Utilities menu.
Error in acquiring waveform from instrument			
E111	Timeout occurred while acquiring a waveform	This is the GPIB timeout information that appears when the application is acquiring the waveform.	Check the physical GPIB connection when using TDSUSB2 with the TDS694C instrument.
E112	Error in turning on a channel	The application failed to turn on the live channel selected as source(s).	Check the physical GPIB connection when using TDSUSB2 with the TDS694C instrument.

Table 3-8:Packet detection warnings

Packet Detection Warning			
E201	No EOP region found	Testing will be performed on a full USB2.0 packet, which includes an EOP region. If no EOP region is found, the results might be incorrect since testing will be performed on a incomplete packet. For Upstream signal quality testing, EOP must be present.	Try acquiring the signals again by pressing Run button.
E202	Number of record points (data points) are too few to process	The application expects a minimum of 500 record points to perform an operation. The application automatically sets the required record length and assumes that the user does not change the record length.	Try acquiring the signals again the pressing Run button.
E203	Idle region is not found after EOP	As part of the USB2.0 packet description, an EOP region follows an idle region. If no idle region is found, it may lead to incorrect results.	Try acquiring the signals again by pressing the Run button.
E204	Reconfirm acquired data before computing the results	As part of the USB2.0 packet description, a minimum of three J-K or K-J state transitions are expected. An absence of these transitions may lead to incorrect results.	Try acquiring the signals again by pressing the Run button.

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Table 3-9: Measurement errors

Signal rate measurement errors or warning			
E301	There should be at least two cross over time values to calculate the signal rate	For signal rate calculations, the application expects a minimum of two cross over points.	Try acquiring the signals again by pressing the Run button.
E306	Device/ File doesn't match with the selected speed	The application expects that the signal rate should be within 30% of the specified signal rate of the Low, Full and High Speed signals.	Please check the speed of the connected device. Ensure that the selection in application is same. For example, if a Low Speed unit is under test, make sure Low Speed is selected in the application.
JK and KJ Jitter Measurement Errors			
E304	Number of bits is not sufficient to calculate JK jitter	More than four cross over points are expected by the algorithm.	Try acquiring the signal again by pressing Run button.
E305	Number of bits is not sufficient to calculate KJ jitter	More than four cross over points are expected by the algorithm.	Try acquiring the signal again by pressing Run button.

Table 3-10:Report generation errors

Report Generation Errors			
E401	Error generating report in Plug Fest format	This error is generated if there are no results to process.	Check if the valid directory and file name is selected for report generation. Check if the file name extension is .htm. Try generating the report again by pressing Run button.
E402	Error Generating report in Tek format	This error is generated if there are no results to process.	Check if the valid directory and file name are selected for report generation. Check if the file name extension is .htm. Try generating the report again by pressing Run button.
E403	Error Generating report in CSV format	This error is generated if there are no results to process.	Check if the valid directory and file name s are selected for report generation. Check if the file name extension is .htm. Try generating the report again by pressing Run button.
E404	No results present to generate report	This error is generated if there are no results present for the USB Inrush, Droop and Signal Quality Check Reports.	Press the Run button to get the results and try again.
E405	Could not generate a report as the Eye diagram is missing	This error is generated if there is no eye diagram found in C:\TekApplications\TDSUSB2\temp	Press the Run button and perform the measurements again.

| E406 | Could not generate report as Waveform plot is missing | This error is generated if there is no waveform plot found in C:\TekApplications\TDSUSB2\temp | Press the Run button and perform the measurements again. |

Table 3-11: Eye and Inrush measurements errors

Eye Measurements			
E601	The maximum zoom factor has been reached	N/A	Press the Reset button or use the Zoom out feature.
E602	Signal not proper, check the signal	This is a check to confirm the acquired waveform.	Try acquiring the correct waveform.
Inrush Measurements			
E501	Final data point is still above the inrush threshold	The signal has not fallen below the Inrush threshold level	Try acquiring the correct waveform

Table 3-12: Utilities errors

Utilities			
E701	Number of edges found in the waveform is less than required edges (user input) to perform the deskew operation.	Before starting the deskew operation, the application tries to find out if the edge(s) available for deskew operation is greater than or equal to the number of edges needed.	Adjust the timebase and (or) increase the record length. Perform the deskew operation by entering less number of edges.
E702	Propagation delay is more than one cycle.	The deskew operation is performed on the same signal source. Check whether dissimilar signals or any external sources (like different probes) are used.	Check whether the same signal source is used for the "From" and "To" channels. Check whether the bandwidth of the probes is sufficient for the signal bandwidth.
E701	Number of edges found in the waveform is less than required edges (user input) to perform the deskew operation.	Before starting the deskew operation, the application tries to find out if the edge(s) available for deskew operation is greater than or equal to the number of edges needed.	Adjust the timebase and (or) increase the record length. Perform the deskew operation by entering less number of edges.
E702	Propagation delay is more than one cycle.	The deskew operation is performed on the same signal source. Check whether dissimilar signals or any external sources (like different probes) are used.	Check whether the same signal source is used for the "From" and "To" channels. Check whether the bandwidth of the probes is sufficient for the signal bandwidth.

Table 3-13: TSV file generator errors:

TSV File Generator			
E721	Error in generating a .tsv file	This message is generated if there is an error while generating the .tsv file for the given inputs.	Check the correctness of the input .csv file(s) and the output .tsv file.
E722	Timestamp of the two .csv files did not match. Conversion failed.	There will be two separate .csv files, one for D+ and another for D-. Each of these files consist of the time values of the D+ and D- signal. It is expected that both the files should have Data at same time stamp.	Try generating the .tsv file with a new set of .csv files.
E725	Invalid CSV file format	This happens if the user does not use a valid CSV file format for the CSV-TSV file conversion	Check whether the CSV files are generated using the TDS694C instrument or TDS5000, TDS6000, TDS7000 series of instruments. For the TDS5000, TDS6000, TDS7000 series of instruments, ensure that "Include waveform scale factors" is selected while generating a CSV file.

| E723 | .csv file(s) not found | The .csv file(s) are needed for the .csv source mode selection are not found. Two valid .csv files are needed for the Single-ended signals and one valid .csv file is needed for Differential signals. | Check that the extension of the file(s) is .csv. Make sure to press the Enter key while entering the file name in the file selection field to update old file names. |
| E724 | tsv file not found | A valid .tsv file is needed as destination file. | Make sure to press the Enter key while entering the file name in the file selection field to update old file names. |

Table 3-14: Save and recall errors

Save and Recall			
E751	The file name has invalid characters and could not be saved	The application expects the file names in alphanumeric characters.	Make sure the valid characters are used in the file names.
E754	The file name has invalid characters and could not be recalled	The application expects the file names in alphanumeric characters.	Make sure that valid characters are used in the file names.
E752	The file doesn't exist	The file name selected for recall does not exist.	Recall an existing filename.
E753	The saved file has been corrupted and not recalled	The application saves the application settings with the .ini file extension. The data inside the file should not be modified by user.	Try recalling a correct file. Store the settings to a new file and recall it when needed.

Table 3-15: Rise Time/Fall Time

Save and Recall			
E901	The High level values needs to be decreased	If no edge is found in the high level the message is displayed.	Decrease the percentage of the high level values of Rise Time/Fall Time
E902	The Low level values needs to be increased	If no edge is found in the low level the message is displayed	Decrease the percentage of the low level values of Rise Time/Fall Time.
E903	Both the High and Low level values needs to be changed	If no edge is found in the high and low level the message is displayed	Increase and decrease the percentage of the high and low level values of Rise Time/Fall Time
E904	The calculated Rise Time is more than the calculated bit time of the input signal	This warning appears when the calculated Rise Time is more than the calculated bit time of the input signal.	Increase the lower level and decrease the upper level of the configure limits of Rise Time/Fall Time
E905	The calculated Fall Time is more than the calculated bit time of the input signal	This warning appears when the calculated Fall Time is more than the calculated bit time of the input signal	Increase the lower level and decrease the upper level of the configure limits of Rise Time/Fall Time
E906	The calculated Rise Time and Fall Time is more than the calculated bit time of the input signal	This warning appears when the calculated Rise Time and Fall Time is more than the calculated bit time of the input signal	Increase the lower level and decrease the upper level of the configure limits of Rise Time/Fall Time

Settings for the Settings for the TDS5000, TDS6000 and TDS7000 Series of Instruments

This section gives a list of default instrument settings that the application uses for TDS5000, TDS6000, TDS7000 series of instruments.

The recommended voltage probe for single-ended signals is the P6245 probe and for differential signals is the P6249 probe. The next table shows the instrument settings for Low Speed and Full Speed signals for the TDS5000, TDS6000, TDS7000 series of instruments.

Upstream Setup for Low Speed signals

Table 3-15 shows the upstream setup for low speed signals.

Table 3-15: Upstream Setup for Low Speed signals

Ch.	Vertical Setups			Horizontal Setup			Trigger Setup					Repeat state
	Position	Scale	Offset	Record length	Main scale	Trigger pos.	Trigger type	Logic func.	Pattern limits	Threshold	Trigger mode	
Ch1 (D-)	0	1 V	0	5000	2.00E-06	74%	Logic	AND	>100 ns	800 mV	Normal	Off
Ch2 (D+)	0	1 V	0	N/A	N/A	N/A	N/A	N/A	N/A	800 mV	N/A	N/A
Ch3 Qualify	0	1 V	0	N/A	N/A	N/A	N/A	N/A	N/A	2.7 V	N/A	N/A

Upstream Setup for Full Speed signals

You can test the Full Speed devices at Tier 6. This testing is also known as legacy testing.

When Full Speed and Low Speed device is High Speed capable, the application uses the signal rate limits of Full Speed Low Speed devices which are not High Speed capable for PASS or FAIL.

Table 3-16 shows the upstream setup for full speed signals.

Table 3-16: Upstream Setup for Full Speed signals

Ch.	Vertical Setups			Horizontal Setup				Trigger Setup					Repeat state
	Position	Scale	Offset	Record length	Main scale	Trigger pos.	Fit to screen	Trigger type	Logic func.	Pattern limits	Threshold	Trigger mode	
Ch1 (D-)	0	1 V	0	5000	200 E-09	83 %	On	Logic	AND	>100 ns	800 mV	Normal	Off
Ch2 (D+)	0	1 V	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	800 mV	N/A	N/A
Ch3 Qualify	0	1 V	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.7 V	N/A	N/A

Downstream Setups for Low Speed signals

Table 3-17 shows the downstream setup for low speed signals.

Table 3-17: Downstream Setup for Low Speed signals

Ch.	Vertical Setups			Horizontal Setups			Trigger Setup				Repeat state
	Position	Scale	Offset	Record length	Main scale	Trigger pos.	Trigger type	Slope	Threshold	Trigger mode	
Ch1 (D-)	0	1 V	0	5000	4.00E-06 s	36%	Edge	Rise	1.65 V	Normal	Off
Ch2 (D+)	0	1 V	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Downstream Setups for Full Speed signals

Table 3-18 shows the downstream setup for full speed signals.

Table 3-18: Downstream Setup for Full Speed signals

Ch.	Vertical Setups			Horizontal Setups				Trigger Setup				Repeat state	Hold off mode
	Position	Scale	Offset	Record length	Main scale	Trigger pos.	Fit to screen	Trigger type	Slope	Threshold	Trigger mode		
Ch1 (D-)	0	1 V	0	5000	400 E-09s	5%	On	N/A	N/A	N/A	N/A	N/A	5 s
Ch2 (D+)	0	1 V	0	N/A	N/A	N/A	N/A	Edge	Rise	1.65 V	Normal	Off	N/A

Upstream Setup for High Speed signals

Table 3-19 shows the upstream setup for high speed signals (Probe Function External Attenuation 1.0).

Table 3-19: Upstream Setup for High Speed signals

Ch.	Vertical Setup Position Scale Offset			Horizontal Setup Record Main Trigger Fit to Length scale pos. screen				Trigger Setup Trigger Threshold Trigger Type mode			Repeat state	Hold off mode	Display Mode
Differ-ential	0	0.1 V	0	20000	2.00 E-07	10 %	On	Edge	176 mV	Normal	Off	1.20 E-06 s	Sin(x)/x

Inrush Setup

Table 3-20 shows the inrush current setup.

Table 3-20: Inrush Setup

Vertical Setup Pos.	Scale	Offset	Coupling	Horizontal Setup Record length	Main scale	Trigger pos.	Trigger Setup Trigger type	Slope	Threshold	Trigger mode	Display mode	Hold off mode
-3	1 A	0	DC	25000	1.00E-05	10%	Edge	Rise	20 mA	Normal	Sin(x)/x	100 E-09

Droop Setup

Table 3-21 shows the droop test setup.

Table 3-21: Droop Setup

Ch.	Vertical Setup Pos.	Scale	Offset	Coupling	Horizontal Setup Record length	Main scale	Trigger pos.	Trigger Setup Trigger type	Slope	Threshold	Display mode	Acquisition mode
Ch1 (Vbus)	2	200 mV	5	DC	5000	2.00 E-05	50%	N/A	N/A	N/A	N/A	Average 16 Points
Ch2 Droop Trigger load	-3	2 V	0	DC	N/A	N/A	N/A	Edge	Rise	2.5 V	Sin(x)/x	N/A

Chirp Setup

Table 3-22 shows the droop test setup.

Table 3-22: Chirp Setup

Ch.	Vertical Setup				Horizontal Setup			Trigger Setup				Repeat state	Hold off	Display mode
	Pos.	Scale	Offset	Coupling	Record length	Main scale	Trigger pos.	Trigger type	Slope	Threshold	Trigger mode			
Ch1 (D+)	-3.4	.5 V	0	DC	5000	4.00 E-04	10%	Edge	Fall	1.35 V	Normal	Off	1.00 E-04	Sin(x)/x
Ch2 (D-)	-3.4	.5 V	0	DC	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Settings for the TDS694C Instrument

This section gives a list of default instrument settings that the application uses for TDS694C instrument.

Upstream Setups for Low Speed signals

Table 3-23 shows the upstream setup for low speed signals.

Table 3-23: Upstream Setup for Low Speed signals

Ch.	Vertical Setup				Horizontal Setup			Trigger Setup				Trigger mode	Repeat state
	Pos.	Scale	Offset	Coupling	Record length	Main scale	Trigger pos.	Trigger type	Logic function	Pattern limit	Threshold		
Ch1 (D-)	0	1 V	0	DC	5000	2.00 E-07s	74%	Logic	AND	>100 ns	800 mV	Normal	Off
Ch2 (D+)	0	1 V	0	DC	N/A	N/A	N/A	N/A	N/A	N/A	800 mV	N/A	N/A
Ch3 Qualify	0	1V	0	DC	N/A	N/A	N/A	N/A	N/A	N/A	2.7 V	N/A	N/A

Downstream Setups for Low Speed signals

Table 3-24 shows the downstream setup for low speed signals.

Table 3-24: Downstream Setup for Low Speed signals

Ch.	Vertical Setup				Horizontal Setup			Trigger Setup			
	Position	Scale	Offset	Coupling	Record length	Main scale	Trigger pos.	Trigger type	Slope	Threshold	Trigger mode
Ch1 (D-)	0	1V	0	DC	2500	5.00 E-07s	6%	Edge	Rise	1.65 V	Normal
Ch2 (D+)	0	1V	0	DC	N/A	N/A	N/A	N/A	N/A	800 mV	N/A

Upstream Setups for Full Speed signals

Table 3-25 shows the downstream setup for low speed signals.

Table 3-25: Upstream Setup for Full Speed signals

Ch.	Vertical Setup				Horizontal Setup			Trigger Setup					Repeat state
	Pos.	Scale	Offset	Coupling	Record length	Main scale	Trigger pos.	Trigger type	Logic function	Pattern limit	Threshold	Trigger mode	
Ch1 (D-)	0	1V	0	DC	5000	25 E-9s	83%	Logic	AND	>100 ns	800 mV	Normal	Off
Ch2 (D+)	0	1V	0	DC	N/A	N/A	N/A	N/A	N/A	N/A	800 mV	N/A	N/A
Ch3 Qualify	0	1V	0	DC	N/A	N/A	N/A	N/A	N/A	N/A	2.7 V	N/A	N/A

Downstream Setups for Full Speed signals

Table 3-26 shows the downstream setup for full speed signals.

Table 3-26: Downstream Setup for Full Speed signals

Ch.	Vertical Setup				Horizontal Setup			Trigger Setup				Repeat state	Hold off mode
	Position	Scale	Offset	Coupling	Record length	Main scale	Trigger pos.	Trigger type	Slope	Threshold	Trigger mode		
Ch1 (D-)	-1.5	1 V	0	DC	5000	50.0 E-9 s	5%	N/A	N/A	N/A	N/A	N/A	5 s
Ch2 (D+)	-1.5	1 V	0	N/A	N/A	N/A	N/A	Edge	Rise	1.65 V	Normal	Off	N/A

High Speed Setup

Table 3-27 shows the downstream setup for high speed signals (Probe Function External Attenuation 1.0).

Table 3-27: High Speed Setup

Ch.	Vertical Setup				Horizontal Setup			Trigger Setup			Repeat state	Hold off time
	Pos.	Scale	Offset	Coupling	Record length	Main scale	Trigger pos.	Trigger type	Threshold	Trigger mode		
Differ-ential	0	0.2 V	0	DC	15000	5.00 E-09s	10%	Edge	176 mV	Normal	Off	1.20 E06

Inrush Setup

Table 3-28 shows the inrush setup.

Table3-28: Inrush Setup

Vertical Setup				Horizontal Setup			Trigger Setup				Display mode	Hold off mode
Pos.	Scale	Offset	Coupling	Record length	Main scale	Trigger pos.	Trigger type	Slope	Threshold	Trigger mode		
-3	1.0 A	0	DC	5000	1.00 E-05	10%	Edge	Rise	20 mA	Normal	Sin(x)/x	100 E-09

Droop Test

Table 3-29 shows the droop test setup.

Table 3-29: Droop Test

Ch.	Vertical Setup				Horizontal Setup			Trigger Setup			Display mode	Acquisition mode
	Pos.	Scale	Offset	Coupling	Record length	Main scale	Trigger position	Trigger type	Slope	Threshold		
Ch1 (Vbus)	2	200 mV	5	DC	5000	2.00 E-06	50%	N/A	N/A	N/A	N/A	Average 16 Points
Ch2 Droop Trigger load	-3	2 V	0	DC	N/A	N/A	N/A	Edge	Rise	2.5 V	Sin(x)/x	N/A

Chirp Setup

Table 3-30 shows the chirp test setup.

Table 3-30: Chirp Setup

Ch.	Vertical Setup				Horizontal Setup			Trigger Setup				Repeat state	Display mode
	Pos.	Scale	Offset	Coupling	Record length	Main scale	Trigger pos.	Trigger type	Slope	Threshold	Trigger mode		
Ch1 (D+)	-3	.5 V	0	DC	15000	2.00 E-05	35%	Edge	Fall	1.35 V	Normal	Off	Sin(x)/x
Ch2 (D-)	-3	.5 V	0	DC	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Setting up the PC to work with the TDS694C Instrument

You must ensure proper connection between the PC and TDS694C instrument before starting the application. You must perform the following steps to set up this connectivity:

1. Install the third party GPIB card in the PC.

2. Install the GPIB driver provided by the third party vendor.

3. Connect the GPIB cable between the PC and the TDS694C instrument.

4. Verify the connectivity by issuing a GPIB query for identification from the PC to the TDS694C instrument using the `*IDN?` GPIB command. The response from this command includes 'TDS694C' as the second word as in the following example:
   `TEKTRONIX,TDS 694C,0,CF:91.1CT FV:v6.4e`

Parameters

About Application Parameters

This section describes the TDSUSB2 application parameters, and includes the menu default settings. You should refer to the user manual for your instrument for operating details of other controls, such as front-panel buttons.

The parameters for the menus and options list the selections or range of values available for each of the following menus, and include the default values.

- File

- Save/Recall

- Preferences

- Measurements

- Configure Signal Quality

- Configure Inrush Current

- Configure Droop

- Results

- Utilities

- Control Menu

File Menus

File Menu   There are no parameters for the File menu items.

Save and Recall Menu   There are no parameters for the Save and Recall menu.

Preferences   Table 3-31 lists the selections for the Preferences menu and range of values available for each.

Table 3-31: Preferences menu parameters

Parameters	Selections	Default setting
Warn if the configuration was not changed since last run	On, Off	On
Show the Eye Diagram window when applicable without having to press Eye Diagram button in the results screen	On, Off	On
Show the Waveform Plot window when applicable without having to press Waveform Plot button in the results screen	On, Off	On
Show the report when generated	On, Off	On
Low Speed or Full Speed device with USB2.0 silicon	On, Off	Off
Prompt for the Drop Test readout during report generation (disables Automatic Report Generation)	On, Off	Off
Allow the user configuration of the limits	On, Off	Off
Allow the user to place the cursors for Packet Identification	On, Off	Off
Always show waiver mask in the eye diagram	On, Off	Off

Measurement Menus

The options available under the Measurements menu are as follows:

- Select

- Configure

Measurement Select Menu Table 3-32 lists the options in the Select Measurements menu by area and the selections and range of values available for each.

Table 3-32: Measurement select menu parameters

Parameters	Selection	Default setting
Low Speed	Eye Diagram Signal Rate EOP Width Rise Time Fall Time Cross Over Voltage Consecutive Jitter Paired JK Jitter Paired KJ Jitter Inrush Current Droop test	None
Full Speed	Eye Diagram Signal Rate EOP Width Rise Time Fall Time Cross Over Voltage Consecutive Jitter Paired JK Jitter Paired KJ Jitter Inrush Current Droop test	Eye Diagram
High Speed	Eye Diagram Signal Rate EOP Width Rise Time Fall Time Monotonic Property Chirp Receiver Sensitivity Inrush Current Droop test	None
Device ID	User defined or fsfe_001	fsfe_001
Device Description	User defined or Dummy Device	Dummy Device

Measurement Configure Menu

You can configure the parameters for the selected measurements. The configurations for the Signal Quality, Inrush, and Droop tests are available as different menus.

Configure Signal Quality Measurement

Tables 3-33 through 3-34 list the parameters in the Configure Signal Quality Measurements menu and the selections and range of values available for each.

Table 3-33: Signal quality measurement: Configure tab parameters

Parameters	Selections	Default setting
Tier	Tier 1, Tier 2, Tier 3, Tier 4, Tier 5, Tier 6	Tier 6
Direction	Upstream, Downstream	Upstream
Test Point	Near End, Far End	Far End

Table 3-34: Signal quality measurement: Source tab parameters

Parameters	Selections	Default setting
Live/Ref Differential	Ch1, Ch2, Ch3, Ch4 Ref1, Ref2, Ref, Ref4	Ch1
Live/Ref Single Ended D+	Ch1, Ch2, Ch3, Ch4 Ref1, Ref2, Ref, Ref4	Ch1
Single Ended D–	Ch1, Ch2, Ch3, Ch4	Ch2
Qualifier	Ch1, Ch2, Ch3, Ch4 Ref1, Ref2, Ref, Ref4	Ch3
File	None	C:\TekApplications\tdsusb2\tsvfiles\FS_SQC.tsv

Configure Inrush Current Measurement

Tables 3-35 through 3-36 list the parameters in the Configure Inrush Current Measurement menu and the selections and range of values available for each.

Table 3-35: Inrush current measurement: Configure tab parameters

Parameters	Selections	Default setting
Tier	None	Tier 1
Vbus	Range	5.15V
Device Type	Hot Plug Attach Low Power Configure Low Power Resume High Power Configure High Power Unconfigure High Power Resume	Hot Plug Attach

Table 3-36: Inrush current measurement: Source tab parameters

Parameters	Selections	Default setting
Live/Ref	Ch1, Ch2, Ch3, Ch4 Ref1, Ref2, Ref, Ref4	Ch4
File	None	C:TekApplications\tdsusb2\tsvfiles\LS_INRUSH.tsv

Configure Droop Test

Tables 3-37 and 3-38 list the parameters in the Configure Droop Test menu and the selections and range of values available for each.

Table 3-37: Droop test: Configure tab parameters

Parameters	Selections	Default setting
Port	Port 1, Port 2, Port 3, Port 4, Port 5, Port 6, Port 7	Port 1
Device Type	Self Powered Hub Bus Powered Hub	Bus Powered Hub

Table 3-38: Droop test: Source tab parameters

Parameters	Selections	Default setting
Live/Ref	Ch1, Ch2, Ch3, Ch4 Ref1, Ref2, Ref, Ref4	Ch1
VBUS channel	Ch1, Ch2, Ch3, Ch4 Ref1, Ref2, Ref, Ref4	
Trigger	Ch1, Ch2, Ch3, Ch4	Ch2
File	None	C:\TekApplications\tdsusb2\tsvfiles\FS_SQC.tsv
V_{BUS} source	Ch1, Ch2, Ch3, Ch4	Ch1

Results Menu

Results Menu   There are no parameters for the Results Menus.

Utilities Menus

Utilities Menu   There are three Utilities menu items:

- Deskew

- Report Generator

- TSV File Generator

Deskew Table 3-39 lists the parameters in the Deskew menu and the selections and range of values available for each.

Table 3-39: Deskew menu parameters

Parameters	Selections	Default setting
Source1 Ref level1 Hysteresis1	Ch1, Ch2, Ch3, Ch4 0 -100 % 0-25%	Ch1 50.0 5.0
Source2 Ref level2 Hysteresis2	Ch1, Ch2, Ch3, Ch4 0 -100 % 0-25%	Ch2 50.0 5.0
Slope	Rise, Fall	Fall
Edges	1 to 50	1

Report Generator Menu Table 3-40 lists the parameters in the Report Generator menu and the selections and range of values available for each.

Table 3-40: Report generator menu parameters

Parameters	Selections	Default setting
Report Format	Tektronix specific, Plug-Fest format, CSV format	Tektronix specific
Generation	Automatic, Manual	Manual
File name	None	C:\TekApplications\tdsusb2\report\fsfe_001-sqc-tek.htm

TSV File Generator Menu Table 3-41 lists the parameters in the TSV File Generator menu and the selections and range of values available for each.

Table 3-41: TSV file generator menu parameters

Parameters	Selections	Default setting
Input	CSV, Live	C:\TekApplications\tdsusb2\csv files\csvFile001.csv
CSV Waveform Source	Single-Ended (D+ D–) Differential	Single-Ended C:\TekApplications\tdsusb2\tsvfilegenerator\Dplus.csv C:\TekApplications\tdsusb2\tsvfilegenerator\Dminus.csv C:\TekApplications\tdsusb2\tsvfilegenerator\Differential.csv

TSV File name	TSV Source File	C:\TekApplications\tdsusb2\tsvfilegenerator\TsvFile001.tsv

Help Menu

Help Menu There are no parameters for the Help menu.

See Also

Using Online Help on page 12

Control Menu

Control Menu Table 3-42 lists the parameters in the Control menu and the selections and range of values available for each.

Table 3-42: Control menu parameters

Parameters	Selections
Run	None
Hide	None
Exit	None

Measurement Algorithms

About Measurement Algorithms

The TDSUSB2 package performs measurements for the USB2.0 compliance. This section contains information about the algorithms used by the application to perform each measurement.

See Also

Cross Over Voltage for Low Speed and Full Speed Signals

You can define the Cross over point as the point where the Data+ line voltage crosses the Data– line voltage. The voltage value at this point is called the Cross over Voltage and the time value is called the Cross over time.

You can define the Reference points as the ideal cross over points that are generated from the first crossover by adding one bit time. In the next figure, C1, C2, C3, C4 and C5 are called Cross over Points and R1, R2, R3, R4, R5, R6 and R7 are called Reference points.
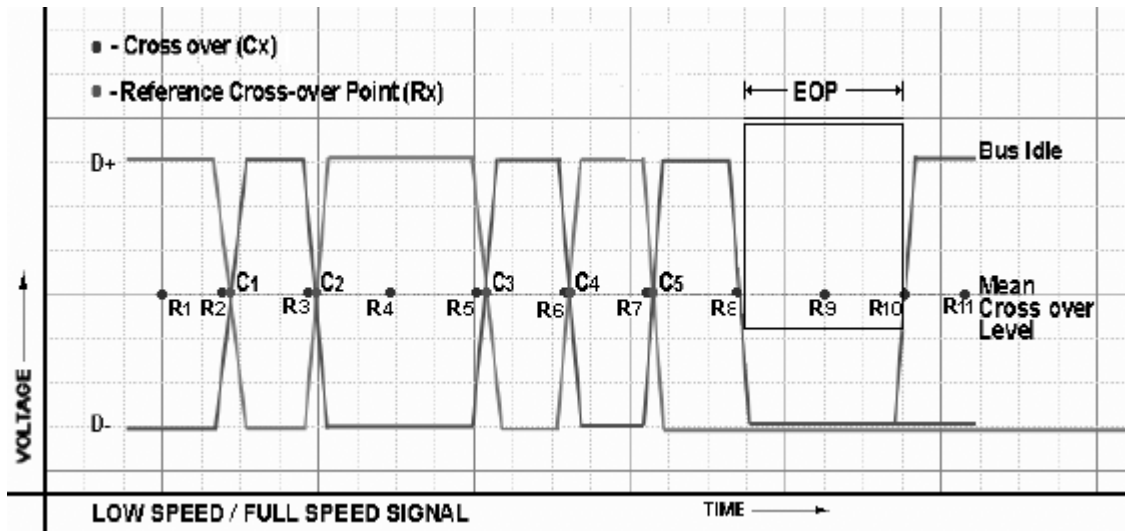
Figure 3-1: Low or full speed pulse diagram

The next figure explains the interpolation technique used to find the actual cross over where p1 and p2 are the two adjacent data points of the D+ signal and q1 and q2 are the two adjacent data points of the D– signal.
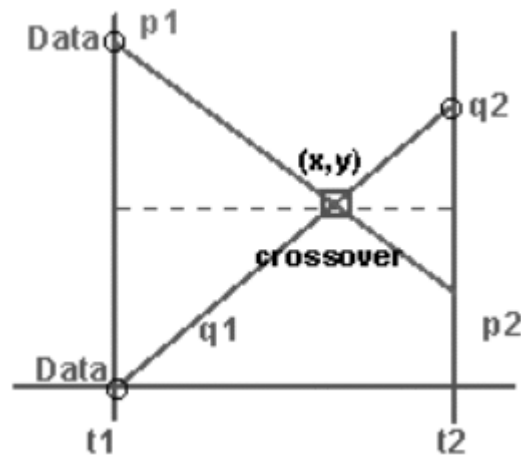
Figure 3-2: Intersection of D+ and D– single ended signal (low or full speed)

The intersection of the four voltage points p1, p2, q1, and q2 gives the cross over point for Voltage level (y) and time (x). x and y coordinates are obtained by solving the following two equations:

$$(p1 - y)/(x - t1) = (p1 - p2)/(t2 - t1)$$

$$(q2 - y)/(t2 - x) = (q2 - q1)/(t2 - t1)$$

Where: p1,p2, q1, and q2 are the consecutive data points of a single-ended signal.

x and y are the cross over coordinates x and y that is given by the intersection of p1, p2, q1, and q2.

t1 and t2 are the time values for the data points p1 and p2.

Cross over Voltage for High Speed Signals

The Cross over is defined as that point where the Differential line voltage becomes zero. The voltage value at this point is called the Cross over Voltage and the time value is called the Cross over Time.
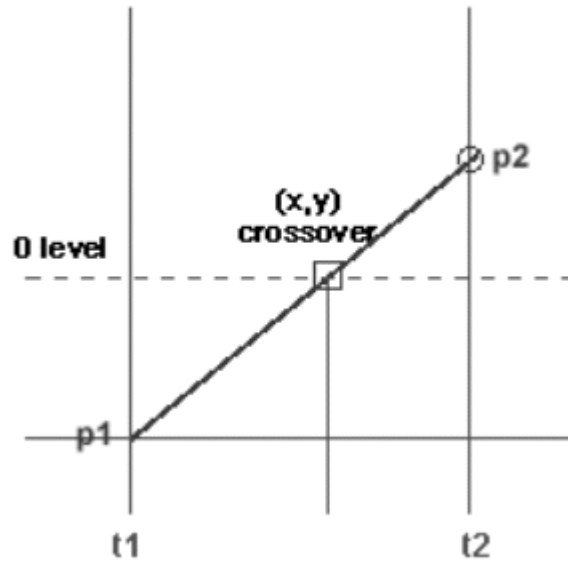
Figure 3-3:Zero crossing of differential signal (high speed)

The following algorithms are used for High Speed signals for Crossover voltage.

$$(p2-y)/(t2-x) = (p2-p1)/(t2-t1)$$

$$y = 0$$

for High Speed y=0

If,

$$p1 \neq p2$$

$$x = (p2t1 - p1t2)/(p2-p1)$$

If,

$$p1 = p2$$

$$x = (t1+t2)/2$$

Where: p1 and p2 are the consecutive data points of a single-ended signal.

x and y are the coordinates of the point where the Differential line voltage becomes zero.

t1 and t2 are the time values for the data points p1 and p2.

> *NOTE: Low Speed and Full Speed Signals are acquired with single-ended probes that enable finding the Cross over Voltage.*
>
> *For High Speed devices, the signal is differential, Cross over voltage is zero and crossover time is the interpolation of two data points at zero crossings.*

Signal Rate You can define the signal rate for Low or Full speed signals as the inverse of the average bit time that gives the transmission rate of the USB2.0 signal. For high speed signals, the signal rate is defined as the inverse of the average bit time that gives the transmission rate of the Test_Packet.
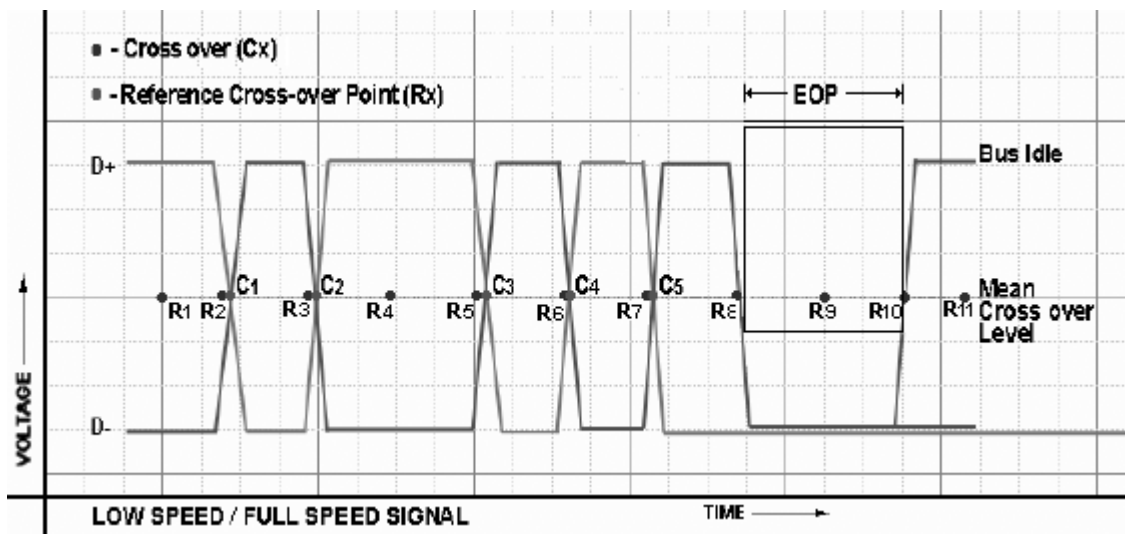
Figure 3-4: Low or full speed pulse diagram

The average signal rate is the calculated average of number of bits divided by sum of all periods.

$$AverageSignalRate = \sum_{i=0}^{lastcrossover} \frac{SumWeights}{SumPeriod}$$

$$BitTime = C2 - C1$$

Where: SumWeights is the total number of bits in the packet.

SumPeriod is the sum of all time periods between the crossovers.

C1 and C2 are the cross over points.

Bit time is the difference of the time values of C2 and C1.

EOP Width Calculation You can define the EOP width for Low or Full speed signals as the width of the end-of-packet of a USB2.0 signal. For high speed signals, it is defined as the width of the end-of-packet pattern of a Test_Packet.
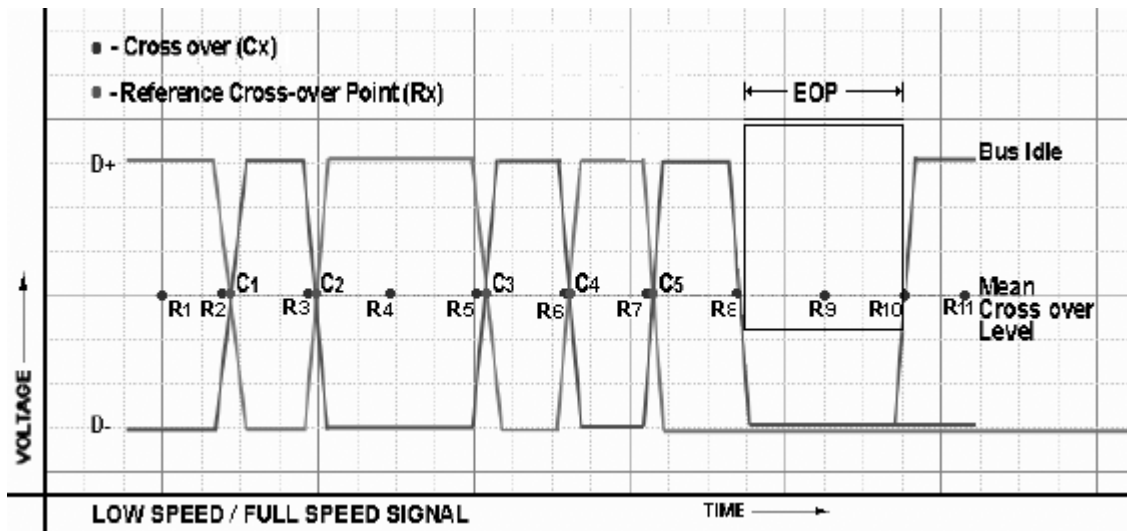
Figure 3-5: Low or full speed pulse diagram

EOP Width is calculated as shown below.

$$EOP Width = (EOP2 - EOP1)$$

Where: EOP1 and EOP2 are the data points on a USB2.0 signal crossing the Mean Cross over level. The cross over level is the mean value of all crossovers in the USB2.0 packet.

Consecutive and Paired Jitter   You can test two types of Jitter measurements: Consecutive and Paired Jitter. Consecutive jitter measures the consecutive data bit calculated using the signal rate.
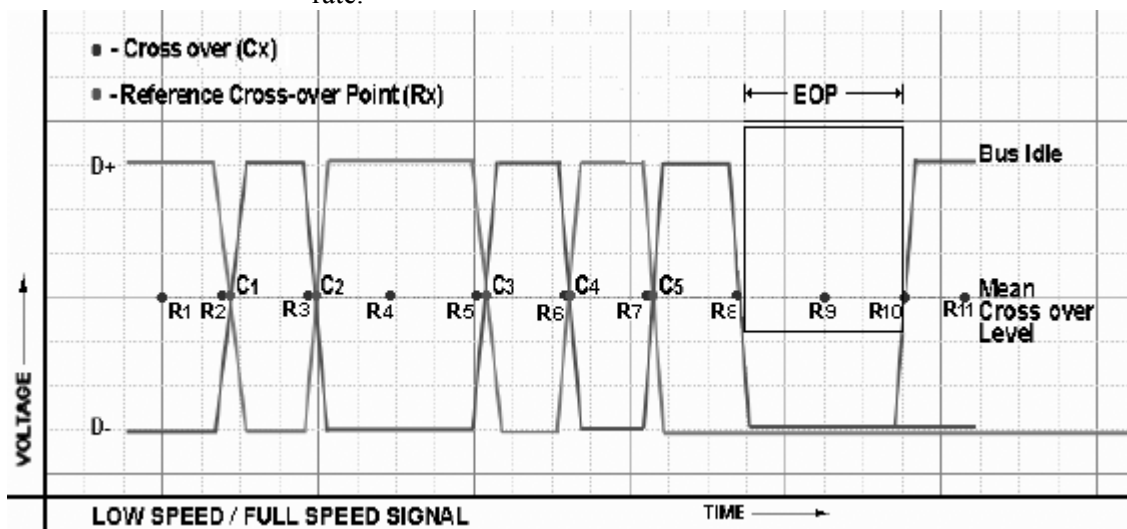
Figure 3-6: USB2.0 signal pulse diagram

Consecutive jitter is calculated as follows.

$$Consecutive Jitter[1] = R1 - C1$$

$$ConsecutiveJitter[2] = R2 - C2$$

$$ConsecutiveJitter[3] = R3 - C3$$

$$ConsecutiveJitter[4] = R4 - C4$$

Where: C1, C2, C3, and C4 are the cross over points.

R1, R2, R3, and R4 are the reference points.

Consecutive jitter is the difference between the time values at Rx and Cx.

Consecutive jitter is calculated for all crossovers of the USB2.0 signal.

Paired JK Jitter is defined as the jitter time for paired (JK next to KJ) differential data transition. Paired KJ Jitter is defined as the jitter time for paired (KJ next to JK) differential data transition. They are calculated for all the consecutive jitters as,

$$PairedJKjitter[1] = ConsecutiveJitter[2] - ConsecutiveJitter[4]$$
$$PairedKJjitter[1] = ConsecutiveJitter[1] - ConsecutiveJitter[3]$$

and so on till the last crossover.

Eye Diagram   The Eye Diagram checks whether the USB signal is aligned with its corresponding eye diagram. It represents the whole signal by splicing it into a number of waveforms of unit interval (each waveform is of one bit time interval) scaled and represented on the eye masks.
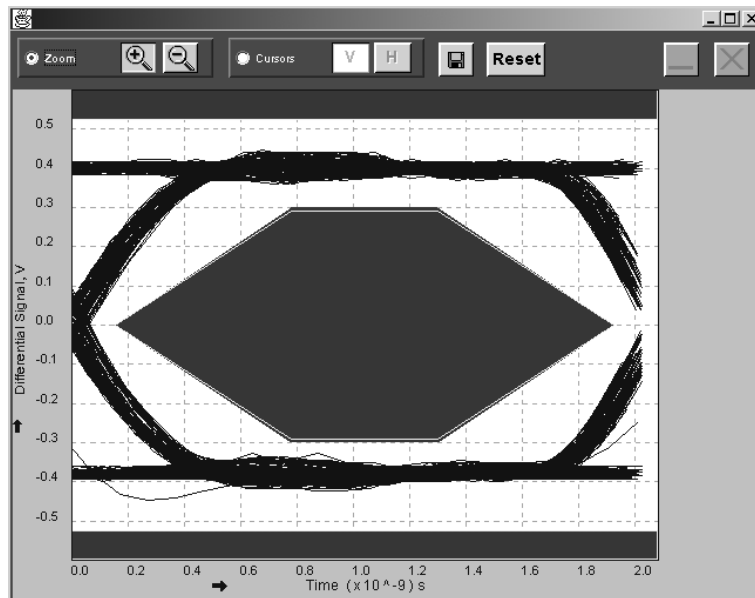
Figure 3-7: Eye diagram

Eye Violation

Eye violations are calculated using the Polygon Collision Algorithm on any waveform violating the eye masks. The results of the Eye Violation are PASS if the waveform does not violate the Eye Masks. The result is FAIL if the waveform violates the Eye Masks.

The result is CONDITIONAL PASS if the waveform violates the eye mask, but is within the waiver mask.

By default, the application displays the waiver mask if the result is either CONDITIONAL PASS or FAIL. If you select the option "Always show the waiver mask in the eye diagram" in File> Preferences menu, the waiver mask is displayed irrespective of the result.

Inrush Current

Inrush Current is calculated by recording all the current values above the 100 mA current level throughout the signal. This is the charge in Coulombs and is calculated using the equation,

$$\int idt$$

Where: i is the current waveform above 100 mA.
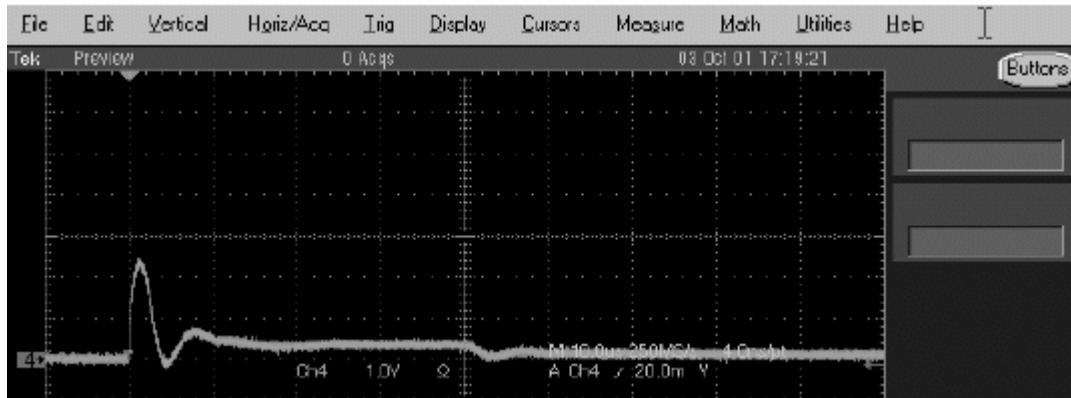
Figure 3-8: Inrush current output

Capacitance is calculated by using the equation,

$$Q = CV$$

Where: C is the capacitance.

Q is the charge.

V is the voltage.

Droop Test

Droop voltage is the difference between the VBUS value when the droop load is off and the lowest voltage of the VBUS value when the droop load is powered on.

$$DroopVoltage = VoltageValue_{LoadOff} - LowestVoltage_{LoadOn}$$

Receiver Sensitivity Test   You can test the receiver sensitivity of a high speed device to respond to the particular data pattern generated by the USB Data Generator (DG2040). Receiver Sensitivity responds whenever the data pattern level is above the voltage level is greater than 150 mV and does not respond when the voltage level is equal to or less than 100 mV below the squelch level. The application provides the procedural steps to do this test.
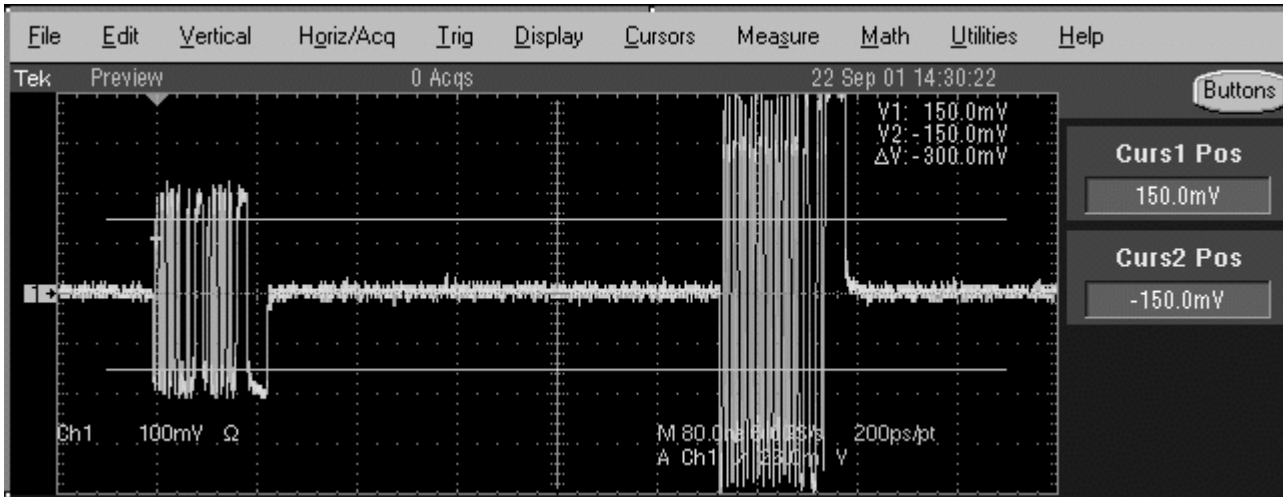
Figure 3-9: Receiver sensitivity output

View the procedural steps on page 50.

Chirp Test   This test examines the basic timing and voltages of both upstream and downstream ports during the speed detection protocol. To get the Chirp signal, hot-plug the unit under test (device) and measure the signaling with single ended probes on both lines. The application analyzes data for the following:

- Reset duration

- Chip-K amplitude

- Chirp-K duration
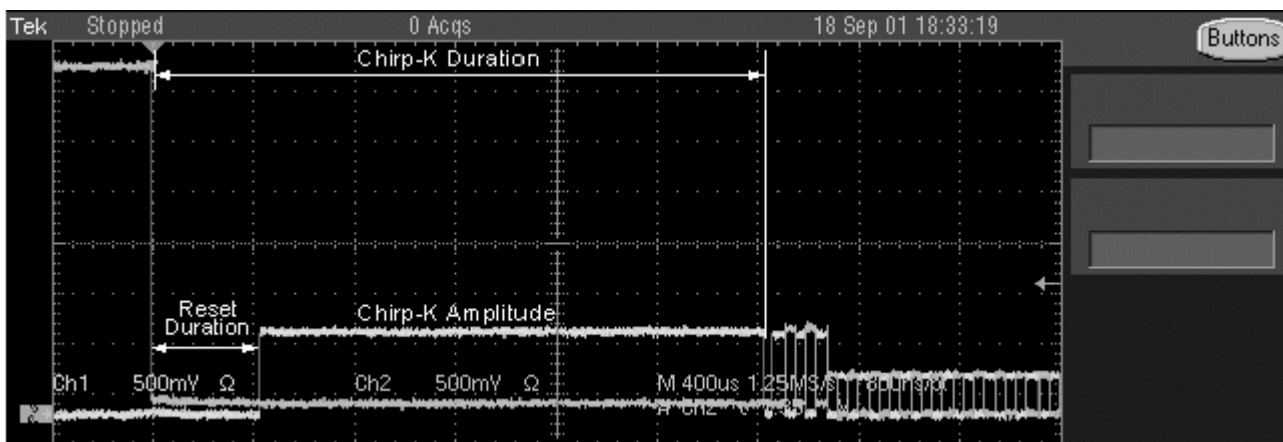
Figure 3-10: Chirp test output

> *NOTE: There must be three K-J pairs after chirp-K that are less than 500 µs. This is to check the response of the device. The response time must be less than 100 µs. You can verify this manually.*

Monotonic Property Test

This algorithm calculates the number of monotonic violations that are present from of the start of the signal to the end of packet (EOP). For the signal to be monotonic, the signal is checked from 15% to 85% of the Peak to Peak differential signal levels or user specified levels.
Monotonicity is calculated for Rising and Falling slopes as
For Rising slope, f(x) is a differential signal if,

$$f(x+1) \geq f(x)$$

signal is monotonic for all values of x till the last data point.

For Falling slope, f(x) is a differential signal if

$$f(x+1) \leq f(x)$$

for all values of x till the last data point.

Rise Time

The Rise Time measurement is the time difference between when the VRefHi reference level is crossed and the VRefLo reference level is crossed on the rising edge of the waveform. The Rise Time algorithm uses the VRef values as the reference voltage level. Each edge is defined by the slope, voltage reference level (threshold) and hysteresis.
The application calculates this measurement using the following equation:

$$T_n^{Rise} = T_n^{Hi} - T_n^{Lo}$$

Where: TRise is the rise time,

THi+ is the VRefHi crossing on the rising edge,

TLo+ is the VRefLo crossing on the rising edge.

Fall Time

The Fall Time measurement is the time difference between when the VRefLo reference level is crossed and the VRefHi reference level is crossed on the falling edge of the waveform. The Fall Time algorithm uses the VRef values as the reference voltage level. The slope, voltage reference level (threshold), and hysteresis define each edge.
The application calculates this measurement using the following equation:

$$T_n^{Fall} = T_n^{Lo} - T_n^{Hi}$$

Where: TFall is the fall time,

TLo-is the VRefLo crossing on the falling edge

THi- is the VRefHi crossing on the falling edge.

Equipment Setup for Tests

Low Speed Downstream Host Equipment Setup

To set up the equipment for Low Speed Downstream test, follow these steps:

1. Connect a cable between the A receptacle from the Inrush test section of the test fixture to the USB device.

2. Connect Ch1 of the D+ probe to the D+ pins on the Inrush section of the test fixture.

3. Connect Ch2 of the D– probe to the D– pins on the Inrush section of the test fixture.

4. Use the connectors to connect the A pin dongle from the Inrush section of the test fixture to any port of the unit under test (host or PC).

5. Select the ![run] command button to run the application.

6. Select OK after acquiring a waveform. Verify that it is a correct waveform.
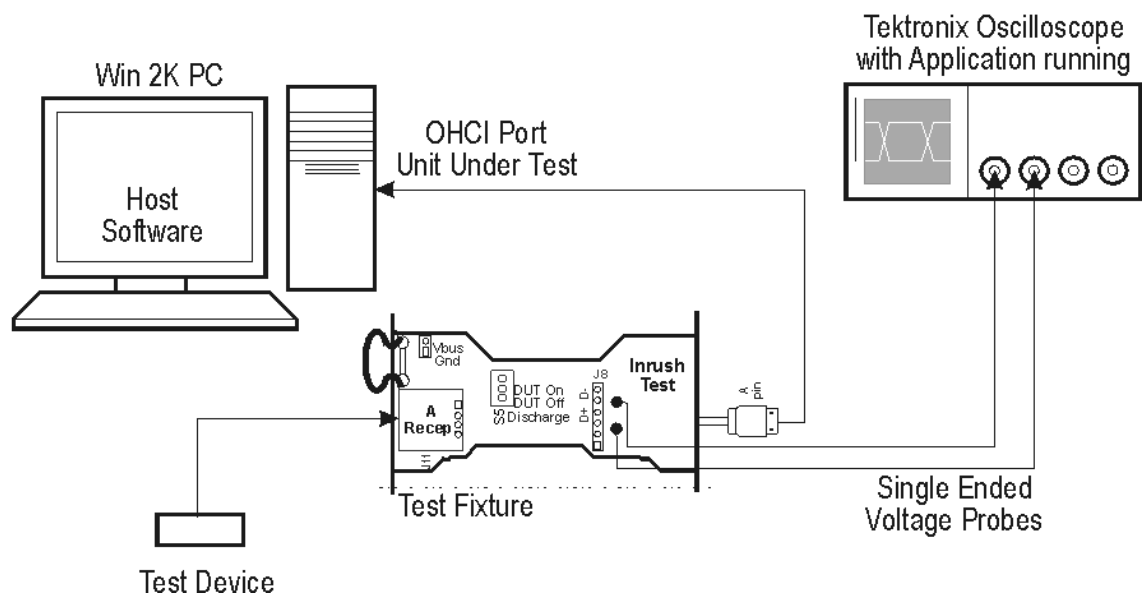
Figure 3-1: Low speed downstream host equipment setup

Low Speed Signal Quality for HUB Downstream

To set up the equipment for Low Speed Signal Quality (hub) test, follow these steps:

1. Connect the A plug dongle from the Inrush Droop section of the test fixture to the port of the unit under test (hub).

2. Connect the low speed test device to the A receptacle on the Inrush Droop section of the test fixture. Keep the Discharge switch always in the ON position.

3. Connect Ch1 of the D+ probe to the D+ pins on the Inrush Droop section of the test fixture.

4. Connect Ch2 of the D– probe to the D– pins on the Inrush Droop section of the test fixture.

5. Select the [icon] command button to run the application.

6. Select OK after acquiring a waveform. Verify that it is a correct waveform.

Figure3-2: Low speed downstream equipment setup

Full Speed Signal Quality HUB Downstream Setup

To set up the equipment for Full Speed Signal Quality Downstream test, follow these steps:

1. Set the S6 switch to the Init position.

2. Use the adapters to connect the dongle from Device SQ test section (marked DUT) of the test fixture to the USB2.0 Low Speed device.

3. Connect Ch1 of the D+ probe to the D+ pins on the Device SQ section of the test fixture.

4. Connect Ch2 of the D– probe to the D– pins on the Device SQ section of the test fixture.

5. Connect the Init port of the Device SQ section of the test fixture to any port of the unit under test (hub) using the USB cable.

6. Select and configure the measurements.

7. Select the command button to run the application.

8. Select OK after acquiring a waveform. Verify that it is a correct waveform.

NOTE: Make sure the acquired signal is a valid waveform.

Figure3-3: Full speed signal quality hub downstream equipment setup

Full Speed Downstream Host Equipment Setup

To set up the equipment for Full Speed Downstream (host) test, follow these steps:

1. Set the S6 switch to the Init position.

2. Connect the dongle from Device SQ test section (marked DUT) of the test fixture to the hub system. Connect the Full Speed test device to the Hub 5.

3. Connect Ch1 of the D+ probe to the D+ pins on the Device SQ section of the test fixture.

4. Connect Ch2 of the D– probe to the D– pins on the Device SQ section of the test fixture.

5. Use the standard 16-ft (five meters) length of USB cable to connect the Device SQ section of test fixture to the test port of the unit under test (host).

6. Select and configure the measurements.

7. Select the command button to run the application.

8. Select OK after acquiring a waveform. Verify that it is a correct waveform.

Full Speed Downstream Host Equipment Setup
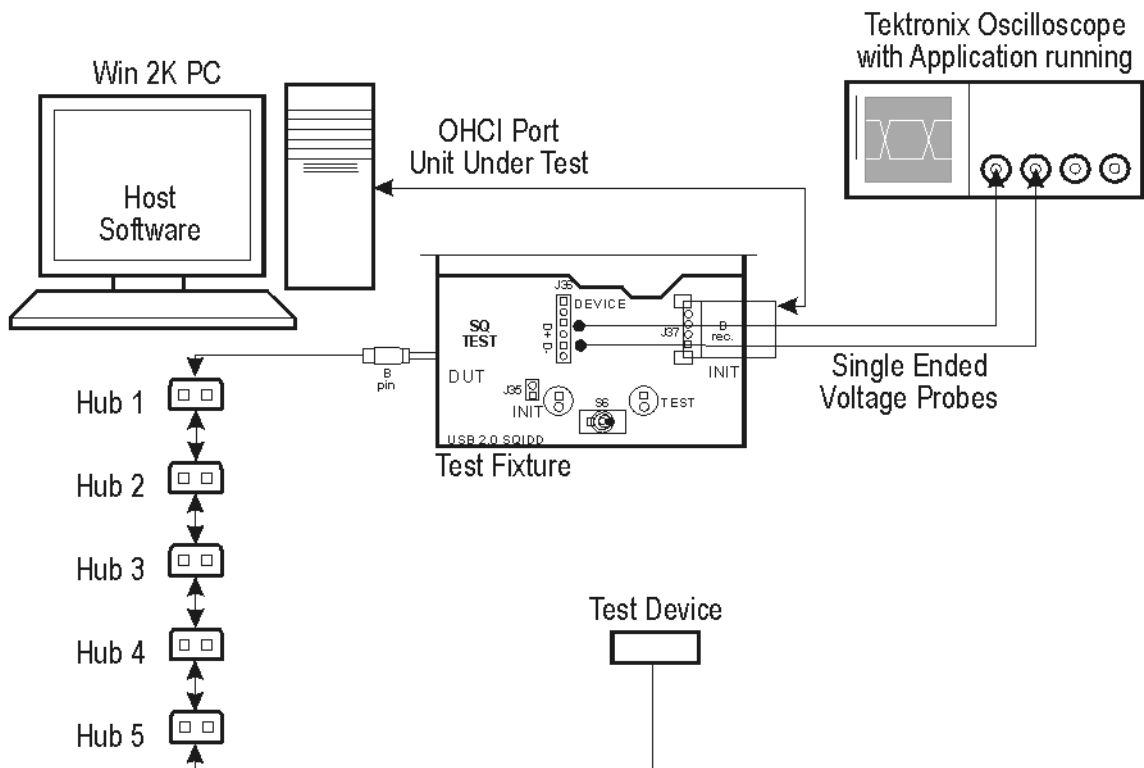
Figure3-4: Full speed downstream host equipment setup

Full Speed Upstream Signal Quality Setup

To set up the equipment for Full Speed Upstream test, follow these steps:

1. Use the A receptacle to connect the USB unit under test (device) to the Inrush Droop section of the test fixture.

2. Connect the Qualifier device to the Adjacent Trigger and Droop section of the test fixture as shown in the next figure.

3. Connect Ch1 of the D+ probe to the D+ pins on the Inrush Droop section of the test fixture.

4. Connect Ch2 of the D– probe to the D– pins on the Inrush Droop section of the test fixture.

5. Connect the D+ (D– for Low speed) pin of the Adjacent Trigger and Droop Section of the test fixture to Ch3 as shown in the next figure.

6. Use the connectors to connect the A pin dongle from the Adjacent Trigger and Droop section of the test fixture to one port of the Hub 5. Use the A pin dongle from the Inrush Droop section of the test fixture to another port of the Hub 5.

7. Select and configure the measurements.

8. Select the command button to run the application.

9. Select OK after acquiring a waveform. Verify that it is a correct waveform.

NOTE: Use the standard 16-ft (five meter) length of USB cables to connect between the hubs. Keep the Discharge switch in the Inrush Droop section in the ON position.
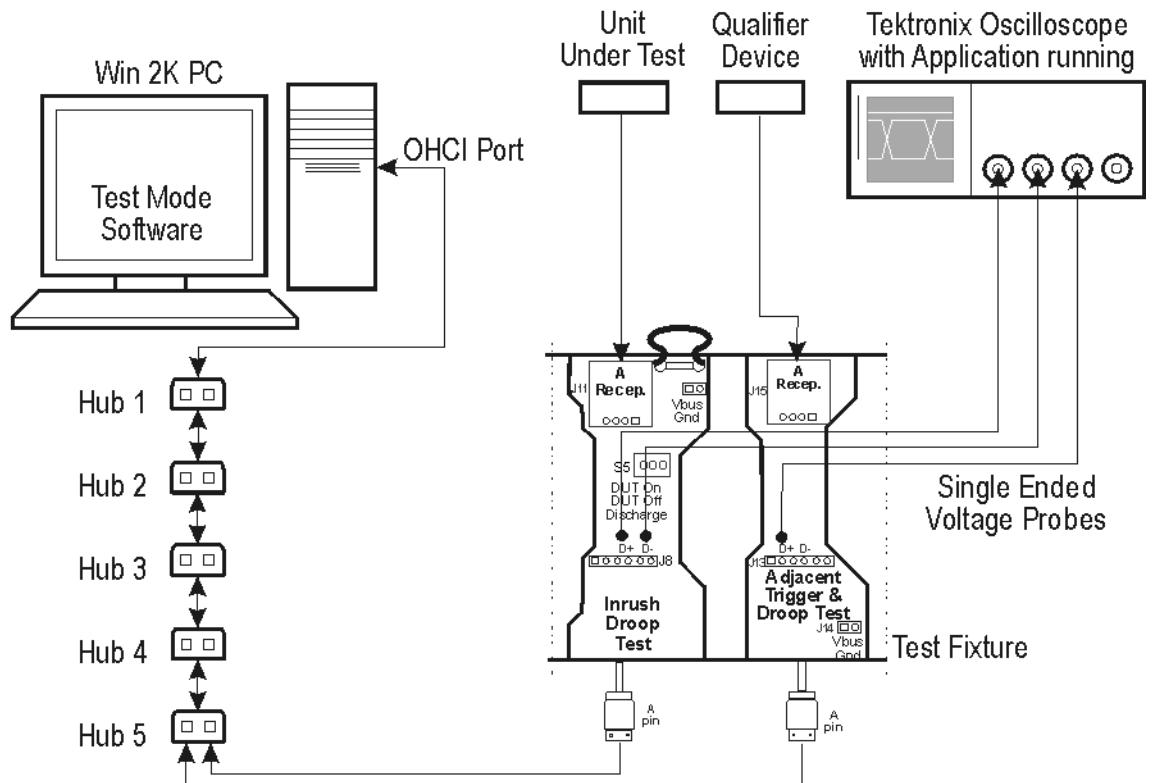
Figure 3-5: Full speed upstream signal quality setup

Full Speed Upstream Signal Quality in the TDS694C Instrument

To set up the equipment for Full Speed Upstream test in the TDS694C instrument, follow these steps:

1. Use the A receptacle to connect the USB unit under test (device) to the Inrush Droop section of the test fixture.

2. Connect the Qualifier device to the Adjacent Trigger and Droop section of the test fixture as shown in the next figure.

3. Connect the Ch1 and Ch2 probes to the D+ and D– pins on the Inrush section of test fixture.

4. Connect Ch1 of the D+ probe to the D+ pins on the Inrush Droop section of the test fixture.

5. Connect Ch2 of the D– probe to the D– pins on the Inrush Droop section of the test fixture.

6. Connect the D+ (D– for Low speed) pin of the Adjacent Trigger Section of the test fixture to Ch3 as shown in the next figure.

7. Use the connectors to connect the A pin dongle from the Adjacent Trigger and Droop section of the test fixture to one port of the Hub 5. Use the A pin dongle from the Inrush Droop section of the test fixture to another port of the Hub 5.

8. Select and configure the measurements.

9. Select the [icon] command button to run the application.

10. Select OK after acquiring a waveform. Verify that it is a correct waveform.

NOTE: Use the standard 16-ft (five meter) length of USB cables to connect between the hubs. Keep the Discharge switch in the Inrush Droop section in the ON position.
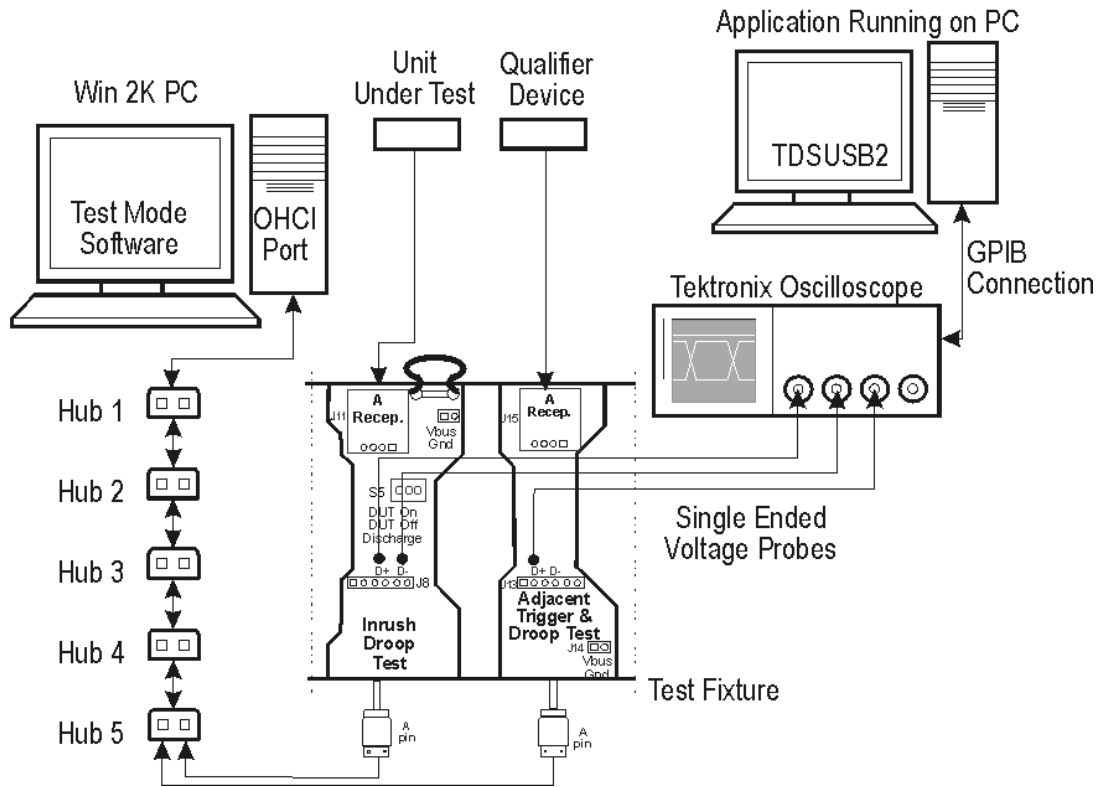
Figure 3-6: Full speed signal quality upstream setup for TDS694C instrument

See Also

Setting up the PC to work with the TDS694C instrument on page 135.

High Speed Signal Quality Setup

To set up the equipment for the High Speed Signal Quality test, follow these steps:

1. Set the S6 switch to the Init position.

2. Connect the standard 16-ft (5 meter) length of USB cable between the Device SQ Init port and the host port.

3. Connect the dongle (marked DUT) from the Device SQ test port of the test fixture to the unit under test (device).

4. Configure the measurements. Select the command button to run the application.

5. Place the device in the test mode Test_Packet from the host controller.

6. Set the test Init switch to the test position to isolate the unit under test while maintaining the bus power.

7. Select OK after acquiring a waveform. Verify that it is a correct waveform.

High Speed Signal Quality
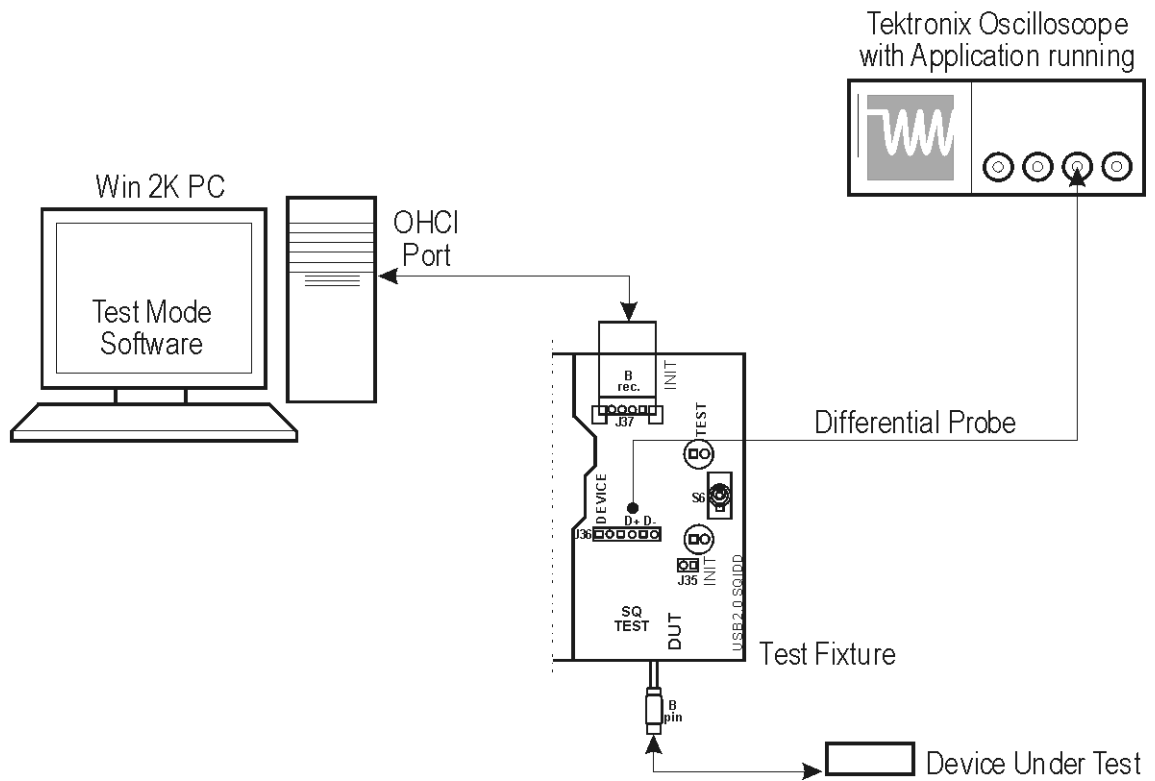
Figure 3-7: High speed signal quality setup

Chirp Test Equipment Setup

The section used for this device test is Device SQ in the test fixture. To set up the equipment for Chirp test, follow these steps:

1. Set the S6 switch to the Init position.

2. Use a standard 16-ft (5 meter) length of USB cable with an A plug on one end and B plug at the other end. Connect one end of the cable to the B receptacle socket connector on the Init port of Device SQ section and the other end to the host port A socket.

3. Connect B plug dongle from the Device SQ test port to the unit under test (device).

4. Connect the single-ended probes of the instrument to the D+ and D– pins.

5. Select the Chirp measurement and select the command button to run the application.

6. Disconnect and connect the unit under test (device) to the port and observe the chirp signal on the instrument.

7. Select OK after acquiring a waveform. Verify that it is a correct waveform.

NOTE: To avoid false triggering for the chirp signals while operating the test fixture, it is recommended that you place the switch in the Init position and connect the unit under test. This disables the switch bounce to the trigger.

Chirp Test Equipment Setup
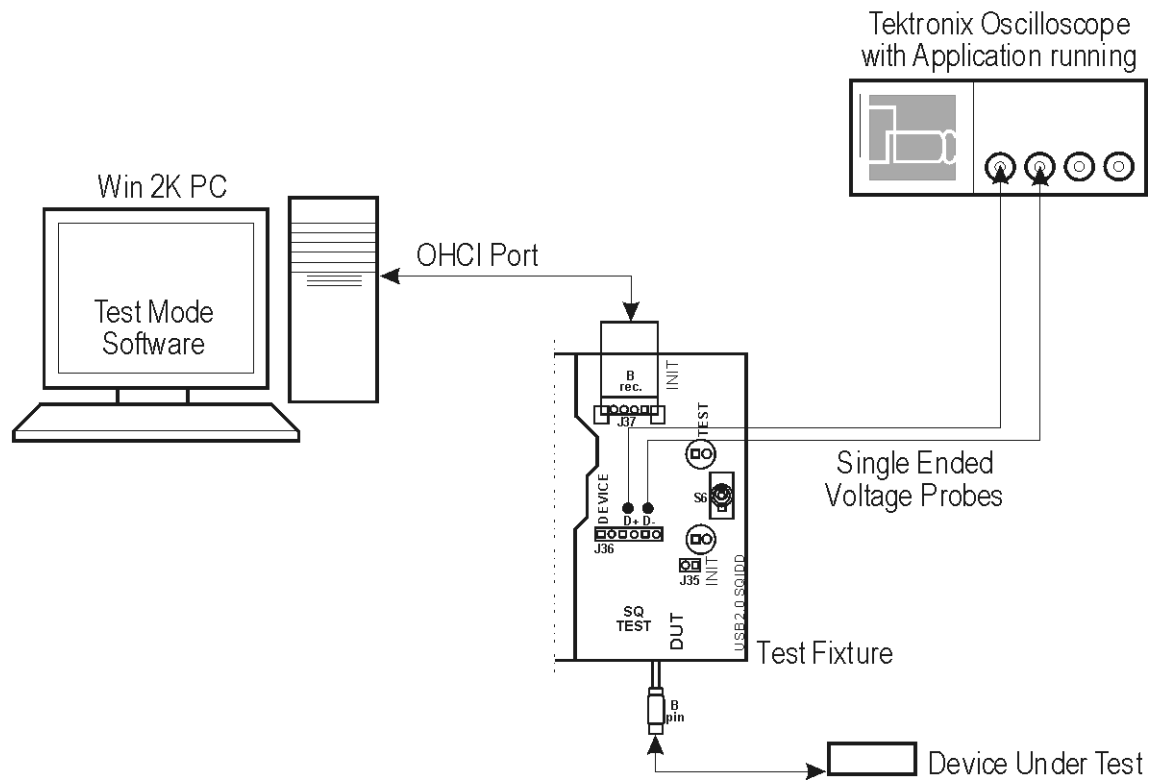
Figure 3-8: Chirp test equipment setup

Receiver Sensitivity Setup

To set up the equipment for Receiver Sensitivity test, follow the procedural steps in the application given on page 50.
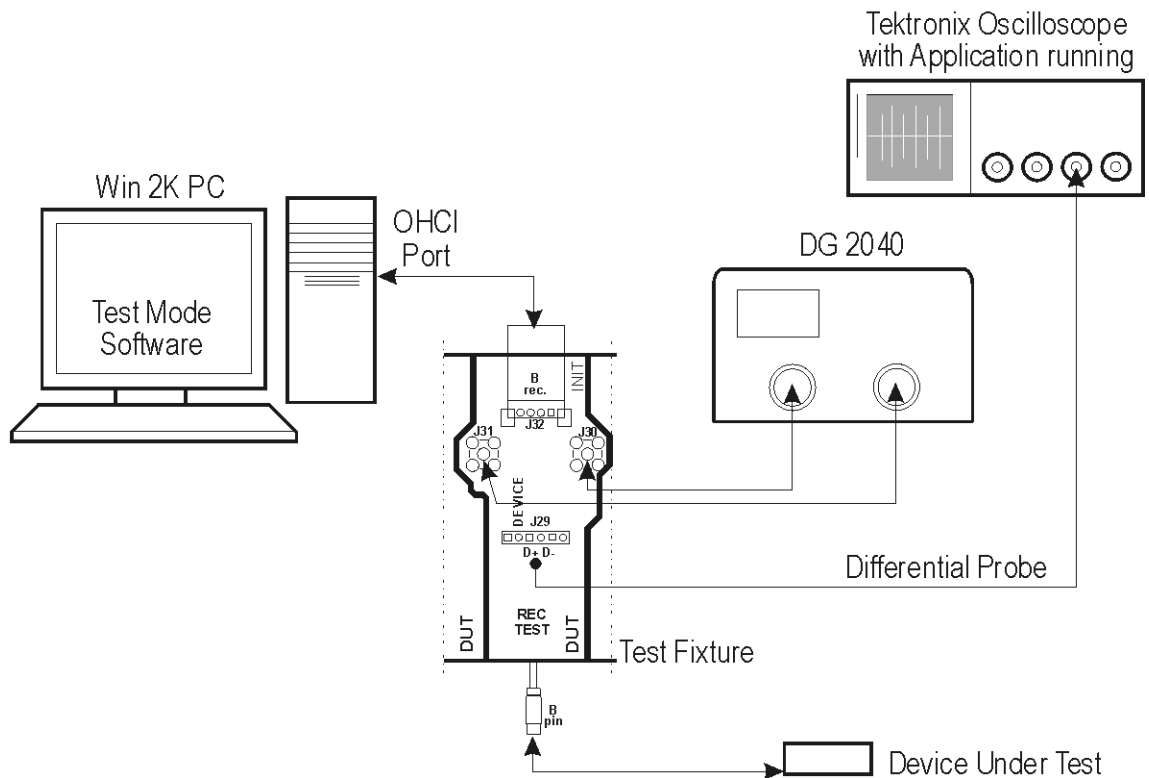
Figure 3-9: Receiver sensitivity test setup

Inrush setup

To set up the equipment for Inrush test, follow these steps:

1. Use the dongles on the Inrush section of the test fixture to connect it to the host system.

2. Connect the current probe between the VBUS loop wire on the Inrush section on the Test fixture and Ch1 of the instrument.

3. Configure the measurement and select the command button to run the application.

4. Connect the unit under test to the A Receptacle of the Inrush section of the test fixture and observe the Inrush current signal.

5. Select OK after acquiring a waveform. Verify that it is a correct waveform.

NOTE: To avoid the triggering of Inrush signals and false inrush current by the discharge switch, place the inrush discharge switch in the ON position and hot-plug the unit under test (device).

In case a valid Inrush signal is not acquired, use the cursor mode in File> Preferences or getup the instrument to get a valid waveform.

Inrush Equipment Setup
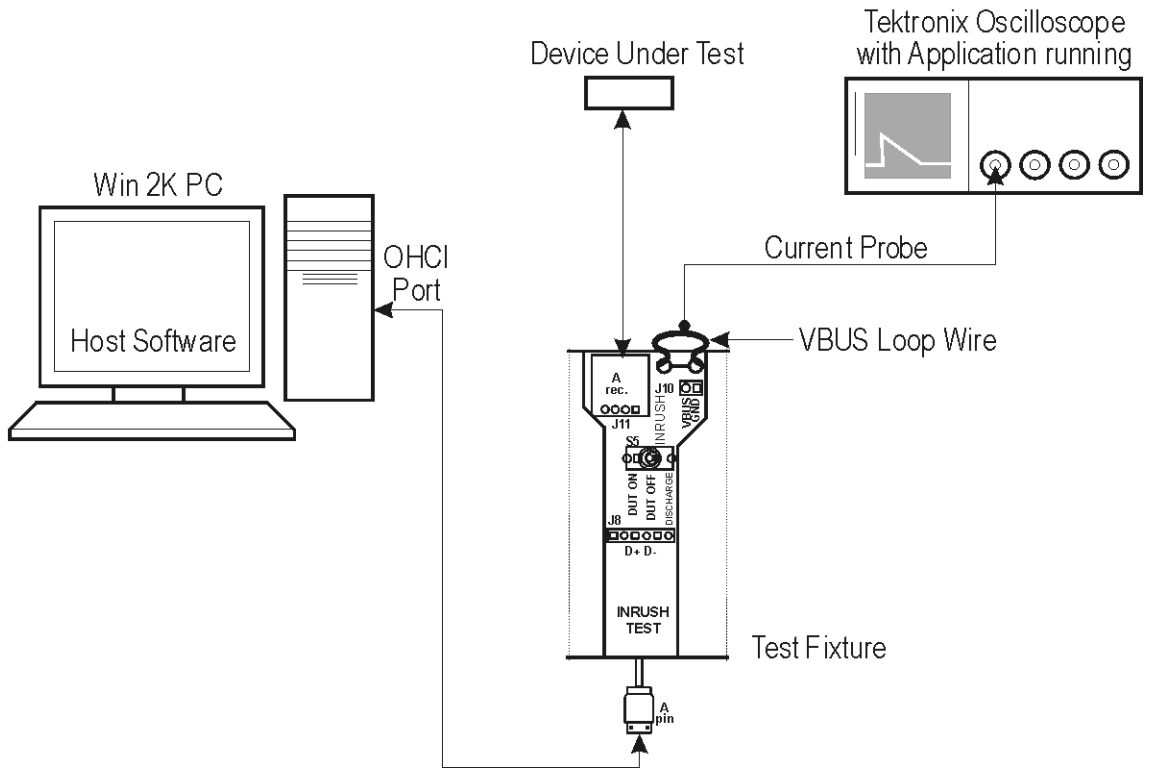
Figure 3-10: Inrush equipment setup

Glossary

Cross over Points
The cross over point is defined as the intersection of the D+ and D– single-ended signals. For differential signals, the cross over is zero crossings of the differential signal.

Downstream
The direction of data flow from the host or away from the host. A downstream port is the port on a hub electrically farthest from the host that generates downstream data traffic from the hub. Downstream ports receive upstream data traffic.

EOP
End-of-Packet.

EOP (E), Idle (I), J, K
The different bus states of the USB signal.

Eye Pattern
A representation of the USB signal that provides minimum and maximum voltage levels, as well as the signal jitter.

Eye Violation
Any part of the waveform, that crosses the defined eye mask.

Full-speed
USB operation at 12 Mb/s.

High-speed
USB operation at 480 Mb/s.

Host
The host computer system where the USB Host Controller is installed. This includes the host hardware platform (CPU, bus, etc.) and the operating system in use.

Host Controller
The host's USB interface.

Hot-Plug
It is the technology that supports automatic configuration of the PC hardware and the attached device. You can attach a device or hot plug and start working without having to manually configure the device. This is how it is referred to in the application.

Hub
A USB device that provides additional connections.

Low-speed
USB operation at 1.5 mb/s.

mb/s
It is the transmission rate expressed in megabits per second.

NAK
A handshake packet indicating a negative acknowledgment.

Pulse Diagram
The Plot of the USB signals showing Annotations of J,K, EOP (E) , Idle (I), Cross over Points (Cov) and Reference Points (Ref).

Reference point
It is the simulation of ideal cross over points which helps for Jitter calculation.

Reflectometer
An instrument capable of measuring impedance characteristics of the USB signal lines.

Sample Rate
It is the number of samples per second, expressed in Hertz (Hz).

Signal Direction Downstream
It is defined as the direction of the data flow away from the host. A downstream port is the port on a hub far most from the host that generates downstream data traffic from the hub. Downstream ports receive upstream data traffic.

Signal Direction Upstream
It is defined as the direction of the data flow towards the host. An upstream port is the port on a device close to the host that generates upstream data traffic from the hub. Upstream ports receive downstream data traffic.

Tier
The position in the hub where the device is connected to the system.

Test Point
A device is classified as far end or near end depending upon the captive cable. A device with captive cable is usually called as a far end device, otherwise as a near end device.

Test Fixture
It is the break-out board that helps in probing signals.

UUT
Called as the Unit Under Test. The unit can be a USB device, port, hub or a host.

Upstream
The direction of data flow towards the host. An upstream port is the port on a device electrically closest to the host that generates upstream data traffic from the hub. Upstream ports receive downstream data traffic.

VBUS

It is the supply voltage which a function or hub requires to work.

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