HSIC Essentials
Electrical Validation and Protocol Decode Solution

Measurements and Setup Library
Methods of Implementation (MOI)

Version 1.0

Technical Reference

077-0779-00

Tektronix

Contacting Tektronix

Tektronix, Inc.
14150 SW Karl Braun Drive
P.O. Box 500
Beaverton, OR 97077
USA
For product information, sales, service, and technical support:
In North America, call 1-800-833-9200.

Revision History			
Version	Issue Date	Pages	Nature of Change
0.1	23 Jul 2012	All	Initial draft version
0.7	27 Sep 2012	All	Added setup files info
0.8	9 Oct 2012	All	Updated with figures. Added Host measurements
0.9	11th Oct 2012	All	Incorporated the review comments
1.0	18th Oct 2012	All	Updated version.

Contents

1 Introduction to the DPOJET HSIC Essentials Setup Library

This document provides the Methods of Implementation (MOI) for performing HSIC transmitter measurements and HSIC Protocol Decoding with Tektronix MSO/DPO5000, DPO7000C, MSO/DPO/DSA70000C/D Win7 64-bit oscilloscopes enabled with option DJA (DPOJET Advanced Jitter and Eye Analysis Tool), and option HSIC. The oscilloscope should have a bandwidth of at least 2 GHz.

Instrument Setup files using DPOJET base measurements are used to perform HSIC specific measurements. DPOJET along with its associated setup files provides transmitter path measurements (amplitude, timing, and jitter), waveform mask testing and limit testing described in the specifications at respective host/device test points.

Table 1 HSIC specifications

Supported Specification Title	Specifications Revision	HSIC Essentials MOI Test Points Defined
Universal Serial Bus Specification	Rev 2.0	Device and Host
High-Speed Inter-Chip USB Electrical Specification	Ver 1.0	
HSIC ECN	Rev 1.0	

In the subsequent sections, step-by-step procedures are described to help you perform HSIC measurements. Each measurement is described as a Method of Implementation (MOI).

For the latest version of this document and the latest HSIC Setup Library, refer to www.tek.com/downloads (keyword ‘HSIC Essentials’).

For further details on HSIC test specifications and compliance testing requirements, you can refer to specification documents available on www.usb.org website.

2 Assumptions

The procedures explained in this document assume that the user will have control of the Device Under Test (DUT) configuration such that the DUT will be able to output the required signal for the testing. The procedures also assume that user has configuration control of the voltage swing in environments where the device supports multiple voltage classes.

3 Equipment Requirements

HSIC Essentials is supported on Tektronix MSO/DPO5000, DPO7000C, MSO/DPO/DSA70000C/D Win7 64-bit oscilloscopes. The following table outlines the equipment requirements for each of these oscilloscope families.

Table 2 List of Equipment

Oscilloscope	Software Options	Probes	Accessories
MSO5204 DPO5204	Opt. HSIC Opt. DJA	Qty. 2 TAP1500	PPM100 Probe Holders
DPO7254C DPO7354C		Qty. 2 TAP1500 or P6245	
MS0/DPO/DSA70000C/D		Qty. 2 P6245 (requires 2 TCA-BNC Adapters. 1 ships with oscilloscope)	

Oscilloscope firmware: TekScope firmware version 6.4.0 or later.

Application Framework: Option DJA: DPOJET Advanced Jitter and Eye Analysis Tool application version 6.0.0 and above.

Application Software: Option HSIC Essentials – Electrical Validation and Protocol Decode Solution (requires DJA). HSIC Essentials software installer includes setup libraries for transmitter measurements and protocol decoder support. Opt. HSIC license key enables setup libraries for transmitter measurements.

4 Accessing the DPOJET HSIC Essentials Measurement Menu

On the oscilloscope TekScope menu, go to Analyze -> HSIC Essentials, and click on it to invoke the HSIC setup library in DPOJET standards tab. Refer to Figure 1.

Figure 1 DPOJET Analyze Menu

4.1 HSIC Essentials Measurement Setup Library

IMPORTANT: Each Setup file is defined with the absolute file paths of the Masks and Limit files used for the respective tests. All Setup files must be in the proper file path locations for correct operation.

The HSIC Measurement Setup Library consists of the following software file types.

HSIC Setup Files

Setup File Library File Path: C:\Users\Public\Tektronix\TekApplications\HSIC\Setups

Description: The HSIC folder contains setup files for the standard. Setup files are available for each group of measurements. Refer to Table 3 of this document for further description.

Saved Setups have been created by using the Save -> Setup function of the supported oscilloscopes. If any changes are made to the Setup file it is recommended you re-save the modified setup file using the Save -> Setup feature of TekScope. Please save them with a different name to avoid writing over the parameters in the factory default distribution files.

HSIC Waveform Masks

Mask Library File Path: C:\Users\Public\Tektronix\TekApplications\HSIC\Masks

Description: The HSIC Mask library contains the waveform mask files used by various setup files. Waveform masks are used to perform Pass/Fail eye diagram template testing on the waveform.

HSIC Limits Files

Limit Library File Path: C:\Users\Public\Tektronix\TekApplications\HSIC\Limits

Description: The HSIC Limits library contains the measurement limit files used by the various setup files. Measurement limits are used to provide Pass/Fail indication for each measurement.

4.2 Specification Test Points and Measurement Setup Library

Test Point Definitions:

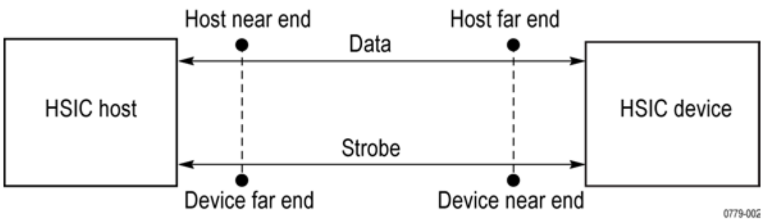


Figure 2 Location of HSIC Test Points

The following table describes the setup file names, supported HSIC test names and corresponding DPOJET base measurements as defined at each test point in the Specification. The limits for these measurements are given in Table 4 of this document.

Table 3 List of measurements supported in Option HSIC Essentials

Option HSIC-Setup file Name	Specification - Reference Section	HSIC Specification - Symbol(s)	HSIC Specification - Parameter/Test name	Option HSIC - DPOJET Base Measurement Method
DeviceSignalQualityNearEnd, DeviceSignalQualityFarEnd, HostSignalQualityNearEnd, HostSignalQualityFarEnd	HSIC spec – Section 4	V_{DD}	HSIC signaling Voltage	High-Low
		T_{slew}	Rise Slew Rate DATA	RiseSlewRate_Data
		T_{slew}	Fall Slew Rate DATA	FallSlewRate_Data
		T_{s}	Receiver Data Setup Time	Setup
		T_{s}	Receiver Data Hold Time	Hold
		F_{strobe}	STROBE Frequency	Frequency
		T_{slew}	Rise Slew Rate STROBE	RiseSlewRate_Strobe
		T_{slew}	Fall Slew Rate STROBE	FallSlewRate_Strobe
	USB2 Spec – Section 7.1.2.2			EyeHeight
				EyeWidth
				EyeMaskHits

The other setup files available in the library include:

DevicePacketParams

DeviceSuspend

DeviceResume

DeviceResetFromSuspend

DeviceResetFromHS

HostPacketParams

HostSOF_EOP

HostSuspend

HostResume

HostResetFromSuspend

HostResetFromHS

5 Preparing to Take Measurements

5.1 Initial Oscilloscope Setup

Connect the oscilloscope to the DUT by using the proper probes for the test. Connect Ch1 to Data and Ch2 to Strobe. Press the DEFAULT SETUP button on the oscilloscope front panel, and turn on Ch1 and Ch2 on the oscilloscope to view the incoming signals on the oscilloscope screen.

Figure 3 below details the connections at the various HSIC test points.

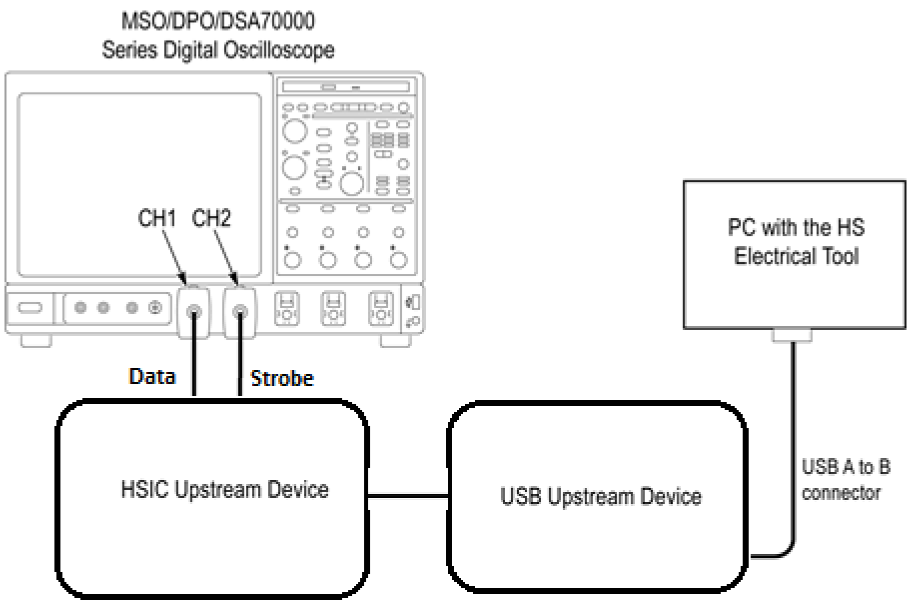


Figure 3 Example Schematic Diagram for a HSIC Device

5.2 Installation

To install HSIC Essentials, , click on the setup.exe present in the Option HSIC installer distribution. After installation, launch TekScope and the HSIC Essentials package is ready to use.

6 HSIC Test Procedure

This section provides the Methods of Implementation (MOIs) for Transmitter tests using Tektronix real-time oscilloscope, probes, and the HSIC DPOJET module.

Note: *It is important that there are probing test points (data and clock) laid out for probing to test this interface. The test points need to be as close to the transmitter and/or the receiver as possible to minimize the reflections observed in the testing of this interface. The reflections will be more pronounced when performing the packet parameter testing and should not impact the ability to make the measurements. In addition, it is important that the test points be of equal length from the transmitter or receiver to ensure accurate setup and hold measurements.*

6.1 Step-by-Step HSIC Device testing

6.1.1 Signal Quality Tests

Scope Setup:

- Connect Ch1 to Data
- Connect Ch2 to Strobe

1. Launch HSIC Essentials from the Analyze menu.
2. In the Standard tab of DPOJET, click on the Setup button.
3. Load setup file – DeviceSignalQualityNearEnd.set.
4. Configure the DUT to send out the USB Test Packet. This can done using the HSET (High Speed Electrical Tool) provided by USB-IF. This setup file can also be used on live traffic.

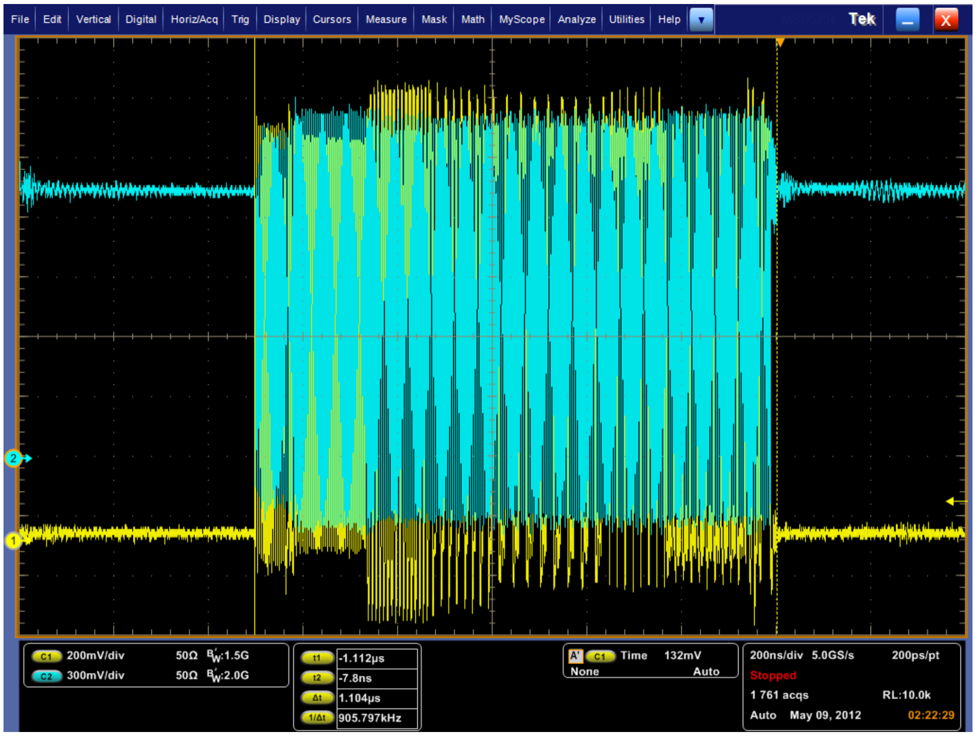


Figure 4 Signal Quality

5. After the setup has been completed, click on the single button in DPOJET. The waveform captured will be as shown in Figure 4.
6. DPOJET automatically selects the limit file based on the test point. The Pass/Fail status is shown in the DPOJET Results tab. Refer to Figure 5. The limits are shown in Table 4 below.

Table 4 Device/Host Signal Quality Pass / Fail Limits

Test	Min	Nominal	Max
High-Low Voltage	1.1 V	1.2 V	1.3 V
Rise Skew rate	0.7 V/ns		2 V/ns
Low Skew Rate	–2 V/ns		–0.7 V/ns
Frequency	239.88 MHz	240 MHz	240.12 MHz
Rx Setup and Hold	365 ps		
Rx Setup and Hold	365 ps		
Eye Mask Hits		Mask File Name: SignalQuality_FarEnd OR SignalQuality_NearEnd	

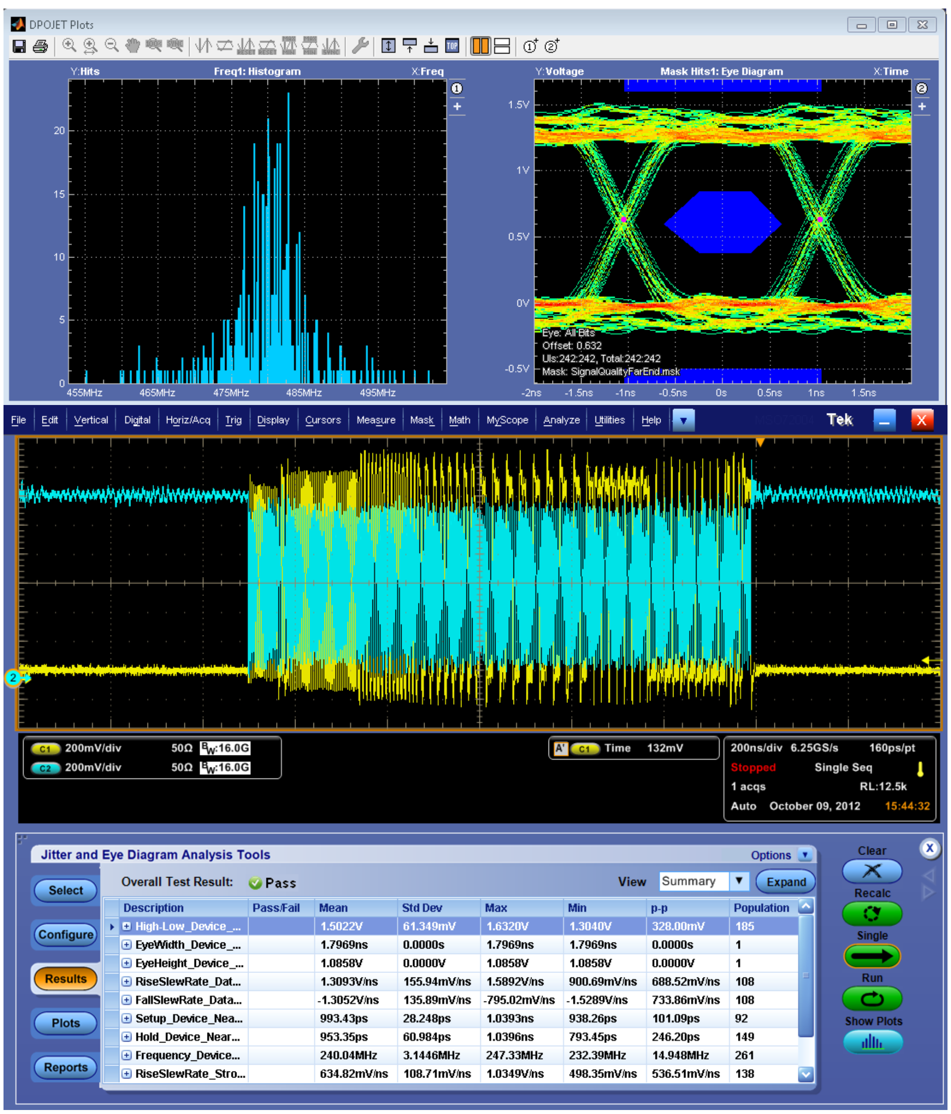
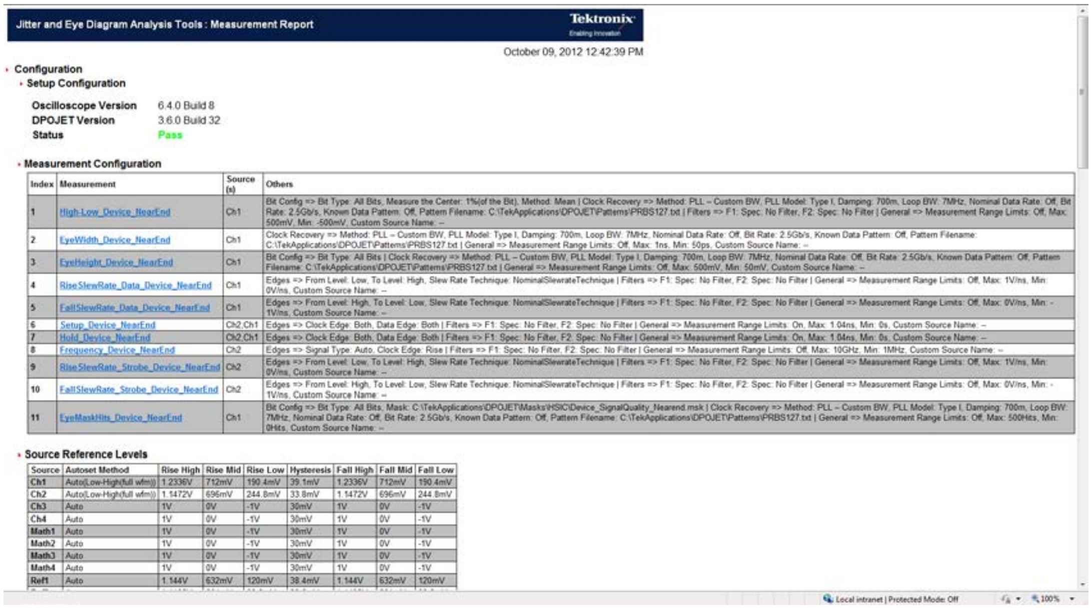


Figure 5 Device Signal Quality Measurement Result

7. Select the Reports button in the DPOJET menu.
8. Press the 'Save As' button and enter the report name.
9. The Report is as shown in Figure 6.



Jitter and Eye Diagram Analysis Tools : Measurement Report

Tektronix

October 09, 2012 12:42:39 PM

Configuration

Setup Configuration

Oscilloscope Version	6.4.0 Build 8
DPOJET Version	3.6.0 Build 32
Status	Pass

Measurement Configuration

Index	Measurement	Source (s)	Others
1	High-Low_Device_NearEnd	Ch1	Bit Config => Bit Type: All Bits, Measure the Center: 1%(of the Bit), Method: Mean | Clock Recovery => Method: PLL – Custom BW, PLL Model: Type I, Damping: 700m, Loop BW: 7MHz, Nominal Data Rate: Off, Bit Rate: 2.5Gb/s, Known Data Pattern: Off, Pattern Filename: C:\TekApplications\DPOJET\Patterns\PRBS127.txt | Filters => F1: Spec: No Filter, F2: Spec: No Filter | General => Measurement Range Limits: Off, Max: 500mV, Min: -500mV, Custom Source Name: –
2	EyeWidth_Device_NearEnd	Ch1	Clock Recovery => Method: PLL – Custom BW, PLL Model: Type I, Damping: 700m, Loop BW: 7MHz, Nominal Data Rate: Off, Bit Rate: 2.5Gb/s, Known Data Pattern: Off, Pattern Filename: C:\TekApplications\DPOJET\Patterns\PRBS127.txt | General => Measurement Range Limits: Off, Max: 1ns, Min: 50ps, Custom Source Name: –
3	EyeHeight_Device_NearEnd	Ch1	Bit Config => Bit Type: All Bits | Clock Recovery => Method: PLL – Custom BW, PLL Model: Type I, Damping: 700m, Loop BW: 7MHz, Nominal Data Rate: Off, Bit Rate: 2.5Gb/s, Known Data Pattern: Off, Pattern Filename: C:\TekApplications\DPOJET\Patterns\PRBS127.txt | General => Measurement Range Limits: Off, Max: 500mV, Min: 50mV, Custom Source Name: –
4	RiseSlewRate_Data_Device_NearEnd	Ch1	Edges => From Level: Low, To Level: High, Slew Rate Technique: NominalSlewrateTechnique | Filters => F1: Spec: No Filter, F2: Spec: No Filter | General => Measurement Range Limits: Off, Max: 1V/ns, Min: 0V/ns, Custom Source Name: –
5	FallSlewRate_Data_Device_NearEnd	Ch1	Edges => From Level: High, To Level: Low, Slew Rate Technique: NominalSlewrateTechnique | Filters => F1: Spec: No Filter, F2: Spec: No Filter | General => Measurement Range Limits: Off, Max: 0V/ns, Min: -1V/ns, Custom Source Name: –
6	Setup_Device_NearEnd	Ch2,Ch1	Edges => Clock Edge: Both, Data Edge: Both | Filters => F1: Spec: No Filter, F2: Spec: No Filter | General => Measurement Range Limits: On, Max: 1.04ns, Min: 0s, Custom Source Name: –
7	Hold_Device_NearEnd	Ch2,Ch1	Edges => Clock Edge: Both, Data Edge: Both | Filters => F1: Spec: No Filter, F2: Spec: No Filter | General => Measurement Range Limits: On, Max: 1.04ns, Min: 0s, Custom Source Name: –
8	Frequency_Device_NearEnd	Ch2	Edges => Signal Type: Auto, Clock Edge: Rise | Filters => F1: Spec: No Filter, F2: Spec: No Filter | General => Measurement Range Limits: Off, Max: 10GHz, Min: 1MHz, Custom Source Name: –
9	RiseSlewRate_Strobe_Device_NearEnd	Ch2	Edges => From Level: Low, To Level: High, Slew Rate Technique: NominalSlewrateTechnique | Filters => F1: Spec: No Filter, F2: Spec: No Filter | General => Measurement Range Limits: Off, Max: 1V/ns, Min: 0V/ns, Custom Source Name: –
10	FallSlewRate_Strobe_Device_NearEnd	Ch2	Edges => From Level: High, To Level: Low, Slew Rate Technique: NominalSlewrateTechnique | Filters => F1: Spec: No Filter, F2: Spec: No Filter | General => Measurement Range Limits: Off, Max: 0V/ns, Min: -1V/ns, Custom Source Name: –
11	EyeMaskHits_Device_NearEnd	Ch1	Bit Config => Bit Type: All Bits, Mask: C:\TekApplications\DPOJET\Masks\HSIC\Device_SignalQuality_Nearend.msk | Clock Recovery => Method: PLL – Custom BW, PLL Model: Type I, Damping: 700m, Loop BW: 7MHz, Nominal Data Rate: Off, Bit Rate: 2.5Gb/s, Known Data Pattern: Off, Pattern Filename: C:\TekApplications\DPOJET\Patterns\PRBS127.txt | General => Measurement Range Limits: Off, Max: 500Hits, Min: 0Hits, Custom Source Name: –

Source Reference Levels

Source	Autoset Method	Rise High	Rise Mid	Rise Low	Hysteresis	Fall High	Fall Mid	Fall Low
Ch1	Auto(Low-High(full wfm))	1.2336V	712mV	190.4mV	39.1mV	1.2336V	712mV	190.4mV
Ch2	Auto(Low-High(full wfm))	1.1472V	696mV	244.8mV	33.8mV	1.1472V	696mV	244.8mV
Ch3	Auto	1V	0V	-1V	30mV	1V	0V	-1V
Ch4	Auto	1V	0V	-1V	30mV	1V	0V	-1V
Math1	Auto	1V	0V	-1V	30mV	1V	0V	-1V
Math2	Auto	1V	0V	-1V	30mV	1V	0V	-1V
Math3	Auto	1V	0V	-1V	30mV	1V	0V	-1V
Math4	Auto	1V	0V	-1V	30mV	1V	0V	-1V
Ref1	Auto	1.144V	632mV	120mV	38.4mV	1.144V	632mV	120mV

Figure 6 Device Signal Quality Measurement Report

6.1.2 Packet Parameter Test

Packet Parameters consist of the following tests:

- **Sync Field –** All transmitted packets (not repeated packets) must begin with a 32 bit SYNC field.
- **Inter-packet gap –** When transmitting after receiving a packet, hosts and devices must provide an inter-packet gap of at least 8 bit times and not more than 192 bit times. Hosts transmitting 2 packets in a row must have an inter-packet gap of at least 88 bit times and not more than 192 bit times.
- **EOP** – The EOP for all transmitting packets (except SOFs) must be an 8 bit NRZ byte of 01111111 without bit stuffing.

All limits for these measurements are taken from USB 2.0 Specification.

Scope Setup:

- Connect Ch1 to Data

1. Launch HSIC Essentials from the Analyze menu.
2. In the Standard tab of DPOJET, click on the Setup button.
3. Load setup file – DevicePacketParams.set.
4. Set trigger to single, then set device to produce the single step set signal. This can done using the HSET (High Speed Electrical Tool) provided by USB-IF. This setup file can also be used on live traffic.
5. The waveform should have 3 bursts of data, similar to Figure 7 below.

Figure 7 Packet Parameter Test – Inter Packet Gap

6. Turn on the Cursors. Click on Cursors menu and select Cursors On. Ensure that the Cursor Type is set to V Bars. Refer to Figure 8.

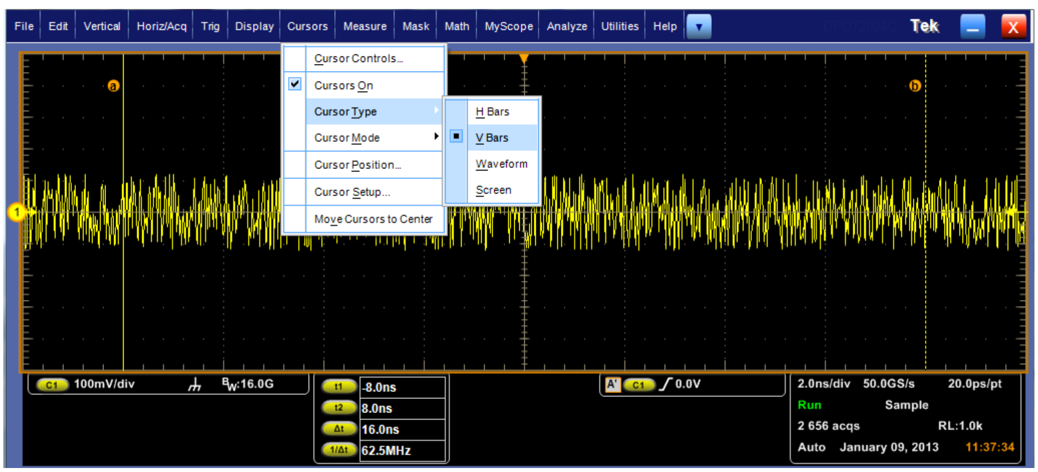


Figure 8 Using cursors

7. Turn on the Zoom feature of the TekScope. Select a region of interest using the mouse to bring up a menu and choose Zoom1 On. Refer to Figure 9.

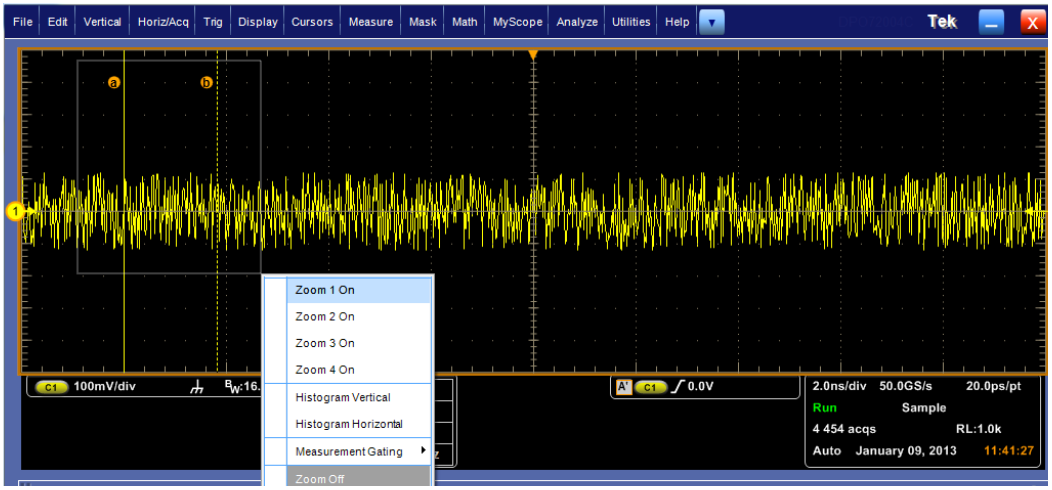


Figure 9 Using zoom feature

8. Turn on the Decode feature. See Section7 of this document for details on setting up the decoder. Ch1 and Ch2 must be turned 'ON' for decoding.

6.1.2.1 Inter Packet Gap Measurement

1. For devices, this measurement should be made between the second and third burst.
2. Zoom in on the gap between the second and third packet and use the cursors to measure the time between bursts. Place 'Cursor a' at the end of 2nd burst and 'Cursor b' at the beginning of the 3rd burst. ΔT value shows the time between the 2 Cursors 'a' and 'b'. Refer to Figure 7 above.
3. The limits, for this measurement to Pass, are between 16.64 ns and 39.94 ms.

6.1.2.2 Sync Field Measurement

1. For devices, this measurement should be made on the third burst.
2. Zoom in on the third packet and use the cursors to measure the sync field. Place 'Cursor a' at the beginning of 3rd burst and 'Cursor b' at the end of Sync field (shows up if the Protocol Decode Bus in turned 'ON'. See Section 7 of this document for details on setting up the decoder. Ch1 and Ch2 must be turned 'ON' for decoding.). Refer to Figure 10.
3. The limits, for this measurement to Pass, are between 65.5 ns and 67.7 ns.

Figure 10 Packet Parameter Test – Sync Field

6.1.2.3 EOP Measurement

1. This measurement is to be done on the third burst. Place 'Cursor a' at the beginning of EOP region of the 3rd burst and 'Cursor b' at the end. Refer to Figure 11.
2. The limits, for this measurement to Pass, are between 14.5 ns and 18.75 ns.

Figure 11 Packet Parameter Test – EOP

Arm the single sequence trigger and forcing the second step of the single step feature to send data from the host; the device should send a response. The waveform should look similar to Figure 12.

6.1.2.4 Second Inter Packet Gap measurement

1. The gap between the two packets needs to be measured.
2. Use the cursors to measure the gap. Place 'Cursor a' at the end of 1st burst and 'Cursor b' at the beginning of the 2nd burst. ΔT value shows the time between the 2 Cursors 'a' and 'b'. Refer to Figure 12.
3. The limits, for the measurement to Pass, are between 16.64 ns and 39.94 ms.

Figure 12 Packet Parameter Test – Inter Packet Gap

In the Reports tab, Press the 'Save As' button and enter the report name. Or press 'Append' to append to the previously saved test report. Screenshots of the zoomed screen will be available in the report.

Alternately, a screenshot can also be saved using the 'Save As' Screen Capture feature of the TekScope.

6.2 Step-by-Step HSIC HOST testing

6.2.1 Signal Quality Test

Scope Setup:

- Connect Ch1 to Data
- Connect Ch2 to Strobe

1. Launch HSIC Essentials from the Analyze menu.
2. In Standards tab of DPOJET, Click on the Setup button.
3. Load setup file – HostSignalQualityNearEnd.set.
4. Configure the DUT to send out the USB Test Packet. This can done using the HSET (High Speed Electrical Tool) provided by USB-IF. This setup file can also be used on live traffic. The waveform is similar to the device signal quality.
5. Place Cursors on either side of the center data packet as shown in Figure 13. Click on the Single button in DPOJET.
6. DPOJET automatically selects the limit file based on the test point with limit values as defined in Table 4 above. The Pass/Fail status is shown in the DPOJET Results tab.
7. Select the Reports button in the DPOJET menu.
8. Press the 'Save As' button and enter the report name. Or press 'Append' to append to the previously saved test report.

Figure 13 Host Signal Quality

6.2.2 Packet Parameter Test

Scope Setup:

- Connect Ch1 to Data

1. Launch HSIC Essentials from the Analyze menu.
2. In the Standard tab of DPOJET, Click on the Setup button.
3. Load setup file – HostPacketParams.set.
4. Set trigger to single, then set device to produce the single step get dev desc signal. This can done using the HSET (High Speed Electrical Tool) provided by USB-IF. This setup file can also be used on live traffic.
   Note: *Refer to Section 7.3 on how to distinguish between Host and Device traffic in an acquired signal.*
5. The waveform should have 3 bursts of data.
6. Turn on the Decode feature. See Section 7 of this document for details on setting up the decoder. Ch1 and Ch2 must be turned 'ON' for decoding.

6.2.2.1 Sync Field Measurement

1. For hosts, this measurement should be made on the first and second burst.
2. Use the cursors to measure the gap. Place 'Cursor a' at the beginning and 'Cursor b' at the end of the Sync field. ΔT value shows the time between the 2 Cursors 'a' and 'b'. Refer to Figure 10.
3. Limits for this measurement to have a Pass result are between 65.5 ns and 67.7 ns

6.2.2.2 EOP Measurement

1. For Hosts, this measurement is to be done on the second burst.
2. Use the cursors to measure the gap. Place 'Cursor a' at the beginning and 'Cursor b' at the end of EOP region of the 2nd burst. Refer to Figure 11.
3. Limits for this measurement to have a Pass result are between 14.5 ns and 18.75 ns.

6.2.2.3 Inter packet Gap

1. For Hosts, this measurement should be made on the first and second burst.
2. Use the cursors to measure the gap. Place 'Cursor a' at the end of 1st burst and 'Cursor b' at the beginning of the 2nd burst. ΔT value shows the time between the 2 Cursors 'a' and 'b'.
3. Limits for this measurement to have a Pass result are between 18.3 ns and 39.94 ms.

Arm the single sequence trigger and forcing the second step of the single step get dev desc feature. The waveform should have 3 bursts.

6.2.2.4 Second Inter Packet Gap measurement

1. The gap between the second and third packets needs to be measured.
2. Use the cursors to measure the gap. Place 'Cursor a' at the end of 2nd burst and 'Cursor b' at the beginning of the 3rd burst. ΔT value shows the time between the 2 Cursors 'a' and 'b'.
3. Use the cursors to measure the gap. The limits for a Pass result are between 16.64 ns and 39.94 ms.

6.2.2.5 SOF EOP measurement

1. Launch HSIC Essentials from the Analyze menu.
2. In the Standard tab of DPOJET, Click on the Setup button.
3. Load setup file – HostSOF_EOP.set.
4. Set trigger to Single, this measurement measures the EOP width of the SOF packet.

5. Use the cursors to measure the gap. Place 'Cursor a' at the beginning and 'Cursor b' at the end of EOP region.
6. The limit for a Pass result is 83.32 ns.

6.3 Bus Timing Measurements

Given below is the table from High-Speed Inter-Chip USB Electrical Specification. Note from the table that the both Strobe and Data are low during Reset.

Table 5 Bus State Signaling

	STROBE	DATA	Description
IDLE	Hi	Lo	1 or more Strobe Periods
CONNECT	Lo	Hi	2 Strobe Periods
RESUME	Lo	Hi	For time periods per USB 2.0 SPEC
SUSPEND	Hi	Lo	Per USB 2.0 SPEC
RESET	Lo	Lo	Per USB2.0 SPEC

The tests mentioned below are easier to measure with the HSIC Decode feature. See Section 7 of this document for details on setting up the decoder.

6.3.1 Suspend Test

Scope Setup:

- Connect Ch1 to Data
- Channel Ch2 to Strobe

1. Launch HSIC Essentials from the Analyze menu.
2. In the Standard tab of DPOJET, Click on the Setup button.
3. Load setup file – DeviceSuspend.set.
4. Set trigger to Single on the scope and configure the DUT to send out the Suspend signal. This can done using the HSET (High Speed Electrical Tool) provided by USB-IF. This setup file can also be used on live traffic.
5. The waveform should look like Figure 14.
6. Once the Idle is found Suspend should last for at least 3 ms. Use Cursors to measure the time duration.

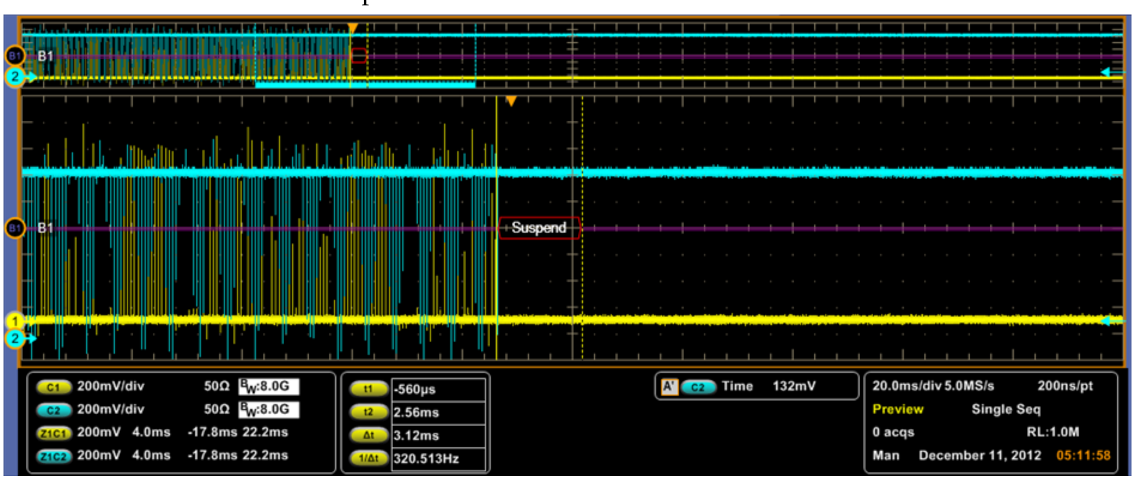


Figure 14 Suspend test

6.3.2 Resume Test

Scope Setup

- Connect Data Signal to Ch1.
- Connect Strobe signal to Ch2.

1. Launch HSIC Essentials from the Analyze menu.
2. In the Standard tab of DPOJET, Click on the Setup button.
3. Set the device to suspend mode.
4. Load setup file – DeviceResume.set.
5. Set trigger to single, then set device to produce Resume signal. This can done using the HSET (High Speed Electrical Tool) provided by USB-IF. This setup file can also be used on live traffic.
6. Place the Cursors and measure the time duration for which the strobe signal is low, as shown in Figure 15.
7. The measured time duration should be at least 20 ms for a pass.

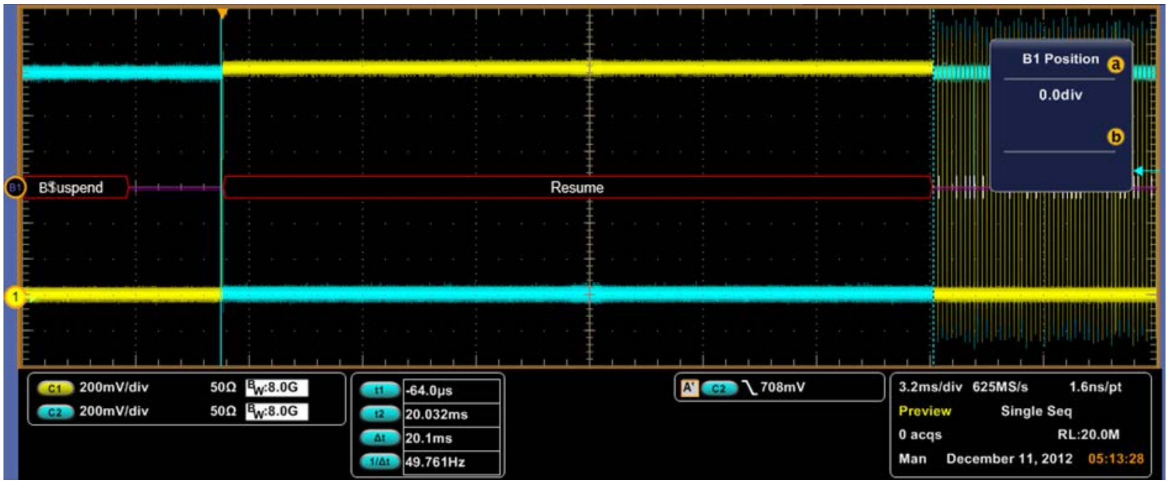


Figure 15 Resume Signal. Strobe Signal (Ch2) in Blue

6.3.3 Reset From Suspend

Scope Setup

- Connect Data Signal to Ch1.
- Connect Strobe signal to Ch2.

1. Launch HSIC Essentials from the Analyze menu.
2. In the Standard tab of DPOJET, Click on the Setup button.
3. Set the device to suspend mode.
4. Load setup file – DeviceResetFromSuspend.set.
5. Set trigger to single, and then reset the device (either a soft or hard reset). This can done using the HSET (High Speed Electrical Tool) provided by USB-IF. This setup file can also be used on live traffic
6. The waveform should look like Figure 16.

7. Both strobe and Data lines should be Low for a Pass, after the suspend region. It should last for at least 2.5 µs.

Figure 16 Reset From Suspend

6.3.4 Reset From High Speed

Scope Setup

- Connect Data Signal to Ch1.
- Connect Strobe signal to Ch2.

1. Launch HSIC Essentials from the Analyze menu.
2. In the Standardtab of DPOJET, Click on the Setup button.
3. Load setup file – DeviceResetFromHS.set.
4. Set the device to High Speed Mode – for example configure to send a Test Packet.
5. Set trigger to single, and then reset the device (either a soft or hard reset). This can done using the HSET (High Speed Electrical Tool) provided by USB-IF. This setup file can also be used on live traffic.
6. The waveform should look like Figure 17.
7. Both strobe and Data lines should be Low for a Pass, following the High speed region. Reset should last for at least 3.1 ms.

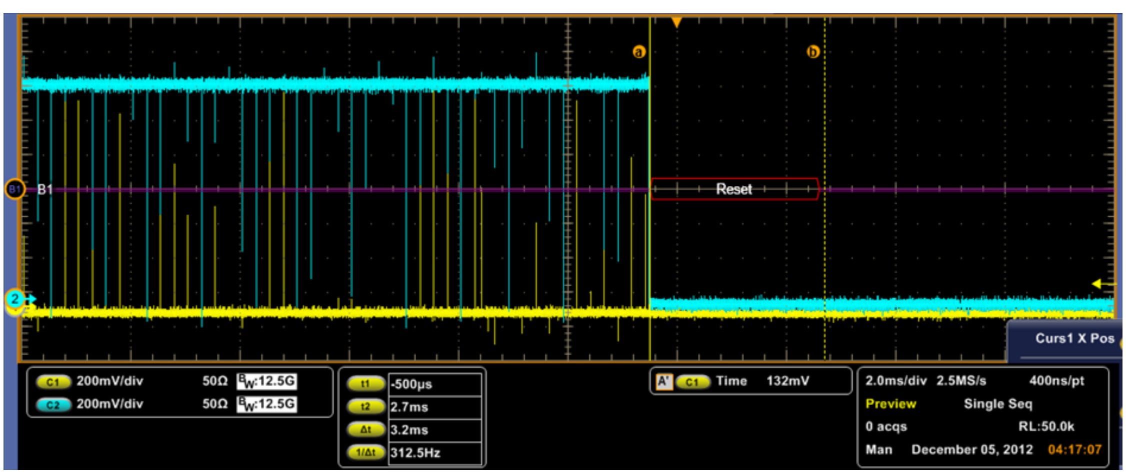


Figure 17 Reset from High Speed

NOTE: *The Bus Timing measurements are similar even for HSIC Host. Please load the corresponding HOST setup file and continue with the measurements as described in the Section 7.3.*

A measurement (frequency) is added in Device/HostPacketParams.set and in all setup files mentioned in Section 6.3. This measurement is a report only measurement. Adding this measurement will enable to save/append the report.

7 HSIC Essentials Protocol Decoding

7.1 Installation

To install HSIC Essentials, click on the setup.exe present in the Option HSIC installer distribution. After installation, launch TekScope and the HSIC Decoder package is ready to use.

7.2 Performing Protocol Decode

Click on the Tekscope Vertical menu or Digital Menu (available only on MSO scopes) and go to Bus Setup as shown in the figure below.

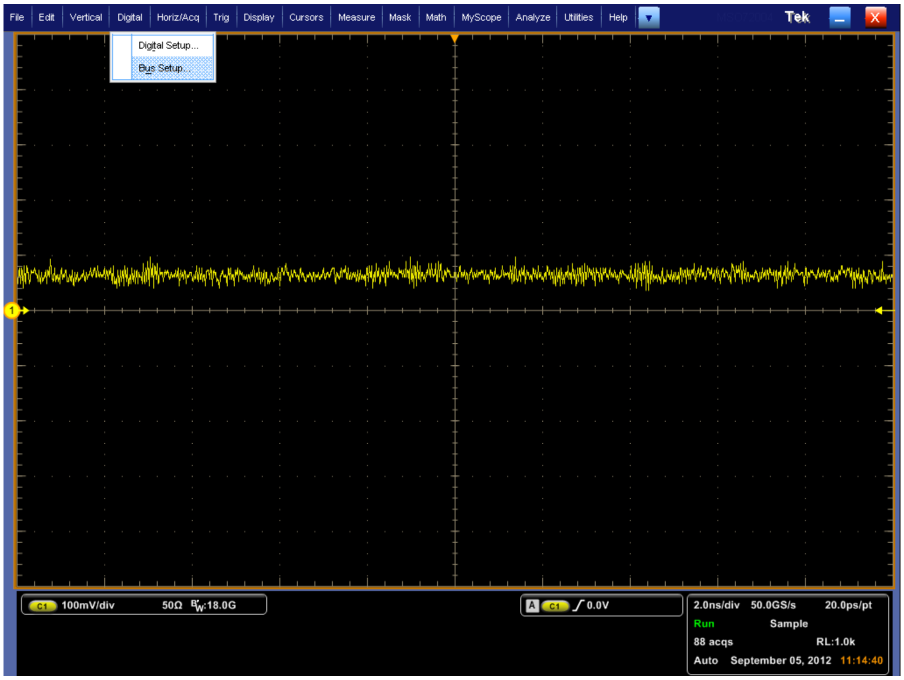


Figure 18 Launching Bus Setup from Vertical Menu

In the Config pane, Choose Serial option and select Custom from the dropdown. Once HSIC is chosen in the Custom Decoder drop down, the threshold has to be set manually based on the incoming signal. Both Ch1 and Ch2 must be turned ON.

After configuring, turn Bus1 On by clicking the button under the Bus 1 label. The decoded packets are displayed on the scope graticule.

Note: *If decoded packets are not displayed, please verify threshold settings.*

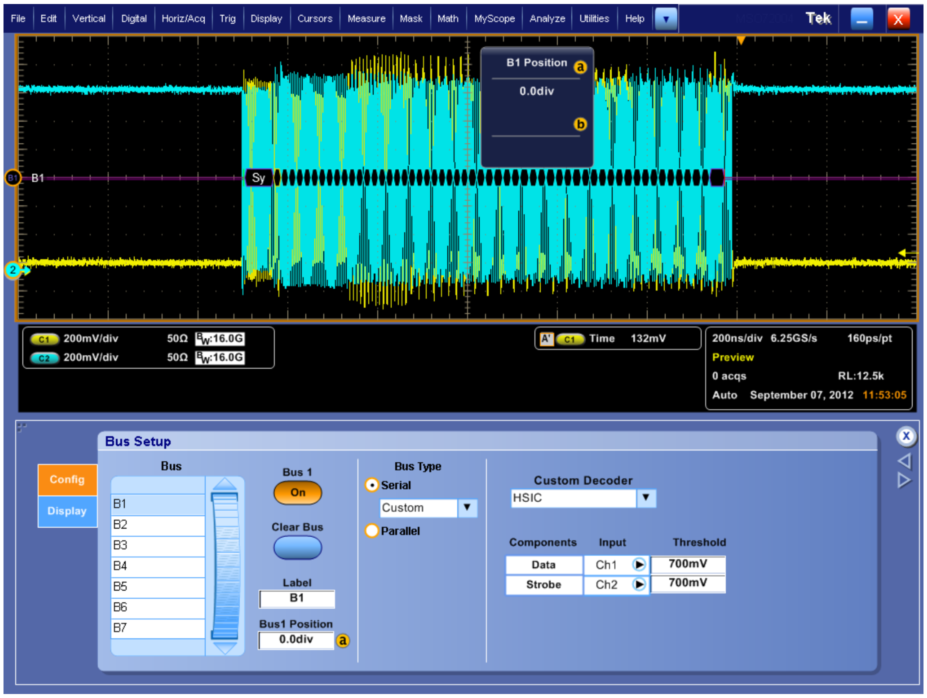


Figure 19 Enabling HSIC Decoder

The Display tab provides an option to select Busform and Waveform. The Protocol Decode Event Table showing the list of decoded packets can be viewed by clicking the button under the Protocol Decode Event Table label.

Click on the Export button to export the packets to the .csv format.

The Protocol Decode Event Table can also be accessed from the Tekscope Analyze menu by selecting Analyze->Results Table.

HSIC decoder provides the Search feature. Once a HSIC bus has been created, search can be done on the various packet Fields. Search can be invoked from the Analyze menu as shown in Figure 20.

Figure 20 Invoking Search

Click on Bus in the Search->Select Tab to get the search options defined for HSIC. Refer to Figure 21.

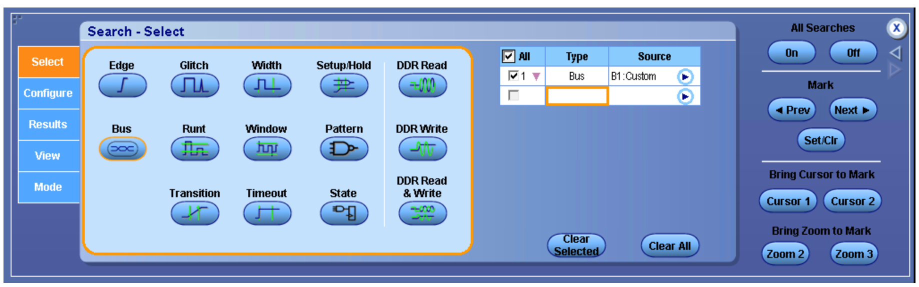


Figure 21 Search->Select Tab

Click on the Configure Tab. Choose from the list of options in the Search For drop down menu. Refer to Figure 22.

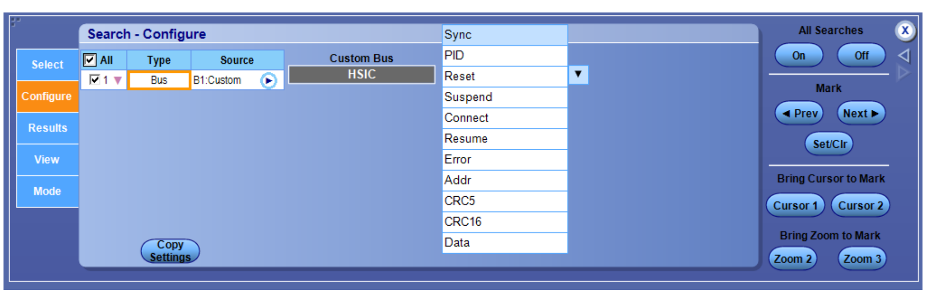


Figure 22 Search For options for HSIC Decoder

Choose Data to search on the Data field of the packet. The Data format can be either Hex or Binary. Enter the Data Value and Click On. The Search hits are highlighted on the search graticule as in Figure 23.

Figure 23 Search Hits

The Results tab shows the list of search hits. Click on the item in the list to go to the specific field on the scope graticule. Refer to Figure 24.

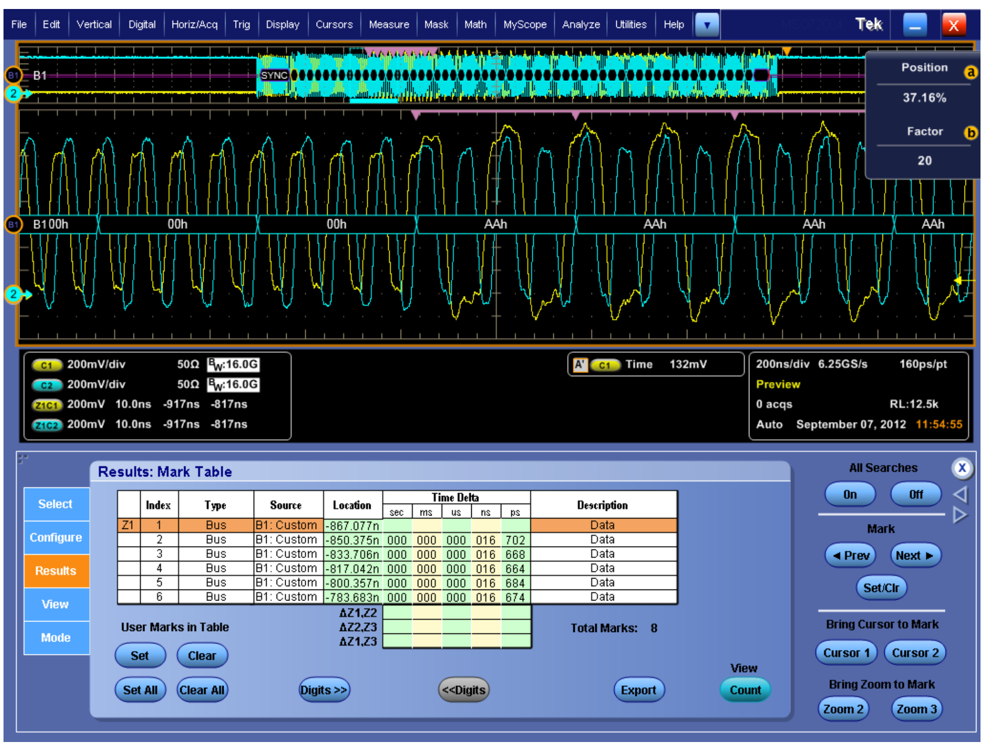


Figure 24 Results: Mark Table

7.3 HSIC Host and Device Traffic Distinction

HSIC Protocol Decoder can be used to distinguish between HOST and Device traffic. Token packets (such as IN, OUT, SETUP) are always issued by USB HSIC hosts. By reading these Token packets through HSIC Protocol Decoder, one would be able to distinguish a Host signal from a Device.

Procedure to identify a HOST packet

1. Launch HSIC Essentials from the Analyze menu.
2. In the Standard tab of DPOJET, Click on the Setup button.
3. Load setup file – DevicePacketParams.set.
4. Turn on Ch1 and Ch2.
5. Configure the bus as shown in section 7.2 – "Performing Protocol Decode"
6. Go to the Analyze menu and choose Search.
7. In the Configure tab choose Search For PID
8. Select any of one these options -IN, OUT, SETUP from the PID Dropdown. Refer to Figure 25.

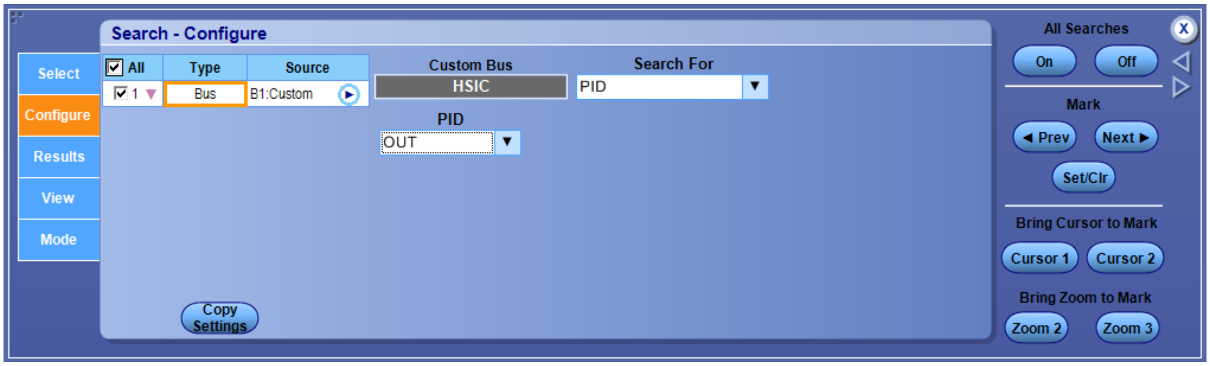


Figure 25 Configure tab – Choose PID option

9. Go to Mode tab. Check "Stop Acquisition if event found" option. Refer to Figure 26.

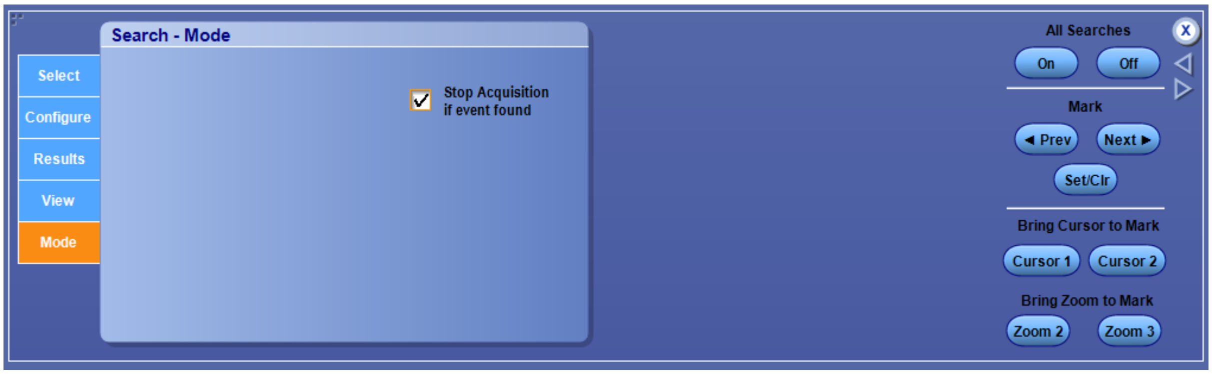


Figure 26 Search-Mode tab to Stop Acquisition when a PID event occurs

10. Click on the Run/Stop Button on the oscilloscope front panel.
11. The acquisition will stop when the selected PID event occurs indicating a Host signal capture. Refer to Figure 27.

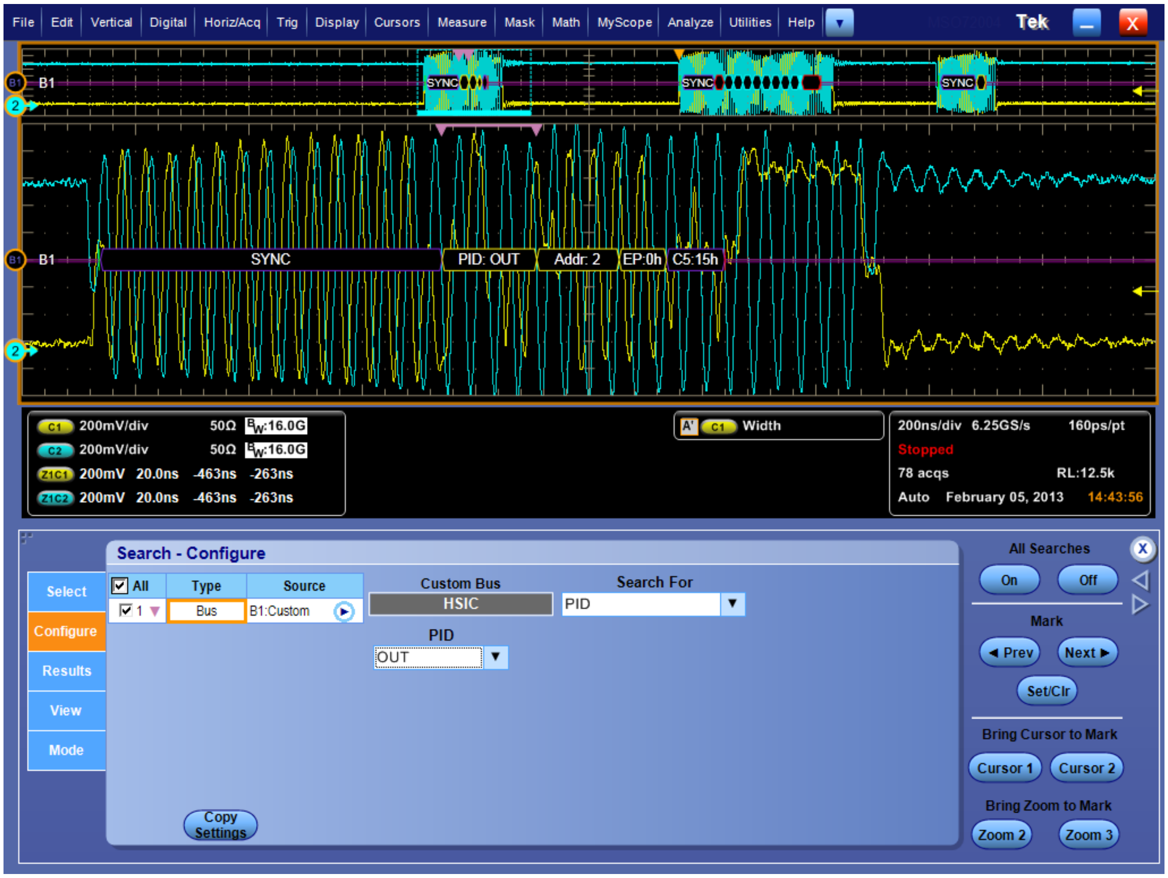


Figure 27 PID Out Event indicating a Host signal has triggered an Acquisition Stop

8 Measurement Methodologies

8.1 High-Low

The High–Low measurement calculates the change in voltage level across a transition in the waveform.

The application calculates the High–Low using the following equation:

$$V_{HIGH-LOW}(n) = V_{LEVEL}(i) - V_{LEVEL}(i+1)$$

Where:

$V_{HIGH-LOW}$ is the high-low amplitude measurement result.
n is the index of a selected transition.
i is the index of the UI (bit) location preceding the transition.
$i+1$ is the index of the UI (bit) location following the transition.
$V_{LEVEL} = OP[v_{PERCENT}(i)]$ is the state level of the unit interval (bit period).
$OP[\bullet\ ]$ is the selected Operation (either Mean or Mode).
$v_{PERCENT}$ is the set of voltage samples over the selected portion (percent) of the unit interval, ranging from 1% to 100%.

NOTE. *If there are no waveform samples that fall within the identified percentage of the unit interval, the single nearest waveform sample preceding the center point of the unit interval will be used.*

8.2 Eye Width

The Eye Width measurement is the measured minimum horizontal eye opening at the zero reference level.

The application calculates this measurement using the following equation:

$$T_{EYE-WIDTH} = UI_{AVG} - TIE_{pk-pk}$$

Where:

UI_{AVG} is the average UI.
TIE_{pk-pk} is the Peak-Peak TIE.

8.3 Eye Height

The Eye Height measurement is the measured minimum vertical eye opening at the UI center as shown in the plot of the eye diagram. There are three types of Eye Height values.

Eye Height

The application calculates this measurement using the following equation:

$$V_{EYE-HEIGHT} = V_{EYE-HI-MIN} - V_{EYE-LO-MAX}$$

Where:

$V_{EYE-HI-MIN}$ is the minimum of the High voltage at mid UI.
$V_{EYE-LO-MAX}$ is the maximum of the Low voltage at mid UI.

Eye Height-Transition

The application calculates this measurement using the following equation:

$$V_{EYE-HEIGHT-TRANS} = V_{EYE-HI-TRAN-MIN} - V_{EYE-LO-TRAN-MAX}$$

Where:

$V_{EYE-HI-TRAN-MIN}$ is the minimum of the High transition bit eye voltage at mid UI.
$V_{EYE-LO-TRAN-MAX}$ is the maximum of the Low transition bit eye voltage at mid UI.

Eye Height-Non-Transition

The application calculates this measurement using the following equation:

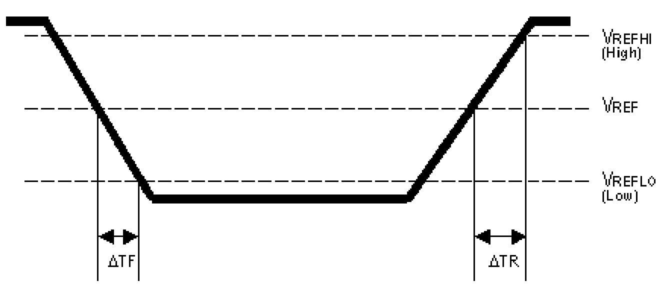
$$V_{EYE-HEIGHT-\mathrm{N}TRANS} = V_{EYE-HI-\mathrm{N}TRAN-MIN} - V_{EYE-LO-\mathrm{N}TRAN-MAX}$$

Where:

$V_{EYE-HI-NTRAN-MIN}$ is the minimum of the High non- transition bit eye voltage at mid UI.
$V_{EYE-LO-NTRAN-MAX}$ is the maximum of the Low non-transition bit eye voltage at mid UI.

8.4 Rise Slew Rate

The Rise Slew Rate is defined as the rate of change of the voltage between the crossings of the specified VREFHI and VREFLO reference voltage levels. The voltage difference is measured between the VREFHI reference level crossing and the VREFLO reference level crossing on the rising edge of the waveform. The time difference is measured as the difference between the low time, and the low time at which VREFLO and VREFHI are crossed. The Rise Slew Rate algorithm uses the high and low rise reference voltage levels to configure the values. Each edge is defined by the slope, voltage reference level (threshold), and the hysteresis.

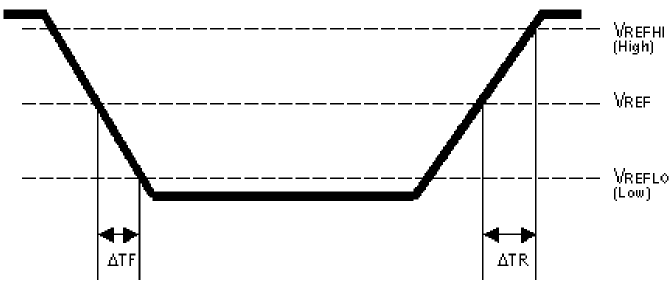


The application calculates this measurement using the following equation:

$$Rise\ Slew\ Rate = \frac{\mathrm{V_{REFHI}} - V_{REFLO}}{\Delta \mathrm{TR}}$$

8.5 Fall Slew Rate

The Fall Slew Rate is defined as the rate of change of the voltage at the specified VREFLO and VREFHI reference voltage levels. The voltage difference is measured between the VREFLO reference level crossing and the VREFHI reference level crossing on the falling edge of the waveform. The time difference is measured as the difference between the high time and low time at which VREFHI and VREFLO are crossed. The Fall Slew Rate algorithm uses the low time and high fall reference voltage levels to configure the values. Each edge is defined by the slope, voltage reference level (threshold), and the hysteresis.



The application calculates this measurement using the following equation:

$$Fall\ Slew\ Rate = \frac{\mathrm{V_{REFLO}} - V_{REFHI}}{\Delta \mathrm{TF}}$$

8.6 Setup

The Setup Time measurement is the elapsed time between the designated edge of a data waveform and when the clock waveform crosses its own voltage reference level. The closest data edge to the clock edge that falls within the range limits is used.

The application calculates this measurement using the following equation:

$$T_n^{Setup} = T_i^{Main} - T_n^{2nd}$$

Where:

T_{Setup} is the setup time.
T_{Main} is the Main input (clock) VRefMidMain crossing time in the specified direction.
T_{2nd} is the 2nd input (data) VRefMid2nd crossing time in the specified direction.

8.7 Hold

The Hold Time measurement is the elapsed time between when the clock waveform crosses its own voltage reference level and the designated edge of a data waveform. The closest data edge to the clock edge that falls within the range limits is used.

The application calculates this measurement using the following equation:

$$T_n^{Hold} = T_n^{2nd} - T_i^{Main}$$

Where:

T_{Hold} is the hold time.
T_{Main} is the Main input (clock) VRefMidMain crossing time in the specified direction.
T_{2nd} is the 2nd input (data) VRefMid2nd crossing time in the specified direction.

8.8 Frequency

The Frequency measurement calculates the inverse of the data period for each cycle.

If the Signal Type is Clock, the application calculates clock frequency measurement using the following equation:

$$F_n^{Clock} = \frac{1}{P_n^{Clock}}$$

Where:

F_{Clock} is the clock frequency.
P_{Clock} is the clock period measurement.

If the Signal Type is Data, the application calculates data frequency measurement using the following equation:

$$F_n^{Data} = \frac{1}{P_n^{Data}}$$

Where:

F_{Data} is the data frequency.
P_{Data} is the data period measurement.

8.9 Mask Hits

The Mask Hits measurement reports the number of unit intervals in the acquisition for which mask hits occurred, for a user-specified mask. In the Results Summary view, the Mask Hits measurement reports the total number of unit intervals for which a mask hit occurred in at least one mask zone. In the Results Details view, the number of hits in each of three segments is reported. The population field shows the total number of unit intervals measured.

The Mask Hits measurement has several unique properties:

- Unlike other measurements, it requires a Mask hits plot. Adding a Mask Hits measurement will cause the corresponding plot to be created automatically. If you delete a Mask Hits plot, the application will remove the corresponding Mask Hits measurement after verifying the action with you.
- The Mask Hits measurement does not support the Worst-Case Waveforms logging feature.
- The Mask Hits measurement does not support Measurement Range Limits.

Appendix

Configuring the DPOJET HSIC Essentials for additional debug analysis and customization of various measurements

On the oscilloscope TekScope menu, go to Analyze > HSIC Essentials, and click on it to invoke the HSIC setup library in DPOJET standards tab as shown in Figure 28 below.

Selecting Measurements

Ensure that HSIC is selected in the standard drop-down list and then click on the Setup button. You select either a single measurement or recall a setup file to run multiple measurements at a time. Recalling a pre-defined setup file loads all the required setup configurations for each test/measurements supported for the setup file.

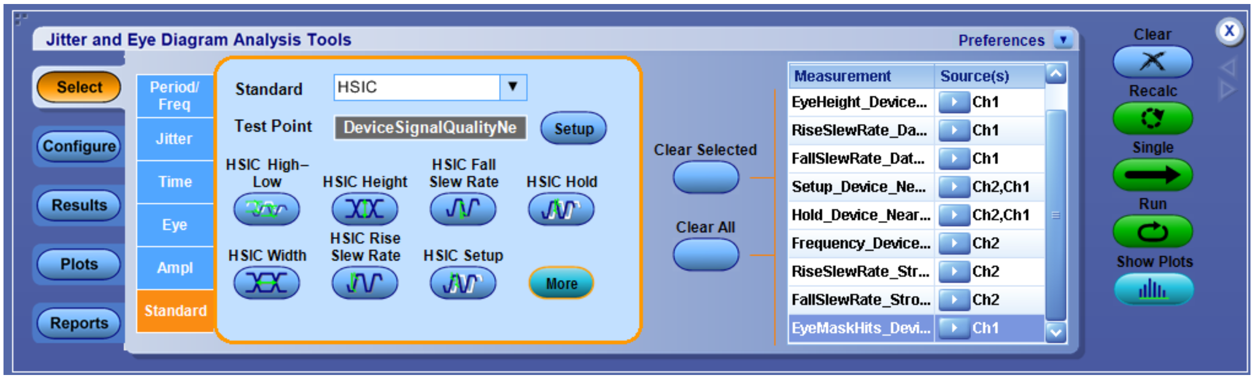


Figure 28 HSIC Standard option in DPOJET standard menu

Each of the measurements listed under HSIC Standards tab can be selected manually by clicking on them. If the measurements are used without the pre-defined setup files, please follow these instructions to configure the oscilloscope setup.

Selecting Limit Files

If a measurement has a pass/fail limit associated with it in the test point file, go to Analyze -> Jitter and Eye Analysis -> Limits to select the limit file from the folder where the limit files are saved. Measurements with pass/fail limits will show up in the Results Summary panel when the compliance test is run.

Configure Mask file:

In the DPOJET application go to ‘Plots’ if you want to enable the Mask file.

1. Select measurement from the measurement column.
2. Click ‘Configure’ to change the default setup for that measurement. The mask selection window opens as shown:
3. In the Mask file selection window, press the ‘Off’ button first and then click ‘Browse’ to select the Mask file.

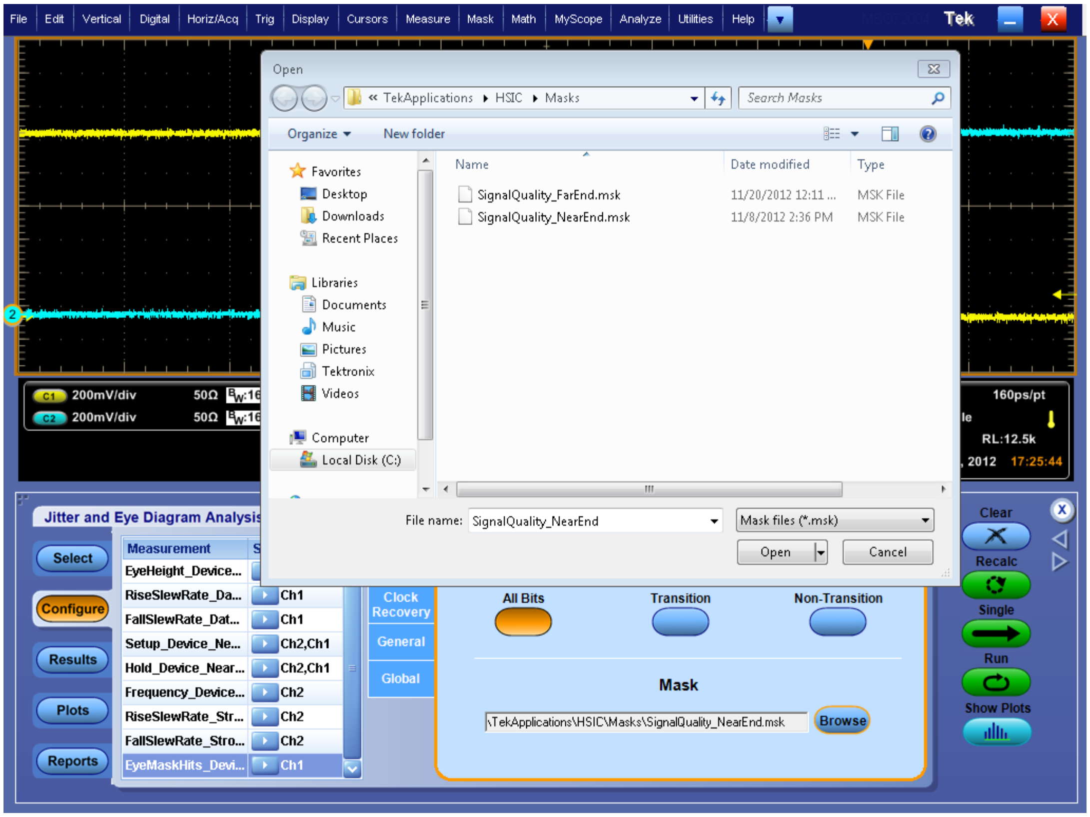


Figure 29 Selecting a Mask File

4. Select the relevant mask file (for example, SignalQuality_Nearend.msk) and click 'Open'.
5. Enable the file by selecting the 'On' button, and click OK.

Configuring Source of Waveforms

The selection options are:

- Live/Ref/Math source selection (uses single ended signal as data and clock source)
- Live channel selections–Ch1, Ch2, Ch3, Ch4
- Reference waveform selections–Ref1, Ref2, Ref3, Ref4

Horizontal Setup

1. Go to the 'Horiz/Acq'-> 'Horizontal /Acquisition Setup' and Change the 'Record Length' and 'Sample Rate' to the required value.

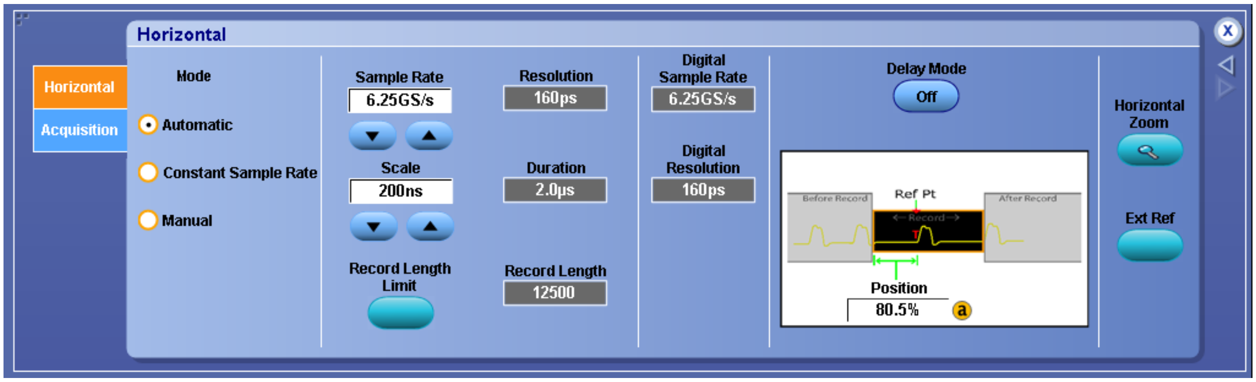


Figure 30 Horizontal/Acquisition Setup

The horizontal parameters are set in the setup files to acquire the correct signal for various tests.