E5381B Differential Flying Leads Probe Set

User Guide

Agilent Technologies

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WARNING

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

This guide provides user and service information for the E5381B Differential Flying Lead Probe Set.

Chapter 1 gives you general information such as inspection, accessories supplied, and characteristics of the probe.

Chapter 2 shows you how to operate the probe and gives you information about some important aspects of probing and how to get the best results with your probe.

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Safety Information

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General Information

E5381B Differential Flying Lead Probe Set

The E5381B is a 17-channel differential flying lead probe set, compatible with the Agilent 16851A, 16852A, 16853A, 16854A, and U4154A logic analyzers. The E5381B enables you to acquire signals from randomly located points in your target system.

Two E5381Bs are required to support all 34 channels on one 16851A. Four E5381Bs are required to support all 68 channels of one 16852A.

A variety of accessories are supplied with the E5381B to allow you to access signals on various types of components on your PC board.

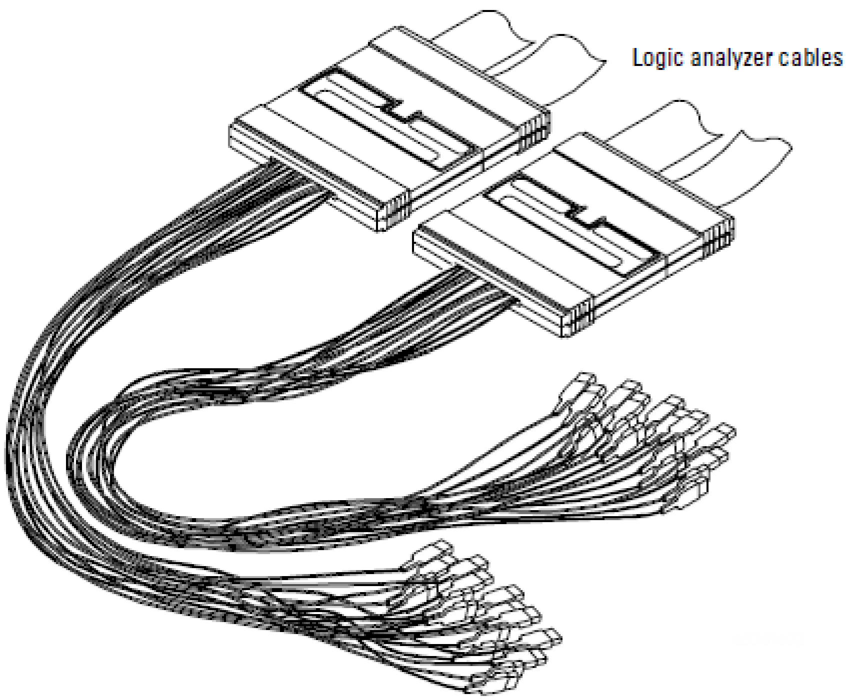


Figure 1 Differential flying lead probe set and Agilent logic analysis module.

To inspect the probe

1 Inspect the shipping container for damage.

   Keep a damaged shipping container or cushioning material until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically.

2 Check the accessories.

   Accessories supplied with the instrument are listed in “Accessories Supplied” later in this chapter.

   - If the contents are incomplete or damaged, notify your Agilent Technologies Sales Office.

3 Inspect the probe.

   If there is a mechanical damage or defect, or if the probe does not operate properly or pass performance tests, notify your Agilent Technologies Sales Office.

   If the shipping container is damaged, or the cushioning materials show signs of stress, notify the carrier as well as your Agilent Technologies Sales Office. Keep the shipping materials for the carrier’s inspection. The Agilent Technologies Office will arrange for repair or replacement at Agilent Technologies’ option without waiting for claim settlement.

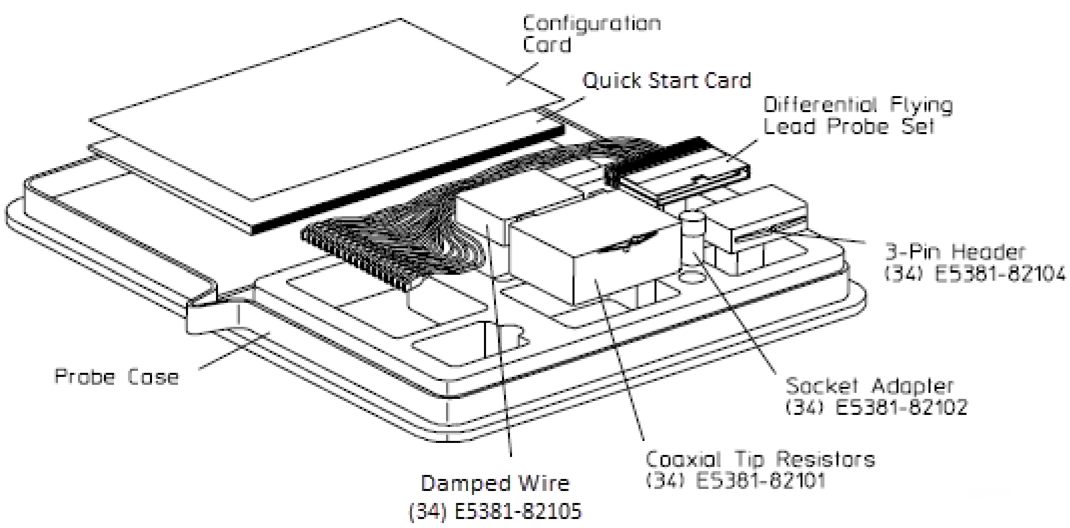


Figure 2 Probe case contents

Accessories

The following figure shows the accessories supplied with the E5381B Differential Flying Lead Probe Set.

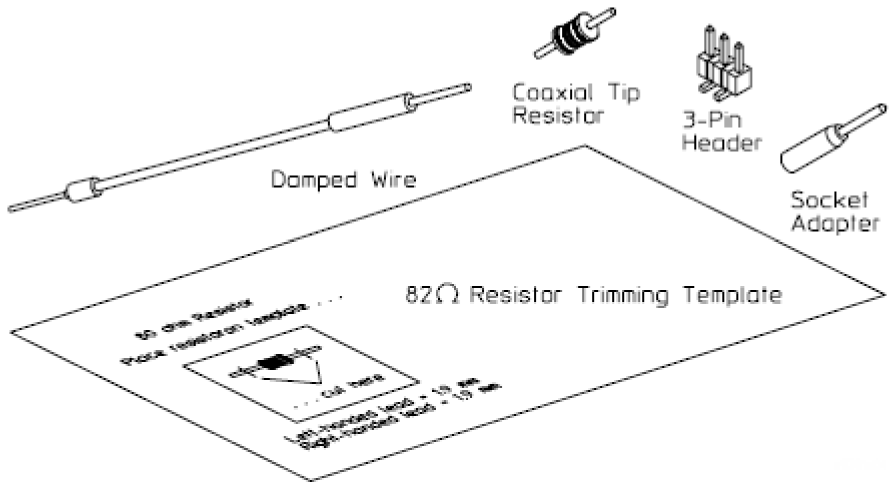


Figure 3 Accessories supplied

The following table shows the part numbers for ordering replacement parts and additional accessories.

Replaceable Parts and Additional Accessories

Description	Qty	Agilent Part Number
82Ω Resistor Trimming Template	1	01131-94309
Accessory Kit - Coaxial Tip Resistors (82Ω)	34	E5381-82101
Accessory Kit - Socket Adapter	34	E5381-82102
Accessory Kit - Damped Wire (160Ω)	34	E5381-82105
Accessory Kit - 3-Pin Header	34	E5381-82104
Cable - Main	1	E5381-61603

Characteristics, Specifications, and Dimensions

The following characteristics are typical for the probe set.

Characteristics

Input Resistance	20 kΩ
Input Capacitance	0.9 pF (accessory-specific, see accessories)
Maximum Recommended State Data Rate	1.5 Gb/s (accessory-specific, see accessories)
Minimum Data Voltage Swing	100 mV p-p each side
Minimum Diff. Clock Voltage Swing	100 mV p-p each side
Input Dynamic Range	-3 V to +5 V
Threshold Accuracy	±(30 mV +1% of setting)
Threshold Range	-3.0 Vdc to +5.0 Vdc
Maximum Nondestructive Input Voltage	40 Vdc
Maximum Input Slew Rate	5 V/ns
Clock Input	differential (2)
Number of Inputs (1)	17 (1 clock and 16 data) (2)

(1) refer to specifications on specific modes of operation for details on how inputs can be used

(2) if using the clock and data as single-ended, the unused negative input must be grounded and the minimum voltage swing for single-ended signal operation is 250mV p-p

Environmental Conditions

	Operating	Non-operating
Humidity	up to 95% relative humidity (non-condensing) at +40 °C	up to 90% relative humidity at +65 °C
Weight	approximately 0.69 kg	approximately 0.69 kg
Dimensions	Refer to the figure below.	Refer to the figure below.
Pollution degree 2	Normally only non-conductive pollution occurs. Occasionally, however, a temporary conductivity caused by condensation must be expected.	
Indoor use		

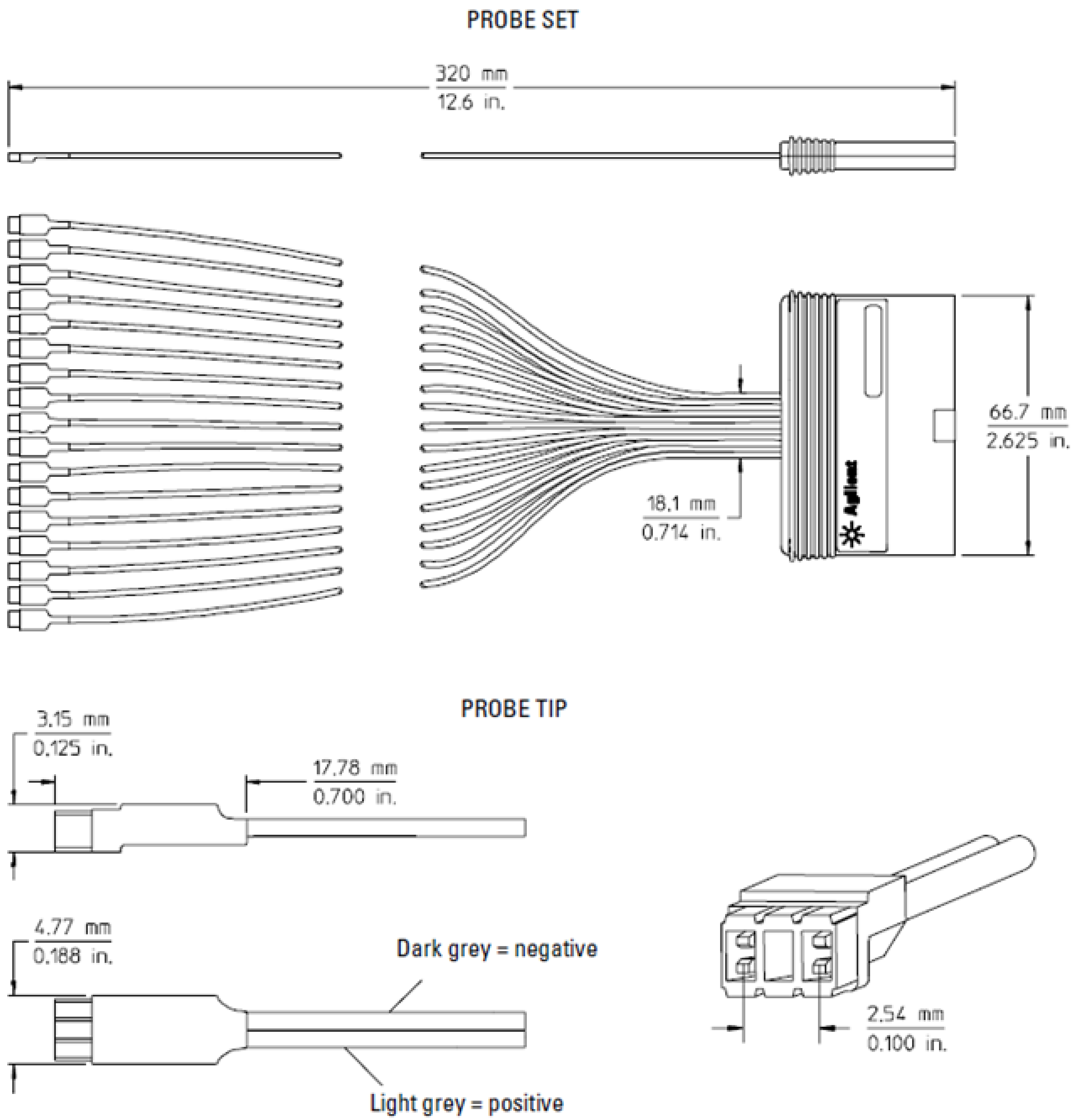
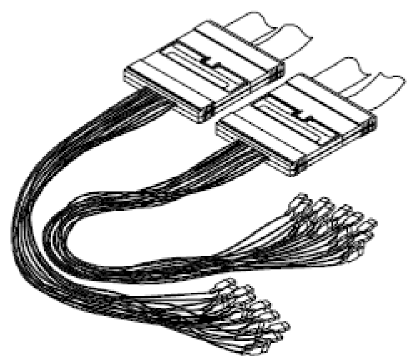


Figure 4 E5381B Differential Flying Lead Probe Set and Probe Tip Dimensions

To probe differential signals

1 Connect the differential probe to the logic analysis module.



2 Set the thresholds.

   The logic analyzer will automatically set the thresholds to “differential”.

3 Connect the flying leads to your target system.

   The next section in this manual shows the recommended probe configurations in the order of best performance. Select the configuration that works with your target system.

To probe single-ended signals

1 Connect the signal using the positive side of the probe tip.

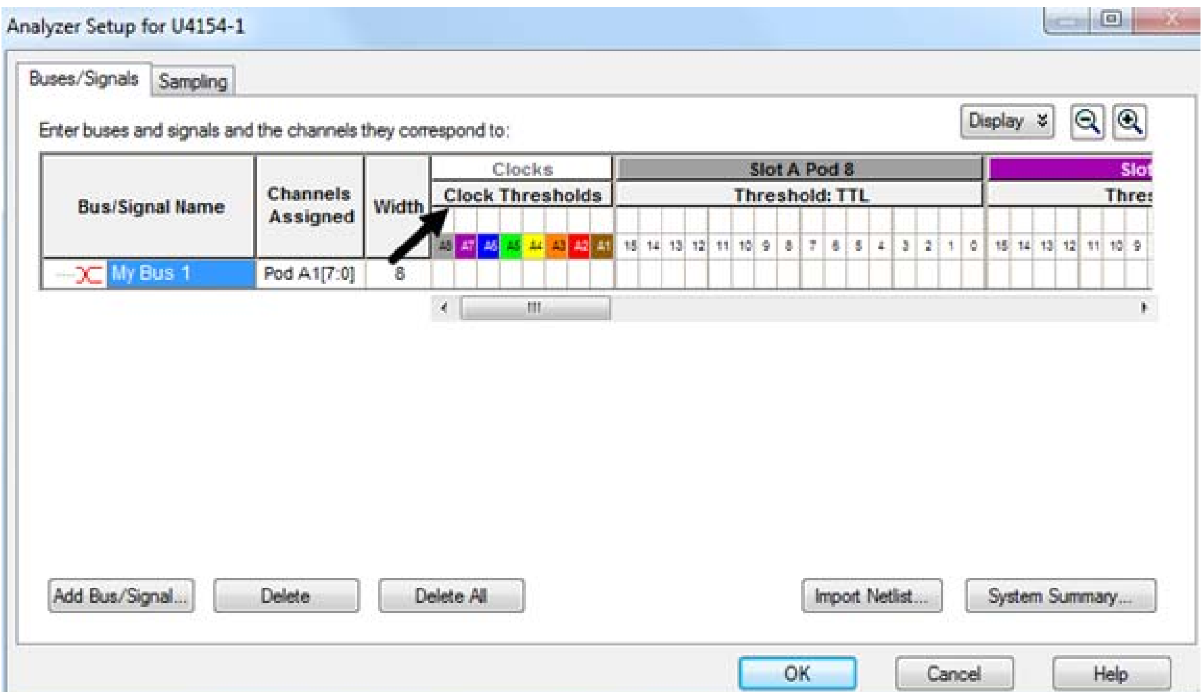
The light grey side of the cable is positive.

2 Connect the negative side of the probe tip to ground.

The dark grey side of the cable is negative. Each probe tip that you are observing a signal on must have the negative terminal grounded.

3 Adjust the thresholds on the logic analyzer. The thresholds can be set on a per/pod basis.

To set clock thresholds, click **Clock Thresholds** in the Buses/Signal screen.



The clock threshold can be adjusted separately.

a In the **Thresholds Settings for Clock Channels** screen in the logic analyzer, if you are using a differential clock, select differential clock threshold.

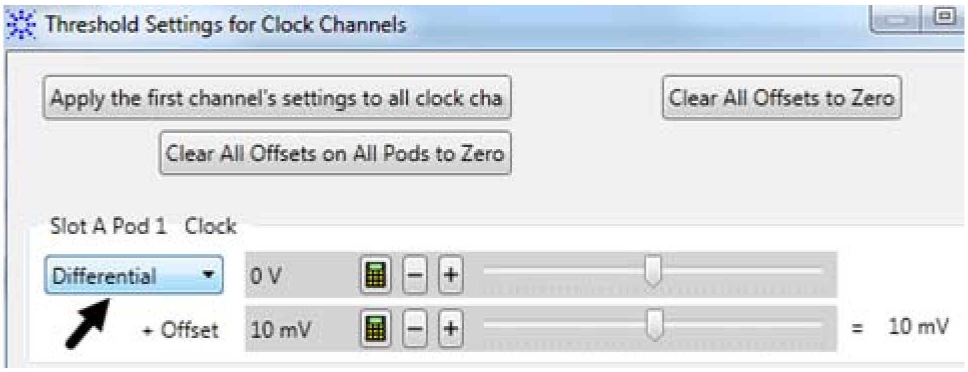


Figure 5 Differential threshold

b If your clock is not differential, ground the unused clock input and set the threshold to the desired level by defining custom thresholds.

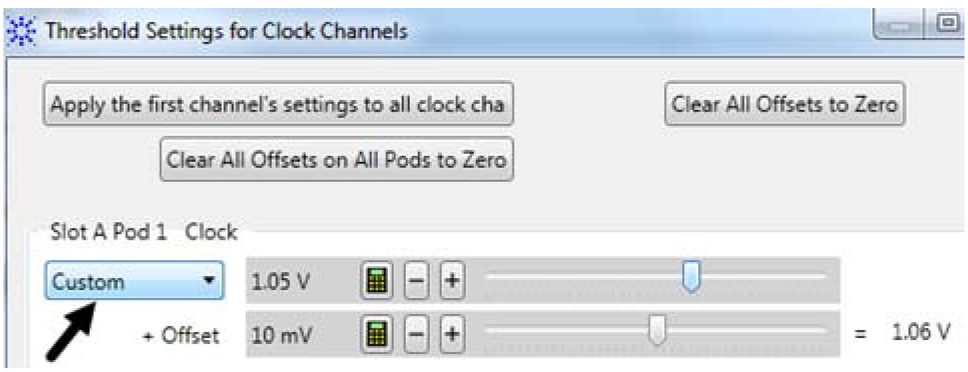


Figure 6 Custom threshold

- Repeat for data.

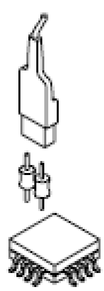
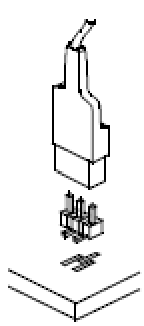
2
Operating the Probe

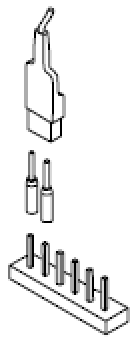
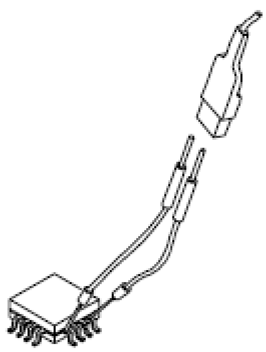
Introduction

The Agilent E5381B differential flying lead probe set comes with accessories that trade off flexibility, ease of use, and performance. Discussion and comparisons between four of the most common intended uses of the accessories are included in this section. The table on this page is an overview of the trade-offs between the various accessories. Each of the four configurations have been characterized for probe loading effects, probe step response, and maximum usable state speed. For more detailed information, refer to the pages indicated for each configuration.

When simulating circuits that include a load model for the probe, a simplified model of the probe's input impedance can usually be used. The following table contains information for the simplified model of the probe using suggested accessory configurations. For more accurate load models and detailed discussion of each configuration's performance, refer to the pages indicated.

Suggested Configurations and Characteristics

Configuration	Description	Total lumped input C	Maximum recommended state speed	Details on page
	Coaxial Tip Resistor (82Ω blue)	0.9 pF	1.5 Gb/s	page 20
	3-Pin Header	1.0 pF	1.5 Gb/s	page 33

Configuration	Description	Total lumped input C	Maximum recommended state speed	Details on page
	Socket Adapters	1.1 pF	1.5 Gb/s	page 45
	Damped Wire (160 Ω)	1.3 pF	1.5 Gb/s	page 59

Coaxial Tip Resistor (82 ohm)

This configuration is recommended for solder-down probing of individual test points. Use the resistor cutting template card (part number 01131-94309) to trim the resistor leads to the appropriate length. Insert the resistors into the positive and negative terminals of the flying lead probe tip, this will hold the resistors in place while the other end of the resistor leads are soldered to the target signals.

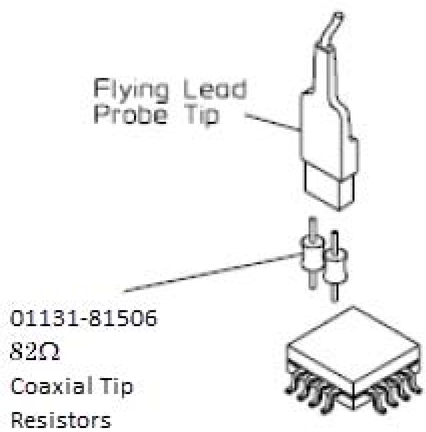


Figure 7 Solder-down probing configuration

Input Impedance

The E5381B probes have an input impedance which varies with frequency, and depends on which accessories are being used. The following schematic shows the circuit model for the input impedance of the probe when using the 82Ω coaxial tip resistors. This model is a simplified equivalent load of the measured input impedance seen by the target.

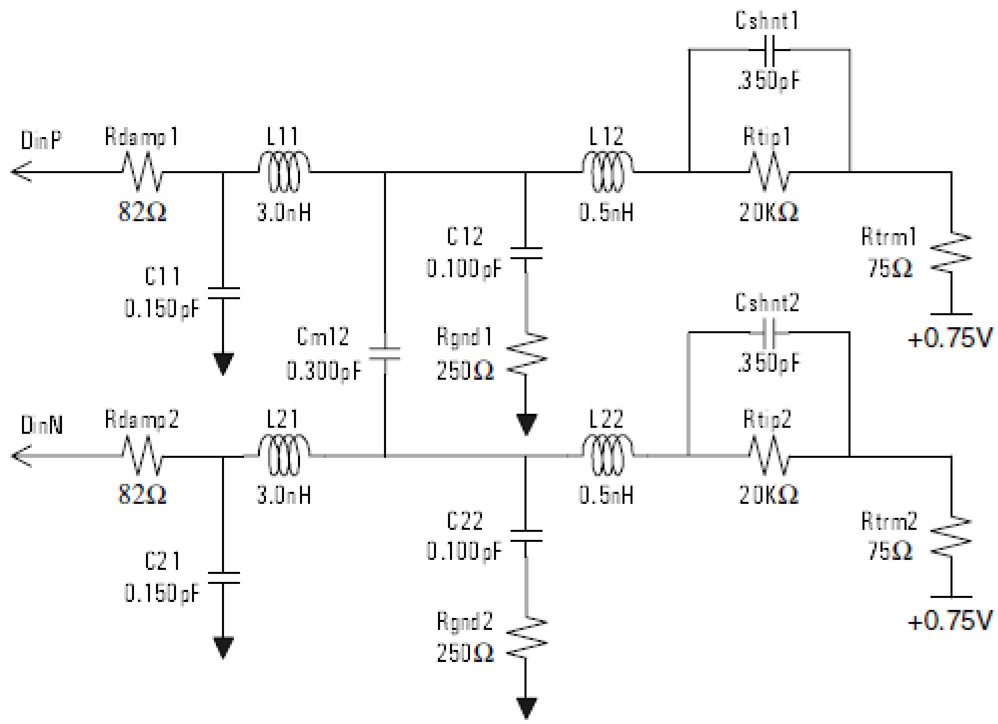


Figure 8 Equivalent load model

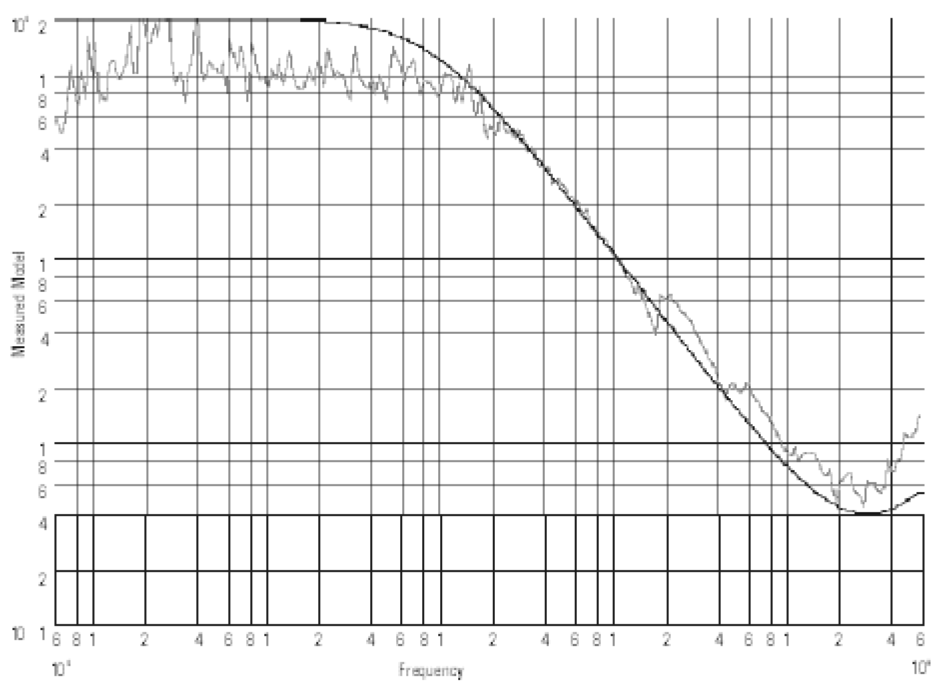


Figure 9 Measured versus modeled input impedance

Tip Resistor Comparison

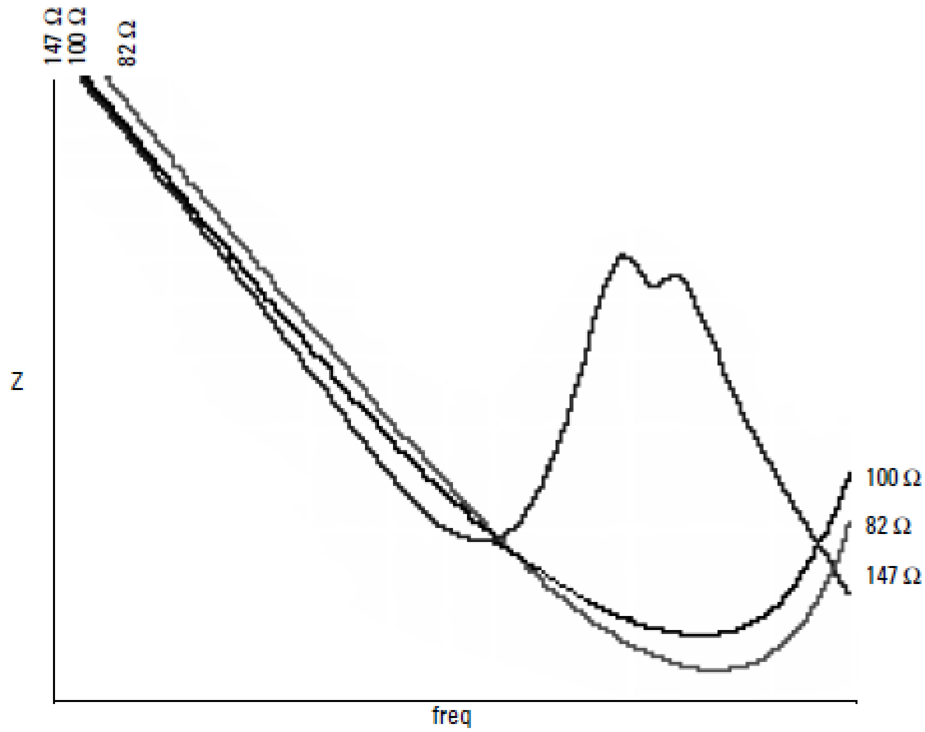
The E5381B allows the user to use coaxial tip resistors to connect to the target. These resistors serve two purposes. First, they allow the user to solder to the target signals without damaging the E5381B probe. Second, the tip resistor isolates the target from the capacitance of the probe and reduces the loading on the target system. The electrical specifications of the tip resistor will affect the loading on the target as well as the probe performance.

The most important factor of the tip resistor is its parasitic series inductance. A high series inductance will cause a resonance with the capacitance of the probe at a lower than acceptable frequency. The 82 Ω High Frequency Metal Film resistors that are shipped with the E5381B have a very low series inductance and are the recommended tip resistor.

A comparison of three common tip resistors are shown in the following graph to demonstrate the impact of the resistor selection on the E5381B's load impedance. The three resistors compared are:

- 82 Ω High-Frequency Metal-Film Resistor - Series Inductance = 3.5nH
- 100 Ω Thin-Film Resistor - Series Inductance = 5nH
- 147 Ω Wire-Wound Resistor - Series Inductance = 50nH

If an alternate tip resistor must be used in place of the 82 Ω, High Frequency, Metal Film Resistor provided, avoid using a wire wound resistor. The series inductance is too high. However, the 100 Ω, Thin Film resistor is adequate.



Time domain transmission (TDT)

All probes have a loading effect on the circuit when they come in contact with the circuit. Time domain transmission (TDT) measurements are useful for understanding the probe loading effects as seen at the target receiver. The following TDT measurements were made mid-bus on a 50 Ω transmission line load terminated at the receiver. These measurements show how the 82 Ω coaxial tip resistor affect the step seen by the receiver for various rise times.

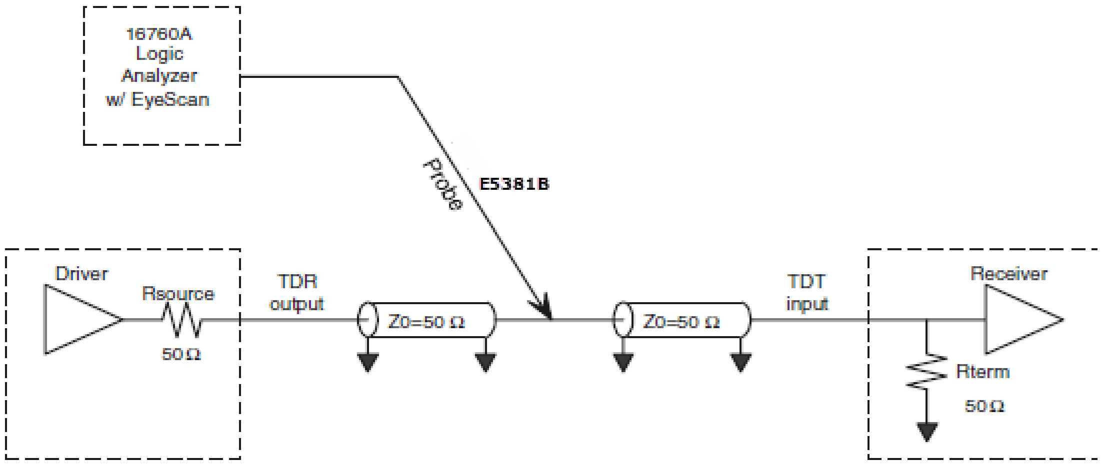


Figure 10 TDT measurement schematic

The 82 Ω coaxial tip resistor configuration is the least intrusive of the four recommended configurations. The graphs show that the loading effects are virtually invisible for targets with rise times >= 500 ps, negligible for targets with 250 ps rise times, and usable for 150 ps rise times. Ultimately, you must determine what is an acceptable amount of distortion of the target signal.

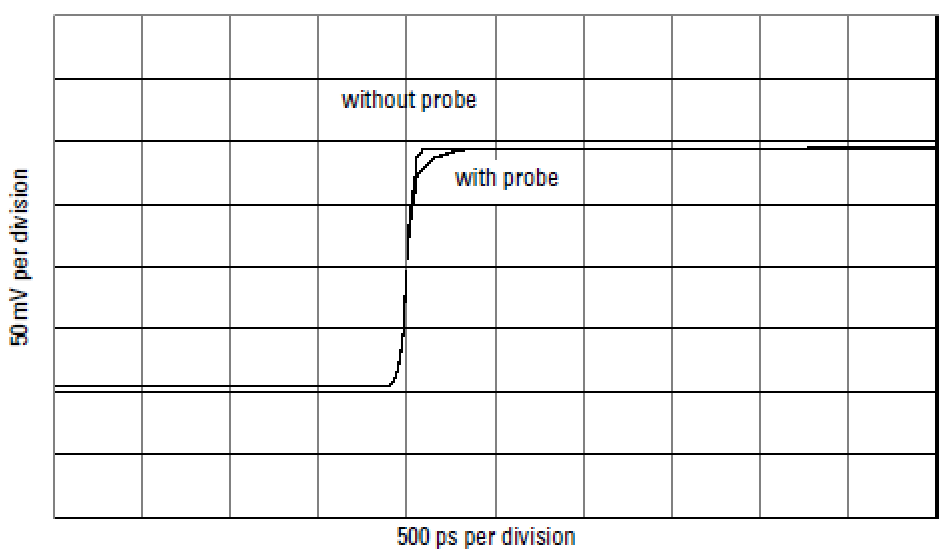


Figure 11 TDT measurement at receiver with and without probe load for 150 ps rise time

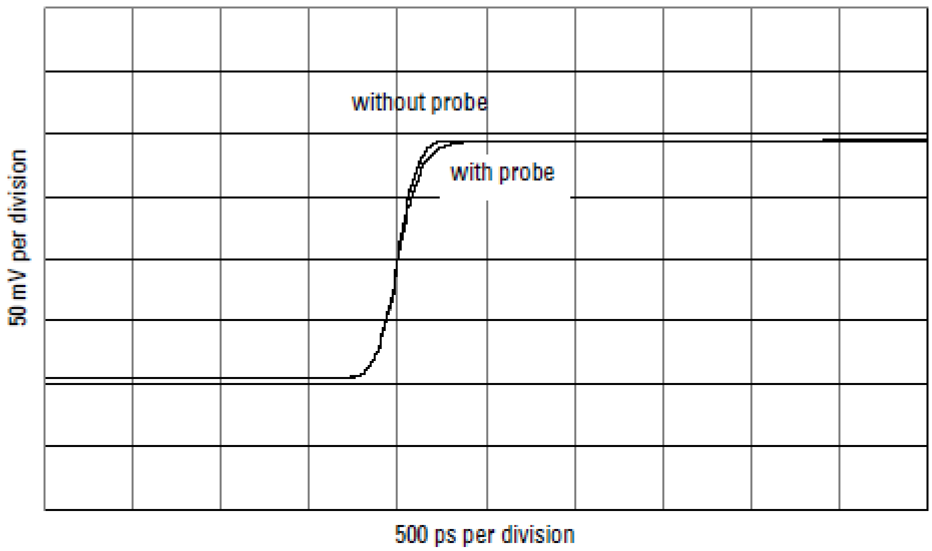


Figure 12 TDT measurement at receiver with and without probe load for 250 ps rise time

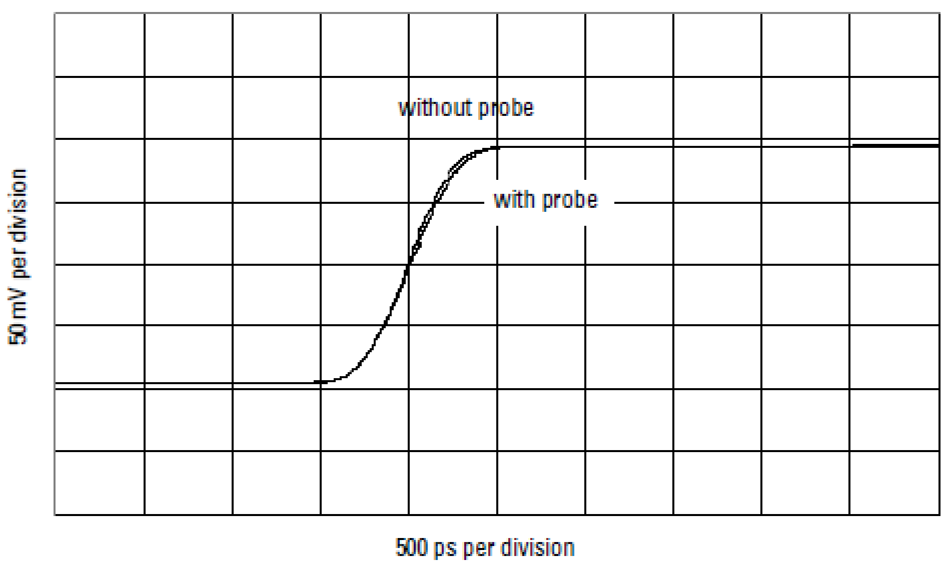


Figure 13 TDT measurement at receiver with and without probe load for 500 ps rise time

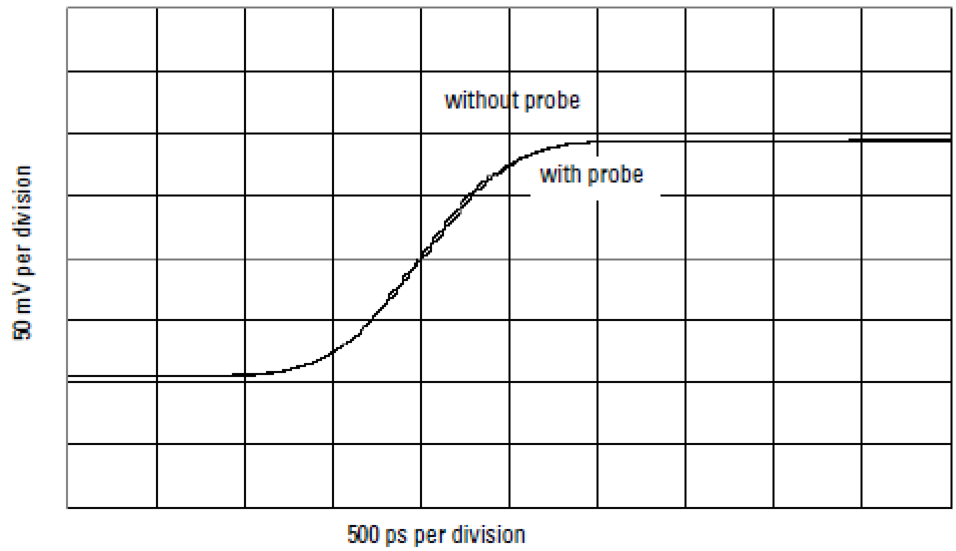


Figure 14 TDT measurement at receiver with and without probe load for 1 ns rise time

Step inputs

Maintaining signal fidelity to the logic analyzer is critical if the analyzer is to accurately capture data. One measure of a system's signal fidelity is to compare Vin to Vout for various step inputs. For the following graphs, Vin is the signal at the logic analyzer probe tip measured by double probing with an Agilent 54701B probe into an Agilent 54750B oscilloscope (total 2.5 GHz BW). Eye Scan is used to measure Vout, the signal seen by the logic analyzer. The measurements were made on a mid-bus connection to a 50 Ω transmission line load terminated at the receiver. These measurements show the logic analyzer's response while using the 82 Ω coaxial tip resistor.

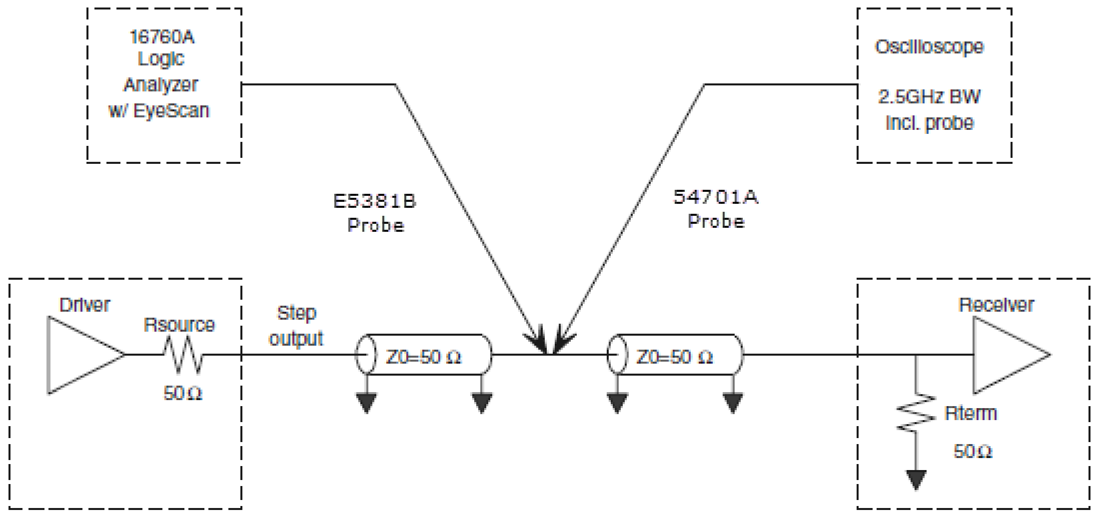


Figure 15 Step input measurement schematic

The following graphs demonstrate the logic analyzer's probe response to different rise times. These graphs are included for you to gain insight into the expected performance of the different recommended configurations.

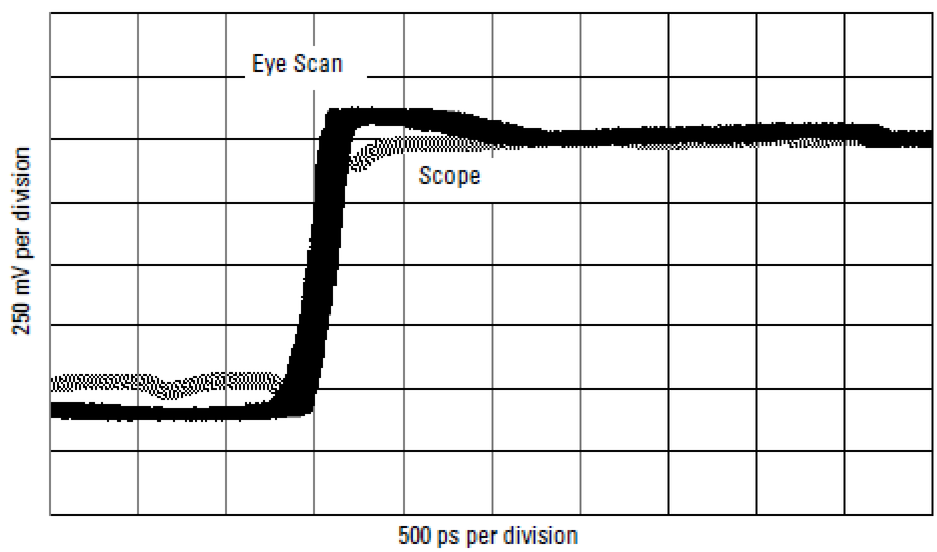


Figure 16 Logic analyzer's response to a 150 ps rise time

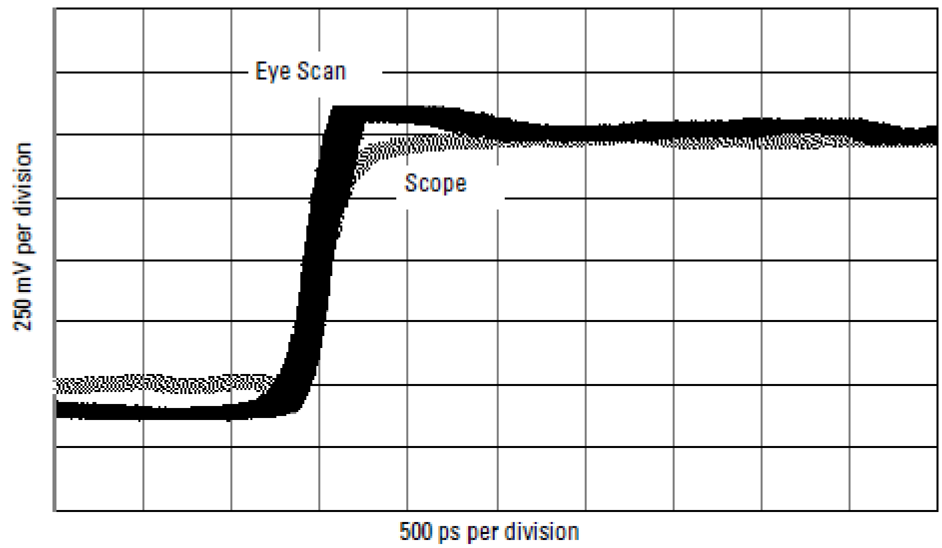


Figure 17 Logic analyzer's response to a 250 ps rise time

NOTE These measurements are not the true step response of the probes. The true step response of a probe is the output of the probe while the input is a perfect step.

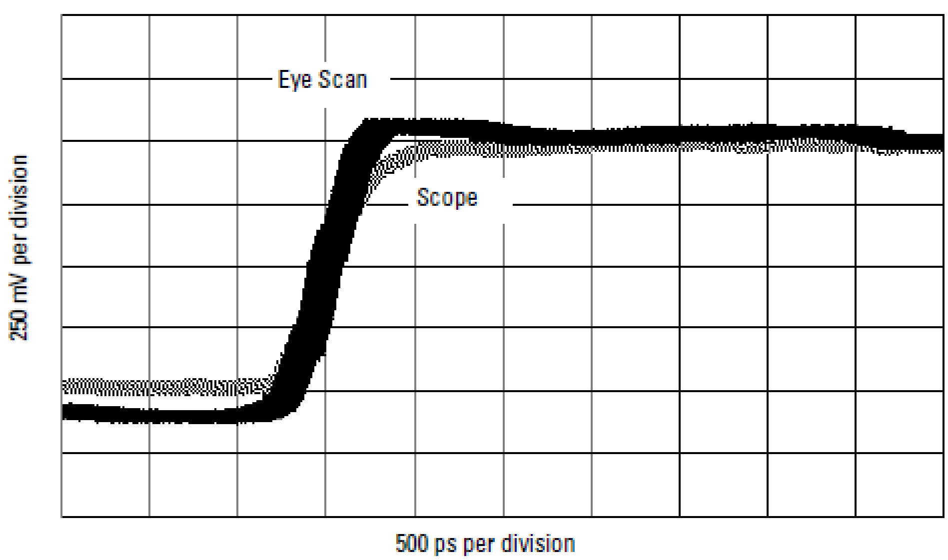


Figure 18 Logic analyzer's response to a 500 ps rise time

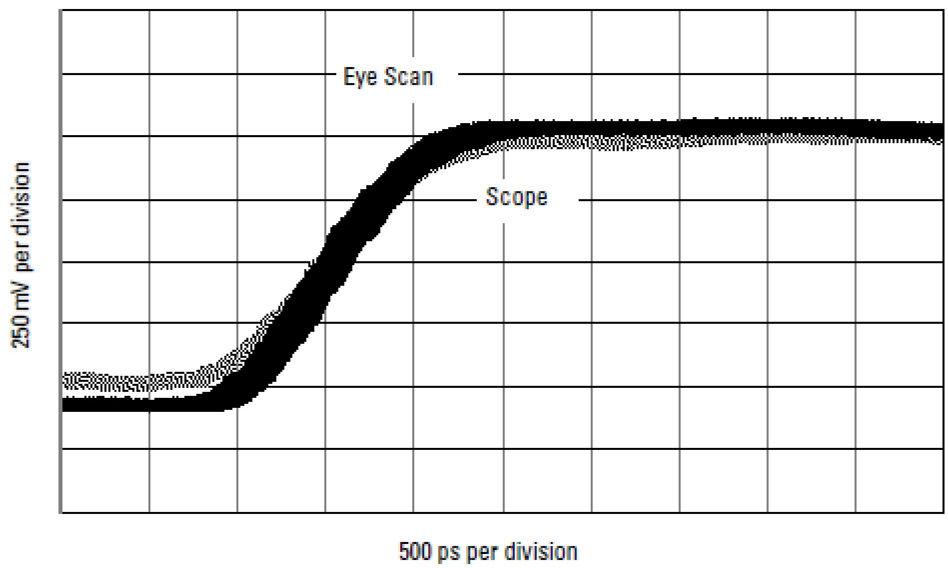


Figure 19 Logic analyzer's response to a 1 ns rise time

NOTE These measurements are not the true step response of the probes. The true step response of a probe is the output of the probe while the input is a perfect step.

Eye opening

The eye opening at the logic analyzer is the truest measure of an analyzer's ability to accurately capture data. Seeing the eye opening at the logic analyzer is possible with Eye Scan. Eye opening helps you know how much margin the logic analyzer has, where to sample and at what threshold. Any probe response that exhibits overshoot and ringing, probe non-flatness, noise and other issues all deteriorate the eye opening seen by the logic analyzer. The following eye diagrams were measured using Eye Scan probed mid-bus on a 50 Ω transmission line load terminated at the receiver. The data patterns were generated using a 223 1 pseudo random bit sequence (PRBS). These measurements show the remaining eye opening at the logic analyzer while using the 82 Ω coaxial tip resistor.

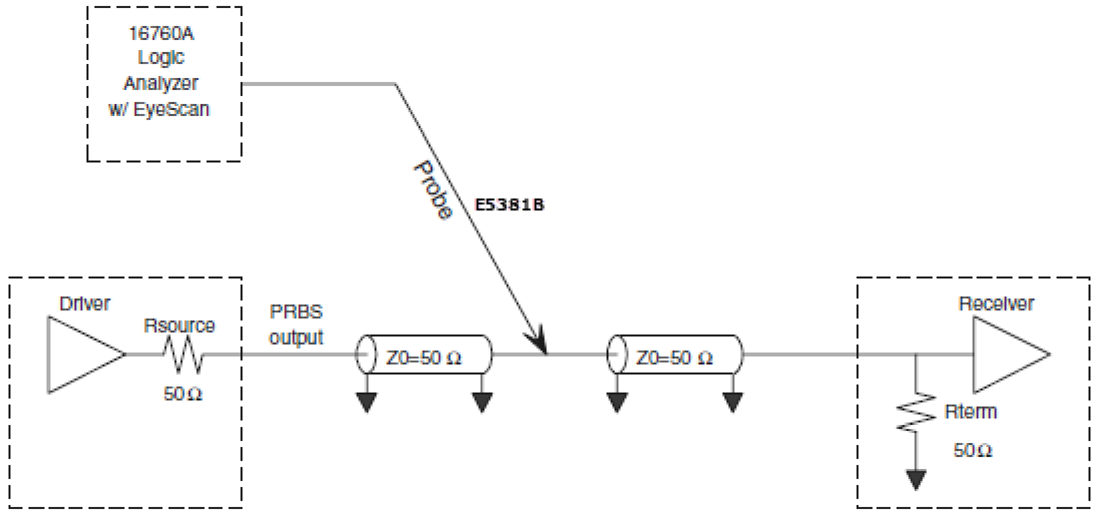


Figure 20 Eye opening measurement schematic

The logic analyzer Eye Scan measurement uses the same circuitry as the synchronous state mode analysis. Therefore, the eye openings measured are exact representations of what the logic analyzer sees and operates on in state mode. The following measurements demonstrate how the eye opening starts to collapse as the clock rate is increased. At 1500 Mb/s, the eye opening is noticeably deteriorating as jitter on the transitions increase and voltage margins decrease. As demonstrated by the last eye diagram, the 82 Ω coaxial tip resistor has a usable eye opening at 1500 Mb/s and minimum signal swing

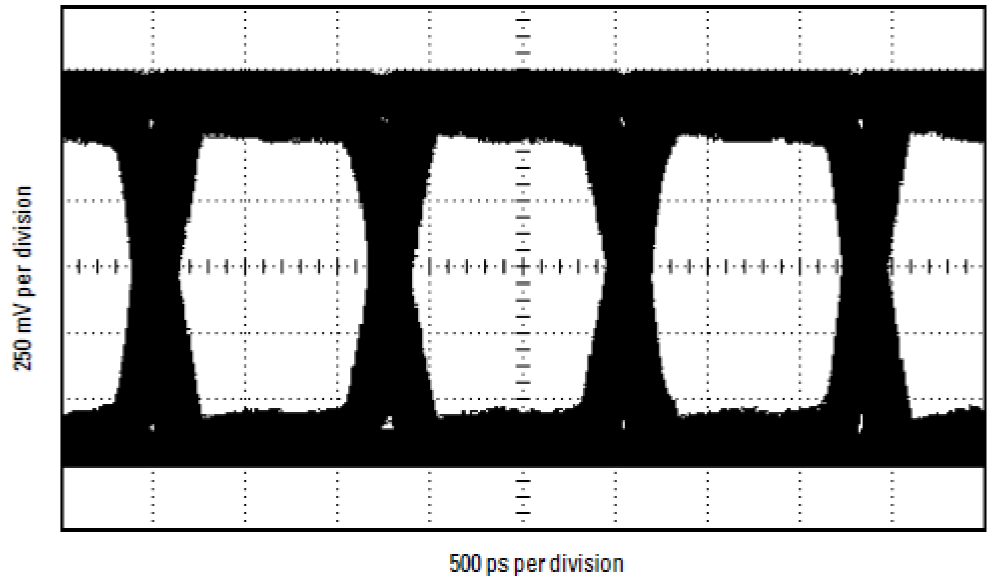


Figure 21 Logic analyzer eye opening for a PRBS signal of 500 mV p-p, 800 Mb/s data rate

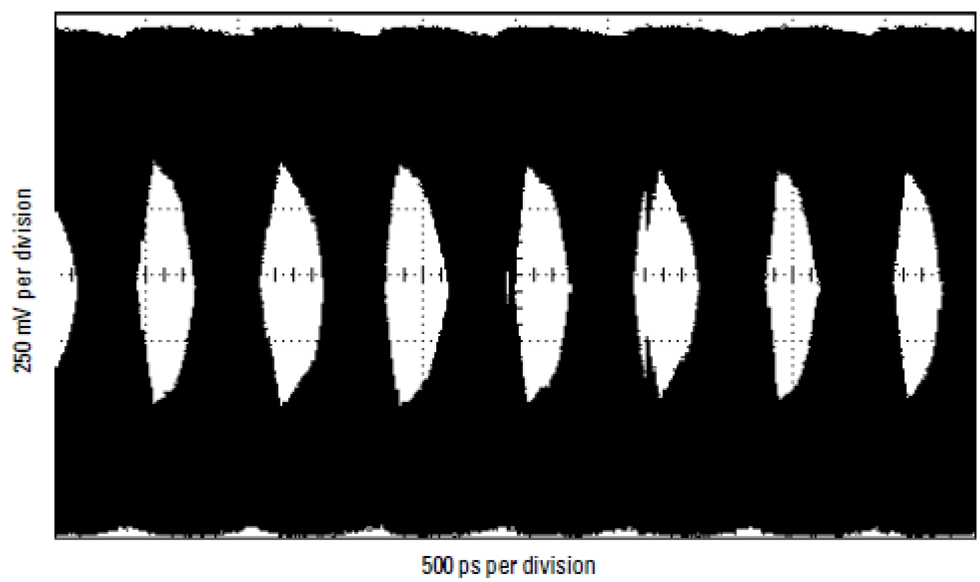


Figure 22 Logic analyzer eye opening for a PRBS signal of 500 mV p-p, 1500 Mb/s data rate

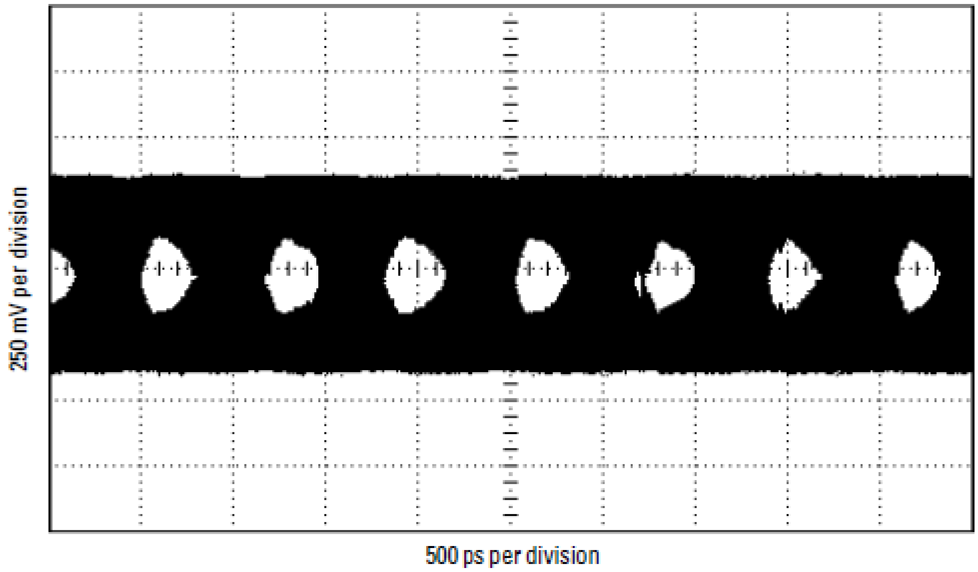


Figure 23 Logic analyzer eye opening for a PRBS signal of 200 mV p-p, 1500 Mb/s data rate

3-Pin Header

This configuration is recommended for probing individual signals. The 3-pin headers provided are SMT compatible and can be loaded during PC board assembly or hand soldered in place at a later time.

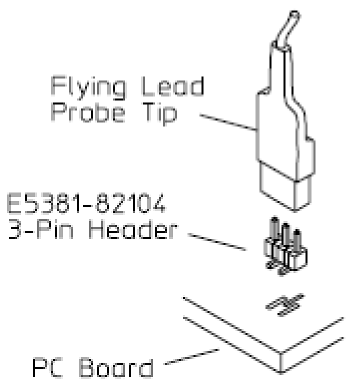


Figure 24 3-pin header probe configuration

The following figure shows the footprint dimensions for surface mounting the 3- pin header on your PC board. Two footprints are shown illustrating minimum clearance.

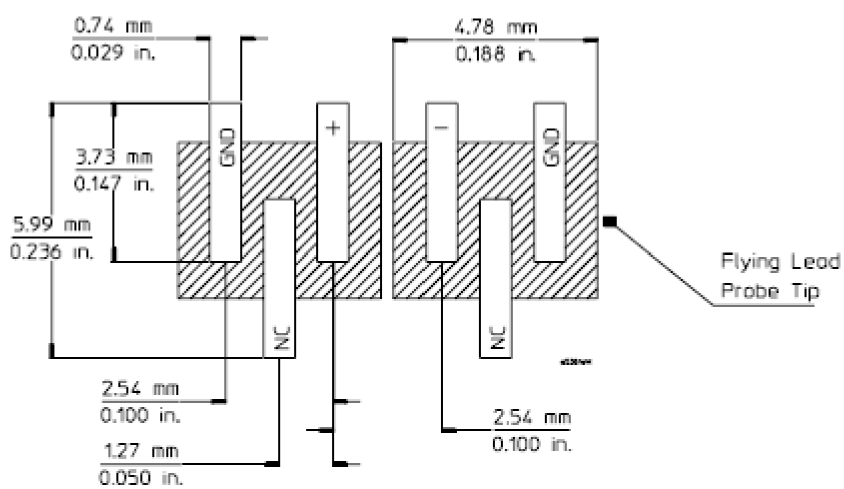


Figure 25 3-pin header probe PC board footprint configuration

Input Impedance

The E5381B probes have an input impedance which varies with frequency, and depends on which accessories are being used. The following schematic shows the circuit model for the input impedance of the probe when using the 3-pin header. This model is a simplified equivalent load of the measured input impedance seen by the target.

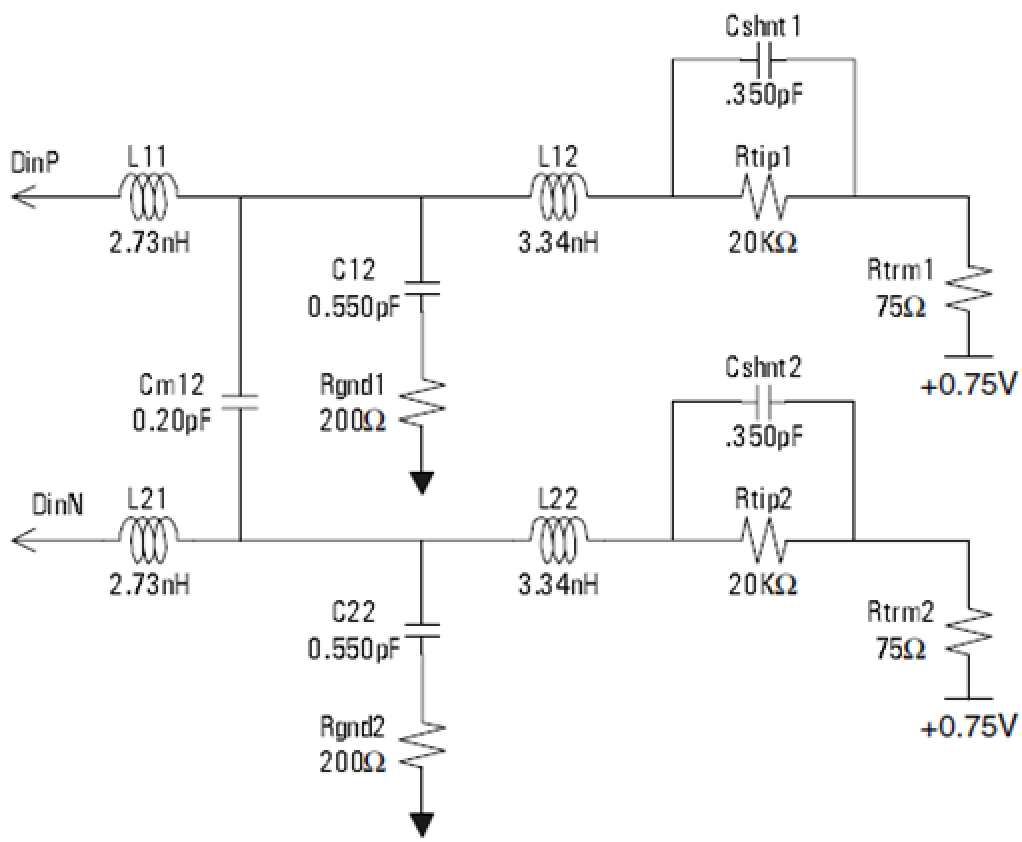


Figure 26 Equivalent load model

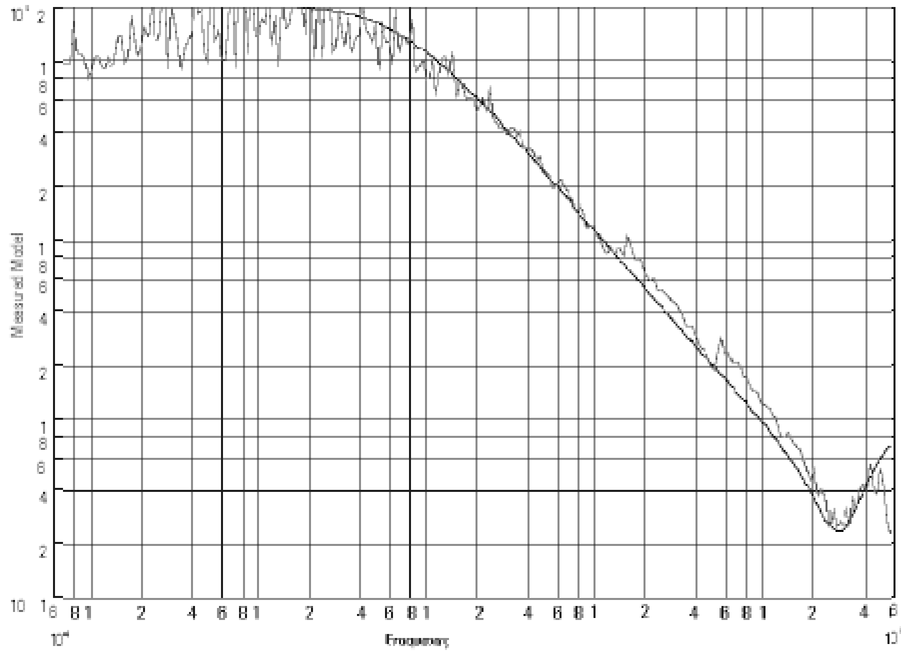


Figure 27 Measured versus modeled input impedance

Time domain transmission (TDT)

All probes have a loading effect on the circuit when they come in contact with the circuit. Time domain transmission (TDT) measurements are useful for understanding the probe loading effects as seen at the target receiver. The following TDT measurements were made mid-bus on a 50 Ω transmission line load terminated at the receiver. These measurements show how the 3-pin header configuration affects the step seen by the receiver for various rise times.

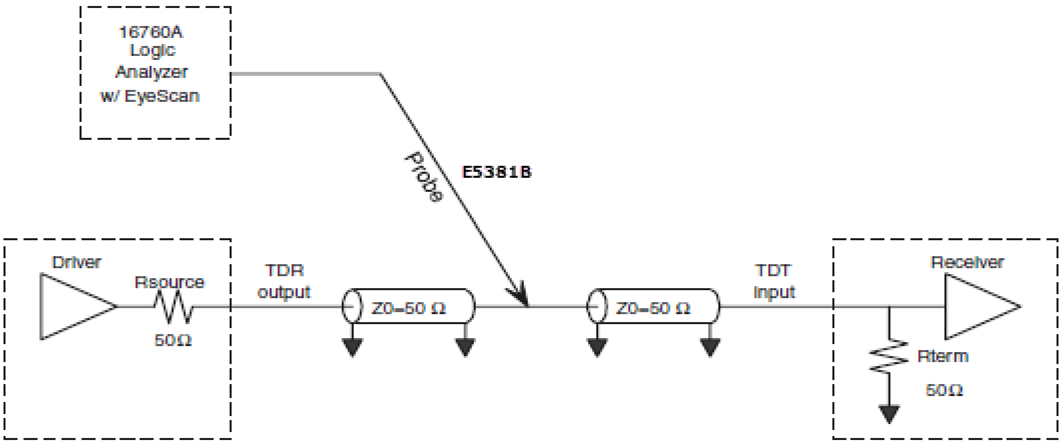


Figure 28 TDT measurement schematic

The recommended configurations are listed in order of loading on the target. As the following graphs demonstrate, the 3-pin header configuration has the 2nd best loading of the four recommended configurations. The graphs show that the loading effects are virtually invisible for targets with rise times >= 500 ps, negligible for targets with 250 ps rise times, and probably still acceptable for 150 ps rise times. Ultimately, you must determine what is an acceptable amount of distortion of the target signal.

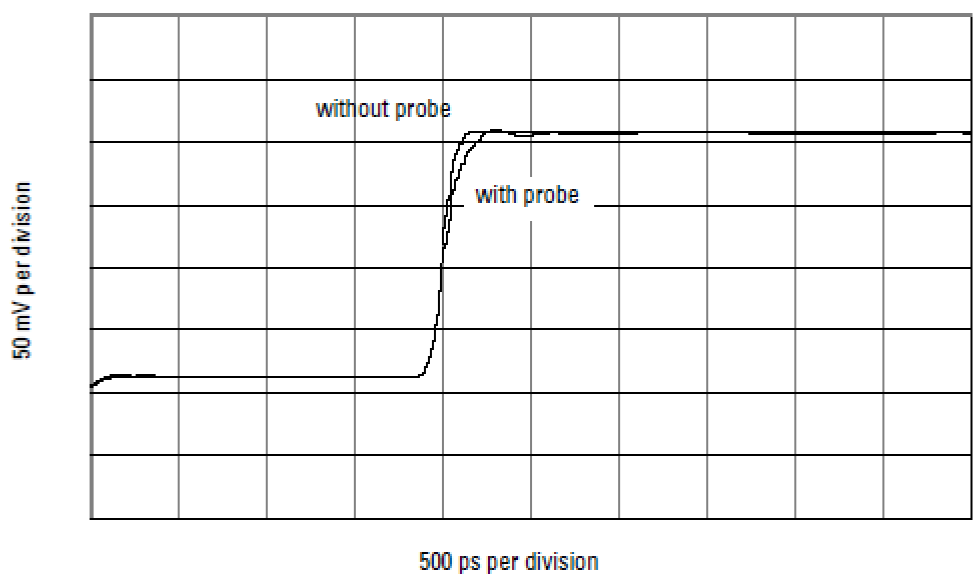


Figure 29 TDT measurement at receiver with and without probe load for 150 ps rise time

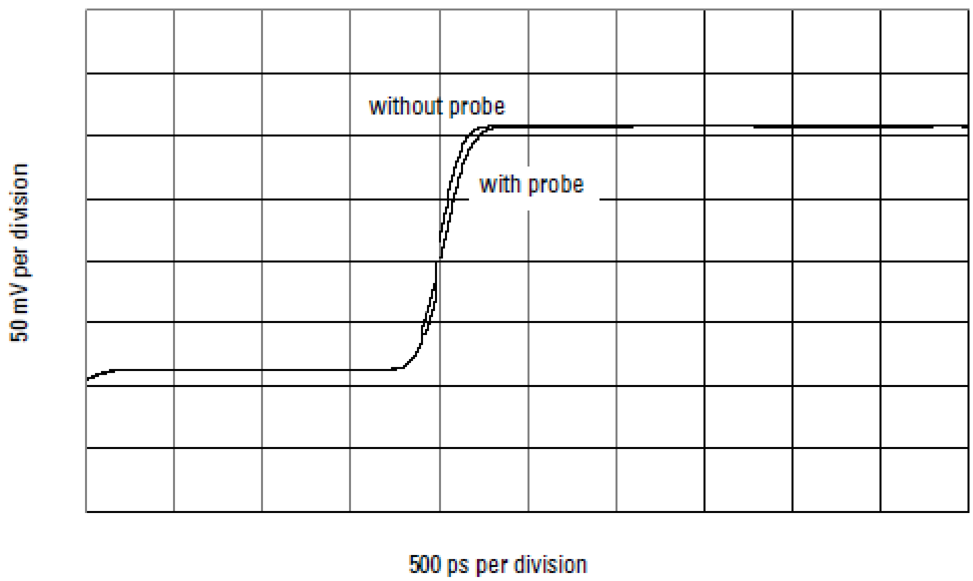


Figure 30 TDT measurement at receiver with and without probe load for 250 ps rise time

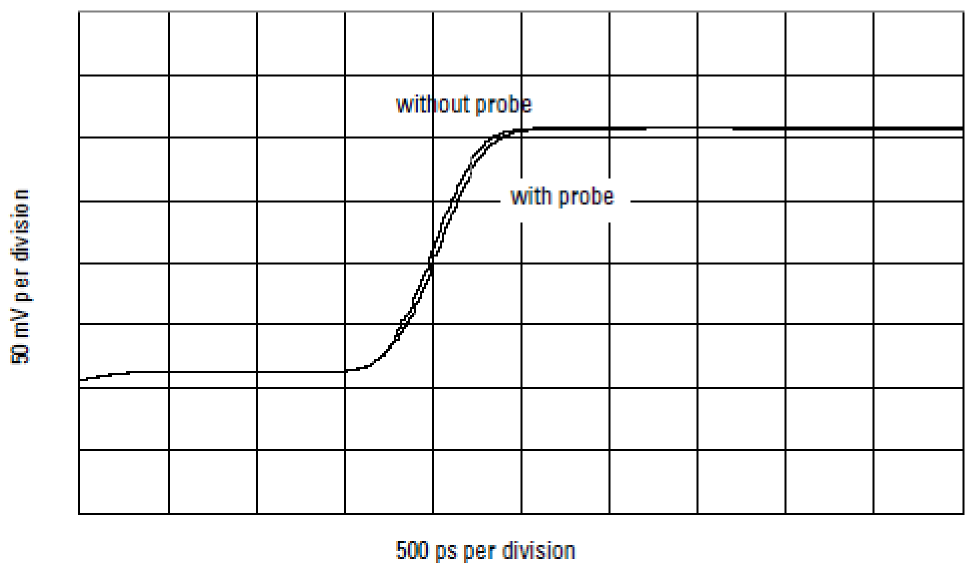


Figure 31 TDT measurement at receiver with and without probe load for 500 ps rise time

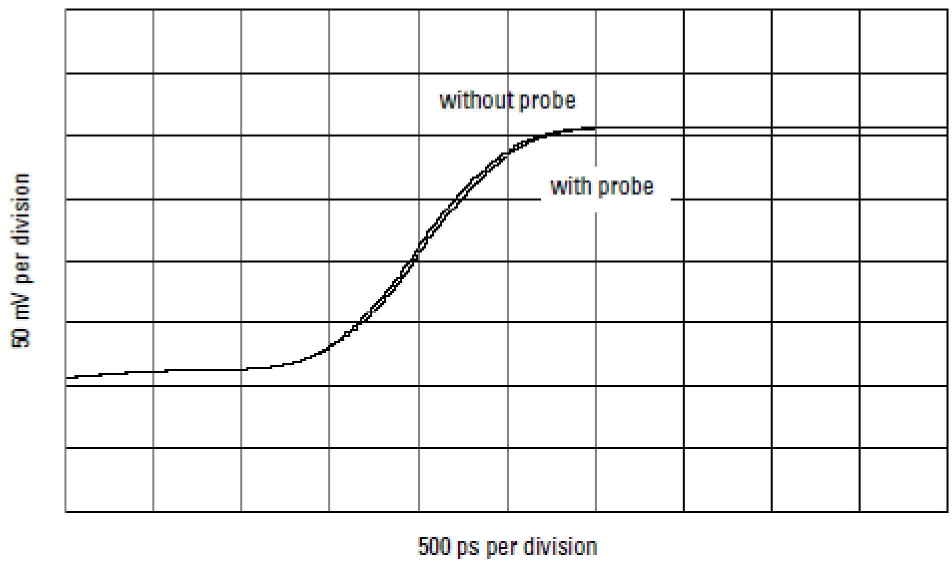


Figure 32 TDT measurement at receiver with and without probe load for 1 ns rise time

Step input

Maintaining signal fidelity to the logic analyzer is critical if the analyzer is to accurately capture data. One measure of a system's signal fidelity is to compare Vin to Vout for various step inputs. For the following graphs, Vin is the signal at the logic analyzer probe tip measured by double probing with an Agilent 54701A probe into an Agilent 54750A oscilloscope (total 2.5 GHz BW). Eye Scan is used to measure Vout, the signal seen by the logic analyzer. The measurements were made on a mid-bus connection to a 50 Ω transmission line load terminated at the receiver. These measurements show the logic analyzer's response while using the 3-pin header configuration.

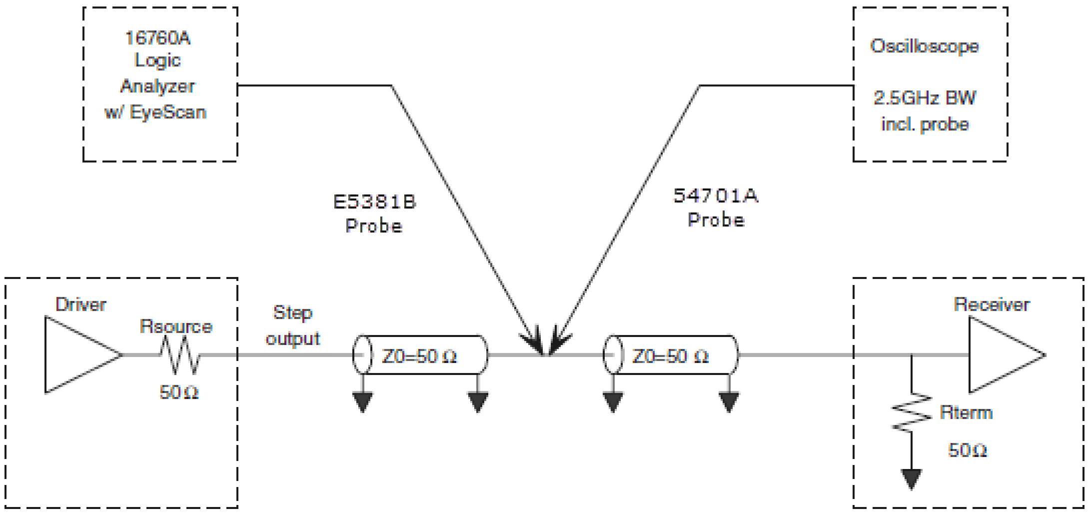


Figure 33 Step input measurement schematic

The following graphs demonstrate the logic analyzer's probe response to different rise times. These graphs are included for you to gain insight into the expected performance of the different recommended configurations.

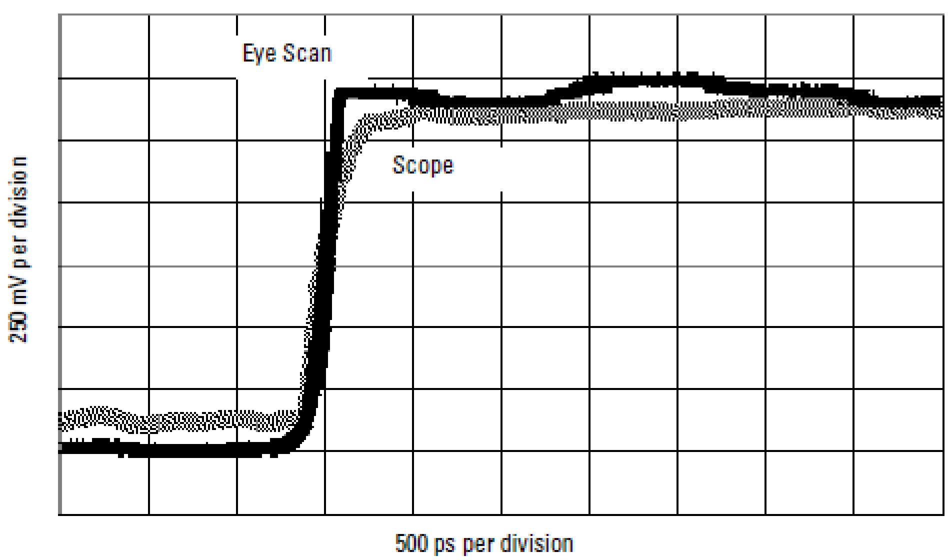


Figure 34 Logic analyzer's response to a 150 ps rise time

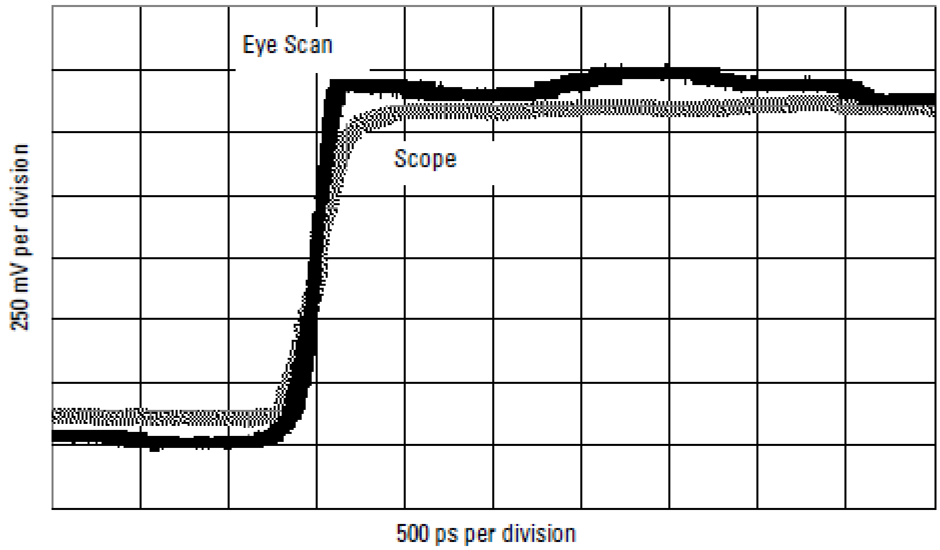


Figure 35 Logic analyzer's response to a 250 ps rise time

NOTE

These measurements are not the true step response of the probes. The true step response of a probe is the output of the probe while the input is a perfect step.

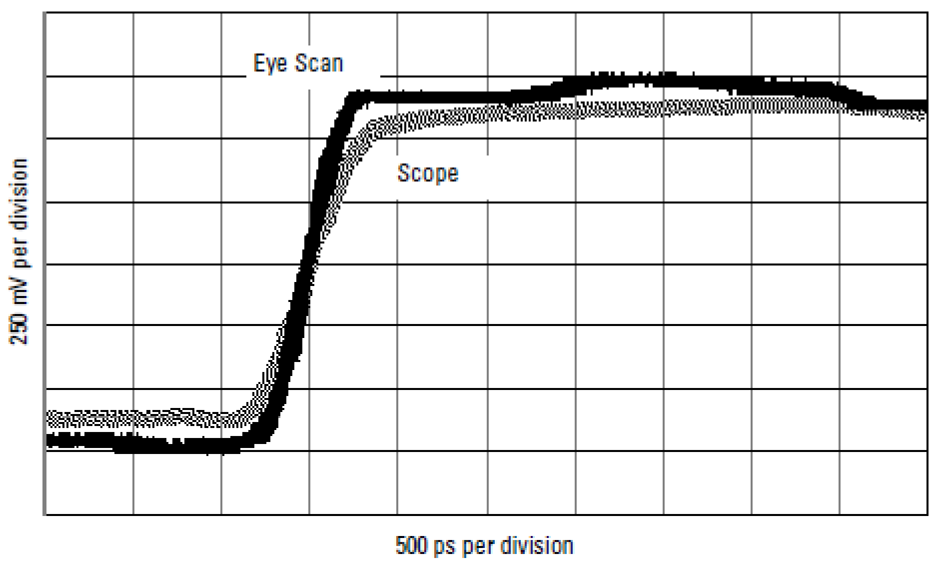


Figure 36 Logic analyzer's response to a 500 ps rise time

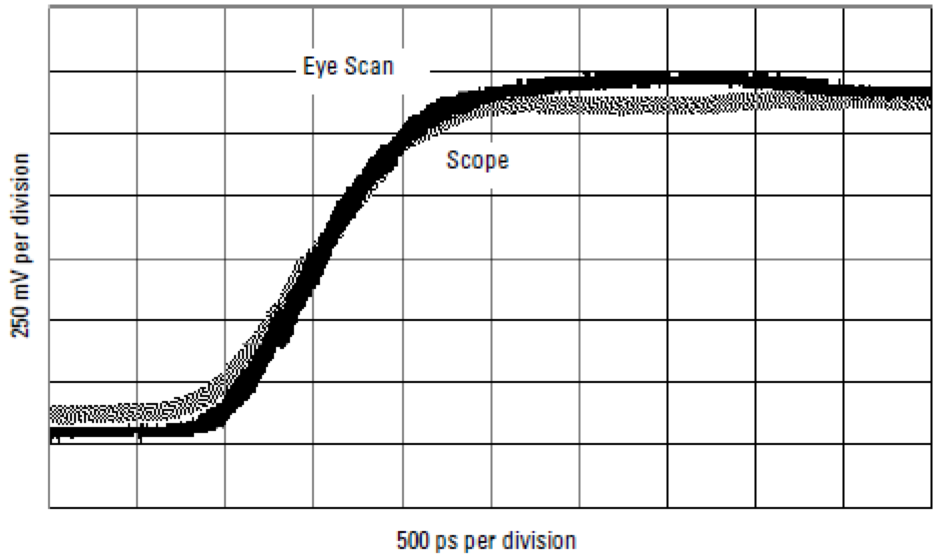


Figure 37 Logic analyzer's response to a 1ns rise time

NOTE These measurements are not the true step response of the probes. The true step response of a probe is the output of the probe while the input is a perfect step.

Eye opening

The eye opening at the logic analyzer is the truest measure of an analyzer's ability to accurately capture data. Seeing the eye opening at the logic analyzer is possible with Eye Scan. Eye opening helps you know how much margin the logic analyzer has, where to sample and at what threshold. Any probe response that exhibits overshoot and ringing, probe non-flatness, noise and other issues all deteriorate the eye opening seen by the logic analyzer. The following eye diagrams were measured using Eye Scan probed mid-bus on a 50 Ω transmission line load terminated at the receiver. The data patterns were generated using a 223 1 pseudo random bit sequence (PRBS). These measurements show the remaining eye opening at the logic analyzer while using the 3-pin header configuration.

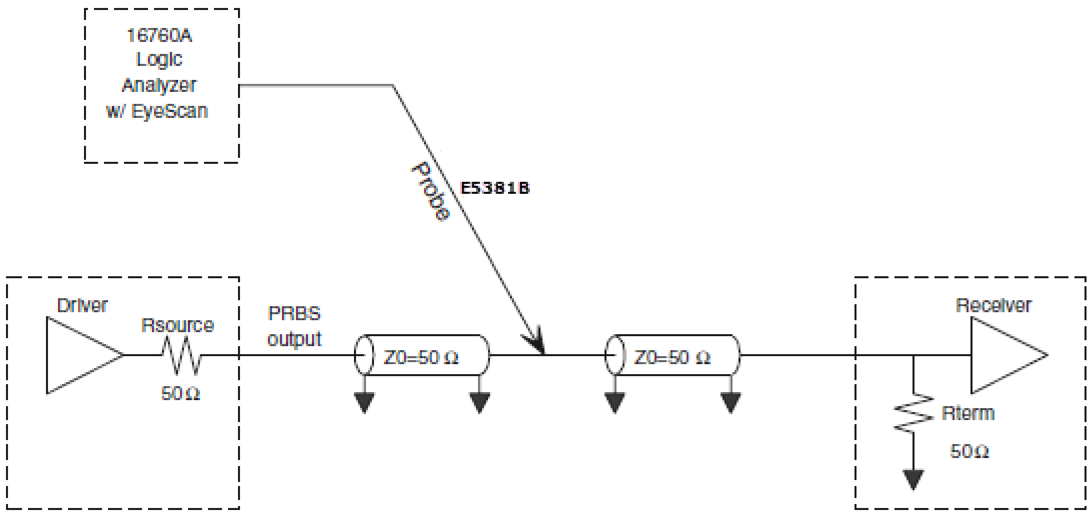


Figure 38 Eye opening measurement schematic

The logic analyzer Eye Scan measurement uses the same circuitry as the synchronous state mode analysis. Therefore, the eye openings measured are exact representations of what the logic analyzer sees and operates on in state mode. The following measurements demonstrate how the eye opening starts to collapse as the clock rate is increased. At 1500 Mb/s, the eye opening is noticeably deteriorating but still usable as jitter on the transitions increase and voltage margins decrease.

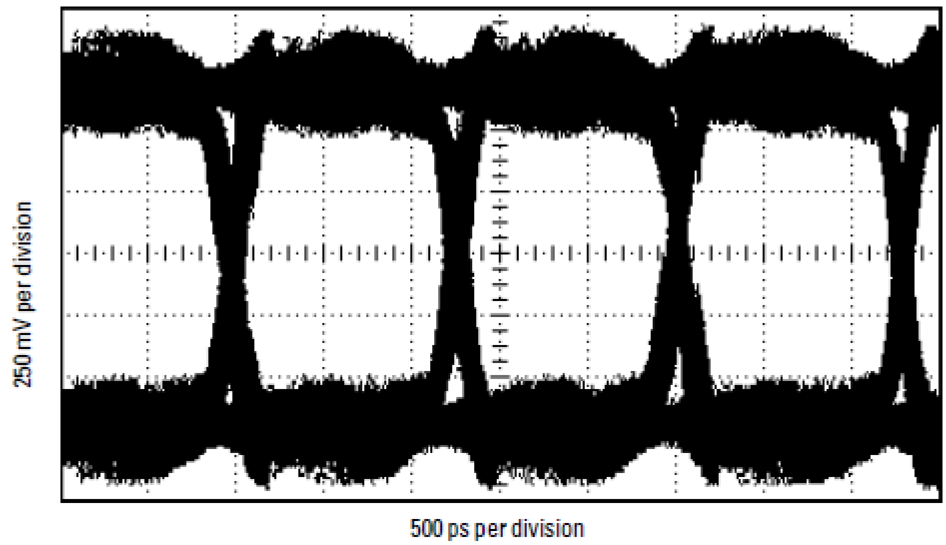


Figure 39 Logic analyzer eye opening for a PRBS signal of 500 mV p-p, 800 Mb/s data rate

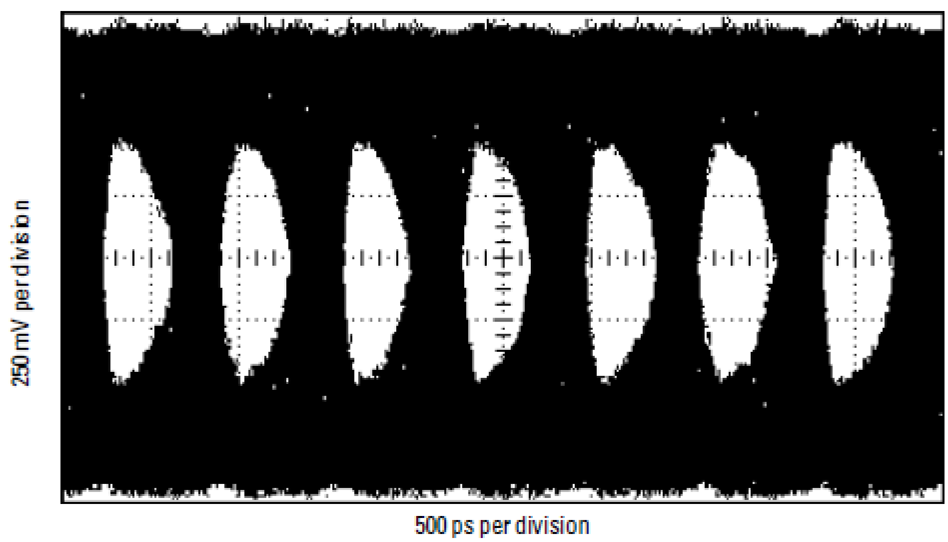


Figure 40 Logic analyzer eye opening for a PRBS signal of 500 mV p-p, 1500 Mb/s data rate

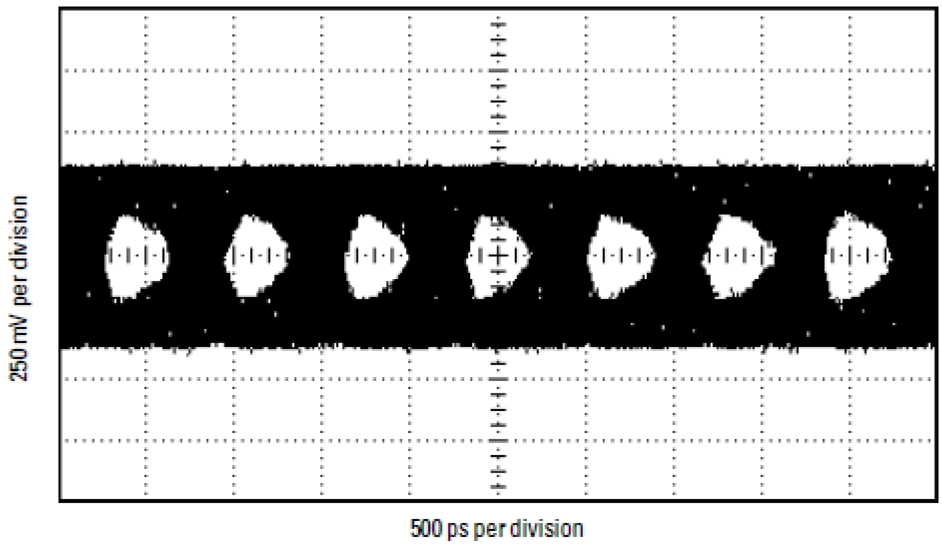


Figure 41 Logic analyzer eye opening for a PRBS signal of 200 mV p-p, 1500 Mb/s data rate

Socket Adapters

This configuration is recommended if you already have 0.635 mm (0.025 inch) pins on 2.54 mm (0.1 inch) centers as test points where you wish to connect the probe. The E5381B only accepts 0.508 mm (0.020 inch) pins. The probe will be damaged if 0.635 mm (0.025 inch) pins are forced into the probe receptacle. The socket adapter provides a means of probing these headers while protecting the flying lead probe tip.

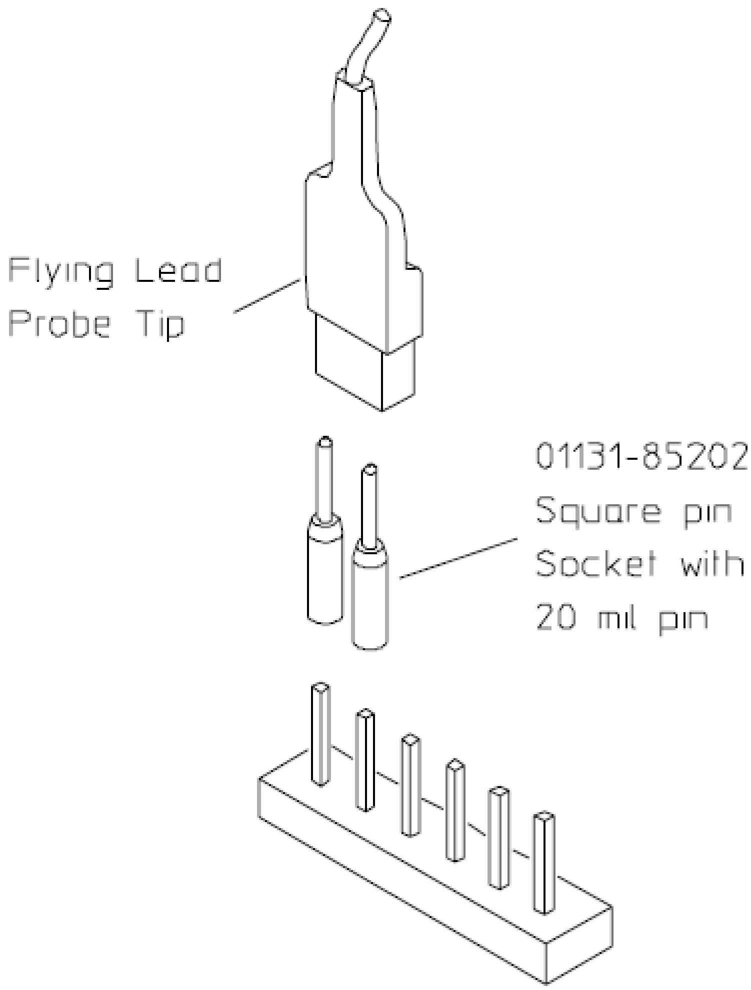


Figure 42 Socket adapter configuration

All of the following measurements for the socket adapter were made on a header with 0.635 mm (0.025 inch) pins on 2.54 mm (0.1 inch) centers that where converted to 0.508 mm (0.020 inch) pins using the socket adapter.

Using multiple socket adapters

The grey boxes in the following diagram show the dimensions of the socket adapters.

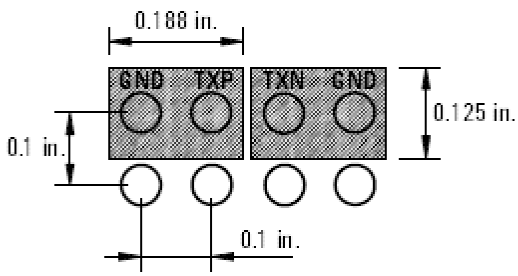
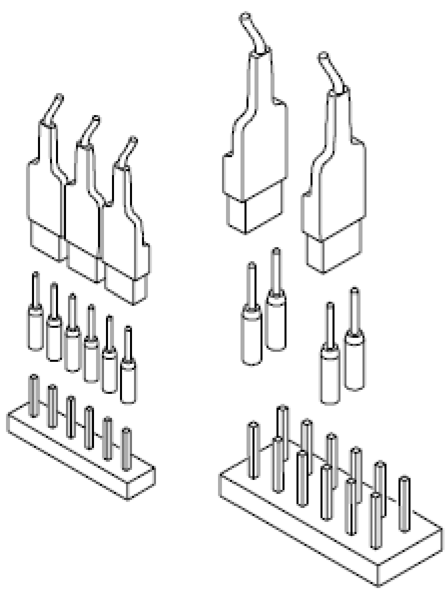
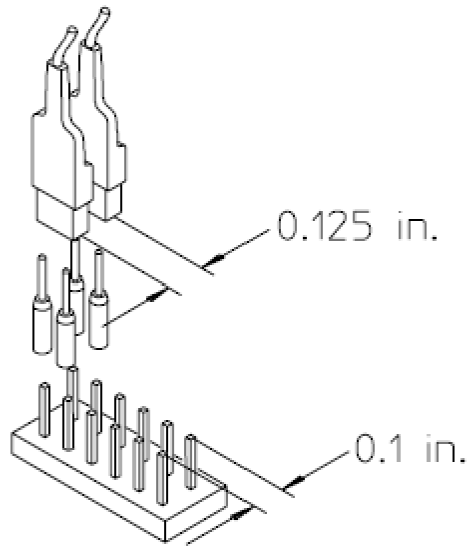


Figure 43 Socket adapter clearance

Multiple adapters can be used side-by-side or in tandem by skipping 1 or more pins as shown.



Mechanical clearance does not allow the adapters to be used back-to-back as shown.



Input Impedance

The E5381B probes have an input impedance which varies with frequency, and depends on which accessories are being used. The following schematic shows the circuit model for the input impedance of the probe when using socket adapters. This model is a simplified equivalent load of the measured input impedance seen by the target.

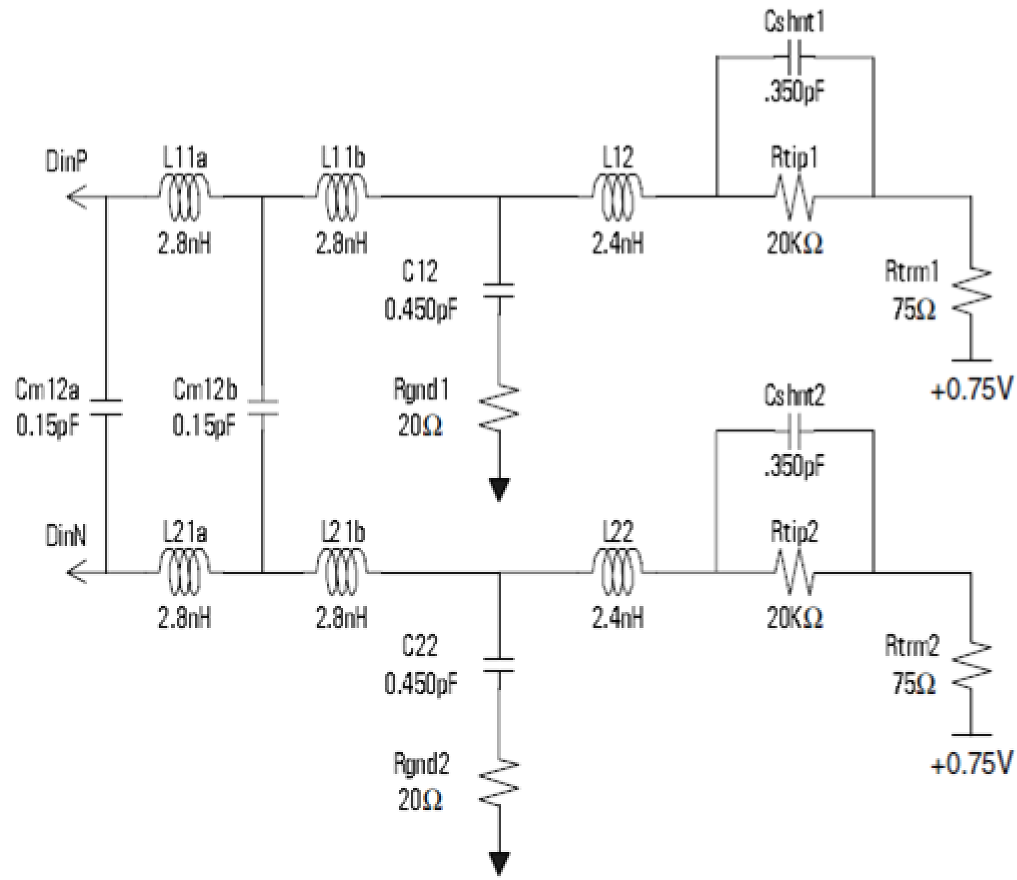


Figure 44 Equivalent load model

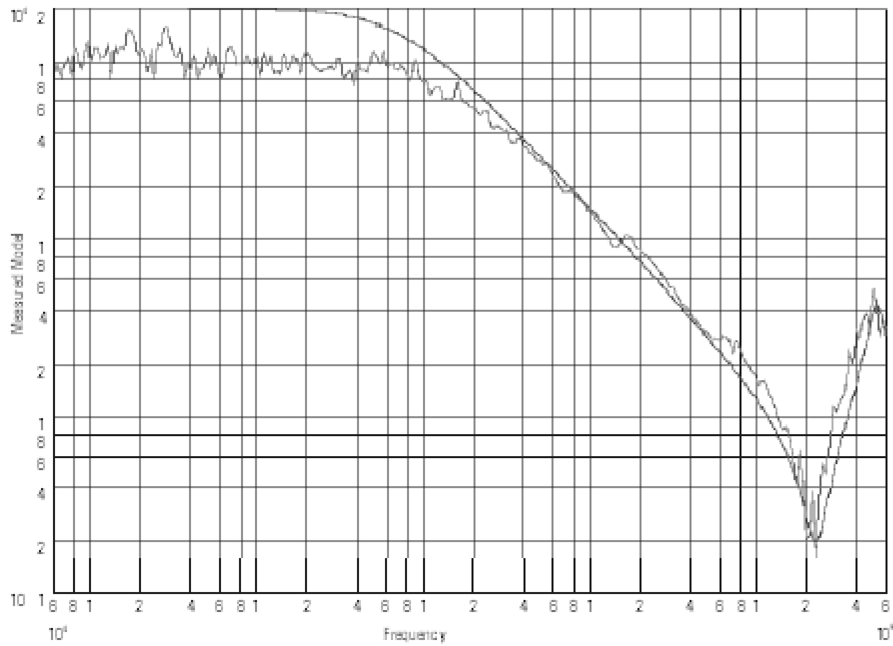


Figure 45 Measured versus modeled input impedance

Time domain transmission (TDT)

All probes have a loading effect on the circuit when they come in contact with the circuit. Time domain transmission (TDT) measurements are useful for understanding the probe loading effects as seen at the target receiver. The following TDT measurements were made mid-bus on a 50 Ω transmission line load terminated at the receiver. These measurements show how the flying lead and socket adapter configuration affect the step seen by the receiver for various rise times.

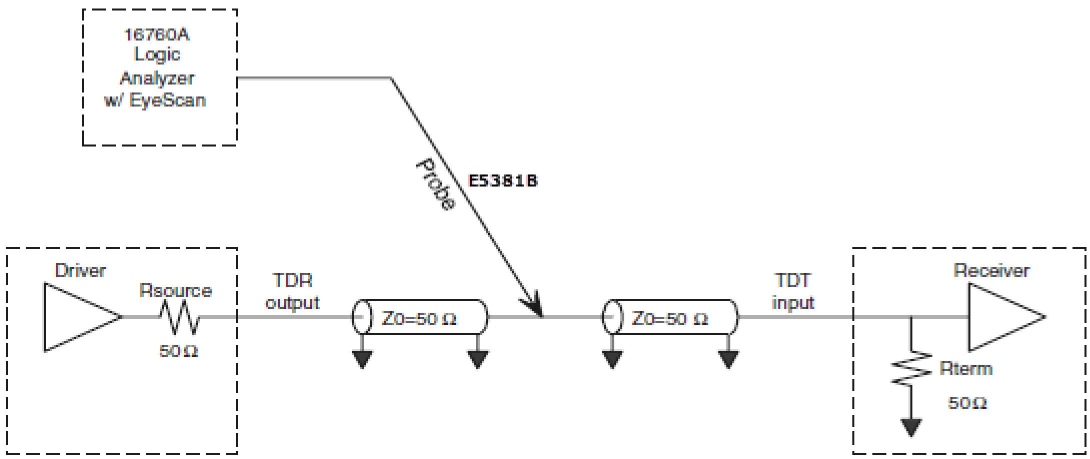


Figure 46 TDT measurement schematic

The recommended configurations are listed in order of loading on the target. As the following graphs demonstrate, the flying lead and socket adapter configuration has the 3rd best loading of the four recommended configurations. The graphs show that the loading effects are negligible for targets with rise times >= 500 ps, probably still acceptable for targets with 250 ps rise times, and may be considered significant for 150 ps rise times. Ultimately, you must determine what is an acceptable amount of distortion of the target signal.

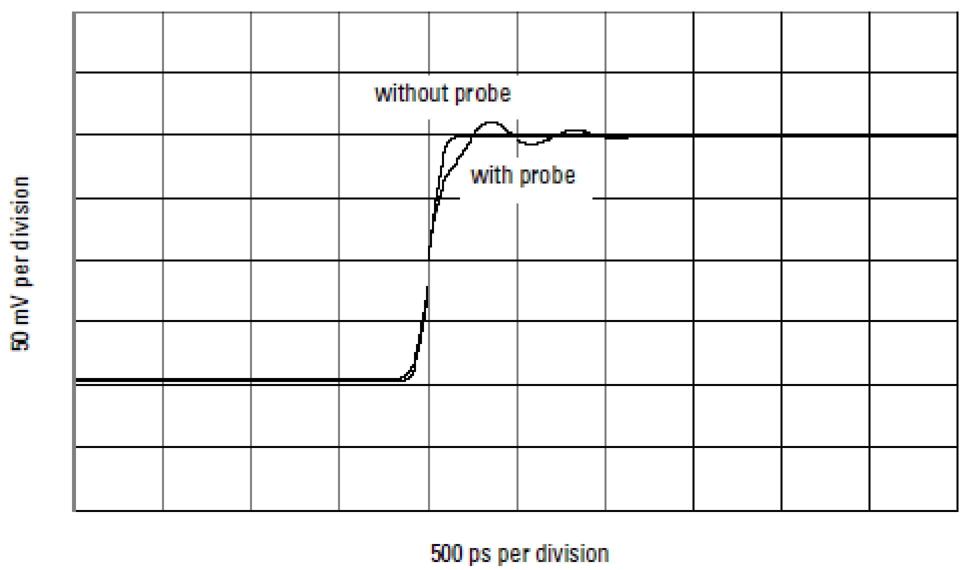


Figure 47 TDT measurement at receiver with and without probe load for 150 ps rise time

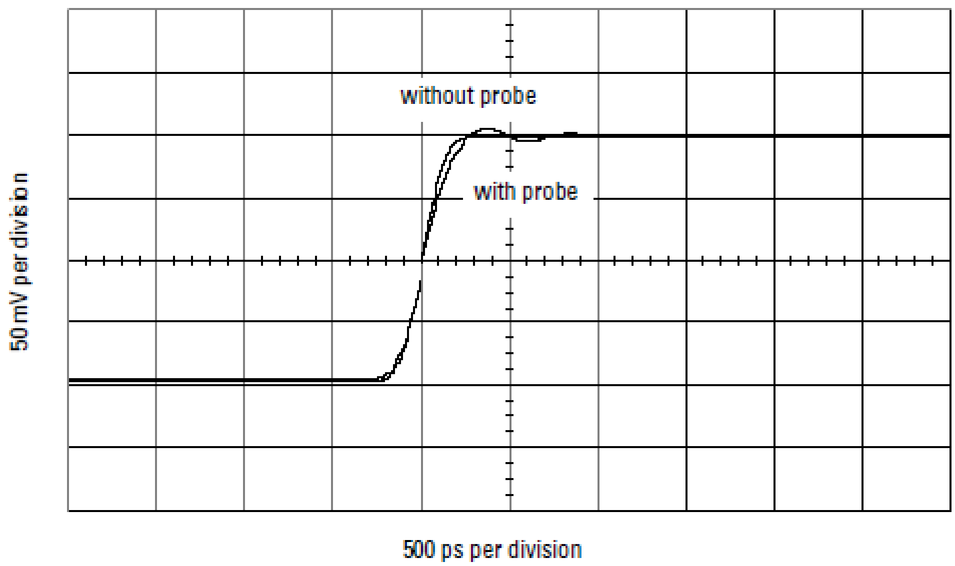


Figure 48 TDT measurement at receiver with and without probe load for 250 ps rise time

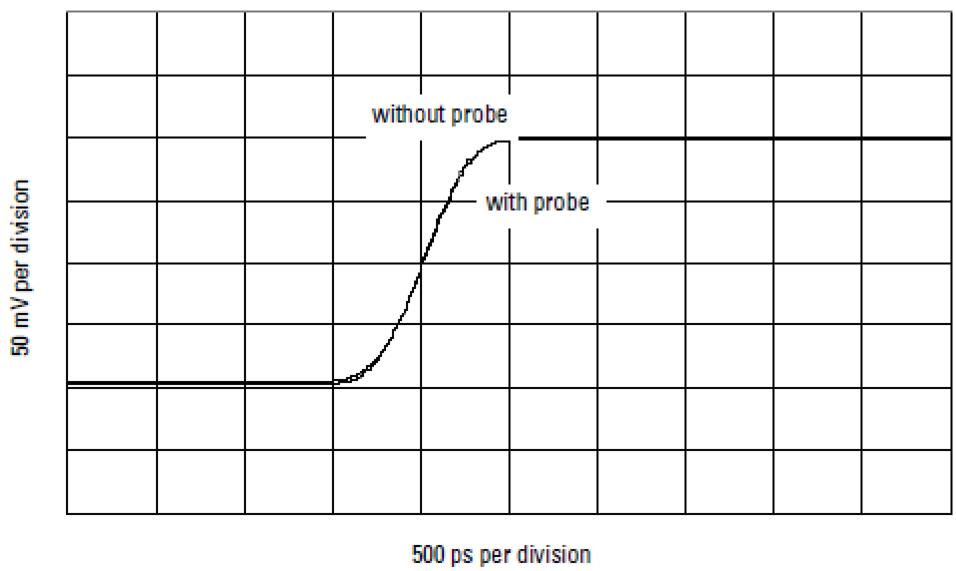


Figure 49 TDT measurement at receiver with and without probe load for 500 ps rise time

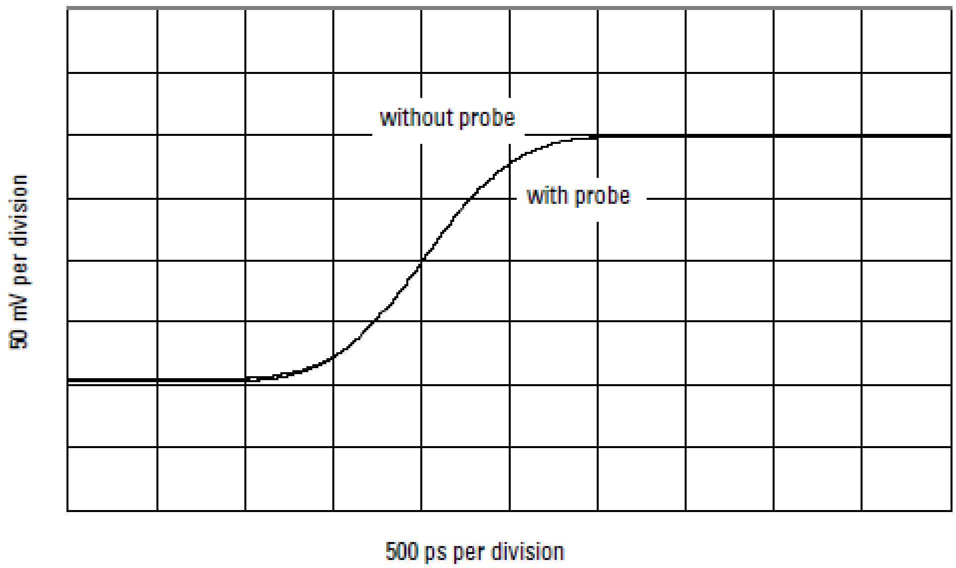


Figure 50 TDT measurement at receiver with and without probe load for 1 ns rise time

Step input

Maintaining signal fidelity to the logic analyzer is critical if the analyzer is to accurately capture data. One measure of a system's signal fidelity is to compare Vin to Vout for various step inputs. For the following graphs, Vin is the signal at the logic analyzer probe tip measured by double probing with an Agilent 54701A probe into an Agilent 54750A oscilloscope (total 2.5 GHz BW). Eye Scan is used to measure Vout, the signal seen by the logic analyzer. The measurements were made on a mid-bus connection to a 50 Ω transmission line load terminated at the receiver. These measurements show the logic analyzer's response while using the flying lead and socket adapter configuration.

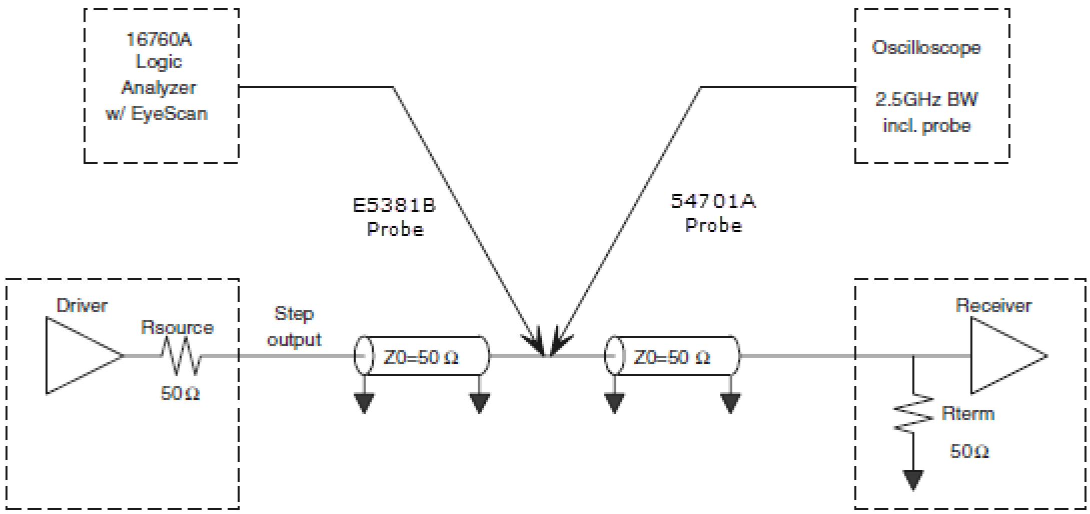


Figure 51 Step measurement schematic

The following graphs demonstrate the logic analyzer's probe response to different rise times. These graphs are included for you to gain insight into the expected performance of the different recommended accessory configurations.

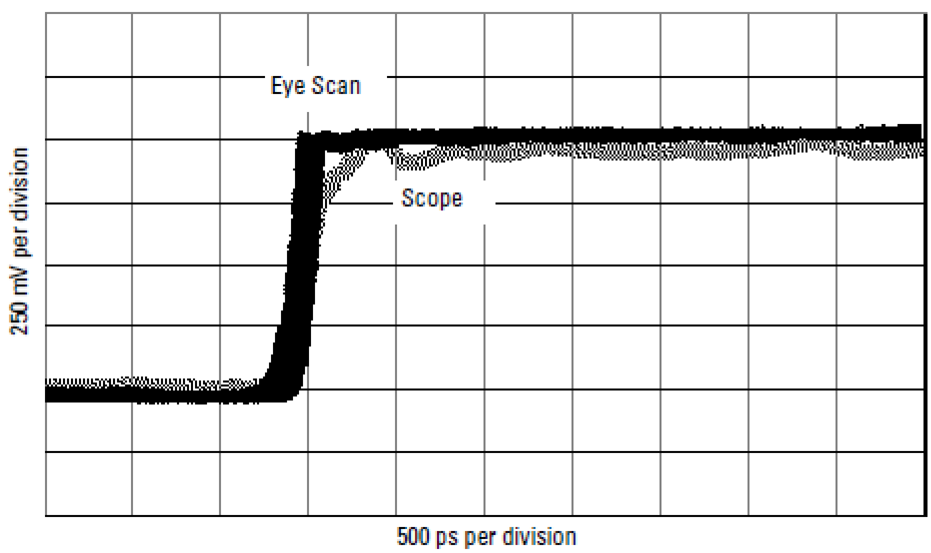


Figure 52 Logic analyzer's response to a 150 ps rise time

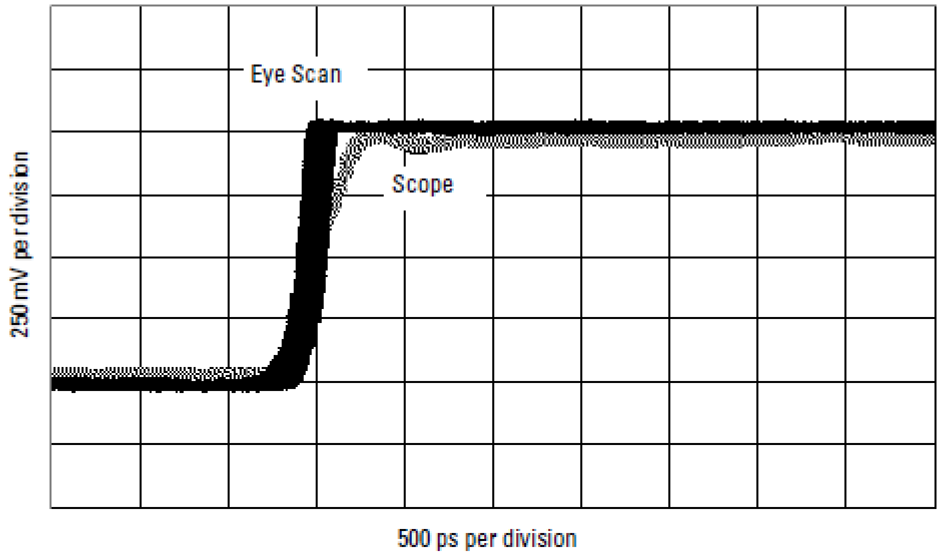


Figure 53 Logic analyzer's response to a 250 ps rise time

NOTE These measurements are not the true step response of the probes. The true step response of a probe is the output of the probe while the input is a perfect step.

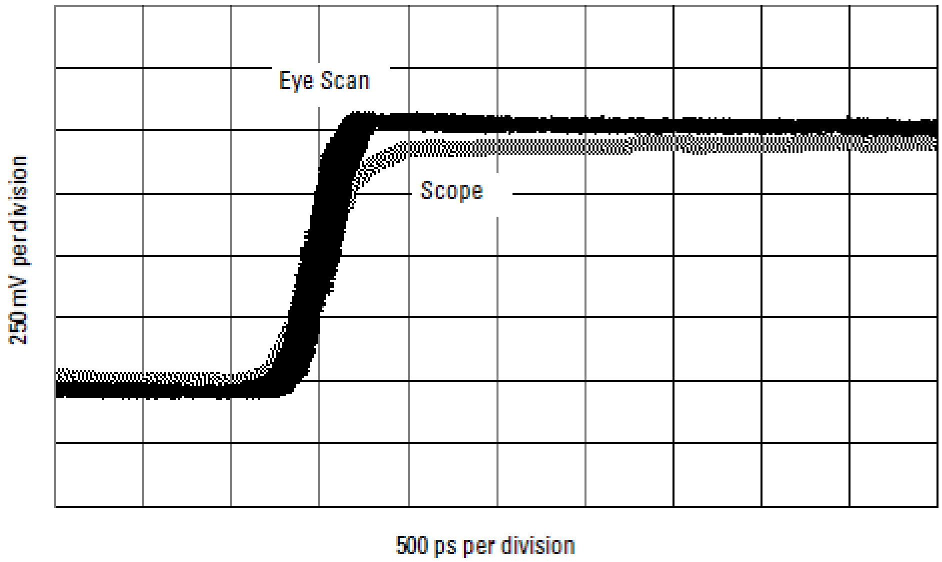


Figure 54 Logic analyzer's response to a 500 ps rise time

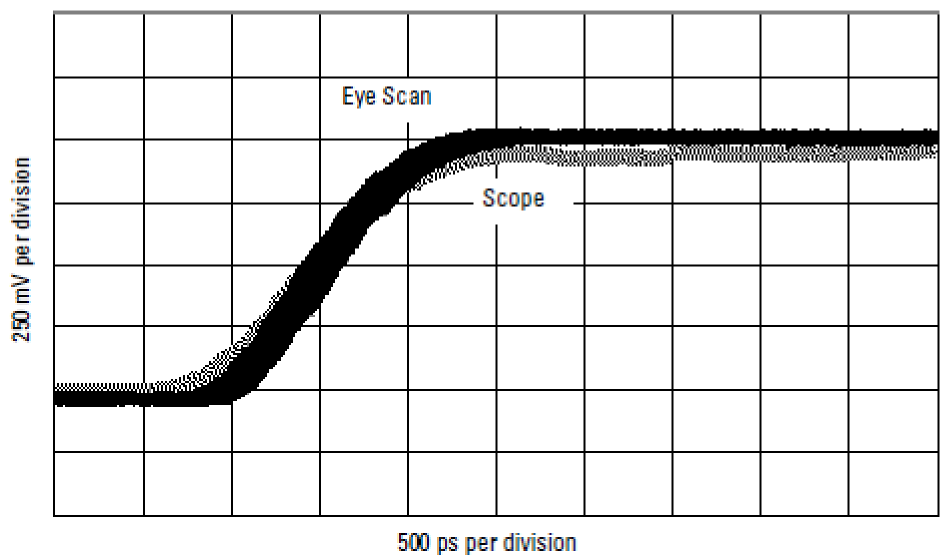


Figure 55 Logic analyzer's response to a 1 ns rise time

NOTE

These measurements are not the true step response of the probes. The true step response of a probe is the output of the probe while the input is a perfect step.

Eye opening

The eye opening at the logic analyzer is the truest measure of an analyzer's ability to accurately capture data. Seeing the eye opening at the logic analyzer is possible with Eye Scan. Eye opening helps you know how much margin the logic analyzer has, where to sample and at what threshold. Any probe response that exhibits overshoot and ringing, probe non-flatness, noise and other issues all deteriorate the eye opening seen by the logic analyzer. The following eye diagrams were measured using Eye Scan probed mid-bus on a 50 Ω transmission line load terminated at the receiver. The data patterns were generated using a 223 1 pseudo random bit sequence (PRBS). These measurements show the remaining eye opening at the logic analyzer while using the flying lead and socket adapter configuration.

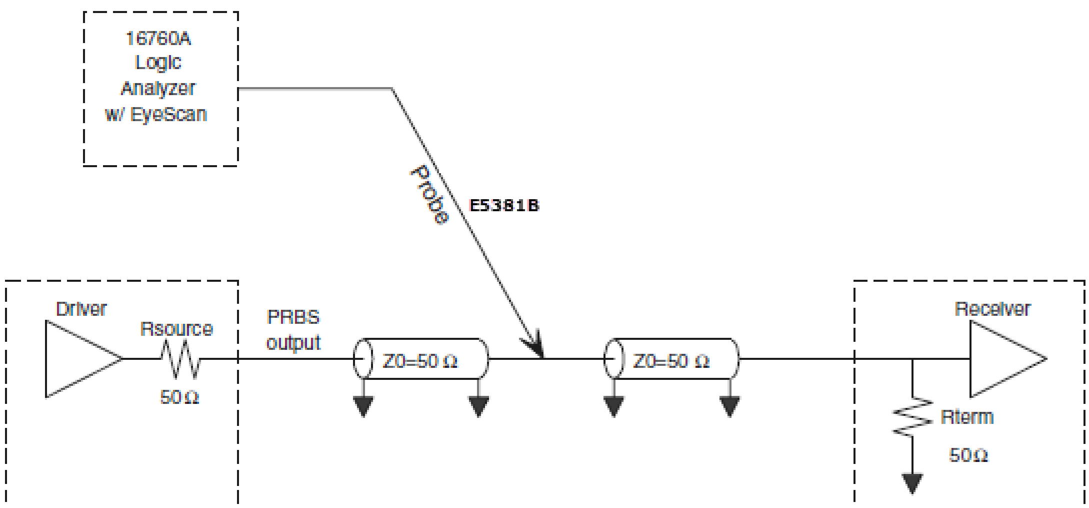


Figure 56 Eye opening measurement schematic

The logic analyzer Eye Scan measurement uses the same circuitry as the synchronous state mode analysis. Therefore, the eye openings measured are exact representations of what the logic analyzer sees and operates on in state mode. The following measurements demonstrate how the eye opening starts to collapse but is still usable as the clock rate is increased.

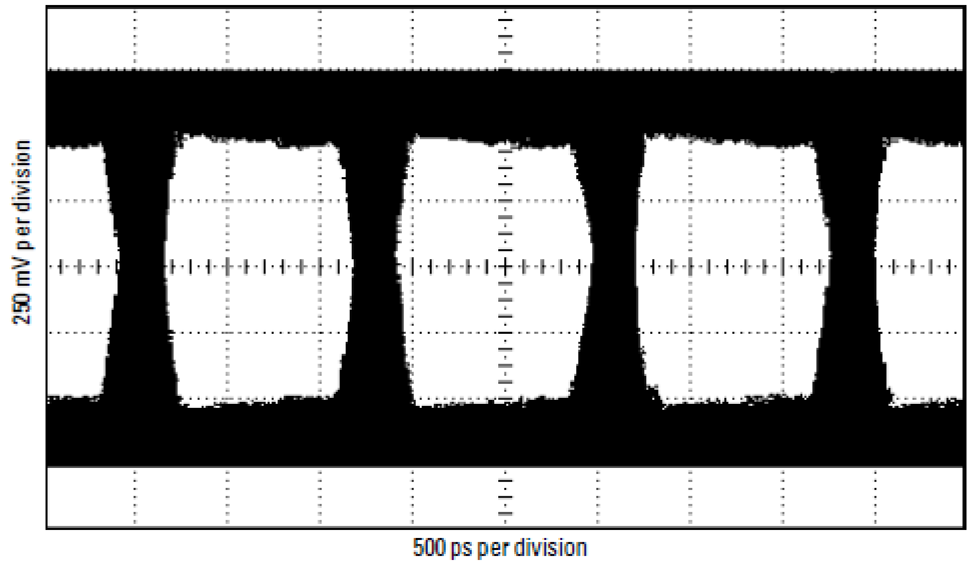


Figure 57 Logic analyzer eye opening for a PRBS signal of 500 mV p-p, 800 Mb/s data rate

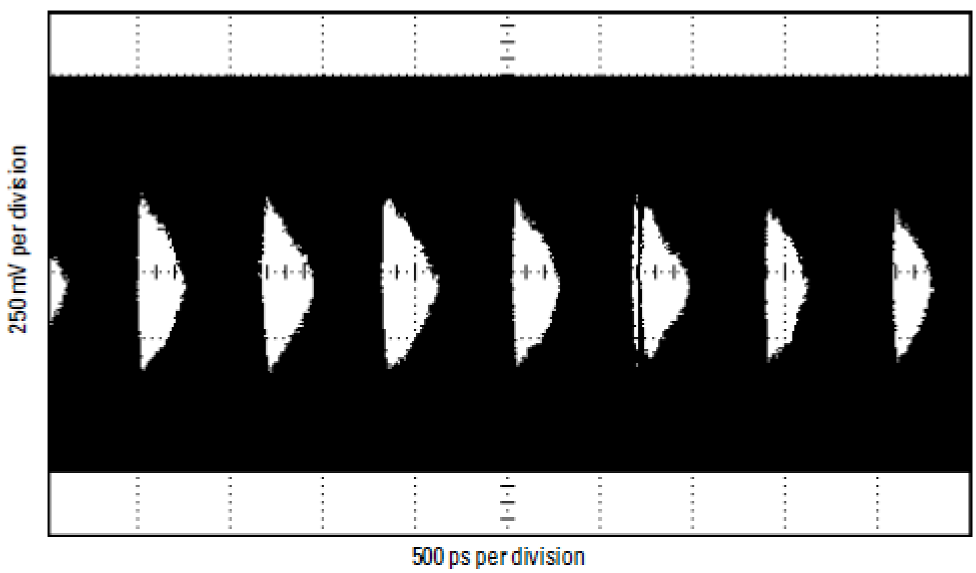


Figure 58 Logic analyzer eye opening for a PRBS signal of 500 mV p-p, 1500 Mb/s data rate

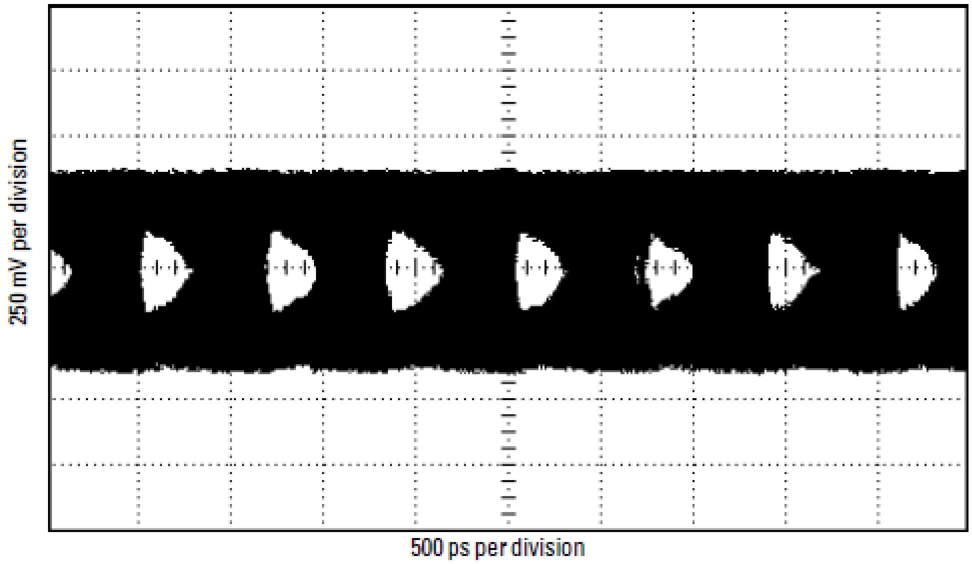


Figure 59 Logic analyzer eye opening for a PRBS signal of 200 mV p-p, 1500 Mb/s data rate

Damped Wire Accessory (160 ohm)

Using the damped wire accessory gives the greatest flexibility for attaching the probe to component leads. The damped wires can be easily formed to reach very constricted regions of the target. However, as you can see from the following information, the signal quality is slightly compromised by this configuration.

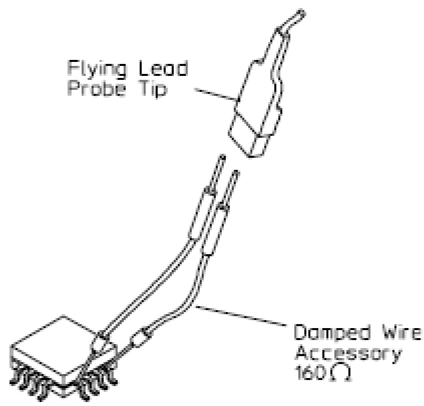


Figure 60 Damped wire configuration

The damped wire accessory is a 160 Ω tip resistor that is followed by a length of wire prior to attaching to the probe tip. This configuration provides flexibility to the user and isolation between the target and the probe capacitance. However, the 160 Ω resistor and the capacitance of the wire form an RC filter that rolls off the response of the signal that the probe tip sees.

Input Impedance

The E5381B probes have an input impedance which varies with frequency, and depends on which accessories are being used. The following schematic shows the circuit model for the input impedance of the probe when using the damped wire configuration. This model is a simplified equivalent load of the measured input impedance seen by the target.

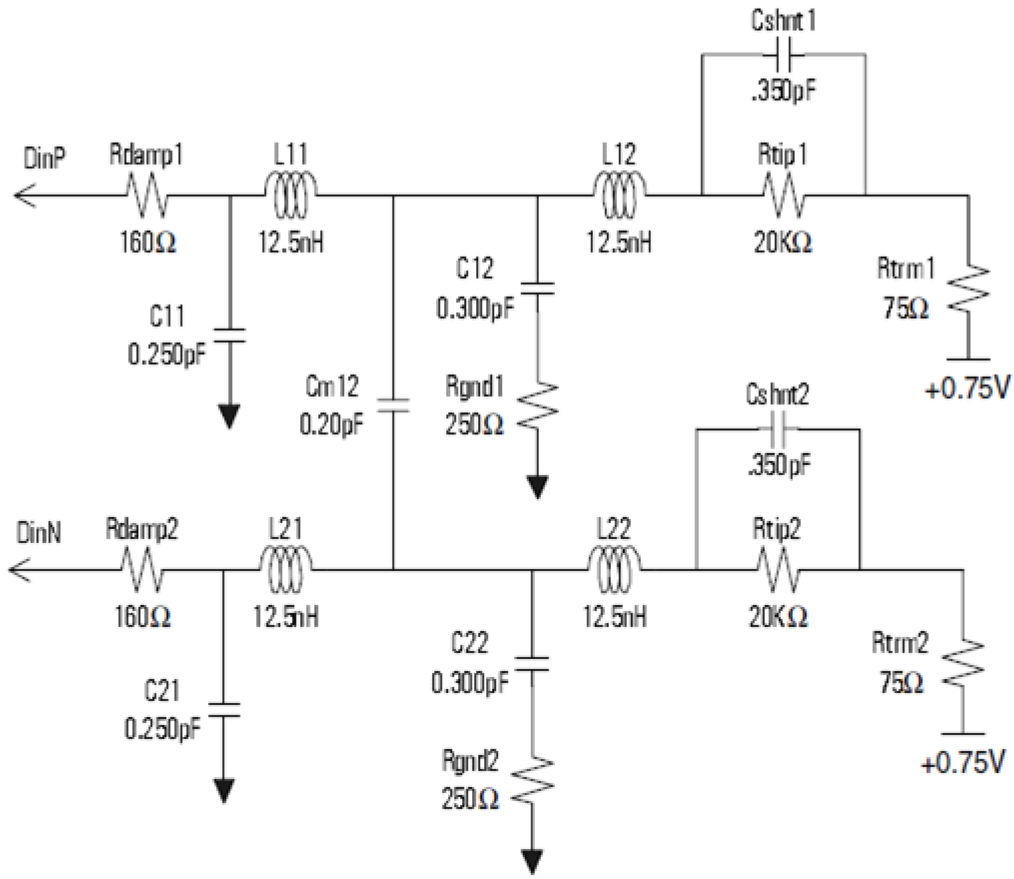


Figure 61 Equivalent load model

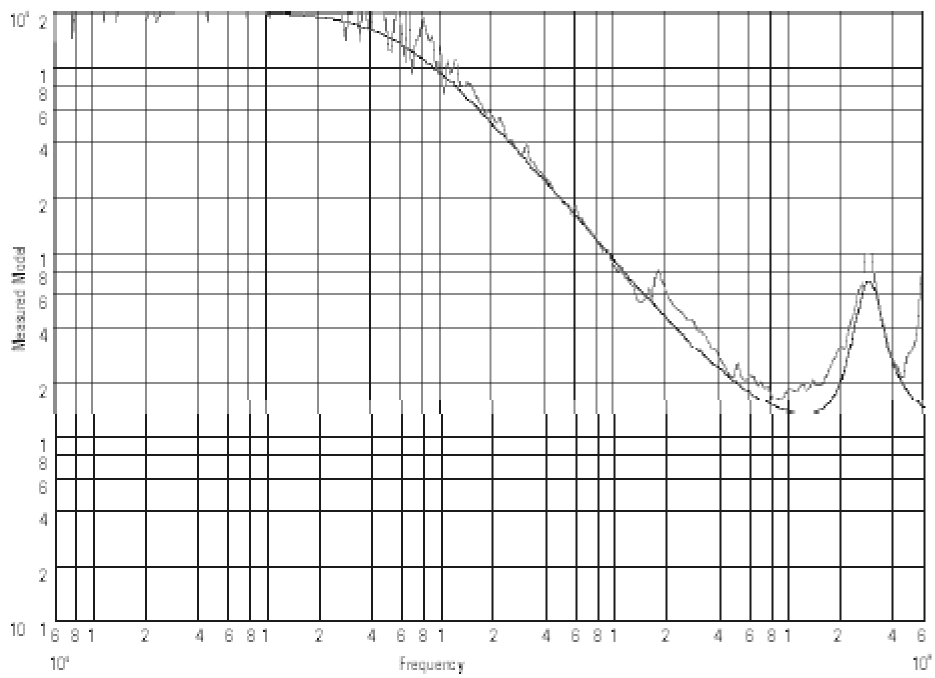


Figure 62 Measured versus modeled input impedance

Other signal lead lengths may be used with these probes but a resistance value needs to be determined from the following figure and a resistor of that value needs to be placed as close as possible to the point being probed.

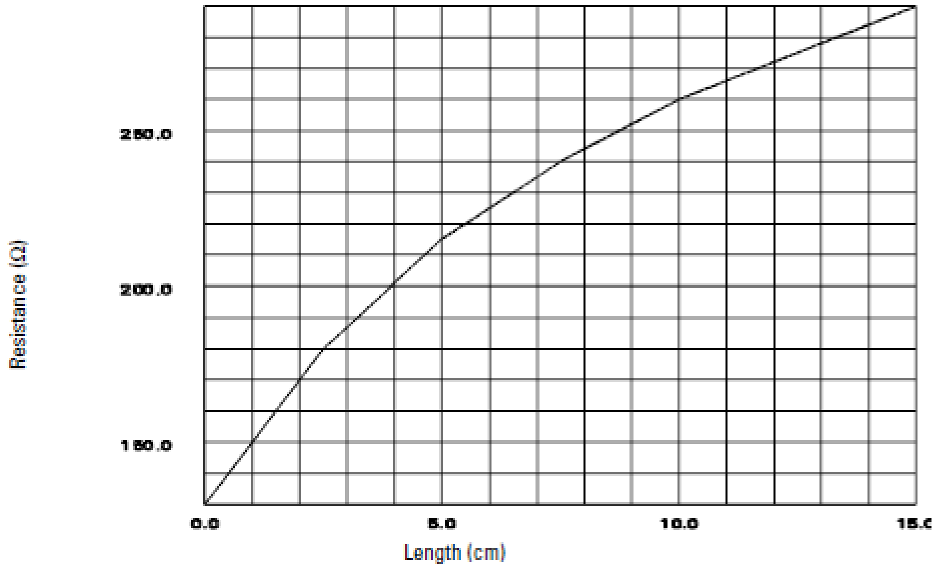


Figure 63 Optimum Damping Resistor Value Versus Signal Lead Length

If a resistor is not used, the response of the probe will be very peaked at high frequencies. This will cause overshoot and ringing to be introduced in the step response of waveforms with fast rise times. Use of this probe without a resistor at the point being probed should be limited to measuring only waveforms with slower rise times.

Time domain transmission (TDT)

All probes have a loading effect on the circuit when they come in contact with the circuit. Time domain transmission (TDT) measurements are useful for understanding the probe loading effects as seen at the target receiver. The following TDT measurements were made mid-bus on a 50 Ω transmission line load terminated at the receiver. These measurements show how the damped wire configuration affect the step seen by the receiver for various rise times.

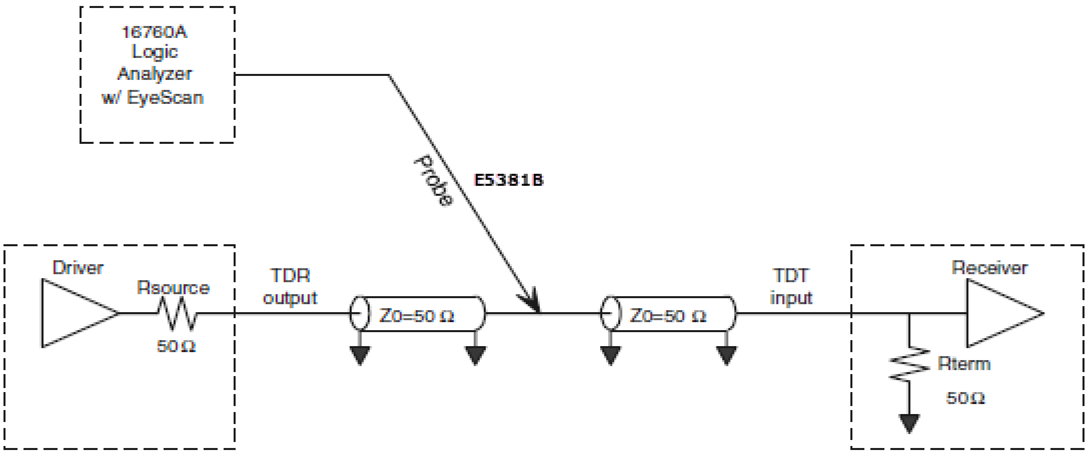


Figure 64 TDT measurement schematic

The loading of the damped wire accessory on the target is still very good. Having the 160 Ω resistor very close to the target isolates the target to from the capacitance of the probe. Ultimately, you must determine what is an acceptable amount of distortion of the target system.

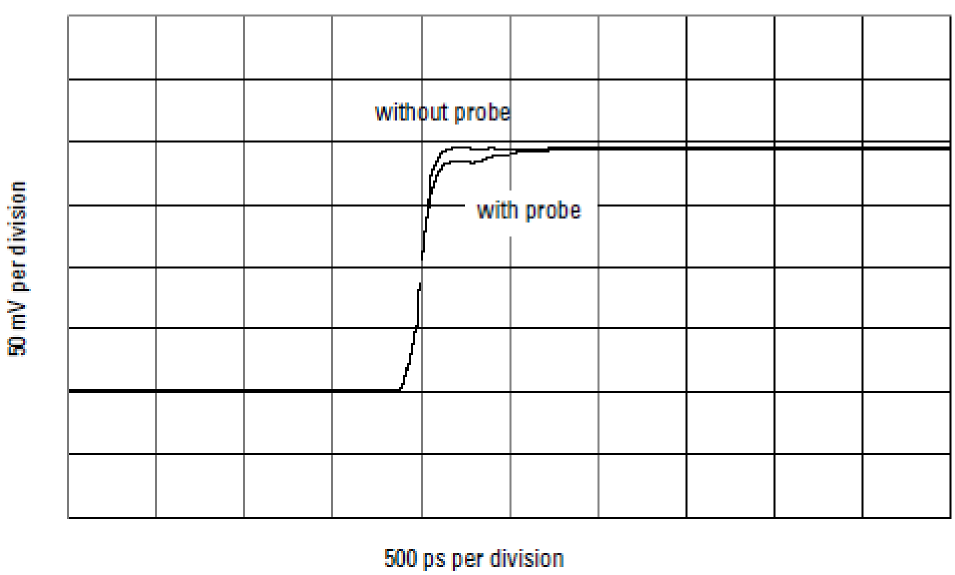


Figure 65 TDT measurement at receiver with and without probe load for 150 ps rise time

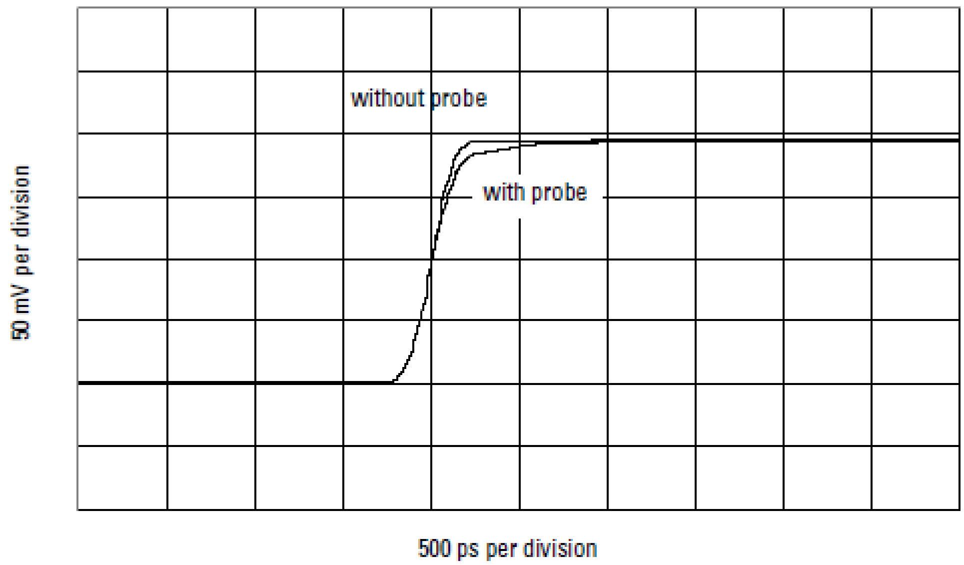


Figure 66 TDT measurement at receiver with and without probe load for 250 ps rise time

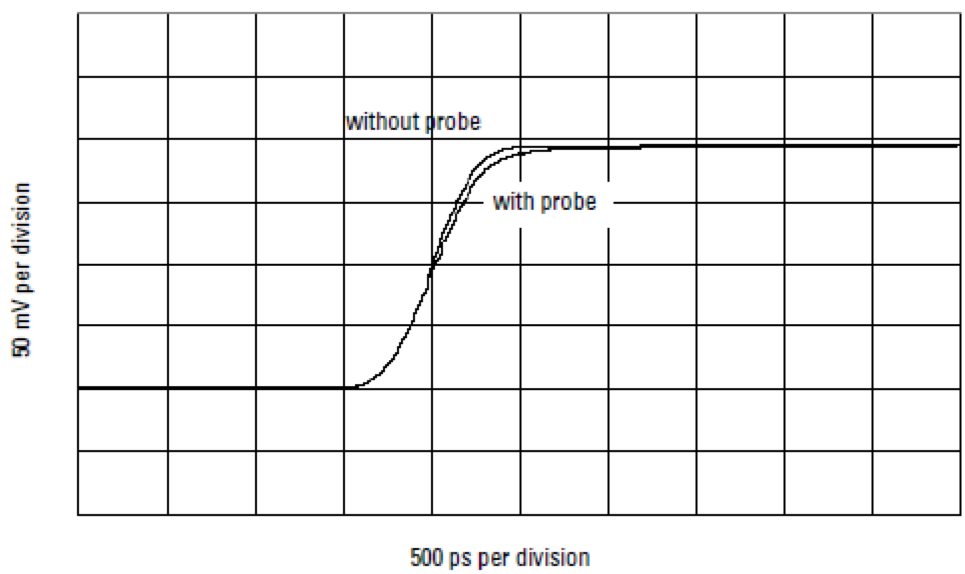


Figure 67 TDT measurement at receiver with and without probe load for 500 ps rise time

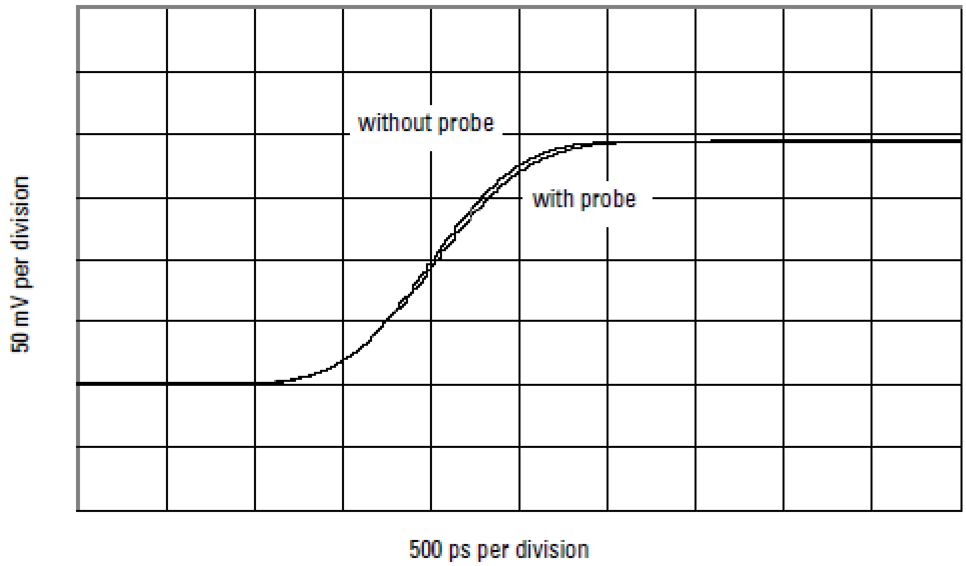


Figure 68 TDT measurement at receiver with and without probe load for 1 ns rise time

Step input

Maintaining signal fidelity to the logic analyzer is critical if the analyzer is to accurately capture data. One measure of a system's signal fidelity is to compare Vin to Vout for various step inputs. For the following graphs, Vin is the signal at the logic analyzer probe tip measured by double probing with an Agilent 54701A probe into an Agilent 54750A oscilloscope (total 2.5 GHz BW). Eye Scan is used to measure Vout, the signal seen by the logic analyzer. The measurements were made on a mid-bus connection to a 50 Ω transmission line load terminated at the receiver. These measurements show the logic analyzer's response while using the damped wire configuration.

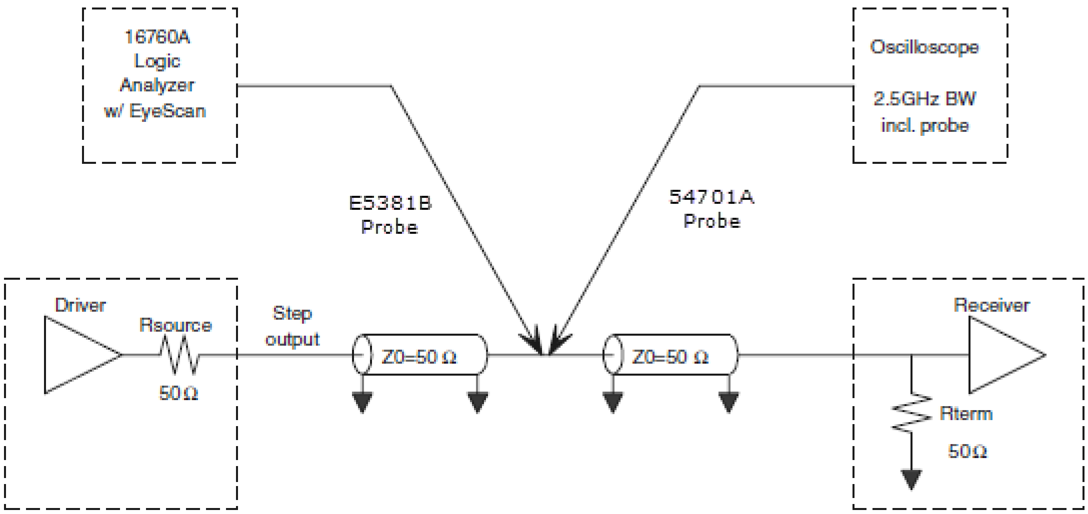


Figure 69 Step measurement schematic

The following graphs demonstrate the logic analyzer's probe response to different rise times. These graphs are included for you to gain insight into the expected performance of the different recommended accessory configurations, particularly for the damped wire configuration. These plots show how the target signals have minimal loading while the signal that the probe tip sees (Eye Scan) is being slightly rolled off. This is due to the RC filter effect of the damped wire configuration.

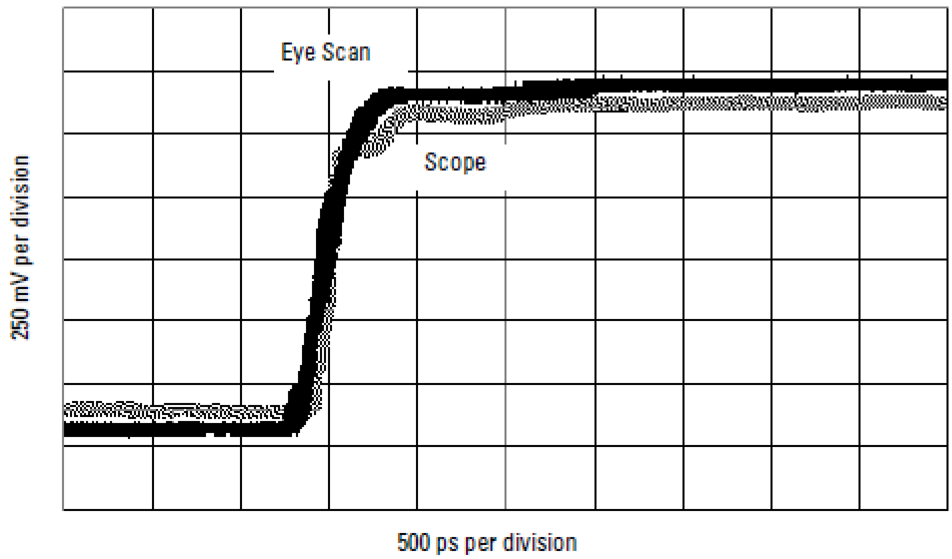


Figure 70 Logic analyzer's response to a 150 ps rise time

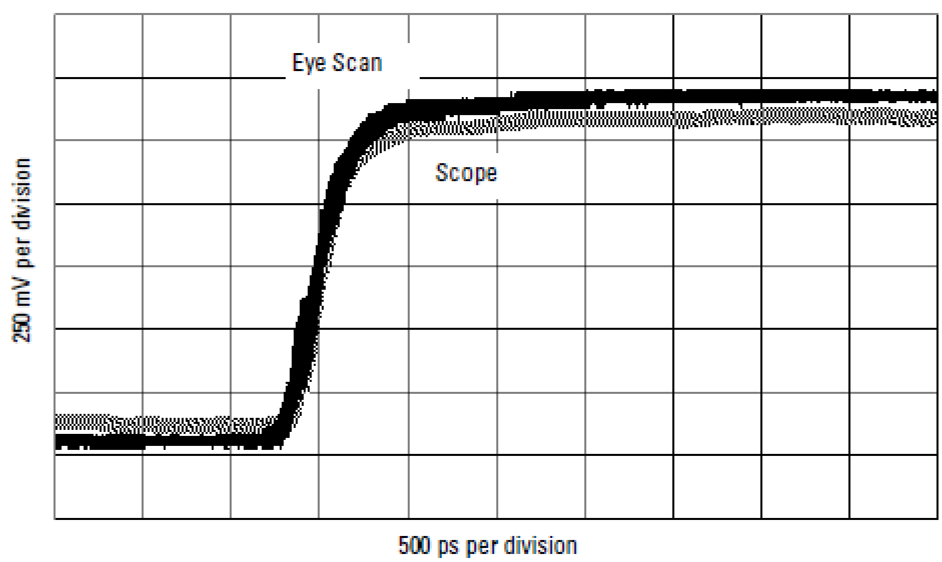


Figure 71 Logic analyzer's response to a 250 ps rise time

NOTE

These measurements are not the true step response of the probes. The true step response of a probe is the output of the probe while the input is a perfect step.

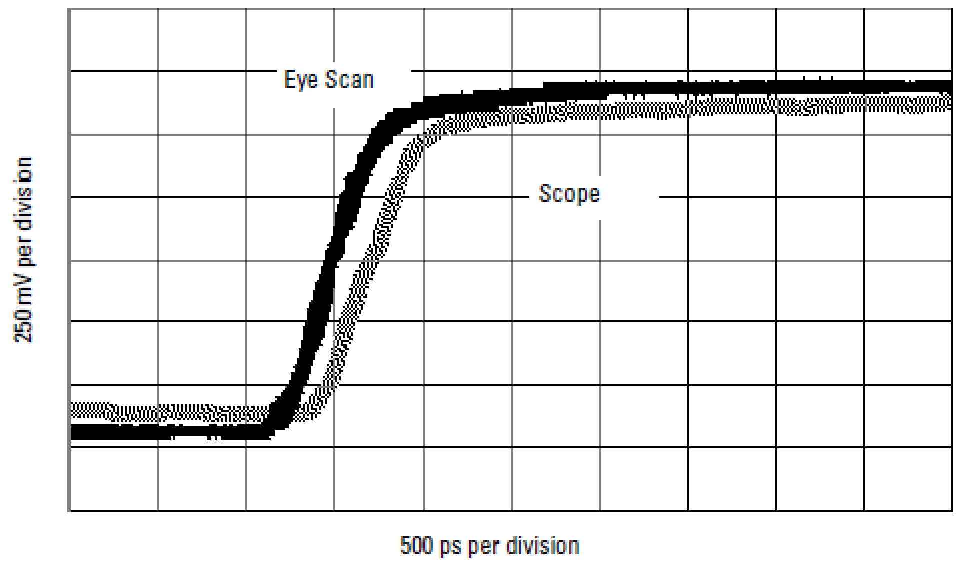


Figure 72 Logic analyzer's response to a 500 ps rise time

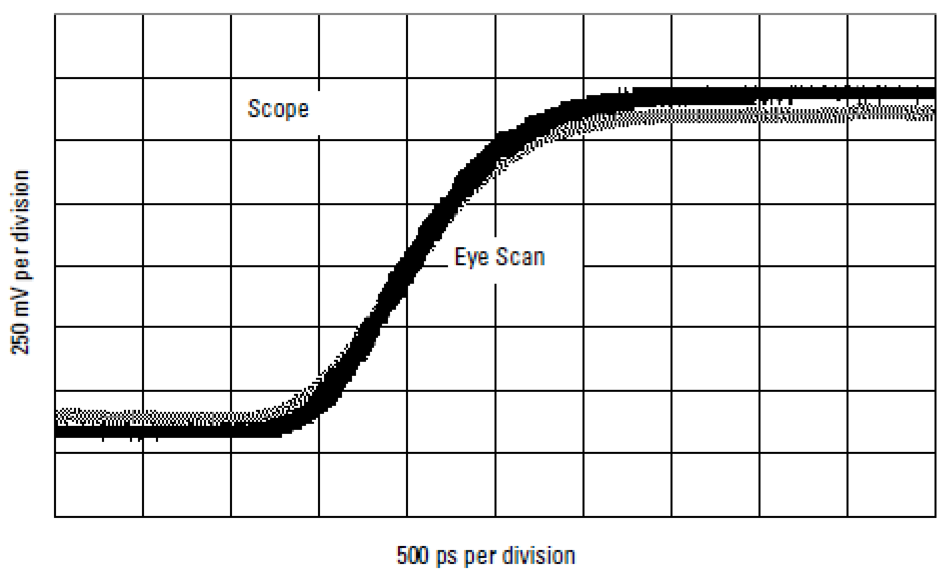


Figure 73 Logic analyzer's response to a 1 ns rise time

NOTE These measurements are not the true step response of the probes. The true step response of a probe is the output of the probe while the input is a perfect step.

Eye opening

The eye opening at the logic analyzer is the truest measure of an analyzer's ability to accurately capture data. Seeing the eye opening at the logic analyzer is possible with Eye Scan. Eye opening helps you know how much margin the logic analyzer has, where to sample and at what threshold. Any probe response that exhibits overshoot and ringing, probe non-flatness, noise and other issues all deteriorate the eye opening seen by the logic analyzer. The following eye diagrams were measured using Eye Scan probed mid-bus on a 50 Ω transmission line load terminated at the receiver. The data patterns were generated using a 223 1 pseudo random bit sequence (PRBS). These measurements show the remaining eye opening at the logic analyzer while using the damped wire configuration.

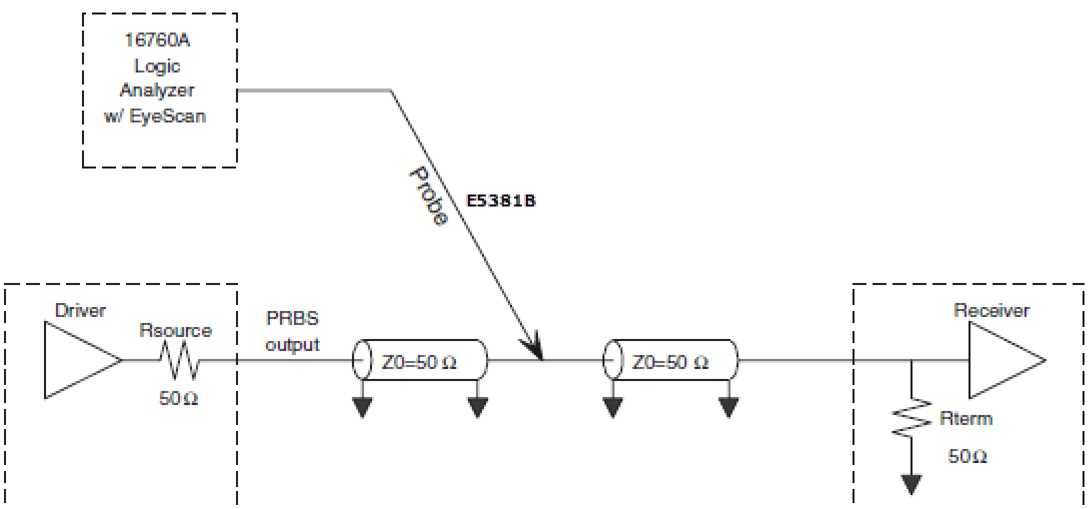


Figure 74 Eye opening measurement schematic

The logic analyzer Eye Scan measurement uses the same circuitry as the synchronous state mode analysis. Therefore, the eye openings measured are exact representations of what the logic analyzer sees and operates on in state mode. The following measurements demonstrate how the eye opening at the logic analyzer is effected by changes in clock speed and voltage level.

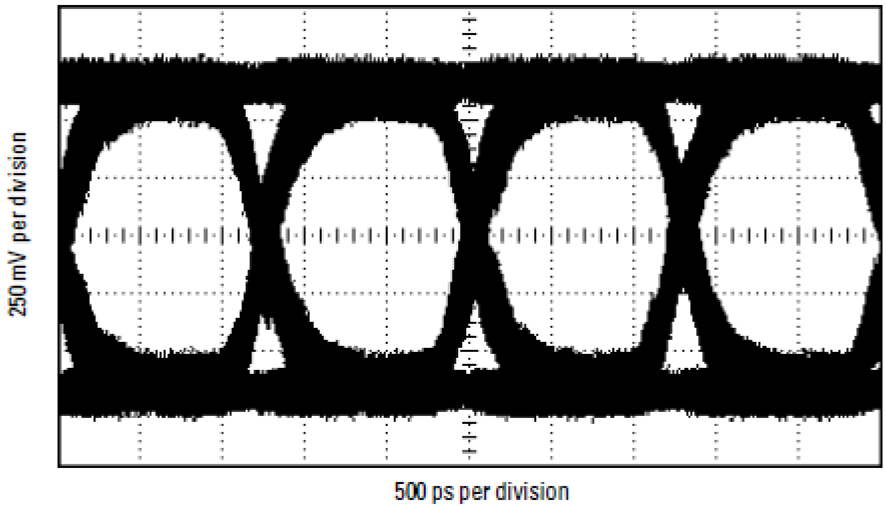


Figure 75 Logic analyzer eye opening for a PRBS signal of 500 mV p-p, 800 Mb/s data rate

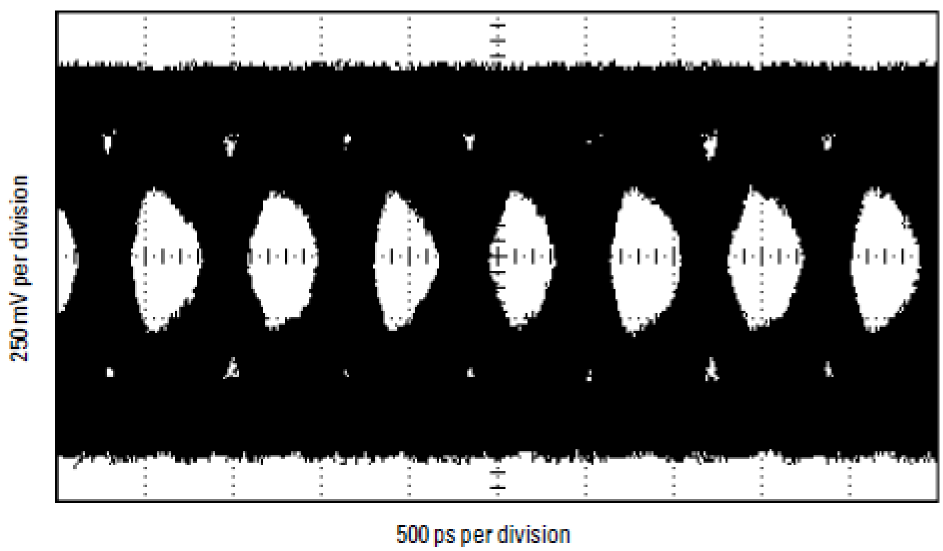


Figure 76 Logic analyzer eye opening for a PRBS signal of 500 mV p-p, 1500 Mb/s data rate

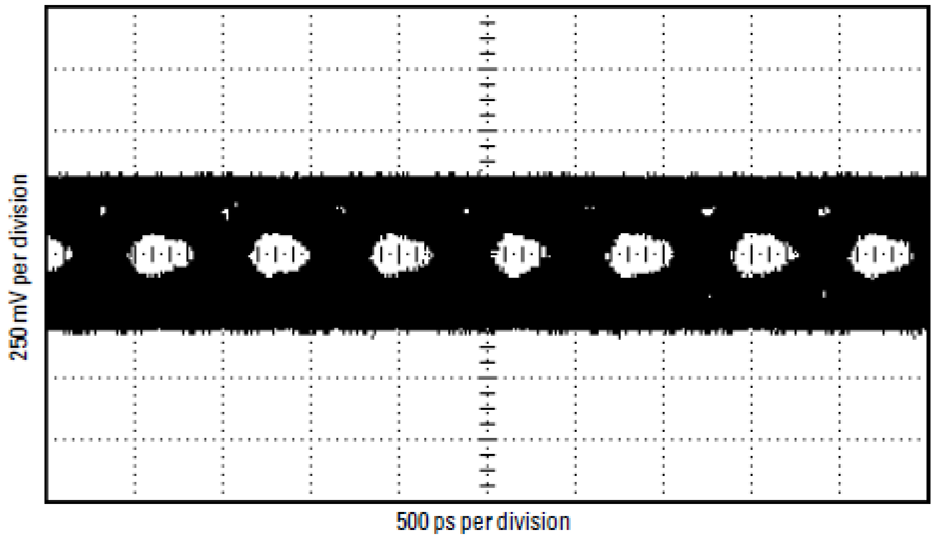


Figure 77 Logic analyzer eye opening for a PRBS signal of 200 mV p-p, 1500 Mb/s data rate

Safety Information

The following general safety precautions must be observed during all phases of operation of this instrument. Failure to comply with these precautions or with specific warnings or operating instructions in the product manuals violates safety standards of design, manufacture, and intended use of the instrument. Agilent Technologies assumes no liability for the customer's failure to comply with these requirements. Product manuals are provided with your instrument on CD-ROM and/or in printed form. Printed manuals are an option for many products. Manuals may also be available on the Web. Go to www.agilent.com and type in your product number in the Search field at the top of the page.

General Do not use this product in any manner not specified by the manufacturer. The protective features of this product may be impaired if it is used in a manner not specified in the operation instructions.

Before Applying Power Verify that all safety precautions are taken. Make all connections to the unit before applying power. Note the instrument's external markings described in "Safety Symbols".

Ground the Instrument If your product is provided with a grounding type power plug, the instrument chassis and cover must be connected to an electrical ground to minimize shock hazard. The ground pin must be firmly connected to an electrical ground (safety ground) terminal at the power outlet. Any interruption of the protective (grounding) conductor or disconnection of the protective earth terminal will cause a potential shock hazard that could result in personal injury.

Fuses See the user's guide or operator's manual for information about line-fuse replacement. Some instruments contain an internal fuse, which is not user accessible.

Do Not Operate in an Explosive Atmosphere Do not operate the instrument in the presence of flammable gases or fumes.

Do Not Remove the Instrument Cover Only qualified, service-trained personnel who are aware of the hazards involved should remove instrument covers. Always disconnect the power cable and any external circuits before removing the instrument cover.

Cleaning Clean the outside of the instrument with a soft, lint-free, slightly dampened cloth. Do not use detergent or chemical solvents.

Do Not Modify the Instrument Do not install substitute parts or perform any unauthorized modification to the product. Return the product to an Agilent Sales and Service Office for service and repair to ensure that safety features are maintained.

In Case of Damage Instruments that appear damaged or defective should be made inoperative and secured against unintended operation until they can be repaired by qualified service personnel.

CAUTION A CAUTION notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

WARNING **A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.**

Safety Symbols

Table 1 Description of Safety related symbols that may appear on a product (Sheet 1 of 3)

Symbol	Description
	Direct current
	Alternating current
	Both direct and alternating current

Table 1 Description of Safety related symbols that may appear on a product (Sheet 2 of 3)

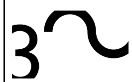
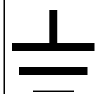
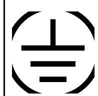
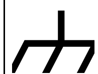
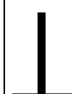
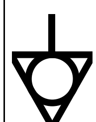
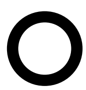
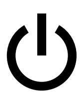
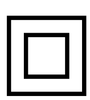
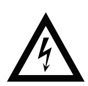
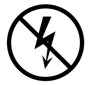
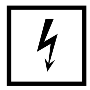
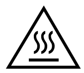
Symbol	Description
	Three phase alternating current
	Earth ground terminal
	Protective earth ground terminal
	Frame or chassis ground terminal
	Terminal is at earth potential
	Equipotentiality
N	Neutral conductor on permanently installed equipment
L	Line conductor on permanently installed equipment
	On (mains supply)
	Off (mains supply)
	Standby (mains supply). The instrument is not completely disconnected from the mains supply when the power switch is in the standby position
	In position of a bi-stable push switch
	Out position of a bi-stable push switch
	Equipment protected throughout by DOUBLE INSULATION or REINFORCED INSULATION
	Caution, refer to accompanying documentation
	Caution, risk of electric shock

Table 1 Description of Safety related symbols that may appear on a product (Sheet 3 of 3)

Symbol	Description
	Do not apply around or remove from HAZARDOUS LIVE conductors
	Application around and removal from HAZARDOUS LIVE conductors is permitted
	Caution, hot surface
	Ionizing radiation
CAT I	IEC Measurement Category I
CAT II	Measurement Category II
CAT III	Measurement Category III
CAT IV	Measurement Category IV

Informations relatives à la sécurité

Les consignes de sécurité générales présentées dans cette section doivent être appliquées au cours des différentes phases d'utilisation de cet appareil. Le non-respect de ces précautions ou des avertissements et consignes d'utilisation spécifiques mentionnés dans les manuels des produits constitue une violation des normes de sécurité relatives à la conception, à la fabrication et à l'usage normal de l'instrument. Agilent Technologies ne saurait être tenu responsable du non-respect de ces consignes. Les manuels des produits sont fournis avec votre instrument sur CD-ROM et/ou en version papier. Les versions papier des manuels sont en option pour de nombreux produits. Certains manuels sont également disponibles en ligne. Pour y accéder, allez sur le site www.agilent.com et saisissez la référence de votre produit dans le champ Rechercher qui se trouve en haut de la page.

Généralités Utilisez ce produit uniquement dans le cadre prévu par le fabricant. Si vous ne respectez pas les instructions d'utilisation, les fonctions de sécurité du produit risquent d'être inhibées.

Avant la mise sous tension Vérifiez que vous avez bien respecté toutes les consignes de sécurité. Faites tous les branchements au niveau de l'appareil avant de mettre ce dernier sous tension. Tenez compte des marquages externes à l'instrument décrits à la section «Symboles de sécurité».

Mise à la terre de l'instrument Si une prise de mise à la terre est fournie avec le produit, le châssis et le capot de l'instrument doivent être reliés à la terre afin de limiter les risques d'électrocution. Le contact à la terre doit être solidement connecté à une borne de terre (de sécurité) au niveau de la prise de courant . Toute interruption du conducteur de protection (mise à la terre) ou tout débranchement de la borne de terre de protection donne lieu à un risque d'électrocution pouvant entraîner des blessures graves.

Fusibles Pour obtenir des instructions sur le changement des fusibles de ligne, consultez le guide de l'utilisateur ou le manuel d'instructions. Certains instruments comportent un fusible interne inaccessible à l'utilisateur.

Ne pas utiliser en atmosphère explosive N'utilisez pas l'instrument en présence de gaz ou de vapeurs inflammables.

Ne pas démonter le capot de l'instrument Seules des personnes qualifiées, formées à la maintenance et conscientes des risques d'électrocution encourus sont autorisées à démonter les capots de l'instrument. Débranchez toujours le cordon d'alimentation secteur et tous les circuits externes avant de démonter le capot de l'instrument.

Nettoyage Nettoyez la partie externe de l'instrument à l'aide d'un chiffon doux et non pelucheux, légèrement humidifié. N'utilisez pas de détergents ou de solvants chimiques.

Ne pas modifier l'instrument N'installez pas de composants de remplacement et n'apportez aucune modification non autorisée à l'appareil. Pour toute opération de maintenance ou de réparation, renvoyez l'appareil à un bureau de vente et de service après-vente Agilent, afin d'être certain que les fonctions de sécurité seront maintenues.

En cas de dommages

Les instruments endommagés ou défectueux doivent être désactivés et protégés contre toute utilisation involontaire jusqu'à ce qu'ils aient été réparés par une personne qualifiée.

ATTENTION

La mention ATTENTION indique un risque. Si la manoeuvre ou le procédé correspondant n'est pas exécuté correctement, il peut y avoir un risque de dommages à l'appareil ou de perte de données importantes. En présence de la mention ATTENTION, il convient de s'interrompre tant que les conditions indiquées n'ont pas été parfaitement comprises et respectées.

AVERTISSEMENT

La mention AVERTISSEMENT signale un danger pour la sécurité de l'opérateur. Si la manœuvre ou le procédé correspondant n'est pas exécuté correctement, il peut y avoir un risque pour la santé des personnes. En présence d'une mention AVERTISSEMENT, il convient de s'interrompre tant que les conditions indiquées n'ont pas été parfaitement comprises et respectées.

Symboles de sécurité:

Table 2 Description des Symboles de Sécurité qui pourraient apparaître sur le produit. (Sheet 1 of 3)

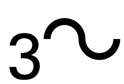
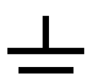
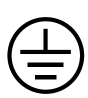
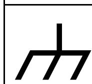
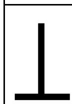
Symboles	Description
	Courant continu.
	Courant alternatif.
	Courant continu et alternatif.
	Courant alternative triphasé.
	Borne de terre (masse).
	Borne de terre de protection.
	Borne de terre reliée au cadre ou au châssis.
	Borne au potentiel de la terre.

Table 2 Description des Symboles de Sécurité qui pourraient apparaître sur le produit. (Sheet 2 of 3)

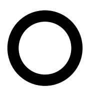
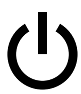
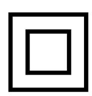
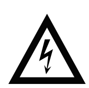
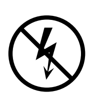
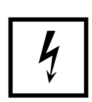
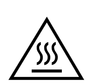
Symboles	Description
	Equipotentialité
N	Conducteur neutre sur un équipement installé à demeure
L	Conducteur de phase sur un équipement installé à demeure.
	Alimentation en marche.
	Alimentation à l'arrêt.
	Alimentation en mode veille. Lorsque l'interrupteur est en mode veille, l'unité n'est pas complètement déconnectée de l'alimentation secteur.
	Position Marche d'un interrupteur par bouton poussoir bi-stable.
	Position Arrêt d'un interrupteur par bouton poussoir bi-stable.
	Appareil entièrement protégé par DOUBLE ISOLATION ou ISOLATION RENFORCÉE
	Attention. Consultez la documentation fournie.
	Attention, danger d'électrocution.
	Ne pas appliquer ou enlever sur des conducteurs SOUS TENSION DANGEREUSE
	Application ou retrait autorisés sur les conducteurs SOUS TENSION DANGEREUSE
	Attention, surface chaude
	Rayonnement ionisant
CAT I	Appareil de mesure de catégorie I selon la norme CEI applicable
CAT II	Appareil de mesure de catégorie II selon la norme CEI applicable

Table 2 Description des Symboles de Sécurité qui pourraient apparaître sur le produit. (Sheet 3 of 3)

Symboles	Description
CAT III	Appareil de mesure de catégorie III selon la norme CEI applicable
CAT IV	Appareil de mesure de catégorie IV selon la norme CEI applicable

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Numerics

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