Keysight U4200A-Series Probes and Cables

User Guide

KEYSIGHT TECHNOLOGIES

Notices

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CAUTION

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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.

In This Guide

This guide provides general usage information for the following Keysight U4200A-series probes and cables used with Keysight Logic analyzers.

U4200A-Series Probes and Cables
▪ U4201A Logic analyzer cable ▪ U4203A 34 channel, flying lead, single-ended, 160-pin direct connect probe ▪ U4204A 34 channel, Soft Touch Pro, single-ended, 160-pin direct connect probe ▪ U4205A 34 channel, Mictor, single-ended, 160-pin direct connect probe ▪ U4206A 34 channel, Soft Touch Pro, single-ended, quad x 160 pin direct connect probe ▪ U4208A 61 pin ZIF for Left Wing no RC, 160-pin direct connect to logic analyzer Probe/Cable Combination ▪ U4209A 61 pin ZIF for Right Wing no RC, 160-pin direct connect to logic analyzer Probe/Cable Combination

See Also

- Some of these U4200A-series probes/cables such as U4208A or U4209A are used with a Keysight interposer. For such probes/cables, you can find the general usage information in this guide and interposer-specific usage information in the interposer's user guide. You can find the user guide for an interposer under the Document Library tab on the interposer's webpage on www.keysight.com.

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4 Circuit Board Design Considerations

5 Setting up the U4200A-Series Probes and Cables

6 Safety Information

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1 Introduction to U4200A Series Probes and Cables

This chapter provides the description of the U4200A-series probes and cables to help you compare and select the appropriate probe/cable for your Keysight Logic analyzer.

U4200A-Series Probing/Cabling Options for Keysight Logic analyzers- At a Glance

In the U4200A-series, Keysight provides direct-connect probes and cables to suit variety of probing requirements. The series has Direct Connect flying lead, Soft Touch Pro, Mictor probes as well as ZIF probes.

These probes and cables are designed to be used with the Keysight logic analyzers that have 160-pin front panel connectors such as 16850-series portable logic analyzers and U4154A/B or U4164A AXIe based logic analyzer modules. (For more information on Keysight logic analyzers, refer to http://www.keysight.com/find/logicanalyzer.)

NOTE

U4200A-series probes connect directly to Keysight logic analyzers and do not require any cable such as a U4201A cable for connectivity to logic analyzers.

Most of the probes in these series connect directly to the target system by designing the required footprint or connector into the target system or by using the accessories supplied with the probes. The ZIF probes in these series however, require a Keysight BGA interposer such as W4641A to connect to DUT thereby allowing you to make measurements while having least impact on the DUT.

Various tables are provided in this section to list the key features of these probes and cables such as maximum state data rate supported or compatibility with logic analyzer(s) etc.

Table 1 Selection of U4200A-Series Probing Options

Probe/Cable Model Number and Name	Probe or Cable Type	Connection to DUT and Logic Analyzer Requirements	Compatible with Logic & Protocol Analyzers
U4201A Logic analyzer cable	General purpose logic analyzer cable	Requires 90-pin logic analyzer probe to connect to DUT	U4154B U4154A U4421A 16850 Series
U4203A Probe, 34 channel, flying lead, single-ended, 160-pin direct connect	Direct Connect - Flying Lead	None (Connects directly to DUT and Logic Analyzer)	U4154B U4154A 16850 Series
U4204A Probe, 34 channel, Soft Touch Pro, single-ended, 160-pin direct connect	Direct Connect - Single-ended Soft Touch Pro Series	None (Connects directly to DUT and Logic Analyzer)	U4154B U4154A 16850 Series
U4205A Probe, 34 channel, Mictor, single-ended, 160-pin direct connect	Direct Connect - Mictor Connector Probe	None (Connects directly to DUT and Logic Analyzer)	U4154B U4154A 16850 Series
U4206A Probe, 34 channel, Soft Touch Pro, single-ended, quad x 160 pin direct connect	Direct Connect - Single-ended Soft Touch Pro Series	None (Connects directly to DUT and Logic Analyzer)	U4164A
U4208A Probe/cable, 61-pin ZIF, from left wing, no RC, 160-pin direct connect to LA	Direct Connect to Logic Analyzer	Connects directly to Logic Analyzer and requires Keysight DDR4/LPDDR4 BGA Interposers (W6601A, W4643A, or W4641A) to connect to DUT	U4164A
U4209A Probe/cable, 61-pin ZIF, from right wing, no RC, 160-pin direct connect to LA	Direct Connect to Logic Analyzer	Connects directly to Logic Analyzer and requires Keysight DDR4/LPDDR4 BGA Interposers (W6601A, W4643A, or W4641A) to connect to DUT	U4164A

Number of Probes Required for a Logic Analyzer

Table 2 Number of U4200A-Series Probes/Cables Required for the Supported Logic Analyzers

Probe Model Number	Number of probes/cables required for...			
	U4154A Logic Analyzer	U4154B Logic Analyzer	U4164A Logic Analyzer	16850-Series Logic Analyzer
U4203A	4	4	n/a	-1 probe for all 34 channels of a 16851A -2 probes for all 68 channels of a 16852A -3 probes for all 102 channels of a 16853A -4 probes for all 136 channels of a 16854A
U4204A	4	4	n/a	-1 probe for all 34 channels of a 16851A -2 probes for all 68 channels of a 16852A -3 probes for all 102 channels of a 16853A -4 probes for all 136 channels of a 16854A
U4205A	4	4	n/a	-1 probe for all 34 channels of a 16851A -2 probes for all 68 channels of a 16852A -3 probes for all 102 channels of a 16853A -4 probes for all 136 channels of a 16854A
U4206A	n/a	n/a	1	n/a
U4208A	n/a	n/a	1	n/a
U4209A	n/a	n/a	1	n/a

Maximum State Speed Supported

The table lists the maximum state speed supported by the combination of a U4200A-series probe and your logic analyzer.

Table 3 Maximum State Speed Supported by U4200A-Series Probes

Probe/Cable Model Number and Name	Maximum State Speed Supported
U4203A	1.5 Gb/s (accessory-specific, see accessories)
U4204A	3.2 Gb/s
U4205A	600 Mb/s
U4206A	4 Gb/s
U4208A	3.2 Gb/s
U4209A	3.2 Gb/s

Number of Data and Clock Inputs

The table lists the number of data and clock inputs provided by the U4200A-series probes/cables for the supported logic analyzers.

Table 4 Number of Data and Clock Inputs Supported

Probe/Cable Model Number and Name	Data and Clock Inputs
U4201A	16
U4203A	34 32 data, 2 clock
U4204A	34 32 data, 2 clock
U4205A	34 32 data, 2 clock
U4206A	34 32 data, 2 clock
U4208A	34 32 data, 2 clock
U4209A	34 32 data, 2 clock

U4201A Logic Analyzer Cable

A U4201A logic analyzer cable is required to connect a 90-pin probe to the U4164A, U4154A/B or 16850A series logic analyzer.

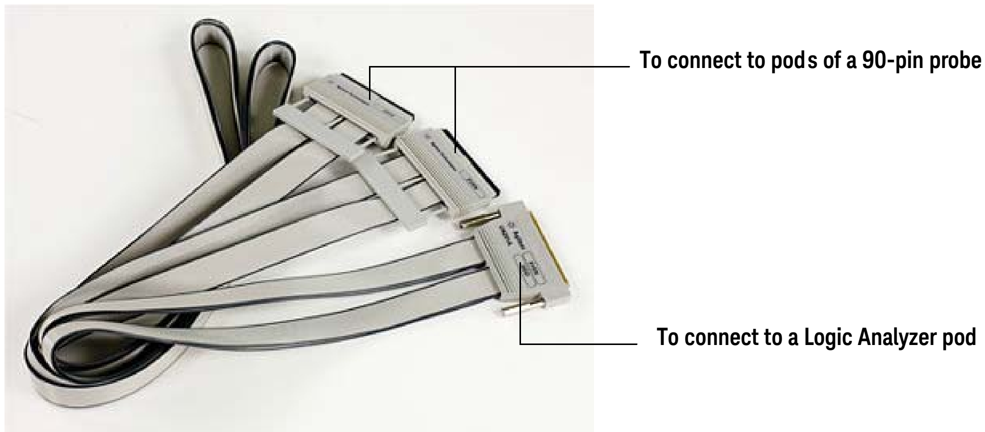


Figure 1 U420A1 Logic Analyzer Cable

Keysight Logic Analyzer probes that are compatible for use with the U4201A cable:

- General-Purpose Flying Lead Probe
  - E5381B 17-ch differential probe for 90 pin LA pod
  - E5382B 17-ch single-ended probe for 90 pin LA pod
- Connectorless probes
  - E5387A 17-ch Differential Soft Touch Probe
  - E5398A Half-Size Soft Touch 17-ch single-ended for 90 pin LA pod
  - E5390A Soft Touch Classic Series 34-ch single-ended for 90 pin LA pod
  - E5405B Soft Touch Pro Series 17-ch differential for 90 pin LA pod
  - E5406A Soft Touch Pro Series: 34-ch single-ended for 90 pin LA pod
- Connector Probes
  - E5378A Samtec 34-ch single-ended probe for 90 pin LA pod
  - E5379A Samtec 17-ch differential probe for 90 pin LA pod
  - E5380B Mictor 34-ch single-ended probe for 90 pin LA pod
- ZIF probes
  - E5847A 46-ch Single-ended ZIF Probe
  - E5849A 46-ch Single-ended ZIF Probe

U4203A Probe, 34 Channel, Flying Lead, Single-ended, 160-pin Direct Connect

The U4203A probe is a 34-channel single-ended flying lead probe set which is compatible with the 160-pin interface on logic analyzers including the Keysight 16850-series portable logic analyzers and U4154A/B logic analysis AXIe-based modules. The U4203A enables you to acquire signals from randomly located points in your target system.

It supports differential or single-ended clock and single-ended data probing.

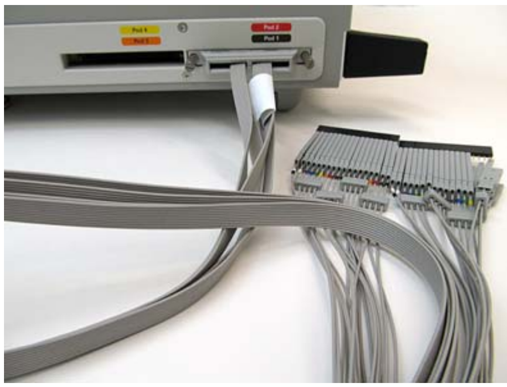


Figure 2 U4203A probe connected to a Logic Analyzer

A variety of accessories are supplied with the U4203A, to access signals on various types of components on your PC board.

U4203A Accessories

The following figure shows the accessories supplied with the U4203A probe. To find a comparison between four of the most common intended uses of these accessories, refer to the chapter“Suggested Configurations and Characteristics" on page 56.

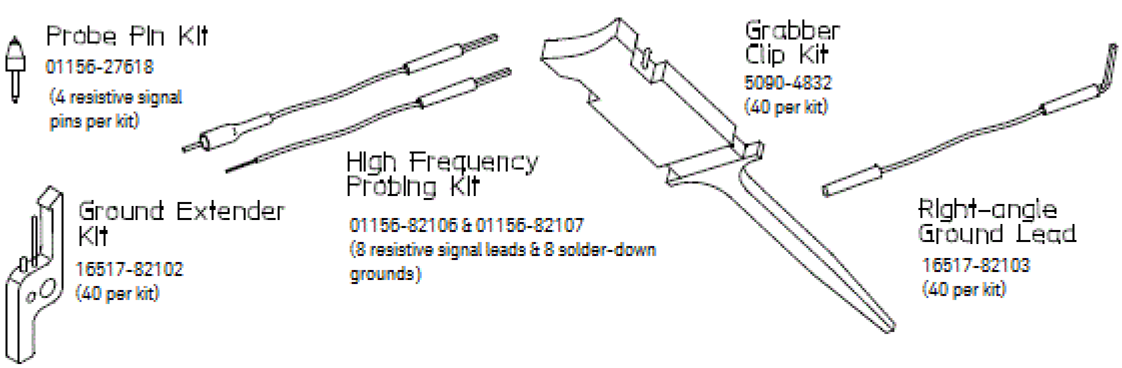


Figure 3 Accessories supplied with U4203A probe

You can order the replacement parts and additional accessories for the U4203A probe as a full accessory kit (part number U4203-68702).

The following table lists the part numbers for replacement parts and additional accessories in the kit.

Table 5 **U4203-68702 Replaceable Parts and Additional Accessories**

Description	Accessories Part Number	Orderable Keysight Part Numbers	Qty
Probe Pin Kit	01156-27618	E5382-82103	a set of 2
High Frequency Probing Kit: ▪ Resistive signal pins ▪ Solder-down grounds	 01156-82106 01156-82107	 E5382-82101	 a set of 4 each a set of 4 each
Ground Extender Kit	16517-82102	16517-82105	a set of 20
Grabber Clip Kit	5090-4832	16517-82109	a set of 20
Right-angle Ground Lead Kit	16517-82103	16517-82106	a set of 20
Cable - Main	U4203-60001	U4203-60001	1
Probe Tip to BNC Adapter	E9638A	E9638A	1

Characteristics and Specifications

The following characteristics are typical for the U4203A probe.

Input Resistance	20 kΩ
Input Capacitance	1.3 pF (accessory-specific, see accessories)
Maximum Recommended State Data Rate	1.5 Gb/s (accessory-specific, see accessories)
Minimum Data Voltage Swing	250 mV p-p
Minimum Diff. Clock Voltage Swing	100 mV p-p each side
Input Dynamic Range	-3 Vdc to +5 Vdc
Threshold Accuracy	±(30 mV +2% of setting)
Threshold Range	-3.0 V to +5.0 V
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)

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

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

General Characteristics

The following general characteristics apply to the U4203A probe.

Environmental Conditions

	Operating	Non-operating
Temperature	0 °C to +55 °C	-40 °C to +70 °C
Humidity	up to 95% relative humidity (non-condensing) at +40 °C	up to 90% relative humidity at +65 °C
Weight	approximately 0.69 kg	
Dimensions	Refer to the topic "Probe Dimensions" on page 29	
Pollution degree 2	Normally only non-conductive pollution occurs. Occasionally, however, a temporary conductivity caused by condensation must be expected.	
Indoor use		

U4204A Probe, 34 Channel, Soft Touch Pro, Single-ended, 160-pin Direct Connect

The U4204A probe requires Pro Series soft touch footprint to be designed into the target. See "U4204A Probe Mechanical Considerations" on page 30 for information on designing your target system board.

A retention module must be installed on the target system board to attach the U4204A probe to the board. A kit of five retention modules are supplied with each probe.

U4204A Accessories

The following figure shows the accessories supplied with the U4204A probe.

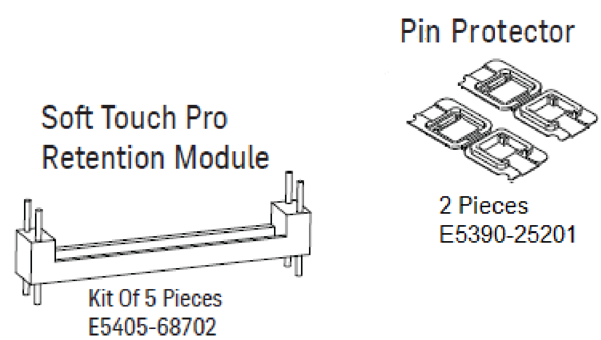


Figure 4 Accessories supplied with U4204A probe

You can also order additional retention modules as a kit of five retention modules (part number E5403A).

Characteristics and Specifications

Electrical characteristics such as equivalent probe loads, input impedance, and time domain transmission are described in Chapter 3 of this guide. Some characteristics are given below. Other characteristics are dependent on the logic analyzer module you are using with the probe.

Input Capacitance	< 0.7 pF
Maximum Recommended State Data Rate	3.2 Gb/s
Minimum Signal Amplitude	Vmax – Vmin 200 mV
Clock Input	differential
Number of Inputs	34 (2 clock and 32 data)

Environmental Conditions

	Operating	Non-operating
Temperature	0 °C to +40 °C	-40 °C to +70 °C

Humidity	50% to 95% relative humidity (non-condensing) at +40 °C	up to 90% relative humidity at +65 °C
Weight	Approximately 0.5018 kg	
Dimensions	Refer to the topic "Probe Dimensions" on page 30.	

U4205A Probe, 34 Channel, Mictor, Single-ended, 160-pin Direct Connect

U4205A is capable of capturing state (synchronous) data at clock speeds up to 600 MHz, at data rates up to 600 Mb/s, with signal amplitudes as small as 300 mV peak- to- peak.

The Keysight E5346-68701 or E5346- 68700 probing connector kit is required for connecting the U4205A probe to your target system. The kit contains five mating connectors and five support shrouds. The connectors and shrouds may be ordered separately if desired.

The U4205A 34-channel 38-pin Single-ended Mictor Probe is:

- Compatible with the 16850 Series and U4154A/B logic analyzers
- Compatible with boards designed for older Keysight E5346A 38-pin probe
- Provides 34 Channels
- State speeds up to 600 Mb/s
- 300 mV peak- to- peak sensitivity
- 38-pin MICTOR connector
- Requires AMP MICTOR 38-pin connector and Keysight support shroud

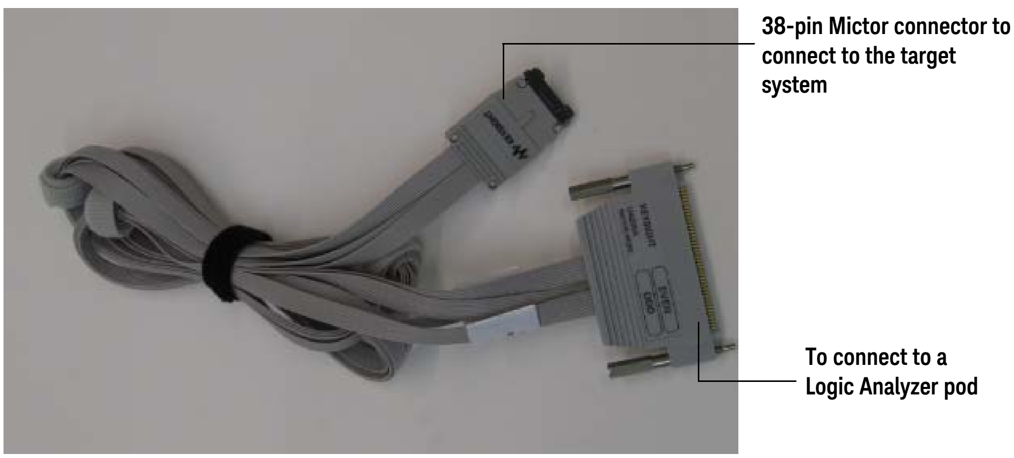


Figure 5 U4205A Probe

See Also: "U4205A Probe Mechanical Considerations" on page 36 for the mechanical information to design the connector into your target system boards.

U4205A Probe - Connector and Shrouds

You can order the connectors and shrouds for U4305A probe in kits or separately as individual pieces using the part numbers given in the following table for kits and individual pieces. Select a support shroud appropriate for the thickness of your PC board.

Table 6 U4305A Probe Connectors and Shrouds Part numbers for Ordering

For Probe Model #	Keysight Part Number	Consists of	For Target PC Board Thickness
U4205A	E5346-68701	5 MICTOR Connectors & 5 Support Shrouds	up to 1.57 mm (0.062 in.)
	E5346-68700	5 MICTOR Connectors & 5 Support Shrouds	1.575 to 3.175 mm (0.062 to 0.125 in.)
	1252-7431	1 MICTOR Connector	n/a
	AMP part #2-767004-2	1 MICTOR Connector	n/a
	E5346-44701	1 Support Shroud	up to 1.57 mm (0.062")
	E5346-44704	1 Support Shroud	1.575 to 3.175 mm (0.062 to 0.125 in.)
	E5346-44703	1 Support Shroud	3.175 to 4.318 mm (0.125 to 0.70 in.)

Characteristics

Electrical considerations such as equivalent probe loads, input impedance, and time domain transmission are shown in Chapter 3 of this guide. Other characteristics are dependent on the logic analyzer module you are using with the probe.

U4206A Probe, 34 Channel, Soft Touch Pro, Single-ended, Quad x 160 pin Direct Connect

The U4206A is a direct connect probe/cable designed for use only with the quad sample state mode or ¼ channel timing mode of a U4164A logic analyzer module.This probe effectively utilizes the quad sampling mode feature provided by the U4164A module.

The probe’s standard soft touch pro connector connects it to the DUT via a retention module supplied with the probe (see “Connecting to DUT using a Retention Module" on page 120). The probe requires a Pro Series soft touch footprint to be designed into the target (see “U4206A Probe Mechanical Considerations" on page 41). For connectivity to a logic analyzer, the probe has four 160-pin connectors that plug into the Odd pods (1, 3, 5, 7) of a U4164A logic analyzer module.

The probe also has two differential flying leads to connect additional clock qualifier signals into the clock inputs on Pods 3 and 7 in the quad sampling mode of U4164A (see “U4206A Clock Qualifiers Connections" on page 121).

To know about how to use the U4164A in quad sample state or ¼ channel 10 GHz timing mode, refer to the Keysight logic and protocol analyzer online help \ user guide for specific details on the operation of the of operation. The help is integrated with the Keysight Logic and Protocol Analyzer GUI and also available on www.keysight.com.

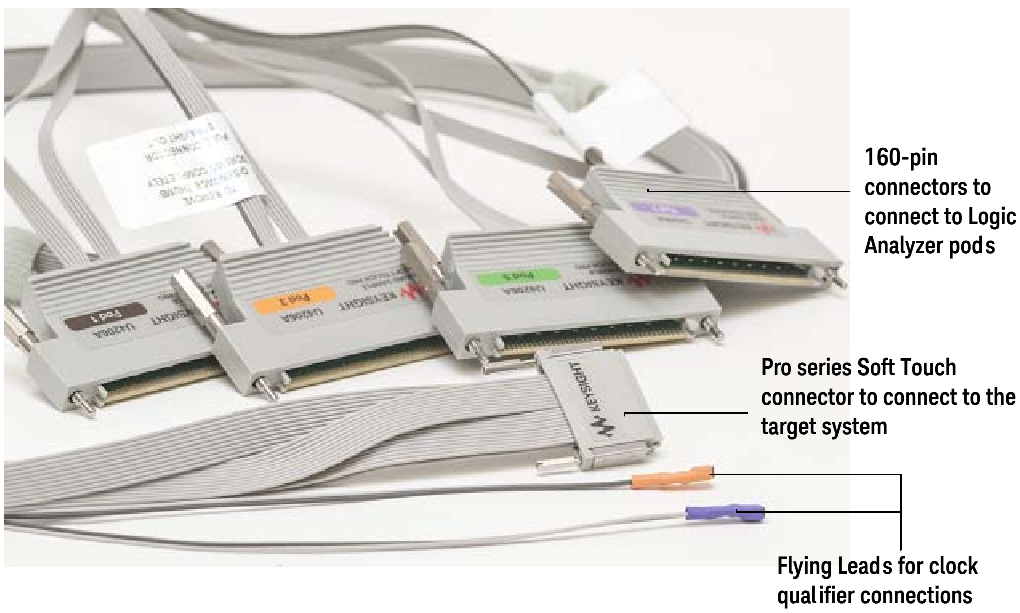


Figure 6 U4206A Probe

U4206A Accessories

The following figure shows the accessories supplied with the U4206A probe.

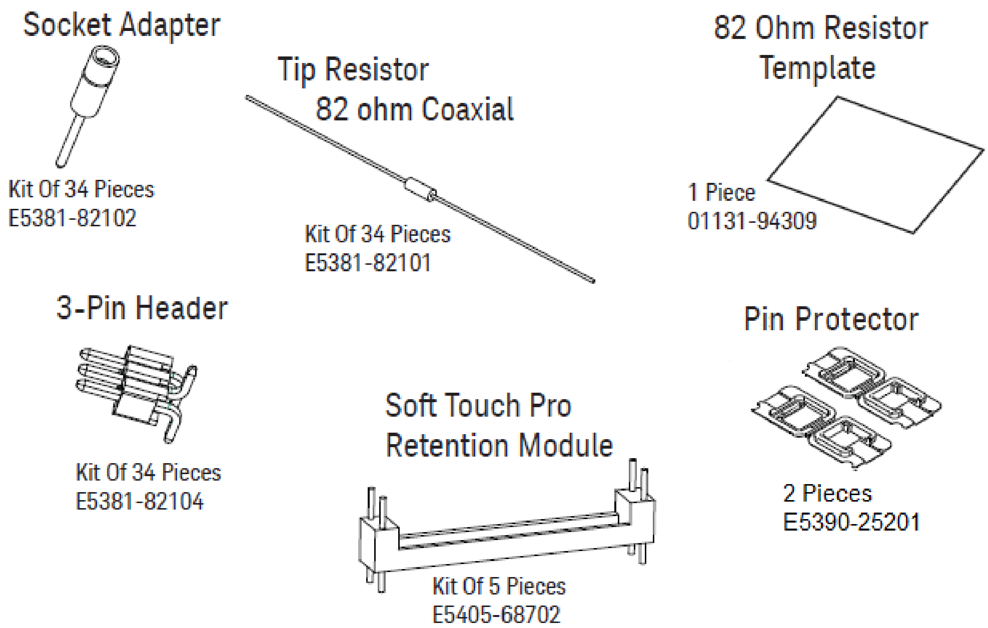


Figure 7 Accessories supplied with U4206A probe

You can also order these accessories using the part numbers specified for these accessories.

To know about the usage of these accessories in detail, refer to the topic "Connecting to DUT using a Retention Module" on page 120 and "U4206A Clock Qualifiers Connections" on page 121.

Characteristics and Specifications

Electrical characteristics such as equivalent probe loads, input impedance, and time domain transmission are described in Chapter 3 of this guide. Some characteristics are given below. Other characteristics are dependent on the logic analyzer module you are using with the probe.

Input Capacitance	< 0.7 pF
Maximum Recommended State Data Rate	4 Gb/s
Minimum Signal Amplitude	Vmax – Vmin 300 mV/200 mV 1 (300 mV input required for data rates greater than 2.5 Gb/s.)
Clock Input	differential
Number of Inputs	34 (2 clock and 32 data)

Environmental Conditions

	Operating	Non-operating
Temperature	0 °C to +55 °C	-40 °C to +70 °C

Humidity	50% to 95% relative humidity (non-condensing) at +40 °C	up to 90% relative humidity at +65 °C
Weight	Approximately 0.8495 kg	
Dimensions	Refer to the topic "Probe Dimensions" on page 41.	

U4208A Probe/Cable, 61-pin ZIF, From Left Wing, no RC, 160-pin Direct Connect to LA

The U4208A is a 61-pin ZIF probe/cable designed for use with the Option -02G (quad sample state mode) of the U4164A logic analyzer module. This probe, when used with a compatible Keysight BGA interposer, effectively utilizes the single touch probing and quad sampling features of the U4164A logic analyzer module thereby allowing you to probe DDR4 DQ signals above 2.5Gb/s without double probe load.

The probe's ZIF connector connects it to a compatible BGA interposer's left wing (see "U4208A and U4209A Setup" on page 125). The interposer interposes between the DRAM being probed and the PC board where the DRAM would normally be soldered.

For connectivity to a logic analyzer, the probe has two 160-pin connectors that plug into the Odd pods of a U4164A logic analyzer module.

To know about how to use the U4164A in quad sample state or ¼ channel 10 GHz timing mode, refer to the Keysight logic and protocol analyzer online help \ user guide for specific details on the operation of the of operation. The help is integrated with the Keysight Logic and Protocol Analyzer GUI and also available on www.keysight.com.

Figure 8 U4208A Probe

U4209A Probe/Cable, 61-pin ZIF, From Right Wing, no RC, 160-pin Direct Connect to LA

The U4209A is a 61-pin ZIF probe/cable designed for use with the Option -02G (quad sample state mode) of the U4164A logic analyzer module. This probe, when used with a compatible Keysight BGA interposer, effectively utilizes the single touch probing and quad sampling features of the U4164A logic analyzer module thereby allowing you to probe DDR4 DQ signals above 2.5Gb/s without double probe load.

The probe's ZIF connector connects it to a compatible BGA interposer's right wing (see "U4208A and U4209A Setup" on page 125). The interposer interposes between the DRAM being probed and the PC board where the DRAM would normally be soldered.

For connectivity to a logic analyzer, the probe has two 160-pin connectors that plug into the Odd pods of a U4164A logic analyzer module.

To know about how to use the U4164A in quad sample state or ¼ channel 10 GHz timing mode, refer to the Keysight logic and protocol analyzer online help \ user guide for specific details on the operation of the of operation. The help is integrated with the Keysight Logic and Protocol Analyzer GUI and also available on www.keysight.com.

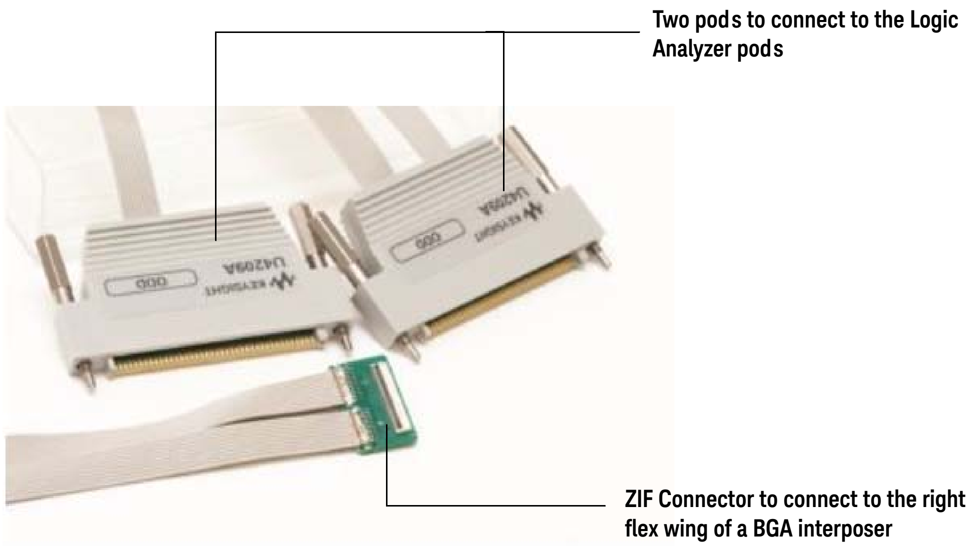


Figure 9 U4209A Probe

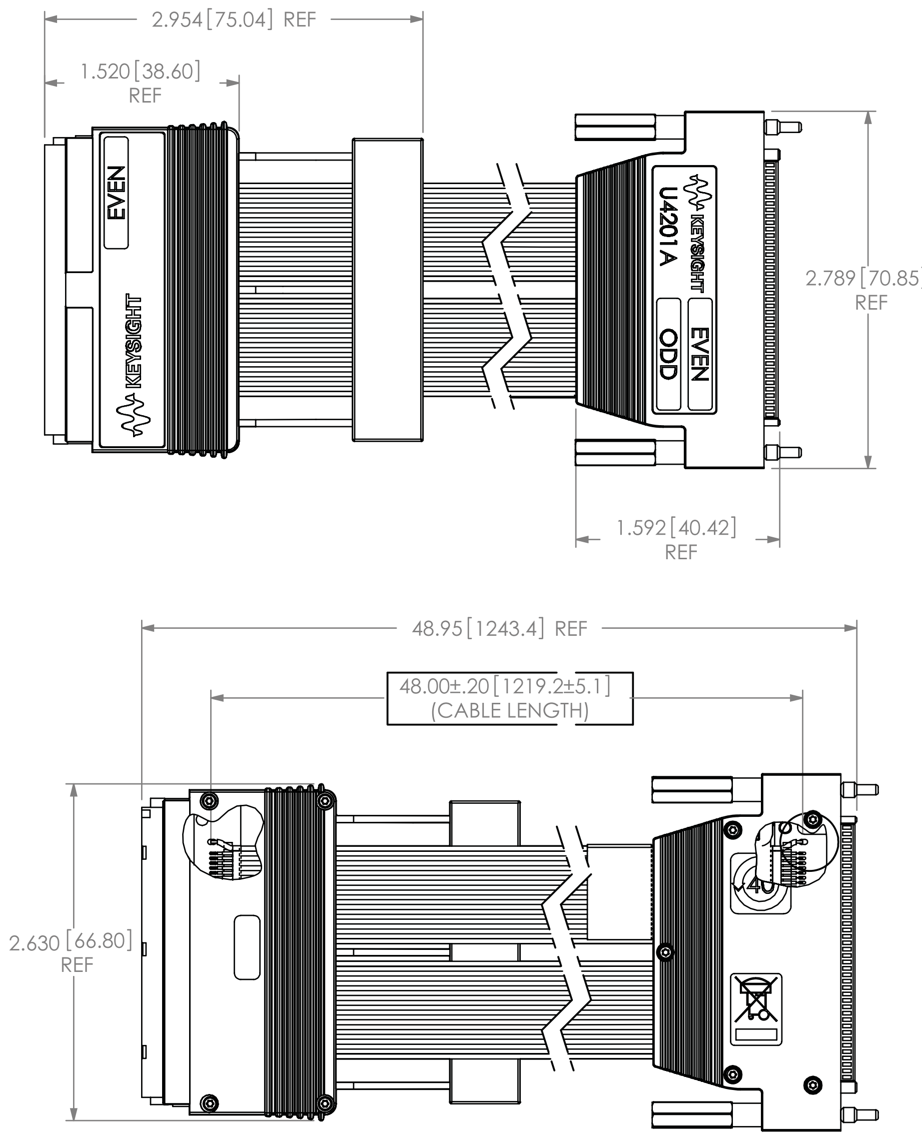
2 Mechanical Considerations

This chapter provides mechanical information for the U4200A-series probes and cables. You can use this information to design your target system board or an appropriate connector into your target system board for use with the U4200A-series probes and cables.

U4201A Cable Mechanical Considerations

Cable Dimensions

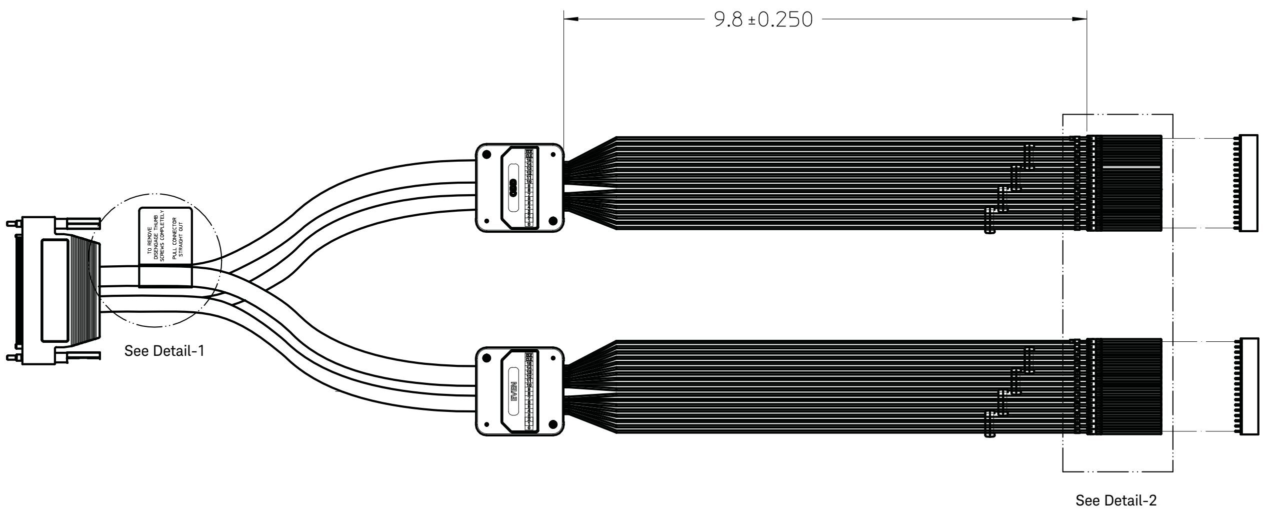
The following figure shows the dimensions of the U4201A cable. All dimensions are in inches.



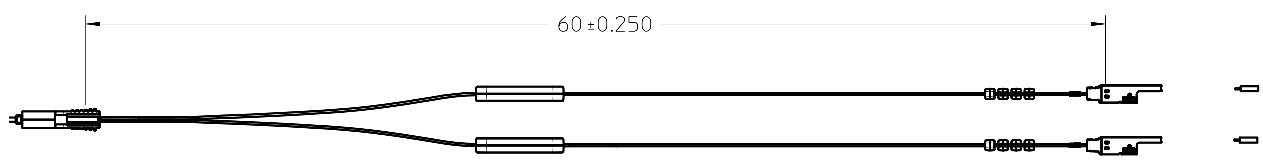
U4203A Probe Mechanical Considerations

Probe Dimensions

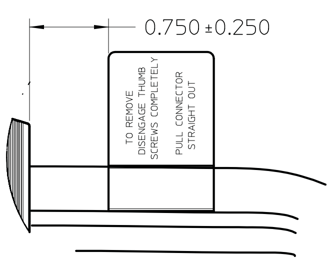
The following figure shows the dimensions of the U4203A probe. All dimensions are in inches.



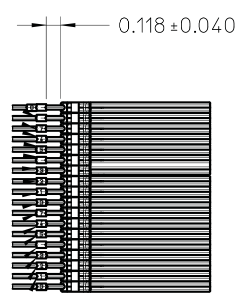
Top View of U4203A Probe



Side View of U4203A Probe



Detail-1

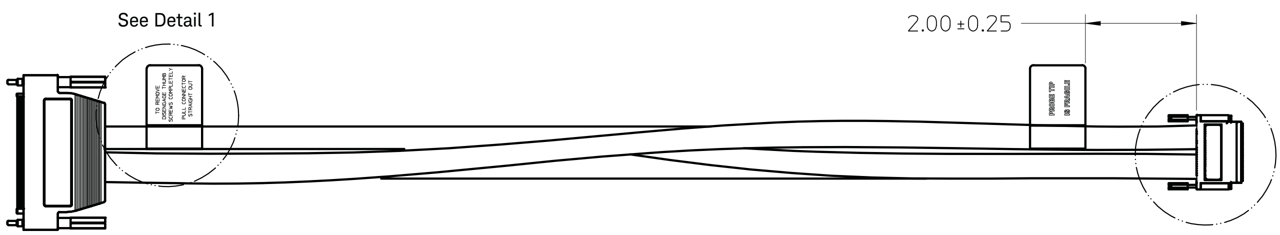


Detail-2

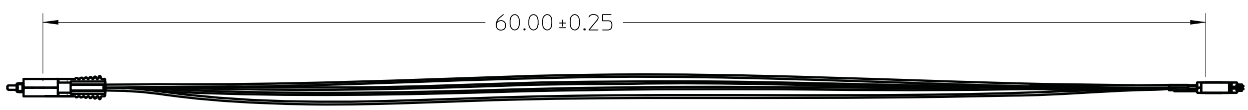
U4204A Probe Mechanical Considerations

Probe Dimensions

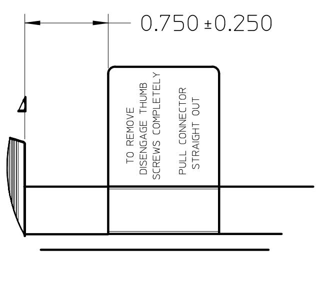
The following figure shows the dimensions of the U4204A probe. All dimensions are in inches.



Top View of the U4204A Probe



Side View of the U4204A Probe



Detail 1

Retention Module Dimensions

The U4204A probe is compatible with the Keysight E5405-68702 retention module that accompanies the probe shipment as a kit of 5 retention modules (part number of kit is E5403A). Use the dimensions given in this topic to lay out your PC board pads and holes for use with the U4204A soft touch probe.

NOTE

Unless otherwise specified, dimensions are in inches and have the following tolerances.

Linear

X.X = +-0.1

X.XX = +-0.01

X.XXX = +-0.005

X.XXXX = +-0.0005

Angular

X = +-1

X.X = +-0.5

X.XX = +-0.25

X.XXX = +-0.125

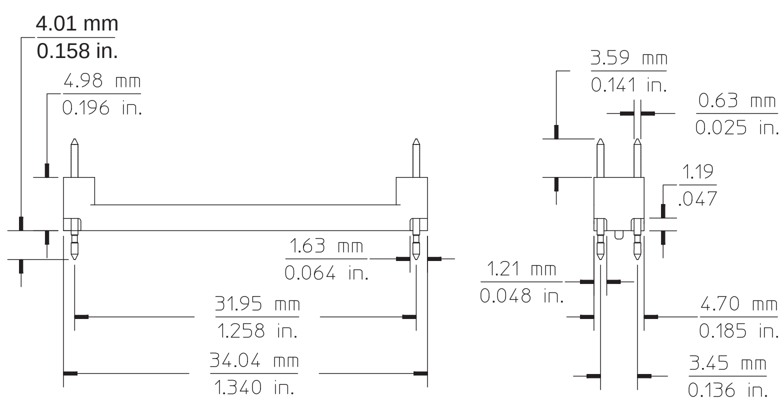


Figure 10 E5405-68702 retention module dimensions

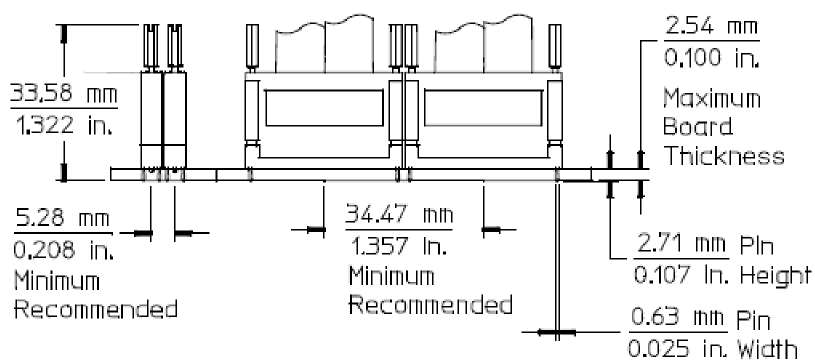


Figure 11 E5405-68702 retention module side-by-side dimensions

Footprint Dimensions

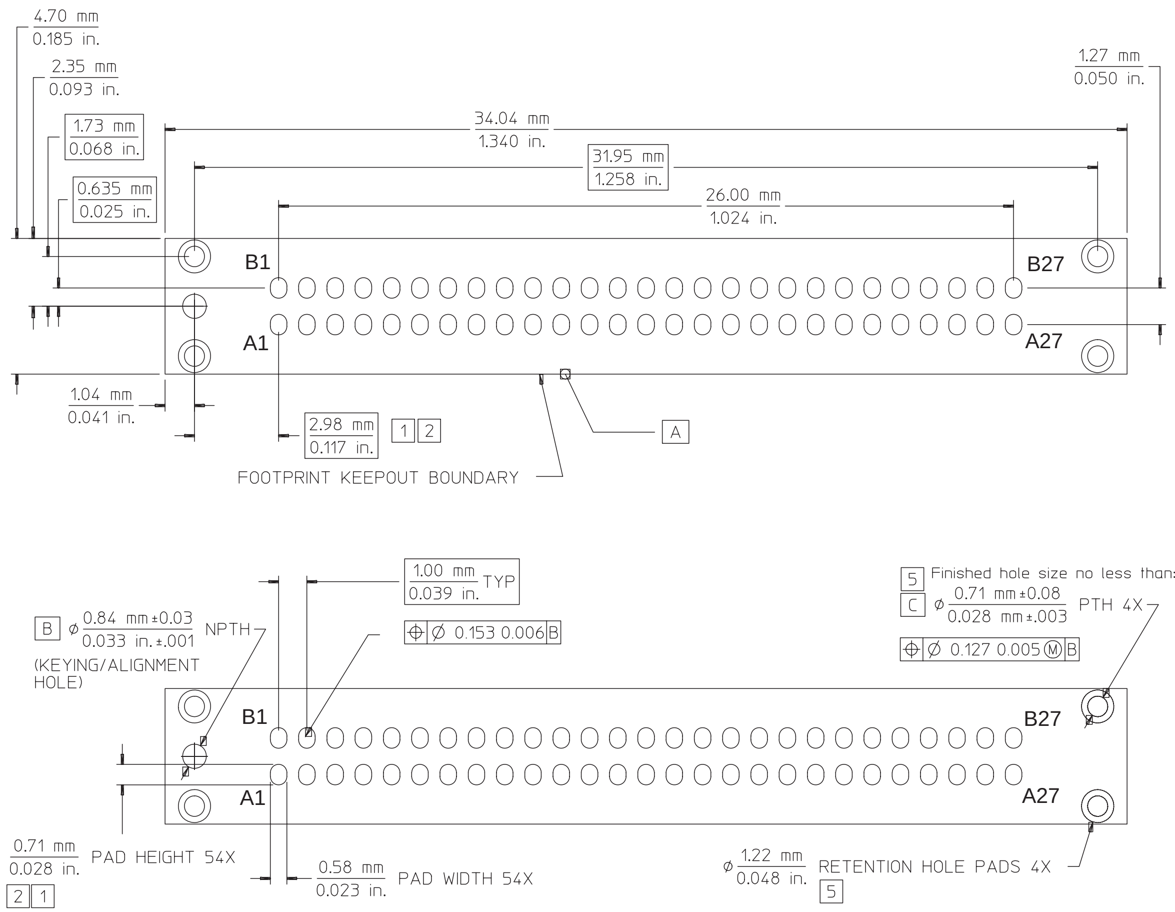


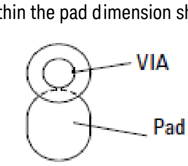
Figure 12 U4204A Top view footprint dimensions (drawing notes below).

NOTE

- The above view is looking down onto the footprint on the printed-circuit board.
- The retention module alignment is symmetrical around the pad footprint.

1 Maintain a solder mask web between pads when traces are routed between the pads on the same layer. The solder mask may not encroach onto the pads within the pad dimension shown.

2 VIAs not allowed on these pads. VIA edges may be tangent to pad edges as long as a solder mask web between VIAs and pads is maintained.



3 Surface finishes on pads should be HASL immersion silver, or gold over nickel.

4 This footprint is compatible with the Keysight retention module (part number E5405-68702). The modules are available as a kit of five modules with part number E5403A.

5 Plated through hole should not be tied to ground plane for thermal relief.

Pinout

The following footprint provides pin out and pad numbers for the U4204A probe.

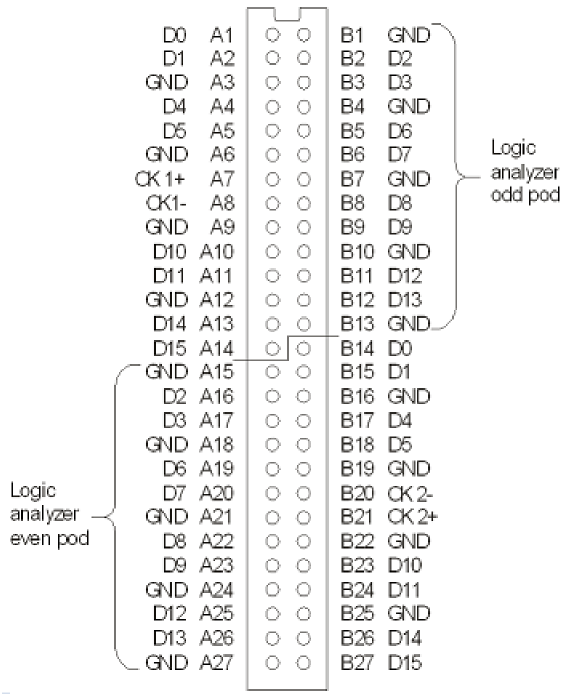


Figure 13 Pin out and Pad numbers for U4204A

U4204A Probe			Logic Analyzer	
Signal Name	**Pad #**		**Channel**	**Pod**
D0	A1	→	0	Whichever logic analyzer pod is connected to “Odd” on the U4204A probe
D1	A2	→	1	
Ground	A3			
D4	A4	→	4	
D5	A5	→	5	
Ground	A6			
Clock 1+	A7	→	Clock	
Clock 1-	A8	→	Clock	
Ground	A9			
D10	A10	→	10	
D11	A11	→	11	
Ground	A12			
D14	A13	→	14	
D15	A14	→	15	

U4204A Probe			Logic Analyzer	
Signal Name	**Pad #**		**Channel**	**Pod**
Ground	B1			Whichever logic analyzer pod is connected to “Odd” on the U4204A probe
D2	B2	→	2	
D3	B3	→	3	
Ground	B4			
D6	B5	→	6	
D7	B6	→	7	
Ground	B7			
D8	B8	→	8	
D9	B9	→	9	
Ground	B10			
D12	B11	→	12	
D13	B12	→	13	
Ground	B13			
D0	B14	→	0	Whichever logic analyzer pod is connected to “Even” on the U4204A probe

U4204A Probe			Logic Analyzer	
Signal Name	Pad #		Channel	Pod
Ground	A15			Whichever logic analyzer pod is connected to “Even” on the U4204A probe ↓
D2	A16	→	2	
D3	A17	→	3	
Ground	A18			
D6	A19	→	6	
D7	A20	→	7	
Ground	A21			
D8	A22	→	8	
D9	A23	→	9	
Ground	A24			
D12	A25	→	12	
D13	A26	→	13	
Ground	A27			

U4204A Probe			Logic Analyzer	
Signal Name	Pad #		Channel	Pod
D1	B15	→	1	↓
Ground	B16			
D4	B17	→	4	
D5	B18	→	5	
Ground	B19			
Clock 2-	B20	→	Clock	
Clock 2+	B21	→	Clock	
Ground	B22			
D10	B23	→	10	
D11	B24	→	11	
Ground	B25			
D14	B26	→	14	
D15	B27	→	15	

U4205A Probe Mechanical Considerations

Probe Dimensions

The following figure shows the dimensions of the U4205A probe. All dimensions are in inches.

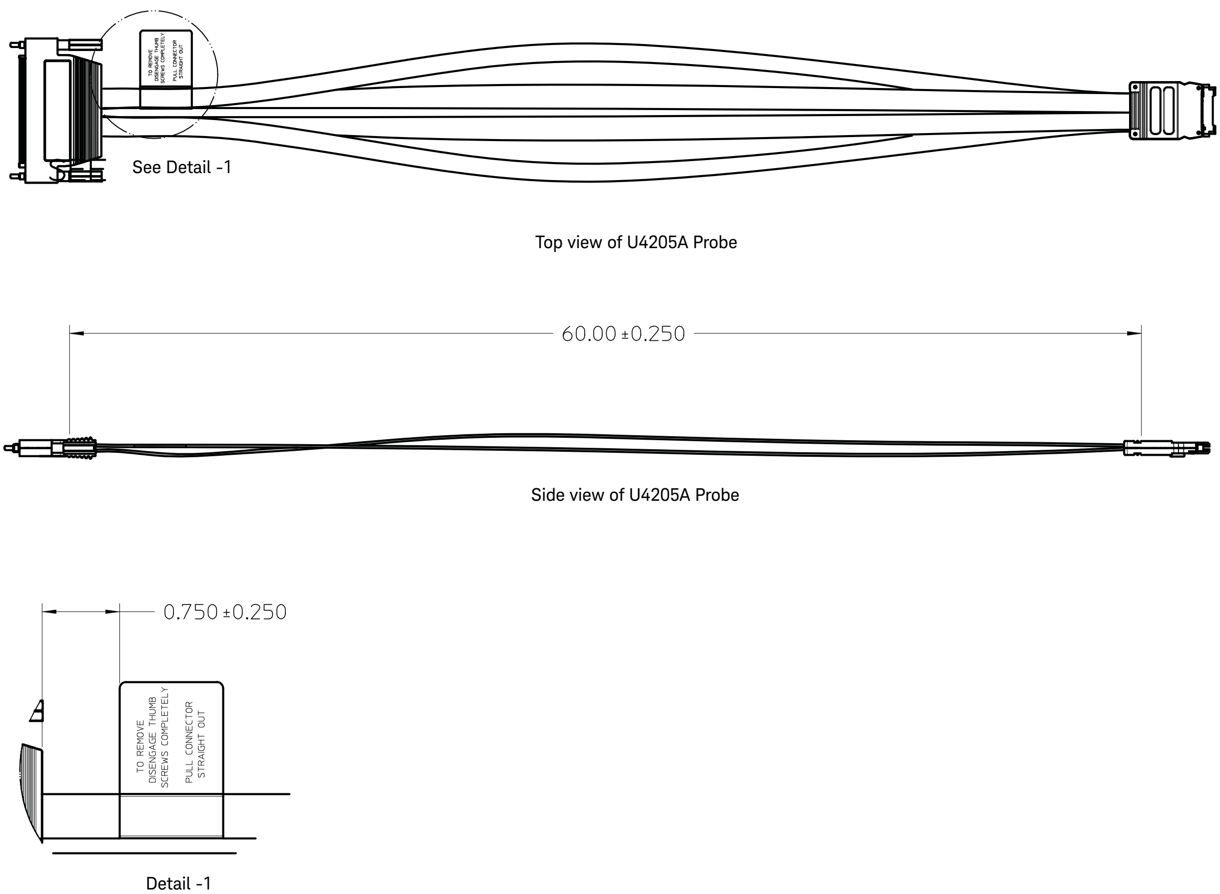


Figure 14 U4205A 38-pin single-ended probe dimensions

MICTOR Connector Dimensions

This U4205A probe requires a probe kit that contains MICTOR connectors and shrouds. Refer to page 19 for the kit part numbers. The dimensions of the MICTOR connector are as follows:

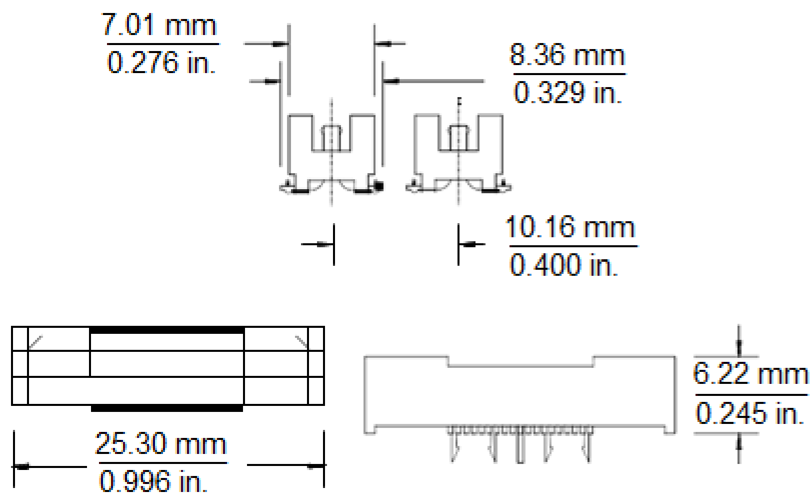
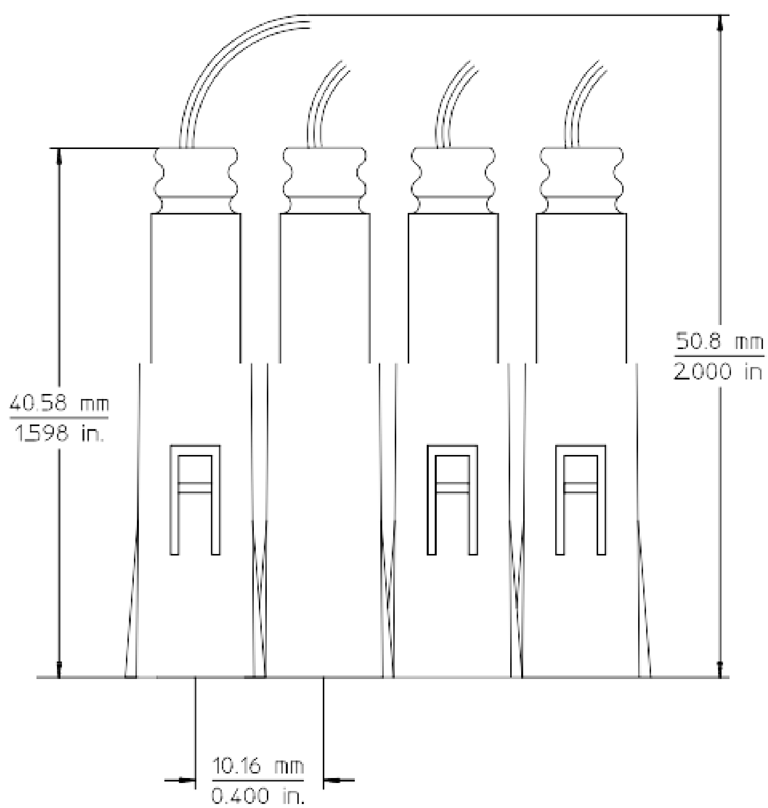


Figure 15 MICTOR 38-pin connector dimensions

Support Shroud Dimensions

Support shrouds are not required but are recommended if pulling forces may be applied to the cables that could cause the connector to be dislodged. Refer to page 19 for the kit part numbers.



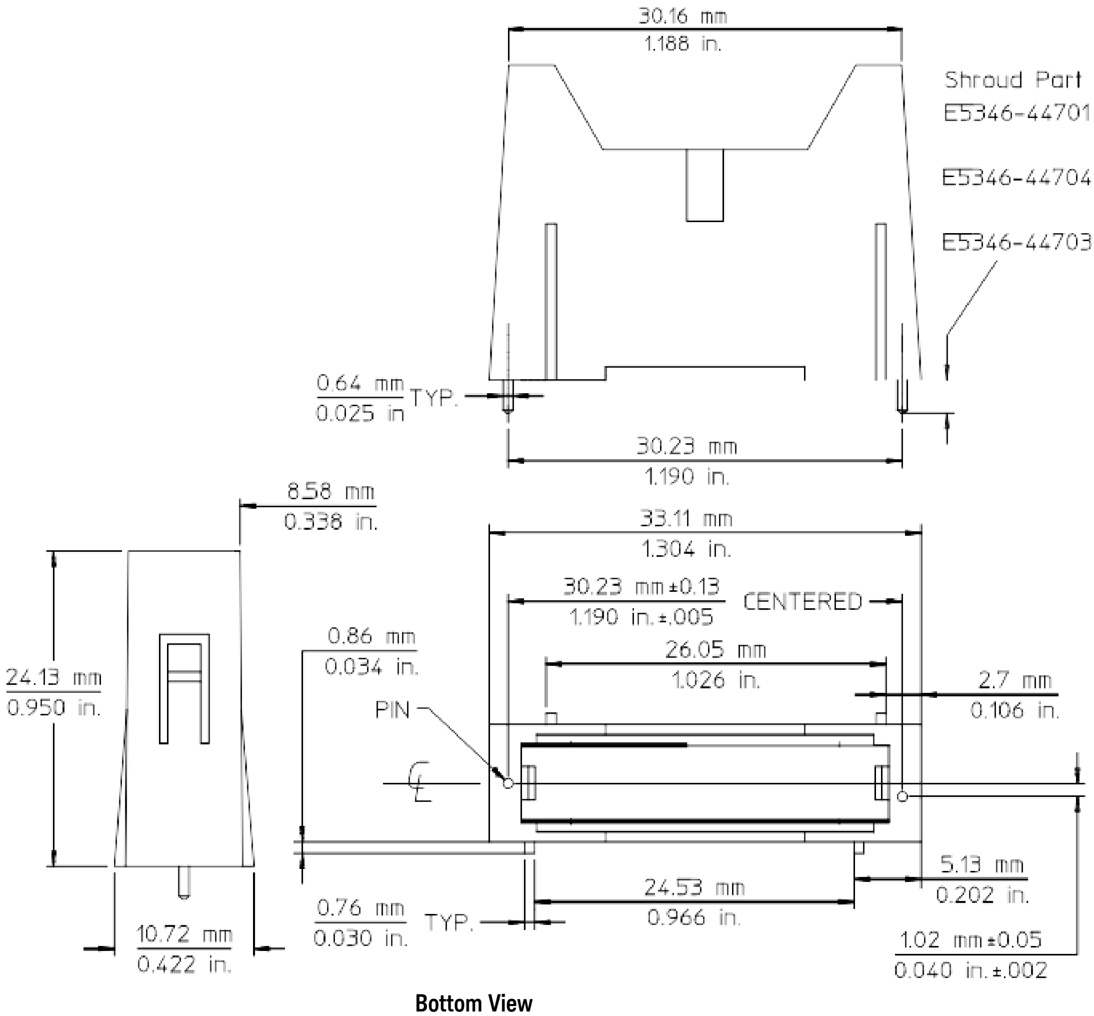


Figure 16 Support shroud dimensions for the U4205A's MICTOR 38-pin connector

Footprint Dimensions

Use the following 38-pin MICTOR connector footprint and support shroud mounting hole dimensions to design your target system board when using the U4205A probe.

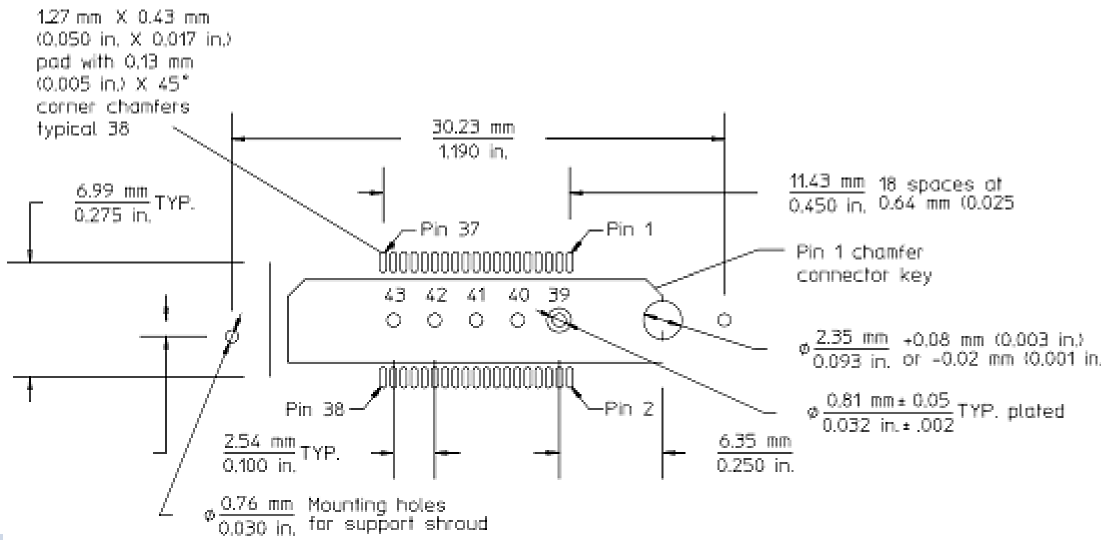


Figure 17 38-pin MICTOR connector footprint and support shroud mounting hole dimensions

U4205A Probe Pinout Table

The following table lists the mapping between the signals, Mictor connector pin numbers and the Logic Analyzer pod and channels for the U4205A probe.

Table 7 U4205A 38-pin single-ended probe pinout table

U4205A Single-ended Probe			Logic Analyzer	
Signal Name	Mictor Pin		Channel	Pod
Clk	5	→	Clk	Whichever Logic Analyzer pod is connected to **"Even"** on the U4205A probe
D 15	7	→	15	
D 14	9	→	14	
D 13	11	→	13	
D 12	13	→	12	
D 11	15	→	11	
D 10	17	→	10	
D 9	19	→	9	
D 8	21	→	8	
D 7	23	→	7	
D 6	25	→	6	
D 5	27	→	5	
D 4	29	→	4	
D 3	31	→	3	
D 2	33	→	2	
D 1	35	→	1	
D 0	37	→	0	
Ground	39-43			

U4205A Single-ended Probe			Logic Analyzer	
Signal Name	Mictor Pin		Channel	Pod
Clk	6	→	Clk	Whichever Logic analyzer pod is connected to **"Odd"** on the U4205A probe
D 15	8	→	15	
D 14	10	→	14	
D 13	12	→	13	
D 12	14	→	12	
D 11	16	→	11	
D 10	18	→	10	
D 9	20	→	9	
D 8	22	→	8	
D 7	24	→	7	
D 6	26	→	6	
D 5	28	→	5	
D 4	30	→	4	
D 3	32	→	3	
D 2	34	→	2	
D 1	36	→	1	
D 0	38	→	0	
Ground	39-43			

NOTE

Do not connect the following pins. These pins are +5 volt supply and DC return for analysis probes.

+5 V dc 1
Ground 3

Do not connect the following pins. They are used by the Keysight logic analyzer with an emulator or analysis probe to program or read target information.

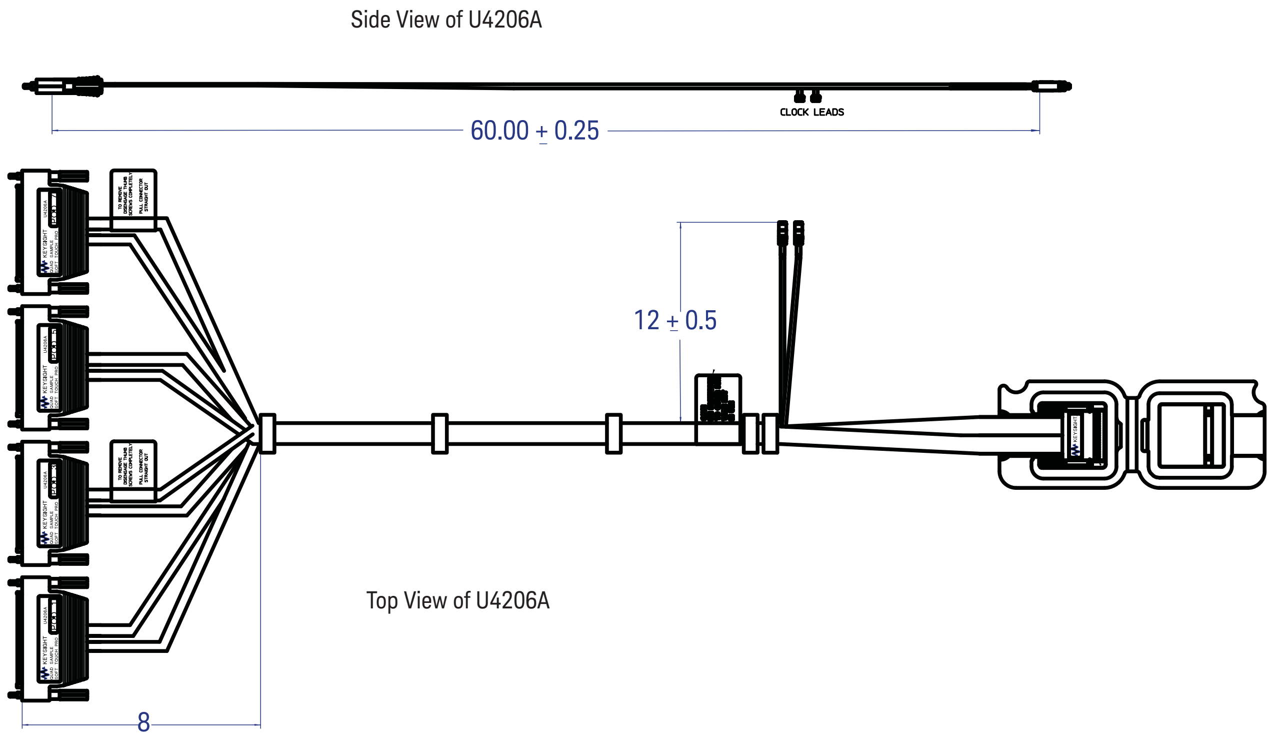
SCL 2

SDA 4

U4206A Probe Mechanical Considerations

Probe Dimensions

The following figure shows the dimensions of the U4206A probe. All dimensions are in millimeters.



Retention Module Dimensions

The U4206A probe is compatible with the Keysight E5405-68702 retention module that accompanies the probe shipment as a kit of 5 retention modules (part number of kit is E5403A). Use the dimensions given in this topic to lay out your PC board pads and holes for use with the U4206A soft touch probe.

NOTE

Unless otherwise specified, dimensions are in inches and have the following tolerances.

Linear

X.X = +-0.1

X.XX = +-0.01

X.XXX = +-0.005

X.XXXX = +-0.0005

Angular

X = +-1

X.X = +-0.5

X.XX = +-0.25

X.XXX = +-0.125

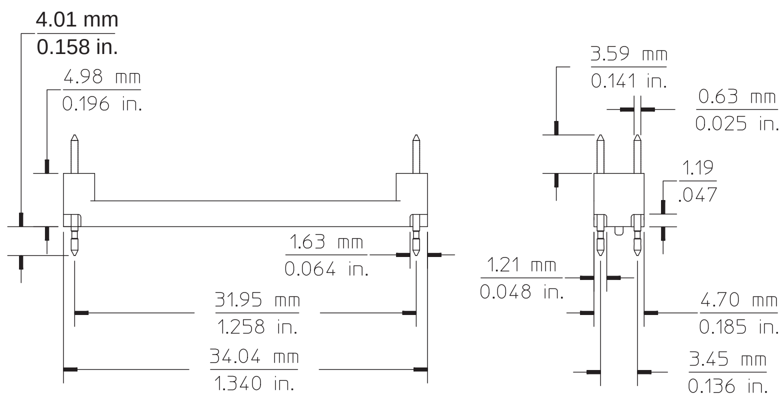


Figure 18 E5405-68702 retention module dimensions

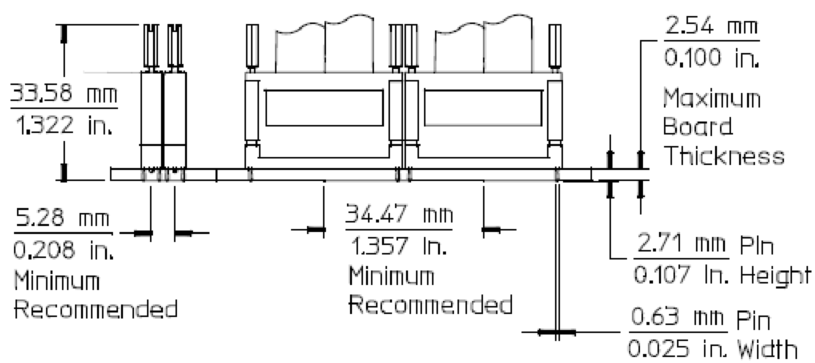


Figure 19 E5405-68702 retention module side-by-side dimensions

Footprint Dimensions

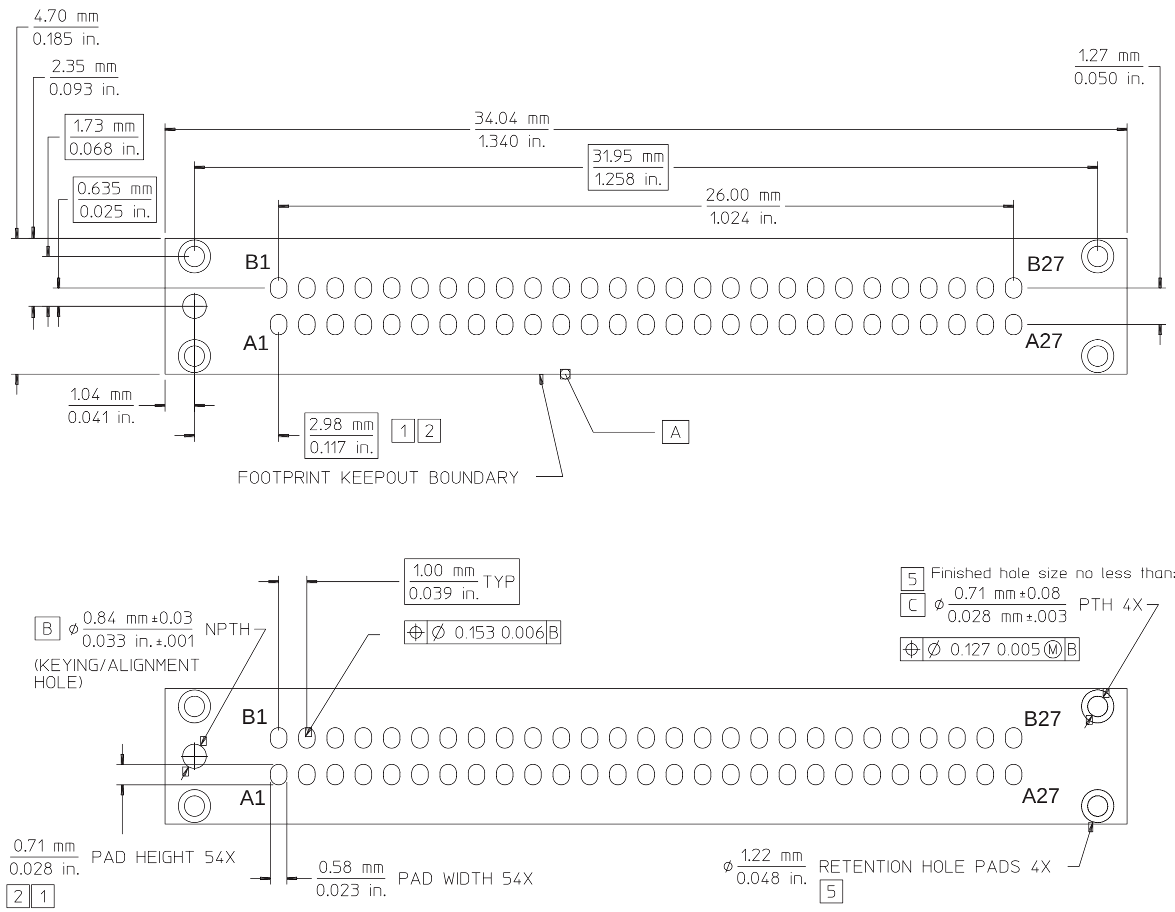


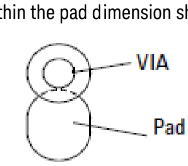
Figure 20 U4206A Top view footprint dimensions (drawing notes below).

NOTE

- The above view is looking down onto the footprint on the printed-circuit board.
- The retention module alignment is symmetrical around the pad footprint.

1 Maintain a solder mask web between pads when traces are routed between the pads on the same layer. The solder mask may not encroach onto the pads within the pad dimension shown.

2 VIAs not allowed on these pads. VIA edges may be tangent to pad edges as long as a solder mask web between VIAs and pads is maintained.



3 Surface finishes on pads should be HASL immersion silver, or gold over nickel.

4 This footprint is compatible with the Keysight retention module (part number E5405-68702). The modules are available as a kit of five modules with part number E5403A.

5 Plated through hole should not be tied to ground plane for thermal relief.

Pinout

The following footprint provides pin out and pad numbers for the U4206A probe for use with the U4164A logic analyzers.

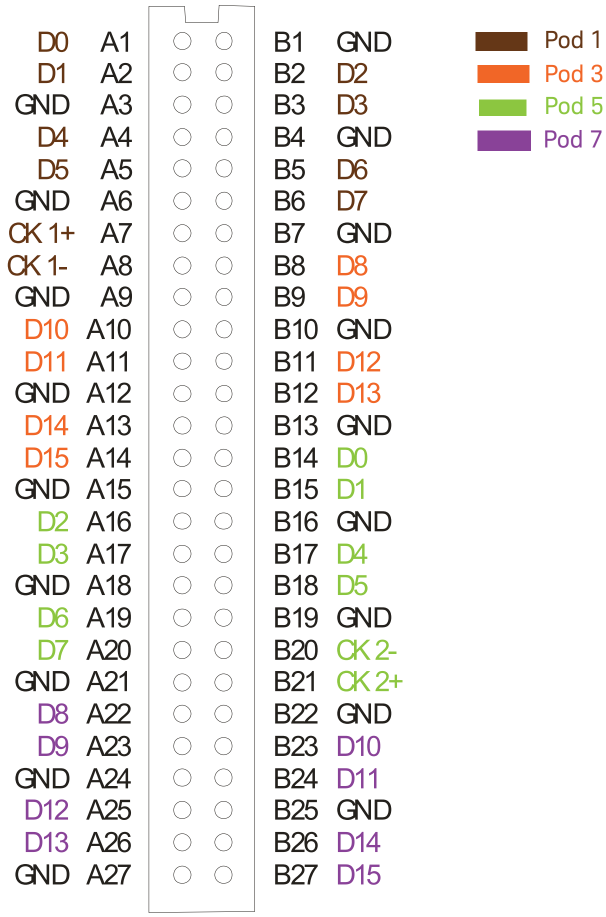


Figure 21 Pin out and Pad numbers for U4206A

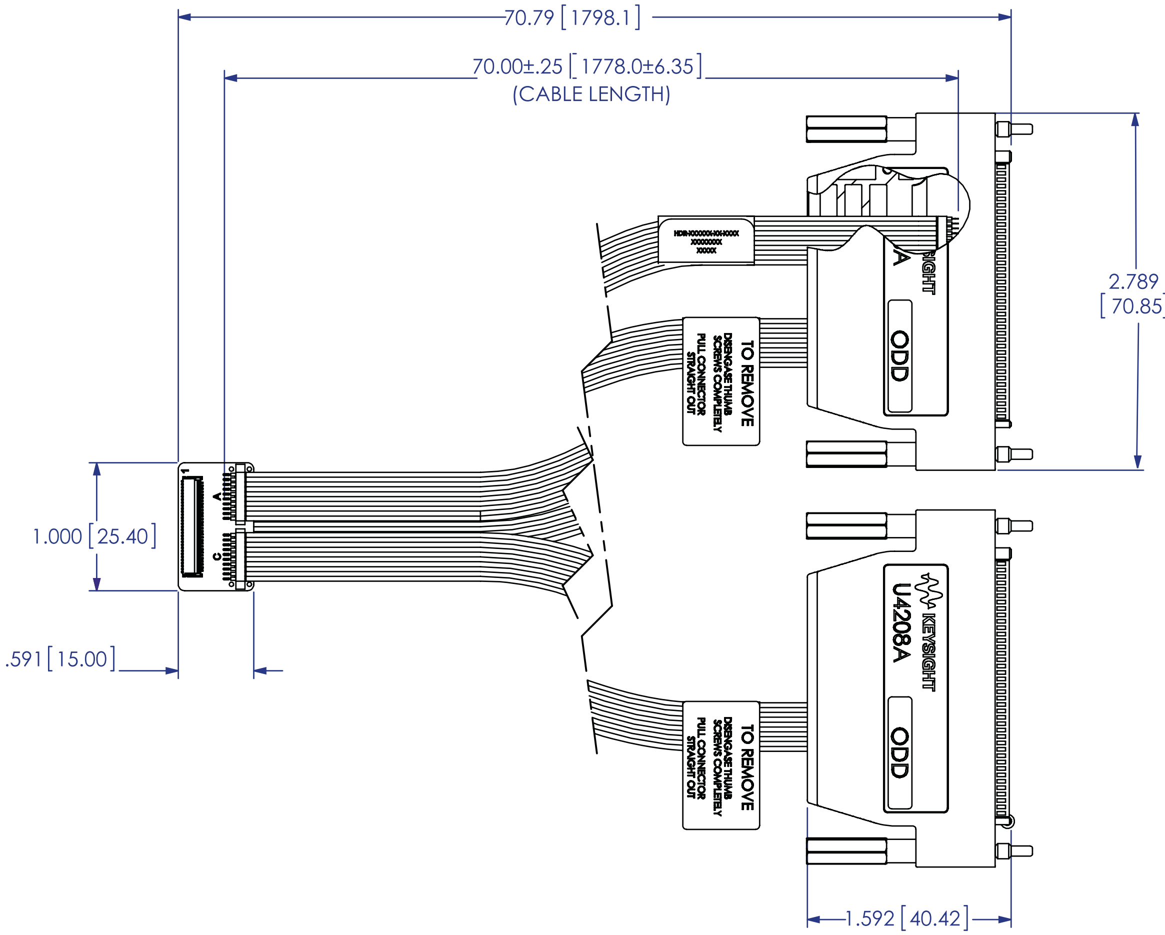
U4206A Probe		Maps to	Logic Analyzer	
Signal Name	Pad #		Channel	Pod
D0	A1	→		Pod1
D1	A2	→		
Ground	A3			
D4	A4	→		
D5	A5	→		
Ground	A6			
Clock 1+	A7	→	Clock	
Clock 1-	A8	→	Clock	
Ground	A9			
D10	A10	→		Pod 3
D11	A11	→		
Ground	A12			
D14	A13	→		
D15	A14	→		
Ground	A15			
D2	A16	→		Pod 5
D3	A17	→		
Ground	A18			
D6	A19	→		
D7	A20	→		
Ground	A21			
D8	A22	→		Pod 7
D9	A23	→		
Ground	A24			
D12	A25	→		
D13	A26	→		
Ground	A27			

U4206A Probe		Maps To	Logic Analyzer	
Signal Name	Pad #		Channel	Pod
Ground	B1			Pod 1
D2	B2	→		
D3	B3	→		
Ground	B4			
D6	B5	→		
D7	B6	→		
Ground	B7			Pod 3
D8	B8	→		
D9	B9	→		
Ground	B10			
D12	B11	→		
D13	B12	→		
Ground	B13			
D0	B14	→		Pod 5
D1	B15	→		
Ground	B16			
D4	B17	→		
D5	B18	→		
Ground	B19			
Clock 2-	B20	→	Clock	
Clock 2+	B21	→	Clock	
Ground	B22			
D10	B23	→		Pod 7
D11	B24	→		
Ground	B25			
D14	B26	→		
D15	B27	→		

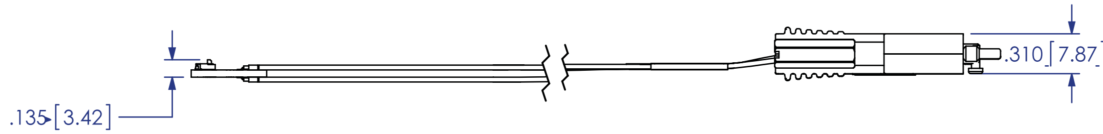
U4208A Probe/Cable Mechanical Considerations

Probe Dimensions

The following figure shows the dimensions of the U4208A probe/cable. All dimensions are in Inches (millimeters).



Top View of U4208A



Side View of U4208A

Pinout

The following figure illustrates the 61-pin connector of the U4208A probe followed by the pinout table for this probe.

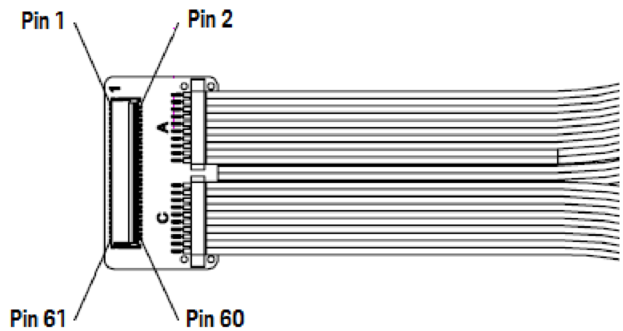


Figure 22 U4208A - Pins Assignment

In the U4208A pinout table below:

- Signals highlighted with dark red are targeted to the U4208A Pod labeled Pod A.
- Signals highlighted with blue are targeted to the U4208A Pod labeled Pod B.

Table 8 Pin assignments for the U4208A Probe/Cable

U4208A Connector Pinout				Maps to	U4208A Cable Pod
Signal Name	Pin #	Pin#	Signal Name		
GND	1	2	D0_p	→	A
GND	3	4	D1_p	→	A
GND	5	6	D2_p	→	A
GND	7	8	D3_p	→	A
GND	9	10	QUALA_p	→	A
GND	11	12	QUALA_n	→	A
GND	13	14	D4_p	→	A
GND	15	16	D5_p	→	A
GND	17	18	D6_p	→	A
GND	19	20	D7_p	→	A
GND	21	22	D8_p	→	A
GND	23	24	D9_p	→	A
GND	25	26	D10_p	→	A
GND	27	28	D11_p	→	A
GND	29	30	CLK_p	→	A
GND	31	32	CLK_n	→	A
GND	33	34	D12_p	→	A
GND	35	36	D13_p	→	A
GND	37	38	D14_p	→	A
GND	39	40	D15_p	→	A
GND	41	42	D16_p	→	B
GND	43	44	D17_p	→	B
GND	45	46	D18_p	→	B
GND	47	48	D19_p	→	B
GND	49	50	QUALB_p	→	B
GND	51	52	QUALB_n	→	B

U4208A Connector Pinout				Maps to	U4208A Cable Pod
Signal Name	Pin #	Pin#	Signal Name		
GND	53	54	D20_p	→	B
GND	55	56	D21_p	→	B
GND	57	58	D22_p	→	B
GND	59	60	D23_p	→	B
GND	61				

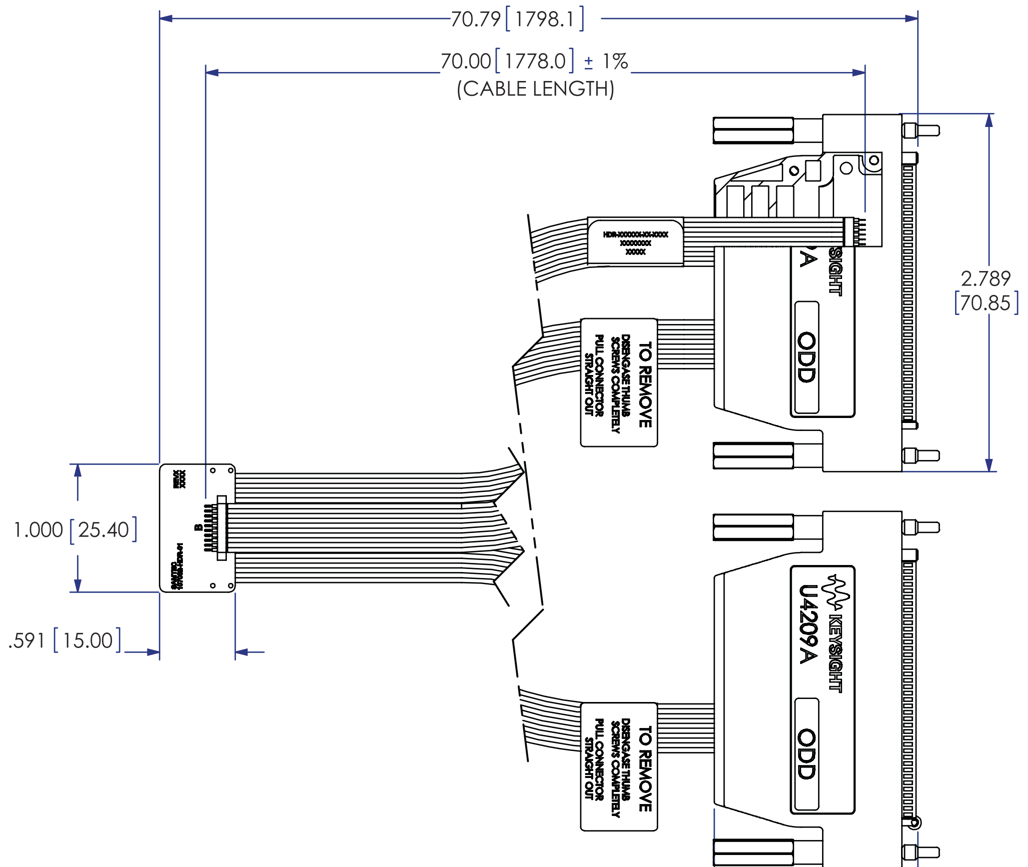
NOTE

The mapping between the DDR/LPDDR signals and the logic analyzer pod channels is based on the Keysight interposer with which you are using the U4208A probe. Therefore, to know about the mapping between the signals on U4208A pods and Logic analyzer pods, refer to the specific guide for the interposer. You can find the guide for an interposer on www.keysight.com by searching for the interposer's model number.

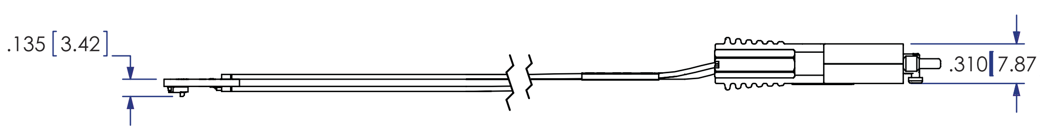
U4209A Probe/Cable Mechanical Considerations

Probe Dimensions

The following figure shows the dimensions of the U4209A probe/cable. All dimensions are in Inches (millimeters).



Top View of U4209A



Side View of U4209A

Pinout

The following figure illustrates the 61-pin connector of the U4209A probe followed by the pinout table for this probe.

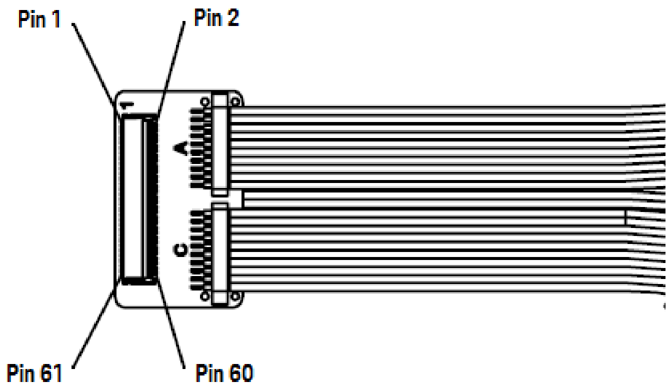


Figure 23 U4209A Connector - Pins Assignment

In the U4209A pinout table below:

- Signals highlighted with dark red are targeted to the U4209A Pod labeled Pod A.
- Signals highlighted with blue are targeted to the U4209A Pod labeled Pod B.

Table 9 Pin assignments for the U4209A Probe/Cable

U4209A Connector Pinout				Maps to	U4209A Cable Pod
Signal Name	Pin #	Pin#	Signal Name		
GND	1	2	D23_p	→	B
GND	3	4	D22_p	→	B
GND	5	6	D21_p	→	B
GND	7	8	D20_p	→	B
GND	9	10	QUALB_n	→	B
GND	11	12	QUALB_p	→	B
GND	13	14	D19_p	→	B
GND	15	16	D18_p	→	B
GND	17	18	D17_p	→	B
GND	19	20	D16_p	→	B
GND	21	22	D15_p	→	A
GND	23	24	D14_p	→	A
GND	25	26	D13_p	→	A
GND	27	28	D12_p	→	A
GND	29	30	CLK_n	→	A
GND	31	32	CLK_p	→	A
GND	33	34	D11_p	→	A
GND	35	36	D10_p	→	A
GND	37	38	D9_p	→	A
GND	39	40	D8_p	→	A
GND	41	42	D7_p	→	A
GND	43	44	D6_p	→	A
GND	45	46	D5_p	→	A
GND	47	48	D4_p	→	A
GND	49	50	QUALA_n	→	A
GND	51	52	QUALA_p	→	A

U4209A Connector Pinout				Maps to	U4209A Cable Pod
Signal Name	Pin #	Pin#	Signal Name		
GND	53	54	D3_p	→	A
GND	55	56	D2_p	→	A
GND	57	58	D1_p	→	A
GND	59	60	D0_p	→	A
GND	61				

NOTE

The mapping between the DDR/LPDDR signals and the logic analyzer pod channels is based on the Keysight interposer with which you are using the U4209A probe. Therefore, to know about the mapping between the signals on U4209A pods and Logic analyzer pods, refer to the specific guide for the interposer. You can find the guide for an interposer on www.keysight.com by searching for the interposer's model number.

3 Electrical Considerations for Operating U4200A-Series Probes

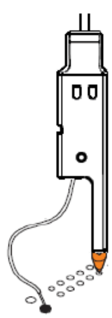
This chapter describes the electrical considerations such as equivalent probe loads, input impedance, time domain transmission (TDT), step inputs, and eye opening for operating the U4200A-series probes.

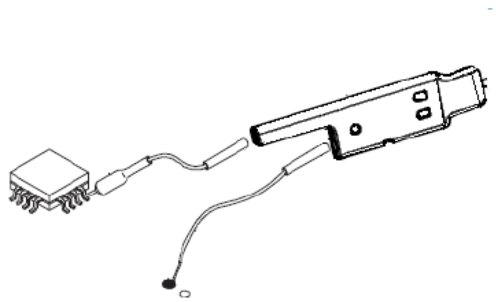
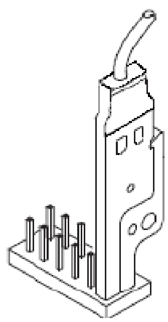
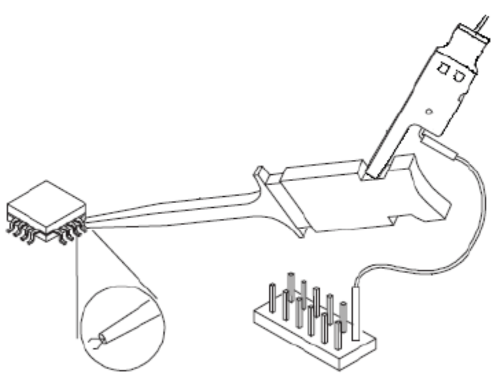
U4203A Probe Electrical Considerations

The U4203A 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 to help you select the configuration that works best with your target system. The table that follows 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

Accessory	Description	Total lumped input C	Maximum recommended state speed	Details on page #
	130 Ω Resistive Signal Pin (orange) and Solder-down Ground Lead	1.3 pF	1.5 Gb/s	page 57

Accessory	Description	Total lumped input C	Maximum recommended state speed	Details on page #
	5 cm Resistive Signal Lead and Solder-down Ground Lead	1.6 pF	1.5 Gb/s	page 67
	Flying Lead and Ground Extender	1.4 pF	1.5 Gb/s	page 78
	Grabber Clip and Right-angle Ground Lead	2.0 pF	600 Mb/s	page 88

130 ohm Resistive Signal Pin (orange) and Solder-down Ground Lead

This configuration is recommended for hand-held probing of individual test points. Use the resistive signal pin for the signal. For the ground, the preferred method is to use the solder-down ground lead. Alternatively, for ground you could use the right-angle ground lead and a grabber clip as shown on page 88.

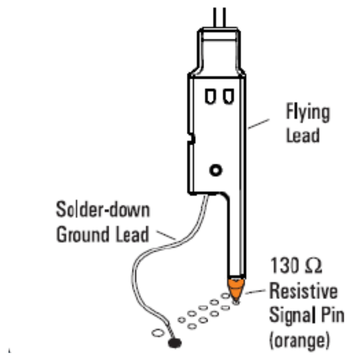


Figure 24 Hand-held probing configuration

The 130 Ω resistive signal pin and solder-down ground leads are identical to the accessories for the Keysight 1156A/57A/58A series oscilloscope probes. They provide similar loading effects and characteristics. The accessories for the 1156A/57A/58A probes are compatible with the E5382B probes allowing you to interchange scope and logic analyzer leads.

Input Impedance

The U4203A 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 130 Ω resistive signal pin (orange) and the solder-down ground wire. This model is a simplified equivalent load of the measured input impedance seen by the target.

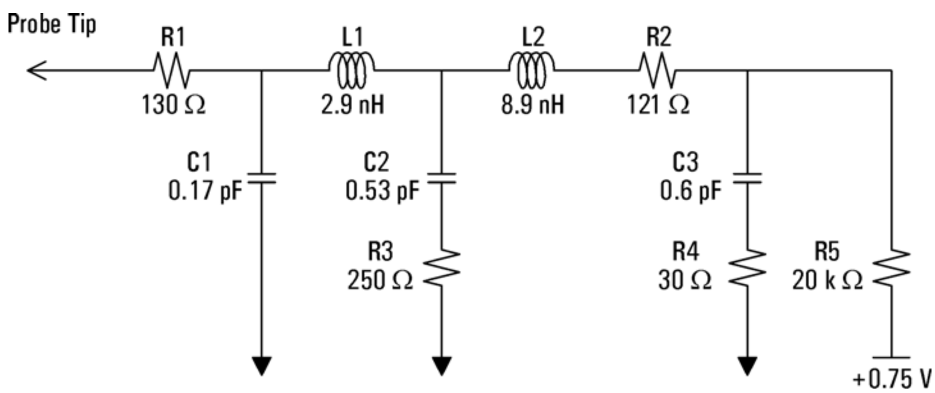


Figure 25 Equivalent load model

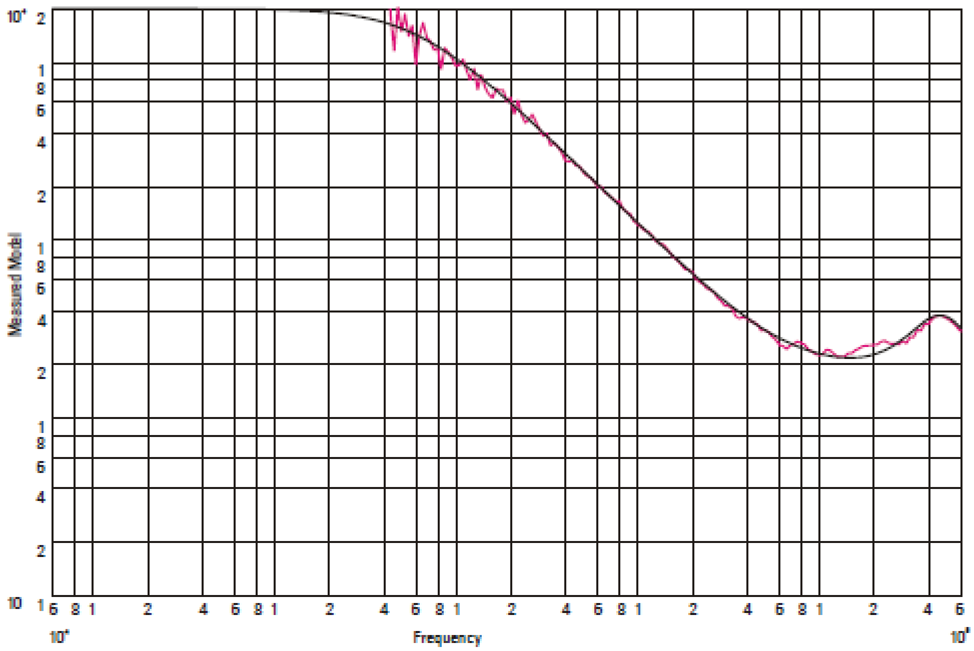


Figure 26 Measured versus modeled input impedance

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 130 **Ω** resistive signal pin (orange) and solder-down ground lead configuration affect the step seen by the receiver for various rise times.

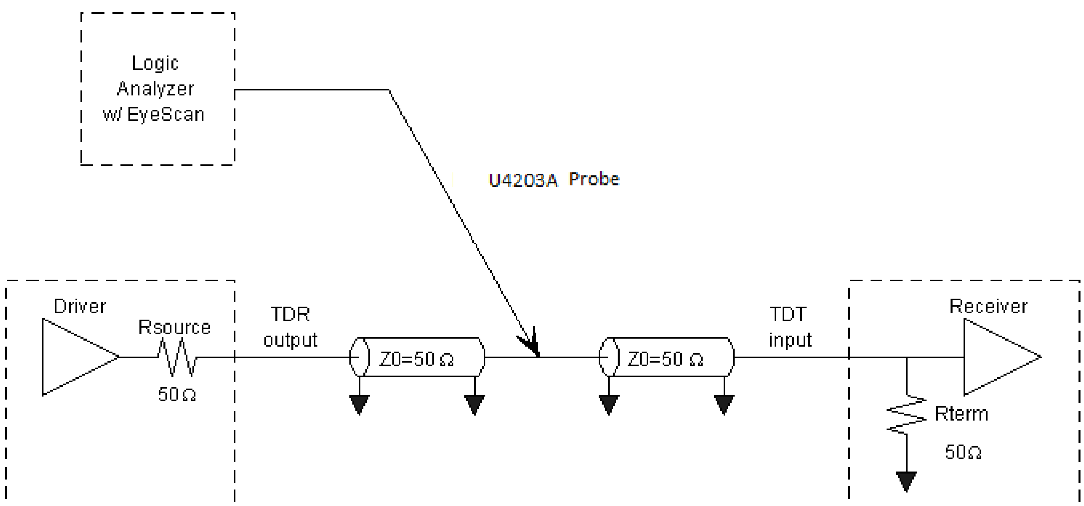


Figure 27 TDT measurement schematic

As the following graphs demonstrate, the 130 Ω resistive signal pin and solder-down ground lead 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 100 ps rise times. Ultimately, you must determine what is an acceptable amount of distortion of the target signal.

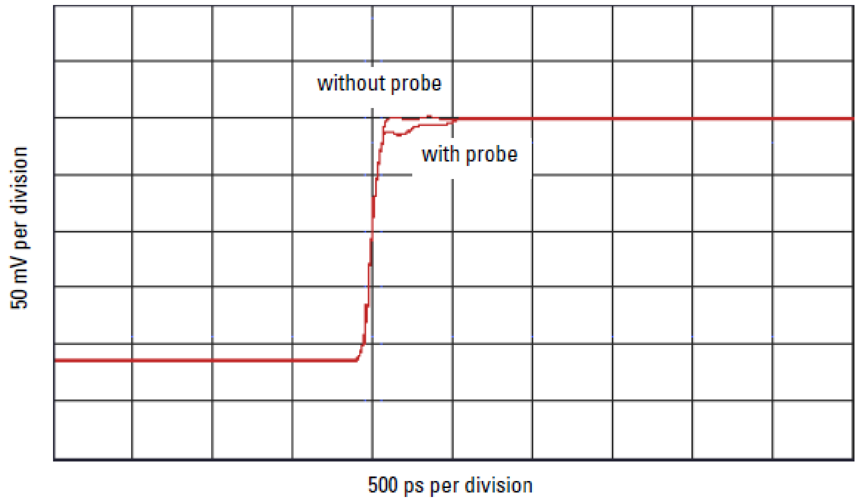


Figure 28 TDT measurement at receiver with and without probe load for 100 ps rise time

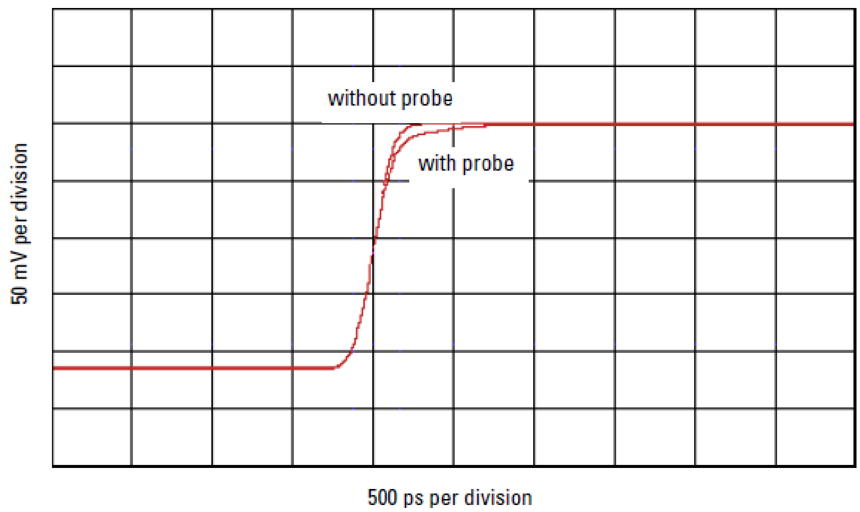


Figure 29 TDT measurement at receiver with and without probe load for 250 ps rise time

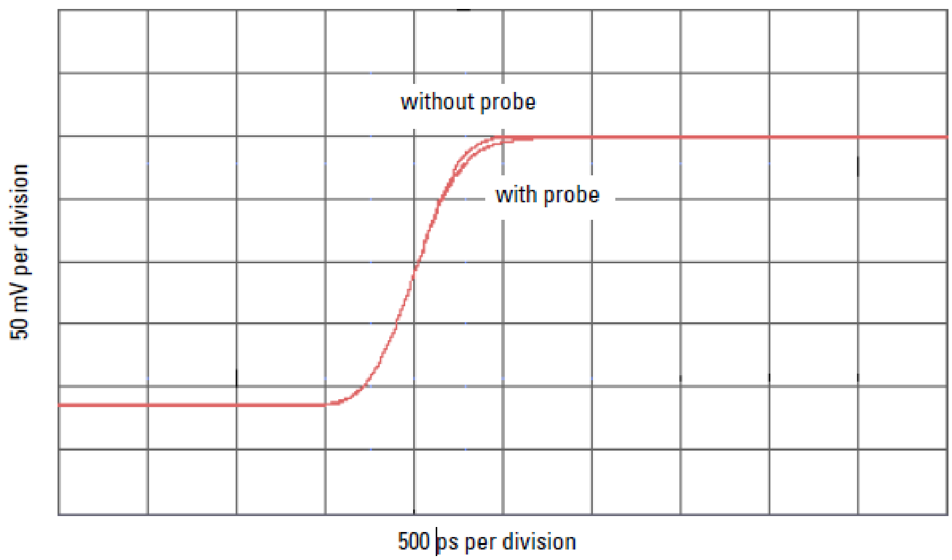


Figure 30 TDT measurement at receiver with and without probe load for 500 ps rise time

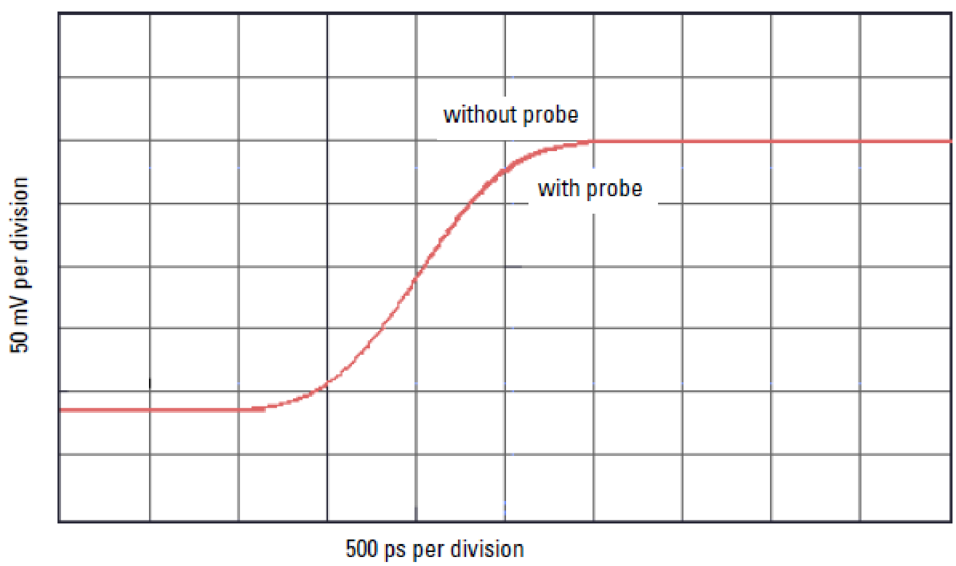


Figure 31 TDT measurement at receiver with and without probe load for 1 ns rise time

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 V_{in} to V_{out} for various step inputs. For the following graphs, V_{in} is the signal at the logic analyzer probe tip measured by double probing with Keysight 54701A probe into Keysight 54750A oscilloscope (total 2.5 GHz BW). Eye Scan is used to measure V_{out}, 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 130 Ω resistive signal pin (orange) and solder-down ground lead configuration.

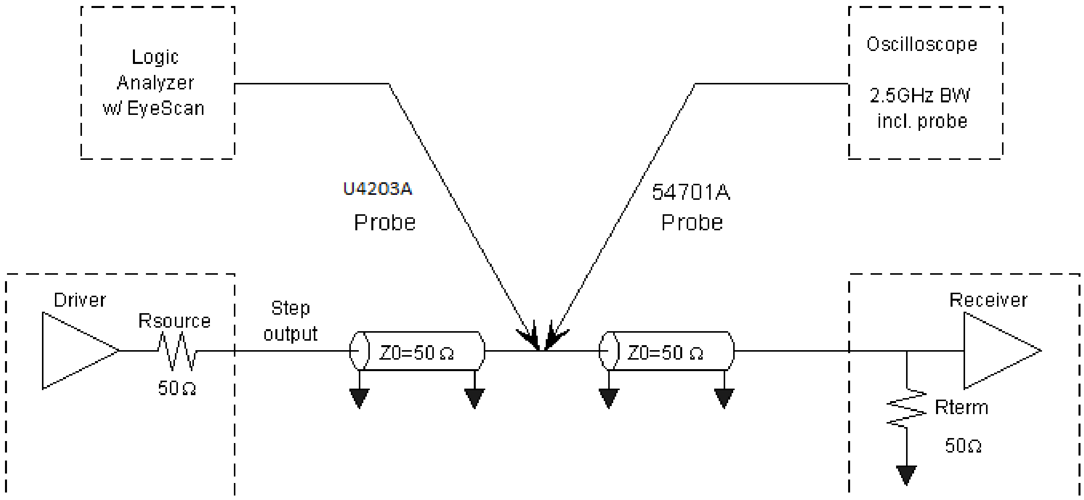


Figure 32 Step input measurement schematic

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.

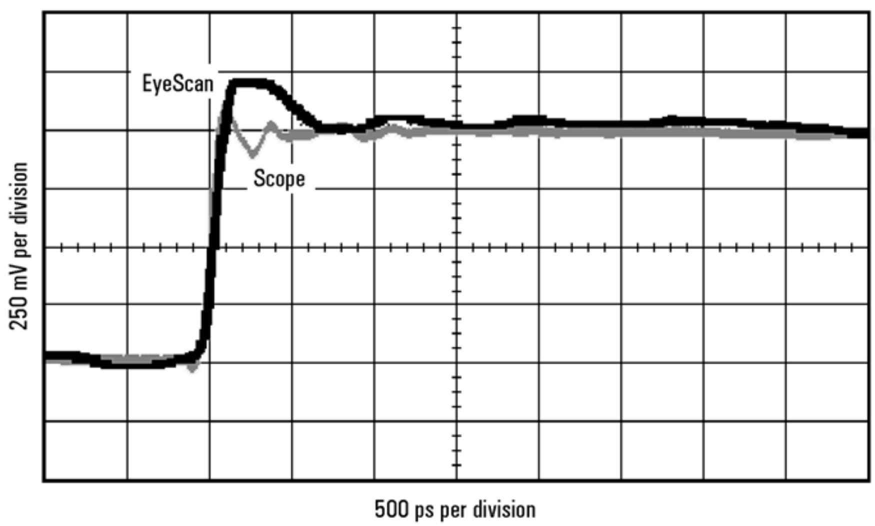


Figure 33 Logic analyzer's response to a 100 ps rise time

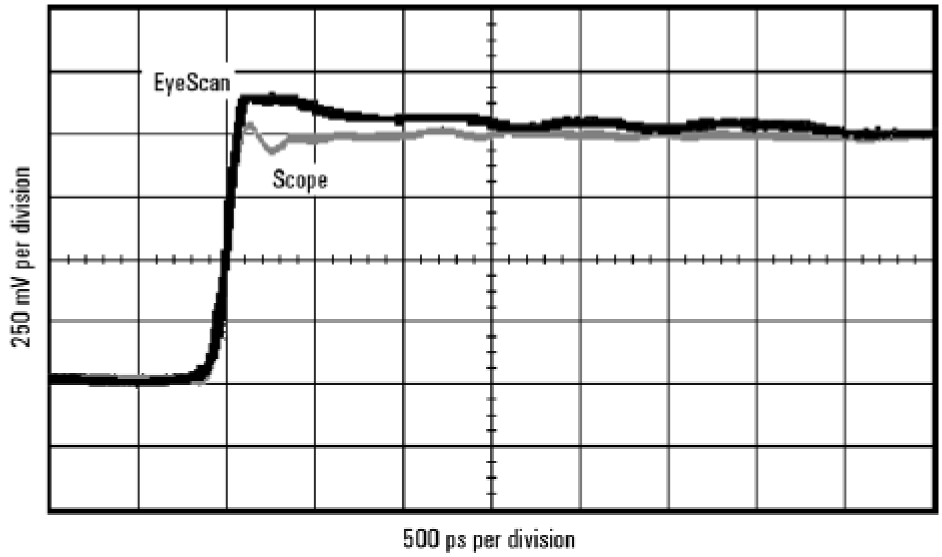


Figure 34 Logic analyzer's response to a 250 ps rise time

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.

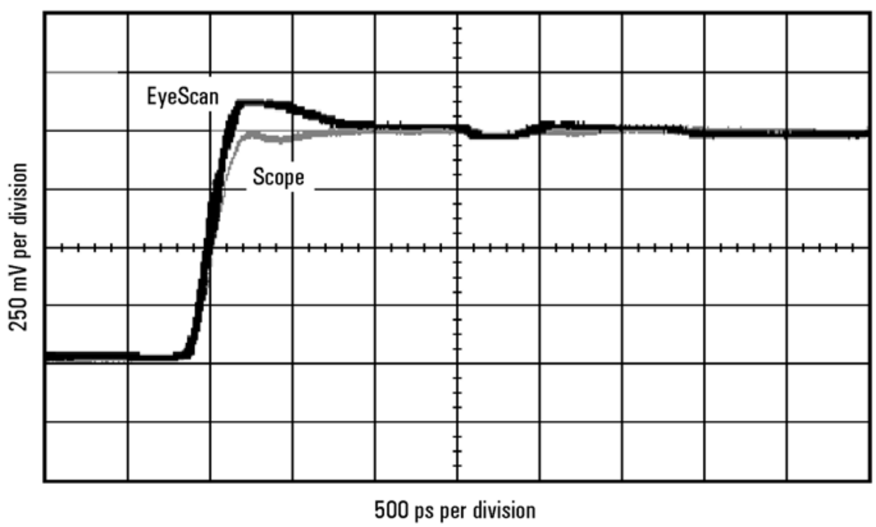


Figure 35 Logic analyzer's response to a 500 ps rise time

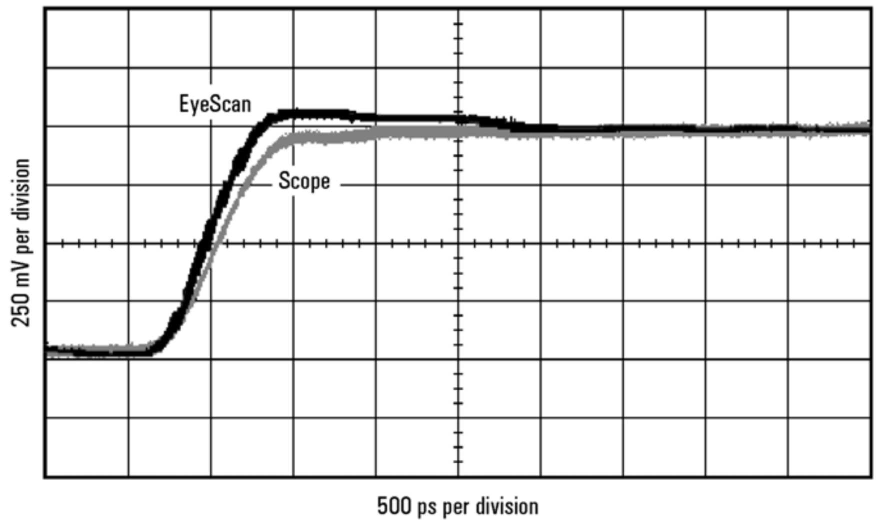


Figure 36 Logic analyzer's response to a 1 ns rise time

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 2^{23}–1 pseudo random bit sequence (PRBS). These measurements show the remaining eye opening at the logic analyzer while using the 130 Ω resistive signal pin (orange) and solder-down ground lead configuration.

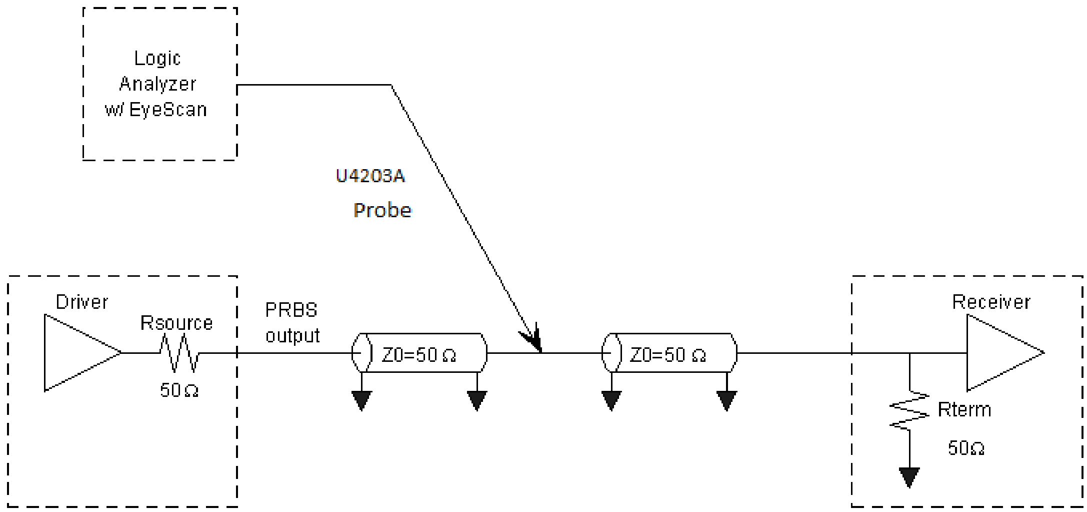


Figure 37 Eye opening measurement schematic

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 130 **Ω** resistive signal pin and solder-down ground lead configuration still has a usable eye opening at 1250 Mb/s and minimum signal swing.

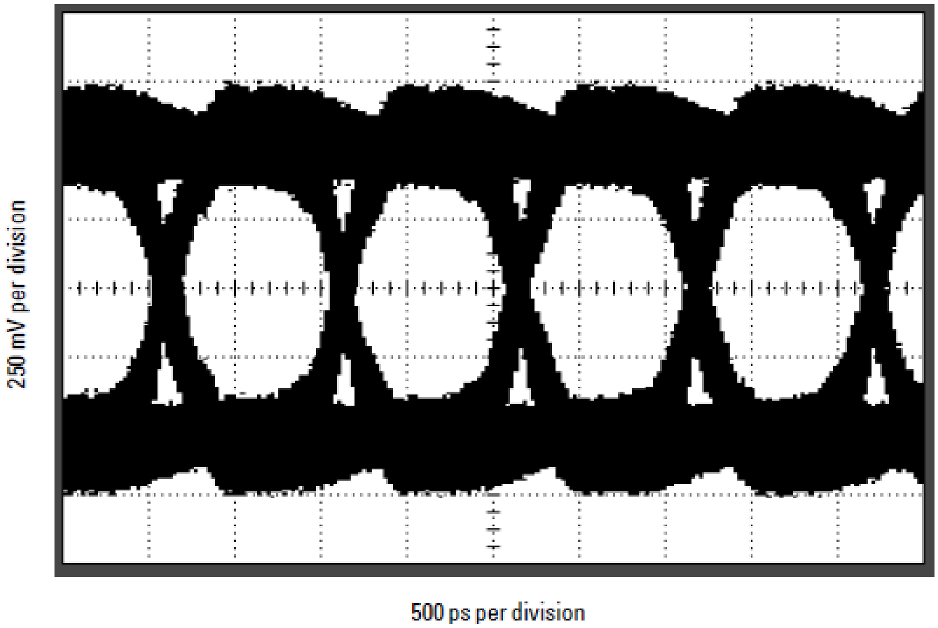


Figure 38 Logic analyzer eye opening for a PRBS signal of 1 V p-p, 1000 Mb/s data rate

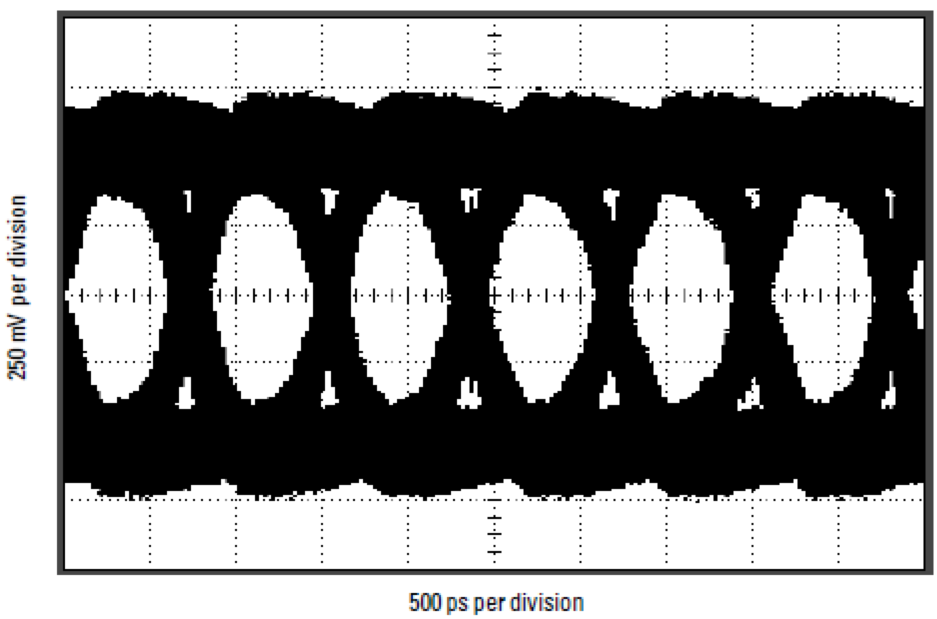


Figure 39 Logic analyzer eye opening for a PRBS signal of 1 V p-p, 1250 Mb/s data rate

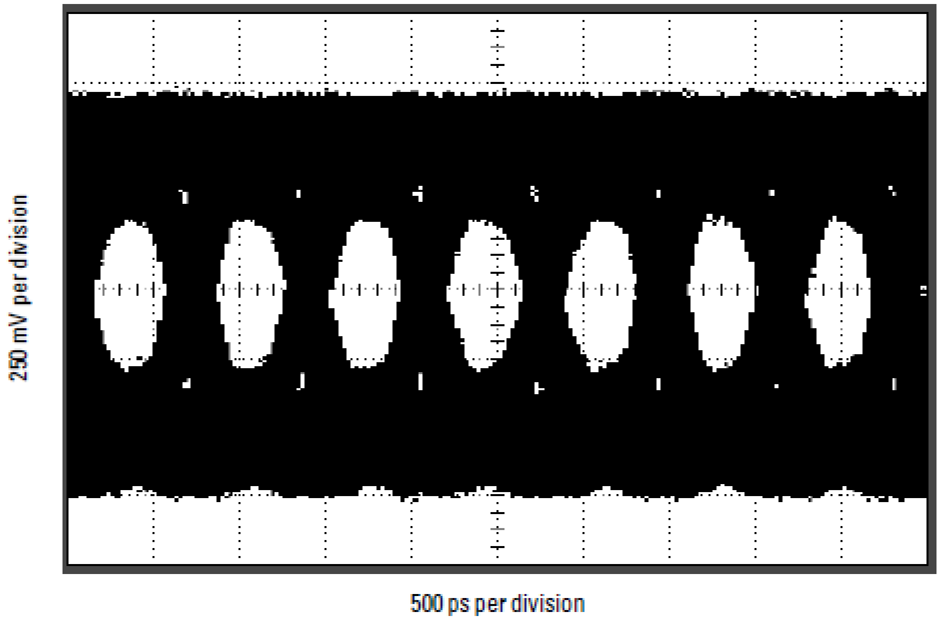


Figure 40 Logic analyzer eye opening for a PRBS signal of 1 V p-p, 1500 Mb/s data rate

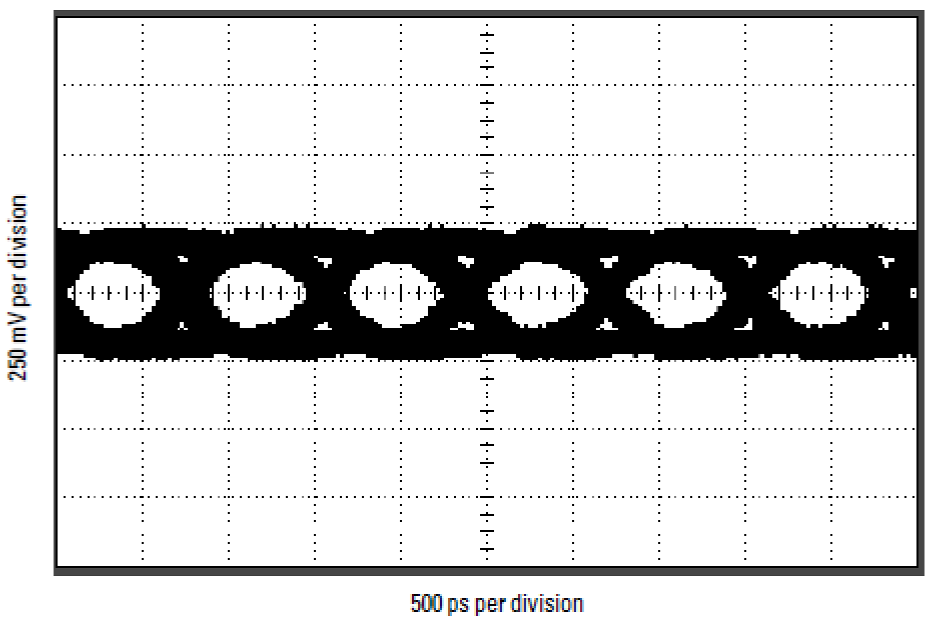


Figure 41 Logic analyzer eye opening for a PRBS signal of 250 mV, 1250 Mb/s data rate

5 cm Resistive Signal Lead and Solder-down Ground Lead

This configuration is recommended for accessing components such as IC leads or surface-mount component leads for hands-off probing.

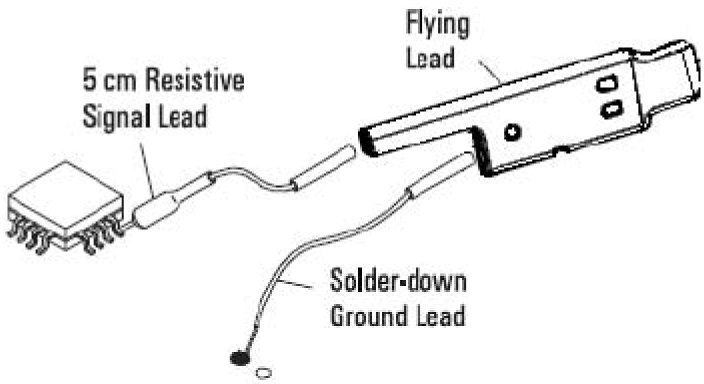


Figure 42 Surface-mount probe configuration

CAUTION The resistor bends easily. A bent resistor could affect the performance of the 5 cm resistive signal lead.

The 5cm resistive signal lead and the solder-down ground leads are identical to the accessories for the Keysight 1156A/57A/58A oscilloscope probes. They provide similar loading effects and characteristics. The accessories for the 1156A/57A/58A oscilloscope probes are compatible with the U4203A probes, allowing you to interchange scope and logic analyzer leads.

Input Impedance

The U4203A 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 SMT solder-down Signal (red) and Ground (black) wires. This model is a simplified equivalent load of the measured input impedance seen by the target.

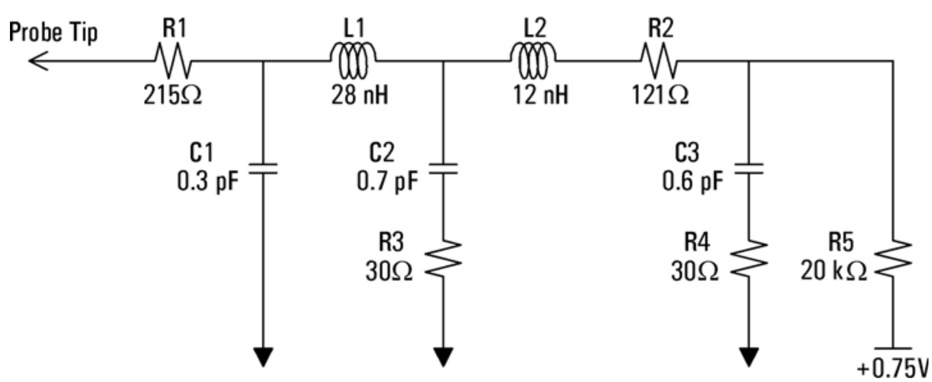


Figure 43 Equivalent load model

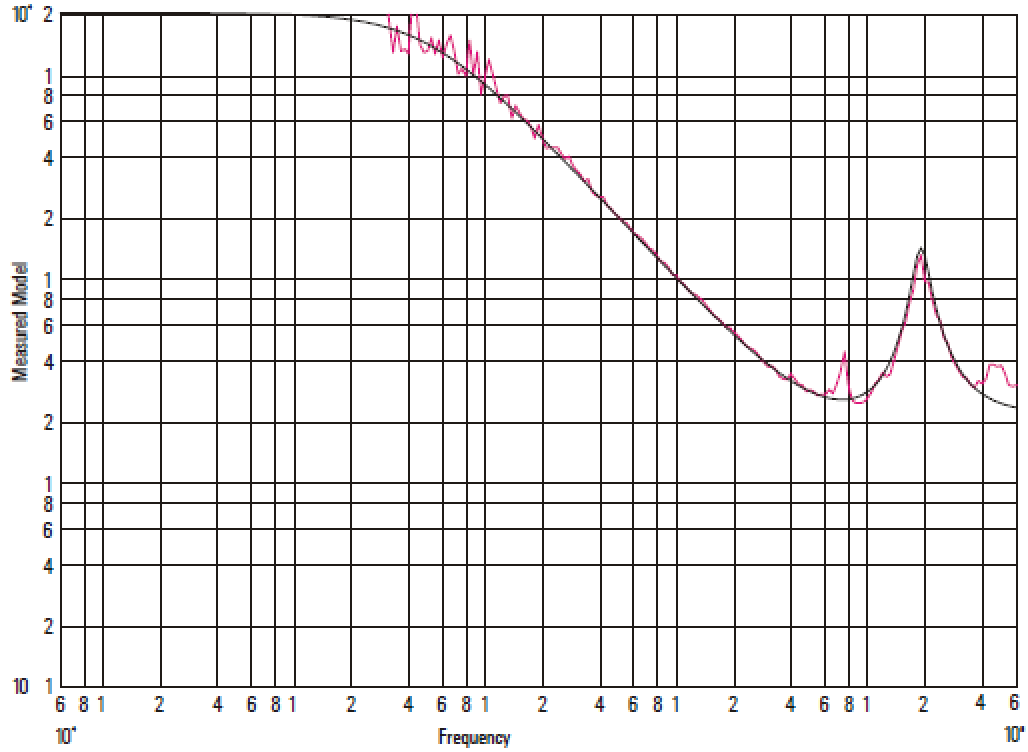


Figure 44 Measured versus modeled input impedance

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.

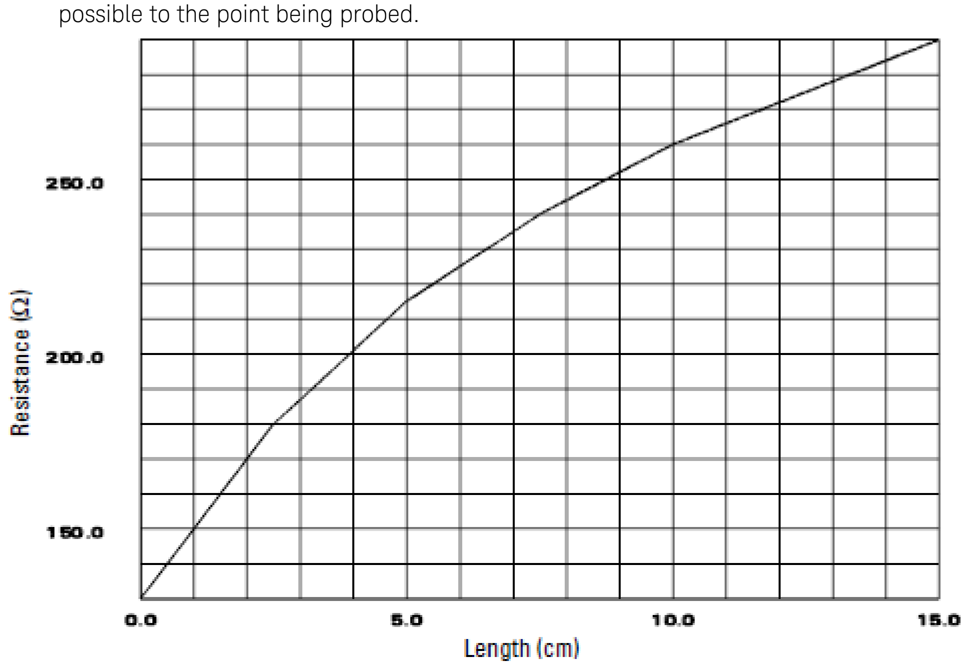


Figure 45 Optimum Damping Resistor Value Versus Signal Lead Length

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 5 cm resistive signal lead and solder-down ground lead configuration affect the step seen by the receiver for various rise times.

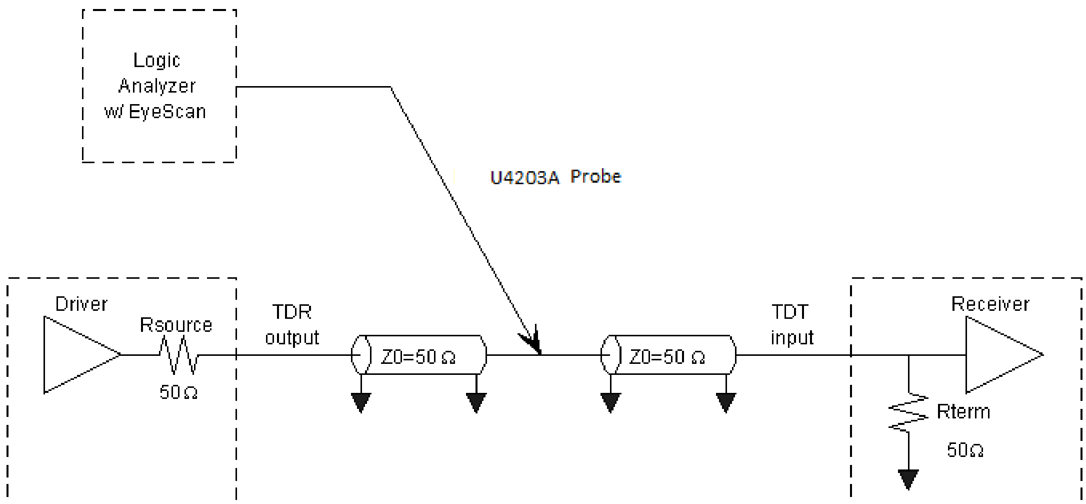


Figure 46 TDT measurement schematic

The recommended configurations are listed in order of loading on the target. As the following graphs demonstrate, the 5 cm resistive signal lead and solder-down ground lead 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 100 ps rise times. Ultimately, you must determine what is an acceptable amount of distortion of the target signal.

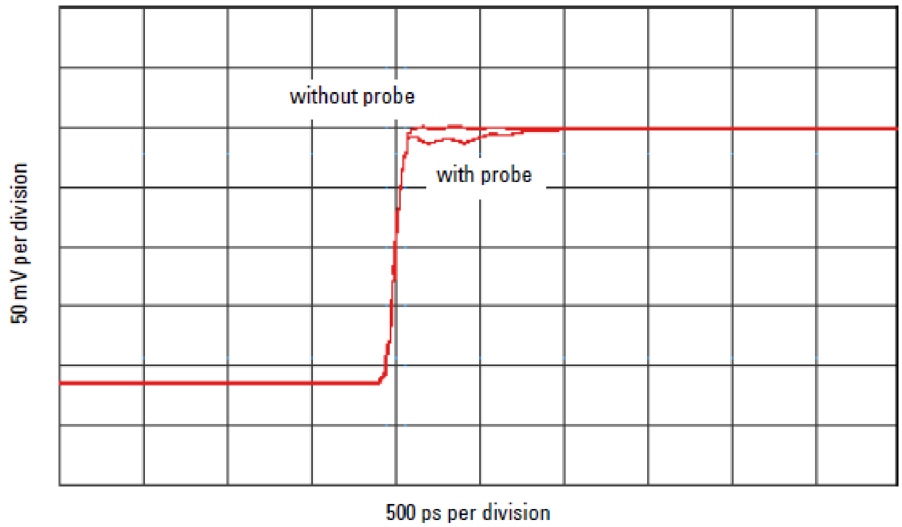


Figure 47 TDT measurement at receiver with and without probe load for 100 ps rise time

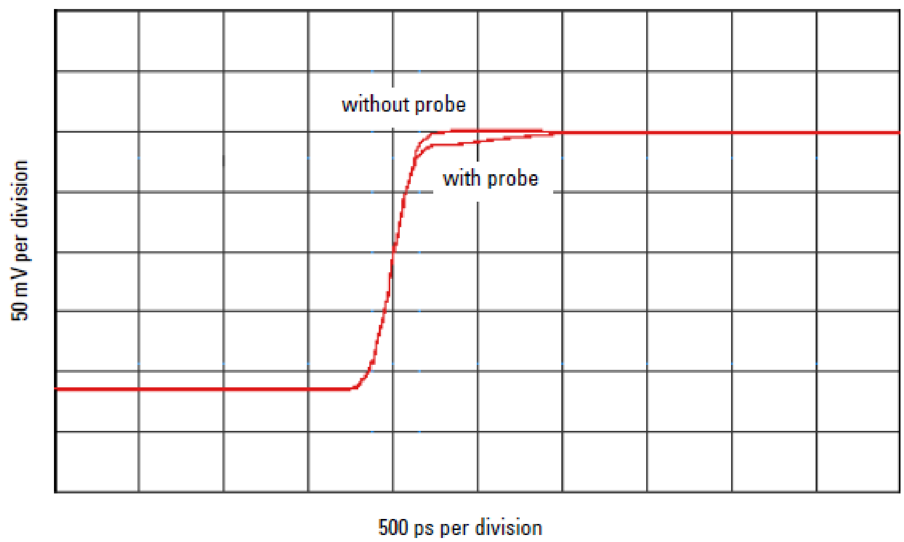


Figure 48 TDT measurement at receiver with and without probe load for 250 ps rise time

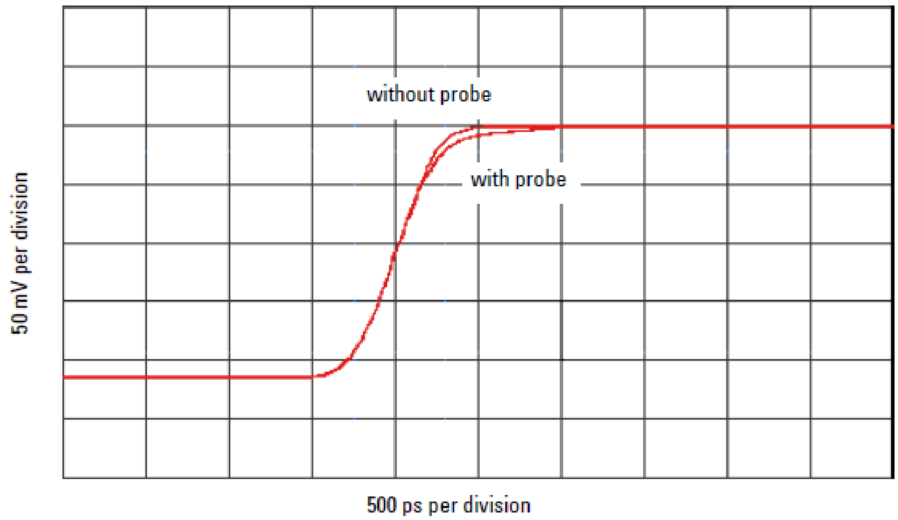


Figure 49 TDT measurement at receiver with and without probe load for 500 ps rise time

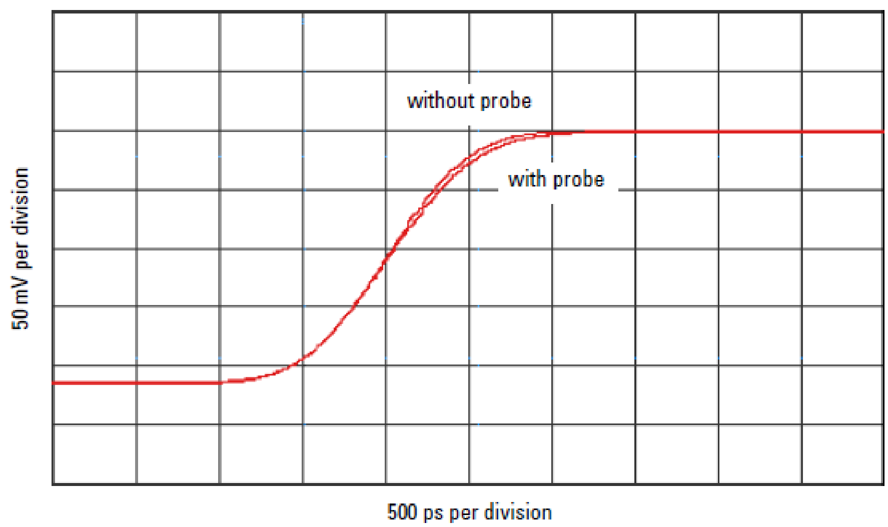


Figure 50 TDT measurement at receiver with and without probe load for 1 ns rise time

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 V_{in} to V_{out} for various step inputs. For the following graphs, V_{in} is the signal at the logic analyzer probe tip measured by double probing with Keysight 54701A probe into Keysight 54750A oscilloscope (total 2.5 GHz BW). Eye Scan is used to measure V_{out}, 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 5 cm resistive signal lead and solder-down ground lead configuration.

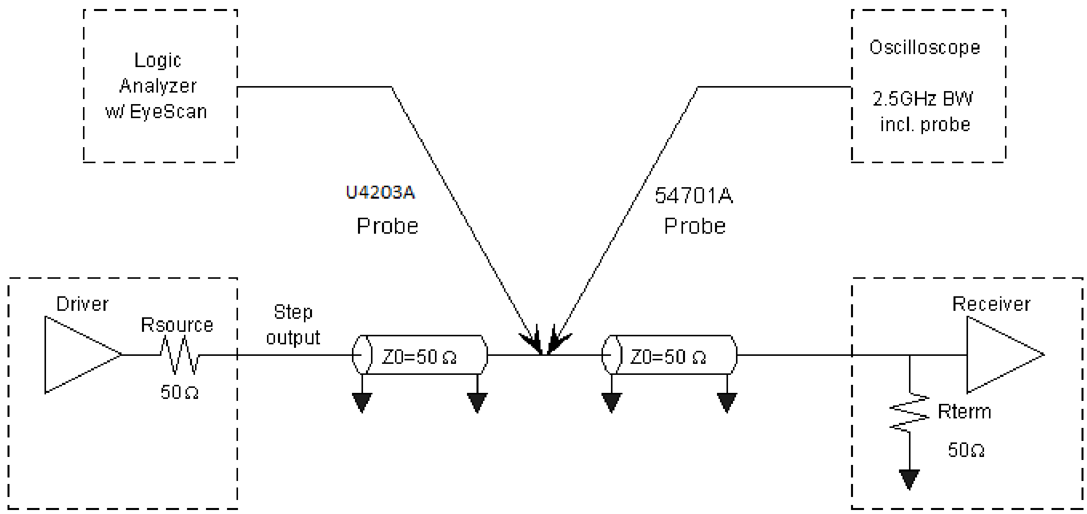


Figure 51 Step input measurement schematic

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.

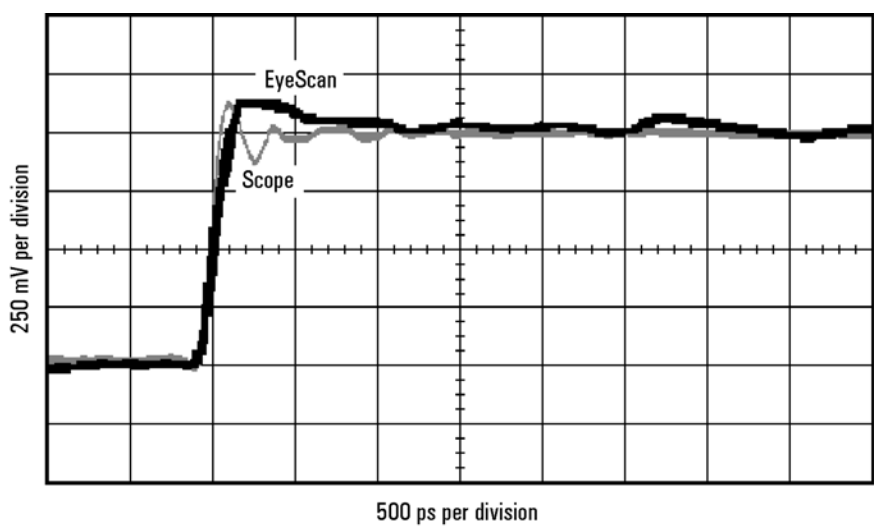


Figure 52 Logic analyzer's response to a 100 ps rise time

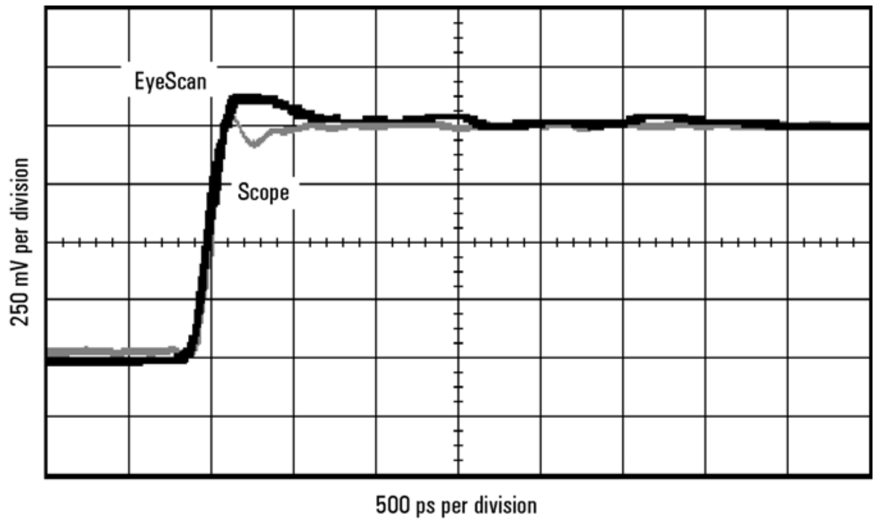


Figure 53 Logic analyzer's response to a 250 ps rise time

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.

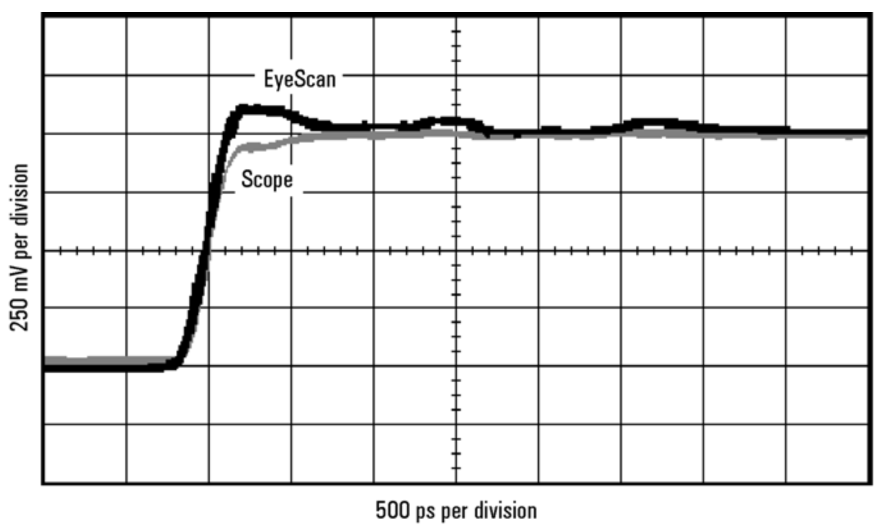


Figure 54 Logic analyzer's response to a 500 ps rise time

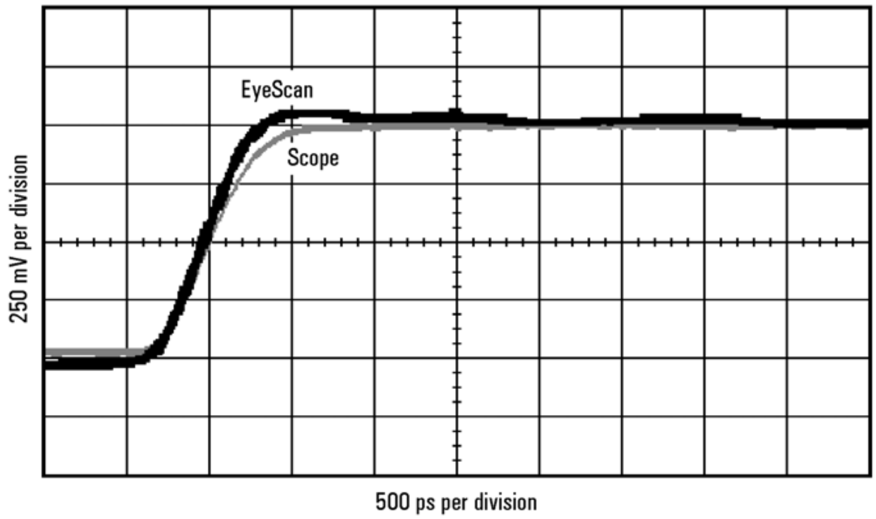


Figure 55 Logic analyzer's response to a 1 ns rise time

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 2^{23}–1 pseudo random bit sequence (PRBS). These measurements show the remaining eye opening at the logic analyzer while using the 5cm resistive signal lead and solder-down ground lead configuration.

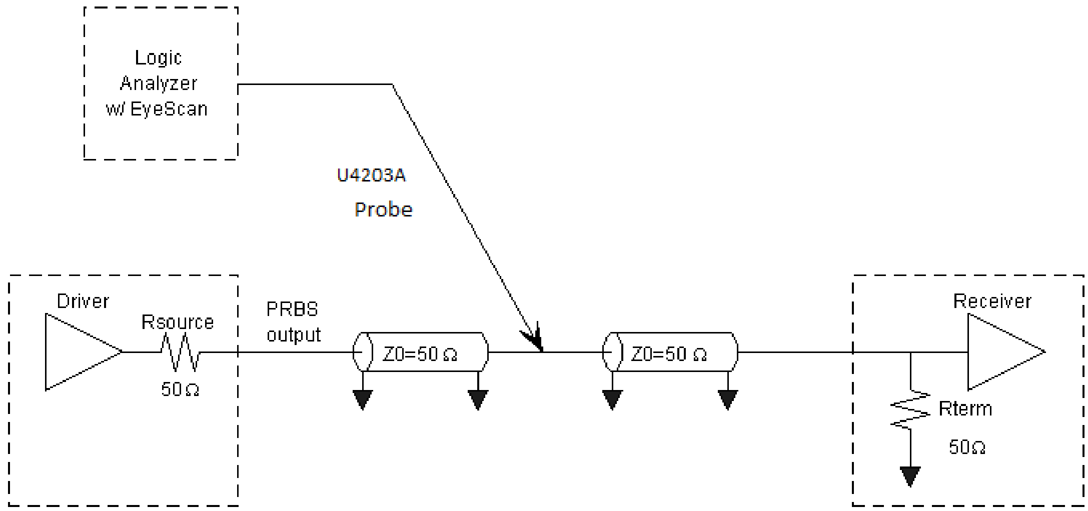


Figure 56 Eye opening measurement schematic

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 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. The bandwidth limiting of the 5 cm resistive signal lead causes more roll-off on the transitions. As demonstrated by the last eye diagram, the 5 cm resistive signal lead and solder-down ground lead configuration still has a usable eye opening at 1250Mb/s and minimum signal swing.

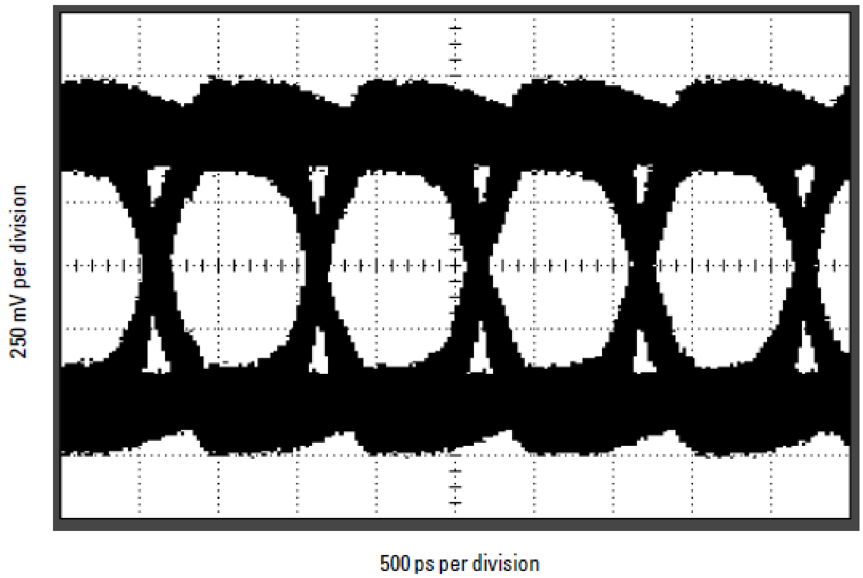


Figure 57 Logic analyzer eye opening for a PRBS signal of 1 V p-p, 100 Mb/s data rate

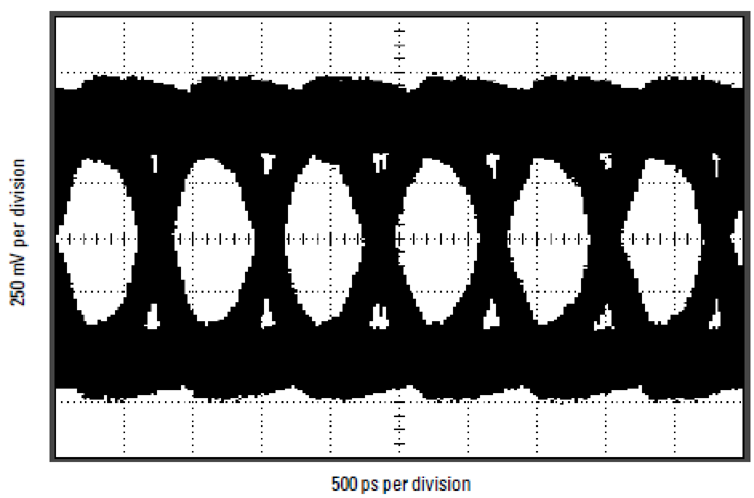


Figure 58 Logic analyzer eye opening for a PRBS signal of 1 V p-p, 1250 Mb/s data rate

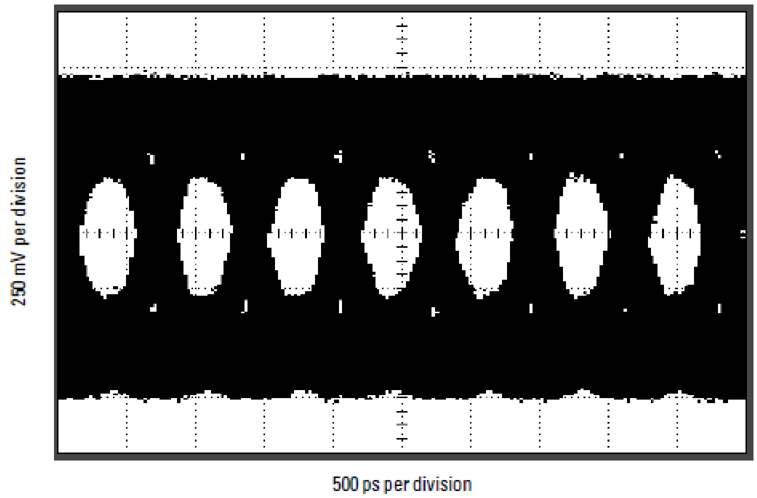


Figure 59 Logic analyzer eye opening for a PRBS signal of 1 V p-p, 1500 Mb/s data rate

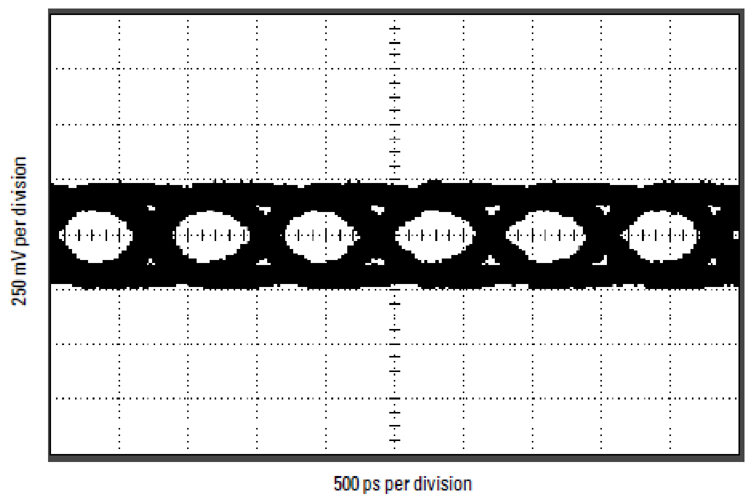


Figure 60 Logic analyzer eye opening for a PRBS signal of 250 mV p-p, 1250 Mb/s data rate

Flying Lead and Ground Extender

This configuration is recommended when you can provide 0.635 mm (0.025 in.) square or round pins on 2.54 mm (0.1 in.) centers as test points where you wish to connect the probe. Alternately, you may substitute soldered-down wires of similar length (up to 1 cm in length) and expect to achieve similar results.

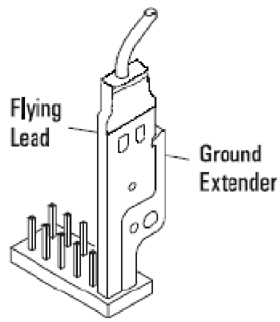


Figure 61 Pin probing configuration

All of the measurements for the flying lead and ground extender configuration were made with standard surface-mount pins on 0.1-inch centers soldered to the test fixture. The input impedance, TDT response, step response, and eye opening measurements all include the combined load of the probe configuration and the surface-mount pins on the target.

Input Impedance

The U4203A 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 ground extender clip. This model is a simplified equivalent load of the measured input impedance seen by the target.

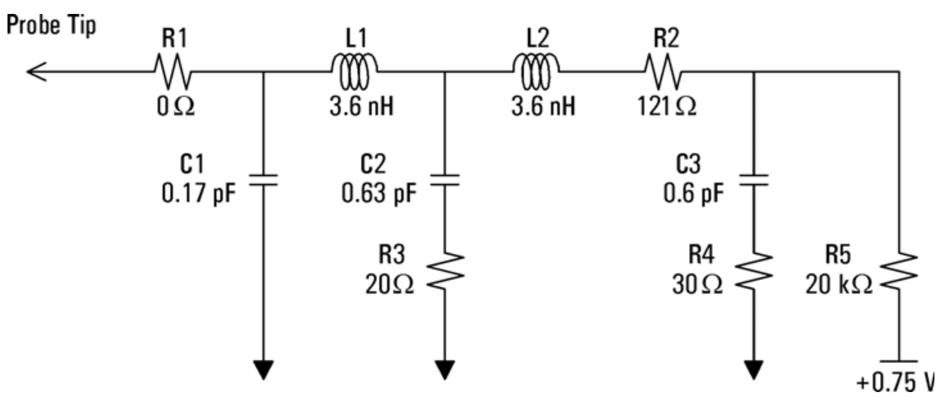


Figure 62 Equivalent load model

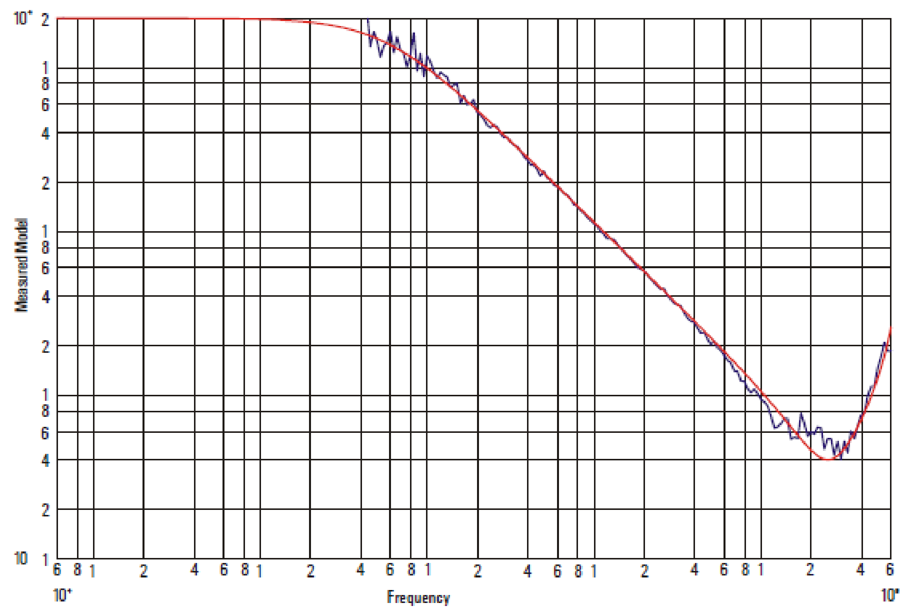


Figure 63 Measured versus modeled input impedance

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 ground extender configuration affect the step seen by the receiver for various rise times.

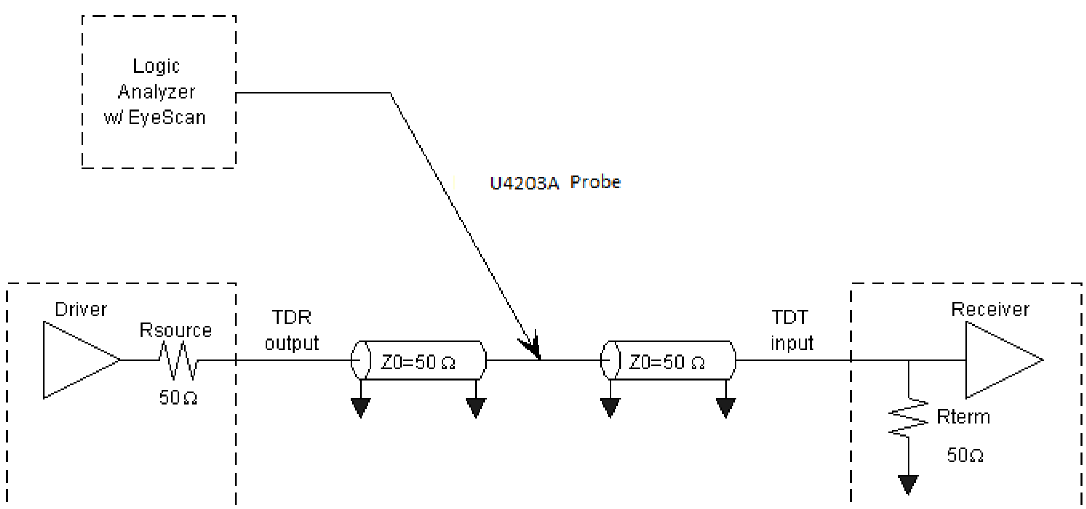


Figure 64 TDT measurement schematic

The recommended configurations are listed in order of loading on the target. As the following graphs demonstrate, the flying lead and ground extender configuration has the 3rd best loading of the four recommended configurations. However, because most of the capacitance of this configuration is undamped, the loading is more noticeable than the previous two 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 100 ps rise times. Ultimately, you must determine what is an acceptable amount of distortion of the target signal.

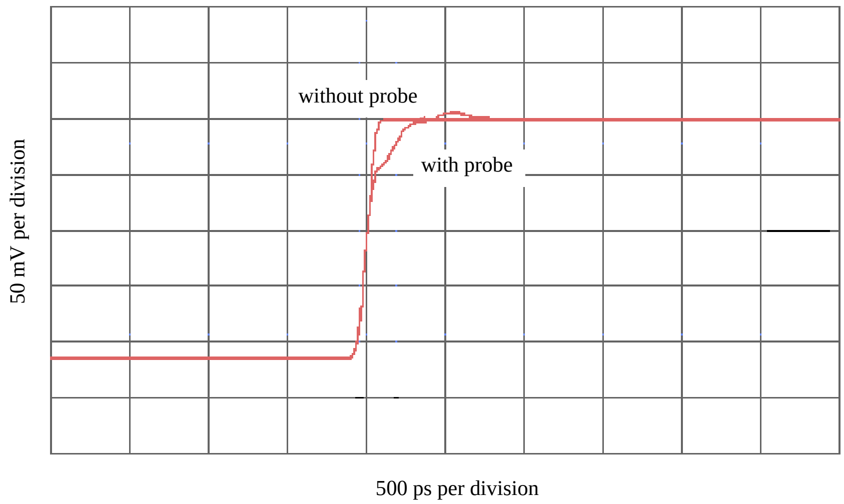


Figure 65 TDT measurement at receiver with and without probe load for 100 ps rise time

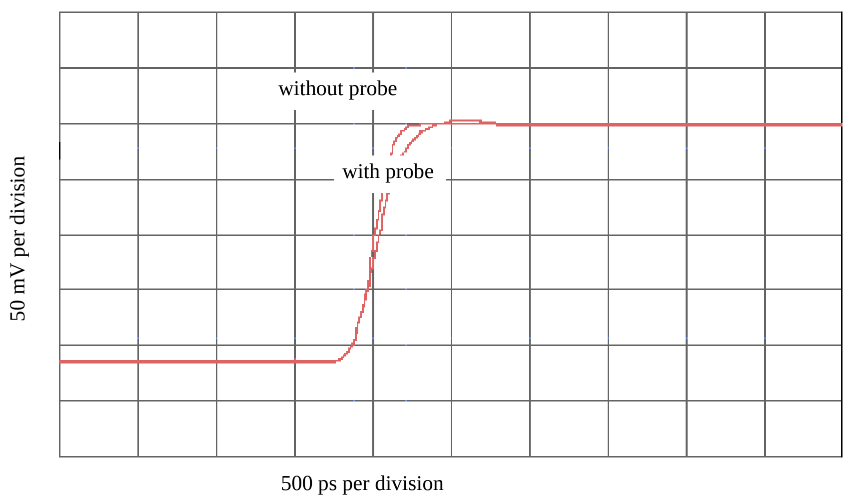


Figure 66 TDT measurement at receiver with and without probe load for 250 ps rise time

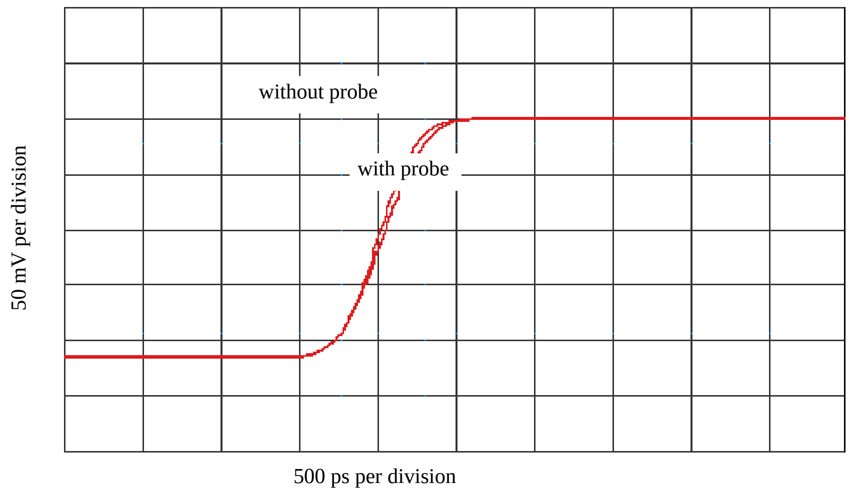


Figure 67 TDT measurement at receiver with and without probe load for 500 ps rise time

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 V_{in} to V_{out} for various step inputs. For the following graphs, V_{in} is the signal at the logic analyzer probe tip measured by double probing with Keysight 54701A probe into Keysight 54750A oscilloscope (total 2.5 GHz BW). Eye Scan is used to measure V_{out}, 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 ground extender configuration.

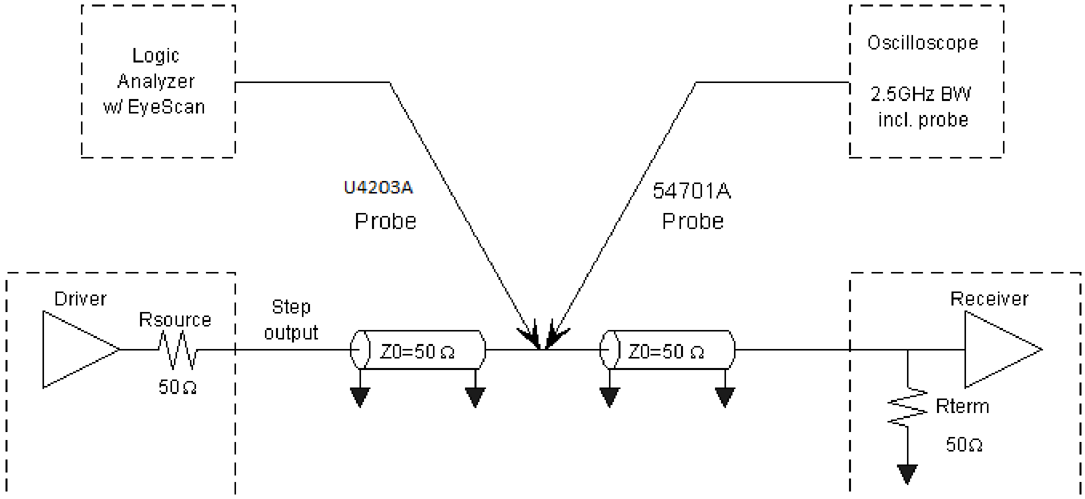


Figure 69 Step measurement schematic

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.

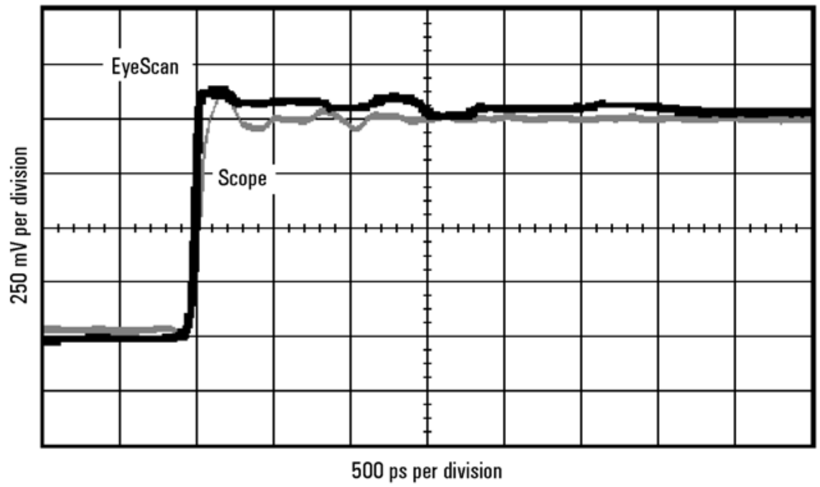


Figure 70 Logic analyzer's response to a 100 ps rise time

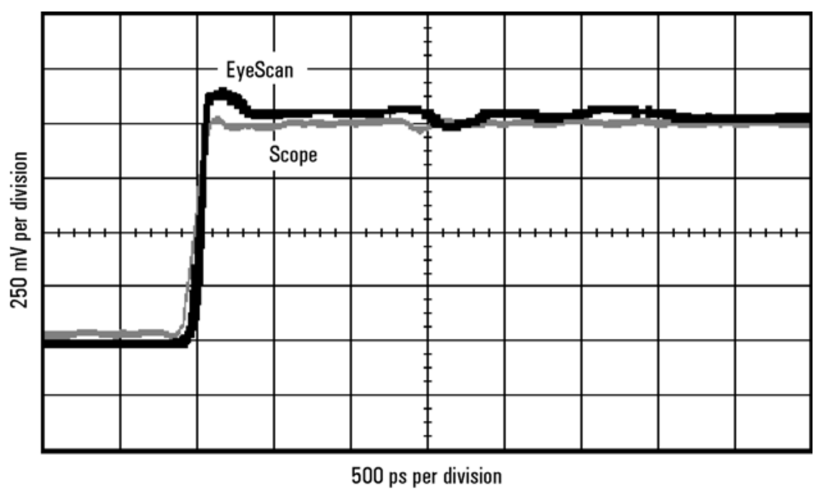


Figure 71 Logic analyzer's response to a 250 ps rise time

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.

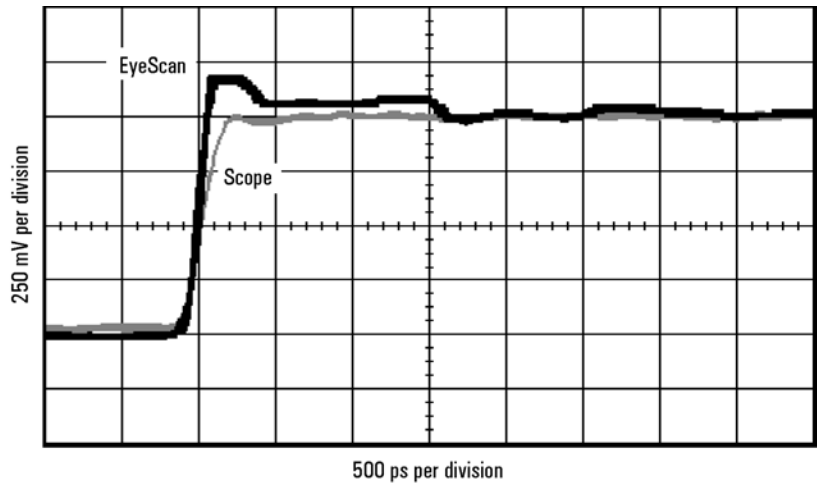


Figure 72 Logic analyzer's response to a 500 ps rise time

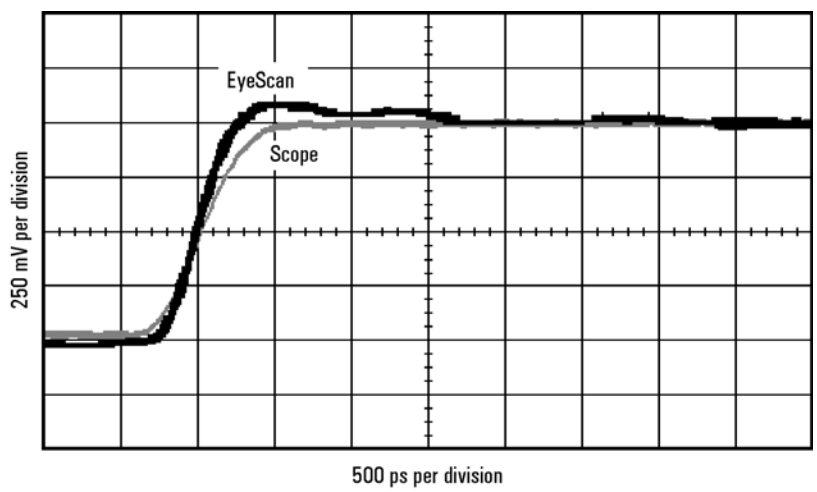


Figure 73 Logic analyzer's response to a 1 ns rise time

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 2^{23}–1 pseudo random bit sequence (PRBS). These measurements show the remaining eye opening at the logic analyzer while using the flying lead and ground extender configuration.

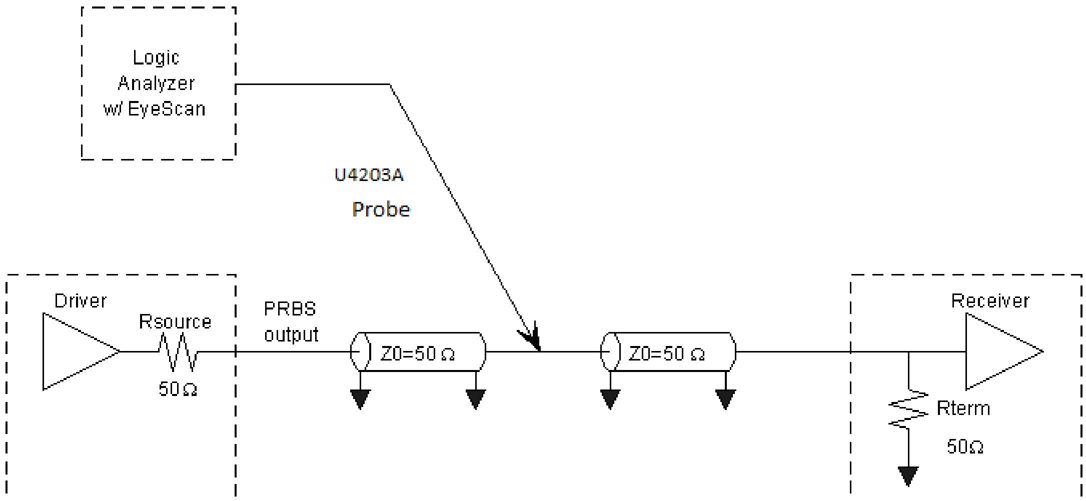


Figure 74 Eye opening measurement schematic

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 starts to collapse as the clock rate is increased. The peaking observed with this configuration on the preceding step-response graphs helps to preserve the eye opening out to 1.5 Gb/s. At 1500 Mb/s the eye opening is still as large as could be hoped for. As demonstrated by the last eye diagram, the flying lead and ground extender configuration still has no noticeable deterioration at 1500 Mb/s and minimum signal swing.

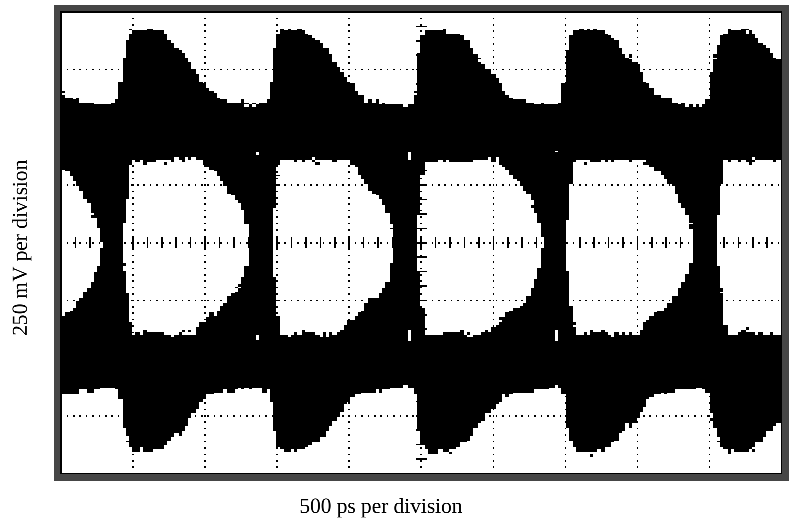


Figure 75 Logic analyzer eye opening for a PRBS signal of 1 V p-p, 1000 Mb/s data rate

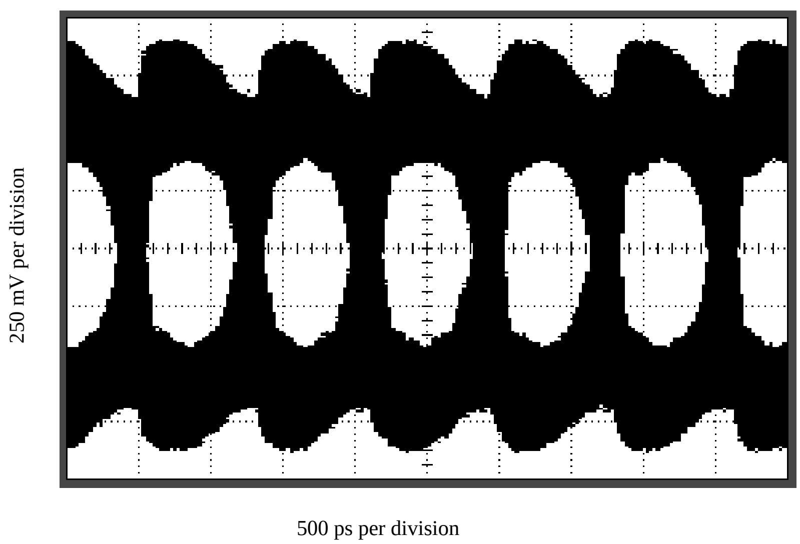


Figure 76 Logic analyzer eye opening for a PRBS signal of 1 V p-p, 1250 Mb/s data rate

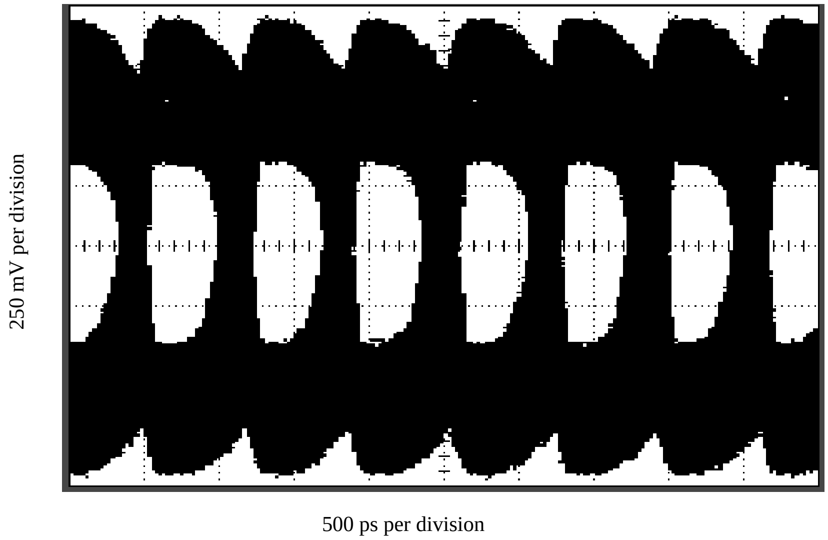


Figure 77 Logic analyzer eye opening for a PRBS signal of 1 V p-p, 1500 Mb/s data rate

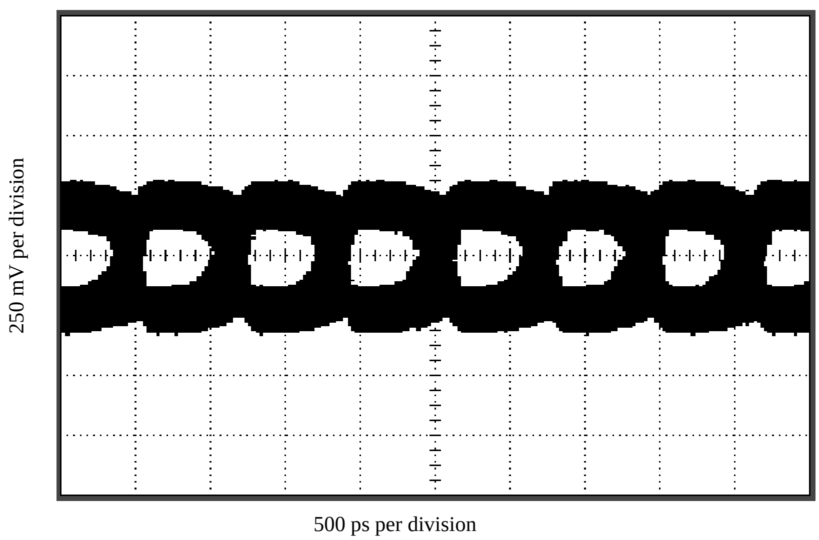


Figure 78 Logic analyzer eye opening for a PRBS signal of 250 mV p-p, 1500 Mb/s data rate

Grabber Clip and Right-angle Ground Lead

Using the grabber clip for the signal and the right-angle for the ground gives you the greatest flexibility for attaching the probe to component leads, however as you can see from the following information, the signal quality is compromised the most severely by this configuration.

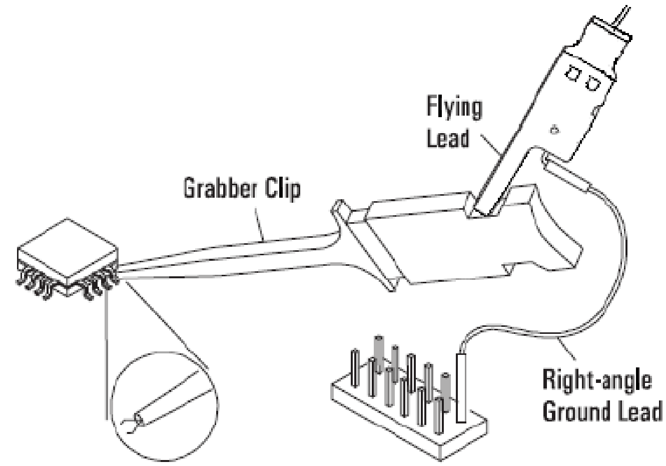


Figure 79 Grabber configuration

This configuration is provided as a convenient method of attaching to systems with slower rise times. The response of the probe is severely over-peaked. The load on the target is also the most severe of the 4 recommended configurations. As will be demonstrated in the following sets of measurements, the grabber clip and right angle ground lead configuration is only for systems with rise times slower than 1ns or effective clock rates less than 600Mb/s.

NOTE It is critical to maintain good probing techniques on the clock signal. If the clock being probed has <1 ns rise times, use an alternative configuration for probing.

Input Impedance

The U4203A 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 SMD IC grabber and the right-angle ground lead. This model is a simplified equivalent load of the measured input impedance seen by the target.

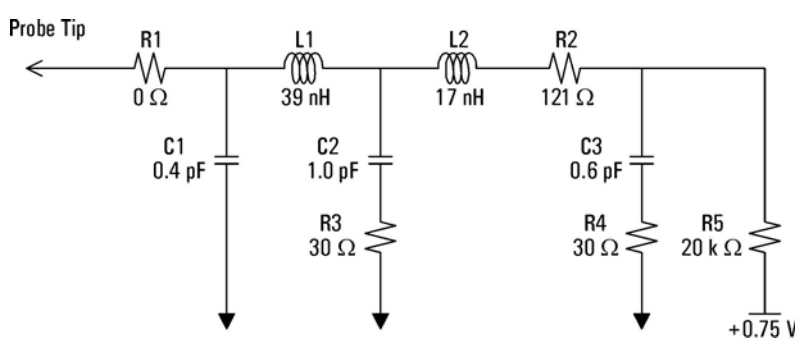


Figure 80 Equivalent load model

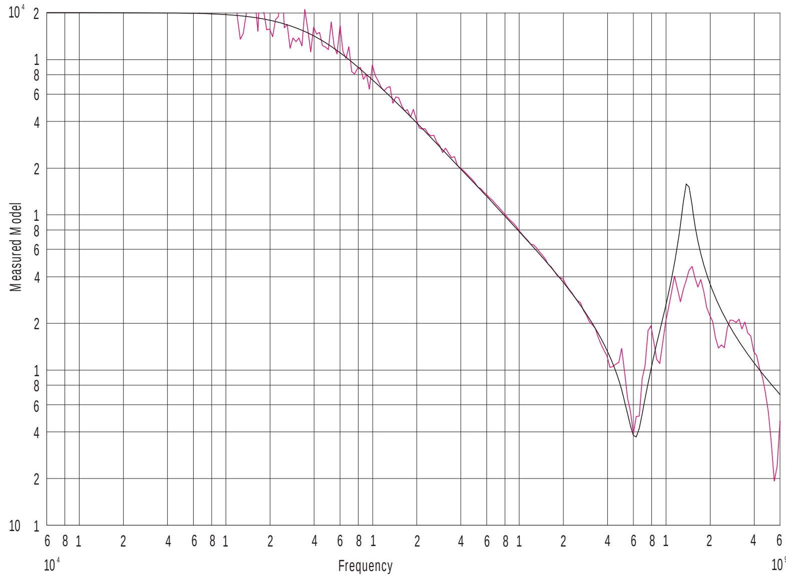


Figure 81 Measured versus modeled input impedance

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 grabber clip and right-angle ground lead configuration affect the step seen by the receiver for various rise times.

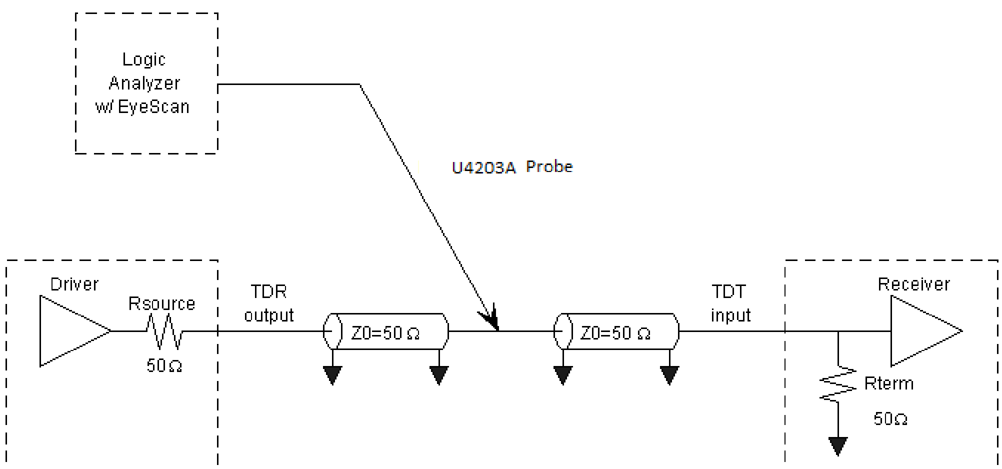


Figure 82 TDT measurement schematic

The recommended configurations are listed in order of loading on the target. As the following graphs demonstrate, the grabber clip and right angle ground lead configuration has the worst loading of the four recommended configurations. The grabber clip is a fairly long length of undamped wire, which presents a much more significant load on the target than the previous three configurations. The graphs show that the loading effects are noticeable even for targets with 1ns rise times. Ultimately, you must determine what is an acceptable amount of distortion of the target signal.

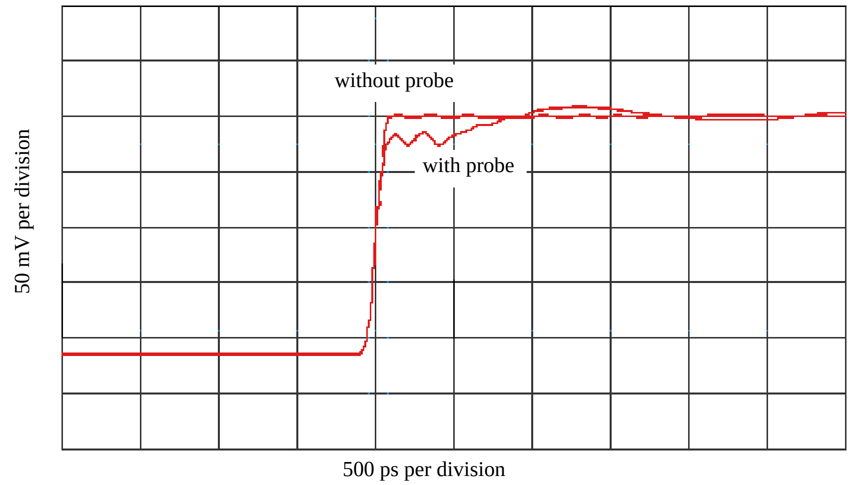


Figure 83 TDT measurement at receiver with and without probe load for 100 ps rise time

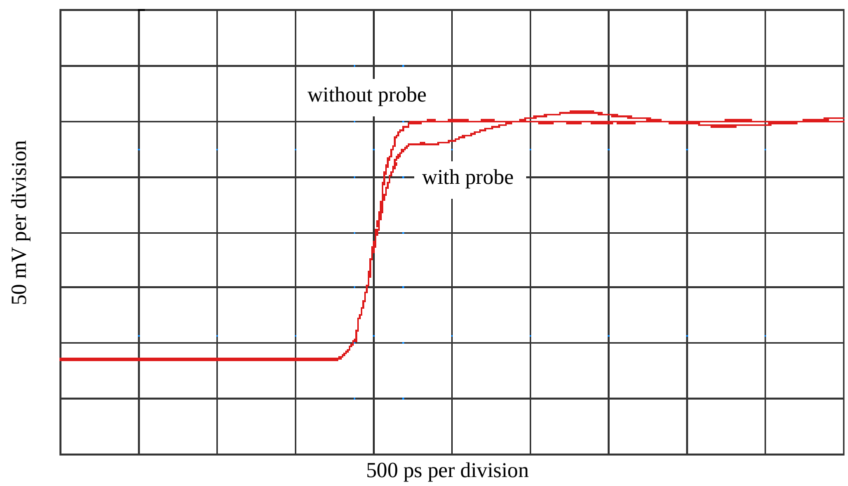


Figure 84 TDT measurement at receiver with and without probe load for 250 ps rise time

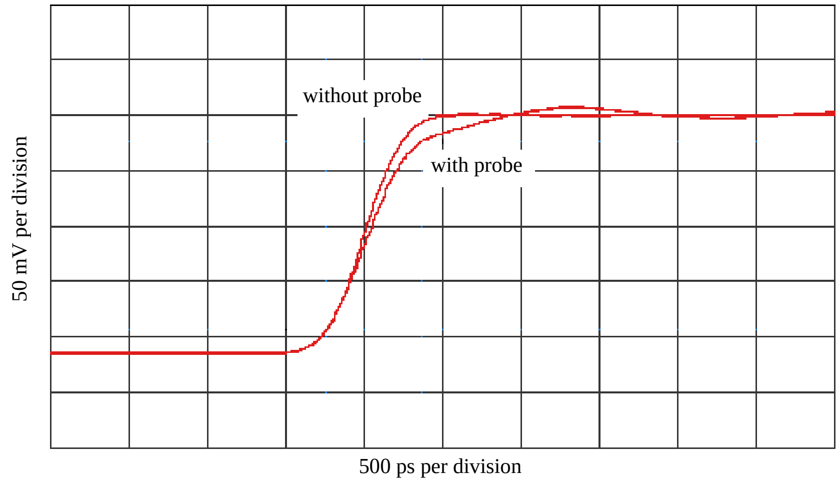


Figure 85 TDT measurement at receiver with and without probe load for 500 ps rise time

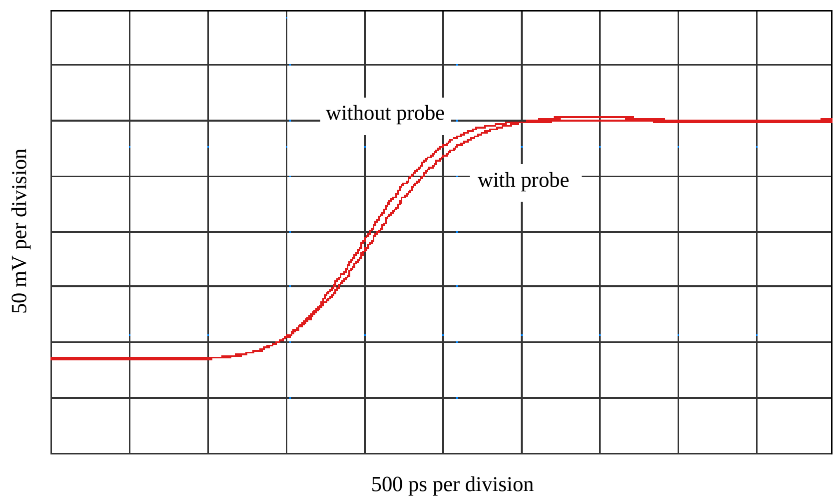


Figure 86 TDT measurement at receiver with and without probe load for 1 ns rise time

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 V_{in} to V_{out} for various step inputs. For the following graphs, V_{in} is the signal at the logic analyzer probe tip measured by double probing with Keysight 54701A probe into Keysight 54750A oscilloscope (total 2.5 GHz BW). Eye Scan is used to measure V_{out}, 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 grabber clip and right-angle ground lead configuration.

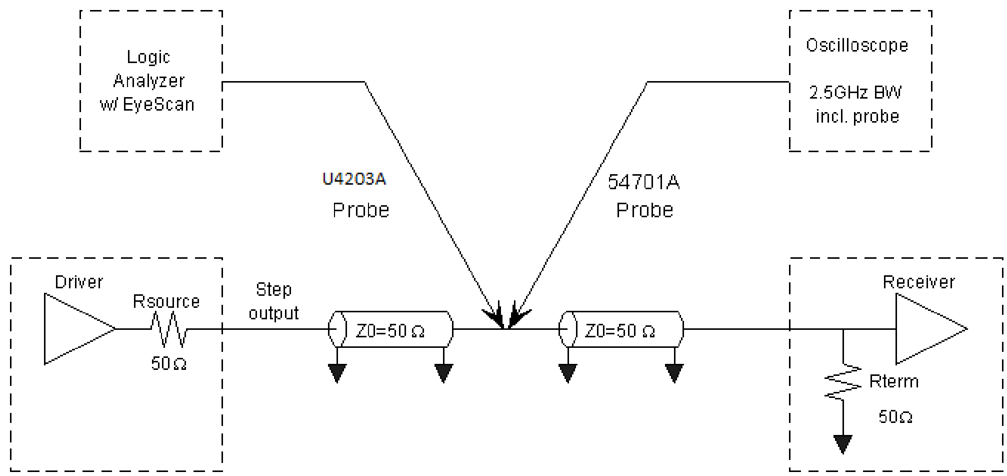


Figure 87 Step measurement schematic

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 grabber clip and right-angle ground lead configuration. As the following graphs will demonstrate, the use of the undamped grabber clip results in excessive overshoot and ringing at the logic analyzer for targets with < 1 ns rise times.

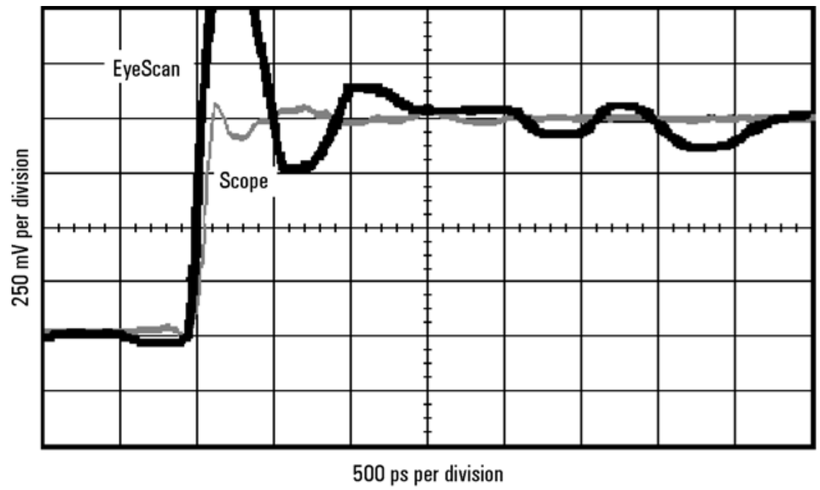


Figure 88 Logic analyzer's response to a 100 ps rise time

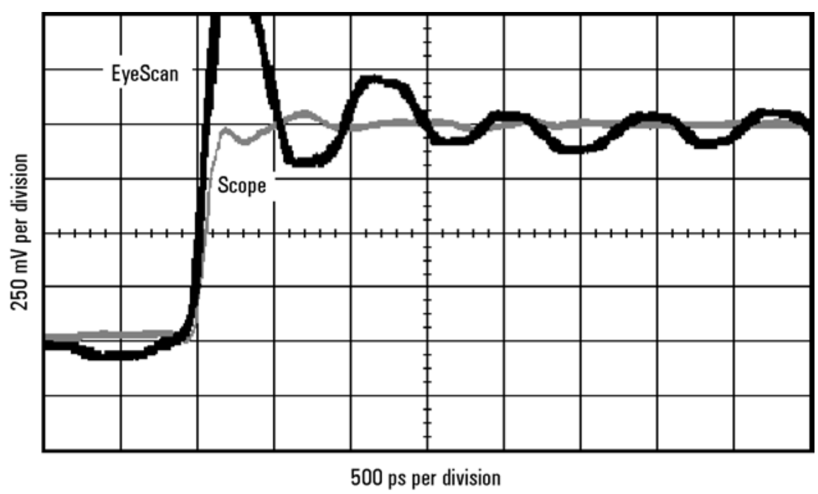


Figure 89 Logic analyzer's response to a 250 ps rise time

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.

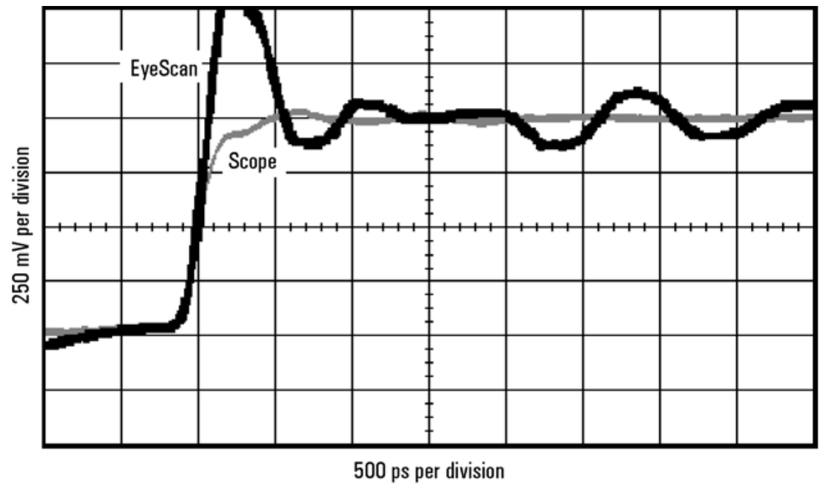


Figure 90 Logic analyzer's response to a 500 ps rise time

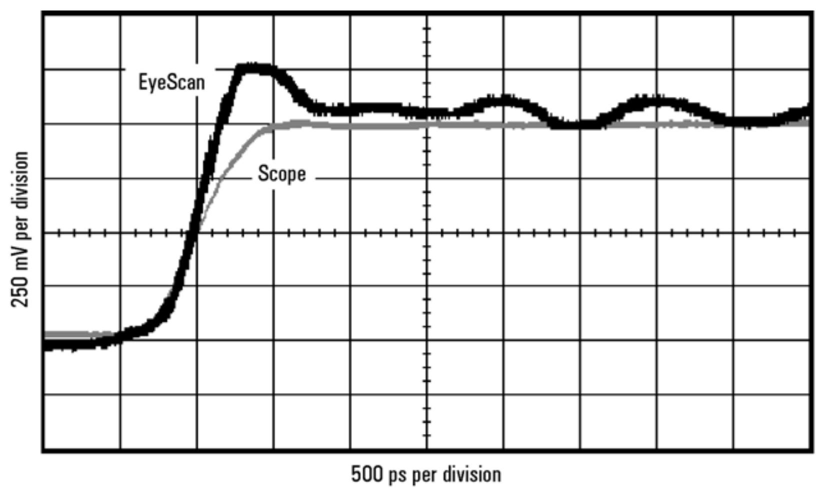


Figure 91 Logic analyzer's response to a 1 ns rise time

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 $2^{23}–1$ pseudo random bit sequence (PRBS). These measurements show the remaining eye opening at the logic analyzer while using the grabber clip and right-angle ground lead configuration.

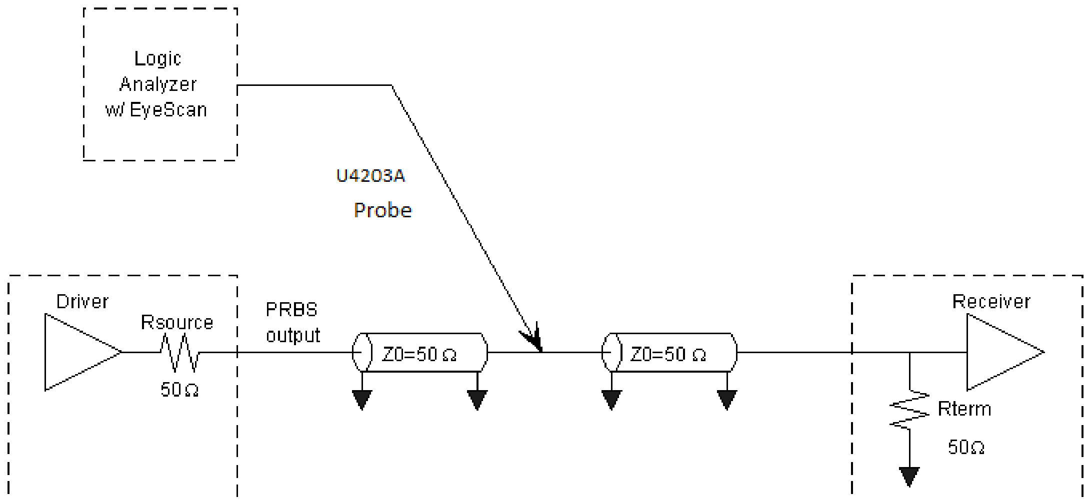


Figure 92 Eye opening measurement schematic

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. The severe overshoot and ringing observed with this configuration on the preceding step-response graphs deteriorates the eye opening for faster rise times. At 500 ps rise times the eye opening shows excessive ring-back and collapsing of the eye. Therefore, it is recommended that this configuration not be used for rise times faster than 1ns or clock rates in excess of 600 Mb/s. The analyzer may still function at faster speeds, but will not meet state speed and setup/hold specifications.

NOTE **it is critical to maintain good probing techniques on the clock signal. if the clock being probed has < 1 ns rise times, use an alternative configuration for probing.**

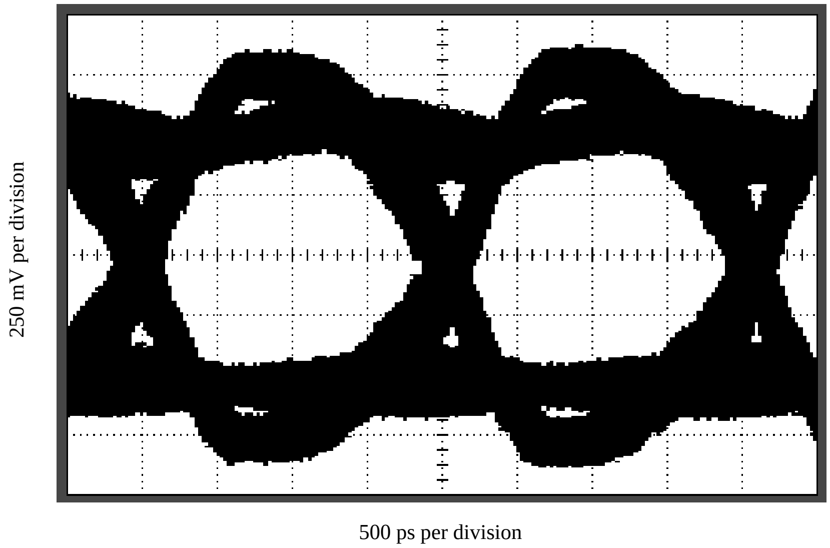


Figure 93 Logic analyzer eye opening for a PRBS signal of 1 V p-p, 500 Mb/s data rate, 1 ns rise time

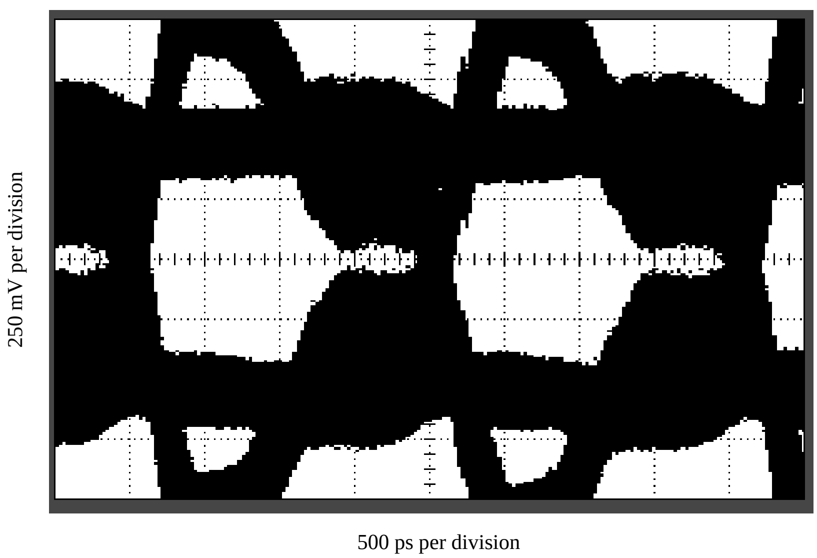


Figure 94 Logic analyzer eye opening for a PRBS signal of 1 V p-p, 500 Mb/s data rate, 500 ps rise time

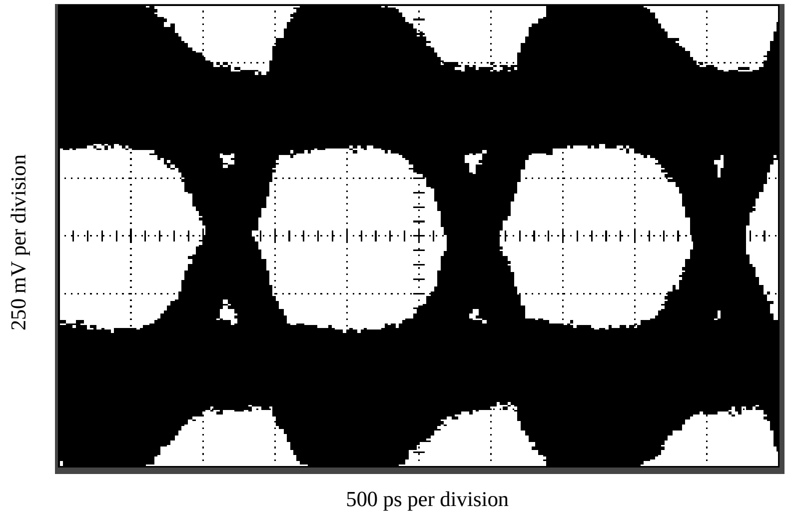


Figure 95 Logic analyzer eye opening for a PRBS signal of 1 V p-p, 600 Mb/s data rate, 1 ns rise time

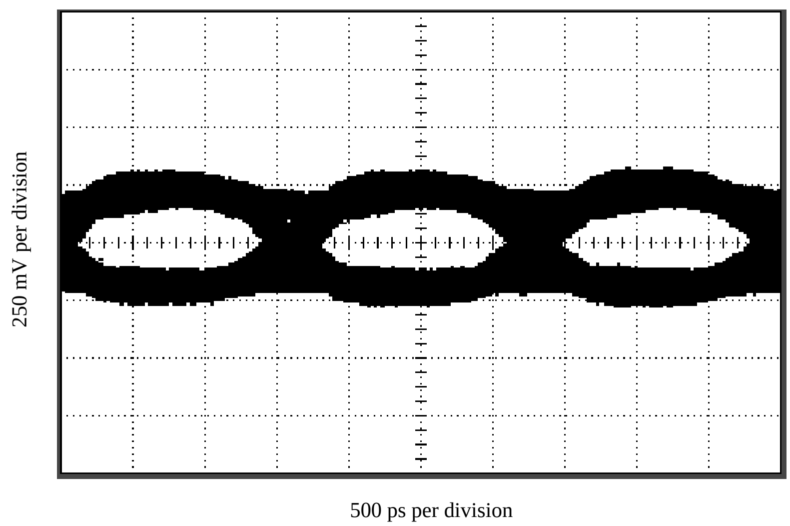


Figure 96 Logic analyzer eye opening for a PRBS signal of 250 mV, 600 Mb/s data rate, 1 ns rise time

Connecting to Coaxial Connectors

You can use the Keysight E9638A to adapt the probe tip to a BNC connector. The adapter and the BNC connector itself will add significant capacitance to the probe load. You can generally assume (though not always) that a BNC connector is intended to form a part of a transmission line terminated in 50 Ω (the characteristic impedance of BNC connectors is 50 Ω). So, the best solution for maintaining signal integrity is to terminate the line in 50 Ω after the BNC connector and a close as possible to the probe tip. That technique minimizes the length of the unterminated stub past the termination. The following picture shows the recommended configuration to achieve this.

NOTE

This configuration has not been characterized for target loading or logic analyzer performance. Therefore no recommendations are being made or implied as to the expected performance of this configuration.

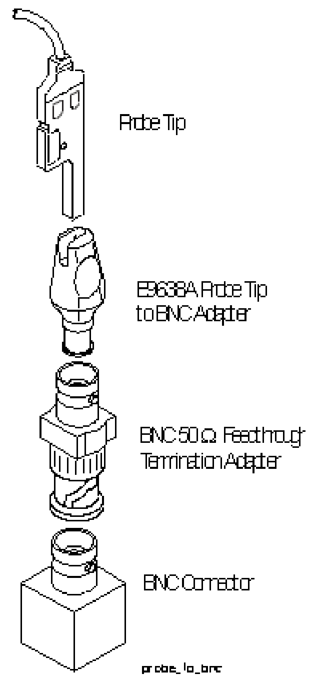


Figure 97 BNC connector

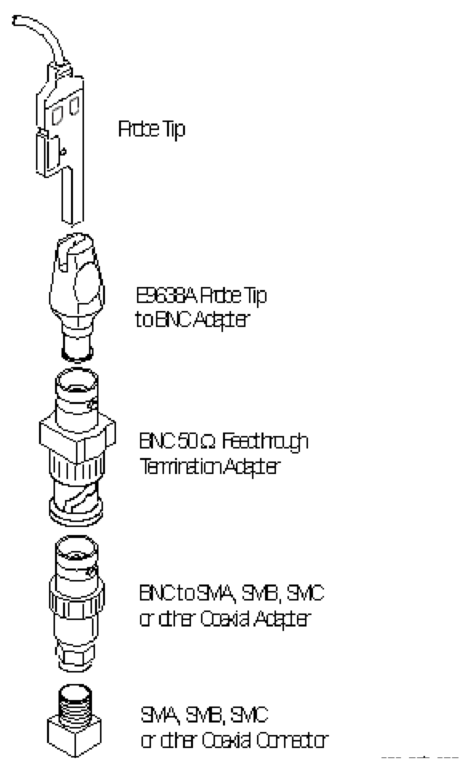


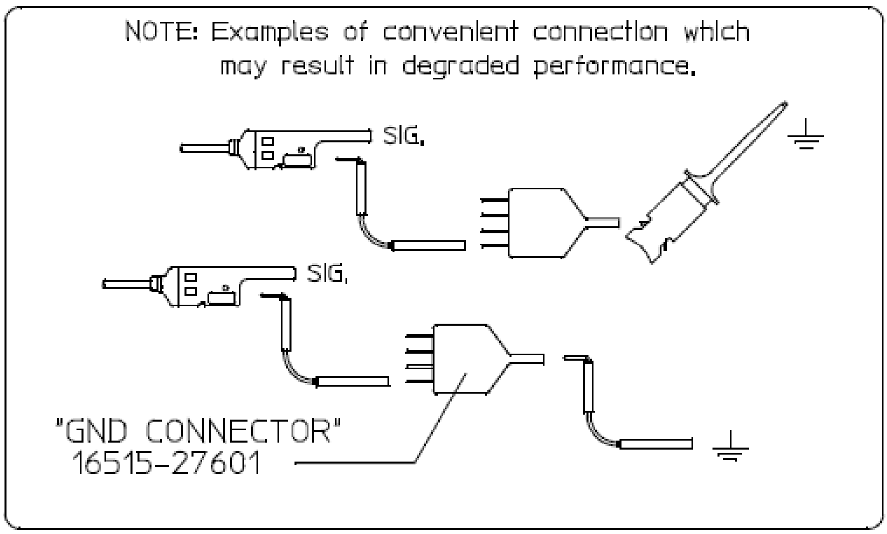
Figure 98 SMA, SMB, SMC, or other coaxial connectors

Combining Grounds

It is essential to ground every tip that is in use. For best performance at high speeds, every tip should be grounded individually to ground in the system under test. For convenience in connecting grounds, you can use the ground connector, Keysight part number 16515-27601, to combine four probe tip grounds to connect to one ground point in the system under test.

Using the 16515-27601 to combine grounds will have some negative impact on performance due to coupling caused by common ground return currents. The exact impact depends on the signals being tested and the configuration of the test, so it is impossible to predict accurately. In general, the faster the rise time of the signals under test, the greater the risk of coupling.

In no case should more than four tip grounds be combined through one 16515-27601 to connect to ground in the system under test.



U4205A Probe Electrical Considerations

Equivalent Probe Load

The equivalent probe load for the U4205A probe is shown in the figure below. It includes the 38- pin MICTOR connector and the target connector. The model is accurate up to 1 GHz.

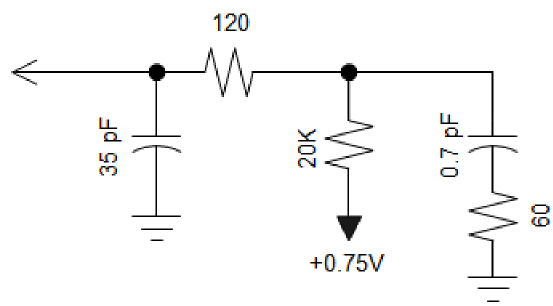


Figure 99 Equivalent load for U4205A

Measured Versus Modeled Input Impedance

The U4205A probes have an input impedance which varies with frequency, and depends on which accessories are being used. The following graph shows the input impedance of the probe.

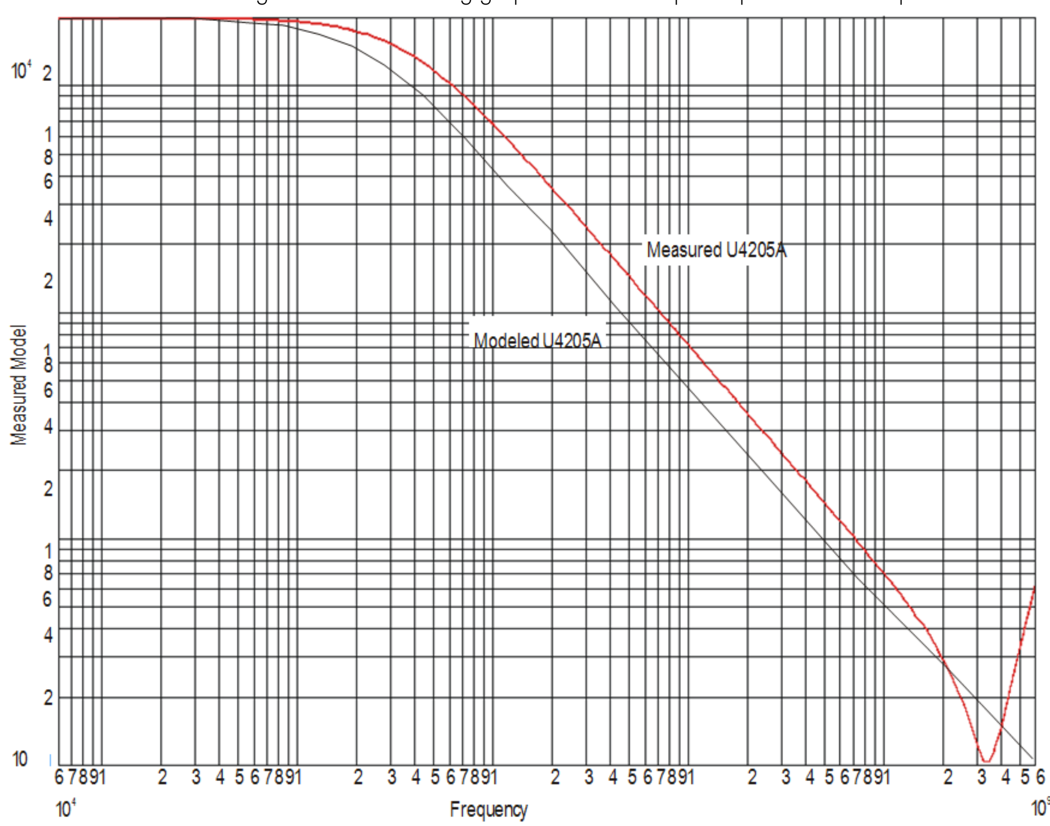


Figure 100 Measured versus modeled input impedance

U4206A and U4204A Electrical Considerations

Equivalent Probe Loads

The following probe load models are based on in-circuit measurements made with a Keysight 8753E 6 GHz network analyzer and a Keysight 54750A TDR/TDT using a 50 Ω test fixture. The following schematic accurately models the probe load out to 6 GHz. The figure on the following page shows the agreement between measured impedance and this model. PC board pads are not included.

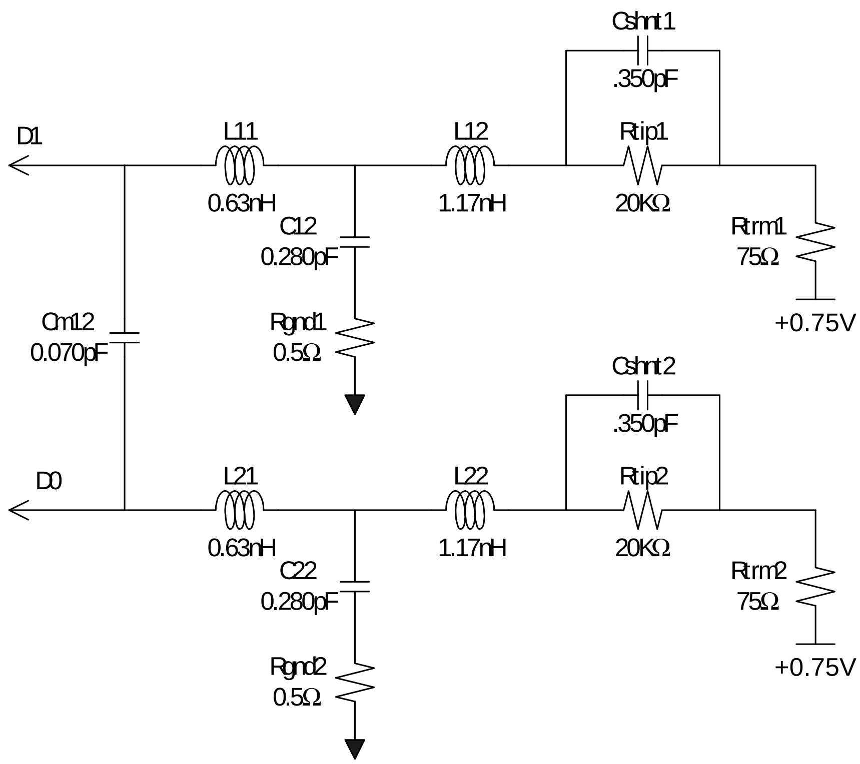


Figure 101 U4206A and U4204A Probe load model

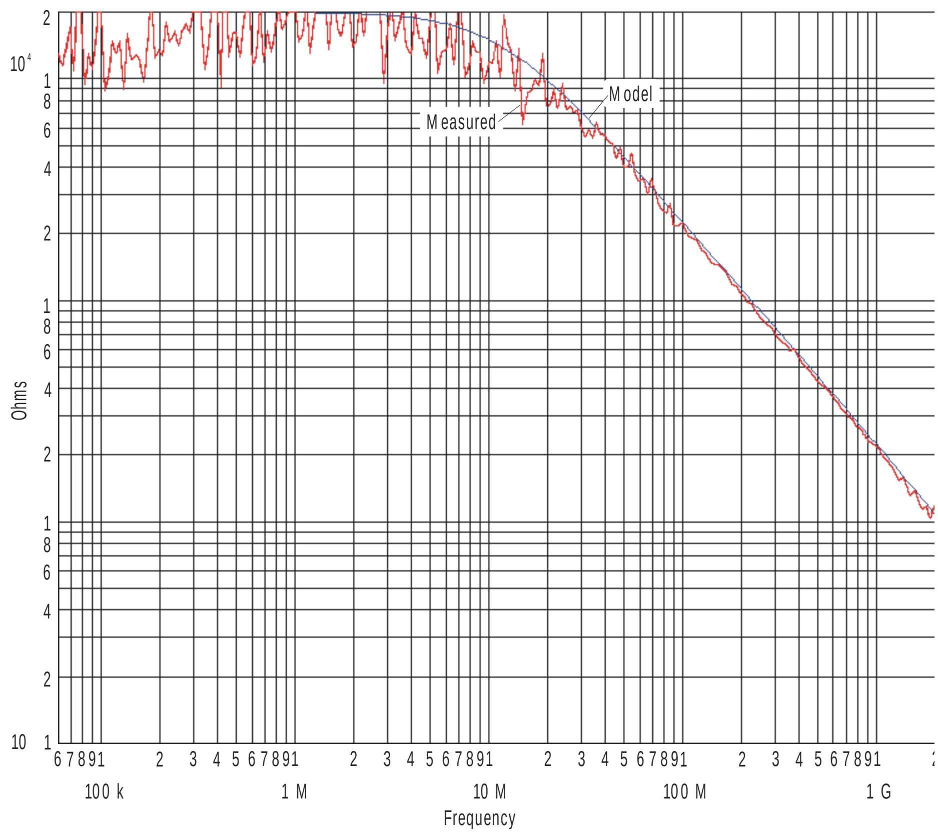


Figure 102 Measured versus modeled input impedance for U4206A and U4204A

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 50Ω transmission line load terminated at the receiver. These measurements show how the U4206A and U4204A soft touch probes affect an ideal step seen by the receiver for various rise times.

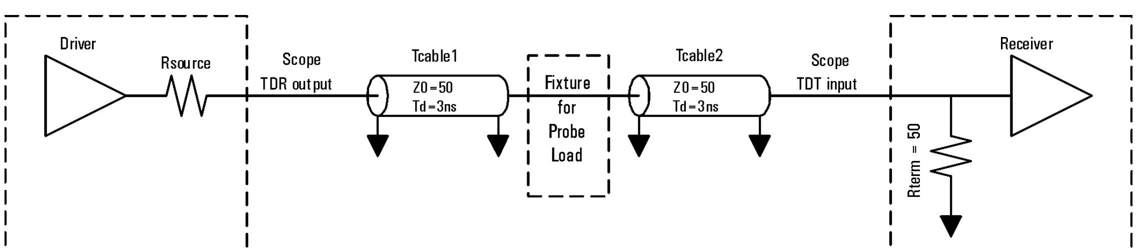


Figure 103 TDT measurement schematic for U4204A and U4206A

The following plots were made on a Keysight 54750A oscilloscope using TDT.

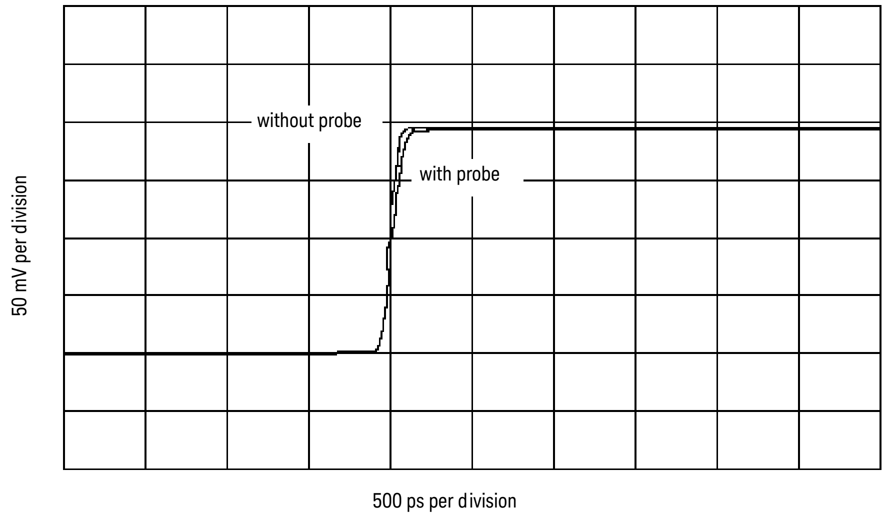


Figure 104 TDT measurement at receiver with and without probe load for 100 ps rise time

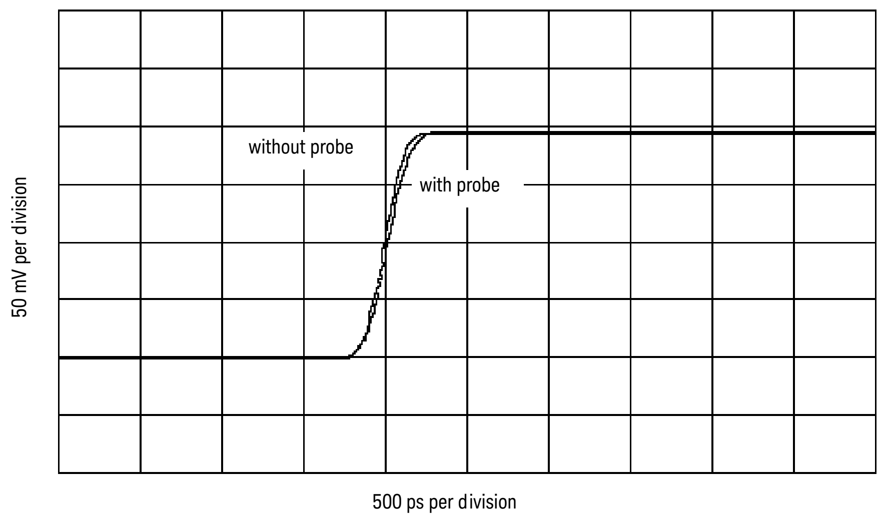


Figure 105 TDT measurement at receiver with and without probe load for 250 ps rise time

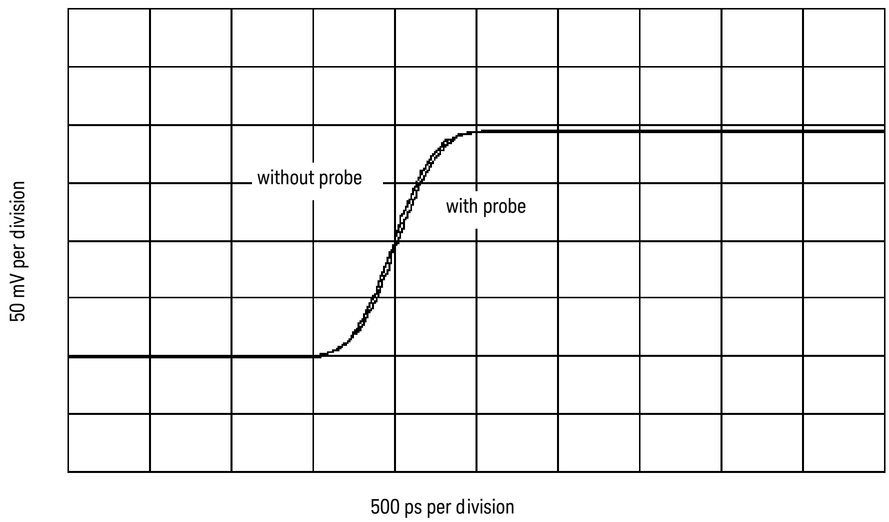


Figure 106 TDT measurement at receiver with and without probe load for 500 ps rise time

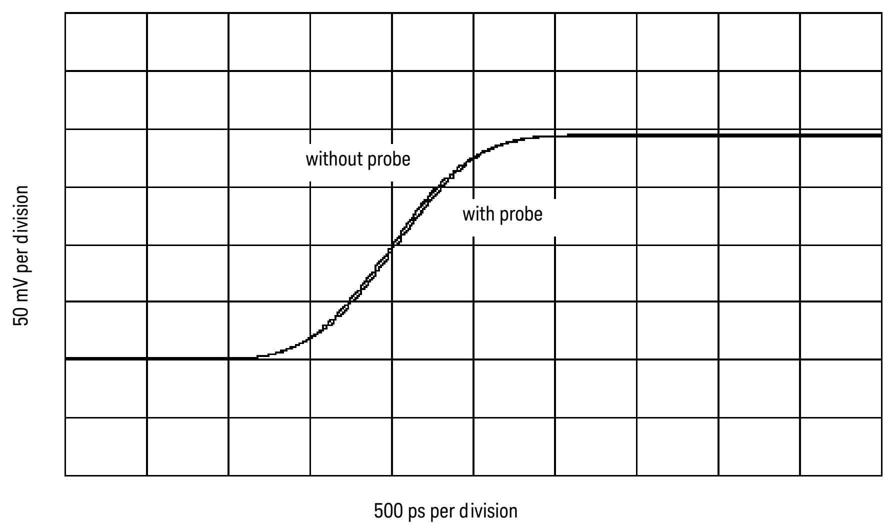


Figure 107 TDT measurement at receiver with and without probe load for 1000 ps rise time

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 V_{in} to V_{out} for various step inputs. For the following graphs, V_{in} is the signal at the logic analyzer probe tip. Eye Scan was used to measure V_{out}, the signal seen by the logic analyzer. The measurements were made on a mid-bus connection to a 50Ω transmission line load terminated at the receiver. These measurements show the logic analyzer's response while using the U4204A and U4206A soft touch probes.

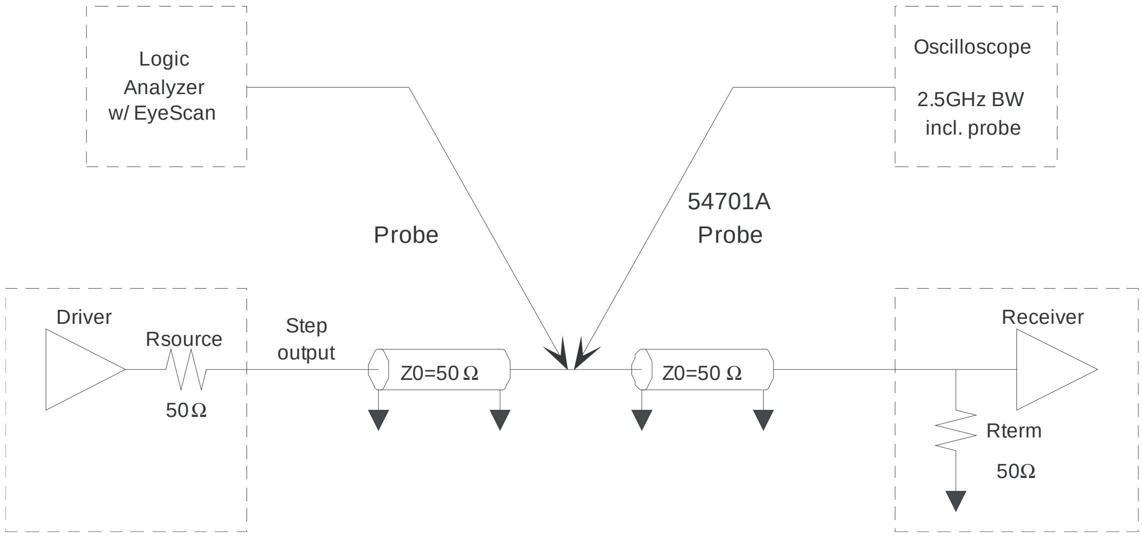


Figure 108 Step input measurement schematic for U4204A and U4206A probes

The following plots were made on a Keysight 54750A oscilloscope and a Keysight 16760A logic analyzer using a Keysight 8133A pulse generator with various rise time converters.

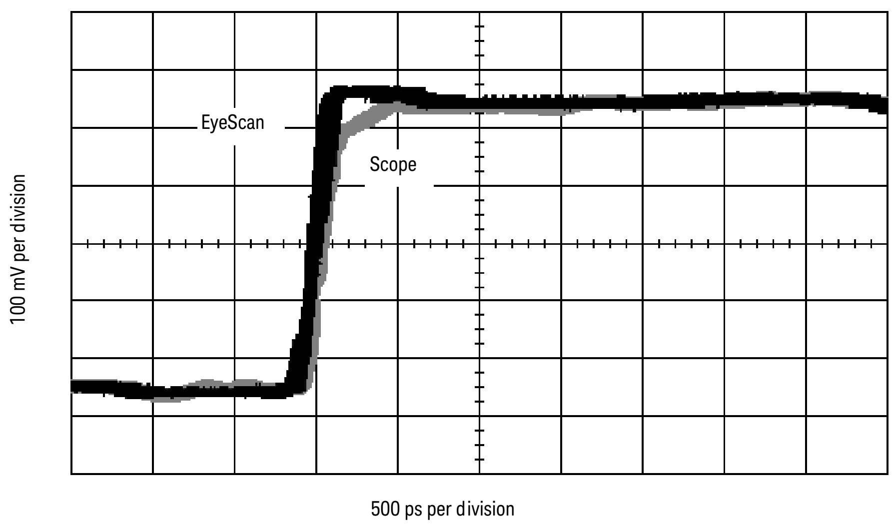


Figure 109 Logic analyzer's response to 150 ps rise time

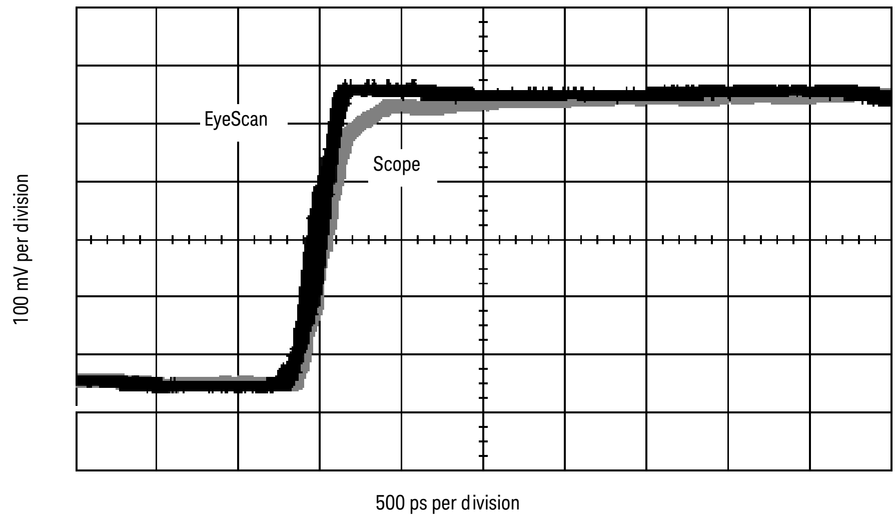


Figure 110 Logic analyzer’s response to 250 ps rise time

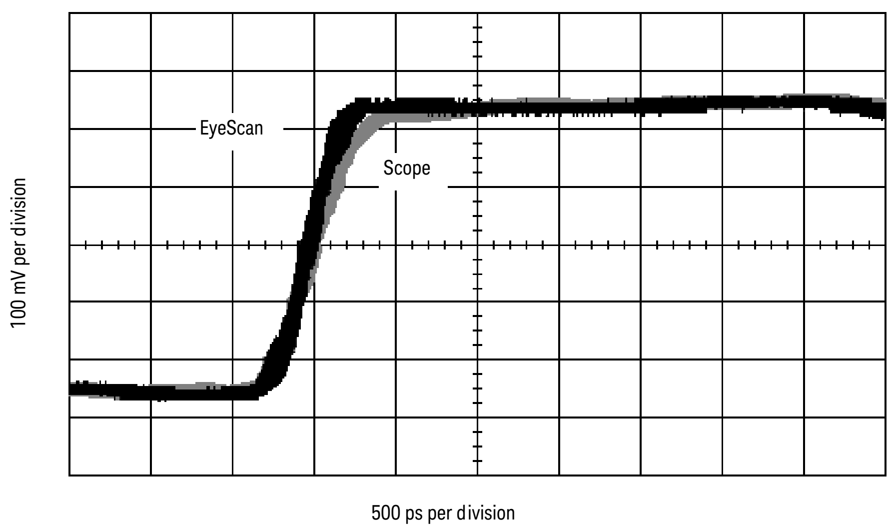


Figure 111 Logic analyzer’s response to 500 ps rise time

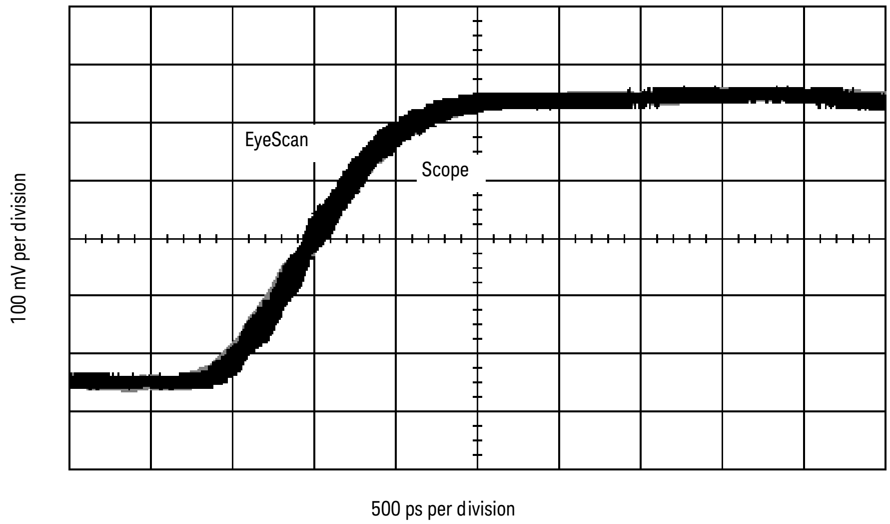


Figure 112 Logic analyzer's response to 1000 ps rise time

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. The eye opening viewed with Eye Scan helps you know how much margin the logic analyzer has, where to sample and at what threshold. Any probe response that exhibits overshoot, 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 U4204A and U4206A soft touch probes and Eye Scan while probed mid-bus on a 50Ω transmission line load terminated at the receiver. The data patterns were generated using a 2^{23}-1 pseudo random bit sequence (PRBS).

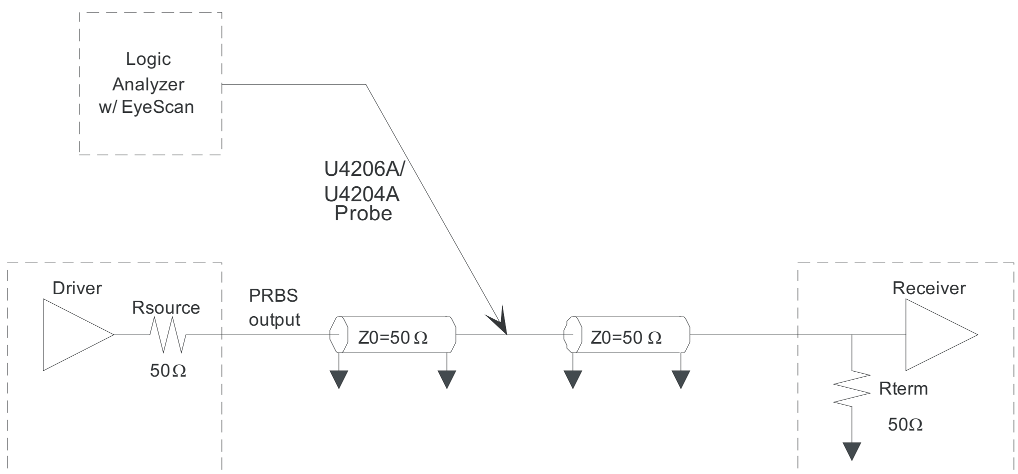


Figure 113 Eye opening measurement schematic for U4204A and U4206A probes

The following plots were made on a Keysight 16760A logic analyzer using a Keysight 8133A pulse generator with a 250 ps rise time converter. The following measurements use Eye Scan to show the margin at 800, 1250, and 1500MT/s. The amplitudes are indicated in the captions.

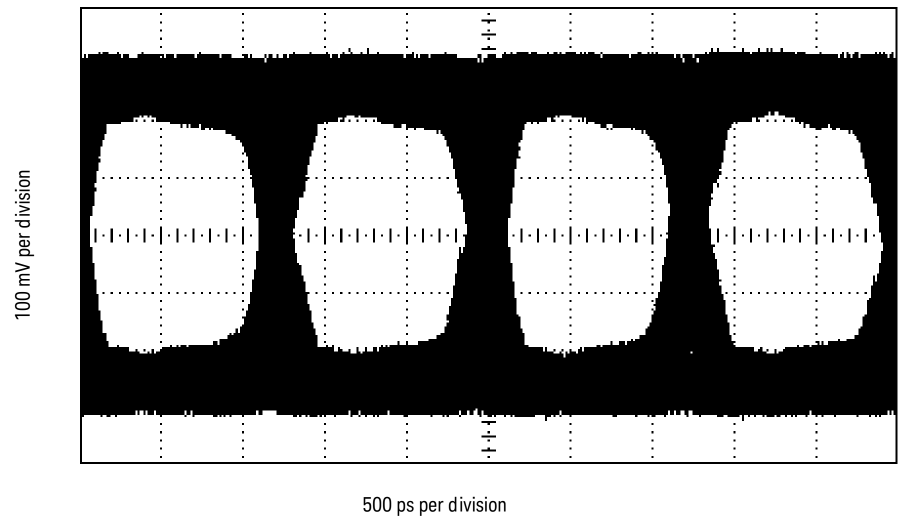


Figure 114 Logic analyzer eye opening for a PRBS signal of 500 mV p-p, 800 MT/s data rate

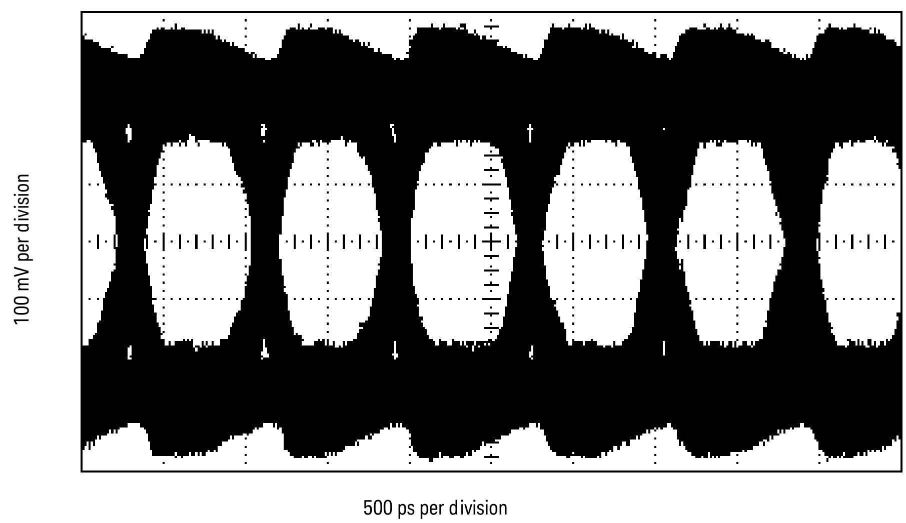


Figure 115 Logic analyzer eye opening for a PRBS signal of 500 mV p-p, 1250 MT/s data rate

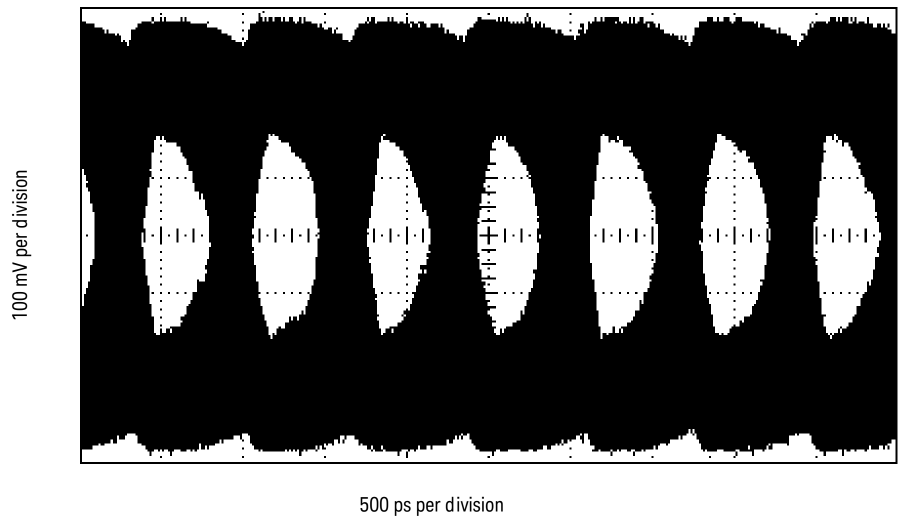


Figure 116 Logic analyzer eye opening for a PRBS signal of 500 mV p-p, 1500 MT/s data rate

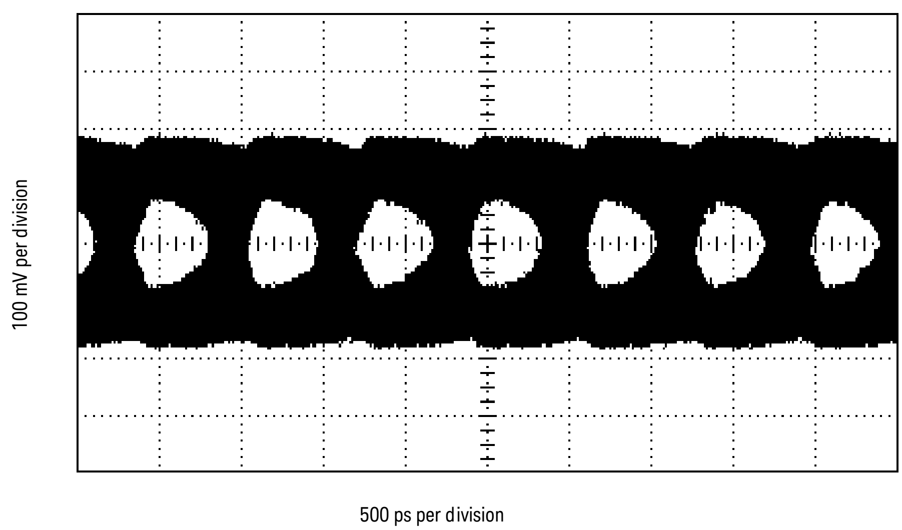


Figure 117 Logic analyzer eye opening for a PRBS signal of 200 mV p-p, 1500 MT/s data rate

4 Circuit Board Design Considerations

This chapter provides design considerations when you layout your circuit board for the U4200A-series probes.

Circuit Board Design Considerations for U4204A and U4206A Probes

Transmission Line Considerations

Stubs connecting signal transmission lines to the connector should be as short as feasible. Longer stubs will cause more loading and reflections on a transmission line. If the electrical length of a stub is less than 1/5 of the signal rise time, it can be modeled as a lumped capacitance. Longer stubs must be treated as transmission lines.

Example

Assume you are using FR-4 PC board material with a dielectric constant of ~4.3 for inner-layer traces (stripline). For example, A 0.28 cm long stub in an inner layer has a propagation delay of ~20 ps. Therefore, for a signal with a rise time of 100 ps or greater, a 0.28 cm stub will behave like a capacitor.

The trace capacitance per unit length will depend on the trace width and the spacing to ground or power planes. If the trace is laid out to have a characteristic impedance of 50 Ω it turns out that the capacitance per unit length is ~1.2 pF/cm. Therefore the 0.28 cm stub in the previous example would have an effective capacitance equal to ~0.34 pF.

This trace capacitance is in addition to the probe load model.

Thresholds

U4204A and U4206A soft touch probes

Clock input

The clock input to the U4204A and U4206A probes is differential. If you supply a differential clock, you should select the “differential” option in the clock threshold user interface of the Logic and Protocol Analyzer GUI.

If your system uses a single-ended clock signal, the $\overline{\text{clock}}$ input should be either grounded or connected to a dc power supply. You may:

- Ground the $\overline{\text{clock}}$ input and adjust the clock threshold from the user interface to between -3V dc and +5V dc.

Signal Access

Labels split across probes

If a label is split across more than one pod, this leads to restrictions in triggering. Refer to “Triggering with the Keysight 1675x and 1676x" (Keysight publication number 5988-2994EN) for more details.

Reordered bits

If bits need to be reordered within a label, this leads to additional restrictions in triggering. Specifically, equalities can be used to evaluate the value of a label with reordered bits, but inequalities cannot be used. You may be able to avoid the need to reorder bits in a label by routing signals to appropriate pins on the probe connector. Refer to “Triggering with the Keysight 1675x and 1676x" (Keysight publication number 5988-2994EN) for more details.

Circuit Board Design Considerations for U4205A Probe

Transmission Line Considerations

Stubs connecting signal transmission lines to the connector should be as short as feasible. Longer stubs will cause more loading and reflections on a transmission line. If the electrical length of a stub is less than 1/5 of the signal rise time, it can be modeled as a lumped capacitance. Longer stubs must be treated as transmission lines.

Example

Assume you are using FR-4 PC board material with a dielectric constant of ~4.3 for inner-layer traces (microstrip). For example, A 0.28 cm long stub in an inner layer has a propagation delay of ~20 ps. Therefore, for a signal with a rise time of 100 ps or greater, a 0.28 cm stub will behave like a capacitor.

The trace capacitance per unit length will depend on the trace width and the spacing to ground or power planes. If the trace is laid out to have a characteristic impedance of 50 ohms, it turns out that the capacitance per unit length is ~ 1.2 pF/cm. Therefore, the 0.28 cm stub in the previous example would have an effective capacitance equal to ~0.34 pF.

This trace capacitance is in addition to the probe load model.

16850 Series and U4154A Data and Clock Inputs per Operating Mode

The following table shows the number of data and clock inputs for each connector on your target system for the various operating modes of your U4154A and 16850 Series logic analyzer.

Table 10 Data clock inputs per operating mode

U4154A and 16850 Series Operating Mode	U4205A
Synchronous (state) analysis maximum 800 Mb/s	32 data plus 2 clock inputs (see Note below)
Eye scan mode 800 Mb/s	32 data plus 2 clock inputs (see Note below)
Timing mode	32 data plus 2 clock inputs

NOTE In synchronous (state) analysis mode, and in the eye scan mode, there is one clock input which must be routed to the clock input on pod 1. The clock inputs on other pods can be assigned to labels and acquired as data inputs.

Thresholds

All inputs in the U4205A 38-pin probe are single-ended. The U4205A probe does not have a threshold reference input. When you use the U4205A, you adjust the logic threshold in the user interface.

The clock input on the U4205A is single-ended. The clock threshold may be adjusted independent of the data.

Signal Access

Labels Split Across Probes

If a label is split across more than one pod, this may lead to restrictions in triggering. Refer to "Triggering with the Keysight 16760A" (Keysight publication number 5988-2994EN) for more details. Triggering restrictions across more than one pod may or may not apply depending upon the actual configuration.

Re-ordered Bits

If bits need to be reordered within a label, this leads to additional restrictions in triggering. Specifically, equalities can be used to evaluate the value of a label with reordered bits, but inequalities cannot be used. You may be able to avoid the need to reorder bits in a label by routing signals to appropriate pins on the probe connector. Refer to “Triggering with the Keysight 16760A" (Keysight publication number 5988-2994EN) for more details.

5 Setting up the U4200A-Series Probes and Cables

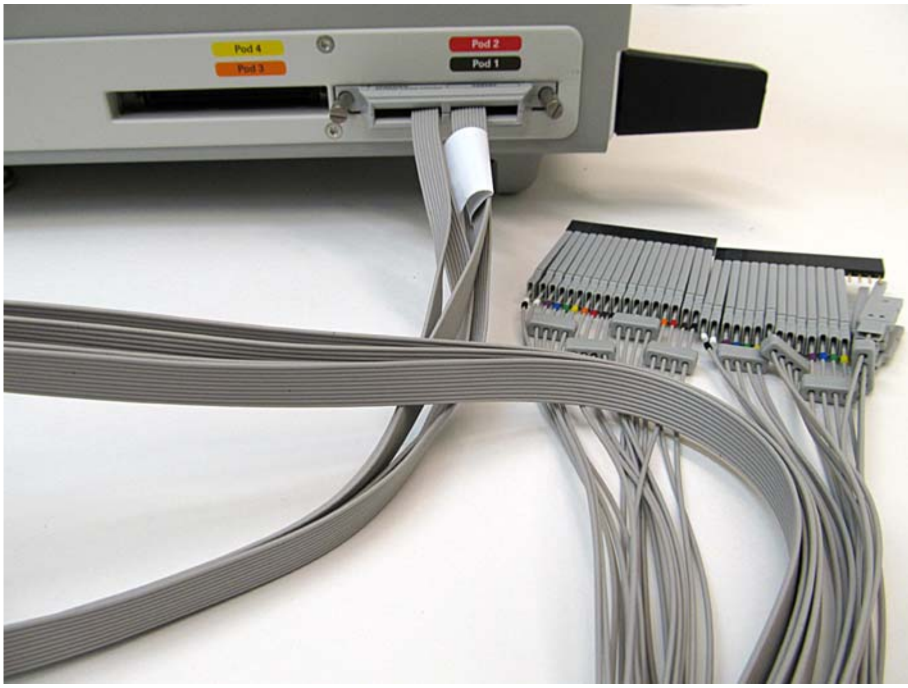
This chapter provides information to help you complete the hardware setup of the U4200A-series probes and cables, that is, steps and information needed for the probe's connectivity to DUT and Keysight logic analyzer.

U4201A Setup

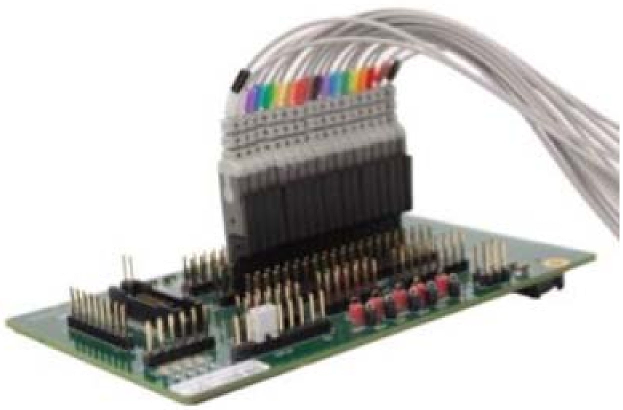
The connections between the U4201A cable pods and Logic analyzer pods depend on the probe with which you are using the U4201A cable. Refer to the specific user guide for the probe with which you want to use the U4201A cable to find out how to perform the complete setup. You can find the guide for a probe on www.keysight.com by searching for the probe's model number and then accessing the Document Library tab on the probe's webpage.

U4203A Setup

1 Connect the single-ended probe to the logic analysis module or to the portable logic analyzer side connector.



2 Connect the flying leads to your target system using the appropriate accessories supplied with your U4203A probe. Refer to the section “U4203A Probe Electrical Considerations" on page 56 to get an overview of the trade-offs between the various accessories based on probe loading effects, probe step response, and maximum usable state speed and select the configuration that works best with your target system.



Flying Leads to Signal Mapping

The flying leads of the U4203A probe are color coded to help you identify the appropriate flying lead cable to be used for probing a specific signal.

The following table lists the signal, color coding, and pin number mapping of each of these flying lead cables of U4203A.

Signal	Color Coding	Pin Number
D0_p	Black	3
D1_p	Brown	4
D2_p	Red	5
D3_p	Orange	6
D4_p	Yellow	7
D5_p	Green	8
D6_p	Blue	9
D7_p	Violet	10
D8_p	Black	1
D9_p	Brown	2
D10_p	Red	3
D11_p	Orange	4
D12_p	Yellow	5
D13_p	Green	6
D14_p	Blue	7
D15_p	Violet	8
Clk_p	White	9
Clk_n	Black with white	10

U4204A Setup

The U4204A soft touch probe is attached to the PC board using a retention module which ensures pin-to-pad alignment and holds the probe in place. The retention module is included in your probe shipment.

1 Use the information provided in Chapter 2 to design pads on your board and holes for mounting the retention module.

2 Use flux as necessary to clean the board and pins before soldering the retention module to the board.

3 If your board has Organic Solder Preservative (OSP) finish, apply solder paste to the footprint pads prior to re-flow or hand soldering.

   Typically, dipped and coated finishes do not require extra solder paste.

4 Attach the retention module to the board from either the top or bottom of the board:

   For Top-side attach (Can be used with most board thicknesses)

   a Insert the retention module into the board noting the keying pin.

   b Solder alignment pins from the top ensuring that solder is added until a fillet is visible on the pin.

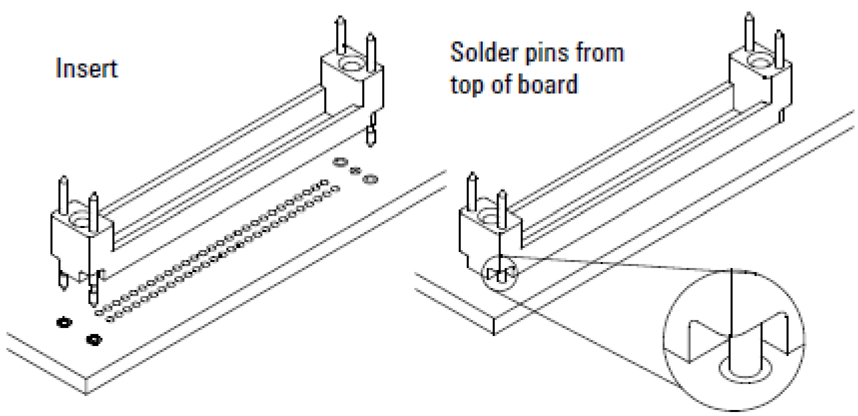


Figure 118 Solder retention module from the top.

   For Bottom-side attach (Can be used for board thickness of 2.54 mm (0.100 in.) or less.)

   a Insert the retention module into the board noting the keying pin.

   b Solder the alignment pins to the back side of the board.

5 Insert the U4206A probe into the retention module.

   Ensure proper keying by aligning the Keysight logo on the probe with the one on the retention module and place the probe end into the retention module.

Alternate turning each screw on the probe a little until both screws are finger tight like you would attach a cable to your PC.

U4206A Setup

Connecting to DUT using a Retention Module

The U4206A soft touch probe is attached to the PC board using a retention module which ensures pin-to-pad alignment and holds the probe in place. The retention module is included in your probe shipment.

1 Use the information provided in Chapter 2 to design pads on your board and holes for mounting the retention module.

2 Use flux as necessary to clean the board and pins before soldering the retention module to the board.

3 If your board has Organic Solder Preservative (OSP) finish, apply solder paste to the footprint pads prior to re-flow or hand soldering.

   Typically, dipped and coated finishes do not require extra solder paste.

4 Attach the retention module to the board from either the top or bottom of the board:

   For Top-side attach (Can be used with most board thicknesses)

   a Insert the retention module into the board noting the keying pin.

   b Solder alignment pins from the top ensuring that solder is added until a fillet is visible on the pin.

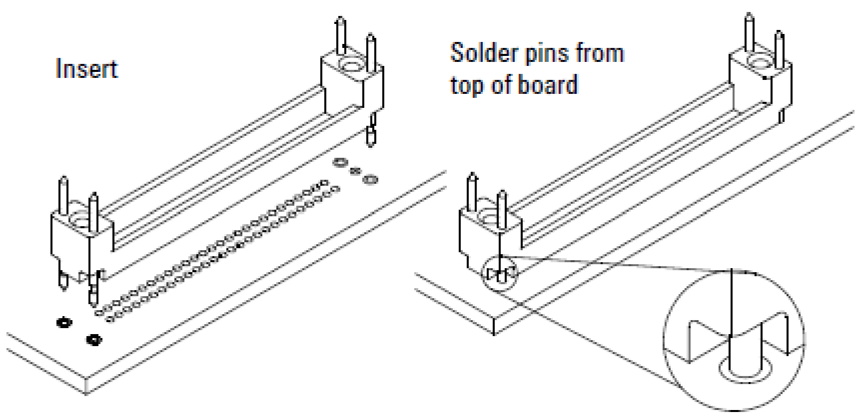


Figure 119 Solder retention module from the top.

   For Bottom-side attach (Can be used for board thickness of 2.54 mm (0.100 in.) or less.)

   a Insert the retention module into the board noting the keying pin.

   b Solder the alignment pins to the back side of the board.

5 Insert the U4206A probe into the retention module.

   Ensure proper keying by aligning the Keysight logo on the probe with the one on the retention module and place the probe end into the retention module.

6 Alternate turning each screw on the probe a little until both screws are finger tight like you would attach a cable to your PC.

Connecting to Logic Analyzer

When connecting the U4206A cable pods to Logic Analyzer pods, match the labels on the U4206A cable pods with the labels on the Logic analyzer pods.

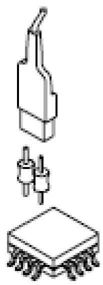
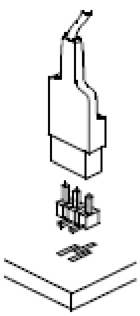
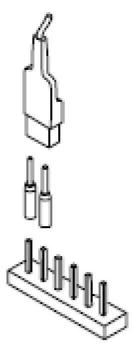
Figure 120 U4206A connected to U4164a Logic Analyzer pods

U4206A Clock Qualifiers Connections

The U4206A probe provides two flying lead connectors to make clock qualifier connections. clkp and clkn of Pod 3 and Pod 7 are driven by these differential flying leads.

The U4206A probe comes with accessories needed to make the clock qualifier connections. The following table provides an overview of the trade-offs between these accessories. Each of the three accessories configurations have been characterized for probe loading effects, probe step response, and maximum usable state speed. For detailed information, refer to the pages indicated for each configuration.

Table 11 Suggested Configurations and Characteristics of Clock Qualifier Accessories

Clock Qualifier Accessory	Description and Usage	Total Lumped Input C	Maximum Recommended State Speed
	**Coaxial Tip Resistor (82W blue)** Recommended for solder-down probing configuration of individual test points. Use the resistor cutting template card (part number 01131-94309) that accompany the U4206A probe 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. These resistors allow you to solder to the target signals without damaging the probe and isolates the target from the capacitance of the probe and reduces the loading on the target system. The 82 W High Frequency Metal Film resistors that are shipped with the U4206A probe have a very low series inductance and are the recommended tip resistor.	0.9 pF	1.5 Gb/s
	**3-Pin Header** 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 121 on page 123 shows the footprint dimensions for surface mounting the 3- pin header on your PC board. Two footprints are shown illustrating minimum clearance.	1.0 pF	1.5 Gb/s
	**Socket Adapters** 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 probe 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. For information on the dimensions of the socket adapters and how to use multiple socket adapters, refer to the topic “Using multiple socket adapters" on page 123.	1.1 pF	1.5 Gb/s

3-Pin Header Footprint Configuration

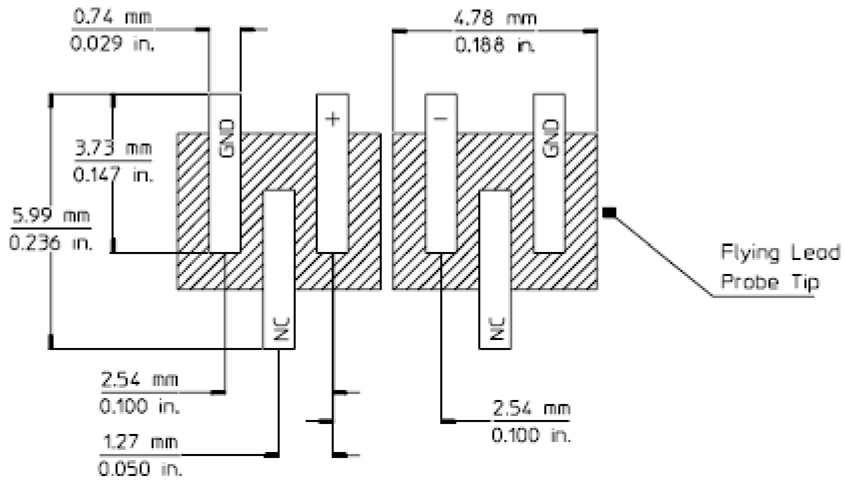


Figure 121 3-pin header probe PC board footprint configuration

Using multiple socket adapters

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

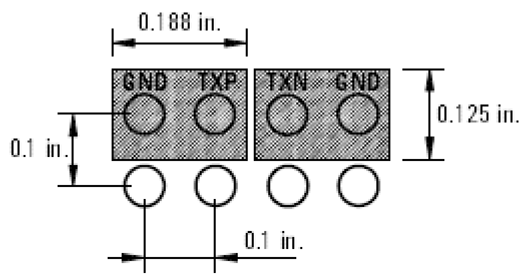
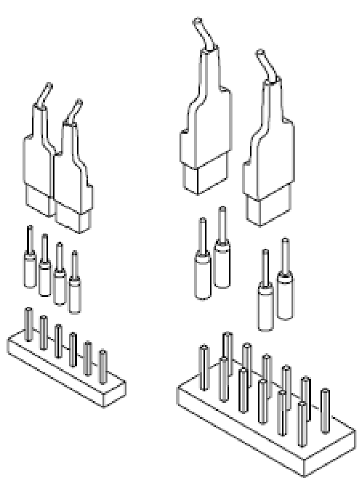
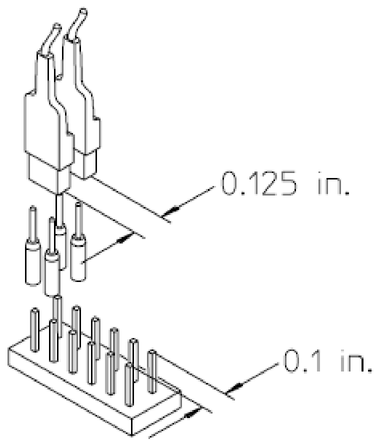


Figure 122 Socket adapter clearance

You can use multiple adapters side-by-side or in tandem by skipping 1 or more pins as shown in the figures below.



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



U4208A and U4209A Setup

For connection to DUT, these probes require a compatible Keysight interposer in between such as a W6601A, W4643A, or W4641A BGA interposer. The U4208A probe connects to the left wing of these interposers and the U4209A probe connects to the right wing of these interposers.

The U4208A and U4209A probes connect directly to Logic Analyzer pods. The pods to which the connection is to be made depends on the interposer used with these probes.

The complete setup of U4208A and U4209A probes require the following steps:

1 Solder the riser, interposer, and memory components.

2 Connect the interposer flex wings to U4208A and U4209A probe cables.

3 Connect the U4208A and U4209A probe cables to a U4164A Logic Analyzer module's pods.

NOTE

To know about soldering the components, performing the complete setup of the applicable interposer, and the connection mapping between the U4208A/9A probe cable pods and Logic analyzer pods, refer to the specific user guide for the interposer. You can find the guide for an interposer on www.keysight.com by searching for the interposer's model number and then accessing the Document Library tab on the interposer's webpage.

A sample setup is shown in the following figure with the U4208A and U4209A probes connected to the U4164A Logic Analyzer and W4641A DDR4 x16 BGA 2-Wings Interposer.

Figure 123 Sample setup for U4208A and U4209A probes

6 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. Keysight 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.keysight.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 Keysight 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.

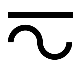
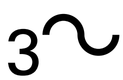
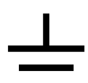
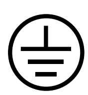
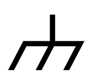
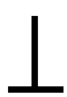
CAUTION

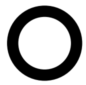
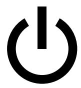
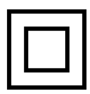
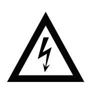
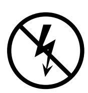
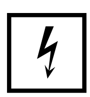
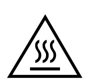
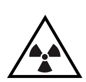
A CAUTION notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood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

Symbols	Description
	Direct current
	Alternating current
	Both direct and alternating current
	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)

Symbols	Description
	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
	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. Keysight 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.keysight.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 keysight, afin d'être certain que les fonctions de sécurité seront maintenues.

En cas de dommages

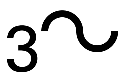
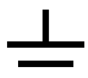
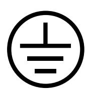
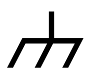
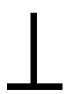
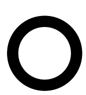
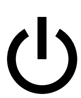
Les instruments endommagés ou défectueux doivent être désactivés et protégés contre toute utilisation involontaire jusqu'à ce qu'ils aient été réparés par une personne qualifiée.

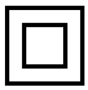
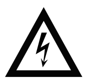
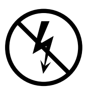
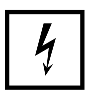
ATTENTION

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:

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.
	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.

Symboles	Description
	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
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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This information is subject to change without notice.

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