Signal Integrity
Logic Analysis Probing Challenges

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Probing

- Probing is how you connect to the signals you want to measure.
- Probing is the first element you must care when designing your prototype board to achieve Scope & Logic Analyzer Measurements without corrupting your signals with badly designed Probe accessories.
- Agilent provides probing for individual pins, groups of pins, connectors, and whole chip packages.
- Agilent also provides analysis probes for specific processors and buses.

Probing Questions

- What chip packages would you like to probe?
- What system buses would you like to see?
- How do you plan to probe other signals on your system?
- Do you need a full solution for a particular processor or bus?

After the Fact Probing

- **Your Prototype Board is already designed and unfortunately it's not working properly**
- **Board Designers didn't consider putting Debug Connectors, or didn't have the space to do it**

-> You must use General purpose Probing Accessories and keep in mind the associated limitations
- Inductive and Capacitive Loading
- Frequency Limit
- Always DoubleCheck what is included in Equivalent

How Much Can we rely on General Purpose Flying Lead Probe Performances??

The characteristics listed in Table 2-16 apply to the leadsets shown in Figures 2-14, 2-15, and 2-16 unless otherwise noted.

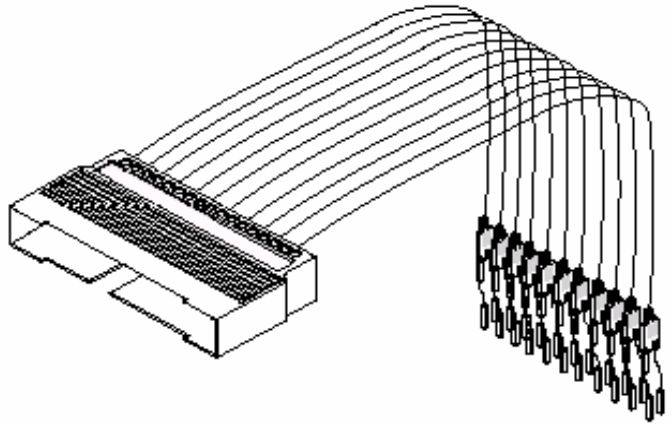
Table 2-16: Characteristics

Recommended usage	TTL and CMOS levels only. Ground leads should be connected to ground of system under test. Not recommended for signals with edge rates > 1 V/ns.
Maximum clock speed	50 MHz (single-ended leadset), one ground lead connected 90 - 100 MHz (single-ended leadset), two ground leads connected
	150 - 200 MHz (differential leadset)
AC loading	< 5 pF per channel as seen by the device under test (plus podlet)

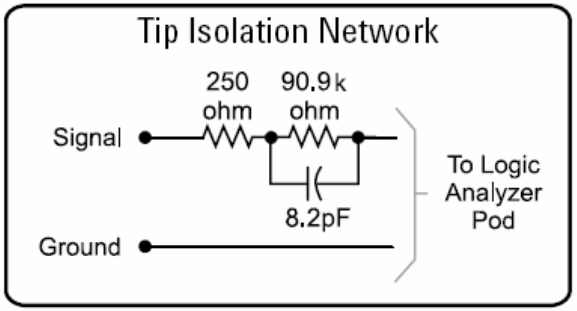
Regular Flying Leads: Good to 400Mb/s Loading 1,5pF

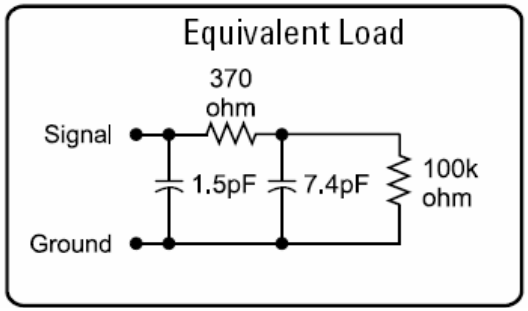
Probing – General Purpose

General Purpose Lead Set: 01650-61608



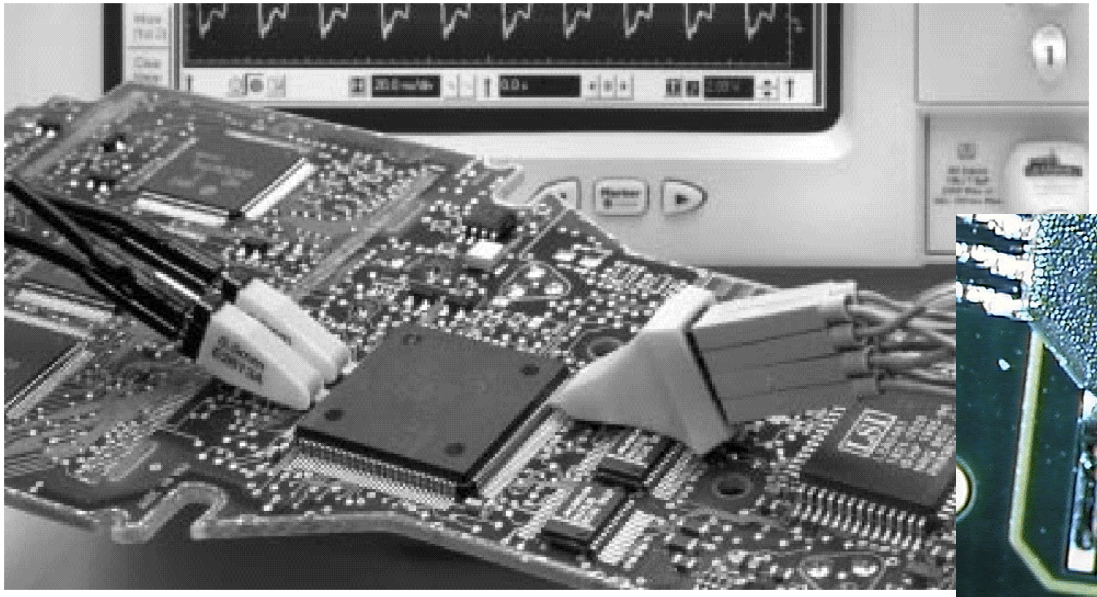
E5383A GP Flying Leads



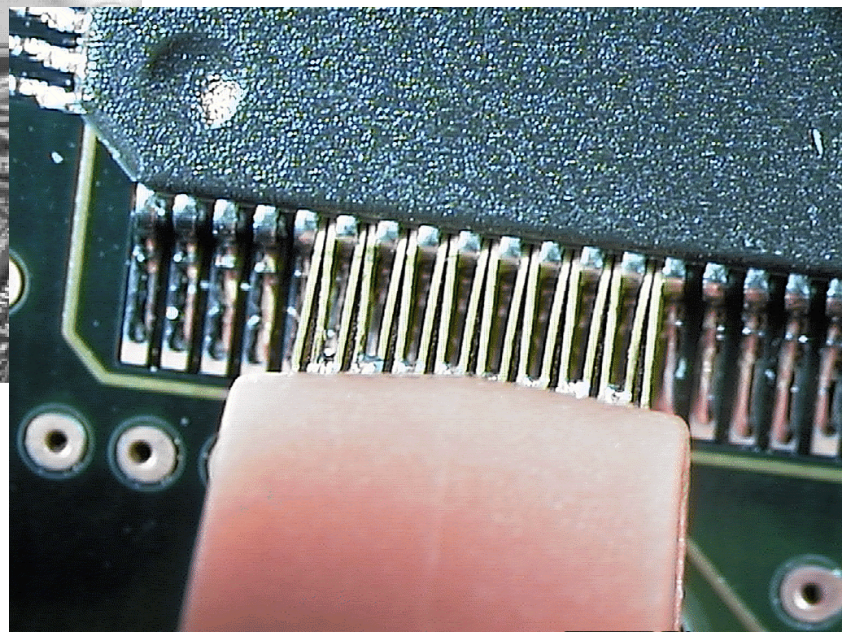


All Included Equivalent Load

The Wedge Probe: Good to 200Mb/S



Metal blade brush
with insulation material
between each metal blades



•Gain quick access to 0.5mm or 0.65mm TQFP or PQFP devices.

• Exist in 3,8 or 16 pin packages.

•3 & 8 pins loading 2pF 15nH (200Mb/s)
•16 pins loading 4,33pF 37nH (100Mb/s)

Agilent High Performance 1,5Gb/S Flying Lead Probes & Accessories 1,3pF Loading

E5382A Single-Ended
E5381A Differential

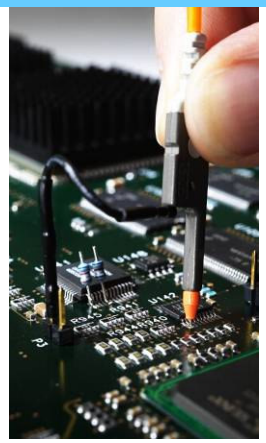
If the signal is on the surface of the board we can probe it at speeds up to 1.5Gb/sec!

Agilent flying lead probes are based on the award winning InfiniiMax Oscilloscope probe technology

They Are available for Single Ended and Differential signaling

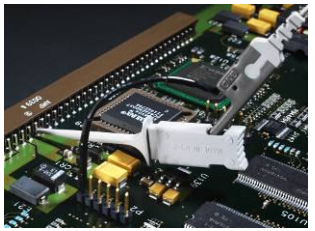
Damped wire accessories allow "Solder in" connection up to 1,5Gb/s

Agilent High Performance Flying Lead Probes & Accessories

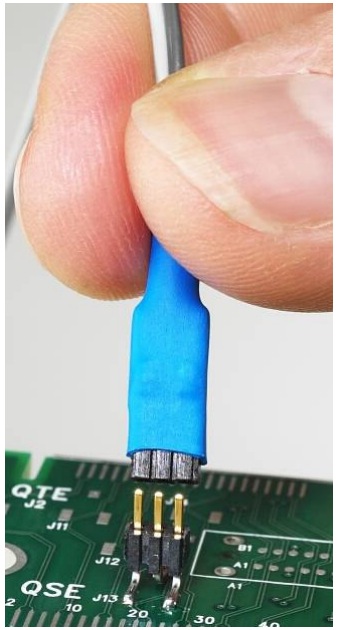


E5382A & Browser

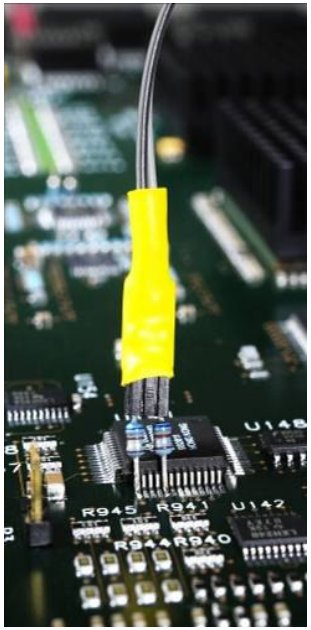
You can use Flying leads by hand, or use damped accessories proposed to achieve reliable measurements and slightest loading of the signal running on your board.



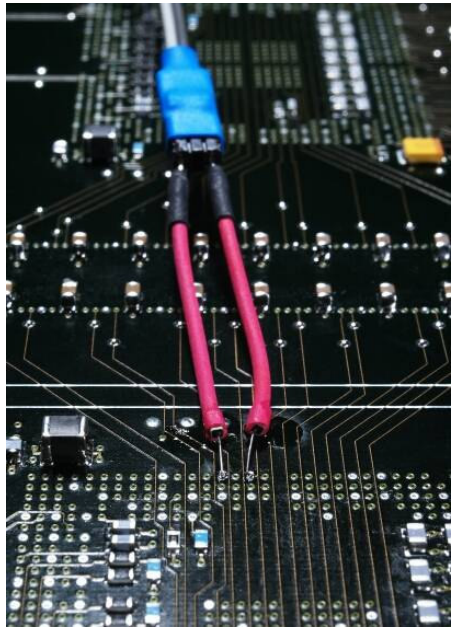
E5382A & Grabber



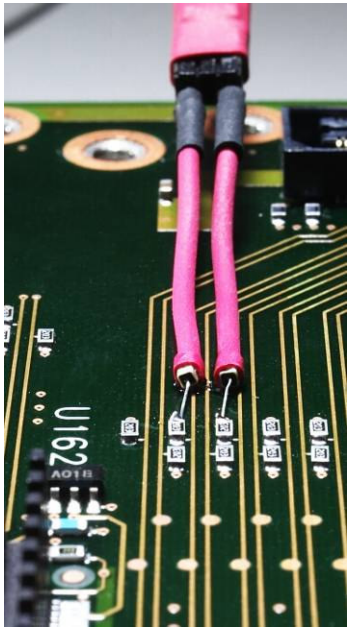
E5381A & Connector



E5381A & Coax Resistor Probing QFP leg

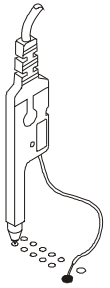


E5381A & Damped Wire Backside Probing a BGA

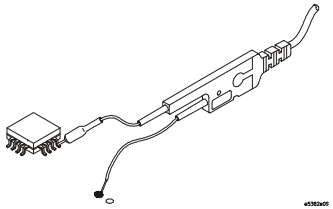


E5381A & Damped Wire Probing SMT 0402 Resistor

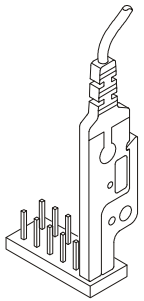
Flying Lead Probing Use Models



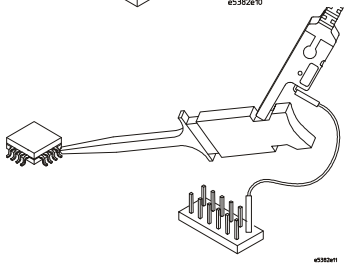
Description	Lumped C	Maximum speed
130 Ohm Resistive Pin and Solder-down Ground Lead	1.3 pF	1.5 Gb/s



5cm Resistive Lead and Solder-down Ground Lead	1.5 pF	1.5 Gb/s



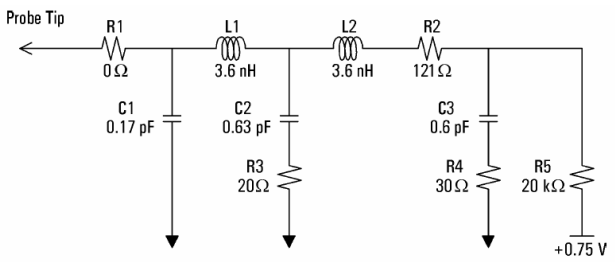
Flying Lead and Ground Extender	1.6 pF	1.5 Gb/s



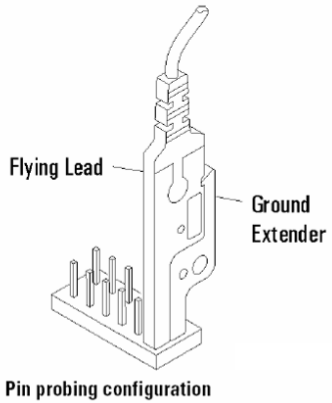
Grabber Clip and Right-angle 2.0 pF Ground Lead	2.0 pF	600 Mb/s

The same as Infiniium scope accessories!

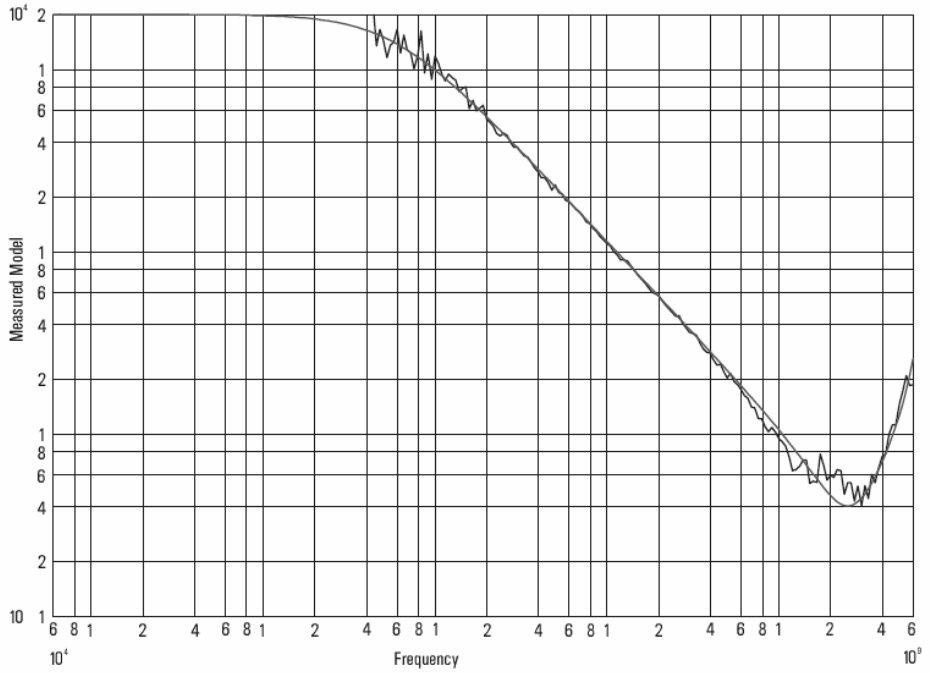
E5382A using Ground Extender Equivalent Load



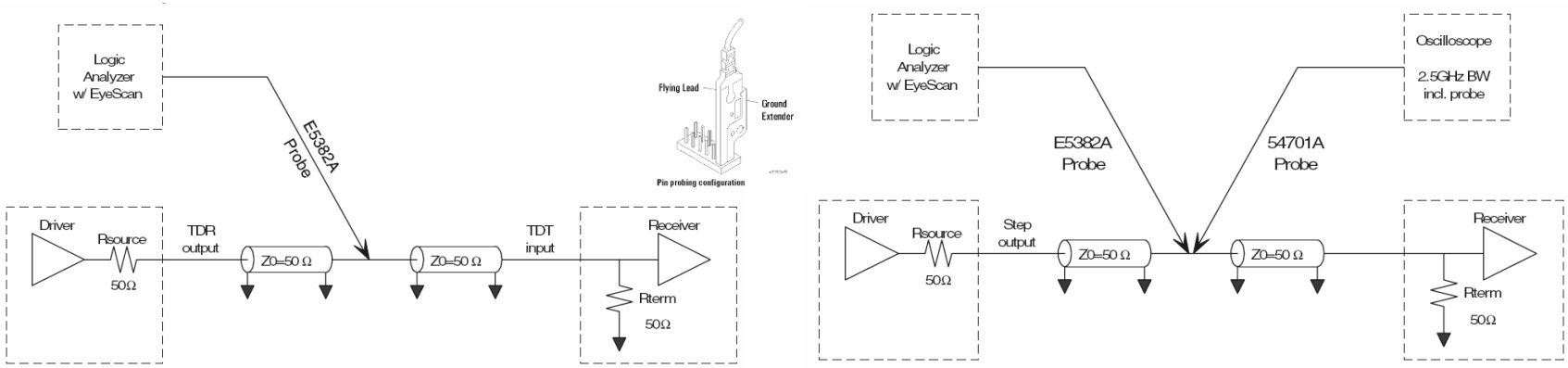
Equivalent load model

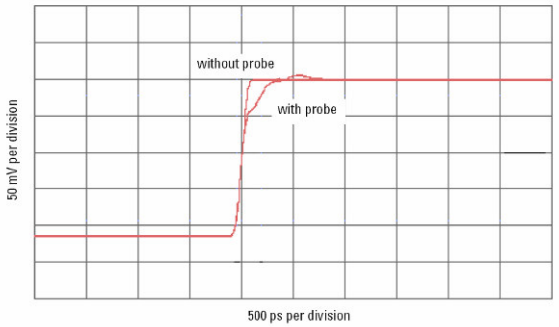


Pin probing configuration

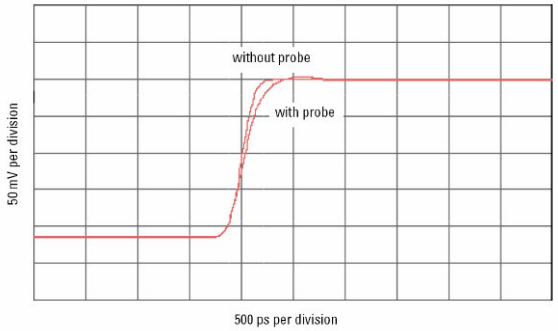


Measured versus modeled input impedance

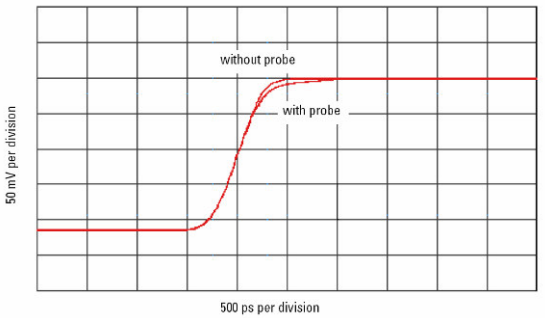




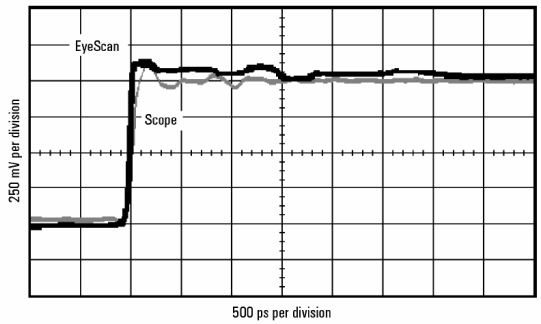
TDT measurement at receiver with and without probe load for 100 ps rise time



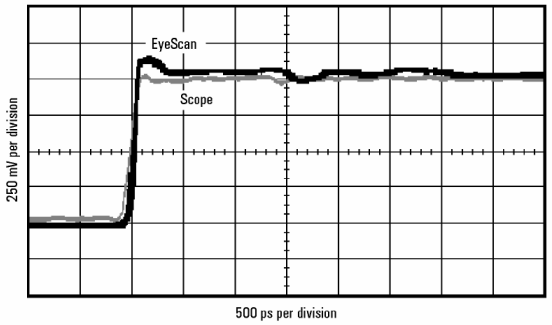
TDT measurement at receiver with and without probe load for 250 ps rise time



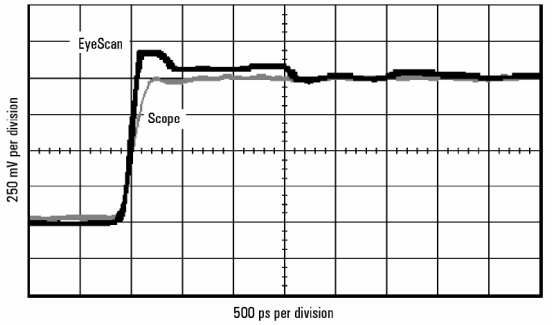
TDT measurement at receiver with and without probe load for 500 ps rise time



Logic analyzer's response to a 100 ps rise time



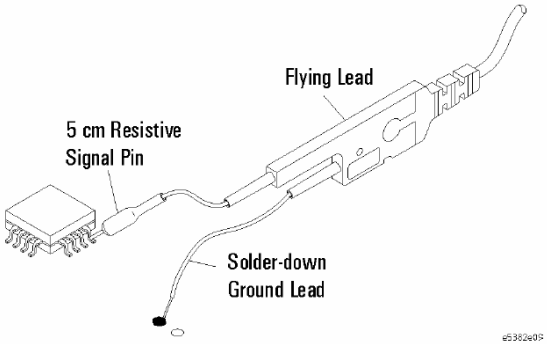
Logic analyzer's response to a 250 ps rise time



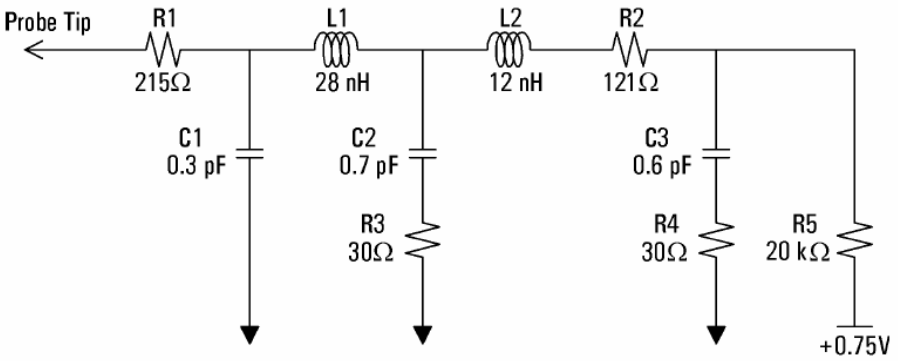
Logic analyzer's response to a 500 ps rise time

5 cm Resistive Signal Lead and Solder-down Ground Lead

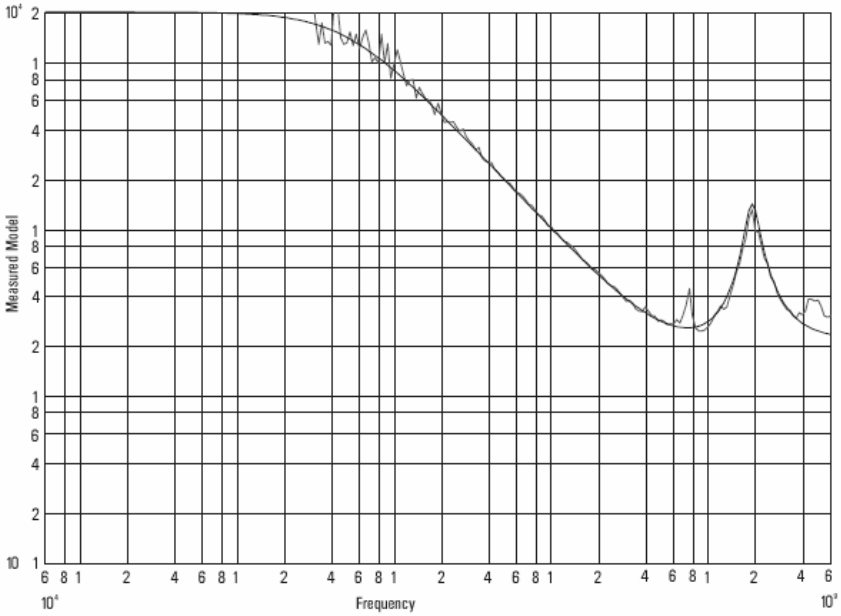
This configuration is recommended for accessing components such as IC leads or surface-mount component leads for hands-off probing.



Surface-mount probe configuration

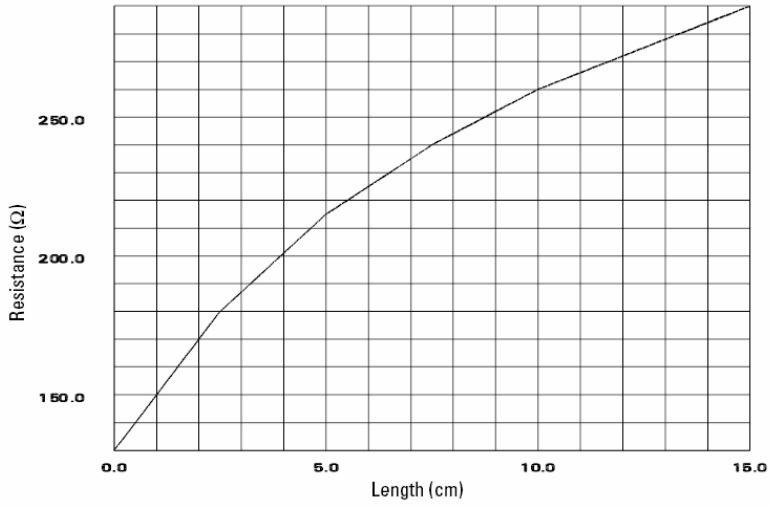


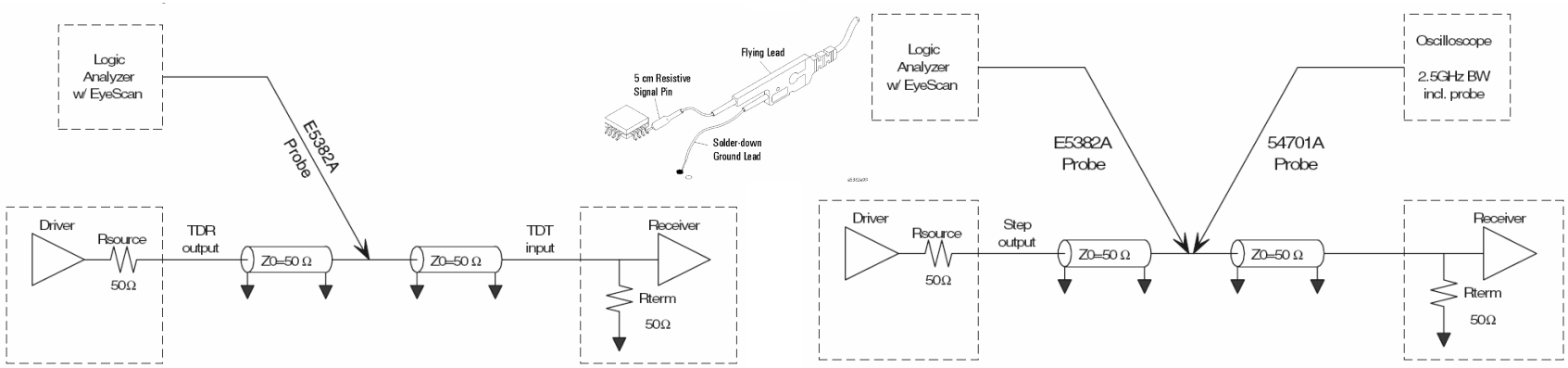
Equivalent load model



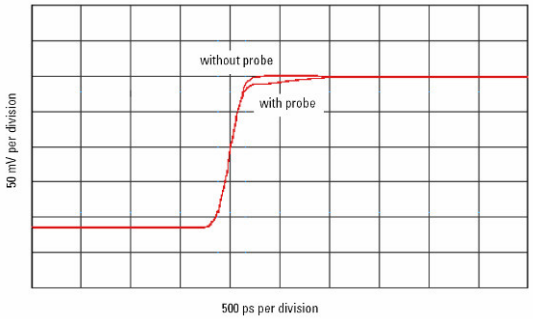
Measured versus modeled input impedance

Optimum Damping Resistor Value Versus Signal Lead Length

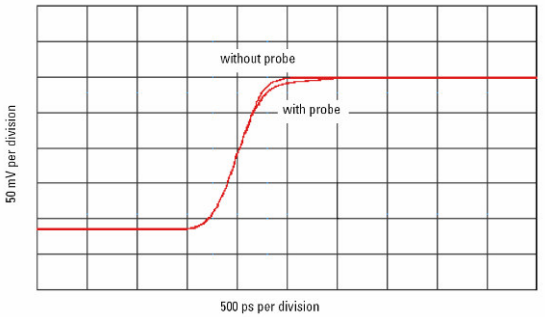




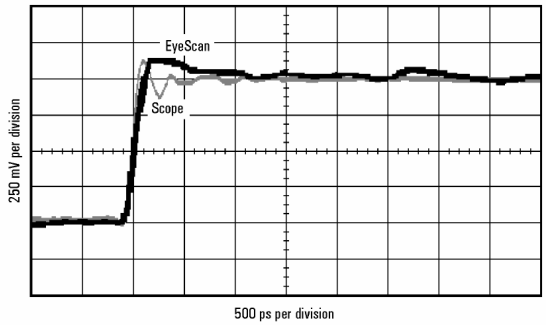
TDT measurement at receiver with and without probe load for 100 ps rise time



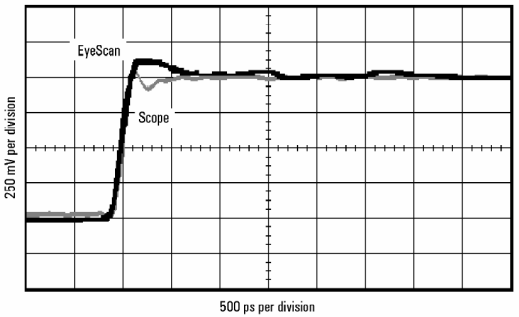
TDT measurement at receiver with and without probe load for 250 ps rise time



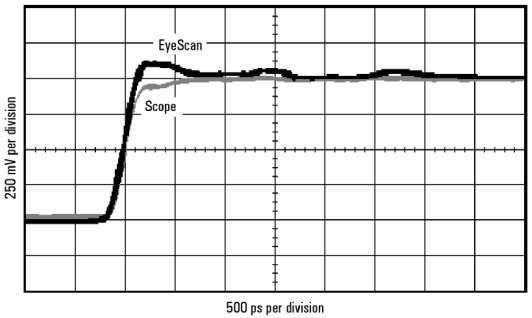
TDT measurement at receiver with and without probe load for 500 ps rise time



Logic analyzer's response to a 100 ps rise time

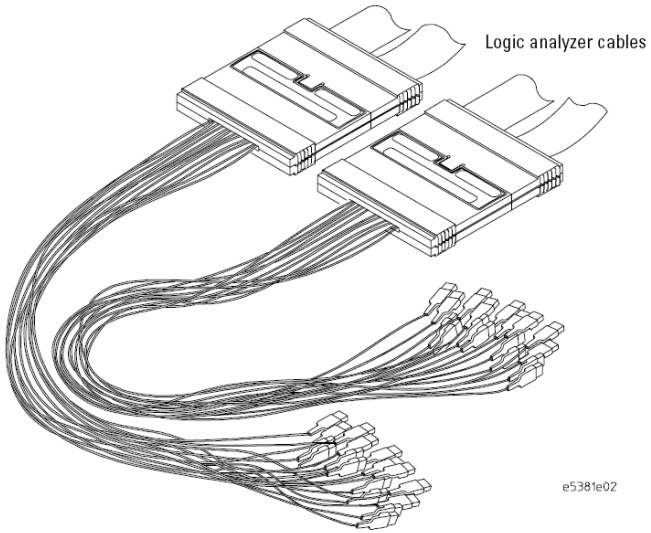


Logic analyzer's response to a 250 ps rise time



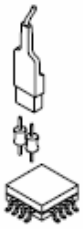
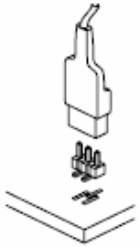
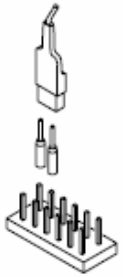
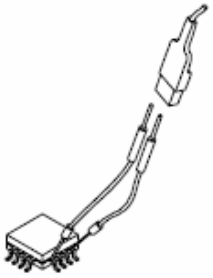
Logic analyzer's response to a 500 ps rise time

E5381A Differential Flying Leads Use Models

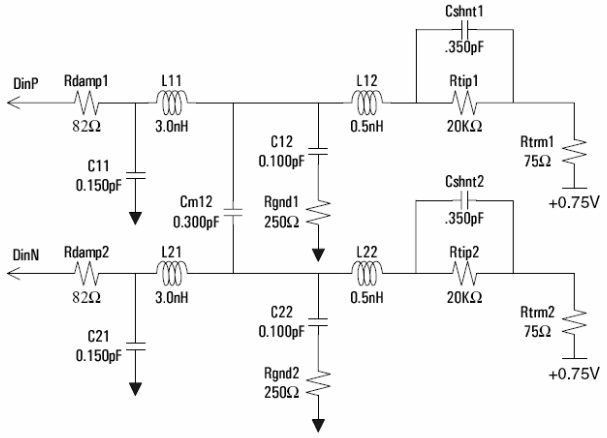


Differential flying lead probe set and Agilent logic analysis module.

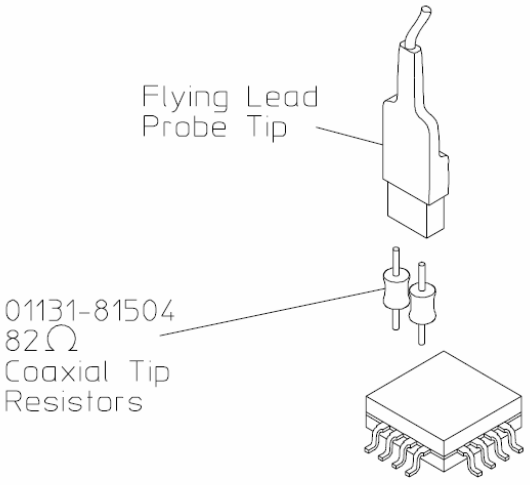
Suggested Configurations and Characteristics

Configuration	Description	Total lumped input C	Maximum recommended state speed
	Coaxial Tip Resistor (82 Ω blue)	0.9 pF	1.5 Gb/s
	3-Pin Header	1.0 pF	1.5 Gb/s
	Socket Adapter	1.1 pF	1.5 Gb/s
	Damped Wire (160 Ω)	1.3 pF	1.5 Gb/s

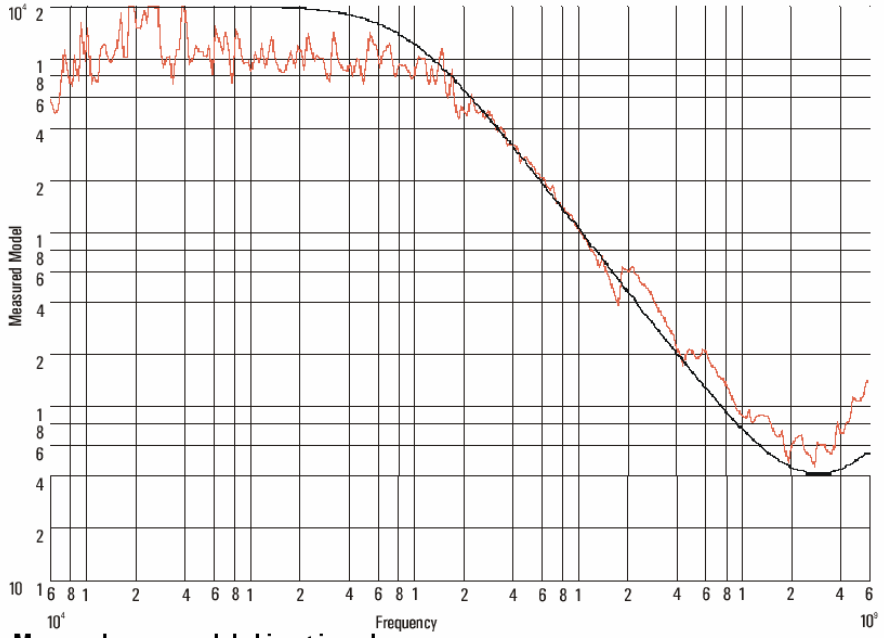
E5381A Differential Flying Leads
Short Coaxial resistors



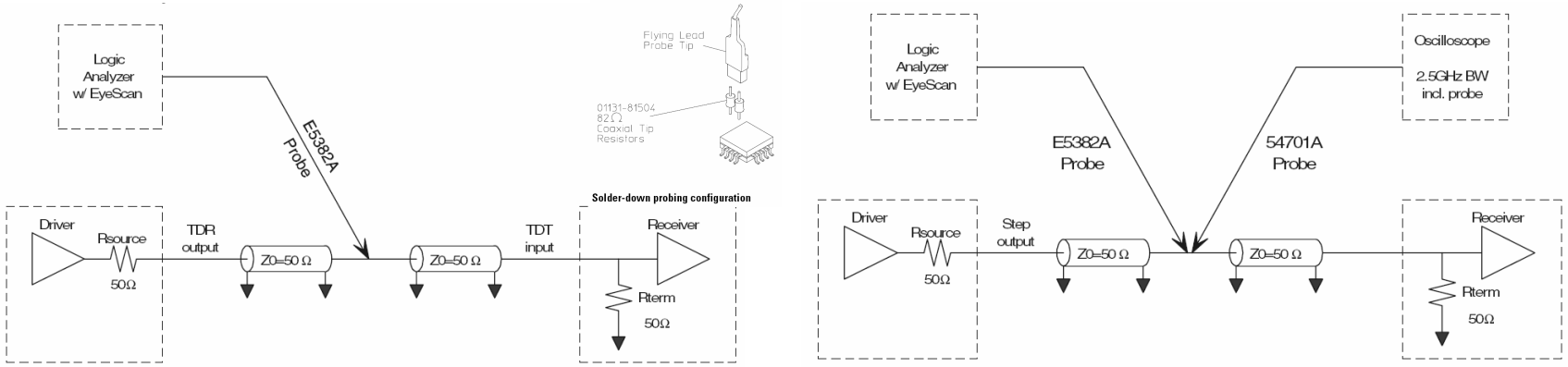
Equivalent load model

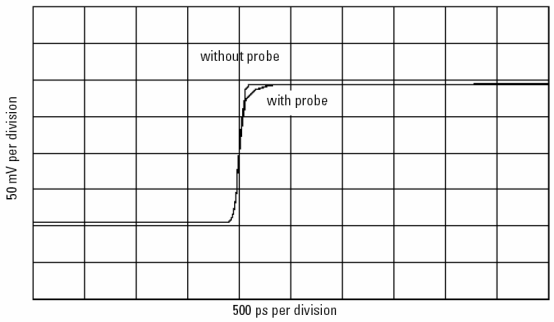


Solder-down probing configuration

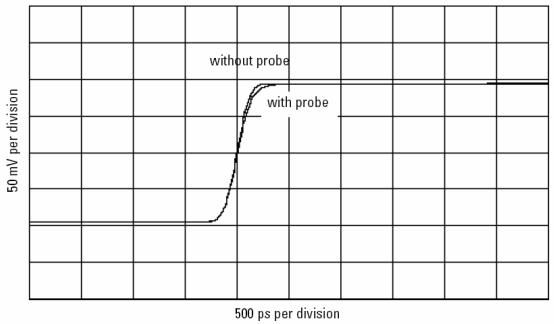


Measured versus modeled input impedance

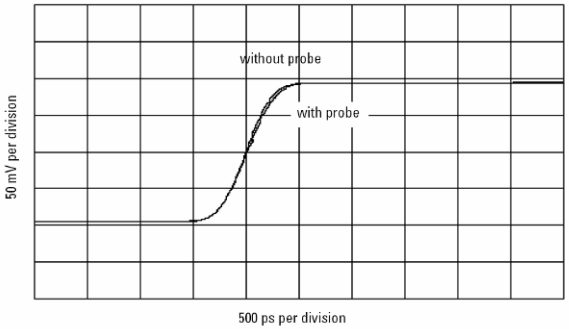




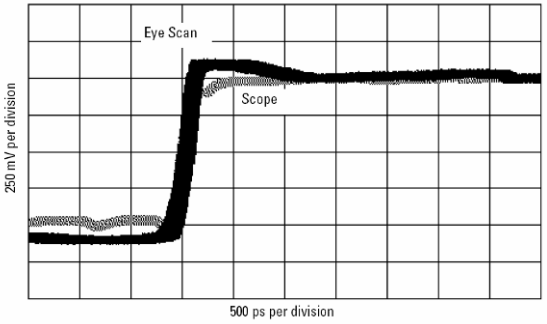
TDT measurement at receiver with and without probe load for 150 ps rise time



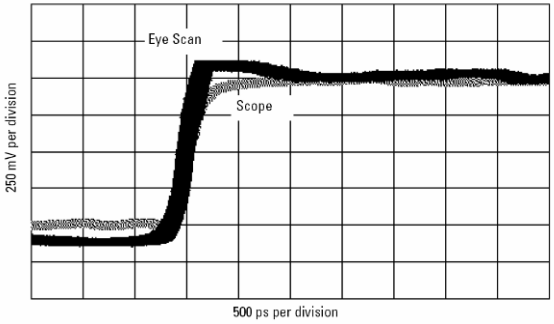
TDT measurement at receiver with and without probe load for 250 ps rise time



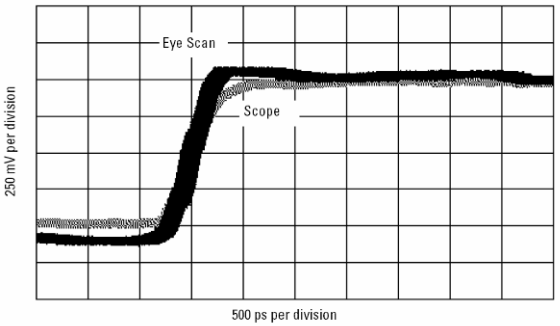
TDT measurement at receiver with and without probe load for 500 ps rise time



Logic analyzer's response to a 150 ps rise time

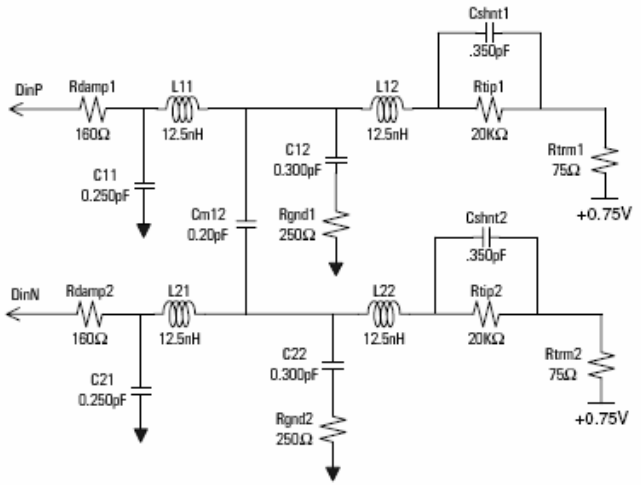


Logic analyzer's response to a 250 ps rise time

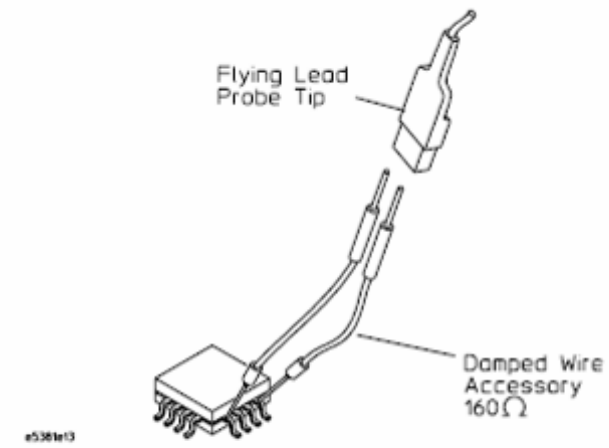


Logic analyzer's response to a 500 ps rise time

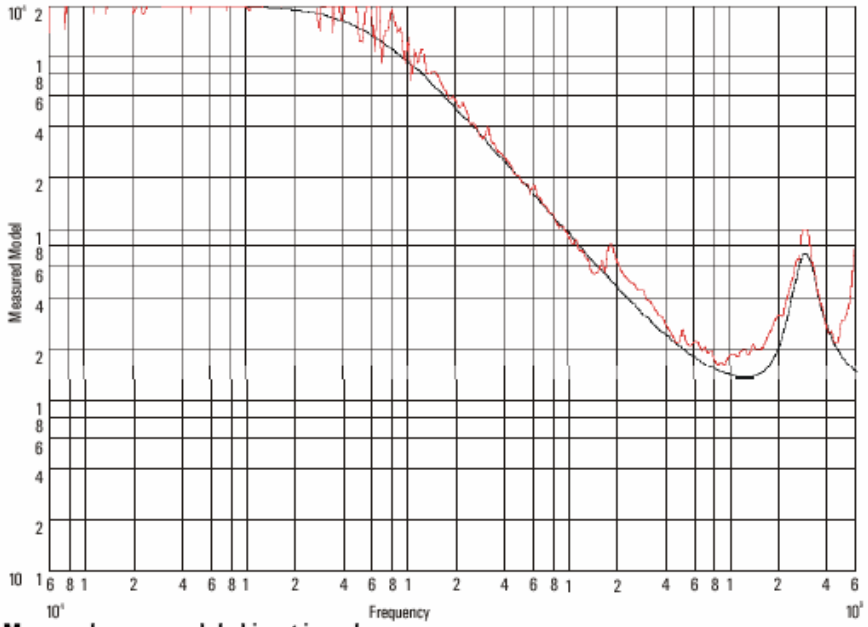
E5381A Differential Flying Leads Damped Wire Accessories



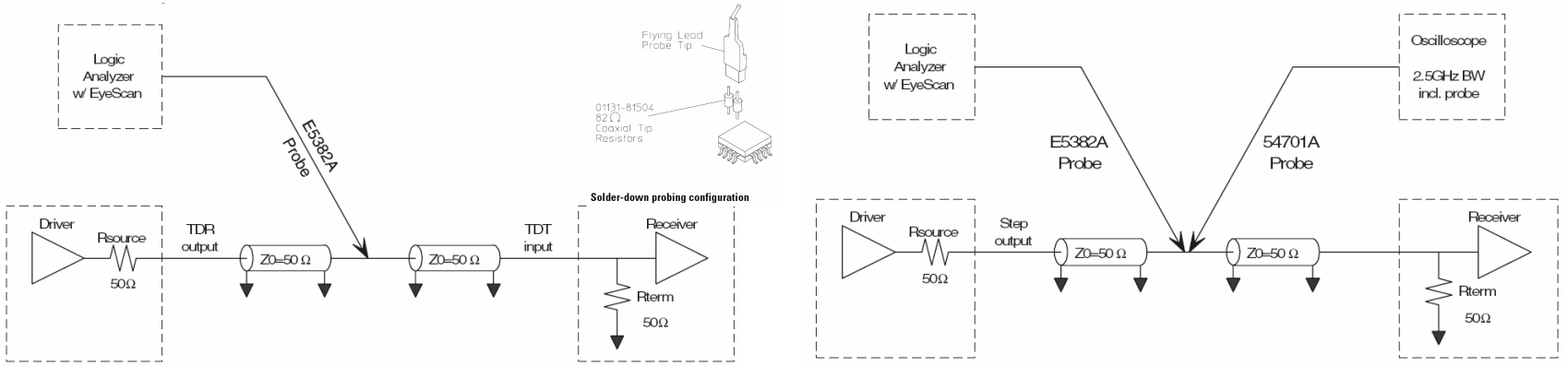
Equivalent load model

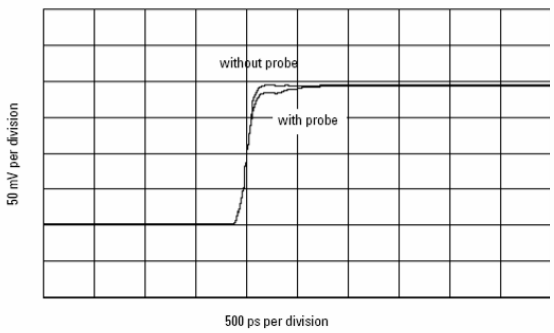


Damped wire configuration

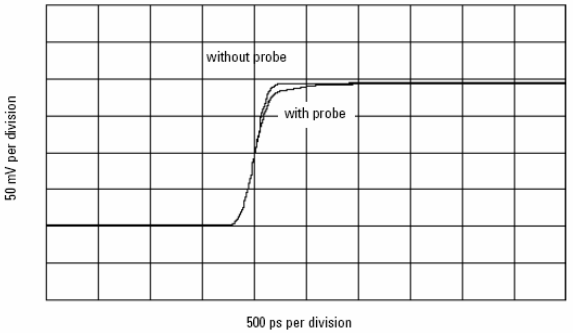


Measured versus modeled input impedance

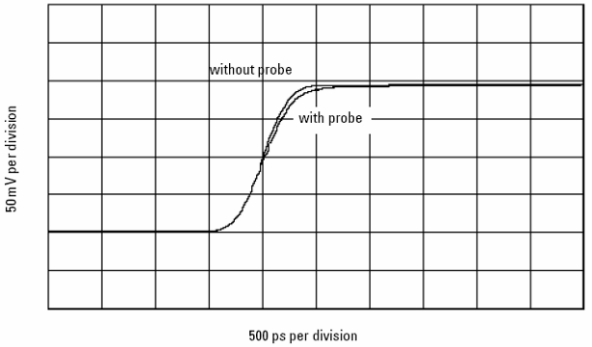




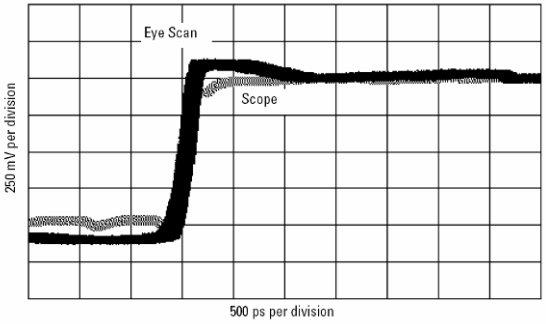
TDT measurement at receiver with and without probe load for 150 ps rise time



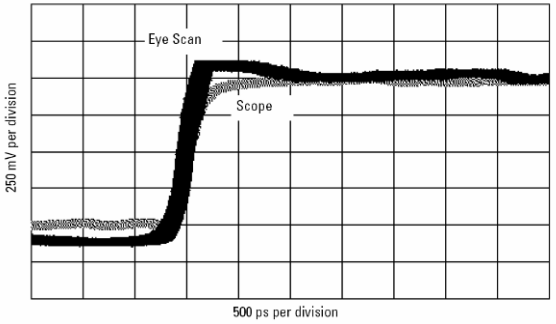
TDT measurement at receiver with and without probe load for 250 ps rise time



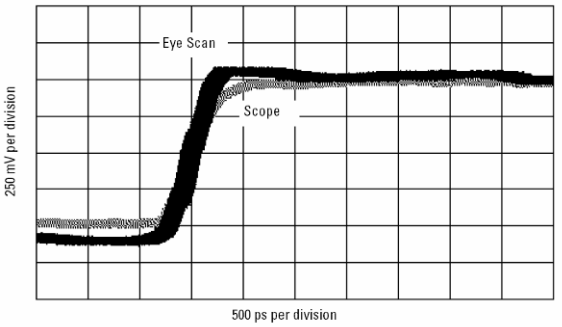
TDT measurement at receiver with and without probe load for 500 ps rise time



Logic analyzer's response to a 150 ps rise time



Logic analyzer's response to a 250 ps rise time



Logic analyzer's response to a 500 ps rise time

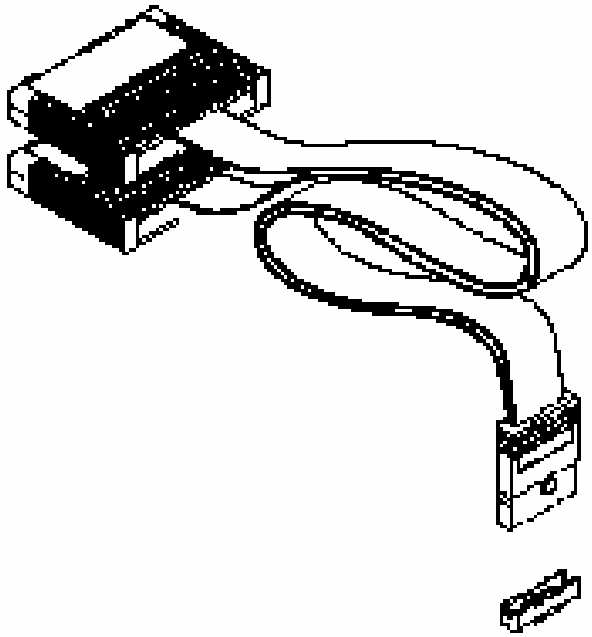
"Designed in" Probing

- Your Prototype Board is still in R&D under definition and you want to consider the available probing solutions, would it be "connector based" solutions or "connector less" solutions

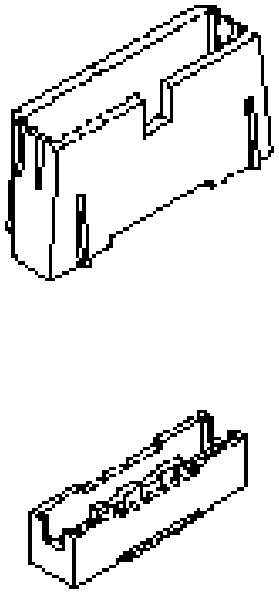
- Based on bus speed, electrical loading acceptable, free space on your board and convenience Agilent will propose you the best probing matching your requirements

High Density Mictor Connectors: Up to 600Mb/s
Loading 3pF

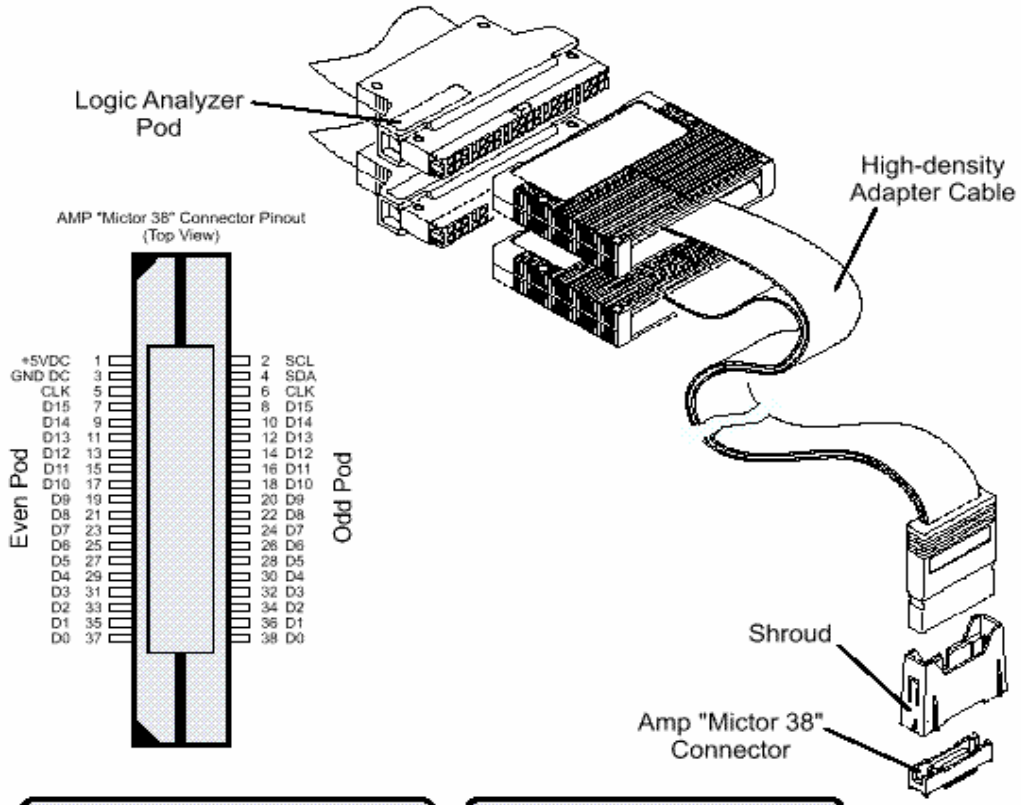
Agilent E5346A High-density termination adapter
32 data channels
2 clock channels

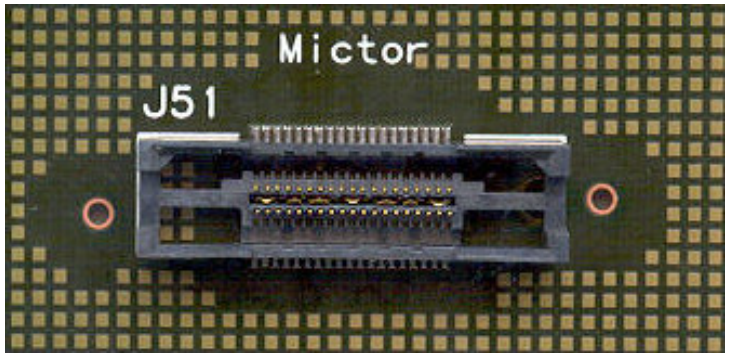


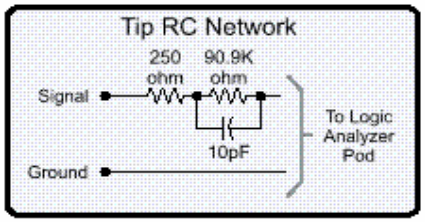
Mictor Connectors for High-density termination adapters

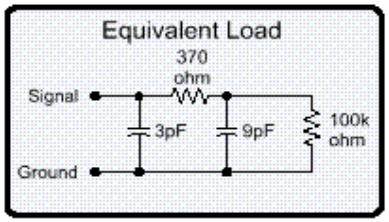


E5346A High Density Adapter







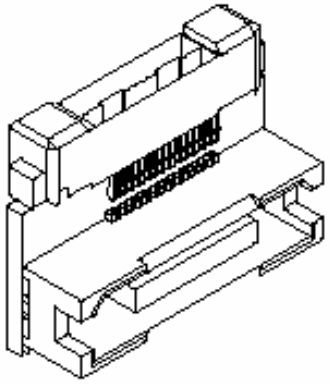


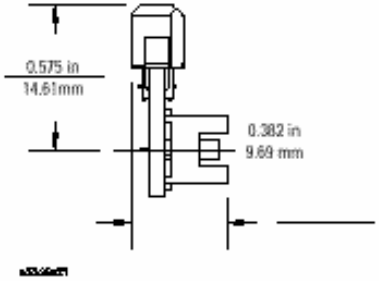
Includes logic analyzer

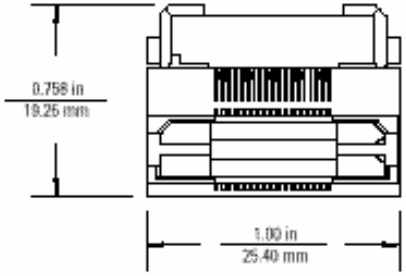
High-Density Mictor Accessories

Right Angle Mictor Adapter

For system constraints above the Mictor Connector, HP offers a right-angle adapter as shown in the figure below. The HP E5346-63201 adapts from the AMP Mictor connector to the high-density adapters. AMP Mictor connectors must be placed side by side on the target system in order to use the right-angle adapters. Support shrouds cannot be used with the right-angle adapter.







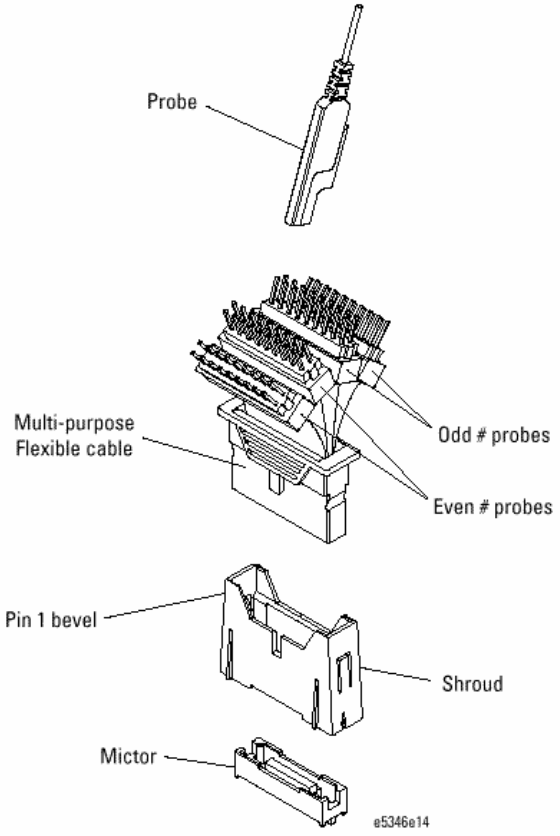
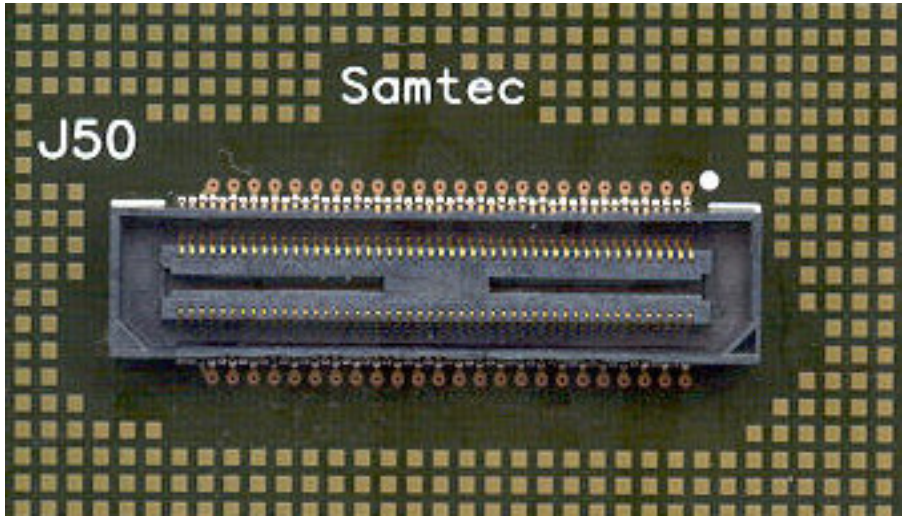


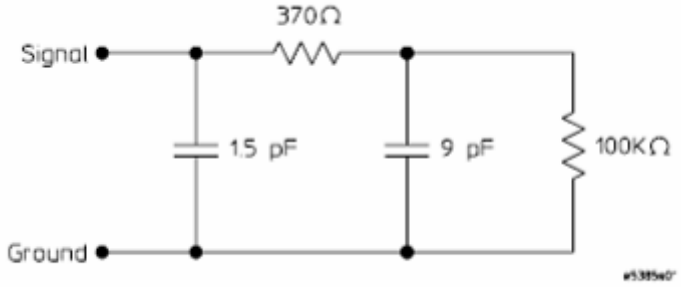
Figure 8. HP E5346-60002 High Speed Mictor Adapter

High Density SAMTEC Connectors: Up to 1.5Gb/s Loading 1.5pF



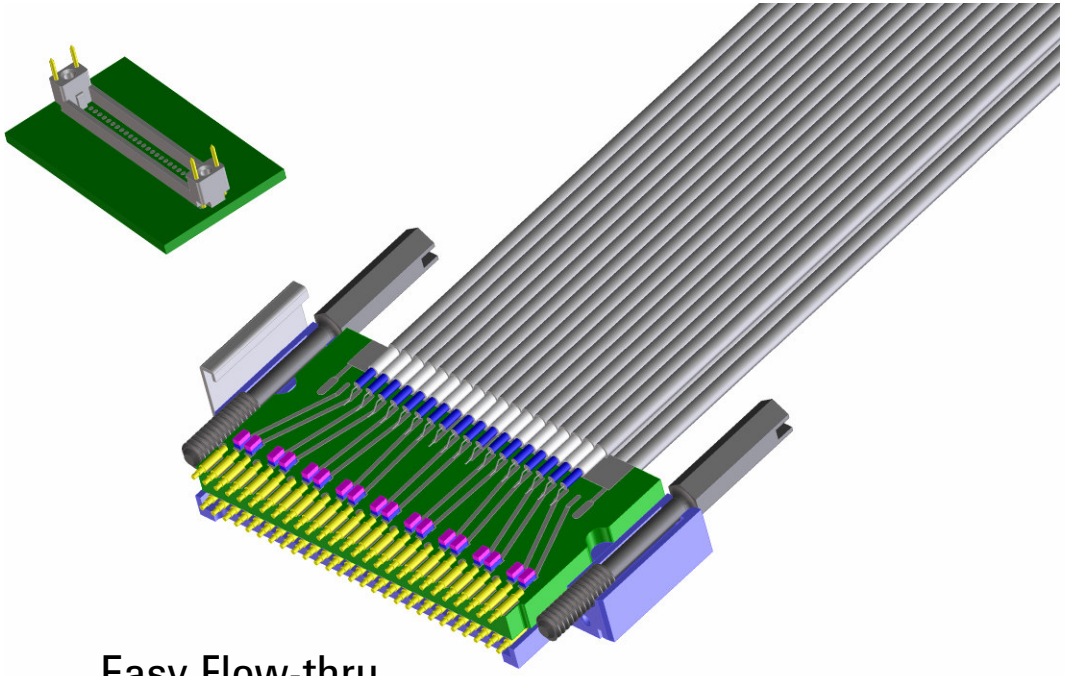
DDR2 memory

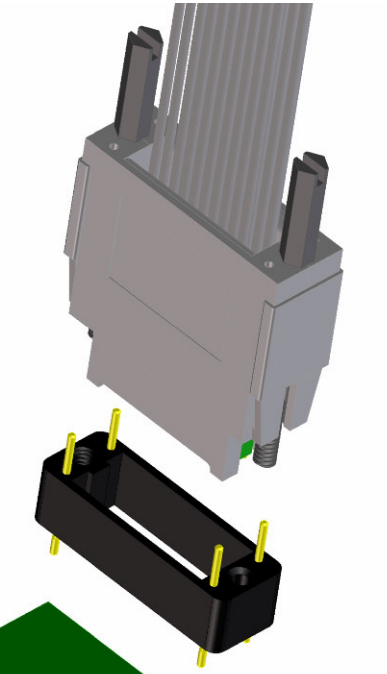
SERIAL ATA



All Included Equivalent Load

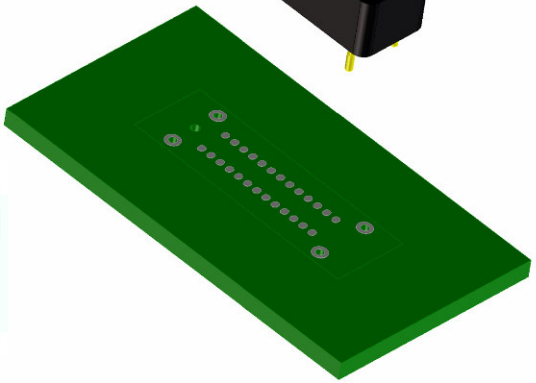
Soft Touch Connectorless Probes Loading <0.7pF



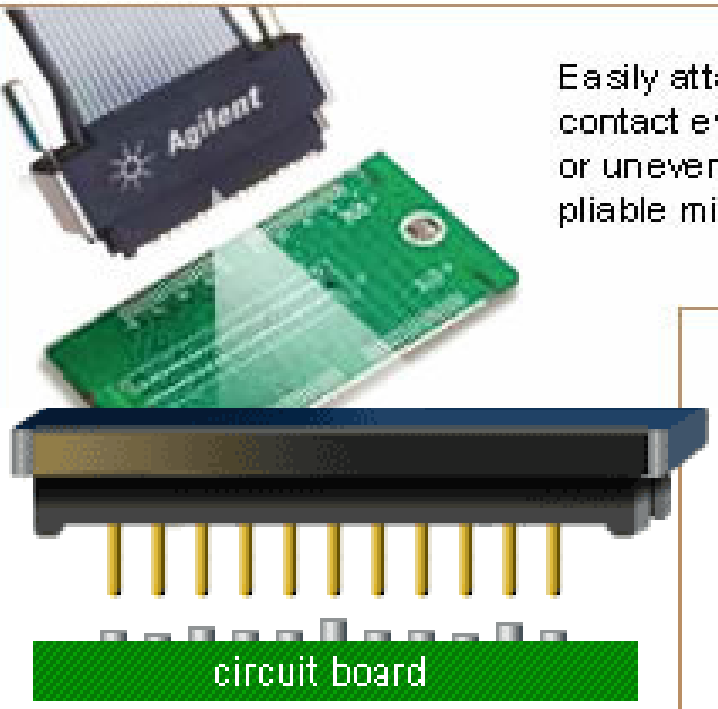


Easy Flow-thru routing

New LA Multivendor Standard



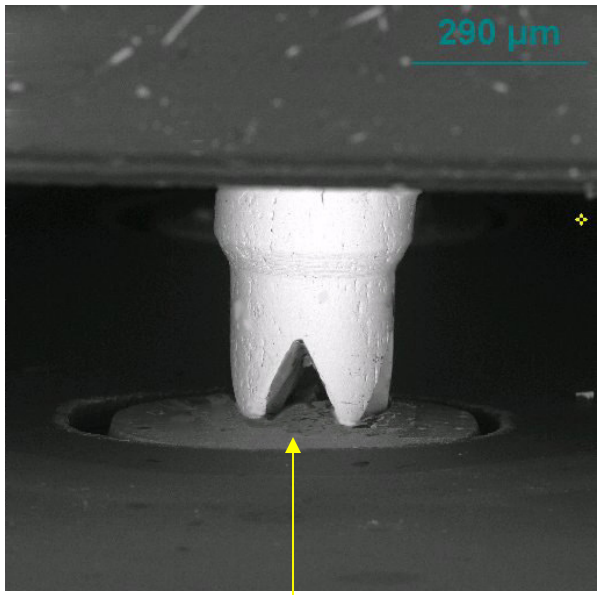
Soft Touch Connectorless Probes

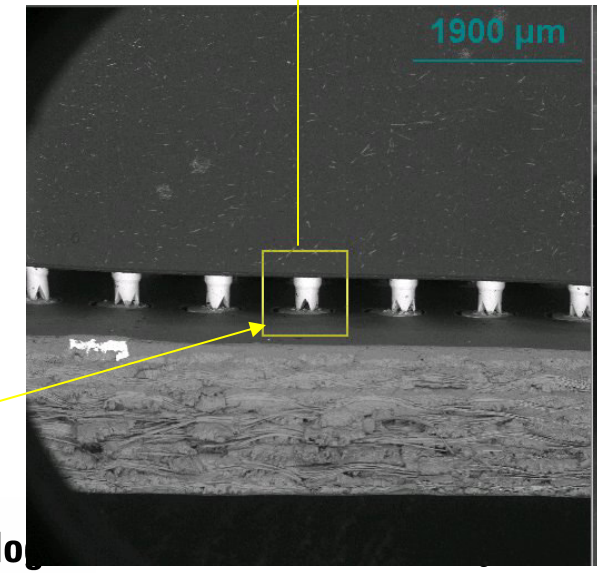


Easily attach—get reliable contact even for contaminated or uneven board surfaces with pliable micro spring-pin design.

Pliable micro spring-pin design

4-point crown tip makes connection, even through contamination

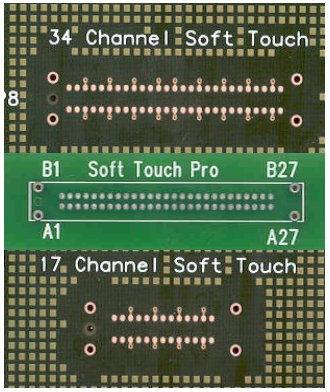




Full Size SoftTouch

SoftTouch PRO

Half Size SoftTouch



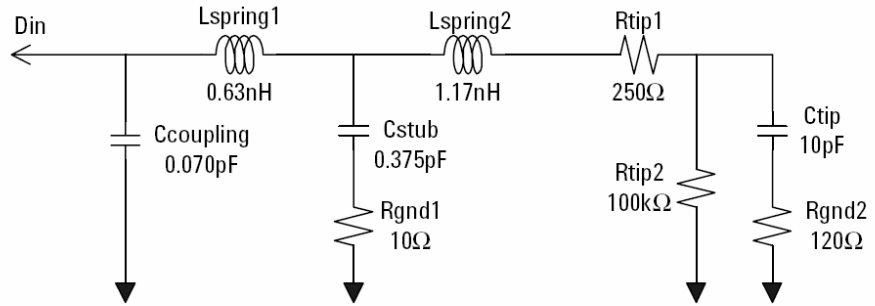
Logic Analysis Probing Challenges

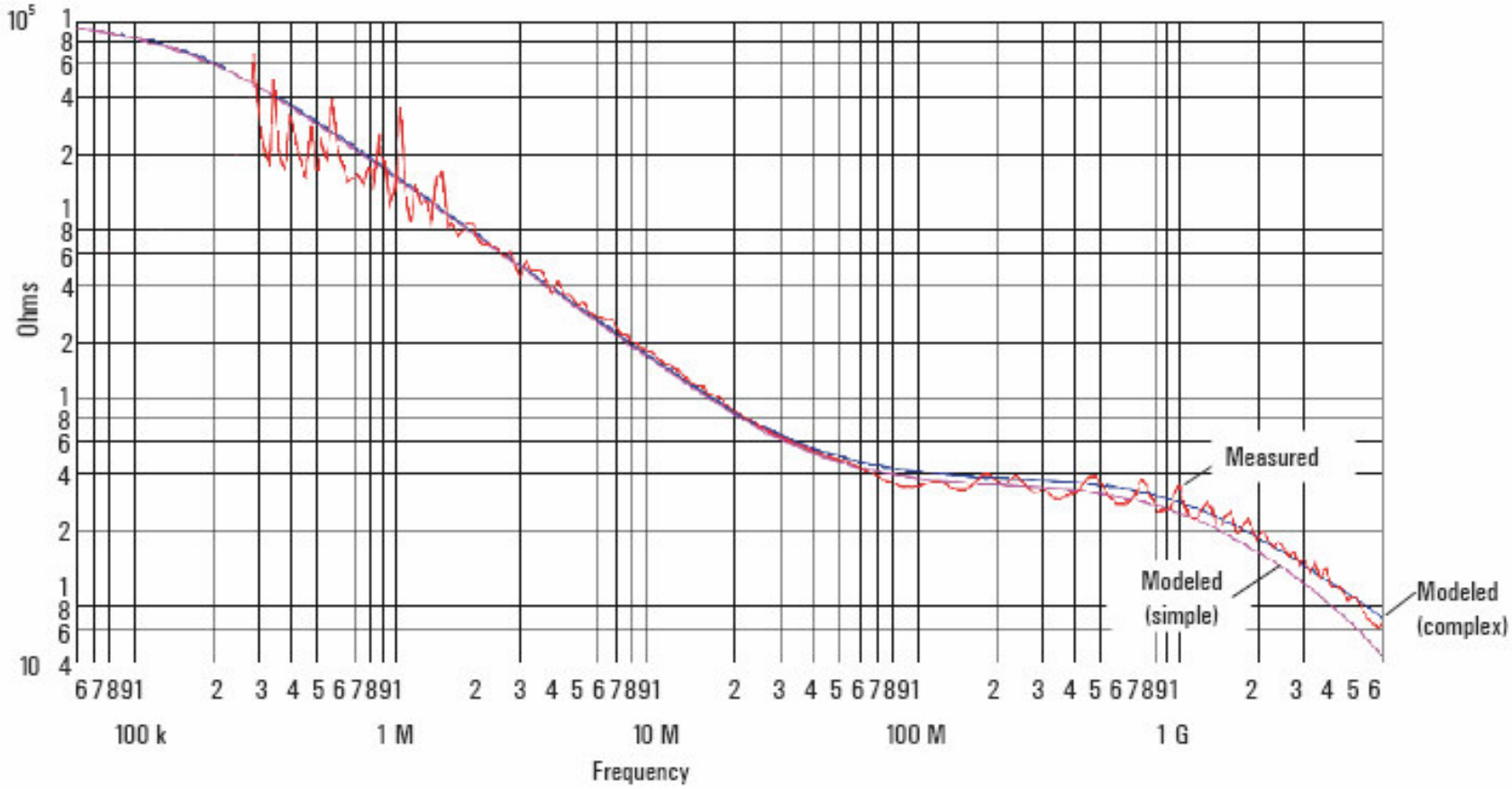
Agilent Technolo

E5404A SoftTouch PRO

34 Channels Single-ended

Equivalent Load





E5404A SoftTouch PRO 34 Channels Single-ended

TimeDomain Loading Effect using TDT

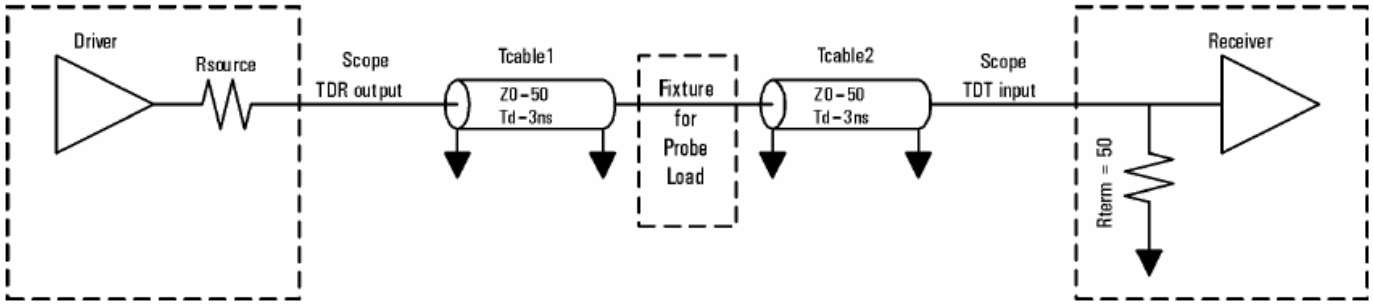


Figure 19 TDT measurement schematic (E5404A)

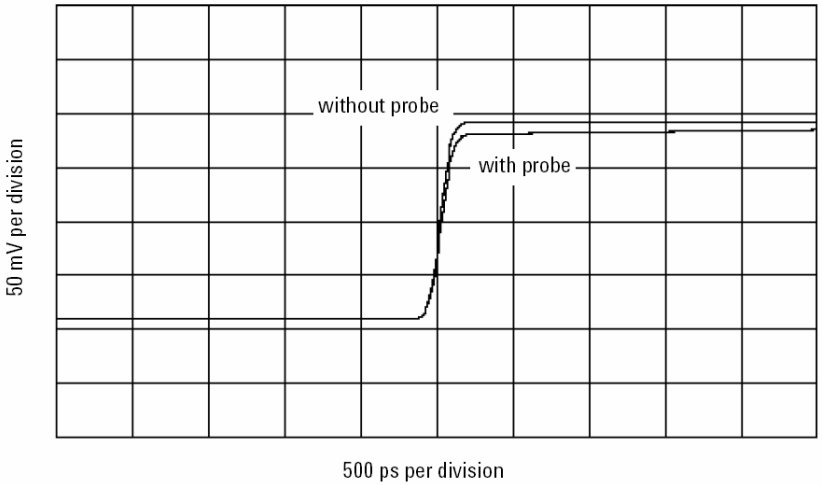


Figure 20 TDT measurement at receiver with and without probe load for 150 ps rise time

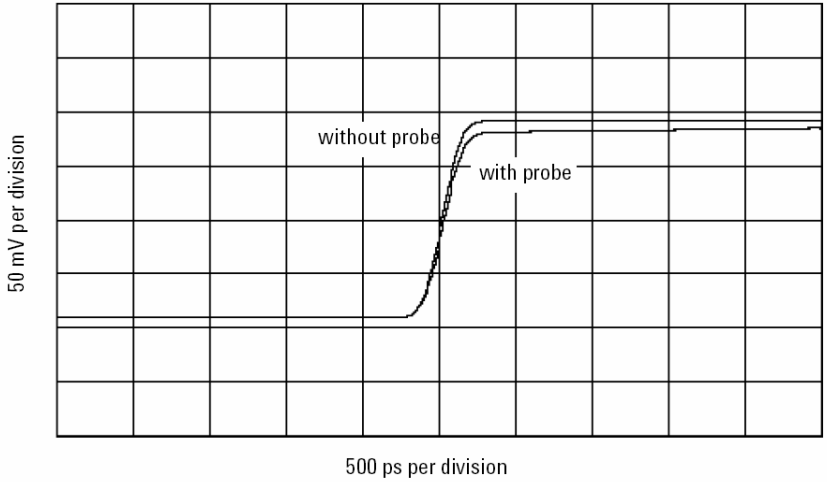
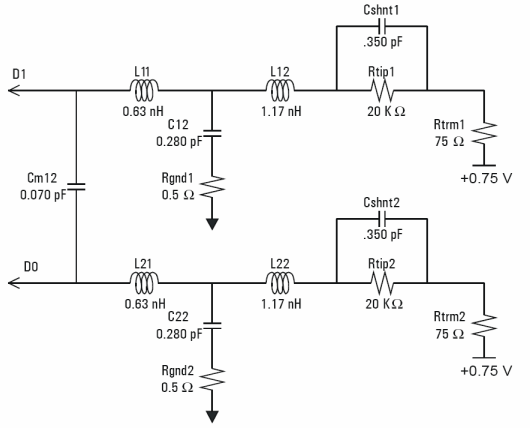


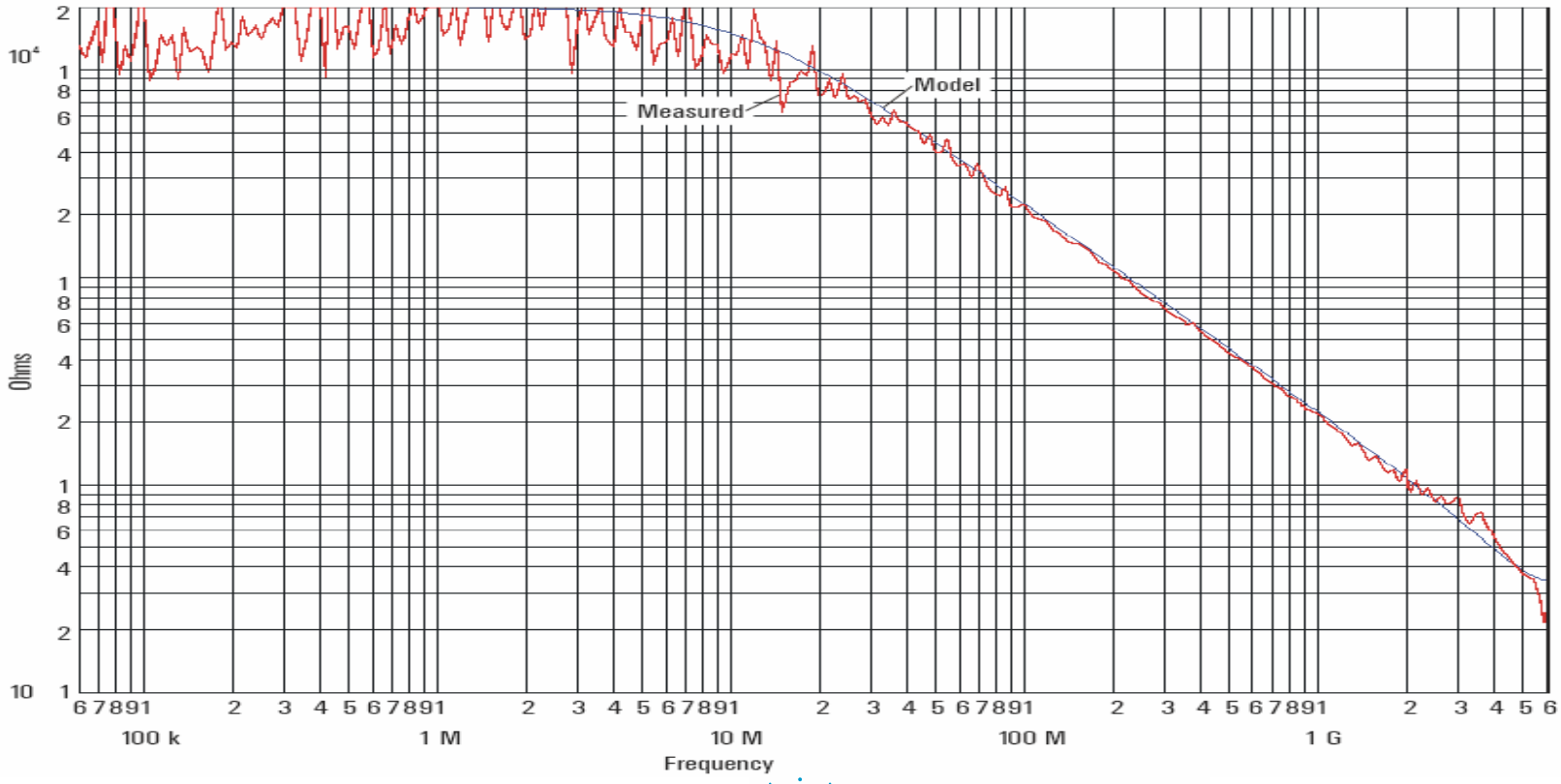
Figure 21 TDT measurement at receiver with and without probe load for 250 ps rise time

E5405A SoftTouch PRO

17 Channels Differential

Equivalent Load





E5405/6A SoftTouch PRO 17 Channels Differential

TimeDomain Loading Effect using TDT

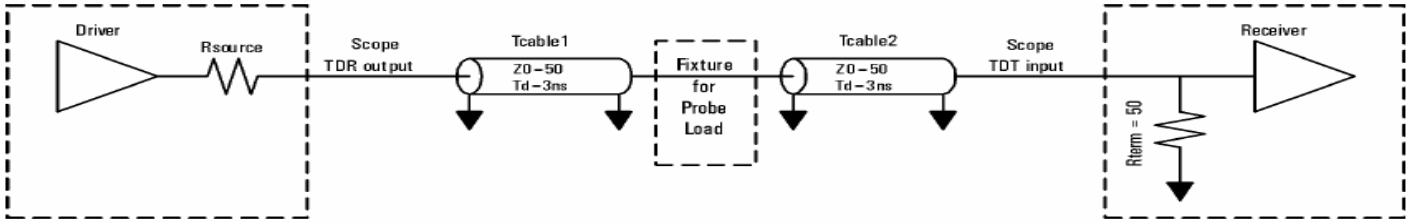


Figure 26 TDT measurement schematic (E5405A and E5406A)

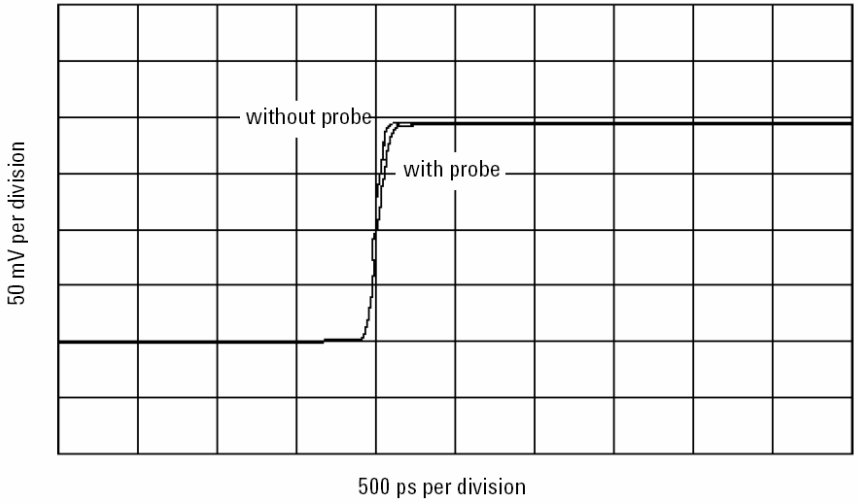


Figure 27 TDT measurement at receiver with and without probe load for 100 ps rise time

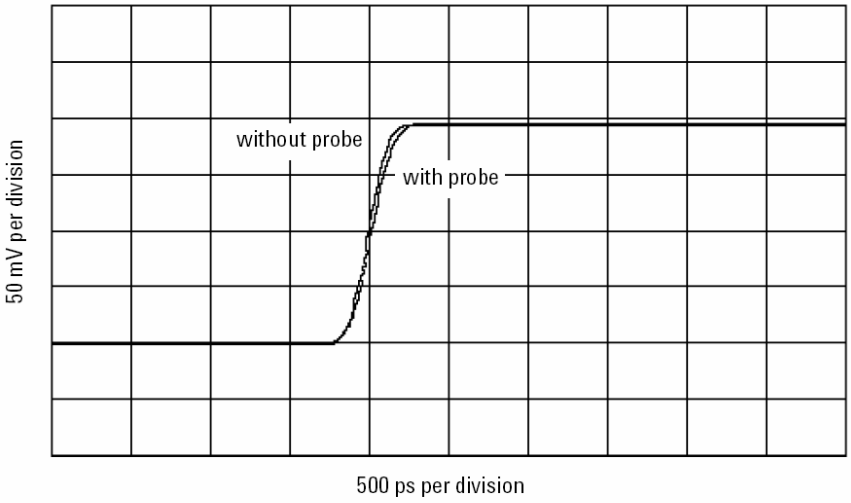
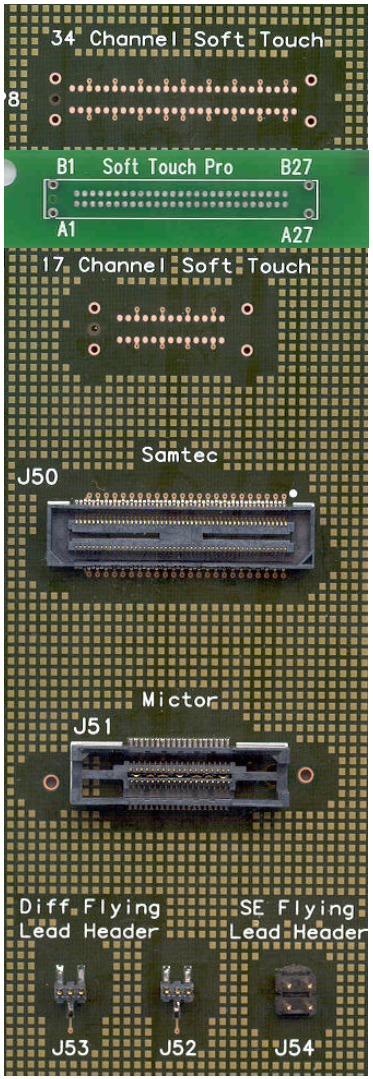


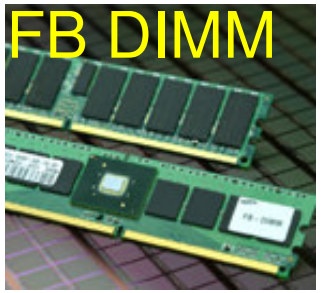
Figure 28 TDT measurement at receiver with and without probe load for 250 ps rise time

Logic Analyzer Probing Choices



Select	If You Want
Soft Touch Connectorless Probe	•Extremely Low Loading—<0.7pf •Ability to Capture Very Fast Signals—1500Mb/s •Easy Flow Thru Routing •Differential Signaling •The Joy of no connector on the board
Samtec Connector Probe	•Very Low Loading—1.5pf •Ability to Capture Very Fast Signals—1,500Mb/s •Flow Thru Routing •Differential Signaling •High performance probe at a low price
Mictor Connector Probe	•Low Loading—3.0pf •Ability to capture Fast Signals—600Mb/s •Common Probing
Flying Lead Probe	•Extremely Low Loading—As low As 0.9pf •Ability to Capture Very Fast Signals—Up to 1,500Mb/s •Differential Signaling •The Ultimate in probing Flexibility

Dedicated Processor & bus probes



Simple and rugged physical connections

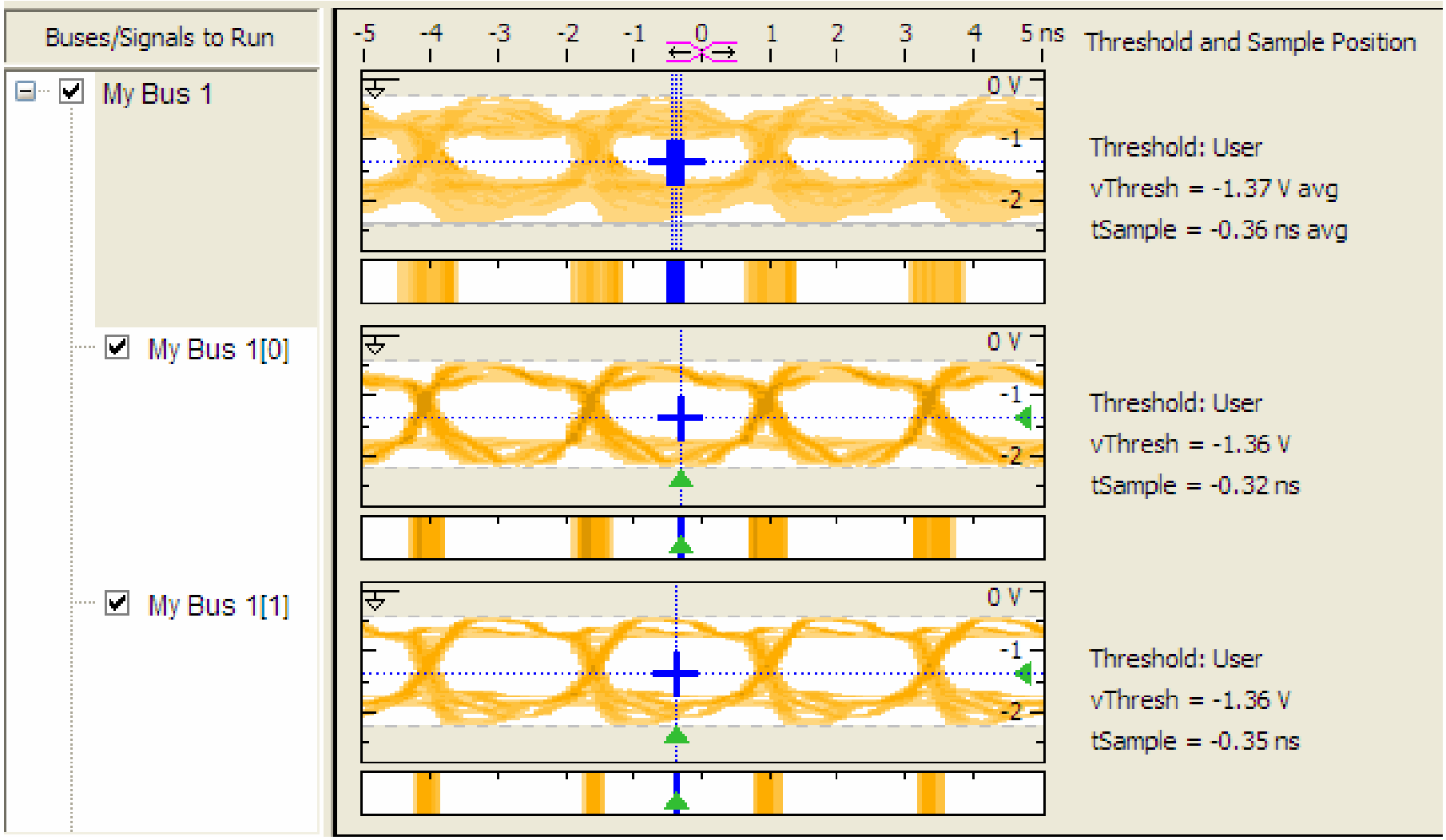
- Non-Instrusive Passive Probing Design
- Conventional/enhanced inverse assembly
- Bus, label, and clock configurations
- On-chip execution tracking
- Custom support available through Agilent's Channel Partners

RS232	I2C	SPI	CAN

Eye scan

A new tool for saving time and building confidence in signal integrity

Looks Familiar ?



What is EYESCAN?

1) Automated Threshold and Sampling Point Adjustment individually on each Channel input

2) "Scope Like" Eyediagram on a Logic Analyzer without Scope

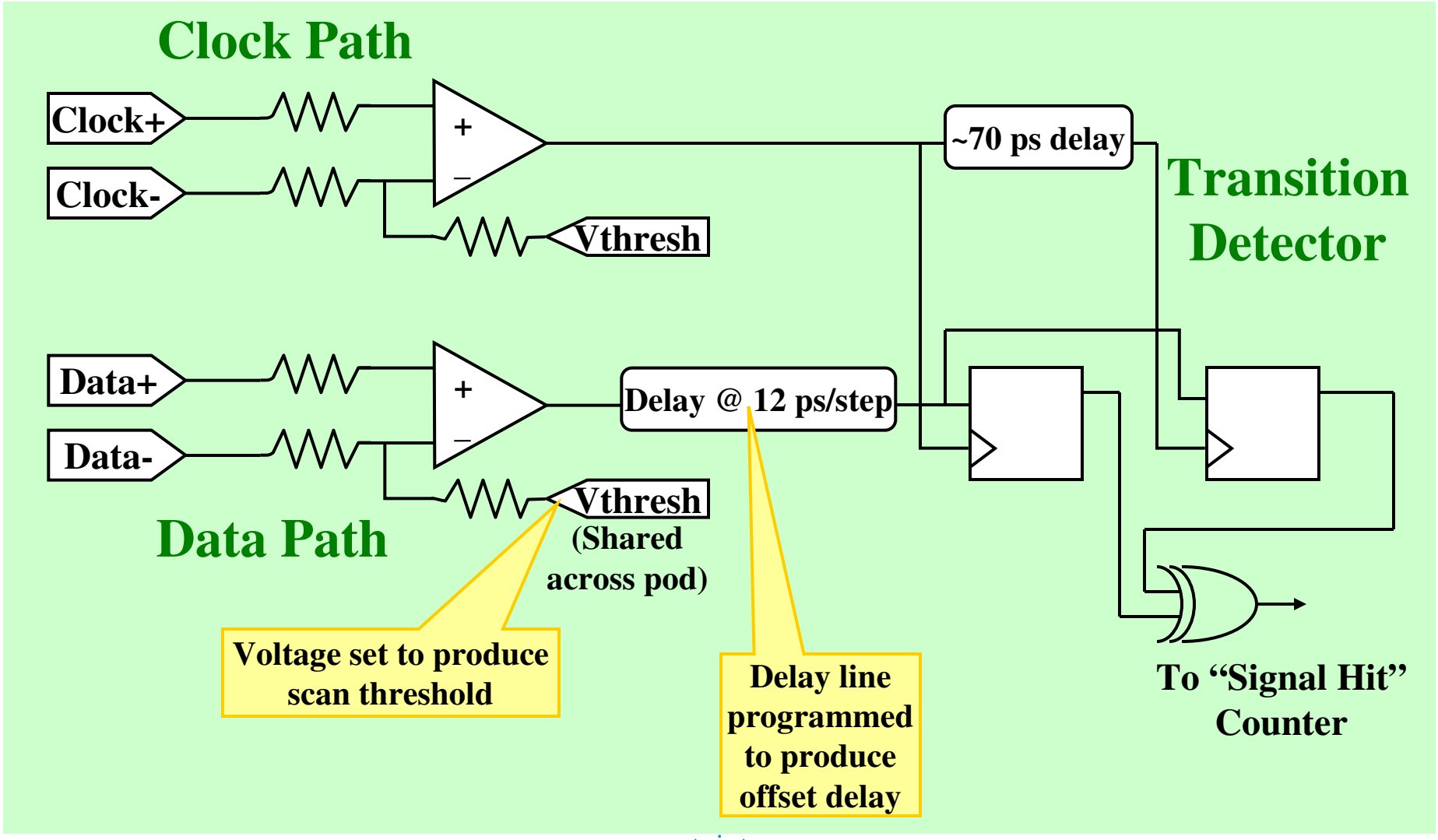
3) Hundreth Simultaneous EyeDiagrams captured and displayed at once

4) Millions CONSECUTIVE Active Clock Edges Analysis on each measurement point (Threshold Value / Time ins respect to Clock Edge)

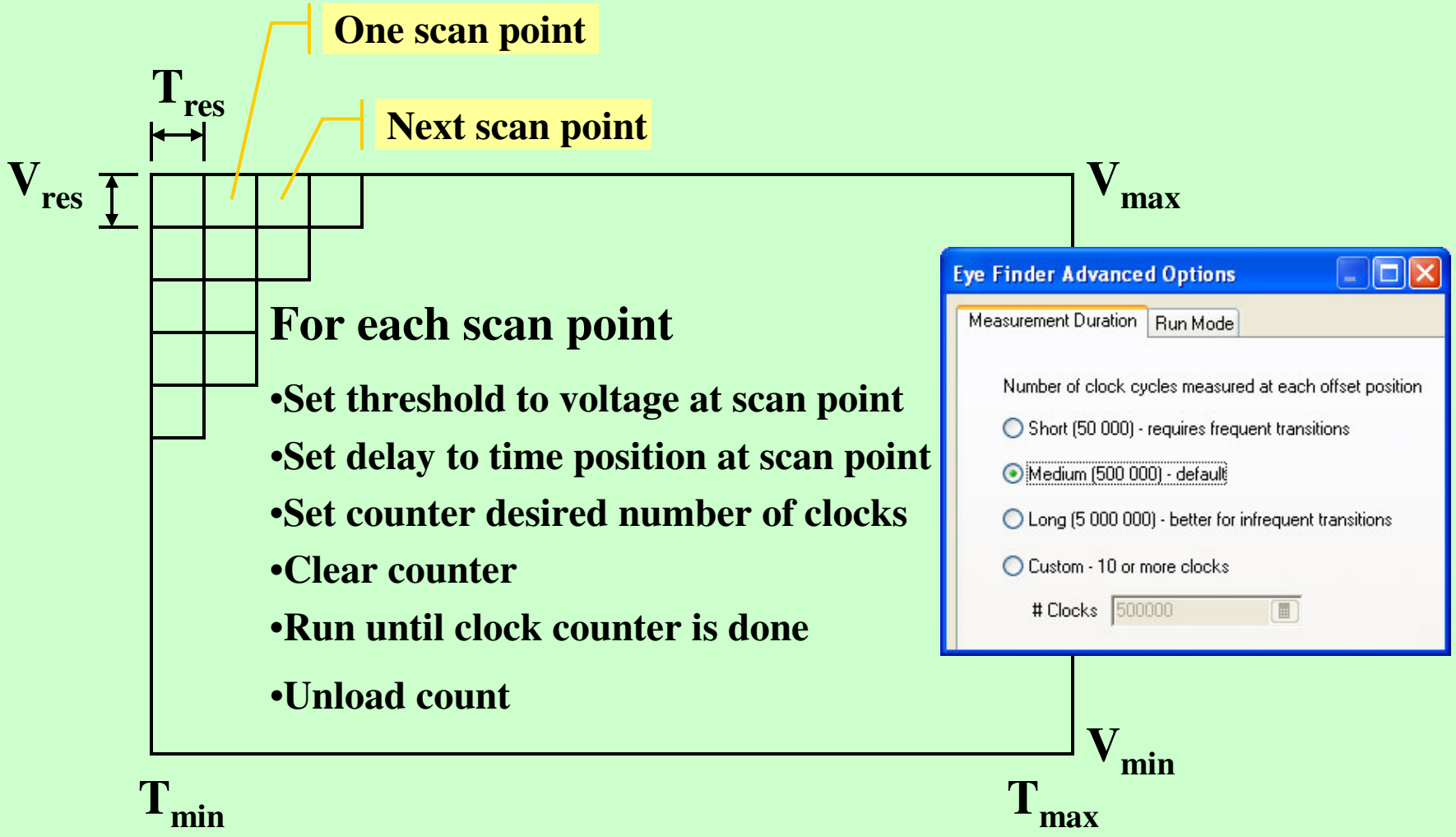
5) Quick Signal Integrity Validation Tool to pinpoint faulty Channels presenting Signal Integrity symptoms Ringing,ISI,DCD,JITTER

6) Time Saving Feature
-> Connect or Solder your 12GHz active Probe and 12GHz 40GSa/s Realtime Scope straight to the faulty channels for advanced Analysis.

How does it Work: The Signal Path

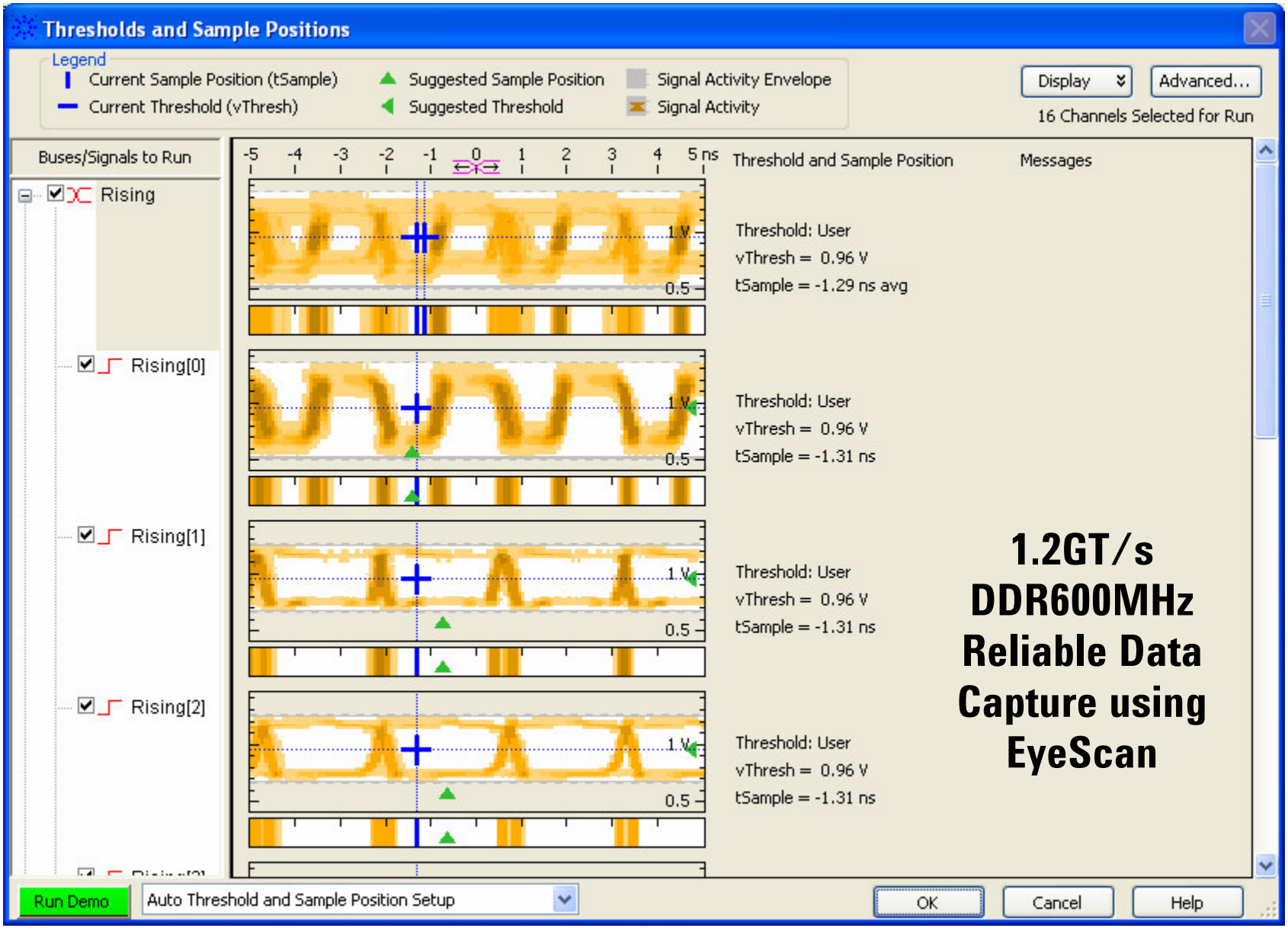


The Measurement Scan



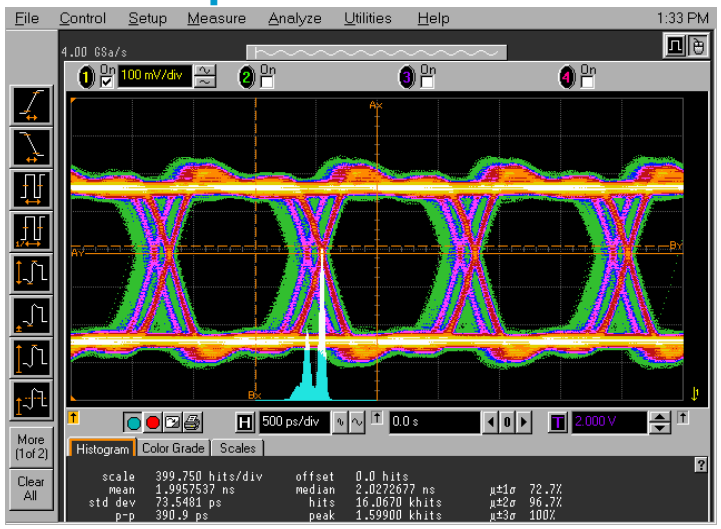
The measurement process

- The counter accumulates the number of transitions detected.
- The delays are constant during each run.
- Each run goes for a fixed number of consecutive clocks edges with no Dead Time
- A stable position has no edges (counter is zero).
- Intensity displayed on the screen corresponds to the number of transitions detected at that point.

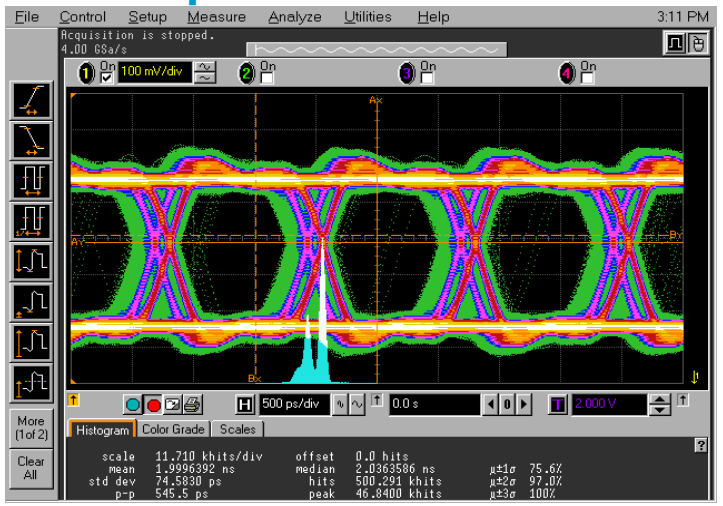

Thresholds and Sample Positions
Legend
Current Sample Position (tSample)
Current Threshold (vThresh)
Suggested Sample Position
Suggested Threshold
Signal Activity Envelope
Signal Activity
Display
Advanced...
16 Channels Selected for Run
Buses/Signals to Run
Rising
Rising[0]
Rising[1]
Rising[2]
-5 -4 -3 -2 -1 0 1 2 3 4 5 ns
Threshold and Sample Position
Messages
Threshold: User
vThresh = 0.96 V
tSample = -1.29 ns avg
Threshold: User
vThresh = 0.96 V
tSample = -1.31 ns
Threshold: User
vThresh = 0.96 V
tSample = -1.31 ns
Threshold: User
vThresh = 0.96 V
tSample = -1.31 ns
1.2GT/s DDR600MHz Reliable Data Capture using EyeScan
Run Demo
Auto Threshold and Sample Position Setup
OK
Cancel
Help

Signal integrity seminar 2005

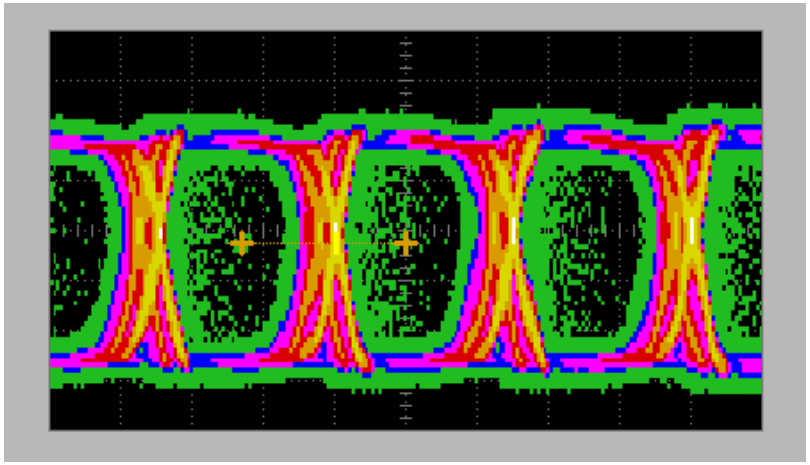
Oscilloscope after 5 minutes



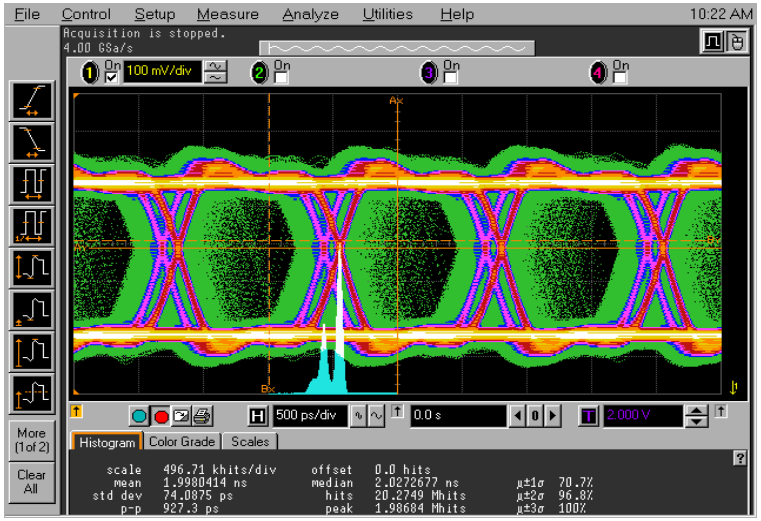
Oscilloscope after 2 hours



Eye scan view after 5min



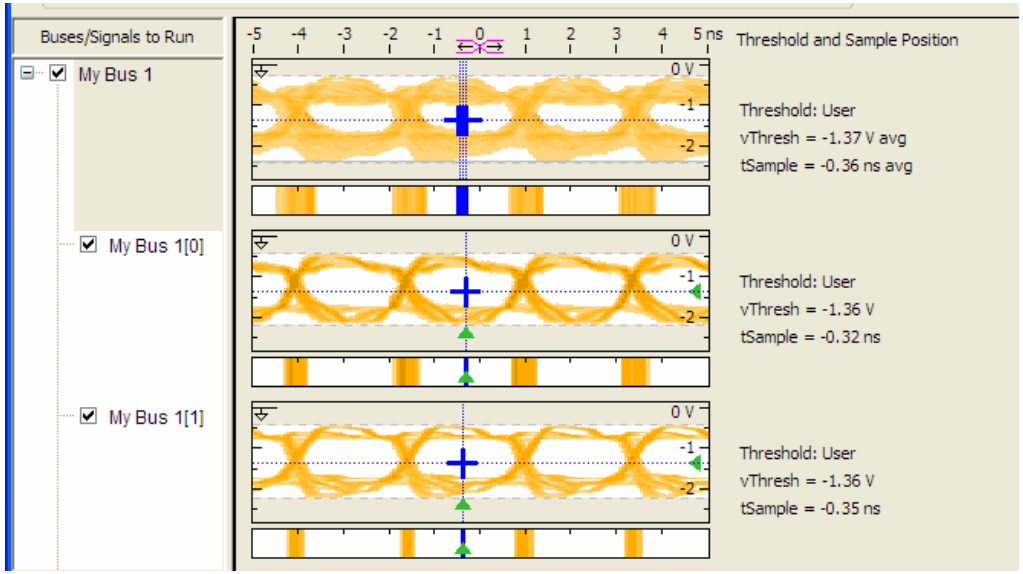
Oscilloscope after 72 hours



16760A High-Speed State/Timing Module for 16900 Series Logic Analysis System

High-speed analysis to meet your needs...

- **1.5 Gb/s max state rate**
- **800 MHz timing**
- **Up to 128 M memory depth**
- **10 ps resolution with Eye finder and Eye Scan**



High-speed designs require THE FASTEST timing/state logic analyzer
The Agilent 16760A

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Thank you for attending the Signal Integrity Logic Analysis Probing Challenges Presentation.

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IMPORTANT
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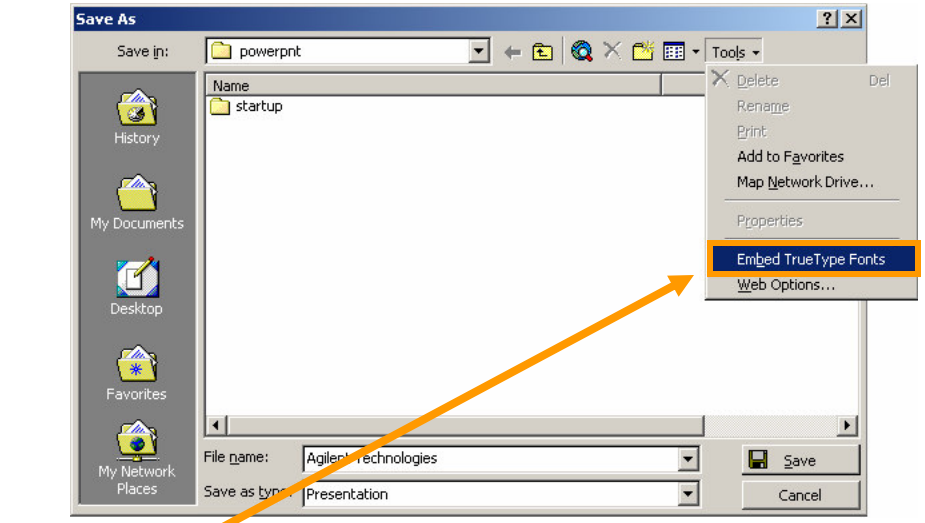
1. **When saving, use File>Save As.**
2. **In the Save As dialog box, select Tools from the menu bar.**
3. **Select Embed True Type Fonts and save the file.**



Screenshot of Microsoft ® PowerPoint 2000

Note: Embedding fonts will increase file size.