User's Guide

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For Safety information, Warranties, and Regulatory information, see the pages behind the index.

Agilent Technologies Connector-based Probes for 1675x/1676x Logic Analyzers

(E5378A, E5379A, E5380A, and E5386A)

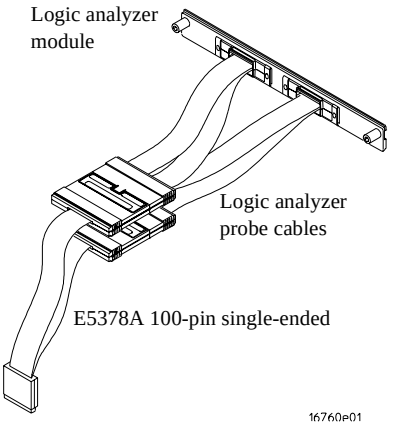
Probing Solutions for Agilent High Speed State Analyzers — At a Glance

The probes in this manual are designed to be used with the Agilent 16753A, 16754A, 16755A, 16756A, and 16760A logic analyzers. They will also work with any future analyzers that use a 90-pin connector on the cable where the probe attaches to the logic analyzer. For more information on Agilent logic analyzers, refer to http://www.agilent.com/find/logicanalyzer. For more information on your specific analyzer, refer to the online help in the product.

E5378A 100-pin Single-ended Probe

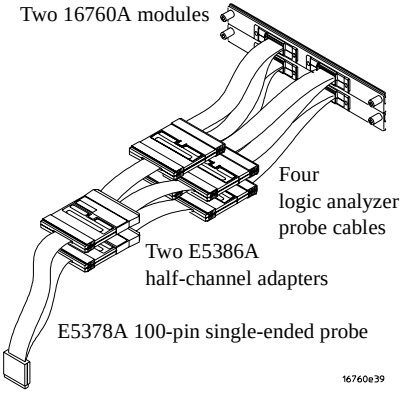
Also available as option 010 on supported Agilent logic analyzers.

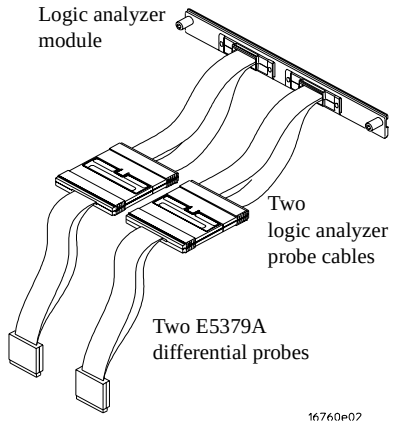
- 34 Channels
- State speeds up to 1.5 Gb/s (17 channels)
- 250 mV peak-to-peak sensitivity
- 100-pin Samtec connector
- Requires Probing Connector Kit (see page 60)



E5386A Half-channel Adapter with E5378A (for use with 16760A)

The E5386A adapter maps the 34 signals from the 100-pin Samtec connector to the 16760A when operating in half-channel state mode..

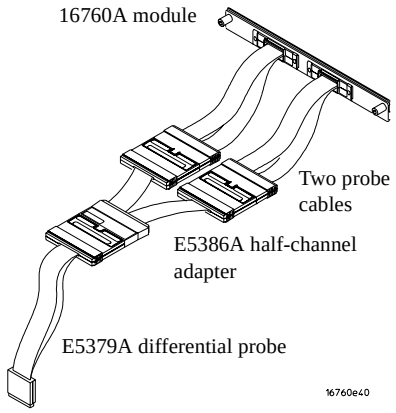




E5379A 100-pin Differential Probe

Also available as option 011 on supported Agilent logic analyzers.

•17 Channels
•State speeds up to 1.5 Gb/s (9 channels)
•200 mV peak-to-peak sensitivity
•100-pin Samtec connector
•Requires Probing Connector Kit
(see page 60)



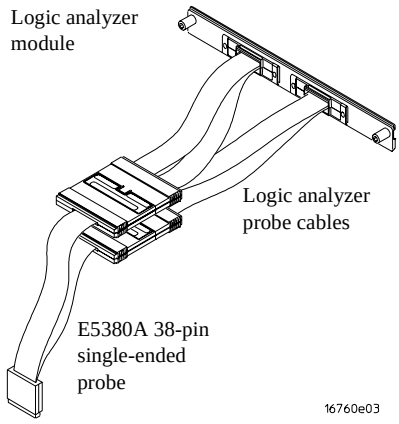
E5386A Half-channel Adapter with E5379A (for use with 16760A)

The E5386A adapter maps the 17 differential signals from the 100-pin Samtec connector to the 16760A when operating in half-channel state mode. This configuration provides state speeds up to 1.5 Gb/s on all 17 channels.

E5380A 38-pin Single-ended Probe

Also available as option 012 on supported Agilent logic analyzers.

- Compatible with boards designed for Agilent E5346A 38-pin Probe
- 34 Channels
- State speeds up to 600 Mb/s
- 300 mV peak-to-peak sensitivity
- 38-pin MICTOR connector
- Requires AMP MICTOR 38 Connector and Agilent Support Shroud
(see page 60)



In This Book

In this book, you will find information that helps you understand and implement the high-bandwidth, high density probing solutions available with the Agilent 16760A high speed state logic analyzer. Use this information to both evaluate the electrical and mechanical implications to your target system's design, and to properly select and layout the proper components used to connect to the logic analyzer.

Chapter 1 provides a description of the available probing options and tables to help determine which probes to use.

Chapter 2 covers the mechanical considerations such as connector/shroud type, footprint for PC board layout, and probe/connector dimensions.

Chapter 3 provides operation information including electrical considerations such as equivalent probe loads, input impedance, time domain transmission (TDT), step inputs, and eye opening.

Chapter 4 provides design considerations for layout of your circuit board.

Chapter 5 offers a list of recommended reading for additional information.

Chapter 6 lists connectors and shrouds that may be ordered.

At a Glance

1 Probing Options 9

2 Mechanical Considerations 17

1

Probing Options

Information to help you select the appropriate probe for your application.

Introduction to Probing Options

This chapter provides information to help you select the appropriate probe for your application. You will find descriptions of the logic analyzer probes and adapters. Tables in this chapter show you the number of probes required and the maximum state speed supported depending on which logic analyzer you have. Another table shows the number of data and clock inputs for the various operating modes of your logic analyzer.

Descriptions of specific probes and adapters

- E5378A 100-pin single-ended probe (page 12)
- E5379A 100-pin differential probe (page 13)
- E5380A 38-pin single-ended probe (page 14)
- E5386A Half-channel adapter (page 15)

NOTE: The 100-pin probes (E5378A, E5379A) are recommended over the 38-pin probe (E5380A). The 100-pin probes have much less intrusive loading on the target system, they operate at the 16760A logic analyzer's full specified state clock speed of 1.5 Gb/s, and they support smaller-amplitude signals.

Number of Probes Required

This table shows how many probes are required to provide connections to all channels of your logic analyzer module.

Probe	Logic Analyzer Module	
	16760A	**16753A, 16754A, 16755A, 16756A**
E5378A 100-pin single-ended probe	1	2
E5379A 100-pin differential probe	2	4
E5380A 38-pin single-ended probe	1	2

Maximum State Speed Supported

This table gives you the maximum state speed that is supported by the combination of a probe and your logic analyzer module.

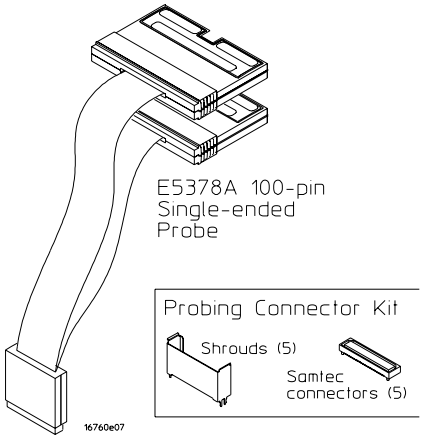
Probe	Logic Analyzer Module	
	16760A	**16753A, 16754A, 16755A, 16756A**
E5378A 100-pin single-ended probe	1.5 Gb/s	600 MHz
E5379A 100-pin differential probe	1.5 Gb/s	600 MHz
E5380A 38-pin single-ended probe	600 Mb/s	600 MHz

The E5378A 100-pin Single-ended Probe

The Agilent E5378A is a 34-channel, single-ended, 100-pin probe compatible with the Agilent 16753A, 16754A, 16755A, 16756A, and 16760A logic analysis modules. It is capable of capturing data up to the rated maximum state (synchronous) analysis clock rates of all the supported analyzers, with signal amplitudes as small as 250 mV peak-to-peak. A 100-pin connector must be installed on the target system board to mate with the E5378A.

The Agilent 16760-68702 or 16760-68703 Probing Connector Kit is required for connecting the E5378A 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. See the table on page 60 for part numbers.

See Also Chapter 2 for the mechanical information to design the connector into your target system board.



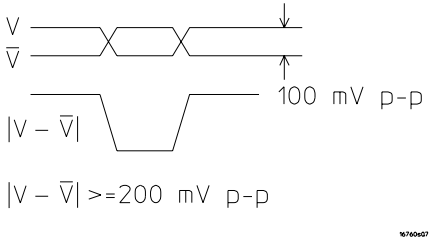
E5378A 100-pin single-ended probe and probing connector kit

The E5379A 100-pin Differential Probe

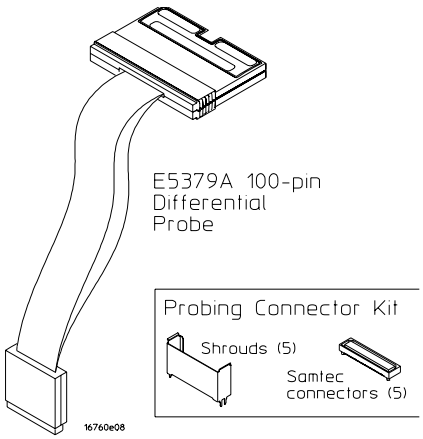
The Agilent E5379A is a 16-channel, single-ended, 100-pin probe compatible with the Agilent 16753A, 16754A, 16755A, 16756A, and 16760A logic analysis modules. It is capable of capturing data up to the rated maximum state (synchronous) analysis clock rates of all the supported analyzers, with differential signal amplitudes as small as 200 mV peak-to-peak (100 mV peak-to-peak on both positive and negative inputs). A 100-pin connector must be installed on the target system board to mate with the E5379A.

The Agilent 16760-68702 or 16760-68703 Probing Connector Kit is required for connecting the E5379A 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. See the table on page 60 for part numbers.

Differential Input Amplitude Definition. For differential signals, the difference voltage V - $\overline{V}$ must be greater than or equal to 200 mV p-p.



See Also
Chapter 2 for the mechanical information to design the connector into your target system boards.



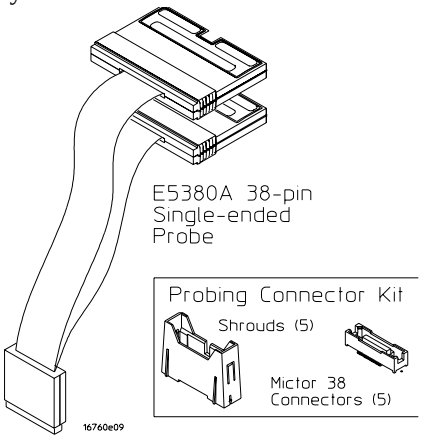
E5379A 100-pin differential probe and probing connector kit

The E5380A 38-pin Single-ended Probe

The E5380A is a 34-channel, single-ended, 38-pin probe designed to be compatible with the AMP MICTOR 38-pin connector. It is pin-compatible with target systems that were designed for the Agilent E5346A 38-pin probe, thus enabling you to use Agilent's latest logic analyzers with target systems that were designed for older Agilent logic analyzers. The E5380A is compatible with the Agilent 16753A, 16754A, 16755A, 16756A, and 16760A logic analysis modules. It 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 Agilent E5346-68701 or E5346-68700 Probing Connector Kit is required for connecting the E5380A 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. See the table on page 60 for part numbers.

See Also Chapter 2 for the mechanical information to design the connector into your target system board

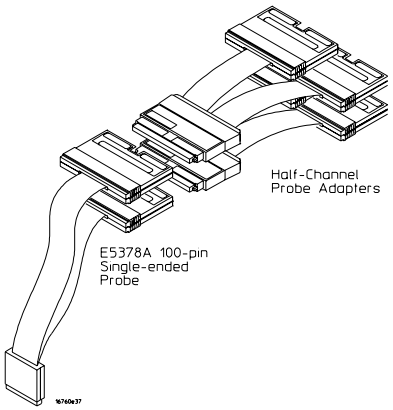


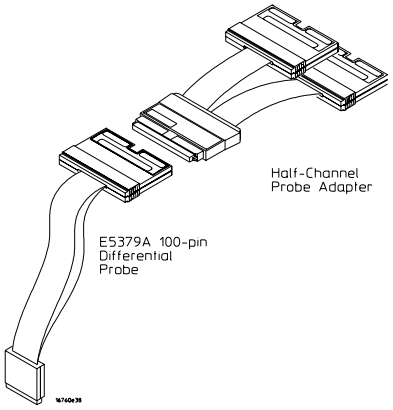
E5380A 38-pin single-ended probe and probing connector kit

The E5386A Half-channel Adapter

The E5386A Half-channel Adapter is intended to be used with the 16760A logic analyzer in half-channel state mode and works with:

- E5378A 100-pin Single-ended Probe
- E5379A 100-pin Differential Probe





The E5386A Half-channel Adapter has its own ID code. When using the adapter, the logic analyzer recognizes its code rather than that of the probe which is attached to the target. Therefore, the user interface format menu doesn't automatically set thresholds to the right values. You need to go into the threshold menu and select (differential, custom, or standard settings).

When using the adapter in half-channel state:

- Clock-bits are not available in half-channel state mode (although JCLK on the master is still used).
- Be sure to connect Master pod 1 of the logic analyzer to the upper bits, 8-15 + clk, on the half-channel adapter. This is necessary to connect the clock in the system under test to the logic analyzer system clock.
- Using the E5386A does not reduce the performance of the 16760A and the E5378A or E5379A system.

If the E5386A is used in full-channel state mode, the thresholds on the unused (odd) bits are floating. This could result in spurious activity indicators in the format menu.

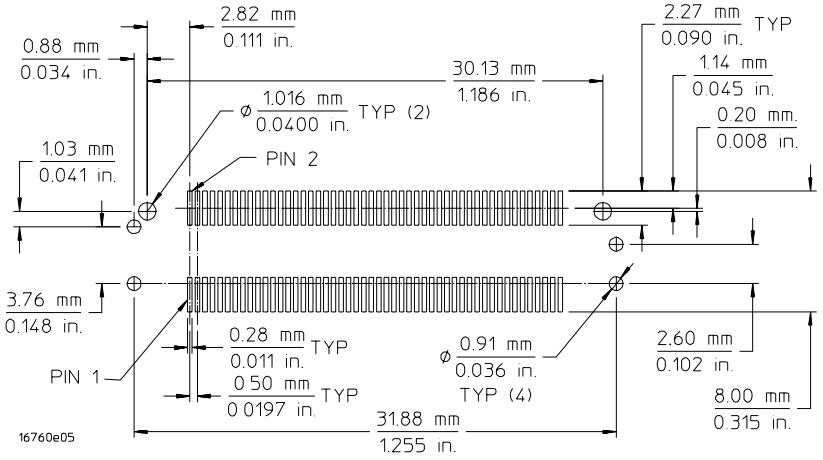
2

Mechanical Considerations

Once you have decided which probe is required, use the following mechanical information to design the appropriate connector into your target system board.

E5378A and E5379A Probe Specifications

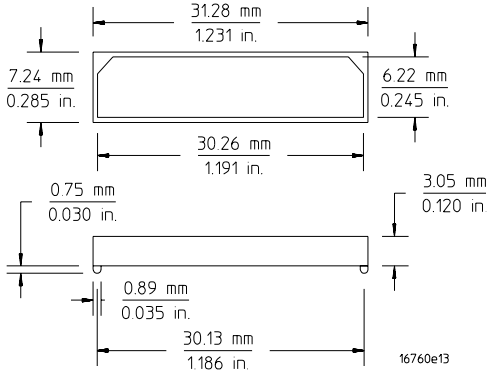
The E5378A and E5379A probes require a probe kit that contains 100-pin Samtec connectors and support shrouds. Refer to the table in Chapter 6 for the kit part numbers.



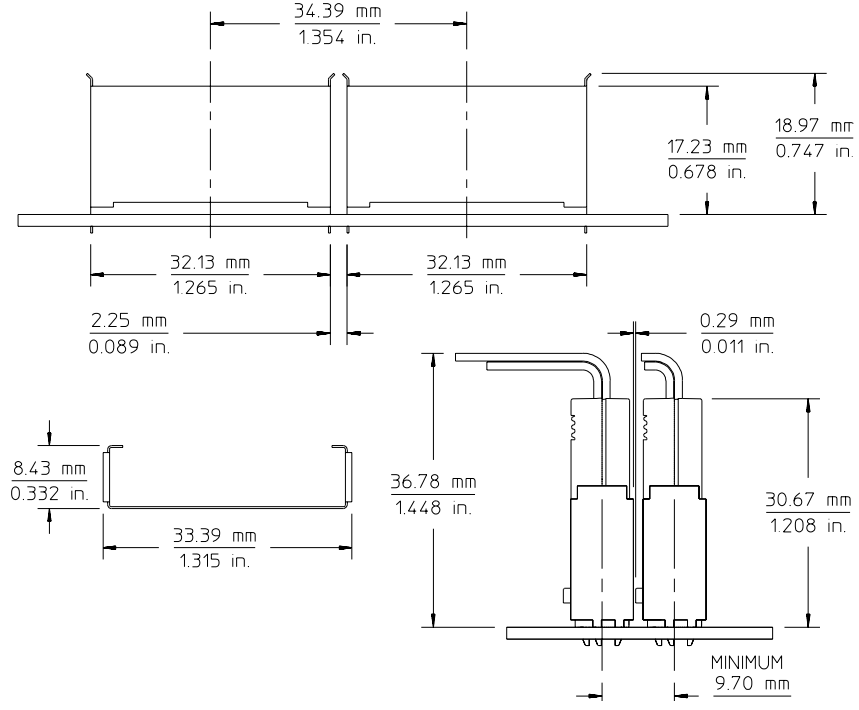
Samtec 100-pin connector footprint and support shroud mounting hole dimensions

CAUTION: The support shrouds are made of conductive metal. Care should be taken to avoid shorting adjacent boards or components with the shrouds. For this reason it may be advisable not to connect the shrouds to ground.

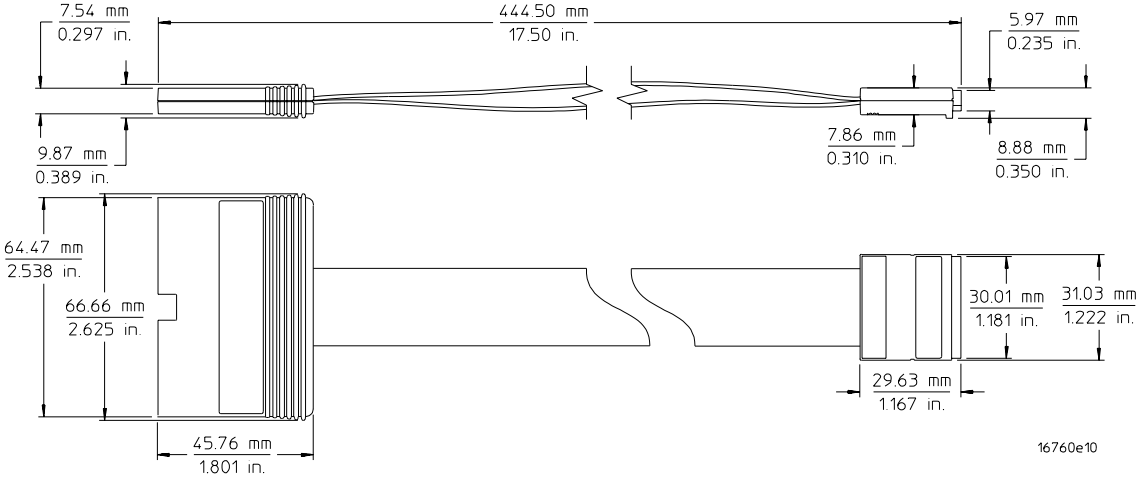
Support shrouds are not required but are recommended if pulling forces may be applied to the cables that could cause the connector to be dislodged.



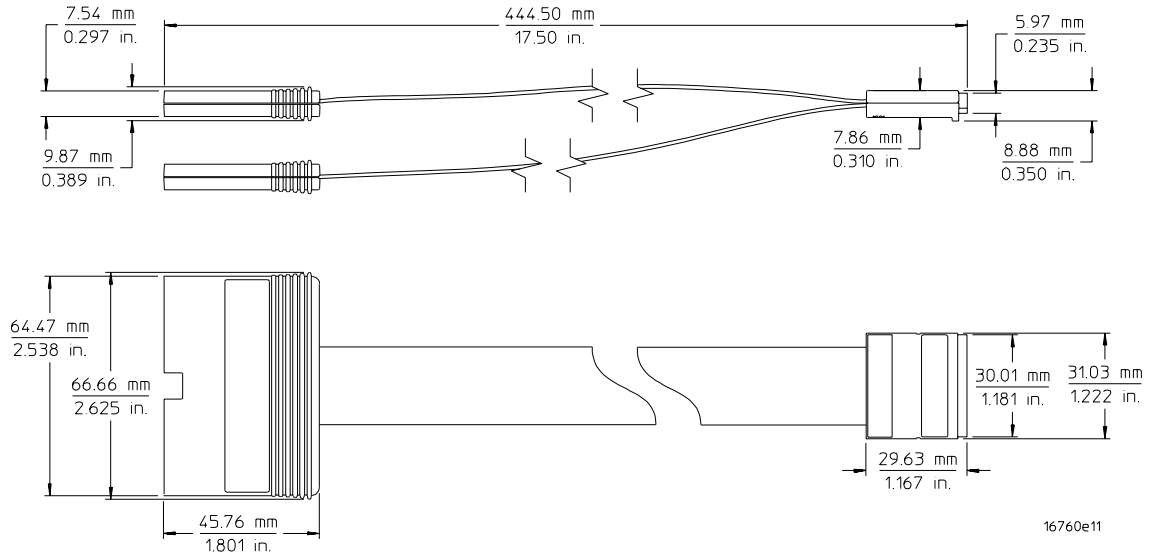
Samtec 100-pin connector dimensions



Support shroud dimensions for 100-pin Samtec connector



E5378A 100-pin single-ended probe dimensions



E5379A 100-pin differential probe dimensions

E5378A 100-pin Single-ended Probe Connector Pin Assignments			
Signal	**Pin Number**	**Pin Number**	**Signal**
Ground	1	2	Ground
Do Not Connect	3	4	Do Not Connect
Ground	5	6	Ground
Odd D0	7	8	Even D0
Ground	9	10	Ground
Odd D1	11	12	Even D1
Ground	13	14	Ground
Odd D2	15	16	Even D2
Ground	17	18	Ground
Odd D3	19	20	Even D3
Ground	21	22	Ground
Odd D4	23	24	Even D4
Ground	25	26	Ground
Odd D5	27	28	Even D5
Ground	29	30	Ground
Odd D6	31	32	Even D6
Ground	33	34	Ground
Odd D7	35	36	Even D7
Ground	37	38	Ground
Odd D8	39	40	Even D8
Ground	41	42	Ground
Odd D9	43	44	Even D9
Ground	45	46	Ground
Odd D10	47	48	Even D10
Ground	49	50	Ground
Odd D11	51	52	Even D11
Ground	53	54	Ground
Odd D12	55	56	Even D12
Ground	57	58	Ground
Odd D13	59	60	Even D13
Ground	61	62	Ground
Odd D14	63	64	Even D14
Ground	65	66	Ground

E5378A 100-pin Single-ended Probe Connector Pin Assignments			
Signal	**Pin Number**	**Pin Number**	**Signal**
Odd D15	67	68	Even D15
Ground	69	70	Ground
NC	71	72	NC
Ground	73	74	Ground
NC	75	76	NC
Ground	77	78	Ground
Odd D16P/Odd CLKP	79	80	Even D16P/Even CLKP
Ground	81	82	Ground
Odd D16N/Odd CLKN	83	84	Even D16N/Even CLKN
Ground	85	86	Ground
Odd External Ref	87	88	Even External Ref
Ground	89	90	Ground
NC	91	92	NC
Ground	93	94	Ground
Ground	95	96	Ground
NC	97	98	NC
NC	99	100	NC

Ground pins indicated in this table are grounded in the probe. Grounding of specific ground pins on the target board is optional. However, the following guidelines should be observed:

1) Multiple ground returns are desirable to maintain signal integrity. As many probe ground pins as possible should be connected to ground in the target system board.

2) The ground pins located between signal pins are particularly important because they provide improved signal-to-signal isolation. This is particularly important for differential inputs. Excessive coupling between differential inputs causes the apparent input capacitance to increase. Capacitance between the two sides of a differential signal will appear to each side as approximately twice the capacitance to ground, because the capacitance is connected to a signal of opposite polarity. The best practice is to ground as many of these pins on the target board as possible.

E5379A 100-pin Differential Probe Connector Pin Assignments			
Signal	**Pin Number**	**Pin Number**	**Signal**
Ground	1	2	Ground
Do Not Connect	3	4	Do Not Connect
Ground	5	6	Ground
D0N	7	8	D0P
Ground	9	10	Ground
D1N	11	12	D1P
Ground	13	14	Ground
D2N	15	16	D2P
Ground	17	18	Ground
D3N	19	20	D3P
Ground	21	22	Ground
D4N	23	24	D4P
Ground	25	26	Ground
D5N	27	28	D5P
Ground	29	30	Ground
D6N	31	32	D6P
Ground	33	34	Ground
D7N	35	36	D7P
Ground	37	38	Ground
D8N	39	40	D8P
Ground	41	42	Ground
D9N	43	44	D9P
Ground	45	46	Ground
D10N	47	48	D10P
Ground	49	50	Ground
D11N	51	52	D11P
Ground	53	54	Ground
D12N	55	56	D12P
Ground	57	58	Ground
D13N	59	60	D13P
Ground	61	62	Ground
D14N	63	64	D14P
Ground	65	66	Ground

E5379A 100-pin Differential Probe Connector Pin Assignments			
Signal	**Pin Number**	**Pin Number**	**Signal**
D15N	67	68	D15P
Ground	69	70	Ground
NC	71	72	NC
Ground	73	74	Ground
NC	75	76	NC
Ground	77	78	Ground
D16N/CLKN	79	80	D16P/CLKP
Ground	81	82	Ground
NC	83	84	NC
Ground	85	86	Ground
NC	87	88	NC
Ground	89	90	Ground
NC	91	92	NC
Ground	93	94	Ground
Ground	95	96	Ground
NC	97	98	NC
NC	99	100	NC

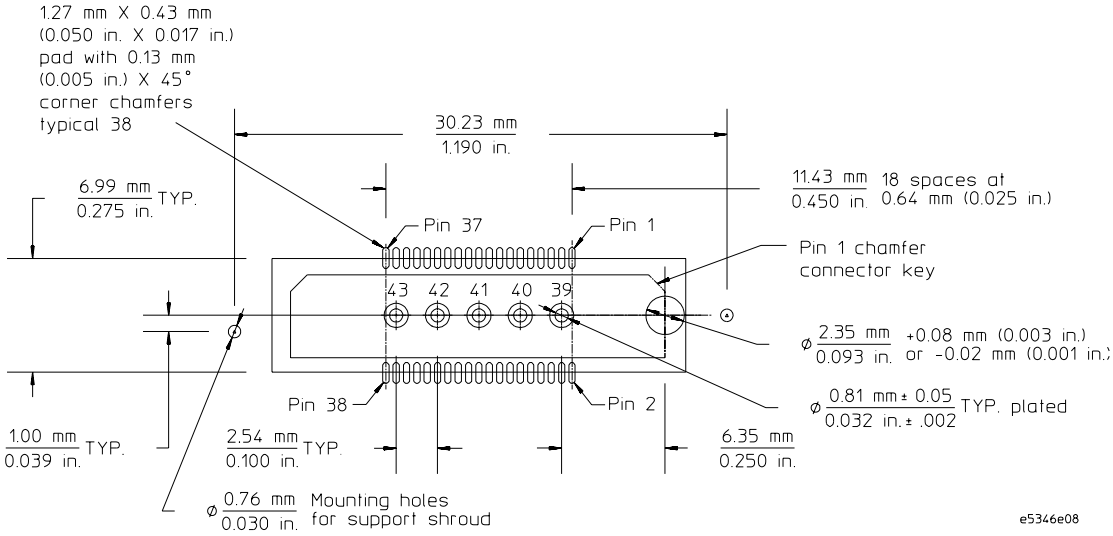
Ground pins indicated in this table are grounded in the probe. Grounding of specific ground pins on the target board is optional. However, the following guidelines should be observed:

1) Multiple ground returns are desirable to maintain signal integrity. As many probe ground pins as possible should be connected to ground in the target system board.

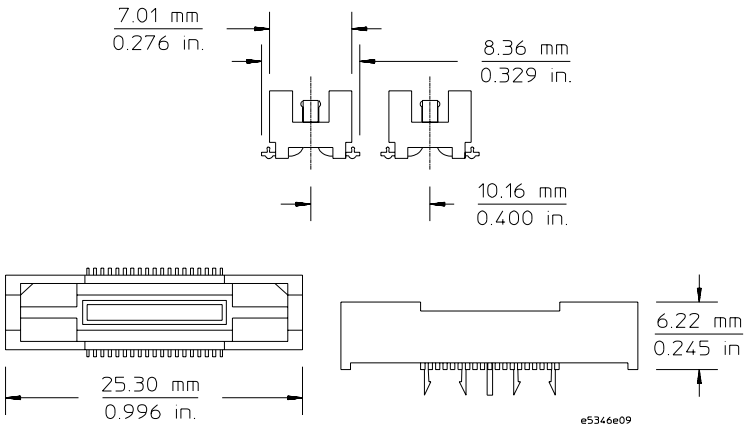
2) The ground pins located between signal pins are particularly important because they provide improved signal-to-signal isolation. This is particularly important for differential inputs. Excessive coupling between differential inputs causes the apparent input capacitance to increase. Capacitance between the two sides of a differential signal will appear to each side as approximately twice the capacitance to ground, because the capacitance is connected to a signal of opposite polarity. The best practice is to ground as many of these pins on the target board as possible.

E5380A 38-pin Single-ended Probe

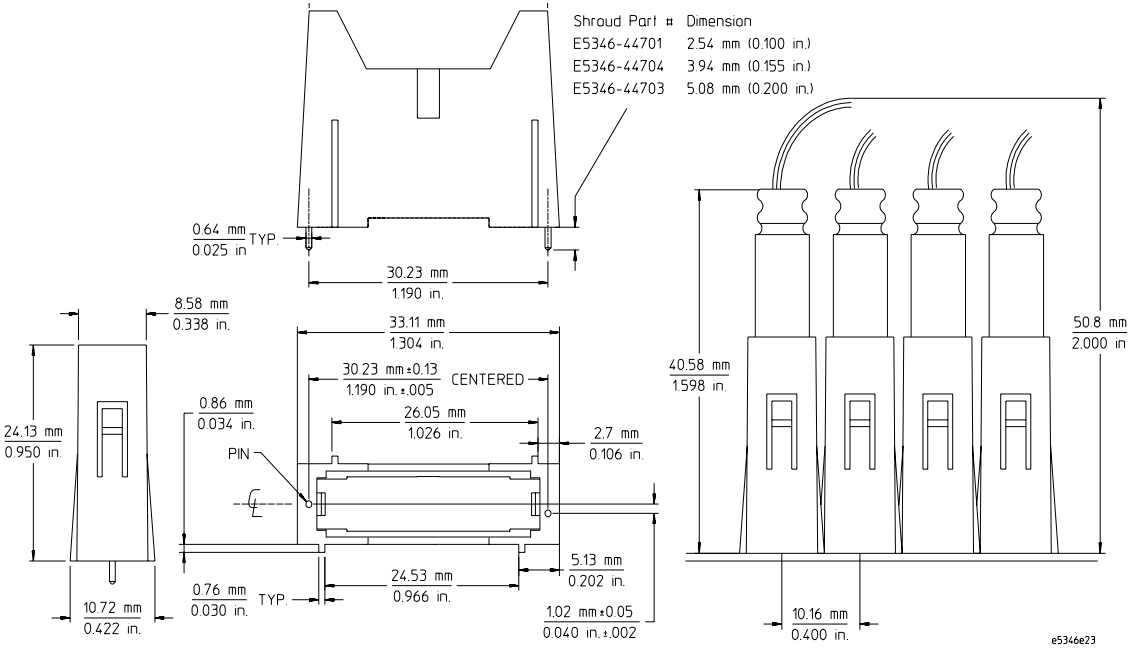
The E5380A probe is compatible with target systems designed for the Agilent E5346A 38-pin probe. This probe requires a probe kit that contains MICTOR connectors and shrouds. Refer to the table in Chapter 6 for the kit part numbers.



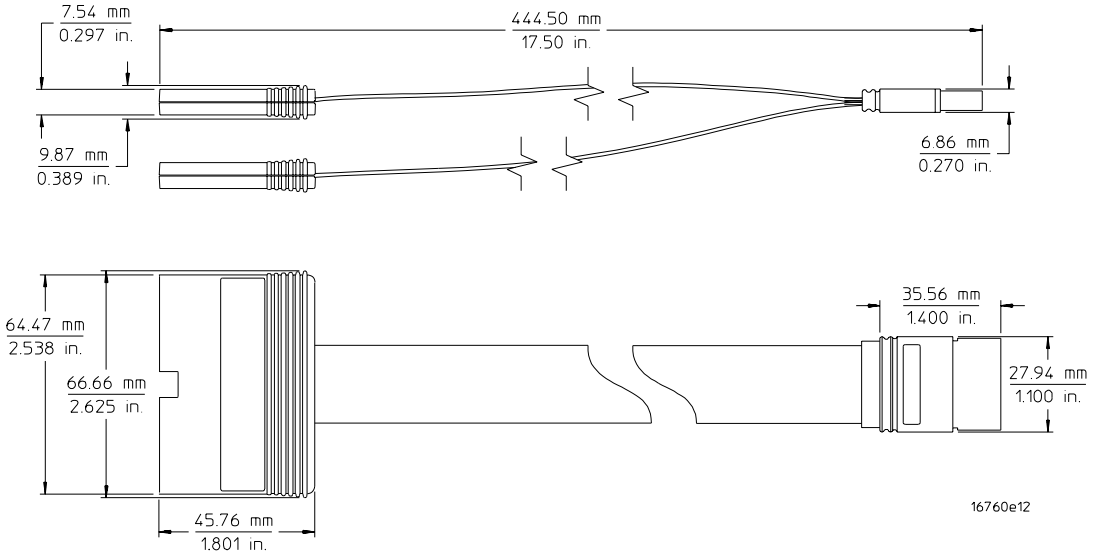
38-pin MICTOR connector footprint and support shroud mounting hole dimensions.



MICTOR connector dimensions



Support shroud dimensions for the MICTOR connector



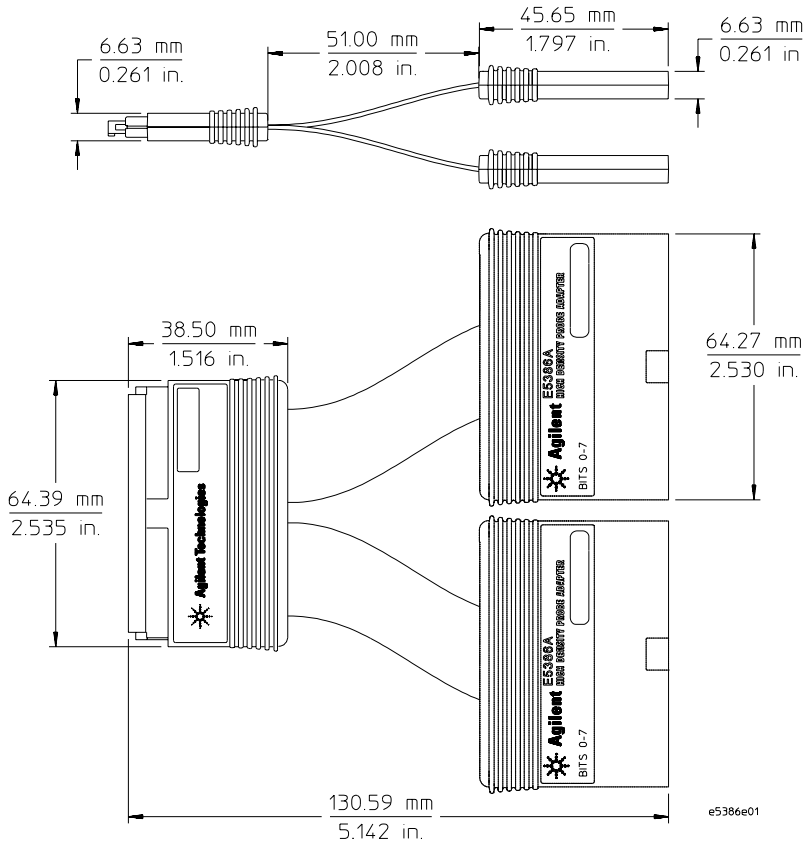
E5380A 38-pin single-ended probe dimensions

E5380A 38-pin Single-ended Probe Pin Assignments			
AMP Mictor-38 Connector		**Logic Analyzer Pods**	
Signal Name	**Pin Number**	**J1 (Even Pod)**	**J2 (Odd Pod)**
CLOCK even	5	3	
D15 even	7	7	
D14 even	9	9	
D13 even	11	11	
D12 even	13	13	
D11 even	15	15	
D10 even	17	17	
D9 even	19	19	
D8 even	21	21	
D7 even	23	23	
D6 even	25	25	
D5 even	27	27	
D4 even	29	29	
D3 even	31	31	
D2 even	33	33	
D1 even	35	35	
D0 even	37	37	
CLOCK odd	6		3
D15 odd	8		7
D14 odd	10		9
D13 odd	12		11
D12 odd	14		13
D11 odd	16		15
D10 odd	18		17
D9 odd	20		19
D8 odd	22		21
D7 odd	24		23
D6 odd	26		25
D5 odd	28		27
D4 odd	30		29
D3 odd	32		31
D2 odd	34		33
D1 odd	36		35
D0 odd	38		37

E5380A 38-pin Single-ended Probe Pin Assignments			
AMP Mictor-38 Connector		**Logic Analyzer Pods**	
Signal Name	**Pin Number**	**J1 (Even Pod)**	**J2 (Odd Pod)**
GROUND	39-43	All even pins	All even pins
Do not connect the following pins. These pins are +5 volt supply and DC return for analysis probes.			
+5 VDC	1	1, 39	1, 39
GROUND	3	2, 40	2, 40
Do not connect the following pins. They are used by the Agilent logic analyzer with an emulator or analysis probe to program or read target information.			
SCL	2		5
SDA	4	5	

E5386A Half-channel Adapter

The E5386A Half-channel Adapter works with the 16760A logic analyzer and the E5378A 100-pin Single-ended Probe and the E5379A 100-pin Differential Probe.



Half-channel adapter dimensions.

Used with E5378A 100-pin Single-ended Probe

When used with the E5378A 100-pin Single-ended Probe, you need two half-channel adapters, one adapter for Odd data and one for Even data. The table below shows the pin assignments.

E5386A Adapter #1			
E5378A Probe		**Logic Analyzer**	
Signal Name	**Pin No.**	**Pod**	**Chan No**
Odd D0	7	Pod 2	0
Odd D1	11	Pod 2	2
Odd D2	15	Pod 2	4
Odd D3	19	Pod 2	6
Odd D4	23	Pod 2	8
Odd D5	27	Pod 2	10
Odd D6	31	Pod 2	12
Odd D7	35	Pod 2	14
Odd D8	39	Pod 1	0
Odd D9	43	Pod 1	2
Odd D10	47	Pod 1	4
Odd D11	51	Pod 1	6
Odd D12	55	Pod 1	8
Odd D13	59	Pod 1	10
Odd D14	63	Pod 1	12
Odd D15	67	Pod 1	14
Odd D16P/ClkP	79	Pod 1	JCLK P
Odd D16N/ClkN	83	Pod 1	JCLK N
Odd Ext Ref	87	Pod 1&2 Ext Ref	

E5386A Adapter #2			
E5378A Probe		**Logic Analyzer**	
Signal Name	**Pin No.**	**Pod**	**Chan No.**
Evn D0	8	Pod 2	0
Evn D1	12	Pod 2	2
Evn D2	16	Pod 2	4
Evn D3	20	Pod 2	6
Evn D4	24	Pod 2	8
Evn D5	28	Pod 2	10
Evn D6	32	Pod 2	12
Evn D7	36	Pod 2	14
Evn D8	40	Pod 1	0
Evn D9	44	Pod 1	2
Evn D10	48	Pod 1	4
Evn D11	52	Pod 1	6
Evn D12	56	Pod 1	8
Evn D13	60	Pod 1	10
Evn D14	64	Pod 1	12
Evn D15	68	Pod 1	14
Evn D16P/ClkP	79	Pod 1	JCLK P
Evn D16N/ClkN	83	Pod 1	JCLK N
Evn Ext Ref	87	Pod 1&2 Ext Ref	

Used with E5379A 100-pin Differential Probe

When used with the E5378A 100-pin Differential Probe, you need only one half-channel adapter. The table below shows the pin assignments.

E5386A Adapter					
E5379A Connector				Logic Analyzer	
Signal Name	Pin No.	Signal Name	Pin No.	Pod	Chan No.
D0n	7	D0p	8	Pod 2	0
D1n	11	D1p	12	Pod 2	2
D2n	15	D2p	16	Pod 2	4
D3n	19	D3p	20	Pod 2	6
D4n	23	D4p	24	Pod 2	8
D5n	27	D5p	28	Pod 2	10
D6n	31	D6p	32	Pod 2	12
D7n	35	D7p	36	Pod 2	14
D8n	39	D8p	40	Pod 1	0
D9n	43	D9p	44	Pod 1	2
D10n	47	D10p	48	Pod 1	4
D11n	51	D11p	52	Pod 1	6
D12n	55	D12p	56	Pod 1	8
D13n	59	D13p	60	Pod 1	10
D14n	63	D14p	64	Pod 1	12
D15n	67	D15p	68	Pod 1	14
D16n/ClkN	79	D16p/ClkP	80	Pod 1	JCLKP

3

Operating the Probes

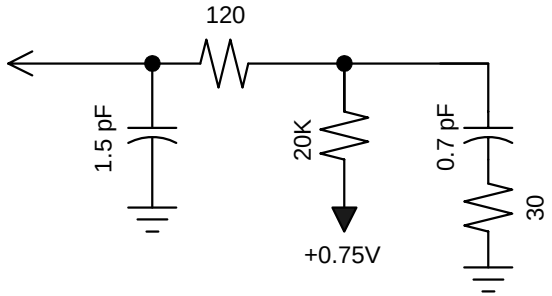
Electrical considerations such as equivalent probe loads, input impedance, time domain transmission (TDT), step inputs, and eye opening.

Equivalent Probe Loads

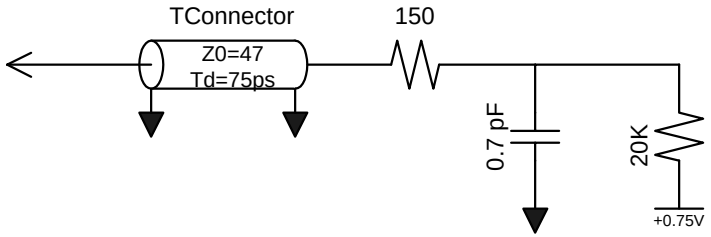
The equivalent probe loads for the E5378A, E5379A, and E5380A probes are shown in the figures below. The equivalent loads include the 100-pin Samtec or 38-pin MICTOR connector.

E5378A and E5379A Models

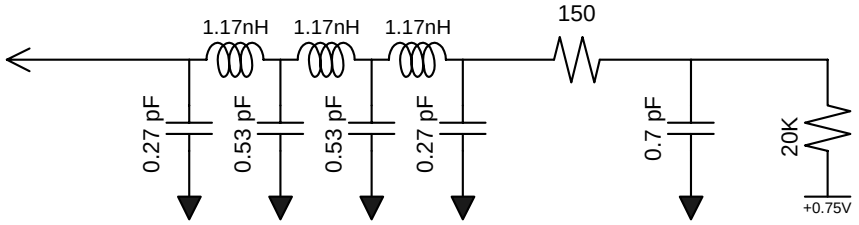
The following simple model is accurate up to 1 GHz. Transient analysis with Spice is fastest with this model.



The following transmission line model is the most accurate. It is accurate up to 5 GHz. Transient analysis with Spice will be the slowest with this model.

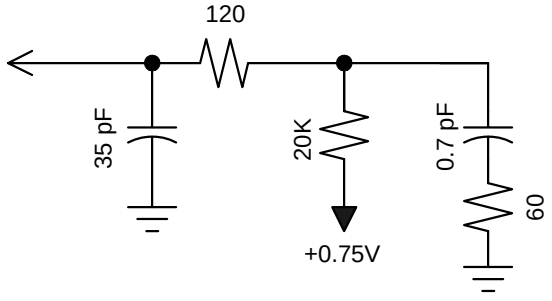


The following lumped LC transmission line model is identical to the transmission line, but provides faster transient analysis.

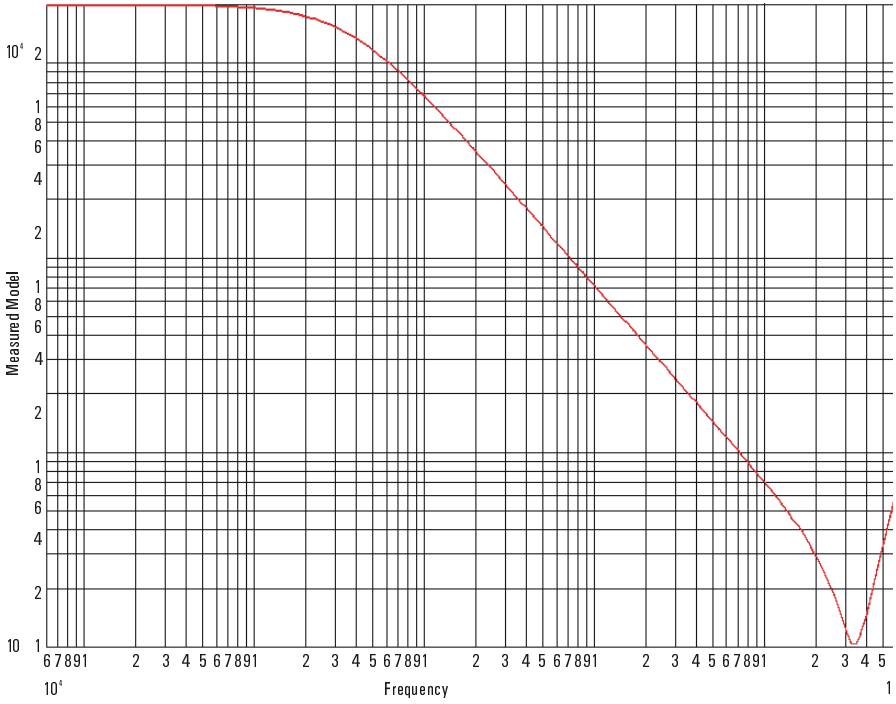


E5380A Model

The following equivalent probe load for the E5380A includes the target connector. The model is accurate up to 1 GHz .

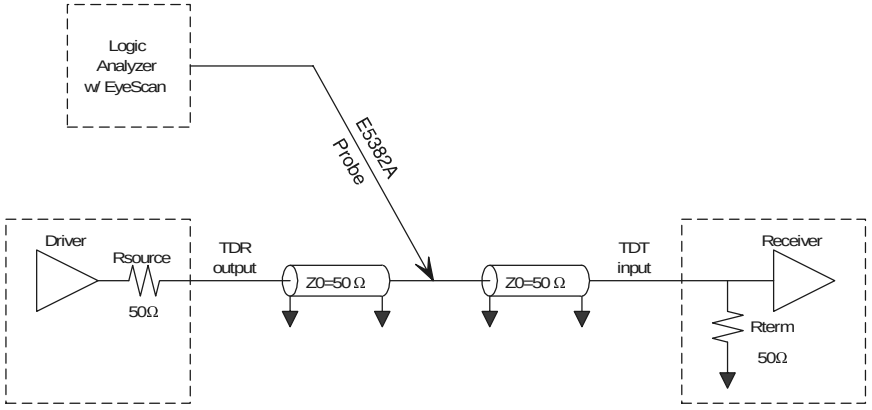


Measured versus modeled input impedance



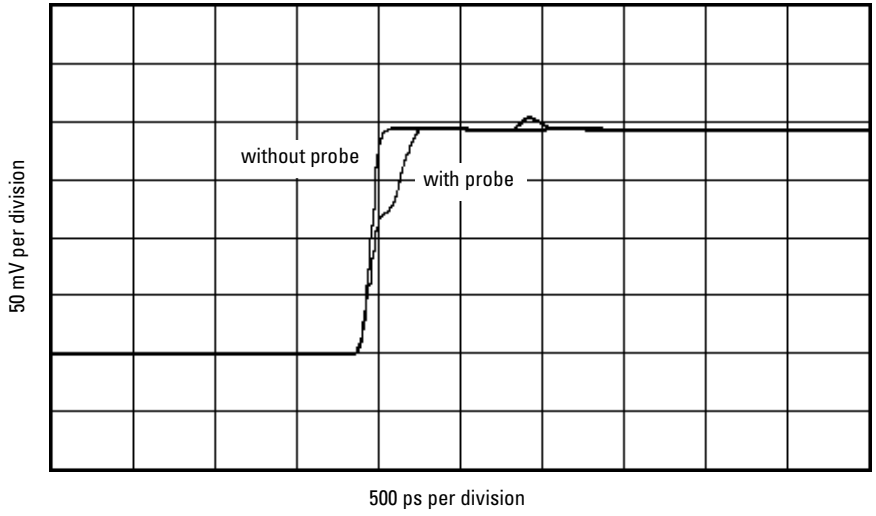
Time Domain Transmission (TDT) E5378/79A

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 E5378A/E5379A probes affect an ideal step seen by the receiver for various rise times.

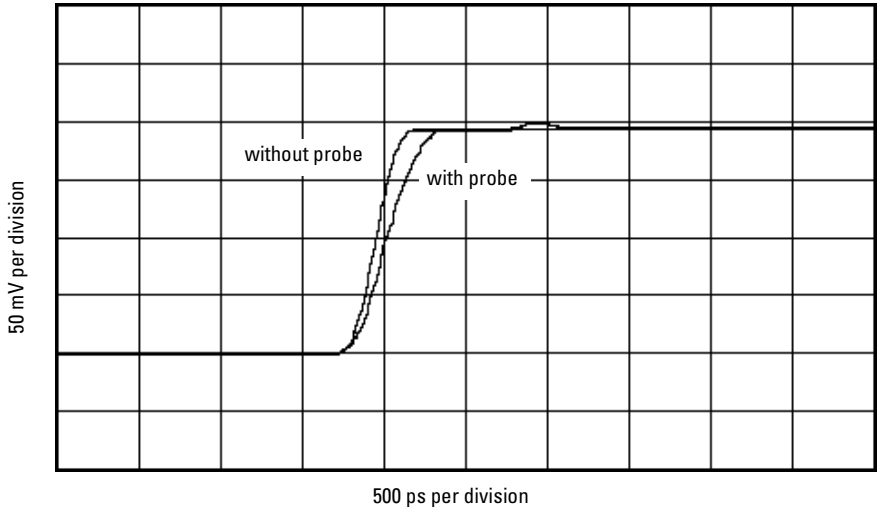


TDT measurement schematic

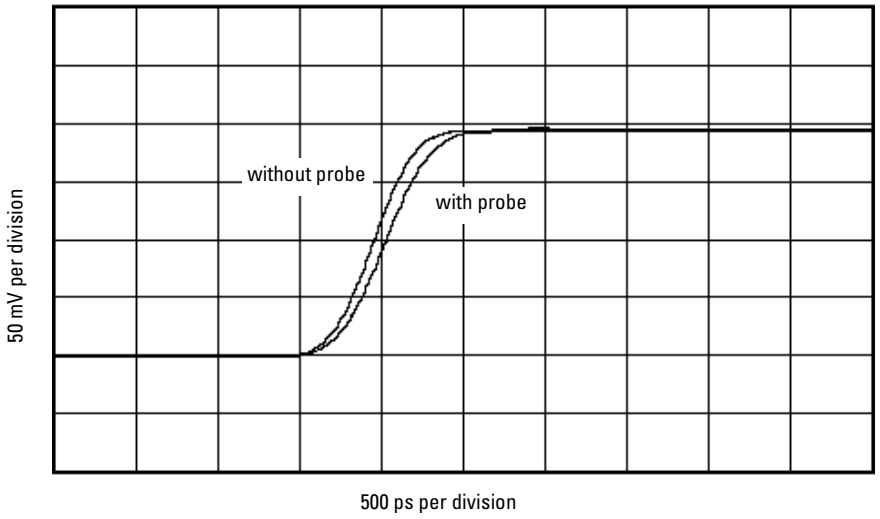
The following plots were made on an Agilent 54750A Oscilloscope using TDR.



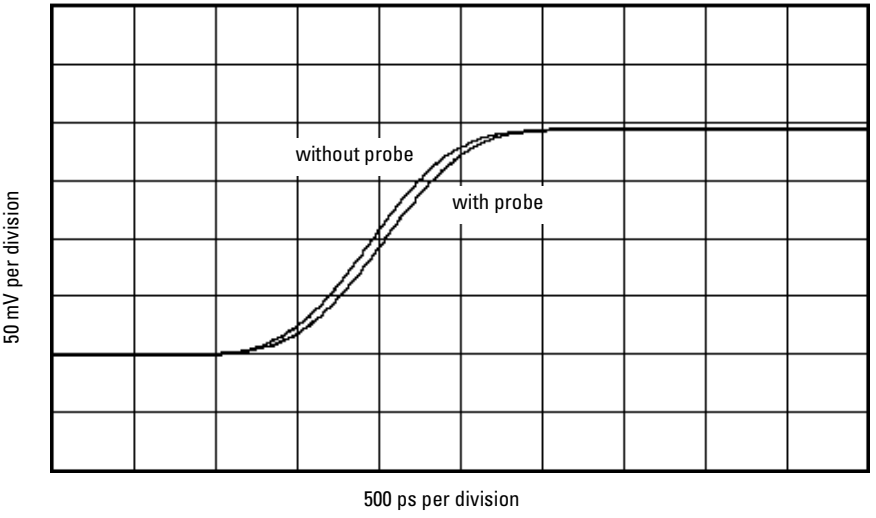
TDT measurement at receiver with and without probe load for 100 ps rise time



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



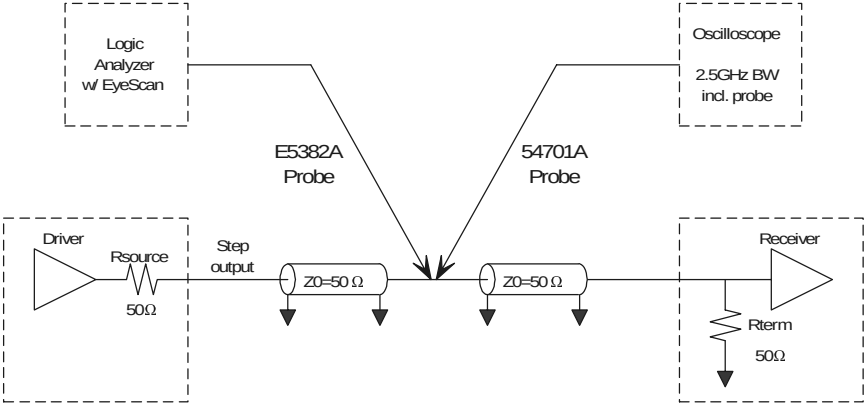
TDT measurement at receiver with and without probe load for 500 ps rise time



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

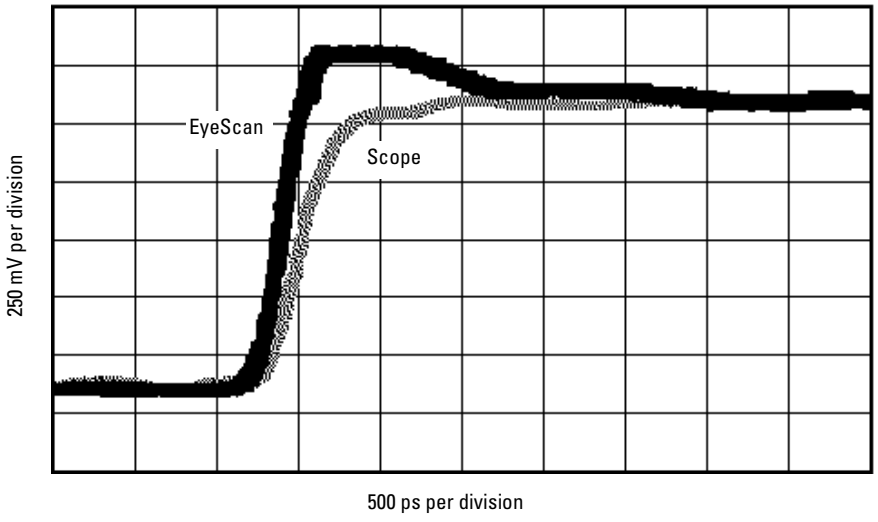
Step Inputs E5378/79A

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 E5378/79/88 probes.

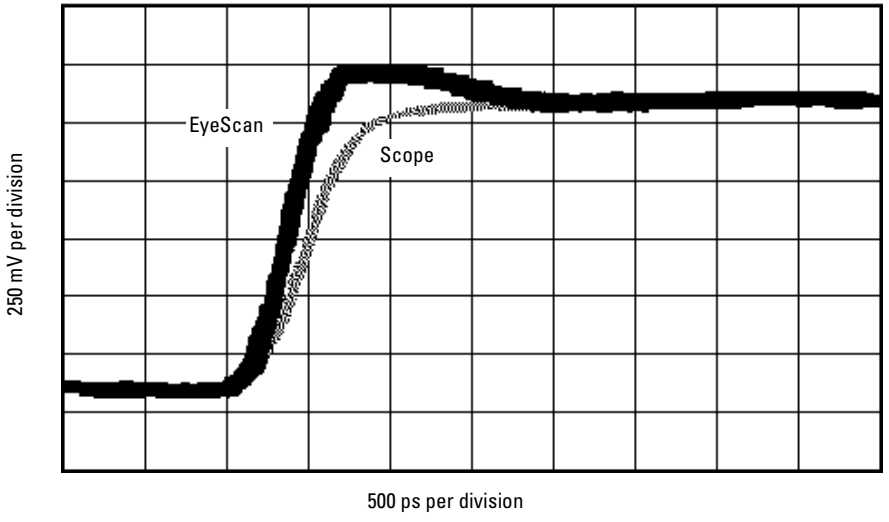


Step input measurement schematic

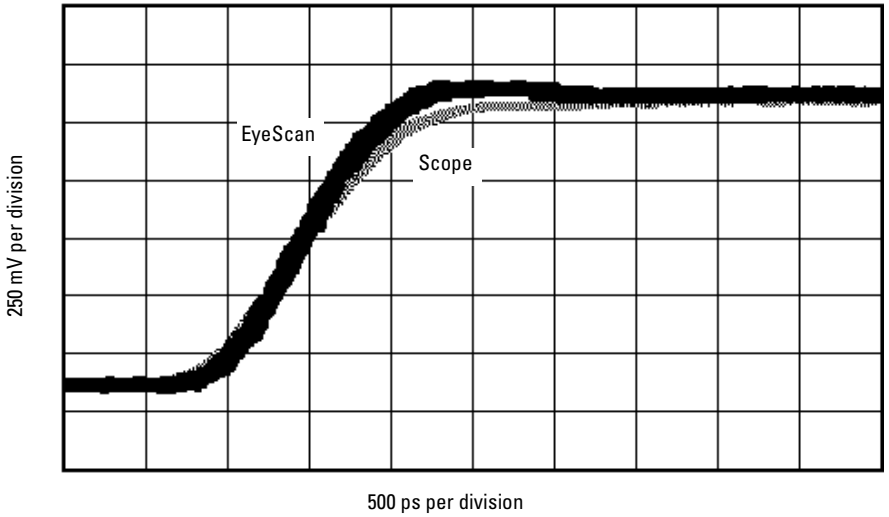
The following plots were made on an Agilent 16760A logic analyzer using an Agilent 8133A pulse generator with various rise time converters.



Logic analyzer's response to 250 ps rise time



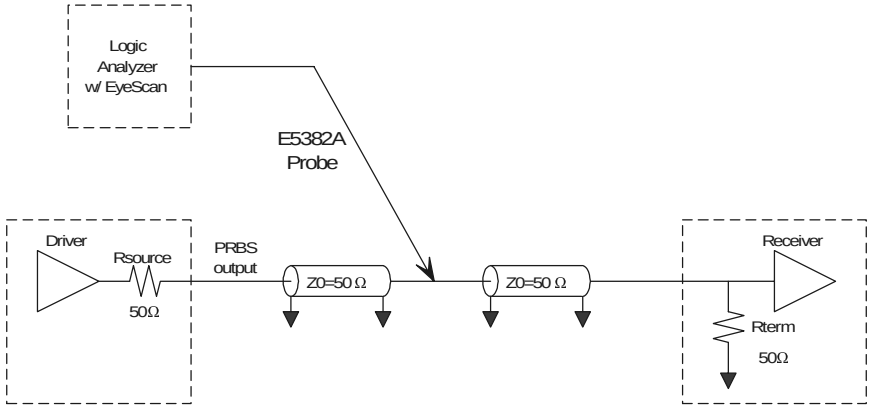
Logic analyzer's response to 500 ps rise time



Logic analyzer's response to 1 ns rise time

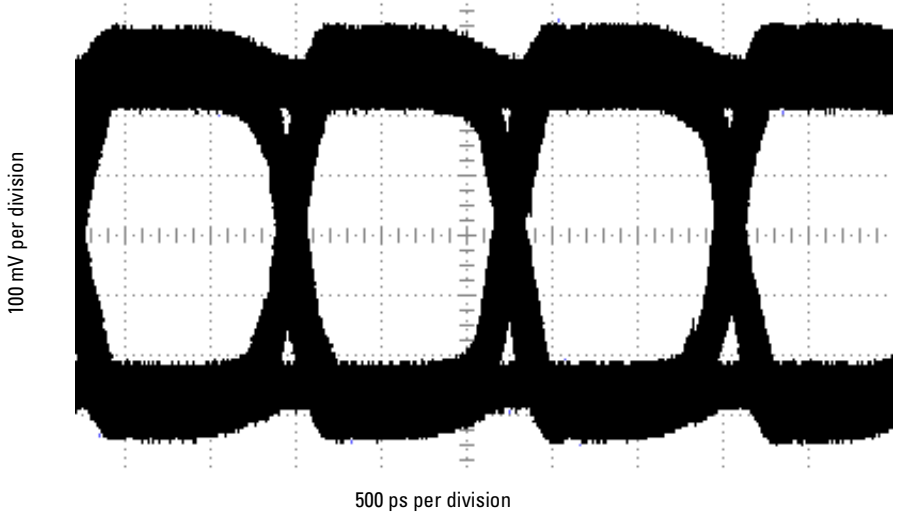
Eye Opening E5378/79A

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 the user 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 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).

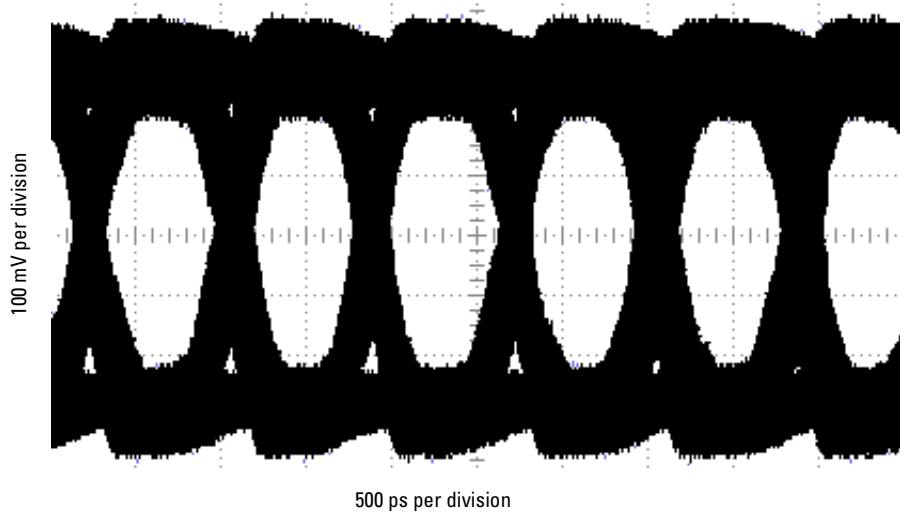


Eye opening measurement schematic

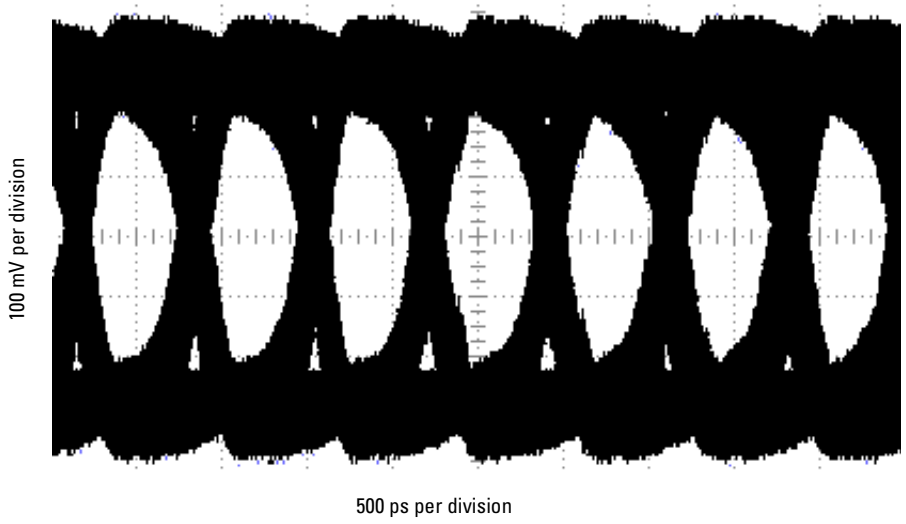
The following plots were made on an Agilent 16760A logic analyzer using an Agilent 8133A pulse generator with a 250 ps rise time converter. The following measurements use Eye Scan to show the margin at 800, 1250, and 1500MT/s.



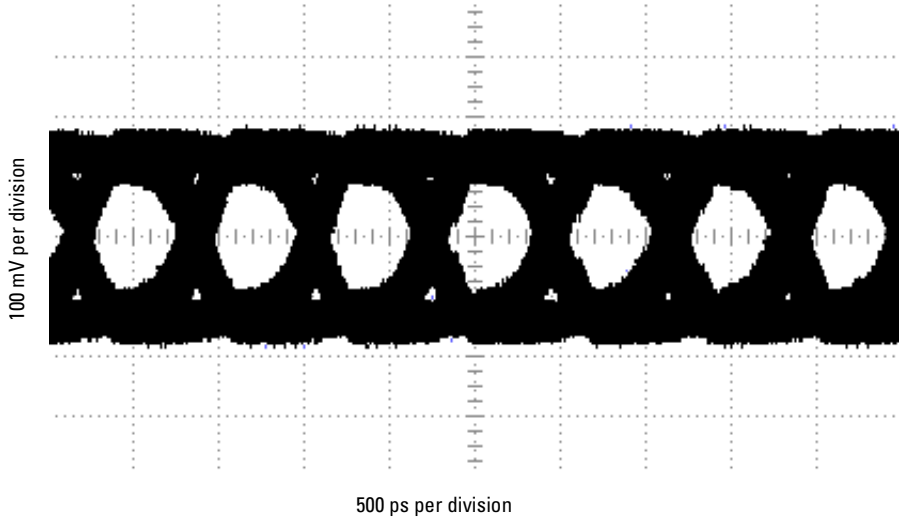
Logic analyzer eye opening for a PRBS signal of 500 mV p-p, 800 Mb/s data rate



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



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



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

4

Circuit Board Design

Design considerations when you layout your circuit board.

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.

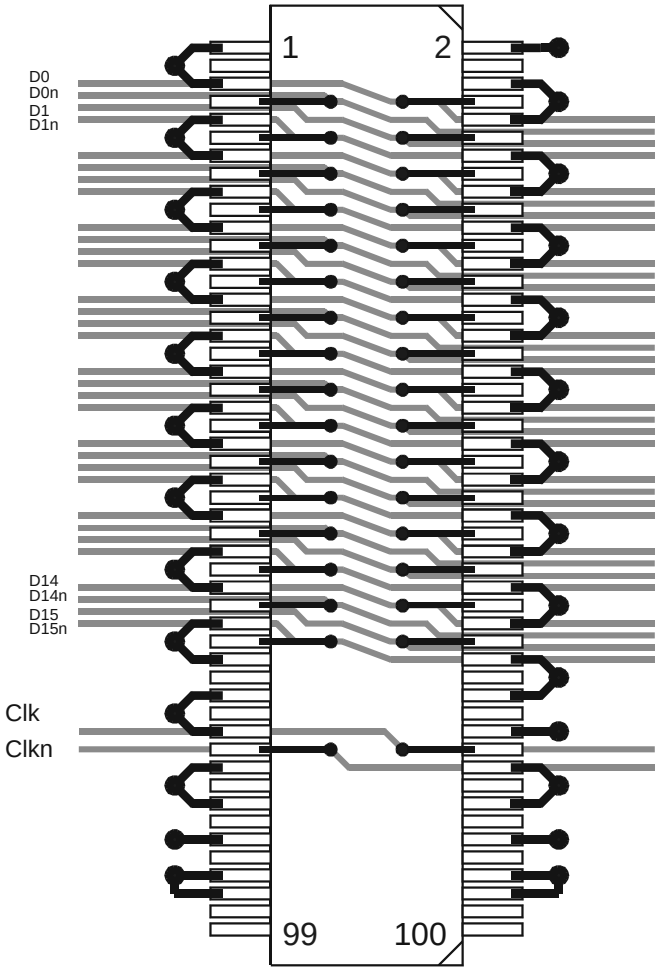
The trace capacitance per unit length will depend on the trace width and the spacing to ground or power planes. If the trace is laid out to have a characteristic impedance of 50 ohms, it turns out that the capacitance per unit length is ~ 1.2 pF/cm. Therefore the 0.28 cm stub in the previous example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

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

Recommended Routing

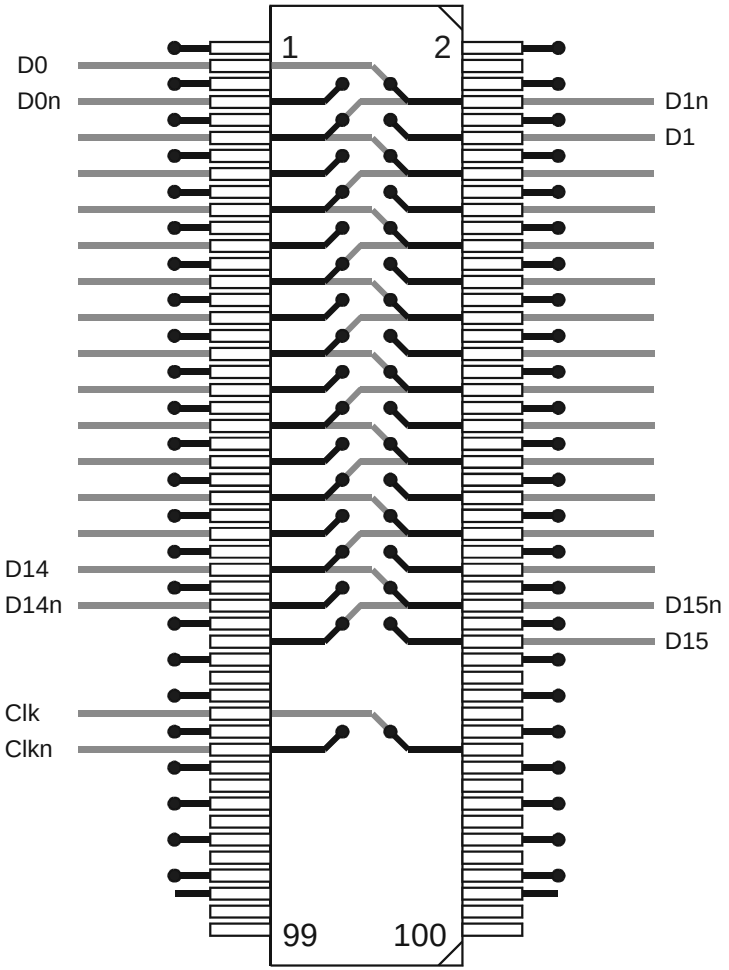
16-bit differential flow-through routing

The probe load models provided in the previous chapter do not include the vias and short stubs shown in this drawing. The additional load on the target due to this rating is very topology dependant. You need to consider these effects in addition to the pubished probe load.



Signal Tracks on 13 mil centers
Ground Tracks 13 mils wide
Vias on 39.8 m centers (2.0 mm)
Vias 1 mm drill size, 25 mil pad size

16-bit differential signal pairs broken out to alternate sides



16760A 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 16760A logic analyzer.

16760A Operating Mode	E5378A	E5378A with half-channel adapter E5386A	E5379A	E5379A with half-channel adapter E5386A	E5380A
Synchronous (state) analysis 200 Mb/s, 400 Mb/s, 800 Mb/s	32 data plus 2 clock inputs (see note 1)	N/A	16 data plus 1 clock input (see note 1)	N/A	32 data plus 2 clock inputs (see note 1)
Synchronous (state) analysis 1250 Mb/s 1500 Mb/s	16 data plus 1 clock input (see note 2)	32 data plus 2 clock inputs (see note 2)	8 data plus 1 clock input (see note 2)	16 data plus 2 clock inputs (see note 2)	N/A
Eye scan mode 800 Mb/s	32 data plus 2 clock inputs (see note 1)	N/A	16 data plus 1 clock input (see note 1)	N/A	32 data plus 2 clock inputs (see note 1)
Eye scan mode 1500 Mb/s	16 data plus 1 clock input (see note 2)	32 data plus 2 clock inputs (see note 2)	8 data plus 1 clock input (see note 2)	16 data plus 2 clock inputs (see note 2)	N/A
Timing mode	32 data plus 2 clock inputs (see note 3)	N/A	16 data plus 1 clock input (see note 3)	N/A	32 data plus 2 clock inputs (see note 3)

Note 1: In the 200 Mb/s, 400 Mb/s, and 800 Mb/s synchronous (state) analysis modes, and the 800 Mb/s eye scan mode, there is one clock input which must be routed to the clock input on pod 1 (of the master module,

in a multi-card set). The clock inputs on other pods can be assigned to labels and acquired as data inputs.

Note 2: In the 1250 Mb/s and 1500 Mb/s synchronous (state) analysis modes, and in the 1500 Mb/s eye scan mode, the clock inputs on other pods cannot be assigned to labels and acquired as data inputs.

Note 3: In asynchronous (timing) analysis, all inputs including clocks can be acquired and assigned to labels.

- To realize 17 data inputs (in full-channel mode) while using time tags in addition to a clock input on a single 16760A module or on the master module in a multi-card set, you must route the data signals to pod 2 and the clock to pod 1. A convenient way to avoid laying out a second connector to connect only the clock signal is to use the Agilent E5382A flying-lead set to make the connection to the clock.
- To use the qualifier input for eye scan, the qualifier signal must be routed to the clock input on pad 2 (K clock), and the clock must be routed to the clock input on pod 1 (J clock), each on the master module in case of a multi-card set.
- In a multiple-card set, the clock used for synchronous (state) analysis must be routed to the clock input on pod 1 of the master module. On a single card, the clock must be routed to the clock input on pod 1.

Thresholds

E5378A 100-pin single-ended probe

Data inputs

The E5378A 100-pin single-ended probe has two inputs for a user-supplied threshold voltage for the data inputs, one for the even pod and one for the odd pod. The threshold inputs (pins 87 and 88) may be grounded, left open, or connected to a dc power supply. For each group of data inputs, you may either:

- Supply a threshold voltage between -3V dc and +5V dc to the threshold input. The logic analyzer will use this threshold to determine when the signal is high or low.

Or

- Adjust the logic threshold in the user interface to between -3V dc and +5V dc.

The advantages of supplying a threshold voltage via the threshold input on the probe are:

- A threshold supplied from the source will typically track changes in supply voltage, temperature, etc.
- A threshold supplied from the target is typically the same threshold that the target system's logic uses to evaluate the signals. Therefore the data captured by the logic analyzer will be congruent with the data as interpreted by the target system.

Clock input

The clock input to the E5378A probe is differential. If you supply a differential clock, you should select the "differential" option in the clock threshold user interface.

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.

Or

- Supply a threshold reference voltage between -3V dc and +5V dc to the $\overline{\text{clock}}$ input. In this case, the clock threshold in the user interface should be set to zero.

If your circuit uses a resistive divider to provide a threshold reference, be sure to consider the equivalent circuit consisting of the 20k Ω resistor connected to +0.75V as shown on page 34 and 35.

The threshold for the clock input has a separate adjustment in the user interface, independent of the data inputs.

E5379A 100-pin differential probe

Data inputs

If you are using the E5379A 100-pin differential probe to acquire differential signals, you would normally allow the logic analyzer to discriminate between high and low states based on the crossover of the data and $\overline{\text{data}}$ inputs.

You may also use the E5379A 100-pin differential probe to acquire single-ended signals. If you are using the E5379A probe to acquire single-ended signals, you should either ground the $\overline{\text{data}}$ inputs or connect them to a dc power supply. You may:

- Ground the $\overline{\text{data}}$ inputs and adjust the threshold in the user interface.

Or

- Supply a threshold reference voltage to the $\overline{\text{data}}$ inputs. In this case, the threshold in the user interface should be set to zero.

If your circuit uses a resistive divider to provide a threshold reference, be sure to consider the equivalent circuit consisting of the 20k Ω resistor connected to +0.75V as shown on page 34 and 35.

Clock input

The same choices exist for the clock input on the E5379A 100-pin differential probe as outlined above for the data inputs. The clock input has a separate, independent threshold adjustment.

E5380A 38-pin single-ended probe

All inputs on the E5380A 38-pin probe are single-ended. The E5380A probe does not have a threshold reference input. When you use the E5380A, you adjust the logic threshold in the user interface.

The clock input on the E5380A 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 leads to restrictions in triggering. Refer to "Triggering with the Agilent 16760A" (Agilent 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 Agilent 16760A" (Agilent publication number 5988-2994EN) for more details.

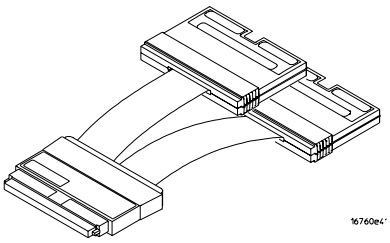
Half-channel 1.25 and 1.5 Gb/s modes (16760A only)

In the half-channel 1.5 Gb/s mode, the 16760A analyzer accesses only the even channels (0,2,4, etc.). In the Format user interface, the connections within a pod (16-signal group) are mapped as follows:

Connector pins	Connection name in this document (pages 21- 24)	Reference in format window
7,8	D0	Bit0
15,16	D2	Bit1
23,24	D4	Bit2
31,32	D6	Bit3
39,40	D8	Bit4
47,48	D10	Bit5
55,56	D12	Bit6
63,64	D14	Bit7

Note that in the 1.5 Gb/s half-channel mode, the clock inputs cannot be assigned as bits in a label.

E5386A Half-channel Adapter. The E5386A can be used with the E5378A 100-pin Single-ended Probe or the E5379A 100-pin Differential Probe to map the signals from the 100-pin Samtec connector to the 16760A when operating in half-channel state mode.



5

Recommended Reading

A list of recommended reading for more information about systems and high-speed digital design.

For More Information

MECL System Design Handbook

Blood, William R. Jr., "MECL System Design Handbook," 4th edition, 1988, published by Motorola. This handbook can be obtained from ON Semiconductor on the web. Go to <http://onsemi.com>. Click on "On-line ordering" under "Documentation." Click on the link "General search." Type in "HB205" in the "Document number" field. Click "Submit." To view the document online, click on "PDF" in the right-hand column titled "PDF MFAX." Or order a hardcopy of the handbook on-line.

High-speed Digital Design

Johnson, Howard W., and Martin Graham, "High-speed Digital Design," Prentice-Hall, 1993, ISBN 0-13-395724-1

Designing High-speed Target Systems for Logic Analyzer Probing

“Designing High-speed Target Systems for Logic Analyzer Probing” Agilent Technologies application note publication number 5988-2989EN.

6

Connectors and Shrouds

A table of part numbers for ordering connectors, shrouds, and kits.

Ordering Probing Connectors and Shrouds

Connectors and shrouds may be ordered in kits or ordered separately. Select a support shroud appropriate for the thickness of your PC board. The following table lists the Agilent part numbers for each.

CAUTION: The support shrouds marked with an asterisk in the following table are made of conductive metal. Care should be taken to avoid shorting adjacent boards or components with the shrouds. For this reason it may be advisable not to connect the shrouds to ground.

For Probe Model #	Agilent Part Number	Consists of	For Target PC Board Thickness
E5378A & E5379A	16760-68702	5 Mating Connectors & 5 Support Shrouds*	up to 1.57 mm (0.062 in.)
	16760-68703		up to 3.05 mm (0.120 in.)
	1253-3620 (or Samtec #ASP-65067-01)	1 100-pin Mating Connector	n/a
	16760-02302	1 Support Shroud*	up to 1.57 mm (0.062 in.)
	16760-02303	1 Support Shroud*	up to 3.05 mm (0.120 in.)
E5380A	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.)

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Safety Notices

This apparatus has been designed and tested in accordance with IEC Publication 1010, Safety Requirements for Measuring Apparatus, and has been supplied in a safe condition. This is a Safety Class I instrument (provided with terminal for protective earthing). Before applying power, verify that the correct safety precautions are taken (see the following warnings). In addition, note the external markings on the instrument that are described under "Safety Symbols."

Warnings

• Before turning on the instrument, you must connect the protective earth terminal of the instrument to the protective conductor of the (mains) power cord. The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. You must not negate the protective action by using an extension cord (power cable) without a protective conductor (grounding). Grounding one conductor of a two-conductor outlet is not sufficient protection.

• Only fuses with the required rated current, voltage, and specified type (normal blow, time delay, etc.) should be used. Do not use repaired fuses or short-circuited fuseholders. To do so could cause a shock or fire hazard.

• If you energize this instrument by an auto transformer (for voltage reduction or mains isolation), the common terminal must be connected to the earth terminal of the power source.

• Whenever it is likely that the ground protection is impaired, you must make the instrument inoperative and secure it against any unintended operation.

• Service instructions are for trained service personnel. To avoid dangerous electric shock, do not perform any service unless qualified to do so. Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

• Do not install substitute parts or perform any unauthorized modification to the instrument.

• Capacitors inside the instrument may retain a charge even if the instrument is disconnected from its source of supply.

• Do not operate the instrument in the presence of flammable gasses or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

• Do not use the instrument in a manner not specified by the manufacturer.

To clean the instrument

If the instrument requires cleaning: (1) Remove power from the instrument. (2) Clean the external surfaces of the instrument with a soft cloth dampened with a mixture of mild detergent and water. (3) Make sure that the instrument is completely dry before reconnecting it to a power source.

Safety Symbols

Instruction manual symbol: the product is marked with this symbol when it is necessary for you to refer to the instruction manual in order to protect against damage to the product..

Hazardous voltage symbol.

Earth terminal symbol: Used to indicate a circuit common connected to grounded chassis.

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Notices

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16760-97008, September 2002
16760-97007, February 2002
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16760-97000, December 2000

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WARNING

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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.