Agilent N4851A/N4861A Probes for MIPI D-PHY

Design Guide

Agilent Technologies

Notices

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Agilent Technologies, Inc.
1900 Garden of the Gods Road
Colorado Springs, CO 80907 USA

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1
Introduction

About this Document

This document will help you design a board so that it may be tested using the Agilent N4851A MIPI D-PHY acquisition probe and the Agilent N4861A MIPI D-PHY stimulus probe.

Product Overview

The Agilent Agilent N4851A MIPI D-PHY Acquisition Probe connects an Agilent Technologies logic analyzer between the peripheral and baseband components on a device under test, to allow decoding and display of MIPI D-PHY signals. Software is provided to decode the DSI and CSI-2 protocols.

The acquisition probe may be connected to a production board, as long as it incorporates the necessary connectors, or the probe may be connected to a test platform.

The Agilent N4861A stimulus probe allows you to generate the digital signals, emulating either a master or slave IC. The stimulus probe is usually connected to a test platform which contains only one of the two ICs.

Connection to the device under test

The 90-pin cable on the Agilent Agilent N4851A MIPI D-PHY Acquisition Probe is the same as the ones which are used on Agilent 1695x-series logic analyzer cards. This allows you to choose from a variety of probes to make the physical connection. See *Probing Solutions for Logic Analyzers*, available from www.agilent.com/find/logic.

The Agilent N4861A stimulus probe is connected to the device under test using four or six SMA cables.

The parts of a measurement system

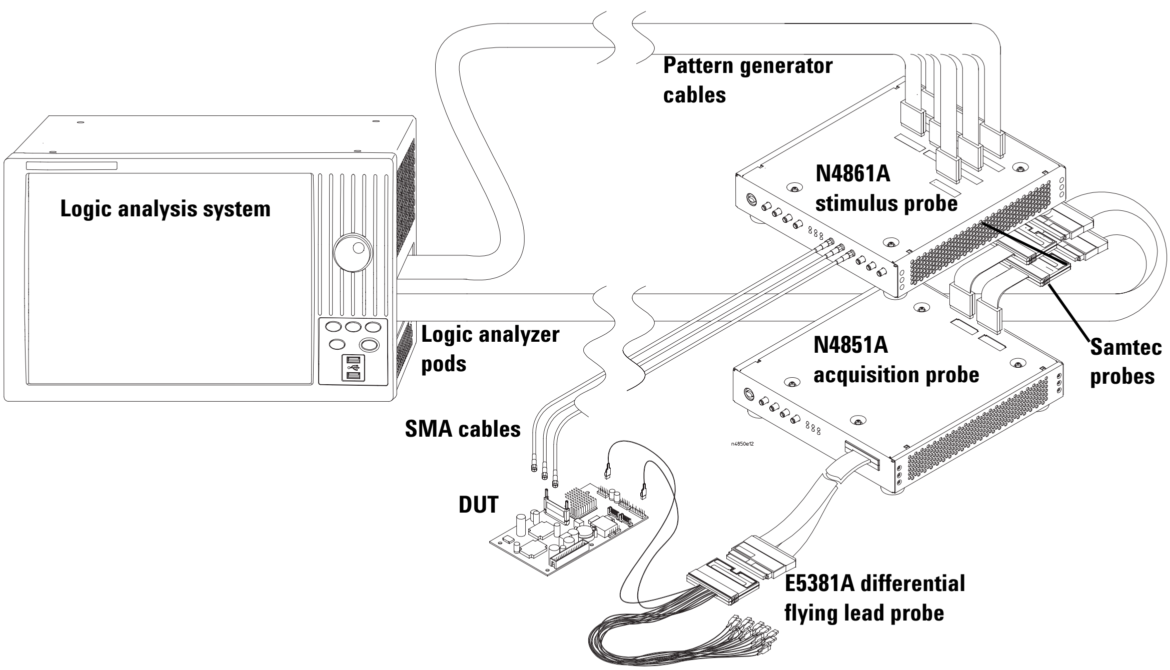


Figure 1 A complete measurement system

The device under test (**DUT**) is your board, which might include an master IC, a slave IC, or both.

The Agilent N4851A digital **acquisition probe** captures the digital signal between the two sides of a link. A **differential flying lead probe** (or another kind of probe, if needed) connects the DUT to the cable on the acquisition probe.

The Agilent N4861A **stimulus probe** can emulate a master or slave IC by supplying the missing digital signals. The stimulus probe connects to the DUT via 50-ohm coaxial cables using SMA connectors.

The acquisition probe and stimulus probe are connected to one another through a short **option cable**.

A **logic analysis system** collects data from the acquisition probe and controls the stimulus probe. The logic analysis system must contain at least one **logic analyzer** card. If you are using the N4861A stimulus probe, the logic analysis system must also contain a **pattern generator** card.

Each of the cables coming out of the logic analyzer card is called a **pod**. These pods require adapter cables, called **Samtec probes**, to mate with the connectors on the acquisition probe and stimulus probe.

For some logic analyzers, the logic analyzer card and pattern generator are built in, rather than being separate cards.

Software installed on the logic analysis system decodes the digital data and displays it as digital waveforms or as decoded packets.

Additional Information Sources

- See the *Agilent N4851A/N4861A Digital Probes Design Guide* for information on how to design the necessary connectors into your board. This document is available by searching for “N4851A” at www.agilent.com.
- See the *Agilent N4861A Stimulus Probe User’s Guide* for information on how to use the N4851A acquisition probe and the N4861A stimulus probe together.
- See the N4851A/N4861A product data sheet for a description of the product and its characteristics.
- See the online help in the logic analysis system for more information on using the software tools.
- Detailed information on Agilent probes (such as the Agilent E5381A differential flying lead probe) is available by searching for the product number at www.agilent.com.
- Additional application notes or white papers may be available from your Agilent representative.

2
Designing connectors for use with the N4851A acquisition probe

Overview

1 Decide where to probe the signals. The following table lists some options.

Table 1 Locations where the bus can be probed

Connection location	Advantages and disadvantages
Each signal probed near the destination chip.	Each signal is probed near its destination. Requires use of flying leads. **This is the method that makes it the easiest to achieve good signal quality.**
All signals probed at one end of the bus.	Can be probed with a single, compact connector. Great care must be taken to maintain adequate signal quality—some signals may be probed too far from their destination chip to get adequate signal quality.
In the middle of the bus.	Can be probed with a single, compact connector. Great care must be taken to maintain adequate signal quality for all signals.

2 Decide which probe to use.

The probe uses the same 90-pin probe cable as the Agilent 1695x-series logic analyzer. That allows you to choose from a variety of probes to make the physical connection.

The probe you choose must meet the following requirements:

- The probe must have 90-pin logic analyzer connector.
- The probe must be able to probe differential signals.

See the sections which follow for more information on some recommended options. Be sure to read the design notes for the Agilent E5381A flying lead probe, no matter which probe you are using.

3. If you are using the flying lead probe (page 21), decide what kind of header to place on your board.
4. Decide which signals, if any, will be required for stimulus.
5. Design the transmission lines for the best signal quality.
6. Lay out footprints for the connectors you will using.

Using Agilent E5381A differential flying leads

The differential flying lead probe set has the flexibility of probing both differential signals as well as single-ended signals. Depending on the your connection, you have analog bandwidths up to 1.5 Gb/s (well beyond what is necessary for 312 Mbps signals. This probe is best used when the signals must be probed at the receivers (that is, when a series termination scheme is used or when parallel termination does not yield a reflectionless signal in the middle of the wire).

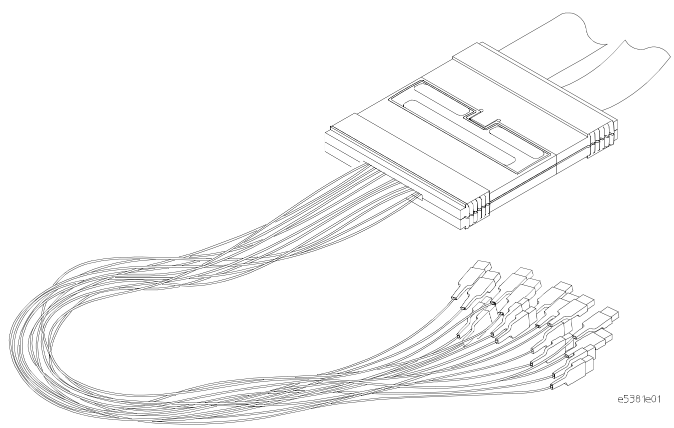


Figure 1 E5381A differential flying leads

Design notes

- Keep all connection points within about 38 cm. (15 inches) of each other.
- Both single-ended and differential signals can be probed.
- The tip of the each lead has positions for three pins, but the middle pin is not electrically connected to anything:

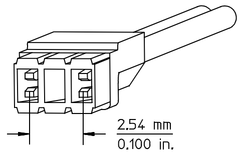


Figure 2 Tip of a flying lead

- Multiple adapters can be used side-by-side or in tandem by skipping one or more pins. Note that the body of the probe head precludes placing them back-to-back (see “Using socket adapters" on page 16 for more information on this).
- See the Agilent *E5381A Differential Flying Leads User’s Guide* for more information on the probe and how to install it. To obtain this document, search for “E5381A” at www.agilent.com.
- Agilent recommends that you check the quality of each signal with an oscilloscope when you first connect the N4851A acquisition probe to your DUT. Plan for a way to probe each signal with an oscilloscope while the acquisition probe is connected.

Signal-to-channel mapping

Table 2 Connections for E5381A flying leads

Signal	Logic analyzer lead to connect	
Clkp	Ch 15, positive	Ground N side of differential probe.
Clkn	CLOCK, positive	Ground N side of differential probe.
VSense	Ch 6, positive	Required if using the N4861A stimulus probe. Optional if using the N4851A acquisition probe alone. Ground N side of differential probe.
Data Lane 0p	Ch 8, positive	Ground N side of differential probe.
Data Lane 0n	Ch 9, positive	Ground N side of differential probe.
Data Lane 1	Ch 10	Probe differentially
Data Lane 2	Ch 11	Not yet supported Probe differentially
Data Lane 3	Ch 12	Not yet supported Probe differentially

The Data Lane 0p, Data Lane 0n, Clkp, and Clkn lines are probed both as single ended and differential, even though the your physical connection is only single ended. This is done to allow the logic analyzer to detect LP and HS modes. The negative sides of all of these connections *must* be connected to ground.

Lanes 1, 2, and 3 are probed by a single differential channel.

Laying out pads for the 3-pin headers

See the Agilent *E5381A Differential Flying Leads User's Guide* for dimensional drawings of the pad sizes for the 3-pin headers and equivalent load models that include the 3-pin header. One example of a 3-pin header is Samtec part number FTR-103-02-S-S.

Data Lane 0

Probe as close as possible to the chip which receives the high-speed data; in other words, place the connector near the pads of the master IC. You can probe Data Lane 0p and Data Lane 0n using two 3-pin connectors as follows:

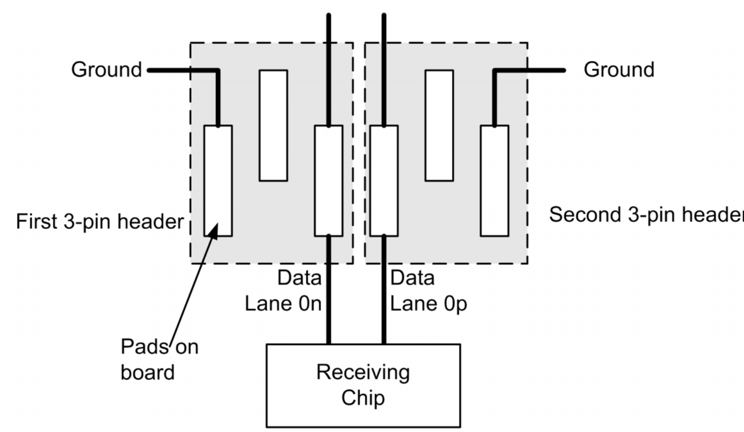


Figure 3 Rx signal connections for side-by-side 3-pin headers

Be careful of the spacing between the 3-pin headers. There must be 0.1 inch between pins:

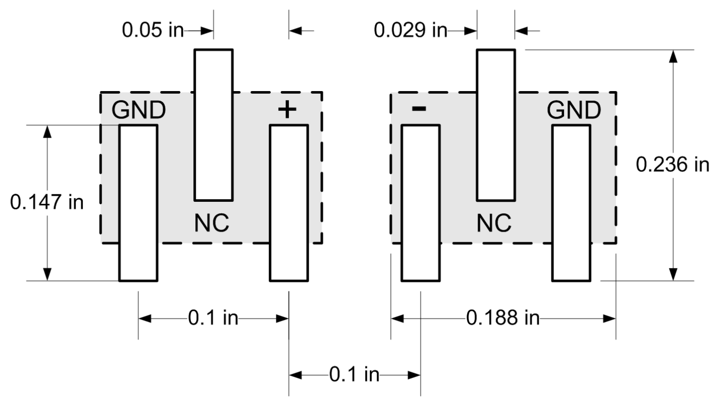


Figure 4 Spacing of pads for two side-by-side 3-pin headers

Clk

Probe Clk near the receiver. Take care to ensure good signal integrity at the connector. Be sure to connect the negative side of the flying lead to ground.

If Clk is AC coupled at the source, you must also place a DC blocking capacitor after the point where the acquisition probe is connecting to the signal. This is because the acquisition probe will bias the signal to 750mV. In this case, set the Vthreshold for Clk to 750mV, not ground, due to this bias. If you cannot add a DC blocking capacitor after the point where the acquisition probe connects to Clk, you can add a resistor to ground to pull the middle voltage back toward ground; the 750mV will look like it has a 20K resistor between the point where it is probing Clk and the 750mV. See the probe load model Figure 19 on page 30 for a typical load model.

Vsense

You must connect Vsense if you are using the N4861A stimulus probe. Vsense is a DC input which tells the N4851A acquisition probe whether the DUT has power. This information is sent to the N4861A stimulus probe, which will not drive the stimulus signals until the DUT is active.

You will enter a minimum voltage for Vsense when you configure the logic analysis system. This voltage can be anywhere between 0.5V and 2.5V. Note that this will be a voltage that is used to detect the “power up” state, so you can use 2.5V even if the voltage is +5V.

Vsense is optional if you are only using the N4851A acquisition probe.

Connect Vsense to a signal which goes low when the IC is powered off (or in any state where it should not receive stimulus). In many cases, a good choice is to connect Vsense to Vcc somewhere near the SMA connectors.

Data Lane 1, Lane 2, Lane 3

As with the other signals, probe as close as possible to the chip which receives the high-speed data.

The connector dimensions are the same as for Data Lane 0, but both the positive and negative sides of the signal will be connected to the same flying lead.

Data Lane 2 and Data Lane 3 are not probed by the N4851A acquisition probe.

Using socket adapters

Use a header with 4 pins, 0.025 inch diameter, that are 0.1 inch center-to-center. Connect the outer two pins to ground, and the inner two pins to the positive and negative sides of Data Lane 0 (or Clk).

Use the square-pin socket adapters:

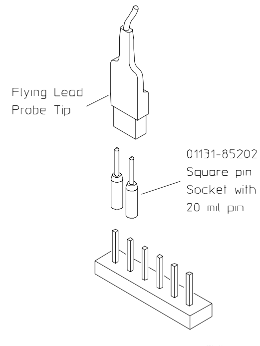


Figure 5 Socket adapters for flying leads

Using a two-row connector

If you do not wish to use a single row connector (due to load-shop considerations), you may use a two-row connector. The flying leads may be placed side-by-side, but not back-to-back:

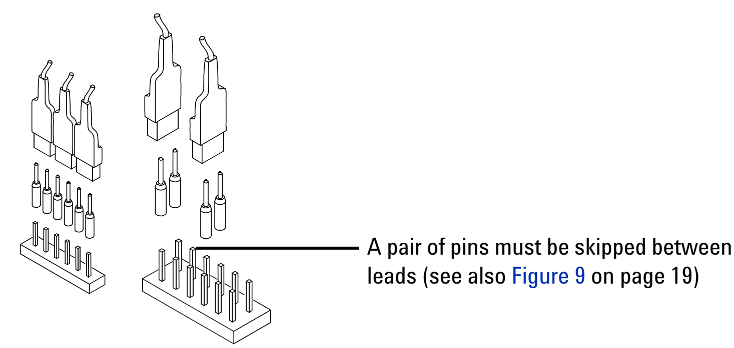


Figure 6 Using a single- or double-row connector

You cannot put the sockets back-to-back; there is a mechanical problem with the tips if you do that:

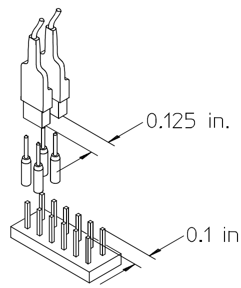


Figure 7 Mechanical interference between flying leads

You can see this with a dimensioned drawing of a 4x2 connector and overlaying the dimensions of the probe head:

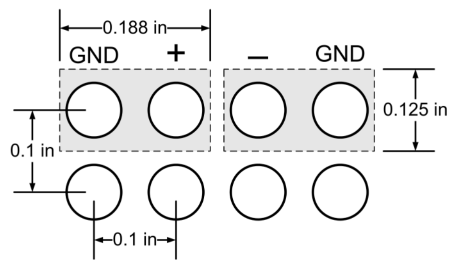


Figure 8 Two-row header with side-by-side flying leads

The connectors may also be placed in tandem by skipping a pair of pins:

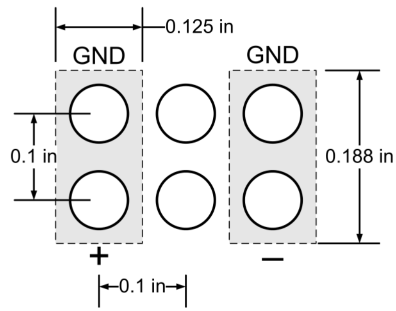


Figure 9 Two-row header with tandem flying leads (shaded area shows flying lead probe tips)

Designing the transmission lines

Especially with the two-row connectors, you will need to use care to maintain a constant trace capacitance per unit length between the traces. Traces for the two sides of a differential signal probably will need to spread apart to reach the pins of a header. Nevertheless, as much as possible, maintain a constant distance between both sides of a differential pair. Avoid stubs if at all possible; where stubs cannot be avoided (as with the connections to the N4851A acquisition probe), minimize their length.

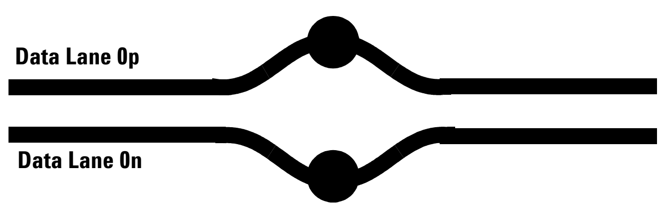


Figure 10 Best layout to maintain constant impedance

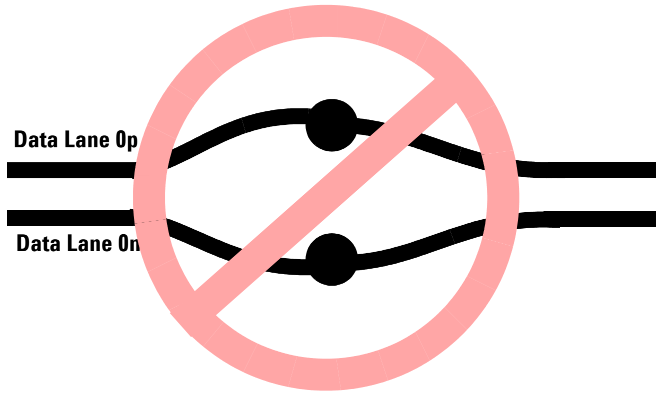


Figure 11 **Avoid** traces not designed to maintain constant impedance

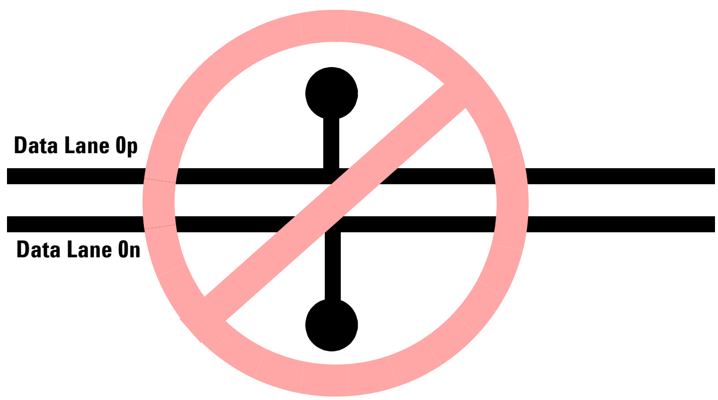


Figure 12 **Avoid** stubs

Probing without designed-in connectors

If headers are not available on your board, you may solder Agilent's 82-ohm coaxial tip resistors directly to the leads of the receiving chip. See the Agilent *E5381A Differential Flying Leads User's Guide* for information on how to install the tip resistors.

Using an Agilent connectorless soft touch probe

The Agilent E5387A differential soft touch connectorless probe and Agilent E5405A-pro series differential soft touch connectorless probe have connections for up to 17 differential channels. The E5405A-pro series has a smaller footprint, so it is usually the better choice.

An Agilent soft touch probe is the least intrusive mass-termination method of connecting to the signals. It should only be used when the signal quality at the point of the soft touch footprint is acceptable—that is, free of ringing and “ledges.” A good quality parallel termination with impedance controlled traces will typically achieve this, as will a trace which is so short its transmission time is less than one-sixth the rise and fall time of the signal. See “Signal quality" on page 29 for more information.

E5387A

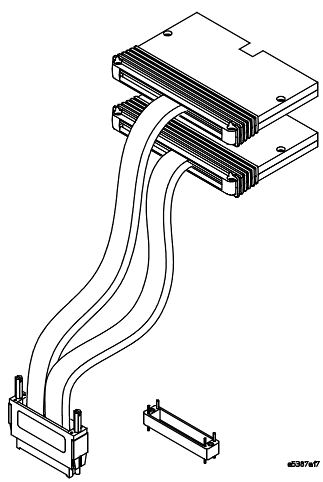


Figure 13 Agilent E5387A differential soft touch connectorless probe

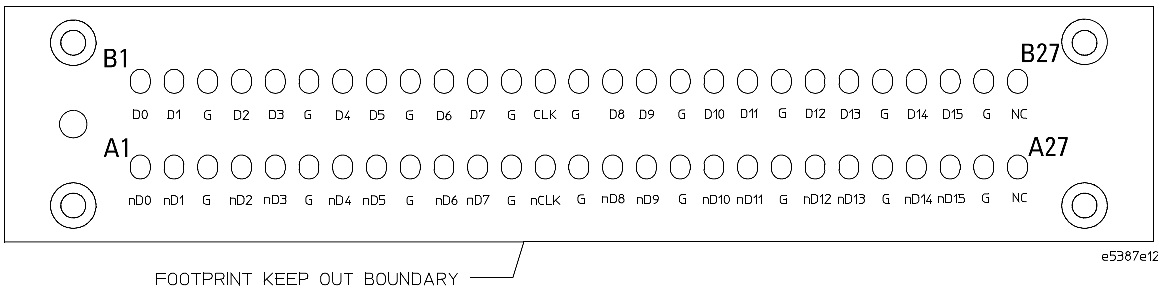


Figure 14 Footprint for E5387A soft touch probe

Table 3 Pad connections for E5387A soft touch probe

Signal	Pad number	Pad number	Signal
NC	A1	B1	NC
NC	A2	B2	NC
GND	A3	B3	GND
NC	A4	B4	NC
GND	A5	B5	NC
GND	A6	B6	GND
GND	A7	B7	NC
NC	A8	B8	NC
GND	A9	B9	GND
GND	A10	B10	VSense
NC	A11	B11	NC
GND	A12	B12	GND
GND	A13	B13	Clkn
GND	A14	B14	GND
GND	A15	B15	Data Lane 0p

Table 3 Pad connections for E5387A soft touch probe

GND	A16	B16	Data Lane 0n
GND	A17	B17	GND
Data Lane 1n	A18	B18	Data Lane 1p
Data Lane 2n*	A19	B19	Data Lane 2n*
GND	A20	B20	GND
Data Lane 3n*	A21	B21	Data Lane 3p*
NC	A22	B22	NC
GND	A23	B23	NC
NC	A24	B24	GND
GND	A25	B25	Clkp
GND	A26	B26	GND
NC	A27	B27	NC

* Optional connection. Data Lane 2 and Data Lane 3 are not probed by the N4851A acquisition probe.

See the *Agilent Technologies Soft Touch Connectorless Probes User's Guide* for more information on this probe.

E5405A

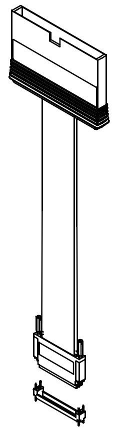


Figure 15 Agilent E5405A-pro series differential soft touch connector-less probe

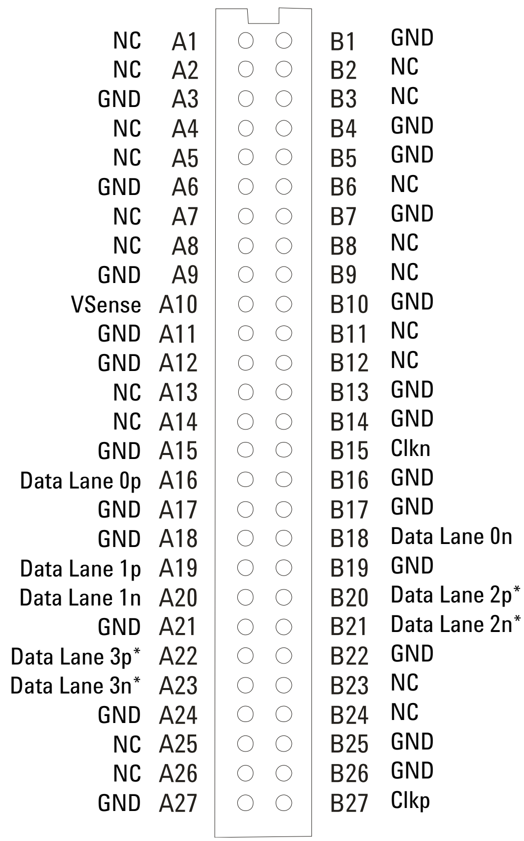


Figure 16 Footprint for E5405A-pro series soft touch probe

* Optional connection. Data Lane 2 and Data Lane 3 are not probed by the N4851A acquisition probe.

See the *Agilent Technologies Soft Touch Connectorless Probes User's Guide* for more information on this probe.

Using an Agilent E5379A 100-pin differential Samtec probe

The E5379A probe is a little more intrusive electrically than the soft touch probes, but that should not be a problem. As with the other probes, the signal quality at the connector must be good.

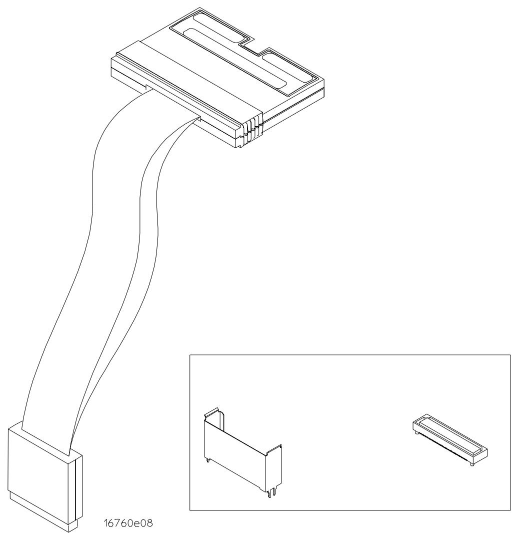


Figure 17 Agilent E5379A 100-pin differential probe

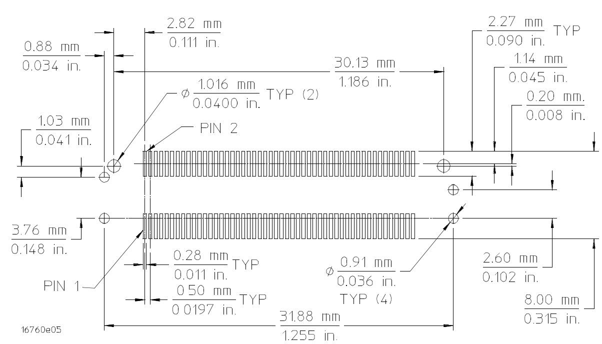


Figure 18 Agilent E5379A 100-pin differential probe connector footprint

Table 4 Pin connections for Agilent E5379A 100-pin differential probe

Signal	Pin number	Pin number	Signal
Ground	1	2	Ground
NC	3	4	NC
Ground	5	6	Ground
NC	7	8	NC
Ground	9	10	Ground
NC	11	12	NC
Ground	13	14	Ground
NC	15	16	NC
Ground	17	18	Ground
NC	19	20	NC
Ground	21	22	Ground
NC	23	24	NC
Ground	25	26	Ground
NC	27	28	NC
Ground	29	30	Ground
Ground	31	32	VSense
Ground	33	34	Ground
NC	35	36	NC
Ground	37	38	Ground
Ground	39	40	Data Lane 0p
Ground	41	42	Ground
Ground	43	44	Data Lane 0n
Ground	45	46	Ground
Data Lane 1n	47	48	Data Lane 1p
Ground	49	50	Ground
Data Lane 2n*	51	52	Data Lane 2p*
Ground	53	54	Ground
Data Lane 3n*	55	56	Data Lane 3p*
Ground	57	58	Ground
NC	59	60	NC
Ground	61	62	Ground
NC	63	64	NC
Ground	65	66	Ground
Ground	67	68	Clkp
Ground	69	70	Ground
NC	71	72	NC
Ground	73	74	Ground
NC	75	76	NC

Table 4 Pin connections for Agilent E5379A 100-pin differential probe

Ground	77	78	Ground
Ground	79	80	Clkn
Ground	81	82	Ground
NC	83	84	NC
Ground	85	86	Ground
NC	87	88	Ground
NC	89	90	NC
NC	91	92	NC
Ground	93	94	Ground
Ground	95	96	Ground
NC	97	98	NC
NC	99	100	NC

* Optional connection. Data Lane 2 and Data Lane 3 are not probed by the N4851A acquisition probe.

For more information on this probe, search for “E5379A” at www.agilent.com.

Signal quality

Minimum signal quality

In order to insure the analyzer will accurately probe the signals, you must insure that the signals meet the requirements set forth in the MIPI Alliance Standard for D-PHY. This signal quality must be present at the location where you will be probing the signal.

Probe load model

It is strongly suggested you use a circuit modelling system such as SPICE to verify compliance across the variability of printed circuit board impedance characteristics, driver characteristics, and components.

The following equivalent circuit shows the effect of placing any of the recommended Agilent probes into your circuit. The model is good up to about 6 GHz. Use this schematic to create a SPICE deck (or equivalent for your modelling system).

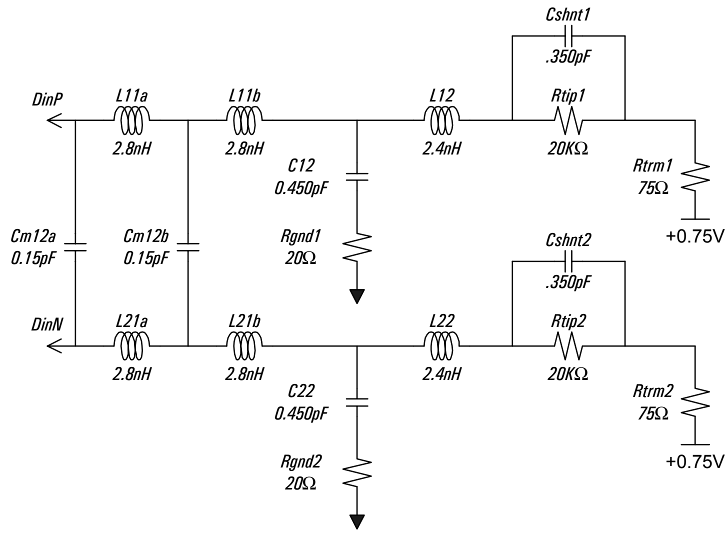


Figure 19 Typical load model for Agilent E5381A flying leads

Probe close to the receiving chip

The probe cannot measure your signals at the ideal location—that is, just inside the die of the chip which is receiving the digital signal.

Probing as closely as possible to the receiving chip's pads is a good way to optimize the probed signal.

Example: How probing location affects signal quality

As an example, consider a signal with the following characteristics:

Table 5 An example LVDS signal

Characteristic	Value
Rise/fall time	2 V/ns, or 500 ps
Voh	1.4 V
Vol	1.0 V
Termination	series

Terminated LVDS at receiver With a transmission line that is 50 ohms + 10% (single ended) an a termination resistor that is 100 ohms - 5%, a transmission line with an delay of 1.4ns (that is, a demo board with room for lots of connectors!), the signal at the receiver looks pretty good:

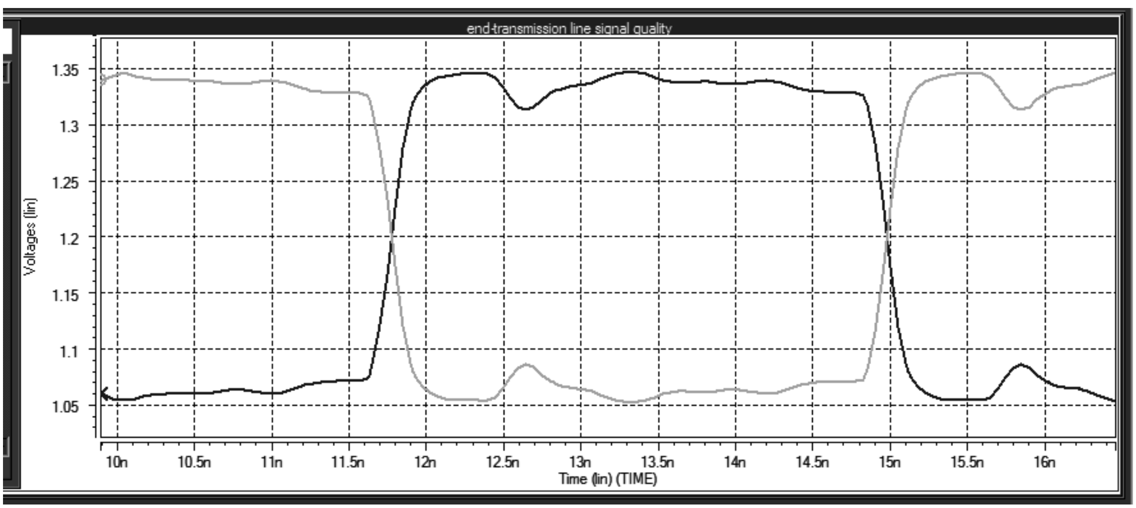


Figure 20 Signal terminated at the receiver

Terminated LVDS at middle of bus However, measuring this same signal in the center of the transmission line (and this is without the load model of the actual probe!) looks much worse:

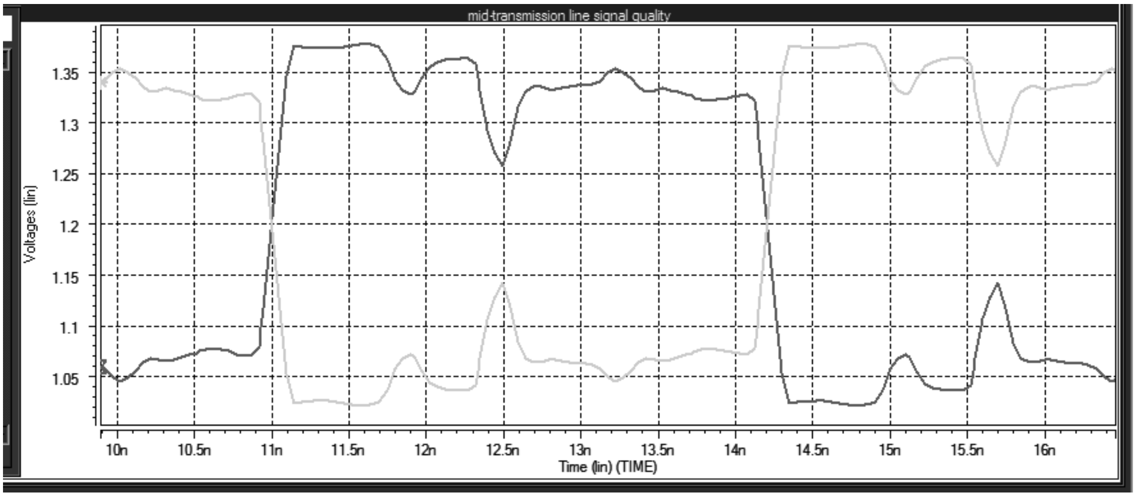


Figure 21 Signal terminated at the middle of the bus

3
Designing connectors for use with the N4861A stimulus probe

Stimulus Overview

The Agilent N4861A stimulus probe allows you to test a master or slave IC. Another way of looking at this is that the stimulus probe emulates an IC which does not exist on your test board. The emulation capability is not a complete emulation, but can be useful for chip turn on and interface testing.

Why the acquisition probe is necessary

The stimulus probe must be configured to generate data going in one direction—it cannot generate bidirectional traffic.

The stimulus probe relies upon output from the Agilent N4851A MIPI D-PHY Acquisition Probe to properly function.

The acquisition probe interprets MIPI D-PHY speed commands and provides additional clues to the stimulus probe. The VSense signal is used to determine if the target IC has power and will disable driving the stimulus lines when power is off.

NOTE Remember, both the stimulus probe and acquisition probe must be connected to the device under test for the stimulus to function properly.

Labeling the connectors

It is important to label each of the SMA connectors with:

- Signal name
- Common mode voltage level
- Voltage swing

The output voltage of the N4861A stimulus probe is user-configurable (using the software running in the logic analysis system).

CAUTION

Be careful to set voltage levels correctly before plugging the N4861A stimulus probe into your board. If the output voltage level is configured at a level too high for your board, your board may be damaged.

Differential Signal Termination

The MIPI D-PHY standard calls for 80-ohm to 125-ohm HS line termination at the receiver. In LP mode, the termination is "switched out" to make an un-terminated, single-ended receiver.

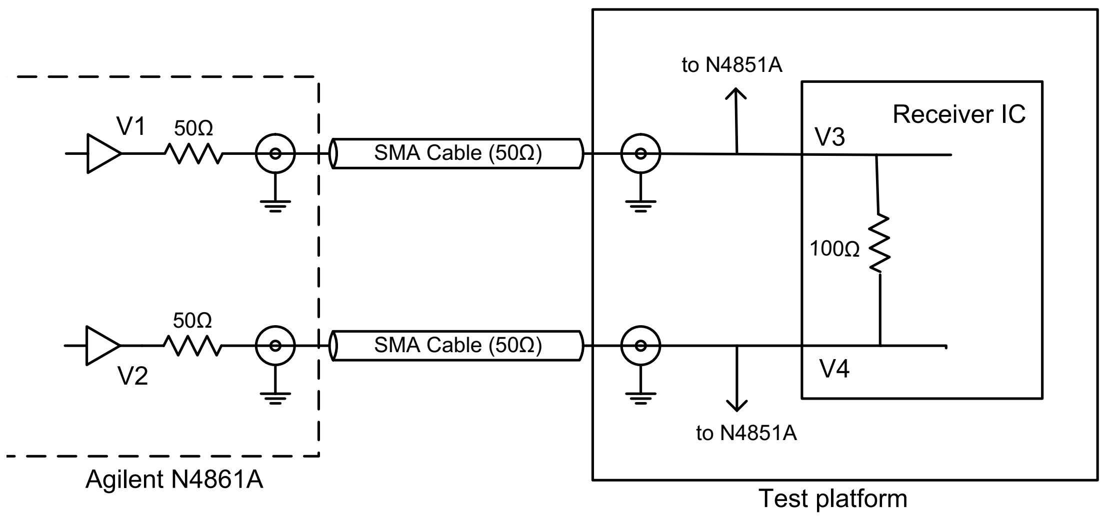


Figure 1 HS line termination

The N4861A stimulus probe controls voltages V1 and V2 independently to generate the desired differential output voltage.

CSI-2 (Emulating a camera)

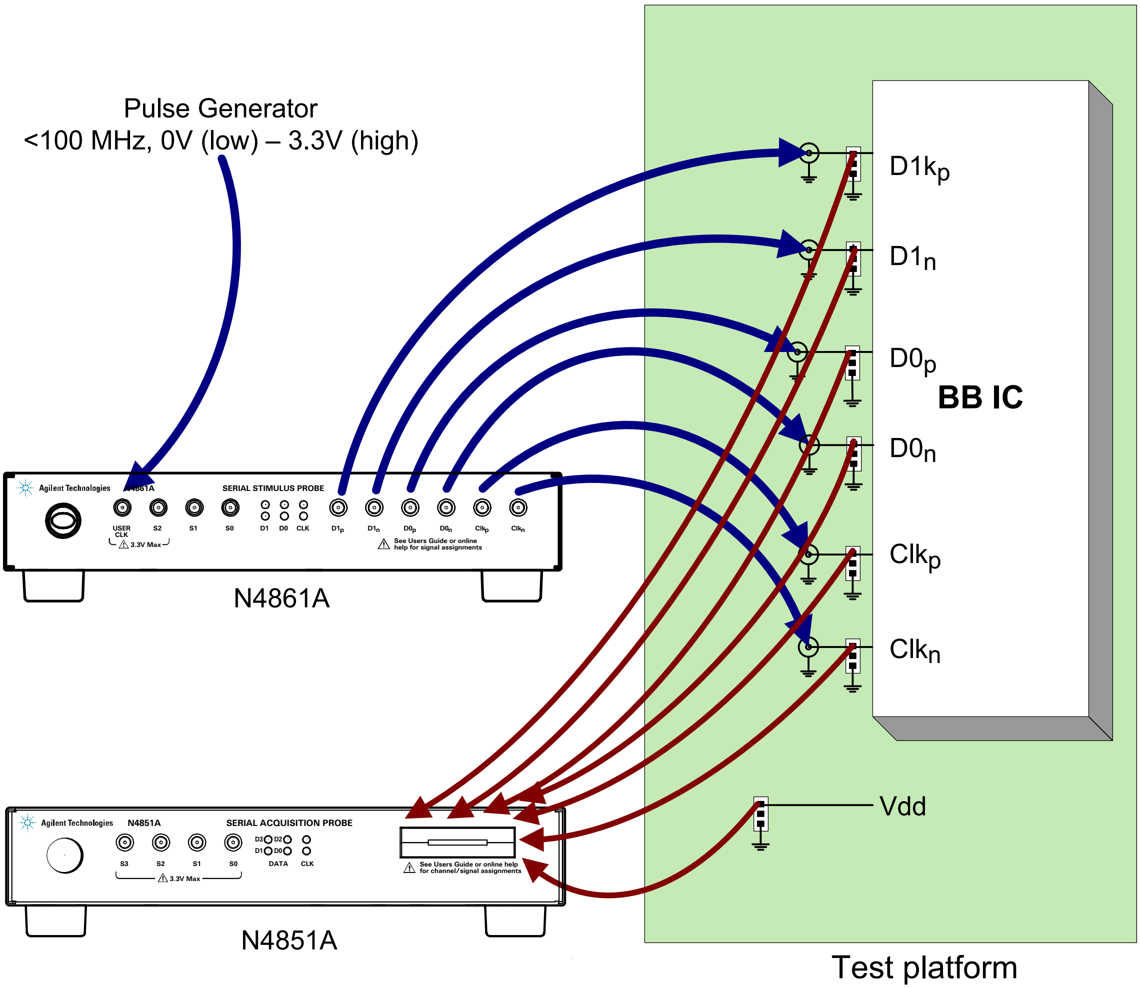


Figure 2 Signal connections for CSI-2

Connectors required

Your test platform needs to incorporate either four or six female SMA connectors for Clkp, Clkn, D0p, D0n, and optionally D1p and D1n. You will need a corresponding number of length-matched SMA cables of approximately 1 meter length.

You also must include a connector for the N4851A acquisition probe. This connection should be between each of the SMA connectors and the IC which is receiving the stimulus. Vsense must also be probed.

Positioning the connectors

Position the SMA connectors as close as possible to the IC. Minimize stub lengths.

DSI (Stimulating a display device)

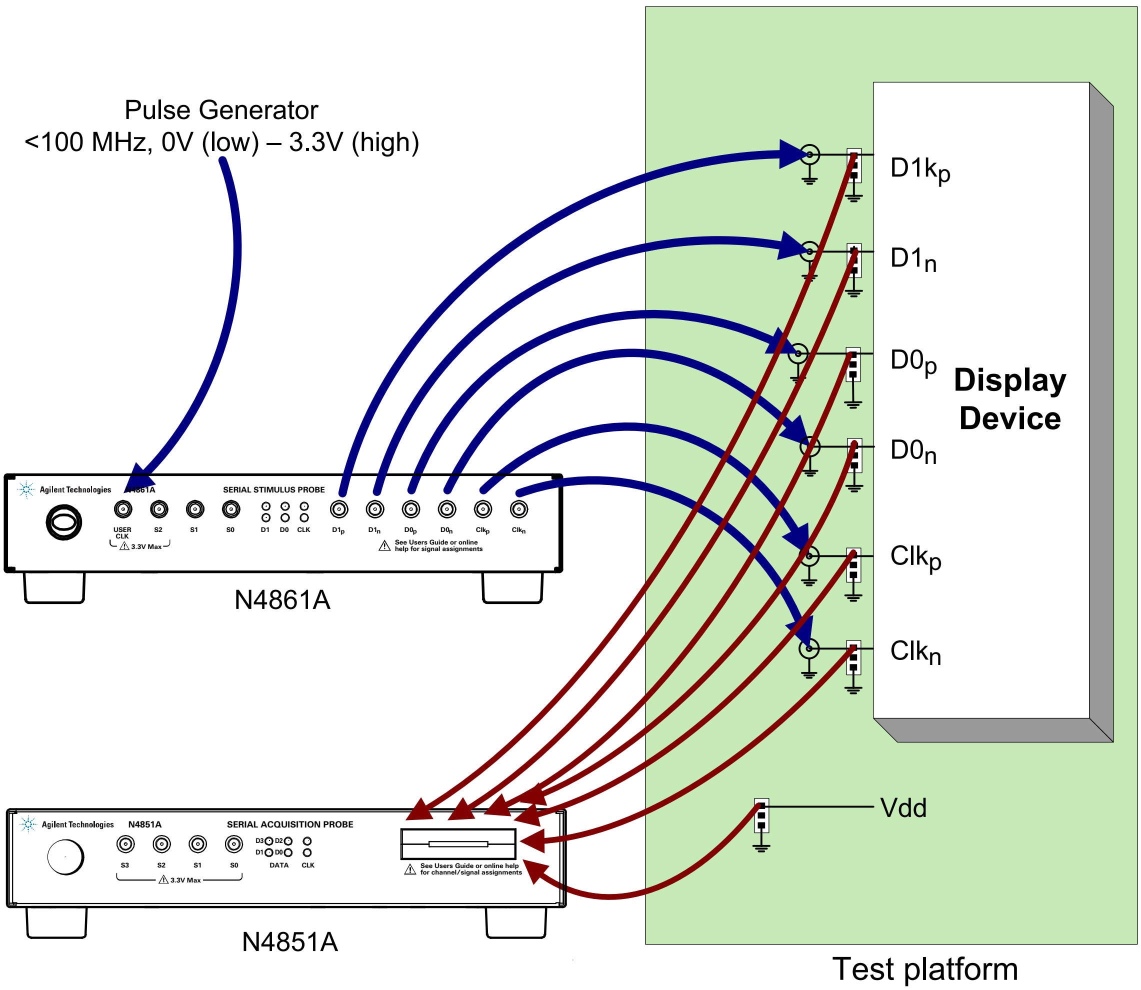


Figure 3 Signal connections for DSI

Connectors required

Your test platform needs to incorporate either four or six female SMA connectors for Clkp, Clkn, D0p, D0n, and optionally D1p and D1n. You will need a corresponding number of length-matched SMA cables of approximately 1 meter length.

You also must include a connector for the N4851A acquisition probe. This connection should be between each of the SMA connectors and the IC which is receiving the stimulus. Vsense must also be probed.

Positioning the connectors

Position the SMA connectors as close as possible to the IC. Minimize stub lengths.

Generating the clock

In most cases, you will want to use a pulse generator to provide the clock input to the N4861A stimulus probe. This allows you to test the response of your device under test to different clock rates. The pulse generator should be connected to SMA labelled "USER CLK" on the N4861A stimulus probe .

CAUTION

The USER CLK input must be non-negative. If a negative voltage is applied to the SMA, the N4861A stimulus probe may be damaged.

The USER CLK input to the N4861A stimulus probe must be non-negative. CMOS levels (0V–3.3V swing) are recommended. The 80MHz Agilent 33250A function/arbitrary waveform generator is an example of an instrument which works well for this purpose.

4
Characteristics — N4851A

Operating Characteristics

The following operating characteristics are not specifications, but are typical operating characteristics.

These characteristics are subject to change. Information in the product data sheet takes precedence over any information listed here.

Table 1 Protocols supported

Protocol	Version supported
MIPI D-PHY	version 0.9
CSI-2	version 1.00
DSI	version 1.01 (version 1.00 is not supported)

Table 2 N4851A Connectors

Connector	Characteristics
Input	Connectors for use only with an Agilent probe. High Speed Mode: Maximum bit rate: 750 Mbps Minimum bit rate: 80 Mbps VHigh: 150mv to +450mV VLow: –17mV to +217mV, (changes with LPVlow or HSVhigh) Low Power Mode: Maximum bit rate: 10 Mbps Minimum bit rate: 800 Kbps VHigh: 0.8V, to 3.3V, Max current 24mA VLow: –100mV to +100mV Minimum voltage swing: Complies with MIPI D-PHY requirements Installation category: CAT I (Mains isolated)
SMA S0, S1, S2, S3	SMA S2, S3: output connector for oscilloscope or other instruments SMA S0, S1: connector reserved for future use. (Input/output function configured in firmware). Min: 0.8V, Max: 3.3V, Max current 24mA DC-50 MHz. CAT I (Mains isolated)
Option Connector	Reserved for use with the Agilent N4861A stimulus probe.
Logic Analyzer Pod Outputs	Two 38-pin Samtec connectors

Table 3 Electrical Characteristics

Electrical Characteristics	
Power Requirements (Power Supply)	Input: 100-240 V, 1.5 A, 50/60 Hz, IEC 320 connector Output: 12 V, 5 A
Power Requirements (N4851A Probe)	Input: 12 V DC, 5 A. Use only with the provided power supply.
Load Model	See the documentation for the probe you are using.

Table 4 Mechanical Characteristics

Mechanical Characteristics

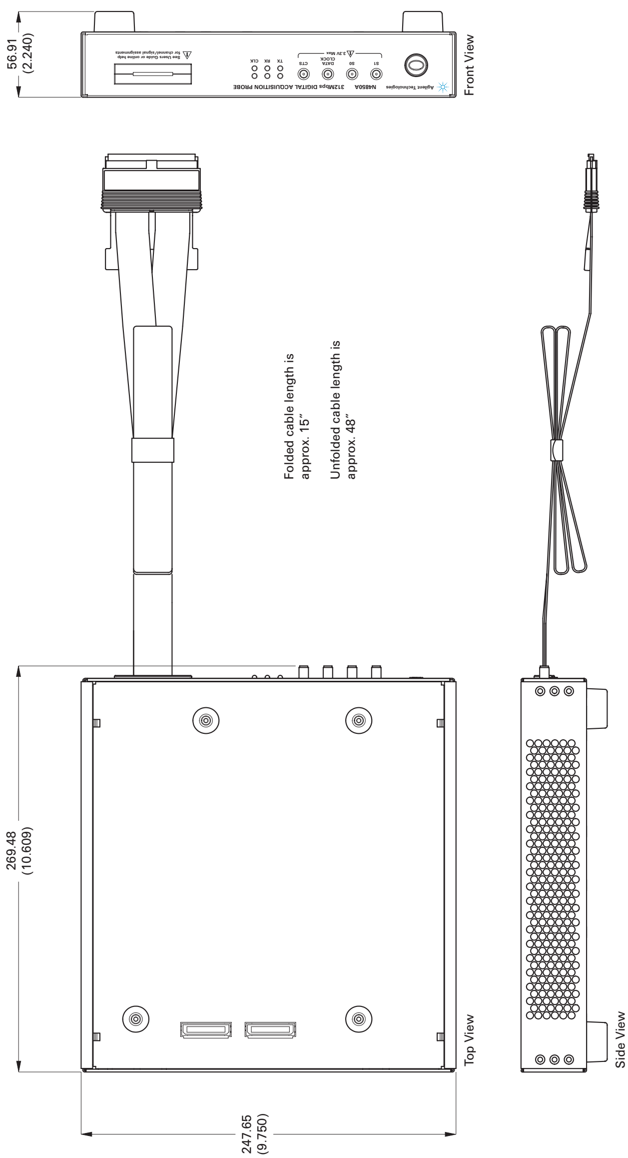


Table 4 Mechanical Characteristics

Mechanical Characteristics	
Weight	Probe: 2.0 kg (4.4 lb), not including power supply

Table 5 Environmental Characteristics (Operating)

Environmental Characteristics (Operating)	
Temperature	Operating/non-operating: +0° to +55° C (+32° to +131° F)
Altitude	Operating/nonoperating 3000 m (10,000 ft)
Humidity	8 to 80% relative humidity at 40° C (104° F).
	Avoid sudden, extreme temperature changes which could cause condensation on the circuit board. For indoor use only.
	Pollution degree 2: Normally only dry non-conductive pollution occurs. Occasionally a temporary conductivity caused by pollution may occur.

5
Characteristics — N4861A

Operating characteristics

The following operating characteristics are not specifications, but are typical operating characteristics.

These characteristics are subject to change. Information in the product data sheet takes precedence over any information listed here.

Table 1 N4861A Connectors

Connector	Characteristics
Pattern Generator Inputs	Seven connectors for use with an Agilent 16720A pattern generator or 16800-series portable logic analyzer with pattern generator.
S0, S1	SMA connector reserved for future use (input/output function configured in software). Min: 0.8V, Max: 3.3V, Max current 24mA DC-50 MHz. CAT I (Mains isolated)
D1p, D1n, D0p, D0n	SMA Differential Output. Min: -100mV, Max: 3.3V (user configurable), Slew rate: Fast/Medium/Slow/Slowest (user configurable) Max current 60 mA

Table 1 N4861A Connectors

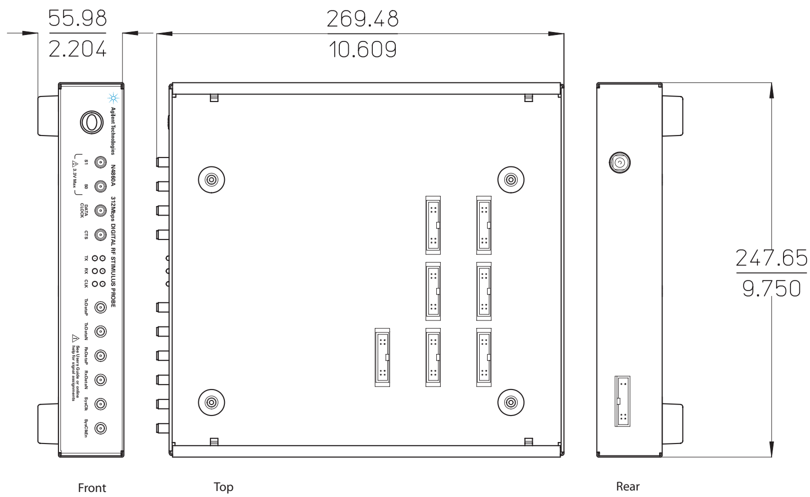
Connector	Characteristics
Clkp, Clkn	SMA Differential Output. Min: -100mV, Max: 3.3V (user configurable), Slew rate: Fast/Medium/Slow/Slowest (user configurable) Max current 60 mA
USER CLK, S2	SMA Input. Min: -1.5 V, Max: 3.3V Maximum clock rate: 100 MHz Slew rate: Fast/Medium/Slow/Slowest (user configurable) Max current 60 mA
Option Connector	Reserved for use with the Agilent N4851A acquisition probe.

Table 2 Electrical Characteristics

Electrical Characteristics	
Power Requirements (Power Supply)	Input: 100-240 V, 1.5 A, 50/60 Hz, IEC 320 connector Output: 12 V, 5 A CAT II (Line voltage in appliance and to wall outlet)
Power Requirements (Agilent N4861A Probe)	Input: 12 V DC, 5 A. Use only with the provided power supply. CAT I (Mains isolated)
Load Model	See the documentation for the probe you are using.

Table 3 Mechanical Characteristics

Mechanical Characteristics	
Analysis Probe Dimensions	



N4860A Dimensional Drawing

Weight	Probe: 2.0 kg (4.4 lb), not including power supply

Table 4 Environmental Characteristics (Operating)

Environmental Characteristics (Operating)	
Temperature	Operating/non-operating: +0° to +55° C (+32° to +131° F)
Altitude	Operating/nonoperating 3000 m (10,000 ft)
Humidity	8 to 80% relative humidity at 40° C (104° F). Avoid sudden, extreme temperature changes which could cause condensation on the circuit board. For indoor use only. Pollution degree 2: Normally only dry non-conductive pollution occurs. Occasionally a temporary conductivity caused by pollution may occur.