
User's Guide

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1131A 3.5 GHz InfiniiMax Differential and Single-ended Probes

In This Book

This book provides user and service documentation for the Agilent Technologies 1131A differential and single-ended probes. It is divided into two chapters.

Chapter 1 provides an overview of the recommended configurations and capacitance values of the probe; shows you how to use the convenience accessories with the probe; and provides the frequency, impedance, and time response for the recommended configurations of the probe.

Chapter 2 provides service and performance verification information for the probe.

At the back of the book you will find Safety information and Regulatory information.

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Introduction

The 1131A InfiniiMax Active Probing System allows probing of differential and single-ended signals to a bandwidth of over 3.5 GHz with excellent common mode rejection. Additionally, Agilent's resistor-at-the-tip technology (introduced in the 115X probe family) provides high fidelity and low input loading. This system uses interchangeable probe heads to optimize the performance and usability of three connection types: hand browsing, solder-in and plug-on socket. Differential probe heads offer easy measurement of differential signals and greatly improve the measurement of single-ended signals. Single-ended probe heads offer extremely small size for probing single-ended signals in confined spaces with some reduction in performance. The probe heads provided for this system are:

- Differential Hand-held Browser (or for probe holders) allows temporary connection to points in a system. This probe head provides the highest performance hand-held browser for measuring differential and single-ended signals while maintaining excellent usability due to the adjustable tip spacing and full z-axis compliance.
- Differential Solder-In Probe Head allows a soldered connection into a system for a reliable, hands-free connection. This probe head provides full bandwidth performance with the lowest input loading for probing differential and single-ended signals. At the tip it uses a miniature axial lead resistor with 8 mil diameter leads which allows connection to very small, fine pitch targets.
- Differential Socket-Tip Probe Head provides sockets that accept 20 mil diameter pins with 100 mil spacing. The intended application for this probe head is to insert two of the supplied 20mil diameter lead resistors into the sockets and then solder the resistors into the target system. This allows a removable, hands-free connection that provides full bandwidth with a minor increase in capacitance over the solder-in probe head for probing differential and single-ended signals. Additionally, 3.6 cm resistor tip wire accessories are provided for high fidelity lower bandwidth probing of signals with very wide spacing.
- Single-ended Hand-held Browser (or for probe holders) allows temporary connection to points in a system for single-ended signals only. This browser has lower bandwidth than the differential browser, but is very small which allows probing in tight areas.
- Single-ended Solder-In Probe Head allows a soldered connection for a reliable hands-free connection to single-ended only. This probe head has lower bandwidth than the differential solder-in probe head, but is extremely small which allows probing in tight areas or probing several signals located close together.

The E2669A Differential Connectivity Kit includes the differential browser, solder-in, and socket-tip probe heads. Also included is an Ergonomic Handle for the browser along with other accessories. This allows full bandwidth probing of differential and single-ended signals.

The E2668A Single-ended Connectivity Kit includes the single-ended browser and solder-in probe heads as well as the differential socket-tip probe head. A single-ended socket-tip probe head was not developed since it did not offer a significant size advantage. Also included is an Ergonomic Handle for the browser along with other accessories.

In order to take the guesswork out of how to connect your probe, the Detailed Information for Recommended Configurations section shows the various probe heads along with their performance information. This allows you to quickly make the measurements you need with confidence in the performance and signal fidelity. Using the recommended connection configurations is your key to making accurate oscilloscope measurements with known performance levels.

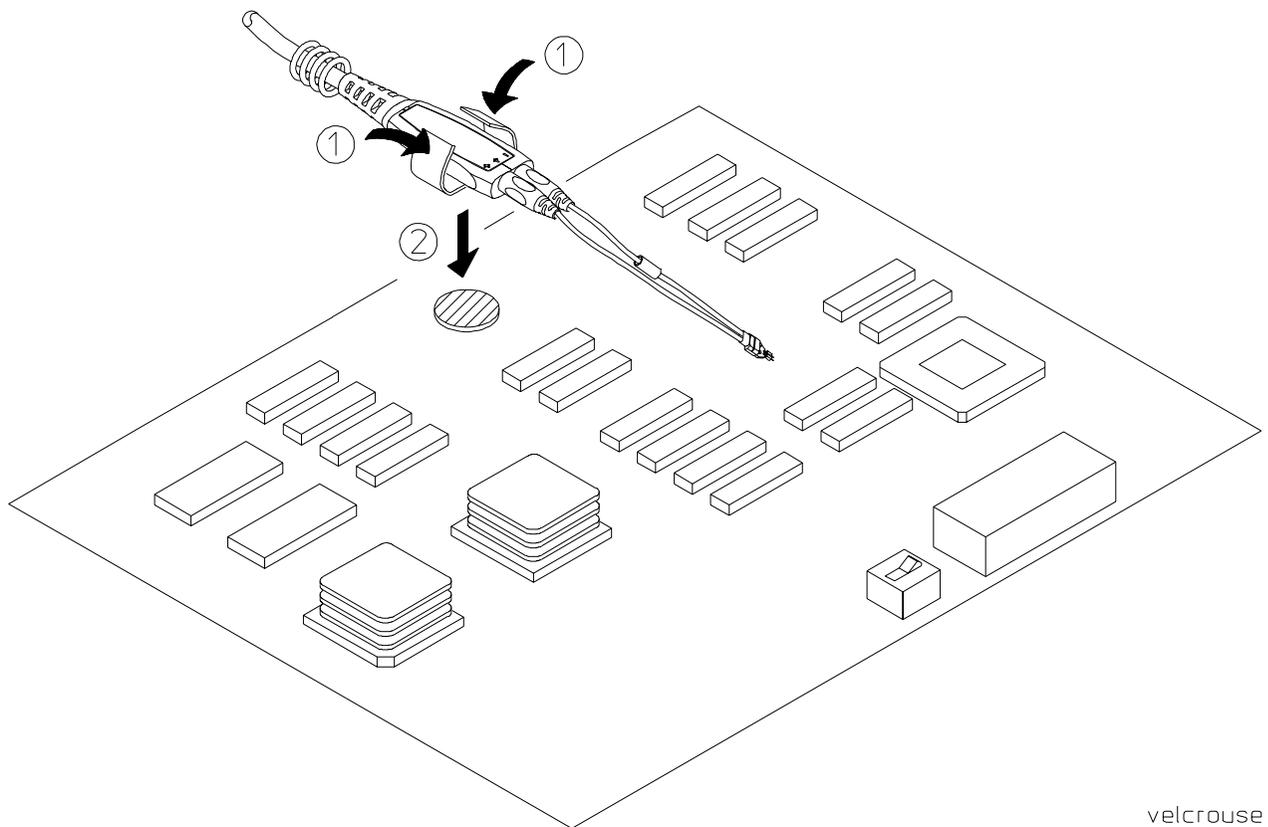
Convenience Accessories

Using the Velcro strips and dots

The Velcro strips and dots can be used to secure the probe amp to a circuit board removing the weight of the probe from the circuit connection. This is done by using the following steps.

- 1 Wrap the Velcro strip around the probe amp body.
- 2 Attach a Velcro dot to the circuit board.
- 3 Attach the Velcro strip to the Velcro dot.

Figure 1-1

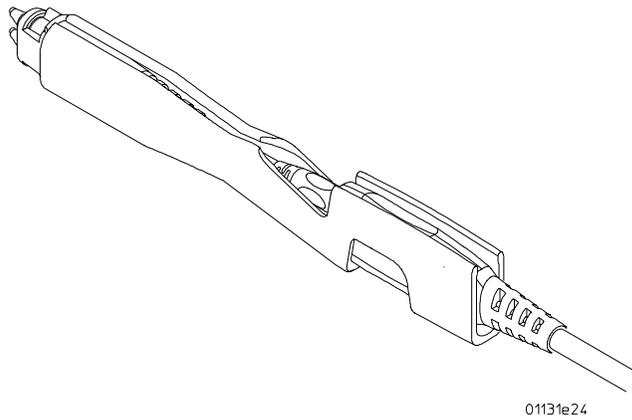
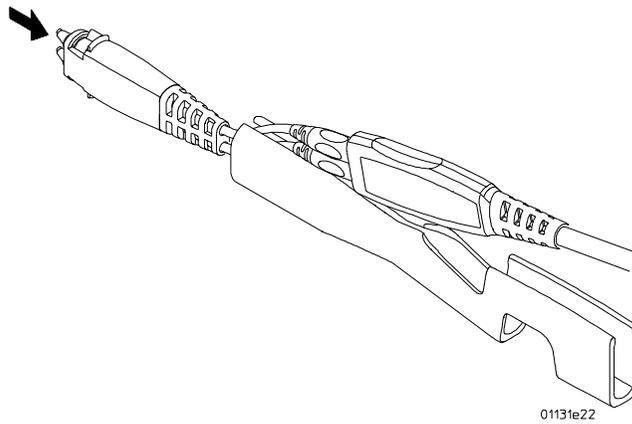
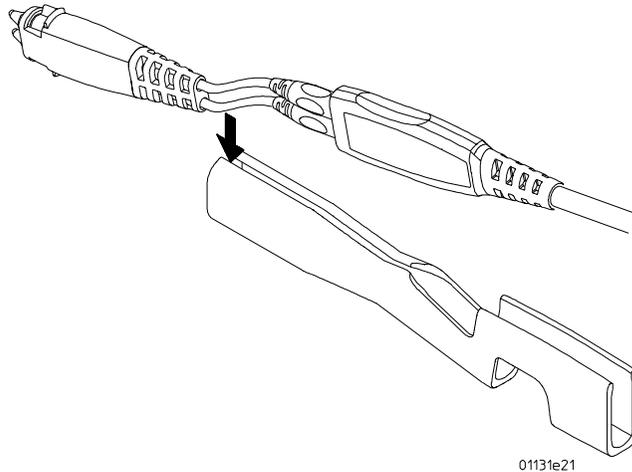


Using the Velcro dots and strips.

Using the ergonomic handle

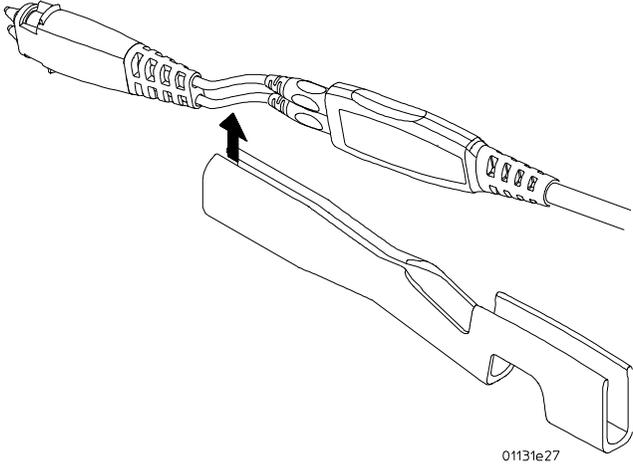
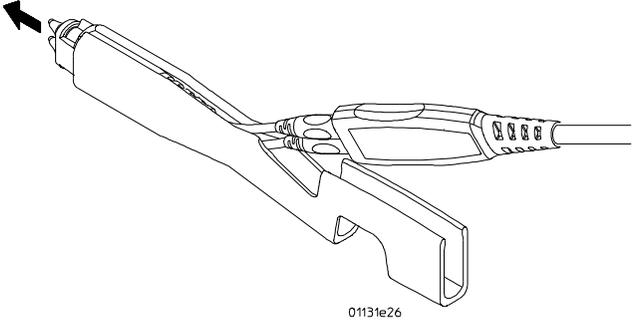
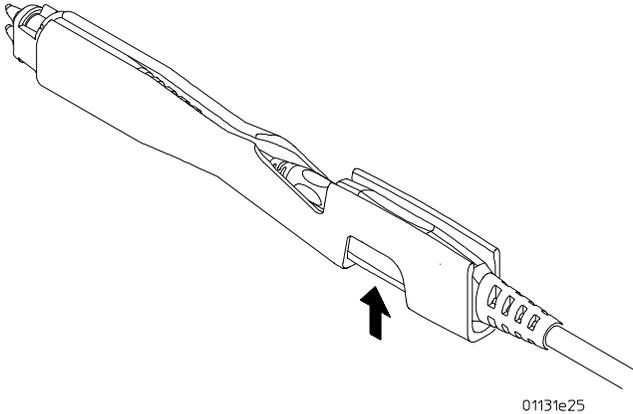
Because of their small size, it can be difficult to hold the single-ended or the differential browsers for extended periods of time. The ergonomic handle can be used to more comfortably hold the browser. The following pictures show how to mount the browser in the ergonomic handle.

Figure 1-2



The following pictures show how to remove the browser from the ergonomic handle.

Figure 1-3



Slew Rate Requirements for Different Technologies

The following table shows the slew rates for several different technologies. The maximum allowed input slew rate is 18 V/ns for single-ended signals and 30 V/ns for differential signals. Table 1-1 shows that the maximum required slew rate for the different technologies is much less that of the probe.

Table 1-1

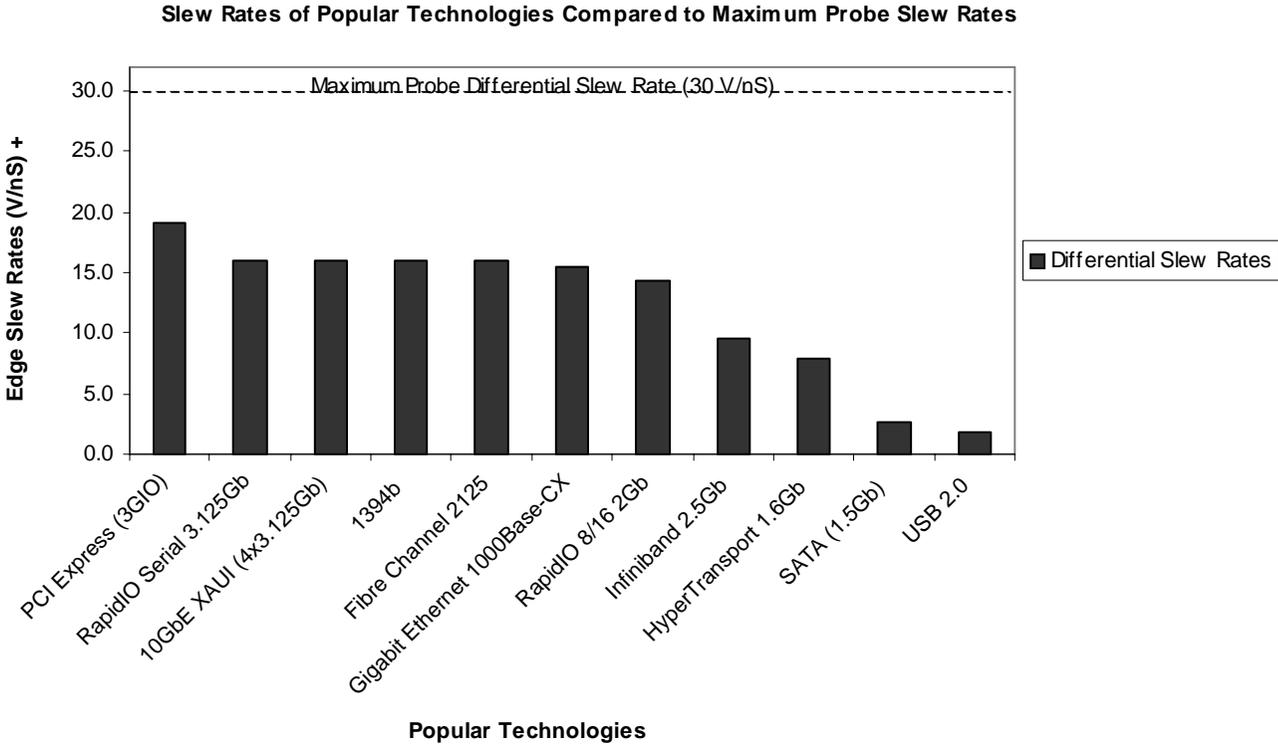
Slew Rate Requirements

Name of Technology	Differential Signal	Max Single-Ended Slew Rate ¹ (V/ns)	Max Differential Slew Rate ² (V/ns)	Driver Min Edge Rate (20%-80% ps)	Max Transmitter Level (Diff V)
PCI Express (3GIO)	YES	9.6	19.2	50	1.6
RapidIO Serial 3.125Gb	YES	8.0	16.0	60	1.6
10GbE XAUI (4x3.125Gb)	YES	8.0	16.0	60	1.6
1394b	YES	8.0	16.0	60	1.6
Fibre Channel 2125	YES	8.0	16.0	75	1
Gigabit Ethernet 1000Base-CX	YES	7.8	15.5	85	2.2
RapidIO 8/16 2Gb	YES	7.2	14.4	50	1.2
Infiniband 2.5Gb	YES	4.8	9.6	100	1.6
HyperTransport 1.6Gb	YES	4.0	8.0	113	1.5
SATA (1.5Gb)	YES	1.3	2.7	134	0.6
USB 2.0	YES	0.9	1.8	375	1.1
DDR 200/266/333	NO	7.2	n/a	300	3.6
PCI	NO	4.3	n/a	500	3.6
AGP-8X	NO	3.1	n/a	137	0.7

¹ The probe specification is 18 V/ns

² The probe specification is 30 V/ns

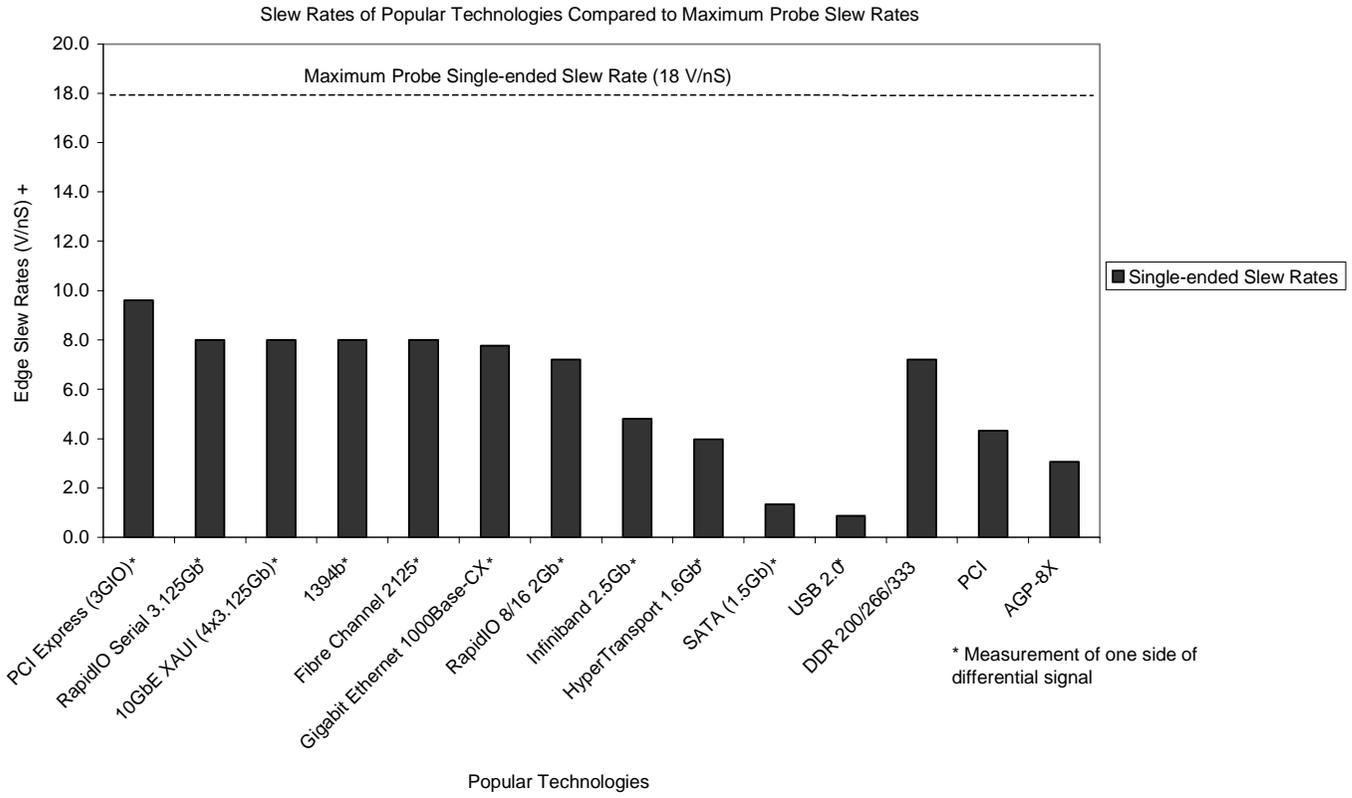
Figure 1-4



+
$$\frac{\text{Maximum Edge Amplitude} \times 0.6}{\text{Minimum 20\% to 80\% Rise Time}}$$

Differential and Single-ended Probe Configurations
Slew Rate Requirements for Different Technologies

Figure 1-5



+ $\frac{\text{Maximum Edge Amplitude} \times 0.6}{\text{Minimum 20\% to 80\% Rise Time}}$

Recommended Configurations Overview

The recommended configurations are designed to give the best probe performance for different probing situations. The probe configurations are shown in the order of the best performance to the least performance.

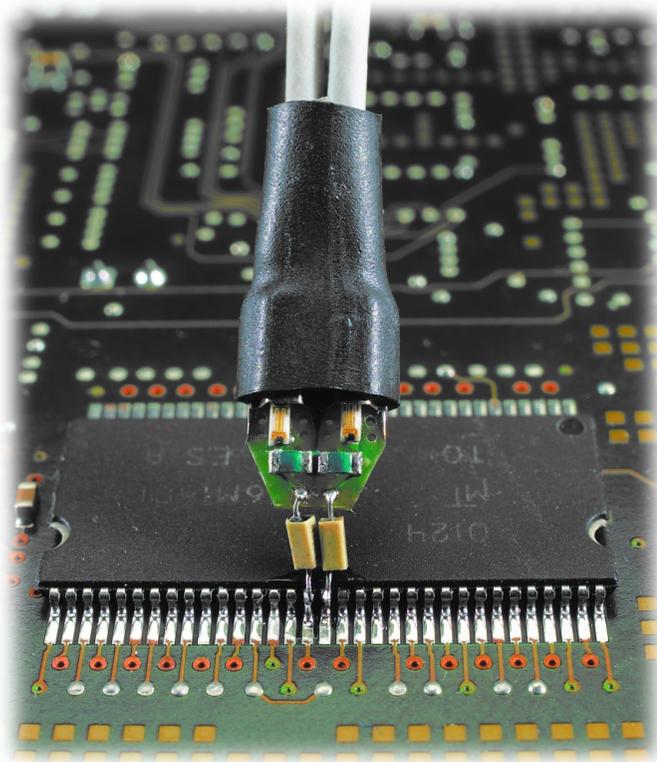
1 Solder-in Differential Probe Head (full bandwidth resistors)

This configuration has a bandwidth of greater than 3.5 GHz (see the graphs starting on page 1-19). The configuration consists of the following parts:

- E2677A — Solder-in Differential Probe Head
- 01131-81508 — 100 Ω mini-axial lead resistors (2 each)

The 01131-81508 resistor has been trimmed and formed as per template 01131-94307.

Figure 1-6



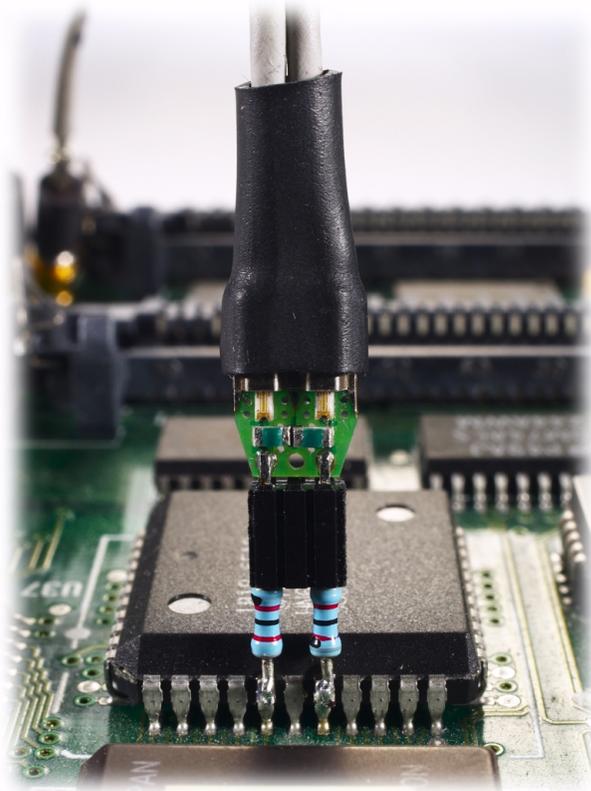
2 Socketed Differential Probe Head (full bandwidth resistors)

This configuration has a bandwidth of approximately equal to 3.5 GHz (see the graphs starting on page 1-22). This configuration consists of the following parts:

- E2678A — Socketed Differential Probe Head
- 01130-81506 — 82 Ω axial lead resistors (2 each)

The 01130-81506 resistor has been trimmed and formed as per template 01131-94309.

Figure 1-7

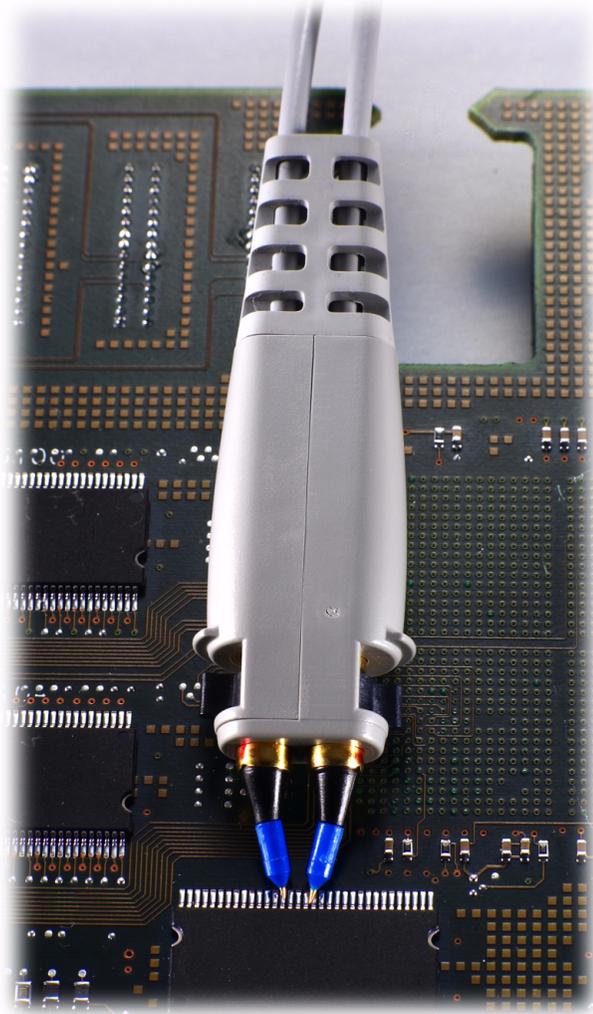


3 Differential Browser Probe Head

This configuration has a bandwidth approximately equal to 3.5 GHz (see the graphs starting on page 1-25). This configuration consists of the following parts:

- E2675A — Differential Browser Probe Head
- 01131-62102 — 91 Ω resistor probe tips (2 each)

Figure 1-8



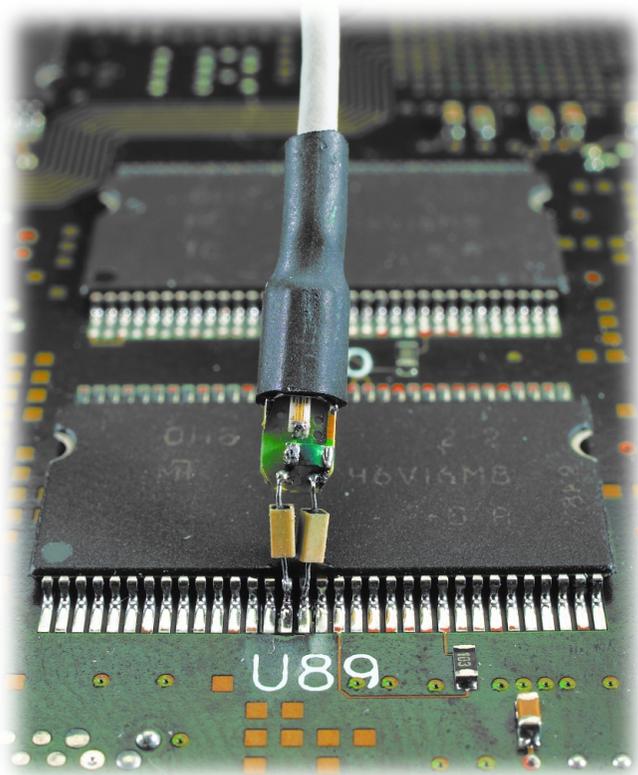
4 Solder-in Single-ended Probe Head (full bandwidth resistors)

This configuration has a bandwidth approximately equal to 3.5 GHz (see the graphs starting on page 1-28). This configuration consists of the following parts:

- E2679A — Solder-in Single-ended Probe Head
- 01131-81508 — 100 Ω mini-axial lead resistor
- 01131-81504 — 0 Ω mini-axial lead resistor

The 01131-81508 and 01131-81504 resistors have been trimmed and formed as per template 01131-94307.

Figure 1-9

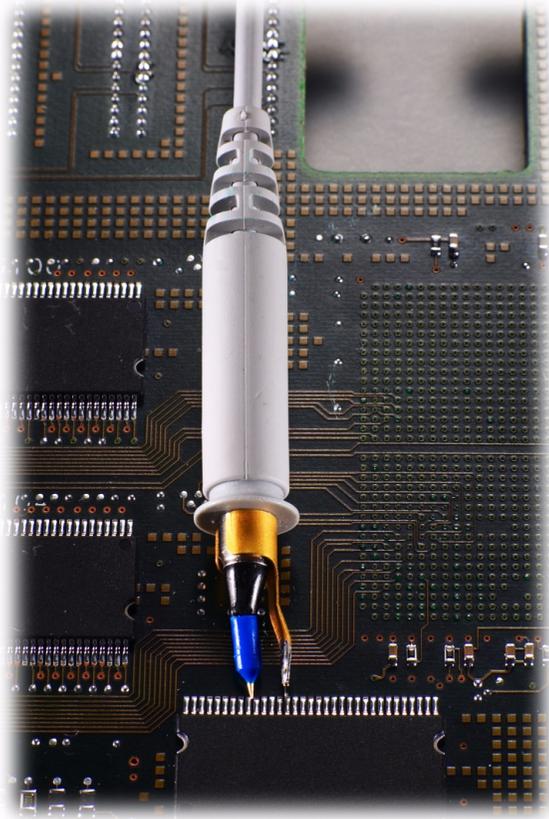


5 Single-ended Browser Probe Head

This configuration has a bandwidth approximately equal to 3.5 GHz (see the graphs starting on page 1-31). This configuration consists of the following parts:

- E2676A — Single-ended Browser Probe Head
- 01131-62102 — 91 Ω resistor probe tip
- 01130-60005 — Ground collar assembly

Figure 1-10



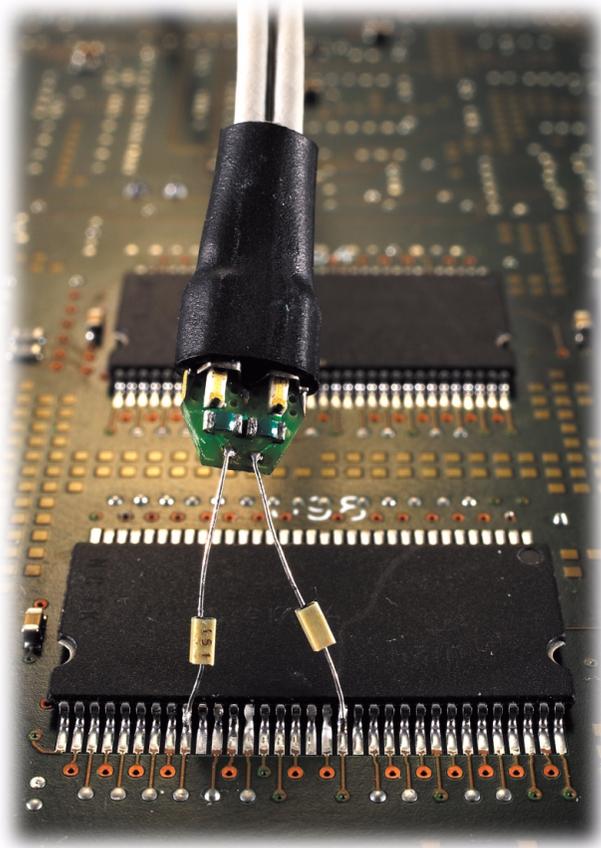
6 Solder-in Differential Probe Head (medium bandwidth resistor)

This configuration has a bandwidth approximately equal to 2.9 GHz (see the graphs starting on page 1-34). This configuration consists of the following parts:

- E2677A — Solder-in Differential Probe Head
- 01131-81506 — 150 Ω mini-axial lead resistors (2 each)

The 01131-81506 resistor has been trimmed and formed as per template 01131-94308.

Figure 1-11



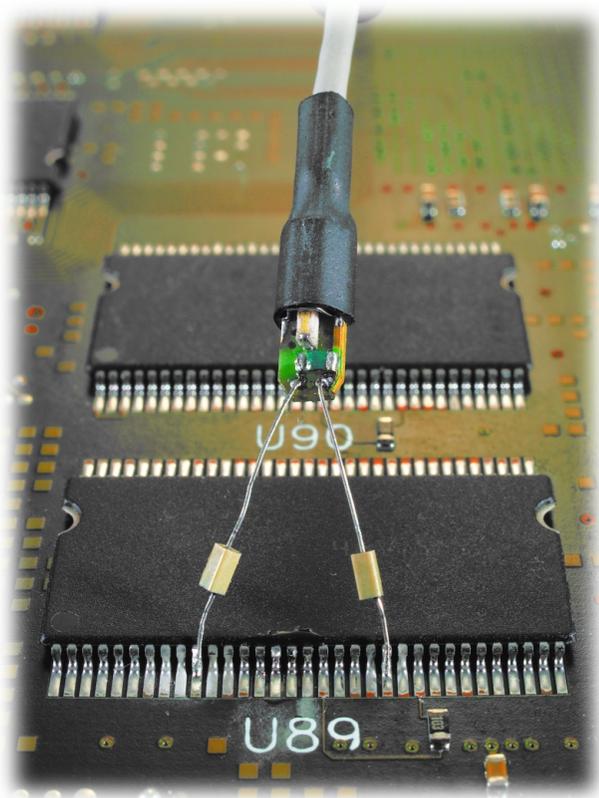
7 Solder-in Single-ended Probe Head (medium bandwidth resistor)

This configuration has a bandwidth approximately equal to 2.2 GHz (see the graphs starting on page 1-37). This configuration consists of the following parts:

- E2679A — Solder-in Single-ended Probe Head
- 01131-81506 — 150 Ω mini-axial lead resistor
- 01131-81504 — 0 Ω mini-axial lead resistor

The 01131-81506 and 01131-81504 resistors have been trimmed and formed as per template 01131-94308.

Figure 1-12

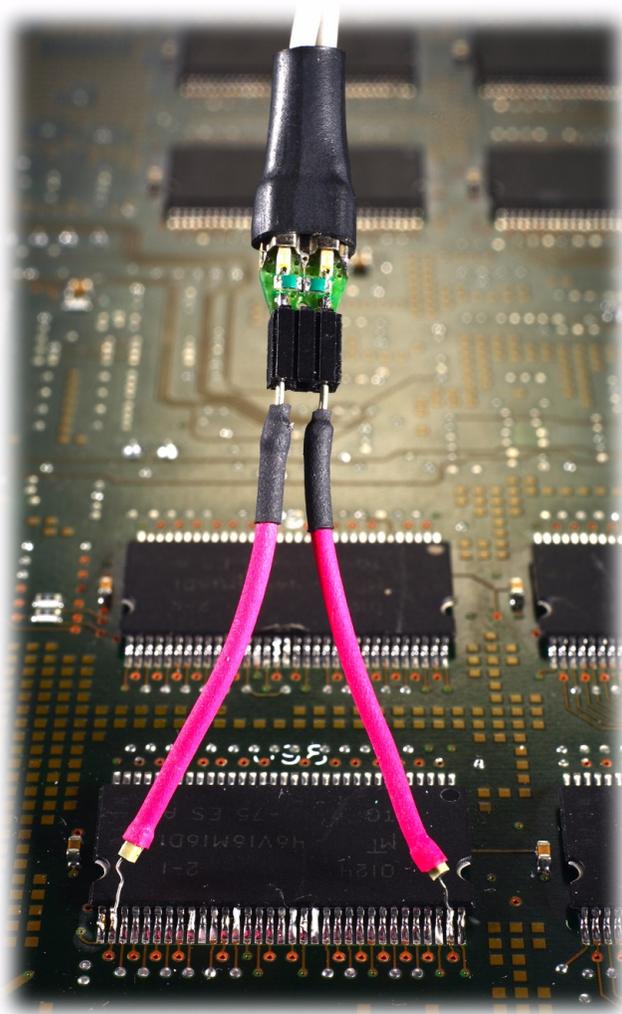


8 Socketed Differential Probe Head with 1damped wire accessory

This configuration has a bandwidth approximately equal to 1.2 GHz (see the graphs starting on page 1-40). This configuration consists of the following parts:

- E2678A — Socketed Differential Probe Head
- 01130-21302 — 160 Ω damped wire accessory (2 each)

Figure 1-13



Recommended configurations at a glance

Table 1-2

Probe Head Configurations	Band width (GHz)	Cdiff ¹ (pF)	Cse ² (pF)	Starting Page of Performance Graphs	Usage
1 Solder-in differential (full bandwidth resistors)	> 3.5	0.27	0.44	1-19	<ul style="list-style-type: none"> Differential and Single-ended signals Solder-in hands free connection Hard to reach targets Very small fine pitch targets Characterization
2 Socketed differential	~ 3.5	0.34	0.56	1-22	<ul style="list-style-type: none"> Differential and Single-ended signals Removable connection using solder-in resistor pins Hard to reach targets
3 Differential browser	~ 3.5	0.32	0.57	1-25	<ul style="list-style-type: none"> Differential and Single-ended signals Hand-held browsing Probe holders General purpose troubleshooting Ergonomic handle available
4 Solder-in single-ended (full bandwidth resistors)	~ 3.5	N/A	0.50	1-28	<ul style="list-style-type: none"> Single-ended signals only Solder-in hands free connection when physical size is critical Hard to reach targets Very small fine pitch targets
5 Single-ended browser	~ 3.5	N/A	0.65	1-31	<ul style="list-style-type: none"> Single-ended signals only Hand or probe holder where physical size is critical General purpose troubleshooting Ergonomic handle available
6 Solder-in differential (medium bandwidth resistors)	~ 2.9	0.33	0.52	1-34	<ul style="list-style-type: none"> Differential and Single-ended signals Solder-in hands free connection Larger span and reach than #1 Very small fine pitch targets
7 Solder-in single-ended (medium bandwidth resistors)	~ 2.2	N/A	0.58	1-37	<ul style="list-style-type: none"> Single-ended signals only Solder-in hands free connection when physical size is critical Larger span and reach than #4 Hard to reach targets Very small fine pitch targets
8 Socketed differential with damped wire accessories	~ 1.2	0.63	0.95	1-40	<ul style="list-style-type: none"> Differential and Single-ended signals For very wide spaced targets Connection to 25 mil square pins when used with supplied sockets

¹ Capacitance seen by differential signals

² Capacitance seen by single-ended signals

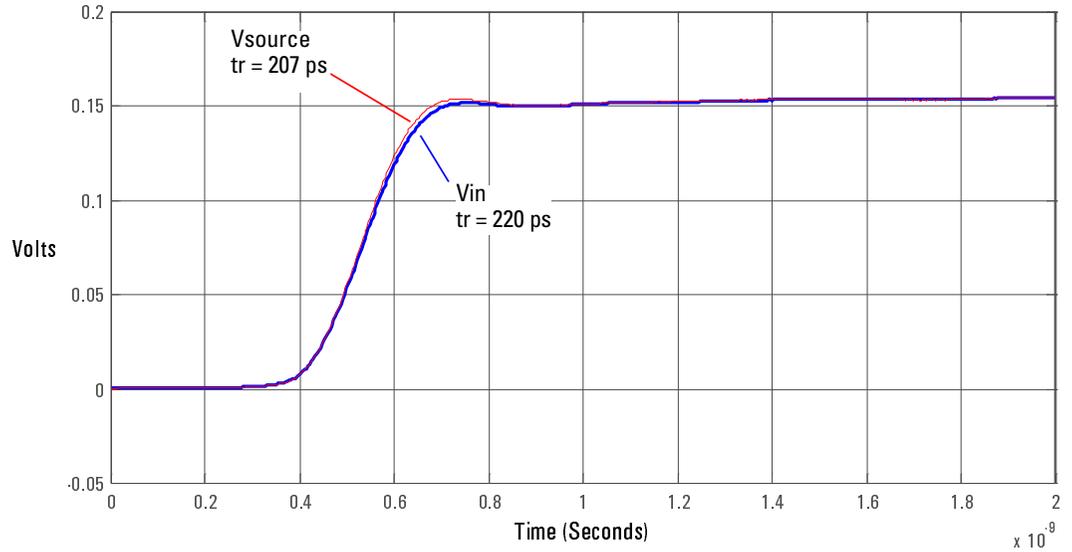
Detailed Information for Recommended Configurations

This section contains graphs of the performance characteristics of the 1131A active probe using the different probe heads that come with the E2668A single-ended and E2669A differential connectivity kits.

All rise times shown are measured from the 10 % to the 90 % amplitude levels.

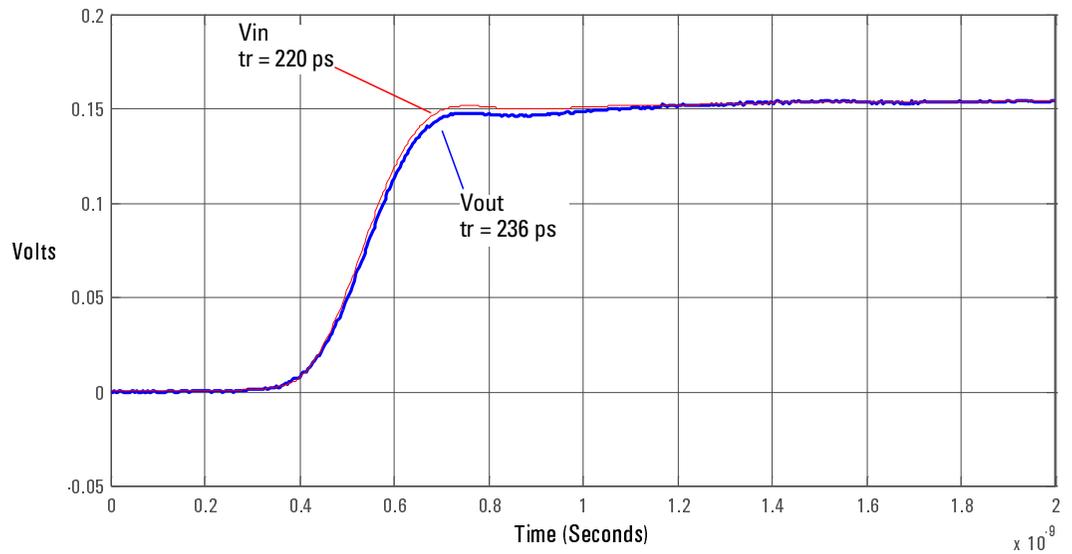
1 Solder-in Differential Probe Head (Full Bandwidth)

Figure 1-1



Graph of 25 Ω 200 ps step generator with and without probe connected.

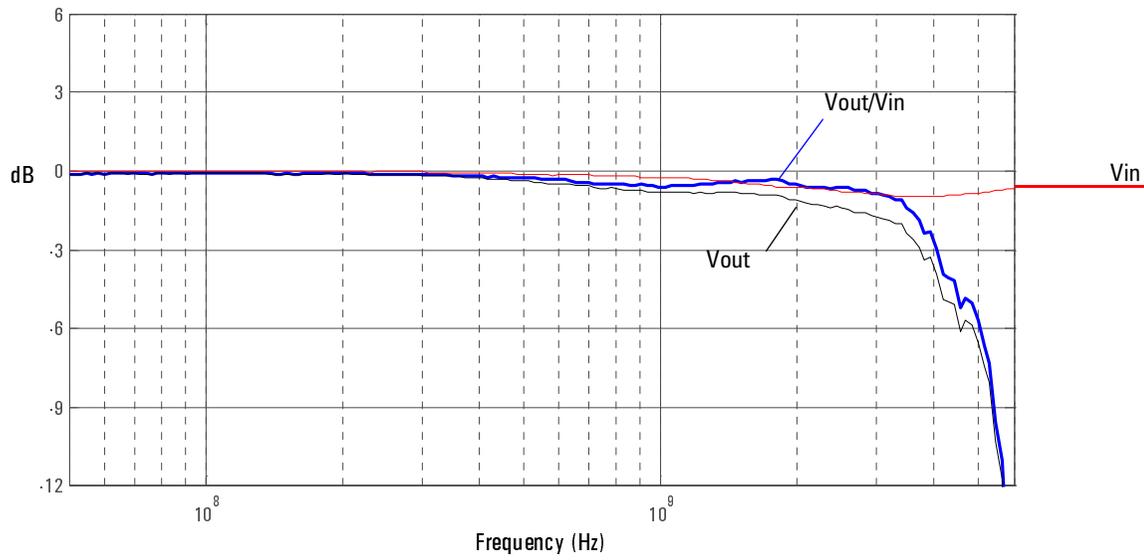
Figure 1-2



Graph of V_{in} and V_{out} of probe with a 25 Ω 200 ps step generator.

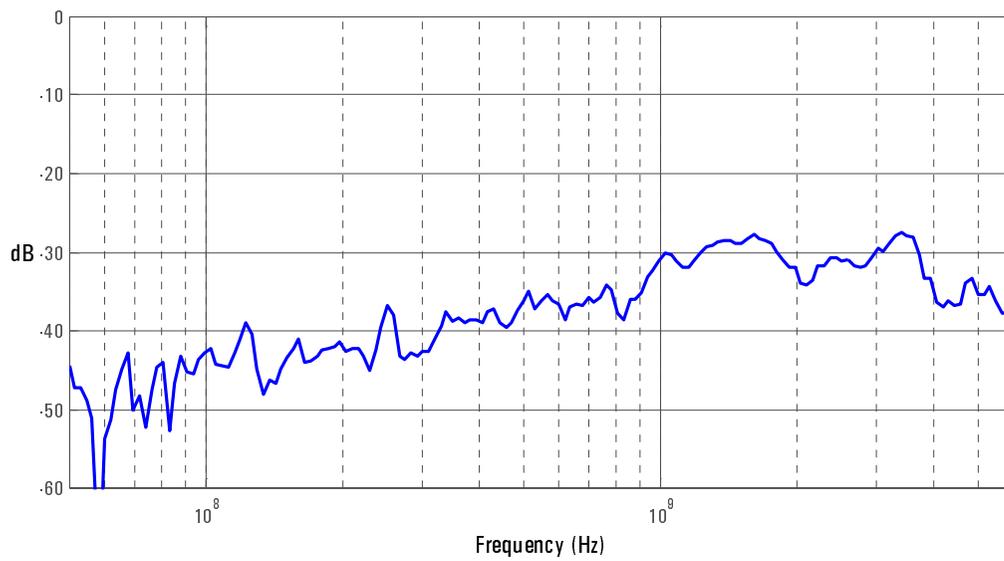
Differential and Single-ended Probe Configurations
1 Solder-in Differential Probe Head (Full Bandwidth)

Figure 1-3



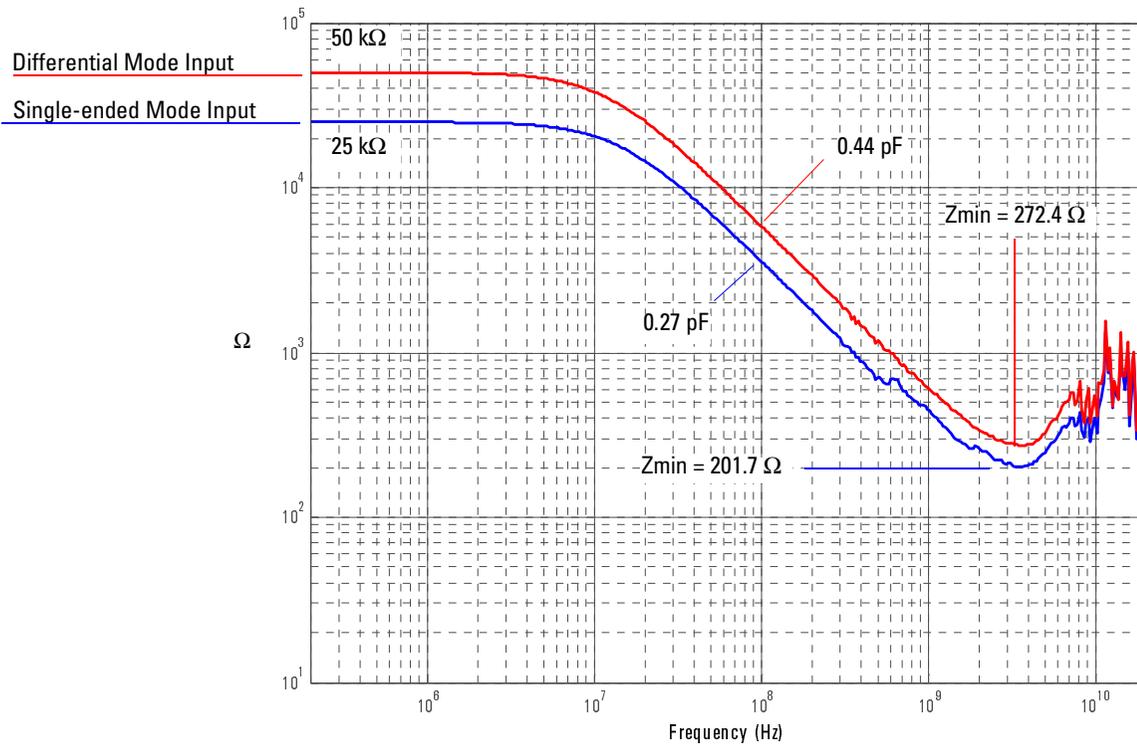
Graph of Vin and Vout of probe with a $25\ \Omega$ source and Vout/Vin frequency response.

Figure 1-4



Graph of Vout/Vin frequency response when inputs driven in common (common mode rejection).

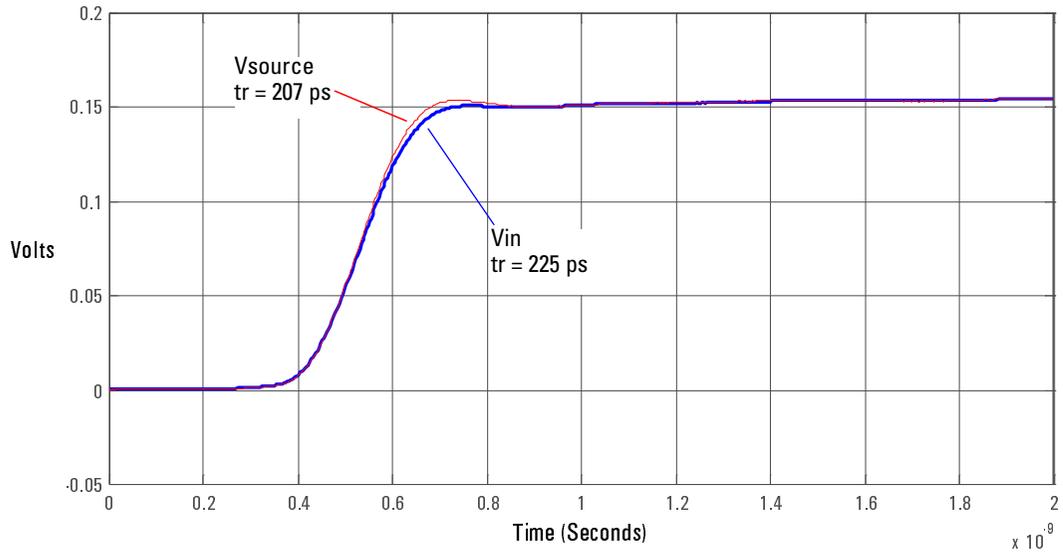
Figure 1-5



Magnitude plot of probe input impedance versus frequency.

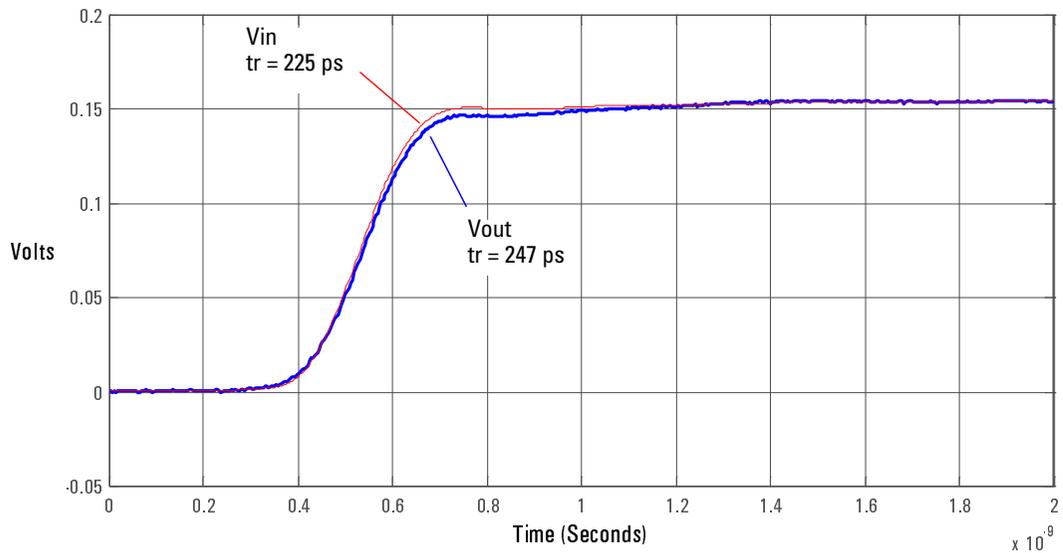
2 Socketed Differential Probe Head (Full Bandwidth)

Figure 1-6



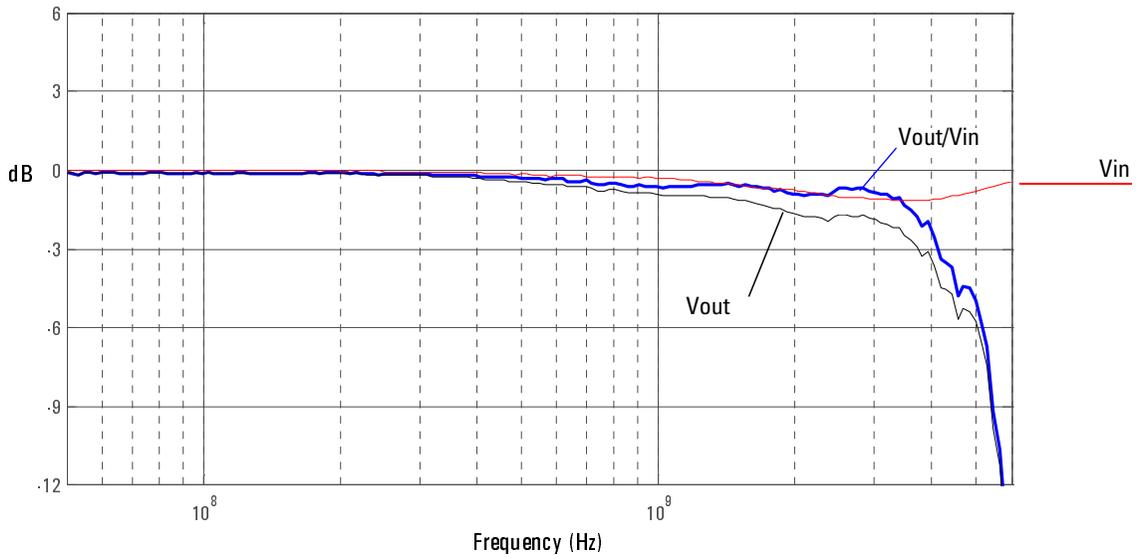
Graph of 25 Ω 200 ps step generator with and without probe connected.

Figure 1-7



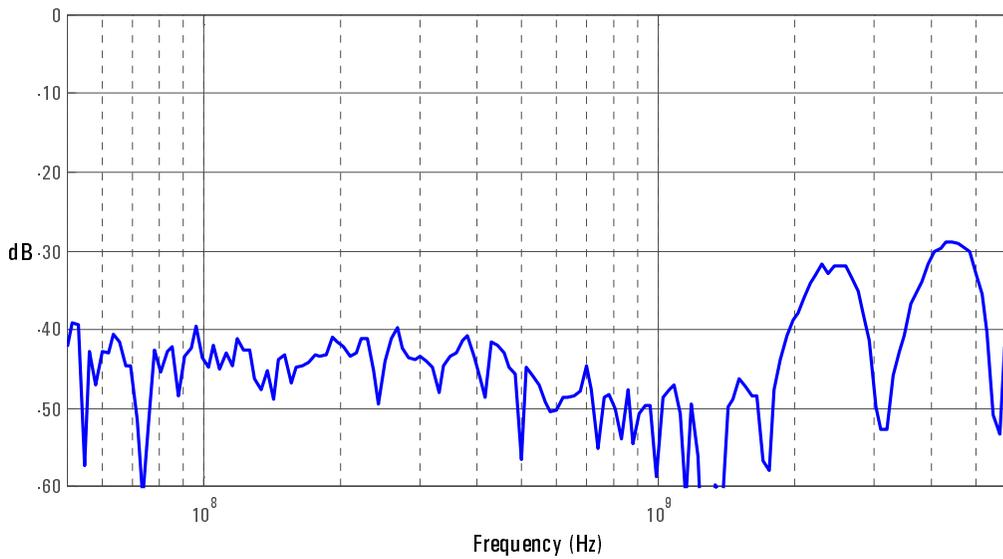
Graph of V_{in} and V_{out} of probe with a 25 Ω 200 ps step generator.

Figure 1-8



Graph of V_{in} and V_{out} of probe with a $25\ \Omega$ source and V_{out}/V_{in} frequency response.

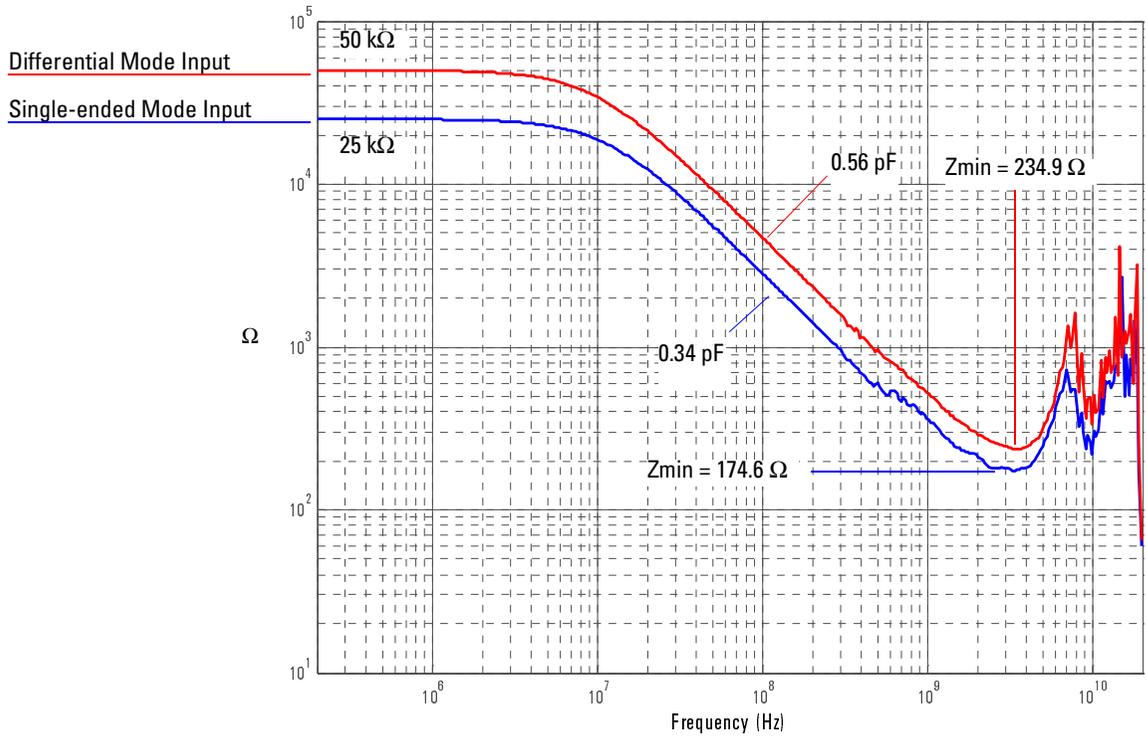
Figure 1-9



Graph of V_{out}/V_{in} frequency response when inputs driven in common (common mode rejection).

Differential and Single-ended Probe Configurations
2 Socketed Differential Probe Head (Full Bandwidth)

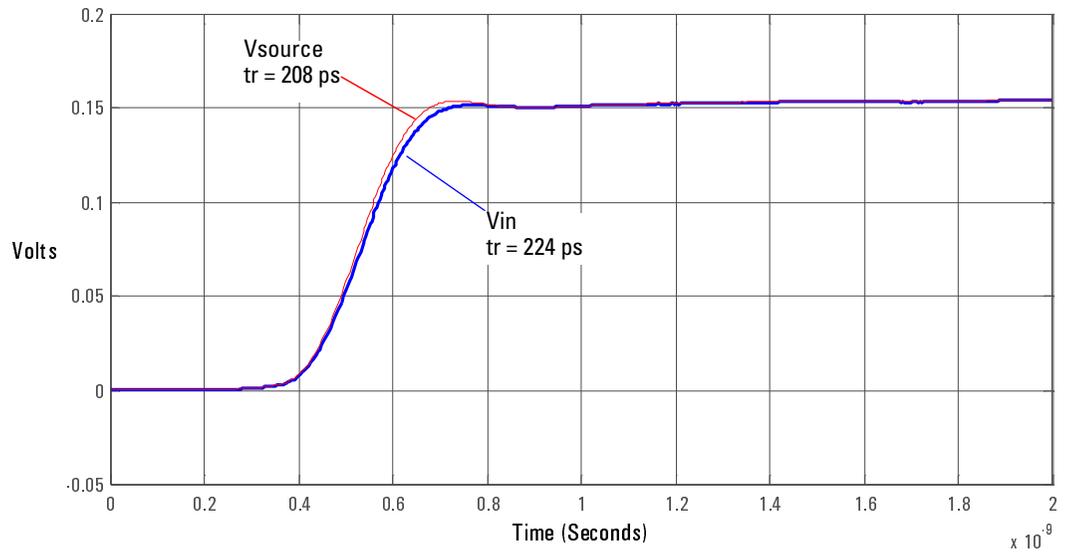
Figure 1-10



Magnitude plot of probe input impedance versus frequency.

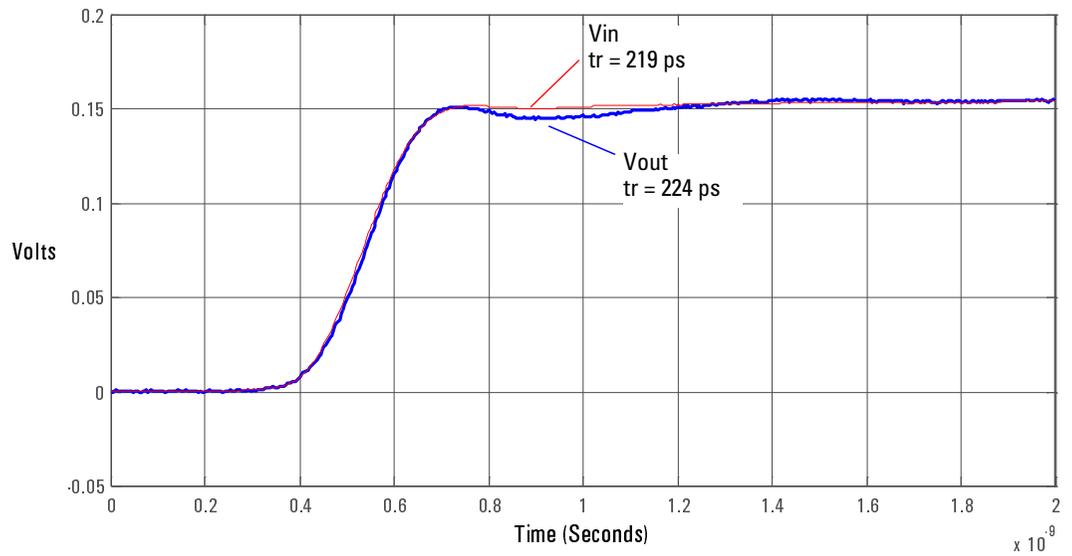
3 Differential Browser

Figure 1-11



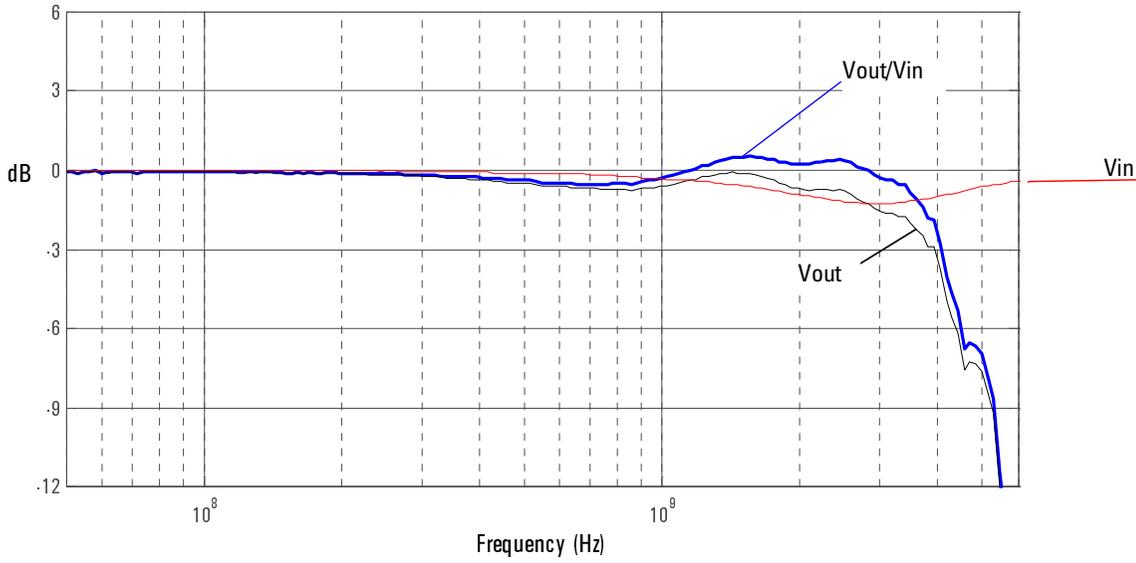
Graph of 25Ω 200 ps step generator with and without probe connected.

Figure 1-12



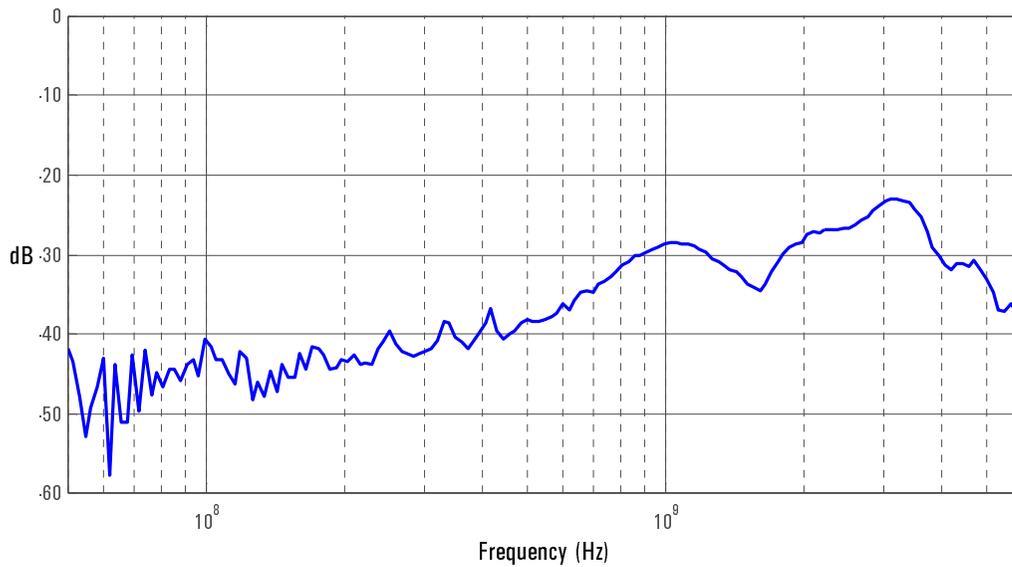
Graph of V_{in} and V_{out} of probe with a 25Ω 200 ps step generator.

Figure 1-13



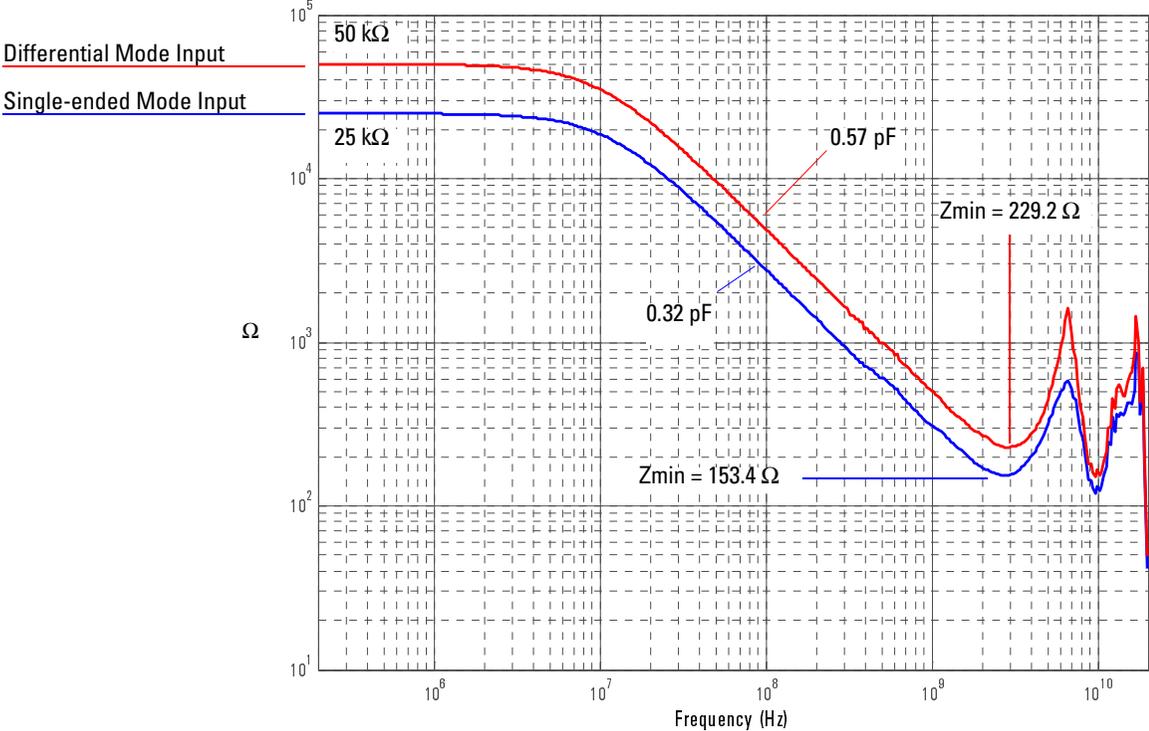
Graph of Vin and Vout of probe with a 25 Ω source and Vout/Vin frequency response.

Figure 1-14



Graph of Vout/Vin frequency response when inputs driven in common (common mode rejection).

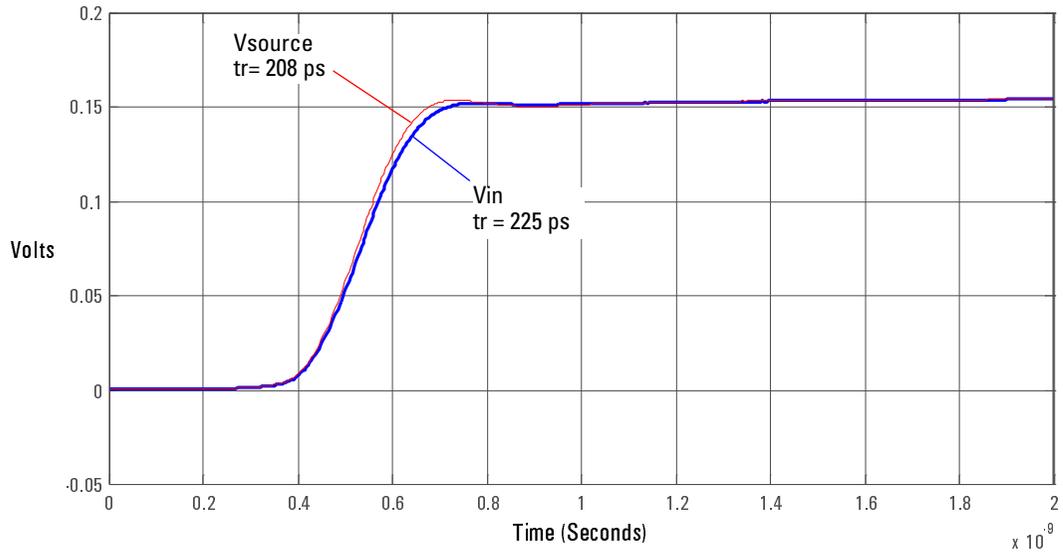
Figure 1-15



Magnitude plot of probe input impedance versus frequency.

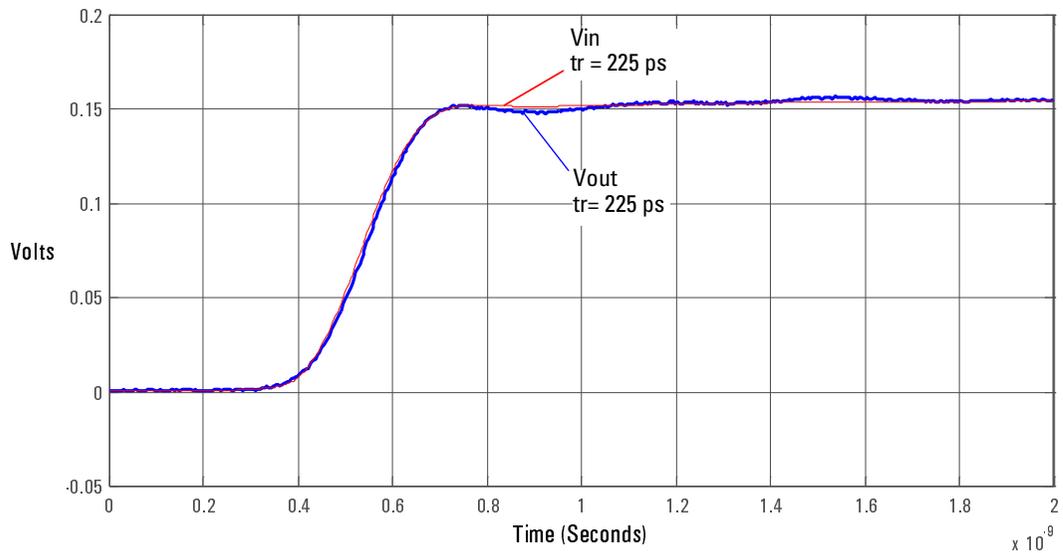
4 Solder-in Single-ended Probe Head (Full Bandwidth)

Figure 1-16



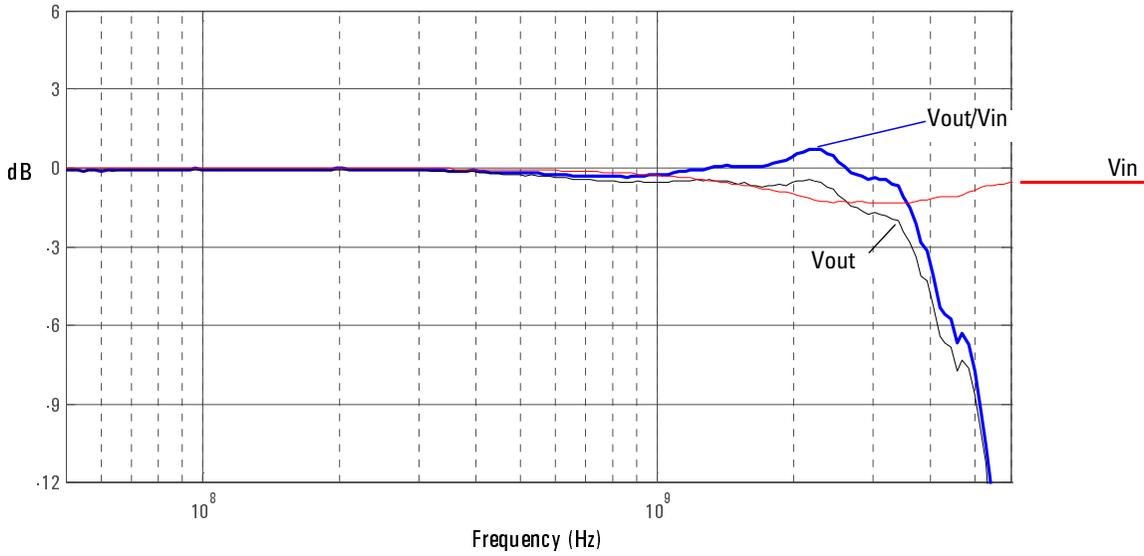
Graph of 25 Ω 200 ps step generator with and without probe connected.

Figure 1-17



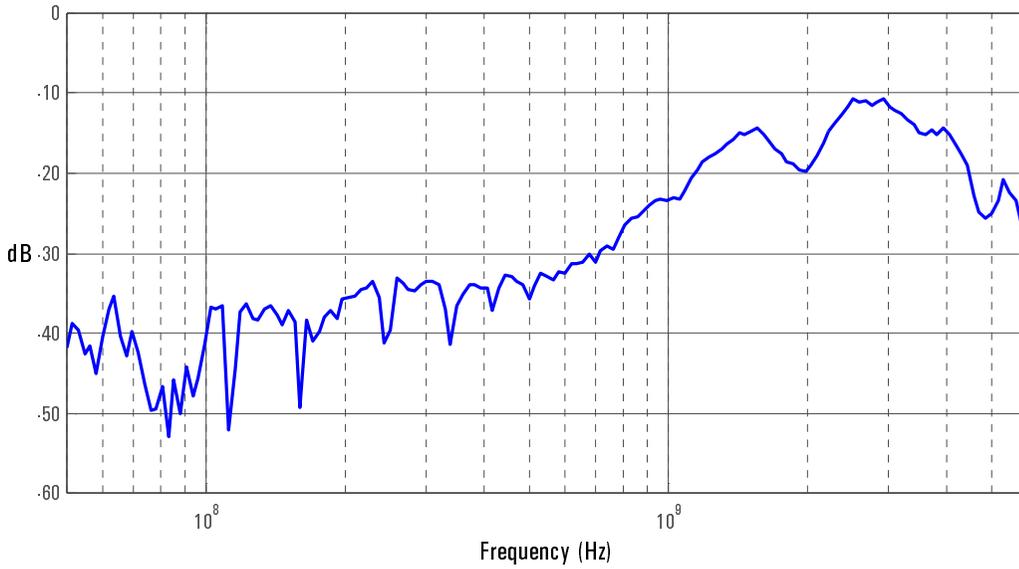
Graph of Vin and Vout of probe with a 25 Ω 200 ps step generator.

Figure 1-18



Graph of V_{in} and V_{out} of probe with a 25Ω source and V_{out}/V_{in} frequency response.

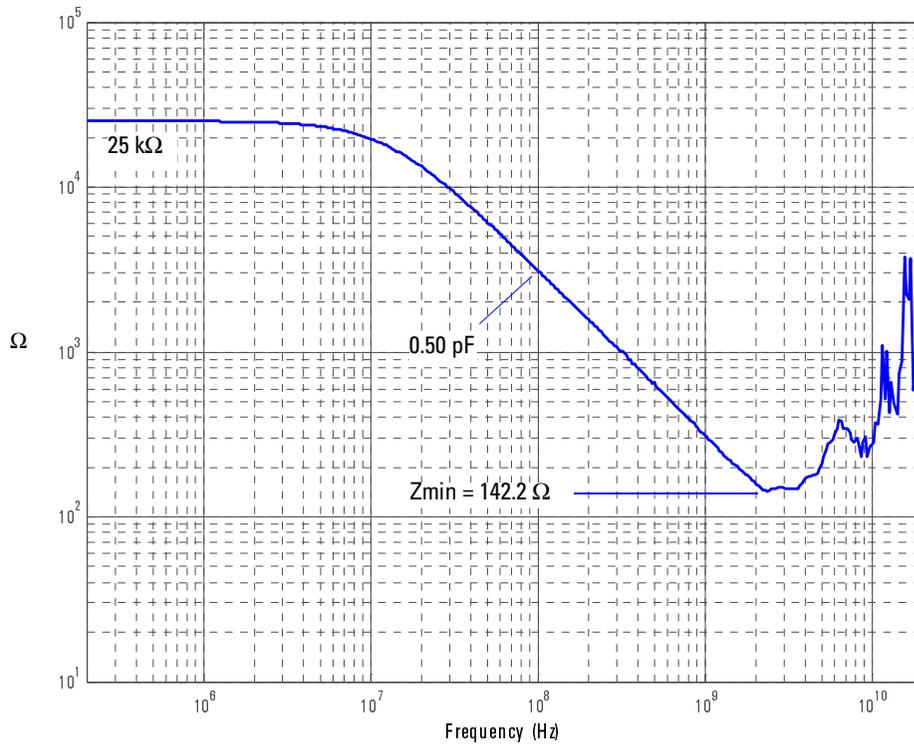
Figure 1-19



Graph of V_{out}/V_{in} frequency response when inputs driven in common (common mode rejection).

Differential and Single-ended Probe Configurations
4 Solder-in Single-ended Probe Head (Full Bandwidth)

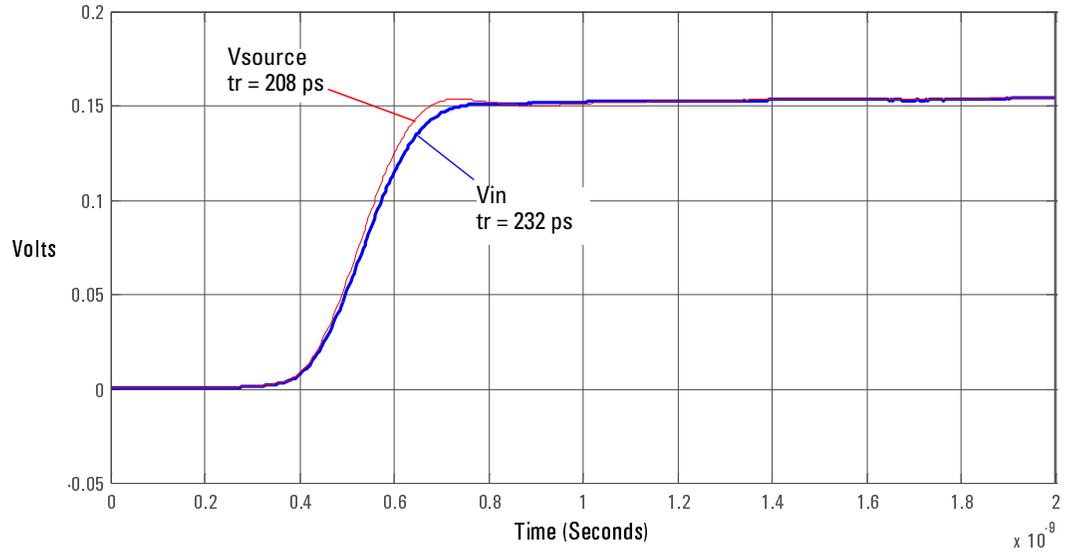
Figure 1-20



Magnitude plot of probe input impedance versus frequency.

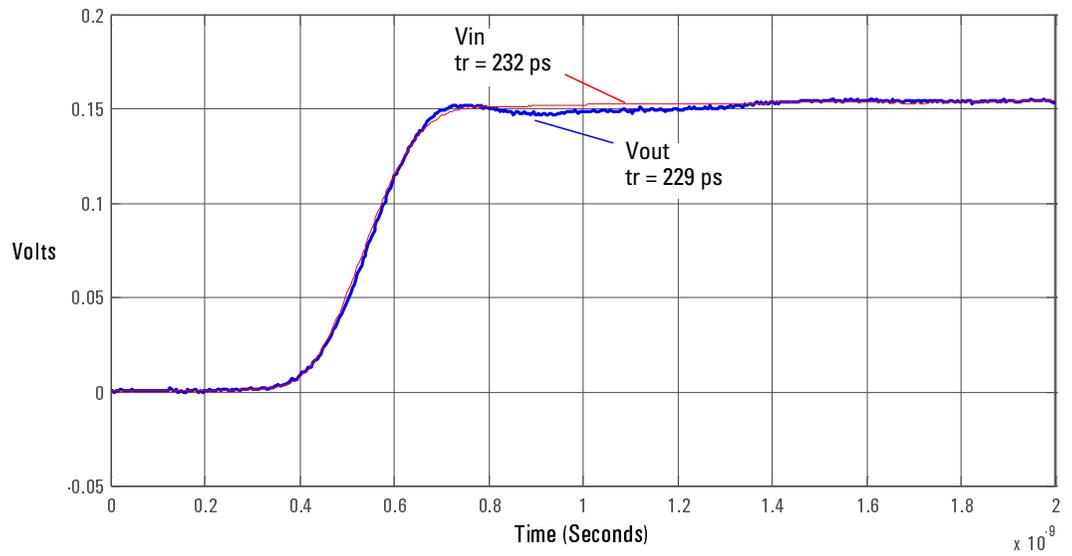
5 Single-ended Browser

Figure 1-21



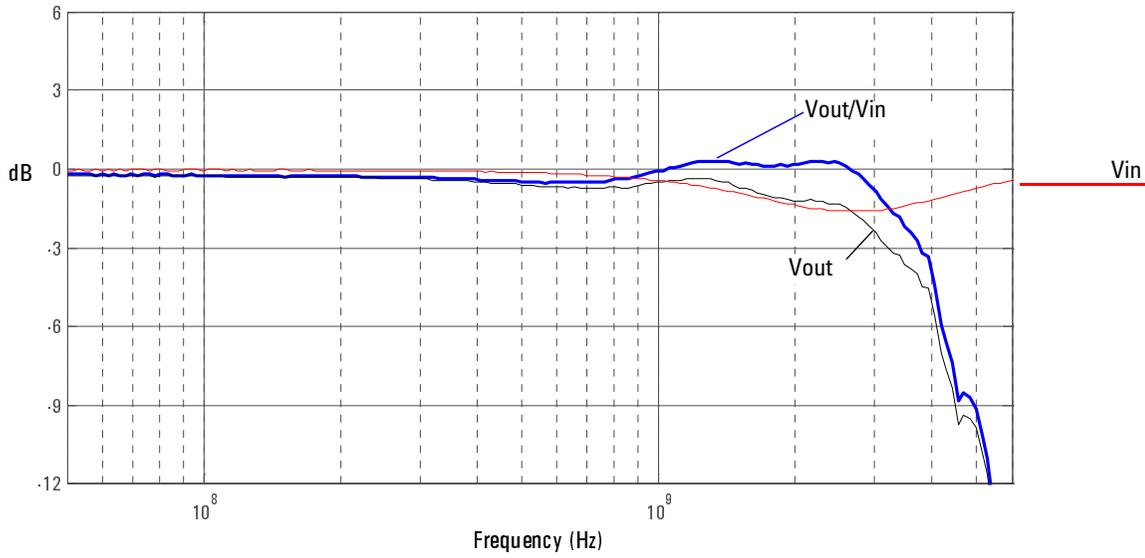
Graph of 25 Ω 200 ps step generator with and without probe connected.

Figure 1-22



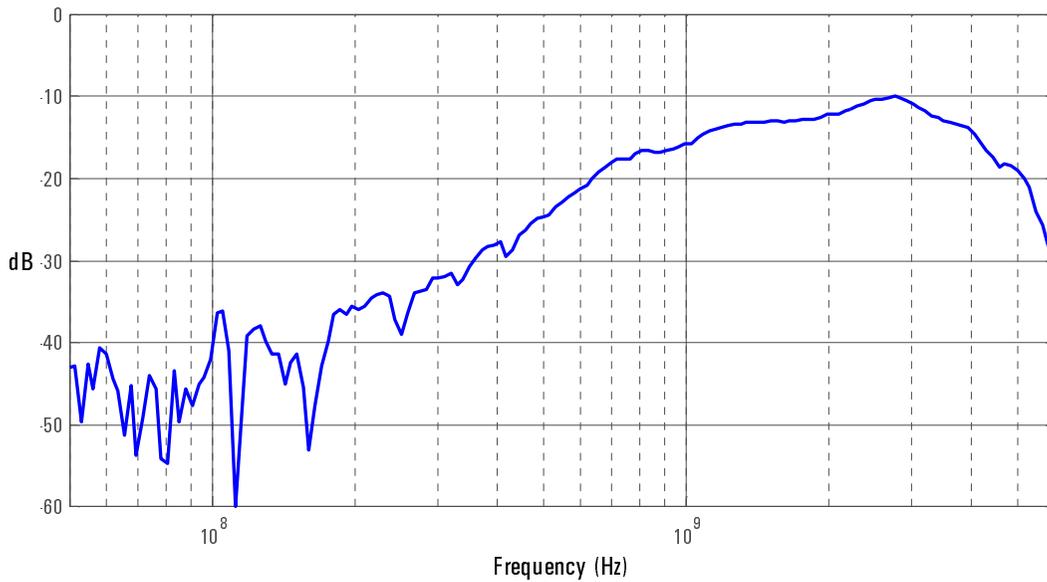
Graph of V_{in} and V_{out} of probe with a 25 Ω 200 ps step generator.

Figure 1-23



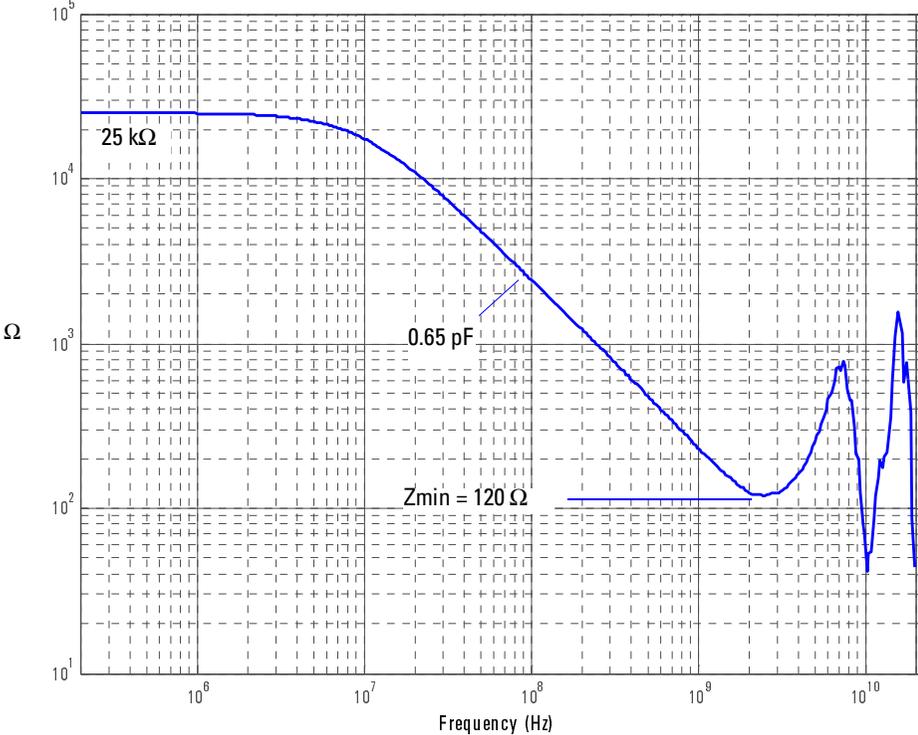
Graph of V_{in} and V_{out} of probe with a $25\ \Omega$ source and V_{out}/V_{in} frequency response.

Figure 1-24



Graph of V_{out}/V_{in} frequency response when inputs driven in common (common mode rejection).

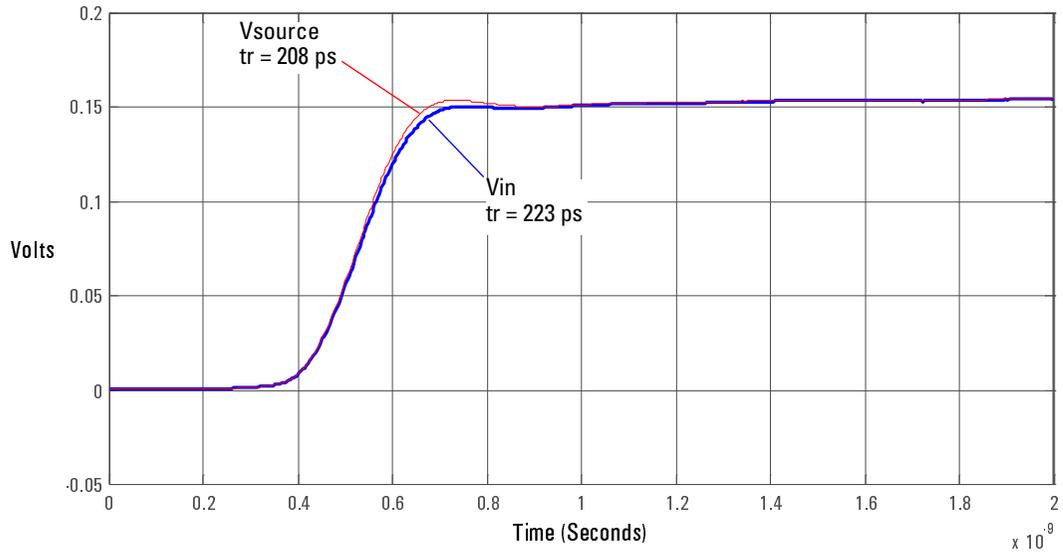
Figure 1-25



Magnitude plot of probe input impedance versus frequency.

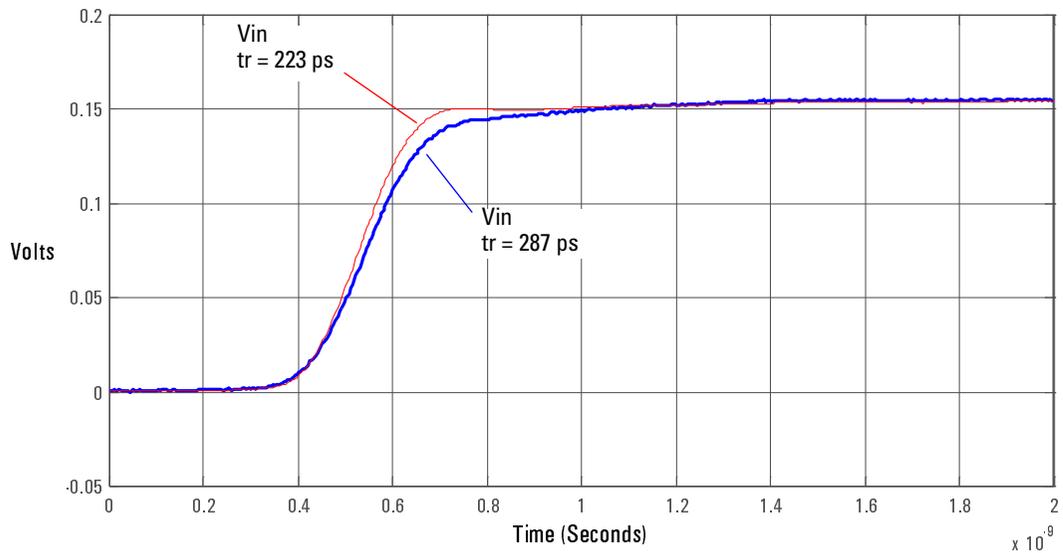
6 Solder-in Differential Probe Head (Medium Bandwidth)

Figure 1-26



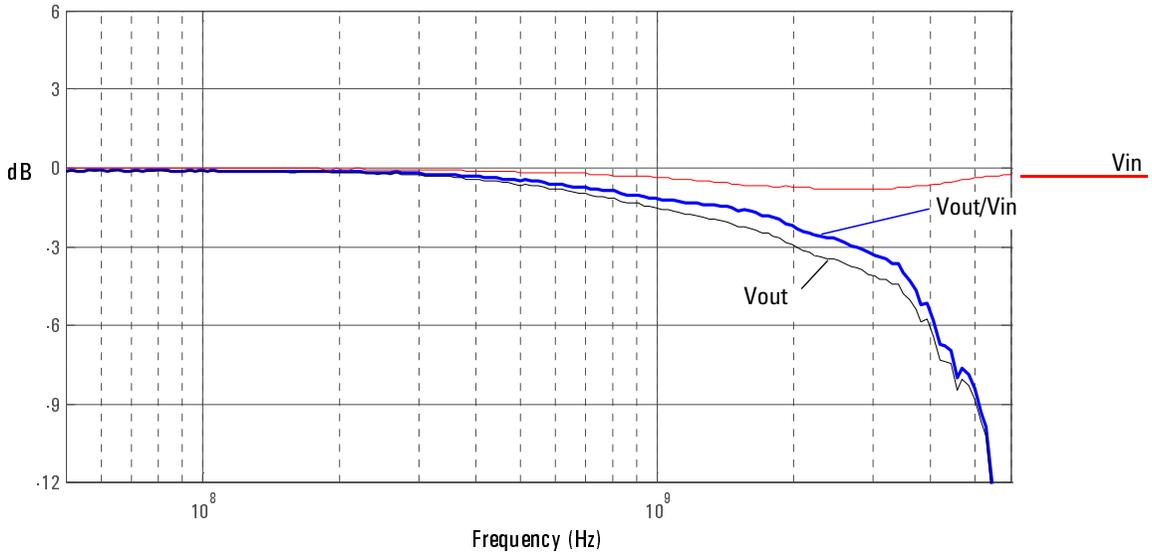
Graph of 25 Ω 200 ps step generator with and without probe connected.

Figure 1-27



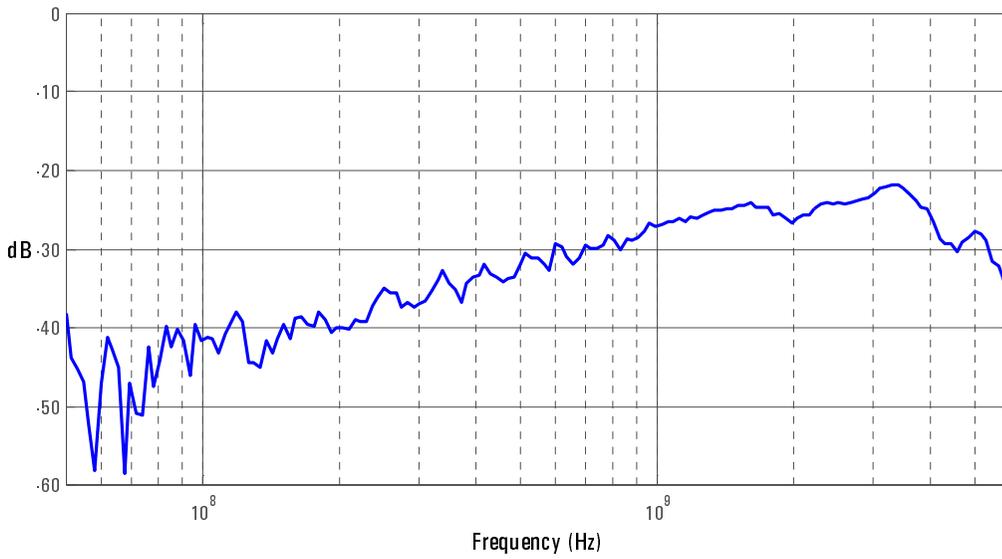
Graph of V_{in} and V_{out} of probe with a 25 Ω 200 ps step generator.

Figure 1-28



Graph of V_{in} and V_{out} of probe with a $25\ \Omega$ source and V_{out}/V_{in} frequency response.

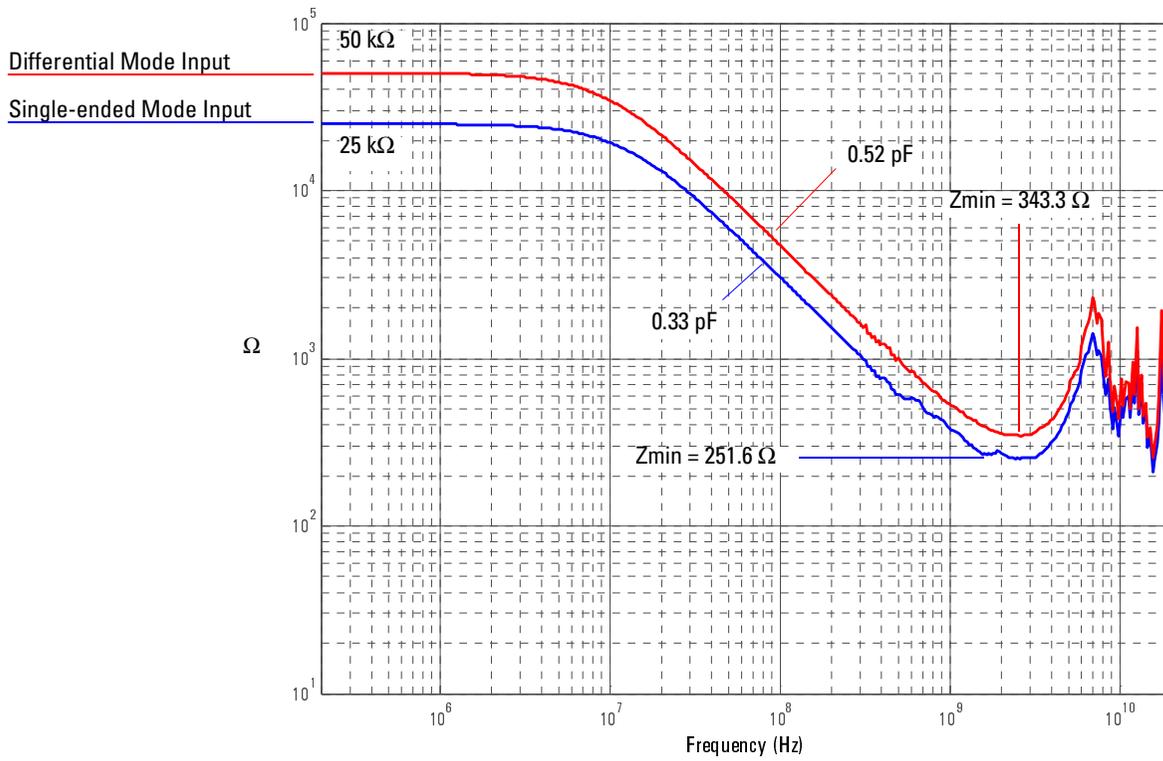
Figure 1-29



Graph of V_{out}/V_{in} frequency response when inputs driven in common (common mode rejection).

Differential and Single-ended Probe Configurations
6 Solder-in Differential Probe Head (Medium Bandwidth)

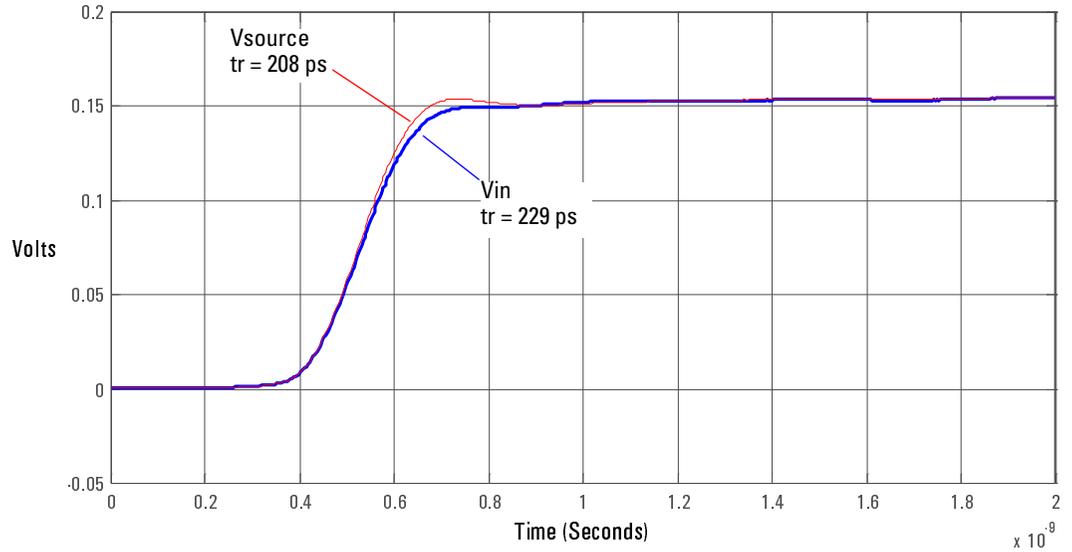
Figure 1-30



Magnitude plot of probe input impedance versus frequency.

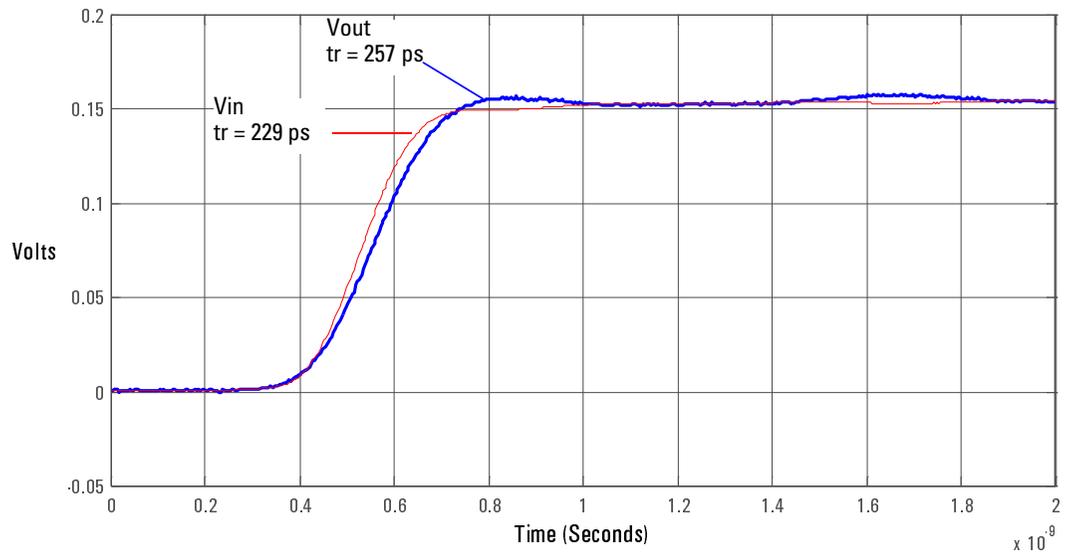
7 Solder-in Single-ended Probe Head (Medium Bandwidth)

Figure 1-31



Graph of 25 Ω 200 ps step generator with and without probe connected.

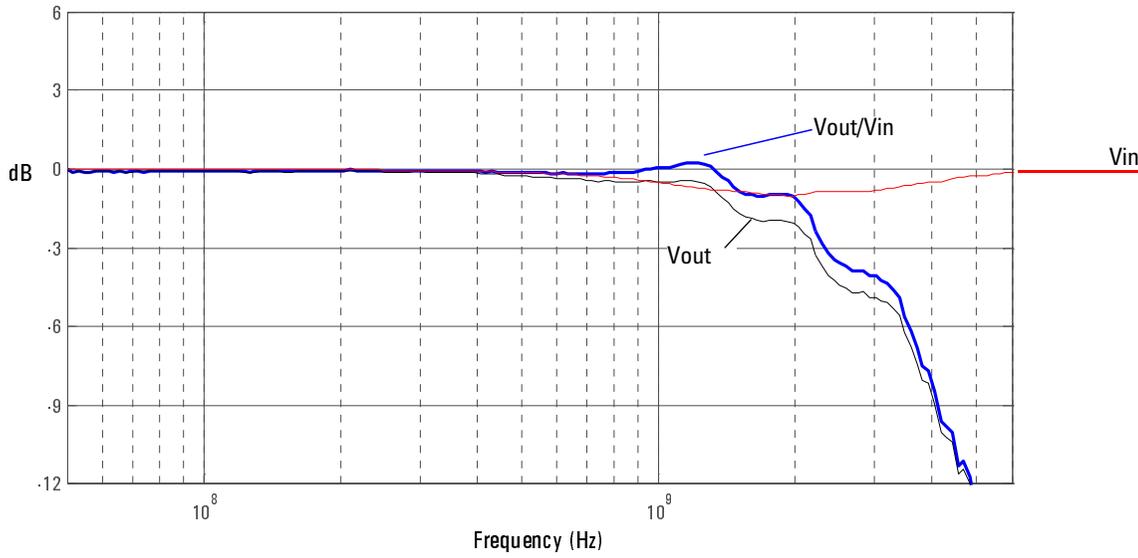
Figure 1-32



Graph of V_{in} and V_{out} of probe with a 25 Ω 200 ps step generator.

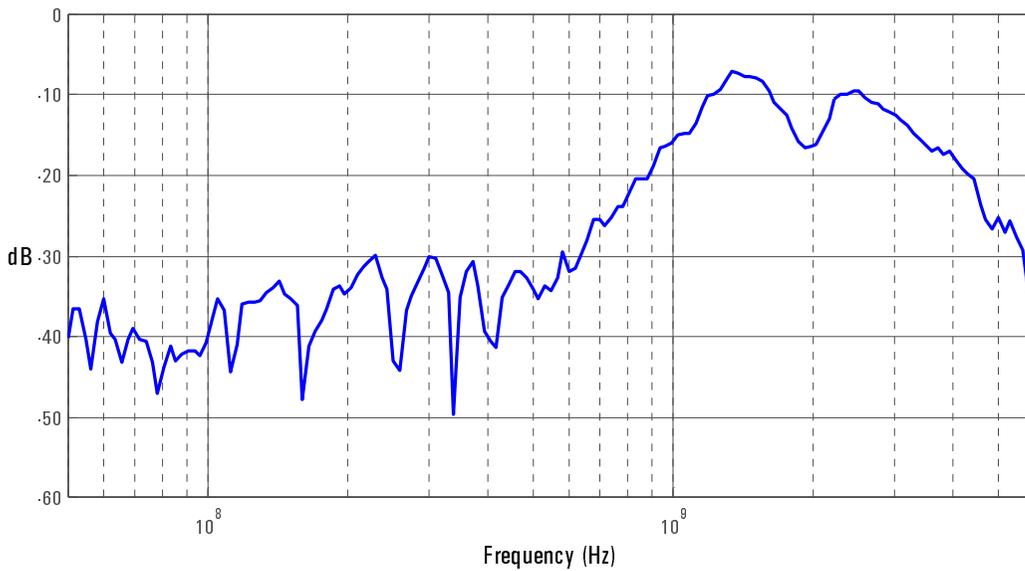
Differential and Single-ended Probe Configurations
7 Solder-in Single-ended Probe Head (Medium Bandwidth)

Figure 1-33



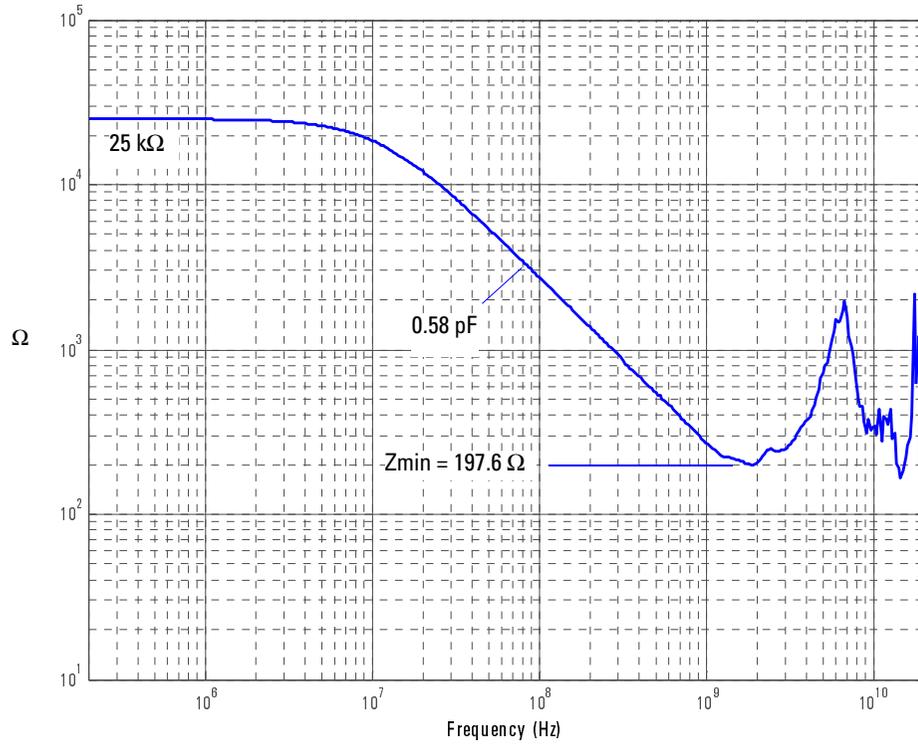
Graph of V_{in} and V_{out} of probe with a $25\ \Omega$ source and V_{out}/V_{in} frequency response.

Figure 1-34



Graph of V_{out}/V_{in} frequency response when inputs driven in common (common mode rejection).

Figure 1-35

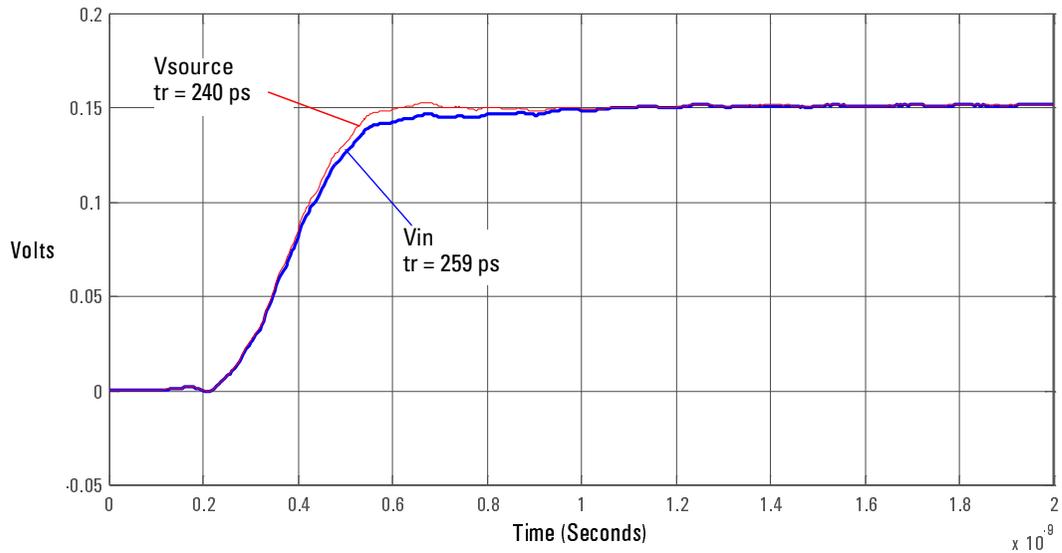


Magnitude plot of probe input impedance versus frequency.

8 Socketed Differential Probe Head with Damped Wire Accessory

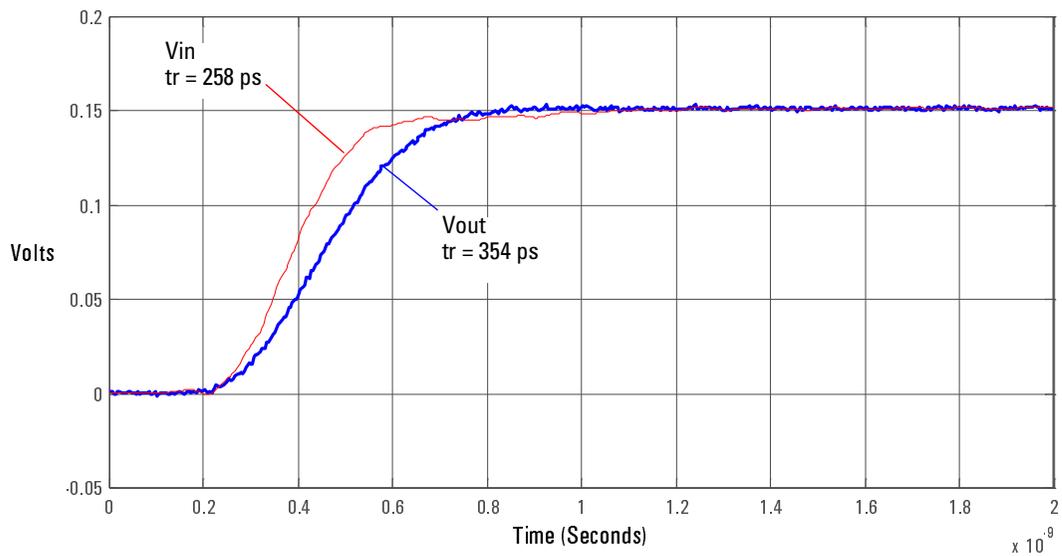
Due to reflections on the long wire accessories, signals being probed should be limited to $\sim \geq 240$ ps rise time measured at the 10% and 90% amplitude levels. This is equivalent to $\sim \leq 1.5$ GHz bandwidth.

Figure 1-36



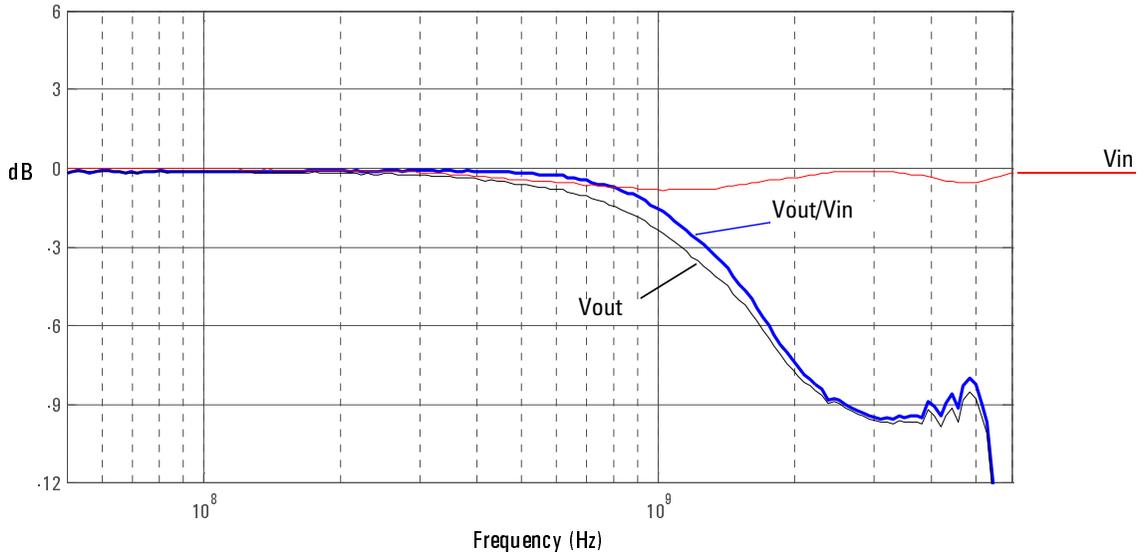
Graph of 25 Ω 240 ps step generator with and without probe connected.

Figure 1-37



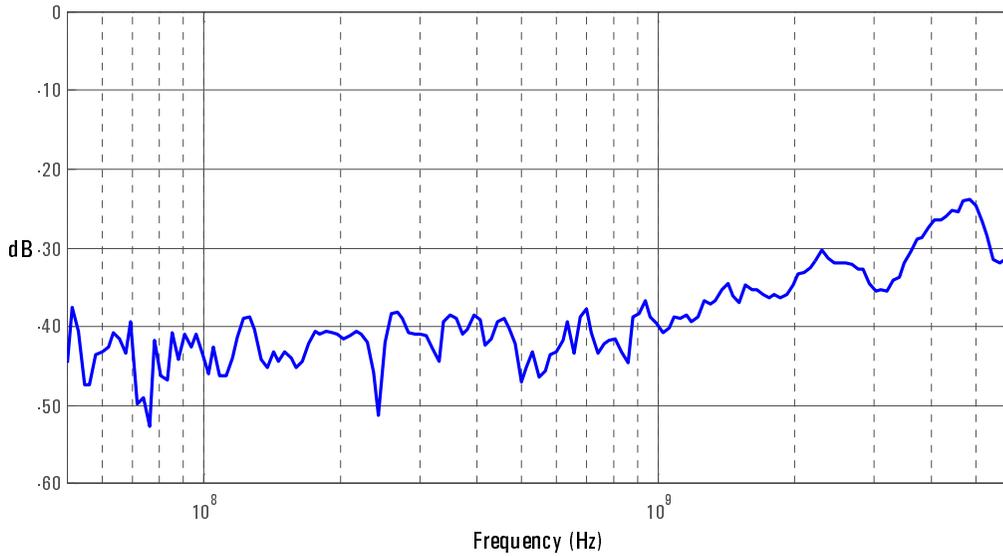
Graph of V_{in} and V_{out} of probe with a 25 Ω 240 ps step generator.

Figure 1-38



Graph of V_{in} and V_{out} of probe with a $25\ \Omega$ source and V_{out}/V_{in} frequency response.

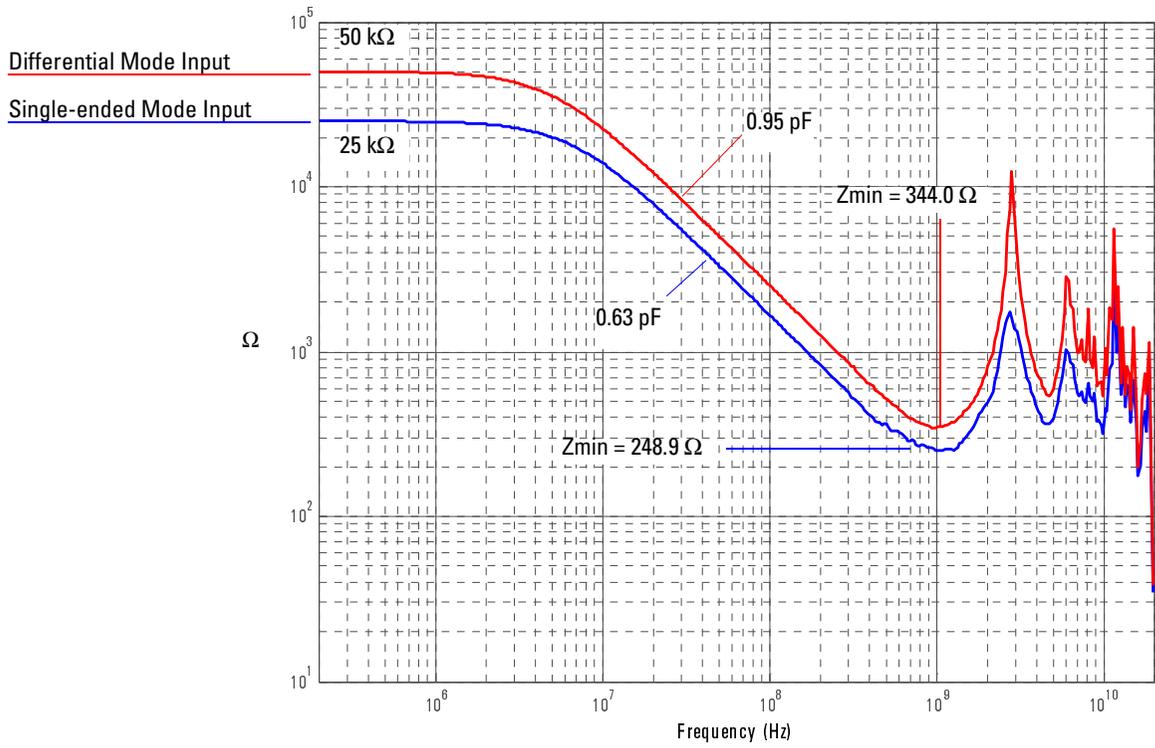
Figure 1-39



Graph of V_{out}/V_{in} frequency response when inputs driven in common (common mode rejection).

Differential and Single-ended Probe Configurations
8 Socketed Differential Probe Head with Damped Wire Accessory

Figure 1-40



Magnitude plot of probe input impedance versus frequency.

Service

Service

The service section of this manual contains the following information:

- Service Strategy for the 1131A probe
- Cleaning the 1131A probe
- Returning the 1131A probe to Agilent Technologies for service
- Recommended tools and test equipment
- Calibration Testing Procedures
 - To Test Bandwidth
 - To Test Input Resistance
 - To Test DC Attenuation
 - To Test Offset Range
 - To Test Offset Accuracy
 - To Test Zero Offset Zero Accuracy
- Performance test record
- Replaceable parts and accessories

Service Strategy for the 1131A Probe

This chapter provides service information for the 1131A family of Active and Differential Probes. The following sections are included in this chapter.

- Service strategy
- Returning to Agilent Technologies for service
- Troubleshooting
- Failure symptoms

The 1131A Active Probe is a high frequency device with many critical relationships between parts. For example, the frequency response of the amplifier on the hybrid is trimmed to match the output coaxial cable. As a result, to return the probe to optimum performance requires factory repair. If the probe is under warranty, normal warranty services apply.

There are several warranted specifications which are listed below.

Table 2-1

Description	Specification	Further Information
Bandwidth	3.5 GHz	
Input Resistance	50 kΩ ±1% 25 kΩ ±1%	50 kΩ is for differential mode 25 kΩ is for single-ended mode each side to ground
DC Attenuation	After calibration 10:1 ±1%	Calibration is on an Agilent Technologies Oscilloscope with the AutoProbe Interface
Offset Range	±12V	Single-ended Mode Only
Offset Gain Accuracy	After calibration < 1% of setting	Calibration is on an Agilent Technologies Oscilloscope with the Auto Probe Interface
Offset Zero Accuracy	After calibration < 5mV	Calibration is on an Agilent Technologies Oscilloscope with the AutoProbe Interface

You may perform the tests in the "Calibration and Operational Verification Tests" later in this chapter to ensure these specifications are met.

If the probe is found to be defective we recommend sending it to an authorized service center for all repair and calibration needs. Please see the "Returning to Agilent Technologies for Service" section later in this chapter.

To return the probe to Agilent Technologies for service

Follow the following steps before shipping the 1131A back to Agilent Technologies for service.

- 1 Contact your nearest Agilent sales office for information on obtaining an RMA number and return address.**
- 2 Write the following information on a tag and attach it to the malfunctioning equipment.**

Name and address of owner

Product model number Example 1131A

Product Serial Number Example MYXXXXXXXX

Description of failure or service required

Only include probing and browsing tips if you feel probe is not meeting performance specifications or a yearly calibration is requested. Any other service requirement only requires failed part be returned.

- 3 Protect the 1131A Probe by wrapping in plastic or heavy paper.**
- 4 Pack the 1131A Probe in the original carrying case or if not available use bubble wrap or packing peanuts.**
- 5 Place securely in sealed shipping container and mark container as "FRAGILE".**

If any correspondence is required, refer to the product by serial number and model number.

Troubleshooting

- If your probe is under warranty and requires repair, return it to Agilent Technologies. Contact your nearest Agilent Technologies Service Center.
- If the failed probe is not under warranty, you may exchange it for a reconditioned probe. See "To Prepare the Probe for Exchange" in this chapter.

Failure Symptoms

The following symptoms may indicate a problem with the probe or the way it is used. Possible remedies and repair strategies are included.

The most important troubleshooting technique is to try different combinations of equipment so you can isolate the problem to a specific probe.

Probe Calibration Fails

Probe calibration failure with an oscilloscope is usually caused by improper setup. If the calibration will not pass, check the following:

- Check that the probe passes a waveform with the correct amplitude.
- If the probe is powered by the oscilloscope, check that the offset is approximately correct. The probe calibration cannot correct major failures.
- Be sure the oscilloscope passes calibration without the probe.

Incorrect Pulse Response (flatness)

If the probe's pulse response shows a top that is not flat, check for the following:

- Output of probe must be terminated into a proper 50 Ω termination. If you are using the probe with an Infiniium oscilloscope, this should not be a problem. If you are using the probe with other test gear, insure the probe is terminated into a low reflectivity 50 Ω load ($\sim \pm 2\%$).
- If the coax or coaxes of the probe head in use has excessive damage, then reflections may be seen within ~ 1 ns of the input edge. If you suspect a probe head, swap it with another probe head and see if the non-flatness problem is fixed.
- If the one of the components in the tip have been damaged there may be a frequency gain non-flatness at around 40 MHz. If you suspect a probe head, swap it with another probe head and see if the non-flatness problem is fixed.

Incorrect Input Resistance

The input resistance is determined by the probe head in use. If the probe head is defective, damaged, or has been exposed to excessive voltage, the input resistor may be damaged. If this is the case, the probe head is no longer useful. A new probe head will need to be obtained either through purchase or warranty return.

Incorrect Offset

Assuming the probe head in use is properly functioning, incorrect offset may be caused by defect or damage to the probe amplifier or by lack of probe calibration with the oscilloscope.

Offset Will Not Zero

Assuming the probe head in use is properly functioning, the dc output of the probe should be within ± 3 mV when the input voltage is set to 0 V and the offset is set at zero. If the probe is connected to an Infiniium oscilloscope, the oscilloscope will calibrate out the offset zero error during a probe calibration. If the offset error cannot be calibrated out, return it to Agilent for repair.

Recommended Tools and Test Equipment

The following table lists all the tools and test equipment needed to perform the tests and maintenance procedures in this chapter. The table includes critical specifications so that a substitute may be used.

Warranted specifications will only be tested on the following equipment.

Table 2-2

Equipment/Tool	Critical Specification	Model Number
Oscilloscope	54845A Infiniium Oscilloscope or newer with AutoProbe Interface; Updated firmware that supports the 1131A probe family	54846B
PV and Deskew Kit	No Substitute	E2655A
Power Supply	±12 V Range with 10 mV accuracy and resolution	E3615A
Digital Multimeter	6 ½ digit (0.1mV) resolution dc V accuracy 8 ppm/year 4 wire resistance accuracy ±0.25%	34401A
Function Generator	Sine Wave 20 Vpp into 1MΩ 70 Hz to 10 MHz output	33120A
Vector Network Analyzer (VNA)	3.5 GHz Bandwidth full 2 port cal	8720ES
calibration Standards	No Substitute	85052D
Adapter	BNC to Dual Grabber	
BNC Cable	BNC Cable - 9 inch	10502A
External Power Supply	No Substitute	1143A
AutoProbe Interface Adapter	No Substitute	N1022A
Outside thread 3.5 mm (male) to 3.5 mm (female) adapter	No Substitute	5062-1247
SMA Cable (2)	3.5 mil;SMA;High Quality	8120-4948
BNC Cable	BNC - 3 feet	10503A

Calibration Testing Procedures

These tests can be performed to ensure the 1131A Probe meets specifications.

Some tests require the probe to be calibrated on an Infiniium oscilloscope channel before testing performance.

To Test Bandwidth

This test ensures that the 1131A Probe meets its specified bandwidth.

1131A >3.5 GHz

Table 2-3

Equipment/Tool	Critical Specification	Model Number
Vector Network Analyzer (VNA)	3.5 GHz sweep range full 2 port cal Option 1D5	8720ES
Calibration Standards	No Substitute	85052D
External Power Supply	No Substitute	1143A
AutoProbe Interface Adapter	No Substitute	N1022A
Outside thread 3.5 mm (male) to 3.5 mm (female) adapter	No Substitute	5062-1247
Cable (2)	3.5 mil; SMA; High Quality	8120-4948
PV/DS Test Board	No Substitute (In E2655A Kit)	E2655-66501

Using the 8720ES VNA successfully

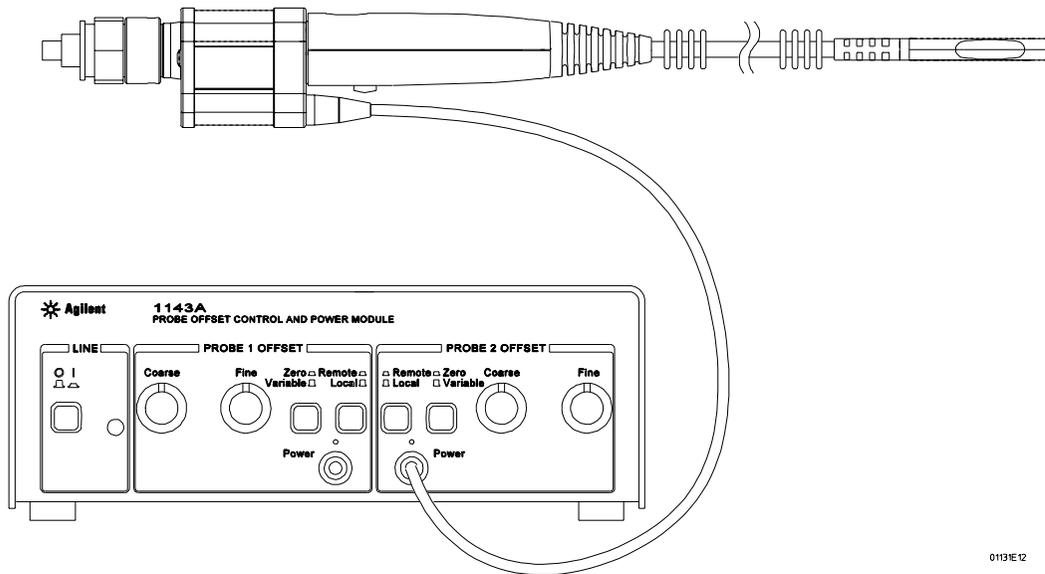
Remember these simple guidelines when working with the 8720ES VNA to get accurate stable measurements.

- 1 Sometimes it may take a few seconds for the waveforms to settle completely. Please allow time for waveforms to settle before continuing.
- 2 Make sure all connections are tight and secure. If needed, use a vice to hold the cables and test board stable while making measurements.
- 3 Be careful not to cross thread or force any connectors. This could be a very costly error to correct.

Initial Setup

- 1 Turn on the 8720ES VNA and let warm up for 20 minutes.
- 2 Press the green "Preset" key on the 8720ES VNA.
- 3 Use the 8720ES VNA's default power setting of 0 dBm. You can locate this feature by pressing the "Power" key on the front panel.
- 4 Set the 8720ES VNA's averaging to 4. You can find this selection menu by pressing the "AVG" key. Then select the "Averaging Factor" screen key to adjust the averaging.
- 5 Press the "Sweep Setup" key on the 8720ES VNA. Then press the "sweep type menu" screen key. Select the "log freq" screen key.
- 6 Connect the 1131A probe under test to the Auto Probe Adapter and power the probe using the 1143A power supply. Install the outside thread adapter to the Auto Probe Adapter.

Figure 2-1

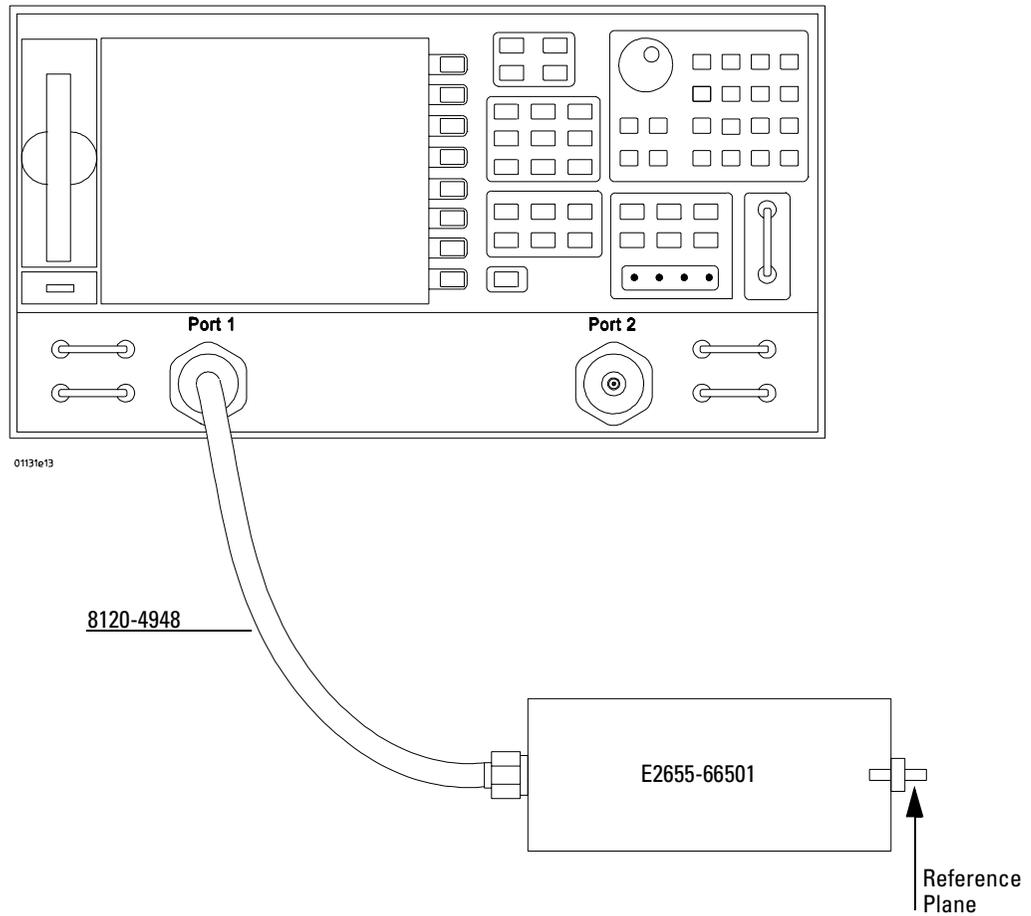


013E12

Calibrating a Reference Plane

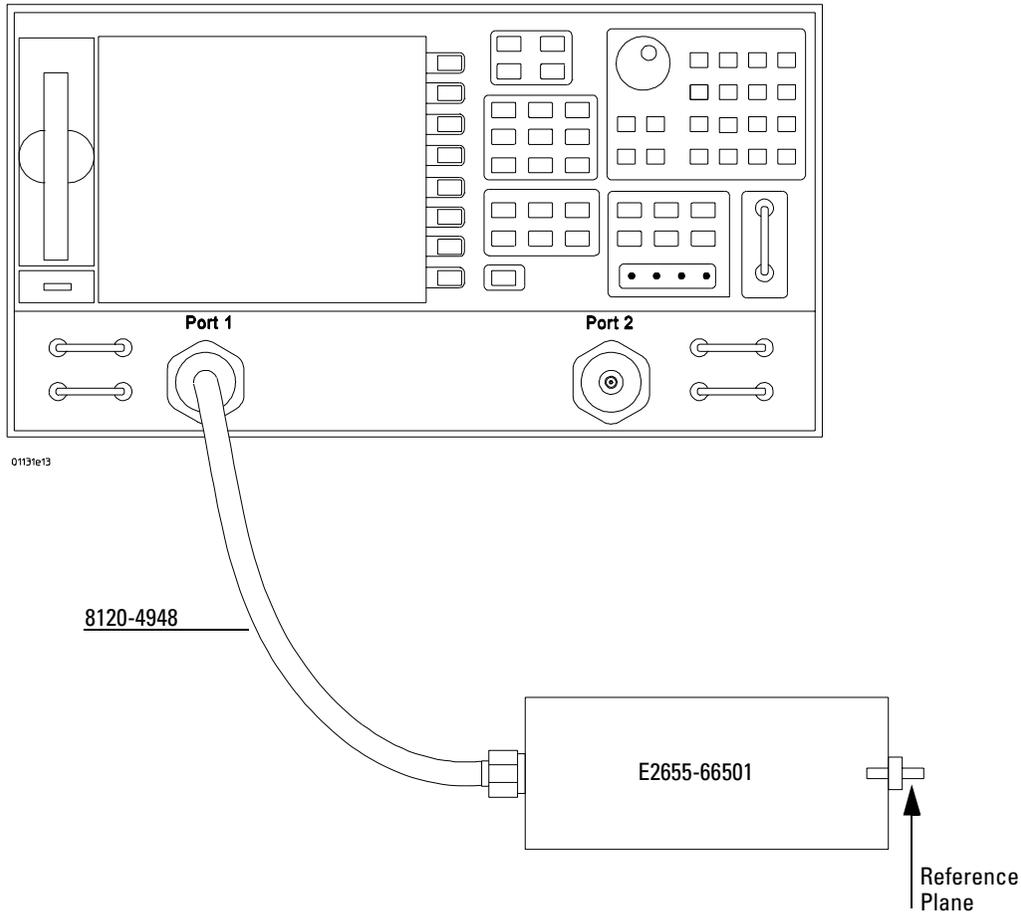
To get a reliable measurement from the 8720ES VNA we must calibrate a reference plane so that the 8720ES VNA knows where the probe under test is located along the transmission line.

1 Press the "Cal" key on the 8720ES VNA.



- 2 Then Press the "cal menu" screen key.
- 3 Finally, press the "full 2 port" screen key.
- 4 Connect one of the high quality SMA cables to port one and to the pincher side of PV/DS test board.
- 5 The calibration reference plane is at the other end of PV/DS test board.

Figure 2-2

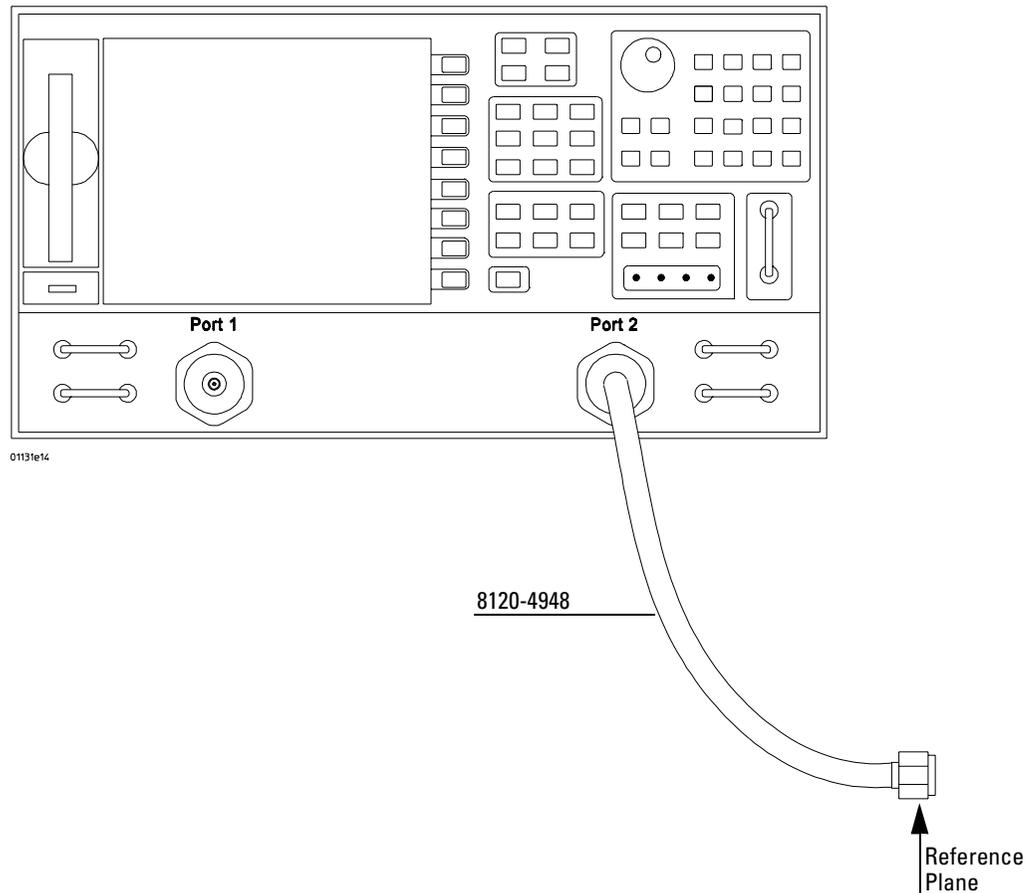


6 Perform Calibration for the port one side of the Reference plane.

- Press the "reflection" screen key
- Connect open end of 85052D to the non-pincher side of the PV/DS test board.
- Select the "open" screen key under the "Forward" group.
- The 8720ES VAN will beep when done.
- Connect short end of 85052D to the non-pincher side of the PV/DS test board.
- Select "short" screen key under the "Forward" group.
- The 8720ES VAN will beep when done.
- Connect load end of 85052D to the non-pincher side of the PV/DS test board.
- Select the "loads" screen key under the "Forward" group.
- Press "broadband" screen key selection.
- The 8720ES VAN will beep when done.
- Press the "done loads" screen key.
- You have just calibrated one side of the reference plane.

7 Connect the other high quality SMA cable to port two of the 8720ES VNA.

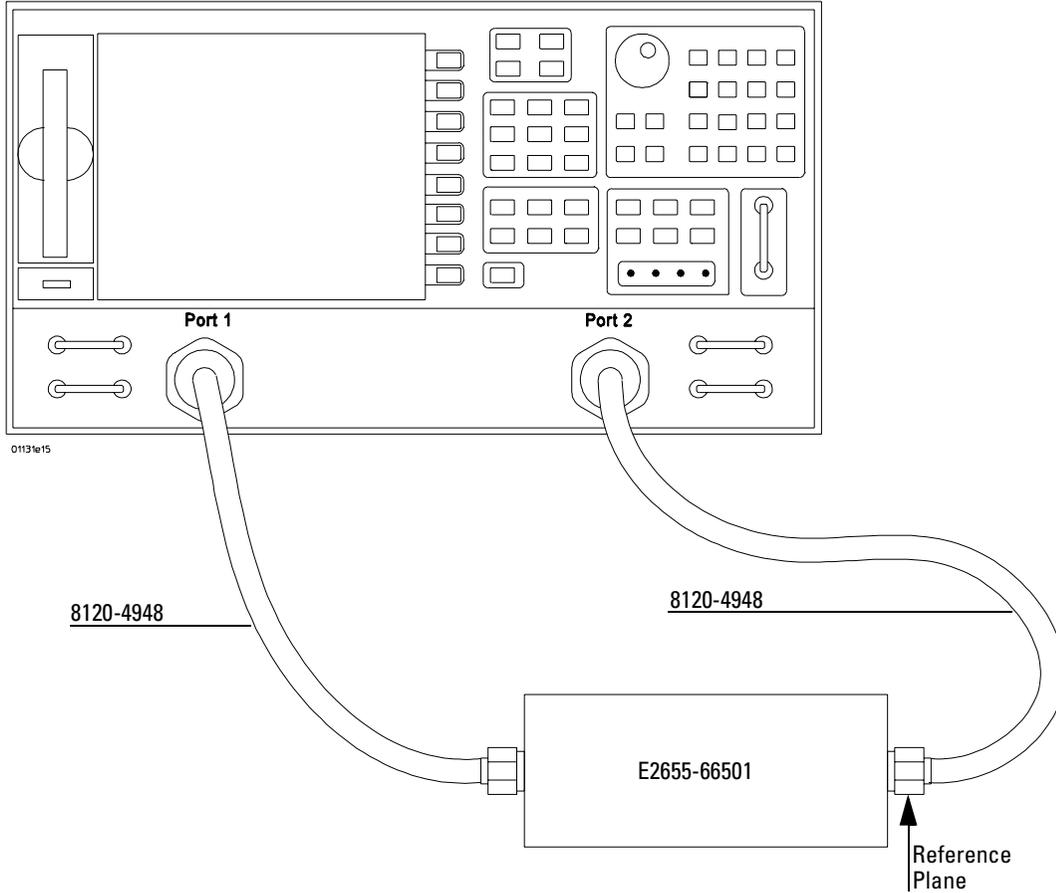
Figure 2-3



- 8 Get the opposite sex of the 85052D calibration standards for the next step.
- 9 Perform Calibration for the port two side of the Reference plane.
 - Press the "reflection" screen key.
 - Connect open end of 85052D to the available end of the port two SMA cable.
 - Select the "open" screen key under the "Reverse" group.
 - The 8720ES VNA will beep when done.
 - Connect short end of 85052D to the available end of the port two SMA cable.
 - Select "short" screen key the "Reverse" group.
 - The 8720ES VNA will beep when done.
 - Connect load end of 85052D to the available end of the port two SMA cable.
 - Select the "loads" screen key the "Reverse" group.
 - Press "broadband" screen key selection.
 - The 8720ES VNA will beep when done.
 - Press the "done loads" screen key.
 - You have just calibrated the other side of the reference plane.
- 10 Press "standards done" key.
- 11 Connect port two SMA cable to the non-pincher side of PV/DS test board.

Service
To Test Bandwidth

Figure 2-4



- 12 Press the "transmission" screen key.
- 13 Press the "do both fwd and reverse" screen key.
- 14 The 8720ES VNA will beep **four** times when done.
- 15 Press the "isolation" screen key.
- 16 Press the "omit isolation" screen key.
- 17 Press "done 2 port cal" screen key.
- 18 Set the 8720ES VNA's averaging to off.
- 19 Save the reference plane cal by pressing the "save recall" key then the "save state" key.
- 20 You may change name if you wish.
- 21 Press the "scale reference" key. Then
 - Set for 1 dB per division.
 - Set reference position for 7 divisions.
 - Set reference value for 0 dB
- 22 Press the "measure" key.
- 23 Press the "s21" screen key.
- 24 Ensure s21 response on screen is flat (about ± 0.1 dB) out to 10 GHz.

Measuring Vin Response

- 1 Position 1131A probe conveniently to make quality connections on the PV/DS board.
- 2 Ensure resistors at the probe tip are reasonably straight and about 0.1 inches apart.
- 3 Connect probe tip under pincher on PV/DS board

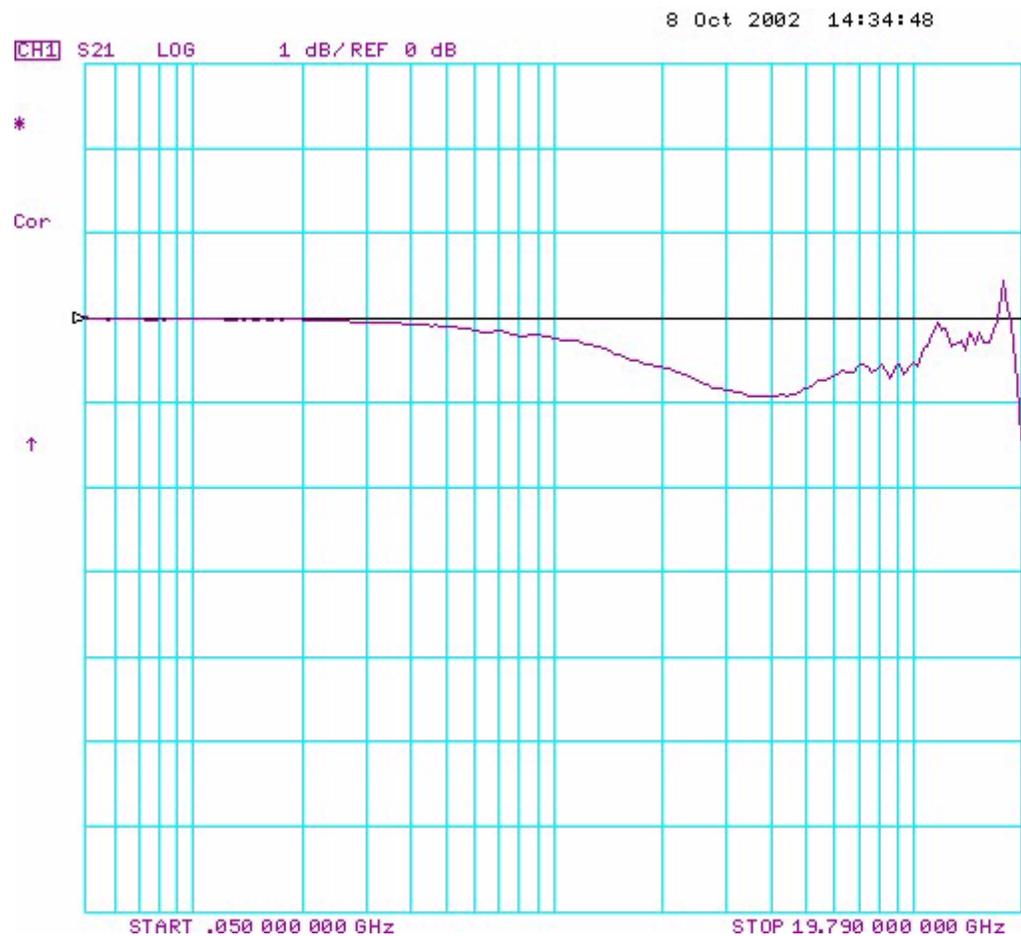
Apply upward pressure to the clip to insure proper electrical connection.

Place the "+" side on center conductor and "-" side to ground.

Press the "Sweep Setup" key on the 8720ES VNA. Then press the "trigger menu" screen key. Select the "continuous" screen key.

- 4 You should now have the Vin waveform on screen. It should look similar to Figure 2-5.

Figure 2-5



- 5 Select "display key" then "data->memory" screen key.
- 6 You have now saved Vin waveform into the 8720ES VNA's memory for future use.

Measuring Vout Response

- 1 Disconnect the port 2 cable from PV/DS test board and attach to probe output on the AutoProbe Adapter.
- 2 Connect the 85052D cal standard load to PV/DS test board (non-pincher side).
- 3 Press "scale reference" key on the 8720ES VNA.
- 4 Set reference value to -20 dB.
- 5 The display on screen is Vout. It should look similar to Figure 2-6.

Figure 2-6



Displaying Vin/Vout Response on 8720ES VNA Screen

- 1 Press the "Display" Key.
- 2 Then select the "Data/Memory" Screen Key. The display should look similar to Figure 2-7.
- 3 Press marker key and position the marker to the first point that the signal is below -3 dB.
- 4 Read marker frequency measurement and record it in the test record located later in this chapter.
- 5 The bandwidth test passes if the frequency measurement is greater than the probe's bandwidth limit. Example: > 3.5 GHz.

Figure 2-7



To Test Input Resistance

This test ensures that the 1131A Probe meets its specified input resistance.

Differential Mode	50 k Ω \pm 1%
Single-ended Mode	25 k Ω \pm 1%

Table 2-8

Equipment/Tool	Critical Specification	Model Number
Oscilloscope	54845 Infiniium Oscilloscope or newer with AutoProbe Interface; Updated firmware that supports the 1131A probe family	54846B
Digital Multimeter	6 ½ digit (0.1 mV) resolution dcV accuracy 8 ppm/year 4 wire resistance accuracy \pm 0.25%	34401A
Adapter	BNC (f) to SMA	
PV/DS Test Board	No Substitute (In E2655A Kit)	E2655-66501

Initial Setup

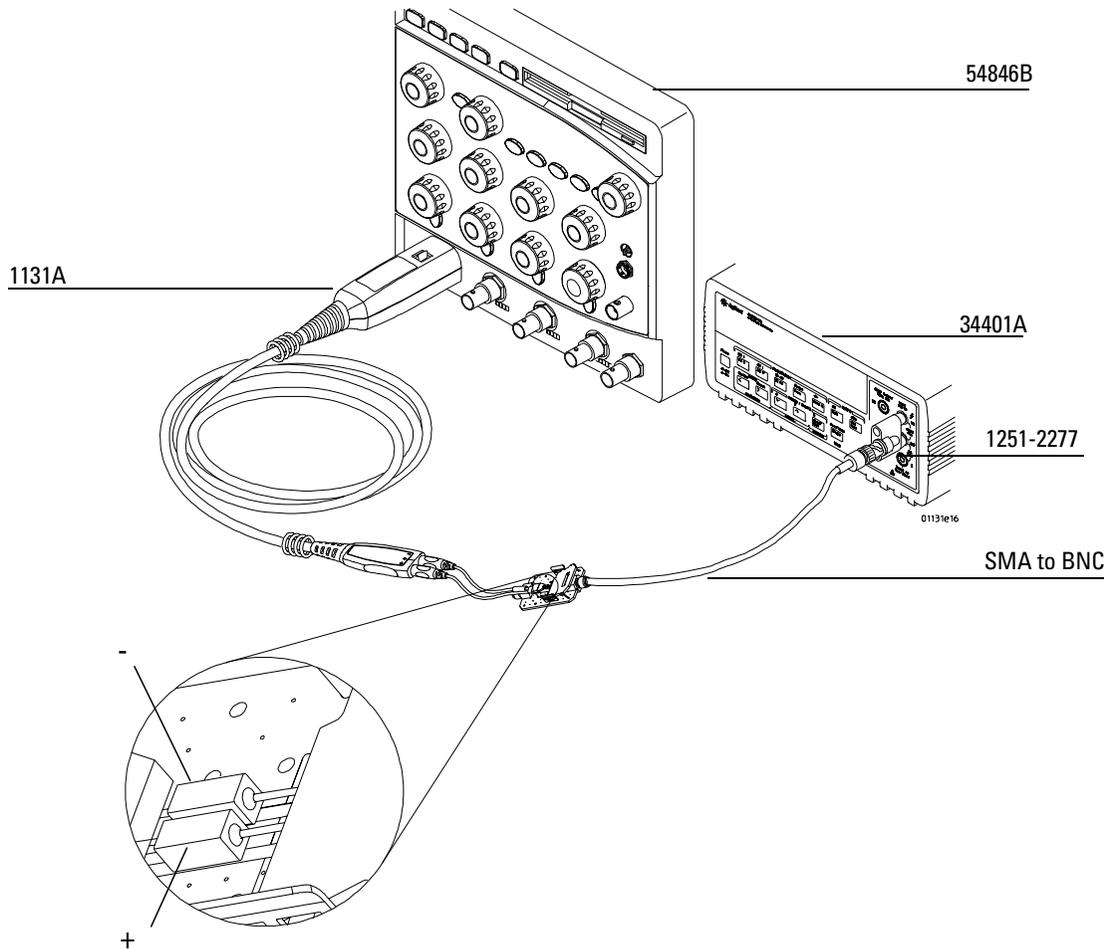
- 1** Power on the 54846B oscilloscope and 34401A DMM.
- 2** Connect the 1131A probe under test to Channel 1 of the 54846B.
- 3** Select the 2-wire Ohm display on the 34401A DMM.

Differential Test

- 1 Using the PV/DS test board, connect the 1131A "+" and "-" probe tips to the 34401A DMM.

Apply upward pressure to the clip to insure proper electrical connection.

Figure 2-9



- 2 Read the 34401A display for the Input Resistance.
- 3 Record the result in the performance test record later in this chapter. To pass this test the result should be between $49,500 \Omega$ and $50,500 \Omega$.

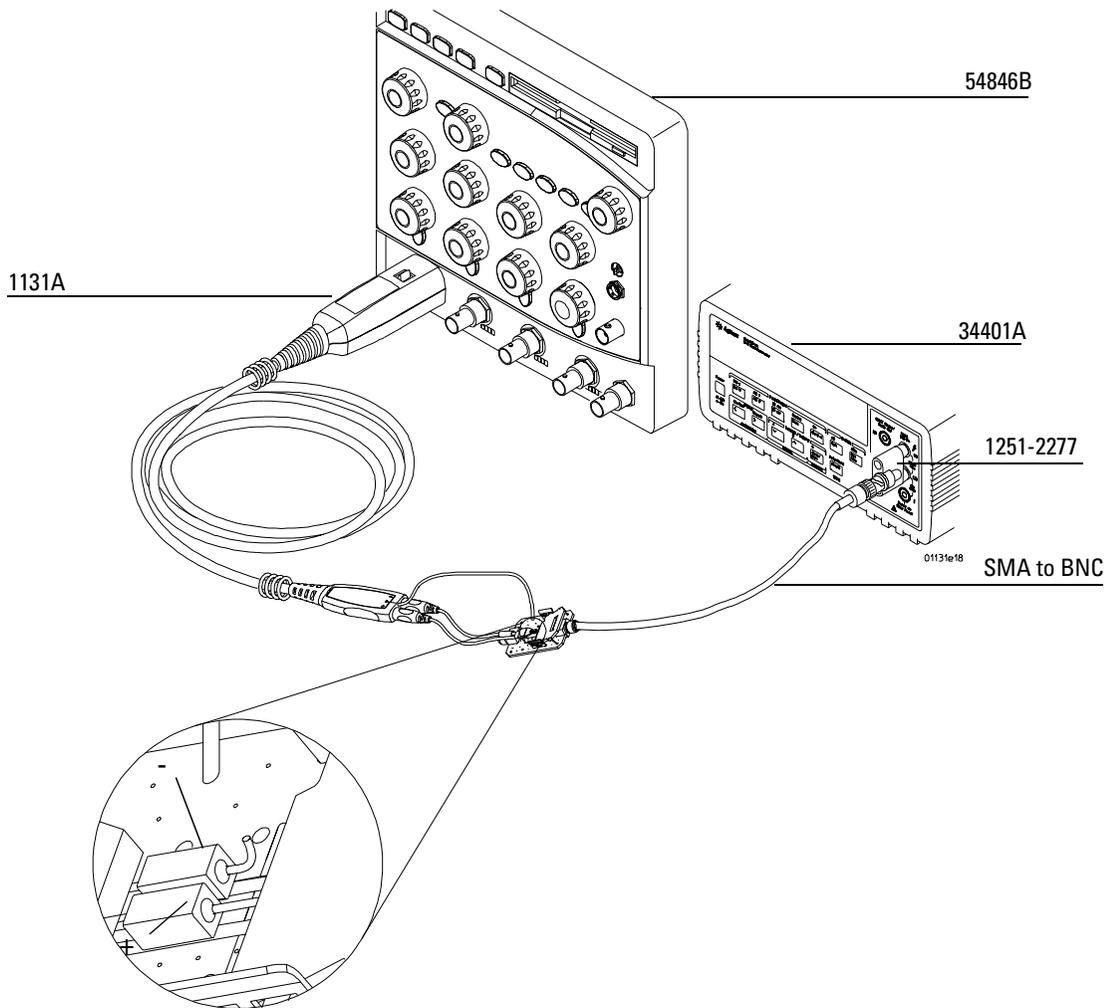
Service
To Test Input Resistance

Single-ended Test

- 1 Using the PV/DS test board, connect the "+" probe trip to the 34401A DMM.

Apply upward pressure to the clip to insure proper electrical connection.
- 2 Connect the amp body ground to the PV/DS test board ground.

Figure 2-10



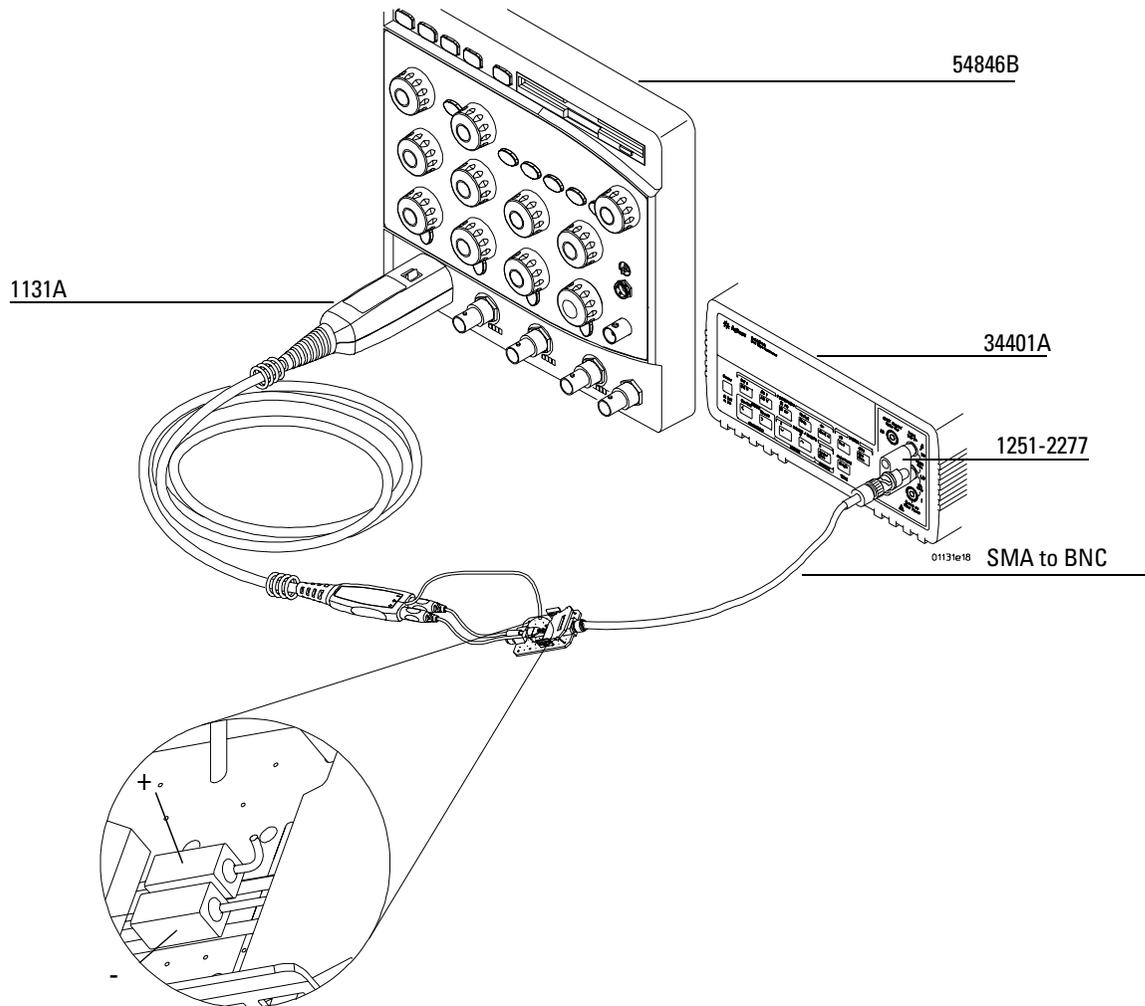
- 3 Read the 34401A display for the Input Resistance.
- 4 Record the result in the performance test record later in this chapter. To pass this test the result should be between 24,500 Ω and 25,500 Ω .

- 5 Using the PV/DS test board, connect the "-" probe tip to the 34401A DMM.

Apply upward pressure to the clip to insure proper electrical connection.

- 6 Connect the amp body to ground on the PV/DS test board.

Figure 2-11



- 7 Read the 34401A display for the Input Resistance.
- 8 Record the result in the performance test record later in this chapter. To pass this test the result should be between 24,500 Ω and 25,500 Ω .

A recommended grounding solution is to use the probe body ground.

To Test DC Attenuation

This test ensures that the 1131A Probe meets its specified DC attenuation.

After Calibration 10:1 ±1%

Table 2-12

Equipment/Tool	Critical Specification	Model Number
Oscilloscope	54845A Infiniium Oscilloscope or newer with Auto Probe Interface; Updated firmware that supports the 1131A probe family	54846B
Digital Multimeter	6 ½ digit (0.1 mV) resolution dcV accuracy 8 ppm/year 4 wire resistance accuracy ±0.25%	34401A
Power Supply	±12 V Range with 10 mV accuracy and resolution	E3615A
Adapter	BNC (f) to Dual Banana (m)	1251-2277
Cable	BNC - 3 feet	10503A
PV/DS Test Board	No Substitute (In E2655A Kit)	E2655-66501

- 1 Turn on the oscilloscope and install probe to be tested to channel 1.
- 2 Allow at least 20 minutes for warm-up.
- 3 Calibrate the probe. See oscilloscope manual or help system for information on calibrating the probe.
- 4 Set the power supply for +2.5 V.
- 5 Connect one end of the PV/DS test board to the power supply. Connect the minus terminal of the power supply to the oscilloscope ground using a banana cable.
- 6 Connect the probe to the PV/DS test board by pressing on the pincher and positioning the + tip over the center conductor of the board and the - tip over the ground conductor to either side. NOTE: You can apply slight upward pressure to the pincher to seat probe tips and insure good contact.
- 7 Set channel 1 offset to 0.0 V and scale to 1 V/div. Ensure probe set for measuring a single-ended signal (in probe menu).
- 8 Use the DVM to measure the actual voltage across the probe tips and record value in the test record (at end of chapter).
- 9 Use oscilloscopes Vavg measurement to get the value measured by the probe and record in test record.
- 10 Set power supply for -2.5 V.
- 11 Use the DVM to measure the actual voltage across the probe tips and record the value in the test record.
- 12 Use the oscilloscopes Vavg measurement to get the value measured by the probe and record in the test record.

To Test Offset Gain Accuracy and Range

This test ensures that the 1131A Probe meets its specified offset accuracy and range.

After Calibration: < 1% of offset setting

Table 2-13

Equipment/Tool	Critical Specification	Model Number
Function Generator	Sine Wave 20 Vpp into 1MΩ 70 Hz to 10 MHz output	33120A
Oscilloscope	54845 Infiniium Oscilloscope or newer w/ Auto Probe Interface; Updated firmware that supports the 1131A probe family	54846B
50 Ω Terminator	In E2655A Kit	
Adapter	BNC (f) to Dual Banana (m)	1251-2277
PV/DS Test Board	No Substitute (In E2655A Kit)	E2655-66501
Cable	BNC - 3 feet	10503A

- 1 Turn the 54846B and 33120A on and let warm up for 30 minutes.
- 2 Set the 33120A Function Generator to 1 kHz and 200 mVrms Sine Wave.
- 3 Connect the output of the function generator to channel 1 of the oscilloscope and measure Vac rms using the BNC cable.
- 4 Record Result. Vac rms = _____ V1
- 5 Use the PV/DS test board to connect the probe tip to the output of the function generator. Connect the output of the probe being tested to channel 2 of the oscilloscope.

Apply upward pressure to the clip to insure proper electrical connection.

- 6 Using the 50 Ω terminator on the open end of the PV/DS test board.
- 7 Ensure that the probe gain is set to 1.00 V.
- 8 Measure the Vac rms at the output of the 1131A probe.
- 9 Record Result. Vac rms = _____ V2
- 10 Calculate the % Gain Error.

$$\% \text{ Gain Error} = \frac{100(V2-V1)}{V1}$$

- 11 Record result in test record later in this chapter.
- 12 Test passes if the following limits are met.

Before calibration on oscilloscope channel: <3%
 After calibration on oscilloscope channel: <1%

Offset Zero Accuracy

This test ensures that the 1131A Probe meets its specified offset zero accuracy.

After Calibration: < 5 mV

Table 2-14

Equipment/Tool	Critical Specification	Model Number
Oscilloscope	54845 Infiniium Oscilloscope or newer w/ Auto Probe Interface; Updated firmware that supports the 1131A probe family	54846B

- 1** Connect the output of the probe to the 54846B oscilloscope.
- 2** Connect the probe tips to the ground.
- 3** Use the Vavg quick measurement to get the result.
- 4** Record result in the test record later in this chapter.
- 5** Tests pass if the limits below are met.

After calibration on oscilloscope channel: <5mV

Performance Test Record

Test Name	Results	Pass/Fail
Bandwidth	>3.5 GHz Result _____ GHz	Pass/Fail
Input Resistance	Differential Mode Limits: 49,500 Ω to 50,500 Ω ± _____ kΩ Single-ended Mode Limits: 24,500 Ω to 25,500 Ω + _____ kΩ - _____ kΩ	Pass/Fail Pass/Fail
DC Attenuation	0.1 x (value step 9 - value step 12)/(value step 8 -value step 11) Should be between 0.099 and 0.101	Pass/Fail
Offset Gain Accuracy and Range	100 x (value step 8 - value step 11)/24 Should be between -1.00 and +1.00	Pass/Fail
% Gain Error	Limits: After calibration on oscilloscope channel: <1% % Gain Error = _____	Pass/Fail
Offset Zero Accuracy	(value step 7) Should be between -5 mV and +5 mV	Pass/Fail

Replaceable Parts and Accessories

See the "User's Quick Start Guide" for a list of replaceable parts and accessories.

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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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