

1168A and 1169A  
InfiniiMax  
Differential and  
Single-ended Probes

**User's Guide**



**Agilent Technologies**

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# User's Guide

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May 2008

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## 1168A and 1169A InfiniiMax Differential and Single-ended Probes

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## In This Book

This book provides user and service documentation for the Agilent Technologies 1168A and 1169A 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 domain 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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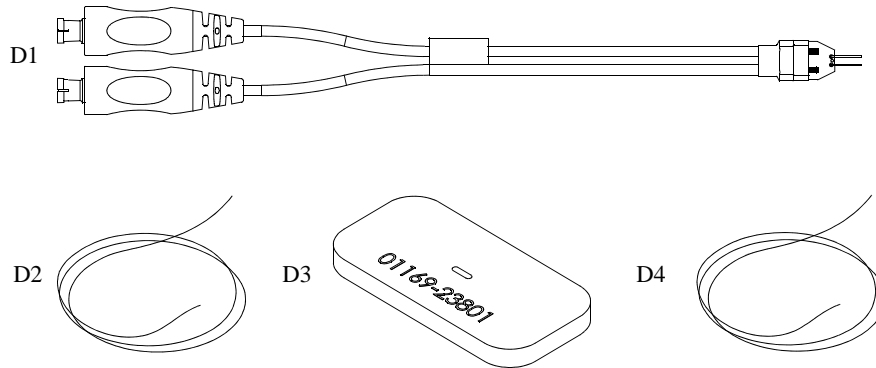
# 1168A 10 GHz and 1169A 12 GHz InfiniiMax Active Probes

The 1168A and 1169A InfiniiMax Active Probes are probe solutions for high-frequency applications. The probes are compatible with the 80000 Series, 8000 Series, 54855A, and 54854A Infiniium AutoProbe Interface which completely configures the Infiniium series of oscilloscopes for the probes.

These probes are also compatible with the N1022A probe adaptor for use with the Infiniium 86100A Digital Communication Analyzer or for use with the 1143A external power supply.

## N5381A 12 GHz Solder-in Differential Probe Head

Figure 1-1



Some parts have been enlarged to show more detail.

### N5381A 12 GHz Solder-in Differential Probe Head Accessories Supplied

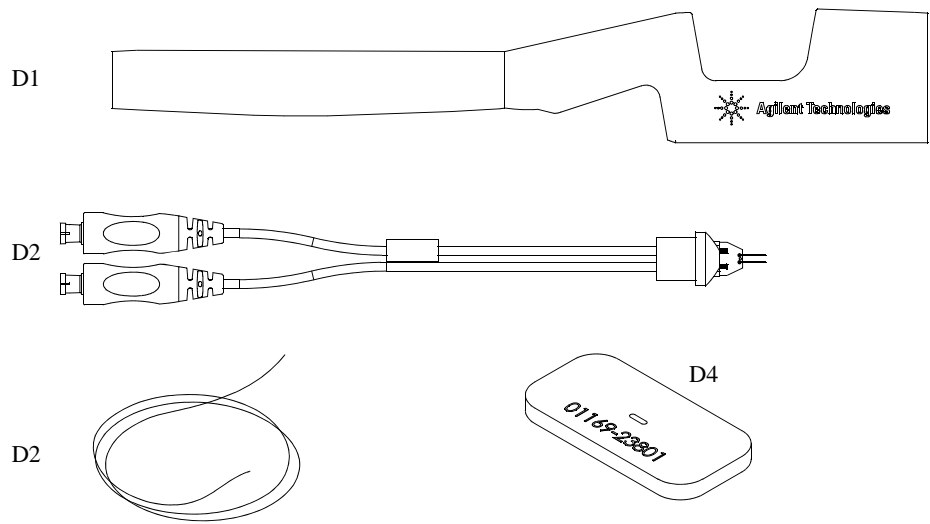
Item	Description	Qty Supplied	Part Supplied
	Solder-in differential probe head kit consists of the following		N5381A
D1	Solder-in differential probe head	1	
D2	0.007 inch tin-plated nickel wire	1	01169-81301
D3	Trim gauge (comes as part of each wire package)	1	
D4	0.005 inch tin-plated nickel wire	1	01169-21306

#### Cut wire

Before using the wire, the two wires must be cut to the correct dimensions using the trim gauge. See instructions for *"Replacing the Wires on N5381A and N5382A Probe Heads"* on page 1-32.

N5382A 12 GHz Differential Browser Probe Head

Figure 1-2



Some parts have been enlarged to show more detail.

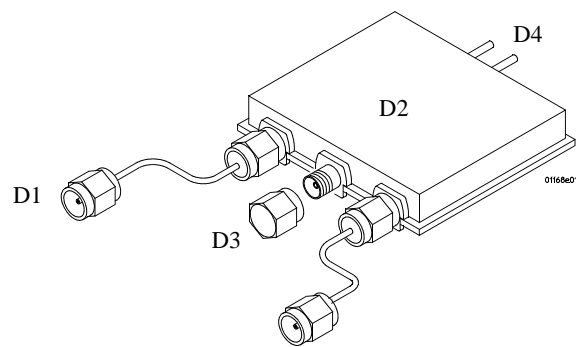
N5381A 12 GHz Differential Browser Probe Head Accessories Supplied

Item	Description	Qty Supplied	Part Supplied
	Solder-in differential probe head kit consists of the following		N5382A
D1	Ergonomic handle	1	01130-43202
D2	Solder-in differential probe head	1	
D3	0.005 inch tin-plated steel wire	1	01169-21304
D4	Trim gauge (comes as part of the wire package)	1	

**Cut wire**  
Before using the wire, the two wires must be cut to the correct dimensions using the trim gauge. See instructions for *"Wire Dimensions"* on page 1-22.

N5380A SMA Probe Head

Figure 1-3

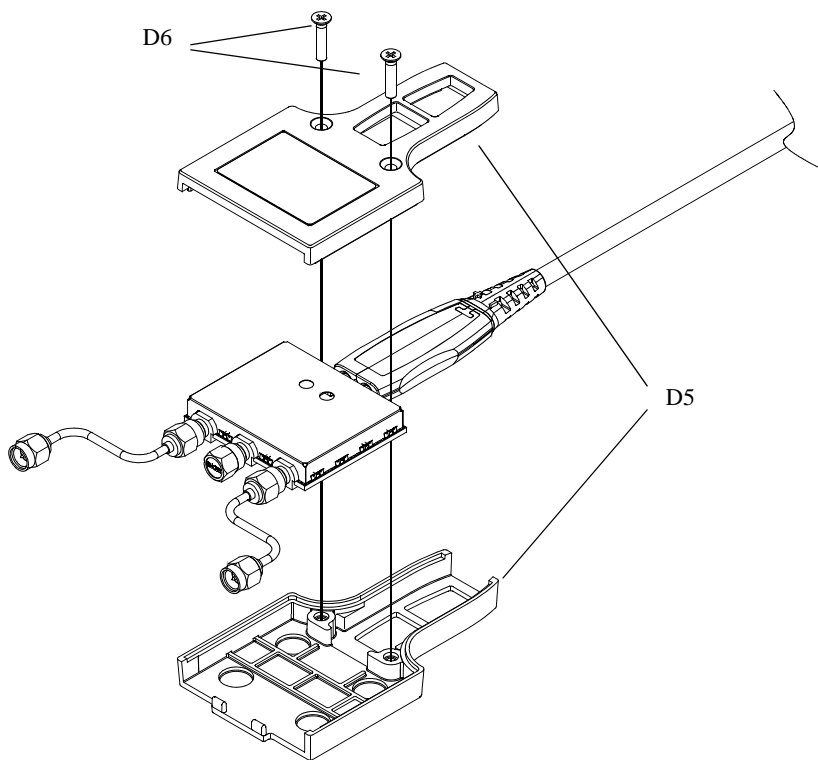


Some parts have been enlarged to show more detail.

N5380A 12 GHz SMA Probe Head Accessories Supplied

Item	Description	Qty Supplied	Part Supplied
	SMA probe head consists of the following		N5380A
D1	SMA-M to SMA-M cables	2	
D2	Probe Head PC Board	1	
D3	SMA shorting cap	1	
D4	GPO-F to GPO-F adaptor	2	

Related Product - N5380-64701 SMA Head Support



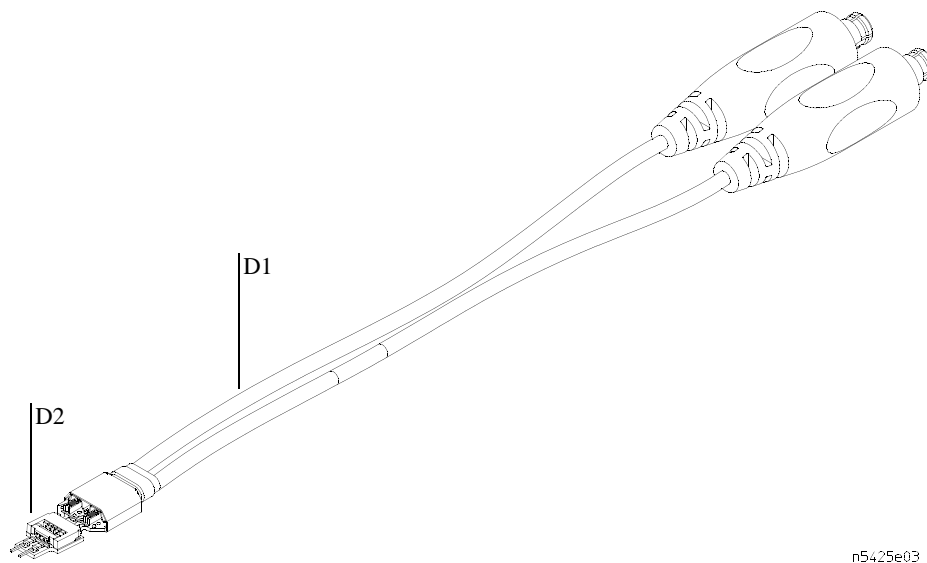
N5380-64701 SMA Head Support Accessories Supplied

Item	Description	Qty Supplied	Part Supplied
	SMA Head Support kit consists of the following		
D5	SMA Head Support	1	N5380-64701
D6	Screws for assembly (2 extra screws have been included)	4	0515-1236

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## N5425A ZIF Probe Head

Figure 1-4



Some parts have been enlarged to show more detail.

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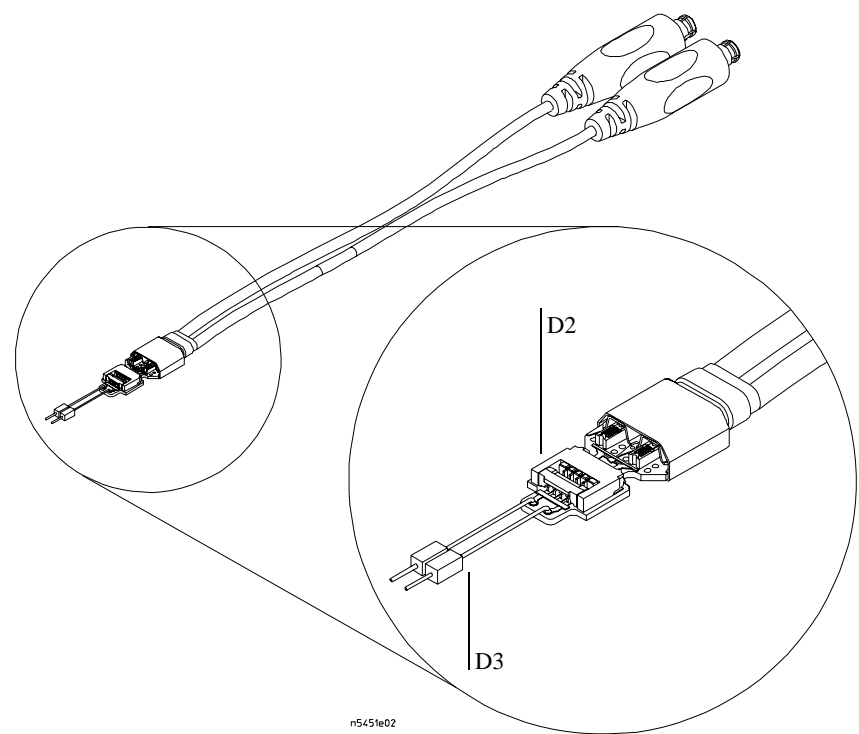
### N5425A 12 GHz ZIF Probe Head Accessories Supplied

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Item	Description	Qty Supplied	Part Supplied
	SMA probe head consists of the following		N5425A
D1	ZIF Probe Head	1	
D2	ZIF Tip	10	N5426A

Related Product - N5451A Long Wired ZIF Probe Tip

Figure 1-5



Some parts have been enlarged to show more detail.

N5451A Infiniimax Long Wired ZIF Probe Tip Accessories Supplied

Item	Description	Qty Supplied	Part Supplied
	Long Wired ZIF Probe Tip kit consists of the following		N5451A
D2	ZIF Tip	10	
D3	Long Wired ZIF Resistor Lead	24	01131-81510
	Trim Gauge (included as part of the packaging)	1	N5451A-94301

Cut wire

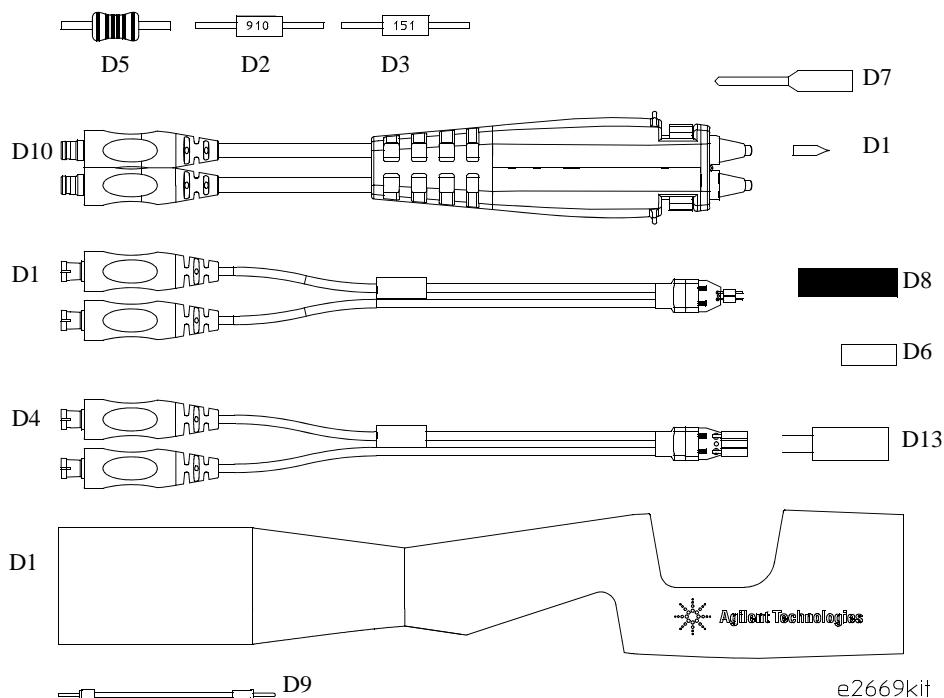
Before using the resistor leads, the two leads must be cut to the correct dimensions using the trim gauge and then soldered onto the Long Wired ZIF Tip. See instructions for "Procedures and Soldering Tips for InfiniiMax Long Wired ZIF Tip Resistor Installation" on page 1-39.

The Long Wired ZIF Probe Tip kit N5451A does not contain the ZIF probe head pictured above. It only contains the tip and resistor leads shown in the enlarged view.



## E2669A Differential Connectivity Kit

Figure 1-6



Some parts have been enlarged to show more detail.

### E2669A Differential Connectivity Kit Accessories Supplied

Item	Description	Qty Supplied	Part Supplied
	Solder-in differential probe head kit consists of the following		E2677A
D1	Solder-in differential probe head	4	01131-62103
D2	Resistor for solder-in differential probe head full bandwidth, 91 W)	80	01131-81510
D3	Resistor for solder-in differential probe head medium bandwidth, 150 W)	40	01131-81506
	91 W resistor template	1	01131-94311
	150 W resistor template	1	01131-94308
	Socketed differential probe head kit consists of the following		E2678A
D4	Socketed differential probe head	2	01131-62105
D5	Resistor for socketed differential probe head full bandwidth, 82 W)	96	01130-81506
D6	Socket for 25 mil (25/1000 inch) square pins, female on both ends	8	01131-85201
D7	25 mil female socket w/20 mil round male pin on other end	8	01131-85202
D8	Heatshrink socket accessory	8	01130-41101
D9	160 W Damped wire accessory	12	01130-21302
D13	Header adapter	4	01130-63201
	82 W resistor template	1	01131-94309
	Differential browser kit consists of the following		E2675A
D10	Differential browser	1	01131-60002

**General Information**  
**E2669A Differential Connectivity Kit**

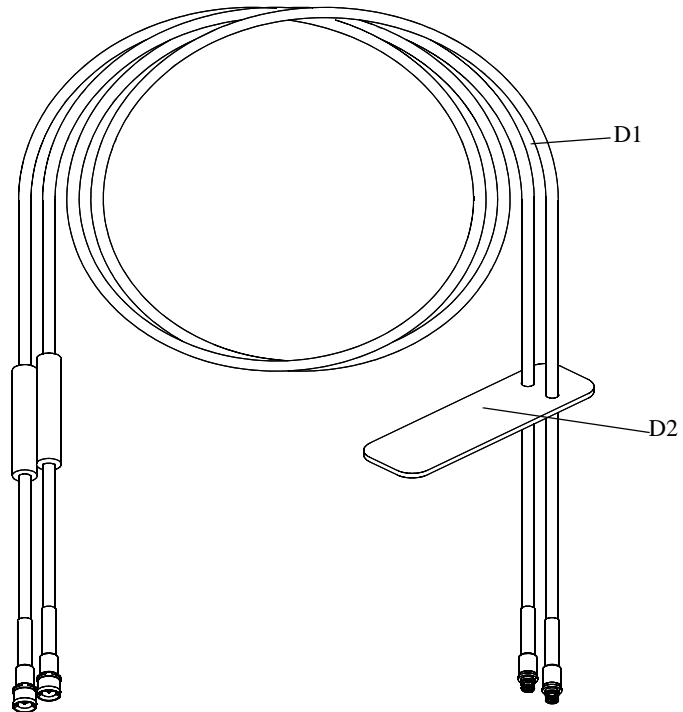
<b>Item</b>	<b>Description</b>	<b>Qty Supplied</b>	<b>Part Supplied</b>
D11	Resistive tip for differential browser (blue)	20	01131-62102
D12	Ergonomic handle	1	01131-43201

**Cut resistors**

Before using the resistors, the resistor wires must be cut to the correct dimensions. For the correct dimensions see "*Resistor Dimensions*" on page 1-23

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## N5450A Extreme Temperature Cable Extension



Some parts have been enlarged to show more detail.

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### N5450A Extreme Temperature Cable Extension Kit Accessories Supplied

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Item	Description	Qty Supplied	Part Supplied
	Extreme Temperature Cable Extension kit consists of the following		N5450A
D1	Extreme Temperature Cable Extension	2	
D2	Coupling Tag	1	N5450-21201

**General Information**  
**Replaceable Parts for the N5380A, N5381A, N5382A, and Probe Amps**

## Replaceable Parts for the N5380A, N5381A, N5382A, and Probe Amps

**Table 1-1**

Agilent Replaceable Parts				
Agilent Part Number	Consists of	Orderable?	Description	Qty
1169A		Yes	12 GHz InfiniiMax Amp Kit	1
1168A		Yes	10 GHz InfiniiMax Amp Kit	1
01169-21304		Yes	0.005 steel wire and trim gauge (N5382A)	1
01169-81301		Yes	0.007 tin-plated nickel wire and trim gauge (N5381A)	1
01169-21306		Yes	0.005 tin-plated nickel wire and trim gauge (N5381A)	1
N5380A		Yes	SMA probe head	1

**Table 1-2**

N5380A Replaceable Parts			
Vendor	Part Number	Description	Qty
Corning Gilbert	#A1A1-0001-03	GPO-F to GPO-F adaptor	2
Rosenberger	#19K 109-K00 E4		

## Replaceable Parts and Additional Accessories for the E2669A

**Table 1-3**

Connectivity Kit				
Agilent Part Number	Consists of	Orderable?	Description	Qty
E2669A		Yes	Differential Connectivity Kit consists of	1
	E2675A	Yes	Differential browser kit	1
	E2677A	Yes	Solder-in differential probe head kit	4
	E2678A	Yes	Socketed differential probe head kit	2
Probe Head Kits				
Agilent Part Number	Consists of	Orderable?	Description	Qty
E2675A		Yes	Differential browser kit	1
	01131-60002	No	Differential browser	1
	01131-62102	(Order E2658A accessory kit)	Resistive tip for browser (blue)	20
	01131-43201		Ergonomic handle for browser	1
E2677A		Yes	Solder-in differential probe head kit	1
	01131-62103	No	Solder-in differential probe head	1
	01131-81510	(Order E2670A accessory kit)	Resistor 91 W full bandwidth	20
	01131-81506		Resistor 150 W medium bandwidth	10
	01131-94311		91 W resistor template	1
	01131-94308		150 W resistor template	1

**General Information**  
**Replaceable Parts and Additional Accessories for the E2669A**

E2678A		Yes	Socketed differential probe head kit	1
	01131-62105	No	Socketed differential probe head	1
	01130-63201	(Order E2671A accessory kit)	Header adapter	2
	01130-81506		Resistor 82 W full bandwidth	48
	01130-21302		160 W damped wire accessory	6
	01131-85201		Socket for 25 mil (25/1000 inch) square pins, female on both ends	4
	01131-85202		25 mil female socket w/20 mil round male pin on other end	4
	01130-41101		Heatshrink socket accessory	4
	01131-94309		82 W resistor template	1

**Accessory Kits**

Agilent Part Number	Consists of	Orderable?	Description	Qty
E2658A		Yes	Replacement accessories for E2675A	1
	01131-62102	No	Resistive tip for browser (blue)	20
	01131-43201	No	Ergonomic handle for browser	1
E2670A		Yes	Replacement accessories for E2677A	1
	01131-81510	No	Resistor 91 W full bandwidth	20
	01131-81506	No	Resistor 150 W medium bandwidth	10
	01131-94311	No	91 W resistor template	1
	01131-94308	No	150 W resistor template	1
E2671A		Yes	Replacement accessories for E2678A	1
	01130-81506	No	Resistor 82 W full bandwidth	48
	01130-21302	No	160 W damped wire accessory	6
	01130-63201	No	91 W header adapter	2
	01131-85201	No	Socket for 25 mil (25/1000 inch) square pins, female on both ends	4
	01131-85202	No	25 mil female socket w/20 mil round male pin on other end	4
	01130-41101	No	Heatshrink socket accessory	4
	01131-94309	No	82 W resistor template	1

**Resistors**

*The Agilent number below is provided as a reference (not orderable) for you to order from the manufacturer.*

Agilent Part Number	Order From Vendor	Orderable Part Number	Description	Qty
01131-81504	AVX Components	HR01000J	Resistor for solder-in single-ended probe head (full bandwidth, 0 W)	1
	BREL International	RMB16-000-J		
01131-81510	AVX Components	HR01910J	Resistor for solder-in single-ended probe head (high bandwidth, 91 W)	1
	BREL International	RMB16-910-J		
01130-81506	BC Components	2312 903 08209	Resistor for socketed differential probe head (high bandwidth, 82 W)	1
	Vishay	SMA0204HF/ MK1HF5082R1 % A		

**General Information**  
**Replaceable Parts and Additional Accessories for the E2669A**

Other Accessories			
Vendor	Part Number	Description	Qty
Cascade <sup>®</sup> Microtech	E2654A	EZ-Probe <sup>®</sup> positioner	1
Agilent	E2655B	Probe deskew and performance verification kit	1
Agilent	E5381-82103	160 W damped wire accessory (01130-21302 34 each)	1
Agilent	01131-68703	Header adapter kit for socketed differential probe head (01130-63201 10 each)	1
Inmet	#8037	SMA coaxial dc block	1
Inmet	#18AH-6	SMA 6 dB coaxial attenuator	1
Inmet	#18AH-12	SMA 12 dB coaxial attenuator	1
ATM Microwave	#P1907	SMA adjustable delay	1

## Specifications

All specifications are warranted and are measured using the probe amp and N5381A solder-in differential probe head.

Table 1-4

Specifications		
<b>Bandwidth (-3 dB)</b>		
<b>1168A</b>	> 10 GHz	
<b>1169A</b>	> 12 GHz (13 GHz typical)	
<b>Input Resistance</b>	50 kW $\pm$ 2%	Differential mode resistance
	25 kW $\pm$ 2%	Single-ended mode resistance each side to ground

## Characteristics

All characteristics are the typical performance values of the InfiniiMax probes using the probe amp and N5381A solder-in differential probe head and are not warranted. Footnotes are located on page 17.

### Typical Performance

#### Oscilloscope and Probe System

##### Bandwidth (-3 dB)

<b>1168A with DSO80804A</b>	8 MHz
<b>1168A with DSO81004A</b>	10 GHz
<b>1169A with DSO81204A</b>	12 GHz
<b>1169A with DSO81304A</b>	13 GHz

##### Rise and Fall Time (10% to 90%)

<b>1168A</b>	48 ps
<b>1169A</b>	40 ps

##### Rise and Fall Time (20% to 80%)

<b>1168A</b>	34 ps
<b>1169A</b>	28 ps

##### Rise and Fall Time (10% to 90%)

(Phase corrected on DSO80000 Series Oscilloscope)

<b>1168A</b>	42 ps
<b>1169A</b>	36 ps

##### Rise and Fall Time (20% to 80%)

(Phase corrected on DSO80000 Series Oscilloscope)

<b>1168A</b>	30 ps
<b>1169A</b>	25 ps

#### Input Capacitance

<b>Cm</b>	0.09 pF
<b>Cg</b>	0.26 pF

Model for input C is Cm is between tips and Cg is to ground for each tip

<b>Cdiff</b>	0.21 pF
--------------	---------

Differential mode capacitance (capacitance when probing a differential signal = Cm + Cg/2)

<b>Cse</b>	0.35 pF
------------	---------

Single-ended mode capacitance (capacitance when probing a single-ended signal = Cm + Cg)

#### Input Dynamic Range

±1.65 V

Differential or single-ended

#### Input Common Mode Range

±6.75 V

dc to 100 Hz

1.25 V peak-to-peak

> 100 Hz

#### Maximum Signal Slew Rate (SRmax)<sup>1</sup>

25 V/ns

When probing a single-ended signal

40 V/ns

When probing a differential signal

#### DC Attenuation

@ 3.45:1<sup>2</sup>

#### Zero offset error referred to input

< 2 mV x DC Attenuation<sup>2</sup>

#### Offset Range

±16.0 V

When probing single-ended

#### Offset Accuracy

< 3%<sup>2</sup>

#### Noise referred to input

2.5 mVrms

#### Propagation Delay

@ 6 ns





<b>Maximum Input Voltage</b>	30 V Peak, CAT I	Maximum non-destructive voltage on each input ground
<b>ESD Tolerance</b>	> 8 kV from 100 pF, 300 W HBM	

1  $S_{rmax}$  of a sine wave =  $Amp \times 2 \times p \times frequency$  or  $SR_{max}$  of a step @  $Amp \times 0.6 / trise$  (20 to 80%) for more information see Table 1-6 on page 21.

2 When calibrated on the oscilloscope, these characteristics are determined by the oscilloscope characteristics.

## InfiniiMax II Series Performance Characteristics with N5380A SMA Probe Head

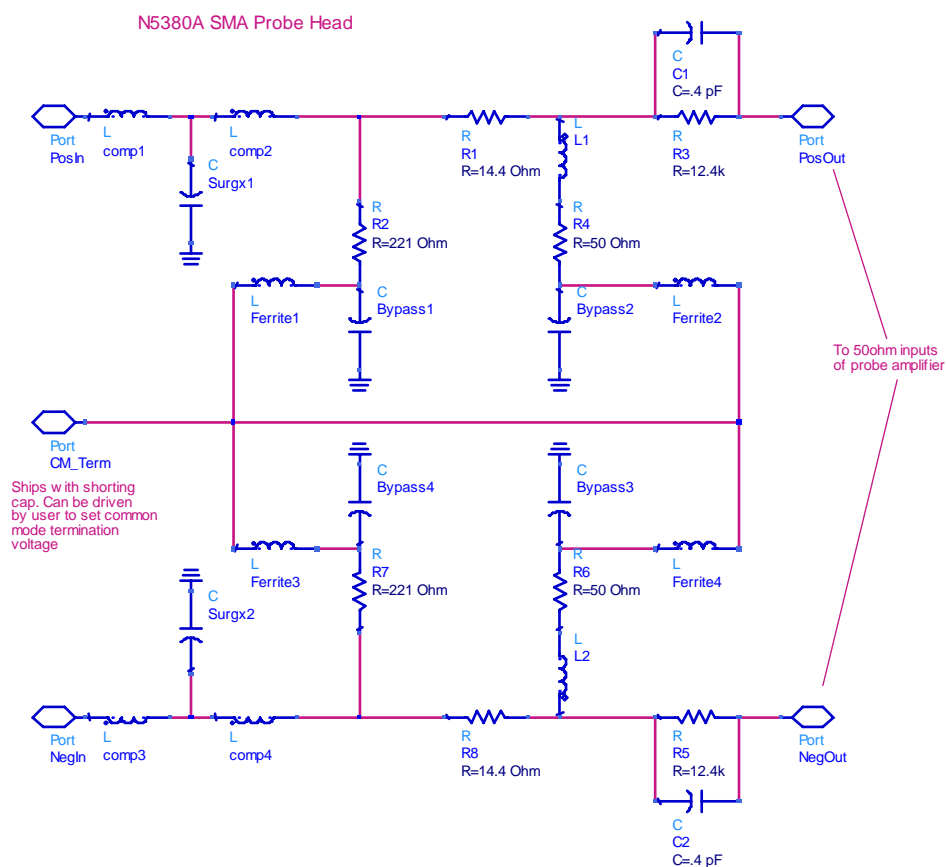
All characteristics are the typical performance values of the InfiniiMax probes using the probe amp and N5380A SMA probe head and are not warranted. Footnotes are located on page 18

<b>Bandwidth</b>	1169A: >12GHz	1168A: > 10GHz
<b>Probe only rise and fall times</b>	1169A: 27.5 ps (20% to 80%) 40 ps (10% to 90%)	1168A: 27.5 ps (20% to 80%) 40 ps (10% to 90%)
<b>System rise and fall times<sup>1</sup></b>	1169A with DSO81304A: 23 ps (20% to 80%) 33 ps (10% to 90%) 1169A with DSO81204A: 25 ps (20% to 80%) 36 ps (10% to 90%)	1168A with DSO81004A: 30 ps (20% to 80%) 42 ps (10% to 90%) 1168A with DSO80804A: 38 ps (20% to 80%) 54 ps (10% to 90%)
<b>System bandwidth (-3 dB)</b>	1169A with DSO81304A: 12.5 GHz 1169A with DSO81204A: 12 GHz	1168A with DSO81004A: 10 GHz 1168A with DSO80804A: 8 GHz
<b>Input Resistance</b>	50 W $\pm$ 2%	
<b>Input dynamic range</b>	$\pm$ 1.1 V Differential or Single-Ended	
<b>Maximum input<sup>4</sup> (Vin-Vcm_term)</b>	2.28 Vrms	
<b>Input common mode range</b>	$\pm$ (4.3 V - Vcm_term $\mp$ 0.29) $\pm$ 0.8 V	dc to 100 Hz > 100 Hz
<b>Maximum Signal Slew Rate<sup>2</sup> (SMA attenuator can extend range. See footnote 3.)</b>	25 V/ns	Differential Input
<b>DC attenuation</b>	~2.2:1 (-6.9db)	
<b>Zero offset error referred to input</b>	< 2 mV	
<b>Noise referred to input</b>	1.6 mVrms (~ 14 nV/rtHz using noise BW of 12.5 GHz)	
<b>Propagation delay</b>	~6.15 ns	

1. Decreased rise and fall times mainly due to phase correction performed in the DSO80000 series, not due to DSP boosting (except in DSO81304A).
2. SR max of sine wave = amplitude x 2 x  $\pi$  x frequency OR SR max of a step approximately equal to the amplitude x 0.6/trise (20-80%).
3. Use of X:1 SMA coaxial attenuators in front of SMA probe head will:
  - a. Increase by X the max input signal slew rate, dynamic range, offset range, common mode range, noise referred to the input, DC attenuation, and maximum input voltage.
  - b. Most likely improve return loss or input TDR if attenuators are high quality
  - c. Not affect bandwidth and rise time if attenuators are high quality.
4. Vcm\_term is the voltage supplied to the common mode termination port of the N5380A. If shorting cap in place, this voltage is zero.

### Simplified Schematic for N5380A SMA Probe Head

**Figure 1-7**



### SMA Probe Head Simplified Schematic

## CAT I: Secondary Circuits

Do not use the probe for measurements within measurement categories II, III and IV.  
The RATED transient overvoltage is 80 volts peak.

## General Characteristics

The following general characteristics apply to the active probe.

Table 1-5

General Characteristics		
Environmental Conditions		
	Operating	Non-operating
Temperature	+5 °C to +40 °C	-40 °C to +70 °C
Humidity	up to 95% relative humidity (non-condensing) at +40 °C	up to 90% relative humidity at +65 °C
Altitude	Up to 4,600 meters	Up to 15,300 meters
Power Requirements	Voltages supplied by the Agilent oscilloscope AutoProbe interface.	
Weight	approximately 0.69 kg	
Dimensions	Refer to the outline in <i>figure 1-13</i> .	
Pollution degree 2	Normally only non-conductive pollution occurs. Occasionally, however, a temporary conductivity caused by condensation must be expected.	
Indoor use only		
WEEE Compliance		



This product complies with the WEEE Directive (2002/96/EC) marking requirements. The affixed label indicates that you must not discard this electrical/electronic product in domestic household waste.

*Product Category: With reference to the equipment types in the WEEE Directive Annex I, this product is classed as a "Monitoring and Control Instrumentation" product.*

**Do not dispose in domestic household waste.**

**To return unwanted products, contact your local Agilent office, or see [www.agilent.com](http://www.agilent.com) for more information.**

## Slew Rate Requirements for Different Technologies

The following table shows the slew rates for several different technologies. The maximum allowed input slew rate is 25 V/ns for single-ended signals and 40 V/ns for differential signals. Table 1-6 shows that the maximum required slew rate for the different technologies is much less than that of the probe.

**Table 1-6**

### Slew Rate Requirements

Name of Technology	Differential Signal	Max Single-Ended Slew Rate <sup>1</sup> (V/ns)	Max Differential Slew Rate <sup>2</sup> (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

<sup>1</sup> The probe specification is 25 V/ns

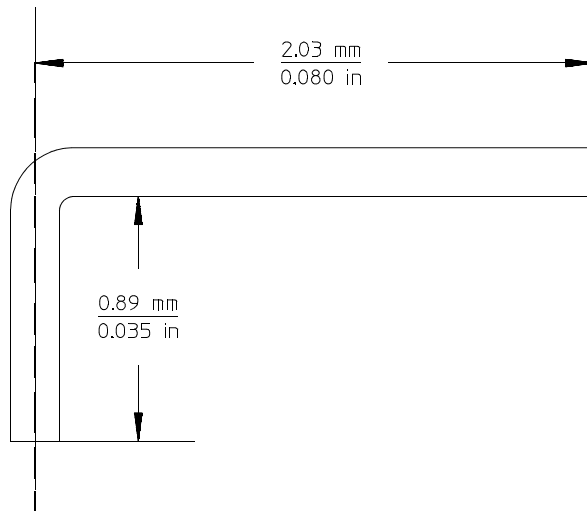
<sup>2</sup> The probe specification is 40 V/ns

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## Wire Dimensions

In order to make measurements with proper fidelity using the N5381A 12 GHz solder-in differential probe head or the N5382A 12 GHz differential browser probe head, the wire leads must be trimmed to a specified length as shown in figure 1-8. The procedure for trimming the wires is found in the section "Replacing the Wires on N5381A and N5382A Probe Heads" on page 1-32

**Figure 1-8**



## Resistor Dimensions

In order to make measurements with proper fidelity, the resistor leads must be trimmed to a specified length and one end bent 90 degrees as shown in figure 1-9, figure 1-10, and figure 1-11. The resistor in figure 1-12 needs to be trimmed but does not require any bending.

### Solder-in 91 Ohm and 0 Ohm Full Bandwidth Resistors

The following part number resistors must be trimmed and bent as shown in figure 1-9.

- 01131-81510 (91 Ohm)
- 01131-81504 (0 Ohm)

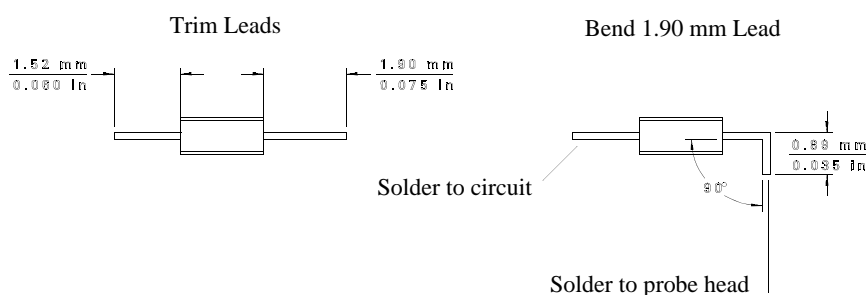
The equipment required is:

- X-acto knife
- Agilent supplied template included with resistors
- Magnifying device
- Tweezers (2)

The instructions for trimming and bending the resistor are:

- 1 Using tweezers, place resistor body inside the rectangle of the trim template.
- 2 Using the X-acto knife, trim the leads even with the trim lines.
- 3 Place resistor body inside the rectangle of the bend template.
- 4 Using another pair of tweezers, bend the 1.90 mm (0.075 in) lead 90 degrees.

Figure 1-9



## General Information

### Resistor Dimensions

#### Solder-in 150 Ohm and 0 Ohm Medium Bandwidth Resistors

The following part number resistors must be trimmed and bent as shown in figure 1-10.

- 01131-81506 (150 Ohm)
- 01131-81504 (0 Ohm)

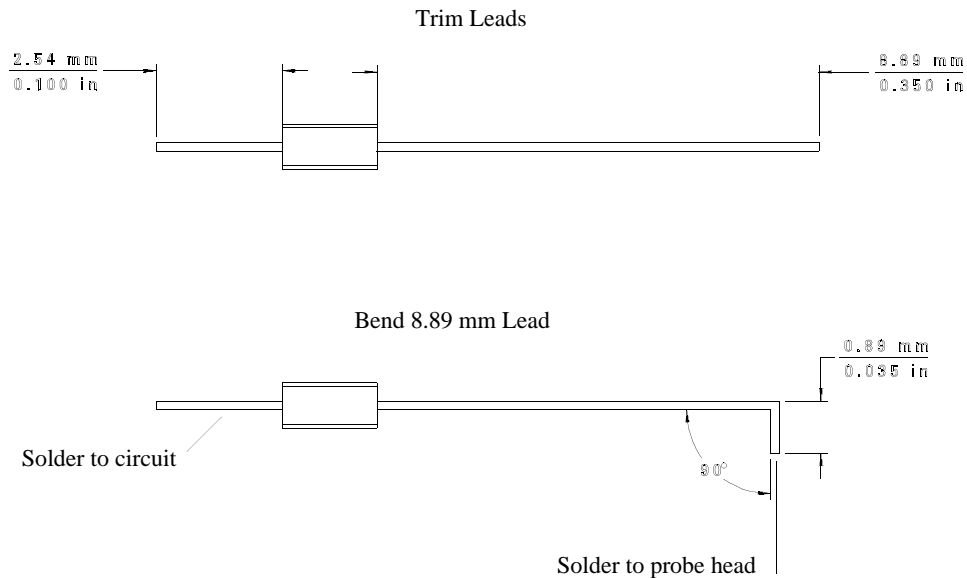
The equipment required is:

- X-acto knife
- Agilent supplied template included with resistors
- Magnifying device
- Tweezers (2)

The instructions for trimming and bending the resistor are:

- 1 Using tweezers, place resistor body inside the rectangle of the trim template.
- 2 Using the X-acto knife, trim the leads even with the trim lines.
- 3 Place resistor body inside the rectangle of the bend template.
- 4 Using another pair of tweezers, bend the 8.89 mm (0.360 in) lead 90 degrees.

Figure 1-10





### Solder-in 91 Ohm Long Wired ZIF Resistor Leads

The following part number resistors must be trimmed and bent using the template (N5451A-94301) provided with the N5451A packaging (see figure 1-11):

- 01131-81510 (91 Ohm)

The template shows how to trim the leads to two different lengths: 7 mm or 11 mm.

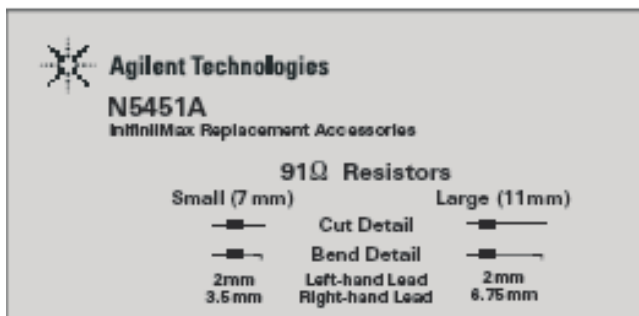
The equipment required is:

- X-acto knife
- Agilent supplied template gauge (N5451A-94301) included as part of the N5451A packaging
- Magnifying device
- Tweezers (2)

The instructions for trimming and bending the resistor are (for additional instructions and pictures regarding trimming, bending, and soldering these resistor leads, refer to "Procedures and Soldering Tips for InfiniiMax Long Wired ZIF Tip Resistor Installation" on page 1-39):

- 1 Using tweezers, place resistor body inside the rectangle of the trim template. The trim template contains two lengths: 7mm and 11mm. Choose the correct length for your application.
- 2 Using the X-acto knife, trim the leads even with the trim lines.
- 3 Place resistor body inside the rectangle of the bend template.
- 4 Using another pair of tweezers, bend the right-hand lead 90 degrees.

Figure 1-11



## General Information

### Resistor Dimensions

#### 82 Ohm Resistor

The following part number resistors must be trimmed as shown in figure 1-12.

- 01130-81506

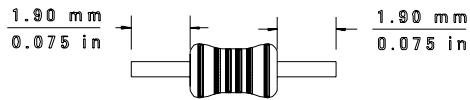
The equipment required is:

- diagonal cutters
- Agilent supplied template included with resistors
- Magnifying device
- Tweezers

The instructions for trimming the resistor are:

- 1 Using tweezers, place resistor body inside the rectangle of the trim template.
- 2 Using the diagonal cutters, trim the leads even with the trim lines.

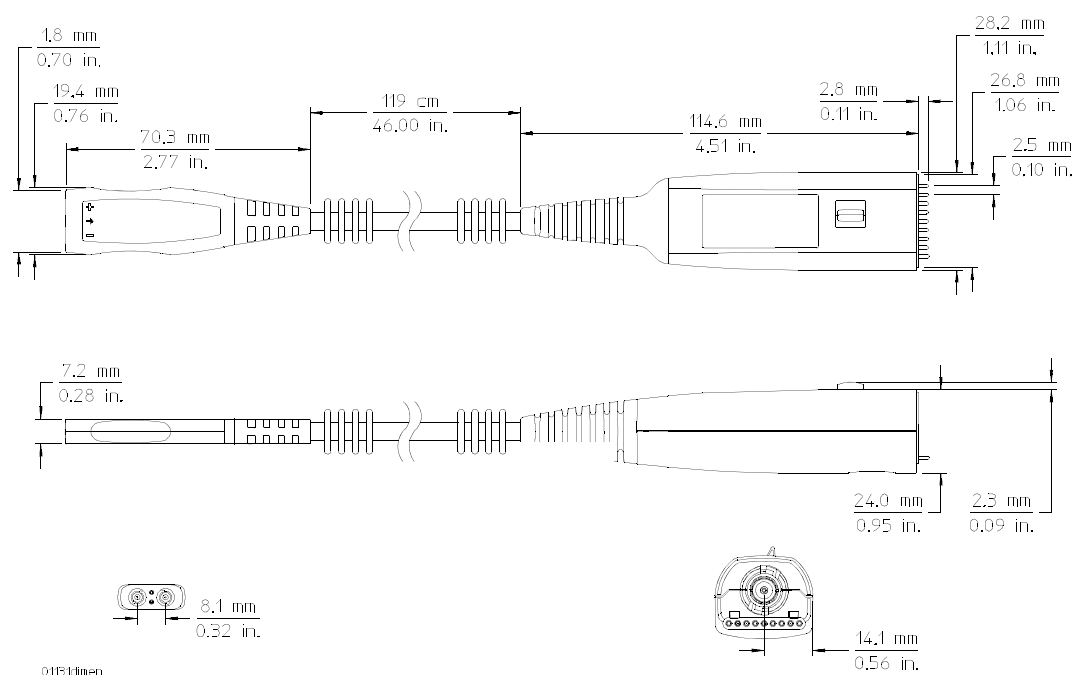
Figure 1-12



## Probe and Probe Head Dimensions

### Probe Amp Dimensions

Figure 1-13

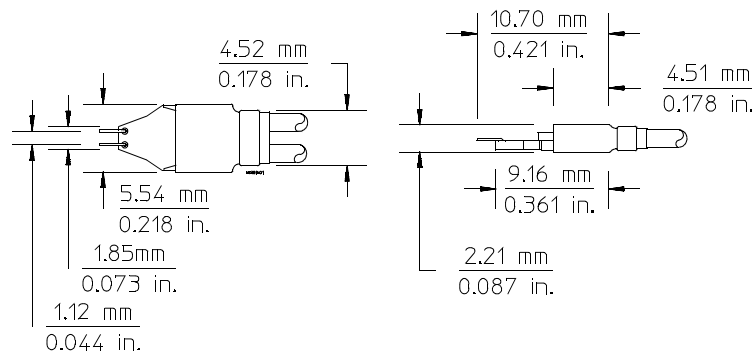


1168A and 1169A Active Probe Dimensions

**General Information**  
**Probe and Probe Head Dimensions**

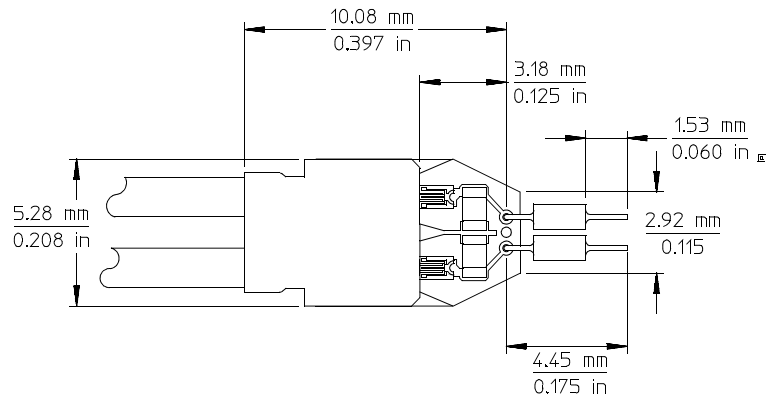
**N5381A and N5382A Probe Head Dimensions**

**Figure 1-14**



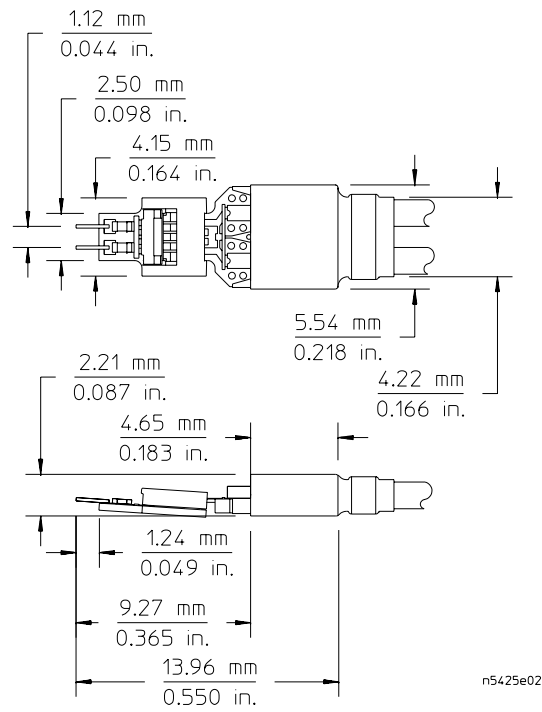
**01131-62103 Solder-in Differential Probe Head Dimensions**

**Figure 1-15**



N5425A ZIF Probe Head Dimensions with ZIF Tip Attached

Figure 1-16

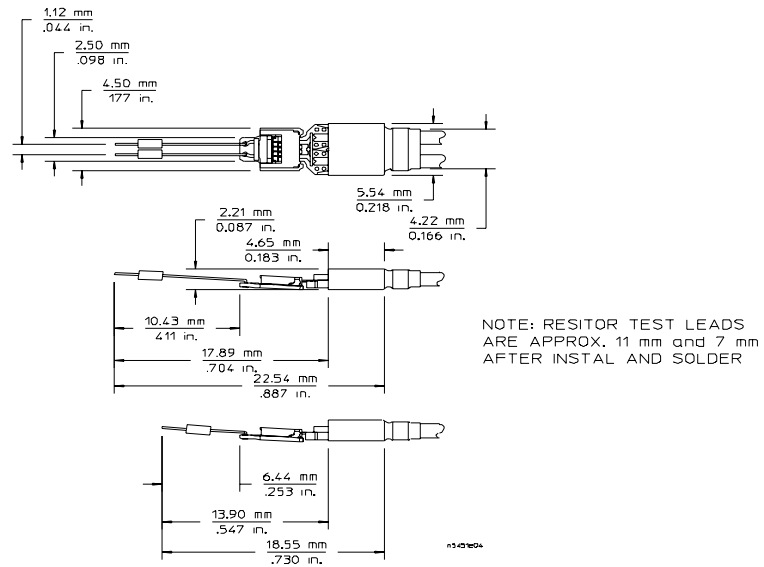


## General Information

### Probe and Probe Head Dimensions

#### N5451A ZIF Probe Head Dimensions with Long Wired ZIF Tip Attached

Figure 1-17



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## Calibrating the probe

The Infiniium family of oscilloscopes provides both power and offset control to the 1168A and 1169A active probes through the front panel connector. Probe offset is changed by adjusting the vertical offset control on the Infiniium oscilloscope. The control should be adjusted to center your signal within the 3.3 volt peak-to-peak (16 volts peak-to-peak for slow signals) dynamic range of the probe.

Before using the 1168A or 1169A probes, a calibration and deskew should be performed.

- 1 Connect the probe output to the oscilloscope input.**
- 2 Calibrate the oscilloscope and probe combination using the Infiniium probe calibration routine.**

When the probe has been calibrated, the dc gain, offset zero, and offset gain will be calibrated.

The degree of accuracy specified at the probe tip is dependent on the oscilloscope system specifications.

---

## Probe handling considerations

This probe has been designed to withstand a moderate amount of physical and electrical stress. However, with an active probe, the technologies necessary to achieve high performance do not allow the probe to be unbreakable. You should treat the probe with care. It can be damaged if excessive force is applied to the probe tip. This damage is considered to be abuse and will void the warranty when verified by Agilent Technologies service professionals.

- Exercise care to prevent the probe end from receiving mechanical shock.
- Store the probe in a shock-resistant case such as the foam-lined shipping case which came with the probe.

---

## Cleaning the probe

If the probe requires cleaning, disconnect it from the oscilloscope and clean it with a soft cloth dampened with a mild soap and water solution. Make sure the probe is completely dry before reconnecting it to the oscilloscope.

---

## Replacing the Wires on N5381A and N5382A Probe Heads

When the wire leads of the N5381A and N5382A probe heads become damaged or break off due to use, the wires can be replaced. Use the appropriate wire for each probe head as follows:

- The N5381A uses the 0.007 inch tin-plated nickel wire. (01169-81301)
- The N5381A uses the 0.005 inch tin-plated nickel wire. (01169-21306)
- The N5382A uses the 0.005 inch tin-plated steel wire. (01169-21304)

The recommended equipment and procedure for replacing the wires is outlined below.

**Table 1-7**

### Equipment

vise or clamp for holding tip

Metcal STTC-022 (600 °C) or STTC-122 (700 °C) tip soldering iron or equivalent. The 600 °C tip will help limit burning of the FR4 tip PC board.

0.381 mm (0.015 in) diameter RMA flux standard tin/lead solder wire

Fine stainless steel tweezers

Rosin flux pencil, RMA type (Kester #186 or equivalent)

Flush cutting wire cutters

Magnifier or low power microscope

Agilent supplied trim gauge (01169-23801)

Ruler

- 1 Use the vise or clamp to position the tip an inch or so off the work surface for easy access. If using a vise, grip the tip on the sides with light force. If using a tweezers clamp, grip the tip either on the sides or at the top and bottom. See figure 1-18.



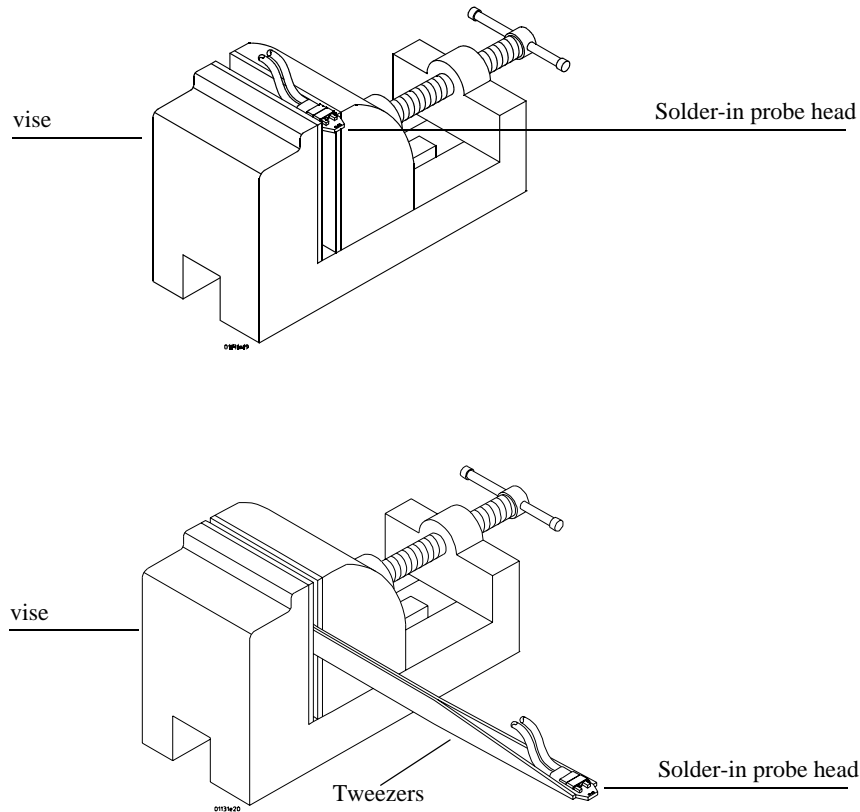
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**CAUTION**

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When tightening the vise, use light force to avoid damaging the solder-in probe head.

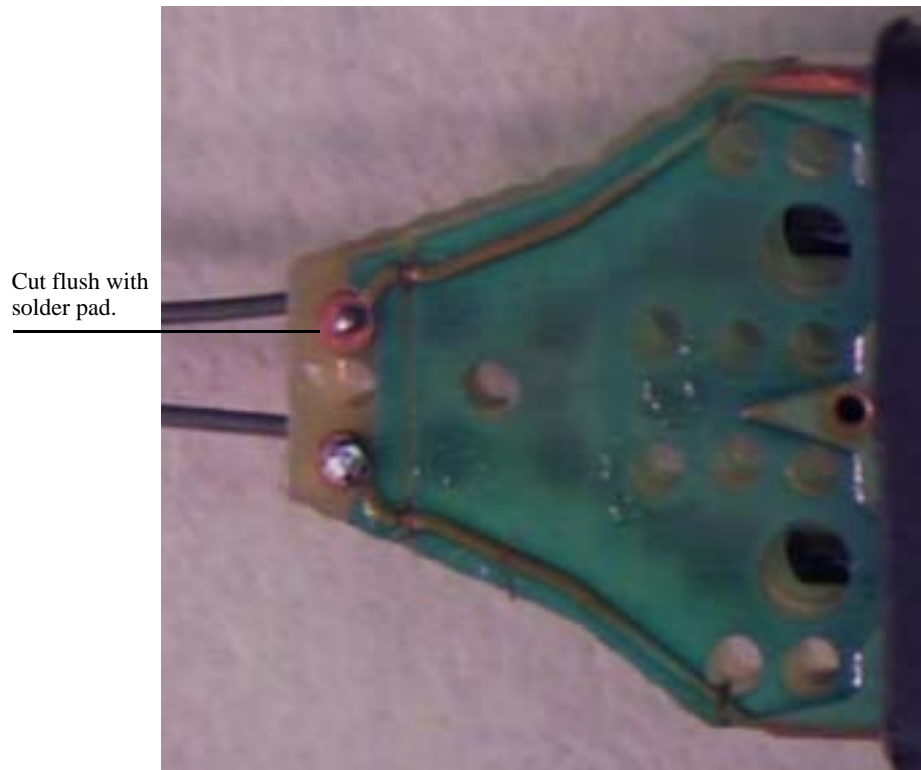
**Figure 1-18**



- 2 Make sure soldering iron tip is free of excess solder. Grab each wire lead with tweezers and pull very gently up. Touch the soldering iron to solder joint just long enough for the wire to come free of the probe head tip. Do not keep the soldering iron in contact with the tip any longer than necessary in order to limit burning and damage to the pc board. This solder joint has very low thermal mass so it should not take very long for the joint to melt and release.
- 3 Prepare the mounting hole(s) for new wire(s) by insuring that the holes are filled with solder. If they are not, use the soldering iron and solder to fill the holes. Again, do not leave the iron in contact with the tip any longer than necessary. When the hole(s) are filled with solder use the flux pencil to coat the solder joint area with flux.
- 4 Cut two wires to a length of about 12.7 mm (0.5 inches).
- 5 Using tweezers, put a 90 degree bend at the end of the wire. Leave enough wire at the bend such that it will protrude through the board when the wire is installed.
- 6 Holding the wire in one hand and the soldering iron in the other hand, position the end of the wire lead over the solder filled hole. Touch the soldering iron to the side of the hole. When the solder in the hole melts, the wire lead will fall into the hole. Remove soldering iron as soon as lead falls into the hole. Again, the thermal mass of the joint is very small so extra dwell time is not needed with the soldering iron to insure a good joint.
- 7 Cut the wires that protrude on the bottom side of the probe head board even with the solder pad.

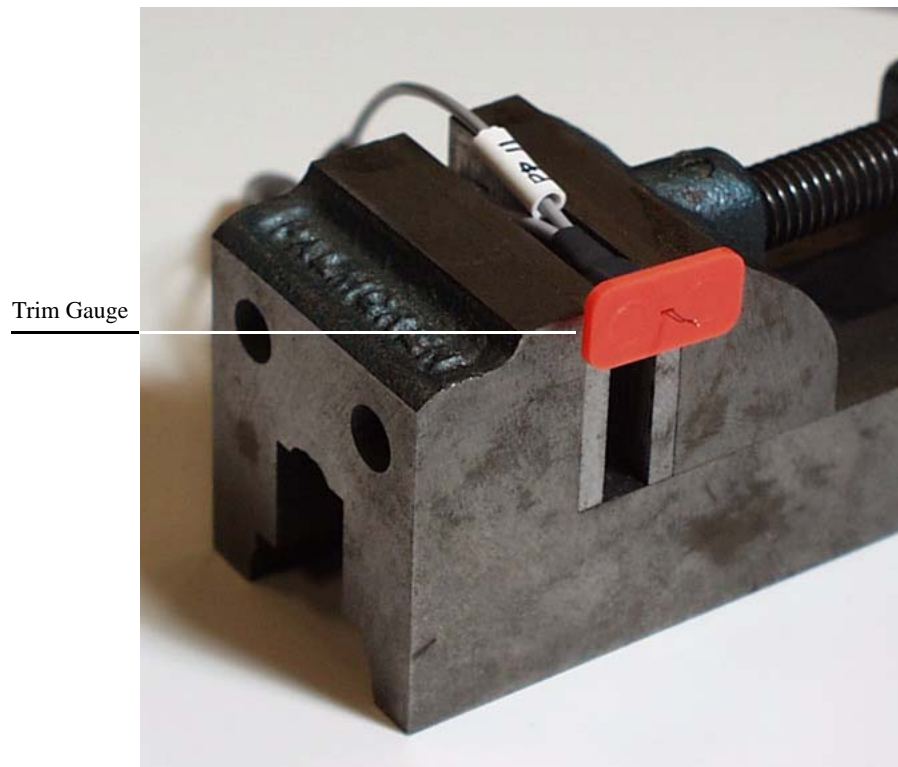
**General Information**  
**Replacing the Wires on N5381A and N5382A Probe Heads**

**Figure 1-19**



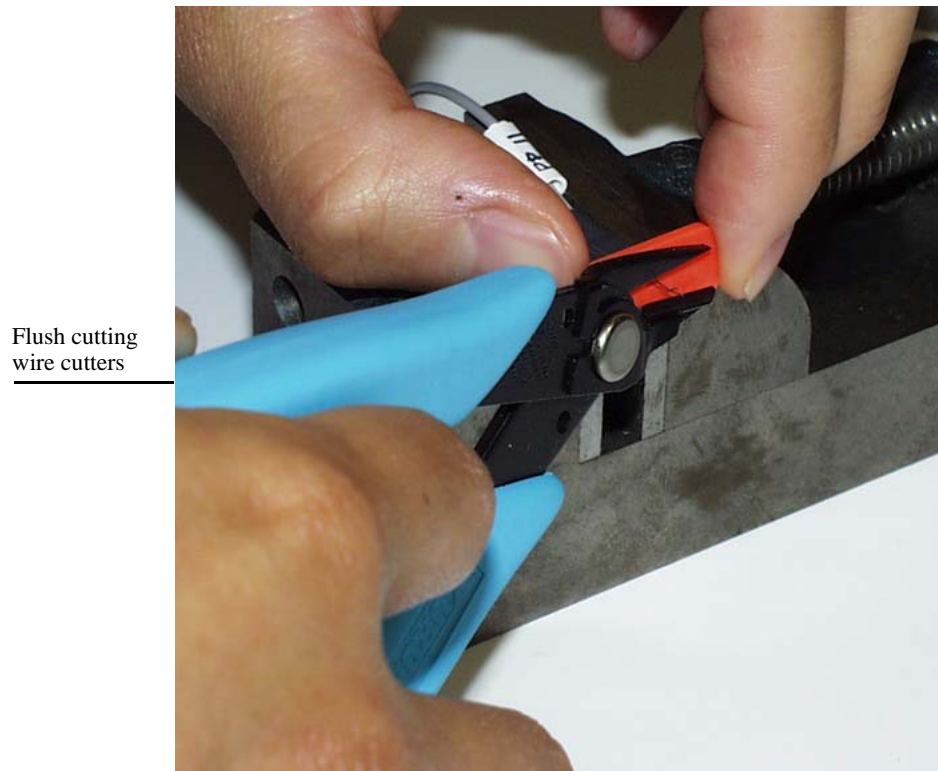
- 8 Place the wires through the hole in the trim gauge with the probe head perpendicular to the trim gauge.

**Figure 1-20**



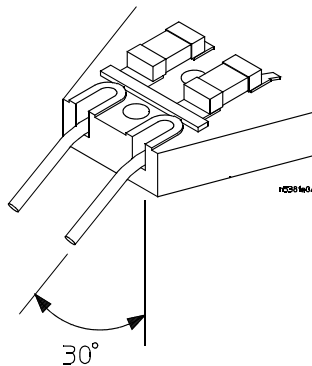
- 9 Cut the wires even with the trim gauge on the side opposite of the probe head.

**Figure 1-21**



10 When replacing wires on the N5382A Browser, bend the wires down at about a 30 degree angle.

**Figure 1-22**



**Tips for Using Browser Probe Heads**

- Spring steel wires will last longer if the span is set by grabbing the lead near the pc board edge and twisting instead of just pulling or pushing the wires apart or together.

**Tips for Using Solder-In Probe Heads**

- When soldering in leads to DUT always use plenty of flux. The flux will insure a good, strong solder joint without having to use an excessive amount of solder.
- Strain relieve the micro coax leading away from the solder-in tips using hook-and-loop fasteners or adhesive tape to protect delicate connections.
- Note that for the differential solder-in probe head, the + and - connection can be determined when the probe head is plugged into the probe amplifier, therefore, it does not matter which way the tip is soldered.

---

## Replacing the Mini-axial Lead Resistors on Solder-In Tips

When the leads of the mini-axial resistors become damaged or break off due to use, the resistors can be replaced. The recommended equipment and procedure for replacing the resistors is outlined below.

**Table 1-8**

### Equipment

vise or clamp for holding tip

Metcal STTC-022 (600 °C) or STTC-122(700 °C) tip soldering iron or equivalent. The 600 °C tip will help limit burning of the FR4 tip PC board.

0.381 mm (0.015 in) diameter RMA flux standard tin/lead solder wire

Fine stainless steel tweezers

Rosin flux pencil, RMA type (Kester #186 or equivalent)

Diagonal cutters

Magnifier or low power microscope

Ruler

### Replacement Procedure

- 1 Use the vise or clamp to position the tip an inch or so off the work surface for easy access. If using a vise, grip the tip on the sides with light force. If using a tweezers clamp, grip the tip either on the sides or top and bottom. See figure 1-23.

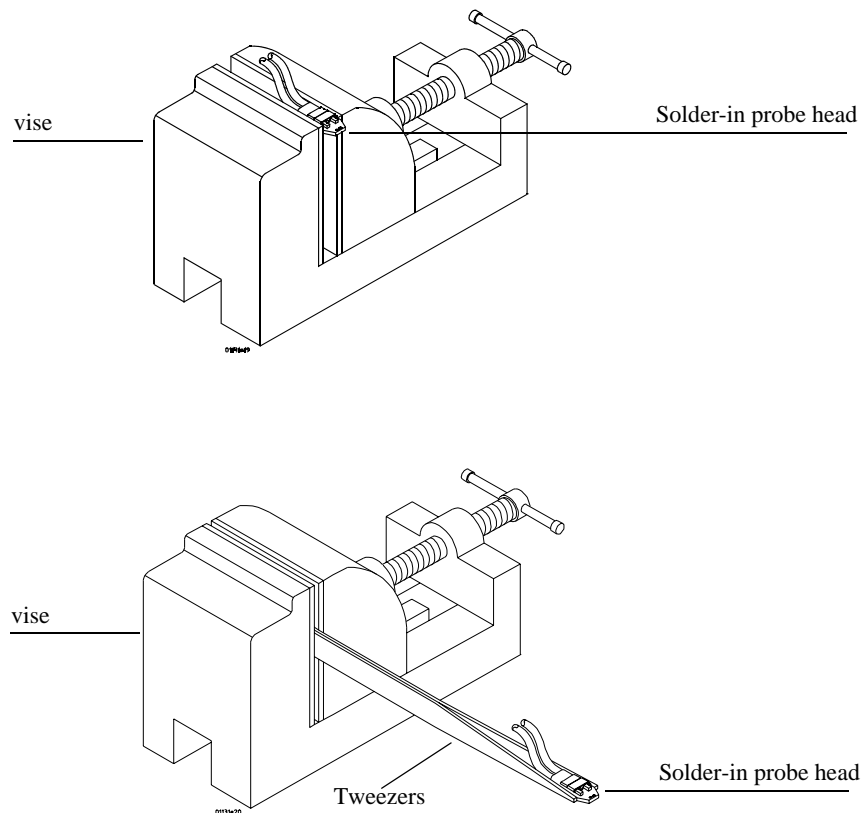
---

**CAUTION**

---

When tightening the vise, use light force to avoid damaging the solder-in probe head.

**Figure 1-23**



- 2 Make sure soldering iron tip is free of excess solder. Grab each resistor lead or body with tweezers and pull very gently up. Touch the soldering iron to solder joint just long enough for the resistor to come free of the probe head tip. Do not keep the soldering iron in contact with the tip any longer than necessary in order to limit burning and damage to the pc board. This solder joint has very low thermal mass so it should not take very long for the joint to melt and release.
- 3 Prepare the mounting hole(s) for new resistors or wires by insuring that the holes are filled with solder. If they are not, use the soldering iron and solder to fill the holes. Again, do not leave the iron in contact with the tip any longer than necessary. When the hole(s) are filled with solder use the flux pencil to coat the solder joint area with flux.
- 4 Prepare the mini-axial lead resistor for attachment to tip pc board. See "Resistor Dimensions" on page 1-23 for dimensions and directions on preparing resistor leads. Lead to be attached to tip pc board will have a 90 degree bend to go into through hole in the tip pc board.
- 5 Holding the resistor lead or wire in one hand and soldering iron in the other, position the end of the resistor lead (after the 90 degree bend) over the solder filled hole. Touch the soldering iron to the side of the hole. When the solder in the hole melts, the resistor lead will fall into the hole. Remove soldering iron as soon as lead falls into the hole. Again, the thermal mass of the joint is very small so extra dwell time is not needed with the soldering iron to insure a good joint.

## **General Information**

### **Replacing the Mini-axial Lead Resistors on Solder-In Tips**

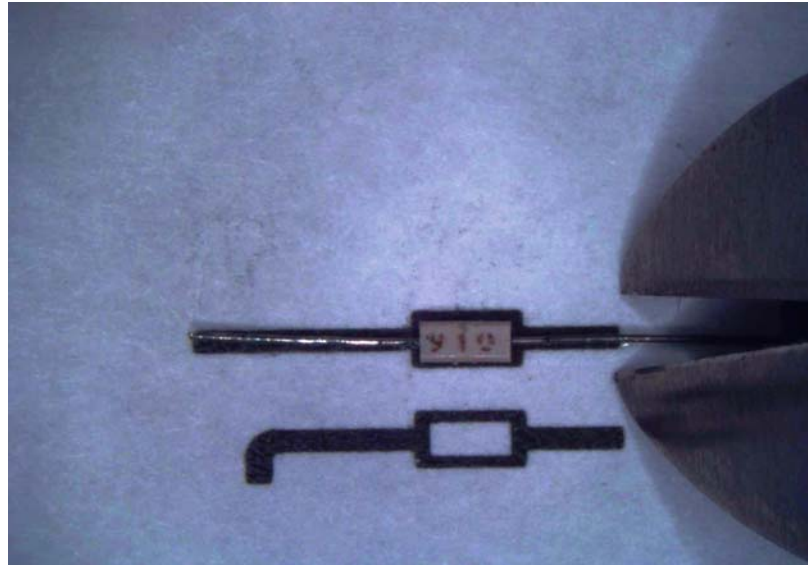
#### **Tips for Using Solder-In Probe Heads**

- Do not solder in resistor leads with a big ball of solder right next to the resistor body. Normally the nickel lead will limit the heat transfer to the resistor body and protect the resistor, but if a ball of solder is right next to the resistor body on the lead, the resistor may come apart internally.
- When soldering leads to DUT always use plenty of flux. The flux will insure a good, strong solder joint without having to use an excessive amount of solder.
- Do not use the wrong value of resistor at the wrong length. See "Resistor Dimensions" on page 1-23 for dimensions and directions on preparing resistor leads.
- Make sure the zero ohm resistor is used for ground leads on the single-ended probe head.
- Strain relieve the micro coax leading away from the solder-in tips using hook-and-loop fasteners or adhesive tape to protect delicate connections.
- Note that for the differential solder-in probe head, the + and - connection can be determined when the probe head is plugged into the probe amplifier, so which way the tip is soldered in is not important.

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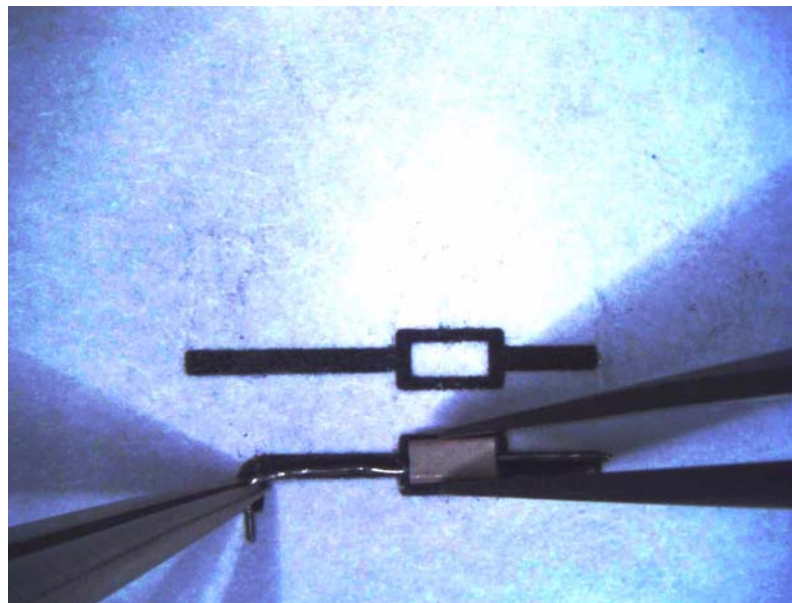
## Procedures and Soldering Tips for InfiniiMax Long Wired ZIF Tip Resistor Installation

Figure 1-24



- 1 Choose a trim length of either 7 mm or 11 mm and use the corresponding trim guide dimensions to trim the resistor lead wires as shown in Figure 1-24. All measurements should be made from the corresponding resistor face datum. The included trim guide should be used for final length verification.

Figure 1-25

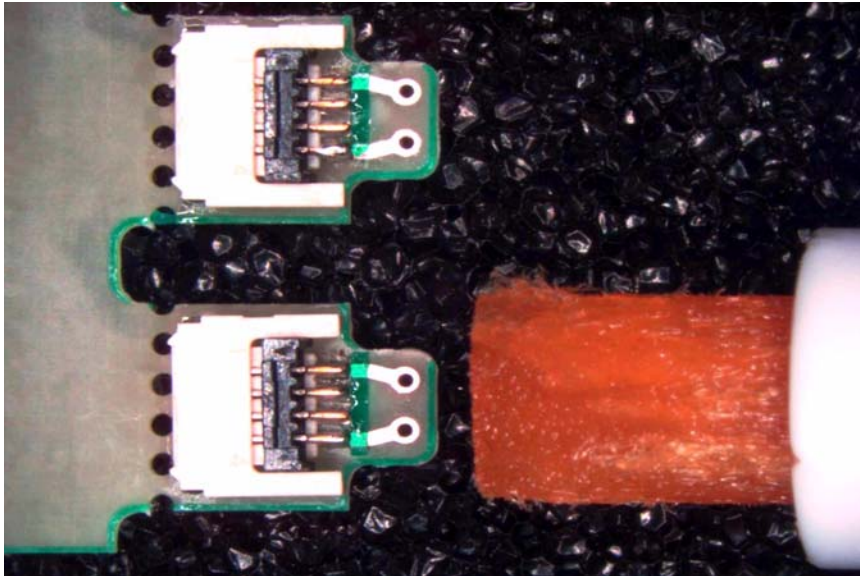


- 2 Bend the tip of the lead wire as shown in Figure 1-25 above. A sharp bend is preferred, but it should not exceed 90 degrees.



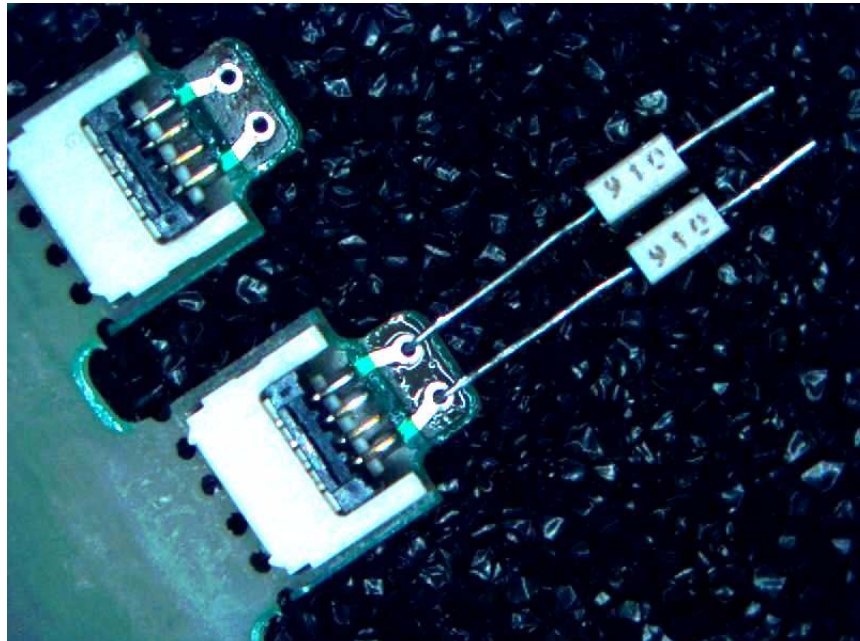
**General Information**  
**Procedures and Soldering Tips for InfiniiMax Long Wired ZIF Tip Resistor Installation**

**Figure 1-26**



- 3 Use a flux pen to add flux to the circular traces on the board. Figure 1-27 below shows a good application of flux.

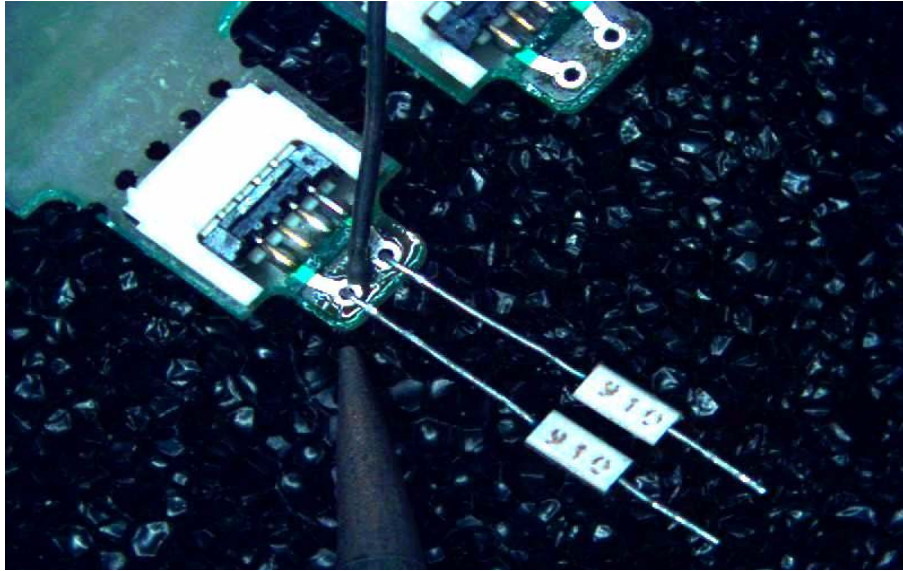
**Figure 1-27**



- 4 Insert one resistor into each through-hole of the circular traces on the board. Align the corresponding resistor faces. Figure 1-27 above shows both the resistors installed and aligned. Make length adjustments as needed.

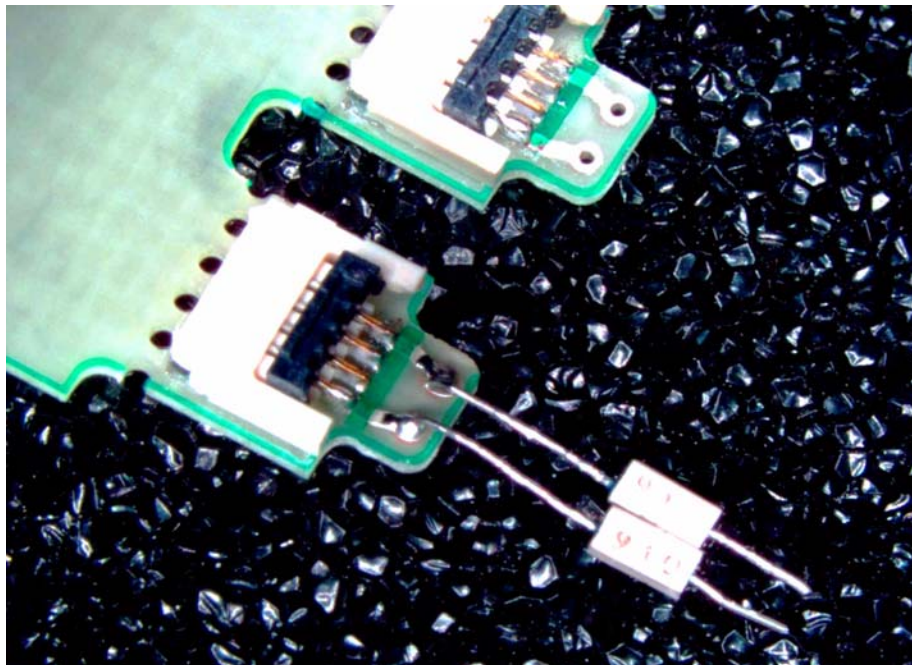


**Figure 1-28**



- 5 Momentarily apply the soldering iron tip to the resistor lead wires as shown in Figure 1-28. Touch the solder to the heated lead wire near the trace hole. Now remove both the solder and the soldering iron away from the Long Wired ZIF Tip. A good fillet should form around the lead wire, thus sealing the trace hole. Figure 1-29 shows good solder fillets surrounding the resistor lead wires. After soldering, clean board of any excess flux. Rotate the Long Wired ZIF Tip 180 degrees until the underside is facing up. Trim any excess lead wire protruding from the board.

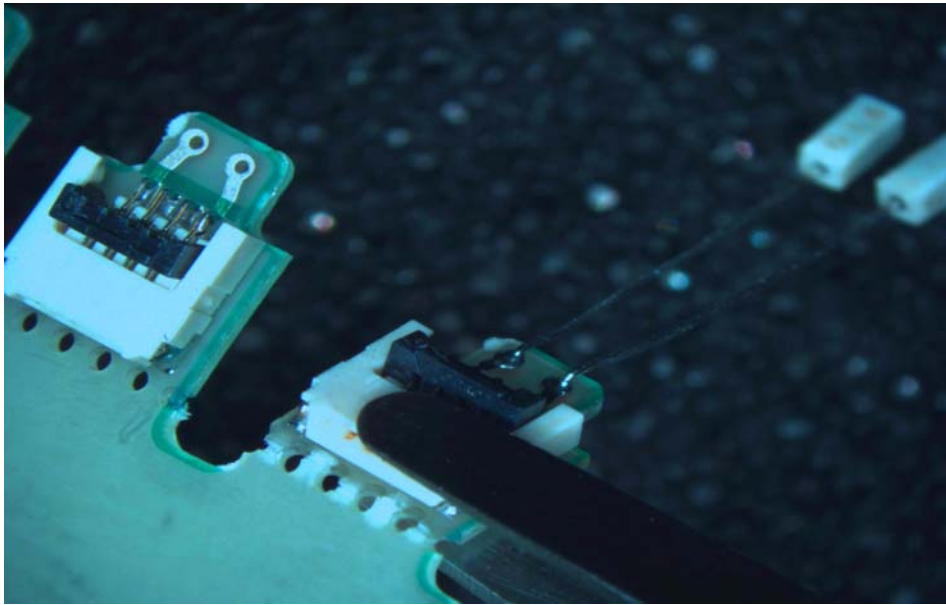
**Figure 1-29**



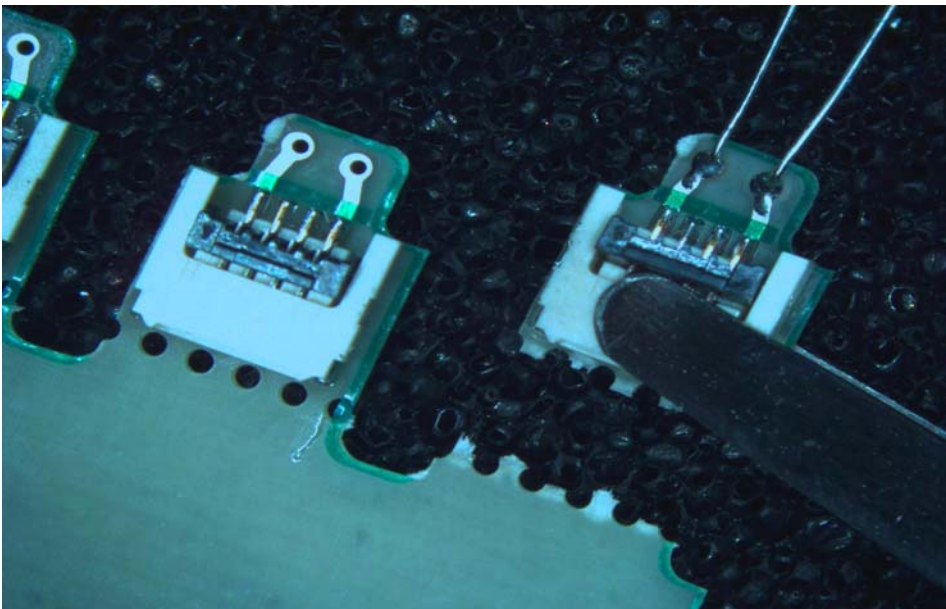
## Procedure for Breaking Off an Infiniimax Long Wired ZIF Tip from the Packaging Strip

The Long Wired ZIF Tip kit N5451A contains ten ZIF tips connected together in a strip. Before a ZIF tip can be used, it must be separated from this strip of ten. To accomplish this, grab one of the tips with two fingers (or tweezers) and bend it back as shown in Figure 1-30. Then bend the tip in the opposite direction and it should break off. Figure 1-31 shows what the tip looks like after it has been separated from the strip.

**Figure 1-30**



**Figure 1-31**



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## Procedures and Soldering Tips for Using InfiniiMax ZIF and Long Wired ZIF Probe Heads

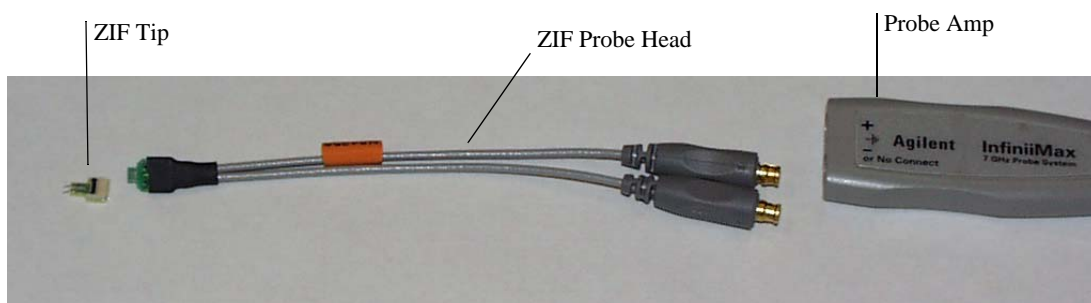
The InfiniiMax ZIF (Zero Insertion Force) Probe Head system is a way to use a less expensive connection accessory (ZIF Tip) that can be installed at many locations on a device under test, to connect to a probe head (N5426A) that transports the signal to the probe amp. The advantages of this system are that the ZIF tip is very small and connects to the probe head using a zero insertion force connector. The small size is critical in probing tight locations and the zero insertion force feature allows connection without compressing the delicate wires which cannot support this compression.

The Long Wired ZIF tip allows for a greater span between the two resistor wires. The pictures below show the InfiniiMax ZIF Probe Head system, but the Long Wired ZIF Probe Head system would be soldered to the DUT in exactly the same manner.

### System Components

The components of this system are shown in Figure 1-32.

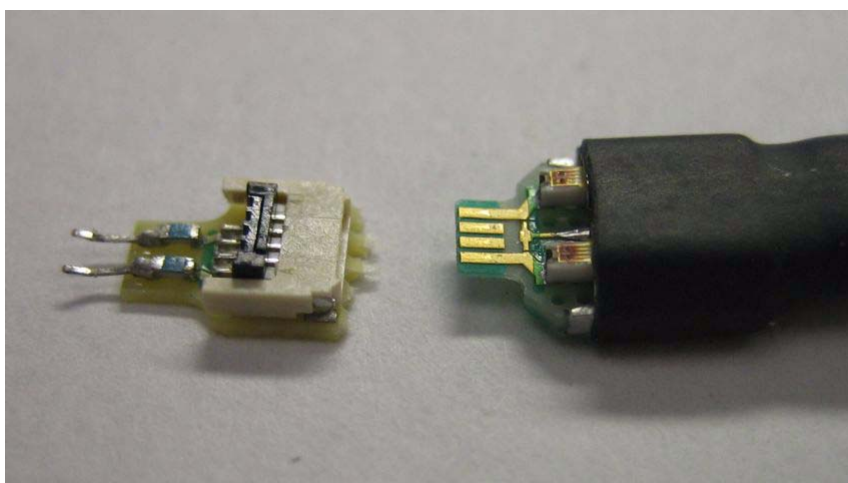
**Figure 1-32**



ZIF Probe Head System Components

A close-up of the ZIF Tip and the ZIF Probe Head before the probe head is inserted into the ZIF Tip is shown in Figure 1-33. Note that lever on the ZIF Tip is shown in the open position (pointed up) which allows the insertion of the probe head contacts into the ZIF Tip with zero insertion force.

**Figure 1-33**



ZIF Tip (open position) and ZIF Probe Head

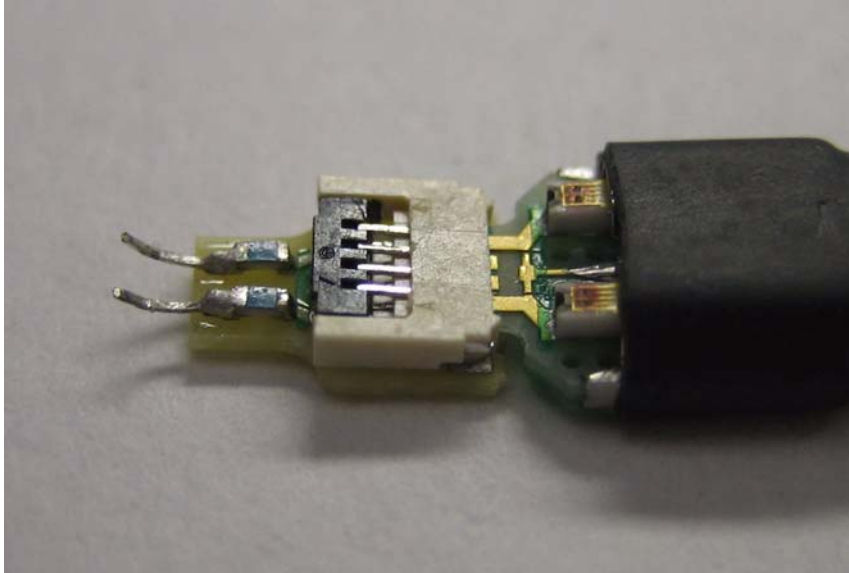


## General Information

### Procedures and Soldering Tips for Using InfiniiMax ZIF and Long Wired ZIF Probe Heads

A close-up of the ZIF Probe Head inserted into the ZIF Tip is shown in Figure 1-34. Note that now the lever on the Tip is in the closed position (down, rotated 90 degrees to the left) which closes the contacts of the ZIF connector.

Figure 1-34



ZIF Tip (closed position) with ZIF Probe Head Inserted

#### Overview of Soldering the ZIF Tip/Long Wired ZIF Tip into a DUT

Soldering the Tip into a DUT is straightforward, but some of the traditional soldering techniques that are typically used on larger components will not work well here. Holding the leads on the ZIF Tip in place while applying the soldering iron and adding solder requires the use of three hands.

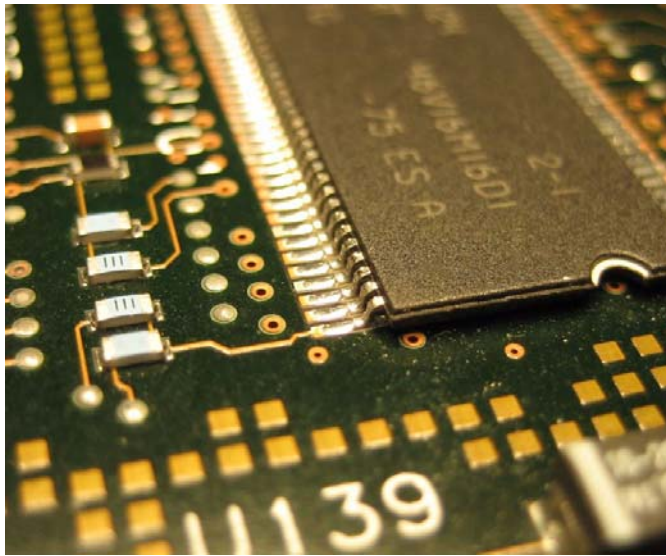
The following is an overview of the recommended soldering techniques

- 1 Add some solder to the DUT connection points. There should be enough solder to provide a good fillet around the ZIF Tip leads, but not so much as to create a big solder ball. A fine MetCal (or equivalent) soldering tip should be used along with some 11 or 15 mil solder.
- 2 Using a rosin flux pen, coat the solder points with flux. The flux core solder does not provide enough flux for this small scale soldering. Also, put flux on the tips of the leads of the ZIF Tip.
- 3 Clean the soldering tip well, then add a little bit of solder to the tip. It may take several tries to get just a little bit of solder right at or near the tip of the soldering iron. The solder on the tip keeps the soldering iron tip from pulling solder off the DUT connection points. This step may be optional if there is already enough solder on the DUT connection points.
- 4 Position a lead of the ZIF Tip on top of one of the target points, then briefly touch the soldering iron tip to the joint. The thermal mass of this joint is very small, so you don't need to dwell on the joint for very long. The flux that was added to the joint should produce a good, clean solder joint. If you don't get a good, shiny, strong solder joint, then there was either not enough flux or the joint was heated too long and the flux boiled off.
- 5 Repeat step 4 for the other lead of the ZIF Tip.
- 6 There is a possibility that if a lead of the ZIF Tip is inserted into a large ball of solder that is heated excessively with a soldering iron, the solder joint holding the lead onto the ZIF Tip pc board could flow and the lead would come off destroying the ZIF Tip. Only the first third of the lead or so needs to be soldered to the target point.

### **Illustrated Procedure of Recommended Soldering Techniques**

An illustrated example of the installation of a ZIF Tip and connection to a ZIF Probe Head is shown below. Figure 1-35 shows a IC package which we will attach a ZIF Tip to the first two package leads. The target could also be via pads or signal traces.

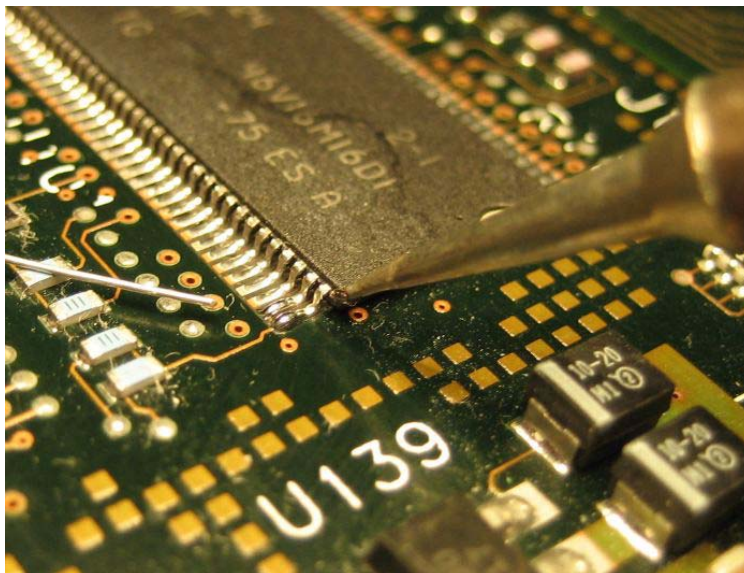
**Figure 1-35**



IC Package for Example ZIF Tip Installation

- 1 Add some solder to the target points in the DUT. Figure 1-36 shows extra solder added to the pads for the first two pins on an IC package.

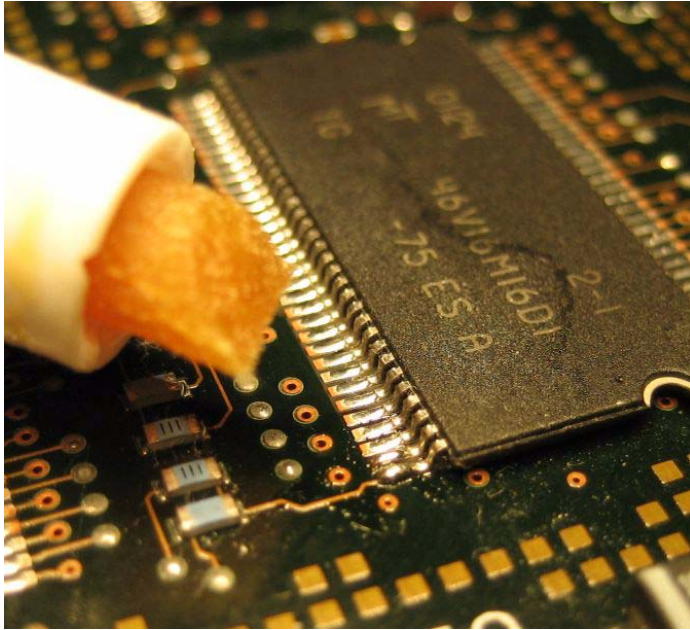
**Figure 1-36**



Solder Added to Target Points

- 2 Use flux pen to add flux to the target points. Also, flux the tip of the lead on the ZIF Tip at this time. Figure 1-37 shows the target points after they have been fluxed in preparation for soldering.

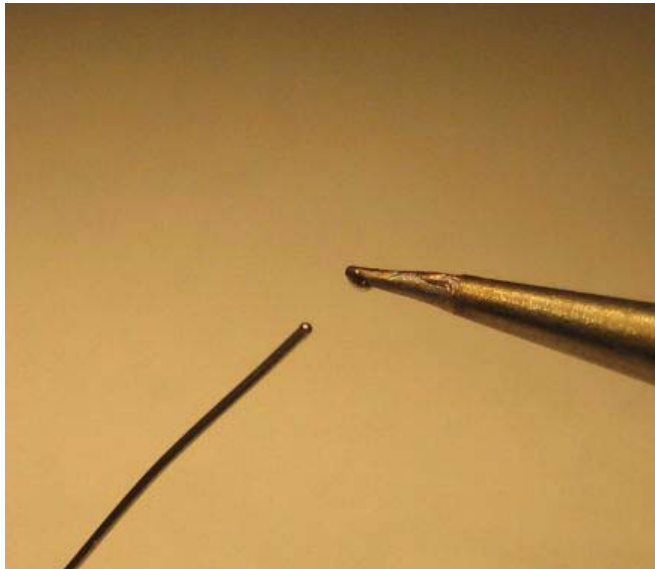
**Figure 1-37**



Fluxing of the Target Points

- 3 Clean the soldering iron tip and add a small amount of solder to the very tip. This may take a few tries because the solder may tend to ball up and move away from the tip. Figure 1-38 shows a small amount of solder on the tip of the soldering iron.

**Figure 1-38**

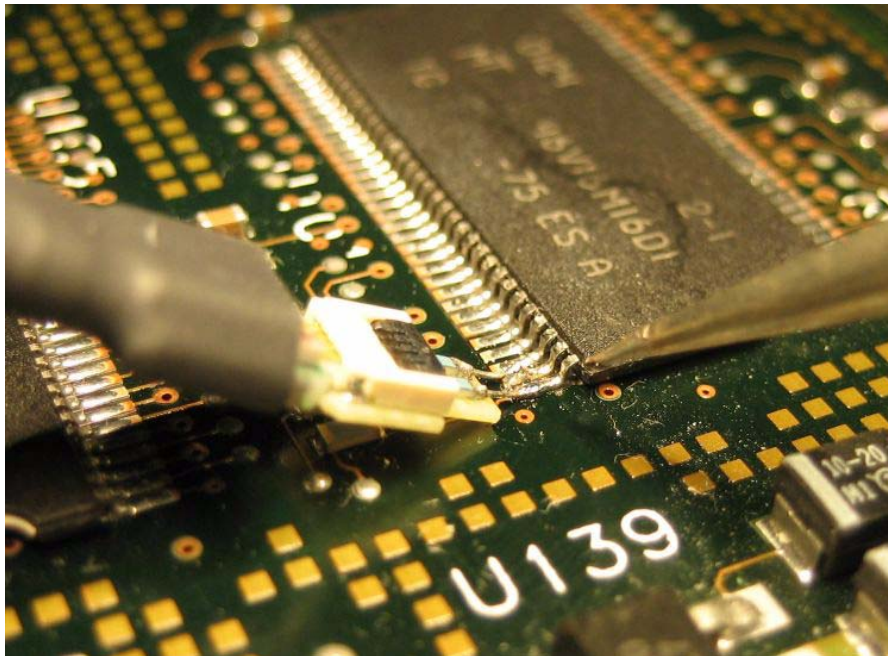


Small Amount of Solder Added to ZIF Tip of Soldering Iron

- 4 Installation of ZIF Tip. Connect the ZIF Tip to the ZIF probe head as shown in Figure 1-33 and Figure 1-34 above. This allows the probe head to be used as a handle for the ZIF Tip to allow positioning in the DUT. Position the lead wires on the target points and then briefly heat the solder joints. There should be enough solder to form a good fillet and enough flux to make the joint shiny. There shouldn't be so much solder that the big solder ball is formed that could cause a solder bridge or overheat the leads on the ZIF Tip. This is shown in Figure 1-39.



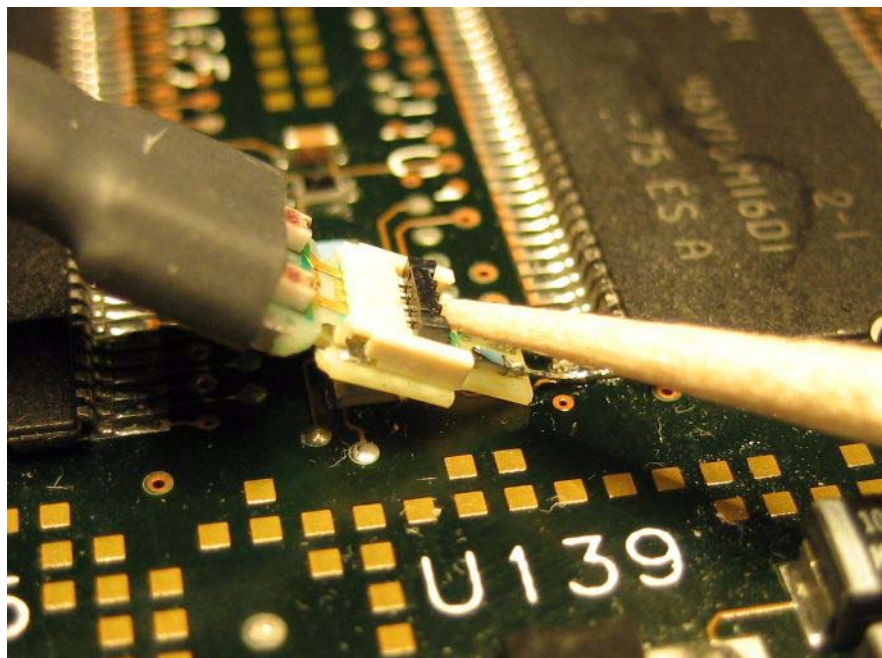
**Figure 1-39**



ZIF Tip Positioned and Soldered In Place

- 5 Remove ZIF Probe Head and leave ZIF Tip behind for future connection. It is best to use a non-conductive, pointed object such as a tooth pick or plastic tool. Hold on the heat-shrink part of the probe head to support the ZIF Tip while releasing the latch. Figure 1-40 shows a toothpick releasing the latch on the ZIF connector and Figure 1-41 shows the ZIF Tip left behind in the DUT with the latch open, ready for future connections.

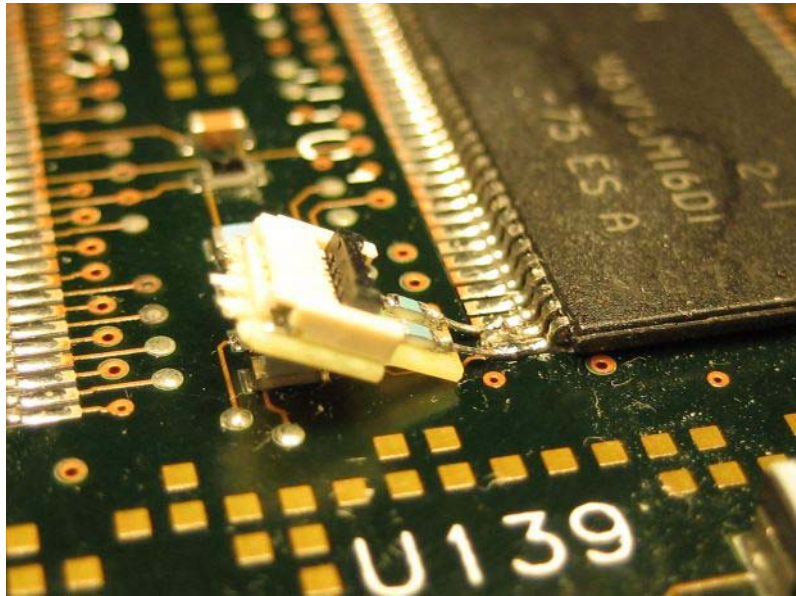
**Figure 1-40**



Using a Non-conductive Tool to Open the ZIF Connector

**General Information**  
**Procedures and Soldering Tips for Using InfiniiMax ZIF and Long Wired ZIF Probe Heads**

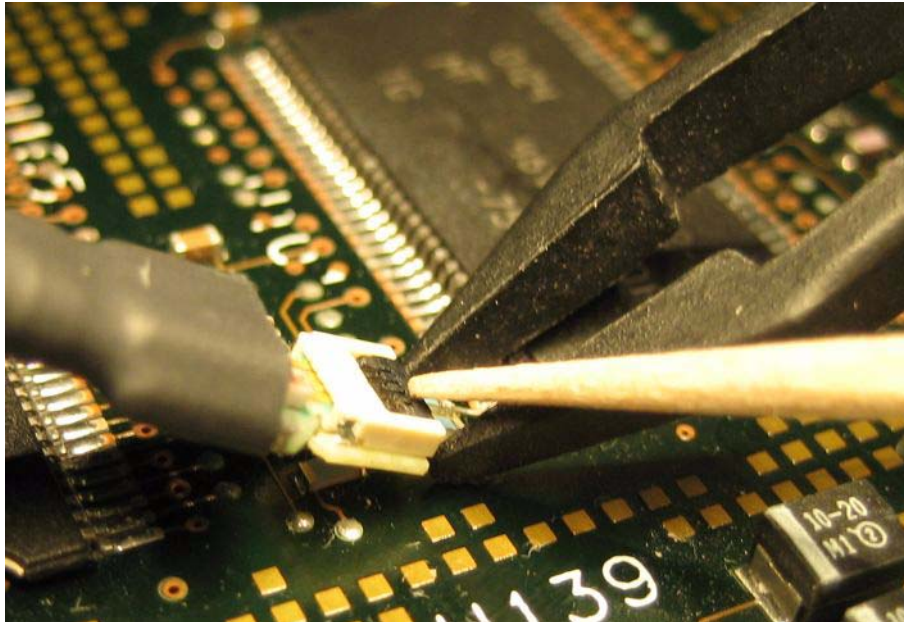
**Figure 1-41**



ZIF Tip Left Behind in DUT with ZIF Latch Open

- 6 Connect ZIF probe head to ZIF Tip desired for measurement. When you need to make a measurement at a point where you've previously installed a ZIF Tip, insure the latch on the ZIF Tip is open, insert the contacts on the probe head into the ZIF socket, and then close the ZIF latch with a non-conductive tool. Depending on the positioning of the ZIF Tip, you may need to support the body of the ZIF Tip while closing the latch. This can be done tweezers or other suitable tool by grabbing the pc board at the tip while the latch is being closed. If the circuit is live and there is concern about shorting anything out, use plastic or non-conductive tweezers. See Figure 1-42.

**Figure 1-42**



Use a Non-conductive Tool to Close the Latch



## Using the Extreme Temperature Cable Extension Kit (N5450A)

The Extreme Temperature Cable Extension kit allows users to use an oscilloscope probe to monitor a system in a temperature chamber. This may be done to verify performance over a wide range of temperatures or to determine the cause of failure at high or low temperatures. Agilent's Infiniimax probe amplifiers have a specified operating temperature range from 5° C to 40° C, but the probe heads can be operated over a much larger range of temperatures. The N5450A extension cables can be used to physically separate the amplifier from the probe head to allow the user to operate the probe head inside a temperature chamber while the probe amplifier remains outside the chamber. The cables can be seen below in figure 1-43.

Figure 1-43



The temperature ranges that can be probed depend upon the configuration of the probe head.

Probe Head Configuration <sup>1</sup>	Temperature Range (°C)	Average Lifetime of the Probe Head (cycles) <sup>2</sup>
N5381A	-55 to +155	> 250
E2677A, E2678A, N5426A, or N5451A	-25 to +80	> 1000

<sup>1</sup>Refers to the probe head or tip that is attached to the cable extension kit

<sup>2</sup>A cycle is defined to be a temperature sweep from either -55° C to 155° C and then back to -55° C or from -25° C to 80° C and then back to -25° C depending upon the probe head configuration being used

It is recommended that users keep their extreme temperature testing probes separate from the probes they use under milder conditions. This is because cycling probe heads through extreme temperature ranges has a marked affect on their lifetimes (refer to the table above for the average lifetimes of various probe heads/tips). It is important to note that only the lifetime of the probe head is affected by temperature cycling. The extension cables and probe amplifier should not need to be replaced with extended temperature cycling.

Rapid changes in temperature can also lead to moisture accumulating in the form of condensation on the probe components, as well as the DUT. If this occurs, the user should wait until the moisture has

## **General Information**

### **Using the Extreme Temperature Cable Extension Kit (N5450A)**

evaporated before making any measurements.

To ensure a high-quality measurement, the N5450A cable set have been phase-matched at the factory. A coupling tag is included with the cables to ensure the cables stay as a matched pair. To install the coupling tag, slip the small end of each cable through the holes in the tag. The tag can be positioned anywhere along the length of the cable and can withstand the temperature ranges specified.

Additional care must be taken when handling probe heads used during extreme temperature cycling because this process makes the probe heads less robust. Agilent recommends that users secure the ends of the extension cable near the probe head to a secure location in their temperature chamber such that the probe head legs are not tugged or moved around significantly. Also, do not rest the extension cables on any metal objects or objects with sharp edges. This will prevent abrasion and tears in the jacket. The cables are designed to be flexible, but are not designed to be bent sharply. To prevent cable failure, do not kink the cables.

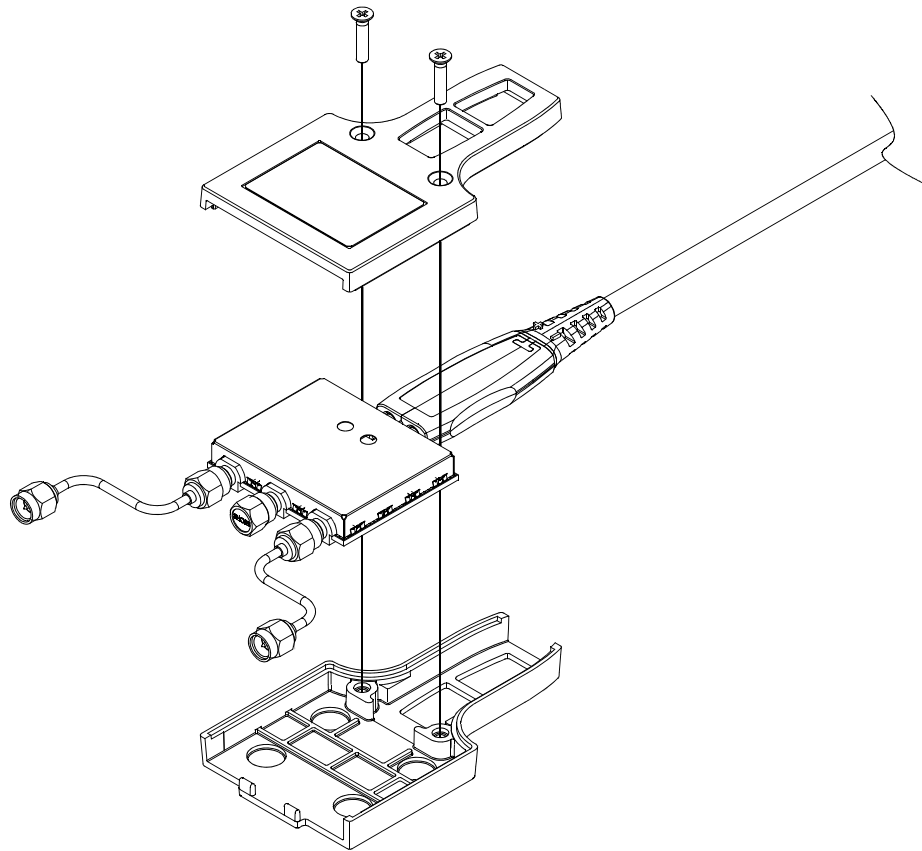
Discoloration or texture changes are possible with the extension cables. These changes do not, however, affect the performance or the quality of a measurement.

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## Using the N5380-64701 SMA Head Support

The Agilent N5380-64701 SMA Head Support is included with the N5380A and E2695A SMA probe heads to prevent damage to the probe amplifier. It is strongly recommended that you use the SMA Head Support whenever you are using either of these probe heads.

Below is a drawing showing how to attach the SMA Head Support using two of the four screws provided in the kit (the other two screws are extras in case you need them in the future). Be sure to plug the probe amplifier into the SMA head before installing the SMA Head Support. Also, do not attempt to plug or unplug the SMA head from the probe amplifier while it is in the SMA Head Support housing.



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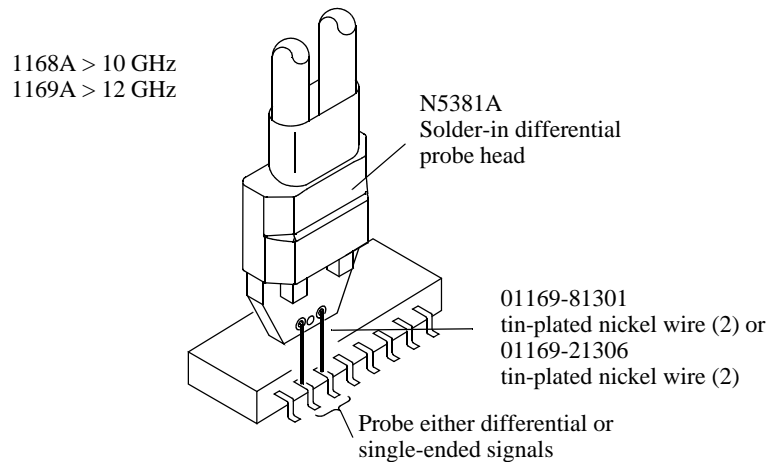
## Using Probe Accessories

The probe configurations shown in this section are the ones recommended for the best performance for different probing situations.

### Solder-in Differential Probe Head (Full Bandwidth)

This probe configuration provides the full bandwidth signals and the lowest capacitive loading for measuring both single-ended and differential signals. The probe head wires must be soldered to the circuit that you are measuring. Because of the small size of the wire leads, it is easy to solder them to very small geometry circuits.

Figure 1-44

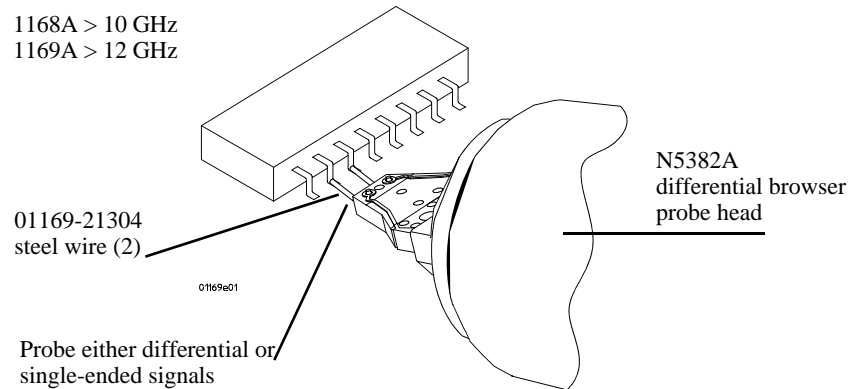


01169-006

### Differential Browser (Full Bandwidth)

The differential browser configuration is the best choice for general purpose troubleshooting of a circuit board for full bandwidth signals.

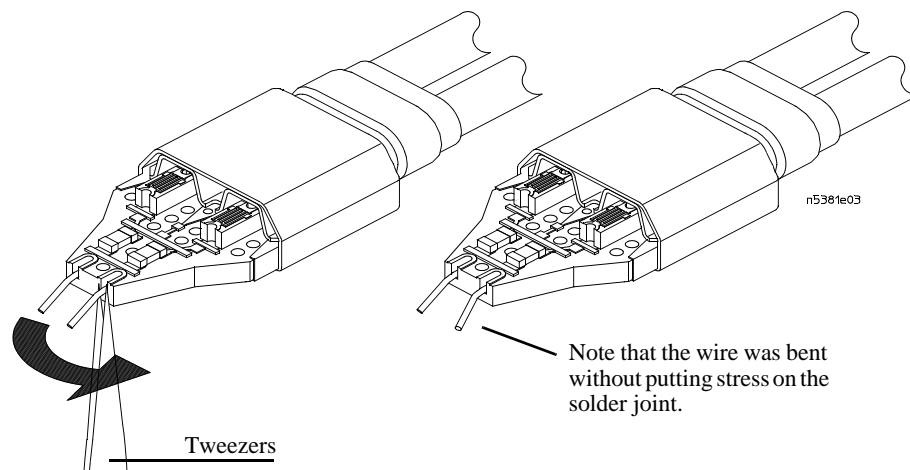
**Figure 1-45**



### Adjusting the Spacing of the Differential Browser Wires

The best way to adjust the spacing of the differential browser wires is by using a pair of tweezers. By using a twisting motion rather than moving the wires around and putting stress at the solder joint, the wires will last much longer with multiple adjustments. See figure 1-46.

**Figure 1-46**



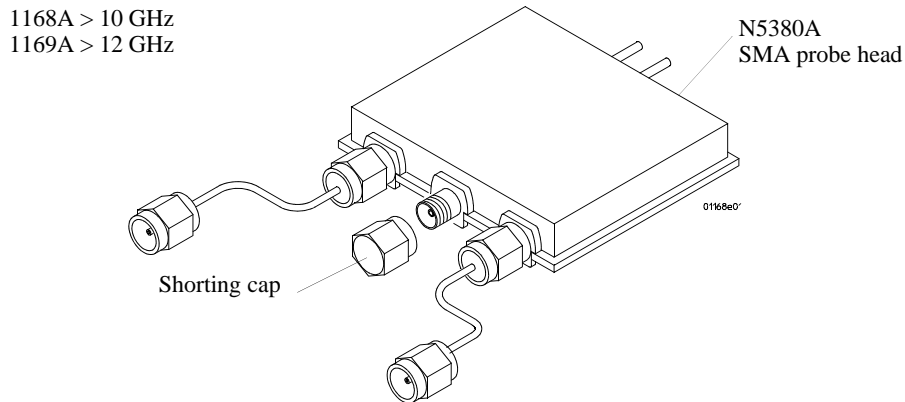
## General Information

### Using Probe Accessories

#### N5380A SMA Probe Head (Full Bandwidth)

This probe head provides the highest bandwidth for connecting to SMA connectors. The input resistance is 50  $\Omega$  on both inputs. The shorting cap connects one side of both resistances to ground. For applications that require the resistances to be referenced to a voltage other than ground, the shorting cap can be removed and a dc voltage can be applied. When using this probe head, always use the N5380-64701 SMA Head Support (see page 51) to prevent damage to the probe amplifier.

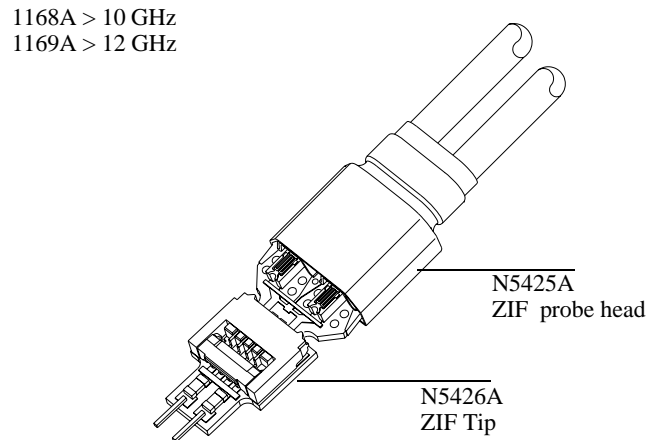
Figure 1-47



#### ZIF Probe Head (High Bandwidth)

This probe configuration provides the high bandwidth signals and the lowest capacitive loading for measuring both single-ended and differential signals. The ZIF Tip must be soldered to the circuit that you are measuring.

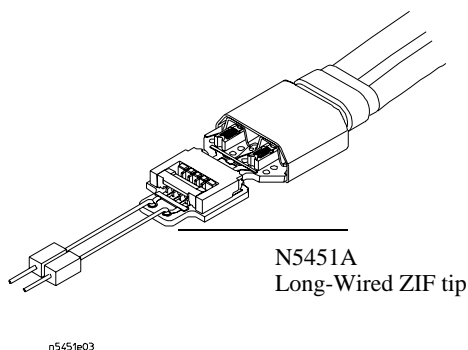
Figure 1-48



### Long Wired ZIF Probe Head

The Long Wired ZIF Tip must be soldered to the circuit you are measuring. Use the shortest resistor length (7 mm or 11 mm) necessary for your application.

Figure 1-49

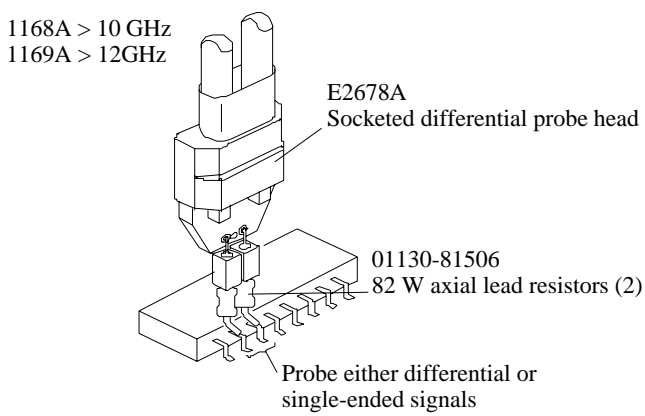


### Socketed Differential Probe Head (High Bandwidth)

This probe configuration provides the high bandwidth signals and minimal capacitive loading for measuring both single-ended and differential signals. The 82 W axial lead resistors are soldered to the circuit that you are measuring. The socketed differential probe head is plugged on to the resistors. This makes it easier to move the probe from one location to another. Because of the larger size of the resistor leads, the target for soldering must be larger than the solder-in probe heads.

The spacing for the socketed tip differential probe head is 0.100 inch (2.54 mm). If the resistors are to be soldered onto a PC board, the targets on the board should be two vias that can accept the 0.020 inch (0.508 mm) diameter resistor leads. A via of 0.025 inch (0.635 mm) diameter is recommended. If soldering a resistor lead to a surface pad on your PC board, the resistor leads can be bent in an “L” shape and soldered down. A pad size of at least 0.030 x 0.030 inch (0.762 mm x 0.762 mm) is recommended.

Figure 1-50



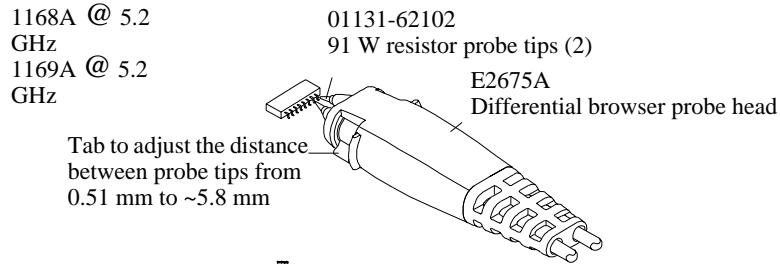
## General Information

### Using Probe Accessories

#### Differential Browser

The differential browser configuration is the best choice for general purpose troubleshooting of a circuit board. The tab on the side of the probe allows the probe tips to be adjusted for different circuit geometries.

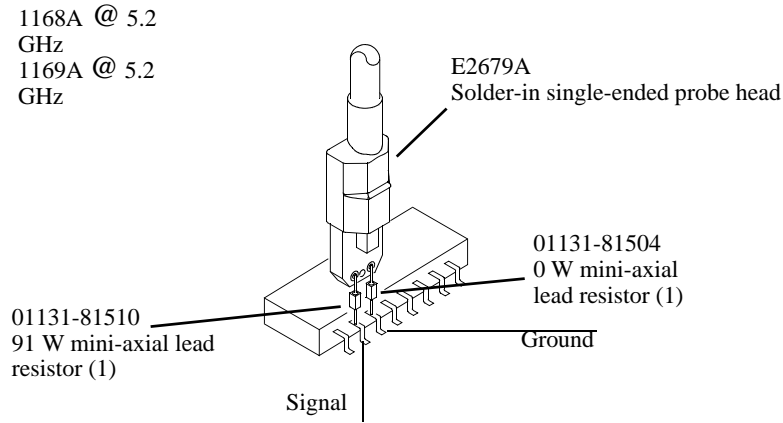
Figure 1-51



#### Solder-in Single-ended Probe Head (High Bandwidth)

This probe configuration provides good bandwidth measurements of single-ended signals with a probe head that is physically very small. The probe head resistors must be soldered to the circuit that you are measuring. Because of the small size of the resistor leads, it is easy to solder them to very small geometry circuits.

Figure 1-52



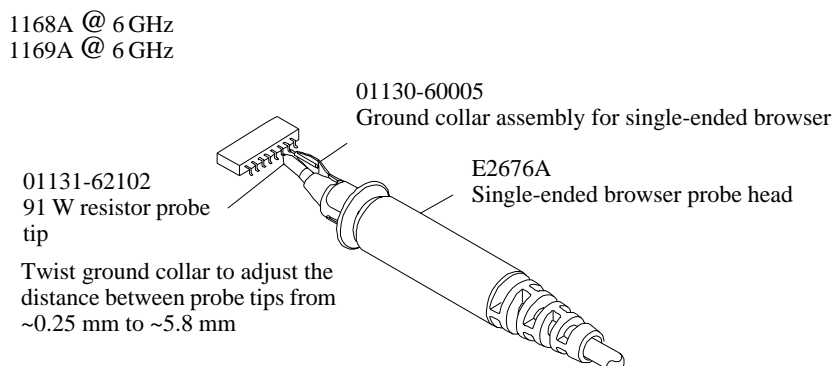


### Single-ended Browser

The single-ended browser is a good choice for general purpose probing of single-ended signals when physical size is critical. Excessive peaking (+6 dB) can occur at about 9 GHz. Therefore, limit the bandwidth of the input signal.

For wider span, non-performance critical browsing (rise times greater than ~0.5 ns), the 5063-2120 socketed ground lead can be used in place of the 01130-60005 ground collar.

Figure 1-53

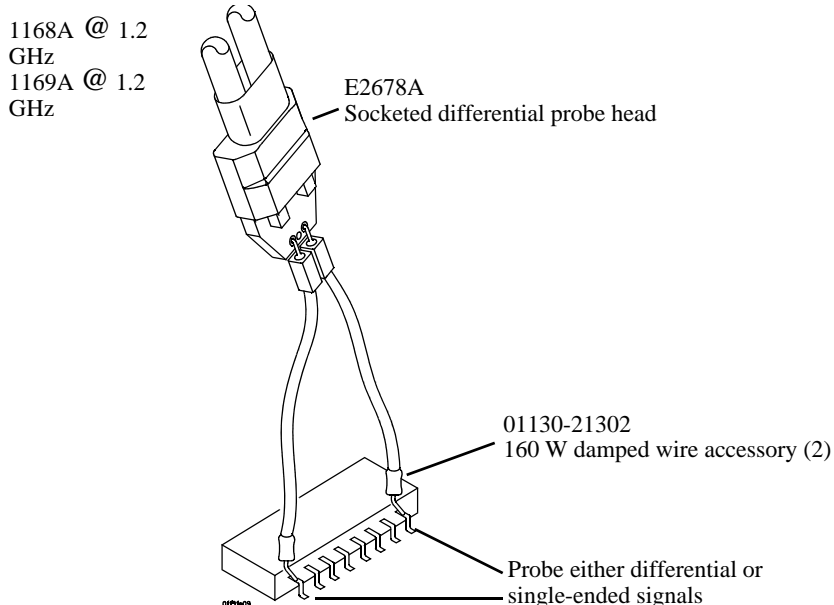


### Socketed Differential Probe Head with Damped Wire Accessory

This probe configuration provides maximum connection reach and flexibility with good signal fidelity but lower bandwidth for measuring differential or single-ended signals. The damped wires must be soldered to the circuit that you are measuring. This configuration can probe circuit points that are farther apart than other configurations.

To adapt the 01130-21302 damped wire accessory from solder-in to plug-on, solder the tip into the 01131-85201 square pin socket and then slip the 01131-41101 heat-shrink sleeve over the solder joint and heat the heat-shrink tubing with a heat gun. This allows the damped wire accessories to be used to plug onto 25 mil square pins.

Figure 1-54



General Information  
Using Probe Accessories

Socketed Differential Probe Head with 01130-63201 Header Adapter

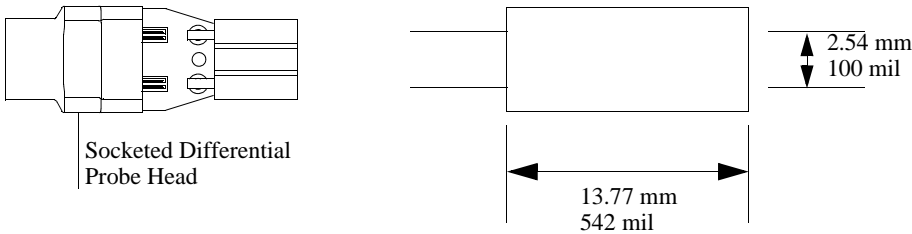
This probe configuration can be used to connect to 25 mil square pin headers with 100 mil spacing such as those used in USB testing. If the header adapter is used with the 1168A (10 GHz) or the 1169A (12 GHz), the rise time of the input signal should be slower than ~150 ps (10% to 90%) to limit the effects of resonances in the adapter.

All of the specifications and characteristics of the header adapter are the same as those for the Socketed Differential Probe Head except for the input capacitance shown in the following table.

Table 1-9

Characteristic Capacitance		
Cm	0.43 pF	Model for input C is Cm between the tips and Cg to ground each tip
Cg	0.54 pF	
Cdiff	0.70 pF	Diff mode capacitance is Cm + Cg/2
Cse	0.97 pF	Se mode capacitance is Cm + Cg

Figure 1-55



01130-63201 Header Adapter Dimensions

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## Differential and Single-ended Probe Configurations

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# Introduction

The 1168A and 1169A InfiniiMax II Active Probing system allows probing of differential and single-ended signals to a bandwidth of over 10 GHz for the 1168A and 12 GHz for the 1169A. The unique architecture of the InfiniiMax probe system provides a large common mode range for measuring differential signals and a large offset range for measuring single-ended signals. Additionally, the lower attenuation and noise greatly enhance the measurement of low-level signals that are so prevalent today, without overly sacrificing the input dynamic range. This family of probes continues the resistor-at-the-tip technology that Agilent pioneered in the 115x and 113x probe families. In this new probe family, the resistors have been moved onto the very edge of the probe tip board because at these extreme frequencies the off-board mini-axial lead resistors cause more response variation than is desirable. The wires or probe tips in front of the resistors are long enough to allow easy connection but are short enough that any resonances caused by them are out of band and don't impact the input impedance. This system uses interchangeable probe heads to optimize the performance and usability of hand (or probe holder) browsing, solder-in, and SMA connections. The new probe heads available for this system are:

- **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 for measuring differential and single-ended signals and utilizes strong 7 mil (or optional 5 mil) diameter nickel wires, which allow connection to very small, fine pitch targets.
- **Differential Hand-held Browser** — (or for probe holders) allows temporary connection to points in a system. This probe head has the same tip pc board and the same length tip wires so it provides the same full bandwidth performance and fidelity as the solder-in probe head for measuring differential and single-ended signals. The tip wires for this probe head are tin plated spring steel that can be formed to different spacing and provide compliance for a reliable connection.
- **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 20 mil 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, but with an increase in capacitive loading over the solder-in and browser probe heads. Additionally, 3.6 cm resistor tip wire accessories are provided for high fidelity lower bandwidth probing of signals with very wide spacing. It is recommended that a 25 mil diameter plated through hole be placed on a board for mounting the 20 mil diameter lead of the resistors.
- **SMA Probe Head** — allows connection to differential and single-ended signals that have 50 W connectors. This probe head provides full bandwidth performance with high quality 50 W terminations and an external port for driving the common mode termination voltage. This is a relatively inexpensive probe head for the 1168A and 1169A probe amps, which allows the probe amp to be used in multiple applications. When using this probe head, always use the N5380-64701 SMA Head Support to prevent damage to the probe amplifier.
- **ZIF Probe Head** — allows connection to differential and single-ended signals that have 50 W connectors. This probe head provides full bandwidth performance with high quality 50 W terminations and an external port for driving the common mode termination voltage. This is a relatively inexpensive probe head for the 1168A and 1169A probe amps, which allows the probe amp to be used in multiple applications.

Also, probe heads from the 113x probe family are supported within the limitations which are noted. Please refer to the 1134A User's Guide for information on these probe heads. Performance graphs and data are provided for all probe heads.

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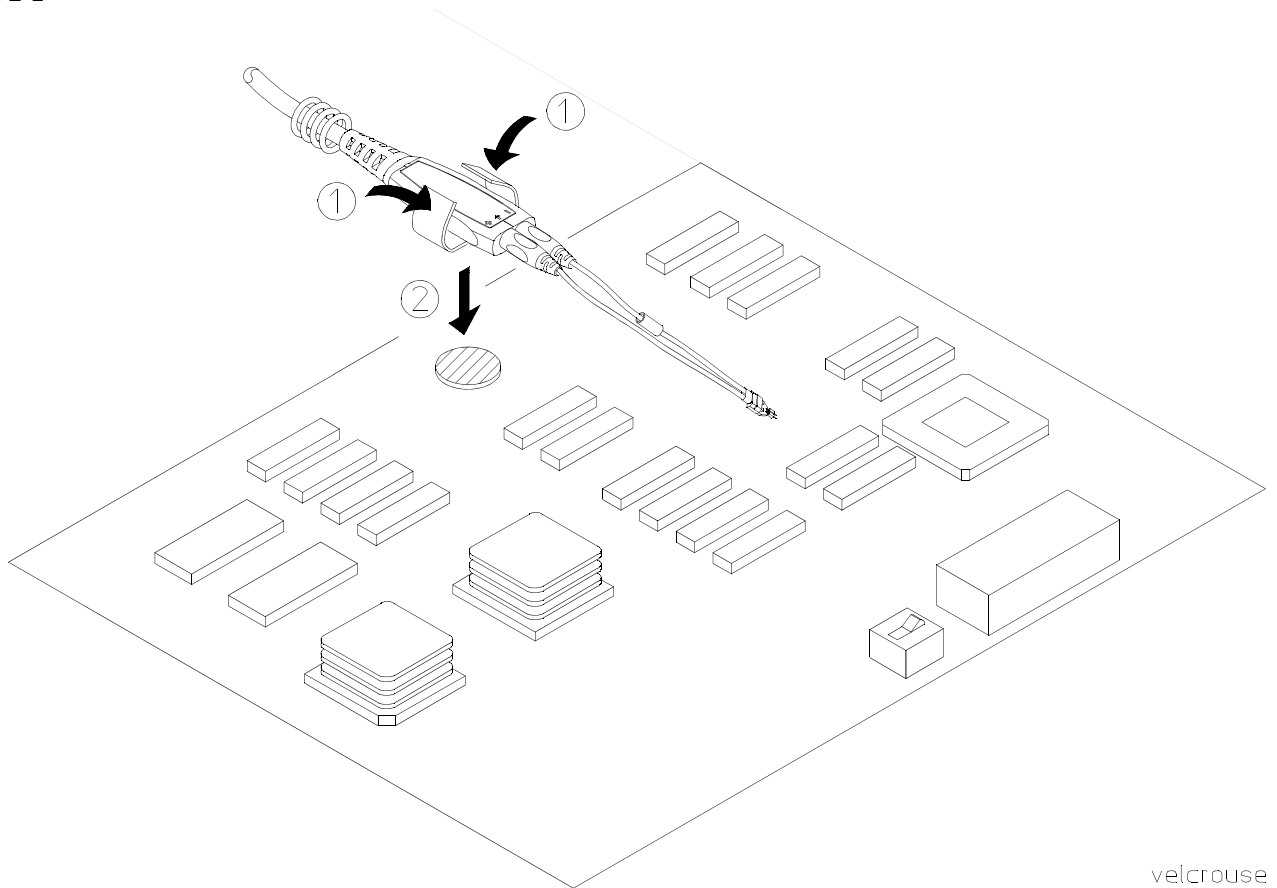
## Convenience Accessories

### 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 2-1**



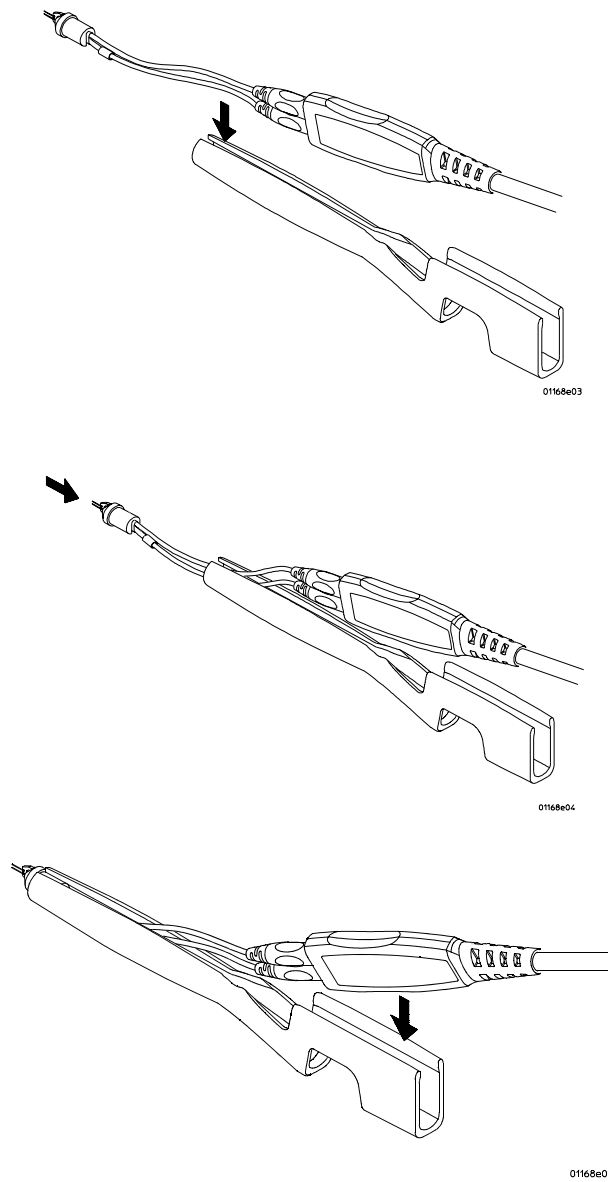
Using the Velcro dots and strips.

### 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.

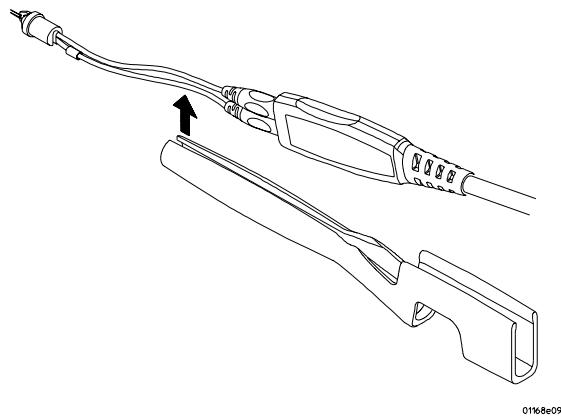
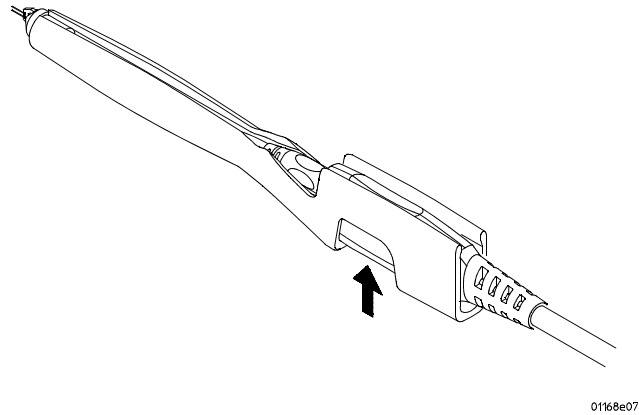
## Differential and Single-ended Probe Configurations Convenience Accessories

Figure 2-2



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

**Figure 2-3**



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

### 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 2-1 shows that the maximum required slew rate for the different technologies is much less than that of the probe.

**Table 2-1**

#### Slew Rate Requirements

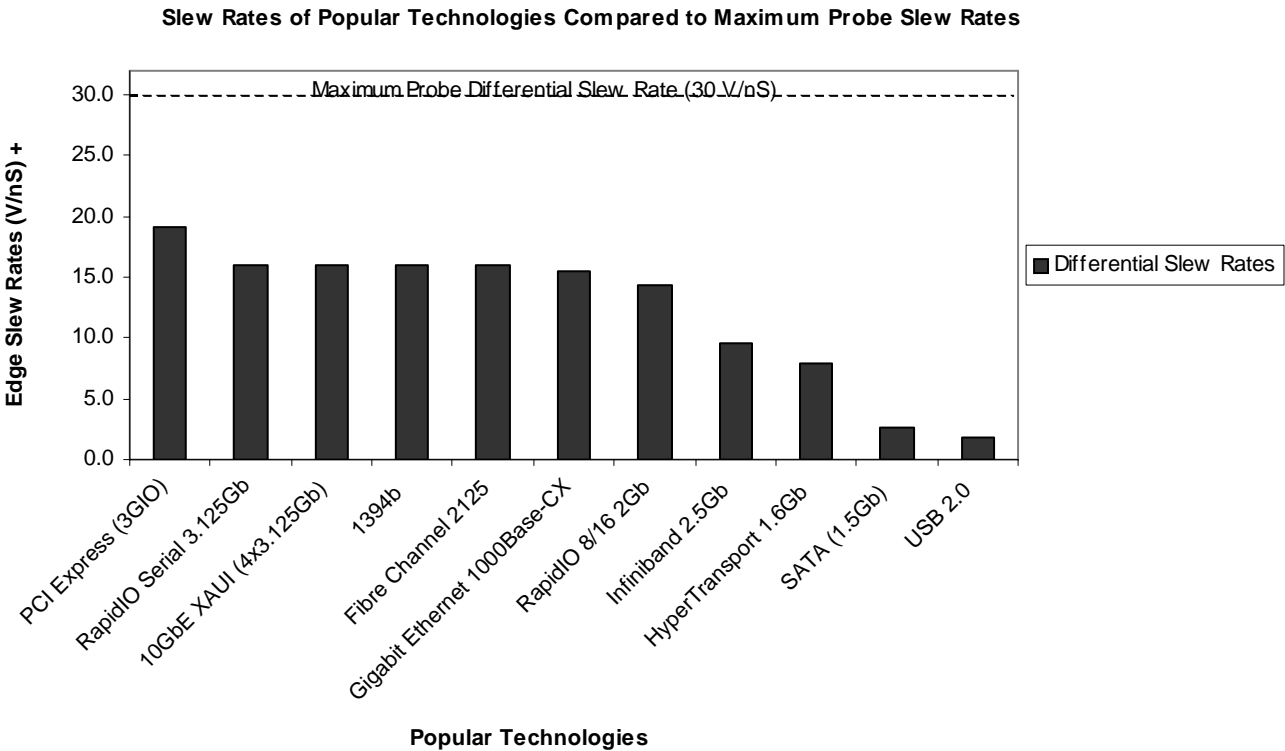
Name of Technology	Differential Signal	Max Single-Ended Slew Rate <sup>1</sup> (V/ns)	Max Differential Slew Rate <sup>2</sup> (V/ns)	Driver Min Edge Rate (20%-80% ps)	Max Transmitter Level (Diff V)
PCI Express (3GIO)	YES	9.6	19.2	50	1.6
RapidIO Serial 3.125Gb	YES	8.0	16.0	60	1.6
10GbE XAUI (4x3.125Gb)	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

<sup>1</sup> The probe specification is 18 V/ns

<sup>2</sup> The probe specification is 30 V/ns



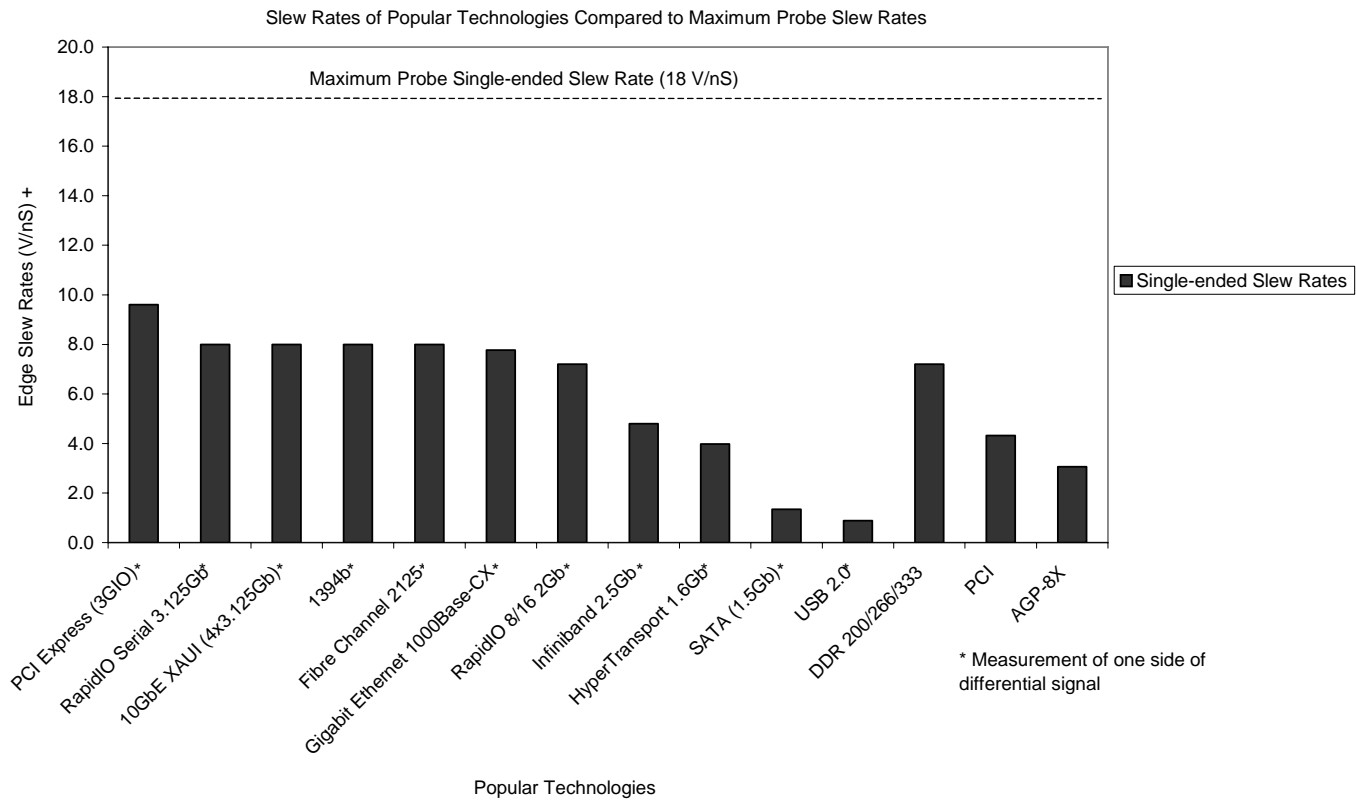
Figure 2-4



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

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

Figure 2-5



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

## 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.

### Recommended configurations at a glance

**Table 2-2**

Probe Head Configurations	Bandwidth (GHz)	Cdiff <sup>1</sup> (pF)	Cse <sup>2</sup> (pF)	Starting Page of Performance Graphs	Usage
1st Choice N5381A Solder-in differential (full bandwidth)	> 10 (1168A) > 12 (1169A)	0.21	0.35	2-24	<ul style="list-style-type: none"> <li>Differential and Single-ended signals</li> <li>Solder-in hands free connection</li> <li>Hard to reach targets</li> <li>Very small fine pitch targets</li> <li>Characterization</li> </ul>
2nd Choice N5382A Differential browser (full bandwidth)	> 10 (1168A) > 12 (1169A)	0.21	0.35	2-24	<ul style="list-style-type: none"> <li>Differential and Single-ended signals</li> <li>Hand-held browsing</li> <li>Probe holders</li> <li>General purpose troubleshooting</li> <li>Ergonomic handle available</li> </ul>
3rd Choice N5380A SMA <sup>3</sup> (full bandwidth)	> 10 (1168A) > 12 (1169A)	N/A	N/A	2-27	<ul style="list-style-type: none"> <li>Full bandwidth</li> <li>Preserve oscilloscope channels as opposed to using the A minus B mode.</li> <li>Removes inherent cable loss through compensation.</li> <li>Common mode termination voltage can be applied</li> <li>Offset matched sma cables adapt to variable spacing</li> </ul>
4th Choice N5425A ZIF (full bandwidth)	> 10 (1168A) > 12 (1169A)	0.33	0.53	2-30	<ul style="list-style-type: none"> <li>Differential and Single-ended signals</li> <li>Solder-in with ZIF Tip connection</li> <li>Very small fine pitch target</li> <li>Slightly higher loading than solder-in probe head</li> </ul>
5th Choice N5425A ZIF with N5451A Long Wired ZIF tip (7 mm resistor length)	~ 9.9 (0° span) <sup>4</sup> ~ 4.4 (60° span) <sup>5</sup>	- -	0.6 0.58	2-34 2-36	<ul style="list-style-type: none"> <li>Differential and Single-ended signals</li> <li>Solder-in with LW ZIF Tip connection</li> <li>Variable pitch targets, including larger pitches</li> <li>Higher loading than solder-in probe head</li> </ul>
6th Choice N5425A ZIF with N5451A Long Wired ZIF tip (11 mm resistor length)	~ 5 (0° span) <sup>4</sup> ~ 3.3 (60° span) <sup>5</sup>	- -	0.68 0.68	2-39 2-42	<ul style="list-style-type: none"> <li>Differential and Single-ended signals</li> <li>Solder-in with LW ZIF Tip connection</li> <li>Variable pitch targets, including larger pitches</li> <li>Higher loading than solder-in probe head</li> </ul>

<sup>1</sup> Capacitance seen by differential signals

<sup>2</sup> Capacitance seen by single-ended signals

<sup>3</sup> Always use the N5380-64701 SMA Head Support with this probe head to prevent damage to the probe amplifier

<sup>4</sup> 0° span between the two LW ZIF resistor leads

<sup>5</sup> 60° span between the two LW ZIF resistor leads

## Differential and Single-ended Probe Configurations Recommended Configurations Overview

### Other configurations at a glance

**Table 2-3**

Probe Head Configurations	Bandwidth (GHz)	Cdiff <sup>1</sup> (pF)	Cse <sup>2</sup> (pF)	Starting Page of Performance Graphs	Usage
7th Choice E2677A Solder-in differential (high bandwidth resistors)	> 10 (1168A) > 12 (1169A)	0.27	0.44	2-46	<ul style="list-style-type: none"> <li>Differential and Single-ended signals</li> <li>Solder-in hands free connection</li> <li>Hard to reach targets</li> <li>Very small fine pitch targets</li> <li>Characterization</li> </ul>
8th Choice E2678A Socketed differential (high bandwidth resistors)	> 10 (1168A) > 12 (1169A)	0.34	0.56	2-48	<ul style="list-style-type: none"> <li>Differential and Single-ended signals</li> <li>Removable connection using solder-in resistor pins</li> <li>Hard to reach targets</li> </ul>
9th Choice E2675A Differential browser	~ 5.2	0.32	0.57	2-50	<ul style="list-style-type: none"> <li>Differential and Single-ended signals</li> <li>Hand-held browsing</li> <li>Probe holders</li> <li>General purpose troubleshooting</li> <li>Ergonomic handle available</li> </ul>
10th Choice E2679A Solder-in single-ended (high bandwidth resistors)	~ 5.2	N/A	0.50	2-52	<ul style="list-style-type: none"> <li>Single-ended signals only</li> <li>Solder-in hands free connection when physical size is critical</li> <li>Hard to reach targets</li> <li>Very small fine pitch targets</li> </ul>
11th Choice E2676A Single-ended browser	~ 6	N/A	0.65	2-54	<ul style="list-style-type: none"> <li>Single-ended signals only</li> <li>Hand or probe holder where physical size is critical</li> <li>General purpose troubleshooting</li> <li>Ergonomic handle available</li> </ul>
12th Choice E2678A Socketed differential with damped wire accessories	~ 1.2	0.63	0.95	2-56	<ul style="list-style-type: none"> <li>Differential and Single-ended signals</li> <li>For very wide spaced targets</li> <li>Connection to 25 mil square pins when used with supplied sockets</li> </ul>
13th Choice E2695A SMA <sup>3</sup>	~ 8	N/A	N/A	2-58	<ul style="list-style-type: none"> <li>Not full bandwidth but good signal fidelity</li> <li>Preserve oscilloscope channels as opposed to using the A minus B mode.</li> <li>Removes inherent cable loss through compensation.</li> <li>Common mode termination voltage can be applied</li> <li>Offset sma cables adapt to variable spacing</li> </ul>

<sup>1</sup> Capacitance seen by differential signals

<sup>2</sup> Capacitance seen by single-ended signals

<sup>3</sup> Always use the N5380-64701 SMA Head Support with this probe head to prevent damage to the probe amplifier

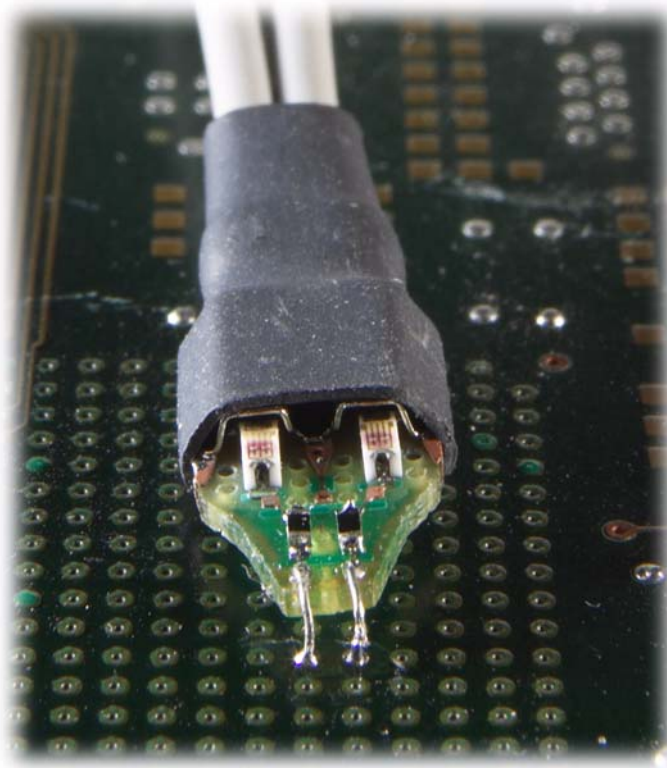
**1st Choice: Solder-in Differential Probe Head (full bandwidth)**

This configuration has a bandwidth of greater than 10 GHz for the 1168A and 12 GHz for the 1169A (see the graphs starting on page 2-46). The configuration consists of the following parts:

- N5381A — Solder-in Differential Probe Head
- 01169-81301 — tin-plated nickel wires (2 each)

The 01169-81301 wire has been trimmed and formed using trim gauge 01169-23801.

**Figure 2-6**



## Differential and Single-ended Probe Configurations Recommended Configurations Overview

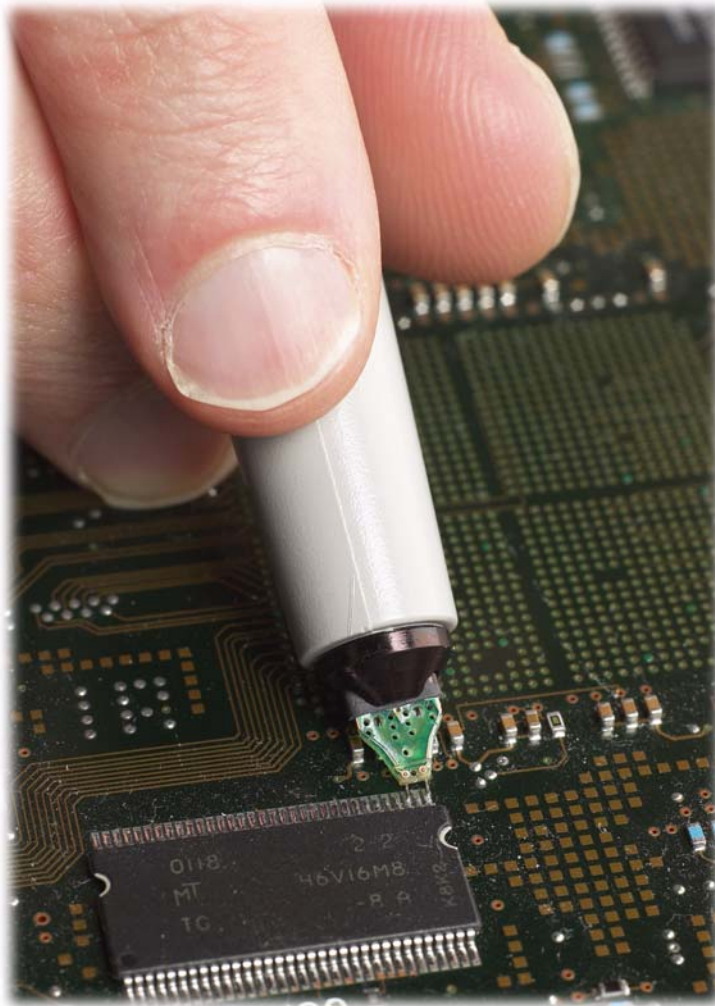
### 2nd Choice: Differential Browser Probe Head (full bandwidth)

This configuration has a bandwidth of greater than 10 GHz for the 1168A and 12 GHz for the 1169A (see the graphs starting on page 2-46). The configuration consists of the following parts:

- N5382A — Differential Browser Probe Head
- 01130-43202 — Ergonomic handle
- 01169-21304 — tin-plated steel wires (2 each)

The 01169-21304 wire has been trimmed and formed using trim gauge 01169-23801.
--

Figure 2-7



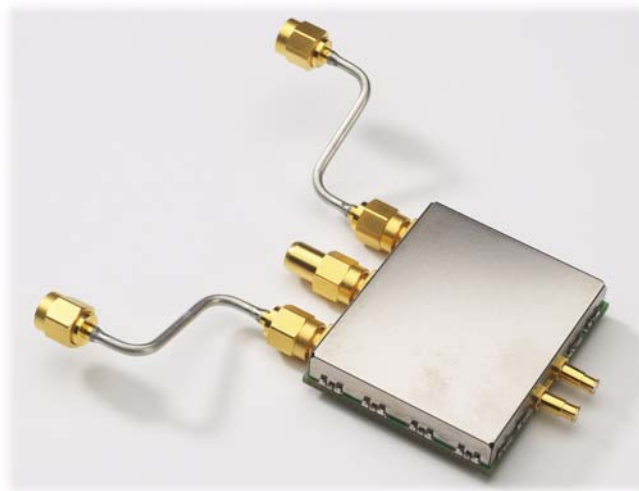
### 3rd Choice: SMA Probe Head (full bandwidth)

This configuration has a bandwidth of greater than 10 GHz for the 1168A and 12 GHz for the 1169A (see the graphs starting on page 2-46). The two outside SMA connectors are for input signal connection and the center SMA connector can be used to provide a dc bias for the termination. The configuration consists of the following parts:

- N5380A — SMA Probe Head

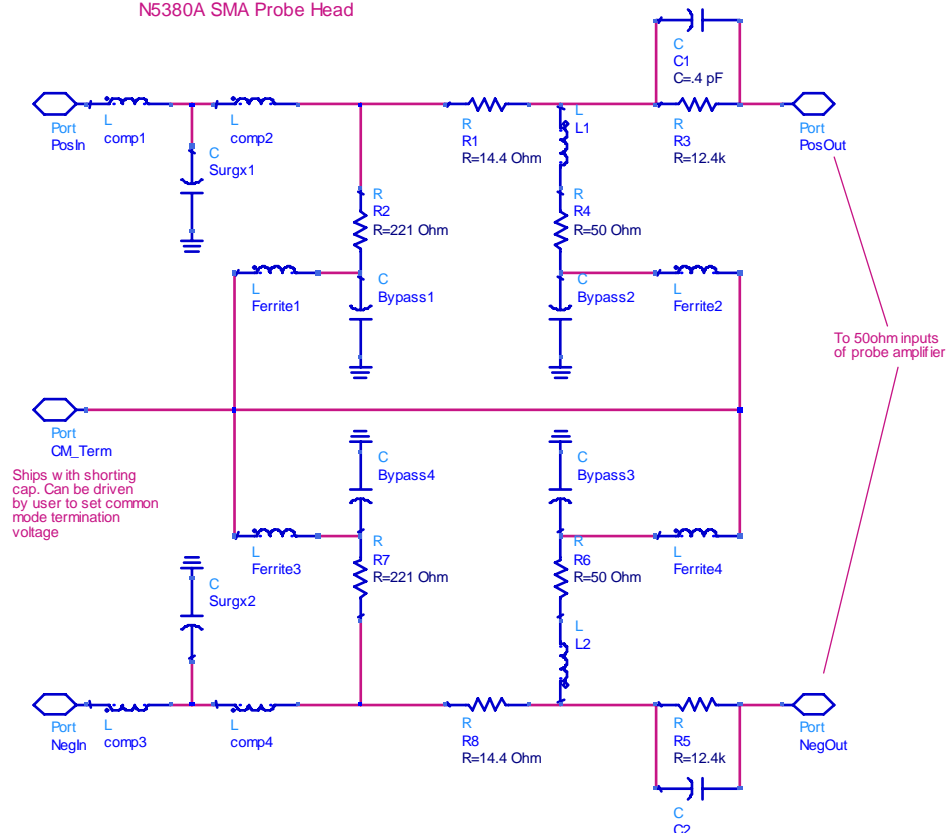
When using this probe head, always use the N5380-64701 SMA Head Support to prevent damage to the probe amplifier.

Figure 2-8



### SMA Probe Head Schematic

N5380A SMA Probe Head



## Differential and Single-ended Probe Configurations

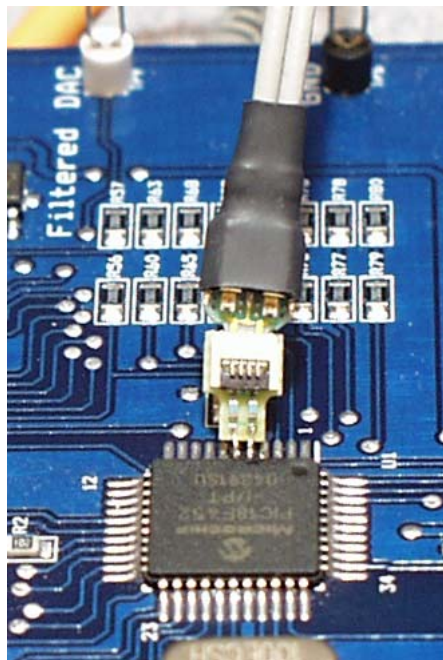
### Recommended Configurations Overview

#### 4th Choice: ZIF Probe Head

This configuration has a bandwidth of greater than 10 GHz for the 1168A and 12 GHz for the 1169A (see the graphs starting on page 2-30). The configuration consists of the following parts:

- N5425A — ZIF Probe Head
- N5426A — ZIF Probe Head Accessory

**Figure 2-9**



ZIF Probe Head



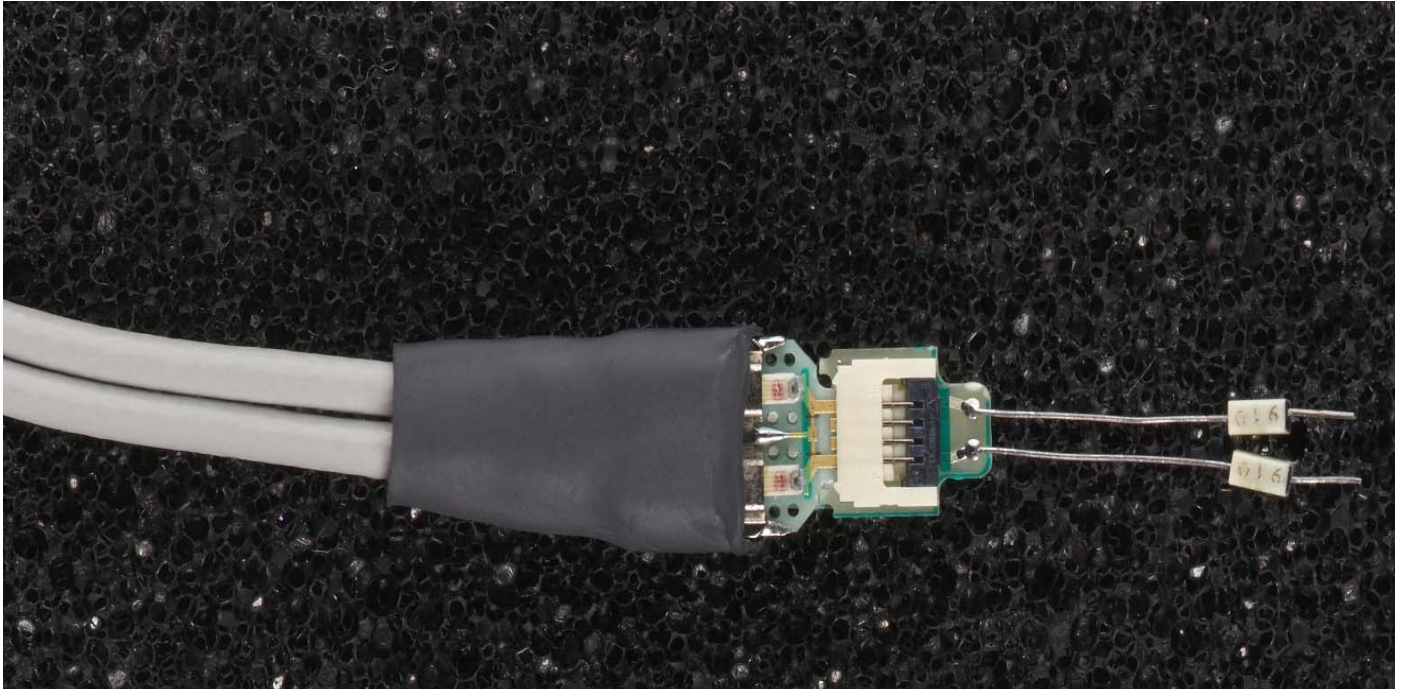
**5th Choice: ZIF Probe Head with Long Wired ZIF Tip - 7mm Resistor Length**

This configuration has a bandwidth of greater than 9 GHz (see the graphs starting on page 2-34). The configuration consists of the following parts:

- N5425A — ZIF Probe Head
- N5451A — Long Wired ZIF Probe Head Accessory

The N5451A resistors have been trimmed and formed using template N5451A-94301.

**Figure 2-10**



Resistor wire lengths shown are not 7 mm and the figure has been enlarged to show detail.

## Differential and Single-ended Probe Configurations Recommended Configurations Overview

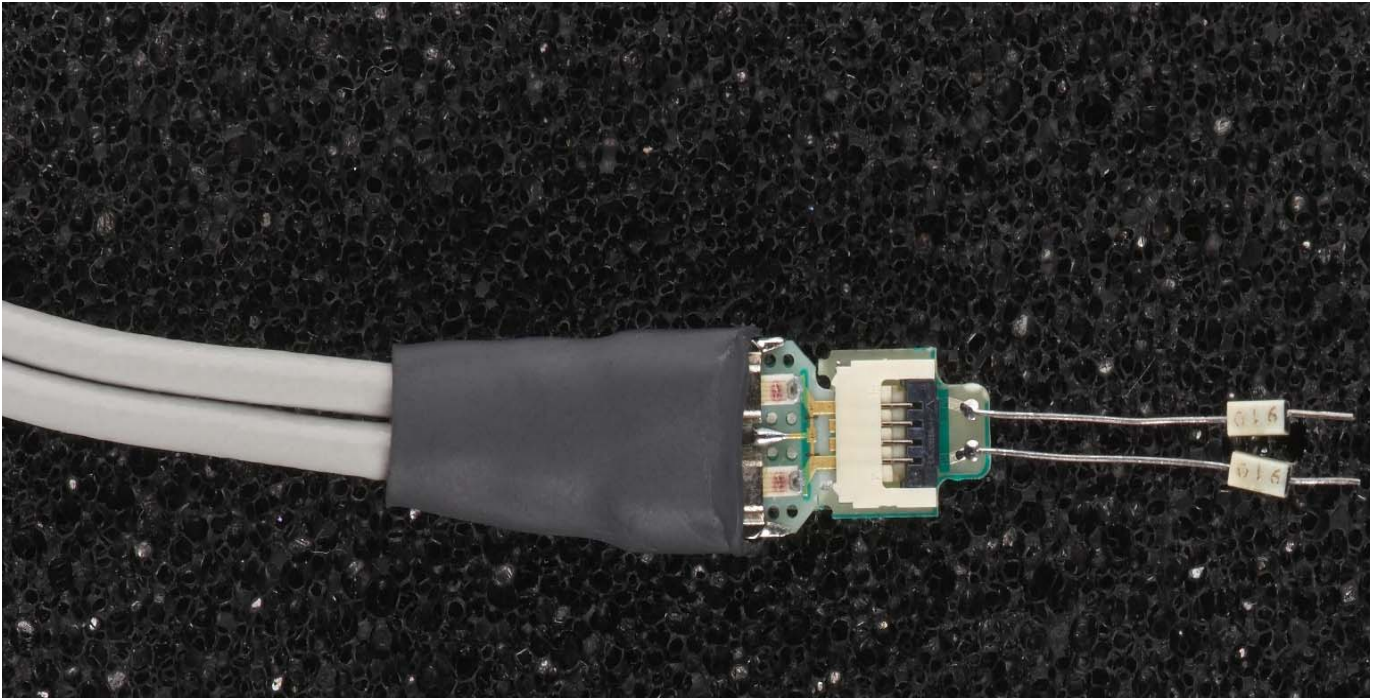
### 6th Choice: ZIF Probe Head with Long Wired ZIF Tip - 11 mm Resistor Length

This configuration has a bandwidth of 5 GHz (see the graphs starting on page 2-39). The configuration consists of the following parts:

- N5425A — ZIF Probe Head
- N5451A — Long Wired ZIF Probe Tip

The N5451A resistors have been trimmed and formed using template N5451A-94301.
--

**Figure 2-11**



Resistor wire lengths shown are not 11 mm and the figure has been enlarged to show detail.

---

## Other Configurations Overview

Other configurations of probe heads are available in the E2669A connectivity kit. Not all of these configurations will give the best probe performance of the 1168A and 1169A. The probe configurations are shown in the order of the best performance to the least performance.

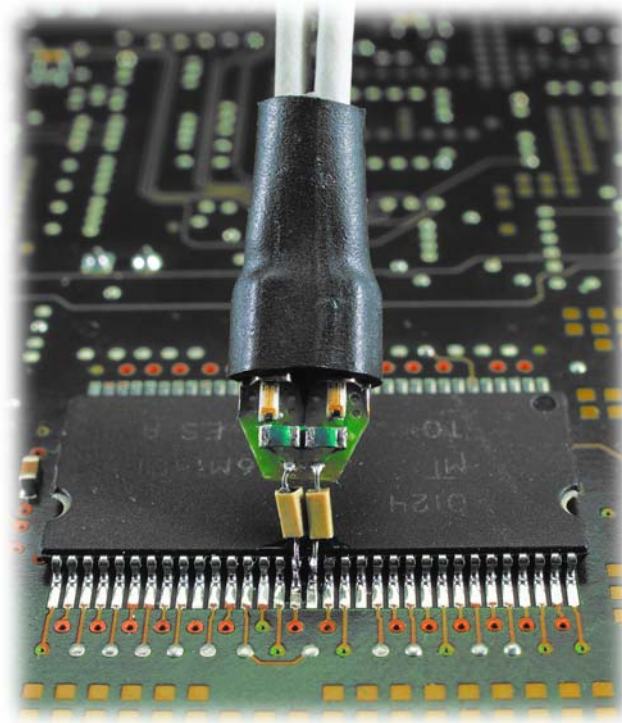
### 7th Choice: Solder-in Differential Probe Head (high bandwidth resistors)

This configuration has a bandwidth of greater than 10 GHz for the 1168A and 12 GHz for the 1169A (see the graphs starting on page 2-46). The configuration consists of the following parts:

- E2677A — Solder-in Differential Probe Head
- 01131-81510 — 91 W mini-axial lead resistors (2 each)

The 01131-81510 resistor has been trimmed and formed using template 01131-94311.
--

Figure 2-12



## Differential and Single-ended Probe Configurations Other Configurations Overview

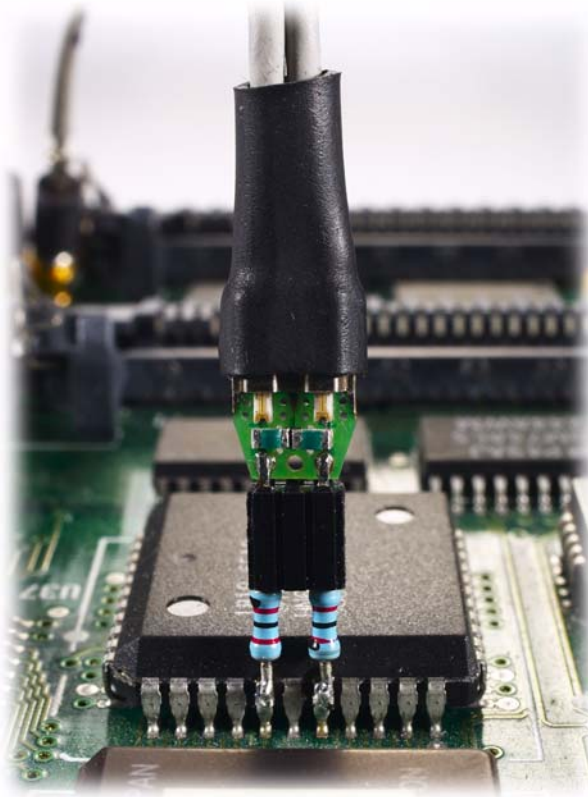
### 8th Choice: Socketed Differential Probe Head (high bandwidth resistors)

This configuration has a bandwidth of greater than 10 GHz for the 1168a and 12 GHz for the 1169A (see the graphs starting on page 2-48). This configuration consists of the following parts:

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

The 01130-81506 resistor has been trimmed and formed using template 01131-94308.
--

Figure 2-13



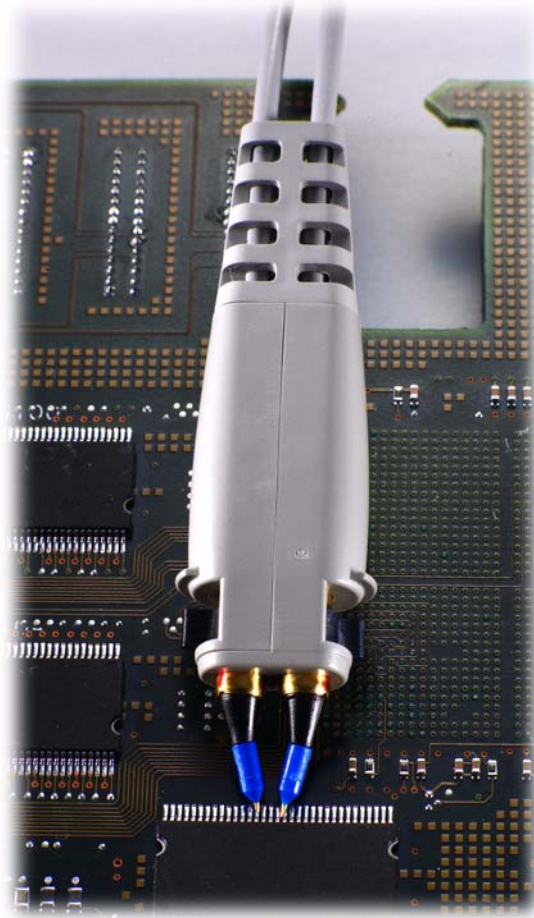


**9th Choice: Differential Browser Probe Head**

This configuration has a bandwidth approximately equal to 5.2 GHz for the 1168A and 6 GHz for the 1169A (see the graphs starting on page 2-50). This configuration consists of the following parts:

- E2675A — Differential Browser Probe Head
- 01131-62102 — 91  $\Omega$  resistor probe tips (2 each)
- 01131-43201 — Ergonomic handle (optional)

**Figure 2-14**



## Differential and Single-ended Probe Configurations

### Other Configurations Overview

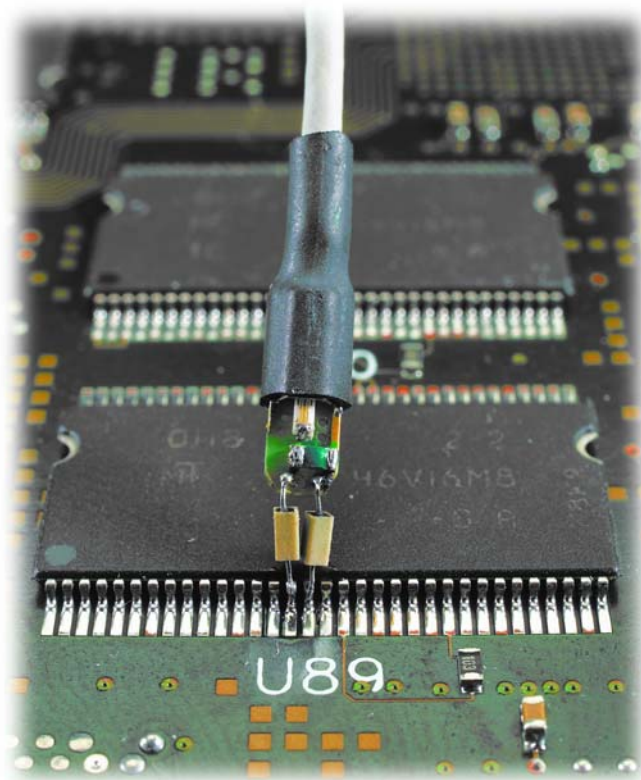
#### 10th Choice: Solder-in Single-ended Probe Head (high bandwidth resistors)

This configuration has a bandwidth approximately equal to 5.2 GHz for the 1168A and 6 GHz for the 1169A (see the graphs starting on page 2-52). This configuration consists of the following parts:

- E2679A — Solder-in Single-ended Probe Head
- 01131-81510 — 91  $\Omega$  mini-axial lead resistor
- 01131-81504 — 0  $\Omega$  mini-axial lead resistor

The 01131-81510 and 01131-81504 resistors have been trimmed and formed using template 01131-94311.

Figure 2-15

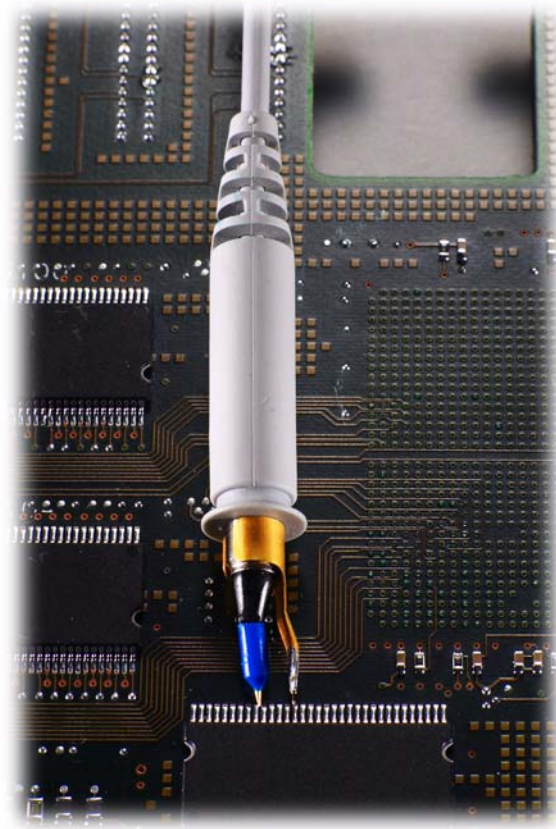


**11th Choice: Single-ended Browser Probe Head**

This configuration has a bandwidth approximately equal to 6 GHz (see the graphs starting on page 2-54). This configuration consists of the following parts:

- E2676A — Single-ended Browser Probe Head
- 01131-43202 — Ergonomic handle (optional)
- 01131-62102 — 91  $\Omega$  resistor probe tip
- 01130-60005 — Ground collar assembly

**Figure 2-16**



## Differential and Single-ended Probe Configurations

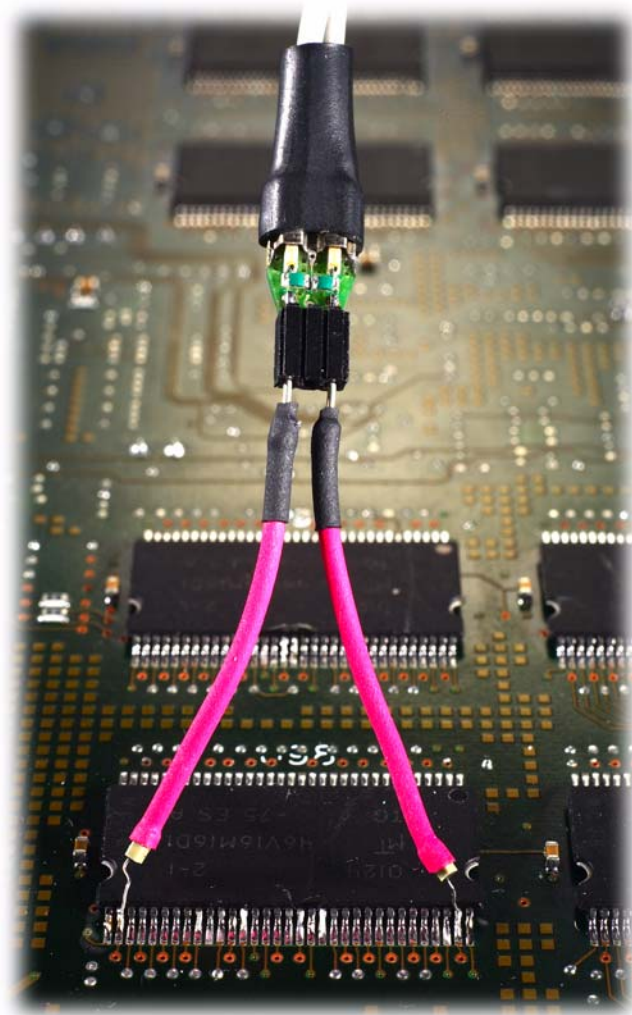
### Other Configurations Overview

#### 12th Choice: Socketed Differential Probe Head with damped wire accessory

This configuration has a bandwidth approximately equal to 1.2 GHz (see the graphs starting on page 2-56). This configuration consists of the following parts:

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

**Figure 2-17**





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## Detailed Information for Recommended Configurations

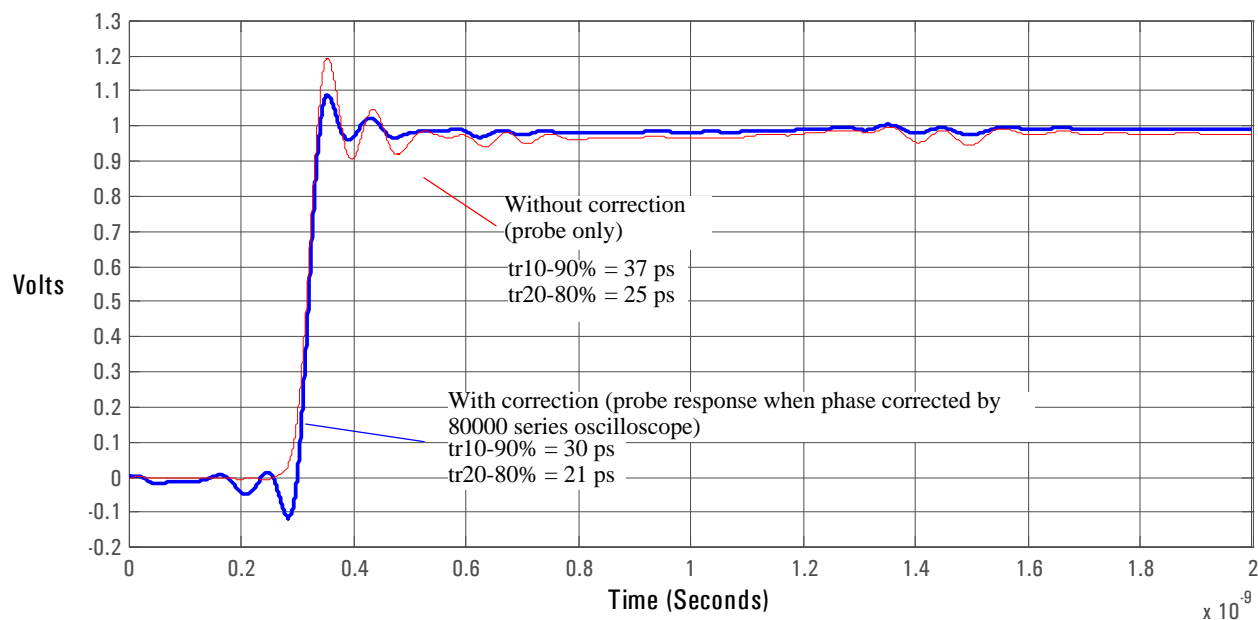
This section contains graphs of the performance characteristics of the 1168A and 1169A active probes using the different probe heads that come with the N5381A, N5382A, N5380A, N5425A, and N5451A kits.

**Differential and Single-ended Probe Configurations**  
**1 N5381A Solder-in Differential Probe Head (Full Bandwidth) and 2 N5382A Differential Browser Probe Head (Full Bandwidth)**

**1 N5381A Solder-in Differential Probe Head (Full Bandwidth)  
and 2 N5382A Differential Browser Probe Head (Full Bandwidth)**

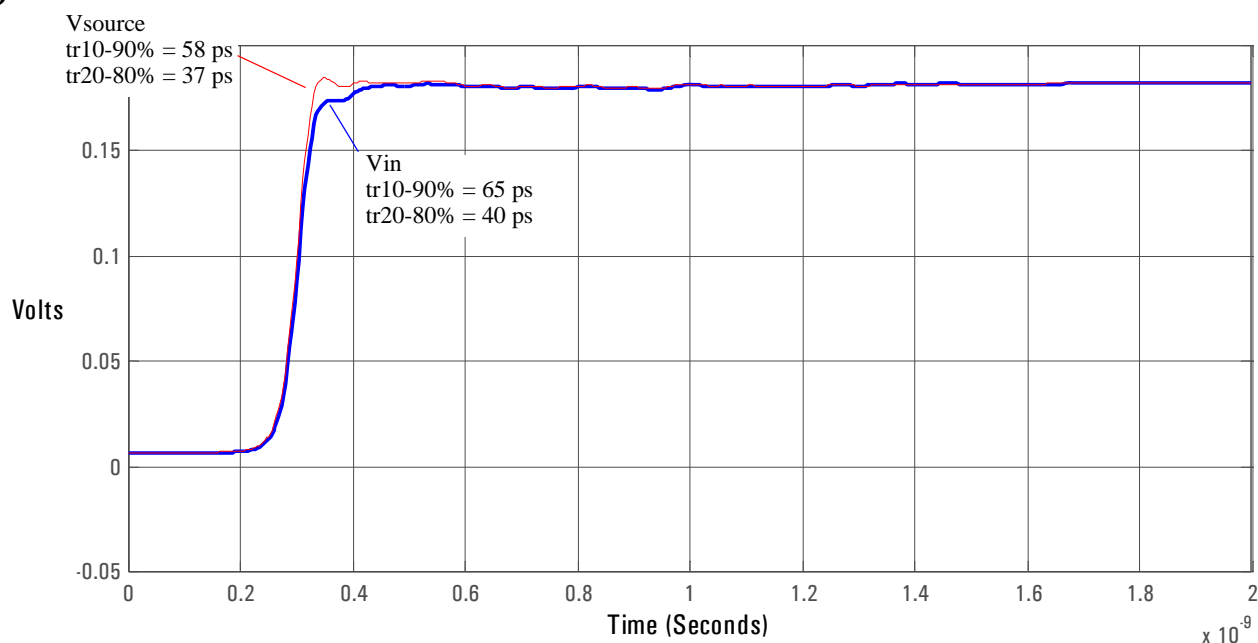
Unless otherwise noted, time and frequency responses shown here are for the probe only. When the probe is used with the 80000 series oscilloscope, magnitude and phase correction can be applied to further optimize the overall response.

**Figure 2-18**



Graph of step response with and without phase correction. Normalized to an ideal input step.

**Figure 2-19**

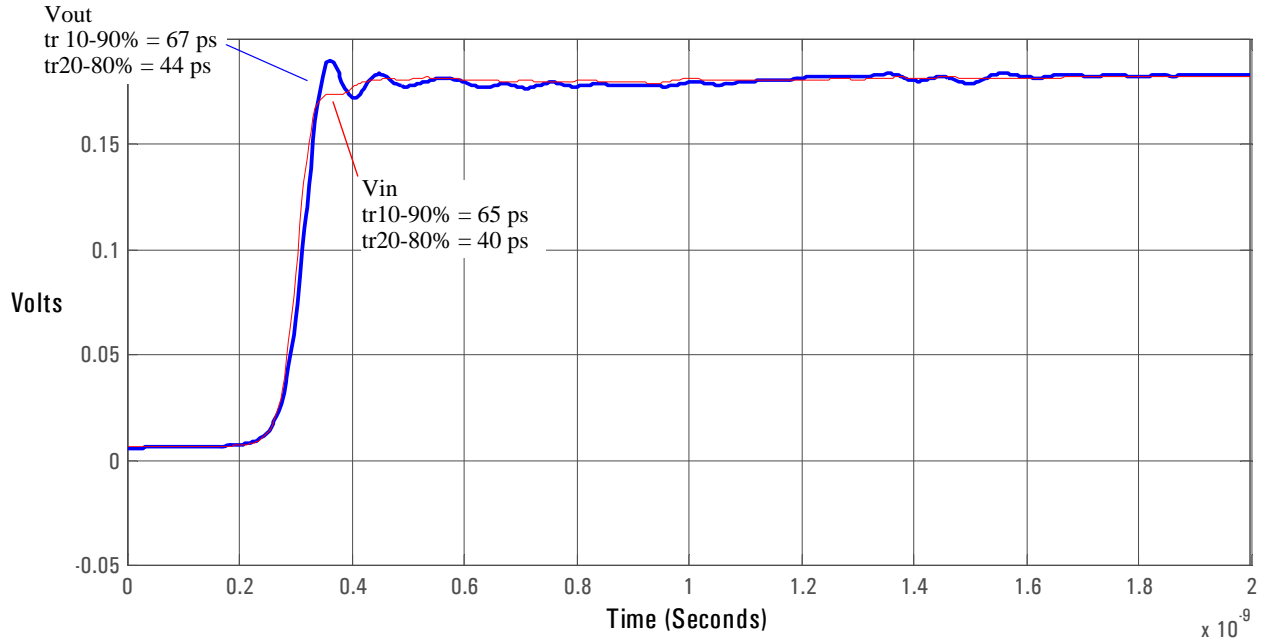


Graph of 25 W 58 ps step generator with and without probe connected.

# Differential and Single-ended Probe Configurations

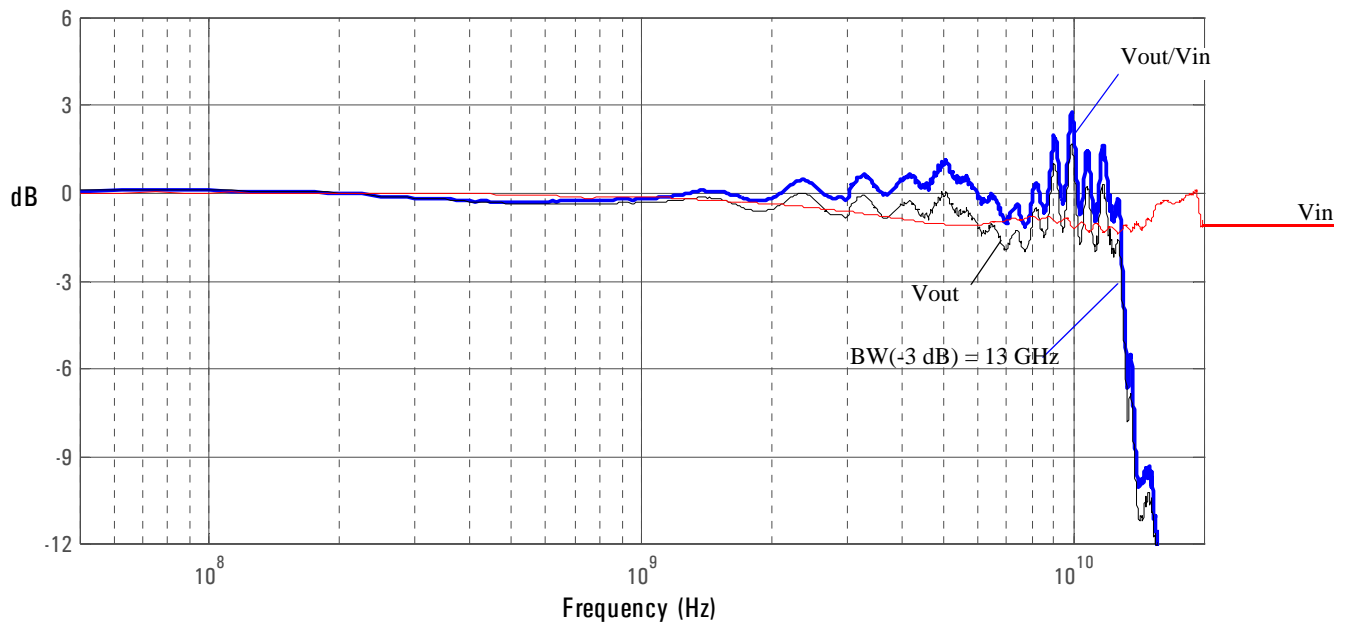
## 1 N5381A Solder-in Differential Probe Head (Full Bandwidth) and 2 N5382A Differential Browser Probe Head (Full Bandwidth)

**Figure 2-20**



Graph of  $V_{in}$  and  $V_{out}$  of probe with a 25 W 58 ps step generator.

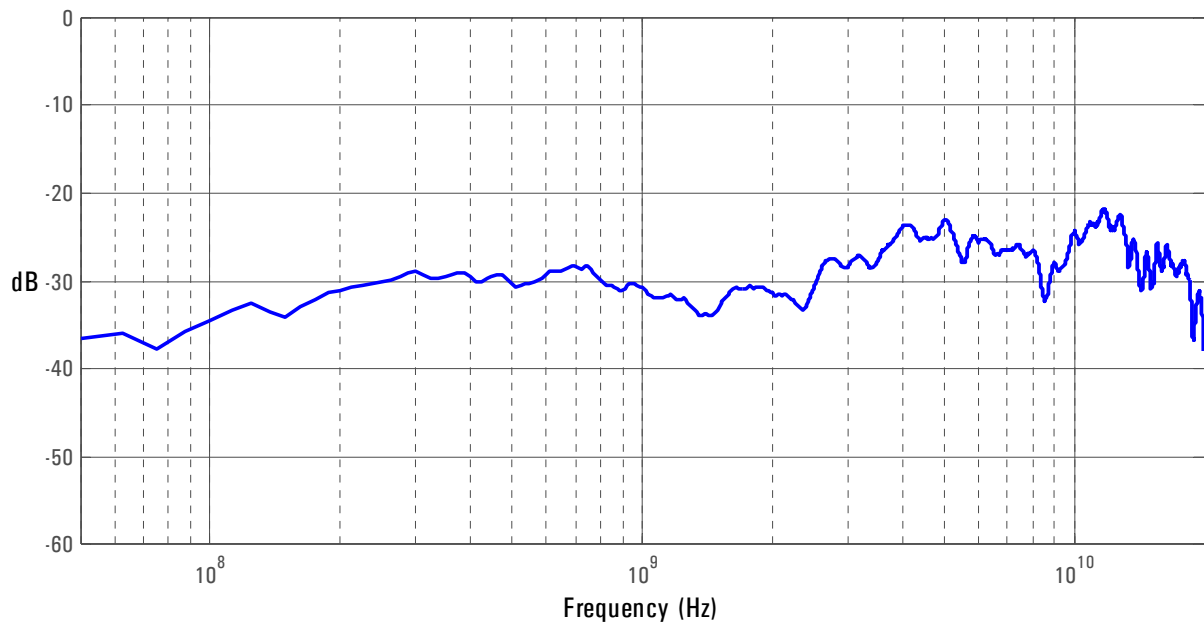
**Figure 2-21**



Graph of  $\text{dB}(V_{in})$  and  $\text{dB}(V_{out}) + 10.8 \text{ dB}$  of probe with a 25 W source and  $\text{dB}(V_{out}/V_{in}) + 10.8 \text{ dB}$  frequency response.

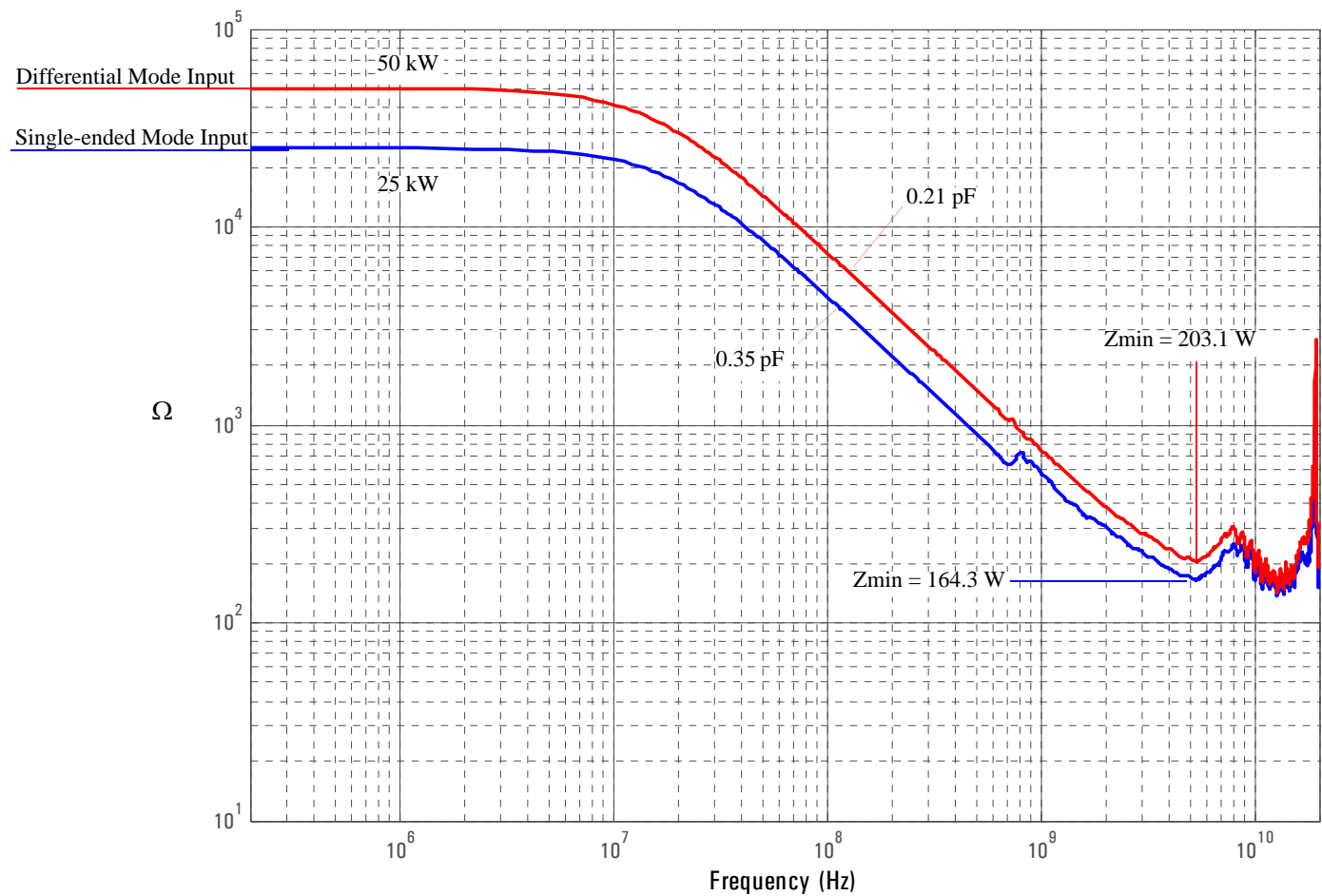
**Differential and Single-ended Probe Configurations**  
**1 N5381A Solder-in Differential Probe Head (Full Bandwidth) and 2 N5382A Differential Browser**  
**Probe Head (Full Bandwidth)**

**Figure 2-22**



Graph of  $\text{dB}(V_{\text{out}}/V_{\text{in}}) + 10.8 \text{ dB}$  frequency response when inputs driven in common (common mode rejection).

**Figure 2-23**

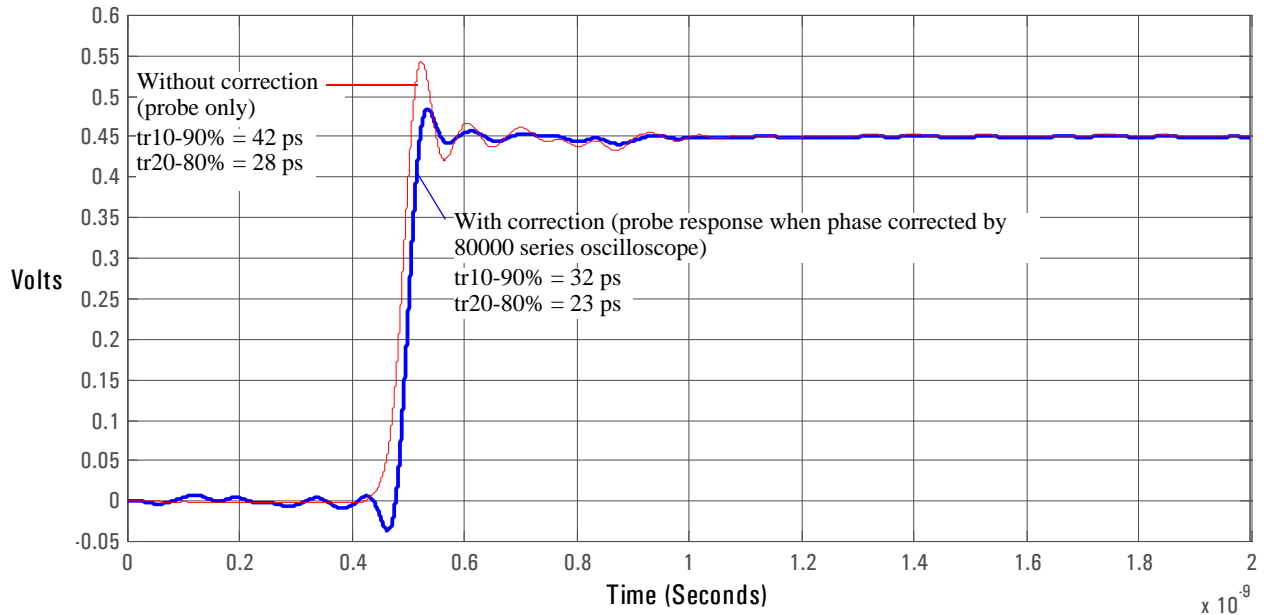


Magnitude plot of probe input impedance versus frequency.

### 3 N5380A SMA Probe Head (Full Bandwidth)

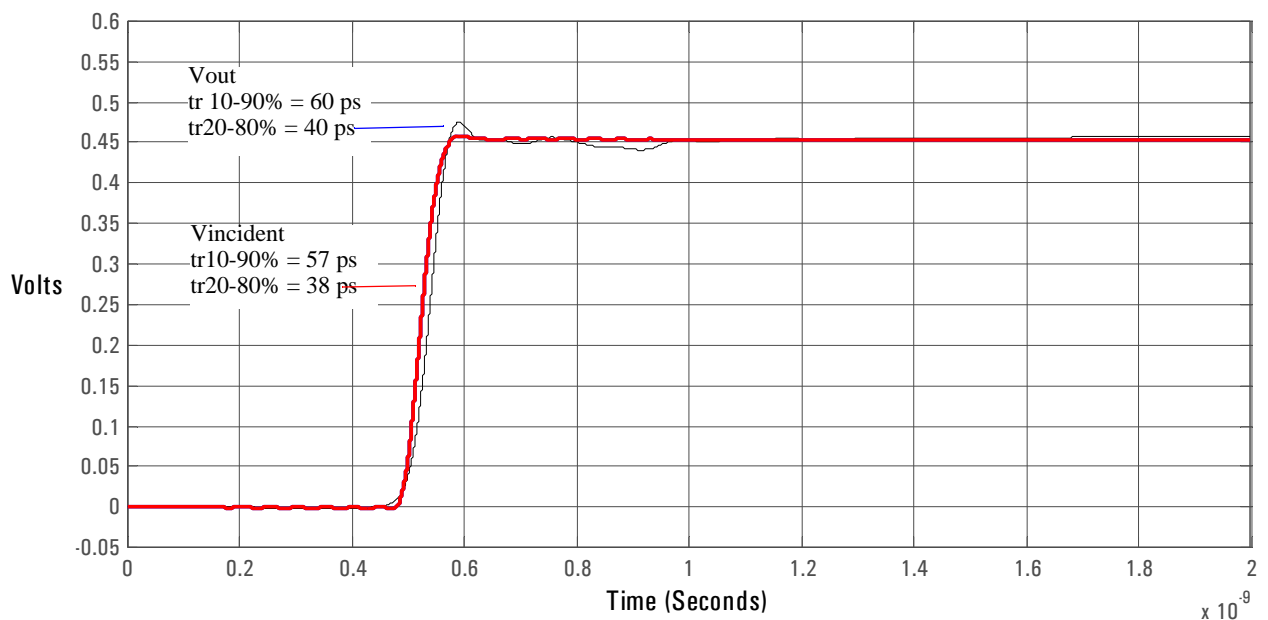
Unless otherwise noted, time and frequency responses shown here are for the probe only. when the probe is used with the 80000 series oscilloscope, magnitude and phase correction is applied to further optimize the overall response.

Figure 2-24



Graph of step response with and without phase correction. Normalized to an ideal input step.

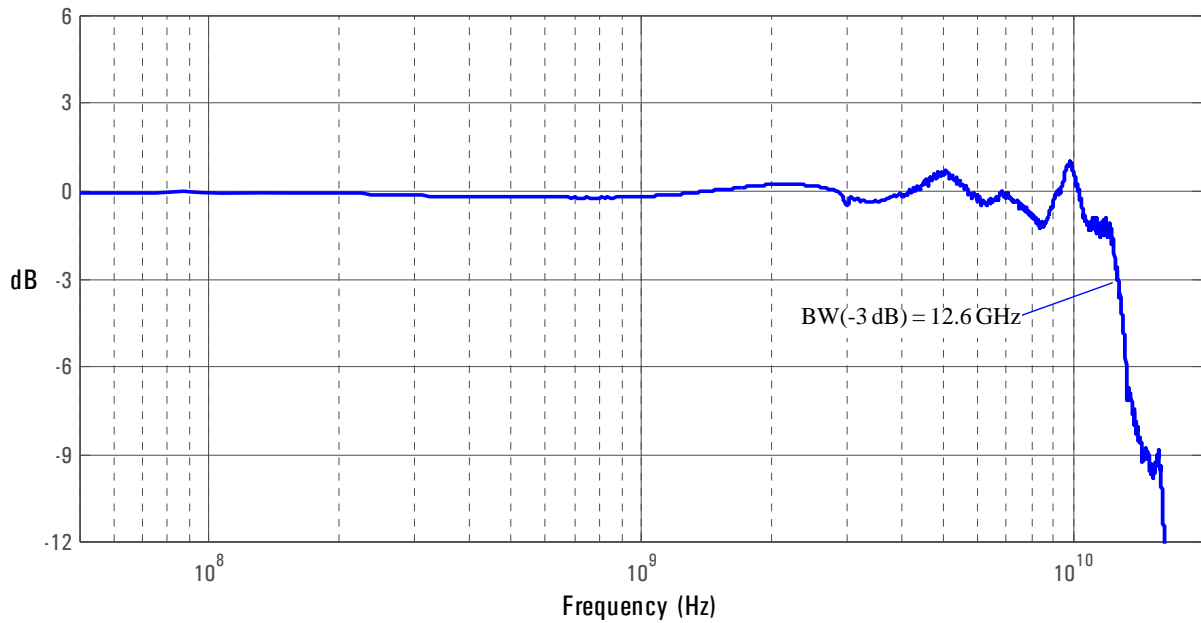
Figure 2-25



Graph of Vincident and Vout of probe with a 57 ps step.

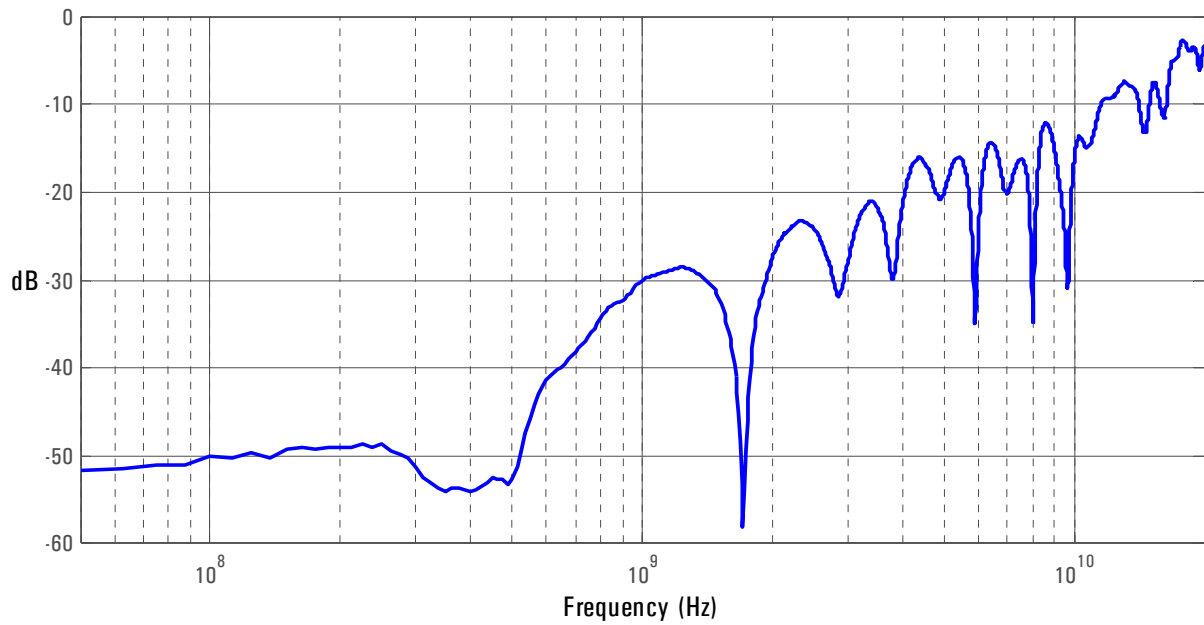
**Differential and Single-ended Probe Configurations**  
**3 N5380A SMA Probe Head (Full Bandwidth)**

**Figure 2-26**



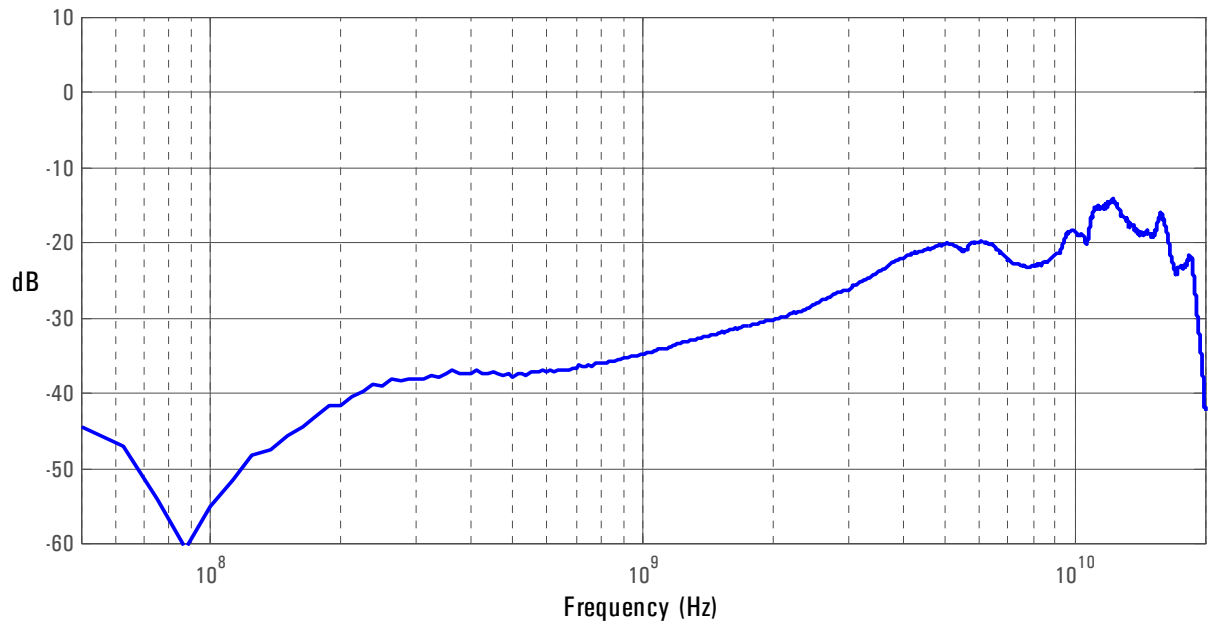
Magnitude plot of differential insertion loss +6.8 dB.

**Figure 2-27**



Magnitude plot of differential return loss.

Figure 2-28

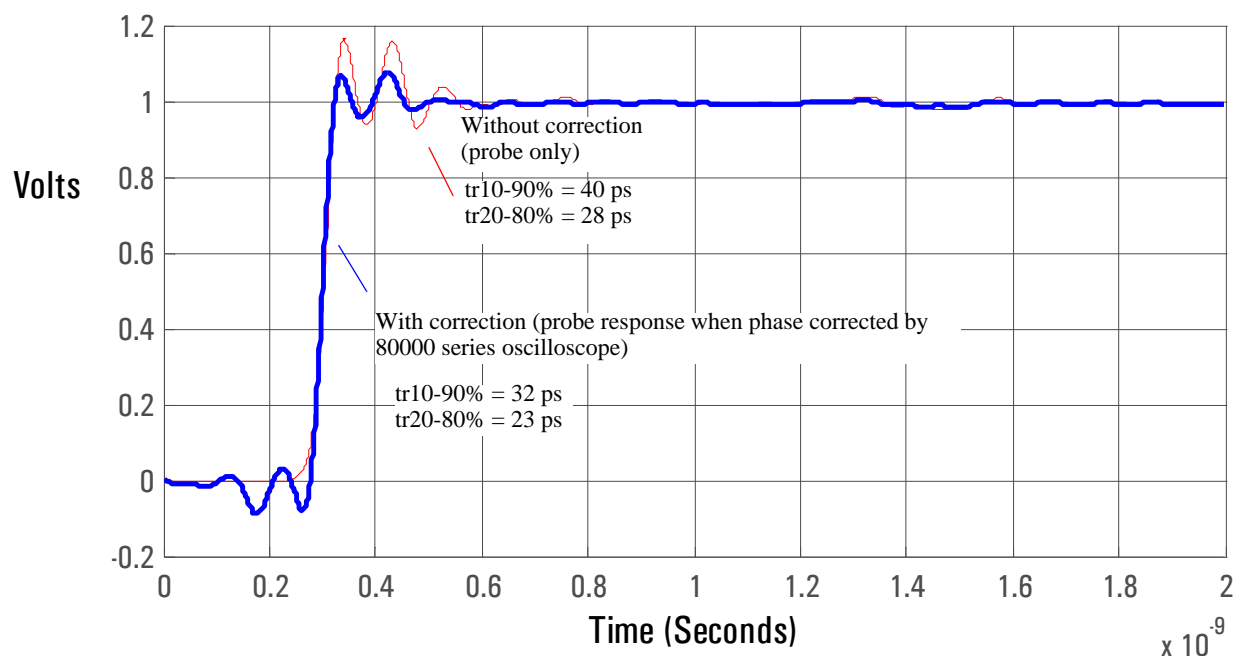


Magnitude plot of common mode response +6.8dB (common mode rejection).

## 4 N5425A ZIF Probe Head (Full Bandwidth)

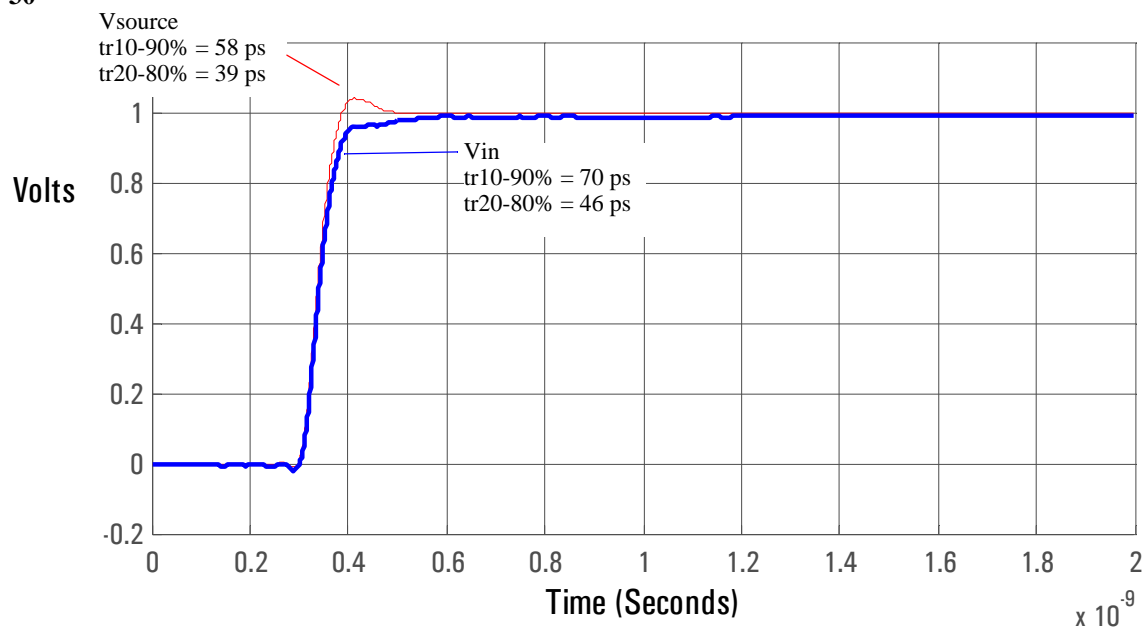
Unless otherwise noted, time and frequency responses shown here are for the probe only. when the probe is used with the 80000 series oscilloscope, magnitude and phase correction is applied to further optimize the overall response.

Figure 2-29



Graph of step response with and without phase correction. Normalized to an ideal input step.

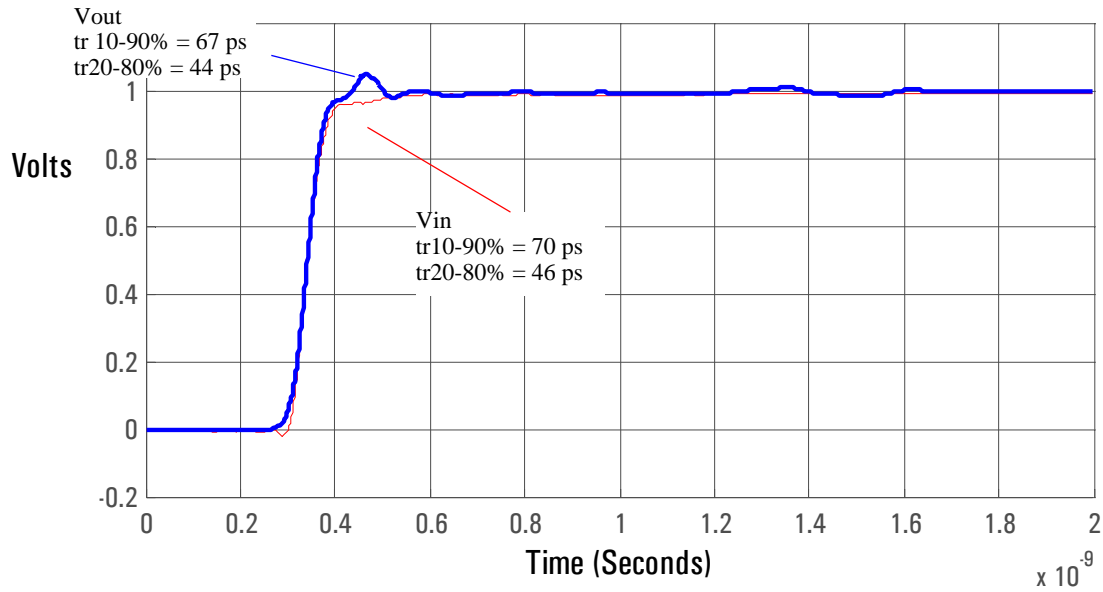
Figure 2-30



Graph of a 25 W 58 ps step with and without the probe connected.

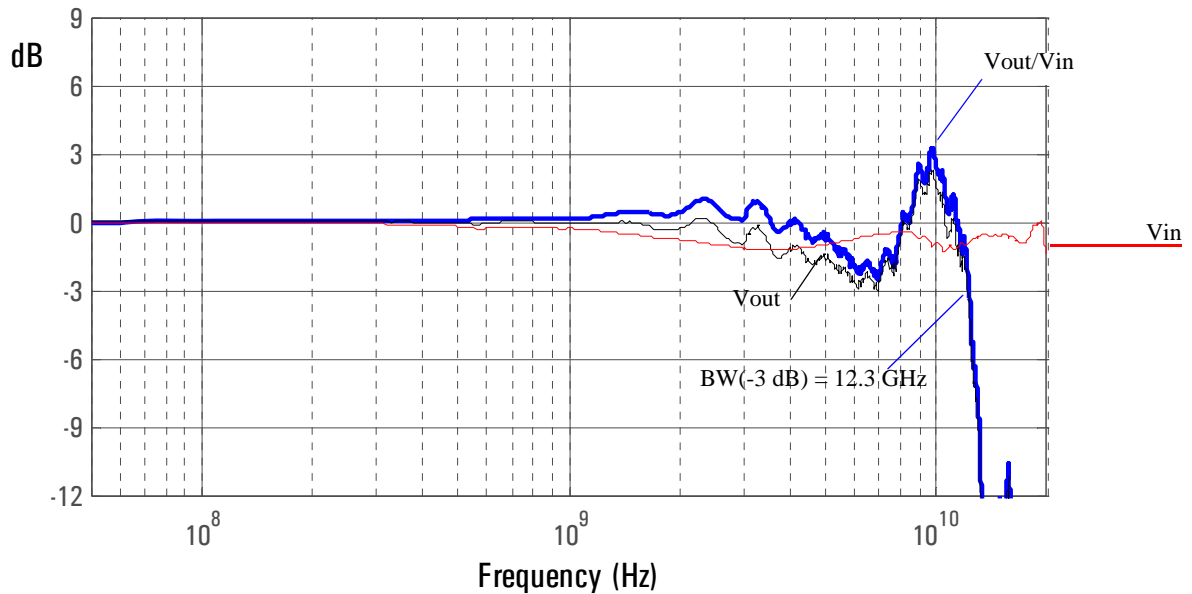


Figure 2-31



Graph of  $V_{in}$  and  $V_{out}$  of probe with a 25 W 58 ps step.

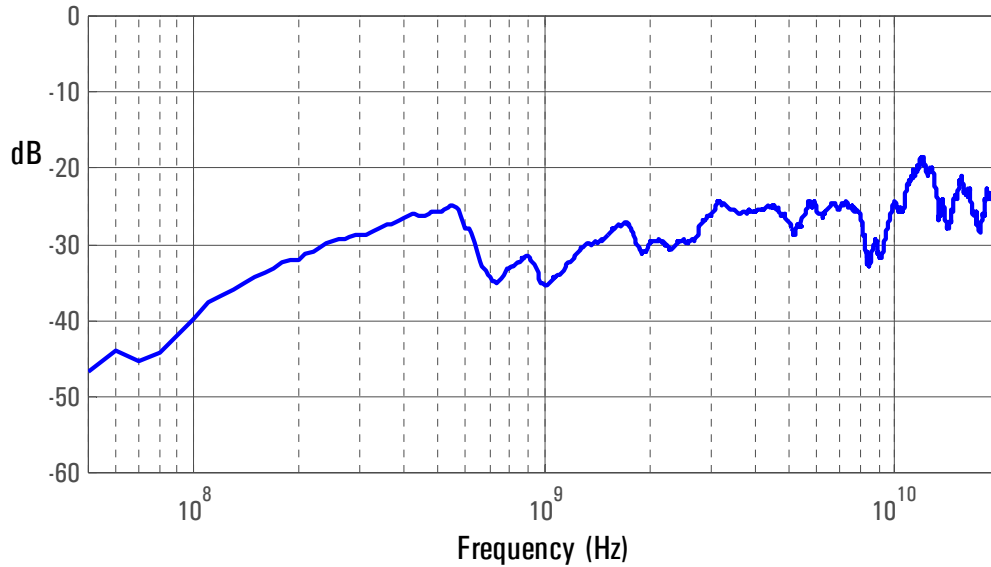
Figure 2-32



Graph of  $dB(V_{in})$  and  $dB(V_{out}) + 10.8$  dB of probe with a 25 W source and  $dB(V_{out}/V_{in}) + 10.8$  dB frequency response.

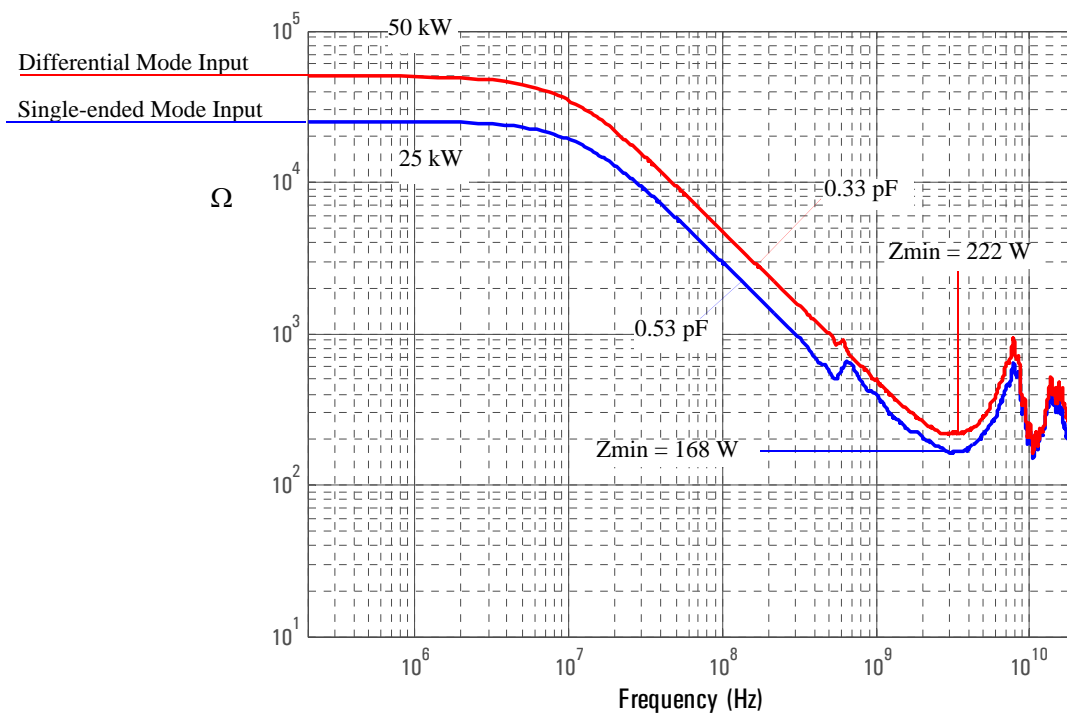
# Differential and Single-ended Probe Configurations 4 N5425A ZIF Probe Head (Full Bandwidth)

Figure 2-33



Graph of  $\text{dB}(V_{\text{out}}/V_{\text{in}}) + 10.8 \text{ dB}$  frequency response when inputs driven in common (common mode rejection).

Figure 2-34

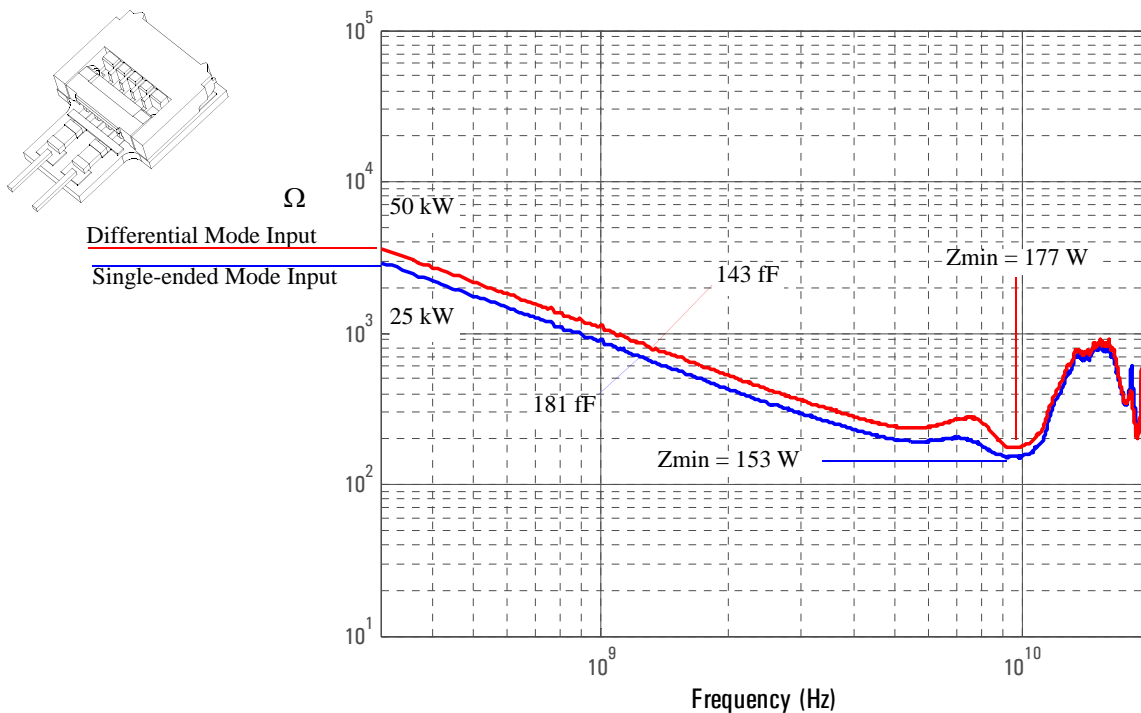


Magnitude plot of probe input impedance versus frequency.

### ZIF Probe Head Accessory Impedance (N5426A)

The impedance plot shown in Figure 2-35 is of the ZIF probe head accessory without the probe head connected.

Figure 2-35



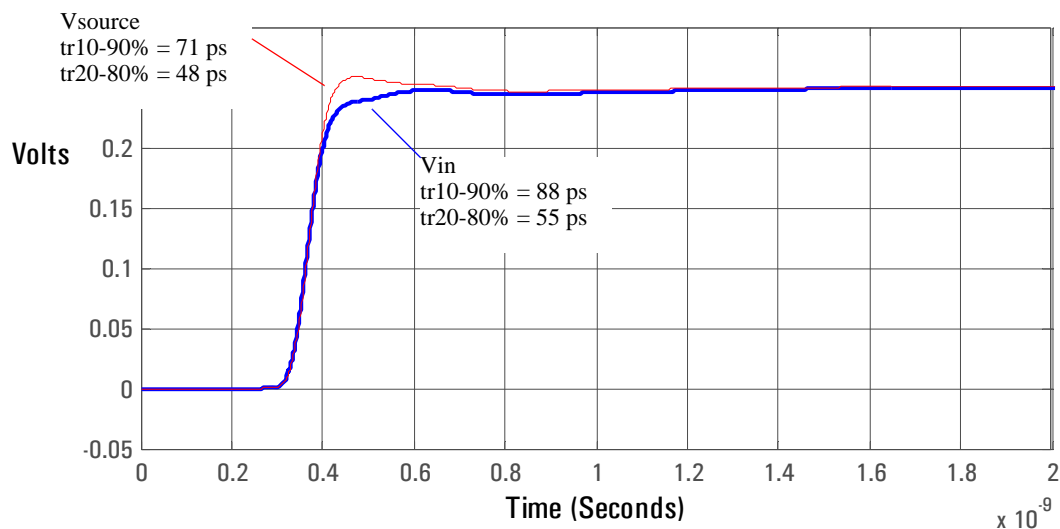
Magnitude plot of accessory input impedance versus frequency.

## 5 and 6 ZIF Probe Head with N5451A Long-Wired ZIF Tip

Unless otherwise noted, time and frequency responses shown here are for the probe only. When the probe is used with the 80000 series oscilloscope, magnitude and phase correction is applied to further optimize the overall response.

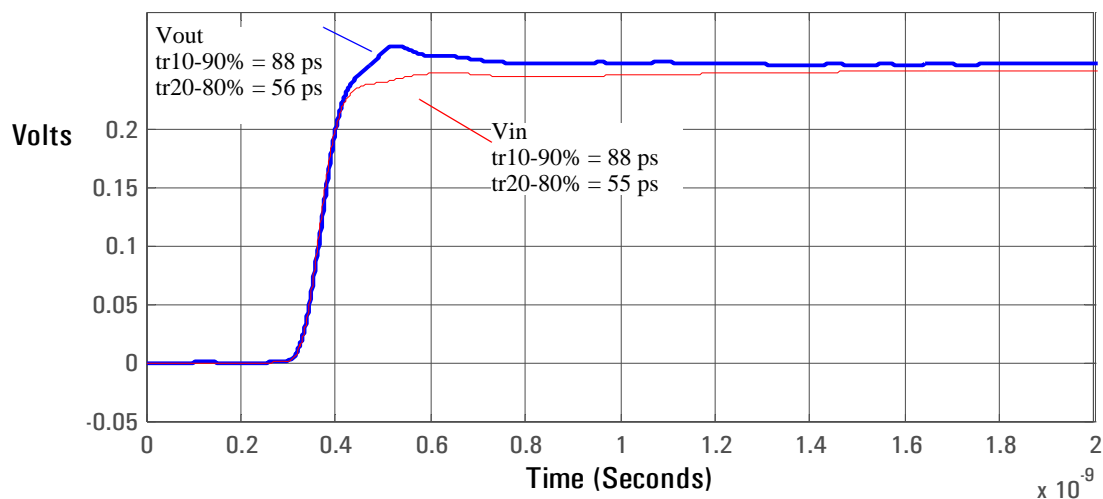
### Plots for 7 mm Lead Length and Zero Degrees of Separation Between the Resistor Leads

Figure 2-36



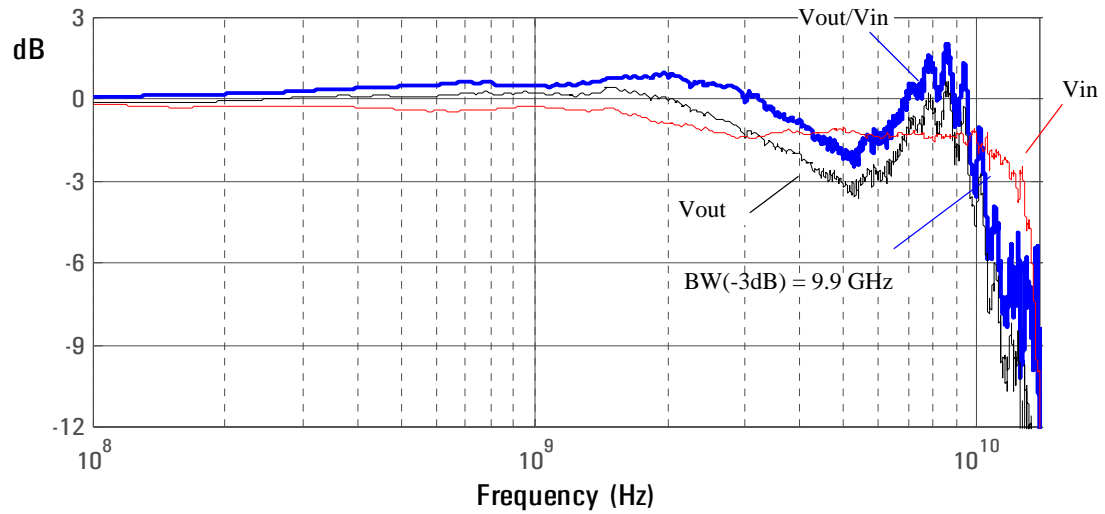
Graph of a 25 W 71 ps step generator with and without the probe connected.

Figure 2-37



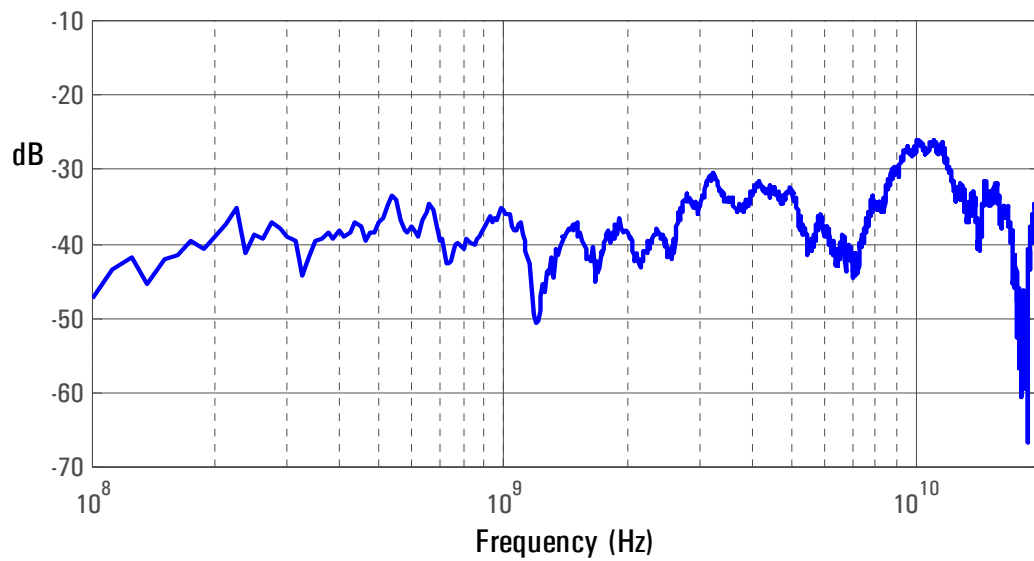
Graph of  $V_{in}$  and  $V_{out}$  of probe with a 25 W 71 ps step generator.

Figure 2-38



Graph of  $dB(V_{in})$  and  $dB(V_{out}) + 10.8 \text{ dB}$  of probe with a 25 W source and  $dB(V_{out}/V_{in}) + 10.8 \text{ dB}$  frequency response.

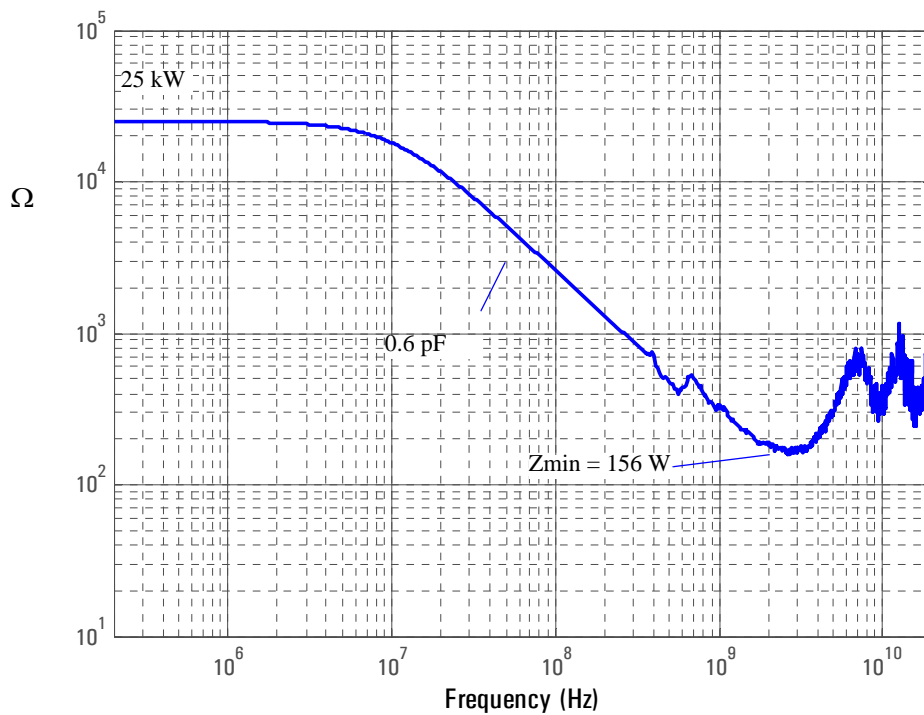
Figure 2-39



Graph of  $dB(V_{out}/V_{in}) + 10.8 \text{ dB}$  frequency response when inputs driven in common (common mode rejection).

# Differential and Single-ended Probe Configurations 5 and 6 ZIF Probe Head with N5451A Long-Wired ZIF Tip

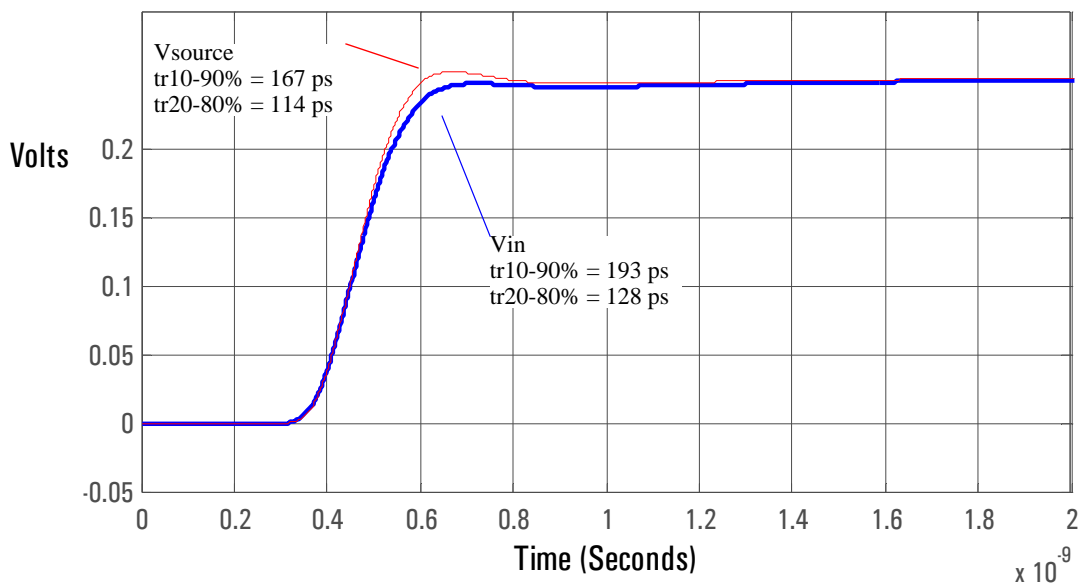
Figure 2-40



Magnitude plot of probe input impedance versus frequency (single ended mode input).

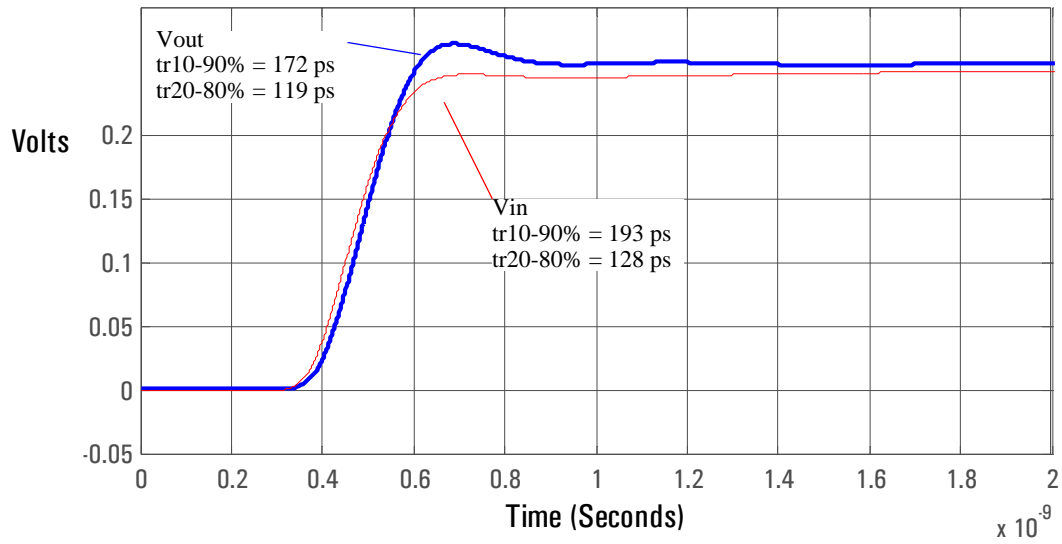
## Plots for 7 mm Lead Length and Sixty Degrees of Separation between the Resistor Leads

Figure 2-41



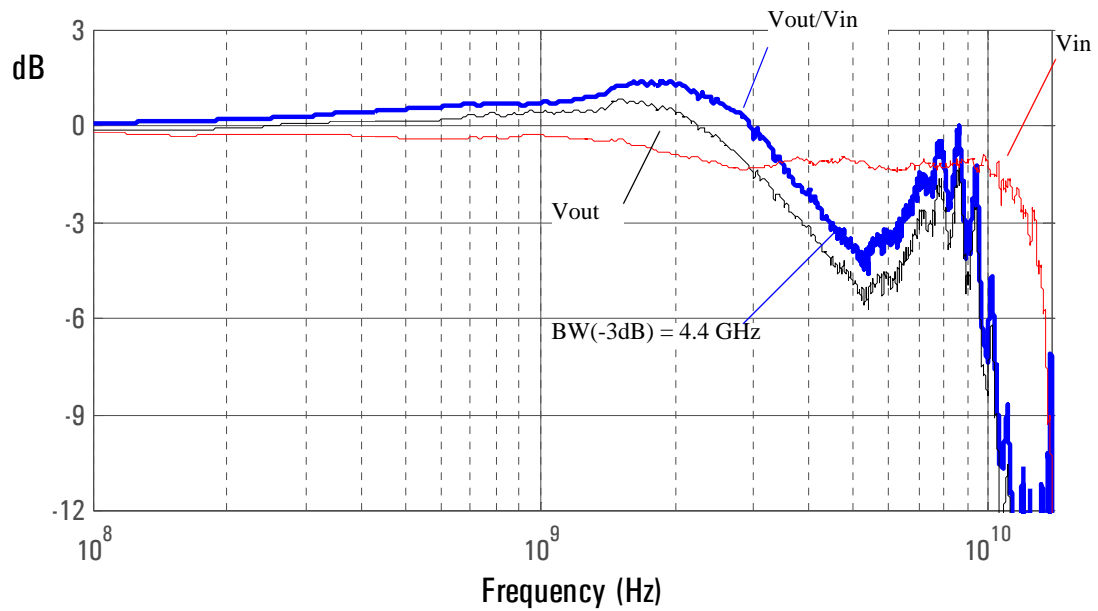
Graph of a 25 W 167 ps step generator with and without the probe connected.

Figure 2-42



Graph of  $V_{out}$  and  $V_{in}$  of probe with a 25 W 167 ps step generator.

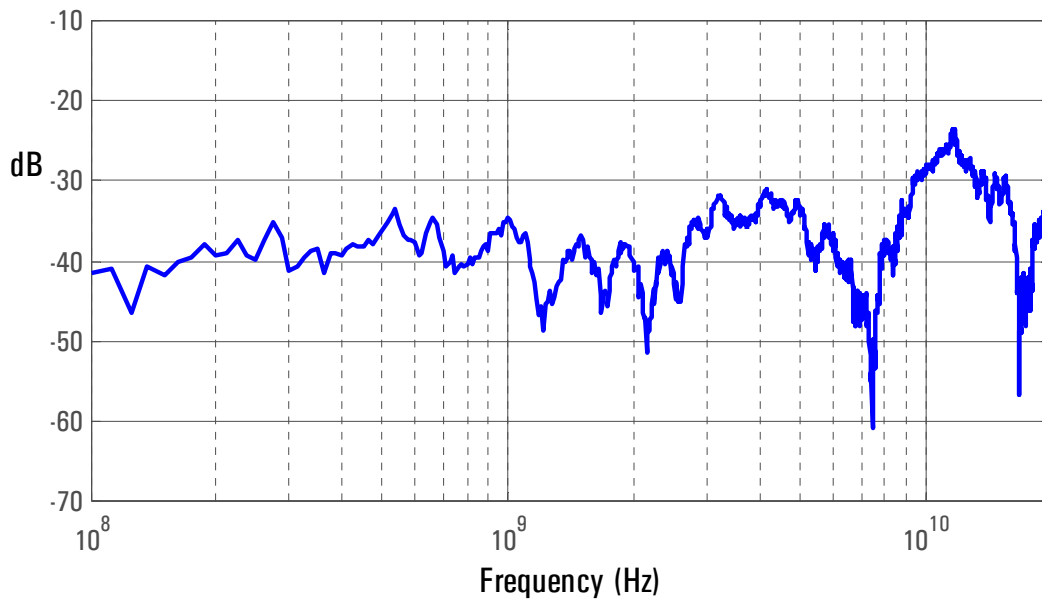
Figure 2-43



Graph of  $dB(V_{in})$  and  $dB(V_{out}) + 10.8$  dB of probe with a 25 W source and  $dB(V_{out}/V_{in}) + 10.8$  dB frequency response.

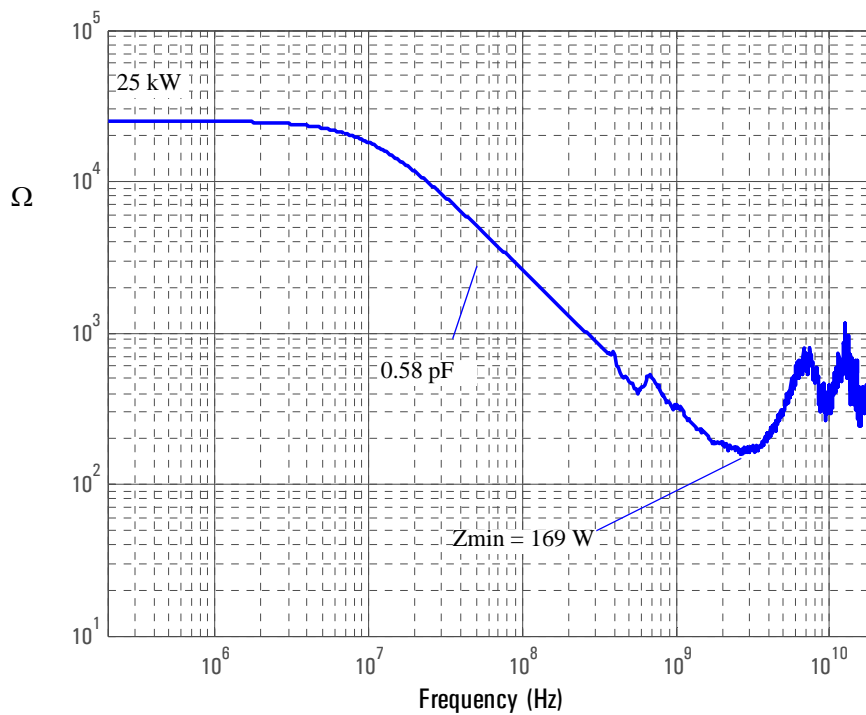
# Differential and Single-ended Probe Configurations 5 and 6 ZIF Probe Head with N5451A Long-Wired ZIF Tip

Figure 2-44



Graph of  $\text{dB}(V_{\text{out}}/V_{\text{in}}) + 10.8$  dB frequency response when inputs driven in common (common mode rejection).

Figure 2-45

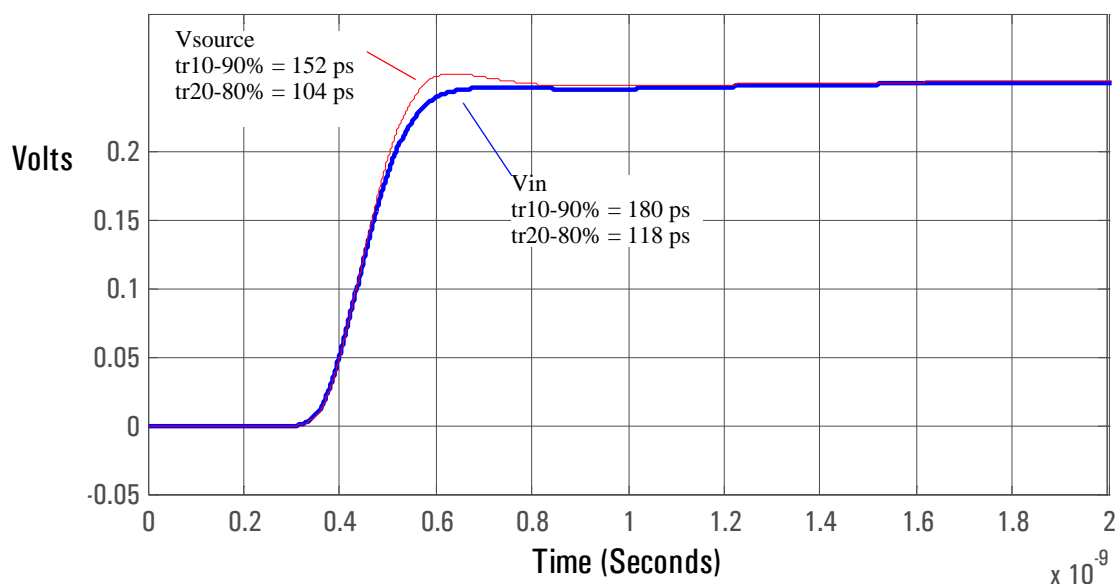


Magnitude plot of probe input impedance versus frequency (single-ended mode input).



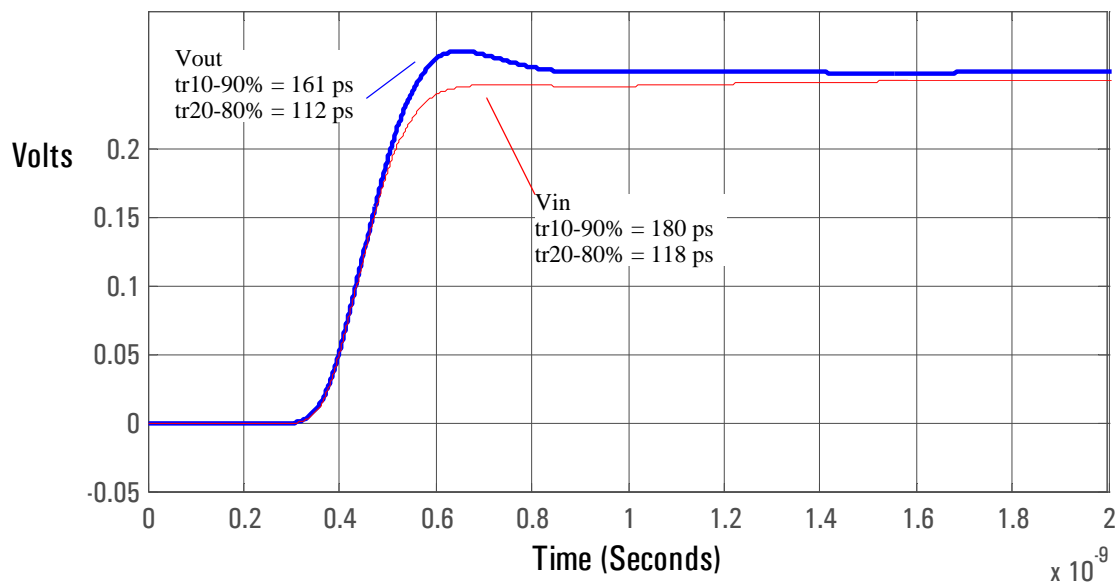
**Plots for 11 mm Lead Length and Zero Degrees of Separation Between the Resistor Leads**

**Figure 2-46**



Graph of 25 W 152 ps step generator with and without the probe connected.

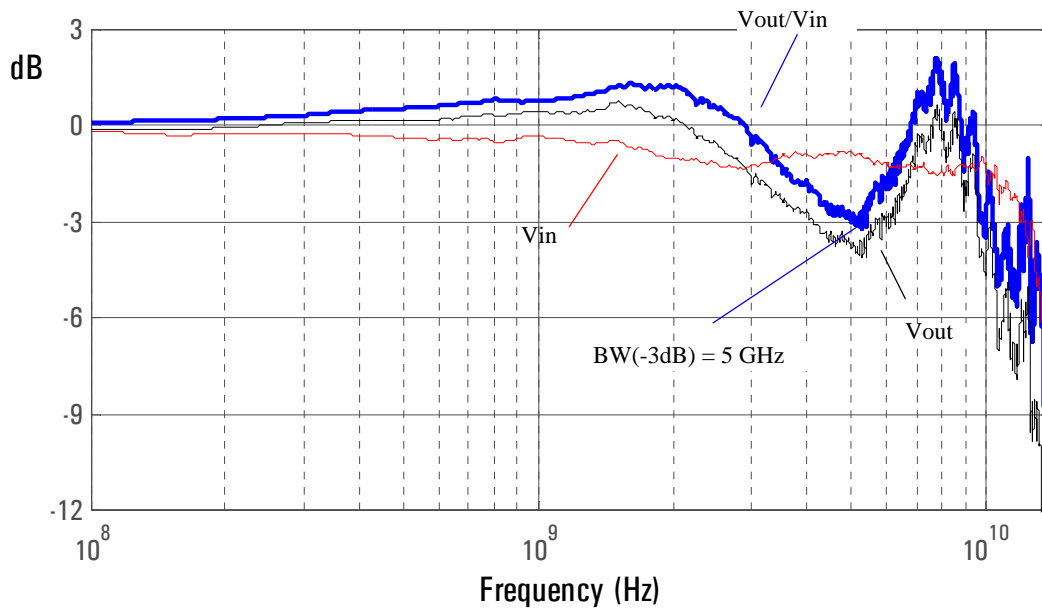
**Figure 2-47**



Graph of  $V_{in}$  and  $V_{out}$  of probe with a 25 W 152 ps step generator.

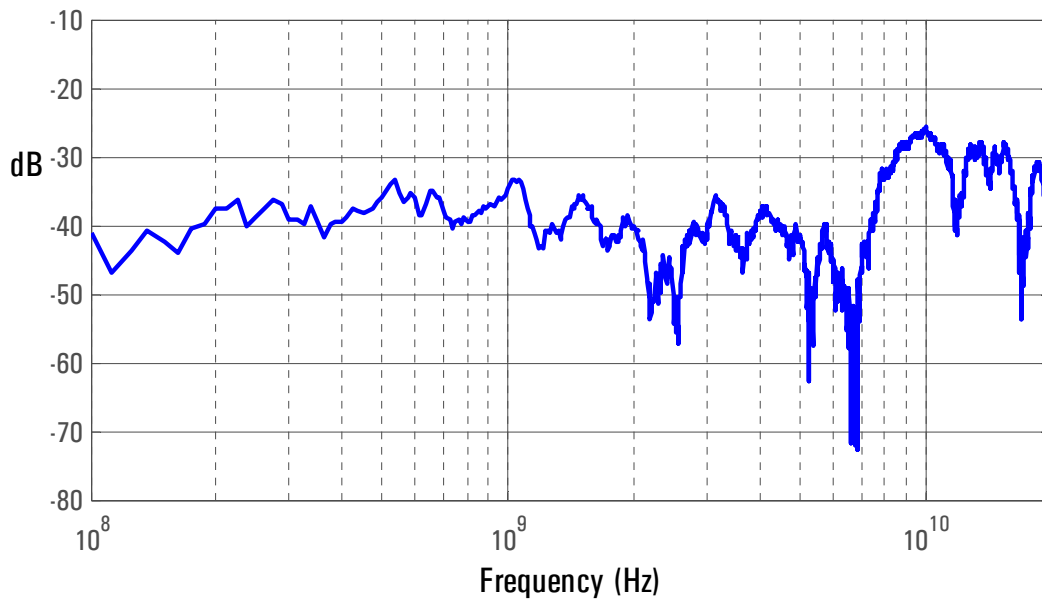
# Differential and Single-ended Probe Configurations 5 and 6 ZIF Probe Head with N5451A Long-Wired ZIF Tip

Figure 2-48



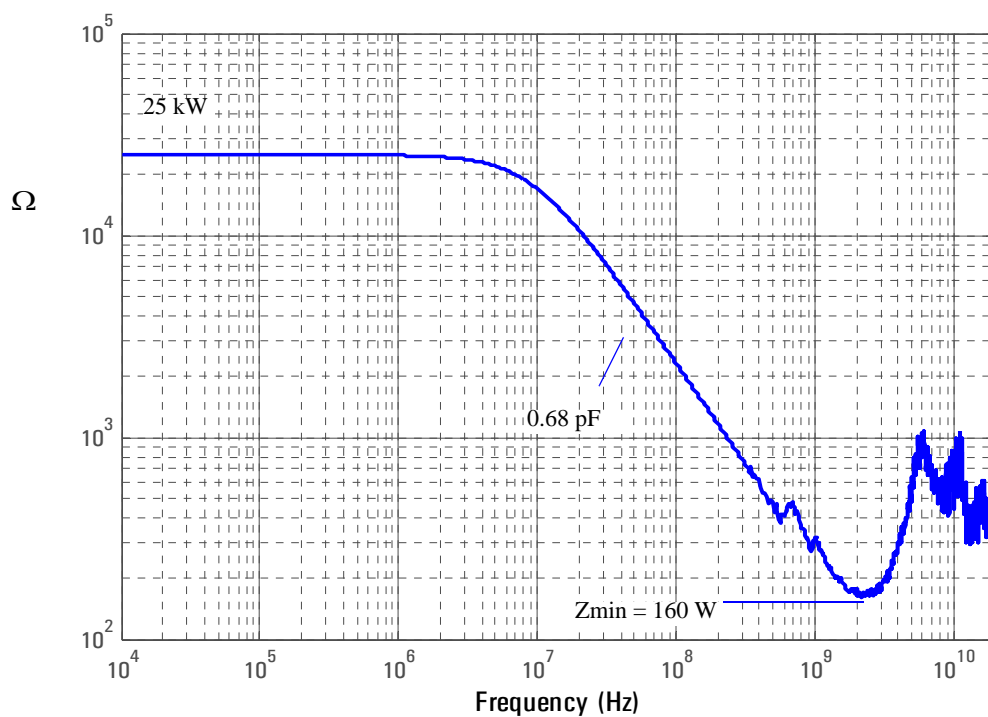
Graph of  $dB(V_{in})$  and  $dB(V_{out}) + 10.8\text{ dB}$  of probe with a 25 W source and  $dB(V_{out}/V_{in}) + 10.8\text{ dB}$  frequency response.

Figure 2-49



Graph of  $dB(V_{out}/V_{in}) + 10.8\text{ dB}$  frequency response when inputs driven in common (common mode rejection).

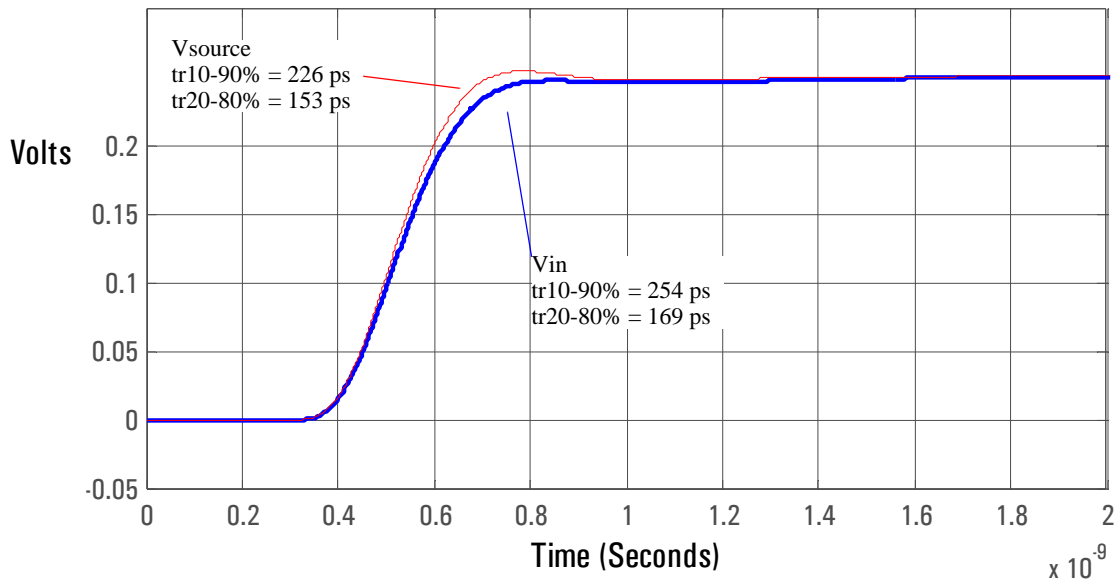
Figure 2-50



Magnitude plot of probe input impedance versus frequency (single-ended mode input).

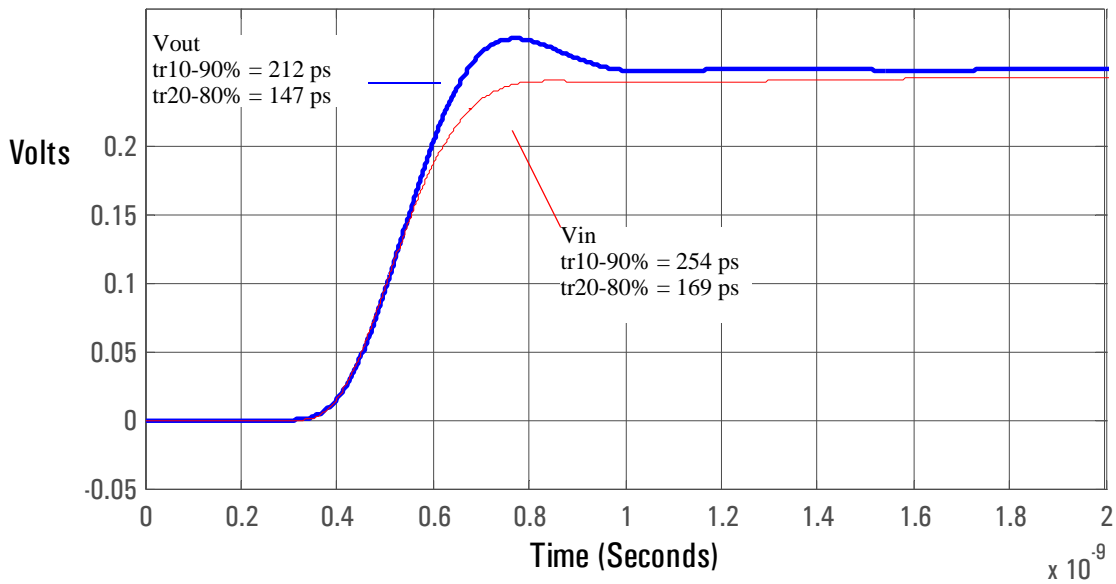
**Plots for 11 mm Lead Length and Sixty Degrees of Separation between the Resistor Leads**

**Figure 2-51**



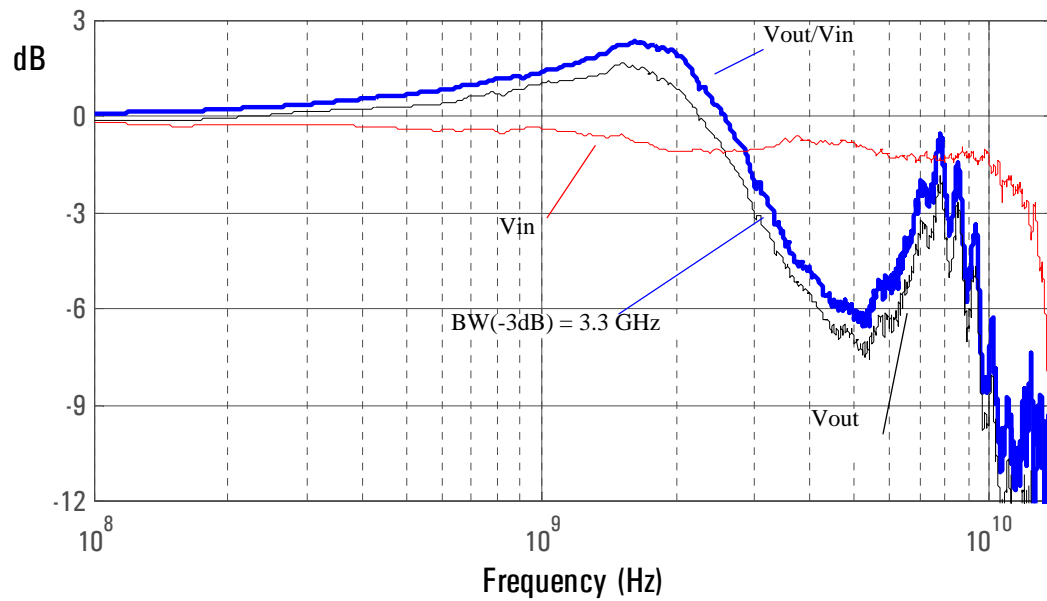
Graph of 25 W 226 ps step generator with and without the probe connected.

**Figure 2-52**



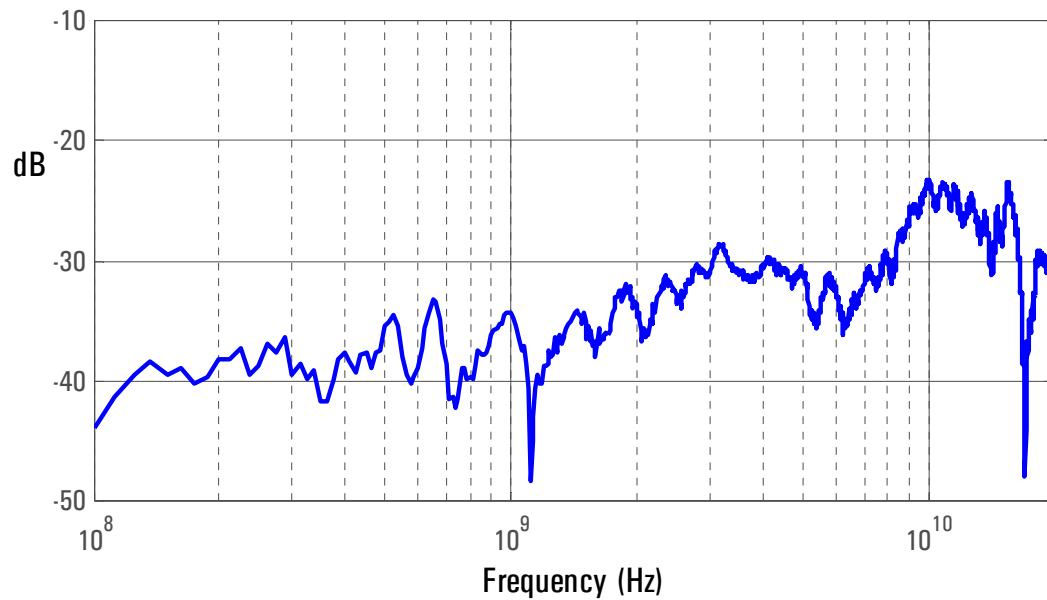
Graph of  $V_{in}$  and  $V_{out}$  of probe with a 25 W 226 ps step generator.

Figure 2-53



Graph of  $\text{dB}(V_{in})$  and  $\text{dB}(V_{out}) + 10.8 \text{ dB}$  of probe with a 25 W source and  $\text{dB}(V_{out}/V_{in}) + 10.8 \text{ dB}$  frequency response.

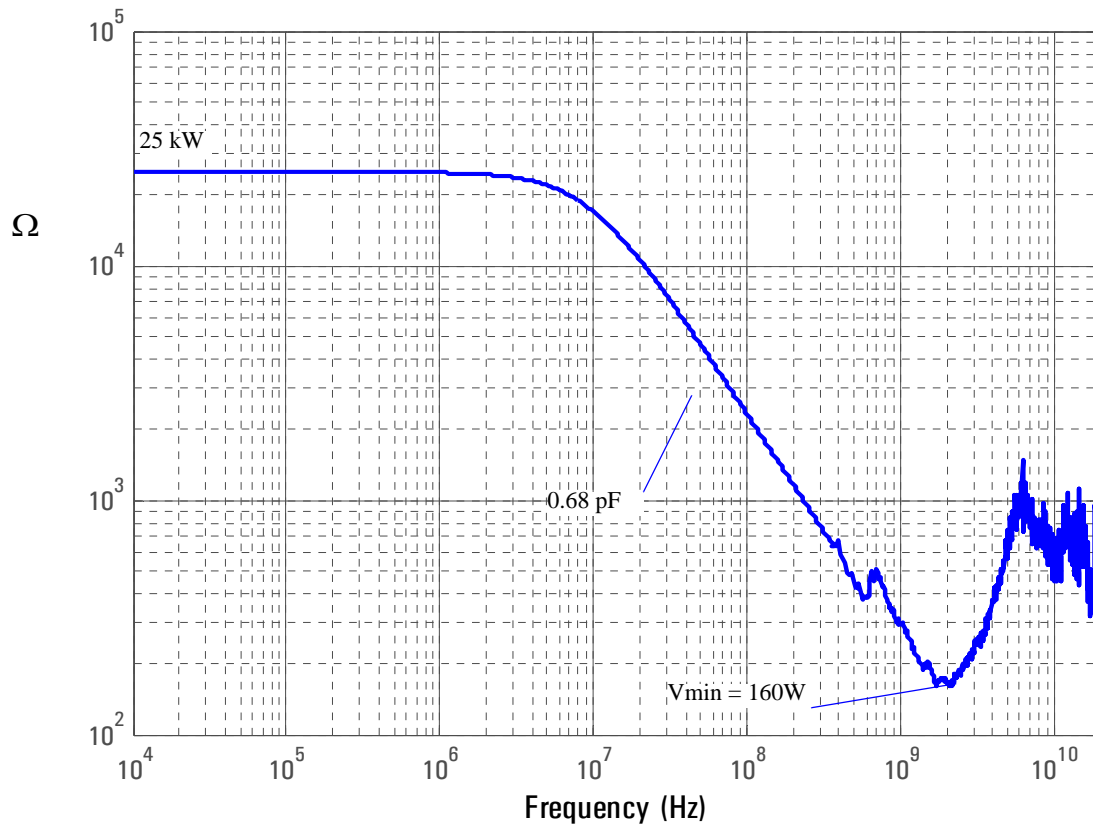
Figure 2-54



Graph of  $\text{dB}(V_{out}/V_{in}) + 10.8 \text{ dB}$  frequency response when inputs driven in common (common mode rejection).

**Differential and Single-ended Probe Configurations**  
**5 and 6 ZIF Probe Head with N5451A Long-Wired ZIF Tip**

**Figure 2-55**



Magnitude plot of probe input impedance versus frequency (single-ended mode input).

---

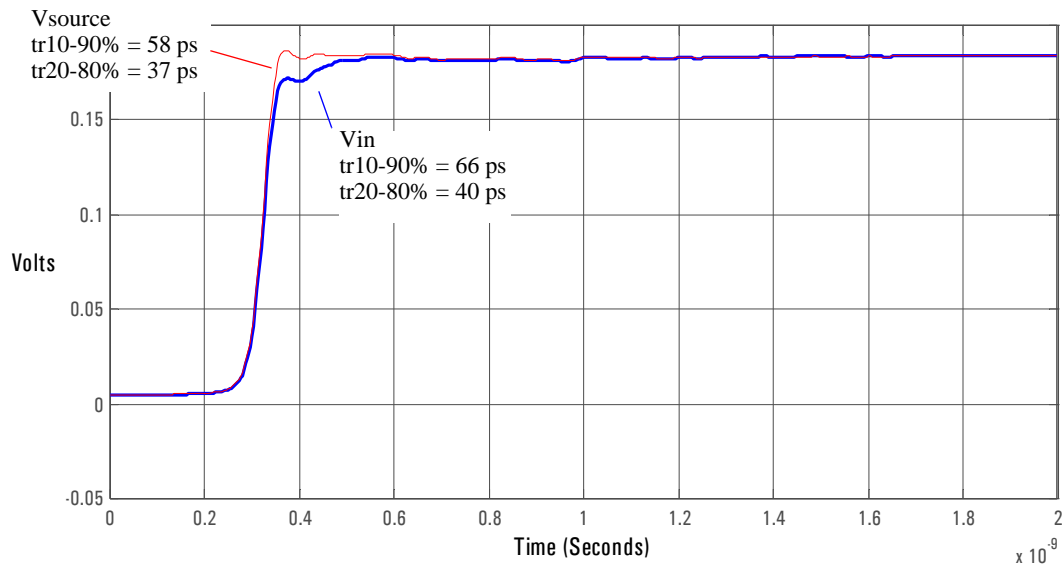
## Detailed Information for Other Configurations

This section contains graphs of the performance characteristics of the 1169A active probe using the different probe heads that come with the E2669A differential connectivity kit and the E2695A SMA probe head.

## 7 E2677A Solder-in Differential Probe Head (High Bandwidth)

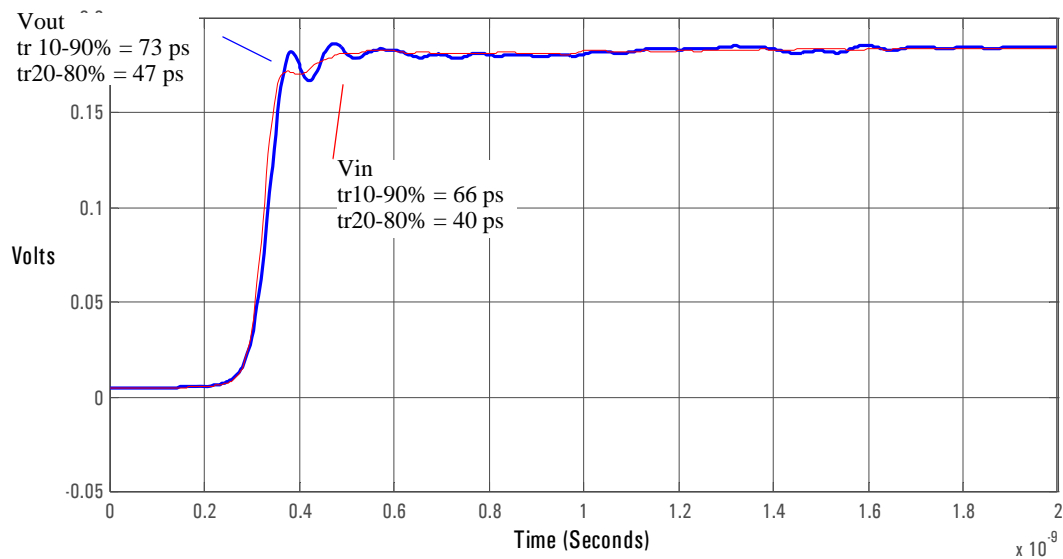
For solder-in applications, the N5381A probe head is preferred. Variations in the manufacture and positioning of the mini-axial lead resistors used with the E2677A cause variations in the response. If you must use the E2677A, insure that the mini-axial lead resistors are positioned directly adjacent to each other and touching.

Figure 2-1



Graph of 25 W 58 ps step generator with and without probe connected.

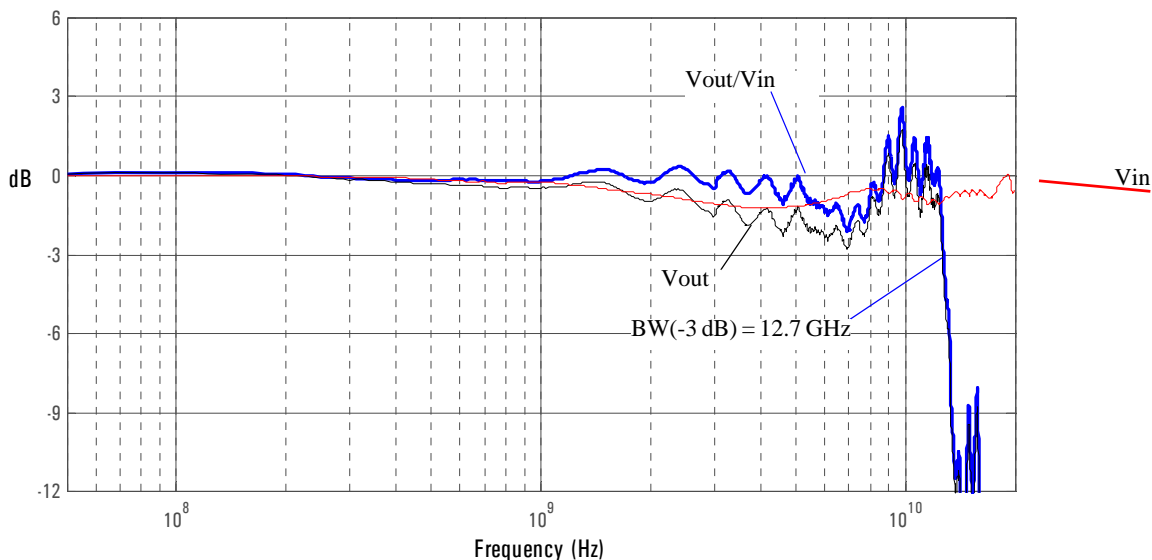
Figure 2-2



Graph of  $V_{in}$  and  $V_{out}$  of probe with a 25 W 58 ps step generator.

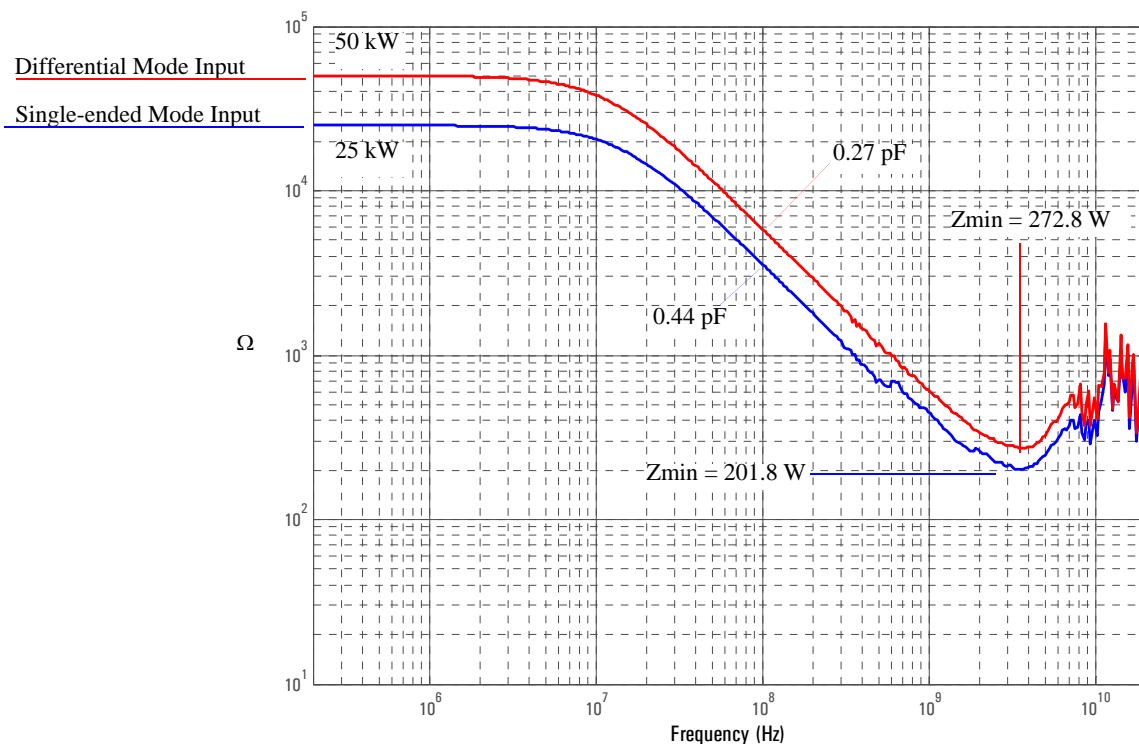


Figure 2-3



Graph of  $\text{dB}(V_{in})$  and  $\text{dB}(V_{out}) + 10.8\text{ dB}$  of probe with a 25 W source and  $\text{dB}(V_{out}/V_{in}) + 10.8\text{ dB}$  frequency response.

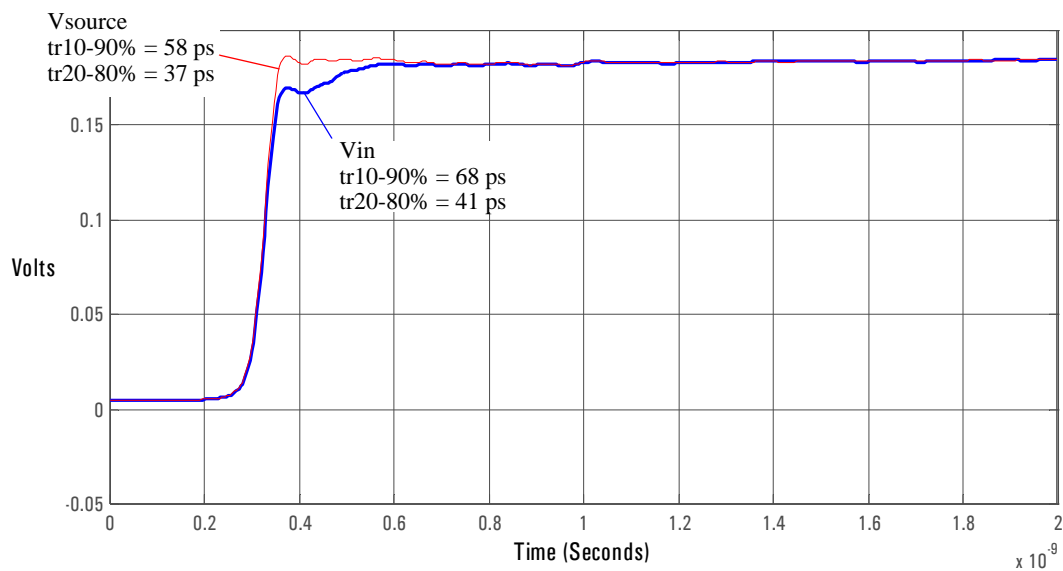
Figure 2-4



Magnitude plot of probe input impedance versus frequency.

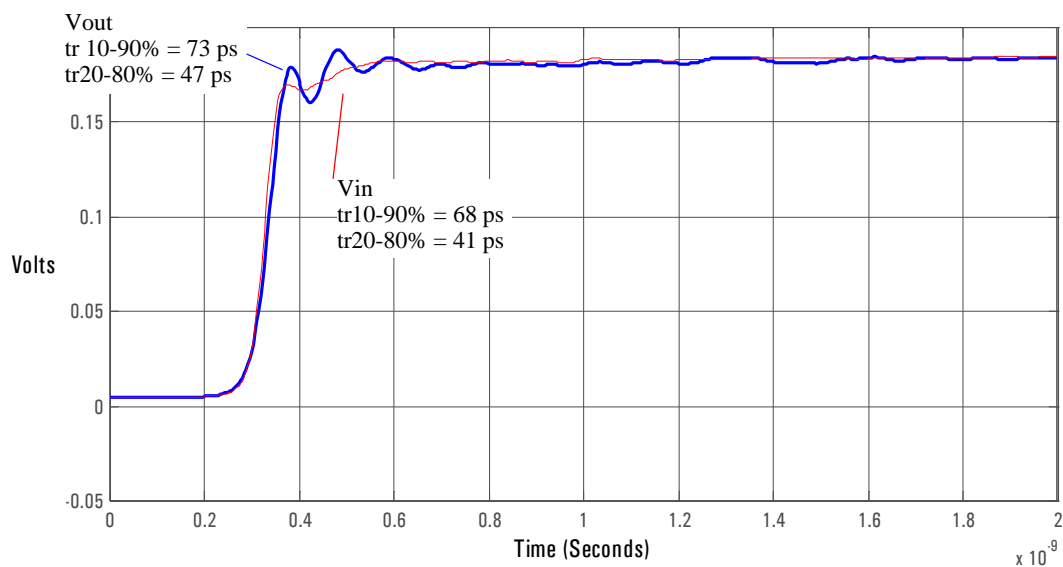
## 8 E2678A Socketed Differential Probe Head (High Bandwidth)

Figure 2-5



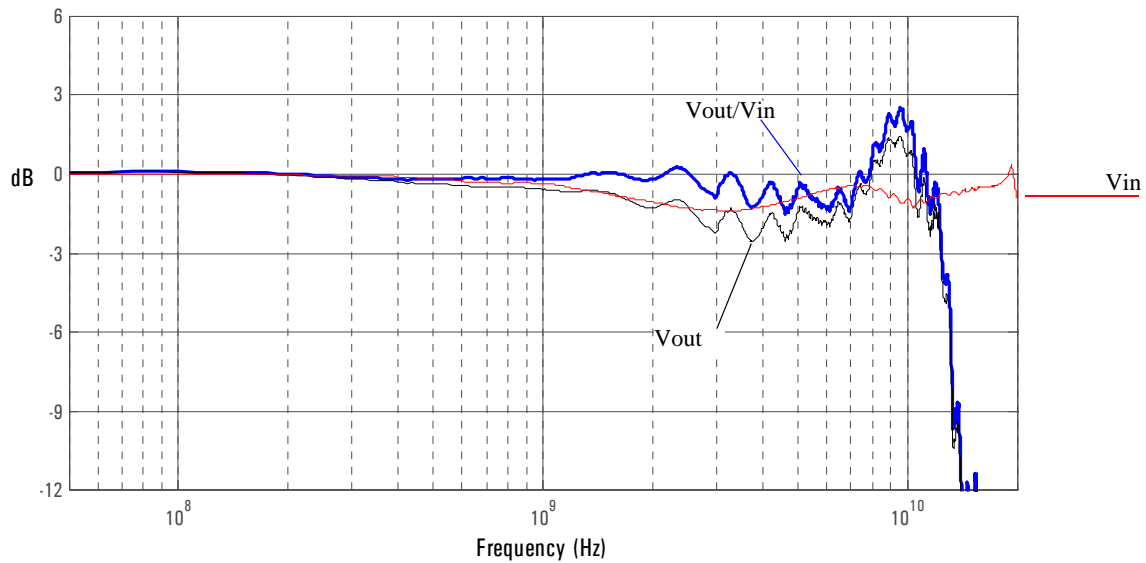
Graph of 25 W 58 ps step generator with and without probe connected.

Figure 2-6



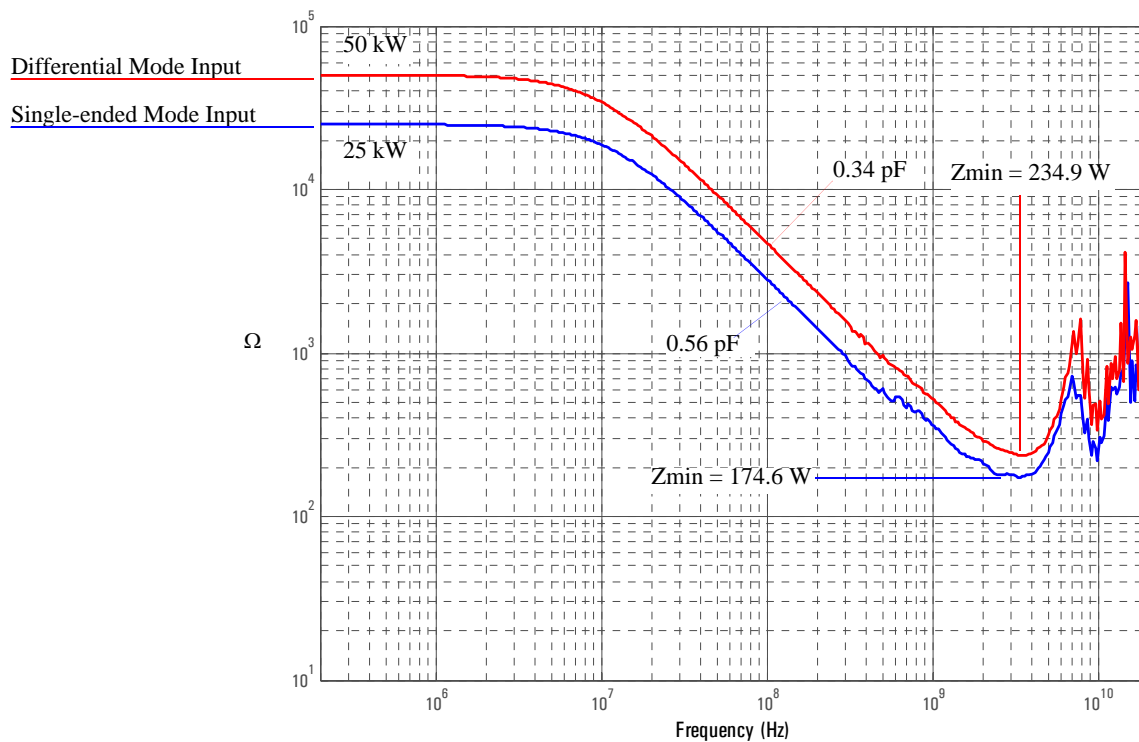
Graph of  $V_{in}$  and  $V_{out}$  of probe with a 25 W 58 ps step generator.

Figure 2-7



Graph of  $\text{dB}(V_{in})$  and  $\text{dB}(V_{out}) + 10.8 \text{ dB}$  of probe with a 25 W source and  $\text{dB}(V_{out}/V_{in}) + 10.8 \text{ dB}$  frequency response.

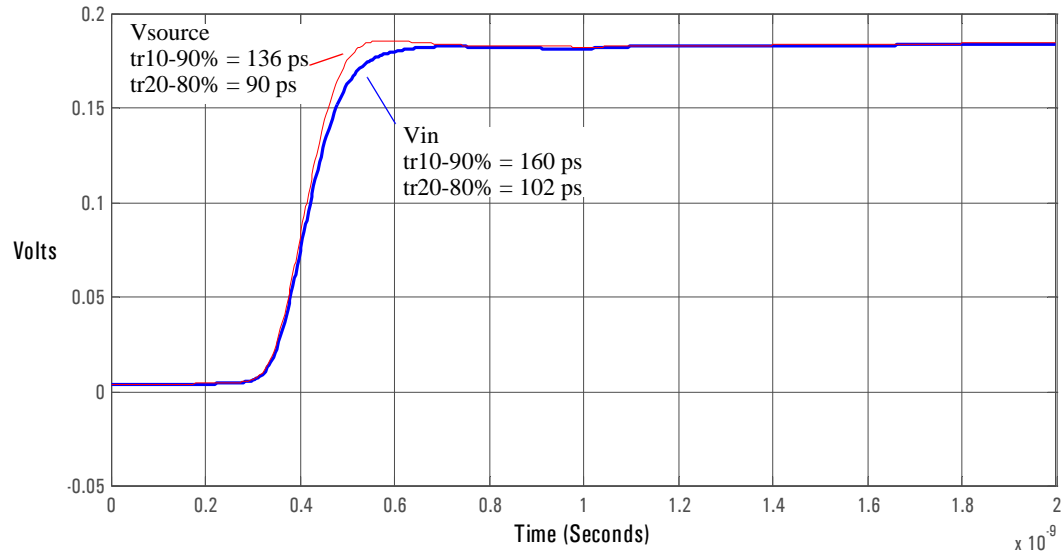
Figure 2-8



Magnitude plot of probe input impedance versus frequency.

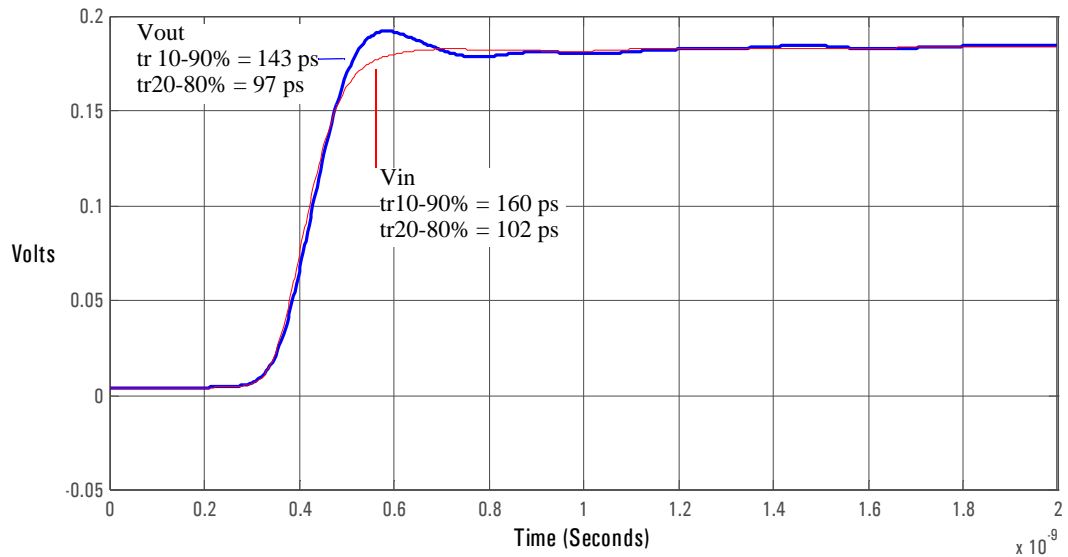
## 9 E2675A Differential Browser

Figure 2-9



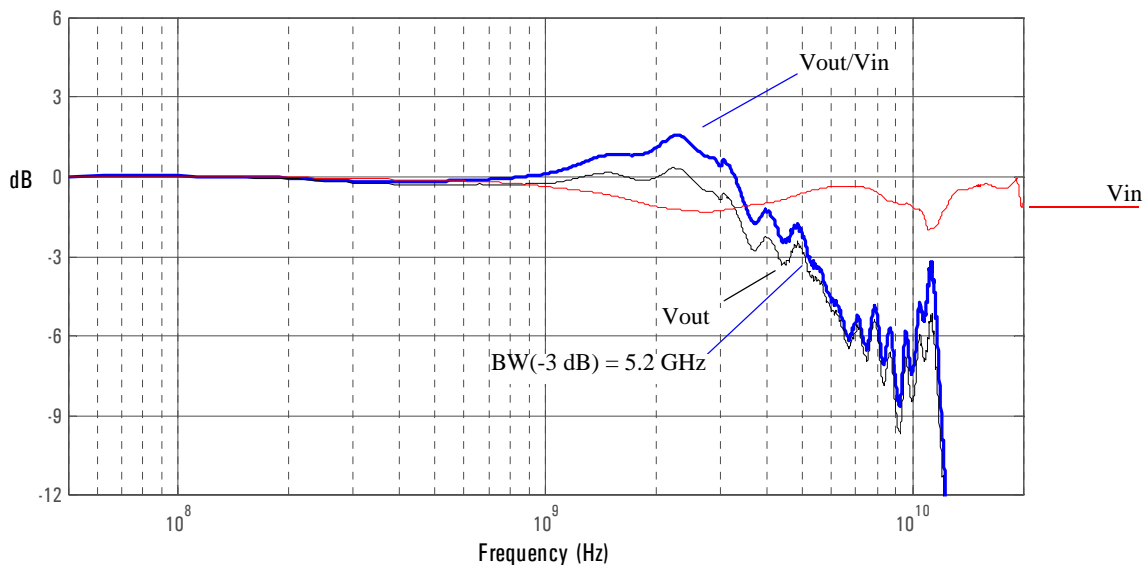
Graph of 25 W 136 ps step generator with and without probe connected.

Figure 2-10



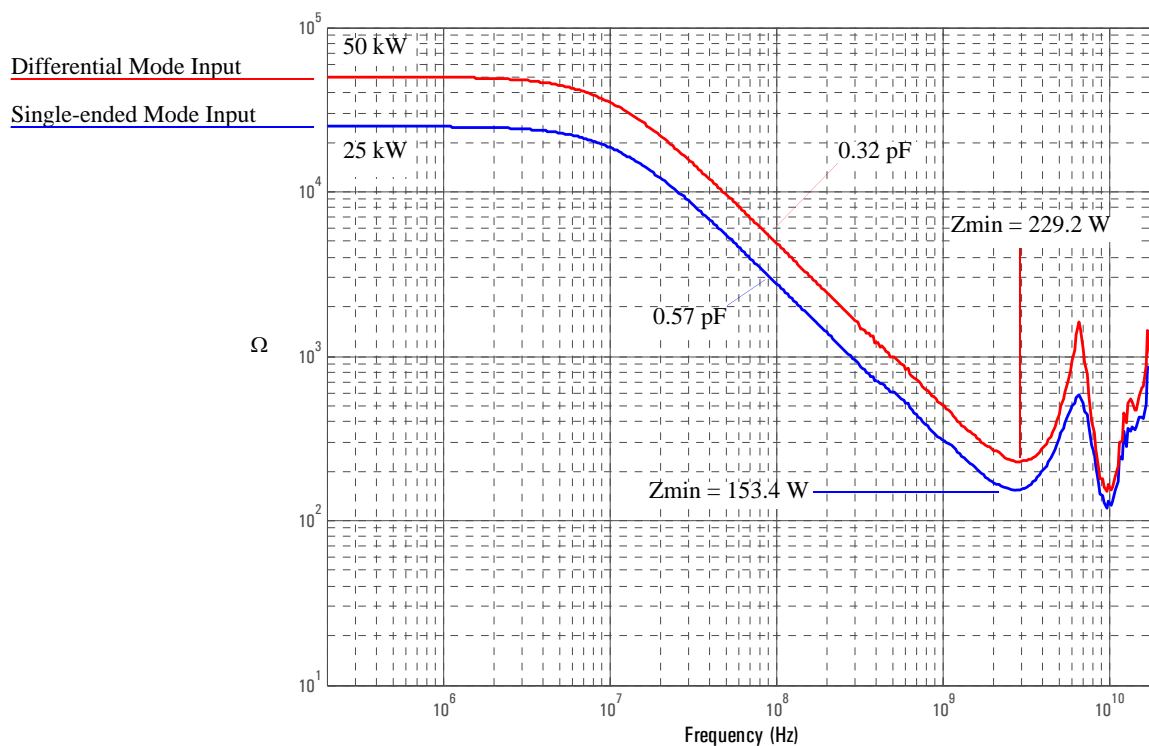
Graph of  $V_{in}$  and  $V_{out}$  of probe with a 25 W 136 ps step generator.

Figure 2-11



Graph of dB( $V_{in}$ ) and dB( $V_{out}$ ) + 10.8 dB of probe with a 25 W source and dB( $V_{out}/V_{in}$ ) + 10.8 dB frequency response.

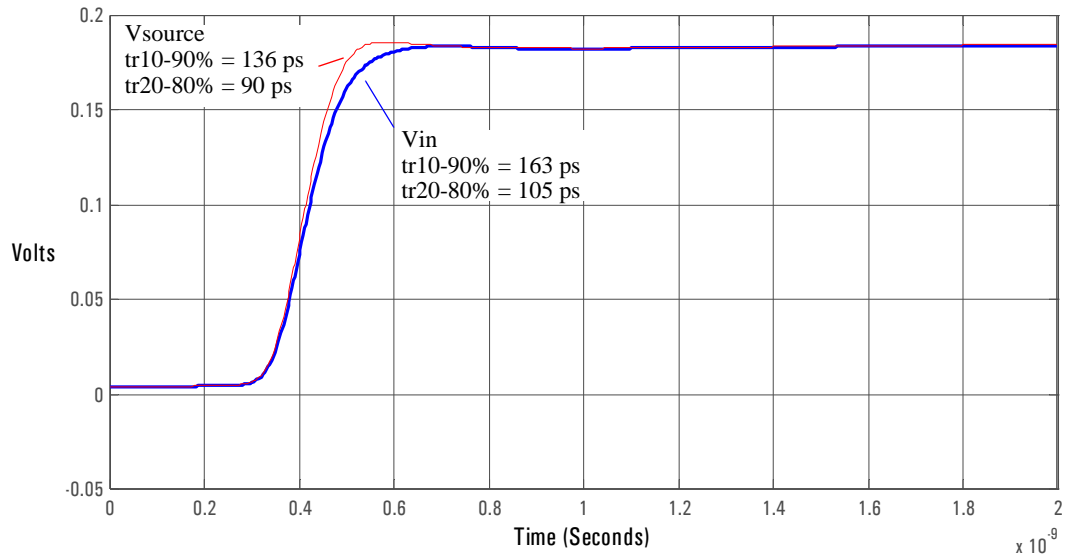
Figure 2-12



Magnitude plot of probe input impedance versus frequency.

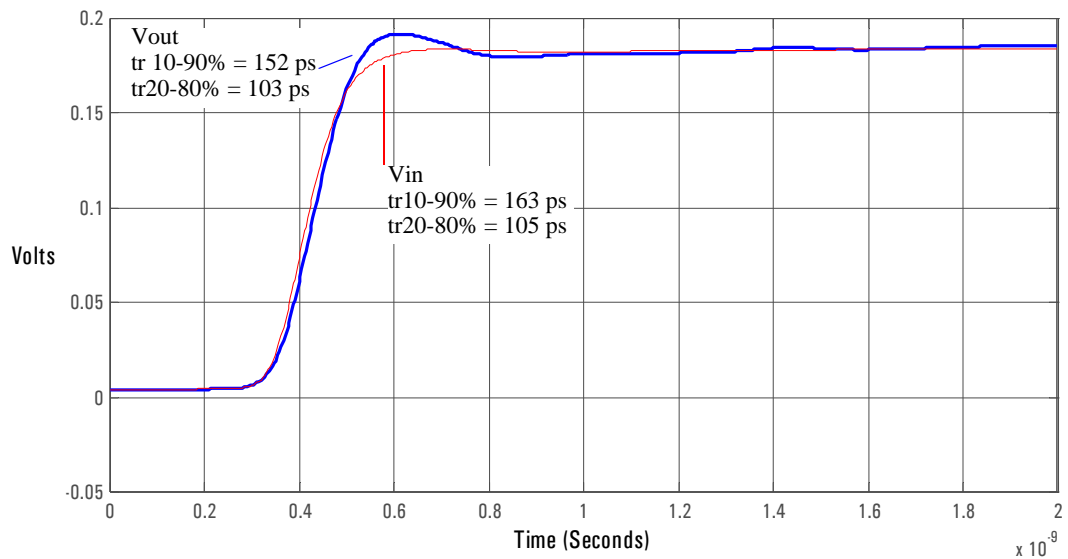
## 10 E2679A Solder-in Single-ended Probe Head (High Bandwidth)

Figure 2-13



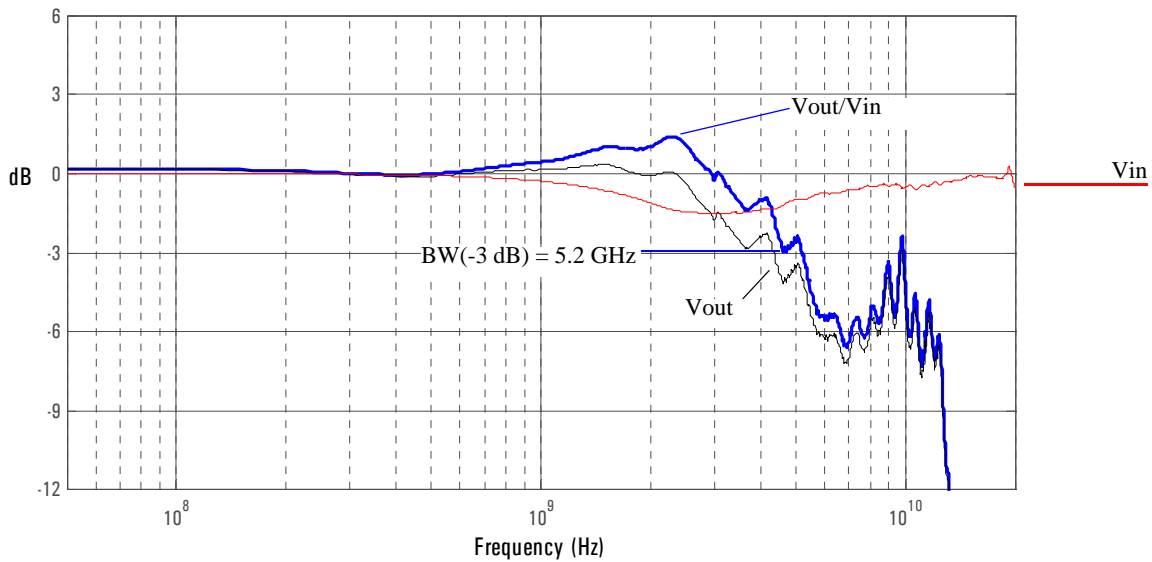
Graph of 25 W 136 ps step generator with and without probe connected.

Figure 2-14



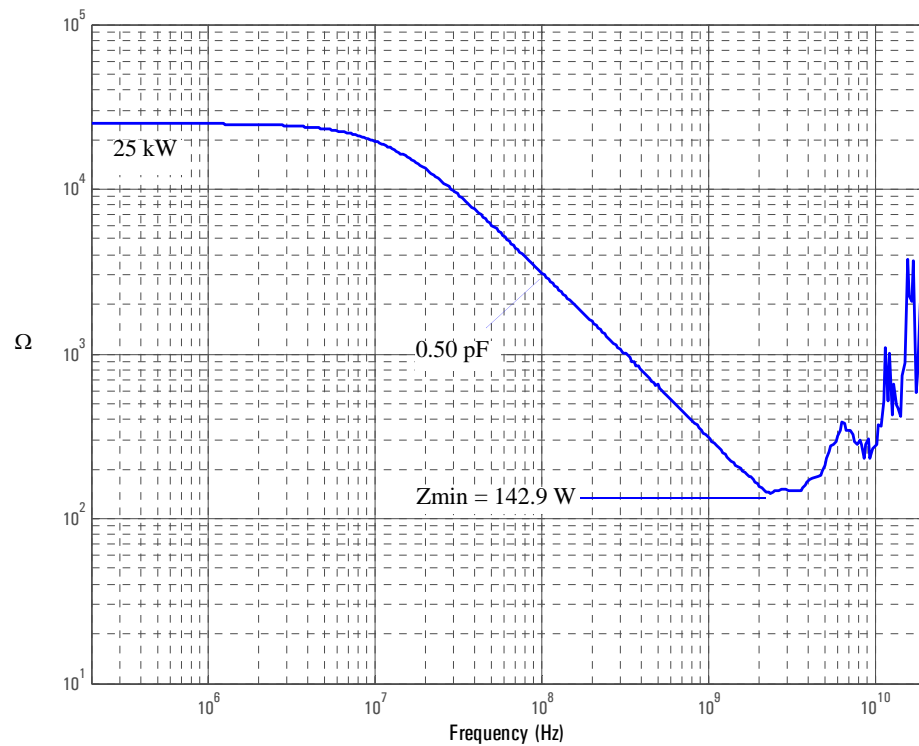
Graph of  $V_{in}$  and  $V_{out}$  of probe with a 25 W 136 ps step generator.

**Figure 2-15**



Graph of  $\text{dB}(V_{in})$  and  $\text{dB}(V_{out}) + 10.8\text{ dB}$  of probe with a 25 W source and  $\text{dB}(V_{out}/V_{in}) + 10.8\text{ dB}$  frequency response.

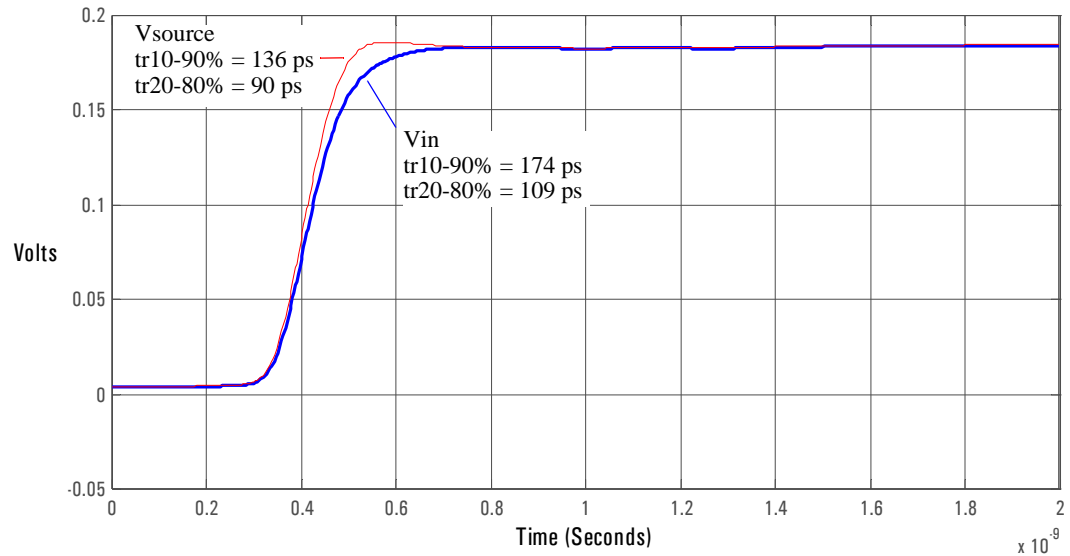
**Figure 2-16**



Magnitude plot of probe input impedance versus frequency.

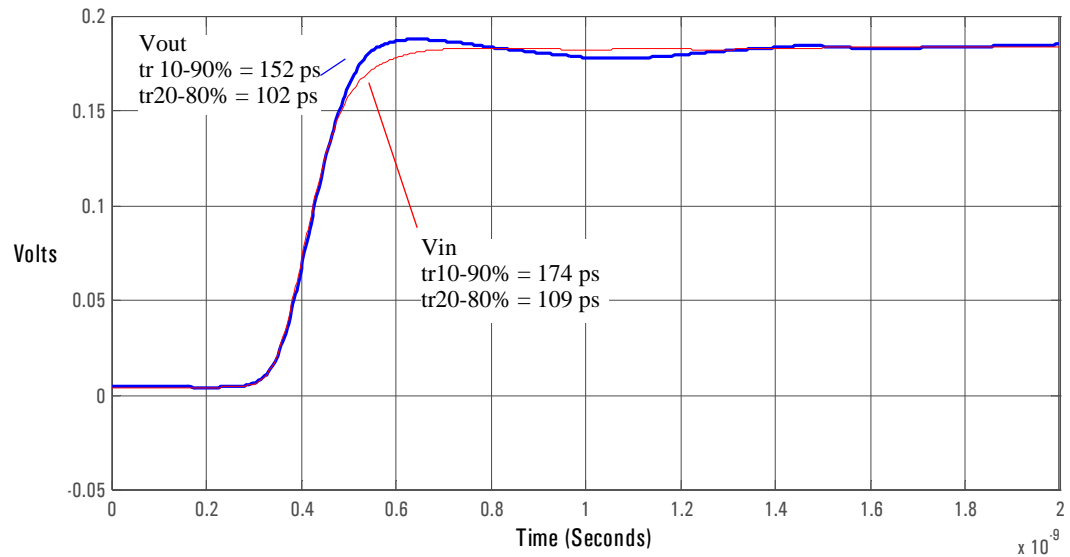
## 11 E2676A Single-ended Browser

Figure 2-17



Graph of 25 W 100 ps step generator with and without probe connected.

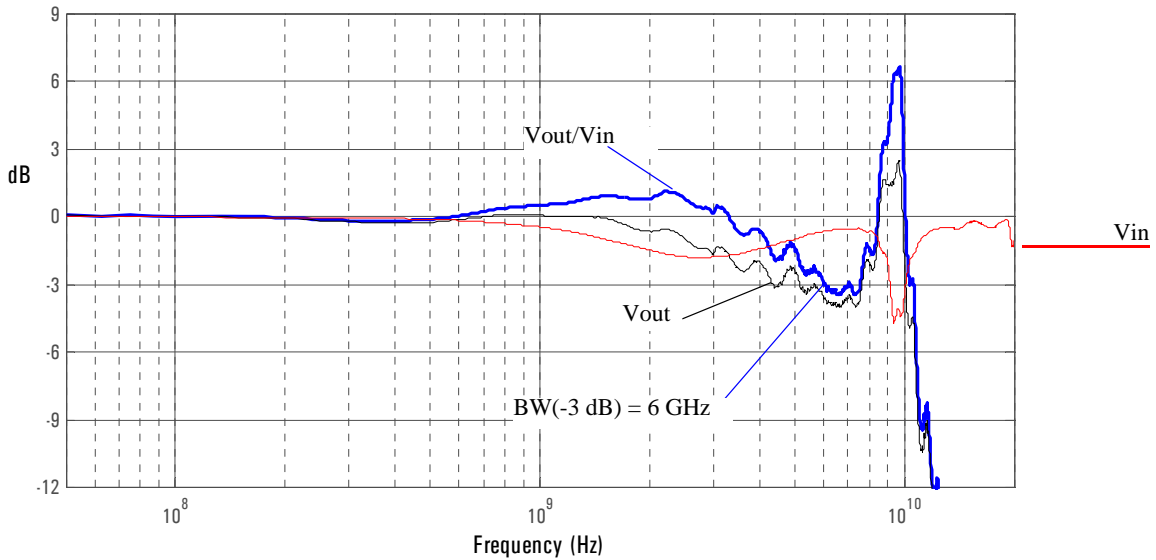
Figure 2-18



Graph of  $V_{in}$  and  $V_{out}$  of probe with a 25 W 100 ps step generator.



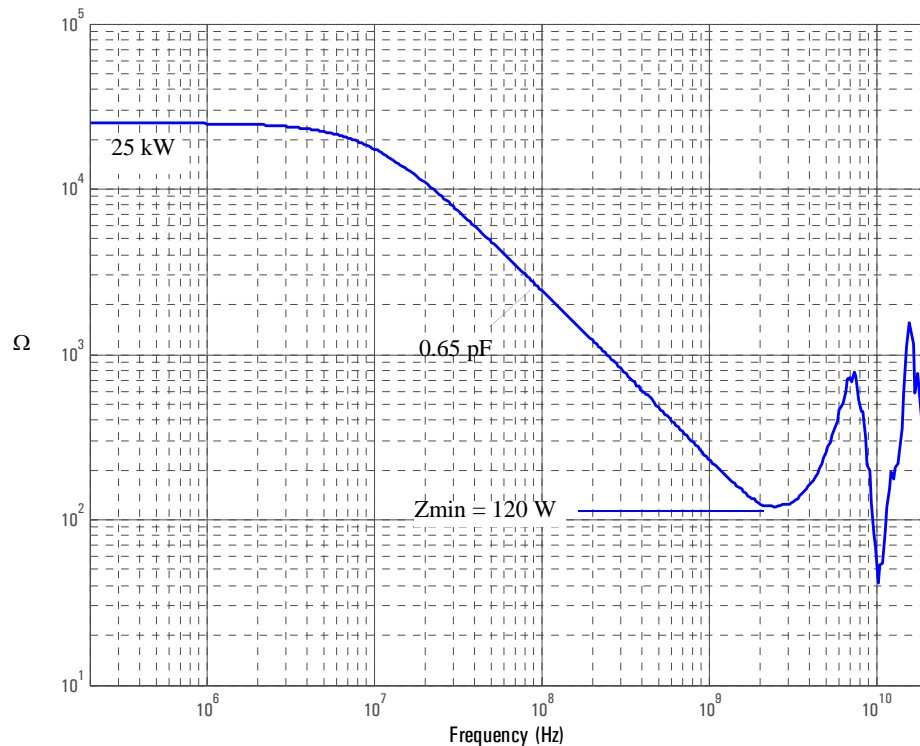
Figure 2-19



Graph of dB( $V_{in}$ ) and dB( $V_{out}$ ) + 10.8 dB of probe with a 25 W source and dB( $V_{out}/V_{in}$ ) + 10.8 dB frequency response.

The ground inductance and structure of the E2676A Single-ended Browser causes a resonant peak at ~10 GHz. This probe head was designed for the 1134A 7 GHz probe system. The input signal should be limited to an equivalent bandwidth of about 4.2 GHz (110 ps, 10-90%) to prevent ringing at 10 GHz

Figure 2-20

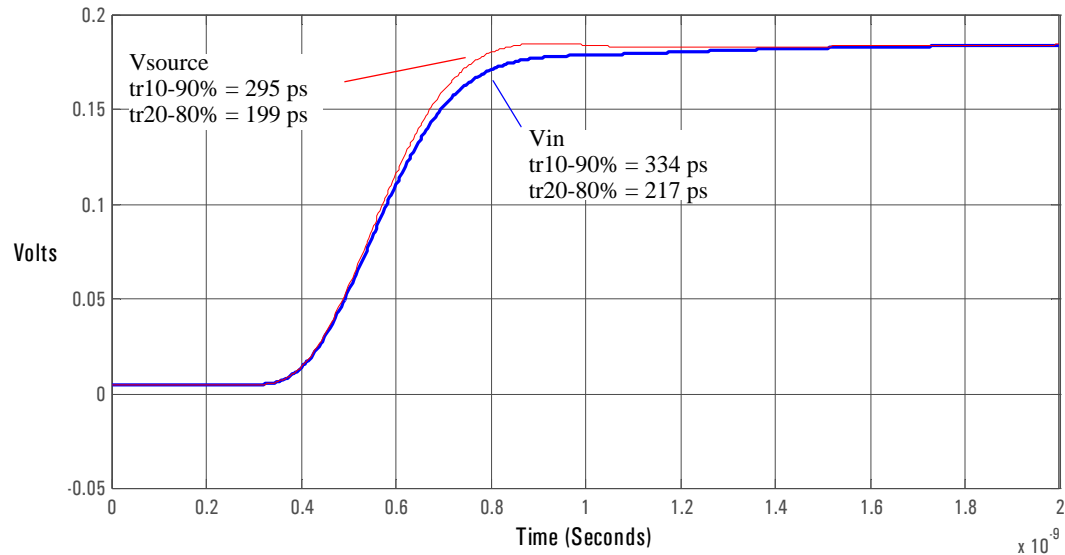


Magnitude plot of probe input impedance versus frequency.

## 12 E2678A Socketed Differential Probe Head with Damped Wire Accessory

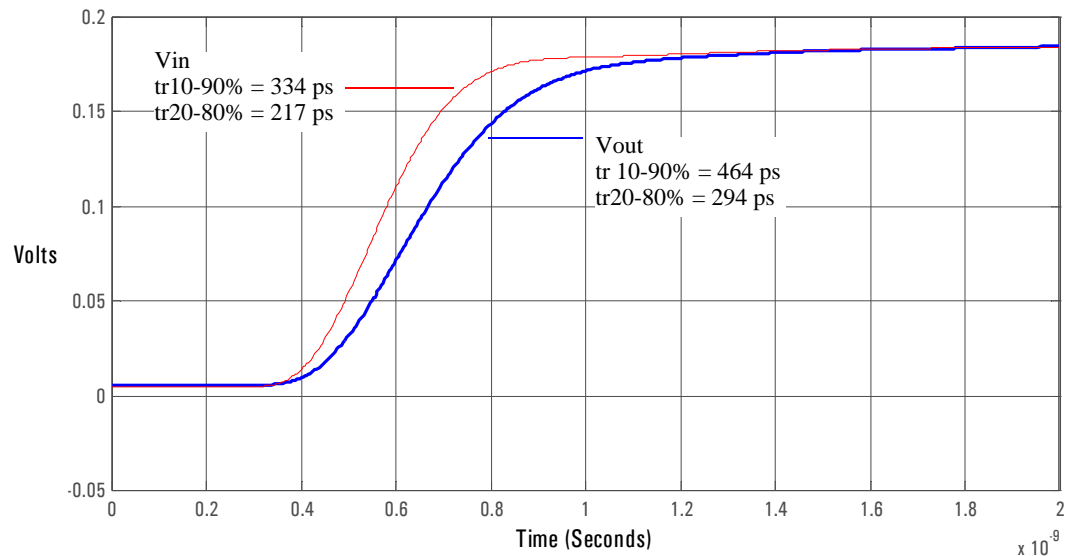
Due to reflections on the long wire accessories, signals being probed should be limited to ~ 240 ps rise time measured at the 10% and 90% amplitude levels. This is equivalent to ~ 1.5 GHz bandwidth.

Figure 2-21



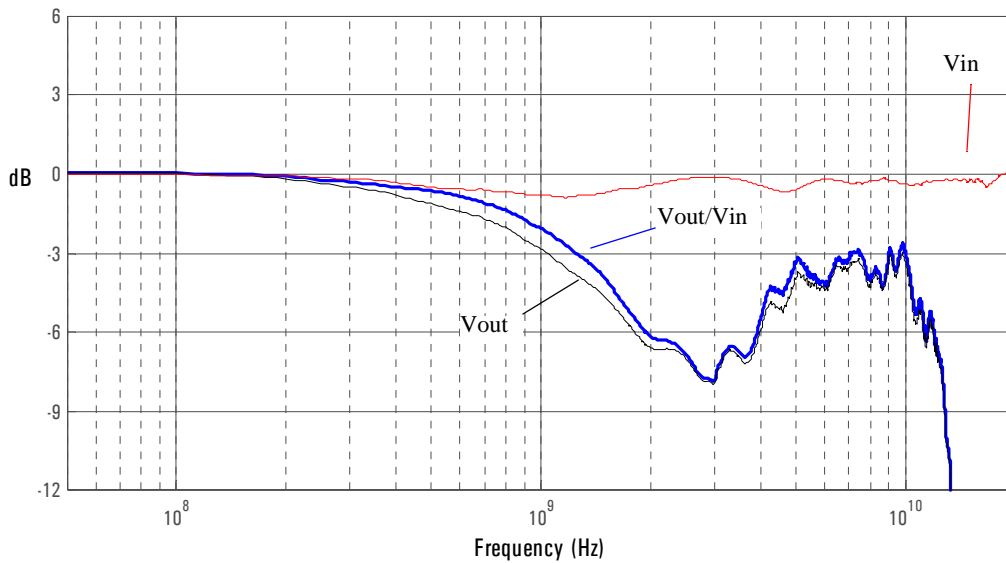
Graph of 25 W 295 ps step generator with and without probe connected.

Figure 2-22



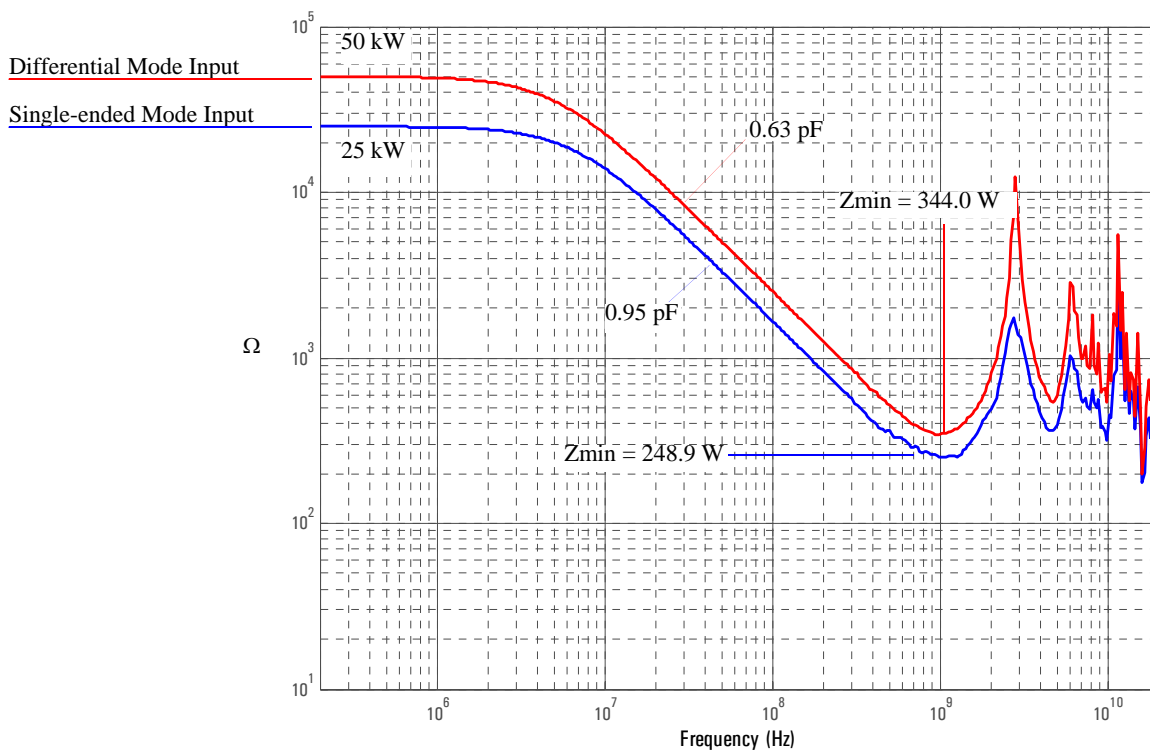
Graph of Vin and Vout of probe with a 25 W 295 ps step generator.

**Figure 2-23**



Graph of  $\text{dB}(V_{in})$  and  $\text{dB}(V_{out}) + 10.8 \text{ dB}$  of probe with a 25 W source and  $\text{dB}(V_{out}/V_{in}) + 10.8 \text{ dB}$  frequency response.

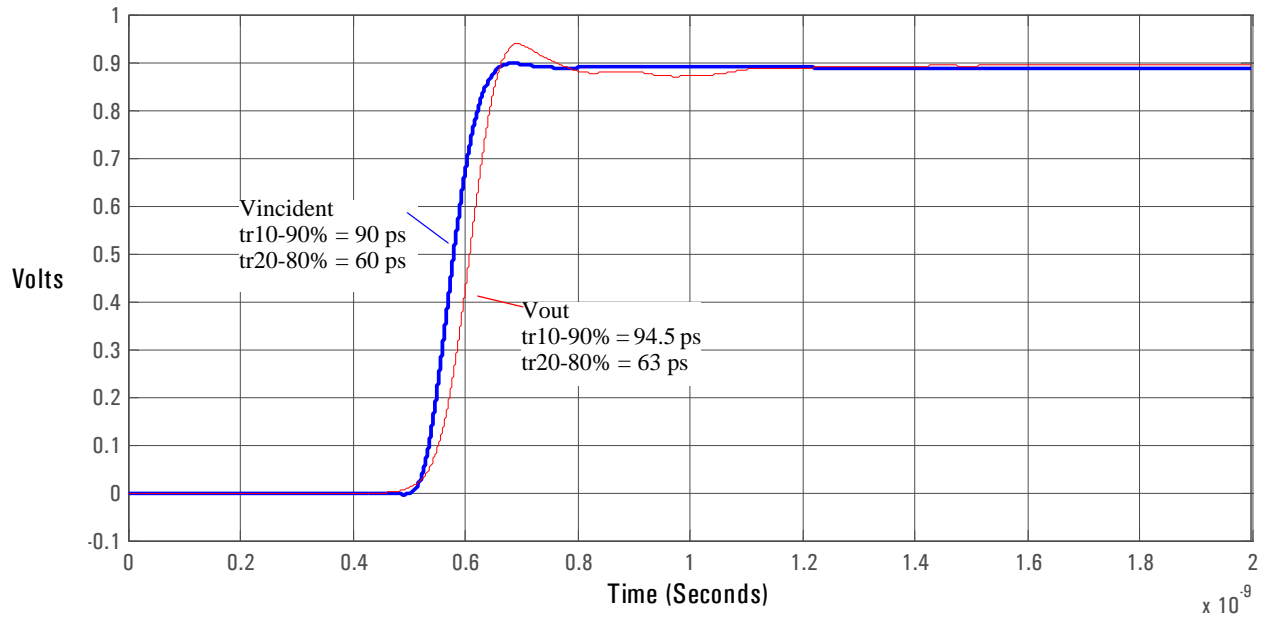
**Figure 2-24**



Magnitude plot of probe input impedance versus frequency.

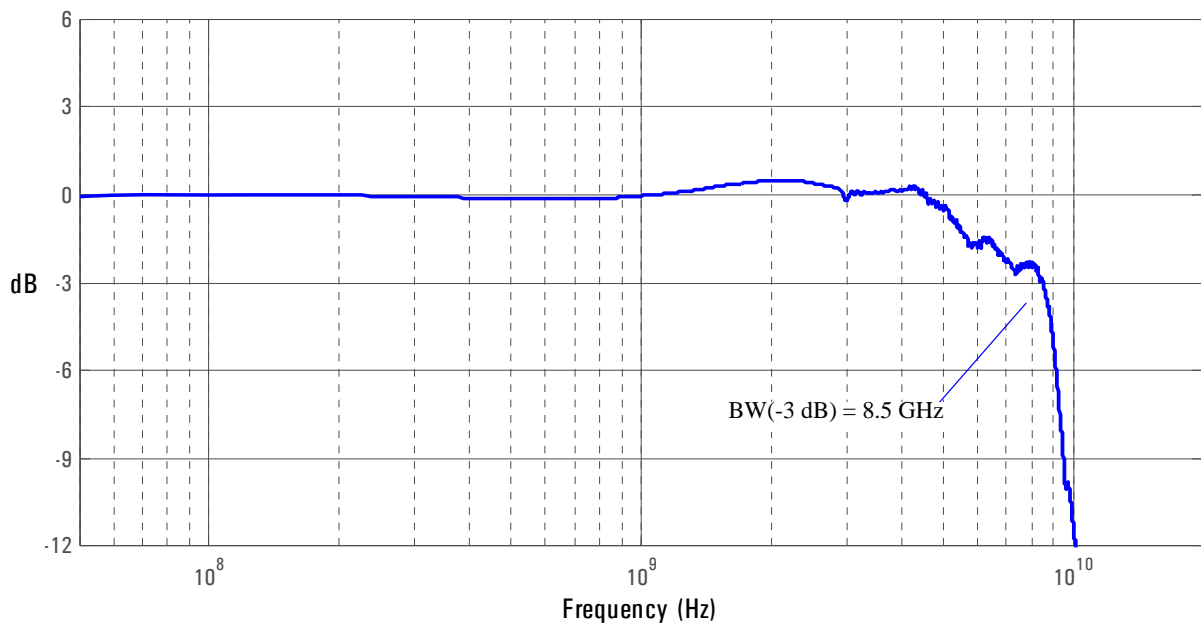
## 13 E2695A SMA Probe Head

Figure 2-25



Graph of Vincident and Vout of probe with a 90 ps step.

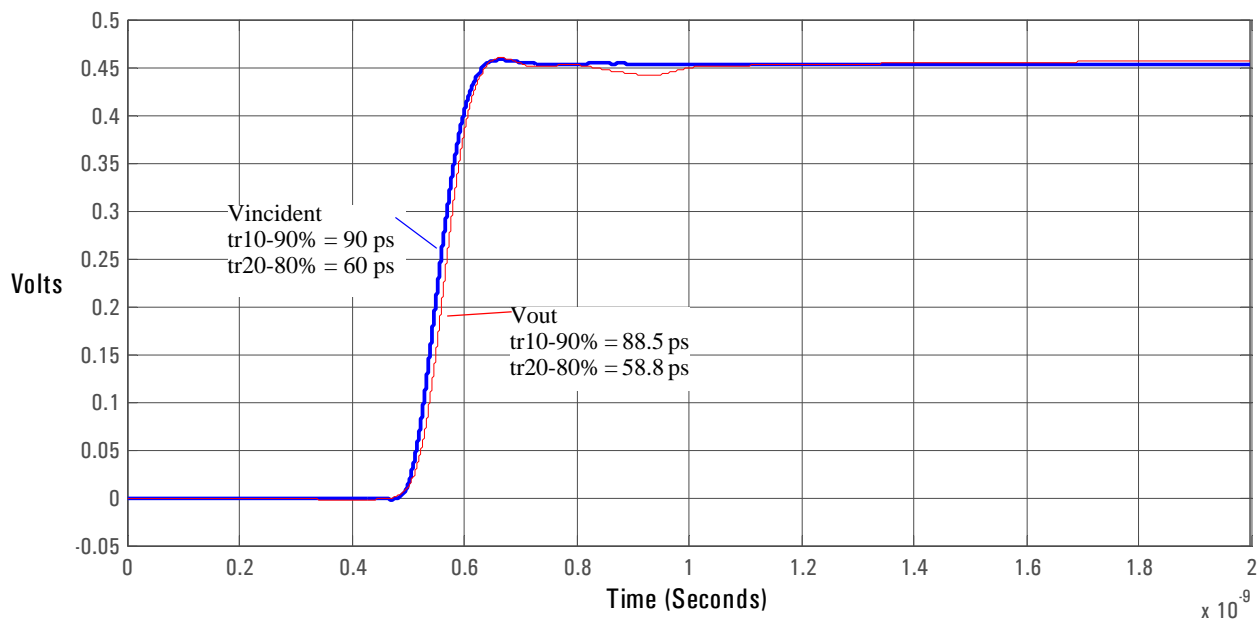
Figure 2-26



Magnitude response of differential insertion loss +1.03 dB.

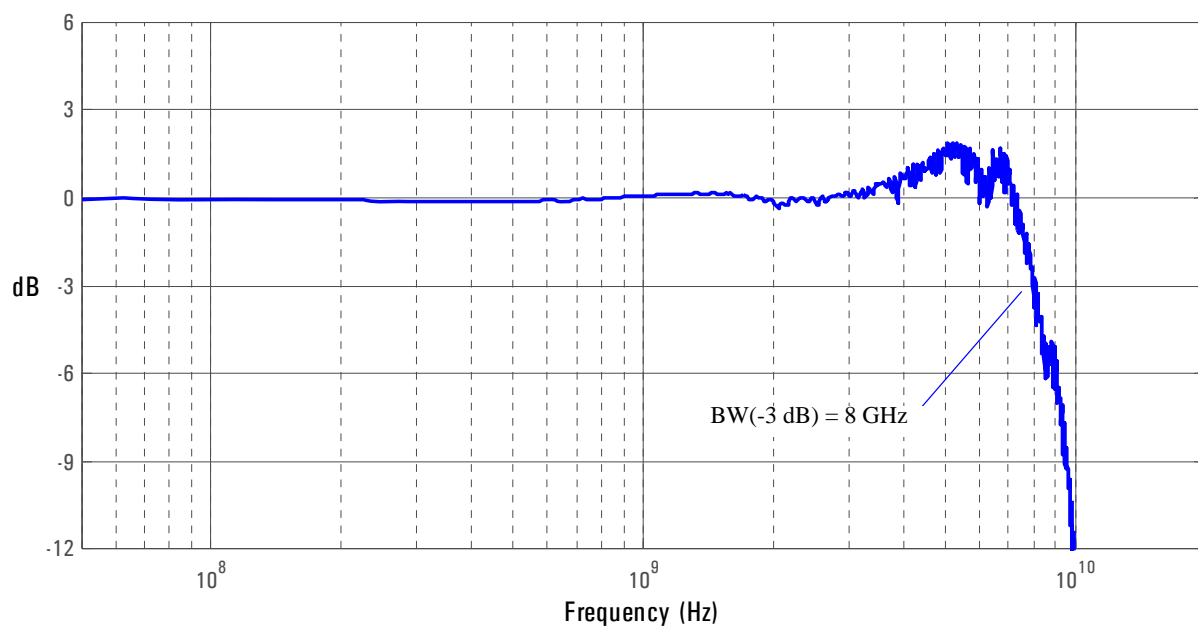
## N5380A SMA Probe Head with the 1134A InfiniiMax Probe

Figure 2-27



Graph of Vincident and Vout of probe with a 90 ps step.

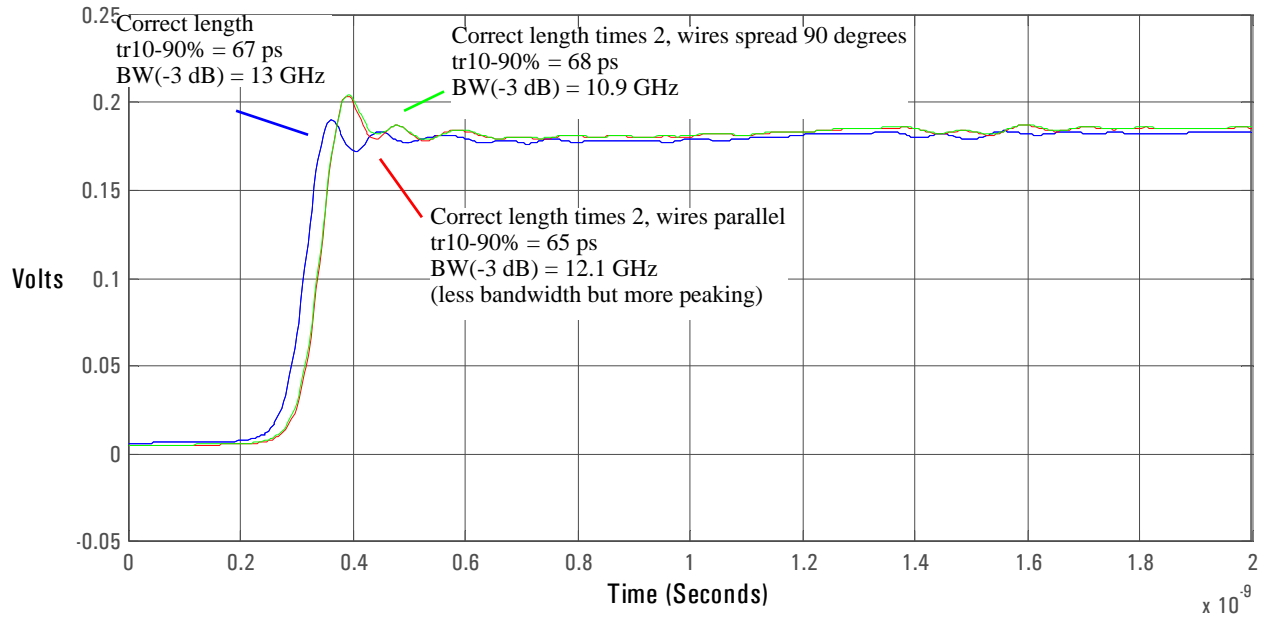
Figure 2-28



Magnitude response of differential insertion loss +16.03 dB.

## N5381A Solder-in Differential Probe Head with 2 x Longer Wires

The following graph shows the probe response to a 25 W, 58 ps step generator with the recommended wire length, twice the recommended wire length with wires parallel to each other, and twice the recommended wire length with wires spread 90 degrees.





---

## **Input Impedance SPICE Models for N5425A, N5426A, N5381A and N5382A Probe Heads**

This document contains SPICE models that can be used to predict the probe loading effects of the InfiniiMax II active probes. Important points about these SPICE models are:

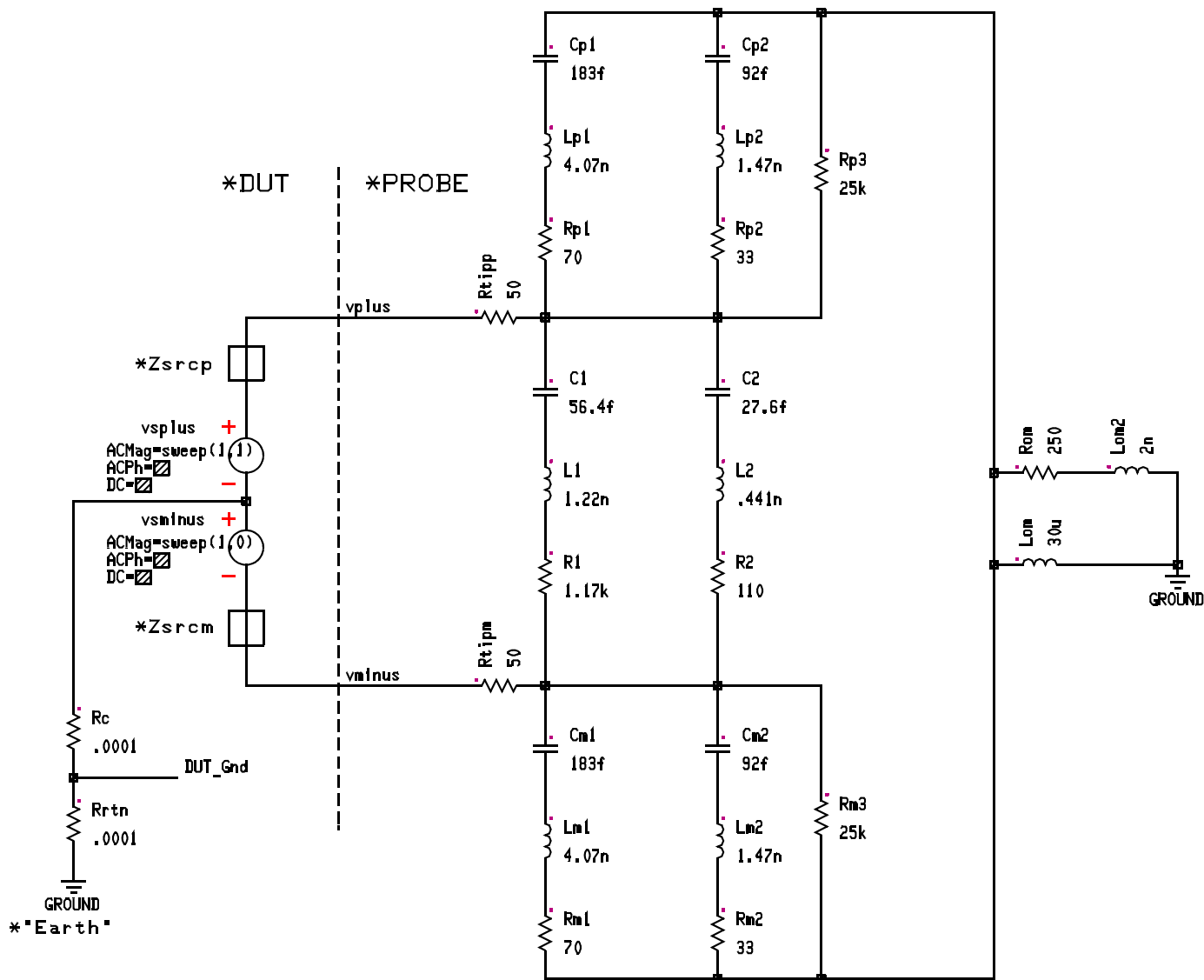
- SPICE models shown here are only for input impedance which allows modeling of the probe loading effects. Probe transfer function is generally flat to the specified bandwidth.
- These input impedance is a function of the probe head type only. The probe amp bandwidth (10 GHz 1168A or 12 GHz 1169A) does not have any effect on the input impedance of the probe heads.

An input impedance plot is given that shows the matching of the measured data to the modeled data. Matching is generally very good up to the specified bandwidth of the probe head.



## Input Impedance SPICE Model for N5381A and N5382A Probe Heads

\*SPICE Model for InfiniiMax 1160 Series  
\*N5381A (&N5382A) Differential Probe Heads



## Spice Models

### Input Impedance SPICE Model for N5381A and N5382A Probe Heads

- Rrtn (or Zrtn) is dependent on connection from DUT ground to "Earth" ground. Most likely modeled by a parallel RL similar to Rom || Lom. Will have slight effect on single-ended input Z and no effect on differential input Z.

When using differential probe to probe single-ended signals:

- vplus connected to DUT signal
- vminus connected to DUT ground which means that  $R_c = 0$ ,  $v_{\text{minus}} = 0$ , and  $Z_{\text{srcm}} = 0$ .
- Input impedance is defined to be  $v_{\text{plus}}/i(v_{\text{plus}})$

When using differential probe to probe differential signals:

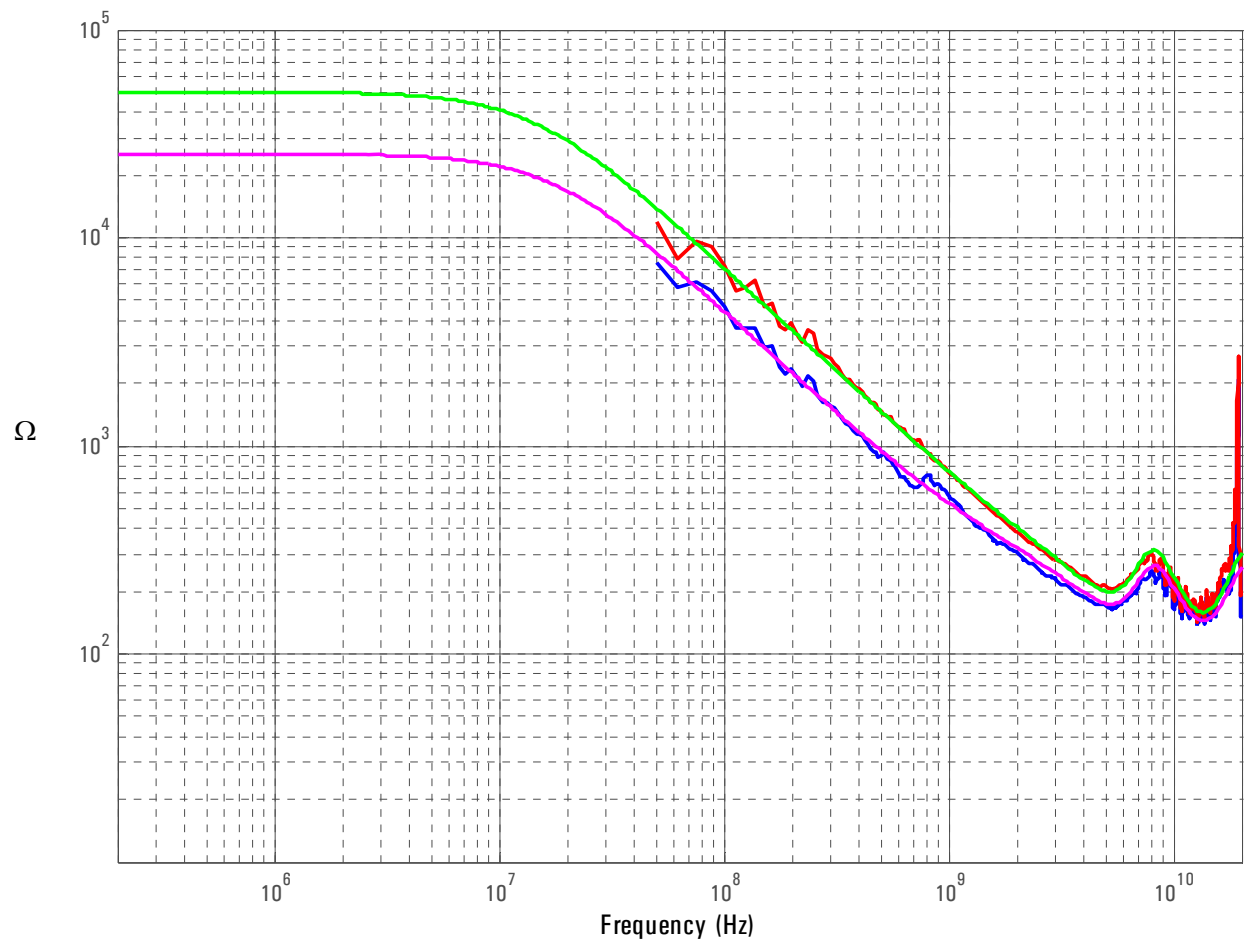
- $R_c$  (or  $Z_c$ ) will depend on the DUT circuit.
- vplus connected to DUT plus signal
- vminus connected to DUT minus signal.
- Input impedance is defined to be  $(v_{\text{plus}} - v_{\text{minus}})/i(v_{\text{plus}})$

#### SPICE Deck

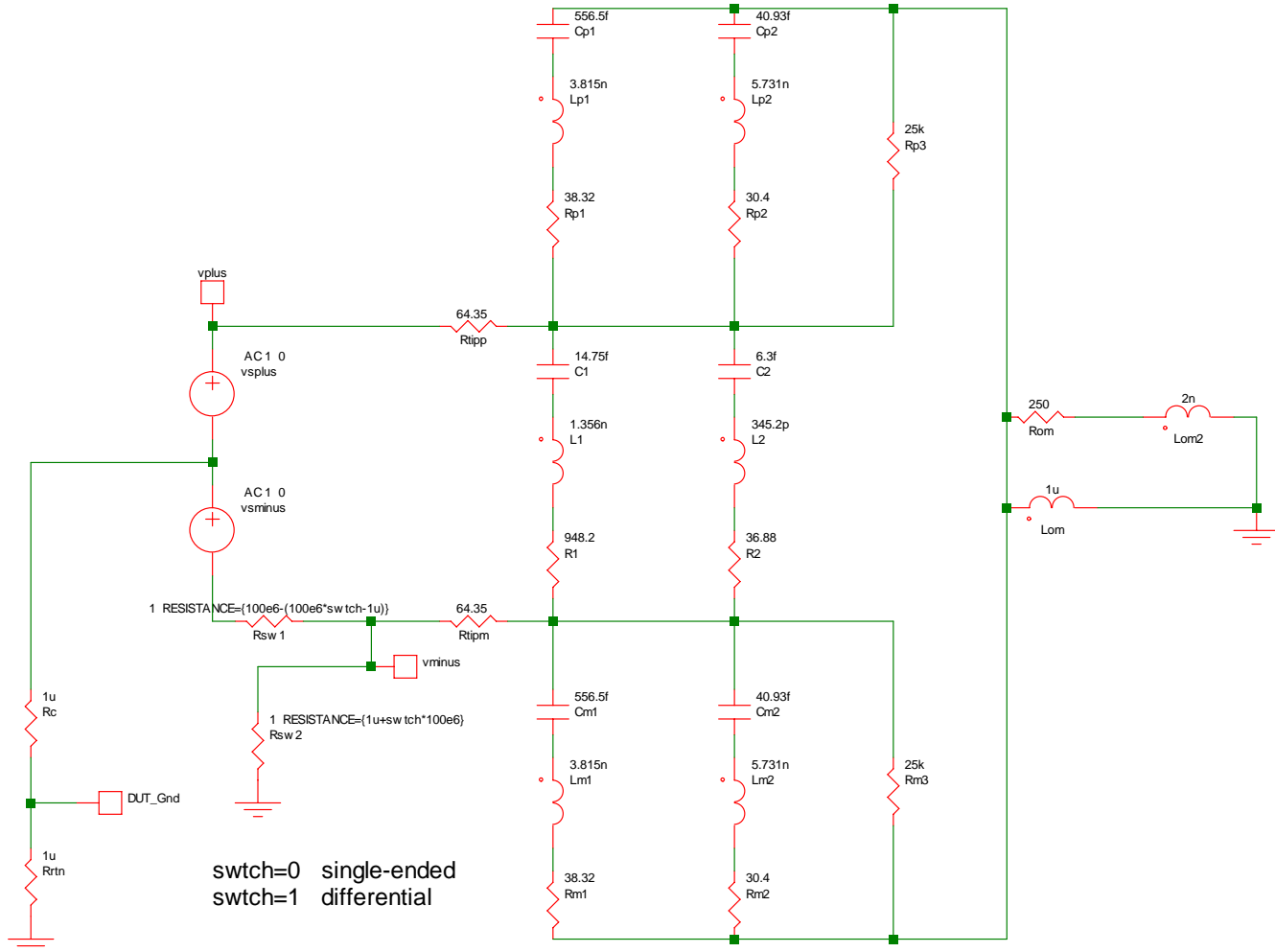
```
C2 %44 %40 27.6f
Cm2 %41 %38 92f
Cp2 %43 %36 92f
Cp1 %43 %34 183f
Cm1 %41 %31 183f
C1 %44 %28 56.4f
vsminus %16 %vminus ACMag=sweep(1,0)
vsplus %vplus %16 ACMag=sweep(1,1)
Lom2 %47 %0 2n
Lom %43 %0 30u
L2 %40 %39 .441n
Lm2 %38 %37 1.47n
Lp2 %36 %35 1.47n
Lp1 %34 %33 4.07n
Lm1 %31 %30 4.07n
L1 %28 %32 1.22n
Rm3 %41 %43 25k
Rp3 %43 %44 25k
Rom %43 %47 250
R2 %39 %41 110
Rm2 %37 %43 33
Rp2 %35 %44 33
Rp1 %33 %44 70
Rm1 %30 %43 70
R1 %32 %41 1.17k
Rtipm %vminus %41 50
Rtipp %vplus %44 50
Rrtn %15 %0 .0001
Rc %16 %15 .0001
```

.END

### Measured and Modeled Data Matching



## Input Impedance SPICE Model for N5425A ZIF Probe Head with N5426A ZIF Tip Attached



When using differential probe to probe single-ended signals:

- vplus connected to DUT signal
- vminus connected to DUT ground which means that  $R_{sw1} = \infty$  and  $R_{sw2} = 0$
- Input impedance is defined to be  $vplus/i(vsplus)$

When using differential probe to probe differential signals:

- $R_c$  (or  $Z_c$ ) will depend on the DUT circuit.
- vplus connected to DUT plus signal
- vminus connected to DUT minus signal.
- Input impedance is defined to be  $(vplus - vminus)/i(vsplus)$

**SPICE Deck of N5425A with N5426A ZIF Tip Attached**

```

Lom2 Rom_P 0 2n
Lm2 Cm2_N Lm2_N 5.731n
Rtipp Rp3_N vplus 64.35
Lm1 Cm1_N Lm1_N 3.815n
Rom Rom_P Cp1_P 250
Cp1 Cp1_P Cp1_N 556.5f
Cp2 Cp1_P Cp2_N 40.93f
Lp1 Cp1_N Lp1_N 3.815n
Lp2 Cp2_N Lp2_N 5.731n
Cm2 R1_N Cm2_N 40.93f
vsminus vsplus_N vsminus_N AC 1 0
L1 C1_N L1_N 1.356n
L2 C2_N L2_N 345.2p
Rp1 Lp1_N Rp3_N 38.32
Cm1 R1_N Cm1_N 556.5f
Rp2 Lp2_N Rp3_N 30.4
Rp3 Cp1_P Rp3_N 25k
Rrtn DUT_Gnd 0 1u
Rsw2 vminus 0 1 RESISTANCE={1u+swtch*100e6}
vsplus vplus vsplus_N AC 1 0
Rm2 Lm2_N Cp1_P 30.4
Rm3 R1_N Cp1_P 25k
Rsw1 vminus vsminus_N 1 RESISTANCE={100e6-(100e6*swtch-1u)}
Lom Cp1_P 0 1u
C2 Rp3_N C2_N 6.3f
Rm1 Lm1_N Cp1_P 38.32
Rc vsplus_N DUT_Gnd 1u
C1 Rp3_N C1_N 14.75f
Rtipm R1_N vminus 64.35
R1 L1_N R1_N 948.2
R2 L2_N R1_N 36.88

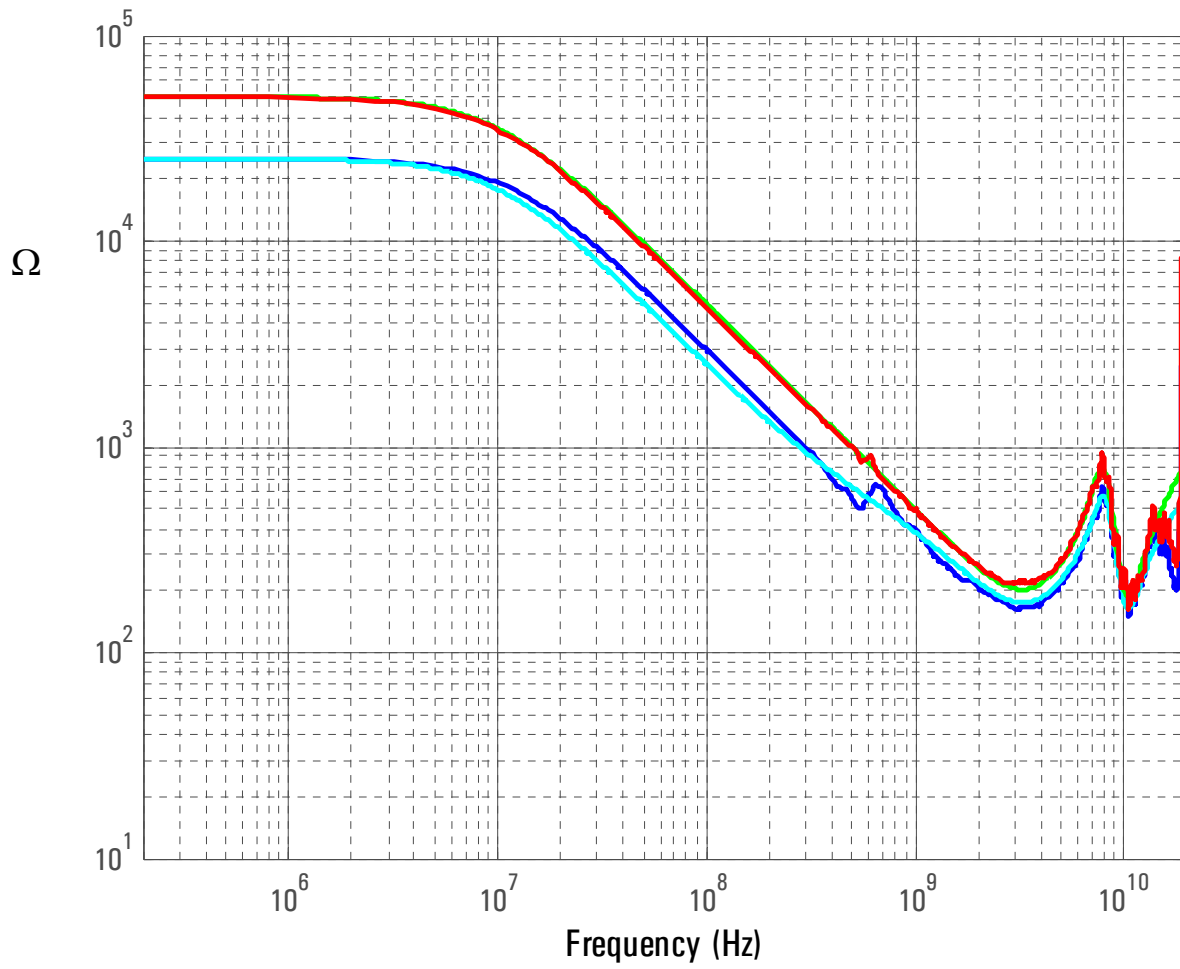
.AC DEC 200 200k 20G SWEEP PARAM=swtch LIN 2 0 1

.PARAM swtch 1

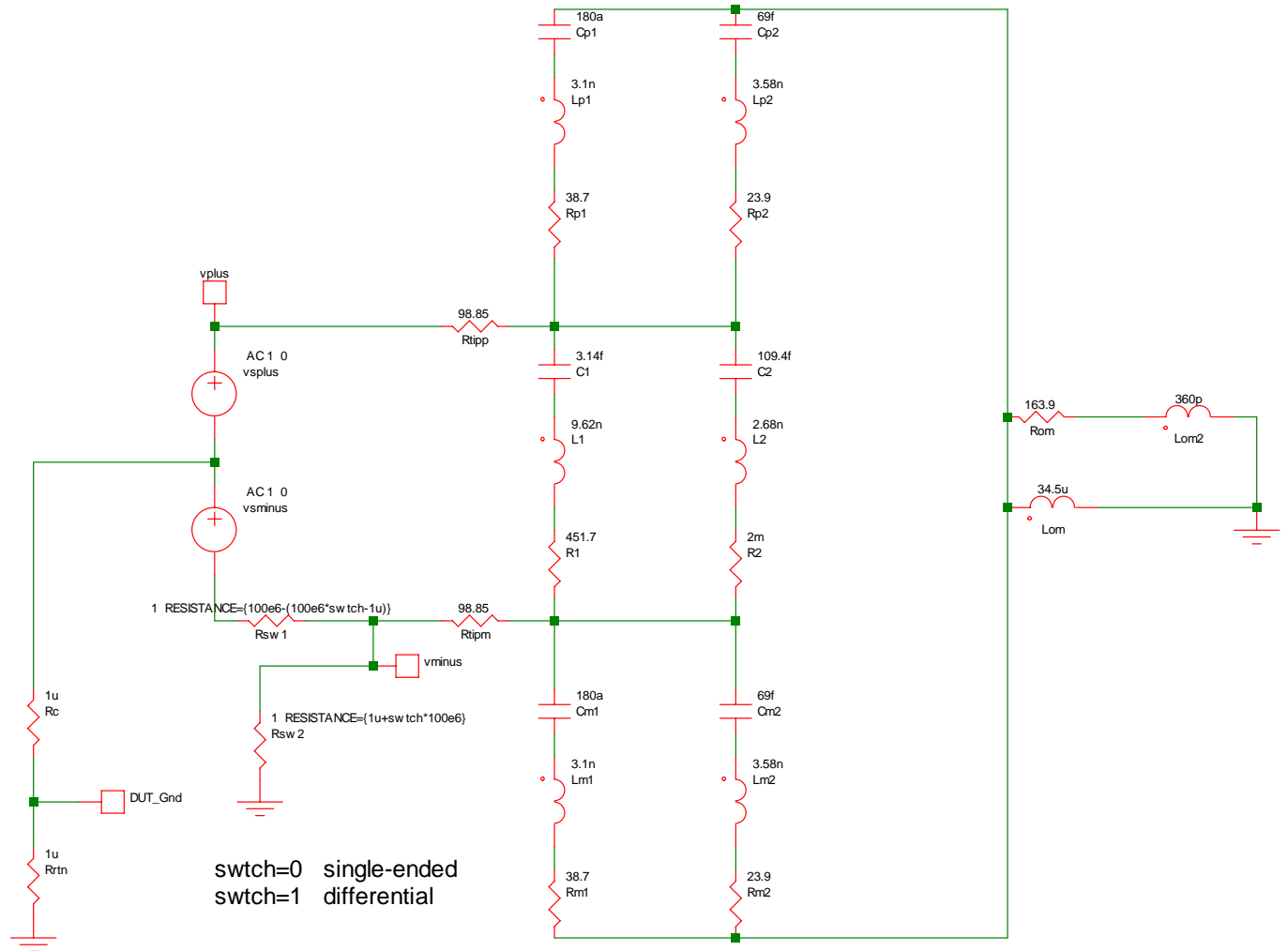
```

**Spice Models**  
**Input Impedance SPICE Model for N5425A ZIF Probe Head with N5426A ZIF Tip Attached**

**Measured and Modeled Data Matching**



## Input Impedance SPICE Model for N5426A ZIF Tip



## Spice Models

### Input Impedance SPICE Model for N5426A ZIF Tip

#### SPICE Deck of N5426A

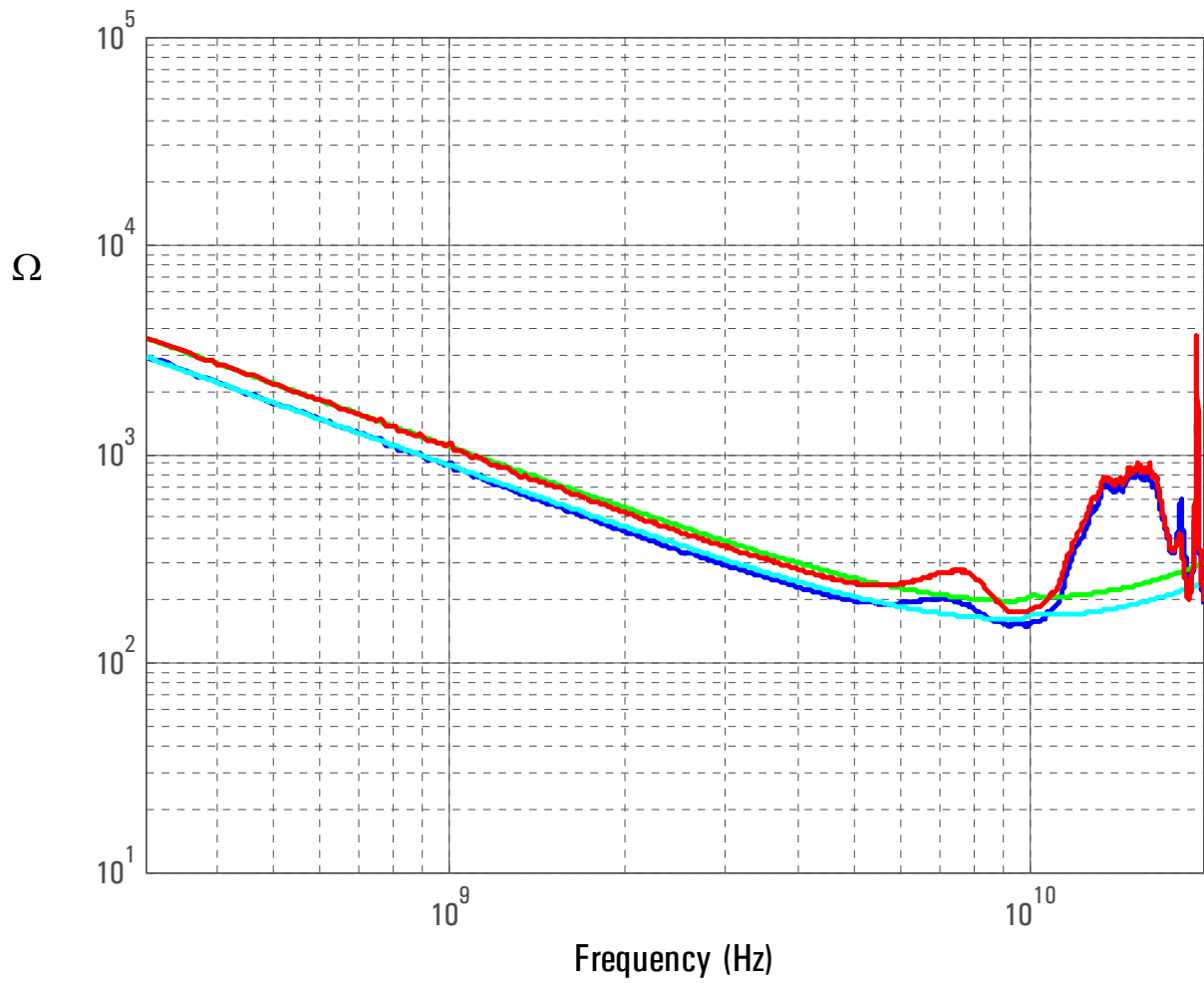
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Lom2 Rom_P 0 360p
Lm2 Cm2_N Lm2_N 3.58n
Rtipp Rp3_N vplus 98.85
Lm1 Cm1_N Lm1_N 3.1n
Rom Rom_P Cp1_P 163.9
Cp1 Cp1_P Cp1_N 180a
Cp2 Cp1_P Cp2_N 69f
Lp1 Cp1_N Lp1_N 3.1n
Lp2 Cp2_N Lp2_N 3.58n
Cm2 R1_N Cm2_N 69f
vsminus vsplus_N vsminus_N AC 1 0
L1 C1_N L1_N 9.62n
L2 C2_N L2_N 2.68n
Rp1 Lp1_N Rp3_N 38.7
Cm1 R1_N Cm1_N 180a
Rp2 Lp2_N Rp3_N 23.9
Rrtn DUT_Gnd 0 1u
Rsw2 vminus 0 1 RESISTANCE={1u+swtch*100e6}
vsplus vplus vsplus_N AC 1 0
Rm2 Lm2_N Cp1_P 23.9
Rsw1 vminus vsminus_N 1 RESISTANCE={100e6-(100e6*swtch-1u)}
Lom Cp1_P 0 34.5u
C2 Rp3_N C2_N 109.4f
Rm1 Lm1_N Cp1_P 38.7
Rc vsplus_N DUT_Gnd 1u
C1 Rp3_N C1_N 3.14f
Rtipm R1_N vminus 98.85
R1 L1_N R1_N 451.7
R2 L2_N R1_N 2m

.AC DEC 200 200k 20G SWEEP PARAM=swtch LIN 2 0 1

.PARAM swtch 1
```



Measured and Modeled Data Matching





**Service**

## Service

The service section of this manual contains the following information:

- Service Strategy for the probe
- Cleaning the probe
- Returning the probe to Agilent Technologies for service
- Recommended tools and test equipment
- Calibration Testing Procedures
  - To Test Bandwidth
  - To Test Input Resistance
- Performance test record
- Replaceable parts and accessories

## Service Strategy for the Probe

This chapter provides service information for the InfiniiMax Probe. The following sections are included in this chapter.

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

The InfiniiMax 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.

Warranted specification are listed below.

Table 4-1

Description	Specification	Further Information
Bandwidth	12 GHz (1169A) 10 GHz (1168A)	
Input Resistance	50 kW ±2% 25 kW ±2%	Differential mode resistance Single-ended mode resistance each side to ground

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 "To return the probe to Agilent Technologies for service" on page 4-4.

## To return the probe to Agilent Technologies for service

Follow the following steps before shipping the InfiniiMax Probe 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 1169A

Product Serial Number Example MYXXXXXXXXX

Description of failure or service required

Include probing and browsing tips if you feel the probe is not meeting performance specifications or a yearly calibration is requested.
---

- 3** Protect the Probe by wrapping in plastic or heavy paper.
- 4** Pack the 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.
- Be sure that the probe head that you are using has been in the oscilloscope's Probe Setup dialog box.

### **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 W 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 W load ( $\sim \pm 2\%$ ).
- If the coax or coaxes of the probe head in use has excessive damage, then reflections may be seen within  $\sim 1$  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 one of the components in the tip has 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.



---

## Calibration Testing Procedures

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

---

## To Test Bandwidth

This test ensures that the Probe meets its specified bandwidth.

1169A >12 GHz  
1168A > 10 GHz

Table 4-2

Equipment/Tool	Critical Specification	Model Number
Vector Network Analyzer (VNA)	13 GHz sweep range full 2 port cal Option 1D5	Agilent 8720ES
Calibration Standards	No Substitute	Agilent 85052D
External Power Supply	No Substitute	Agilent 1143A
AutoProbe Interface Adapter	No Substitute	Agilent N1022A
Outside thread 3.5 mm (male) to 3.5 mm (female) adapter	No Substitute	Agilent 5062-1247
Cable (2)	3.5 mil; SMA; High Quality	Agilent 8120-4948
Cable	1.5 mil Probe Power Extension No Substitute	Agilent 01143-61602
PV/DS Test Board	No Substitute (In E2655B Kit)	Agilent E2655-66503

### Using the 8720ES VNA successfully

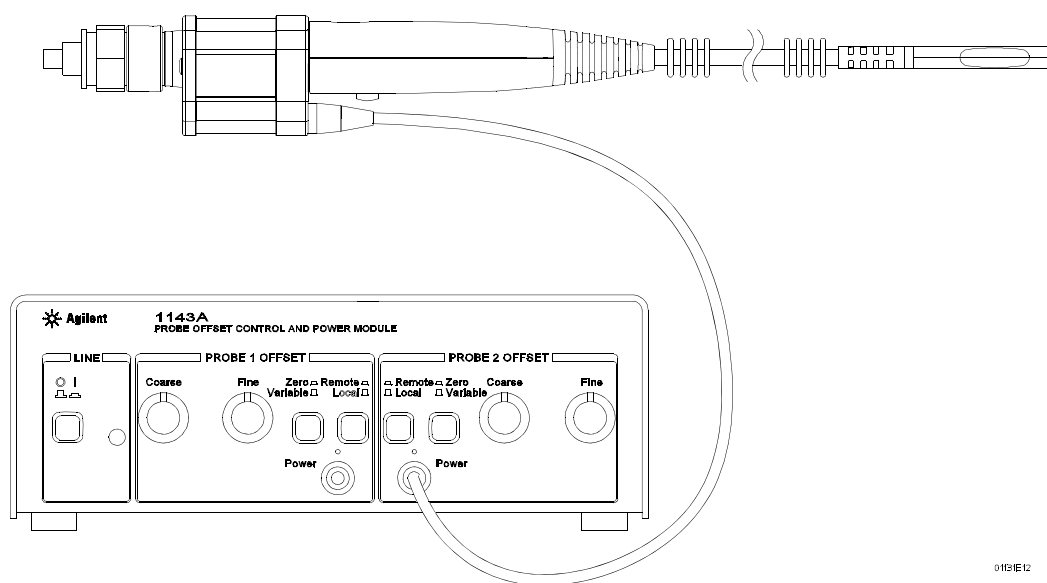
Remember these simple guidelines when working with the 8720ES VNA to get accurate stable measurements.

- 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 vise 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 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 4-1



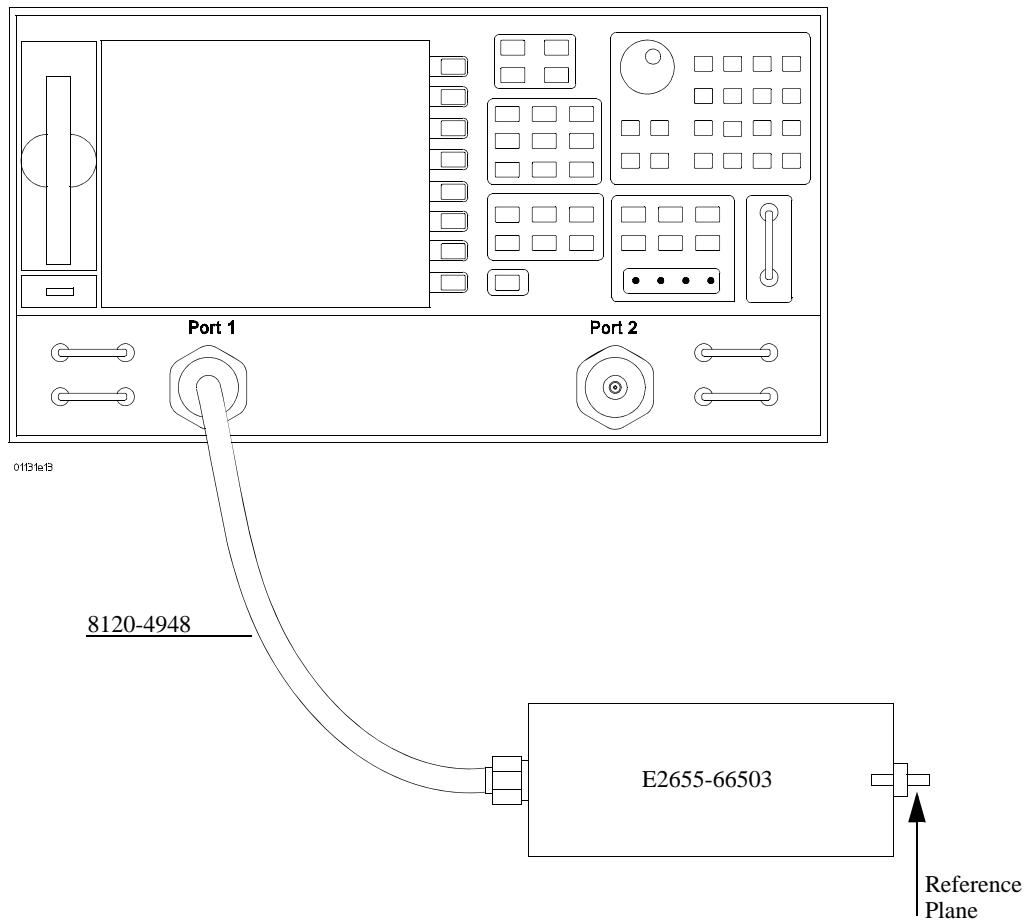
01B/E12

#### 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.

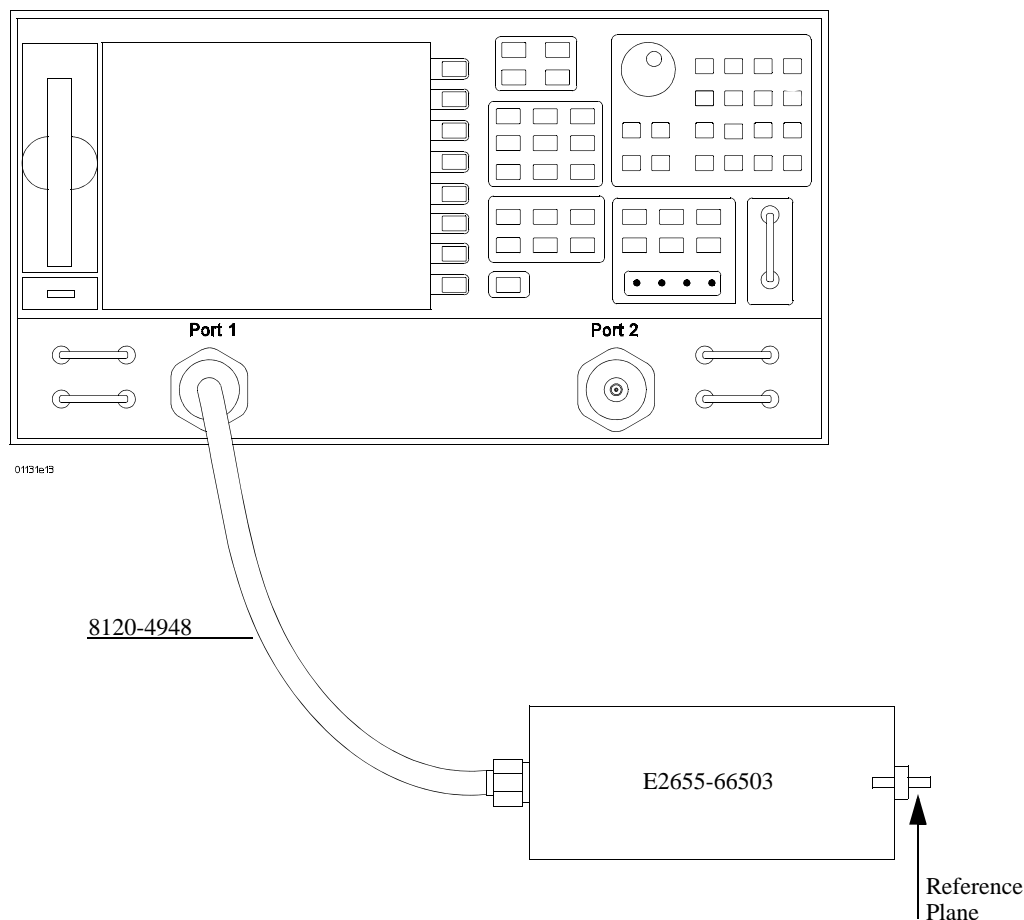
## Service To Test Bandwidth

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



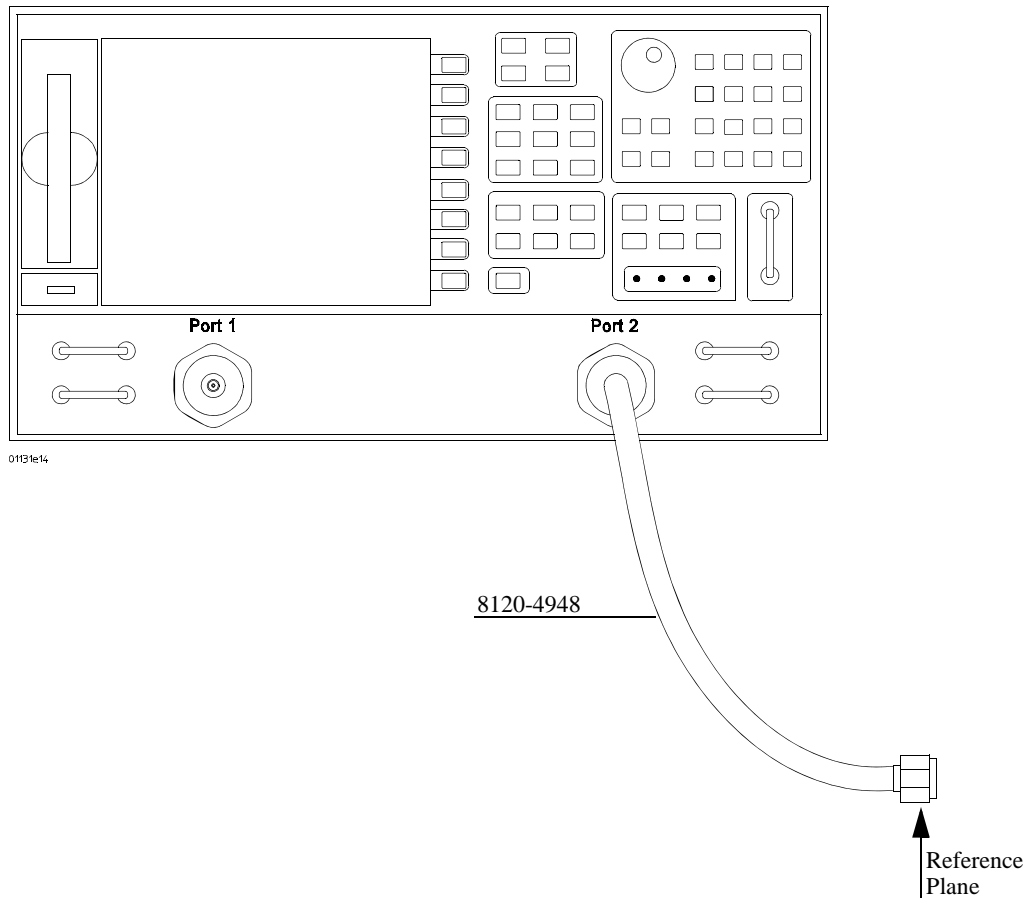
- 2 Then Press the "cal menu" screen key.
- 3 Finally, press the "full 2 port" screen key.
- 4 Connect one of the high quality SMA cables to port one and to the pincher side of PV/DS test board.
- 5 The calibration reference plane is at the other end of PV/DS test board.

Figure 4-2



- 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 4-3**



**8** Get the opposite sex of the 85052D calibration standards for the next step.

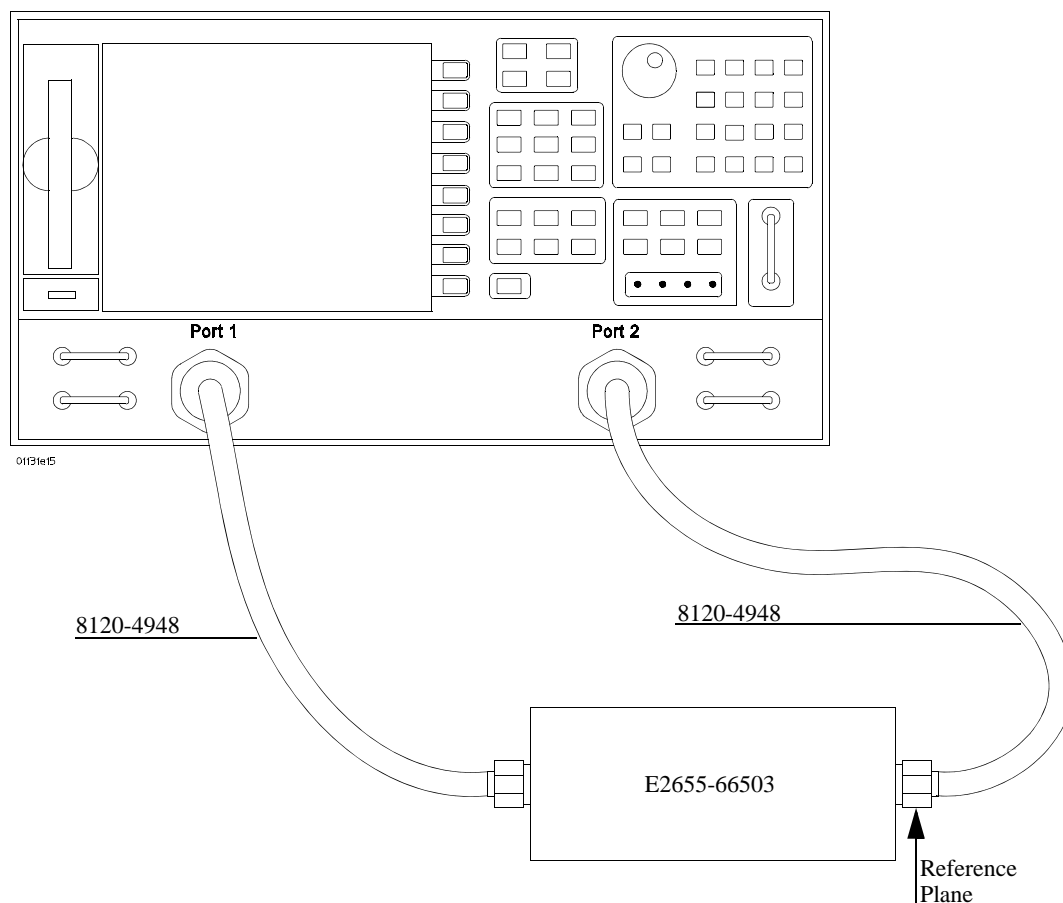
**9** Perform Calibration for the port two side of the Reference plane.

- Press the "reflection" screen key.
- Connect open end of 85052D to the available end of the port two SMA cable.
- Select 8720ES t 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.

Figure 4-4



- 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  $\pm 0.1$  dB) out to 13 GHz.

## Service To Test Bandwidth

### Measuring Vin Response

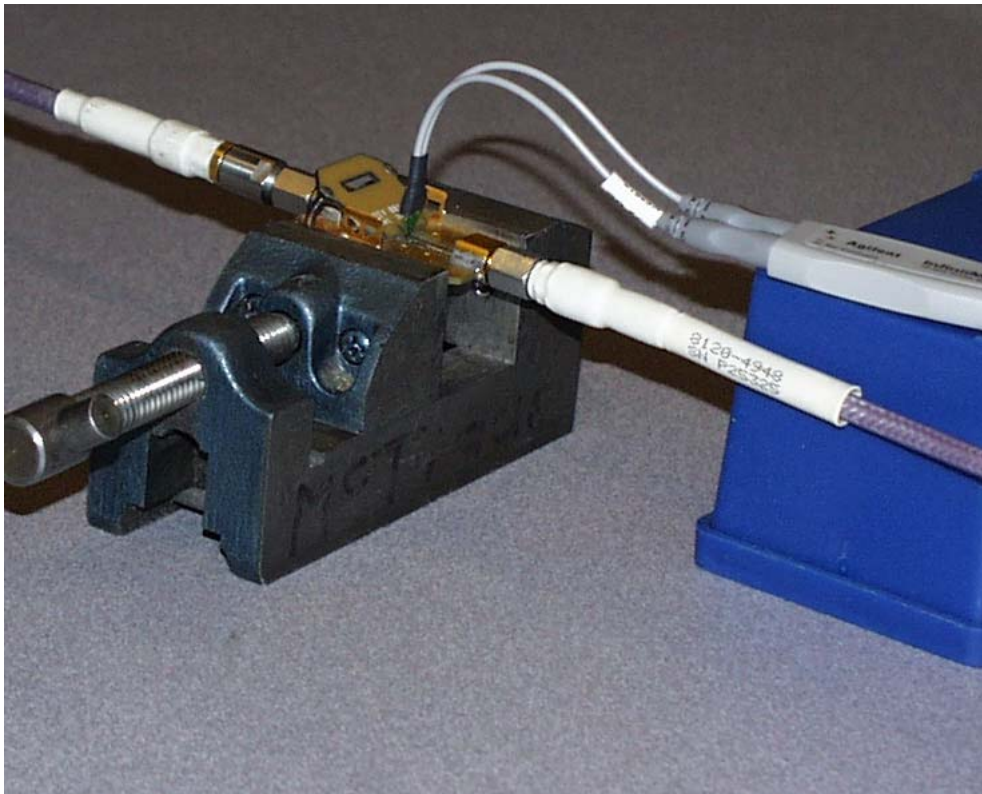
- 1 Position the probe conveniently to allow the probe tip to be normal to the PV/DS board. See Figure 4-5.
- 2 Spread the probe tip wires slightly so that the tips are a little bit wider than the gap between the signal trace and the ground on PV/DS board
- 3 To best simulate the conditions that are present when the probe is in actual use, inset only the tips of the wires under the pincher. Do not inset the wires completely under the pincher such that the contact points are right next to the tip of the PC board. The best way to accomplish this is to insert the wires under the pincher with the probe head at a 45 degree angle with respect to the PV/DS board, then apply upward pressure to the clip to hold the tip wires firmly. Gently pull the probe head up to the 90 degree position. This will actually form the wires into an "L" shape.

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.

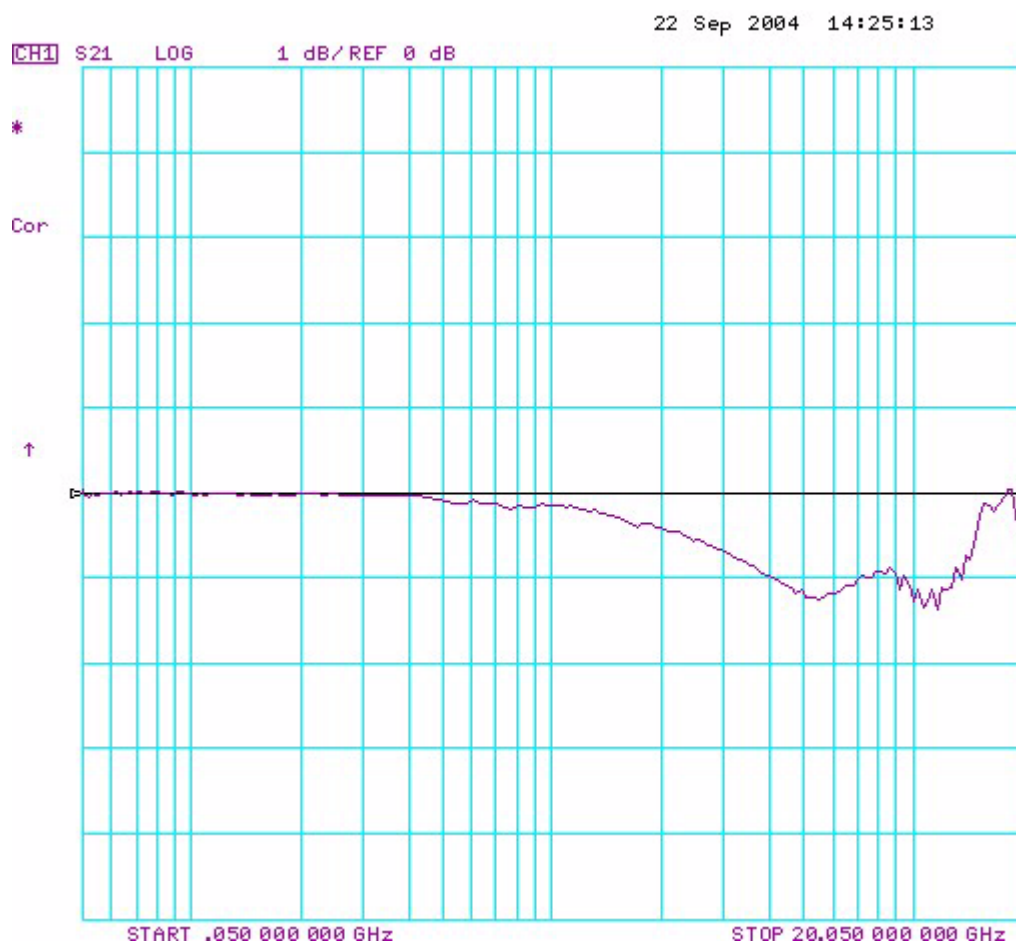
Figure 4-5



- 4 You should now have the Vin waveform on screen. It should look similar to Figure 4-6.



Figure 4-6



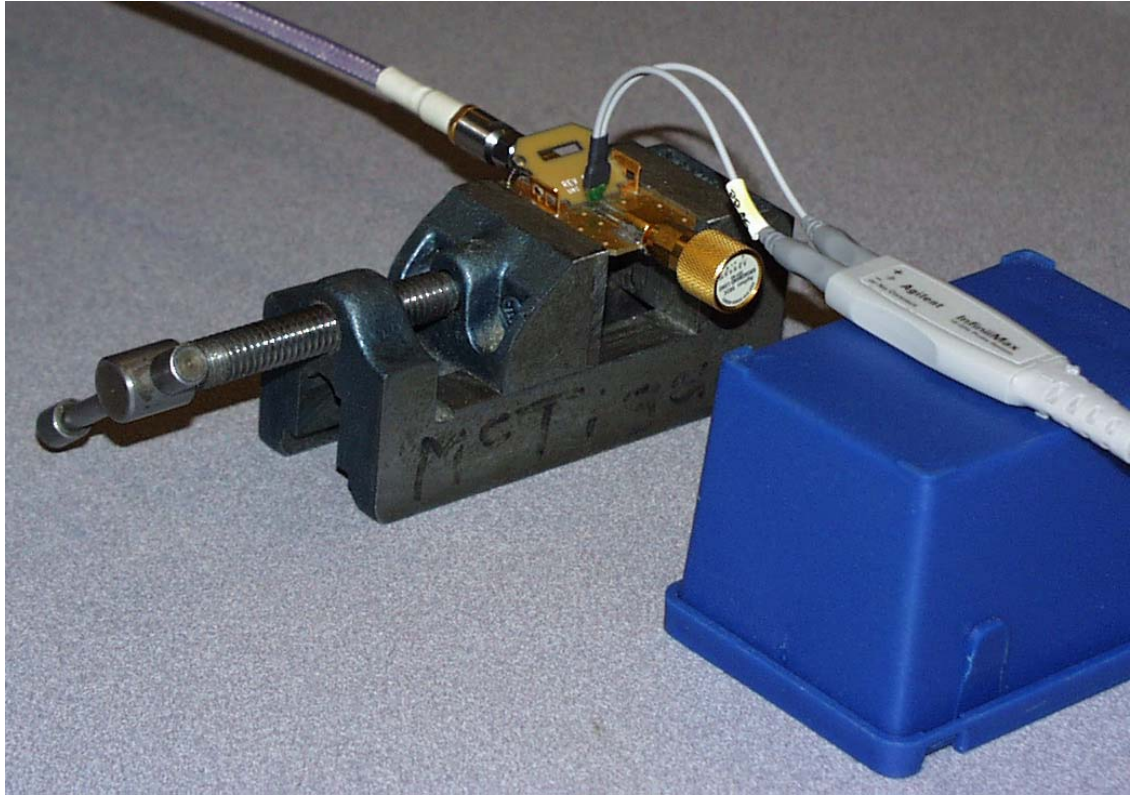
- 5 Select "display key" then "data->memory" screen key.
- 6 You have now saved Vin waveform into the 8720ES VNA's memory for future use.

## Service To Test Bandwidth

### Measuring Vout Response

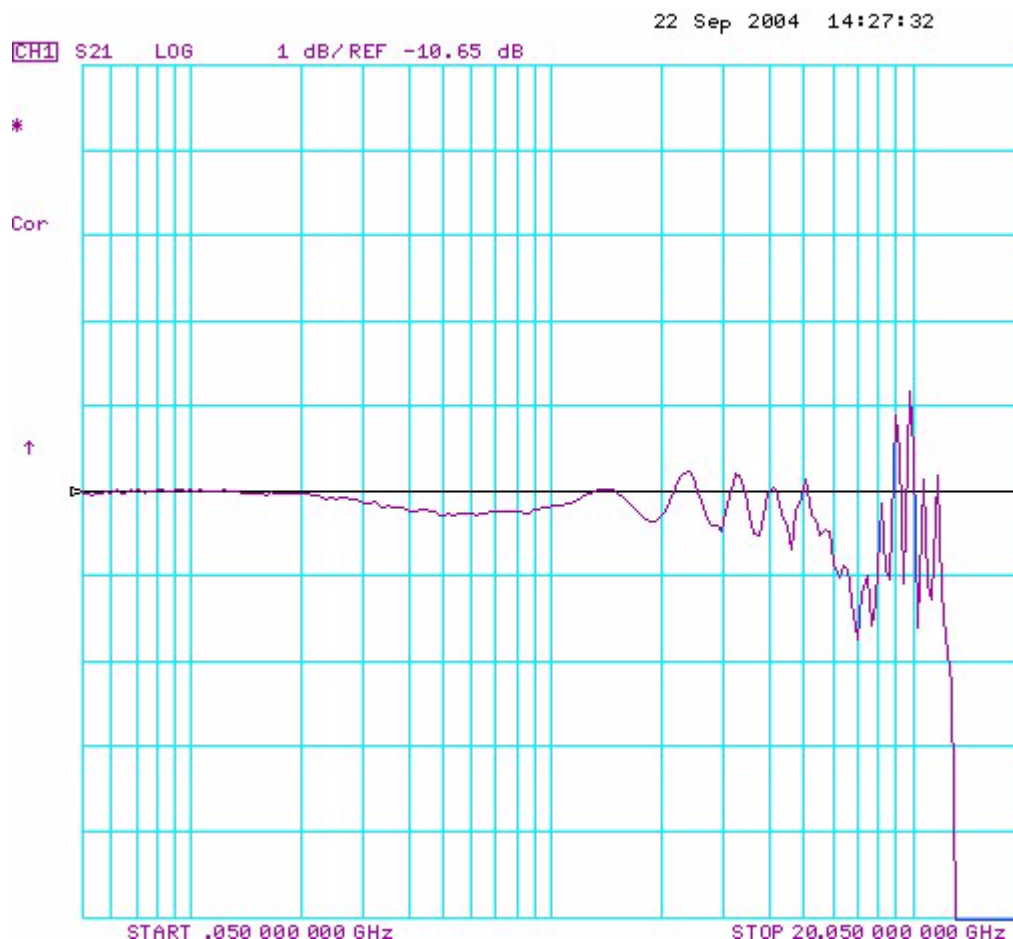
- 1 Disconnect the port 2 cable from PV/DS test board and attach to probe output on the AutoProbe Adapter.
- 2 Connect the 85052D cal standard load to PV/DS test board (non-pincher side). See Figure 4-7.
- 3 Check that the tip connection is still proper. See "Measuring Vin Response" on page 4-14

Figure 4-7



- 4 Press "scale reference" key on the 8720ES VNA.
- 5 Set reference value to -10.8 dB.
- 6 The display on screen is Vout. It should look similar to Figure 4-8.

Figure 4-8

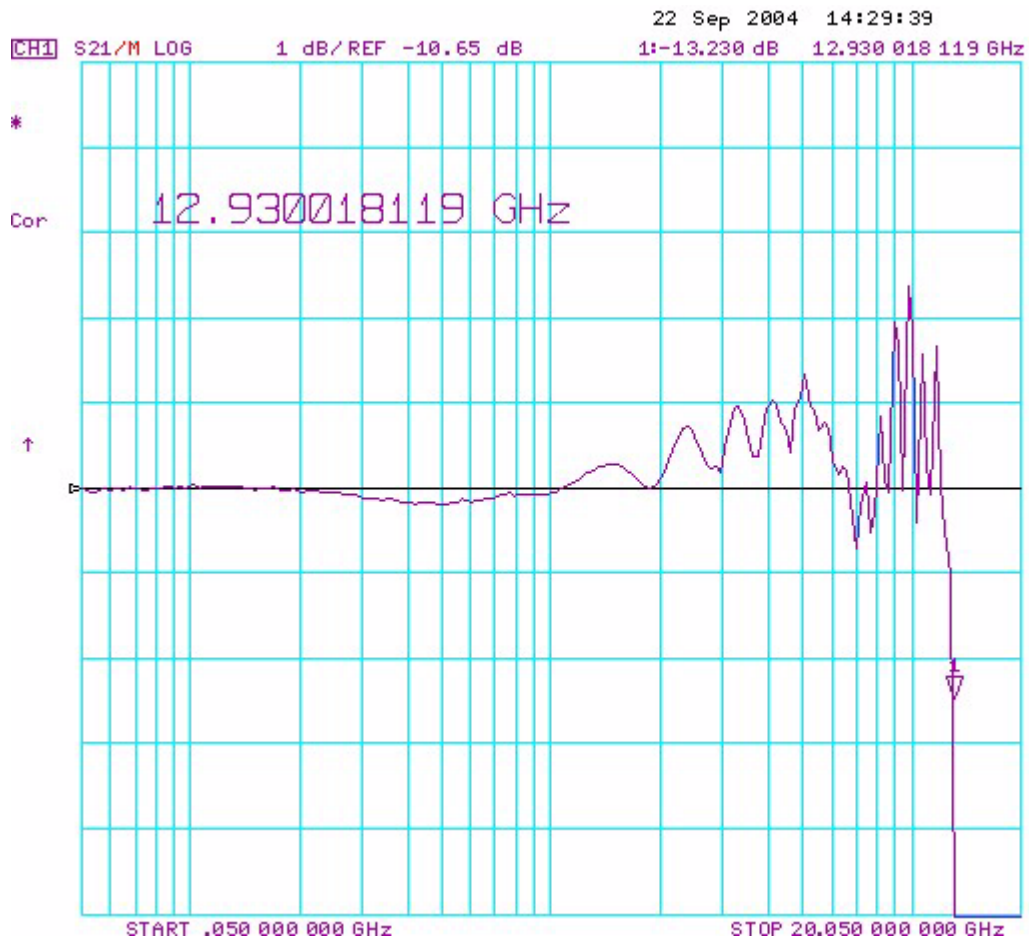


#### Displaying Vout/Vin Response on 8720ES VNA Screen

- 1 Press the "Display" Key.
- 2 Then select the "Data/Memory" Screen Key. The display should look similar to Figure 4-9. You may need to adjust the "Reference Value", located under the "Scale Ref" key, slightly to position the waveform at center screen at 100 MHz.
- 3 Press marker key and position the marker to the first point that the signal is -2.6 dB below center screen. Minus 2.6 dB is used rather than -3 dB because the loss caused by the PV/DS board makes a slightly optimistic measurement.
- 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: > 12 GHz (1169A) or 10 GHz (1168A).

Service  
To Test Bandwidth

Figure 4-9



---

## To Test Input Resistance

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

Differential Mode	50 kW $\pm 2\%$
Single-ended Mode	25 kW $\pm 2\%$

**Table 4-10**

Equipment/Tool	Critical Specification	Model Number
Oscilloscope	No substitute. Requires precision BNC connectors	DSO80000 Series Infiniium Oscilloscope
Digital Multimeter	2 wire resistance accuracy better than $\pm 0.01\%$	34401A
Adapter	BNC (f) to SMA(m) (In E2655B Kit)	E2655-83201
PV/DS Test Board	No Substitute (In E2655B Kit)	E2655-66503

### Initial Setup

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

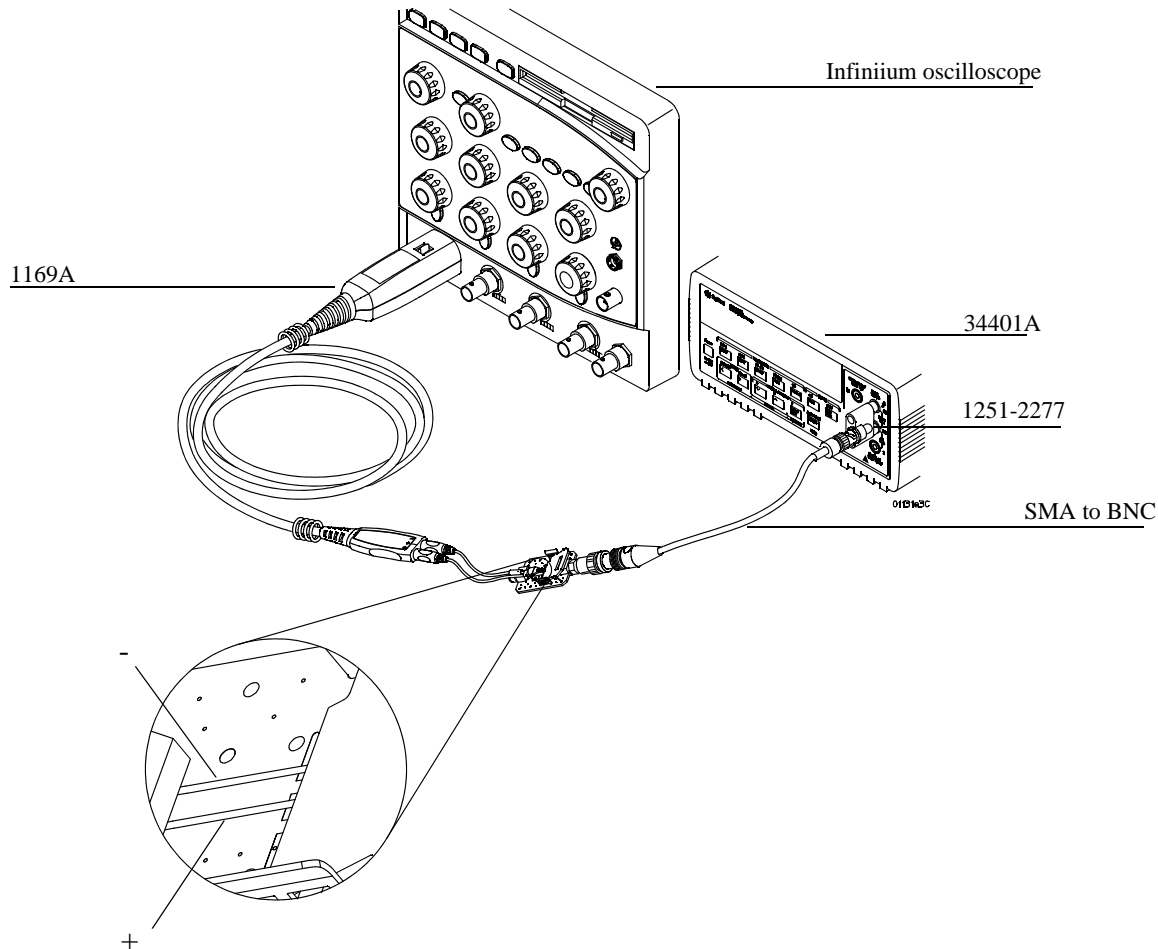
**Service**  
**To Test Input Resistance**

**Differential Test**

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

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

**Figure 4-11**



- 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 49,000 W and 51,000 W.

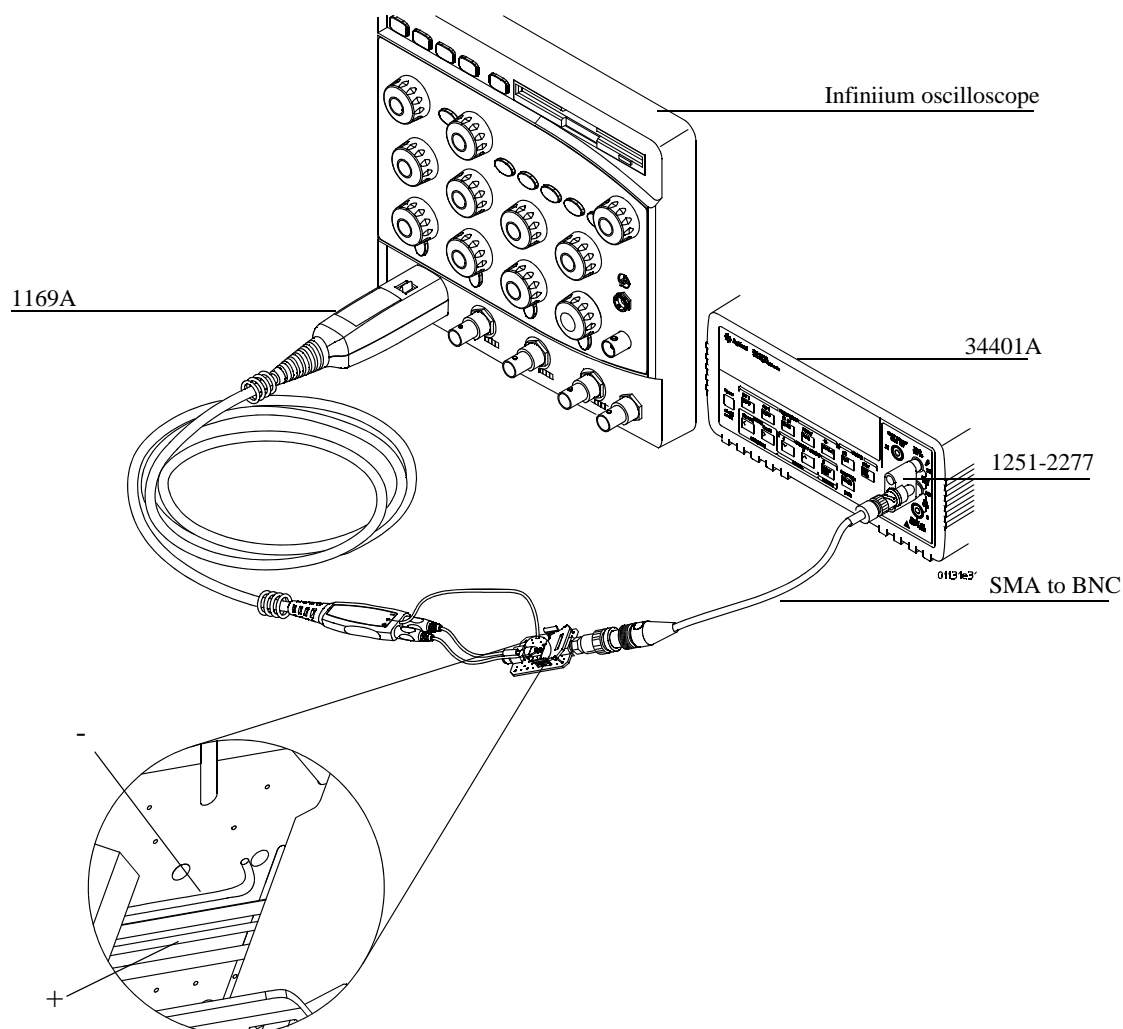
### Single-ended Test

- 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 4-12



- 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 W and 25,500 W.

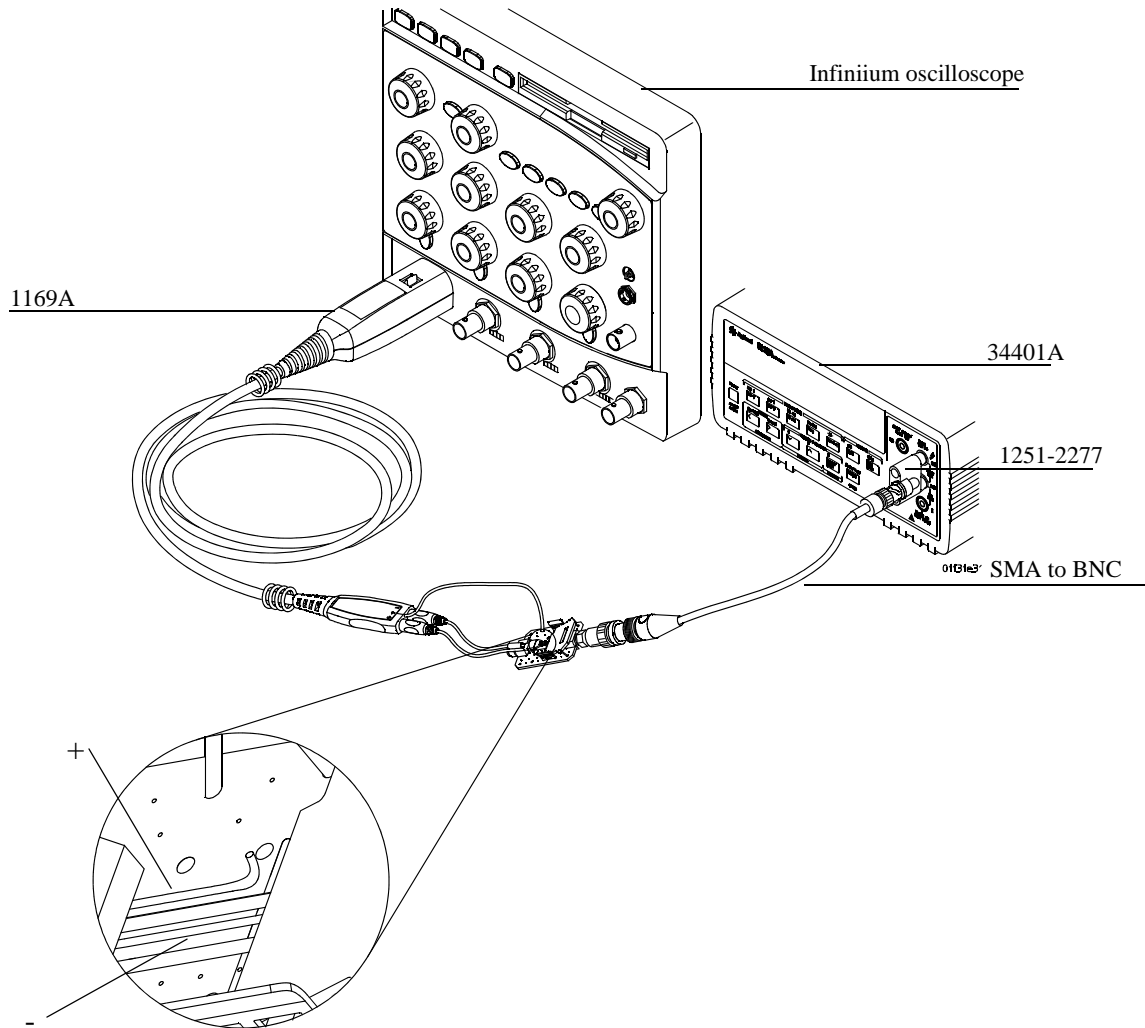
**Service**  
**To Test Input Resistance**

- 5 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.

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

**Figure 4-13**



- 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 W and 25,500 W.

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



Performance Test Record

Test Name	Results	
Bandwidth	> 12 GHz (1169A) > 10 GHz (1168A)  Result _____ GHz	Pass/Fail
Input Resistance	Differential Mode Limits: 49,000 W to 51,000 W $\pm$ _____ kW  Single-ended Mode Limits: 24,500 W to 25,500 W + _____ kW - _____ kW	Pass/Fail   Pass/Fail



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