Keysight InfiniiMax III Series Probes

Keysight Technologies

User's Guide

Notices

Manual Part Number

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Safety Notices

CAUTION. **CAUTION** denotes a hazard. It calls attention to a procedure that, if not correctly performed or adhered to, could result in damage to or destruction of the product. Do not proceed beyond a caution note until the indicated conditions are fully understood and met.

WARNING. WARNING denotes a hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in personal injury or loss of life. Do not proceed beyond a warning note until the indicated conditions are fully understood and met.

Contents

Contents

1 Using InfiniiMax III Series Probes

This chapter contains documentation on using the InfiniiMax III probing system.

The InfiniiMax III probing system offers you the highest performance available for measuring differential and single-ended signals, with flexible connectivity solutions for today's high-density ICs and circuit boards. Four different InfiniiMax III probe amplifiers ranging from 16 GHz to 30 GHz are available for matching your probing solution to your performance and budget requirements. A proprietary 200 GHz fT InP (indium phosphide) IC process with backside ground vias and novel thick film technology is utilized to accommodate your highest performance needs.

The family diagram for the InfiniiMax III probing system is shown in "InfiniiMax III and III+ Probing System Family Diagram" on page 14. This system is designed to give you the maximum flexibility in matching your probe to your setup. The following pages will discuss each of the adapters, probe amplifiers, and probe heads in detail.

CAUTION — **Refer to "Proper Handling Techniques" on page 9 before connecting any probe to the oscilloscope.**

KEYSIGHT TECHNOLOGIES

InfiniiMax III Probe Amplifiers

There are four InfiniiMax III amplifier models:

- N2800A 16 GHz Probe Amplifier
- N2801A 20 GHz Probe Amplifier
- N2802A 25 GHz Probe Amplifier
- N2803A 30 GHz Probe Amplifier

Each probe amplifier is pre-loaded with its specific measured S-parameters. When used with the Infiniium 90000 X-series, the oscilloscope downloads these parameters and automatically corrects the response of the unique probe system.

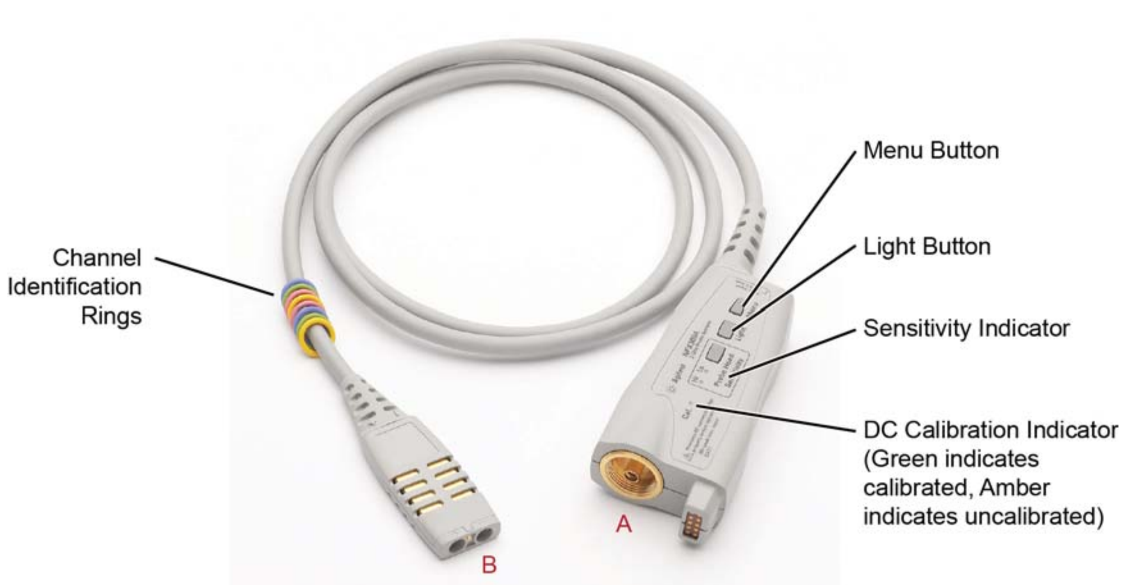


Figure 1 InfiniiMax III Probe Amplifier

Menu Button

Press this button to bring up the Probe dialog box in the oscilloscope GUI.

Light Button

Press this button to turn the LED headlights on the browser probe head on/off. Pressing and holding this button will ramp the intensity of the LED headlights. You may want to adjust the brightness to accommodate different lighting or glare conditions.

Sensitivity Indicator

If you are using the ZIF probe head, the sensitivity indicator tells you which ZIF tip is connected to the probe head. If the N5447A ceramic high sensitivity ZIF tip is connected then the “Hi” sensitivity LED will be illuminated. If the N5440A ceramic ZIF tip is connected then the “Normal” sensitivity LED will be illuminated. This will assist you in ensuring that the correct ZIF tip is selected in the oscilloscope GUI’s probe dialog box.

CAUTION If you select the wrong pairing of ZIF probe head and ZIF probe tip in the oscilloscope GUI's probe menu, your waveforms will look incorrect.

DC Calibration Indicator

Indicates if the particular combination of probe amplifier, probe head, and oscilloscope channel input is calibrated. Any time you use a new probe head type, a new probe amplifier, or a different channel on the oscilloscope, the **DC Cal** indicator turns amber, indicating that a DC calibration is required. After performing a calibration as described in Chapter 4, "Calibration / Deskew Procedure", the **DC Cal** indicator turns green.

Channel Identification Rings

Use the channel-identification rings to match each probe to the color of the oscilloscope's input channel to which it is connected. This enables you to quickly know which probe is connected to each channel without having to trace cables back to the oscilloscope inputs.

Channel Connection

CAUTION Refer to "Proper Handling Techniques" on page 9 before connecting any probe to the oscilloscope.

The connector labeled A in Figure 1 on page 6 plugs into one of the oscilloscope channel inputs. If connecting it directly to an Infiniium 90000 X-series oscilloscope, plug it into the channel and then turn the gray clutch/dial around the input (Figure 2 on page 8) until it clicks. To disconnect the probe amplifier, loosen the clutch on the oscilloscope input and disconnect the probe amplifier. If you are using an InfiniiMax III probe amplifier with a Keysight sampling oscilloscope, you will need to use the N5477A sampling scope adapter.

The connector labeled B in Figure 1 on page 6 connects to one of the InfiniiMax III probe heads.

CAUTION InfiniiMax I and II probe heads are not compatible with the InfiniiMax III probe amplifiers and vice versa.

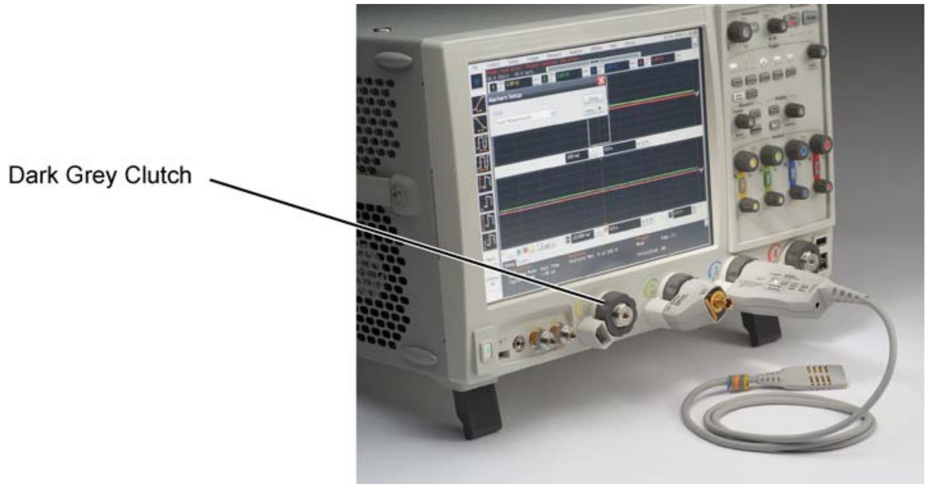


Figure 2 Clutches on an Infiniium 90000 X-series oscilloscope

NOTE The clutches on the Infiniium 90000 X-series do not require a mechanical calibration. They will maintain the same tolerance as the Keysight torque wrench (8 in lbs ±1 in lbs).

Probe Amplifier Bandwidth Upgrades

The InfiniiMax III probe amplifiers are upgradeable. When you order a probe bandwidth upgrade, you receive a new probe with a new model number and new serial number. The bandwidth upgrades are:

- N5446A-001 16 GHz to 20 GHz bandwidth upgrade
- N5446A-002 20 GHz to 25 GHz bandwidth upgrade
- N5446A-003 25 GHz to 30 GHz bandwidth upgrade
- N5446A-004 16 GHz to 25 GHz bandwidth upgrade
- N5446A-005 16 GHz to 30 GHz bandwidth upgrade
- N5446A-006 20 GHz to 30 GHz bandwidth upgrade

Proper Handling Techniques

This guide will assist you in properly handling your InfiniiMax III N2800A-series probes to prevent damage and maintain high performance. For more safe-handling information, go to **www.keysight.com/find/scope-demo**, click on **See Keysight's probes in action**, and then InfiniiMax III ESD Best Practices demo video listed under the Document Library tab.

CAUTION Electrostatic discharge (ESD) can quickly and imperceptibly damage or destroy high-performance probes, resulting in costly repairs. Always wear a wrist strap when handling probe components.

CAUTION Probes are sensitive devices and should be treated with care. Do not bend or kink the probe amplifier cable. Do not drop heavy objects on the probe, drop the probe from large heights, spill liquids on the probe, etc. Any of these examples can significantly degrade the performance of the probe.

CAUTION When storing the probe, it is best to coil the cable in a large radius and avoid a net twist in the cable during the process. This can be done in a similar manner to how garden hoses or extension cords are typically coiled.

CAUTION InfiniiMax I and II probe heads cannot be used with InfiniiMax III probe amplifiers and InfiniiMax III probe heads cannot be used with InfiniiMax I and II amplifiers.

CAUTION Never allow the probe head to be connected to the probe amplifier, if the probe amplifier is *not* connected to the oscilloscope channel.

CAUTION Always disconnect an N5441A solder-in probe head from the probe amplifier before unsoldering, moving to a new position, and resoldering the head.

Before Connecting a Probe

InfiniiMax probes and accessories are ESD sensitive devices and should be treated with care. Before using or handling the probe or accessories, always wear a grounded ESD wrist strap and ensure that cables and probe heads are discharged before being connected.

All work, including connecting probe amplifiers to the oscilloscope, should be performed at a static-safe work station as shown in Figure 3 on page 10.

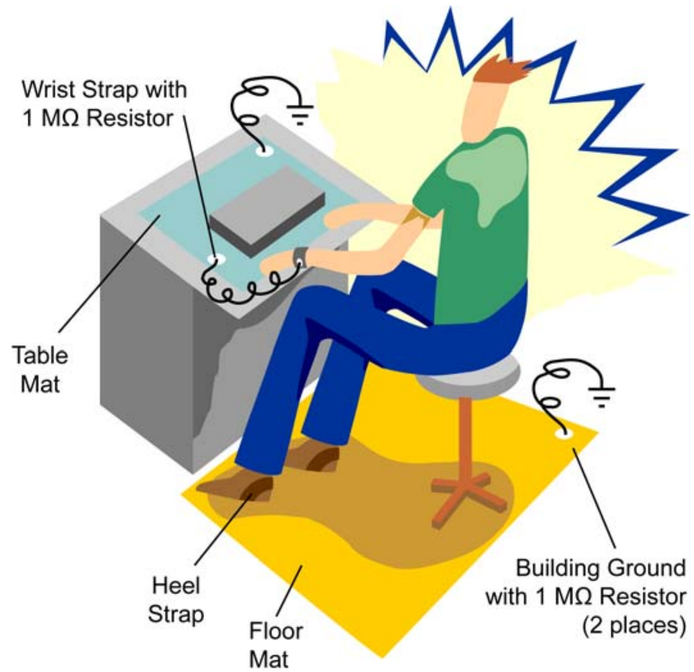


Figure 3 Static-Safe Work Station

Many scopes including Keysight's 90000X series have a front-panel ground socket. You can plug the wrist strap into the ground socket as seen in the following picture.

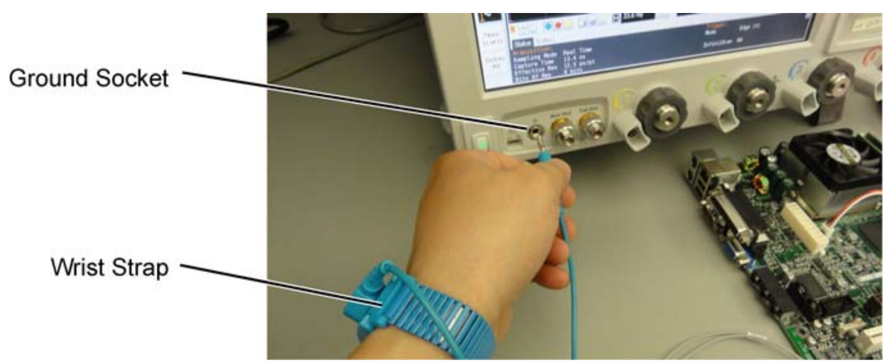


Figure 4 Wrist Strap Connected to Oscilloscope Ground Socket

The static-safe work station shown in Figure 3 uses two types of ESD protection:

- Conductive table-mat and wrist-strap combination.
- Conductive floor-mat and heel-strap combination.

Both types, when used together, provide a significant level of ESD protection. Of the two, only the table-mat and wrist-strap combination provides adequate ESD protection when used alone. To ensure user safety, the static-safe accessories must provide at least 1 MΩ of isolation from ground. Purchase acceptable ESD accessories from your local supplier.

WARNING **These techniques for a static-safe work station should not be used when working on circuitry with a voltage potential greater than 500 volts.**

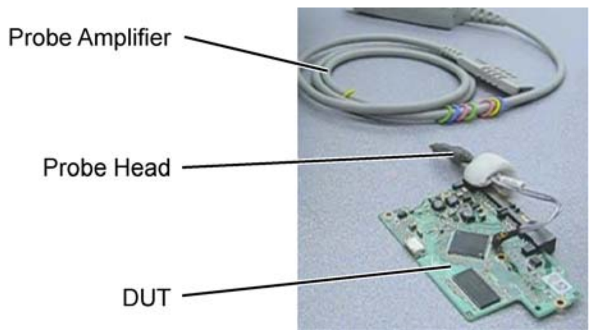
Connecting a Probe to an Oscilloscope Channel

To protect against ESD damage, always use the following steps when connecting your probe to the oscilloscope.

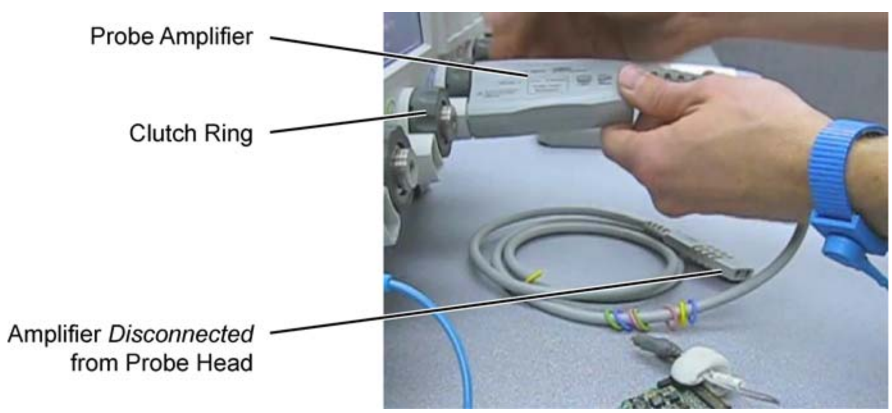
1 If the Device Under Test (DUT) is *not* grounded to the oscilloscope via the AC mains ground, connect the DUT ground to the oscilloscope ground. An example of a device having a floating ground would be a battery-powered DUT.

2 Attach the probe head to the DUT.

CAUTION At this point, the N2800A-series probe amplifier must *not* be connected to the oscilloscope or the probe head.



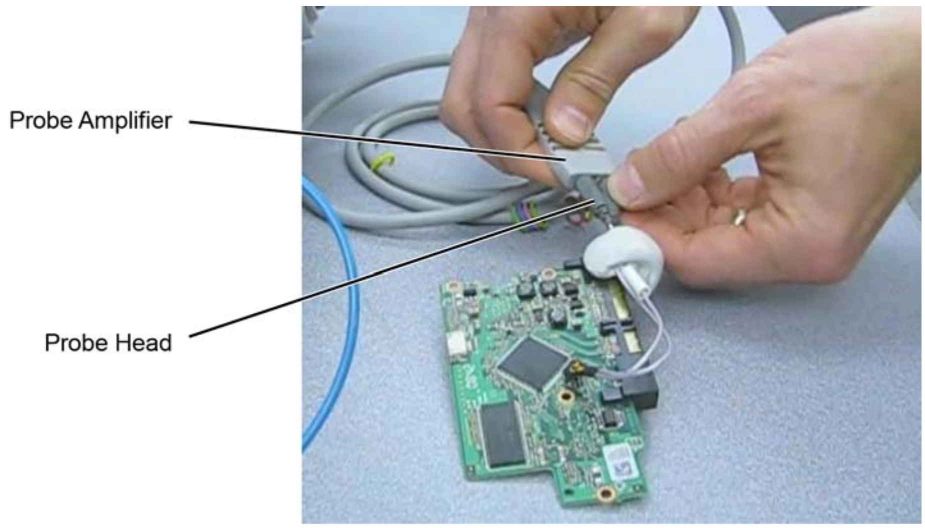
3 Connect the probe amplifier to the oscilloscope while hand tightening the dark gray clutch ring. The clutch ring limits the applied torque to 8 in-lb (±1 in-lb).



4 Connect the probe head to the probe amplifier.

CAUTION

When connecting a probe head to a probe amplifier, push straight in. When disconnecting a probe head from an amplifier, pull the probe head connectors straight out of the sockets. Never bend the probe head in order to pry it loose from the amplifier. Also, do not wiggle the probe head up and down or twist it to remove the connectors from the sockets. This can damage the pins in the amplifier or the probe head itself.



Disconnecting a Probe from an Oscilloscope Channel

Always disconnect the probe head from the probe amplifier before:

- disconnecting the probe amplifier from the oscilloscope.
- switching the probe amplifier from one oscilloscope channel to another.

CAUTION

Never allow the probe head to be connected to the probe amplifier, if the probe amplifier is *not* connected to the oscilloscope channel.

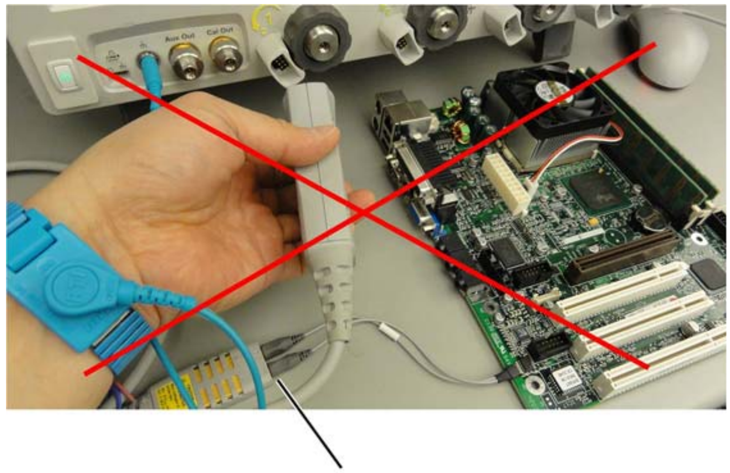


Figure 5 Probe Improperly Disconnected from Oscilloscope while Probe Head is Connected to the Probe Amplifier

Probing the DUT

When making your measurements, you'll often need to probe different locations on the DUT. You can safely move any of the following three probe heads without having to first break the amplifier-to-head connection:

- N5445A differential browser head
- N5439A ZIF head
- N5444A 2.92 mm/3.5 mm/SMA head

The only exception is when the DUT is not grounded to the oscilloscope via the AC mains ground. In this case, connect the DUT ground to the oscilloscope ground before moving the probe. An example of a device having a floating ground would be a battery-powered DUT.

When probing with an N5441A solder-in probe head, always disconnect the probe head from the amplifier before moving the head to a new probing point. This is because some soldering-iron tips can hold a charge which can damage the probe amplifier.

CAUTION **Always disconnect an N5441A solder-in probe head from the probe amplifier before unsoldering, moving to a new position, and resoldering the head.**

InfiniiMax III and III+ Probing System Family Diagram

The following diagram shows the InfiniiMax III and InfiniiMax III+ probes and probe heads. The diagram is not drawn to scale.

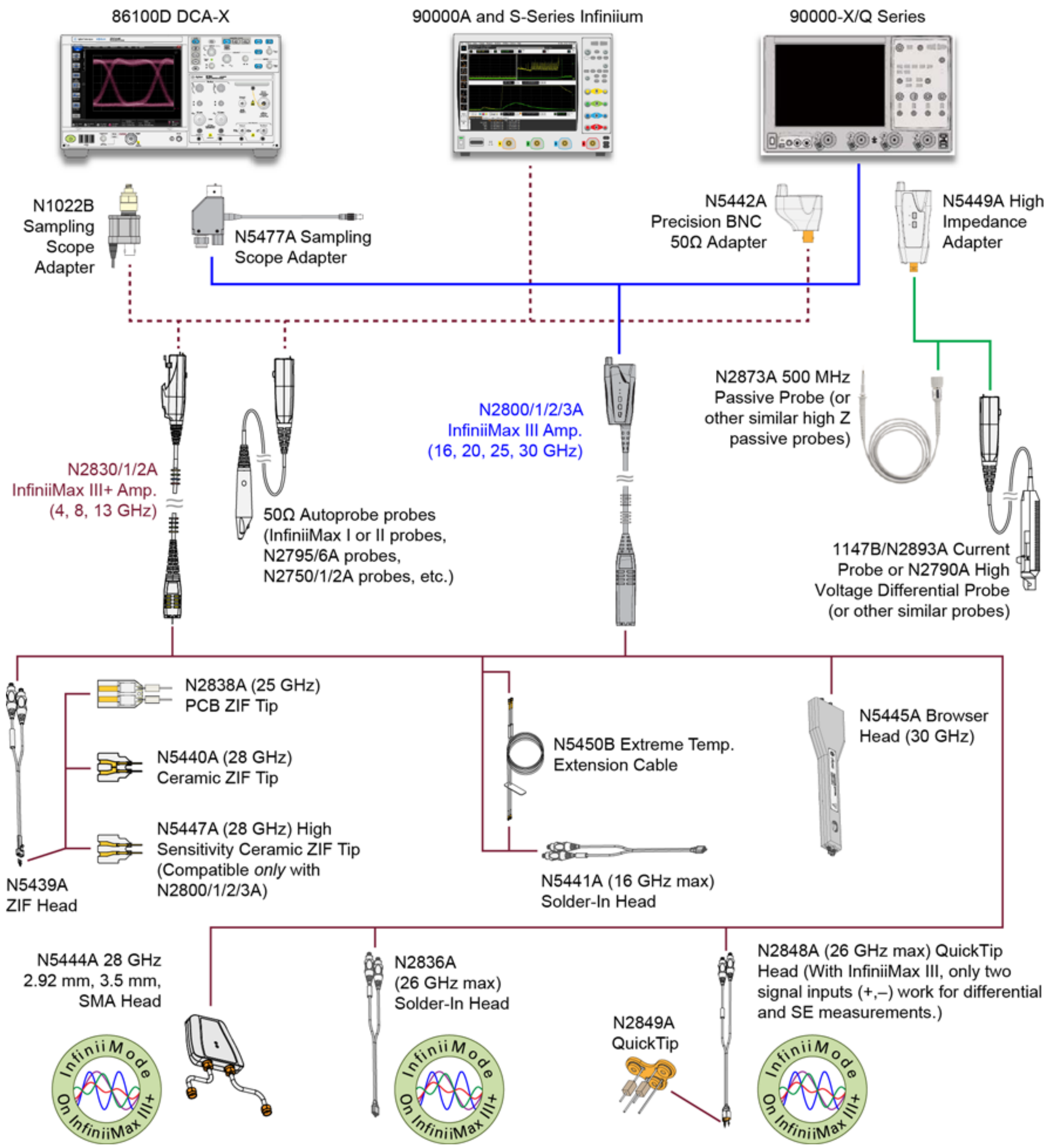


Figure 6 InfiniiMax III / III+ Probing System

For extreme temperature testing, use the N5450B InfiniiMax extreme temperature extension cable with the N5441A solder-in head. The N5441A can withstand temperatures from –55°C to +150°C for up to 250 test cycles.

CAUTION None of the N2800/1/2/3A probe amplifiers can withstand the extreme temperatures (–55°C to +150°C) that the N5450B can withstand. When using the N5450B extension cable, do not subject the InfiniiMax III probe amplifier to extreme temperatures.

CAUTION None of the other probe heads are designed for extreme temperature testing.

The N5449A includes one N2873A probe. The adapter is specifically tuned for the N2873A probe. Similar probes (1 MΩ input) can be used. Other probes may not meet the bandwidth specification.

CAUTION When using the N5450B extension cable, do not subject the InfiniiMax III probe amplifier or probe head (other than the N5441A solder-in probe head) to extreme temperatures.

Use the N5443A Performance Verification (PV) accessory fixture to properly position the probe for PV testing.

N5477A Sampling Scope Adapter

The N5477A Sampling Scope Adapter allows you to connect the InfiniiMax III probing system to the Infiniium 86100D DCA-X sampling oscilloscope or other RF instruments.

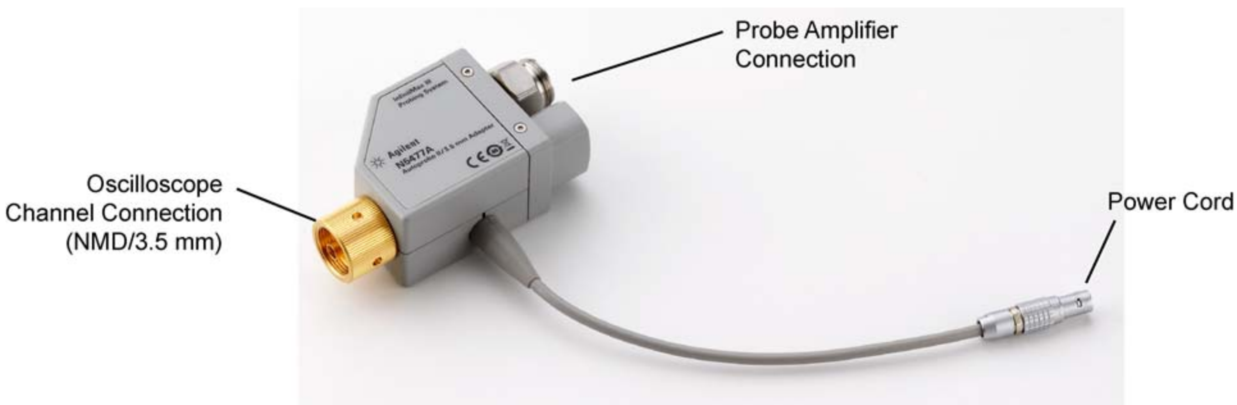


Figure 7 N5477A InfiniiMax III Sampling Scope Adapter

Connect the NMD/3.5 mm side of the adapter to one of the channel inputs on the sampling oscilloscope. Then connect the power cord to either the probe power output on the DCA-X 86100D wideband oscilloscope (if the module being used has this receptacle) or to the 1143A power module. Finally, connect the other side of the adapter to the InfiniiMax III probe amplifier.

Previously, the DCA-X wideband oscilloscope was limited to 13 GHz of probing, but with the N5477A sampling oscilloscope adapter, the DCA-X can now probe up to 30 GHz.

The N5477A sampling oscilloscope adapter can also be used to connect the InfiniiMax III probing system to generic 50 Ohm test equipment as long as the 1143A power supply and 5062-1247 NMD male-to-3.5mm female adapter are used. Both of these parts can be ordered through Keysight Technologies.

Cautions

In addition to the CAUTION notices below, also refer to the CAUTION notices listed in each section of this book.

CAUTION Electrostatic discharge (ESD) can quickly and imperceptibly damage or destroy high-performance probes, resulting in costly repairs. Always wear a wrist strap when handling probe components.

CAUTION Probes are sensitive devices and should be treated with care. Do not bend or kink the probe amplifier cable. Do not drop heavy objects on the probe, drop the probe from large heights, spill liquids on the probe, etc. Any of these examples can significantly degrade the performance of the probe.

CAUTION Whenever you disconnect a probe head from an InfiniiMax amplifier, pull the probe head connectors straight out of the sockets. When connecting a probe head to an amplifier, push straight in also. Never bend the probe head in order to “pop” it loose from the amplifier. Also, do not wiggle the probe head up and down or twist it to remove the connectors from the sockets. This can damage the pins in the amplifier or the probe head itself.

CAUTION When storing the probe, it is best to coil the cable in a large radius and avoid a net twist in the cable during the process. This can be done in a similar manner to how garden hoses or extension cords are typically coiled.

CAUTION InfiniiMax I and II probe heads cannot be used with InfiniiMax III probe amplifiers and InfiniiMax III probe heads cannot be used with InfiniiMax I and II amplifiers.

CAUTION Always remove the probe head from the device under test (DUT) before disconnecting the probe amp from the oscilloscope.

SPICE Models for N5440A, N5447A, N5441A, N5445A, and N5444A Probe Heads

These are SPICE models for the input impedances of the various InfiniiMax III probes. Generic SPICE sub-circuit files are listed so they can be copied and pasted into user's SPICE simulations.

Chapter 6, "Performance Plots" shows the matching between the measured input impedance and these modeled input impedances for the various probe heads.

The following diagram shows the SPICE circuit used for these probe heads:

- N5440A 28 GHz Ceramic ZIF Tips (with N5439A ZIF Probe Head)
- N5447A 28 GHz Ceramic High Sensitivity ZIF Tips (with N5439A ZIF Probe Head)
- N5441A 16 GHz Solder-In Probe Head
- N5445A Browser Probe Head
- N5444A SMA Probe Head

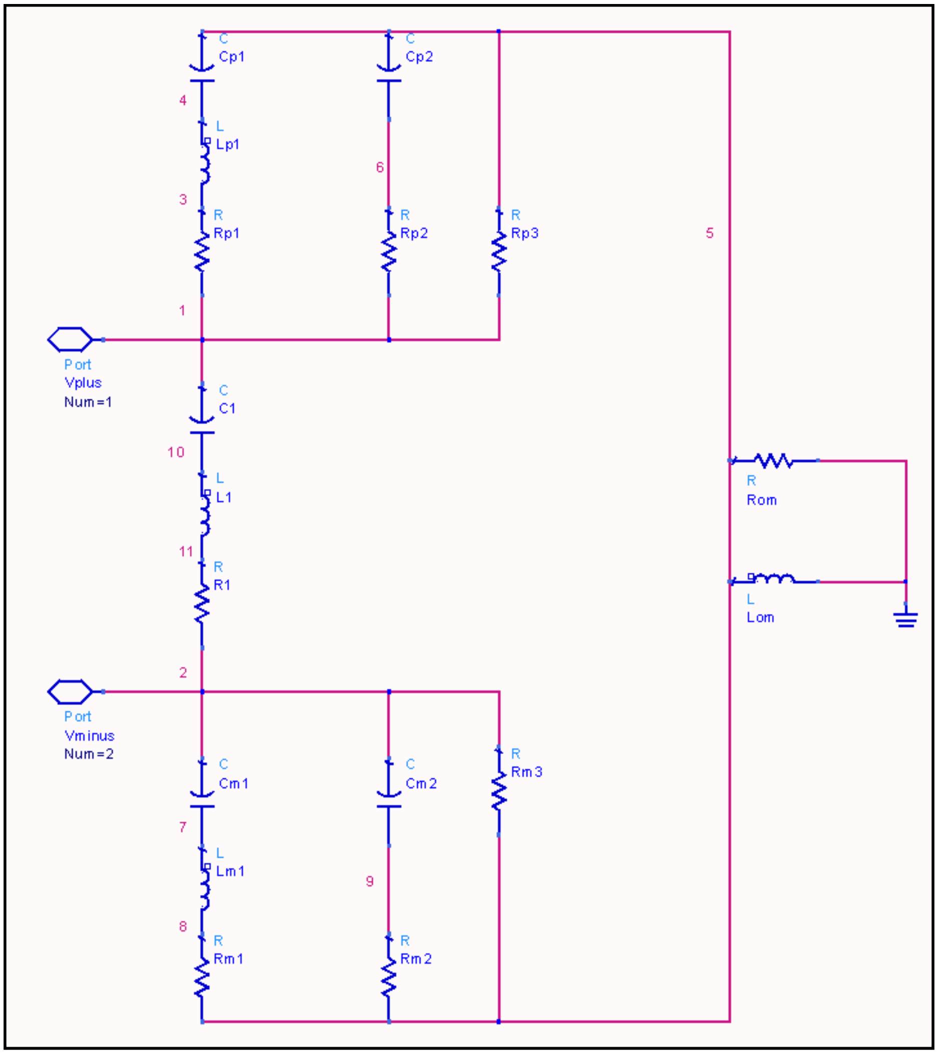


Figure 8 SPICE circuit to use for N5440A, N5447A, N5441A, N5445A, and N5444A probe heads

The input impedance is only a function of the probe head; the amplifier input does not significantly affect the input impedance.

NOTE You'll find the following SPICE data on the documentation CD that was shipped with your probe. Copying this data from the CD is the simplest most reliable method to get the data.

N5440A Ceramic ZIF Tip, N5439A ZIF Probe Head

```
.subckt N5440A_N5439A_450ohmZIF 1 2
c1 1 10 20f
l1 10 11 1.5n
r1 11 2 180
rp1 1 3 180
lp1 3 4 1.5n
cp1 4 5 24f
cp2 5 6 100n
rp2 6 1 500
rp3 5 1 50k
cm1 2 7 24f
lm1 7 8 1.5n
rm1 8 5 180
cm2 2 9 100n
rm2 9 5 500
rm3 2 5 50k
rom 5 0 180
lom 5 0 30u
.ends
```

N5447A Ceramic High Sensitivity ZIF Tip, N5439A ZIF Probe Head

```
.subckt N5447A_N5439A_200ohmZIF 1 2
c1 1 10 20f
l1 10 11 2.3n
r1 11 2 250
rp1 1 3 1.2k
lp1 3 4 2.3n
cp1 4 5 24f
cp2 5 6 100n
rp2 6 1 250
rp3 5 1 25k
cm1 2 7 24f
lm1 7 8 2.3n
rm1 8 5 1.2k
cm2 2 9 100n
rm2 9 5 250
rm3 2 5 25k
rom 5 0 150
lom 5 0 30u
.ends
```

N5441A Solder-In Probe Head

```
.subckt N5441A_SldrIn 1 2
c1 1 10 50f
l1 10 11 2.1n
r1 11 2 65
rp1 1 3 65
lp1 3 4 2.5n
cp1 4 5 55f
cp2 5 6 100n
rp2 6 1 500
rp3 5 1 50k
cm1 2 7 55f
lm1 7 8 2.5n
rm1 8 5 65
cm2 2 9 100n
rm2 9 5 500
rm3 2 5 50k
rom 5 0 130
lom 5 0 30u
.ends
```

N5445A Browser Probe Head (1 mm span)

```
.subckt N5445A_Brwsr1mmSpn 1 2
c1 1 10 20f
l1 10 11 2.3n
r1 11 2 150
rp1 1 3 150
lp1 3 4 2.3n
cp1 4 5 30f
cp2 5 6 100n
rp2 6 1 500
rp3 5 1 50k
cm1 2 7 30f
lm1 7 8 2.3n
rm1 8 5 150
cm2 2 9 100n
rm2 9 5 500
rm3 2 5 50k
rom 5 0 40
lom 5 0 30u
.ends
```

N5445A Browser Probe Head (2 mm span)

```
.subckt N5445A_Brwsr2mmSpn 1 2
c1 1 10 20f
l1 10 11 2.3n
r1 11 2 250
rp1 1 3 250
lp1 3 4 2.3n
cp1 4 5 30f
cp2 5 6 100n
rp2 6 1 500
rp3 5 1 50k
cm1 2 7 30f
lm1 7 8 2.3n
rm1 8 5 250
cm2 2 9 100n
rm2 9 5 500
rm3 2 5 50k
rom 5 0 40
lom 5 0 30u
.ends
```

N5445A Browser Probe Head (3 mm span)

```
.subckt N5445A_Brwsr3mmSpn 1 2
c1 1 10 20f
l1 10 11 2.3n
r1 11 2 300
rp1 1 3 300
lp1 3 4 2.3n
cp1 4 5 30f
cp2 5 6 100n
rp2 6 1 500
rp3 5 1 50k
cm1 2 7 30f
lm1 7 8 2.3n
rm1 8 5 300
cm2 2 9 100n
rm2 9 5 500
rm3 2 5 50k
rom 5 0 40
lom 5 0 30u
.ends
```

N5444A SMA Probe Head

The N5444A 2.92 mm/3.5 mm/SMA probe head is modeled by 40 short transmission lines of varying impedance. This accurately models the temporal nature of this probe head. The sub-circuit text is:

```
.subckt N5444A_2p92mm 01
t01 01 0 02 0 z0=50.1226 td=4.5p
t02 02 0 03 0 z0=48.6767 td=4.5p
t03 03 0 04 0 z0=50.0690 td=4.5p
t04 04 0 05 0 z0=50.1226 td=4.5p
t05 05 0 06 0 z0=47.8189 td=4.5p
t06 06 0 07 0 z0=48.4842 td=4.5p
t07 07 0 08 0 z0=51.5636 td=4.5p
t08 08 0 09 0 z0=51.3432 td=4.5p
t09 09 0 10 0 z0=50.1231 td=4.5p
t10 10 0 11 0 z0=50.9715 td=4.5p
t11 11 0 12 0 z0=51.2048 td=4.5p
t12 12 0 13 0 z0=49.3079 td=4.5p
t13 13 0 14 0 z0=48.3903 td=4.5p
t14 14 0 15 0 z0=50.1144 td=4.5p
t15 15 0 16 0 z0=51.9126 td=4.5p
t16 16 0 17 0 z0=51.1671 td=4.5p
t17 17 0 18 0 z0=48.7858 td=4.5p
t18 18 0 19 0 z0=49.7704 td=4.5p
t19 19 0 20 0 z0=54.9662 td=4.5p
t20 20 0 21 0 z0=55.6338 td=4.5p
t21 21 0 22 0 z0=50.6714 td=4.5p
t22 22 0 23 0 z0=47.9673 td=4.5p
t23 23 0 24 0 z0=48.6942 td=4.5p
t24 24 0 25 0 z0=51.3949 td=4.5p
t25 25 0 26 0 z0=52.4910 td=4.5p
t26 26 0 27 0 z0=50.3990 td=4.5p
t27 27 0 28 0 z0=49.9508 td=4.5p
t28 28 0 29 0 z0=50.5692 td=4.5p
t29 29 0 30 0 z0=49.8539 td=4.5p
t30 30 0 31 0 z0=51.6006 td=4.5p
t31 31 0 32 0 z0=49.4657 td=4.5p
t32 32 0 33 0 z0=51.3932 td=4.5p
t33 33 0 34 0 z0=50.6702 td=4.5p
t34 34 0 35 0 z0=50.1108 td=4.5p
t35 35 0 36 0 z0=50.9072 td=4.5p
t36 36 0 37 0 z0=50.6940 td=4.5p
t37 37 0 38 0 z0=50.1733 td=4.5p
t38 38 0 39 0 z0=50.2609 td=4.5p
t39 39 0 40 0 z0=50.1355 td=4.5p
t40 40 0 41 0 z0=51.2333 td=4.5p
rterm 41 0 50.3
.ends
```

SPICE Models for N2838A and N2836A Probe Heads

These are SPICE models for the input impedances of the various InfiniiMax III probes. Generic SPICE sub-circuit files are listed so they can be copied and pasted into user's SPICE simulations.

Chapter 6, "Performance Plots" shows the matching between the measured input impedance and these modeled input impedances for the various probe heads.

The following diagram shows the SPICE circuit used for these probe heads:

- N2838A 25 GHz PC Board ZIF Tip (with N5439A ZIF Probe Head)
- N2836A 26 GHz Solder-In Probe Head

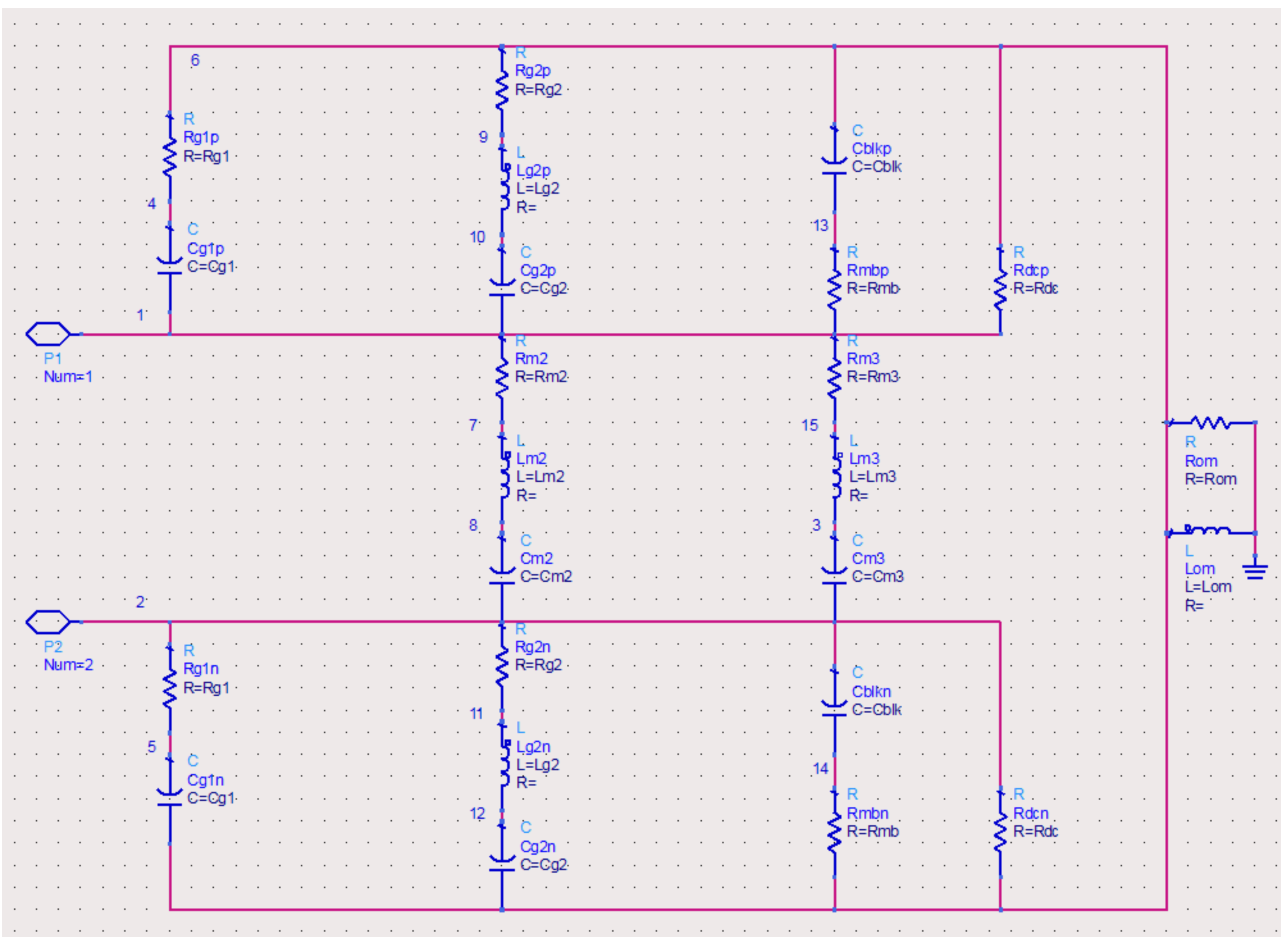


Figure 9 SPICE circuit to use for N2838A and N2836A probe heads

The input impedance is only a function of the probe head; the amplifier input does not significantly affect the input impedance.

NOTE You'll find the following SPICE data on the documentation CD that was shipped with your probe. Copying this data from the CD is the simplest most reliable method to get the data.

N2838A PC Board ZIF Tip, N5439A ZIF Probe Head

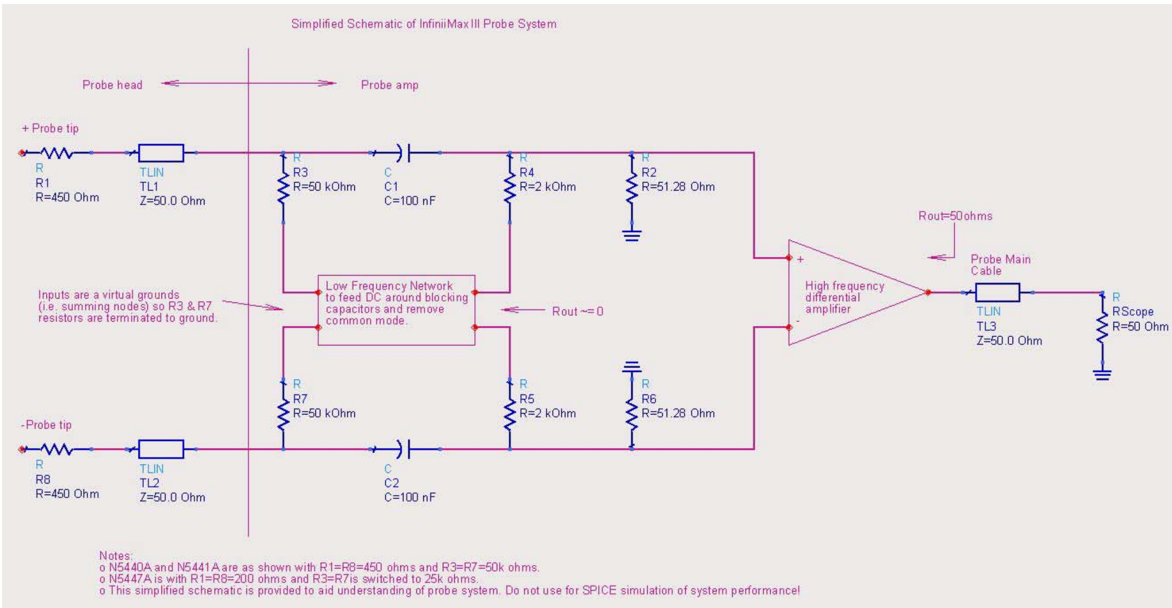
```
.subckt N2838A_N5439A_PcbZif 1 2
Cblkp 6 13 100n
Cblkn 2 14 100n
Cg1p 1 4 26.1f
Cg1n 5 6 26.1f
Cg2p 1 10 128.4f
Cg2n 12 6 128.4f
Cm2 2 8 3.04f
Cm3 2 3 7.05f
Rg1p 4 6 67.8
Rg1n 2 5 67.8
Rg2p 9 6 126.2
Rg2n 2 11 126.2
Rm2 1 7 225.9
Rm3 1 15 71.5
Rmbp 1 13 500
Rmbn 14 6 500
Rdcp 1 6 50k
Rdcn 2 6 50k
Rom 6 0 110
Lom 6 0 30u
Lg2p 9 10 1.21n
Lg2n 11 12 1.21n
Lm2 7 8 15.3n
Lm3 3 15 5.76n
.ends
```

N2836A Solder-In Probe Head

```
.subckt N2836A_SldrIn 1 2
Cblkp 6 13 100n
Cblkn 2 14 100n
Cg1p 1 4 20.7f
Cg1n 5 6 20.7f
Cg2p 1 10 152.2f
Cg2n 12 6 152.2f
Cm2 2 8 4.12f
Cm3 2 3 6.46f
Rg1p 4 6 52.4
Rg1n 2 5 52.4
Rg2p 9 6 142
Rg2n 2 11 142
Rm2 1 7 172.4
Rm3 1 15 67.9
Rmbp 1 13 500
Rmbn 14 6 500
Rdcp 1 6 50k
Rdcn 2 6 50k
Rom 6 0 110
Lom 6 0 30u
Lg2p 9 10 1.12n
Lg2n 11 12 1.12n
Lm2 7 8 11.2n
Lm3 3 15 5.90n
.ends
```

Simplified InfiniiMax III Schematic

NOTE Do not use this simplified schematic as a SPICE model.



2
InfiniiMax III Probe Heads

This chapter documents the InfiniiMax III probe heads.

CAUTION Refer to "Proper Handling Techniques" on page 9 before connecting any probe head to a probe amplifier.

N5445A InfiniiMax III Differential Browser Probe Head

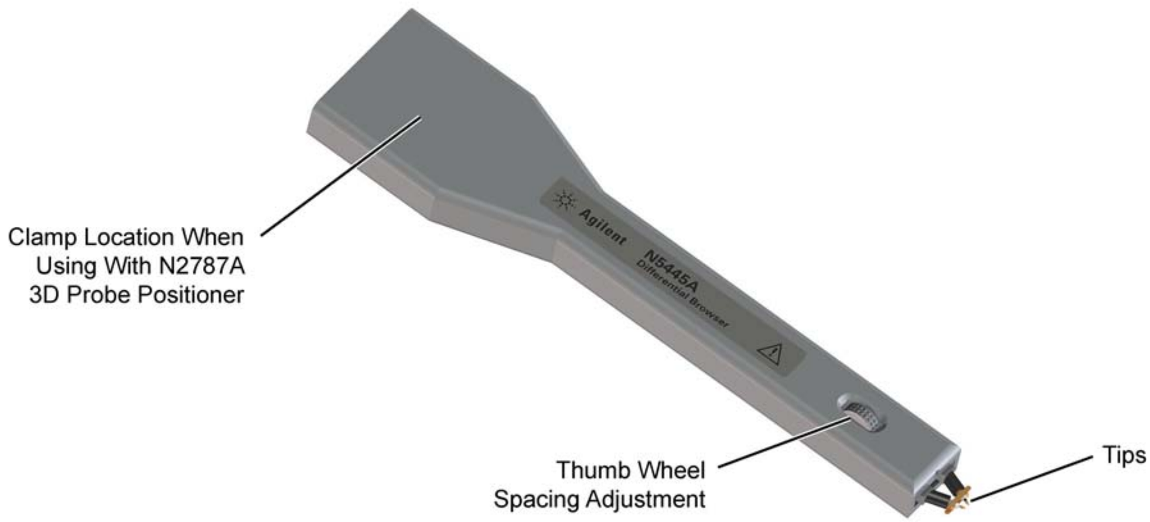


Figure 10 N5445A InfiniiMax III Differential Browser Head

The N5445A browser head (30 GHz) is the best choice for the general-purpose trouble shooting of differential signals with spring-loaded tips and variable spacing from 20 mil – 125 mil (or 0.5 mm – 3.1 mm). The span between the signal tips is easily adjusted with a thumb wheel on the browser (see Figure 10).

Using the LED Headlights

A pair of LED headlights are integrated into the tip of the browser to illuminate the probing area for better visibility. The headlights are controlled via the Light button on the InfiniiMax III probe amplifier (see Figure 1 on page 6). Pressing this button turns the headlights on / off while pressing the button and holding it down ramps the intensity of the headlights.

Adjusting the Tip Span

The thumb wheel on the browser (see Figure 10) is used to adjust the spacing of the tips between 20 mil – 125 mil (or 0.5 mm – 3.1 mm). Stop adjusting the span of the tips when the end of the range is reached and do not force anything.

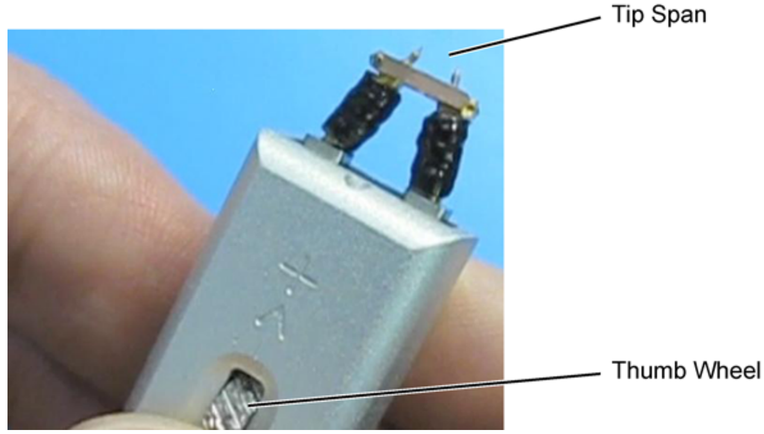


Figure 11 Location of thumb wheel and definition of tip span

You will need to tell the oscilloscope GUI what span you are using when calibrating the probe. To do this, set your span and then use the browser's protective cap to measure which of the possible values your span most closely matches. Then set this value in the Probe Calibration dialog box on the oscilloscope.

Using the Browser Mounting Holes

There are two holes on the back side of the browser. These holes are there for mounting the browser to a holder using a bracket or holder designed by the customer. Figure 12 below shows the dimensions of these mounting holes.

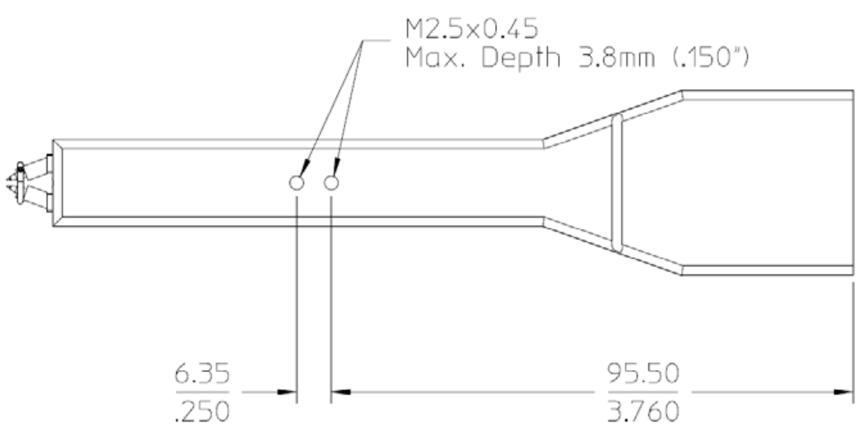


Figure 12 Dimensions of mounting holes on browser

Tips for Using the Browser Probe Head

Tip 1.

Probe along the browser's axis to prevent tip damage. Hold the probe vertical and perpendicular to the circuit board.

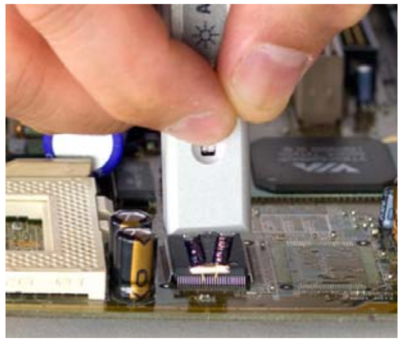


Figure 13 Proper Probe Handling

CAUTION Do not apply side load to the browser.

Figure 14 Improper Probe Handling

CAUTION Do not apply too much force when browsing. The weight of the probe in your hand should be sufficient. The axial travel of the probe is about 15 mils (0.4 mm).

CAUTION The browser's protective cap should be kept on the browser at all times except when probing.

CAUTION Always remove the browser from the device under test (DUT) before disconnecting the probe amp from the oscilloscope.

Tip 2. Use the N2787A 3D Probe Positioner to help in positioning the browser

- First, lock the vertical compliance of the probe positioner
- Clamp the browser into the positioner, aligning the browser's slot with the positioners gripping pad
- While holding the browser, loosen the main knob and position the probe
- Use the browser's own weight to depress the tips, and tighten the main knob to lock the probe's position

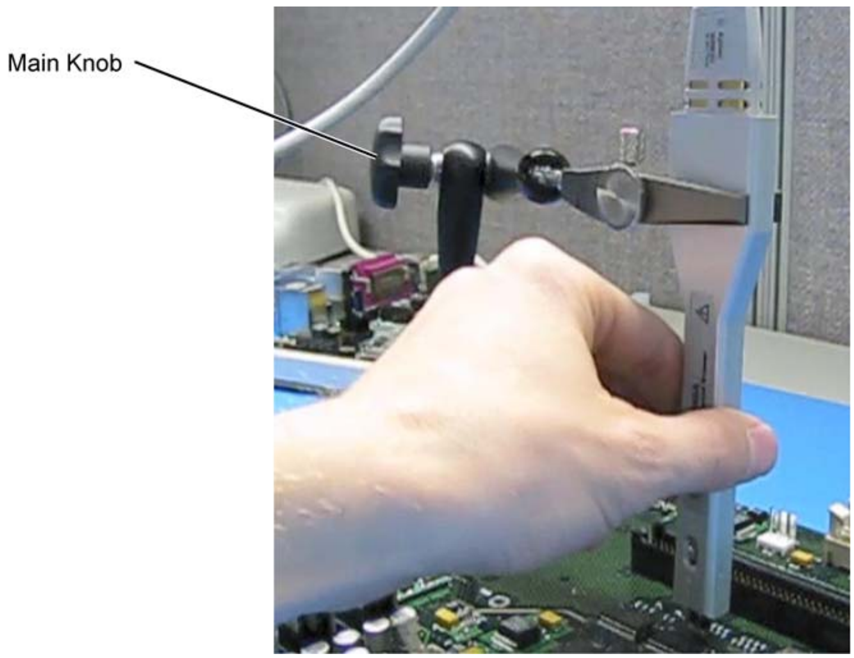


Figure 15 Using the Browser with the N2787A 3D Probe Positioner

Replaceable Parts

The following parts are replaceable:

- N5476A replacement browser tips (qty. 4)
- N5445-68700 replacement browser ground blades (qty. 4)
- N5445-68701 replacement browser screws (qty. 4)

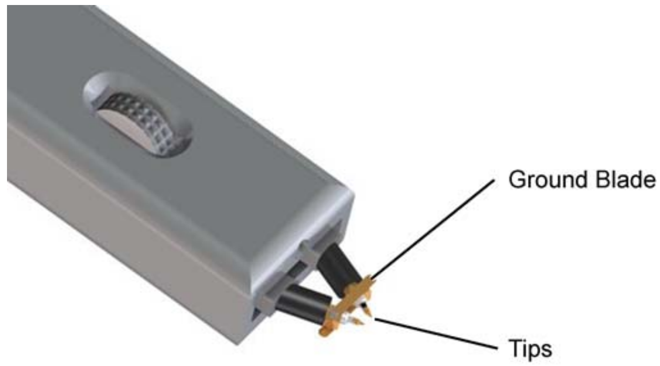


Figure 16 Browser Tips and Ground Blade

N2848A InfiniiMax III+ QuickTip InfiniiMode Probe Head

The N2848A QuickTip probe head is used with an N2849A QuickTip and together they provide the following advantages:

- Easy-to-make secure magnetic mechanical connection between probe head and QuickTip. No latch lever is used!
- Extreme temperature environments such as temperature chambers.
- To use the head's InfiniiMode capability, use this head with N2830A-series probe amplifiers. InfiniiMode allows you to make differential, common mode, and single ended measurements without having to re-solder the tip leads.

Table 1 N2848A with N2803A Probe Amplifier

Item	Characteristic
Bandwidth	16 GHz
Input C (Differential)	340 fF
Input C (Single Ended)	200 fF
Rise Time	27.1 ps (10 - 90%)
Fall Time	19.3 ps (20 - 80%)

Permanently solder any number of QuickTips to your DUT as shown in Figure 17 on page 36. Because the probe head is magnetically connected (instead of mechanically connected) to the QuickTip, you can effortlessly connect and disconnect to each QuickTip. For best performance, position the QuickTip vertically on the DUT. Because this is an InfiniiMode compatible head, the tip has two signal leads and two ground leads. The ground leads have minimal effect on your differential measurements. However, if you are making only differential measurements you can optionally cut off the ground leads or fold them out of the way. Be aware that without the ground leads, the mechanical stability of the QuickTip will be reduced and you will need to stabilize the probe head.

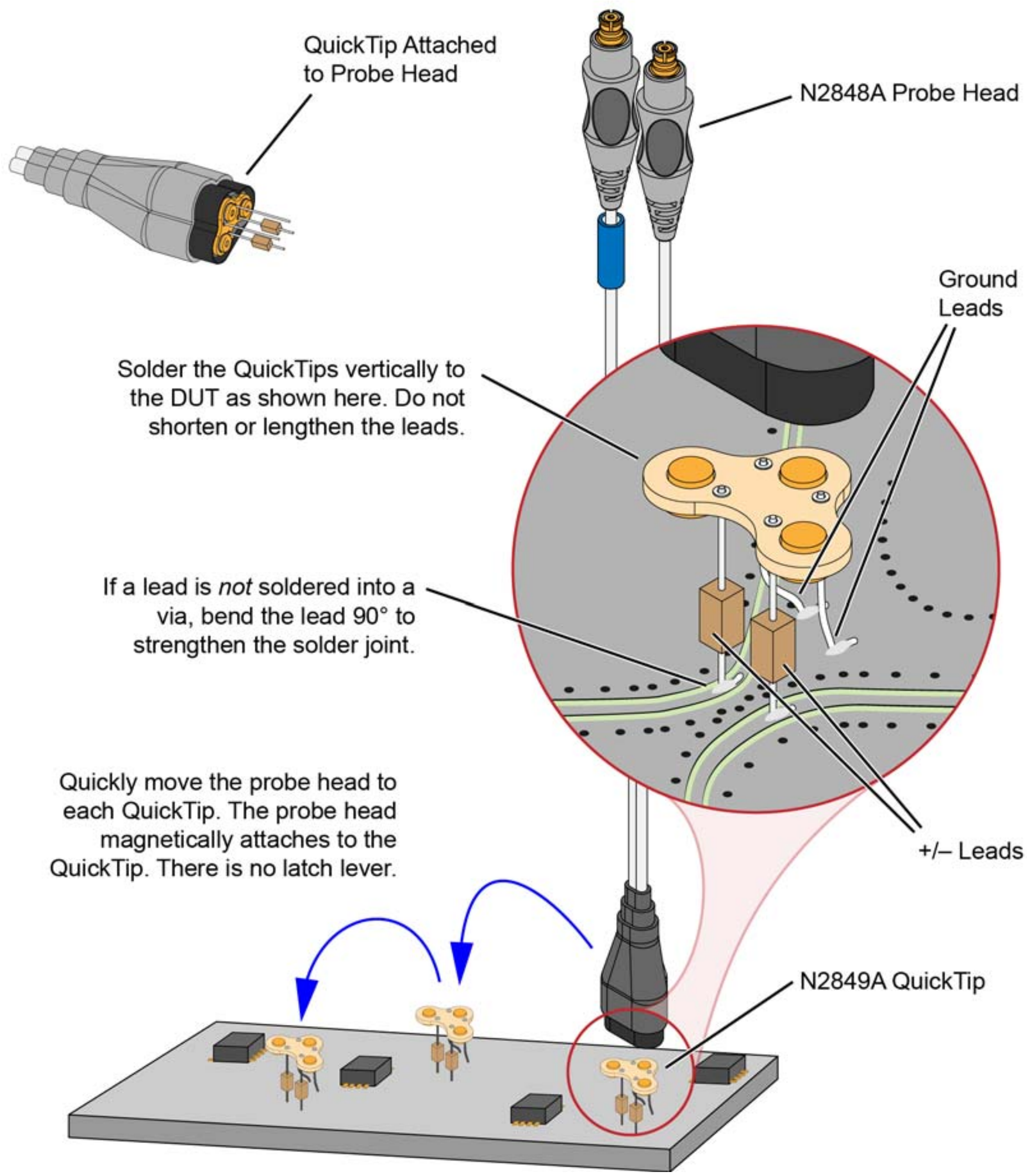


Figure 17 Probing with the N2848A Probe Head and N2849A QuickTip

CAUTION Do not replace or repair the N2849A QuickTip's resistor or ground leads. Attempting to do so will damage the ability of the tip to mate with the N2848A probe head.

NOTE The N2848A does not include any N2849A QuickTips. The N2849A must be ordered separately.

Connecting a QuickTip to the DUT

Use the following tips when soldering the QuickTips to your DUT:

- Orient the QuickTip vertically as shown in Figure 17 on page 36.
- Solder the four leads to vias or surfaces.

CAUTION Always mechanically strain-relieve the QuickTip head *before* using to protect both your probe accessories and DUT from damage.

NOTE Resistor and wire leads on the QuickTip are factory trimmed to the proper length for use. Adding wire length to the tip of the mini-axial lead resistors or to the ground leads will degrade the performance of the probe.

NOTE Soldering the ground wires is not required when making differential or single-ended (+ or – leads) measurements.

- When soldering to a via, always trim the lead close to the via's underside.
- If a lead is to be soldered to a surface and not a via, make a stronger solder joint by bending the end of the lead 90°. For signal leads, bend the wire approximately half way between the resistor and the end of the wire. Bend the ground leads at about the same distance.

CAUTION Be careful not to damage the tip wires when handling the QuickTips. Wires can be carefully reshaped with tweezers or fingers if necessary.

CAUTION The QuickTips are very fragile. They must be manufactured in this way in order to meet the high-performance, high bandwidth applications they are intended for. Be extremely careful when handling.

N5439A InfiniiMax III ZIF (Zero Insertion Force) Probe Head

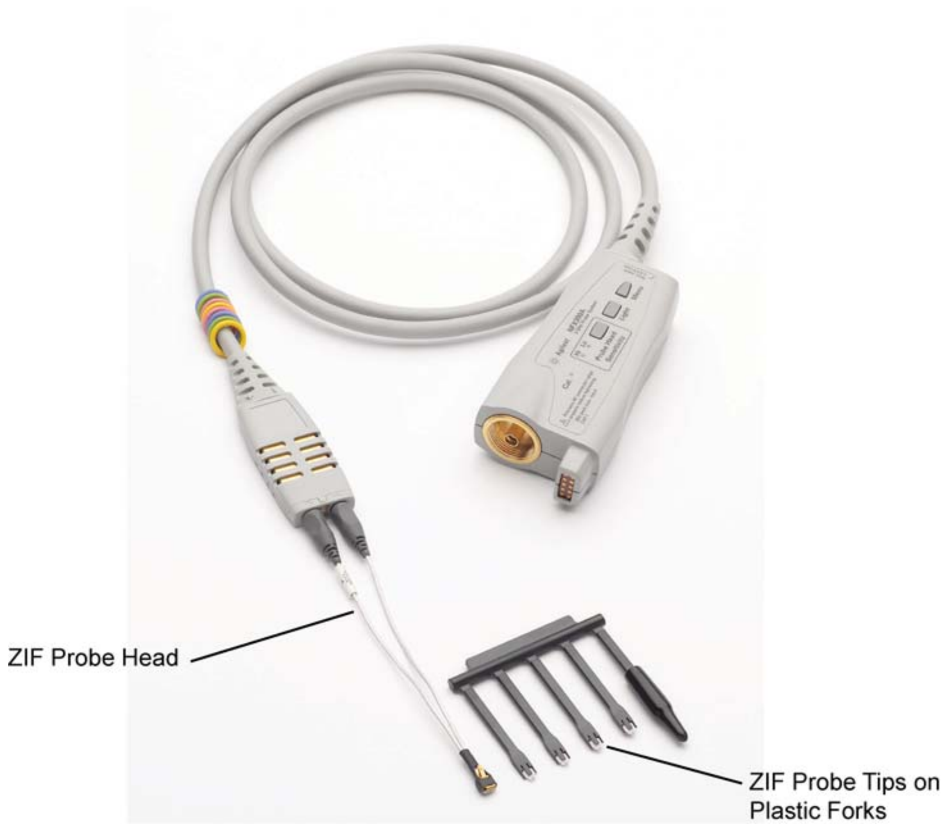


Figure 18 N5439A InfiniiMax III ZIF Probe Head and N2838A/N5440A/N5447A ZIF Probe Tips

The N5439A ZIF probe head provides 28 GHz bandwidth in an economical replaceable tip form factor. Because of their extremely low loading, the ZIF tips can be left on the DUT as the probe head is moved from one probing site to the next. For a set of 5 ZIF tips with plastic forks to aid in soldering the tips to your DUT, order:

- N2838A 25 GHz PC Board ZIF Tips
- N5440A 28 GHz Ceramic ZIF Tips
- N5447A 28 GHz Ceramic High Sensitivity ZIF Tips

The N5439A does not include any ZIF probe tips.

NOTE **The N5439A does not include any ZIF tips. You must order either N2838A, N5440A, or N5447A in addition to N5439A.**

Using the ZIF Probe Tips

There are three different models of ZIF probe tips:

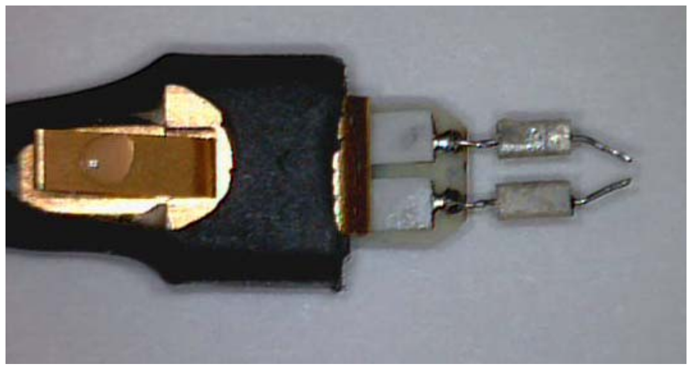
- N2838A 25 GHz PC board ZIF tips.

  Variable spacing from 5 mil – 250 mil (or 0.127 mm – 6.35 mm).

NOTE

The specifications and performance plots of the N2838A ZIF tip were measured with a nominal spacing of 40 mil (1 mm).

In order to achieve the proper response (as shown in the performace plots), you need to keep the mini-axial lead bodies roughly parallel and use the tip wires on the mini-axial leads to get the desired span.



If you need to position the mini-axial lead resistor bodies different than this (that is, resistor bodies close together or spread way apart), use Precision Probe to perform an AC calibration of the probe; the AC calibration will capture the response properly.

Increasing the spacing to 250 mil will degrade the performance some, but Precision Probe can be used to compensate or qualify the effect.

  The axial resistors on N2838A ZIF tips can be replaced if they break or become damaged. See "Replacing Axial Resistors on the N2836A Solder-in Probe Head or N2838A ZIF Tips" on page 49.

- N5440A 28 GHz ceramic ZIF tips.

  Variable spacing from 5 mil – 80 mil (or 0.127 mm – 2 mm).

- N5447A 28 Ghz ceramic high sensitivity ZIF tips.

  Variable spacing from 5 mil – 80 mil (or 0.127 mm – 2 mm).

To tell these two models apart from each other, look at the gold pattern etched on each of the tips (see Figure 19 which follows).

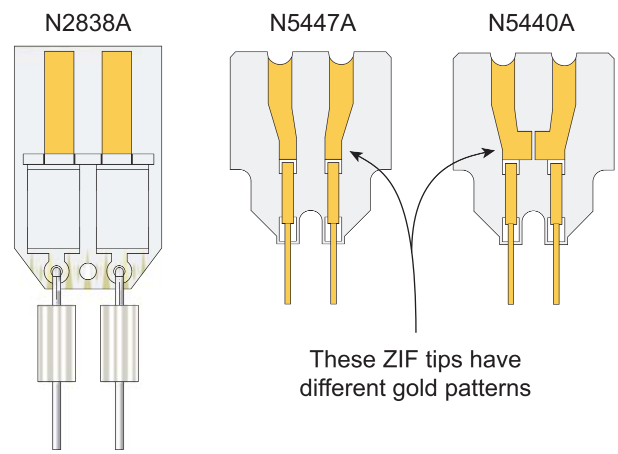


Figure 19 Differentiating Between the N5440A and N5447A ZIF Tips

These tips come in groups of five, with each tip being attached to the end of a plastic fork as shown in Figure 20. Break a ZIF tip off at the point shown in the figure, and use the fork as a handle when soldering the ZIF tip to your DUT. The fork allows you to handle these small tips.

Figure 20 InfiniiMax III ZIF tips

ZIF tips can be carefully handled with your fingertips and reinserted into a plastic fork if necessary.

CAUTION Be careful not to damage the tip wires when handling the ZIF tips. Wires can be carefully reshaped with tweezers or fingers if necessary.

CAUTION The ZIF probe tips are very fragile. They must be manufactured in this way in order to meet the high-performance, high bandwidth applications they are intended for. Be extremely careful when handling.

Soldering the ZIF Tips

This is the recommended soldering procedure:

1 Flux and tin the target DUT leads.

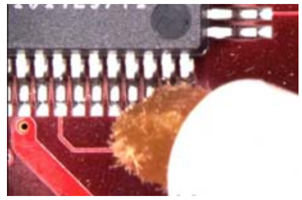


Figure 21 Preparing the DUT Leads

2 Form the ZIF tip wires to match the DUT's pitch / angle (recommended to keep the ZIF tip in the plastic fork so it is easy to hold on to).

3 Flux the ZIF tip wires and DUT leads.

4 Position the ZIF tip and carefully reflow the solder.

NOTE Make sure the gold traces on the ZIF tip are facing up as this will be important later.

CAUTION Do not dwell on this solder joint.

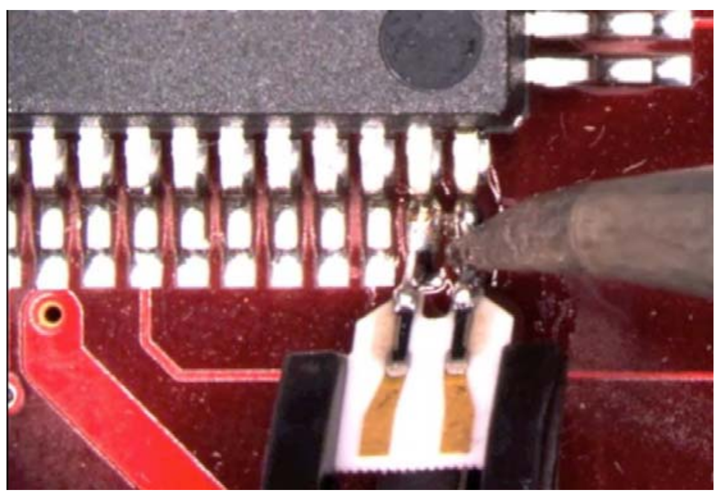


Figure 22 Soldering the ZIF Tip

5 Remove the ZIF fork handle from the ZIF tip by pulling the tip in the direction shown in the following figure. Your tip is now ready to connect to a N5439A probe head.

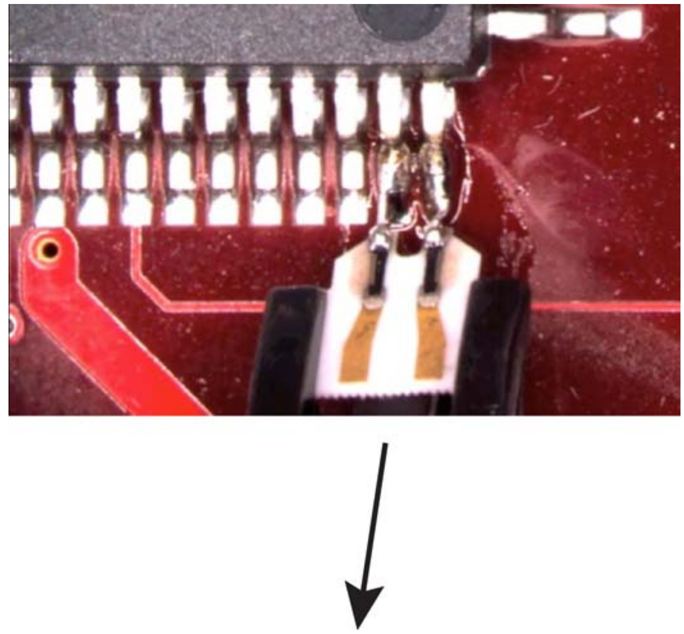


Figure 23 Removing the Fork Handle from the ZIF Tip

6 You can connect ZIF tips to any of the locations on a DUT that you need to probe and then move the ZIF probe head between them for quick, easy access to multiple probing locations.

Strain Relieving the ZIF Probe Head

High-performance probes have small physical geometries to ensure the lowest possible loading and best electrical response. Because of their small size, probing accessories are often delicate. It is important to mechanically secure your probes to protect both your equipment and designs from damage. There are several methods that Keysight recommends:

Tack-putty

Keysight recommends the use of tack-putty for securing both probe heads and amplifiers. Wrap a small amount of tack-putty around your probe head cables, taking care to not pinch them. The mass can then be secured to a rigid body neat your DUT.

A similar techniques can be used to secure probe amplifiers where you apply some tack-putty to the underside of the probe amplifier body and attach it to a rigid body near your DUT.

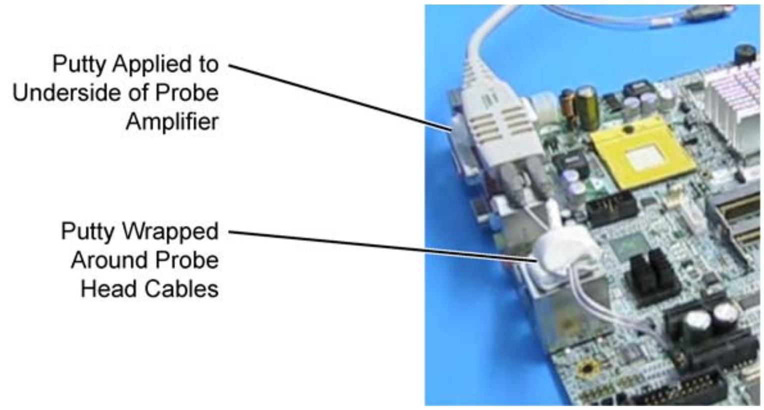


Figure 24 Using tack-putty to strain relieve a probe head and amplifier

You can also use putty with a positioner, such as the Keysight N2787A.

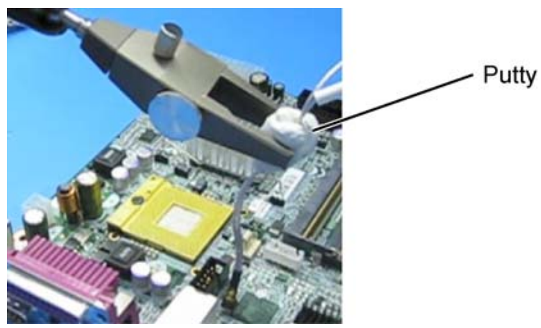


Figure 25 Using putty with the N2787A 3D Probe Positioner

The same positioner can also be used to support your probe amplifier as shown in Figure 15 on page 33.

Low-temperature Hot Glue

You can also use low-temperature hot glue to secure cables.

CAUTION Only use LOW temperature hot glue. To remove the hot glue, warm it with a heat gun set on low. Only heat the hot glue enough to remove it.

Figure 26 Using low-temperature hot glue to secure a probe head

General Tips on Strain Relief

Keep in mind that different accessories have different cable stiffness. You should choose a strain relief method appropriate for the cable stiffness. For instance, it is best to secure the stiffer N5439A near the SMP connectors and form the cable to the optimal location.

Other strain-relief options like tape or hook-and-loop work fine as well, but keep the following guidelines in mind to protect your probing investment.

CAUTION Do not kink cables. Do not crush cables. Do not use aggressive adhesives or high temperatures

Connecting the ZIF Probe Head to the ZIF Tips

To connect a ZIF probe head to a ZIF tip, first solder the ZIF tip to the DUT and strain relieve the ZIF probe head as described in previous sections. Then form the coaxial cables to bring the probe head near the tip. Press the lever down on the ZIF probe head (Figure 27) and slide the probe head onto the tip. Pressing on this lever removes the clamping force of the connector and enables you to insert or remove ZIF tips.

CAUTION If you encounter any resistance at all when sliding the probe head over the ZIF tip, STOP! Check your alignment, make sure the lever is pressed, and try again. The ZIF heads and tips should have “zero” insertion force.

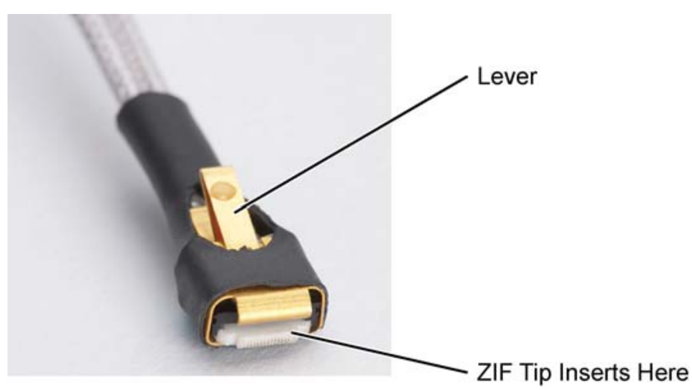


Figure 27 InfiniiMax III ZIF Probe Head - location of lever

After the probe head is connected to the soldered ZIF tip, it should look similar to the following:

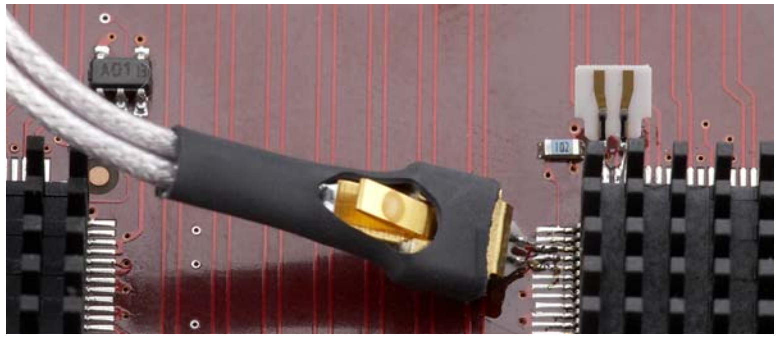


Figure 28 ZIF probe head connected to a soldered ZIF tip

NOTE Please note in the solder procedure that you were instructed to have the gold traces on the ZIF tip facing up. This is so it will properly mate with the ZIF probe head. The gold traces on the tips should be on the same side as the lever.

NOTE You will get more repeatable results if you orient your connection perpendicular to your device as shown in Figure 29.

Figure 29 InfiniiMax III ZIF probe head connected to ZIF tip at more of a perpendicular angle than shown in Figure 28

NOTE You can use tweezers to actuate the lever in tight places.

To then move the probe head to a different tip, press the lever and remove the ZIF probe head from the ZIF tip (the ZIF tip will remain soldered to the DUT). Then simply connect the ZIF head to another ZIF tip at a different location on the DUT.

CAUTION Always use the lever when inserting or removing ZIF tips.

Replaceable Parts

- N5439-65201 Strain Relief Putty
- N2838A 25 GHz PC board ZIF tips (qty. 5)
- N5440A 28 GHz ceramic ZIF tips (qty. 5)
- N5447A 28 GHz ceramic high sensitivity ZIF tips (qty 5)

N2836A InfiniiMax III Solder-in Probe Head

The N2836A InfiniiMax III solder-in probe head is an economical semi-permanent connection that provides up to 26 GHz of system bandwidth.

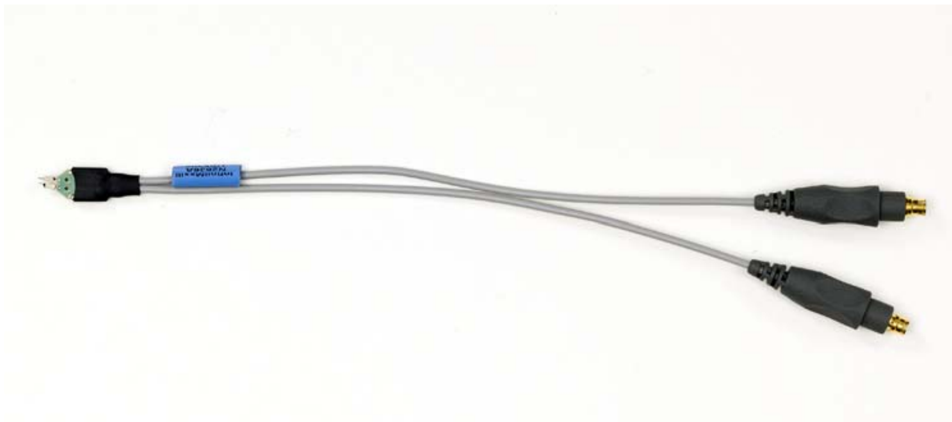
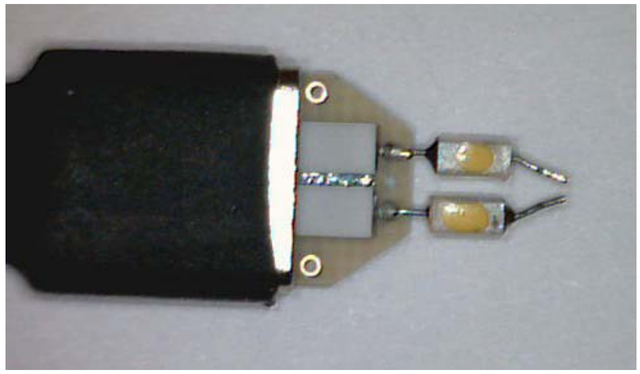


Figure 30 N2836A InfiniiMax III solder-in probe head

Variable span of the leads ranges from 5 mil - 250 mil (0.127 mm - 6.35 mm).

NOTE The specifications and performance plots of the N2836A solder-in probe head were measured with a nominal spacing of 40 mil (1 mm).

In order to achieve the proper response (as shown in the performace plots), you need to keep the mini-axial lead bodies roughly parallel and use the tip wires on the mini-axial leads to get the desired span.



If you need to position the mini-axial lead resistor bodies different than this (that is, resistor bodies close together or spread way apart), use Precision Probe to perform an AC calibration of the probe; the AC calibration will capture the response properly.

Increasing the spacing to 250 mil will degrade the performance some, but Precision Probe can be used to compensate or qualify the effect.

CAUTION The axial resistors on the N2836A solder-in probe head are fragile. They must be manufactured in this way in order to meet the high-performance, high bandwidth applications they are intended for. Be careful when handling.

For instructions on soldering the N2836A solder-in probe head into a device under test (DUT), see “Soldering the N2836A or N5441A InfiniiMax III Solder-in Probe Heads" on page 58.

The axial resistors on the tip of the N2836A solder-in probe head can be replaced if they break or become damaged. See “Replacing Axial Resistors on the N2836A Solder-in Probe Head or N2838A ZIF Tips" on page 49.

Replacing Axial Resistors on the N2836A Solder-in Probe Head or N2838A ZIF Tips

The 130 ohm axial resistors at the tip of the N2836A solder-in probe head or the N2838A ZIF tip can be replaced when they are worn out or damaged.

The replacement axial resistor kit for the N2836A and N2838A is N2836-68701. Each resistor kit contains 10 resistors.

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

Recommended 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.

WARNING

Only experienced soldering technicians should attempt this repair, as it is very easy to permanently damage the probe heads and tips.

Replacement Procedure

NOTE

The pictures in the following procedure show the N2836A solder-in probe head, but the same procedure applies to the N2838A ZIF tip.

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 31.

CAUTION

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

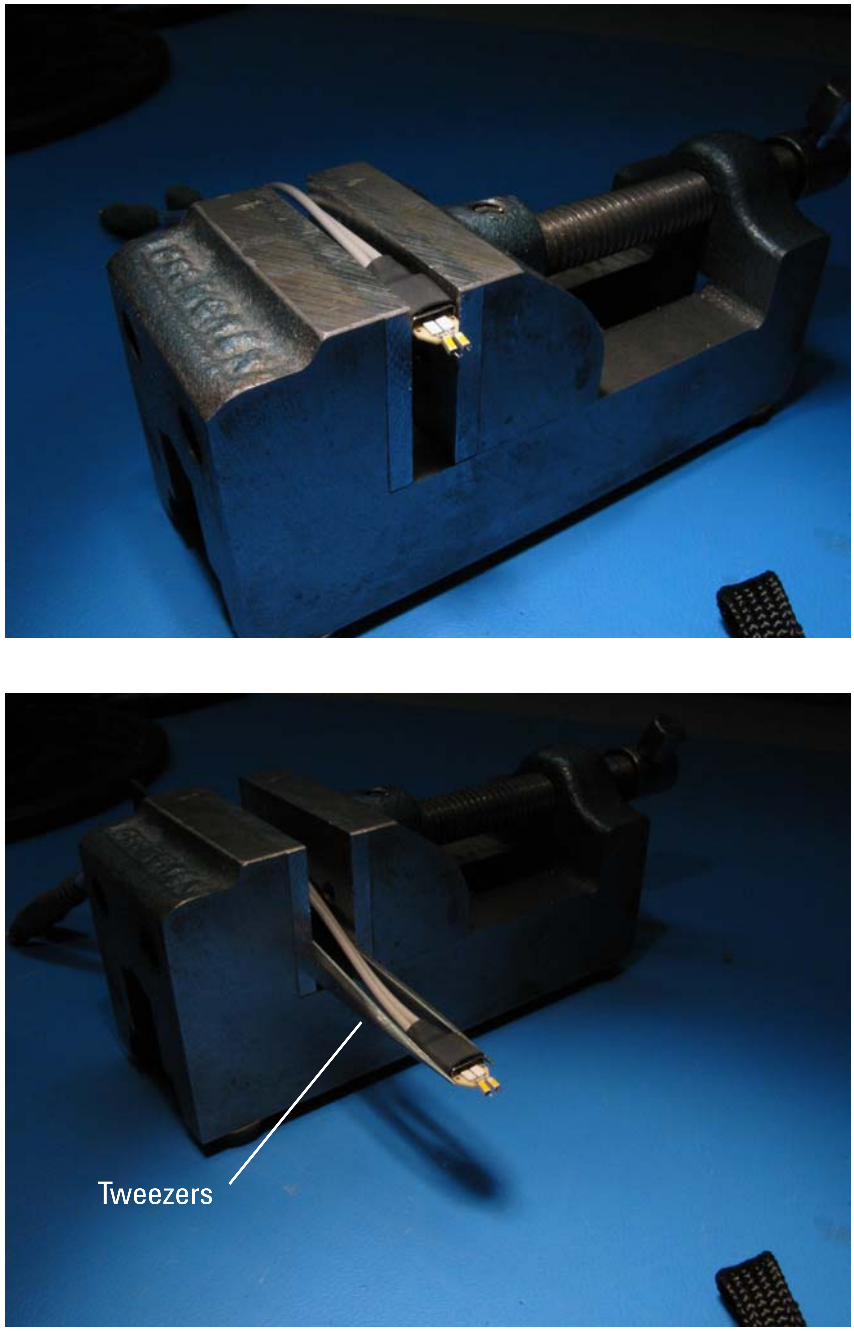


Figure 31 Clamping the solder-in probe or ZIF tip

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.

Excessive dwell time with the iron will permanently damage the flip-chip resistor.

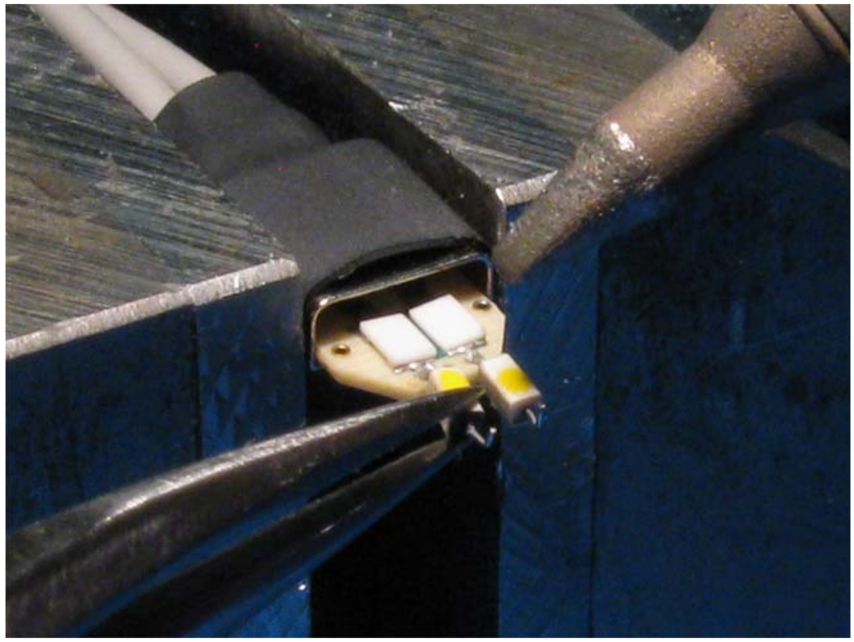


Figure 32 Removing the axial resistor

3 Prepare the mounting hole(s) for new resistors or wires by ensuring 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 by trimming and bending its leads as specified by the trim guage (supplied with the N2836-68701 replacement axial resistor kit which includes ten 130 ohm resistors).

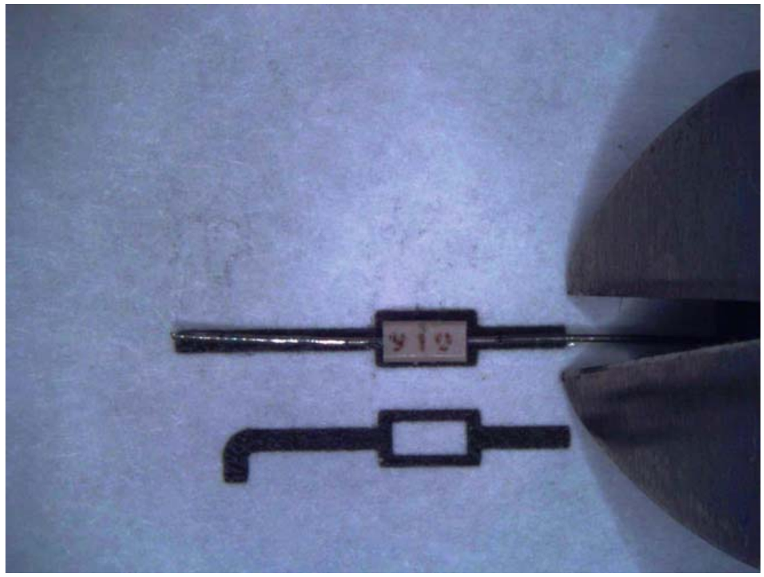


Figure 33 Trimming axial resistor leads

The lead to be attached to tip pc board will have a 90 degree bend to go into through hole in the tip pc board.

The orientation of the lead is not important.

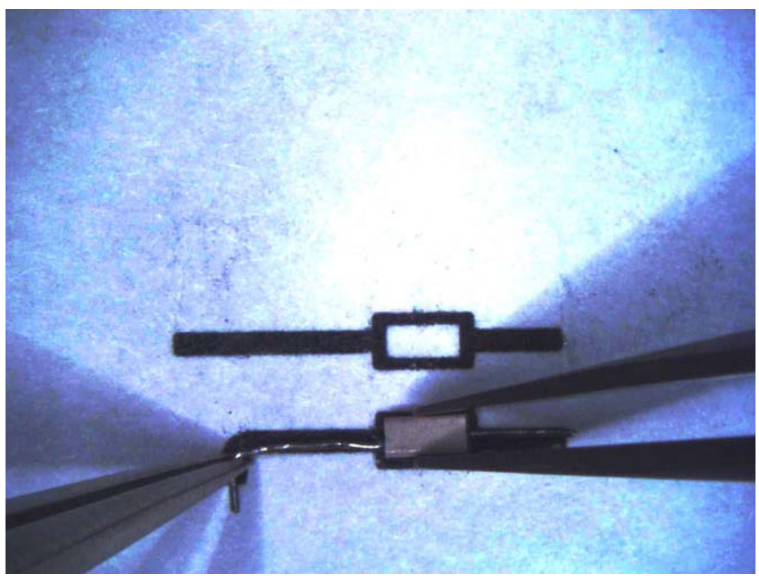


Figure 34 Bending axial resistor leads

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.

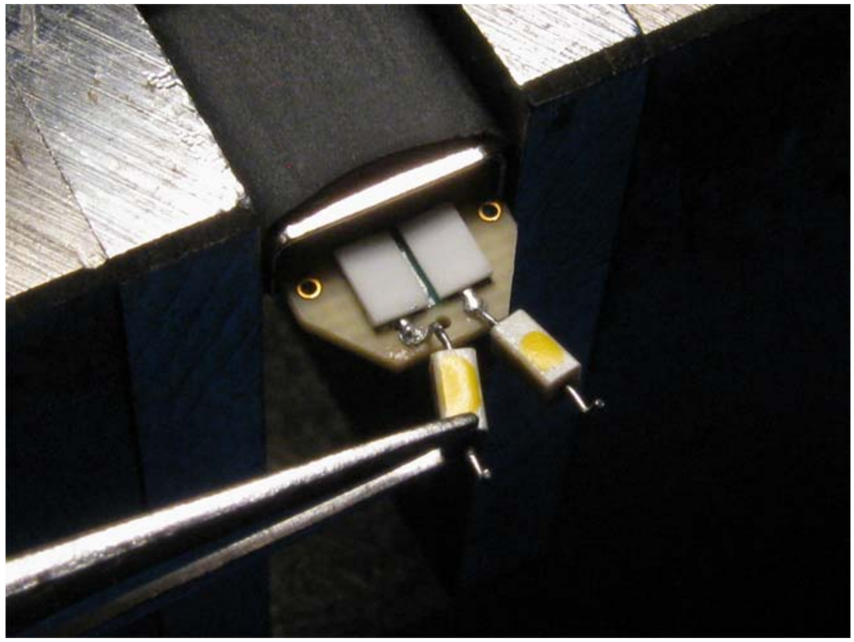


Figure 35 Soldering in a new axial resistor

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 the soldering iron as soon as the 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 ensure a good joint.

6 When complete, measure the resistance from the coax center conductor to the resistor tip with a DVM.

The DC resistance should measure 450 ohms.

N5441A InfiniiMax III Solder-in Probe Head

The N5441A InfiniiMax III solder-in probe head is an economical semi-permanent connection that provides up to 16 GHz of system bandwidth. Variable span of the leads ranges from 5 mil - 80 mil (0.127 mm - 2 mm).

The N5441A probe head can be used with the N5450B InfiniiMax extreme temperature extension cable. This is the only InfiniiMax III probe head that can withstand the –55°C to +150°C extreme temperature range (for up to 250 test cycles).

CAUTION **When using the N5450B extension cable, do not subject the InfiniiMax III probe amplifier or probe head (other than the N5441A solder-in probe head) to extreme temperatures.**

Figure 36 N5441A InfiniiMax III solder-in probe head

CAUTION **The wires on the N5441A are fragile. They must be manufactured in this way in order to meet the high-performance, high bandwidth applications they are intended for. Be careful when handling.**

For instructions on soldering the N5441A solder-in probe head into a device under test (DUT), see "Soldering the N2836A or N5441A InfiniiMax III Solder-in Probe Heads" on page 58.

The tip wires on the N5441A solder-in probe head can be replaced if they break or become damaged. See "Replacing Wires on the N5441A Solder-in Probe Head" on page 55.

Replacing Wires on the N5441A Solder-in Probe Head

The N5441A solder-in probe head's tip wires can be replaced when they are worn out or damaged. 0.005" and 0.007" wire kits are included with each probe head. 0.005" wire can be used for attaching to small vias.

To replace wires, complete the following steps:

1 Begin by clamping the probe head GENTLY.

Figure 37 Clamping the Probe Head

2 Remove the old wires with tweezers while reflowing the solder from the probe underside.

CAUTION Apply heat quickly to avoid damaging your probe.

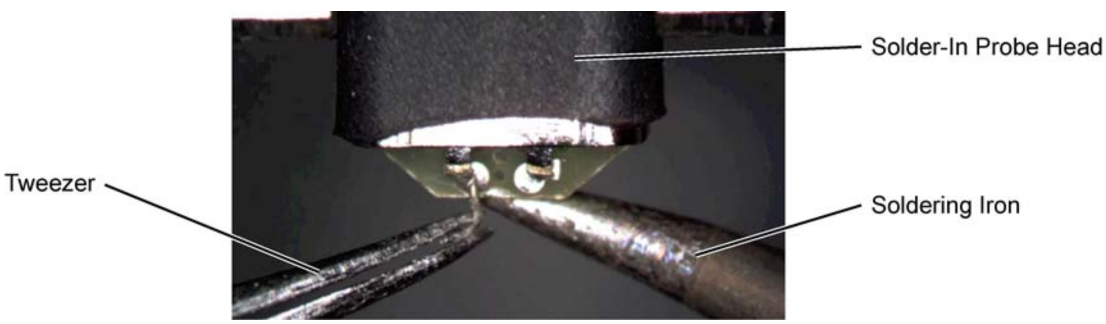


Figure 38 Removing the Old Wire

3 If necessary, add a small amount of solder to the holes and apply flux.

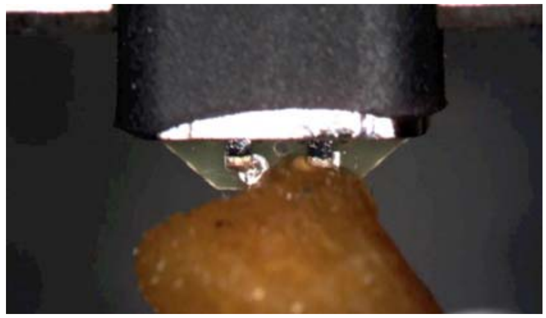


Figure 39 Adding Solder and Flux

4 Reflow the solder from the underside and insert a new piece of wire. It is best to shape the wire into an “L” before attempting to insert.

CAUTION Try not to dwell with the iron in contact with the probe head.

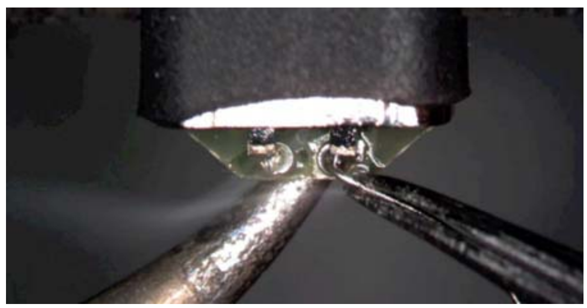


Figure 40 Adding a New Wire

5 After attaching both the wires, they should look like the following picture.

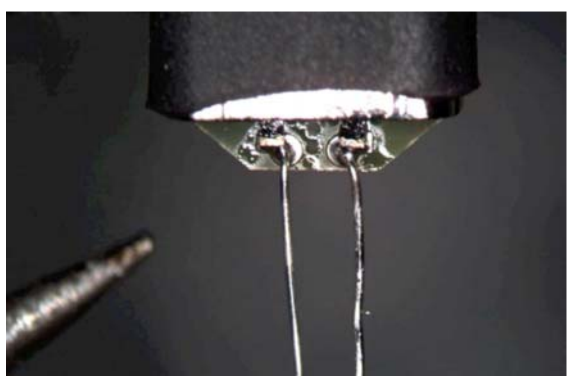


Figure 41 Both Wires Attached

6 Trim any wire stubs on the probe head underside.

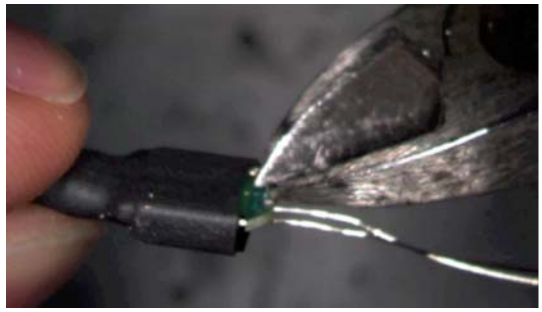


Figure 42 Trim Wire Stubs

7 Use the included trim gauge to cut the wire lengths. Doing so will ensure the best performance from your probe head.

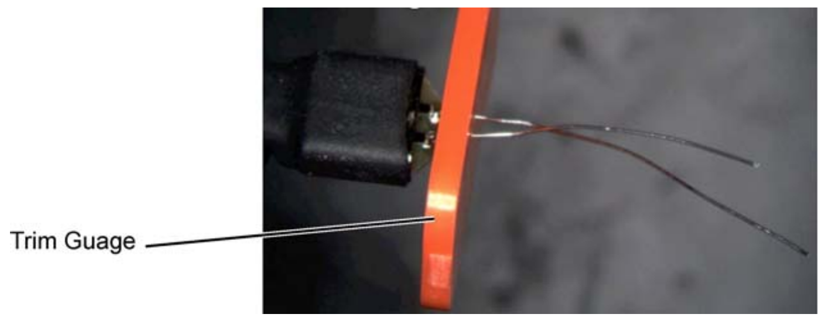


Figure 43 Trim Guage Placed on Wires

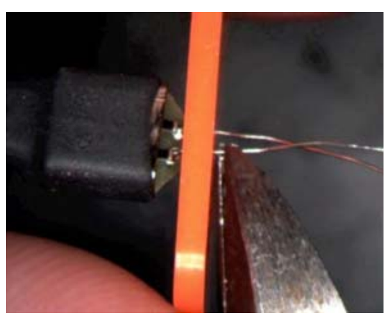


Figure 44 Removing Excess Wire

8 Check the DC resistance of each probe leg when you have replaced the wires. The correct resistance should be 450 ohms.

Soldering the N2836A or N5441A InfiniiMax III Solder-in Probe Heads

To solder the N2836A or N5441A solder-in probe head to your DUT, complete the following steps (the procedure is very similar to that for the ZIF probe tips used with the N5439A probe head):

1 Apply flux to your target leads.

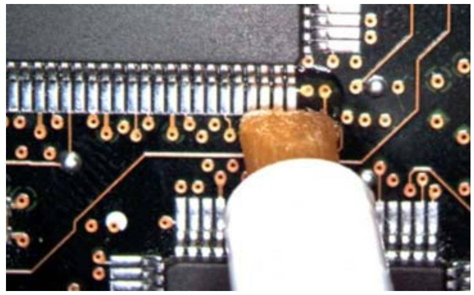


Figure 45 Applying Flux

2 Tin the leads with a small amount of solder.

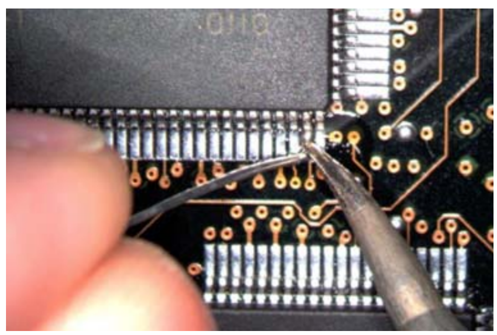


Figure 46 Tin the Leads

3 Use tweezers to form the probe head wires to fit your DUT's geometry.

4 Flux the DUT leads and your probe head wires.

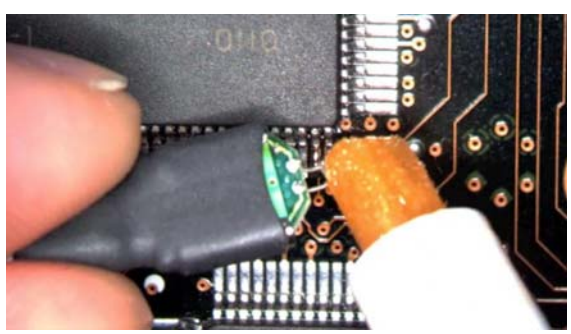


Figure 47 Applying Flux to Leads and Wires

5 Position the probe head wires on the DUT leads and reflow the solder quickly.

CAUTION Do not leave the iron in contact with the probe head for more than a few seconds at a time.

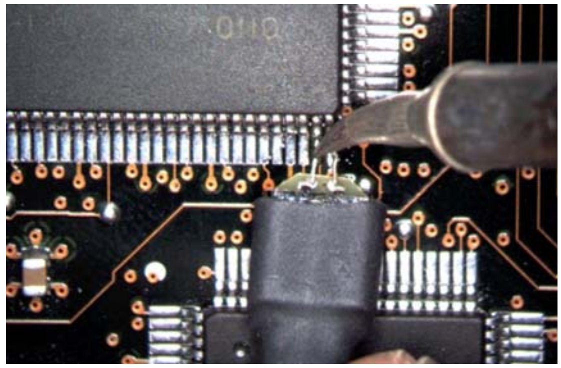


Figure 48 Positioning Wires

Strain Relieving the Solder-in Probe Head

High-performance probes have small physical geometries to ensure the lowest possible loading and best electrical response. Because of their small size, probing accessories are often delicate. It is important to mechanically secure your probes to protect both your equipment and designs from damage. There are several methods that Keysight recommends:

Tack-putty

Keysight recommends the use of tack-putty for securing both probe heads and amplifiers. Wrap a small amount of tack-putty around your probe head cables, taking care to not pinch them. The mass can then be secured to a rigid body neat your DUT.

A similar techniques can be used to secure probe amplifiers where you apply some tack-putty to the underside of the probe amplifier body and attach it to a rigid body near your DUT.

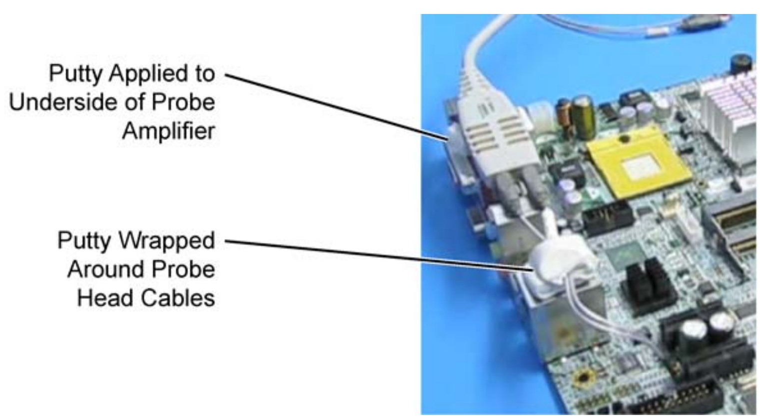


Figure 49 Using tack-putty to strain relieve a probe head and amplifier

You can also use putty with a positioner, such as the Keysight N2787A.

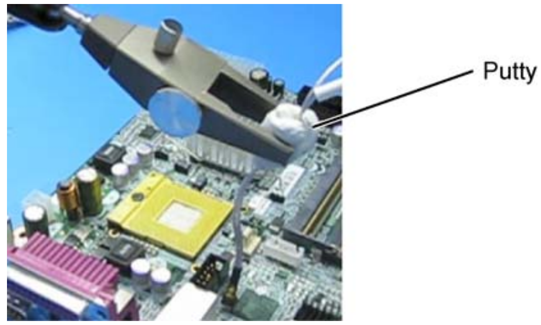


Figure 50 Using putty with the N2787A 3D Probe Positioner

The same positioner can also be used to support your probe amplifier as shown in Figure 15 on page 33.

Low-temperature Hot Glue

You can also use low-temperature hot glue to secure cables.

CAUTION Only use LOW temperature hot glue. To remove the hot glue, warm it with a heat gun set on low. Only heat the hot glue enough to remove it.

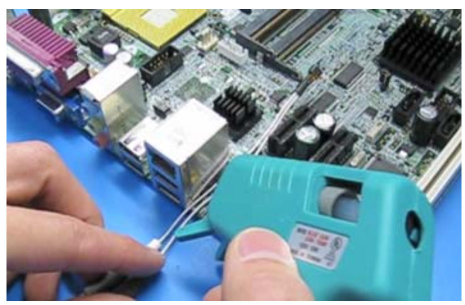


Figure 51 Using low-temperature hot glue to secure a probe head

General Tips on Strain Relief

Keep in mind that different accessories have different cable stiffness. You should choose a strain relief method appropriate for the cable stiffness. For instance, it is best to secure the stiffer N5439A near the SMP connectors and form the cable to the optimal location.

Other strain-relief options like tape or hook-and-loop work fine as well, but keep the following guidelines in mind to protect your probing investment.

CAUTION Do not kink cables. Do not crush cables. Do not use aggressive adhesives or high temperatures

Replaceable Parts

Extra wire (for solder-in probe head only). 01169-81301 (7 mil), 01169-21306 (5 mil)

N5439-65201 Strain Relief Putty

N5444A InfiniiMax III 2.92 mm / 3.5 mm / SMA Probe Head

The N5444A InfiniiMax III 2.92mm/3.5mm/SMA probe head provides 28 GHz bandwidth and allows you to connect two 2.92mm, 3.5mm, or SMA cables to make a differential measurement on a single oscilloscope channel.

The N5444A provides for a termination to a common DC voltage rather than to ground, which is required for many signal standards. It is implemented such that from DC to approximately 1 kHz, the termination is 55 Ohms to the termination voltage, and above approximately 10 kHz, the termination is 50 Ohms to 0.9 times the termination voltage. The termination voltage range is ±4V with a minimum step of 5 mV and a maximum current of 80 mA. The termination voltage can be controlled internally by the oscilloscope or applied externally using the supplied DC jack.

Figure 52 N5444A InfiniiMax III 2.92mm/3.5mm/SMA Probe Head

Order N5448A 2.92 mm head flex cables (10” or 25 cm long) to extend the cable length and add convenience. Figure 53 on page 63 shows the N5448A cables attached to the N5444A probe head. You must first remove the supplied rigid cables before connecting the N5448A cables.

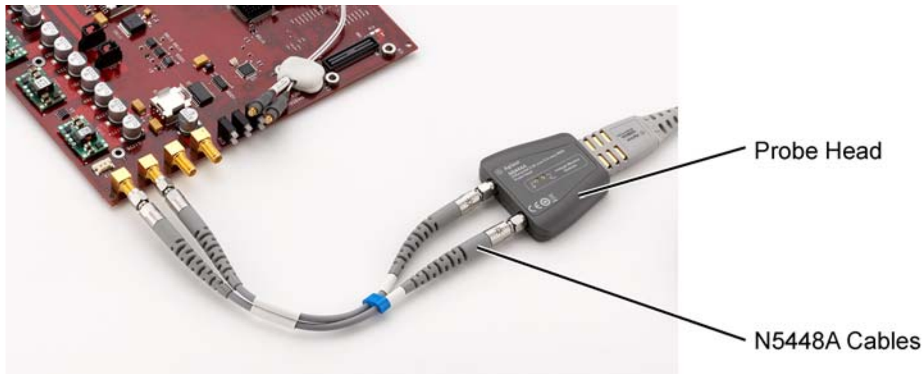


Figure 53 N5444A Probe Head With N5448A Head Flex Cables Attached

Replaceable Parts

N5448A. 2.92mm Extension Cables

3
Performance Specifications / Characteristics

The InfiniiMax III series probe amplifiers and probe heads are designed to be used within the temperature range of the 90000-X series oscilloscope. The only exception is the N5441A solder-in probe head. The N5441A solder-in probe head temperature range is from –55°C to +150°C for up to 250 test cycles. The N5441A is compatible with the N5450B InfiniiMax extreme temperature extension cable.

Table 2 Probe Amplifiers

Probe Amplifier	BW	tr
N2800A	16 GHz	27.1 ps
N2801A	20 GHz	21.7 ps
N2802A	25 GHz	17.4 ps
N2803A	30 GHz	14.3 ps

Table 3 N2803A Amplifier with N2836A, N5441A, and N2848A Probe Heads

Specifications / Characteristics	N2836A Solder-In	N5441A Solder-In)	N2848A QuickTip Head with N2849A Tip
Probe Bandwidth (–3 dB), Probe Only	27 GHz *(typical)*	17.2 GHz *(typical)*	16 GHz *(typical)*
Rise and Fall Time, Probe Only (Single-Ended)	21.1 ps (10-90%) 13.8 ps (20-80%)	34.8 ps (10-90%) 26.6 ps (20-80%)	–
Rise and Fall Time, Probe Only (Differential Mode)	16.1 ps (10-90%) 11.4 ps (20-80%)	17.2 ps (10-90%) 26.6 ps (20-80%)	27.1 ps (10-90%) 19.3 ps (20-80%)
System Bandwidth (–3 dB) with DSO/DSAX93204A	26 GHz	16 GHz	
Rise and fall time with DSO/DSAX93204A	16.5 ps (10-90%) 11.7 ps (20-80%)	27.1 ps (10-90%) 19.2 ps (20-80%)	
Input Capacitance	Cdiff = 108 fF Cse = 140 fF	Cdiff = 77 fF Cse = 105 fF	Cdiff = 340 fF Cse = 200 fF
DC Input Resistance*	Rse = 50 kΩ ±2% each input to ground Rdiff = 100 kΩ ±2% Rcm = 25 kΩ ±2%	Rse = 50 kΩ ±2% each input to ground Rdiff = 100 kΩ ±2% Rcm = 25 kΩ ±2%	Rse = 50 kΩ ±2% each input to ground Rdiff = 100 kΩ ±2% Rcm = 25 kΩ ±2%
Input Resistance (> 10 kHz)	Rse = 500Ω each input to ground Rdiff = 1 kΩ Rcm = 250Ω	Rse = 500Ω each input to ground Rdiff = 1 kΩ Rcm = 250Ω	Rse = 500Ω each input to ground Rdiff = 1 kΩ Rcm = 250Ω
Input Voltage Range (Differential or Single-Ended)	1.6Vpp, ±0.8V (HD2&3< –34 dBc), 2.5Vpp, ±1.25V (HD2&3< –38 dB)**	1.6Vpp, ±0.8V (HD2&3< –34 dBc), 2.5Vpp, ±1.25V (HD2&3< –38 dB)**	1.6Vpp, ±0.8V (HD2&3< –34 dBc), 2.5Vpp, ±1.25V (HD2&3< –38 dB)**
Input Common Mode Range	±12V DC to 250 Hz ±1.25V > 250 Hz	±12V DC to 250 Hz ±1.25V > 250 Hz	±12V DC to 250 Hz ±1.25V > 250 Hz
DC attenuation Ratio	6:1	6:1	5:1 or 10:1
Offset Range (for probing a single-ended signal)	±16V	±16V	±16V
Input Referred Noise Spectral Density	23.9 nV/rt (Hz)	23.9 nV/rt (Hz)	23.9 nV/rt (Hz)
Input Referred Noise Example	4 mVrms	4 mVrms	
Maximum Input Voltage	18V peak CAT I	18V peak CAT I	18V peak CAT I

*Denotes warranted characteristic - all others are typical
**Harmonic distortion < –38 dB is standard; < –34 dB wider input range with slightly increased distortion

Table 4 N2803A Amplifier with N2838A, N5447A, and N5440A ZIF Tips

	N5439A ZIF Probe Head		
Specifications / Characteristics	**N2838A** **PC Board ZIF Tip**	**N5440A** **Ceramic ZIF Tip**	**N5447A** **High Sensitivity Ceramic ZIF Tip**
Probe Bandwidth (–3 dB), Probe Only	25 GHz *(typical)*	28 GHz *(typical)*, 26 GHz warranted	28 GHz *(typical)*
Rise and Fall Time, Probe Only (Single-Ended)	23.1 ps (10-90%) 14.9 ps (20-80%)	20.9 ps (10-90%) 13.8 ps (20-80%)	20.9 ps (10-90%) 13.8 ps (20-80%)
Rise and Fall Time, Probe Only (Differential Mode)	17.4 ps (10-90%) 12.3 ps (20-80%)	15.6 ps (10-90%) 11.0 ps (20-80%)	15.5 ps (10-90%) 11.0 ps (20-80%)
System Bandwidth (–3 dB) with DSO/DSAX93204A	25 GHz	28 GHz	28 GHz
Rise and fall time with DSO/DSAX93204A	17.6 ps (10-90%) 12.5 ps (20-80%)	15.5 ps (10-90%) 11.0 ps (20-80%)	15.5 ps (10-90%) 11.0 ps (20-80%)
Input Capacitance	Cdiff = 95 fF Cse = 130 fF	Cdiff = 32 fF Cse = 44 fF	Cdiff = 32 fF Cse = 44 fF
DC Input Resistance*	Rse = 50 kΩ ±2% each input to ground Rdiff = 100 kΩ ±2% Rcm = 25 kΩ ±2%	Rse = 50 kΩ ±2% each input to ground Rdiff = 100 kΩ ±2% Rcm = 25 kΩ ±2%	Rse = 50 kΩ ±2% each input to ground Rdiff = 100 kΩ ±2% Rcm = 25 kΩ ±2%
Input Resistance (> 10 kHz)	Rse = 500Ω each input to ground Rdiff = 1 kΩ Rcm = 250Ω	Rse = 500Ω each input to ground Rdiff = 1 kΩ Rcm = 250Ω	Rse = 500Ω each input to ground Rdiff = 1 kΩ Rcm = 250Ω
Input Voltage Range (Differential or Single-Ended)	1.6Vpp, ±0.8V (HD2&3< –34 dBc), 2.5Vpp, ±1.25V (HD2&3< –38 dB)**	1.6Vpp, ±0.8V (HD2&3< –34 dBc), 2.5Vpp, ±1.25V (HD2&3< –38 dB)**	0.8Vpp, ±0.4V (HD2&3< –34 dBc), 1.6Vpp ±0.8V (HD2&3< –38 dB)**
Input Common Mode Range	±12V DC to 250 Hz ±1.25V > 250 Hz	±12V DC to 250 Hz ±1.25V > 250 Hz	±6V DC to 250 Hz ±0.65V > 250 Hz
DC attenuation Ratio	6:1	6:1	3:1
Offset Range (for probing a single-ended signal)	±16V	±16V	±8V
Input Referred Noise Spectral Density	23.9 nV/rt (Hz)	23.9 nV/rt (Hz)	12.0 nV/rt (Hz)
Input Referred Noise Example	4 mVrms	4 mVrms	2 mVrms
Maximum Input Voltage	18V peak CAT I	18V peak CAT I	18V peak CAT I
*Denotes warranted characteristic - all others are typical **Harmonic distortion < –38 dB is standard; < –34 dB wider input range with slightly increased distortion			

Table 5 N2803A Amplifier with N5444A and N5445A Probe Heads

Specifications / Characteristics	**N5444A** **SMA, 3.5 mm, 2.92 mm Adapter**	**N5445A** **Browser**
Probe Bandwidth (–3 dB), Probe Only	28 GHz *(typical)*	30 GHz *(typical)*, 28 GHz warranted
Rise and Fall Time, Probe Only (Single-Ended)	15.5 ps (10-90%) 11.0 ps (20-80%)	16.2 ps (10-90%) 10.9 ps (20-80%)
Rise and Fall Time, Probe Only (Differential Mode)	15.5 ps (10-90%) 11.0 ps (20-80%)	14.5 ps (10-90%) 10.3 ps (20-80%)
System Bandwidth (–3 dB) with DSO/DSAX93204A	28 GHz	30 GHz
Rise and fall time with DSO/DSAX93204A	15.5 ps (10-90%) 11.0 ps (20-80%)	14.3 ps (10-90%) 10.2 ps (20-80%)
Input Capacitance	N/A	Cdiff = 35 fF Cse = 50 fF
DC Input Resistance*	55Ω to Vterm	Rse = 50 kΩ ±2% each input to gnd Rdiff = 100 kΩ ±2% Rcm = 25 kΩ ±2%
Input Resistance (> 10 kHz)	50Ω to (0.909)(Vterm)	Rse = 500Ω each input to ground Rdiff = 1 kΩ Rcm = 250Ω
Input Voltage Range (Differential or Single-Ended)	1.6Vpp, ±0.8V (HD2&3< –34 dBc), 2.5Vpp, ±1.25V (HD2&3< –38 dB)**	1.6Vpp, ±0.8V (HD2&3< –34 dBc), 2.5Vpp, ±1.25V (HD2&3< –38 dB)**
Input Common Mode Range	±6V DC to 250 Hz ±1.25V > 250 Hz without violating maximum input power	±12V DC to 250 Hz ±1.25V > 250 Hz
DC attenuation Ratio	6:1	6:1
Offset Range (for probing a single-ended signal)	±6V without violating maximum input power	±16V
Input Referred Noise Spectral Density	23.9 nV/rt (Hz)	23.9 nV/rt (Hz)
Input Referred Noise Example	4 mVrms	4 mVrms
Maximum Input Voltage	8V peak without violating maximum input power	18V peak CAT I
Maximum Input Power	125 mW calculated with the following equation for each input: $P_{max} = (\mathrm{rms}_{(V_{in} - V_{term})})^{\frac{2}{55}}$	N/A

*Denotes warranted characteristic - all others are typical
**Harmonic distortion < –38 dB is standard; < –34 dB wider input range with slightly increased distortion

4
Calibration / Deskew Procedure

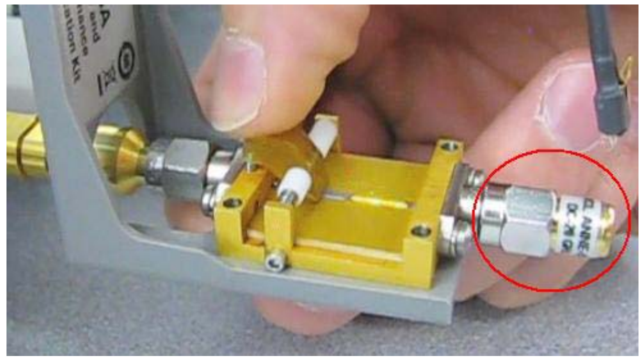
To perform a calibration/deskew for the InfiniiMax III Probing system, you will be using the N5443A Calibration/Deskew Fixture.

This fixture enables you to not only calibrate / deskew your InfiniiMax III probe, but it also ensures you properly position the probe amplifier during the procedure via the plastic holder. You can remove the plastic holder from the fixture by removing the four screws on the bottom side of the holder if you prefer.

KEYSIGHT TECHNOLOGIES

Procedure

1 To perform a DC calibration / calibrated skew, make sure the 50 ohm terminator (included with N5443A) is connected to the fixture as shown below.



2 Hold the N5443A upright and connect the fixture to the Cal Out on the oscilloscope. Turn the nut on the Cal Out counter-clockwise to tighten.

3 While holding the fixture upright with one hand, use an 8 in. lbs. torque wrench to fully tighten the connector as shown on the next page.

4 Connect the probe amplifier to one of the channel inputs on the oscilloscope.

5 Insert the amplifier into the top of the fixture holder. The amplifier can slide up and down in the holder to adjust the probe head position.

CAUTION **Always wear an ESD wrist strap when working with active probes. Not doing so can result in the probe becoming permanently damaged.**

6 Before connecting to the N5443A fixture, form the N5439A probe head ZIF tip wires as shown below (if using the ZIF tip for the calibration / deskew).

Or form the wires as shown below if using the N5441A solder-in probe head.

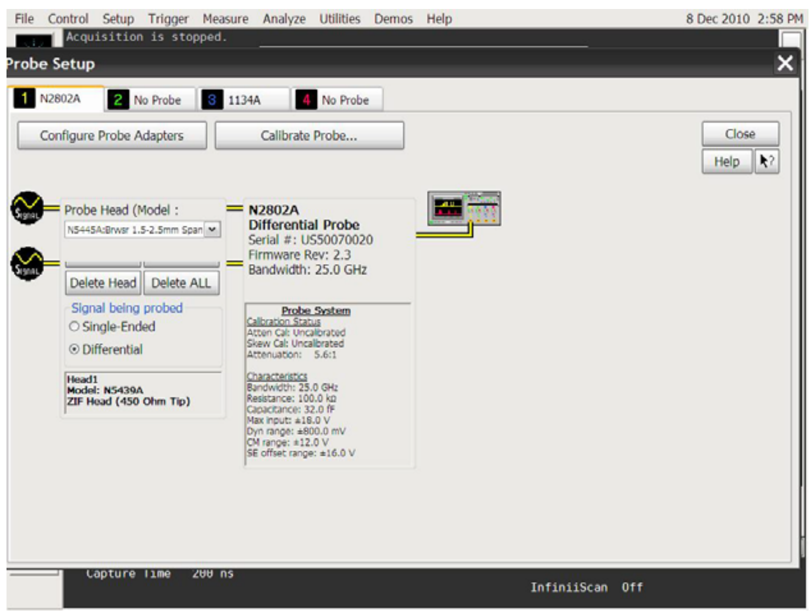
If you are using the browser probe head then you do not need to adjust the shape of the tips.

7 Connect your probe head to the amplifier.

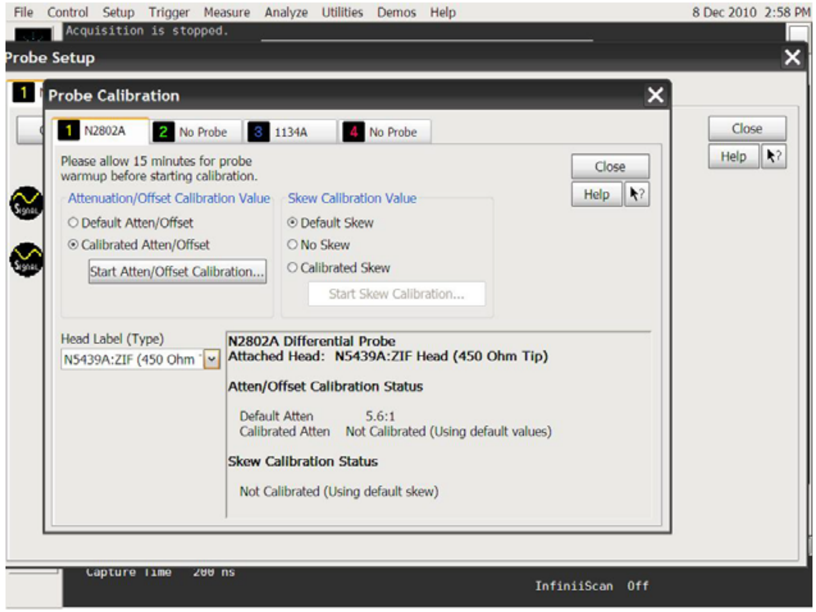
8 Position the probe head wires (if you are using the ZIF or Solder-in probe heads) so they curl towards the scope as shown below.

9 Press the Menu button on the probe amplifier to bring up the Probe Setup dialog box on the oscilloscope.

10 In the Probe Setup dialog box, click on the Calibrate Probe ... button. This will open the Probe Calibration dialog box.



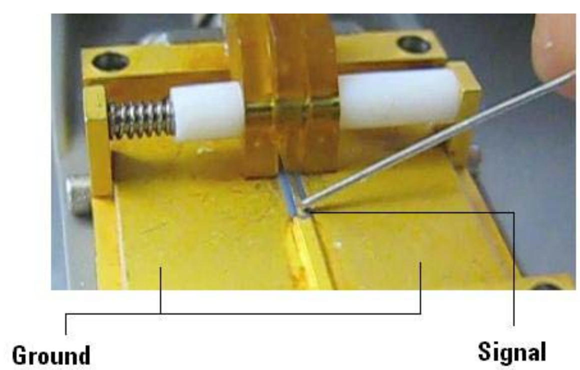
11 In the Probe Calibration dialog box, select the probe head you are using in the Head Label (Type) field, select the Calibrated Atten/Offset radio button, and press the Start Atten/Offset Calibration... button.



12 A dialog box will then open that tells you how to connect the probe head to the calibration/deskew fixture.

The fixture has three spring-loaded fingers (shown below) that clamp probe head wires to the fixture if you are using the ZIF probe head or the Solder-in probe head.

13 On the fixture, the center gold trace is signal and the large plates on either side are both ground as shown below.

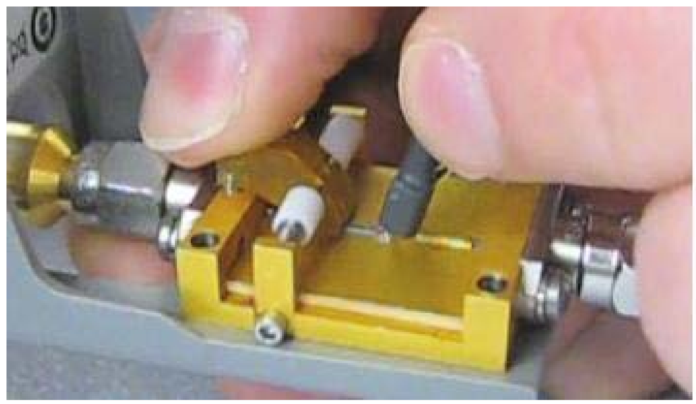


CAUTION NEVER solder a probe tip to the thickfilm gold. The gold will immediately dissolve into the solder and disappear.

14 Follow the instructions on the oscilloscope to clamp the wires to either the signal or ground. When connecting the probe wires to the fixture, press down on the spring-loaded fingers described in Step 12 and insert the probe wires. You can check that the wires are connected correctly by pressing the autoscale button on the front panel and checking that you have a stable step on screen (note that pressing autoscale will close the Probe Calibration dialog box).

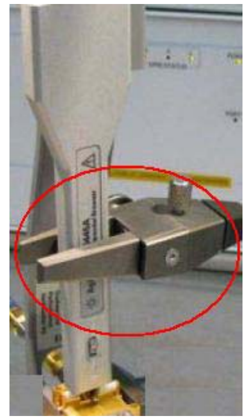
People tend to have their own preference for this step in terms of the angle to view and insert the probe wires under the spring-loaded fingers. Try different angles to determine your optimum method.

CAUTION When connecting the probe head to the fixture, do not press down with much force or you could snap off the fixture from the Cal Out connection. Light contact is all that is needed for the calibration.



15 If you are using the browser probe head, it is recommended that you use the N2787A 3D Probe Positioner to hold the browser in place (as shown below). The browser uses spring-loaded tips so you do not need much force to get a solid contact. You can check that the tips are connected correctly by pressing the autoscale button on the front panel and checking that you have a stable step on screen (note that pressing autoscale will close the Probe Calibration dialog box).

CAUTION When connecting the probe head to the fixture, do not press down with much force or you could snap off the fixture from the Cal Out connection. Light contact is all that is needed for the calibration.



16 With the probe head correctly connected to the fixture, press OK in the dialog box on the oscilloscope and wait for the calibration to finish. It will report whether the calibration was successful or not.

17 Once the calibration has successfully completed, the DC Cal LED on the probe amplifier will turn green indicating that the particular combination of probe amplifier, probe head, and oscilloscope channel input has been calibrated.

NOTE Any time you use a new probe head type, a new probe amplifier, or a different channel on the oscilloscope, the **DC Cal** LED will be amber, indicating that a DC calibration is required.

18 Once the DC vertical calibration has successfully completed, select the Calibrated Skew radio button from the Probe Calibration dialog box on the oscilloscope. Then press the Start Skew Calibration... button and follow the on-screen instructions for the skew calibration.

5 Performance Verification

This chapter describes the equipment and procedures needed to verify the performance of InfiniiMax III probes. Due to the very high frequency of the InfiniiMax III probing system, it is important to carefully adhere to the techniques and procedures described in this chapter to accurately measure the performance.

It is also important to note that the performance measured here is of the probe by itself. Keysight high performance real-time scopes (and sampling scopes under certain conditions) will apply probe correction that will further enhance the performance of the probes.

CAUTION Electrostatic discharge (ESD) can quickly and imperceptibly damage or destroy high performance probes, resulting in costly repairs. Always wear a wrist strap when handling probe components and insure that cables are discharged before being connected.

KEYSIGHT TECHNOLOGIES

Bandwidth Performance Verification

This section documents the bandwidth performance of the N2803A InfiniiMax III Probe Amplifier with the N5439A ZIF probe head and N5440A ceramic ZIF tip or with the N5445A browser probe head.

Keysight recommends a test interval of one year or 2000 hours of operation.

Equipment Needed

- Keysight 2 port E8361A/C Vector Network Analyzer:
  - Or equivalent VNA that covers at least a 50 MHz to 34 GHz range. This procedure is written assuming the E8361A/C PNA. If a different VNA is used, references that are specific to the PNA will need to be modified.
  - Needs proper test port cables and/or adaptors to provide male 2.92 mm connectors at reference planes. If test port cables are 2.4 mm or 1.85 mm cables, then Keysight 11904A and 11904D adaptors can be used to convert to 2.92 mm male connectors.
  - Needs to be capable of using a Touchstone file to de-embed at a port.
  - Needs to have bias port for port 1 of the VNA (i.e. has internal bias T's and a BNC port that allows bias to be applied to port 1)
- Keysight N5443A Performance Verification Fixture.
- Maury Microwave 8775B2 2.92 mm male broadband load.

  Or other 2.92 mm male load with similar or better return loss.

  A high quality 2.92 mm adaptor to a 2.4 mm or 1.85 mm VNA calibration load with required return loss could be used.
- Keysight N5477A Autoprobe II/3.5 mm Adaptor.
- Keysight 1143A Power supply.
- Keysight 5062-1247 outside thread 3.5 mm (male) to 3.5 mm (female) adaptor.
- Keysight N4692A-00F 2.92 mm (female/female) ECal module:
  - Or other 2.92 mm calibration kit that can calibrate to the 2.92 mm male connectors at the test ports.
- BNC 50 ohm male terminator:

  Or equivalent; not a critical part
  - Example: Pomona number 3840-50 or 4119-50.
- InfiniiMax III Probe Head
  - Either the N5439A ZIF probe head with the N5440A ceramic ZIF probe tip or the N5445A browser probe head.

VNA Setup

- Power level: -6 dBm.
- Sweep: Log Frequency 50 MHz to 34 GHz, 284 points (100 pts/decade).

- IF BW: 1 kHz.
- Test port cables and adaptors (if needed) to provide male 2.92 mm connectors at measurement planes.
- Install the BNC 50 ohm terminator to the bias input for port 1 of the VNA (on the rear panel of E8361 PNA). This provides a DC 50 ohm termination for the probe amp output.
- Clear all traces from display, then select S12 to display.
- Set scale for S12 to 3 dB/div, with reference level to 0 dB and reference position to 5 divisions.

Procedure

1 Calibrate the PNA to the two male 2.92 mm connectors (connectors can be seen in Figure 55) using the N4692A-00F ECal module (or equivalent 2.92 mm cal kit).

CAUTION **As with all precision connector interfaces, make sure to torque all connections using the proper torque wrench!**

2 Prepare the N5439A ZIF probe head for connection to the PV fixture as shown in Figure 54.

a Install a N5440A ceramic ZIF tip into the N5439A ZIF probe head. Make sure it is fully inserted.

b Bend the tip wires down at their halfway point using fine tweezers.

c Slightly spread the tips wires to better match the spacing needed for the PV fixture.

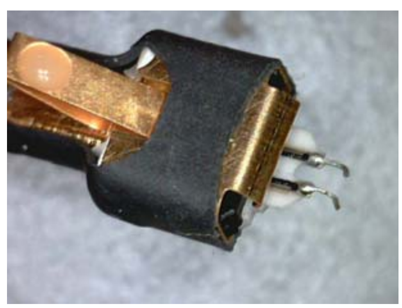


Figure 54 N5439A ZIF Probe Head

3 Connect the 1250-1749 adapter and N5443A PV fixture assembly to the calibrated ports of the PNA as shown in Figure 55. A small bench vise is useful to hold PV fixture steady.

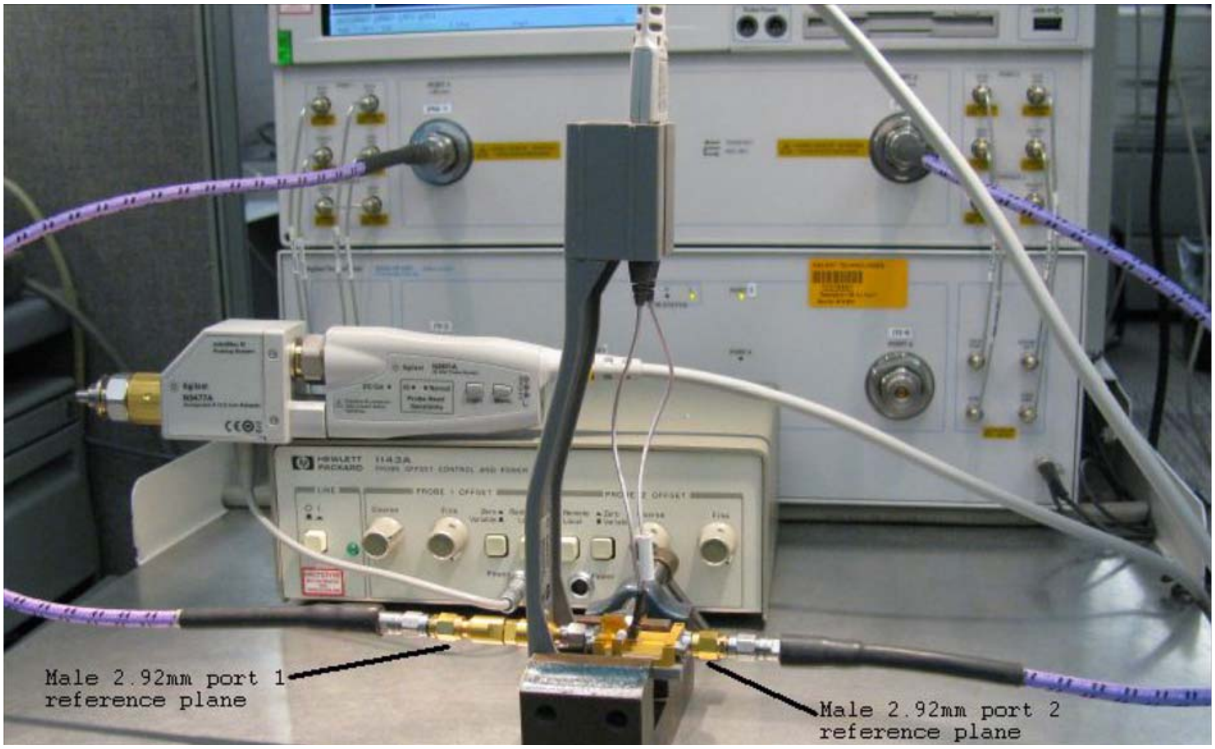


Figure 55 Setup for measuring “Vin” of probe

4 Connect the N5477A AutoProbe II adaptor to the 1143A power supply and turn on the power supply.

a Make sure the probe offset control button on the 1143A is set to “Zero” so no probe offset is applied.

b The 5062_1247 adapter should be attached to the N5477A and properly torqued.

5 Connect the probe amp pod end to the N5477A and torque connector.

6 Connect the probe to the N5443A PV fixture:

a Probe amp with ZIF probe head is inserted into the PV holder far enough that the tip wires can easily reach the pinchers on the PV fixture.

b Form the coax cables so that the tip wires are close to the pincher points before trying to connect the tip wires. The connectors between the probe head and the probe amp can be rotated to align the probe tip properly to the pinchers. Since the center trace of the PV fixture is above the ground plane, the probe head should be tipped slightly so the tip wires touch the center trace and ground plane at the same time.

c Depress the actuators on the pinchers and carefully insert one wire under the center pincher and the other wire under one of the side pinchers. Either polarity of the probe can be tested and will yield the same results (but opposite phase) if the probe is working properly.

Figure 56 shows a close up of the tip wires positioned under the pinchers.

d Ideally the probe head should not be angled toward the port 2 side of the PV fixture, but a slight angle of 5 degrees is acceptable. If angled too much, the measured BW of the probe will be degraded due to coupling from the trace to the probe tip.

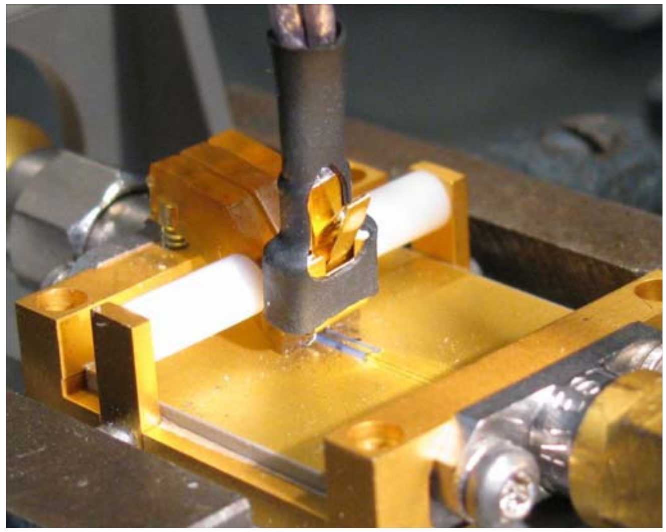


Figure 56 Close-up of tip wires positioned under pinchers

7 Install the proper file to de-embed the 1250-1749 adapter and the output side of the N5443A (i.e. the path from the male 2.92 mm connector to the probe point of the N5443A) from port 1 of the VNA.

a Create a Touchstone file for the 1250-1749 and N5443A PV fixture by cutting and pasting the text in "Touchstone File (1250-1749 & N5443A)" on page 87. Name the file **Adaptor_1250_1749___OutputSideOfFixture_N5443A.s2p**.

b On the VNA, go to menu "Calibration/Fixturing Selections/2 Port De-embedding" and select Port 1.

c Set S2P file selection to the file saved in step a.

d Check the "Enable De-embedding".

e Under "Calibration" menu, select "Fixturing ON/off" to turn on de-embedding.

8 Trigger VNA to perform a single sweep. a. Press "Trigger" under Channel Setup, and then the green soft-key for "Single". Display should look like Figure 57. If it looks noticeably different, the probe tip wires may not be making contact under the pinchers.

9 Under "Trace/Math/Memory" select "Data->Memory". This will save the de-embedded input voltage trace into the memory.

Figure 57 De-embedded “Vin” trace

10 Now move the 2.92 mm male test port 1 connector to the 5062_1247 adapter and N5477A Autoprobe II adapter assembly. Connect the Maury Microwave 8775B2 2.92 mm male broadband load to the 1250_1749 adaptor and N5443A PV fixture assembly. This new setup is shown in Figure 58. Torque all connections.

11 Install the proper file to de-embed the 5062_1247 adapter and N5477A adapter from port 1 of the VNA.

   a Create a Touchstone file for the 5062-1247 and N5477A by cutting and pasting the text in “Touchstone File (5062-1247 & N5477A)" on page 91. Name the file **Adapter_5062_1247__Adapter_N5477A.s2p**.

   b Go to menu “Calibration/Fixturing Selections/2 Port De-embedding” and select Port 1.

   c Set S2P file selection to the file saved in step a.

   d Make sure the “Enable De-embedding” box is still checked.

   e Under “Calibration” menu, make sure “Fixturing ON/off” is still checked so file is being used for de-embedding.

12 Trigger VNA to perform a single sweep.

   a Press “Trigger” under Channel Setup, and then the green soft-key for “Single”.

   b Under “Scale” menu, adjust the reference level until the 50 MHz point (left side of the screen) is at center screen. Reference level should be approximately -15.3 dB, but can vary a few tenths of a dB either way.

c Display should look like Figure 59. If it looks noticeably different, the probe tip wires may not be making contact under the pinchers.

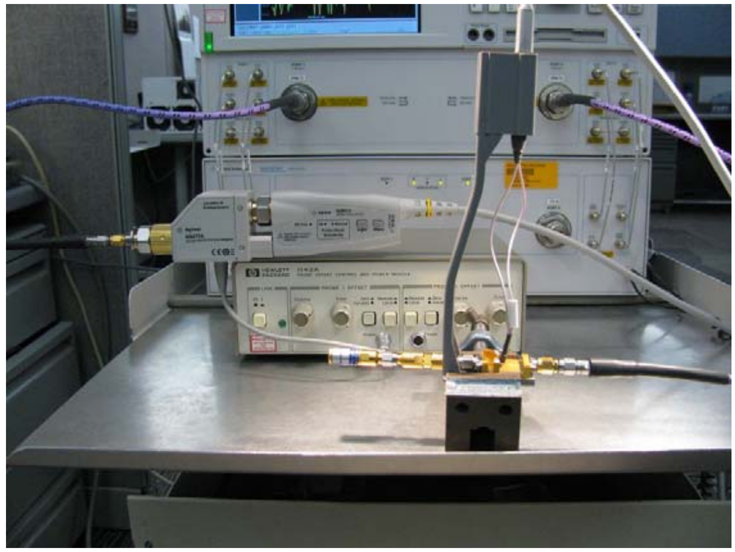


Figure 58 Setup to measure “Vout” of probe

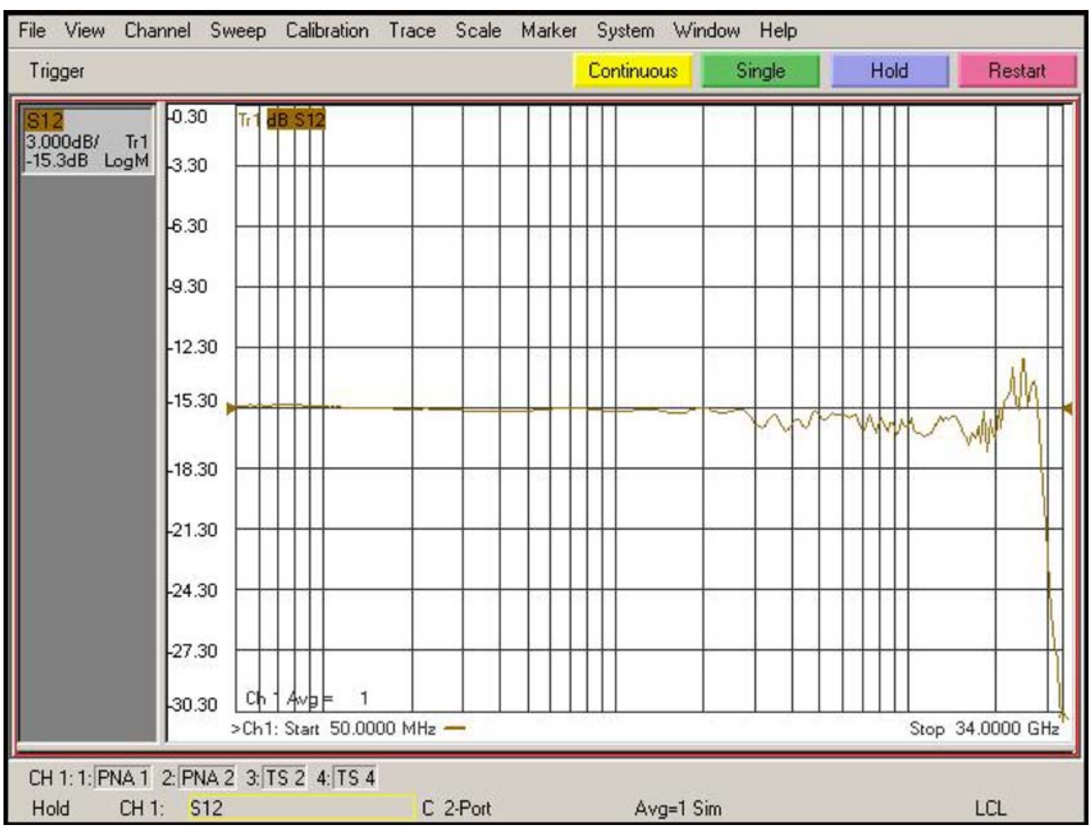


Figure 59 De-embedded “Vout” trace

13 Under menu “Trace/Math/Memory” select “Data/Memory” in the “Data Math” box.

a This will divide the current trace (de-embedded vout trace) by the memory trace (de-embedded vin trace) and therefore show the voltage transfer function of the probe or “vout/vin”.

b Again, adjust the “Reference Level” in the scale menu so the 50MHz point is at center screen. The display should look like Figure 60.

c Turn on a marker and adjust it to where the trace crosses 3 dB below the 50 MHz point (which is 1 division below center screen since screen is set to 3 dB/div).

d Verify that the BW is ≥ 26 GHz for the N5440A ceramic ZIF tip, N5439A ZIF probe head, and N2803A 30 GHz probe amp combination.

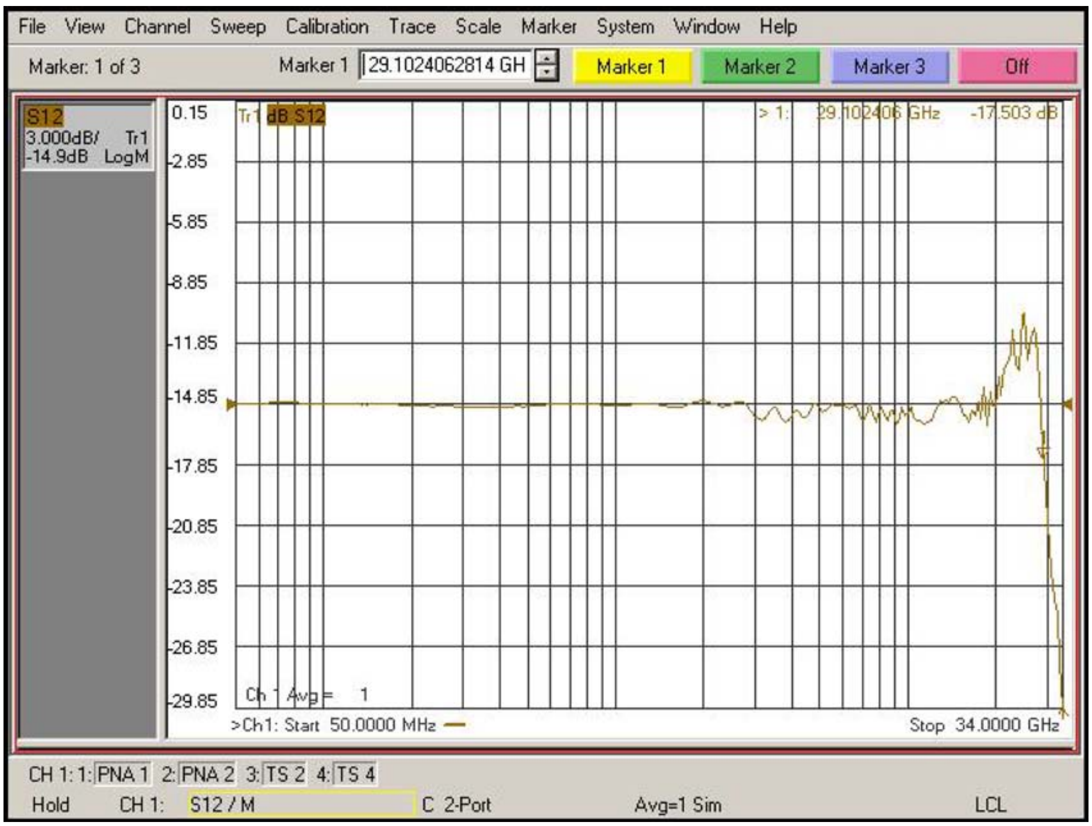


Figure 60 De-embedded “Vout/Vin” response of the probe

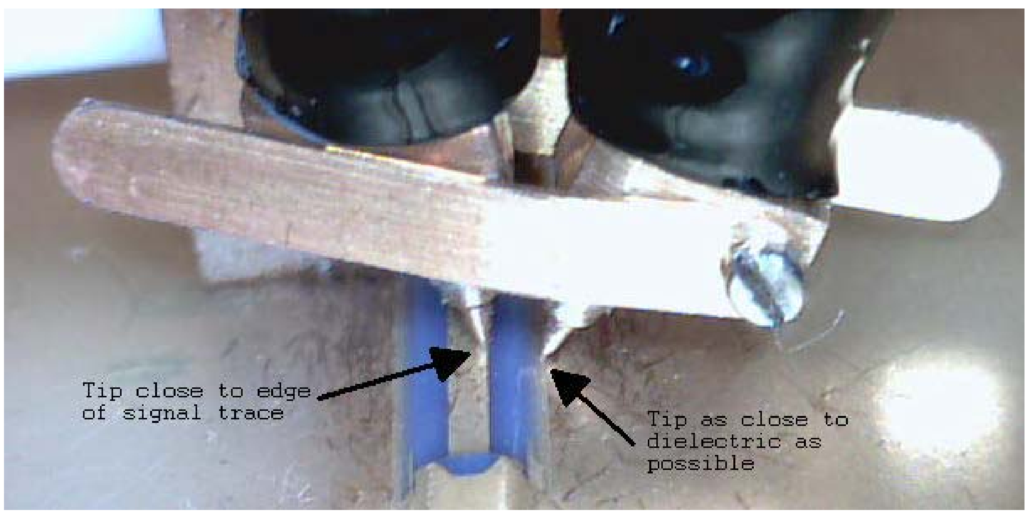
NOTE You only need to perform the Bandwidth Performance Verification test with the ZIF tip as described above. If the probe passes with the ZIF probe head then it will pass with the browser probe head as well. You are not required to test the bandwidth specification with both probe heads. If you have the choice between using the ZIF probe head or the browser, Keysight suggests using the ZIF probe head because measurements are more repeatable with it and it is easier to make a proper connection.

To measure the performance of the N5445A Browser with the N2803A probe amp, the same procedure as described above is used except the browser is held in position with a probe positioner. This setup is shown in Figure 61 using the Keysight N2787A 3D Probe Positioner.

a Tilt the browser slightly so the two tips touch the center trace and the ground plane on the PV fixture at about the same time.

b Probe the halfway point between the where the pinchers are and where the microstrip transitions into the rectangular coax line.

c Set the span of the browser to the minimum possible as should in this picture:



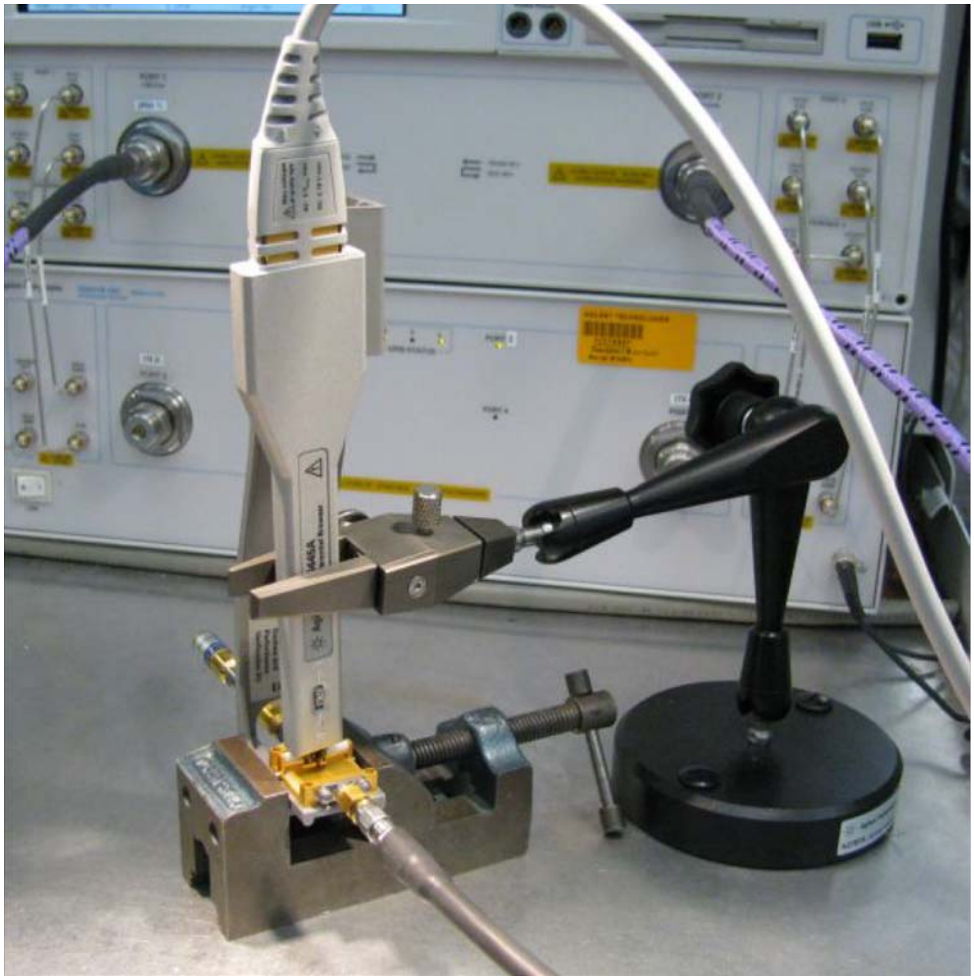


Figure 61 N2787A 3D Probe Positioner used to measure the N5445A browser with the N2803A amp

Touchstone File (1250-1749 & N5443A)

Cut and paste the following text and save in a text file named **Adapter_1250_1749__OutputSideOfFixture_N5443A.s2p**. This file is used in Step 7 on page 81.

NOTE You'll find the following data on the Adobe AIR version of the Probe Resource Center (PRC). Copying this data from the PRC is the simplest most reliable method to get the data. To download the PRC, visit http://www.Keysight.com/find/PRC.

```
! freq S11 S21 S12 S22
!Port 1=female 3.5mm connector of 1250-1749 adaptor, Port 2=probe point on N5443A fixture
# Hz S DB R 50
50000000.000000 -49.528411 110.869328 -0.026318 -4.180881 -0.025870 -4.223772 -67.754661 -176.153454
51165694.067857 -49.988587 91.181375 -0.025517 -4.280433 -0.024720 -4.324675 -68.880923 -164.662475
52358564.988911 -50.522661 71.165730 -0.024697 -4.382306 -0.023543 -4.427929 -70.190588 -152.193533
53579246.361093 -51.148132 50.755093 -0.023858 -4.486555 -0.022339 -4.533591 -71.710672 -138.296498
54828386.553961 -51.883012 29.852775 -0.023000 -4.593234 -0.021107 -4.641716 -73.455393 -122.229302
56106649.053084 -52.745137 8.328609 -0.022122 -4.702400 -0.019846 -4.752362 -75.383422 -102.800368
57414712.812455 -53.751090 -13.985221 -0.021223 -4.814111 -0.018557 -4.865588 -77.285484 -78.453735
58753272.615119 -54.914477 -37.296089 -0.020304 -4.928426 -0.017237 -4.981454 -78.641246 -48.710849
60123039.442212 -56.136285 -60.059373 -0.019410 -5.044783 -0.015920 -5.098670 -78.505514 -17.996645
61524740.850598 -56.339746 -65.253403 -0.018972 -5.157375 -0.014907 -5.204612 -74.600997 0.238726
62959121.359318 -56.549712 -70.614809 -0.018523 -5.272593 -0.013871 -5.313024 -71.786638 16.619539
64426942.845040 -56.765722 -76.151300 -0.018064 -5.390497 -0.012811 -5.423964 -69.665881 32.555062
65928984.946733 -56.987159 -81.870529 -0.017595 -5.511150 -0.011726 -5.537491 -68.056466 48.587163
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70648506.535956 -57.624590 -110.396155 -0.016195 -5.894832 -0.009445 -5.897344 -64.822182 90.200098
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73981088.416647 -57.272309 -174.184620 -0.015537 -6.186061 -0.012827 -6.165369 -61.314332 74.543748
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Touchstone File (5062-1247 & N5477A)

Cut and paste the following text and save in an text file named **Adapter_5062_1247___Adapter_N5477A.s2p**. This file is used in Step 11 on page 82.

NOTE You'll find the following data on the Adobe AIR version of the Probe Resource Center (PRC). Copying this data from the PRC is the simplest most reliable method to get the data. To download the PRC, visit http://www.keysight.com/find/PRC.

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!Port 1=female side of 5062_1247 adaptor, Port 2=male side of N5477A
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16262796355.032291 -27.166721 -58.757340 -0.374921 54.662998 -0.370241 54.704425 -24.529908 6.247539
16641945259.788942 -26.763536 -160.007113 -0.384264 -19.616642 -0.380796 -19.558669 -25.302166 -67.497161
17029933597.127781 -28.644756 87.146320 -0.372689 -95.667199 -0.369029 -95.638847 -36.512177 -114.107070
17426967448.531292 -47.848604 -54.576713 -0.375307 -173.611851 -0.371314 -173.536994 -32.117741 -37.192426
17833257700.041199 -25.373848 77.107861 -0.381565 106.681389 -0.381826 106.752623 -26.695748 -57.166454
18249020154.271370 -21.671814 -12.233474 -0.399919 25.179522 -0.406146 25.266365 -22.459690 -107.844721
18674475645.032219 -26.742937 -85.593837 -0.395158 -58.204220 -0.395133 -58.095952 -24.909696 162.854364
19109850154.627415 -28.414119 -65.676430 -0.397429 -143.696471 -0.389362 -143.605337 -27.890896 -19.577772
19555374933.885239 -24.586218 -144.108105 -0.414361 128.893776 -0.407288 129.005005 -22.618008 -141.317301
20011286624.988346 -26.045948 105.213101 -0.402389 39.501393 -0.389836 39.614344 -25.938526 122.482384
20477827387.167168 -25.898538 12.536934 -0.388736 -52.130474 -0.375999 -52.034114 -30.307011 51.901194
20955245025.323700 -25.863619 -61.341207 -0.403561 -145.804189 -0.393551 -145.786077 -26.672025 -32.965204
21443793121.654022 -31.243910 -92.221920 -0.402312 118.118322 -0.396327 118.261313 -31.028754 -177.176860
21943731170.339451 -23.158869 -142.365828 -0.443013 19.867220 -0.432500 19.917340 -22.801909 8.354422
22455324715.377853 -20.480757 91.146321 -0.465176 -80.436626 -0.462656 -80.272536 -20.450127 -78.156390
22978845491.628361 -23.350751 -42.524375 -0.439231 176.888332 -0.437659 176.972824 -24.720232 -132.556294
23514571569.144375 -29.096385 25.034429 -0.434284 71.509130 -0.415904 71.569311 -29.744440 -88.823584
24062787500.871529 -20.867025 -106.511416 -0.473044 -36.135123 -0.451251 -36.183006 -20.573606 -144.546395
24623784473.789066 -26.684148 130.707972 -0.463478 -146.321169 -0.428301 -146.096394 -24.004558 127.818009
25197860463.574921 -31.160196 61.734789 -0.446323 100.735661 -0.410981 100.913010 -39.408221 -29.991332
25785320392.876629 -25.533397 -17.272853 -0.440480 -14.729362 -0.438068 -14.647444 -26.709420 161.061882
26386476293.272152 -22.711245 -101.871135 -0.471170 -133.063592 -0.457863 -133.066616 -23.104139 19.695494
27001647471.006645 -27.253283 112.297230 -0.461232 106.068363 -0.457380 106.198584 -26.510214 -77.900230
27631160676.593178 -30.361881 -168.178401 -0.455009 -17.907822 -0.473248 -17.742401 -33.304329 -45.653780
28275350278.367512 -17.914343 -10.269666 -0.535415 -144.847239 -0.495666 -144.767531 -18.500405 -94.926037
28934558440.089119 -25.403265 -145.855952 -0.458652 85.819950 -0.471521 86.027882 -25.033409 132.887622
29609135302.682766 -21.411602 -123.245956 -0.500273 -47.265432 -0.509761 -47.235075 -21.254847 -153.392821
30299439170.217197 -27.014691 72.673095 -0.489298 176.678655 -0.474972 177.031191 -25.338474 101.072054
31005836700.219704 -26.316760 -92.472631 -0.452905 37.601195 -0.500821 37.724078 -24.884493 -3.740226
31728703098.427670 -24.576379 -122.274522 -0.482050 -105.277061 -0.496607 -105.184253 -22.985629 83.341478
32468422318.080524 -18.473439 97.257414 -0.522336 109.131590 -0.552294 109.178004 -17.832689 -62.528240
33225387263.857967 -35.956091 36.668777 -0.453368 -40.549604 -0.433040 -40.351388 -38.607656 -59.673550
34000000000.000000 -18.584633 -83.525655 -0.518071 166.056015 -0.538472 166.289380 -18.908405 -121.618048
```

DC Input Resistance Performance Verification

Keysight recommends a test interval of one year or 2000 hours of operation.

Equipment Needed

- Keysight N5443A Performance Verification Fixture
  - No substitute
- BNC(m) to SMA(m) Adapter
  - Pomona 4288 or equivalent
- Banana Plug to BNC(f)
  - Pomona 1269 or equivalent
- Digital Multimeter
  - Keysight 33401A or equivalent
  - Critical specification: 2 wire resistance accuracy
  - Power Supply for Probe
  - DSO/DSA 90000 X-series oscilloscope or 1134A power supply with N5477A Autoprobe adapter (see the “Bandwidth Performance Verification procedure)
  - No substitute
- Probe Positioner
  - Keysight N2787A 3D Probe Positioner
  - Critical specification: stable/accurate positioning
- Small Bench Vise
- InfiniiMax III Probe Head
  - Either the N5439A ZIF probe head with the N5440A ceramic ZIF tip, the N5441A solder-in probe head, or the N5445A browser probe head. (You only need to perform the Performance Verification test on one of these probe heads, not all of them. If it passes for one of them, then it will pass for all of them.)

Measuring Input Resistance for ZIF Probe Heads or Solder-in Probe Heads

Figure 62 shows the correct setup for measuring the differential input resistance for ZIF probe heads or the solder-in probe head.

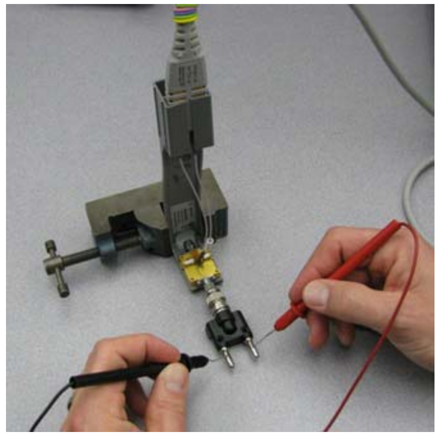


Figure 62 Measuring the differential input resistance of a ZIF or solder-in probe head

1 Connect the BNC to SMA adapter and BNC to Banana Plug adapters as shown in Figure 62.
2 Position the PV fixture on a table top and clamp it with a small bench vise to steady it. Ensure that the PV fixture is flush with the table top so that when the banana plugs are probed, it does not rock the PV fixture.
3 Connect the probe amplifier to the oscilloscope or power supply so it is powered.
4 Connect the ZIF or solder-in probe head to the probe amp and insert it into the PV fixture as shown Figure 62.
5 Depress the pincher fingers on the PV fixture so they open and carefully insert the tip wires under the pinchers. Release the pichers once the tips are inserted.
6 As shown in Figure 62, measure the DC input resistance between the banana plugs. Since one tip wire is connected to the signal line and the other tip is connected to the PV fixture ground, this is a measurement of the differential input resistance. It should be 100 kOhms +/- 2% (98 to 102 kOhms).
7 To measure the single-ended input resistance, measure the resistance between the signal plug of the banana adapter and the probe amplifier ground, which can be accessed as shown in Figure 63 (through the vent window of the probe amplifier).

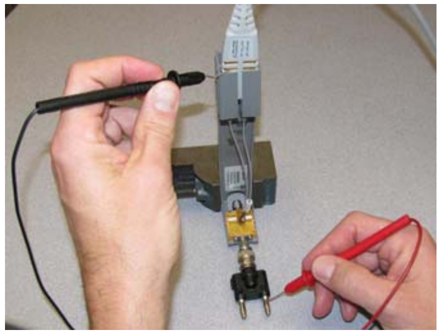


Figure 63 Measuring the single-ended input resistance of a ZIF or solder-in probe head

Measuring Input Resistance for the Browser Probe Head

The following image shows the correct setup for measuring the differential input resistance of the N5445A Browser probe head (Figure 64).

Figure 64 Setup for Measuring Input Resistance for Browser Probe Head

1. Set the browser for a fairly wide span (span does not impact this DC measurement).
2. Plug the probe amplifier into the browser.
3. Clamp the browser with the N2787A probe positioner.
4. Hold the browser with one hand and loosen the arm locking knob on the probe positioner with the other hand.
5. Carefully position one tip over the signal trace on the PV fixture and the other over the ground plane. Then let the weight of the browser slightly compress the tips so good contact is made.
6. Now the differential and single-ended input resistance can be measured in the same manner as for the ZIF and solder-in probe head procedure above.

Performance Test Record

NOTE The recommended test interval is 1 Year/2000 hours.

Keysight Technologies	Keysight InfiniiMax III Series Probe
Model Number:	**Tested by:**
Serial Number:	**Work Order Number:**
Recommended next test date:	**Date:**

Probe Head (only required to test one)	Test Limits	Result	Pass/Fail
Bandwidth Performance Test			
N5439A with N5440A	≥ 26 GHz		
N5445A	≥ 28 GHz		
DC Input Resistance Performance Test			
N5439A with N5440A	98 to 102 kΩ (differential mode) 49 to 51 kΩ (single-ended mode)		
N5445A	98 to 102 kΩ (differential mode) 49 to 51 kΩ (single-ended mode)		
N5441A	98 to 102 kΩ (differential mode) 49 to 51 kΩ (single-ended mode)		

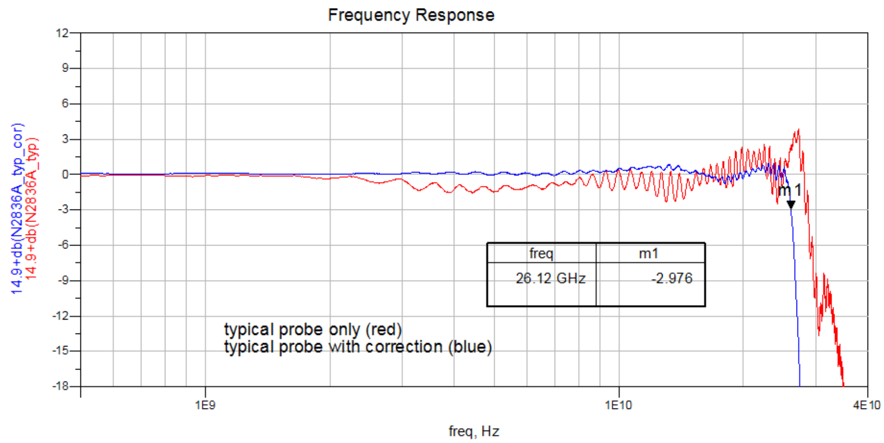
6
Performance Plots

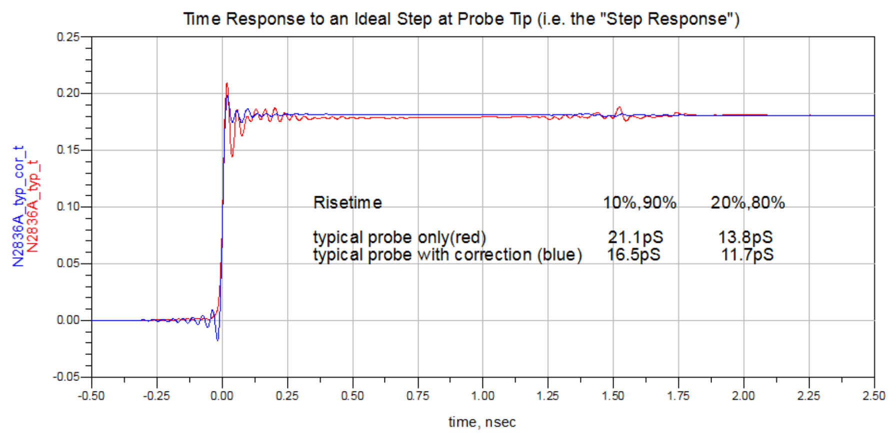
The performance plots in this chapter are for the N2803A 30 GHz probe amplifier with various configurations InfiniiMax III probe heads. Items to note are:

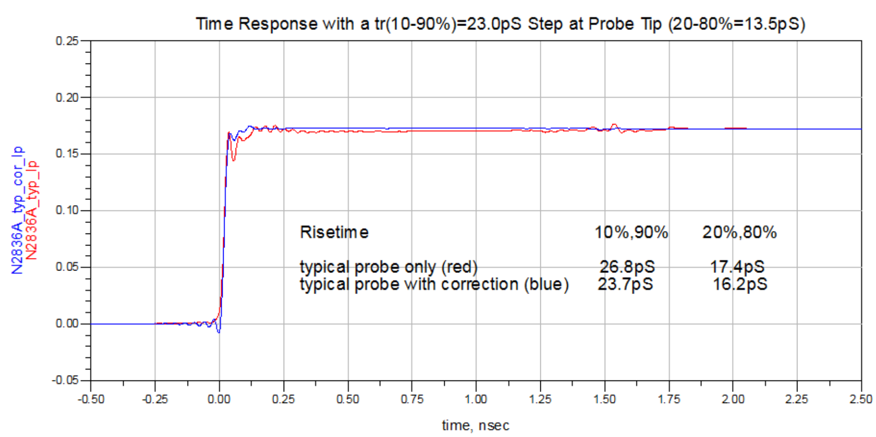
- When InfiniiMax III probes are used with Keysight Infiniium 90000 X-Series Oscilloscopes (and the Keysight DCA-X Wide-Bandwidth Sampling Scopes in some cases), probe correction is applied to enhance the probe accuracy.
- Probe correction is computed from the s parameters of the various probe components such as probe heads, probe amps, and accessories.
- Typically, the largest variation in a probe's response is due to variation in the response of the probe amplifier. For the InfiniiMax III probes, the s parameters of each probe amplifier are measured at manufacture and stored in non-volatile memory in the probe amplifier, thus allowing the removal of this component of variation.
- If care is taken in the manufacture of the probe heads and other accessories, the variation in the probe response due to these components is minimal since they tend to be simple passive devices. Therefore, the s parameters for probe heads and other accessories are based on an average of a cross-section of parts. These nominal s parameters are stored in the oscilloscopes firmware based on the model number of the probe head or accessory and used in conjunction with the measured probe amplifiers s parameters to compute the overall probe correction.

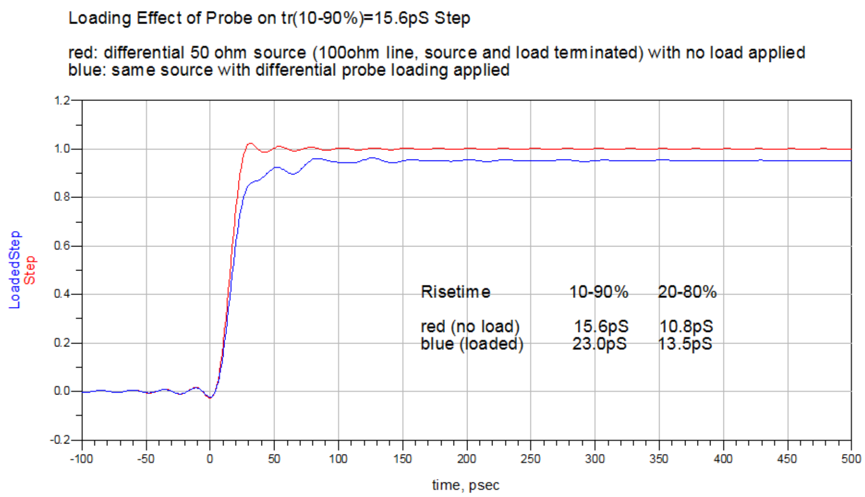
- Since InfiniiMax III probes can be used with instruments that do not apply probe correction, the plots below show the response of a typical probe head and typical probe amp with no probe correction (i.e. probe hardware only) as well as the response with probe correction based on the nominal probe head s parameters and measured probe amp s parameters.
- Measurement data used for these plots and for determining probe correction were made using Keysight vector network analyzers swept to 40GHz and calibrated with NIST traceable calibration standards.
- Two time responses are shown:
  - "Time Response to an Ideal Step at Probe Tip" This is the classical "step response" which is defined as the time response to an ideal, zero rise-time step present at the probe tip. This can be determined accurately because the probe rolls off significantly within the 40GHz measurement range.
  - "Time Response to a ?ps Step at Probe Tip" This is the time response of the probe when measuring a step with the indicated 10%-90% rise-time present at the probe tip. The measured step is generated using a 5th order Bessel low pass filter that has an edge shape as shown in the plot showing the loading effect of the probe. The rise-time of this test step is picked to illustrate approximately the fastest step the probe can measure with less than 3% error in the rise-time measurement.

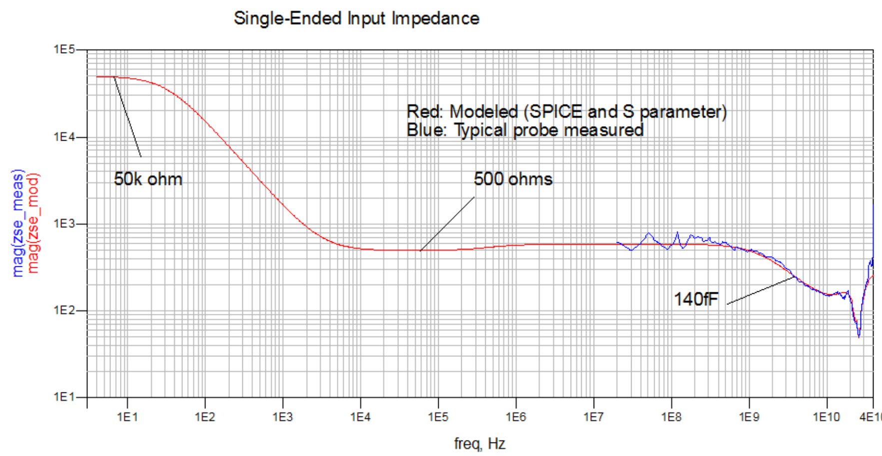
N2836A 26 GHz Solder-In Head (with N2803A)

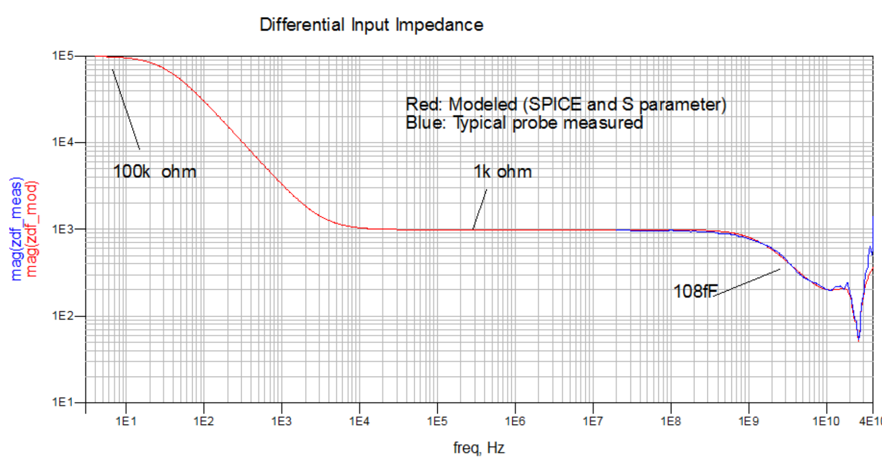


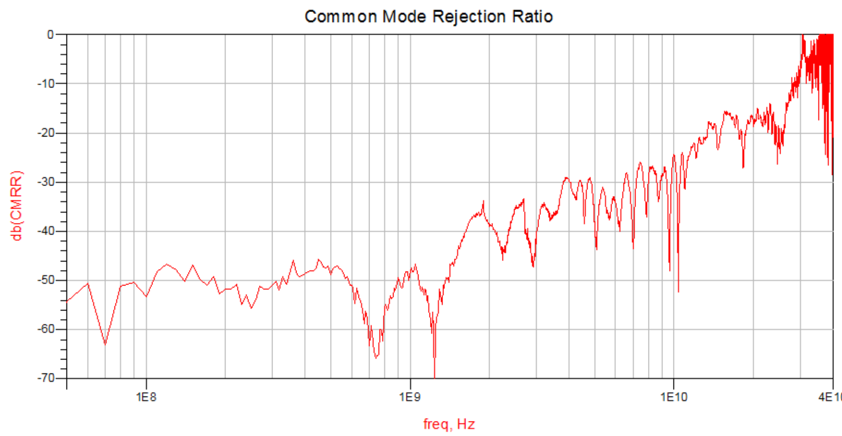




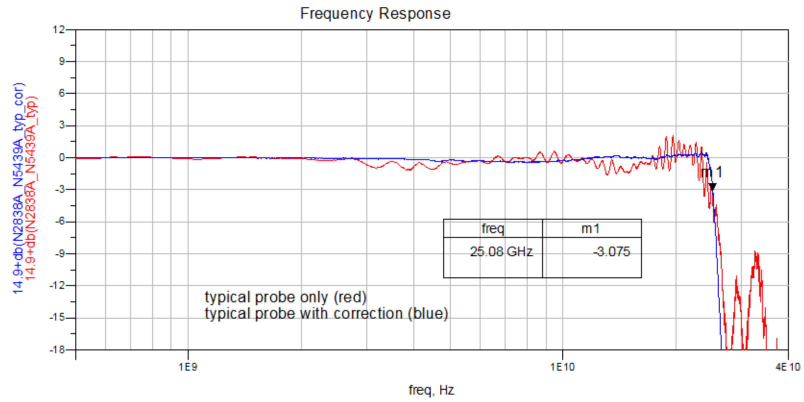

Loading Effect of Probe on tr(10-90%)=15.6pS Step
red: differential 50 ohm source (100ohm line, source and load terminated) with no load applied
blue: same source with differential probe loading applied
LoadedStep
Step
Risetime 10-90% 20-80%
red (no load) 15.6pS 10.8pS
blue (loaded) 23.0pS 13.5pS
time, psec

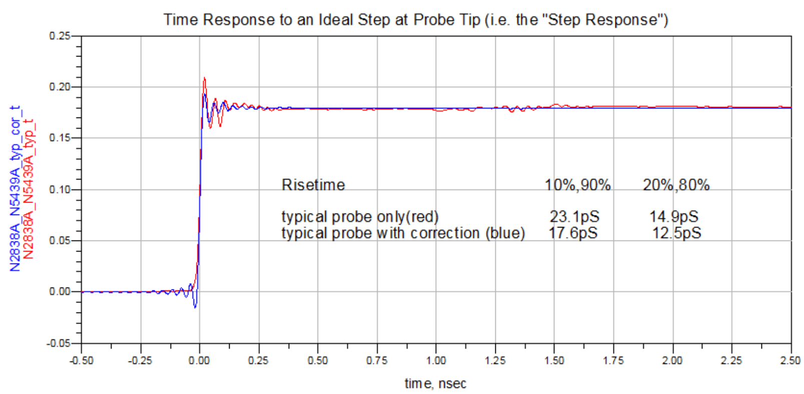

Single-Ended Input Impedance
Red: Modeled (SPICE and S parameter)
Blue: Typical probe measured
50k ohm
500 ohms
140fF
mag(zse_meas)
mag(zse_mod)
freq, Hz

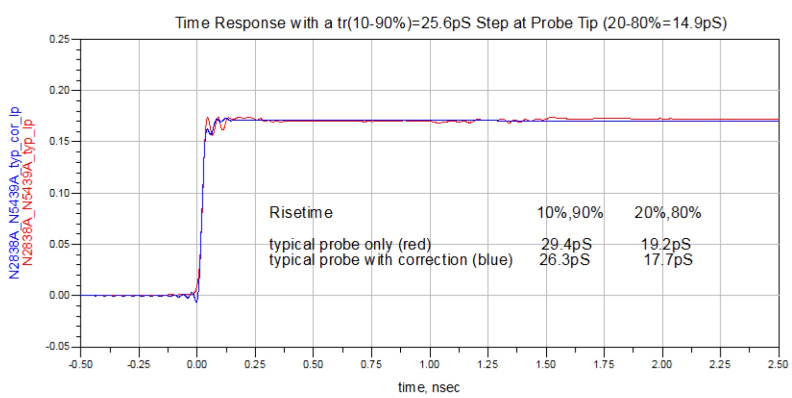

Differential Input Impedance
Red: Modeled (SPICE and S parameter)
Blue: Typical probe measured
100k ohm
1k ohm
108fF
mag(zdf_meas)
mag(zdf_mod)
freq, Hz

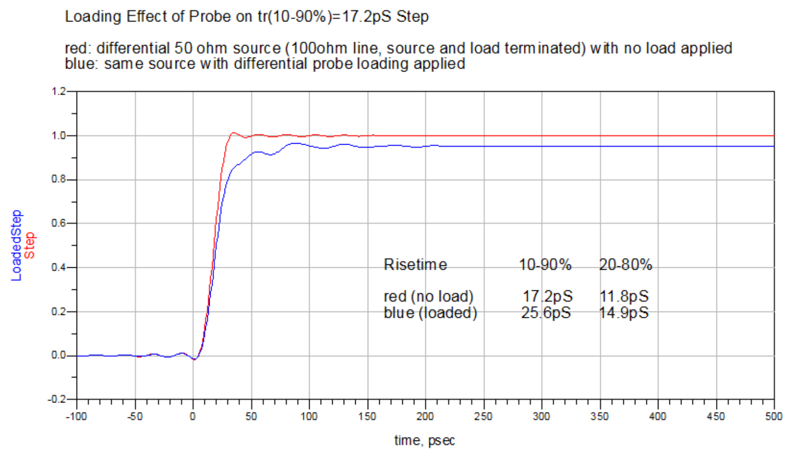

Common Mode Rejection Ratio
db(CMRR)
0
-10
-20
-30
-40
-50
-60
-70
1E8
1E9
1E10
4E10
freq, Hz

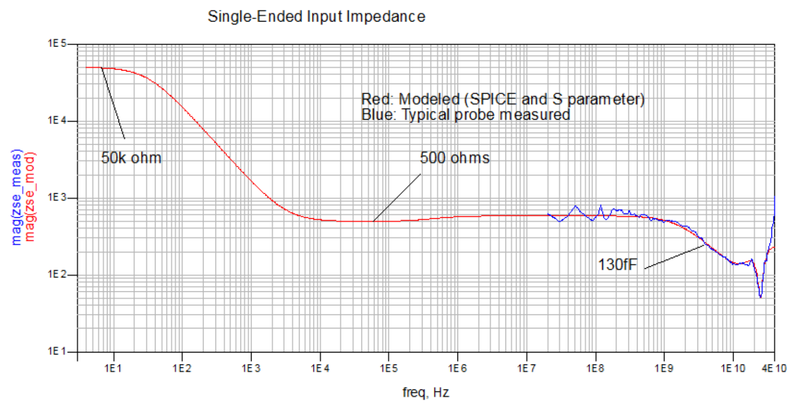
N2838A/N5439A 25 GHz PCB ZIF Tip/Head (with N2803A)

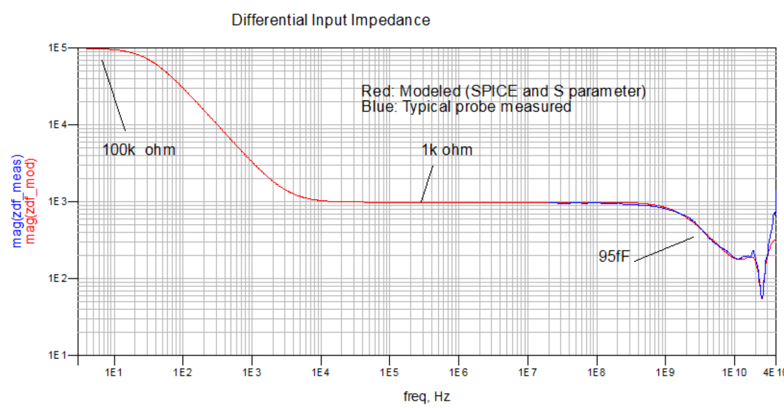


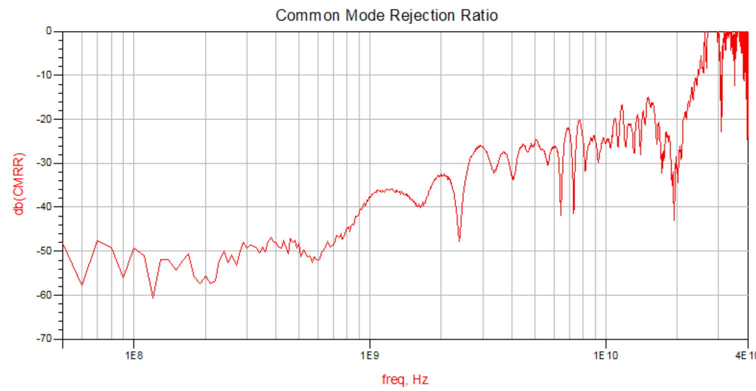




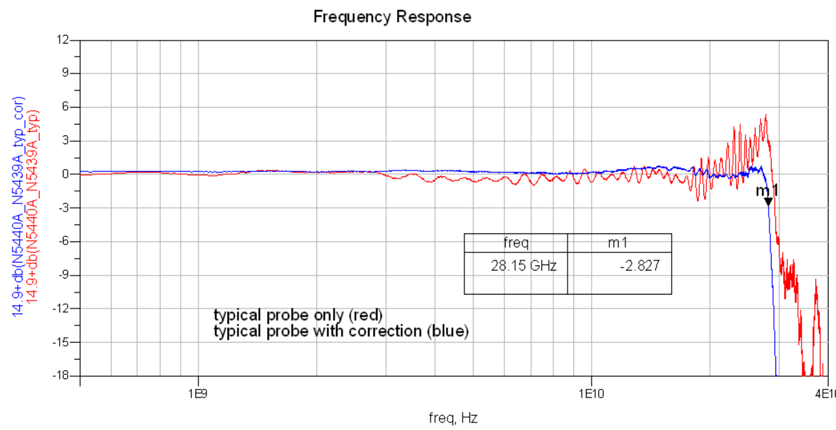

Loading Effect of Probe on tr(10-90%)=17.2pS Step
red: differential 50 ohm source (100ohm line, source and load terminated) with no load applied
blue: same source with differential probe loading applied
LoadedStep
Step
Risetime 10-90% 20-80%
red (no load) 17.2pS 11.8pS
blue (loaded) 25.6pS 14.9pS
time, psec

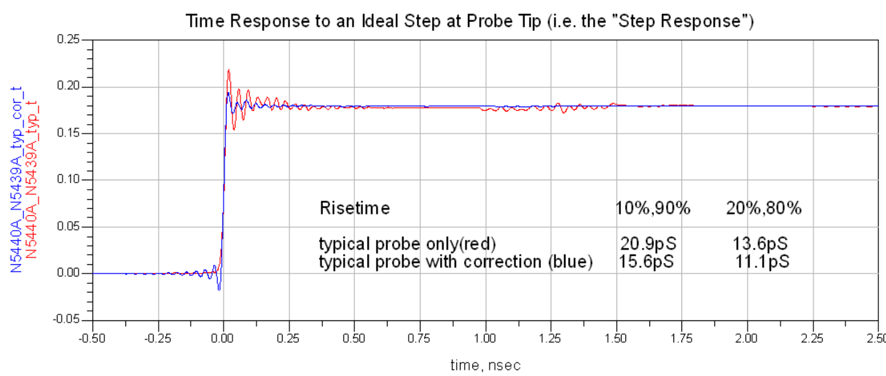

Single-Ended Input Impedance
Red: Modeled (SPICE and S parameter)
Blue: Typical probe measured
50k ohm
500 ohms
130fF
mag(zse_meas)
mag(zse_mod)
freq, Hz

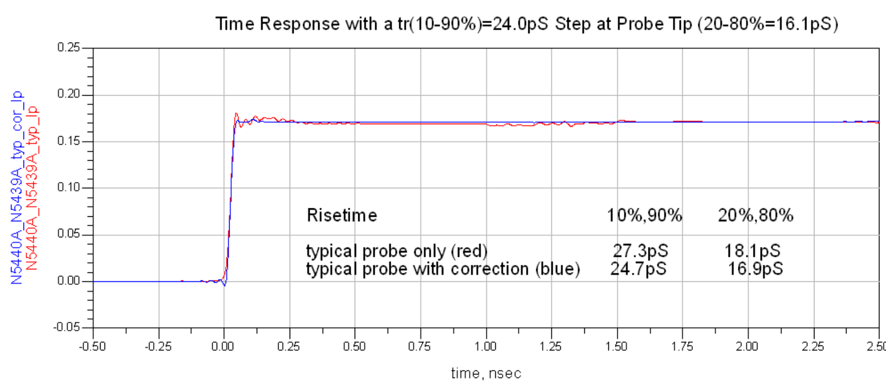

Differential Input Impedance
Red: Modeled (SPICE and S parameter)
Blue: Typical probe measured
100k ohm
1k ohm
95fF
mag(zdf_meas)
mag(zdf_mod)
freq, Hz

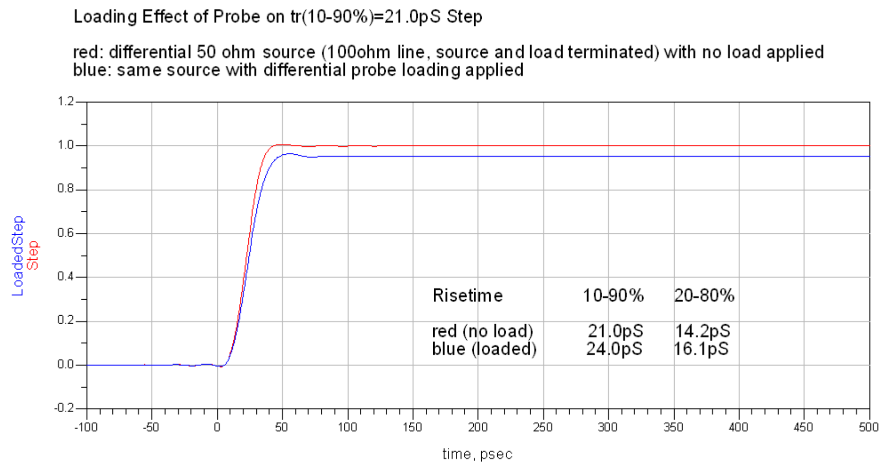

Common Mode Rejection Ratio
db(CMRR)
0
-10
-20
-30
-40
-50
-60
-70
1E8
1E9
1E10
4E10
freq, Hz

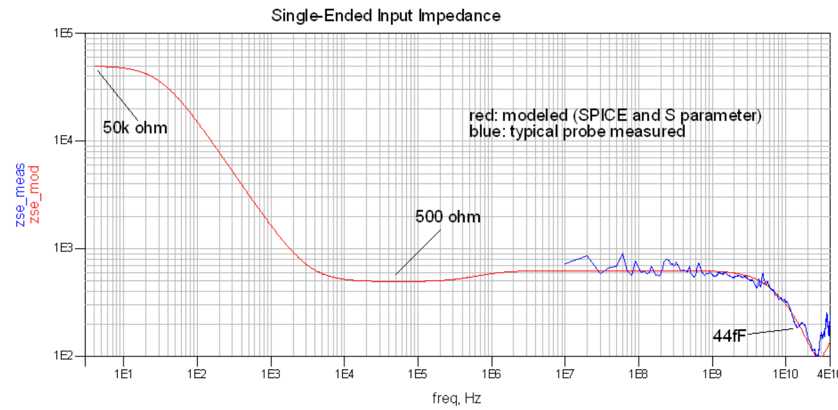
N5440A/N5439A 28 GHz Ceramic ZIF Tip/Head (with N2803A)

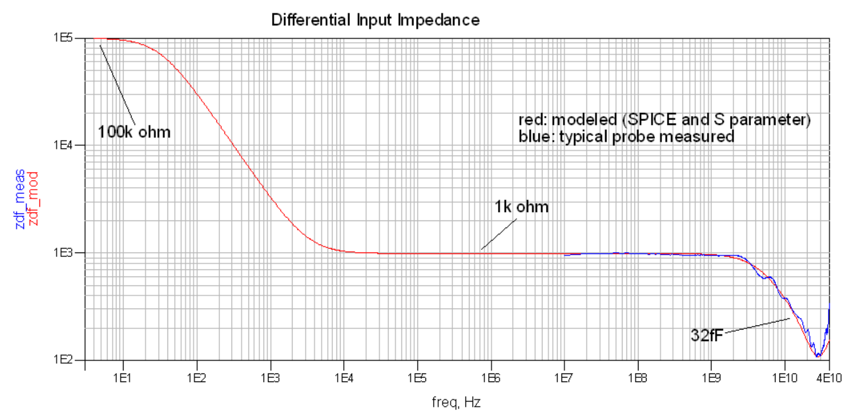


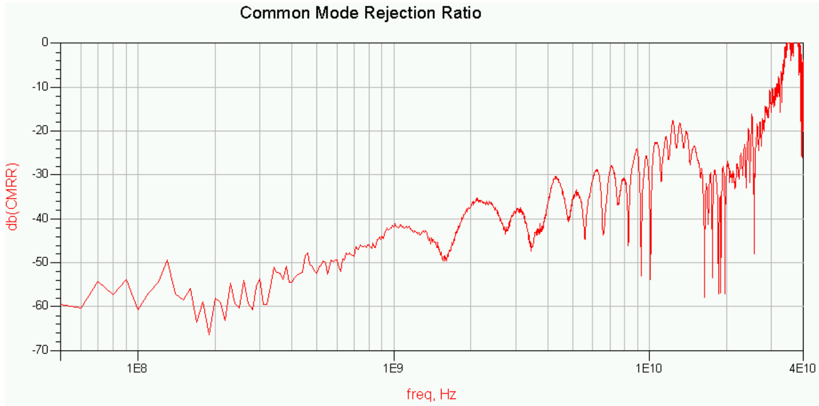




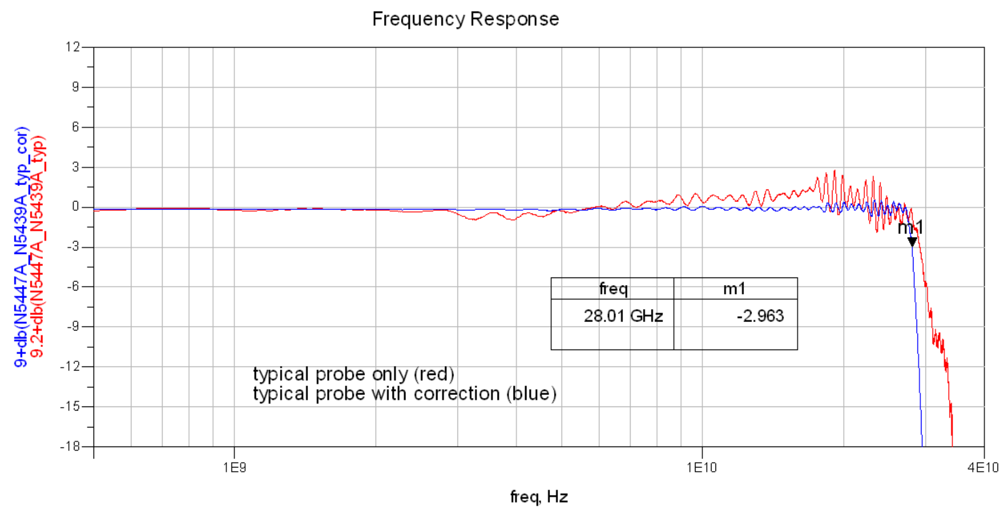

Loading Effect of Probe on tr(10-90%)=21.0pS Step
red: differential 50 ohm source (100ohm line, source and load terminated) with no load applied
blue: same source with differential probe loading applied
LoadedStep
Step
Risetime 10-90% 20-80%
red (no load) 21.0pS 14.2pS
blue (loaded) 24.0pS 16.1pS
time, psec

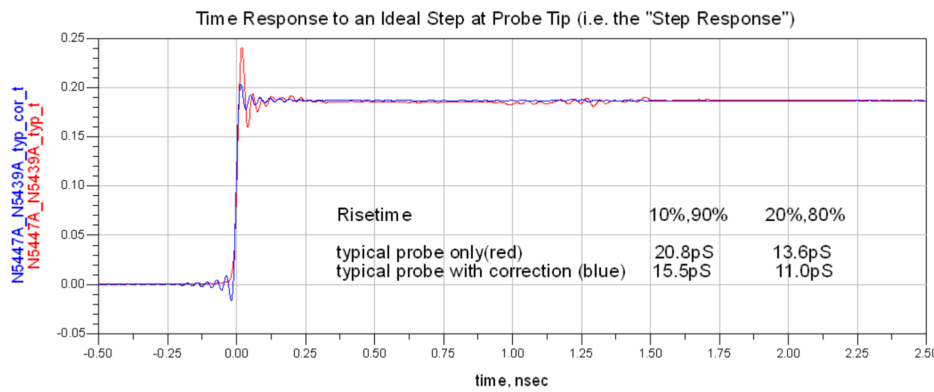

Single-Ended Input Impedance
50k ohm
red: modeled (SPICE and S parameter)
blue: typical probe measured
500 ohm
44fF
zse_meas
zse_mod
freq, Hz

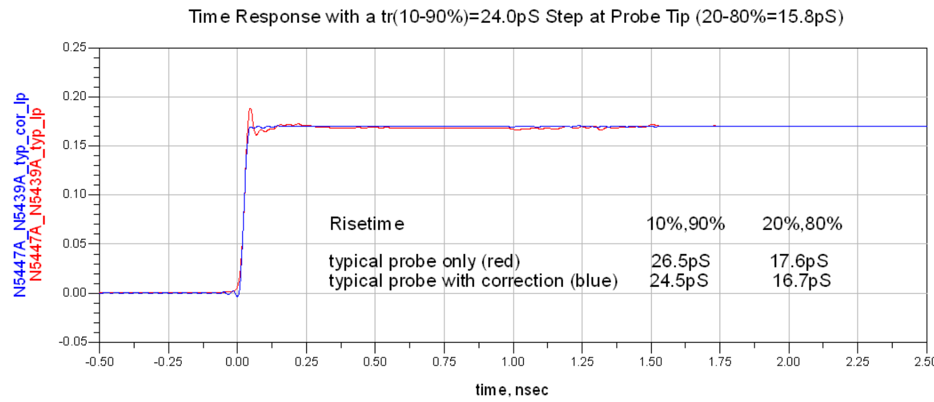

Differential Input Impedance
100k ohm
red: modeled (SPICE and S parameter)
blue: typical probe measured
1k ohm
32fF
zdf_meas
zdf_mod
freq, Hz

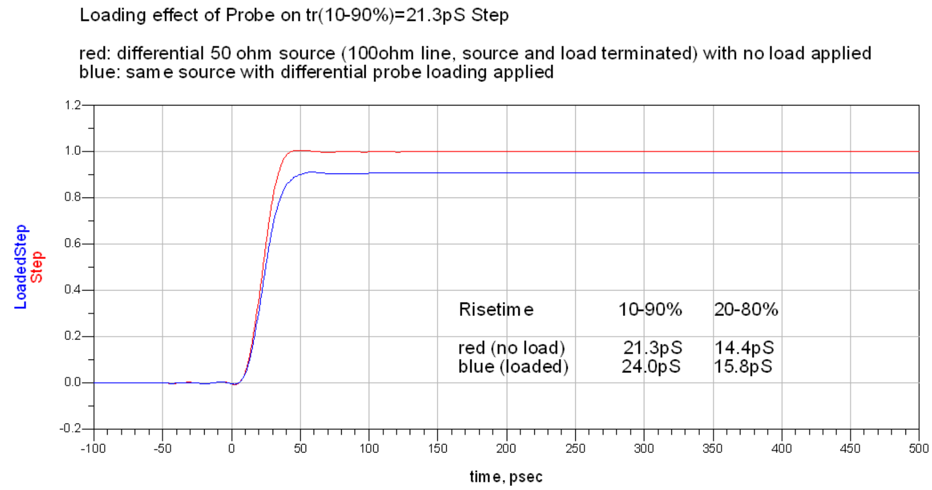

Common Mode Rejection Ratio
db(CMRR)
0
-10
-20
-30
-40
-50
-60
-70
1E8
1E9
1E10
4E10
freq, Hz

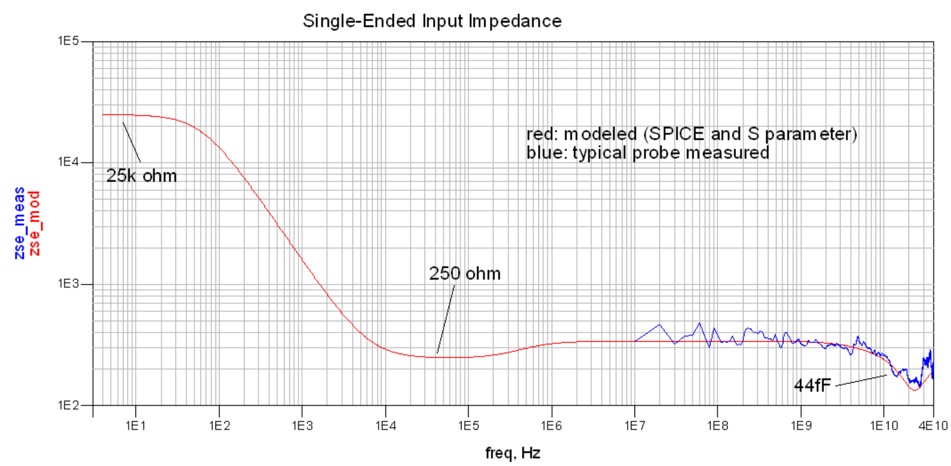
N5447A/N5439A 28 GHz Ceramic High-Sensitivity ZIF Tip/Head (with N2803A)

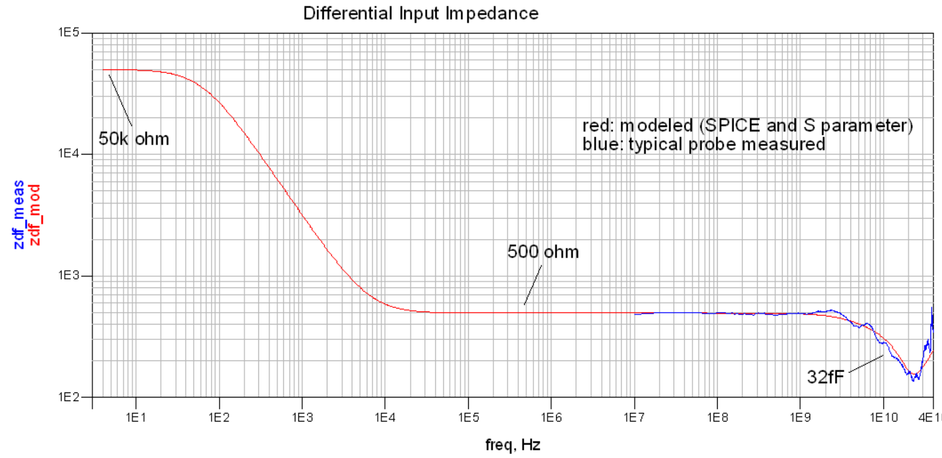


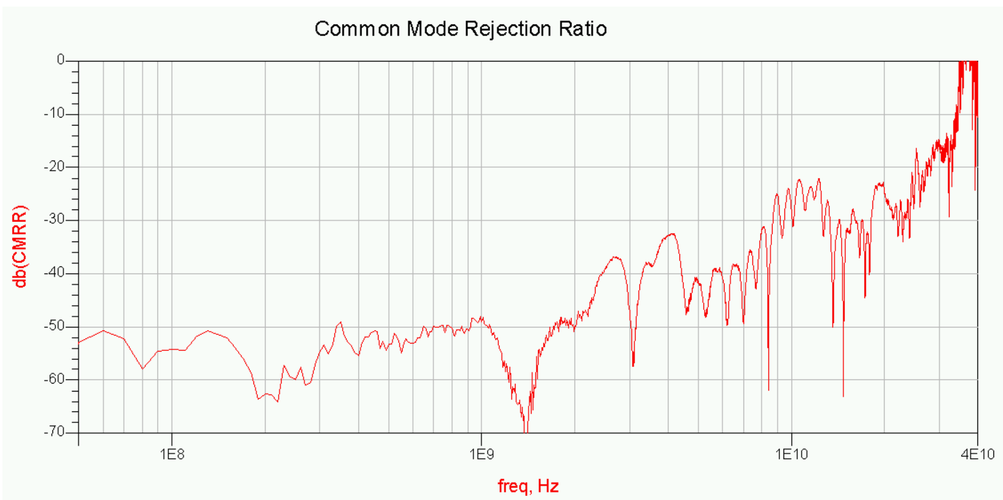



Time Response with a tr(10-90%)=24.0pS Step at Probe Tip (20-80%=15.8pS)
N5447A_N5439A_typ_cor_lp
N5447A_N5439A_typ_lp
Risetime
10%,90%
20%,80%
typical probe only (red)
26.5pS
17.6pS
typical probe with correction (blue)
24.5pS
16.7pS
time, nsec

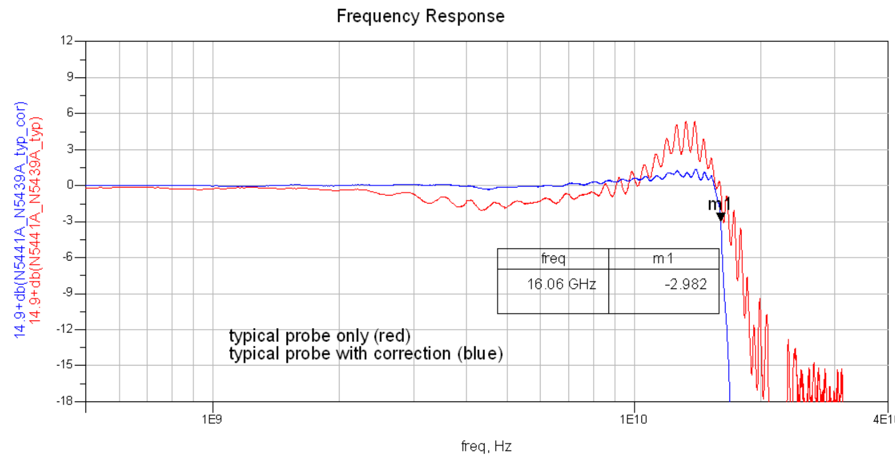

Loading effect of Probe on tr(10-90%)=21.3pS Step
red: differential 50 ohm source (100ohm line, source and load terminated) with no load applied
blue: same source with differential probe loading applied
LoadedStep
Step
Risetime
10-90%
20-80%
red (no load)
21.3pS
14.4pS
blue (loaded)
24.0pS
15.8pS
time, psec

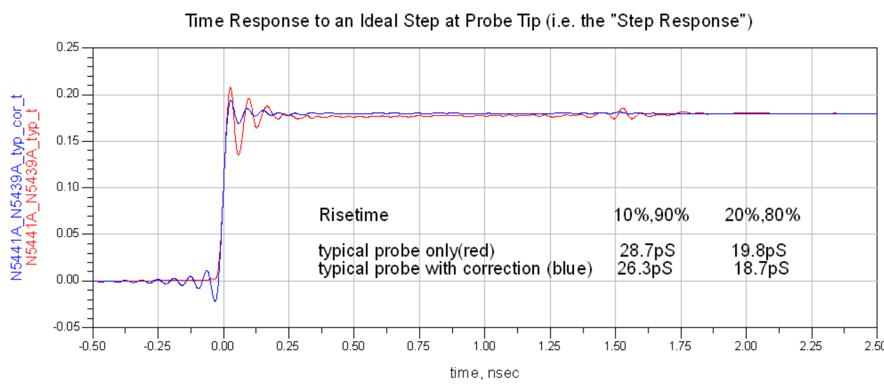

Single-Ended Input Impedance
zse_meas
zse_mod
red: modeled (SPICE and S parameter)
blue: typical probe measured
25k ohm
250 ohm
44fF
freq, Hz

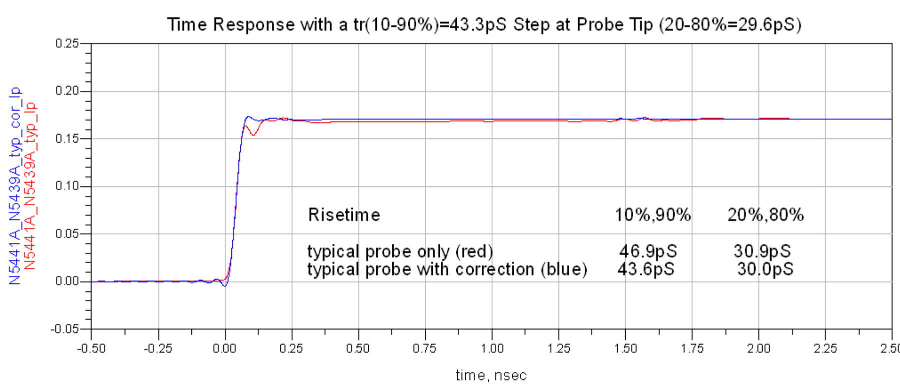

Differential Input Impedance
1E5
1E4
1E3
1E2
zdf_meas
zdf_mod
50k ohm
red: modeled (SPICE and S parameter)
blue: typical probe measured
500 ohm
32fF
1E1
1E2
1E3
1E4
1E5
1E6
1E7
1E8
1E9
1E10
4E10
freq, Hz

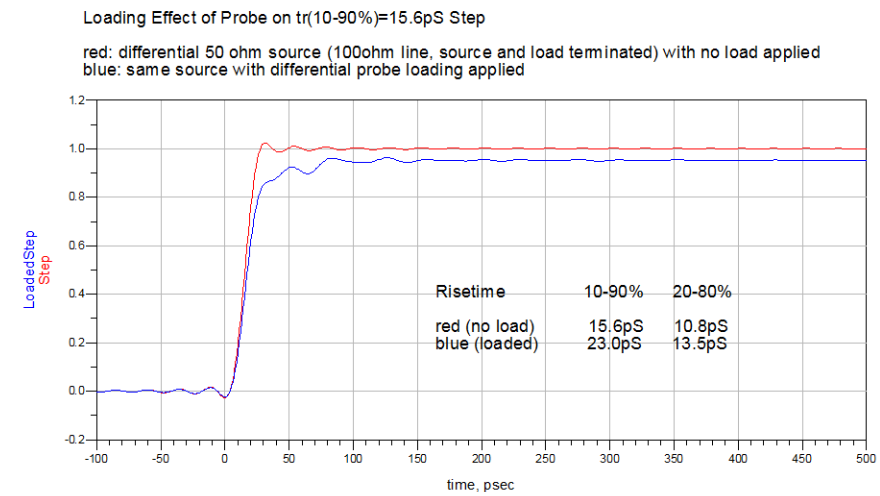

Common Mode Rejection Ratio
0
-10
-20
-30
-40
-50
-60
-70
db(CMRR)
1E8
1E9
1E10
4E10
freq, Hz

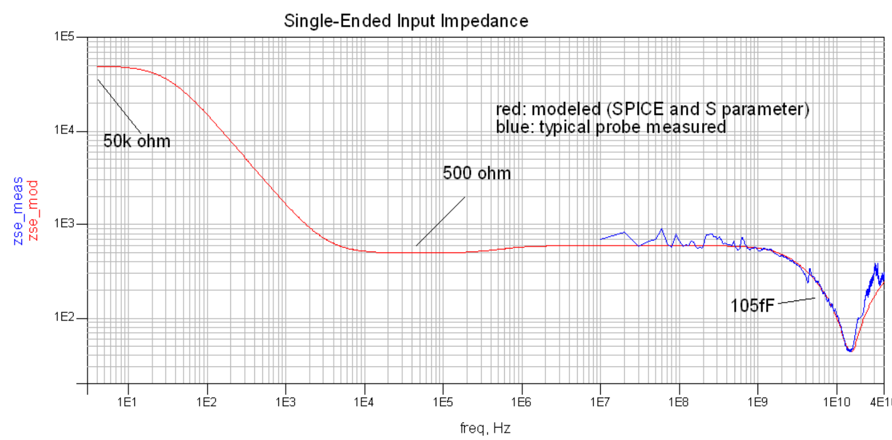
N5441A 16 GHz Solder-In Head (with N2803A)

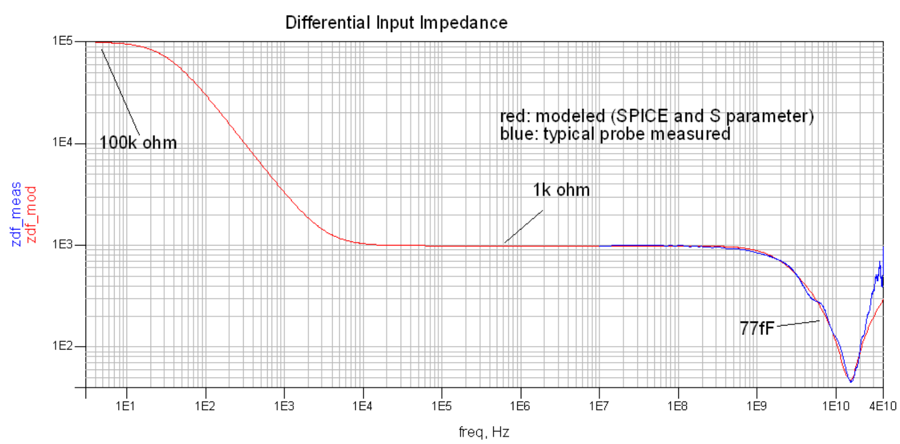


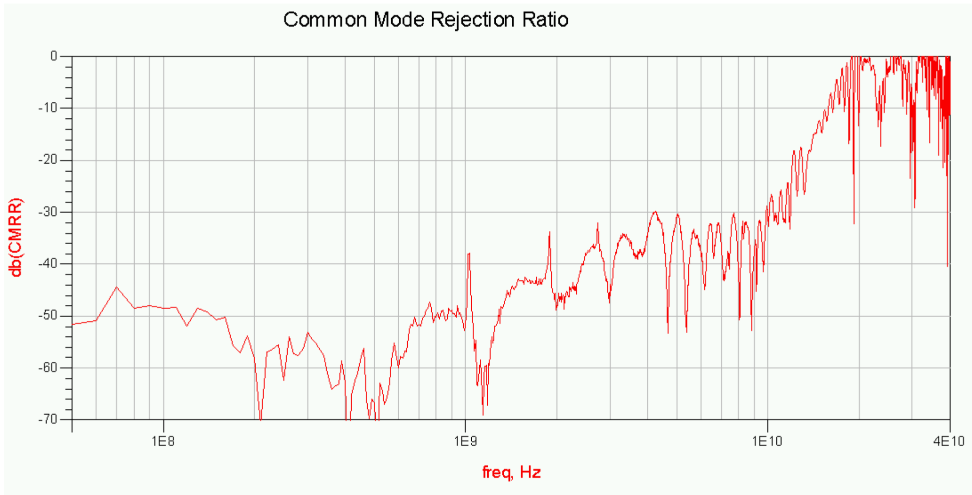




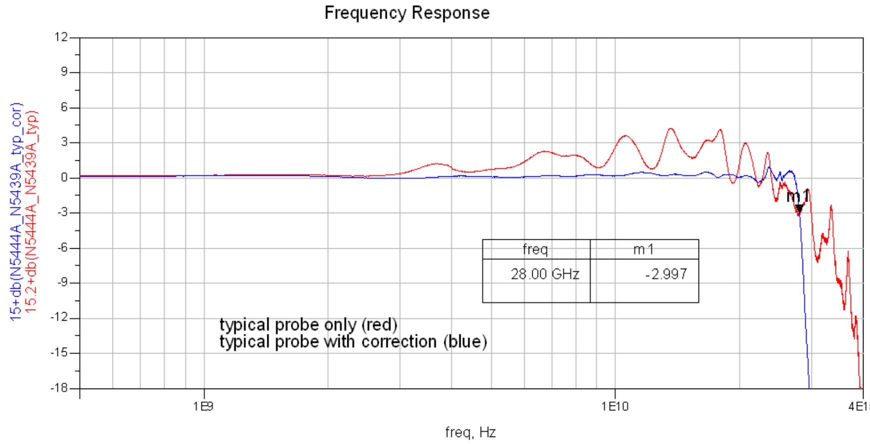

Loading Effect of Probe on tr(10-90%)=15.6pS Step
red: differential 50 ohm source (100ohm line, source and load terminated) with no load applied
blue: same source with differential probe loading applied
LoadedStep
Step
Risetime 10-90% 20-80%
red (no load) 15.6pS 10.8pS
blue (loaded) 23.0pS 13.5pS
time, psec

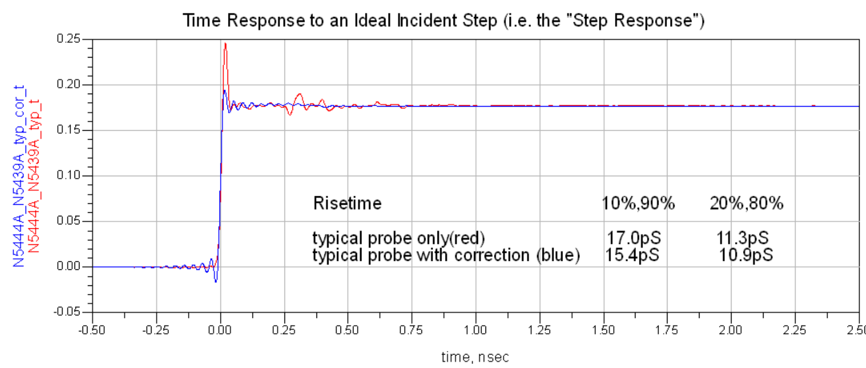

Single-Ended Input Impedance
red: modeled (SPICE and S parameter)
blue: typical probe measured
50k ohm
500 ohm
105fF
zse_meas
zse_mod
freq, Hz

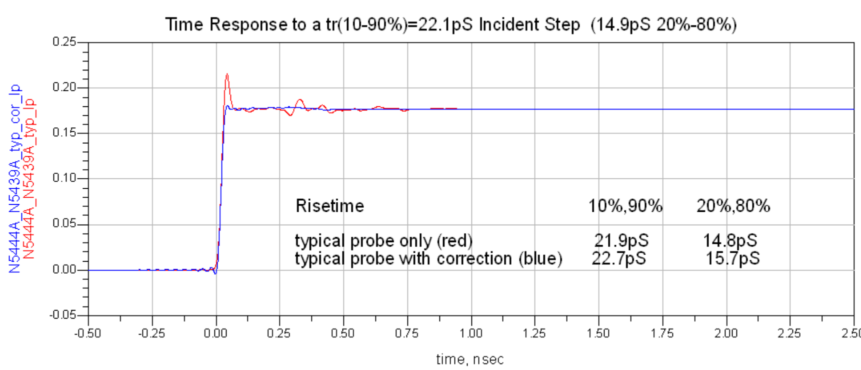

Differential Input Impedance
red: modeled (SPICE and S parameter)
blue: typical probe measured
100k ohm
1k ohm
77fF
zdf_meas
zdf_mod
freq, Hz

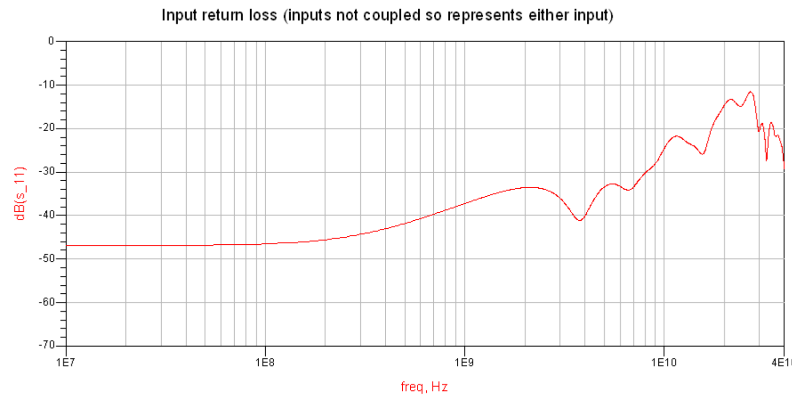

Common Mode Rejection Ratio
db(CMRR)
0
-10
-20
-30
-40
-50
-60
-70
1E8
1E9
1E10
4E10
freq, Hz

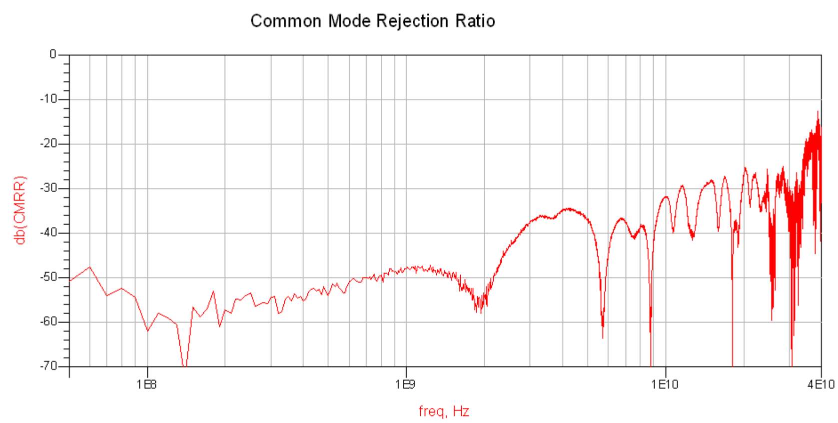
N5444A 28 GHz SMA 2.92 mm Head (with N2803A)



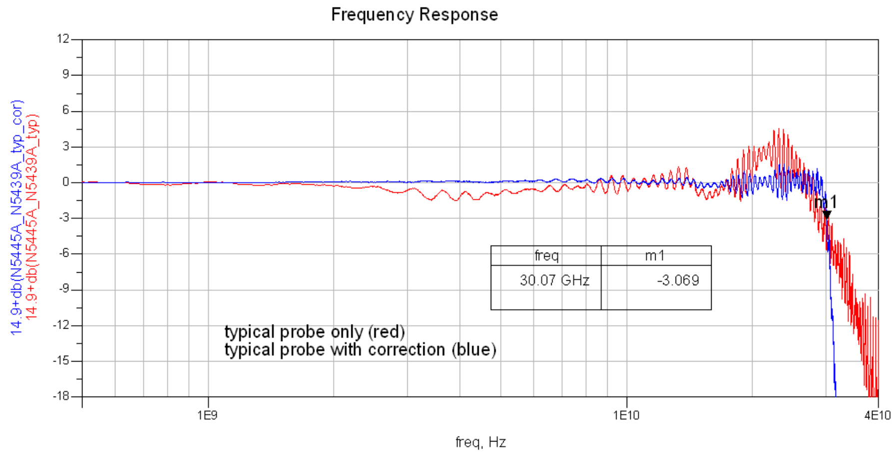


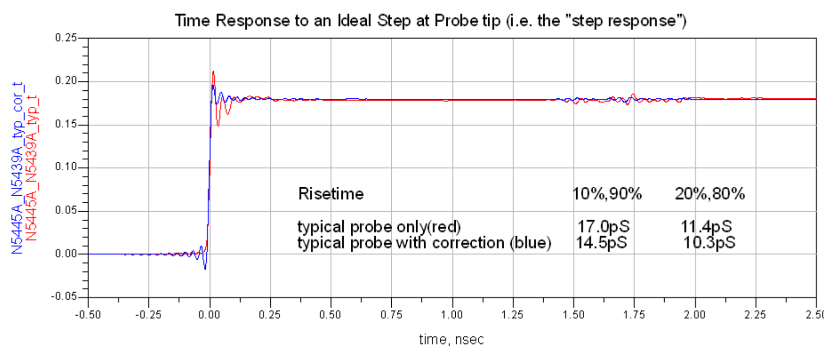


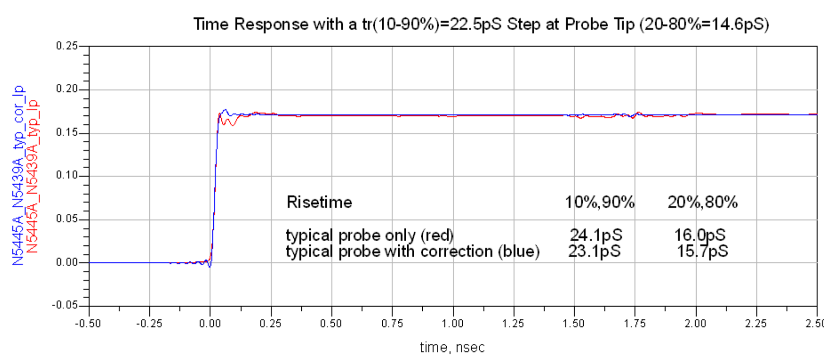

Input return loss (inputs not coupled so represents either input)
dB(s_11)
0
-10
-20
-30
-40
-50
-60
-70
1E7
1E8
1E9
1E10
4E10
freq, Hz

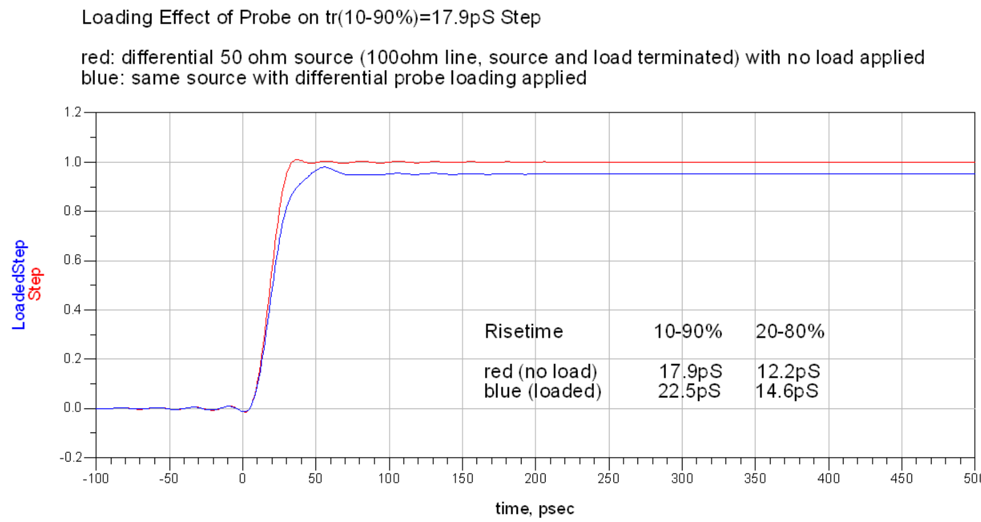

Common Mode Rejection Ratio
db(CMRR)
0
-10
-20
-30
-40
-50
-60
-70
1E8
1E9
1E10
4E10
freq, Hz

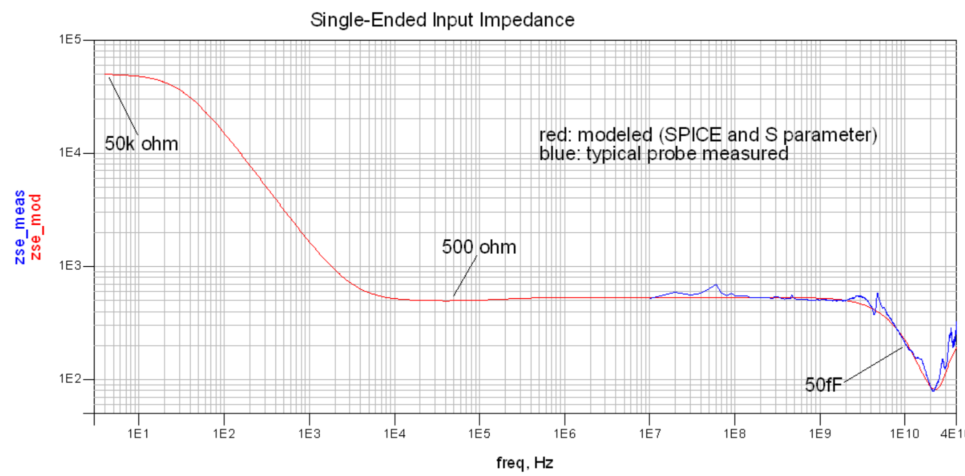
N5445A 30 GHz Browser Head, 1 mm span (with N2803A)

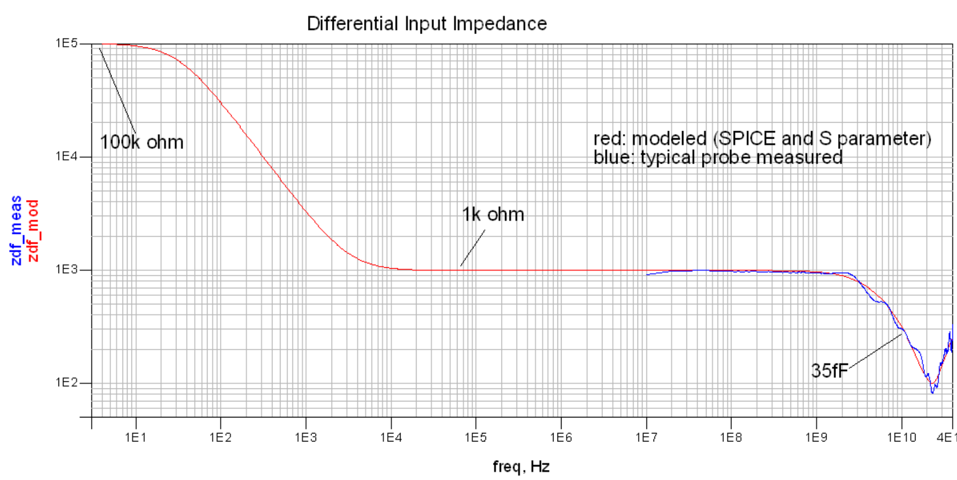




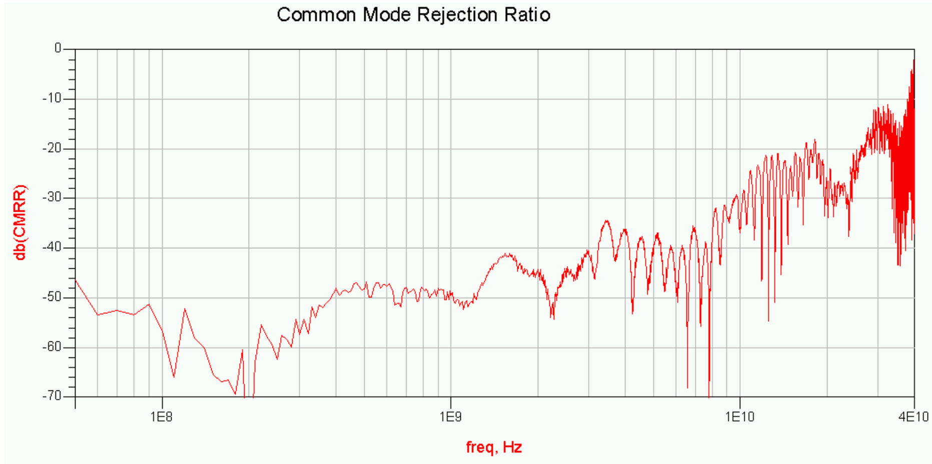



Loading Effect of Probe on tr(10-90%)=17.9pS Step
red: differential 50 ohm source (100ohm line, source and load terminated) with no load applied
blue: same source with differential probe loading applied
LoadedStep
Step
Risetime 10-90% 20-80%
red (no load) 17.9pS 12.2pS
blue (loaded) 22.5pS 14.6pS
time, psec

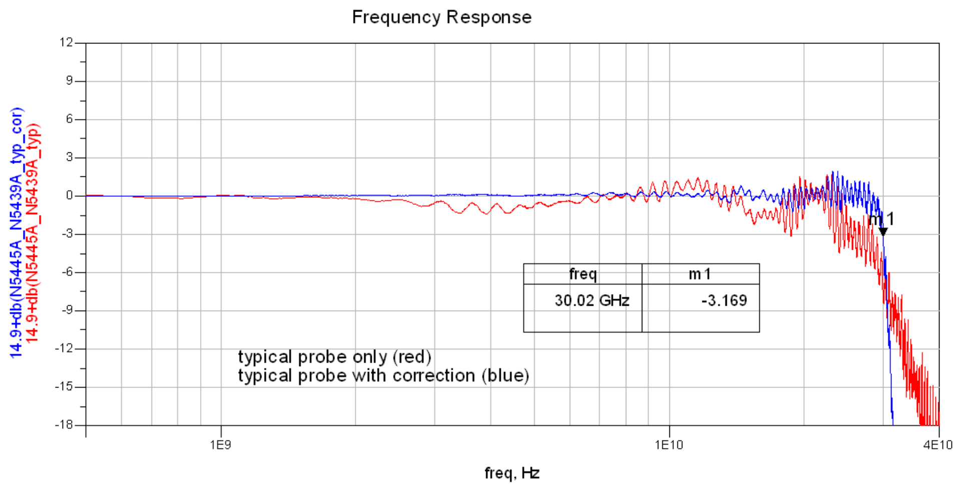

Single-Ended Input Impedance
zse_meas
zse_mod
50k ohm
red: modeled (SPICE and S parameter)
blue: typical probe measured
500 ohm
50fF
freq, Hz

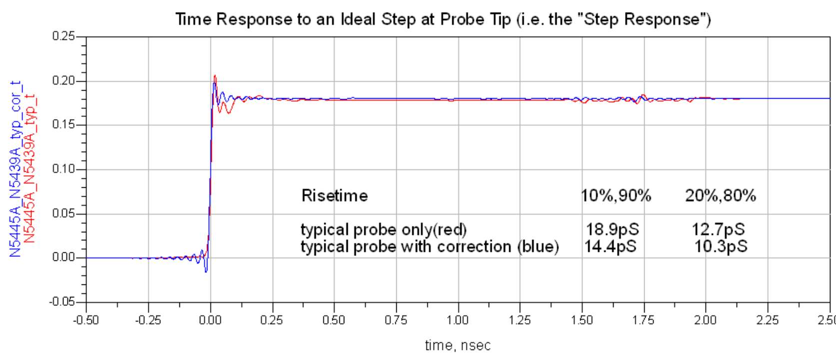

Differential Input Impedance
zdf_meas
zdf_mod
100k ohm
red: modeled (SPICE and S parameter)
blue: typical probe measured
1k ohm
35fF
freq, Hz

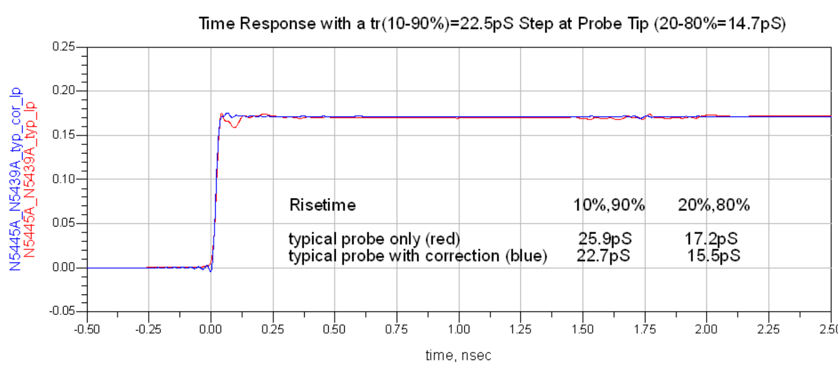
N5445A 30 GHz Browser Head, 1 mm span (with N2803A)

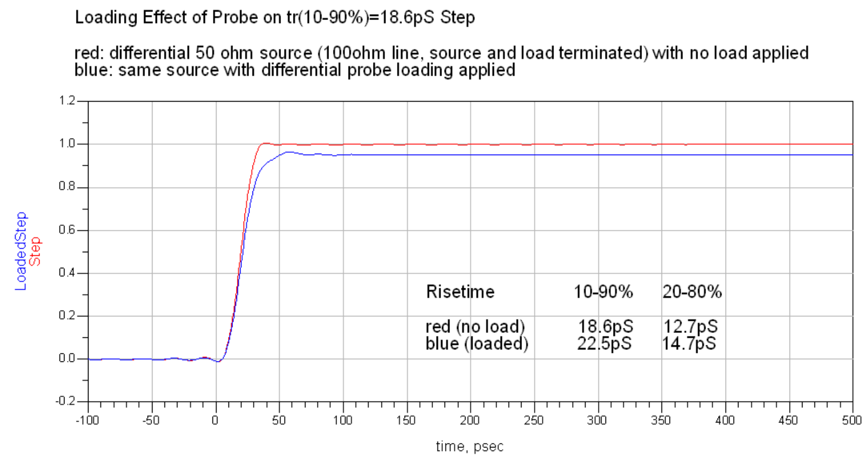


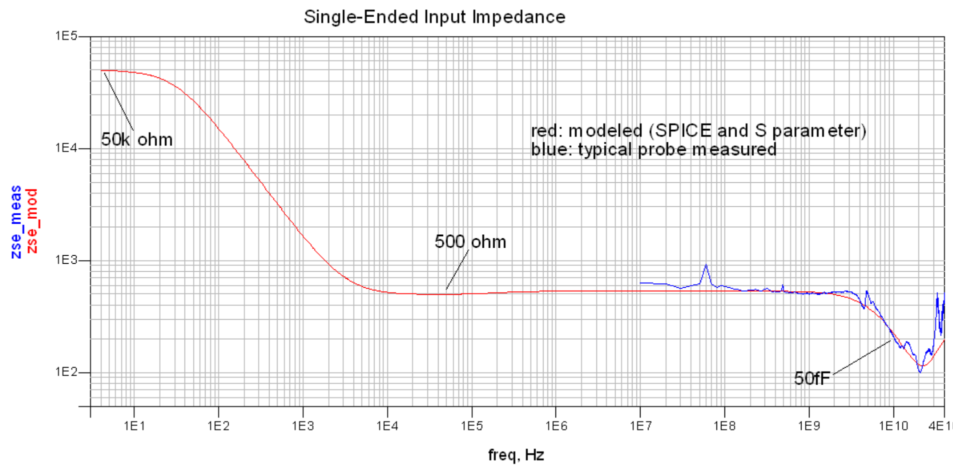
N5445A 30 GHz Browser Head, 2 mm span (with N2803A)

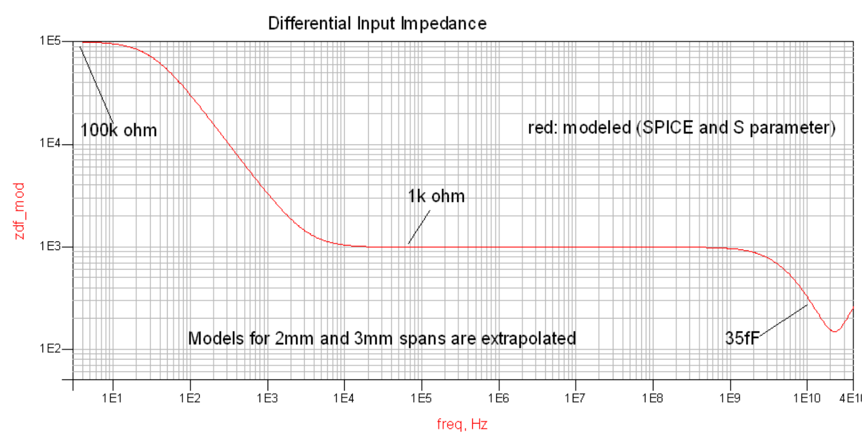






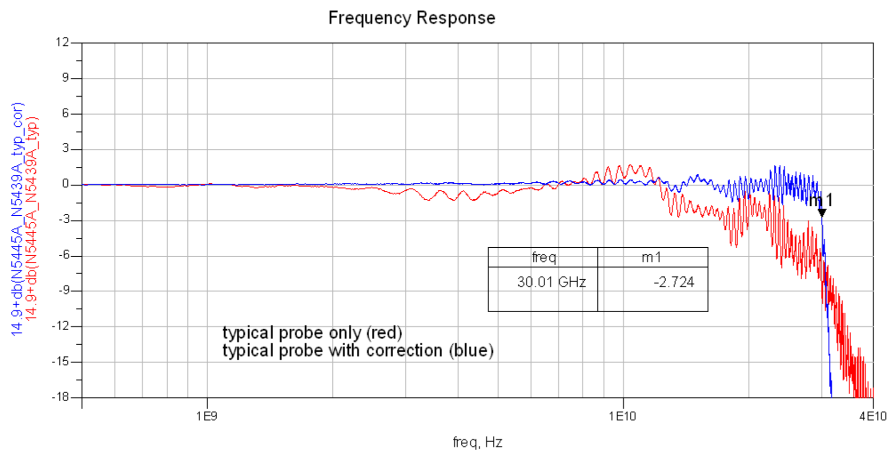


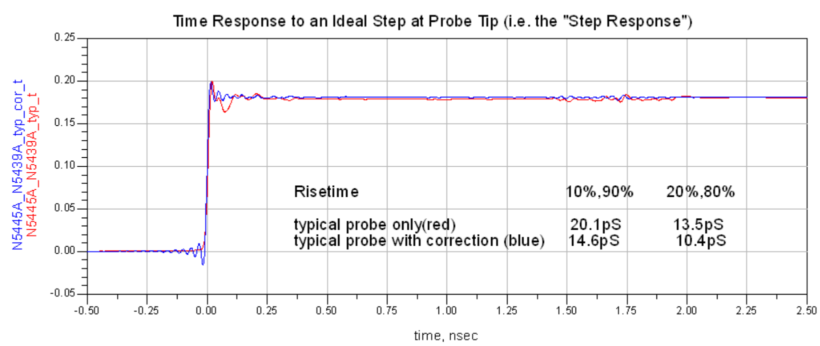


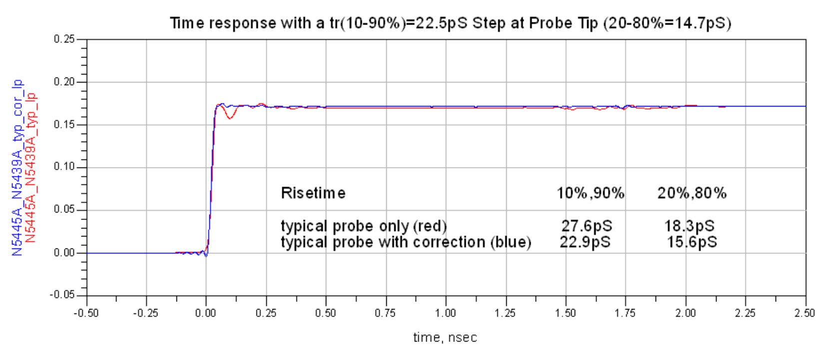


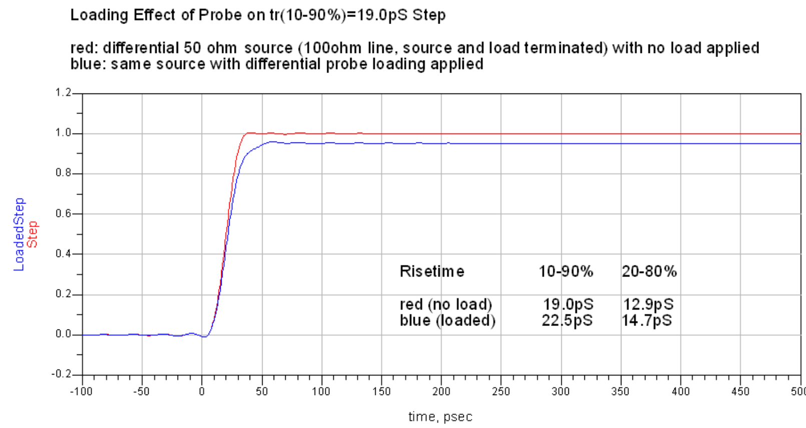
NOTE For browser spans of 2 and 3mm, the biggest effect is in the frequency and time responses. The input loading is nearly the same as for the 1mm span except that the impedance minimum at ~22 GHz is slightly higher.

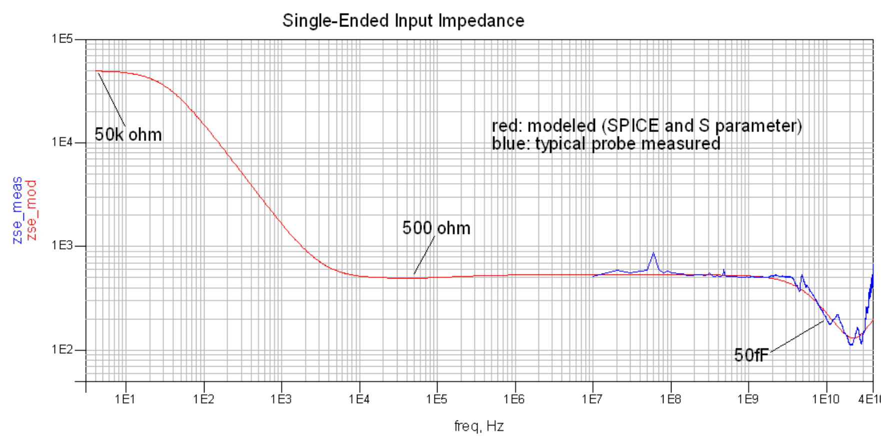
N5445A 30 GHz Browser Head, 3 mm span (with N2803A)

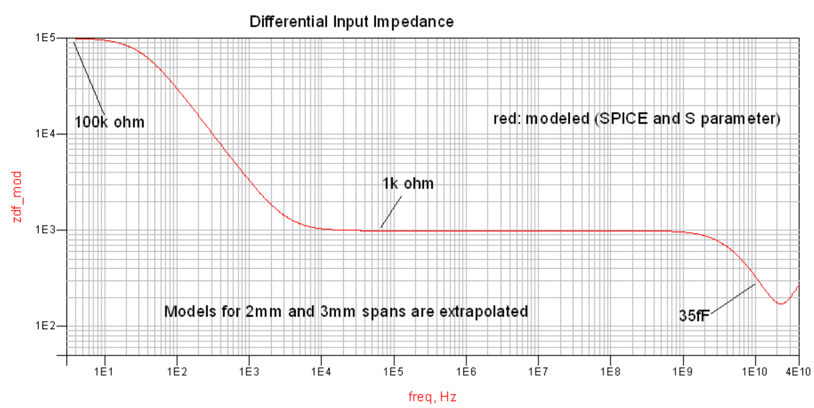












NOTE

For browser spans of 2 and 3mm, the biggest effect is in the frequency and time responses. The input loading is nearly the same as for the 1mm span except that the impedance minimum at ~22 GHz is slightly higher.

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