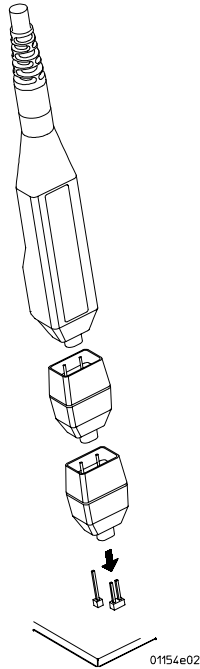




User's Guide

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For Safety, Regulatory, and publishing information, see the pages at the back of this book.

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1154A 500 MHz Differential Probe

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Inspect the Probe

☐ **Inspect the shipping container for damage.**

Keep a damaged shipping container or cushioning material until the contents of the shipment have been checked for completeness and the probe has been checked mechanically and electrically.

☐ **Check the accessories.**

Any accessories that were supplied with the probe are listed in “Accessories” on page 5.

- If the contents are incomplete or damaged, notify your Agilent Sales Office.

☐ **Inspect the instrument.**

- If there is mechanical damage or defect, or if the probe does not operate properly or pass calibration tests, notify your Agilent Sales Office.
- If the shipping container is damaged, or the cushioning materials show signs of stress, notify the carrier as well as your Agilent Sales Office. Keep the shipping materials for the carrier’s inspection. The Agilent office will arrange for repair or replacement at Agilent’s option without waiting for claim settlement.

1154A Differential Probes Introduction

The 1154A is a wide-band differential active probe. The probe features low noise, low input capacitance, high common mode rejection, and Field Effect Transistor (FET) buffered inputs in the probe head. User-selectable offset gives the probe flexibility to measure a large range of signal types. Plug-on attenuators and AC coupling accessories further extend the application range. Included interconnect accessories allow connection to surface mount and through-hole components with minimal signal degradation. The input receptacles in the probe head are compatible with standard 0.025" (0.635 mm) square pins, which provide a convenient low-cost method of creating device characterization test fixtures.

The 1154A is ideal for acquiring high speed differential signals such as those found in disk drive read channels, differential LAN, video, etc. The high impedance characteristics of both inputs allow the probe to be used as a FET probe to make single-ended measurements in digital systems without introducing a ground loop as a conventional FET probe would.

Differential Amplifiers and CMRR

The 1154A Differential Probe is a high input impedance amplifier. A characteristic of differential amplifiers is the ability to reject signals that are common to the two inputs. The common mode rejection ratio (CMRR) is the measurement of this ability. It is expressed as the ratio between the amplitudes of the common mode and differential signals that produce equal outputs. These measurements can be referred to the probe input, if the differential gain is known. The CMRR is usually expressed in dB:

$$\text{CMRR in dB} = 20\log\left(\frac{V_{\text{common mode input}} \times \text{Gain}}{V_{\text{common mode output}}}\right)$$

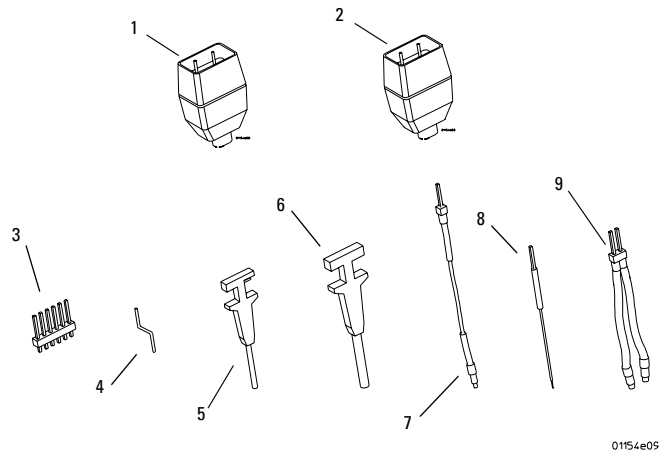
The CMRR is only specified for unity Gain, therefore the gain term can be ignored in the equation shown above.

The ability to reject common mode signals depends on the balance designed into the probe amplifier. As the frequency of the common mode signal increases, it becomes harder to balance the amplifier parasitic parameters. This leads to degradation of the CMRR.

The CMRR of the 1154A Differential probe is specified from the probe tip. This method of specifying the probe CMRR eliminates the effects of source impedance, provided the connections from the probe tip to the signal source are symmetrical.

Accessories

The following diagram and table show the accessories supplied with the 1154A Differential Probe.



Probe Accessories

Item	Description	Qty.	Part Number
1	AC coupler	1	01154-82101
2	10:1 Attenuator	1	01154-82102
3	Header	1	N/A
4	Offset Pin	4	N/A
5	0.5 Grabber	2	N/A
6	0.8 Grabber	3	N/A
7	Ground Wire	1	N/A
8	SMT Lead	4	N/A
9	Wire Lead	1	N/A

Accessories**To Order Replaceable Parts**

To order a replaceable part, in the United States and Canada call our toll-free hotline at 1-877-447-7278, or call your local Agilent Technologies Sales Office.

Replaceable Parts

Item	Description	Qty.	Agilent Part Number
1	AC coupler	1	01154-82101
2	10:1 Attenuator (includes an adjustment tool)	1	01154-82102
	Connection Kit	1	01154-60004
3	Header	1	N/A
4	Offset Pin	4	N/A
5	0.5 Grabber	2	N/A
6	0.8 Grabber	3	N/A
7	Ground Wire	1	N/A
8	SMT Lead	4	N/A
9	Wire Lead	1	N/A
	Trimmer Tool (0.635 mm square head)	1	5063-2196

Using the Accessories

The 1154A Differential Probe and accessories provide many ways to connect to circuitry under test. Any method used to connect the probe signal inputs to the circuit under test degrades the performance of the probing solution. Take the following precautions to optimize common mode rejection.

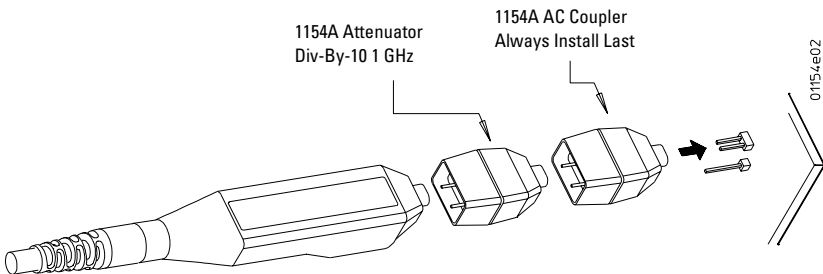
- Maintain tip connection lead length as short as possible and the same length.
- Follow the same path for wires used to connect the inputs of the probe to the circuit under test.
- Probes do not have infinite input impedance and therefore load the circuit under test. If the impedance of the test points is not identical, unequal loading will occur. This degrades the common mode rejection.
- The ground lead length is not usually critical with a differential probe.
- Carefully consider the ground potential relative to the oscilloscope ground potential. The potential difference must be within the common mode range of the probe.
- The DC potential between the AC coupling adapter and the *oscilloscope ground* must not exceed 42 Vpk.
- Do not cascade the external attenuators.
- Cascade the external AC coupling adapter in the following order: *probe*, *attenuator*, and *AC coupling adapter*.

Other Probe Accessories

The Agilent Wedge was designed to interface directly with the differential probe. These devices simplify connections to surface mount integrated circuits and have output pins compatible with the probe tip and attenuator sockets.

Attaching External Attenuators to the Probe

The external attenuators plug directly on to the probe tip. They are calibrated at the factory to provide the optimum common mode rejection and should not be swapped between probes.



The 1154A probe's best performance is achieved when the probe attenuation is set to /10 in the Infiniium's Probes Setup dialog box.

Specifications and Characteristics

Specifications

Input Configuration: Ground Connector	True Differential (+ and - inputs), with shield
Effective Gain*	X10, X1, ÷X10, ÷X100 (external attenuator)
LF Gain Accuracy X10	2% into Infinium 50 Ω load measured at 1 kHz
LF Gain Accuracy X1	2% into Infinium 50 Ω load measured at 1 kHz
LF Gain Accuracy ÷10	2% into Infinium 50 Ω load measured at 1 kHz



Input Coupling	DC/AC: Coupling obtained by installing AC Coupling Adapter
Maximum Input Voltage Either input from ground	± 42 V either input from ground
CMRR (Unity Probe Gain)	at 70 Hz: ≥ 80dB at 100 kHz: ≥ 80dB at 1 MHz: ≥ 60dB at 10 MHz: ≥ 40dB at 250 MHz: ≥ 14dB

AC coupling is obtained by installing the AC coupling adapter.

Range

Mode	÷ 1 internal probe attenuation	÷ 10 internal probe attenuation	÷ 100 internal probe attenuation
Differential with 10X Gain	± 40 mV	± 400 mV	± 4V
Differential with 1X Gain	± 400 mV	± 4 V	± 40 V
Common	± 4.2 V	± 42 V	± 42 V

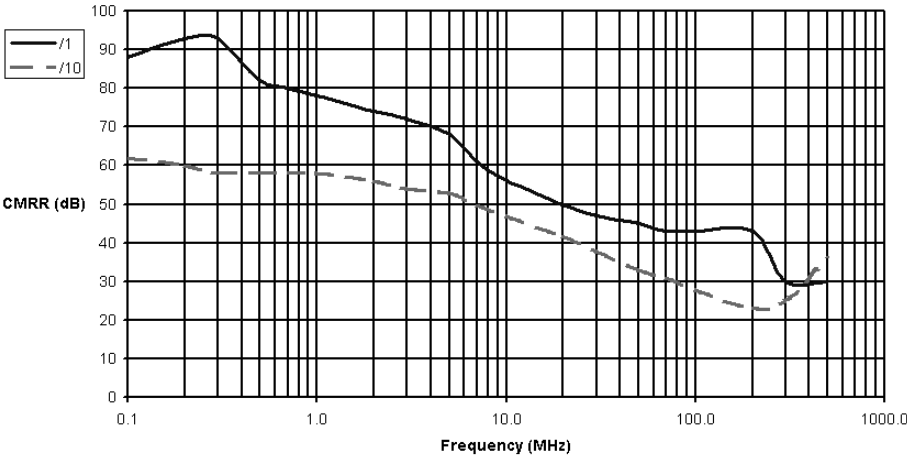
Range when using external ÷ 10 attenuator

Mode	÷ 10 internal probe attenuation
Differential with 10X Gain	± 4 V
Differential with 1X Gain	± 40 V
Common	± 40 V

Characteristics

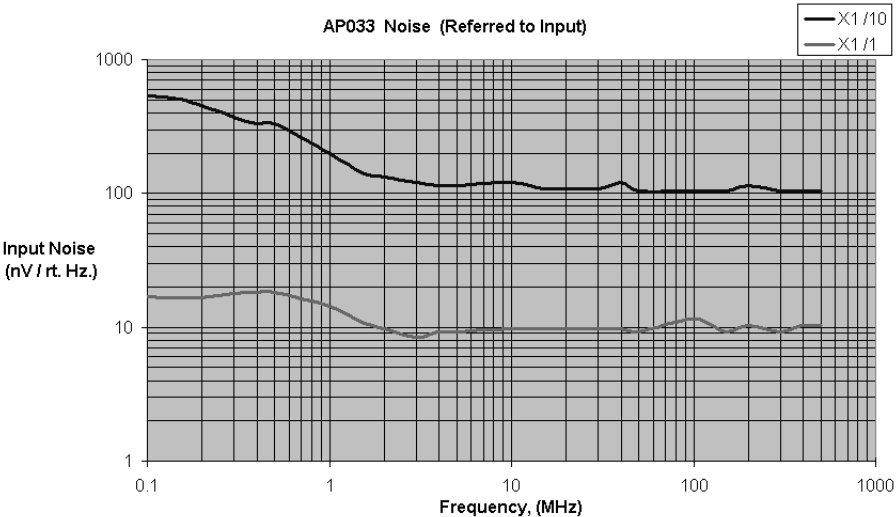
Probe Bandwidth (Probe Only) (-3 dB)	DC to 500 MHz (÷ 10 Attenuation)
Rise Time (Probe Only)	$\leq 700 \text{ pS}$ (÷ 10 Attenuation) $\leq 875 \text{ pS}$ (÷ 1 Attenuation)
Input Resistance (Each Side to Ground)	$1 \text{ M}\Omega$
Input Capacitance (Between Inputs) (No External Attenuators)	$\leq 1.6 \text{ pF}$ (÷ 10 Attenuation) $\leq 3.1 \text{ pF}$ (÷ 1 Attenuation)
Input Capacitance (Each Side to Ground) (No External Attenuators)	$\leq 3 \text{ pF}$ (÷ 10 Attenuation) $\leq 6 \text{ pF}$ (÷ 1 Attenuation)
Noise (Referred to Input, 5 - 1000 MHz)	$6 \text{ nV} / \sqrt{\text{Hz}}$ (÷ 1 Attenuation, 10X Gain) $10 \text{ nV} / \sqrt{\text{Hz}}$ (÷ 1 Attenuation, 1X Gain) $50 \text{ nV} / \sqrt{\text{Hz}}$ (÷ 10 Attenuation, 10X Gain) $115 \text{ nV} / \sqrt{\text{Hz}}$ (÷ 10 Attenuation, 1X Gain)
Output Impedance	50Ω Nominal (Intended to Drive 50Ω)

Typical CMRR



1154A 500 MHz Differential Probe
Specifications and Characteristics

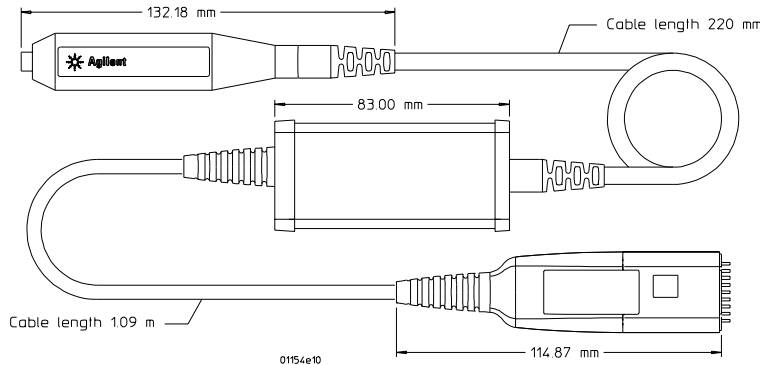
Typical Noise



Environmental Specifications

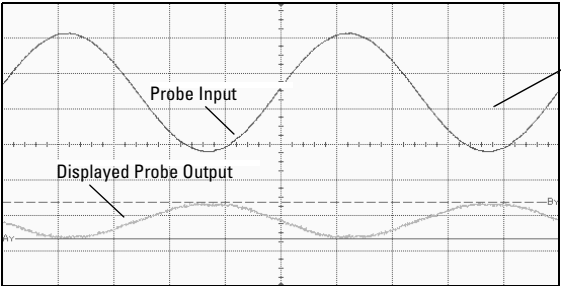
	Operating	Non-operating
Temperature	0 to 50 °C	-40 to 75 °C
Humidity	Up to 80% RH at 40 °C	Up to 80% RH at 75 °C
Altitude	Up to 4,600 meters (15,000 feet)	Up to 15,000 meters (50,000 feet)
Vibration	Random vibration 5 to 500 Hz, 10 minutes per axis, 0.3 g _{rms}	Random vibration 5 to 500 Hz, 10 minutes per axis, 2.41 g _{rms} . Resonant search 5 to 500 Hz swept sine, 1 octave/min. sweep rate, (0.75 g), 5 minutes resonant dwell at 4 resonance's per axis.
Weight	Approximately 226 g	
Dimensions	Refer to the Dimensions drawing on page 11.	

Dimensions

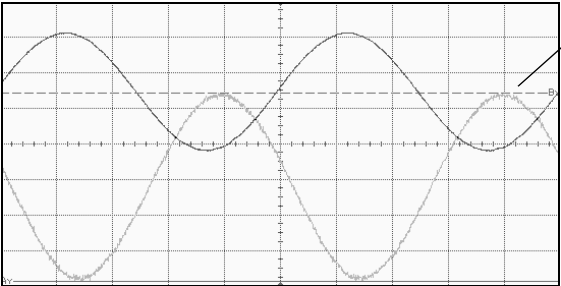


To Connect the Probe to the Circuit under Test

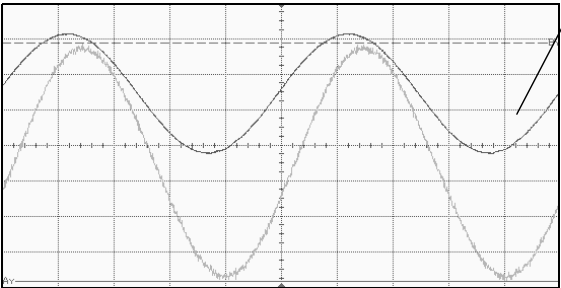
The method you use to connect the probe to the circuit under test is critical for accurate measurements. The following examples examine the effect of using different lengths of wire at 100MHz to connect the signal source to the probe tip.



Data taken at 100 MHz
Both inputs derived from a common signal at the probe tip.
CMRR = 43.5 dB



Both signals derived from a common signal via 5cm coupling lead.
CMRR = 29.8 dB



Both inputs derived from a common signal via leads of different length.
Positive input 5.3 cm.
Negative input 7.5 cm.
CMRR = 28.1 dB

The Impedance of the Source

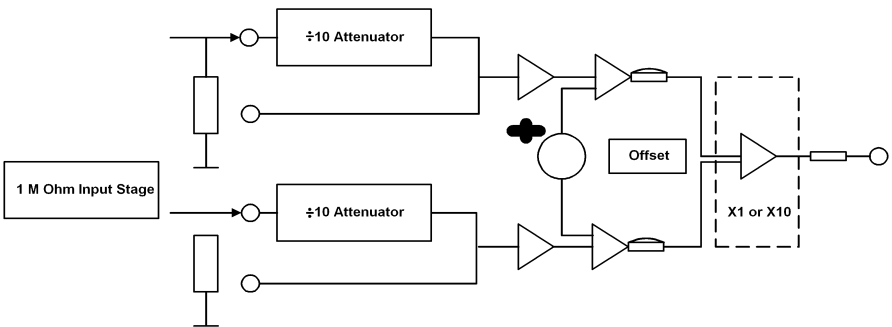
This is another instance where the symmetry of the differential circuit is important. The impedance of the source forms a network with the input impedance of the connection and the probe. This network determines the frequency response for the measurement. If each side of the differential source has a different impedance, the frequency response of each side will be different. This lack of balance is reflected in reduced CMRR. The higher the impedance of the source, the more critical these parasitic effects.

The Ground Connection

A poorly located ground connection allows ground loops to add to the common mode signal. The differential probe measures the potential difference between two locations on a PC board. Usually it is not necessary to ground the probe. Whether you ground the probe depends on the magnitude and frequency of the voltage difference between the oscilloscope ground and the board ground. It is good practice to maintain a board ground. Without this ground reference, you can easily exceed the common mode range of the probe.

Selecting the Best Mode of Operation

The 1154A probe has some unique features, allowing the probe to be optimized for many commonly encountered measurements. To apply these features, an understanding of the probe's block diagram is helpful.



Probe Attenuation or Gain Within the probe tip of the 1154A is a selectable 10:1 passive attenuator. The control unit has a selectable gain of 1 or 10. This gives the following combinations of attenuation and gain.

Internal Probe Gain	Internal Probe Attenuator	Resultant Gain or Attenuation
10	1	10
10	10	1
1	1	1
1	10	1/10

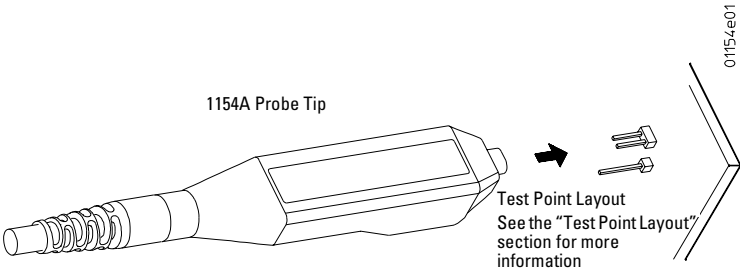
Note When the probe is switched from $\div 1$ to $\div 10$ there is a small change in probe input impedance. The external $\div 10$ attenuator has been adjusted to give optimum performance when the internal probe attenuator is set to $\div 10$. When the Tip Adapters are used, there is some loss of CMRR. To obtain the maximum dynamic range, use the $\div 10$ adapter with the internal $\div 10$ attenuator. This is a significant advantage as the $\times 10$ Gain can be used in this mode, giving a combined gain of only $\div 10$.

Recommended Probe Configurations

For best performance, use the following configurations. They are presented in the recommended order from the most desirable to the least.

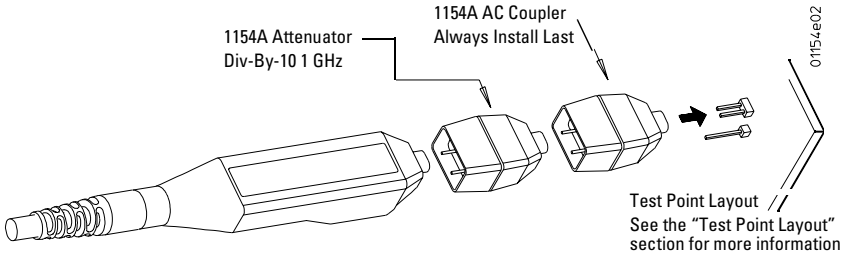
Note The use of the ground connection is optional for all configurations.

Direct Connection



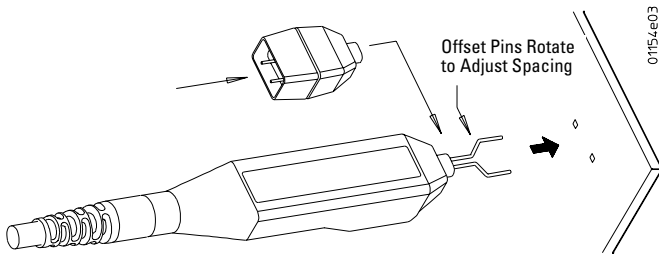
AC Adapter/Attenuator

Use the attenuator shipped with the probe and marked with the same serial number for accurate measurements. Do not use the attenuators with other probes.



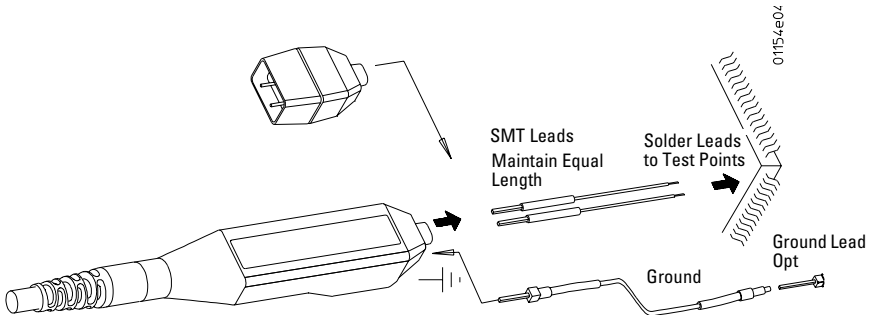
Offset Pins

You may use offset pins with any of the tip adapters.



SMT Lead

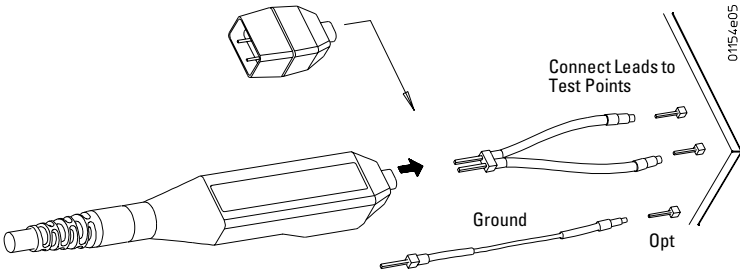
You may use SMT leads with any of the tip adapters.



1154A 500 MHz Differential Probe
Recommended Probe Configurations

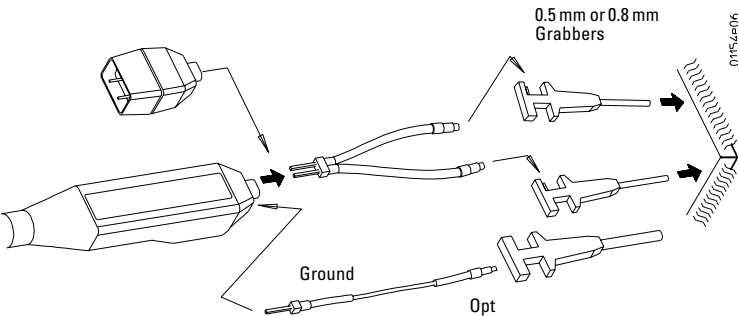
Wire Leads

You may use wire leads with any of the tip adapters.

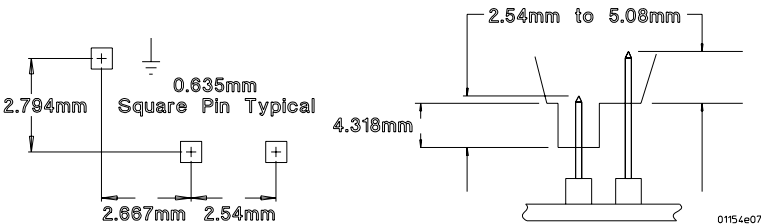


Grabbers

Using grabbers and wire leads results in significant lead length. Expect measurement quality degradation with fast signals.



Test Point Layout



Safety Considerations

Read the Safety summary in the warranty pages at the back of this guide before servicing the instrument. Before performing any procedure, review the safety information for cautions and warnings.

WARNING



Trained service personnel aware of the hazard involved (for example, fire and electric shock) should perform maintenance on the instrument. When maintenance can be performed without power applied, the power cord must be removed from the instrument.

Service Strategy

For repair and calibration, return the 1154A probe to an Agilent Service Center. If the probe is under warranty, than normal warranty services will apply. If the probe is not under warranty, repair costs will be applied.

To Return the Probe to Agilent for Service

Call (877) 447-7278 for further details and the location of your nearest Agilent Service Office.

- 1 Write the following information on a tag and attach it to the probe.**
 - Name and address of owner.
 - Probe model number.
 - Probe serial number.
 - Description of the service required or failure indications.
- 2 Return the following accessories with the probe:**
 - Attenuators
 - AC coupling adapter

Retain all other accessories.
- 3 Return the probe in its case or pack the probe in foam or other shock absorbing material and place it in a strong shipping container.**

You can use the original shipping materials or order materials from an Agilent Sales Office. If neither are available, place 3 to 4 inches of shock-absorbing material around the instrument and place it in a box that does not allow movement during shipping.
- 4 Seal the shipping container securely.**
- 5 Mark the shipping container as FRAGILE.**

In all correspondence, refer to the instrument by model number and full serial number.

Testing Procedures

These procedures are used to test the warranted specifications for the 1154A Differential Probe. The recommended calibration test interval for the 1154A is once a year. Use the equipment listed in the “Test Equipment Required” section to complete the testing procedures.

- 1 Perform the steps listed in the “Test Gain Accuracy” section on page 24.
- 2 Perform the steps listed in the “Test Offset” section on page 25.
- 3 Perform the steps listed in the “Test Differential Mode Range” section on page 25.
- 4 Perform the steps listed in the “CMRR Test” section on page 27.

Test Equipment Required

Description	Minimum Requirements	Test Equipment
Infinium Oscilloscope	1.5 GHz	54845A
Digital AC/DC Voltmeter	DC: 0.1% accuracy AC: 0.2% accuracy 200 mV @ 1 kHz 5 1/2 digit resolution	34401A
Function Generator	Sine Wave and Square Wave output waveforms 20 V _{pp} into 1 M Ω 70 Hz to 10 MHz	33120A E4400B Option UNB
Sine Wave Generator	50 MHz to 500 MHz	
BNC T		
Probe Tip BNC Adapter		5063-2143
Calibration Fixture		01154-63801
10:1 resistor divider probe (provided with the 54845A)	10 M Ω	1161A
Trimmer Tools (included when attenuators are purchased separately)	Flat blade 0.04" (1 mm) wide Square Head 0.025" (0.635 mm)	5063-2196

Setup Files for Testing

Save the setup information shown below for the various performance verification tests to the specified file names on the C drive of the 54845A or to a floppy disk in drive A.

Setup for Differential Mode Range

File Name: 1154ACAL0

Probe Connected to CH1	1154A
Probe Connected to CH4	1161A
CH1 and CH4 Sensitivity	200 mV/div
CH2 and CH3	Off
Offset and Position CH1, CH2, CH3 and CH4	0 V
Measurements: CH1 and CH4	V amplitude under Measure Voltage
Timebase	500 μ Sec/div
Timebase Delay	0 Sec
Setup Acquisition	Equivalent time: 8 averages
Trigger	CH4: level 0 V
Probe	First Test: Att 1; Gain 1 Second Test: Att 1/10; Gain $\times 10$

Testing Procedures**Setup for CMRR at 70 Hz****File Name: 1154ACAL1**

Probe Connected to CH1	1154A
Probe Connected to CH4	1161A
CH1 Sensitivity	2 mV/div
CH4 Sensitivity	5 V/div
CH2 and CH3	Off
Offset and Position CH1, CH2, CH3 and CH4	0 V
Timebase	10 mSec/div
Timebase Delay	0 Sec
Setup Acquisition	Equivalent time: 64 averages
Trigger	CH4; level 0 V
Probe	Att $\times 1$; Gain $\times 1$

Setup for CMRR at 100 kHz**File Name: 1154ACAL2**

Probe Connected to CH1	1154A
Probe Connected to CH4	1161A
CH1 Sensitivity	2 mV/div
CH4 Sensitivity	5 V/div
CH2 and CH3	Off
Offset and Position CH1, CH2, CH3 and CH4	0 V
Timebase	5 μ Sec/div
Timebase Delay	0 Sec
Setup Acquisition	Equivalent time: 64 averages
Trigger	CH4: level 0 V + ve edge
Probe	Att $\times 1$; Gain $\times 1$

Setup for CMRR at 1 MHz

File Name: 1154ACAL3

Probe Connected to CH1	1154A
Probe Connected to CH4	1161A
CH1 Sensitivity	10 mV/div
CH4 Sensitivity	5 V/div
CH2, CH3, and CH4	Off
Offset and Position CH1, CH2, CH3 and CH4	0 V
Timebase	500 nSec/div
Timebase Delay	0 Sec
Setup Acquisition	Equivalent time: 64 averages
Trigger	CH4; level 0 V
Probe	Att $\times 1$; Gain $\times 1$

Setup for CMRR at 10 MHz

File Name: 1154ACAL4a

Probe Connected to CH1	None
Probe Connected to CH4	1161A
CH1 Sensitivity (50 Ω)	200 mV/div
CH4 Sensitivity	200 mV/div
CH2, CH3, and CH4	Off
Offset and Position CH1, CH2, CH3 and CH4	0 V
Timebase	100 nSec/div
Timebase Delay	0 Sec
Setup Acquisition	Equivalent time: 64 averages
Trigger	CH4; level 0 V
Probe	Att $\times 1$; Gain $\times 1$

Testing Procedures**Setup for CMRR at 10 MHz****File Name: 1154ACAL4b**

Probe Connected to CH1	1154A
Probe Connected to CH4	1161A
CH1 Sensitivity	2 mV/div
CH4 Sensitivity	200 mV/div
CH2, CH3, and CH4	Off
Offset and Position CH1, CH2, CH3 and CH4	0 V
Timebase	100 nSec/div
Timebase Delay	0 Sec
Setup Acquisition	Equivalent time: 64 averages
Trigger	CH4; 0 V + ve trig
Probe	Att $\times 1$; Gain $\times 1$

Setup for CMRR at 250 MHz**File Name: 1154ACAL5a**

Probe Connected to CH1	None
Probe Connected to CH4	1161A
CH1 Sensitivity	200 mV/div
CH2, CH3, and CH4	Off
Offset and Position CH1, CH2, CH3 and CH4	0 V
Timebase	2 nSec/div
Timebase Delay	0 Sec
Setup Acquisition	Equivalent time: 64 averages
Trigger	CH4; 0 V + ve trig
Probe	Att $\times 1$; Gain $\times 1$

Setup for CMRR at 250 MHz

File Name: 1154ACAL5b

Probe Connected to CH1	1154A
Probe Connected to CH4	1161A
CH1 Sensitivity	50 mV/div
CH2, CH3, and CH4	Off
Offset and Position CH1, CH2, CH3 and CH4	0 V
Timebase	2 nSec/div
Timebase Delay	0 Sec
Setup Acquisition	Equivalent time: 16 averages
Trigger	CH4: 0 V + ve edge
Probe	Att \times 1; Gain \times 1

Test Gain Accuracy

This test should be performed by qualified Agilent Service Center personnel.

- 1 Connect a BNC tee connector function generator, P/N 33120A.
- 2 Connect a 50-Ω cable from the BNC tee to the channel on the Infiniium oscilloscope.
- 3 Set the termination on channel 1 to 50-Ω.
- 4 Connect the digital voltmeter (DVM) to the other side of the BNC tee.
- 5 Set the frequency on the function generator to 1 kHz and the amplitude to 200 mvrms as read on the digital voltmeter.
- 6 Set the oscilloscope trigger source to channel.
- 7 Set the horizontal scale to 200 μsec/div and the vertical scale to 100 mV/div.
- 8 Set the oscilloscope to equivalent time sampling mode and enable averaging with 16 averages.
- 9 Measure and record Vamptd _____.
Vamptd should be -566 mV which is 2.828×200 mvrms.
- 10 Disconnect the 50-Ω cable from the oscilloscope and connect it to the middle BNC source of the calibration test fixture, P/N 01154-63801.
- 11 Connect the probe under test to channel 1 on the oscilloscope and the other end of the probe to the probe input on the middle source of the calibration test fixture.
- 12 Adjust the function generator until the Vamptd reading is the same as in the step 9.
- 13 Record the VRMS reading on the digital multimeter _____.
The reading will be slightly different from the original 200 mvrms setting if the probe gain is not exactly 1:1.
- 14 Calculate the actual gain of the probe by:

$$\text{Gain} = \frac{\text{VRMS reading}}{200\text{mvrms}}$$

- 15 The percentage error of gain is:

$$\text{Gain Error (\%)} = (\text{Gain} - 1) \times 100$$

Note

A remaining source of error is the 50-Ω termination resistor in the oscilloscope. That error is minimized by using the same channel on the oscilloscope for all measurements. That same error exists in the current method of measurement since the probe is not being terminated in an exact 50-Ω. Agilent oscilloscopes have 1% 50-Ω termination resistors.

Test Offset

This test is an important step in testing the probe. This test should be done even though no data is recored in the Calibration Test Record.

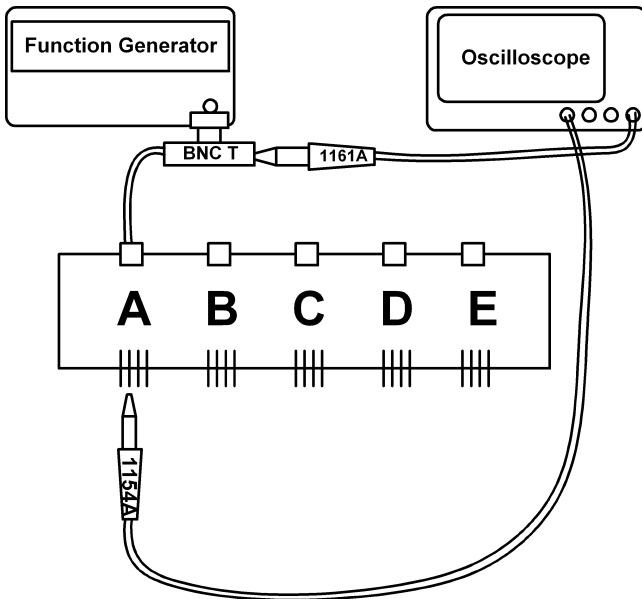
- 1 Disconnect the probe tip from the calibration fixture.
- 2 Set the probe gain to 1 using the Channel Set Up menu.
- 3 Select Auto Zero under the probe menu.
- 4 Measure the probe output with DVM DC mode.

Note

The DVM reading should be approximately 2mV or less. This is not a warranted specification.

Test Differential Mode Range

Use setup file 1154ACAL0 for this test. Setup the test equipment as shown in the following diagram.



- 1 Press Default Setup.
- 2 Connect the 1154A to CH1 of the oscilloscope.
- 3 Load 1154ACAL0.

Testing Procedures

- 4 Connect the 1161A from BNC T (connected to the function generators output) to CH4 of the oscilloscope.
- 5 Set up the test equipment as shown in the following table.

Test Equipment	Setting
Function generator	frequency: 1 kHz output amplitude: 800 mV _{pp}

- 6 Select Auto Zero under the probe menu.
Do not connect the probe tip or the function generator to the fixture when Auto Zero is performed.
- 7 Measure the amplitude on CH4.
- 8 Connect a coaxial cable from BNC T (connected to the function generator) to Calibration fixture A.
- 9 Connect the 1154A probe tip to the calibration fixture.
- 10 Record “Pass” in the “Differential Mode Range” section of the Calibration Test Record on page 35 if no clipping occurs. Record “Fail” if visible clipping occurs.
- 11 Repeat steps 6 - 10. Use the following probe settings.

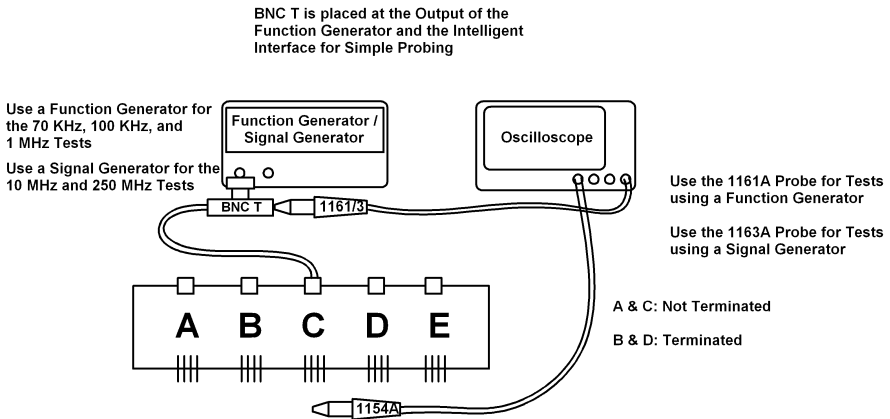
Probe Settings

Attenuator	1/10 (See probe set up menu)
Gain	× 10 (See probe set up menu)

CMRR Test

Use setup files 1154ACAL1 through 1154ACAL5b to perform the CMRR tests. Use the information in the following sections to test CMRR at 70 Hz, 100 kHz, 1 MHz, 10 MHz, and 250 MHz.

Set the test equipment as shown in the following diagram.



Test CMRR at 70 Hz Use setup file 1154ACAL1 in this test. Press **Clear Display** before starting each test. Wait for averaging to complete before taking readings. If only a short time has elapsed from the last AUTO-ZERO calibration this step may be omitted.

- 1 Set the function generator as shown in the following table.

Setting	Value
Output Level	20 V _{pp}
Frequency	70 Hz Sine Wave

- 2 Load setup file 1154ACAL1.
- 3 Connect the 1161A to the function generator output and CH4 of the oscilloscope.
- 4 Connect the 1154A probe to the CH C probe input of the calibration fixture.
- 5 Set the 1154A probe gain and attenuation to 1.
- 6 Select Auto Zero under the probe menu.

Do not connect a signal to the probe tip of the fixture during Auto Zeroing.

Testing Procedures

7 Connect the function generator to Channel C BNC of the calibration fixture.

8 Measure the amplitude of the function generator output (CH4).

Record V1: _____

9 Measure the amplitude of CH1.

The signal may be too small for an accurate reading. In this case, the reading obtained is less than that required to meet the CMRR specification.

Record V2: _____

10 Calculate CMRR.

$$\text{CMRR} = 20\log\left(\frac{\text{V2 amplitude}}{\text{V1 amplitude}}\right)$$

11 Record CMRR in the “CMRR at 70 Hz” section of the Calibration Test Record on page 35.

Note

CMRR must be 80dB or greater.

Test CMRR at 100 kHz Use setup file 1154ACAL2 in this test.

1 Set the function generator as shown in the following table.

Setting	Value
Output Level	20 V _{pp}
Frequency	100 kHz Sine Wave
Offset	0 V

2 Disconnect the function generator from the BNC calibration fixture.

3 Load setup file 1154ACAL2.

4 Perform Auto Zero under the probe menu.

Do not connect a signal to the probe tip of the calibration fixture during Auto Zeroing.

5 Connect the function generator to CHANNEL C BNC on the calibration fixture.

6 Measure the amplitude of the function generator output (CH4).

Record V1: _____

7 Measure the amplitude of CH1.

Record V2: _____

8 Calculate CMRR.

$$\text{CMRR} = 20\log\left(\frac{\text{V2 amplitude}}{\text{V1 amplitude}}\right)$$

- 9 Record CMRR in the “CMRR at 100 kHz” section of the Calibration Test Record on page 35.

Note CMRR must 80dB or greater.

Test CMRR at 1 MHz Use setup file 1154ACAL3 in this test.

- 1 Set the function generator as shown in the following table.

Setting	Value
Output Level	20 V _{pp}
Frequency	1 MHz

- 2 Disconnect the function generator from the BNC calibration fixture.
- 3 Load setup file 1154ACAL3.
- 4 Select Auto Zero under the probe menu.
Do not connect a signal to the probe tip of the calibration fixture during Auto Zeroing.
- 5 Connect the function generator to BNC C on the calibration fixture.
- 6 Measure the amplitude of the function generator output (CH 4).
Record V1:_____
- 7 Measure the amplitude of CH1.
Record V2:_____
- 8 Calculate CMRR.

$$\text{CMRR} = 20\log\left(\frac{\text{V2 amplitude}}{\text{V1 amplitude}}\right)$$

- 9 Record CMRR in the “CMRR at 1 MHz” section of the Calibration Test Record on page 35.

Note CMRR must 60 dB or greater.

Test CMRR at 10 MHz Use setup files 1154ACAL4a and 1154ACAL4b in this test.

- 1 Set the signal generator as shown in the following table.

Setting	Value
Output Level	5 dBm
Frequency	10 MHz

- 2 Disconnect the 1154A probe from the CH1 and connect it to CH2 to maintain a constant temperature.

Testing Procedures

- 3 Load setup file 1154ACAL4a.
- 4 Connect the signal generator to CH1 on the oscilloscope.
- 5 Measure the amplitude of the signal generator output.

Record V1: _____

- 6 Remove the signal generator from CH1.
- 7 Remove the 1154A probe from CH2 and connect it to CH1.
- 8 Select Auto Zero under the probe menu.

Do not connect the probe tip to the calibration fixture during Auto Zeroing.

- 9 Connect the signal generator to BNC D of the calibration fixture.
- 10 Load setup file 1154ACAL4b.
- 11 Connect the 1154A probe to BNC D on the calibration fixture.
- 12 Measure the maximum value of CH1.

Record V2: _____

- 13 Calculate CMRR.

$$\text{CMRR} = 20\log\left(\frac{\text{V2 amplitude}}{\text{V1 amplitude}}\right)$$

- 14 Record CMRR in the “CMRR at 10 MHz” section of the Calibration Test Record on page 35.

Note

CMRR must 40 dB or greater.

Test CMRR at 250 MHz Use setup files 1154ACAL5a and 1154ACAL5b in this test.

- 1 Set the signal generator as shown in the following table.

Setting	Value
Output Level	5 dBm
Frequency	250 MHz

- 2 Disconnect the 1154A probe from the CH1 and connect it to CH2 to maintain a constant temperature.
 - 3 Load setup file 1154ACAL5a.
 - 4 Connect the signal generator to CH1 on the oscilloscope.
 - 5 Measure the amplitude of the signal generator output.
- Record V1: _____
- 6 Remove the signal generator from CH1.
 - 7 Remove the 1154A probe from CH2 and connect it to CH1.
 - 8 Select Auto Zero under the probe menu.

Do not connect the probe tip to the calibration fixture during Auto Zeroing.

- 9 Connect the signal generator to BNC D of the calibration fixture.
- 10 Load setup file 1154ACAL5b.
- 11 Connect the 1154A probe to D on the calibration fixture.
- 12 Measure the maximum value of CH1.

Record V2: _____

- 13 Calculate CMRR.

$$\text{CMRR} = 20\log\left(\frac{\text{V2 amplitude}}{\text{V1 amplitude}}\right)$$

- 14 Record CMRR in the “CMRR at 250 MHz” section of the Calibration Test Record on page 35.

Note

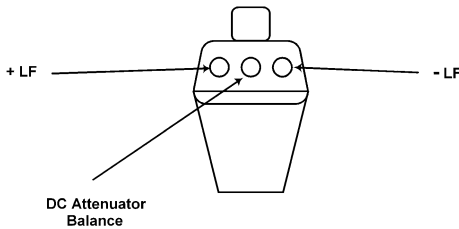
CMRR must 14 dB or greater.

Adjustment of 10:1 Attenuators

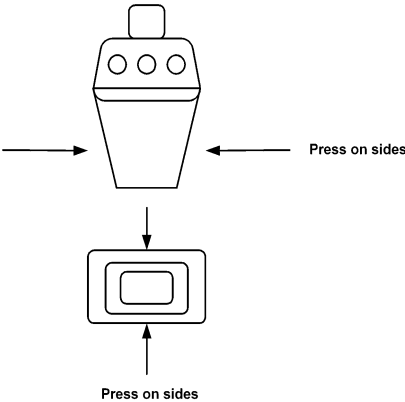
A 10:1 attenuator is supplied with the 1154A probe. This attenuator is matched to the probe and should require no further adjustment. The attenuator is labeled with the last four digits of the probe serial number. Identify matching probes and attenuators using these numbers. If you purchase new attenuators for the probe, you must adjust them to match the probe.

Optimizing CMRR for an Attenuator

For optimum CMRR when the attenuator is connected to the probe, the DC and HF attenuation should be the same for both active inputs of the probe. Three trimmers are provided in the attenuator to match the two active inputs. The adjustments are located under the serial number label. Apply a new label after calibration and mark this label with the last four digits of the probe's serial number. You should only adjust an attenuator if it is not the original attenuator shipped with the probe.



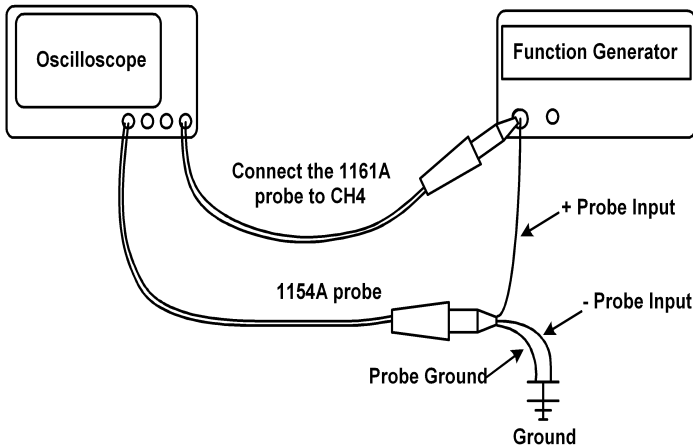
You may remove the attenuator's plastic covers. Take care not to damage the probe attenuator pins.



10:1 Attenuator Adjustment Procedure

Use the following steps to adjust the 10:1 attenuator.

- 1 **Connect the function generator, probe and oscilloscope as shown.**
Connect the + active probe input to the function generator output for these tests. Connect the - active input to ground with the probe ground socket.



- 2 **Connect the 1154A Probe to CH1 of the oscilloscope.**
- 3 **Turn on the test equipment.**
Allow 30 minutes for the probe to warm up.
- 4 **Place the 10:1 attenuator on the 1154A probe.**
Do not connect a signal to the probe at this time.
- 5 **Set the function generator as shown in the following table.**
Use a function with a flat top for this test.

Setting	Value
Square Wave Output Amplitude	1 V
Frequency	5 kHz
Offset	0 V

- 6 **Select Auto Zero on the probe menu.**
Do not connect the probe tip to the calibration fixture during Auto Zeroing.

Adjustment of 10:1 Attenuators**7 Connect the 1154A probe as shown.**

Use the clips to make these connections. The frequency being considered has a fundamental of 5kHz. Connect the + probe input to the signal source. Connect the -probe input to ground.

8 Set the oscilloscope time base to 500 nS/div.**9 Press Auto Scale to set the 54845A to trigger off Ch4.****10 Use the square head trimmer tool to adjust the +LF comp to achieve the best square corner and flat top of the displayed waveform.**

Adjust so that the signal characteristics are correct when you remove the adjustment tool.

11 Connect the + and - probe inputs to the function generator output while the probe ground is connected to the function generator ground.

You can use the calibration fixture BNC to make these connections.

12 Set the function generator to 50 Hz and the output to 10 V amplitude.

The 1161A CH 4 will show this amplitude.

13 Set the oscilloscope time base to 5 mS/div.**14 Set Ch1 sensitivity to maximum.****15 Adjust DC attenuator balance for the minimum square wave amplitude.**

The phase of the signal will change by 180° as you adjust the balance control through zero.

16 Set the function generator to 5 kHz and amplitude to 1 V_{pp}.**17 Connect the - Probe input to the function generator's output and the + input to ground (calibration fixture BNC A).**

Maintain the probe ground.

18 Press Auto Scale.**19 Use the square head trimmer tool to set the -LF compensation for a minimum of overshoot or undershoot at the leading edge of the waveform.**

The correct adjustment is achieved when the wave-form has a flat top. Adjust so that the signal characteristics are correct when you remove the adjustment tool.

20 Set the oscilloscope time base to 500 nS/div.**21 Connect the probe + input and - inputs to the function generator output.**

You may use BNC C on the calibration fixture. Connect the probe ground to the function generator ground.

22 Set the function generator as shown in the following table.

Setting	Value
Amplitude	10 V
Frequency	5 kHz

- 23 Set the oscilloscope sensitivity to maximum.
- 24 Use the square head trimmer tool to adjust the -LF compensation for minimum signal amplitude.
- It is not possible to make the trace completely flat.

Calibration Test Record

Agilent Technologies		1154A 500 MHz Differential Probe	
Recommended Test Interval: 1 Year		Serial No.: _____	
Recommended Date of Next Certification: _____		Certification Date: _____	
Certification Temperature: _____		Tested By: _____	
Test	Limit Minimum	Results	
			Limit Maximum
Accuracy at 1 kHz into 50 Ω input of 54845A	Min Gain 98%		Max Gain 102%
Differential Mode Range	No Clipping	Pass	Fail
Att 1; Gain 1		_____	_____
Att 10; Gain 10		_____	_____
CMRR at 70 Hz	80 dB		N/A
CMRR at 100 MHz	80 dB		N/A
CMRR at 1 MHz	60 dB		N/A
CMRR at 10 MHz	40 dB		N/A
CMRR at 250 MHz	14 dB		N/A

DECLARATION OF CONFORMITY

according to ISO/IEC Guide 22 and EN 45014

Manufacturer's Name: Agilent Technologies
Manufacturer's Address: Colorado Springs Division
1900 Garden of the Gods Road
Colorado Springs, CO 80907, U.S.A.

declares, that the product

Product Name: Active Differential Voltage Probe
Model Number(s): 1154A
Product Option(s): All

conforms to the following Product Specifications:

Safety: IEC 1010-1:1990+A1 / EN 61010-1:1993
UL 3111
CSA-C22.2 No. 1010.1:1993

EMC: CISPR 11:1990 / EN 55011:1991 Group 1, Class A
IEC 555-2:1982 + A1:1985 / EN 60555-2:1987
IEC 555-3:1982 + A1:1990 / EN 60555-2:1987 + A1:1991
IEC 801-2:1991 / EN 50082-1:1992 4 kV CD, 8 kV AD
IEC 801-3:1984 / EN 50082-1:1992 3 V/m, {1kHz 80% AM, 27-1000 MHz}
IEC 801-4:1988 / EN 50082-1:1992 0.5 kV Sig. Lines, 1 kV Power Lines

Supplementary Information:

The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC, and carries the CE-marking accordingly.

This product was tested in a typical configuration with Agilent test systems.

Colorado Springs, 1/12/2000



Ken Wyatt, Quality Manager

Product Regulations

Performance
Criteria

Safety	IEC 1010-1:1990+A1 / EN 61010-1:1993 UL 3111 CSA-C22.2 No. 1010.1:1993	
EMC	CISPR 11:1990 / EN 55011:1991 Group 1, Class A IEC 555-2:1982 + A1:1985 / EN60555-2:1987 IEC 555-3:1982 + A1:1990 / EN 60555-2:1987 + A1:1991 IEC 801-2:1991 / EN 50082-1:1992 4 kV CD, 8 kV AD IEC 801-3:1984 / EN 50082-1:1992 3 V/m, {1kHz 80% AM, 27-1000 MHz} IEC 801-4:1988 / EN 50082-1:1992 0.5 kV Sig. Lines, 1 kV Power Lines	 A A B B B

Additional Information

The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC (including 93/68/EEC) and carries the CE Marking accordingly (European Union).

- Performance Criteria:
- A PASS - Normal operation, no effect.
 - B PASS - Temporary degradation, self recoverable.
 - C PASS - Temporary degradation, operator intervention required.
 - D FAIL - Not recoverable, component damage.

Notes:

Sound Pressure Level N/A

Regulatory Information for Canada

ICES/NMB-001

This ISM device complies with Canadian ICES-001.
Cet appareil ISM est conforme à la norme NMB-001 du Canada.

Regulatory Information for Australia/New Zealand

This ISM device complies with Australian/New Zealand AS/NZS 2064.1



Safety Notices

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

Warnings

- Before turning on the instrument, you must connect the protective earth terminal of the instrument to the protective conductor of the (mains) power cord. The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. You must not negate the protective action by using an extension cord (power cable) without a protective conductor (grounding). Grounding one conductor of a two-conductor outlet is not sufficient protection.
- Only fuses with the required rated current, voltage, and specified type (normal blow, time delay, etc.) should be used. Do not use repaired fuses or short-circuited fuse-holders. To do so could cause a shock or fire hazard.
- If you energize this instrument by an auto transformer (for voltage reduction or mains isolation), the common terminal must be connected to the earth terminal of the power source.
- Whenever it is likely that the ground protection is impaired, you must make the instrument inoperative and secure it against any unintended operation.
- Service instructions are for trained service personnel. To avoid dangerous electric shock, do not perform any service unless qualified to do so. Do not attempt internal service or adjustment unless another person, capable of

rendering first aid and resuscitation, is present.

- Do not install substitute parts or perform any unauthorized modification to the instrument.
- Capacitors inside the instrument may retain a charge even if the instrument is disconnected from its source of supply.
- Do not operate the instrument in the presence of flammable gasses or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.
- Do not use the instrument in a manner not specified by the manufacturer.

To clean the instrument

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

Safety Symbols



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



Hazardous voltage symbol.



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

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1900 Garden of the Gods Road
Colorado Springs, CO 80907
USA

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