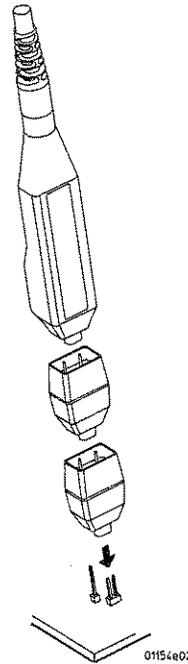


Agilent Technologies

## User's Guide

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

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# 1159A 1GHz Active Differential Probe

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## Contents

	Inspect the Probe	3
	1159A Active Differential Probes Introduction	4
	Probe Accessories Supplied	5
	Attaching External Attenuators to the Probe	7
	Specifications and Characteristics	8
	To Connect the Probe to the Circuit under Test	12
	Recommended Probe Configurations	14
	Safety Considerations	17
	Service Strategy	18
	Performance Verification	19
	Adjustment of 10:1 and 20:1 Attenuators	33
	Performance Test Record	37

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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 "Probe Accessories Supplied" 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 performance 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.

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## 1159A Active Differential Probes Introduction

The 1159A 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 1159A is ideal for acquiring high speed differential signals such as those found in disk drive read channels, differential LAN, video, and so on. The high impedance characteristics of both inputs allow you to use the probe 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 1159A 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. If the differential gain is known, these measurements can be referred to the probe input. CMRR is usually expressed in dB:

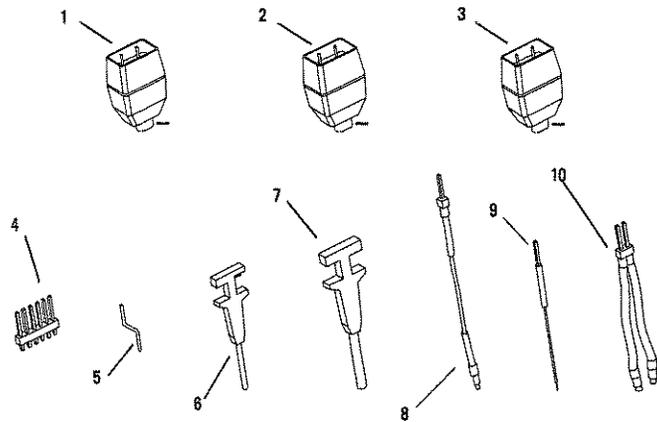
$$\text{CMRR in dB} = 20 \log \left( \frac{V_{\text{common mode input}} \times \text{Gain}}{V_{\text{common mode output}}} \right)$$

The 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 1159A Differential probe is specified from the probe tip. This method of specifying the probe CMMR eliminates the effects of source impedance, provided the connections from the probe tip to the signal source are symmetrical.

### Probe Accessories Supplied

The following diagram and table show the accessories supplied with the 1159A Differential Probe.



01154e09

### Probe Accessories

Item	Description	Qty.	Part Number
1	AC coupler	1	01154-82101
2	10:1 Attenuator	1	01159-82104
3	20:1 Attenuator	1	01159-82105
4	Header	1	N/A
5	Offset Pin	4	N/A
6	0.5 Grabber	2	N/A
7	0.8 Grabber	3	N/A
8	Ground Wire	1	N/A
9	SMT Lead	4	N/A
10	Wire Lead	1	N/A

**1159A 1GHz Active Differential Probe  
Probe Accessories Supplied**

**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.	Part Number
1	AC coupler	1	01154-82101
2	10:1 Attenuator (includes an adjustment tool)	1	01159-82104
3	20:1 Attenuator (includes an adjustment tool)	1	01159-82105
	Connection Kit	1	01154-60004
4	Header	1	N/A
5	Offset Pin	4	N/A
6	0.5 Grabber	2	N/A
7	0.8 Grabber	3	N/A
8	Ground Wire	1	N/A
9	SMT Lead	4	N/A
10	Wire Lead	1	N/A
	Trimmer Tool (0.635 mm square head)	1	5063-2196

**Using the Accessories**

The 1159A Differential Probe and accessories provide a variety of 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 do load the circuit under test. If the impedance of the test points is not identical, unequal loading will occur. This degrades 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*.

1159A 1GHz Active Differential Probe  
Attaching External Attenuators to the Probe

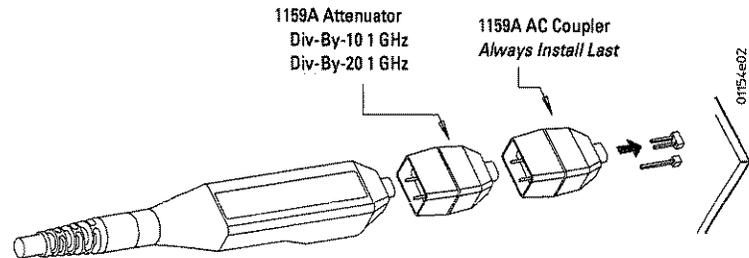
**Other Probe Accessories**

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 1159A probe's best performance is achieved when the probe attenuation is set to /10 in the Infiniium's Probes Setup dialog box.**

**1159A 1GHz Active Differential Probe  
Specifications and Characteristics**

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**Specifications and Characteristics**

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**Specifications**

	<p>Input Configuration</p> <p>Input Coupling</p> <p>Gain Accuracy at 1 kHz</p> <p>Maximum Input Voltage Either input from ground</p> <p>CMRR</p>	<p>Ground Connector True Differential (+ and – inputs), with shield</p> <p>DC AC coupling obtained by installing an AC coupling adapter</p> <p>2%</p> <p>&lt; ±42 V</p> <p>at 70 Hz: 80dB at 1 MHz: 40dB at 100 MHz: 25dB at 500 MHz: 19dB at 1 GHz: 13dB</p>
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**Range**

<b>Mode</b>	<b>No attenuator</b>	<b>+10 attenuator</b>	<b>+20 attenuator</b>
Differential	< ±400 mV	< ±4 V	< ± 8V
Common	< ±16 V	< ±42 V	< ±42 V
Offset (Common)	< ±1.6 V	< ±16 V	< ±32 V

## 1159A 1GHz Active Differential Probe Specifications and Characteristics

The following characteristics are valid for the 1159A probe after the probe has reached operating temperature, which is 20 minutes with power applied in a environment with stable ambient temperature. The probe must be operating within the environmental conditions listed in the “Environmental Specifications” section on page 11, and must have been calibrated within the past 12 months in a ambient temperature of  $23 \pm 5$  °C.

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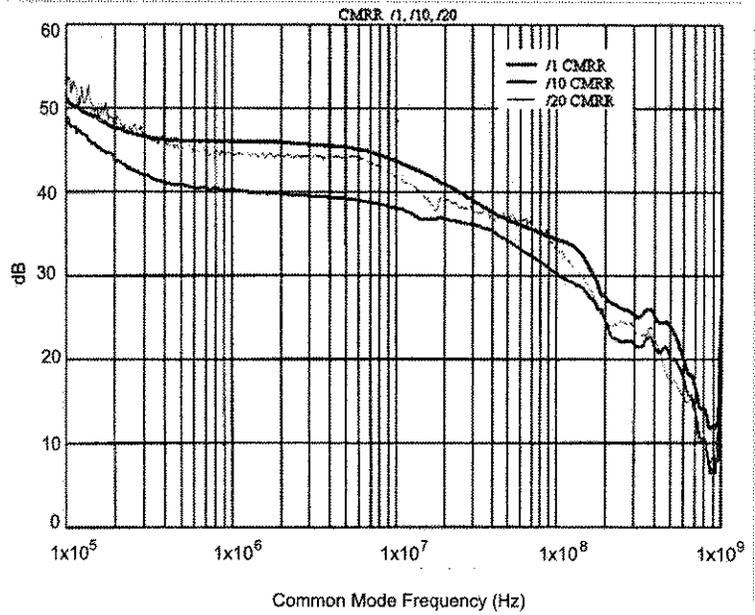
### Performance Characteristics

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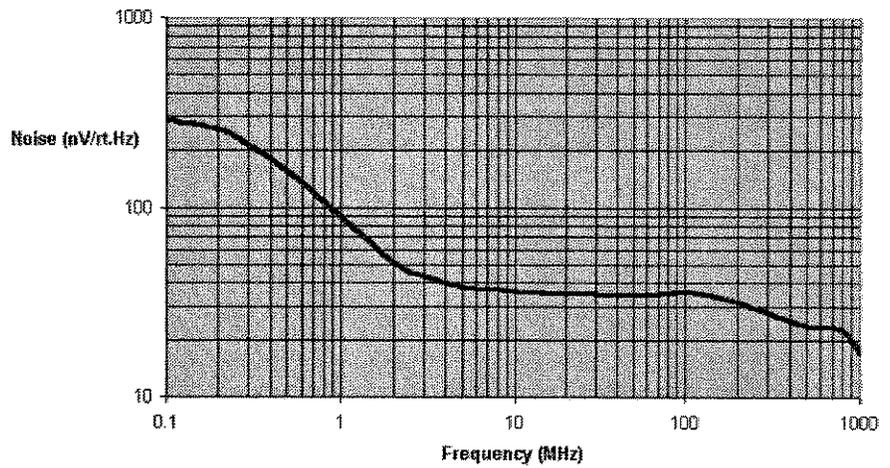
Probe Bandwidth (-3 dB)	DC to 1 GHz
Offset Range	$\pm 1.6$ V
Rise Time (Probe only) 1:1 Attenuation Internal switched attenuation only	<350 ps
Input Resistance (each side to ground)	1 M $\Omega$
Input Capacitance (between inputs) 1:1 Attenuation No external attenuators	<0.85 pF
Input Capacitance (each side to ground) 1:1 Attenuation No external attenuators	<1.5 pF

# 1159A 1GHz Active Differential Probe Specifications and Characteristics

## Typical CMRR versus Frequency (Hz)



## Typical Noise

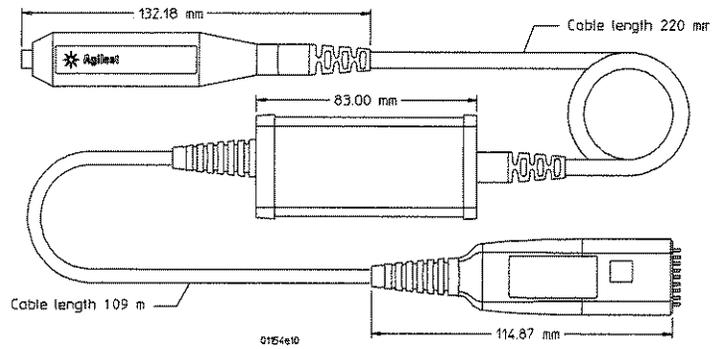


**1159A 1GHz Active Differential Probe  
Specifications and Characteristics**

**Environmental Specifications**

	<b>Operating</b>	<b>Non-operating</b>
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 <sub>rms</sub>	Random vibration 5 to 500 Hz, 10 minutes per axis, 2.41 g <sub>rms</sub> . 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 drawing shown below	

**Dimensions**



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## 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 ensuring 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.

### 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 to 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 could easily exceed the common mode range of the probe.

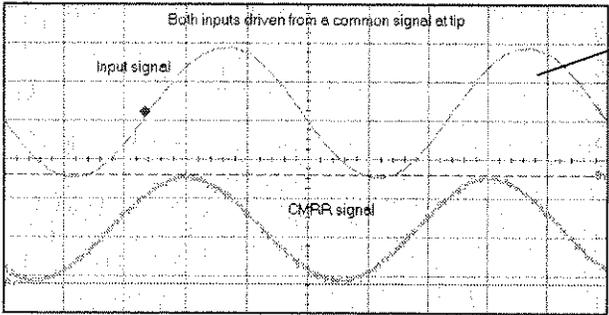
### Probe Offset

The amplifiers in the 1159A probe limit the Differential Mode Range to 400mV. If the input to the probe is approaching 400mV, there is little offset range available for positioning the trace on screen. There are two solutions to this problem:

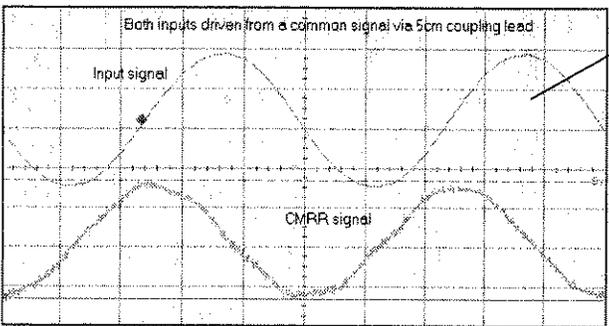
- **Attenuate the signal into the probe with the 1/10 or 1/20 attenuator. This mode of operation will induce some small loss in CMRR.**
- **Use Position to position the trace on screen.**

The added feature of position control independent of Offset allows trace positioning without calculating how much probe offset range is available. The trace can be positioned by *dragging* the trace or positioning the trace under the Probe menu.

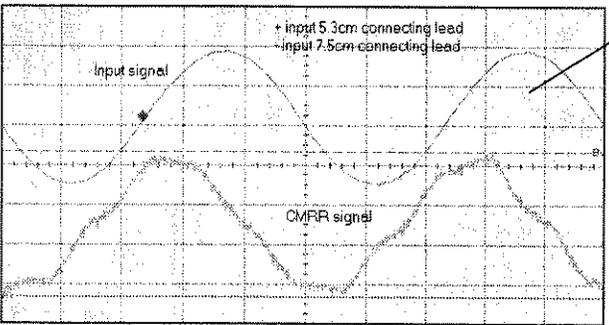
**1159A 1GHz Active Differential Probe  
To Connect the Probe to the Circuit under Test**



Both inputs derived from a common signal at probe tip.  
CMRR = 35.6dB



Both inputs derived from a common signal via 5cm coupling lead.  
CMRR = 35dB



Probe coupling leads of different length.  
Positive input 5.3cm.  
Negative input 7.5cm.  
CMRR = 33dB

1159A 1GHz Active Differential Probe  
**Recommended Probe Configurations**

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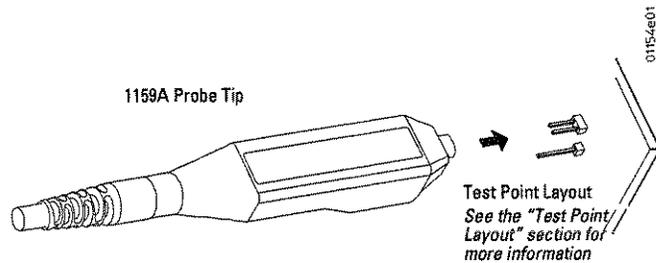
## Recommended Probe Configurations

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.

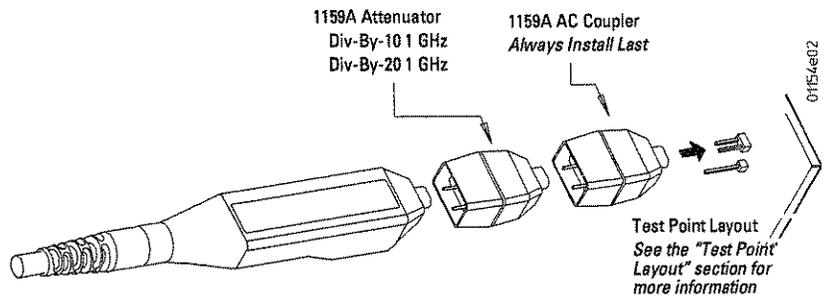
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### Direct Connection



### AC Adapter/Attenuator

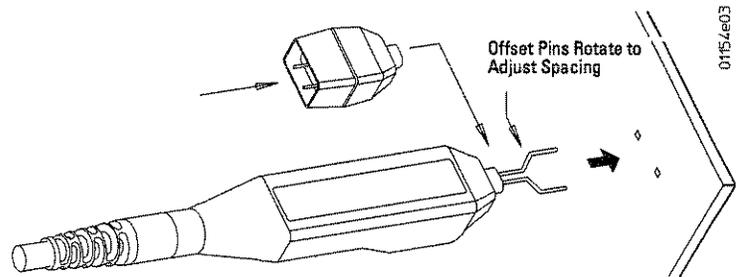
Use the attenuator shipped with the probe and marked with the same serial number for accurate measurements. Do not use the attenuators with other probes.



**1159A 1GHz Active Differential Probe  
Recommended Probe Configurations**

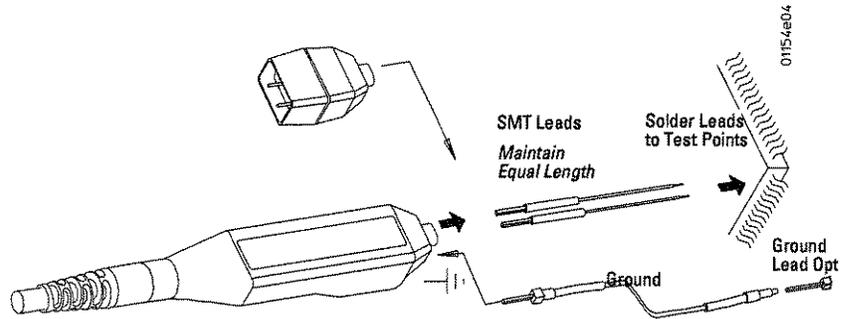
**Offset Pins**

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



**SMT Lead**

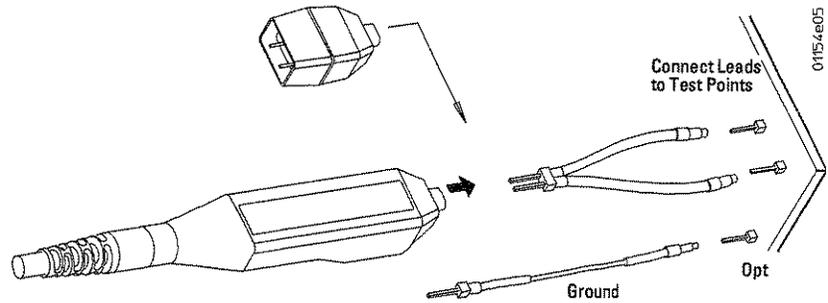
You may use SMT leads with any of the tip adapters.



## 1159A 1GHz Active Differential Probe Recommended Probe Configurations

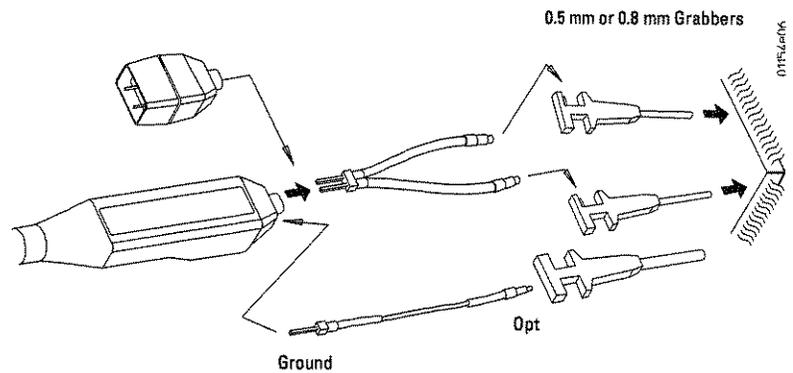
### Wire Leads

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

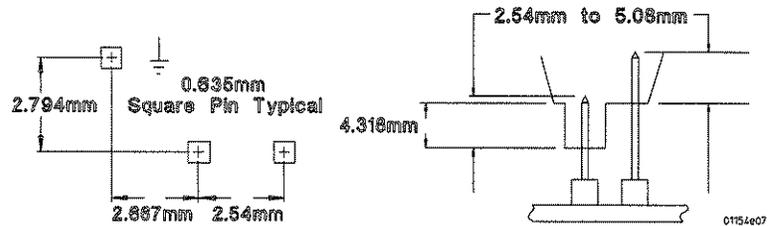


### Grabbers

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**



Only trained service personnel aware of the hazards 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.

**1159A 1GHz Active Differential Probe  
Service Strategy**

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## **Service Strategy**

To return the 1159A 1 GHz Differential Probe to optimum performance requires factory repair. Return all probes to the service group for repair and calibration. If the probe is under warranty, normal warranty services apply. If the probe is not under warranty, you can exchange a failed probe for a reconditioned one at a nominal cost.

### **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 adapterRetain 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.

## Performance Verification

Use this procedure to verify the warranted characteristics of the 1159A 1 GHz Differential Probe. The recommended performance verification interval for the 1159A is one year. Perform the complete performance verification procedure as the first step of annual certification. You can complete performance verification without removing the probe covers. There are no user adjustments available for calibration. Use the equipment shown in the “Test Equipment Required” section to complete the performance verification procedures.

- 1 Perform the steps listed in the “Preliminary Procedure” section on page 20.
- 2 Perform the steps listed in the “Test Gain Accuracy at 1 kHz” section on page 25.
- 3 Perform the steps listed in the “Test Offset” section on page 26.
- 4 Perform the steps listed in the “Test Differential Mode Range” section on page 26.
- 5 Perform the steps listed in the “CMRR Test Introduction” section on page 27.

### Test Equipment Required

Description	Minimum Requirements	Part Number
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 <sub>pp</sub> into 1 M $\Omega$ 70 Hz to 10 MHz	33120A
Sine Wave Generator	50 MHz to 1 GHz	
BNC T		E9625A
Probe Tip BNC Adapter		5063-2143
Calibration Fixture		01154-63801
Intelligent Interface		01154-63401
High Frequency 10:1 Resistor Divider Probe	500 $\Omega$	1163A
10:1 Resistor Divider Probe (provided with the 54845A)	10 M $\Omega$	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

**1159A 1GHz Active Differential Probe  
Performance Verification**

**Preliminary Procedure**

- 1** Turn on the oscilloscope, the 1159A, and the other test equipment.  
Allow 30 minutes for all test equipment to warm up.
- 2** Press Default Setup.
- 3** Perform Probe Tip Cal on the 1161A connected to CH4 of the oscilloscope (54845A).
- 4** Save the setup files listed in the "Performance Verification Setup Files" section on page 20 to the C drive of the 54845A.  
These setups can also be saved to drive A and filed for future use.

**Performance Verification Setup Files**

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. Connect the probes to the specified channels before creating and storing the setup files.

**Setup for Differential Mode Range**

**File Name: 1159CAL0**

Probe Connected to CH1	1159A
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 $\mu$ Sec/div
Timebase Delay	0 Sec
Setup Acquisition	Equivalent time: 8 averages
Trigger	CH4; level 0 V + ve edge

**Setup for CMRR at 70 Hz**

**File Name: 1159CAL1**

Probe Connected to CH1	1159A
Probe Connected to CH4	1161A
CH1 Sensitivity	2 mV/div
CH4 Sensitivity	5 V/div
Measure Amplitude	CH1 and CH4
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 + ve edge

**Setup for CMRR at 1 MHz**

**File Name: 1159CAL2**

Probe Connected to CH1	1159A
Probe Connected to CH4	1161A
CH1 Sensitivity	10 mV/div
CH4 Sensitivity	5 V/div
CH2 and CH3	Off
Offset and Position CH1, CH2, CH3 and CH4	0 V
Measure Amplitude	CH1 and CH4
Timebase	500 nSec/div
Timebase Delay	0 Sec
Setup Acquisition	Equivalent time: 64 averages
Trigger	CH4; level 0 V + ve edge

**1159A 1GHz Active Differential Probe  
Performance Verification**

**Setup for CMRR at 100 MHz**

**File Name: 1159CAL3a**

Probe Connected to CH1	None
Probe Connected to CH4	1163A
CH1 Sensitivity	200 mV/div; 50 $\Omega$
CH4 Sensitivity	200 mV/div; 50 $\Omega$
CH2, CH3, and CH4	Off
Offset and Position CH1, CH2, CH3 and CH4	0 V
Measure Amplitude	CH1
Timebase	5 nSec/div
Timebase Delay	0 Sec
Setup Acquisition	Equivalent time: 64 averages
Trigger	CH4; 0 V + ve edge

**Setup for CMRR at 100 MHz**

**File Name: 1159CAL3b**

Probe Connected to CH1	1159A
Probe Connected to CH4	1163A
CH1 Sensitivity	5 mV/div
CH4 Sensitivity	200 mV
CH2, CH3, and CH4	Off
Offset and Position CH1, CH2, CH3 and CH4	0 V
Measure Amplitude	CH1
Timebase	5 nSec/div
Timebase Delay	0 Sec
Setup Acquisition	Equivalent time: 64 averages
Trigger	CH4; 0 V+ ve edge

**Setup for CMRR at 500 MHz**

**File Name: 1159CAL4a**

Probe Connected to CH4	1163A
CH1 Sensitivity	200 mV/div; 50 $\Omega$
CH4 Sensitivity	200 mV/div; 50 $\Omega$
Offset and Position CH1, CH2, CH3 and CH4	0 V
Measure Amplitude	CH1
Timebase	1 nSec/div
Timebase Delay	0 Sec
Setup Acquisition	Equivalent time: 64 averages
Trigger	CH4; 0 V

**Setup for CMRR at 500 MHz**

**File Name: 1159CAL4b**

Probe Connected to CH1	1159A
Probe Connected to CH4	1163A
CH1 Sensitivity	20 mV/div
CH4 Sensitivity	200 mV/div; 50 $\Omega$
Offset and Position CH1, CH2, CH3 and CH4	0 V offset
Measure Amplitude	CH1
Timebase	1 nSec/div
Timebase Delay	0 Sec
Setup Acquisition	Equivalent time: 16 averages
Trigger	CH4; 0 V

**1159A 1GHz Active Differential Probe  
Performance Verification**

**Setup for CMRR at 1 GHz**

**File Name: 1159CAL5a**

Probe Connected to CH1	None
Probe Connected to CH4	1163A
CH1 Sensitivity	200 mV/div; 50 $\Omega$
CH4 Sensitivity	200 mV/div; 50 $\Omega$
CH2, CH3, and CH4	Off
Offset and Position CH1, CH2, CH3 and CH4	0 V
Measure Amplitude	CH1
Timebase	500 pSec/div
Timebase Delay	0 Sec
Setup Acquisition	Equivalent time: 16 averages
Trigger	CH4; 0 V

**Setup for CMRR at 1 GHz**

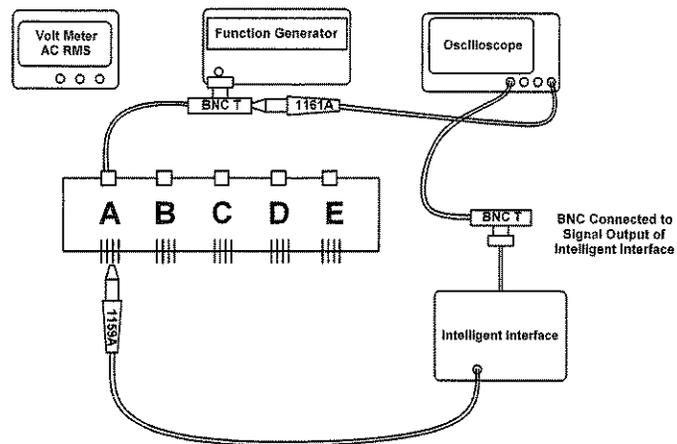
**File Name: 1159CAL5b**

Probe Connected to CH1	1159A
Probe Connected to CH4	1163A
CH1 Sensitivity	50 mV/div
CH4 Sensitivity	200 mV/div; 50 $\Omega$
CH2, CH3, and CH4	Off
Offset and Position CH1, CH2, CH3 and CH4	0 V
Measure Amplitude	CH1
Timebase	500 pSec/div
Timebase Delay	0 Sec
Setup Acquisition	Equivalent time: 16 averages
Trigger	CH4; 0 V

**Test Gain Accuracy at 1 kHz**

Setup the test equipment as shown in the following diagram.

BNC T is placed at the output of the Function Generator and the Intelligent Interface for simple probing



- 1 Select Auto Zero on the probe menu.  
The probe tip *must not* be connected to a signal source when Auto Zero is performed.
- 2 Set the function generator as shown in the following table.  
RMS (Sine wave) as measured with DVM.

Setting	Value
Frequency	1 kHz
Output Amplitude	200 mV <sub>rms</sub> Sine Wave

- 3 Connect the 1159A via Intelligent Interface to the oscilloscope.
- 4 Connect the function generator to BNC A of the calibration fixture.
- 5 Connect the probe tip to the probe input A of the calibration fixture.
- 6 Set and measure with DVM (RMS mode) output of the function generator at the calibration fixture.  
Record V1: \_\_\_\_\_.
- 7 Measure the probe output with the same DVM at Intelligent Interface.  
Record V2: \_\_\_\_\_.
- 8 Calculate the % gain error.  
(% Gain Error = 100(V2 - V1)/V1). Record % Gain Error: \_\_\_\_\_.

**1159A 1GHz Active Differential Probe  
Performance Verification**

- 9 Record the % Gain Error in the Performance Test Record on page 37.

**Note** Probe voltages at the calibration fixture and the output of the Intelligent Interface.

**Test Offset**

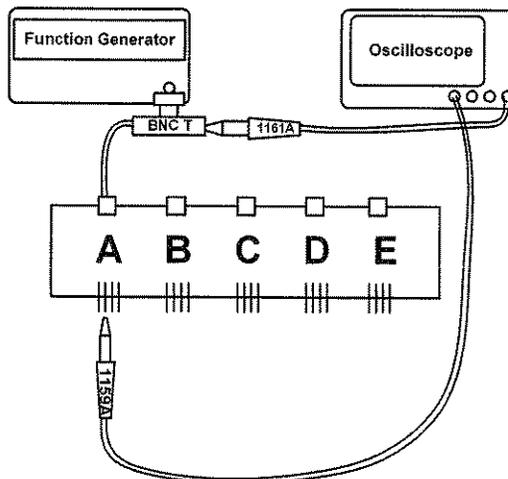
This is an important step in the performance verification process. It should be performed, even though no data is recorded in the Performance Test Record.

- 1 Disconnect the probe tip from the calibration fixture.
- 2 Select Auto Zero under the probe menu.
- 3 Measure the probe output (at BNC T of the Intelligent Interface) 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 1159CAL0 for this test. Set up the test equipment as shown in the following diagram.



- 1 Disconnect the intelligent interface.
- 2 Connect the 1159A to CH1 of the oscilloscope.
- 3 Load 1159CAL0.

- 4 Connect the 1161A to the output of the function generator and CH4 of the oscilloscope.
- 5 Setup the test equipment as shown in the following table. Connect the 1161A probe to CH4 of the oscilloscope. Measure the amplitude on CH4.

Test Equipment	Setting
1161A	Offset: 0
Function Generator	Frequency: 1 kHz Output Amplitude: 800 mV <sub>pp</sub>

- 6 Select Auto Zero under the probe menu.  
Do not connect the probe tip to the fixture when Auto Zero is performed.
- 7 Connect a coaxial cable from the function generator to BNC A on the calibration fixture.
- 8 Connect the 1159A probe to the output of the calibration fixture CH A.
- 9 Record "Pass" in the "Differential Mode Range" section of the Performance Test Record on page 37 if no clipping occurs. Record "Fail" if visible clipping occurs.

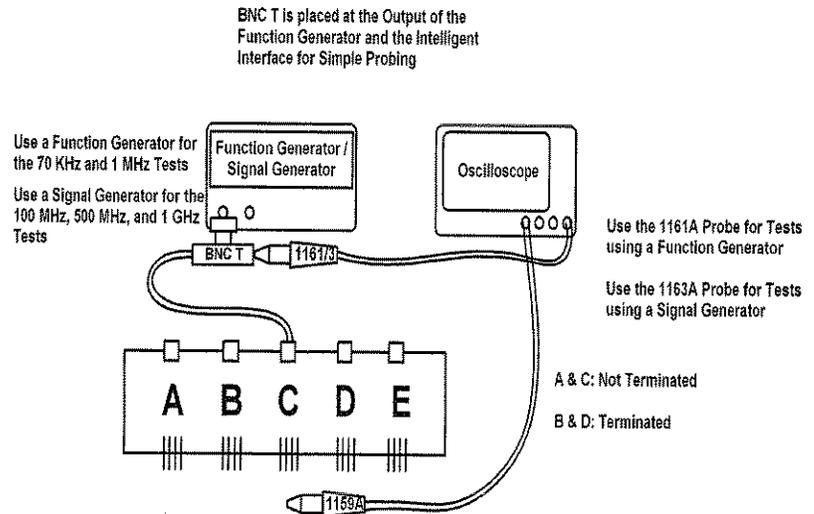
#### CMRR Test Introduction

You will use setup files 1159CAL1 through 1159CAL5b to perform the CMRR tests.

- 1 Set the output of the function generator to 20 V<sub>pp</sub>.
- 2 Connect the 1161A probe to the output of the function generator using BNC T.

## 1159A 1GHz Active Differential Probe Performance Verification

The instrument setup is shown in the following diagram.



- 3 Follow the steps in the “Test CMRR at 70 Hz” section on page 28.
- 4 Follow the steps in the “Test CMRR at 1 MHz” section on page 29.
- 5 Follow the steps in the “Test CMRR at 100 MHz” section on page 30.
- 6 Follow the steps in the “Test CMRR at 500 MHz” section on page 31.
- 7 Follow the steps in the “Test CMRR at 1 GHz” section on page 31.

**Test CMRR at 70 Hz** Use setup file 1159CAL1 in this test. 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 <sub>pp</sub>
Frequency	70 Hz

- 2 Connect the 1161A to the function generator output and CH4 of the oscilloscope.
- 3 Connect the 1159A probe to the CH C probe input of the calibration fixture.
- 4 Load setup file 1159CAL1.
- 5 Select Auto Zero under the probe menu.  
Do not connect the probe tip to the fixture during Auto Zeroing.

- 6 Connect the function generator to Channel C BNC of the calibration fixture.
- 7 Measure the amplitude of the function generator output (CH4).  
Record V1: \_\_\_\_\_
- 8 Measure the maximum value of CH1.  
Record V2: \_\_\_\_\_
- 9 Calculate CMRR.

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

- 10 Record CMRR in the "CMRR at 70 Hz" section of the Performance Test Record on page 37.

---

**Note** CMRR must 80dB or greater.

---

**Test CMRR at 1 MHz** Use setup file 1159CAL2 in this test.

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

Setting	Value
Output Level	20 V <sub>pp</sub>
Frequency	1 MHz

- 2 Disconnect the function generator from the BNC calibration fixture.
- 3 Load setup file 1159CAL2.
- 4 Perform Auto Zero under the probe menu.  
Do not connect the probe tip to 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 maximum value of CH1.  
Record V2: \_\_\_\_\_
- 8 Calculate CMRR.

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

**1159A 1GHz Active Differential Probe  
Performance Verification**

- 9** Record CMRR in the “CMRR at 1 MHz” section of the Performance Test Record on page 37.

---

**Note** CMRR must 40dB or greater.

---

**Test CMRR at 100 MHz** Use setup files 1159CAL3a and 1159CAL3b in this test.

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

Setting	Value
Output Level	5 dBm
Frequency	100 MHz

- 2** Disconnect the 1159A probe from CH1 and connect it to CH2 to maintain a constant temperature.
- 3** Load setup file 1159CAL3a.
- 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 1159A 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 1159CAL3b.
- 11** Connect the 1159A probe to D on the calibration fixture.
- 12** Measure the maximum value of CH1.  
Record V2: \_\_\_\_\_
- 13** Calculate CMRR.

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

- 14** Record CMRR in the “CMRR at 100 MHz” section of the Performance Test Record on page 37.

---

**Note** CMRR must 25dB or greater.

---

**Test CMRR at 500 MHz** Use setup files 1159CAL4a and 1159CAL4b in this test.

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

Setting	Value
Output Level	5 dBm
Frequency	500 MHz

- 2 Disconnect the 1159A probe from the CH1 and connect it to CH2 to maintain a constant temperature.
- 3 Load setup file 1159CAL4a.
- 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 1159A 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 C of the calibration fixture.
- 10 Load setup file 1159CAL4b.
- 11 Connect the 1159A probe to D of the calibration fixture.
- 12 Measure the maximum value of CH1.  
Record V2: \_\_\_\_\_
- 13 Calculate CMRR.

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

- 14 Record CMRR in the "CMRR at 500 MHz" section of the Performance Test Record on page 37.

---

**Note** CMRR must 19dB or greater.

---

**Test CMRR at 1 GHz** Use setup files 1159CAL5a and 1159CAL5b in this test.

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

Setting	Value
Output Level	5 dBm
Frequency	1 GHz

- 2 Disconnect the 1159A probe from the CH1 and connect it to CH2 to maintain a constant temperature.

1159A 1GHz Active Differential Probe  
**Performance Verification**

- 3 Load setup file 1159CAL5a.
- 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 1159A 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 C of the calibration fixture.
- 10 Load setup file 1159CAL5b.
- 11 Measure the maximum value of CH1.  
Record V2: \_\_\_\_\_
- 12 Calculate CMRR.  
$$\text{CMRR in dB} = 20\log\left(\frac{\text{V2 amplitude}}{\text{V1 amplitude}}\right)$$
- 13 Record CMRR in the "CMRR at 1 GHz" section of the Performance Test Record on page 37.

---

**Note** CMRR must 13dB or greater.

---

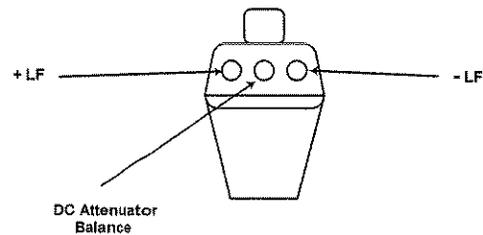
---

## Adjustment of 10:1 and 20:1 Attenuators

10:1 and 20:1 attenuators are supplied with the 1159A probe. This attenuator is matched to the probe and should require no further adjustment. Each attenuator is labeled with a serial number that matches the last four digits of the probe serial number. Identify matching probes and attenuators using this number. If you purchase new attenuators for the probe, you must adjust them to match the probe.

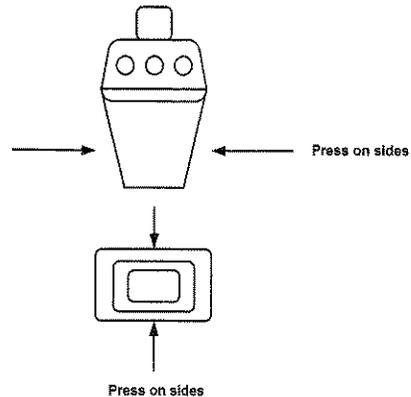
### Optimizing CMRR for an Attenuator

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. Only adjust an attenuator if it is not the original attenuator shipped with the probe.



## 1159A 1GHz Active Differential Probe Adjustment of 10:1 and 20:1 Attenuators

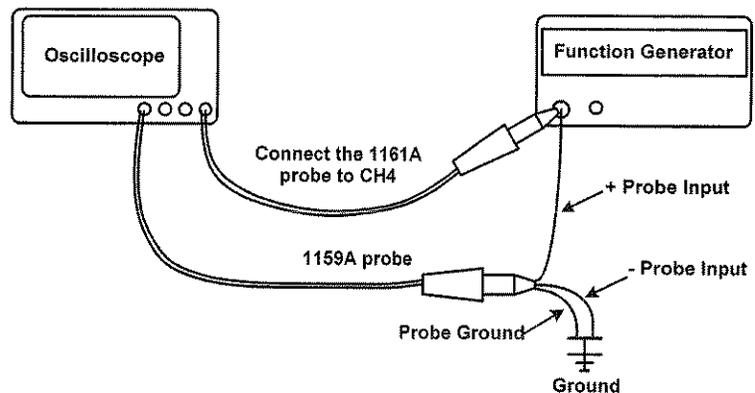
The attenuator's plastic covers may be removed. You must take care not to damage the probe attenuator pins.



### 10:1 and 20:1 Attenuator Adjustment Procedure

Use the following steps to adjust the 10:1 or 20:1 attenuators.

- 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 1159A Probe to CH1 of the oscilloscope.**
- 3 **Turn on the test equipment.**  
Allow 30 minutes for the probe to warm up.

**1159A 1GHz Active Differential Probe  
Adjustment of 10:1 and 20:1 Attenuators**

- 4** Place the 10:1 or 20:1 attenuator on the 1159A 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.

<b>Setting</b>	<b>Value</b>
Square Wave Output Amplitude	1 V
Frequency	5 kHz
Offset	0

- 6** Select Auto Zero on the probe menu.
- 7** Connect the 1159A probe as shown.  
Use the clips to make these connections. The frequency being considered has a fundamental of 5 kHz. Connect the + input of the probe to the signal source. Connect the – input to ground.
- 8** Set the oscilloscope time base to 500 nS/div.
- 9** Press Auto Scale.  
The 54845A triggers off CH 4.
- 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 the compensation to achieve the best waveform characteristics when you remove the tool.
- 11** Connect the + and – probe inputs to the function generator output while the probe ground is connected.  
You can use the calibration fixture BNC to make these connections.
- 12** Set the function generator to 50Hz and the output to 10V 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 Att. 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<sub>pp</sub>.
- 17** Connect the – Probe input to function generator's output and the + input to the ground. You can use BNC A on the calibration fixture.  
Maintain the probe ground.
- 18** Press Auto Scale.

**1159A 1GHz Active Differential Probe  
Adjustment of 10:1 and 20:1 Attenuators**

- 19** Use the square head trimmer tool to set the + LF compensation for a minimum of overshoot and undershoot at the leading edge of the waveform.  
Adjust the compensation to achieve the best waveform characteristics when you remove the tool.
- 20** Set the oscilloscope time base to 500 nS/div
- 21** Connect the probe + and - inputs to the function generator output.  
You can use BNC C on the calibration fixture. Connect the probe ground to the function generator ground.
- 22** Set the amplitude of the function generator to 10 V and the frequency to 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.

**Performance Test Record**

<b>Agilent Technologies</b>		1159A 1 GHz Differential Probe		
Recommended Test Interval: 1 Year		Serial No.: _____		
Recommended Date of Next Certification: _____		Certification Date: _____		
Certification Temperature: _____		Tested By: _____		
<b>Test</b>	<b>Limit Minimum</b>	<b>Results</b>		<b>Limit Maximum</b>
Accuracy at 1 kHz into 50 $\Omega$ input of 54845 A	Min Gain 98%			Max Gain 102%
Differential Mode Range Att 1; Gain 1	No Clipping	<b>Pass</b> _____ _____	<b>Fail</b> _____ _____	N/A
Att 10; Gain 10				
CMRR at 70 Hz	80 dB			N/A
CMRR at 1 MHz	40 dB			N/A
CMRR at 100 MHz	25 dB			N/A
CMRR at 500 MHz	19 dB			N/A
CMRR at 1 GHz	13 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):** 1159A  
**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

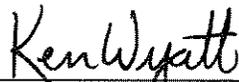
**EMC:** CISPR 11:1990 / EN 55011:1991 Group 1, Class A  
IEC 555-2:1982 + A1:1985 / EN60555-2:1987  
IEC 555-3:1982 + A1:1990 / EN 60555-2:1987 + A1:1991  
IEC 801-2:1991 / EN 50082-1:1992 4 kV CD, 8 kV AD  
IEC 801-3:1984 / EN 50082-1:1992 3 V/m, {1kHz 80% AM, 27-1000 MHz}  
IEC 801-4:1988 / EN 50082-1:1992 0.5 kV Sig. Lines, 1 kV Power Lines

### 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

European Contact: Your local Agilent Technologies Sales and Service Office

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facility, and to the  
calibration facilities of other  
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Organization members.

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Colorado Springs, CO 80901

### Safety

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. To ensure safe operation and to keep the product safe, the information, cautions, and warnings in this operating manual must be heeded. In addition, note the external markings on the instrument that are described under "Safety Symbols."

### 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.

### WARNING

The Warning sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a Warning sign until the indicated conditions are fully understood and met.

### CAUTION

The Caution sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product. Do not proceed beyond a Caution symbol until the indicated conditions are fully understood or met.

### About this edition

This is the 1159 Active Differential Voltage Probe User's Guide.

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New editions are complete revisions of the manual. Many product updates do not require manual changes; and, conversely, manual corrections may be done without accompanying product changes. Therefore, do not expect a one-to-one correspondence between product updates and manual updates.