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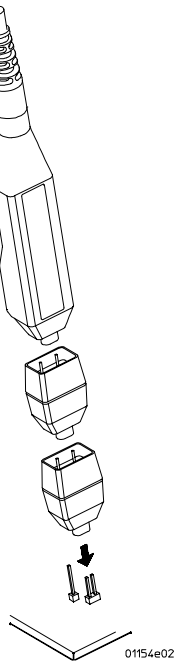
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Find the *Keysight / Agilent 1159A* at our website: ***Click HERE***

Agilent Technologies

User's Guide

Publication number 01159-92001
August 2002



For Safety, Regulatory, 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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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 calibration, 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:

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

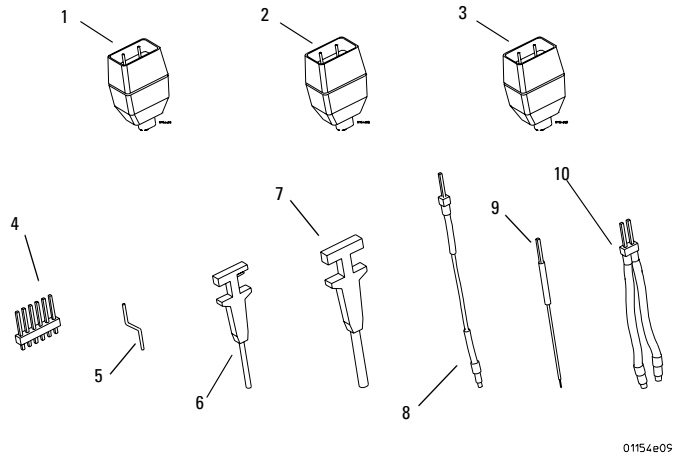
The ability to reject common mode signals depends on the balance designed into the probe amplifier. As the frequency of the common mode signal increases, it becomes harder to balance the amplifier parasitic parameters. This leads to degradation of the CMRR.

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.

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Probe Accessories Supplied

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



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

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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*.

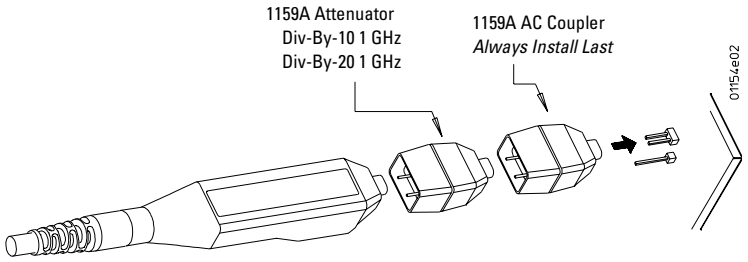
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Other Probe Accessories

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.

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Specifications and Characteristics

Specifications

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

Range

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

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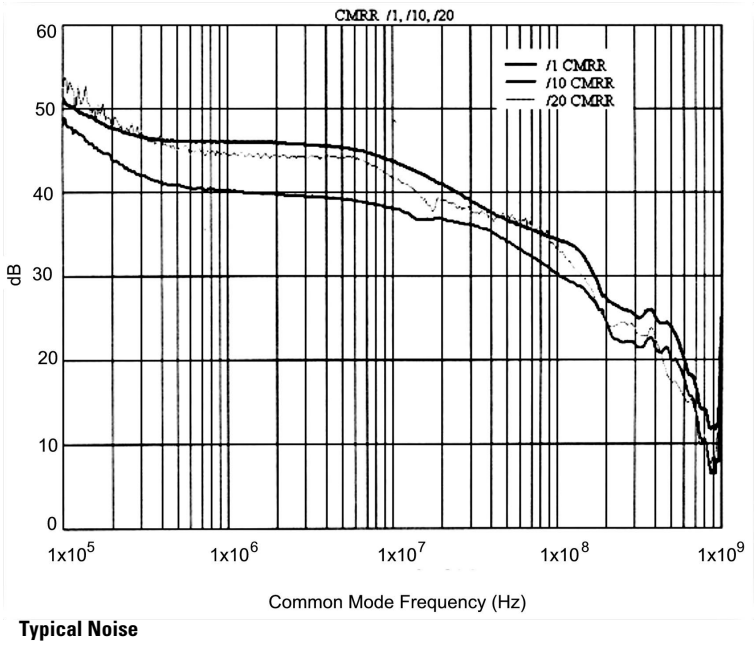
The following characteristics are valid for the 1159A probe after the probe has reached operating temperature, which is 20 minutes with power applied in a environment with stable ambient temperature. The probe must be operating within the environmental conditions listed in the "Environmental Specifications"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

Characteristics

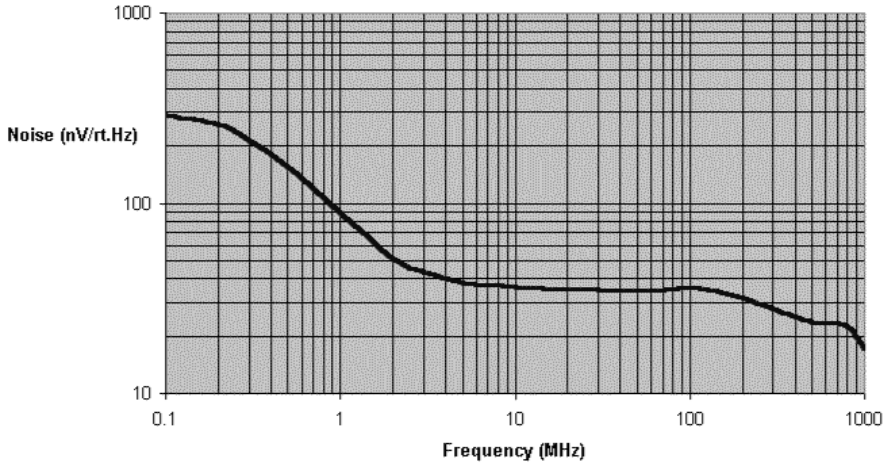
Probe Bandwidth (-3 dB)	DC to 1 GHz
Offset Range	±1.6 V
Rise Time (Probe only) 1:1 Attenuation Internal switched attenuation only	<350 ps
Input Resistance (each side to ground)	1 MΩ
Input Capacitance (between inputs) 1:1 Attenuation No external attenuators	<0.85 pF
Input Capacitance (each side to ground)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

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Typical CMRR versus Frequency (Hz)



Typical Noise

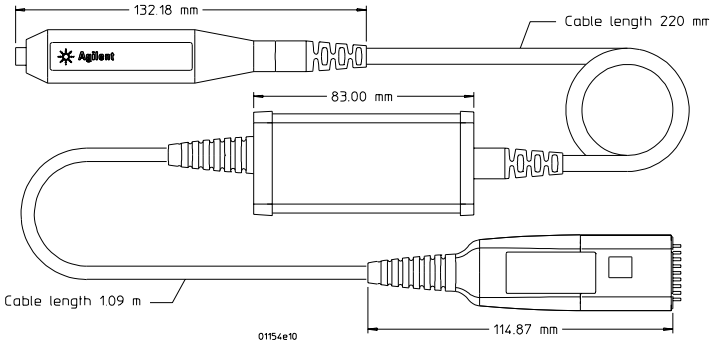


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Environmental Specifications

	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 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.

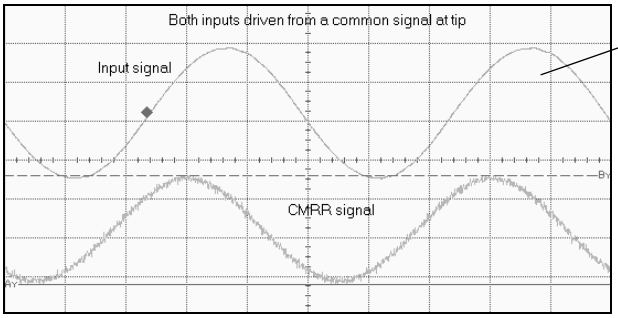
Probe Offset

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.

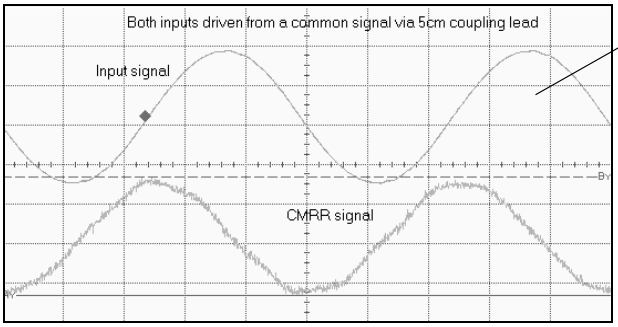
  The added feature of position control independent of Offset allows trace positioning without calculating how much probe offset range is available. The trace can be positioned by *dragging* the trace or positioning the trace under the Probe menu.

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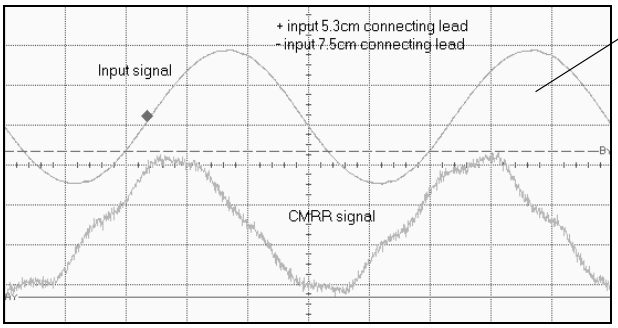
Both inputs derived from a common signal at probe tip.

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

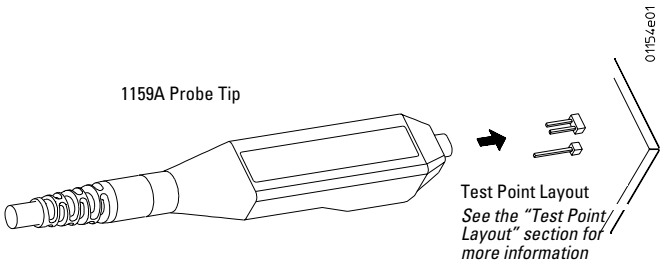
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Recommended Probe Configurations

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

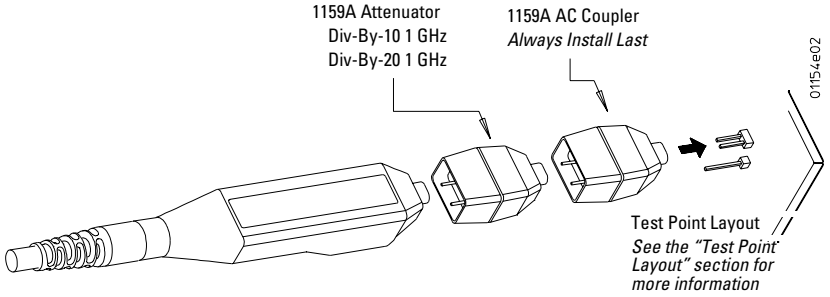
Note The use of the ground connection is optional for all configurations.

Direct Connection



AC Adapter/Attenuator

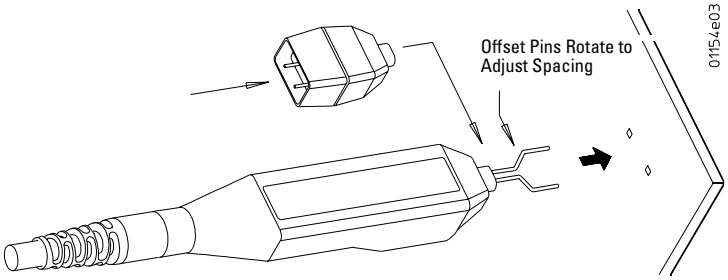
Use the attenuator shipped with the probe and marked with the same serial number for accurate measurements. Do not use the attenuators with other probes.



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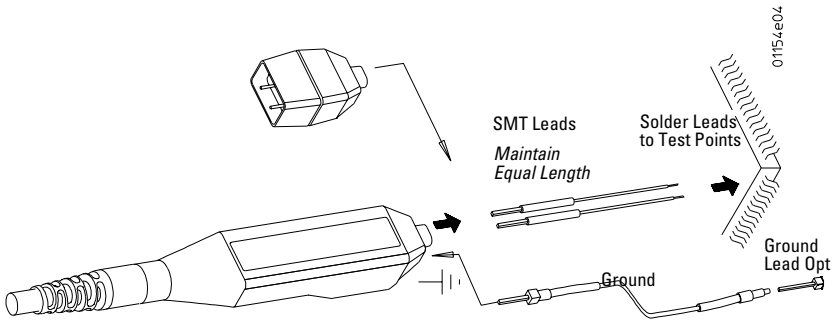
Offset Pins

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



SMT Lead

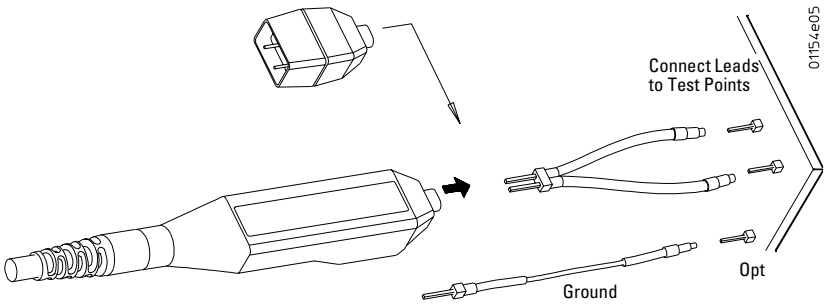
You may use SMT leads with any of the tip adapters.



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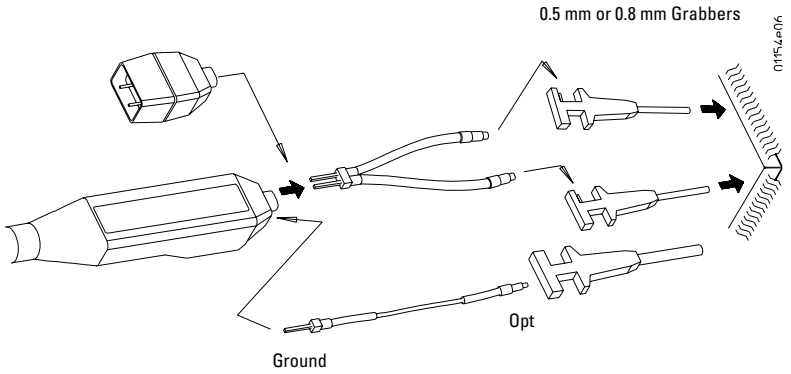
Wire Leads

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



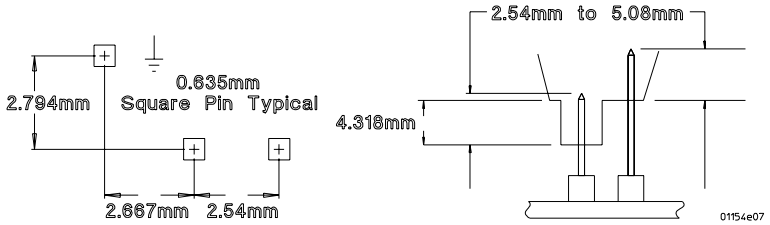
Grabbers

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



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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.

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Service Strategy

For repair and calibration, return the 1154A probe to an Agilent Service Center. If the probe is under warranty, normal warranty service 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.

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Calibration Testing Procedures

These procedures are used to test the warranted specifications for the 1159A Differential probe. The recommended calibration test interval for the 1159A 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 "Preliminary Procedure" section on page 19.
2. Perform the steps listed in the "Gain Accuracy Testing Procedure" 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_{pp} into 1 MΩ 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
High Frequency 10:1 Resistor Divider Probe	500 Ω	1163A
10:1 Resistor Divider Probe (provided with the 54845A)	10 MΩ	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

Preliminary Procedure

1. Turn on the oscilloscope, the 1159A, and the other test equipment.
   Allow 30 minutes for all test equipment to warm up.

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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 "Setup Files for testing" 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.

Setup Files for testing

Save the setup information shown below for the various 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 µSec/div
Timebase Delay	0 Sec
Setup Acquisition	Equivalent time: 8 averages
Trigger	CH4; level 0 V + ve edge

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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

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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 Ω
CH4 Sensitivity	200 mV/div; 50 Ω
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

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Setup for CMRR at 500 MHz
File Name: 1159CAL4a

Probe Connected to CH4	1163A
CH1 Sensitivity	200 mV/div; 50 Ω
CH4 Sensitivity	200 mV/div; 50 Ω
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 Ω
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

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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 Ω
CH4 Sensitivity	200 mV/div; 50 Ω
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 Ω
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

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Gain Accuracy Testing Procedure

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

1. Connect a BNC tee connector to the 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 voltmeter.
6. Set the oscilloscope trigger source to channel 1.
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 x 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 step 9.
13. Record VRMS reading 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.

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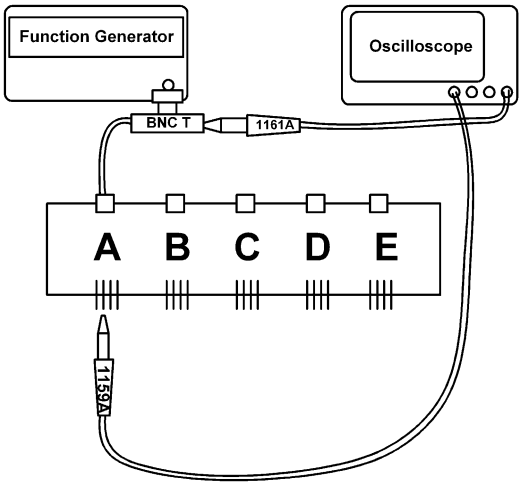
Test Offset

This is an important step in testing the probe. 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 with DVM DC mode.

Test Differential Mode Range

Use setup file 1159CAL0 for this test. Set up the test equipment as shown in the following diagram.



1 Connect the 1159A to CH1 of the oscilloscope.
2 Load 1159CAL0.
3 Connect the 1161A to the output of the function generator and CH4 of the oscilloscope.
4 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_{pp}

5 Select Auto Zero under the probe menu.
Do not connect the probe tip to the fixture when Auto Zero is performed.

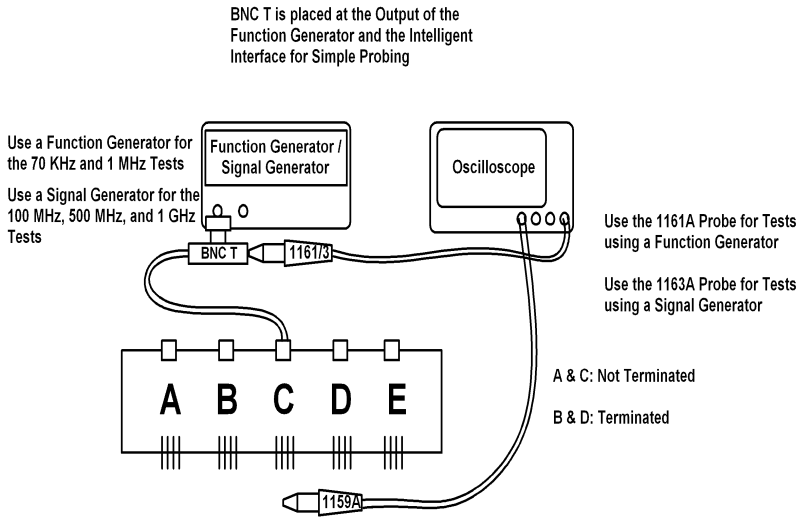
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6 Connect a coaxial cable from the function generator to BNC A on the calibration fixture.
7 Connect the 1159A probe to the output of the calibration fixture CH A.
8 Record “Pass” in the “Differential Mode Range” section of the Calibration Test Record on page 36 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_{pp}.
2 Connect the 1161A probe to the output of the function generator using BNC T.
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 28.
5 Follow the steps in the “Test CMRR at 100 MHz” section on page 29.
6 Follow the steps in the “Test CMRR at 500 MHz” section on page 30.
7 Follow the steps in the “Test CMRR at 1 GHz” section on page 31.

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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_{pp}
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 Calibration Test Record on page 36.

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_{pp}
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.

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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.

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

9 Record CMRR in the “CMRR at 1 MHz” section of the Calibration Test Record on page 36.

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:_____

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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 Calibration Test Record on page 36.

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.

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

14 Record CMRR in the "CMRR at 500 MHz" section of the Calibration Test Record on page 36.

Note CMRR must 19dB or greater.

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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.

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 Calibration Test Record on page 36.

Note CMRR must 13dB or greater.

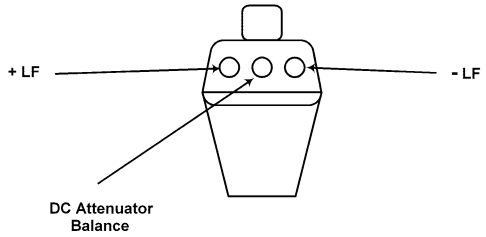
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Adjustment of 10:1 and 20:1 Attenuators

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.

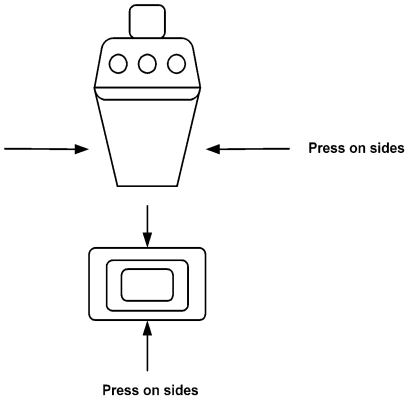
Optimizing CMRR for an Attenuator

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.



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

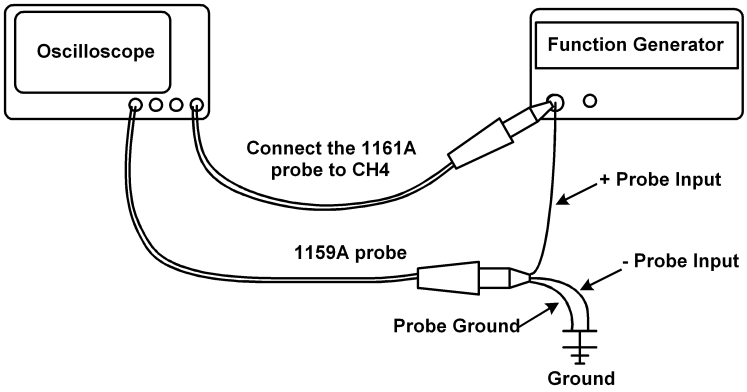


10:1 and 20:1 Attenuator Adjustment Procedure

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 Ð 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.

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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.

Setting	Value
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 Ð 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 Ð 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_{pp}.
17. Connect the Ð 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.

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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 Ð 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 ÐLF compensation for minimum signal amplitude.

It is not possible to make the trace completely flat.

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Calibration Test Record

Agilent Technologies Recommended Test Interval: 1 Year Recommended Date of Next Certification:_____ Certification Temperature:_____		1159A 1 GHz Differential Probe Serial No.:_____ Certification Date:_____ Tested By:_____ _____ _____		
Test	**Limit Minimum**	**Results**		**Limit Maximum**
Accuracy at 1 kHz into 50 Ω input of 54845 A	Min Gain 98%			Max Gain 102%
Differential Mode Range Att 1; Gain 1 Att 10; Gain 10	No Clipping	**Pass** _____ _____	**Fail** _____ _____	N/A
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

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DECLARATION OF CONFORMITY

According to ISO/IEC Guide 22 and CEN/CENELEC 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: Oscilloscope Differential Probe

Model Number(s): 1159A

Product Option(s): This declaration covers all options of the above product(s).

Conforms with the following product standards

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

Safety: IEC 61010-1:1990+A1:1992+A2:1995 / EN 61010-1:1993+A2:1995

Conformity/Supplementary 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).

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

Colorado Springs, 06/28/2000

Ken Wyatt, Quality Manager

European Contact: Your local Agilent Technologies Sales and Service Office

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Product Regulations

Safety	IEC 61010-1:1990+A1:1992+A2:1995 / EN 61010-1:1993+A1:1995	
EMC		Performance Criteria
	CISPR 11:1990 / EN 55011:1991	
	IEC 555-2:1982 + A1:1985 / EN60555-2:1987	
	IEC 555-3:1982 + A1:1990 / EN 60555-2:1987 + A1:1991	A
	IEC 801-2:1991 / EN 50082-1:1992	B
	IEC 801-3:1984 / EN 50082-1:1992	A
	IEC 801-4:1988 / EN 50082-1:1992	A

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.

Sound Pressure Level N/A

Regulatory Information for Canada

ICES/NMB-001

This ISM device complies with Canadian ICES-001.
Cet appareil ISM est confomre 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

N10149

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Safety Notices

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

Warnings

- Before turning on the instrument, you must connect the protective earth terminal of the instrument to the protective conductor of the (mains) power cord. The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. You must not negate the protective action by using an extension cord (power cable) without a protective conductor (grounding). Grounding one conductor of a two-conductor outlet is not sufficient protection.
- Only fuses with the required rated current, voltage, and specified type (normal blow, time delay, etc.) should be used. Do not use repaired fuses or short-circuited fuseholders. To do so could cause a shock or fire hazard.
- If you energize this instrument by an auto transformer (for voltage reduction or mains isolation), the common terminal must be connected to the earth terminal of the power source.
- Whenever it is likely that the ground protection is impaired, you must make the instrument inoperative and secure it against any unintended operation.
- Service instructions are for trained service personnel. To avoid dangerous electric shock, do not perform any service unless qualified to do so. Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.
- Do not install substitute parts or perform any unauthorized modification to the instrument.
- Capacitors inside the instrument may retain a charge even if the instrument is disconnected from its source of supply.
- Do not operate the instrument in the presence of flammable gasses or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.
- Do not use the instrument in a manner not specified by the manufacturer.

To clean the instrument

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

Safety Symbols



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



Hazardous voltage symbol.



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

Agilent Technologies
P.O. Box 2197
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USA

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