RIGOL

# Performance Verification Guide

## DS1000E/D Series Digital Oscilloscope

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RIGOL Technologies, Inc.

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# General Safety Summary

Please review the following safety precautions carefully before putting the instrument into operation so as to avoid any personal injuries or damages to the instrument and any product connected to it. To prevent potential hazards, please use the instrument only specified by this manual.

### Use Proper Power Cord.

Only the power cord designed for the instrument and authorized by local country could be used.

### Ground The Instrument.

The instrument is grounded through the Protective Earth lead of the power cord. To avoid electric shock, it is essential to connect the earth terminal of power cord to the Protective Earth terminal before any inputs or outputs.

### Connect the Probe Correctly.

Do not connect the ground lead to high voltage since it has the isobaric electric potential as ground.

### Observe All Terminal Ratings.

To avoid fire or shock hazard, observe all ratings and markers on the instrument and check your manual for more information about ratings before connecting.

### Use Proper Overvoltage Protection.

Make sure that no overvoltage (such as that caused by a thunderstorm) can reach the product, or else the operator might expose to danger of electrical shock.

### Do Not Operate Without Covers.

Do not operate the instrument with covers or panels removed.

### Use Proper Fuse.

Please use the specified fuses.

### Avoid Circuit or Wire Exposure.

Do not touch exposed junctions and components when the unit is powered.

### Do Not Operate With Suspected Failures.

If you suspect damage occurs to the instrument, have it inspected by qualified service personnel before further operations. Any maintenance, adjustment or replacement especially to circuits or accessories must be performed by **RIGOL** authorized personnel.

### Keep Well Ventilation.

Inadequate ventilation may cause increasing of temperature or damages to the device. So please keep well ventilated and inspect the intake and fan regularly.

### Do Not Operate in Wet Conditions.

In order to avoid short circuiting to the interior of the device or electric shock, please do not operate in a humid environment.

### Do Not Operate in an Explosive Atmosphere.

In order to avoid damages to the device or personal injuries, it is important to operate the device away from an explosive atmosphere.

### Keep Product Surfaces Clean and Dry.

To avoid the influence of dust and/or moisture in air, please keep the surface of device clean and dry.

### Electrostatic Prevention.

Operate in an electrostatic discharge protective area environment to avoid damages induced by static discharges. Always ground both the internal and external conductors of the cable to release static before connecting.

### Handling Safety.

Please handle with care during transportation to avoid damages to buttons, knob interfaces and other parts on the panels.

# Safety Terms and Symbols

**Terms on the Product.** These terms may appear on the Product:

**DANGER** indicates an injury or hazard may immediately happen.

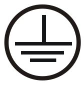
**WARNING** indicates an injury or hazard may be accessible potentially.

**CAUTION** indicates a potential damage to the instrument or other property might occur.

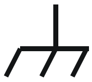
**Symbols on the Product.** These symbols may appear on the product:

**Hazardous Voltage**

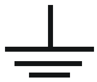
**Safety Warning**



**Protective Earth Terminal**



**Chassis Ground**



**Test Ground**

# Contents

# Document Overview

This manual guides users to correctly test the performance of **RIGOL** DS2000 series digital oscilloscope.

## Main topics in this manual:

**Chapter 1 Overview**
This chapter introduces the preparations and precautions of the performance verification test.

**Chapter 2 Performance Calibration Test**
This chapter introduces the limit, test device required as well as test method and procedures of each performance.

**Appendix Test Record Form**
In the appendix, a test record form is provided for test result so as to determine whether each performance fulfills the requirement.

## Format Conventions in this Manual:

Front Panel Key: denoted by "Text Box + Button Name (Bold)", for example, **Utility**.

Menu Softkey: denoted by "Character Shading + Menu Word (Bold)", for example, **Self-Cal**.

Operation Step: denoted by an arrow "→", for example, **Utility** → **Self-Cal**.

## Contents Conventions in this Manual:

In this manual, DS1102E is taken as an example to illustrate the performance verification method. The introductions in this manual are applicable to all the models of DS1000E/DS1000D.

| Model | DS1102E | DS1052E | DS1102D | DS1052D |
|---|---|---|---|---|
| Analog Bandwidth | 100 MHz | 50 MHz | 100 MHz | 50 MHz |
| channels | 2 | 2 | 2 | 2 |
| Max Real-time Sample Rate | 1 GSa/s | | | |

# Chapter 1 Overview

## Test Preparations

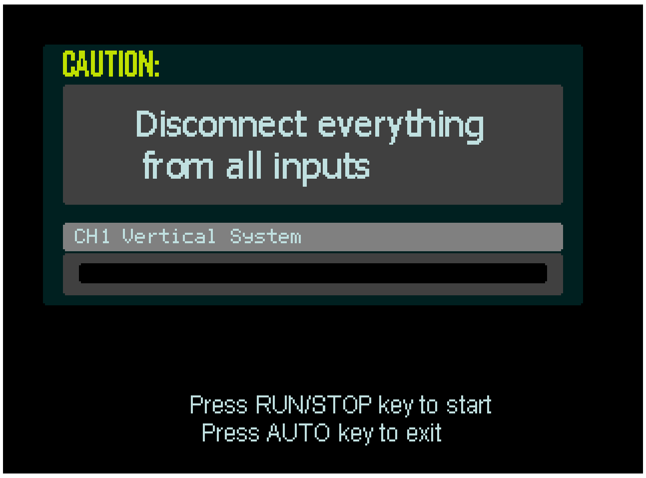
The following preparations should be done before the test:

1) Warm-up: warm the oscilloscope up for at least 30 minutes;
2) Self-calibration: calibrate the oscilloscope.

## Self-calibration

Before performing self-calibration, make sure that the oscilloscope has been warmed up or running for 30 minutes.

1) Disconnect the connections of all the channels.
2) Press **Utility** → **Self-Cal**, "Press RUN/STOP key to start/Press AUTO key to exit" will be displayed on the screen and Press **RUN/STOP**, the oscilloscope starts to execute the self-calibration program as shown in the figure below:




3) The self-calibration takes about 5 minutes. "Calibration finished/Press RUN/STOP key to exit", please restart the oscilloscope after exiting.
4) Press **Acquire**→ **Acquisition** and use ↺ to select "Average". Then, press **Averages** and use ↺ to set the number of averages to 16.
5) Press down the **VERTICAL** **POSITION** knob of each channel respectively to set the vertical position of the two channels to zero. View the distance between the waveform of each channel and the screen center at 2 mV/div. when the distance is greater than 0.2div, please perform self-calibration again until the calibration succeeds (note: make sure that the instrument passes the self-calibration before performing the performance verification test; otherwise, the test results might not be accurate).

## Test Result Record

Record and keep the test result of each test. In the Appendix of this manual, a test result record form which lists all the test items and their corresponding performance limits as well as spaces for users to record the test results, is provided.

**Tip:**
It is recommended that users photocopy the test record form before each test and record the test results in the copy so that the form can be used repeatedly.

# Chapter 2 Performance Calibration Test

This chapter introduces the performance verification test method of DS1000E/DS1000D series digital oscilloscope by taking DS1102E as an example. You can perform the following test in any order. In this manual, the test device used is Fluke 9500B. You can also use other devices that fulfill the specification requirements for the test.

**Recommended Devices List:**

| Device | Specification | Recommended Model |
|---|---|---|
| Oscilloscope Calibrator | Output range of DC voltage:<br>1 MΩ: 1 mV to 200 V<br>50 MΩ：1 mV to 200 V<br>The rise time of fast edge signal: ≤ 150 ps | Fluke 9500B |
| Digital Multimeter | The resistance measurement accuracy is higher than ±0.1% of reading | RIGOL DM3058/3068 |
| Test Cable | BNC (male) to Dual-banana Plug Cable | -- |
| Signal Generator | Frequency Accuracy: ±1 ppm | RIGOL DG4162 |
| Test Cable | BNC (m)-BNC (m) cable | -- |

**Note:**

1) Make sure that the oscilloscope passes the self-calibration before performing the performance calibration test.
2) Make sure that the oscilloscope has been warmed up for 30 minutes before executing any of the following tests.
3) Please reset the instrument to the factory setting before or after executing any of the following tests.

# Impedance Test

**Specifications:**

| | |
|---|---|
| Input Impedance | 1 MΩ ±2% (0.98 MΩ to 1.02 MΩ) |

**Test Devices:** Fluke 9500B or Digital Multimeter and BNC (male) to Dual-banana Plug Cable. In this manual, the test device is Fluke 9500B.

**Test Procedures:**

**1. Impedance test of CH1 and CH2**

1) Connect the active head of Fluke 9500B to CH1 of the oscilloscope.
2) Configure the oscilloscope:
   a) Press **CH1** in the vertical control area (VERTICAL) at the front panel to enable CH1.
   b) Rotate **VERTICAL** **SCALE** to set the vertical scale of CH1 to 100 mV/div.
3) Enable the Fluke 9500B and select the resistance measurement function, read and record the resistance measurement value.
4) Rotate **VERTICAL** **SCALE** to adjust the vertical scale of CH1 to 500 mV/div; then, read and record the resistance measurement value.
5) Turn CH1 off. Repeat the above test steps to test CH2 and record the test results.

**2. Impedance test of [EXT TRIG] channel**

1) Disconnect the connections of the two input channels.
2) Connect the active head of Fluke 9500B to the external trigger channel **[EXT TRIG]**.
3) Enable the Fluke 9500B and select the resistance measurement function, read and record the resistance measurement value.

**Test Record Form:**

| Channel | Vertical Scale | Test Result | Limit | Pass/Fail |
|---|---|---|---|---|
| CH1 | 100 mV/div | | ≥ 0.98 MΩ and ≤ 1.02 MΩ | |
| | 500 mV/div | | | |
| CH2 | 100 mV/div | | | |
| | 500 mV/div | | | |
| EXT TRIG | -- | | | |

# DC Gain Accuracy Test

**Specifications:**

| | |
|---|---|
| DC Gain Accuracy | ≤4%×Full Scale (2 mV/div to 5 mV/div)<br>≤3%×Full Scale (10 mV/div to 10 V/div) |
| **Explanation:**<br>Full Scale = 8 div×vertical scale. Relative error of each scale: $\lvert(Vavg1–Vavg2)–(V_{out1}-V_{out2})\rvert$/Full Scale×100%≤X% (the value of X is 3 when the vertical scale is 10 mV/div to 10 V/div and the value of X is 4 when the vertical scale is 2 mV/div to 5 mV/div); otherwise, the test fails. For example, when the vertical scale is 1 V/div, input DC signals with +3 $V_{DC}$ and -3 $V_{DC}$ voltages respectively, the values of Vavg1 and Vavg2 are +3.06 V and -3.04 V respectively, the relative error is \|(+3.06 V-(-3.04 V))-(+3 V-(-3 V)) \|/(1 V/div*8 div) × 100% = 1.25% and the test passes. | |

**Test Device:** Fluke 9500B

**Test Procedures:**

1) Connect the active head of Fluke 9500B to CH1 of the oscilloscope.
2) Enable Fluke 9500B and set the output impedance to 1 MΩ.
3) Output a DC signal with +6 $mV_{DC}$ voltage ($V_{out1}$) from Fluke 9500B.
4) Configure the oscilloscope:
   a) Press **CH1** in the vertical control area (VERTICAL) at the front panel to enable CH1.
   b) Rotate **VERTICAL** **SCALE** to set the vertical scale to 2 mV/div.
   c) Rotate **HORIZONTAL** **SCALE** to set the horizontal time base to 10 μs.
   d) Rotate **VERTICAL** **POSITION** to set the vertical position to 0.
   e) Press **Acquire**→ **Acquisition** and use to select “Average”. Then, press **Averages** and use to set the number of averages to 32.
5) Enable the average measurement function of the oscilloscope. Read and record Vavg1.
6) Adjust Fluke 9500B to output a DC signal with -6 $mV_{DC}$ voltage($V_{out2}$).
7) Read and record the average value Vavg2 at the moment.
8) Calculate the relative error of the vertical scale:
   $\lvert(Vavg1–Vavg2)–(V_{out1}-V_{out2})\rvert$/Full Scale×100%.
9) Keep other settings of the oscilloscope unchanged:
   a) Set the vertical scale to 5 mV/div, 10 mV/div, 20 mV/div, 50 mV/div, 100 mV/div, 200 mV/div, 500 mV/div, 1 V/div, 2 V/div, 5 V/div and 10 V/div respectively.
   b) Adjust the output voltage of Fluke 9500B to ±3 div respectively.
   c) Repeats steps 2), 3), 4), 5), 6) and 7) and record the results.
   d) Calculate the relative error of each scale.
10) Turn CH1 off. Repeat the above test steps to test CH2 and record the test results.

**Test Record Form:**

| Channel | Vertical Scale | Test Result | | | Limit | Pass/Fail |
|---|---|---|---|---|---|---|
| | | Vavg1 | Vavg2 | Calculation Result[1] | | |
| CH1 | 2 mV/div | | | | ≤4% | |
| | 5 mV/div | | | | | |
| | 10 mV/div | | | | ≤3% | |
| | 20 mV/div | | | | | |
| | 50 mV/div | | | | | |
| | 100 mV/div | | | | | |
| | 200 mV/div | | | | | |
| | 500 mV/div | | | | | |
| | 1 V/div | | | | | |
| | 2 V/div | | | | | |
| | 5 V/div | | | | | |
| | 10 V/div | | | | | |
| CH2 | 2 mV/div | | | | ≤4% | |
| | 5 mV/div | | | | | |
| | 10 mV/div | | | | ≤3% | |
| | 20 mV/div | | | | | |
| | 50 mV/div | | | | | |
| | 100 mV/div | | | | | |
| | 200 mV/div | | | | | |
| | 500 mV/div | | | | | |
| | 1 V/div | | | | | |
| | 2 V/div | | | | | |
| | 5 V/div | | | | | |
| | 10 V/div | | | | | |

**Note[1]:** the calculation formula is $|(Vavg1–Vavg2)–(V_{out1}-V_{out2})|/\text{Full Scale}\times100\%$; wherein, $V_{out1}$ and $V_{out2}$ are 3 and -3 times of the current vertical scale respectively.

# Bandwidth Test

**Specification:**

| Amplitude Loss | -3 dB to 1 dB |
|---|---|
| **Explanation:**<br>Amplitude loss (dB) = $20\times lg^{(Vrms2/Vrms1)}$. | |

**Test device:** Fluke 9500B

**Test Procedures:**

1) Connect the active head of Fluke 9500B to CH1 of the oscilloscope.
2) Enable the Fluke 9500B and set the output impedance to 1 MΩ.
3) Output a sine signal with 1 MHz frequency and 600 mVpp amplitude from Fluke 9500B.
4) Configure the oscilloscope:
   a) Press **CH1** in the vertical control area (VERTICAL) at the front panel to enable CH1.
   b) Rotate **HORIZONTAL** **SCALE** to set the horizontal time base to 500 ns.
   c) Rotate **VERTICAL** **SCALE** to set the vertical scale to 100 mV/div.
   d) Rotate **HORIZONTAL** **POSITION** and **VERTICAL** **POSITION** to set the horizontal position and vertical position to 0 respectively.
   e) Rotate **TRIGGER** **LEVEL** to set the trigger level to 0 V.
5) Enable the root mean square measurement function of the oscilloscope. Read and record Vrms1.
6) Output a sine signal with 100 MHz frequency (for 50 MHz bandwidth oscilloscopes, the frequency is 50 MHz) and 600 mVpp amplitude from Fluke 9500B.
7) Rotate **HORIZONTAL** **SCALE** of the oscilloscope to set the horizontal time base to 5 ns (for 50 MHz bandwidth oscilloscopes, the time base is 10 ns).
8) Read and record the root mean square Vrms2.
9) Calculate the amplitude loss: amplitude loss (dB) = $20\times lg^{(Vrms2/Vrms1)}$.
10) Keep the other settings of the oscilloscope unchanged and set the vertical scale to 200 mV/div and 500 mV/div respectively.
11) Output sine signals with 1 MHz frequency and 1.2 Vpp/3 Vpp amplitude from Fluke 9500B respectively.
12) Repeat step 5).
13) Output sine signals with 100 MHz frequency (for 50 MHz bandwidth oscilloscopes, the frequency is 50 MHz) and 1.2 Vpp/3 Vpp amplitude from Fluke 9500B respectively.
14) Repeat steps 7), 8) and 9).
15) Turn CH1 off. Test CH2 according to the above test steps and record the test results.

**Test Record Form:**

<table>
<tr><th>Channel</th><th>Vertical Scale</th><th colspan="2">Test Result</th><th>Limit</th><th>Pass/Fail</th></tr>
<tr><td rowspan="9">CH1</td><td rowspan="3">100 mV/div</td><td>Vrms1</td><td></td><td rowspan="18">≥ -3 dB and ≤ 1 dB</td><td rowspan="3"></td></tr>
<tr><td>Vrms2</td><td></td></tr>
<tr><td>Amplitude Loss[1]</td><td></td></tr>
<tr><td rowspan="3">200 mV/div</td><td>Vrms1</td><td></td><td rowspan="3"></td></tr>
<tr><td>Vrms2</td><td></td></tr>
<tr><td>Amplitude Loss</td><td></td></tr>
<tr><td rowspan="3">500 mV/div</td><td>Vrms1</td><td></td><td rowspan="3"></td></tr>
<tr><td>Vrms2</td><td></td></tr>
<tr><td>Amplitude Loss</td><td></td></tr>
<tr><td rowspan="9">CH2</td><td rowspan="3">100 mV/div</td><td>Vrms1</td><td></td><td rowspan="3"></td></tr>
<tr><td>Vrms2</td><td></td></tr>
<tr><td>Amplitude Loss</td><td></td></tr>
<tr><td rowspan="3">200 mV/div</td><td>Vrms1</td><td></td><td rowspan="3"></td></tr>
<tr><td>Vrms2</td><td></td></tr>
<tr><td>Amplitude Loss</td><td></td></tr>
<tr><td rowspan="3">500 mV/div</td><td>Vrms1</td><td></td><td rowspan="3"></td></tr>
<tr><td>Vrms2</td><td></td></tr>
<tr><td>Amplitude Loss</td><td></td></tr>
</table>

**Note[1]:** amplitude loss (dB) = $20\times lg^{(Vrms2/Vrms1)}$.

# Bandwidth Limit Test

**Specification:**

| Amplitude Loss | -3 dB to 1 dB |
|---|---|
| **Explanation:**<br>Amplitude Loss (dB) = $20\times lg^{(Vrmsn/Vrms1)}$. Wherein, Vrmsn represents Vrms2 and Vrms3. | |

**Test Device:** Fluke 9500B

**Test procedures:**

1) Connect the active head of Fluke 9500B to CH1 of the oscilloscope.
2) Set the output impedance of Fluke 9500B to 1 MΩ.
3) Configure the oscilloscope:
   a) Press **CH1** in the vertical control area (VERTICAL) at the front panel to enable CH1.
   b) Rotate **VERTICAL** **SCALE** to set the vertical scale to 100 mV/div.
   c) Rotate **HORIZONTAL** **SCALE** to set the horizontal time base to 500 ns.
   d) Rotate **HORIZONTAL** **POSITION** and **VERTICAL** **POSITION** to set the horizontal position and vertical position to 0 respectively.
   e) Rotate **TRIGGER** **LEVEL** to set the trigger level to 0 V.
4) Press **CH1** → **BW limit** to enable the function of the bandwidth limit.
5) Output a sine waveform with 1 MHz frequency and 600 mVpp amplitude from Fluke 9500B.
6) Enable the root mean square measurement function of the oscilloscope. Read and record Vrms1.
7) Output a sine waveform with 20 MHz frequency and 600 mVpp amplitude from Fluke 9500B.
8) Rotate **HORIZONTAL** **SCALE** of the oscilloscope to set the horizontal time base to 50 ns.
9) Read and record root mean square value Vrms2.
10) Calculate the amplitude loss and compare it to the specification: Amplitude Loss (dB) = $20\times lg^{(Vrms2/Vrms1)}$. Amplitude loss should be in the range of the specification at this point.
11) Output a sine waveform with 50 MHz frequency and 600 mVpp amplitude from Fluke 9500B.
12) Rotate **HORIZONTAL** **SCALE** of the oscilloscope to set the horizontal time base to 20 ns.
13) Read and record root mean square value Vrms2.
14) Calculate the amplitude loss and compare it to the specification: Amplitude Loss (dB) = $20\times lg^{(Vrms3/Vrms1)}$. Amplitude loss should be lower than -3 dB at this point.
15) Keep other settings of the oscilloscope unchanged and set the vertical scale to 200 mV/div.
16) Output a sine waveform with 1 MHz frequency and 1.2 Vpp amplitude from Fluke 9500B.
17) Repeat step 6).
18) Output a sine waveform with 20 MHz frequency and 1.2 Vpp amplitude from Fluke 9500B.
19) Repeat step 8), 9) and 10).
20) Output a sine waveform with 50 MHz frequency and 1.2 Vpp amplitude from Fluke 9500B.
21) Repeat step 12), 13) and 14).
22) Keep other settings of the oscilloscope unchanged and set the vertical scale to 500 mV/div.

23) Output a sine waveform with 1 MHz frequency and 3 Vpp amplitude from Fluke 9500B.
24) Repeat step 6).
25) Output a sine waveform with 20 MHz frequency and 3 Vpp amplitude from Fluke 9500B.
26) Repeat step 8), 9) and 10).
27) Output a sine waveform with 50 MHz frequency and 3 Vpp amplitude from Fluke 9500B.
28) Repeat step 12), 13) and 14).
29) Turn CH1 off. Test CH2 according to the above test steps and record the test results.

**Test Record Form:**

| Channel | Vertical Scale | Test Result | | Limit | Pass /Fail |
|---|---|---|---|---|---|
| CH1 | 100 mV/div | Vrms1 | | -- | |
| | | Vrms2 | | | |
| | | Vrms3 | | | |
| | | Amplitude Loss[1] (dB) = $20\times\lg^{(Vrms2/Vrms1)}$ | | ≥ -3 dB and ≤ 1 dB | |
| | | Amplitude Loss[1] (dB) = $20\times\lg^{(Vrms3/Vrms1)}$ | | ≤ 3 dB | |
| | 200 mV/div | Vrms1 | | -- | |
| | | Vrms2 | | | |
| | | Vrms3 | | | |
| | | Amplitude Loss[1] (dB) = $20\times\lg^{(Vrms2/Vrms1)}$ | | ≥ -3 dB and ≤ 1 dB | |
| | | Amplitude Loss[1] (dB) = $20\times\lg^{(Vrms3/Vrms1)}$ | | ≤ 3 dB | |
| | 500 mV/div | Vrms1 | | -- | |
| | | Vrms2 | | | |
| | | Vrms3 | | | |
| | | Amplitude Loss[1] (dB) = $20\times\lg^{(Vrms2/Vrms1)}$ | | ≥ -3 dB and ≤ 1 dB | |
| | | Amplitude Loss[1] (dB) = $20\times\lg^{(Vrms3/Vrms1)}$ | | ≤ 3 dB | |
| CH2 | 100 mV/div | Vrms1 | | -- | |
| | | Vrms2 | | | |
| | | Vrms3 | | | |
| | | Amplitude Loss[1] (dB) = $20\times\lg^{(Vrms2/Vrms1)}$ | | ≥ -3 dB and ≤ 1 dB | |
| | | Amplitude Loss[1] (dB) = $20\times\lg^{(Vrms3/Vrms1)}$ | | ≤ 3 dB | |
| | 200 mV/div | Vrms1 | | -- | |
| | | Vrms2 | | | |
| | | Vrms3 | | | |
| | | Amplitude Loss[1] (dB) = $20\times\lg^{(Vrms2/Vrms1)}$ | | ≥ -3 dB and ≤ 1 dB | |
| | | Amplitude Loss[1] (dB) = $20\times\lg^{(Vrms3/Vrms1)}$ | | ≤ 3 dB | |
| | 500 mV/div | Vrms1 | | -- | |
| | | Vrms2 | | | |
| | | Vrms3 | | | |
| | | Amplitude Loss[1] (dB) = $20\times\lg^{(Vrms2/Vrms1)}$ | | ≥ -3 dB and ≤ 1 dB | |
| | | Amplitude Loss[1] (dB) = $20\times\lg^{(Vrms3/Vrms1)}$ | | ≤ 3 dB | |

**Note[1]:** amplitude loss (dB) = $20\times\lg^{(Vrmsn/Vrms1)}$. Here, Vrmsn represents Vrms2 and Vrms3.

# Time Base Accuracy Test

**Specification:**

| | |
|---|---|
| Time Base Accuracy | ≤ ±50 ppm |

**Test Devices:** Fluke 9500B or signal generator and BNC (m)-BNC (m) cable.

**Test procedures:**

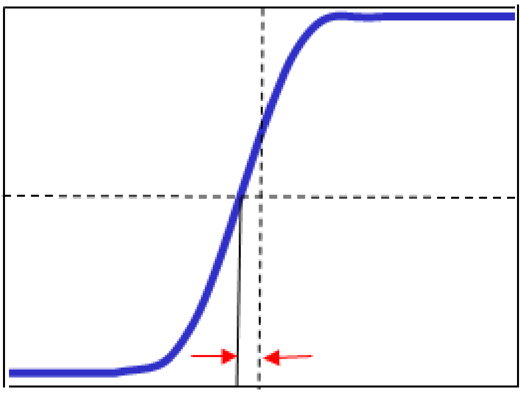
1) Connect the active head of Fluke 9500B to CH1 of the oscilloscope.
2) Output a sine waveform with 1 MHz frequency and 1 Vpp amplitude from Fluke 9500B.
3) Configure the oscilloscope:
   a) Press **CH1** in the vertical control area (VERTICAL) at the front panel to enable CH1.
   b) Rotate **VERTICAL** **SCALE** to set the vertical scale to 200 mV/div.
   c) Rotate **VERTICAL** **POSITION** to set the vertical position to 0.
   d) Rotate **HORIZONTAL** **SCALE** to set the horizontal time base to 20 ns.
   e) Rotate **HORIZONTAL** **POSITION** to set the horizontal position to 1 ms.
4) Observe the display of the oscilloscope and measure the offset (ΔT) of the midpoint of the signal relative to the center of the screen.
5) Calculate the time base accuracy, namely the ratio of ΔT to the horizontal position of the oscilloscope. For example, if the offset of this test is 8 ns, the time base accuracy is 10 ns/1 ms=10 ppm.

**Test Record Form:**

| Channel | Test Result ΔT | Calculation Result | Limit | Pass/Fail |
|---|---|---|---|---|
| CH1 | | | ±50 ppm | |

# Zero Point Offset Test

Zero point offset is defined as the offset of the crossing point of the waveform and the trigger level relative to the trigger position as shown in the figure below.



Zero Point Offset

**Specification:**

| | |
|---|---|
| Zero Point Offset | 500 ps |

**Test Devices:** Fluke 9500B

**Test Procedures:**

1) Connect the active head of Fluke 9500B to CH1 of the oscilloscope.
2) Output a fast edge signal with 150 ps rise time and 600 mV amplitude from Fluke 9500B.
3) Configure the oscilloscope:
   a) Press **CH1** in the vertical control area (VERTICAL) at the front panel to enable CH1.
   b) Rotate **VERTICAL** **SCALE** to set the vertical scale to 100 mV/div.
   c) Rotate **HORIZONTAL** **SCALE** to set the horizontal time base to 2 ns (for 50 MHz bandwidth oscilloscopes, set the horizontal time base to 5 ns).
   d) Rotate **VERTICAL** **POSITION** and **HORIZONTAL** **POSITION** to set the vertical position and horizontal position to appropriate values respectively.
   e) Rotate **TRIGGER** **LEVEL** to adjust the trigger level to the middle of the screen.
4) Observe the display of the oscilloscope. Press **Cursor** → **Mode** →"Manual" to enable the manual cursor function to measure the zero point offset and record the measurement result.
5) Keep other settings unchanged and adjust the amplitude of the fast edge signal to 3 V.
6) Set the vertical scale to 500 mV/div. Measure the zero point offset according to the above method and record the test result.
7) Turn CH1 off. Repeat the above test steps to measure CH2 and record the test results.

**Test Record Form:**

| Channel | Fast Edge Signal Amplitude | Vertical Scale | Test Result | Limit | Pass/Fail |
|---|---|---|---|---|---|
| CH1 | 600 mV | 100 mV/div | | ≤ 500 ps | |
| | 3 V | 500 mV/div | | | |
| CH2 | 600 mV | 100 mV/div | | | |
| | 3 V | 500 mV/div | | | |

# Appendix Test Record Form

**RIGOL** DS1000E/D Series Digital Oscilloscope Performance Verification Test Record Form

Model: ________________ Tested by: ________________ Test Date: _______________

**Impedance Test:**

| Channel | Vertical Scale | Test Result | Limit | Pass/Fail |
|---|---|---|---|---|
| CH1 | 100 mV/div | | ≥ 0.98 MΩ and ≤ 1.02 MΩ | |
| | 500 mV/div | | | |
| CH2 | 100 mV/div | | | |
| | 500 mV/div | | | |
| EXT TRIG | -- | | | |

### DC Gain Accuracy Test:

| Channel | Vertical Scale | Test Result | | | Limit | Pass/Fail |
|---|---|---|---|---|---|---|
| | | Vavg1 | Vavg2 | Calculation Result[1] | | |
| CH1 | 2 mV/div | | | | ≤4% | |
| | 5 mV/div | | | | | |
| | 10 mV/div | | | | ≤3% | |
| | 20 mV/div | | | | | |
| | 50 mV/div | | | | | |
| | 100 mV/div | | | | | |
| | 200 mV/div | | | | | |
| | 500 mV/div | | | | | |
| | 1 V/div | | | | | |
| | 2 V/div | | | | | |
| | 5 V/div | | | | | |
| | 10 V/div | | | | | |
| CH2 | 2 mV/div | | | | ≤4% | |
| | 5 mV/div | | | | | |
| | 10 mV/div | | | | ≤3% | |
| | 20 mV/div | | | | | |
| | 50 mV/div | | | | | |
| | 100 mV/div | | | | | |
| | 200 mV/div | | | | | |
| | 500 mV/div | | | | | |
| | 1 V/div | | | | | |
| | 2 V/div | | | | | |
| | 5 V/div | | | | | |
| | 10 V/div | | | | | |

**Note[1]:** the calculation formula is $|(Vavg1–Vavg2)–(V_{out1}-V_{out2})|$/Full Scale×100%; wherein, $V_{out1}$ and $V_{out2}$ are 3 and -3 times of the current vertical scale respectively.

**Bandwidth Test:**

| Channel | Vertical Scale | Test Result | | Limit | Pass/Fail |
|---|---|---|---|---|---|
| CH1 | 100 mV/div | Vrms1 | | ≥ -3 dB and ≤ 1 dB | |
| | | Vrms2 | | | |
| | | Amplitude Loss[1] | | | |
| | 200 mV/div | Vrms1 | | | |
| | | Vrms2 | | | |
| | | Amplitude Loss | | | |
| | 500 mV/div | Vrms1 | | | |
| | | Vrms2 | | | |
| | | Amplitude Loss | | | |
| CH2 | 100 mV/div | Vrms1 | | | |
| | | Vrms2 | | | |
| | | Amplitude Loss | | | |
| | 200 mV/div | Vrms1 | | | |
| | | Vrms2 | | | |
| | | Amplitude Loss | | | |
| | 500 mV/div | Vrms1 | | | |
| | | Vrms2 | | | |
| | | Amplitude Loss | | | |

**Note[1]:** amplitude loss (dB) = $20\times lg^{(Vrms2/Vrms1)}$.

### Bandwidth Limit Test:

| Channel | Vertical Scale | Test Result | | Limit | Pass/Fail |
|---|---|---|---|---|---|
| CH1 | 100 mV/div | Vrms1 | | -- | |
| | | Vrms2 | | | |
| | | Vrms3 | | | |
| | | Amplitude Loss[1] (dB) = $20\times lg^{(Vrms2/Vrms1)}$ | | ≥ -3 dB and ≤ 1 dB | |
| | | Amplitude Loss[1] (dB) = $20\times lg^{(Vrms3/Vrms1)}$ | | ≤ 3 dB | |
| | 200 mV/div | Vrms1 | | -- | |
| | | Vrms2 | | | |
| | | Vrms3 | | | |
| | | Amplitude Loss[1] (dB) = $20\times lg^{(Vrms2/Vrms1)}$ | | ≥ -3 dB and ≤ 1 dB | |
| | | Amplitude Loss[1] (dB) = $20\times lg^{(Vrms3/Vrms1)}$ | | ≤3 dB | |
| | 500 mV/div | Vrms1 | | -- | |
| | | Vrms2 | | | |
| | | Vrms3 | | | |
| | | Amplitude Loss[1] (dB) = $20\times lg^{(Vrms2/Vrms1)}$ | | ≥ -3 dB and ≤ 1 dB | |
| | | Amplitude Loss[1] (dB) = $20\times lg^{(Vrms3/Vrms1)}$ | | ≤ 3 dB | |
| CH2 | 100 mV/div | Vrms1 | | -- | |
| | | Vrms2 | | | |
| | | Vrms3 | | | |
| | | Amplitude Loss[1] (dB) = $20\times lg^{(Vrms2/Vrms1)}$ | | ≥ -3 dB and ≤ 1 dB | |
| | | Amplitude Loss[1] (dB) = $20\times lg^{(Vrms3/Vrms1)}$ | | ≤ 3 dB | |
| | 200 mV/div | Vrms1 | | -- | |
| | | Vrms2 | | | |
| | | Vrms3 | | | |
| | | Amplitude Loss[1] (dB) = $20\times lg^{(Vrms2/Vrms1)}$ | | ≥ -3 dB and ≤ 1 dB | |
| | | Amplitude Loss[1] (dB) = $20\times lg^{(Vrms3/Vrms1)}$ | | ≤ 3 dB | |
| | 500 mV/div | Vrms1 | | -- | |
| | | Vrms2 | | | |
| | | Vrms3 | | | |
| | | Amplitude Loss[1] (dB) = $20\times lg^{(Vrms2/Vrms1)}$ | | ≥ -3 dB and ≤ 1 dB | |
| | | Amplitude Loss[1] (dB) = $20\times lg^{(Vrms3/Vrms1)}$ | | ≤ 3 dB | |

**Note[1]:** amplitude loss (dB) = $20\times lg^{(Vrmsn/Vrms1)}$. Wherein, Vrmsn represents Vrms2 and Vrms3.

### Time Base Accuracy Test:

| Channel | Test Result ΔT | Calculation Result | Limit | Pass/Fail |
|---|---|---|---|---|
| CH1 | | | ±50 ppm | |

**Zero Point Offset Test:**

| Channel | Fast Edge Signal Amplitude | Vertical Scale | Test Result | Limit | Pass/Fail |
|---|---|---|---|---|---|
| CH1 | 600 mV | 100 mV/div | | ≤ 500 ps | |
| | 3 V | 500 mV/div | | | |
| CH2 | 600 mV | 100 mV/div | | | |
| | 3 V | 500 mV/div | | | |