RIGOL

Performance Verification Guide

DS4000 Series Digital Oscilloscope

Jul. 2013

RIGOL Technologies, Inc.

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Publication Number

PVA10102-1110

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If you have any problem or requirement when using our products or this manual, please contact **RIGOL**.

E-mail: service@rigol.com
Websites: www.rigol.com

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:

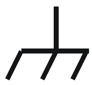
DANGER indicates an injury or hazard may immediately happen.
WARNING indicates an injury or hazard may be accessible potentially.
CAUTION indicates a potential damage to the instrument or other property might occur.

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

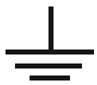
Hazardous Voltage

Safety Warning

Protective Earth Terminal



Chassis Ground



Test Ground

Contents

Document Overview

This manual guides users to correctly test the performance of **RIGOL** DS4000 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 Verification Test
This chapter introduces the limit, test devices 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 recording the test results 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, **System**.
Operation Step: denoted by an arrow "→", for example, **Utility** → **System**.
Link: denoted by the blue characters which are bold and underlined, for example, **Chapter 1 Overview**

Content Conventions in this Manual:

In this manual, DS4054 is taken as an example to illustrate the performance verification method. The introductions in this manual are applicable to all the models of the DS4000 series:

Model	Analog Band-width	Channels	Max Real-time Sample Rate	Standard Memory Depth	Wave-form Capture Rate
DS4054	500	4	4 GSa/s	140 Mpts	Up to 110 000 wfs/s
DS4052	500	2			
DS4034	350	4			
DS4032	350	2			
DS4024	200	4			
DS4022	200	2			
DS4014	100	4			
DS4012	100	2			

Chapter 1 Overview

Test Preparations

The following preparations should be done before the test:

1. Self-test: perform self-test to make sure that the oscilloscope can work normally;
2. Warm-up: warm the oscilloscope up for at least 30 minutes;
3. Self-calibration: calibrate the oscilloscope.

Self-test

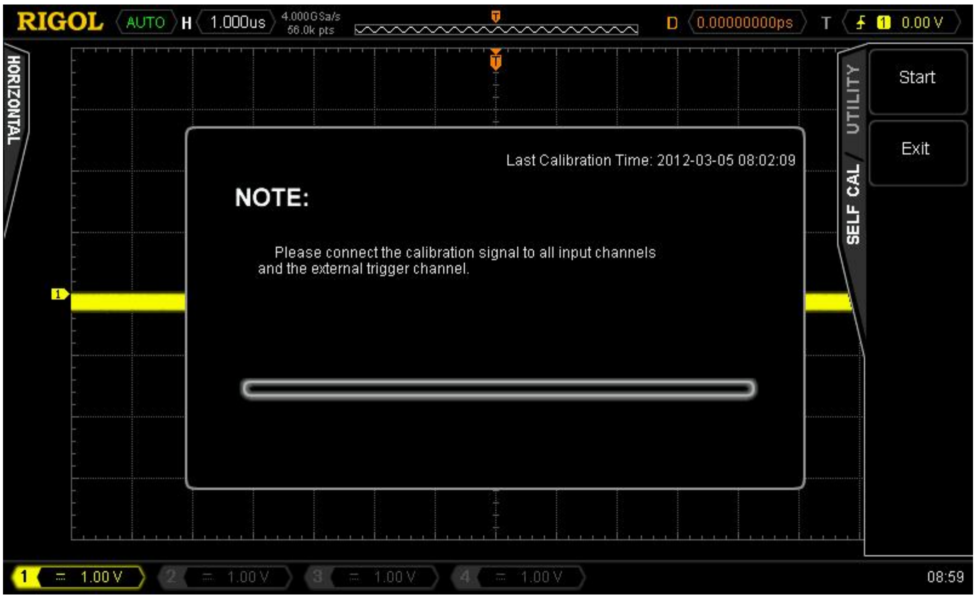
When the oscilloscope is in power-on state, press the power key  at the lower left corner of the front panel to start the oscilloscope. During the start-up, the instrument performs a series of self-test items and users can hear the sound of relay switching. The welcome screen is displayed after the self-test is finished. Users can view the self-test result through **Utility** → **System** → **SelfTestInfo**.

If the self-test fails, make sure that the problems are found and resolved and do not perform calibration and performance test until the instrument passes the self-test.

Self-calibration

Make sure that the oscilloscope has been warmed up or running for more than 30 minutes before performing self-calibration. Then, follow the steps to calibrate the oscilloscope.

1. Connect the **[Trigout/Calibration]** connector at the rear panel to the four input channels and external trigger input channel using the **BNC One-to-Five Cable**.
2. Press **Utility** → **Self-Cal** and the self-calibration interface as shown in the figure below will be displayed on the screen.



3. Press **Start** and the oscilloscope will start to execute the self-calibration program.
4. It takes about 20 minutes (15 minutes for two-channel model) to finish the calibration. Restart the oscilloscope when the "Calibration finished, please restart the oscilloscope!" message is displayed.
5. Press **Acquire** → **Acquisition** to select "Average", and then, press **Averages** to set the number of averages to 16.
6. Disconnect the input signals of all the channels and observe the offset of the waveform of each channel at 2 mV/div scale. Calibrate again if the offset exceeds 1div.

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 Verification Test

This chapter introduces the performance verification test method and procedures of DS4000 series digital oscilloscope by taking DS4054 as an example. You can perform the following tests 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 Device List:

Device	Specification	Recommended Model
Oscilloscope Calibrator	Output range of DC voltage: 1 MΩ: 1 mV to 200 V 50 MΩ：1 mV to 200 V 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-test and self-calibration before executing performance verification test.
2. Make sure that the oscilloscope has been warmed up for at least 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

Specification:

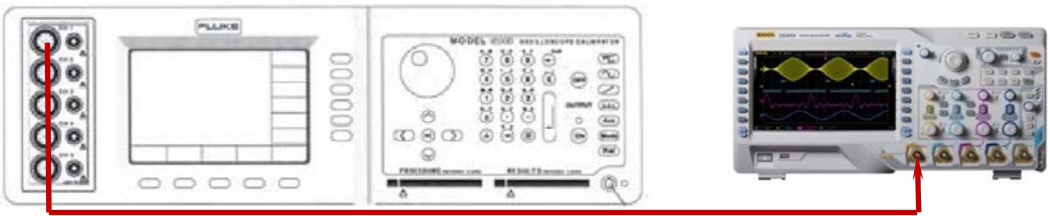
Input Impedance	1 MΩ：0.99 MΩ to 1.01 MΩ 50 Ω：49.99 Ω to 50.01 Ω

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 to CH4 when the input impedance is 1 MΩ

1) Connect the active head of Fluke 9500B to CH1 of the oscilloscope, as shown in the figure below.



2) Configure the oscilloscope:
   a) Press **CH1** in the vertical control area (VERTICAL) at the front panel to enable CH1.
   b) Press **CH1** → **Input** to set the input impedance to 1 MΩ.
   c) Rotate **VERTICAL** **SCALE** to set the vertical scale of CH1 to 100 mV/div.
3) Enable Fluke 9500B, set the impedance to 1 MΩ 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, CH3 and CH4, and record the test results.

2. Impedance test of CH1 to CH4 when the input impedance is 50 Ω

1) Connect the active head of Fluke 9500B to CH1 of the oscilloscope and enable CH1.
2) Keep other configurations unchanged and set the input impedance of CH1 to 50 Ω and the vertical scale of CH1 to 100 mV/div.
3) Enable Fluke 9500B, set the impedance to 50 Ω 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, CH3 and CH4, and record the test results.

3. Impedance test of [EXT TRIG] channel:

1) Disconnect the connections of the four input channels.
2) Connect the active head of Fluke 9500B to the external trigger channel **[EXT TRIG]** of the oscilloscope.
3) Press **UTIL** → **Ext Trigger** to set the input impedance of the external trigger channel to 1 MΩ.
4) Enable Fluke 9500B, set the impedance to 1 MΩ and select the resistance measurement function, read and record the resistance measurement value.
5) Press **UTIL** → **Ext Trigger** to set the input impedance of the external trigger channel to 50 Ω.
6) Set the impedance of Fluke 9500B to 50 Ω, read and record the resistance measurement value.

Test Record Form: CH1-CH4 input impedance is 1MΩ

Channel	Vertical Scale	Test Result	Limit	Pass/Fail
CH1	100 mV/div		≥ 0.99 MΩ and ≤1.01 MΩ	
	500 mV/div			
CH2	100 mV/div			
	500 mV/div			
CH3	100 mV/div			
	500 mV/div			
CH4	100 mV/div			
	500 mV/div			

Test Record Form: CH1-CH4 input impedance is 50 Ω

Channel	Vertical Scale	Test Result	Limit	Pass/Fail
CH1	100 mV/div		≥49.99 Ω and ≤50.01 Ω	
	500 mV/div			
CH2	100 mV/div			
	500 mV/div			
CH3	100 mV/div			
	500 mV/div			
CH4	100 mV/div			
	500 mV/div			

Test Record Form: external trigger channel

Channel	Input Impedance	Test Result	Limit	Pass/Fail
EXT TRIG	50 Ω		≥49.99 Ω and ≤50.01 Ω	
	1 MΩ		≥0.99 MΩ and ≤1.01MΩ	

DC Gain Accuracy Test

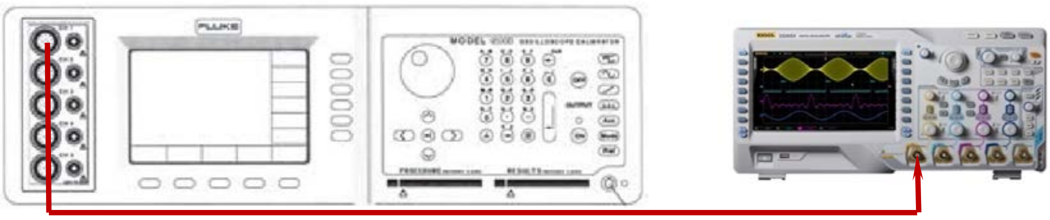
Specification:

DC Gain Accuracy	≤2%×Full Scale
Explanation: Full Scale = 8 div×vertical scale. Relative error of each scale: |(Vavg1–Vavg2)–(V_{out1}-V_{out2})|/Full Scale×100%≤2%; otherwise, the test fails. For example, when the vertical scale is 1 V/div, input DC signals with +1 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-(-6.04 V))-(+3 V-(-3 V)) |/(1 V/div*8 div) × 100% = 1.25% and the test passes.	

Test Device: Fluke 9500B

Test Procedures:

1. **DC gain accuracy test when the input impedance is 50 Ω**
   1) Connect the active head of Fluke 9500B to CH1 of the oscilloscope, as shown in the figure below.



   2) Enable Fluke 9500B and set the impedance to 50 Ω.
   3) Output a DC signal with +3 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) Press **CH1** → **Input** to set the input impedance to 1 MΩ.
      c) Rotate **VERTICAL** **SCALE** to set the vertical scale to 1 mV/div.
      d) Rotate **HORIZONTAL** **SCALE** to set the horizontal time base to 2 ms.
      e) Rotate **VERTICAL** **POSITION** to set the vertical position to 0.
      f) Press **ACQ** → **Acquisition** and use to select "Average". Then, press **Averages** and use to set the number of averages to 32.
   5) Press **MENU** → **Vavg** at the left of the screen to enable the average measurement function of the oscilloscope. Read and record Vavg1.
   6) Adjust Fluke 9500B to output a DC signal with -3 mV_{DC} voltage (V_{out2}).
   7) Press **MENU** → **Vavg** at the left of the screen to enable the average measurement function of the oscilloscope. Read and record Vavg2.
   8) Calculate the relative error of the scale: |(Vavg1–Vavg2)–(V_{out1}-V_{out2})|/Full Scale×100%.
   9) Keep other settings of the oscilloscope unchanged:
      a) Set the vertical scale to 2 mv/div, 5 mV/div, 10 mV/div, 20 mV/div, 50 mV/div, 100 mV/div, 200 mV/div, 500 mV/div, 1 V/div respectively.
      b) Adjust the output voltage of Fluke 9500B to ±3 div respectively.

c) Repeat steps 1), 2), 3), 4), 5), 6) and 7) and record the test results.

d) Calculate the relative error of each scale: |(Vavg1–Vavg2)–(V_{out1}-V_{out2})|/Full Scale×100%.

10) Turn CH1 off. Repeat the above test steps to test CH2, CH3 and CH4, and record the test results.

2. DC gain accuracy test when the input impedance is 1 MΩ

1) Keep the other configurations unchanged and set the input impedance of all the channels of the oscilloscope to 1 MΩ.
2) Set the impedance of Fluke 9500B to 1 MΩ.
3) Set the vertical scale of the oscilloscope to 2 mV/div, 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 and 5 V/div successively.
4) Adjust the output voltage of Fluke 9500B to ±3 div successively.
5) According to the test method described in **DC gain accuracy test when the input impedance is 50 Ω** to test CH1 to CH4 respectively and record the test results; then, calculate the relative error of the scale.

Test Record Form: the input impedance is 50 Ω

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

(Continued) Test Record Form: the input impedance is 50 Ω

Channel	Vertical Scale	Test Result			Limit	Pass/Fail
		Vavg1	Vavg2	Calculation Result[1]		
CH3	1 mV/div				≤ 2%	
	2 mV/div					
	5 mV/div					
	10 mV/div					
	20 mV/div					
	50 mV/div					
	100 mV/div					
	200 mV/div					
	500 mV/div					
	1 V/div					
CH4	1 mV/div					
	2 mV/div					
	5 mV/div					
	10 mV/div					
	20 mV/div					
	50 mV/div					
	100 mV/div					
	200 mV/div					
	500 mV/div					
	1 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.

Test Record Form: the input impedance is 1 MΩ

Channel	Vertical Scale	Test Result			Limit	Pass/Fail
		Vavg1	Vavg2	Calculation Result[1]		
CH1	1 mV/div				≤ 2%	
	2 mV/div					
	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					
CH2	1 mV/div					
	2 mV/div					
	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					

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.

(Continued) Test Record Form: the input impedance is 1 MΩ

Channel	Vertical Scale	Test Result			Limit	Pass/Fail
		Vavg1	Vavg2	Calculation Result[1]		
CH3	1 mV/div				≤ 2%	
	2 mV/div					
	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					
CH4	1 mV/div					
	2 mV/div					
	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					

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

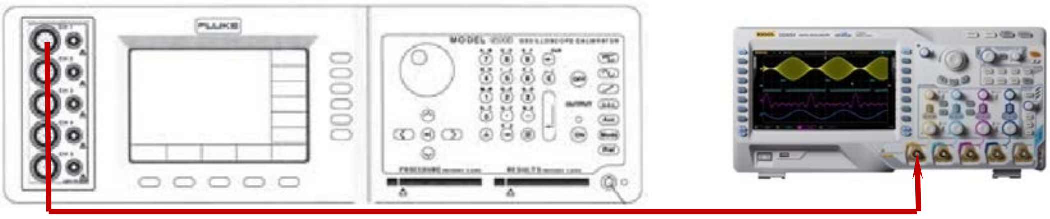
Specification:

Amplitude Loss	-3 dB to 1 dB
Explanation: 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, as shown in the figure below.



2) Enable Fluke 9500B and set the impedance to 50 Ω.
3) Configure the oscilloscope:
   a) Press **CH1** in the vertical control area (VERTICAL) at the front panel to enable CH1.
   b) Press **CH1** → **Input** to set the input impedance to 50 Ω.
   c) Rotate **HORIZONTAL** **SCALE** to set the horizontal time base to 500 ns.
   d) Rotate **VERTICAL** **SCALE** to set the vertical scale to 100 mV/div.
   e) Rotate **HORIZONTAL** **POSITION** and **VERTICAL** **POSITION** to set the horizontal position and vertical position to 0 respectively.
   f) Rotate **TRIGGER** **LEVEL** to set the trigger level to 0 V.
4) Output a sine signal with 1 MHz frequency and 600 mVpp amplitude from Fluke 9500B.
5) Press **MENU** → **Vrms** at the left of the screen to enable the root mean square measurement function of the oscilloscope. Read and record Vrms1.
6) Output a sine signal with 500 MHz frequency (for different bandwidth of DS4000 series oscilloscope, the corresponding frequency output is full bandwidth) and 600 mVpp amplitude from Fluke 9500B.
7) Rotate **HORIZONTAL** **SCALE** of the oscilloscope to set the horizontal time base to 1 ns (for 350 MHz and 200 MHz bandwidth models, the time base is 5 ns; for 100MHz bandwidth models, the time base is 10 ns).
8) Press **MENU** → **Vrms** at the left of the screen to enable the root mean square measurement function of the oscilloscope. Read and record 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.
11) Output a sine signal with 1 MHz frequency and 1.2 Vpp amplitude from Fluke 9500B.

12) Repeat step 5).
13) Output a sine signal with 500 MHz frequency (for different bandwidth of DS4000 series oscilloscope, the corresponding frequency output is full bandwidth) and 1.2 Vpp amplitude from Fluke 9500B.
14) Repeat steps 7), 8) and 9).
15) Keep the other settings of the oscilloscope unchanged and set the vertical scale to 500 mV/div.
16) Output a sine signal with 1 MHz frequency and 3 Vpp amplitude from Fluke 9500B.
17) Repeat step 5).
18) Output a sine signal with 500 MHz frequency (for different bandwidth of DS4000 series oscilloscope, the corresponding frequency output is full bandwidth) and 3 Vpp amplitude from Fluke 9500B.
19) Repeat steps 7), 8) and 9).
20) Turn CH1 off. Test CH2, CH3 and CH4 respectively 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		≥ -3 dB and ≤ 1 dB	
		Vrms2			
		Amplitude Loss[1]			
	200 mV/div	Vrms1			
		Vrms2			
		Amplitude Loss[1]			
	500 mV/div	Vrms1			
		Vrms2			
		Amplitude Loss[1]			
CH2	100 mV/div	Vrms1			
		Vrms2			
		Amplitude Loss[1]			
	200 mV/div	Vrms1			
		Vrms2			
		Amplitude Loss[1]			
	500 mV/div	Vrms1			
		Vrms2			
		Amplitude Loss[1]			
CH3	100 mV/div	Vrms1			
		Vrms2			
		Amplitude Loss[1]			
	200 mV/div	Vrms1			
		Vrms2			
		Amplitude Loss[1]			
	500 mV/div	Vrms1			
		Vrms2			
		Amplitude Loss[1]			
CH4	100 mV/div	Vrms1			
		Vrms2			
		Amplitude Loss[1]			
	200 mV/div	Vrms1			
		Vrms2			
		Amplitude Loss[1]			
	500 mV/div	Vrms1			
		Vrms2			
		Amplitude Loss[1]			

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

Bandwidth Limit Test

Bandwidth limit test verifies the 20 MHz bandwidth limit, 100 MHz and 200 MHz bandwidth limit functions respectively.

The bandwidth limits available for oscilloscopes with different bandwidths are different.

Models	Bandwidth Limit
DS405x/ DS403x	20 MHz/100 MHz/200 MHz
DS402x	20 MHz/100 MHz
DS401x	20 MHz

20MHz Bandwidth Limit Test

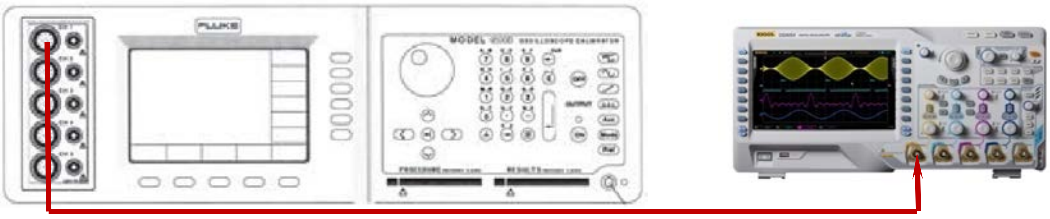
Specification:

Amplitude Loss	-3 dB to 1 dB
Explanation: Amplitude Loss (dB) = 20×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, as shown in the figure below.



2) Enable Fluke 9500B and set the impedance to 50 Ω.
3) Configure the oscilloscope:
   a) Press **CH1** in the vertical control area (VERTICAL) at the front panel to enable CH1.
   b) Press **CH1** → **Input** to set the input impedance to 50 Ω.
   c) Rotate **VERTICAL** **SCALE** to set the vertical scale to 100 mV/div.
   d) Rotate **HORIZONTAL** **SCALE** to set the horizontal time base to 500 ns.
   e) Rotate **HORIZONTAL** **POSITION** and **VERTICAL** **POSITION** to set the horizontal position and vertical position to 0 respectively.
   f) Rotate **TRIGGER** **LEVEL** to set the trigger level to 0 V.
4) Press **CH1** → **BW Limit** and use to select "20 MHz" bandwidth limit.
5) Output a sine signal with 1 MHz frequency and 600 mVpp amplitude from Fluke 9500B.
6) Press **MENU** →**Vrms** at the left of the screen to enable the root mean square measurement function of the oscilloscope. Read and record Vrms1.
7) Output a sine signal 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) Press **MENU** →**Vrms** at the left of the screen to enable the root mean square measurement function of the oscilloscope. Read and record Vrms2.
10) Calculate the amplitude loss and compare it to the specification: Amplitude Loss (dB) = 20×lg$^{(Vrms2/Vrms1)}$. Amplitude loss should be in the range of the specification at this point.
11) Output a sine signal 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) Press **MENU** →**Vrms** at the left of the screen to enable the root mean square

measurement function of the oscilloscope. Read and record Vrms3.

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 signal with 1 MHz frequency and 1.2 Vpp amplitude from Fluke 9500B.
17) Repeat step 6).
18) Output a sine signal with 20 MHz frequency and 1.2 Vpp amplitude from Fluke 9500B.
19) Repeat step 8), 9) and 10).
20) Output a sine signal 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 signal with 1 MHz frequency and 3 Vpp amplitude from Fluke 9500B.
24) Repeat step 6).
25) Output a sine signal with 20 MHz frequency and 3 Vpp amplitude from Fluke 9500B.
26) Repeat step 8), 9) and 10).
27) Output a sine signal with 50 MHz frequency and 3 Vpp amplitude from Fluke 9500B.
28) Repeat step 12), 13) and 14).
29) Turn CH1 off. Test CH2, CH3 and CH4 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) = $20\times lg^{(Vrmsn/Vrms1)}$. Wherein, Vrmsn represents Vrms2 and Vrms3.

(Continued) Test Record Form:

Channel	Vertical Scale	Test Result		Limit	Pass/Fail
CH3	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	
CH4	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.

100MHz Bandwidth Limit Test

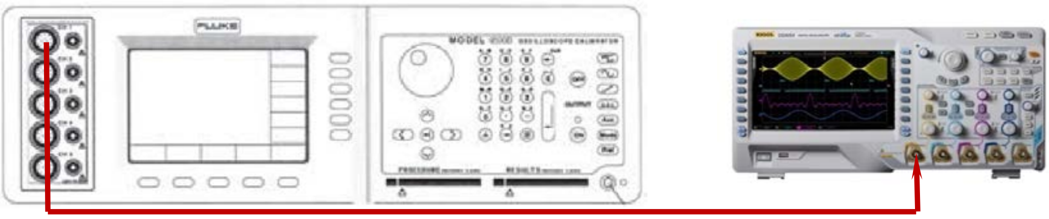
Specification:

Amplitude Loss	-3 dB to 1 dB
Explanation: 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, as shown in the figure below.



2) Enable Fluke 9500B and set the impedance to 50 Ω.
3) Configure the oscilloscope:
   g) Press **CH1** in the vertical control area (VERTICAL) at the front panel to enable CH1.
   h) Press **CH1** → **Input** to set the input impedance to 50 Ω.
   i) Rotate **VERTICAL** **SCALE** to set the vertical scale to 100 mV/div.
   j) Rotate **HORIZONTAL** **SCALE** to set the horizontal time base to 500 ns.
   k) Rotate **HORIZONTAL** **POSITION** and **VERTICAL** **POSITION** to set the horizontal position and vertical position to 0 respectively.
   l) Rotate **TRIGGER** **LEVEL** to set the trigger level to 0 V.
4) Press **CH1** → **BW Limit** and use to select "100 MHz" bandwidth limit.
5) Output a sine signal with 1 MHz frequency and 600 mVpp amplitude from Fluke 9500B.
6) Press **MENU** →**Vrms** at the left of the screen to enable the root mean square measurement function of the oscilloscope. Read and record Vrms1.
7) Output a sine signal with 100 MHz frequency and 600 mVpp amplitude from Fluke 9500B.
8) Rotate **HORIZONTAL** **SCALE** of the oscilloscope to set the horizontal time base to 10 ns.
9) Press **MENU** →**Vrms** at the left of the screen to enable the root mean square measurement function of the oscilloscope. Read and record 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 signal with 200 MHz frequency and 600 mVpp amplitude from Fluke 9500B.
12) Rotate **HORIZONTAL** **SCALE** of the oscilloscope to set the horizontal time base to 5 ns.
13) Press **MENU** →**Vrms** at the left of the screen to enable the root mean square

measurement function of the oscilloscope. Read and record Vrms3.

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 signal with 1 MHz frequency and 1.2 Vpp amplitude from Fluke 9500B.
17) Repeat step 6).
18) Output a sine signal with 100 MHz frequency and 1.2 Vpp amplitude from Fluke 9500B.
19) Repeat step 8), 9) and 10).
20) Output a sine signal with 200 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 signal with 1 MHz frequency and 3 Vpp amplitude from Fluke 9500B.
24) Repeat step 6).
25) Output a sine signal with 200 MHz frequency and 3 Vpp amplitude from Fluke 9500B.
26) Repeat step 8), 9) and 10).
27) Output a sine signal with 400 MHz frequency and 3 Vpp amplitude from Fluke 9500B.
28) Repeat step 12), 13) and 14).
29) Turn CH1 off. Test CH2, CH3 and CH4 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) = $20\times lg^{(Vrmsn/Vrms1)}$. Wherein, Vrmsn represents Vrms2 and Vrms3.

(Continued) Test Record Form:

Channel	Vertical Scale	Test Result		Limit	Pass/Fail
CH3	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	
CH4	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.

200MHz Bandwidth Limit Test

Specification:

Amplitude Loss	-3 dB to 1 dB
Explanation: 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, as shown in the figure below.

2) Enable Fluke 9500B and set the impedance to 50 Ω.
3) Configure the oscilloscope:
   m) Press **CH1** in the vertical control area (VERTICAL) at the front panel to enable CH1.
   n) Press **CH1** → **Input** to set the input impedance to 50 Ω.
   o) Rotate **VERTICAL** **SCALE** to set the vertical scale to 100 mV/div.
   p) Rotate **HORIZONTAL** **SCALE** to set the horizontal time base to 500 ns.
   q) Rotate **HORIZONTAL** **POSITION** and **VERTICAL** **POSITION** to set the horizontal position and vertical position to 0 respectively.
   r) Rotate **TRIGGER** **LEVEL** to set the trigger level to 0 V.
4) Press **CH1** → **BW Limit** and use to select "200 MHz" bandwidth limit.
5) Output a sine signal with 1 MHz frequency and 600 mVpp amplitude from Fluke 9500B.
6) Press **MENU** →**Vrms** at the left of the screen to enable the root mean square measurement function of the oscilloscope. Read and record Vrms1.
7) Output a sine signal with 200 MHz frequency and 600 mVpp amplitude from Fluke 9500B.
8) Rotate **HORIZONTAL** **SCALE** of the oscilloscope to set the horizontal time base to 5 ns.
9) Press **MENU** →**Vrms** at the left of the screen to enable the root mean square measurement function of the oscilloscope. Read and record 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 signal with 400 MHz frequency and 600 mVpp amplitude from Fluke 9500B.
12) Rotate **HORIZONTAL** **SCALE** of the oscilloscope to set the horizontal time base to 5 ns.
13) Press **MENU** →**Vrms** at the left of the screen to enable the root mean square

measurement function of the oscilloscope. Read and record Vrms3.

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 signal with 1 MHz frequency and 1.2 Vpp amplitude from Fluke 9500B.
17) Repeat step 6).
18) Output a sine signal with 200 MHz frequency and 1.2 Vpp amplitude from Fluke 9500B.
19) Repeat step 8), 9) and 10).
20) Output a sine signal with 400 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 signal with 1 MHz frequency and 3 Vpp amplitude from Fluke 9500B.
24) Repeat step 6).
25) Output a sine signal with 200 MHz frequency and 3 Vpp amplitude from Fluke 9500B.
26) Repeat step 8), 9) and 10).
27) Output a sine signal with 400 MHz frequency and 3 Vpp amplitude from Fluke 9500B.
28) Repeat step 12), 13) and 14).
29) Turn CH1 off. Test CH2, CH3 and CH4 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×lg$^{(Vrms2/Vrms1)}$		≥-3 dB and ≤1 dB	
		Amplitude Loss[1] (dB) = 20×lg$^{(Vrms3/Vrms1)}$		≤-3 dB	
	200 mV/div	Vrms1		--	
		Vrms2			
		Vrms3			
		Amplitude Loss[1] (dB) = 20×lg$^{(Vrms2/Vrms1)}$		≥-3 dB and ≤1 dB	
		Amplitude Loss[1] (dB) = 20×lg$^{(Vrms3/Vrms1)}$		≤-3 dB	
	500 mV/div	Vrms1		--	
		Vrms2			
		Vrms3			
		Amplitude Loss[1] (dB) = 20×lg$^{(Vrms2/Vrms1)}$		≥-3 dB and ≤1 dB	
		Amplitude Loss[1] (dB) = 20×lg$^{(Vrms3/Vrms1)}$		≤-3 dB	
CH2	100 mV/div	Vrms1		--	
		Vrms2			
		Vrms3			
		Amplitude Loss[1] (dB) = 20×lg$^{(Vrms2/Vrms1)}$		≥-3 dB and ≤1 dB	
		Amplitude Loss[1] (dB) = 20×lg$^{(Vrms3/Vrms1)}$		≤-3 dB	
	200 mV/div	Vrms1		--	
		Vrms2			
		Vrms3			
		Amplitude Loss[1] (dB) = 20×lg$^{(Vrms2/Vrms1)}$		≥-3 dB and ≤1 dB	
		Amplitude Loss[1] (dB) = 20×lg$^{(Vrms3/Vrms1)}$		≤-3 dB	
	500 mV/div	Vrms1		--	
		Vrms2			
		Vrms3			
		Amplitude Loss[1] (dB) = 20×lg$^{(Vrms2/Vrms1)}$		≥-3 dB and ≤1 dB	
		Amplitude Loss[1] (dB) = 20×lg$^{(Vrms3/Vrms1)}$		≤-3 dB	

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

(Continued) Test Record Form:

Channel	Vertical Scale	Test Result		Limit	Pass/ Fail
CH3	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	
CH4	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

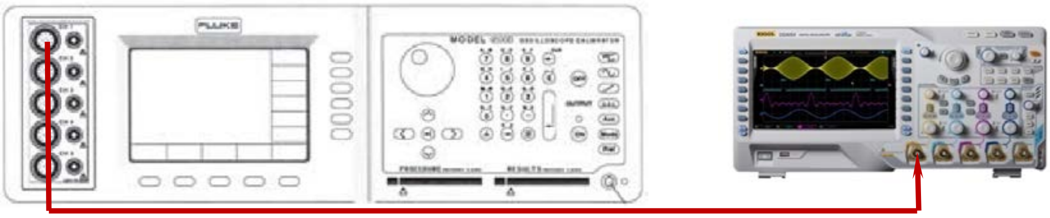
Specification:

Time Base Accuracy [1]	≤ ±(4 ppm + 2 ppm/year×completed years of service[2])
Note[1]: typical value. **Note[2]:** for the completed years of service of the instrument, calculate it according to the date in the verification certificate provided when the instrument left the factory.	

Test Devices: Fluke 9500B

Test Procedures:

1) Connect the active head of Fluke 9500B to CH1 of the oscilloscope, as shown in the figure below.



2) Output a sine waveform with 10 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 2 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 1 ns, the time base accuracy is 1 ns/1 ms=1 ppm.
6) Calculate the limit of the time base accuracy using the limit formula "±(4 ppm + 2 ppm/year×completed years of service)".

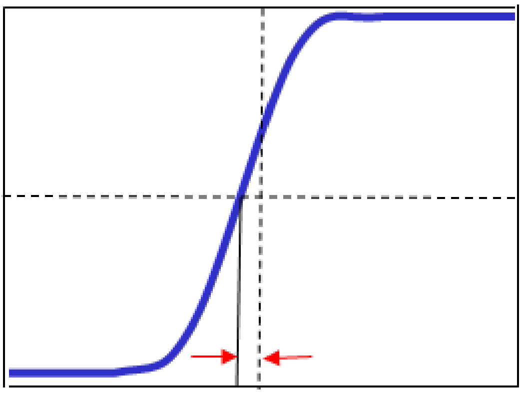
Test Record Form:

Channel	Test Result ΔT	Calculation Result	Limit	Pass/Fail
CH1			≤ ±(4 ppm + 2 ppm/year×completed years of service[1])	

Note [1]: for the completed years of service of the instrument, calculate it according to the date in the verification certificate provided when the instrument left the factory.

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

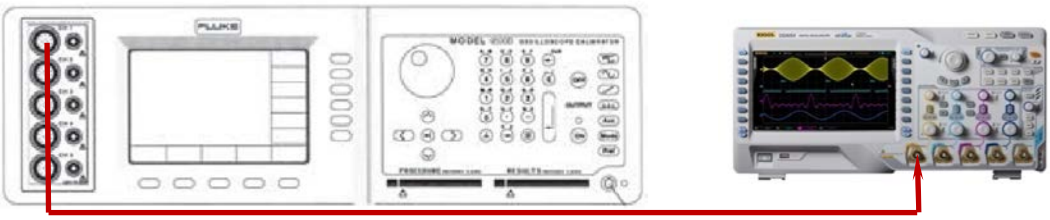
Specification:

Zero Point Offset	250 ps

Test Devices: Fluke 9500B

Test Procedures:

1) Connect the active head of Fluke 9500B to CH1 of the oscilloscope, as shown in the figure below.



2) Enable Fluke 9500B and set the impedance to 50 Ω.
3) Output a fast edge signal with 150 ps rise time and 1.2 V 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) Press **CH1** → **Input** to set the input impedance to 50 Ω.
   c) Rotate **VERTICAL** **SCALE** to set the vertical scale to 200 mV/div.
   d) Rotate **HORIZONTAL** **SCALE** to set the horizontal time base to 1 ns (for 350 MHz, 200MHz, 100 MHz bandwidth models, the horizontal time base is 2 ns, 2 ns, 5 ns successively).
   e) Rotate **TRIGGER** **LEVEL** to adjust the trigger level to the middle of the screen.
   f) Rotate **VERTICAL** **POSITION** and **HORIZONTAL** **POSITION** to set the vertical position and horizontal position to appropriate values respectively.

5) 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.
6) Keep other settings unchanged and set the vertical scale of the oscilloscope to 500 mV/div.
7) Output a fast edge signal with 150 ps rise time and 3 V amplitude from Fluke 9500B.
8) Measure the zero point offset according to the above method and record the test result.
9) Turn CH1 off. Repeat the above test steps to measure CH2, CH3 and CH4, and record the test results.

Test Record Form:

Channel	Fast Edge Signal Amplitude	Vertical Scale	Test Result	Limit	Pass/Fail
CH1	1.2 Vpp	200 mV/div		≤ 250 ps	
	3 Vpp	500 mV/div			
CH2	1.2 Vpp	200 mV/div			
	3 Vpp	500 mV/div			
CH3	1.2 Vpp	200 mV/div			
	3 Vpp	500 mV/div			
CH4	1.2 Vpp	200 mV/div			
	3 Vpp	500 mV/div			

Appendix Test Record Form

RIGOL DS4000 Series Digital Oscilloscope Performance Verification Test Record Form

Model: _______________ Tested by: _______________ Test Date: ______________

Impedance Test

Test Record Form: CH1-CH4 input impedance is 1MΩ

Channel	Vertical Scale	Test Result	Limit	Pass/Fail
CH1	100 mV/div		≥ 0.99 MΩ and ≤1.01 MΩ	
	500 mV/div			
CH2	100 mV/div			
	500 mV/div			
CH3	100 mV/div			
	500 mV/div			
CH4	100 mV/div			
	500 mV/div			

Test Record Form: CH1-CH4 input impedance is 50 Ω

Channel	Vertical Scale	Test Result	Limit	Pass/Fail
CH1	100 mV/div		≥49.99 Ω and ≤50.01 Ω	
	500 mV/div			
CH2	100 mV/div			
	500 mV/div			
CH3	100 mV/div			
	500 mV/div			
CH4	100 mV/div			
	500 mV/div			

Test Record Form: external trigger channel

Channel	Input Impedance	Test Result	Limit	Pass/Fail
EXT TRIG	50 Ω		≥49.99 Ω and ≤50.01 Ω	
	1 MΩ		≥0.99 MΩ and ≤1.01MΩ	

DC Gain Accuracy Test

Test Record Form: the input impedance is 50 Ω

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

(Continued) Test Record Form: the input impedance is 50 Ω

Channel	Vertical Scale	Test Result			Limit	Pass/Fail
		Vavg1	Vavg2	Calculation Result[1]		
CH3	1 mV/div				≤ 2%	
	2 mV/div					
	5 mV/div					
	10 mV/div					
	20 mV/div					
	50 mV/div					
	100 mV/div					
	200 mV/div					
	500 mV/div					
	1 V/div					
CH4	1 mV/div					
	2 mV/div					
	5 mV/div					
	10 mV/div					
	20 mV/div					
	50 mV/div					
	100 mV/div					
	200 mV/div					
	500 mV/div					
	1 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.

Test Record Form: the input impedance is 1 MΩ

Channel	Vertical Scale	Test Result			Limit	Pass/Fail
		Vavg1	Vavg2	Calculation Result[1]		
CH1	1 mV/div				≤ 2%	
	2 mV/div					
	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					
CH2	1 mV/div					
	2 mV/div					
	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					

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.

(Continued) Test Record Form: the input impedance is 1 MΩ

Channel	Vertical Scale	Test Result			Limit	Pass/Fail
		Vavg1	Vavg2	Calculation Result[1]		
CH3	1 mV/div				≤ 2%	
	2 mV/div					
	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					
CH4	1 mV/div					
	2 mV/div					
	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					

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

Test Record Form:

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[1]			
	500 mV/div	Vrms1			
		Vrms2			
		Amplitude Loss[1]			
CH2	100 mV/div	Vrms1			
		Vrms2			
		Amplitude Loss[1]			
	200 mV/div	Vrms1			
		Vrms2			
		Amplitude Loss[1]			
	500 mV/div	Vrms1			
		Vrms2			
		Amplitude Loss[1]			
CH3	100 mV/div	Vrms1			
		Vrms2			
		Amplitude Loss[1]			
	200 mV/div	Vrms1			
		Vrms2			
		Amplitude Loss[1]			
	500 mV/div	Vrms1			
		Vrms2			
		Amplitude Loss[1]			
CH4	100 mV/div	Vrms1			
		Vrms2			
		Amplitude Loss[1]			
	200 mV/div	Vrms1			
		Vrms2			
		Amplitude Loss[1]			
	500 mV/div	Vrms1			
		Vrms2			
		Amplitude Loss[1]			

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

Bandwidth Limit Test

Test Record Form: 20 MHz 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.

(Continued) Test Record Form: 20 MHz Bandwidth Limit Test

Channel	Vertical Scale	Test Result		Limit	Pass/Fail
CH3	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	
CH4	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.

Test Record Form: 100 MHz 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.

(Continued) Test Record Form: 100 MHz Bandwidth Limit Test

Channel	Vertical Scale	Test Result		Limit	Pass/Fail
CH3	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	
CH4	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.

Test Record Form: 200 MHz 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.

(Continued) Test Record Form: 200 MHz Bandwidth Limit Test

Channel	Vertical Scale	Test Result		Limit	Pass/Fail
CH3	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	
CH4	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

Test Record Form:

Channel	Test Result ΔT	Calculation Result	Limit	Pass/Fail
CH1			±(4 ppm + 2 ppm/year×completed years of service[1])	

Note[1]: for the completed years of service of the instrument, calculate it according to the date in the verification certificate provided when the instrument left factory.

Zero Point Offset Test

Test Record Form:

Channel	Fast Edge Signal Amplitude	Vertical Scale	Test Result	Limit	Pass/Fail
CH1	1.2 Vpp	200 mV/div		≤ 250 ps	
	3 Vpp	500 mV/div			
CH2	1.2 Vpp	200 mV/div			
	3 Vpp	500 mV/div			
CH3	1.2 Vpp	200 mV/div			
	3 Vpp	500 mV/div			
CH4	1.2 Vpp	200 mV/div			
	3 Vpp	500 mV/div			